

OEH Environmental Assessment of the Long Beach Coastal Wattle Management Project



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Photos – All photos by Danny Wiecek (OEH) except where indicated.

1 Introduction

Eurobodalla Shire Council (Council) sought the input of coastal management staff from the Office of Environment and Heritage (OEH) to evaluate the environmental outcomes of the Long Beach Coastal Wattle Management Project, funded by the NSW Environmental Trust.

This report has been prepared to assist Council understand whether or not the funding and significant Council and community resources expended on the project have led to environmental outcomes consistent with best practice dune rehabilitation. This understanding can then be used to inform decisions about future dune management works both at Long Beach and more broadly across the Eurobodalla local government area.

2 Background

There has been a strong and ongoing community interest associated with the environmental, social and scenic values of the Long Beach dune system since development of the area. Since the establishment of a Dunecare Group in the mid 1990's, Council has provided support and guidance in collaboration with various NSW Government agencies on coastal dune management at Long Beach (Eurobodalla Shire Council, 2012). In more recent years, various interest groups and residents have expressed concerns regarding the spread and growth of Coastal Wattle *Acacia longifolia* subsp. *sophorae* at Long Beach and its impacts on beach amenity, views and biodiversity of the dunes and adjacent areas. However, these concerns are not shared by all, with the community consultation completed with Long Beach residents indicating that the priorities and expectations relating to the scenic and environmental values of the dune system are highly varied and often polarised.

The ongoing concerns expressed by some sections of the community with Coastal Wattle proliferation led to the preparation of the 'Long Beach Coastal Wattle Strategy' (Eco Logical Australia, 2010), Council obtaining a Property Vegetation Plan (PVP) to trial clearing of a small amount of Coastal wattle based on this strategy, and the 'Long Beach Coastal Wattle Control Implementation Plan' (ESC, 2012) to guide implementation of the PVP. These documents formed the basis for Council's application to the NSW Environmental Trust for funding to improve the biodiversity of the dunal area through targeted removal of Coastal Wattle and revegetation with other native dune species.

Prior to commencing the project in 2013, Council sought advice from various NSW Government agencies including OEH. The initial advice provided by OEH detailed that the primary aim of the project should be to improve the biodiversity and long term resilience of the dune system through a focus on revegetation, rather than on clearing Coastal Wattle. It was advised that this would best be achieved using a variety of native primary, secondary and tertiary dune species planted out in poorly vegetated areas, areas subject to Coastal Wattle dieback, and the landward extent of the foredune.

3 Long Beach Coastal Wattle Project Overview

The Long Beach Coastal Wattle Management Project was undertaken by Council with funding assistance from the NSW Environment Trust's Restoration and Rehabilitation program and completed over a 4-year period, from 2013 – 2017. Extensive in-kind support was provided by

Council and local community groups including Long Beach Landcare (LBL) and the Long Beach Community Association (LBCA).

The focus of the Coastal Wattle Management Project was to increase the floristic diversity of the dune system through a reduction in Coastal Wattle and revegetation. To assist with achieving sustainable dune management outcomes, the key objective that guided the project was, *“to improve the biodiversity of the dunal area at Western Long Beach which is under pressure from the invasion of Coastal Wattle, a native species creating a monoculture, and preventing its incursion into coastal hind dunes and wetland”*.

The key activities completed throughout the life of the project have included the mechanical removal (trittering) and pruning of Coastal Wattle, primary and secondary weeding, pest species control, the planting and maintenance of local native species and community consultation. A monitoring and evaluation program was also established for the project which incorporated vegetation survey, photo point monitoring, GPS survey and GIS mapping. These activities were implemented to assist with achieving the primary purpose of the project, which was to reduce and control Coastal Wattle to facilitate an increase in the biodiversity of the Long Beach dune system. Table 1 provides a summary of the key project details and outputs for the project.

Table 1. Summary of Long Beach project details and outputs.

Long Beach Coastal Wattle Management - Project Details & Outputs	
NSW Environment Trust Grant funding	\$52,692
Total project cost	\$86,255
Total approx. work hours (Council staff and contractors)	1110
Total approx. work hours (volunteers only)	2723
Total approx. works area	11.6ha
Total approx. area of Coastal Wattle removed	0.54ha (0.2ha in trial areas)
Total approx. length of foredune where Coastal Wattle pruned	800m
Total number of plants planted	2600

4 Project Evaluation

This project evaluation has incorporated a review of project outcomes, with consideration to the key guiding principles that underpin coastal management detailed within policy, legislation and industry guidelines for dune management. The evaluation includes a review of the progress reports and final report prepared and submitted to the NSW Environment Trust in fulfilling the grant funding program requirements of the project. To assist with interpreting these reports and to undertake an independent evaluation of project outcomes on the ground, OEH has completed a number of site inspections from 2013 onwards, with the last inspection of the Long Beach project site on 6th September 2017.

