TOWN OF COTTESLOE
NATURAL AREAS
CONDITION ASSESSMENT
SUMMARY REPORT 2022

JUNE 2023

FOR
TOWN OF COTTESLOE

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REPORT DETAILS:

Version No.	Date	Author	Reviewer	Comment
1	24.03.2023	RT	RT	Issue to ToC
	20.04.2023		AM	Review Comments Received
2	20.04.2023	RT	RT	Final Issue to ToC
3	07.06.2023		AM	ToC requests the addition of JBDP skate park information and
3	09.06.2023	RT		Final Issueto ToC

	Signature		Signature
Author: RT		**Reviewer**:	RT
Position: Principal Environmental Scientist/Botanist		**Position**: Principal Environmental Scientist/Botanist	

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INTRODUCTION

1.0 BACKGROUND TO THIS REPORT

Syrinx Environmental PL (Syrinx) was commissioned in September 2022 by the Town of Cottesloe (the Town) to undertake a vegetation condition survey of the Town's natural areas. The aim of the survey was to assess the current status of vegetation condition and compare the findings to the 2015 baseline data. The Town and the local volunteer group Cottesloe Coastcare Association (CCA) have invested considerable effort in maintaining and improving the condition of the natural areas after the 2015 baseline mapping. To assess the success of these efforts, the current survey sought to:

- determine if the vegetation condition of natural areas has been maintained and / or improved based on the key performance indicators (KPIs) listed in the 2015 NAMP update;
- identify current issues with vegetation condition management; and
- Provide recommendations for the improvement of natural areas management

The outputs of the current work are a series of vegetation condition maps, quantification graphs outlining changes in vegetation condition and this report that summarises the overall findings and key recommendations. This document and associated outputs will provide another point of reference for vegetation condition assessments in the future and should be used to inform future short to long term improvements to the natural areas condition.

2.0 DATA COLLECTION

2.1 DESKTOP REVIEW AND DATA COLLECTION

Desktop data was collected to supplement and organise field data in a way that is meaningful to the Town and CCA whilst making sure it was congruent with and comparable to the 2015 mapping.

During the 2015 – 2022 period, the Town has updated several beach access pathways and installed new signage reflecting the location of each pathway utilising Beach Emergency Number (BEN) signs.

Previously pathway signage referred to the location of the pathways from the central beach (C 1 – C4) (Indiana Teahouse to John Black Dune Park), North (N) (north of John

Black Park to Swanbourne) (N1-N12) and south of Indiana Teahouse to Vlamingh Memorial (S1-S15). These pathway names were used in the 2015 mapping to label natural areas. The areas north of the pathway were assigned the same identification as the pathway, e.g. N1 area was located north of the N1 access pathway.

The location of updated beach location access pathways (e.g. CT1 – CT59), as provided by the Town, was used to label the natural areas along the shoreline in the same way as in 2015 (i.e. natural area north of CT57 is labelled as CT57) for both 2015 and 2022 vegetation condition data. The name of the beach location was also added to the attribute table to reflect the new signage (e.g. Vlamingh Memorial, Dutch Inn, Vera View Beach etc.). Examples of the old and new signage are shown in Figure 1 below.

Figure 1. Example of new BEN signage utilised for beach access in Cottesloe (left) and an example of old signage (right) (Note: signage locations are of different areas)

A number of beach access pathways were also closed since 2015 as part of the upgraded beach access. These pathways (e.g. N2, N5, N11 and C3) were revegetated to form a contiguous vegetation patch between neighbouring patches. As a result, the 2015 vegetation condition data had to be updated to reflect this and allow for direct comparison with the 2022 data. This involved drawing polygons over the pathways and adding them to the 'Completely Degraded' condition category.

The size of John Black Dune Park was reduced by approximately 0.5ha for the construction of the new tennis courts in 2016. As a result, the 2015 dataset was modified to excise the area and allow for direct comparison with 2022 results.

Figure 2. Changes in the mapping area for John Black Dune Park due to tennis court expansion in 2016 (Imagery: Nearmaps, April 2015 and December 2022)

Similarly, changes also occurred at Victoria Station with the more recent construction of the Principal Shared Pathway, reducing the overall area previously mapped as being vegetated and requiring amendments to the 2015 dataset and the boundary of the natural areas.

A number of smaller areas along Grant Street and Marine Parade verges were mapped in 2015 and included in the final area calculations. After reviewing the data and after discussions with the Town and CCA, it was decided to remove these areas from the natural areas category as these will likely form part of the Town's green infrastructure network and are managed under different budgets to the natural areas. The example of the areas excluded is presented in Figure 3.

Figure 3. Example of verge areas excluded from natural areas condition mapping

The verge encompassing the Secret Gnome Garden was not considered as a natural area in 2015 and was hence not presented on the maps in the 2015 NAMP addendum. This area has been added to the natural areas in 2022 and the 2015 dataset was amended to include mapping of this area based on the field notes taken in 2015.

Finally, a number of pathways along the shoreline were realigned as part of beach access and the stormwater pipework upgrade works. As much as possible, amendments were made to the natural area boundary to reflect its true extent via aerial imagery from April 2015 and October to December 2022. Detailed feature surveys of infrastructure (beyond specific beach access pathway survey work) were not available.

A summary of the effort / hours invested by the CCA volunteers for the 2015 – 2022 period and the funding / grants obtained over this time were sourced from the CCA.

2.2 FIELD ASSESSMENT

Field assessment involved traversing the natural areas on foot in a series of transects parallel to the shoreline, generally 5 m apart, where vegetation was sparse enough to allow passage without damage to vegetation. Where access was not possible (i.e. vegetation was very dense or the slope too steep and unstable), vegetation was observed from a greater distance (generally within 10 m) and mapped from either top or bottom of the slope.

All field observations and mapping were conducted by the same botanist who conducted the 2015 survey using the same vegetation condition scale and classification rules as presented in the 2015 NAMP report (see Table 1 for vegetation condition classification).

Table 1. Vegetation Condition Scale for Town of Cottesloe Natural Areas

	Completely Degraded	Degraded	Good	Very Good
Keighery, B.J. (1994)	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Croft et al (2005) (modified) Native species diversity	0 to 5%	5 to 20%	20-60%	60-100%
Weed species abundance	60-100%	20-60%	5 to 20%	0 to 5%
General Health % plants with significant health problems	>70%	50-70%	30-50%	15-30%
Disturbance Soil and/or substrate disturbance. Such astrampling, tracks, erosion.	Disturbance incidence very high. Affecting 80-100% of the area.	Widespread high level disturbance affecting 60-<80% of the area.	Widespread high level disturbance affecting 40 to <60% of the area.	Generally low-level disturbance. May be high in small patches. Affecting 20 to <40% of the area.

Areas with native Western Australian trees, such as *Melaleuca lanceolata* or *Agonis flexuosa* were given a 'Good' status. Given that the 2022 survey occurred in October when several annual weeds were present, the mapping has considered this, and the focus was predominantly on the perennial species as recorded in 2015.

Restored areas were examined for plant survival, weed cover and overall growth since planting to establish their condition. In general, most of the areas within two years from planting were mapped as degraded as the plants were too young to determine if they were established (usually, this should be assessed after 3 – 5 years after establishment).

All information was recorded on field maps, and any points of interest recorded using a handheld GPS to assist with mapping.

2.2.1 Weeds

Weeds were recorded for each natural area assessed, and the abundance was recorded on the maps to assist with data interpretation. The list of dominant weed species recorded per each natural area is presented in Appendix 2.

Leptospermum laevigatum (Coast Teatree) mapping was completed using the same method presented in the 2015 NAMP (Syrinx, 2015).

2.3 CONSULTATION

Syrinx has liaised with the Town's Natural Resource Management (NRM) representatives and the CCA during map development to determine the outputs required and seek feedback on the best way to present data in this report. Syrinx has also sought to understand how the natural areas are currently managed to identify any resource or information gaps that could assist the Town towards progressing with improving the condition of the natural regions.

A preliminary presentation outlining the initial findings of the survey was held with the above parties and the Town's Operations team to highlight problem areas and indicate potential improvements for future maintenance and implementation activities.

2.4 DATA ANALYSIS AND MAPPING

Data collected in the field was digitised in the ArcMap GIS Software by forming polygons around specific features (e.g. patches of native vegetation or patches of introduced trees such as *Leptospermum laevigatum*). Each polygon is given specific attributes, including:

- **Location ID** (as per BEN signage (e.g. CT 1, CT4 etc.);
- **Area Name 1** (as per BEN signage, e.g. Vlamingh Memorial, Dutch Inn, Vera View Beach etc.);
- **Area name 2** (larger group areas to denote locations as used by CCA);
- **Vegetation Condition** (rating: Completely Degraded – Very Good);
- **Area** (m^2) (Calculated in GIS);
- **Notes** (plant species name, whether an area has been revegetated, has eroding features, notes on mulching etc.).

The 2015 dataset retains both old and new nomenclature for the natural areas for easy reference with the old NAMP documents (i.e. Ecoscape, 2008 and Syrinx, 2015).

Once mapped, the vegetation condition was quantified by calculating areas for each condition category. This was completed by exporting attributes from GIS to an Excel spreadsheet and creating relevant summary graphs as presented in 3.0 and Appendix 1. Each summary graph is prefaced with the map showing different ways in which natural areas were grouped for assessment (e.g. Location ID as per BEN signage (either CT numbers or names provided on signage) and the larger grouping as is used by CCA and the Town personnel.

3.0 KEY FINDINGS

3.1 VEGETATION CONDITION

Vegetation condition varied across all sites and is reflective of efforts invested in weed control and revegetation activities. The change in vegetation condition across agglomerated natural areas is illustrated in Figure 4. Detailed vegetation condition maps for these areas are presented in Appendix 1.

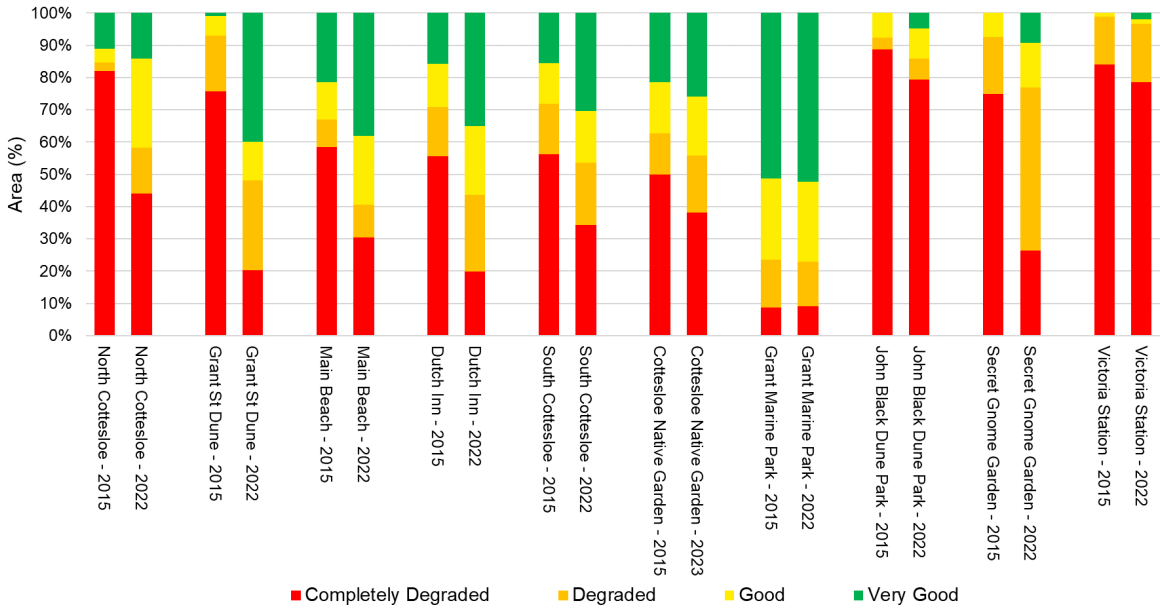
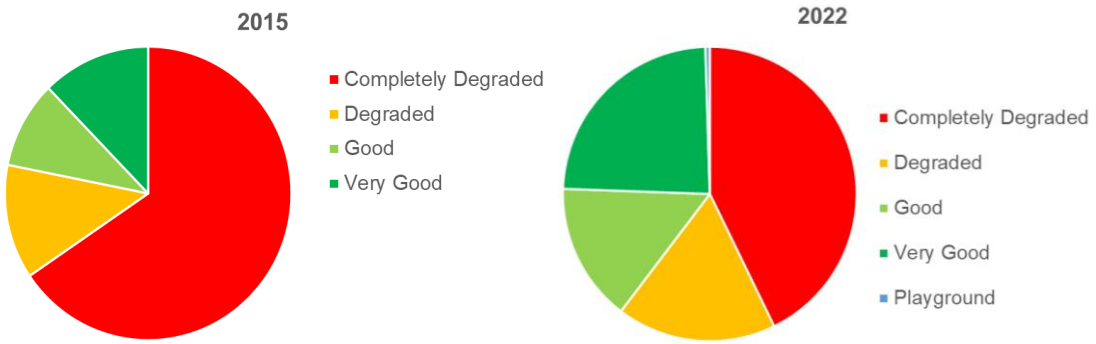


Figure 4. Current vegetation condition for the Town of Cottesloe Natural areas compared to 2015 data

Results in the figure above indicate that with the exception of the Grant St Marine Park, which maintains the same condition by % area as recorded in 2015, and marginal improvements for the Victoria Station and John Black Dune Park, other areas show between 10 – 50% improvement in vegetation condition. This improvement is mainly noted by the decrease in the 'Completely Degraded' category and the increase in 'Degraded' or better categories. The greatest improvements were made at Grant St Dune, Dutch Inn, Main Beach and South Cottesloe, which are a result of 2018 – 2021 planting revegetation efforts in particular. The improvements to John Black Dune Park are due to revegetation efforts along the western boundary of the site after the expansion of tennis courts in 2016 and growth projection in the crown of the native trees in the area. Victoria Station Principal Shared Pathway (PSP) greening efforts have provided improvement to approximately 5% of the overall area.

