Briefing to Environment Victoria on threats to the marine environment with development of the Port of Hastings.

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The Victorian Government may be planning to extend the Port of Hastings to provide for bulk coal carriers to transport brown coal from the Goulburn Valley. The Port of Hastings is located within Westernport, a designated Ramsar site. Westernport is recognised world-wide for its seagrass, mangrove and salt marsh communities. These form ideal habitats for a wide range of animals, birds, insects, fish and marine invertebrates. The waters cover 680 km^2, including 270 km^2 of exposed mud flats at low tide. Over 3,500 ha of coastal land are zoned for port related uses for the expansion for container ships.

There will be some impacts of the proposed expansion of the Port of Hastings on seagrass, mangroves and salt marsh.

Seagrasses

There are four species of seagrass growing in Westernport. At the western mouth, in wave driven and vigorous water flow, *Amphibolis antarctica* forms beds in subtidal water on sand or near rocks. It propagates by releasing small seedlings with an anchoring device that can attach to rocks, seaweed or its own uncovered rhizomes. *Heterozostera nigricaulis* is a subtidal seagrass that grows on muddy sand, sand or mud. It cannot tolerate exposure to heat or sunlight. Growing next to *H. nigricaulis* is *Zostera muelleri* but in the intertidal areas of Westernport. *Z. muelleri* is the most visible seagrass in Westernport and probably occupies the largest area. Its leaves are very similar to those of *H. nigricaulis* but the plant lacks the fibrous black stems of *H. nigricaulis*. The other seagrass species in Westernport although of minor importance is *Halophila australis*. This plant grows amongst the others in small communities of less than one metre square.

Swans feed on *Z. muelleri* rhizomes and many invertebrates live on all the seagrass species' leaves and in the substrate in which the plants live. Above ground fauna include shrimps, juvenile fish and prawns of commercial use and snails, bivalves, starfish and ascidians. Living on the leaves are snails, hydroids, anemones and bivalves. Some of these are the grazers of algal epiphytes but few animals eat the seagrass leaves directly.

Apart from their nursery role to juvenile commercially and recreationally taken fish and prawns, seagrass stabilises the sediment, is a collection site for organic detritus eaten by detritivores and is a nutrient sink for inorganic nitrogen and phosphorus. The main threat to seagrass in Westernport is reduction of light to plants by increased sediment loads in the water, phytoplankton blooms and excessive growth of epiphytes.

Salt marsh

A comprehensive study by Boon et al. (2011) provided an excellent review and description of mangroves and salt marsh in Westernport (http://www.ozcoasts.gov.au/geom_geol/vic/index.jsp)

"Salt marshes occur around much of the coast of Westernport, generally between the mangrove fringe on the seaward side and more terrestrial vegetation, such as Swamp Paperbarks and Manna Gum woodlands, on the landward side. There are about 1 000 ha of salt marsh in Westernport, which is about the same area as there is of mangroves. A number of the larger salt marshes in Westernport occur in protected areas, such as the Yaringa (980 ha), French Island (2 800 ha) and Churchill Island (670 ha) Marine National Parks. Salt marshes in Westernport are likely to be very vulnerable to sea-level rise and other consequences of climate change, especially rising air and water temperatures. Salt marshes have been progressively lost already, due mostly to development for agriculture and industry, around the western and northern shores of Westernport" (taken from Boon, 2011).

Mangroves

In Victoria, mangroves grow at their southernmost global limit and only one species exists, the grey or white mangrove *Avicennia marina*. Mangroves are found only in a few locations in Victoria, generally where they are protected from the high energy waves of Bass Strait, including Barwon Heads, Port Phillip Bay and Wilson's Promontory, with the largest population growing along the shores of Westernport. These mangrove populations are considered to be ecologically stressed and extremely sensitive to disturbance and other impacts (EPA, 1996).

Avicennia marina fringes a large proportion of Westernport Bay. The species has a wide tolerance to salinity, intertidal position and temperature and is able to occupy rocky and sandy sheltered embayments and offshore lagoons. Common to all *Avicennia* species (and many other mangrove species) is their viviparous fruit which germinates while still attached to the parent plant. Another distinguishing feature of these plants is their pneumatophores which are specialised root structures allowing gas exchange functions for root respiration in waterlogged soils. Mangroves respond to and assist with sedimentation processes. The pneumatophores, the mangrove's root system, trap and retain sediment and, while facilitating sediment deposition, protect shorelines from erosion by wave action. They do this in four ways;

- fine mats of surface roots bind sediment;
- pneumatophores decrease current velocities and encourage deposition of fine particles;
- the plants add organic matter to sediments via primary production and thus contribute to surface elevation; and
- the dense plant roots help reduce burrowing invertebrates from reworking sediments.

There has been little research on the natural recruitment characteristics of mangroves in Westernport Bay with the most comprehensive study undertaken as part of the Westernport Bay Environmental Study in 1974 (Shapiro, 1975). This study examined the factors contributing to the growth and establishment of *A. marina* in Westernport Bay.

Salmarsh

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salt marsh in Westernport, which is about the same area as there is of mangroves. A number of the larger salt marshes in Westernport occur in protected areas, such as the Yaringa (980 ha), French Island (2 800 ha) and Churchill Island (670 ha) Marine National Parks. Salt marshes in Westernport are likely to be very vulnerable to sea-level rise and other consequences of climate change, especially rising air and water temperatures. Salt marshes have been progressively lost already, due mostly to development for agriculture and industry, around the western and northern shores of Westernport" (taken from Boon, 2011).

