COAL & ALLIED

Managed by Rio Tinto Coal Australia

Appendix 1

2016 Complaints Summary

Mount Thorley Warkworth Complaints 2016

Type	Date	Time	Method	Location
Noise	1/01/2016	12:18 AM	hotline	Bulga
Noise	1/01/2016	1:37 AM	hotline	Bulga
Noise	1/01/2016	2:23 AM	hotline	Bulga
Noise	1/01/2016	7:38 AM	hotline	Bulga
Noise	1/01/2016	7:44 AM	hotline	Bulga
Noise	1/01/2016	7:52 AM	hotline	Bulga
Blast	4/01/2016	11:09 AM	hotline	Bulga
Noise	4/01/2016	9:13 PM	hotline	Bulga
Other	7/01/2016	1:15 PM	hotline	Glenridding
Blast	8/01/2016	11:05 AM	hotline	Bulga
Noise	9/01/2016	11:23 PM	hotline	Bulga
Noise	10/01/2016	10:14 PM	hotline	Bulga
Noise	11/01/2016	1:28 AM	hotline	Bulga
Dust	11/01/2016	3:27 PM	hotline	Bulga
Noise	11/01/2016	7:51 PM	hotline	Bulga
Noise	11/01/2016	8:06 PM	hotline	Bulga
Noise	11/01/2016	9:26 PM	hotline	Bulga
Noise	11/01/2016	11:30 PM	hotline	Bulga
Noise	13/01/2016	8:32 PM	hotline	Bulga
Noise	13/01/2016	10:59 PM	hotline	Bulga
Noise	14/01/2016	4:03 AM	hotline	Bulga
Blast	14/01/2016	2:13 PM	hotline	Bulga
Light	14/01/2016	7:41 PM	hotline	Glennridding
Noise	17/01/2016	10:24 PM	hotline	Bulga
Noise	17/01/2016	10:54 PM	hotline	Bulga
Noise	18/01/2016	10:04 PM	hotline	Bulga
Blast	19/01/2016	2:24 PM	hotline	Bulga
Blast	20/01/2016	1:33 PM	hotline	Bulga
Light	20/01/2016	11:33 PM	hotline	Bulga
Noise	27/01/2016	12:28 AM	hotline	Bulga
Noise	27/01/2016	8:18 AM	hotline	Bulga
Noise	27/01/2016	11:18 PM	hotline	Bulga
Noise	27/01/2016	11:49 PM	hotline	Bulga
Noise	28/01/2016	12:12 AM	hotline	Bulga
Noise	28/01/2016	10:15 PM	hotline	Bulga
Noise	29/01/2016	11:01 PM	hotline	Bulga
Noise	30/01/2016	6:05 PM	hotline	Bulga
Noise	30/01/2016	7:58 PM	hotline	Bulga
Noise	30/01/2016	10:10 PM	hotline	Bulga
Blast	1/02/2016	11:26 AM	hotline	Bulga
Noise	2/02/2016	9:18 PM	hotline	Bulga

Type	Date	Time	Method	Location
Noise	6/02/2016	11:14 PM	hotline	Bulga
Dust	8/02/2016	4:20 PM	hotline	Long Point
Noise	9/02/2016	10:31 PM	hotline	Bulga
Noise	10/02/2016	5:31 AM	hotline	Unknown
Noise	10/02/2016	5:41 AM	hotline	Bulga
Noise	11/02/2016	7:40 AM	hotline	Bulga
Noise	11/02/2016	7:21 PM	hotline	Bulga
Noise	12/02/2016	8:29 AM	hotline	Bulga
Noise	13/02/2016	7:34 AM	hotline	Bulga
Noise	13/02/2016	8:10 AM	hotline	Bulga
Noise	13/02/2016	10:49 PM	hotline	Bulga
Noise	14/02/2016	10:13 AM	hotline	Unknown
Noise	15/02/2016	8:00 PM	hotline	Bulga
Noise	15/02/2016	8:00 PM	hotline	Bulga
Noise	15/02/2016	8:06 PM	hotline	Bulga
Noise	15/02/2016	8:36 PM	hotline	Bulga
Noise	15/02/2016	8:43 PM	hotline	Bulga
Noise	15/02/2016	10:23 PM	hotline	Bulga
Light	16/02/2016	8:20 PM	hotline	Glennridding
Noise	17/02/2016	10:36 PM	hotline	Bulga
Noise	17/02/2016	11:43 PM	hotline	Bulga
Blast	18/02/2016	1:01 PM	hotline	Bulga
Blast	18/02/2016	1:23 PM	hotline	Greg
Noise	18/02/2016	10:38 PM	hotline	Bulga
Blast	19/02/2016	2:08 PM	hotline	Bulga
Dust	19/02/2016	5:45 PM	hotline	Bulga
Noise	19/02/2016	9:20 PM	hotline	Bulga
Noise	22/02/2016	5:29 AM	hotline	Bulga
Noise	22/02/2016	8:42 PM	hotline	Bulga
Blast	25/02/2016	12:43 PM	hotline	Bulga
Blast	25/02/2016	12:47 PM	hotline	Bulga
Noise	1/03/2016	3:51 AM	hotline	Bulga
Noise	1/03/2016	8:26 AM	hotline	Bulga
Noise	1/03/2016	8:40 AM	hotline	Bulga
Noise	1/03/2016	9:20 PM	hotline	Bulga
Noise	1/03/2016	10:06 PM	hotline	Bulga
Noise	1/03/2016	10:52 PM	hotline	Bulga
Noise	4/03/2016	9:09 PM	hotline	Bulga
Noise	4/03/2016	10:18 PM	hotline	Bulga
Noise	5/03/2016	12:03 AM	hotline	Bulga
Noise	6/03/2016	12:34 AM	hotline	Bulga
Noise	7/03/2016	10:08 PM	hotline	Bulga
Noise	7/03/2016	11:08 PM	hotline	Bulga

Type	Date	Time	Method	Location
Dust	8/03/2016	4:40 PM	hotline	Bulga
Noise	9/03/2016	12:38 AM	hotline	Bulga
Noise	16/03/2016	3:10 AM	hotline	Bulga
Noise	17/03/2016	10:36 PM	hotline	Bulga
Noise	18/03/2016	1:59 AM	hotline	Bulga
Noise	20/03/2016	12:07 AM	hotline	Bulga
Noise	20/03/2016	12:11 AM	hotline	Bulga
Noise	20/03/2016	12:56 AM	hotline	Bulga
Noise	23/03/2016	9:31 PM	hotline	Bulga
Noise	23/03/2016	10:31 PM	hotline	Bulga
Noise	24/03/2016	3:50 AM	hotline	Bulga
Blast	24/03/2016	12:07 PM	hotline	Bulga
Blast	24/03/2016	12:44 PM	hotline	Bulga
Noise	24/03/2016	9:16 PM	hotline	Bulga
Noise	24/03/2016	9:29 PM	hotline	Bulga
Noise	24/03/2016	10:01 PM	hotline	Bulga
Noise	24/03/2016	10:04 PM	hotline	Bulga
Noise	24/03/2016	10:08 PM	hotline	Bulga
Noise	24/03/2016	10:36 PM	hotline	Bulga
Noise	24/03/2016	10:50 PM	hotline	Bulga
Noise	24/03/2016	10:52 PM	hotline	Bulga
Noise	24/03/2016	11:05 PM	hotline	Bulga
Noise	25/03/2016	8:04 PM	hotline	Bulga
Noise	25/03/2016	11:19 PM	hotline	Bulga
Noise	26/03/2016	7:20 AM	hotline	Bulga
Noise	26/03/2016	9:18 PM	hotline	Bulga
Noise	26/03/2016	9:36 PM	hotline	Bulga
Noise	27/03/2016	10:00 PM	hotline	Bulga
Noise	27/03/2016	10:14 PM	hotline	Bulga
Noise	27/03/2016	10:32 PM	hotline	Bulga
Noise	28/03/2016	9:48 PM	hotline	Bulga
Light	31/03/2016	9:28 PM	hotline	Glennridding
Noise	31/03/2016	10:17 PM	hotline	Bulga
Noise	31/03/2016	10:29 PM	hotline	Bulga
Noise	31/03/2016	10:42 PM	hotline	Bulga
Noise	1/04/2016	2:17 AM	hotline	Bulga
Blast	1/04/2016	11:41 AM	hotline	Bulga
Noise	1/04/2016	9:40 PM	manual entry	Bulga
Dust	2/04/2016	9:02 AM	manual entry	Bulga
Dust	2/04/2016	2:44 PM	manual entry	Bulga
Noise	2/04/2016	9:12 PM	manual entry	Bulga
Noise	2/04/2016	10:37 PM	manual entry	Bulga
Noise	3/04/2016	7:18 AM	hotline	Bulga

Type	Date	Time	Method	Location
Noise	3/04/2016	7:24 AM	hotline	Bulga
Noise	3/04/2016	7:36 AM	hotline	Bulga
Noise	3/04/2016	9:44 PM	hotline	Bulga
Noise	3/04/2016	10:19 PM	hotline	Bulga
Noise	3/04/2016	11:39 PM	hotline	Bulga
Noise	4/04/2016	4:56 AM	hotline	Bulga
Noise	5/04/2016	8:05 PM	hotline	Bulga
Noise	5/04/2016	9:11 PM	hotline	Bulga
Noise	8/04/2016	7:51 AM	hotline	Bulga
Noise	8/04/2016	8:14 AM	hotline	Bulga
Noise	8/04/2016	8:47 AM	hotline	Bulga
Blast	8/04/2016	1:36 PM	hotline	Bulga
Noise	9/04/2016	11:28 PM	hotline	Bulga
Noise	10/04/2016	1:00 AM	hotline	Bulga
Noise	10/04/2016	9:05 PM	hotline	Bulga
Noise	10/04/2016	10:08 PM	hotline	Bulga
Noise	12/04/2016	9:58 PM	hotline	Bulga
Noise	12/04/2016	11:37 PM	hotline	Bulga
Dust	13/04/2016	2:32 PM	hotline	Bulga
Noise	13/04/2016	9:56 PM	hotline	Bulga
Noise	13/04/2016	10:36 PM	hotline	Bulga
Noise	14/04/2016	7:44 PM	hotline	Bulga
Noise	14/04/2016	7:55 PM	hotline	Bulga
Noise	14/04/2016	7:55 PM	hotline	Bulga
Noise	14/04/2016	8:41 PM	hotline	Bulga
Noise	14/04/2016	8:55 PM	hotline	Bulga
Noise	14/04/2016	9:02 PM	hotline	Bulga
Noise	14/04/2016	9:08 PM	hotline	Bulga
Noise	14/04/2016	9:09 PM	hotline	Bulga
Noise	14/04/2016	10:03 PM	hotline	Bulga
Noise	15/04/2016	12:52 AM	hotline	Bulga
Dust	15/04/2016	12:49 PM	hotline	Bulga
Dust	15/04/2016	1:20 PM	hotline	Bulga
Other	15/04/2016	1:36 PM	hotline	Bulga
Noise	15/04/2016	7:50 PM	hotline	Bulga
Noise	15/04/2016	8:37 PM	hotline	Bulga
Noise	15/04/2016	8:52 PM	hotline	Bulga
Noise	16/04/2016	1:00 AM	hotline	Bulga
Noise	16/04/2016	4:11 AM	hotline	Bulga
Noise	16/04/2016	7:56 PM	hotline	Bulga
Noise	16/04/2016	8:21 PM	hotline	Bulga
Noise	18/04/2016	11:36 PM	hotline	Bulga
Noise	19/04/2016	8:36 PM	hotline	Bulga

Type	Date	Time	Method	Location
Noise	19/04/2016	8:47 PM	hotline	Bulga
Noise	19/04/2016	9:56 PM	hotline	Bulga
Noise	19/04/2016	10:40 PM	hotline	Bulga
Noise	20/04/2016	9:31 PM	hotline	Bulga
Noise	20/04/2016	10:07 PM	hotline	Bulga
Noise	20/04/2016	11:36 PM	hotline	Bulga
Other	21/04/2016	2:36 PM	hotline	Bulga
Dust	21/04/2016	4:05 PM	hotline	Bulga
Other	21/04/2016	5:28 PM	hotline	Bulga
Noise	21/04/2016	8:33 PM	hotline	Bulga
Noise	21/04/2016	10:24 PM	hotline	Bulga
Noise	21/04/2016	11:11 PM	hotline	Bulga
Other	22/04/2016	12:51 PM	hotline	Bulga
Noise	23/04/2016	10:04 PM	hotline	Bulga
Noise	24/04/2016	10:47 PM	hotline	Bulga
Noise	25/04/2016	1:12 AM	hotline	Bulga
Noise	25/04/2016	11:08 PM	hotline	Bulga
Noise	25/04/2016	11:45 PM	hotline	Bulga
Noise	26/04/2016	7:14 AM	hotline	Bulga
Noise	26/04/2016	7:40 AM	hotline	Bulga
Noise	26/04/2016	8:20 AM	hotline	Bulga
Noise	26/04/2016	7:42 PM	hotline	Bulga
Noise	26/04/2016	10:31 PM	hotline	Bulga
Noise	27/04/2016	9:47 PM	hotline	Bulga
Other	28/04/2016	12:10 PM	hotline	Bulga
Noise	28/04/2016	9:56 PM	hotline	Bulga
Dust	29/04/2016	8:16 AM	hotline	Bulga
Blast	29/04/2016	12:19 PM	hotline	Bulga
Blast	29/04/2016	12:24 PM	hotline	Bulga
Noise	4/05/2016	10:16 PM	hotline	Gowrie
Blast	5/05/2016	1:06 PM	hotline	Bulga
Noise	6/05/2016	6:41 AM	hotline	Bulga
Noise	6/05/2016	10:32 PM	hotline	Bulga
Noise	7/05/2016	10:12 PM	hotline	Bulga
Noise	8/05/2016	7:19 PM	hotline	Bulga
Noise	8/05/2016	9:15 PM	hotline	Bulga
Noise	8/05/2016	9:20 PM	hotline	Bulga
Noise	8/05/2016	9:21 PM	hotline	Bulga
Noise	8/05/2016	9:32 PM	hotline	Unknown
Noise	8/05/2016	9:35 PM	hotline	Unknown
Noise	8/05/2016	9:37 PM	hotline	Bulga
Noise	8/05/2016	9:38 PM	hotline	Bulga
Noise	8/05/2016	10:32 PM	hotline	Bulga

Type	Date	Time	Method	Location
Blast	12/05/2016	2:02 PM	hotline	Bulga
Blast	12/05/2016	2:30 PM	manual entry	Unknown
Blast	13/05/2016	1:24 PM	hotline	Bulga
Noise	20/05/2016	9:47 PM	hotline	Bulga
Noise	21/05/2016	9:17 PM	hotline	Bulga
Noise	21/05/2016	10:43 PM	hotline	Bulga
Dust	23/05/2016	11:56 AM	hotline	Bulga
Dust	23/05/2016	12:20 PM	hotline	Bulga
Dust	24/05/2016	2:42 PM	hotline	Bulga
Blast	25/05/2016	11:47 AM	hotline	Bulga
Blast	25/05/2016	12:46 PM	hotline	Broke
Blast	27/05/2016	11:15 AM	hotline	Bulga
Dust	27/05/2016	11:19 AM	hotline	Bulga
Dust	29/05/2016	2:37 PM	hotline	Bulga
Noise	30/05/2016	8:12 PM	hotline	Bulga
Light	31/05/2016	5:17 PM	hotline	Glennridding
Blast	1/06/2016	12:44 PM	hotline	Bulga
Light	1/06/2016	5:12 PM	hotline	Glennridding
Light	1/06/2016	6:46 PM	hotline	Glennridding
Noise	1/06/2016	9:38 PM	hotline	Bulga
Noise	1/06/2016	11:22 PM	hotline	Bulga
Noise	2/06/2016	10:33 PM	hotline	Bulga
Noise	3/06/2016	7:29 PM	hotline	Bulga
Noise	3/06/2016	8:32 PM	hotline	Bulga
Noise	3/06/2016	9:54 PM	hotline	Bulga
Noise	3/06/2016	10:07 PM	hotline	Bulga
Noise	3/06/2016	11:13 PM	hotline	Bulga
Noise	3/06/2016	11:23 PM	hotline	Bulga
Light	6/06/2016	6:12 PM	hotline	Glennridding
Noise	14/06/2016	12:49 AM	hotline	Bulga
Noise	15/06/2016	10:23 PM	hotline	Bulga
Noise	15/06/2016	11:01 PM	hotline	Bulga
Noise	15/06/2016	11:16 PM	hotline	Bulga
Noise	15/06/2016	11:24 PM	hotline	Bulga
Blast	16/06/2016	12:47 PM	hotline	Bulga
Blast	17/06/2016	1:38 PM	hotline	Bulga
Noise	17/06/2016	6:33 PM	hotline	Bulga
Dust	22/06/2016	7:37 PM	hotline	Bulga
Blast	23/06/2016	12:56 PM	hotline	Bulga
Light	23/06/2016	8:27 PM	hotline	Bulga
Light	26/06/2016	5:30 PM	hotline	Glennridding
Light	27/06/2016	5:12 PM	hotline	Glennridding
Noise	27/06/2016	10:58 PM	hotline	Gowrie

Type	Date	Time	Method	Location
Noise	28/06/2016	9:42 PM	hotline	Gowrie
Noise	29/06/2016	6:43 PM	hotline	Bulga
Blast	30/06/2016	1:16 PM	hotline	Bulga
Noise	2/07/2016	5:17 PM	hotline	Gowrie
Noise	5/07/2016	4:54 AM	hotline	Bulga
Noise	7/07/2016	12:42 AM	hotline	Anonymous
Noise	7/07/2016	1:22 AM	hotline	Anonymous
Noise	7/07/2016	1:24 AM	hotline	Declined
Noise	7/07/2016	1:46 AM	hotline	Declined
Noise	7/07/2016	1:46 AM	hotline	Declined
Noise	8/07/2016	1:44 AM	hotline	Declined
Noise	8/07/2016	1:50 AM	hotline	Declined
Noise	9/07/2016	11:16 PM	hotline	Bulga
Noise	16/07/2016	1:02 AM	hotline	Bulga
Dust	16/07/2016	8:19 AM	hotline	Bulga
Noise	17/07/2016	9:00 PM	hotline	Bulga
Other	18/07/2016	4:32 PM	hotline	Bulga
Other	18/07/2016	4:33 PM	hotline	Bulga
Blast	18/07/2016	4:33 PM	hotline	Bulga
Blast	18/07/2016	4:39 PM	hotline	Bulga
Other	18/07/2016	4:40 PM	hotline	Unknown
Other	18/07/2016	4:45 PM	hotline	Bulga
Other	18/07/2016	4:52 PM	hotline	Bulga
Other	18/07/2016	4:53 PM	hotline	Bulga
Other	18/07/2016	5:01 PM	hotline	Bulga
Other	18/07/2016	5:30 PM	hotline	Unknown
Other	20/07/2016	10:49 AM	hotline	Bulga
Other	20/07/2016	12:24 PM	hotline	Unknown
Noise	20/07/2016	11:54 PM	hotline	Declined
Blast	28/07/2016	11:29 AM	hotline	Bulga
Blast	28/07/2016	11:30 AM	hotline	Bulga
Blast	28/07/2016	4:28 PM	hotline	Bulga
Noise	30/07/2016	8:20 PM	hotline	Bulga
Noise	30/07/2016	9:39 PM	hotline	Bulga
Noise	1/08/2016	7:08 PM	hotline	Bulga
Noise	1/08/2016	7:36 PM	hotline	Bulga
Noise	1/08/2016	9:20 PM	hotline	Bulga
Blast	3/08/2016	11:17 AM	hotline	Bulga
Noise	5/08/2016	12:07 AM	hotline	Bulga
Noise	6/08/2016	7:41 PM	hotline	Bulga
Noise	7/08/2016	8:48 AM	hotline	Gowrie
Noise	7/08/2016	7:20 PM	hotline	Bulga
Noise	7/08/2016	7:32 PM	hotline	Bulga

Type	Date	Time	Method	Location
Noise	7/08/2016	10:22 PM	hotline	Bulga
Noise	8/08/2016	4:16 AM	hotline	Gowrie
Noise	8/08/2016	4:42 AM	hotline	Anonymous
Noise	8/08/2016	9:54 PM	hotline	Bulga
Noise	8/08/2016	10:23 PM	hotline	Bulga
Blast	9/08/2016	2:17 PM	hotline	Bulga
Blast	9/08/2016	2:20 PM	hotline	Bulga
Blast	9/08/2016	2:21 PM	hotline	Anonymous
Noise	13/08/2016	5:04 AM	hotline	Bulga
Noise	13/08/2016	8:46 AM	hotline	Gowrie
Noise	13/08/2016	10:27 PM	hotline	Declined
Noise	13/08/2016	11:06 PM	hotline	Declined
Noise	13/08/2016	11:12 PM	hotline	Gowrie
Noise	14/08/2016	9:05 PM	hotline	Bulga
Noise	14/08/2016	9:49 PM	hotline	Bulga
Noise	14/08/2016	10:28 PM	hotline	Bulga
Noise	15/08/2016	12:58 AM	hotline	Bulga
Noise	15/08/2016	10:56 PM	hotline	Bulga
Dust	16/08/2016	9:03 AM	hotline	Bulga
Dust	16/08/2016	12:34 PM	hotline	Bulga
Noise	17/08/2016	6:19 AM	hotline	Anonymous
Blast	18/08/2016	2:07 PM	hotline	Bulga
Blast	18/08/2016	2:22 PM	hotline	Bulga
Blast	18/08/2016	2:24 PM	hotline	Bulga
Blast	19/08/2016	1:23 PM	hotline	Bulga
Noise	21/08/2016	6:17 AM	hotline	Anonymous
Noise	21/08/2016	6:29 AM	hotline	Anonymous
Noise	21/08/2016	6:57 AM	hotline	Gowrie
Noise	22/08/2016	7:49 AM	hotline	Bulga
Noise	22/08/2016	8:28 AM	hotline	Bulga
Noise	24/08/2016	4:56 AM	hotline	Bulga
Noise	25/08/2016	10:00 PM	hotline	Declined
Noise	25/08/2016	10:02 PM	hotline	Declined
Noise	25/08/2016	10:04 PM	hotline	Declined
Noise	25/08/2016	10:25 PM	hotline	Gowrie
Blast	26/08/2016	3:02 PM	hotline	Bulga
Other	26/08/2016	3:45 PM	hotline	Unknown
Noise	28/08/2016	10:57 PM	hotline	Bulga
Dust	29/08/2016	9:05 AM	hotline	Bulga
Noise	29/08/2016	8:49 PM	hotline	Bulga
Noise	29/08/2016	11:24 PM	hotline	Bulga
Blast	30/08/2016	12:47 PM	hotline	Bulga
Light	30/08/2016	6:23 PM	hotline	Bulga

Type	Date	Time	Method	Location
Noise	30/08/2016	7:59 PM	hotline	Bulga
Noise	30/08/2016	8:09 PM	hotline	Unknown
Noise	30/08/2016	9:22 PM	hotline	Bulga
Noise	30/08/2016	9:24 PM	hotline	Unknown
Noise	30/08/2016	9:28 PM	hotline	Bulga
Noise	30/08/2016	9:38 PM	hotline	Bulga
Noise	30/08/2016	10:06 PM	hotline	Bulga
Noise	31/08/2016	1:00 AM	hotline	Bulga
Noise	31/08/2016	2:22 AM	hotline	Bulga
Noise	31/08/2016	4:57 AM	hotline	Bulga
Noise	1/09/2016	10:13 PM	hotline	Bulga
Noise	4/09/2016	9:07 PM	hotline	Declined
Noise	4/09/2016	9:20 PM	hotline	Declined
Noise	4/09/2016	10:22 PM	hotline	Declined
Noise	5/09/2016	10:42 PM	hotline	Bulga
Noise	6/09/2016	11:37 PM	hotline	Bulga
Blast	7/09/2016	12:18 PM	hotline	Bulga
Noise	7/09/2016	9:11 PM	hotline	Bulga
Noise	7/09/2016	10:06 PM	hotline	Bulga
Noise	7/09/2016	10:39 PM	hotline	Bulga
Blast	8/09/2016	3:06 PM	manual entry	Bulga
Noise	8/09/2016	8:55 PM	hotline	Bulga
Dust	9/09/2016	3:16 PM	hotline	Bulga
Noise	9/09/2016	7:53 PM	hotline	Bulga
Noise	9/09/2016	8:46 PM	hotline	Bulga
Noise	9/09/2016	10:32 PM	hotline	Bulga
Noise	12/09/2016	7:40 PM	hotline	Bulga
Noise	12/09/2016	8:10 PM	hotline	Bulga
Noise	12/09/2016	10:03 PM	hotline	Bulga
Noise	12/09/2016	11:23 PM	hotline	Bulga
Noise	13/09/2016	8:20 PM	hotline	Bulga
Noise	17/09/2016	9:39 PM	hotline	Bulga
Blast	19/09/2016	12:36 PM	hotline	Bulga
Noise	20/09/2016	9:50 PM	hotline	Bulga
Noise	20/09/2016	11:27 PM	hotline	Bulga
Noise	20/09/2016	11:47 PM	hotline	Bulga
Noise	21/09/2016	1:40 AM	hotline	Bulga
Dust	22/09/2016	2:24 PM	hotline	Bulga
Blast	22/09/2016	2:24 PM	hotline	Bulga
Blast	22/09/2016	2:25 PM	hotline	Bulga
Blast	23/09/2016	1:09 PM	hotline	Bulga
Other	23/09/2016	1:47 PM	hotline	Bulga
Noise	25/09/2016	9:02 AM	hotline	Declined

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Noise	9/10/2016	8:40 PM	hotline	Bulga
Noise	9/10/2016	8:42 PM	hotline	Bulga
Noise	9/10/2016	9:00 PM	hotline	Bulga
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Blast	8/11/2016	1:42 PM	hotline	Bulga
Dust	8/11/2016	6:47 PM	hotline	Bulga
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COAL & ALLIED

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Appendix 2

Groundwater Monitoring Report

Australasian Groundwater and
Environmental Consultants Pty Ltd

Report on

Mount Thorley and Warkworth Mines

Annual Review 2016

Prepared for
Rio Tinto Coal Australia

Project No. G1468H March2017
www.ageconsultants.com.au ABN 64 080 238 642

Document details and history

Document details

Project number: G1468H
Document title: Mount Thorley and Warkworth Mines Annual Review 2016
Site address:
File name: G1468H.MTW_AnnualReview_Final.docx

Document status and review

Edition	Comments	Author	Authorised by	Date
Draft 1	Draft report to RTCA for comment	J Tomlin	C Conte	1/03/17
Draft 2	Updated draft report to address RTCA comments	J Tomlin	J Tomlin	3/03/17
Final	Addressed final comments	J Tomlin	J Tomlin	10/3/17

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Report on

Mount Thorley and Warkworth Mines
Annual Review 2016

1 Introduction

Rio Tinto Coal Australia (RTCA) operates the Mount Thorley and Warkworth mines as an amalgamated complex known as MTW. Whilst the complex is operated in an amalgamated manner, the Mount Thorley and Warkworth mines both have separate conditions of approval issued by the New South Wales Department of Planning and Environment. The development consents (Warkworth SSD- 6464; and Mt Thorley SSD 6465) for both mines include conditions that require environmental monitoring data is collected at each mine, with the Warkworth mine required to review the data annually according to consent conditions.

