

Chapter 12. Summary and Conclusions

The SIR has detailed soil maps of 148 soil types classified into 6 major soil groups. Soil groups were mapped on the basis of soil texture and position in geomorphological landscape units, and were designed primarily to give an indication of the crop suitability of soils. Although broad association has often been made between soil permeability and soil groups, overall there has been a poor understanding of the hydraulic properties of the soils in the region. The availability of information on soil hydraulic properties is expected to add significant value to the existing soil maps. Soil hydraulic properties provide a knowledge link between irrigation management and impact on water table and salinity, and between farm and catchment management. This project aims to provide a tool to facilitate land use changes consistent with the principles of water use efficiency and sustainability. The tool contains regional scale soil hydraulic property information of the major soil types in the SIR.

Using the existing regional soil maps as a reference, measurements of soil hydraulic properties were conducted at 79 sites for 34 soil types, which represent 75% of the total area of the SIR. In situ measurements of saturated hydraulic conductivity were made at Horizons A, B1 and B2. Final infiltration was measured at top of Horizon B1. On 8 sites, intensive measurements of soil hydraulic properties were carried out to describe paddock scale variability of soil hydraulic properties. Soil water capacities of 32 soil types were determined in the laboratory on undisturbed soil cores. Soil physical properties including soil texture, bulk density and organic matter content of Horizons A and B1 of 34 soil types were measured in the laboratory. In addition soil chemical properties such as EC, pH and exchangeable cations of Horizons A and B1 were measured.

12.1 Regional Soil Hydraulic Property Data

12.1.1 Soil Physical Properties

Clay content of Horizon A showed an increasing trend from Group 1 to 5. However, the difference in soil texture was not found statistically significant between Groups 1 and 2, between Groups 3 and 4, and between Groups 5 and 6.

Large variability in clay content of Horizon B1 within soil groups was found. Within-soil-group variability of clay content was due to both between-soil-type variability and within-soil-type variability. It is noted that even at a paddock scale, variability can be quite high, in some cases a paddock can cover much of the within-soil-type variability.

Average bulk density of Horizon B1 showed a decreasing trend with soil group except for Group 6. Overall, Horizon B1 has higher average bulk density than Horizon A. Except for Group 5, organic matter content of Horizon A showed a decreasing trend with soil group.

12.1.2 Chemical Properties

Horizon B1 generally has higher pH, exchangeable Na and ESP than Horizon A for all soil groups. Group 5 has the highest average exchangeable Ca, Mg, Na and K among all soil groups. Group 2 has the highest average ESP of Horizon A, and Group 5 has the highest average ESP of Horizon B1.

12.1.3 Saturated Hydraulic Conductivity

Saturated hydraulic conductivity (Ksat) of Horizons A, B1 and B2 is reasonably well defined between upper and lower quartiles for Groups 2, 4, 5 and 6, and it is recommended that the average values of these groups could be used as indicative values for practical applications. For Groups 1 and 3, however, Ksat is quite variable, due to both between-soil-type variability and within-soil-type variability. It is suggested that soil types of Groups 1 and 3 should be considered individually. It is noted that even at a paddock scale, variability can be quite high, and in some cases a paddock can cover much of within-soil-type variability.

Saturated hydraulic conductivity (Ksat) of all soil horizons decreases from Group 1 to Group 6 except for Groups 2 and 5. However, the differences in Ksat of Horizons B1 and B2 was not found statistically significant between Groups 4 and 5, and between Groups 5 and 6.

Ksat of Horizon A is generally one order of magnitude or more larger than that of Horizons B1 and B2. Ksat of Horizons B1 and B2 are similar for all soil groups. However, Ksat of Horizon B1 tends to be slightly lower than that of Horizon B2 for Groups 2 and 3, indicating that Horizon B1 is the more restricting layer.

Some spatial trends of Ksat have been found across the three irrigation districts in SIR – Murray Valley (MV), Goulburn Valley (GV) and Rochester (RO). MV District has the highest Ksat of Horizons A and B1 among Group 1 soils. MV District has the lowest Ksat of Horizons B1 among soils of each of the Groups 3, 5 and 6. On the other hand, GV District generally has the highest Ksat of Horizon B1 among soils of each of the Groups 2, 3, 4, 5 and 6.

12.1.4 Final Infiltration Rate

The final infiltration rate (FIR) of Horizon B1 is reasonably well defined for soil groups except Group 1, and it is recommended that the average values of Groups 2 to 6 could be used as indicative values for practical applications. For Group 1, between-soil-type variability of FIR is quite large. It is suggested that soil types of Group 1 should be considered individually.

The FIR of Horizon B1 decreases from Group 1 to Group 6, except Group 2. However, the FIR of Horizon B1 was not found statistically significantly different between Groups 4 and 5, and between Groups 5 and 6.

The FIR of Horizon B1 is generally lower than the saturated hydraulic conductivity of Horizon B1. It is suggested that the upper part of Horizon B1 is more permeable than further down, because the FIR measurement allowed a longer time for water to penetrate down the soil profile more deeply.

12.1.5 Soil Water Capacity

Available water capacities of Horizons A and B1 are reasonably well defined for Groups 3, 4, 5 and 6, but were much more variable for Groups 1 and 2.

Available water capacities of Horizon A decrease from Group 1 to Group 5. This pattern does not hold for Horizon B1. The soil water capacities of Horizon A are greater than those of Horizon B1 for Groups 1, 2 and 3, while the reverse is true for Groups 4, 5 and 6.

12.2 Indirect Estimation of Hydraulic Properties

Pedotransfer functions for predicting soil water retention characteristic from easily measurable soil properties were developed and were found to be useful for the indirect estimation of soil water capacities. However, consistent correlation between saturated hydraulic conductivity or final infiltration rate and easily measurable soil properties were not found.

EM data measured by an EM38 instrument did not show consistent correlations with soil hydraulic properties.

12.3 Development of a Database of Regional Hydraulic Properties

The collected data were compiled in a database of soil hydraulic properties of the SIR. The database is in the form of look-up tables, arranged along soil properties as well as soil types and soil groups. Values of mean, median and variability measures are given. The database can also be directly linked with the digital soil maps through GIS.

The database adds significant value to the existing soil maps. It will assist in land use planning, irrigation design, water management and irrigation related policy initiatives.

12.4 Conclusions

The project has built up a picture of trends and the variability of soil properties in the SIR. Although some useful trends with respect to soil groups, soil horizons and irrigation districts have been identified, overall soil hydraulic properties are found to be highly variable. This is particularly so for soil Groups 1 and 3, each comprising highly dissimilar soil types. For this reason, it is suggested that hydraulic property values of individual soil types should be used. Group values should be used as an indication only for those soil types which have not been directly measured.

The new information on soil hydraulic properties adds significant value to the existing soil maps and will assist in land use planning, irrigation design, water management and irrigation related policy initiatives. However, a framework is needed for the application of soil hydraulic property information so that irrigation systems and enterprises can be better matched with soils to achieve both farm and catchment outcomes. The development of such a framework should be the focus of future work on practical applications of the data collected in this project.