POLICY BACKGROUND PAPER

WATER QUALITY OBJECTIVES FOR MARINE AND ESTUARINE WATERS – ECOSYSTEM PROTECTION

DRAFT STATE ENVIRONMENT PROTECTION POLICY

(WATERS OF VICTORIA)

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WATER QUALITY OBJECTIVES FOR MARINE AND ESTUARINE WATERS – ECOSYSTEM PROTECTION

Draft State Environment Protection Policy (Waters of Victoria)

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HOW TO MAKE A SUBMISSION ON THE DRAFT STATE ENVIRONMENT PROTECTION POLICY (WATERS OF VICTORIA)

EPA welcomes all comments on the draft State environment protection policy, Policy Impact Assessment, and the supporting publications providing the background and development process for environmental quality objectives.

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Closing date for submissions is 29 March 2002

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1. INTRODUCTION

This report is a support document to the 2001 draft revision[1] of the 1988 State environment protection policy *Waters of Victoria* (*SEPP* WoV)[2], (referred hereafter to as the '*SEPP WoV* (1988)' and the '*draft SEPP WoV* (2001)'). Throughout this document a number of technical terms, having specific meanings within the context of the *Environment Protection Act* 1970, are highlighted in **bold**, an explanation of their meaning can be found in the glossary.

For those parts of Victoria's marine and estuarine environments not covered by regional *Schedules to SEPP WoV* (1988), this report –

- explains the rationale for defining segments of the environment;
- outlines key threats to water quality;
- recommends the environmental objectives and **indicators** which best describe the water quality required to protect **beneficial uses**.

Generally in the marine and estuarine environment the most sensitive beneficial use to be protected is that of **ecosystem health**.

Since the *SEPP WOV* (1988), there have been many advances in our approach to the protection of aquatic environments, which reflect a greater understanding of the ecological consequences of environmental threats, and how to deal with them more efficiently and effectively.

Increased **loads** of **nutrients**, principally nitrogen (N) and phosphorus (P), and **sediments** from the surrounding catchments remain the two key threats with the potential to cause degradation in **nutrient status** and **water clarity** at a regional scale.

Toxicants are recognised to have a more localised influence on marine and estuarine environments, usually close to the mouths of rivers and creeks, or **point-source discharges**.

Ecosystem health needs to be protected from these threats to water quality. This will ensure support for the beneficial uses of Victoria's marine and estuarine environments. This document aims to propose a system of environmental objectives and **indicators** to protect ecosystem health.

In developing objectives, many of the indicators, and the factors that modify them, vary in time and space. This variation can occur from natural differences in climate, geomorphology, and the ecological processes and structure of these ecosystems. In some cases these differences may be caused by human activities. These activities include: urbanisation, industry, agriculture and forestry in adjacent catchments, water diversions and extractions.

This document recommends environmental objectives for indicators of water quality (nutrients, water clarity and toxicants) in segments that are not described by current *Schedules*. For the key indicators of nutrients and water clarity, the segments not specified by *Schedules* include the *Open coast* and *Estuaries and Inlets*. For these two segments, the south-east Australian **NWQMS trigger values** for marine and estuarine waters are recommended. The segments covered by *Schedules* are *Port Phillip Bay (Schedule F6[4]), Western Port* (*Schedule F8[5])* and the *Gippsland Lakes*[2 6] *(Schedules F3 and F5)*. These Schedules include regionally specific objectives. These Schedules will be reviewed periodically in the light of new

information. In particular, *Schedules F3 and F5* may be reviewed following the results of the current CSIRO Gippsland Lakes study[7].

The NWQMS trigger levels for toxicants are recommended as objectives for marine surface waters, except where there are current objectives in *Schedules*. These are *Schedules F6*[4] (*Port Phillip Bay)* and *Schedule F8*[5] *(Western Port*), that list objectives for metals.

2. DESCRIPTION OF SEGMENTS.

Environmental segments, for the purposes of the *Draft SEPP WoV* (2001), are parts of the environment where common beneficial uses and environmental objectives apply. Segments can be defined on a geographic basis, or on the basis of waterbodies that are environmentally similar (even if they are geographically separated).

SEPP (WoV) Approach

The two segments that are not covered by *Schedules*, the *Open Coast* and *Estuaries and Inlets*, are defined in Box 1.

Box 1. Definition of segment areas

Open Coast: State waters lying within 3nm of the coast and extending from Cape Howe (37°S, 149°E) in the east to Discovery Bay in the west (38°S, 141°E)[1].

Estuaries and Inlets: Consist of surface waters, other than Port Phillip Bay, Western Port and the Gippsland Lakes, where marine intrusions into freshwater occurs[1].

The natural features, threats to water quality and ecological assets of these two segments are briefly discussed below.

Open Coast

The *Open Coast* is characterised by extensive rocky shore platforms, interspersed with long, sandy beaches. Whilst there are different bioregions along the coast[8], the current information on water quality, suggest a single *Open Coast* segment is appropriate.