RTCA commissioned Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) to review the groundwater monitoring data for the 2016 calendar year. This report presents groundwater monitoring data collected at the MTW complex and discusses the impact of mining on the groundwater regime.

2 Conditions of consent

The conditions of consent for Mt Thorley and Warkworth mines require a '*Groundwater Management Plan, which includes:*

- *detailed baseline data on groundwater levels, yield and quality in the region, and privately-owned groundwater bores, that could be affected by the development;*
- *groundwater assessment criteria, including trigger levels for investigating any potentially adverse groundwater impacts;*
- *a program to monitor and report on:*
    - *groundwater inflows to the open cut pits;*
    - *the seepage/leachate from water storages, emplacements, backfilled voids and final voids;*
    - *the impacts of the development on:*
        - *regional and local (including alluvial) aquifers;*
        - *groundwater supply of potentially affected landowners;*
        - *groundwater dependent ecosystems and riparian vegetation;*
        - *base flows to Wollombi Brook;*
    - *a plan to respond to any exceedances of the groundwater assessment criteria; and*
    - *a program to validate the groundwater model for the development, including an independent review of the model with every independent environmental audit, and compare the monitoring results with modelled predictions.'*

3 Groundwater monitoring network and triggers

RTCA prepared a Water Management Plan for MTW (RTCA 2016) as required by the conditions of approval. The WMP contains within it a groundwater management plan (Section 8 of the WMP), which outlines the impacts of the project, the groundwater monitoring network and water quality triggers (Appendix C). The groundwater monitoring network comprises a total of 60 monitoring sites comprised of:

- 46 PVC monitoring bores; and
- 14 vibrating wire piezometer (VWP) installations.

Figure 3.2 shows the locations of the monitoring sites at MTW. Appendix A contains a list of the known details for each monitoring sites, as well as the monitoring plan reproduced from the WMP. The bores generally aim to monitor either alluvial aquifers occurring within the Wollombi Brook and Hunter River flood plain as well as coal seams and interburden units within the Permian coal measures sequence. The coal seams currently mined at Warkworth Mine include the Redbank Creek, Wambo, Whynot, Blakefield, Glen Munro, Woodlands Hill, Arrowfield, Bowfield, Warkworth and Mt Arthur Seams. Currently approved mining at Mt Thorley targets seams down to the Woodlands Hill. Figure 3.1 shows the stratigraphic column for the region, identifying the main geological formations and coal seams.

As per the Statement of Commitments outlined in Table 22.1 of the Warkworth Continuation 2014 EIS, three nested monitoring bores along the Wollombi Brook (MB15MTW01(D and S), MB15MTW02(D and S) and MB15MTW03, PZ10, PZ11 and PZ12) were constructed in 2016. These bores will be added to an update of the groundwater monitoring programme, currently in preparation. Following the acquisition of a neighbouring property, five monitoring bores adjacent to the Wollombi Brook will also be added to the groundwater monitoring programme. In addition, eight monitoring bores were constructed in 2016 in the Warkworth Sands system and will be added to the groundwater monitoring programme. Monitoring results for the newly constructed bores will be incorporated into the subsequent Annual Groundwater Review.

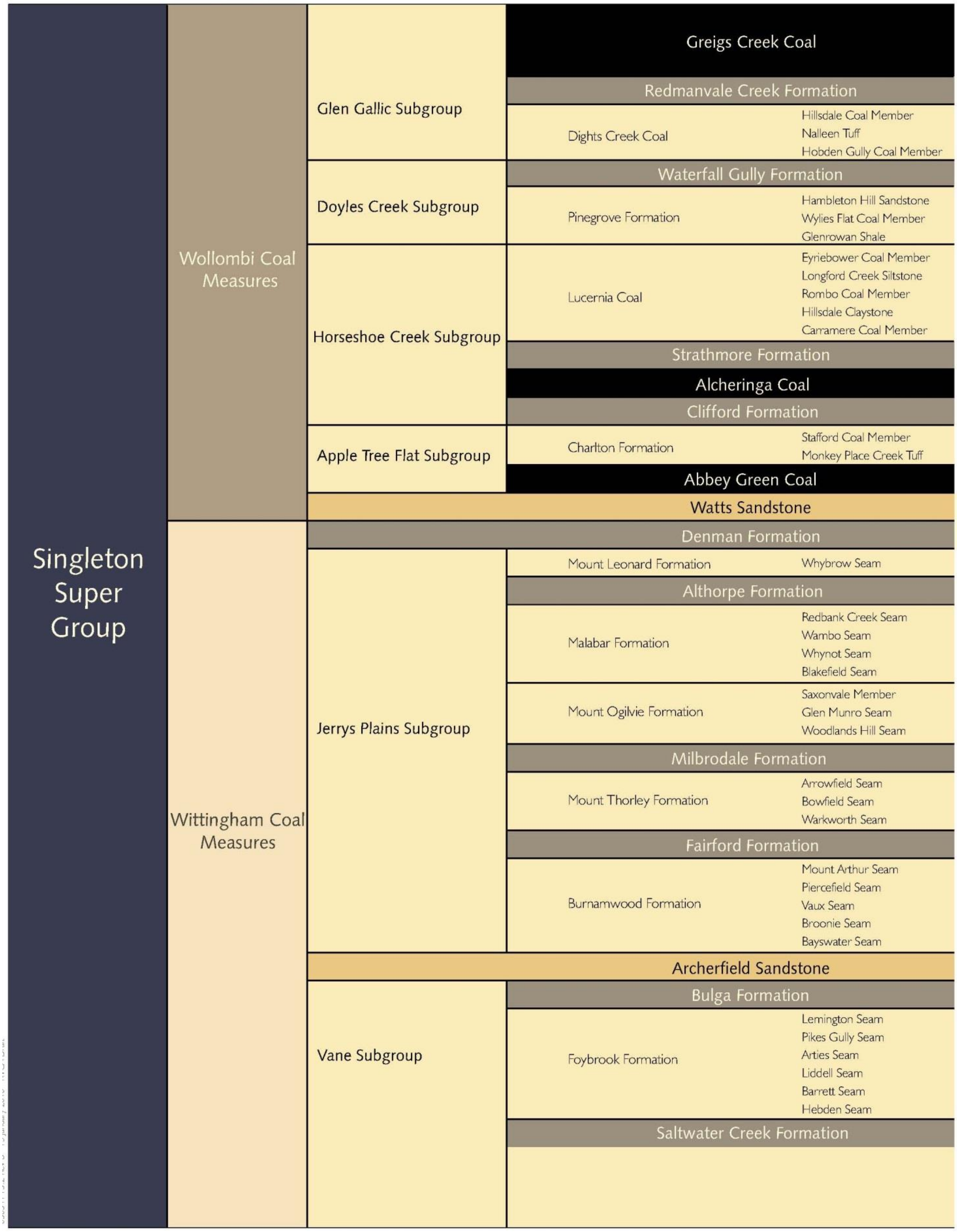


Figure 3.1 Stratigraphic column

VWP installations comprise pressure sensors grouted within each borehole and are used for monitoring of piezometric head; however, these installations do not allow measurement of water quality.

At each monitoring bore site, groundwater levels, electrical conductivity and pH are measured in the field on a quarterly basis. A groundwater sample is also collected from each monitoring bore annually and analysed by an offsite laboratory for:

- total dissolved solids (TDS);
- major ions – Ca, Mg, Na, K, Cl, SO_4(or S);
- total alkalinity, bicarbonate alkalinity, carbonate alkalinity, hydroxide alkalinity; and
- trace elements - Al, As, B, Cd, Cu, Hg, Ni, Pb, Se, Zn (plus Mo, V and Cr for selected bores).

The WMP also applies groundwater quality trigger limits for a subset of bores. Trigger limits are only applied to bores with a sufficient baseline dataset. The triggers apply and are calculated for groups of bores installed within the same geological unit and utilise percentiles of the available data to trigger further investigation. Three consecutive measurements falling outside the 5^{th} and 95^{th} percentile for pH triggers further investigation, whilst three consecutive results above the 95^{th} percentile for electrical conductivity require investigation. Appendix A contains trigger values determined for each group of bores reproduced from the WMP.

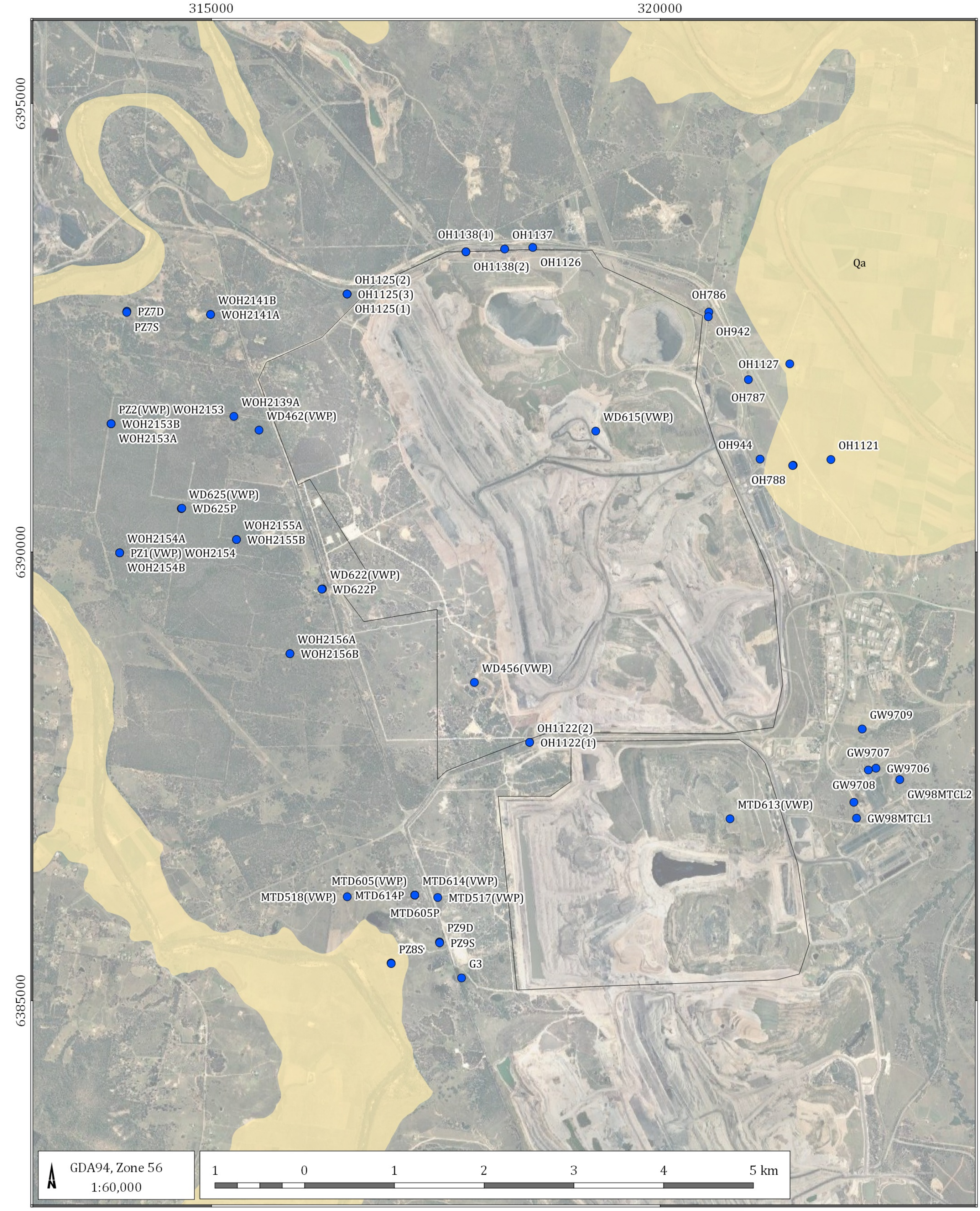
Section 9.2 of the WMP provides a methodology to investigate samples that exceed the triggers for pH and electrical conductivity. The WMP requires that '*in the event that a water quality measurement exceeds a predetermined trigger value, exceedances will be recorded and MTW will initiate a site specific investigation if:*

- *professional judgement determines that the single deviation or a developing trend could result in environmental harm; or*
- *or three consecutive measurements of EC or pH exceed trigger values.*

The investigation will:

- *determine the source and risk of impact on downstream water quality.*
- *determine the need for and extent of contingency measures.*
- *communicate outcomes to senior management.*
- *be reported in the AR* [annual review].

Whilst the WMP does not specify a trigger for groundwater levels it does require an annual review of '*depressurisation of coal measures and alluvium by a suitably qualified hydrogeologist.'*



LEGEND

- Grounwater monitoring network
- Active mining area 2016
- Highly productive alluvium

Mount Thorley and Warkworth Mines Annual Review (G1468H)

Groundwater monitoring network

AGE

DATE 03/03/2017

FIGURE No: **3-2**

G:/Projects/G1468H.Warkworth Annual Review/3_GIS/Workspaces/001_Deliverable1/03-02_G1468H_Groundwater monitoring network.qgs

4 Groundwater level and water quality trends

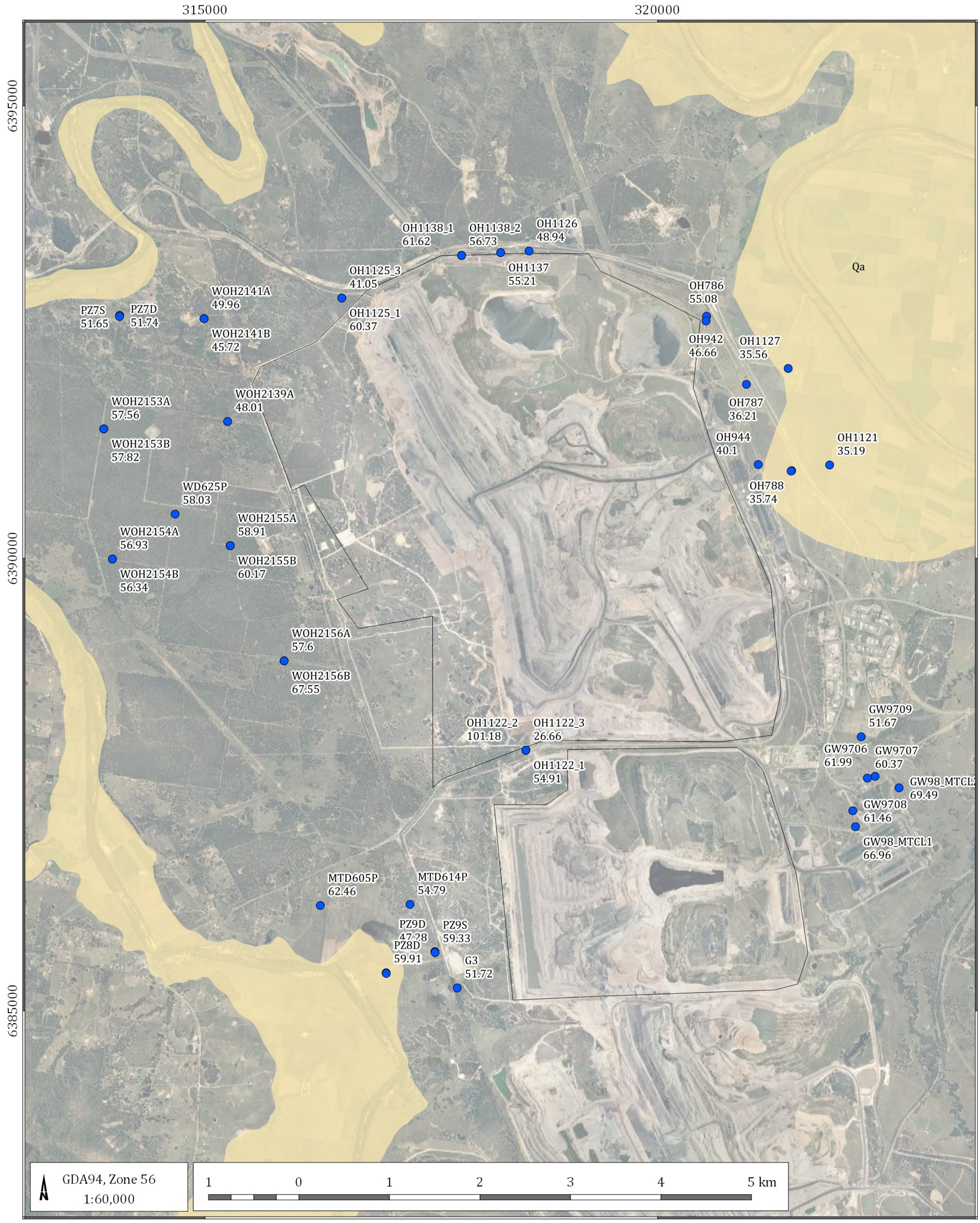
Groundwater level measurements provided by RTCA were used to prepare hydrographs for each monitoring point. The groundwater levels were also plotted along with the Cumulative Rainfall Departure (CRD) to determine if trends in water levels were related to climatic factors or other influences. The CRD shows monthly rainfall trends compared with long term averages. An increase trend in the CRD indicates periods of above average rainfall, whilst a declining trend indicates below average rainfall. Where recharge occurs from rainfall, groundwater levels are often correlated with the CRD. This comparison can be used to 'screen out' climatic trends and determine where other factors such as mining are influencing groundwater levels.

Appendix B contains the hydrographs generated for each bore. The hydrographs include long term data preceding the 2016 reporting year to ensure long term trends are identified and considered. Appendix C contains groundwater level hydrographs with the bores grouped according to geological unit. These figures also show the pH and electrical conductivity measured for each bore (with a trigger applied) to allow water levels and water quality trends to be compared and determine if they are interrelated. Figure 4.1 shows groundwater levels measured at key bores during December 2016, and can be used to determine groundwater flow directions and hydraulic gradients. Groundwater level contours are not provided as the bores are screened within a range of geological units.

The groundwater level trends observed within the monitoring network depend on the location and geological units screened and long term trends can therefore grouped into:

- Western down-dip depressurisation zone – monitoring bores in Permian coal measures to the west and 'down-dip' of the mining area that are recording depressurisation due to mining operations, as predicted by groundwater modelling.
- Eastern up-dip coal measures and alluvium – bores to the east of the mining area within Hunter River alluvium and Bayswater coal seam that are 'up-dip' of mining and are responding only to climatic influences.
- Wollombi Brook alluvium – bores within the Wollombi Brook alluvium that have a varied response, suggesting localised impact where mining is close to the flood plain and no impact where mining is more distant.
- Warkworth Sands – bores within the perched aquifer of the Warkworth Sands, which is located in elevated areas, generally do not respond to mining.

The sections below discuss water level and quality trends within each of these zones. Samples collected that exceeded the nominated triggers values are also discussed.



LEGEND

- Observer water levels December 2016 (mAHD)
- Active mining area 2016
- Highly productive alluvium

Mount Thorley and Warkworth Mines Annual Review (G1468H)

Groundwater levels - December 2016

AGE

DATE 03/03/2017

FIGURE No: **4-1**

G:/Projects/G1468H.Warkworth Annual Review/3_GIS/Workspaces/001_Deliverable1/04-01_G1468H_Groundwater levels - December 2016.qgs

4.1 Western down-dip depressurisation zone

RTCA have developed a number of numerical models to simulate groundwater flow at MTW (within EIS reports from 2002, 2009 and 2014). The most recent updated to the model was conducted by AGE (2015) which updated the model developed for the 2014 EIS. All numerical models developed have consistently predicted mining will depressurise groundwater within the coal measures down-dip and west of the mining area. The models predict the zone of depressurised Permian bedrock will extend under the Wollombi Brook alluvium, but the alluvium water level will be largely unaffected. Groundwater monitoring generally confirms this conclusion with a general loss of water pressure and level occurring in many of the monitoring sites installed within Permian bedrock to the west of the mining area.

The measured decline in water levels is not as uniform as predicted by groundwater modelling due to heterogeneities within the groundwater systems. The sections below discuss the water level and quality data collected from the bores grouped together for trigger levels. Water level and quality graphs for each group of bores are included within Appendix C.

4.1.1 Redbank Creek coal seam bores

There are four bores within this group located west and down-dip of the mine. The data for these bores indicates:

- a long term declining trend in groundwater levels as predicted by groundwater modelling – the water levels have continued to decline over 2016, despite some above average rainfall events indicating an impact from mining activities; and
- pH fell below the 5th percentile trigger in all four samples collected from WOH2156A, triggering the requirement to investigate this trend.

The declining pH within samples collected from WOH2156A is weakly correlated with the declining groundwater level within this bore. The pH during 2017 remained relatively stable at pH 7.0, which is relatively neutral and is not expected to compromise beneficial use or environmental value. Historical measurements have also recorded pH 7.0, and a continuing declining trend is considered unlikely.

4.1.2 Wambo coal seam bores

There are five bores within the Wambo seam group, west and down-dip of the mine. The data for these bores indicates:

- Relatively stable groundwater levels within all bores - the exception is bore G3 which is located to the west of and adjacent to the Mt Thorley mine Loders Pit. Historically, this bore has recorded a long term decline in water level, but rose rapidly in late 2015 presumably in response to water storage within Loders Pit, and this rise has continued over 2016.
- The rising water level trend within bore G3 is correlated with a declining pH, which fell below the 5th percentile trigger for each monitoring event in 2016.
- All samples from bore WOH2156B exceeded the electrical conductivity trigger in 2016.
- One quarterly pH and electrical conductivity measurement was missed in 2016 for WOH2156B, because there was insufficient yield from the bore to collect sufficient water for laboratory testing.

The rising water level changes and the declining pH trend evident within bore G3 are considered likely to be resultant from mining activities, given the close proximity of the bore to Loders Pit and Bulga Mine. Whilst the pH has declined below the trigger levels, a measurement of pH 6.9 remains relatively neutral and is not expected to compromise beneficial use or environmental value.

Samples collected from WOH2156B first exceeded the electrical conductivity trigger in early 2014, and have stabilised at above the trigger level since this time. Whilst the reason for the increase in unclear, this bore is down-dip of the mining where there is an inward hydraulic gradient preventing the outward movement of mine water to the groundwater systems. The change in electrical conductivity over time is considered likely to relate to local changes in water pressures around the borehole, and not a widespread feature that could compromise beneficial use or environmental value.

4.1.3 Blakefield coal seam bores

There are three bores within this group, downdip of the Warkworth mining area. The data indicates:

- declining Permian pressure within the Blakefield seam as predicted by groundwater modelling, except for bore OH1125(1) which only responds to climatic influences;
- quarterly pH, electrical conductivity and water level measurements were missed once for WOH2139A;
- quarterly pH, electrical conductivity and water level measurements were missed twice for OH1122(1) – the bore was reported as damaged in December 2016 and could not be utilised;
- three samples collected from WOH2139A exceeded the trigger for pH; and
- one sample collected from OH1125(1) exceeded the trigger level for electrical conductivity.

It is understood there was no safe way to access to OH1122(1) and WOH2139A during the March 2016 monitoring event. In addition bore OH1122 (1) was damaged prior to the December monitoring event. RTCA are current investigating repair options.

Bore WOH2139A is located to the west of and downdip of the mining area. The bore has recorded a declining trend in the water level which shows some weak correlation with a rising pH. The pH varies naturally within the Blakefield seam group bores, and bore WOH2139A is at the upper end of the data set. Fluctuations in EC are therefore more likely to trigger within this bore than in other bores. Whilst the decline in water level has potentially influenced the pH slightly at this location, it is not considered sufficient to compromise beneficial use or environmental value.

4.1.4 Bowfield coal seam bores

There is one bore installed within this group to the north of Warkworth mine: OH1125(3). The data for this bore indicates:

- the water level fluctuations within OH1125(3) appear correlated with climate records, but do show a relatively wide fluctuation range; and
- one sample collected from OH1125(3) exceeded the trigger for electrical conductivity and pH.

There is no clear rising trend in electrical conductivity or pH and the single trigger exceedances appear due to natural variability in samples collected from the bore.

4.1.5 Warkworth seam bores

There are two nested bores (OH1138 (1) and OH1138 (2)) within this group located to the north of Warkworth mine. The data for these bores indicates:

- stable groundwater levels correlated with climate records and no evidence of impact from mining; and
- no samples exceeded the trigger values nominated for pH and electrical conductivity.

4.1.6 Vaux coal seam bores

There are three bores installed within the Vaux seam group that surround the Warkworth mine to the north, east and west. The data for these bores indicates:

- stable groundwater levels correlated with climate records and no evidence of impact from mining; and
- no samples exceeded the trigger values nominated for pH and electrical conductivity.

4.1.7 Interburden/overburden under Wollombi Brook alluvium

There are three bores installed within interburden/overburden material underlying the Wollombi Brook alluvium (PZ8D, PZ9D) and Warkworth Sands (PZ7D) to the west of the Warkworth and Mt Thorley mines. The bores are paired with shallow bores monitoring the overlying alluvial and aeolian sediments. The data for these bores indicates:

- stable groundwater levels, except for PZ9D which has recorded a gradual decline over time that stabilised in 2016 – the fluctuations within PZ9D do not correlate with climate and appear related to mining activities in Mt Thorley Loders pit and/or Bulga mine as predicted by numerical modelling; and
- a single sample from PZ7D exceeded the trigger values nominated for pH, whilst two non-consecutive samples collected from PZ9D exceeded the trigger level for electrical conductivity.

Whilst bore PZ9D has water level records influenced by mining, the water quality samples that exceeded the electrical conductivity trigger are not considered to be a result of mining activities. This is because similar to other bores, the electrical conductivity data lie naturally at the upper end of the data set for this group of bores. Fluctuations in electrical conductivity are therefore more likely to trigger within this bore than in other bores. There is also no obvious increasing or decreasing trend within these bores that appears correlated with the water level trend, supporting this conclusion. Similarly, the single pH exceedance in bore PZ7D also lies naturally at the upper end of the dataset and does not show any rising trend.

