

# Vegetation Assessment of Jan Juc and Spring Creek, Jan Juc, Victoria: EVC Mapping, Assessment of Potential Net Gain and Landscape Planning Recommendations.



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**Beacon Ecological**

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**Cover Photos:**

*Background:* Spring Creek from Duffields Road.

*Inset:* Bower Spinach *Tetragonia implexicoma* within the study area, modified landscape looking west from Hoylake Avenue on Jan Juc Creek and Water Ribbons *Triglochin procera* from within the study area.

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## ABBREVIATIONS

BCS	Bioregional Conservation Status
DBH	Diameter at Breast Height
DSE	Department of Sustainability and Environment
ESO	Environmental Significance Overlay
EVC	Ecological Vegetation Class
FIS	Flora Information System
GPS	Global Positioning Systems
LOT	Large Old Tree
The Framework	<i>Victoria's Native Vegetation Management – A Framework for Action</i>
VLOT	Very Large Old Tree
VPO	Vegetation Protection Overlay

## DISCLAIMER

The author advises that the information presented in this report, including any advice, has been prepared with all due diligence and care, and based on the best available knowledge and research.

However the author takes no responsibility for any loss, injury or financial damage resulting from the reliance and/or application of advice provided in the report.

## SUMMARY

Beacon Ecological was commissioned by the Surf Coast Shire to undertake vegetation mapping, an assessment of potential Net Gain and to develop landscape planning recommendations regarding conservation values for sections of Jan Juc Creek and Spring Creek, Torquay, Victoria.

Information collected during vegetation mapping will be utilised by the Surf Coast Shire as baseline data to monitor and manage ecological values within the Jan Juc Creek and Spring Creek corridors. Furthermore, an assessment of any potential Net Gain available within the study area, which could be utilised as an offset by the Surf Coast Shire or interested third parties, has also been calculated.

Based on the vegetation mapping, community consultation and assessment of potential Net Gain, recommendations were made regarding the management of conservation values and potential restoration actions within Jan Juc Creek and Spring Creek. These recommendations will be considered alongside a range of other investigations such as environmental, cultural and social values in the development of future master plans for the two reserves.

This report also details revegetation guidelines applicable to the study area for use by the Surf Coast Shire and any relevant community groups, such as the Friends of Jan Juc Creek, Torquay Landcare Group and the Surf Coast and Inland Plains Network.

## **Methods**

The DSE Interactive Biodiversity Mapping tool and *Surf Coast Biodiversity Map* were utilised to assist in the determination of current and pre-1750 EVCs (i.e. prior to European settlement) within the study area. The entire study area was traversed on foot with EVCs, dominant species and general condition of all vegetation noted. Ecological Vegetation Classes present and any incidental records of significant flora species were mapped using aerial photography and a handheld GPS.

Any potential Net Gains (or offsets) available within the study area were calculated using the 'habitat hectare' and/or 'scattered tree' approach as described within the DSE Net Gain assessment methodology.

All landscape planning recommendations and revegetation guidelines were developed in consultation with relevant active community groups and in conjunction with a thorough literature review of current best-practice management approaches to creating and sustaining habitat linkages in urban environments.

## Vegetation Mapping

The survey revealed both the Jan Juc and Spring Creek corridors contained a mix of open mowed grassy areas, revegetation consisting of both indigenous and introduced species, and areas of remnant vegetation including aquatic and terrestrial communities.

Six remnant EVCs were identified and assessed under the habitat hectare methodology including. All identified EVCs within the study area are listed as Vulnerable or Endangered within the Otway Plain Bioregion.

## Potential Net Gain

Within the Jan Juc Creek Study Area there is a potential gain of 0.43 habitat hectares comprising:

- 0.11 habitat hectares of Very High conservation significance Tall Marsh;
- 0.15 habitat hectares of Very High conservation significance Swampy Riparian Woodland;
- 0.13 habitat hectares of High conservation significance Swampy Riparian Woodland;
- 0.01 habitat hectares of Very High conservation significance Coastal Alkaline Scrub;
- 0.03 habitat hectares of High conservation significance Plains Freshwater Sedge Wetland;
- 0.11 habitat hectares of High conservation significance Grassy Woodland;
- Three scattered Medium Old Trees; and,
- 13 Large Old Trees.

Within the Spring Creek study area there is a potential Net Gain of 1.66 habitat hectares comprising:

- 0.81 habitat hectares of Very High conservation significance Coastal Alkaline Scrub;
- 0.03 habitat hectares of High conservation significance Coastal Alkaline Scrub;
- 0.03 habitat hectares of Very High conservation significance Estuarine Wetland;
- 0.03 habitat hectares of Very High conservation significance Tall Marsh;
- 0.1 habitat hectares of Very High conservation significance Plains Brackish Sedge Wetland;
- 0.42 habitat hectares of Very High conservation significance Grassy Woodland;
- 0.36 habitat hectares of High conservation significance Grassy Woodland;
- One Very Large Old Trees; and,
- 15 Large Old Trees.

Within the study area there is approximately 1 hectare of revegetation, which has previously been implemented. If this revegetation meets the defined DSE standards, an additional potential gain of 0.22 habitat hectares is available.

### **Landscape Planning and Revegetation Guidelines**

Section 6 of this report discusses opportunities for the future management and enhancement of ecological values within the Jan Juc and Spring Creek corridors. Recommended management approaches include the designation of Conservation Zones, the installation of appropriate vegetation buffers along the creek systems and the revegetation of degraded areas using indigenous species.

To facilitate the revegetation of the Jan Juc and Spring creek corridors guidelines have been provided in Section 7 of this report detailing preferred species selection, planting guidelines and site maintenance and monitoring actions.

# 1 INTRODUCTION

## 1.1 Project Background

Beacon Ecological was commissioned by the Surf Coast Shire to undertake vegetation mapping, an assessment of any potential Net Gain and to prepare landscape planning recommendations regarding conservation values for sections of Jan Juc Creek and Spring Creek, Torquay, Victoria.

Information collected during vegetation mapping will be utilised by the Surf Coast Shire as baseline data to record and manage ecological values within the Jan Juc Creek and Spring Creek corridors.

As the study area is council freehold land, certain management actions which lead to the improvement of the quality and extent of native vegetation within these areas can be utilised as Net Gain credits to offset the removal of native vegetation elsewhere. The Surf Coast Shire can choose to use these credits (or offsets) or sell them to external third parties through the DSE Bush Broker Scheme – a native vegetation credit trading system. Therefore, an assessment of any potential Net Gain credits within the study area has been undertaken to identify available offsets.

The planning recommendations included within this report will contribute to the short, medium and long-term management of the study area and ensure that the protection and enhancement of environmental values underpin Council's future reserve planning processes. Furthermore, this report also details revegetation guidelines, including species lists and recommended Ecological Vegetation Classes (EVCs) for planting within the study area. This information is intended for use by the Surf Coast Shire and any relevant community groups, such as the Friends of Jan Juc Creek, Torquay Landcare Group and the Surf Coast and Inland Plains Network.

## 1.2 Scope of Works

The following tasks were completed for the Jan Juc and Spring Creek Assessment:

### *Vegetation Mapping*

- Current EVC mapping of the Surf Coast Shire was reviewed noting mapped areas and EVC description methodology;
- EVCs present within the study areas were mapped, capturing data in Mapinfo format that is compatible with the Surf Coast Shire GIS; and,



- The findings were documented in this report detailing project background, methodology, limitations, summary of results, photographs and summary of Bioregional Conservation Status (BCS) of mapped EVCs.

#### *Assessment of Potential Net Gain*

- A habitat hectare analysis was undertaken within the study area using the methodology as described in the *Vegetation Quality Assessment Manual* (DSE 2004). This assessment included mapping of all EVCs present with differing habitat hectare scores. Large and Very Large Trees were mapped both within native vegetation 'patches' and as 'scattered trees';
- The potential gains for a variety of management actions were calculated for any mapped 'patches' of native vegetation. The Department of Sustainability and Environment (DSE) guidelines *Scoring Gain from an offset – user instructions* (DSE 2006a), *Native Vegetation: Vegetation Gain Approach* (DSE 2006b) and the *DSE Gain Score Calculator* (DSE website [www.dse.vic.gov.au](http://www.dse.vic.gov.au)) were used to calculate habitat hectare gains within any potential offset areas; and,

#### *Landscape Planning*

- The current best practice management approaches to creating and sustaining habitat linkages in urban environments were reviewed;
- A set of guiding principles was formulated to support the methodology. This is a set of prescriptive standards that underpin mapping, minimum number of species and approach to ratios and revegetation.
- Site assessments were undertaken in conjunction with consultation from active community groups such as the Friends of Jan Juc Creek, Torquay Landcare Group and the Surf Coast and Inland Plains Network; and,
- The findings and recommendations from each of the above tasks are documented in this report, together with a series of maps illustrating ecological values, recommended Conservation Zones and appropriate EVC revegetation. All relevant mapping is also provided to the Surf Coast Shire in Mapinfo GIS format.

## 1.3 Study Area

The study area includes sections of two creeks within the townships of Jan Juc and Torquay: Jan Juc Creek and Spring Creek (Figure 1). The townships of Jan Juc and Torquay lie approximately 20 kilometers south of Geelong and 85 kilometres south-west of Melbourne.

The study area is located within the Otway Plain Bioregion and the management boundaries of the Surf Coast Shire and the Corangamite Catchment Management Authority.

### Jan Juc Creek

The Jan Juc Creek study area comprises council freehold land and extends in an east-west direction from the Jan Juc Surf Life Saving Club and includes two tributaries along Delview Court and Wattle Court in the west (Melway Reference 506 D10 to H10) (Figure 2a). The study area is bordered by the Jan Juc foreshore, residential housing and the Jan Juc Cricket Oval. The Jan Juc Creek study area currently supports a mix of vegetation including remnant terrestrial and aquatic vegetation, planted indigenous vegetation, planted exotic vegetation and open grassed areas for recreation and drainage use. There is also an overflow car park for the Jan Juc foreshore at the eastern end of the study area. Jan Juc Creek study area intersects Hoylake Avenue, Duffields Road, Torquay Boulevard and Domain Road.

Jan Juc Creek is currently zoned Public Park and Recreation (PPRZ) from The Jan Juc Lifesaving club to Torquay Boulevard and then west of Domain Road on the southern tributary. From Torquay Boulevard to the western end of the upper tributary the area is zoned as Public Conservation and Resource Zone (PCRZ), (Surf Coast Shire Planning Schemes Online 2006a).

No planning overlays pertaining to ecological values cover the Jan Juc Creek study area.

### Spring Creek

The Spring Creek study area comprises a mixture of council freehold land and land in the process of being transferred from private to council freehold land. This study area extends north from the Great Ocean Road and then west to Duffields Road (Melway Reference 506 J8 to G6)(Figure 2b). The study area is bordered by the Torquay Football Oval, residential housing and grazing paddocks. The Spring Creek study area currently supports a mix of vegetation including remnant terrestrial and aquatic vegetation, planted indigenous vegetation, planted exotic vegetation and wetland areas. The southern portion

of the Spring Creek study area is currently zoned Public Conservation and Resource Zone (PCRZ) while the remainder is Residential Zone (RZ1). However any RZ1 areas within the study area are currently being transferred to the Surf Coast shire for rezoning.

An Environmental Significance Overlay (*ESO1 - Wetland and Associated Dryland Habitat Protection*) currently covers the Spring Creek study area under the current Surf Coast Shire Planning Scheme. Much of Spring Creek is also covered by a Floodplain Overlay (FO) and the surrounds are covered by a Land Subject to Inundation Overlay (LSIO), (Surf Coast Shire Planning Scheme Online 2006a).

## 2 METHODS

### 2.1 Background Information Review

Ecological Vegetation Class mapping from the DSE Interactive Biodiversity Mapping tool (DSE 2009a) and *Surf Coast Biodiversity Map* (DSE 2007a) were used to assist with the determination of current and pre-1750 EVCs (i.e. prior to European settlement) within the study area.

Plant taxonomy follows the Flora Information System (FIS) and the *Census of the Vascular Plants of Victoria* (Walsh and Stajsic 2007). Vegetation classification and community titles follow the DSE EVC benchmark system (DSE 2009b).

Other relevant literature, such as the Spring Creek Catchment Plan (Spring Creek Management Committee 2003), *Biodiversity Action Planning – Landscape plan for Gherang Zone, Otway Plain Bioregion* (Grant *et al.* 2003) and previous flora and fauna surveys, Net Gain assessments and Offset Plans (Moulton and Spittle 2007, Costello 2007; Kimber *et al.* 2001). A species list was compiled from previous flora surveys and is listed in Appendix 3.

Any DSE published documents can be found on the DSE website ([www.dse.vic.gov.au](http://www.dse.vic.gov.au)).

### 2.2 Vegetation Mapping

The entire study area was traversed on foot with the EVC, dominant species and general vegetation condition noted (See Appendix 1 for Vegetation Condition descriptors). Ecological Vegetation Classes present and any incidental records of significant flora species were mapped using aerial photography and a handheld GPS unit if required.

For existing remnant vegetation to be classified as an EVC, vegetation must meet condition thresholds detailed in the DSE *Vegetation Quality Assessment Manual* (DSE 2004). These are described as:

- An area of vegetation, with or without trees, where less than 75% of the total understorey vegetative cover is considered weeds or non-native plants; OR
- A group (at least three) of native trees where the canopy cover is at least 20%.

For each study area, a description of any ecological values including photo points with GPS locations, EVCs, dominant species and general vegetation

condition is provided. Maps for the study area illustrating the likely pre-1750 EVC mapping, and the current extent of EVCs are also provided.

## 2.3 Assessment of Potential Net Gain

### Net Gain

Victoria's Native Vegetation– A Framework for Action (the Framework), (NRE 2002) establishes the strategic direction for the protection, enhancement and revegetation of native vegetation across the state. Reference to the Framework in the Planning Scheme is made in State Planning Policy Framework Clause 15.09 (Conservation of Native Flora and Fauna) and Particular Provisions Clause 52.17 (Native Vegetation) indicating that the Framework is to be considered when assessing any proposals involving native vegetation clearance.

The primary goal of the Framework is:

'A reversal, across the entire landscape of the long-term decline in the extent and quality of native vegetation, leading to a Net Gain.' (NRE 2002)

Net gain is when overall gains in native vegetation are greater than overall losses and where individual losses are avoided where possible. Permitted clearance of vegetation must be offset in a way that adequately addresses the future impacts of such clearance.

In applying the Net Gain policy, there are **three key steps** for land managers and owners to address when considering vegetation clearing:

1. **Avoid** adverse impacts, particularly through vegetation clearance;
2. If impacts cannot be avoided, **minimise** impacts by careful planning, design and management; and,
3. If vegetation clearing must occur, the clearing must be **offset**.

The study area was surveyed to determine any potential Net Gain available which could be used as offsets for the Surf Coast Shire or traded with interested third parties as offset credits.

To calculate any potential Net Gain available within the study area, the Net Gain assessment methodology as described by DSE must be followed (DSE 2007). Under the Net Gain assessment methodology there are two ways in which native vegetation can be categorised and assessed according to *Victoria's Native Vegetation Management: A Framework for Action (NRE 2002)*(the Framework:) the 'habitat hectare' and/or 'scattered tree' approach.

## 1. Patches of remnant native vegetation –‘habitat hectares’

The first assessment methodology relates to patches of remnant native vegetation. According to DSE habitat hectare assessment methodology, a remnant patch of native vegetation is defined as:

An area of vegetation, with or without trees where less than 75% of the total understorey *vegetative* cover is considered weeds or non-native plants; OR

A group (at least three) of trees where the canopy cover is at least 20% (DSE 2007).

A patch of native vegetation is able to be assessed using the habitat hectare methodology as described in the *Vegetation Quality Assessment Manual* (DSE 2004). This is a ten component scoring system that incorporates measurements such as presence of mature trees (Large Old Trees and/or Very Large Old Trees), variety of lifeforms, weediness and species recruitment against predetermined EVC benchmarks. These measurements are considered in conjunction with the size of the assessed area to give one score which reflects the quality and quantity of native vegetation. Conservation significance for any patches of native vegetation can then be calculated using EVC BCS and the Framework or relevant Regional Native Vegetation Plans. In this case the relevant Regional Native Vegetation Plan is the *Corangamite Native Vegetation Plan 2003 – 2008* (CCMA 2005).

The Framework also recognises that mature trees are important environmental assets within patches of remnant native vegetation. As such, mature trees located within patches or remnant vegetation, assessed as Large or Very Large Old Trees according to the relevant EVC benchmark, form an important component of a habitat hectare assessment.

## 2. Remnant mature trees over a degraded understorey – ‘scattered trees’

The second assessment methodology relates to remnant mature trees over a degraded understorey. According to DSE the definition of a scattered tree is:

Where native canopy trees are located within areas where at least 75% of the total understorey vegetative cover is weeds or non-native plants and the overall canopy cover for a group (at least three) is less than 20% (DSE 2007).

Each scattered tree is assessed and classified based on the Diameter at Breast Height (DBH, the diameter of the tree measured at 1.3 metres above the

ground). The tree is then classified as a 'Smaller Tree', 'Medium Old Tree', 'Large Old Tree' or 'Very Large Old Tree' according to the appropriate EVC benchmark and the Framework or Regional Native Vegetation Plan. Offsets for any scattered trees proposed to be removed can then be calculated using the 'scattered tree' offset ratios in the Framework and/or the relevant Regional Native Vegetation Plans.

Vegetation that is not a remnant patch or scattered tree should be treated as '**degraded treeless vegetation**' and is not assessable under the Framework.

### **Net Gain Offsets**

Under the Framework, offsets are required to compensate for any permitted loss of native vegetation in order to achieve a Net Gain as per the principle of the Net Gain policy. Offsets must be of an ongoing and secure nature and may be on or off the property where the vegetation loss is proposed. Offsets may be areas of existing native vegetation that are protected and managed or areas of land that are protected and revegetated. Typically, proposed offsets are detailed in an Offset Management Plan.

In this instance, the Surf Coast Shire is using the habitat hectare assessment to determine what potential gains may be achieved within the study area. These potential gains (or offsets) may be utilised by the Surf Coast Shire for any future vegetation clearance associated with council works or by external third parties.

### **Like for like rules**

When identifying appropriate offsets, the quality and quantity of the offset must be commensurate with the vegetation lost. As such, *like for like* rules as per Appendix 4 of the Framework must be followed to ensure tradeoffs between the loss of higher significance vegetation and replacement/protection of lower significance vegetation does not occur.

### **Calculating Gains within Offsets**

Once an offset site has been selected, management actions must be developed, established and implemented over a ten-year period to achieve a gain in vegetation quality. The vegetation is then assessed and gains are calculated, in habitat hectares, for the 10-year management period. This amount of habitat hectare gain must equal or exceed the habitat hectare loss for any proposed vegetation clearance. The *DSE Gain Score Calculator* (DSE

website [www.dse.vic.gov.au](http://www.dse.vic.gov.au)) has been used to calculate any habitat hectare gains within offset areas.

Four types of gain are available: 1) Prior Management Gain, 2) Security Gain, 3) Maintenance Gain and 4) Improvement Gain. However not all types of gain are available for all offset areas. The DSE guidelines *Scoring Gain from an offset – user instructions* (DSE 2006a) and *Native Vegetation: Vegetation Gain Approach* (DSE 2006b) explain the four types of gain and the offset process in more detail.