The threats to water quality in the *Open Coast*, include 16 licensed discharges (Figure 1) and catchment inputs containing contaminated run-off (Figure 2). These discharges may have some immediate influence on near-shore waters and localised impacts can be significant. The dilution capacity of the *Open Coast* is great, consequently these inputs pose a low **risk** to general water quality.

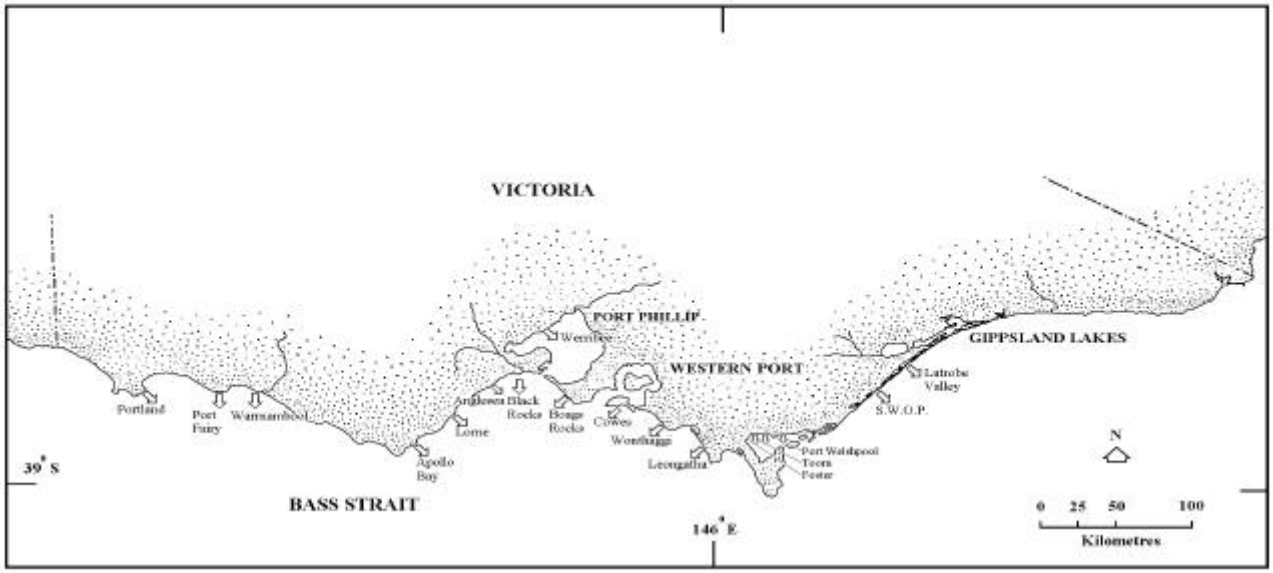


Figure 1. Map of the *Open Coast*s showing the location of licensed discharges.

