Appendix 2: Nunduk Retreat & Spa Regenerative Strategy

And Biodiversity Sensitive Design

Executive Summary

Nunduk Retreat & Spa is a luxurious eco-resort proposed at the southern edge of Lake Wellington, Gippsland Lakes. As part of its high sustainability aspirations, Nunduk aims to become the first development to use Regenerative Development strategies to establish a nature reserve leading to the eco-resort, attracting native wildlife the site, recreating a freshwater wetland, increasing the ecological capital of the site, protecting the site from future erosion and supporting the local region socially and economically. This report compilates a series of recommendations and strategies that have been developed to support the design team to support the ecological restoration and regeneration of the site. The information is particularly relevant for the landscape architecture team but can be helpful for a diverse group of industries working in this project.

In Chapter 1, we provide the background information summarising some of the key ecological threats and observation of the site for the proposed development. We also explore the concept to Regenerative Development, and highlight the results from the process championed by Dominique Hes and Thrive Research Hub to develop regenerative design guidelines that this strategy follows. Meanwhile, Chapter 2, we provide a brief description of the project and outline the methodology followed by Dominique Hes and BioUrbem to identify key species to support regenerative strategy.

In Chapter 3, the Regenerative Landscape Strategy outlines a series of actions that will enhance the capability of the ecological system to adapt to novel brackish conditions, prospected climate change and enhance the capacity of these ecosystems to provide their services. Specifically, it aims to support the existing ecological communities, foster higher biodiversity, enhance the connectivity in the landscape, create a soft edge between the wetland and the surrounding environment, and enhance the ability of the system to provide ecological services. To achieve the aforementioned objectives we proposed to subdivide the 200 acres of the Retreat & Spa to:

- Diversify the Coastal Saltmarsh flora (Zone 1)
- Strengthen the Estuarine Scrub EVC (Zone 2)
- Use living systems to stabilise the shoreline (Zone 3)
- Insert Paddock Trees (Zone 4)
- Create a Fresh Water Wetland (Zone 5)

In Chapter 4, the Regenerative Social Strategy outlines a series of actions that will enhance potential of the project by:

- Celebrate the regenerative infrastructure
- Celebrate the indigenous ancestry
- Promote Public Access and project engagement
- Export knowledge

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Background

Nunduk is a proposed Retreat & Spa planned to the southern edge of Lake Wellington on the Gippsland Lakes system. As part of its high sustainability aspirations, Nunduk aims to become Australia's first Regenerative Development project by: establishing a nature reservoir leading to the main building, attracting native wildlife to the site, recreating a freshwater wetland and implementing strategies that will allow the land to adapt to the environmental changes that have and are expected to occur in the region. This report compiles a series of recommendations and strategies that have been developed to support the landscape architects in the development of their design strategy. This strategy aims to restore the ecological system of the proposed site and to increase the vitality and viability of the ecosystems on the site so that is can continue to thrive into the future.

The Retreat & Spa is located at the western edge of the Seacombe West Wetland. Based on the environmental assessment conducted by BioUrbem (2017), Seacombe West Wetland is a hypersaline coastal saltmarsh surrounded by an Estuarine Scrub. These two Ecological Vegetation Classes, the saltmarsh and Estuarine Scrub, are not in stable but represent a transitional state as the land degrades from what was previously a freshwater Swamp Scrub into an Arid Salt Pan (Figure 1). This degradation is a result of the influence of the increasing salinity of the Gippsland Lake Systems - over the last 30 years, the salinity levels at Lake Wellington have increased from ~5ppt to 20ppt (Ladson et al. 2011).

Based on this transitional state, the environmental assessment concluded that the Seacombe West Wetland is in moderate condition: this conclusion was based on the highly modified salinity of the wetland system, the low variety of vegetation species and the high proportion of weeds (for further details refer to the Ecological Assessment BioUrbem, 2017). The wetland is also vulnerable to further ecological degradation caused by climate change impacts such as sea level rise, increasing erosion rates as species that previously protected the shoreline die, increased frequency and duration of droughts and so forth (Saintilan and Rogers 2013, EGCMA 2015). It is noteworthy that, based on photographic evidence, ~10m of shoreline has eroded over the last 20 years and that similar erosion rates have been recorded in various other areas of the Gippsland Lakes (Sjerp et al. 2002). Assuming these conditions remain constant, the thin barrier currently separating Lake Wellington from Seacombe West Wetland will disappear within the next decade causing Lake Wellington to permanently flood most of the existing wetland.

Whole of Country Principles:

"We have cultural obligations: *It is our inherent responsibility to look after Country – to heal the damage of the past and protect it from future generations"*

"Everything is connected: *There is no separation between our landscapes, waterways, coasts and oceans, natural and cultural resources. All are linked to our people, law and custom"*

Every bit matters: *We understand the need to prioritise limited resources, but every part of our Country remains important.*

"Don't wait until it is gone: *When you lose a site, it is gone forever. We need to act now to prevent any further loss of environmental or cultural values"*

"Look at what was there before: *When we are healing and restoring degraded landscapes, we should try to put back the plants and animals that used to be there"*

"Seek collective benefits: *We use our resources for the benefits of the mob rather than seek individual gain"*

"Our traditional knowledge is valuable: *Our traditional practices*

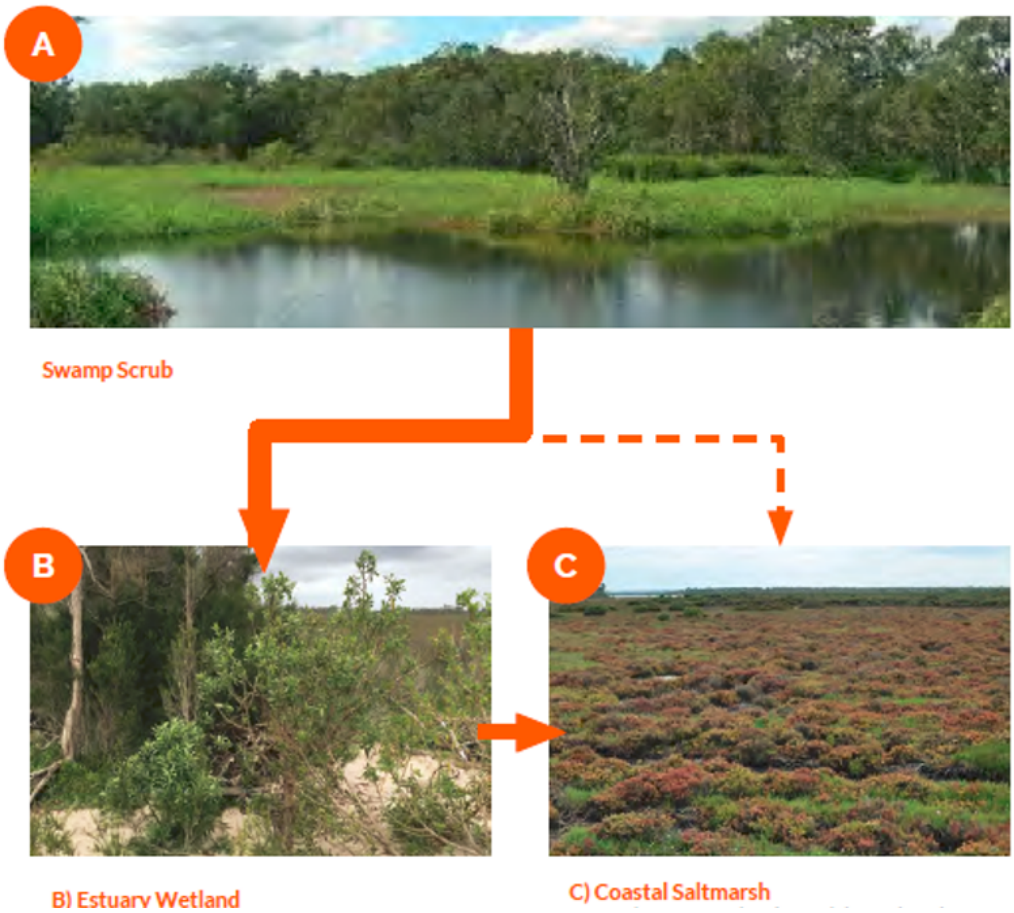


Figure 1: EVC transition observed at Seacombe West Wetland. Modified from BioUrbem 2017, p22.

1.1 Regenerative Design & Development

Regenerative Development is defined as a 'whole-systems' approach which aims to develop a partnership between people and their place to co-create a resilient ecosystem. The Regenerative Development approach encourages communities to support and create positive relationships that will benefit society and our environments. A simplified version of the approach can be summarised as:

1. Understanding the flows that infuse life and activity into a system. This learning process considers both physical flows (i.e. water, salinity, soil) as well as intangible variables acting within the system (i.e. governance, culture, place attachment) and the way in which these flows interact with the place.
2. Designing place-based solutions that:
    a. Encourage stronger relationships between people and 'place'.
    b. Improve the condition of the ecological system.
    c. Work across multiple scales expanding the scope beyond the boundary of a project.
    d. Benefits the whole system.
    e. Embrace uncertainty and change as an inherent capacity of the system.

3. Apply long-term strategies to allow the ongoing co-evolution of the system to continuously enhance the resilience of the system.

The principles that guide this 'systems design' are fundamentally different from the current development strategies. This paradigm emerges from an ecological mindset by understanding that systems are in perpetual movement; it evolves. As in nature, new things are trialled constantly, they interact with the system when they work, they are maintained, when they don't, new strategies emerge. Figure 2 summarises the key differences between the dominant paradigm driving development (mechanistic) and regenerative development (also known as 'whole system development').

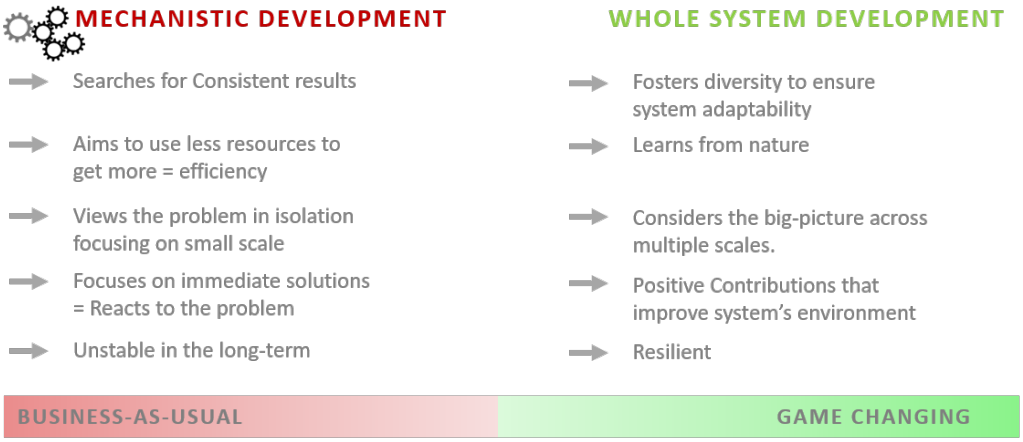


Figure 2: Differences between Mechanistic Development and Whole System Development. Image credits: Michael McGowen and Cris Hernandez.