This section is broken up under key headings to outline what the environmental and/or other outcomes are in terms of the projects key components.

4.1 Reduction in Coastal Wattle extent

A review of the project indicates that the objective of limiting the expansion and landward migration of Coastal Wattle has been addressed over the project period. A reduction of Coastal

Wattle extent through trittering and pruning is evident when comparing before and after photos (Figure 1, and Figures 1-5 in Appendix D), and has also been accurately mapped by Council (Appendix A). The GPS survey and GIS mapping of vegetation extent undertaken as part of the project demonstrates this reduction to be around 0.54ha.



Figure 1: A direct pre and post project comparison along the landward extent of the Long Beach foredune showing a typical area of Coastal Wattle that was removed (left, 24-9-2013) and the same location at project completion without Coastal Wattle and now dominated by groundcover species (right, 6-9-2017).

While these methods have reduced the Coastal Wattle extent as proposed, the ability to limit the landward migration of Coastal Wattle without the need for ongoing control in the longer term has not been achieved. This will only be possible through extensive revegetation along the back of the foredune using tertiary dune species, characteristic of the hind dune zone in the central area of Long Beach (Figure 2). These species would include Coast Banksia *Banksia integrifolia*, and to a lesser extent Bangalay *Eucalyptus botryoides*, Forest Red Gum *Eucalyptus tereticornis* and She-Oak *Casurina glauca*. The establishment of such species, characteristic of intact hind dune vegetation at Long Beach, would naturally restrict Coastal Wattle dominating the less vegetated areas across the back of the dune system once established.



Figure 2: A view showing a section of Coastal Wattle backed by grass only (foreground) compared to a section of well vegetated hind dune comprising tertiary species dominated by Coast Banksia and where Coastal Wattle is largely naturally absent (6-9-2017).

Few, if any, tertiary species that were planted in the areas where Coastal Wattle was removed at the back of the foredune have survived. While some tertiary species were planted in these areas, it is understood that contributing factors to their loss were vandalism, herbivory, and dry seasonal conditions. The vegetation that has established is predominately grasses with some small shrubs, and over time is not likely to be sufficient in restricting the spread of Coastal Wattle, which can outcompete and grow over smaller species. This lack of tertiary species can be clearly seen when looking through time series of photos taken prior to and throughout the course of the project (Figure 3).

The overall environmental benefit of the reduction in Coastal Wattle is not significant and is not expected to provide long-term benefits without ongoing manual control.



Figure 3: Time series of a section at the back of the foredune from prior to work starting (top left, 24-9-13), after removal of Coastal Wattle encroaching landward (top right, 7-3-14), revegetation of the cleared area with a variety of species (bottom left, 25-6-14), and at project completion showing only ground cover species have survived (bottom right, 1-8-17).

4.2 Building longer term dune resilience

Dunes that are densely vegetated and consist of a variety of native dune species are more likely to be stable long-term and provide a natural defence against windblown sand and other coastal hazards. Maintaining or creating a stable and resilient dune system should be a priority strategy for any beach, and is a key recommendation in best practice dune management guidelines (DLWC, 2001).

While Coastal Wattle is a native species that is commonly found on the foredune along the NSW coast, it is recognised that a monoculture of this species is less than ideal in terms of long-term dune resilience. Without a variety of native foredune species, dunes covered only in Coastal Wattle can be destabilised and left open to weed invasion and erosion when the Coastal Wattle dies off, which for this species is likely after 8-10 years (DLWC, 2001). In this situation, increasing species diversity into the dune through revegetation with a variety of other native species in areas where Coastal Wattle has naturally died off, and/or other disturbed areas where vegetation density is low, should be a high priority. Long Beach has extensive areas where dieback has occurred and where revegetation would assist with improving dune resilience (Figure 4, and Figures 15-16 in Appendix D).



Figure 4: Examples of natural dieback of Coastal Wattle along the foredune at Long Beach. Targeted revegetation in these areas would improve long-term dune resilience and limit weed invasion and destabilisation through erosion (left, 6-9-2017 and right, 1-8-17).

Large sections at the back of the foredune underwent revegetation with a variety of species. However, practically none of the tertiary species planted that contribute to long-term dune stability have survived (as previously noted in Section 4.1). In addition, only limited revegetation occurred more broadly across the foredune in barer and disturbed areas (Figure 5), or where Coastal Wattle had died off. As a result, it is considered that the project has not led to any significant improvements to long-term dune resilience.



Figure 5: Example of an area of foredune disturbed through illegal vegetation clearing that was revegetated with a variety of species (left, 25-6-2014). However, only a few scattered low-lying species are evident at project completion (right, 6-9-2017).