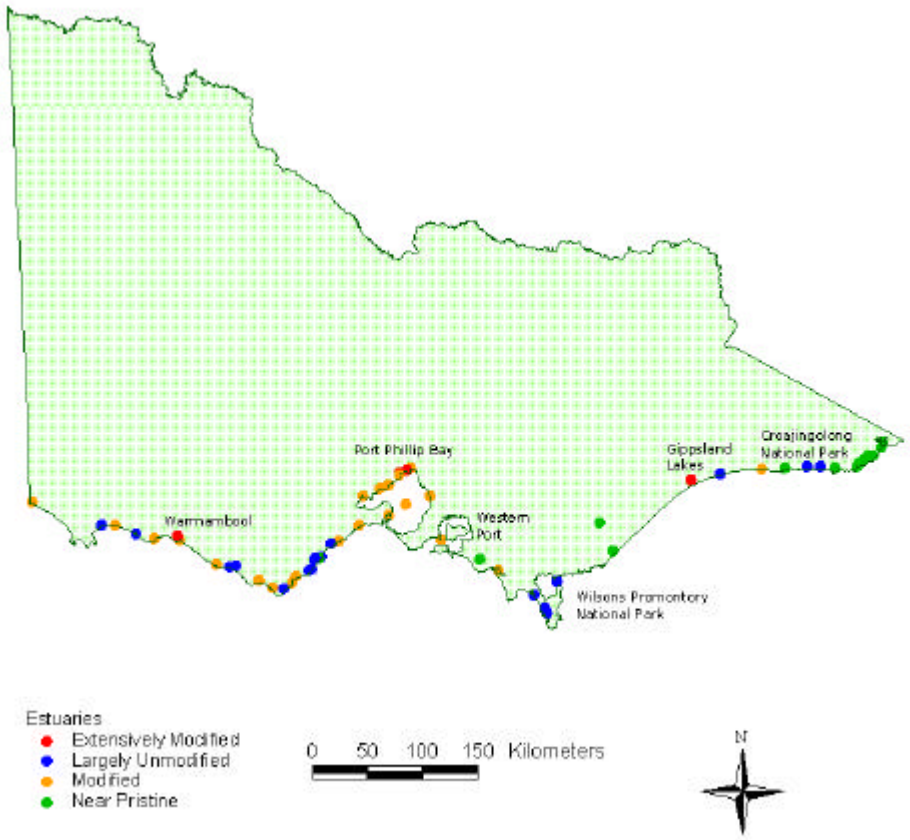
Estuaries and Inlets

The 61 estuaries along the Victorian coast vary from small wave and river dominated estuaries in the west, to several large inlets such as Corner Inlet and Andersons Inlet, to a network of small wave-dominated estuaries in the east (Figure 2). The general condition of these estuaries improves from west to east. This is primarily because of the differences in the size and morphology[8] of the surrounding catchment, and the dominant land-use practices[10]. Many of the estuaries in eastern Victoria are located within National Parks and are largely unmodified. These are valuable conservation areas.

The small wave-dominated estuaries common in West Victoria are most at risk from inappropriate land-use practices and are in need of targeted management. As many of these estuaries have temporary openings to the coast and the adjacent catchment is often steep and predominantly agricultural, nutrients, sediment and associated toxicants can accumulate in these estuaries.

Urbanisation, industry, agriculture and forestry in adjacent catchments, and water diversions and extractions have resulted in major modifications to many estuaries throughout Victoria. It is anticipated that pressures on estuaries will increase in the future.

Whilst a single segment for *Estuaries and Inlets* is proposed it is anticipated this will need to be re-assessed in the light of additional information.



Western		Central		Eastern	
Glenelg River	●	Barwon River	●	Anderson Inlet	●
Surrey River	●	Swan Bay	●	Shallow Inlet	●
Fitzroy River	●	Limeburners Bay	●	Darby River	●
Lake Yambuk	●	Little River	●	Tidal River	●
Moyne River	●	Werribee River	●	Corner Inlet	●
Merri River	●	Skeleton Creek	●	Jack Smith Lake	●
Hopkins River	●	Vo2o	●	Merriman Creek	●
Curdies Inlet	●	Kororoit Creek	●	Gippsland Lakes	●
Port Campbell River	●	Yarra River	●	Lake Tyers	●
Sherbrook River	●	Patterson River	●	Snowy River	●
Gellibrand River	●	Port Phillip Bay	●	Sydenham Inlet	●
Aire River	●	Western Port	●	Tamboon Inlet	●
Elliot River	●	Powlett River	●	Yeerung River	●
Barham River	●			Thurra River	●
Skenes Creek	●			Wingin Inlet	●
Grey River	●			Easby Creek	●
Kennett River	●			Red River	●
Wye River	●			Benedore River	●
Jamieson River	●			Shipwreck Creek	●
Cumberland River	●			Betka River	●
St George River	●			Mallacoota Inlet	●
Erskine River	●			Mueller River	●
Painkalac Creek	●				
Anglesea River	●				
Thomson Creek	●				

Figure 2. Estuaries and Inlets and their condition assessment from the National Land and Water Resource Audit

3. RECOMMENDED INDICATORS

Increased loads of nutrients and sediments from activities in the surrounding catchment are the two key threats to marine and estuarine water quality.

As marine water is well buffered to changes in **pH,** temperature and total dissolved solids, the effect of human activities on the values of these parameters are restricted to the close proximity of licensed discharges. The pH, temperature and total dissolved solids (surrogate measure of salinity) are not considered major threats to the water quality of marine and estuarine systems as a whole. They are, however, considered to be important modifying factors that alter the bioavailability of nutrients and toxicants. Therefore, the impact of thermal, fresh/saline, and pH discharges on the protection of beneficial uses will need to be assessed using the proposed risk assessment approach[12].

The indicators of nutrients and sediments are influenced by human activities from both **diffuse inputs** (urbanisation and agriculture) and point discharges to the environment. The recommended indicators need to be biologically meaningful, yet readily collected and interpreted in relation to the ecological condition.

Nutrient Status

Increased availability of nitrogen (N) and phosphorus (P) from anthropogenic sources, can stimulate the growth of phytoplankton and **macroalgae**, sometimes with serious ecological and socioeconomic consequences.

Six indicators of nutrients are recommended for assessing the status of marine and estuarine waters. These are *Dissolved Inorganic Nitrogen (DIN), Total Nitrogen (TN), Dissolved Inorganic Phosphorus (DIP), Total Phosphorus (TP), Chlorophyll a (Chl a)* and *Dissolved oxygen (DO)*. Individual indicators have their own limitations, but when all six are used together they provide a strong indication of nutrient status.

1. DIN

DIN is the combined concentrations of nitrate, nitrite and ammonia. DIN is the **bioavailable** fraction of nitrogen in the water column.

