# Valuing Victoria's Parks

## Accounting for ecosystems and valuing their benefits:

## Report of first phase findings

Parks VICTORIA

Healthy Parks Healthy People®

VICTORIA State Government | Environment, Land, Water and Planning

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# Valuing Victoria's Parks

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## Summary and key findings

Victoria's parks are central to ensuring the State conserves its natural assets, specifically in relation to key ecosystems, landscape and biodiversity features. Parks also allow people to connect with nature, enable cultural and spiritual connections and provide diverse opportunities for outdoor recreation and learning about our environment. Less recognised is the critical role that the Victorian parks network plays in maintaining and improving liveability in our society and supporting the economy. Many of the services provided by Victoria's parks provide multiple benefits that can be considered as public goods. These benefits are often not captured in market transactions, resulting in these services not being included in many private economic decisions.

This project was developed as a collaboration between Parks Victoria and the Department of Environment, Land, Water and Planning (DELWP) with the objective to establish a framework to recognise, quantify and value the ecosystem services provided by Victoria's parks and the environmental and societal benefits generated, based on international best practice.

The development of improved and consistent environmental and economic information on park ecosystems can inform strategic and operational park management decisions for the purpose of:

- Monitoring of natural and other assets and trend analysis
- Understanding the contribution of ecosystem assets to current socioeconomic activities
- Estimating benefits of ecosystem services to society under different management options

### Approach and application to park management

This work contributes to the management of public land for conservation by developing a base of knowledge to construct pilot ecosystem asset and ecosystem service accounts based on internationally accepted environmental accounting standards. The pilot provides a first assessment of the value of ecosystem services of the parks network, which required a comprehensive review of literature, recent data and application of sound environmental valuation techniques.

While environmental accounting and valuation can be linked they are generally used for different purposes. The purpose of environmental accounting is to provide consistent and comparable information on ecosystem assets and the services they provide, along with performance measures of resource use and emissions in the economy (e.g. water, energy, carbon). Environmental valuation is used to assess the benefits provided by environmental assets and places a value in monetary terms, which enables appraisal of competing use of resources, alternative policies or investments.

The ability to quantify and account for changes in natural assets and the contribution that Victoria's parks and their management make in our society is an important step in improved business practice.

The approach to assess ecosystem services followed a systematic review including: identifying the benefits and beneficiaries of each ecosystem service, understanding the context and links to other services, calculating the quantity of services provided, selecting appropriate valuation methods and then undertaking a valuation of benefits from ecosystem services in parks.

### Key findings

Consistent with international accounting standards, an initial system of experimental accounts has been developed for the Victorian parks network. The ecosystem asset accounts provide a snapshot of parks ecosystems and their key features, while ecosystem service flow accounts provide a snapshot of the quantity of services delivered across the parks network.

**Status of Victoria's park ecosystems**

Parks Victoria manages over 3.7 million hectares of protected areas and almost 206,000 hectares of non-protected areas. Victoria's parks protect ecosystem assets of high significance for the State and internationally. Specifically, national, State and wilderness parks present large areas of native vegetation, accounting for 38% of all native vegetation in the State. In addition, the parks network as a whole accounts for 60% of wetland areas of international significance in the State. Based on modelled data on vegetation quality, native vegetation in parks is found in better condition than outside park areas across all ecological vegetation classes.

Although specific data for marine and river assets in parks is more limited, the accounts suggest their condition is relatively good. The parks network supports Marine Protected Areas with significant habitats, such as sub-tidal and intertidal reefs, mangroves, seagrass and marine soft-sediment.

In terms of biodiversity, Victoria's parks provide highly suitable habitats for many native species. An assessment of around 640 of the nearly 3,000 parks and reserves indicates that Victoria's parks provide 888 threatened species with at least 50% of suitable habitat in the State.

**Ecosystem services delivered by park ecosystems**

The contribution of Victoria's park ecosystems was assessed for three types of ecosystem services:

- *Delivery of natural resource products used in economic activities (provisioning services),* such as clean water and honey. Importantly, over one million hectares of water supply catchments are located within Victoria's parks. The annual run-off from nine high water yielding parks is 3,400 gigalitres (16% of the State total). This water is particularly significant for the communities of eastern Victoria (Alpine, Lake Eildon National Parks), western Victoria (Grampians National Park) and Greater Melbourne (Yarra Ranges National Park). Beehives in parks and reserves are estimated to produce about 1,200 to 1,600 tonnes of honey products per annum.
- *Sustaining public benefits from natural regulating processes (regulating services)*, such as water purification, air filtration, climate regulation, pollination, coastal protection, along with maintenance of habitats for native species, nursery populations and genetic diversity. Victoria's parks offer most suitable habitats in the State to 888 rare or threatened species in Victoria. The Victorian parks network is a major carbon sink with 270 million tonnes of carbon stored across land and coastal habitats. Parks provide valuable water filtration services with current sediment loads of 4,165 tonnes of solids (from nine high yielding parks) entering regulated rivers, which is about 8% of what would be released if these parks were not protected.
- *Conserving intrinsic non-material ecosystem features that people appreciate* (c*ultural services*) such as recreation, amenity, cultural heritage connection and health. Parks receive 30-51 million visits every year, with almost 17 million visitor nights being from tourists. Of this, around 23 million visits to parks from Victorians involve physical activity which can provide health benefits.

Other types of assets in Victoria's parks include over 28,000 built assets which are largely infrastructure to support visitor access, recreational and education activities. In addition, the parks network protects over 11,800 cultural objects in aboriginal cultural places, along with 145 historical places listed in the State heritage register.

**Current market values associated with park ecosystems**

The economic contribution of park-attributable tourism to the Victorian economy is conservatively estimated at around $1 billion Gross Value Added (GVA) and 14,000 jobs. The park-based apiary

sector produces honey and related products worth $3.4-$4.6 million per annum and receives payments to beekeepers for pollination services in the range of $0.6-$1 million per annum.

In addition to managing parks, Parks Victoria manages built infrastructure and recreational activities for the Port Phillip, Western Port and Port Campbell local ports. Parks Victoria visitation data indicate these local ports and bays receive 45 million visits every year. Through the management of these local ports, Parks Victoria plays a significant role in the contribution these three ports make to the State economy, estimated at over $300 million GVA per annum in total.

**The benefits of ecosystem services delivered by parks**

To highlight the contribution that Victoria's parks play in communities and the economy, a range of ecosystem services were assessed in their current land use (as park), compared to an alternative land use. The counterfactual used is the surrounding land use (e.g. cleared grazing for national and State parks, and urban infrastructure for metropolitan parks).

The ecosystem service flows currently delivered by parks and their park-related benefits in monetary terms are summarised in Table S.1. The main benefits from Victoria's parks were estimated as follows:

- *Benefits to Victoria's economic activities* include modest benefits of $0.6-1 million to honey producers every year and further benefits of $123-167 million to consumers and producers across 30 crops from pollination services.
- *Benefits supporting Victoria's healthy and productive environment* include the provision of water filtration services from non-metropolitan parks (e.g. national parks) valued at $50 million per annum, along with prevention of nitrogen in metropolitan waterways with an avoided cost of $33 million per annum and retention of stormwater runoff from metropolitan parks avoiding $46 million in additional infrastructure. Additionally, parks provide coastal protection services for communities along 285 km of Victoria's shoreline which is valued at $24-56 million per annum. Parks also provide highly suitable habitats for 516 threatened species assessed over 638 parks.
- *Benefits sustaining Victorians' wellbeing* include recreational value to park visitors estimated at $600-$1,000 million per annum and a range of $80-$200 million per annum in avoided health costs for physically active park visitors (noting that part of these values may overlap). Parks Victoria managed parks in Melbourne provide amenity value to adjacent residents of $21-28 million per annum. Victoria's parks further provides social benefits through volunteering work in parks valued at $6 million per annum and park-related heritage valued at $6-23 million per annum.

## Caveats and further work

The assessment of the quantity and value of ecosystem services provided by parks is not definitive and is based on gathering available data in a relatively short time period. Nevertheless, as the first assessment of the Victorian parks network, the report provides both an indicative and conservative estimate of the value of ecosystem services attributable to parks and an applied framework in which to populate new information.

The benefits of some recreation and tourism services are based on well-established methods. Valuation of other ecosystem services linked more directly to ecological and natural regulating processes is a relatively new area is limited by the availability of empirical literature or primary data.

The monetary values of benefits from the assessed ecosystem services cannot necessarily be aggregated as a number of services may overlap. The accounting framework can be linked to regular reporting such as State of the Parks reporting. Insights from this work can play an important role in

informing the community about the connection between having healthy, resilient parks and the State's economy and community wellbeing.

The proposed approach can support park and public land planning, investment, management and evaluation decisions for parks as well as inform policy and supporting funding models to maintain parks' natural capital, while maximising their value to the society.

Adapting this work to inform decision-making for land management will require further work including greater focus on assessment of marginal values for ecosystem services from different management options and more thorough assessment of the broader costs and benefits of these alternatives. Additionally, conceptual models linking changes in the condition of ecosystems to service flows will be required to undertake broader applications on program evaluation.

## Table S.1 Summary of ecosystem flows and benefits of parks ecosystem services assessed

| Ecosystem service | Quantity of ecosystem service flow (currently delivered by parks) | Annual benefits (AUD $) – welfare gains compared to surrounding land use | Other measures of economic activity | Level of confidence in flow quantities / monetary values |
|---|---|---|---|---|
| **Provisioning services** | | | | |
| Water supply | Water run-off of 3,392 gigalitres (from nine highest yielding parks) | | Value of water of $244 million p.a. for supply (imputed) | Higher / Medium |
| Honey supply | Honey products of 1,119 -1,615 tonnes p.a. | Benefit to producers only: $0.6-$1 million p.a. | Gross value of production of honey: $3.4 -$4.6 million p.a. | Lower / Higher |
| **Regulating services** | | | | |
| Water purification (metro parks) | 31,425 kilograms of total nitrogen p.a. going in metro waterways (a reduction of 182,000 kilograms from the counterfactual) | Avoided costs to maintain water quality at current levels: $33 million p.a. | | Higher / Higher |
| Water purification (non-metro parks) | 4,165 tonnes of sediment p.a. entering regulated rivers (preventing release of 47,000 tonnes from the counterfactual) | Avoided value of lost storage in regulated rivers (net of water yield reduction): $50 million p.a. | | Higher / Higher |
| Coastal asset protection | Mangrove, saltmarsh and dune park ecosystems protect 285 kilometres of coast near communities | Avoided costs for built assets or improved management: $24-$56 million p.a. | | Medium / Lower |
| Flood protection | 34,372 megalitres of stormwater p.a. going into Melbourne's waterways (avoiding 40,000 extra stormwater from the counterfactual) | Avoided infrastructure costs to deal with additional stormwater: $46 million p.a. | | Higher / Higher |
| Climate regulation: Carbon storage | 270 million tonnes of carbon stored in terrestrial parks and 850,000 tonnes stored in marine parks | *Annual value not assessed* [1] | | Higher / Higher |
| Carbon sequestration (from revegetation) | An average of 21,000 tonnes of carbon sequestered p.a. through two revegetation programs in parks | Value of carbon absorbed is $1-$5 million p.a. over the first 30 years of plantings | | Medium / Higher |
| Pollination & seed dispersal | 1,235 - 1,700 honeybee sites | Benefit to agriculture (producers and consumers): $123-$167 million p.a. | Service payments to beekeepers: $0.6-$1 million p.a. | Medium / Medium |
| Habitats for species (intermediate service) | 638 parks provide 50-100% habitat suitability for over 888 rare and threatened species | | | |
| Maintenance of nursery populations | 92 tonnes of fish stock enhanced (King George whiting only) | *Not assessed* | $1.1 million of fish catch p.a. (imputed) | Higher / Lower |
| **Cultural services** | | | | |
| Recreation opportunities | 51 million visits to parks and 45 million visits to bays | Value to visitor enjoyment: $600 million - $1 billion p.a. | | Higher / Medium |
| | 16.9 million park tourist visitor nights per annum | | Economic contribution of park related tourism: $1 billion GVA and 13,783 FTEs p.a. | Medium /Higher |
| | 23.1 million visits to parks for physical exercise | Avoided health costs of physical inactivity: $80-$200 million p.a. (may overlap with enjoyment) | | Higher / Medium |
| Education opportunities | 183,000 participants in education programs per year | | | |
| Scientific research opportunities | 215 research permits issued p.a. | | | |
| Amenity (Melbourne's parks) | 12,000 immediate neighbours around 70 Greater Melbourne parks 85,000 immediate neighbours around parks outside Melbourne | Amenity benefit for residents of $21-$28 million p.a. (Greater Melbourne only) | | Medium / Lower |
| Opportunities for cultural connection | 54%-69% Victorians valuing park related historical heritage | Willingness to pay to maintain heritage: $6-$23 million p.a. | | Higher / Lower |
| | Indigenous heritage under joint or co-management with Traditional Owners across 643,513 hectares | | | |
| Social cohesion and sense of place | 211,000 volunteering hours p.a. | Opportunity cost of time: $6 million p.a. | Labour value: $6 million p.a. (imputed) | Higher / Higher |

Note: Total values have been annualised over 30 years at a discount rate of 5%, where appropriate. Imputed values represent the value of transactions expected to be observed if there was a market for this product or service.

[1] Annual benefit values could not be assessed for carbon storage due to lack of models to assess carbon releases under the counterfactual. However, if *all* carbon currently stored in parks was released, the cost to offset these emissions would be valued at around $15 billion. The social cost of the emissions (without any offsets) is estimated at $63 billion.

# Glossary

| | |
|---|---|
| Consumer surplus | A measure of the benefits to consumers from the consumption of a good or service. It is measured as the value of the demand for a good or service (through the amount that an individual is willing to pay for it) additional to the price actually paid for it. In the case of natural parks, the price above which consumer surplus is measured refers to the value of entry fees to the park, which is zero in most open access resources. |
| Cultural services | Non-material ecosystem outputs that have symbolic, social or intellectual significance for individuals or communities. Examples include recreation, spiritual, social and cultural connection, landscape amenity, health and wellbeing, social cohesion and involvement. |
| Economic contribution | The economic contribution measures the employment and valued added to the local, State and national economies associated with expenditure on specific goods or services. The total economic contribution consists of the direct contribution of a market activity (e.g. value of gross operating surplus, labour income to staff and taxes paid minus subsidies) and flow on effects stimulated across other sectors (e.g. through the purchase of intermediary inputs). |
| Ecosystem assets | Spatial areas containing a combination of biotic and abiotic components and other characteristics that function together.[1] |
| Ecosystem services | Contributions of ecosystems to benefits used in economic and other human activity. They are generated through ecosystem processes reflecting the combination of characteristics, intra-ecosystem and inter-ecosystem flows. [2] |
| Environmental-economic accounts | System of data and information reporting used to describe environmental assets and flows of ecosystem goods and services and their linkages to the economy and society. |
| Ecosystem accounting | Statistical framework for organising biophysical data, measuring ecosystem services, tracking changes in ecosystem assets and linking this to economic and other human activity. |
| Externalities | The result of an activity (production or consumption) causing incidental benefits or damages to others with no corresponding compensation provided to or paid for by those generating it. |
| Intermediate ecosystem services | Services provided within ecosystems (intra-ecosystem flows) or between ecosystems (inter-ecosystem flows). Examples include maintaining soil health and enhancing the habitat to native species, which both benefit specific ecosystems directly but not society or the economy. Intermediate services may benefit other provisioning, regulating and cultural services indirectly. |
| Non-use value | Values reflecting individual's preferences through willingness to pay measures to preserve a resource aside from any actual use. |
| Parks | Parks refer to terrestrial, river or marine areas that are managed by the State for the purposes of conservation, recreation, leisure, tourism or water transport. Victorian parks include both areas classified as 'protected areas' such as national parks and non-protected areas such as metropolitan parks. Under the International Union for the Conservation of Nature (IUCN) classification system, a protected area is a clearly defined geographical space, recognised, dedicated and managed through legal or other effective means, to achieve the long term conservation of nature with associated ecosystem services and cultural values[3]. For the purposes of this report parks include both parks and reserves. |
| Provisioning services | Tangible goods and services that can be exchanged or traded, as well as consumed or used directly by people. Examples include food, water and other raw materials. |
| Regulating services | Ways in which ecosystems control or modify parameters that define the environment of people. Ecosystem outputs are not consumed, but affect individuals, communities and populations and their activities. Examples include climate regulation, watershed regulation such as purification, flood control and biological processes, including pest control, pollination and genetic diversity. |
| Service flows | Quantity of services provided from ecosystem to beneficiaries. |
| Total economic value | Sum of the various constituents of utilitarian value, including use values and non-use values. |
| Use value | Value derived from the direct use of a good or service for consumption, production or other indirect uses (e.g. water treatment services through wetlands for water use downstream). |

[1] United Nations 2014, System of Environmental-Economic Accounting 2012: Central Framework

[2] Ibid

[3] IUCN Definition 2008. Available online at http://www.iucn.org/about/work/programmes/gpap_home/pas_gpap/

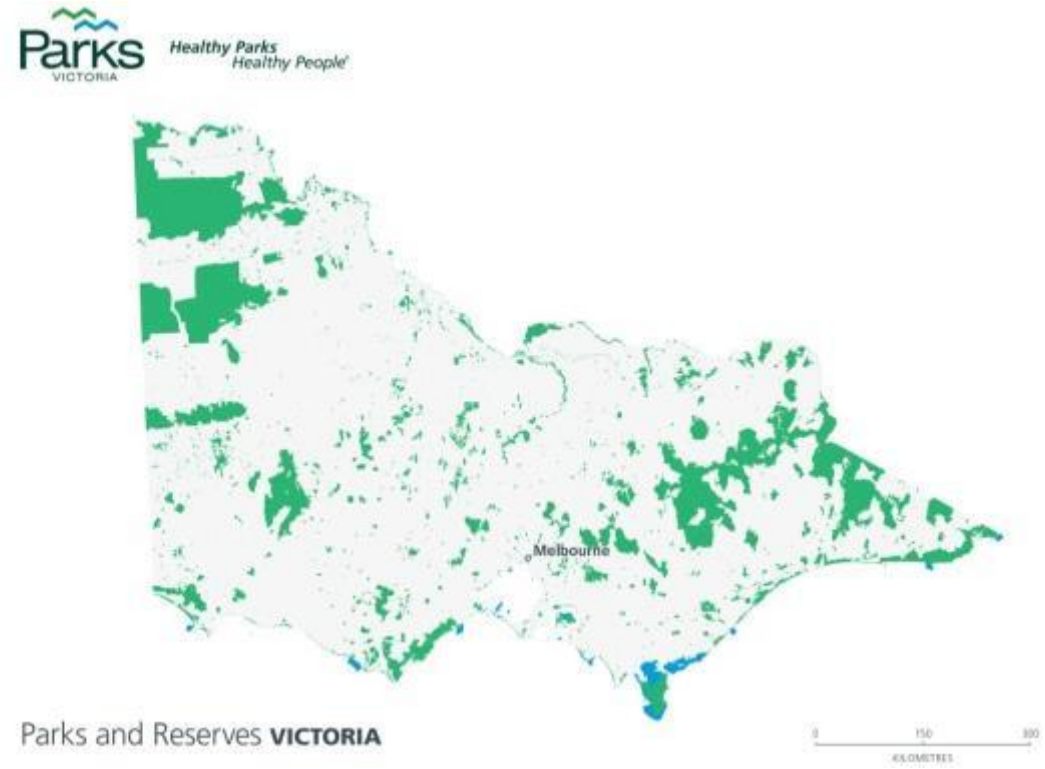
# 1. Introduction and context

On behalf of the Victorian Government, Parks Victoria manages one of the most diverse park and waterway networks in the world. The network contains a highly diverse range of natural and cultural resources that provide a wide range of benefits to the environment, the community and the economy. Under its legislative obligations, Parks Victoria's core functions are to provide services to the State and its agencies in relation to the management of parks, reserves, State-managed land and waterways for the purposes of conservation, recreation, leisure, tourism or water transport.

## 1.1 The Victorian parks network

Victoria's parks and waterway network covers approximately 4 million hectares, including both protected areas as defined by the International Union for Conservation of Nature (IUCN) and other parks and reserves. The protected area system includes both land and marine parks. The land-based parks include 45 national parks, 26 State parks, three wilderness parks and over 2,500 conservation reserves covering 17% or 3.45 million hectares of Victoria's land area, with a number of these being jointly managed or co-managed with Traditional Owners. A representative system of 24 marine national parks and sanctuaries covers 5% of Victoria's coastal waters (around 54,000 hectares). Details of the different types of park purposes by IUCN classification are summarised in Appendix 1. In addition to the protected area estate, Parks Victoria also manages a comprehensive network of 90 metropolitan, reservoir and regional parks and has responsibilities as the local port manager for Port Phillip Bay, Western Port and Port Campbell, and is the designated waterway manager for the Lower Yarra and Maribyrnong rivers, and recreational manager of the Bays. The parks and reserves network is shown in Figure 1.1.

**Figure 1.1 Map of Victorian parks and reserves**




Source: Parks Victoria

The parks network includes a diverse range of natural, cultural and built assets including:

- the majority of the State's most intact natural ecosystems covering, alpine, wet forest and rainforest, dry forest and woodland, heathland, grassland, wetland, river, coastal and marine ecosystems;
- more than 4,400 recorded native plant species and 1,000 native animal species, including 348 species not found anywhere else in the world;
- much of the State's most suitable habitat for threatened species;
- many of the State's opportunities for Aboriginal people's cultural connection to land including more than 11,000 recorded Aboriginal places;
- over one million hectares of the State's water supply catchments;
- more than 2,500 historic heritage assets, including 150 places of national and State heritage significance;
- a complex array of more than 28,000 built assets to service visitors including visitor centre buildings, shelters, toilets, viewing lookouts, roads, walking and cycling trails, boat ramps, pedestrian and vehicular bridges, playgrounds and sporting facilities;
- 14,000 kilometres of roads and 3,700 kilometres of walking tracks; and
- 217 piers and jetties, water access points and around 950 navigation aids in the waterways estate.

In 2014 there were 51 million visits to Victoria's land and marine parks and 45 million visits to bay assets. Three-quarters of the Victorian population has visited a park managed by Parks Victoria in the previous 12 months.[4]

## 1.2 The purpose, value and benefits of Victoria's parks

Victoria's parks are managed in accordance with a broad range of State and Commonwealth legislative obligations including the Victorian *National Parks Act 1975* (National, State, Wilderness and some other parks); the *Crown Land (Reserves) Act 1978* (Conservation Reserves and Metropolitan Parks), the *Port Management Act 1985*, *Marine Safety Act 2010* and the *Port of Melbourne Authority Act 1958*. Additionally it has obligations under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* and the State's *Flora and fauna Guarantee Act 1988.*

A distinguishing feature of the Victorian parks network is that it encompasses a diverse range of park types with different primary purposes and goals, covering nature conservation, culture and heritage conservation and recreational objectives.

In recognising the value of parks, it is important to note that the fundamental objectives of the State's parks network under the legislation are to:

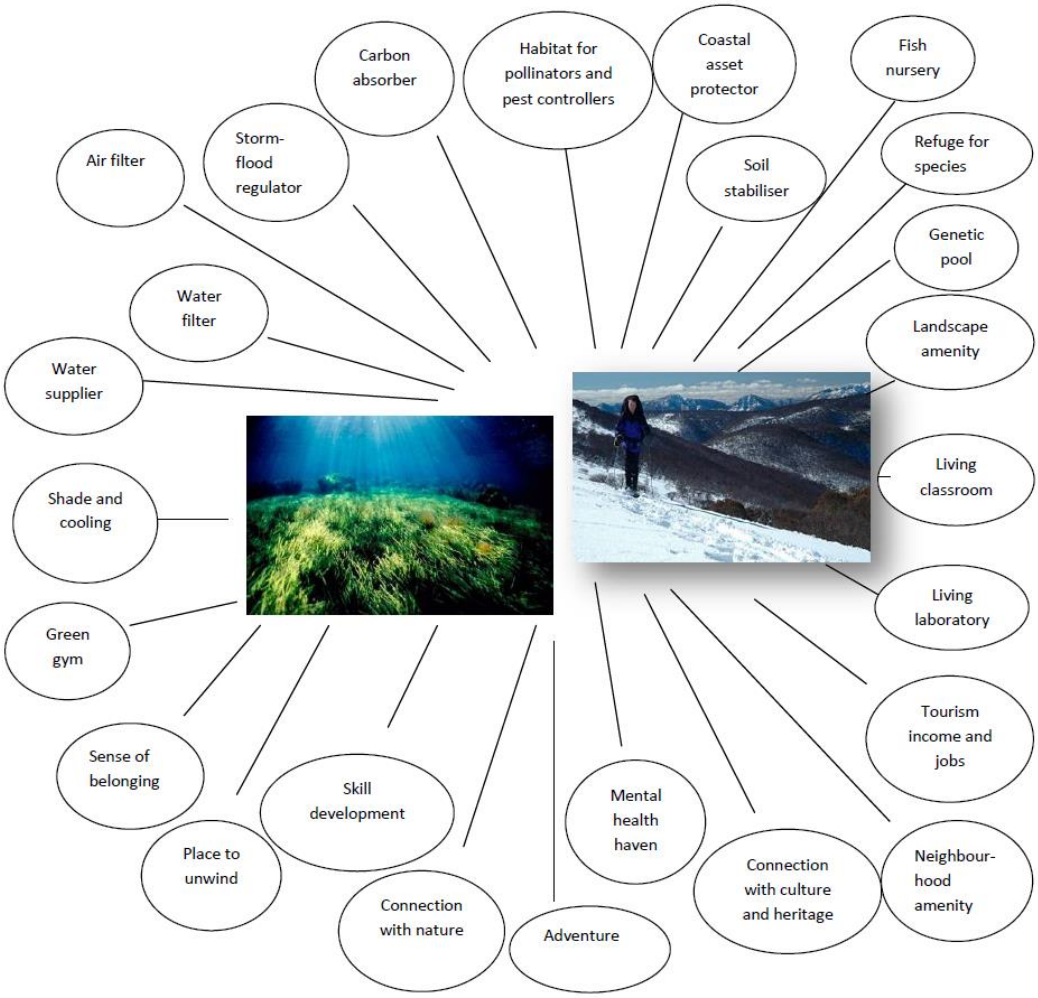
- ensure ecological integrity and resilience by conserving representative examples of Victoria's ecosystems and the biodiversity contained within them;
- protect and conserve culture and heritage; and,
- connect people with parks by providing opportunities for appropriate use, enjoyment and learning.

In addition to being the backbone for conservation of the State's flora and fauna and their habitats, the Victorian parks and reserves network provides a wide range of services that benefit the State's economy and community wellbeing. Many of these benefits are shown in Figure 1.2. Over the past decade, there

[4] Parks Victoria Community Perception Monitor

have been many examples in which government and non-government organisations have sought to assess some of these benefits and describe the multiple values of parks[5].

**Figure 1.2 Contribution of parks to Victoria's environment, economic and community wellbeing**




Victoria's parks are highly valued by the community with 89% of Victorians supporting the State having a comprehensive network of national parks and other conservation reserves across land and sea[6]. Parks allow people to connect with nature, enable cultural and spiritual connections and provide diverse opportunities for outdoor recreation. Less recognised is the critical role that the Victorian parks network plays in maintaining and improving Victoria's liveability and supporting the economy. Parks provide tangible benefits such as clean water, climate and heat regulation, nurseries for fish breeding, pollination and pest control services for agriculture, storm protection for coastal communities, and physical and mental health benefits for park visitors. They also provide benefits such as neighbourhood amenity, social cohesion and scientific and educational opportunities. Across the world these 'ecosystem services' are increasingly being recognised as critical to supporting human life and improving community wellbeing. Both our protected areas such as national parks as well as our urban parks contribute to the provision of these services.

[5] For example, see Moyle B.D., Weiler B and Moore S.A 2014 Benefits that matter to managers: an exploratory study of three national park management agencies and Parks Forum 2008, The Value of Parks. Produced in partnership with IUCN World Commission on Protected Areas (WCPA) and The People and Parks Foundation. Printed May 2008. ISBN 978-0-646-49197-4 (http http://www.sustainabletourismonline.com/awms/Upload/Resource/Value%20of%20Parks%20Document.pdf)

[6] Essential Research 2014. *Attitudes to National Parks and Conservation.* Survey prepared for the Victorian National Parks Association. Available in http://vnpa.org.au/admin/library/attachments/PDFs/Surveys/survey-attitudes-national-parks.pdf

Globally and nationally, there has been increased awareness and a rapidly increasing body of evidence that community health and wellbeing and economic resilience are inextricably linked to having healthy and resilient ecosystems[7]. In Victoria, the fundamental connection between people and nature has been highlighted by Parks Victoria's motto of *Healthy Parks Healthy People* (HPHP), which is based on a strong body of scientific evidence that contact with nature is beneficial for physical, mental, emotional and spiritual health and wellbeing[8].

While some of the benefits of Victoria's parks have been broadly described in the past, and some of the economic contribution of parks has been quantified in isolated studies,[9] there has not been an overarching framework to assess the status of natural and other park assets or to indicate the contribution of the diverse range of services provided by parks to Victoria's economy and community wellbeing[10]. Moreover, there is often limited evidence to assess the benefits of ecosystem services under protected areas, such as parks, which is a key input in economic analysis for budget planning or resource allocation among competing land uses. The ability to quantify and account for changes in natural assets and the contribution that Victoria's parks and their management make in sustaining our society and economy is an important step in improved business practice.

## 1.3 Natural capital and ecosystem services

Since the United Nations led the Millennium Ecosystem Assessment of 2005 (MA), there has been a rapidly growing global interest in the recognition, accounting and valuation of ecosystem services. This work has highlighted the dependence of human wellbeing on healthy natural assets and the economic, social and environmental consequences of degradation of ecosystems.

Earlier international work in environmental economics and measurement of natural resource depletion increasingly acknowledged that individual economic behaviour in open access or public good resources is unlikely to lead to the best social outcomes. This work went on to highlight the importance of policies to address externalities or non-market goods or services affecting consumption and production activities.

Through the MA, the longstanding work undertaken in environmental economics, the emerging research under the Economics of Ecosystems and Biodiversity initiative (TEEB)[11], the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES)[12] and the System of Economic-Environmental Accounting (SEEA)[13], valuation approaches for assessing the consequences of ecosystem change for human wellbeing have become more widely accepted. This includes the increasing recognition of ecosystems and natural resources as natural capital, like any other capital resources.

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[7] Millennium Ecosystem Assessment, 2005. Ecosystems and human wellbeing: wetlands and water Synthesis. World Resources Institute, Washington, DC. Available in: http://www.unep.org/maweb/documents/document.358.aspx.pdf

[8] Deakin University 2008, *Healthy parks, healthy people, The health benefits of contact with nature in a park context: A review of relevant literature*, 2nd edition. School of Health and Social Development, Faculty of Health, Medicine, Nursing and Behavioural Science.

[9] See Price Waterhouse Coopers 2003, *Economic contributions of Victoria's parks*. Parks Victoria, Melbourne. Note that based on that PWC report the economic value of "tourism and recreation" in parks was valued at $1.86 billion in 2004. This estimate used a different method of calculating economic contribution to the methods in this report and included management expenditure.

[10] See Parks Forum, 2013, The economic value of parks: Establishing the need for an industry wide approach. Parks Forum, Melbourne.

[11] TEEB: http://www.teebweb.org

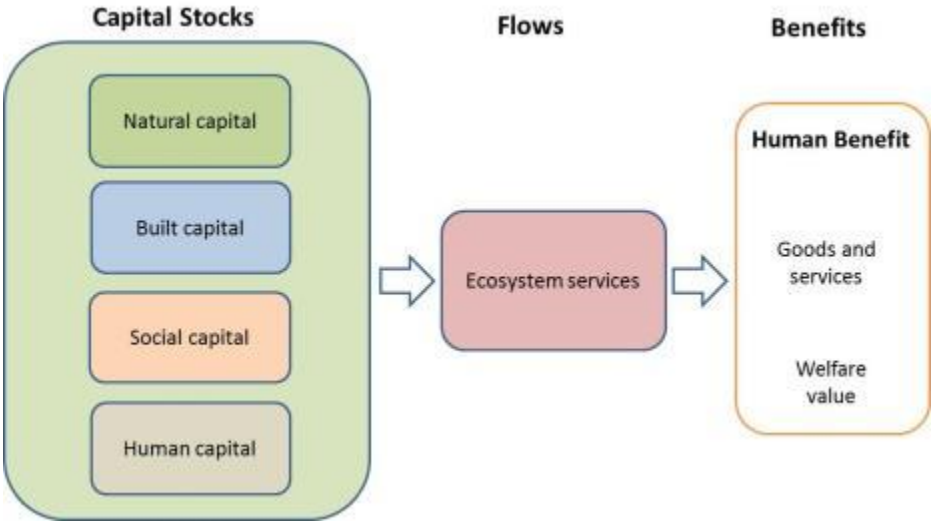
[12] IPBES: http://www.ipbes.net/

[13] SEEA: http://unstats.un.org/unsd/envaccounting/seea.asp

Natural capital is defined as our stocks of natural assets that are either used in production or provide nonmarket services and includes earth's natural resources and ecological systems providing vital life-support services to society and all living things[14], e.g. soil, air, water, habitats and biodiversity. The natural capital of parks can be considered as the basic units that generate ecosystem services and benefits for the community through their interaction with other human, social and built capital[15], as shown in Figure 1.3. Parks Victoria is responsible for the management of natural, built, social and human capital. This approach provides a broadening of the income and consumption concepts relative to standard economic measures.

Ecosystem services are the benefits people obtain from ecosystems.[16] Assessment of ecosystem services has become an internationally accepted approach to recognise and account for the value of nature in economic decisions and is gaining acceptance across Australia.[17] This concept describes the benefits that humans obtain from the environment in a language that a wide range of stakeholders can understand. From an economic perspective, ecosystem services are those contributions of natural capital which generate goods or services, which people value.

**Figure 1.3 The capitals model**




Source: Parks Victoria

If well-managed, the capital of our ecosystems yield a flow of services to communities including the production of goods from natural resources such as water supply or wood, life support processes such as water filtering, regulation of climate, protection from storms and flooding, and other services such as opportunities for cultural and spiritual connection, recreation opportunities and associated tourism, and the preservation of genetic diversity for use in medical research. However, due to the nature of public goods and services provided by the State's parks, many benefits are not reflected in economic markets and are therefore often excluded from investment decisions.

[14] Grafton et al. 2004,'The economics of the environment and natural resources'. Blackwell Publishing. Victoria. Australia.
[15] United Nations 2013, *System of Environmental-Economic Accounting 2012: Experimental Ecosystem Accounting*; *Dickie, I., Cryle, P. & Maskell, L. 2014, UK National Ecosystem Assessment Follow-on. Work Package Report 1 UNEP-WCMC, LWEC, UK;* Costanza et al. 2014, 'Changes in the global value of ecosystem services'. *Global Environmental Change* 26; UNEP 2014, *Guidance Manual on Valuation and Accounting of Ecosystem Services for Small Island Developing States.* Report prepared by the Ecosystem Services Economics Unit, Division of Environmental Policy Implementation. December 2014; http://www.naturalcapitalproject.org/
[16] See Millennium Ecosystem Assessment (www.maweb.org) and SEEA (http://unstats.un.org/unsd/envaccounting/seea.asp)
[17] See Cork S, Gorrie G, Ampt P, Maynard S, Rowland P 2012 Discussion Paper on Ecosystem Services for the Department of Agriculture. Final Report for the Department of Agriculture, Fisheries, and Forestry, Australia21, Canberra..

Ensuring the natural capital Parks Victoria manages does not degrade, and maximising the benefits derived from ecosystem services is important for meeting the objectives of the parks network discussed in Section 1.2. Thus, core goals for Parks Victoria are to ensure that the natural and other capital assets of the parks network are maintained or restored. By doing this, Parks Victoria contributes to maintaining the flow of ecosystem services and their associated benefits to the community.

## 1.4 Classification of ecosystem services

The diverse nature of ecosystem services and their beneficiaries has motivated the development of ecosystem service classification systems. Three categories of services have emerged from the Common International Classification of Ecosystem Services (CICES)[18], listed in Table 1.1 below.

**Table 1.1 CICES ecosystem service classification**

| Ecosystem Service | Definition | Examples |
|---|---|---|
| **Provisioning services** | Tangible goods and services that can be exchanged or traded, as well as consumed or used directly by people. | Provision of food, water and other raw materials. |
| **Regulating services** | Ways in which ecosystems control or modify parameters that define the environment of people; these are ecosystem outputs that are not consumed but affect individuals, communities and populations and their activities. | Climate regulation; watershed regulation such as purification and flood control; and biological processes such as pest control, pollination and genetic diversity. |
| **Cultural services** | Non-material ecosystem outputs that have symbolic, cultural or intellectual significance. | Recreational services; spiritual and cultural connection; landscape amenity; health services; social cohesion and involvement. |

A fourth category of ecosystem service, known as 'supporting' or 'intermediate services', has been recognised to reflect services within or between ecosystems. For example, maintaining soil health and enhancing habitat for native species is likely to benefit other ecosystems directly and may also indirectly benefit the delivery of other ecosystem services outlined in Table 1.1.

A detailed list of ecosystem services applicable to any landscape is provided in Table 1.2. In the context of the Victoria's parks network, most of the major ecosystem services are regulating, cultural and supporting services. This is because most park-based land use has been primarily set aside for conservation and recreation purposes, rather than production. While some parks allow for provisioning services involving resource extraction (such as firewood collection, honey production and commercial fishing), they are often considered as 'permitted uses', but are not the primary aims of the parks. Many of those types of provisioning services apply to other public land.

Conceptually, the provision of ecosystem services and their benefits to human wellbeing has been described as a natural production system, which is determined directly by ecological features of the natural capital, along with any environmental and socioeconomic drivers. These relationships are depicted in Figure 1.4. In practice, a number of interactions and feedback effects may be present and are likely to affect these relationships at different levels. This highlights the need for the assessment of ecosystem services to be tailored to each specific context.

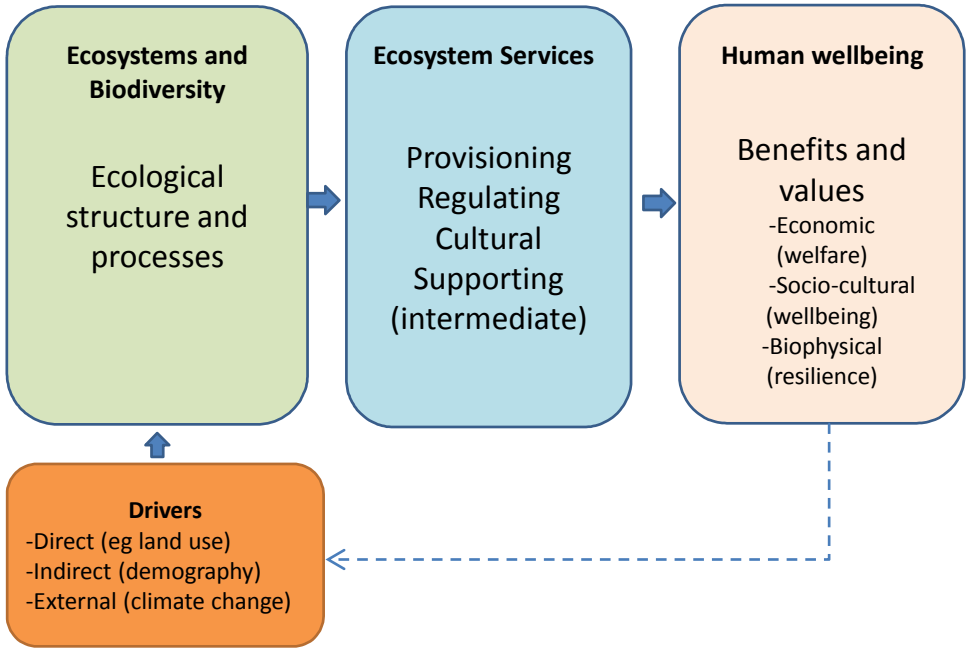
[18] *See www*.cices.eu

**Table 1.2 Overview of ecosystem services (services related to Victorian parks are in bold)**

| Provisioning services | Regulating services | Cultural services | Supporting or Intermediate Services |
|---|---|---|---|
| • **Water supply/availability (for industry, household or recreational use)**<br>• **Unfarmed plants and animals for food (e.g. honey)**<br>• Nutrients and natural feed for farmed systems<br>• Plant and animal fibres and materials (harvested for manufacturing or domestic use)<br>• Chemicals from plants and animals<br>• **Genetic materials for breeding programs**<br>• Biomass for fuel or energy production<br>• Pets, exotic animals and plants for households, recreation or scientific use | • **Water purification**<br>• **Water flow regulation (flooding, timing & recharge)**<br>• **Coastal asset protection**<br>• **Atmospheric regulation (carbon storage & sequestration, urban cooling)**<br>• **Soil cycle regulation (maintenance of soil quality & fertility)**<br>• **Pollination & seed dispersal**<br>• **Pest and disease control**<br>• **Maintenance of genetic diversity**<br>• **Maintenance of nursery populations**<br>• **Mass flow regulation (soil & mudflow stability)**<br>• **Bioremediation**<br>• Maintenance of structure in cultivated systems<br>• Noise regulation | • **Recreation opportunities (enjoyment, physical & mental health)**<br>• **Information and knowledge (research & education)**<br>• **Landscape or neighbourhood amenity**<br>• **Opportunities for cultural connection**<br>• **Social cohesion and sense of place and group identity**<br>• **Non-use services (species/ecosystem existence for future generations)** | • Habitat services |

Source: Adapted from CICES classification in United Nations 2013, *System of Environmental-Economic Accounting 2012: Experimental Ecosystem Accounting*.

