

6.3 Bulk Density

Soil bulk density of Horizons A and B1 was measured at 348 points across 79 sites. Results are summarised in Tables 6.10 and 6.11. Horizon A of Groups 1, 2 and 3 has larger standard deviation compared to Horizon B1. For Groups 1, 2 and 3, bulk density of Horizon A has larger variability within group compared to those of Horizon B1. Table 6.12 shows bulk density of soil types.

Table 6.10 Bulk Density of Horizon A

Soil Group	No. of Points	Bulk Density (g/cm ³)						
		Mean	Std.	Min.	Max.	Percentile		
						25	50	75
1	78	1.49	0.17	0.96	1.80	1.39	1.48	1.62
2	112	1.53	0.15	1.01	1.77	1.46	1.55	1.62
3	86	1.55	0.17	1.00	1.81	1.48	1.59	1.68
4	34	1.53	0.12	1.33	1.78	1.43	1.53	1.64
5	16	1.43	0.10	1.29	1.65	1.37	1.41	1.51
6	22	1.56	0.12	1.23	1.72	1.53	1.55	1.64

Table 6.11 Bulk Density of Horizon B1

Soil Group	No. of Points	Bulk Density (g/cm ³)						
		Mean	Std.	Min.	Max.	Percentile		
						25	50	75
1	78	1.69	0.09	1.46	1.93	1.63	1.69	1.74
2	112	1.64	0.09	1.44	1.95	1.58	1.63	1.68
3	85	1.62	0.12	1.29	1.94	1.56	1.62	1.71
4	34	1.61	0.12	1.42	1.91	1.52	1.60	1.66
5	16	1.51	0.09	1.41	1.69	1.44	1.47	1.59
6	22	1.60	0.12	1.41	1.86	1.52	1.59	1.65

