Department of
Sustainability and
Environment

land asset–based approach framework

action
Salinity & Water
AUSTRALIA

A Victorian Government initiative

Victoria
The Place To Be

This framework was prepared by Shayne Annett and Kate Adamson, Sustainable Rural Landscapes Unit, Department of Sustainability and Environment (2008).

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1. Introduction

1.1 Project background

This framework was developed in response to a discussion paper completed as part of the land assets project. The discussion paper, *Asset-based approach for natural resource management in Victoria: Discussion paper* (DSE 2006) outlines the need for a structured asset-based approach to land management.

The framework includes:

- definitions
- a list of land assets
- a description for measuring services provided by assets
- a base set of threats
- a list of data to describe and quantify threats
- principles of risk assessment for land assets and services
- the basic structure of an asset-based approach (Figure 1).

An asset-based approach focuses on protecting or maintaining biophysical assets that are of value to people, rather than focusing on issues. **Assets** are the biophysical or physical elements of the environment we are trying to protect. The desire to protect these assets is due to the social, economic and environmental **services** which they provide.

The conceptual framework for an asset-based approach to natural resource management investment is illustrated in Figure 1.

An effective assets based approach will:

- identify where actions take place and why
- describe the logic behind the action.

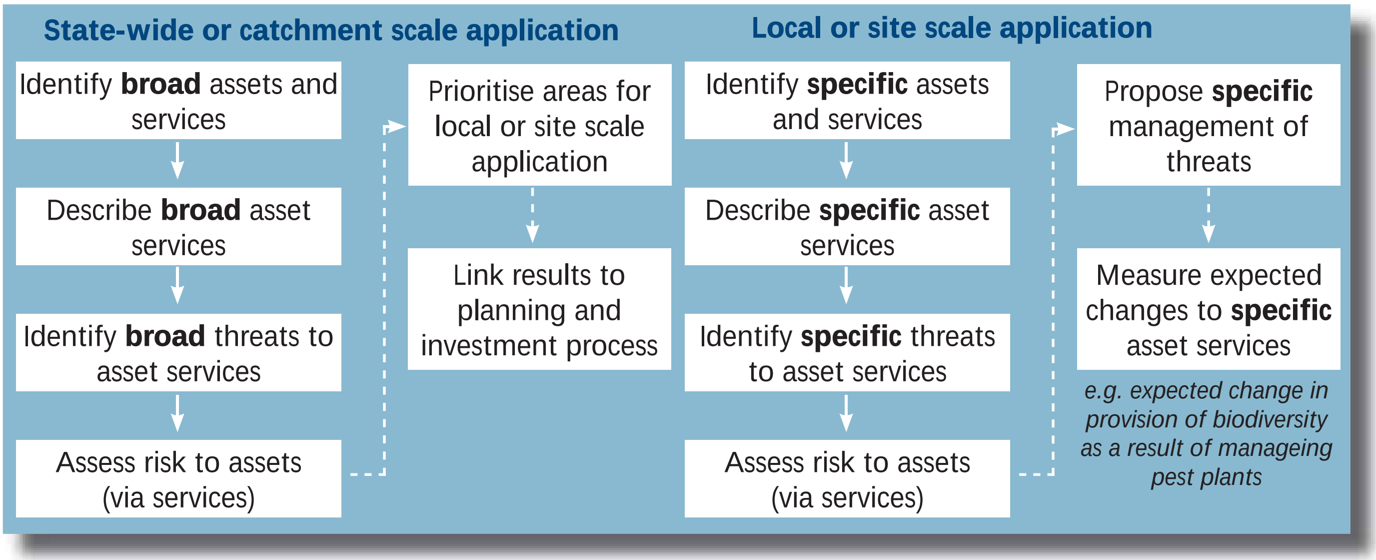

Figure 1: The Asset-based Approach Conceptual Framework for broad and specific application.

1.2 The application of an asset-based approach to land management in Victoria

The adoption of a structured approach for land management is currently impeded by the lack of a detailed framework for the asset-based approach. There is still a great deal of uncertainty surrounding the approach with no consistent state-wide definition of what an asset is, let alone how to assign value, measure and rank each asset.

As the discussion paper prepared by DSE in 2006 noted, if the asset-based approach for land is to be a useful tool, analysis of assets needed to be:

- spatially based
- based on the best available data.

The framework draws on recent action plans, strategies and projects that use these principles to identify and value assets and threats. Additionally the recently prepared guidelines for regional Pest Plant and Animal Plans and Multiple Outcome Projects give specific directions for asset and threat description (see appendix 1).

The methodologies and approaches used in the regions have provided valuable information for the development of a state-wide asset-based approach.

Key lessons from the recent application of asset-based approaches are:

- recognition of the difficulties of applying the asset-based approach at the sub-strategy or project level in the absence of a state-wide framework
- recognition of the need for different stakeholders to focus on different land assets, such as native vegetation or primary production assets, rather than for land as a whole
- the lack of any intrinsic unit for land that divides the landscape into geographically identifiable and accepted units
- the framework needs to be flexible enough to allow for regional views and investment priorities
- the output of the land assets approach is different to the outputs of the River Health Program's approach.

Workshops held across the state also informed the development of this framework.

1.3 The asset-based approach in the State and Regional Investment Framework

An asset-based approach in Victoria will help investment decision-making in regional natural resource management. Setting priorities for investment in natural resource management is important, especially where the threats are great and resources limited. The asset-based approach provides critical information to help natural resource managers to determine priorities and decide where to allocate funds.

An asset-based approach to setting priorities is a multi-stage process. It requires:

- an inventory of assets and the services they provide
- an assessment of their worth and condition
- an assessment of the threat to their condition
- an assessment of the difficulty of managing the threat.

