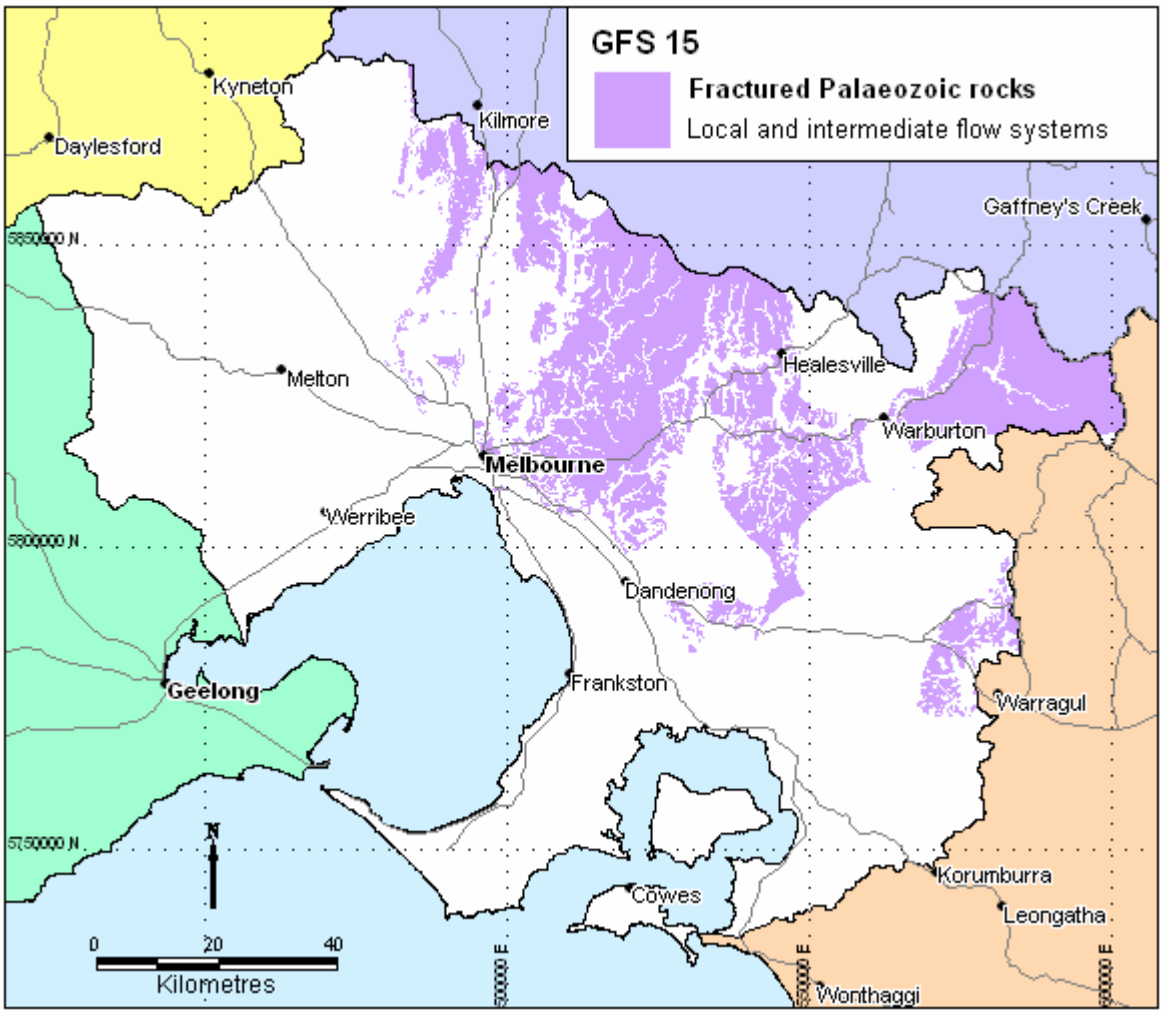
Local and intermediate flow systems of the fractured Palaeozoic rocks

Region: Central and northern PPWP CMA region

Type areas: Doncaster, Hurstbridge, Whittlesea, McMahons Creek

Brief description: Sedimentary rocks of Silurian and Devonian age make up most of the hilly and mountainous areas north east of Melbourne. These folded and faulted sandstones, siltstones, shales, mudstones, conglomerates and limestones have been metamorphosed adjacent to the igneous intrusive rocks to form hornfels. Groundwater flows through the fractures in the rocks in local and intermediate flow systems. Local systems are more prevalent in the steeper terrains, whereas intermediate systems dominate the undulating landscapes.