**Figure 1.4 Ecosystems services and wellbeing**




Source: Adapted from TEEB, 2012

## 1.5 About this study

### 1.5.1 Purpose of this work

This project was established to develop a framework to account for and value the environmental, community and economic assets, services and benefits of Victorian Parks using international and national best practice standards. The aim of developing improved and consistent environmental and economic information of ecosystems is to inform park management strategic, operational and implementation decisions for three purposes:

- **Monitoring of assets and trend analysis**: assessment of the status of parks' environmental (and associated built and cultural) assets;
- **Understanding the contribution of ecosystem assets to current socioeconomic activities**: reporting the amount of ecosystem services, their changes over time and any associated transactions in the economy or society; and,
- **Estimating benefits of parks' ecosystem services to society**: appraisal of the benefits of ecosystem services provided in park areas as compared to alternative land uses or under proposed changes in policy or investment.

The study marks an important development in the way that Parks are valued and managed for all Victorians, recognising parks as significant environmental assets of the State that need to be maintained and restored in order to provide a broad range ecosystem service benefits to the community.

In developing this project specifically for Victoria's parks, the project is strongly aligned with ongoing work at the Department of Environment, Land, Water and Planning to develop and implement standard environmental-economic accounting information for integration into reporting, analysis and policy advice to improve the accountability, effectiveness and efficiency of investments in environmental management. This work also supports the use of consistent information to undertake valuations of economic, community and environmental benefits provided by Victoria's natural resources and environment more broadly.

It is important to recognise that ecosystem services provided by parks may be measured through both monetary and non-monetary metrics. Depending on the purpose of the assessment, both metrics are valid and complementary.

Specifically the objectives of the study were to:

- Establish a framework to recognise, quantify and value the ecosystem services provided by Victoria's parks and the economic, community and environmental benefits generated, based on international best practice;
- Prioritise and where possible undertake valuations for selected ecosystem services;
- Establish a program of works, including prioritisation of ecosystem accounting and valuation projects and data acquisition, to enable the ongoing assessment of the ecosystem services provided by Victoria's parks along with key benefits generated; and,
- Develop a set of experimental ecosystem accounts for Parks Victoria that will serve as a pilot ecosystem accounts for public land.

### 1.5.2 Study approach

The approach used in developing the accounting and valuation framework for Victoria's parks builds on the ongoing work of the interdisciplinary initiatives outlined in Section 1.3 (discussed in further detail through the report). The approach adopted for this project consisted of the following stages:

1. Review international practice, literature and relevant methodologies used in ecosystem accounting and valuation frameworks
2. Link and tailor these frameworks for application to the Victorian parks network:
    - Develop an accounting framework for ecosystem assets and ecosystem services – ecosystem asset accounts are used for monitoring, while ecosystem service accounts present the contribution of ecosystem assets to current socioeconomic activities.
    - Undertake analysis of available parks data to populate a set of pilot accounts.
    - Develop a valuation framework to assess the current benefits of parks ecosystem services – with focus on benefits from parks to society, which involved defining a counterfactual alternative land use in the absence of parks.
    - Undertake analysis of selected ecosystem services to quantify their benefits in monetary and/or non-monetary metrics, where appropriate.
3. Develop case studies to illustrate application of the above accounting and valuation frameworks to park management activities
4. Identify areas of uncertainty and further work to refine the set of ecosystem accounts and underlying data over time, as well as to improve current valuation estimates.

### 1.5.3 How will this report be used?

The development of pilot ecosystem accounts for Victoria's parks and the valuation of the benefits generated by ecosystem services are intended to be used for a number of different purposes discussed in further detail below. This report specifically introduces the foundations for both accounting and valuation frameworks and discusses the findings from this pilot, which will be the basis for ongoing work between DELWP and PV to improve environmental information and land management decision-making tools.

*Awareness:*

- Raise awareness among resource managers, policy and decision makers and the broader community that Victoria's parks should be valued not just for their role in ensuring ecosystem resilience, conserving nature, protecting cultural heritage and providing enjoyment and learning for visitors and the community; they are indeed critical assets for the State that provide a range of services that contribute to the prosperity and improved wellbeing of Victorians.

*Accounting:*

- Facilitate improved monitoring and reporting of the extent, status and condition of ecosystem and other assets of Victoria's parks and the quantity of ecosystem services provided.
- Account for the improvement, maintenance or degradation of Victoria's natural parks over time and the flow of services they provide against organisational goals (backward-looking analysis).

*Valuation:*

- Provide a stronger evidence base to inform investment decisions for parks, particularly in assessing benefits and calculating the return on investment and the cost-effectiveness of alternative options in meeting desired Government outcomes (forward-looking analysis).
- Demonstrate the level of contribution that parks can make to current socioeconomic activities, supporting the prosperity and wellbeing of Victoria, in addition to the range of ecosystem resilience, biodiversity conservation and cultural and recreational functions they provide.

This work will also inform strategic directions for the management of Victoria's public land, natural resources and environment. The framework is aimed at supporting informed and transparent planning and management decisions for parks and public land, particularly where trade-offs between economic, community and environmental benefits are required.

### 1.5.4 Caveats on the report

The Valuing Victoria's Parks study is an important first step in developing a new and tailored approach to estimate and account for the quantity of ecosystems services and the value of benefits provided by Victoria's parks.

The approach involves the application of an environmental-economic accounting framework to assess the status of parks assets and quantities of ecosystem service flows, which then can feed into a valuation framework used to assess the ecosystem benefits provided to society. Although both frameworks and their distinctive purposes are discussed in this report, it is important to note that the report does not intend to be used as a manual and the linkages between both frameworks will continue to evolve as more data becomes available. The application of techniques across these fields requires solid understanding and experience in both the environmental-economic accounting and environmental valuation areas.

The estimates of quantity and value of a selected number of services are based on available data and valuation methods that could be undertaken during the duration of the project. A number of ecosystems services have been recognised as potentially significant but have not been assessed in this first phase of the program.

In viewing monetary values of selected ecosystems services provided by the report, it is important to recognise that the economic value for different services cannot necessarily be aggregated. This can be due to data availability, different valuation concepts and measures being used and the potential overlap in some cases, where available values may incorporate benefits of more than one service.

It is important to note that the assessment of both the quantity and value of ecosystem services generated by parks in this report is not definitive and is based on gathering available data in a relatively short time period. A prioritised program of further assessments is discussed in Section 6, which will seek to improve the quality of the assessments over time. Nevertheless, as the first assessment of the Victorian parks network, the report provides both an accounting framework in which to populate new information and indicative estimates of the value of key ecosystem services attributable to parks.

## 2. Review of environmental accounting and valuation frameworks

This project brings together different disciplines and analytical tools to better inform Parks Victoria about the ecosystem assets they manage. Thus, a number of relevant frameworks and initiatives that seek to assess ecosystem services and incorporate them into decision-making have been reviewed to inform this project.

This section introduces concepts and frameworks for environmental-economic accounting and environmental valuation. A detailed discussion on the distinctive use of these frameworks and related techniques is also included in this section.

While accounting for natural capital, accounting for ecosystem assets and their services, and environmental valuation can be linked they are generally used for different purposes, highlighted in Table 2.1 below.

Accounting provides the capacity to systematically monitor changes in the extent and quality of environmental resources and enables a framework for the consistent reporting on the contribution of environmental resources to economic activity, growth and performance. Specifically, the purpose of environmental-economic accounting is to provide consistent and comparable information on ecosystem assets and the services they provide, along with performance measures of resource use and emissions in the economy (e.g. water, energy, carbon). By contrast, natural capital accounting encompasses the services of all natural resources, including abiotic services (e.g. mineral resources).

Environmental valuation is used to assess the benefits of goods and services provided by environmental assets and places a welfare value in monetary terms, which enables appraisal of competing use of resources, alternative policies or investments (typically conducted using cost-benefit analysis). While the total determined value of ecosystem service benefits can be useful for strategic planning and raising awareness about the quantum of value provided by park services, valuation is generally applied to assess the incremental change in costs and benefits of alternative options and potential trade-offs associated with changes in environmental quality.

**Table 2.1 The purposes of natural capital accounting and environmental valuation**

| Features | Natural capital accounting | Environmental-economic accounting | Environmental valuation |
|---|---|---|---|
| Scope | Consistent, comparable measurements of information on the extent and condition of natural assets, including relevant abiotic services (e.g. mineral resources) | Consistent, comparable measurements of information on the extent and condition of natural assets, along with ecosystem services | Assessment of incremental and total benefits derived from ecosystem services, under different management options |
| Monetary measures | Exchange value: value of economic activities and transactions observed in the economy | Exchange value: value of economic activities and transactions observed in the economy | Welfare value: non-market benefits (or costs) derived for consumers and producers |
| Decision-making supported | • Reporting of environmental performance<br>• Consistent reporting on the contribution of ecosystem assets and services to economic activity, growth and performance<br>• Providing input to economic analysis for land/environmental policy<br>• Raising awareness of parks assets and their services to the community | | • Comparing benefits across land uses or policy and investment options<br>• Resource allocation across competing uses of ecosystems<br>• Awareness of parks benefits |

It is important to note that the current systems of accounting focuses on tracking stocks and service flows in physical units and monetary terms, referring to the activity generated within society under present social preferences and environmental and institutional conditions. By contrast, environmental valuation focuses on the assessment of non-market costs and benefits (or externalities) due to a specific

intervention, which requires assessing the change in outcomes of ecosystem services with and without the intervention (in this project, this is comparing park land use with private land use). Thus, environmental valuation produces economic 'welfare values' consistent with cost-benefit analysis, while accounting reports the current transactions in terms of 'exchange values'. These concepts are described in further detail in Section 2.3.

## 2.1 Ecosystem accounting frameworks

### 2.1.1 System of Environmental-Economic Accounting

The conceptual basis of accounting is defining capital (stocks) and income (flows) of assets that are valued through time and space or between entities (e.g. people or businesses). An economic account describes stocks and flows of economic goods and services, whereas the subject of environmental accounts is environmental assets and flows of ecosystem goods and services.

The System of National Accounts (SNA) is jointly released by the United Nations Statistics Division (UNSD), the European Commission, The Organisation for Economic Cooperation and Development, the International Monetary Fund and the World Bank. The first SNA was released by the United Nations in 1953 and has been progressively updated and refined since then. The SNA provides a consistent structured basis for reporting on economic performance. However, the accounts did not cover measures of human, social and natural capital[19]. Internationally, efforts are being directed at extending national accounts to incorporate these. The UNSD and other agencies have developed the System of Environmental-Economic Accounting (SEEA) over the last decade to allow countries to monitor and value their natural assets.

The SEEA Central Framework[20] is a multipurpose conceptual framework for understanding the interactions between the economy and the environment, and for describing stocks and changes in stocks of environmental assets. It is the first iteration of a statistical standard for environmental-economic accounting. The System of Environmental-Economic Accounting (SEEA) Experimental Ecosystem Accounting[21] complements the SEEA Central Framework.

### 2.1.2 SEEA Experimental Ecosystem Accounting

The SEEA Experimental Ecosystem Accounting (SEEA-EEA) is an integrated statistical framework for organising biophysical data, measuring ecosystem services, tracking changes in ecosystem assets and linking this information to economic and other human activity. SEEA-EEA accounts include:

- **Ecosystem assets,** which are spatial areas containing a combination of biotic (living) and abiotic (non-living) components and other characteristics that function together; and,
- **Ecosystem services,** which are the contributions of ecosystems to benefits used in economic and other human activity. They are generated through ecosystem processes reflecting the combination of assets characteristics, intra-ecosystem and inter-ecosystem flows.

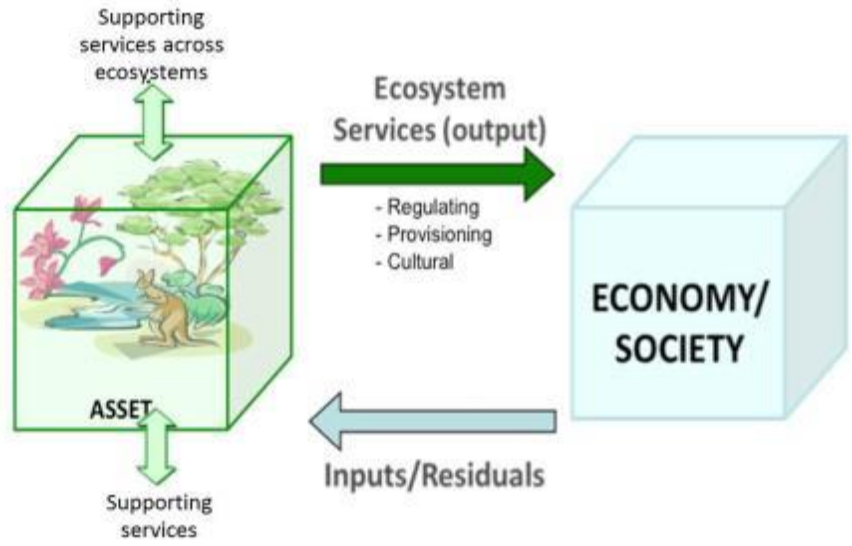
[19] As discussed in Grafton et al. (2014), relying on GDP as the main measure of economic performance may encourage countries to follow unsustainable paths of development, because GDP makes no deduction for the depreciation for capital stock. Earlier solutions advocated by some economists (e.g. Repetto in 1992, Pearce and Atkinson in 1995) referred to including natural capital in the capital accounts of the SNA to derive an environmentally adjusted version of the Net Domestic Product (interpreted as the maximum level of sustainable consumption). Grafton et al. 2004,'The economics of the environment and natural resources'. Blackwell Publishing. Victoria. Australia.

[20] United Nations 2014, *System of Environmental-Economic Accounting 2012: Central Framework*.

[21] United Nations 2013, *System of Environmental-Economic Accounting 2012: Experimental Ecosystem Accounting*.

Figure 2.1 below summarises the approach to experimental ecosystem accounting.

**Figure 2.1 Experimental ecosystem accounting**




Source: Eigenraam, M., Chua, J. Hasker, J. 2012 Land and Ecosystem Services: Measurement and Accounting in Practice. 18th Meeting of the London Group on Environmental Accounting, Ottawa, Canada.

Ecosystem accounting is used to measure the flows of environmental services from ecosystem assets into the economy and society more broadly. Thus, the development of ecosystem accounts is central to assessing the linkages and interdependencies between natural resources and human and economic activities. In this context, ecosystems can be considered as a type of endowment supporting an economy, but providing additionally broader non-market benefits to human wellbeing.

The development of the SEEA-EEA has been motivated by the need for:

- Understanding about the extent of self-regeneration and degradation of the environment in a consistent framework that complements the SEEA and SNA
- Identifying and assessing impacts of economic and other human activity on the environment and understanding potential trade-offs between alternative uses of a given ecosystem
- Providing meaningful information about ecosystems in policy areas, such as sustainable development, natural resource use and land management

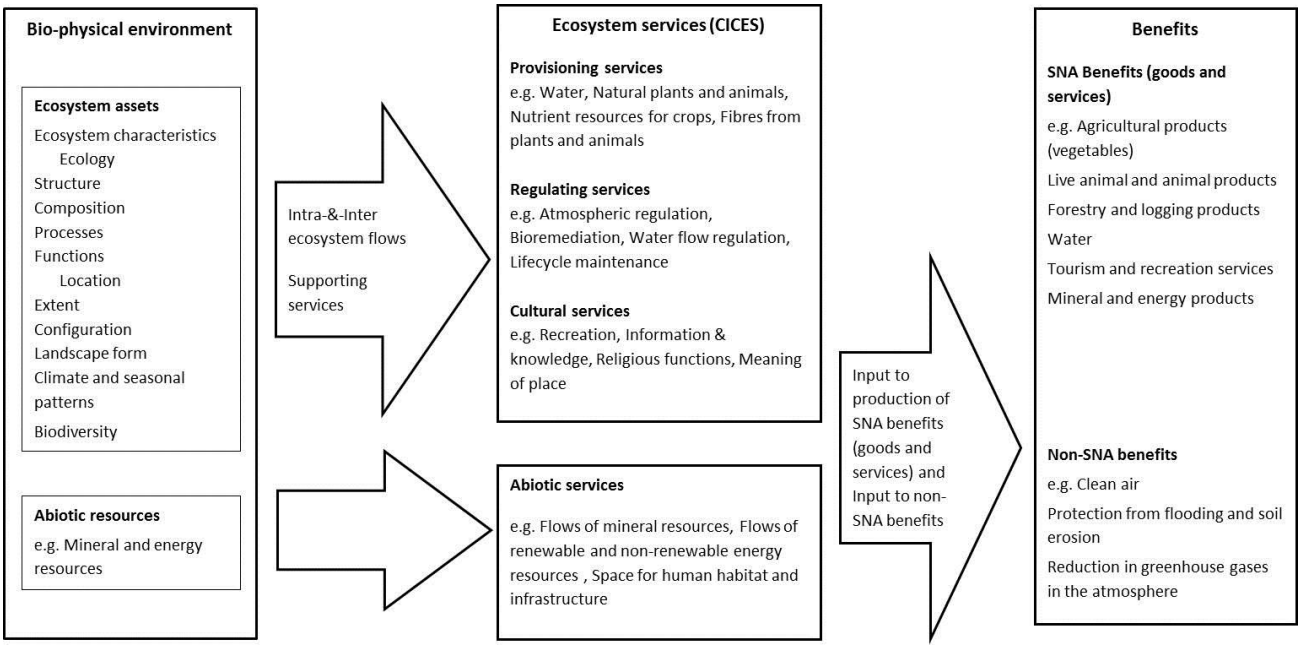
Overall, ecosystem accounts will provide a better understanding of the contribution of ecosystem services to the economy, and the attribution of the environmental degradation, restoration and enhancement and will assist in the development of more complete measures of regional and national wealth.

Ecosystem accounting supplements the information of core environmental-economic accounting (as described in the SEEA Central Framework) by explicitly identifying and appraising each of the service flows provided by ecosystem assets. For instance, the current application of environmental-economic accounting focuses on the measurement of resource use/supply and footprint in each sector of the economy under the SNA classification (e.g. in terms of water, energy, land use, air pollution and greenhouse gas emissions), while ecosystem accounting encompasses assessing both the quantity and economic, environmental or social value of final ecosystem services that can be linked to any production or consumption activities beyond the SNA structure.

The model of flows in ecosystem accounting is presented in Figure 2.2 below. The model presents concrete examples of key relationships between the bio-physical environment, ecosystem services and benefits attained in economic and other human activity.

Note that in the context of ecosystem accounting there are two types of benefits: SNA benefits and non-SNA benefits. SNA benefits are obtained from goods and services produced or distributed by economic units (e.g. food and water), while non-SNA benefits are not (e.g. clean air). By convention, the measurement scope of non-SNA benefits for ecosystem accounting purposes is limited to the flow of ecosystem services with an identifiable link to human wellbeing.

**Figure 2.2 Model of flows in ecosystem accounting**




Source: United Nations 2013. *System of Environmental-Economic Accounting 2012: Experimental Ecosystem Accounting*.

### 2.1.3 The Victorian experience in ecosystem accounting

The Victorian Government has been contributing to the development of SEEA-EEA. Over the past ten years, Victoria has been establishing the information systems required for government to implement a market-based approach to manage ecosystem assets and make effective investment in increasing the supply of ecosystem services at least cost. These systems have relied on an extensive array of information including spatial layers, ecosystem condition assessments, ecosystem condition modelling, ecosystem service modelling and ecosystem change modelling. As a result, Victoria's modelling capabilities are able to provide information about the current levels of some selected ecosystem flows and further predict likely changes in ecosystem flows due to changes in land use and management.

A set of accounts has been developed for Victoria, building on the methodological guidance of SEEA-EEA. The Victorian approach is based on a bottom-up methodology, which models and monitors cumulative chains of ecological processes across a whole system. The development of the accounts is undertaken in three stages: assessment of asset conditions, calculating the volume of inter-ecosystem flows as a

function of the asset condition and its context in the landscape and quantifying the volume of ecosystem services[22].

The first set of experimental accounts presented in 2013 were classified in the following groups:

- **Ecosystem Asset Accounts**, which measured the Victorian terrestrial extent and condition across major vegetation groups (e.g. forests, grasslands, woodlands, scrublands) for the years 1750 and 2005. These covered 24 native vegetation groups and other land categories, including sea and estuaries, inland aquatic and cleared, non-native vegetation and buildings.
- **Asset Flow Accounts**, which recorded the changes in the stock of ecosystem assets between 1994 and 2004, showing both additions (e.g. growth in terrestrial extent, whether via managed revegetation or unmanaged regeneration) and reductions (e.g. extractions, normal loss of stock and catastrophic events).
- **Physical Flow Accounts**, which recorded the flows between ecosystem assets and used these as proxies for the services that contribute to human benefits.
- **Environmental Payment Accounts**, which recorded the economic transactions that affect the stocks and flows of ecosystem assets, including the expenditures for improvement and maintenance of ecosystem assets. Of particular importance to water quality were payments on wastewater management, protection and remediation of soil, groundwater and surface water, and protection of biodiversity and landscapes.

This set of experimental environmental-economic accounts used the ABS 2012 Land Account data in Victoria, which provided a link between the ecosystem and economic land valuation data and socio-demographic geographical units.

The accounts were instrumental in gaining an understanding of the nature of changes in ecosystem assets in Victoria, mainly in terms of native vegetation groups and the changes in land tenure/classifications. However, the 2013 land accounts did not look at the full range of final ecosystem services provided by specific assets and did not include any valuation associated with environmental services. This is a new development of this pilot for Victorian parks.

## 2.2 Valuation of ecosystem services

Different people attach different meanings to the word ‘value’. Economists use the word to describe the extent to which a good or service contributes to the wellbeing of an individual or society. In other words economists consider value from a human perspective. Ecologists often assess value by the relative contribution or ‘significance’ of intrinsic ecological processes, functions and resilience to disturbance.

While there is ongoing debate in the context of valuing ecosystem services about the degree to which different approaches can determine value, whichever interpretation of value is used, there is increasing agreement that the absence of a price for ecosystem services does not indicate absence of value.

In order to quantify the contribution of the land, water and ecosystem assets of Victoria’s parks to the Victorian economy and wellbeing of the community we need a common framework of measurement. Many of the services provided by Victoria’s parks are public goods that provide multiple benefits. These benefits are often not captured in market transactions, resulting in these services not being included in many private economic decisions. The purpose of valuation is to explicitly recognise the importance of

[22] Eigenraam, Chua and Hasker 2013 Environmental-Economic Accounting: Victorian Experimental Ecosystem Accounts, Version 1.0. Department of Sustainability and Environment. State of Victoria.

the range of assets, services and benefits provided by parks. Having a common language of value is particularly important for decision-makers in assessing the trade-offs associated with management and investment decisions relating to parks and their management.

In this context, it is important to distinguish between monetary values developed for economic evaluations (or welfare analysis) and monetary values that are sought in the context of environmental-economic accounting. These two values are different (but often related) in the accounting and valuation of ecosystem services:

1. **Exchange values** are used by accountants to measure the value of economic activity or transactions that are consistent with SNA definitions and SEEA international standards; and

2. **Welfare values** are used by economists to measure the net benefits (or change in welfare) associated with a specific land use, proposed policy or investment[23].

In the case of non-market goods or services (e.g. most ecosystem services not observed in market transactions), environmental valuation is used to assess benefits. Exchange values for non-market goods or services could be derived from specific environmental valuation techniques to provide the value of economic activity or transactions that would occur if the 'missing' price were in place[24].

Exchange values are consistent with all other transaction values recorded in the SNA. The main purpose of obtaining these values could be to develop satellite accounts, in which the contribution of ecosystems can be compared with other SNA production and consumption activities in the economy. In the context of this project, the aim is to assess the benefits of Victoria's parks and therefore welfare values are the main focus.

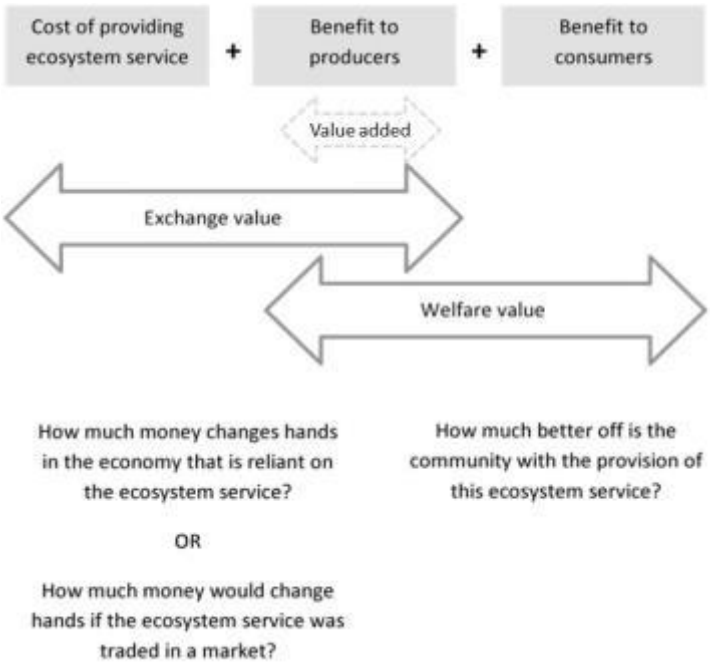
To value Victoria's parks we have compiled and estimated benefits based on the data and modelling available at the time of this project. However, we further indicate where some of the data gathered could be also suitable to derive exchange values for environmental-economic accounting.

Figure 2.3 below summarises the relationship between monetary values developed for environmental valuation and accounting purposes. Welfare values are derived from a snapshot of market demand and supply cost curves in the short-run, i.e. where fixed or investment costs are not taken into account. By contrast, exchange values include fixed costs as well as taxes and subsidies. In this way, the economic contribution or value added to an economy can be calculated directly from exchange values measuring profit as the return to labour and capital.

[23] The economic welfare of society is the total benefit measured by the consumer and producer surplus. Recent work has attempted to use welfare values for 'inclusive wealth accounting' as discussed in the UNEP Inclusive Wealth Report 2012: Measuring Progress Toward Sustainability. However, the assumptions required are contentious and so, this initiative should be considered as a developing area.

[24] Economic theory indicates that the optimal price that maximises welfare would tend to be the same to the observed price in in competitive markets, without any market failures. Under these market conditions, the relationships to derive exchange and welfare values may be more direct, but this is often not the case for ecosystem services.

**Figure 2.3 Different accounting and valuation concepts**



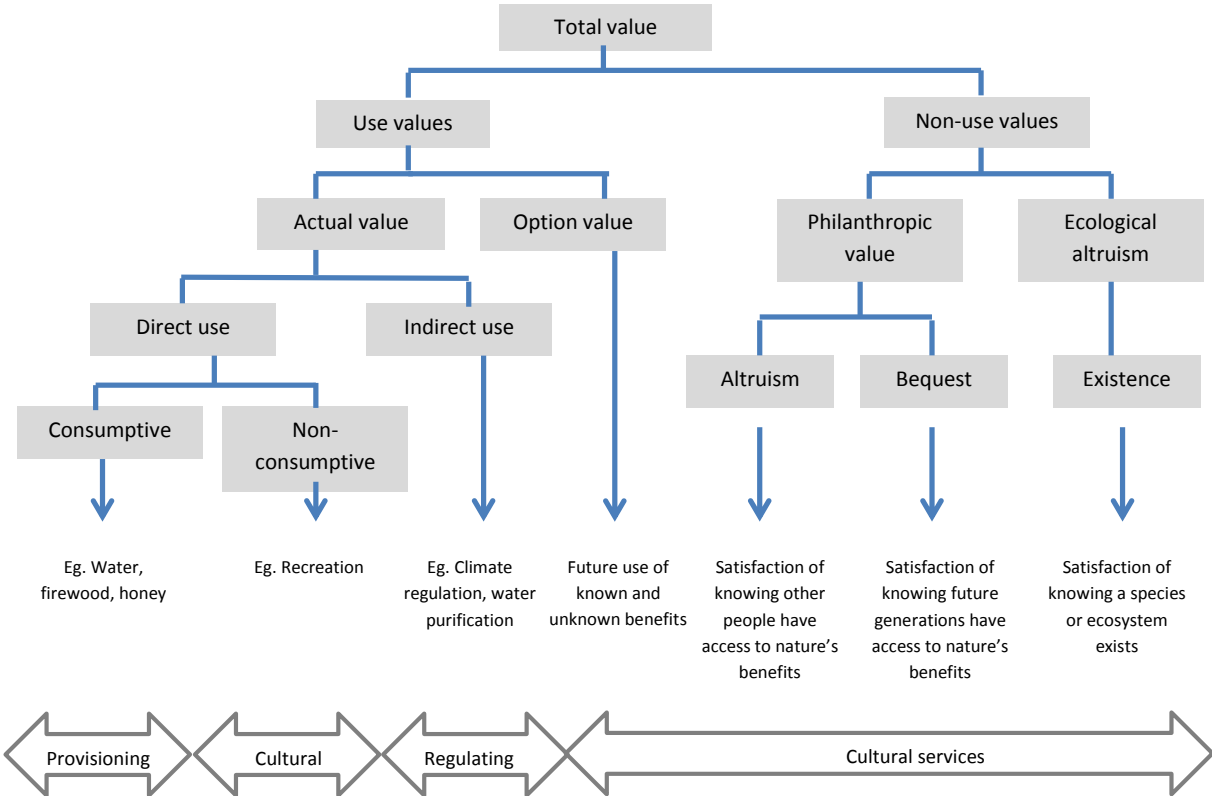

### 2.2.1 Environmental valuation concepts

The concept of Total Economic Value (TEV) was formally introduced in the 1990s[25], but its components have been discussed in the economics literature since the 1960s[26]. Figure 2.4 presents an overview of the classification of economic values and their relevance to different ecosystem services.

Total economic value is defined as the sum of the various constituents of utilitarian value, including use values and non-use values. Use values result from either the direct use of a good (that can be consumed directly) or the indirect use of a good (that provides functional benefits such as a wetland treating water for use downstream). Non-use or passive use values reflect individual's willingness to pay to preserve a resource aside from any actual use. These values may result for various reasons such as providing a bequest for future generations, altruism from knowing others have access to a benefit and gaining satisfaction from the existence of a species or ecosystem.

[25] Pearce and Turner 1990, *Economics of natural resources and the environment*, Johns Hopkins University Press. Chapter 9.
[26] Weisbrod, B. A. 1964, 'Collective-Consumption Services of Individual-Consumption Goods', *Quarterly Journal of Economics 78*, pp. 471-477. Krutilla, J. 1967, 'Conservation Reconsidered', *American Economic Review 57*, p. 777-786. Arrow, K. J. and A. C. Fisher 1974. 'Environmental Preservation, Uncertainty and Irreversibility', *Quarterly Journal of Economics 89*, pp. 312-19.

**Figure 2.4 Components of the value of parks**




Source: Adapted from TEEB Foundations Report 2010 Chapter 5 The Economics of Valuing Ecosystem Services and Biodiversity.

Some commentators argue that valuation in monetary terms may have counterproductive outcomes for biodiversity conservation[27] or that valuing ecosystem services is the same as privatising or commodifying nature. Other commentators raise ethical objections to valuing the environment based on individual or community preferences, arguing that the environment has 'intrinsic value' that is unrelated to human preferences. Others argue the concept of intrinsic value is difficult to apply in a decision-making context. This is because once one environmental asset is assigned intrinsic value, it is difficult to see how unavoidable trade-offs with other environmental, cultural or social assets that are also afforded intrinsic value could be resolved[28]. Others point out the limitations of monetary valuation in the face of the highly complex behaviour and high levels of uncertainty about ecosystem functions[29].

In valuing ecosystem services and quantifying their benefits both monetary and non-monetary units can be used. Increasingly economists are using monetary units to place an economic value on the benefits obtained, however many benefits can also be expressed in non-monetary units to demonstrate absolute or incremental level of benefits. For some benefits a monetary unit is not considered either appropriate or feasible.

The approach in this project is to pursue valuation of the benefits of ecosystem services in monetary terms where possible and appropriate to demonstrate the links to the economy and value provided to the community. It is acknowledged that other valuation paradigms are also valid (e.g. the existence of

[27] Gomez-Baggethun and Perez 2011 *Economic Valuation and the Commodification of Ecosystem Services*, Progress in Physical Geography.
[28] Productivity Commission 2014 *Environmental Policy Analysis: A Guide to Non-Market Valuation*, Productivity Commission Staff Working Paper, January 2014
[29] Farly 2008 *Valuing Natural Capital: The Limits of Complex Valuation in Complex Systems*, conference paper prepared for Economics and Conservation in the Tropics: A Strategic Dialogue.

intrinsic values separate from values to humans), but this does not negate the importance of the monetary valuation work. Where monetary valuation of the benefits of ecosystem services is not feasible or desirable, proxy indicators can be developed using available scientific information to reflect the importance of the service.

Economists rely on valuation using preference-based methods to provide information about the relative level of resource scarcity to assist in best allocating limited resources, while ecologists have traditionally used biophysical methods. Some ecosystem services (such as recreation) have a monetary value that relates to the contribution of tourism to the economy. Other ecosystem services may have a social value where a monetary unit is used to reflect that value (e.g. willingness to pay). In other cases, it may be either undesirable or not feasible to put a monetary value on the service and there will be a proxy measurement (e.g. an index of value such as relative contribution or benefit).

Economists favour analysing policy decisions using an economic framework, ideally through a cost–benefit analysis. This allows decisions to be informed by the trade-offs that the individuals who make up the community would be prepared to make and aims to select options that make the community better off overall. However, applying a cost–benefit framework is not easy where ecosystem services are impacted. This emphasises the need to pursue monetary valuation of ecosystem services as well as ensuring frameworks for decision making allow for different types of valuation.

Non-market valuation in the context of ecosystem accounting focuses on appraising the total economic value derived from the ecosystem assets. The total economic value encompasses a range of use and non-use values held by the community reflecting the range of ecosystem services that may be provided by a single asset. Individual ecosystem services often have a single type of value – they reflect either a use or non-use value – and therefore one valuation method can be selected to value the benefits of each ecosystem service. Given the difficulty in measuring non-use values and linking them to economic and social activities, use values have been the focus of valuation in this project, while selected non-use values from the literature have been considered at the high level only.

### 2.2.2 Economic valuation methods

A range of techniques for valuing environmental assets in monetary terms have been developed to carry out traditional economic evaluations to inform policies and programs aimed at improving the environment or to feed into project appraisals with significant impacts on the environment. The main types of techniques for estimating monetary values are briefly described in Table 2.2 below.

There are three main types of primary research techniques typically used for valuing environmental benefits. **Market based techniques** provide the greatest confidence to value non-market benefits as the monetary values are directly observed in markets. However, these methods cannot be used to value goods or services where prices do not exist. **Revealed preference techniques** can capture non-market values but require more detailed data and analysis from any existing markets that can be linked to the goods or services of interest. **Stated preference techniques** are based on hypothetical markets, are more technically difficult and require careful survey design to ensure robust outputs.

An alternative technique is based on secondary research referred to as **benefit transfer** (or value transfer). Benefit transfer derives a proxy value from existing research and the original work may be from any of the three types of techniques outlined above. Careful judgement is needed in selecting, applying and interpreting the results of valuation techniques.

**Table 2.2 Overview of valuation techniques**

| Valuation techniques | Approach | Examples |
|---|---|---|
| Primary research techniques | | |
| Market based techniques | Estimating values based on market prices where there is an existing market for the ecosystem service or market prices. | **Market price approach**: Determining the value based on a marketed good provided by the ecosystem directly such as fish or timber.<br>**Productivity method**: Where an ecosystem service affects production levels, costs or prices. The contribution to output is used as a proxy for the value of the service.<br>**Replacement cost approach:** often applied to indirect use values of ecosystem services, such as nutrient cycling or water purification, whereby the value of a service is estimated by the cost of the next best option to achieve the same outcome (e.g. a water purification plant). |
| Revealed preference techniques | Eliciting or deriving values based on observed behaviours and actual choices in related markets that affect the ecosystem goods or services of interest. | **Hedonic pricing:** used to derive values for amenity and the aesthetic qualities of environmental assets by observing how another related market changes in value due to proximity to such assets (e.g. real estate values changing in proximity to parks).<br>**Travel cost method**: generally used to estimate the recreational values of particular sites by observing visitor travel patterns and the expenditure that people are willing to pay in order to enjoy such a site. |
| Stated preference techniques | Eliciting values based on individual statements or choices in a hypothetical market for the ecosystem service. | For non-use values, stated preference techniques are the only option available (e.g. deriving people's willingness to pay to protect endangered species habitat by presenting sets of choices with payment mechanisms).<br>Two techniques are used:<br>**Contingent valuation:** used to elicit the perceived value of certain environmental amenities.<br>**Discrete choice modelling:** used to infer trade-off values between key attributes of environmental amenities. |
| Secondary research | | |
| Benefit transfer | Provides transferable values from other studies under the following conditions:<br>• the study and policy site should be similar;<br>• the environmental change under consideration at the policy site should be similar to the proposed change at the study site; and<br>• the socioeconomic characteristics and preferences of the population should be similar. | **Transfer of an average value**: defensible only if ecosystem asset/service and context is very similar (e.g. filtration services valued at $x per hectare per year is applied to an ecosystem with similar characteristics).<br>**Transfer using meta-analysis**: value tailored through a relationship derived from many relevant studies (e.g. on average a x% increase in water treatment costs for each y% loss in forest cover in developed countries).<br>**Transfer using a spatially explicit value function**: detailed analysis of assets and services based on spatial and temporal scales (e.g. the UK National Ecosystem Assessment land use scenarios). |

The prerequisite for choosing a valuation technique is to determine the purpose of the valuation. Selecting the right technique for each situation will depend on a number of factors such as:

- the motivation for the valuation
- the type of economic and environmental data already available
- the ecosystem service (some techniques are suited to particular types of ecosystem services)
- the time and budget available
- the availability of experienced practitioners

The Productivity Commission recently prepared a guide to non-market valuation, as an accepted approach to assess the *relative importance* community places on specific environmental outcomes[30]. It states that:

> *"Because non-market valuation methods can generally provide an objective estimate of the value that the community places on environmental outcomes, they offer advantages over other approaches to factoring these outcomes into policy analysis."*

In relation to individual techniques, the Productivity Commission has confirmed that revealed preference methods are widely accepted, but there are many circumstances where they cannot provide the estimates needed for environmental policy analysis. They advise that stated preference methods are able to provide valid estimates for use in environmental policy analysis, noting however that:

- there are many elements that practitioners need to get right to produce meaningful results; and,
- value estimates are likely to be less reliable when respondents are asked about environmental assets that are especially complex or relatively unfamiliar to them.

The Productivity Commission also advises that the accuracy of benefit transfer is likely to be low unless the primary studies are of high quality and relate to similar environmental and policy contexts.

The Victorian Department of Treasury and Finance *Technical Guidelines on Economic Evaluation for Business Cases* includes a section on valuation techniques. The guidance document acknowledges the range of techniques available to value market and non-market impacts in monetary terms. It advises that:

- impacts should only be assigned a monetary value when this is done in a robust and neutral manner in line with the appropriate use of existing widely accepted valuation techniques or default values; and,
- if impacts cannot be assigned monetary values then they should still be described in quantitative / qualitative terms.

### 2.2.3 The Economics of Ecosystems and Biodiversity

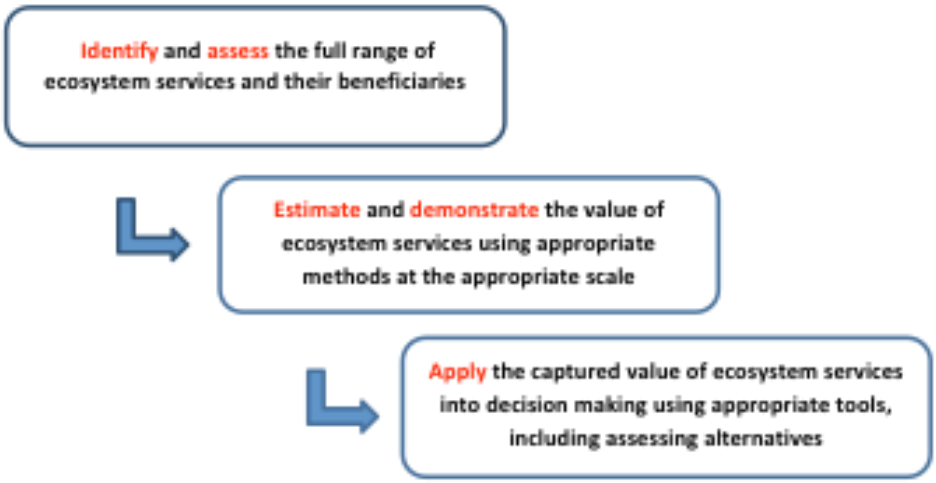
The Economics of Ecosystems and Biodiversity (TEEB) is a global initiative focused on drawing attention to the economic benefits of biodiversity. TEEB provides a framework to help decision-makers recognise, demonstrate and capture the values of ecosystems and biodiversity, and incorporate those values into decision-making.