### Gains from Revegetation

Offsets can be achieved through revegetation that meets the defined DSE standard (refer to *Revegetation Planting Standards: A guide to establishing native vegetation for net gain accounting* DSE (2006c). Gains through revegetation come from three categories; 1. Replacing lifeforms relevant to the appropriate EVC; 2. Reinstatement of fallen timber for fauna habitat, and; 3. Landscape context.

1. Replacing EVC lifeforms: For revegetation which achieves defined DSE EVC standards relating to lifeforms to be introduced, species densities, target densities etc. a gain of **seven habitat hectare points** per hectare is available.

2. Reinstatement of fallen timber: For the replacement of logs and fallen timber (for timber to qualify as a log it must have a diameter greater than 20 centimeters) a score of **up to five habitat hectare points** per hectare is available.

3. Landscape context: The potential landscape context gain depends on the width (minimum of 10 meters for riparian revegetation not including adjoining vegetation), shape, connection to other native vegetation and context of the revegetation. The potential gains for this habitat component are between **three and 10 habitat hectare points** per hectare. Considering the nature and size of most revegetation projects within the study area, a landscape context score of five is assumed achievable from revegetation within the study area.



**Table 1 – Summary of potential gains from revegetation**

Habitat component	Potential gain score/ha (habitat hectare points)	Notes
Potential EVC lifeform replacement and fallen timber reinstatement gain/ha	12	This score includes the reinstatement of the EVC lifeforms, benchmark length of logs and fallen timber.
Potential landscape context gain/ha	5	This is a likely score given the nature (size, position, connection to surrounding vegetation remnants etc) of revegetation projects implemented within the study area.
<b>Total revegetation gain/ha</b>	<b>17</b>	This is the total gain each revegetation area within the study area is likely to achieve, however each site may vary slightly and require an assessment by DSE staff. All revegetation efforts must meet DSE standards to qualify as a gain (DSE 2006c)

As such any areas within the study area that are to be revegetated are assumed to be able to create a potential gain of **17 habitat hectare points** per hectare. Each revegetation area may vary slightly and require an assessment by DSE staff. All revegetation efforts must meet DSE standards at the end of a ten-year period to qualify as a gain (DSE 2006c).

### Offset Monitoring and Assessment

Offsets are to be reported on to DSE over the ten year period that they are improved according to conditions set out in any offset plans. DSE is currently in the process of implementing a system to record and track all registered offsets to ensure that any required gains are achieved.

## 2.4 Landscape Planning

A thorough literature review of the current best-practice management approaches to creating and sustaining urban habitat linkages was undertaken. From this review, a set of guiding principles was formulated detailing prescriptive revegetation standards including minimum number and ratios of species.

Study area assessments were undertaken in consultation with relevant active community groups, such as the Friends of Jan Juc Creek, Torquay Landcare Group and the Surf Coast and Inland Plains Networks.

Areas suitable for revegetation as part of linkages were identified using indigenous species from appropriate EVCs.

## 2.5 Limitations

The investigation was undertaken during winter (July/August), which is not considered an optimum survey time for many flowering flora species particularly as the study area is currently experiencing prolonged drought conditions. As such, many species may not have been observed or identified to species level. Additionally, vegetation within parts of the study area was recently slashed or grazed which further reduced the identification of some flora to the species level.

Ecological Vegetation Classes are often not clearly delineated and in most cases the change from one EVC to another occurs across a gradient where the vegetation is a complex of both EVCs. In these situations EVC boundaries have been mapped on a best fit approach and vegetation has been allocated to EVCs with the greatest affinities. Further, the study area has been subject to extensive revegetation in the past, and in some instances determining revegetated areas from remnant areas was difficult.

Ecological assessments typically provide a sampling of the ecological values present within an area at a given time. As such, additional species may be detected with a prolonged time in the field or if surveys were undertaken during more favorable seasonal conditions (spring).

A full survey including a detailed flora list was beyond the scope of this investigation, however a compilation of species identified in previous studies within the study area and adjacent areas has been included (See Appendix 3).

The survey effort and review of existing relevant information is considered sufficient to provide an assessment of the ecological assets of the study area and make subsequent recommendations.

## 3 VEGETATION MAPPING

### 3.1 Vegetation Mapping Jan Juc Creek

#### 3.2.1 Pre-1750 Maps

Pre-1750 vegetation mapping, managed by DSE, is typically undertaken at a scale of 1:100,000 and gives an indication of the dominant EVCs likely to be present only. Pre-1750 DSE mapping indicates that the Jan Juc study area is likely to have supported two main EVCs prior to European settlement. These EVCs include Grassy Woodland (EVC 175) which is thought to have covered the bulk of the Jan Juc Creek system with Shrubby Dry Forest (EVC 21) at the western end.

#### 3.2.2 Current Assessment

Broad scale 2005 EVC mapping, also managed by DSE (DSE 2009a) and the *Surf Coast Biodiversity Map* (DSE 2007a), indicate that that the study area is devoid of remnant native vegetation. On inspection, the survey revealed a mix of open mowed grassy areas, revegetation consisting of both indigenous and introduced species, and areas of remnant vegetation including aquatic and terrestrial communities (Figures 2a, 3a and 3b). Remnant EVCs present and their BCS include:

*Coastal Alkaline Scrub (EVC 858, BCS Endangered)*: one small patch at the eastern end of the study area adjacent to the golf course.

*Tall Marsh (EVC 21, BCS Vulnerable)*: scattered patches within wetter areas of the creekline.

*Plains Freshwater Sedge Wetland (899, BCS Vulnerable)*: patches of open wetland between Hoylake Avenue and Torquay Boulevard.

*Grassy Woodland (EVC 175, BCS Endangered)*: patches of varying quality scattered along the creekline with some larger areas around the Jan Juc Cricket Oval.

*Swampy Riparian Woodland (EVC 83, BCS Endangered)*: one large patch west of Domain Road on the upper reach and another large patch west of the Jan Juc Cricket Oval.

*Indigenous Revegetation (No relevant EVC or BCS):* revegetation patches are scattered through the centre of the study area between Duffields Road and Torquay Boulevard. Supplementary revegetation has also been undertaken in several areas of remnant vegetation.

### 3.2.3 Vegetation Condition

Vegetation within the Jan Juc Creek corridor is of varying condition with the majority considered to be in poor to moderate condition due to low native species diversity and a high cover of weed species. Areas cleared of native vegetation are highly modified and support a mix of introduced flora species and are considered to be in poor condition. See Section 3.3 and the habitat hectare assessments in Section 3.4 for further information regarding vegetation condition.

## 3.2 Vegetation Mapping Spring Creek

### 3.2.1 Pre-1750 Maps

Pre-1750 DSE mapping shows the Spring Creek study area is likely to have supported two main EVCs prior to European settlement. These include Coastal Alkaline Scrub (EVC 858) from the estuary system south of the Great Ocean Road to approximately 400 meters east of Duffields Road where it becomes Swampy Riparian Woodland (EVC 83). Grassy Woodland (EVC 175) was shown to border this area prior to European settlement.

### 3.2.2 Current Assessment

Broad scale 2005 DSE EVC mapping (DSE 2009a), Moulton and Spittle (2007) and the *Surf Coast Biodiversity Map* (DSE 2007a) indicate that the study area supports patches of Coastal Alkaline Scrub in the south with patches of Swampy Riparian Woodland and Grassy Woodland at the northern end of the study area. The survey revealed a mix of open mowed grassy areas, revegetation of both indigenous and introduced species and areas of remnant vegetation including aquatic and terrestrial communities (See Figures 2b, 3c, 3d and 3e). EVCs present within the Spring Creek study area and their Bioregional Conservation Significance (BCS) include:

*Estuarine Wetland (EVC 10, BCS Endangered):* Small patch on the west side of the creek in the south of the study area.

*Coastal Alkaline Scrub (EVC 858, BCS Endangered)*: Located on both sides of the creek up until the creek bends to the west. Areas of this EVC also display affinities with Estuarine Wetland however it was considered to be more closely aligned with Coastal Alkaline Scrub.

*Grassy Woodland (EVC 175, BCS Endangered)*: Located in drier, raised areas along the creek.

*Plains Brackish Sedge Wetland (EVC 891, BCS Vulnerable)*: A relatively intact wetland of this EVC exists at the end of Spring Valley Drive.

*Indigenous Revegetation (No relevant EVC)*: On the western side of the creek there are artificial stormwater wetlands that have been revegetated with an assortment of indigenous species. Areas of terrestrial revegetation also exist on the western side of the creek towards the south of the study area.

### 3.2.3 Vegetation Condition

Vegetation within the Spring Creek study area is of varying condition. However, the majority of native vegetation is considered to be in moderate condition due to a fair native species diversity and a moderate cover of weed species. Some areas are considered to be in good condition, such as sections of Coastal Alkaline Scrub, Plains Brackish Sedge Wetland and Grassy Woodland. Areas cleared of native vegetation are highly modified and support a mix of native and introduced flora species and are considered to be in poor condition. See Section 3.3 and the habitat hectare assessments in Section 3.4 for further information regarding vegetation condition.

## 3.3 Vegetation Descriptions

### *Coastal Alkaline Scrub (EVC 858, BCS Endangered)*

The Coastal Alkaline Scrub EVC present within the study area is dominated by Moonah *Melaleuca lanceolata* with scattered occurrences of native shrubs such as Coast Beard Heath *Leucopogon parviflorus*, Boobiella *Myoporum insulare*, Prickly Moses *Acacia verticillata*, Golden Wattle *Acacia pycnantha* and Gold Dust Wattle *Acacia acinacea*. In drier areas, scattered Bellarine Yellow Gums *Eucalyptus leucoxylon* subsp. *bellarinensis* were noted. The understory supports a mix of native and introduced species. Native understorey species include Seaberry Saltbush *Rhagodia candolleana*, Coast Flax Lily *Dianella revoluta* var. *brevicaulis*, Blue Tussock Grass *Poa poiformis*, Bower Spinach *Tetragonia implexicoma*, Chaffy Saw-

sedge *Gahnia filum*, Australian Salt Grass *Distichlis distichophylla* and Sea Rush *Juncus kraussii*. This EVC varied in condition from moderate to good with areas of moderate condition supporting infestations of introduced species such as Boxthorn *Lycium ferocissimum*, Cocksfoot *Dactylis glomerata*, Soursob *Oxalis pes-caprae*, Panic Veldt Grass *Ehrharta erecta*, Annual Veldt Grass *Ehrharta longifolia*, Ribwort *Plantago lanceolata*, Bridal Creeper *Asparagus asparagoides*, and Bellarine Pea *Polygala myrtifolia*. Plate 1 shows an example of Coastal Alkaline Scrub from the study area.



**Plate 1: Coastal Alkaline Scrub from Spring Creek**

### **Tall Marsh (EVC 21, BCS Vulnerable)**

Tall Marsh occurs within the creekline and water logged areas in the Jan Juc Creek study area and is generally of good condition (Plate 2). This EVC generally supports low levels of floristic diversity which is the case of the examples within the study area. The dominant species is Common Reed *Phragmites australis* (Cumbungi *Typha* sp. in some areas) with scattered native species such as Water Ribbons *Triglochin procerum*, Sea Rush, Creeping Brookweed *Samolus repens*, Common Spike-Rush *Eleocharis acuta*, Swampweed *Selliera radicans*, Australian Salt Grass, Streaked Arrow Grass *Triglochin striatum* and Common Tussock Grass *Poa labillardierei* on drier edges. Weed species are generally restricted to the drier edges and

include Cleavers *Galium aparine*, Starwort *Aster subulatus*, Kikuyu *Pennisetum clandestinum*, Angled Onion *Allium triquetrum*, Curly Dock *Rumex crispus*, and Toowoomba Canary Grass *Phalaris aquatica*.



Plate 2 – Tall Marsh within Spring Creek

*Plains Freshwater Sedge Wetland (EVC 899, BCS Vulnerable)*

This EVC was recorded within the Jan Juc Creek study area only and is confined to a few patches between Duffields Road and Domain Road (Plate 3). These aquatic wetland communities are dominated variously by Common Spike Rush, Water Ribbons, Knobby Club Rush *Ficinia nodosa*, Swamp Stonecrop *Crassula helmsii* and Tall Sedge *Carex appressa*. Weed species present within the EVC include Toowoomba Canary Grass, Drain Sedge *Cyperus eragrostis*, Kikuyu, Couch *Cynodon dactylon* and Yorkshire Fog *Holcus lanatus*.



Plate 3 - Plains Freshwater Sedge Wetland within Jan Juc Creek

**Grassy Woodland (EVC 175, BCS Endangered)**

Grassy Woodland is scattered throughout both the Jan Juc Creek and Spring Creek study areas (Plate 4). The overstorey is generally dominated by Bellarine Yellow Gum and Manna Gum *Eucalyptus viminalis* with occasional Swamp Gums *Eucalyptus ovata*. Indigenous understorey species include Coast Beard Heath, Varnish Wattle *Acacia verniciflua*, Black Wattle *Acacia mearnsii*, Kangaroo Grass *Themeda triandra*, Wallaby Grasses *Austrodanthonia* spp., Small Grass Tree *Xanthorrhoea minor*, Coast Flax Lily, Weeping Grass *Microlaena stipoides*, Raspwort *Gonocarpus tetragynus*, Kidney Weed *Dichondra repens*, and Stone Crop *Crassula sieberiana*. This EVC varies greatly in condition from areas of relatively intact indigenous understorey to areas completely dominated by introduced species. Introduced species include Annual Veldt Grass, Soursob, Ribwort, Catsear *Hypochoeris radicata*, Sweet Pittosporum *Pittosporum undulatum*, Gorse *Ulex europaeus*, Annual Grass *Poa annua*, Rye Grass *Lolium* sp., Italian Buckthorn *Rhamnus alaternus*, Mirror Bush *Coprosma repens*, Chickweed *Stellaria media*, Boneseed *Chrysanthemoides monilifera* ssp. *monilifera* and Serrated Tussock *Nassella trichotoma*.





Plate 4 – Grassy Woodland on Spring Creek with revegetation in the foreground

*Swampy Riparian Woodland (EVC 83, BCS Endangered)*

Swampy Riparian Woodland was recorded within the Jan Juc Creek study area only in flat, wet sections west of Torquay Boulevard (Plate 5). The overstorey is dominated by Bellarine Yellow Gum and Manna Gum with indigenous understorey species such as Black Wattle, Sweet Bursaria *Bursaria spinosa*, Golden Wattle, Prickly Moses, Coast Beard Heath, Spiny-Headed Mat-Rush, Coast Flax Lily, Common Tussock Grass, Austral Bracken *Pteridium esculentum*, Weeping Grass, Old Mans Beard *Clematis microphylla*, Wallaby Grasses, Kangaroo Apple *Solanum laciniatum*, Kidney Weed and Bower Spinach. Furthermore, some indigenous aquatic species are present in wetter areas such as Tall Sedge and Water Ribbons. Observed patches of Swampy Riparian Woodland generally supported high levels of introduced species such as planted non-native Eucalypts, Panic Veldt Grass, Ribwort, Soursob, Tuart, Ox tongue *Helminthotheca echioides*, Angled Onion, Toowoomba Canary Grass, Sweet Pittosporum and Mirror Bush. Areas of Swampy Riparian Woodland adjacent to the Jan Juc Cricket Oval are regularly slashed and act as a walkway from the Jan Juc Caravan Park to the oval.



Plate 5 – Swampy Riparian Woodland on Jan Juc Creek. Note slashed areas in left of photo.

*Plains Brackish Sedge Wetland (EVC 891, BCS Vulnerable)*

Plains Brackish Sedge Wetland was observed at the end of Spring Valley Drive in the Spring Creek study area (Plate 6). This wetland EVC is generally considered to be in good condition and is dominated by Sea Rush with patches of Salt Club-sedge *Bolboschoenus caldwellii* and Water Ribbons in wetter areas. Additional scattered native species include Common Cotula *Cotula australis*, Streaked Arrow Grass, Australian Salt Grass, Blown Grass *Lachnagrostis filliformis*, Creeping Brookweed and Swamp Weed. Introduced species are generally low in cover within this EVC.



Plate 6 –Plains Brackish Sedge Wetland, Spring Creek

*Estuarine Wetland (EVC 891, BCS Endangered)*

A small area of Estuarine Wetland was observed on the western bank of Spring Creek in the south of the study area (Plate 7). This EVC is considered to be of poor to moderate condition dominated by a mix of exotic and native species. The dominant species is the introduced Buckshorn Plantain *Plantago coronopus*. Native species include Blue Tussock-grass, Australian Salt Grass, Chaffy Saw-sedge, Beaded Glasswort *Sarcocornia quinqueflora*, Swampweed, Creeping Brookweed and Sea Rush.



Plate 7 –Estuarine Wetland, Spring Creek.

*Indigenous Revegetation Areas (No relevant EVC or BCS)*

Indigenous revegetation areas are scattered throughout both the Jan Juc Creek and Spring Creek study areas reflecting the commendable efforts of local community groups in restoring these areas (Plates 7 and 8). Areas of revegetation are generally in keeping with the appropriate EVCs for the area and are dominated by species such as Manna Gum, Bellarine Yellow Gum, Golden Wattle, Varnish Wattle, Sweet Bursaria, Black Wattle, and understorey species such as Spiny-headed Mat-rush, Common Tussock Grass. The majority of the revegetation areas have a groundcover of thick mulch to aid weed suppression and as such have varying levels of weed cover.



Plate 8 –Established revegetation site, Jan Juc Creek.



Plate 9 – Recent revegetation site, Jan Juc Creek

### *Introduced Vegetation (No relevant EVC)*

Areas of introduced vegetation comprise open slashed grassy areas and areas of planted trees and shrubs (Plate 9 and 10). Slashed areas are variously dominated by introduced ground covers such as Kikuyu, Couch, Brome *Bromus catharticus*, Clover *Trifolium* spp., Annual Grass, Rye Grass, Ribwort and Paspalum. Areas of planted introduced trees and shrubs area more prominent in the Jan Juc Creek study area and mostly comprise non-indigenous Australian species. Conversations with local residents suggest the area between Domain Road and Torquay Boulevard was planted out by community members seeking to beautify the area 15 to 18 years ago. Many other areas have undoubtedly been planted with non-indigenous Australian species by the Surf Coast Shire as this management action was historically considered common practice.

Due to the modified condition of the vegetation structure, via slashing and proliferation of introduced species, these cleared areas are considered to be in poor condition.



**Plate 10 – Non-locally indegnous trees and shrubs in the Jan Juc Creek corridor, Note the modified landscape in the foreground and lack of defined water channel.**



Plate 11 – Example of a highly modified section of the Jan Juc Creek corridor.

## 4 HABITAT HECTARE ASSESSMENT

Native vegetation remnants were classified into habitat zones (HZ) due to the varying condition and form of vegetation present within each of the EVCs. Conservation significance and habitat hectare scores for each HZ are presented in Tables 2, 3 and 4 on the following pages. Additionally, several Large Old Trees (LOT) were also identified within patches of native vegetation. Due to some patches being small in size, the Large Tree score was calculated by averaging the number of Large Old Trees in the general vicinity.

In addition to HZs assessed within the study area, several significant canopy trees were also identified. One Very Large Old Tree (VLOT) was recorded along Spring Creek and several Medium to Large Old Trees (MOT - LOT) were recorded within the Spring Creek and Jan Juc Creek study areas as 'scattered trees'.



