Identifying the Biodiversity Attributes of the Plantation Estate and its contribution to Biodiversity Conservation in the Green Triangle Region
ACKNOWLEDGEMENTS

This project was funded by the Green Triangle Regional Plantation Committee, following the publication of six case study sites within the region in the brochure ‘Protecting and enhancing biodiversity in a plantation landscape’ in March 2006.

The project was undertaken with the valued assistance, support and advice of staff of the South East Resource Information Centre (SERIC), HVP Plantations, Greening Australia South Australia, Greening Australia Victoria, the Green Triangle Regional Plantation Committee and its members including, ForestrySA and Primary Industries and Resources (South Australia) – Forestry (PIRSA Forestry), Department of Primary Industries (Victoria), plantation companies including Auspine, Great Southern, Green Triangle Forest Products, Integrated Tree Cropping, Timbercorp and WA Plantation Resources, and other plantation owners in the Green Triangle region.

**Green Triangle Regional Plantation Committee: (www.gtplantations.org)**

The GTRPC brings together a range of stakeholders and interested parties (growers, processors, State and local government, natural resource managers, farm foresters, consultants, etc.) in the plantation sector from across the region, to work on issues addressing planning, infrastructure, education, training and promotion of forest-based industries and associated enterprises.

The GTRPC has a vision: ‘A sustainable forestry sector providing long-term economic, environmental and social benefits to the Green Triangle region.’

**Greening Australia: (www.greeningaustralia.org.au)**

Greening Australia’s mission is to ‘engage the community in vegetation management to protect and restore the health, diversity and productivity of our unique Australian landscapes.’

With a network of over 300 staff in 80 locations across the continent, we tackle critical issues like salinity, declining water quality, soil degradation, climate change and biodiversity loss through an innovative blend of practical experience, science, community engagement and commitment. We adopt a partnership model working with landholders, the community, government and business to tackle environmental degradation in a practical, apolitical, scientific way.

Prepared by Jeremy Freeman and David Warne
February 2008

**DISCLAIMER**

This report identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
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1. EXECUTIVE SUMMARY

This report, the first of its type, examines the potential habitat value of native vegetation existing within the plantation estate and how it contributes towards biodiversity conservation in the Green Triangle region. This was achieved by analyzing digital data information across the plantation estate using a variety of data from plantation owners, government agencies and other commercially available geographic information systems (GIS).

The project consisted of four stages. The first was an inventory of land use within the total plantation estate (both Radiata Pine (Pinus radiata) and Tasmanian Blue Gum (Eucalyptus globulus)) in the Green Triangle region. The plantation estate land was classified into three categories as follows:

- Plantation (Radiata Pine, Tasmanian Blue Gum), or
- Infrastructure (roads, buildings, fire breaks, dams etc.), or
- Reserve Area (potential conservation areas including remnant native vegetation and cleared lands, swamps, etc, not suitable for plantation forestry).

Within the total plantation estate of 377,000 hectares in 2006, 11% or 42,000 ha was classified as Reserve Areas of which 33,000 ha was remnant native vegetation, and 9,000 ha was either swamps and wetlands or cleared land not suitable for commercial tree growing but suitable for revegetation of local native species.

The second stage of the project ranked, using a range of standard GIS derived landscape metrics or attributes, the potential habitat value of the 42,000 ha of Reserve Areas; the higher the ranking the more valuable the habitat. The results showed that 71.5% (over 30,000 ha) of the Reserve Areas were in the top 40% of the scoring system indicating that these areas were of significant biodiversity value.

The third stage used neighbourhood relationships and proximity to identify individual zones, where protection and enhancement would be of greatest benefit to the regional corridors and networks with these zones being able to connect or expand the region’s large (>2000 ha) Core Remnants of native vegetation.

Twenty one Core Connectivity Zones were identified within plantations that could act as “ecological stepping stones” between large native vegetation Core Remnants outside the gross plantation estate. These Core Connectivity Zones were almost exclusively in the Victorian portion of the Green Triangle region, and mostly through the recently established Tasmanian Blue Gum plantations. In addition, another seventeen Core Expansion Zones were identified, occurring both in South Australia and Victoria, adjacent to significant vegetation remnants enabling the consolidation of neighbouring native vegetation Core Remnants or creating potential linkage between disparate parts of the same remnant.

On-ground surveys of the connectivity and expansion zones are recommended to further develop knowledge and to develop potential management plans for the region’s natural resource managers.

The fourth stage of the report concludes with some suggested future actions and potential collaborative partners and funding sources to support conservation activities in priority zones.
The plantation industry is potentially a major partner in the development of large landscape conservation initiatives, complementing the industry’s existing environmental resources and other natural resource managers currently managing significant areas of native vegetation and wildlife habitat. Through partnerships, it may be possible to actively manage the native vegetation Core Remnants or create new native vegetation corridors to connect, expand and enhance critical wildlife habitat in the Green Triangle region through the plantation estate.

Recommendations of future benefits for regional biodiversity conservation:

- Prioritization of areas for on-ground conservation activities,
- On-ground surveys and development of management plans for identified high priority connectivity and expansion zones,
- Collaborative environmental funding applications for on-ground activities in priority zones,
- Development of a standardized habitat monitoring program for plantation forestry and other natural resource managers,
- Promotion of the significant conservation values contained in the plantation estate,
- Continued collaboration between the plantation sector and other natural resource managers and agencies to meet regional conservation targets, and
- Continuation of flora, fauna and wetlands research across the plantation estate and its surrounds.
2. GLOSSARY OF TERMS

Biodiversity Hot Spot: a term used to identify areas that have a high level of biodiversity and play a key ecological role in the broader landscape.

CMA: Catchment Management Authority.

Core Connectivity Zone: an area of predominately plantation land which contains a cluster of Reserve Areas and connects two or more large Core Remnants.

Core Expansion Zone: an area of plantation land containing a cluster of Reserve Areas and adjacent to a large Core Remnant.

Core Remnant: a continuous area of native vegetation over 2,000 ha.

Corridor: an area of vegetation designed to link fragmented Core Remnants of native vegetation.

DSE: Department of Sustainability and Environment, Victorian Government Agency.


EVC: Ecological vegetation class, the classification system developed by DSE to map and assess vegetation in Victoria.

Floristic Communities: the South Australian Government vegetation classification system.

GIS: geographic information systems.

GTRPC: Green Triangle Regional Plantation Committee.

Green Triangle: a roughly triangular region of south east South Australia and south west Victoria that encompasses much of the plantation forestry lands.

Habitat Hectares: a method developed by the DSE to assess the habitat value of remnant vegetation from on ground and desktop analysis.

Infrastructure: areas within the plantation estate such as firebreaks, dams, houses, quarries, power lines etc. which are prescribed for other plantation related functions.

Landscape Context Habitat Value: a value determined in this project to represent the relative worth of Reserve Areas to support biodiversity from a landscape perspective.

Landscape Stewardship Tender: a system of funding for environmental management on private land where land managers bid for funds to carry out environmental protection and enhancement activities.

Landscape/Vegetation Class: a project specific classification system for remnant vegetation, used to combined datasets from SA and Victoria by common characteristics.

LGA: Local Government Area.

NGO: Non-Government Organization.

NRM: Natural Resource Management.
IDENTIFYING THE BIODIVERSITY ATTRIBUTES OF THE PLANTATION ESTATE AND ITS CONTRIBUTION TO BIODIVERSITY CONSERVATION IN THE GREEN TRIANGLE REGION

**NHT:** National Heritage Trust. A Federal Government fund established to support environmental activities.

**Plantation:** the area of land planted with plantation tree species to produce commercial timber products, or land designated for plantation use.