It is useful for decision-making at a range of scales, from state and catchment level through to paddock and site scale.

The asset-based approach operates at two levels. Broad-scale analysis supported by spatial information from GIS libraries can identify areas that contain valuable assets under threat, according to policy priorities and the imperatives of the Regional Catchment Strategy. Local or site-scale analysis carried out via site inspection can then assess the condition of the assets and the nature of the threats they face. This will help determine the most effective course of action.

As illustrated in Figure 1, information on assets, threats and risk then inform the investment decision-making process, along with the range of other considerations such as feasibility, cost analysis, benefit analysis and community support.

1.4 Consistency with other projects and policies

Any framework developed for land assets must be compatible with:

- pre-existing applications of the asset-based approach like the Victorian River Health Strategy and RiVERS system
- relevant state policies, for example native vegetation and biodiversity
- ecosystem services and the work underway as part of the development of the Land and Biodiversity White paper
- Triple Bottom Line Indicators Project (DPI/DSE) that will provide input for Victorian Catchment Management Council state of catchment and state of the environment reporting.

2. Land assets and ecosystem services

The idea that ecosystem services flow from biophysical assets is central to an asset-based approach.

Ecosystem services is a concept gaining momentum in natural resource management overseas and in Victoria.

The confusion between assets and the services they provide has impeded many previous applications of the asset-based approach for land. This confusion complicates both the identification and the valuation of assets.

For this reason there is a very strong need for the framework for land assets to further clarify exactly what assets are and how they relate to the concept of ecosystem services. For this reason this section outlines what the term ecosystem service means, how it relates to assets and why it's critical that the asset-based approach framework for land incorporates an ecosystem services focus.

2.1 Ecosystem services

Ecosystem services are the processes and conditions by which natural ecosystems sustain and fulfil human life (Cork and Shelton 2000). They are the benefits that people obtain from ecosystems.

These include:

- **provisioning** services such as food and water
- **regulating** services such as regulation of floods, drought, land degradation and disease
- **supporting** services such as soil formation and nitrogen cycling
- **cultural** services such as recreation, spiritual and other non-material benefits.

Some of these are non-market and unmeasured ecosystems that underpin our basic needs and health, and are arguably as important to human wellbeing as measures of consumption and economic growth.

Previously, ecosystem services were assumed to be endlessly renewable. There is now clear evidence that the current use of some environmental assets is resulting in accelerated degradation of the asset base. This will significantly reduce benefits available to future generations (Bennett 2002).

In an attempt to benchmark the contribution of ecosystems at a world scale, Costanza et al estimated the value of ecosystem services to be in the range of US$16-54 trillion per year, with an average of $33 trillion offered. At the same period the global gross national product was US$18 trillion per year (Costanza et al 1997). Similar work undertaken by the CSRIO has estimated the total annual value of ecosystem services in Australia to be $1,327 billion. This is approximately four times Australia's gross national product (Australian Museum 2000).

2.2 Relationship between land assets and ecosystem services

Land has a range of values for different people, including economic, spiritual, environmental, cultural or aesthetic (DSE 2006). One way to understand these different values is to identify the assets and associated ecosystem services in a landscape.

The distinction between assets and ecosystem services is crucial. When we value land assets, we must take into account the ecosystem services they provide. For example, soil is a biophysical asset that is valued due to the influence it has on two key services, the provision of food and fibre and the provision of biodiversity. It is also valued for its contribution to many other less understood but potentially equally important ecosystem services, such as carbon sequestration, pollination, water and waste filtration.

Measuring asset services reflects the health and condition of the assets, as long as adequate data is available. Focusing valuation on asset services means:

- reducing the risk of double counting
- considering the full range of services associated with land
- looking at what exactly is valued within a landscape.

2.3 Scope of the asset–based approach for land project

The aim of this project is to further develop the asset-based approach for land. There is already a well-developed and accepted asset framework in existence for river assets, which has informed the development of a framework for estuaries. Recent work by DSE focuses on similar approaches for both marine and wetland assets.

The scope of this paper is to articulate the framework for land-based assets. Not all assets identified will be important for everyone involved in land management in Victoria, with different people interested in particular land assets and services. Although this project is limited to land assets, the links between land and water assets are important and this should be noted in risk assessment processes for both land and water assets. This framework attempts to represent the full list of assets in the landscape and sets guidelines for describing and measuring them.

3. Proposed asset–based approach framework methodologies

3.1 Purpose

The aim of the proposed framework is to allow land assets, services and threats to be identified and quantified in a consistent way across the state. The framework will help determine what the key land assets, services and threats are, how they are measured, and how they can be mapped. Although the framework focuses on land assets, it is compatible with other asset types.

In particular, this section seeks to document a consistent method for the identification of:

- land-based assets and services, and measurement of their value
- threats to assets, and measurement of their extent
- principles of risk assessment.

It is very important to note that this methodology is applicable at two scales. It applies to broad-scale analyses, which might be used to identify areas of primary interest, and also to site-level detailed analyses of assets, services and threats where specific actions need to be determined.

The principles of risk assessment apply to both situations. However the time required to conduct thorough risk assessment dictates that it has most relevance for site level analyses where the value of assets and existence of threats has been established.

3.2 Asset classification

In the past assets were defined as the physical elements of the environment that are of value. As such, assets can be organized and described at a number of levels. In current Regional Catchment Strategies, regions generally group assets into two main levels:

> **Primary Asset Classes:** this represents the contextual or thematic level. For example land, water and air.
>
> **Secondary Asset Classes:** these represent the level at which asset categories are summarised and reported in current Regional Catchment Strategies. For example, water can be further divided into rivers, wetlands and estuaries. The broad range of assets included in land are sometimes separated further into economic, social and environmental categories, or divided into the key services that flow from land, such as native vegetation and soil-based production.