A summary of the condition improvements achieved across all natural areas are presented in Figure 5.



Year	Completely Degraded (ha)	Degraded (ha)	Good (ha)	Very Good (ha)	Total (ha)
2015	12.3	2.4	1.8	2.3	18.8
2022	8.1	3.4	2.8	4.5	18.8
Reduction or increase in condition between 2015 and 2022					
(ha)	-4.2	1.0	1.0	2.2	
%	-23%	5%	6%	12%	

Figure 5 Change in Vegetation Condition Status for the Town of Cottesloe Natural Areas

A 22% improvement in the overall natural area condition was achieved between 2015 and 2022. This improvement resulted in a reduction of 'Completely Degraded' condition ranked areas by 23% (or 4.2 ha) and an increase in 'Degraded' or better condition vegetation. The 'Very Good' and 'Good' condition area increases indicate that the older revegetation prior to 2020 had good survival and that the 'Good – Very Good' condition vegetation recorded in 2015 was mostly maintained or has increased its canopy cover.

A high proportion of the areas mapped as having degraded condition are newly planted areas (less than two years old). This indicates a potential for further improvement in vegetation condition in the short term if the revegetation areas are appropriately managed.

A small area rehabilitated as a nature playground adjacent to Vlamingh Memorial has been classified as 'Degraded' for calculations but has been represented individually in pie charts and maps. It is recommended that this area be accounted for / mapped in the same way in the future as it still retains Coast Teatrees and is generally bare (mulched) but provides the habitat for wildlife because of its unique setting (surrounded by planted native vegetation) and soft landscape.

A visual representation of the improvements in vegetation condition for all Natural Areas is presented in Figure 6.

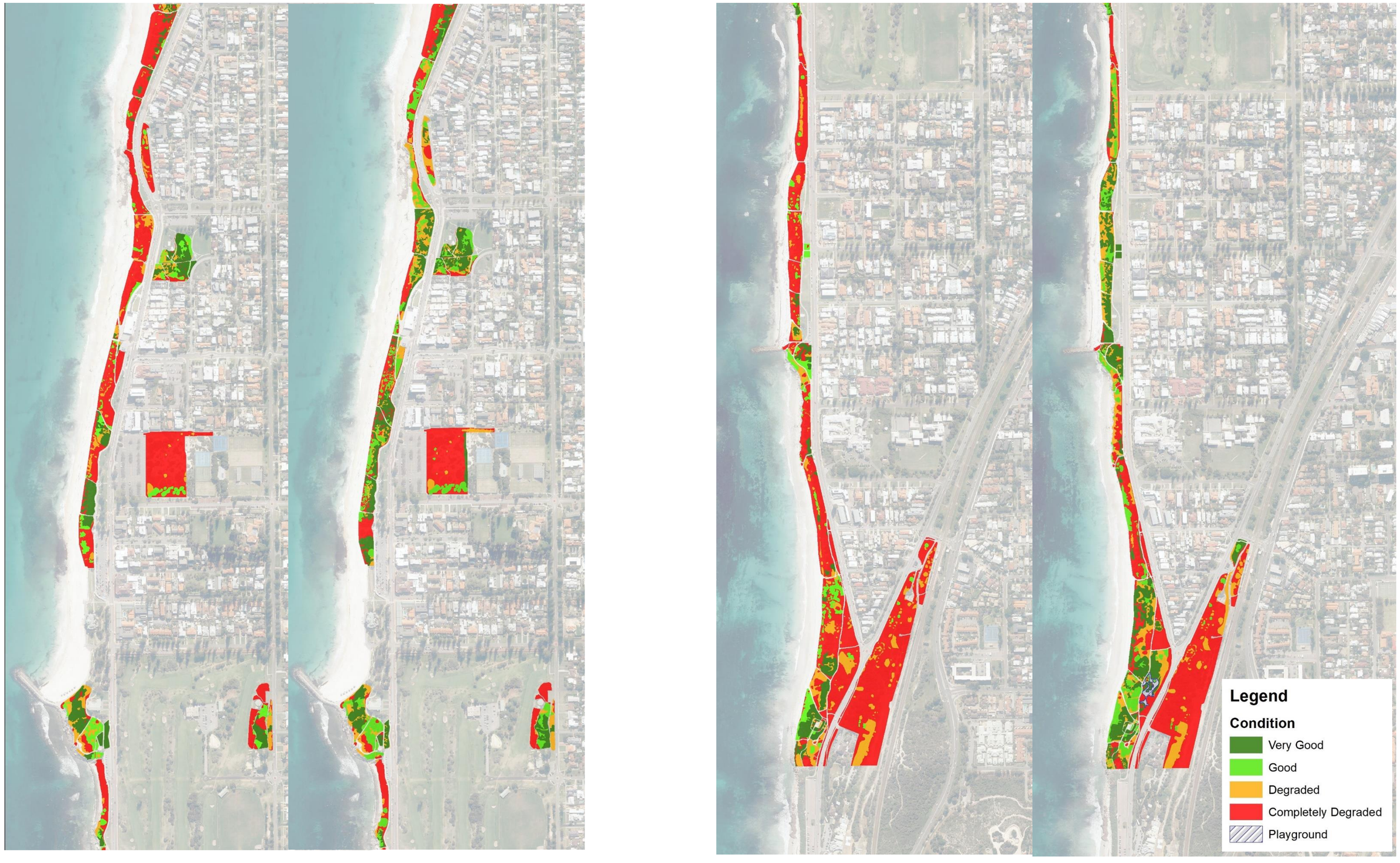


Figure 6 Changes in Vegetation Condition across Town of Cottesloe Natural Areas 2015 (left) and 2022 (right)

3.2 WEEDS

Overall, priority weed cover in the Natural Areas has been reduced as a result of revegetation efforts and native cover expansion. However, the distribution of priority weeds remains the same and additional weed species were recorded at Victoria Station PSP revegetation areas. These species appear to have been introduced via mulch application (*Reichardia tingitana, Cyperus congestus* and in one location with few plants, only *Echium plantagineum* (Pattersons Curse), which is a Declared Pest in Western Australia).

Some reduction in *Ammophila arenaria* (Marram Grass) population was noted since 2015 mainly for the northern beaches from Grant Street north. This reduction is attributed to both revegetation / maintenance but also dune foredune erosion during May 2020 storms.

Grant Street Beach, Dutch Inn, Main Beach and Southern Cottesloe showed a significant reduction in weed cover as a result of revegetation works and the subsequent weed control efforts.

Ferraria crispa (Black Flag) persists in most areas despite ongoing management. The Mudurup Rocks area shows infestation on par or slightly higher than in 2015. For other areas, this weed occurs sporadically and appears to be well controlled. *Pelargonium capitatum* (Rose Pelargonium) and *Trachyandra divaricata* (False Onion Weed) retain the same extent as in 2015. While a notable reduction in Rose Pelargonium abundance was achieved across all restored areas, particularly at Main Beach, other areas appear to have similar abundance and cover to 2015. *Trachyandra divaricata* control appears to have been less successful; however, reductions in cover across restored areas is evident.

The cover of Couch and the Sea Spinach has decreased in the high performing areas / newly revegetated areas, particularly the Dutch Inn beaches. Sea spinach however, is not well controlled in the older rehabilitation areas, especially the Main Beach areas (e.g. planting adjacent to Barchetta restaurant) causing many of the native plants to be overgrown, reducing the area condition. This indicates that the current maintenance effort is not sufficient to keep this weed in check for the old revegetated areas.

The cover of Coast Teatree has been reduced as a result of various revegetation works and clearing to make room for new infrastructure such as tennis courts and the PSP at Victoria Station. However, the remaining trees / shrubs have increased canopy cover over time, therefore, making the overall cover reduction less significant. Removal of this

species is staged due to the difficulty of removal and to protect the dunes from erosion. Significant improvement was made at Cottesloe Native Gardens (CNG) by removing a central core of this species and revegetating it with native endemic species.

Ehrharta longiflora (Annual Veldt Grass) was most prolific at CNG alongside Rye Grass, with the latter being common but not as abundant at Grant Marine Park. *Gazania* sp. occurrence was also reduced as a result of works in the Dutch Inn area but remains on the steep slopes of the southern beaches.

Argyranthemum frutescens (Marguerite Daisy) distribution and cover are similar to 2015 and isolated to the southern corner of Grant Marine Park. The list of species occurring within each of the natural areas is presented in Appendix 2.

3.3 MANAGEMENT IMPROVEMENTS

Due to beach access upgrades, there were a number of improvements in the way some sections of the natural areas are managed. Installation of concrete curbing to prevent the turf from entering revegetated areas, new fencing to protect vegetation and removing turf and weeds between natural areas and the pathway have made significant improvements and will, over time, reduce the maintenance burden.

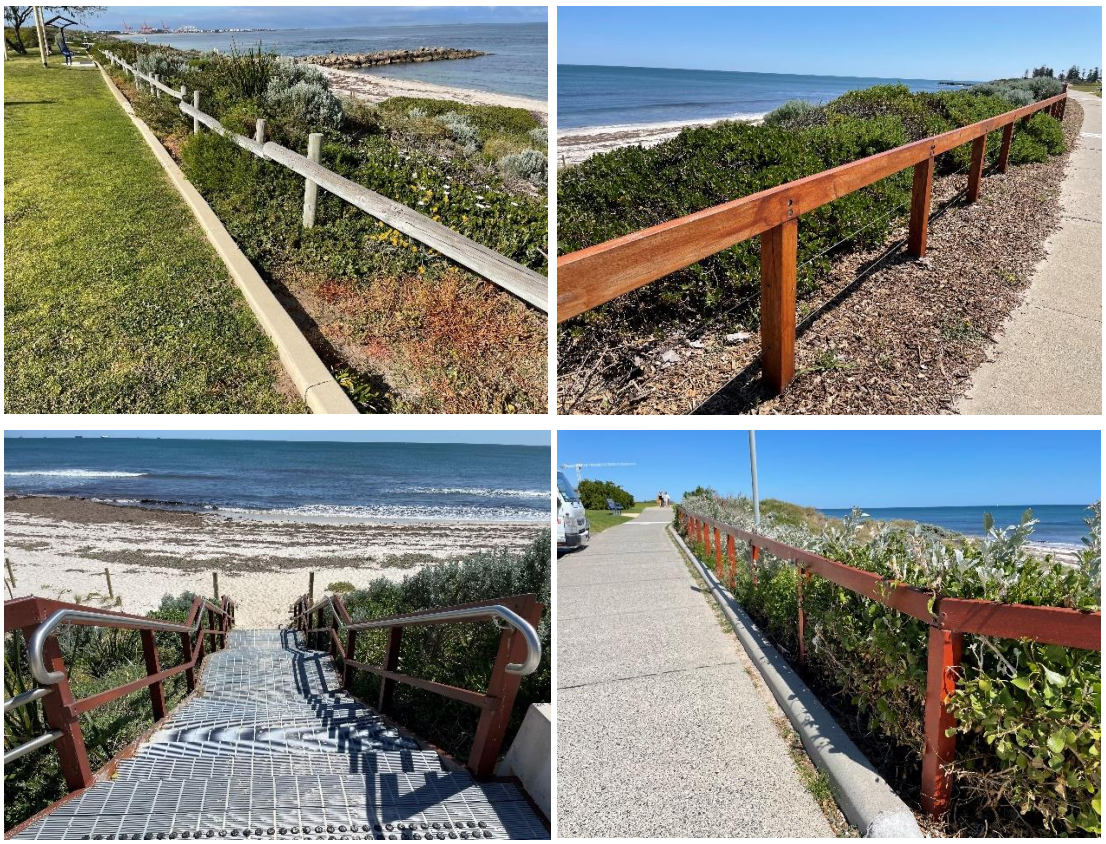


Figure 7. Improvements to beach access while protecting native vegetation

Regular weed control is implemented; however, the timing of the weed control appears to be suboptimal, resulting in a poor outcome for the overall vegetation condition and a reduction in the abundance of some weed species.