TEEB recognises that linking biophysical aspects of ecosystems with human benefits through the notion of ecosystem services is important for assessing trade-offs. Decisions lead to actions that have impacts on ecosystems, causing changes in ecosystem structure and function. These changes lead to changes in the provision of ecosystem services. Changes in ecosystem services in turn have impacts on human welfare.

The TEEB approach to valuation of ecosystem services involves the steps shown in Figure 2.5 below.

[30] Productivity Commission 2014 *Environmental Policy Analysis: A Guide to Non-Market Valuation*.

**Figure 2.5 TEEB approach to valuation of ecosystem services**




Source: TEEB, 2010. The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature: A synthesis of the approach, conclusions and recommendations of TEEB.

Before benefits and values can be assessed, the performance or availability of ecosystem services has to be measured in biophysical terms. In some cases the state of ecological knowledge and the data availability allow using some direct measures of services, while in other cases it is necessary to make use of proxies.

TEEB adopts an economic (anthropocentric) framework with preference based values and proposes two components to the economic value of ecosystems. The first is total economic value of the ecosystem service benefits at a given ecological state. The second is the ecological or insurance value that lies in sustaining the resilience of the ecosystem, which provides flows of ecosystem service benefits with stability over a range of variable environmental conditions.

The TEEB framework recognises that some aspects of ecosystem functioning such as ecological resilience or the proximity of tipping points are difficult to capture in valuations. In such cases it is recommended that this information is presented alongside valuation calculations. TEEB suggests an ecological (insurance) value is defined through a non-monetary assessment of ecosystem integrity, health, or resilience, all of which are important indicators to determine critical thresholds and minimum requirements for ecosystem service provision.

TEEB is a broad initiative that aims to guide practical policy responses to losses of biodiversity and ecosystem services. TEEB identifies settings where benefits and values can inform decisions and provides a range of case studies and examples of incorporating ecosystem service values into decision making. A range of reports and case studies have been developed under the TEEB initiative for national and international policy making, local and regional policy management and business and enterprise.

## 2.3 Synthesis of relevant valuation and accounting frameworks

A review of a range of classification, accounting, and evaluation frameworks including TEEB and SEEA was carried out and is summarised in Table 2.3 below. The review was conducted with the following four criteria in mind:

1. Clarity of definition and classification of natural capital and ecosystem services
2. Consistency of methods for converting data into information for decisions and confidence in methods
3. Ability to audit and report on economic, community and environmental benefits
4. Ability to adapt over time

**Table 2.3 Summary of Frameworks reviewed**

| Framework | Purpose | Conceptual framework | Insights for this project |
|---|---|---|---|
| Ecosystem services initiatives | | | |
| Millennium Ecosystem Assessment (MA) | To assess consequences of ecosystem change for human wellbeing; to establish scientific basis for sustainable use of ecosystems | Four components: direct and indirect drivers of change; ecosystem services and human wellbeing | Useful introduction; the first classification scheme |
| Environmental-Economic Accounting | To understand the interactions between the economy and the environment so that this can be taken into account in decision making | Describing stocks, changes in stocks of environmental assets and changes in ecosystem service flows | Provides a framework for organising physical data to assist in managing environmental assets |
| The Economics of Ecosystems and Biodiversity (TEEB) | To help decision makers recognise, demonstrate and capture the values of ecosystems and biodiversity | Adds to MA conceptual framework; identifies benefits and values of ecosystem services and links to decision making | Provides useful guidance on monetary and non-monetary valuation approaches with significant flexibility |
| Valuing Nature Network | To promote research capacity in the valuation of biodiversity, ecosystem services and natural resources and facilitate integration into policy and practice | Categorisation of values into individual wellbeing values and collective shared wellbeing values | Interesting conceptualisation of value, including shared social values |
| Classification frameworks | | | |
| Common International Classification of Ecosystem Services (CICES) | To provide a clear classification of ecosystem services for accounting purposes | Based on the MA; focuses on final ecosystem services | Most commonly used classification; can be adapted to suit the needs of the project |
| Final Ecosystem Goods and Services Classification System (FEGS) | To provide a set of detailed definitions, metrics and indicators to link ecosystem services and human wellbeing | Identifies a set of beneficiary classes and services that are connected directly to what people value | Useful focus on identifying beneficiaries when classifying to avoid ambiguity and double counting |
| Accounting frameworks | | | |
| System of Environmental-Economic Accounting (SEEA): Central Framework | To provide a statistical standard for measuring stocks and changes in stocks of environmental assets | Physical supply and use tables; functional accounts and asset accounts. | SEEA offers an international standard for environmental-economic accounting that integrates with the System of National Accounts |
| System of Environmental-Economic Accounting (SEEA): Experimental Ecosystem Accounting | To synthesise current knowledge regarding an accounting approach to the measurement of ecosystems | Measures flows of ecosystem services to people; measures ecosystem asset condition in terms of capacity to provide services | Offers experimental approach to ecosystem accounting that can be adapted for the project; organises physical data that can be used in estimating the value of ecosystem services for other purposes as well |

The SEEA and CICES best meet the criteria of providing a clear definition and classification of ecosystem assets and services as an internationally recognised approach. This combination will provide consistency of methods for converting data into information for decisions, linking information with existing evaluation frameworks and a structure for auditing and reporting on benefits. SEEA organises physical

data that can be used in estimating the value of environmental services using a range of valuation concepts (for accounting or other evaluation purposes).

The scope of TEEB is very broad – it is an approach rather than a framework. The TEEB documentation provides very useful guidance on methods to convert data on ecosystem services into information for decisions. We draw on the methods for monetary and non-monetary valuation described in TEEB in the sections to follow, and provide tailored guidance to assist in deciding which methods should be used for different purposes to promote more consistency in the Victorian context. Each of the evaluation frameworks has been developed for different purposes and can all be adapted to consider ecosystem services.

# 3. Application of ecosystem accounting and valuation frameworks to Victorian parks

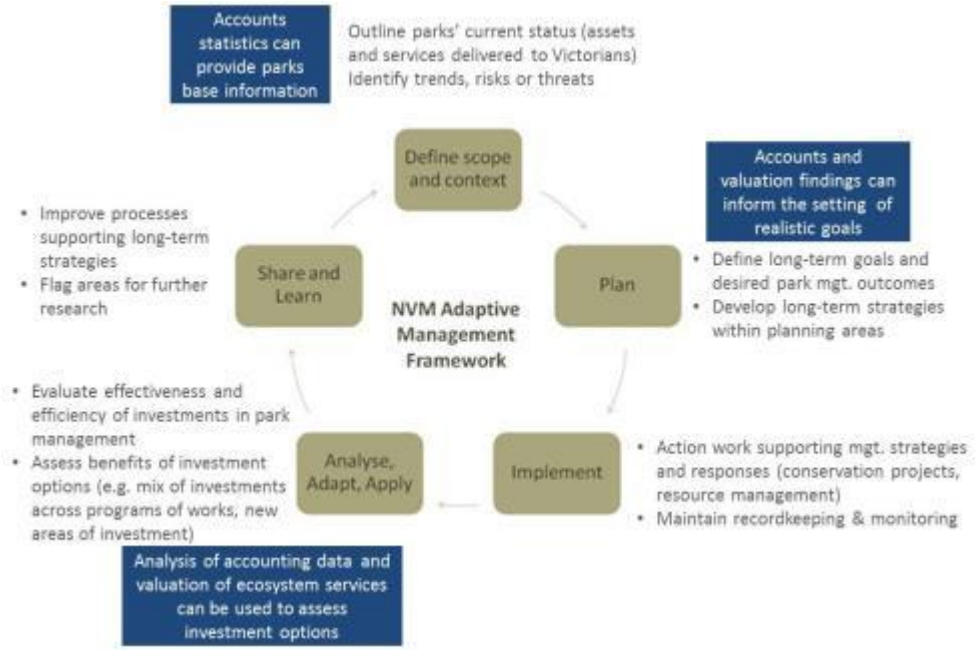
A key aim of this project is to provide more understanding about the scope and magnitude of ecosystem services and benefits provided by parks to inform park management priorities. For this we apply available ecosystem accounting and valuation frameworks to the management of Victoria's parks by both integrating these into Parks Victoria's business systems as well as to provide insights for the broader application of environmental valuation and accounting to public land. This section outlines the distinctive purpose of incorporating each of these frameworks into park management.

## 3.1 Park management framework in Victoria

Parks Victoria has adopted a park management framework based on the Open Standards for the Practice of Conservation[31] (Figure 3.1). Like similar adaptive management frameworks it recognises that effective park management includes understanding the assets (or stocks) managed and the flow of ecosystem services generated, clear measurable goals and objectives, strategies to meet those goals and evaluation of alternative investment strategies and systems to enable evaluation of the extent to which the goals have been met.

Within this park management framework, environmental-economic accounting frameworks are most relevant in seeking to consistently generate accounts to record both the extent and condition of park assets and the quantity of ecosystem services generated over time. Valuation frameworks are most useful in being able to assess the benefits of park services under alternative management options and assess trade-offs.

**Figure 3.1 Parks Victoria park management framework**



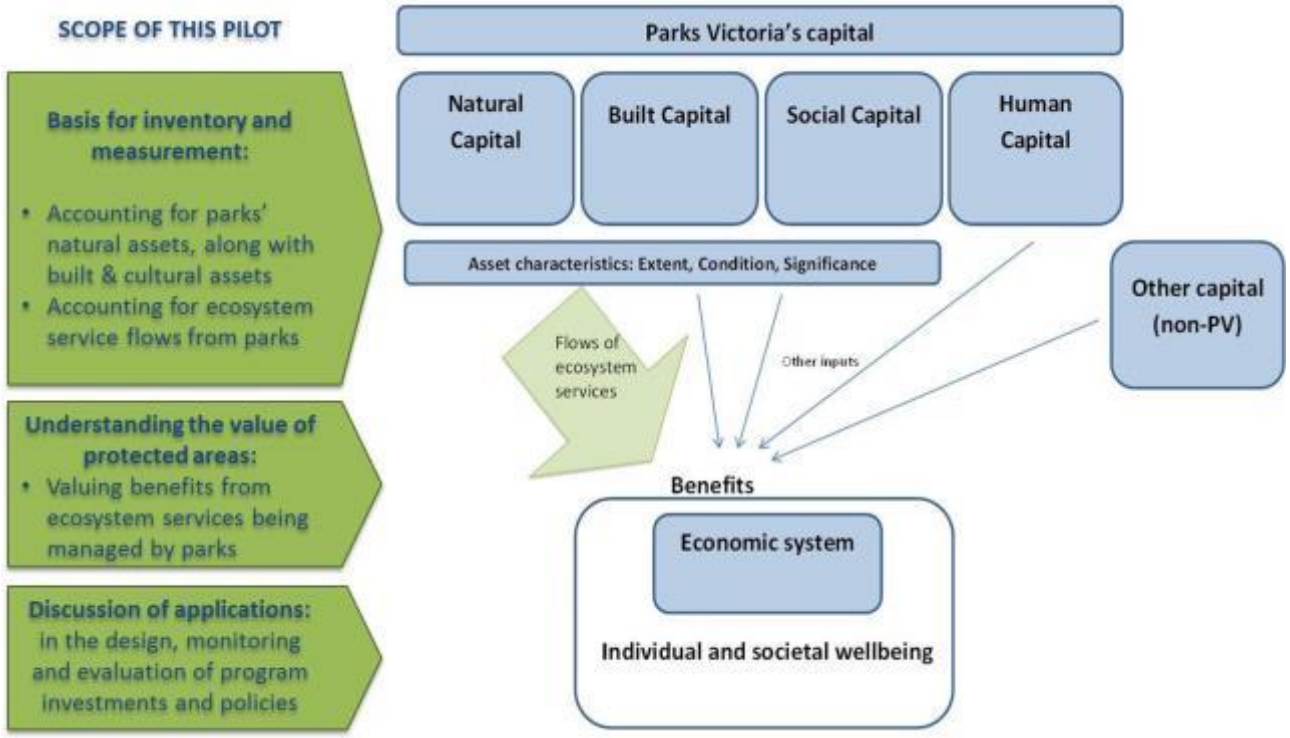

Source: Parks Victoria and DELPW

[31] The Conservation Measures Partnership 2013. Open Standards for the Practice of Conservation, Version 3.0. April 2013. Available in http://cmp-openstandards.org/wp-content/uploads/2014/03/CMP-OS-V3-0-Final.pdf

## 3.2 Use of ecosystem accounting and valuation for park management

In developing accounts and valuing the ecosystem services generated by parks, it is important to note that ecosystem services are combined with inputs from other forms of capital, as well as capital inputs outside Parks Victoria, to provide a range of benefits to the community. Some of these benefits will be included in the economic system, whereas other benefits will not. Figure 3.2 shows the scope of information gathered for this pilot and the different instances in which accounting for ecosystem services and valuation of their benefits can be used to inform Parks Victoria's programs and strategies to maximise the value of Victorian parks. An overview of the core components covered in this study is illustrated in the figure below and introduced in the following sections.

**Figure 3.2 Overview of ecosystem accounting and valuation uses for Victorian parks**




### 3.2.1 Accounting for parks' natural assets

The starting point to improve information for park management is an inventory of the natural, cultural and built assets managed by Parks Victoria. For natural assets, the purpose is to understand what types of ecosystems are supported by the parks network (e.g. land, rivers, wetlands, marine areas) and their main attributes (e.g. extent, condition, biodiversity significance). This information is organised into ecosystem asset accounts, which is the first part of our proposed accounting framework, described in further detail in Section 4.

### 3.2.2 Accounting for ecosystem services provided by Victoria's parks

Park management could improve its efficiency by better understanding the ecosystem services parks provide to Victorians and developing more targeted interventions. The proposed accounting framework provides a consistent approach to identify and quantify biophysical measures of a range of ecosystem

services provided by Victoria's parks. This information is to be reported into ecosystem service accounts, which focus on the contribution of ecosystems providing benefits to humans[32].

Table 3.1 presents a summary of ecosystem services considered for this pilot. Each ecosystem service is described conceptually in terms of the type of benefit it provides and its direct beneficiaries. Note that in ecosystem accounting, beneficiaries are the direct users of the ecosystem service, e.g. producers who extract a resource to produce goods and services.

Ecosystem service accounts could be used to summarise ecosystem services provided in terms of:

- the physical quantity of ecosystem service flows;
- the value of commercial or market transactions in monetary terms (for provisioning services mainly, as these are captured under SNA sectors);
- the value of non-monetary transactions (for services that can be linked to economic activities but where market prices are not observable, e.g. education or health public infrastructure); and,
- the equivalent exchange value of non-market services (for ecosystem services outside the SNA and where exchange values can be derived from non-market valuation, as discussed in Section 5).

In the case of Victoria's parks, ecosystem assets are dedicated for conservation and/or recreational use and most provisioning services (extraction of resources for commercial use) are typically not part of parks' primary goals. Therefore, the focus of this project is on the quantity of ecosystem services, which is to be reported and monitored through the ecosystem service accounts. However, in the case of tourism it was possible to estimate the number of visitors attributable to parks and their expenditure, which then enables calculating the economic contribution of parks' tourism.

In general, services which can be linked to economic activity through the supply or use of resources in the value chain or which involve expenditure through market transactions can be recorded in accounts, as they align with current SNA structure. Note that an economic contribution in this sense is not a measure of benefits, because it does not indicate whether this is the best way of spending resources as compared to an alternative.

Although in principle it is possible to derive accounts using exchange values in monetary terms for non-market services not covered under the SNA (as discussed in Section 5), this was not pursued in this first stage of the project. The reasons for this is that deriving such exchange values relies on specific valuation techniques being used[33], it requires good demand data for ecosystem services which is often a challenge, and its main purpose would be to expand the structure of current national accounts, which is not the objective of this pilot.

The methodology used to quantify annual service flows is described in Section 4, with further details about data sources, analysis or modelling used for each ecosystem service provided at Appendix 2.

[32] Intermediary regulating services may provide benefits to other ecosystems directly and to humans indirectly only

[33] Building ecosystem accounts based on constructed exchange values for non-market services is an area under current development. SEEA-EEA indicates that it is conceptually feasible to obtain exchange values from valuation techniques such as the travel cost or the replacement cost methods, in which a demand curve for the ecosystem service can be derived.

**Table 3.1 Typology of ecosystem services observed in Victorian parks**

| Ecosystem service | Benefits to society and economy | Direct beneficiaries | End users and final beneficiaries |
|---|---|---|---|
| **Provisioning goods** | | | |
| Water supply[1] | Water for drinking; water for food production, energy production | Urban water consumers, food producers, energy consumers | Water, food and energy consumers |
| Honey supply[2] | Honey products | Producers of honey products | Honey consumers and businesses |
| **Regulating services** | | | |
| Water purification | Protects human health; purifies water for water, energy and food sectors | Water, energy and food producers | Water, energy and food consumers and businesses |
| Flood protection | Protects assets and infrastructure | Local councils, Victorian government | Victorian communities and businesses |
| Coastal asset protection | Protects coastal infrastructure and homes | Local council, Victorian government | Victorian communities and businesses |
| Carbon storage and sequestration | Protects human health; protects assets and infrastructure | Farmers and land managers | Global community |
| Local climate regulation - urban cooling | Protects human health; reduces demand for energy | Urban communities | Victorian communities |
| Air quality | Protects human health | Urban communities | Victorian communities |
| Soil quality and stability | Agricultural productivity | Agricultural producers | Consumers of agricultural products and businesses |
| Pollination & seed dispersal | Native and introduced pollinators assisting agricultural productivity | Agricultural producers | Consumers of agricultural products and businesses |
| Pest and disease control | Agricultural productivity | Agricultural producers | Consumers of agricultural products and businesses |
| Habitats for species (intermediate service only) | Indirect benefit through other final services | Ecosystems and native species | |
| Maintenance of genetic diversity | Indirect benefit to human health | Medical industry | Victorian communities and businesses |
| Maintenance of nursery populations | Agricultural productivity | Agricultural producers | Consumers of agricultural products and businesses |
| **Cultural services** | | | |
| Recreation opportunities | Enjoyment, physical and mental health | Park visitors (locals and tourists) | Victorian and global communities |
| | Tourism | Tourists | Victorian and regional communities and businesses |
| Scientific research and education opportunities | Education, human health, economic productivity | Researchers,, students, general public | Victorian and global communities and businesses |
| Landscape and neighbourhood amenity | Enjoyment, mental health | Residents surrounding parks | Victorian communities |
| Opportunities for cultural connection | Spiritual health, economic productivity from Aboriginal connection to land | Traditional Owners | Indigenous communities, Victorian and Australian community |
| | Community wellbeing from connection to historic heritage | Population valuing historic heritage | Victorian and Australian community |
| Social cohesion and sense of place | Economic productivity, wellbeing, mental health | Communities connected through sense of place from natural parks | Victorian and Australian community |
| Preservation of species and ecosystems | Satisfaction of knowing a species or ecosystem exists, ecological resilience | Population valuing the preservation of ecosystems for future generations | Victorian and Australian community |

[1] Ecosystems in parks collect filtered water to transport and release water, which is then transferred via built infrastructure (e.g. pipes, channels) to downstream users mainly for drinking and agriculture. There is debate around the attribution of water provisioning and filtering to park land use. This issue is considered further in Section 5. Hydroelectric power stations in parks benefit from clean filtered water**,** which improves the durability of turbines and efficiency of power generation, however renewable generation based on abiotic resources is not an ecosystem service under the CICES classification.

[2] The parks network contains many apiary sites used to produce honey. There is debate around the attribution of honey supply to parks, but this discussed in Section 5 (i.e. whether honey production could be equally provided by other land uses).

As the Victorian parks network is diverse and includes a range of different types of parks with different primary purposes, the relative significance of ecosystem services will vary both across park types as across different ecosystems. Tables 3.2 outlines the relative significance of each of the ecosystem services by park type.

Overall, terrestrial national and State parks contribute to a large extent to all ecosystem services, with marine parks contributing significantly to carbon storage and biodiversity services. Conservation reserves are also important contributors of biodiversity related services (e.g. genetic diversity, habitat for species, maintenance of nursery populations). Metropolitan parks contribute importantly to recreation and neighbourhood amenity but also provide significant water filtration services. Recreational management of bays and waterways contributes primarily to recreation, tourism, amenity and social cohesion.

### 3.2.3 Valuing benefits from parks ecosystem services

In addition to reporting and monitoring the physical quantities of parks' ecosystem service flows, it is important to assess their benefits, which to a large extent are not reflected in current markets or economic transactions.

Valuation frameworks provide economic measures to estimate the value of benefits from ecosystem services provided by parks (the methodology is discussed in detail in Section 5). Valuation is relevant to park management, as it can inform the types of intervention and the resource allocation both across park management and other government services, as well as within park management across diverse park areas, which support different types of ecosystem services.

The assessment of each ecosystem service follows a systematic approach including: identifying the relevant benefits and beneficiaries for each ecosystem service, understanding the background context and links to other services, calculating the quantity of services provided, selecting appropriate valuation methods and a valuation of benefits. This approach is applied systematically to each of the ecosystem services relevant to Victoria's parks, covered in Appendix 2.

It is important to note that the assessment of both the quantity and value of ecosystem services generated by parks in this report is not definitive and is based on gathering available data in a relatively short time period. A prioritised program of further assessments is discussed in Section 6, which will seek to improve the quality of the assessments over time. Nevertheless, as the first assessment of the Victorian parks network, the report provides both an accounting framework in which to populate new information and an indicative estimate of the value of key ecosystem services attributable to parks.

**Table 3.2 Relative importance of ecosystem services by park type**

| | Protected Areas | | | Other parks | | |
|---|---|---|---|---|---|---|
| **Ecosystem services in Parks** | **Terrestrial national and State parks** | **Marine parks** | **Conservation reserves** | **Metropolitan parks** | **Gardens/ cultural places** | **Bays and waterways[2]** |
| **Provisioning Services** | | | | | | |
| Water supply[1] | *** | n/a | * | n/a | n/a | n/a |
| Honey products | *** | n/a | ** | * | n/a | n/a |
| **Regulating services** | | | | | | |
| Water purification/filtration | *** | n/a | ** | ** | n/a | n/a |
| Flood protection | *** | n/a | * | *** | * | * |
| Climate regulation - Carbon storage and sequestration | *** | *** | ** | * | * | * |
| Local climate regulation- urban cooling | ** | * | * | *** | n/a | * |
| Coastal asset protection | *** | *** | ** | *** | n/a | * |
| Air quality regulation | ** | n/a | ** | *** | * | n/a |
| Pollination & seed dispersal | *** | * | * | ** | ** | n/a |
| Soil quality and stability | *** | * | ** | ** | * | * |
| Pest and disease control | *** | ** | ** | ** | ** | n/a |
| Genetic diversity/gene pool protection | *** | *** | *** | ** | ** | n/a |
| Habitat for species | *** | *** | *** | ** | * | * |
| Maintenance of nursery populations | *** | *** | *** | ** | * | * |
| **Cultural services** | | | | | | |
| Recreation opportunities | *** | ** | * | *** | ** | *** |
| Tourism | *** | ** | * | * | ** | *** |
| Physical and mental health benefits | *** | ** | * | *** | ** | ** |
| Landscape and neighbourhood amenity | ** | ** | * | *** | ** | *** |
| Opportunities for cultural connection | *** | ** | ** | ** | *** | ** |
| Scientific research and education opportunities | *** | *** | ** | ** | *** | * |
| Social cohesion and sense of place | *** | ** | * | *** | *** | *** |

Source: Parks Victoria (qualitative assessment in a 3-point scale: * represents relatively low importance and *** represent high importance for a park type relative to other parks)

[1] Water use for hydroelectric generation occurs in the Alpine National Park, however note that renewable energy generation from abiotic resources is not an ecosystem service.

[2] Note that the while marine ecosystems in the bays may generate provisioning, regulating and cultural ecosystem services, Parks Victoria primarily is responsible for management of extensive built assets for local port services and recreational uses of the bays. While management of these assets greatly facilitates the commercial fishing industry and other recreational activities in regional economies, Parks Victoria does not directly manage the marine ecosystems and therefore its management cannot be attributed directly to the provisioning services of fisheries production or regulating services such as carbon sequestration. However these ecosystem services can be attributed to other parts of Government.

# 4. Ecosystem asset and service flow accounts

Establishing core asset accounts for ecosystem, cultural and built assets managed by Parks Victoria is the starting point to assess the current scope and status of park assets and understand their potential to sustain underlying processes in the provision of services to the society and economy.

## 4.1 Methodology to construct pilot ecosystem accounts

Pilot ecosystem accounts provide a systematic approach to accounting for changes in the quantity and quality of ecosystem assets and resulting flows of ecosystem services, which provide benefits to the community. The development of pilot ecosystem accounts was undertaken in the following steps (outlined in Figure 4.1 below):

**STEP 1 Define ecosystem assets** – the starting point is to define key ecosystem assets which are spatially aligned with Ecosystem Accounting Units (EAU). In this pilot EAUs are individual park areas. Note that the focus of analysis is on the biophysical environment in which their components operate as a functional unit, implying a systems perspective is used. For the purpose of this project, we have taken into account built and cultural/historical assets, which are not provided by the ecosystem, but provide a more holistic overview of parks' amenities.

**STEP 2 Assess the condition of ecosystem assets** – the next stage requires compiling and analysing relevant spatial and other data for each ecosystem asset, understanding key attributes to measure and assessing their condition (the condition is typically evaluated in comparison to a reference year or baseline). A clearly defined typology and hierarchy of ecosystem assets in which condition scores can be aggregated and compared is required.

**STEP 3 Identify measures and quantify ecosystem service flows** – in this stage the ecosystem service flows provided by a given ecosystem asset, along with their beneficiaries, are identified and classified as part of four main service types:

- Provisioning services (e.g. food, water)
- Regulating services (e.g. climate regulation, water purification, pollination)
- Cultural services (e.g. recreation, cultural heritage)
- Supporting services (e.g. soil formation, nutrient cycling).

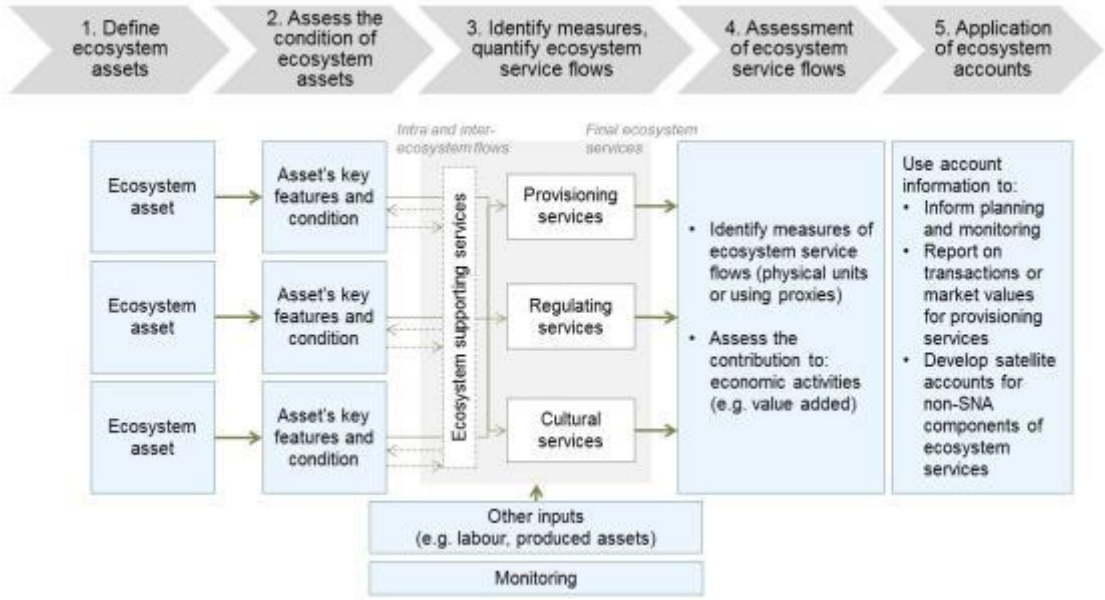
The first three are final services, while supporting services are considered intermediary ecosystem processes, providing services within and across ecosystem assets.

**STEP 4 Assessment of ecosystem services flows** – this stage involves assessing ecosystem services in physical quantities or units at agreed reporting intervals. This is done through a range of available tools including models. Only final service flows are quantified, as only these can be linked directly to production/consumption activities and human wellbeing. The contribution to economic activity in monetary units can also be quantified for relevant ecosystem services, if appropriate.

**STEP 5 Application of ecosystem accounts** – the final step seeks to present the accounting data in a way that is consistent with the SEEA framework and is useful to inform key stakeholders managing the parks and associated resources. This includes identifying SNA and non-SNA components, breakdowns for

suppliers and users of ecosystem services (e.g. by type of park, organisations active in parks areas) and summarising transactions associated with the provision of some services.

**Figure 4.1 Overview of approach to generate pilot ecosystem accounts**




## 4.2 Ecosystem Accounting Units

Ecosystem Accounting Units for Parks Victoria have been defined using the current geographical boundaries for each park. For land cover these can be further subdivided into Ecological Vegetation Divisions or EVDs. This selection enables the aggregation and reporting of the ecosystem assets on a park by park basis over time. With Parks Victoria managing nearly 3,000 parks and reserves, these can be aggregated at a parks network scale by IUCN protected areas category, which is a common internationally recognised classification system.

For the purpose of this report, the account tables present the main characteristics of park assets for the whole of the parks network only. Over time accounts will be developed at multiple scales from park, to bioregion to parks network. Note that in these examples geographical information is not presented for the built and cultural assets data.

## 4.3 Ecosystem asset accounts

### 4.3.1 Environmental metrics used

Ecosystem assets are generally characterised at a given point in time using two key metrics, namely extent and condition. Extent refers broadly to the area within each EAU in terms of Basic Spatial Units (e.g. hectares of land), while condition describes the quality of ecosystem assets and is typically assessed through an aggregated condition score measuring the current ecosystem composition, processes and functioning relative to a baseline year.

The DEWLP statewide approach to native vegetation condition scores provides a representation of how far an environmental asset is from being from a reference condition, based on a pre-1750 benchmark. The native vegetation condition is modelled, based on available data. An alternative approach to condition is the extent to which goals for ecological integrity are being met, based on agreed criteria for

the key attributes of the ecosystem. This recognises that reference condition may change over time.[34] While common ecosystem metrics include native vegetation extent and quality, accounts could also include the number of recorded species by faunal (e.g. mammals, reptiles, fish) or floral (flowering vs non flowering plant) group. While this information is available for the extent (number of recorded species) of biodiversity assets, there are limited common standards for quality. "Conservation status" or degree of representation is often used as a proxy measure at a State, bioregional or national scale.

The assessment of the extent and condition of ecosystem assets can be undertaken with different levels of granularity to provide different information about the status of parks. For ecosystem asset accounting purposes, the following three options were identified as relevant to the parks network:

- Overall condition scores for different assets by park type, as outlined in Table 4.1; while this provides a consistent index across all ecosystems and land tenures it is coarse in scale.
- Specific attributes, such as biodiversity or species significance by land cover type and comparing the condition of each EVD within and outside the parks network, as shown in Tables 4.2 and 4.3;
- Providing an overview of ecosystems of high significance, e.g. Ramsar wetlands, as part of meeting goals for conservation obligations for the parks network, as shown in Tables 4.4 and 4.5.

### 4.3.2 Overview of parks ecosystem assets and their condition

The stocks and composite condition scores across ecosystem assets under the IUCN Protected Area classification for protected and other non-protected areas is summarised in Table 4.1 below.

Parks Victoria manages terrestrial parks with over 3.7 million hectares of protected areas and almost 206,000 hectares of non-protected areas, totalling around 3.9 million hectares, which is 38% of all native vegetation areas in the State.

In addition, Victoria's parks support over 201,000 hectares of wetlands in protected areas along with further 73,000 hectares in non-protected areas, which altogether account for 42% of all wetland areas in Victoria. The area of marine national parks and sanctuaries managed by Parks Victoria is over 53,000 hectares. The area within parks where rivers run through is 47,905 hectares.

The largest stocks of native vegetation from the parks network are found in national, State and wilderness parks. Based on modelled vegetation quality, the average condition score for these parks is good (79), compared to the whole of the parks network that has a condition score of 65.

Wetland ecosystems are evenly distributed across national and State parks, wildlife reserves and non-protected conservation reserves. Although wetland condition is on average good, there is a small drop in the average quality of wetlands observed in non-protected areas.

Note that the condition scores of rivers below represent direct observations taken in relevant parks, but can be largely influenced by social and economic activities and the condition of other ecosystems located outside of the parks network (particularly in downstream flows). The numbers reported below are indicative of the condition of rivers in the parks area, but cannot be fully attributed to the parks' ecosystems[35].

[34] See Parks Canada Ecological Integrity program, http://www.pc.gc.ca/eng/progs/np-pn/ie-ei.aspx

[35] A detailed analysis of river condition scores in parks will require additional modelling and data including flow direction.

**Table 4.1 Stocks and condition of ecosystem assets in parks network – extent and condition by IUCN category**

| Ecosystem assets | Native vegetation | | Wetlands | | Rivers | | Marine | |
|---|---|---|---|---|---|---|---|---|
| | 2010 | | 2014 | 2011 | 2011 | | 2014 | |
| | Extent | Condition | Extent | Condition | Extent | Condition | Extent | Condition |
| Assets measures | Hectare | Native Vegetation score[1] | Hectare | Index of wetland condition[2] | Hectares with river | Index of stream condition[3] | Hectare | Marine Habitat condition[4] |
| **Protected Areas (IUCN PA Categories)** | | | | | | | | |
| IA Nature Conservation Reserves | 254,255 | 71 | 16,009 | 7 | 2,911 | 29 | - | - |
| IB Wilderness Parks | 200,094 | 82 | 22 | 1 | 1,000 | 41 | - | - |
| II National and State Parks | 3,061,274 | 79 | 68,681 | 7 | 31,874 | 32 | 52,809 | VG |
| III Natural Features Reserves | 63,097 | 62 | 1,788 | 7 | 4,026 | 28 | 231 | F |
| IV Bushland Reserves | 41,287 | 61 | 1,821 | 6 | 512 | 27 | - | - |
| V Protected landscape | | 62 | | - | | | - | - |
| VI Wildlife Reserves | 111,078 | 63 | 112,867 | 6 | 1,926 | 25 | - | - |
| **Non-protected areas** | | | | | | | | |
| Conservation reserve | 113,140 | 62 | 61,854 | 6 | 2,600 | 29 | - | - |
| Port and coastal asset | 1 | 7 | 194 | 10 | | | - | - |
| Urban, regional and other parks | 92,784 | 63 | 11,598 | 7 | 3,056 | 25 | - | - |
| **Parks total** | **3,937,010** | **65** | **274,834** | **7** | **47,905** | **29** | **53,040** | **-** |
| **Parks share of total assets in Victoria (%)** | **38%** | | **42%** | | **16%** | | | |

[1] The Native Vegetation Condition score is a normalised value in a 100-point scale to assess the quality of native vegetation, based on DEPI's modelled condition.
[2] The index of wetland condition is a hierarchical index on a 10-point score scale based on six key characteristics that define wetlands, namely wetland catchment, physical form, hydrology, soils, water properties and biota (DSE, 2005). Large wetland areas in parks are unassessed in the most recent dataset.
[3] The index of stream condition is based on a 50-point score scale and is made up of five sub-indices describing the condition of a river reach, namely hydrology, streamside zone, physical form, water quality and aquatic life (DEPI 2012).
[4] Marine condition based on Parks Victoria's marine monitoring program and marine report cards which assesses condition of key habitats across multiple parks, as follows: VG = Very Good, F = Fair

### Native Vegetation

A detailed breakdown of the extent, condition and significance (representation) of each native vegetation type found in the parks networks (based on Ecological Vegetation Division (EVD)) is provided in Table 4.2. The parks network contains the largest representation of Alpine Treeless (75%) and Hummock-grass Mallee (86%) in Victoria. Other native vegetation well represented in Victoria's parks include Broombush Whipstick, Coastal, Granitic Hillslopes, High Altitude Wetland, Lowan Mallee, Rocky Knoll, Saline Wetland and Saltbush Mallee. The average condition of native vegetation established within park areas is significantly higher (65) than that of vegetation found outside of park areas (45). The average condition within parks is higher than outside parks in all native vegetation types.

**Table 4.2 Characteristics of ecosystem assets – ecosystem level diversity/biodiversity significance of native vegetation in parks network (% of each Victorian EVD in parks)**

| Native veg classification | Extent (Ha) | Average condition score within parks | Average condition score outside parks | Proportion of area within parks (%) |
|---|---|---|---|---|
| Alluvial Plains Grassland | 9,398 | 64 | 47 | 33% |
| Alpine Treeless | 13,037 | 79 | 53 | 75% |
| Basalt Grassland | 4,760 | 60 | 43 | 4% |
| Broombush Whipstick | 134,296 | 67 | 44 | 62% |
| Chenopod Shrubland | 14,377 | 69 | 44 | 34% |
| Closed-forest | 18,068 | 78 | 54 | 49% |
| Coastal | 40,764 | 60 | 45 | 73% |
| Damp Scrub | 29,535 | 63 | 45 | 33% |
| Dry Woodland (non- | 104,677 | 63 | 43 | 54% |
| Foothills Forest | 64,993 | 66 | 45 | 19% |
| Forby Forest | 270,393 | 66 | 44 | 21% |
| Freshwater Wetland | 24,398 | 64 | 45 | 39% |
| Freshwater Wetland | 57,669 | 64 | 44 | 37% |
| Granitic Hillslopes | 29,148 | 69 | 45 | 61% |
| Grassy/Heathy Dry Forest | 522,093 | 72 | 47 | 32% |
| Heathland (sands) | 357,740 | 70 | 46 | 58% |
| High Altitude Shrubland / | 265,088 | 79 | 47 | 48% |
| High Altitude Wetland | 2,852 | 77 | 46 | 70% |
| Hummock-grass Mallee | 520,011 | 63 | 43 | 86% |
| Inland Plains Woodland | 28,449 | 59 | 43 | 5% |
| Ironbark / Box | 78,697 | 68 | 46 | 25% |
| Lowan Mallee | 304,866 | 68 | 46 | 69% |
| Moist Forest | 220,324 | 73 | 48 | 27% |
| Riparian (higher rainfall) | 24,077 | 70 | 45 | 24% |
| Riverine Woodland / Forest | 95,983 | 60 | 42 | 41% |
| Rocky Knoll | 53,400 | 76 | 53 | 66% |
| Saline Wetland | 98,501 | 58 | 44 | 60% |
| Saltbush Mallee | 160,719 | 62 | 44 | 67% |
| Tall Mist Forest | 155,245 | 72 | 52 | 35% |
| Tall Mixed Forest (Eastern) | 143,061 | 72 | 47 | 27% |
| Treed Swampy Wetland | 44,023 | 62 | 44 | 28% |
| Western Plains Woodland | 13,528 | 63 | 43 | 20% |
| **Grand total** | | **65** | **45** | **38%** |

## Wetlands

The following wetland account table describes the change in extent across Victoria's wetlands over time. Parks Victoria currently manages about 42% of wetland areas, consisting mostly of 160,000 hectares of permanent and semi-permanent saline wetlands, along with 114,000 hectares of other wetland types.

**Table 4.3 Assets accounts for each wetland type found in Victoria's parks**

| | Pre-European wetland area in Victoria (ha) | Current statewide wetland area (ha) | Area in the parks network (ha) | Proportion of wetlands in the parks network |
|---|---|---|---|---|
| **Year** | **1750** | **2010** | **2010** | **2010** |
| Deep freshwater marsh | 176,601 | 54,861 | 26,548 | 48% |
| Freshwater meadow | 181,246 | 132,455 | 38,753 | 29% |
| Permanent open freshwater | 70,658 | 177,139 | 33,277 | 19% |
| Permanent saline | 155,608 | 154,192 | 116,863 | 76% |
| Salt works | 0 | 2,012 | 580 | 29% |
| Semi-permanent saline | 67,404 | 70,276 | 42,755 | 61% |
| Sewerage pond | 0 | 3,979 | 89 | 2% |
| Shallow freshwater marsh | 127,031 | 54,605 | 14,823 | 27% |
| **Total** | **778,548** | **649,519** | **273,688** | **42%** |

Source: Parks Victoria. The slight variation in the total wetlands area, as compared to Table 4.1, is due to differences in the parks data scale and boundaries.

Additional information to be outlined in the parks ecosystem accounts includes the extent of highly significant ecosystem assets, as defined by international standards. For instance, the parks network currently sustains almost 60% of all Ramsar wetland areas found in Victoria. The most significant regions in terms of their wetland extent within the parks network include the Barmah and Gunbower Forests, Gippsland Lakes, Corner inlet and Western District Lakes.

**Table 4.4 Characteristics of ecosystem assets – significance of wetlands in parks network (area and % of area of Ramsar listed wetlands in parks)**

| | Total area of Ramsar wetlands in parks network (hectares) | Total area of Ramsar wetlands in Victoria (hectares) | *Proportion of current statewide area in parks network (%)* |
|---|---|---|---|
| Barmah Forest | 29,236 | 29,317 | 100% |
| Corner Inlet | 59,218 | 67,242 | 88% |
| Edithvale-Seaford Wetlands | 0 | 257 | 0% |
| Gippsland Lakes | 24,448 | 61,126 | 40% |
| Gunbower Forest | 10,343 | 20,246 | 51% |
| Hattah-Kulkyne Lakes | 979 | 979 | 100% |
| Kerang Wetlands | 5,745 | 9,799 | 59% |
| Lake Albacutya | 5,664 | 5,665 | 100% |
| Port Phillip Bay (Western Shoreline) | 7,839 | 22,637 | 35% |
| Western District Lakes | 32,626 | 32,673 | 100% |
| Western Port | 7,326 | 59,962 | 12% |
| **Grand Total** | **183,424** | **309,903** | **59%** |

In terms of marine habitats, parks provide large areas of ecosystems in soft sediments, followed by sub-tidal reefs and seagrass, which are particularly important to nursery habitats.