The ecological paradigm required to achieve regenerative development is not new. In fact, it closely resembles the Whole of Country Principles. The box to the left shows some of the principles that resonate with the inherent drivers of regenerative development. These principles were written by the Gunaikuranai for their Whole of Country Plan (WCP) and appear in the Gippsland Lakes Ramsar Site Management Plan (EGCMA 2015).

1.2 Weaving Nunduk Retreat & Spa Regenerative Story

Researchers applied a regenerative design process comprising four different workshops (Figure 3). The first workshop focused on understanding the indigenous story of 'place'. Meanwhile, workshop two, three and four applied the Lenses Framework (Figure 4) to: explore the concept of regenerative development; identify and prioritise the needs of the local community; and, develop the design principles guiding the project. The fourth workshop brought together over 40 experts to collaborate in a design charrette and co-create the design concepts and ideas that the design team has continued to work on. Topics discussed included renewable energy options, built environment (including private and shared spaces), ecological condition, ocean dynamics,

regenerative design, biomimicry, amongst many others. Thrive Research Hub published the results from the facilitation process in various journals and concluded that it resulted in the emergence of more holistic guidelines that can inform design processes and trigger a greater regenerative potential of built infrastructure (Hes et al. 2016, Plaut et al. 2016).

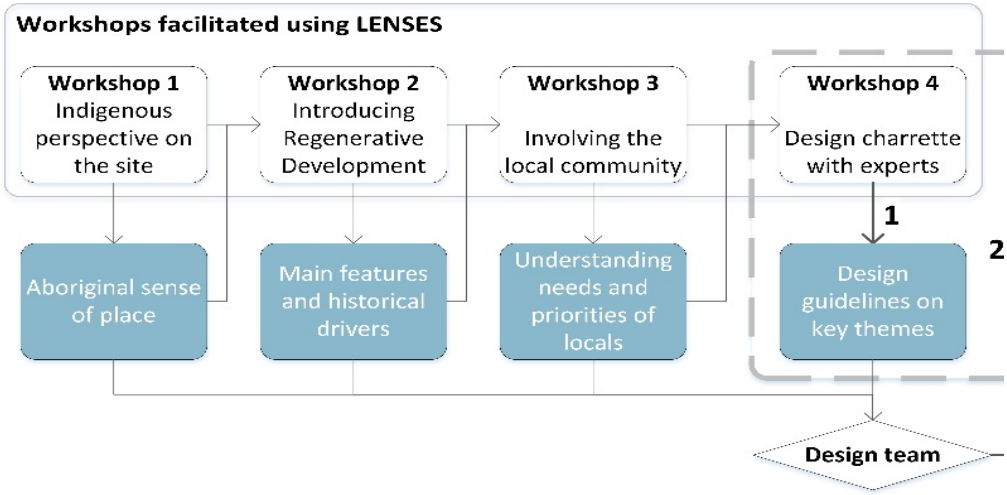


Figure 3: Overall Regenerative Facilitation Process. Modified from Hes et. al 2016.

By the end of the facilitation process, the design team were provided with an aboriginal sense of place, a historic timeline extending to 67,000 years ago, an objective prioritisation of project aims and design guidelines. While the scope of the project has since adapted to its environment, these documents have served as drivers of the design process.

Nunduk Retreat & Spa will become the heart for the ecological restoration of Seacombe West Wetland. The visitors will experience life in unison with the landscape; a model for regenerative living. Given the regenerative framework, the development of the Retreat & Spa and its regenerative ambitions, it will incentivise other sustainable energy and agriculture practices to emerge and service the visitors and other surrounding communities with 'next practice' options evolving towards increasing states of health and abundance.

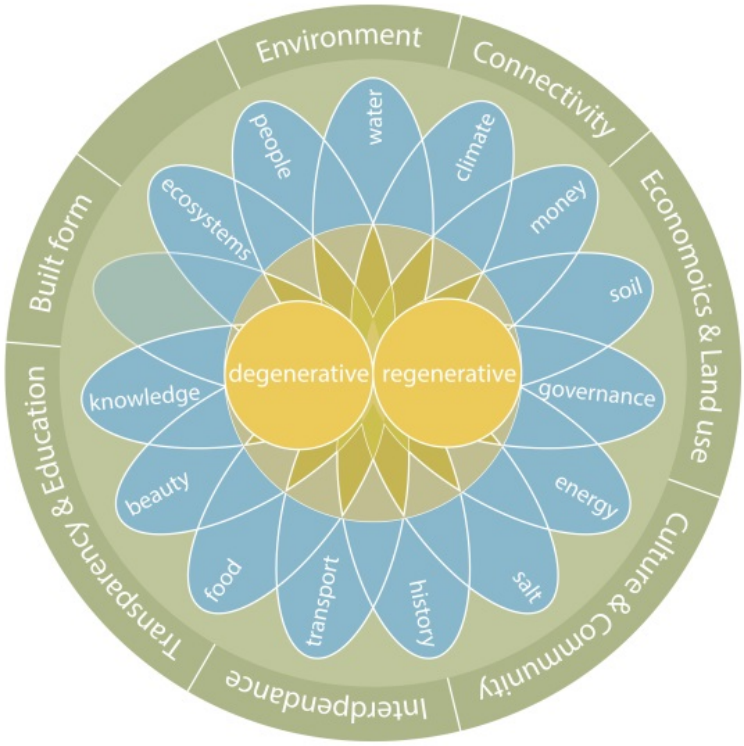
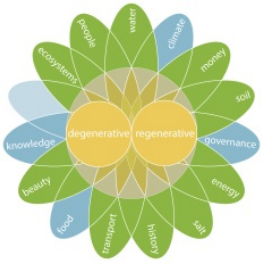
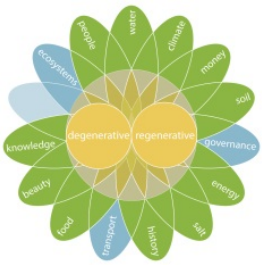
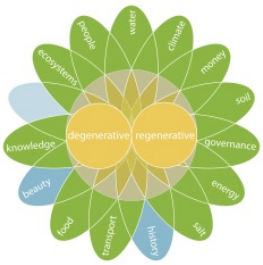
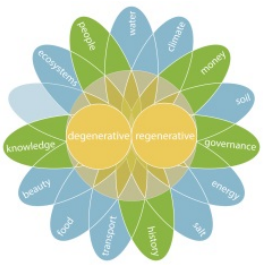
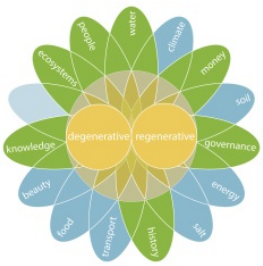


Figure 4: LENSES Framework. Living Environments in Natural, Social and Economic Systems (LENSES) framework commonly represented as three overlaid lenses: the foundation lens (in green) shows the guiding principles important for any design project, the flow lens (in blue) shows different flows to consider and explore, and the vitality lens (in yellow) reminds us that every design decision can have 'regenerative' or 'degenerative' outcomes and reminds us to find the 'regenerative' actions. The foundation lens shows a variety of guiding principles for a design project.

The visitors of the Retreat & Spa will:

1. Enjoy the relaxation and well-being benefits of a waterfront vacation.
2. Respect, honour and understand the aboriginal ancestry of the landscape.
3. Build the local economy by supporting local businesses that contribute to the regenerative lifestyle (i.e. energy, food, and recreation services).
4. Learn and enjoy the benefits of 100% renewable energy.
5. Enjoy the benefits of regenerative agriculture practices.
6. Spend their time immersed in the natural landscape.
7. An innovation hub building capability and exporting knowledge to enable regenerative lifestyles.
8. Share a contributive mindset and support each other.
9. Nunduk will be a place that leaves lasting impressions for visitors, a place to call home.

1.2.1 Regenerative Design Guidelines

Group	Main design guidelines
 Land and Water	Improve the quality of the entire site through land works, including elevating land for development, creating waterways and separating fresh from saline water and stabilising edges with landscaping elements to prevent erosion. Inland freshwater bodies (see also Ecosystems) would support local ecosystems and biodiversity. Potential solar power desalination plants with excess freshwater fed back into the lake to help reduce salinity.
 Ecosystems	Enhancing and regenerating the current ecosystem by generating a range of microclimates through different wind exposures and land masses (e.g. islands, secluded spaces, elevated red gums, and others), creating freshwater systems within the site, minimising salt intrusions through micro-barrages with fish gates. This is done in conjunction with producing food through regenerative agriculture practices that could include: submerged algae, aquaponics. Lastly, enhancing knowledge transfer through living labs, interactive workshops, and nature interpretation trails.
 Built Environment Systems	Carbon positive (if achievable) building and secluded villas. Where possible, made from local materials to support the local industries from the Gippsland Lakes. Buildings are off the grid and self-reliant. Some systems recommended for detailed consideration include: recycling water system, composting food, waste carbon dioxide and heat used to grow food in greenhouses and development, multi-use solar panels generating energy, collecting water, and displaying regenerative living practices to visitors. While this is not a complete list, it is a starting point.
 People Governance Money Culture	A spiral of innovation. A percentage of the profits are reinvested into the monitoring and ongoing custodianship of the land. A web based tour of the premises emphasising the regenerative activities occurring within the site. Teaching through events: four open days per year functioning simultaneously as a celebratory festival and inspiration event welcoming all the community to visit the Retreat & Spa.
 Vision and inspiration	Developing a sense of stewardship within the community (visitors and workers) with the focus on contributing to the place, caring for the land, family and for life as well as fostering a collective sense of responsibility. Developing partnerships with a wide range of stakeholders (i.e. universities, government) to bring the lessons learned through regenerative practice to other places. Emphasis is made on inclusivity, championing aboriginal culture, and developing tolerance of all cultures. Exporting knowledge.

Methodology

Prospected development area

Located within the Gippsland Plains Bioregion, Wellington Park comprises 2,750 ha of low-lying plains at the southern edge of Lake Wellington, Gippsland Lakes Complex. Currently a sheep farm, Wellington Park is proposing to build a luxury Retreat & Spa near its coastline with Lake Wellington. The Nunduk Retreat & Spa will be a 200-acre hotel development positioned on the currently degraded Seacombe West Wetland (Figure 5).

