Chapter 10. Final Infiltration Rate

10.1 Final Infiltration Rate (FIR)

Final infiltration rate (FIR) was measured at the top of Horizon B1 at 250 points across 69 sites. Results are summarised in Table 10.1. Similar to Ksat of Horizon B1, average FIR of Horizon B1 decreases from Group 1 to Group 6 except for Group 2, which has a lower FIR value than Group 3. The standard deviation of FIR of Horizon B1 is greater for Groups 1, 2 and 3 than other soil groups. Except for Group 1, average FIR values are lower than Ksat of Horizon B1. FIR over 10 mm/hr was observed only in Groups 1, 2 and 3.

Table 10.1 Final Infiltration Rate of Horizon B1

Soil Group	Mean Depth to Horizon B1 (mm)	No of Points	Final Infiltration Rate (mm/hr)						
			Avg.	Std.	Min.	Max.	Percentile		
							25	50	75
1	196	64	21.20	70.20	0.005	420.00	0.27	2.17	13.86
2	185	78	0.88	2.06	0.005	10.86	0.07	0.14	0.74
3	170	55	1.97	3.99	0.005	25.92	0.29	0.66	1.43
4	186	25	0.53	0.61	0.005	1.98	0.10	0.29	0.81
5	176	12	0.36	0.42	0.024	1.20	0.05	0.14	0.49
6	190	16	0.19	0.24	0.003	0.73	0.02	0.06	0.38

The averages of measured values of FIR for the soil groups are presented in Figure 10.1, with a comparison with Ksat of Horizons A, B1 and B2. The comparison indicates that Horizon B2 has similar Ksat to Horizon B1, while Ksat of Horizon A is generally one order of magnitude or more greater than Horizons B1 and B2. The averages of measured final infiltration rates for the soil groups are generally lower than Ksat of Horizons B1 and B2.

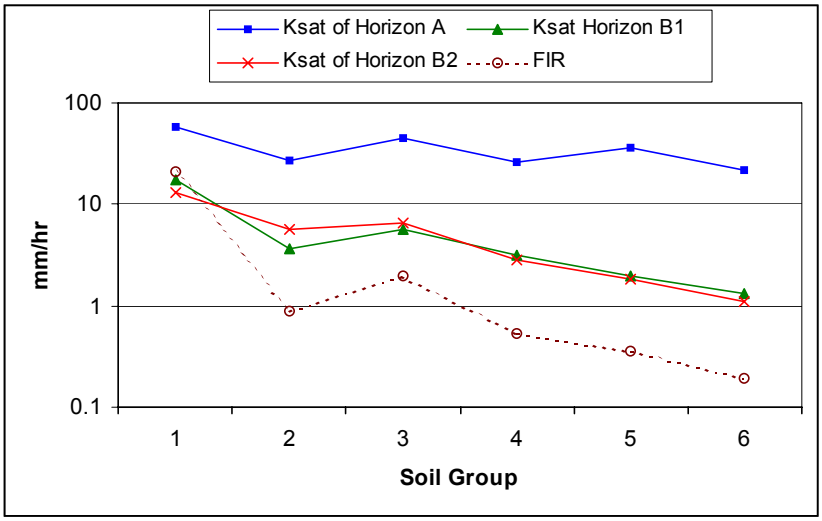

Figure 10.1 A Comparison of Average Ksat of Horizons A, B1 and B2, and FIR

10.2 FIR of Soil Groups

A box and whisker plot of FIR data of Horizon B1 is presented in Figure 10.2 to understand the source of within-group-variability of FIR. The distribution of FIR data of Groups 1, 2 and 3 is skewed due to a few very large values of FIR. Except for Group 1, the bands between upper and lower quartiles are relatively narrow to suggest that average values could be used as indicative values for the respective soils for practical applications. In comparison, Group 1 has a larger band between upper and lower quartiles, and therefore its average value is much less useful for practical applications. The FIR of Groups 4 and 5 was not found significantly different when their means were compared in a t-test. The same was found for Groups 5 and 6.