**Table 4.5 Extent of marine habitats in Victoria's marine parks**

| Marine habitat | Total area (hectares) |
|---|---|
| Intertidal reef | 219[1] |
| Sub-tidal reef | 21,812 |
| Soft sediment | 70,125 |
| Mangrove | 3,435 |
| Saltmarsh | 3,775 |
| Seagrass | 20,164 |

Except for intertidal reefs, hectares are measured across marine protected areas and coastal parks. Intertidal reefs that fall within terrestrial (coastal) parks has not been accurately estimated, but is significantly larger. Source: Parks Victoria.

### Habitat for Species

An indicator of ecosystem asset significance is the number of rare or threatened species that are supported by park ecosystems, and the quality of that habitat. Table 4.6 shows that the parks network provides the most suitable habitat in the State for many rare and vulnerable species. Based on an assessment of around 638 of the nearly 3,000 parks and reserves in the parks network, parks provide around 770 of these species with at least 60% of habitat suitability in the State. Victoria's parks offer most suitable habitats in the State (with at least 50% suitability) to a total 888 rare and threatened species.

**Table 4.6 Characteristics of ecosystem assets – species significance (number of species for which parks provide important habitat) in national parks and nature conservation reserves**

| Habitat importance in selected parks[1] | Threatened species type [2] | | | | | |
|---|---|---|---|---|---|---|
| | Critically endangered | Endangered | Rare | Vulnerable | Not specified | Total |
| 80%-100% of best habitat | 17 | 75 | 241 | 181 | 2 | 516 |
| 60%-80% of best habitat | 4 | 34 | 158 | 59 | 2 | 257 |
| 40%-60% of best habitat | 7 | 39 | 149 | 72 | 1 | 268 |
| 20%-40% of best habitat | 7 | 58 | 152 | 96 | 1 | 314 |
| 0%-20% of best habitat | 12 | 51 | 92 | 70 | 1 | 226 |
| **Total** | **47** | **257** | **792** | **478** | **7** | **1,581** |

Notes: [1] 638 parks representing National Parks Act parks and larger nature conservation reserves were selected for assessment. [2] The number of species for which parks provide important habitat was derived through a combination of condition and species distribution importance modelling from DEPIs' NaturePrint.

## 4.4 Built asset accounts

Parks Victoria currently manages over 28,000 built assets, including 44 visitor centre buildings, 703 shelters, 515 viewing lookouts and several other visitor amenities such as playgrounds, sporting facilities and bathrooms. In addition, Parks Victoria is responsible for maintaining core infrastructure to connect Victorian parks, comprising 14,000 km of roads, 3,700 km of walking tracks, 1,213 pedestrian and vehicular bridges and 217 piers and jetties.

The number of built assets managed by Parks Victoria increased from 25,000 to 28,000 over 2010 to 2013, mainly as result of the fire recovery program in a number of parks and included visitor facilities as well as road infrastructure, such as culverts. Thus, the condition profile of the asset inventory

improved due to new assets being established as part of the fire recovery program. The following built asset accounts from 2010 shows Victorian parks' capacity to sustain visitor experiences through its built asset network, as built assets provide input to the provision of cultural services and benefits. The value of these assets is not listed below, but could be included in a separate standard account.

**Table 4.7 Built assets in parks network**

| Asset category | Number of built assets | Condition | | | | |
|---|---|---|---|---|---|---|
| | | Excellent | Good | Average | Poor | Very poor |
| Access | 13,153 | 8.2% | 30.2% | 47.7% | 10.0% | 3.9% |
| Buildings & Services | 1,411 | 7.0% | 29.7% | 40.3% | 15.9% | 7.1% |
| Cultural Heritage Assets | 1,467 | 2.7% | 20.7% | 63.2% | 9.5% | 4.0% |
| Infrastructure Services | 2,296 | 8.3% | 46.1% | 34.8% | 5.9% | 4.9% |
| Landscaped Assets | 281 | 11.4% | 33.8% | 44.5% | 8.5% | 1.8% |
| Maritime & Waterways | 1,427 | 12.9% | 27.3% | 26.8% | 20.1% | 12.9% |
| Visitor Facilities | 4,540 | 11.3% | 37.5% | 36.0% | 9.1% | 6.1% |
| **Total** | **24,575** | | | | | |

The built assets include three local ports which make a contribution to the Victorian economy of $300 million Gross Value Added per annum. While this contribution is not ecologically connected to marine ecosystem assets managed by Parks Victoria, it is important to acknowledge the natural features of these ports and associated infrastructure provide space for significant economic activity on coastal land. For instance, Parks Victoria visitation data indicate these local ports and bays receive 45 million visits every year. Ports management and maintenance issues like dredging could have an ecological connection, however there is insufficient data to assess these impacts at this stage. Appendix 3 outlines the economic contribution of the three local ports managed by Parks Victoria.

## 4.5 Cultural assets accounts

Cultural assets include both the tangible/physical cultural assets of Aboriginal culture as well as the physical assets of historic heritage. Further work is required to develop a standard set of metrics to assess the condition of Aboriginal cultural places.

These tables provide a summary of the stock of cultural assets in the parks, which along with the ecosystem and built assets provide a range of cultural services to park visitors (e.g. recreational activities, cultural/spiritual connection and social and community cohesion).

**Table 4.8 Aboriginal cultural places in the Victorian parks network**

| Place component | Total number of sites | Proportion of sites within the parks network |
|---|---|---|
| Historical Place | 16 | 0.1% |
| Non Archaeological Place (intangible) | 9 | 0.1% |
| Artefact Scatter | 4,794 | 40.5% |
| Earth Feature | 1,089 | 9.2% |
| Human Remains | 176 | 1.5% |
| Object Collection | 33 | 0.3% |
| Quarry | 93 | 0.8% |
| Rock Art | 131 | 1.1% |
| Scarred Tree | 3,406 | 28.8% |
| Shell Midden | 1,929 | 16.3% |
| Stone Feature | 154 | 1.3% |
| **Total** | **11,830** | |

Source: Aboriginal Affairs Victoria

**Table 4.9 Historical places in the Victorian parks network**

| Asset category | Number of built assets | Condition | | | | |
|---|---|---|---|---|---|---|
| | | Excellent | Good | Average | Poor | Very poor |
| Cemeteries & burial sites | 34 | 0% | 9% | 47% | 9% | 6% |
| Commercial | 27 | 0% | 0% | 78% | 0% | 3% |
| Defence | 33 | 0% | 6% | 36% | 15% | 27% |
| Exploration | 45 | 31% | 5% | 31% | 4% | 0% |
| Government buildings | 92 | 2% | 2% | 45% | 14% | 0% |
| Halls & libraries | 15 | 0% | 6% | 66% | 0% | 0% |
| Huts, houses, homesteads, settlement sites & farms | 464 | 1% | 18% | 46% | 11% | 9% |
| Industrial | 1156 | 0.3% | 16% | 47% | 7% | 2% |
| Memorials | 61 | 8% | 21% | 38% | 10% | 3% |
| Miscellaneous | 56 | 9% | 27% | 26% | 8% | 5% |
| Public utilities | 115 | 3% | 31% | 30% | 4% | 4% |
| Recreation & Gardens | 213 | 6% | 22% | 31% | 9% | 9% |
| Religious | 5 | 0% | 0% | 80% | 20% | 0% |
| Shipping & coastal | 164 | 2% | 12% | 47% | 13% | 7% |
| Transport & communication | 85 | 1% | 8.2% | 39% | 5% | 8% |
| Using natural resources | 58 | 3% | 15% | 48% | 0% | 3% |
| **Total** | **2,631** | | | | | |

The following table provides a representation of the significance of historical places found in the parks network, indicating the type of 145 heritage sites that have been listed thus far on the State heritage register.

**Table 4.10 Extent of listed historical places in the Victorian parks network by historic theme**

| Historic theme | Number of historic places |
|---|---|
| Accessing & Appreciating Natural Wonders | 3 |
| Australian Manufacturing | 3 |
| Defending coastal Victoria | 3 |
| Dying | 5 |
| Governing & Administering Victoria | 2 |
| Living in Remote Areas | 1 |
| Living in Rural Areas | 1 |
| Moving Goods & People | 3 |
| Primary production | 3 |
| Settlement of Port Phillip | 5 |
| Shipping along the coast | 16 |
| Using resources - Energy | 1 |
| Using Resources - Forestry | 6 |
| Using Resources - Mining | 81 |
| Other | 12 |
| **Total** | **145** |

## 4.6 Ecosystem service flow account

Ecosystem service accounts report on physical flows of ecosystem services provided to the beneficiaries, as discussed in Section 3. Each of the ecosystem service flows were assessed using a systematic approach, involving the analysis of Parks Victoria data or the application of a wide range of analytical tools (e.g. modelling, spatial analysis, top-down analysis).

The following account table provides the total magnitude of the annual flows of ecosystem services assessed as part of this project for the whole of the parks network. These quantities were calculated considering the most relevant group of beneficiaries for which data was available (e.g. in the case of water services the analysis considered both household and irrigation use). The level of confidence in the estimates obtained from each assessment is provided at the right hand side, with services in red requiring more or better data to support the analysis. The table also includes values if parks were not there (the counterfactual), which highlight the relative impact of not protecting ecosystems on each ecosystem service. Proxies were included where no suitable measures for service flows could be found. For example, park areas jointly managed with Traditional Owners do not represent a service, however it was the only information available to assess indigenous heritage.

Specific accounts for key services could include time series data with a breakdown of suppliers or users for tourism and water ecosystem services (e.g. by park type, bioregion or regional areas), as modelled data for these two services allows for a higher level of spatial granularity. For most other services, a more detailed classification of users (e.g. households, industries) may not be appropriate or currently feasible due to lack of data.

Following on the statewide summary of ecosystem services, Figures 4.2 to 4.3 provide maps used to visualise any spatial variation of ecosystem service flows across the parks network. These maps indicate that large carbon stocks are concentrated in parks around northeast Victoria, while park areas with the largest number of species in suitable habitats include the Mallee, Grampians and Central Highlands, Murray East and the High Country regions. Except for the Mallee, these regions also present the largest number of park visits per year, along with other smaller coastal parks.

## Table 4.11 Ecosystem service flows account – quantity of services or indicator

| Service | Quantity delivered by Victorian parks | Quantity in the counterfactual | Units | Sources | |
|---|---|---|---|---|---|
| **Provisioning services** | | | | | |
| Water supply | 3,392,000 | 4,244,000 | ML of water runoff p.a. for nine highest yielding parks | MJA (2014) | ● |
| Honey supply | 1,119 - 1,615 | 0 | Tonnes of honey supplied p.a. | DSE (2012) | ● |
| **Regulating services** | | | | | |
| Water purification: | | | | | |
| Pollution load (Nitrogen) | 31,425 | 213,559 | Kg of Nitrogen p.a.in metro waterways | MJA (2014) | ● |
| Sediment load | 4,165 | 50,960 | Tonnes of solids entering in regulated rivers p.a. for nine highest yielding parks | MJA (2014) | ● |
| Coastal protection | 285 | 285 | Km of protected shoreline near coastal communities (proxy) | PV analysis, unpublished | ● |
| Flood control/protection: | | | | | |
| Stormwater runoff in metro parks | 34,372 | 74,162 | ML of stormwater released in metro waterways p.a. | MJA (2014) | ● |
| Peak flows in selected non-metro parks | 49 - 3,159 | 54 - 3,926 | Range of 100-year ARI peak flows ($m^3/s$) across selected parks | MJA (2014) | ● |
| Carbon storage: | | | | | |
| Land ecosystem assets | 270,000,000 | Not estimated | Tonnes of carbon stored in parks | DEPI (2014) | ● |
| Marine ecosystem assets (mangroves, saltmarsh, seagrass habitats) | 850,000 | Not estimated | Tonnes of carbon stored in Marine Protected Areas in Victoria | Deakin Uni. (2014) | ● |
| Carbon sequestration (from revegetation) | 21,000 | 0 | Tonnes of carbon sequestered p.a. from programs in parks | PV data, unpublished | ● |
| Urban cooling | Not estimated | Not estimated | Temperature differential | - | |
| Air quality | Not estimated | Not estimated | Quantity of air pollution | - | |
| Soil quality | Not estimated | Not estimated | Soil health index | - | |
| Soil stability | Not estimated | Not estimated | Tonnes of soil erosion | - | |
| Pollination | 1,235 - 1,700 | 0 | Honeybee sites (proxy) | DSE (2012) | ● |
| Pest and disease control | Not estimated | Not estimated | Abundance and diversity of insectivorous birds and bats | - | |
| Habitat suitability for threatened species (measured across over 600 parks) | 888 | Not estimated | Nr of threatened species where parks 50-100% habitat suitability | DELWP analysis, unpublished | ● |
| Maintenance of genetic diversity | 4,431 flora<br>1,081 fauna<br>333 marine | Not estimated | Nr of species recorded | DELWP (Victorian Biodiversity Atlas) | ● |
| Maintenance of nursery populations | 3,848 | Not estimated | Tonnes of fish stock enhanced p.a. | DELWP & PV analysis | ● |
| **Cultural services** | | | | | |
| Recreation opportunities: | | | | | |
| Enjoyment | 33,000,000 and up to 51,000,000<br>45,000,000 | 0<br>Not estimated | Nr of visits to parks p.a.<br>Nr of visits to bays p.a. | PV data, Visitor number monitor | ● |
| Tourism | 16,900,000 | 0 | Nr of tourist nights attributable to parks p.a. | DAE (2014) | ● |
| Health | 23,091,850 | 0 | Nr of visits to parks p.a. with physical exercise as main purpose | PV & DELWP analysis, unpublished, Parks visitation monitor | ● |
| | 1,532,090 (180,000) | 0 | Nr of Victorian visitors p.a. going to parks to do physical exercise (nr of regular visitors for physical exercise) | | ● |
| Education opportunities | 183,000 | Not assessed | Nr of participants in education programs p.a. | PV annual report | ● |
| Scientific research opportunities | 215 | Not assessed | Nr of research permits p.a. | PV data, unpublished | ● |
| Amenity | 12,000 Melbourne<br>85,000 Other | 0 | Nr of residential properties immediately adjacent to parks | PV data, unpublished | ● |
| Opportunities for cultural connection | 648,513 | Not estimated | Area of joint management with Traditional Owners (proxy) | PV data, unpublished | ● |
| | 54%-69% | Not estimated | % Victorian households who value park-related historical heritage | PV data, unpublished | ● |
| Social & community cohesion | 211,000 | 0 | Nr of volunteering hours on park related projects p.a. | PV data, unpublished | ● |
| Species/ecosystem existence (non-use value to protect endangered species) | Not estimated | Not estimated | Nr of persons who value the species/ecosystem existence | - | |

Relative levels of confidence in measurement: higher ● medium ● lower ●

**Figure 4.2 Carbon storage in Victoria's parks (tonnes of Carbon stored in terrestrial assets)**

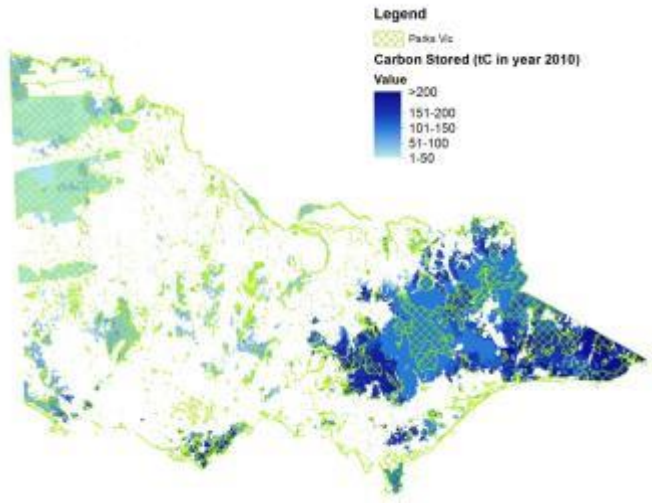



**Figure 4.3 Habitat for native species in Victoria's parks (number of species with suitable habitats)**

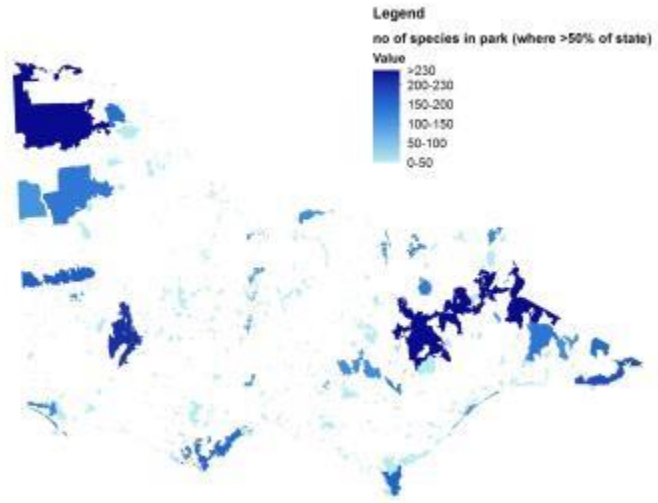
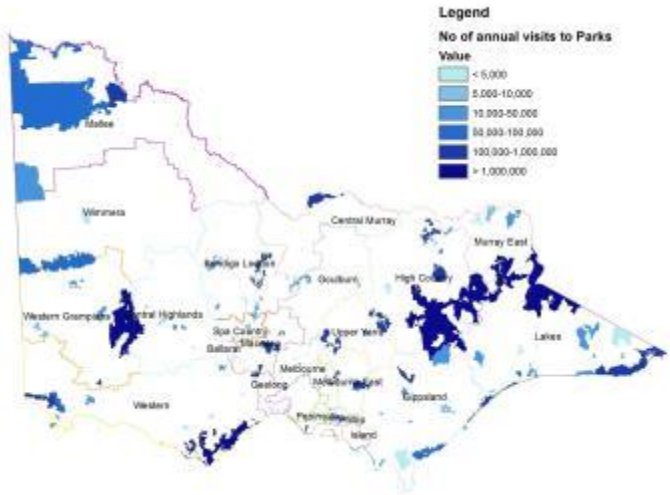



**Figure 4.4 Recreation service flow in Victoria's parks (number of visits per annum)**



## 4.7 Case study: Ecosystem assets and services in the Mallee parks

This section shows how asset accounting information can be used to monitor environmental outcomes, particularly in relation to recent native vegetation restoration programs in the Mallee parks. This case study further provides an overview of key ecosystem services provided by these parks, illustrating in this way the application of environmental-economic accounts as a knowledge base to assist park management and the evaluation of environmental programs.

### Background about the Mallee parks

The Mallee region of north-west Victoria has seen substantial land use change over the last 150 years. Prior to the 1990s extensive areas of public land containing significant semi-arid woodland habitats in the Mallee region had been subject to grazing leases, and the Victorian Government integrated additional areas into the Victoria's national parks network in 1991 and terminated any grazing tenures in 1996. These areas had been subject to severe impacts from not only stock grazing, but also from rabbits and overabundant kangaroos. This process followed the recommendations provided by the Land Conservation Council Reviews of 1977 and 1989. The group of Mallee national parks for this case study consists of the Murray-Sunset National Park (over 665,000 ha), the Wyperfeld National Park (about 360,000 ha) and the Hattah-Kulkyne National Park (about 50,000 ha).

The rationale and objectives for restoring native vegetation (and particularly semi-arid woodlands) was developed in the "Restoring the Balance" program which focussed on regeneration of native vegetation through reducing total grazing pressure. More recently a program of revegetation has commenced through the Mallee Biofund project, a Commonwealth funded initiative. This is being undertaken in conjunction with other State funded restoration management programs (e.g. rabbits and overabundant kangaroos) including partnerships with the Mallee Catchment Management Authority.

Table 4.12 presents the change in extent and condition across main native vegetation groups in the three major Mallee parks. The table provides an overview of the status of the key ecosystem assets across the three relevant parks over 2010 and 2013, measured through a qualitative Parks Victoria State of the Parks score[36]. With the ongoing development of monitoring programs, more frequent data will be available and it could be possible to identify the changes in extent and condition that can be attributed to natural causes, land management measures or other human activity.

The Mallee parks include a wide range of vegetation types from riverine woodlands in the north, to large areas of Mallee Eucalypt to semi-arid dry non-Eucalypt woodlands. While extensive areas of Mallee eucalypt habitats are in relatively intact condition, most of the management effort has been directed to the dry non eucalypt woodlands which have been in poor condition due to a legacy of past land use and grazing pressure. At a broad scale, over the past decade the three national parks in the Mallee region have seen some improvement in the condition of native vegetation. These changes do not relate to changes in the size of native vegetation areas, but to the improvement of land cover quality. Previously this was mainly achieved by controlling grazing from introduced rabbits, goats and overabundant kangaroos. The current management program is introducing both active revegetation of semi-arid dry woodland in addition to 'passive' restoration through reduction of grazing pressure by goats, rabbits and kangaroos.

[36] The State of the Parks assessment is a qualitative assessment by park managers based on best available knowledge. In this case the overall assessment is based on results of field based monitoring and remote sensing condition assessments.

### Mallee Ecosystem extent and condition

Table 4.12 summarises the extent and condition scores for each of the three national parks between 2010 and 2013. Across all Mallee native vegetation Park Victoria's assessment shows that in the Hattah-Kulkyne and Wyperfeld National Parks only riverine woodland vegetation appears to have improved from poor to fair categories, while in the Murray Sunset National Park, changes across most types of native vegetation and freshwater wetlands are observed over the same period. Since current activities of the Mallee Restoration Program have focused on dry woodland areas, the condition changes that can be attributed to the Program at this stage should be linked to this specific vegetation type.

**Table 4.12 Changes in stocks of ecosystem assets for the Mallee parks**

| Mallee Parks | Hattah - Kulkyne National Park | | Murray - Sunset National Park | | Wyperfeld National Park | |
|---|---|---|---|---|---|---|
| Asset extent and condition | Extent (ha) | PV score | Extent (ha) | PV score | Extent (ha) | PV score |
| **OPENING BALANCE (2010)** | | | | | | |
| **Native vegetation** | | | | | | |
| Dry-woodland (non-euc) | 6,546 | fair | 65,752 | poor | 16,348 | poor |
| Riverine woodland EVDs | 10,349 | poor | 13,577 | poor | 3,030 | poor |
| Hummock grass Mallee EVDs | 22,976 | fair | 380,337 | good | 64,162 | good |
| Saltbush mallee EVDs | 5,188 | fair | 141,591 | fair | 373 | n/a |
| Broombush whipstick | n/a | n/a | 16,713 | fair | 57,255 | good |
| Chenopod shrublands | n/a | n/a | 11,769 | fair | | n/a |
| Lowan mallee | n/a | n/a | n/a | n/a | 138,427 | good |
| Heathlands | n/a | n/a | n/a | n/a | 76,615 | good |
| **Wetlands** | | | | | | |
| Saline wetlands | 35 | | 13,678 | good | 483 | n/a |
| Freshwater wetlands | 1,777 | fair | 10,280 | poor | n/a | n/a |
| **Other** | 3,123 | | 11,856 | | 3,356 | |
| **Total by park** | **49,994** | **4.44** | **665,553** | **6.16** | **360,049** | **7.21** |
| Improvements: | | | | | | |
| Natural regeneration | - | - | - | - | - | - |
| Improved management | - | 0.55 | - | 0.99 | - | 0.02 |
| Reductions: | | | | | | |
| Natural losses, natural events: fires | | | | | 40,000 | *not assessed* |
| Human activity | - | - | - | - | - | - |
| **CLOSING BALANCE (2013)** | | | | | | |
| **Native vegetation** | | | | | | |
| Dry-woodland (non-euc) | 6,546 | fair | 65,752 | fair | 16,348 | poor |
| Riverine woodland EVDs | 10,349 | fair | 13,577 | fair | 3,030 | fair |
| Hummock grass Mallee EVDs | 22,976 | fair | 380,337 | good | 64,162 | good |
| Saltbush mallee EVDs | 5,188 | fair | 141,591 | good | 373 | n/a |
| Broombush whipstick | n/a | n/a | 16,713 | good | 57,255 | good |
| Chenopod shrublands | n/a | n/a | 11,769 | good | n/a | n/a |
| Lowan mallee | n/a | n/a | n/a | n/a | 138,427 | good |
| Heathlands | n/a | n/a | n/a | n/a | 76,615 | good |
| **Wetlands** | | | | | | |
| **Saline wetlands** | 35 | | 13,678 | good | 483 | **n/a** |
| Freshwater wetlands | 1,777 | fair | 10,280 | fair | n/a | n/a |
| **Other** | 3,123 | | 11,856 | | 3,356 | |
| **Total by park** | **49,994** | **5.00** | **665,553** | **7.16** | **360,049** | **7.23** |

Sources: Extent data is from DEPI 2013 data. Parks Victoria State of the Parks score (PV score) is a qualitative assessment undertaken onsite by park managers based on best available information. The total park score is the weighted average of the data provided for each vegetation type in a ten-point scale. Blank fields represent modelling data or measurements that could not be retrieved.

### Ecosystem services provided by the Mallee parks

The following account presents an overview of parks' ecosystem service flows in the Mallee region. Key services provided by the Mallee parks include carbon storage and sequestration, soil stability, habitat for threatened species, along with recreation, tourism, scientific research and cultural connection, particularly relevant to Traditional Owners.

The main provisioning service from the parks in the Mallee region that can be linked to agricultural production is honey production. The three national parks contain about 237 hectares with apiary sites. Of this, the Murray Sunset National Park accounts for over 151 hectares, which is the largest area with apiary sites across all parks in Victoria. There is some debate as to the effect of the land use designation as a park on honey production with some arguing that honey production as an ecosystem service could be inconsistent with the primary conservation objectives of the park even though it is a "permitted use", while others other argue the park contributes significantly to honey production due to its native vegetation being conserved.

The Mallee parks provide a number of important regulating services including soil stability, flood regulation, water filtration and carbon storage and sequestration (mainly because of the large extent of area available, which is approximately one million hectares of native vegetation). In flood regulation, both the Murray-Sunset and Hattah-Kulkyne National Parks significantly reduce flood peaks (2.2 and 1.6 times compared to an alternative land use). The Mallee Parks provide large areas of native vegetation in north-west Victoria and play an important role in stabilising the soil of this region. Parks Victoria plans to undertake further work to quantify the role of the improved native vegetation in the Mallee parks in minimising soil erosion and loss.

The Mallee parks offer further intermediate services, with the Murray Sunset NP providing at least 80% of the State's best habitat for 38 native species that are considered rare or threatened.

Finally, while the total number of tourist visits to the Mallee parks is relatively small in a statewide context, it provides important remote recreation and tourism experiences as semi-arid parks.

**Table 4.13 Service flows account for the Mallee parks (annual flows)**

| Ecosystem service flows | Mallee Parks | | | TOTAL |
|---|---|---|---|---|
| | Hattah-Kulykne National Park | Murray Sunset National Park | Wyperfield National Park | |
| **Provisioning services** | | | | |
| Honey production [hectares with apiary sites] | 52 | 151 | 34 | 237 |
| **Regulating services** | | | | |
| Carbon storage [tonnes carbon] | 2,453,886 | 20,880,588 | 9,746,048 | 33,080,521 |
| Carbon sequestration [tonnes C02 et/yr[1]] | | | | |
| - revegetation (300 ha) | 760 (209) | 760 (209) | 760 (209) | 2280 (628) |
| - restoration(20,000 ha) | 14,600 (4,022) | 14,600 (4,022) | 14,600 (4,022) | 43,800 (12,066) |
| Soil stability and quality [land area] | *Limited data* | *Limited data* | *Limited data* | - |
| Habitats for threatened species [nr of species having suitable habitats] | 13 | 112 | 11 | 136 |
| **Cultural services** | | | | |
| Opportunities for cultural connection [hectares co-managed with TO] | 49,994 | 665,553 | 360,049 | 1,075,596 |
| Recreation enjoyment [nr of visits] | 118,603 | 76,438 | 52,142 | 247,183 |
| Tourism [nr of visitor nights] | 278,731 | 179,638 | 122,540 | 580,908 |
| Scientific research [nr of research permits] | 12 | 15 | 15 | 20 |

[1] Estimate of sequestration rate of mallee ecosystems is 7.6 C02 t/ha/yr for revegetation and 0.7 T C02 e-/ha/yr for restoration

While for this project there has not been a longer term assessment of historical or empirical data to assess the impacts of improving the quality of native vegetation on these service flows, further assessment of long term datasets could be undertaken. Once this data becomes available it would be possible to link the additional investment in restoration programs with changes in environmental outcomes and ecosystem services, in the short and longer term. To do this, the accounts could incorporate values of the linkages between the expected improvement in the condition of park ecosystems and the improvement in the services flows they deliver. This would require measuring key indicators of ecosystem service flows in field experiments to assess the effects of specific interventions (i.e. identifying control and treatment groups) or using advanced modelling tools, such as EnSym[37], to assess the outcomes of specific management scenarios.

A complete analysis of trends over time should also identify changes in ecosystem flows due to other interventions that are not related to the programs of works by Parks Victoria (e.g. natural disasters or change in land use in surrounding regions) or due to shifts in demand (e.g. changes in regulation leading to restricted access to park sites). At this stage of the restoration works in the Mallee parks, it was not possible to identify other intervening programs, economic activities or demand driven changes in the provision of ecosystem services.

## 4.8 Case study: Ecosystem assets and services in the Alpine National Park

The Alpine National Park was originally established in 1979 and now covers an area of 660,550 hectares. The nationally significant park covers five bioregions, including extensive alpine and sub-alpine, wet forest and dry forest ecosystems and contains the headwaters of most of eastern Victoria's river systems, including eight heritage rivers. The park has many places of Aboriginal cultural and historic heritage significance and is a major tourism destination. While no area of the park is currently under formal joint or co-management agreements with Traditional Owners, the Victorian Alps Traditional Owners Reference Group advises Parks Victoria on a range of park management and cultural issues.

The table below provides a summary of the extent and condition scores across the Alpine National Park between 2010 and 2013. Over this period there was no reclassifications of land or other reductions or additions in the boundary areas of the Alpine National Park. The shares of the extent for each native vegetation type relative to the parks network total area and the State did not change over the three years either. By contrast, there appears to be a significant improvement in the condition of native vegetation, as the overall condition of native vegetation increased from 5.3 in 2010 to 6.3 in 2013 (this is an increase of 16% over three years). However these results are indicative only, as the assessment has used qualitative metrics, based on available information. Nevertheless the improvements in condition need to take into account preceding work on recovery from major fires (2003, 2006) and ongoing restoration work undertaken in alpine wetlands.

[37] The Environmental Systems Modelling Platform developed by the Department of Environment and Primary Industries

**Table 4.14 Changes in stocks of ecosystem assets for the Alpine National Park**

| Alpine National Park | Asset extent and condition | | | |
|---|---|---|---|---|
| | Extent (ha) | *% in parks network* | *% of park EVD in State* | Condition score (2010) PV score (2013 |
| **OPENING BALANCE (2010)** | | | | |
| **Native vegetation** | | | | |
| Alpine Treeless | 12,038 | 92.3 | 71.4 | 6.9 |
| Closed Forest | 29 | 0.2 | 0.1 | 5.5 |
| Foothills Forest | 2,890 | 4.5 | 0.8 | 5 |
| Forby Forest | 123,424 | 45.7 | 9.5 | 4.5 |
| Freshwater wetland (permanent) | 278 | 0.5 | 0.2 | 7 |
| Grassy /Heathy Dry Forest | 180,889 | 34.7 | 10.9 | 4.7 |
| High Altitude Shrubland/woodland | 222,648 | 84 | 41 | 6.0 |
| High Altitude wetland | 1,959 | 68.7 | 49.7 | 6.8 |
| Moist forest | 88,079 | 40.0 | 10.3 | 5.5 |
| Riparian (high rainfall) | 6,401 | 26.6 | 6.5 | 4.9 |
| Ricky Knoll | 9,153 | 17.1 | 11.2 | 5.0 |
| Tall mist Forest | 12,087 | 7.8 | 2.6 | 5.3 |
| Tall mixed Forest | 5 | 0 | 0 | 5.0 |
| Treed Swampy Wetland | 374 | 0.9 | 0.2 | 4.7 |
| **Total by park** | 660,395 | | | 5.3 |
| Improvements: | | | | |
| Natural regeneration | - | | | *Not assessed* |
| Improved management | - | | | *Not assessed* |
| Reductions: | | | | |
| Natural losses, natural events | - | | | *Not assessed* |
| Human activity | - | | | *Not assessed* |
| **CLOSING BALANCE (2013)** | | | | |
| **Native vegetation** | | | | |
| Alpine Treeless | 12,038 | 92.3 | 71.4 | G/I |
| Closed Forest | 29 | 0.2 | 0.1 | G/I |
| Foothills Forest | 2,890 | 4.5 | 0.8 | F/I |
| Forby Forest | 123,424 | 45.7 | 9.5 | F/I |
| Freshwater wetland (permanent) | 278 | 0.5 | 0.2 | G/M |
| Grassy /Heathy Dry Forest | 180,889 | 34.7 | 10.9 | F/I |
| High Altitude Shrubland/woodland | 222,648 | 84 | 41 | G/I |
| High Altitude wetland | 1,959 | 68.7 | 49.7 | G/M |
| Moist forest | 88,079 | 40.0 | 10.3 | G/I |
| Riparian (high rainfall) | 6,401 | 26.6 | 6.5 | P/D |
| Rocky Knoll | 9,153 | 17.1 | 11.2 | G/M |
| Tall mist Forest | 12,087 | 7.8 | 2.6 | G/I |
| Tall mixed Forest | 5 | 0 | 0 | F/I |
| Treed Swampy Wetland | 374 | 0.9 | 0.2 | U |
| **Total by park** | 660,395 | | | 6.3 |

Sources: Parks Victoria data. Qualitative condition acronyms: excellent (E), good (G), fair (F), poor (P), unknown (U). Parks Victoria State of the Parks score (PV score) is a qualitative assessment undertaken onsite by park managers based on available information. The total park score is the weighted average of the data provided for each vegetation type in a ten-point scale. Blank fields represent modelling data or measurements that could not be retrieved.

The table below illustrates a service flows account for the Alpine National Park. The park has by far the largest mean annual water flow of any Victorian park at 2,631 GL per annum and supplies water to a wide range of users including local towns and downstream irrigators. Thus, the parks watersheds provide a major water and purification service to the community.

The park provides the largest carbon sink of any Victorian park, storing more than 70 million tonnes of carbon or more than a quarter of the carbon of the parks network. It plays a significant role for threatened species by providing at least 60% of the best habitat in the State for 238 species.

The Alpine National Park contributes to 70% of the number of tourist visitor nights in the Victoria's High Country tourism region, which is the third largest region providing park-attributable expenditure as a share of total tourism. Around 20 licensed tour operators use the park.

Honey supply is another relevant service provided by this national park, particularly over summer months. However, no production data from apiary sites at the subregional level was available. Although this National Park contains a relatively small area with bee sites (28 hectares as compared with a total of 3,742 hectares across the parks network), the total production from this region may be significant due to its climate and native vegetation. The apiary industry based in this region also provides pollination services, which are important for fruit production and can benefit other field crops such as canola and sunflowers, along with reseeding of pastures.

**Table 4.15 Service flows account for the Alpine National Park (annual flows)**

| Ecosystem service flows | Total Alpine National Park |
|---|---|
| **Provisioning services** | |
| Honey production [tonnes of honey products] | *No data available* |
| Water supply (regulated) [ML] | 1,079,000 |
| Water supply (unregulated) [ML] | 1,547,000 |
| **Regulating services** | |
| Carbon storage [tonnes carbon] | 70,582,949 |
| Carbon sequestration [tonnes carbon] | *No data available* |
| Sedimentation [tonnes p.a.] | 2,940,000 |
| Soil stability and quality [land area] | *No data available* |
| Pollination [hectares of land with apiary sites] | 28 |
| Habitats for threatened species [nr of species having suitable habitats] | 238 |
| **Cultural services** | |
| Recreation enjoyment [nr of visits] | 1,320,618 |
| Tourism [nr of visitor nights] | 677,555 |
| Scientific research [nr of research permits granted] | 20 |
| Social & community cohesion [nr of volunteering hours] | 5400 |

# 5. Valuation of ecosystem service benefits from Victoria's parks

Once environmental assets are fully described and the physical flows of ecosystems services are quantified, valuation can be used to provide measures of non-market benefits in monetary terms. These economic measures are very useful to communicate diverse benefit values across a range of stakeholders and decision makers.

This section discusses the potential use of valuation measures, followed by a description of the approach used to select relevant valuation techniques and derive the value of non-market benefits, and concludes with a summary of all the ecosystem services assessed for Parks Victoria. Parks' benefits are initially described in terms of physical units (e.g. avoided nitrogen in metro waterways) and after the valuation techniques are applied, welfare values for the provision of ecosystem services in monetary terms can be provided (e.g. the value of water filtering services).

## 5.1 Purpose of valuation

As discussed in Section 2, economic valuation can be used for a variety of purposes, particularly in relation to environmental impact assessments, evaluations of investment programs, policies and resource allocation affecting non-market goods or services. Depending on the purpose of the valuation, two main types of benefit measures can be required:

- **Total values** – for example to indicate the size of total non-market benefits associated with current demand levels for an ecosystem service, or alternatively the total magnitude of externalities currently being experienced. These values are most useful for improving awareness and long-term strategic decision-making on competing uses of natural resources.
- **Marginal values** – indicate the incremental benefit/cost expected from an improvement or a reduction in the delivery of ecosystem services (e.g. as a result of policy or projects leading to environmental improvements or losses). These values are useful to inform prioritisation of policy/project options and decision-making, such as through cost benefit analysis.

In the first phase of this project we have focused on assessing total values for the benefits of ecosystem services provided by Victorian parks. Assessment of marginal benefits is most appropriate as part of the development of specific business cases relating to environmental improvements or changes achieved from major decisions and/or investment proposals for management of parks ecosystem and built assets, which is another potential application outlined in Section 6.

## 5.2 Methodology to value benefits from ecosystem services

The systematic analysis of ecosystem services and valuation of their benefits can be initiated once the purpose of the valuation has been defined and agreed. This section outlines the main steps followed to value the benefits of ecosystem services provided by parks, summarised in Figure 5.1.

**STEP 1 Identify the ecosystem service and beneficiary**

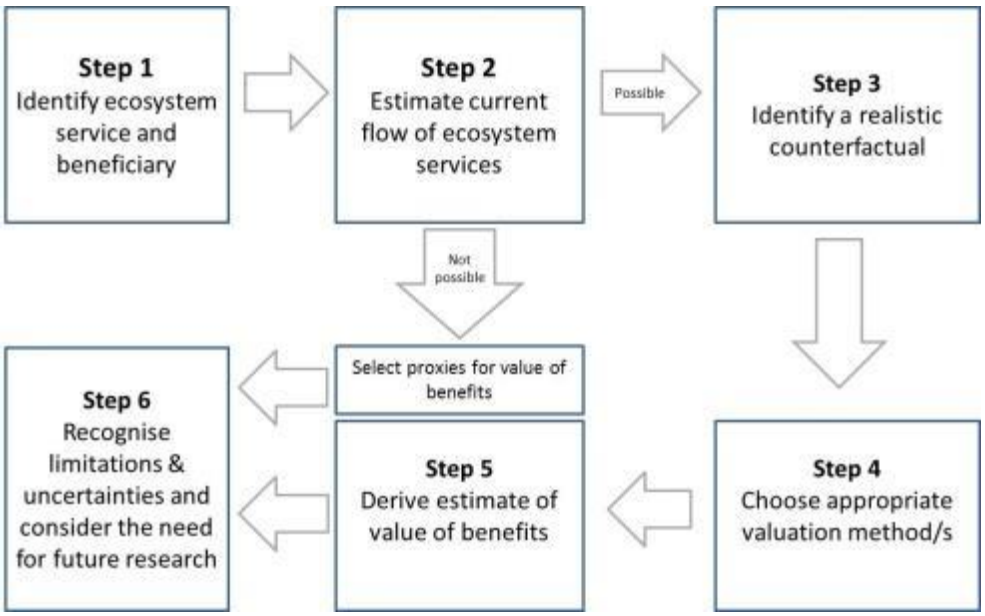
The first step is to identify the ecosystem service and beneficiary of the flow of the ecosystem service, which should be aligned with the ecosystem service accounts discussed in Section 4. This is useful context for any valuation work as it helps to ensure a consistent definition of final ecosystem services contributing to human wellbeing, as defined by the CICES classification system, and any

double counting issues are avoided or minimised. It also helps to clearly communicate to stakeholders about the linkages between ecosystems to the economy and community, supported by a clear description of the benefit of the ecosystem services and who is receiving it.

**STEP 2 Estimate current flows of ecosystem services**

The next step is to estimate the current flow of service in physical units. For some ecosystem services identifying the flow of services is fairly straightforward. For example the provisioning service of water can be measured by the quantity of water supplied, the regulating service of carbon storage as the amount of carbon stored and the cultural service of recreation through the number of visits. These estimates of the amount of the flow (reported in the service flow accounts) can then form the basis of any monetary valuation exercise.