Classification into these asset classes was a key first step in the preparation of the last Regional Catchment Strategies, but for land there is no agreed standard for what constitutes a primary or secondary asset.

For the purposes of this framework, this is not a critical distinction. Rather, it is more important to have a consistent way to describe, measure and map land assets, services and threats.

3.3 Identification of land assets and services

A proposed list of land assets is shown in Figure 3. These assets are likely to be found across landscapes, and they can be used as a basis for valuation.

Assets need protection because they provide social, economic and environmental services (Figure 3). The services presented in Figure 2 are partly based on services identified in the Millennium Ecosystem Assessment Framework (UN 2005) and the work undertaken by the DSE/DPI Triple Bottom Line Indicators Project.

3.4 Measuring asset services

Measuring the importance of asset services is a critical step in the framework. In order to set priorities for limited funds, we need to identify the assets and services that generate the highest possible environmental, social and economic benefit.

In this step, asset services are identified and measured (quantitatively or qualitatively) at a specific location. These measures can then be used to compare the relative importance of different areas. For example, the importance of native vegetation for biodiversity can be determined across the state, allowing us to identify areas of high importance, and therefore giving an indication of priority areas.

A consistent valuation method must be applied to each asset service. The first step is to identify asset services to give an indication of the measures to be used. The second step is to determine the appropriate data for this measurement. Figure 3 provides examples of the services associated with land assets (from Figure 2) and the means for quantifying their importance.

The measures outlined in Figure 3 are based on the principles of being:

- measurable
- of direct relevance to natural resource management investment decisions
- supported by data that is
  – currently available or easy to collect
  – collected at a relevant spatial scale.

Figure 2: Assets and services associated with land

Assets	Services										
	Environmental					Economic			Social		
	Provision of biodiversity	Climate regulation	Pollination	Disease mitigation	Water/waste filtration	Provision of food	Provision of fibre	Tourism	Cultural services	Aesthetic	Recreational
Native flora	x	x		x			x	x			x
Native fauna	x		x					x			
Soil	x	x		x	x	x	x				
Land for primary production	x				x	x	x				
European heritage sites								x	x		
Indigenous heritage sites								x	x		
Recreational sites								x	x		x
Scenic landscapes								x	x		
Geomorphological features								x	x	x	x
Groundwater	x					x	x				
Surface water	x					x	x	x			x
Infrastructure								x			x

Asset services	Possible measures	Possible data sources
Environmental		
Provision of biodiversity (provision of habitat and genetic resources)	» Vegetation type and conservation status	» EVC mapping modelled
	» Vegetation extent	» Modelled native vegetation extent
	» Vegetation site condition	» Vegetation site condition model » Part of Habitat hectares score
	» Vegetation Landscape context	» Landscape context model layer » Part of Habitat hectares score
	» Presence of rare and threatened fauna and flora	» Sites of biological significance, » Flora and Fauna Survey Site Points » Habitat models for threatened species
	» Soil biota	» Future soil health index
Climate regulation	» Carbon sequestration	» Amount sequested
Pollination Disease mitigation Water/waste filtration	N/A	N/A
Economic		
Primary production (food & fibre)	» Economic return » Land capability	» Gross value of production (ABS) » Economic multipliers for each industry
Tourism	» Economic return	» Value of Tourism ($)
Social		
Cultural	» Listed Indigenous heritage sites	» Cultural heritage sites » Register of the national estate
	» Listed European heritage sites	» Historic places » Register of the national estate
	» Flagship species	» Estimation of importance to community
Recreational	» Recreational sites, key attraction sites and features	» High use recreational sites within or adjacent to public land » Visitor numbers » Estimation of importance to community
Aesthetics	» Significant geological or geomorphological features	» Geographically significant features as ranked by geological society of Australia
	» Iconic landscapes	» Listed landscapes overlay

Figure 3: Asset services, measures and data for land

3.4.1 Outputs from asset identification and valuation

The asset identification and valuation process will result in maps that show the value of the various asset services associated with land across the state. Areas with clusters of high value assets and services can then be identified. For example, Figure 4 shows modelled vegetation quality across Victoria. This modelling shows how information on an asset, such as native vegetation, can be used to highlight areas of high asset value from one particular perspective. [1]

The information on asset value can be used by itself to help inform priorities, or it can be further refined by layering various asset maps to identify areas where different high value assets overlap. These maps can also include threat level information.
Once broad priorities have been set in a region, other considerations such as asset condition, threats and the difficulty of managing the threat can be determined at a local or site scale.