Any future works planned for the Long Beach dune system should prioritise revegetation of the hind dune with a focus on establishing tertiary species. Additionally, revegetation throughout the dune system in areas where Coastal Wattle dieback has occurred and in disturbed and poorly vegetated areas should be a priority.

4.3 Improving the biodiversity of the dunes

Improving the biodiversity of the dunes was an important component to this project. To achieve this, several activities were undertaken including reducing Coastal Wattle extent, weeding and pest species control, and revegetation, all with differing levels of success.

Reduction of Coastal Wattle extent

Despite a reduction in extent of Coastal Wattle consistent with the aims of the project (see Section 4.1), the monoculture of Coastal Wattle along the foredune remains dominant (Figure 6). As the reduction in extent has been targeted at the back of the foredune, this has likely slowed down the landward spread of this species in the short term. However, as previously discussed, this is not considered to be sustainable longer term due to the intensive nature of ongoing mechanical removal that will be required in the absence of the natural control that tertiary vegetation provides. The biodiversity outcomes achieved from this component of the project are not considered obvious (Figure 7) or significant. At a cost of ~\$15,000 (mechanical \$5000; hand removal \$10,000) for this component, this money is likely to have been better utilised on more extensive revegetation.



Figure 6: Typical sections along the foredune crest dominated by Coastal Wattle (top, 1-8-17; bottom, 13-2-2017).



Figure 7: An area along the rear of the foredune where trittering was undertaken to reduce the landward extent of Coastal Wattle (left, 7-3-14) and the same location at project completion (right, 13-2-17). While the landward extent of Coastal Wattle has been reduced by a couple of metres, there are no obvious biodiversity benefits. This is a good example of where planting tertiary species such as Bangalay and Coast Banksia would have led to biodiversity improvements.

Weeding and pest species control

Weeding and pest species (rabbit) control are considered successful and contributed to improving local biodiversity. Invasive weeds were continually targeted across the works area to assist with reducing the extent of weed cover, encouraging natural recruitment of native species and enhancing the success of revegetation. The final site inspections completed by OEH highlighted little evidence of weed species over the project area due to this effective control (Figure 17, Appendix D).

The rabbit control undertaken during early stages of the project was also successful in limiting the local population and impacts to natural regeneration and revegetation of the dune system. The weeding and rabbit control aspects of the project are considered to have led to positive environmental outcomes and good value for money at around \$20,000.

Revegetation and natural recruitment

A total of 2600 plants comprising a mixture of primary, secondary and tertiary species (See plant list – Appendix B) were planted along the foredune at Long Beach. The vast majority of these were planted towards the western end of the beach at the back of the foredune. At a cost of ~\$10, 000 (tubestock, guards, other materials) this component of the project has been a mixed success. Some biodiversity improvement has been achieved and the number of plants established represents good use of funding and resources. However, better outcomes would have been achieved through significantly expanding the revegetation component across the entire dune profile, and including a greater variety and quantity of secondary and tertiary species at the back of the foredune.

The species that have successfully established from the revegetation completed include primary and secondary ground cover species such as White Correa *Correa alba*, Spiny Headed Mat Rush *Lomandra longifolia*, Coastal Rosemary *Westringia fruticosa*, Kangaroo Grass, *Themada australis*, Seaberry Saltbush, *Rhagodia candolleana* and Knobby Club Rush *Ficinia nodosa* (Figure 8, and Figures 6-14 in Appendix D). The planting of such species has led to some dune biodiversity improvement and assisted with reducing weed incursion in areas disturbed by trittering. It is noted however, that these species are more typically found at the

back of foredune in association with larger shrub and tree species, rather than predominantly in isolation of other larger species. Had larger species established from the efforts of Council and volunteers who planted them on more than one occasion, then greater long term biodiversity outcomes would have been achieved. In addition, there are some existing Eucalypt tree species at the back of the dune (Figure 8) that over time will increase habitat complexity and provide a good basis for adding to with further tertiary dominated revegetation.



Figure 8: Looking west along the back of the foredune across a section that was planted out (left, 25-6-2014), and the same location at project completion showing successful establishment of a variety of ground cover species in an area that was trittered, as well as some of the existing Eucalypt trees present prior to the project (right, 6-9-2017).

The vegetation monitoring and reporting undertaken by Council indicated that the natural recruitment of local native species, particularly Knobby Club Rush, had been very successful in areas where trittering and restoration activities were completed. While this is a positive outcome, it was noted on the OEH site inspections that removal of vegetation and ground disturbance, particularly where revegetation did not occur, only promoted groundcover and/or pioneer species (Figure 9). Revegetation using larger species would have assisted rehabilitation of these areas and improved environmental outcomes.



