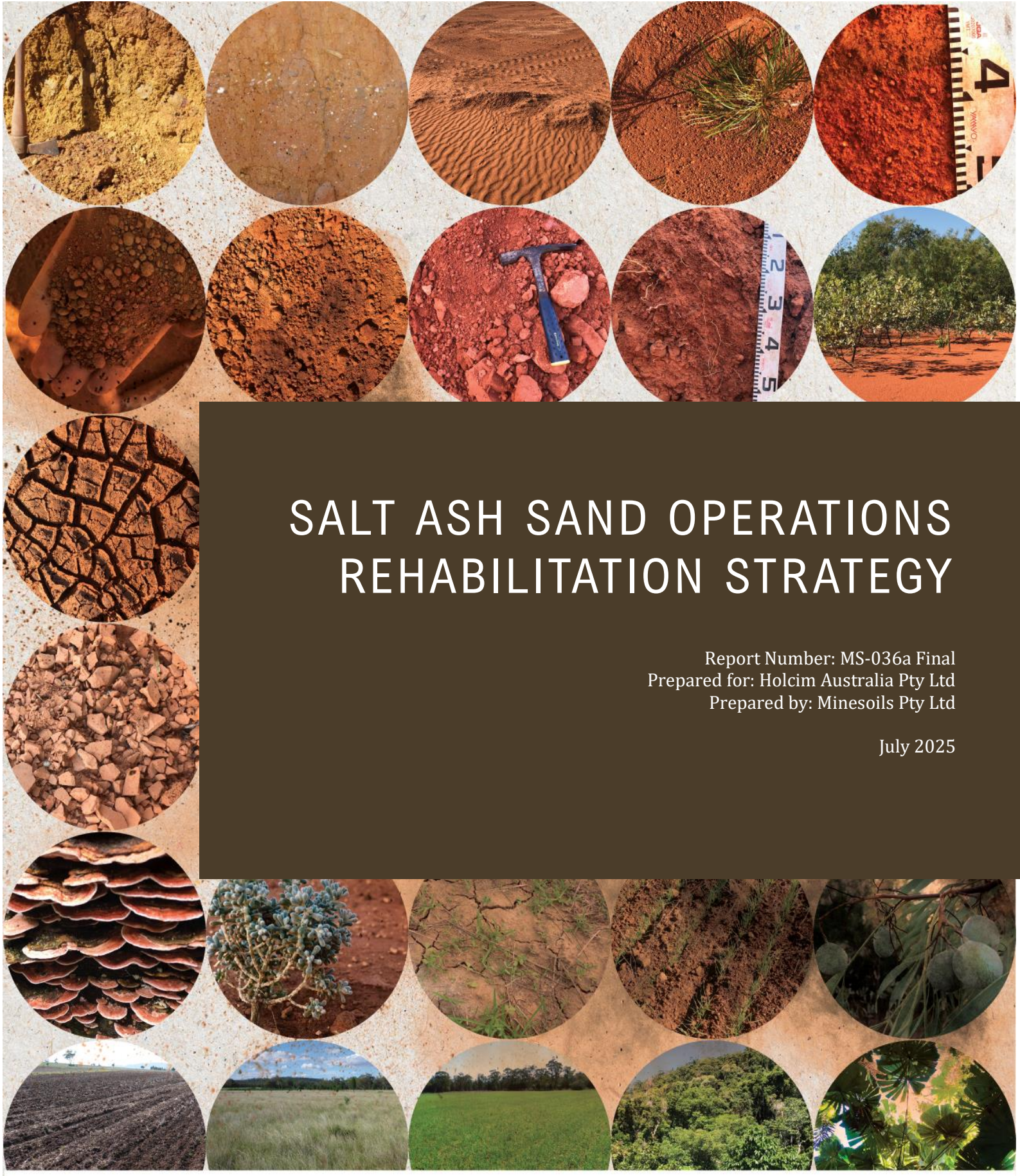

SALT ASH SAND OPERATIONS REHABILITATION STRATEGY

Report Number: MS-036a Final
Prepared for: Holcim Australia Pty Ltd
Prepared by: Minesoils Pty Ltd

July 2025

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DOCUMENT CONTROL

Reference	Date	Prepared by	Approved
MS-036a_ Draft 1	13 May 2025	Matt Hemingway	Clayton Richards
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EXECUTIVE SUMMARY

Holcim (Australia) Pty Ltd (Holcim) owns and operates the Salt Ash Sand Operations (the 'site' or the 'quarry'), a long-standing quarry at 8 Oakvale Drive, Salt Ash, New South Wales (Lot 4 DP 774726) that imports, extracts, processes and transports sand products for use in the production of industrial and construction materials, such as glass and concrete.

Holcim propose to meet part of the increased forecast demand in natural sand in the Hunter and Greater Sydney regions by maximising the extraction of remaining sand resource from the quarry through a State significant development (SSD) application.

The proposed development involves the extraction and processing of up to 550,000 tonnes per annum (tpa) of sand at the site using both dry extraction and dredging techniques. Holcim also propose to continue importing up to 200,000 tpa of sand from their Tanilba Bay and Anna Bay operations, as well as other local extractive operations for processing at the site, resulting in a total of up to 750,000 tonnes of sand products processed and dispatched from the site per year (the 'Project'). The project will operate for up to 30 years.

The proposed disturbance footprint of the project covers an area of approximately 35.4 hectares (ha), and encompasses all areas to be disturbed by sand extraction (dry extraction and dredging), internal access roadways (including slope batters) and processing operations, and encompasses all areas of vegetation clearing.

During the operational phase and following the completion of sand extraction from the site, rehabilitation and revegetation will be undertaken. Whilst still operational, the onsite rehabilitation will focus on progressively stabilising those areas which have already been excavated and enhancing those areas on site which exist outside of operational areas, such as historical rehabilitation areas, and the boundary buffer zone. Once operations are complete, rehabilitation of the remaining areas will be achieved.

At the end of the operational life of the Project, the Project site would be rehabilitated to a landform consisting of a large remnant pond of approximately 30 ha, surrounded by native vegetation consistent with the surrounding ecosystem and vegetation communities of the Worimi National Park over approximately 5.4 ha.

The final land use value of the pond would be for ecotourism attraction or environmental conservation purposes, or a combination of the two.

This report outlines rehabilitation strategies specific to the Project based on the above rehabilitation options, and are summarised as follows:

- Establishing a stable final landform that meets geotechnical standards and is suited to the selected final land use option;
- Where possible, salvaging topdressing prior to disturbance for re-use as a growth medium for revegetation, with organic material (such as felled trees and decomposing mulch) to be salvaged and used as for topdressing enhancement, fauna habitat and erosion and sediment control;
- Revegetation using a combination of endemic species with proven rehabilitation success in areas designated for conservation;
- Control methods to mitigate the identified risks to rehabilitation success, including pest flora and fauna, erosion and sedimentation issues, groundwater contamination and landform instability; and
- Adherence to a monitoring program whereby corrective maintenance can be actioned in order for the rehabilitated land to develop towards satisfying the success criteria.

These measures and controls, once implemented on the site during and following Project operations, will ensure the rehabilitation success criteria is met and the selected final land use committed to is accomplished.

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1 INTRODUCTION

1.1 PROJECT BACKGROUND

Holcim (Australia) Pty Ltd (Holcim) owns and operates the Salt Ash Sand Operations (the 'site' or the 'quarry'), a long-standing quarry at 8 Oakvale Drive, Salt Ash, New South Wales (Lot 4 DP 774726) that imports, extracts, processes and transports sand products for use in the production of industrial and construction materials, such as glass and concrete. The quarry, which has been in operation since 1980, produces a variety of dry form and wet processed sand for glass and construction applications.

Holcim propose to meet part of the increased forecast demand in natural sand in the Hunter and Greater Sydney regions by maximising the extraction of remaining sand resource from the quarry through a State significant development (SSD) application.

The proposed development (the Project) involves the extraction and processing of up to 550,000 tonnes per annum (tpa) of sand at the site using both dry extraction and dredging techniques. Holcim also propose to continue to import up to 200,000 tpa of sand from their Tanilba Bay and Anna Bay operations, as well as other local extractive operations for processing at the site, resulting in a total of up to 750,000 tonnes of sand products processed and dispatched from the site per year (the 'Project'). The Project will operate for up to 30 years.

The proposed disturbance footprint of the project covers an area of approximately 35.4 hectares (ha) (refer **Figure 1**) and encompasses all areas to be disturbed by sand extraction (dry extraction and dredging), internal access roadways (including slope batters) and processing operations and encompasses all areas of vegetation clearing.

During the operational phase and following the completion of sand extraction from the site, rehabilitation and revegetation will be undertaken. Whilst still operational, the onsite rehabilitation will focus on stabilising those areas which have already been excavated and enhancing those areas on site which exist outside of operational areas, such as historical rehabilitation areas, and the boundary buffer zone. Once operations are complete, rehabilitation of the remaining areas will be achieved.

1.2 REPORT OBJECTIVES AND APPROACH

This report forms part of the submissions report, prepared following previous exhibition of an environmental impact statement (EIS) and has been prepared for submission to the Department of Planning, Housing and Infrastructure (DPHI) to satisfy the provisions of Part 4 of the *NSW Environmental Planning & Assessment Act 1979* (EP&A Act).

The rehabilitation strategy prepared for the EIS (Minesoils, 2022), addressed the Secretary's Environmental Assessment Requirements (SEARs) listed is **Table 1**, and presented three rehabilitation final land use options.

- Option 1 – Fully Backfilled Site: This accounted for the potential to fill the site to adjacent ground level and transform the site into community use and /or environmental conservation land use.
- Option 2 - Partially Backfilled Site, Small Pond: This accounted for the partial backfilling of the pond which would remain in-situ and cover an area of approximately 10ha, for use as an ecotourism attraction and/or environmental conservation land use.
- Option 3 – No Backfilling, Large Pond: This accounted for the possibility of the dredge pond to remain at its full extent over approximately 30ha for use as for use as an ecotourism attraction and/or environmental conservation as per Option 2, albeit with a more significant pond footprint over the site.

The aim of this report is to provide a revised rehabilitation strategy based on a single proposed final land use, and addresses the rehabilitation related agency submissions received following public exhibition of the EIS and the original rehabilitation strategy, as presented in **Table 2**.

Furthermore, this report has been developed in accordance with the revised rehabilitation goals, objectives and strategic frameworks developed in consultation with Holcim throughout the EIS process.

