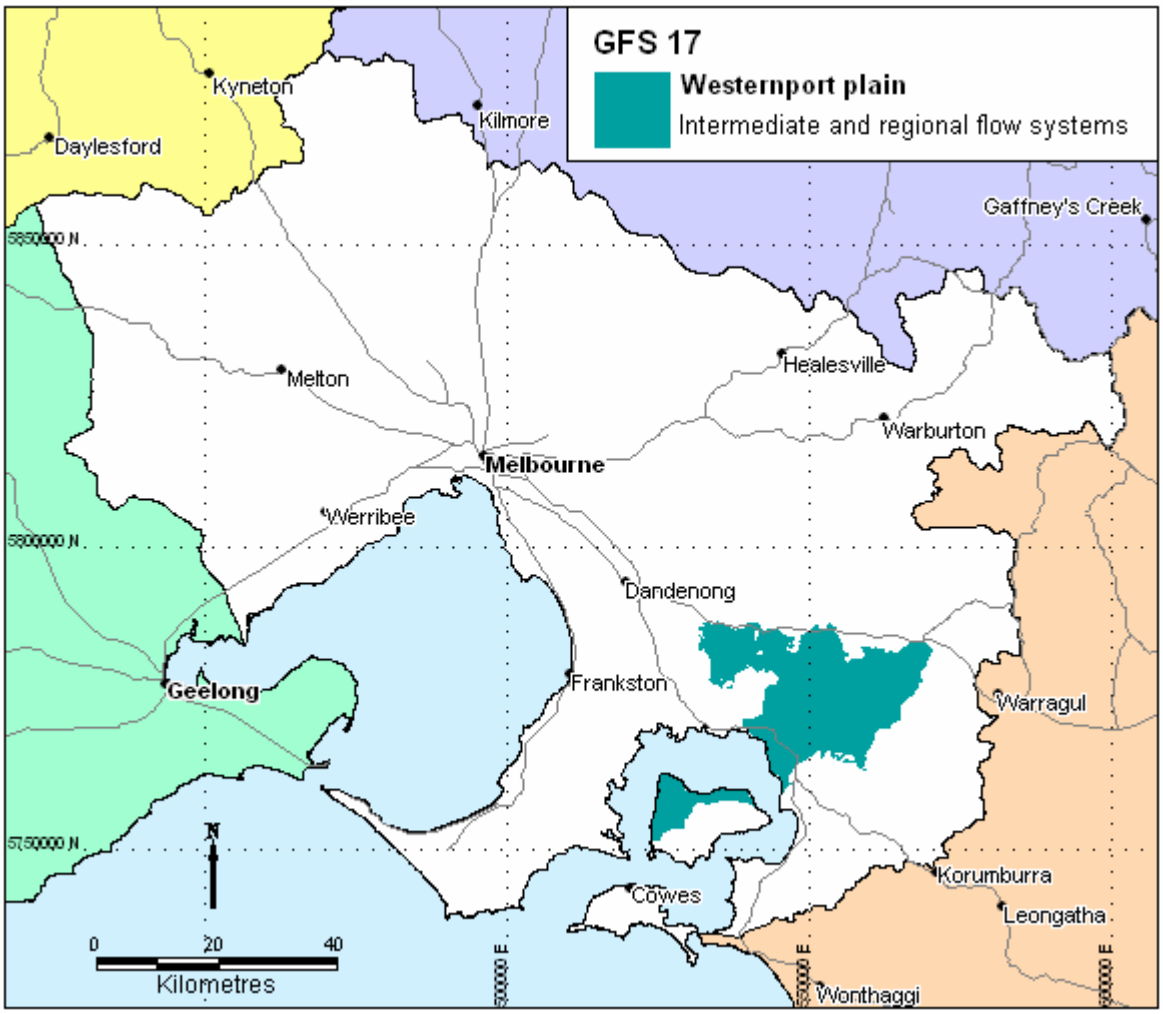
Intermediate and regional flow systems of the Westernport plain

Region: South east PPWP CMA region

Type areas: Koo-wee-rup, Koo-wee-rup North, Modella

Brief description: The Westernport plains are underlain by a sequence of stratigraphic units of marine and alluvial origins. Groundwater moves through the various units and forms a complex three-dimensional system. The unit is hydraulically connected at depth to the French island exposures of the GFS.