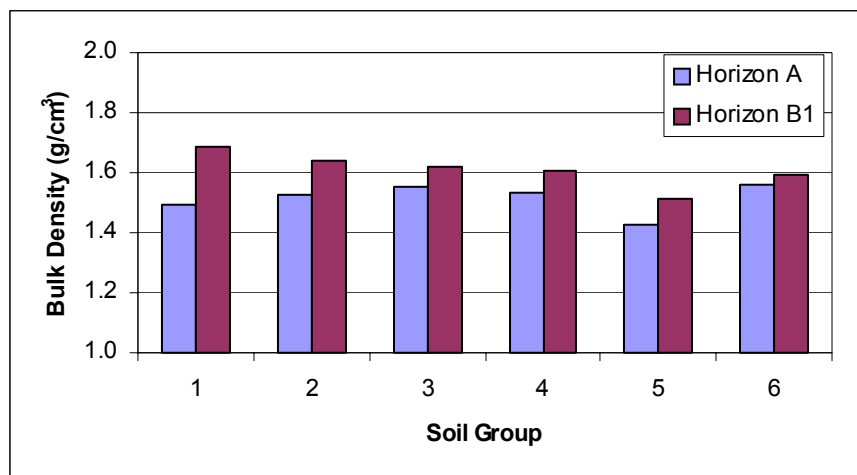


Figure 6.18 Bulk Density of Horizons A and B1

Table 6.12 Bulk Density of Soil Types

Irrigation District	Soil Group	Soil Type	No. of Points	Bulk Density (g/cm ³)													
				Horizon A						Horizon B1							
				Avg	Std.	Min	Max	Percentile			Avg	Std.	Min	Max	Percentile		
								25	50	75					25	50	75
MV	1	Sandmount sand	4	1.59	0.07	1.52	1.66	1.53	1.58	1.64	1.65	0.10	1.54	1.74	1.56	1.66	1.74
	1	Sandmount sand phase	4	1.71	0.05	1.67	1.79	1.67	1.70	1.75	1.83	0.07	1.73	1.88	1.79	1.85	1.86
	1	Cobram sandy loam & Ss	2	1.63		1.58	1.69				1.71		1.67	1.74			
	2	Waaia loam	10	1.57	0.13	1.26	1.74	1.53	1.59	1.61	1.60	0.07	1.49	1.69	1.56	1.58	1.67
	2	Waaia loam phase	4	1.33	0.05	1.26	1.37	1.30	1.35	1.37	1.64	0.04	1.60	1.70	1.61	1.63	1.67
	2	Cobram loam	12	1.58	0.12	1.31	1.75	1.54	1.58	1.65	1.69	0.10	1.55	1.84	1.62	1.66	1.77
	2	Moirira loam friable phase	10	1.65	0.08	1.49	1.76	1.61	1.66	1.71	1.59	0.07	1.44	1.66	1.57	1.61	1.63
	3	Moirira loam	2	1.64		1.55	1.73				1.73		1.62	1.84			
	3	Naring loam	8	1.68	0.07	1.57	1.77	1.64	1.67	1.73	1.66	0.13	1.42	1.84	1.59	1.68	1.74
	5	Ulupna clay	2	1.56		1.47	1.65				1.55		1.42	1.69			
	6	Muckatah clay loam	6	1.54	0.09	1.38	1.64	1.54	1.55	1.57	1.63	0.08	1.52	1.71	1.57	1.63	1.71
	6	Boosey loam friable phase	4	1.64	0.08	1.53	1.72	1.59	1.66	1.70	1.68	0.13	1.55	1.86	1.60	1.65	1.75
	6	Boosey loam	2	1.63		1.61	1.65				1.52		1.47	1.57			
GV	1	East Shepparton fine sandy loam	14	1.62	0.12	1.36	1.80	1.53	1.61	1.72	1.70	0.09	1.53	1.83	1.65	1.72	1.76
	2	Katamatite loam	4	1.62	0.12	1.44	1.70	1.54	1.66	1.69	1.84	0.14	1.64	1.95	1.74	1.89	1.94
	2	Shepparton fine sandy loam	14	1.53	0.12	1.01	1.76	1.49	1.53	1.57	1.64	0.06	1.51	1.81	1.59	1.63	1.67
	3	Lemnos loam friable phase	8	1.67	0.09	1.53	1.79	1.58	1.68	1.74	1.69	0.09	1.58	1.81	1.63	1.66	1.79
	3	Lemnos loam semi friable phase	4	1.61	0.03	1.58	1.64	1.60	1.62	1.63	1.66	0.12	1.49	1.73	1.60	1.72	1.73
	3	Lemnos loam	38	1.51	0.19	1.00	1.77	1.40	1.56	1.62	1.65	0.10	1.48	1.94	1.59	1.63	1.73
	3	Goulburn loam friable phase	4	1.75	0.06	1.68	1.81	1.71	1.76	1.80	1.57	0.03	1.52	1.60	1.55	1.58	1.59
	4	Goulburn loam	20	1.50	0.12	1.33	1.78	1.41	1.48	1.58	1.64	0.13	1.41	1.91	1.55	1.63	1.72
	4	Goulburn clay loam	4	1.65	0.01	1.64	1.66	1.64	1.65	1.66	1.69	0.05	1.63	1.74	1.65	1.70	1.74
	5	Congupna clay loam	6	1.52	0.02	1.48	1.53	1.50	1.52	1.53	1.68	0.07	1.63	1.79	1.64	1.66	1.73
	6	Congupna clay	4	1.40	0.07	1.32	1.51	1.36	1.38	1.45	1.58	0.08	1.47	1.67	1.53	1.59	1.65
RO	1	Nanneella fine sandy loam	54	1.43	0.16	0.96	1.80	1.37	1.44	1.50	1.68	0.08	1.46	1.93	1.63	1.68	1.72
	2	Timmering loam	18	1.43	0.18	1.09	1.77	1.28	1.44	1.58	1.62	0.10	1.48	1.81	1.55	1.59	1.68
	3	Wanalta loam	22	1.50	0.15	1.19	1.73	1.38	1.54	1.61	1.53	0.11	1.29	1.71	1.47	1.52	1.59
	4	Wana loam	2	1.40		1.34	1.45				1.50		1.47	1.52			
	4	Koyuga clay loam	4	1.64	0.10	1.51	1.74	1.57	1.66	1.72	1.50	0.05	1.43	1.55	1.46	1.51	1.54
	4	Koga clay loam	4	1.52	0.09	1.41	1.63	1.46	1.52	1.59	1.54	0.04	1.49	1.57	1.52	1.56	1.56
	5	Rochester clay	2	1.51		1.50	1.53				1.47		1.46	1.48			
	5	Alta clay loam	6	1.38	0.08	1.29	1.51	1.30	1.38	1.43	1.45	0.03	1.41	1.51	1.43	1.44	1.46
	6	Wallenjoe clay	2	1.42		1.23	1.61				1.49		1.41	1.57			
	6	Carag clay	4	1.58	0.16	1.36	1.72	1.45	1.61	1.70	1.47	0.06	1.41	1.56	1.42	1.45	1.51

Figure 6.18 shows average bulk densities of Horizons A and B1. Group 5 has the lowest average bulk density of Horizon A. Except for Group 6, the average bulk density of Horizon B1 shows a decreasing trend with soil group. Horizon B1 has higher average bulk density than Horizon A.