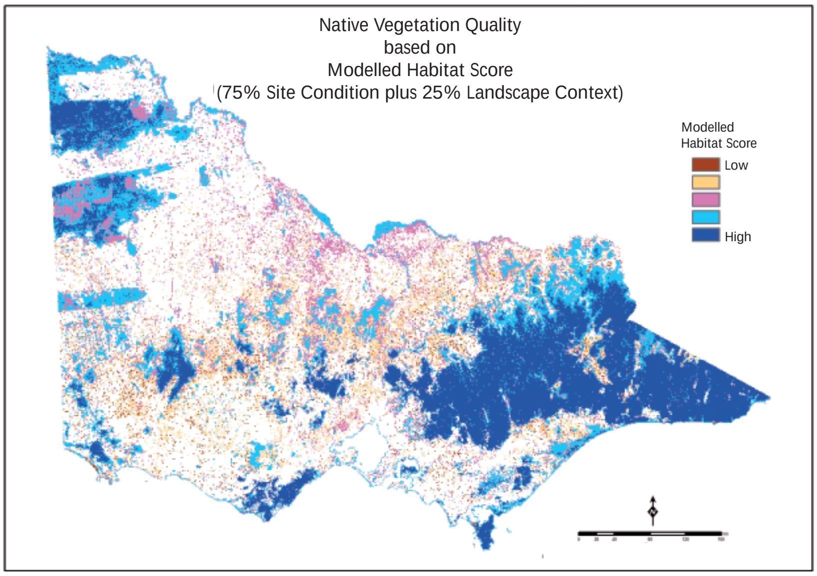

Figure 4. Modelled vegetation quality (combines site condition and landscape context.) Quality is rated from 0% (lowest quality, in red) to 100% (highest quality, in blue).

3.5 Assessing threats to assets

Threats are potential causes of degradation to an asset, and in particular to the services associated with that asset. Threatening processes can be natural or induced. They include things like salinity, soil erosion, and the spread of pest plants and animals.

Threat information is critical for risk assessment, based on likelihood and consequence. Analysis of the extent and severity of a threat informs the assessment of its likelihood. Data on the impact of the threats to assets and asset services informs the assessment of its consequence.

The key threats to asset services are briefly described below. These threats are the most common to land in Victoria. They are taken from information in the ten current Regional Catchment Strategies and the 2002 Victorian Catchment Management Council State of the Catchment Report.

[1] This map is based on draft data, which will be refined further prior to being made available on the DSE Corporate Geospatial Data Library.

Soil structure decline
Soil structure decline is one of a range of soil health issues that can be influenced by land management practices. The structural decline of soils can occur through a number of land management practices including compaction by farm machinery, pugging from hard-hoofed animals, and aggregate breakdown from soil tillage practices. Soil structure decline can lead to reduced water infiltration and aeration, reduced plant germination and increased wind or water erosion.

Soil acidification
Soil acidity is also influenced by land management practices. The causes of soil acidification are many and varied, but past and present farming systems continue to accelerate the decline in soil pH through nitrate leaching and removal of produce. Up to three million hectares of Victoria's agricultural land is estimated to be suffering losses in productivity due to soil acidity (NRE 2001).

Coastal acid sulfate soils
Acid sulfate soil is the common name given to naturally occurring soil, sediment or rock that contains elevated levels of iron sulfides, principally pyrite or FeS_2. When exposed to air, iron sulfides oxidise and produce sulfuric acid. Exposure and oxidation of soils rich in iron sulfide can occur as a result of drainage (including agricultural drains) and excavation works. The soil itself can neutralise some of the sulfuric acid. The remaining acid moves through the soil, acidifying soil water, groundwater and, eventually, surface water.

Water erosion
Water erosion is a natural process that is accelerated by land management practices that disturb the soil or leave it bare of vegetation. Accelerated water erosion has long-term implications for biodiversity, water quality and agricultural productivity.

Wind erosion
Wind erosion is a natural process that is accelerated by land management practices that disturb the soil or leave it bare of vegetation for periods of time. Dust storms have the capacity to create large sand drifts that may cover roads, bury fences and block water supply channels and drainage systems. From an agricultural perspective, wind erosion events remove productive topsoils which leads to declining yields.

Climate change
Changes in rainfall and temperature patterns, and in the frequency of extreme weather events such as storms and droughts could affect water resources, coastal environments, native flora and fauna, agriculture and forestry. The potential threat posed by climate change must be considered across almost all assets.

Salinity
Salinity occurs naturally, even in healthy catchment areas. Secondary salinity occurs in the form of irrigated salinity, when irrigation causes groundwater to rise, and dryland salinity, caused by the removal of vegetation that would otherwise keep saline groundwater below the root zone.

Salinity in the form of rising saline water-tables poses a threat to agricultural production, native flora and fauna, waterways and water resources and infrastructure. Currently around 260,000 hectares are affected in Victoria. The best estimate of damage to infrastructure in non-metropolitan areas from salinity and rising water tables is $12.2 million per year (NLWRA 2000). Salinity affects up to 800 species of threatened native biodiversity.

Pest plants
Weeds are a serious threat to primary production and biodiversity in Victoria. They reduce farm and forest productivity, displace native species and contribute significantly to land and water degradation. The most recent estimate puts the direct cost of weeds to Victorian agriculture at more than $360 million per year. Additional costs are borne by public land managers, industry, local government and utility companies. The impact of weeds on natural ecosystems is significant but ways of understanding this impact are still being developed.

Exotic weed species now comprise 28 per cent of Victoria's flora. Weeds cannot be eradicated from a region or state where they are well-established. Established weeds, however, can be stopped from spreading into other valued areas at risk. In addition, isolated infestations of serious weeds can be prevented from becoming established. This is particularly important, as the threat of new weeds becoming established in Victoria is serious and increasing.

Pest animals
Pest animals have a significant impact on the value and quality of the state's land and water resources, as well as on natural ecosystems. Pest animals such as foxes and rabbits have the potential to destroy the biodiversity values of highly prized ecosystems. Rabbits cause significant economic and environmental damage. Figures for Victoria indicate a potential increase in agricultural profits of $133.34 million if the impact of rabbits was removed (NRE 2000).

Fire
Fires are an inherent part of the Australian environment. Fires have a fundamental and irreplaceable role in sustaining many of Australia's natural ecosystems and ecological processes, and are a valuable tool for achieving many land management objectives. If they are too frequent or too infrequent, too severe or too mild, or mistimed, they can erode ecosystem health and biodiversity, and compromise other land management goals—just as uncontrolled fires can threaten life, property, infrastructure and production systems (Whelan et al 2006).