4.2 Eastern up-dip coal measures and alluvium

A network of monitoring bores is present to the east of the MTW mining area. This network includes bores screened within the Hunter River alluvium and also bores screened within the Bayswater seam underlying the alluvium. The sections below discuss the monitoring results for each of these bores.

4.2.1 Hunter River alluvium bores

There are six bores located to the east of the Warkworth mining area screened within the Hunter River alluvium. The monitoring data for these bores indicates:

- all monitoring bores have recorded relatively stable groundwater levels with no evidence of any declining trends;
- Bore OH944 had insufficient water to allow collection of a sample in June and December 2016;
- no samples exceeded the pH and electrical conductivity triggers, except for:
  - OH942:
    - a single pH reading below the 5th percentile trigger for pH in early 2016; and
    - a single electrical conductivity reading slightly exceeded the 95th percentile trigger.
  - OH944:
    - a single pH reading slightly below the 5th percentile trigger for pH.

Bore OH942 has historically recorded very stable groundwater levels and there is no clear trend of increasing or decreasing pH or electrical conductivity. There is no obvious increasing trend and the lack of any correlation with mining means the trigger events are not considered problematic or to pose any environmental risk.

Bore OH944 has a very limited baseline dataset for pH, and therefore a relatively narrow range for the triggers of less than 1 pH unit. There may be insufficient baseline data to calculate triggers within this bore, and given the lack any obvious trend the single exceedance is not considered as having potential to compromise beneficial use or environmental value.

4.2.2 Bayswater coal seam bores

The Bayswater seam is the basal coal seam within the Jerry's Plains subgroup. Mining at MTW does not remove the Bayswater seam, and therefore it is representative of the 'under-burden' bedrock sequence within the pit floor. There are seven bores within the Bayswater group, with the monitoring data indicating:

- groundwater levels follow climatic cycles and appear unaffected by mining activities;
- no samples exceeded the pH and electrical conductivity triggers, except for:
  - a single pH measurement in GW9706;
  - a single pH measurement in GW98MTCL2;
  - two consecutive pH measurements from GW9709; and
  - a single electrical conductivity measurement from GW9709.

Within the bores that recorded exceedences there is no clear trend of increasing or decreasing pH, electrical conductivity or water level. Again, the same conclusions drawn for other bores apply; that is, given no obvious trends, and the lack of any correlation with mining, the trigger events are due to natural variability and not considered problematic or to pose any environmental risk.

4.3 Wollombi Brook Alluvium

Two bores are installed within the Wollombi Brook alluvium. The bores are located in proximity to the Mt Thorley mine Loders Pit where the Wollombi Brook alluvium encroaches on this location. The available data for these bores indicates:

- within the alluvium immediately adjacent to Loders Pit, bore PZ9S has recorded a declining trend, that is not correlated with climatic records and as predicted by numerical modelling appears related to mining;
- further west closer to Wollombi Brook bore PZ8S has fluctuated in response to climatic trends; and
- no samples exceeded the pH and electrical conductivity triggers.

4.4 Warkworth Sands

A single monitoring bore is installed at the foot-slopes of the Warkworth Sands Woodland. The dataset for this bore indicates:

- relatively stable groundwater levels that follow climatic trends;
- two pH readings fell slightly below the 5th percentile trigger for pH; and
- a single electrical conductivity measurement exceeded the 95th percentile trigger.

Similar to other bores recorded samples exceeding triggers, there is no clear trend of increasing or decreasing pH, electrical conductivity or water level within this bore. Again, the same conclusions applies that given no obvious trends, and the lack of any correlation with mining, the trigger events are not considered problematic or to pose any environmental risk.

5 Water licensing

Mining activities create a zone of low water pressure within the pit void, which induces groundwater flow towards the pit. At many mines, including MTW, the volume of groundwater ingress to mining areas cannot be directly measured because it is not collected at a single point, and is subject to range of processes including evaporation from the mine face, mixing with surface runoff and adhering to mined materials.

RTCA have previously simulated the volume of groundwater ingress to the mining area from the Permian strata using numerical groundwater flow models. The numerical groundwater flow model from the 2014 EIS and subsequent 2015 groundwater model refinement work provided estimates of future groundwater ingress to the mining areas. Whilst these estimates cannot be validated with measured data for the 2016 calendar year, the lack of inflow does confirm previous predictions of limited groundwater within the mining area.

MTW accounts for groundwater seepage into the mining area with Water Assess Licenses (WAL) issued under the *Water Management Act 2000*. MTW is located within the 'North Coast Fractured and Porous Rock Groundwater Water Sharing Plan' area. This Water Sharing Plan commenced in July 2016, midway through the annual review period. The area was formerly regulated under the Water Act 1912, and as part of the change in legislation water licenses are being converted to new formats. It is understood the conversion process is still underway at the time of writing. Table 5.1 below summarises water assess licenses held by MTW for the mining area excavations, and for individual bores. The table also includes RTCA's estimate of actual extraction under each water license, based on previous groundwater modelling simulations, which indicates sufficient entitlement to account for the water taken due to mining.

Table 5.1 Summary of licenses held by MTW

Licence number	Description	Water source	Water sharing plan	Water source management zone	Approved extraction (ML)*	Actual extraction 2016 (ML)
WAL40464 (previously 20BL170011)	Mt Thorley Pit Excavation	Permian Coal Seams	North Coast Fractured and Porous Rock Groundwater Sources WSP (commenced 1/7/16) Previously Water Act 1912	Sydney Basin – North Coast Groundwater Source	180	110#
WAL40465 (previously 20BL170012)	Warkworth Pit Excavation	Permian Coal Seams	North Coast Fractured and Porous Rock Groundwater Sources WSP (commenced 1/7/16) Previously Water Act 1912	Sydney Basin – North Coast Groundwater Source	750	140#
WAL18233	Old Farm	Hunter River Alluvium	Hunter Unregulated and Alluvial Water Sources WSP	Hunter Regulated River Alluvial Water Source – Downstream Glennies Creek Management Zone	5	3#
WAL18558	Hawkes	Wollombi Brook	Hunter Unregulated and Alluvial Water Sources WSP	Lower Wollombi Brook Water Source	50	9#
WAL19022	Sandy Hollow Creek	Unregulated River	Hunter Unregulated and Alluvial Water Sources WSP	Singleton Water Source	60	0

Notes: ** approved extraction limits are for a financial year*

 # passive take / groundwater inflows to pit

6 Impacts on users

There are no private water bores within the zone of depressurisation and drawdown identified by the MTW groundwater monitoring data. Private users of groundwater are present to the west of Wollombi Brook and typically (but not always) extract water from the alluvial sediments. Whilst there is no indication of any impact on groundwater levels within the bedrock or alluvium to the west of Wollombi Brook, there are no monitoring bores in this area to verify this conclusion.

Previous ecological studies for mine approvals identified the potential for riparian vegetation along Wollombi Brook to depend on the shallow groundwater table within the alluvial sediments. Similar to the conclusion above, there is no indication that depressurisation and drawdown is impacting upon groundwater levels within the Wollombi Brook alluvium in the existing monitoring data.

As noted in Chapter 3, additional monitoring bores were constructed within the Wollombi Brook alluvium to the west of MTW, which will assist in determining potential for impact on private users and ecological communities.

7 Conclusions and recommendations

The groundwater monitoring data collected during the 2016 calendar year was reviewed to determine if it complied with commitments within the MTW WMP. Groundwater monitoring is occurring on a quarterly basis in accordance with the WMP. The progression of mining means some bores appear to have not been accessible or had gone dry due to mining induced depressurisation and were therefore not monitored. These bores should be noted within the WMP or removed from the document.

In general, groundwater levels are responding in a manner similar to that predicted by previous groundwater modelling. The Permian coal measures are continuing to depressurise to the west and down dip of the mining area resulting in falling water levels within monitoring bores. The alluvial systems to the east along the Hunter River and the west along the Wollombi Brook are not measurably affected by mining. The exception is where the Wollombi Brook alluvium encroaches within close proximity to the Mt Thorley Loders Pit and a decline in alluvial water levels has been observed. Previous numerical modelling predicted a decline in this area, and a change in groundwater levels within this area was therefore expected. This is of little consequence as the alluvium immediately adjacent to Loders Pit has previously been identified to have a low productivity (AGE 2015).

A number of samples analysed during 2016 for pH and electrical conductivity exceeded trigger limits applied within the WMP. The WMP requires three consecutive measurements outside the trigger limit to initiate further investigation. The WMP also requires use of professional judgement to determine if a single deviation or a developing trend could result in environmental harm.

The available data for these bores with single or multiple exceedences was reviewed and it was concluded the majority of the trigger events are not related to mining activities. The majority of the bores did not record any long term rising or falling trends in water level or water chemistry. The trigger events are considered related to samples naturally falling outside the 95th and 5th percentile bounds adopted as triggers. Most of the bores that triggered recorded either pH or electrical conductivity that naturally fell at the bounds of the dataset, and therefore were more likely to trigger than bores closer to the median values.

Four bores recorded three consecutive samples above the trigger limits that require investigation. For each of these bores it was concluded:

- Bore G3 within the Wambo seam group in this area has recorded rising water levels and a declining pH trend evident considered likely to be resultant from mining activities, given the close proximity to Loders Pit and Bulga Mine. Whilst the pH has declined below the trigger levels, at pH 6.9 it remains relatively neutral and is not expected to compromise beneficial use. However, mining activities that have resulted in the changes in this bore should be confirmed.
- Bore WOH2139A is located to the west of and downdip of the mining area. The bore has recorded a declining trend in the water level which shows some weak correlation with a rising pH. The pH varies naturally within the bores within the Blakefield seam group, and bore WOH2139A is at the upper end of the data set. Fluctuations in EC are therefore more likely to trigger within this bore than in other bores. Whilst the decline in water level has potential influenced the pH slightly at this location, it is not considered sufficient to compromise beneficial use or environmental value.
- The declining pH within samples collected from WOH2156A is weakly correlated with the declining groundwater level within this bore. The pH during 2017 remained relatively stable at pH 7.0, which is relatively neutral and is not expected to compromise beneficial use or environmental value. Historical measurements have also recorded pH 7.0, and the available data suggests a continuing declining trend is unlikely.
- Samples collected from WOH2156B first exceed the electrical conductivity trigger in early 2014, and have stabilised at above the trigger level since this time. Whilst the reason for the increase in unclear, this bore is downdip of the mining where there is an inward hydraulic gradient preventing the outward movement of mine water to the groundwater systems. The change in electrical conductivity over time is considered likely to relate to local changes in water pressures around the borehole and would compromise beneficial use or environmental value.

As noted previously, the imminent addition to the monitoring programme of recently constructed nested monitoring bores along the Wollombi Brook will assist in the ongoing assessment of potential offsite impacts associated with the development.

8 References

Australasian Groundwater and Environmental Consultants Pty Ltd (2015). *Mount Thorley and Warkworth Mines Long Term Approvals Model Update*, Project No, G1468G, dated February 2015.

Rio Tinto Coal Australia (2016) *Mount Thorley Warkworth, Water Management Plan*, Prepared by Rio Tinto Coal Australia, dated 21 March 2016.

Appendix A Monitoring program details

Bore ID	Year	Coordinates (MGA94)		Ground level (mAHD)	Depth (m)	Screen			Trigger grouping
		mE	mN			Geology	Top (m)	Bot (m)	
ABGOH07	2006	308890*	1386614*	77.817					
ABGOH12	2006	308831*	1387800*	67.990					
MTAGP1		321516	6386558	78.206	28				
MTAGP2		321575	6386019	72.307	33				
OH786		308145	6389990	67.3		Alluvium			Hunter River alluvium
OH787		308571	6392112	49.9		Alluvium			Hunter River alluvium
OH788		309052	6391146	44.7		Alluvium			Hunter River alluvium
OH942		308138	6392818	54.8		Alluvium			Hunter River alluvium
OH943		309046	6391142	44.7		Alluvium			Hunter River alluvium
OH944		308684	6391218	42.8		Alluvium			Hunter River alluvium
OH1121		309473	6391201	44.6	24	Permian			Vaux seam
OH1122 (1)		306058	6388120	100.2		Permian			Blakefield seam
OH1122 (2)		306058	6388120	100.2		Permian			
OH1122 (3)		306058	6388120	100.2		Permian			Bowfield seam
OH1123 (1)		304521	6389764	98.3		Permian			
OH1123 (2)		304521	6389764	98.3		Permian			
OH1123 (3)		304521	6389764	98.3		Permian			
OH1124		316893	6391526	88.2	168				
OH1125 (1)		304125	6393151	85.4	156	Permian			Blakefield seam
OH1125 (2)		304125	6393151	85.4		Permian			
OH1125 (3)		304125	6393151	85.4		Permian			Bowfield seam
OH1126		306202	6393618	63.7	78	Permian			Vaux seam
OH1127		309035	6392276	50.3	27	Permian			Bayswater Seam
OH1128		318423	6389901	113.59	26.8				
OH1129		318423	6389866	113.67	26.6				
OH1130		318527	6389797	107.27	26.3				
OH1131		318475	6389831	108.3	26.3				
OH1132		318440	6389849	111.67	26.7				

Bore ID	Year	Coordinates (MGA94)		Ground level (mAHD)	Depth (m)	Screen			Trigger grouping
		mE	mN			Geology	Top (m)	Bot (m)	
OH1133		318371	6390731	92.2	17.8				
OH1134		318405	6390644	92.75	14				
OH1135		318353	6390592	92.61	18				
OH1136		318371	6390523	92.15	21.5				
OH1137		305889	6393613	67.7	99.9	Alluvium			Vaux seam
OH1138 (1)		305451	6393592	70.5	99.9	Permian			Warkworth seam
OH1138 (2)		305451	6393592	70.5		Permian			Warkworth seam
GW9706	1997	322403	6387589	64.2		-	18	21	Bayswater Seam
GW9707	1997	322319	6387568	63.9		-	18	21	Bayswater Seam
GW9708	1997	322158	6387208	73.1		-	26	29	Bayswater Seam
GW9709	1997	322251	6388026	60.3		-	18	21	Bayswater Seam
GW98MTCL1	1997	322185	6387133	77.012			15	19	Bayswater Seam
GW98MTCL2	1997	322669	6387464	78.792			21	27	Bayswater Seam
G3		317785	6385249	-		-			Wambo seam
WOH2139A		315165	6391540	88.7		Permian			Blakefield seam
WOH2139 (PZ5)		315165	6391540	88.7217			95	46	
WOH2141 (PZ6)		314923	6392636	91.791			75	48	
WOH2141A		314923	6392636	91.8		Permian			
WOH2141B		314923	6392636	91.8		Permian			Blakefield seam
WOH2153 (PZ2)		313874	6391503	68.1731			62	43	
WOH2153A		313874	6391503	68.2		Permian			Redbank seam
WOH2153B		313874	6391503	68.2		Permian			Wambo seam
WOH2154 (PZ1)		314064	6389972	67.8919			98	69	
WOH2154A		314064	6389972	67.9		Permian			Redbank seam
WOH2154B		314064	6389972	67.9		Permian			Wambo seam

Bore ID	Year	Coordinates (MGA94)		Ground level (mAHD)	Depth (m)	Screen			Trigger grouping
		mE	mN			Geology	Top (m)	Bot (m)	
WOH2155 (PZ4)		315279	6390125	74.3105			71	46	
WOH2155A		315279	6390125	74.3		Permian			Redbank seam
WOH2155B		315279	6390125	74.3		Permian			Wambo seam
WOH2156 (PZ3)		315837	6388878	79.4308			80	55	
WOH2156A		315837	6388878	79.7		Permian			Redbank seam
WOH2156B		315837	6388878	79.4		Permian			Wambo seam
PZ7S		314055	6392671	57.4		Alluvium			Warkworth sands
PZ7D		314057	6392684	57.4		Permian			Shallow overburden
PZ8S		317002	6385411	64.7		Alluvium			Wollombi Brook alluvium
PZ8D		317001	6385418	64.8		Permian			Shallow overburden
PZ9S		317542	6385642	64.5		Alluvium			Wollombi Brook alluvium
PZ9D		317541	6385652	64.6		Permian			Shallow overburden

Note: ** - coordinates integrated survey grid (ISG)*

2 Programme

Table 1: Groundwater Monitoring Locations - Parameters and Frequency

Location	Parameter & Frequency				
Sample Point	**Water Level**	**EC**	**pH**	**Comprehensive Analysis[1]**	**Alk/Acidity**
G3	Q	Q	Q	A	Q
OH 786	Q	Q	Q	A	
OH 787	Q	Q	Q	A*	Q
OH 788	Q	Q	Q	A	
OH 942	Q	Q	Q	A*	
OH 943	Q	Q	Q	A	
OH 944	Q	Q	Q	A	
OH1121	Q	Q	Q	A	
OH1122 (1)	Q	Q	Q	A*	
OH1122(2)	Q	Q	Q	A*	
OH 1125(1)	Q	Q	Q	A*	Q
OH 1125(2)	Q	Q	Q	A*	Q
OH 1125(3)	Q	Q	Q	A*	Q
OH 1126	Q	Q	Q	A	Q
OH 1127	Q	Q	Q	A	
OH 1137	Q	Q	Q	A	
OH 1138(1)	Q	Q	Q	A	
OH 1138(2)	Q	Q	Q	A	
WOH2139A	Q	Q	Q	A*	
WOH2153A	Q	Q	Q	A	
WOH2153B	Q	Q	Q	A	
WOH2154A	Q	Q	Q	A	
WOH2154B	Q	Q	Q	A	
WOH2155A	Q	Q	Q	A	
WOH2155B	Q	Q	Q	A	

WOH2156A	Q	Q	Q	A	
WOH2156B	Q	Q	Q	A	
WOH2141A	Q	Q	Q	A	
WOH2141B	Q				
PZ7D	Q	Q	Q	A	
PZ7S	Q	Q	Q	A	
PZ8D	Q	Q	Q	A	
PZ8S	Q	Q	Q	A	
PZ9D	Q	Q	Q	A	
PZ9S	Q	Q	Q	A	
GW9706	Q	Q	Q	A	
GW9707	Q	Q	Q	A	
GW9708	Q	Q	Q	A	
GW9709	Q	Q	Q	A	
GW98MTCL1	Q	Q	Q	A	
GW98MTCL2	Q	Q	Q	A	
PZ1 (VWP)	Q	Q	Q	A	
PZ2 (VWP)	Q	Q	Q	A	
WD609A (VWP)	Q				
WD615 (VWP)	Q				
WD625 (VWP)	Q				
WD625P	Q	Q	Q	A	
WD622 (VWP)	Q				
WD622P	Q	Q	Q	A	
MTD616 (VWP)	Q				
MTD616P	Q	Q	Q	A	
MTD613 (VWP)	Q				
MTD605 (VWP)	Q				
MTD605P	Q	Q	Q	A	
MTD614 (VWP)	Q				
MTD614P	Q	Q	Q	A	
WD456 (VWP)	Q	Q	Q	A	
WD462 (VWP)	Q	Q	Q	A	
MTD517 (VWP)	Q	Q	Q	A	
MTD518 (VWP)	Q	Q	Q	A	

[1]Comprehensive analysis includes major ions TDS, Al, As, B, Ca, Cd, Cl, (CO3), Cu, Hg, K, Mg, Na, Ni, Pb, Se, SO4 (or S), Zn, Total Alkalinity, Bicarbonate Alkalinity, Carbonate Alkalinity, Hydroxide Alkalinity.

*=Comprehensive analysis also includes: Mo, V and Cr

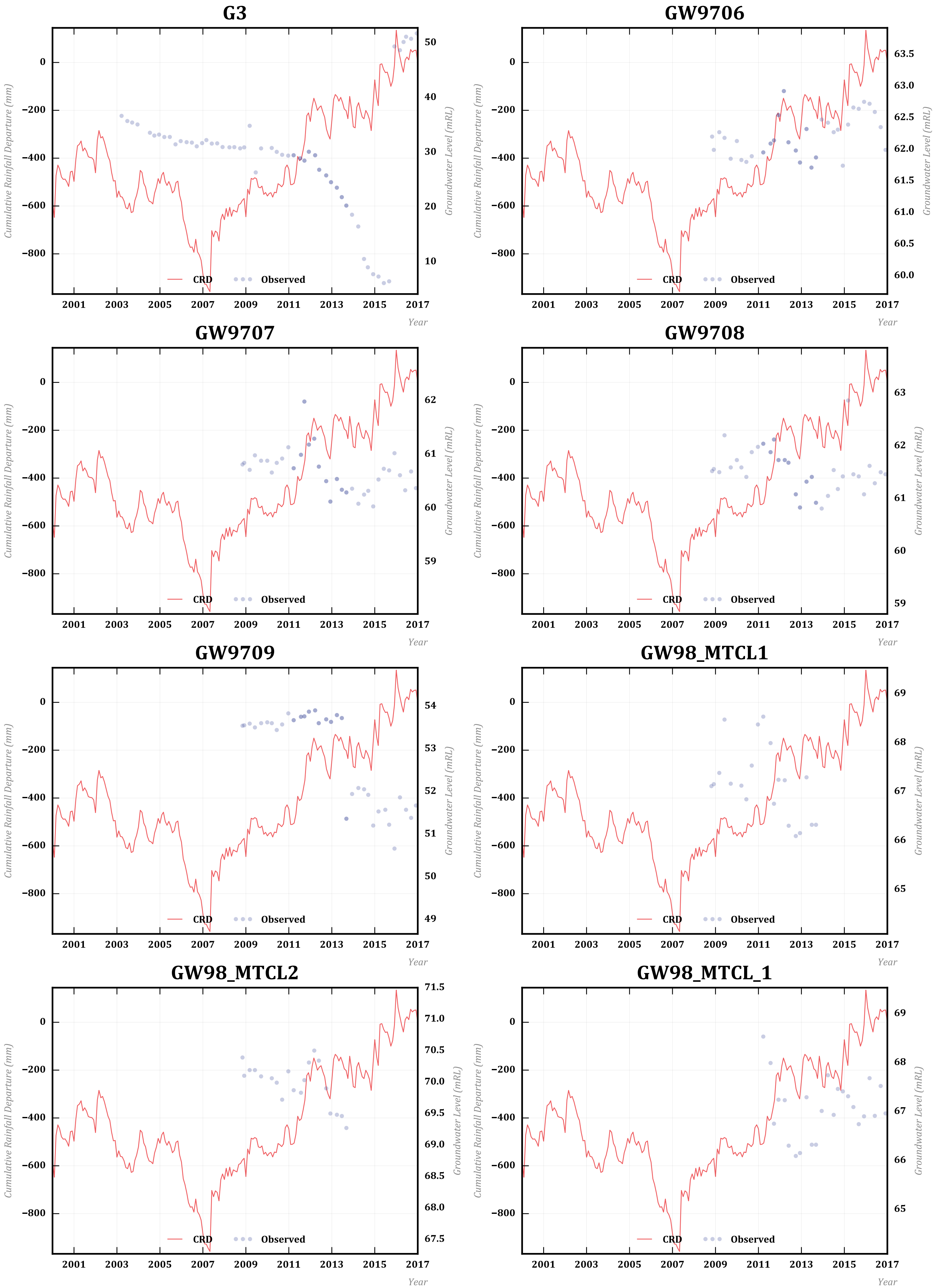
(DL) denotes the presence of a Datalogger.

(VWP) denotes vibrating wire piezometer.