6.4 Soil Electrical Conductivity (EC)

The soil EC of Horizons A and B1 was measured in a 1:5 soil water suspension at 261 points across 79 sites. Results are summarised in Tables 6.13 and 6.14. Group 5 has the highest EC of both Horizons A and B1 among soil groups. The EC of Horizon A is similar to that of Horizon B1 for all soil groups except Group 1.

Table 6.13 EC of Horizon A

Soil Group	No. of Points	Electrical Conductivity (dS/m)						
		Average	Std	Min	Max	Percentile		
						25	50	75
1	65	0.14	0.08	<0.05	0.45	0.10	0.13	0.16
2	84	0.14	0.13	<0.05	0.98	0.09	0.12	0.16
3	57	0.18	0.16	<0.05	0.72	0.08	0.13	0.22
4	26	0.16	0.16	<0.05	0.73	0.07	0.11	0.21
5	12	0.29	0.16	0.10	0.64	0.19	0.22	0.42
6	17	0.09	0.04	<0.05	0.21	0.08	0.08	0.11

Table 6.14 EC of Horizon B1

Soil Group	No. of Points	Electrical Conductivity (dS/m)						
		Average	Std	Min	Max	Percentile		
						25	50	75
1	65	0.09	0.04	<0.05	0.30	0.07	0.08	0.10
2	84	0.14	0.13	<0.05	0.84	0.08	0.10	0.15
3	57	0.16	0.18	<0.05	1.10	0.07	0.10	0.21
4	26	0.16	0.15	<0.05	0.52	0.06	0.08	0.26
5	12	0.28	0.17	0.09	0.64	0.14	0.24	0.35
6	17	0.09	0.05	<0.05	0.21	0.06	0.07	0.10

6.5 Soil pH

Soil pH of Horizons A and B1 was measured in 1:5 soil water suspension at 261 points across 79 sites. Results are summarised in Tables 6.15 and 6.16. In all soil groups, Horizon B1 has higher average pH than Horizon A. Group 5 has the highest average pH among soil groups and Group 6 has the lowest average pH among soil groups.

Table 6.15 pH of Horizon A

Soil Group	No. of Points	pH (H ₂ O)						
		Average	Std	Min	Max	Percentile		
						25	50	75
1	65	6.25	1.01	5.20	9.00	5.60	5.80	6.70
2	84	6.20	0.66	5.00	8.40	5.90	6.00	6.25
3	57	6.34	0.80	4.70	8.60	5.78	6.40	6.80
4	26	6.25	0.72	5.40	8.40	5.80	6.10	6.40
5	12	6.83	0.44	6.00	7.80	6.55	6.85	7.05
6	17	6.05	0.66	5.40	7.60	5.58	5.80	6.40

Table 6.16 pH of Horizon B1

Soil Group	No. of Points	pH (H ₂ O)						
		Average	Std	Min	Max	Percentile		
						25	50	75
1	65	7.02	0.86	5.20	8.80	6.60	6.90	7.35
2	84	7.03	0.68	6.00	8.80	6.50	6.85	7.50
3	57	7.18	0.73	5.80	9.10	6.70	7.10	7.53
4	26	7.07	0.49	6.20	8.00	6.70	6.95	7.50
5	12	7.51	0.42	6.30	7.90	7.45	7.65	7.70
6	17	6.98	0.60	6.10	8.00	6.35	7.10	7.23

6.6 Organic Matter

Soil organic matter content of Horizons A and B1 was measured at 261 points across 79 sites. Results are summarised in Tables 6.17 and 6.18. In all soil groups, Horizon A has higher average organic matter than Horizon B1. Except Group 5, organic matter content of Horizon A showed a decreasing trend with soil groups.

