Groundwater Resource Appraisal for Southeast Melbourne

3 August 2010

Southern Rural Water Authority

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Executive summary

This report presents the findings of the groundwater resource assessment for south-eastern Melbourne. The work was commissioned by Southern Rural Water after a period of prolonged low rainfall across the greater Melbourne area and a rapid growth in the installation of groundwater bores for stock and domestic use had necessitated the need for an updated understanding of the resource capacity and risks of the shallow groundwater system.

The groundwater resource appraisal for the Quaternary and Upper Tertiary aquifers in south-east Melbourne was developed around five groundwater flow systems, referred to in this report as: Moorabbin, Frankston, Mornington, Dromana and Nepean. The study area covers 720 km2 with highlands to the east sloping to coastal plains and Port Phillip Bay to the west and south. The Nepean area is further surrounded by the Bass Strait to the south-west.

The objectives of the groundwater resource appraisal were to:

- Provide water balance calculations of the study area, with boundaries defined either laterally or vertically in a logical manner.
- Provide an evaluation of the uncertainty associated with the water balance calculations and outline a methodology for quantifying these uncertainties commensurate with the calculation approach.
- Investigate the contribution of groundwater extractions to the overall water balance and the potential impacts resulting from these extractions.

A large amount of existing data from a wide range of sources was reviewed for the resource appraisal. A total of 17 previous reports, additional references and databases were included. More than 2,800 water table elevation observations from approximately 400 bores and almost 1,300 potentiometric elevation observations from 180 bores in the Upper Tertiary Aquifer have been collated from across the study area. This includes more than 300 observations from EPA audits of contaminated sites, supplementing the currently available data from the GMS, the Melbourne Groundwater Directory (MGWD) and the Victorian Water Resources Data Warehouse.

Discrepancies have been observed between the potentiometric elevation observations and maps produced for the MGWD. While the median discrepancy is close to zero in the Upper Tertiary Aquifer, interpolated water table elevations in the Quaternary Aquifer are consistently too high, particularly in the Nepean area. A map of the discrepancies shows that underestimates of potentiometric elevation are prevalent in the east of the study area, while overestimates are more common close to the coast.

Long-term hydrographs are inconsistently available over the study area. There is good coverage of State Observation Bores in the Nepean area and hydrographs show that since 1997 water levels have declined by up to 2 m to the east while they have generally remained stable to the west. There is a scattering of bores with long-term data in the vicinity of Dandenong. These show that groundwater levels have declined by approximately 1.5 m since 1997 across the eastern and northern part of the Frankston study area but there are large gaps in the central and coastal part of the area. No long-term monitoring data are available in the Mornington, Dromana and Moorabbin areas.

More than 2,400 observations of groundwater salinity have been collated from across the study area, including 1300 from EPA audits of contaminated sites. These observations support the map of water table salinity produced for the MGWD.

Analysis of rainfall data from 35 weather stations in the vicinity of the study area has been completed. The resultant maps show a significant reduction (by between 100 and 200 mm/yr) in mean annual rainfall from 1997-2009 when compared to 1970-1996. This is a greater reduction in rainfall than that predicted by the CSIRO Mk3.5 model for all IPCC scenarios up to 2030.

An analysis of the potential extraction rates of groundwater via licensed and stock and domestic bores in the study area has been completed. The Nepean area has the most growth in S & D bores (40% of total licences in this area have been granted in the last 5 years) and more than 60% of the total potential extraction (0.8 GL/yr from S & D bores and 5.2 GL/yr from licensed bores). There has also been a significant increase in S&D bores near the coast in other parts of the study area.

Recharge is estimated to be approximately 7% of rainfall in the Moorabbin (2.9 GL/yr), Frankston (19.8 GL/yr), Mornington (3.7 GL/yr) and Dromana (0.8 GL/yr) areas and 17% of rainfall in the Nepean area (13.2 GL/yr) where the soil is sandy and surface drainage is poorly developed.

Recharge has fallen by approximately 20% since 1997 in the Moorabbin, Frankston, Mornington and Dromana areas. On the other hand, recharge has fallen by up to 50% in the Nepean area in the same time. It is not known whether this is real or in part a limitation in calculating 'historical' recharge to make such a comparison.

An analysis of anthropogenic recharge has been carried out, based on data supplied by South East Water. Leakage from water supply and waste water pipes is contributing approximately 10.1 GL/yr of water to recharge across the entire study area. There is an additional 3 GL/yr of recharge in the Nepean area due to infiltration from septic tanks.

The water balance for the Nepean is in deficit by approximately 1.3 GL/yr. This is consistent with observed water level declines and may be due to a combination of reduced rainfall and increased groundwater extraction. This situation could lead to greater intrusion of saline groundwater into the freshwater aquifer and this risk should be further evaluated.

The water balance for the Frankston area is in deficit by approximately 6.7 GL/yr. This estimate is supported by declining water levels across parts of the area but the overall balance is poorly constrained. Outflows to rivers and wetlands represent a large component of the Frankston water balance but limited data are available on stream flow, particularly near the coast. The low lying coastal parts of this area already contain brackish groundwater and there is a risk of further intrusion of saline groundwater. Further work is required in this area to further constrain the water balance and assess the risk of saline groundwater intrusion.

There is lack of reliable long-term data for the Moorabbin, Mornington and Dromana study areas to assess the relative balance in these groundwater flow systems. Over 1.4 GL of groundwater is extracted annually and while it does not appear that the area is immediately vulnerable to saline groundwater intrusion, it would be prudent to install monitoring wells to confirm these findings. This would help constrain the water balance and assist management of the resource. The volume of groundwater extracted in the Mornington and Dromana area is small (<0.2 GL/yr), however, and the potential groundwater management issues in these areas should not be a priority.

In order to better constrain the uncertainties in this study and understand the risk to the natural resource we recommend work in the following areas:

- Constrain the estimates of recharge through the collection of more river gauging data and field studies.

- Further evaluation of the impacts of stock and domestic bore use in the Nepean area. This should include further constraining the estimate of groundwater extraction via stock and domestic bores and verifying groundwater elevations in the Portsea area.

- Further evaluation of the risk of saline groundwater intrusion through the establishment of monitoring bores in the western part of Frankston area and conducting numerical modelling to verify the timing and magnitude of this risk.

- Verify the actual dependence of significant groundwater dependant ecosystems (GDE's) on groundwater and potential risk if groundwater levels or quality change. The work should concentrate on significant environmental assets in the study area, namely the RAMSAR listed Edithvale-Seaford Wetlands and Patterson's River, Balcombe Creek/Estuary, Dandenong/Eumemmerring Creeks and Chinaman's Creek/Boneo Swamp. This should include field mapping and monitoring bore installation near the GDE's.

- Further work should consider incorporating additional data from recently completed topographic surveys by the DSE, contaminated site reports in the vicinity of GDE's and research conducted by University of Texas on the subject of recharge in urban areas.