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THE VICTORIAN COASTAL COUNCIL

Assessing the value of Coastal Resources in Victoria

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PROJECT 301010-01215 - ASSESSING THE VALUE OF COASTAL RESOURCES IN VICTORIA

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EXECUTIVE SUMMARY

Most Victorians live, work and play close to the coast. It is also home to critical infrastructure, important economic hubs and many significant ecosystems.

The purpose of this study is to identify, characterize and quantify the "market" and "non-market" (commercial and non-commercial) value of the natural resources of the Victorian coast. The results from this study are intended to assist in policy development and decision-making that takes into account the both commercial and ecosystem service values and the interdependency of economic benefits and the health of coastal ecosystems.

Economic value is a measure of the benefit gained from a good or service. Most often economic value is thought of in financial terms, however the concept of economic value goes beyond financial considerations. Many goods and services, particularly those that are provided by nature, are not traded in the markets, yet individuals and society benefit from them in a myriad of ways. Victorians benefit from the coastline in a variety of ways, such as the opportunity to visit the beach, to go swimming and diving, to go boating, to go fishing, or to be outdoors and enjoy bushwalking, the scenery and fresh air. In addition to these recreational opportunities, coastal ecosystems also provide services in the form erosion protection, water filtration, purification and nutrient cycling services. People also value the very existence of biodiversity, and the notion that it will be enjoyed by future generations.

The ecosystem services concept holds that natural ecological systems provide a range of goods and services that benefit human society, and ultimately on which all life depends. The Millennium Ecosystem Assessment (2005) divided the range of ecosystem services into four broad categories:

tangible, easy to measure

less tangible, harder to measure

- Provisioning services – products from nature such as food, pharmaceuticals, fisheries, shells, sand and lime, gas/oil
- Cultural services – non-material benefits arising through, for example, recreation opportunities, aesthetics, spiritual values, amenity
- Regulating services – benefits from the regulation of ecosystem processes such as storm protection, erosion buffers, flood and disease control
- Supporting services – which are necessary for the production of all other ecosystem services, and include habitat, biodiversity, nutrient cycling, biogeochemical services

Some provisioning services form the basis of commercial activities and their value can be measured in monetary terms (e.g. value of production or contribution to GDP). Similarly, cultural services such as recreational opportunities form the basis of the tourism industry,

which can be valued using traditional economic analysis. Services that are not traded commercially (non-market ecosystem services) require different methods to evaluate.

For this report, the value of provisioning services was sourced from published economic studies of commercial activities. Because the values were derived from a number of sources and used a number of different methods, the figures provided may not be directly comparable to each other, nor to those from past studies (e.g. URS 2007). Nevertheless, they provide a useful indication of the relative scale and magnitude of the economic value of these services to Victoria.

The value of non-commercial services that are provided by Victorian coastal ecosystems is not easily quantified and has not been studied in detail previously. Using a 'value transfer method', published data from Victoria and elsewhere was used to ascribe a combined value for the regulating and supporting services provided by each of a number of habitat types considered. The value of cultural services was considered as recreation value for the coast as a whole, independent of habitat type.

While a fair amount of research has been done on the economic value of ecosystem services globally (Costanza *et al.* 1997, Nunes, 2001, Spurgeon, 1999), little peer-reviewed work has been undertaken to explicitly estimate the economic value of coastal ecosystem services in Victoria. Therefore, values were required to be "transferred" from previous studies outside the state of Victoria. Similarly, for some habitat types, eg grassland and forest, there is a lack of coastal specific data, so general terrestrial values were used. These values are not necessarily meant to represent the most accurate values possible for the Victorian coast, but rather provide a means of demonstrating the approximate non-commercial ecosystem service value that needs to be considered, utilising the available data. Due to a lack of suitable primary studies it has not been possible to value all ecosystem services provided by all habitat types, therefore it is considered that the estimate for non-commercial value of ecosystem services is likely to be conservative.

Table E1 - Total Economic Value of the Victorian Coast

Commercial Activities (Provisioning Services)			
Industry	**Economic Contribution ($million/yr)**	**Employment (jobs) direct**	**Employment (jobs) indirect**
Commercial Ports	3,017	15,883	(n/a)
Petroleum	3,600	1,280	(n/a)
Wind Power	31	300	900
Tourism	3,154	23,010	16,770
Fisheries	68	646	1,054
Commercial Sub Total	**9,870**	**41,000**	**20,000**

Non-Commercial Ecosystem Services			
Habitat or Service	**Estimated Value ($million/yr)**	**Lower Bound ($million/yr)**	**Upper Bound ($million/yr)**
Coastal Recreation (Beaches) - includes non-commercial value of beach visits, swimming and fishing	2,385	2,149	2,660
Forest – includes woodlands and scrub	383	268	499
Grassland/Heathland – includes coastal dunes vegetation	24	17	31
Wetlands/Marshes – fresh and saline, includes intertidal flats	207	24	1,122
Estuaries/Rivers – all rivers and lakes within 5km of coast, tidal inlets	2,549	1,784	3,314
Mangrove – includes mangrove/saltmarsh/mudflat mosaic	320	36	605
Seagrass – seagrass meadows	1,854	800	6,081
Other Marine – coastal waters other than seagrass and mangroves, includes sandy/rocky bed and reef habitats	729	510	947
Non-Commercial Sub Total	**8,441**	**5,588**	**15,258**

TOTAL ESTIMATED VALUE ($million/yr)	**18,311**

A key finding from this study is that the value of Victoria's non-commercial coastal ecosystem services ($8.4 billion per year) is similar to the value of commercial coastal activities ($9.8 billion per year). This finding has important implications for the way decisions about the use of ecosystem services ought to be made, particularly where there are competing demands for those services.

The results demonstrate the need for decision makers to consider the tradeoffs between the benefits of healthy functioning ecosystems and those associated with expanding use and development. Not doing so unknowingly puts at risk a large amount of value in the form of natural capital and associated services. Quantifying the cause and effect relationships between human activities and their impact of ecosystem services, particular where the effects of the activity are separated from the activity in space and/or time is the key challenge in adopting a sustainable decision approach for the Victorian coast.

A limitation of this study is the lack of relevant economic valuation studies for some types of ecosystems in Victoria (such as temperate reefs, seagrass, mangroves, wetlands). More original studies in these research areas are called for, particularly in the context of large projects or developments that have the potential to affect ecosystem services. Such studies would provide the necessary data to support sustainable long-term decision making.

This study provides a limited, baseline estimate of the ecosystem values of the Victorian coast. No primary research was done for this study. The results from this study are intended to be indicative only and therefore need to be interpreted with caution. For planning and management decisions, more detailed, original valuation studies would be required.

CONTENTS

1. INTRODUCTION

Many Victorians live, work and play near the coast. It is also home to critical infrastructure, important economic hubs and many significant ecosystems.

The purpose of this study is to identify, characterise and quantify the "market" and "non-market" (commercial and non-commercial) values of the natural resources of the Victorian coast. The results from this study are intended to assist in policy development and decision-making that takes into account the value of ecosystem services and the interdependency of economic benefits and the health of coastal ecosystems.

The 2000 km of the Victorian coastline supports a wide variety of commercial and non-commercial uses that benefit the human population. Commercial uses of the coast include ports, commercial fishing and coastal tourism, each of which have direct and flow on benefits to local, regional and national economies. Non-commercial uses such as the regulation of the climate, the purification of air and water, and flood protection are critical to the function of the ecological systems and contribute significantly to the welfare of Victorian residents. These are largely ignored and not generally considered within policy appraisal. Estimating the economic value of ecosystem goods and services is increasingly recognized as a necessary condition for environmental decision-making, sustainable business practice, and land-use planning at multiple geographic scales and socio-political levels of analysis (Defra, 2007).

Coastal ecosystems are unique because they exist at the interface between the sea, land and the catchments. For this reason it has been suggested that coastal ecosystems can produce cumulative benefits that are much more significant and unique than the services provided by any single ecosystem (Barbier *et al*.2011).

With increasing population on and near the coast, and increasing numbers of people benefiting from commercial and non-commercial uses of the coast, there is increasing pressure on the coastal ecosystems that support them. For example, the coastline of Victoria has seen considerable loss of seagrass, mangrove and other important habitats over preceding decades, as well as changes in the water quality and plant and animal populations of coastal estuaries and wetlands. Many of these changes are the inadvertent result of human use of ecosystem services, often in parts of the catchment distant from where the effects are felt. Traditional decision making frameworks have been unable to encompass such interactions, nor have they allowed for full evaluation of trade-offs that are sometimes inherent in the use of ecosystem services for human benefit.

A potential barrier to evaluating trade-offs is the lack of a common currency for comparing value – for example how do we compare the benefits from a strip of sandy beach to those of a new boat anchorage?

The study *Assessing the value of the coast to Victoria* (URS, 2007) valued the commercial uses of the coast. This report updates the URS 2007 work on commercial uses and makes a first attempt at placing dollar values on the ecosystem services provided by the Victorian coast. It is a high-level assessment as a detailed evaluation of each ecosystem service is beyond the scope of this project. Nevertheless, the attempt highlights the potential value of these services and reveals the knowledge gaps and information requirements for the coast.

1.1 Scope

The Victorian Coastal Council has engaged WorleyParsons to provide an assessment of the value of the coast to Victoria. The aims of this work are to:

- Identify the commercial value of coastal assets and activities to Victoria;
- Identify the value of non-commercial (environmental, social, cultural) assets along the Victorian coast. For environmental assets identify the value of the ecosystem services they provide;
- Highlight connections and interdependencies between the commercial and non-commercial values identified above; and
- Estimate the combined value of commercial and non-commercial assets and identify potential threats which may alter the value of the coast to the Victorian economy.

This project builds on previous work commissioned by the VCC and is intended to inform the development of the Victorian Coastal Strategy.

2. METHODS

2.1 Economic value

Economic value is a measure of the benefit gained from a good or service. Most often economic value is thought of in financial terms - how much money does the particular good or service cost and how much is the consumer willing to pay. However the concept of economic value goes beyond financial considerations. Many goods and services, particularly those that are provided by nature, are not traded in the markets, yet individuals and society benefit from them in a myriad of ways. Victorians benefit from the coastline in a variety of ways, such as the opportunity to visit the beach, to go swimming and diving, to go boating, to go fishing, or to be outdoors and enjoy bushwalking, the scenery and fresh air. In addition to these recreational opportunities, coastal systems also provide services in the form of erosion protection, water filtration, purification and nutrient cycling services (via estuaries and wetlands). People also value the very existence of biodiversity, and the notion that it will be enjoyed by future generations. At the global scale ecosystems contribute to a range of goods and services that are products of the natural ecosystem and are hence termed ecosystem services.

The ecosystem services concept holds that natural ecological systems provide a range of goods and services that benefit human society, and ultimately on which all life depends. The Millennium Ecosystem Assessment (2005) divided the range of ecosystem services into four broad categories:

tangible, easy to measure

less tangible, harder to measure

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Some provisioning services form the basis of commercial activities and their value can be measured in monetary terms (e.g. value of production or contribution to GDP). Similarly, cultural services such as recreational opportunities form the basis of the tourism industry,

which can be valued using traditional economic analysis. Services that are not traded commercially (non-market ecosystem services) require different methods to evaluate (see section 2.2).

The concept of total economic value (Figure 2.1) refers to the combined value that society derives from a given set of goods and services (in this case the aggregate of all ecosystem services listed above). Total economic value consists of use and non-use values of goods and services, where use values may be direct use (provisioning), indirect use arising from ecosystem functions (e.g. regulating services), or option value (retaining the option to obtain future benefits). Non-use values are less tangible and include bequest value (the value of ensuring benefits are available for future generations) and existence value (the value of knowing that a good or service exists without ever using it).

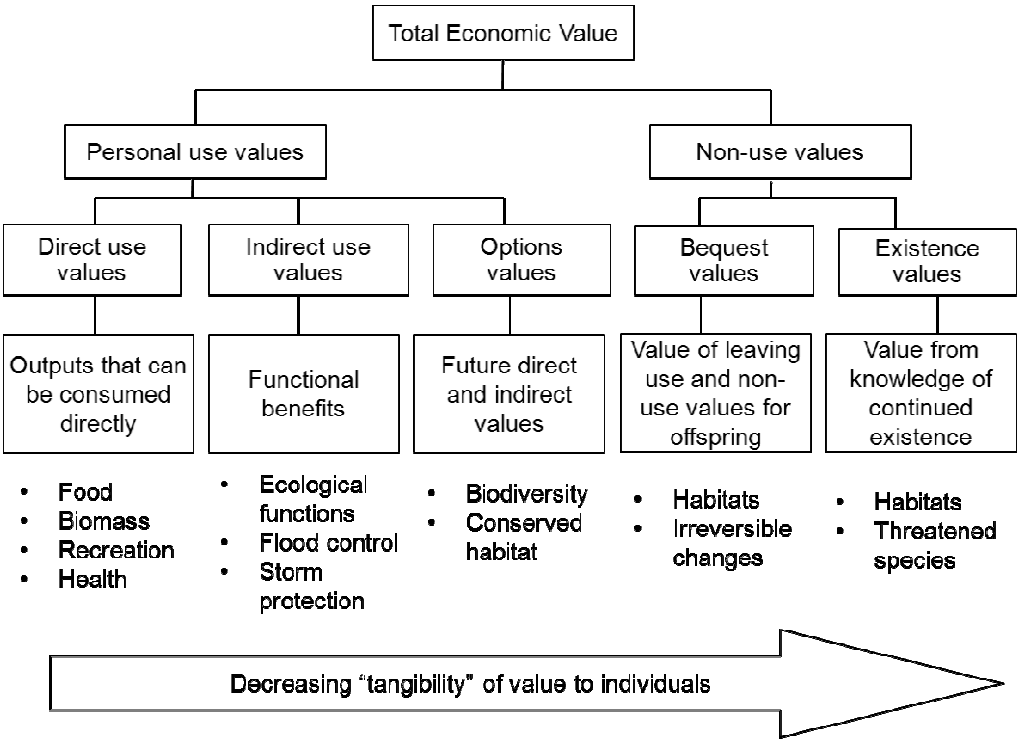

Figure 2.1. Total economic value framework.

2.2 Quantifying economic value

2.2.1 Economic value of commercial services

For goods and services that are traded in the marketplace, economic value can be measured as their market value. However, the economic value of these activities extends beyond the simple market value in the form of added value (the difference between the cost of production and the selling price), and indirect or flow-on effects (e.g. ancillary activities, such as the transport and distribution networks associated with a port, effects on the local economy). Employment is a frequently used indicator of economic benefit, and may be direct or indirect. A plethora of data and studies exists on the economic value of a whole range of industries.

For this report, the value of commercial services was sourced from published economic studies. Because the values were derived from a number of sources and used a number of different methods, the figures provided may not be directly comparable to each other, nor to those from past studies (e.g. URS 2007). Nevertheless, they provide a useful indication of the relative scale and magnitude of the economic value of these services to Victoria.

A broad range of economic activity occurs on the Victorian coast, but not all of that activity is dependent on being on the coast. This study focuses on activities that are dependent to some degree on being on or near the coast, and that utilise coastal resources to generate income. Some of these activities, such as tourism and fisheries depend on healthy coastal ecosystems. The main activities considered and their dependence on the coast (or relationship to the coastal ecosystem) are shown in Table 2.1

Table 2.1 Commercial coastal activities assessed in this report and their relationship to the coastal ecosystem

Activity	Services used
Coastal tourism	Amenity value, recreational value particular to the coast
Ports	Coastal land and seabed used for siting infrastructure, areas of the sea bed used for channels. Coastal waterways are used as transport corridors
Petroleum extraction	Exploitation of naturally occurring petroleum deposits in marine areas, marine and coastal infrastructure (e.g. pipelines, shipping terminals to bring product on shore).
Wind power generation	Utilisation of naturally high wind coastal areas.
Fisheries	Fish production, source of food for aquaculture

The range of activities considered is similar to that of URS (2007).

2.2.2 Economic value of non-commercial ecosystem services

The value of non-commercial goods and services that are provided by coastal ecosystems is not easily quantified. These include regulating services (eg storm protection, flood and disease control) supporting services (eg. habitat, biodiversity) and cultural services (eg. recreation, spiritual). Nevertheless, there is a clear need to consider the value of these services in order to provide a rational basis for policy setting and decision making. Economists have devised a range of methods for estimating the dollar value of ecosystem services, but such estimates involve a greater level of uncertainty than for commercial services due to the less tangible and complex nature of the non-commercial ecosystem services.

This study makes a first attempt at placing dollar values on the ecosystem services provided by the Victorian coast. It is a high-level assessment making use of both coastal and general data sets as a detailed evaluation of each ecosystem service is not available and is beyond the scope of this project. Nevertheless, the attempt highlights the potential value of these services and reveals the knowledge gaps and information requirements for the coast.

Establishing the non-market (non-commercial) value of natural assets and services is a complex problem which often requires considerable research and data collection to provide a reliable estimate. Economic valuation attempts to elicit public preferences for changes in the state of the environment in monetary terms. The main types of economic valuation methods available for estimating public preferences for changes in ecosystem services are Revealed Preference (RP), Stated Preference (SP) methods and Value Transfer.

- Revealed Preference (RP) methods
  - *Market Price Method (MP):* estimates the economic value of ecosystem products or services that are bought and sold in markets.
  - *Productivity Method (PM)*: focuses on the relationship that may exist between a particular ecosystem service and the production of a market good.
  - *Hedonic Pricing Method (HP)*: is used to estimate the value of environmental amenities that affect prices of marketed goods (residential housing prices).

- *Travel Cost Method (TC)*: is a survey-based technique that uses the costs incurred by individuals taking a trip to a recreation site (e.g. travel costs, entry fees, opportunity cost of time) as a proxy for the recreational value of that site.
- *Damage Cost Avoided*, Replacement Cost, and Substitute Cost Methods: do not provide strict measures of economic values and should be used as a last resort to value ecosystem services

- Stated Preference (SP) methods
  - *Contingent Valuation (CV)*: is a survey-style approach that constructs a hypothetical market via a questionnaire.
  - *Choice Modelling (CM):* is a survey-style approach that focuses on the individual attributes of the ecosystem in question.
- Value Transfer
  - Value transfer (also known as "benefits transfer (BT)") is a process of using secondary valuation evidence sourced from previously undertaken studies to apply to a new decision-making context (Defra, 2010). Its particular appeal lies in it being a quicker and lower cost approach compared to the commissioning a primary valuation study. A greater use of "value transfer" will be key to more practical use of environmental values in policy making (Defra, 2010).