**Plantation Estate:** the gross area of land owned or managed by the plantation forestry industry, including *Plantations, Infrastructure* and *Reserve Areas*.

**Reserve Area:** areas of the plantation estate comprising remnant vegetation and/or unplantable lands such as shallow soils, rocky ground or swampy areas. This land is available for either environmental protection or enhancement.

**Remnant Vegetation:** patches of native vegetation which remains in a relatively undisturbed condition and has been mapped at 1:100,000 scale from satellite images by state Government agencies.

**Remote sensing:** satellite or aerial photo sensors used in land monitoring.

**SERIC:** South East Resource Information Centre, a holder of Government and private GIS data for the region.

**Stepping Stone:** an area of native vegetation that provides ecological linkage between two other *Remnant Vegetation* patches without being physically linked.
3. **INTRODUCTION**

The Green Triangle region of south east South Australia and south west Victoria contains a variety of environments each with their own unique biodiversity, including coastal areas, wetlands, hills and ranges, limestone flats and volcanic plains. Significant losses of these natural habitats and associated biodiversity have occurred since European settlement, resulting in a fragmented and degraded natural landscape.

The Green Triangle Regional Plantation Committee recognise that appropriate management of the numerous native vegetation remnants embedded within forestry managed lands is therefore vital to the conservation of regional biodiversity (Figure 1). Forestry managers are in the position to make a major contribution to biodiversity conservation in the Green Triangle region.

![Figure 1. Remnant native vegetation within forestry managed lands](image)

3.1. **Project Objective**

This project aimed to determine the potential habitat value of Reserve Areas within the plantation estate and how that estate can contribute towards biodiversity conservation of the Green Triangle region.

The project involved:

1. Conducting an inventory of the plantation estate to:
   1.1. Determine the net and gross area occupied by plantations,
   1.2. Determine the area occupied by Reserve Areas, and
   1.3. Identify areas suitable for protection and enhancement.
2. Determining the significance and habitat value of Reserve Areas within the plantation estate from a landscape perspective.
3. Identifying key areas that could add to regional landscape health and ecological function.
4. Identifying potential projects and partnerships in which to carry out conservation activities complimentary to natural resource management agencies and their targets.

The results, presented in map and tabular form, show land use, presence of native vegetation, areas for further biodiversity protection and enhancement together with a summary of potential management options. This information provides the framework for a network of interconnecting biodiversity corridors across the landscape for use by plantation managers and other regional natural resource managers.

3.2. Study Area

The Green Triangle region covers a triangular area across the south east of South Australia and south west Victoria from Kingston in the west, through Naracoorte and Edenhope in the north to Port Fairy and Portland in the east and Port MacDonnell and Millicent in the south. The region includes the townships of Mount Gambier, Hamilton, Penola, Robe and Casterton (Figure 2).

The Green Triangle region includes all or sections of nine Local Government Areas (LGAs) including Grant, Mount Gambier, Naracoorte – Lucindale, Wattle Range, Robe, West Wimmera, Glenelg, Southern Grampians and Moyne. Some studies of the Green Triangle region also include the Local Government Areas of Kingston, Tatiara and the south west parts of the Rural City of Ararat. However, collectively, these LGAs have relatively small areas of plantations (<10,000 ha) and have been excluded from this study.

The forestry plantations of the Green Triangle region represent almost 20% of Australia’s plantation estate. The industry generates 16% of the Gross Regional Product (GRP) and provides 12% of employment (GTRPC 2006). The first plantings of Radiata Pine occurred in the 1880’s and since then substantial infrastructure has been established. The plantation estate now stands at was approximately 174,000 ha of Pine plantations and the more recently established 164,000 ha of Tasmanian Blue Gums in December 2007 (GTRPC 2008: Un-published data).

Figure 2. The Green Triangle as defined in this study
3.3. Biodiversity Conservation and Landscape Connectivity

One of the challenges facing the Australian landscape is to retain and enhance remaining natural ecosystems. Preserving ecosystems as isolated remnants is not a viable long term approach for biodiversity conservation (see for example Hall 2003 or Shearer 2003). The wider landscape requires a high degree of connectivity for plants and animals to maintain genetically diverse and healthy populations, and respond to threatening processes such as fire and climate change.

Recent studies suggest approximately 30-35% native vegetation cover is required in the landscape to sustain viable populations of woodland bird species in southern Australia (Radford et al 2004). Small birds and insect pollinators, critical to landscape health, also often have limited ranges requiring continuous vegetation cover. This is often restricted by open paddocks or degraded habitat limiting movement and effectively isolating many species within the landscape (Bennett 1990, Downes et al 1997). Furthermore, animals such as the Yellow-bellied Glider and Southern Brown Bandicoot require a near constant linkage of vegetation between habitats in order to migrate (Commonwealth of Australia 2000 and Department for Environment and Heritage 2008 respectively).

Wetlands also provide important habitat for native flora and fauna and are essential to maintaining landscape health. Despite extensive drainage, a significant network of wetlands still exists across the region, providing vital feeding and breeding grounds for highly mobile species such as parrots, water birds, emus and kangaroos. Significant opportunities exist to improve landscape connectivity by protecting and enhancing these wetlands within the plantation estate. Opportunities to participate in such initiatives are discussed in Chapter 6.
4. METHODOLOGY

4.1. Geographic Information Systems

A geographic information system (GIS) is a system for capturing, storing, analyzing and managing data and associated attributes which are spatially referenced to the earth. Basically it is a computer system capable of integrating, storing, editing, analyzing, sharing, and displaying geographically-referenced information and allows the user to create interactive queries, analyze spatial information, edit data, create maps, and present results. GIS technology is extensively used by the forestry plantation industry for resource and asset management, planning and logistics. In addition to the plantations companies using GIS, the South East Resources Information Centre (SERIC) also manages data for a wide range of clients in the Green Triangle region and provides consultancy services for those seeking GIS related data. The data include road, rail, energy networks, geological and other natural resource information.

A more detailed description of the analysis process associated with the GIS dataset is presented in Appendix A.

Figure 3 identifies the complex pattern of land use in the Green Triangle.

![Figure 3. A complex land management pattern](image)

4.2. Data Sources

The current project involved a desk-top study using data supplied to and maintained by SERIC with additional data contributed by plantation companies including Auspine, ForestrySA, Great Southern Plantations, HVP Plantations, Green Triangle Forest Products, Integrated Tree Cropping, Timbercorp and WA Plantation Resources.

The SERIC data were subject to detailed spatial analysis of the plantation estate following agreements between SERIC, the Green Triangle Regional Plantation Committee (GTRPC), Greening Australia (GA) and the plantation managers.
4.3. **Land Use Classification**

The combined regional GIS dataset held by SERIC was extensively edited to create standardized classifications. Individual digital property maps were then classified into plantation land (current or future), infrastructure (roads, firebreaks, dams etc) and Reserve Areas (remnant vegetation and non-plantation land) and the respective areas calculated. In addition, the status and area of remnant vegetation managed by other land managers were determined across the Green Triangle region.

4.4. **Landscape Context Habitat Values**

*Landscape Context Habitat Value* is a value derived by combining a number of variables or parameters present in the GIS dataset to give a value that represents the relative worth of a *Reserve Area* to support biodiversity from a landscape perspective.

This study adapted previously reported measures to determine a Landscape Context Habitat Value, and to categorize the relative value for each Reserve Area within the plantation estate. Site related variables often used for landscape assessments of fragmented remnants include patch size, regional vegetation, distance to *Core Remnants* (single bodies of native vegetation greater than 2,000ha), adjacent land use and biological survey inputs (*EPA Biodiversity Planning Unit 2002, Cawsey and Freudenberger 2005, Shelton et al 2004, Ferwerda 2003, New and England 2002, DSE 2004, Cote and Reynolds 2002*). Because of differences in mapping scale, State vegetation classifications and data availability, it was necessary to create a specific and customized methodology for this study.