Table 2 – Net Gain Habitat Hectare Scores for Jan Juc Creek

Habitat Zone			JJ TM1	JJ SRW1	JJ SRW2	JJ SRW3	JJ CAS1	JJ PFSW1	JJ PFSW2	JJ GW1	JJ GW2	JJ GW3	JJ GW4	JJ GW5	JJ GW6
EVC			TM	SRW	SRW	SRW	CAS	PFSW	PFSW	GW	GW	GW	GW	GW	GW
EVC Number			821	83			858	899	899	175					
EVC Bioregional Conservation Status			Vul	End			End	Vul	Vul	End					
Bioregion		Max Score	Otway Plain												
Patch Size			0.338	0.749	0.701	0.072	0.045	0.128	0.036	0.116	0.195	0.132	0.293	0.168	0.163
Site Condition	Large Old Trees	10	N/A	6	4	0	N/A	N/A	N/A	0	0	3	3	0	0
	Canopy Cover	5	N/A	5	5	0	5	N/A	N/A	0	5	5	5	0	0
	Understorey	25	15	15	15	5	5	5	15	5	5	15	5	5	5
	Lack of Weeds	15	13	2	4	0	9	11	9	9	4	4	4	7	0
	Recruitment	10	5	3	1	0	3	5	5	1	0	3	0	3	0
	Organic Litter	5	3	5	5	5	5	0	0	5	5	5	5	5	0
	Logs	5	N/A	2	0	4	0	N/A	N/A	0	0	0	0	0	0
Landscape Value	Patch Size	10	8	4	1	1	8	1	1	1	1	4	4	1	1
	Neighborhood	10	0	0	0	0	0	0	0	0	0	0	0	0	0
	Distance to Core	5	4	1	4	4	4	4	4	4	4	4	4	4	4
Habitat Quality Score		100	61.0	43.0	39.0	19.0	43.1	33.6	44.4	25.0	24.0	43.0	30.0	25.0	15.0
Habitat Hectares		1	0.21	0.32	0.27	0.01	0.02	0.04	0.02	0.03	0.05	0.06	0.09	0.04	0.02
Conservation Significance	Conservation Status x Habitat Score		Very High	Very High	High	High	Very High	High	High	High	High	Very High	High	High	High
	Threatened Species Rating		N/A	N/A	N/A	N/A	N/A	N/A	N/A	High	High	High	High	High	High
	Other Site Attribute Rating		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Overall Conservation Significance			Very High	Very High	High	High	Very High	High	High	High	High	High	High	High	High

Notes: JJ – Jan Juc, TM – Tall Marsh, SRW – Swampy Riparian Woodland, CAS – Coastal Alkaline Scrub, PFSW – Plains Freshwater Sedge Wetland, GW – Grassy Woodland, Vul - Vulnerable, End – Endangered

Table 3 – Net Gain Habitat Hectare Scores for Spring Creek

Habitat Zone			SC CAS1	SC CAS2	SC TM1	SC EW1	SC PBSW1
EVC			CAS		TM	EW	PBSW
EVC Number			858		821	10	891
EVC Bioregional Conservation Status			Endangered		Vul	End	Vul
Bioregion		Max Score	Otway Plain				
	Patch Size		2.774	0.275	2.683	0.127	0.4
Site Condition	Large Old Trees	10	N/A	N/A	N/A	N/A	N/A
	Canopy Cover	5	5	5	N/A	N/A	N/A
	Understorey	25	15	5	15	15	15
	Lack of Weeds	15	9	9	13	4	9
	Recruitment	10	6	0	5	5	5
	Organic Litter	5	5	5	3	0	5
	Logs	5	5	0	N/A	N/A	N/A
Multiplier (x 1.15 for CAS, 1.36 for TM EW and PBW1)		x 1	51.75	27.6	48.1	32.64	46.24
Landscape Value	Patch Size	10	8	8	8	8	8
	Neighborhood	10	0	0	0	0	0
	Distance to Core	5	4	4	4	4	4
Habitat Quality Score		100	63.75	39.6	60.1	44.64	58.24
Habitat Hectares		1	1.77	0.11	1.61	0.06	0.23
Conservation Significance	Conservation Status x Habitat Score		Very High	High	Very High	Very High	Very High
	Threatened Species Rating		N/A	N/A	N/A	N/A	N/A
	Other Site Attribute Rating		N/A	N/A	N/A	N/A	N/A
Overall Conservation Significance			Very High	High	Very High	Very High	Very High

Notes: SC – Spring Creek, CAS – Coastal Alkaline Scrub, TM – Tall Marsh, PBSW – Plains Brackish Sedge Wetland, Vul - Vulnerable, End – Endangered

**Table 4 – Net Gain Habitat Hectare Scores for Spring Creek**

Habitat Zone			SC GW1	SC GW2	SC GW3	SC GW4	SC GW5	SC GW6	SC GW7	SC GW8	SC GW9	SCG W10	SC GW11	SC GW12	SC GW13	SC GW14	SC GW15	SC GW16	
EVC (Number)			Grassy Woodland (175)																
EVC Bioregional Conservation Status			Endangered																
Bioregion		Max Score	Otway Plain																
Patch Size			0.235	0.12	0.02	0.182	0.057	0.173	0.186	0.913	0.969	0.41	N/A	N/A	0.076	0.097	0.884	0.975	
Site Condition	Large Old Trees	10	0	0	0	0	0	8	8	0	8	0	8	8	0	0	0	0	
	Canopy Cover	5	5	5	0	3	5	5	3	0	5	0	5	5	0	0	0	0	
	Understorey	25	5	0	5	5	15	5	5	15	5	5	15	15	5	5	15	5	
	Lack of Weeds	15	7	7	15	0	7	7	4	9	4	2	20	15	6	6	4	9	
	Recruitment	10	1	0	0	0	0	5	5	6	0	5	6	5	0	6	5	0	
	Organic Litter	5	5	3	0	5	5	5	5	5	3	5	3	3	2	5	3	5	
	Logs	5	0	0	0	2	0	5	4	4	5	5	5	5	0	0	0	0	
Landscape Value	Patch Size	10	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	
	Neighborhood	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Distance to Core	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
Habitat Quality Score		100	35	27	32	27	44	52	46	51	42	34	74	68	25	34	39	31	
Habitat Hectares		1	0.08	0.03	0.01	0.05	0.03	0.09	0.09	0.47	0.41	0.14	0.00	0.00	0.02	0.03	0.34	0.30	
Conservation Significance	Conservation Status x Habitat Score		High	High	High	High	High	Very High	High	Very High	High	High	Very High	Very High	High	High	High	High	
	Threatened Species Rating		High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High
	Other Site Attribute Rating		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Overall Conservation Significance			High	High	High	High	High	Very High	High	Very High	High	High	Very High	Very High	High	High	High	High	

Notes: SC – Spring Creek, GW – Grassy Woodland.

## 4.1 Habitat Hectare Assessment Summary

### Jan Juc Creek

Within the Jan Juc Creek study area there is a total of 1.18 habitat hectares comprising:

- 0.21 habitat hectares of Very High conservation significance Tall Marsh;
- 0.32 habitat hectares of Very High conservation significance Swampy Riparian Woodland;
- 0.28 habitat hectares of High conservation significance Swampy Riparian Woodland;
- 0.02 habitat hectares of Very High conservation significance Coastal Alkaline Scrub;
- 0.06 habitat hectares of High conservation significance Plains Freshwater Sedge Wetland;
- 0.06 habitat hectares of Very High conservation significance Grassy Woodland
- 0.23 habitat hectares of High conservation significance Grassy Woodland;
- Three scattered Medium Old Trees; and,
- Thirteen Large Old Trees.

### Spring Creek

Within the Spring Creek study area there is a total of 5.61 habitat hectares comprising:

- 1.77 habitat hectares of Very High conservation significance Coastal Alkaline Scrub;
- 0.11 habitat hectares of High conservation significance Coastal Alkaline Scrub;
- 1.61 habitat hectares of High conservation significance Tall Marsh;
- 0.06 habitat hectares of Very High conservation significance Estuarine Wetland;
- 0.23 habitat hectares of Very High conservation significance Plains Brackish Wetland;
- 0.56 habitat hectares of Very High conservation significance Grassy Woodland;
- 1.53 habitat hectares of High conservation significance Grassy Woodland;
- One Very Large Old Trees; and,
- 15 Large Old Trees.

## 5 POTENTIAL NET GAIN

### Within areas of Remnant Vegetation

Potential gains were calculated by inputting assessed habitat hectare scores into the *DSE Gain Score Calculator* (DSE website [www.dse.vic.gov.au](http://www.dse.vic.gov.au)). The following management actions to be implemented over a ten-year period to achieve gains in vegetation quality:

- Implement security arrangement in perpetuity by way of a Section 173 or Section 69 agreement;
- Exclude stock and ensure weed cover does not increase beyond current levels;
- Retain all standing trees, dead or alive;
- Retain all fallen timber/branches/leaf litter; and,
- Eliminate high threat woody weeds and control pest animals.

Different levels of gain may be calculated for each habitat zone if different management actions are undertaken within separate areas. Fewer gains may be achieved via solely applying a security arrangement to any vegetation proposed to be used as an offset.

When identifying appropriate offsets for any permitted vegetation clearance, the quality and quantity of the offset must be commensurate with the vegetation lost. As such, *like for like* rules as per Appendix 4 of the Framework (NRE 2002) must be adhered to, to ensure tradeoffs between higher and lower significance vegetation does not occur.

Table 4 details the potential gains, including a breakdown of the potential availability of maintenance, improvement, prior management and security gains within each habitat zone.

### Within areas of Revegetation

As outlined in the methodology (see Section 2), a gain of 17 habitat hectare points per hectare is likely to be gained from the majority of the revegetation within the study area. Within the study area, there is approximately 1 hectare of revegetation, which has previously been implemented. If all this revegetation meets the defined DSE standards an additional potential gain of 0.22 habitat hectares is available.

Table 4 Potential Net Gain from habitat hectare zones within the study area

Habitat Zone	Conservation Significance	Standardised Sum of Maintenance and Improvement Gain/Ha	Prior Management Gain/Ha	Security Gain/Ha	Total Gain/Ha	Size of habitat zone (Ha)	Total Potential Gain (Habitat Hectares)
<b>Jan Juc Creek</b>							
JJTM1	Very High	21.42	6.1	6.1	33.62	0.338	<b>0.11</b>
JJSRW1	Very High	11.2	4.3	4.3	19.8	0.749	<b>0.15</b>
JJSRW2	High	9	3.9	3.9	16.8	0.7	<b>0.12</b>
JJSRW3	High	7	1.9	1.9	10.8	0.07	<b>0.01</b>
JJCAS1	Very High	3.8	3.7	3.7	11.2	0.045	<b>0.01</b>
JJPFSW1	High	6.8	3.4	3.4	13.6	0.128	<b>0.02</b>
JJPFSW2	High	14.28	4.4	4.4	23.08	0.036	<b>0.01</b>
JJGW1	High	3.1	2.5	2.5	8.1	0.116	<b>0.01</b>
JJGW2	High	3.4	2.4	2.4	8.2	0.195	<b>0.02</b>
JJGW3	High	9.2	4.3	4.3	17.8	0.132	<b>0.02</b>
JJGW4	High	3.4	3	3	9.4	0.293	<b>0.03</b>
JJGW5	High	3.3	2.5	2.5	8.3	0.168	<b>0.01</b>
JJGW6	High	9.5	1.5	1.5	12.5	0.163	<b>0.02</b>
<b>Total: 0.43</b>							
<b>Spring Creek</b>							
SCCAS1	Very High	16.5	6.4	6.4	29.3	2.774	<b>0.81</b>
SCCAS2	High	4.2	4	4	12.2	0.275	<b>0.03</b>
SCEW1	Very High	14.28	4.5	4.5	23.28	0.127	<b>0.03</b>
SCTM1	Very High	14.69	6.1	6.1	26.89	0.127	<b>0.03</b>
SCPBSW1	Very High	12.24	5.8	5.8	23.84	0.4	<b>0.1</b>
SCGW1	High	3.75	3.5	3.5	10.75	0.235	<b>0.03</b>
SCGW2	High	4.95	2.7	2.7	10.35	0.12	<b>0.01</b>
SCGW3	High	4.5	3.2	3.2	10.9	0.02	<b>0.002</b>
SCGW4	High	5.95	2.7	2.7	11.35	0.182	<b>0.02</b>
SCGW5	High	9.15	4.4	4.4	17.95	0.057	<b>0.01</b>
SCGW6	Very High	8.75	5.2	5.2	19.15	0.173	<b>0.03</b>
SCGW7	High	8.45	4.6	4.6	17.65	0.186	<b>0.03</b>
SCGW8	Very High	13.1	5.1	5.1	23.3	0.913	<b>0.21</b>
SCGW9	High	10.05	4.2	4.2	18.45	0.969	<b>0.18</b>
SCGW10	High	8.5	3.4	3.4	15.3	0.41	<b>0.06</b>
SCGW13	High	4.7	2.5	2.5	9.7	0.076	<b>0.01</b>
SCGW14	High	3.6	3.4	3.4	10.4	0.097	<b>0.01</b>
SCGW15	High	4.7	2.5	2.5	9.7	0.884	<b>0.09</b>
SCGW16	High	3	3.1	3.1	9.2	0.975	<b>0.09</b>
<b>Total: 1.78</b>							

## 5.1 Potential Net Gain Summary

### Jan Juc

Within the Jan Juc Creek Study Area there is a potential gain of 0.43 habitat hectares comprising:

- 0.11 habitat hectares of Very High conservation significance Tall Marsh;
- 0.15 habitat hectares of Very High conservation significance Swampy Riparian Woodland;
- 0.13 habitat hectares of High conservation significance Swampy Riparian Woodland;
- 0.01 habitat hectares of Very High conservation significance Coastal Alkaline Scrub;
- 0.03 habitat hectares of High conservation significance Plains Freshwater Sedge Wetland;
- 0.11 habitat hectares of High conservation significance Grassy Woodland;
- Three scattered Medium Old Trees; and,
- 13 Large Old Trees.

### Spring Creek

Within the Spring Creek study area there is a potential Net Gain of 1.66 habitat hectares comprising:

- 0.81 habitat hectares of Very High conservation significance Coastal Alkaline Scrub;
- 0.03 habitat hectares of High conservation significance Coastal Alkaline Scrub;
- 0.03 habitat hectares of Very High conservation significance Estuarine Wetland;
- 0.03 habitat hectares of Very High conservation significance Tall Marsh;
- 0.1 habitat hectares of Very High conservation significance Plains Brackish Sedge Wetland;
- 0.42 habitat hectares of Very High conservation significance Grassy Woodland;
- 0.36 habitat hectares of High conservation significance Grassy Woodland;
- One Very Large Old Trees; and,
- 15 Large Old Trees.

Within the study area, (both Jan Juc and Spring Creeks) there is approximately 1.3 hectares of revegetation, which has been previously implemented. If all of this revegetation area meets defined DSE standards, a potential gain of 0.22 habitat hectares through revegetation is available.

## 6 LANDSCAPE PLANNING

The landscape planning component of the project entailed the assessment of the study area to demonstrate the potential application of a proposed 'open space classification system'. The proposed classification system applies zones to areas within reserves where each classification zone contains specific management objectives. The proposed zoning system works in addition to the *Surf Coast Shire planning scheme*.

As per the *Surf Coast Shire planning scheme* the definitions for these zones are as follows:

**Conservation Zone A – Remnant Vegetation and Existing Revegetation:** to conserve and enhance indigenous flora and fauna. Manage for nature conservation with walking/nature appreciation permissible.

**Passive recreation Conservation Zone B – Rehabilitation and Restoration Zones:** To re-instate, conserve and enhance indigenous flora and fauna. Manage to increase indigenous species biodiversity. Walking/nature appreciation permissible.

**Recreation Zone:** To provide enjoyable, safe recreational opportunities.

This report recommends areas for zoning Conservation A or Conservation B. The other zones will be considered as part of the masterplanning process.

Passive recreation such as nature appreciation, walking and bike riding is encouraged in both zones A and B and community groups from both Jan Juc Creek and Spring Creek expressed the need for discreet paths along the length of the study area and interpretive signage to encourage community access, ownership and appreciation of the natural environment.

The impacts on ecological values within the Jan Juc and Spring Creeks study area via vegetation fragmentation has been discussed by Dobson (2006) and designating a conservation zone along the corridor of both creeks aims to ameliorate this issue. This may also include rehabilitating degraded areas in order to link existing remnant or revegetation areas. Additionally, the installation of a conservation zone along both Jan Juc and Spring Creeks has been further supported and was outlined in the *Spring Creek Catchment Plan* in 2003. The *Spring Creek Catchment Plan* also

Vegetation Mapping, Assessment of Potential Net Gain and Planning Recommendations for Jan Juc and Spring Creek, Jan Juc, Victoria



states that to '*protect remnant vegetation and revegetate damaged areas*' along the creek corridors is of high priority, and to '*conserve and regenerate... Grassy Woodlands vegetation systems where opportunity is defined*' is an action of medium priority and should be acted upon.

Conservation zone recommendations also take into account priorities set out in the *Biodiversity Action Planning – Landscape plan for Gherang Zone, Otway Plain Bioregion* (Grant *et al.* 2003) which also covers the study area. These priorities are:

1. *Protection* - reservation, covenants, management agreements, statutory planning and fencing.

2. *Enhancement* - management by controlling threats such as weeds, introduced predators, inappropriate/uncontrolled grazing by stock and native animals, salinity, and encouraging natural regeneration and revegetation of the understorey.

3. *Restoration* - revegetation to create corridors, buffers, patches of habitat, reintroduction of individual plants and animals into depleted populations.

Conservation zone recommendations also take into account relevant specific priority biodiversity actions of the Gherang landscape zone for Private Land and Public Land Water Frontage including:

- Develop habitat links through roadsides and streams to link remnants on private land and public land.
- Control erosion by stabilising stream banks, controlling stock access or undertaking engineering works where necessary.
- Coordinate restoration and revegetation initiatives to assist landholders, shires, extension officers and program coordinators to consolidate local remnant networks. Giving priority to threatened EVC remnants.
- Encourage and assist in the establishment of vegetated buffers along drainage lines.
- Ensure restoration and revegetation of blocks and linkages is based on pre-1750 EVCs.
- Identify adjoining or strategic landholdings and easements having potential connectivity (e.g. adjacent roadsides) or enhancement value (e.g. nodes at roadside / streamside intersections) and encourage collaboration using incentives and voluntary programs.

- In particular, manage tenure to best facilitate the linkage of Spring Creek Public Land Water Frontages with freehold remnants.

Several investigations have attempted to develop effective vegetated buffer widths for waterways, however no consensus or specific width has been concluded (Hellmund and Smith 2006, Dobson 2006). In this instance the installation of a vegetation buffer of greater than 10 meters (typically 15 to 20 meters) is recommended along Jan Juc Creek. This width has also been suggested, as any revegetation along riparian zones must be a minimum of *10 meters wide* in order to qualify for landscape context gains under the DSE *Native Vegetation: Vegetation Gain Approach* guidelines (DSE 2006b). A much wider buffer has been recommended along Spring Creek to account for the higher ecological values and processes this creek supports.

A minimum of a four metre buffer has been retained along the boundaries of any private properties for fire safety reasons. This is to take in to account the interim fire prevention measures released by the Victorian State government that state that a four metre wide strip can be cleared of vegetation along property boundaries without a permit.

Mapping of the recommended conservation zones has been provided to the Surf Coast Shire in electronic format. If maps at different scales to those provided in this document they should be requested from the Surf Coast Shire.