Value Transfer is the primary method employed in this study as it the most appropriate method to deliver a high-level, first pass valuation with limited resources available. The method makes the most use of existing data and previous studies from Victoria and analogous areas worldwide.

2.2.3 Geographic analysis and habitat types

Valuations of ecosystem services at large spatial scales, such as this study, typically divide the landscape into broad habitat categories, because these are recognisable units of the ecological landscape that are easily delineated and mapped, and that provide a distinct combination of ecosystem services (Seppelt *et al.* 2011). The choice of habitat types for valuation was based on two main criteria – the availability of spatial data to characterise them and the availability of suitable data for value transfer.

The broad habitat types considered in this study are:

- **Beaches** – Sandy beaches, areas of primary importance to coastal recreation
- **Forests** – includes all types of forest and woodland and most scrub types
- **Grassland/Heathland** – Grasslands, Heathlands, coastal dune scrub. excludes pasture
- **Wetlands/Marshes** – freshwater, estuarine and saline wetlands, sedgelands, reed beds and marshes. Intertidal mud flats. Includes some pasture areas recognised as important wetlands by the WetlandsDIR data set.

- **Estuaries/Rivers** - All rivers and lakes within 5km of the coast are assumed to be estuarine. Tidal inlets such as Westernport Bay and coastal lagoons such as the Gippsland Lakes are also included in this category (other than areas identified as seagrass)
- **Mangroves** – intertidal mangrove forests and mangrove/mudflat/saltmash mosaics
- **Seagrass** - intertidal and subtidal Seagrass meadows
- **Other Marine** – Coastal waters not included in one of the other categories. Includes bays and coastal waters with sand/sediment bed and rocky reef.

A range of spatial data sets were examined to determine the area of broad habitat types considered. All data was obtained from the Department of Sustainability and Environment, under license, except the Smartline, which was obtained from Geoscience Australia (see Table 2.3).

Table 2.3 Spatial data used for this report

Data set	Description	Use
Smartline	Detailed mapping of coastal landform types for the Australian coast	Length of coastline, beach and rocky shores
Ecological Vegetation Classes (EVC_2005)	Modelled 2005 Ecological Vegetation Classes. Geographic occurrence of EVCs assigned on the basis of an expert interpretation of statistical and spatial information	Area of key onshore habitats including mangroves, rivers, estuaries, forests, dunes, wetlands and grasslands
Directory of important wetlands (WetlandsDIR)	This layer contains Victorian wetlands listed in the 3rd Edition of 'A Directory of Important Wetlands of Australia' (2001).	Area of wetlands onshore, and estuaries.
LCC Coastal Classification	The layer is based on the coastal and marine habitat map produced by Natural Resource Systems for the Land Conservation Council Marine and Coastal Special Investigation in 1993.	Area of seagrass habitat
LiDAR derived habitat mapping	This layer contains marine habitat information derived from LiDAR (Light Detection and Ranging) imaging for the Victorian coastline.	Not used as this extremely high-resolution and largely un-groundtruthed data is not practical for high-level, state wide assessment

For consistency with previous work (URS 2007), the coastal area was defined as the strip of land within 5km of the coast and the marine area to the limit of state waters (3 nautical miles from shore).

Ecological Vegetation Classes (EVC's) were used to classify the habitats on the landward side of the shoreline. EVC's are the basic mapping units used in Victoria for biodiversity planning and conservation assessment at landscape scales. Each EVC represents a group of plant species that occur in similar physical environments and have similar ecological responses. There are around 300 EVC's in Victoria.

To determine the area of general forest, grassland/heathland, marsh and estuarine habitats, the area of each EVC was extracted from the spatial data layers using GIS software, for the coastal strip and EVC's were assigned to each of these categories, thus each habitat comprised a number of EVC's. For example, the forest category consisted of 71 forest and woodland EVCs.

For marine habitats, there was less information available. LiDAR-derived mapping has been conducted recently, but reliable habitat data were not available. For seagrass, the total area of seagrass habitat was obtained from the LCC Coastal Classification. While this is not the most recent data for seagrass, it was the most comprehensive data available. More recent local data is available for selected locations, however this mapping does not cover the entire coast (this data could be used for studies at a regional scale). The LCC data was considered the most suitable for the study. While there was some data describing the extent of temperate rocky reef habitat, there were no primary valuation studies available for this habitat type. The remainder of the marine area was therefore considered as a single category called "other marine".

The WetlandsDIR data identifies large areas of important wetland and estuaries. These have been used to identify additional wetland (onshore) or estuary (marine) areas where there is poor coverage of the EVC data.

Smartline spatial data incorporates detailed coastal landform information for the Australian coast and was used to determine the length of beach habitat and rocky shoreline along the Victorian coastline. As the data did not allow calculation of the area of each habitat (just the length of coastline), this data was not used in the valuation.

The data used for the study is considered reliable at the landscape scale, however for site-based assessments it is recommended that ground-truthing be undertaken. Furthermore, the area of some habitats may have changed over time and while this would affect the assessment, it is emphasised that the valuation should be seen as indicative of the potential value of ecosystem services. Maps of the various habitat types are shown in Appendix 3

Although each habitat type provides multiple ecosystem services, only a subset of these services were incorporated into the valuation due to a lack of primary valuation studies (Barbier *et al.* 2011 reviewed a large number of primary studies and identified gaps). For

example, sandy beaches provide provisioning, regulating, supporting and cultural services, however the primary valuation studies for beaches focus almost exclusively on the cultural service of recreation (Table 2.2). The services considered in the valuation for each habitat type are listed in Table 2.2.

Table 2.2. Ecological habitat types considered in the valuation, the services they provide and the services included in the valuation data.

Coastal habitat types / **Ecosystem services**	Beaches	Forests	Grassland/Heathland	Wetlands/Marshes	Estuaries/Rivers	Mangroves	Seagrass	Other marine
Provisioning								
Food	o	x	x	x	x	x	o	x
Energy	o							o
Materials		x						x
Regulating								
Carbon storage		x	x	o		o	o	o
Erosion control	o	x	x			x	o	
Purification (air/water)		x	x	x	x	x	o	
Supporting								
Nutrient cycling	o	o		o	x	o	x	x
Primary production	o	o		o	o	o	o	o
Dispersal					o			o
Biodiversity		o		x	x	x	o	o
Cultural								
Recreational	x	x	x	x	x	x		x
Spiritual	x	x	x		o			x

Blank - service not provided, o – service provided but not valued, x – service included in valuation.

2.2.4 Value transfer

While a fair amount of research has been done on the economic value of ecosystem services globally (Costanza *et al.* 1997, Nunes, 2001, Spurgeon, 1999), little peer-reviewed work has been undertaken to explicitly estimate the economic value of ecosystem services in Victoria. Therefore, values were required to be "transferred" from previous studies outside the state of Victoria. Similarly, for some habitat types, eg grassland and forest, there is a lack of coastal specific data, so general terrestrial values are used. These values are not necessarily meant to represent the most accurate values possible for of the Victorian coast, but rather provide a means of demonstrating that the non-commercial ecosystem services do have a value that needs to be considered, utilising the available data.

The basic process of valuing non-commercial natural assets of the Victorian coast using value transfer methods involves the following steps:

- Conduct a thorough review of existing studies to ensure that all evidence potentially relevant is identified, sourced from existing guidance documents, government or other organisations' reports, value transfer databases, academic publications, working papers, conference papers and consultation with valuation experts, such as:
    a. The Environmental Valuation Reference Inventory™ (EVRI) - a benefits transfer infobase developed by Environment Canada in collaboration with a number of international experts and organisations that stores economic values derived from the peer-reviewed literature; and
    b. WorleyParsons' ExterNality Assessment Database (ENAD) constructed for a range of EcoNomics™ Assessment projects – a comprehensive resource containing details of hundreds examples of previously published data on the value of natural assets and services globally.
- Compare the similarity of policy and study context;
- Assess the quality of the valuation evidence in order to employ the potential value estimates derived from sound data collection procedures and best practice methods;
- Select appropriate valuation evidence to transfer on the basis of the availability of the suitable studies and supporting data;
- Consider other factors including spatial sensitivity of the ecosystem service and its value - using available geographical (GIS) data and other sources to see if there is a distance-decay relationship;

- Aggregate the unit economic value over the type of value (e.g. adding benefits of flood protection to benefits of water quality improvements), over the affected population (e.g. summing unit economic value per household or per individual over the affected population), and over time (e.g. estimating the present value of the change using discounting), so as to derive the total economic value of the Victorian coast.
- Finally, select the appropriate approach to providing the ranges of valuation estimates.

A more detailed explanation of the methods used and their limitations is provided in Appendix 1.

Valuation evidence for this study was sought from a range of sources including existing guidance documents, government or other organisations' reports, value transfer databases, academic publications, working papers and conference papers. Criteria for economic studies selected for value transfer were:

- Published in peer-reviewed journals or books
- Focused on regions in Australia
- Limited to results that can readily be transferred: $ per ha or $ per household data

Data were standardised to 2013 Australian dollars per hectare to provide a consistent basis for comparison. Lower bound and upper bound estimates of dollar values were derived from the various sources for the study sites.

After empirical valuation studies were selected and the estimates for value transfer standardised, the resulting values were assigned to the GIS land cover categories at the study site in a spatially explicit manner.

The total value of ecosystem services is calculated as:

$$Total\ value(\$) = \sum_{i=1}^{10} Area_i\ (ha) \times Unit\ value_i\ (\$/ha)$$

Where $Area_i$ = *Area of land cover type i,*

$Unit\ value_i$ = *Annual ecosystem value per unit area of land cover type i*

3. RESULTS

3.1 Commercial services

The combined value of the coastal commercial activities examined is around $9.9 billion per annum (Table 3.1). Of the industries examined, petroleum, tourism and commercial ports are the largest, each contributing more than $3 billion to the economy each year. The tourism industry is by far the largest contributor to employment, with an estimated 23,000 jobs created directly.

This result is greater than that from URS (2007) mainly due to:

- The inclusion of petroleum industry, valued at $3.6 billion in total. If petroleum is excluded, the total is $6.3 billion.
- The much greater value of tourism industry ($3.2 billion as opposed to $0.9 billion in 2007). The updated figure was based on tourism expenditure data rather than wages from the coastal tourism workforce (TRA 2011).

Other notable differences are:

- A general increase in the contribution of ports, driven at least in part, by greater throughput and value of commodities.
- The increase in the value of wind power generation, due to increased capacity and higher electricity prices.

In interpreting these figures it is important to bear in mind that the values provided may not be directly comparable to each other, or to past results, due to differences in methodology and assumptions.

Table 3.1 Economic value of selected commercial activities dependent on the Victorian coast

Industry	Economic Contribution ($million)	Employment (number of jobs) direct (indirect)
Commercial ports	3,017	15,883*
Petroleum	3,600	1,280 (n/a)
Wind power	31	300 (900)
Tourism	3,154	23,010 (16,770)
Fisheries	68	646 (1,054)
Total	**9,870**	**41,000 (20,000)**

*(*estimate includes direct and indirect employment as separate figures not available for some ports)*

3.1.1 Tourism

Tourism provides direct benefits, such as employment in tourism industry, and indirect benefits or flow-on effects to other industries. In 2010-2011 tourism contributed $15.9 billion in total to Victoria's gross state product (GSP) or 5% of GSP for Victoria (TRA 2012).

The most recent regional study of the economic impact of tourism was conducted by Tourism Research Australia (TRA 2011) using data from 2007/08. To gauge the size of regional tourism industries, TRA modelled regional tourism expenditure using data from National Visitor Survey and International Visitor Survey. Total tourism expenditure was calculated by combining estimates for each tourism region's domestic day, domestic overnight, and international visitor expenditure. Note that the URS 2007 study used a less direct approach based tourism wages to calculate the estimate.

Twenty-one tourism regions were defined in Victoria, each made up of a number of smaller Statistical Local Areas (as defined by the Australian Bureau of Statistics). Seven of these regions include areas of coast and were therefore classified as coastal tourist areas for the purpose of this analysis. Of these, the Melbourne region made by far the largest contribution; however visiting the coast is unlikely to be a strong driver of tourist visits to Melbourne. Results for Melbourne are therefore presented separately in Table 3.2. In summary, tourism in coastal areas (excluding Melbourne) contributed about 23% of the total 2007/08 value of tourism. Tourism in non-coastal regional and rural areas contributed around 18% and Melbourne made up the rest.

Table 3.2. Contribution of coastal and non-coastal tourism regions to overall tourism value for Victoria for 2007/08 (summarised from TRA 2011).

Region	Tourism Expenditure in basic prices ($million)	Total Regional Output ($million)	Percentage of total tourism expenditure	Economic contribution to the region
Melbourne	8,233	357,108	59.6	2.3
Coastal	3,154	101,361	22.8	2.1
Inland	2,424	60,571	17.6	3.0
Total	**13,811**	**519,040**	**100.0**	**2.3**

A regional breakdown of tourism expenditure for coastal regions (Table 3.3) shows that regions that made the largest contributions were Western Victoria, the Mornington Peninsula, Geelong and South Gippsland. Tourism is particularly important to the Phillip Island and Lakes regions, contributing 19% and 9% respectively of the total regional economic output.

Table 3.3. Coastal tourism expenditure, sample sizes, total output and economic importance of tourism regions in Victoria 2007/08 (TRA 2011)

Tourism Region (west to east)	Tourism Expenditure in basic prices ($m)	Total economic output of the region in basic prices ($m)	Economic contribution to the region (%)
Western (Torquay to SA border)	794	12,820	2.3
Geelong (inc. Bellarine Peninsula)	475	18,367	2.6
Peninsula (Mornington Peninsula)	572	23,618	2.4
Melbourne East (including north shore of Westernport)	285	26,754	1.1
Phillip Island (including Bass Coast)	353	1,887	18.7
Gippsland (South Gippsland)	408	15,017	2.7
Lakes (Gippsland Lakes and East Gippsland)	267	2,898	9.2

Given that the tourism regions are large and in some cases extend inland well beyond the coast, it is acknowledged that not all of the expenditure would have been tied specifically to coastal tourism. Nonetheless these areas contain some of Victoria's most popular coastal tourism destinations (Great Ocean Road, Bellarine & Mornington Peninsulas, Phillip Island, Wilsons Promontory, Gippsland Lakes). Furthermore, the areas considered here are based on ABS Statistical Local Areas, and are therefore spatially comparable with those in URS (2007).

3.1.2 Ports

Victoria's ports consist of four main commercial trading ports – Melbourne, Geelong, Portland and Hastings, which handle the bulk of commercial trade, and fourteen local ports which primarily serve as commercial fishing and recreational boating hubs.

Commercial ports

Victoria's four commercial trading ports provide the key international economic gateways for the state, with the equivalent of 30% of GSP passing through them each year (Meyrick & Associates 2008). The Port of Melbourne is Victoria's largest port, with a total container throughput in 2011-12 of 2.58 million twenty-foot equivalent container units (PoMC 2012).

The Port of Geelong is the second largest port Victoria, with a total throughput of 12.2 million tonnes of cargo in 2010/11, valued at approximately $7.6 billion (Econsearch 2012).

The Port of Hastings' main trade groups include import and export of oil, LPG, ULP and (formerly) steel. Trade comprises over two million tonnes of petroleum products (oil, LPG and ULP) per year.

The Port of Portland specialises in bulk commodities including forestry, smelter, fertiliser, grain and mineral sands products.

Port operations generate employment and income for the surrounding community, as well as flow-on effects to other industries, and revenue to government from taxes and other charges. The economic impact of the four commercial ports is summarised from the most recent available studies in Table 3.4. Overall, Victoria's commercial ports contribute around $3 billion to the economy each year and create 18,000 jobs.

Table 3.4 Summary of the economic impact of commercial ports in Victoria

Port	Economic impact ($millions)	Employment - Direct (Indirect)
Port of Melbourne[1]	2400	7600 (8100)
Port of Geelong[2]	489	728 (877)
Port of Portland[3]	122	509
Port of Hastings[3]	67	241
Total	**3078**	**9078 (8977)**

Sources: 1: GHD/Econsearch 2010 2: Econsearch 2012. 3: Meyrick & Associates 2008

Local ports

Victoria has fourteen local ports which primarily serve as commercial fishing and recreational boating hubs. The local ports vary in size from small facilities that service mainly recreational uses (e.g. Barwon Heads) to large facilities with a significant commercial base (e.g. Gippsland Lakes).

An economic analysis of local ports found that, for a number of coastal communities, access and interaction with the local port helps support not only local industry, but plays a significant role in the identity of the town (SKM 2010).

Local ports were estimated to provide direct economic benefits to the state of $202M per year, with an estimated $355M per year in indirect benefits (SKM 2010). A significant proportion of these benefits are likely to be included in the tourism and fishery figures, therefore they have not been included in the total to avoid double counting. Local ports were not included in the URS 2007 study for similar reasons.

3.1.3 Fisheries

Victoria's commercial fisheries occur within state waters (to 3 nautical miles), or in some cases beyond and in bays, inlets and estuaries. The most valuable wild-caught fishery sectors are abalone ($24 million) and rock lobster (15.8 million).

In 2010–11 the gross value of Victorian commercial fisheries production was estimated to be $68.4 million. The wild-catch sector, valued at $50.7 million, accounted for 74 per cent of this total value.

Aquaculture accounted for the remaining 26 per cent, valued at $17.7 million, although if freshwater salmonid (trout) production is excluded the figure is $11.8 million.

Compared with 2009–10, the gross value of fisheries production rose by 5 per cent ($3.1 million) in 2010–11, following a 22 per cent (1479 tonnes) increase in the total volume of production (Skirtun *et al.* 2012).

There is little accurate data on employment in commercial fisheries. ABS census data (2011) indicates that around 646 people are employed in commercial fishing in Victoria, with an additional 1054 people employed in seafood processing and wholesaling. These figures are considered as highly conservative, in part because they tend to under report employees and attribute some activities to other industries such as transport and generalised food processing (Skirtun *et al.* 2012).

3.1.4 Petroleum

The petroleum sector encompasses the exploration, appraisal, development, construction and production of natural gas and petroleum liquid resources (DPI 2012a). Victoria's petroleum exploration and production is located mainly in the Gippsland and Otway basins.

While much of the production occurs beyond the 3 nautical mile limit of state waters, the product is brought onshore in Victoria for refining, storage and distribution.