3.5.1 Measuring threats

There are state-wide datasets that describe the extent and in some cases severity of many threats (Figure 5). Most of this data will be available in the 2007 Victorian Catchment Management Council State of the Catchment Report and DSE's Triple Bottom Line Indicators (TBL) Project (available through Victorian Resources Online). Where known, the sources of this data are listed in Figure 5.

Threat	*Potential data layers*	*Source*
Soil structure decline	*Inherent susceptibility to soil structure decline.*	*Centre for Land Protection Research*
Soil acidity	*Surface soil $pHCaCl_2$ present*	*NRE 2001*
	Soil pH risk 2050.	*NRE*
Coastal acid sulfate soils	*Existence of coastal acid sulfate soils*	*Centre for Land Protection Research, 2003*
Water erosion	*Overall water erosion risk in Victoria*	*Centre for Land Protection Research, 2002*
Wind erosion	*Inherent susceptibility to wind erosion*	*Centre for Land Protection Research, 2002*
Climate change	*Rainfall change*	*Victorian Greenhouse Strategy, 2002*
	Temperature change	*Victorian Greenhouse Strategy, 2002*
Salinity	*Salinity risk in Victoria: 1998*	*NLWRA, 2000.*
	Soil salinisation	*VCMC 2007, TBL*
	Groundwater level trend	*VCMC 2007, TBL*
	Groundwater flow system responsiveness index	*Centre for Land Protection Research, 2002*
	Salinity risk in Victoria: 1998	*NLWRA, 2000*
	Depth to groundwater	*NLWRA, 2007*
	Groundwater salinity	*NLWRA, 2007*
	Baseflow salinity	*NLWRA, 2007*
Fire	*Extent*	*DSE*
Pest Plants	*State prohibited weeds: trends*	*NLWRA, 2007*
	Biosecurity: pests and weeds	*DPI, Integrated Pest Management System*
	Distribution of weeds of national significance	*DPI, Integrated Pest Management System*
	Distribution of state prohibited weeds	*DPI, Integrated Pest Management System*
	Distribution of regionally prohibited weeds	*DPI, Integrated Pest Management System*
Pest animals	*Distribution of foxes, rabbits, pigs and dogs*	*NLWRA, 2007*

Figure 5: Threats and possible data sources

3.5.2 Outputs from the identification of extent and severity of threats

The identification of the extent and severity of threats can best be presented as maps showing the occurrence of the various threats across the landscape. Areas of overlap between high value asset services and threats can then be identified. This, in turn, provides a starting point for more detailed risk assessment.

For example, Figure 6 shows a map of the potential distribution of serrated tussock in Victoria from the DSE Integrated Pest Management System. While there are considerable limitations to this type of statewide threat data, at a broad level it can provide a rough assessment of the risk of threats to assets and services. Once areas of interest have been identified, the actual extent and severity of threat can be assessed at the site level.

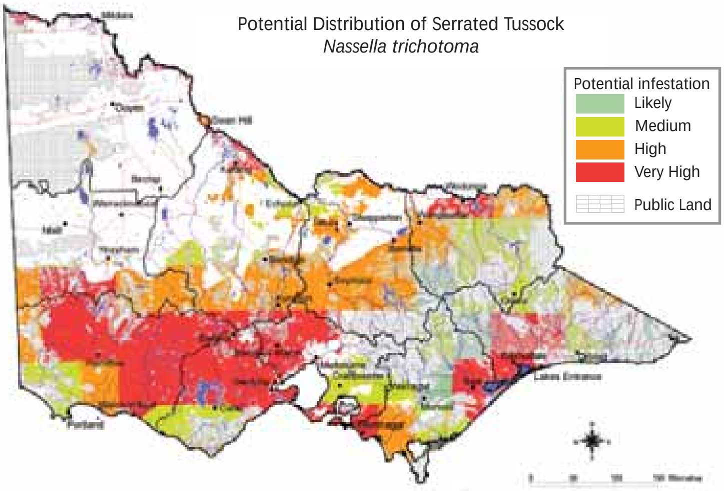

Figure 6. Map of potential distribution of serrated tussock in Victoria. Source DSE, Integrated Pest Management System (Victorian Resources Online).

3.5.3 Degree of association: linking threats and asset services

Not all threats impact on all assets and services, so identifying the degree of association between each threat and asset service is an important step before undertaking a risk assessment. Figure 7 shows one hypothetical way to represent this relationship at a broad scale. In this matrix, threats are linked to assets. The matrix can be used to roughly determine which threat layers are relevant for particular asset services, and it can help narrow down the risk assessment process. This can be further refined by including a rating of the strength of the degree of association, such as high, medium and low, and including consideration of asset services in addition to assets.

Each cross in Figure 7 represents the combination of a threat to an asset, and requires a risk assessment. This assessment, based on likelihood and consequence of threats for each asset value, will be discussed in the next section.

Figure 7: Relationship between commonly identified threats and assets

Assets	Threats: Salinity	Pest plants	Pest animals	Erosion	Acidity	Soil structure decline	Recreational pressure	Climate change	Land clearing	Fire	Land use change
Native flora	X	X	X	X	X	X	X	X	X	X	X
Native fauna	X	X	X		X	X	X	X	X	X	X
Soil	X			X	X	X	X	X			X
Land for primary production	X	X	X	X	X	X	X	X		X	
Infrastructure	X			X	X			X		X	
Tourism								X			
European heritage sites	X	X		X			X	X			X
Scenic landscapes		X	X	X			X	X	X	X	X
Recreational sites		X		X			X	X	X	X	X
Indigenous heritage sites		X	X	X	X	X	X	X		X	X
Groundwater								X			
Surface water				X				X			
Infrastructure	X									X	

3.5.4 Impact of threat

Where an asset is threatened, the impact of the threat on specific services must be investigated. This analysis, along with data on asset value, will reveal the consequence of a threat, and is a part of the risk assessment process. Figure 8 shows one way this can be documented at a broad level as a preceding step to risk assessment.