The Landscape Context Habitat Value was determined by assessing each Reserve Area within the plantation estate against ten criteria (Table 1). Each criterion comprised a scale of values which, when summed with the other criteria, gave a ranking on a scale of 0 to 100. Thus the higher the score, the higher the Reserve Area’s potential habitat value in a landscape wide context.

It should be noted that the scores given for any value (i.e. distance to core remnant, area, etc.) are arbitrary. Although based on measures applied in other studies, it is recognized that there is no ‘magic’ number that defines habitat value. The aim was to create a scale of relative difference between Reserve Areas within the plantation estate. Another inherent difficulty is the definition of habitat values used by individual States, regions and land managers. For example, Victoria classifies vegetation into over 300 different ecological vegetation classes (EVCs), whilst South Australia uses floristic communities, with the two systems not being directly interchangeable. Analysis therefore based on vegetation data, such as conservation status, biodiversity value and land condition, was constrained. As a result, analysis was carried out on features common to all datasets.
Table 1. Summary of Landscape Context Habitat Value Metrics.

<table>
<thead>
<tr>
<th>Metric</th>
<th>Max value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area</td>
<td>20</td>
</tr>
<tr>
<td>Distance from Core Remnant</td>
<td>10</td>
</tr>
<tr>
<td>Vegetation within 500m</td>
<td>10</td>
</tr>
<tr>
<td>Vegetation within 1 Km</td>
<td>10</td>
</tr>
<tr>
<td>Vegetation within 5 Km</td>
<td>5</td>
</tr>
<tr>
<td>Dominant Land Use within 1 km</td>
<td>10</td>
</tr>
<tr>
<td>Dominant Land Use within 5 km</td>
<td>5</td>
</tr>
<tr>
<td>Flora biodiversity</td>
<td>10</td>
</tr>
<tr>
<td>Fauna biodiversity</td>
<td>10</td>
</tr>
<tr>
<td>Ecological Hotspot</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

4.4.1. **Area Score**

The land area of a remnant is one of the most powerful measures for determining its potential habitat value in a landscape context, as many plants and animals require sizable areas of habitat to sustain viable populations. Larger intact areas tend to be less disturbed and less frequented by humans, vehicles and pest plant and animals. Larger areas also provide the space for a greater number of species and individuals to exist with a higher level of genetic diversity, and provide the potential for greater variation in the landscape and greater diversity in habitat types. An area that supports larger and more diverse species populations is also more resistant to catastrophic events such as fire or disease. Area is easily determined from GIS data.

Table 2. Size of Reserve Area Score.

<table>
<thead>
<tr>
<th>Area (ha)</th>
<th>Area Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 300</td>
<td>20</td>
</tr>
<tr>
<td>150 - 300</td>
<td>18</td>
</tr>
<tr>
<td>100 - 150</td>
<td>16</td>
</tr>
<tr>
<td>80 - 100</td>
<td>14</td>
</tr>
<tr>
<td>60 - 80</td>
<td>12</td>
</tr>
<tr>
<td>40 - 60</td>
<td>10</td>
</tr>
<tr>
<td>20 - 40</td>
<td>8</td>
</tr>
<tr>
<td>10 - 20</td>
<td>6</td>
</tr>
<tr>
<td>5 - 10</td>
<td>4</td>
</tr>
<tr>
<td>1 - 5</td>
<td>2</td>
</tr>
</tbody>
</table>

4.4.2. **Distance to Core Remnant Score**

*Core Remnants* were defined and delineated as single large bodies of native vegetation greater than 2,000 ha. The majority of the Core Remnants in the Green Triangle region were located in Victoria with only a limited number identified in South Australia (Figure 4).
Core Remnants represent significant areas of native vegetation and are likely to have many attributes to support viable and stable biodiversity components. The Distance to Core Remnant parameter is a quantitative measure or value of the distance of a Reserve Area within the plantation estate from a large Core Remnant (area > 2,000 ha).

![Figure 4. Map of Core Vegetation Remnants](image)

### Table 3. Distance to Core Remnant.

<table>
<thead>
<tr>
<th>Distance (km)</th>
<th>Distance to Core Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 0.5</td>
<td>10</td>
</tr>
<tr>
<td>0.5 - 1</td>
<td>9</td>
</tr>
<tr>
<td>1 - 3</td>
<td>8</td>
</tr>
<tr>
<td>3 - 5</td>
<td>7</td>
</tr>
<tr>
<td>5 - 10</td>
<td>6</td>
</tr>
<tr>
<td>10 - 15</td>
<td>5</td>
</tr>
<tr>
<td>15 - 20</td>
<td>4</td>
</tr>
<tr>
<td>20 - 50</td>
<td>3</td>
</tr>
<tr>
<td>50 - 100</td>
<td>2</td>
</tr>
<tr>
<td>100 - 150</td>
<td>1</td>
</tr>
</tbody>
</table>

#### 4.4.3. Native Vegetation within 500 m/1 km/5 km Score

The Australian landscape is a mosaic of interconnecting ecosystems such as wetlands, woodlands and grasslands often occurring within short distances, with many fauna species able to move across non-preferred areas to reach a preferred habitat type.

The biodiversity value of a Reserve Area within the plantation estate is not solely related to its size, but also to its proximity and relationship to other areas of native vegetation in its neighbourhood. This parameter or score was determined by calculating the percentage of native vegetation within each of three zones, 500m, 1km and 5km, around each Reserve Area in the plantation estate.
Figure 5. Blocks of native vegetation within close proximity to each other.

Table 4. Scoring system reflecting the percent of native vegetation within 500m, 1km, 5km.

<table>
<thead>
<tr>
<th>Native Vegetation %</th>
<th>500m</th>
<th>1km</th>
<th>5km</th>
</tr>
</thead>
<tbody>
<tr>
<td>60-100</td>
<td>10</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>40-60</td>
<td>8</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>20-40</td>
<td>6</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>10-20</td>
<td>4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>5-10</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>0-5</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

4.4.4. Flora and Fauna Biodiversity Score

This measure estimated the relative richness of flora and fauna biodiversity within a number of identified landscape/vegetation categories present in the Green Triangle region.

Because habitat classification across the Green Triangle region differs between the two States, it was necessary to develop a suitably broad model of habitat classification. Two characteristics were used:

- Vegetation form (grassland, herbland, shrubland, mallee, woodland, forest, heathland, heathy woodland), and
- Landscape type (hills, plains, coastal, wetland).

In creating a matrix with these two characteristics, of the 32 possible categories only 22 categories were found in the plantation estate (Table 5). For each of the landscape/vegetation category a flora and fauna richness value was assigned from the respective DEH and DSE survey datasets. The resulting flora and fauna values gave a relative ranking of the categories present in the plantation estate.
<table>
<thead>
<tr>
<th>Vegetation/ Landscape Type</th>
<th>Fauna Value</th>
<th>Flora Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coastal / Grassland</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Coastal / Herbland</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Coastal / Shrubland</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Hills / Forest</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Hills / Heathy Woodland</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Hills / Mallee</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Hills / Shrubland</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Hills / Woodland</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Plain / Forest</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Plain / Grassland</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Plain / Heathland</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Plain / Heathy Woodland</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Plain / Shrubland</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>Plain / Wet Forest</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Plain / Woodland</td>
<td>8</td>
<td>8</td>
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<tr>
<td>Wetland / Grassland</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Wetland / Heathland</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Wetland / Herbland</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Wetland / Sedgeland</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Wetland / Shrubland</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Wetland / Woodland</td>
<td>10</td>
<td>8</td>
</tr>
</tbody>
</table>

4.4.5. **Dominant Land Use within 1 Km and 5 Km Score**

One factor that may influence the biodiversity viability of individual Reserve Areas will be nearby dominant land use. The more disturbance associated with the adjacent land use, the more the Reserve Area will be at risk of degradation or loss of biodiversity. Using a number of recent ecological studies (Loyn et al. 2006, MacHunter et al. 2006, Strauss 2001, Lindenmayer 2002), a score was developed to reflect the degree of disturbance associated with adjoining land use and its ability to impact on a Reserve Area’s biodiversity based on zones within one and five kilometres.