Victoria accounts for the second largest share of petroleum sales nationally, contributing around $3.6 billion to industry sales, most of which is sourced from the Gippsland Basin (of estimated national sales of $29.9 billion).

Overall, the oil and gas industry contributed around $28.3 billion to the Australian economy in 2011 (DAE 2012). The majority of economic value from the sector comes from extraction and refining operations. Flow on effects to other industries (e.g. exploration support, professional services, maintenance and construction, transport and storage and wholesale trade) are estimated nationally to be about 15%, and these are included in the value estimate.

Based on the proportion of industry sales coming from Victoria (12%), the Victorian contribution is estimated at 3.4 billion. Of this, it is estimated that the direct contribution is 2.9 billion with 0.5 billion in indirect contribution.

Crude oil production peaked in 1985 with an annual production of 166 Mbbl; compared with annual production of 28 Mbbl in 2008. As Victoria's oil production declines, gas production is increasing and has a significant domestic market. In 2008 Victoria's gas production was 371.7 mmcf and was worth over $1.1 billion (DPI 2010), with the large majority from offshore and coastal areas.

3.1.5 Wind energy

Victoria's coast has been identified as having considerable potential for the siting of wind farms due to consistent high wind speeds (Coppin *et al.* 2003), although it is noted that there are some smaller areas further inland that also have suitable wind resources. The current installed capacity of wind farms in Victoria is 432 MW, of which 183 MW is located in five coastal wind farms. Annual production (to end of 2011) was 522 MWh from coastal wind farms (Sustainability Victoria 2012).

The value of production was calculated by multiplying the wholesale electricity price (sourced from the Australian Energy Market Operator web site). At 2011 wholesale prices this production was valued at around $14.2 million, however at 2012-13 prices the value of this production is $30.8 million.

Wind farms provide employment opportunities during the construction phase (approximately 2 years) equivalent to 1.25 jobs per MW of installed capacity, and ongoing employment of 0.09 jobs per MW (Clean Energy Council 2012). For Victoria's currently installed coastal wind farms, direct employment generated would equate to around 2282-year construction jobs and 16 ongoing jobs.

It is noted that the capacity of coastal wind farms is set to increase more than 3-fold with an additional 474 MW of capacity under construction near the Victorian coast at Macarthur (420 MW) and Portland (54 MW) (Sustainability Victoria 2013).

3.1.6 Other power sources

The Victorian Coast also has the potential to provide renewable wave and tidal power. Wave energy is highest in the western half of the state and tidal energy is greatest at the entrances to large bays and estuaries. Neither wave nor tidal power is commercially captured in Victoria at the current time and, while active research is ongoing, these are immature technologies and it is not clear when, or at what scale, these resources may be tapped in the future. As such no estimate of the value of these resources has been included in this study.

3.2 Non-commercial services

The value of non-commercial goods and services that are provided by coastal ecosystems is not easily quantified. These include regulating services (eg storm protection, flood and disease control) supporting services (eg. habitat, biodiversity) and cultural services (eg. recreation, spiritual) (refer section 2.1).

Using the value transfer method, published data from Victoria and elsewhere was used to ascribe a combined value for the regulating and supporting services provided by each of the habitat types considered. The value of cultural services was considered as recreation value for the coast as a whole, independent of habitat type.

Economic valuation data for ecosystems from 147 sources was reviewed for this study. This comprised 19 studies for Victoria, 32 for New South Wales, 38 for Queensland and 27 global review studies (Table 3.5 and Appendix 2).

Table 3.5 Summary of valuation studies in Australia and globally used to derive the estimates of the economic value of ecosystem goods and services for the Victorian coast.

	Number of observations	VIC	NSW	QLD	SA	WA	TAS	ACT	NT	Australia wide	Global summary
1. Coastal Recreation (Beaches)	**24**	1	3	6		6					8
2. Forest	**17**	7	5	3							2
3. Grassland/Heathland	**4**	1	2								1
4. Wetlands/Marshes	**56**	4	15	15	6	3	1	1	2	1	8
5. Esturies/Rivers	**37**	6	7	12	1	2	3	1	1	1	3
6. Mangrove	**3**			1							2
7. Seagrass	**5**			1	1		1				2
8. Other marine	**1**										1
Total	**147**	**19**	**32**	**38**	**8**	**11**	**5**	**2**	**3**	**2**	**27**

Table 3.6 below provides a summary of the results for the non-commercial ecosystem service, including upper and lower bounds. For coastal recreation, the value is calculated based on a unit value for trips to the coast, as per section 3.2.1. For each habitat type the value of other non-commercial ecosystem services is calculated on a unit area basis.

Table 3.6 Summary of annual value of ecosystem services by habitat type for the Victorian coast.

	Area	Unit value $/ha/yr	lower bound $/ha/yr	Upper bound $/ha/yr	Total value (m$/yr)	Low (m$/yr)	High (m$/yr)
1. Coastal Recreation (Beaches)					$ 2,385	$ 2,149	$ 2,660
2. Forest	252,627 ha	$ 1,518	$ 1,063	$ 1,973	$ 383	$ 268	$ 499
3. Grassland/Heathland	65,844 ha	$ 363	$ 254	$ 472	$ 24	$ 17	$ 31
4. Wetlands/Marshes	48,422 ha	$ 4,265	$ 500	$ 23,161	$ 207	$ 24	$ 1,122
5. Estuaries/Rivers	71,264 ha	$ 35,768	$ 25,037	$ 46,498	$ 2,549	$ 1,784	$ 3,314
6. Mangrove	8,264 ha	$ 38,750	$ 4,304	$ 73,173	$ 320	$ 36	$ 605
7. Seagrass	61,961 ha	$ 29,771	$ 12,913	$ 98,138	$ 1,845	$ 800	$ 6,081
8. Other marine	806,141 ha	$ 904	$ 633	$ 1,175	$ 729	$ 510	$ 947
Total					**$ 8,441**	**$ 5,588**	**$ 15,258**

The results indicate that the cultural service of coastal recreation is highly valued at $2.4 billion per annum. This represents the willingness of people to pay for coastal recreation opportunities over and above what they actually spend on tourism. Estuaries/Rivers were the most valuable habitat class at $2.5 billion per annum. Seagrass habitats were also highly valued at around 1.8 billion per annum. Ecosystem services from mangroves had the highest value per unit area (Table 3.6), indicating the importance accorded to their ecosystem services in the valuation literature, however total contribution was lower due to the relatively small area. More detail on the valuation of services for each ecosystem type is provided below

3.2.1 Coastal recreational (beaches)

Coastal recreation is an ecosystem service that occurs across several habitat types, and it's value has been assessed independently of habitat type. However it is primarily related to beaches (URS 2007), and is a major component of the value for beach habitats, so it can be used as a proxy for the non-commercial value of beaches.

Recreationally oriented activities taking place in the coastal zone include both extractive (e.g., hunting, fishing, and shellfish collecting) and non-extractive uses (e.g., swimming, sun-bathing, boating, wind-surfing, bird-watching, snorkeling, and diving). The true welfare impact of these activities is for a large part not reflected in market transactions or remains out of the scope of most analyses (Ghermandi and Nunes, 2011).

The Coastal and Marine Environment Community Attitudes & Behaviour (Wave Four) Report updated by IPSOS-Eureka was designed to provide insight into public attitudes towards the Victorian coast and the value it delivers (IPSOS-Eureka, 2012). They found that the coast is

an important part of the lives of most Victorians. Victorians make a substantial number of trips to the coast on a yearly basis, over four-in-five (84%) reported having made at least one day trip to the coast in the last twelve months with the average number of day trips in the last twelve months being 23.4 trips. The most frequently visited locations along the Victorian coast were Phillip Island (7%); Sorrento (6%); Lorne (5%); Torquay (5%); and Apollo Bay (5%). Those living within five kilometres of the coast reported visiting their local foreshore frequently, over a quarter (26%) said that they visited daily, and 86% report visiting their local foreshore at least once a month. Among those who made visits to the coast, the most commonly mentioned activity was walking or hiking, (by almost two thirds, 63%). Swimming was the next most common activity (52%), then nature-based activities / appreciation (31%).

The frequent visits to the coast and the wide range of recreational activities demonstrate the value of the coast to the Victorian community. Economic values are of two types: market values (as revealed by the cost of goods and services purchased by consumers) and non-market values (represented by the willingness of the residents and visitors to the coast to pay simply for the experience of an activity, or being on or near the coast). These non-market values represent the portion of willingness to pay of residents and visitors for recreational activities above what they actually pay in direct spending, called "consumer surplus". URS (2007) estimated the individual consumer surplus of the recreational use of the Victorian coast using the travel cost approach. The factors that were important for residents and visitors' enjoyment included sporting activities, nature and wildlife, quiet and uncrowded, undeveloped landscapes, cafes and restaurant, and cultural heritage. This is so far the only valuation study of coastal recreation undertaken for Victoria.

The value of coastal recreation in Victoria has been updated from URS (2007) as per the dot points below, giving a total estimated value of $2.4 billion. This explicitly includes visits to the beach, swimming and fishing.

- The value of coastal recreation (consumer surplus) was estimated as $182 per trip for the average individual with a 95 per cent confidence interval of $164-203 (converted to 2013 Australian dollars) (URS 2007).
- Victoria received 62.4 million domestic visitors for the year ending June 2012 (44.1 million daytrip visitors and 18.3 million overnight visitors). Of these it is estimated that approximately 21%, or 13.1 million visits, are to the coast (16% of the visitors go to the beach (including swimming) and 5% go fishing) (Tourism Victoria, 2012).
- Total coastal recreation value of coast is estimated as 13.1 million visits x $182 = $2.4 billion per annum (confidence interval of $2.1 to 2.7 billion per annum).

3.2.2 Forest

The Forest habitat class includes all types of forest and woodland and most scrub types. Forest provide a wide range of ecosystem services including provisioning (food and

materials), regulating (carbon storage, erosion control, purification of air and water), supporting (nutrient cycling, biodiversity) and cultural (recreation, spiritual).

Costanza *et al.* (1997) valued the world's forests at US$969 per hectare per year, equivalent to AUD$1,518 per hectare per year (in 2013 dollars). The upper and lower bound was assumed to be ± 30% of the base value.

- There was 252,672 hectares of forest identified on the Victorian coast (Table 3.6).
- Total economic value of forest: $383 million per annum (ranging between $268 and 499 million per annum).

3.2.3 Grassland/heathland

The Grassland/Heathland habitat class includes all types of grasslands, heathland and coastal dune vegetation, but excludes pasture. These habitat types are characterised by the dominance of grasses and/or shrub species. These habitats provide ecosystem services including climate and water regulation, erosion control, food production and recreation (Havstad *et al.* 2007). On the coast in particular, grassy dune vegetation is recognised for its role in preventing erosion.

A few specific grassland habitat types have been valued in Australia. The non-market benefits provided by natural vegetation on beach dunes to NSW North Coast residents was estimated at AUD$4.18 per household per month, or AUD$22,000 per km of coastline (1992) (Pitt, 1993). This value is for a highly developed shoreline exposed to ocean storms and is not applicable to the Victorian situation where there is typically a much lower density of development at risk of storm erosion.

The non-market value of remnant native grassland in northeast Victoria and the southern Riverina of New South Wales was valued at around $38-98 (1998) per household per year (Lockwood and Carberry, 1998).

This general habitat type is more commonly known in the northern hemisphere as rangelands. Costanza *et al.* (1997) valued the *world's* grass/rangelands at US$232 per hectare per year, equivalent to AUD$363 per hectare per year (in 2013 dollars), which has been adopted by this study. The upper and lower bound was assumed to be ± 30% of the base value. It is acknowledged that this figure may be an underestimate of the true value of the Victorian coastal grasslands as it does not consider the protection from coastal erosion service provided.

- There were 65,844 hectares of grassland/heathland identified for the Victorian coast (Table 3.6).
- Total economic value of grasslands: $24 million per annum (ranging between $17 and 31 million per annum).

3.2.4 Wetlands/marshes

The Wetlands/Marshes habitat class includes freshwater, estuarine and saline wetlands, sedgelands, reed beds and marshes. Also included are some pasture areas and intertidal mud flats recognized as important wetlands by the WetlandsDIR data set. Wetlands and mashes provide ecosystem services including provisioning (food), regulating (carbon storage and purification of water), and supporting (nutrient cycling and biodiversity).

There were 48,422 hectares of wetlands and marshes identified for Victorian coastal areas. These wetlands and marshes support a wide range of habitats and provides for a number of direct and indirect uses.

Costanza *et al.* (1997) placed a value for ecological services of US$9,990 per hectare per year on wetlands – specifically tidal salt marshes and mangroves and an annual global value of US$1,648 billion. A 2006 meta-analysis of wetlands valuation studies around the world found that the average annual value is just over $2,800 per hectare (Brander, Florax and Vermaat, 2006). These figures may have limitations but provide a useful basis in understanding the value of wetlands and marshes.

Converted to 2013 Australian dollars, the economic value of wetlands and marshes was estimated to be AUD$4,265 per hectare per year, ranging between $500 - 23,161 per hectare per year.

- There were 48,422 hectares of wetlands and marshes identified for the Victorian coast (Table 3.6).
- Total economic value of wetlands and marshes: $207 million per annum (ranging between $24 million and $1.1 billion per annum).

3.2.5 Estuaries/rivers

The Estuaries/Rivers habitat class includes all rivers and lakes within 5km of the coast. Also included are tidal inlets such as Westernport Bay (other than areas identified as seagrass). It is noted that the large majority of these area more estuarine than riverine in character, eg the Gippsland Lakes and Westernport, and they have been valued accordingly.

Rivers and estuaries have many direct and indirect ecosystem services values such as breeding grounds and habitats for juvenile species, provision of habitat, nutrient cycling and water filtration, in addition to goods linked to the fisheries industry (Robinson, 2001). Estuaries also provide additional services including sheltered water for shipping movement, shoreline protection, waste disposal and tourism activity (Robinson, 2001, Kirkpatrick, 2011).

Kragt et. al. (2007) evaluated how much the residents of Goulburn, Gellibrand and Melbourne were willing to pay to improve the health of the Goulburn River, Victoria using the choice experiment method. The average 'willingness to pay' (WTP) for increasing the

number of fish and bird species lay between AUD$4.02 and AUD$5.86 per fish species, and between AUD$2.18 and AUD$3.18 per species of waterbird and native animal. The average WTP for an increase in healthy vegetation along the Goulburn River was between AUD$3.21 and AUD$5.39.

The meta-analysis study by Brouwer (2009) estimated the benefits of rivers and wetlands in Australia based on the results of previous choice experiment valuation studies. Mean marginal willingness-to-pay (MWTP) for rivers were $6.6 as an annual payment or $23.6 as a one-off payment. Another meta-analysis of choice experiment (CE) studies relating to river health in Australia undertaken by Rolfe and Brouwer (2011) estimated the mean WTP per kilometre of waterways in good health was estimated at $3.13 per household (2010 AUD$), with a standard deviation of 5.47.

Costanza *et al.* (1997) valued the world's rivers and estuary systems at US$8,498 and US$22,832 per hectare per year respectively. For estuaries this is equivalent to AUD$35,768 per hectare per year (in 2013 dollars). This figure was adopted for this study with arbitrary upper and lower bounds of ± 30% of the base value.

- There were 71,264 hectares of estuaries and rivers identified on the Victorian coast (Table 3.6).
- Total economic value of estuaries and rivers: 2.5 billion per annum (ranging between $1.8 and 3.3 billion per annum).

3.2.6 Mangroves

The Mangrove habitat class includes intertidal mangrove forests and mangrove/mudflat/ saltmash mosaics

Although significantly cleared in the past, mangroves in Australia are now protected which is a reflection of the high values they contain. Mangroves are one of the most productive ecosystems in the world and their values include habitat for commercially important fish species, habitat for juvenile fish and prawn species, nutrient cycling, sediment accumulation, wave dissipation, storm protection and erosion buffer (Kirkpatrick, 2011).

Few valuation studies were found for Victoria in the literature. Morton (1990) sampled total fish biomass in the mangroves of Moreton Bay, Queensland. The study estimated the value of mangroves at AUD$8,380 per hectare based on the market value of the fish caught. Rönnbäck (1999) discusses the economic valuations of seafood production supported by mangrove ecosystems and estimated the annual market value of capture fisheries supported by mangroves ranges from US$750 to US$1180 per hectare. It is noted that these studies underestimated the total economic value of mangrove as they only focused on the market value of fisheries.

Spurgeon (1999) provides a global summary of economic values of mangroves, which indicates a range from $3000 to $51,000 per hectare per year (1997 US Dollars), equivalent

to AUD$4,304 to 73,173 per hectare per year in 2013 Australian dollars. These were taken as the lower and upper bound estimates. Due to lack of information, the mean value of the range, AUD$38,750 per hectare per year, was adopted as the base case estimate.

- There was 8,264 hectares of mangrove habitat identified for the Victorian coast (Table 3.6).
- Total economic value of mangroves: $320 million per annum (ranging between $36 and 605 million per annum).

3.2.7 Seagrasses

Seagrass meadows provide non-commercial ecosystem services important to human welfare, for example, nutrient sink, habitat for many species forming a complex ecosystem, nursery area for juvenile species including several of commercial value, high rates of productivity, stabilisation of coastal sediments, influence on longshore sand transport (Kirkpatrick, 2011).

Recent work shows that seagrass is a potentially large sink for carbon, (Forquerean et al. 2012), however the only figures available are for *Posidonia australis* beds in NSW. These are not considered applicable to Victoria as Victorian beds are typically much less dense.

McArthur and Boland (2006) estimated that the economic contribution of seagrass habitats to secondary production of some important fish species in the gulf waters of South Australia is of the order of AUD$114 million per year. Furthermore, they estimated in a particular example that the economic cost of a 16% decline of seagrass in one small area was $235,000 per year in lost production of commercially harvested fish species (at 2001/02 market prices). Watson *et al.* (1993) placed an average value of $1.2 million per year on the production of three major commercial prawn species dependent on seagrass within the Cairns Harbour, Northern Queensland, Australia.

Costanza *et al.* (1997) also included seagrass in their global assessment of ecological services (nutrient cycling) and estimated an annual value of US$19,004 per hectare (in 1994 dollars), along with a global value of US$3,801 billion. This was converted to AUD$29,771 per hectare per year (in 2013 dollars) as the base estimate for this study.