**Figure 5.1 Steps to value ecosystem services**




For services like maintenance of genetic diversity or species existence there is no easy measure available. In these cases estimation of service flow is much more complex and is likely to require input from economists, ecologists and other relevant experts. For this project we have used proxy indicators of service flow for some services where monetary estimation is not feasible. The proxy indicators are based on the characteristics of ecosystem assets that are known to be important in the provision of those services. While this does not provide a platform for monetary valuation, it does offer a starting point for considering their significance in providing benefits to the community.

**STEP 3 Identify a realistic counterfactual**

The counterfactual describes the situation if the parks did not exist and were some other land use. The selection of the counterfactual is a critical step that will define the level of net benefits delivered to society as a whole. The counterfactual needs to be consistent across all ecosystem services and should be realistic and reflect the next most likely use of land.

In the context of this project, the valuation consists of comparing the outcomes of ecosystem services under current parks managed land versus the counterfactual that in the absence of park land use, the land would have not been protected (i.e. private uses would have been allowed). More specifically for metropolitan parks, the counterfactual is that parks land would have been used for

residential developments[38], while in national and State parks the counterfactual is that parks land would be used for low-productive agricultural uses such as grazing.

The discussion for the selection of a counterfactual considered a range of diverse alternative land uses, but the one described above was found to be the most appropriate for the purpose of this study. For example, changes to intensifying forestry uses are not considered, as it is unlikely that this shift would happen widely across the State and the relevant outcomes would need to take into account time lags in forest development.

For the purpose of this work, the analysis of the counterfactual seeks to assess parks ecosystem service benefits for which a partial analysis of the effect of changing land use on a specific ecosystem service is needed. We acknowledge that this approach does not provide a complete view of the total cost or benefits achieved from projects/programs involving land use changes.

If the purpose of this project was to undertake a full assessment of projects/programs involving land use changes, the analysis of the projects/programs would need to take into account the value of all relevant additional costs and benefits (including externalities) arising from the alternative land use and attributable to the project/program. For example, in the case of grazing, additional costs would include land preparation and additional benefits would include the value of cattle/sheep and their by-products. In the case of residential developments, additional costs would include transactions of title transfers and benefits would include the value of properties built.

**STEP 4 Choose appropriate valuation method/s**

A range of valuation techniques is available, as discussed in Section 2.3.3. Selecting the right technique to value each ecosystem service will depend on a number of factors:

- the motivation for the valuation
- the ecosystem service (some techniques are suited to particular types of ecosystem services)
- the type of economic and environmental data available
- the time and budget available
- the availability of experienced practitioners

Typically **provisioning services** can be valued using a market-based method such as the productivity approach. For example, deriving the benefit of timber supplied from a forest from its market price. The first preference for valuation is often a market-based method as the values can be directly observed in markets and there is greatest confidence in the outcomes. They can also be widely applied in cost-benefit analyses and for deriving exchange values for accounting purposes.

**Regulating services** are often valued using a replacement cost method. For example, deriving the benefit of water purification provided by a forested catchment by estimating the cost of replacing this service. In other words, the replacement cost method requires the selection of an alternative substitute that could provide an equivalent service at the same level.

A wide range of types of techniques is used to value the benefits of **cultural services.** Specific techniques are suitable for some cultural services (such as the travel cost method[39] for recreation

[38] Normal density development (500-800 sq meter lots)

and the hedonic price method[40] for amenity). Cultural services involving non-use values require stated preference methods such as contingent valuation or choice modelling.

Note that most techniques for the estimation of benefits involving consumer's willingness to pay – for example using the travel cost method or stated preference methods – are not suitable for deriving exchange values for current accounting frameworks. There is potential to use some techniques including stated preference to describe a demand curve and then use assumptions or other information to define a supply curve and hence identify an exchange value. For cultural services this is a promising avenue.

If no primary data are available for the valuation, benefit transfer could be used. Any type of ecosystem service can be valued using benefit transfer as long as certain conditions are met. The conditions that need to be satisfied for benefit transfer to be valid include[41]:

- The value from the original study site needs to be theoretically and methodologically valid
- The beneficiaries near the study and policy sites must be similar
- The difference between baseline ecosystem conditions and extent of ecosystem change must be similar across the study and policy sites
- The study and policy sites must be similar in terms of environmental characteristics (including size)
- The distribution of property rights and other institutions must be similar across sites.

A number of databases of ecosystem valuation studies exist including the Canadian Environmental Valuation Reference Inventory[42]; the Ecosystem Service Valuation Database[43]; the Earth Economics: Ecosystem Valuation Toolkit[44]; and the Catalogue of Assessments on Biodiversity and Ecosystem Services[45].

More than one valuation method can be used to derive an estimate. This allows cross checking of results and provides greater confidence in the accuracy of the estimated value. However, this is only valid if both applications are measuring according to the same value concept. Benefit transfer can be particularly useful to build confidence in the estimation of the order of magnitude of a value or impact.

**STEP 5 Derive benefit values**

Most derivations of the benefits of ecosystem services will require advice from an experienced practitioner. There are various manuals and guidance materials available covering best practice techniques for each valuation method[46].

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[39] The travel cost method uses survey information on visitor travel mode, distance and time and other travel expenditure to impute utility derived from recreation.

[40] The hedonic price method derives values for amenity and the aesthetic qualities of environmental assets by observing how another related market changes in value due to proximity to such assets (e.g. real estate values changing in proximity to parks).

[41] World Resources Institute 2014, *Coastal Capital: Ecosystem Valuation for Decision Making in the Caribbean*.

[42] www.evri.ca

[43] www.es-partnership.org

[44] www.esvaluation.org

[45] catalog.ipbes.net

[46] See for example: Eftec 2009, Valuing Environmental Impacts: Practical Guidance for the Use of Value Transfer in Policy and Project Appraisal, prepared for UK DEFRA; D. Pearce, G. Atkinson, & S. Mourato, Cost-Benefit Analysis and the

There are two key issues of particular relevance to valuation of provisioning services that need to be taken into account when using current market prices:

- Current market prices may overestimate the benefits from ecosystem services to the extent that any additional human-provided inputs also contribute to the benefits; and
- Current market prices may underestimate the benefits from ecosystem services to the extent that market conditions and regulatory policies allow ecosystem degradation.

Monetary valuation of benefits of ecosystem services using market prices should recognise and where possible adjust estimates to take these factors above into account.

In using replacement costs for regulating services it is important to ensure that the alternative considered provides the same services; the alternative is the next best least cost option and there is evidence that the service would be demanded by society if it was provided.

To effectively use stated preference techniques ecosystem services and expected changes must be described in terms that people relate to and the payment vehicle must be believable.

The steps involved in benefit or value transfer include:

- Understand the ecosystem service to be valued at the policy site and gather information on the population affected.
- Identify relevant studies that could potentially be used for benefit transfer.
- Assess available studies for their quality and applicability.
- Transfer the value measures either using a single value, function representing the relationship between value and site conditions, or meta-analysis function where the relationship is derived from multiple study sites.
- Determine the population and spatial extent over which values at the policy site are aggregated.
- Adjust prices for inflation and purchasing power parity if using international studies.

**STEP 6 Recognise limitations/uncertainties and consider the need for future research**

It is important to recognise limitations and uncertainties associated with the estimated values and describe all judgements and assumptions and their potential impact on the values derived.

In considering the type of future research to fill gaps or improve confidence it is important to consider data availability, measurement issues, and the state of play of current knowledge in determining how the ecological production of ecosystem services translates into economic valuation of these benefits.

The Department of Treasury and Finance guidance on economic evaluation for business cases recognises that deriving monetary values through primary research can be resource intensive. The guidance advises that the additional effort and expense incurred in assigning monetary values to costs and benefits should reflect the likely size of those impacts.

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Environment: Recent Developments, OECD, Paris, 2006; HM Treasury 2011, The Green Book: Appraisal and Evaluation in Central Government, TSO, London.

**Table 5.1 Valuation of ecosystem services in Victoria's parks**

| Ecosystem service | Measure of service flow | Type of value | Approach to valuation | Priority for Parks Victoria | Confidence in monetary valuation |
|---|---|---|---|---|---|
| Provisioning goods | | | | | |
| Water supply | Quantity of water flows | Direct use value | Replacement cost of supplying water | High | High |
| Honey products | Quantity of honey supplied | Direct use value | Producer surplus for honey production | Medium | High |
| Regulating services | | | | | |
| Water purification/filtration | Quantity of sediment, nutrients and pollutants retained c/w alternative land use | Indirect use value | Replacement cost of water purification | High | High |
| Flood /stormwater regulation | Impact on flood peaks c/w alternative land use | Indirect use value | Replacement cost of flood control infrastructure | High | High |
| Climate regulation- carbon storage and sequestration | Quantity of carbon stored; Quantity of carbon sequestered | Indirect use value | Indicative price under national emission reduction fund | High | High |
| Climate regulation-local climate-urban cooling | Difference in temperature between park areas c/w non parks | Indirect use value | *Avoided health costs; avoided cost of energy consumption* | Medium | Medium |
| Coastal protection | Area of coastal habitats providing protection to communities | Indirect use value | Replacement cost of coastal protection infrastructure or restoration | High | Medium |
| Air quality regulation | Quantity of pollutants/particulates absorbed by vegetation | Indirect use value | *Avoided health costs of air pollution based on population exposed* | Medium | Future |
| Soil quality and stability | Soil health index; Quantity of soil loss/ erosion avoided c/w alternative land use | Indirect use value | *Avoided costs of land degradation and rehabilitation costs* | Medium | Future |
| Pollination and seed dispersal | Number of apiary sites in parks | Indirect use value | Consumer and producer surplus of agricultural crops affected by pollination | High | Future |
| Pest and disease control | Diversity and abundance of insectivorous birds | Indirect use value | *Avoided loss of production or increased value of crops* | Medium | Future |
| Habitats for species | Condition and representation of habitats | Indirect use value | Non-monetary indicator: % of best habitat in the State for rare and threatened species | High | High |
| Maintenance of nursery services | Area of nursery habitats; enhancement of biomass | Indirect use value | Benefit transfer (*increased productivity in commercial fishing*) | Medium | Medium |
| Maintenance of genetic diversity | Significance and representation of rare and threatened species | Indirect use value | Non-monetary indicator: % of best habitat in the State for rare and threatened species | High | Medium |
| Cultural services | | | | | |
| Recreation | Number of visitors; Index of satisfaction; Index of personal benefit | Direct use value | Benefit transfer (*travel cost method for enjoyment*) | High | High |
| | Number of 'park tourists' (tourists contribution to State and regional employment attributable to parks); | Direct use value | Difference in the contribution to economic activity attributed to method and input/output analysis, productivity method, *stated preference methods* | High | High |

| Ecosystem service | Measure of service flow | Type of value | Approach to valuation | Priority for Parks Victoria | Confidence in monetary valuation |
|---|---|---|---|---|---|
| | Number and proportion of visitors doing physical exercise; Number and proportion of parks visitors undertaking relaxation activities | Direct use value | Avoided costs of physical inactivity attributable to activity in parks<br><br>*Mental health metrics* | High<br><br>High | Medium<br><br>Low |
| Landscape and neighbourhood amenity | Number of neighbouring properties, average distance to parks | Indirect use value | Benefit transfer (*hedonic price approach or transfer of hedonic functions*) | High | Medium |
| Scientific research and education | Number of participants in educational experiences in parks | Direct use value | *Productivity method* | Medium | Low |
| | Number of research programs in parks | Direct use value | *Productivity method* | High | Low |
| Cultural and spiritual connection | Area of joint and co-managed land with Traditional Owners; social capital measures | Direct use value | *Productivity method* | High | Low |
| | Community demand for heritage conservation | Non-use value | Benefit transfer (*willingness to pay for heritage conservation*) | Medium | Medium |
| Social cohesion and sense of place | Number of volunteer equivalent FTEs | Direct use value | Shadow price of volunteering time;<br>*other social capital metrics* | High | Low |
| Species existence | Significance and representation of rare and threatened species in parks | Non-use value | *Stated preference methods: willingness to pay for species existence* | High | Low |
| Insurance | Condition of park ecosystems | Option value (use value) and altruism and bequest values (non-use values) | *Stated preference methods: willingness to pay for biodiversity and ecosystem resilience* | Medium | Low |

Notes: The approach to valuation column includes either the approach used for this study or the approach generally used to value the benefits of the service (in italics)

## 5.3 Ecosystem service benefits from Victoria's parks

Table 5.2 presents a range of measures in monetary terms or indicators used to value the services provided by Victoria's parks (details on how these values are derived are provided in Appendix 2).

The purpose of this table is to report consistently on the benefits of ecosystem services identified through this project in terms of community welfare (listed in the first column, shaded). Additional information using economic measures of park related economic activities (e.g. gross value of production (GVP) and value added to the Gross State Product (GSP)) is also listed where this information was available. Only monetary values under the same column may be additive.

As discussed in Section 3, the benefits are mainly in relation to the welfare gains generated to society (to both producers and consumers) from protecting parks ecosystems or managing it as land for conservation, as compared to the counterfactual. Conversely, the accounting or exchange measures assess the current contribution of ecosystem assets to activities in the economy, which to some extent may continue to be provided regardless of the land use or parks' management strategy. We report both measures as the information they provide are complementary: welfare values are an important input to understand the best value of resources use, while exchange values can provide insight about key linkages among environmental assets, the economy and society.

While the benefits of recreation are relatively large, it is important to note that the valuation of other ecosystem services linked more directly to ecological and natural regulating processes is a relatively new area and is therefore limited to the extent that relevant empirical literature or data for the service was available.

**Table 5.2 Ecosystem service benefits of protecting parks and relevant economic activity (annual)**

| Ecosystem services | (1) BENEFITS OF PROTECTING PARKS | (2) ECONOMIC ACTIVITY | (3) VALUE ADDED IN THE ECONOMY | | (4) NON-MONETARY MEASURES |
|---|---|---|---|---|---|
| Economic values (annual): | Benefits to producers and/or consumers ($) | Market output value or gross value of production ($) | Direct contribution to GSP ($) | Total contribution to GSP ($) | Indicators or qualitative info |
| Definition: | What are the welfare gains as compared to the counterfactual? | Exchange value: how much would this be worth today? (snapshot) | What is the value added generated in the economy today? derived from (2) | | What other features or measures are suitable? |
| **Provisioning services** | | | | | |
| Supply of clean water (from nine highest yielding non-metro parks) | | $244 million (imputed) [4] 🟡 | ✓ | ✓ | |
| Honey supply [1] | $0.6-$1.0 million 🟢 | $3.4 -$4.6 million 🟢 | ✓ | ✓ | |
| **Regulating services** | | | | | |
| Water purification [2] | $32 million (metro parks) $50 million (State/national parks) 🟢 | | | | |
| Coastal protection | $24-$56 million 🔴 | | | | |
| Flood control/protection | $46 million 🟢 | | | | |
| Carbon storage | *Annual values not estimated* [3] | | | | |
| Carbon sequestration (from revegetation only) | $1-5 million 🟢 | | | | ✓ |
| Urban cooling | Not estimated | | | | ✓ |
| Air quality | Not estimated | | | | ✓ |
| Soil quality | Not estimated | | | | ✓ |
| Soil stability | Not estimated | | | | ✓ |
| Pollination | $123-$167 million 🟡 | $0.6-1 million 🟡 | | | |
| Pest and disease control | Not estimated | | | | |
| Habitat suitability for threatened species (in over 600 parks) | | | | | 888 threatened species in suitable habitats |
| Maintenance of genetic diversity | ✓ | ✓ | ✓ | ✓ | |
| Maintenance of nursery populations | Not estimated | $1.1 million (imputed) [4] 🔴 | | | |
| **Cultural services** | | | | | |
| Recreation opportunities: | | | | | |
| Enjoyment | $600 - $1,000 million 🟡 | | | | |
| Tourism | | Expenditure: $1.4 billion 🟢 | $449 million 7,921 FTE 🟢 | $1,021 million 13,783 FTE 🟢 | |
| Health (avoided costs) | $80-$200 million 🟡 | | | | |
| Education opportunities | Not estimated | ✓ | ✓ | ✓ | 183,000 participants in educ. programs |
| Scientific research opportunities | Not estimated | ✓ | ✓ | ✓ | 215 research permits |
| Amenity (Melbourne's parks) | $21-28 million 🔴 | | | | ✓ |
| Opportunities for cultural connection (heritage) | $6-23 million 🔴 | ✓ | ✓ | ✓ | 648,513 hectares managed with TOs |
| Social & community cohesion | $6 million 🟢 | $6 million (imputed) [4] 🟢 | | | ✓ |
| Species/ecosystem existence (protect endangered species) | Not estimated | | | | ✓ |

[1] Honey production has lower levels of confidence in Table 4.10 because annual flows are derived from top-down estimates, however the valuation use monetary estimates based on market data for honey production. [2] Water filtration service in non-metropolitan parks is net off yield reduction as compared to the counterfactual. [3] Annual benefit values could not be assessed for carbon storage due to lack of models to assess carbon releases under the counterfactual. However, if all carbon currently stored in parks was released, the cost to offset these emissions would be valued at around $15 billion. The social cost of the emissions (without any offsets) is estimated at $63 billion. [4] Imputed values are not actual transactions, but represent the value of transaction that would be observed if there was a market for this service.

Relative levels of confidence in valuation applied: higher 🟢 medium 🟡 lower 🔴
(not including uncertainty associated with the assessment of service flows)

In addition to managing park ecosystems, Parks Victoria manages infrastructure and recreational activity in and around Victorian bays and waterways, including Port Phillip, Western Port and Port Campbell. Access to local ports enables a range of activities such as commercial and recreational fishing and boating. The commercial and recreational benefits provided by these waterways have not been included in the table above as Parks Victoria has a role as infrastructure and recreational manager rather than natural asset manager in this context. Local ports managed by Parks Victoria (Port Phillip, Western Port and Port Campbell) are estimated to contribute over $300 million per annum to the Victorian economy (see Appendix 3 for more detail). Part of this economic contribution is attributable to Parks Victoria's management of built and social capital.

# 6. Summary of findings and further work

The natural capital and ecosystem services based approaches explored in this report provide a foundation for a new direction in recognising, quantifying, valuing and reporting on the contribution of Victoria's parks to Victoria's environment, economy and wellbeing.

This project builds on, and complements, other work being undertaken within Parks Victoria on State of the Parks management effectiveness evaluation and development of improved objectives based evaluation and monitoring frameworks. This work also complements the development of decision-making frameworks based on environmental-economic accounting to inform current monitoring, evaluation and investments undertaken through environmental markets or programs led by the Department of Environment, Land, Water and Planning.

## 6.1 Application for Parks Victoria

While many in the community value Victoria's parks for their intrinsic values, and others anecdotally recognise the benefits of parks, some people perceive parks as being restrictive and of limited social or economic value. The accounting framework explored views parks as significant environmental assets that provide a range of services to State and regional economies and communities, in addition to the contribution of the parks network to conservation of habitats and biodiversity. In addition, the valuation framework is used to understand the full range of costs and benefits of maintaining protected public land areas, which support ecosystem assets. Thus, the outcomes of this work have the potential to shift perceptions about why we have parks and the management requirements to ensure that these key assets and services are maintained and/or enhanced so that services can continue to be provided.

The proposed frameworks for ecosystem accounting and valuation present an opportunity to apply the concepts of natural capital, ecosystem services, value and benefits more formally into organisational business and reporting systems. This can be undertaken in three ways:

(i) By developing and applying new **international standards for environmental-economic accounting** to Victorian parks. A more business-like approach to accounting for park management and investment would highlight the dependencies between park management activity, economic prosperity, social wellbeing and economic performance.

(ii) The development of environmental-economic accounts can bring the State's key environmental assets onto the balance sheet and **draw a link between the management of State assets with economic measures** of Gross State Product. Environmental valuation and other economic analysis **based on these relationships can then provide a consistent base of knowledge to assess the changes in welfare due to environmental programs or policy changes**. In summary the integration of this approach into 'normal park management business' will be able to more transparently demonstrate the return on investment in meeting Government outcomes for the environment, economic growth and community wellbeing.

(iii) The approach can **align and integrate with Parks Victoria systems and measures for monitoring, evaluation and reporting** through the Parks Victoria State of the Parks management effectiveness evaluation program.

## 6.2 Learnings and further work

Some of the key issues that have arisen that are important to this work include:

**Economic issues**. There are well-accepted valuation techniques used by economists. However, not all of these techniques produce values that are consistent with accounting frameworks. Accounting frameworks for ecosystem services are also new and developing. Selection and application of valuation techniques can be quite complex, however primary research assessing key ecosystem services in the Victorian context can provide a foundation for broader applications.

Some of the stated preference (survey based) valuation methods have the potential to capture values that have been more difficult to quantify. Although their application to environmental and ecological values is relatively new, the number of applications is increasing and the methods are improving. Rigorous application of existing techniques and continual improvement in the performance of new techniques is important.

This report highlights that most valuation work is piecemeal, specifically because it tends to be location and service specific. This points out the need for more strategic level information. Some valuation techniques lend themselves to more strategic level assessment, and precedents for this type of exercise exist[47]. An important pre-requisite to any strategic studies is to identify the types of impacts that are of most relevance and which values would be most needed in subsequent policy and program impact assessments.

**Scientific issues**. All valuations of ecosystem services require good scientific information on the physical flows of ecosystem services being provided. In order to assess changes in ecosystem services a good understanding of ecological structure and processes is required to assess asset condition, and good information on cause and effect relationships is required to link changes in condition to the likely flow of ecosystem services. The science must be applied and policy relevant. Our scientists and economists need to work together so that scientific outputs can be used in the valuation and accounting framework. There is also a need to align modelling data and measurements to facilitate data sharing.

**Acceptance issues.** The use of economic valuation to develop monetary values or consider trade-offs can be controversial when applied to ecosystems. However, it is important to note that relative values are always applied in making decisions (along with trade-offs made implicitly) whether there are monetary valuations available or not. While economic and other techniques exist to quantify the values held by the community, some people are sceptical of the capacity of the public to understand the complexities of the issues involved, or concerned about possible biases in the development of values. In the absence of values we need to effectively communicate that the development of values provides an opportunity to improve decision-making.

[47] An example of a precedent for the development of strategic level information is a study prepared for the NSW Environment Protection Authority to provide information on the values held by the people of NSW for environmental and recreational attributes of rivers. The study estimated environmental values for a number of representative rivers across the State to provide a database of environmental values that could be drawn on by Water Management Committees when assessing alternative river management options. The study provided value estimates for changes in riverine vegetation, the presence of native fish and waterbirds, as well as values for improved recreational amenities (such as swimming and fishing) associated with water quality improvements.

**Prioritising effort**. Many applications of valuation techniques to develop new values have strong data requirements and therefore significant costs. Improving scientific information to develop cause-and-effect relationships can also be very demanding and it will be important to identify synergies with other work. Prioritising effort will be important to maximise the applicability of values for different contexts across Victoria.

The highest priorities for improving the quantification of individual ecosystem services for Victorian parks are summarised in Table 6.1 below.

**Table 6.1 Areas for further work identified for selected ecosystem services for Victorian parks**

| Ecosystem services | Information gaps |
|---|---|
| Provisioning services | Further work is required to develop more detailed water accounts, outlining the not only consumption uses, but the specific ecosystems providing water flows, in terms of groundwater, surface water and soil water.<br>Further work is required to develop exchange values for water and honey supply services that are consistent with State and national accounts. A top down approach was used for honey supply and further work could be done to take into account spatial variation in honey supply services across the parks network. |
| Regulating services | |
| Flood management - non-regulated rivers and wetlands | Recent estimates have been undertaken of the impact of metropolitan parks on stormwater regulation and the impact of some national parks with regulated rivers on peak flows. However there are information gaps on the contribution of parks in non-regulated river systems. Additionally contribution to flood regulation of the wetland ecosystems of the parks network requires further data and analysis. |
| Coastal asset protection | Further work could be done on the nature and costs of climate adaption measures for coastal settlements such as relocation and/or making existing buildings and infrastructure more resilient to coastal flooding for example through better drainage, on-site design changes, raising roads/bridges etc. |
| Carbon storage and sequestration | While Victoria has modelled estimates of above ground land carbon volumes, recent research in the central highlands has highlighted that the modelled estimates may be significantly lower that the models indicate. Additionally this research has highlighted other biomass such as woody debris and soil may contribute substantially to the role of parks as carbon sinks.<br>There is a need to develop improved estimates of contribution parks network in land carbon sequestration - both for revegetation across different landscape types, as well as well as the contribution of 'passive restoration' management interventions such as through management of grazing by introduced and overabundant native animals.<br>Increasingly marine and coastal wetland ecosystems are being highlighted around the world as potentially very significant for their role in storing and sequestering carbon, particularly in the organic sediment. There is a need to further understand and quantify the contribution of coastal wetlands to climate regulation. |
| Soil health and stability | Healthy parks are likely to play an important role within a broader landscape by minimising the volume of soil lost through soil erosion maximising soil health and productivity through the natural retention of critical soil health properties such as organic matter. There is a need to quantify the contribution of the different natural ecosystems of parks to soil stability and health. |
| Pest and disease control | While some international studies have sought to estimate both the volume of natural pest control services and their economic value, there have been limited local studies undertaken. The contribution that both larger intact parks and smaller reserves play in improving agricultural productivity (by providing healthy habitats for insectivorous birds, bats and native insects) is potentially very large. |
| Nursery services | The body of evidence for marine protected areas as nurseries for the recruitment of commercial and recreational species is growing, however there is a need to develop improved evidence on the quantity and value of coastal and marine parks in providing these nursery services. |

| Ecosystem services | Information gaps |
|---|---|
| Cultural services | |
| Recreation | New studies are required to update consumer surplus values provided in earlier studies, reflecting current environmental amenities in parks and population's preferences and activities undertaken in the parks network. |
| Physical and mental health benefits | While there is a large and growing body of evidence about the connection between human health and nature, there is a further need to develop improved metrics that can quantify and value the attribution of parks to both physical and mental health outcomes. While some direct use benefits can currently be measured, the contribution of parks to both use and non-use values relating to health is a challenge due to impact of many other health drivers. |
| Social benefits | While the current project has sought to introduce some immediately usable measures of social value such as volunteerism, there are significant information gaps in the metrics for quantifying and valuing social values such developing cultural and heritage connection to place, sense of belonging to community, social interaction and enjoyment and life satisfaction related to parks. |
| Connection to Country | Within the limited timeframes of this project limited data was able to be collected on the tangible social and cultural benefits of connection to country by Aboriginal communities. While there have been a number of studies undertaken in Australia, further work is required to develop consistent and comparable measures and gather suitable data on these benefits in the context of Victorian parks. |
| Non-use values | As a starting point, the current project has sought to wherever possible adopt market-based or other sound valuation methods to many of the use values in parks. There is currently limited data available on non-use value of Victorian parks and there are many opportunities to improve our knowledge of these values to inform decision-making. This could include valuation at different scales as the existence value of having a comprehensive and representative network of parks is likely to be much greater than the sum of the value of individual parks. |

Additional priorities for further development of the pilot accounts for Parks Victoria include:

- Extension of the coverage of the pilot accounts and more comprehensive assessment of the condition of assets.
- Developing technical and procedural standards for data collection to ensure robust, consistent assumptions and quality of any modelling used to generate data for pilot ecosystem accounts.
- Conceptual models linking changes in the extent and condition of ecosystem assets to the likely future flow of services.

Further areas to expand this work to inform land policy and management include:

- Identification and quantification of ecosystem services from the broader range of land uses applicable across the public land estate.
- Greater focus on marginal values associated with ecosystem services from different land uses to support decision-making. Few decisions involve total losses of ecosystems – most will involve modest changes in assets and service flows.
- Further work on values where we have been limited in our ability to capture non-use values, such as for biodiversity as well as spiritual and shared values.
- Incorporation of stocks of natural resources and impacts of degradation or improvement into economic analyses of policies and programs.

- Derivation of aggregate measures of economic activity adjusted for ecosystem degradation that could link into State and national accounting.

## 6.3 Implications of climate change

Going forward, park management will need to take into account potential changes in ecosystem condition and ecosystem service flows under climate change. The current pilot assessment across the parks network can be used as baseline, until better data becomes available.

The decision-making process can use historical data from accounts reporting on ecosystem condition and services, as well as forward-looking assessment to understand potential risks across the landscape. Given the nature of climate change, it would be important to assess any impacts on ecosystems through probabilistic models and to highlight any issues at the extremes. Integrated assessment models would be most suitable to simulate and quantify climate change impacts where there are significant interactions across diverse ecosystems and sectors of the economy, but in their absence regional or sectoral models could be used.

Research organisations, including the Commonwealth Scientific and Industrial Research Organisation (CSIRO) through its Climate Adaptation Flagship, have started to work on the impact assessment of climate change across selected ecosystem services (e.g. water and fire regimes) at a range of scales. This area of work will be scoped and covered in further detail in the second phase of work between PV and DELWP.

## 6.4 Data requirements to assess return on investment

In the process of developing the system of pilot accounts for parks and assessing parks ecosystem services, Parks Victoria and DELWP have identified a number of recommendations to use consistent information for the evaluation of conservation programs or ongoing natural resource management activities from parks.

The next stage of work could provide specific applications to use the information from the pilot accounts and benefit estimates to feed into an analysis of programs' return on investment (ROI) across a selection of parks and at for the whole of the parks network. The ROI presents the value of environmental outcomes attained per dollar invested. As such, this is a cost-effectiveness measure, not to be confused with a rate of return on the value of ecosystem assets.

To calculate the value of environmental improvements per dollar invested, two pieces of information are required:

- the **net cost of a program** over a predefined period; and,
- **outcomes measures to assess environmental improvements**.

At a minimum, the program should have clear timeframe and geographical boundaries indicating where management activities are being undertaken and where monitoring is available (or for which modelled estimates could be obtained).

For each program, a selection of key outcomes in terms of ecosystem features or main ecosystem services, which are likely to be affected due to the program, should be identified and data availability for these outcomes should be assessed from the start.

Over time the following information should be compiled consistently as a requirement to exploit efficiencies from the accounting and valuation works:

**Program cost data**

- Park management programs (including environmental, culture and heritage, recreational and educational, commercial and support programs) include activities in relation to planning, risk management, on the ground works, stakeholder management and communications and monitoring and evaluation – it is important to understand and document the core objectives, desired outcomes and approach used to deliver a program to identify relevant activities to prioritise efforts around the data analysis.

- Program budgets and historical spend are the main source for the costs of the program for a given group of parks. The budget should have a format consistent with SNA protection expenditure accounts, which has a breakdown of operating costs (labour costs, intermediate goods and services), fixed capital costs and revenue or any payments from/to the government. If accounts and valuation for cost benefit analysis are to be developed for individual parks (e.g. Alpine National Park), business management systems need to recognise this.

- For the purpose of program evaluation, the net costs should also consider the full value of a program including further government implementation costs or in kind contributions, depreciation of any built assets should be also included.

- In the program expenditure accounts, revenue payments (e.g. park entrance fees) should be included and if possible be allocated across the relevant program of works.

- If other intervening programs (in surrounding landscapes), policies or regulation are identified, the analysis should note them and try to find a suitable attribution approach for some of the program costs overlapping and outcomes being evaluated.

**Environmental outcomes data**

- A hierarchy of suitable metrics must be identified to enable change in key attributes from ecosystem assets to be compared over time (e.g. shown in the pilot ecosystem asset accounts) and/or changes in ecosystem service flows (e.g. discussed in the pilot ecosystem service flow accounts). Parks Victoria is currently developing 'conservation outcome hierarchies' for each of its major landscapes and ecosystems.

- A priority in the application of environmental-economic accounting work is to develop or use estimates of the partial effect of changes of environmental attributes (e.g. condition, water quality) on changes in ecosystem services (e.g. recreation, water purification)

- Historical data would be the main source for an ex-post assessment, while for an ex-ante assessment modelling of expected outcomes would be needed. If modelling is required it is important to ensure models are calibrated and suitable to the program timeframe in which outcomes need to be assessed.

- Two types of outcomes can be considered in the ROI analysis: short-term outcomes are those that are likely to be evident by the end of the program, while longer-term outcomes are those ongoing benefits arising and/or being realised beyond the duration of the program

- Assessment of ecosystem service benefits should follow the valuation methodology from Section 5.2 or find reference values if relevant to the current status of parks and the counterfactual. The impact of the program (defining a treatment group) should be ideally measured as the change over time and as compared to similar areas outside the program (control group).

- Consider carefully whether aggregation is possible and if this is not the case, present the multiple outcomes of key ecosystem services, for example in groups describing similar types of benefit or beneficiaries:

    - Contribution to activities in the economy
    - Contribution to human wellbeing
    - Contribution to other ecosystem services to maintain a healthy environment

- Note that these three types of benefits cannot be always aggregated, but considered together, as a whole, can provide a more complete picture of any trade-offs involved and the value for money provided through a program.

# Appendix 1: Types of parks in the Victorian parks network

### Table A1.1 Classification of Victorian parks

| Park type | Category | Primary objectives |
|---|---|---|
| Nature Conservation Reserve | International Union for Conservation of Nature Protected Areas (IUCN PA) Category IA | Set aside primarily to conserve species of plants and animals that may be rare or endangered, critical habitat, or other plant associations and animals that have conservation significance. |
| Wilderness Parks | IUCN PA Category IB | Set aside for conservation and self-reliant recreation, these are large areas with landforms and native plant and animal communities relatively unaltered or unaffected by the influence of the European settlement of Australia. |
| National and State Parks | IUCN PA Category II | National parks are areas of nationwide significance because of their outstanding natural environments, features, scenic landscapes, and diverse land types. They protect natural and cultural features and usually offer visitor facilities. They have limited areas for intensive recreation or development. State parks are generally smaller than national parks and make up an area of land containing natural environments and features, scenic landscapes and one or more land types that represent the major land types of the State. |
| Natural Features Reserves (Cave Reserves; Streamside Reserves; Scenic Reserves; some National Park Act parks) | IUCN PA Category III | Relatively small areas that are specifically allocated to protect a natural monument and its surrounding habitats. These monuments can be natural in the wholest sense or include elements that have been influenced or introduced by humans. They also provide for appropriate recreational use. |
| Natural features Reserves (Bushland Reserves) | IUCN PA Category IV | These reserves help to protect, or restore: flora and fauna species of international, national or local importance; or their habitats. The size of the area varies but can often be relatively small. They also provide for appropriate recreational use. |
| Currently none assigned in Victoria | IUCN PA Category V | |
| Non National Park Act Regional Parks, some Schedule 3 National Park Act parks | Regional parks | An area of public land, readily accessible from urban centres or a major tourist route, set aside primarily to provide recreation for large numbers of people in natural or semi-natural surroundings. Regional parks have significant value for nature conservation as habitat, as well as for their cultural heritage features. |
| Metropolitan Parks and Reservoir Parks and Gardens | Metropolitan Parks, Reservoir Parks and Gardens | An area of public land set aside primarily for recreation and provides for conservation of natural and cultural landscapes. |
| Historic Areas, Historic Parks, Historic Reserves, Lighthouse Reserves, Heritage National park | Historic areas, parks and reserves and lighthouse reserves | Places with important relics or historical associations that together with sites of historical and archaeological interest represent Victoria's main historical themes. |
| Natural Features Reserve- Lake Reserve, Highway park, Education area, Coastal Reserves | Other natural features reserves | |
| Waterway Manager for the waters of the local ports of Port Phillip, Western Port, Port Campbell, the Yarra, Maribyrnong and Patterson Rivers, Lake Moodemere and Albert Park Lake | Bay and waterways | |
| Designated port of Port Phillip, Western Port and Port Campbell | Local Ports | |

Source: Parks Victoria

# Appendix 2: Assessment of selected ecosystem services in parks

## A2.1 Provisioning services from parks

### (i) Provision of clean water

#### *Benefit and beneficiary*

Water supply catchments in Victoria's parks capture water and release it cleaner to physical infrastructure for drinking, food production and other uses such as small-scale power generation, providing benefits to water consumers, food producers and consumers, and other industries. The infrastructure includes pipes, channels and water storage facilities.

SEEA defines water supply as a provisioning service where the water is *abstracted* from water bodies, such as rivers or lakes, that are located within a given ecosystem, despite the water itself being generated across multiple ecosystems[48]. Consumption data from water diversion points located in parks was not available for this project, but we report the volumes of water released from parks' rivers to assess the capacity of parks ecosystems to supply water to the State.

#### *Context*

Over one million hectares of Victorian water supply catchments are located within Victoria's parks and 36 of the State's water supply catchments contain at least 50% of their area as park. The living infrastructure of these catchments enables the water run-off to be collected and distributed through built infrastructure such as pipes, pumps and storages and is a valuable resource for consumptive and productive uses, particularly for drinking water and agricultural use. The forest and wetland ecosystems of parks influence the total quantity, quality and seasonal variation of flows, with intact forests and wetlands soaking up and storing water when it is abundant and releasing it in dry periods.

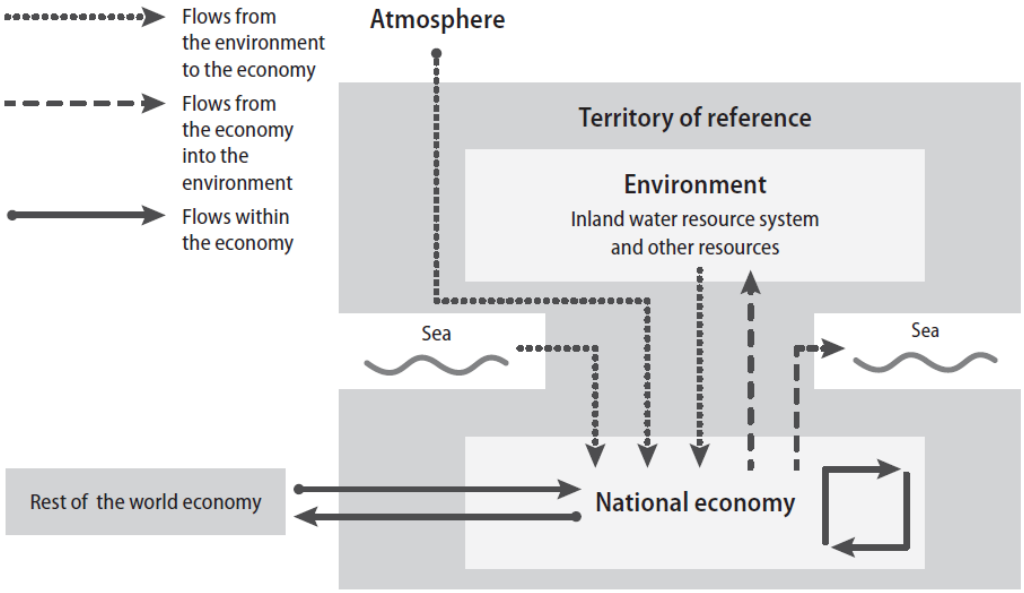
Water catchments in parks capture water for many of Victoria's cities and towns including Melbourne and Geelong. For example 90% of Melbourne's water supply is captured from park catchments and the catchments of the Grampians National Park supply water to 45 towns and 7,000 rural properties[49].

Market transaction values relating to water supply are already included in the System of National Accounts (SNA) and attributed to the water supply industry. The SEEA-Water accounts aim to integrate information on the economy, hydrology, other natural resources and social systems. The SEEA-Water accounting framework includes physical water supply and use tables describing water flows in physical units within the economy and between the environment and the economy (as shown in Figure A2.1 below). This requires identifying the flow of water through parks and the proportion of this that is released to physical infrastructure for distribution to households and agricultural users.

[48] United Nations 2013, *SEEA 2012: Experimental Ecosystem Accounting*. p. 47.

[49] http://www.gwmwater.org.au/customers/publications/brochures/cat_view/170-publications/79-brochures

**Figure A2.1 SEEA Water Flows in the physical supply and use tables**




Source: *SEEA-Water System of Environmental-Economic Accounting for Water*, United Nations Statistics Division, 2012

The market value of water supplied in the Alpine National Park's seven river systems was assessed by URS in 2005[50]. This study estimated a total annual value of water from the Alpine National Park of around $12 million per year based on 2003 water prices. In addition, the study indicated the value of production that would be foregone if the proportion of water currently used for irrigation were not supplied by the Alpine National Park would be in the order of $45 million per annum in Australia's GDP (through irrigation alone). According to this report, the economic contribution could potentially increase to around $110 million per year if other water uses (such as urban industrial and household consumption, hydroelectricity and aquaculture) are included.

In 2013 Yarra Valley Water published a study prepared by Trucost estimating the economic value of water resources and related ecosystem services[51]. The study estimates direct and indirect use values for water abstracted and distributed by Yarra Valley Water to residential households, commercial and industrial users in Melbourne. This study found that the annual indirect use value of water as a natural asset used in the Melbourne ranges (most of which is national park) through ecological functions[52] was $2 billion on average and ranged from $570 million to $3 billion over the eight-year period analysed (from 2003/04 to 2010/11), depending on the level of water scarcity. The $2 billion value is almost twice the $1 billion value of Melbourne water retailers' sales in 2010-11. Direct use values were derived from the average prices charged and willingness to pay across different users for water supply provided by Yarra Valley Water and amount to $1.8-2.9/$m^3$ for residential users and $0.2-5.1/$m^3$ for industrial commercial users. Recreational fishing values were estimated at $126 million per annum. However, note that this study uses a benefit transfer approach largely based on estimates and water demand functions from overseas studies to measure the marginal value of water to different users.