Figure 9: A typical area after trittering of Coastal Wattle where some natural regeneration of groundcover species (Knobby Club Rush) occurred in the layer of mulch left on site (29-9-2015).

4.4 Community consultation, education and project challenges

Community consultation and education

Both prior to and throughout the current Coastal Wattle Management Project, Council has facilitated ongoing community consultation with Long Beach residents regarding management of the dune vegetation. Consultation activities have included meetings with both land owners and stakeholder groups, public workshops and media releases (Eurobodalla Shire Council, 2012).

From the commencement of the project, stakeholder meetings were held involving community interest group representatives including LBL and LBCA and various Council staff. The stakeholder meetings were held as a forum to discuss the planned activities and outcomes under the project, and any concerns raised by stakeholder representatives. Stakeholder groups were specifically consulted regarding the development of a project planting schedule. Feedback was provided by LBL and LBCA on preferred species and locations for certain species to be planted. Input was also sought regarding the locations for trial areas of Coastal Wattle removal in accordance with the PVP.

In addition to the project specific stakeholder meetings, Council engaged with community representatives and volunteers extensively, through attending site meetings as well as conducting community planting and education activities at Long Beach. For example, Council coordinated seven community planting days during the first year of the project, with four education events also held over the project duration. These activities were held in addition to regular monthly 'working bees' of LBL (Figures 18-19, Appendix D).

The measurable outcomes of the project with regards to stakeholder and community education and participation, indicate that extensive resources were allocated to engaging the community. During the project, over 70 individuals were reached with 67 volunteers contributing towards over 2700 volunteer hours and over 100 attendees participating in educational activities. This highlights Council's commitment in aiming to facilitate sustainable environmental and social outcomes through community consultation and is a very positive outcome from the project. It also highlights the passion within the local community for this project.

Project challenges

While the project has incorporated extensive stakeholder and community participation and education, there have been a range of challenges that have limited the success of the project. The revegetation completed under the project has been subject to illegal vandalism, and this has compromised the environmental benefits of the project as discussed previously.

In addition, the existing established dune vegetation has also been subject to ongoing clearing and vandalism, particularly mature trees and shrubs (Figure 10). The clearing and modification of dune vegetation significantly increases the risk of dune instability issues and also increases the risk from coastal hazards overtime.

In an attempt to address the ongoing vandalism at Long Beach, Council has engaged with local residents regarding the role of dune vegetation and the purpose of the Coastal Wattle Management Project. To reinforce the intent and purpose of the project and discourage further vandalism, educational signage was also installed along the rear of the foredune, along with illegal tree removal notices where vandalism occurred (Figure 11).

While these strategies may have reduced instances of illegal clearing, this sort of vandalism still remains an issue at Long Beach, as it does at other locations in the Eurobodalla and more broadly where conflict exists around vegetation and views. A review of how Council manages the issue of illegal clearing of vegetation may be necessary, and could include consideration of other management strategies involving surveillance and visual deterrents in the form of screens and bolder signage in areas where vandalism has occurred.



Figure 10: An example of illegal vandalism of vegetation showing poisoned Coastal Banksias (main image, 1-8-2017) and another area where similar vandalism occurred and where illegal tree vandalism signage was installed (photo insert top left, 23-8-2013).



Figure 11: Educational signage installed by Council regarding the intent of the Long Beach Coastal Wattle Management Project (left), and illegal tree removal signage installed by Council in an area where Coastal Banksia's were poisoned and lopped (right).

4.5 Monitoring, reporting and evaluation

The project monitoring and reporting completed by Council for the life of the project is comprehensive. The monitoring activities, which have included photo monitoring, vegetation surveys pre and post completed works, and GIS mapping of works completed and changes in Coastal Wattle distribution, are considered best practice. These aspects have been valuable in determining the baseline condition of the dune vegetation and recording changes as a result of the management activities completed under the project.

For example, the Coastal Wattle extent in 2013, prior to control works starting, and again in 2017 after control works were completed, was mapped by Council (Appendix A), and this has enabled the change in Coastal Wattle distribution across the dunes to be accurately quantified. The use of photo monitoring points to highlight changes on the ground has also been an excellent way of showing changes through each stage of the project. Both these aspects enable a thorough evaluation of whether the project has met its objectives, as well as allowing independent evaluation of the environmental outcomes achieved.

The implementation of any future dune management works at Long Beach, or other beaches across the Eurobodalla, should incorporate monitoring activities similar to those under this project, which will enable their success to be easily quantified. Through completing effective monitoring and reporting activities, not only can the success of management actions be measured, but also, any constraints and barriers can be identified that may assist with developing and revising future management strategies.