Spurgeon (1999) provides a variety of cost and benefit values associated with four coastal habitat types such as coral reefs, mangroves, seagrass, and saltmarshes. For seagrasses, the economic values range from US$9,000 to 68,400 per hectare per year (1997 US Dollars), equivalent to AUD$12,913 to 98,380 per hectare per year in 2013 Australian dollars. These were taken as the lower and upper bound estimates.

- There was 61,961 hectares of seagrasses habitat identified for the Victorian coast (Table 3.6).

- Total economic value of seagrass: $1.85 billion per annum (ranging between $0.8 and 6.1 billion per annum).

3.2.8 Other marine areas

This habitat type includes all coastal waters not included in one of the other categories. The marine area of the coast consists of diverse habitats including temperate rocky reefs, rhodolith beds, areas of sand and the water column itself. There is little or no valuation data on these specific habitat types and due to these information gaps the areas were combined and assessed as one.

Costanza *et al.* (1997) placed an average value of the *world's* marine systems at US$577 per hectare per year, equivalent to AUD$904 per hectare per year (in 2013 dollars). The upper and lower bound was assumed to be ± 30% of the base value.

- There were 806,141 hectares of 'other marine' areas in addition to seagrasses and mangroves identified for the Victorian coast (Table 3.6).
- Total economic value of other marine systems: $729 million per annum (ranging between $510 and 947 million per annum).

4. DISCUSSION

A key finding from this study is that, notwithstanding the points raised below, the value of Victoria's non-commercial coastal ecosystem services ($8.4 billion per year) is similar to the value of commercial coastal activities ($9.8 billion per year). This finding has important implications for the way decisions about the use of ecosystem services ought to be made, particularly where there are competing demands for those services.

Tourism, commercial ports and petroleum were the highest valued coastal industries, each contributing more the $3 billion per year. Tourism employs by far the largest number of people, with almost 40,000 jobs created either directly or indirectly as a result of tourism in coastal regions.

For commercial activities, it is also important to note that the estimates of economic impact cited in this report are indicative of the general magnitude of effects. They do not provide precise estimates, as only approximate data were available for many of the inputs, and various assumptions are made (e.g. the use of multipliers to work out flow on effects). This is acknowledged by the authors of at least some of these studies. However the results are deemed to be fit for purpose – that is to indicate the approximate economic impact of these activities.

For coastal ecosystem services, Estuaries had the highest value of $2.5 billion per year. Coastal Recreation, associated principally with beaches, had a value at $2.4 billion per year. The third highest was Seagrass, contributing $1.8 billion per year. Mangroves were assigned the highest value per unit area at $38,750 per hectare per year (noting that this value was somewhat arbitrary) however their contribution overall was small due to the relatively small area of mangrove habitats in Victoria. The terrestrial habitats, Forests and Grassland/Heathland, were assessed as having the lowest unit rates and overall value ($24 and 383 million respectively).

This study is the first attempt to value the ecosystem services of the Victorian coast, and the results must be considered in that context. The value transfer method is widely used and fit for purpose however it is acknowledged that value estimates are subject to a degree of uncertainty, as illustrated by the upper and lower bounds of the estimates. In this study, uncertainty also arises from the small number of primary valuation studies, with only nineteen Victorian studies covering a limited subset of possible ecosystem services. In most of these cases, the valuation was for a very specific habitat type (e.g. old growth eucalypt forest) and was not considered applicable to the broad ecosystem types used here. For several ecosystem types where no suitable local or regional data was available, a global average value was applied. Clearly this is the least preferred method, as the value of ecosystem services is likely to be highly dependent on the local setting. Nevertheless, comparison of values across multiple studies provides context for the selection of appropriate values, and in most cases conservatively low values were chosen.

Another significant limitation for the ecosystem services valuation is that the available studies do not cover the full range of ecosystem services provided. For example, seagrass habitats are widely acknowledged to provide coastal protection, erosion prevention and water purification services, but those services have not been valued (Barbier *et al.* 2011). The estimate for seagrass presented in this study ($1.8 billion per annum, range $0.8 to 6.1 billion per annum) was based primarily on a global average value for nutrient cycling services. Similarly there are no reliable valuations for key services of sandy beaches or dune systems. The overall value for ecosystem services is therefore likely to be considerably underestimated.

This study highlights the general lack of detailed information about ecosystem services, not just for Victoria, but also nationally and internationally. For example, surprisingly this study found no attempt to value the ecosystem services of temperate rocky reefs, despite their importance for fisheries and marine biodiversity. As outlined above, there have been very few evaluations of seagrass or coastal marine habitats generally. One exception for Victoria is the role of Port Phillip Bay in nutrient cycling, and more particularly the capacity of the bay to process and remove nitrogen inputs, including those from the Western Treatment Plant (e.g. Harris *et al.* 1996, Longmore and Nicholson 2012).

This study also highlights a lack of recent, comprehensive mapping data on the extent of coastal and marine ecosystems.

These estimates provide a guide to the potential economic value of Victoria's coastal ecosystems. It is not intended that these estimates be used in planning or decision making. Any decisions about particular projects or developments will need local assessment and stakeholder input to fully assess the value of ecosystem services.

4.1 Potential threats to the economic value of the coast

Both the commercial and non-commercial value of the coast face a range of threats. Threats to coastal and marine ecosystems have flow on effects for commercial activities such as tourism and fisheries that rely on healthy coastal ecosystems. Other commercial activities like ports and the petroleum industry do not depend on healthy ecosystems, but need to carefully manage their impact on ecosystem services on which other activities depend.

Coastal marine habitats such as seagrasses, mangroves and salt marshes have been affected by increasing land use and coastal development. Seagrasses are vulnerable to poor water quality, which reduces the amount of light available for growth, and elevated nutrient levels causing increased growth of algae. Mangroves have been subject to clearing in the past, and remain vulnerable to coastal development, river catchment modification and pollution. Saltmarshes have been cleared and modified for human use, causing disrupted connectivity, increased nutrient inputs, and altered sediment dynamics. Coastal and marine ecosystems have also been affected by introduced species, overfishing and pollution in the form of excessive nutrients or toxicants. On land, threats include habitat fragmentation and loss,

leading to a loss of biodiversity over time. Introduced predators and weeds exacerbate these problems. Coastal erosion is an ongoing natural process in many places, and may be more severe in areas where vegetation has been lost through other processes.

These threats to coastal ecosystems are well known and have been articulated numerous times (e.g. DCC 2009). Despite this knowledge, many of these threats continue to impact on coastal and marine environments.

In addition to these local and regional pressures, the predicted effects of climate change are likely to cause global changes to coastal and marine ecosystems. These effects will be brought about through a combination of factors including:

- Sea level rise
- Greater frequency of extreme weather events
- Increased water temperature
- Altered rainfall patterns affecting catchment inputs
- Ocean acidification
- Changes to oceanic circulation patterns

Sea level rise and extreme weather events such as storm surges are the greatest direct threat to commercial services. For example it has been estimated that in Victoria a 1.1 m sea level rise would place 31,000 homes and $22 billion worth of coastal infrastructure at risk of damage by inundation, erosion or accelerated degradation (DCCEE 2011).

The effect of climate change on coastal and marine ecosystems is unclear, but is likely to be significant. As the sea level rises the shoreline will generally move landward, inundating areas now above tide level, increasing the frequency of inundation for intertidal areas and increasing the depth of submerged areas. It is expected that ecosystems will adapt to some extent through landward migration along with the shoreline so that habitats zones maintain their preferred depth or height above sea level, where possible. Change is expected to be greatest in developed parts of the coastal zone due to the lack of room to allow habitats and ecosystems to migrate inland (DCCEE 2010). In these areas a complete change in the habitat type may occur.

Considering threats as trade-offs

Ecosystem services do not exist independently, but interact with one another in complex and sometimes unpredictable ways (Rodriguez *et al.* 2005). Decisions about using a particular ecosystem service, (knowingly or unknowingly) involve trade-offs, changing the type, magnitude and relative mix of ecosystem services. For example creating a marine protected area involves a tradeoff between the provisioning and cultural services of fishing, which are foregone in return for scientific, biodiversity and alternative cultural benefits.

Tradeoffs frequently result in off-site effects, for example where freshwater extraction upstream in a river has negative consequences downstream. Tradeoffs may also occur in time, where the decision to use a service now decreases the opportunity for future use. The costs of such decisions, either to those downstream or to future generations are termed "externalities" because they are not factored into traditional financial cost-benefit analysis. The cost of services lost is borne by others than those benefiting from the decision to use a particular set of services (Rodriguez *et al.* 2006). By quantifying the value of the services lost, they can be factored into decision making.

Threats to coastal ecosystem services arise primarily from human activity. Parts of Victoria's coast are intensively used for agriculture, human settlement and industry, with considerable benefits to individuals and society. These benefits have, in effect, been traded off against changes to the coastal ecosystem, resulting in the loss of habitats and the services they provide. While the value of the services lost is not known, evidence presented here indicates that it may be considerable. In the past, when some of these changes occurred, decision makers were unlikely to have been aware of the range of services and the value being traded off against the perceived benefits. Indeed, even if they had been aware, those services are unlikely to have been accorded the same value in the past as they are now, due to their apparent abundance and invulnerability to depletion (Hardisty 2010). Decision making can utilise non-market valuation methods to assist in making comprehensive trade-off decisions.

4.2 Relationship between commercial and non-commercial services – understanding tradeoffs

A key driver for the valuation of ecosystem services is the need to inform better, more sustainable decision making about their use, particularly in situations where there are competing demands for those services. Two examples are provided below to illustrate interdependencies between ecosystem services, showing how the use of ecosystem services in one part of a system may change the value of services available in other parts of the system.

Water extraction and estuarine ecosystems – Murray –Darling and the Coorong

The provision of freshwater is one of the most important ecosystem services for human existence. The extraction of freshwater from rivers and its use for agriculture provides great benefits to society in terms of the food that is produced, but results in progressively reduced flows further downstream. These changes have well documented effects for estuarine ecosystems, including increased salinity, closure of river mouths, lack of flushing by tides, algal blooms, decreased productivity, loss of biodiversity, lower water levels and exposure of acid sulfate soils. These changes have a number of flow-on effects to other ecosystem services, such as the provision of estuarine habitat, loss of commercial and recreational fishing opportunities and loss of recreational opportunities. A well-known local example is the effect of water extraction from the Murray – Darling River system on the

estuary and wetlands of the lower Murray River, which include the iconic Coorong coastal wetland in South Australia.

In the case of the Murray, recognition of the requirements of the ecosystem, along with the benefits of agriculture, has allowed a solution to be formulated that seeks to redress the balance between the competing demands of agriculture and the ecosystem by allocating a portion of the resource to the environment. The Basin Plan has been adopted by the Commonwealth government, and is in the early stages of implementation. The plan requires industry to forgo some of the direct financial benefits of agricultural production in return for improvements to the ecosystem (MDBA 2012). The basin-wide benefits, in terms of ecosystem services, of the plan were estimated to be in the range of $3-8 billion. For the Coorong wetland, it was estimated that implementation of the plan would create an additional $124 million per annum in recreational benefits (CSIRO 2012).

Land use and water quality

Poor water quality and associated impacts on coastal and marine ecosystem services represents a tradeoff between the beneficial use of land for agriculture, human settlement and infrastructure and off-site effects on coastal and marine habitats and the ecosystem services they provide. We forgo the ecosystem services provided by aquatic habitats in return for more productive agriculture or the existence of key coastal infrastructure (e.g. ports).

One of the consequences of poor water quality that can results from modified land use is the loss of seagrass. Seagrass habitats occur in sheltered, shallow coastal waters and provide a wide range of ecosystem services including nutrient cycling, enhanced fisheries productivity, habitats for a wide variety of species, coastal protection, carbon storage and erosion control (Barbier *et al.* 2011).

Seagrasses are declining globally, and it has been estimated that seagrass has been disappearing at the rate of 110 square kilometres per year since 1980, and that 29% of the world's seagrass habitat has been lost since the first records were made in 1879 (Waycott *et al.* 2009). The decline of seagrass has been attributed to several potential causes, with poor water quality resulting from land use being ranked highly.

In Victoria, seagrass has declined significantly in Western Port from 250 km^2 in the 1970's to around 60 km^2 in 1983, although it has since increased to around 150 km^2 in 1999. Some of the ecosystem services provided by seagrass are illustrated by the consequences of their decline, which have included increased sediment instability, loss of estuary bank stability, decreased light, and eventual loss of habitat and associated biota (Walker 2011).

The issue of seagrass habitats demonstrates one of the key challenges for management of the coast in that the relationship between activities on land that contribute to poor water quality and the loss of seagrass are spatially disconnected, and difficult to quantify.

Establishing quantitative cause and effect pathways for seagrass loss will be necessary to fully understand the nature of tradeoffs and factor them into decision making.

Towards a solution

More recently, awareness of ecosystem services and their potential loss has become more widely recognized. Sustainable Development (SD) as articulated by the Bruntland Commission in 1987, and the related concept of the triple bottom line, provide a framework for addressing these issues, and have been embraced in numerous government policies and incorporated in legislation in Victoria and around the world. In practice, however SD has failed to deliver the promised benefits, due to the inability or unwillingness to rigorously apply its principles to decision making (Hardisty 2010).

One of the barriers to implementation of SD may be the lack of awareness of the extent to which society relies upon and gains benefits from ecosystem services, that is their true value. Another barrier may be the lack of an accepted decision making framework that would allow a proper analysis of the trade-offs in terms of the total (financial, social and environmental) costs and benefits of particular projects or developments. A third barrier might be the lack of any incentive for those making investment decisions to perform such an analysis.

Valuation of ecosystem services in monetary terms may form part of the solution to this problem. Once ecosystem goods and services are appropriately valued in dollar terms, it is relatively simple to perform a cost-benefit analysis that will reveal the overall net benefit of a decision, or that will allow options to be compared to select the one that will deliver the optimum net benefit to society. Once decision makers are aware of the dollar value of the ecosystem services that are at stake, the incentive to carry out such analyses may become much stronger.

An alternative view is that the ecosystem services are essential to human (and other) life and therefore priceless (Costanza *et al*, 1997). This may be true in the aggregate, but it leaves us with no way of making balanced and informed decisions about development and ecosystem services on a local scale. In order to address this concern the values ascribed to non-commercial ecosystem services will ultimately need to flexible and linked to the scarcity and demand for the service.

5. CONCLUSIONS

- The purpose of this study is to identify, characterise and quantify the "market" and "non-market" (commercial and non-commercial) values of the natural resources of the Victorian coast. The results from this study are intended to assist in policy development and decision-making that takes into account the value of ecosystem services and the interdependency of economic benefits and the health of coastal ecosystems.
- The coastal area of Victoria contains significant areas of marine, terrestrial and estuarine habitat. These areas provide a range of provisioning, regulating, supporting and cultural ecosystem services.
- From the biological and ecological perspective of the living resources, the Victorian coast provides habitat, food and protection, including estuary water resources and wetlands that support flora and fauna, and fish, wildlife, insects and birds. Furthermore, it is highly valued by humans for their enjoyment of recreational activities such as boating, fishing and swimming, as well as aesthetic environmental features.
- The value of the main commercial activities dependent on the Victorian coast was found to be around $9.8 billion annually.
- Tourism, ports and the petroleum industries made the largest economic contributions, valued at over $3 billion each.
- The petroleum industry relies largely on resources that are outside Victoria's coastal waters. If the contribution of the petroleum industry is excluded from the analysis, the overall value of commercial activities is around $6.3 billion.
- The value of non-market ecosystem services of the Victorian coast was estimated at $8.4 billion per annum, illustrating their considerable value to the Victorian community.
- The greatest ecosystem values derive from services provided by estuaries ($2.5 billion per annum) followed by cultural services in the form of coastal recreation, mainly associated with beach use ($2.4 billion per annum), followed by services provided by seagrasses ($1.8 billion per annum), and other marine waters ($730 million per annum)
- The valuation of non-market ecosystem services considers only a subset of the possible ecosystem services provided by the Victorian coast, due to a lack of primary valuation data. For example, there are no applicable primary valuation studies that consider the role of seagrasses in carbon sequestration or erosion control. Similarly, valuation of beaches concentrates on recreational value, largely ignoring ecological

services, such as natural coastal defence. The value of the full suite of services is likely to be much greater.

- Despite the limitations of this study, it is clear that the value of services provided by natural assets of the coast is likely to be similar in magnitude, if not greater than the value of the main commercial activities. Some of the main commercial activities, eg tourism, also depend heavily on ecosystem services.
- The results demonstrate the need for decision makers to consider the tradeoffs between the benefits of healthy functioning ecosystems and those associated with expanding use and development. Not doing so unknowingly puts at risk a large amount of value in the form of natural capital and associated services.
- One of the key challenges in sustainable decision making on the coast is quantifying the cause and effect relationships between human activities and their impact of ecosystem services, particular where the effects of the activity are separated from the activity in space and/or time.
- There are few relevant economic valuation studies for some types of ecosystems in Victoria (such as temperate reefs, seagrass, mangroves, wetlands). More original studies in these research areas are called for, particularly in the context of large projects or developments that have the potential to affect ecosystem services. Such studies would provide the necessary data to support sustainable long-term decision making.
- This study provides a limited, baseline estimate of the ecosystem values of the Victorian coast. No primary research was done for this study. The results from this study are intended to be indicative only and therefore need to be interpreted with caution. For planning and management decisions, more detailed, original valuation studies would be required.

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Appendix 1 - Value Transfer Methods

While a fair amount of research has been done on the economic value of ecosystem services globally (Costanza *et al.* 1997, Nunes, 2001, Spurgeon, 1999), little peer-reviewed work has been done to explicitly estimate the economic value of ecosystems in Victoria. Therefore, values were required to be "transferred" from previous studies outside the state (often termed "study site") to the current "policy site".

Value transfer (also known as "benefits transfer") is a process of using secondary valuation evidence sourced from previously undertaken studies to apply to a new decision-making context (Defra, 2010). Its particular appeal lies in it being a quicker and lower cost approach compared to the commissioning a primary valuation study. A greater use of "value transfer" will be key to more practical use of environmental values in policy making (Defra, 2010). This approach was adopted for this study.

In this report, value transfer information from 147 sources (see Table 3.5 and Appendix 2) was used to derive estimates of the economic values of ecosystem goods and services for the Victorian coast. To do so, the research team used

- The Environmental Valuation Reference Inventory™ (EVRI) - a benefits transfer infobase developed by Environment Canada in collaboration with a number of international experts and organizations that stores economic values derived from the peer-reviewed literature; and
- WorleyParsons' ExterNality Assessment Database (ENAD) constructed for a range of EcoNomics™ Assessment projects – a comprehensive resource containing details of hundreds examples of previously published data on the value of natural assets and services globally.