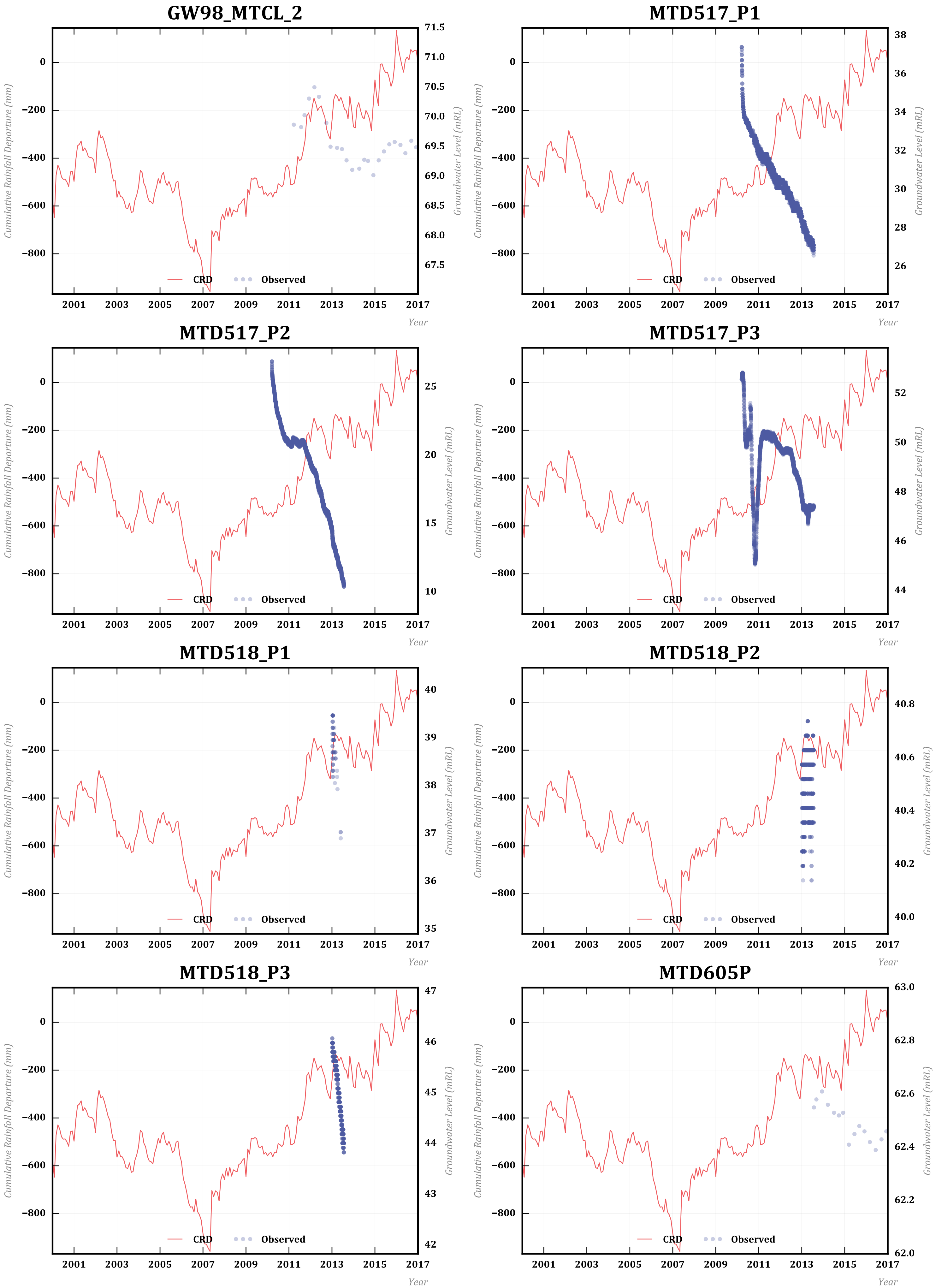
Table 2: Groundwater Trigger Limits

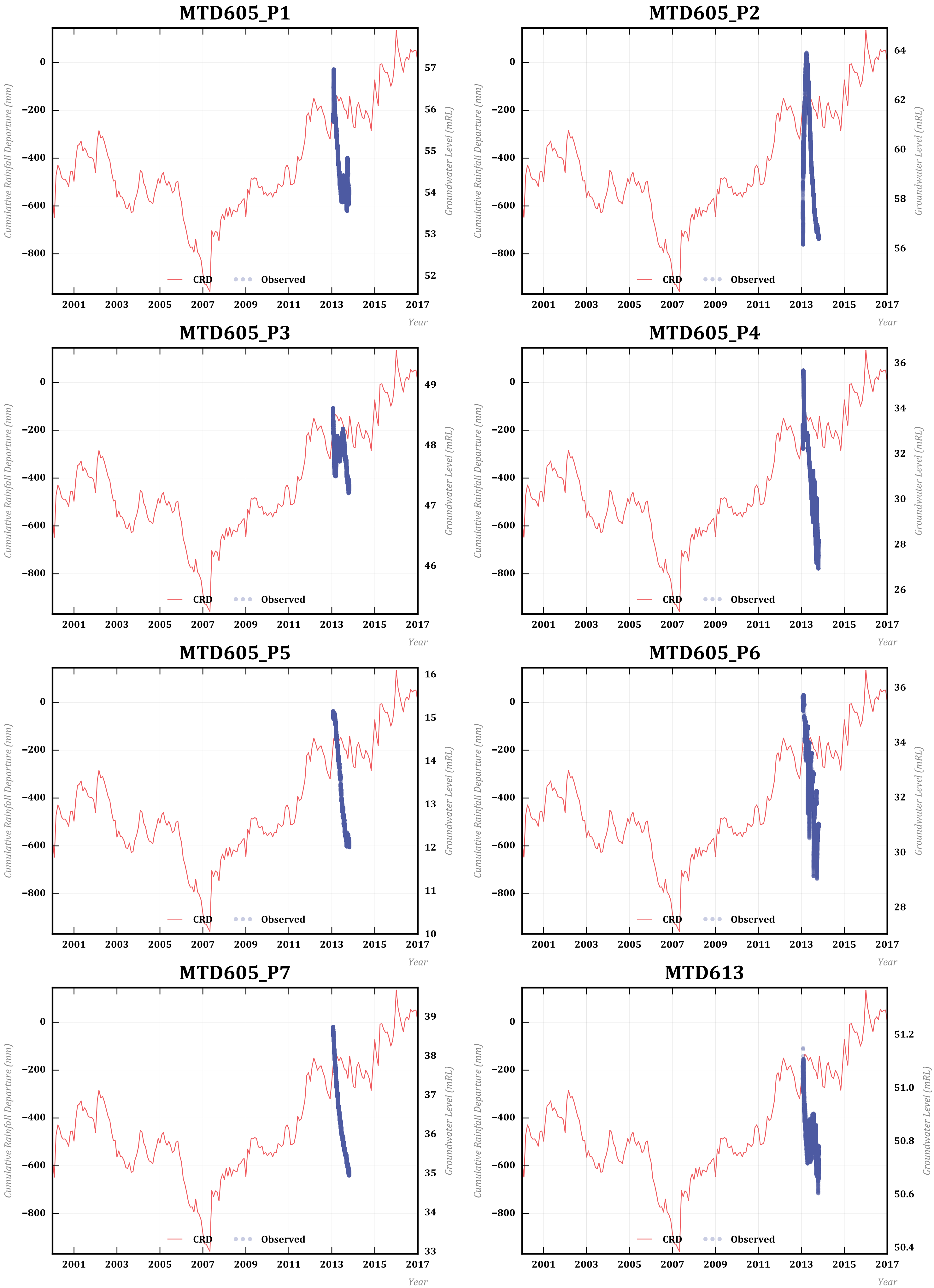
Sample Point	Target Seam	Electrical Conductivity	pH	
		95	5	95
OH 786	Hunter River Alluvium	933	7.0	7.7
OH 787	Hunter River Alluvium	17895	7.3	7.7
OH 942	Hunter River Alluvium	24845	6.6	7.1
OH 943	Hunter River Alluvium	8451	7.2	7.6
OH 944	Hunter River Alluvium	7758	7.9	8.0
OH 788	Hunter River Alluvium	11798	7.0	7.9
PZ8S PZ9S	Wollombi Brook Alluvium	16020	6.6	7.0
PZ7S	Aeolian Warkworth Sands	1677	6.8	7.5
GW9706 GW9707 GW9708 GW9709 GW98MTCL1 GW98MTCL2 OH 1127	Bayswater	23010	6.7	7.5
OH1125(3)	Bowfield Seam	14570	6.6	6.9
OH1122 (1) WOH2139A OH1125(1)	Blakefield	14980	6.6	7.4
WOH2153A WOH2154A WOH2155A WOH2156A	Redbank	16293	7.1	7.9
PZ7D PZ8D PZ9D	Shallow Overburden	10100	6.9	8.1
OH 1137 OH 1126 OH1121	Vaux	17748	6.7	7.1
G3 WOH2153B WOH2154B WOH2155B WOH2156B	Wambo	12112	7.2	7.9
OH 1138(2) OH 1138(1)	Warkworth	18930	6.4	7.1

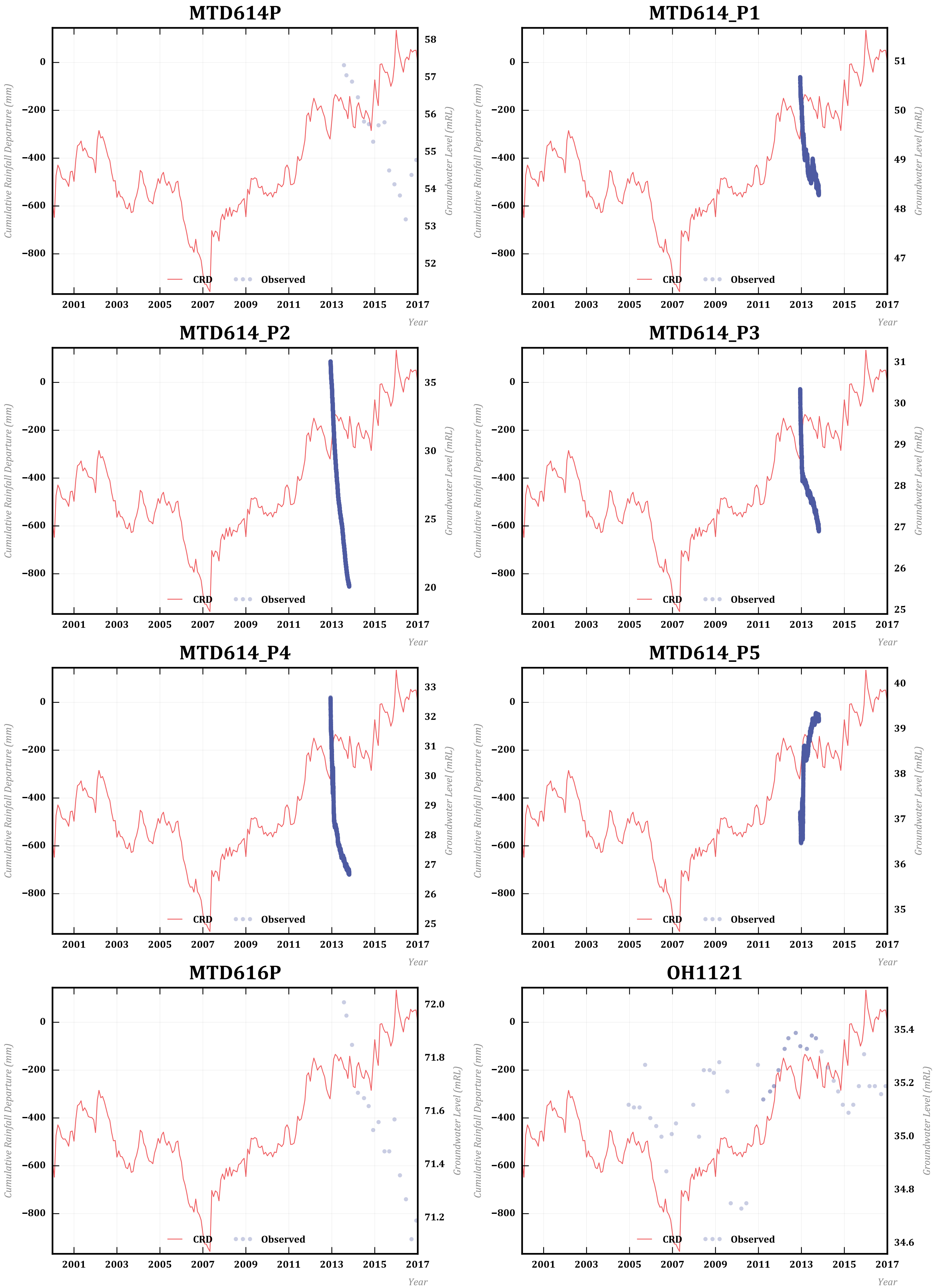
Appendix B Hydrographs and CRD

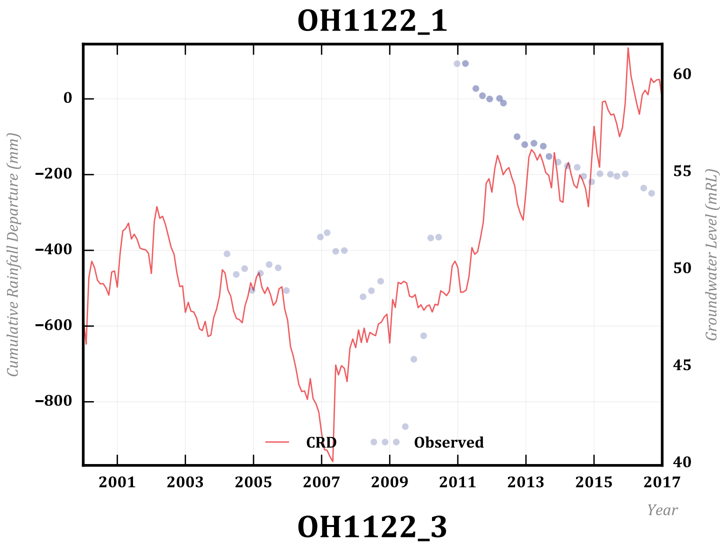


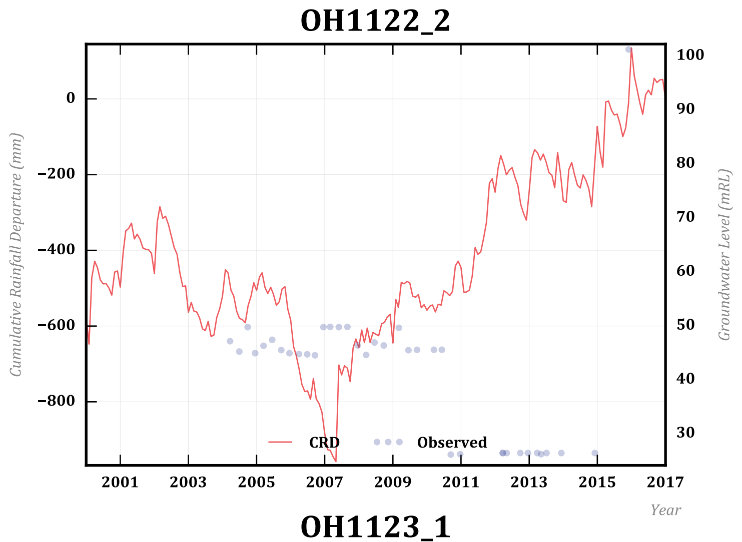
G3
GW9706
GW9707
GW9708
GW9709
GW98_MTCL1
GW98_MTCL2
GW98_MTCL_1
Cumulative Rainfall Departure (mm)
Groundwater Level (mRL)
Year
CRD
Observed
0
−200
−400
−600
−800
2001
2003
2005
2007
2009
2011
2013
2015
2017

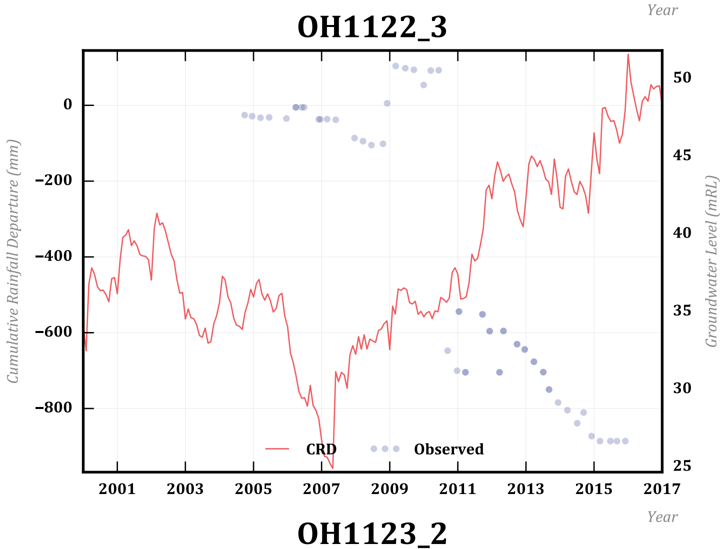

GW98_MTCL_2
MTD517_P1
MTD517_P2
MTD517_P3
MTD518_P1
MTD518_P2
MTD518_P3
MTD605P
Cumulative Rainfall Departure (mm)
Groundwater Level (mRL)
Year
CRD
Observed
2001
2003
2005
2007
2009
2011
2013
2015
2017

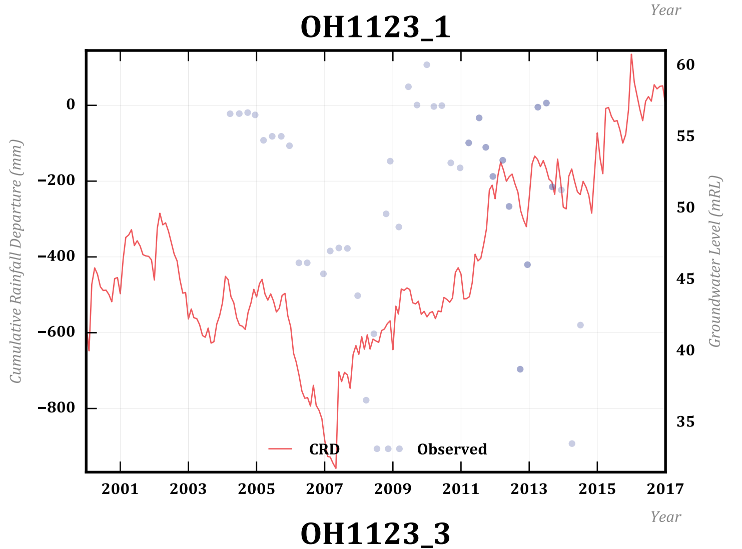

MTD605_P1
MTD605_P2
MTD605_P3
MTD605_P4
MTD605_P5
MTD605_P6
MTD605_P7
MTD613
Cumulative Rainfall Departure (mm)
Groundwater Level (mRL)
Year
CRD
Observed
2001
2003
2005
2007
2009
2011
2013
2015
2017

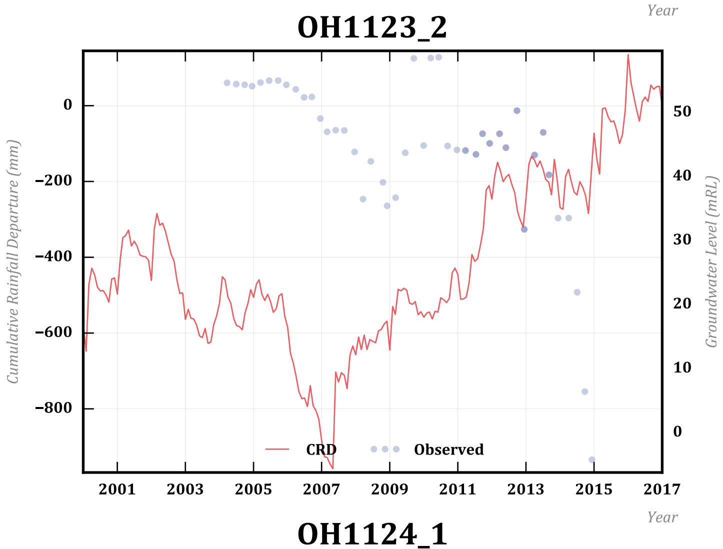

MTD614P
MTD614_P1
MTD614_P2
MTD614_P3
MTD614_P4
MTD614_P5
MTD616P
OH1121
Cumulative Rainfall Departure (mm)
Groundwater Level (mRL)
Year
CRD
Observed

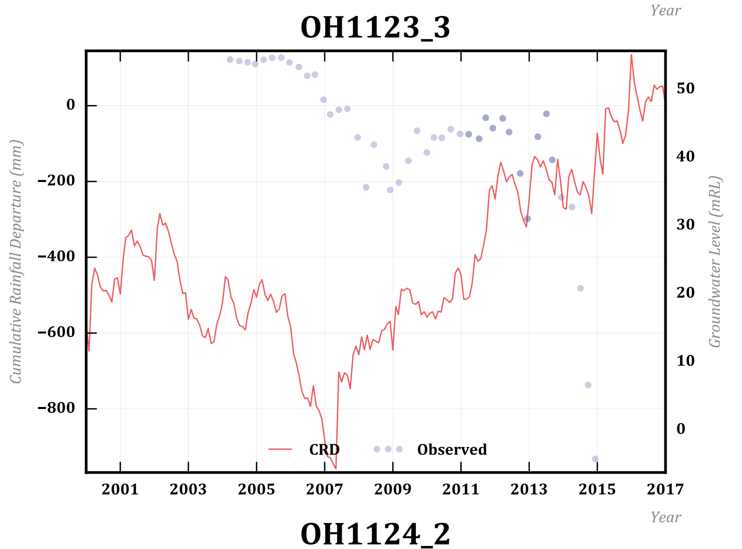

OH1122_1
Cumulative Rainfall Departure (mm)
Groundwater Level (mRL)
Year
CRD
Observed

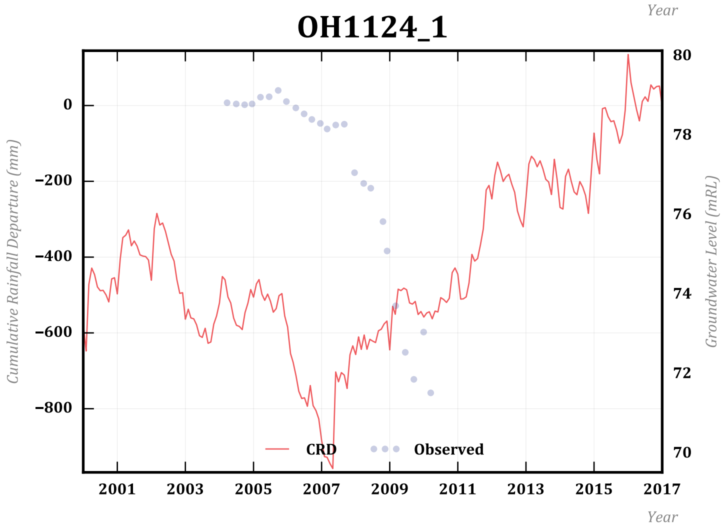

OH1122_2
Cumulative Rainfall Departure (mm)
Groundwater Level (mRL)
Year
CRD
Observed

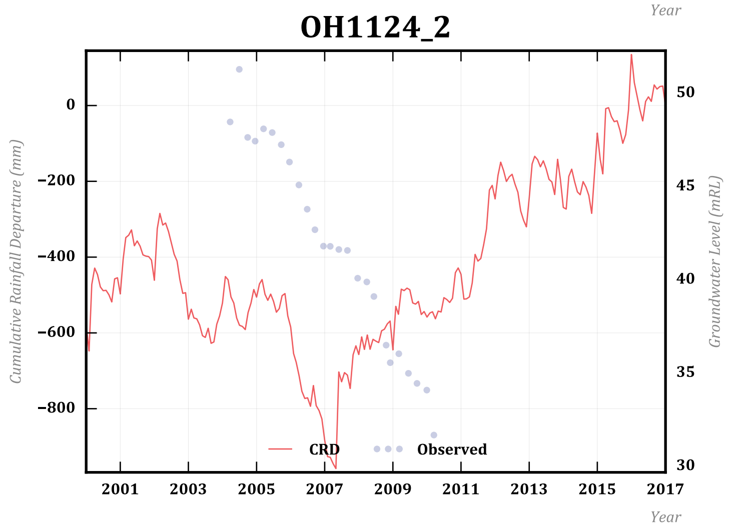

OH1122_3
Cumulative Rainfall Departure (mm)
Groundwater Level (mRL)
Year
CRD
Observed

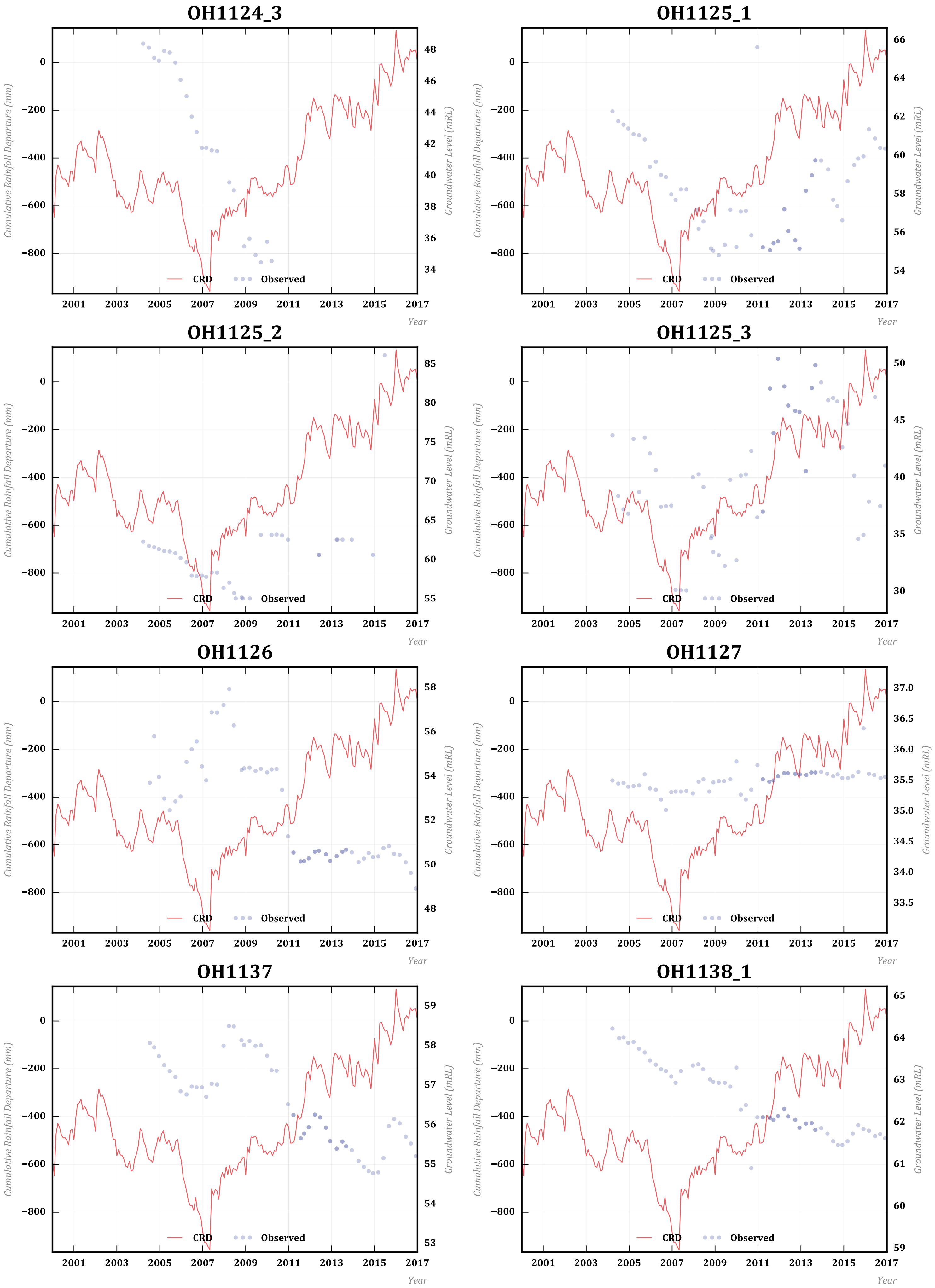

OH1123_1
Cumulative Rainfall Departure (mm)
Groundwater Level (mRL)
Year
CRD
Observed


OH1123_2
Cumulative Rainfall Departure (mm)
Groundwater Level (mRL)
Year
CRD
Observed