In Victoria, threats to land are described in a number of ways, depending on whether the focus is on the threatening activity, threatening process, or impact. Documenting this relationship helps to prevent double-counting of threats.

The key piece of information for risk assessment is the impact on asset services.

Cause (Threatening activity)	*Threat (Threatening processes)*	*Impact on assets*	*Impact on asset services*
Grazing of vegetated areas	*Weed invasion*	*Reduced revegetation results in a loss of threatened flora*	*Decrease in provision of biodiversity* *Decrease in value of recreation and tourism*
Grazing of vegetated areas	*Soil structure decline*	*Soil quality decline and associated decline in native flora and fauna and agricultural land*	*Decrease in provision of biodiversity* *Decrease in food and fibre production*
Clearing *Irrigation*	*Rising saline water table*	*Rising saline water table: results in salinisation of soil and damage to infrastructure*	*Decrease in food and fibre production*
Greenhouse gas emissions	*Climate change:* ■ temperature ■ rainfall	*Hard to quantify: potential impact on many assets such as native fauna and flora and agricultural land*	*Will impact on the level of services provided by assets*

Figure 8: Relationship between cause, threat and impact

3.6 Risk assessment

Risk assessment provides an objective measure of the risk a particular threat poses to an asset and its services. Risk assessment in natural resource management planning can help stakeholders assign resources and implement actions in a considered and appropriate way. Effective risk management makes risks more transparent and understandable to stakeholders and allows for sharing of best practice in implementing methods for identifying, assessing and treating risks (Shortreed et al 2003).

In the asset-based approach, risk assessment is based on detailed information about both the service produced by an asset and the likelihood and consequence of threats to that asset, as outlined in Figure 9.

Detailed risk assessment is a time-consuming process. For this reason, it may be more appropriate to use the broad data on assets and threats to select areas of potential interest (asset areas). Following this, more detailed risk assessment can then be conducted at the site level, with the focus narrowed to the specific services of priority assets.

3.6.1 Definitions of risk

Risk is expressed as a function of likelihood and consequence. The Australian and New Zealand Standard Risk Management AS/NZ 4360:1999 gives guiding principles for risk assessment, including standard definitions and ratings of likelihood and consequence.

In the assets-based approach, **likelihood** is a measure of the potential or probability that a particular threat can or will have an impact on a particular asset service. This potential can be represented by the extent and severity of the threat and association between the threat and the asset service in question.

Consequence is an assessment of the impact that a threat can have on assets at a specific location. This can range from no impact or only a small temporary impact, through to a catastrophic impact such as complete loss. In the asset-based approach, consequence is identified using two key considerations: the value of the threatened asset and its services, and the impact that will result from the loss of those services.

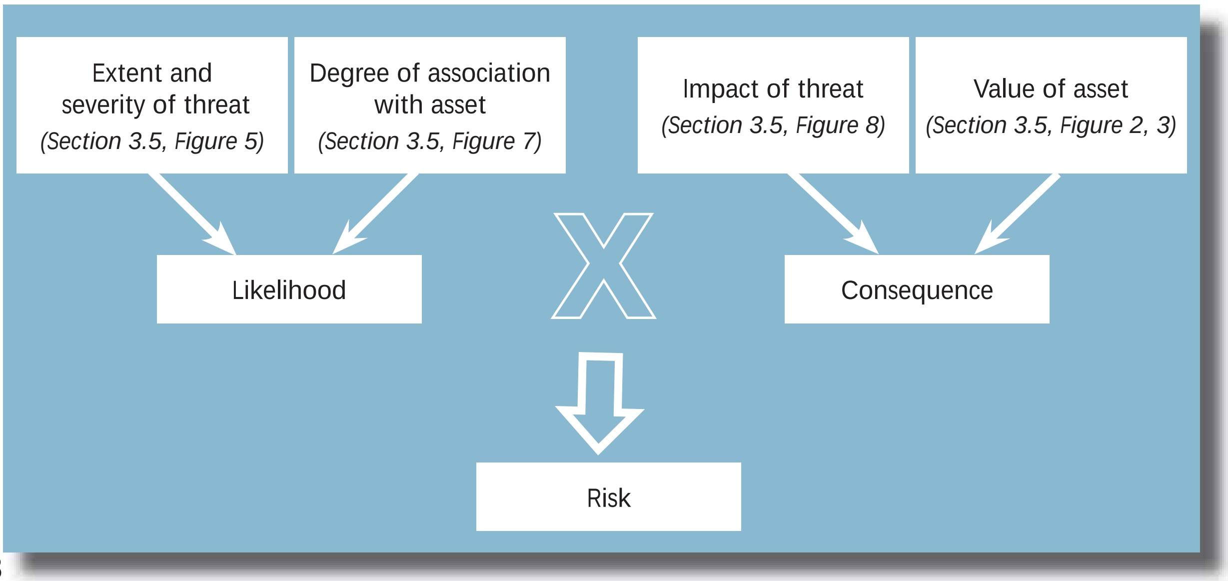

Figure 9. Risk analysis framework drawing from asset and threat information

3.6.2 Principles of risk assessment

Risk analysis helps land managers decide which assets are the most valuable and the most threatened. It can assist in setting priorities for management and in planning responses to threatening processes. Because of the scale of data used and the qualitative nature of risk assessment, the approach outlined here will help determine the types of responses required rather than detail the exact management response.