The critical underlying assumption of applying value transfer from the databases is that the economic value of ecosystem goods or services at the policy site can be inferred with sufficient accuracy from the analysis of existing valuation studies. The degree of value transfer accuracy is an empirical question. Brouwer (2000) surveyed seven of these value transfer studies and found that the average transfer error[1] is around 20-40% for unit value transfers. Ready *et al.* (2004) found an average transfer error of 38% in a multi-country transfer test both for unit and function transfer. Shrestha and Loomis (2001) found an average transfer error of 28% in a meta-analysis model of 131 US recreation studies.

[1] In the value transfer validity tests, two or more parallel valuation studies are conducted at different sites. Then an imaginary transfer is conducted from previous studies (or study sites) to a policy site where an original study has been performed. The transferred value is then compared to the value estimated in the primary valuation study at the policy site. The transfer error (TE) is calculated as the percent difference between the two estimates (Navrud, 2007).

To summarize, the transfer validity studies conducted to date show that the average transfer error for spatial value transfers both within and across countries tends to be in the range of 25% - 40% (Navrud, 2007). The validity tests also support the closer the study site is to the policy site or the greater the similarity of the policy site with the study site, the smaller the expected error (Boyle and Bergstrom 1992; Desvousges *et al.* 1998, Navrud, 2007). For this reason, the values from Victorian studies were adopted to transfer with the top priority in this research (among 147 source studies, there were only 19 studies for Victoria, 32 for New South Wales, 38 for Queensland and 27 for global review studies, see Table 3.5). When little valuation information for some ecosystem services could be found, a nationwide average or global average values were used to transfer.

Valuation studies selected and used for this study were:

- Published in peer-reviewed journals or books
- Focused on regions in Australia
- Limited to results that can readily be transferred: $ per ha or $ per household data

Data derived from a set of viable studies were then standardized to 2013 Australian dollar to provide a consistent basis for comparison. A lower bound and upper bound estimate of dollar values were also derived for the policy site. After the standardized estimates selected for value transfer, the resulting value estimate were assigned to the appropriate Geographic Information Systems (GIS) land cover categories at the policy site in a spatially explicit manner. The land cover types included in this report were (see Table 3.6):

- Beaches (not used for value transfer)
- Seagrasses
- Mangroves
- Wetlands/Marshes
- Rivers/Estuaries
- Forest
- Grasslands
- Other marine

Total ecosystem service value for the Victorian coast was determined by adding up all cover-specific ecosystem service values for the policy site, i.e.:

$$Total\ value(\$) = \sum_{i=1}^{10} Area_{\ i}\ (ha) \times Unit\ value_i\ (\$/ha)$$

Where

$Area_i$ = *Area of land cover type i*

$Unit\ value_i$ = *Annual ecosytem value per unit area of land cover type i*

The coastal recreation value of beaches was also considered by updating the work of URS (2007) which was based on the 'Travel Cost' methodology.

Appendix 2 - Summary of studies reviewed for value transfer

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
1) Coastal recreation (beaches)	URS	2007	Assessing the Value of the Coast to Victoria	Australia	VIC	Victorian coast	Coastal recreation value of AUD$154 per trip for the average individual; AUD$48 per visitor day	TC	Report	Yes
1) Coastal recreation (beaches)	Pitt, M.	1992	The Value of Beach and Dune Maintenance to Tourism: A Contingent Valuation Study on the North Coast of NSW in Valuing Natural Areas	Australia	NSW	North coast	WTP AUD$1.9 per week per visitor to assist in beach and dune maintenance and improvement	CV	Book chapter	No
1) Coastal recreation (beaches)	Anning, D.et al	2009	Valuing climate change impacts on Sydney beaches to inform coastal management decisions	Australia	NSW	3 Sydney beaches (Manly, Collaroy-Narrabeen, Hawkesbury River foreshores)	To demonstrate the critical need for economic information to inform the selection of coastal management options for the beaches of the Sydney region and to outline the project currently under way to address this information gap.		Journal	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
1) Coastal recreation (beaches)	Sydney coastal council	2011	Quantifying the Value of Sydney's Beaches	Australia	NSW	3 Sydney beaches (Manly, Collaroy-Narrabeen, Hawkesbury River foreshores)	HP: an environmental premium associated with beachfront properties of around 40%, relative to an otherwise identical property immediately landward of the first row; TC: Travel costs associated with daytrip recreation are around $6 per person per day, with additional onsite expenditure of around $5. CV: Approximately half of all respondents would give in-principle support to the development of a beach management fund to prevent these erosion impacts (at the beach where they were surveyed), with a further 20% of respondents willing to consider donating if the fund was dedicated to their 'home' beach.	HP, TC, CV	Report	No
1) Coastal recreation (beaches)	Pitt, M. W.	1992	The value of coastal land: an application of travel cost methodology on the NSW north coast	Australia	NSW	Lower, Mid and Far North Coast	Recreation value of visitors was estimated at an average CS of $150.85 per individual (1991). The CS per annum per 100 meters of coastline varied from about $51,000 in the Lower Coast to $219,000 in the Mid Coast.	TC	Journal	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
1) Coastal recreation (beaches)	Campbell, H.F. and C.R.M. Reid	2000	Consumption Externalities in a Commercial Fishery: The Queensland Beam Trawl Fishery	Australia	QLD	Southern coastal Queensland, recreational boat fishing	The annual consumer surplus for the average boat fisher is $552, and $226 for the average shore fisher. Mean WTP of AUD$40.17 for a day of fishing. Sightings of commercial vessels reduced the average boat fisher's willingness to pay by $5.25 (1998).	CV	Journal	No
1) Coastal recreation (beaches)	Prayaga, P., J. Rolfe and N. Stoeckl	2009	The value of recreational fishing along the Capricorn Coast: A pooled revealed preference and contingent behaviour model	Australia	QLD	Great Barrier Reef Marine Park along the Capricorn Coast in Central Queensland, spanning about 95kms of coastline from Byfield and Shoalwater Bay in the north to Keppel Sands in the south	Value of Recreational fishing of AUD$385 per group and AUD$ 167 per angler (2007)	TC	Conference paper	No
1) Coastal recreation (beaches)	Wilson, C. and C. Tisdell	2003	Conservation and Economic Benefits of Wildlife-Based Marine Tourism: Sea Turtles and Whales as Case Studies	Australia	QLD	Mon Repos and Hervey Bay	Average Weekly WTP AUD$2-2.7 per houehold to protect Sea Turtles and WTP AUD$2.6-4 per household to protect Whales for 10 years	CV	Journal	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
1) Coastal recreation (beaches)	Huybers, T. and J. W. Bennett	2000	Impact Of The Environment On Holiday Destination Choices Of Prospective Tourists: Implications For Tropical North Queensland	Australia	QLD	Tropical North Queensland region, around the cities of Cairns and Port Douglas.	UK tourists WTP GBP 229-880 per visitor from very spoilt to some spoilt; WTP GBP 617-738 from some spoilt to unspoilt environment (1998)	CM	Journal	No
1) Coastal recreation (beaches)	Raybould & Lazarow		Economic and social values of beach recreation on the Gold Coast	Australia	QLD	Gold coast	GC residents spent travel costs btween $64 per adult and $270 per adult accessing the beach in 2007; GC day visitors spent travel costs of between $15 to $45.	TC	Report	No
1) Coastal recreation (beaches)	Blackwell, B.	2007	The value of recreational beach visit: An application to Mooloolaba Beach and comparisons with other outdoor recreation sites	Australia	WA, QLD	Kawana, Mooloolaba, Alex and Maroochydore on the Sunshine Coast in South East Queensland, with a small sub-sample from Cottesloe beach in Western Australia	Recreational value of AUD$119.95 per person for a recreation day visit (2000) to australian beaches for the entire sample: the visitor equivalent is $107.75 while the resident's is $17.41.	TC	Journal	No
1) Coastal recreation (beaches)	Rogers, A.	2011	Is Choice Modelling Really Necessary? Public versus Expert Values for Marine Reserves in Western Australia	Australia	WA	Ningaloo Marine Park, Ngari Capes Marine Park	Annual WTP value for the public range from AUD$26 to AUD$108 per household per year (2009) as estimates of benefits provided by marine parks	CM	Conference paper	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
1) Coastal recreation (beaches)	McCartney, A.	2006	The Social Value of Seascapes in the Jurien Bay Marine Park: An Assessment of Positive and Negative Preferences for Change	Australia	WA	coastal areas in the vicinity of Jurien Bay Marine Park (JBMP) such as in Jurien Bay, Cervantes, and other coastal areas between Wedge Island and Green Head	WTP of AUD$34.28 per household (2003) for the protection of the pristine seascapes including views of the ocean and of the coastline	CV	Journal	No
1) Coastal recreation (beaches)	Raguragava n, J., A. Hailu and M. Burton	2010	Economic Valuation of Recreational Fishing in Western Australia, Working Paper 1001	Australia	WA	Eight fishing regions and 48 fishing sites along the coast stretching from Esperance region in the southwest to the Kimberly region in the north	Value of recreational fishing of all the eight major fishing regions and 48 fishing sites in Western Australia was estimated at AUD$15 per angler for table fish and AUD$31 per angler for prize fish (2001)	TC	Working paper	No
1) Coastal recreation (beaches)	Gillespie, R. and J. Bennett	2011	Non Use Economic Values of Marine Protected Areas in the South-West Marine Area, Environmental Economics Research Hub (EERH) Research Report No. 103	Australia	WA	South-West Marine Region	WTP of $104-110 per household forestablishment of new marine protected areas in the South-West Marine Region (2010)	CV	Working paper	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
1) Coastal recreation (beaches)	The Allen Consulting Group, T.	2009	The Economics of Marine Protected Areas: Application of Principles to Australia's South West Marine Region	Australia	WA	South West Marine Region	Estimate economic costs and benefits of marine protected areas along the South West of Western Australia.	BT	Report	No
1) Coastal recreation (beaches)	Dyck, A. J. and U. R. Sumaila	2010	Economic Impact of Ocean Fish Populations in the Global Fishery	Global			The global economic impact of marine fisheries estimated to be about $ 235.1 billion (2003 US)	I-O	Journal	No
1) Coastal recreation (beaches)	Cisneros-Montemayor, A. M.	2010	A Global Estimate of Benefits From Ecosystem-Based Marine Recreation: Potential Impacts and Implications for Management	Global			Marine recreational value of US$386 per person world average (2003), data collected for 144 major maritime countries of the world through a review of secondary sources.	BT	Journal	No
1) Coastal recreation (beaches)	Liu, S. and D. I. Stern	2008	A Meta-Analysis of Contingent Valuation Studies in Coastal and Near-Shore Marine Ecosystems	Global			Mean willingness to pay was US$766 per household per year; median WTP was US$88.50 per household per year (2006 US Dollars) based on 39 studies and 120 observations from studies on coastal and nearshore marine systems.	MA	Working paper	No
1) Coastal recreation (beaches)	Ghermandi, A. and P. ALD. Nunes	2011	A Global Map of Coastal Recreation Values: Results from a Spatially Explicit Meta-analysis, Working Papers No.	Global			Global annual coastal recreation value US$71,112 per ha per year (2003) based on 253 observations from 79 primary valuation studies conducted	MA	Working paper	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
			08/WP/2011				between 1981 and 2008.			
1) Coastal recreation (beaches)	Ghermandi, A., P. A. L. D. Nunes, R. Portela, N. Rao and S. S. Teelucksingh	2009	Recreational, Cultural and Aesthetic Services from Estuarine and Coastal Ecosystems	Global			Beach recreation (178.9 USD/person/year); non-consumptive recreation in estuarine waters (83.5 USD/person/year); recreational fishing (408.7 USD/person/year); and recreation in coral reef ecosystems (700.4 USD/person/year); non-use value $191.6/person/yr (200?)	MA	Working paper	No
1) Coastal recreation (beaches)	Spurgeon, J.	1999	The Socio-Economic Costs and Benefits of Coastal Habitat Rehabilitation and Creation	Global			For coral reefs, costs range from $10,000 to 6.5 million/hectare (ha); for mangroves $3000-510,000/ha; for seagrasses $9000-684,000/ha; and for saltmarshes $2000-160,000/ha (1997 US Dollars).	CBA	Journal	No
1) Coastal recreation (beaches)	Narita, D., K. Rehdanz and R. SJ. Tol	2011	Economic Costs of Ocean Acidification: A Look into the Impacts on Shellfish Production	Global			Global consumer surplus losses from a decrease in mollusk production due to ocean acidification of $3.7 billion.	MP	Working paper	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
1) Coastal recreation (beaches)	Ghermandi, A., P. A. L. D. Nunes, R. Portela, N. Rao and S. S. Teelucksingh	2009	Recreational, Cultural and Aesthetic Services from Estuarine and Coastal Ecosystems	Global			Beach recreation (178.9 USD/person/year); non-consumptive recreation in estuarine waters (83.5 USD/person/year); recreational fishing (408.7 USD/person/year); and recreation in coral reef ecosystems (700.4 USD/person/year); non-use value $191.6/person/yr (200?)	MA	Working paper	No
2) Forest	Bennett, J. W., R. Dumsday, C. Lloyd and M. Kragt	2007	Non-use values of Victorian Public Land: Case Studies of River Red Gum and East Gippsland Forests	Australia	VIC	Forests in the North and Northern-East of Victoria	The purpose of this study was to estimate the values associated with Victorian forests that are not marketed (tourism activities, ecosystem conservation and protection of cultural heritage sites) that compete against land uses such as timber production, mining and grazing. Respondents were found to be willing to pay AUD$3.96-8.39 per household per year (2006) for an increase of 100 breeding pairs of parrots.	CM	Report	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
2) Forest	Lockwood, M.	1999	Preference Structures, Property Rights, and Paired Comparisons	Australia	VIC	nature conservation and scenic values of wet eucalypt forest	WTP of AUD$70-96/hh/yr (1998) for the protection of wet eucalypt forest from logging in Victoria: $70 for a 10% increase in the area of wet eucalypt forest reserves, $96 for a 30% increase, and $15 for a 50% increase from the 50% baseline.	CV	Journal	No
2) Forest	Lowell, K., J. Drohan, C. Hajek, C. Beverly and M. Lee	2007	A Science Driven Market Based Instrument for Determining the Cost of Environmental Services: A Comparison of Two Catchments in Australia	Australia	VIC	Gippsland and Corangamite catchments	The offsite impacts on dryland salinity and the change in water yield resulting from forest plantation for one hectare was estimated to be $5,340/ha (2006 Australian Dollar) for Gippsland and $1,235/ha for Corangamite, in which grants to owners were $1165/ha and $640/ha respectively.	MP	Journal	No
2) Forest	Lockwood, M., J. Loomis and T. DeLacy	1993	A Contingent Valuation Survey and Benefit-Cost Analysis of Forest Preservation in East Gippsland	Australia	VIC	East Gippsland	WTP AUD$ 52 per household to ensure inclusion of East Gippsland UNE forests in national parks (1993)	CV	Journal	No
2) Forest	Lockwood, M., J. Loomis and T. De Lacy	1994	The relative unimportance of a nonmarket willingness to pay for timber harvesting	Australia	VIC	East Gippsland in Southeastern Australia	WTP of AUD$19-38 per respondent (1991) for logging of native forests in East Gippsland.	CV	Journal	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
2) Forest	Loomis, J., M. Lockwood, and T. DeLacy	1993	Some Empirical Evidence on Embedding Effects in Contingent Valuation of Forest Protection	Australia	VIC, NSW	The Unreserved Natural Estate (UNE) forests of southeastern Australia	Annual willingness to pay for the preservation of old growth forests ranges from $39 to $103 (1991)	CV	Journal	No
2) Forest	Bennett, J. W. and M. Carter	1993	Prospects For Contingent Valuation: Lessons From The South-East Forests	Australia	NSW, VIC	South-East New South Wales, East Gippsland in Victoria	WTP AUD$43.65 per household per year (1991) to conserve areas of forests in south-east New South Wales and East Gippsland in Victoria	CV	Journal	No
2) Forest	Rogers, M.F. and J.A. Sindin	1994	Safe Minimum Standard for Environmental Choices: Old-growth forest in New South Wales	Australia	NSW	Chaelundi State Forest	A majority of correspondents were prepared to forego $2 million and 10 jobs for the species preservation an old-growth forest	CV	Journal	No
2) Forest	Bennett, J.W.	1984	Using Direct Questioning to Value the Existence Benefits of Preserved Natural Areas	Australia	NSW	Nadgee Forest Reserve in Canberra	WTP of AUD$27.08 (1979) to prevent the loss of existence benefits from the Nadgee Nature Reserve in Canberra	CV	Journal	No
2) Forest	Hundloe, T.J., G.T. McDonald and R.K. Blamey	1990	Socio-Economic Analysis of Non-Extractive Natural Resource Uses in the Great Sandy Region	Australia	QLD	Fraser Island	WTP of AUD$316 for users and AUD$187 for non users (1990) for recreation and preservation of forests in Fraser Island in Queensland	CV and TC	Book chapter	No
2) Forest	Scheufele, G. and J. Bennett	2011	Valuing Ecosystem Resilience, The Crawford School of	Australia	QLD	Border Ranges Rainforests	One-off household payment $855 to improve ecosystem resilience (2010)	CM	Report	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
			Economics and Government							
2) Forest	Rolfe, J. and J. W. Bennett	2002	Assessing Rainforest Conservation Demands	Australia	QLD, NSW	Rainforest areas in Far North Queensland, South East Queensland and Northern New South Wales, Vanuatu, South America and Indonesia	WTP of AUD$52-81 per household (1996) for protecting rainforests	CM	Journal	No
2) Forest	Chiabai, A., C. M. Travisi, H. Ding, A. Markandya and P. A. L. D. Nunes	2009	Economic Valuation of Forest Ecosystem Services: Methodology and Monetary Estimates	Global			The total economic losses caused by the decrease in forestry area by 2050 compared to 2007 was estimated at €78 billion (2007)	BT	Working paper	No
2) Forest	Costanza, R. et.al.	1997	The value of the world's ecosystem services and natural capital	Global			Average global value of annual ecosystem services: forest US$ 969 per hectare per year (1994)	Review	Journal	Yes
3) Grassland/ Heathland	Lockwood M. and D. Carberry	1998	Stated Preference Surveys of Remnant Native Vegetation Conservation	Australia	VIC, NSW	Northeast Catchment Management Region and the Murray Catchment Management Region	Tthe nonmarket economic values of remnant native vegetation (RNV) in private property in northeast Victoria and the southern Riverina of New South Wales (NSW) in	CV and CM	Report	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
							Australia: AUD$38-87/hh/yr in NSW; AUD$43-98/hh/yr in VIC (1997)			
3) Grassland/ Heathland	Pitt, M. W.	1993	The Contingent Value of Maintaining Natural Vegetation on Beach Dunes	Australia	NSW	North Coast	The dunes of North Cost, New South Wales, Australia are environmentally sensitive, easily damaged by both extreme climatic events and human activities. the non-market benefits provided by natural vegetation on beach dunes to North Coast residents: AUD$4.18 per household per month; AUD$22,000 per km (1992)	CV	Conference paper	No
3) Grassland/ Heathland	Costanza, R. et.al.	1997	The value of the world's ecosystem services and natural capital	Global			Average global value of annual ecosystem services: grasslands US$ 232 per hectare per year (1994)	Review	Journal	Yes