Improvements were made to stormwater drainage at the Main Beach. However, these works have made a substantial disturbance to the surrounding vegetation. The planting of new seedlings appears to have been completed late in the season, causing many seedlings to die (>80%). Therefore, supplementary planting and maintenance are required, and the area was mapped as 'Completely Degraded'.

The deep planting technique utilised by CCA, combined with the regular watering and hand weeding in the first two years of establishment, has had a significant positive impact on vegetation condition. The application of mulch on the upper slope of the restored dunes appears to have had a positive effect on moisture retention and suppression of some weeds, such as Sea Spinach. However, it was also observed that the mulch areas had large populations of annual weeds like Burmedic (*Medicago* spp), Cape Weed and *Senecio* sp. Anecdotal evidence (CCA) suggests that these weeds were on site previously (i.e. in 2015) but were not recorded due to the late timing of that survey (April). It is likely that organic content and the moisture retention in mulch assist with the preferential establishment of some annual weeds, and as such, the mulch should be limited to upland areas of the beach where weed maintenance is easier and does not interfere with natural sand migration within the dune system.

Figure 8. Mulch (foreground) and brush application in the newly restored areas

As a result of on ground research in 2019 - 2020, CCA has developed a more effective control for many of the priority species within natural areas, which are currently being implemented and will aid with the improvement of vegetation condition in the future.

3.4 LANDUSE CHANGES

As a result of a successful grant in 2019/2020, CCA and the Town have established a nature playground opposite the Vlamingh Reserve. This project has made substantial improvements to the biodiversity and condition of the area and indicates that improvements in natural areas are possible when combined with recreational use spaces.

More recently, the Council obtained funding for the development of a Skate Park within the John Black Dune Park area. A schematic design showing the position of the Skate Park hardscape and revegetation areas is shown in Figure 9 (Town of Cottesloe, 2022).

The Town plans to work closely with CCA to compile a suitable list of local provenance coastal plants which will contribute to the improvement of the Town's overall natural areas condition and provide habitat for native birds, reptiles and pollinators.

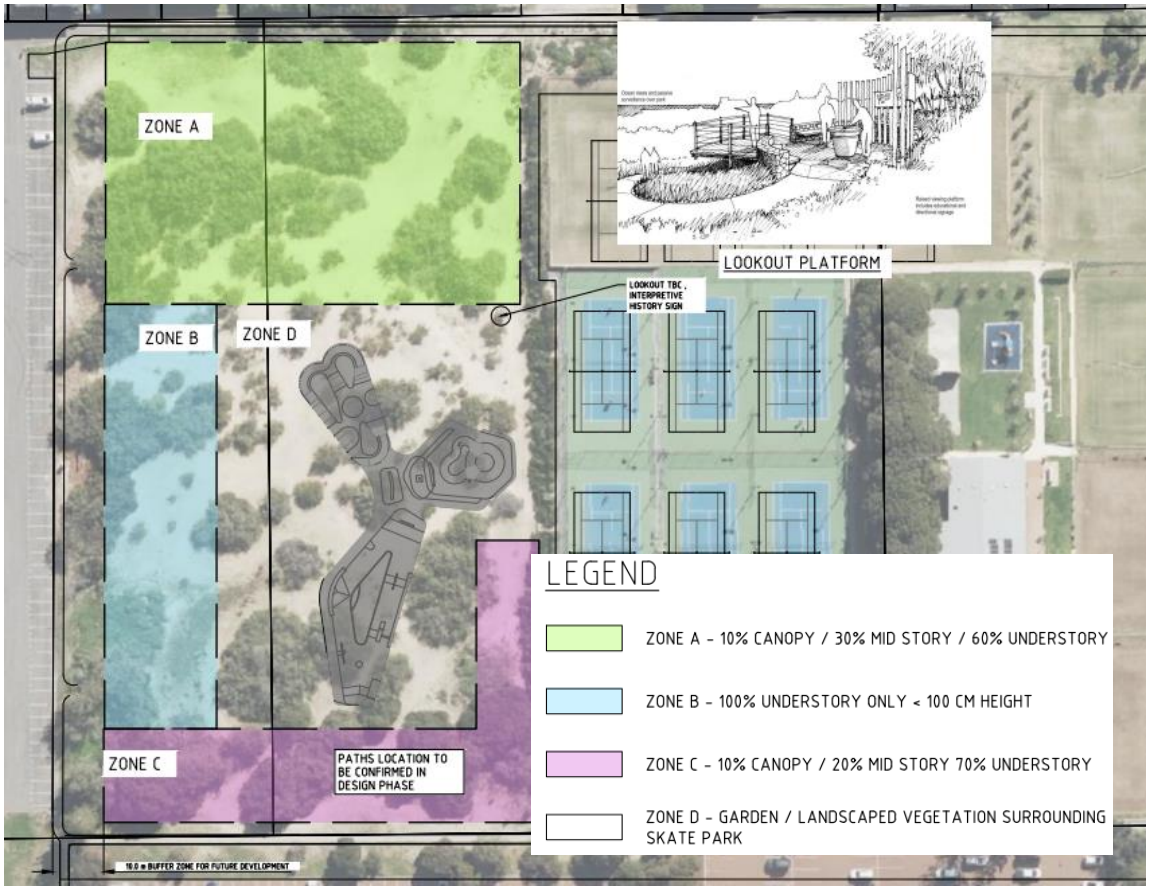


Figure 9. John Black Dune Park Development (Source: Town of Cottesloe, 2022)

3.5 EFFORT

The effort expended in improving vegetation condition includes financial contributions by the Town and the CCA, as well as on-ground work (labour hours), which included slope stabilisation, revegetation and maintenance activities.

While CCA maintains an ongoing strong involvement with the improvement and maintenance of natural areas, the Town has, as a result of the 2015 condition assessment, increased its contribution both financially and with labour input, although the latter was relatively limited due to resourcing.

For the past five years (2017 - 2022), the Town contributed $668,000 for the maintenance and improvement of natural areas which included the $20,000 contribution by the Perth NRM. The 2022/23 budget includes $60,000 for natural area improvement projects and $100,000 for maintenance activities by the Natural Areas Team. Additional funds obtained for the 22/23 year included $13,000 for the natural areas condition mapping (preparation of this document) and a $20,000 Perth NRM contribution. This brings the overall total of available funds for 22/23 to $193,000 and the overall funding for Natural areas management for the past six years at $861,000.

From the volunteer hour records provided by CCA for the same period (2017- 2022) over 9000 hours were invested by the group on various tasks to improve the vegetation condition of natural areas. A breakdown of this effort is shown for each year in Figure 10. When using current Volunteer WA rates, the total effort expended by the CCA over the past five years is $434,000. In addition, CCA has obtained $112,527 of funding via various grant applications and has attracted contributions of over 3800 hours by external parties and experts at an approximate value of $187,000. This brings the overall total for the five-year period to $733,527, which is a significant and highly valuable contribution to the Town's investment in green infrastructure.

As Figure 10 shows, almost 50% of the volunteer time is spent on weeding and watering, with the remainder attributed to site preparation and revegetation. As the restoration areas are expanding and no dedicated staff are present in the Town to manage weed control in a timely fashion, volunteers are expending their efforts across many areas, making them inefficient and causing fatigue. As the restoration continues in the future, it would be very difficult for the group to maintain the same level of presence in the maintenance of wider natural areas and this will be one of the key problems to resolve when planning works for the future restoration efforts.

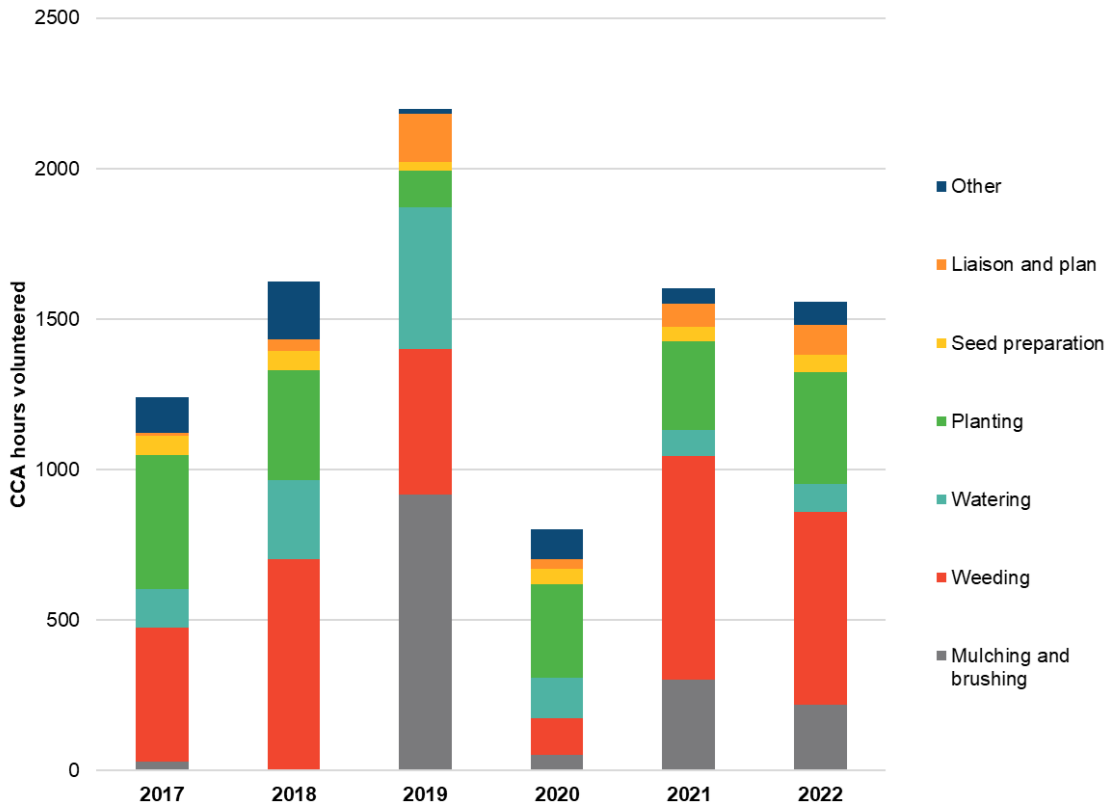


Figure 10. Effort expended by CCA group in the improvement of Natural Areas between 2015 and 2022 (less hours in 2020 due to COVID and event cancellations)

4.0 KEY PERFORMANCE INDICATORS (KPI'S)

2015 NAMP Addendum states six key performance indicators to determine if the improvement in vegetation condition was achieved. It is recognised that there are many other parameters that could be assessed, particularly from the ecosystem services perspective and carbon sequestration; however, these are not discussed here as the primary topic of this assessment is the overall vegetation condition improvement.

The performance against each KPI is listed in Table 2.

Significant improvements were made to the increase in good quality vegetation (22%) and the improved beach access.

Weed control has reduced weed coverage/abundance, but the priority weeds are persisting within the same extents, and new revegetation areas are under pressure due to high seed banks of some species, like Sea Spinach which require timely, frequent and ongoing control.

A reduction in feral animal occurrence was noted, but this improvement is hard to quantify without detailed investigations. Anecdotal evidence from CCA suggests this is an ongoing issue for the Grant Marine Park and evidence of rabbit grazing was also observed at Northern beaches.

Improvements have been made to the Main Beach drainage; however, other stormwater drains however minor require upgrades and or detention of flows within the upper catchment to reduce pressure on outfall areas.