Table 10.2 Final Infiltration Rate of Horizon B1 of Irrigation Districts

Irrigation District	Soil Group	No of Points	Final Infiltration Rate (mm/hr)						
			Avg.	Std.	Min.	Max.	Percentile		
							25	50	75
MV	**1**	10	107.23	155.86	8.52	420.00	15.06	21.45	156.00
	2	18	0.89	2.44	0.01	10.56	0.02	0.15	0.78
	3	4	0.87	1.40	0.01	2.95	0.01	0.27	1.74
	4*	*	*	*	*	*	*	*	*
	5	1	1.14						
	6	8	0.19	0.19	0.00	0.46	0.02	0.12	0.38
GV	**1**	11	10.30	12.50	0.05	33.78	0.19	7.50	17.87
	2	52	0.81	2.02	0.01	10.86	0.08	0.13	0.47
	3	35	1.87	4.36	0.10	25.92	0.32	0.69	1.43
	4	20	0.37	0.53	0.01	1.92	0.09	0.16	0.36
	5	5	0.12	0.17	0.02	0.42	0.03	0.05	0.15
	6	4	0.37	0.36	0.05	0.73	0.07	0.36	0.68
RO	**1**	43	3.98	7.17	0.01	36.18	0.20	1.23	3.28
	2	8	1.29	1.50	0.08	3.92	0.18	0.41	2.57
	3	16	2.48	3.66	0.01	10.26	0.25	0.74	3.06
	4	5	1.18	0.51	0.70	1.98	0.77	1.16	1.44
	5	6	0.42	0.43	0.06	1.20	0.08	0.34	0.51
	6	4	0.03	0.02	0.01	0.05	0.01	0.03	0.05

Note: * No soil is defined under Group 4 of MV District in the existing soil maps

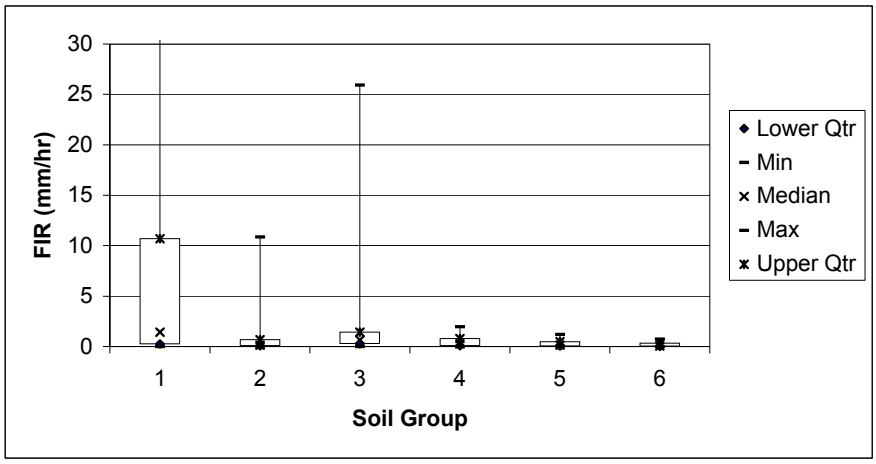

Figure 10.2 Final Infiltration Rate of Horizon B1 of Soil Groups

10.3 FIR of Soil Groups of Irrigation Districts

Table 10.2 shows FIR of Horizon B1 of soil groups of three irrigation districts. Average FIR values of Horizon B1 of soil groups of three districts are plotted in Figure 10.3. Similar to Ksat of Horizon B1, the average FIR value of Group 1 of MV District is significantly higher than the values of Group 1 of the other two districts. This is due to large percentage area of Sandmount sand soil in Group 1 of MV District, which contains more than 90% sand. Groups 2, 3 and 4 of RO District have the highest average FIR values for these soil groups among three districts.