2. TN

DIN may rapidly disappear as it is assimilated by algae and so TN provides a better indication of the **nitrogen cycling** through the algal community and how much is dissolved in the water. TN is the sum concentration of bioavailable (dissolved) and particulate forms of inorganic and organic nitrogen.

3. DIP

DIP is typically measured as the concentration of reactive orthophosphate, which is the form of phosphorus most readily bioavailable to aquatic plants.

4. TP

Like DIN, DIP may be rapidly assimilated by algae and so TP provides a better indication of the phosphorus cycling through the algal community and how much is dissolved in the water. TP is the sum concentration of dissolved and particulate forms of inorganic and organic phosphorus.

5. Chl a

Chl *a* is a crude measure of phytoplankton biomass. Apart from light, phytoplankton are primarily limited by nutrient availability, Chl *a* is often used as an integrated, surrogate measure of nutrient status.

6. DO

DO, measured preferably as per cent saturation (%), is the net balance of the amount of oxygen produced by photosynthesis, relative to that consumed by respiration and other forms of biological and chemical oxygen demand. Low DO (hypoxia) can arise following **bloom**s of phytoplankton stimulated by **nutrient enrichment**. As the large mass of plant tissue decays, DO is lowered in the water column, and this can result in fish kills and nutrient inputs from the sediments.

Water clarity

Sunlight is critical to the photosynthesis of plankton and submerged aquatic vegetation such as **seagrasses**, and macroalgae (for example, seaweed) and benthic **microalgae**. **Attenuation of light** through the water column can limit the growth of these plants (refer to Box 2). Attenuation of light is caused by suspended sediment or organic matter. These light absorbing materials are delivered via run-off from the surrounding catchment or are resuspended by the action of tides and waves (Box 2). As with the indicators recommended for nutrients, individual indicators of water clarity have their own limitations. For this reason, three indicators of water clarity are recommended to provide a stronger overall indication of water clarity. These indicators are attenuation of light, turbidity and suspended solids.

1. Attenuation of light

The attenuation of light through the water column can be estimated by measuring the decrease in Photosynthetically Active Radiation (**PAR**) with depth. This data can be used to obtain an extinction coefficient (m^{-1}) for light with increasing depth. This extinction coefficient can be approximated by **Secchi depth** using a simple relationship. The Secchi depth method is quick, simple and cheap but is less accurate than PAR (m^{-1}).

2. Turbidity

Turbidity, measured in nephelometric turbidity units, is a measure of light absorption over distance, but not depth. This indicator is recommended because it is an easy to measure indicator of general water clarity.

3. Suspended sediment

Suspended sediments are a measure of the amount of particulate matter in the water column. This is an important measure of potential smothering and asphyxiation of organisms by settling particulate matter.

Toxicants

Toxicity in the water column and in bottom sediments can have poisonous effects to aquatic biota. These effects in Victorian marine and estuarine ecosystems are usually restricted to the proximity of point discharges. If the exposure of biota to toxicants is high enough, toxic effects occur.

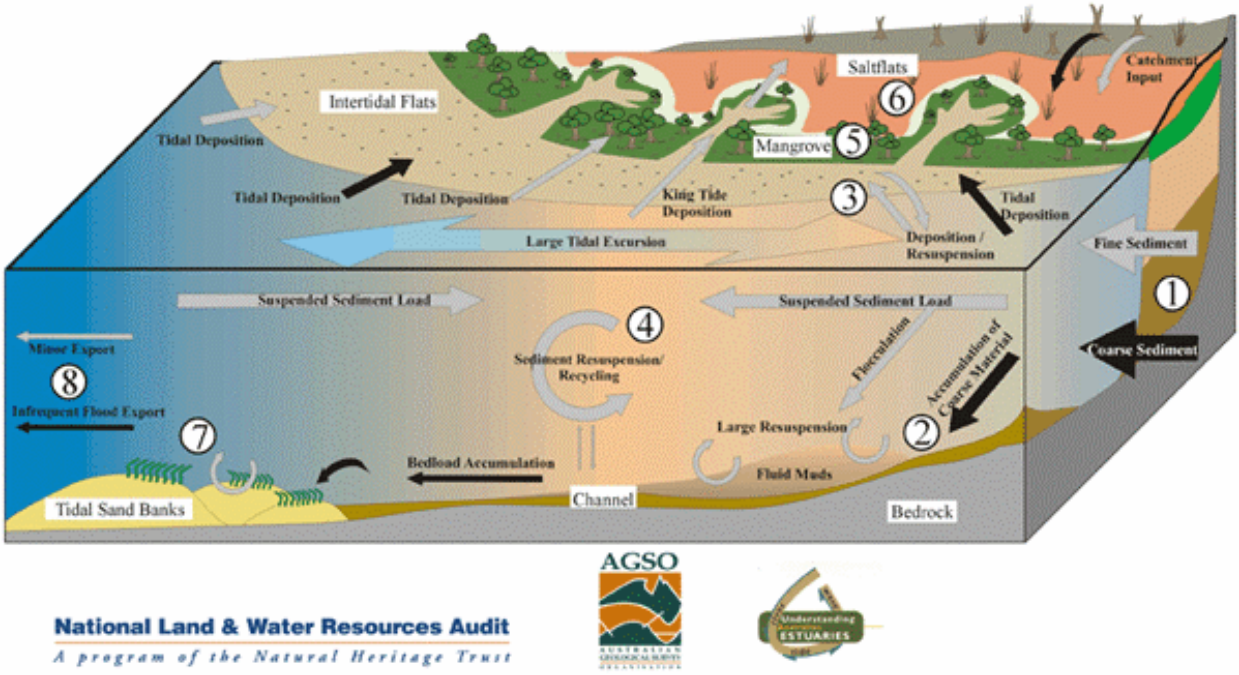
The most commonly used indicator of toxicity is the concentration of a toxicant in both the water column and in bottom sediments. In cases where there are multiple toxicants present, a direct measure of toxicity may be the preferred approach to control discharges[3].