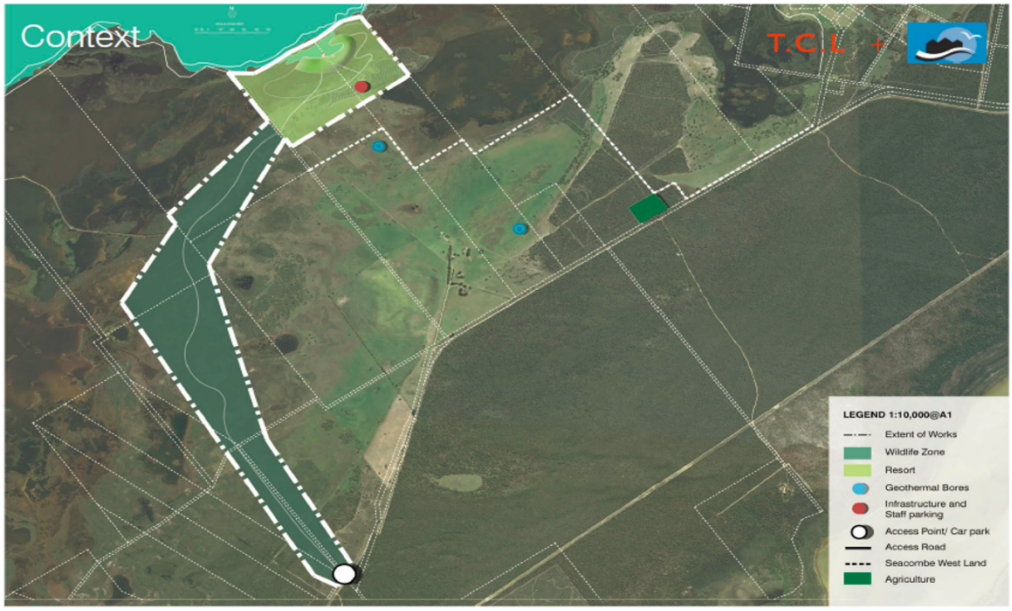


Figure 5: Development area in Regional Context

This exclusive resort will include a spa, 36 rooms and 10 secluded villas. As part of its commitment to nature restoration, 500 acres will be converted into a wildlife sanctuary which will surround the visitor's access to the resort via car. Furthermore, it is expected to be a fully off-grid resort with zero emissions for its ongoing operation. Services required to support this development include:

- A restaurant and spa catering for the guests of the hotel;
- An exclusive port for recreational purposes of the guests;
- Geothermal and solar providing the totality of the energy requirements of the resort;
- Rainwater harvesting and a recycling grey water system;
- A greenhouse system growing organic produce to service the restaurant;
- An aquaponic system also to service the restaurant
- A freshwater wetland will naturally filter and clean grey water.

While not every service mentioned above are included within the 200 acres of the resort (e.g. the geothermal and agriculture), the Retreat & Spa will be the catalyzer harnessing the interest and support of other private businesses to invest in regenerative agriculture, energy, and water systems. These will service both the Retreat & Spa & spa as well as other communities in the surrounding areas.

People involved in the development of the Regenerative Strategy

This strategy was developed as a partnership between Dominique Hes and BioUrbem. The advised regenerative landscape strategy in this report is based upon dialogue with the project's landscape architects. It is the responsibility of the project's landscape architects to determine how the advice is adopted in a revised landscape strategy.

Regenerative Landscape Strategy- a healthy ecological system

To propose species suitable for the region, we referred to studies exploring the plant-based biodiversity of coastal saltmarsh in the Gippsland Bioregion (see Davis 2002) Furthermore, flora and fauna recorded within 10km from the site were identified from an existing database (ALA 2017). This resulted in a list of 416 different plant species across different vegetation classes. Using a variety of existing plant databases (i.e. Agriculture Victoria, Australian Botanic Gardens) the list of species was screened to determine their suitability for the project based on their associated ecological vegetation class (EVC). The species were retained if they belonged to any of the following EVC:

- Coastal Saltmarsh;
- Estuary Wetland; and
- Estuarine Scrub.

To identify species able to stabilise the shoreline, we referred to the nearest Mangrove Shrubland (Corner Inlet) to the site and looked at its associated seagrass beds to identify salt tolerant species that can also be used to stabilise the shoreline.

There is no warrant that the species will be successful in the specific area as, for instance, Coastal Saltmarsh and Mangrove Shrubland are generally found on areas with tidal influences that are not present at the Seacombe West Wetland.

Regenerative Social Strategy

The regenerative strategy comprises a series of recommendations to develop formalised walking pathways for visitors' leisure, the development of partnership with local indigenous communities and universities as well as enhancing the accessibility of the project through the differentiation between public and private areas as well as through 'open days' that enable people outside from the target market to visit and learn about the project.

Regenerative Landscape Strategy

The Value of Coastal Ecosystems

Saltmarshes provide four important ecological services: carbon sequestration, water quality, coastal protection (erosion control and stormwater management) and biodiversity.

1. Carbon sequestration: Sea Grass, Mangrove and Coastal Saltmarsh are known collectively as 'blue carbon' as they contribute up to 50% of the world's carbon sequestration and burial (Mcleod et al. 2011, Duarte et al. 2013).
2. Water quality: Saltmarsh slows down water flow, filter pollutants and absorbing nutrients. In particular, they can trap heavy metals and minimise nutrient surplus from farming practices before they reach the ocean (Gedan et al. 2009, Creighton et al. 2015).
3. Coastal Protection
    a. Erosion: Sea Grass, Mangrove and Coastal Saltmarsh make shorelines less susceptible to erosion and storm damage as their plant assemblages dissipate the energy of the tide (Gedan et al. 2011).
    b. Stormwater management: saltmarshes and mangroves can absorb and dissipate the energy of waves effectively reducing the impact of storm events (Othman 1994, Creighton et al. 2015).
4. Biodiversity: Coastal saltmarshes provide habitat for niche communities specialised to tolerate shifting conditions of soil and water salinity that are usually much higher than the more stable conditions at the lower tide level. The specific use of the habitat varies depending on the trophic level of the organisms (Saintilan 2009a).
    a. Primary producers: phytoplankton
    b. Nursery ground for invertebrates (i.e. molluscs, bivalves), shrimp and crab.
    c. Breeding and habitat ground for various fish species.
    d. Feeding grounds for water birds including resident and migratory birds.

Short-term Impact, Long-term Benefits

Regenerative Development goes beyond the restoration of the landscape. A restoration intention consistent with the 'Look at what was there before' principle of the Gunaikuranai would attempt to take the landscape back towards the extant vegetation (Swamp Scrub). However, this vegetation class cannot withstand the new saline conditions of Lake Wellington. Thus, the regenerative strategy aims to enhance the capability of this wetland to adapt to novel brackish conditions, prospected climate change and enhance the capacity of these ecosystems to provide their services.

Specific objectives of the strategy include:

- Support existing ecological communities in their adaptation to the novel environment by increasing saline plant biodiversity.
- Foster higher fauna biodiversity adapted to the novel ecosystem.
- Support remnant resident and migratory species reliant on freshwater wetland
- Enhancing the connectivity and resilience of the Estuarine Scrub
- Create a soft edge between the wetland and the surrounding land facilitating dispersal between the proposed nature reserve and the wetland system.
- Enhance the ability of this coastal ecosystem to increase their ecosystem services as described above.

To achieve the aforementioned objectives we propose to(Figure 6):

1. Diversify the Coastal Saltmarsh Flora (Zone 1)
2. Strengthen the Estuarine Scrub EVC (Zone 2)
3. Use living systems to stabilise the shoreline (Zone 3)
4. Insert Paddock Trees (Zone 4)
5. Create a Fresh Water Wetland (Zone 5)

This chapter describes each point of the regenerative strategy outlining recommended vegetation species (Appendix A), weeds to avoid (Appendix B). We apply the following premises:

- Humans and nature are partners; we are the custodians of the land;
- Although coastal saltmarsh is a valuable saline wetland, in this case, it is a sign of degradation lead by the increased salinity of Lake Wellington;
- We cannot modify the salinity of the water system, but the site has the potential of working as a test site developing ecological regeneration strategies applicable in various areas of Lake Wellington and extend to the remaining Gippsland Lakes system;
- Small-scale experimentation is encouraged to testing new strategies to improve the system.
- Where possible, natural strategies for environmental change adaptation are prioritised;
- With a mutual benefit mindset; it is acceptable to produce a small impact on the land (development) if this leads to higher long-term benefits for the system.

Figure 6: Land zonation representing five different interventions

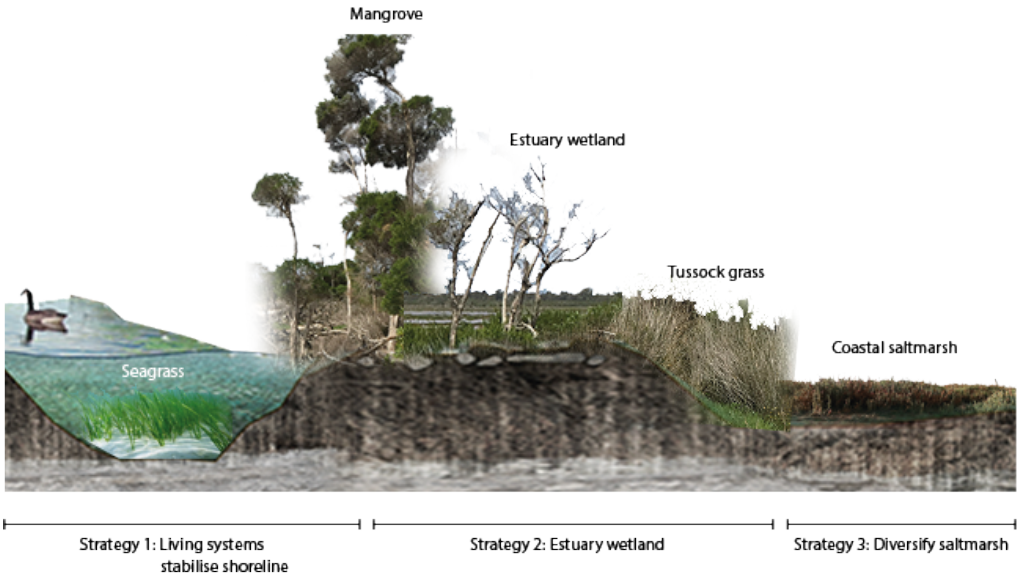


Figure 7: Cross section of the interaction between proposed strategies.

Figure 8: Die-back in Seacombe West Wetland. A) Swamp Paperbark at the edge of the Coastal Saltmarsh; B) Dead Eucalyptus between the Coastal Saltmarsh and the Estuarine Scrub; C) Fallen tree at the shoreline of Seacombe West Wetland; D) Decomposing trunk of Swamp Paperbark in the middle of the Coastal Saltmarsh.

3.1 Enhancing Saltmarsh Biodiversity

Victorian Coastal Saltmarshes are unique and biodiverse. They are described as an intertidal vegetation class dominated by low and shrubby succulents. In the first chapter of 'Mangroves and coastal saltmarsh of Victoria" Boon et al. (2011) lists a series of definitions used in the literature; this list highlights the strong emphasis that is placed on 'intertidal' influence to define coastal Saltmarsh. In particular, a recent study on coastal wetlands describes coastal saltmarsh as **"land that experiences recurrent low-energy inundation by sea water and not usually by substantial freshwater flows, which is vegetated by low-growing vascular plants (generally <1.5m height), [...] but excluding vegetation dominated by the mangrove *Avicennia marina*"** (Boon et al. 2015 pp. 459) and describes seven saltmarsh typologies differentiated through their composition of flora (Boon et al. 2015). For Victoria, it is estimated that there are ~192km of coastal saltmarsh (Boon et al. 2015); approximately 5-20% less than the 1750s (Sinclair and Boon 2012).