**Table 6. Surrounding dominant land use score.**

<table>
<thead>
<tr>
<th>Land use</th>
<th>1km</th>
<th>5km</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conservation</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Partial conservation (State Forests)</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Blue gum plantation</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Pine plantation</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Grazing</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Cropping</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Urban</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>
4.4.6. Ecological Hotspots Score

This measure attempted to quantify the specific biodiversity characteristics of each Reserve Area. There are a number of ecologically significant features within the Green Triangle region landscape. For example:

- Caves contain habitat for specialized plant and animal species.
- Wetlands (streams, lagoons and swamps) are important focal points in the broader landscape providing food, water and breeding grounds for plants and animals outside the immediate ecosystem. They are ecological transition zones that generally support a diverse range of species and often indicate the overall health of the landscape as they transport and recycle nutrients.

The ecological hotspot score quantified how many of these important ecosystem types were present in or adjacent to individual Reserve Areas.

Table 7. Ecological hotspot scores

<table>
<thead>
<tr>
<th>Hotspot Type</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sinkhole and wetland</td>
<td>10</td>
</tr>
<tr>
<td>Wetland</td>
<td>8</td>
</tr>
<tr>
<td>Sinkhole</td>
<td>6</td>
</tr>
<tr>
<td>Rocky outcrop</td>
<td>6</td>
</tr>
<tr>
<td>Within 100m of wetland</td>
<td>4</td>
</tr>
<tr>
<td>None</td>
<td>0</td>
</tr>
</tbody>
</table>

Figure 6. Plantation estate wetlands

Figure 7. A limestone sinkhole
Thus by summing the values for each of the described parameters, the Landscape Context Habitat Value (on a scale from 0 to 100) was derived for each Reserve Area within the plantation estate.

4.5. Core Connectivity and Expansion Zones

4.5.1. Core Remnants

To develop functional, viable and sustainable biodiversity corridors and networks, it was necessary to identify the significant consolidated areas of remnant native vegetation across the region; these being termed Core Remnants. The GIS dataset indicated the minimum area of Conservation Reserves or State Forests in the Green Triangle region was about 2,000 hectares and this became the minimum standard for defining a Core Remnant. Note that a Core Remnant may be dissected by roads or other infrastructure, but is still effectively one contiguous area of native vegetation.

Having identified Core Remnants, it was then possible to identify potential connecting links (Core Connectivity Zones) between neighbouring Core Remnants and to also identify areas adjacent to Core Remnants that could be developed to essentially expand the area of a Core Remnant (Core Expansion Zones).

4.5.2. Identifying Core Connectivity Zones

The characteristics of a Core Connectivity Zone (or corridor) were:

- proximity to neighbouring Core Remnants where the two Core Remnants were joined by contiguous plantation land including remnants outside the plantation, or
- where the potential Core Connectivity Zone contained individual areas of remnant vegetation, which when aggregated, comprised at least 15% of the Zone.

Thus these criteria could result in Core Connectivity Zones that effectively contained “stepping stones” of remnants between Core Remnants. Generally these “stepping stones” would be less than 1km apart.

The Core Connectivity Zones were further prioritised according to:

- The median Landscape Context Habitat Value of the Reserve Areas in the plantation component
- The density of Reserve Areas in the Zone,
- The percentage of total remnant native vegetation in the Zone,
- The area of the Core Connectivity Zone; smaller being better, and
- The number of nationally or regionally threatened flora and fauna species within two kilometers of the Core Connectivity Zone.

4.5.3. Identifying Core Expansion Zones

Core Expansion Zones were defined as clusters or networks of remnant vegetation (includes Reserve Areas and native vegetation outside the plantations estate) with High Landscape Habitat Values in close proximity to Core Remnants such that more than 30% of the Core Expansion Zone was remnant vegetation as either:
Blocks which were clusters of Reserve Areas adjacent to large Core Remnants, or

Networks which were areas where future protection or enhancement of Reserve Areas would create greater connectivity within the same Core Remnant or alternatively, create a new Core Remnant by linking a number of smaller Reserve Areas.

Core Expansion Zones were further prioritised according to:

- The median Landscape Context Habitat Value of Reserve Areas within the Zone,
- The density of Reserve Areas in the Zone,
- The percentage of remnant native vegetation in the Zone,
- The increase in area of the Core Expansion Zone associated with expansion; the smaller the better, and
- The increase in the area of the adjacent Core Remnant.
Figure 8. GIS processing flowchart.
5. RESULTS AND DISCUSSION

5.1. GIS Analysis of Land Use in the Green Triangle Region

GIS data analysis of the Green Triangle region showed a total area of 2,287,000 ha, of which 1,672,000 ha (73%) was managed for agricultural and horticultural enterprises, 238,000 ha (10%) was protected in parks and reserves, and 377,000 ha (16%) was within forestry managed lands. Urban areas and other land uses accounted for around 1%.

5.1.1. Remnant Vegetation

Only 16% or 371,000 ha of native vegetation remains across the region with 238,000 ha (64%) protected in conservation reserves, 99,000 ha (27%) embedded within the agriculture landscape and 33,000 ha (9%) occurring within the plantation estate.

5.1.2. Plantation Estate

The plantation estate (Appendix B) in 2005 consisted of 304,000 ha (81%) of commercial tree plantations, 31,000 ha (8%) as infrastructure (roads, dams, firebreaks, easements etc.) and 42,000 ha (11%) of Reserve Areas, which in turn consisted of 33,000 ha remnant native vegetation and 9,000 ha of areas set aside from commercial tree growing but available for native vegetation restoration or enhancement.

Thus, the plantation estate contains significant areas (11% regionally) of native vegetation that contribute to regional biodiversity and which is generally protected from further degradation such as livestock grazing. Note that the area of remnant vegetation within the plantation estate may be an underestimate as many riparian areas were mapped as fire breaks, i.e. infrastructure, but are generally protected from any mechanical activity.

In terms of managing natural resources, per unit area, the plantation estate contains about 50% more remnant vegetation than most land under agriculture and is managed by a small number of land managers. These two characteristics provide significant opportunities for collaboration and partnerships with regional natural resource management agencies and non-government organizations to develop effective landscape conservation initiatives.
5.2. Landscape Context Habitat Values for Reserve Areas within the Plantation Estate

Landscape Context Habitat Values were calculated for all Reserve Areas greater than one hectare across the plantation estate. Over 71% of all Reserve Areas were categorized as having high to moderately high (1st and 2nd quintiles) Landscape Context Habitat Values indicating that a large majority of Reserve Areas were of a relatively high standard with respect to biodiversity conservation (Table 8). These high value Reserve Areas were distributed throughout the region with the ForestrySA reserves being the most significant because of their larger size.

Within a regional context, these Reserve Areas of high to moderately high Landscape Context Habitat Value should become the focus for protection and enhancement within regional biodiversity and conservation activities.