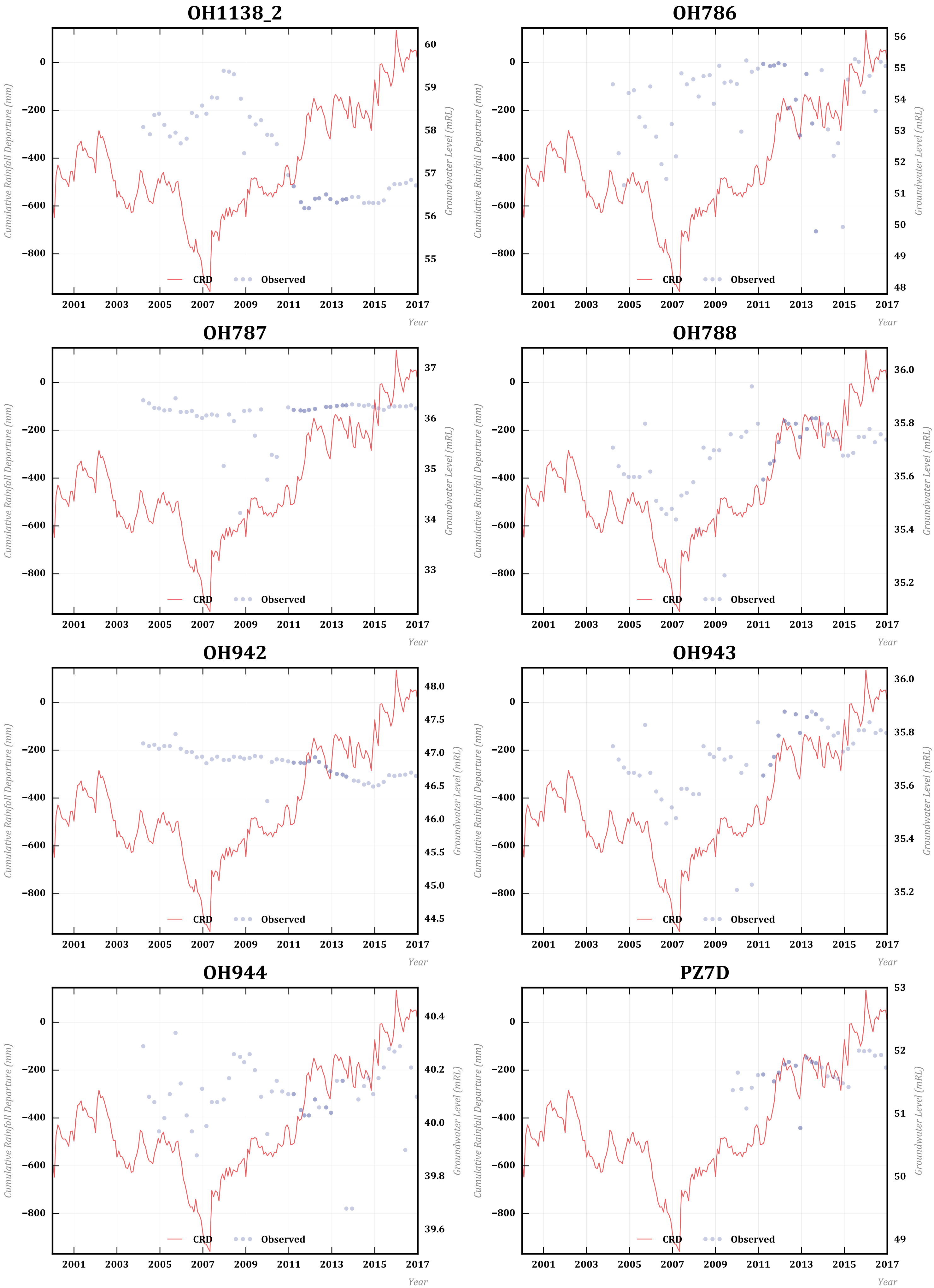

OH1123_3
Cumulative Rainfall Departure (mm)
Groundwater Level (mRL)
Year
CRD
Observed

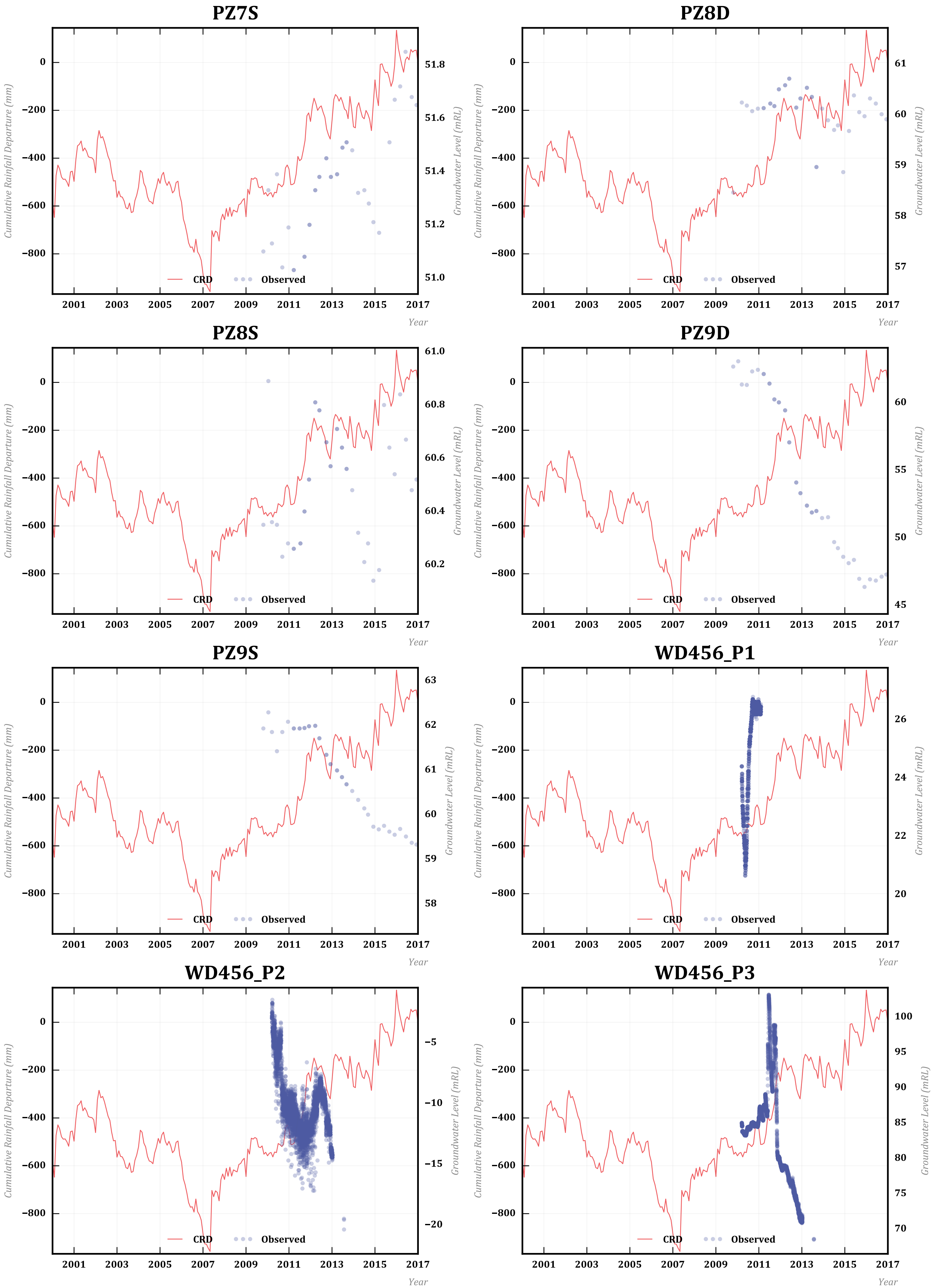

OH1124_1
Cumulative Rainfall Departure (mm)
Groundwater Level (mRL)
Year
CRD
Observed


OH1124_2
Cumulative Rainfall Departure (mm)
Groundwater Level (mRL)
Year
CRD
Observed

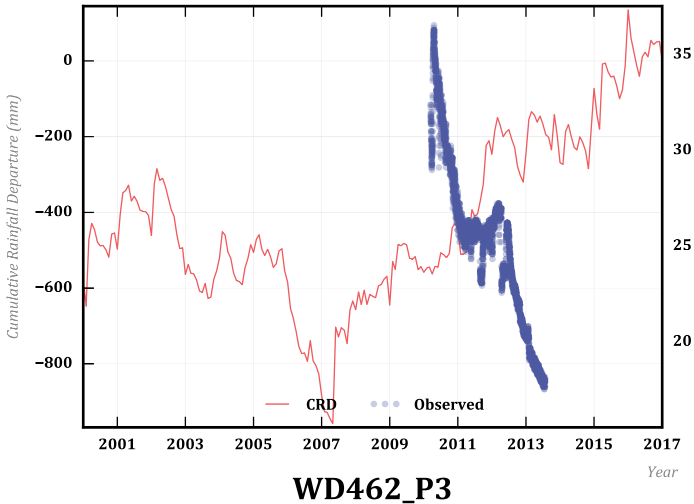


OH1124_3
OH1125_1
OH1125_2
OH1125_3
OH1126
OH1127
OH1137
OH1138_1
Cumulative Rainfall Departure (mm)
Groundwater Level (mRL)
Year
CRD
Observed
2001
2003
2005
2007
2009
2011
2013
2015
2017


OH1138_2
OH786
OH787
OH788
OH942
OH943
OH944
PZ7D
Cumulative Rainfall Departure (mm)
Groundwater Level (mRL)
Year
CRD
Observed
2001
2003
2005
2007
2009
2011
2013
2015
2017


PZ7S
Cumulative Rainfall Departure (mm)
0
−200
−400
−600
−800
Groundwater Level (mRL)
51.8
51.6
51.4
51.2
51.0
CRD
Observed
2001 2003 2005 2007 2009 2011 2013 2015 2017
Year
PZ8D
Cumulative Rainfall Departure (mm)
Groundwater Level (mRL)
61
60
59
58
57
CRD
Observed
Year
PZ8S
Cumulative Rainfall Departure (mm)
Groundwater Level (mRL)
61.0
60.8
60.6
60.4
60.2
CRD
Observed
Year
PZ9D
Cumulative Rainfall Departure (mm)
Groundwater Level (mRL)
60
55
50
45
CRD
Observed
Year
PZ9S
Cumulative Rainfall Departure (mm)
Groundwater Level (mRL)
63
62
61
60
59
58
CRD
Observed
Year
WD456_P1
Cumulative Rainfall Departure (mm)
Groundwater Level (mRL)
26
24
22
20
CRD
Observed
Year
WD456_P2
Cumulative Rainfall Departure (mm)
Groundwater Level (mRL)
−5
−10
−15
−20
CRD
Observed
Year
WD456_P3
Cumulative Rainfall Departure (mm)
Groundwater Level (mRL)
100
95
90
85
80
75
70
CRD
Observed
Year

WD462_P1



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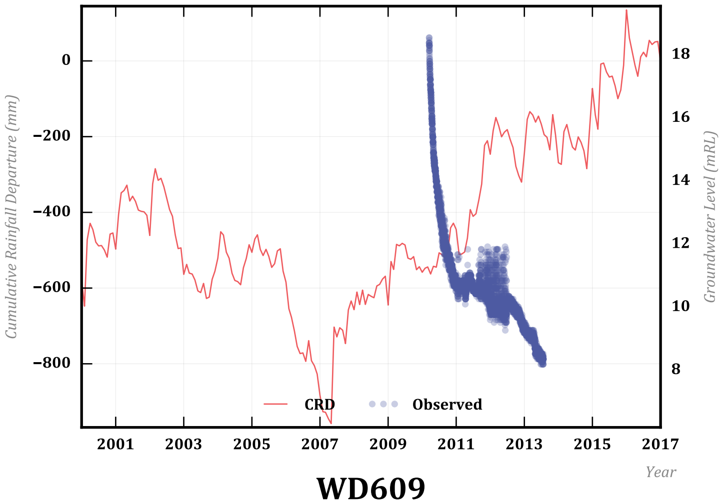
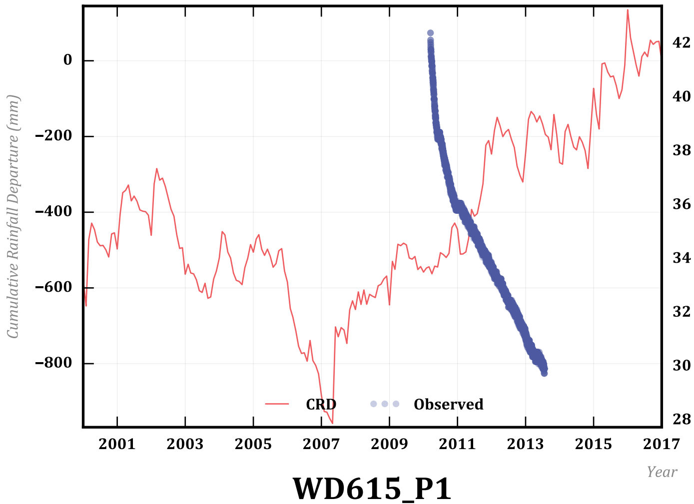
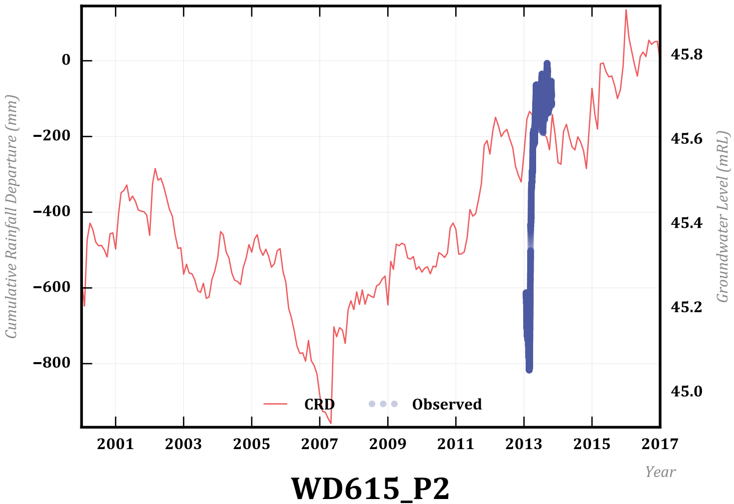


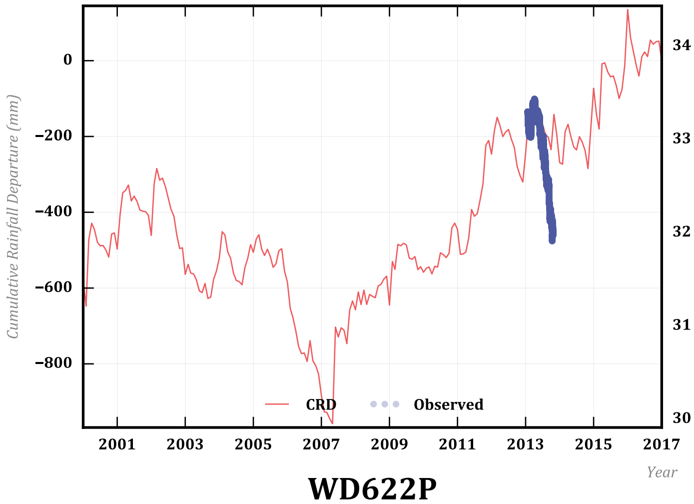
WD462_P3



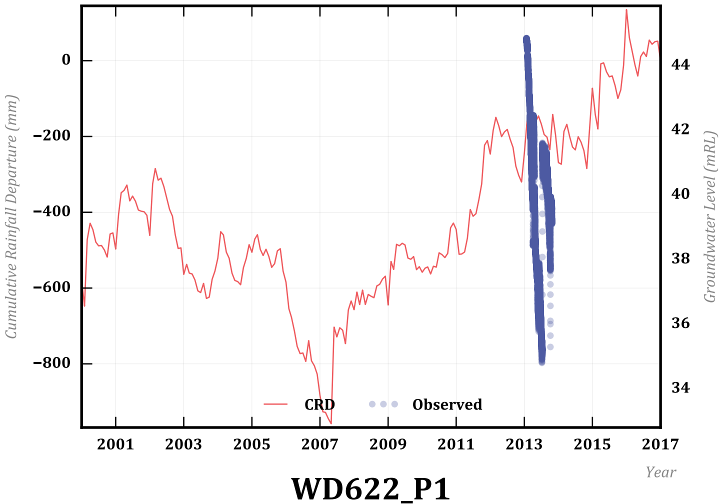
WD609



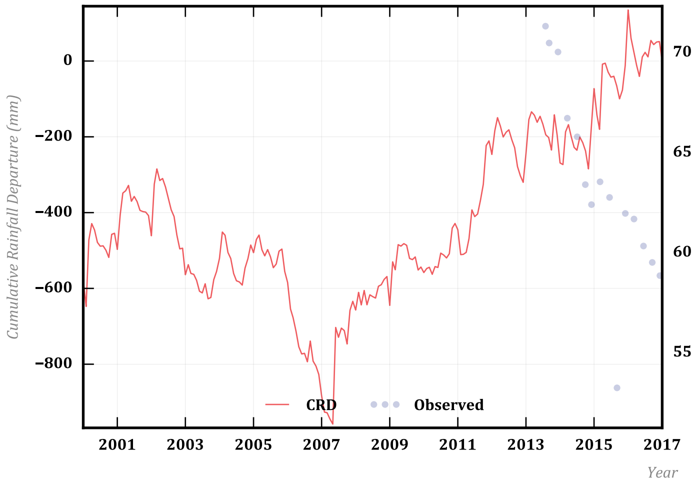
WD615_P1



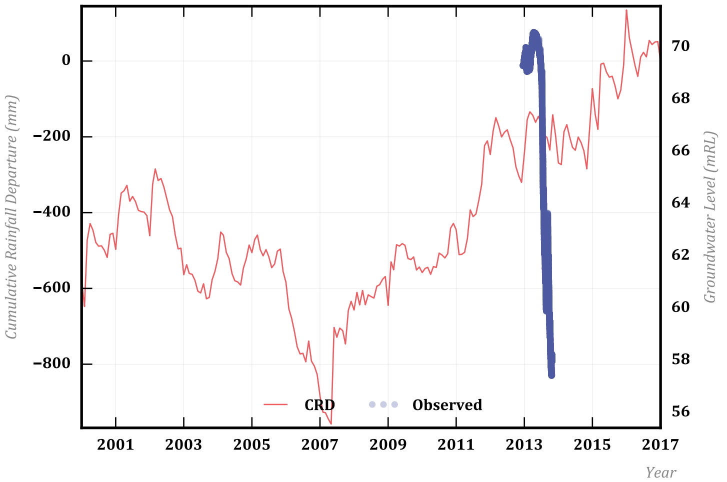
WD615_P2



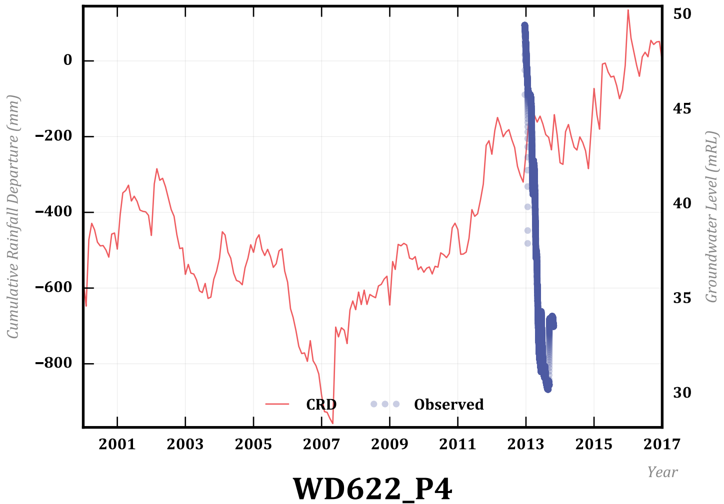
WD622P



WD622_P1



WD622_P2



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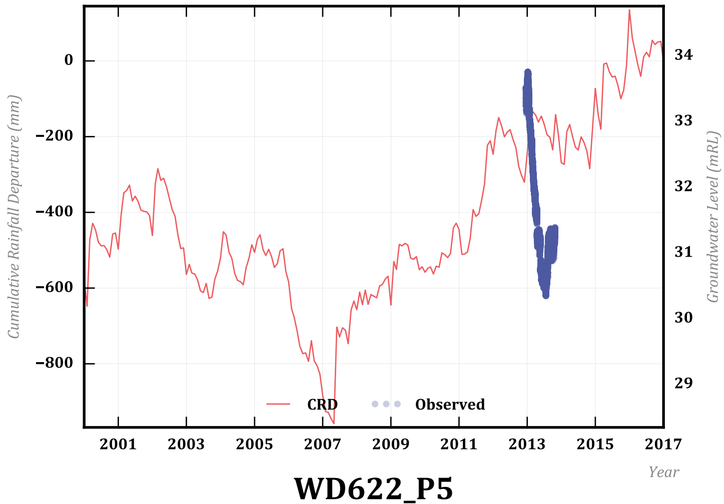
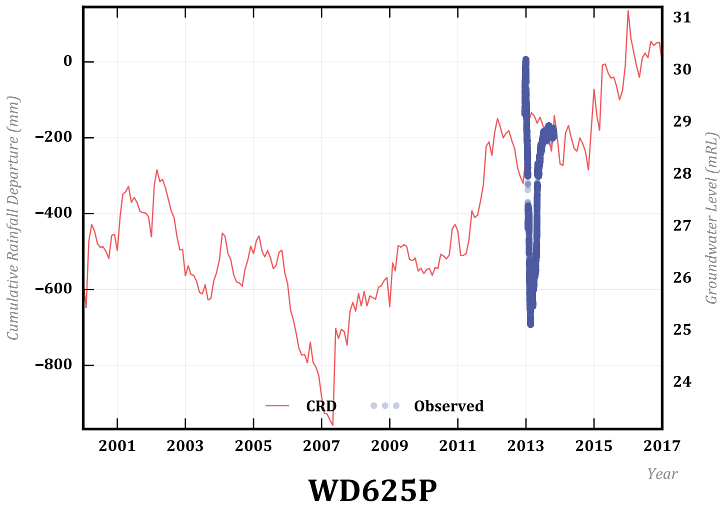
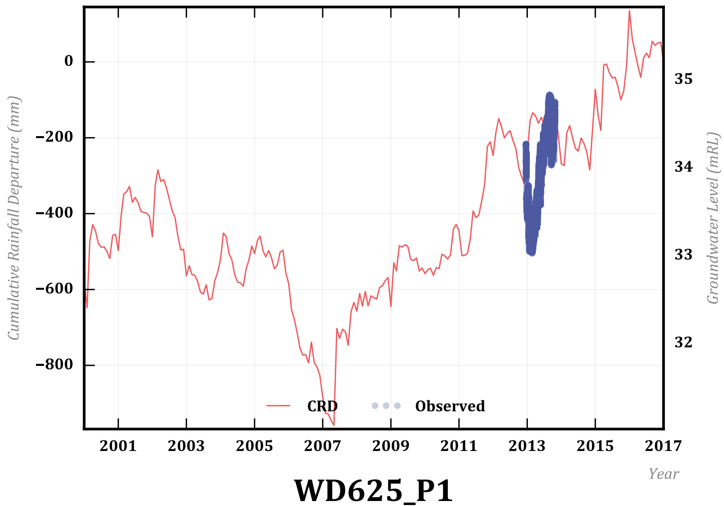