Broad-level risk assessment can be conducted using state-wide data sets. Depending on the reliability and availability of the data, this can help assess risk and identify where risks are correlated spatially with high value assets.

The second level of risk assessment occurs at a site level, and can be used as a method of setting priorities, such as choosing between a number of different high value asset areas. It can also determine management action, such as providing information on exactly what is threatening the asset services at a site, and therefore what needs to be addressed to protect the asset.

At either level, to be useful, risk assessment must focus on individual assets and asset services, rather than on asset categories. For example assessing the risk of salinity on land provides much less data than assessing the risk of salinity on all land assets, such as native flora, native fauna, agricultural land, tourism sites, cultural heritage sites and the services they provide.

At the broad level, risk assessment focuses on assets or services generally (for example, how salinity affects native fauna). After broad level analysis of assets and threats, site level risk assessment focuses on the high value asset items in each asset area and the risk of each threat affecting those assets (for example, how salinity affects a high value population of Powerful Owls, a scar tree, or patch of native vegetation).

3.6.3 Scoring rules

At whichever level risk assessment is conducted, risk is calculated by multiplying ‘likelihood by consequence’, a process which requires the elements of risk to be established numerically. This provides an objective measure for the risk that each threat poses to a particular asset and its services.

The asset and threat information is then used to inform the scoring of the likelihood and consequence of each threat impacting on the value of an asset. At a site level this scoring will also be informed by additional information from a range of sources, such as site level inspections, local knowledge and expert opinions.

Likelihood and consequence are then scored, based on the data, on a 1-5 scale. Figures 10 and 11 outline criteria by which likelihood and consequence can be scored for each possible combination of threats and asset services. These rules are modified from RiVERS.

Value	Meaning	Clarifier
1	*Practically impossible*	*Practically impossible that the threat will impact on the services.*
2	*Remotely possible*	*No evidence of threat impacting on services, but it is remotely possible.*
3	*Unusual but possible*	*Evidence in a few isolated cases where threat has impacted on the services.*
4	*Quite possible*	*Some evidence that threat has an impact on the services.*
5	*Almost certain*	*Good evidence that the threat always impacts on the services.*

Figure 10: Criteria used to score likelihood

Value	Meaning	Clarifier		
		Environmental	Social	Economic
1	*Noticeable*	*Temporary disruption to asset services*	*Temporary disruption to human activities*	*Cost > $5,000*
2	*Serious or important*	*Impacts on services confined to asset area*	*Impacts to human activity confined to reach*	*Cost > $100,000*
3	*Very serious*	*Impacts to services beyond asset area*	*Impacts to human activity beyond asset area*	*Cost > $1 million*
4	*Disastrous*	*Widespread damage to asset condition and services*	*Serious injury to multiple humans*	*Cost > $5 million*
5	*Catastrophic*	*Irreversible damage to assets and services*	*Loss of human life*	*Cost > $10 million*

Figure 11: Criteria used to score consequence

4. Conclusion

An asset-based approach to investment across all areas of land management is a critical first step to improving investment in natural resource management. It represents an important shift from funding threat-focused work to protecting assets and their services. In other words, it is a shift to focusing on the benefits of investment.

There are still some important issues to be addressed. These include:

- How do we compare the value of different land assets and services? For example, is the provision of biodiversity more or less important that the provision of primary production?
- How do we compare land assets with water assets?
- How well can we assess cost effectiveness? Do we have enough information to decide between investing in small projects that target high value assets across the landscape or larger project areas that have more assets that are not as highly valued?
- How do we determine how much is too much when deciding on investments?

In conclusion, the framework proposed here is intended to contribute to the overall system of natural resource management investment decision-making. Applied well, it will assist in describing the aims of investments much more clearly than before.

5. Glossary

Assets: the biophysical or physical elements of the environment we are trying to protect. The desire to protect these assets is due to the social, economic and environmental services they provide.

Asset area: an area containing one or more environmental, social, cultural or economic asset of value to the community, or a cluster of asset services.

Asset items: specific assets, such as an area of agricultural land, patch of native vegetation, population of native fauna, or recreational site.

Asset services: the specific ecosystem services associated with specific assets or within an asset area.

Consequence: a measure of the impact that a threat can have on a particular asset. This can range from no impact or only a temporary, small impact, through to a catastrophic impact such as complete loss of the species or value. The higher the value of an asset, the greater the consequence if a threat acts on the value.

Likelihood: a measure of the probability that a particular threat will have an impact on a particular value. Likelihood is a combination of the level of the threat (its severity), and the degree of association (or connectivity) between the threat and the value in question.

Services (or ecosystem services): refers to the ecosystem services provided by biophysical assets to the community.

Threat: source of impending danger or harm to the condition of natural resource assets or the services that they provide. Threats to assets include those processes that could reduce asset values if left unchecked. Threats can include issues such as salinity, water quality, and pest plants and animals.

Risk: expressed as a function of likelihood and consequence. The aim of risk assessment is to provide an objective measure of the hazard to a particular asset by a specific threat

Value: the value placed by the community on ecosystem services provided by biophysical assets. Valuation methods involve quantifying the value of services provided by an asset in order to allow comparison and ranking.