5 Comparison to Another Dune Rehabilitation Project

To put the environmental outcomes of the Long Beach project into perspective, comparison is made to a similar dune rehabilitation project, the Warilla Beach Dune and Habitat Rehabilitation Project, considered to have achieved successful environmental outcomes consistent with best practice dune management.

The Warilla Beach Dune and Habitat Rehabilitation Project was co-funded by Shellharbour City Council and OEH under the Coastal Management Program, with an overall aim to improve dune stability and resilience. For context, Warilla Beach is located in the Shellharbour local government area and is backed by urban development for much of its length, similar to Long Beach. Also similar to Long Beach, the dune vegetation was degraded and in areas heavily dominated by single species including Coastal Wattle and/or Tea Tree. Large areas were also poorly vegetated and contained a number of weed species.

Rehabilitation works at Warilla Beach commenced in 2009 and were staged until 2015. Works were staged to complete smaller sections of the dune at a time, before moving on to another dune section in subsequent years (see Appendix C). While the level of funding for the project was greater at Warilla Beach compared to Long Beach (Table 2), the types of works involved were similar. These involved primary weeding, mulching and planting across the works area. One of the key differences between the projects was there was no attempt to remove species like Coastal Wattle in areas where it was forming a monoculture in the Warilla dunes, with works instead focusing on increasing species diversity across the whole dunes through revegetation in areas of vegetation die off, in other disturbed areas where species cover and diversity was poor, and where weeding had been undertaken. Another difference was that

more extensive weeding was required at Warilla Beach and this component was completed through the use of contractors, adding to the total project cost significantly.

Table 2 – Warilla Beach dune and habitat rehabilitation project details and outputs.

Warilla Beach Dune & Habitat Rehabilitation Project Details & Outputs	
Project Duration	2009-2015
Total project funding (Coastal Management Program)	\$84,000
Total Project Cost	\$168, 000
Total approx. work hours (Council staff and contractors only)	2817
Total approx. works area	4ha
Total number of plants planted	4875

The selection of species utilised for the Warilla Beach project was reflective of local dune vegetation communities such as Coastal Sand Scrub and Bangalay Sand Forest, and included a selection of primary, secondary and tertiary species (Appendix B, Table 2), similar to that at Long Beach. However, Coastal Wattle was also used amongst a variety of other species in some poorly vegetated areas. Like Long Beach, there was a lack of tertiary species behind the foredune, and revegetation with tertiary species was a key strategy used to promote long term dune stability and improve the capacity of the dunes as a buffer to coastal hazards.

As per Long Beach, monitoring of the works was undertaken for the life of the project to record changes to the dune system and assess the success of the on-ground management activities. Key components to this monitoring included the use of photo points and annual vegetation surveys. What the monitoring highlighted was that key environmental outcomes were able to be achieved, which included:

- Enhanced long term dune stability and resilience through the successful establishment of a variety of local native dune species in areas that were degraded and poorly vegetated. This included tertiary species behind the foredune where this vegetation type was poorly represented (Figures 12 and 13 and Appendix C).
- Improved natural regeneration capacity of the dune system through removal of weeds and increased species diversity through extensive revegetation over the entire dune system.
- Increased local biodiversity and habitat connectivity through focusing on revegetation in sparsely vegetated areas and where monocultures of species such as Coastal Wattle occurred.



Figure 12: Section along the back of the foredune at Warilla Beach just after mulching and planting into a bare area (left, 6-7-12) and the same location (right, 11-9-2017) with well established tertiary species and smaller groundcovers underneath.



Figure 13: Section along the back of the foredune at Warilla Beach just after mulching of a bare area prior to planting (left, 1-2-2012) and the same location (right, 11-9-17) showing well established tertiary species.

While this project was not as constrained by polarised views on dune management as at Long Beach, some illegal removal and vandalism of dune vegetation also occurred over the life of the project and required management consideration. In response to this, supplementary planting was carried out for some areas using a similar mix of primary, secondary, and tertiary vegetation. While some removal of tertiary species still resulted, extensive areas at the back of the foredune now have well established tertiary species (Figures 12 and 13). Whilst this is an example of a successful dune restoration project, continued investment in weeding and supplementary planting is still required to ensure outcomes are not compromised over time.

What this comparison highlights is that although considerable effort has been expended on the Long Beach Coastal Wattle Management Project, the overall environmental outcomes achieved have not been as significant and do not closely align with other successful dune management projects that are considered to better reflect best practice. While some of this can be attributed to the greater amount of funding and concentration of work over a smaller area at Warilla Beach compared to Long Beach, it is also reflective of the overall focus of each project. From a cost benefit point of view, although the Warilla Beach total project cost is approximately double that of Long Beach, the environmental benefits from this expenditure are much clearer.