Table 2. Vegetation Condition assessment against KPIs set in the 2015 NAMP

Key Performance Criterion	Summary of Performance	
1. Percentage increase in good quality vegetation.	22% overall improvement in vegetation condition was achieved, with 18% of this being attributed to the increase in Good or Very Good vegetation condition. This increase is due to revegetation and maintenance efforts allowing for the overall increase in the native vegetation cover and survival rates post-revegetation.	
2. Reduction in the number of high priority weeds.	All high priority weeds persist in the natural areas. While for the most part high priority weed coverage was reduced, more timely maintenance by staff familiar with the natural areas would provide a much better outcome.	
3. Reduction in feral animals / feral animal activity (e.g. rabbits, rats) (i.e. no plant damage / diggings or excreta noted).	There was a reduction in the observed scatts across the Natural Areas. However, rabbits are still persisting at Grant Marine Park, Grant Street Beach and North Cottesloe in particular. Rat diggings were observed around stormwater drains at Grant St Beach (just north of the surf club). In comparison, evidence of grazing was low (this is also due to the timing of the survey when introduced grasses and herbs provided fodder for rabbits). Rabbit presence was also noted anecdotally at Cottesloe Native Gardens, and evidence of grazing and scats noted at Northern beaches.	
4. Reduction of use of old and creation of new access pathways.	The creation of new access pathways and the closure of old pathways has improved the condition of some sections of natural areas. However, evidence of foot traffic and trampling is still evident around the Dutch Inn area, and the Mudurup Rocks patch also shows significant trampling by what appears to be frequent foot traffic between the surf club and the limestone cliff.	
5. No leaky drainage outlets on the slopes, particularly in North Cottesloe.	Drainage improvements were made at Main Beach; however, other stormwater drains are still in the state of disrepair and require attention to avoid erosion due to higher than average rainfall events (e.g. storm event of 2020).	
6. Increase in funds for the management of restored areas.	The Town has increased funding for the improvement of natural areas, which has resulted in the overall improvement in the vegetation condition and biodiversity. However, the weed coverage, particularly in older restoration areas is high, indicating that increased funding and effort are required to maintain these in addition to newly rehabilitated areas.	

5.0 KEY ISSUES AND RECOMMENDATIONS

The improvement of vegetation condition in the Natural Areas was due to significant on ground effort and funding over the past five years. This not only improves the biodiversity of the area but also increases amenity and climate resilience and will, in the future, help mitigate the pressures of coastal erosion.

As the LGAs move toward sustainable ways of managing climate change, they are looking to green infrastructure/ natural areas to provide the many ecosystem services essential to the well-being of its residents, the economy, natural history, culture and biodiversity. The Town is recognised as a premier beach location in WA and as such, showcases the best that Western Australia has to offer. By increasing the value of its natural assets, the Town has not only local but also regional and wider positive impact.

There are currently several issues that prevent the Town from achieving high standards of natural areas restoration. It is recognised that the narrow natural areas along the foreshore are more susceptible to damage by anthropogenic (e.g. high visitation rates, trampling) and natural (e.g. storms) factors. Despite this, there are a number of issues that can be managed:

Issue 1 - Maintenence

Maintenance of natural areas is lacking mainly as a result of poor resourcing within the Town and the issues with contracting experienced and well resourced weed management contractors to control weeds in a timely fashion.

Issue 2 – Reduction in the maintenance budget for natural areas

Reduction of budget for maintenance is an issue as natural areas require maintenance of not only newly established areas but also areas that are already established. This is an ongoing commitment, and the reduction in funding can only be applied when results show that maintenance efforts can be reduced.

Issue 3 – Knowledge Transfer and the Future of volunteer involvement

Currently, the CCA volunteers, who have over 30 years of experience in the ongoing on-ground management and restoration of local beach dunes and hold significant knowledge, cannot facilitate this knowledge transfer without resource allocation and commitment from the Town.

The expansion of revegetation activities is putting pressure on the resources of CCA who spend considerable time conducting weed control when they could be spending this time seeking additional funds, growing membership and participating in the planning and

implementation decisions alongside the Environment Coordinator, the NRM team and the Town's Maintenance staff.

Issue 4 – Introduction of new weeds through restoration activities

New weeds have been recorded at the Victoria station PSP revegetation site as a result of mulch application that contained the weed seed. While this can be managed as part of weed control, the expense of this adds to further pressures financially and hinders native plant establishment.

Issue 5 – Inappropriate species selection for planting on primary dunes

The survey has noted that planting of some shrubs is best suited to secondary dune systems and was planted too low on the primary dune profile where Spinifex species are most suited.

Issue 6 – Hard infrastructure development and upgrades

Narrow spaces with turf and weeds between the pathway and natural areas persist. Damaged and or poorly functioning stormwater outlets/drains are also present. While these divert water from a small catchment (adjacent.road) they cause localised erosion.

Issue 7 – Persistence of Marram Grass on northern beaches and their influence on erosion

Marram Grass displaces native sand-binders and decreases the proportion of bare sand, which alters the natural dynamics of dune systems and result in a drastically changed coastal topography or beach profile. This has been demonstrated through the erosion of the steep dunes during the May 2020 Storm. Figure 11 shows the eroded steep dune face and the image interpreting the different ways in which Marram Grass colonises dunes as compared to Spinifex species and Pingao (New Zealand Native species).

Figure 11. Marram Grass growth and the eroded steep dune and a representation of the Marram Grass colonisation against other species (Gadgil, 2006)

Recommendations:

1. The Town should appoint a full time 'on the ground' Bushcare Officer to maintain the natural areas only. The officer would ensure timely weed control and liaise with the Town's Environmental Coordinator and the Operations Team to ensure resources are available at high-demand times. The officer would work closely with CCA to maximise volunteer input into the management of vegetation and ensure knowledge transfer that can then be passed on to subsequent staff who will have this role.

2. Facilitate knowledge transfer between CCA and the Town's staff (ongoing) and develop ways along with the CCA in which volunteer membership and assistance can be retained and or improved into the future both in short (e.g. five years) medium 5 – 10 and long (10 – 20 years) term. Long term planning is especially important as most restored ecosystems become self-regenerating after 15 or 20 years (depending on species and location).

3. Maintain and or increase budgets for the maintenance of natural areas. Should this not be possible, concentrate efforts on the areas that are already established while sourcing funding for the following years. State funding should be investiated given that the Cottesloe Beach is a premier tourist location in the Perth area.This may cover maintenance costs for the central (most visited) section of the foreshore.

4. Ensure that the machinery, mulch or any other materials used on any restoration site are weed free / screened. Monitor and control weeds during their establishment period to prevent spread.

5. Ensure all new infrastructure is planned in a way that protects and enhances natural areas. Avoid planting / maintaining turf in small strips of land less than 1 m wide between the pathway and the natural areas.

6. Ensure adequate planning is in place when considering the movement of people from street carparks to beach access areas – do not plant native plants somewhere where they will be easily damaged by public movement, as these areas will have a high likelihood of vandalism and require higher maintenance.

7. Make improvements to stormwater drain outlets discharging onto primary dune areas. This includes diversion and stormwater capture upgradient from the beach

and or bioengineering (e.g. brushing and or alternative methods) to minimise dune scour (where drain outputs are small).

8. Revegetation is recommended with tubestock and a variety of suitable local provenance species should be used. Cottesloe Coastcare's website provides a comprehensive species list and includes 72 original plant species that are local in Cottesloe

9. Select the species most appropriate to the hydrogeomorphological position. Use elevation profiles and slope orientation to ensure the selection that is most appropriate and will ensure planting success. Foredunes should contain *Spinifex hisuitus* and *Spinifex longifolius* which can occupy the lower slope of the primary dune and the Town should have an ongoing order at the nursery (e.g. 5 – 10,000 plants per annum) so that the spinifex belt can be maintained and or improved.

10. Ensure planting density is increased in the foredune or primary dune lower slope. Mark out young plants so that they can be easier to distinguish from young Marram Grass or Sea Wheat during the first two years of growth (e.g. Bamboo stake).

11. The selection of trees like *Casuarina equisetifolia* detracts from the natural beach setting. While trees are always a preferred option to shade structures, the incorporation of sustainable energy generating and unique in design (e.g. sculptural design) shade structures may offer a better solution for some exposed sites with seating. Alternatively, *Melaleuca lanceolata* offers a more natural option but should be grown to a larger size in the nursery and hardened off at the Towns depot prior to installation as a shade / street / carpark tree.

12. Increase knowledge of restoring coastal systems via ongoing training and development and engagement in on ground research.

13. Use only sustainable and biodegradable materials for slope stabilisation to avoid pollution and damage to wildlife (e.g. avoid the use of coir matting with plastic mesh backing).

14. Use experienced contractors with sufficient resources to ensure delivery of assigned tasks such as weed control.

15. Monitor the progress of work and implement improvements along the way. Liaise with CCA, research organisations and specialist consultants to develop the most appropriate and timely solutions.

16. Protect the natural heritage of the area, which include landforms and or remnant vegetation. E.g. limestone ridge behind the Cable Station.

17. Implement smaller projects in high-impact areas and maintain them well. This can include highly visible sites or sites with erosion issues before moving to larger areas. Always ensure an adequate maintenance budget is available before progressing with the restoration of new areas.

6.0 PROPOSED BUDGET FOR 10 YEAR TIMEFRAME

The Town has provided the proposed cost allocations for maintaining natural area sites between 2023/24 and 2032/33 to assist with budgeting requirements. The budget allocations are outlined in Table 3.

The proposed activities and cost allocations for restoring the John Black Dune Park which will be scheduled between 2023/24 and 2025/26 following the construction of the skate park are outlined in Table 4.

Table 3. Town of Cottesloe Natural Areas Proposed Budget for 2023 – 2033

Natural Areas Maintenance Works	Cost per annum	Year 1 - 2023/24 Proposed Sites	Year 2 - 2024/25 Proposed Sites	Year 3 - 2025/26 Proposed Sites	Year 4- 2026/27 Proposed Sites	Year 5 - 2027/28 Proposed Sites	Year 6 - 2028/29 Proposed Sites	Year 7 - 2029/30 Proposed Sites	Year 8 - 2030/31 Proposed Sites	Year 9 - 2031/32 Proposed Sites	Year 10 - 2032/33 Proposed Sites
Weed control works - contractor engagement for autumn and spring herbicide treatments	$ 36,000.00	All Sites - Coastal and Curtin Avenue	All Sites - Coastal and Curtin Avenue	All Sites - Coastal and Curtin Avenue	All Sites - Coastal and Curtin Avenue	All Sites - Coastal and Curtin Avenue	All Sites - Coastal and Curtin Avenue	All Sites - Coastal and Curtin Avenue	All Sites - Coastal and Curtin Avenue	All Sites - Coastal and Curtin Avenue	All Sites - Coastal and Curtin Avenue
Hand weeding and woody weed removal where spraying is not feasible (10 days with 2 staff). Note: inspect sites for priority weeding.	$ 12,000.00	Main Beach South Cottesloe	Grant Marine Park Grant Street Dune	Dutch Inn Cottesloe Native Garden Secret Gnome Garden	North Cottesloe Victoria Station/ Curtin Avenue	John Black Dune Park Victoria Station/ Curtin Avenue	Main Beach South Cottesloe	Secret Gnome Garden North Cottesloe	Grant Marine Park Grant Street Dune	Dutch Inn Cottesloe Native Garden	North Cottesloe Victoria Station/ Curtin Avenue
Bulbs Weed treatment - Black flag, Lachenalia and Freesias (4 days with two operators)	$ 5,000.00	Main Beach South Cottesloe Cottesloe Native Garden John Black Dune Park Grant Marine Park	Main Beach South Cottesloe Cottesloe Native Garden John Black Dune Park Grant Marine Park	Main Beach South Cottesloe Cottesloe Native Garden John Black Dune Park Grant Marine Park	Main Beach South Cottesloe Cottesloe Native Garden John Black Dune Park Grant Marine Park	Main Beach South Cottesloe Cottesloe Native Garden John Black Dune Park Grant Marine Park	Main Beach South Cottesloe Cottesloe Native Garden John Black Dune Park Grant Marine Park	Main Beach South Cottesloe Cottesloe Native Garden John Black Dune Park Grant Marine Park	Main Beach South Cottesloe Cottesloe Native Garden John Black Dune Park Grant Marine Park	Main Beach South Cottesloe Cottesloe Native Garden John Black Dune Park Grant Marine Park	Main Beach South Cottesloe Cottesloe Native Garden John Black Dune Park Grant Marine Park
Erosion Control - Where needed coir matting will be installed to stabilise the dunes (including dune blow outs)	$ 2,000.00	South Cottesloe (Vlamingh dunes)	North Cottesloe Dunes (Vera View)	South Cottesloe (Pearse Street)	North Cottesloe	Main Beach	South Cottesloe (Mudurup Rocks)	South Cottesloe (Mudurup Rocks)	North Cottesloe (north of Grant Street)	North Cottesloe (north of Grant Street)	Main Beach
Purchasing plants - 8,000 seedlings purchased at ~$2/plant for infill planting (including ongoing spinifex order for foredune planting) plus Coastcare's plants	$ 16,000.00										
Site Preparation by contractors - Auger 8,000 deep basin holes at both Town and Coastcare sites.	$ 8,000.00	Main Beach South Cottesloe (Vlamingh) Infill at various sites	South Cottesloe North Cottesloe Infill at various sites	South Cottesloe Victoria Station Infill at various sites	Grant Street Dunes North Cottesloe Infill at various sites	Main Beach North Cottesloe Infill at various sites	South Cottesloe (Mudurup Rocks) Infill at various sites	Secret Gnome Garden Dutch Inn Infill at various sites	South Cottesloe Infill at various sites	Grant Street Dunes Infill at various sites	North Cottesloe Infill at various sites
Planting by contractors - Plant 5,000 seedlings with fertiliser at Town's sites (volunteer planting at Coastcare sites).	$ 5,000.00	Main Beach South Cottesloe (Vlamingh) Infill at various sites	South Cottesloe North Cottesloe Infill at various sites	South Cottesloe Victoria Station Infill at various sites	Grant Street Dunes North Cottesloe Infill at various sites	Main Beach North Cottesloe Infill at various sites	South Cottesloe (Mudurup Rocks) Infill at various sites	Secret Gnome Garden Dutch Inn Infill at various sites	South Cottesloe Infill at various sites	Grant Street Dunes Infill at various sites	North Cottesloe Infill at various sites
Water new seedlings over the summer - 5,000 seedlings between December - March (2 waterings per month). Coastcare sites watered by Coastcare.	$ 6,000.00	Main Beach South Cottesloe (Vlamingh) Infill at various sites	South Cottesloe North Cottesloe Infill at various sites	South Cottesloe Victoria Station Infill at various sites	Grant Street Dunes North Cottesloe Infill at various sites	Main Beach North Cottesloe Infill at various sites	South Cottesloe (Mudurup Rocks) Infill at various sites	Secret Gnome Garden Dutch Inn Infill at various sites	South Cottesloe Infill at various sites	Grant Street Dunes Infill at various sites	North Cottesloe Infill at various sites
TOTAL COST PER ANNUM	**$ 90,000.00**										