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
4) Wetlands/ Marshes	Lansdell, N. and L. Gangadharan	2003	Comparing Travel Cost Models and the Precision of their Consumer Surplus Estimates: Albert Park and Maroondah Reservoir	Australia	VIC	Albert Park and Maroondah Reservoir	The recreational value of Albert and Maroondah Reservoir parks, Victoria, Australia, using travel cost models. For Maroondah Reservoir park, the authors estimated consumer surplus ranging from $2.2 to $3.5 million; $1.5 to $13.1 million; and $0.1 to $6.7 million for the regional, city, and postcode zone methods respectively. For Albert park, consumer surplus estimates ranged from 1.1 to 63.6 million and $-21,124 to $3768.8 million using the regional and postcode zone methods respectively (1999 value)	TC	Journal	No
4) Wetlands/ Marshes	Lowell, K., J. Drohan, C. Hajek, C. Beverly and M. Lee	2007	A Science Driven Market Based Instrument for Determining the Cost of Environmental Services: A Comparison of Two Catchments in Australia	Australia	VIC	Gippsland and Corangamite catchments	This study used market-based instrument (MBI) to determine payments for environmental services to reduce salinity in Australia. The net benefit of forest plantation for one hectare was estimated to be $5,340 (2006 Australian Dollar) for Gippsland and $1,235 for Corangamite.	MP	Journal	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
4) Wetlands/ Marshes	Sappideen, B.	1993	Valuing the Recreational Benefits of the Sale Wetlands Using the Contingent Valuation Method	Australia	VIC	Sale wetlands	For the general residents the mean willingness to pay to a conservation fund to protect the environmental values of the Sale wetlands from current status to deteriorated statuswas calculated as $2.58 (1993 Australian Dollars) while for game hunters the value was calculated as $4.67. (1993)	CV	Conference paper	No
4) Wetlands/ Marshes	Mwebaze, P. and J. Bennett	2011	Valuing Australian Botanic Collections: A Combined Travel-Cost and Contingent Valuation Study	Australia	ACT, VIC, NSW	Three botanic gardens: the Australian National Botanic Garden (ANBG) in Canberra, the Royal Botanic Garden Melbourne (RBGM), and the Royal Botanic Garden Sydney (RBGS)	CS of AUD$34 per trip for each botanic garden (2010)	TC and CV	Conference paper	No
4) Wetlands/ Marshes	Streever, W.J., M. Callaghan-Perry, A. Searles, T. Stevens, and P. Svoboda	1998	Public Attitudes and Values for Wetland Conservation in New South Wales, Australia	Australia	NSW	Wetlands in New South Wales provide residents food such as shellfish and recreational benefits	Mean: AUD$124.37/hh/yr (1996) Median: AUD$100/hh/yr (1996) The median value per household indicated by the survey results was used to estimate the aggregate WTP for the protection of wetlands. All non-respondents were assumed	CV	Journal	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
							to have zero values for wetland conservation. Aggregate value for wetlands in New South Wales is AUD$38 million (1996 Australian dollars) per year for the next five years.			
4) Wetlands/ Marshes	Morrison M., J. Bennett, R. Blamey, and J. Louviere	2002	Choice Modeling and Tests of Benefit Transfer	Australia	NSW	Macquarie Marshes and Gwydir wetlands	Macquarie Marshes and Gwydir wetlands have a number of significant environmental values such as important habitats for waterbird breeding, habitats for many endangered and protected waterbird species, and high quality feed for cattle grazing. The estimated compensating surplus was AUD$80.96-119.31/hh/yr (1997).	CM	Journal	No
4) Wetlands/ Marshes	Sinden J.A.	2004	Estimating the Opportunity Costs of Biodiversity Protection in the Brigalow Belt, New South Wales	Australia	NSW	Brigalow Belt South Bio-region	The opportunity costs (OC) of biodiversity protection on farmland includes the loss in land value and the gain in number of species protected. The estimated losses per ha vary from $48 to $121 (December 2000 US$) according to the farmer's plans to retain vegetation and the legislative	BT	Journal	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
							requirement.			
4) Wetlands/ Marshes	Lockwood, M and K. Tracy	1995	Nonmarket Economic Valuation of an Urban Recreation Park	Australia	NSW	Centennial Park, Sydney consists of 220 hectares of parkland ranging from sculptured gardens and ornamental wetlands to sports fields and more natural areas.	Annual nonmarket value to the users of the Centennial Park of between $23 million and $33 million together with a non use value of at least $2.6 million (1993 Australian Dollars). The average bid per household was $25.81, giving a total WTP for the population of $31 million per annum. TC: AUD$7.42-$10.56 per visit; CV: WTP AUD$25.81/hh/yr; non-use AUD$12.10/hh/yr (1993)	TC and CV	Journal	No
4) Wetlands/ Marshes	Morrison M., J. Bennett, R. Blamey, and J. Louviere	2002	Understanding local community preferences for wetland quality	Australia	NSW	ephemeral wetlands	Macquarie Marshes and Gwydir wetlands have a number of significant environmental values such as important habitats for waterbird breeding, habitats for many endangered and protected waterbird species, and high quality feed for cattle grazing: AUD$27.83-103.80/hh/yr	CM	Journal	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
4) Wetlands/ Marshes	Morrison, M. D., J. W. Bennett and R. K. Blamey	1998	Valuing improved wetland quality using choice modelling	Australia	NSW	The Macquarie Marshes in central western New South Wales	WTP AUD$36.10 per household to increase of 400m2 wetland area (1997)	CM	Journal	No
4) Wetlands/ Marshes	Morrison, M.	2002	Understanding local community preferences for wetland quality	Australia	NSW	The Macquarie Marshes, an ephemeral wetland on the Macquarie River, in north-western New South Wales	WTP AUD$3.63 to preserve an extra 100 km2 of wetland (1999)	CM	Journal	No
4) Wetlands/ Marshes	Whitten, S. and J. Bennnett	2005	Social Values of Privately Owned Wetland Resources	Australia	NSW	Upper South East (South Australia), Murrumbidgee River Floodplian (New South Wales)	Willing to pay (per household as a one-off payment) $11.39 for an extra 1000 hectares of healthy wetlands, $0.55 for a one percent increase in the population of native wetland and woodland birds and $0.34 for a one percent increase in the population of native fish.	CM	Report	No
4) Wetlands/ Marshes	Morrison, M.	2002	Understanding local community preferences for wetland quality	Australia	NSW	The Macquarie Marshes, an ephemeral wetland on the Macquarie River, in north-western New South Wales	WTP AUD$3.63 to preserve an extra 100 km2 of wetland (1999)	CM	Journal	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
4) Wetlands/ Marshes	Bennett, J.	1995	Economic Value of Recreational Use: Gibraltar Range and Dorrigo National Parks	Australia	NSW	Dorrigo and Gibraltar Range National Parks	For Dorrigo Park the value per visit and annual value was estimated to be $17.33 (1995 Australian Dollars) and $2.75 million respectively. For Gibraltar Park the value per visit and annual value was estimated to be $15.83 and $630,000 respectively.	TC	Journal	No
4) Wetlands/ Marshes	Pitt, M. W.	1992	The Value of Coastal Land: An Application of Travel Cost Methodology - NSW North Coast	Australia	NSW	Lower, Mid and Far North Coast	The non-market value of the coastal land of North Coast in New South Wales was estimated at AUD$150.85 per individual (1991)	TC	Journal	No
4) Wetlands/ Marshes	Sinden, J. A., P. O. Downey, S. M. Hester and O. Cacho	2008	Valuing The Biodiversity Gains From Protecting Native Plant Communities From Bitou Bush (Chrysanthemoides Monilifera Subsp. Rotundata (D.C.) T. Norl.) In New South Wales: Application Of The Defensive Expenditure Method	Australia	NSW		The most costly site has a present value of $50,000 and an annuity equivalent of $2,500. The annual value of the biodiversity gains per site is $1,020 at the mean quantity of species and communities protected and $5,020 at the equilibrium quantities.	Defensive expenditure method	Conference paper	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
4) Wetlands/ Marshes	Mazur, K. and J. W. Bennett	2009	Location differences in communities' preferences for environmental improvements in selected NSW catchments: A Choice Modelling approach	Australia	NSW	Three catchments in New South Wales: Lachlan catchment, Namoi catchment, and Hawkesbury-Nepean catchment	Willingness to pay (WTP) for improvements in environmental quality in three New South Wales catchments: Lachlan, Namoi, and Hawkesbury-Nepean: AUD$2-8 per household per year (2008)	CM	Report	No
4) Wetlands/ Marshes	Gillepsie, R.	2008	Managing the impact of a mine in the southern coalfield: a survey of community attitudes	Australia	NSW	The Metropolitan Colliery, located 30 kilometres north of Wollongong in New South Wales	WTP AUD$0.43-0.45 per household per year to protect an additional hectare of upland swamp (2008)	CM	Report	No
4) Wetlands/ Marshes	Mallawaarachchi, T., R.K. Blamey, M.D. Morrison, A.K.L. Johnson, and J.W. Bennet	2001	Community Values for Environmental Protection in a Cane Farming Catchment in Northern Australia: A Choice Modelling Study	Australia	QLD	Herbert River District	WTP AUD$ 2.56/hh/yr for preserving teatree woodlands, AUD$39.95 for Herbert wetlands; AUD$18 per ha for teatree woodlands, and AUD$2812 per ha for wetlands (1998)	CM	Journal	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
4) Wetlands/ Marshes	Kuosmanen , T., E. Nillesen, and J. Wesseler	2005	Does Ignoring Multi-Destination Trips in the Travel Cost Method Cause a Systematic Downward Bias?	Australia	QLD	Bellenden Kerr National Park, part of the Wet Tropics World Heritage Area (WTWHA) in northern Queensland	The benefits of recreation from visiting Bellenden Ker National Park in Australia. In particular the study examined the issue of multi-destination travellers and the impact they have on consumer surplus estimates. Consumer surplus estimates ranged from $137 to $773 (2001 Australian dollars) per visitor per year (2001)	TC	Journal	No
4) Wetlands Marshes	Nillesen, Eleonora; Wesseler, Justus; Cook, Averil	2005	Estimating the recreational-use value for hiking in Bellenden Ker National Park, Australia	Australia	QLD	Bellenden Kerr National Park, part of the Wet Tropics World Heritage Area (WTWHA) in northern Queensland	The recreational-use value of hiking in the Bellenden Ker National Park, Australia was found to be AUD$US 250,825 per year, or AUD$US 144.45 per visitor per year (2001)	TC	Journal	No
4) Wetlands/ Marshes	Windle, J. and R.A. Cramb	1993	Contingent Valuation as a Guide to Environmental Policy: An Application to the Conservation of Natural Bushland in Brisbane	Australia	QLD	Whites Hill, Sankey Mountain and Pine Mountain Reserves	WTP $31.83/hh/yr for the preservation, upgrading and maintenance of an area of natural bushland (1991) in the Whites Hill, Sankey Mountain and Pine Mountain Reserves (for a ten year period)	CV	Journal	No
4) Wetlands/ Marshes	Beal D.J.	1995	A Travel Cost Analysis of the Value of Carnarvon Gorge	Australia	QLD	Carnarvon Gorge National Park	The recreational use value of the Carnarvon Gorge National Park was AUD$ 2.4m (1994)	TC	Journal	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
			National Park for Recreational Use							
4) Wetlands/ Marshes	Asafu-Adjaye, J., R. Brown and A. Straton	2005	On Measuring Wealth: A Case Study on the State of Queensland	Australia	QLD		Natural capital stock of the state of Queensland is AUD$355.6 billion (1996)	BT	Journal	No
4) Wetlands/ Marshes	Curtis, I.A.	2004	Valuing Ecosystem Goods and Services: A New Approach Using a Surrogate Market and the Combination of A Multiple Criteria Analysis and a Delphi Panel to Assign Weights to the Attributes	Australia	QLD	Wet Tropics World Heritage Area	The total value of the ecosystem goods and services in the various tenure categories in the Wet Tropics World Heritage Area was found to be in the range AUD$188 to $211 million a year, or AUD$210 to $236 per ha per year across tenures (2002 AUD).	MP	Journal	No
4) Wetlands/ Marshes	Ambrey, C. and C. Fleming	2011	Valuing Ecosystem Diversity in South East Queensland: A Life Satisfaction Approach	Australia	QLD	South East Queensland bioregion, 59,403 square kilometres	On average, the willingness-to-pay (WTP) for a one-unit improvement in ecosystem diversity is $20,244.86 per household (2010)	Life Satisfaction Approach (LSA)	Conference paper	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
4) Wetlands/ Marshes	Windle, J. and J. Rolfe	2007	Developing a Benefit Transfer Database for Environmental Values in Queensland	Australia	QLD	Mackay, Rockhampton, Toowoomba, Brisbane	For benefit transfer across the State, the study recommended the use of marginal values in the pooled regional models as conservative estimates, viz: $3.70 for a 1% improvement in soil condition; $2.90 for a 1% improvement in healthy vegetation; and $5.80 for a 1% improvement in healthy waterways with a higher value of $7.80 in target sites in GBR coastal areas and a lower value of $3.40 in target sites in South East Queensland (2005)	CM	Conference paper	No
4) Wetlands/ Marshes	Blamey, R., J. Rolfe, J. Bennett and M. Morrison	2000	Valuing Remnant Vegetation In Central Queensland Using Choice Modelling	Australia	QLD	Desert Uplands of central Queensland (6,881,790 hectares)	Willingness-to-pay (WTP) values to improve cattle grazing production in the Desert Uplands region of central Queensland. For the environmental attributes, the mean WTP per household to maintain endangered species in the region, option A, is $11.39 per species, the mean WTP per household to avoid each one per cent loss in non-threatened species is $1.69, while the mean WTP for to avoid each one per cent loss in area of unique	CM	Journal	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
							ecosystem is $3.68 (United States dollars, 1997).			
4) Wetlands/ Marshes	Mallawaarachchi, T., R. Blamey, M. Morrison, A. Johnson and J. W. Bennett	2001	Community Values For Environmental Protection In A Cane Farming Catchment In Northern Australia	Australia	QLD	Herbert River District of North Queensland	WTP AUD$39.95 per household to increase Herbert wetland by 100 ha (1998)	CM	Journal	No
4) Wetlands/ Marshes	Blamey, R. K., J. W. Bennett, J. J. Louviere, M. D. Morrison and J. Rolfe	2000	A Test of Policy Labels in Environmental Choice Modelling Studies	Australia	QLD	Desert Uplands of Central Queensland	WTP AUD$83-119 per household for tree retention (1998)	CM	Journal	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
4) Wetlands/ Marshes	Blamey, R. K., J. W. Bennett, J. J. Louviere, M. D. Morrison and J. C. Rolfe	2002	Attribute causality in Environmental Choice Modelling	Australia	QLD	Desert Uplands of Central Queensland	WTP AUD$11-17 per household for the endangered species attribute	CM	Journal	No
4) Wetlands/ Marshes	Rolfe, J. and J. Windle	2008	Testing for differences in benefit transfer values between state and regional frameworks	Australia	QLD	Four areas in Queensland: the coastal region adjacent to the Great Barrier Reef, the inland region that have potential environmental linkages with the health of the Great Barrier Reef, the Murray-Darling Basin, and South East Queensland	WTP AUD$3.7 per household per year for a 1% improvement in soil condition; AUD$2.90 per household for a 1% improvement in healthy vegetation (2005)	CM	Journal	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
4) Wetlands/ Marshes	Van Bueren, M. and J. W. Bennett	2004	Towards The Development Of A Transferable Set Of Value Estimates For Environmental Attributes	Australia	QLD, WA	The Great Southern Region of Western Australia (8.3 million hectares), the Fritzoy Basin of Central Queensland (14.3 million hectares) and Australia wide	WTP AUD$0.68 per household per year for protected species; AUD$0.07 per 10,000 ha of countryside restored; AUD$0.08 per 10 km of waterway restored	CM	Journal	No
4) Wetlands/ Marshes	Pepper, C., L. McCann and D. Burton	2005	Valuation Study of Urban Bushland at Hartfield Park, Forrestfield, Western Australia	Australia	WA	Hartfield Park, Perth	Annual mean and median willingness to pay for preservation per person were estimated to be $21.60 (2001 Australian Dollars) and $4.35 respectively. Aggregating these values to Perth households resulted in values of $9.6 million and $1.9 million for mean and median values respectively.	CV	Journal	No
4) Wetlands/ Marshes	Concu, B. G.	2007	Investigating Distance Effects on Environmental Values: A Choice Modeling Approach	Australia	WA	Kings Park, Perth	WTP AUD$1.15-4.36 per individdual to fence the bushland (2003)	CM	Journal	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
4) Wetlands/ Marshes	Blamey, R. K., J. W. Bennett and M. D. Morrison	1999	Yea-saying In Contingent Valuation Surveys	Australia	SA	Upper South-East of South Australia	the estimation of non-market environmental costs caused by saline water from agricultural areas being drained into the Tilley Swamp wetlands in the Upper South East (USE) of South Australia. Households' willingness to pay for the construction of a pipe ranged between $16 and $53 (1997 Australian dollars)	CV	Journal	No
4) Wetlands/ Marshes	Bennett, J. W. and S. M. Whitten	2002	A Travel Cost Study Of Duck Hunting In The Upper South East Of South Australia	Australia	SA	Upper South East (USE) of South Australia	Duck hunters' consumers' surplus by hunting in wetlands in the Upper South East of South Australia was estimated at AUD$47.73 per capita per visit (2000)	TC	Journal	No
4) Wetlands/ Marshes	Morrison, M., R. K. Blamey and J. W. Bennett	2000	Payment Vehicle Bias in Contingent Valuation Studies	Australia	SA	Upper South East region of South Australia	WTP AUD$120-172 per household to prevent environmental damages that would be caused by drained saline water from agricultural areas to wetlands (1996)	CM	Journal	No
4) Wetlands/ Marshes	Schmidt, C. E.	2008	The Economic Cost of Wetland Destruction	Australia	SA	Lower Murry dairy swamps	Replacement cost of $14,118 to $28,032 per hectare per year; Natural wetlands for water filtration are worth $7,100 to $25,200 per hectare per year	Replacement costs	Conference paper	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
4) Wetlands/ Marshes	Rolfe, J., and B. Dyack	2011	Valuing Recreation in the Coorong, Australia, with Travel Cost and Contingent Behaviour Models	Australia	SA	Coorong national park	CS of AUD$242 per person; recreational value of the Coorong was $111 per adult visitor per day (2006)	CV	Journal	No
4) Wetlands/ Marshes	Morrison, M. D., R. K. Blamey and J. W. Bennett	2000	Minimising Payment Vehicle Bias in Contingent Valuation Studies	Australia	SA	Two wetlands in the Upper South East region of South Australia: Tilley Swamp and the Coorong	WTP of AUD$155 per household to prevent damage to the wetlands (1996)	CV	Journal	No
4) Wetlands/ Marshes	Putten, I. E., S.M. Jennings, J. J. Louviere and L. B. Burgess	2011	Tasmanian landowner preferences for conservation incentive programs: A latent class approach	Australia	TAS		Landoweners Willing to accept on average $4961 per ha while multi-objective owners are willing to accept $3287 per ha	CM	Journal	No
4) Wetlands/ Marshes	Carson, R.T., L. Wilks, and D. Imber	1994	Valuing the Preservation of Australia's Kakadu Conservation Zone	Australia	NT	Kakadu National Park	WTP AUD$80-143/hh (Australia sample); AUD$35/hh/yr (NT sample) for the addition of the Kakadu Conservation Zone to the Kakadu National Park (1990)	CV	Journal	No
4) Wetlands/ Marshes	De Groot, R., M. Finlayson, B. Verschuure n, O. Ypma	2008	Integrated Assessment of Wetland Services and Values as a Tool to Analyse Policy Trade-offs and Management Options: A Case Study	Australia	NT	Daly and Mary River	For the Mary River catchment, the total annual value was estimated at $50.76 million (2004 Australian Dollar) with value per hectare at $450. For the Daly River catchment, the	BT	Report	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
	and M. Zylstra		in the Daly and Mary River				total annual value was estimated to be $138.8 million and per hectare value of $390 (2004)			
4) Wetlands/ Marshes	Brouwer, R.	2009	Multi-Attribute Choice Modeling of Australia's Rivers and Wetlands: A Meta-Analysis of Ten Years of Research	Australia	Nationwide		WTP AUD$6.6 per household per year or $23.6 per household one-off for river health; WTP AUD$1.3 per household per year or $7.6 per household one-off for wetlands	MA	Working paper	No
4) Wetlands/ Marshes	Kazmierczak, R. F.	2001	Economic Linkages Between Coastal Wetlands and Habitat/Species Protection: A Review of Value Estimates Reported in the Published Literature	US, Canada, Australia			Mean and median value of habitat and species protection services of $249.44/acre/year and $253.47/acre/year (2000)	Review	Working paper	No
4) Wetlands/ Marshes	Lindhjem, H. and T. H. Tuan	2008	Meta-analysis of Nature Conservation Values in Asia & Oceania: Data Heterogeneity and Benefit Transfer Issues	Asia and Oceania			A meta-analysis (MA) was conducted of around 100 studies valuing nature conservation in Asia and Oceania. Wetlands had the highest value at US$ 514 (2006).	MA	Working paper	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
4) Wetlands/ Marshes	Brander, L.M.; R.J.G.M. Florax; and J.E. Vermaat	2004	The Empirics of Wetland Valuation: A Comprehensive Summary and a Meta-Analysis of the Literature	Global	25 countries	Wetlands used for hunting, fishing, timber, flood control, water supply, water quality, habitat, biodiversity.	Reviewed valuation studies of wetlands from 25 countries, the average wetland value was estimated at $2,800 (1995 US Dollars) per hectare per year. The median value was estimated at $150 US$ per hectare per year (1995 US$). The authors found an over-all transfer error of 74%, where low values were systematically over-estimated, and the value of high value wetlands was systematically slightly under estimated.	MA	Conference paper	Yes
4) Wetlands/ Marshes	Gallai, N., J. M. Salles, J. Settele and B. E. Vaissière	2008	Economic Valuation of the Vulnerability of World Agriculture Confronted with Pollinator Decline	Global			The total economic value of pollination worldwide amounted to €153 billion; the consumer surplus loss was estimated between €190 and €310 billion (2007)	MP, Demand Analysis, BT	Journal	No
4) Wetlands/ Marshes	Nunes, P.A.L.D., J.C.J.M. van den Bergh	2001	Economic Valuation of Biodiversity: Sense or Nonsense	Global			The study reviewed a total of 61 representative biodiversity valuation studies from various countries mainly the United States, published between 1983 and 1999. Coastal habitat was valued at US$9-51/hh/yr (1999).	MA	Journal	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
4) Wetlands/ Marshes	WRI	2008	Economic Values of Coral Reefs, Mangroves, and Seagrasses A Global Compilation	Global			A 2006 meta-analysis of wetlands valuation studies around the world found that the average annual value is just over $2,800 per hectare (Brander, Florax and Vermaat, 2006).	Review	Report	No
4) Wetlands/ Marshes	Spurgeon, J.	1999	The Socio-Economic Costs and Benefits of Coastal Habitat Rehabilitation and Creation	Global			For saltmarshes $2000-160,000/ha (1997 US Dollars).	Review	Report	No
4) Wetland/ Marshes	Costanza, R. et.al.	1997	The value of the world's ecosystem services and natural capital	Global			Average global value of annual ecosystem services: wetlands US$ 14,785 per hectare per year (1994)	Review	Journal	No
5) Estuaries/ Rivers	Walpole, S.	1991	The Recreational and Environmental Benefits of the Ovens-King River System	Australia	VIC	Recreational sites along the Ovens-King River system	The benefit values of recreation in the Ovens-King River System, located in northeast Victoria: the range value between all 25 sites was $23.10 and the average benefit value was $15.90 per visitor (1990).	CV,	Journal	No
5) Estuaries/ Rivers	Sinden, J.A.	1990	Valuation of the Recreational Benefits of River Management: A Case Study in the Ovens and King Basin	Australia	VIC	Ovens and King Rivers	The benefits of recreational opportunities to help in the erosion control management planning process in the Ovens-King river system: AUD$1,000 per angler per annum (1990)	TC	Report	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
5) Estuaries/ Rivers	Bennett, J. W., R. Dumsday, G. Howell, C. Lloyd, N. Sturgess and L. Van Raalte	2008	The Economic Value Of Improved Environmental Health In Victorian Rivers	Australia	VIC	Goulburn, Broken and Corangamite river catchments	For the four environmental improvement attributes, the estimated values of willingness to pay were: from AUS$2.19 to 5.56 for the number of pre-settlement fish species, from AUS$2.91 to 5.56 for the river's length with healthy vegetation on both banks, from AUS$3.04 to 22.07 for the number of native waterbird and other animals, and from AUS-$0.59 to 2.12 for water quality improvement units. (2005)	CM	Journal	No
5) Estuaries/ Rivers	Kragt, M., J. Bennett, C. Lloyd and R. Dumsday	2007	Comparing Choice Models of River Health Improvement for the Goulburn River	Australia	VIC	Goulburn River	The average WTP for increasing the number of fish and bird species lied between AUD$4.02 and AUD$5.86 per fish species, and between AUD$2.18 and AUD$3.18 per species of waterbirds and native animals (in Australian Dollars). The average WTP for an increase in healthy vegetation along the Goulbourn River was between AUD$3.21 and AUD$5.39 (2006)	CM	Conference paper	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
5) Estuaries/ Rivers	MacDonald, D. H., M. D. Morrison, J. M. Rose and K. J. Boyle	2011	Valuing a multistate river: the case of the River Murray	Australia	NSW, SA, ACT, VIC	The River Murray and the Coorong	WTP AUD$ 108-168 per household per year for 10 years for improvements in environmental quality to reduce deterioration of the health of the river (2009)	CM		No
5) Estuaries/ Rivers	Crase, L. and R. Gillepsie	2008	The impact of water quality and water level on the recreation values of Lake Hume	Australia	NSW, VIC	Lake Hume, located upstream of Albury, on the border between New South Wales and Victoria. It is the major regulating structure on the River Murray	recreational values held by visitors to Lake Hume, on the border between Victoria and New South Wales, Australia: Consumer surplus of AUD$33 per visit (2006)	TC	Journal	No
5) Estuaries/ Rivers	Brouwer, R.	2009	Multi-Attribute Choice Modeling of Australia's Rivers and Wetlands: A Meta-Analysis of Ten Years of Research	Australia	NSW	Murrumbidgee and Gwydir catchment	WTP AUD$6.6 per householsd per year or $23.6 per household one-off for river health; WTP AUD$1.3 per household per year or $7.6 per household one-off for wetlands (2006)	MA	Working paper	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
5) Estuaries/ Rivers	Gillepsie, R.	2008	Managing the impact of a mine in the southern coalfield: a survey of community attitudes	Australia	NSW	The Metropolitan Colliery, located 30 kilometres north of Wollongong in New South Wales	Respondents were found to be willing to pay per annum per household for 20 years $4.78 to $5.13 for every kilometre of stream protected from adverse affects of the mine, $4.17 to $4.91 for every additional year that the mine would provide 320 jobs, $0.43 to $0.45 to protect an additional hectare of upland swamp and between $0.37 and $0.44 to protect an additional Aboriginal site from adverse affects (2008)	CM	Report	No
5) Estuaries/ Rivers	Greyling, T. and J. Bennett	2011	Protecting the Booroolong Frog in the Namoi Catchment: A Cost-Benefit Analysis	Australia	NSW	Peel River above the Chaffey Dam in the Namoi Catchment	Booroolong frog: AUD$10.82 per household; Healthy waterways: AUD$0.48 per household per km of waterway	BT.	Report	No
5) Estuaries/ Rivers	Hodgkinson, A. and A. Valadkhani	2009	Community Valuations of Environmental Quality in Coastal Lakes: Lake Illawarra Case Study	Australia	NSW	Lake Illawarra	The value of Lake Illwarra in New South Wales to residents in the surrounding suburbs: On average, being located one more metre further away from Lake Illwarra leads toAUD$24 decrease in the value of a property valued at $307,035. A house with lake frontage adds $48,326 to the value of the house. Aggregated across all the	HP	Working paper	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
							households in the study area, the lake value is estimated to be $174 million.			
5) Estuaries/ Rivers	Morrison, M. and J. Bennett	2004	Valuing New South Wales Rivers for Use in Benefit Transfer	Australia	NSW	Bega, Clarence, Georges, Gwydir and Murrumbidgee	WTP between $30.10-$55.55 for improving river health from boatable to fishable, and (5) between $29.00-$38.74 for improving river health from fishable to swimmable (2002)	CM	Journal	No
5) Estuaries/ Rivers	Rolfe, J. and P. Prayaga	2007	Estimating Values for Recreational Fishing at Freshwater Dams in Queensland	Australia	QLD	Boondooma Dam and Bjelke-Petersen Dam in the South Burnett region in South-east Queensland; Fairbairn Dam in Central Highlands region, Central Queensland	Based on TCM, the total annual CS ranged from $0.9 million to $1.1 million for frequent anglers and from $0.2 million to $3.4 million for occasional anglers. Based on CVM, the mean annual WTP for a 20% improvement in fishing experience ranged from $19 to $43 per group. The total annual WTP ranged from $0.1 million for Bjelke-Petersen to $0.4 million for Boondooma. (2003)	CV and TC	Journal	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
5) Estuaries/ Rivers	Rolfe, J. and J. Bennett	2003	WTP and WTA in Relation to Irrigation Development in the Fitzroy Basin, Queensland	Australia	QLD	Fitzroy River Basin	The estimated value of attributes per household per year was $5.31 for a 1% increase in water left in reserve for future use; $3.04 for an additional 1% healthy vegetation remaining in flood plains; $0.05 for an additional kilometer of waterways in catchment remaining in good health; and -$1.09 for an increase in the number of people leaving rural or country areas every year.	CM	Report	No
5) Estuaries/ Rivers	Rolfe, J. and J. Bennett	2004	Assessing Social Values for Water Allocation with the Contingent Valuation Method	Australia	QLD	Fitzroy River Basin	Community values for social and environmental impacts associated with the allocation of water resources in the Fitzroy River Basin to particular equity sectors in the central Queensland region: Median and mean payments of $6.27 and $74.28 per household across Brisbane households (2002,USD$)	CM	Report	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
5) Estuaries/ Rivers	Rolfe, J. A. Loch and J. Bennett	2002	Tests of Benefit Transfer Across Sites and Population in the Fitzroy Basin	Australia	QLD	Fitzroy Basin (Emerald, Rockhampton, Brisbane, Comet/Nogoa/Mackenzie, Dawson)	non-use values associated with further floodplain development in the Fitzroy River Basin in Australia and its two major rivers, the Comet/Nogoa/Mackenzie and the Dawson rivers: WTP $0.08 to $0.09 per kilometer of waterways (2001)	CM	Report	No
5) Estuaries/ Rivers	Greiner, R. and J. Rolfe	2004	Estimating consumer surplus and elasticity of demand of tourist visitation to a region in North Queensland using contingent valuation	Australia	QLD	The coastal rainforest area north of the Daintree River, in the Cape Tribulation region, North Queensland	the recreational value of self-drive visitation to the Cape Tribulation Region, and particularly, the Daintree Rainforest region: an increase of the one-way crossing price to AUS$27.90 would halve the self-drive traffic on the ferry (1999).	CV	Journal	No
5) Estuaries/ Rivers	Rolfe, J. and J. Windle	2005	Valuing options for reserve water in the Fitzroy Basin	Australia	QLD	The Fitzroy River Basin (in its whole and two subcatchments: the Dawson River subcatchment, and the Comet/Nogoa/Mackenzie (CNM) subcatchment) in Central Queensland	Option value associated with keeping in reserve, unallocated water in the Fitzroy River Basin: AUD$22-37 per household per year (2001)	CM	Journal	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
5) Estuaries/ Rivers	Robinson, J., B. Clouston and J. Suh	2002	Estimating preferences for water quality improvements using a citizens' jury and choice modelling: a case study on the Bremer River catchment	Australia	QLD	Bremer River catchment in south east Queensland	WTP AUD$21-87 per household/year for improvement of water quality in the Bremer River catchment in south east Queensland (2002)	CM.	Journal	No
5) Estuaries/ Rivers	Straton, A. and K. Zander	2009	The Value of Australia's tropical River Ecosystem Services (3 of 3), Tropical Rivers and Coastal Knowledge	Australia	QLD	Mitchell River	The benefits of four specific ecosystem services provided by the Mitchell River in Queensland: households were willing to make one time payment of $69.41 to $322.06 (95% confidence interval: $147.70 - $1,710.14) to have medium area floodplain in good condition.	CM	Report	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
5) Estuaries/ Rivers	Rolfe, J. and J. Windle	2008	Testing for differences in benefit transfer values between state and regional frameworks	Australia	QLD	Four areas in Queensland: the coastal region adjacent to the Great Barrier Reef, the inland region that have potential environmental linkages with the health of the Great Barrier Reef, the Murray-Darling Basin, and South East Queensland	Willingness to pay: AUS$3.70 per household for a 1% improvement in soil condition, AUS$2.90 per household for a 1% improvement in healthy vegetation, and AUS$5.80 per household for a 1% improvement in healthy waterways.	CM	Journal	No
5) Estuaries/ Rivers	Zander, K. K. and A. Straton	2010	An Economic Assessment of the Value of Tropical River Ecosystem Services: Heterogeneous Preferences among Aboriginal and Non-Aboriginal Australians	Australia	WA, NT, QLD	Mitchell River region, Daly River region, and Fitzroy River region	WTP AUD$28-128 per household to maintain and the quantity and quality of tropical river ecosystem services (2008)	CM	Journal	No
5) Estuaries/ Rivers	Straton, A. K. Zander	2009	The Value of Australia's tropical River Ecosystem Services (1 of 3), Tropical Rivers and Coastal Knowledge	Australia	WA	Fitzroy River catchment	Willing to make one time payment of $49.15 (95% confidence interval: $17.08 - $90.60) to $86.47 (95% confidence interval: $29.05 - $112.49) to have medium area floodplain in good condition.	CM	Report	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
5) Estuaries/ Rivers	Kragt, M. E. and J. W. Bennett	2009	Using choice experiments to value river and estuary health in Tasmania with individual preference heterogeneity	Australia	TAS	The George catchment in north-eastern Tasmania	The values that Tasmanian households hold for protecting natural resources in the George catchment, located in north-eastern Tasmania: AUD$0.11 per ha of seagrass; AUD$3.57 per km of healthy riverside vegetation; $8.42 per species (2008)	CM	Report	No
5) Estuaries/ Rivers	Kragt, M. E., J. W. Bennett and A. J. Jakeman	2011	An Integrated Assessment Approach to Linking Biophysical Modelling and Economic Valuation Tools	Australia	TAS	The George catchment	The non-market benefits of management plans to increase native riparian vegetation in the George Catchment, Tasmania: on average, one-off WTPof $3.57 for every km increase in native riparian vegetation (2005).	CM	Journal	No
5) Estuaries/ Rivers	Rolfe, J. and R. Brouwer	2011	Testing for Value Stability with a Meta-Analysis of Choice Experiments: River Health in Australia	Australia			The mean WTP AUD$3.13 per household per km of waterways in good health (2010)	MA	Report	No
5) Estuaries/ Rivers	Brander, L., R. Brouwer and A. Wagtendonk	2011	A Multi-Level Meta-Analysis Regression Model of Contingent Values for Water Ecosystem Services	Australia, Asia, North America			Mean WTP value was $4.246 per household per year (US Dollars, 2007 prices) for water quality improvement	MA	Conference paper	No
5) Estuaries/	Costanza, R. et.al.	1997	The value of the world's ecosystem services and	Global			Average global value of annual ecosystem services: rivers/lakes	Review	Journal	Yes

