Summary of the Resource Condition Monitoring drilling in the Northern Perth Basin

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Introduction

The aim of the Resource Condition Monitoring (RCM) project in the Northern Agricultural Region (NAR) was to establish representative groundwater monitoring sites at a Soil Landscape Zone (SLZ) level.

The Northern Perth Basin occupies most of the western half of the NAR covering an area of about 2.5 million ha. It stretches about 450 km north-south in the NAR and is up to 90 km in east-west width. It is bounded by the Darling Fault along its eastern margin and the Indian Ocean along its western margin except north of Geraldton where it is bounded to the west by the Northampton Block. The northern boundary is the uncleared pastoral country and the southern boundary coincides with the southern boundary of the Shire of Gingin.

To achieve the aim of the RCM project, drilling was only required in 8 of the 13 Soil Landscape Zones covering the Northern Perth Basin in the NAR.

Site description

The climate is typical of a warm temperate to semi-arid region with dominantly winter rainfall and hot dry summers. Rainfall decreases from south to north. The long term average rainfall at Gingin in the south of the region is 730 mm however the annual average this century is 595 mm. The long term average rainfall at Balla in the north of the region is 308 mm however the annual average this century is 230 mm (SILO 2008).

The study area in the Northern Perth Basin is spread over parts of four drainage basins. In the south it overlaps a small part of the Swan Coastal Basin (Basin 616). In central areas the Northern Perth Basin substantially overlaps the Moore – Hill Rivers Basin (Basin 617) and Greenough River Basin (Basin 701). In the north it partly overlaps the Murchison River Basin (Basin 702). The Northern Perth Basin is drained by the Moore, Hill, Arrowsmith, Irwin, Greenough and Murchison Rivers.

The study area is comprised of 8 Soil Landscape Zones in the Northern Perth Basin. In the NAR most of the Dandaragan Plateau Zone (222) and the entire extent of the Arrowsmith Zone (224), Lockier Zone (226) and Southern Victoria Sandplain Zone (220) occur in the midst of the Northern Perth Basin. The entire mapped extent of the Tenindewa Zone (227) and Victoria Plateau Zone (223) and parts of the Chapman Zone (225) and Victoria Red Sandplain Zone (234) occur in the north of the Northern Perth Basin.

The Southern Victoria Sandplain Zone (220) is gently undulating, weakly dissected sandplain with yellow deep sands, pale deep sands over gravel and minor areas of lateritic duricrust (Schoknecht et al 2004).

The Dandaragan Plateau Zone (222) is moderately dissected lateritic plateau and sandplain with pale deep sand (often gravelly), yellow deep sand, deep sand, gravel and duplex sandy gravel (ibid).

The Victoria Plateau Zone (223) is weakly dissected sandplain with dune ridges and yellow deep sands with some red deep sands and red-brown hardpan shallow loams (ibid).

The Arrowsmith Zone (224) is dissected lateritic terrain with hills, breakaways and plateau and sandplain remnants and pale deep sand (often gravelly), yellow deep sand, deep sandy gravel and grey deep sandy duplex (ibid).

The Chapman Zone (225) is dissected lateritic terrain (with hills, sandplains, breakaways and plateaux) and red shallow loamy and sandy duplexes, yellow deep sands, red loamy earths, red shallow loams and yellow/brown sandy duplexes (ibid).

The Lockier Zone (226) is dissected lateritic terrain with hills, breakaways and plateau remnants and hard cracking clay, red shallow loamy duplex (often alkaline), red loam (often with red-brown hardpan), yellow deep sand and calcareous loamy earth (ibid).

The Tenindewa Zone (227) is alluvial valley slopes and sandplain remnants with relict hardpan wash plains and yellow deep sands and red-brown hardpan shallow loams with some yellow sandy earths and red sandy earths (ibid).

The Victoria Red Sandplain Zone (234) is sandplains (with occasional dunes) and red deep sands (ibid).