Table 4. Town of Cottesloe Proposed Budget for John Black Dune Park Restoration Project

Financial Year	Proposed Activities – Soft Landscaping	Estimated costs	Budget available
2023/2024	Landscaping design (includes community consultation if required, Aboriginal liaison, seating nodes, water points for drink fountains and irrigation if required for lawn, water drainage patterns and any earthworks, pathways and universal access points, location of viewing platform)	$ 50,000.00	$ 80,000.00
	1st Staged Removal of Vic tea trees (carefully assessed with Coastcare to avoid unnecessary habitat destruction)	$ 4,000.00	
	Construct swales and other earthworks if required for water drainage	$ 5,000.00	
	Weed control (particular attention to the black flag) using manual and chemical methods	$ 5,000.00	
	Mulch @ 50mm Thickness across approx 1 ha (500m cubed) – free mulch from Town's stocks, spread with bobcat	$ 2,000.00	
	The first round of planting with 5,000 coastal native tubestock. Contractors to auger holes in preparation for volunteer planting events. Include tall tree species to allow early establishment.	$ 14,000.00	
2024/25	Additional mulching in areas to be planted - Mulch @ 50mm Thickness – free mulch from Town's stocks	$ 5,000.00	$ 80,000.00
	2nd Staged Removal of Vic tea trees (carefully assessed with Coastcare to avoid unnecessary habitat destruction)	$ 6,000.00	
	Plant 10,000 coastal native seedlings in mulched garden beds outside construction zones using contractors	$ 42,000.00	
	Summer watering is scheduled from November to March	$ 12,000.00	
	Weed control (particular attention to the black flag) using manual and chemical methods	$ 15,000.00	
2025/26	Plant buffer zones around construction areas and infill plant revegetation areas with 5,000 coastal native seedlings. Utlise contractors.	$ 20,000.00	$ 80,000.00
	Weed control (particular attention to the black flag) using manual and chemical methods	$ 10,000.00	
	Summer watering is scheduled from November to March	$ 10,000.00	
	Develop a "bush tucker" garden with signage re species and health benefits /medicinal uses	$ 40,000.00	
	Proposed Activities – Hard Landscaping		
2024/25	Install viewing platform and concrete pathways (including universal access pathways)	$ 60,000.00	$ 100,000.00
2025/26	Install seating, shade structures (if required) and interactive signage	$ 40,000.00	

Note: ongoing maintenance costs (i.e. weed control) of the John Black Dune Park area after 2026 will be absorbed into the Natural Areas budget.

Tables 3 and 4 supplied by Town of Cottesloe.

REFERENCES

Ecoscape (2008) Cottesloe Natural AreasManagement Plan – Final. Technical Report for Town of Cottesloe, 22nd September 2008.

Gadgil, R.L. (2006) A review of the use of Ammophilla arenaria on New Zealand Sand Dunes. CDVN Technical Bulletin No. 5

Keighery, B.J. (1994) Bushland Plant Survey. Wildflower Society of Western Australia.

Syrinx (2015) Town of Cottesloe NAMP Addendum 1. Technical Report for Town of Cottesloe, June 2015.

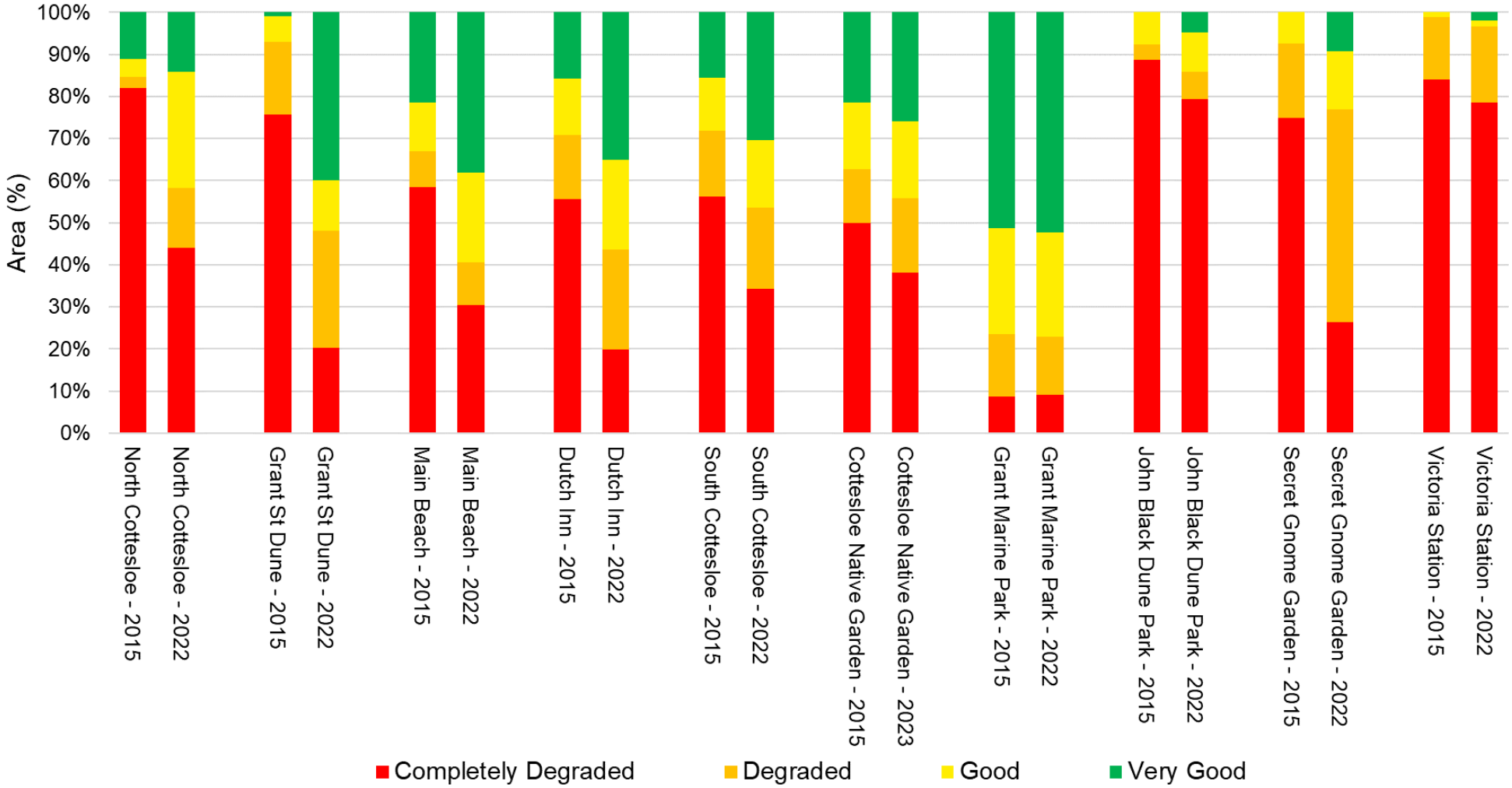
Town of Cottesloe (2022) John Black Dune Park Skate Park Masterplan https://www.cottesloe.wa.gov.au/council-meetings/ordinary-council-meeting/26-april-2022-ordinary-council-meeting/301/documents/1015-john-black-dune-masterplan.pdf

APPENDICES

Appendix 1 Assessment Graphs and Vegetation Condition Maps for 2022 Natural Areas Assessment

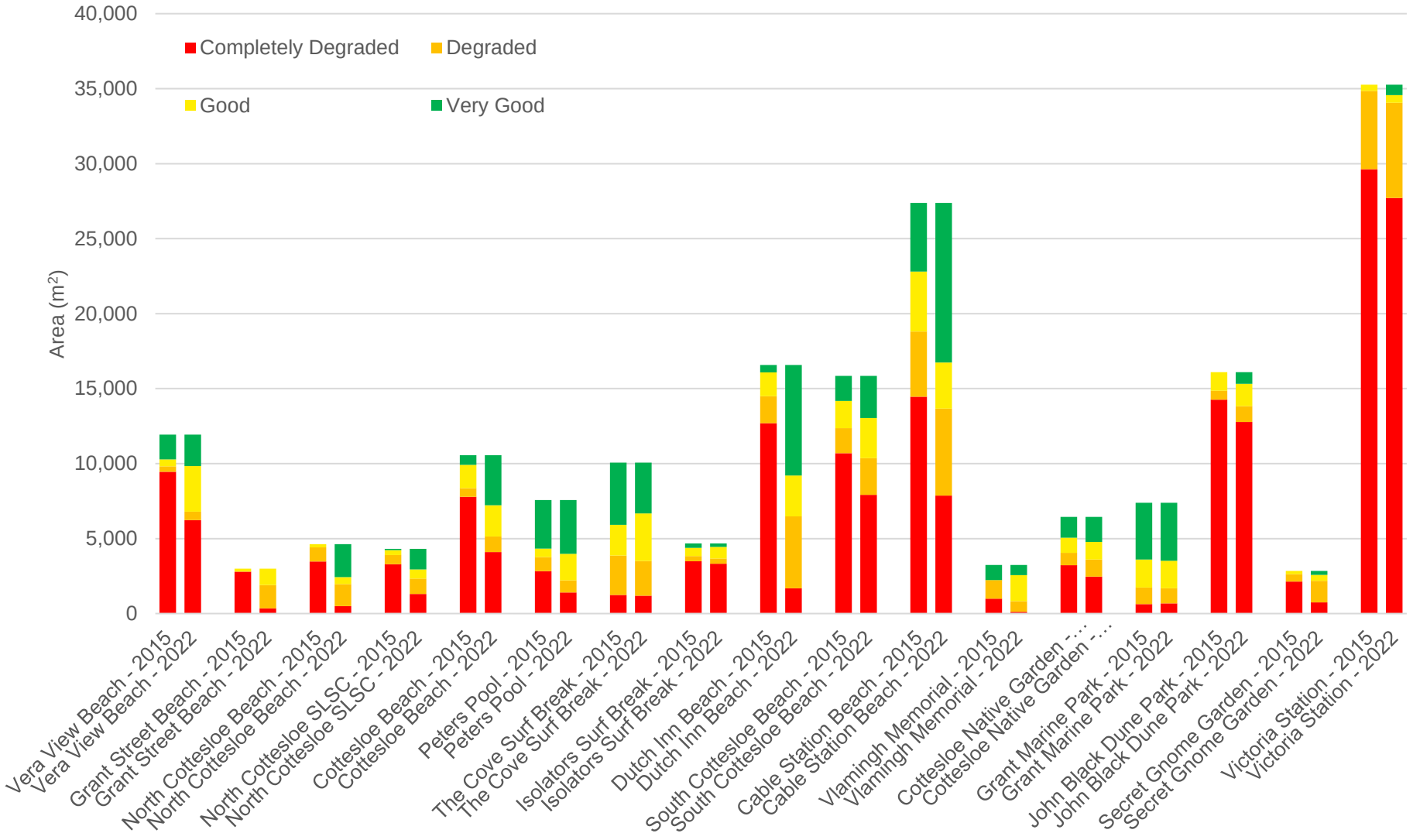
Common Natural Area Names as used by CCA and the Town