Problem statement: Groundwater extraction, tidal influences of Westernport Bay and cross formational flow between the aquifers at depth add to the complexity of salinity processes in this system. Small outbreaks of salinity have been mapped north and west of Cardinia and in the Nar Nar Goon area.

Right:

Irrigated horticulture (asparagus) at Koo-wee-rup

Landscape attributes

Geology: Quaternary flood plain deposits (Qpw), alluvium (Qra), aeolian coastal and inland dunes, dune sand and minor swamp deposits (Qrd), lagoon and swamp deposits (Qrm).

Topography: Plain, undulating plain

Land Systems:

South Victorian Coastal Plains	South Victorian Riverine Plains
8.4 Fans and Terraces – Westernport	*9.1 Present Flood Plain - Gippsland*

Regolith: Unconsolidated sand, silt and clay. Minor gravels.

Annual rainfall: 750 mm to 950 mm

Dominant mid-1800s vegetation type: Grassland, Rushland, Heathland and Scrub with minor occurrences of Forest and Woodland on the outskirts

Current dominant land uses: Grazing, horticulture, urban & rural development.

Mapping method: Outcrop geology

Hydrogeology

Aquifer type (porosity): Unconsolidated gravel, sand, silt and clay (primary porosity).

Aquifer type (conditions): Unconfined, with confined aquifers at depth.

Hydraulic Conductivity (lateral permeability): Extremely variable. Probable range from 10^{-5} m/d to 10^{2} m/d, with clayey facies < 1 m/d; sandy facies up to 100 m/d.

Aquifer Transmissivity: Variable, in the moderate range.

Aquifer Storativity: Extremely variable. Estimated to be from 0.001 to 0.05.

Hydraulic gradient: Generally very low to low, with moderate to locally steep gradients in the colluvium around the boundaries.

Flow length: Ranges from a few kilometres to >20 kms

Catchment size: Moderate (< 500 km^2)

Recharge estimate: Varies with the rainfall and landscape setting at any location.

Temporal distribution of recharge: Seasonal (winter and spring), with more recharge in wetter years. Irrigation and cross formational flow may contribute.

Spatial distribution of recharge: Catchment wide, with local irrigation mounds and contributions for deeper aquifers.

Aquifer uses: Irrigation, stock and domestic use.

Salinity

Groundwater salinity (TDS): Generally in the range of <1000 mg/L to 3000 mg/L.

Salt store: Moderate

Salinity occurrence: Secondary salinity occurs in low lying and flat areas, drainage lines, and swampy or waterlogged areas.

Soil Salinity Rating: S1, S2

Salt export: Wash off from surface.

Salt impacts: Mostly on-site. Some impacts off-site.

Risk

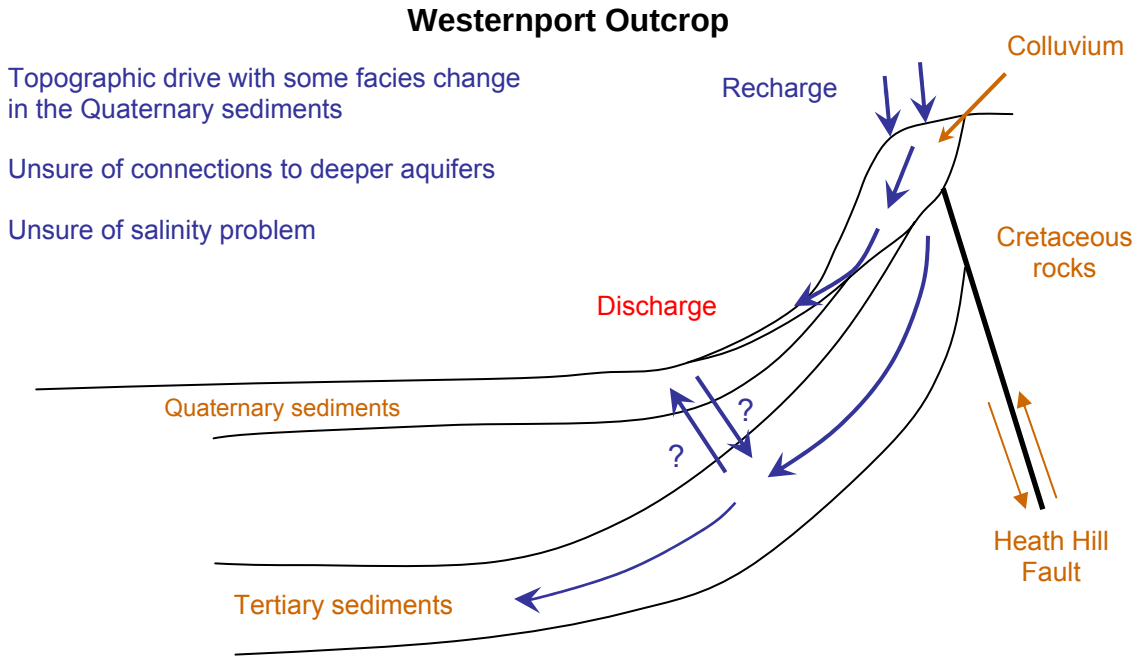
Soil salinity hazard: Low to moderate.