The objective of this report is to document the following:

- The revised proposed final landform and land use for the rehabilitated site;
- An overview of the rehabilitation process in accordance with quarry rehabilitation best practice, strategic land use planning and relevant policies;
- Specific rehabilitation objectives for the Project;
- An approach for meeting rehabilitation objectives, including landform design, topdressing material management, use of organic material and felled timber, and revegetation measures.
- A framework for rehabilitation monitoring with performance standards and proposed completion criteria;
- Maintenance actions that may be required following rehabilitation; and
- Key risks to rehabilitation success and mitigation controls.

This report has been prepared in accordance with the requirements of the following relevant strategic land use planning and resource management plans and policies relating to mine rehabilitation and mine closure. These include:

- I&I-MR Policy (edg 03) – Guidelines to the Mining, Rehabilitation & Environmental Management Process;
- The Strategic Framework for Mine Closure (ANZMEC & MCA, 2000);
- Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth of Australia); and
- Leading Practice Sustainable Development Program for the Mining Industry – Mine Closure and Completion (Federal Department of Industry, Tourism and Resources, 2002).

Table 1 SEARs Requirements

SEARs Requirement	Addressed
The proposed rehabilitation strategy for the site having regard to the key principles in the Strategic Framework for Mine Closure, including:	
- rehabilitation objectives, methodology, monitoring programs, performance standards and proposed completion criteria;	Section 4
- nominated final land use, having regard to any relevant strategic land use planning or resource management plans or policies; and	Section 2.2
- the potential for integrating this strategy with any other rehabilitation and/or offset strategies in the region.	Section 3.1.2

Table 2 Submission relating to rehabilitation and where addressed

ID	Submission	Addressed
Hunter Water		
1	The remaining parts of the land (the perimeter buffer area) are proposed to be rehabilitated using native vegetation species on completion of quarrying activities. The methodology for native ecosystem rehabilitation is well established, although requires careful management for it to be successful. In that regard the description of this rehabilitation approach in the EIS is generally acceptable, although at least two key aspects of the proposed quarrying operations would significantly influence that success; the management of topsoil resources and the management of proposed fill materials. Specifically, recovery and subsequent reuse of native topsoil are integral to the success of native ecosystem re-establishment and the use of introduced soil materials in areas where native species rehabilitation is generally inconsistent with the objective of re-establishing local ecological attributes. More details are required for these and other aspects described in the EIS to ensure the rehabilitation objectives (i.e. via anticipated performance standards and completion criteria) would be achieved by the proposed activities and to address other risks to rehabilitation success identified in the EIS. Information provided in the EIS requires substantial refinement to address this aspect of rehabilitation for the proposal.	**4.2.3**
2	Inadequate justification is provided for the establishment of an open water pond "for use as an ecotourism attraction and/or environmental conservation" as the final land use for some or the majority of the site and similarly for the completely back-filled option. Hunter Water recommends that greater certainty around the final landform and long-term land use at the site be provided prior to determining the application to assist consideration of the proposal. Hunter Water considers that establishing an open water pond on the majority of the site is inconsistent with surrounding land uses, would essentially sterilise the land from productive future use that is compatible with the surrounding area and, therefore, does not represent a sustainable long-term land use or comply with the objects of the Environmental Planning and Assessment Act 1979. In contrast to the likely end use for the majority of the site as an open water pond, limiting extraction to above the groundwater table would likely facilitate a more productive land use outcome that would be consistent with the surrounding area and/or the current RU2 – Rural Landscape land zoning, without the identified risks. Such future land use would assist in conserving water in the adjacent and underlying aquifer, as well as benefitting from it.	**2.3**
NSW EPA		
3	In order to assess the impact and management measures proposed, a firm commitment on the rehabilitation of the site and timeframes involved is required.	**2.2, 2.4**
4	It is noted that a rehabilitation and landscape management plan is proposed to identify trigger events or indicators related to the above threats and provide appropriate response strategies. This level of detail is required to ensure that the site can operate within acceptable parameters.	**5.6**
National Parks and Wildlife Services		
5	NPWS is concerned regarding the vagueness of the final state of the land at the end of Holcim's quarrying operations. The Rehabilitation Strategy Report provides 3 potential final stages of site rehabilitation. It is understood that fully backfilling the pit is dependent on sourcing suitable material, and that seems unlikely. As such, there are concerns regarding the stability of the final landform in what is a combined mobile and forested sand dune system.	**2.2, 4.2.5**

Figure 1
Local context

HOLCIM SALT ASH SAND OPERATIONS
ENVIRONMENTAL IMPACT STATEMENT

Source: LPI (2018), Nearmap (2020), Holcim (2020), Cambium Group (2022).

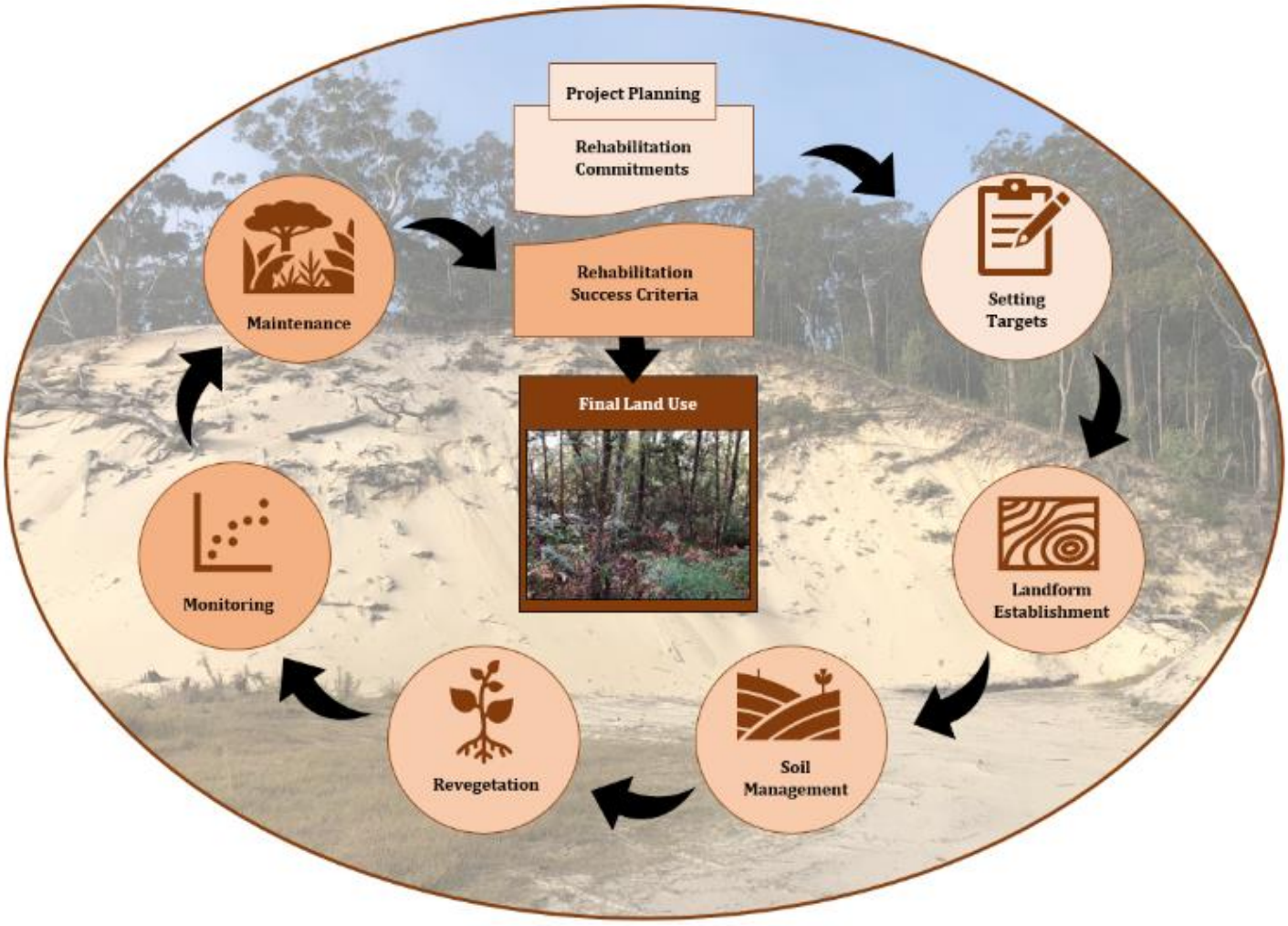
2 REHABILITATION OVERVIEW

2.1 REHABILITATION PROCESS

A conceptual overview of land rehabilitation is presented in **Figure 2** below and outlines the process from a project planning phase through to the achievement of a final land use that meets the successful rehabilitation criteria, whereby the site can then be relinquished.

Each of these phases is described below.

Figure 2: Rehabilitation Process Overview



Rehabilitation Commitments

Commitments to rehabilitation are established in the project planning phase. Appropriate, well defined, and achievable rehabilitation commitments that account for a range of environmental and social factors are a requirement for project approval. The rehabilitation commitments for the Project, or options currently considered, are outlined in Section 2.2.

Setting Targets

This report comprises the 'Setting Targets' phase of rehabilitation for the Project. It includes the determination of final land use objectives and the actions required to achieve them.

Targets are refined based on current land use and land management within the Project locality and take into account key learnings from rehabilitated lands associated with sand quarry operations in the Project's locality (Section 3.1), as well as findings from independent technical geotechnical, hydrogeological and ecology assessments (Section 3.2).

Successful rehabilitation will be achieved through adhering to the rehabilitation methodology (Section 4.2). Specific targets are included as the completion criteria (Section 4.2). Rehabilitation monitoring will be undertaken to measure the success of the rehabilitation outcomes against the targets. The mechanism for rehabilitation monitoring is detailed in Section 4.3

Landform Establishment

Landform establishment is undertaken to develop the land for its specific post disturbance use. This phase of the rehabilitation process is crucial for ensure landform design is stable and sustainable and will account for suitable drainage features and the implementation of erosion and sediment controls. Methodology is outlined in Section 4.2.5.

Soil Management

Soil management includes the assessment of the characteristics of soil and determine stripping depths for reuse in areas of surface disturbance. Soil handling techniques are employed to prevent excessive soil deterioration. Soil is respread at nominal depth range and seedbeds are prepared to optimise growth for rehabilitation. Methodology is outlined in Section 4.2.4 and 4.2.5.

Revegetation

Revegetation with species targeted to post disturbance land use (i.e., conservation with native vegetation). Revegetation to be initiated following seedbed preparation. Methodology for revegetation is outlined in Section 4.2.7.

Monitoring

Monitoring is undertaken to determine if the objectives of rehabilitation have been achieved. Implement monitoring program by a suitably experienced/trained person that is conducted periodically with reference sites as a control. Details of monitoring approach is outlined in Section 4.3.1.