## 6.1 Jan Juc Creek Landscape Planning

The landscape within the Jan Juc Creek study area is highly modified and currently supports high level recreation use with high density residential areas bordering the study area. In consultation with the Friends of Jan Juc community group and due to the general landscape of the study area, all remnant vegetation and existing revegetation is recommended to be incorporated into Conservation Zone A, with a linear Conservation Zone B strip along the centre of the creekline (See figures 4a and 4b). These zones will enhance the ecological values within the study area by creating a habitat corridor along the creek system while still leaving adequate space for high levels of recreational use. This zoning plan also takes into consideration fire safety issues associated with any revegetation too close to residential properties and fence lines as there is a large buffer between conservation zones and residential properties.

Several sections of Jan Juc Creek have been piped underground (west of Duffields Road to Hoylake Avenue) or have been modified so that no

creepline currently exists and water flows over open grassy areas in times of flood (east of Domain Road). For these areas to be appropriately revegetated, reinstatement of the creekbed using earth working machinery may be necessary to facilitate natural flow regimes, the introduction of riparian habitat and associated ecological processes. Additional guidelines regarding indigenous revegetation are provided in Section 7.

## 6.2 Spring Creek Landscape Planning

The landscape within the Spring Creek study area supports large areas of relatively intact indigenous vegetation, revegetated artificial wetlands and modified grassy areas. Residential areas border the southern sections of the study area and future development is anticipated for the remainder of the study area. The general landscape and after consultation with community members from the Torquay Landcare Group and the Surf Coast and Inland Plains Network, indicates that all remnant vegetation and existing revegetation should be incorporated into Conservation Zone A. The remainder of the corridor is suggested to be incorporated into Conservation Zone B, excluding a fire safety buffer along the residential boundaries, the recently constructed bike track and proposed adjacent picnic area and a small area at the end of Aurora Crescent (See figures 4c, 4d and 4e). This proposed conservation zoning is supported by the Surf Coast planning scheme which has the Spring Creek corridor covered by an Environmental Significance Overlay (ESO1 -WETLAND AND ASSOCIATED DRYLAND HABITAT PROTECTION), the aims of which tie in with the proposed conservation zones.

The aims of the ESO1 - WETLAND AND ASSOCIATED DRYLAND HABITAT PROTECTION are to:

- To protect and ensure the long term future of terrestrial and aquatic habitat for native flora and fauna.
- To protect and ensure the long term future of threatened species of flora and fauna.
- To maintain the physical and biological integrity and functioning of natural systems including:
  - the ability of watercourses to carry natural flows.
  - the maintenance of natural flooding regimes.
  - the natural opening and closing of coastal wetlands and estuaries.
  - the filtering of nutrients and other pollutants.

- the recharge and discharge of ground waters.
- To protect water quality and prevent water pollution in watercourses, water bodies, wetlands and groundwater.
- To prevent accelerated erosion and siltation or sedimentation.
- To prevent further loss of wetland habitat
- To protect wetlands identified in international agreements.
- To encourage ecological restoration, regeneration and revegetation with indigenous species, within and adjoining habitat areas.
- To protect cultural (including aboriginal and non-aboriginals heritage) values, and visual quality of habitat areas.

While this investigation deals with the Spring Creek corridor only it must be noted that the area to the north of the creek the along Duffields Road is proposed to be developed with high density residential housing. To adequately protect and conserve the ecological values with the Spring Creek corridor is it important that adequate open space be provided for recreation purposes within any proposed development and that the tributary which runs into Spring Creek from this area is also managed for conservation purposes and revegetated with locally indigenous species. This is required to prevent the invasion of weed species and increased nutrient levels.

## 7 REVEGETATION GUIDELINES

Revegetation with indigenous species and rehabilitating remnant vegetation provides numerous ecological, aesthetic and social benefits, particularly in riparian corridors such as:

- Improving water quality by reducing sedimentation and filtering out high nutrient levels;
- Enhancing biodiversity through increasing floristic species diversity, and providing habitat and food sources for fauna species,
- Reinstating natural ecological processes;
- Improving aesthetic values for local residents and visitors. This increase in natural values may be reflected in an increase in real estate values adjacent to the site;
- Suppressing weed species;
- To sequester carbon to contribute to the reduction of greenhouse gases; and,
- To increase community capacity and sense of ownership and well being through community planting days and involvement with the natural environment.

As such it is important that any revegetation undertaken as supplementary planting in Conservation Zone A or as restoration in Conservation Zone B is undertaken in the correct manner using appropriate species and revegetation methodology.

As outlined in the *Surf Coast Environmental Management Strategy* (Surf Coast Shire 2006b) the shire supports any proposed community restoration or revegetation projects by *'providing financial and other assistance, within budgetary constraints, to groups and community networks that proactively manage waterways lakes and wetlands in the shire'* (Surf Coast Shire 2006b).

### 7.1 Site Preparation

The successful establishment of native vegetation is dependant on site preparation prior to planting. Ideally weed control should commence at least twelve months prior to planting. There are various methods of weed control including mechanical, manual, biological and chemical approaches. It is important to consider the various options and choose the most appropriate

approach that suits the site conditions, skills and qualifications of the personnel undertaking the works. An example of an ideal chemical program using a knockdown herbicide for a spring planting program is provided below:

**Table 5 Example chemical weed control plan (Greening Australia 2006)**

Spray	Timing	Purpose
Spray 1	Spring in the year before planting	Prevent seed set in the existing weeds. This may also weaken hard to manage perennials such as Toowoomba Canary Grass
Spray 2	Ideally after the autumn break or the first rains of the season	Control seedlings that germinate after the break. Be aware that knocking out the first set of weeds may create ideal conditions for seeds of broadleaf's to germinate.
Spray 3	6 – 12 weeks after spray 2	May be worth considering controlling any new seedlings that have emerged or are emerging.
Final Spray at planting	A final Spray may be able to take place shortly prior to planting. Always delay the recommended time after spraying before allowing people to undertake revegetation.	

## 7.2 Species Selection and Plant Numbers

The recommended range of species and target densities have been chosen with reference to the appropriate Otway Plain EVC benchmarks, remnant species present within the study area and the 10 year revegetation lifeform density targets as outlined in the *DSE Revegetation Planting Standards* (DSE 2006d). Generally, these target numbers are between 500 and 2500 plants per hectare depending on the EVC. To account for any plant mortality it is generally prudent to increase this amount by twenty five percent. See Figure 5a and 5b for recommended EVC revegetation zones within the study area.

As per the *Revegetation Planting Standards* (DSE 2006d), ground covers and native grasses have been omitted from the planting schedules (except for some robust grass species) as these lifeforms generally have a high risk of failure associated with establishment, largely due to competition from high threat herbaceous weeds and require high levels of maintenance. However, ground cover species may be appropriate in some instances such as educational displays or in areas where there is a high level of community support that can accommodate the increased maintenance requirements. See Appendix 2 (Appendices A2.1 – A 2.3) for recommended planting lists and densities.

## 7.3 Planting

Natural regeneration, direct seeding and planting are the three main techniques for establishing indigenous vegetation. All three methods may be appropriate

for different locations along Jan Juc and Spring Creek. When establishing native vegetation the following issues should be considered:

- Planting should be undertaken in autumn through to early winter if the site is dry in summer, particularly if the site has a northerly or westerly aspect. Plant in spring if the site suffers water logging;
- Seed or cutting material should be sourced from indigenous plant stock within or as close as possible to the study area.
- Revegetation areas should be adequately prepared with thorough weed control by licensed contractors undertaken prior to any planting or direct seeding;
- Planting design should be carried out on a case by case basis however, in general understorey forms should be planted in dense patches when using tube stock to create a mosaic effect and to shade out any competing weed species while ensuring that disturbance to any native ground cover is minimised;
- Revegetation should be undertaken with native species of local provenance (See Appendix 2 for recommended planting lists and densities) and natural regeneration of native species should be encouraged; and,
- Consult with adjacent local residents regarding the suitability of the revegetation design. Residents may be concerned regarding possible fire risk associated with revegetation sites or the blocking of views. As is indicated through the conservation zones, there should be a buffer of at least 4 metres between any revegetation sites and residential boundaries.

## 7.4 Site Maintenance

Weeds are a serious threat to both remnant native vegetation communities and revegetation sites, particularly in drainage areas that receive high moisture and nutrient levels (Lovett and Price 2007). As such, it is vital to ensure that funding for adequate follow up maintenance is accounted for with all revegetation projects. This includes regular weed control and replacement of any plantings due to species mortality for at least three years. Projects should not be implemented if this level of follow up maintenance cannot be provided. Adequate site preparation before revegetation should significantly reduce follow up weed control. Any follow up use of chemical control should avoid off target damage of plantings. Follow up watering of plants may be required if plants have been established in very dry seasons.

Always allocate time and resources to removing tree guards which is a process that is often overlooked.

When working in remnant vegetation always begin weed removal in areas of lower infestation level, moving towards areas of higher infestation. For more information on restoring indigenous vegetation consult *Bringing Back the Bush* (Bradley 2002) and *Bush Invaders of South-East Australia* (Muyt 2001).

## 7.5 Monitoring

Monitoring and measuring project success are vital components of any revegetation or restoration project. To determine project success *measurable* goals must first be outlined.

There are several approaches to monitoring revegetation and restoration projects. Examples include: using photo points, recording survivorship and establishment of different species, measuring cover and diversity of indigenous species and measuring the presence of fauna within the project area.

When setting quantifiable project goals and monitoring techniques it is important to consider the desired outcomes (habitat, aesthetics, erosion control, shelter etc) and the time and skills required to undertake the monitoring process.

## 7.6 Revegetation as offsets

For the Surf Coast Shire to use any proposed revegetation areas within the study area as offsets they must adhere to the *Revegetation Planting Guidelines* (DSE 2006d). As grazing is not present within the study area revegetation sites would not be required to be fenced. It must be noted that while revegetation offsets on council owned land can be implemented by community groups any required funds cannot be sourced through government funding such as Landcare or the Corangamite Catchment Management Authority. Generally the security and management of remnant vegetation is more economically feasible than revegetation offsets.



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## 9 FIGURES

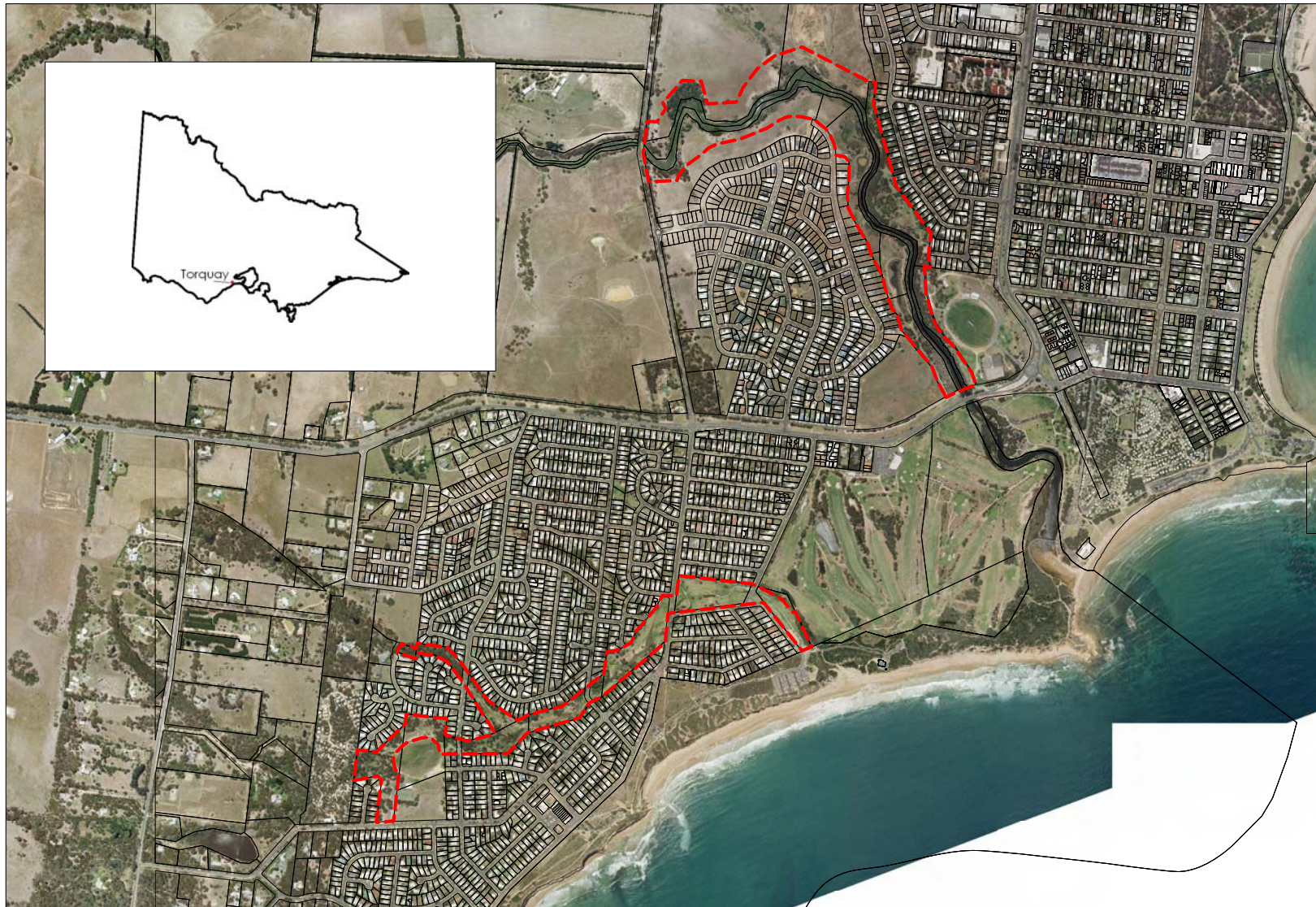


Figure 1

Study Area

Vegetation Mapping, Potential Net Gain Assessment and Planning Recommendations for Jan Juc and Spring Creek, Torquay, Victoria

Beacon Ecological

Scale 1:2,500

**Legend**  
- - - Study\_Area



# Beacon Ecological

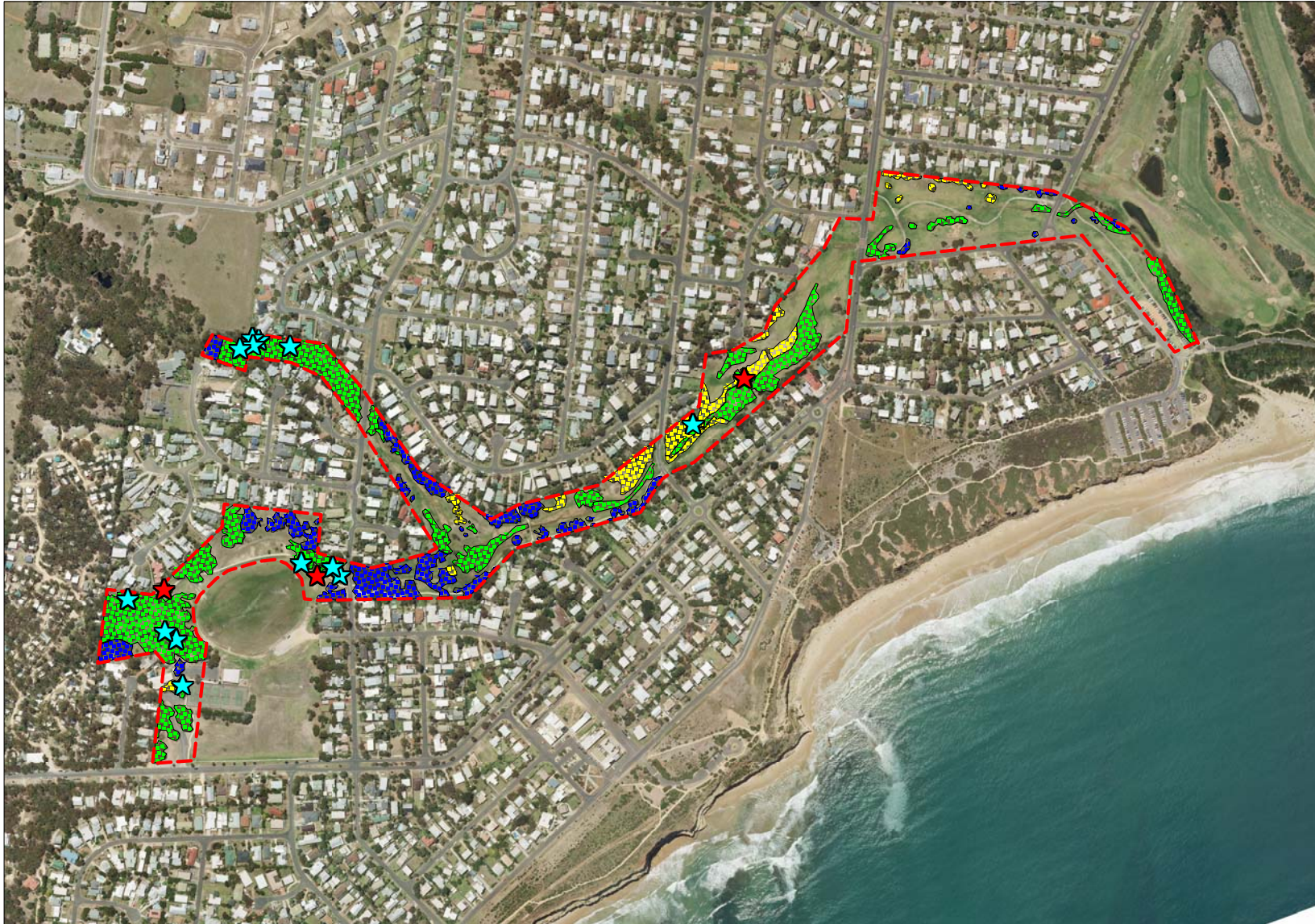


Figure 2a






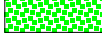

Vegetation Mapping Overview

Jan Juc Creek

Beacon Ecological

Scale 1: 1,000

## Legend

-  Very Large Old Trees
-  Large Old Trees
-  Medium Old Trees
-  Study Area
-  Revegetation
-  Remnant Vegetation
-  Planted Non Native Vegetation



# Beacon Ecological



Figure 2b

Vegetation Mapping Spring Creek

Beacon Ecological

Scale 1:1000

### Legend

- ★ Medium Old Trees
- ★ Large Old Trees
- ★ Very Large Old Trees
- Study Area
- Planted Non Native Vegetation
- Revegetation
- Remnant Vegetation