[50] URS 2005 *The Value of Water from the Victorian Alpine National Park*, prepared for the Department of Sustainability and Environment.
[51] Trucost 2013 *White Paper: Valuing water to drive more effective decisions*, prepared for Yarra Valley Water.
[52] The following ecosystem functions were included: hydrological functions (e.g. groundwater recharge and freshwater replenishment), biogeochemical functions (e.g. waste assimilation) and ecological functions (e.g. habitat maintenance)

### *Links to other services*

Water is necessary to many other provisioning ecosystem services (e.g. food) and most regulating ecosystem services (e.g. water purification, flood protection), supporting ecosystem services (e.g. photosynthesis, nutrient cycling) and cultural ecosystem services (e.g. recreation, aesthetic experience).

### *Quantity of service provided*

Previous estimates of the water runoff delivered by 86 of Victoria's National and State parks have been estimated at 7,100 Gigalitres (GL) per year, equating to 34% of Victoria's total water runoff in 2005.[53]

Recent modelling of nine of Victoria's National and State parks in non-metropolitan areas commissioned by Parks Victoria[54], including some of the State's highest yielding parks, has estimated that these parks provide annual water flows of about 3,392 GL per year on average (excluding any environmental flows not captured in unregulated supply). This is about 16% of the State's total runoff[55]. The highest yielding parks are the Alpine and Yarra Ranges National Parks, but other parks such as the Grampians National Park also contribute significantly to local water supply. Modelling of the metropolitan parks indicated these parks supply approximately 34 GL of water per annum.

**Table A2.1 Water annual mean flows across selected national and State (non-metropolitan) parks**

| | Modelled park hectares | Mean annual flow (ML/year) |
|---|---|---|
| **Alpine National Park** | | **2,625,000** |
| Regulated | 237,917 | 1,079,000 |
| Unregulated | 387,319 | 1,547,000 |
| **Baw Baw National Park** | | **47,000** |
| Greater Melbourne | 8,092 | 47,000 |
| **Bunyip State Park** | | **31,000** |
| Unregulated | 10,150 | 31,000 |
| **Great Otway National Park** | | **28,000** |
| Greater Melbourne | 11,429 | 28,000 |
| **Grampians National Park** | | **156,000** |
| Regulated | 76,231 | 98,000 |
| Unregulated | 45,484 | 58,000 |
| **Lerderderg National Park** | | **25,000** |
| Regulated | 20,486 | 25,000 |
| **Lake Eildon National Park** | | **123,000** |
| Regulated | 26,766 | 123,000 |
| **Warby Ovens National Park** | | **6,000** |
| Regulated | 7,332 | 6,000 |
| **Yarra Ranges National Park** | | **351,000** |
| Greater Melbourne | 44,691 | 243,000 |
| Unregulated | 20,429 | 108,000 |
| Total Greater Melbourne | 64,212 | 318,000 |
| Total Regulated | 368,732 | 1,330,000 |
| Total Unregulated | 463,423 | 1,744,000 |
| **Total** | | **3,392,000** |

Source: Marsden Jacobs Associates (MJA) 2014, Valuing the Water Services provided by Victoria's Parks.

Notes: analysis based on 43 of the 115 park outlets that account for 90% of total annual yield. Regulated uses are water flows from park outlets drain into regulated rivers, i.e. rivers where downstream flows are regulated by a major storage or dam. Unregulated uses are water flows from park outlets drain into unregulated rivers, i.e. rivers without a major storage or dam.

[53] SKM 2005, *Runoff from Victorian Parks*, Report prepared Parks Victoria. About 25% of the State's annual runoff (21,120 GL) is used for consumption in Victoria (4,993 GL in 2004-05 and 4,220 GL in 2012-13, Source: ABS 2013, Water Account, Australia, 2012-13). Entitlements for surface water was 6,423 GL in 2012-13 (Source: DEPI 2014, Victorian Water Accounts).
[54] Marsden Jacobs Associates 2014, *Valuing the Water Services provided by Victoria's Parks.* Report prepared for Parks Victoria
[55] Available surface water in the State was 21,185 GL in 2012-13. DEPI 2014, Victorian Water Accounts.

### *Counterfactual: the world without parks*

In the absence of parks, the counterfactual is that the national and State (non-metropolitan) park areas would have been cleared and used for grazing, while current metropolitan park areas would have been used for residential development. Under the counterfactual, cleared park areas for grazing would see increased water runoff estimated by MJA at 852,000 ML per year across the relevant catchments. The additional availability of surface water, however will not necessarily translate into additional/new entitlements or water consumption at current market prices. In addition, flooding and more sediment would arise as a result of clearing land for grazing, which will negatively impact water quality and create some negative externalities for both productive and recreational uses.

### *Valuation method*

The valuation of water supply is based on market-based techniques for changes in water availability valued with equivalent entitlement prices or supply costs to water corporations. Although market based values of water are available, prices charged for abstraction do not reflect the full value of water. Water prices generally cover the infrastructure, maintenance and operations, including energy costs, to distribute clean water and treat wastewater. These prices therefore largely reflect the value of capital inputs on the supply side rather than the water itself.

From the point of view of consumers (e.g. households, irrigators using water as an input), the value of clean water being supplied is likely to be much higher than what is implicit in current prices charged. In other words, people would be willing to pay more in their current charges to maintain water quality and avoid issues (e.g. pollution, salinity), which could impact on the environment, health and business productivity. This consumer surplus value is not captured in the market-based techniques for changes in water availability at current water quality levels.

Marsden Jacob Associates (MJA) were commissioned by Parks Victoria to value water services from Victoria's parks as part of this project. MJA used the market value of entitlements for the change in water supply available to irrigation in non-metropolitan areas and the avoided cost of alternative supply in metropolitan areas (i.e. cost of water supply from Lake Eildon via the Sugarloaf pipeline).

The modelling of catchments and rivers running through current park areas indicates that 82% of water runoff is used in agriculture, 9% is supplied to Greater Melbourne and the remainder is used for other unregulated consumption (likely to include a large part of environmental flows). The value of water supply is derived from a combination of the following least-cost options: 35% of water is used for agriculture with high reliability entitlements, 47% of water is used for agriculture with low reliability entitlements, the 9% of urban water for Melbourne will use a combination of Sugarloaf Reservoir and high reliability entitlements (the cost of the desalination plant was well above the other options and therefore was not used).

Water absorption by parks' vegetation represents about 20% of water availability that would become available under the counterfactual, however this runoff may not necessarily have commercial value for other uses. Under the assumptions of the MJA valuation that all runoff going through cleared parkland in non-metropolitan areas would be valued with current entitlement prices, and after incorporating the externalities of reduced water quality (assessed in Section A2.2), gives the value of the net benefit for park watershed services for the supply of clean water (recreational or environmental water values were not included).

### *Value of benefits*

The value of providing clean water comprises the joint impact of change in land use on water runoff and sediment released. Therefore, the welfare value is provided in the water filtration service (Section A2.2), which takes into account the reduction in yield and increased water quality due to parks.

In terms of economic activity, the market value of all water runoff supplied in nine of the higher yielding Victorian national parks was estimated at $244 million per annum, assuming it could be used for entitlements or supply to Greater Melbourne. If the runoff would be for environmental use only, then a welfare value would need to be derived using other valuation techniques.

## (ii) Honey production

### *Benefit and beneficiary*

Honey and other apiary products are produced from bee sites in Victorian parks providing benefits to producers and consumers of these products.

### *Context*

Bees produce honey and other bee products such as beeswax, pollen, propolis, and royal jelly. However, there are very few producers of propolis and royal jelly in Australia[56]. Honey is by far the most common bee product in Australia. The majority of Australian honey is produced by European honeybees, although there is a small amount of production by native bees. Bees require access to floral resources on public or private land.

Table A2.2 shows the number of bee sites on public and private land in Victoria in 2012. There are 1,235 bee sites in parks, 28% of the Victorian total. There are another 459 bee sites on other public land including conservation reserves (primarily managed by Parks Victoria). The estimated proportion of bee sites on land managed by Parks Victoria is 28%-38% of the Victorian total[57].

**Table A2.2 Bee sites in Victoria, 2012**

| Land | Number of sites | Per cent of total |
|---|---|---|
| Victoria | 4,500 | 100% |
| Private land | 863 | 19% |
| Public land | 3,637 | 81% |
| State forest | 1,943 | 43% |
| Parks | 1,235 | 28% |
| Other public land (including conservation reserves) | 459 | 10% |

Source: Department of Sustainability and Environment 2012, 'Putting the buzz back in agriculture, Background – Issues paper'

Bee sites are not always licensed and even licensed sites may not be occupied, as occupation is dependent on nearby floral resources, which are seasonable and variable. Although occupation is sporadic, beekeepers tend to retain sites on a permanent basis to ensure access. A hive of bees may be moved four to seven times per year[58].

There were an estimated 101,820 beehives managed by 2,407 beekeepers in 2011. Each site, when occupied, carries 100 to 150 beehives. Between 70% and 80% of honey production in the State is derived from *Eucalyptus sp.,* which mostly occur on public land[59].

### *Links to other services*

Honeybees also provide the regulating service of pollination.

[56] Centre for International Economics 2005, 'Future directions for the Australian honeybee industry, p. ix.
[57] Department of Sustainability 2012, 'Putting the buzz back in agriculture, Background – Issues paper', pp 3-4.
[58] Department of Sustainability 2012, 'Putting the buzz back in agriculture, Background – Issues paper', p. 4, 28.
[59] Department of Sustainability 2012, 'Putting the buzz back in agriculture, Background – Issues paper', p. 4.

### *Quantity of service provided in the parks network*

Victoria produces around 4,250 tonnes of honey products on average per year, around 17% of Australia's honey production[60]. Based on the 28-38% proportion of bee sites found in Victorian parks (outlined in Table A2.2), the quantity of honey produced from parks is estimated at around 1,190-1,615 tonnes per year.

### *Counterfactual: the world without parks*

In the absence of parks, the counterfactual is that national and State (non-metropolitan) parks would have been cleared and used for grazing, while metropolitan park areas would have been used for residential development. Under the counterfactual, there would not be sufficient native vegetation across the State to maintain production levels from bee sites currently located in non-metropolitan parks areas.

An earlier apiary industry report concluded that without access to public land, this industry would not be able to survive in its present form[61]. This dependency on public land (particularly national parks, State forests and other conserved forests) is because public land contains the majority of native forests on which the industry is so reliant and provides much of the network of apiary sites which the industry needs to access in order to harvest honey flows, which occur irregularly and for short periods. In addition, native forests on public land also provide a safe environment and clean rehabilitation area, which is needed to rebuild the strength and health of hives.

As a result, without parks, the relocation of some beehives could be possible in the short-term, but the increased beekeeping costs associated with limiting the current movement of hives around the State and Australia would greatly reduce the productivity and the profitability of the industry. As a result, producers would cease producing honey in Victoria. In the long-term, producers would adjust by shifting to other Australian regions, while consumers would purchase imported honey or use substitutes of honey.

### *Valuation method*

The valuation of honey supply is based on market-based techniques. Some market data is available for the production of honey and related products. Specifically, the average price received by Victorian honeybee businesses for honey sold during 2006-07 was $2.80 per kg, while their cash costs were $2.30 per kg[62]. The benefit of the industry in the short-term is obtained from beekeepers' Gross Operating Surplus ($0.50 per kg of honey) and the quantity of honey produced attributable to parks.

### *Value of benefits*

Based on the valuation method and assumptions described above, **benefits of honey production from park managed areas is estimated to be in the range of $0.6-$1.0 million per year.** Additional potential benefits to consumers, measured as the consumer surplus, were not taken into account.

[60] Department of Sustainability 2012, 'Putting the buzz back in agriculture, Background – Issues paper', p. 27.
[61] Gibbs and Muirhead 1998, *The economic value and environmental impact of the Australian beekeeping industry.* A report prepared for the Australian beekeeping industry. February 1998.
[62] RIRDC 2008. Australian honeybee industry survey, 2006-07. RIRDC Publication No. 08/170

In terms of economic activity, honey and related products worth $12 million were traded in the Victorian economy in 2011[63]. Based on the proportion of bee sites in parks, the contribution of park-based apiary sector to agricultural gross output is estimated at around $3.4-$4.6 million in 2011. This represents the economic activity *associated* with park-based honey production, which is larger than the value directly attributable to Victorian parks.

[63] Department of Sustainability and Environment 2012, 'Putting the buzz back in agriculture, Background – Issues paper', p.3.

## A2.2 Regulating services from parks

### (i) Water purification and filtration services

#### *Benefit and beneficiary*

Parks filter and purify water, which benefits water consumers and agricultural producers. Clean water is critical for human health and is also essential for water-based recreation.

#### *Context*

The forests, woodlands and wetlands of Victoria's parks improve water quality by naturally purifying and filtering water and reducing the release of soil sediment, pollutants and organic matter that would otherwise reach our waterways.

Many of Victoria's national parks and reserves contain water catchments that are used for either drinking water or agricultural production and these parks provide cost-effective living infrastructure to purify and filter water before it reaches water consumers. Metropolitan parks play an important role in reducing the level of nutrients and toxicants that affect water quality and ecosystem health in our urban waterways and bays.

Water quality can be reduced when ecosystems are degraded or disturbed, such as through loss of vegetation cover, trampling or overgrazing by introduced animals or introduction of pathogens or disease. Large-scale fires can have a significant short-term impact on water quality through movement of sediment and other matter into waterways and water supply infrastructure. The maintenance or improvement of catchment condition can significantly lower potential water treatment costs.

In providing a water purification service, parks contribute significantly to the delivery of the *State Environment Protection Policy (Waters of Victoria)* and *Victoria's Urban Stormwater Best Practice Environmental Management Guidelines.* Without parks, more water treatment infrastructure would be needed to maintain current water quality standards, and the cost to Government and taxpayers would be significantly higher.

#### *Links to other services*

Clean water is necessary for many other ecosystem services including provisioning ecosystem services (e.g. food production), regulating services (e.g. carbon storage and sequestration, genetic diversity), supporting services (e.g. photosynthesis, nutrient cycling), and cultural ecosystem services (e.g. recreation, aesthetic experience).

#### *Quantity of service provided*

The service flows for water purification and filtration are quantified in terms of sediment output for non-metropolitan parks and nitrogen nutrient loads for metropolitan parks.

**Non-metropolitan national parks**

Based on a partial assessment of the parks network using detailed hydrological models of eight of the State's highest water yielding national parks, these parks are estimated to provide in total around 4,165 tonnes of sediments into non-metropolitan waterways as compared with potentially 50,960

tonnes, which would be produced if the land were cleared for grazing. The amount of sediment loads from parks is compared to the loads under cleared land in Table A2.3. The Alpine National Park provides about 2,700 tonnes of sediment output per annum, while the annual sediment output if land would be cleared for grazing in this area would be 30,700 tonnes per annum. This National Park alone provides a significant capacity of purification services and erosion control, which prevents this sediment from entering waterways and water supply infrastructure, as compared to an alternative agricultural land use. The Yarra Ranges National Park is also significant in providing water purification services and it is estimated that it could prevent 12,590 tonnes of sediment from entering waterways and water supply infrastructure, as compared to grazing land use.

Note the analysis of non-metropolitan parks is restricted to regulated systems – i.e. water flows from park outlets into rivers where downstream flows are regulated by a major storage or dam.

**Table A2.3 Total sediment loads in parks compared with an alternative land use**

| | | Sediment Output (tonne per year) | | |
|---|---|---|---|---|
| | **Hectares modelled** | **Existing Parks** | **Grazing** | **Difference** |
| **Alpine National Park** | | | | |
| Regulated | 237,917 | 2,700 | 30,700 | 28,000 |
| **Baw Baw National Park** | | | | |
| Greater Melbourne | 8,092 | 30 | 420 | 390 |
| **Great Otway NP** | | | | |
| Greater Melbourne | 11,429 | 140 | 160 | 20 |
| **Grampians National Park** | | | | |
| Regulated | 76,231 | 220 | 1,150 | 930 |
| **Lerderderg NP** | | | | |
| Regulated | 20,486 | 530 | 4,070 | 3,540 |
| **Lake Eildon NP** | | | | |
| Regulated | 26,766 | 320 | 1,620 | 1,300 |
| **Warby Ovens NP** | | | | |
| Regulated | 7,332 | 155 | 180 | 25 |
| **Yarra Ranges NP** | | | | |
| Greater Melbourne | 44,691 | 70 | 12,660 | 12,590 |
| Total Greater Melbourne | 64,212 | 240 | 13,240 | 13,000 |
| Total Regulated | 368,732 | 3,925 | 37,720 | 33,795 |
| **Total** | | **4,165** | **50,960** | **46,795** |

Source: MJA 2014, Valuing the Water Services Provided by Victoria's Parks. Report prepared for Parks Victoria.

Notes: analysis based on 43 of the 115 park outlets that account for 90% of total annual yield. Regulated uses are water flows from park outlets drain into regulated rivers, i.e. rivers where downstream flows are regulated by a major storage or dam. Unregulated uses are water flows from park outlets drain into unregulated rivers, i.e. rivers without a major storage or dam.

### Metropolitan parks

Melbourne's metropolitan parks are estimated to release on average over 31 tonnes of nitrogen per annum. By contrast, under a residential land use, the total amount of nitrogen loads expected would be about 213 tonnes per annum, which is a decrease in nutrients loads of 182 tonnes per annum. Without these parks the additional nutrient loads, under alternative land uses, would make their way into the waterways and bays of both Port Phillip and Westernport and so, additional costs would be required to maintain the quality of water released at current standards.

### *Counterfactual: the world without parks*

In the absence of parks, the counterfactual is that national and State (non-metropolitan) parks would have been cleared and used for grazing, while current metropolitan park areas would have been used for residential development.

As discussed in the previous section, under the counterfactual, cleared park areas for grazing would see increased sediment loads estimated at 46,795 tonnes per year across the relevant catchments. In the case of metropolitan parks, land use change to residential development would produce an increase in nitrogen loads of about 182 tonnes per annum. These additional pollutant loads will require additional infrastructure to maintain water quality at current levels.

### *Valuation method*

Marsden Jacob Associates (MJA) were commissioned by Parks Victoria to value water services from Victoria's parks as part of this project. The water regulation services of selected Victorian parks have been valued using market based approaches based on the replacement cost approach and the cost of new water treatment infrastructure to deal with the additional sediment or nitrogen loads under the counterfactual, as described below. For **non-metropolitan national parks** the assessment is based on the cost of supplying the equivalent volume of water to replace dam storage that is lost due to sediment accumulation. For parks servicing Greater Melbourne, this is based on the cost of sourcing water from Lake Eildon via the Sugarloaf pipeline. For parks servicing irrigated agriculture and rural townships, the cost is based on purchasing water entitlements for the volume of sediment taking up storage space in dams. This is a partial estimate and does not take into account the avoided costs of sediment affecting water distribution infrastructure, such as pumps, which would be damaged badly.

For Melbourne's **metropolitan parks** the assessment is based on the avoided cost of filtration infrastructure. The cost is based on the water quality charges component of Melbourne Water's developer contribution charges, designed to fund off-site infrastructure to achieve stormwater quality requirements where on-site stormwater treatment is not possible or feasible. The cost is $2,250 per kilogram of annual Total Nitrogen load.

### *Value of benefits*

Based on a partial assessment of the Victorian parks network, including a selection of higher yielding parks, the value of the sediment filtration service for *regulated rivers* in non-metropolitan parks is around $125 million per annum (65% of this affects water use in Greater Melbourne, the remainder is from other regulated water use)[64]. After taking into account the reduction in runoff of non-metropolitan parks (as discussed in Section A2.1), the resulting net **benefits of watershed services in non-metropolitan parks are estimated at $50 million per annum.**

Based on modelling of the quantity of nitrogen nutrients filtered and the estimated cost of filtration infrastructure, **the benefits of water filtration in Melbourne's metropolitan parks network is in the order of $33 million per year**[65]. This equates to an avoided cost of $33,000 per hectare or almost $2,150 per hectare per year.

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[64] Source: Marsden Jacobs Associates 2014, *Valuing the Water Services provided by Victoria's Parks*, Report prepared for Parks Victoria

[65] Ibid

In summary the **water purification and filtration services of selected Victorian parks are estimated to provide an annual value of benefits of about $83 million per year**. The benefits of filtration services provided by parks are summarised in Table A2.4.

**Table A2.4 Summary of economic value of water filtration services of selected parks**

| Parks | Water filtration services from selected Victorian parks | |
|---|---|---|
| | Capital value ($ million) | Annualised value ($ million) |
| National parks network | $770 | $50 |
| Reduced sediment in regulated rivers | $1,920 | $125 |
| Reduced sediment in unregulated rivers | *Not included* | *Not included* |
| Water yield reduction | -$1,150 | -$75 |
| Metropolitan parks network | $500 | $33 |
| **Total (metropolitan and national parks)** | **$1,270** | **$83** |

Note: Annualised value derived from capitalised values, using a 5% discount rate over 30 years.

## (ii) Flood and stormwater regulation services

### *Benefit and beneficiary*

Parks help mitigate damage by floods and stormwater runoff to private and community assets and infrastructure. The beneficiaries are Victorian communities, agricultural producers and water consumers.

### *Context*

The native vegetation, wetlands and green spaces of parks help regulate the flow of water in catchments, providing protection against flooding.

In national parks and reserves, the healthy vegetation and soil of forests, woodlands, grasslands and wetlands absorb rain and regulate water movement within the catchment. This assists in releasing water into waterways at more natural velocities and volumes. Parks also contribute to reducing soil loss and erosion from rain events.

Within the Melbourne area, the extensive permeable surfaces of metropolitan parks play an important role in reducing the volume and velocity of stormwater reaching waterways. This means reduced physical infrastructure and stormwater management actions are needed, and the cost to Government and taxpayers is significantly lower than it would be without parks.

### *Links to other services*

Flood and stormwater regulation services have interdependencies with a range of ecosystem processes including the carbon cycle and nutrient cycle. Wetlands also provide essential habitats for many species.

### *Quantity of service provided*

The service flow for metropolitan parks is quantified in terms of stormwater runoff avoided, while for non-metropolitan parks the measure used is reduction in peak flows.

**Stormwater regulation from Metropolitan parks**

Melbourne's metropolitan parks are estimated to provide 34 GL per year under the current land use as a park, but if the land was used for urban residential development the volume of stormwater runoff would be 74 GL per year. Without its metropolitan parks, Melbourne's stormwater management infrastructure would require a major increase in capacity to cope with this doubling of stormwater volume.

**Flood regulation from national parks and reserves**

Based on modelling of a number of national and State (non-metropolitan) parks, the peak flows in selected parks vary widely from a range of 49-3,159 $m^3/s$ to 54-3,926 $m^3/s$ for peak 100-year Average Recurrence Interval (ARI) flows[66]. The recurrence of peak flows under a scenario of cleared land for grazing would increase by more than 20% across most parks, depending on their location, as described in Table A2.5 below.

[66] Measured as peak flows with 1:100 year Average Recurrence Interval (ARI)

**Table A2.5 Peak flows (m3/s) from parks compared with alternative land use**

| Park | Peak flows from park land use (ARI_100) | Peak flows from agricultural land use (ARI_100) | Reduction in ARI_100 |
|---|---|---|---|
| Alpine NP | 3,159 | 3,926 | 24% |
| Yarra Ranges NP | 337 | 726 | 115% |
| Great Otway NP | 321 | 518 | 61% |
| Grampians NP | 266 | 416 | 56% |
| Lerderderg SP | 117 | 154 | 31% |
| Lake Eildon NP | 88 | 108 | 23% |
| Bunyip NP | 87 | 116 | 33% |
| Baw Baw NP | 81 | 87 | 7% |
| Warby Ovens NP | 49 | 54 | 11% |

ARI_100 = 1:100 Average Recurrence Interval. Source: MJA 2014, Valuing the Water Services Provided by Victoria's Parks. Report prepared for Parks Victoria.

### *Counterfactual: the world without parks*

In the absence of parks, the counterfactual is that national and State (non-metropolitan) parks would have been cleared and used for grazing, while current metropolitan park areas would have been used for residential development.

As discussed in the previous section, under the counterfactual, most cleared land in current catchments in national parks would see an increase in peak flows (100-year ARI) of 7% to 215% across the relevant catchments (with a mean increase of 40%). In the case of metropolitan parks, land use change to residential development would require Melbourne Water to provide additional stormwater regulation and retention services, which may include onsite infrastructure that conveys or retards stormwater and waterway protection works.

### *Valuation method*

Only stormwater regulation in metropolitan parks was valued for this project, due to the complexity of peak flows modelling and valuation for non-metropolitan parks.

For metropolitan parks, valuation is based on the per hectare avoided cost of flood detention or retarding basin storage.[67] The cost is based on the hydraulic component of Melbourne Water's developer contribution charges – reflecting the cost of on-site infrastructure that conveys or retards stormwater, including waterway protection works. As the hydraulic charges are site specific, MJA sampled recent development sites where hydraulic charges were applied to develop weighted average cost estimates of around $28,000 per hectare east of Melbourne and $68,000 per hectare north or west of Melbourne.

### *Value of benefits*

Based on hydrological modelling of metropolitan parks only, **the benefit of the stormwater retention services of Parks Victoria's metropolitan parks is estimated at $46 million per annum** (or almost $3,000 per hectare per annum). This is a partial estimate, as the avoided costs of alternative flood retention infrastructure for non-metropolitan areas could not be assessed as part of this project.

[67] Marsden Jacobs Associates 2014, *Valuing the Water Services provided by Victoria's Parks*, Report prepared for Parks Victoria

## (iii) Climate regulation services

### *Benefit and beneficiary*

The beneficiary of climate regulation services is the Victorian community as well as the global community more broadly.

### *Context*

Carbon storage relates to the carbon held in plant biomass and soils (stocks). Carbon flows relate to the process of sequestering or emitting carbon to the atmosphere.

Across the world, intact terrestrial, wetland and marine and coastal ecosystems of parks play a vital role in regulating the earth's climate by adding and removing carbon dioxide from the atmosphere and storing it in the form of organic carbon in plant (trunks, branches, foliage, and roots) biomass and soil. These ecosystems store more carbon than the atmosphere and are vital to influencing carbon dioxide-driven climate change.

Forests and woodlands are particularly important in the global carbon cycle because they can sequester large amounts of carbon over long time periods. Victorian parks are nationally and internationally significant for their ability to store carbon[68]. For instance, the mountain ash forests of the Central Highlands (including the Yarra Ranges National Park) have shown to contain the world's highest carbon biomass density of up to 1,867 tonnes of carbon per hectare, more than the forests of the Amazon.

While there is much evidence of the role that terrestrial ecosystems play in carbon storage, there is an increasing body of evidence that coastal and marine ecosystems, such as seagrass habitats, tidal marshes and mangroves, store very large volumes of organic carbon. Recent estimates suggest that these Australian coastal ecosystems can store more than five times the volume of 'blue carbon' than terrestrial ecosystems and can sequester at rates of up to 66 times that of terrestrial ecosystems[69].

By ensuring parks are well managed, including preventing soil erosion, large scale severe fires, vegetation disease, impacts of introduced species and human pressure and by undertaking restoration programs such as revegetation, parks can protect and increase carbon stocks and sequester carbon over time. When preserved, carbon is stored in these ecosystems, however when vegetation is destroyed or degraded, carbon is emitted back into the atmosphere.

Carbon emissions may occur from natural events through large-scale disturbances (e.g. bushfires) or smaller scale disturbances (e.g. local habitat degradation or planned burning). Based on modelling in Victorian forests, the loss of carbon from fire related emissions was estimated at around 2% of the total carbon stock on public land between 2000 and 2009[70].

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[68] Norris, J., Arnold, S. and Fairman, T. 2010. 'An indicative estimate of carbon stocks on Victoria's publicly managed land using the FullCAM carbon accounting model'. *Australian Forestry 73*. pp.209-219; Keith, H., Mackey B.g and Lindenmayer D.B. 2009, R*e-evaluation of forest biomass carbon stocks and lessons from the world's most carbon-dense forests*, PNAS Vol. 106, Number 28.

[69] Lawrence, A.J., Baker, E., Lovelock, C.E. 2011, Optimising and managing coastal carbon: Comparative sequestration and mitigation opportunities across Australia's landscapes and land uses. Fisheries Research and Development Corporation (FRDC) Report 2011/084.

[70] Norris et al. 2010 (Op. cit. p.82)

There is a school of thought that parks consist mostly of areas of older terrestrial vegetation that are already close to their carbon carrying capacity, and therefore play a limited role in carbon sequestration. However, new evidence is emerging suggesting that these ecosystems may play a significant role as sequesters of carbon[71].

The climate regulation service that parks can play is therefore threefold:

- protection of large stocks of carbon through maintenance of intact healthy forests, woodlands, wetlands, grasslands and coastal and marine ecosystems;
- sequestration of carbon in areas that are not currently at their carbon carrying capacity; and,
- sequestration of carbon through direct revegetation and habitat restoration programs, such as grazer control.

A recent study assessed the contribution of US National Park Service (NPS) parks to carbon sequestration through plant growth using baseline data over 2001 and 2005 and models to assess the amount of carbon expected to be sequestered from 2006 to 2050. The estimates were based on parks boundary and land cover data, along with peer-reviewed work on carbon sequestration rates. The study found that US NPS currently sequesters an average of 17.5 million of tonnes $CO_2$ per annum, which is valued at $707 million dollars (using a social cost of carbon of $40.45 per tonne). The benefits to Americans from this ecosystem service alone is about 28% of the NPS budget.

Further, the study found that projections of carbon sequestration in the US NPS are expected to drop by 31% due to climate change and associated increase in fire hazards (this estimate assumes there are no changes in land management). Thus, without greater intervention by NPS, the amount of carbon sequestered will decline due to global climate trends[72].

This climate regulation service fits within Australia's international undertaking to reduce greenhouse gas emissions by at least five per cent by 2020, compared with 2000 levels, under the Kyoto Protocol[73]. At the United Nations climate change negotiations in Durban, South Africa in 2011, parties to the Kyoto Protocol decided to establish a second commitment period from 1 January 2013. The Federal Coalition has given 'in-principle support' to Australia's involvement in a second round of the Kyoto Protocol. At the 2011 negotiations some important decisions were made about future carbon accounting in the land use, land use change and forestry sector. Key decisions of direct relevance to the Department of Environment, Land, Water and Planning and Parks Victoria include:

- all managed forests will be subject to carbon accounting in the next international commitment period (starting 2013); and,
- countries will be allowed to exclude emissions resulting from major natural disturbances, such as bushfires, from their carbon accounting (force majeure).

The changes mean Australia will have to account for all forest emissions above a national reference level, except in circumstances when the Commonwealth decides to use the force majeure provision to exclude emissions from accounting because of natural disturbance.

[71] Keith et al. 2009 (Op. cit. p.82)

[72] Banasiak, Adam, Linda Bilmes, and John Loomis. "Carbon Sequestration in the U.S. National Parks: A Value Beyond Visitation." Discussion Paper 2015-66. Cambridge, Mass.: Harvard Project on Climate Agreements, February 2015.

[73] The Kyoto Protocol is an international agreement created under the United Nations Framework Convention on Climate Change in Kyoto, Japan in 1997.

The extension of carbon accounting in this area means the area of Victorian public land covered is likely to increase from the current negligible level (approximately 100,000 hectares) up to at least 1.3 million hectares (mainly State Forest), and potentially more. The 'managed forest' definition is not clear at this time, but could include forests in Victoria's parks and other public land, if they are deemed 'managed forests'. This will depend on how the Commonwealth will translate the international accounting obligation into a domestic policy decision about responsibility for carbon management of forests.

If parks were defined in the future as 'managed forests', this would mean that existing stocks of carbon in Victorian parks are potential economic liabilities (if carbon is released through environmental degradation or disturbances) or an asset (if further carbon sequestration occurs).

#### *Links to other services*

The storage and removal of carbon dioxide by a forest or wetland ecosystem are connected to other regulating services, including habitat services, air filtration and water filtration.

#### *Quantity of service provided*

**Land carbon storage**

The estimated volume of carbon currently stored in Victorian terrestrial parks is around 270 million tonnes[74] (almost 1 billion tonnes of carbon dioxide equivalent[75]), which is equivalent to around nine years of Victoria's total annual greenhouse gas emissions[76]. The table below shows the estimated carbon stocks in twelve national parks.

**Table A2.6 Average above ground carbon stocks in selected Victorian parks**

| Park | Estimated carbon stocks (million tonnes) | Approximate area (hectare) | Average tonnes of carbon per hectare |
|---|---|---|---|
| Alpine National Park | 71 | 662,000 | 106 |
| Murray-Sunset National Park | 21 | 666,000 | 31 |
| Snowy River National Park | 16 | 115,000 | 142 |
| Croajingalong National Park | 15 | 87,000 | 176 |
| Great Otway National Park | 14 | 103,000 | 135 |
| Yarra Ranges National Park | 12 | 77,000 | 156 |
| Wyperfeld National Park | 10 | 360,000 | 27 |
| Grampians National Park | 9 | 168,000 | 54 |
| Coopracambra National Park | 7 | 38,000 | 191 |
| Errindundra National Park | 6 | 40,000 | 158 |
| Wilsons Promontory National Park | 5 | 47,000 | 107 |
| Avon Wilderness Park | 4 | 40,000 | 99 |

Source: Land carbon 3 model (DSE 2012) which used the National Carbon Accounting Toolbox Full Carbon Accounting Model along with DSE corporate data such as fire and harvesting history, vegetation type and soil type.

The Alpine National Park accounts for nearly one quarter of the carbon stocks in the Victorian parks network, with around 70 million tonnes of carbon stored. The parks of eastern Victoria with their tall

[74] Data on carbon stocks based on Land carbon 3 model (DSE 2012) which used the National Carbon Accounting Toolbox Full Carbon Accounting Model along with DSE corporate data such as fire and harvesting history, vegetation type and soil type.
[75] 1 tonne of carbon = 3.664 tonnes of carbon dioxide equivalent.
[76] Victoria's annual emissions in 2010-11 were 118 million tonnes of carbon dioxide equivalent. See Commissioner for Environmental Sustainability Victoria 2013, *Victoria State of the Environment 2013 Report*.

wet forests (such as Yarra Ranges National Park) store much larger volumes of carbon per hectare than similar sized parks in drier landscapes. Some parks such as Murray-Sunset and Wyperfeld National Parks provide an important role in storing large amounts of carbon, because of their large size.

The modelled estimates are likely to be conservative. Recent studies based on measured field data indicate that the volumes of carbon from healthy forests may be significantly higher than the modelled estimates. For example, in the Central Highlands, carbon stocks were measured to be between two and five times that estimated by the model, depending on vegetation type and age since the last major fire[77].

**Land carbon sequestration**

The volume of carbon sequestered varies according to vegetation type as well as the age of the vegetation. There are currently limited estimates available. The quantity of sequestration is thought to be relatively small, but as discussed above, there is recent evidence suggesting that park ecosystems may play a more significant role as sequesters of carbon than previously thought. The expected outcomes of two major revegetation programs described below provide an indicative value of carbon sequestration from revegetation programs in selected parks.

Greenfleet revegetation program in parks

Since 2000 approximately 1,000 hectares across 30 parks have been revegetated under the Greenfleet revegetation program. Greenfleet has estimated that carbon sequestration across these parks due to this program could be up to 350,000 tonnes by year 20 and 500,000 tonnes by year 100 (in tonnes $CO_2$ equivalent, this is 1.3 and 1.8 million respectively). Based on these estimates, this would give carbon sequestration flows of about 18,350 tonnes of carbon dioxide equivalent being sequestered every year and an average sequestration rate of 5 tonnes of carbon per hectare per annum.

Two Million Trees program

Suitable carbon data was not available for this program. A high level analysis based on a conservative estimate of 2 tonnes of carbon per hectare per annum[78] indicates that 500 hectares of revegetation could provide additional carbon sequestration by approximately 70,000 tonnes by year 20 and 100,000 tonnes by year 100 (this is 257,000 and 367,000 $CO_2$ equivalent, respectively). Upon maturity of the forest, this would give about 3,670 tonnes of carbon dioxide equivalent being sequestered every year.

**Blue carbon storage and sequestration**

The Victorian parks network contains more than 25,000 hectares of mangrove, saltmarsh and seagrass habitats. Emerging research suggests that these coastal wetland ecosystems may be significant for both carbon storage and sequestration, with global estimates from the literature of 830 tonnes of $CO_2$ equivalent per hectare [79].

[77] Keith, H., D. Lindenmayer, B. Mackey, D. Blair, L. Carter, L. McBurney, S. Okada, and T. Konishi-Nagano. 2014. Managing temperate forests for carbon storage: impacts of logging versus forest protection on carbon stocks. Ecosphere 5. http://dx.doi.org/10.1890/ES14-00051.1

[78] Based on carbon sequestration rate of revegetation sites in the dryland regions of South Australia of 7.6 CO2-e t/ha/year

[79] See http://www.thebluecarboninitiative.org ; CSIRO http://www.csiro.au/Organisation-Structure/Flagships/Wealth-from-Oceans-Flagship/ORCA/Coastal-Carbon-Cluster.aspx; Fourqurean, JW., C.M Duarte, H.Kennedy, N.Marba, M.Holmer,

Recent studies in Victoria[80] have quantified the volume of carbon within coastal habitats. Table A2.7 below highlights that in over 25,000 ha of mangrove, saltmarsh and seagrass habitats protected within the States Marine Protected Areas, more than 850,000 tonnes of carbon or over three million of carbon dioxide equivalent is stored.

**Table A2.7 Carbon stored (tonnes) in Victoria's Marine Protected Areas**

| Park name | Marine ecosystem | Area (hectare) | Carbon stored per hectare | Total quantity of carbon stored |
|---|---|---|---|---|
| Wilsons Promontory Marine Park | Saltmarsh | 10 | 62 | 616 |
| Shallow Inlet Marine & Coastal Park | Saltmarsh | 104 | 62 | 6,523 |
| | Seagrass | 836 | 19 | 16,062 |
| Corner Inlet Marine & Coastal Park | Mangrove | 817 | 52 | 42,175 |
| | Saltmarsh | 362 | 62 | 22,616 |
| | Seagrass | 10,656 | 19 | 204,810 |
| Nooramunga Marine & Coastal Park | Mangrove | 2,082 | 52 | 107,509 |
| | Saltmarsh | 3,062 | 62 | 191,146 |
| | Seagrass | 2,123 | 19 | 40,799 |
| Churchill Island Marine National Park | Mangrove | 15 | 83 | 1,243 |
| | Saltmarsh | 3 | 104 | 293 |
| | Seagrass | 445 | 38 | 16,994 |
| Corner Inlet Marine National Park | Mangrove | 4 | 52 | 197 |
| | Saltmarsh | 1 | 62 | 85 |
| | Seagrass | 1,020 | 19 | 19,607 |
| French Island Marine National Park | Mangrove | 204 | 83 | 16,897 |
| | Saltmarsh | 7 | 104 | 766 |
| | Seagrass | 1,039 | 38 | 39,642 |
| Port Phillip Heads Marine National Park | Saltmarsh | 27 | 104 | 2,825 |
| | Seagrass | 1,875 | 38 | 71,522 |
| Yaringa Marine National Park | Mangrove | 313 | 83 | 25,966 |
| | Saltmarsh | 149 | 104 | 15,422 |
| | Seagrass | 276 | 38 | 10,538 |
| Jawbone Marine Sanctuary | Mangrove | 0 | 83 | 15 |
| | Saltmarsh | 1 | 104 | 58 |
| | Seagrass | 2 | 38 | 67 |
| Mushroom Reef Marine Sanctuary | Seagrass | 12 | 38 | 442 |
| Ricketts Point Marine Sanctuary | Seagrass | 2 | 38 | 70 |
| **Total** | | **25,445** | **34** | **854,905** |

Source: Deakin University, 2014

### *Counterfactual: the world without parks*

In the absence of parks, the counterfactual is that national and State (non-metropolitan) parks would have been cleared and used for grazing, while current metropolitan park areas would have been used for residential development. In the case of blue carbon currently stored in wetlands and saltmarsh,

MA.mateo, E.T.Apostolaki, G.A Kendrick, D.Krause-jensen and K.J McGlathery, 2012, *Seagrass ecosystems as a globally significant carbon stock*, Nature Geoscience 5. Pp. 505-509.

[80] Paul Carnell, Carolyn Ewers, Ellen Rochelmeyer, Daniel Ierodiaconou, and Peter Macreadie 2014, The Distribution and Abundance of 'Blue Carbon' within East Gippsland A report for the East Gippsland Catchment Management Authority

alternative land uses if the ecosystems were not protected could include clearing or dredging for resource extraction.

Under the counterfactual, some part of the carbon stored in parks would have been released as part of the soil disturbance associated with the clearing process and grazing activities, while wetland and coastal areas may be more affected by increased degradation of the ecosystems. The amount potentially released under the counterfactual would largely depend on the use and disposal of vegetation and trees biomass. However, at this stage it was not possible to assess the amount of carbon that would be released under the counterfactual.

In terms of carbon sequestration, parks provide a net benefit from the forests and vegetation it currently supports, which would be largely inexistent if parks did not exist.