Box 2. Effects of changes in water clarity on marine and estuarine ecosystems

A variety of factors attenuate light in water resulting in differences in water colour that are visible to the human eye. Water itself absorbs light, particularly in red wavelengths leaving only blue wavelengths. Phytoplankton floating in the water also absorb light primarily due to photosynthetic pigments such as chlorophyll which absorbs red and blue wavelengths. Suspended particles reflect light effectively increasing the path-length for light in water and the absorption of red light resulting in blue or blue-green water colour. Coloured dissolved organic matter (CDOM), such as humic and tannic acids, absorb blue light resulting in a yellow-brown color.

Different species of phytoplankton have different light requirements but are typically four to 29 per cent of incident light[11]. Researchers have shown that light can play a critical role in determining the response of marine and estuarine systems to nutrient loading.

Sediments from land-clearing cause instability and erosion, leading to the transport of sediments to marine and estuarine environments following storms. Channel (gully and stream-bank) erosion is the dominant erosion process, although hill-slope (sheet and rill) erosion is an important source in some catchments, particularly those where cultivated land is common. Once in the estuary or marine environment, a variety of factors transport, remobilise and deposit sediment. The figure below shows some of these in a tide–dominated estuary.



(1) fine and coarse sediment enter the estuary from the catchment; (2) coarse material is deposited at the head of the estuary, due to a reduction of river flow velocity; (3) fine sediment undergoes both deposition and erosion in intertidal flats, aided by biological activity such as burrowing; (4) large quantities of suspended sediment can pool temporarily within the channel; (5) mangrove sedimentary environments, serve as a depocentre for fine and flocculated sediment; (6) Saltflat sedimentary environments experience inundation by king tides, and some deposition of fine sediment can occur; (7) accumulation of coarse bedload material can occur within the mouth of the estuary, forming tidal sand banks;(8) very little sediment is exported from the estuary overall, due to net landward transport driven by tidal action. The majority of sediment export occurs during flood events.

The provision of this graphic by the CRC for Coastal Waters is gratefully acknowledged.

4. RECOMMENDED OBJECTIVES

The recommended **environmental objectives** for the defined marine and estuarine segments using the indicators, are set to protect and maintain aquatic ecosystem health. The suggested use of the recommended objectives is that their exceedance indicates a potential risk of adverse ecological effects. Exceedance of the objective indicates the requirement for further investigation or management action. This is summarised in the decision tree in Figure 3.

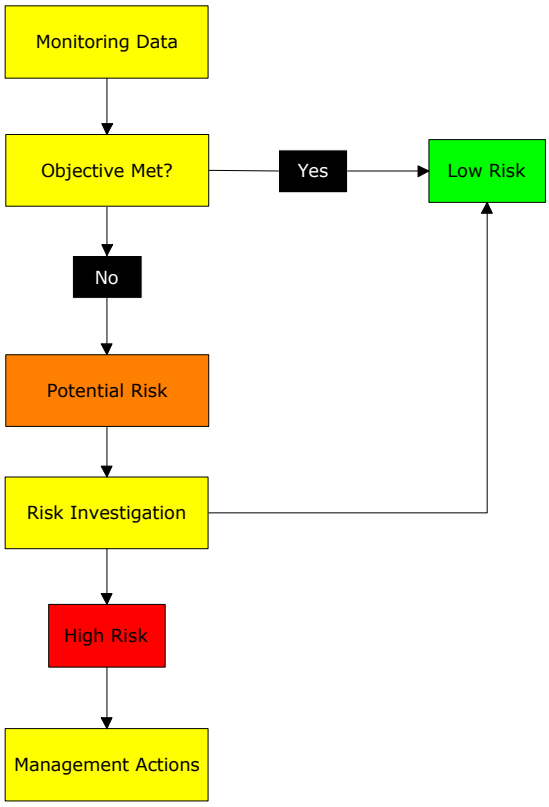


Figure 3. Risk based decision framework.