Table 8. Landscape Context Habitat Value scores for Reserve Areas greater than one hectare across the plantation estate in the Green Triangle region.

<table>
<thead>
<tr>
<th>Quantile Ranking</th>
<th>Landscape Context Habitat Value</th>
<th>No. of Remnants</th>
<th>Percentage of Remnant Area (%)</th>
<th>Area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>54-96</td>
<td>613</td>
<td>54</td>
<td>22,680</td>
</tr>
<tr>
<td>2nd</td>
<td>45-53</td>
<td>724</td>
<td>17.5</td>
<td>7,350</td>
</tr>
<tr>
<td>3rd</td>
<td>38-44</td>
<td>779</td>
<td>12</td>
<td>5,040</td>
</tr>
<tr>
<td>4th</td>
<td>31-37</td>
<td>860</td>
<td>9.5</td>
<td>3,990</td>
</tr>
<tr>
<td>5th</td>
<td>0-30</td>
<td>841</td>
<td>7</td>
<td>2,940</td>
</tr>
</tbody>
</table>

An alternative classification was to use five equal categories of Landscape Context Habitat Value. Table 9 shows that 43% of Reserve Areas had Landscape Context Habitat Values within the 1st and 2nd quintiles.
Habitat Value high to moderately high and almost 80% of Reserve Areas were rated moderate or higher.

**Table 9. Landscape Context Habitat Values**

<table>
<thead>
<tr>
<th>Category</th>
<th>Landscape Context Habitat Value</th>
<th>Percentage of remnant area</th>
<th>Area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>81-100</td>
<td>13%</td>
<td>5,460</td>
</tr>
<tr>
<td>Moderate high</td>
<td>61-80</td>
<td>30%</td>
<td>12,600</td>
</tr>
<tr>
<td>Moderate</td>
<td>41-60</td>
<td>36.5%</td>
<td>15,370</td>
</tr>
<tr>
<td>Moderate low</td>
<td>21-40</td>
<td>20%</td>
<td>8,400</td>
</tr>
<tr>
<td>Low</td>
<td>0-20</td>
<td>0.5%</td>
<td>210</td>
</tr>
</tbody>
</table>

In Victoria, DSE assess biodiversity quality (Landscape Context Habitat Value) using the Habitat Hectares Assessment. In the current study a Landscape Context Habitat Value of less than 40 would be equivalent to being significantly degraded using the Habitat Hectare Assessment. Thus the bulk of the Reserve Area in the plantation estate can be considered to be in reasonable condition.

Collectively natural resource managers may use this type of scoring for individual remnants in setting priorities for protecting and enhancing local biodiversity assets.

### 5.3. Core Connectivity Zones

Areas identified as Core Connectivity Zones provide natural resource managers with a process for directing activities to protect or enhance existing biodiversity by better connecting the ‘stepping stones’ across plantation Reserve Areas and Core Remnants. This may permit movement of flora and fauna between large but isolated Core Remnants. Effective management of weeds, feral animals, fire, altered hydrology and disease should allow normal ecological function to continue. Additional revegetation with overstorey and/or understorey species would also assist ecological function.

Twenty-one Core Connectivity Zones, varying in size from 65 ha to over 10,000 ha, were identified in the region (Figure 11). Importantly eleven of the 19 large Core Remnants are currently linked by Core Connectivity Zones.

Figure 11 shows that the Core Connectivity Zones are predominately in Victoria and are mostly associated with Tasmanian Blue Gum plantations. Notable exceptions include the link from the Penola Forest Reserve and the Rennick State Forest to the Lower Glenelg National Park via plantations around the State Border.

Table 10 presents a summary of most of the components of the Landscape Context Habitat Score for the 21 Core Connectivity Zones. The rankings were assigned only for comparative purposes.
The remnant vegetation ranking was derived from a measure of the percentage of remnant vegetation within the zone. The vegetation density ranking was from a measure of the distribution of Reserve Areas, and would be indicative of clustering (bottom rank) or even dispersal (top rank). The habitat score ranking was the median landscape context habitat value of Reserve Areas in the zone based on a 50 m x 50 m grid across the zone. The area of activity score ranked small zones higher as they require less resources to manage.

Using the “Portland Horsham Forest Explorer” (DSE) it was possible to identify the locations of threatened flora and fauna and also rank their significance within associated Core Connectivity Zones. The ranking classified each Zone based on the number of regionally or nationally threatened species located within 3 km. For example the Core Connectivity Zones linking Lower Glenelg River National Park to Rennick Forest and Mount Richmond stand out as the most consistently highly ranked zones.
Figure 11. Core Connectivity Zones

Note: All Individual Core Connectivity Zone maps can be seen in Appendix C.

DISCLAIMER
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
Table 10. Summary of rankings for Core Connectivity Zones

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Name</th>
<th>Vegetation Density</th>
<th>Habitat Score</th>
<th>Percent Vegetation</th>
<th>Area Of Activity</th>
<th>Threatened Fauna</th>
<th>Threatened Flora</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rennick – Glenelg West</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>14.5</td>
<td>H</td>
</tr>
<tr>
<td>2.a</td>
<td>Glenelg – Mt Richmond</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>7</td>
<td>5</td>
<td>21</td>
<td>H</td>
</tr>
<tr>
<td>2.b</td>
<td>Drajurk – Wilkin</td>
<td>7</td>
<td>3</td>
<td>8</td>
<td>6</td>
<td>9</td>
<td>8</td>
<td>H</td>
</tr>
<tr>
<td>4</td>
<td>Old Caves Road</td>
<td>2</td>
<td>17</td>
<td>6</td>
<td>2</td>
<td>3</td>
<td>14.5</td>
<td>H</td>
</tr>
<tr>
<td>5</td>
<td>Rennick – Glenelg East</td>
<td>11</td>
<td>1</td>
<td>9</td>
<td>12</td>
<td>1</td>
<td>11.5</td>
<td>H</td>
</tr>
<tr>
<td>6</td>
<td>Kilmoc Road</td>
<td>5</td>
<td>8</td>
<td>2</td>
<td>10</td>
<td>16</td>
<td>5.5</td>
<td>H</td>
</tr>
<tr>
<td>7</td>
<td>Wilkin – Weecurra South</td>
<td>6</td>
<td>15</td>
<td>1</td>
<td>14</td>
<td>9</td>
<td>2.5</td>
<td>H</td>
</tr>
<tr>
<td>8</td>
<td>Annya – Mount Eccles</td>
<td>10</td>
<td>6</td>
<td>4</td>
<td>20</td>
<td>6</td>
<td>5.5</td>
<td>M</td>
</tr>
<tr>
<td>9</td>
<td>Wilkin – Weecurra</td>
<td>9</td>
<td>9</td>
<td>7</td>
<td>18</td>
<td>11</td>
<td>2.5</td>
<td>M</td>
</tr>
<tr>
<td>10</td>
<td>Meereek – Dergholm</td>
<td>13</td>
<td>11</td>
<td>15.5</td>
<td>11</td>
<td>4</td>
<td>11.5</td>
<td>M</td>
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<tr>
<td>11</td>
<td>Range Road</td>
<td>8</td>
<td>14</td>
<td>13.5</td>
<td>15</td>
<td>12</td>
<td>4</td>
<td>M</td>
</tr>
<tr>
<td>12</td>
<td>Hotspur – Winayung</td>
<td>4</td>
<td>12</td>
<td>13.5</td>
<td>1</td>
<td>19</td>
<td>19</td>
<td>M</td>
</tr>
<tr>
<td>13</td>
<td>Bogalara – Dergholm</td>
<td>12</td>
<td>13</td>
<td>12</td>
<td>9</td>
<td>13.5</td>
<td>14.5</td>
<td>M</td>
</tr>
<tr>
<td>14</td>
<td>Weecurra – Winayung</td>
<td>16</td>
<td>7</td>
<td>10</td>
<td>13</td>
<td>21</td>
<td>9</td>
<td>M</td>
</tr>
<tr>
<td>15</td>
<td>Lake Mundi – Penola</td>
<td>15</td>
<td>2</td>
<td>15.5</td>
<td>16</td>
<td>18</td>
<td>19</td>
<td>L</td>
</tr>
<tr>
<td>16</td>
<td>Dorodong – Roseneath</td>
<td>17</td>
<td>10</td>
<td>17</td>
<td>21</td>
<td>7</td>
<td>14.5</td>
<td>L</td>
</tr>
<tr>
<td>17</td>
<td>Dergholm – Roseneath</td>
<td>14</td>
<td>18</td>
<td>19</td>
<td>19</td>
<td>16</td>
<td>1</td>
<td>L</td>
</tr>
<tr>
<td>18</td>
<td>Glenelg – Nolan Junction</td>
<td>18</td>
<td>21</td>
<td>11</td>
<td>5</td>
<td>13.5</td>
<td>19</td>
<td>L</td>
</tr>
<tr>
<td>19</td>
<td>Dergholm – Dorodong</td>
<td>19</td>
<td>16</td>
<td>20</td>
<td>17</td>
<td>9</td>
<td>7</td>
<td>L</td>
</tr>
<tr>
<td>20</td>
<td>Winayung – Annya</td>
<td>20</td>
<td>19</td>
<td>18</td>
<td>8</td>
<td>16</td>
<td>10</td>
<td>L</td>
</tr>
<tr>
<td>21</td>
<td>Meereek – Durong</td>
<td>21</td>
<td>20</td>
<td>21</td>
<td>4</td>
<td>20</td>
<td>17</td>
<td>L</td>
</tr>
</tbody>
</table>
5.4. Core Expansion Zones