Maintenance

Continual maintenance or additional maintenance will be undertaken guided by monitoring results. This may include targeted revegetation or soil amelioration on under-performing areas, landform modification to achieve stability, erosion and sediment control measures and ongoing weed and feral animal control.

Rehabilitation Success Criteria

The success criteria are performance objectives or standards against which rehabilitation success in achieving a sustainable system for the proposed post-mine land use is demonstrated. The rehabilitation success criteria will be met as a result of monitoring and maintenance outcomes. The rehabilitation success criteria specific to the Project are outlined in Section 4.4.

2.2 PROPOSED FINAL LANDFORM AND LAND USES

Appropriate, well defined, and achievable rehabilitation commitments that account for a range of environmental and social factors have been considered for the Project. In addition, uncertainties around the availability of sufficient backfilling material to refill the pond at the end of the Projects life have been considered.

As a result, the Project site would be rehabilitated to a landform consisting of a large remnant pond of approximately 30 ha surrounded by native vegetation consistent with the surrounding ecosystem and vegetation communities of the Worimi National Park over approximately 5.4 ha.

The final land use value of the pond would be for ecotourism attraction or environmental conservation purposes, or a combination of the two.

The pond would cover the majority of the Project site that is not used as perimeter batter. For remaining terrestrial areas, the Project would create a landform characteristic that is gently undulating to flat based on intended final land use (i.e., areas of revegetation for conservation could be enhanced by undulations, while the use of this area for ecotourism infrastructure on the pond periphery would benefit from more level surfaces).

A depiction of the proposed final landform is presented in **Figure 3** and **Graphic 1**.

2.3 JUSTIFICATION

The originally proposed alternative options to the final pond landform as presented above consisted of the following:

- Option 1 – Fully Backfilled Site: This accounted for the potential to fill the site to adjacent ground level and transform the site into community use and /or environmental conservation land use.
- Option 2 - Partially Backfilled Site, Small Pond: This accounted for the partial backfilling of the pond which would remain in-situ and cover an area of approximately 10ha, for use as an ecotourism attraction and/or environmental conservation land use.

Further investigation by Holcim has determined that partial or complete backfilling of the pond is not viable, based on the following considerations.

1. In order to protect water quality and flow in the aquifer, the selection of backfill material will essentially be limited to similar sand material that is extracted from the pit. There are no developments with appropriate soil properties that could supply enough fill to backfill the dredge pond. Initially tunnel boring projects in Sydney were considered (similar to how the recent Hornsby Quarry was backfilled with spoil from the various metro tunnelling projects), however soil overlying Hawkesbury sandstone is high in iron content, which if placed in the dredge pond has the potential to mobilise in the aquifer and compromise water quality.
2. Emplacement of material in the aquifer has the potential to alter existing hydrological flow regime of the aquifer which if reduced could impact receiving water users and Tilligerry Creek downslope.

The resulting final landform of an approximately 30 ha pond and potential land use options for its periphery area of approximately 5.4 ha have been developed to align with the Hunter Regional Plan 2036 (NSW Planning and Environment, 2016) and the Port Stephens Local Strategic Planning Statement (LSPS) (Port Stephens Council, 2020). The LSPS was adopted by Port Stephens Council in July 2020 identifies the 20-year vision for land use in Port Stephens informed by the broader planning goals of the Hunter Regional Plan 2036: Economy, Environment, Housing and Transport.

The planning priorities set out by the LSPS include the following:

- Priority 1: Support the growth of strategic centres and major employment areas
- Priority 2: Make business growth easier
- Priority 3: Support tourism development and attract events
- Priority 4: Ensure suitable land supply
- Priority 5: Increase diversity of housing choice
- Priority 6: Plan infrastructure to support communities

- Priority 7: Conserve biodiversity values and corridors
- Priority 8: Improve resilience to hazards and climate change
- Priority 9: Protect and preserve productive agricultural land
- Priority 10: Create people friendly spaces in our local centres where people can come together
- Priority 11: Integrate land use and transport planning
- Priority 12: Enhance inter-regional connections

The potential final land use options presented are designed to account for local and regional land use objectives, with direct regard for the LSPS priorities 3, 6 and 7, in conjunction with an aim to integrate with the character of the locality. The following key factors in particular were considered when determining suitable final land use options:

- Project site location adjacent to conservation area;
- Project site location immediately adjacent to the proposed Nelson Bay Road duplication alignment (thereby providing optimal positioning for future community and eco-tourism uses);
- Context of Worimi National Park, Oakvale Wildlife Park and Stockton Bight as tourist attractions; and
- Low agricultural potential of the Project site and immediate surrounds.

The visitor economy in the Port Stephens LGA is strongly linked to the appeal of the natural environment. There has been significant recent investment in growing emerging tourism markets and infrastructure such as the Tomaree Coastal Walk, the Koala Sanctuary at Anna Bay, and the Birubi Information Centre (Port Stephens Council, 2020).

The creation of a pond is considered a unique asset for ecotourism and would be supplementary attraction in addition to the locality's other tourist attractions.

The final land form of a pond could be used as a landscape feature basis to promote an eco-tourism enterprise and attract spending to the area, which would have a positive economic impact on the local businesses, such as the Oakvale Wildlife Park, Foodworks, fuel stations and food option (restaurants, shops and take-aways). Eco-tourism would provide additional employment availability to the locality (refer LSPS priorities 3 and 7).

Alternatively, returning the pond periphery to a natural ecosystem would be suitable given the unimpeded movement of species and the flow of natural processes between the Worimi National Park and the rehabilitated area. This is known as ecological connectivity and would promote successful long term conservation (refer LSPS priority 7).

Given the low agricultural potential of the Project site, conservation or ecotourism, or a combination of the two, are considered more environmentally, socially and economically beneficial final land use options that take advantage of the remaining pond, and the visual amenity, landscape values and tourism infrastructure of the region.

2.4 TIMING

During the operation of the Project, rehabilitation will be undertaken progressively to limit the extent of exposed areas at any one time as far as practical. Rehabilitation will be occur as dredge stages progress throughout the operational stage of the Project. Release of an Rehabilitation Bond (if required by conditions of approval) may occur progressively during the life of the operation.

At the end of the operational life of the Project, all landform establishment and stabilisation, topdressing preparation and revegetation would be completed within two years. Rehabilitation monitoring and maintenance would follow for a further two years or as long as required until a time at which relinquishment is achieved.

FIGURE 3
Final Landform Design

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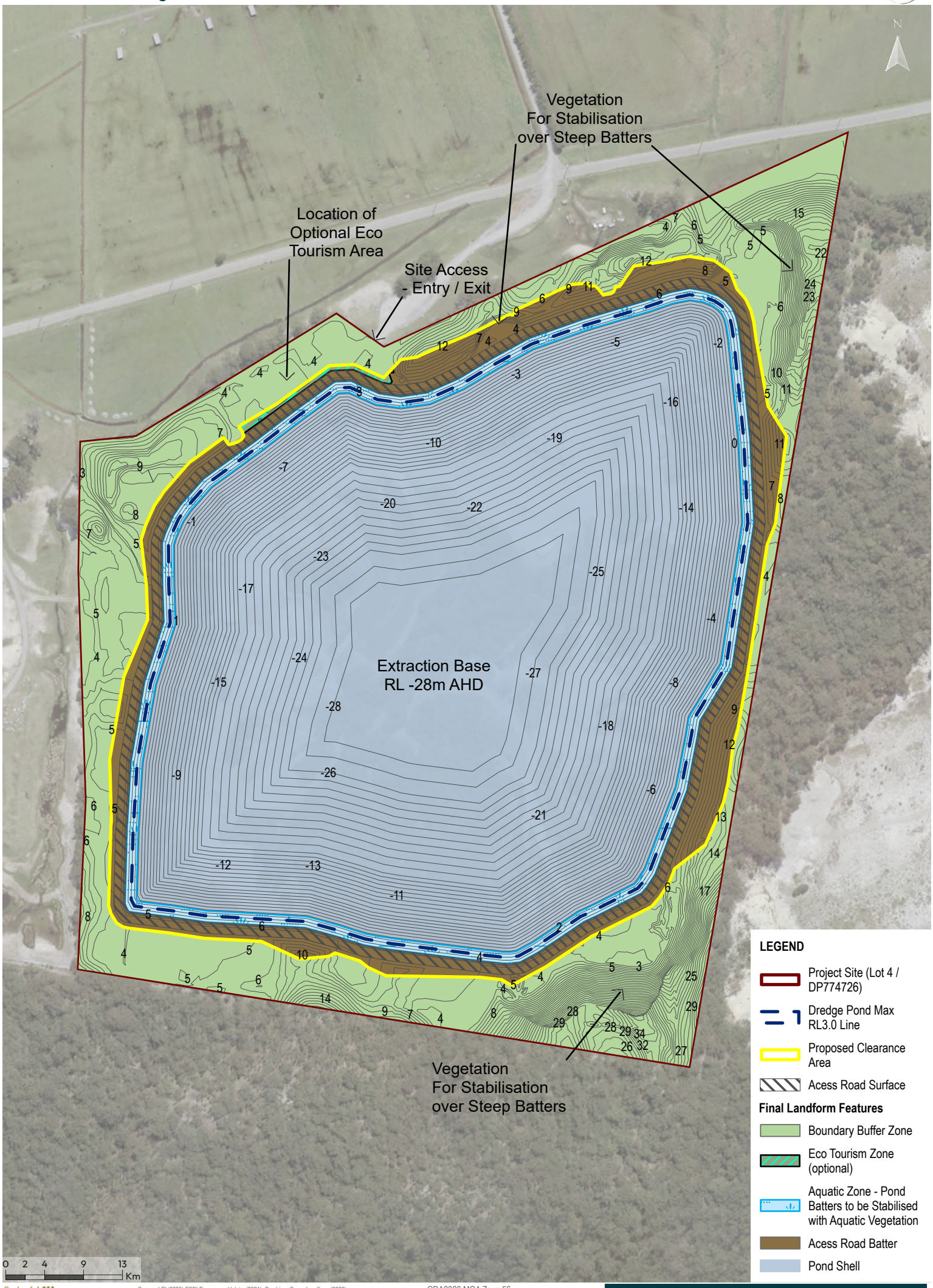

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Source: LPI (2025) ESRI Basemaps, Holcim (2021), Cambium Group Landform (2022)

GDA2020 MGA Zone 56
2/07/2025

Holcim Salt Ash Sand Operations

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GRAPHIC 1
Salt Ash Final Landform Conceptual Vew

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C:\Global_Design_Hub\A02_Clients\MS_Minesoils\Holcim\MS01_001_Holcim_SaltAsh_SSD\MS01_001_SaltAshSSD_01.aprx | Graphic 1 - Final Landform Imagery

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GDA2020 MGA Zone 56
30/06/2025

Holcim Salt Ash Sand Operations

3 EXISTING ENVIRONMENT

3.1 REGIONAL CONTEXT

3.1.1 LOCATION

The quarry is in Salt Ash, approximately 20 kilometres (km) north east of Newcastle and is in the Port Stephens local government area (LGA).