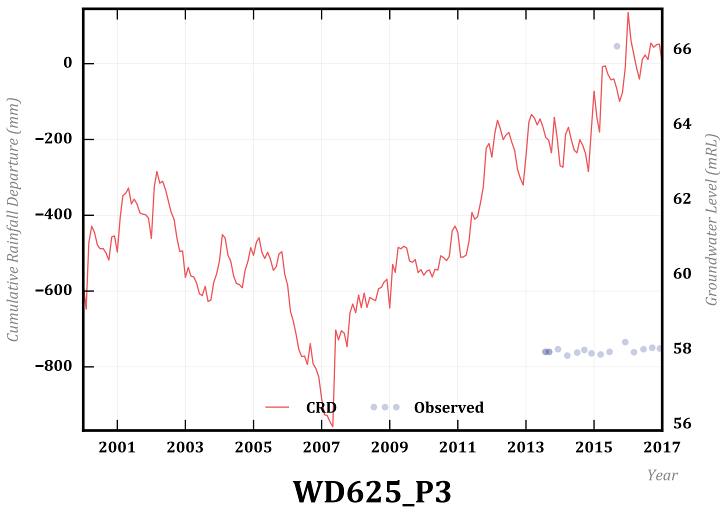
WD622_P4



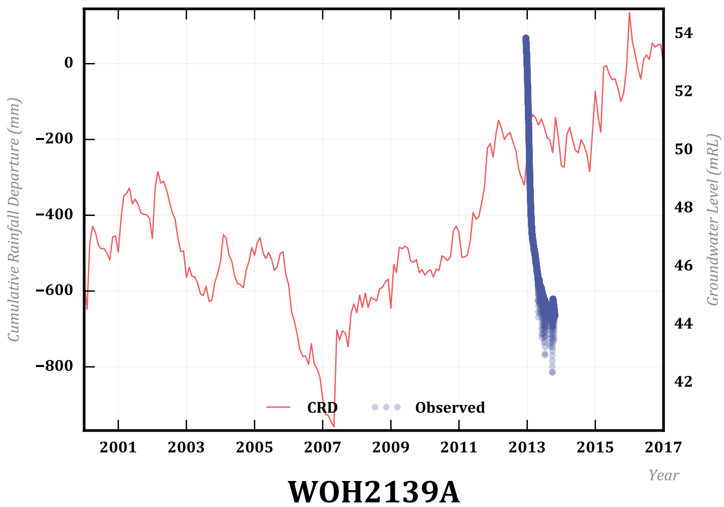
WD622_P5



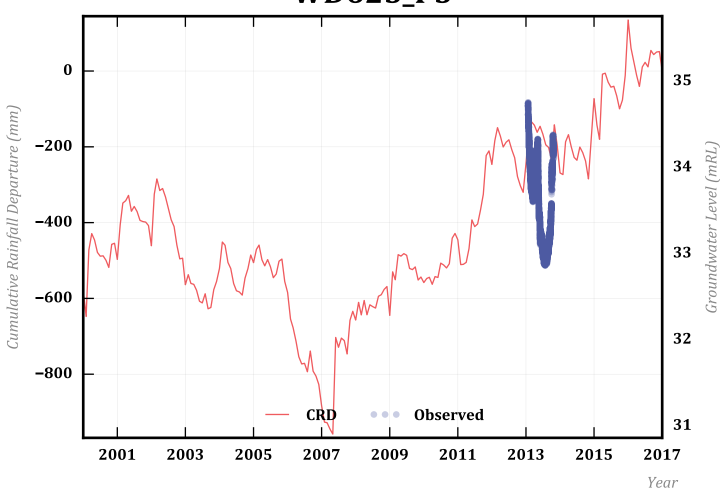
WD625P



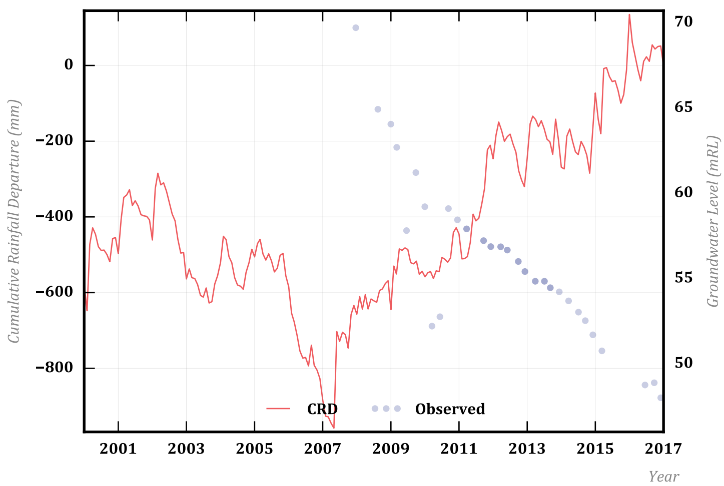
WD625_P1

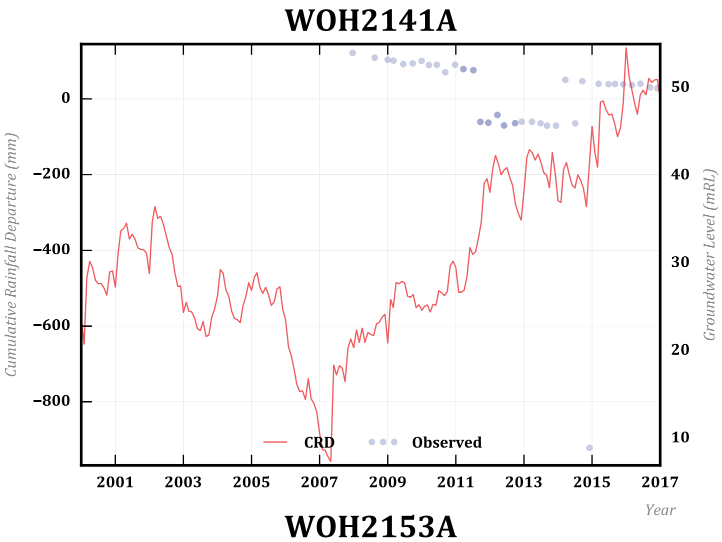
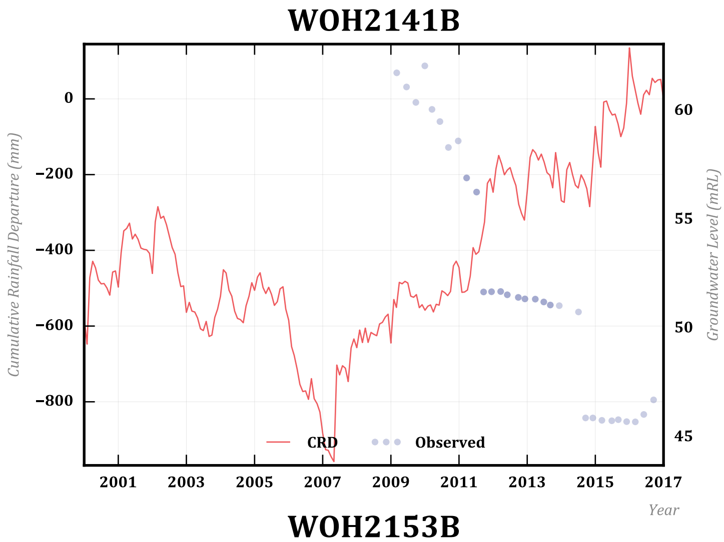
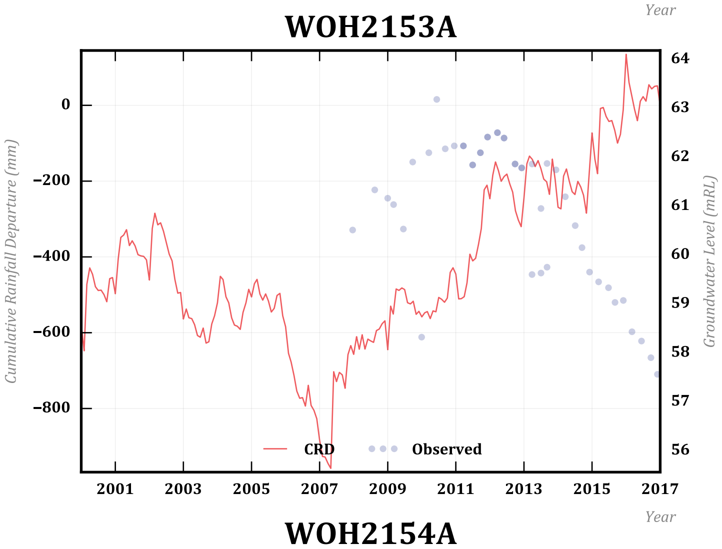
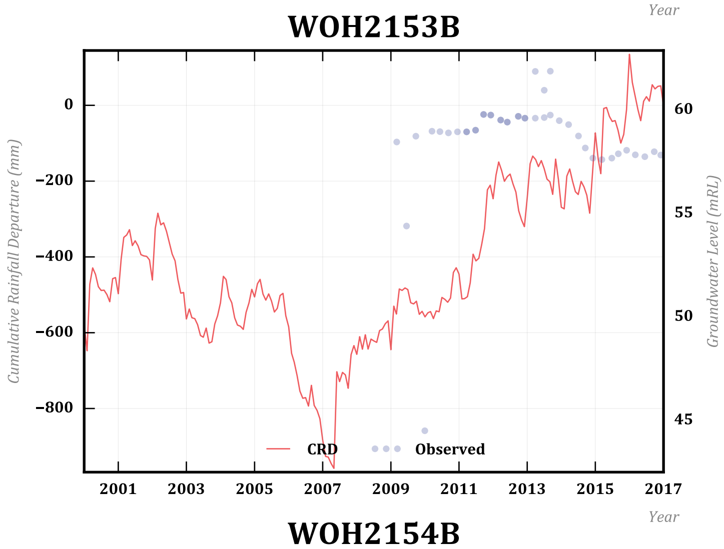
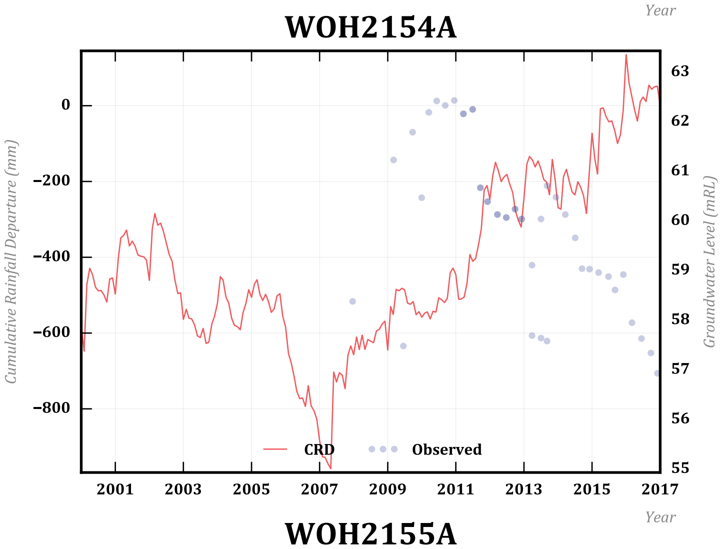
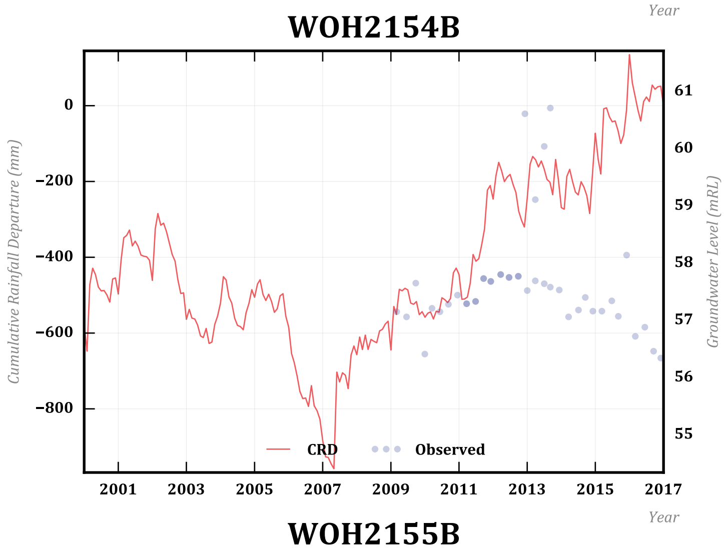
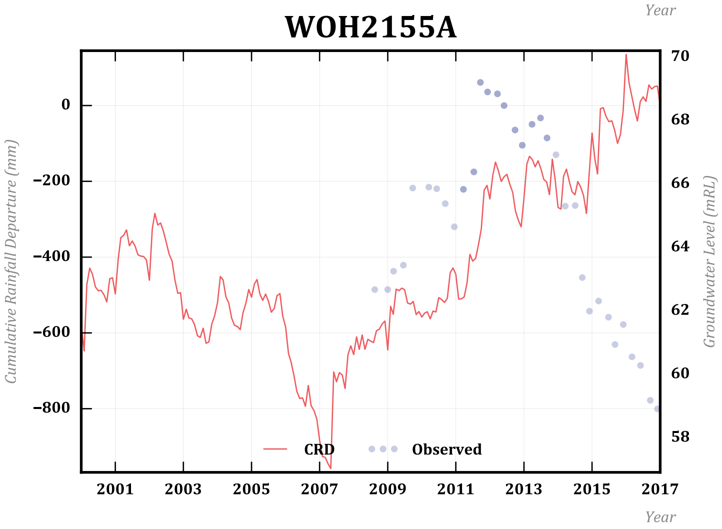
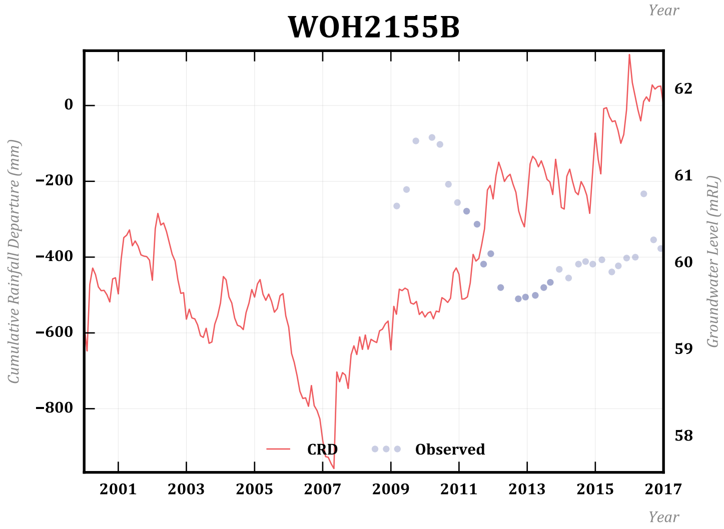


WD625_P3

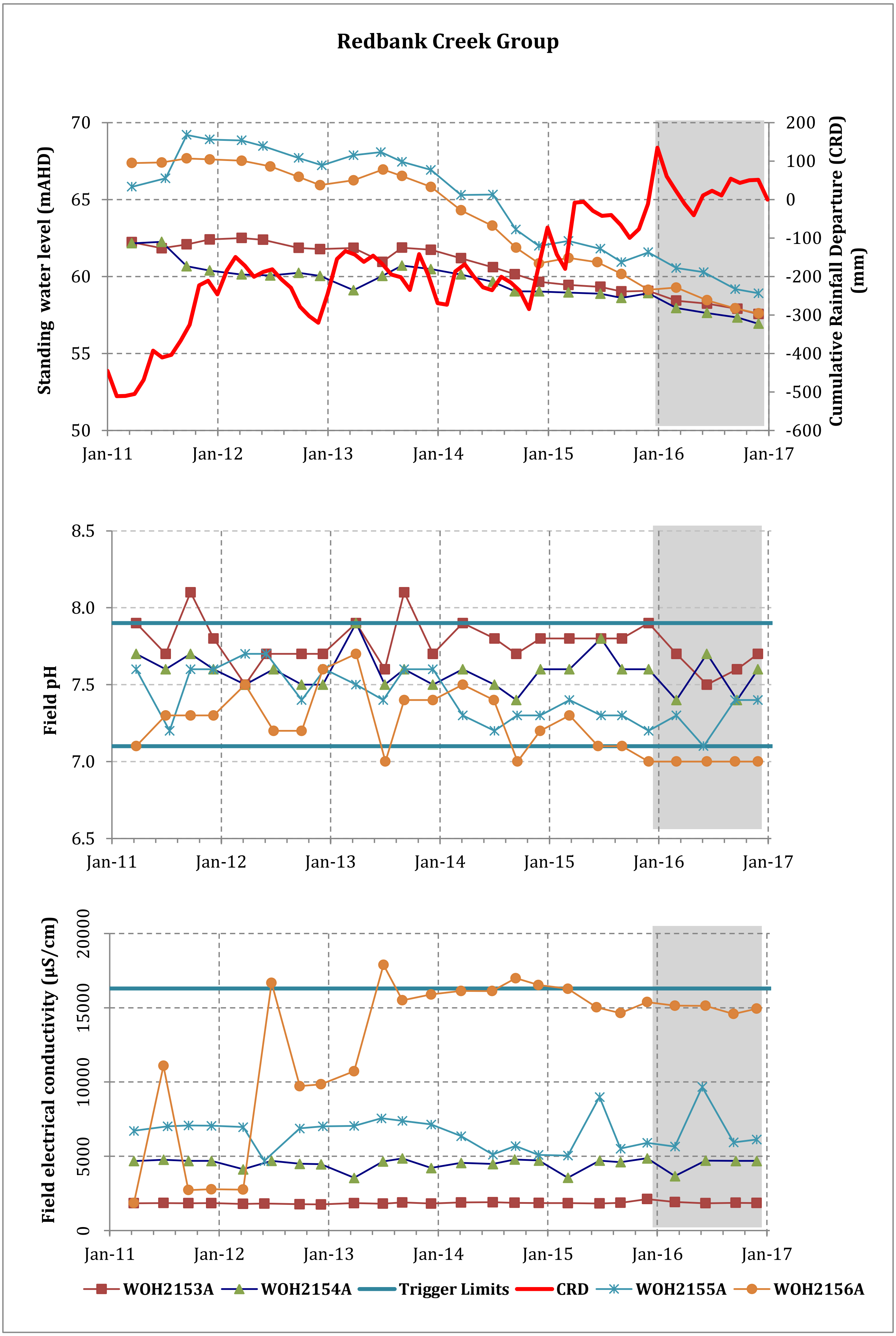


WOH2139A

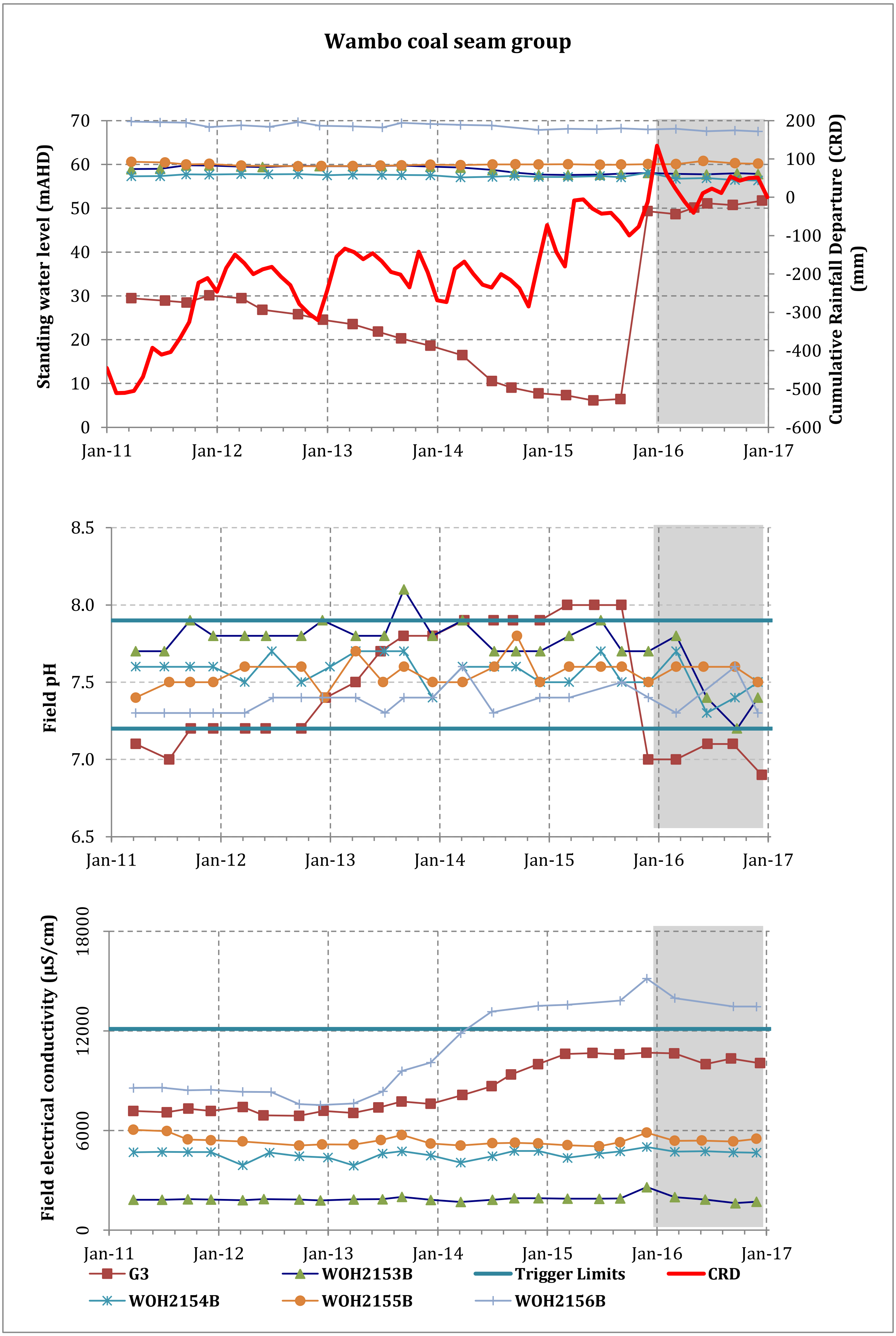


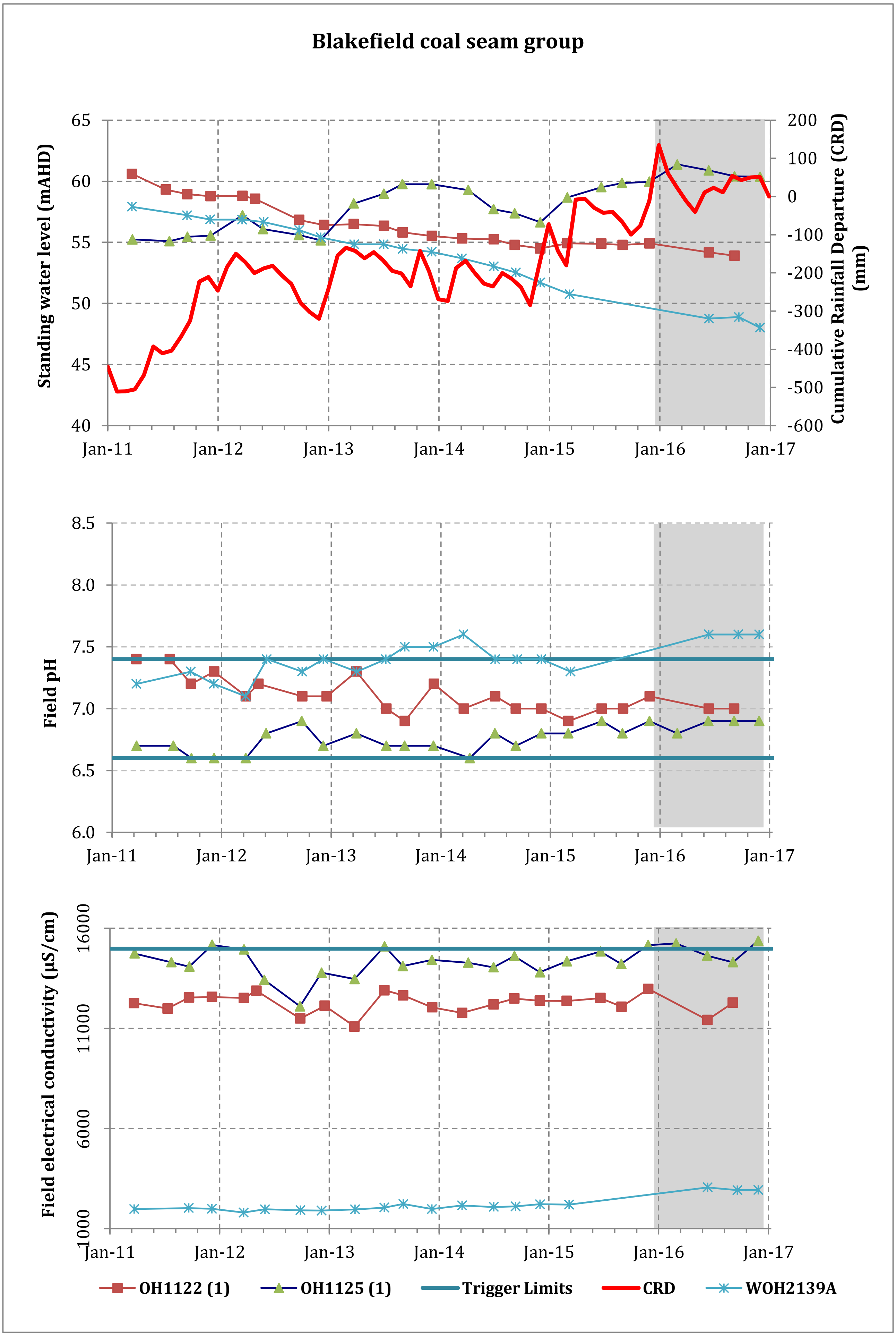

WOH2141A
Cumulative Rainfall Departure (mm)
Groundwater Level (mRL)
Year
CRD
Observed

WOH2141B
Cumulative Rainfall Departure (mm)
Groundwater Level (mRL)
Year
CRD
Observed

WOH2153A
Cumulative Rainfall Departure (mm)
Groundwater Level (mRL)
Year
CRD
Observed

WOH2153B
Cumulative Rainfall Departure (mm)
Groundwater Level (mRL)
Year
CRD
Observed

WOH2154A
Cumulative Rainfall Departure (mm)
Groundwater Level (mRL)
Year
CRD
Observed

WOH2154B
Cumulative Rainfall Departure (mm)
Groundwater Level (mRL)
Year
CRD
Observed

WOH2155A
Cumulative Rainfall Departure (mm)
Groundwater Level (mRL)
Year
CRD
Observed

WOH2155B
Cumulative Rainfall Departure (mm)
Groundwater Level (mRL)
Year
CRD
Observed