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
Rivers			natural capital				US$ 8,498 per hectare per year (1994)			
5) Estuaries/ Rivers	Windle, J. and J. Rolfe	2004	Assessing values for estuary protection with Choice Modelling using different payment mechanisms, Valuing floodplain development in the Fitzroy Basin research report	Australia	QLD	Fitzroy river estuary	Community values for the protection of the Fitzroy river estuary in Queensland, Australia: The river estuary, valued for both commercial and recreational fishing, among others, is threatened by sediment run-off and nutrients from land use activities. For a 1% increase in healthy vegetation remaining in flood plains, the mean part-worths ranged from $2.85 to $3.39 for the annual payment models compared with $0.70 for the lump sum model. For a 1% increase in river estuary in good health, the mean part-worth were $3.23 to $3.89 and $0.50, respectively. For an increase in healthy waterways, the mean part-worths across models ranged from $0.01 to $0.11 per kilometer (2003).	CM	Report	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
5) Estuaries/ Rivers	Windle, J. and J. Rolfe	2005	Assessing non-use values for environmental protection of an estuary in a Great Barrier Reef catchment	Australia	QLD	The Fitzroy River estuary in Queensland. The Fitzroy Basin is the largest of the river basins in the Great Barrier Reef catchment.	Non-use values held for protecting the environmental health of the Fitzroy River estuary in central Queensland:AUD$3.21 per household per year for a 20-year period for a 1% improvement in the area of the Fitzroy River estuary that is in good condition (2003)	CM	Journal	No
5) Estuaries/ Rivers	Kragt, M. E. and J. W. Bennett	2009	Using choice experiments to value river and estuary health in Tasmania with individual preference heterogeneity	Australia	TAS	The George catchment in north-eastern Tasmania	The values that Tasmanian households hold for protecting natural resources in the George catchment, located in north-eastern Tasmania: Respondents from the full sample were found to be, on average, willing to pay AUS$0.11 for a hectare increase in seagrass area, $3.57 for a kilometre increase in native riverside vegetation and $8.42 for the protection of each rare native animal and plant species (2008)	CM	Report	No
5) Estuaries/ Rivers	Costanza, R. et.al.	1997	The value of the world's ecosystem services and natural capital	Global			Average global value of annual ecosystem services: estuaries US$ 22,832 per hectare per year (1994)	Review	Journal	Yes