Access to the site is via Nelson Bay Road and Oakvale Drive. Oakvale Drive is a local roadway which terminates at the entrance to private property at 4 Oakvale Drive (Lot 8 DP833768). A private road then runs south through the property to the entrance of the quarry. This private road will become redundant with the construction of the new Nelson Bay Road Duplication Project. Nelson Bay Road is a major arterial road which links the Newcastle central business district to Newcastle Airport, Nelson Bay and the wider Port Stephens area to the north.

The project is in the central portion of the site and contains all areas to be disturbed by project operations and covers an area of approximately 35.4 ha.

The site is zoned RU2 – Rural Landscape under the Port Stephens Local Environmental Plan (LEP) 2013 and extractive industries are permitted with consent. Land to the north of the site to Nelson Bay Road is also zoned RU2, whilst land to the south of the site is zoned E1 – National Parks and Nature Reserves and is associated with the Worimi Conservation Lands. A portion of land adjacent to the east of the site (Lot 220 DP 1049608) is also zoned E3 – Environmental Management.

The existing quarry is positioned within a rural residential area, which comprises a mix of residential properties, commercial, agricultural, tourism and extractive industry premises. The main access for these properties is via Oakfield Road, David Drive and Oakvale Drive to and from Nelson Bay Road.

The majority of residential properties are separated from the quarry by agricultural operations and Tilligerry Creek. To the south of Tilligerry Creek are scattered residential properties of large rural lots, with the closest resident approximately 465 metres (m) north west of the quarry. Two additional dwellings, inhabited by employees of the adjoining quarry operation are also located approximately 75 m and 430 m west of the quarry respectively.

The Oakvale Wildlife Park is a prominent tourist attraction for the Port Stephens region. The Park is located approximately 540 m north of the quarry, with the access route to and from the quarry running along the northern boundary of the Wildlife Park to Oakvale Drive.

The environmental conservation areas to the south of the site extend along the Stockton Bight beach and dune system, which is predominantly utilised for recreational purposes including fishing, four-wheel driving, quad bike riding, hiking and horse riding.

3.1.2 REHABILITATION OUTCOMES

There are several examples of post-quarrying landscapes of sand quarries within the region that have been rehabilitated according to their respective rehabilitation plans, primarily to a reinstatement of coastal woodland ecological communities. These rehabilitation plans and the subsequential rehabilitation performance have been reviewed as part of the formulation of this rehabilitation strategy. While the rehabilitation of these sites has been largely successful, some aspects of the rehabilitation indicate areas where improvements and efficiencies can be made. The following limitations to success of rehabilitation have been identified (Environmental Earth Sciences 2019, Umwelt 2020, AECOM 2016).

- High wind exposure on elevated dunes impacting surface stabilisation;
- Lack of habitat for species using wood hollows;

- Nutrient deficiencies limiting plant establishment;
- Lack of soil moisture limiting plant establishment; and
- Weed invasion impacting rehabilitation areas. Species of particular persistence include red natal grass (*Melinis repens*), kikuyu grass (*Pennisetum clandestinum*), bitou bush (*Chrysanthemoides monilifera*), farmer's friend (*Bidens pilosa*), Large-leaved Pennywort (*Hydrocotyle bonariensis*), and flax leaf fleabane (*Conyza bonariensis*).

This rehabilitation strategy aims to implement controls to mitigate unsuccessful aspects of previous rehabilitation efforts within the region.

Integrating the learnings of rehabilitation efforts within the region into a refined methodology has the benefit of consistency in approach for land managers and operators in the region for soil improvement, erosion management, pest species mitigation, and consistent use of rehabilitation species with proven success.

3.2 PROJECT SITE

3.2.1 SOIL CHARACTERISTICS

The limited land and soil capability of the Project site correlates to soil landscape units which have been mapped for the site (SALIS, 2021). Two soil landscape units occur within the Project site: Boyces Track and Hawkes Nest. These units represent steep Quaternary Holocene sand dunes trending to low Holocene sandsheets and low transgressive dunes on the Tomago Coastal Plain. Soil textures are dominated by loamy sand to sand topsoils and deep sand subsoils.

Limitations for topsoil materials that will be salvaged and respread as a topdressing for rehabilitation (if feasible) include low fertility, low moisture retention, non-cohesive nature and wind erosion hazard. Controls to mitigate these factors are outlined in Section 4.2 below.

3.2.2 AGRICULTURAL PRODUCTIVITY

The site and its immediate surrounds are generally not suitable for agricultural purposes. Regional mapping for land and soil capability for the Project site and adjacent lots as Class 6 and Class 8, indicating low capability land to extremely low capability land (SALIS, 2021). Given these limitations, rehabilitation for a final land use of agriculture (grazing) was not considered a justifiable option.

3.2.3 HYDROGEOLOGY

A groundwater report completed by Hydrominex Geoscience (2022) outlines the hydrogeology status of the Project site, as hereby described. Most of the site is from 5 – 10 m in elevation (above sea level), with a 30m high, north-east / south-west trending Holocene dune located in the south-eastern corner of the site. The topography south of the sand dune drops off south-east toward Stockton Bight and the Pacific Ocean, which is approximately 1.9 (km) south of the site.

The majority of the site drains north-west towards Tilligerry Creek, which is located approximately 510 m north of the site. A small tributary of Tilligerry Creek flows north-east along the part of the northern site boundary.

The site is underlain by the Stockton Sandbeds, which have been mined above the water table for many years at the site and adjacent quarry sites. The Stockton Sandbeds form is an unconfined, aquifer that runs parallel to the coast, between Tilligerry Creek/Cove and the Stockton Bight.

The Tomago-Tomaree-Stockton Sandbeds constitute sand units that are an important (but unused) emergency water supply aquifer along the coast north of Newcastle.

The sands constitute an unconfined aquifer system that is directly recharged by rainfall. The aquifer shows a rapid response to rainfall events, with rises in groundwater level within hours to days of significant rain events.

3.2.4 ECOLOGY

An ecological assessment was undertaken by Niche Environment and Heritage (2025). About 60 per cent of the Project site supports native vegetation in various condition states. The remainder of the subject area supports a mixture of non-native vegetation, infrastructure, dams, roads and areas of cleared land supporting current mining operations. Two Plant Community Types (PCTs) were mapped within the Project site:

- PCT 1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast; and
- PCT 1718 - Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast.

PCT 1718 forms part of the BC Act listed Endangered Ecological Community (EEC) Swamp sclerophyll forest on coastal floodplains of the NSW North Coast Sydney Basin and Southeast Corner bioregions.

One threatened flora species was recorded at the quarry, namely Sand Doubletail (Diuris arenaria). The location of the species is outside the proposed disturbance area of the Project and will not be directly impacted.

Six threatened fauna species were recorded within the Project site: Squirrel Glider (*Petaurus norfolcensis*), Koala (*Phascolarctos cinereus*), Southern Myotis (*Myotis macropus*), Little Bentwing Bat (*Miniopterus australis*), Yellow Sheathtail Bat (*Saccolaimus flaviventris*) and Large Bentwing Bat (*Miniopterus orianae oceanensis*).

For the majority of these species, based on specific habitat requirements for each species, it is likely that Project site would only be used on an intermittent basis for foraging, if at all, based on the surveyed habitat features. The extensive native vegetation that occurs to the north and south within Worimi Regional Park and Worimi State Conservation Area are likely to offer greater habitat suitability (extent, diversity and abundance of resources) for each of these species.

4 REHABILITATION STRATEGY

4.1 REHABILITATION OBJECTIVES

The ultimate rehabilitation objective for Project is to create a safe, stable and sustainable landform that compliments existing natural resource values and connectivity to and adjacent lands and ecosystems. The following objectives form the basis for the rehabilitation strategy and are used as a reference for the creation of a success criteria.

- Rehabilitation and final land use outcomes will be consistent with the proposed final landform and land use options specified in Section 2.2, or a final land use option considered similarly suitable;
- Rehabilitation and the final land use outcomes will be compatible with the surrounding land fabric and land use requirements;
- Rehabilitation will be based on a success criteria and outcomes developed through stakeholder consultation;
- Compliance with the relevant regulatory requirements and that regulatory consensus is attained on the successful closure and rehabilitation of the site;
- Where rehabilitation of native vegetation is undertaken, it will be integrated with undisturbed native vegetation to provide consolidated areas and wildlife corridors where possible;
- The final land form will be sustainable and stable, and the terrestrial and aquatic ecosystems within the landform will have maintenance needs no greater than those of the surrounding land;
- Waste substances that have the potential to affect land use or result in pollution will be secured and safely contained;
- The rehabilitated site will not present a health and safety hazard to persons or native fauna;
- The rehabilitated site will be clean and tidy and any remaining structures will be left in a condition that provides for the safety of the public; and
- Closure, decommissioning and rehabilitation works are completed as quickly and cost effective as possible whilst providing that the above objectives are achieved.

4.2 REHABILITATION METHODOLOGY

The following methodology outlines the key actions required for the successful achievement of the rehabilitation objectives;

4.2.1 SECURE FINANCING

To ensure that all rehabilitation (mitigation) measures are sufficiently financed, Holcim will secure funds for the closure of the site which includes all costs for the final rehabilitation, as well as mitigation measures during works.

4.2.2 STAGED REHABILITATION

In order to reduce the amount of disturbed land at any one time, progressive rehabilitation will be targeted to areas that cease to be used for sand extraction or quarry-related activities as soon as practical. Results from early successful rehabilitation across the Project site can be used to refine the proposed rehabilitation methods including aspects such as the selection of appropriate drainage measures / structures and plant species for re-establishment.

Due to the erosion and sedimentation risks associated with exposed sand, early rehabilitation efforts will target areas of the Project site that have been subject to direct surface disturbance and clearing, based on risk based priority. Notwithstanding this, in some areas it will only be possible to undertake interim rehabilitation due to either difficult access onsite or continued operation of the Project.

Rehabilitation may be limited to sowing vegetation species that are associated with erosion and sediment control and stabilisation. Therefore, while some rehabilitation measures will be instituted during operation, key rehabilitation steps will be undertaken following the decommissioning of surface infrastructure.