The Northern Perth Basin is a deep trough containing thousands of metres of Mesozoic sediments. Significant and regional aquifers containing vast resources of good quality water are present in the Yarragadee and overlying Parmelia Formations.

Methodology

Drilling in the Northern Perth Basin was carried out between October 2007 and May 2008. Fifty four piezometers and 36 observation bores were installed at 54 sites.

Drill site selection was based on establishing representative groundwater monitoring sites at a SLZ level and access for the rig. Drill site locations are shown in Figure 1.

Drilling was carried out by Drilling & Grouting Services using a reverse circulation air-core drilling rig, Smithdrill using a mud-rotary drilling rig and Wheatbelt Water Drillers using a rotary air-blast drilling rig.

Bores were constructed with 50 mm diameter class 12 PVC casing with class 18 PVC end caps. The casing intake sections are machine slotted. All of the bores were

constructed with 2 m slotted intake sections over the lowest part of the casing except for the piezometer 08SV2D which has a 6 m slotted intake section and the piezometers 08DP27D and 08DP28D which both have 3 m slotted intake sections.

The annulus around the slotted intake section was packed with 8-16 gravel (about 1.6 to 3.2 mm diameter). Bentonite pellets were used to seal the annulus above the slotted intake section in every piezometer. The annulus of all piezometers and observation bores were back-filled to ground surface with 8-16 gravel or drill cuttings.

Bore tube tops were cut off at about 0.5 m above the ground surface. A one metre long lockable steel collar with 100 mm diameter was placed over the bore tube top and pushed about halfway into the ground to provide protective headworks. The headworks were set in concrete.

All bores were cleaned and developed by airlift after construction and removal of the rig.

Bore construction details are listed in Table 1.

Drill samples were collected over one metre intervals during drilling. Samples were oven dried at 60^{o} C and chip trays were and will be prepared for storage at the Geraldton office of the Department of Agriculture and Food.

Locations (Eastings and Northings) of the groundwater monitoring sites were measured with a global positioning system (GPS) and are listed in Table 1. The map zone is Zone 50.