The upper tide level generally limits coastal saltmarsh distribution (Davies et al. 2002, Saintilan 2009a, b, Boon et al. 2011, Saintilan and Rogers 2013, Creighton et al. 2015). Once a freshwater system, the appearance of saltmarsh around Lake Wellington is a relatively recent phenomenon resulting from the increasing salinisation of the lake (Bird 1956, 1966 in Saintilan 2009a). This theory was supported by the on-site observation by the BioUrbem team where evidence of Swamp Paperbark die-back was spotted in the Seacombe West Wetland (see Figure 8) (BioUrbem 2017).

3.1.1 Seacombe West Wetland – Coastal Saltmarsh Condition and Function

The coastal saltmarsh present in the Seacombe West Wetland is hypersaline and isolated from Lake Wellington by a thin barrier of Estuarine Scrub (BioUrbem 2017). This brackish vegetation class is a valuable yet 'novel' ecosystem for the Seacombe West Wetland. While the ecological functions it provides are valued, observations from the ecological assessment (see. BioUrbem 2017) indicate that it is a transitional state where the existing vegetation will disappear leading to a decline in its ability to act as a carbon sink. Similarly, the remaining services will also be affected by the natural changes that will occur in the site unless action is taken to support them. Knowing the potential contribution of healthy saltmarshes to mitigate the effects of climate change, it is important to conserve existing saltmarshes and enhance their ability to provide their ecological services (Mcleod et al. 2011).

The environmental assessment indicated that the Coastal Saltmarsh has less plant diversity (n=2) than the surrounding habitats (Estuarine Scrub and Damp-sands Herb-Rich Woodland). While low plant diversity is common for temperate saltmarshes, Victorian saltmarshes are considered diverse as they support a wide array of specialised organisms (Saintilan 2009a). However, the plant

species present within the saltmarsh can indicate the presence of other associated organisms. For instance, Ross et al. (2003, 2006) found that some *Ophicardelus* (snails) and *Plauroloba* are associated with the roots of *Juncus kaussii* and *Sporobolus virginicus* (Saintilan 2009a). Thus, enhancing the plant biodiversity of the existing coastal saltmarsh can enable the wetland to support a wider diversity of organisms. Similarly, there is no evidence of fish communities occurring within the inundated portions of the saltmarsh and there is low bird diversity. The most abundant species is the Australian Shelduck and the Chestnut Teal. The lack of fish or other insect-eating animals has led to an uncontrolled population of mosquitos.

3.1.2 Proposed Changes

We have identified a total of 56 species (Appendix A) that could be introduced within a small portion of Coastal Saltmarsh (Zone 1). This list has been compiled based on the nearest saltmarshes: Lake Reeve and Jack Smith Lake as described through previous studies (see Davis 2002) or which have been recorded within 10km of the site and are associated with Coastal Saltmarsh (ALA 2017). Figure 9 indicates the distribution of Coastal Saltmarsh in Victoria highlighting those from which species lists were extracted. Each species was then screened for their suitability within the Gippsland Bioregion before being selected.

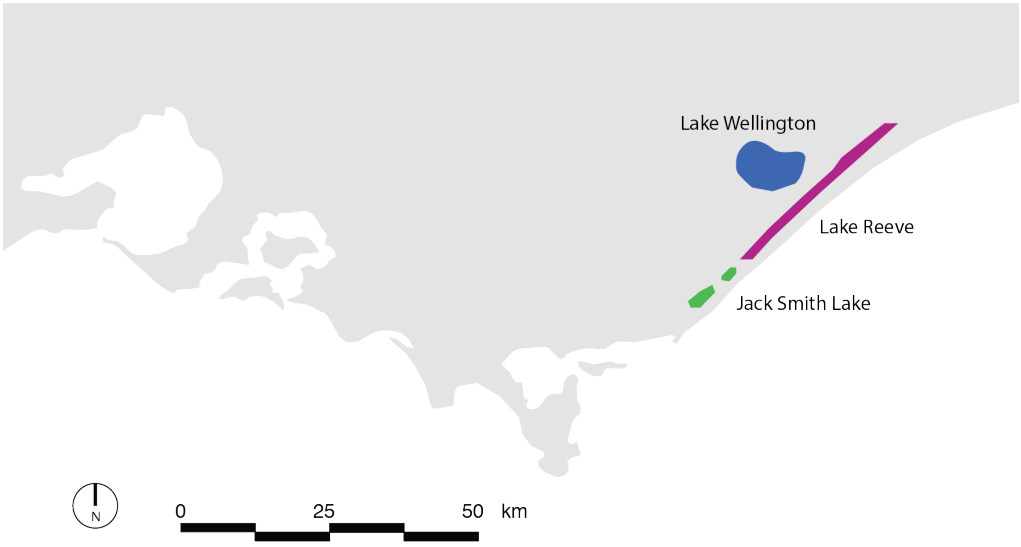


Figure 9: Distribution of selected Coastal Saltmarsh in relation to Lake Wellington, Victoria.

3.2 Strengthening Estuarine Scrub & Estuary Wetland

In broad terms, an estuary corresponds to the niche microhabitat created when the freshwater meets the ocean. The area of convergence is characterised for swings in salinity. The Estuarine Scrub forms a closed scrub of approximately six meters in height and has a ground cover dominated by tufted grass and salt resistant herbs such as Sea Celery and Sedges; meanwhile, the Estuarine Scrub has a higher dominance of non-tufted grass (DELWP 2016).

The Estuarine Scrub present in the Seacombe West Wetland is acting as a barrier that prevents the permanent inundation of the adjacent saltmarsh (BioUrbem 2017). The vegetation composition provides evidence of the historical shift and dieback of the freshwater Swamp Scrub that existed before 1750's. It has been colonised by species that tolerate salty soil but with limited tolerance to permanent inundation. Thus, the areas that are more constantly under water have transformed into the saltmarsh ecosystem and the sections naturally elevated by the topography are now considered an estuary wetland.

3.2.1 Condition and function

During the ecological survey, the extension of the Estuarine Scrub within Seacombe West Wetland was quantified, it showed that 9.3 ha out of 91.9 ha are covered by this vegetation class. It is distributed mostly along the edges of the coastal saltmarsh creating a thin strip that supports at least 15 bird species (BioUrbem 2017). Studying common habitat restoration practices, it was found that the size and shape of the plantings determine the quality of the vegetation; with larger and block planting, more effective than small and/or strip plantings (Lindenmayer et al. 2010). This indicates that, if the Estuarine Scrub plantation were wider, the ecosystem would be able to support a higher abundance and diversity of species.

However, it is also under stress from at both sides of this edge. To the north-west, the water flow in Lake Wellington is eroding the coast; the estuary is thinning and trees have been lost. To the south-east, the hyper-salinisation of the soil is causing dieback of the vegetation; this is affecting Swamp Paperbark (*Melaleuca ericifolia*) also thinning the upper story. Meanwhile, the understory is being colonised by the dominant species of the novel Seacombe West Coastal Saltmarsh – Beaded Samphire or Beaded Glasswort (*Sarcocornia quinqueflora*) and Rounded noon flower (*Disphyma crassifolium*) (BioUrbem 2017). Unless protected from both the erosion and hypersalinity, the Estuarine Scrub will continue to degrade until it is no longer able to support the species currently inhabiting it.

3.2.2 Proposed Changes

We have identified a total of 55 species (Appendix A) that could be used to support and enhance the quality of the Estuarine Scrub (Zone 2, **Error! Reference source not found.**). This list has been compiled through careful screening of the vegetation recorded within 10 km of the area as reported in the Victorian Biodiversity Atlas. Species were screened and selected if they were found to be associated with any of the following vegetation classes: Estuarine Scrub, Estuarine Scrub, or Coast Banksia Woodland. The proposed changes could generate another 0.1km2 of Estuarine Scrub and enhance the habitat condition by providing a larger vegetated patch to support birds. It will also provide a small-scale experimental approach to compare the effect increasing the size of the estuary patch vs. the strip planting and evaluate the suitability of the strategy to be implemented at larger scale.

To ensure that this habitat will improve health, vitality and viability, the strategy incorporates the following measures:

- The land should be raised at least one meter above Lake Wellington water level to remain above permanent inundation levels.
- A barrier of Tussock grass should be incorporated to attenuate the edge between the Estuarine Scrub and the Coastal Saltmarsh.
- Tall trees that are currently present in the area either alive or dead should remain in place (unless showing the risk of falling as per the recommendation of expert tree surveyors).
- Tall shrubs and trees incorporated into this section should cover approximately 15% of the overstory cover while grasses should extend to no more than 30% of the understory. Another 10% of the understory should be created by small and medium herbs.
- The edge between the estuarine vegetation and Lake Wellington should be protected from erosion through natural strategies (see section 3.3 of this strategy)
- The species composition should allow for a soft shift in dominant vegetation going from more shrubby species (i.e. Swamp Paperbark, Honey Myrtle, Wholly Tea Tree, Common Boobialla) near the edges to a dominance of Eucalyptus and Coastal Banksia closer to the remanent woodland patch at the south of the Retreat & Spa.

3.3 Living Systems to Stabilise the Shoreline

A mentioned before, Seacombe West Wetland is separated from Lake Wellington by a thin strip of Estuarine Scrub, however, the EVC is subject to rapid rates of erosion threaten to break through this barrier permanently flooding the Seacombe West Wetland (BioUrbem 2017). Thus, it is necessary to engage in strategies that enhance the coastal protection of the Seacombe West Wetland.

Given the new saline conditions of Lake Wellington, we suggest that it is important to look towards groups that can enhance the resilience of the shoreline and can withstand the shifting salinity levels. Mangrove and seagrass are known for their ability to stabilise substrates (Den Hartog and Phillips 2001, Gedan et al. 2011). Not only do they prevent erosion by keeping soil in place but they can also help the beach grow by helping new sand accumulate in the shoreline. Simultaneously, they trap excess nutrients and act as a resource and/or refuge for a variety of species including migratory birds, turtles, fish, and crustaceans (Othman 1994, Den Hartog and Phillips 2001).

3.3.1 Proposed Changes

There are two key strategies considered to stabilise the shoreline: build seagrass beds and introduce scattered clusters of Mangrove Shrubland. Therefore, we have identified a total of five species (Appendix A) that could be introduced to stabilise the soil from erosion. These five species are not naturally found in Lake Wellington, but their resistance to brackish (mangrove) and saline water (seagrass) indicates that they are the most suitable to help the wetland adapt to the new conditions of water salinity.

Seagrass Beds

Seagrass often occurs in association with Mangrove Shrubland but remains permanently underwater. Algae grow on their leaves and feed sea molluscs which in turn feed other organisms (i.e. crab, fish, and birds). We suggest a total of four different seagrass species which have been recorded near at Wilsons Promontory National Park (Corner Inlet). Among them, *Zostera tasmanica* seems to be the best suited for the job as it is a common seagrass that inhabits shallow bays and estuaries (Short et al. 2010). This indicates that it may be best suited to withstand current and future salinity shifts of Lake Wellington.

Mangrove Shrubland

In Victoria, Mangrove Shrubland is comprised of a single mangrove species: White Mangrove (*Avicennia marina*) which forms dense monoculture clumps of

mangrove (DELWP 2016). In general terms, they are restricted by the same forces that determine saltmarsh distribution: influence of low energy tidal influence, present at the edge of coastal environments (Duke 2006) and providing the same ecological services to a similar array of species. In contrast, they are usually restricted to the band between the low tide and the high tide, where the salinity levels are constant and soil is constantly moist (DELWP 2016).