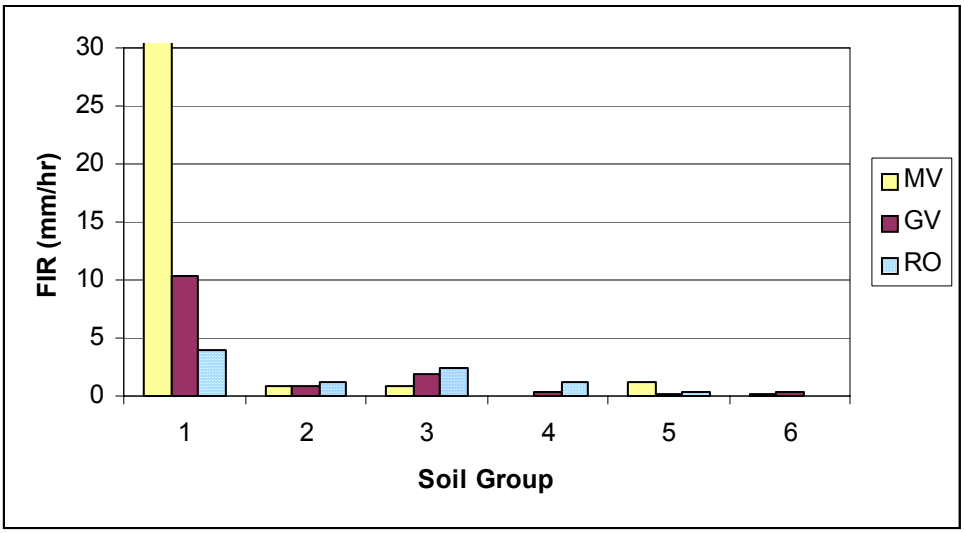

Figure 10.3 Average FIR of Soil Groups of Irrigation Districts

10.4 FIR of Soil Types

Table 10.4 shows FIR of Horizon B1 for 33 soil types of MV, GV, and RO Districts. Sandmount sand of Group 1 has the highest and Boosey loam friable phase of Group 6 has the lowest average FIR among all soil types. Soil types of Group 1 of the MV District have higher FIRs than soils of GV and RO Districts. Soils of Groups 3, 4 and 5 of RO District generally have higher FIRs than the soils of GV and MV Districts.

To understand the sources of the within-soil-group variability, FIR data of Horizon B1 of selected soil types are presented in Figure 10.4. The larger within-soil-group variability of FIR of Horizon B1 for Groups 1, 2 and 3 is due to both between-soil-type variability and within-soil-type variability. In Group 1, non duplex soils such as Ss and Ssp have significantly higher FIR values than duplex soil types. Group 1 can be subdivided into non-duplex soil such as Ss and Ssp and duplex soil types.

Table 10.4 Final Infiltration Rate of Horizon B1 of Soil Types

Irrigation District	Soil Group	Soil Type	No of Points	Final Infiltration Rate (mm/hr)						
				Avg.	Std.	Min.	Max.	Percentile		
								25	50	75
MV	1	Sandmount sand	4	244.1	176.7	40.32	420.0	98.16	258.0	390.0
	1	Sandmount sand phase	4	13.28	3.61	8.52	16.86	10.59	13.86	15.96
	1	Cobram sandy loam & Ss	2	21.45		20.9	22.0			
	2	Waaia loam	3	0.36	0.37	0.10	0.78	0.12	0.19	0.63
	2	Waaia loam phase	4	3.14	4.95	0.42	10.56	0.58	0.79	5.70
	2	Cobram loam	5	0.18	0.34	0.02	0.79	0.02	0.02	0.25
	2	Moira loam friable phase	6	0.25	0.43	0.01	1.09	0.01	0.04	0.33
	3	Moira loam	1	2.95						
	3	Naring loam	3	0.18	0.29	0.01	0.52	0.01	0.02	0.40
	5	Ulupna clay	1	1.14						
	6	Muckatah clay loam	3	0.32		0.17	0.46			
	6	Boosey loam friable phase	4	0.02	0.03	0.00	0.06	0.01	0.02	0.04
	6	Boosey loam	1	0.42						
GV	1	East Shepparton fine sandy loam	11	10.30	12.50	0.05	33.78	0.19	7.50	17.87
	2	Katamatite loam	4	3.99	3.80	1.63	9.60	1.66	2.36	6.31
	2	Shepparton fine sandy loam	48	0.54	1.61	0.01	10.86	0.07	0.13	0.33
	3	Lemnos loam friable phase	8	3.85	9.01	0.10	25.92	0.12	0.21	2.06
	3	Lemnos loam semi friable phase	4	0.64	0.56	0.18	1.44	0.25	0.47	1.03
	3	Lemnos loam	19	1.41	1.27	0.23	4.85	0.66	1.11	1.74
	3	Goulburn loam friable phase	4	1.27	1.25	0.49	3.12	0.52	0.74	2.02
	4	Goulburn loam	16	0.43	0.59	0.01	1.92	0.07	0.23	0.44
	4	Goulburn clay loam	4	0.14	0.03	0.10	0.17	0.12	0.14	0.16
	5	Congupna clay loam	5	0.12	0.17	0.02	0.42	0.03	0.05	0.15
	6	Congupna clay	4	0.37	0.36	0.05	0.73	0.07	0.36	0.68
RO	1	Nanneella fine sandy loam	43	3.98	7.17	0.01	36.18	0.20	1.23	3.28
	2	Timmering loam	8	1.29	1.50	0.08	3.92	0.18	0.41	2.57
	3	Wanalta loam	16	2.48	3.66	0.01	10.26	0.25	0.74	3.07
	4	Wana loam	1	1.98						
	4	Koyuga clay loam	2	1.21		1.16	1.26			
	4	Koga clay loam	2	0.75		0.70	0.79			
	5	Rochester clay	1	0.51						
	5	Alta clay loam	5	0.41	0.47	0.06	1.20	0.08	0.20	0.66
	6	Carag clay	4	0.03	0.02	0.01	0.05	0.01	0.03	0.05