# Beacon Ecological

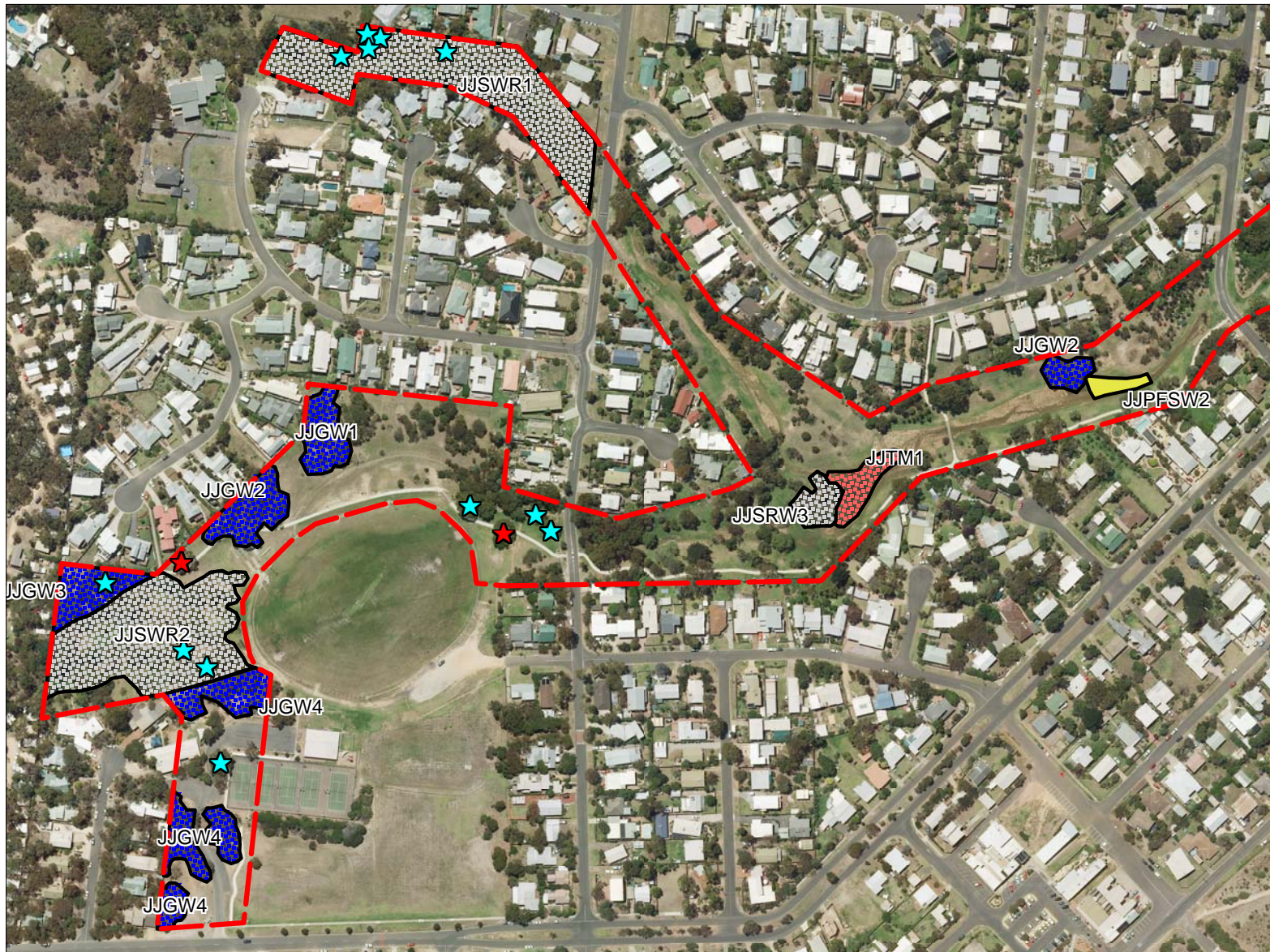
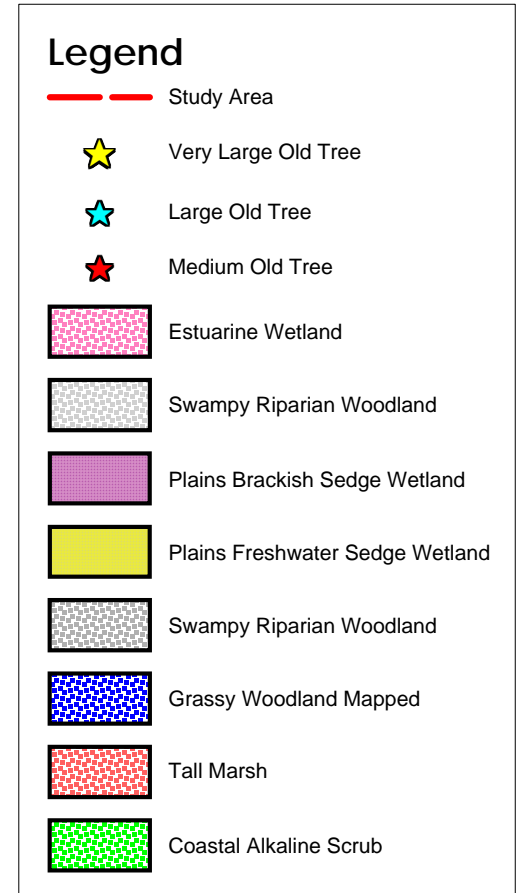


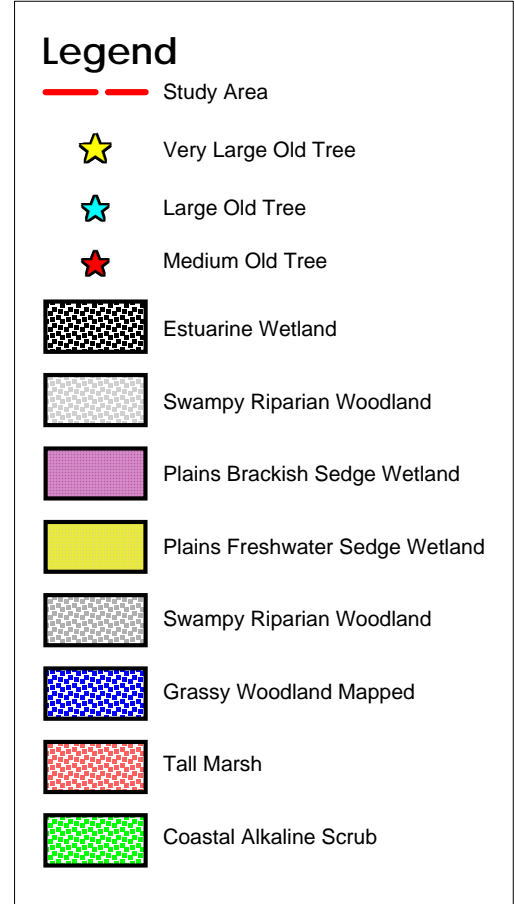
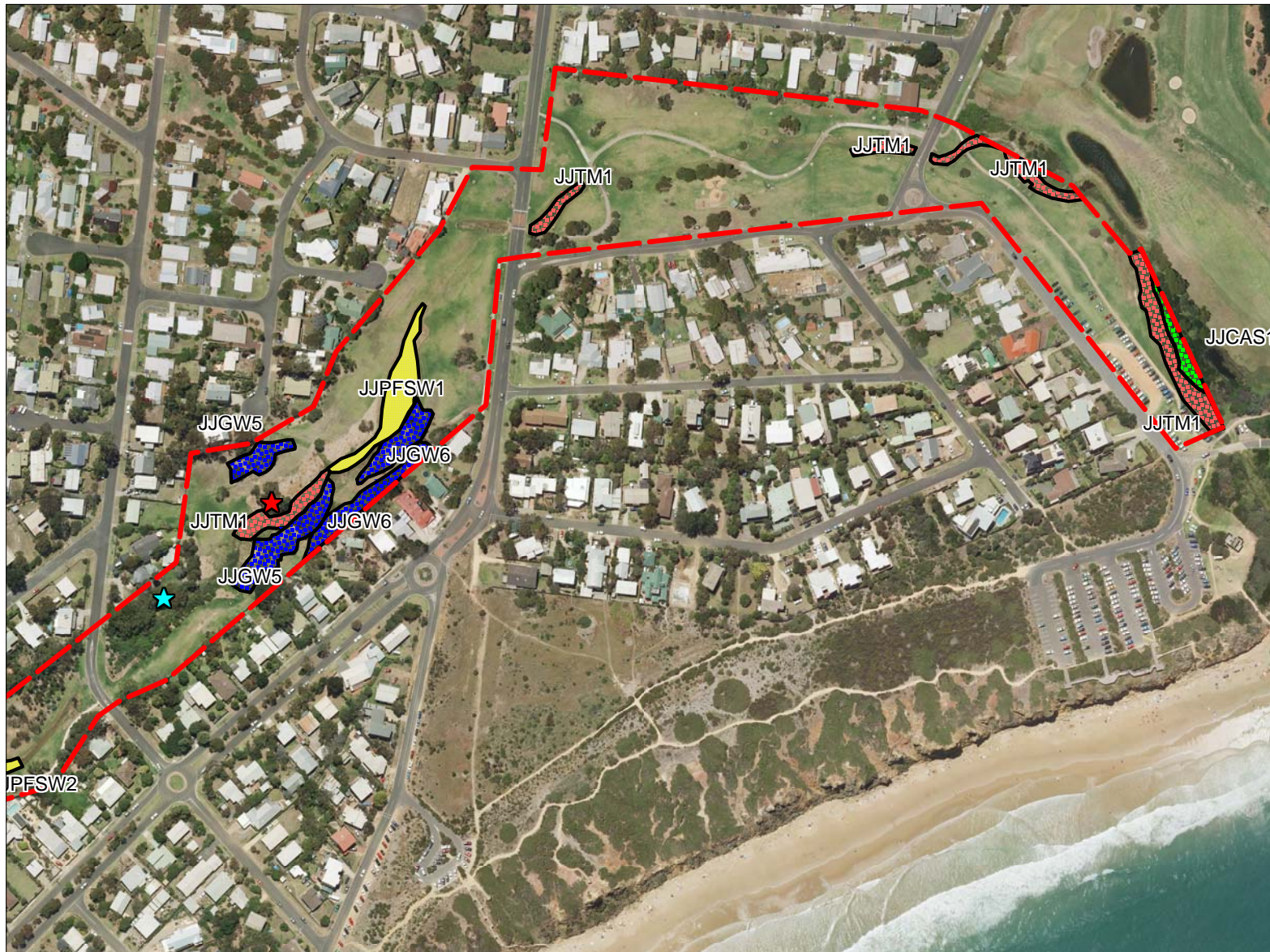
Figure 3a  
 Habitat Hectare Mapping Jan Juc Creek  
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 Scale 1:500



# Beacon Ecological



Figure 3b  
 Habitat Hectare Mapping Jan Juc Creek  
 Beacon Ecological  
 Scale 1:500



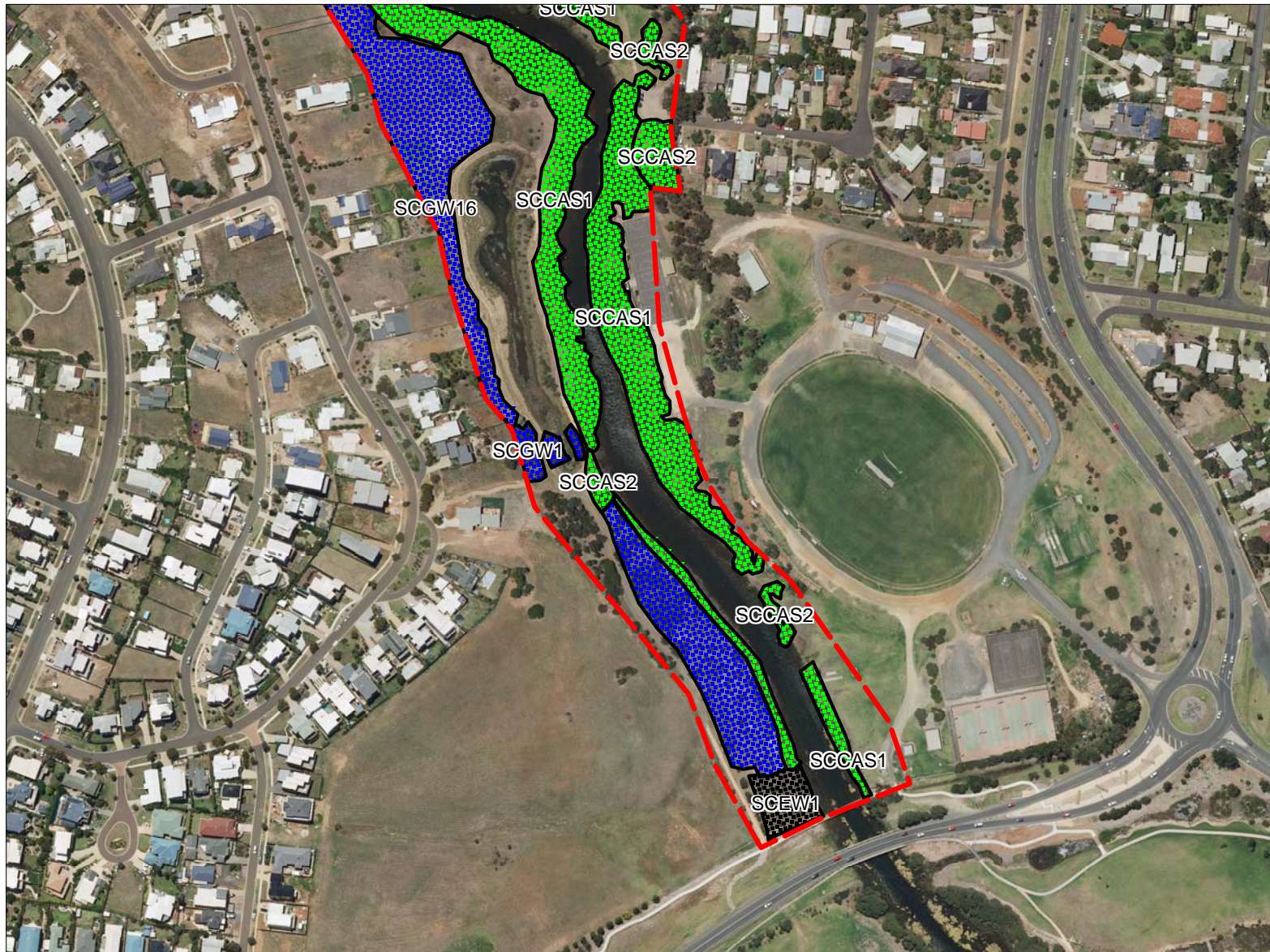
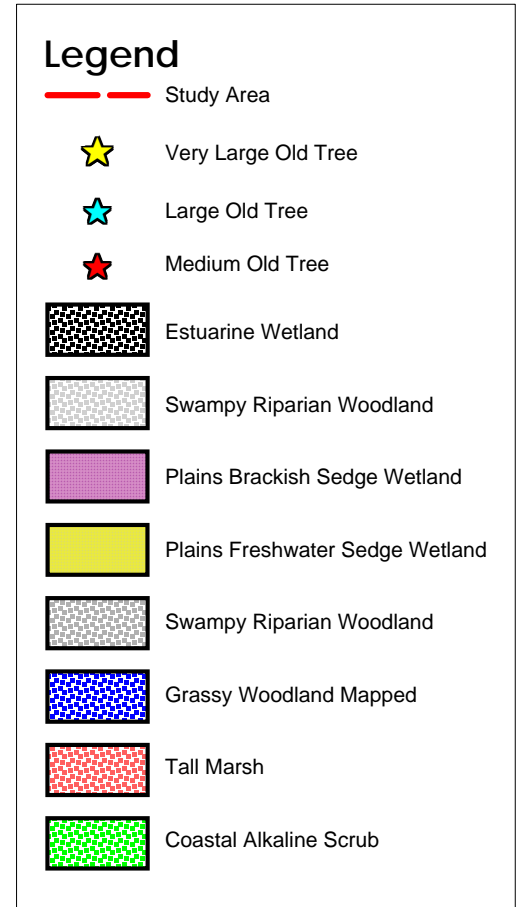


Figure 3c  
 Habitat Hectare Mapping Spring Creek  
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 Scale 1:500



# Beacon Ecological

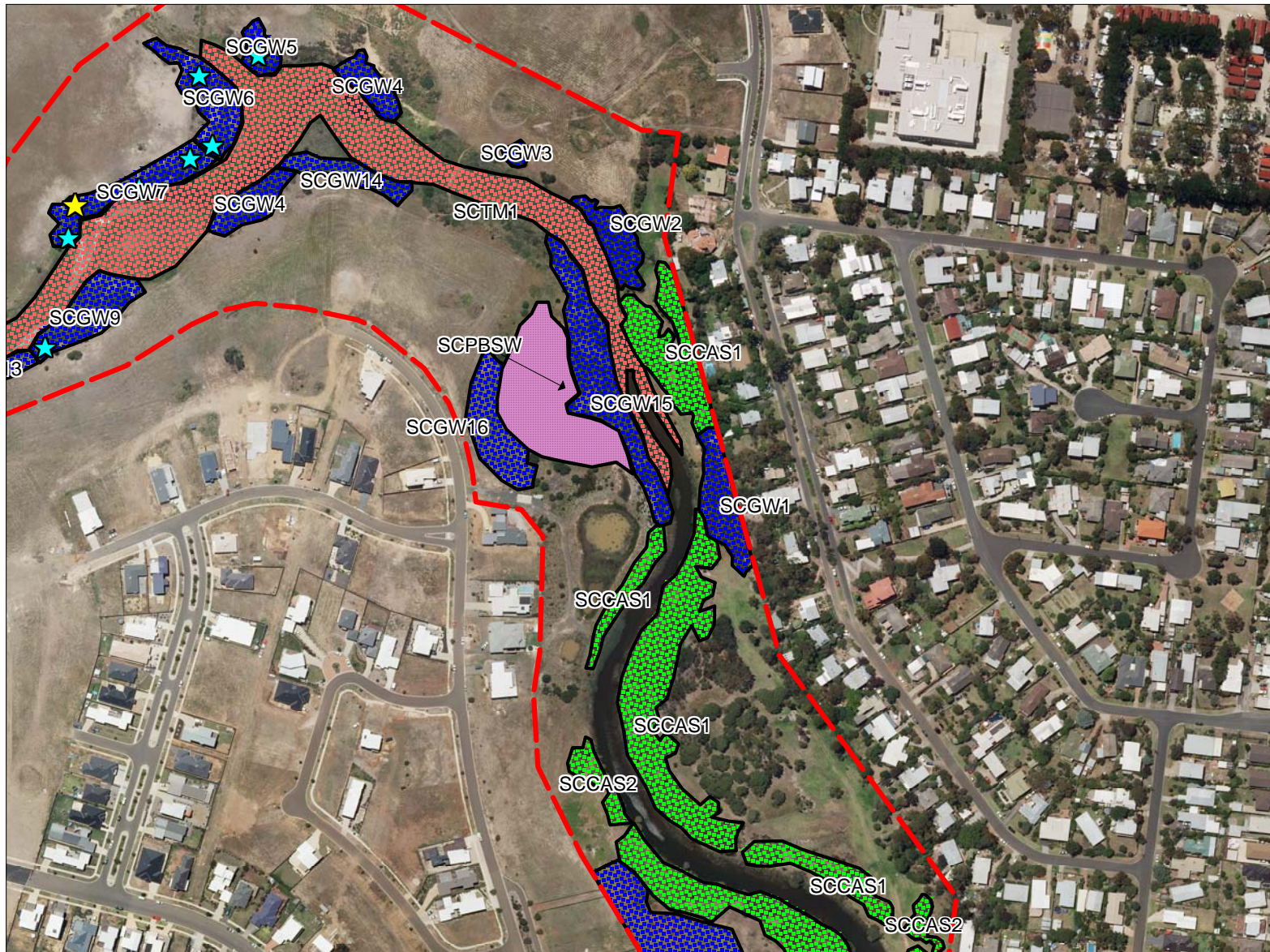


Figure 3d  
 Habitat Hectare Mapping Spring Creek  
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 Scale 1:500