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
6) Mangroves	Morton (1990)	1990	Community structure, density and standing crop of fishes in a subtropical Australian mangrove area	Australia	QLD	Moreton Bay, Queensland	The value of mangroves at $8,380 per hectare based on the market value of the fish caught (not taking into account juvenile fish of commercially important species).	MP	Journal	No
6) Mangroves	Rönnbäck, P.	1999	The Ecological Basis for Economic Value of Seafood Production Supported by Mangrove Ecosystems	Global			For crustaceans, fish and molluscs that use mangroves as habitat, the annual market value of capture fisheries supported by mangroves ranges from US$750 to US$1180 per hectare (US Dollars).	MP	Journal	No
6) Mangroves	Spurgeon, J.	1999	The Socio-Economic Costs and Benefits of Coastal Habitat Rehabilitation and Creation	Global			Based on the available literature, this study provides a variety of cost and benefit values associated with four coastal habitat types, namely coral reefs, mangroves, seagrass, and saltmarshes. For coral reefs, costs range from $10,000 to 6.5 million/hectare (ha); for mangroves $3000-510,000/ha; for seagrasses $9000-684,000/ha; and for saltmarshes $2000-160,000/ha (1997 US Dollars).	BT	Journal	Yes

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
7) Seagrass	Watson, R.A., Coles, R.G. and Lee Long, W.J.	1993	Simulation estimates of annual yield and landed value for commercial penaeid prawns from a tropical seagrass habitat, Northern Queensland, Australia	Australia	QLD	Cairns Harbour - a tropical seagrass habitat, Northern Queensland, Australia	an average value of $1.2 million per year on the three major commercial prawn species dependent on seagrass within the Cairns Harbour.	MP	Journal	No
7) Seagrass	Kragt, M. E. and J. W. Bennett	2009	Using choice experiments to value river and estuary health in Tasmania with individual preference heterogeneity	Australia	TAS	The George catchment in north-eastern Tasmania	Respondents were found to be, on average, willing to pay AUD$0.11 for a hectare increase in seagrass area, $3.57 for a kilometre increase in native riverside vegetation and $8.42 for the protection of each rare native animal and plant species (2008)	CM	Report	No
7) Seagrass	McArthur, L. C.	2006	The Economic Contribution of Seagrass to Secondary Production in South Australia	Australia	SA	Fishing block 23 located on the eastern bank of Northern Spencer Gulf	The total economic contribution of seagrass habitats to secondary production was valued at AUD$113.24 million per year or about AUD$133.23/ha/yr (2001)	MP	Journal	No

Habitat or ecosystem service	Author	Year	Title of Source	Country	State	Location	Mean/Median Value	Method (refer table below)	Doc Type	Used in this study
7) Seagrass	Spurgeon, J.	1999	The Socio-Economic Costs and Benefits of Coastal Habitat Rehabilitation and Creation	Global			Based on the available literature, this study provides a variety of cost and benefit values associated with four coastal habitat types, namely coral reefs, mangroves, seagrass, and saltmarshes. For coral reefs, costs range from $10,000 to 6.5 million/hectare (ha); for mangroves $3000-510,000/ha; for seagrasses $9000-684,000/ha; and for saltmarshes $2000-160,000/ha (1997 US Dollars).	BT	Journal	Yes
7) Seagrass	Costanza, R. et.al.	1997	The value of the world's ecosystem services and natural capital	Global			Average global value of annual ecosystem services: seagrasses US$ 19,004 per hectare per year (1994)	Review	Journal	Yes
8) Other marine	Costanza, R. et.al.	1997	The value of the world's ecosystem services and natural capital	Global			Average global value of annual ecosystem services: marine US$ 577 per hectare per year (1994)	Review	Journal	Yes

Key to method acronyms:

BT - Benefits Transfer

CBA - Costs Benefit Analysis

CM - Choice Modelling

CV - Contingent Valuation

DA - Demand Analysis

DEM - Defence Expenditure Method

HP - Hedonic Pricing Method

I-O - Input-Output Model

LSA - Life Satisfaction Approach

MA - Meta-Analysis

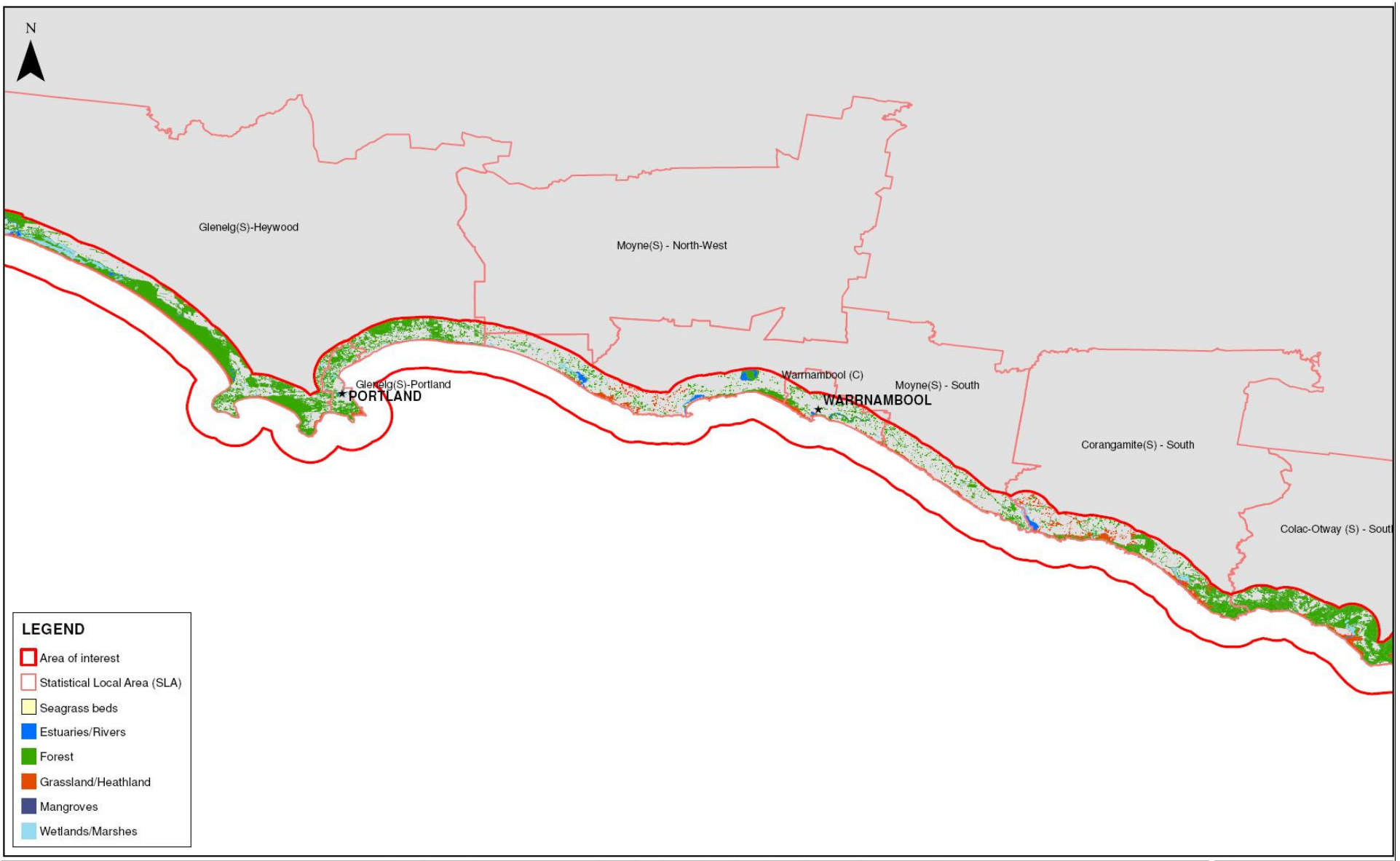
MP - Market Price Method

RP - Replacement Cost

Review - Review of published studies

TC - Travel Cost Method

Appendix 3 - Habitat maps



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A4 SHEET SCALE: 1:967,775

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Figure A3-1
Location map with categories of assessment highlighted for western Victoria

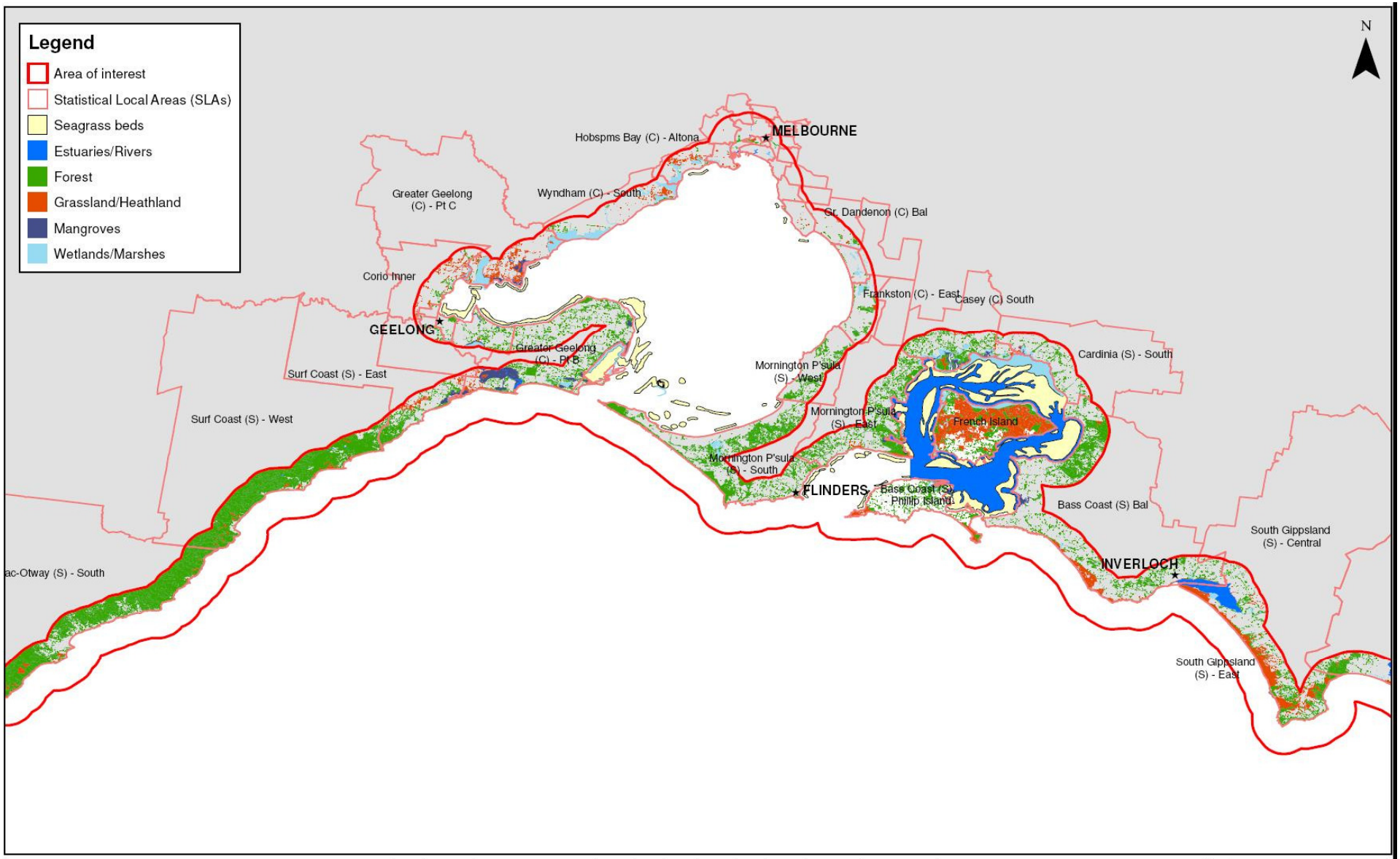

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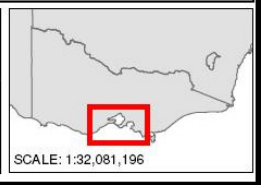
Figure A3-2
Location map with categories of assessment highlighted for central Victoria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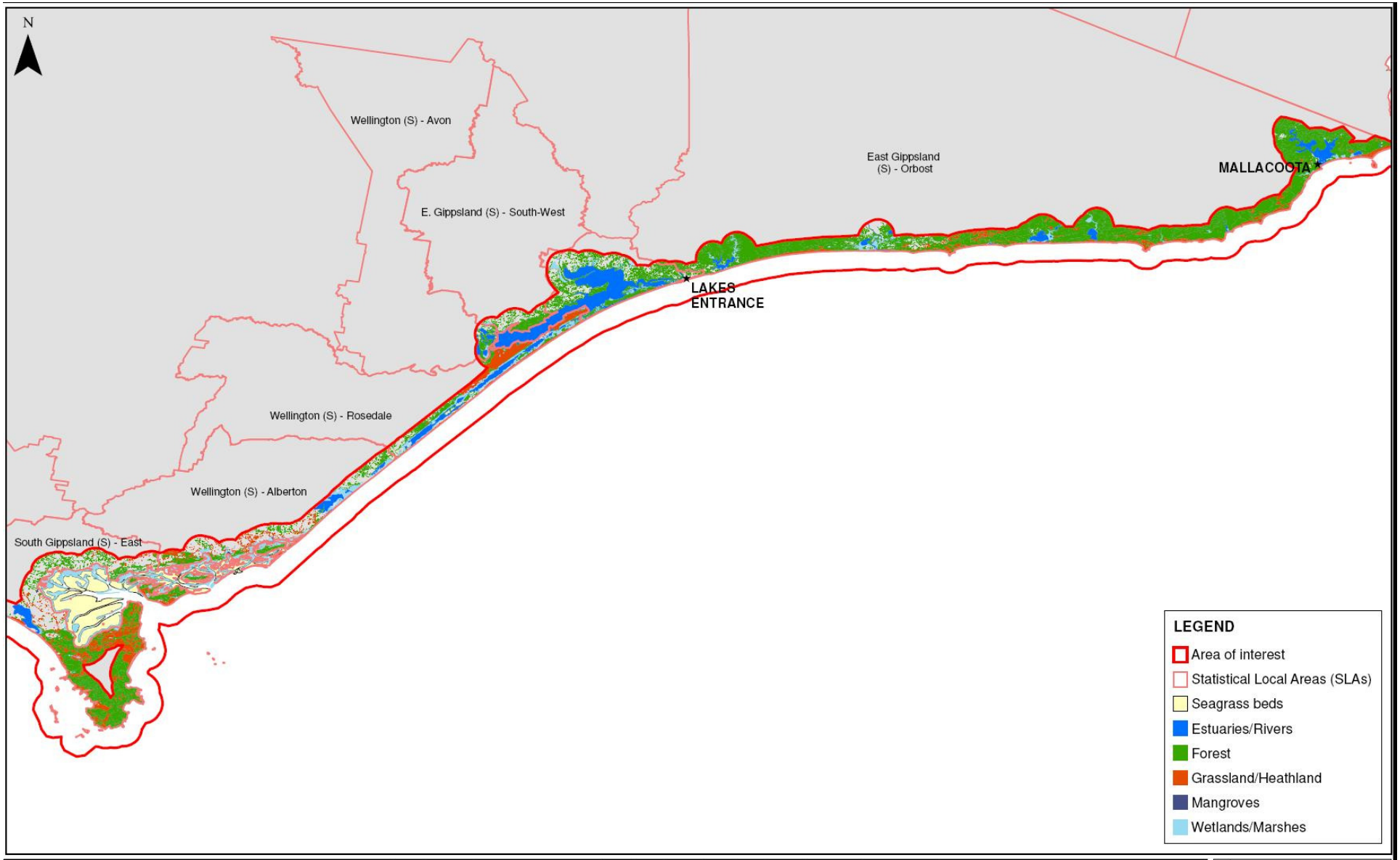

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PROJECT NO: 301010-01215

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Figure A3-3

Location map with categories of assessment highlighted for eastern Victoria