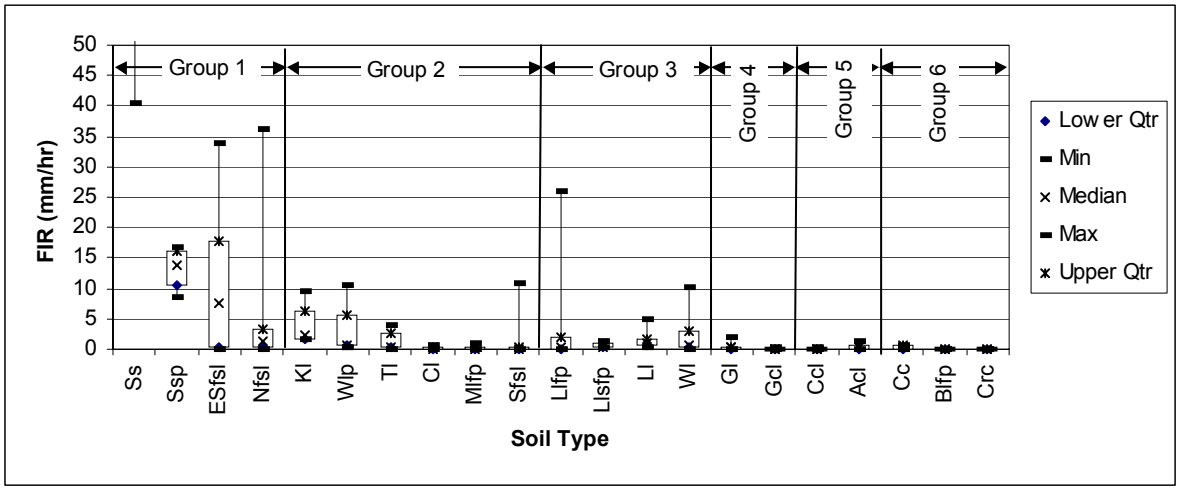

Figure 10.4 FIR of Horizon B1 of Selected Soil Types

10.5 FIR Variability within a Paddock

Figure 10.5 shows the distribution of FIR data of Horizon B1 within paddocks of selected soil types. The Mixed soil paddock has Csl, Mlfp, Wal and Nl soil types mapped and the other paddocks have only one soil type mapped. Except for Ll and Wl soil types, within paddock variability of FIR can explain more than half of observed within-soil-type variability. The Mixed paddock has a large variability of FIR due to diverse range of soil types. The maximum FIR of the Mixed paddock is associated with a soil type from Group 1. Except for the ESfsl soil type, the bands between upper and lower quartiles are relatively narrow, suggesting that the average values could be used as indicative values for the respective soils for practical applications.