Table 6.17 Organic Matter of Horizon A

Soil Group	No. of Points	Organic Matter (%)						
		Average	Std	Min	Max	Percentile		
						25	50	75
1	65	6.0	3.1	1.3	12.0	2.9	6.8	8.4
2	84	5.1	1.3	1.9	8.4	4.4	5.1	6.1
3	57	4.3	1.5	2.1	8.2	3.1	4.0	5.1
4	26	4.3	0.9	2.5	6.7	3.4	4.3	4.8
5	12	5.1	1.6	2.5	8.0	4.1	5.3	6.1
6	17	3.7	1.4	1.4	6.5	2.8	3.8	4.3

Table 6.18 Organic Matter of Horizon B1

Soil Group	No. of Points	Organic Matter (%)						
		Average	Std	Min	Max	Percentile		
						25	50	75
1	65	2.3	0.8	0.6	3.8	1.9	2.5	2.7
2	84	2.6	0.7	1.1	4.2	2.1	2.6	3.1
3	57	2.0	0.5	1.1	3.8	1.7	1.9	2.4
4	26	2.0	0.9	1.0	5.0	1.5	1.9	2.1
5	12	1.9	0.4	1.3	2.5	1.7	1.8	2.2
6	17	1.7	0.7	0.7	3.3	1.3	1.6	2.2

6.7 Exchangeable Cations

(1) Calcium (Ca)

Soil exchangeable calcium (Ca) of Horizons A and B1 was measured at 261 points across 79 sites. Results are summarised in Tables 6.19 and 6.20. Group 5 has the highest average exchangeable Ca among soil groups.

Table 6.19 Ca of Horizon A

Soil Group	No. of Points	Exchangeable Ca (meq/100g)						
		Average	Std	Min	Max	Percentile		
						25	50	75
1	65	5.9	2.1	1.0	11.0	4.1	6.5	7.4
2	84	5.8	1.6	3.2	12.0	4.7	5.7	6.2
3	57	6.0	2.7	3.1	18.0	4.0	5.4	7.3
4	26	5.9	2.1	3.1	13.0	4.6	5.6	6.5
5	12	9.7	2.5	5.9	15.0	7.8	9.5	11.5
6	17	5.9	2.9	3.8	16.0	4.3	5.2	6.2

Table 6.20 Ca of Horizon B1

Soil Group	No. of Points	Exchangeable Ca (meq/100g)						
		Average	Std	Min	Max	Percentile		
						25	50	75
1	65	5.3	2.3	0.7	10.0	3.5	5.8	7.0
2	84	5.8	2.3	2.0	17.0	4.4	5.6	6.8
3	57	5.8	2.7	1.9	18.0	4.2	5.4	6.8
4	26	6.4	2.9	2.6	17.0	4.2	6.3	7.4
5	12	8.8	2.6	3.4	14.0	7.5	9.1	9.7
6	17	6.3	3.1	2.8	15.0	3.2	6.5	7.5

(2) Magnesium (Mg)

Soil exchangeable Mg of Horizons A and B1 was measured at 261 points across 79 sites. Results are summarised in Tables 6.21 and 6.22. Group 5 has the highest average exchangeable Mg among soil groups. Horizon B1 has higher average exchangeable Mg of soil group than Horizon A.

Table 6.21 Mg of Horizon A

Soil Group	No. of Points	Exchangeable Mg (meq/100g)						
		Average	Std	Min	Max	Percentile		
						25	50	75
1	65	3.5	1.3	0.2	5.6	2.9	3.7	4.3
2	84	3.4	1.3	0.9	9.1	2.8	3.4	3.9
3	57	3.8	2.1	0.9	8.7	2.1	3.1	5.3
4	26	3.1	1.5	0.6	6.5	2.0	3.0	4.2
5	12	7.0	1.3	5.0	10.0	6.4	6.9	7.6
6	17	3.4	2.2	1.0	8.6	1.8	3.2	4.0

Table 6.22 Mg of Horizon B1

Soil Group	No. of Points	Exchangeable Mg (meq/100g)						
		Average	Std	Min	Max	Percentile		
						25	50	75
1	65	3.5	1.6	0.1	6.5	2.2	3.8	4.5
2	84	4.3	1.7	1.1	8.7	3.0	4.2	5.4
3	57	5.6	2.5	1.5	10.0	3.5	5.0	7.6
4	26	5.0	2.7	1.4	13.0	3.5	4.6	5.9
5	12	8.9	3.0	3.7	13.0	6.4	9.8	11.5
6	17	6.0	3.2	1.3	11.0	3.2	5.0	9.8

(3) Sodium (Na)

Soil exchangeable Na of Horizons A and B1 was measured at 261 points across 79 sites. Results are summarised in Tables 6.23 and 6.24. Group 5 has the highest average exchangeable Na among soil groups. In each soil group, Horizon B1 has higher average exchangeable Na than Horizon A.