Core Expansion Zones were classified as either blocks or networks. This classification indicated whether the Core Expansion Zone was a large clustered block of Reserve Areas or a string of Reserve Areas linking disparate parts of the same large Core Remnant, or potentially creating a new Core Remnant by linking a number of smaller Reserve Areas.

Table 11 presents a summary for ranking the Core Expansion Zones using a number of parameters. The rankings were comparative and subjective.

The remnant vegetation ranking was derived from a measure of the percentage of remnant vegetation within the Core Expansion Zone. The vegetation density ranking was a measure of the distribution of Reserve Areas and indicated clustering (bottom rank) or even dispersal (top rank). The Landscape Context Habitat ranking was the median value of the Reserve Areas in the zone based on a 50m x 50m grid across the zone. The area of activity criteria ranked smaller areas as higher as they require fewer resources to manage. The core increase ranking gave top ranking to zones which firstly create a core remnant and then by how much a core remnant was expanded, with the greater increase obtaining a higher ranking. The biodiversity benefit of expanding core remnants by only 1 or 2% would not be as great as the benefit from expanding several moderately sized native vegetation remnants or even creating a whole new core vegetation remnant, as is happening in ForestrySA lands throughout the region.
Figure 12. Core Expansion Zones

Note: All Individual Core Expansion Zone maps can be seen in Appendix D.

DISCLAIMER
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
Table 11. Summary of rankings for Core Expansion Zones

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Name</th>
<th>Zone Type</th>
<th>Remnant Vegetation</th>
<th>Vegetation Density</th>
<th>Habitat Score</th>
<th>Area of Activity</th>
<th>Core Increase</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Glemsia Road</td>
<td>block</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>1</td>
<td>11.5</td>
<td>H</td>
</tr>
<tr>
<td>2</td>
<td>Drik Drik</td>
<td>block</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>16.5</td>
<td>H</td>
</tr>
<tr>
<td>3.a</td>
<td>Keegans Bend</td>
<td>block</td>
<td>4</td>
<td>3</td>
<td>9</td>
<td>2</td>
<td>16.5</td>
<td>H</td>
</tr>
<tr>
<td>3.b</td>
<td>Roseneath</td>
<td>block</td>
<td>6</td>
<td>5</td>
<td>5</td>
<td>7</td>
<td>11.5</td>
<td>H</td>
</tr>
<tr>
<td>5</td>
<td>Mount Burr</td>
<td>network</td>
<td>5</td>
<td>9</td>
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<td>17</td>
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<td>H</td>
</tr>
<tr>
<td>6</td>
<td>Glenelg River</td>
<td>network</td>
<td>3</td>
<td>4</td>
<td>11</td>
<td>12</td>
<td>8.5</td>
<td>M</td>
</tr>
<tr>
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<td>Myora</td>
<td>network</td>
<td>7</td>
<td>12</td>
<td>1</td>
<td>13</td>
<td>8.5</td>
<td>M</td>
</tr>
<tr>
<td>8</td>
<td>Comaum</td>
<td>network</td>
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<td>10</td>
<td>4</td>
<td>16</td>
<td>4</td>
<td>M</td>
</tr>
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<td>9</td>
<td>Lyons Hotspur</td>
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<td>7</td>
<td>7</td>
<td>10</td>
<td>11.5</td>
<td>M</td>
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<td>10</td>
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<td>15</td>
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<td>8</td>
<td>3</td>
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<td>4</td>
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<td>9</td>
<td>14.5</td>
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<tr>
<td>14</td>
<td>Penola</td>
<td>network</td>
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<td>14</td>
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<td>15</td>
<td>1</td>
<td>L</td>
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<tr>
<td>15</td>
<td>Warrock</td>
<td>block</td>
<td>17</td>
<td>17</td>
<td>14</td>
<td>5</td>
<td>7</td>
<td>L</td>
</tr>
<tr>
<td>16</td>
<td>Dwyer Creek</td>
<td>block</td>
<td>14</td>
<td>13</td>
<td>15</td>
<td>11</td>
<td>11.5</td>
<td>L</td>
</tr>
<tr>
<td>17</td>
<td>Big Heath West</td>
<td>block</td>
<td>16</td>
<td>16</td>
<td>17</td>
<td>14</td>
<td>5</td>
<td>L</td>
</tr>
</tbody>
</table>
6. POTENTIAL PROJECTS AND PARTNERSHIPS

The analysis of remnant vegetation and Reserve Areas in the plantation estate provides a basis for the industry and other natural resource managers to evaluate the biodiversity values and status across the plantation estate and could be also applied to other landholders in the region. The fragmented distribution of the residual native vegetation has been acknowledged as a major threat to landscape health and this report identifies a significant resource for major biodiversity protection and improvement across the region, especially as many of the Reserve Areas have reduced grazing pressure. This report also identifies sites and locations for re-connecting isolated remnant vegetation.

6.1. Potential Projects

6.1.1. On Ground Works

A total of 42,000 ha of Reserve Areas were identified across the plantation estate, of which 33,000 ha were remnant vegetation and 9,000 ha were available for revegetation and enhancement. Integrating these areas with surrounding Core Remnants through Core Connectivity Zones or Core Expansion Zones represents a significant opportunity for the plantation industry, in collaboration with other natural resource managers and landholders, to make a substantial contribution to the conservation of regional biodiversity. There are 21 Core Connectivity Zones and 17 Core Expansion Zones where on-ground conservation works could be initiated with the knowledge that such investment would meet regional conservation targets developed by organisations such as the Glenelg Hopkins Catchment Management Authority.

Individually and in collaboration with other agencies, plantation owners have already undertaken some protection and enhancement activities to protect and expand existing biodiversity assets.