Threats

The plant habitats of Westernport are under continual threat. Anthropogenic impacts from runoff, dredging, nutrient addition, and changed hydrology are reinforced by climate change and natural disturbance to put Westernport in a vulnerable position. For seagrass the main threat is turbidity from eroding edges, runoff and disturbance of areas already denuded of seagrass. For mangrove the main threat is clearing them and possible oil spills. Salt marsh is vulnerable to clearing and a lack of respect for its value.

The development and use of the port at Hastings will bring further potential disturbance to the natural resources of Westernport. The footprint of the new port and facilities will be mainly on seagrass beds. Vessel generated waves could disturb the various habitats by increasing turbidity or by erosion.

Runoff from land clearing in preparation for housing construction may be the largest impact on offshore seagrass meadows. The problem is that the land is cleared for building and sometimes heavy rains wash off the topsoil because it is no longer held by vegetation. New roads and cuttings for roads are another source of sediment run-off.

Development of the coast by building causeways and shoreline armouring may divert water and generally destabilize beaches and shorelines. Rivers are often diverted or changed to enable the extraction of freshwater and this may have an effect on seagrass beds, saltmarsh and mangroves

Physical damage to these habitats can occur when marinas, jetties and boat ramps are built on or adjacent to them or these structures may change the hydrology (water circulation patterns) of the area, reducing on-shore drift and water flow.

Human occupation of the coastal zone is accompanied by the dangers of pollution. Industrial chemicals from factories, including heavy metals, petrochemicals and toxic compounds are a danger to these ecosystems. Heavy metals, petrochemicals and nutrients enter the sea from runoff and stormwater drains. Agricultural runoff containing herbicides and insecticides can damage habitats and their associated fauna.

By far the most damaging pollutant in seagrass beds is nutrients. These nutrients promote epiphyte growth that smothers seagrass. Eutrophication occurs when high nutrient

loads, particularly inorganic nitrogen, are taken up by opportunistic macroalgae growing on seagrass leaves. Growth of epiphytic algae blocks light to the seagrass blades, preventing photosynthesis, and eventually smothers the seagrass. The epiphytes and dead seagrass leaves fall to the substrate beneath, are broken down by bacteria that use up oxygen, and this anoxic sediment gives off hydrogen sulphide that kills the benthic flora and the whole seagrass ecosystem may be lost. Mangroves and saltmarsh are also susceptible to excess nutrients. In shallow sheltered areas, large drifts of *Ulva* (together with dead seagrass), prevent or retard the establishment and growth of young mangrove seedlings, and also choke established trees by smothering and eventually killing the aerial roots or pneumatophores.

Acid sulphate soil is the common name given to naturally occurring soil and sediment containing iron sulphides, principally the mineral iron pyrite, or containing acidic products of the oxidation of sulphides. Mangrove soils contain iron sulphides and when these are exposed to air, oxidation takes place and sulphuric acid is ultimately produced when the soil's capacity to neutralise the acidity is exceeded. As long as the sulphide soils remain under the water table, oxidation cannot occur and the soils are quite harmless and can remain so indefinitely.

Another way that seagrass plants are prevented from photosynthesising is by increasing the turbidity of the surrounding water. As mentioned above, this occurs when runoff containing sediment flows across the seagrass bed. Dredging near seagrass beds increases turbidity and there may be a smothering effect as well if silt screens are not used. If the sediment load is very high, the effect of seagrass leaves slowing the surrounding water will cause the sediment to drop out of the water column and smother plants.

Landfill can modify patterns of tidal inundation. Once the landfill area is in use, other environmental problems usually follow. Stormwater runoff, acid sulphate soils, accidental spills of pollutants and discharge of treated or untreated effluent cause environmental problems in remaining mangrove forests.

Straightening meandering tidal channels causes changed tidal levels and reduced nutrient uptake for the remaining mangroves and saltmarsh. These ecosystems remove nutrients from runoff and river deltas by having meandering streams that slowly release water to the sea. If these meanders are straightened, for example for boating channels or drainage, the water passes quickly to the sea with little chance for nutrients and organic matter to be retained and used in the mangroves. Bund walls and estuarine dredging may be for flood

mitigation but environmental impacts include destruction of habitat in the dredged area and alteration of channels causing erosion. Hydrodynamic changes to the mangrove and saltmarsh habitat have multi-faceted impacts. *Avicennia marina* can survive in conditions that may be two or three times the salinity of seawater. However, it shows signs of stress and much reduced growth rate at these high salinities. Any changes in the freshwater drainage patterns through a swamp are likely to have a serious effect on its condition. Reduction in oxygen in the immediate environment of roots, when land immediately behind a mangrove stand or saltmarsh is drained or roadways cut through these swamps without the provision of drainage pathways, will damage them. These stresses on mangroves and saltmarsh in Westernport are especially important as mangroves are already stressed by growing at their southernmost limit.

The effects of overfishing on seagrass beds can be quite devastating. A top-down trophic cascade can occur when the top level predators are removed. The decline in large predators brought about by fishing causes an increase in small fish predators which deplete populations of mollusc and crustacean grazers that keep down epiphyte loads. Increasing epiphytes leads to a gradual loss of seagrass as explained above. The threat of a trophic cascade caused by recreational and commercial fishing should always be kept in mind. N.B. only long-lining is permitted for commercial fishing in Westernport.