For more details on the risk-based approach used by EPA, refer to: Environment Protection Authority Victoria, *Draft State environment protection policy (Waters of Victoria) Risk Assessment Approach – Ecosystem Protection*, Publication 790, 2001.

The risk-based approach (RBA) is the main change in the development and application of ecological objectives since the previous *SEPP WoV* (1988).

The RBA is based on the National Water Quality Management Strategy Guidelines[3] (NWQMS) and focuses resources to where they are needed; to high-risk situations for ecosystems. The utility of this approach to protecting ecosystems has been described in another supporting document[12] and is briefly summarised here. The RBA acknowledges the complexity and variability of marine and estuarine ecosystems.

For each of the important water quality issues there is a formalised approach to assessing risk using appropriate indicators and objectives. The objectives themselves are 'packages' for assessing potential risks consisting initially of a value (that is a concentration or level) and a protocol (for example, monitoring and data analysis) to assess whether the objective is met. Where the objective is exceeded, this triggers a decision framework for further investigation that leads to an informed assessment of the potential risk (Figure 3).

In some environments, the environmental objectives that are based on the high level of protection are neither practical nor achievable in the short-term. In these areas, regional targets and management actions aim to provide realistic goals that accommodate the constraints of the segment and the aspirations of the local community. Management actions aim for progressive improvement towards the environmental objectives. Conversely, where objectives are being met, this does not imply levels in these environments can, or should be increased. Rather, the default objective

should be no difference from the **background** levels of the indicator of interest and management actions should aim at maintaining the existing environmental quality.

Application

For the recommended objectives to provide effective protection of water quality, several conditions need to be met in their application. A full assessment of water quality requires measurement of all the relevant indicators and comparison to the objectives. It is not intended that attainment of the objective should be evaluated by one-off samples. Further, the objectives are only to be used for evaluating ambient water quality.

The forthcoming *Waters of Victoria* (WoV) Protocol for Environmental Management will address the use and measurement of these indicators. The basis for their use and measurement is likely to be the National Water Quality Management Strategy (**NWQMS**) monitoring guidelines[3].

Objectives for *the Open Coast* and *Estuaries and Inlets* are set at the highest level of protection based on **largely unmodified ecosystems**[3]. This is effectively no change from background[12].

Exceedance of the objectives triggers a risk-based assessment[3]. Examples of these assessments for both nutrients and toxicants are described in a supporting document[12].

Nutrient and water clarity objectives

These NWQMS trigger values are proposed as objectives for nutrients and water clarity in the *Open Coast* and *Estuaries and Inlets*. The only deviation from the NWQMS trigger values is the specification of the $75^{th}/25^{th}$ percentiles instead of the $80^{th}/20^{th}$ percentiles recommended in the guidelines. This is based on the suggested sampling for attainment. This is a sampling duration of at least one year, with monthly sampling, resulting in at least 12 samples[13]. A sample number of 12 only reliably allows determination of the $75^{th}/25^{th}$ percentiles.

There is sufficient background information on the *Open Coast* and *Estuaries and Inlets,* to specify values of objectives for nutrients in the NWQMS guidelines. However, the lack of this information for the water clarity indicators, suggests an approach (75^{th} or 25^{th} percentiles of the reference data) rather than values should be recommended at this time.

The *Draft SEPP WoV (2001)* environmental objectives for nutrients and water clarity in the *Open Coast*s plus *Estuaries and Inlets* are summarised in Table 1, and compared to values in the *SEPP WoV (1988)* in Table 2.

Open Coast

The large contribution of Victorian nutrient data to the NWQMS trigger values for the *Open Coast* of south-east Australia, justified the selection of these objectives.

The *SEPP WoV (1988)* objectives have been updated by the addition of objectives for nutrients and chlorophyll *a,* and for two indicators of water clarity (PAR Attenuation, turbidity).

Estuaries and Inlets

The National Land and Water Resource Audit (NLWRA) collated existing data of estuaries in Victoria that was still short of the required **data quality** to determine segment specific objective

values[10]. The recommended objectives for this segment are, therefore, the generalised NWQMS estuarine trigger values for south-east Australia.

The paucity of information to characterise the condition of *Estuaries and Inlets* is a key knowledge gap. The use of the NWQMS trigger values when applied as triggers for risk assessment, will enable the development of segment-specific objectives and a review of the level of protection for individual estuaries.

The *SEPP WoV (1988)* objectives for *Estuaries and Inlets* have been updated by the addition of objectives for nutrients and chlorophyll *a*, plus a recommended approach for determining objectives for two additional water clarity indicators (PAR Attenuation, turbidity).