Water salinity hazard: Low

Assets at risk: Agricultural land, urban and engineering infrastructure, conservation areas.

Responsiveness to land management: Varied, but generally moderate. Groundwater extraction, irrigation, tidal influences and connection to underlying aquifers make the response to land-use change uncertain.

Conceptual model



Management Options

Given the interpreted original existence of grassy woodlands grading to Melaleuca and mangrove swamp progressively lower on the Western Port plain (and that the region abuts a permanent seawater head), generalised waterlogging and high watertables occurred naturally across the landscape. Land use change has likely exacerbated this condition, and probably led to local increases in soil salinity. On the basis of the natural condition, it is unrealistic to expect that waterlogging and elevated watertables can be significantly abated by any reasonable means.

The re-establishment of waterlogging and salt tolerant vegetation will assist in minimising the magnitude and period of waterlogging, and potentially maintain a sufficient unsaturated soil profile to allow leaching of shallow soil salt build-up. The long term prognosis for land management on groundwater salinities is unknown.
In some areas of primary salinity, management may be needed to retain the biodiversity values. Indigenous halophytic ecologies generally have a high conservation value, and are especially important in the larger estuarine wetlands of Port Phillip Bay and Western Port Bay.

Dryland agriculture options for managing intermediate and regional flows on the **Westernport plain** **Salinity focus: Nar Nar Goon, Cardinia**		
Options	**Treatments**	**Comments**
Biological Management of recharge	Perennial pastures	Low impact– high rainfall and regional flow system. Salinity and waterlogging tolerance required
	Crop management	Low impact– cropping is generally absent in these landscapes
	Trees/woody vegetation	Low to moderate impact– plantings will assist in reducing the extent and duration of waterlogging and soil salt build-up. Effective recharge will require mass planting due to scale of the flow systems
Engineering intervention	Surface drainage	Low impact– shallow gradients an issue
	Groundwater pumping	Low impact– only low to moderate watertable aquifer permeability. Issues of disposal and subsidence. Specific asset protection only
Productive uses of saline land and water	Salt tolerant pastures	Moderate impact– salt and waterlogging tolerant pastures/grasses for stabilisation and aesthetics
	Halophytic vegetation	Low– poorly suited to climate
	Saline aquaculture	Low– may be limited opportunities where there is sufficient groundwater, and where offsite salinity and nutrient issues can be managed
	Salt harvesting	Low– groundwater is not sufficiently saline
	Others	Consider revegetating low lying areas with indigenous waterlogging and salt tolerant trees (e.g. Melaleuca). See OPUS database (NDSP)

Management implications given projected land use

The designation of the Pakenham plain as an urban growth corridor, with concentrated development of infrastructure, means that an adaptive approach to salinity and waterlogging will be required, though development ought to be avoided in the most hazardous areas. Developments should be designed and engineered to withstand shallow brackish watertables waterlogging and elevated soil salinity. Landscape hydrological modification that results in additional inputs to recharge and run-off loads ought be avoided. Further, the development of artificial water bodies need to be considered in respect to the additional hydraulic loads that they provide in the landscape, in relation to the barrier that they provide to surface and sub-surface drainage, and the impacts of leakage. There should be attention to prudent species selection in gardens, green areas and parklands.

Where there is additional horticultural development this should be sited in respect to land suitability and in relation to defined hazards. Additional excess recharge and waterlogging should be avoided by optimising the efficiency of irrigation applications.