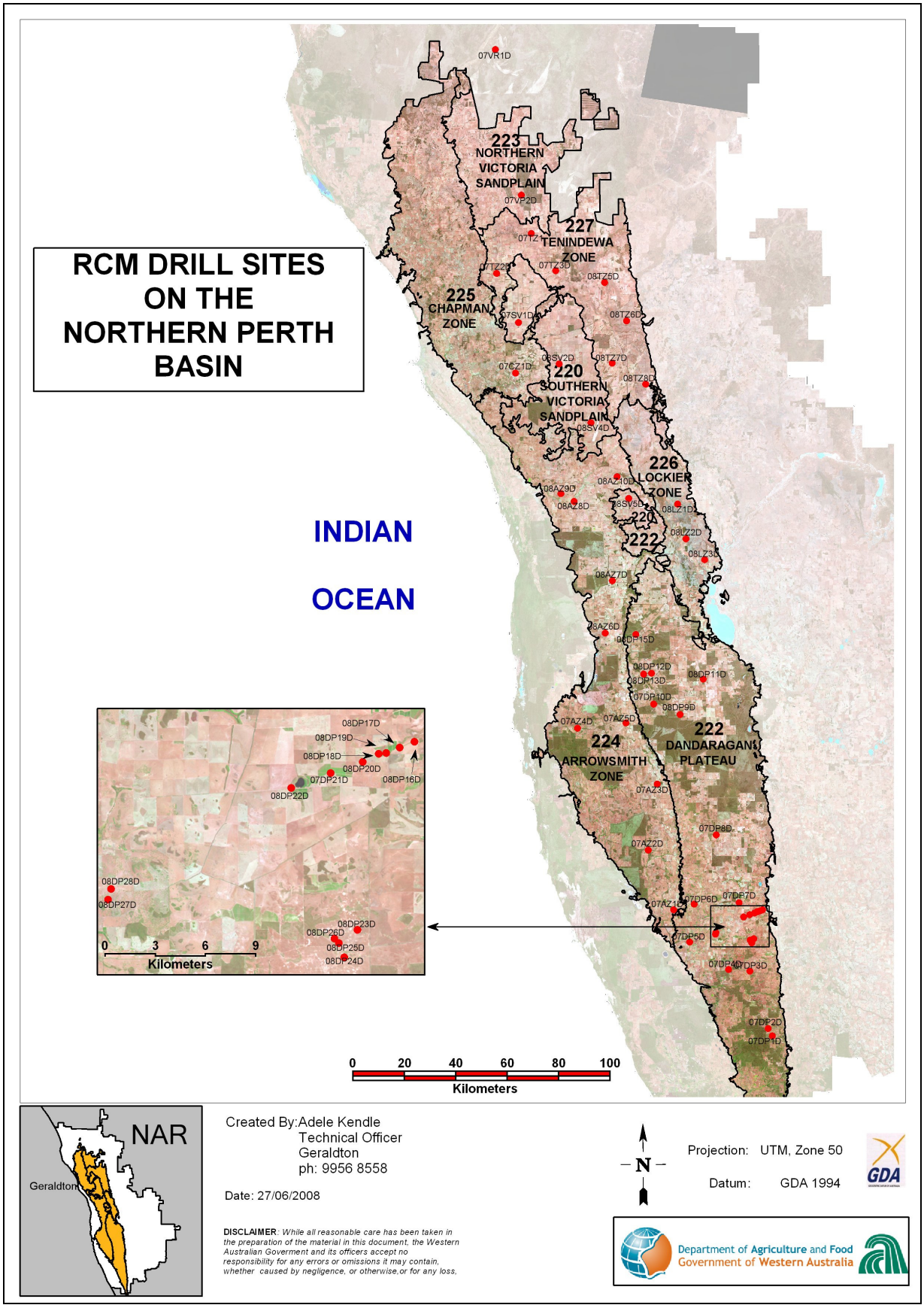

Figure 1. RCM drill site locations in the Northern Perth Basin.

Table 1. Drill site locations, bore construction details and groundwater depth and electrical conductivity.