Table 6.23 Na of Horizon A

Soil Group	No. of Points	Exchangeable Na (meq/100g)						
		Average	Std	Min	Max	Percentile		
						25	50	75
1	65	0.6	0.5	0.0	3.4	0.4	0.5	0.7
2	84	0.9	0.6	0.1	4.4	0.5	0.8	1.0
3	57	0.8	0.8	0.1	4.6	0.3	0.6	1.1
4	26	0.7	1.0	0.1	4.2	0.2	0.3	0.8
5	12	1.3	0.6	0.5	2.4	0.8	1.4	1.8
6	17	0.5	0.3	0.1	1.5	0.4	0.5	0.6

Table 6.24 Na of Horizon B1

Soil Group	No. of Points	Exchangeable Na (meq/100g)						
		Average	Std	Min	Max	Percentile		
						25	50	75
1	65	0.7	0.4	0.0	2.3	0.4	0.6	0.8
2	84	1.3	0.9	0.2	5.6	0.8	1.1	1.5
3	57	1.3	1.0	0.2	4.8	0.6	1.1	1.8
4	26	1.2	1.1	0.2	4.0	0.5	0.8	1.4
5	12	2.4	1.4	0.7	4.3	1.1	2.3	3.7
6	17	1.0	0.7	0.2	2.6	0.5	1.0	1.2

(4) Potassium (K)

Soil exchangeable K of Horizons A and B1 was measured at 261 points across 79 sites. Results are summarised in Tables 6.25 and 6.26. Group 5 has the highest average exchangeable K among soil groups.

Table 6.25 K of Horizon A

Soil Group	No. of Points	Exchangeable K (meq/100g)						
		Average	Std	Min	Max	Percentile		
						25	50	75
1	65	0.6	0.4	0.1	2.1	0.3	0.6	0.9
2	84	0.5	0.5	0.1	2.2	0.2	0.3	0.4
3	57	0.6	0.4	0.1	1.6	0.3	0.4	0.9
4	26	0.7	0.4	0.2	1.4	0.4	0.6	0.9
5	12	1.0	0.3	0.4	1.4	0.9	1.0	1.3
6	17	0.6	0.7	0.2	2.9	0.2	0.4	0.7

Table 6.26 K of Horizon B1

Soil Group	No. of Points	Exchangeable K (meq/100g)						
		Average	Std	Min	Max	Percentile		
						25	50	75
1	65	0.5	0.3	0.1	1.5	0.3	0.4	0.6
2	84	0.6	0.5	0.1	2.8	0.3	0.4	0.7
3	57	0.7	0.4	0.1	1.4	0.4	0.7	1.0
4	26	0.6	0.3	0.2	1.4	0.4	0.5	0.8
5	12	1.4	0.7	0.2	2.6	0.9	1.4	1.9
6	17	0.7	0.5	0.2	2.2	0.4	0.5	1.0

(5) Exchangeable Sodium Percentage (ESP)

ESP was determined by dividing exchangeable Na by the sum of the four cations (Ca, Mg, Na and K). Soil ESP of Horizons A and B1 was calculated for 261 points. Results are summarised in Tables 6.27 and 6.28. Group 2 has the highest average ESP of Horizon A and Group 5 has the highest average ESP of Horizon B1. In all soil groups, Horizon B1 has higher average ESP than Horizon A.

Table 6.27 ESP of Horizon A

Soil Group	No. of Points	ESP (%)						
		Average	Std	Min	Max	Percentile		
						25	50	75
1	65	6.2	5.3	1.3	31.3	3.5	4.5	6.0
2	84	7.9	3.6	2.0	22.3	6.0	8.1	9.3
3	57	6.9	4.7	1.5	25.5	3.6	5.6	8.6
4	26	6.1	5.6	0.5	23.0	2.0	4.1	7.8
5	12	7.1	3.4	2.9	13.6	4.3	7.3	9.2
6	17	5.1	1.8	1.8	7.6	3.8	5.8	6.5

Table 6.28 ESP of Horizon B1

Soil Group	No. of Points	ESP (%)						
		Average	Std	Min	Max	Percentile		
						25	50	75
1	65	7.2	5.7	1.6	32.8	4.4	5.6	7.6
2	84	10.6	5.2	1.5	28.8	7.9	10.1	11.8
3	57	9.9	5.8	2.4	28.2	4.8	8.5	13.2
4	26	8.3	5.8	2.0	26.0	4.9	6.6	11.0
5	12	10.7	5.0	3.9	17.2	5.9	11.4	15.7
6	17	7.0	2.3	2.1	11.1	5.9	7.1	8.2