4.2.3 SALVAGE OF TOPDRESSING MATERIALS

Minesoils investigated the topsoil materials of the site during site investigations in 2021. In addition, an acid sulfate soils characterisation investigation recorded soil profile information for a range of assessment locations within the site (Geosyntec, 2025). Soil profiles are noted to be dominated by coarse sands, and some silty sands, with organic materials on and close to the surface.

Successful regional rehabilitation efforts recognise the importance of a suitable growth matrix for native revegetation and a topsoil containing an endemic seedbank. This includes soil identification, stripping, and management practices for successful rehabilitation and the achievement of the desired post-closure land use and species composition.

Given the requirement of approximately 5.4 ha of land to be rehabilitated on the periphery of the final pond, Minesoils recommends topsoil stripping is undertaking to salvage the top 100mm of soil (where feasible) in disturbance areas, until a suitable volume of material for rehabilitation requirements has been achieved.

The following soil handling techniques are recommended to prevent excessive soil deterioration and dispersion:

- Strip desirable material to minimum excavation depths (approximately 100mm) to provide a soil balance that will be sufficient for rehabilitation, subject to further investigation as required.
- The surface of soil stockpiles should be left in as coarsely structured a condition as possible in order to promote infiltration and minimise erosion until vegetation is established, and to prevent anaerobic zones forming.
- Where necessary, a flow diversion bank or catch drain should be placed up-slope of a stockpile to direct surface water flows away. All stockpiles shall remain in a free-draining location to avoid long term soil saturation.
- Where necessary, silt fences or cleared vegetation should be installed around topsoil stockpiles or stripped areas as a form of erosion and sediment control. Mulch or wood chip from cleared vegetation can also be applied as a veneer over topsoil stockpiles to slow erosion, weed establishment and to maintain moisture content.
- Long-term stockpiles (longer than 6 months) will not exceed a height of three metres, short-term stockpiles (up to six-months) may be of greater dimension, depending on the optimal requirements of the particular situation
- Based on experience within the region, vegetation is expected to regenerate naturally on the stockpiles (germination of the seedbank). Where native vegetation does not establish on the stockpiles it will be established (seeding/ planting). Final rehabilitation target species should be established on stockpiles to build up a desirable species seed bank in the topsoil and to maintain soil biological activity
- An inventory of available soil should be maintained to ensure adequate materials are available for planned rehabilitation activities.

Throughout the life of the Project a topsoil inventory will be maintained to determine the volume of topsoil reclaimed and available for subsequent landform rehabilitation.

In the unlikely event that enough topdressing material is able to be sourced from the Project site, additional material should be sourced from the local area. This material should be assessed by a suitably qualified person as being physiochemically consistent with the topdressing salvaged on site and suitable for the purposes of rehabilitation.

4.2.4 OTHER REHABILITATION MATERIALS

Due to the sandy texture and limited soil development of areas subject to disturbance, organic surface matter, such as leaf litter and general discomposed mulch, is important and should be salvaged and stockpiled separately for use as a capping layer for soil stockpiles and then on respread topdressing during rehabilitation.

In addition, if practical to do so, large debris such as felled trees and branches can be salvaged and stored for respreading over final landform. This will assist in creating habitat for native fauna and provides surface structures that can be strategically placed to inhibit erosion and sedimentation. Furthermore, the felled timber can be mulched on site and incorporated into topdressing as surface mulch. Given the anticipated long duration of storage of the mulched timber, this material should be composted by the time respreading occurs. Mulching is more costly to undertake however the benefits of increased organic matter in some of these marginal soils will enhance rehabilitation outcomes in the long term. (Note - mulch not fully composted may inhibit germination of rehabilitation.)

4.2.5 LANDFORM ESTABLISHMENT AND STABILITY OF LANDFORM

The final landform will be designed based on the proposed final land use option (refer Section 2.2). However, a 20 degree batter for the perimeter of the site will be established as it is considered suitable for boundary dune batter during operations (Xstract, 2021), and therefore will be appropriate for any of the final landform options. This angle of repose has been confirmed to be an acceptable slope steepness and slope length to facilitate site drainage, erosion control and establishment of slope stability (further confirmatory geotechnical investigations will be undertaken to assess final landform). The final dredge pond lake design therefore presents a design acceptance criteria (DAC) well in exceedance of geotechnical best practices (Encompass Mining, 2024).

For additional stability, these slopes will be revegetated with native species (refer Section 4.2.6). For all areas designated for native revegetation, landform establishment will aim to develop a ‘natural’ contour profile that emulates surrounding geomorphology, including swales, and will be shaped to suitable finished elevations as determined by geotechnical investigations. This may be limited to the perimeter batter or extend over a larger portion of the site.

Further, there will be limited risk of excessive erosion and slumping impacting the wider area as the dredge pond crest is set-back at a considerable distance from the lease boundary and sand dune system (Encompass Mining, 2024).

By retaining the remnant dredge pond over approximately 30 ha of the Project site, the pond will cover the majority of the Project site that is not used as perimeter batter. For remaining terrestrial areas of approximately 5.4 ha, a landform characteristic will be created that is gently undulating to flat based on intended land use (i.e., areas of revegetation for conservation could be enhanced by undulations, while use as area for ecotourism infrastructure on pond periphery would benefit from more level surfaces).

Key elements of the landform establishment will include:

- Final pond positioning to be determined by dredge pond location at end of operations.
- Stripped and stockpiled material (refer Section 4.2.3) to be pushed onto pond perimeter to elongate pond edges, stabilise bank and form a suitable growth medium for aquatic and terrestrial vegetation (refer Section 4.2.6 and 4.2.8).
- Create low berm around perimeter of pond to prevent longer term sedimentation.
- Final surface level to increase to be at least 1.5 m above the maximum predicted groundwater level on a 20 degree rise away from pond edges. This surface height to be at least 1.5 m above the maximum predicted groundwater level across the terrestrial, non-battered sections of the Project site.
- Add felled trees, organic debris, rocks and roughage to banks to further increase stability (refer Section 4.2.8).

4.2.6 PREPARATION OF TOPDRESSING

The following re-spreading and surface preparation techniques are recommended to prevent excessive soil deterioration and dispersion during rehabilitation.

- Topsoil is to be transferred and respread directly over the previous mined area/cleared area as soon as it is no longer required for access
- Where practical, direct topsoil transfer from a disturbance area to a rehabilitation as soon as possible would facilitate the natural regeneration of plant species and limit the degradation of soil microbes;
- Topsoil will be re-distributed at an average depth of 300 mm.
- Topdressing material should be treated with fertiliser and seeded in one consecutive operation, to reduce the potential for topsoil loss to wind and water erosion.
- Mulch and organic debris should be used as a capping material in order to shield sand from wind exposure and increase moisture retention in the soil and available nutrients.

4.2.7 TERRESTRIAL REVEGETATION

For the pond periphery, species selection at the planning stage must promote the establishment of a diverse and robust ecological environment which is representative of local native vegetation and require low ongoing maintenance. Endemic species mixes/ tubestock supplies should be utilised where possible.

Thorough seedbed preparation following preparation of surfaces should be undertaken to ensure optimum establishment and growth of vegetation. In addition, direct planting of tube stock or established large pot canopy trees may be undertaken to strengthen the presence select species as required during rehabilitation. Revegetation efforts will target a density of approximately 1000 stems/ha with subsequent infill planting of up to approximately 300 trees/ha (as required) in the following year to replace any vegetation that does not survive.

All revegetation operations are best undertaken immediately after ripping so that the exposed surface has minimal time to erode prior to seed application. The most effective way of controlling erosion will be to establish and/or maintain a healthy vegetation cover. Vegetation will provide effective surface protection against raindrop impact, bind the underlying soil to resist detachment by surface flows, and improve and maintain the soil's infiltration capacity thereby decreasing the velocity and volume of runoff. Vegetation will also improve the aesthetic appearance of each area and the operational efficiency of structural erosion and sediment control measures employed.

The main revegetation steps will therefore include:

- Species selection for seed mix and tubestock supplies;
- Sowing/planting rates and species proportions;
- Seed pre-treatment;
- Soil amelioration and fertiliser; and
- Timing.

Should natural revegetation require acceleration, the following rehabilitation methods and techniques will be implemented depending on the requirements.

- Use of additional mulch for soil protection;
- Use of more intensive tubestock planting programs;
- Brush harvesting from nearby areas; and
- Ripping of compacted areas and wheel tracks.

Endemic species occurring in the Project site and wider region, and which have been used to success in rehabilitation projects within the region, are as follows:

Canopy species:

- Swamp Mahogany (*Eucalyptus robusta*);
- Broad leaved Paperbark (*Melaleuca quinquenervia*);
- Blackbutt (*Eucalyptus pilularis*); and
- Smooth-barked Apple (*Angophora costata*).

Understorey species:

- Saw Toothed Banksia (*Banksia serrata*);
- Coastal Wattle (*Acacia sophorae*); and
- Coastal Teatree (*Leptospermum laevigatum*).

Groundcover species:

- Pig Face (*Carpobrotus glaucescens*);
- Beach Fescue (*Austrofestuca littoralis*); and
- Beach Spinifex (*Spinifex sericeus*).

A combination of the species listed above, as well as additional species as recommended by ecologists at the time of revegetation, will be used in areas designated for conservation.

Species selection should also consider species diversity and succession over time. While some species, such as wattles, may perform well in the short term, they may result in a monoculture which inhibits establishment of other species.

4.2.8 NATIVE HABITAT ENHANCEMENT

If a conservation final land use is selected for the pond periphery at the time or rehabilitation, nest boxes will be used in lieu of salvaged tree hollows if appropriate, as determined as part of the ongoing rehabilitation management of the site. Since nest boxes will be used where there is insufficient salvaged tree hollows, it is difficult to quantify the amount or type of additional nest boxes that will be required. A suitably qualified and experienced ecologist will determine the most appropriate nest box requirement based on the final land use option. Nest box design will consider the full range of hollow-dependant species recorded in the project area and known to occur in the local area in similar/contiguous habitat, in particular hollow dependant threatened fauna species such as the Squirrel glider (*Petaurus norfolcensis*) and threatened tree roosting micro-bats. The density of salvaged tree hollows and nest boxes in rehabilitation areas will consider the carrying capacity of the rehabilitated vegetation in which the boxes are being established.

4.2.9 AQUATIC VEGETATION AND POND ENHANCEMENT

The pond will require bank stabilisation including the introduction of suitable aquatic species revegetation within the aquatic zone.

The common Spike Rush (*Eleocharis acuta*) is a suitable endemic species that will be cultivated within the aquatic zone. This will have the effect of absorbing wave energy generated by winds along pond edges. Terrestrial embankments will be planted with native low growing shrubs and grasses to provide bank stability and reduce erosion (such as species outlined in Section 4.2.6).