2015 – 2022 Vegetation condition change comparison for Natural Areas by common area names used by the CCA and the Town maintenance personnel

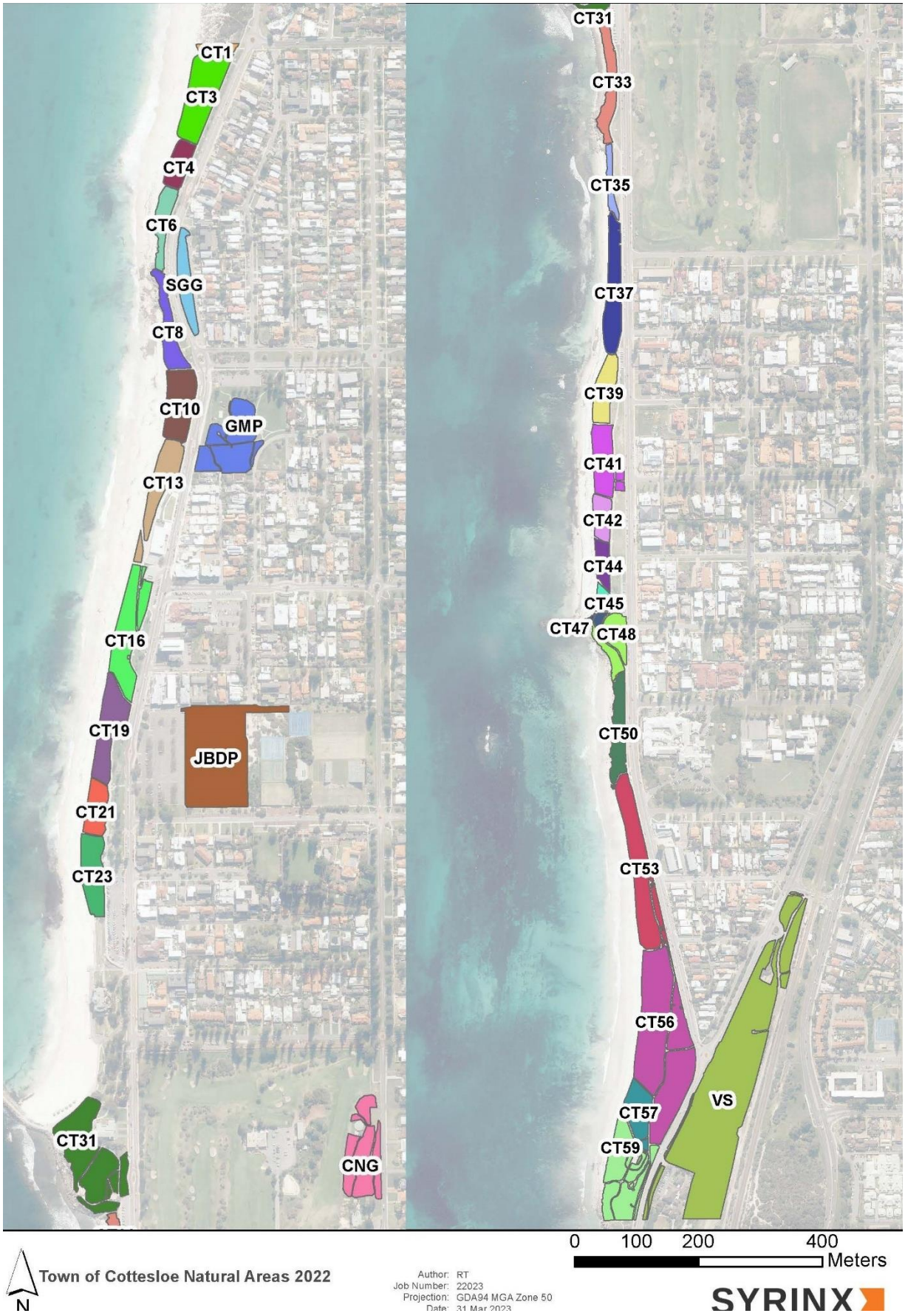


Natural Area Names as outlined on BEN signage

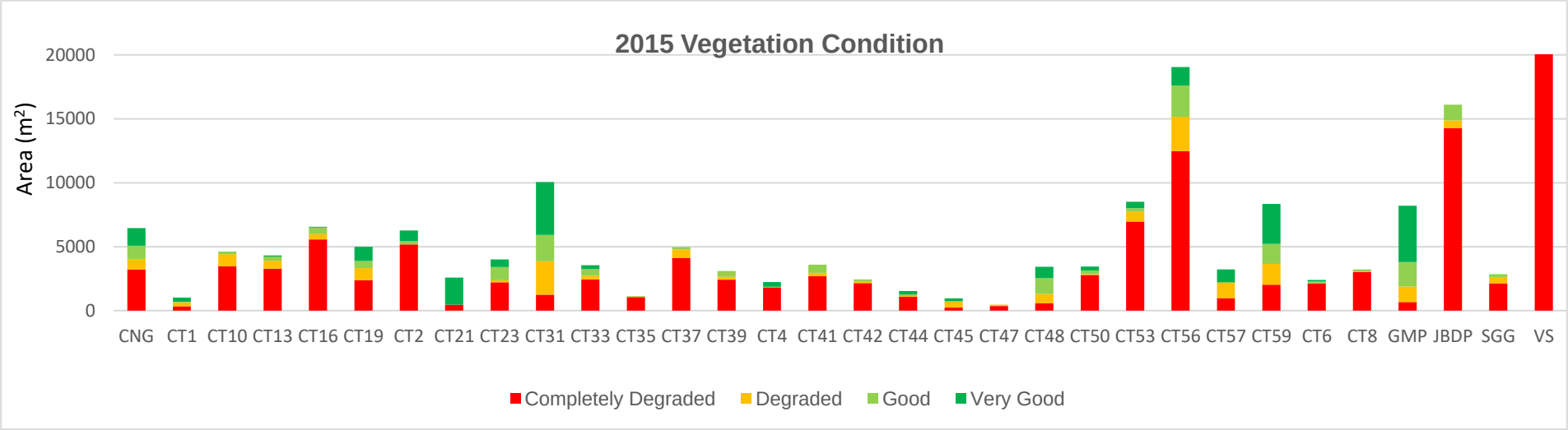
2015 – 2022 Vegetation condition change comparison for Natural Areas grouped by BEN signage area names

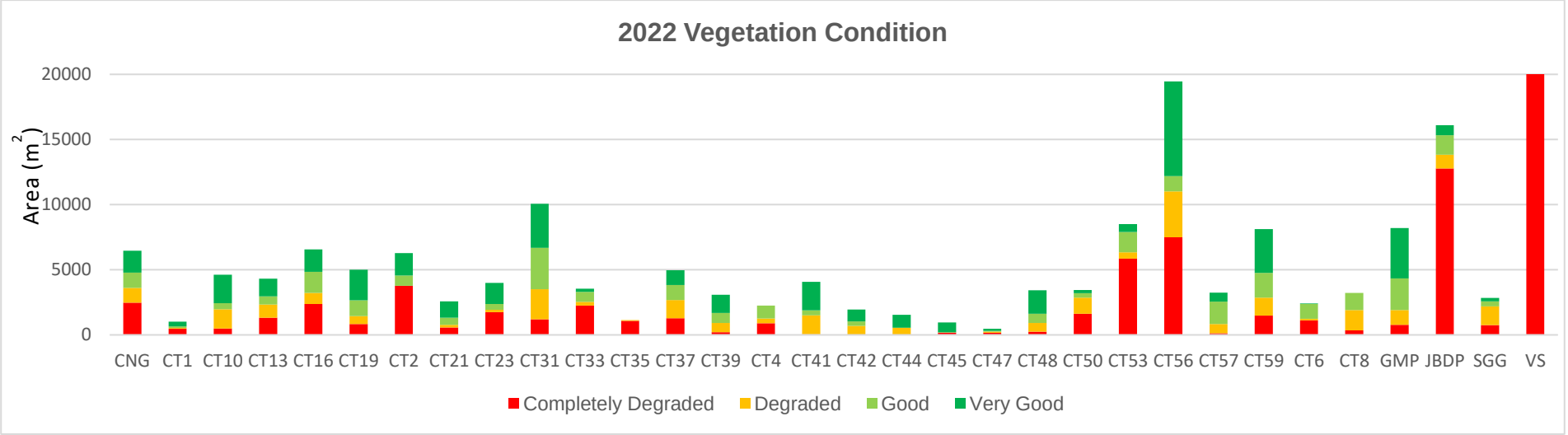


Natural Area Names after BEN Signage numbers (i.e. CT1 – CT59)



2015 – 2022 Vegetation condition change comparison for Natural Areas using BEN signage numbers (CT1 – CT59)





***NOTE**: Victoria Street area(m^2) is not fully shown due to the small scale of other sites – refer to previous graphs for details about this area.*

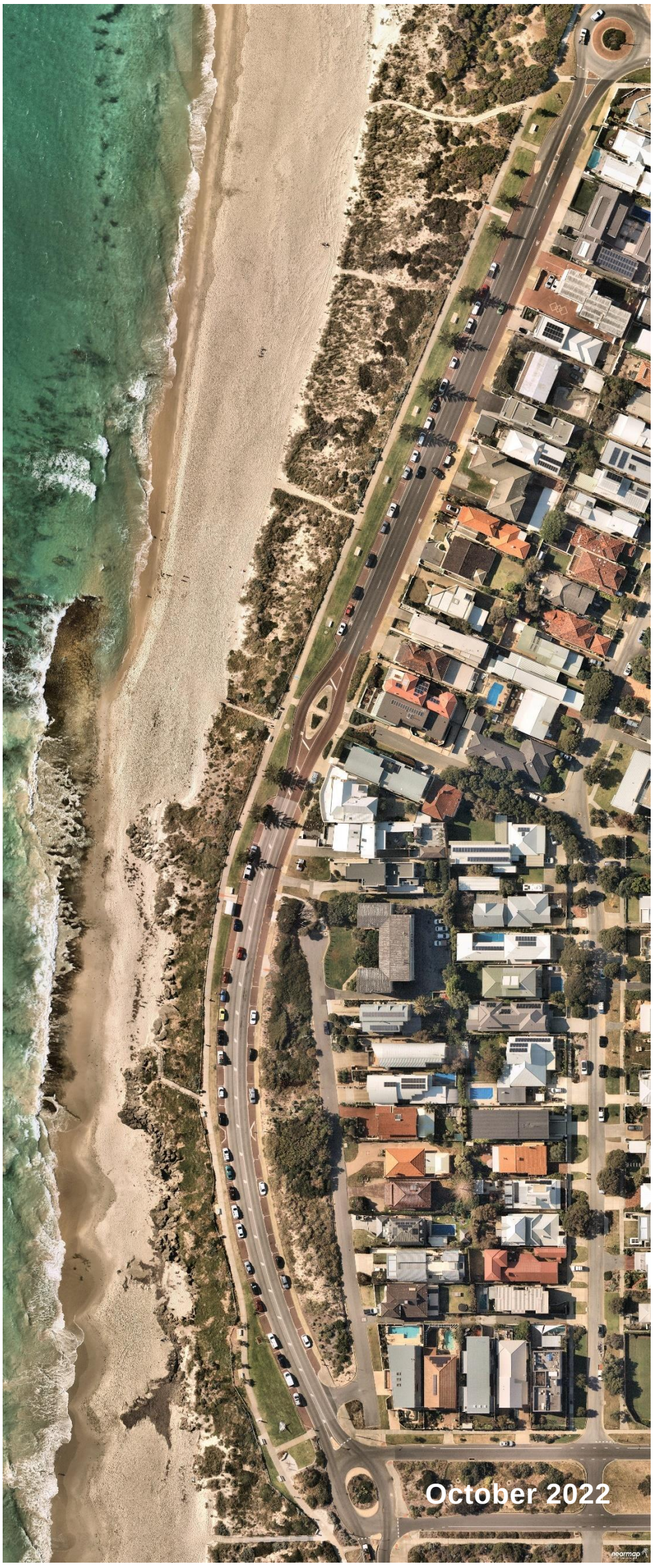
Appendix 2 Dominant and Weed Priority Weed Species Recorded Across Natural Areas