Bore ID	SLZ	Easting (mE)	Northing (mN)	Total depth below ground (m)	Tube top above ground (m)	Groundwater depth below surface (m)	Electrical conductivity (mS/m)
07VR1D	234	296771	6935817	101.54	0.60	69.57 29-Nov-07	1299 29-Nov-07
07CZ1D	225	304611	6810144	92.73	0.42	67.84 20-Nov-07	339 20-Nov-07
07CZ1OB				14.99	0.48	dry 20-Nov-07	dry
07SV1D	220	305756	6829761	101.62	0.52	53.90 12-Nov-07	423 12-Nov-07
07SV1OB				31.05	0.49	dry 12-Nov-07	dry
08SV2D	220	321595	6813727	71.21	0.55	dry 12-Mar-08	dry
08SV4D	220	333963	6790818	71.30	0.50	67.75 12-Mar-08	237 12-Mar-08
08SV5D	220	348649	6761437	96.20	0.55	80.45 12-Mar-08	178 12-Mar-08
07TZ1	227	310728	6864359	101.89	0.61	87.99 20-Nov-07	843 20-Nov-07
07TZ2D	227	297263	6848872	71.00	0.59	7.12 9-Jan-08	723 20-Nov-07
07TZ2OB				4.90	0.59	1.01 20-Nov-07	201 20-Nov-07
07TZ3D	227	320252	6849889	49.77	0.61	13.61 20-Nov-07	1901 20-Nov-07
07TZ3OB				16.91	0.63	13.86 20-Nov-07	3810 20-Nov-07
08TZ5D	227	339276	6845324	58.34	0.62	46.7 6-Jun-08	493 23-Jun-08
08TZ5OB				7.75	0.65	dry 6-Jun-08	dry
08TZ6D	227	347820	6830399	59.87	0.60	25.91 6-Jun-08	3430 25-Jun-08
08TZ6OB1				24.59	0.57	10.7 6-Jun-08	4680 25-Jun-08
08TZ6OB2				8.81	0.68	dry 6-Jun-08	dry
08TZ7D	227	342232	6814012	29.76	0.58	3.56 6-Jun-08	4130 25-Jun-08
08TZ7OB				13.70	0.60	3.63 6-Jun-08	2880 25-Jun-08
08TZ8D	227	355267	6805841	29.77	0.51	22.81 6-Jun-08	4380 25-Jun-08
08TZ8OB				11.55	0.53	7.69 6-Jun-08	4390 25-Jun-08
08LZ1D	226	367698	6759244	44.19	0.53	4.83 6-Jun-08	2530 23-Jun-08
08LZ1OB				3.69	0.61	dry 6-Jun-08	dry
08LZ2D	226	370940	6745735	40.70	0.45	14.75 6-Jun-08	496 23-Jun-08
08LZ2OB				16.22	0.52	dry 6-Jun-08	1295 23-Jun-08
08LZ3D	226	378199	6737667	59.87	0.52	10.08 6-Jun-08	4230 23-Jun-08
07VP2D	223	306892	6879253	99.66	0.60	69.03 20-Nov-07	662 20-Nov-07
07AZ1D	224	366156	6601648	99.06	0.55	53.95 6-Mar-08	256 6-Mar-08
07AZ2D	224	356270	6624836	96.25	0.50	75.61 14-Apr-2008	111 14-apr-08
07AZ3D	224	359754	6650492	71.37	0.50	dry 4-Jan-08	dry
07AZ4D	224	328765	6672191	118.90	0.60	40.33 7-Mar-08	358 7-Mar-08
07AZ4OB				11.40	0.60	1.92 7-Mar-08	2520 7-Mar-08
07AZ5D	224	347576	6674238	41.23	0.50	dry 6-Mar-08	dry
07AZ5OB				10.44	0.50	dry 6-Mar-08	dry
08AZ6D	224	339525	6709152	101.25	0.50	69.62 8-Mar-08	158 8-Mar-08
08AZ6OB				14.09	0.57	11.46 8-Mar-08	115 8-Mar-08
08AZ7D	224	342305	6729468	100.30	0.50	47.06 12-Mar-08	148 12-Mar-08
08AZ7OB				24.23	0.50	dry 12-Mar-08	dry
08AZ8D	224	327407	6760253	41.25	0.50	2.39 12-Mar-08	230 12-Mar-08
08AZ9D	224	322281	6763325	41.25	0.55	35.56 12-Mar-08	316 12-Mar-08
08AZ9OB				9.90	0.45	dry 12-Mar-08	dry
08AZ10D	224	344118	6769882	41.25	0.55	37.67 12-Mar-08	333 12-Mar-08
08AZ10OB				9.59	0.55	dry 12-Mar-08	dry
07DP1D	222	404551	6552665	40.41	0.55	2.95 5-Mar-08	167 5-Mar-08
07DP1OB				5.43	0.65	3.21 5-Mar-08	286 5-Mar-08
07DP2D	222	402918	6555517	41.55	0.60	2.91 5-Mar-08	80 5-Mar-08
07DP2OB				6.60	0.60	2.83 5-Mar-08	79 5-Mar-08
07DP3D	222	395811	6577839	33.99	0.55	5.16 5-Mar-08	244 5-Mar-08
07DP3OB				5.54	0.50	5.48 5-Mar-08	6 5-Mar-08
07DP4D	222	387503	6578461	40.14	0.60	4.16 5-Mar-08	98 5-Mar-08
07DP5D	222	372383	6589146	29.25	0.30	16.75 16-Jan-08	462 25-Jun-8
07DP6D	222	374137	6603856	25.33	0.55	2.34 9-Apr-08	1223 25-Jun-08
07DP6OB				6.12	0.55	2.36 9-Apr-08	761 25-Jun-08
07DP7D	222	391598	6604416	35.52	0.45	17.97 6-Mar-08	148 6-Mar-08
07DP7OB				12.27	0.45	dry 6-Mar-08	dry
07DP8D	222	382732	6630733	35.10	0.55	0.79 6-Mar-08	234 6-Mar-08
07DP8OB				6.08	0.55	1.29 6-Mar-08	165 6-Mar-08
08DP9D	222	368650	6677518	57.96	0.50	32.47 8-Mar-08	106 8-Mar-08
07DP10D	222	358377	6681543	41.55	0.50	31.83 7-Mar-08	163 7-Mar-08
08DP11D	222	377657	6691267	71.42	0.60	27.98 7-Mar-08	150 7-Mar-08
08DP11OB				9.66	0.60	dry 7-Mar-08	dry
08DP12D	222	357513	6693550	41.49	0.55	11.43 7-Mar-08	26 7-Mar-08
08DP13D	222	354470	6693182	41.39	0.50	4.73 7-Mar-08	440 7-Mar-08
08DP15D	222	351419	6708602	101.21	0.60	18.04 8-Mar-08	102 8-Mar-08