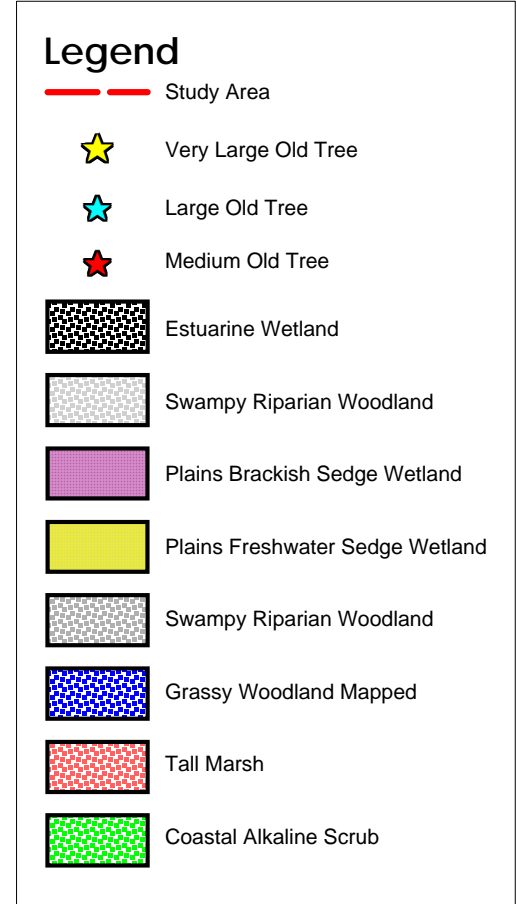
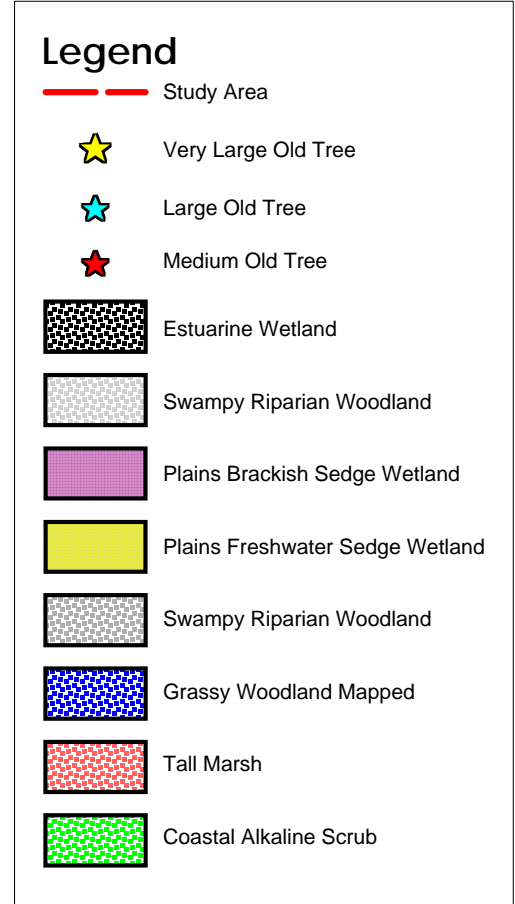
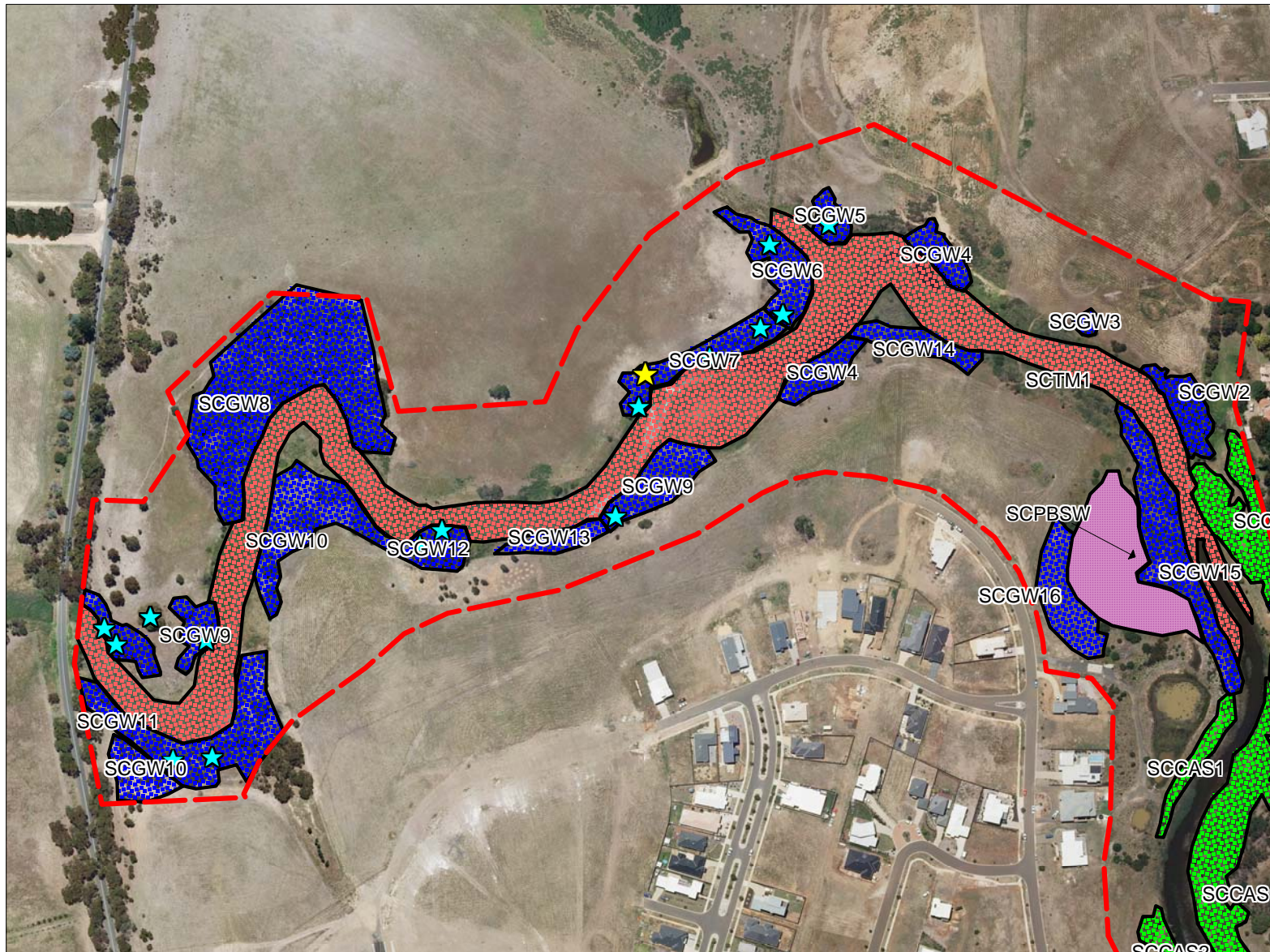


Figure 3e  
 Habitat Hectare Mapping Spring Creek  
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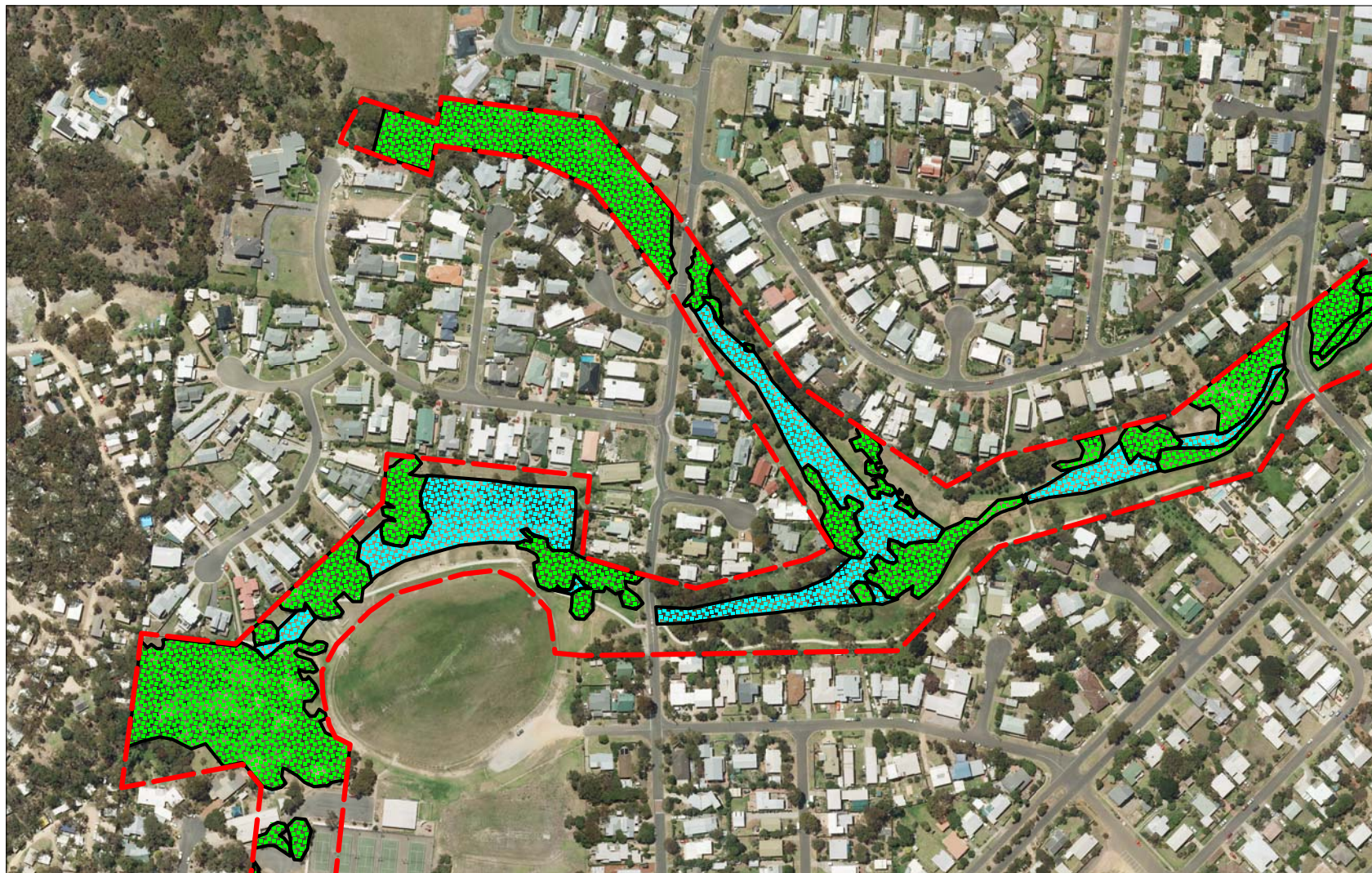


Figure 4a



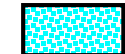
Recommended Landscape Zones

Jan Juc

Beacon Ecological

Scale 1:500

### Legend

-  Study Area
-  Conservation Zone A
-  Conservation Zone B



# Beacon Ecological

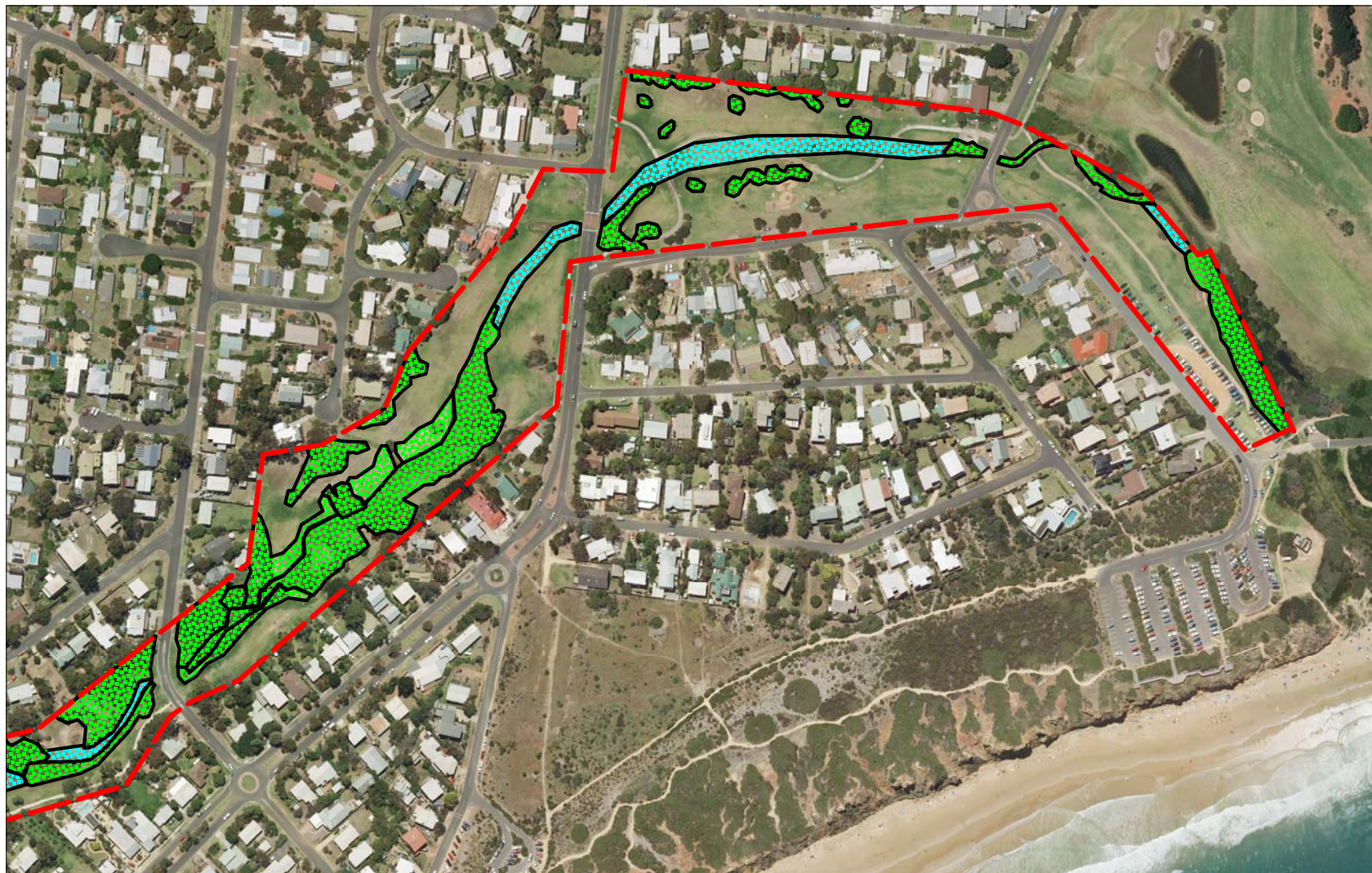
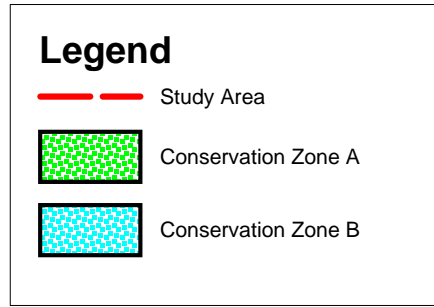


Figure 4b  
Recommended Landscape Zones  
Jan Juc  
Beacon Ecological  
Scale 1:500



# Beacon Ecological

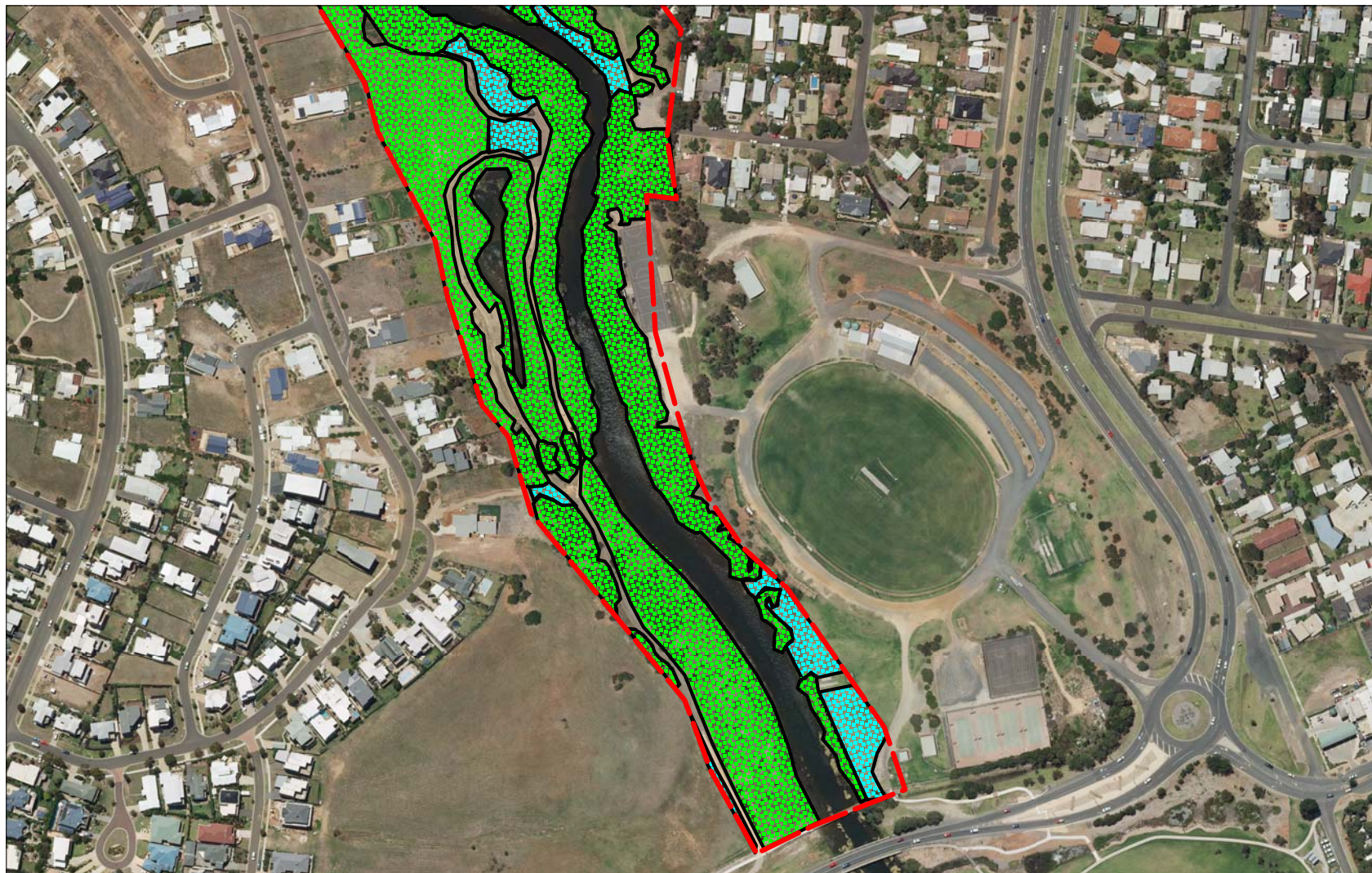
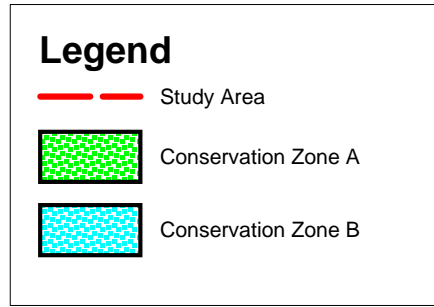


Figure 4c  
Recommended Landscape Zones  
Spring Creek  
Beacon Ecological  
Scale 1:500