In addition, tree stumps, rocks and other organic materials that were salvaged or introduced to site can be placed along pond edges, and on banks and berms. The purpose of the placement of the materials is to:

- Create habitat that promotes ecosystem connectivity between terrestrial revegetation efforts and the aquatic environment; and
- Provide additional erosion and sedimentation controls that support landform stability.

- These measures will increase in the sustainability of the pond landform and it's established habitat.

4.3 MONITORING AND MAINTENANCE

4.3.1 REHABILITATION MONITORING

Regular monitoring of the rehabilitated areas will be required during the initial vegetation establishment period and beyond to demonstrate whether the objectives of the rehabilitation strategy are being achieved and whether a sustainable, stable landform has been achieved. Monitoring will determine the following:

- Pond water quality issues;
- Evidence of any erosion or sedimentation;
- Success of initial establishment of crop or grass cover and tree and shrub seeding / plantings
- Natural regeneration of native species;
- Weed infestation presence (primarily noxious weeds, but also where rehabilitation areas are dominated by other weeds);
- Integrity of graded banks, diversion drains, waterways and sediment control structures; and
- General stability of the rehabilitation areas.

Monitoring will be conducted periodically by suitably skilled and qualified persons at locations which will be representative of the range of conditions on the rehabilitating areas.

Monitoring methodologies will be developed and modified where necessary to enable an assessment of trends and the progress towards the achievement of the success criteria indicators identified in Section 4.4, with monitoring undertaken regularly in order to establish the trend towards achievement of those criteria.

Where a return to native vegetation is the objective, at least two reference sites will be monitored to allow a comparison of the development and success of the rehabilitation against a control. Reference sites indicate the condition of surrounding un-disturbed areas and can be located in non-disturbed or previously signed off rehabilitation areas of the Project site.

Table 3 outlines a proposed ongoing monitoring program following the establishment phase for comparison against reference criteria and analogue sites. Reference criteria (i.e., for pond water quality) will be developed by a technical expect. Analogue sites will be used as the standard for rehabilitation elements such as native vegetation, native fauna, pests, water and landform stability. Where a return to a native environment is not intended (i.e., for areas subject to ecotourism infrastructure), the rehabilitation objectives of the final land will be used as the standard for the land use and health and safety elements.

During the establishment phase of rehabilitation, a higher frequency of monitoring and greater intensity of maintenance will be required than the subsequent ongoing monitoring and maintenance of the established rehabilitation areas. This establishment phase will consist of continued (weekly as a minimum) inspections by suitably trained site personnel in order to closely monitor the success of revegetation and the stability of the landform. During this phase, watering, weed elimination, replacement of failed plantings, erosion and sediment control maintenance, general enhancements and opportunistic improvements will be undertaken on an as required basis. Technical experts will be engaged as required during this phase to qualify the progress and success of establishment. Following the establishment phase, the ongoing monitoring program outlined below will be instituted.

Table 3: Proposed Ongoing Monitoring Program

Rehabilitation Element	Factors for Monitoring	Monitoring Frequency
Pond and Site Water	Water quality including pH, EC and total suspended solids.	Monthly for the first 12 months after establishment and then quarterly + opportunistic after significant* rainfall events.
	Groundwater quality and depth	
	Efficiency of landform surface water drainage systems (integrity of banks and drains)	
Native Vegetation	Describe the vegetation in general terms	Quarterly for the first 12 months after establishment and then every 12 months
	Count the number of plants of all species, excluding grass	
	Record details of ground cover (litter, logs, rocks etc.)	
	Count, by species, all trees >1.6m tall	
	Tag and measure the diameter at breast height (DBH) of trees >1.6m tall, to a maximum of 10 for any one species	
	Subjectively describe tree health, by species if relevant, noting signs of drought stress, nutrient deficiencies, disease and severe insect attack. Where health problems are noted, record the percentage of unhealthy trees	
	Record any new plant species not targeted, including any problem and declared noxious weeds	
	Maintain photographic record with constant reference points	
Native Fauna	General observations relating to the availability and variety of food sources (e.g., flowering/fruiting trees, presence of invertebrates etc)	Quarterly for the first 12 months after establishment and then every 12 months
	Availability and variety of habitat and shelter (e.g. depth of leaf litter, presence of logs, hollows etc.)	
	Presence/absence of free water in the rehabilitated areas	
	General observations of vertebrate species (including species of conservation significance)	After rehabilitation is 3 years old undertake monitoring biennially at a time of year determined to be appropriate for majority of species
	Detailed fauna surveys including presence and approximate abundance and distribution of vertebrate species (focussing on species of conservation significance)	
	Diversity and abundance of present invertebrate species	Bi-Annually, at times of year determined to be appropriate for majority of species
Pests	Species identified	Quarterly during the first two years and biennially after that. Inspections should be opportunistic after
	Approximate numbers/level of infestation	

Rehabilitation Element	Factors for Monitoring	Monitoring Frequency
	Observations of impact on rehabilitation (if any)	significant rainfall events.
Landform Stability	Assessment of the stability of batters and also looking at surface settlements (sink holes). In particular where these features could impact on the performance of any surface water management system	Annually or opportunistic after significant* rainfall events.
	Pond stability	
	Surface integrity of landform cover/capping (measurement of extent of integrity failure)	
	Severity and presence of landform slumping	
	Severity of erosion and sedimentation	
Safety Hazards	Risk assessment (likelihood vs consequence) of site health and safety hazards and their controls.	Quarterly for the first 12 months after establishment and then annually.
Land Use	Land use achievability of selected rehabilitation option and landform design	Annually

* A significant rainfall event a rain event that site personnel would deem out of the ordinary given local weather patterns, this maybe a storm event or prolonged periods of continuous rainfall.

4.3.2 REHABILITATION MAINTENANCE

Where rehabilitation success appears limited and monitoring results are divergent from reference sites and/or rehabilitation objectives, maintenance works and corrective actions will be triggered.

Measures undertaken may include the following:

- Targeted water quality improvement measures including addressing pollution sources, vegetation and land management controls, and engineered solutions.
- Implement suitable watering during establishment phase and an ongoing watering regime within the first 12 months after establishment that allows for targeted watering based on seasonal rainfall variations, and weather events (such as drought or heat waves).
- Re-seeding and, where necessary, re-topsoiling and/or the application of specialised treatments such as composted mulch or biosolids to areas with poor vegetation establishment;
- Installation of tree guards around planted seedlings or construction of temporary fencing suitable for excluding native and feral fauna species should grazing by animals be excessive;
- Replacement of drainage controls if they are found to be inadequate for their intended purpose, or compromised by vegetation or wildlife;
- Maintaining, repairing and cleaning out sediment control structure;
- Repairing eroded areas;
- Landform modification to achieve stability;
- De-silting or repair of sediment control structures; and
- Where monitoring indicates the presence of excessive weeds or the potential for noxious weed infestation, necessary precautions to prevent the development of weeds within the rehabilitated areas will be undertaken.

Any unexpected monitoring results or issues identified during monitoring will be highlighted and an investigation will be completed and any corrective actions recorded. The issue will be considered unresolved until:

- The issue has been resolved by corrective maintenance;
- A new or revised procedure has been established and implemented;
- Training has been provided to relevant personnel/ sub-contractors; or
- Additional specific environmental management plans and monitoring criteria are instituted.

4.4 SUCCESS CRITERIA

The success criteria are performance objectives or standards against which rehabilitation success in achieving a sustainable system for the proposed final land use is demonstrated. Satisfaction and maintenance of the success criteria (as indicated by monitoring results) will demonstrate that the rehabilitated landscape is ready to be relinquished from Holcim's control and could be handed over to stakeholders in a stable and sustainable condition. The success criteria will be reviewed every three to five years with relevant stakeholder participation where considered appropriate to ensure the nominated success criteria remain realistic and achievable.

The preliminary success criteria for the rehabilitation of the final landform will be as outlined in the **Table 4** below. This success criteria can be adapted to meet the objectives of any revisions rehabilitation strategy where required.

Table 4: Preliminary Success Criteria

Rehabilitation Element	Indicator	Criteria
Native Vegetation	Land Use	Designated conservation area accomplishes and remains as a healthy native coastal woodland.
	Surface Cover	Minimum of 70% vegetative cover is present (or 50% if rocks, logs or other features of cover are present). No bare surfaces >20 m^2 in area or >10 m in length down slope.
	Species composition	Subject to proposed land use, comprise a mixture of native trees, shrubs and grasses representative of regionally occurring coastal woodland and suitable aquatic species in pond.
	Resilience to disturbance	Established species survive and/or regenerate after disturbance. Weeds do not dominate native species after disturbance or after rain. Pests do not occur in substantial numbers or visibly affect the development of native plant species.
	Sustainability	Species are capable of setting viable seed, flowering or otherwise reproducing. Evidence of second generation of shrub and understorey species. Vegetation develops and maintains a litter layer evidenced by a consistent mass and depth of litter over subsequent seasons. More than 75% of shrubs and/or trees are healthy when ranked healthy, sick or dead.
	Aquatic species	Established aquatic species survive and regenerate within the aquatic zone. Weeds do not dominate target species. (Subject to creation of pond).
Native Fauna	Vertebrate species	Representation of a range of species characteristics from each faunal assemblage group (e.g., reptiles, birds, mammals), present in the ecosystem type, based on pre-disturbance fauna lists that were sighted within the three-year period preceding quarry closure. The number of vertebrate species does not show a decrease over a number of successive seasons prior to quarry closure.

Rehabilitation Element	Indicator	Criteria
	Invertebrate species	Presence of representatives of a broad range of functional indicator groups involved in different ecological processes.
	Aquatic species	Established aquatic species survive and regenerate within the aquatic zone. (Subject to creation of pond).
	Habitat structure	Typical food, shelter and water sources required by the majority of vertebrate and invertebrate inhabitants of that ecosystem type are present, including: a variety of food plants; evidence of active use of habitat provided during rehabilitation such as nest boxes, and logs and signs of natural generation of shelter sources including leaf litter.
Landform Stability	Slope gradient	Rehabilitated landform assessed by a qualified geotechnical engineer to validate that it is stable, and does not pose a safety risk.
	Erosion control	Erosion control structures are installed at intervals commensurate with the slope of the landform. Dimensions and frequency of occurrence of erosion rills and gullies are generally no greater than that in reference sites that exhibit similar landform characteristics.
	Surface Water Drainage	Use of contour banks and diversion drains to direct water into stable areas or sediment control basins. All landforms will be free draining except where specific structures have been constructed for the storage of water as required for sediment and erosion control or rehabilitated land use.
Pond Water Quality	EC, pH, TSS	Pond water to have appropriate chemical and physical properties for human and environmental receptors.
Topsoil/Topdressing	pH	Soil pH is between 5.4 and 8.5.
	Salinity (electrical conductivity)	Soil salinity content is <0.6 dS/m.
	Sodium content	Soil Exchange Sodium Percentage (ESP) is <15%.
	Nutrient cycling	Nutrient accumulation and recycling processes are occurring as evidenced by the presence of a litter layer, mycorrhizae and/or other microsymbionts. Adequate macro and micronutrients are present
Safety	Risk Assessment	Site has acceptable health and safety hazards and controls for its land use.
Land Use	Land Use	Land is being used as per target land use of ecotourism or nature conservation.