Problem statement: Small outbreaks of salinity are associated with this GFS at the boundary with the Westernport plain (GFS 17) and the Volcanic Plain (GFS 18). In the Upper Yarra, the majority of the GFS remains as forested water supply catchments.

Landscape attributes

Geology: Silurian and Devonian marine sediments (sandstones, siltstones, shales, mudstones, conglomerates and limestones) (S, SDjg, SDl, Sla, Sld, Sls Sud, Suk, Sum, Dlc, Dlh, Dlwm, Dlwn, Dmk) and Devonian Hornfels (Duh)

Topography: Dissected uplands, ridges, spurs, hills and valleys.

Land Systems:

Central Victorian Uplands

1.1 East Victorian Dissected Uplands

2.1 West Victorian Dissected Uplands - Midlands

South Victorian Uplands

3.4 Dissected Fault Block – Otway Range

Regolith: Variable. Highly weathered sandstones and mudstones in the less steep terrain, and moderately to slightly weathered sedimentary rocks in the steeper terrain.

Annual rainfall: 600 mm to 1750 mm

Dominant mid-1800s vegetation type: Forest

Current dominant land uses: Urban and industrial development, water supply catchment, forests, conservation areas, rural residential developments.

Mapping method: Outcrop geology

Hydrogeology

Aquifer type (porosity): Fractured rock and saprolite (secondary porosity)

Aquifer type (conditions): Unconfined and locally semi confined

Hydraulic Conductivity (lateral permeability): Variable from approximately 10^{-5} m/d to 1 m/d

Aquifer Transmissivity: Highly variable in the low to moderate range. Estimated to be generally less than 50 m^2/d.

Aquifer Storativity: Variable. Estimated to be in the 0.02 to 0.05 range.

Hydraulic gradient: Estimated to be moderate in intermediate systems and locally steep in local systems.

Flow length: Generally <25 km for intermediate systems and <5 km for local systems.

Catchment size: Small (~<500 Ha) for local systems and moderate (>100 km^2) for intermediate systems.

Recharge estimate: Possibly in the range of 50 mm to 100 mm annually. Could be considerably lower in suburban and industrial areas.

Temporal distribution of recharge: Seasonal (winter and spring), with more recharge in wetter years. Some episodic snowmelt contributions.

Spatial distribution of recharge: Catchment wide but varies with the depth of regolith, slope and land-use.

Aquifer uses: Minor use, mainly for stock and domestic purposes. Baseflow to streams is an important source of water supply.

Salinity

Groundwater salinity (TDS): Fresh to brackish. Generally less than 1500 mg/L, but could be up to 5000 mg/L.

Salt store: Low to moderate.

Salinity occurrence: Some small areas adjacent to the boundary with GFS 17 (Pakenham, Officer, Clyde North) and GFS 18 (Upper Maribyrnong River system), and GFS 1 (Upper Plenty River system)