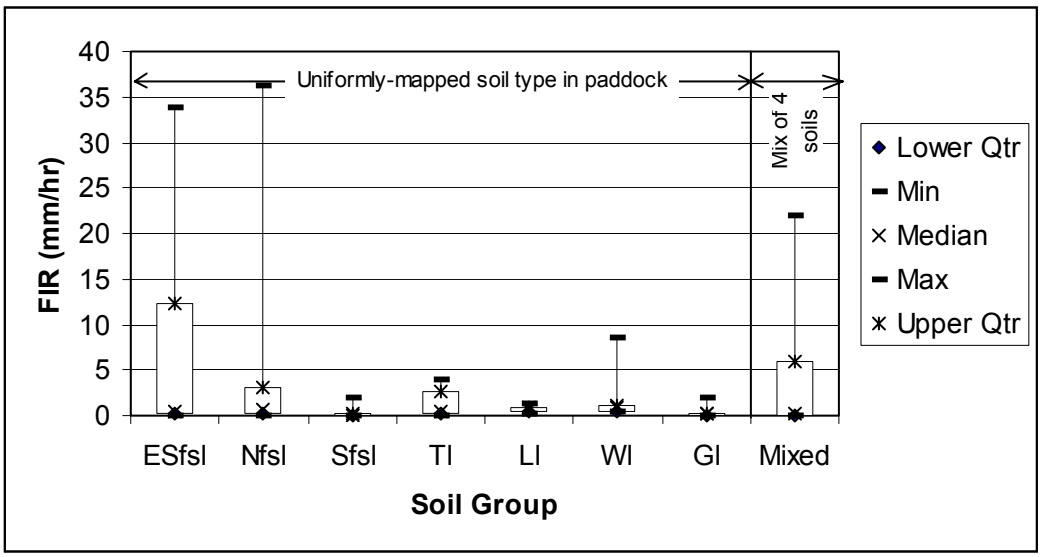

Figure 10.5 Paddock Scale Variability of FIR of Soil Types

Figure 10.6 shows within-paddock FIR variability of Nfsl soil type observed on 10 m x 20 m grid in a 70 m x 80 m paddock. It shows that FIR varies greatly within a paddock. The paddock has a few pockets of high FIR values. No particular spatial pattern can be observed in FIR data.

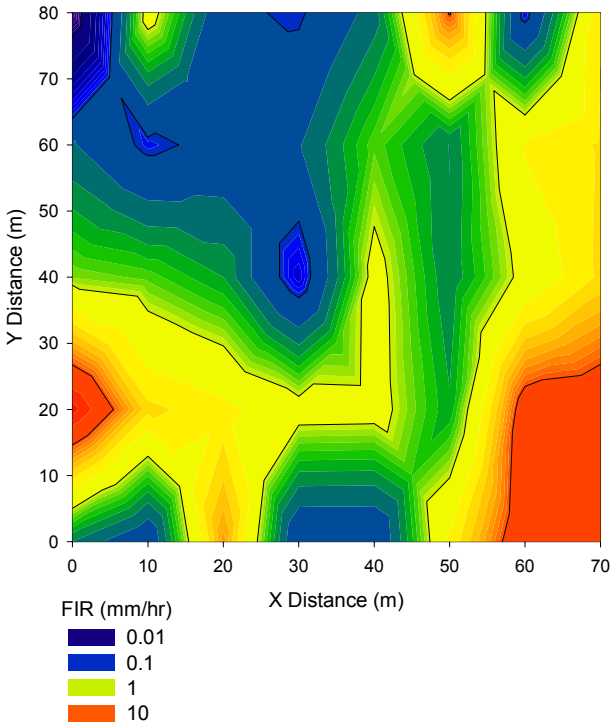

Figure 10.6 FIR of a Nfsl Soil within a Paddock

10.6 Conclusions

The final infiltration rate (FIR) of 33 soil types was measured at Horizon B1 across 69 sites in SIR.

The FIR of Horizon B1 is reasonably well defined for soil groups except for 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 for Group 2. However, Groups 4 and 5, and Groups 5 and 6 were not found statistically significantly different from each other.

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 longer time for water to penetrate down the soil profile more deeply.

Some spatial trends of FIR across irrigation districts have been found. Group 1 of MV District has the highest FIR among all irrigation districts because of the prevalence of Sandmount sand soil type. Groups 2, 3 and 4 appear to have higher FIR of Horizons B1 in RO District than other irrigation districts.