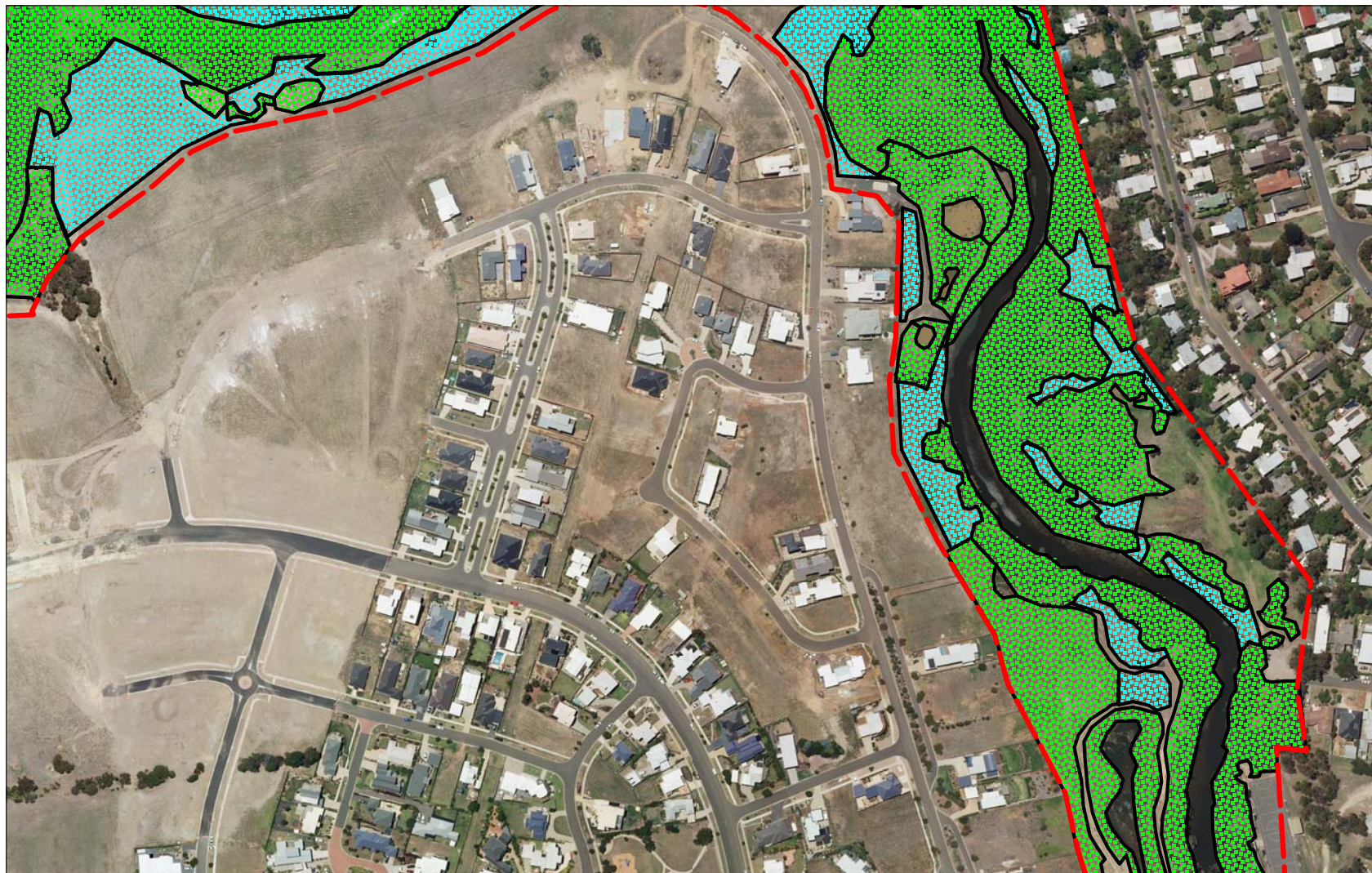
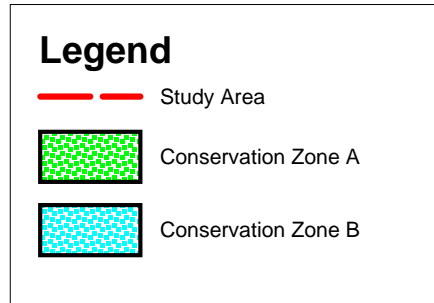


Figure 4d  
Recommended Landscape Zones  
Spring Creek  
Beacon Ecological  
Scale 1:500



**Beacon Ecological**



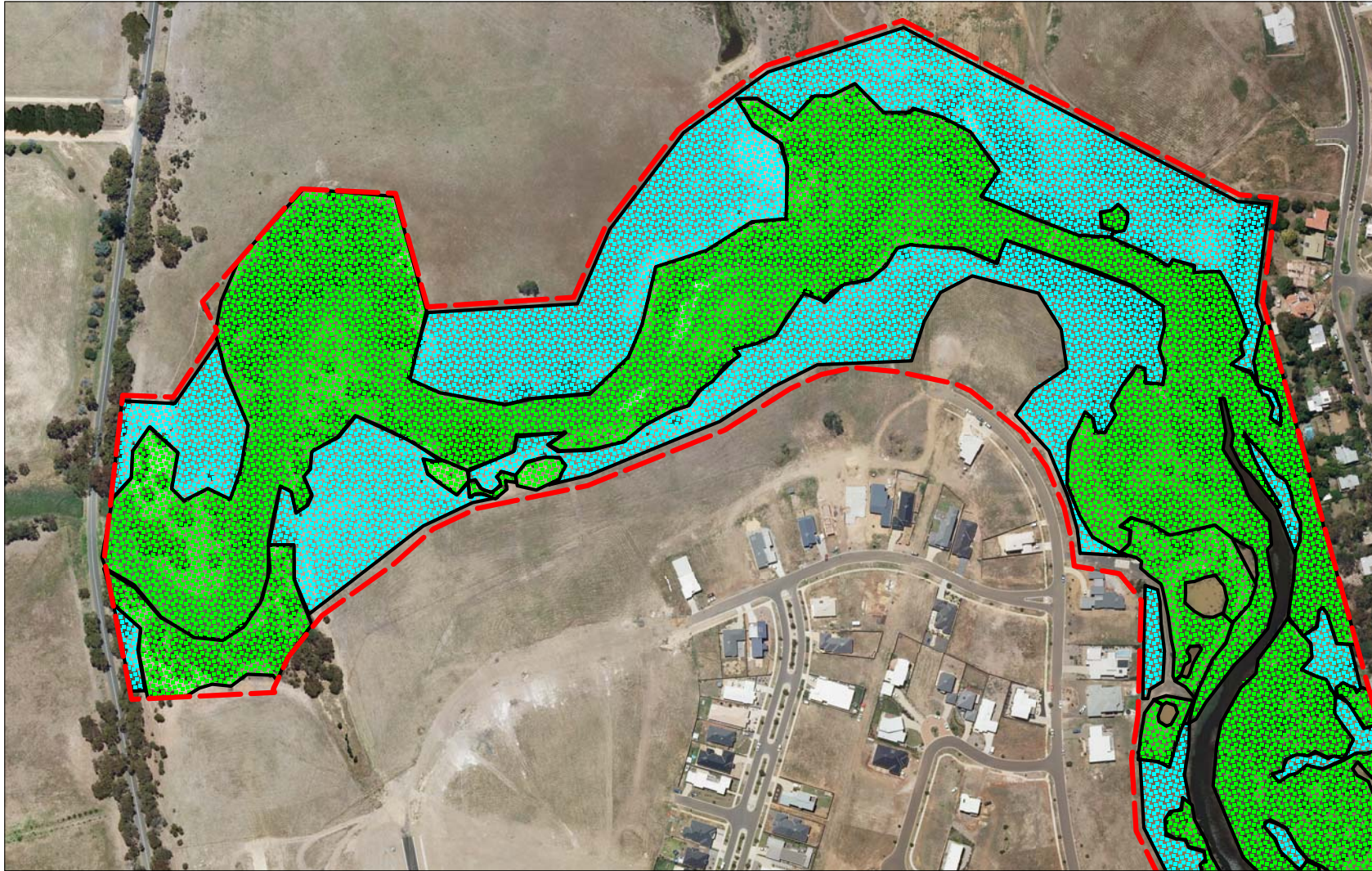
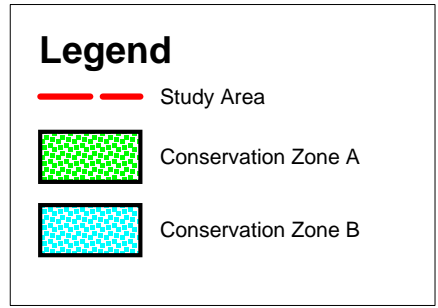


Figure 4e  
Recommended Landscape Zones  
Spring Creek  
Beacon Ecological  
Scale 1:500



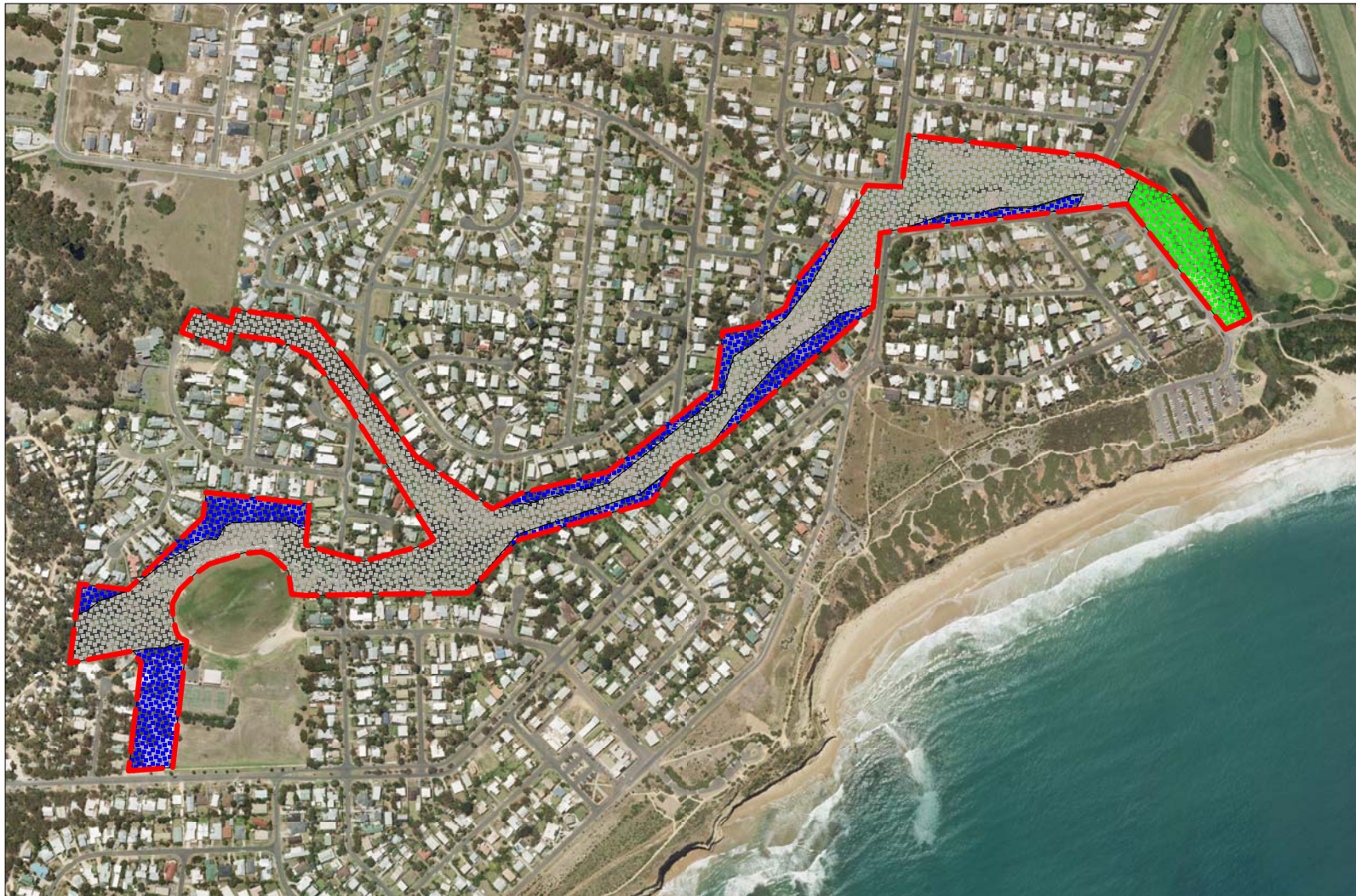


Figure 5a


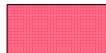

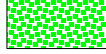
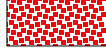

Recommended EVCs for  
Revegetation

Jan Juc Creek

Beacon Ecological

Scale 1:1000

### Legend

-  Study Area
-  Plains Brackish Sedge Wetland
-  Swampy Riparian Woodland
-  Coastal Alkaline Scrub
-  Tall Marsh
-  Grassy Woodland



# Beacon Ecological

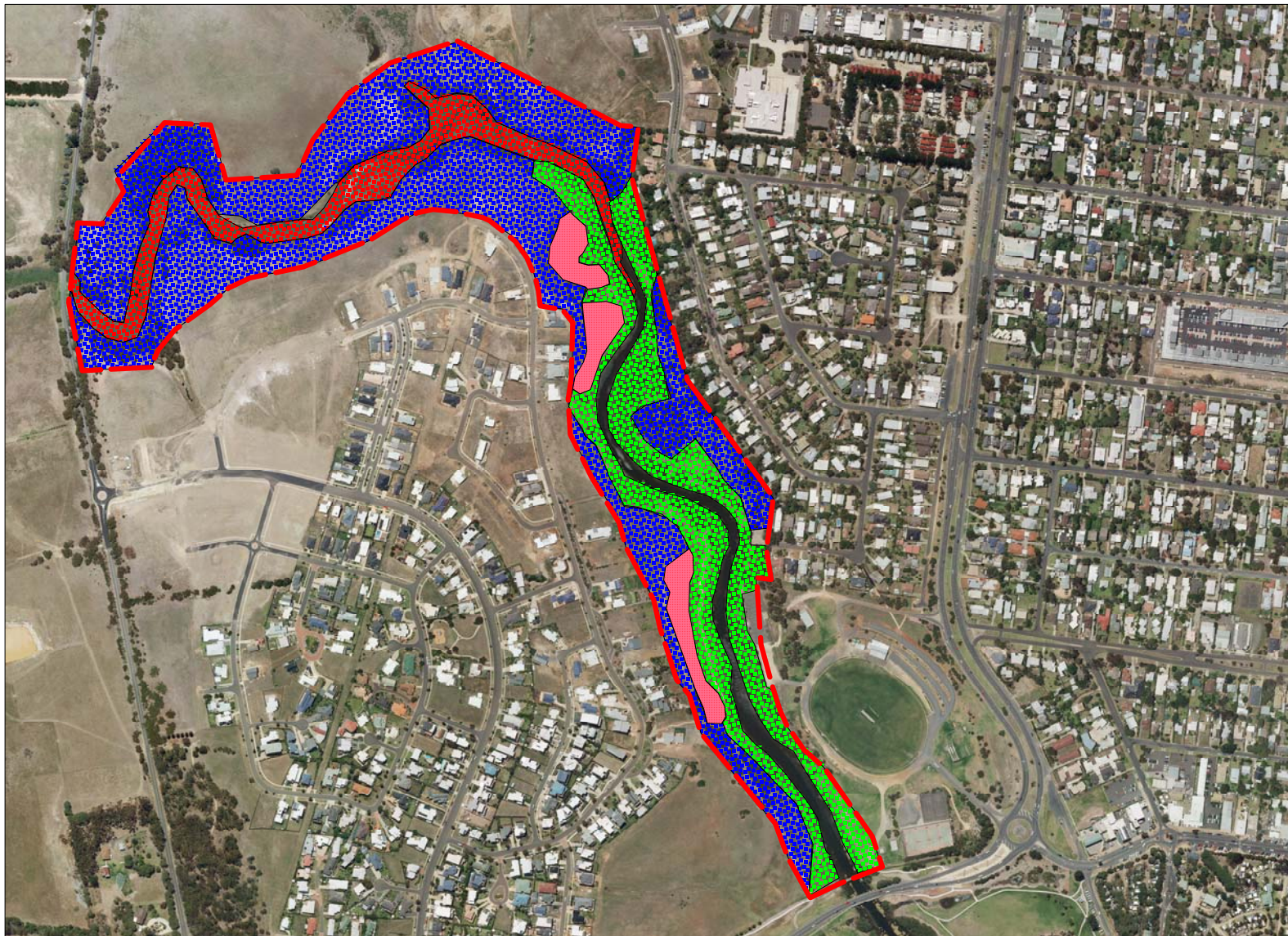


Figure 5b




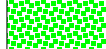
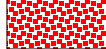

Recommended EVCs for  
Revegetation

Spring Creek

Beacon Ecological

Scale 1:1000

### Legend

-  Study Area
-  Plains Brackish Sedge Wetland
-  Swampy Riparian Woodland
-  Coastal Alkaline Scrub
-  Tall Marsh
-  Grassy Woodland



# Beacon Ecological

# APPENDIX 1

## A1 Vegetation Condition Criteria

### **Good Condition**

Vegetation of good condition is likely to support a diverse range of native floristic and structural components. Cover of introduced species is likely to be low and relevant ecosystem processes likely to be intact.

### **Moderate Condition**

Vegetation of moderate condition is likely to support some range of floristic and structural components with greater than 25% cover of introduced species. Some ecosystem processes may be present or disrupted in some way.

### **Poor Condition**

Vegetation of poor condition is likely to be dominated by introduced species with a low presence of native floristic and structural components. Relevant ecosystem processes are likely to be absent.

## APPENDIX 2

### A2.1 Grassy Woodland Planting List

Lifeform	Common Name	Scientific Name	Plants Per Hectare	Adjusted for mortality (x 1.25)
Overstorey Trees	Bellarine Yellow Gum	<i>Eucalyptus leucoxylon</i> subsp. <i>bellarinensis</i>	50	63
	Manna Gum	<i>Eucalyptus viminalis</i>		
Tree (>5m high)	Drooping Sheoak	<i>Allocasuarina verticillata</i>	150	188
	Black Wattle	<i>Acacia mearnsii</i>		
	Blackwood	<i>Acacia melanoxylon</i>		
Medium Shrub (1 to 5m high)	Prickly Tea-tree	<i>Leptospermum continentale</i>	800	1000
	Sweet Bursaria	<i>Bursaria spinosa</i>		
	Hedge Wattle	<i>Acacia paradoxa</i>		
	Golden Wattle	<i>Acacia pycnantha</i>		
	Varnish Wattle	<i>Acacia verniciflua</i>		
	Parrot Pea	<i>Dillwynia glaberrima</i>		
Small Shrub (<1m high)	Common Rice Flower	<i>Pimelea humilis</i>	500	625
	Erect Guinea Flower	<i>Hibbertia riparia</i>		
	Seaberry Saltbush	<i>Rhagodia candolleana</i>		
Ground Cover	Grey Tussock-grass	<i>Poa sieberiana</i>	1,000	1,250
	Spiny-headed Mat-rush	<i>Lomandra longifolia</i>		
	Small grass tree	<i>Xanthorrhoea minor</i>		
	*Common Tussock-grass	<i>Poa labillardierei</i>		
<b>TOTAL</b>			<b>2,500</b>	<b>3,125</b>

\* To be planted in water logged area or creek edge only.