Soil Salinity Rating: S1, S2

Salt export: Wash off from surface

Salt impacts: Both on-site and off-site

Risk

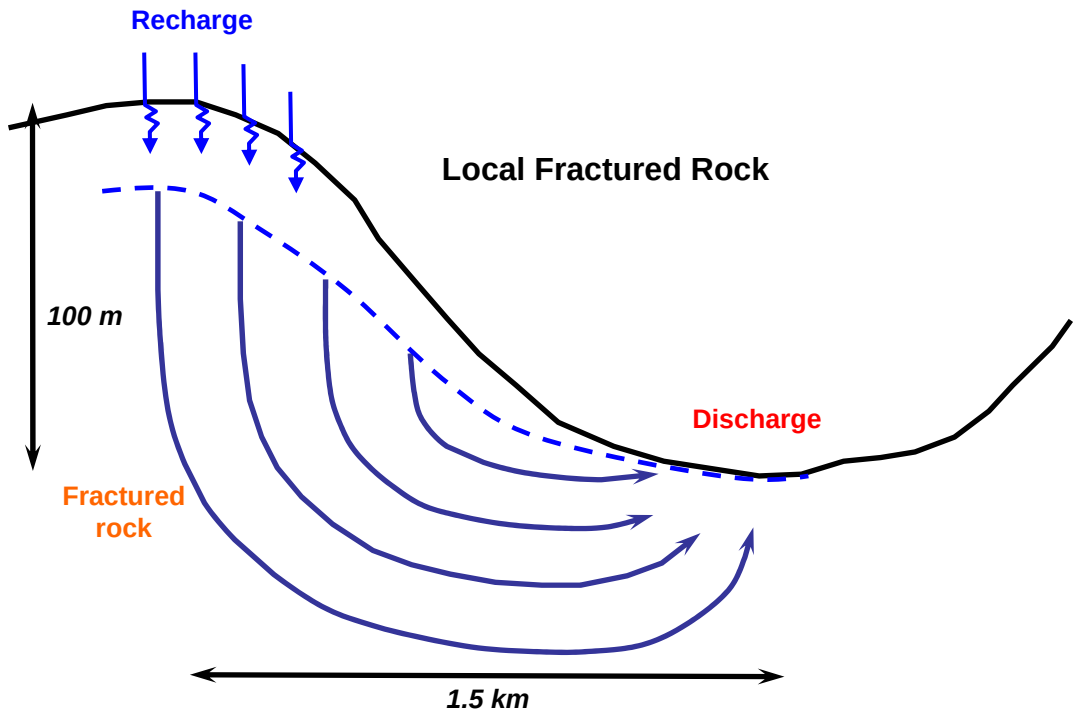
Soil salinity hazard: Low to moderate

Water salinity hazard: Low

Assets at risk: Water quality and aquatic biodiversity in Upper Maribyrnong and Upper Plenty river systems, agricultural land, urban development.

Responsiveness to land management: Unknown, but should be high for local systems and moderate for intermediate systems.

Conceptual model



Management Options

Isolated salinity issues are known to occur on the western and southern margins of this GFS. The extent to which groundwater flow through the fractured bedrock hills rising from the Westernport plain contributes to salinity on the plain (GFS17) and alluvial/colluvial sediments (GFS1) is unknown, but some level of impact is probable. On the western flanks of the GFS, the salinity may be partially related to groundwater emerging from thinning basalt (GFS 18), along the bedrock-basalt contact at the surface. Ultimately, management of salinity processes in this GFS requires a greater understanding of the hydrogeological relationship to the adjacent GFSs.

Where salinity can be directly related to flow processes occurring in this GFS, most solutions may practically reside with discharge management. Effective recharge control is limited by the slower response of intermediate flow systems and the generally moderate (>600 mm north of Melbourne) to high (>700 mm east of Melbourne) annual rainfall. In agricultural zones, maintaining perennial pasture health will at least assist in resisting runoff and associated waterlogging.

Dryland agriculture options for managing salinity in local and intermediate flows in the **Fractured Palaeozoic rocks**

Salinity focus: Pakenham footslopes, Clyde Nth, Upper Maribyrnong region

Options	Treatments	Comments
Biological Management of recharge	Perennial pastures	Low to moderate impact– rainfall too high for significant impact. Offers some level of run-off and waterlogging control.
	Crop management	Low impact– cropping is generally absent in these landscapes
	Trees/woody vegetation	Moderate impact– in local systems where they can be incorporated into existing land uses. Plantations and belts will reduce gross recharge, run-off, waterlogging
Engineering intervention	Surface drainage	Low impact– disposal issues
	Groundwater pumping	Low impact– low hydraulic conductivities make pumping expensive. Disposal issues
Productive uses of saline land and water	Salt tolerant pastures	High impact– to stabilise and aesthetically improve salt affected areas
	Halophytic vegetation	Low impact– climate and environs not likely to be conducive
	Saline aquaculture	Low impact– discharge sites only minor in extent
	Salt harvesting	Low impact– groundwater is not sufficiently saline
	Others	See OPUS database (NDSP)

Management implications given projected land use

Urban and peri-urban development pressures occur in the vicinity of this GFS both to the east (Pakenham corridor) and north (Whittlesea corridor) GFS. In these circumstances developments in areas contributing to salinity hazards should be planned to be generally sensitive to recharge and runoff control, and avoided where hazard is expressed in the landscape.