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Appendix 1: Guidance on asset and threat descriptions for multiple outcome projects (DSE, 2006)

Asset description

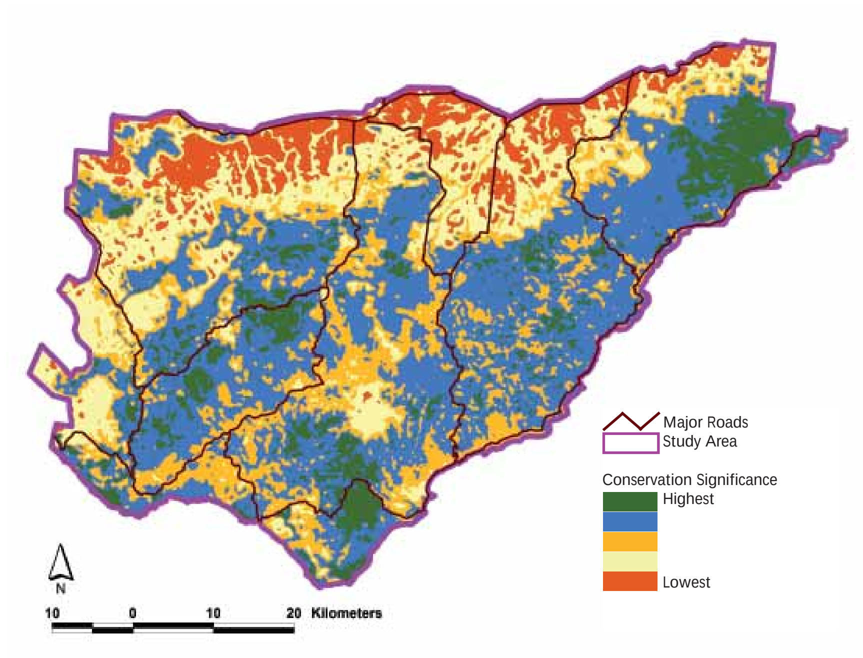
- If there are extensive tables or raw data please include these as appendices and summarise the findings in the main part of the project plan.
- Regardless of the format that the final product takes, the emphasis should be placed on clearly describing the method employed. It is important that the principles behind choices are documented to ensure transparency of decision–making processes.

Tier 1	*Tier 2*	*Tier 3*
Describe the asset items that are the focus of the project, and using evidence quantify why the assets are valuable, as outlined in the current assets approach RCIP guidance note (2006-07 appendix 2), and the 'notes on evaluating assets description' appendix 3. Include a map of key assets. *It may be necessary to hold an evidence-based workshop with key stakeholders to supplement information put together for the RCIP bid.*	*Rank asset services across the MOP landscape and update the Tier 1 map accordingly. Ensure the system of ranking is aligned with best practice and uses the best available evidence.* *For example, biodiversity assets might be ranked from 1 to 5 according to their EVC status.* *Consultation with experts or key stakeholders to identify assets in the landscape may be necessary.*	*Undertake integrated modelling of asset classes to reveal any 'bundles' of asset services.*

Useful data: EVC status, threatened flora and fauna, degree of fragmentation (landscape context), land use, Biodiversity Action Plans, River Health Plans, Regional Vegetation Plans.

Further information: Decision-making processes for investment in land management: The asset based approach discussion paper (available on MOP TeamRoom), River Health Strategy.

Example: Tier 3 - To reveal 'bundles' of biodiversity asset services in the Otway-Angahook region, conservation status of EVCs, threatened flora and fauna, and degree of fragmentation (landscape context) datasets were used.



Map of important areas of biodiversity in the Otway–Angahook region of Victoria.

Asset threats

- If there are extensive tables or raw data please include these as appendices and summarise the findings in the main part of the project plan.
- Regardless of the format that the final product takes, the emphasis should be placed on clearly describing the method employed. It is important that the principles behind choices are documented to ensure transparency of decision-making processes.

Tier 1	Tier 2	Tier 3
Describe the threats that are most likely to impact upon the key assets and services in the project area as outlined in the current assets approach RCIP guidance note (2006-07 Appendix 2). This information should already be available.	*Rank threats across the MOP landscape and include a map of the most significantly threatened assets. Ensure the system of ranking is aligned with best practice and uses the best available evidence.* *For example, salinity threats might be ranked from 1 to 5 according to depth to watertable.* *Consultation with experts or key stakeholders to identify threats in the landscape may be necessary.*	*Undertake a quantitative risk assessment based on the likelihood and consequence of threats impacting on asset services. Update the Tier 2 map accordingly. Consideration should be given to the significance of threats at a State and National Level e.g. Weeds of National Significance.*

Sources of data: A generic list of threats is available on the MOP TeamRoom, weed and pest action plans, fox state-wide analysis, biodiversity action plans.

Further information: Decision-making processes for investment in land management: The asset based approach discussion paper (available on MOP TeamRoom).

Example: Tier 2 - An expert panel ranked weeds impacting on the environment in the Angahook-Otways region by considering the relevant attributes (ecological impact, potential distribution/invasiveness, rate of dispersal, Figure 5) according to their potential level of impact on important assets.

Species	Invasiveness [1]	Ecological Impact [2]	Impact attributes [3]	Potential distribution [4]	Habitat range [5]	Rate of dispersal [6]	Ranking score
HIGH IMPACT WEEDS							
Asparagus scandens		H	6,7,8,9	E	H	R	1
Cotoneaster pannosus		H		E	H	R	1
Hedera heliex		H	6,7,8,9	E	H	R	1
Lonicera japonica		H		E	H	R	1
Acacia longifolia		H		E	H	R	1
Fraxinus spp.		H	1,2,4,6,7,8,9	E	H	M	2
Allum triquetrum		H	2,6,7,8,9	E	H	M	2

Weeds impacting on the environment in the Angahook-Otways region ranked according to their significance as a threat to assets.

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