From 2006 to 2015, the extension of this ecosystem shrank from 62km^2 to 51km^2 just in Victoria (Duke 2006, Boon et al. 2015). Within the Gippsland bioregion they occur in three key locations:

- Andersons Inlet
- Corner Inlet
- Cunningham Arm, Lakes Entrance

It is believed that the mangroves of Lakes Entrance are not naturally occurring but that have been introduced. Meanwhile, the mangroves at Corner Inlet are the southern-most mangroves of the world (Duke 2006).

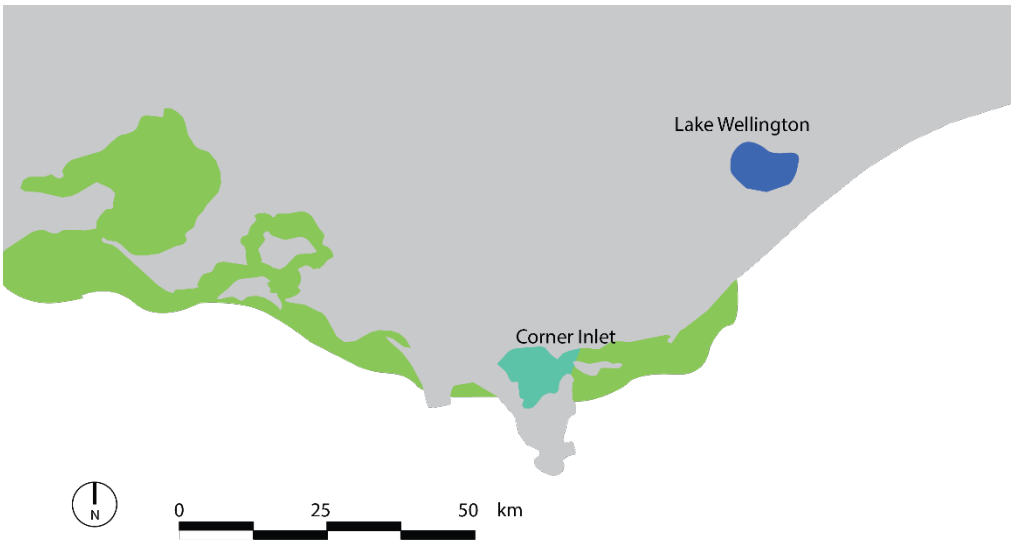


Figure 10: Distribution of Mangrove Shrubland and seagrass in Victoria. The species selected for this strategy are present at Corner Inlet

3.3.2 Strategies of intervention

Mangroves and seagrass are in decline mostly due to coastal development and climate change. Given that the site for the proposed development does not currently have either of these species, we suggest that all infrastructure including pedestrian pathways to be built before landscape interventions. Then, the Mangrove Shrubland can be grown around pedestrian pathways and seagrass beds placed in areas of low accessibility for the tourists.

3.4 Paddock Trees

In agricultural landscapes, Paddock Trees are renown as a 'keystone' structure that provides a wide arrange of ecosystem services including carbon storage, habitat, food resources and stepping stones for species dispersal (Lindenmayer et al. 2016). Diverse studies have linked the presence of this important resource to increased abundance of avifauna (Fischer and Lindenmayer 2002, Lindenmayer et al. 2010) and lizards (Lindenmayer et al. 2016). This can be explained as Paddock Trees provide cover from potential predators (i.e. birds of prey), thus allowing different species to move between remanent woodlands with minimal risk. Lindenmayer et al. (2016) found that remnant patches of woodlands with Paddock trees in the surrounding supported more species than woodlands without this resource. Simultaneously, all existing trees should be retained.

3.4.1 Proposed Changes

In the south-western corner of the Retreat & Spa development, we suggest that a low-density planting eucalyptus trees be introduced. The eucalyptus species are suitable for the area and already recorded within the woodland. These trees will act as stepping stones for birds allowing them to disperse between the Estuarine Scrub and the 500 acres of wildlife sanctuary. They will also provide shelter to

3.5 Freshwater Wetland

Lake Wellington is protected under the RAMSAR Convention as it provides habitat for resident and migratory bird species. However, the area used to exist as a fresh water system. Although no studies could be found exploring the differences in bird species assemblages and composition per se, it is likely that the freshwater dependent species have been displaced and replaced by salt tolerant species in similar ways as the changes recorded in the vegetation composition. It is theorised that this is one of the reasons that some bird species have not been recorded in 30+ years is their dependence on fresh water.

Developing a freshwater wetland can potentially benefit displaced species and attract them back into the site. Although this recommendation was made considering the avifauna, this could help other terrestrial species of environmental significance such as the New Holland Mouse, a protected species that has been recorded within 5 km of the development site.

To achieve this benefit, it is expected that further literature research will be needed to identify the specific landscape and vegetation attributes best suited to attract relevant species.

3.6 Evaluating Success

One of the most challenging elements of any new project is choosing the right indicators to indicate success. For business-as-usual developments, normal indicators would comprise quantifiable measures such as rate of visitors. Recommended indicators for the success of the regenerative landscape strategy are:

- An established and increased diversity of plants in the Coastal Saltmarsh;
- Growth of the shoreline through sand accumulation near clusters of mangrove and seagrass plantation;
- Constant visit of kangaroos in the area surrounding the Retreat & Spa;
- Increased abundance of top-predator species (birds of prey);
- Increased overlap of 'generalist' avifauna species between the Estuarine Scrub and the wildlife sanctuary as indicators of increased dispersal;
- Decreased soil salinity in the permanently inundated portions of the Coastal Saltmarsh;
- A permanent population of amphibians in the freshwater wetland; it will aim to attract some threatened populations that have been recorded in the area such as the Growling Grass Frog (*Litoria raniformis*).
- The recovery of freshwater bird species visiting the freshwater wetland.

To evaluate the expected outcomes, we recommend the Biodiversity Sensitive Urban Design (BSUD) Framework observing the effect of the actions described above to 1) maintain or introduce habitat; 2) facilitate dispersal of native species; 3) minimize threats and anthropogenic disturbances; 4) facilitate natural ecological processes; and 5) facilitate positive human-nature interactions. These outcomes can be evaluated through an ongoing monitoring program with winter and summer surveys determining presence/absence and abundance of various wildlife groups including detailed vegetation assessment, resident and migratory avifauna, reptile and amphibian, bats; and mammals. A regenerated ecosystem will include evidence of the increased vitality, viability, and ability to adapt to change of the system. The above will help in telling this story. Critically the monitoring and associated research allow opportunities for increased understanding and education of the ecosystem and its abilities to respond.

Other useful surveys requiring saltmarsh ecology experts are:

a) Mollusc diversity in the Coastal Saltmarsh;
b) Invertebrate diversity in the Coastal Saltmarsh; and,
c) The effects of introducing mangrove.

Social Regenerative Strategy

Regenerative development aims to channel the energy of people to create outcomes that increase the vitality viability and ability to adapt of the system within which they are working. It is an approach that is based on the ecological worldview.

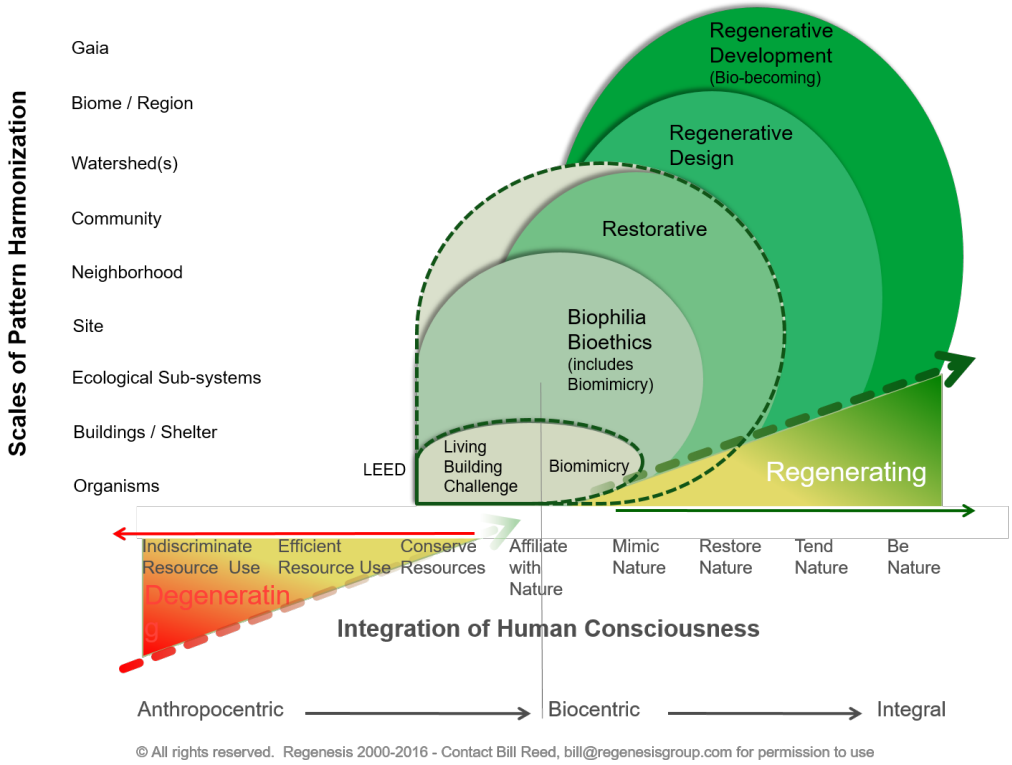


Figure 11: Image credits: Bill Reed

This addresses the fact that we are trying to create sustainable outcomes that improve social and ecological well-being, within the same worldview or framework that created the degradation. Our current framework structuring sustainable development is couched in the language of quantitative, performance-based indicators reporting on performance in isolated categories, compliance with which is largely driven by individual interest: reputational, financial, or simply avoiding prosecution. Much has been written about the flaws in this framework and its foundation in the so-called mechanistic worldview, as well as the need to shift towards a more relational worldview that will help us develop frameworks suitable for working with living systems (Murray 2011) (Hes and Du Plessis 2014)
This more relational worldview is called by many the ecological worldview, and its needs highlighted in built environment practice as early as the 1960s by Ian McHarg (McHarg and Mumford 1969). Since then numerous authors have explored the characteristics of the emerging ecological worldview and its main narratives (Capra 1997, Elgin 1997). The consensus is that the ecological worldview represents a shift from looking at the behaviour, performance and interests of individual 'parts', considering the well-being of the whole as expressed through interdependent relationships - a web of life of which humans are irreducibly part. That is to design solutions that work at the biophysical level, within inherently nested systems, across scales including

and most importantly at the mental level. The critical aspect here is the interrelated and connectedness of the world and that what the current approach to sustainable development has really forgotten is the mind and the heart of people. It has forgotten that what we need to create is an irresistible narrative that will change behaviour not just because we have to but because we want to. Unfortunately, the current irresistible narrative is based on the values of the mechanistic worldview those of competition, imperialism and rationalism; a narrative that rewards power, monetary wealth and status. To transition to eco-cities requires a shift from striving for sustainability within a mechanistic worldview, towards thriving and regenerative development within an ecological worldview.