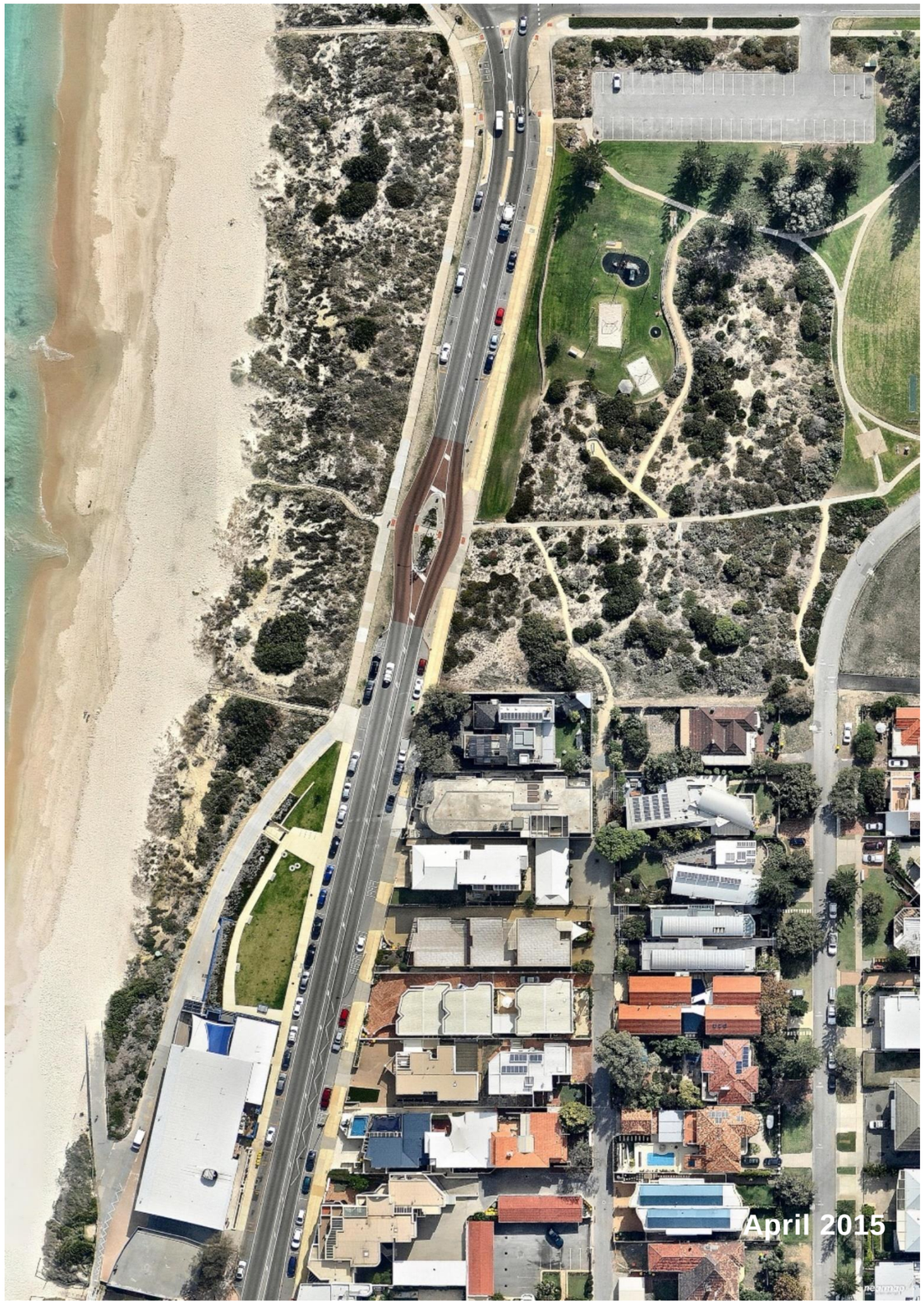
Species name	Common name	CT 1	CT 3	CT 4	CT 6	CT 8	CT 10	CT 13	CT 16	CT 19	CT 21	CT 23	CT 31	CT 33	CT 35	CT 37	CT 39	CT 41	CT 42	CT 44	CT 45	CT 47	CT 48	CT 50	CT 53	CT 56	CT 57	CT 59	SGG	JBDP	GMP	CNG	VS	Optimum treatment time	Control Options
Agave americana	Century Plant	■	■																														■	Nov - Jan	Dig out and/or hand remove small infestations. Stem inject into base of leaves 1 part Tordon®/5 parts diesel.
Ammophila arenaria	Marram Grass	■	■	■			■	■	■		■	■													■									Sep - Nov	Dig out small infestations (best in Mar - May). Alternatively spray with 1% Glyphosate + penetrant. Slashing in Autumn can make spraying easier - **Consider potential for erosion prior to doing this!** Requires ongoing manual removal and/or treatment of regrowth.
Arctotheca calendula	Cape Weed	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	Jun - Nov	Cut out small infestations, ensuring root is severed well below ground level to prevent re-sprouting from the crown. Spot spray 1% Glyphosate. A combination of chemical and physical control with follow up treatment provides optimal control.
Arctotis stoechadifolia	White Arctotis																														■			Mar - Oct	Try manually removing small/isolated populations. Spray with 1% Glyphosate
Argyranthemum frutescens	Marguerite Daisy																														■			All year	Hand pull small infestations.
Asparagus asparagoides	Bridal Creeper																										■						■	Jul - Aug	Spray 0.2 g metsulfuron methyl + Pulse® in 15 L water (or 2.5 - 5g /ha + Pulse®). Best results achieved when flowering.
Cenchrus clandestinum	Kikuyu				■	■		■		■			■	■									■				■	■			■	■	■	Nov - Jan	Spray with 1% Glyphosate or Fusilade® Forte at 16 ml/L + wetting agent or for generic fluazifop-p (212g/L active ingredient) 10ml/L + wetting agent. 2-3 sprays over a single growing season are often required.
Cynodon dactylon	Couch	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	Nov - Feb	Spray Fusilade® Forte at 13 ml/L + wetting agent or for generic fluazifop-p (212g/L active ingredient) 8mL/L + wetting agent when plants are small and beginning new growth, or 1% Glyphosate in late spring/summer and autumn when rhizomes are actively growing. In sensitive areas try painting runners or crowns with 50% Glyphosate. Follow-up is nearly always required.
Cyperus congestus	Dense Flat-sedge																																■	Jun - Aug	Spray with 1% glyphosate + Pulse®.
Echium plantagineum	Patterson's Curse																																■	May - Aug	Spot spray in late autumn/winter when most seed has germinated for the year with 0.5 g/10 L chlorsulfuron + wetting agent, this will also help prevent further germination. Glyphosate at 75 ml -100 ml is also effective
Ehrharta calycina	Perennial Veldt Grass		■																								■	■			■	■		Nov - Feb	For small infestations, cut out plants ensuring crown removal. Do not slash. Alternatively spray with Fusilade® Forte 13 ml/L or 6.5 L/ha + wetting agent on actively growing and unstressed plants. For generic fluazifop-p (212g/L active ingredient) 8ml/L or 4L/ha +wetting agent. Follow-up in subsequent years.
Ehrharta longifolia	Annual Veldt Grass	■																							■				■	■	■	■	■	Jul - Sep	Spot spray 1% Glyphosate.
Euphorbia paralias	Sea Spurge	■	■		■	■	■						■	■	■		■						■	■	■		■	■						Sep - Jan	Hand remove small isolated infestations, ensuring use of appropriate personal protective equipment and safety guidelines. When actively growing, spray with 50 mL Glyphosate (360 g/L) + 0.2 g metsulfuron + Pulse® in 10 L water.
Euphorbia terracina	Geraldton Carnation Weed												■										■		■			■				■	■	Jun - Aug	Logran® at 12.5 g/100L + the penetrant Pulse ® is very effective on adults and juveniles with little off target damage in coastal heathlands. Hand removal can stimulate germination of the soil seedbank. Ensure adequate personal protective clothing is worn to avoid contact with sap.
Ferraria crispa	Black Flag									■			■	■									■	■	■	■	■	■		■	■	■	■	Aug - Sep	Hand remove very small populations in degraded sites. Sift soil to find all corms. Spray 2,2 DPA 10 g/L + Pulse® when flowering. In degraded sites try Glyphosate 1% + metsulfuron methyl 0.2 g/15 L + Pulse®. Takes a number of years to control populations.
Freesia alba x leichtlinii	Freesia																								■							■	■	Jul - Aug	Spray metsulfuron methyl 0.2 g/15 L + Pulse® or 2.5-5 g/ha + Pulse®. Apply just on flowering at corm exhaustion.
Fumaria capreolata	White Fumitory	■				■							■	■											■	■	■	■	■			■	■	Jul - Sep	Spray metsulfuron methyl at 0.1 g/15 L (2.5 g/ha) + wetting agent or Glyphosate 0.5%.
Gazania linearis	Gazania		■							■			■										■	■	■	■	■	■						Apr - Jun	Manually remove isolated or small infestations prior to or at flowering. Spray plants until just wet with 5% Glyphosate or 4g of Lontrel 750 plus 25ml of Pulse in 10 L of water.
Gladiolus undulatus	Wild Gladiolus																																■	Jul	Spot spray metsulfuron methyl 0.2 g/15 L + Pulse® or 2.5-5 g/ha + Pulse®. Herbicide application should be just on corm exhaustion. Physical removal can result in spread of cormels.
Lachenalia bulbifera	Red Soldiers																														■			Aug - Sep	Spot spray metsulfuron methyl 0.2 g/15 L + Pulse® or 2.5-5 g/ha + Pulse®. Apply just on flowering at corm exhaustion. Physical removal can result in spread of bulbils.
Lachenalia reflexa	Yellow Soldiers																														■			July	Spot spray metsulfuron methyl 0.2 g/15 L + Pulse® (2.5g-5 g/ha). Read the manufacturers' labels and material safety data sheets before using herbicides.
Leptospermum laevigatum	Coast Tea Tree		■										■										■	■	■	■	■	■		■		■	■	Jul - Oct	Hand pull seedlings. Fell mature plants. Resprouting has been recorded in some areas. Where resprouting has been observed, apply 250 ml Access® in 15 L of diesel to bottom 50 cm of trunk (basal bark).
Lupinus angustifolius	Narrow-Leaf lupin																														■	■		Jul - Sep	Hand remove scattered plants. Spray dense infestations with metsulfuron methyl 0.1 g/15 L (2-3 g/ha) + wetting agent or spot spray Lontrel® 6 ml/10 L (300 ml/ha) + wetting agent to late flowering, this will prevent seed set.
Lupinus cosentinii	Blue Lupin																															■		Jun - Sep	Hand remove scattered plants prior to flowering. Spray dense infestations with metsulfuron methyl 0.1g/15 L (2-3 g/ha) + wetting agent. Larger areas can be treated with more selective herbicides such as 200 g/ha Lontrel® or 50 g/ha Logran® (based on 500 L of water/ha). For spot spraying use 4 g Lontrel® or 1 g Logran® in 10 L of water + wetting agent. Glyphosate is relatively ineffective.
Pelargonium capitatum	Rose Pelargonium	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	Jun - Oct	Hand pull isolated plants taking care to remove the entire stem as it can reshoot from below ground level. Spot spray metsulfuron methyl 5 g/ha + Pulse®.
Reichardia tingitana	False Sowthistle																																■	Jul - Sep	Spray with 1% Glyphosate prior to flowering
Schinus terebinthifolius	Brazilian pepper																															■	■	Dec - Mar	Hand pull seedlings ensuring removal of all root material. Stem inject older plants using 50% Glyphosate or basal bark with 250 ml Access® in 15 L of diesel to bottom 50 cm of trunk during summer. Avoid root disturbance until trees are confirmed dead.
Stenotaphrum secundatum	Buffalo grass							■		■																	■				■		■	Nov - May	Spray with 1% Glyphosate 2-3 times over a single growing season, alternatively spray Fusilade® Forte 13ml/L + wetting agent or for generic fluazifop-p (212g/L active ingredient) 8ml/L. Solarisation over warmer months can be useful for small, isolated infestations.
Tetragonia decumbens	Sea Spinach	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	Sep - Nov	Manually remove isolated or small infestations prior to flowering. 1%Tordon® or Grazon® are the likely to provide high levels of control.
Thinopyrum distichum	Sea Wheat					■		■	■	■	■												■		■									Sep - Nov	Dig out small infestations (best in Mar - May). Alternatively spray with 1% Glyphosate + penetrant. Slashing in Autumn can make spraying easier - **Consider potential for erosion prior to doing this but not as crucial as for Marrarm grass.** Requires ongoing manual removal and/or treatment of regrowth.
Trachyandra divaricata	Dune Onion Weed	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	Jun - Aug	Manually remove isolated or small infestations prior to flowering. Wipe with 50% Glyphosate solution before flowering. For dense infestations in degraded areas spot spray 0.4 g chlorosulfuron plus 25 ml wetting agent in 10 L of water when plants actively growing.
Tropaeolum majus	Garden Nasturtium																														■			April - July	Manually remove isolated or small infestations prior to flowering. Spray small germinants with 1% Glyphosate and wetting agent.