Bore ID	SLZ	Easting (mE)	Northing (mN)	Total depth below ground (m)	Tube top above ground (m)	Groundwater depth below surface (m)	Electrical conductivity (mS/m)
08DP15OB				28.20	0.60	17.78 8-Mar-08	183 8-Mar-08
08DP16D	222	400741	6601629	75.05	0.60	13.54 24-Apr-08	255 7-May-08
08DP16OB				15.40	0.62	1.51 24-Apr-08	127 7-May-08
08DP17D	222	399858	6601282	77.33	0.48	17.54 24-Apr-08	201 7-May-08
08DP17OB				6.27	0.55	0.72 24-Apr-08	104 7May-08
08DP18D	222	399053	6600955	60.09	0.60	22.28 29-Apr-08	156 7-May-08
08DP18OB				7.99	0.55	6.88 29-Apr-08	128 7-May-08
08DP19D	222	398603	6600910	60.04	0.55	39.67 30-Apr-08	1454 25-Jun-08
08DP19OB				5.22	0.57	3.66 30-Apr-08	73 7-May-08
08DP20D	222	397648	6600422	60.03	0.58	9.98 30-Apr-08	664 25-Jun-08
08DP20OB				7.96	0.60	4.25 30-Apr-08	205 25-Jun-08
08DP21D	222	395729	6599757	101.33	0.55	7.32 28-Apr-08	124 7-May-08
08DP21OB				9.79	0.50	6.53 28-Apr-08	32 7-May-08
08DP22D	222	393369	6598868	60.18	0.55	16.9 30-Apr-08	180 7-May-08
08DP22OB				14.75	0.43	7.14 30-Apr-08	95 7-May-08
08DP23D	222	397333	6590393	18.02	0.54	dry 30-Apr-08	dry
08DP23OB				4.13	0.58	dry 30-Apr-08	dry
08DP24D	222	396541	6588755	18.65	0.60	dry 1-May-08	dry
08DP24OB				6.93	0.55	dry 1-May-08	dry
08DP25D	222	396217	6589603	20.08	0.55	8.56 1-May-08	262 10-Jun-08
08DP25OB				3.95	0.58	dry 1-May-08	dry
08DP26D	222	395955	6589871	18.25	0.55	6.61 10-jun-08	201 10-Jun-08
08DP26OB				3.75	0.55	dry 10-jun-08	dry
08DP27D	222	382409	6592199	131.18	0.65	73.53 10-jun-08	176 10-Jun-08
08DP28D	222	382592	6592836	128.16	0.65	96.35 10-jun-08	143 10-Jun-08

Results

The initial measurements of depth to groundwater and electrical conductivity of groundwater samples are listed in Table 1.

References

Schoknecht, N., Tille, P., and Purdie, B. (2004) *Soil-landscape mapping in South-Western Australia*, Department of agriculture and Food Western Australia, Resource Management Technical Report 280.

SILO Patch Point Dataset (accessed 2008). Queensland Department of Natural Resources and Mines.