Understanding the Project in its broader context

If we look at this luxury resort as a niche within the Gippsland area, we can see it as one would a colonising species and ecosystem. What the resort would anchor into place would be an investment, jobs, ecological restoration, and so forth. But within the ecological worldview the ideas of exclusivity, gated communities, and the inability of everyone to access a site is problematic. It reduces the potential of this project to influence and inform and create benefit across the system. To address this, we recommend eating carefully around strategies of access education transparent reinvestment and so forth.

Project certification will provide an outward facing method to communicate the project's intentions and achievements. It can also provide a roadmap for what is designed built and maintained. The systems that should be considered to certify this project are:

1. LEED - the most internationally recognised development rating scheme
2. Green Star – Australia's equivalent to LEED
3. Green Globe - international tools specifically aimed at tourism type developments
4. Living Building Challenge - the tool that comes closest to the intentions of regenerative development
5. One Planet Living - a very effective and flexible tool for this kind of development and it could be adapted to integrate regenerative development intentions

If the project is aiming to achieve regenerative outcomes it is blazing a trail and there are no precedents for its certification. If we adopt Bill Reed's trajectory from degeneration to regeneration then we find lead and green Star and green Globe in the less bad but still net negative or degenerative realm with one planet living in the living building challenge giving the industry the tools to start transitioning towards net positive outcomes.

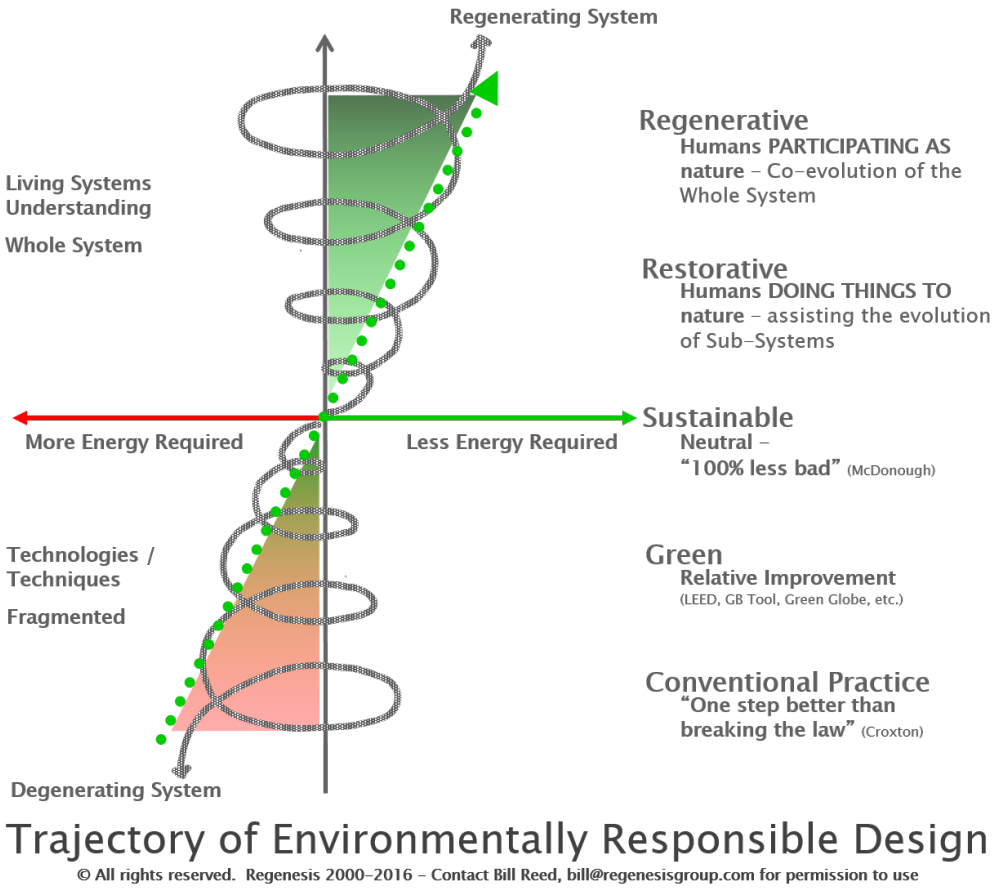


Figure 12: Trajectory of Environmentally Responsible Design. Image Credit: Bill Reed

For the ecological regeneration of this project, there are no current tools that embrace compact complexity and extent of what is being proposed here. It is the opportunity of this project to contribute to the building of knowledge on how to create a net positive development; where humans are contributing to a more resilient thriving future.

Project as a catalyser

Although outside of the specific scope of the Retreat & Spa, is acting as a catalyser for the development of sustainable energy and agriculture practices of the area.

Just outside of the project boundary, a hot water geothermal plant is prospected to occur primarily to support the Spa services (based on meetings with client). Additionally, to take advantage of the exceeding hot energy, an aquaponic and greenhouse system is also proposed. These two activities are proposed within Wellington Park farmland Figure 1 Figure 13: Infrastructure to service the Retreat & Spa Development. In light green, the project boundary for the activity area. In dark green a portion of the wildlife refuge. In red the prospected location of the solar panels and fresh water wetland. In blue, the prospected area for the geothermal plant including the inlet and outlet of the

hot water services. Dark green rectangle in the south-west corner, the prospected location of the aquaponic and greenhouse system providing regenerative agriculture to service the spa restaurant and surrounding community.and are in accordance with the Farming Zone overlay.

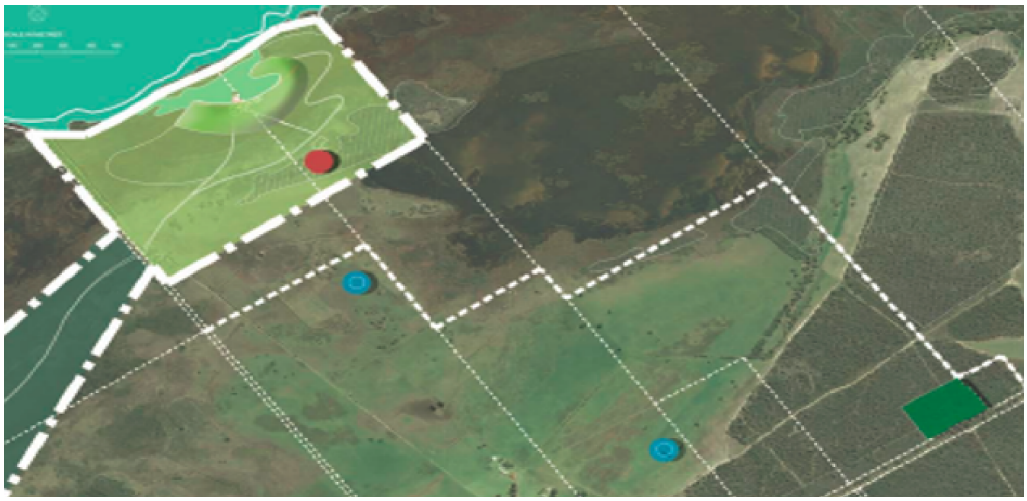


Figure 13: Infrastructure to service the Retreat & Spa Development. In light green, the project boundary for the activity area. In dark green a portion of the wildlife refuge. In red the prospected location of the solar panels and fresh water wetland. In blue, the prospected area for the geothermal plant including the inlet and outlet of the hot water services. Dark green rectangle in the south-west corner, the prospected location of the aquaponic and greenhouse system providing regenerative agriculture to service the spa restaurant and surrounding community. Image credits: T.C.L. Landscape Architects and Seacombe West.

Basis for a Social Regenerative Strategy

Critical to regenerative development asks how are social systems and people integrated into the considerations of a project and empowered to thrive?

Many projects begin with the best intentions but get derailed through the design, development, and operation process. Some common barriers to regenerative development are:

- A small number of stakeholders with a strong personality and strong views influences decisions disempowering other members of the community.
- Communities are not engaged through the process limiting their opportunity to contribute and develop ownership over the prospected results.
- Inability to consider the long-term negative impacts of a project on ecological and social system.

As mentioned in the background information of this document, in 2016, Dominique Hes and Thrive Research Hub facilitated a process designed to allow various stakeholders to understand the concept behind Regenerative Development, to prioritise objectives, brainstorm ideas and develop the regenerative design guidelines. Much of the effort of the initial regenerative

development process for the site with thinking around how to engage in place and facilitate the ability for the social systems and the people within it to be able to contribute grow and learn and be the best they can be. Within the retreats development, its associated regenerative ecological strategies, the geothermal component and the agricultural component there are many opportunities to engage in a social aspect of the potential of this place.

Principles relevant for the social strategy include:

1. The visitors will experience life in unison with the landscape;
2. The visitors will learn and be inspired by its regenerative lifestyle; this includes experiencing interactive workshops and nature interpretation trails;
3. The re-investment of profits back into the land and local businesses;
4. The project acting as catalyser for other sustainable energy and agriculture practices to emerge and service the visitors and other surrounding communities with 'next practice' options evolving towards increasing states of health and abundance;
5. Developing a sense of stewardship within the community (visitors and workers) with the focus on contributing to the place, caring for the land, family and for life as well as fostering a collective sense of responsibility.
6. Developing partnerships with a wide range of stakeholders (i.e. universities, government) to bring the lessons learned through regenerative practice to other places; and,
7. Championing aboriginal culture, and developing tolerance of all cultures.

The following strategies are in alignment with the afore mentioned principles and have been discussed with the project developers and the project's landscape architects.

4.1 Celebrating Regenerative Infrastructure -

As stated, various renewable energy sources service the proposed development. Furthermore, the design incorporates ecology principles and living systems. The social strategy proposes that these activities are celebrated and walkways formalised to encourage visitors to visit and understand the principles of these actions.

4.1.1 Solar Walk

The solar walk will provide an interactive and accessible way for guests and visitors to learn about renewable energy and get in touch with those services required to make the Retreat and Spa function. In particular, we suggest that the project's landscape architects and energy specialists work together to oranise the solar panels in a way that results attractive and functional.

4.1.2 Wetland and Mangrove Walk

The wetland walk will provide a safe and accessible way to engage with the Ecological Regenerative Strategy and will provide both researchers and visitors the ability to interact with the restoration and revitalisation work being done to the degraded site. This will raise profile and interest for the site as it will attract ecologists, birdwatchers, researchers, and developers interested in how buildings can catalyse increased ecosystem viability and adaptability. The mangrove walk in particular will demonstrate how human wisdom and natures wisdom can come together to future proof integrated ecosystem.

4.2 Celebrating Indigenous Ancestry

Leading practice in the integration of indigenous culture in non-indigenous design, this project aspires to celebrate the ecological and cultural history of the site. This project has always had a vision that the pre-European history will be something that you feel in your bones as you come to the site. As part of this is the connection of people of the land to those visiting and staying at the site.