The GTRPC provides a regional focus for supporting this type of activity and has potential to invest resources and develop additional partnerships. Potential opportunities for collaborative funding are discussed in the following section.

6.1.2. On Ground Surveys

This project has developed a means of evaluating the existing biodiversity values for areas of remnant native vegetation across the plantation estate of the Green Triangle region. The GIS derived Landscape Context Habitat Value of individual Reserve Areas also permitted the identification of Core Connectivity Zones and Core Expansion Zones. Key Reserve Areas with potentially high Landscape Context Habitat Values or which are located in Core Connectivity or Core Expansion Zones should be targeted for further on-ground flora and fauna surveys to identify specific vegetation communities, fauna, threatened species and threatening processes. Data from such surveys, if combined with the Landscape Context Habitat Values would give an enhanced biodiversity value of those Reserve Areas. These data could then be incorporated with other data as part of ongoing forestry accreditation.
6.1.3. Management Plans

Plantation growers operate under a number of codes of practice, environmental assessments, certification, etc., all of which require protection of remnant native vegetation while managing the plantations for commercial wood production. These obligations are generally documented in management plans and while the Reserve Areas represent a minor part of the total estate, considerable resources are already directed towards biodiversity conservation.

6.1.4. Monitoring Program

The GTRPC is well placed to support the development of a simple and practical habitat monitoring program which would assist documentation of biodiversity attributes. Potentially a decision support system which monitored management actions would assist plantation growers in the assessment and long term monitoring of the biodiversity within the estate.

6.1.5. Promotion of Environmental Contribution

A published summary of this report will provide a wider audience with a better understanding of the contribution that the forestry industry makes to regional environmental management. Data from this report confirm the commitment the forestry industry has placed on natural resource management and to biodiversity conservation across the region and provides leadership for other natural resource managers to follow.

6.1.6. Research

There are several fields of research that would support conservation initiatives potentially developed by the forestry industry. In particular, research focused on:

- Wetlands: Wetlands have been significantly degraded across south-east Australia, however they are generally protected within the plantation estate. Research into the role of forestry in wetland conservation would be important in the Green Triangle region.

- Systematic DNA data collection: This would provide objective assessment of the success or otherwise of the creation of regional ecological linkages across the plantation estate.

- Impact of plantations on remnant native vegetation: This may include research both into the impact of plantations on vegetation patches and isolated paddock trees which would inform discussion regarding a topic of significant debate but little objective data.

- Standardized classification and mapping dataset: This would facilitate local area analysis as the current 1:100,000 scale mapping is only of value for broad regional assessments.

6.2. Partnerships

Landscape scale protection and enhancement activities require collaborative efforts in bringing together the expertise, skills and resources of government and non-government organisations. In the Green Triangle region, the State border can make collaboration complex. There are, however, key areas where the GTRPC can form collaborative links to assist environmental works. These are through:
• The National Heritage Trust (NHT),
• Natural Resource Management Boards and Catchment Management Authorities,
• Habitat 141, and
• The National Biodiversity Hotspots Program.

There may also be other opportunities to fund works through carbon sequestration plantings or habitat tender schemes.

6.2.1. National Heritage Trust

The Federal Government’s National Heritage Trust (NHT) program provides a range of funding opportunities from small Envirofund grants (up to $50,000) to multi-million dollar cross-NRM region projects. Participation in any NHT funded project would require a strong collaborative element with the broader natural resource management community.

6.2.2. Catchment Management Authorities and Natural Resource Management Boards

Individual companies and the GTRPC continue to be actively engaged in CMA and NRM board processes. It is beneficial to identify NRM/CMA priorities and how forestry objectives match with these. This will assist the development of collaborative projects and provide additional funding for forestry conservation initiatives that meet regional goals. Such projects may focus on preserving and enhancing biodiversity, improving riparian zones or management of wetland areas within the plantation estate.

6.2.3. Habitat 141

There is an opportunity for the GTRPC and the plantation growers to work collaboratively with regional NRM organizations and NGOs in a larger scale initiative that is complimentary to the ‘Habitat 141’ vision. This vision is part of a tri-state (SA, Vic, NSW) project being undertaken between Greening Australia, the Wilderness Society, Trust for Nature, SE NRM Board, CMAs, Government agencies and other interested groups. The project aims to restore landscape health from the Mallee region to the coast. One of the primary regions of interest is the Green Triangle region. The GTRPC members would obviously be valuable participants in this major project of landscape restoration, and potentially the most important landholders of the southern region.

6.2.4. National Biodiversity Hotspots Program

One of the earliest drivers of the Habitat 141 vision could be through the Federal Government’s National Biodiversity Hotspots Program, or other programs which may develop to provide stewardship payments to landholders to manage high priority biodiversity assets. The Green Triangle region has 2 of the 15 nationally identified biodiversity hotspots (1. South Australia’s South-East / Victoria’s South-West, 2. Victorian Volcanic Plain). Plantation forestry could be part of a cross border landscape stewardship tender program to protect and enhance significant areas of remnant habitat. As a very significant landholder in the Green Triangle region it is likely that forestry would be a key player in any such project.
7. CONCLUSIONS

This report identified 42,000 ha of reserves within the plantation estate of the Green Triangle region, of which 33,000 ha was remnant native vegetation. Some of these areas are critical to the conservation of regional biodiversity. This report provides a framework under which the plantation industry can influence biodiversity enhancement programs in south-eastern Australia. The GTRPC, with a membership of major plantation growers, provides a forum for the collaborative development of programs to enhance the biodiversity assets within the plantation estate and adjoining natural resource managers. This provides the forestry industry with an opportunity to highlight and expand its conservation programs in south-eastern Australia.

The methodology employed has identified priority zones for protection and expansion of important areas of native vegetation within the plantation estate. Core Connectivity and Core Expansion Zones have been ranked based on a range of GIS derived metrics which identified areas of greatest ecological significance across the Green Triangle region. In evaluating identified Core Connectivity Zones, the Rennick – Glenelg West Core Connectivity Zone generally scored high rankings across all criteria. The Glenelg – Mt Richmond and Drajurk – Wilkin Core Connectivity Zones likewise received a relatively high ranking across all criteria, and both zones had the same mean ranking. Across Core Expansion Zones, Glenmia Road and Drik Drik were the two highest mean ranked sites.

On-ground protection and enhancement activities at priority sites should be supported by on-ground surveys, which will then contribute towards the other regional strategies and management plans. Continuous improvement can be effected by regular monitoring programs and assist in developing future activities and reporting to investors.

This report provides a number of priorities for ongoing activities:

- Further prioritization of areas for on-ground conservation activities. The above-mentioned highest ranked zones should be the focus for initial ground truthing.
- On-ground surveys and regional management strategies and plans would establish priorities for activities in Core Connectivity and Core Expansion Zones. These activities should be the focus of future biodiversity enhancement programs. The methodology employed in this project provides sufficient justification for expenditure of future resources by the GTRPC and others to such programs.
- Collaborative environmental funding applications for on-ground activities in priority zones.
- Standardized habitat monitoring programs would assist natural resource managers in identifying and protecting significant biodiversity assets.
- Continued promotion of the role that plantations contribute to regional biodiversity conservation.
- Collaboration by the forestry industry collaboration with other natural resource managers and agencies to support regional conservation targets.
Continued research into the flora, fauna and wetlands of forestry managed lands.
8. BIBLIOGRAPHY


9. **APPENDIX A** GIS METHODOLOGY

9.1. **Limitations**

9.1.1. **Methodology**

The first limitation that must be recognised is that the GIS derived Landscape Context Habitat Value for Reserve Areas generated in this report is a subjective measure of the actual habitat value. The method shows the potential habitat value of a Reserve Area in a landscape scale context and could be used as a targeting mechanism to prioritise analysis of different areas. The results do not provide the sole basis for decision making and it should not be assumed that Reserve Areas with low values are not potentially valuable.