Appendix 3 Vegetation Condition Maps for October 2022 and April 2015 (Utilising 2022 Natural Areas Boundaries)

Appendix 4 Comparative 2015 – 2022 Aerial Images for Natural Areas


April 2015

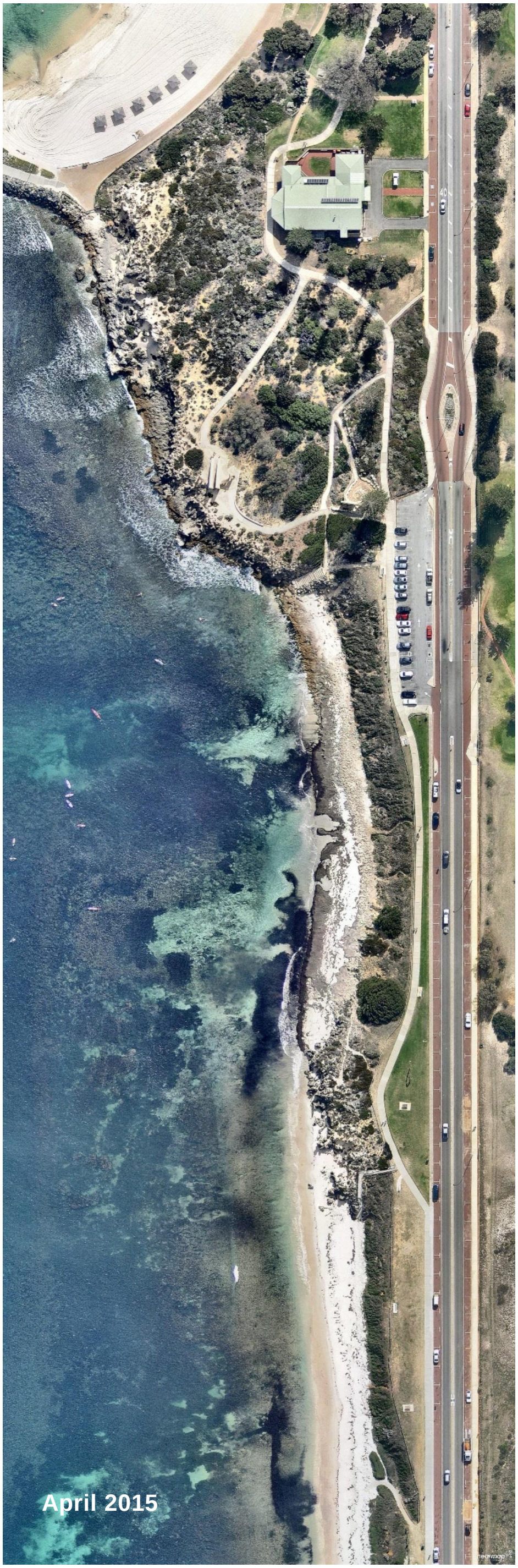

October 2022


April 2015


October 2022


April 2015
nearmap


October 2022
nearmap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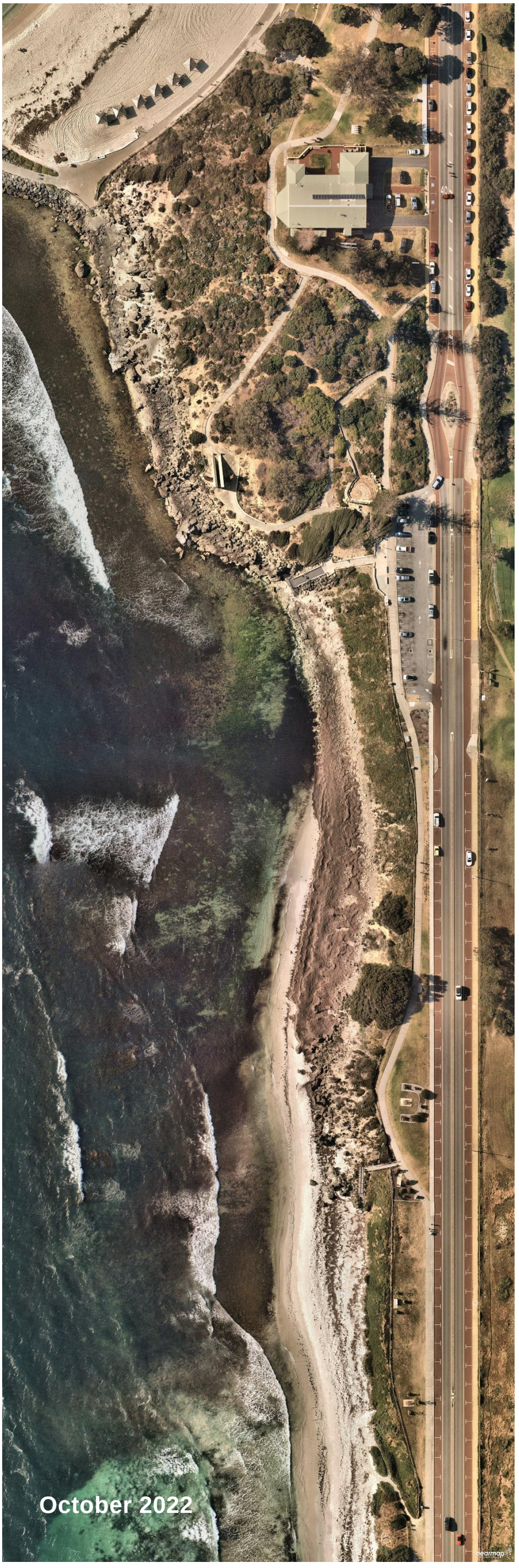
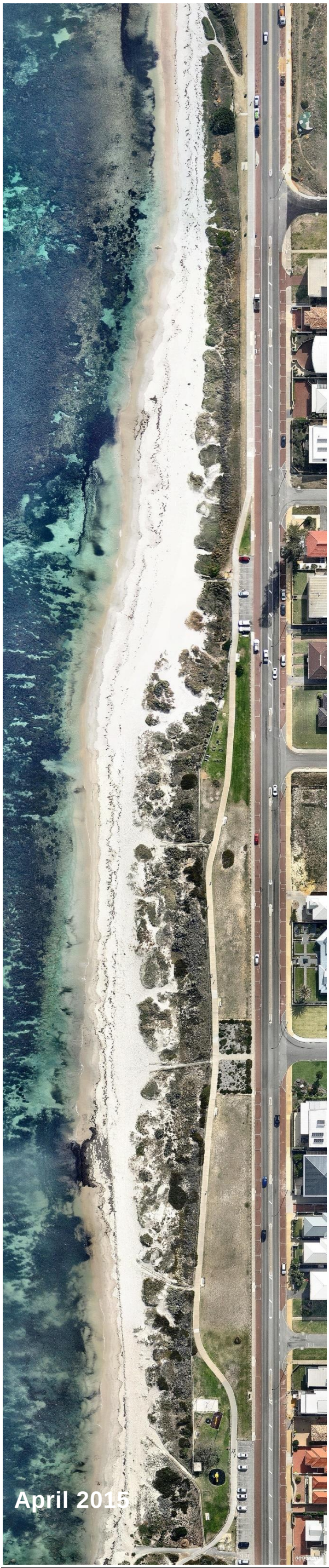

October 2022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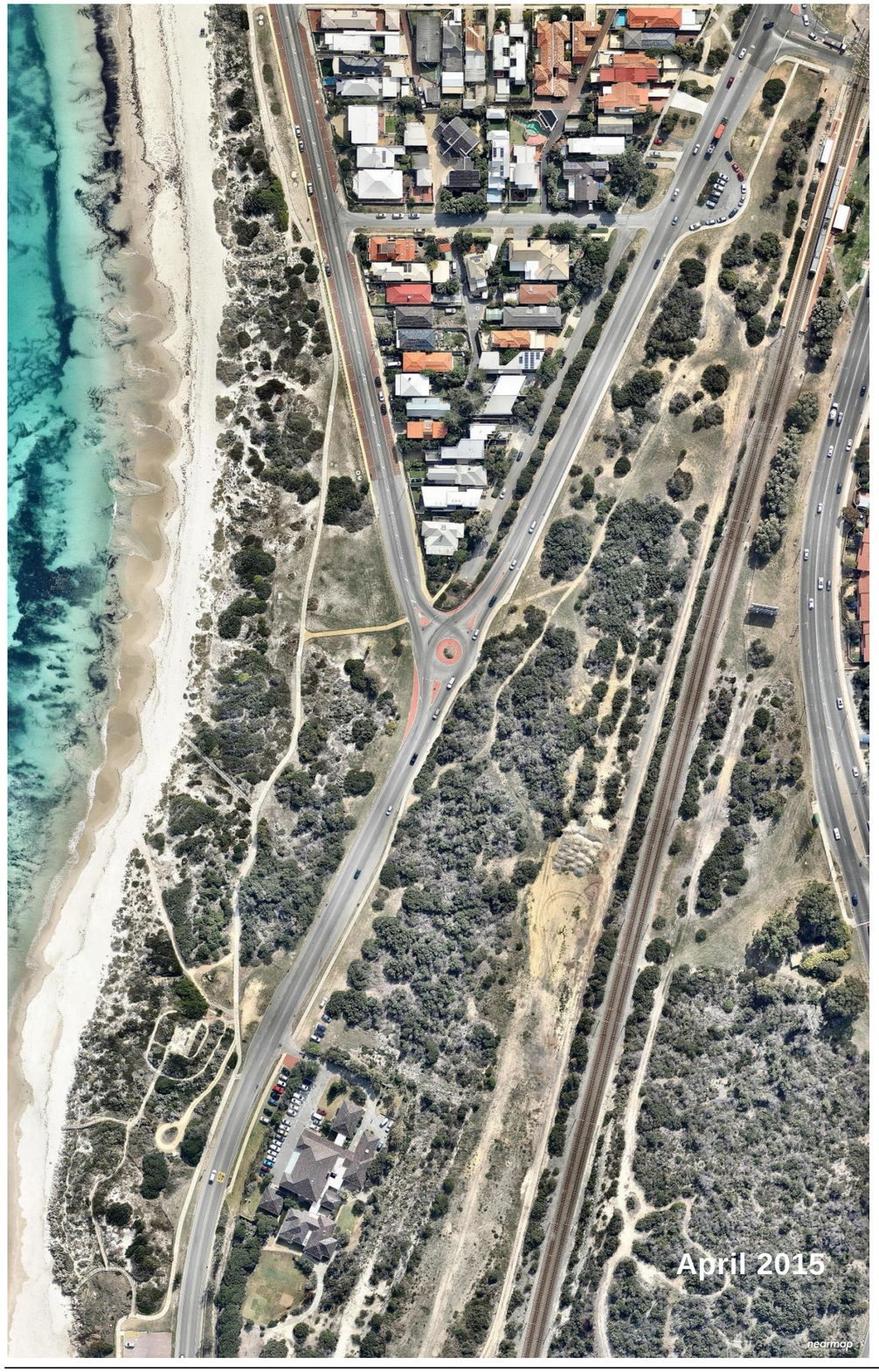
October 2022


April 2015
nearmap


October 2022
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