We suggest that the partnership that began between the land owners and the Gunnai/kuranai to understand the history if the site should grow to encompass indigenous care of the land in the Wildlife Refuge. A series of initiatives can be incorporated into this area to celebrate and integrate indigenous culture. Current thoughts include:

- A bush food walk: designed and managed by the Gunnai/kuranai.
- Indigenous tours: visitor guided by Gunnai/kuranai as they explore the local flora and fauna. The tour could include stories of the origin of the culture and its close relationship with wetland birds (Please refer to the Gunnai/Kurnai Cultural information relevant to the Seacombe West Development Report).
- Designating nature management practices emerging from indigenous practice.

4.3 Export Knowledge

4.3.1 Education Strategy

As the potential benefits of this project grow and the regenerative strategies continue to improve, more people need to know about these practices to learn and apply them at other projects. It is important that the Retreat & Spa and other profit driven projects on this site see themselves as an integral part to creating the vital, vibrant, and holistic vision of this project.

It is our recommendation that there is some ability for these projects to read reinvest some profits into the ongoing research and educational strategies for the site. As within all regenerative projects from this investment there will be benefits for example the demonstration of the ecological benefit that is being created, interest in the site and the retreat beyond that of the standard visitor poll, investing profits in these aspects will result in publications broadly and internationally in both research and public interest journals.

4.3.2 Knowledge Partnerships

It is the intention of the investors to establish a partnership with Australian universities, research institutions and regenerative practitioners to:

- Conduct the ongoing monitoring of the site observing changes before and after construction;
- Evaluate the suitability of different ecological strategies to be implemented to other areas in Gippsland;
- Evaluate the progress and continued evolution of the regenerative approach from both the social and ecological perspective.

4.4 Promote Public Access

The Retreat & Spa Development is proposed as a small and exclusive eco-resort. It is targeting a very specific and narrow niche within the market; thus, to maximise the potential of this project to export knowledge outside of the research community, the communication strategy will be of critical importance. We suggest that the Nunduk online presence should become an active portal to communicate the ongoing results of the strategies pioneered within this project. Additionally, there is the suggestion of making portions of the development accessible to the broader community.

4.4.1 Public Access

The main road should function simultaneously as a welcoming point of entry and source of information. The road is the gateway, the liminal space, that sets up the expectations and intentions of the site. It is the point where visitors begin to experience the place and participate in the song of the site, the song of nature and the Gunnai/Kumai indigenous ancestry. It is an invitation that welcomes all visitors in a journey of sensory learning.

Subsequently, there is a differentiation between public and private portions of the development. Visitors are welcome to visit the infrastructure systems, the wildlife refuge, and the solar and wetland walks. Ideally, this distinction will be nuanced and managed through landscape design creating the sense of private areas without the need of including physical barriers to prevent visitors from visiting the private portions of the project.

It is critical that the Retreat is seen within the narrative of a catalyst for regenerative development within the site by both the guests of the Retreat & Spa and other visitors.

4.4.2 Open day

To enable the extended community to visit the main building, spa, and restaurant, four ‘open days’ will be incorporated into the communication and celebration strategy of the site. This open days will not only be an educational opportunity for the broader community but provide opportunities to harness international interest in this world leading project. It will provide international

market opportunities in addition to the Australian based visitors currently expected for the project.

4.5 Synergy between social and ecological strategies

There is a latent synergy between the social and ecological regenerative strategies outlined in this document; they act together creating a systemic cascade where the by-products of one activity are celebrated, shared and built upon.

For example, given the intention to use geothermal energy to service the spa, the exceeding energy can be utilised to create an aquaponic and greenhouse food production, subsequently, it is also an opportunity to develop a simple café for visitors where they can enjoy the produce and learn about the project. Similarly, the project incorporates a wildlife refuge with; although this partnership has not formalised to this date, the intention is to utilise indigenous strategies to care for the land. Subsequently, a bush food walk can be incorporated and the efforts communicated with the guests and visitors of the Retreat & Spa to enhance knowledge of the land and traditional practices.

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Species found during the onsite Vegetation Surveys (VS) conducted by BioUrbem through 2016-2017 are indicated by *

Species recorded in the Atlas of Living Australia (ALA) species database are also indicated under to filters: species recorded within 5km of the proposed development and plants recorded within 10km.

Plant Typology

G = Grass

H = Herb

F = Fern

AP = Aquatic Plant

SH = Shrub

ST = Small tree

Appendix A: Recommended Plant Species

The following list of plants is recommended for the design based on their suitability to achieve objectives established in the regenerative strategy and their suitability to the region. The list has been zoned into six sections:

W (Water): seagrass beds permanently under saline water.

M (Mangrove Shrubland): emerging vegetation and the edge of the channel.

E (Estuarine Scrub): tolerant to soil salinity but not ongoing floods.

C (Coastal Saltmarsh):

P (Paddock trees):

F (Fresh water Wetland)

VS (Vegetation Survey)

Species		Common Name	Type	W	M	E	C	P	F	VS	ALA
Acacia	*Mearnsii*	Black Wattle	ST			X		X		*	5km
Acacia	*Suaveolens*	Sweet wattle	SH				X				5km
Acrotriche	*Serrulata*	Honey pots	SH					X			5km
Actites	*megalocarpus*	Coastal sow thistle	H			X					10km
Agrostis	*avenacea*	Common Blown Grass	G				X				
Agrostis	*billardierianum*	Coast Blown Grass	G				X				
Allocasuarina	*verticillata*	Drooping Sheoak	SH/T			X					10km
Almaleea	*subumbellata*	Hook					X				10km
Amphibolis	*antarctica*	Sea nymph	AP	X							
Angianthus	*preissianus*	Salt Angianthus	H				X				10km
Apium	*prostratum*	Sea Celery	H			X				*	5km
Apodasmia	*brownii*	Coarse Twine-rush	AP				X				10km
Arthropodium	*minus*	Small Vanilla Lily	H								10km
Asplenium	*flabellifolium*	Necklace fern	H								5km
Atriplex	*cinerea*	Coast Saltbush	SH			X				*	
Atriplex	*paludosa*	Marsh Saltbush	SH					X			5km
Atriplex	*prostrata*	Hastate Orache	SH				X				5km
Austrostipa	*stipoides*	Prickly Spear-grass	G				X				
Avicennia	*marina*	White mangrove	SH/ST		X						
Banksia	*serrata*	Saw banksia	ST			X					5km
Banksia	*integrifolia*	Coast Banksia	ST			X				*	5km
Baumea	*juncea*	Bare Twig-sedge	AP			X					10km
Boronia	*anemonifolia*	Narrow leaved boronia	SH			X					5km
Bossiaea	*heterophylla*	Pea flowers	SH			X					5km

Species		Common Name	Type	W	M	E	C	P	F	VS	ALA
Brachyscome	*graminea*	Grass Daisy	H				X				
Burchardia	*umbellata*	milkmaids	AP				X	X			5km
Bursaria	*spinosa*	Sweet Bursaria	SH			X					5km
Cakile	*maritima*	Sea rocket	H				X	X			10km
Carpobrotus	*rossii*	Karkalla	H	X		X	X				10km
Chenopodium	*glaucum*	Glaucous Goosefoot	H			X					10km
Cirsium	*vulgare*	Spear Thistle	H			X	X				5km
Cotula	*coronopifolia*	Water Buttons	H				X				5km
Crassula	*decumbens*	Spreading Crassula	H			X	X				5km
Cynodon	*dactylon*	Couch grass	G				X				10km
Disphyma	*crassifolium*	Rouded Noon-flower	AP				X			*	5km
Distichlis	*distinchophylla*	Australian Salt-grass	G			X					5km
Eleocharis	*acuta*	Common Spike-sedge	AP				X				10km
Epilobium	*billardierianum*	Willow-herb	H				X				10km
Eucalyptus	*viminalis pryoriana*	Rough-barked Manna Gum	T			X		X			5km
Eucalyptus	*willisii*	Shinning Peppermint	T			X		X			5km
Exocarpus	*cupressiformis*	Cherry Ballart, Wild Cherry	T			X					10km
Ficinia	*nodosa*	Knobby Club-sedge	G			X					5km
Frankenia	*pauciflora*	Southern Sea-heath	SH				X				5km
Halophila	*ovalis*	Spoon grass	AP	X							
Heterozostera	*tasmanica*	Hartog	AP	X							
Hydrocotyle	*hirta*	Hairy Pennywort	H			X					5km
Isolepis	*nodosa*	Knobby Club-sedge	AP				X				
Isolepis	*cernua*	Nodding Club-sedge	AP				X				10km
Juncus	*kraussii*	Sea rush	G			X					5km
Juncus	*pallidus*	Pale Rush	TG			X					5km
Juncus	*acutus*	Spiny Rush	G			X	X				5km
Juncus	*kraussii*	Sea Rush	AP				X				
Juncus	*revolutus*	Creeping Rush	AP				X				
Lachnagrostis	*billardierei*	Coast Blown-grass	G				X				10km
Lachnagrostis	*filiformis*	Common Blown-grass	G				X				10km
Lawrencia	*spicata*	Salt Lawrencia	H	X		X	X				10km
Leptinella	*reptans*	Creeping Cortula	H				X				
Lilaeopsis	*polyantha*	Australian Lilaeopsis	H				X				5km
Lobelia	*anceps*	Angled Lobelia	H				X				10km
Melaleuca	*armillaris*	Giant Honey-myrtle				X					10km

Species		Common Name	Type	W	M	E	C	P	F	VS	ALA
Melaleuca	*ericifolia*	Swamp Paperbark	SH			X				*	5km
Melaleuca	*lanceolata*	Moonah	SH			X					
Melilotus	*albus*	Bokhara Clover	H			X					10km
Myoporum	*insulare*	Boobialla	SH/ST			X				*	5km
Parapholis	*incurva*	Coast Barb-grass	G			X					5km
Plantago	*coronopus*	Buck's Horn Plantain	H				X				5km
Poa	*labillardieri*	Common Tussock-grass	TG			X				*	5km
Poa	*poiformis*	Blue Tussock-grass	TG			X					10km
Polypogon	*monspeliensis*	Annual Beard Grass	G	X		X					5km
Posidonia	*australis*	Sea grass	AP	X							
Phragmites	*australis*	Common Reed	AP						X		
Pratia	*irrigua*	Salt Pratia	AP				X				
Pteridium	*esculentum*	Austral Bracken	F			X				*	5km
Puccinellia	*stricta*	Australian Saltmarsh-grass	G				X				10km
Rhagodia	*candolleana*	Seaberry Saltbush	SH			X					5km
Samolus	*repens*	Creeping Brookweed	H			X	X				5km
Sarcocornia	*quinqueflora*	Beaded Glasswort	H				X				5km
Selliera	*radicans*	Swamp weed	H			X	X				5km
Senecio	*glomeratus*	Annual Fireweed	H				X				5km
Senecio	*pinnatifolius*	Variable Groundsel	H				X				5km
Sonchus	*asper*	Rough Sow-thistle	H				X				5km
Sonchus	*oleraceus*	Common Sow-thistle	H					X			5km
Spergularia	*marina*	Lesser Sea-Spurrey	H			X	X				5km
Sporobolus	*virginicus*	Salt-Couch	G				X				5km
Suaeda	*australis*	Austral Seablite	SH	X		X	X				5km
Terticornia	*arbuscula*	Shrubby Glasswort	SH				X				
Tetragonia	*implexicoma*	Bower Spinach	H			X	X				10km
Trifolium	*fragiferum*	Strawberry Clover	H					X			10km
Triglochin	*striatum*	Streaked Arrow-grass	H				X				
Triglochin	*striata*	Streaked Arrow-grass	AP				X				5km
Wilsonia	*bakhousei*	Narrow-leaf Wilsonia	SH			X					
Wilsonia	*rotundifolia*	Round-leaf Wilsonia	H			X					10km
Wilsonia	*humilis*	Silky Wilsonia					X				10km
Zostera	*marina*	Eeelgrass	AP	X							

Appendix B: Weeds

The following list of plants comprises recognised weeds for the state of Victoria. They are divided based on their impact level resulting in prohibitions or regulation across the state or the Gippsland Region. The list was extracted from Victoria's Noxious Weeds, 2014. The plants appering in this list should be avoided at al costs and future restoration and conservation actions should actively remove (de-weed) any of them should they appear within the site.