6 Evaluation Summary

The project review and evaluation undertaken by OEH highlights Council's commitment to improving the ecological condition and value of the Long Beach dune system. This is demonstrated through the restoration activities completed across the works area including weeding, revegetation and rabbit control. Through working collaboratively with key community groups including LBL and LBCA in delivering the project, a number of co-benefits including an increase on the social awareness of the importance of coastal dunes continue to be achieved. However, opposing community views and perspectives regarding dune vegetation, as evident through vandalism of taller species, both planted and already established, remains a management constraint.

The mechanical removal of Coastal Wattle has assisted with partially achieving the project objectives, however the benefits associated with this work are considered to be short term. Whilst the control techniques including trittering and pruning have restricted the immediate expansion of Coastal Wattle, the overall long-term project success in this regard has been limited.

Revegetation of the dune system following trittering has been compromised through illegal activity including vegetation removal and vandalism. Along with other contributing factors, this has resulted in the unsuccessful use of tertiary species in revegetation that would have led to greater longer term environmental outcomes through: limiting the expansion of Coastal Wattle; building longer term dune resilience and stability; and increasing the floristics and ecological value of the hind dune system.

A review of this project from an environmental perspective indicates that the implementation of future Coastal Wattle removal and modification should not be a priority as a management strategy for the Long Beach dune system. To increase long-term dune resilience and develop more complex and diverse dune vegetation, it will be necessary to undertake staged revegetation using appropriate species suited to various zones across the whole of the dune system. For any sustainable dune management program to be effective at Long Beach, continued community consultation and education will be necessary to address competing community priorities, expectations and opposing attitudes relating to dune management and choice of species used in revegetation. Based on the environmental outcomes achieved, it is anticipated that further dune management activities focusing around the removal of Coastal Wattle at Long Beach will be difficult for funding bodies to financially support.

7 Recommendations for Future Dune Management at Long Beach and More Broadly Across the Eurobodalla

The recommendations outlined below have been included to guide future dune restoration activities at Long Beach, and are also likely to be applicable more broadly across other Eurobodalla beaches:

- Greater focus on establishing a more diverse and densely vegetated foredune and hind dune through targeted revegetation throughout the entire dune system, particularly in areas that are poorly vegetated and disturbed and where Coastal Wattle dieback is occurring. This will increase dune stability and resilience to coastal hazards, as well as improve the ecological function and biodiversity of the dunes.
- Continue to revegetate using a mix of primary, secondary and tertiary native species, with a focus on establishing tertiary vegetation at the back of the foredune that will naturally limit landward encroachment of Coastal Wattle.
- Continue to implement management activities that target the control of priority weed and pest species that threaten the longer term stability and biodiversity of the dune system.
- Abandon broadscale clearing and modification of Coastal Wattle and focus on dune revegetation with minor pruning of Coastal Wattle only to maintain recreational access points and any necessary emergency access provisions. Further Coastal Wattle removal without successful establishment of tertiary species at the back of the foredune is not considered to be economically sustainable or environmentally sound for the Long Beach dune system.

- Stage dune rehabilitation works such as weeding and revegetation over smaller sections of the dune to focus limited resources and attempt to more fully restore a section of the entire dune profile. Once a section is successfully weeded and appropriately planted out, then move onto another section, with follow up minor maintenance of the previous section only.
- To assist with protecting the environmental and social values of the Long Beach dune system, consideration of other management strategies for dealing with illegal vegetation clearing is encouraged. This could involve the use of surveillance and visual deterrents in the form of screens and bolder signage in areas where vandalism has occurred; and development of community awareness information regarding the process, including contacts for providing information on illegal clearing.
- To increase community awareness regarding the importance of the role of dune vegetation, continue to deliver community education initiatives highlighting the social, environmental and financial benefits of a well maintained and vegetated dune system.