4.5 RELINQUISHMENT

Subject to the compliance with the completion criteria outlined in Section 4.4, the responsibility of Holcim for further rehabilitation works will cease. At this time, the following steps are to be undertaken:

- Collate all relevant records, monitoring and research data, including previous long term rehabilitation monitoring reports, which are to be used as supporting information for assessing compliance with rehabilitation criteria;

- Submit a rehabilitation completion criteria report to DPHI for review and opportunity to comment; and
- Arrange for a close-out inspection with relevant government agencies, to obtain consensus that the necessary requirements have been fulfilled and that no further work is required. As part of the meeting, justification (e.g. rehabilitation monitoring results) as to how closure criteria have been met should be presented. If consensus is not achieved, an action plan is to be developed to address any potential outstanding issues in order to achieve sign-off.

It is the intention that where rehabilitation has been assessed as meeting the appropriate criteria that opportunities for potential partial lease relinquishment through the life of the operation, and release of the Rehabilitation Bond may occur progressively during the life of the operation.

5 KEY RISKS AND MITIGATION MEASURES

5.1 GEOTECHNICAL STABILITY OF FINAL LANDFORM

The final landform involves instability risk due to the requirement to batter existing slopes. The design criteria approach for a slope stability analysis of a selected final landform will be based on the minimum required factor of safety ("FoS") for the appropriate consequence of failure. The adopted FoS will be in accordance with those typically adopted within the industry for slope stability assessments and in general accordance with NSW Health and Safety at Quarries Guidelines. Further, friction angle of sand above and below static water is the same, however, wave impact due to wind energy on the pond perimeter may not reflect conventional slope stability.

A geotechnical investigation which assessed the final landform determined the final dredge pond lake design presents a design acceptance criteria (DAC) well in exceedance of geotechnical best practices (Encompass Mining, 2024).

In addition, the geotechnical assessment determined that there will be a limited risk of excessive erosion and slumping impacting the terrestrial periphery area. Further, the final pond is set-back at a considerable distance from the lease boundary and sand dune system, reducing erosion and slumping risk to adjacent areas (Encompass Mining, 2024).

5.2 GROUNDWATER EVAPORATION AND QUALITY

The final pond will act as a window on the water table and will result in increased evaporation from the aquifer, leading to a permanent modification of the site water balance and potential consequences for the water table elevation locally. Evaporation is the primary driver of model performance post quarry closure. A water licence will be required to cover the volume of water lost from the aquifer due to modification of site conditions. Further evaporation modelling will be undertaken to determine suitability of final landform options involving ponds. Evaporation could be reduced or returned to pre-disturbance levels if part or all of the quarry pit is backfilled.

In order to meet the physical and chemical water quality requirements of the Stockton Groundwater Source, Virgin Excavated Natural Material (VENM) and/or Excavated Natural Material (ENM) would be needed during or upon completion of dredging, to aide in batter and ground stabilisation, while preventing any degradation of groundwater quality related to the materials used.

The material will be selected to consist of predominantly fine grained sand or coarser material that will not reduce the very high hydraulic conductivity of the sand sequence or reduce the hydraulic conductivity on site, which could change the groundwater gradient. For this reason finer clayey and silty material will be avoided. Material will be analysed to ensure it will not degrade groundwater quality and add to acid sulfate soils (ASS) acid generation under natural moderately acidic conditions.

Consequently material imported to site will be sampled and characterised and consistent with the guidelines for ENM material provided by the NSW EPA.

5.3 EROSION AND SEDIMENTATION

Erosion and sediment controls are currently implemented at the Project site due to the loose, apedal, coarse texture of the sandy materials, exposure to wind and high rainfall events, and the slope characteristics of the site.

Long-term erosion and sediment controls will be designed and installed in accordance with the specifications contained in Managing Urban Stormwater – Soils and Construction, Volume 1, 4th edition (Landcom, 2004), Volume 2A Installation of Services (DECC, 2008a) and Volume 2C Unsealed Roads (DECC, 2008b) or equivalent. An erosion

and sediment control plan will be prepared for each phase of the Project. Local climate conditions will be considered.

Current control measures will continue throughout the Project and into the rehabilitation phase. These measures include:

- Diversion of 'clean' overland flow away from 'dirty' areas;
- Vegetation and maintenance of drainage pathways to minimise erosion and sediment accumulation in flowing water;
- Dust suppression on the existing and proposed haul roads (as required); and
- Maintain the exposed sand surface to a minimum to reduce erosion.

Areas subject to high winds, such as elevated dunes, require additional stabilisation to allow vegetation establishment. These areas may also require use of more robust species, such as spinifex to stabilise surface soils.

Prior to the re-establishment of vegetation cover, temporary control measures will be utilised for erosion and sediment control. These measures may include the use of sediment fences for non-channelised flow over disturbed areas, sand bags, rip rap, or any combination of those materials.

5.4 PEST SPECIES

The presence of weed species has the potential to have a major impact on revegetation and regeneration outcomes. Additionally, any presence of weed species within the surrounding land has the potential to significantly impact on the biodiversity value of the rehabilitated areas. Weed management will be a critical component of rehabilitation activities.

In particular, bitou bush (*Crysanthemoides monolifera subsp. chrysanthemoides*) is a highly invasive species occurring in coastal habitats along the NSW coast with potential to invade the newly disturbed and rehabilitated site. This weed has a vigorous growth habitat which results in the smothering of native groundcovers and inhibiting regeneration. This species will be targeted for eradication in any areas where it is recorded and measures such as herbicide sprays will be implemented to prevent it from establishing in new rehabilitation areas. Bitou bush control will be undertaken in accordance with procedures set out in: Current management and control options for bitou bush (*Chrysanthemoides monilifera ssp. rotundata*) in Australia, (2008).

If the occurrence of a previously unrecorded weed species is discovered, advice will be sought from a suitably qualified and experienced person on the management and control options for that species and appropriate measures for mitigating any impacts caused by its management on native species will be developed.

Weeds in general will be managed across the site through a series of control measures, including:

- Prior to re-spreading stockpiled topsoil onto the disturbance area, an assessment of weed infestation on stockpiles will be undertaken to determine if individual stockpiles require herbicide application and / or "scalping" of weed species prior to topsoil spreading.
- Rehabilitation monitoring programs and routine inspections will be undertaken to identify potential weed infestations; and
- There will be an ongoing effort to identify and eliminate (spray) existing weed populations on-site over the life of the Project.

The spread of declared noxious weeds will be prevented by using the measures above. The monitoring and control of weed populations using non-chemical methods (slashing, hand removal) and herbicides will significantly reduce weed infestations. Weed control, if required, will be undertaken in a manner that will minimise soil disturbance. Any use of herbicides will be carried out in accordance with the regulatory requirements and with control measures in place to restrict the contamination of groundwater/pond. Herbicides applied to the edge of the pond, or in wetted

areas around its edge, must be registered for use in aquatic environments by the Australian Pesticides & Veterinary Medicines Authority. Such herbicides need the following characteristics:

- Low eco-toxicity;
- Nil or low volatility at all temperatures (e.g. <10–6 mm Hg) (to reduce spray drift potential);
- Low water solubility (e.g. <3 mg/L) (to reduce potential for leaching to groundwater);
- High soil absorption co-efficient (e.g. Koc >1900 cm^3/g) (to reduce potential for leaching to groundwater)
- Short half-life (in water <15 days; aerobic soil metabolism <610 days; anaerobic soil metabolism <9 days).

Controls to reduce impacts of herbicides on the pond and groundwater include the following:

- Never spray herbicides over the waterbody;
- Direct the spray away from the waterbody where possible (never spray herbicides over the waterbody);
- Spray only to the extent of covering foliage with droplets;
- Spray when weather is calm;
- Use a flat fan nozzle and a low pump/spray pressure to reduce the likelihood of spray drift; and
- Do not spray when rainfall is forecast within six hours as herbicide can be washed off the pest plant and run off into aquatic ecosystem.

Records will be maintained of weed infestations and control programs will be implemented according to best management practice for the weed species concerned.

Feral animal control will be undertaken in consultation with neighbouring landholders. Programs to control feral animals will include the determination of appropriate control practices, consultation with appropriate authorities, obtaining appropriate approvals, implementing control practices and undertaking follow-up monitoring and control as required. If a substantial increase in the numbers of any known feral fauna species, or the occurrence of a previously unrecorded feral fauna species, is discovered, advice will be sought from a suitably qualified and experienced person on the management and control options for that species and appropriate measures for mitigating any impacts caused by its management on native species.

Feral animals may include foxes, cats, rabbits and dogs and will be controlled in accordance with Livestock Health and Pest Authority procedures.

5.5 MANAGEMENT PLANS

A Rehabilitation and Landscape Management Plan (RLMP) will be developed to provide a structured and documented process for managing and improving rehabilitation activities at the Project site. The plan will serve as a process map for interdepartmental administration of rehabilitation activities within the site planning and implementation process. The RLMP will supersede this Rehabilitation Strategy and will provide an increased level of detail based on, but not restricted, to this Rehabilitation Strategy. The RLMP will also be revised to incorporate any conditions of approval. The RLMP will have two focus areas:

1. The integration of rehabilitation activities between the various responsibilities within the site organisational structure through all stages of the rehabilitation process. To achieve this, the RLMP will separate the rehabilitation process into different phases and outline responsibilities at each stage with hold points.
2. The second focus is on refining effective and robust monitoring methods with clear guidelines on the process to be followed to achieve quarry rehabilitation objectives, and a means to record the process followed and results obtained.

The RLMP will be reviewed on the following basis:

- Every five years to ensure its continuing effectiveness;

- When environmental management plans are update with new information relevant to rehabilitation methodology;
- Where an audit recommends a review;
- Where there are repeat issues or unexpected outcomes, and these are not closed out within the agreed timeframe; and
- As otherwise determined by the Environmental Manager.