Table 1. Environmental quality objectives for *Open Coast* plus *Estuaries and Inlets* – nutrients status and water clarity.

SEGMENT	*INDICATOR*									
	[a]Total phosphorus	[a]Dissolved Inorganic Phosphorus	[a]Total Nitrogen	[a]Dissolved Inorganic Nitrogen	Chlorophyll *a*	Dissolved oxygen		PAR Attenuation	Suspended Solids	Turbidity
	µg/L	µg/L	µg/L	µg/L	µg/L	%		m^{-1}	µg/L	NTU
	75th percentile	75th percentile	75th percentile	75th percentile	75th percentile	Annual minimum	Annual maximum	25th percentile	75th percentile	75th percentile
Estuaries and Inlets	30	5	300	30	4	80	110	R25	R75	R75
Open Coasts	25	10	120	20	1	90	110	R25	R75	R75

All nutrient objectives are based on the NWQMS south-east Australian trigger values. Water clarity objectives recommend use of the 75th (R75) and 25th (R25) percentile of background levels from reference sites.

Exceedance of these objectives triggers a risk-based assessment[3]. Examples of these assessments for both nutrients and toxicants are described in a supporting document[12].

Table 2. Comparison of *Draft SEPP WoV (2001)* objectives and the *SEPP WoV (1988)* objectives for the *Open Coast* and *Estuaries and Inlets*

		Draft SEPP WoV (2001)		*SEPP WoV (1988)* Objective	
	Indicator (units)	*Open*	*Estuaries*	*Open Coast*	*Estuaries*
Nutrient	DIP (μgL^{-1})	‹10	‹5	-	-
enrichment	TP (μgL^{-1})	‹25	‹30	-	-
	DIN (μgL^{-1})	‹20	‹30	-	-
	TN (μgL^{-1})	‹120	‹300	-	-
	Chl *a* (μgL^{-1})	‹1	‹4	-	-
	DO (%)	90/110	80/110	›85%	›60%
Water	PAR attenuation (m^{-1})	‹R75	‹R75	-	-
Clarity	Suspended solids (gm^{-3})	‹R75	‹R75	10^{1}	25^{1}
				25^{2}	90^{2}
	Turbidity (NTU)	‹R75	‹R75	-	-
Phys-Chem	pH	NWQMS	NWQMS	6.5-8.5	7.5-8.5
	Temperature	NWQMS	NWQMS	‹1°C N	‹0.5°C N
	Total dissolved solids	NWQMS	NWQMS	‹5% N	‹5% N

Note: The superscripts [1]=median; [2]=90th percentile. '-' denotes not listed. 'R75' is the 75th percentile of background concentration. 'N'is background. NWQMS refers to the risk-based approach[3].

Objectives for toxicants

The recommended objectives for toxicants are the generic marine NWQMS trigger values, unless there are segment specific objectives developed from local information on either toxicity or background concentrations. Currently the only segment specific objectives are those listed for specific metals listed in *Schedules F6 and F8* (Western Port and Port Phillip Bay).

For marine and estuarine waters, the NWQMS trigger values for toxicants are recommended as objectives at a high level of protection. These trigger values aim to protect 99 per cent of species at 50 per cent certainty.

NWQMS trigger values (interim sediment quality guidelines (ISQG)–low values[3]) are also proposed as objectives to protect the quality of bottom sediments, but no per cent species protection is stated. The ISQG–low values, as for the water quality objectives, are triggers for an investigative process of **contaminant** bioavailability and toxicity[3 12].

The NWQMS trigger values for both bottom sediments and water can be replaced by segment specific objectives in the light of new information on background concentrations of toxicants. For largely unmodified ecosystems (*Open Coast*, *Estuaries and Inlets*) there is a lack of information on concentrations of metals and synthetic organic compounds and this remains a key knowledge gap. If this information becomes available, metal objectives are based on background levels as there are always trace amounts detected in surface waters and sediments. However, unlike metals, synthetic organic compounds at detectable concentrations could be grounds for investigation and management intervention[3].

For slightly modified ecosystems (Port Phillip Bay, Western Port, Gippsland Lakes), use of background data requires a robust analysis to detect changes in concentrations of toxicants[3]. The most preferable option is to use local toxicity information to derive objectives. The default option is to use the NWQMS trigger values as objectives.

5. KEY KNOWLEDGE GAPS

In developing the recommended environmental objectives a number of key knowledge gaps were identified that set the agenda for future research and monitoring. These gaps are:

- Routine data collection in *Estuaries and Inlets* to define environmental objectives, for individual estuaries. With sufficient data it may be necessary to define environmental objectives for estuaries according to their geomorphological classification[9] or groupings according to latitude.
- Biological indicators, for assessing nutrient status and water clarity in marine and estuarine environments.
- A baseline for background levels of toxicants in the largely unmodified *Open Coast*.
- Protocols and data to develop measures of water clarity such as light attenuation and suspended sediment and link these to biological indicators.