### A2.2 Swampy Riparian Woodland Planting List

Lifeform	Common Name	Scientific Name	Plants Per Hectare	Adjusted for mortality (x 1.25)
Overstorey Trees	Swamp Gum	<i>Eucalyptus ovata</i>	50	63
	Manna Gum	<i>Eucalyptus viminalis</i>		
Tree (>5m high)	Golden Wattle	<i>Acacia pycnantha</i>	150	188
	Black Wattle	<i>Acacia mearnsii</i>		
	Blackwood	<i>Acacia melanoxylon</i>		
Medium Shrub (1 to 5m high)	Prickly Moses	<i>Acacia verticillata</i>	400	500
	Woolly Tea-tree	<i>Leptospermum lanigerum</i>		
	Sweet Bursaria	<i>Bursaria spinosa</i>		
	Varnish Wattle	<i>Acacia verniciflua</i>		
	Coast Beard Heath	<i>Leucopogon parviflorus</i>		
	Kangaroo Apple	<i>Solanum laciniatum</i>		
Ground Cover	Spiny-headed Mat-rush	<i>Lomandra longifolia</i>	2,500	3,125
	Common Tussock-grass	<i>Poa labillardierei</i>		
	Tall Rush	<i>Juncus procerus</i>		
	Pale Rush	<i>Juncus pallidus</i>		
	Tall Sedge	<i>Carex appressa</i>		
<b>TOTAL</b>			<b>3,100</b>	<b>3,875</b>

### A2.3 Coastal Alkaline Scrub Planting List

Lifeform	Common Name	Scientific Name	Plants Per Hectare	Adjusted for mortality (x 1.25)
Medium Shrub (1 to 5m high)	Moonah	<i>Melaleuca lanceolata</i>	800	1,000
	Drooping Sheoak	<i>Allocasuarina verticillata</i>		
	Sweet Bursaria	<i>Bursaria spinosa</i>		
	Prickly Moses	<i>Acacia verticillata</i>		
	Coast Beard Heath	<i>Leucopogon parviflorus</i>		
	Inland Pomaderris	<i>Pomaderris paniculosa</i> ssp. <i>paralia</i>		
Small Shrub	Seaberry Saltbush	<i>Rhagodia candolleana</i>	200	250
	Gold Dust Wattle	<i>Acacia acinacea</i>		
Ground Cover	Spiny-headed Mat-rush	<i>Lomandra longifolia</i>	500	625
	Sea Rush*	<i>Juncus kraussii</i>		
	Bower Spinach	<i>Tetragonia implexicoma</i>		
	Blue Tussock Grass	<i>Poa poiformis</i>		
	Chaffy Saw-sedge*	<i>Gahnia filum</i>		
<b>TOTAL</b>			<b>1,500</b>	<b>1,875</b>

\* To be planted in water logged area or creek edge only.

## APPENDIX 3

### A3.1 Spring Creek Flora List from previous surveys

SCIENTIFIC NAME	COMMON NAME	Kimber et al 2001	Costello 2007	Moulton and Spittle 2007	Carr 1999
<b>NATIVE SPECIES</b>					
<i>Acacia mearnsii</i>	Black Wattle	*	*		
<i>Acacia paradoxa</i>	Hedge Wattle	*	*		*
<i>Acacia pycnantha</i>	Golden Wattle	*	*		*
<i>Acacia verniciflua</i>	Varnish Wattle	*	*		
<i>Acacia verticillata</i>	Prickly Moses	*	*		
<i>Acaena agnipila</i>	Hairy Sheep's Burr				*
<i>Acaena echinata</i>	Sheep's Burr		*		
<i>Acaena novae-zelandiae</i>	Bidgee-widgee		*		
<i>Acaena ovina</i>	Australian Sheep's Burr				*
<i>Allocasuarina verticillata</i>	Drooping Sheoak	*	*		*
<i>Apium prostratum</i> subsp. <i>prostratum</i>	Sea Celery	*	*		
<i>Arthropodium</i> spp. (s.s.)	Vanilla Lily	*	*		
<i>Arthropodium strictum</i> s.l.	Chocolate Lily				*
<i>Asperula conferta</i>	Common Woodruff	*	*		
<i>Astroloma humifusum</i>	Cranberry Heath	*			
<i>Austrodanthonia duttoniana</i>	Brown-back Wallaby- grass	*			
<i>Austrodanthonia geniculata</i>	Kneed Wallaby-grass				*
<i>Austrodanthonia racemosa</i> var. <i>racemosa</i>	Stiped Wallaby-grass		*		*
<i>Austrodanthonia setacea</i>	Bristly Wallaby-grass	*	*		
<i>Austrostipa</i> spp.	Spear Grass	*	*		*
<i>Austrostipa mollis</i>	Supple Spear-grass				*
<i>Bossiaea prostrata</i>	Creeping Bossiaea	*	*		*
<i>Burchardia umbellata</i>	Milkmaids		*		*
<i>Bursaria spinosa</i>	Sweet Bursaria	*	*		*
<i>Calocephalus lacteus</i>	Milky Beauty-heads	*			
<i>Carex appressa</i>	Tall Sedge	*			
<i>Carex breviculmis</i>	Common Grass-sedge				*
<i>Carex</i> spp.	Sedge	*			
<i>Clematis microphylla</i>	Small-leaved Clematis	*			*
<i>Convolvulus erubescens</i> spp. agg.	Pink Bindweed	*	*		*
<i>Coprosma quadrifida</i>	Prickly Currant-bush	*			

SCIENTIFIC NAME	COMMON NAME	Kimber et al 2001	Costello 2007	Moulton and Spittle 2007	Carr 1999
<i>Crassula decumbens</i> var. <i>decumbens</i>	Spreading Crassula		*		*
<i>Cynoglossum suaveolens</i>	Sweet Hound's-tongue	*	*		
<i>Dianella brevicaulis</i>	Small-flower Flax-lily	*	*	*	*
<i>Dianella revoluta</i> s.l.	Black-anther Flax-lily	*	*		
<i>Dichondra repens</i>	Kidney-weed	*	*		*
<i>Distichlis distichophylla</i>	Australian Salt-grass	*	*		
<i>Drosera glanduligera</i>	Scarlet Sundew	*			
<i>Drosera peltata</i>	Pale Sundew				*
<i>Drosera whittakeri</i> subsp. <i>aberrans</i>	Scented Sundew	*			
<i>Einadia nutans</i> subsp. <i>nutans</i>	Nodding Saltbush	*	*		
<i>Eleocharis sphacelata</i>	Tall Spike-sedge	*			
<i>Elymus scaber</i> var. <i>scaber</i>	Common Wheat-grass		*		*
<i>Epilobium</i> spp.	Willow Herb	*			
<i>Eucalyptus leucoxyton</i> subsp. <i>bellarinensis</i>	Bellarine Yellow-gum	*	*	*	*
<i>Eucalyptus viminalis</i> subsp. <i>prioriana</i>	Manna Gum	*	*		*
<i>Gahnia filum</i>	Chaffy Saw-sedge	*			
<i>Geranium retrorsum</i> s.l.	Grassland Cranesbill	*	*		
<i>Geranium solanderi</i> s.l.	Austral Cranesbill				*
<i>Gonocarpus tetragynus</i>	Common Raspwort	*	*		*
<i>Goodenia ovata</i>	Hop Goodenia	*			
<i>Hypoxis vaginata</i> var. <i>brevistigmata</i>	Yellow Star				*
<i>Isolepis cernua</i> var. <i>cernua</i>	Nodding Club-sedge	*			
<i>Juncus kraussii</i> subsp. <i>australiensis</i>	Sea Rush	*			
<i>Juncus pallidus</i>	Pale Rush	*	*		*
<i>Juncus subsecundus</i>	Finger Rush	*			
<i>Lepidosperma curtisiae</i>	Little Sword-sedge		*		
<i>Lepidosperma semiteres</i>	Wire Rapier-sedge	*			
<i>Leucopogon parviflorus</i>	Coast Beard-heath	*	*		*
<i>Lissanthe strigosa</i> subsp. <i>subulata</i>	Peach Heath	*	*		*
<i>Lobelia</i> spp.	Lobelia	*			
<i>Lomandra filiformis</i> subsp. <i>coriacea</i>	Wattle Mat-rush	*	*		*
<i>Lomandra longifolia</i>	Spiny-headed Mat-rush	*	*		
<i>Lomandra micrantha</i> s.l.	Small-flower Mat-rush		*		
<i>Lotus</i> spp.	Trefoil	*			
<i>Lythrum hyssopifolia</i>	Small Loosestrife	*			



SCIENTIFIC NAME	COMMON NAME	Kimber et al 2001	Costello 2007	Moulton and Spittle 2007	Carr 1999
<i>Malva</i> spp.	Mallow	*			
<i>Melaleuca lanceolata</i> subsp. <i>lanceolata</i>	Moonah	*		*	*
<i>Microlaena stipoides</i> var. <i>stipoides</i>	Weeping Grass	*	*		*
<i>Microtis</i> spp.	Onion Orchid	*			*
<i>Neopaxia australasica</i>	White Purslane	*			
<i>Oxalis corniculata</i> s.l.	Yellow Wood-sorrel	*			
<i>Oxalis exilis</i>	Shady Wood-sorrel				*
<i>Oxalis perennans</i>	Grassland Wood-sorrel		*		
<i>Phragmites australis</i>	Common Reed	*	*		
<i>Pimelea humilis</i>	Common Rice-flower	*	*		*
<i>Plantago varia</i>	Variable Plantain				*
<i>Poa labillardierei</i>	Common Tussock-grass	*	*		*
<i>Poa morrisii</i>	Soft Tussock-grass				*
<i>Poa poliformis</i>	Coast Tussock-grass	*	*		
<i>Poa rodwayi</i>	Velvet Tussock-grass		*		
<i>Poa sieberiana</i>	Grey Tussock-grass		*		
<i>Poa</i> spp.	Tussock Grass	*			
<i>Pteridium esculentum</i>	Austral Bracken	*	*		
<i>Ranunculus</i> spp.	Buttercup				*
<i>Rhagodia candolleana</i> subsp. <i>candolleana</i>	Seaberry Saltbush	*	*	*	*
<i>Rumex brownii</i>	Slender Dock				*
<i>Samolus repens</i>	Creeping Brookweed	*			
<i>Sarcocornia quinqueflora</i>	Beaded Glasswort	*			
<i>Schoenus nitens</i>	Shiny Bog-sedge				*
<i>Senecio glomeratus</i>	Annual Fireweed	*			
<i>Solanum laciniatum</i>	Large Kangaroo Apple	*	*		
<i>Tetragonia implexicoma</i>	Bower Spinach	*	*	*	*
<i>Themeda triandra</i>	Kangaroo Grass	*	*	*	*
<i>Tricoryne elatior</i>	Yellow Rush-lily	*	*		
<i>Triglochin procera</i> s.l.	Water Ribbons	*			
<i>Triglochin striata</i>	Streaked Arrowgrass	*			
<i>Typha domingensis</i>	Narrow-leaf Cumbungi	*			
<i>Xanthorrhoea minor</i> subsp. <i>lutea</i>	Small Grass-tree	*	*		
<b>INTRODUCED SPECIES</b>					
<i>Acacia saligna</i>	Golden Wreath Wattle	*			*
<i>Acetosella vulgaris</i>	Sheep Sorrel	*			
<i>Agrostis</i> s.l. spp.	Bent/Blown Grass	*	*		

SCIENTIFIC NAME	COMMON NAME	Kimber et al 2001	Costello 2007	Moulton and Spittle 2007	Carr 1999
<i>Aira spp.</i>	Hair Grass	*	*		*
<i>Agapanthus praecox subsp. orientalis</i>	Agapanthus				*
<i>Allium triquetrum</i>	Three-corner Garlic	*			*
<i>Anagallis arvensis</i>	Pimpernel	*	*		
<i>Anthoxanthum odoratum</i>	Sweet Vernal-grass		*		
<i>Aphanes arvensis</i>		*			*
<i>Arctotheca calendula</i>	Cape Weed	*	*		*
<i>Asparagus asparagoides</i>	Bridal Creeper	*			
<i>Aster subulatus</i>	Aster-weed	*			
<i>Atriplex prostrata</i>	Hastate Orache	*			
<i>Briza maxima</i>	Large Quaking-grass	*	*		*
<i>Bromus diandrus</i>	Great Brome	*	*		*
<i>Catapodium rigidum</i>	Fern Grass	*			
<i>Centaureum erythraea</i>	Common Centaury		*		*
<i>Centaureum tenuiflorum</i>	Slender Centaury	*	*		
<i>Chenopodium murale</i>	Sowbane	*			
<i>Chrysanthemoides monilifera</i>	Boneseed	*	*		*
<i>Cirsium arvense</i>	Perennial Thistle	*			
<i>Cirsium vulgare</i>	Spear Thistle		*		
<i>Coprosma repens</i>	Mirror Bush	*	*		*
<i>Corymbia ficifolia</i>	Spotted Gum	*			
<i>Cotoneaster glaucophyllus var. serotinus</i>	Large-leaf Cotoneaster	*			
<i>Cotoneaster pannosus</i>	Velvet Cotoneaster	*			
<i>Cotula coronopifolia</i>	Water Buttons	*			
<i>Crassula multicava ssp. Multicava</i>		*			
<i>Crassula tetragona subsp. robusta</i>	Shrubby Crassula	*	*		
<i>Cupressus sempervirens 'Stricta'</i>	Pencil Pine	*			
<i>Cynodon dactylon var. dactylon</i>	Couch	*			*
<i>Cynosurus echinatus</i>	Rough Dog's-tail	*			*
<i>Dactylis glomerata</i>	Cocksfoot	*	*		*
<i>Ehrharta erecta var. erecta</i>	Panic Veldt-grass	*	*		*
<i>Ehrharta longiflora</i>	Annual Veldt-grass	*	*		
<i>Erodium botrys</i>	Big Heron's-bill	*			
<i>Erodium cicutarium</i>	Common Heron's-bill	*			
<i>Euphorbia peplus</i>	Petty Spurge	*			
<i>Foeniculum vulgare</i>	Fennel	*			
<i>Fumaria indica</i>	Indian Fumitory	*			*

SCIENTIFIC NAME	COMMON NAME	Kimber et al 2001	Costello 2007	Moulton and Spittle 2007	Carr 1999
<i>Galium aparine</i>	Cleavers		*		
<i>Galium murale</i>	Small Goosegrass	*			
<i>Gazania linearis</i>	Gazania				*
<i>Gladiolus undulatus</i>	Wild Gladiolus	*	*		*
<i>Helminthotheca echioides</i>	Ox-tongue	*			
<i>Holcus lanatus</i>	Yorkshire Fog	*	*		*
<i>Hypochoeris glabra</i>	Smooth Cat's-ear				*
<i>Hypochoeris radicata</i>	Cat's Ear	*	*		
<i>Lagurus ovatus</i>	Hare's-tail Grass	*			
<i>Lepidium africanum</i>	Common Peppergrass	*			
<i>Lolium perenne</i>	Perennial Rye-grass				*
<i>Lolium rigidum</i>	Wimmera Rye-grass	*	*		*
<i>Lycium ferocissimum</i>	African Box-thorn	*	*		
<i>Marrubium vulgare</i>	Horehound	*			
<i>Medicago polymorpha</i>	Burr Medic	*			
<i>Nassella neesiana</i>	Chilean Needle-grass	*			
<i>Nassella trichotoma</i>	Serrated Tussock		*		*
<i>Oxalis pes-caprae</i>	Soursob	*	*		*
<i>Paspalum dilatatum</i>	Paspalum	*			*
<i>Pennisetum clandestinum</i>	Kikuyu	*	*		*
<i>Phalaris aquatica</i>	Toowoomba Canary-grass	*	*		*
<i>Pinus radiata</i>	Radiata Pine	*			
<i>Plantago coronopus</i>	Buck's-horn Plantain	*	*		*
<i>Plantago lanceolata</i>	Ribwort	*	*		*
<i>Polycarpon tetraphyllum</i>	Four-leaved Allseed	*			
<i>Polygala myrtifolia</i> var. <i>myrtifolia</i>	Myrtle-leaf Milkwort	*			
<i>Raphanus raphanistrum</i>	Wild Radish	*			
<i>Rhamnus alaternus</i>	Italian Buckthorn	*	*		
<i>Romulea rosea</i>	Onion Grass	*	*		*
<i>Rosa rubiginosa</i>	Sweet Briar	*	*		*
<i>Rubus fruticosus</i> spp. agg.	Blackberry	*			
<i>Rumex crispus</i>	Curled Dock	*			
<i>Silene</i> spp.	Catchfly				*
<i>Solanum nigrum</i> s.s.	Black Nightshade	*			
<i>Sonchus asper</i> s.l.	Rough Sow-thistle	*			*
<i>Sonchus oleraceus</i>	Common Sow-thistle	*	*		*
<i>Sporobolus indicus</i>	Rats Tail Grass	*	*		*
<i>Stellaria media</i>	Chickweed	*			*
<i>Stenotaphrum secundatum</i>	Buffalo Grass	*			

SCIENTIFIC NAME	COMMON NAME	Kimber et al 2001	Costello 2007	Moulton and Spittle 2007	Carr 1999
<i>Trifolium dubium</i>	Suckling Clover				*
<i>Trifolium repens var. repens</i>	White Clover	*			
<i>Trifolium spp.</i>	Clover	*			
<i>Trifolium subterraneum</i>	Subterranean Clover	*	*		*
<i>Ulex europaeus</i>	Gorse	*			
<i>Vicia sativa</i>	Common Vetch	*			
<i>Viola odorata</i>	Common Violet				*
<i>Vulpia spp.</i>	Fescue				*
<i>Watsonia spp.</i>	Watsonia	*			*
<i>Acacia longifolia subsp. longifolia</i>	Sallow Wattle	*			
<i>Acacia longifolia subsp. sophorae</i>	Coast Wattle	*	*		*
<i>Leptospermum laevigatum</i>	Coast Tea-tree	*			*
<i>Melaleuca armillaris subsp. armillaris</i>	Giant Honey-myrtle	*			
<i>Myoporum insulare</i>	Common Boobiolla	*			
<i>Pittosporum undulatum</i>	Sweet Pittosporum	*			*
<i>Acacia acinacea s.l.</i>	Gold-dust Wattle	*			
<i>Acrotriche serrulata</i>	Honey-pots	*			
<i>Ficinia nodosa</i>	Knobby Club-Rush	*	*		*

\* Denotes recorded during survey,

Note: This flora list is compiled from flora lists of previous surveys which covered the spring creek study area and surrounding areas. As this list includes species found away from the creek corridor it should not be used as a planting guide. Species to be used as planting guides can be found in Appendix 2. Carr 1999 taken from Kimber et al.

## APPENDIX 4

### A4.1 Revegetation Checklist

1. **Determine community interest.** Is there enough interest from the local community to undertake a revegetation project?
2. **Determine Revegetation Location.** If sufficient interest determine appropriate revegetation site taking into account habitat linkages, conservation zoning, community needs, high priority sites, aesthetics, education value.
3. **Seek consent.** Check with the Surf Coast Shire and local residents to ensure that the revegetation project will not cause maintenance problems or issues with nearby neighbors.
4. **Seek funding.** When seeking funding take into account sufficient support for adequate site preparation and follow up work. Also at this stage set goals that can be measured at a later date to determine success.
5. **Source plants.** Ensure enough time to grow seedlings and that plants are of local provenance.
6. **Prepare site.** Ensure that adequate weed control is implemented prior to any planting.
7. **Implement Revegetation.** Plant during spring or autumn to ensure best survivorship results.
8. **Follow up maintenance.** Follow up maintenance is imperative to any revegetation project and must always be allowed for.
9. **Monitoring.** Undertake monitoring of the project site to measure against predetermined indicators of success and undertake replacement plantings and additional weed control or fencing if required.
10. **Celebrate!** Take before and after photos to document group successes and send media releases to local publications to let the community know of your environmental successes.