8 References

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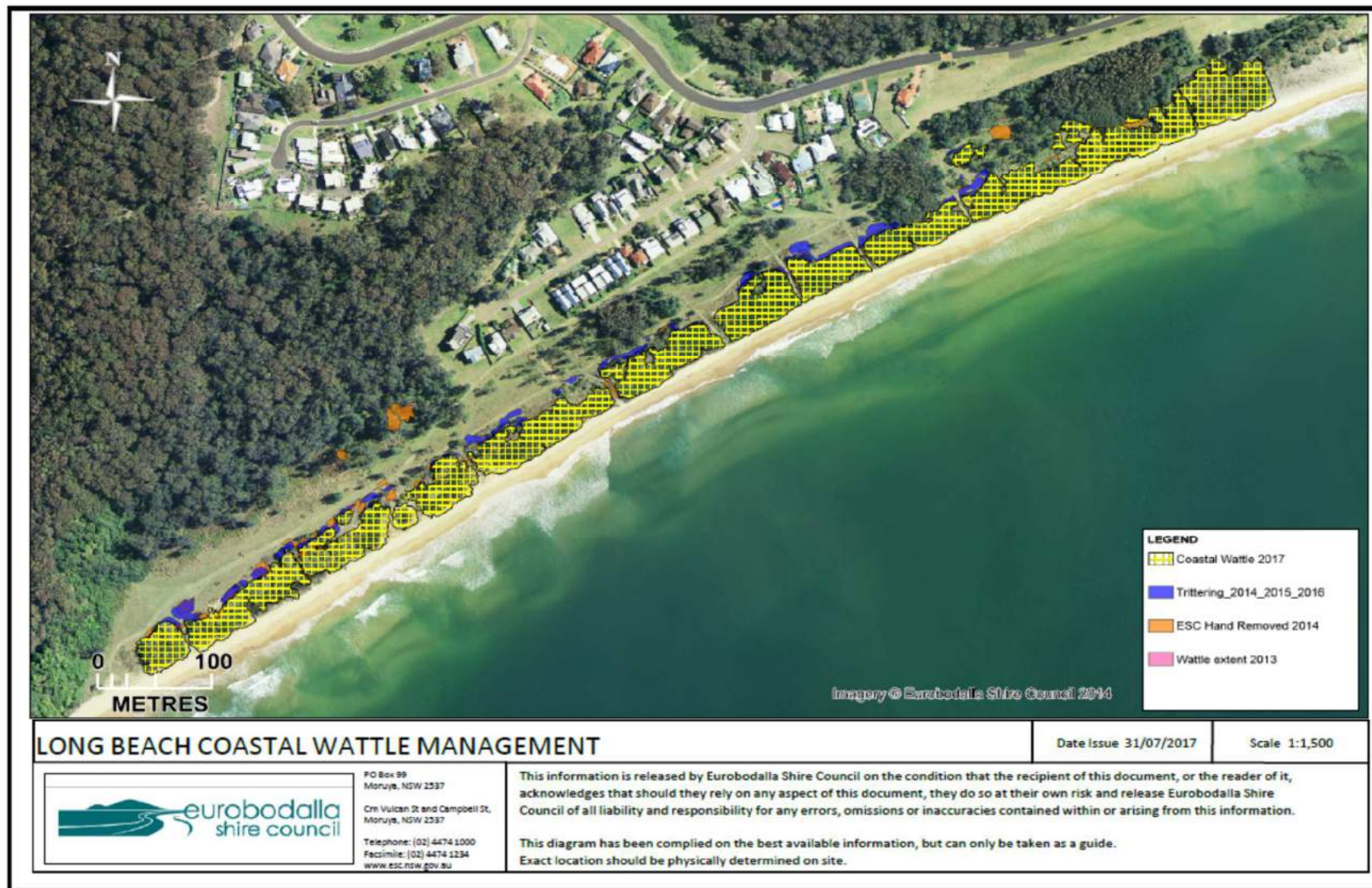
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Appendix A

Map 1 – Distribution of Coastal Wattle mapped by Council prior to any work being undertaken in 2013



Map 2 – Coastal Wattle distribution in 2017 and areas where trittering and hand removal works were completed

Map 3 – Change in Coastal Wattle distribution between 2013 and 2017 upon completion of works



Appendix B – Species Planting List**Table 1 – Long Beach revegetation plant species list**

Species	Common name	Description	Foredune	Mid-dune	Hind dune	Number planted
Atriplex cinerea	Grey Saltbush	Low greyish shrub of open coastal areas. Leaves semi-fleshy, grey, narrow, with white flecks on surface. Flowers -cream-yellow, Sep to Oct or Dec.	x	x		145
Banksia integrifolia	Coast Banksia	Tree growing 10-12m. Full sun or dappled shade. Tolerates coastal exposure. Yellow flowers summer / winter			x	5
Banksia serrata	Old Man Banksia	Tree to 8m with gnarled trunk. Sun or semi shade needs good drainage. Large greyish yellow flowers from summer to winter.			x	5
Carpobrotus glaucescens	Pig Face	Prostrate perennial with stems to 2 m long, Groundcover producing large, striking, deep pink-purple flowers from October to January.	x	x		200
Correa alba	White Correa	Dense bushy shrub to 2m. Requires good drainage prefers full sun. White flowers from winter to summer.		x	x	125
Eucalyptus botryoides	Bangalay	Large spreading tree. Thick dark green glossy leaves. Cream flowers Summer - Autumn. Tolerates poorly drained soils.			x	15
Ficinea nodosa previously Isolepis nodosa	Knobby Club Rush	Tufted perennial sedge up to 1m high. Grows in a range of soils. Tolerates water logging. Salt tolerant	x	x	x	425