A management approach will be developed and documented to achieve compliance for rehabilitation activities. Plans that will be used in conjunction with the RLMP, and will include the following:

- Detailed Closure Plan
- Biodiversity Management Plan
- Pest and Weed Management Plan
- Soil Management Plan (including ASS)
- Erosion and Sediment Control Plan
- Water Management Plan
- Bushfire Management Plan

The RLMP will aim to integrate the recommendations of technical assessments and plans into an overarching final outcome objective and as such management actions comprised within other plans will require holistic consideration.

5.6 TRIGGER ACTION RESPONSE PLAN

A trigger action response plan (TARP) for rehabilitation will be developed to identify required mitigation measures and contingency strategies in the event of unexpected impacts to rehabilitation, or where rehabilitation outcomes are not achieved in an acceptable timeframe. A conceptual TARP is provided as **Table 5**.

Table 5: Conceptual Trigger Action Response Plan

Threat	Trigger/ Response	Minor	Major
Geotechnical instability	Trigger	Minor geotechnical instability or slope slumping/movement observed	Severe geotechnical instability or slope slumping/movement observed
	Response	An inspection of the site will be undertaken by a suitably trained person. Investigate potential for worsening. Remediate as soon as practical. Implement additional stabilisation controls as required.	Undertake a review of the landform design. Source and budget for implementation of additional stabilisation controls. Undertake regrading and revegetation of the area, within 1 year.
Erosion	Trigger	Minor erosion observed.	Major erosion present compromising landform stability.
	Response	An inspection of the site will be undertaken by a suitably trained person. Investigate opportunities to install (or augment existing) water management infrastructure to address erosion. Remediate as appropriate.	Engage a consultant to assist with the management of erosion and sedimentation at the site and provide recommendations to appropriately remediate the erosion. Remediate as soon as practicable.

Threat	Trigger/ Response	Minor	Major
Poor pond water quality	Trigger	Water quality exceeds EPL or performance criteria but does not indicate a long-term rehabilitation issue.	Water quality exceeds criteria, indicating a long-term rehabilitation liability.
	Response	Review and investigate water quality monitoring and management where appropriate. Implement relevant remedial measures where required within 6 months.	Implement relevant responses and undertake immediate review to determine source of issues and implement remediation measures identified as soon as practicable within 1 year.
Groundwater quality and depth	Trigger	Monitoring indicates sporadic and short lived impacts to groundwater quality and depth as a result of the final pond	Monitoring indicates long term groundwater quality and depth as a result of the final pond
	Response	Implement review, increased monitoring and further investigation as required. Implement relevant remedial measures where required as soon as practicable.	Implement relevant notifications, responses and undertake immediate investigations to determine source of issues and implement remediation measures identified as soon as practicable.
Inadequate growth medium volumes	Trigger	Topsoil and mulch balance indicates a deficiency in topsoil or mulch available for rehabilitation	Deficiency significant and alternate not available such that it will delay rehabilitation progression and the likelihood of rehabilitation success is low.
	Response	Investigate options and alternatives to be able to meet future topsoil requirements.	Source and budget for purchasing topsoil growth medium for use in rehabilitation, Investigate use of alternatives such as organic material.
Inadequate growth medium quality	Trigger	Properties of soil are inconsistent with analogue sites and representative soil profiles but are capable of sustaining selected vegetation species.	Properties of soil are inconsistent with analogue sites and representative soils profiles and material is physically or chemically unsuitable for sustaining selected vegetation species.
	Response	Investigate application of additional soil, and/or use of appropriate soil ameliorants or management options to address soil quality if deemed necessary.	Consultant to be engaged to assist with recommendations to appropriately remediate soil quality and depth. Remediate as soon as practicable.
Insufficient ground cover	Trigger	Bare patches are > 15% and < 30 % (excluding rocks and logs).	Bare patches are > 30% (excluding rocks and logs).
	Response	Investigate likely causes of unsatisfactory germination rates. Reseed areas with unsatisfactory cover. Review seeding procedures including seasonal mixes, timing and seed rate per hectare.	Undertake analytical soil testing and evaluation, where appropriate implement recommendations for amelioration. Implement appropriate management actions including revising rehabilitation procedures if required.
Poor vegetation health	Trigger	Vegetation health index not in the range of analogue sites.	Long term declining trend in vegetation health index.

Threat	Trigger/ Response	Minor	Major
	Response	Investigate likely causes of vegetation sickness and / or mortality rates. Reseed or replant areas with high sickness or mortality rates. Review seeding and / or planting procedures.	Engage a suitably qualified specialist to investigate causes for vegetation sickness and mortality. Implement appropriate management actions including revising rehabilitation procedures if required.
Prolonged drought	Trigger	Region is Drought Affected as defined by Department of Primary Industries Combined Drought Indicator	Region is Declared in Drought as defined by Department of Primary Industries Combined Drought Indicator
	Response	Investigate long term rainfall forecast and consider planting sterile cover crop as interim measure to reduce wind erosion, dust generation and weed invasion. Consider delay to final seeding rehabilitation with approval from Resources Regulator. Investigate increased erosion and sediment controls.	Plant sterile cover crop as interim measure on any new rehab areas to reduce wind erosion, dust generation and weed invasion. Delay final seeding rehabilitation with approval from Resources Regulator. Install increased erosion and sediment controls to reduce topsoil loss when drought breaks.
Off target species composition	Trigger	Species composition is not consistent with the sewn seed mix and or, surrounding ecosystem.	Ongoing decline in species composition away from target composition
	Response	Investigate the likely causes of unsatisfactory germination and or, growth rates. Reseed areas with unsatisfactory cover. Review seeding procedures including seasonal mixes, timing and seed rate per hectare.	Undertake analytical soil testing and evaluation. Where appropriate implement recommendations for amelioration. Implement appropriate management actions including revising rehabilitation procedures if required.
Weed proliferation	Trigger	Monitoring indicates the density of weeds in rehabilitation areas exceeds analogue sites.	Monitoring indicates substantial weed infestations.
	Response	Undertake weed management to remove / spray introduced weed species. Treatment of infestations as appropriate to the species.	Undertake weed management to remove introduced weed species. Investigate management measures to reduce weeds including additional soil amelioration, establishment and retention of cover crops until weed presence is at acceptable levels. Implement recommendations as appropriate.
Pest animal presence	Trigger	Pest animal species are causing damage to rehabilitation.	Continued damage to rehabilitation from pests after tree guards and fencing has been installed.
	Response	Consult with relevant government agencies to recommend and implement appropriate pest animal control campaign, including tree guards.	Liaise with government agencies and consider appropriate options in accordance with regulations.

6 SUMMARY

The Project site would be rehabilitated to a landform consisting of a large remnant pond of approximately 30 ha surrounded by native vegetation consistent with the surrounding ecosystem and vegetation communities of the Worimi National Park over approximately 5.4 ha.

The final land use value of the pond would be for ecotourism attraction or environmental conservation purposes, or a combination of the two.

The rehabilitation strategy, as outlined in this report, includes establishing a stable final landform, salvaging topdressing and organic surface materials for re-use as seedbeds, revegetation using native species with proven rehabilitation success, and the adherence to a monitoring program whereby corrective maintenance can be actioned in order for the rehabilitated land to develop towards satisfying a success criteria. Additionally, controls are provided to mitigate the risks to rehabilitation success as seen is similar projects within the region.

When implemented on the Project site following operations, these measures and controls will ensure the rehabilitation success criteria is met and the proposed final land from and land use options committed to by Holcim are achieved.

7 REFERENCES

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Appendix 1
Photographs

Plate 1: Example of unstable angle of repose on existing landform to be intersected with 20° batter.

Plate 2: Example of using coarse material as protective cover to stockpile onsite.

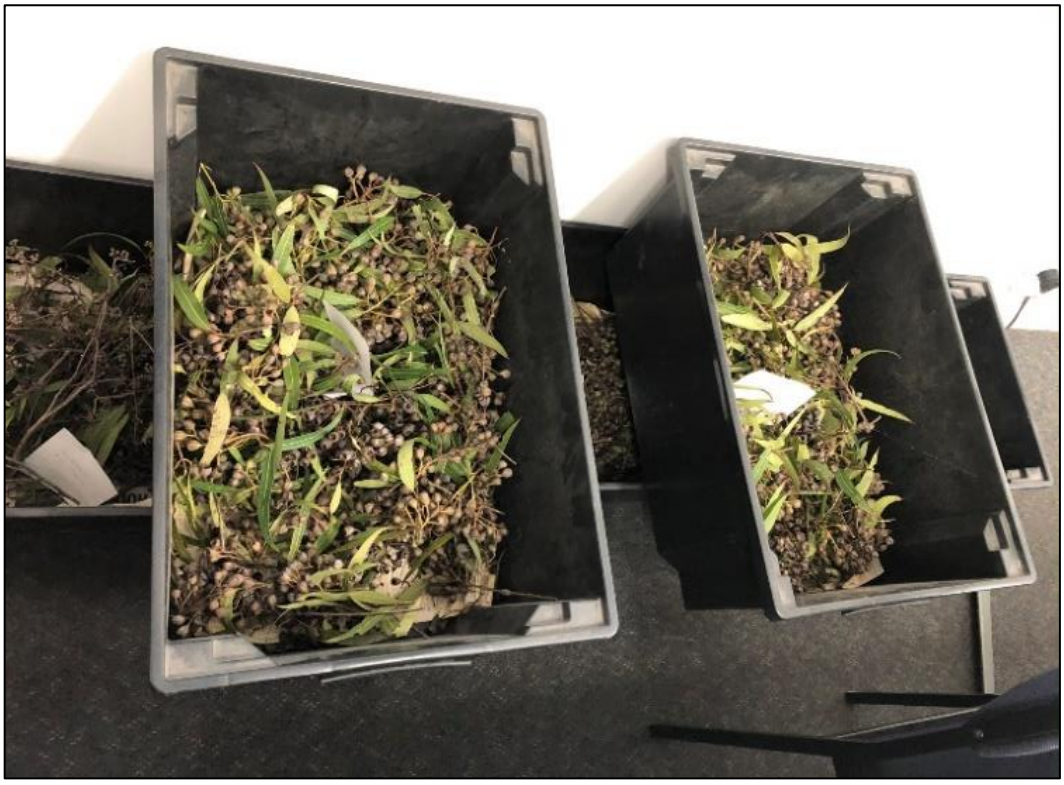

Plate 3: Seedbank store for rehabilitation purposes.

Plate 4. Felled trees stored for use in rehabilitation as fauna habitat and erosion control.

Plate 5: Identified weed species including *Ricinus communis* (foreground) to be eliminated as part of pest management measures.

Plate 6. Coastal woodland native species including *Banksia Serrata* (foreground), target rehabilitation species; observed June 2020.