#### *Valuation method*

**Carbon sequestration**

We consider two unit values of carbon sequestration. One is market price of reductions in emissions of carbon dioxide equivalent in current markets and the other is the social cost of carbon, which is the value of damage costs associated with greenhouse gas emissions. With the repeal of the Commonwealth Government's carbon price legislation, there is currently no legislated market price of carbon in Australia. The current cost of purchasing emission reductions in international markets has been estimated at AUD $0.50 to $2 per tonne of carbon dioxide equivalent for Clean Development Mechanism credits[81], while European Union Allowance (EUA) prices stabilised around EUR $5 per tonne of carbon dioxide over 2013 and California Carbon Allowance (CCA) prices reached AUD $15 per tonne of carbon dioxide[82]. Forecasts of international carbon prices for 2020 range from AUD $6 to $80 per tonne of carbon dioxide equivalent[83].

In terms of carbon sequestration from forestry or revegetation projects, current market transactions through the Carbon Farming Initiative indicate values closer to $23 per tonne carbon dioxide equivalent, however industry stakeholders have indicated that under the newly created Emissions Reductions Fund (ERF) these values are likely to be set at around $5-8 per tonne of carbon dioxide equivalent[84], which would be less than outlined in the original plan announced of $15 per tonne[85]. For the purpose of this valuation, the originally announced $15 per tonne of carbon sequestered is used as a lower bound for carbon sequestered in parks. This is consistent with recent voluntary carbon offset programs such as Greenfleet.

As the upper bound, this valuation uses the social cost of carbon. The social cost of carbon is a modelling estimate of the total cost today of a tonne of carbon emitted now, summing the full global cost of the damage associated with carbon over the whole of its time in the atmosphere. The social

[81] Commonwealth of Australia (Climate Change Authority) 2014, *Reducing Australia's Greenhouse Gas Emissions, Targets and Progress Review – Final Report*.
[82] Parliament of Australia 2013, Emission Trading Schemes around the world - Background note (available in www.aph.gov.au)
[83] Ibid
[84] Personal communication with James Schultz, CEO of GCS and Board member of the Carbon Market Institute (2 August 2014)
[85] The Coalition's proposed 'Direct Action Plan: Environment & Climate Change 2010' recommended using $15 per tonne for carbon sequestered in domestic forestry projects that are successful under the national Emissions Reduction Fund (ERF).

cost of a tonne of carbon dioxide emitted now has been estimated in a recent study published by the US Government at US$39[86] in 2011 dollars (around AUD$63 in 2014).

The valuation could be applied to specific reforestation programs undertaken in parks only, as there was not data at the park model or suitable DELWP models available for a broader statewide assessment of carbon sequestration across the parks network.

**Carbon storage**

There is no existing market mechanism for valuing carbon storage services. However, there is increased interest in financial incentives to avoid release of carbon from ecosystems in the first place, so-called 'Reduced Emissions from Deforestation and Degradation' (REDD).

There are a number of possibilities for valuing the benefits of carbon storage services from parks.

1. Some studies derive the benefit of current storage services by comparing the situation where all carbon is released. They treat carbon storage as an investment with valuation over a number of years using market prices or the social cost of carbon. However, if parks were not protected areas it is unlikely that all carbon would be released and therefore this value is an upper bound.

2. An accounting approach would treat carbon storage as a liability associated with ecosystem assets due to the potential or expected release of emissions. If there were no chance of the carbon being lost there would be no service flow. An estimate of the expected transaction value of the liability could be derived based on the probability of the release of emissions under current conditions and management. However, this provides a value for the ecosystem asset (liability) rather than the service of carbon storage.

3. An alternative is to consider parks as providing insurance to the community by storing the carbon. Using this approach the expected liability (i.e. the value of the carbon stock adjusted for chance of loss) would be the expected claim. The premium would be the cost to store the carbon some other way (using a replacement cost approach). The value of the storage service would be the premium received less the expected claim.

None of the options outlined above was considered to be realistic and therefore this report presents the volume of carbon stored and its monetary value only. This is not sufficient information to assess the benefits of parks in this respect, indicating that ongoing work to progress the valuation of this ecosystem service would require further modelling to calculate the level of carbon emissions that would have occurred under the counterfactual.

#### *Value of benefits*

**If all carbon stored in parks would be released from changing land use, the cost to offset these emissions would be valued at around $15 billion** (note this value is not annualised), based on an announced market price of $15 per tonne $CO_{2e}$. The total social cost of the emissions (without any offsets) is estimated at $63 billion based on the social cost of carbon. These estimates are indicative only as they reflect the upper value of the cost if all carbon stored were released, however a detailed

[86] Source: US EPA 2013, The social cost of carbon. In http://www.epa.gov/climatechange/EPAactivities/economics/scc.html

assessment was not feasible to assess realistically how much carbon could be lost under the counterfactual. This value is not annualised and does not take into account the likelihood of other types of natural release.

The sequestration potential across the whole of the parks network could not be quantified, due to lack of data. However, based on the information of two major revegetation programs in parks, it is estimated that around 21,000 tonnes of carbon dioxide equivalent could be sequestered annually. **The sequestration through these two reforestation or revegetation programs in the first 30 years would be potentially valued at over $1 to $5 million per annum**, using a market price of $15 per tonne $CO_{2e}$ as the lower bound and the social cost of carbon as the upper bound. Over the first 30 years, this gives a Net Present Value of about $18 to $75 million.

## (iv) Pollination and seed dispersal

### *Benefit and beneficiary*

Native and introduced pollinators support agricultural activity providing benefits to agricultural producers and consumers.

### *Context*

The forest, woodland and other habitats of the parks network provide a range of pollinator species such as insects, birds and bats that pollinate plants and trees that are essential for the development of fruits, vegetables and seeds for human use. European honeybees are the most common pollinators of agriculture in Australia, while other species, including native bees and other insects, also perform some pollination for agriculture.

The extent to which agriculture is dependent on pollinators is significant with 65% of horticultural and agricultural crops introduced in Australia requiring honeybees for pollination[87]. Some crops, such as such as almonds, are highly dependent on pollination by honeybees for production (dependence on honeybees has been estimated for 35 Australian crops, ranging from 10% for peanuts up to 100% for almonds, i.e. the removal of honeybees would lead to loss of all almond production) [88].

Some pollination services are paid (particularly in almond orchards of Victoria and South Australia), with beekeepers receiving income from placing hives adjacent to flowering crops. However, the large majority of pollination services are unpaid (incidental pollination), and represent a beneficial or positive externality derived from beekeeping activities[89]. Both native and introduced pollinators provide a direct service to agriculture as well as an indirect service to the community through their contribution to ecosystem health and resilience.

### *Links to other services*

As well as providing a final service to agriculture, pollination is an intermediate service contributing to the maintenance of genetic diversity and ecosystem insurance. Honeybees also provide the provisioning service of supply of honey and other bee products.

### *Counterfactual: the world without parks*

In the absence of parks, the counterfactual is that national and State (non-metropolitan) parks would have been cleared and used for grazing, while metropolitan park areas would have been used for residential development. In line with the counterfactual for honey supply in Section A2.1, under the counterfactual, any pollination services depending on park ecosystems would be lost.

### *Quantity of service provided*

Since different crops depend to a different extent on honeybee pollination, the quantity of service provided is measured here by the number of bee sites within parks. As discussed in the honey supply

[87] Gibbs, D. & Muirhead, I. 1998, 'The economic value and environmental impact of the Australian beekeeping industry', prepared for the Australian Beekeeping Industry, p. 26.
[88] Gordon, J. & Davis, L. 2003, 'Valuing honeybee pollination', Centre for International Economics, prepared for the Rural Industries Research and Development Corporation, p 7.
[89] Department of Sustainability and Environment 2012, 'Putting the buzz back in agriculture, Background – Issues paper', p. 3-4.

service section, the estimated proportion of bee sites on land managed by Parks Victoria is 28%-38% of the Victorian total or around 1,235-1,694 sites[90].

### *Valuation method*

The valuation method used is benefit transfer from a valuation study in Australia by Gordon and Davies (2003) applying the productivity cost method[91]. The Australian value for pollination was then apportioned based on the proportion of bee sites in Victoria.

Gordon and Davis (2003) used available market data to assess the sum of the changed consumer and producer surplus in each of domestic, import and export markets for 35 Australian agricultural products depending on honeybee pollination. This involved developing 35 partial-equilibrium models to obtain how prices and quantities would change after a supply shock, where pollination is an input.

Other earlier studies used Gross Value Product to measure the impact on economic activity and focused on the expected change in production with a loss of pollination. Market data is available for paid pollination services in Victoria ($50-$70 per hive)[92], but this market value is insufficient, as it assumes zero costs and accounts for a small share of all pollination services only.

### *Value of benefits*

The value of pollination services across Australia has been estimated to be over $1.7 billion per annum ($877 million is the benefit to producers across 35 crops and $839 is a benefit to consumers, as without pollination reduced supply in some agricultural products would drive higher prices or certain products would not be available)[93]. Victoria has 17% of the total number of bee hives in Australia[94]. Based on the proportion of bee sites in Victorian parks, **the value of pollination services from parks is estimated to be between $123 and $167 million 2014 AUD per annum.**

In terms of relevant economic activity, pollinators receive payment for about $3.3 million per year across Australia[95], with early estimates for Victoria of about $0.6 to $1 million per annum[96]. Similar to honey production, this represents the economic activity associated with park-based pollination, which is larger than the value directly attributable to Victorian parks. In 2012, the gross value of Victorian agricultural produce linked to both direct and indirect honeybee pollination was estimated to be $400 million per annum[97].

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[90] Department of Sustainability and Environment 2012, 'Putting the buzz back in agriculture, Background – Issues paper', p. 4.
[91] Gordon, J. & Davis, L. 2003, 'Valuing honeybee pollination', Centre for International Economics, prepared for the Rural Industries Research and Development Corporation.
[92] Market based valuation techniques have also been used to derive an implicit price for pollination services to Australian agriculture. Department of Sustainability and Environment 2012, 'Putting the buzz back in agriculture, Background – Issues paper', p. 4.
[93] Valuation is usually assessed in the short-term, but in the longer term, additional modelling indicates that if producers absorb some income loss or both producers and consumers shift their activities towards other sectors not dependant on pollination, this value could be reduced to between $100 million to $1.2 billion per annum. See Gordon, J. & Davis, L. 2003, 'Valuing honeybee pollination', Centre for International Economics, prepared for the Rural Industries Research and Development Corporation.
[94] RIRDC 2008. Australian honeybee industry survey, 2006-07. RIRDC Publication No. 08/170
[95] Centre for International Economics 2005, 'Future directions for the Australian honeybee industry', p. 9.
[96] Gibbs and Muirhead 1998, The economic value and environmental impact of the Australian beekeeping industry. A report prepared for the Australian beekeeping industry. February 1998. p. 28.
[97] Department of Sustainability and Environment 2012, 'Putting the buzz back in agriculture, Background – Issues paper', p. 27.

## (v) Coastal asset protection

### *Benefit and beneficiary*

Coastal wetland and dune habitats protect community assets from storm surge events, sea inundation and coastal erosion.

### *Context*

Around 19% of the State's population live by the coast and many coastal communities rely on stable and healthy coastal ecosystems, which could avoid inundation of homes and assets from storm and tidal surges. Parks Victoria manages around 70% of the Victorian coast as national or State parks, coastal reserve or marine national park or sanctuary.

Coastal and marine habitats including mangrove, salt marsh, seagrass and coastal dune systems can be described as 'living infrastructure' that provide important coastal protection services by absorbing wave energy, helping to minimise shoreline areas from storm damage, inundation and erosion. If intact, these ecosystems can provide highly cost effective natural buffers against incoming waves. By protecting against storm damage, flooding, and erosion, these habitats protect human populations and help mitigate economic loss of coastal assets.

Coastal ecosystems are threatened by a range of human and other pressures, which can reduce the quantity of ecosystem services provided, leading to detrimental economic impacts. Without these functioning ecosystems, alternative infrastructure such as sea walls and breakwaters would be required to manage storm surges and inundation events.

The frequency, extent and magnitude of coastal and river inundation is likely to be altered by climate change over time and through the combined interactions with sea level rise, tide ranges, storm surges and other coastal processes. These are likely to lead to greater coastal inundation and erosion that may cause damage and loss to property, infrastructure and the environment.

The Victorian Government's *Report on Climate Change Science and Greenhouse Gas Emissions in Victoria* 2012 indicates that 100-year storm tide return periods between Cape Schanck and Wilsons Promontory may reduce to one to two years by the end of the century[98]. A recent report by CSIRO[99] highlighted that in Western Port Bay, storm surges that currently occur at 1:100 years may occur at 1:4 years by 2070 with at least 12,000 residential houses at threat.

The Victorian Coastal Strategy 2008 has indicated a number of priorities to deal with potential climate change impacts in the Victorian coastlines. As a result, the Victoria Planning Provisions now require that Victorian planning authorities plan for possible sea level rise of 0.8 metres by 2100, and allow for the combined effects of tides, storm surges, coastal processes and local conditions. The importance of intact and stable coastal ecosystems for coastal protection services will become more important into the future.

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[98] McInnes, KL, Macadam, I and O'Grady, J 2009 *The effect of climate change on extreme sea levels along Victoria's coast*. Report to the Victorian Government Department of Sustainability and Environment, CSIRO, Australia.

[99] Fletcher, CS, Taylor, BM, Rambaldi, AN, Harman, BP, Heyenga, S, Ganegodage, KR, Lipkin, F & McAllister, RRJ 2013, *Costs and coasts: An empirical assessment of physical and institutional climate adaptation pathways*, National Climate Change Adaptation Research Facility, Gold Coast, 53 p

### *Links to other services*

Coastal, estuarine and marine habitats play an important role in providing habitat services, including nursery services for fisheries. Coastal wetlands provide also storage and sequestration of carbon to regulate climate, filtering and detoxifying water and recreation services, in particular recreational enjoyment, tourism and broader amenity benefits.

### *Counterfactual: the world without parks*

In the absence of parks, the counterfactual is that current coastal wetlands would not be protected and therefore cleared or be left to degrade. This would lead to their deterioration of coastal ecosystems to a point where they would not be able to provide protection against storm surge events, sea inundation or coastal erosion.

### *Quantity of service provided*

Victoria's parks protect over 80,000 hectares of intertidal and sandy coastal habitats along 722 km of the coastline, in addition to 585 km of rocky coastline. Of this, Parks Victoria suggests that 285 km are located around coastal townships and communities.

**Table A2.8 Area and length of coastal beach and wetland systems in parks**

| Shoreline habitat | Parks network (ha) | Parks coastline total (Km) | Coast near coastal communities (Km) |
|---|---|---|---|
| Coastal and sandy beach EVCs | 48,720 | 527 | 160 |
| Intertidal habitats | 33,100 | 195 | 125 |
| **Total** | **81,800** | **722** | **285** |

The majority of intertidal habitats that protect coastal communities are located in Western Port Bay (including Yaringa Marine National Park and Northern Westernport Nature Conservation Reserve, which cover over 90km of coastline) and northern Port Phillip Bay. Both locations are vulnerable to storm surges and very vulnerable to sea level rise.[100] Sandy shore habitats that protect coastal communities include the Mornington Peninsula National Park, Nooramunga Marine and Coastal Park, Point Cook Coastal Park and Jawbone Flora and Fauna Reserve as well as the Gippsland Lakes Coastal Park. For some parks with limited coastal communities, only those sections of the park that are adjacent to communities are included in the estimate above. This includes Tidal River at Wilsons Promontory. Note the parks network also includes approximately 550 km of rocky shoreline which, although is subject to increasing pressure from storm surges and sea level rise, has been considered as being of lower risk to coastal communities for this assessment.

### *Valuation method*

The valuation method is based on deriving a high-level estimate of the replacement cost of protection services for coastal communities through either hard engineering infrastructure (e.g. seawalls) or a combination of hard engineering and restoration of living infrastructure (through revegetation projects). The values are indicative and were derived for two coastal protection approaches:

- Protection of *all* coastal assets along the park coastline through infrastructure (hard engineering via sea wall)

[100] http://www.climatechange.vic.gov.au/adapting-to-climate-change/future-coasts/victorian-coastal-inundation-dataset

- Targeted strategy for the protection of *main towns and surrounding areas* with restoration of original ecosystem for the remainder

The estimates are based on the average costs of construction for seawall/rockwall structures of $3,000 per metre as an alternative to living infrastructure, quoted to Parks Victoria for this project (summarised in Table A2.9). Alternative protection mechanisms may include purchase of additional land or retreat of assets further inland, however these options are likely to be more expensive.

**Table A2.9 Value of coastal protection services provided by parks**

| | Scenario 1 – Protection of all coastal assets through infrastructure (hard engineering via sea wall) | | Scenario 2 – Targeted strategy for the protection of main towns with restoration of original ecosystem for the remainder | |
|---|---|---|---|---|
| | Km | million $AUD | Km | million $ AUD |
| Seawall construction[1] | 285 | $855 | 90 | $270 |
| Intertidal restoration (mangrove, saltmarsh) replacement restoration[2] | n/a | n/a | 90 | $54 |
| Coastal dune replacement/restoration[3] | n/a | n/a | 95 | $38 |
| Total avoided capital costs | 285 | $855 | 285 | $362 |
| Avoided cost per annum[4] | | $56 | | $24 |

[1] Seawall construction @$3,000/m; [2] Intertidal wetlands replacement/restoration @$60,000/ha; [3] Coastal dune restoration @$40,000/ha; [4] externalities for the civil works could be assessed and taken into account

It should be recognised that these results are the best estimates obtained with the data available at the time of this project, but there are a range of uncertainties associated with this assessment that deserve further investigation. This includes confirming the physical distances required and the level of demand for the protection services described above. One key uncertainty is how resilient and effective marine habitats would be as a buffer, particularly as sea levels rise and ocean temperatures increase under relevant climate change scenarios (e.g. whether newly regenerated areas die as sea levels rise or might migrate up the coastline).

### *Value of benefits*

Based on the valuation method and assumptions described above, the **benefits of coastal protection from parks ecosystem assets are estimated at about $24 to $56 million per annum**, derived from the following two options:

- If all the intertidal and sandy coastal ecosystems of parks were lost or degraded to a point where they were no longer providing their coastal protection service, it would cost $855 million (or $56 million per annum) in capital costs to replace these services through alternative engineered structures (such as sea walls) to provide equivalent protection across the 285 kilometres of park coastline with local communities.
- If a more targeted approach of using a combination of 'hard engineering' via seawalls in priority locations with restoration of coastal systems is undertaken for the remainder of the 285 km of coast, the capital cost required would be $362 million (or $24 million per annum).

## (vi) Maintenance of nursery habitats

### *Benefit and beneficiary*

Parks' ecosystems provide the environment and nutrients to support spawning and recruitment processes, which benefit recreational and commercial fisheries along with genetic diversity.

### *Context*

Marine and coastal parks provide an important service by providing healthy nursery habitats for the recruitment of juvenile species used for commercial and recreational uses such as fishing. Of particular importance is the role that parks play in protection and conservation of seagrass, mangrove and reef habitats, which are recognised around the world as providing essential nursery and recruitment services for many species.

### *Links to other services*

Habitat nursery services are linked to provisioning services in fishing industries and other regulating services such as water purification. They are also linked to cultural services, including recreational use, cultural connection and health.

### *Quantity of service provided*

According to Parks Victoria data, nearly 22,000 hectares of coastal wetlands that are located within the parks network provide nursery services, including seagrass and mangrove communities. About 18,000 hectares of this area consists of seagrass communities. The Corner Inlet Marine National Park and Corner Inlet Marine and Coastal Parks contain the majority of seagrass habitat areas comprising nearly 12,000 hectares.

A recent study provides estimates of total annual enhancement across a number of species that are commercially fished in Victoria, such as King George whiting. For this species, seagrass habitat are estimated to provide an annual enhancement (across all age classes) of 0.51grams/$m^2$ [101]. Across the parks network this gives about 93 tonnes of fish stock per year. The table below shows the total fish stock per year that parks provide for species that are commercially fished in Victoria. However, this represents the quantity of fish stock provided by parks, as opposed to realised catch by commercial fisheries.

**Table A2.10 Quantity of fish stock per year provided by parks**

| Fish name | Annual enhancement (g per $m^2$) | Annual enhancement by parks (tonnes) |
|---|---|---|
| Australian anchovy | 0.012 | 2.19 |
| Blue weed whiting | 0.702 | 128.36 |
| Southern sea garfish | 0.008 x $10^{-2}$ | 0.015 |
| Six-spined leatherjacket | 8.674 | 1,586.00 |
| Yellowfin leatherjacket | 11.152 | 2,039.08 |
| King George whiting | 0.507 | 92.70 |
| **Total** | - | 3,848.35 |

Source: Blandon and zu Ermgassen (2014)

[101] Blandon, Abigayil and zu Ermgassen Philine S.E. 2014. 'Quantitative estimate of commercial fish enhancement by seagrass habitat in southern Australia'. *Estuarine, Coastal and Shelf Science 141,* pp.1-8.

### *Counterfactual: the world without parks*

In the absence of parks, the counterfactual is that the non-metropolitan parks would have been cleared and used for an alternative land use such as grazing, while metropolitan park areas would have been used for residential development. Marine and coastal parks would no longer be protected areas and would be subject to the same fishing, aquaculture, industry and recreational activity as non-protected areas of Victoria's waters and coastline. Alternative land uses if the ecosystems were not protected could include clearing or dredging for resource extraction. Under the counterfactual, increased commercial use would result in the degradation and loss of coastal wetlands, seagrass, mangrove and reef, which provide nursery habitat for the recruitment of juvenile fish species.

As a result of the reduction in nursery habitat, the stock of certain fish species would diminish. Over time this would impact on commercial fish catch and the productivity and profitability of the Victorian fishing industry. As a result, producers would reduce their catch of local species. In the long-term, producers would adjust by shifting to other Australian regions, while consumers would purchase fish imported from interstate or overseas or would consume substitutes.

### *Valuation method*

The analysis adopted for this project is based on benefit transfer of a recent assessment of abundance of juvenile commercial species in southern Australian seagrass habitats, based on a meta-analysis of relevant Australian research that included five Victorian studies[102]. This study estimated the economic value of enhancement from juvenile commercial species applying the productivity approach on primary data on the maintenance of nursery habitats. Species not recorded in Victoria were excluded from the valuation. These values reported represent the stock enhancement where all fish species are present, as opposed to realised catch. Based on this study, a value of $3,000 per hectare was used as a central estimate[103] for the value of seagrass habitats for nursery services across all seagrass habitats in Victorian parks.

### *Value of service*

Welfare values for this ecosystem service could not be assessed due to poor data availability.

Based on the above valuation study, the output value of seagrass habitats in parks for juvenile fish enhancement is estimated at around $54 million, which is about $3.5 million per annum after accounting for fish recruitment lags[104]. This represents the potential gross value of fish production if it could all be caught, it does not take into account catch rates or other commercial fishing inputs. This value therefore overestimates the likely market value that can be realised from fish enhancement.

A market value for realised catch can be calculated using price data available from the former Victorian Department of Primary Industries (now the Department of Economic Development, Jobs, Transport and Research). For fish identified as being recruitment enhanced in seagrass habitat[105], the

[102] Blandon, Abigayil and zu Ermgassen Philine S.E. 2014. 'Quantitative estimate of commercial fish enhancement by seagrass habitat in southern Australia'. *Estuarine, Coastal and Shelf Science 141,* pp.1-8.
[103] Most species in the above study were assessed to reach an economic value of enhancement associated with seagrass between AUD $800-7,000 per hectare.
[104] The study notes that it takes at least 26 years for all fish to be fully recruited to the habitat after restoration. The annual values are calculated over a 30-year timeframe and a 5% discount rate.
[105] The fish species that were included in the valuation of nursery habitat are Australian anchovy, blue weed whiting, southern sea garfish, leatherjackets, and King George whiting. These species were identified as being stock enhanced by

total market value of fisheries catch was $2.8 million for the whole of Victoria in 2009-10[106], largely due to King George whiting catch which was valued at $2.1 million. There are around 47,000 hectares of seagrass in the whole of Victoria[107], with 18,000 hectares located in marine parks. Based on this, the value of fisheries catch dependent on seagrass habitat in parks is approximately $1.1 million per annum. This represents the economic activity *associated* with parks' maintenance of nursery populations, which is larger than the value directly attributable to parks.

It is important to note that this value for seagrass habitats is based on fish prices provided by the State Departments and relevant agencies in Australia, such as the Department of Environment and Primary Industries, the South Australian Research and Development Institute and Department of Fisheries Western Australia. Therefore, these values should be tracked over time to account for changes in market trends and fish stocks, particularly in highly valued species. A comparison with other seagrass valuation studies for fish production shows that the central estimate adopted in this analysis is conservative[108].

Further work is required to quantify the extent of the nursery service provided by both seagrass and mangrove habitats as nursery habitats in Victoria, as well as to generate a more robust economic value of these habitats for their nursery services. This is also the case for other marine habitats such as sub-tidal reefs, which provide nursery services for some commercial and recreational species.

seagrass habitat and commercially fished in Victoria. See Blandon, Abigayil and zu Ermgassen Philine S.E. 2014. 'Quantitative estimate of commercial fish enhancement by seagrass habitat in southern Australia'. *Estuarine, Coastal and Shelf Science 141* and Department of Primary Industries 2012. 'Fisheries Victoria Commercial Fish Production Information Bulletin 2012'.

[106] Department of Primary Industries 2012. 'Fisheries Victoria Commercial Fish Production Information Bulletin 2012'. p. 4.

[107] Lawrence, A.J., Baker, E., Lovelock, C.E. 2011, Optimising and managing coastal carbon: Comparative sequestration and mitigation opportunities across Australia's landscapes and land uses. Fisheries Research and Development Corporation (FRDC) Report 2011/084, p. 40.

[108] A summary of valuation studies is available in: Unsworth, R. and Cullen-Unsworth, L. 2010. 'A dollar value on seagrass'. *Seagrass-Watch News.* McKenzie, L. J., Yoshida R.L. and Unsworth, R. (Eds) Issue 41, June 2010. Seagrass Watch HQ. 24pp.

## (vii) Maintenance of habitats for species

### *Benefit and beneficiary*

Parks ecosystems support habitats for species, which is an intermediate service under the SEEA definition of ecosystem services.

### *Context*

One of the primary purposes of the Victorian parks network is to protect and conserve representative ecosystems and the biodiversity contained within them. Biodiversity is the variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part. Biodiversity includes diversity within species, between species and between ecosystems. These ecosystems and the species, functions and processes within them provide the foundation for a range of additional ecosystem services. They also have a fundamental intrinsic value.

### *Links to other services*

Maintenance of habitats provides a supporting service to other ecosystem services and maintenance of genetic diversity, along with cultural services for the conservation of unique species.

### *Quantity of service provided*

Of the 4,755 native flora species recorded in Victoria, 4,431 are found within the parks network (93%). This includes 344 endemic species to Victoria and 32 species only found in a single park. Of the 1,232 fauna species recorded in Victoria, 1,081 are likely to be found within the parks network. This includes four endemic species.

The parks network provides important habitat for over 1,800 rare and threatened flora and fauna species and a number of individual parks provide more than 80% of habitat suitability for over 500 of these species. Around 1,570 native flora species and 280 fauna species that are listed rare and threatened have been recorded within the parks network. The table below shows data for individual parks considered as the most important parks for the provision of habitat services.

**Table A2.9 Top ten parks – total number of rare and threatened species supported by parks**

| | Nr of rare and threatened species in parks |
|---|---|
| Alpine National Park | 476 |
| Murray-Sunset National Park | 247 |
| Grampians National Park | 229 |
| Croajingolong National Park | 225 |
| Snowy River National Park | 195 |
| Coopracambra National Park | 171 |
| Great Otway National Park | 166 |
| Hattah-Kulkyne National Park | 154 |
| Avon Wilderness National Park | 149 |
| Wilsons Promontory National Park | 126 |

The Alpine National Park supports the highest number of rare and threatened species at over 470 species. For over 120 of these species, the Alpine National Park provides at least 80% of the most suitable habitat found in the State – suggesting high dependency of these species on the park.

**Table A2.11 Top ten parks – number of rare and threatened species with most suitable habitats**

| | Number of species for which park provides over 80% of habitat suitability |
|---|---|
| Alpine National Park | 127 |
| Grampians National Park | 66 |
| Murray-Sunset National Park | 38 |
| Croajingolong National Park | 32 |
| Little Desert National Park | 15 |
| Wilsons Promontory National Park | 12 |
| Hattah-Kulkyne National Park | 9 |
| Mount Buffalo National Park | 9 |
| Wyperfeld National Park | 8 |
| Baw Baw National Park | 8 |

Thirty-seven communities throughout Victoria that are listed as threatened under the Flora and Fauna Guarantee (FFG) Act are contained within the park network, as outlined below.

**Table A2.12 Flora and Fauna Guarantee (FFG) Act listed threatened communities**

| FFG-listed community | Number of parks |
|---|---|
| **Flora** | |
| Alpine Bog Community | 8 |
| Alpine Snowpatch Community | 1 |
| Caltha introloba Herbland Community | 2 |
| Central Gippsland Plains Grassland Community | 49 |
| Coastal Moonah (Melaleuca lanceolata subsp. lanceolata) Woodland Community | 48 |
| Cool Temperate Rainforest Community | 22 |
| Cool Temperate Mixed Forest | 0 |
| Creekline Grassy Woodland (Goldfields) Community | 171 |
| Devonian Limestone Pomaderris Shrubland Community | 1 |
| Dry Rainforest (Limestone) Community | 4 |
| Fen (Bog Pool) Community | 4 |
| Forest Red Gum Grassy Woodland Community | 50 |
| Granite Foothills Spring Wetland (North-East Victoria) Community | 8 |
| Grey Box - Buloke Grassy Woodland Community | 236 |
| Herb-rich Plains Grassy Wetland (West Gippsland) Community | 13 |
| Limestone Grassy Woodland Community | 24 |
| Limestone Pomaderris Shrubland Community | 1 |
| Montane Swamp Complex Community | 1 |
| Northern Plains Grassland Community | 254 |
| Plains Grassland (South Gippsland) Community | 6 |
| Red Gum Swamp Community No. 1 | 121 |
| Rocky Chenopod Open Scrub Community | 3 |
| Sedge Rich Eucalyptus camphora Swamp Community | 1 |
| Semi-arid Herbaceous Pine Woodland Community | 219 |
| Semi-arid Herbaceous Pine - Buloke Woodland Community | 219 |

| FFG-listed community | Number of parks |
|---|---|
| **Flora** | |
| Semi-arid Northwest Plains Buloke Grassy Woodlands Community | 224 |
| Semi-arid Shrubby Pine - Buloke Woodland Community | 234 |
| Warm Temperate Rainforest (Coastal East Gippsland) Community | 22 |
| Warm Temperate Rainforest (Cool Temperate Overlap, Howe Range) Community | 28 |
| Warm Temperate Rainforest (East Gippsland Alluvial Terraces) Community | 27 |
| Warm Temperate Rainforest (Far East Gippsland) Community | 41 |
| Western (Basalt) Plains Grasslands Community | 94 |
| Western Basalt Plains (River Red Gum) Grassy Woodland Floristic Community 55-04 | 125 |
| **Total number of parks with FFG listed flora community** | **1151** |
| **Total number of flora communities** | **33** |
| **Fauna** | |
| Butterfly Community No. 1 | 1 |
| Lowland Riverine Fish Community of the Southern Murray-Darling Basin | 94 |
| Port Phillip Bay Entrance Deep Canyon Marine Community | 2 |
| San Remo Marine Community | 1 |
| Victorian Mallee bird community | 23 |
| Victorian temperate-woodland bird community | 1365 |
| **Total number of parks with FFG listed flora community** | **1486** |
| **Total number of fauna communities** | **6** |

### *Counterfactual: the world without parks*

In the absence of parks, the counterfactual is that national and State (non-metropolitan) parks would have been cleared and used for grazing, while metropolitan park areas would have been used for residential development. In this context, rare and threatened species dependent on parks would face increased threats and risks of loss. Some of the species may possibly need to be relocated, which would lead to greater government expenditure. Under the counterfactual, biodiversity in the State could be severely impacted and the access for people to enjoy of native species would be very limited.

### *Valuation method*

To assess the value of the intermediate service of habitat service, we used an indicator describing the relative importance of parks in providing habitats for rare and threatened species. A combination of condition score and species distribution modelling is used to assess the relative suitability of parks in providing habitat services. Although this indicator is a characteristic of parks ecosystem asset condition, it provides an indication of the capability of park assets to provide this service.

### *Value of benefits*

At this stage, the benefits of parks for species have not been assessed in monetary terms. The value of protection of rare and threatened species could be assessed more easily for specific iconic species, for which survey data exist or could be collected. This analysis could then take into account the habitat suitability indicators presented above to attribute the relative contribution of parks in providing suitable habitat for the preservation of a given species.

## (viii) Other regulating services for further assessment

### *(a) Pest and disease control services*

#### *Benefit and beneficiary*

Parks provide protected habitats for native species that can help controlling pests, benefiting agricultural producers

#### *Context*

Some groups of native species such as birds and bats are major predators of insects including many crop and forest pests. CSIRO research has found that native vegetation may provide a reservoir of natural enemies, which have potential to suppress pest populations in crops.[109]

Victoria's parks network provides suitable habitats for 20 species of insectivorous bats and more than 120 species of insectivorous birds as well as many other insect eating species such as spiders, reptiles and mammals. These native species consume millions of insects each year and can act as natural controllers of pests and diseases on agricultural land to improve productivity. For example, bats can significantly reduce insects that are harmful to crops and is estimated that a large group of 1,000 bats can eat 5kg or more of insects per night.

In addition to insectivorous species, Victorian parks provide habitats for 25 native birds of prey, which can contribute to the management of overabundant pest species such as rabbits and mice.

Declines in the extent and quality of suitable habitats for birds, bats and native insects such as beetles, could have significant implications for agricultural productivity. While some faunal groups such as bats are relatively abundant and adaptable within Victoria, other groups such as woodland birds have suffered long-term declines.

A 2011 study in the US estimated the value of bats to the agricultural industry as roughly $22.9 billion per annum, indicating the loss of bat species could lead to agricultural losses of a minimum of USD $3.7 billion per annum.[110] Another study found that the value of insects in providing ecological services in the US was estimated to be at least $57 billion per annum (consisting of $0.38 billion for dung burial, $3.07 billion for pollination, $4.49 billion for pest control of native herbivores and $49.96 billion for recreation).[111]

While many birds, bats and other native species provide an important service to benefit agriculture, some species (e.g. galah, corella, flying fox, kangaroo) can also be considered as a pest.

#### *Quantity of services and valuation approach*

While currently there is limited Australian data to quantify current levels of pest and disease control services, the value of native fauna in pest control could be estimated as the costs avoided by using birds or bats instead of pesticides. The proportion of birds or bats, for which parks provide a suitable habitat, could be used to attribute the total benefits from this ecosystem service to parks.

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[109] http://www.csiro.au/Outcomes/Environment/Biodiversity/ecosystem-service-pest-control-native-vegetation.aspx

[110] Boyle J. G., Cryan P, M., McCracken G.F., and Kunz T.H., 2011. Economic Importance of Bats in Agriculture, Science 332, pp. 41-42. DOI: 10.1126/science.1201366

[111] Losey.J.E., and Vaughan. M., 2006. 'The Economic Value of Ecological Services Provided by Insects'. *BioScience 56* No. 4

## *(b) Local climate regulation*

### *Benefit and beneficiary*

The vegetation of parks can regulate local climate by cooling down urban areas affected by the Urban Heat Island (UHI) effect, alleviating any impacts of extreme heat on human health.

### *Context*

Melbourne's parks play an important role in cooling down the city due to the 'urban heat island effect'. The heat island effect is where temperatures increase due to the absorption of solar radiation on paved and dark surfaces. The heat island effect is most pronounced in the central business district and away from coastal areas.

With their permeable, green open spaces and mature trees, the temperature in parks can be several degrees cooler than surrounding areas, providing shade and cooler environments. The vegetation and waterways of parks help regulate local climate by trapping moisture and cooling the earth's surface and mature trees can generate the equivalent cooling effect of several air conditioners.

A recent study undertaken for the City of Melbourne with heat maps of the Greater Melbourne area demonstrate that areas with few trees are warmer than treed areas. In Melbourne, researchers have reported a mean UHI of around 2°C to 4°C and as high as 7°C depending on the location, season and time of day.[112]

This study highlighted that the impacts of hot weather caused by climate change (both in terms of average temperature and number of extreme hot days) is expected to produce a range of impacts on health, transport operation and infrastructure, energy demand and infrastructure, biodiversity and crime[113]. This study found that the net economic impact of hot weather within the City of Melbourne is estimated at $1,860 million as a present value, of which approximately $300 million (or 16%) is attributable to the UHI effect. The vast majority of these costs were related to human health costs. Reducing impacts on human health will also decrease adverse effects on employment productivity, e.g. through absenteeism, long-term employment conditions and premature mortality.

With CSIRO predictions that Melbourne's climate is likely to become increasingly warm, dry, and subject to more frequent extremes of heat and inundation over the next twenty or more years, parks and waterways are likely to provide an increasingly important resource for the relief of heat related illness.

### *Quantity of services and valuation approach*

While studies of temperature regulation have been undertaken in a number of cities around the world, quantifying the urban climate regulation service of Parks Victoria's parks needs further work. In the first instance, this work would require assessing the difference in temperatures between city and park areas and then linking the cooling effect to the number of incidence and prevalence cases of heat related illness that could be avoided or delayed from metropolitan parks infrastructure.

The valuation could focus on health costs (comfort may be an additional consideration), which can be derived from epidemiological studies and dose-response functions for specific heat related conditions.

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[112] AECOM 2012, Economic Assessment of the Urban Heat Island Effect, Prepared for the City of Melbourne.
[113] Ibid

## *(c) Air quality regulation*

### *Benefit and beneficiary*

Parks' vegetation help filtering air pollutants, reducing health impacts for Victorian residents.

### *Context*

Trees and other native vegetation and waterways help filter a number of air pollutants, including airborne particulate matter. Several studies have linked exposure to particle pollution to a number of health problems, including respiratory diseases such as asthma. Trees help cleanse the air by intercepting airborne particles, reducing heat and absorbing other pollutants such as carbon monoxide, sulfur dioxide, and nitrogen dioxide. For example, studies from the US have found that a single mature tree can filter 27 kilograms of airborne pollutants per year.[114]

While Melbourne's air quality has improved since the 1980s due to improved car and industry emissions regulations, particle-based pollution can still be an issue. This is mainly due to increased transport use, increased trends of population exposed in inner areas of the State and localised interactions with other pollutants from chemical industries, which could exacerbate ozone effects.

The filtering role of parks needs to be balanced against the emission of Biogenic Volatile Organic Compounds from eucalypt dominated vegetation, which can have a role significant role in the formation of ground ozone based photochemical smog.

### *Quantity of services and valuation approach*

While quantity estimates of air pollution are available for the State, there is insufficient data to assess what proportion of air filtering in metropolitan areas could be attributable to park vegetation.

In terms of the valuation approach, some relevant studies have been undertaken in a number of cities around the world, focusing on the health costs from air pollution. However, these health costs are typically attributable to the industries generating it – rather than ecosystems counterbalancing it. Therefore, the impact of Parks Victoria's parks on air quality regulation within Melbourne requires further investigation.

[114] See Nowak D.J and Heisler.G.M 2010, Air Quality Effects of Urban Trees and Parks National Park and Recreation Association, Research Series

## A2.3 Cultural services from parks

### (i) Recreation services: enjoyment, tourism and health benefits

#### *Benefits and beneficiaries*

Victoria's parks provide diverse opportunities for nature-based recreation experiences. The direct benefit is the personal enjoyment and appreciation of nature, which then provides additional health and economic benefits created by visitors going to parks.

The three key recreational benefits considered for this assessment include:

- Personal enjoyment from park visits of all visitors recorded, including locals and tourists
- Economic activity and employment in the State supported by tourist visitors (i.e. not locals) during their travel and visits to Victorian parks
- Improved physical and mental health in regular park visitors that are physically active in parks

#### *Context*

Victoria's parks contain and conserve natural, cultural and historical values that are treasured by Victorians and contribute to their sense of place. Our parks are conserved both for their intrinsic worth and for the benefit, use and enjoyment of the public. Park visitors can derive a wide range of personal benefits, including enjoyment and improved health, while contributing to the tourism industry.

*Enjoyment benefits:* People visit parks to gain a wide range of experiences that are mainly supported or enhanced by the environmental amenities parks provide. These include appreciating scenic beauty or biodiversity, to escaping the urban environment, learning about nature, culture and heritage, experiencing adventure and self-reliance, having fun, socialising with friends and family or finding peace and solitude. Some of the most common activities undertaken in parks include sightseeing, walking, picnicking, running, cycling, fishing, sailing, surfing, diving, photography, birdwatching and nature study, bushwalking, rock climbing, vehicle touring, and camping. Other activities such as hunting occur at appropriate locations. Parks enable people of all cultures and backgrounds can share in these experiences.

*Tourism benefits:* The opportunities for recreational enjoyment (previously described) motivate tourists to travel and visit Victoria's parks. Parks Victoria is the State's largest provider of nature-based tourism. An impact assessment of the closure of the Grampians National Park following the 2014 fire illustrates the importance of parks for tourism. The impact assessment undertaken by Grampians Tourism highlighted that 60% of tour operators were unable to trade during the park closure, there was a 50% decline in takings and immediate bookings with a further 54% decline in forward bookings and 100 businesses that use the park were impacted. The impacts from this closure were estimated as a loss of at least $47 million to the regional economy with a potential further impact of $35 million[115].