Leucopogon parviflorus	Coast Beard Heath	Bushy medium sized shrub 1 to 3m. Sandy or clay soils must have good drainage. Woolly white flowers during spring/summer.	x	x		Nil (unable to be sourced)
Lomandra longifolia	Spiny-headed Matt Rush	Tussock to 1m x 1m. Found in most habitats. Suits any situation. Flowers in spring. Fruits orange when ripe in summer.	x	x	x	625
Poa poiformis	Coast Tussock Grass	Tufted perennial grass which forms tussocks from 60cm to 1.2m. For most soils including cliff tops and sand dunes. Sun to semi-shade. Cut off at just above ground level to rejuvenate.	x	x	x	200
Rhagodia candolleana	Seaberry Saltbush	Medium shrub to 1.5m. Sandy soil in full sun can take semi-shade. Reasonable drainage. Flowers pale spikes most of year followed by red berries. Front row coastal plant erosion control.	x	x	x	250
Spinifex sericeus	Beach Spinifex	Stoloniferous grass with long runners. Covering several meters. Sand binding and colonising on coastal sand dunes. Full sun. Drought and salt tolerant.	x			200
Themeda australis	Kangaroo Grass	Tufted perennial grass up to 1.2m high by 0.5 across. Full sun or part shade. Well drained soils. Salt tolerant. Flowers spring-summer.		x	x	200
Zoysia macrantha	Prickly couch	Spreading perennial grass to 0.25cm tall. Full Sun or part shade. Well drained soils. Frost and salt tolerant. Suitable as a turf species.	x	x		200
Casuarina Glauca	Swamp Oak	Tree 8-20m high, producing suckers. Full sun or part shade. Tolerates sandy soils.			x	5

Table 2 – Warilla Beach revegetation plant species list

Species	Common name	Foredune	Mid-dune	Hind dune
Acacia longifolia subsp. Sophorae	Coastal Wattle		x	x
Angophora floribunda	Rough Barked Apple			x
Banksia integrifolia	Coast Banksia			x
Carpobrotus glaucescens	Pig Face	x	x	
Correa alba	White Correa		x	x
Eucalyptus botryoides	Bangalay			x
Dichelachne crinita	Long Haired Plume Grass		x	x
Eucalyptus robusta	Swamp Mahogany			x
Ficinia nodosa previously Isolepis nodosa	Knobby Club Rush		x	x
Leucopogon parviflorus	Coast Beard Heath		x	x
Leptospermum laevigatum	Coastal Tee Tree			x
Lomandra longifolia	Spiny-headed Matt Rush	x	x	x
Poa poiformis	Coast Tussock Grass	x	x	x
Spinifex sericeus	Beach Spinifex	x		
Themeda australis	Kangaroo Grass		x	x

Appendix C – Warilla Beach Aerial Photo Comparison

An example of one stage of works (100m length of beach) completed at Warilla Beach. Every year a new stage was started once primary weeding and revegetation were completed, with only follow up maintenance works occurring in the prior stages.



Appendix D – Additional Long Beach Photos

Reduction of Coastal Wattle



Figure 1. Before (top, 24-9-2013) and after (bottom, 6-9-2017)



Figure 2. Before (left, 24-9-2013) and after (right, 1-8-2017)



Figure 3. Before (left, 24-9-2013) and after (right, 7-3-2014)



Figure 4. Before (left, 24-9-2013) and after (right 6-9-2017)



Figure 5. Mechanical removal of Coastal Wattle during an early trial (14/11/2013).

Revegetation - examples of the primary revegetation completed under the project



Figure 6. Before (left, 25-6-2014) and after (right, 13-2-17)



Figure 7. Before (left, 25-6-2014) and after (right, 6-9-2017)



Figure 8. Before (left 25-6-2014) and after (right, 1-8-2017)



Figure 9. After trittering (left, 7-3-2014) and after revegetation (right 25-6-2014) and at project completion (bottom 12-2-2017).





Figure 10. Before (top, 7-3-2014) and after (bottom, 6-9-2017)



Figure 11. (13-2-2017)



Figure 12. (1-8-2017)



Figure 13. (6-9-2017)



Figure 14. (6-9-2017)

Coastal Wattle Dieback



Figure 15. (6-9-2017)



Figure 16. (12-2-2017)

Weed Removal – examples of areas successfully weeded



Figure 17. Area of weeds after dune disturbed from fire (top, 29-9-2015) and at project completion where no weeds are evident (below, 6-9-2017).

Community Engagement



Figure 18. A community engagement activity that was held within Long Beach Reserve*.



Figure 19. A volunteer planting day completed as part of the project*.

**Photos used in Figure 18-19 were used in the Environmental Trust reports prepared for the project and provided by ESC.*