6. GLOSSARY AND ACRONYMS

Assessment sites: Sites which are used for the assessment of current condition usually compared to a reference site.

Attainment: In slightly modified ecosystems, the median value of the assessment site is less than the environmental objective. In largely unmodified ecosystems it is the 75th percentile that is used.

Attenuation of light: Rate of light decrease per metre depth of water.

Background The level of an indicator in surface waters outside the influence of any waste containing a measurable level of that indicator. (The level must be measured in a manner and at a location specified by EPA Victoria)

Beneficial Use: a use of the environment or any element of segment of the environment which:

(a) is conducive to public benefit, welfare, safety, health or aesthetic enjoyment and which requires protection from the effects of waste discharges, emissions or deposits or of the emission of noise; or

(b) .is declared in State environmental protection policy to be *beneficial uses*.

Benthic: Pertaining to the seafloor.

Bioavailable: The fraction of the total chemical in the surrounding environmental media (water, sediment, soil, suspended particles, and food items) that is able to cross biological membranes.

Bloom: An unusually large number of organisms per unit of water, usually algae made up of one or a few species.

Contaminant: A material added by humans or natural activities that may, in sufficient concentrations, render the environment unacceptable for biota. The mere presence of these materials is not necessarily harmful.

Data quality: The totality of features and characteristics of data that bears on their ability to satisfy a given purpose; the sum of the degrees of excellence for factors related to data.

Direct toxicity assessment: The use of toxicity tests to determine the acute and/or chronic toxicity of waste-water discharges or total pollutant loads in receiving waters (assesses the toxicity of mixtures of chemicals rather than individual chemicals).

Diffuse inputs: Movement of contaminants into an ecosystem that cannot be traced to a specific location; for example, water run-off from urban areas, construction sites, agricultural and silvicultural operations, and so forth.

Discharge: A complex waste material (for example, liquid industrial effluent or sewage) that may be discharged into the environment.

Ecosystem: A system that is made up of a community of animals, plants, and bacteria and its interrelated physical and chemical environment.

Ecosystem health: The overall condition of an ecosystem interpreted from levels of indicators (such as bioindicators and/or physical and chemical indicators).

Indicator: measurable feature which singly or in combination provide managerially and scientifically useful evidence of environmental and ecosystem quality or reliable evidence of trends in quality.

Largely unmodified ecosystems: typically (but not always) occurring in national parks, conservation reserves or in remote and/or inaccessible locations, whose ecological integrity is regarded as intact.

Loads: Amount of substance in a discharge (weight/volume/time).

Macroalgae: Multicellular plants that are visible to the human eye (for example, seaweed)

Microalgae: Small plants that live in the water and cannot be seen by the naked eye.

Nitrogen cycling: The balance, changes and nature of nitrogen containing compounds circulating between the atmosphere, water, biota and sediments.

NWQMS trigger values: The least certain of the three types of environmental objectives, providing an indication of potential risk across many different environments.

Nutrient enrichment: introduction of excess nutrients.

NLWRA: National Land and Water Resources Audit.

PAR: Photosynthetically Available Radiation.

pH: Value taken to represent the acidity or alkalinity of an aqueous solution. It is defined as the negative logarithm of the hydrogen ion acidity of the solution.

Point-source discharge: Discharge of contaminants through a pipe or some other discrete source from municipal water-treatment plants, factories, confined animal feedlots, or combined sewers.

Population: A. For the purposes of natural-resource planning, the set of individuals of the same species that occurs within the natural resource of interest. B. An aggregate of interbreeding individuals of a biological species within a specified location.

Primary productivity: Establishment of plant communities from photosynthetic activity.

Reference sites: Sites located in the best possible condition given the prevailing topography, soil, geology, potential vegetation, and general land-use of the region.

Risk: probability or likelihood of an adverse effect having regard to its consequence or magnitude.

Seagrass: Marine flowering plant, generally rooted in the sediments

Secchi depth: A black and white, plate sized disc is lowered into the water column, the depth in the water that it can no longer be seen, is the Secchi depth.

Sediment: Unconsolidated mineral and organic particulate material that has settled to the bottom of marine and estuarine environments.

Segment: Any portion or portions of the environment expressed in terms of volume, space, area, quantity, or time or any combination thereof.

Segment Specific Objectives (SSOs): The most certain environmental objectives that are already written into *SEPP* schedules or are developed from existing information. This information may be the ambient physical or chemical data, or biological effects data from species within the local community.

Slightly modified ecosystems: ecosystems in which aquatic biological diversity may have been adversely affected to a relatively small but measurable degree by human activity.

Surface waters: Surface water refers to both freshwater (for example, rivers, lakes and wetlands), or marine and estuarine waters.

Toxicants: contaminant usually a metal or organic compound causing harmful effects to biota.

Water clarity: Rate of decrease in light intensity with depth in the water column.

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