*Health benefits:* There is a large and increasing body of evidence showing that contact with nature and parks provide a wide range of physical and mental health benefits.[116] Other recent research suggests that access to parks can help people increase their level of physical activity[117] and being close to green space is associated with reduced depression, anxiety and other related conditions. Thus, recreation

[115] Parks Victoria 2015, personal communication

and amenity services that Victoria's parks provide can contribute to the prevention of some physical and mental health costs or the improvement of health outcomes that can be influenced by lifestyle.

Health benefits from park-related physical activity is relevant in Australia considering that56% of Australians are either sedentary or have a low level of exercise[118]. Physical inactivity is a risk factor for cardiovascular disease, stroke, high blood pressure, diabetes, colon cancers, osteoporosis, falls-related injuries and mental health problems including depression. In 2008, Medibank Private indicated that physical inactivity was costing the Australian economy $13.8 billion per year[119] (about $1,660 per person per annum for each physically inactive person), consisting of:

- direct medical costs of $719 million per annum
- labour productivity costs of $9,299 million per annum
- people's value to avoid burden of disease or mortality of $3,812 million per annum

The Medibank Private study also found an estimated 16,179 people die prematurely each year due to conditions and diseases attributable to physical inactivity. In 2009, another study estimated that a 10% reduction in physical inactivity (from 70% to 60%) of Australians would annually result in 6,000 fewer cases of disease (13% reduction), 2,000 fewer deaths (15% reduction), loss of 114,000 additional working days and reduced costs to the health sector of about $96 million.[120]

#### *Links to other services*

Recreation is linked to and often reliant on other ecosystem services including regulating services, such as water purification, flood protection, regulation of air quality and habitat services, and other cultural services, such as amenity, spiritual connection, social cohesion and sense of place.

#### *Quantity of service provided*

Recreation services are measured in terms of the number of visitors and visit duration times. These measures indicate people's interactions and use of ecosystem services. The following values of visitor numbers are used to assess each of the three benefits identified:

*Enjoyment benefits:* Parks Victoria survey data indicates that more than three quarters of the Victorian population had visited a park at least once in the previous 12 months[121]. Parks Victoria data for the State indicates the number of visits to all parks (including bays and piers) has increased by 38.6% over the period 2002 to 2013, with a compound annual growth rate of 3%.

The total number of annual visits to the Victorian parks network has been estimated at 51 million to national, State and metropolitan parks. In addition, Parks Victoria managed bay and waterway assets (e.g. piers in local ports) receive 45 million visits per annum.

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[116] Townsend M and Weerasuriya, R 2010 Beyond Blue to Green, The benefits of contact with nature for mental health and well-being. Melbourne, Australia. Maller, C., Townsend, M., Brown, P. and St Leger, L., Henderson-Wilson, C., Pryor, A., Prosser, L., Moore, M. 2008. 'Literature Review: Healthy Parks Healthy People: The Health Benefits of Contact with Nature in a Park Context - A Review of Current Literature'. 2nd Edition. Deakin University. Melbourne, Australia.
[117] Harnik. P.H. and Welle. B, 2009 Measuring the Economic Value of a City Park System, Trust for Public Land.
[118] ABS 2013, Cat. 4364.0.55.004 Australian Health Survey: Physical Activity, 2011-12, Australia.
[119] These are conservative estimates of the cost of physical inactivity, as they do not take into account the cost of individuals being outside the workforce or the value of unpaid work. See Medibank Private, 2008, The Cost of Physical Inactivity. Available in http://www.medibank.com.au/Client/Documents/Pdfs/The_Cost_Of_Physical_Inactivity_08.pdf.
[120] Cadilhac D A, Toby B Cumming, Sheppard L, Pearce D.C, Carter R and Magnus A 2011 The economic benefits of reducing physical inactivity: an Australian example International Journal of Behavioral Nutrition and Physical Activity 2011, 8:99
[121] Newspoll, 2013. Parks Visitation Monitor Quarter 1-4 – 2012/2013, July 2013. Report prepared for Parks Victoria.

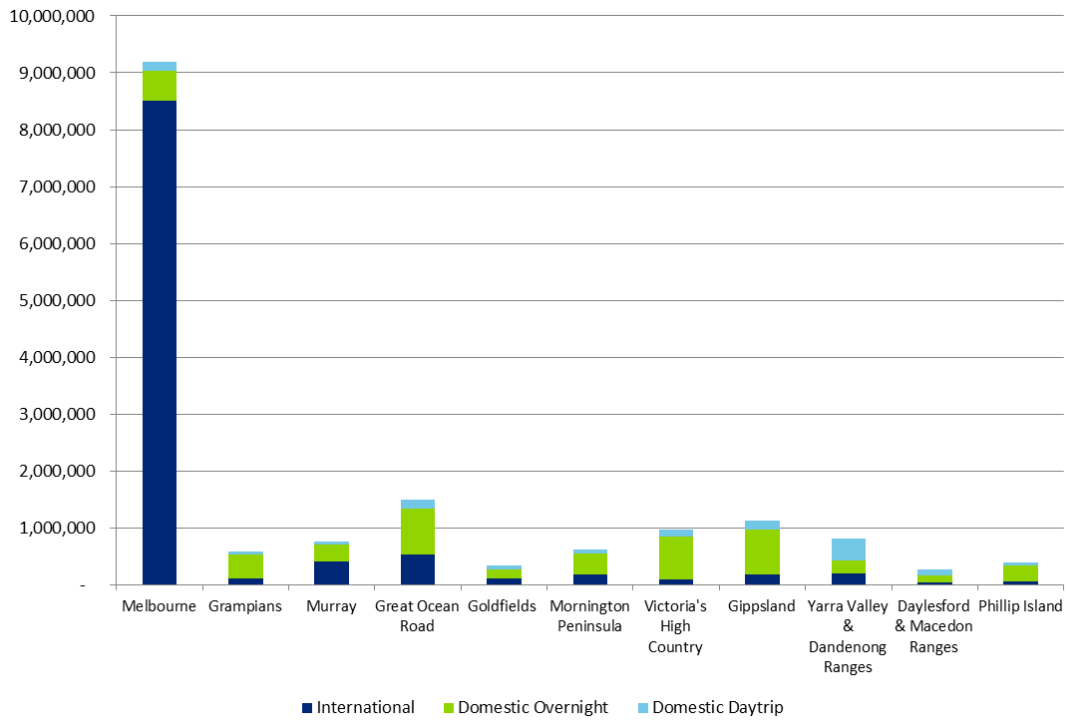
**Table A2.13 Number of visits to Victorian parks**

| Park type | 2003/04 | 2012/13 |
|---|---|---|
| National and State parks | 24.9 million | 34.8 million |
| (Marine national parks) | (2.7 million) | (3.8 million) |
| Metropolitan parks | 14.1 million | 16.4 million |
| Bays and waterways assets (piers) | 27.0 million | 44.6 million |
| **Total** | **69.1 million** | **95.8 million** |

Source: Parks Visitation Monitor Quarter 1-4 – 2012/2013, July 2013. Note: the number of visits to marine national parks is a subset of the total number of visits to National and State parks.

*Tourism benefits:* Based on international and national visitation survey data by Tourism Research Australia (TRA), Victoria averaged a total of 3.6 million 'tourist visitors' going to parks in 2010-11. After accounting for the duration of the stay, this gives an average of 16.9 million park tourist visitor nights, which corresponds to about 33-56% of the total number of visits reported by Parks Victoria. Melbourne attracted the large majority of tourist visits in the State, as shown in the figure below.

**Figure A2.1 Parks visitation rate (visitor nights) by tourist type (2010-11)**




Source: Deloitte Access Economics *Report on Valuing the Tourism Services provided by Victorian Parks*, May 2014.

*Health benefits:* According to the 2011-12 ABS national survey of participation in sport and physical recreation[122], of the 3 million people who undertook some kind of exercise in Victoria, 44% used parks and reserves and 25% used off road trails and bike paths. Walking for exercise was the most popular activity undertaken. Across all physically-active respondents in Victoria, 52% reported to have exercised on average at least two times per week.

The following table presents an overview of the main activities undertaken in park visits.

[122] ABS 2012, Catalogue 4177.0 - Participation in Sport and Physical Recreation, Australia, 2011-12. Available online.

**Table A2.14 Most popular recreational activities undertaken in parks**

| Purpose of visits to parks and activities undertaken | National and State parks (% of visits) | Metropolitan parks (% of visits) | Relevance to health benefits |
|---|---|---|---|
| Primarily for physical activity: | | 55 | |
| • Long walks | 38 | | |
| • Short walks | 11 | 21 | |
| • Fitness | 38 | 10 | Physical activity |
| • Cycling | 6 | 6 | |
| • Jogging | | 6 | |
| • Walk the dog | | 8 | |
| Physical activity | 66 | 71 | Physical activity |
| Sightseeing & Spectating | 28 | 15 | Mental health and relaxation |
| Eating & Drinking | 20 | 21 | |
| Socialising & Child's play | 18 | 21 | Mental health and relaxation |
| Journey / Tour | 12 | 3 | Physical activity, mental health & relaxation |
| Passive activities | 9 | 6 | |
| Events & Markets | 2 | 5 | |

Parks Visitation Monitor Quarter 1-4 – 2012/2013, July 2013.

While around 38-55% of visits to Victoria's parks are primarily for physical activity, for people to gain physical health benefits from exercise, they need to be physically active, which needs to be moderate exercise for at least 2.5 hours per week preferably on most days[123]. An individual that does not do regular exercise is not considered to be physically active. Parks Victoria survey data indicate there are on average about 180,00 regular visitors to parks every year, who do exercise for more than one hour at least three times per week.

The Parks Victoria visitation data above indicates that metropolitan and non-metropolitan parks receive respectively around 780,000 and 750,000 Victorian visitors per annum whose main purpose is undertaking a physical activity. For average visitors, it is estimated that parks contribute to about 11% and 17% of their recommended physical activity each year. These high-level estimates of park contribution to people's annual recommended physical activity are based on an annual *average* of 12 and 18 visits per active visitor going to metropolitan and non-metropolitan parks, respectively, and a benchmark of a minimum of two days per week per person to maintain regular physical activity.

While there is considerable overlap between physical and mental health benefits from visiting a park, data from Parks Victoria's Visitor Satisfaction Monitor has shown that the most positive aspects of a visit to a park included: being outdoors (32%), being in nature (32%), scenery and views (32%) and being in a peaceful, relaxing setting (21%).

### *Counterfactual: the world without parks*

In the absence of parks, the counterfactual is that national and State (non-metropolitan) parks would have been cleared and used for grazing, while metropolitan park areas would have been used for residential development. Under the counterfactual visitors to parks would lose all personal enjoyment derived from parks ecosystems. This would lead to the loss of all tourist expenditure attributable to

[123] Department of Health 2014, Australia's Physical Activity and Sedentary Behaviour Guidelines. Available in http://www.health.gov.au/internet/main/publishing.nsf/content/health-pubhlth-strateg-phys-act-guidelines

park visits (note that in the long-term this expenditure could be transferred to other sectors of the economy or moved away to other areas of Australia). In the case of health, we have assumed that without parks, non-tourist visitors whose main purpose is going to parks to do sport and physical activities would reduce a proportion of the level of physical activity they undertake every year.

#### *Valuation method*

Different valuation techniques are required to assess the three benefits from recreation services, as discussed in detail for each case below.

*Enjoyment benefits:* The valuation method is benefit transfer based on an earlier study in Australia using the travel cost techniques by Read Sturgess (1999)[124]. The purpose of this valuation technique is to measure the utility visitors receive when they visit parks. The travel cost method is a long-standing and accepted method for estimating this type of benefit for recreational users of parks.

Read Sturgess developed travel cost models for Victoria to estimate recreation values using visitation data from 1999 for around 70 parks and extrapolated values to another 80 parks. The study found that recreation in Victorian parks was valued at $340 million per annum. The table below shows the updated average values derived from the Read Sturgess study across the current park classification. It is recognised that the original data requires review to recognise contemporary visitor use patterns and park developments. Therefore, the updated estimates should be considered as indicative only.

**Table A2.15 Indicative recreation values per visit by park type**

| Type of park | Value per visit |
|---|---|
| National parks | $32 |
| Natural features wildlife hunting reserves | $27 |
| Wilderness parks | $20 |
| Port and coastal facilities | $16 |
| Reservoir parks | $14 |
| Natural features reserves | $13 |
| Historic reserves | $12 |
| State parks | $11 |
| Metropolitan parks | $9 |
| Other terrestrial parks | $9 |

*Tourism benefits:* Tourism benefits to the State economy are measured as the economic contribution of tourist visits to parks. The approach requires estimating park-dependent tourism expenditure (by identifying the proportion of spending by tourists in a region that can be directly attributed to a park). In other words, if a tourist visited the park as part of a broader trip and would have continued with their travel arrangements had the park not existed, then this tourist's expenditure cannot be attributed to the park.

The contribution of parks has been disaggregated from the broader contribution of tourism for each Victorian tourism region based on the tourism satellite accounts. The contribution of tourism to parks is estimated using information on the expenditure patterns of tourists who visit the parks. Then, Input-Output multiplier analysis is used to assess the economic activity generated by park tourists. The

[124]Read Sturgess and Associates 1999. Economic assessment of the recreational values of Victorian Parks. Consultancy undertaken for Department of Natural Resources and Environment. April 1999.

contribution analysis is based on Australia's national accounting framework. The tourism contribution of parks has been estimated as a contribution to State's Gross Value Added, Gross Regional Product and employment.

*Health benefits:* The method used is an avoided cost approach for park visitors undertaking physical activity in parks and uses recent estimates from the literature about the marginal effect of increased physical activity on health conditions[125].

Health benefits are quantified in terms of savings in health care, mortality and productivity. Specifically, savings in health care relate to reduced health system (medical or treatment) costs, savings from mortality relates to people's willingness to pay to avoid burden of disease and savings in productivity refers to the loss of labour income due to physical inactivity related illnesses.

While there are a number of well-established metrics to quantify the marginal effects of outdoor activities undertaken in parks on levels and change in a number of physical and mental health benefits, the direct attribution of parks to health outcomes including economic benefits is challenging and is an area in need of further research. Therefore, the estimates provided in this section are indicative.

While this report has sought to initially quantify the physical health benefits of parks in monetary value, determining the direct attribution of mental health benefits of parks can be challenging and further work is required in this area.

### *Value of benefits*

*Enjoyment benefits:* If the values generated from the Read Sturgess study are simply updated to 2014 dollars the value increases by 50% to around $515 million per annum. If the values are updated and applied to current estimates of visits numbers to Victorian parks (with a lower bound of 33 million visits per annum based high confidence survey data only and an upper bound of 51 million visits per annum) **the current total value of recreation services is estimated to be at least $600 - $1,000 million per annum** (increasing by 75%-200%). The range reflects the level of confidence in the estimated total annual visits and therefore recreational value. The table below summarises the makeup of the estimate.

**Table A2.16 Estimated range for value of annual recreation services from Victorian Parks**

| PV confidence in visitor data | Type of data transferred from original travel cost study | Cumulative number of parks included | Cumulative value of recreation ($m pa) |
|---|---|---|---|
| Best confidence | Park specific data | 23 | $607 |
| | Extrapolated data | 33 | $663 |
| Medium confidence | Park specific data | 49 | $731 |
| | Extrapolated data | 89 | $791 |
| Lowest confidence | Park specific data | 99 | $795 |
| | Extrapolated data | 344 | $1,067 |

Sources: PV visitation data 2013 and Read Sturgess and Associates 1999, *Economic Assessment of Recreational Values of Victorian Parks*, prepared for the Department of Natural Resources and the Environment.

In valuing recreational enjoyment and tourism we are measuring different types of benefits that may potentially be relevant to different groups of people. Park visitors derive personal benefits from

[125] Warburton D. E. R., Nicol C. W., Bredin S. S. D. 2006 Health benefits of physical activity: the evidence. Canadian Medical Association Journal 174, pp. 801–809. DOI: 10.1503/cmaj.051351

visiting parks. Some of these park visitors are tourists (meaning visitors who are not local residents), who generate benefits for regional communities and the broader Victorian community through their trip-related expenditure. Information on 'park attributable' travel expenditure by visitors is used as a key input to assess both enjoyment and tourism benefits. However, expenditure itself is not a measure of either benefit. The enjoyment value is derived from visitors' willingness to pay to access parks beyond what they currently have to pay in entrance fees (or consumer surplus). These benefits measure visitor utility gains (implied in part from the cost of travel), while the focus of the tourism value is on the economic contribution of tourist spending to the Victorian economy, which can be observed in current market transactions.

*Tourism benefits:* Based on an economic contribution study for Parks Victoria by Deloitte Access Economics in 2014, the total **economic contribution of park-attributable tourism has been estimated at $1 billion of Gross Value Added (GVA) and around 14,000 jobs in 2010-11**. GVA is considered the most accurate measure of the contribution of tourism to an economy. The table below shows the breakdown of GVA and employment by tourism region. GVA is the value of output less the value of inputs sourced from other industries supplying goods and services to the tourism sector.

**Table A2.17 Economic contribution of park-attributable tourism ($m in 2010-11)**

| Tourism region | Economic contribution (GVA) | Number of people employed | % of regional economy |
|---|---|---|---|
| Melbourne | $433 | 6,130 | 0.1 |
| Grampians | $102 | 1,164 | 0.4 |
| Great Ocean Road | $87 | 1,235 | 0.3 |
| Yarra Valley and Dandenong Ranges | $85 | 1,103 | 0.3 |
| Gippsland | $82 | 1,112 | 0.3 |
| Murray | $71 | 894 | 0.2 |
| Victoria's High Country | $56 | 779 | 0.8 |
| Mornington Peninsula | $47 | 639 | 0.2 |
| Daylesford and the Macedon Ranges | $23 | 269 | 0.2 |
| Phillip Island | $20 | 219 | 0.5 |
| Goldfields | $17 | 240 | 0.1 |
| **Total** | **$1,021** | **13,783** | |

Source: Deloitte Access Economics *Report on Valuing the Tourism Services provided by Victorian Parks*, May 2014.

Around half of the total economic contribution relates to direct impacts, where there is a direct relationship between the visitor and the producer of the good or service. The other half relates to downstream flow-on and supplier effects of tourism demand for intermediary materials or services (e.g. fruit and vegetables supplied to a restaurant visited by a tourist on a trip to visit a park).

In the absence of a specific data on the primary motivation for a park visit, the economic contribution analysis includes assumptions about the motivation of visitors in a tourism region using a 'drawcard approach' to estimate the proportion of expenditure that can be attributed to parks.

It should be noted that the economic contribution has been derived using visitor data from Tourism Research Australia rather than Parks Victoria data. This is because use of the Parks Victoria data results in park-attributable tourism expenditure was greater than the total tourism expenditure derived in the regional tourism satellite accounts. This suggests that the tourism estimates above may be

conservative. Recent changes to Parks Victoria visitor surveys have included questions about primary motivation of the visit, which will increase the confidence of the data and enable revised estimates. It should also be noted that these estimates are not total economic contribution of Victoria's parks, but related to tourism services only.

For the purpose of environmental-economic accounting, it is important to note that the economic contribution values cannot be used directly as exchange values. They reflect the value add generated in the economy through the operations of a specific business in the economy.

*Health benefits:* Based on the estimate of health costs from physical inactivity of $1,660 per person, the table below provides indicative high-level estimates of the avoided costs associated with physical activity for metropolitan parks and national and State parks that could be attributed to parks.

**Table A2.18 Indicative estimates of avoided health costs from park visits**

| Scope | Urban parks | National and State parks |
|---|---|---|
| Victorian population (aged 15 and over in 2013) [1] | 4.3 million | |
| % of Victorian population that visited parks in the previous 12 months [2] | 33% | 46% |
| Number of Victorian visitors to parks | 1.4 million | 2.0 million |
| Number of *total* park visitors with the primary purpose of fitness/physical activity [2]<br>(number of *regular physically active* park visitors with at least three one-hour exercise visits per week) [2] | 780,450<br>(141,900) | 751,640 |
| Share of *physically inactive* visitors, i.e. doing less exercise than the minimum recommended in national health guidelines [3] | 56%<br>(0%) | 56% |
| Average number of park visits per year | 12<br>(156) | 18 |
| Contribution of parks to recommended physical activity per year,using two sessions of exercise per week as benchmark | 11%<br>(100%) | 17% |
| Avoided healthcare and productivity costs per person due to physical inactivity [4] | $1,660 | |
| Proportion of park visit substitutes, where people decide to do exercise somewhere else outdoors – own assumption | 0% (50%) | |
| **Indicative estimate of avoided costs** | **$80.6m<br>($117.7 million)** | **$118.2m** |

Note: the values in brackets correspond to regular park visitors, who are physically active with at least one-hour exercise visits per week in parks. Sources: [1] ABS 2014, Australian Historical Population Statistics; [2] PV visitation data 2013; [3] ABS 2013, Australian Health Survey: Physical Activity 2011-12; [4] Medibank Private, 2008, The Cost of Physical Inactivity.

It should be noted that the estimates above may overlap as some people may be visiting both metropolitan parks and national/State parks. In addition, it assumes that regardless of the level of activity, occasional visitors would decrease the risk of developing relevant diseases associated with physical inactivity.

A more detailed and rigorous analysis would assess the level of physical activity obtained through exercise undertaken by people in equivalent control and treatment groups (where the treatment group includes those going to parks). The analysis would then look at the reduction in the likelihood of prevalence or incidence of specific physical/mental health conditions (e.g. cardiovascular disease, type 2 diabetes) due to increased physical activity (this can be assessed with information from epidemiological studies on the population attributable fraction, which measures the contribution of a risk factor to a disease or death). However, no Australian data was available at the time of this report to measure this more precisely.

The indicative analysis suggests that **avoided healthcare costs and productivity impacts associated with physical activity in Victorian parks could be in the range of $80-200 million per annum.** Sensitivity checks around potential substitution effects and the share of health costs according to visitor's health status could increase this range of park-related health benefits from between $40 to around $300 million per annum.

While the costs above include savings in the treatment of depression conditions, the current project has not attempted to quantify the avoided costs of broader mental health services by visiting parks. Mental health benefits of contact with parks and nature have been well documented, but this is a significant area where further research on valuing these benefits is required.

## (ii) Landscape and neighbourhood amenity

### *Benefit and beneficiary*

Victoria's parks provide enjoyment and mental health benefits to surrounding residents, particularly residents near urban and peri-urban parks in Melbourne and regional cities.

### *Context*

Parks provide important amenity services to surrounding residents, enabling a range of personal and community benefits. This may include both use values from having closer proximity to access greenspace, to gaining heath and enjoyment benefits from viewing nature and wildlife as well as non-use values by knowing that nature is being conserved nearby.

A common method of valuing the amenity value of parks is through hedonic house price modelling which compares the sale price between homes that are in close proximity to parks against those that are not, taking into consideration other factors, such as house features, building age, transport, schools and other influences on home price.

A recent review of hedonic price studies from the USA, UK and Europe and has shown that there is good evidence that parks and open space have a positive impact on nearby residential property values[126]. While different types of parks may have different types of effects, proximity to parks can add between 5% and 20% to the value of homes. Locally, an ongoing study of home values surrounding Wattle Park in Melbourne found an increase in value of up to 20%[127], while a study of Noosa National park in Queensland (a peri-urban park) found an increase of 7% in home value[128]. A number of these studies have also found a positive relationship between distance from a park and property value. Some research has also highlighted a relationship between parks that are well maintained which have higher increases in value.

Amenity value may also be reflected in life satisfaction of nearby residents. A recent Australian study that examined the influence of public greenspace on the life satisfaction of residents of Australia's capital cities found a positive relationship between the percentage of public greenspace in a resident's local area and their self-reported life satisfaction. On average, it found that a resident has an implicit willingness-to-pay of $1,168 in annual household income for a one per cent increase in public green space.[129]

### *Links to other services*

The provision of amenity is linked to other services such as recreation enjoyment (with many residents also likely to be park visitors), health benefits (with residents also likely to be undertaking physical

[126] Maruthaveeran *S 2013,Konijnendijk C.C.,Annerstedt M Busse Nielsen A Copenhagen and Alnarp, January* Benefits of Urban Parks A systematic review *A Report for IFPRA.* This review lists a 1995 study on the Sydney's Centennial Park, but this Sydney study used the travel cost methods and contingent valuation and cannot be compared with the findings of other international studies using hedonic price modelling.

[127] D. Cochrane, personal communication, 2014

[128] Pearson, L., Tisdell, C., Lisle, A., 2002. The impact of Noosa National Park on surrounding property values: An application of the Hedonic Price Method. Economic Analysis and Policy 32, 155-171

[129] Fleming C and Ambrey C, 2013 Public Greenspace and Life Satisfaction in Urban Australia, Urban Studies http://usj.sagepub.com/content/early/2013/07/18/0042098013494417.abstract

activities in parks), other cultural services including ecosystem/species existence and a range of regulating services including watershed and habitat services.

### *Quantity of service provided*

In 2013, the number of immediate neighbours to Melbourne's urban and peri-urban parks was 11,757, which included 4,680 to urban parks and 7,077 to peri-urban parks[130]. This excludes residents who live next to Port Phillip Bay. Additionally, outside the Greater Melbourne area there were 38,000 immediate neighbours to National and State parks and 47,000 neighbouring conservation reserves.

### *Counterfactual: the world without parks*

In the absence of parks, the counterfactual is that national and State (non-metropolitan) parks would have been cleared and used for grazing, while metropolitan park areas would have been used for residential development. As a result, the amenity services parks provide to surrounding residents, such as access, enjoyment or mental health benefits, would no longer be provided. This could have a negative impact on residential value, which captures some of the landscape and amenity services parks provide.

### *Valuation method*

The valuation method for amenity value is based on a benefit transfer of multiple hedonic home price studies for urban and peri-urban parks only. While the international evidence suggests that the effect of parks surrounding properties is 5-20% in increased home prices, we have used a conservative range from 5-7%. This is in line with findings from recent published studies available in the Australian context, such as a 2013 thesis indicating an average increase of 8.6-15.6% due an increased Enhanced Vegetation Index (used as a proxy for green infrastructure)[131].

A spatial analysis was undertaken to identify the number of immediate neighbours to urban and peri-urban parks managed by Parks Victoria and data on surrounding median home price was reviewed for each park. Consequently the calculation of the number of households obtaining amenity value from Melbourne's parks provides a conservative estimate, as research suggests that increased home prices gradually drop with distance from the park. Only urban and peri-urban parks were assessed, as the evidence for amenity value for other parks is more limited.

The benefits of living near a park can include both direct use benefits and non-use benefits. It is probable that one of the direct use benefits of proximity to a park is increased health benefits and/or recreational enjoyment associated with visiting the park more frequently.

### *Value of benefits*

Based on the assumptions above of a 5-7% increase in home value for immediate urban and peri-urban park neighbours, **the amenity value for residents immediately surrounding Melbourne's urban and peri-parks is $326-438 million or $21-28 million per annum.** While the assessment has been only applied to Parks Victoria managed parks within Melbourne's urban and peri-urban area, if applied to a

[130] Parks Victoria spatial analysis
[131] Rossetti 2013, Valuation of Australia's green infrastructure: hedonic pricing model using the enhanced vegetation index. Monash University Thesis 2013.

regional centre such as Bendigo, amenity values associated with the Greater Bendigo National Park which surrounds the City of Bendigo could be about $17 million.[132]

Further work is required to improve the quality of data for amenity value of Melbourne-based parks and extend assessment of amenity value to other parks within Victorian regional centres.

[132] Assuming a 5% increase in home value for the 1,014 residents that live adjacent to this park.

## (iii) Social cohesion and sense of place

### *Benefit and beneficiary*

Community members that volunteer in parks gain social connection, a sense of community contribution and physical and mental health benefits.

### *Context*

Increasingly, social scientists have argued that communities with higher levels of volunteer participation and active social networks have better economic outcomes, higher educational achievements, improved community safety, better experiences for families and children and better health and wellbeing.

Volunteering and community participation is an important avenue through which Parks Victoria and the community collaborate in the conservation, protection and interpretation of parks and reserves. Volunteering contributes to social capital through individuals and communities connecting with parks and Parks Victoria being connected with the community.

The benefits to volunteering to volunteers include:

- satisfaction, fulfilment and enjoyment from activities carried out in natural or cultural environments;
- learning and development of new skills and experiences;
- increased knowledge about park management and Parks Victoria; and,
- social interaction with like-minded people.

The contribution of volunteers to parks includes:

- the opportunity to build and maintain positive links and understanding between Parks Victoria and the community;
- tangible achievements towards the protection, preservation, enhancement and enjoyment of natural and cultural environments and visitor experience;
- access to skills and abilities that may not be readily available through Parks Victoria's own resources;
- broadening community responsibility and pride in the parks system; and,
- understanding of community expectations in relation to park management.

### *Links to other services*

Opportunities for volunteering in parks are linked to other cultural services, including recreational enjoyment, tourism, connection to cultural heritage, and intermediary services, such as conservation of habitats.

### *Quantity of service provided*

In 2013 volunteers contributed to 211,000 hours in Victoria's parks, which is equivalent to more than 100 full time equivalent staff[133].

[133] Parks Victoria corporate datasets. Refer also to: Ironmonger. D. ,2012. 'The Economic Value of Volunteering in Victoria'. A Report Commissioned by The Department of Planning and Community Development. Victorian Government.

### *Counterfactual: the world without parks*

In the absence of parks, some volunteers could shift to support other social work, but those volunteers with special interest in nature may stop or reduce their level of involvement in conservation activities. This is because there would be more limited opportunities for engaging in unpaid work offering activities in prominent landscapes, contact with threatened and rare species, or alternative options available with other organisations could be in less accessible sites.

Due to the lack of data, we have assumed that current volunteers are mainly motivated in nature related work and therefore they would cease any volunteering activities without parks.

### *Valuation method*

The method selected for the valuation of volunteering in Victoria's parks is an output based measure. Based on ABS guidelines, the wage chosen for a volunteer is either (1) the opportunity cost of the time the persons involved in unpaid work could have obtained if they had spent the time in paid work (reflecting the use of time for equivalent activities, rather than substituting the main occupation); or (2) the 'specialist wage' that would be needed to pay a specialist from the market to do the activity (say, a botanist to do a survey) be paid to do the unpaid work.

The estimate of the value of volunteer time is based on the 'average compensation per employee'. These estimates have previously been calculated between 1992 and 2006, based on earlier work by the ABS[134]. The equivalent hourly wage rate for volunteers was $24.09 in 2006, which has been adjusted for inflation.

### *Value of benefits*

The total **volunteer hours of 211,000 in 2013 is equivalent to 100 full time equivalent staff, which is valued at $6 million per annum.**

Note that this initial estimate of volunteer value is limited to financial opportunity cost. The additional health and social cohesion benefits of volunteer involvement have not been calculated and is an area for further research.

[134] Australian Bureau of Statistics 2000, *Unpaid Work and the Australian Economy*.

## (iv) Opportunities for scientific research and education

### *Benefit and beneficiary*

Victoria's parks provide unique ecosystems as input to research and education activities that benefit directly park visitors and scientists, and contribute indirectly to Victorian, national and global communities who benefit from research outcomes (through progress in knowledge or technologies).

### *Context*

Parks provide a wide range of opportunities for research and knowledge development and the knowledge gained from parks contributes to the broader knowledge of the community about nature and cultural heritage. Parks Victoria recognises the importance of research in parks to ensure that its management is informed by good science and evidence.

Additionally, our parks network provides major opportunities for the community to gain a greater appreciation of nature and heritage through formal and informal interpretation education programs.

Parks Victoria's Research Partners Program (RPP) encourages research to be undertaken in parks through collaboration with universities and other research institutions. The RPP encourages researchers and park managers to

- build a strong body of knowledge to guide park management;
- improve understanding of the natural values of the park system;
- encourage research into park management issues and support tertiary students in park-based research;
- attract support for, and encourage collaboration in, scientific research in parks and reserves; and,
- enable scientists and park managers to work together to enhance protection of parks.

A wide range of formal and informal education and interpretation programs are undertaken in parks to inspire and educate visitors about nature and assist them to understand how to minimise detrimental impacts on park values. This includes a school education program, as well as summer ranger interpretation programs.

### *Links to other services*

Research and education services are linked with other cultural services such as recreation services and cultural connection. They are closely connected to many regulating services, including maintenance of habitats for species and maintenance of genetic diversity.

### *Quantity of service provided*

Recent data from the last three years indicates that on average 215 research permits are issued in parks every year and 183,000 people participate in parks related education programs every year.

### *Counterfactual: the world without parks*

In the absence of parks, some research areas would become more costly as additional arrangements would be needed to access suitable control and treatment groups across Victorian ecosystems and access to private land could require higher transaction costs. As a result, under the counterfactual,

some biophysical research outcomes or genetic materials could be delayed (developed years later), take place in other Australian regions or not occur at all. This would depend largely on the type of research being undertaken in the parks network.

### *Valuation method*

The valuation method for research and education, could include the productivity method, but would greatly depend on the outcomes sought, adoption and long-term impact of research in society. The valuation method would very much depend on the type of research being undertaken and their impacts on society and may require a selection of case studies.

For the purpose of Parks Victoria, reporting financial contributions (as revenue stream net of any costs from the Research Partners Program) is sufficient to indicate a lower-bound estimate of the benefits expected by research and education partners to access parks.

### *Value of benefits*

Assessment of the value of scientific research and education in parks could be undertaken in the future once more data becomes available.

In a previous assessment of Parks Victoria's Research Partners Program[135] it was determined that each dollar of Parks Victoria research funding resulted in approximately six dollars of leveraged research funding from other research partners. This exchange value represents the costs for current research areas only and does not take into account the actual benefits created in society or the economy from the knowledge, materials or technologies obtained from research once they have been adopted. Some of these benefits could include productivity or efficiency gains in the management of native species or development of genetic material for medical research.

[135] Review of the research partners program, unpublished report, Parks Victoria, 2005

## (v) Historic place conservation

### *Benefit and beneficiary*

Some of Victoria's parks provide landscapes and sites of historical significance that park visitors, Victorian, national and global communities value as part of their heritage.

### *Context*

Conservation of historic heritage enables Victorians to connect with the rich stories of our past land use. Parks Victoria manages more than 2,500 historic places within its parks network including 145 places listed as being of National or State heritage significance. Nationally listed sites include the Castlemaine Diggings National Heritage Park, Werribee Park and Point Nepean National Park.

Physically, heritage places include about 260 substantial buildings and structures, 70 huts (mainly in the high country) and more than 1,200 archaeological sites, shipwrecks and minor structures. Many sites also hold collections, large and small, of movable heritage objects.

State listed places include lighthouses, shipwrecks, huts, gardens, historic buildings and relic mining sites. The historic places within the parks network represent a wide range of historic themes and stories covering use of natural resources, mining, shipping, agriculture, settlement of Port Phillip, defence and transport. Parks Victoria manages 58% of Victoria's historic parks and reserves (94 parks out of 161 in total).

### *Links to other services*

Heritage conservation is linked with other cultural services such as recreation and existence values.

### *Quantity of service provided*

Historic heritage is the primary purpose for a significant number of visitors to Victorian parks. This is reflected in the activities undertaken by visitors to parks, including visiting historic places. In 2009, 55% of the population had visited a heritage place managed by Parks Victoria within the previous 12 months.

### *Counterfactual: the world without parks*

In the absence of parks, the counterfactual is that national and State (non-metropolitan) parks would have been cleared and used for grazing, while metropolitan park areas would have been used for residential development. Under this scenario, the historic landscapes and sites that are conserved and managed by Parks Victoria would be significantly degraded or destroyed. As a result, the heritage value provided to park visitors, Victorian, national and global communities would diminish or be lost entirely.

### *Valuation method*

The method adopted to value historic heritage is based on a 2009 survey on households' willingness to pay for conservation of park-related heritage[136]. In this survey, Victorian households were asked to state their willingness to pay from a range of choices.

### *Value of service provided*

Based on the survey data collected in 2009, 60% of Victorian households expressed they would support a yearly charge to maintain Victoria's park-related heritage places and 54% of respondents stated they would support a yearly surcharge of $20 for management of heritage places in parks. These survey results are used to estimate a value range for the **conservation of park-related heritage of $6-$23 million per annum**, as shown in Table A2.19. However, these estimates are only a lower bound of the value people place on park-related heritage, as survey participants were only asked their willingness to pay $5, $10 or $20 once, rather than presenting higher bid values iteratively.

**Table A2.19 Value of heritage conservation**

| Survey subsample | 1 | 2 | 3 |
|---|---|---|---|
| Number of Victorian households (2011) | | 2,154,000 | |
| Yearly surcharge on Victorian households for the management of heritage places in parks ($ AUD) | $5 | $10 | $20 |
| Proportion of households that would support a yearly surcharge | 59% | 69% | 54% |
| **Value of Parks Victoria managed heritage places per year** | **$6.3 million** | **$14.8 million** | **$23.3 million** |

The original study has not been reviewed in detail and therefore this estimate is indicative only. It is not clear whether the survey was explicitly designed to elicit a value for specific or generic historic heritage sites or whether the technical requirements for a robust stated preference method were met. In addition, it was not possible to assess the sampling strategy used and whether the participating households or respondents were representative of the Victorian population in order to extrapolate the results.

[136] Market Solutions 2009, Community perception of heritage management in parks

## Appendix 3: Local ports in Victoria's parks network

In addition to managing parks, Parks Victoria manages infrastructure and recreational activity around some Victorian bays and waterways. Access to local ports enables a range of activities such as commercial and recreational fishing and boating. The commercial and recreational benefits provided by these waterways have not been included in the ecosystem accounts for Parks Victoria given their role as infrastructure and recreational manager rather than natural asset manager in this context. Part of this economic contribution is attributable to Parks Victoria's management of built and social capital.

Of the 14 local ports on the Victorian coast, Parks Victoria manages three local ports: Port Phillip, Western Port and Port Campbell. These local ports provide a range of economic and social benefits related to recreation and tourism, through supporting recreational fishing, boating and other tourism activities. The local ports are a focal point of economic and social activity in many regional communities.

The ports provide essential infrastructure for fisheries and aquaculture industries along Port Phillip, Western Port and Port Campbell, benefiting food producers and consumers. A key benefit from access to a local port is the ability for commercial fishing and aquaculture activities to take place around local areas. Port services include provision of mooring and navigation assets for boating and support for vessel maintenance, boatyards, transport and marine safety.

Although the management of the port infrastructure supports a range of activities, the ecosystem assets providing the ecosystem services are not part of the Parks Victoria network. Therefore they are not included along with the other services provided by Parks Victoria's ecosystem assets.

A range of the benefits associated with ports has been previously assessed through the economic analysis of commercial fishing and other recreational activities at Victoria's local ports by SKM in 2010 and Deloitte Access Economics in 2013[137].

The analysis measured the economic contribution of local ports managed by Parks Victoria based on the value of the local port in terms of the economic benefits the community would lose if the local port closed.

The valuation included:

- Estimation of overall expenditure based on commercial fishing, recreational fishing, recreational boating, aquaculture, tourism, direct local expenditure directly dependent upon ports, and other minor expenditures.
- Indirect or flow on impacts to the economy including consumption of intermediary goods and services using input output analysis.
- Estimate of consumer surplus gained (i.e. how much port users value the port experience above and beyond what they have to pay for)
- Consideration, where possible, of other value including heritage values and social values, including sense of place, sense of belonging, community ownership and heritage values.

[137] SKM 2010, The Economic and Social Value of Victoria's Local Ports. Deloitte Access Economics 2013. The economic and social value of Victoria's local ports. Report to Department of Transport, Planning and Local Infrastructure.

The catch of commercial fishing landed through the Parks Victoria managed local ports in 2011/12 was 874 tonnes. The gross output of commercial fisheries and aquaculture that lands through the three local ports managed by Parks Victoria amounts to $19.8 million per annum, as shown in the table below.

**Table A3.1 Commercial fisheries and aquaculture attributed to local ports**

| Local Port | Gross output ($million per annum) |
|---|---|
| Port Phillip | 8.40 |
| Western Port | 8.57 |
| Port Campbell | 3.77 |
| **Total** | **19.76** |

Source: Deloitte Access Economics 2013. The economic and social value of Victoria's local ports.

The same economic analysis highlighted that the recreational and tourism value of the three local ports managed by Parks Victoria was at least $86 million. Port Phillip had the highest value for recreation and tourism of all 14 designated ports in the State.

**Table A3.2 Economic value of recreation and tourism in local ports managed by Parks Victoria**

| Local port | Recreational fishing ($M per annum) | Recreational boating ($M per annum) | Tourism ($M per annum) | Total ($M per annum) |
|---|---|---|---|---|
| Port Phillip | 24.5 | 35.3 | 2.25 | 62.06 |
| Western Port | 7.96 | 12.63 | 1.61 | 22.2 |
| Port Campbell | 0.58 | 0.96 | 0.14 | 1.9 |
| **Total** | **33.04** | **48.9** | **4.0** | **86.16** |

The total economic contribution estimated by the analysis is summarised in the table below.

**Table A3.3 Total economic contribution of local ports managed by Parks Victoria**

| Local port | Total direct value ($M per annum) | Indirect value ($M per annum) | Total value ($M per annum) | Consumer surplus ($M per annum) |
|---|---|---|---|---|
| Port Phillip | 73.87 | 129.28 | 203.15 | 7.40 |
| Western Port | 32.36 | 57.64 | 90.00 | 1.83 |
| Port Campbell | 6.48 | 11.34 | 17.82 | 0.08 |
| **Total** | **112.71** | **198.26** | **310.97** | **9.3** |