9.1.2. **Data**

The results from any project which utilizes GIS is dependent on the quality of the data on which the analysis is made. Some of the regionally supplied data is coarse and perhaps only applicable for regional analysis. For example, when obtaining data from satellite imagery, the scale available results in poor definition of smaller areas, thus some small patches may have been overlooked as a result of mapping scale. However, much of the data provided by plantation growers is more detailed and specific and based on physical measurement.

Another limitation of the study is the definitions of reserves and remnant vegetation. Remnant vegetation was mapped as discrete wooded areas, but areas of scattered paddock trees were not differentiated in the agricultural context, even though a paddock tree supports some biodiversity. Grasslands and wetlands were also not easily differentiated from exotic grazing pastures, even though these are very significant habitats. There is no reliable regional GIS data on land condition for the whole region and all areas therefore are regarded as the same in this respect.

The GIS data used to identify biodiversity hotspots, which added value to some areas by identifying wetlands and important geological features such as sinkholes within a reserve, is not definitive. The classification of these datasets was broad and did not allow a capacity to identify different qualities of biodiversity value of wetlands or sinkholes.

Combining vegetation datasets from the two States also meant a loss of detail. The only common fields shared by South Australian and Victorian data was broad vegetation structure (e.g. woodland, Grassland, Heath) and landscape type (e.g. hills, wetlands, coast).

Finally, it may have been worthwhile combining remnants within a distance say of 100 m to form clusters, rather than differentiate between different remnants. These clusters could then assume the highest values of any individual constituent remnant.

9.2. **Further Analysis**

9.2.1. **Expanded GIS Inputs**
Additional GIS or other digital data may be incorporated for future analysis. Layers may include hydrological status, weed distribution, land condition, tree density, etc. These layers could add value to determining Landscape Context Habitat Values.

9.2.2. Threat matrix

The derived Landscape Context Habitat Values used in this study gave a high score for a Reserve Area, indicating the potential of that area to positively influence the surrounding landscape. Additional analysis using known threats may identify priority areas for further protection by targeting those areas of high conservation value.
10. **APPENDIX B LAND USE IN THE GREEN TRIANGLE REGION, 2005**

10.1. The Green Triangle region

<table>
<thead>
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<th>Percentage of area (%)</th>
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</thead>
<tbody>
<tr>
<td>Total</td>
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<tr>
<td>Agricultural land</td>
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</tr>
<tr>
<td>Plantation Estate</td>
<td>377,000</td>
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<tr>
<td>Conservation Parks *</td>
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<tr>
<td>Remnant vegetation (on all land types)</td>
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* does not include ForestrySA conservation areas

10.2. Forestry Plantation Estate

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<td>Plantation</td>
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* includes native vegetation contained within the total Remnant Area
10.3. Remnant Vegetation in the Green Triangle region.

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<th>Percentage of area (%)</th>
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<td>Conservation Reserves</td>
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<tr>
<td>Agriculture</td>
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<tr>
<td>Plantation</td>
<td>33,000</td>
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10.4. Remnant Vegetation by Land Use

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<th>Remnant vegetation (ha)</th>
<th>Percentage of area (%)</th>
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<tr>
<td>Conservation Reserves</td>
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<td>33,000</td>
<td>9</td>
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</tbody>
</table>
11. APPENDIX C: CORE CONNECTIVITY ZONES

11.1. Rennick – Glenelg West

DISCLAIMER
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
11.2. Glenelg – Mt Richmond

DISCLAIMER
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
11.3. Drajurk – Wilkin

DISCLAIMER
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
11.4. Old Caves Road

DISCLAIMER
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
11.5. Rennick – Glenelg East

DISCLAIMER
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
11.6. Kilmoc Road

DISCLAIMER
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
11.7. Wilkin – Weecurra South

DISCLAIMER
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
11.8. Annya – Mt Eccles

DISCLAIMER
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
11.9. Wilkin – Weecurra

DISCLAIMER
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
11.10. Meereek – Dergholm

DISCLAIMER
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
11.11. Range Road

**DISCLAIMER**
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
11.12. Hotspur – Winayung

DISCLAIMER
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
11.13. Bogalara – Dergholm

**DISCLAIMER**
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
Weecurra – Winayung

DISCLAIMER
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
11.15. Lake Mundi – Penola

DISCLAIMER
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
11.16. Dorodong – Roseneath

DISCLAIMER
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
11.17. Dergholm – Roseneath

DISCLAIMER
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
**11.18. Glenelg – Nolan Junction**

**DISCLAIMER**

This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
11.19. Dergholm – Dorodong

DISCLAIMER
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
11.20. Winayung – Annya

DISCLAIMER
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
11.21. Meereek - Durong

DISCLAIMER
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
12. APPENDIX D: CORE EXPANSION ZONES

12.1. Glenmia Road

DISCLAIMER
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
12.2. Drik Drik

DISCLAIMER
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
12.3. Keegans Bend

**DISCLAIMER**
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
12.4. Roseneath

DISCLAIMER
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
12.5. Mount Burr

DISCLAIMER
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
12.6. Glenelg River

DISCLAIMER
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
12.7. Myora

DISCLAIMER
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
DISCLAIMER
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
12.9. Lyons – Hotspur

DISCLAIMER
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
12.10. Dunmore

**DISCLAIMER**
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
12.11. Big Heath South

**DISCLAIMER**
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
12.12. Stokes River

DISCLAIMER
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
DISCLAIMER
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
12.14. Penola

DISCLAIMER
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12.15. Warrock

DISCLAIMER
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12.16. Dwyer Creek

DISCLAIMER
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
12.17. Big Heath West

DISCLAIMER
This map identifies some priority areas that may be suitable for enhancing biodiversity. This has been done in a contextual and aspirational context and seeks only willing and co-operative partnerships.
13. **APPENDIX E: NATIONAL BIODIVERSITY HOTSPOTS IN THE GREEN TRIANGLE REGION**

Accessed 4th January 2008

13.1. **Victorian Volcanic Plain**

“The Victorian Volcanic Plain is a flat to undulating area stretching west from Melbourne to Portland. It is characterised by fertile volcanic soils that were originally covered with open grasslands, grassy woodlands, large shallow lakes and wetlands. After European settlement most of the plains were converted to pasture, and the region is still dominated by grazing with extensive agricultural crops and plantation forestry. This hotspot includes 65 species listed as nationally threatened and 173 threatened in Victoria. …..The remaining areas of native vegetation, although fragmented, are crucial for the continued existence of endemic orchid species. The degradation of vegetation and habitat, predation by foxes and cats, changing fire patterns, weed invasion and the total grazing pressure of domestic stock, kangaroos and feral rabbits all pose major threats to this region's biodiversity.”

13.2. **South Australia’s South-East/Victoria’s South-West**

“This hotspot straddles the South Australia –Victoria border. Extensive clearing has occurred in South Australia, with Victoria holding more extensive areas of remnant vegetation………

Habitat fragmentation and degradation are key threats to native plants and animals. Feral animals such as rabbits, foxes, cats, goats and deer threaten native plants and animals through grazing, competition and predation. Exotic weeds, such as bridal creeper, African boxthorn, radiata pine and Salvation Jane also represent significant threats.”
Citation:


Copies available as CD ROM from:

Executive Officer
Green Triangle Regional Plantation Committee
PO Box 1339
Mount Gambier SA 5290