Appendix C Water level and quality summary graphs

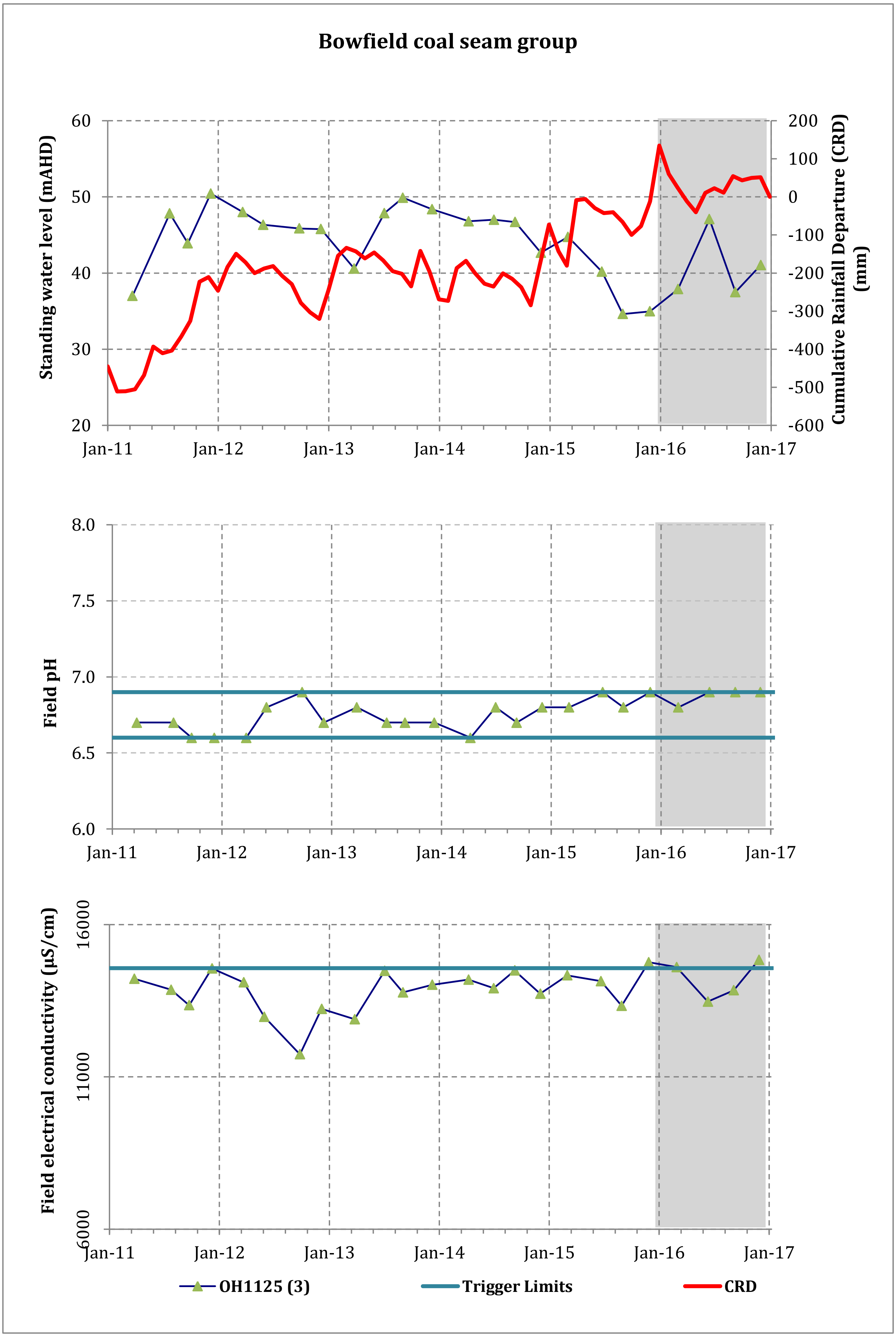


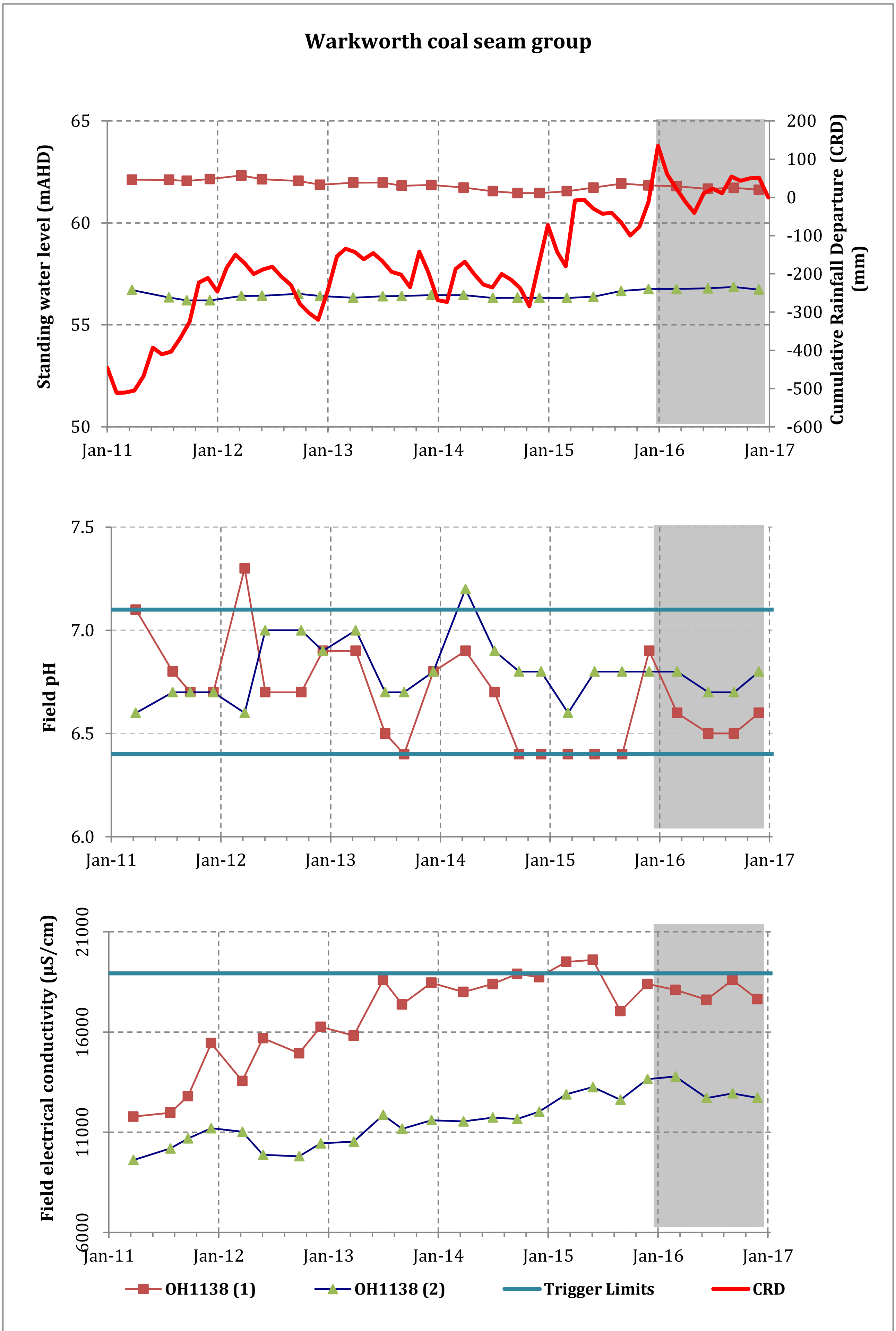
Redbank Creek Group
Standing water level (mAHD)
Cumulative Rainfall Departure (CRD) (mm)
70
65
60
55
50
200
100
0
-100
-200
-300
-400
-500
-600
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Field pH
8.5
8.0
7.5
7.0
6.5
Field electrical conductivity (µS/cm)
20000
15000
10000
5000
0
WOH2153A
WOH2154A
Trigger Limits
CRD
WOH2155A
WOH2156A

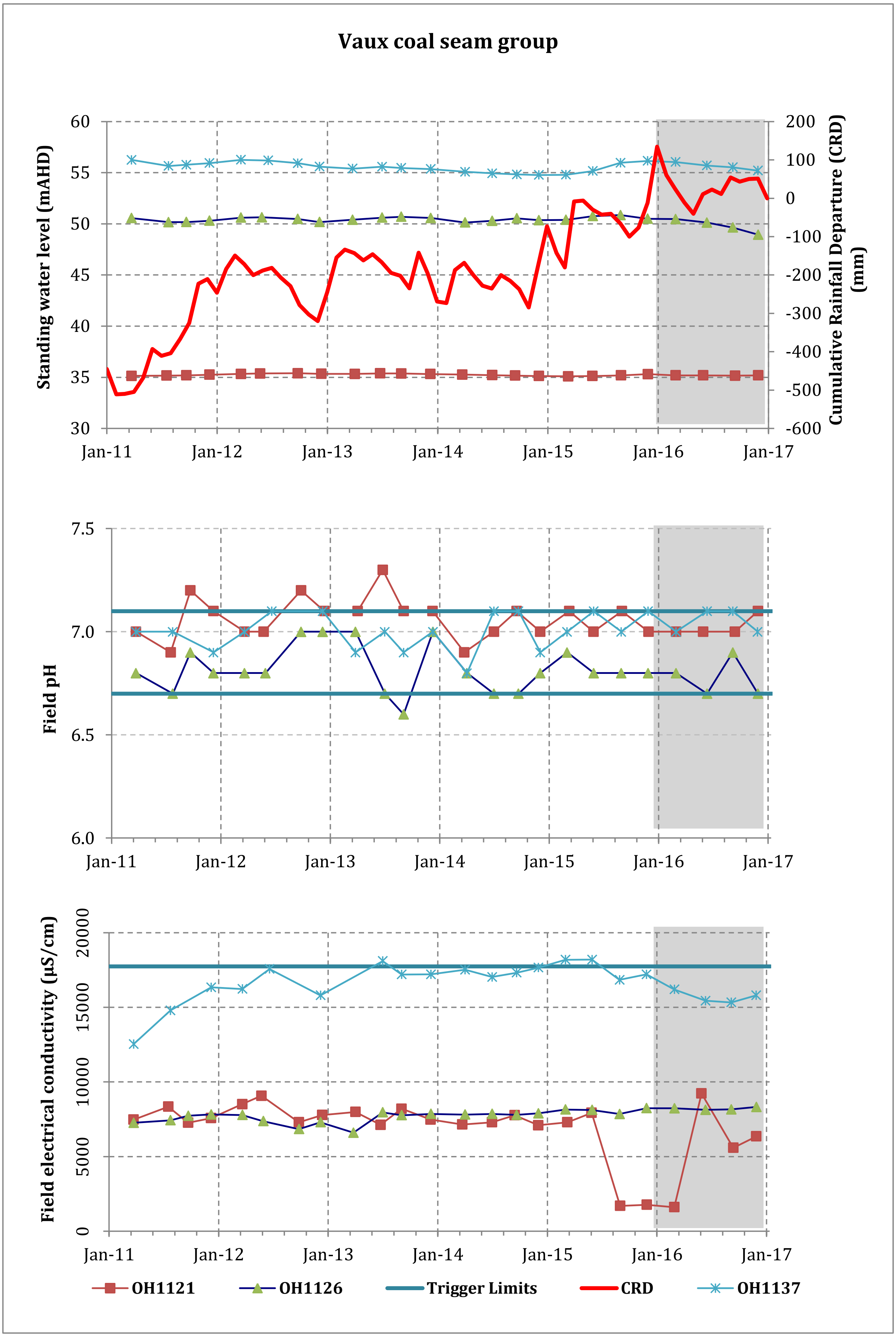

Wambo coal seam group
Standing water level (mAHD)
Cumulative Rainfall Departure (CRD) (mm)
70
60
50
40
30
20
10
0
200
100
0
-100
-200
-300
-400
-500
-600
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Field pH
8.5
8.0
7.5
7.0
6.5
Field electrical conductivity (µS/cm)
18000
12000
6000
0
G3
WOH2153B
Trigger Limits
CRD
WOH2154B
WOH2155B
WOH2156B



Blakefield coal seam group
Standing water level (mAHD)
Cumulative Rainfall Departure (CRD) (mm)
Field pH
Field electrical conductivity (µS/cm)
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
OH1122 (1)
OH1125 (1)
Trigger Limits
CRD
WOH2139A

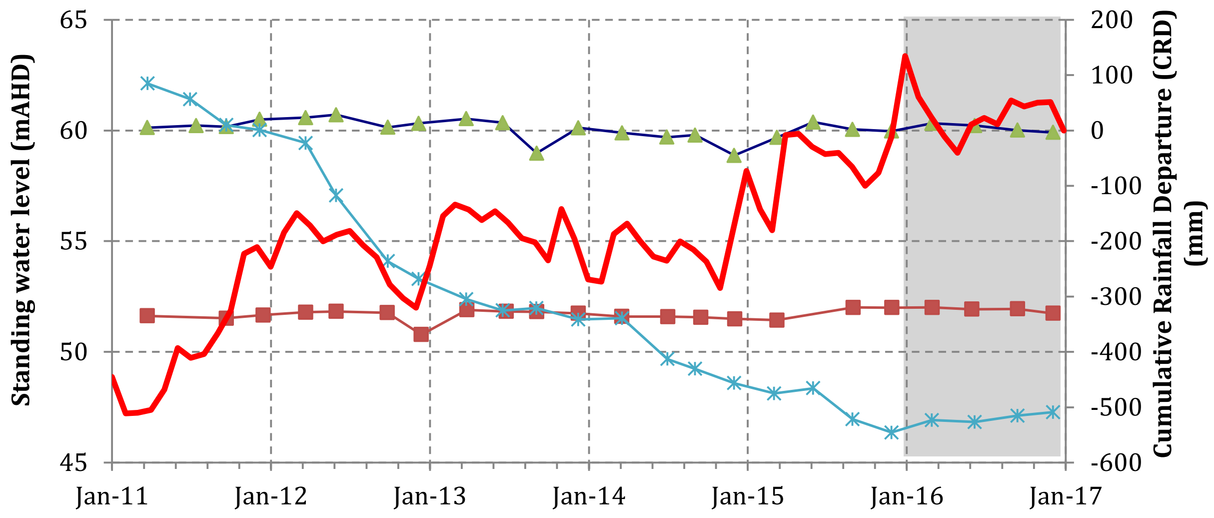

Bowfield coal seam group
Standing water level (mAHD)
Cumulative Rainfall Departure (CRD) (mm)
Field pH
Field electrical conductivity (µS/cm)
60
50
40
30
20
200
100
0
-100
-200
-300
-400
-500
-600
8.0
7.5
7.0
6.5
6.0
16000
11000
6000
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
OH1125 (3)
Trigger Limits
CRD

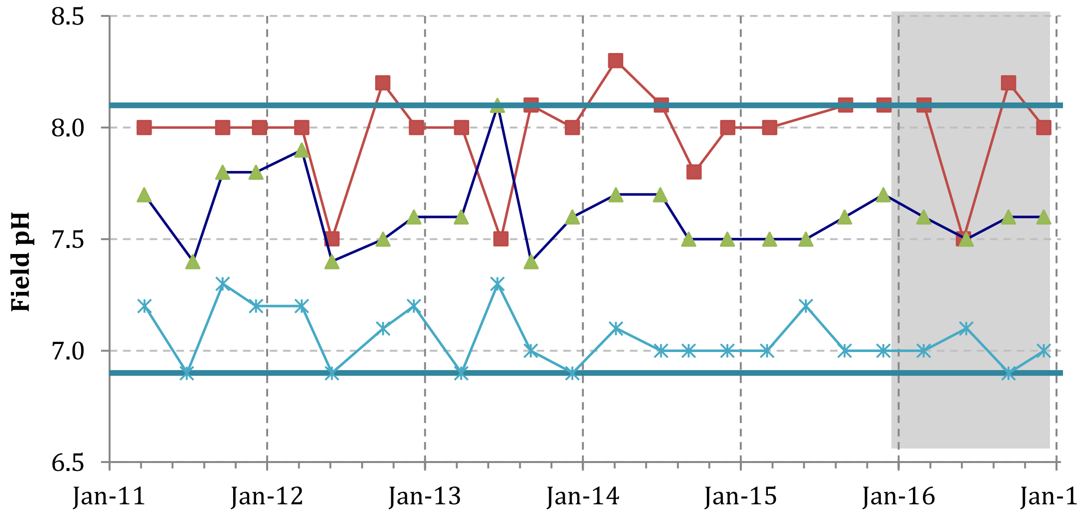

Warkworth coal seam group
Standing water level (mAHD)
Cumulative Rainfall Departure (CRD) (mm)
Field pH
Field electrical conductivity (µS/cm)
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
OH1138 (1)
OH1138 (2)
Trigger Limits
CRD

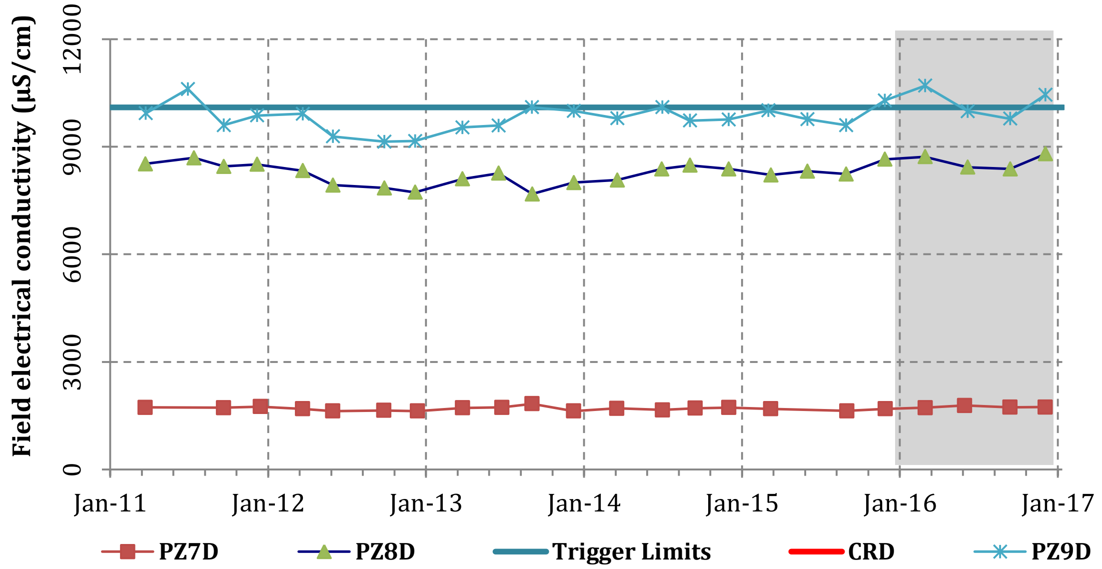


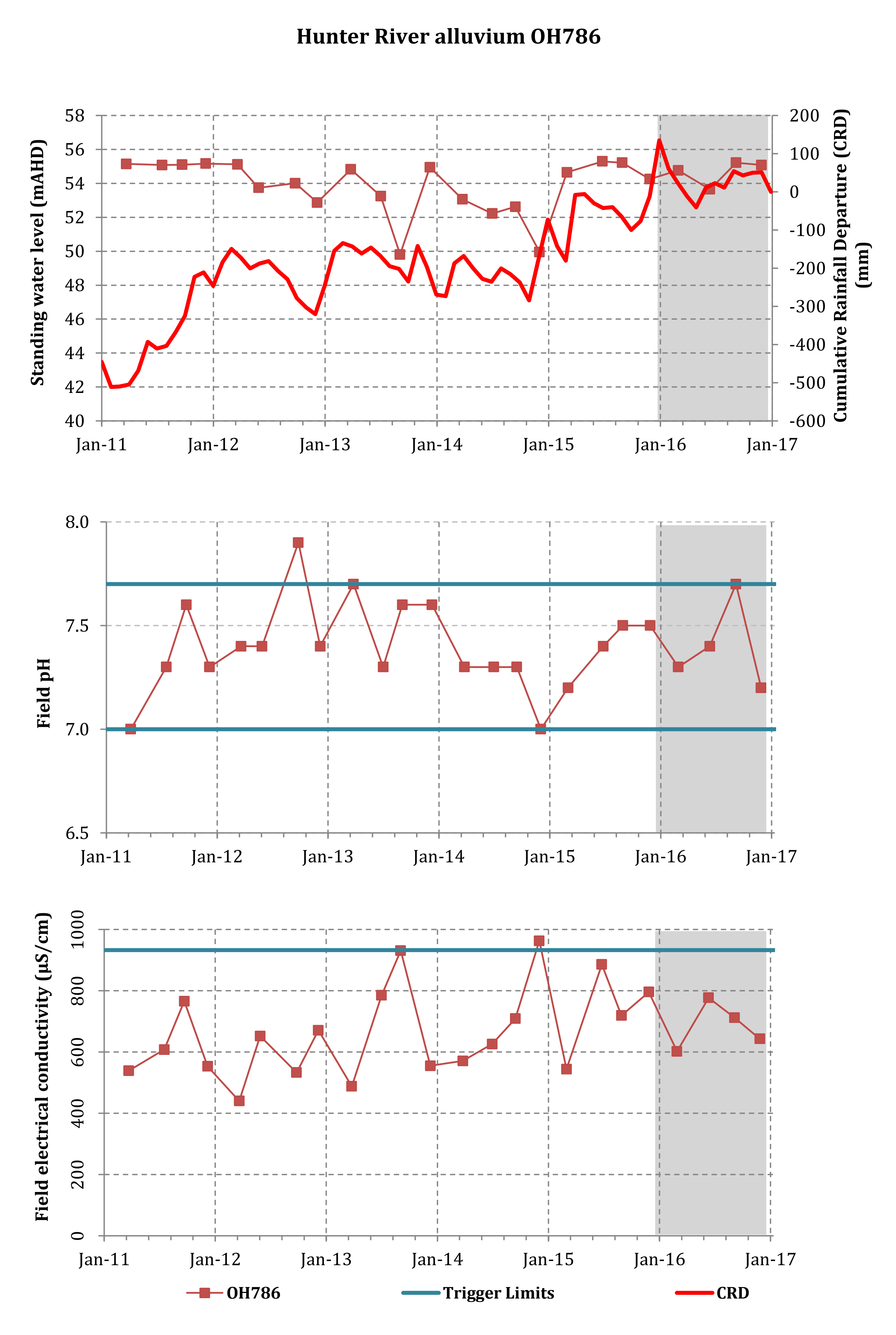
Vaux coal seam group
Standing water level (mAHD)
Cumulative Rainfall Departure (CRD) (mm)
60
55
50
45
40
35
30
200
100
0
-100
-200
-300
-400
-500
-600
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Field pH
7.5
7.0
6.5
6.0
Field electrical conductivity (µS/cm)
20000
15000
10000
5000
0
OH1121
OH1126
Trigger Limits
CRD
OH1137