State wide prohibited weeds

Family	Species	Common Name	Typology
Amaranthaceae	*Alternanthera philoxeroides*	Alligator Weed	Aquatic Plant
Asteraceae	*Ambrosia psilostachya*	Perennial ragweed	Herb
Asteraceae	*Cardanuus nutans*	Nodding thistle	Herb
Asteraceae	*Centaurea nigra*	Black knapweed	Herb
Asteraceae	*Hieracium spp.*	Hawkweed	Herb
Asteraceae	*Iva axillaris*	Poverty weed	Herb
Asteraceae	*Parthenium hysterophorus*	Parthenium weed	Herb
Cannabaceae	*Canavis sativa*	Marijauna	
Equisetaceae	*Equisetum spp.*	Horsetail	Aquatic Plant
Fabaceae	*Acacia erioloba*	Giraffe thorn	Small Tree
Fabaceae	*Acacia karroo*	Karoo thorn	Tree
Fabaceae	*Alhagi maurorum*	Camel thorn	Shrub
Fabaceae	*Prosopis spp.*	Mesquite	Tree
Hydrocharitaceae	*Lagarosiphon major*	Lagarosiphon	
Hypericaceae	*Hypericum triquetrifolium*	Tangled hypericum	Herb
Malvaceae	*Malvella leprosa*	Ivy-leafed sida	Herb
Orobanchaceae	*Orobanche ramosa*	Branched broomrape	Herb
Poaceae	*Festuca gautieri*	Bear-skin fescue	Tufted Grass
Poaceae	*Nassella charruana*	Lobed needle grass	Tuffted Grass
Poaceae	*Nassella tenuissima*	Mexican feather grass	Tuffted Grass
Polygonaceae	*Fallopia japonica*	Japanese knotweed	Shrub
Polygonaceae	*Fallopia sachalinensis*	Giant knotweed	Herb
Polygonaceae	*Fallopia X bohemica*	Japanese knotweed hybrid	Shrub
Pontederiaceae	*Eichhornia crassipes*	Water hyacinth	Aquatic Plant
Salviniaceae	*Salvinia molesta*	Salvinia	Aquatic Plant
Amaranthaceae	*Alternanthera philoxeroides*	Alligator Weed	Aquatic Plant

Appendix B: Weeds (Continued)

Prohibited weeds for the Gippsland bioregion

Family	Species	Common Name	Typology
Alismataceae	*Sagittaria*	Arrowhead	Herb
Amaranthaceae	*Alternanthera pungens*	Khaki weed	Ground Cover
Asteraceae	*Centaurea solstitialis*	St. Barnaby's thistle	Herb
Asteraceae	*Chrysanthemoides monilifera*	Boneseed/Bitoubush	Herb
Asteraceae	*Onopordum illyricum*	Illyrian thistle	Herb
Cactaceae	*Opuntia aurantiaca*	Tiger pear	Cactus
Convolvulaceae	*Convolvulus arvensis*	Bindweed	Ground Cover
Fabaceae	*Cytisus scoparius*	Enlish broom	Shrub
Fabaceae	*Genista linifolia*	Flax-leaved broom	Shrub
Fabaceae	*Ulex europaeus*	Gorse/Furze	Shrub
Iridaceae	*Moraea miniata*	Cape Tulip	Herb
Poaceae	*Nasella thrichotoma*	Serrated tussock	Tuffted Grass
Poaceae	*Pennisetum macrourum*	African feather grass	Grass
Solanaceae	*Cestrum parqui*	Chilean cestrum	Shrub
Solanaceae	*Salpichroa origanifolia*	Pampas lily-of-the-valley	Herb

Controlled weeds for the Gippsland bioregion

Family	Species	Common Name	Typology
Asteraceae	*Carduus tenuiflorus*	Slender, Shore thistle	Herb
Asteraceae	*Carthamus lanatus*	Saffron thistle	Ground Cover
Asteraceae	*Centaurea calcitrapa*	Star thistle	Herb
Asteraceae	*Cirsium arvense*	Perennial thistle	Herb
Asteraceae	*Cirsium vulgare*	*Spear thistle	Herb
Asteraceae	*Onopordum acaulon*	Stemless thistle	Herb
Asteraceae	*Senecio jacobaea*	Ragwort	Herb
Asteraceae	*Silybum marianum*	Variegated thistle	Herb
Asteraceae	*Xanthium spinosum*	Bathurst burr	Herb
Boraginaceae	*Amsinckia spp.*	Amsinckia	Herb
Boraginaceae	*Echium plantagineum*	Paterson's curse	Herb
Boraginaceae	*Echium vulgare*	Viper's bugloss	Herb
Fabaceae	*Genista monspessulana*	Cape broom	Shrub
Hypericaceae	*Hypericum androsaemum*	Tutsan	Shrub
Hypericaceae	*Hypericum perforatum*	St. John's wort	Herb

Appendix B: Weeds (Continued)

Controlled weeds for the Gippsland bioregion (continued)

Family	Species	Common Name	Typology
Iridaceae	Moraea flaccida	Cape tulip	Herb
Iridaceae	Watsonia meriana	Wild watsonia	Herb
Juncaceae	*Juncus acutus*	Spiny rush	Rush
Lamiaceae	*Marrubium vulgare*	Horehound	Ground Cover
Poaceae	*Eragrostis curvula*	African love grass	Tuffted Grass
Rosaceae	*Crataegus monogyna*	Hawthorn	Shrub
Rosaceae	*Rosa rubiginosa*	Sweet briar	Shrub
Rosaceae	*Rubus fruticosus*	Blackberry	Shrub
Scrophulariaceae	*Verbascum thapsus*	Great mullein	Herb
Simaroubaceae	*Ailanthus altissima*	Tree of heaven	Tree
Solanaceae	*Lycium ferocissimum*	African boxthorn	Shrub
Solanaceae	*Physalis hederifolia*	Prairie ground cherry	Herb
Solanaceae	*Solanum linnaeanum*	Apple of Sodom	Herb

Regionally restricted weeds

Family	Species	Common Name	Typology
Alliaceae	*Allium triquetrum*	Angled onion	Herb
Alliaceae	*Allium vineale*	Wild garlic	Herb
Annonaceae	*Annona glabra*	Pond apple	Tree
Apiaceae	*Conium maculatum*	Hemlock	Fern
Apiaceae	*Foeniculum vulgare*	Fennel	Herb
Apocynaceae	*Cryptostegia grandiflora*	Rubber vine	Vine
Asparagaceae	*Asparagus asparagoides*	Bridal creeper	Herb
Asphodelaceae	*Asphodelus fistulosus*	Onion weed	Herb
Asteraceae	*Chondrilla juncea*	Skeleton weed	Rush
Asteraceae	*Cynara cardunculus*	Artichoke thistle	Herb
Asteraceae	*Dittrichia graveolens*	Stinkwort	Herb
Asteraceae	*Leucanthemum vulgare*	Ox-eye daisy	Herb
Asteraceae	*Onopordum acanthium*	Scotch, Heraldic thistle	Herb
Asteraceae	*Picnomon acarna*	Soldier thistle	Herb
Asteraceae	*Rhaponticum repens*	Hardheads	Herb
Asteraceae	*Scolymus hispanicus*	Golden thistle	Herb
Asteraceae	*Senecio pterophorus*	African daisy	Herb

Appendix B: Weeds (Continued)

Regionally restricted weeds (Continued)

Family	Species	Common Name	Typology
Asteraceae	*Xanthium strumariam*	Noogoora burr	Herb
Brassicaceae	*Diplotaxis tenuifolia*	Sand rocket, Sand mustard	Ground Cover
Brassicaceae	*Lepidium draba*	Hoary cress	Herb
Cabombaceae	*Cabomba caroliana*	Cabomba	Aquatic plant
Cactaceae	*Opuntia monacantha*	Drooping Prickly pear	Cactus
Cactaceae	*Opuntia robusta*	Wheel cactus	Cactus
Cactaceae	*Opuntia stricta*	Prickly pear	Cactus
Caprifoliaceae	*Dipsacus fullonum*	Wild teasel	Herb
Convolvulaceae	*Cuscuta*	Dodder	Vine
Fabaceae	*Acacia nilotica*	Prickly acacia	Tree
Fabaceae	*Calicotome spinosa*	Spiny broom	Shrub
Fabaceae	*Mimosa pigra*	Mimosa	Shrub/Small Tree
Fabaceae	*Parkinsonia aculeata*	Jerusalem-thorn	Shrub/Small Tree
Hypericaceae	*Hypericum tetrapterum*	St. Peter's wort	Herb
Lamiaceae	*Lavandula stoechas*	Topped lavender	Shrub
Martyniaceae	*Proboscidea louisianica*	Devil's claw	Ground Cover
Martyniaceae	*Proboscidea lutea*	Devil's claw	Ground Cover
Melianthaceae	*Melianthus comosus*	Tufted honey flower	Shrub
Oxalidaceae	*Oxalis pes-caprae*	Soursob	Ground Cover
Poaceae	*Cenchrus longispinus*	Spiny burr grass	Grass
Poaceae	*Hymenachne amplesicaulis*	Olive hymenachne	Aquatic Plant
Poaceae	*Nassella neesiana*	Chilean needle grass	Tufted Grass
Polygonaceae	*Emex australis*	Spiny emex	Ground Cover
Resedaceae	*Reseda luteola*	Wild mignonette	Herb
Salicaceae	*Salix spp.*	Willows	Tree
Solanaceae	*Datura ferox*	Long spine thorn apple	Herb
Solanaceae	*Datura inoxia*	Thorn apple	Herb
Solanaceae	*Datura stramonium*	Common thorn apple	Herb
Solanaceae	*Solanum elaeagnifolium*	Silverleaf nightshade	Herb
Solanaceae	*Solanum rostratum*	Buffalo burr	Herb
Tamaricaceae	*Tamarix aphylla*	Athel pine, Tamarisk	Shrub
Verbenaceae	*Lantana camara*	Lantana	Shrub
Zygophyllaceae	*Tribulus terrestris*	Caltrop	Herb