Interburden/overburden group

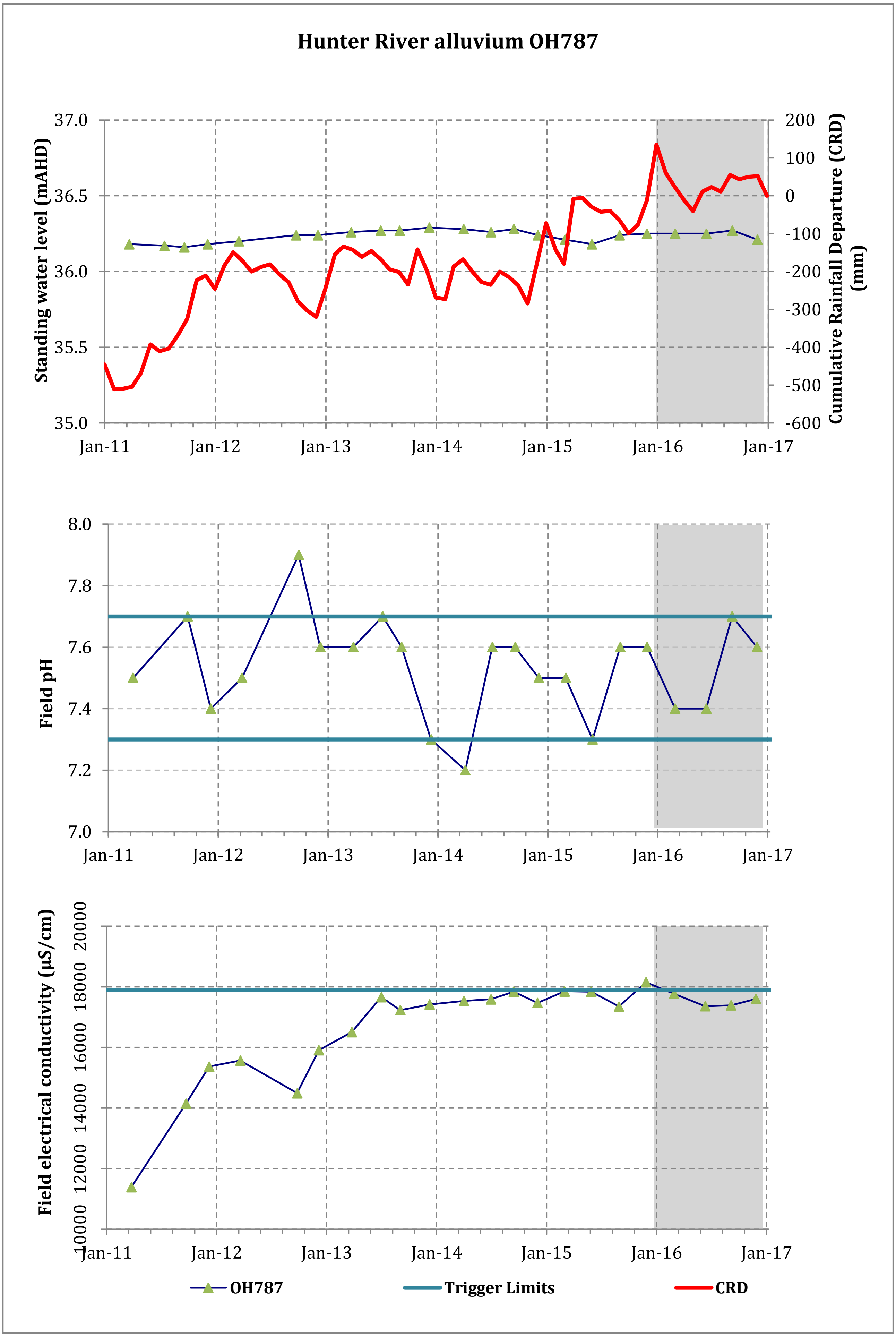




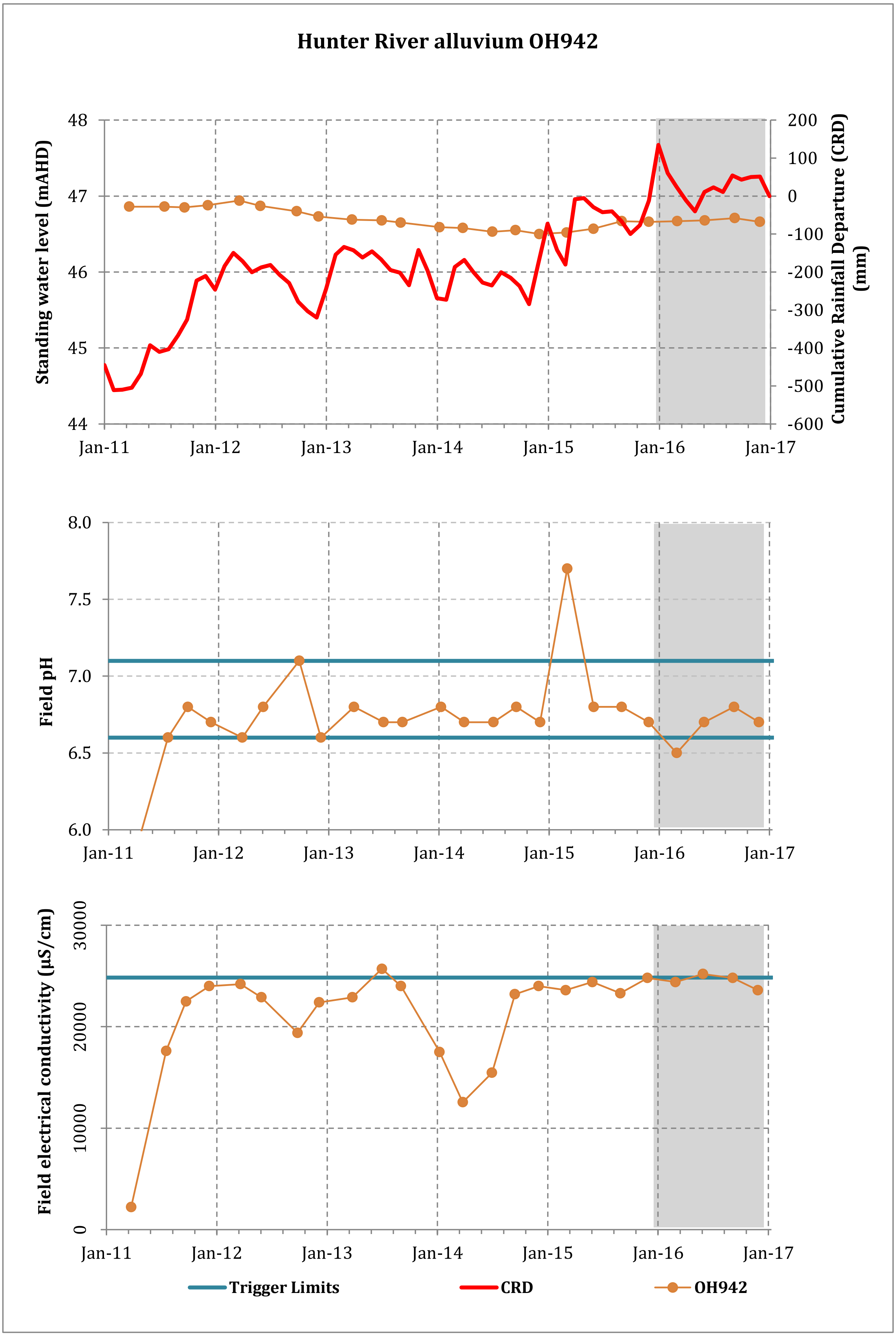




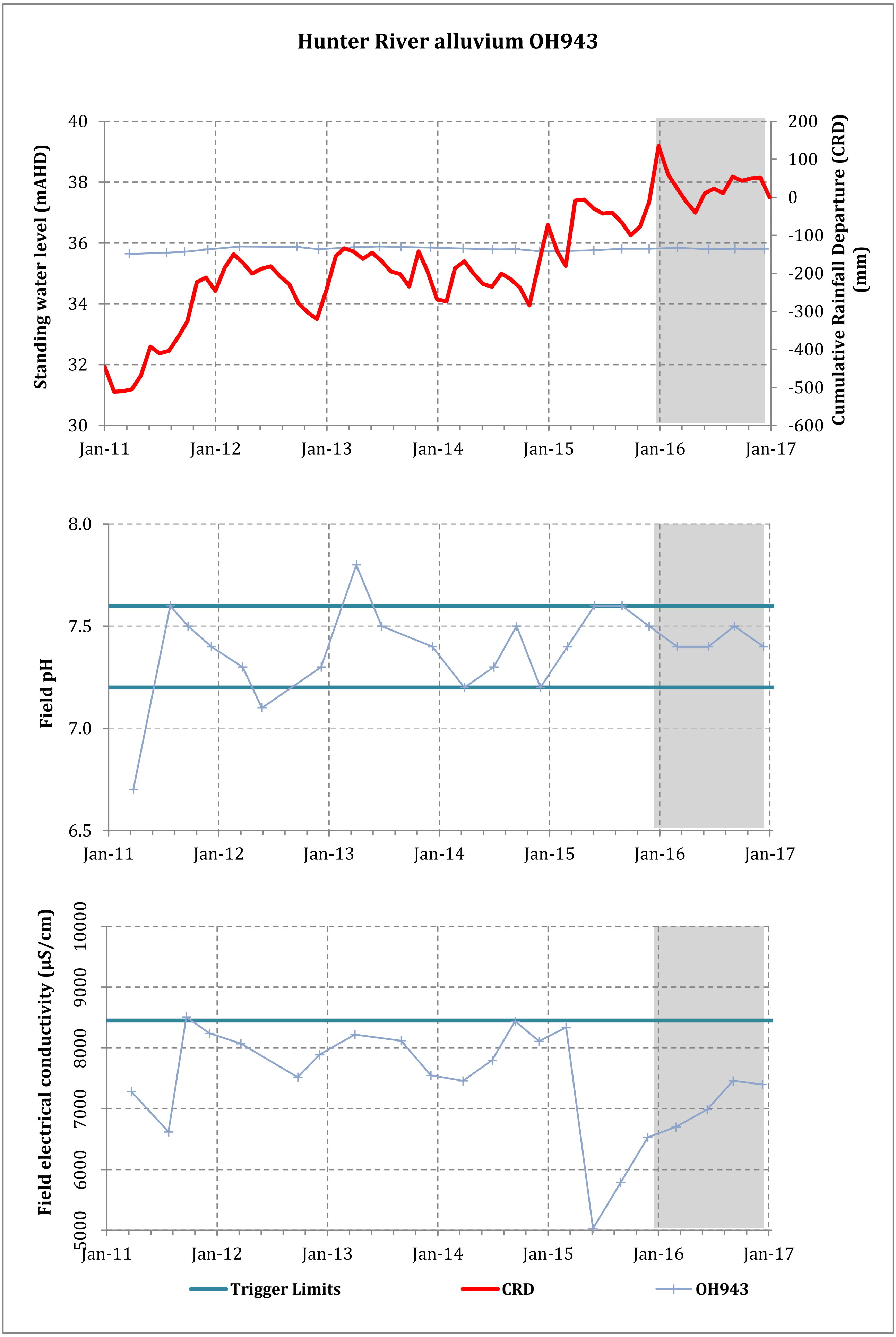
Hunter River alluvium OH786
Standing water level (mAHD)
Cumulative Rainfall Departure (CRD) (mm)
58
56
54
52
50
48
46
44
42
40
200
100
0
-100
-200
-300
-400
-500
-600
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Field pH
8.0
7.5
7.0
6.5
Field electrical conductivity (µS/cm)
1000
800
600
400
200
0
OH786
Trigger Limits
CRD

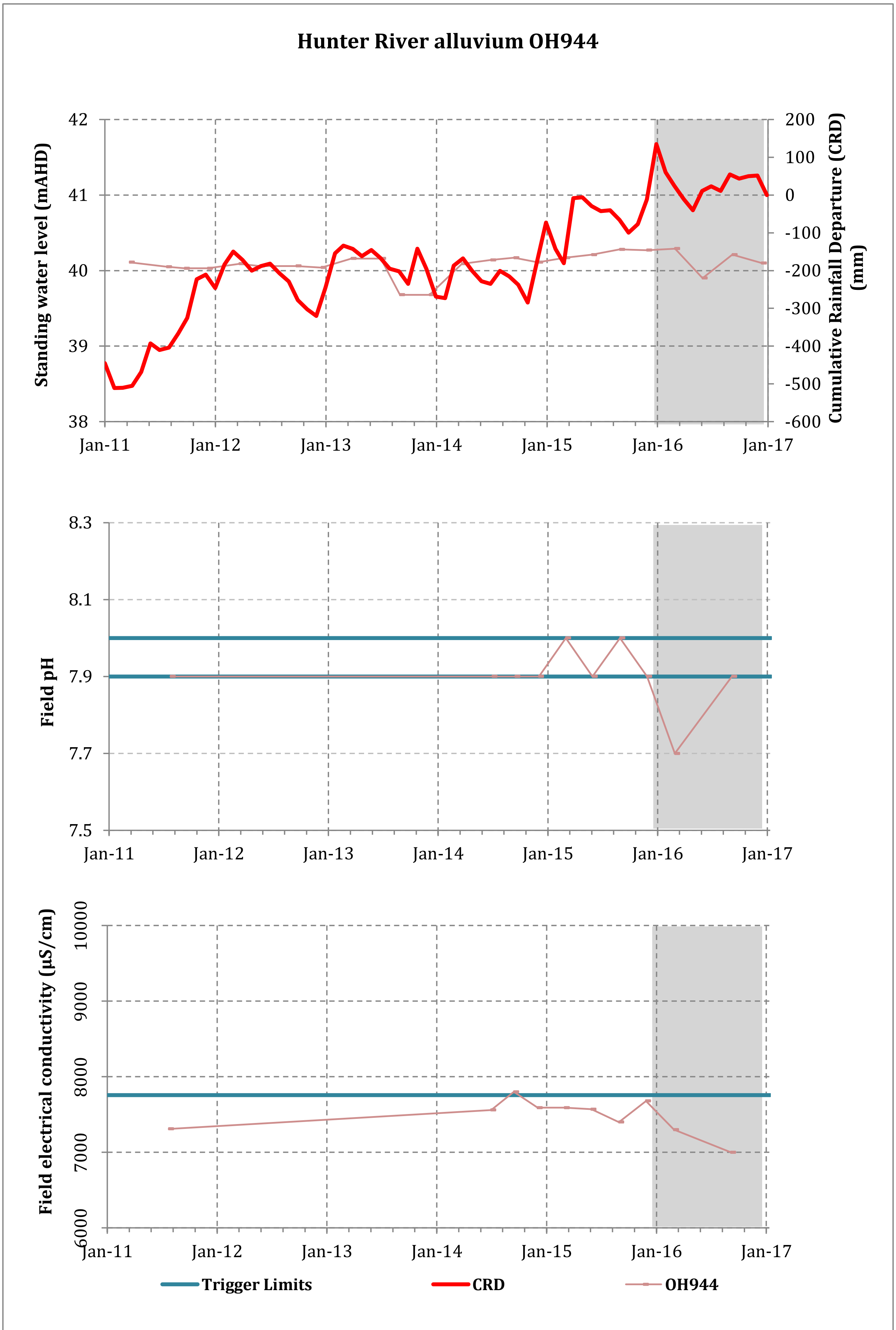


Hunter River alluvium OH787
Standing water level (mAHD)
Cumulative Rainfall Departure (CRD) (mm)
37.0
36.5
36.0
35.5
35.0
200
100
0
-100
-200
-300
-400
-500
-600
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Field pH
8.0
7.8
7.6
7.4
7.2
7.0
Field electrical conductivity (µS/cm)
20000
18000
16000
14000
12000
10000
OH787
Trigger Limits
CRD

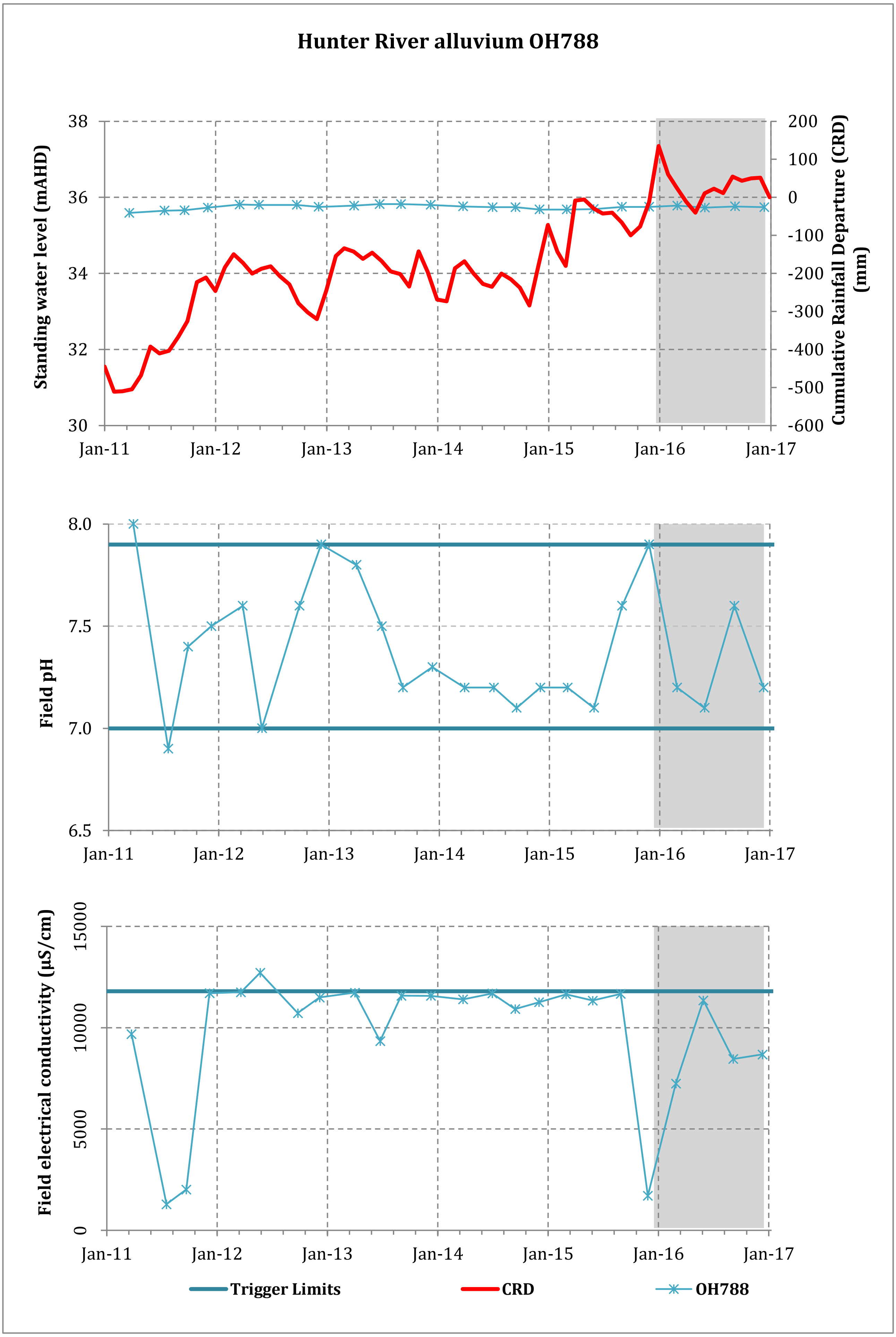


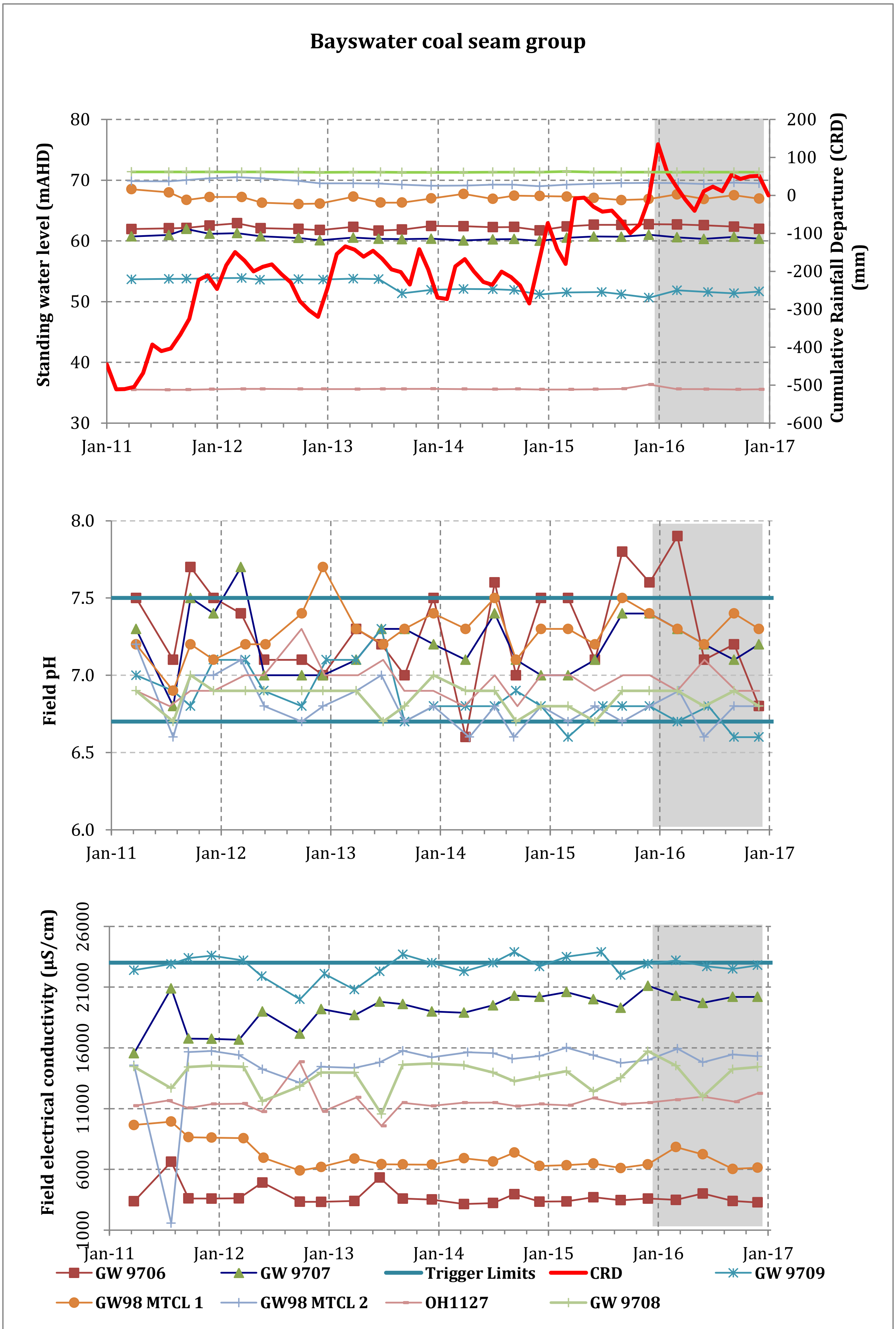
Hunter River alluvium OH942
Standing water level (mAHD)
48
47
46
45
44
Cumulative Rainfall Departure (CRD) (mm)
200
100
0
-100
-200
-300
-400
-500
-600
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Field pH
8.0
7.5
7.0
6.5
6.0
Field electrical conductivity (µS/cm)
30000
20000
10000
0
Trigger Limits
CRD
OH942


Hunter River alluvium OH943
Standing water level (mAHD)
Cumulative Rainfall Departure (CRD) (mm)
40
38
36
34
32
30
200
100
0
-100
-200
-300
-400
-500
-600
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Field pH
8.0
7.5
7.0
6.5
Field electrical conductivity (µS/cm)
10000
9000
8000
7000
6000
5000
Trigger Limits
CRD
OH943

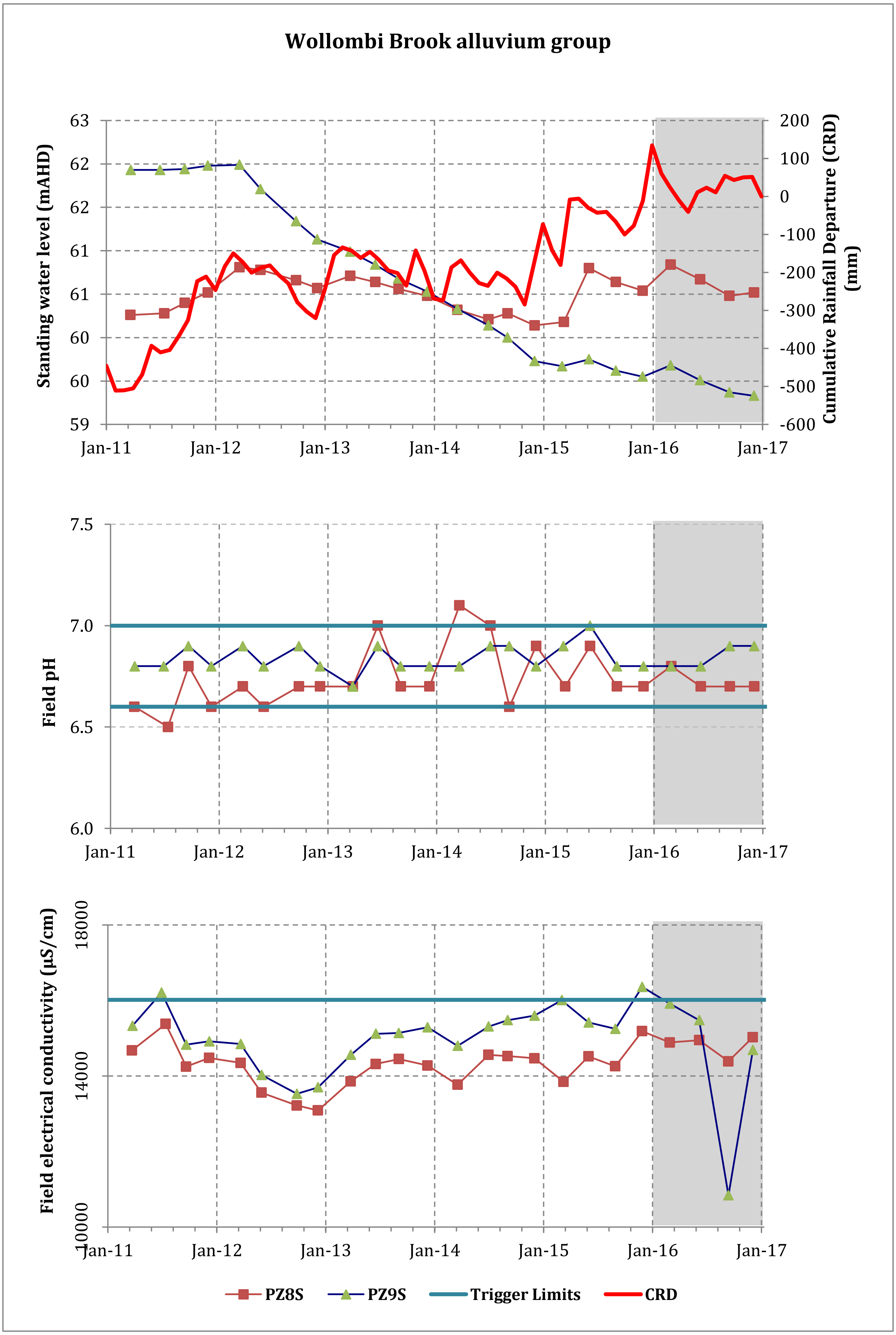


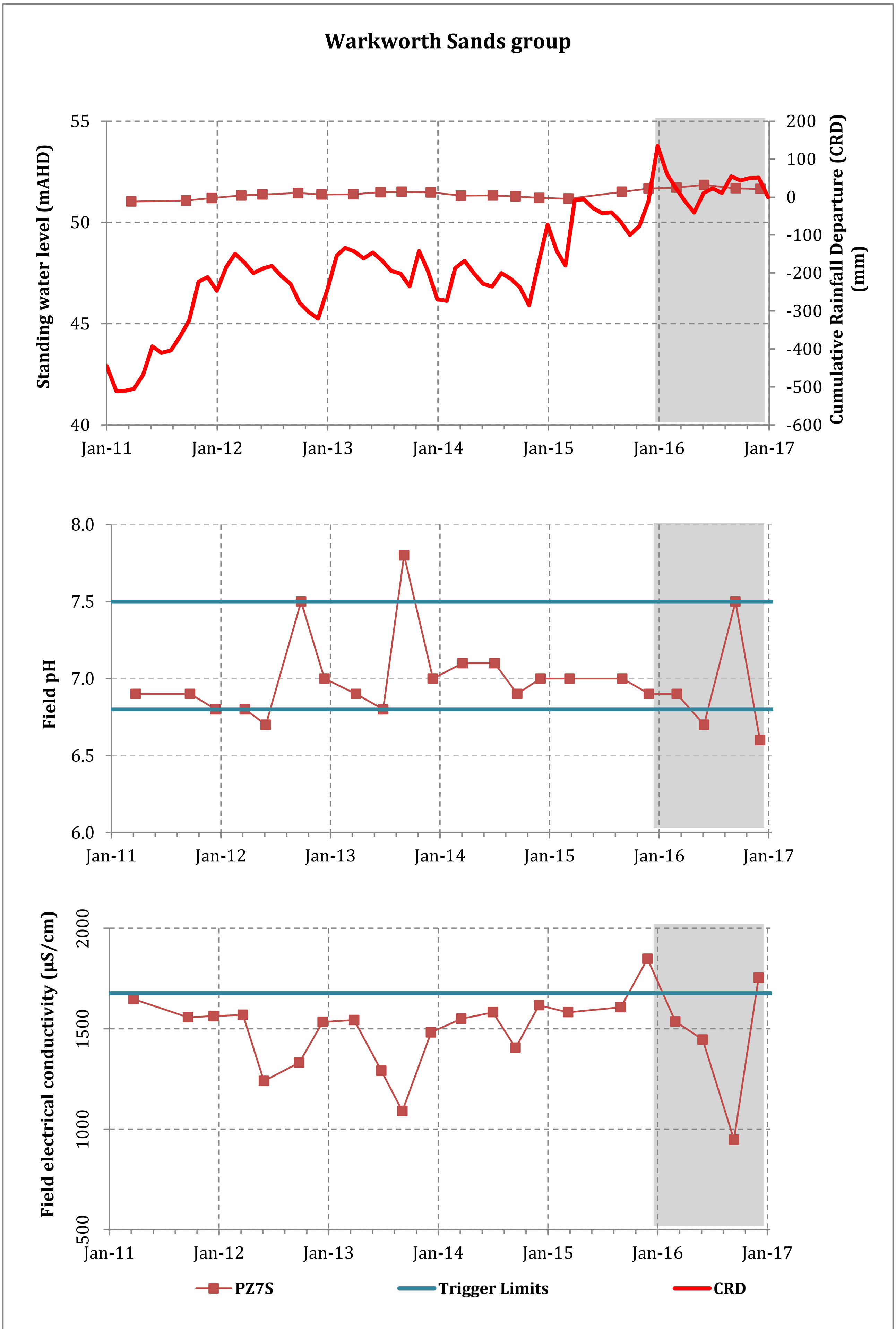
Hunter River alluvium OH944
Standing water level (mAHD)
Cumulative Rainfall Departure (CRD) (mm)
42
41
40
39
38
200
100
0
-100
-200
-300
-400
-500
-600
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Field pH
8.3
8.1
7.9
7.7
7.5
Field electrical conductivity (µS/cm)
10000
9000
8000
7000
6000
Trigger Limits
CRD
OH944


Hunter River alluvium OH788
Standing water level (mAHD)
Cumulative Rainfall Departure (CRD) (mm)
38
36
34
32
30
200
100
0
-100
-200
-300
-400
-500
-600
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Field pH
8.0
7.5
7.0
6.5
Field electrical conductivity (µS/cm)
15000
10000
5000
0
Trigger Limits
CRD
OH788



Bayswater coal seam group
Standing water level (mAHD)
Cumulative Rainfall Departure (CRD) (mm)
80
70
60
50
40
30
200
100
0
-100
-200
-300
-400
-500
-600
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Field pH
8.0
7.5
7.0
6.5
6.0
Field electrical conductivity (µS/cm)
26000
21000
16000
11000
6000
1000
GW 9706
GW 9707
Trigger Limits
CRD
GW 9709
GW98 MTCL 1
GW98 MTCL 2
OH1127
GW 9708


Wollombi Brook alluvium group
Standing water level (mAHD)
Cumulative Rainfall Departure (CRD) (mm)
63
62
62
61
61
60
60
59
200
100
0
-100
-200
-300
-400
-500
-600
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Field pH
7.5
7.0
6.5
6.0
Field electrical conductivity (µS/cm)
18000
14000
10000
PZ8S
PZ9S
Trigger Limits
CRD



Warkworth Sands group
Standing water level (mAHD)
Cumulative Rainfall Departure (CRD) (mm)
55
50
45
40
200
100
0
-100
-200
-300
-400
-500
-600
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Field pH
8.0
7.5
7.0
6.5
6.0
Field electrical conductivity (µS/cm)
2000
1500
1000
500
PZ7S
Trigger Limits
CRD

COAL & ALLIED

Managed by Rio Tinto Coal Australia

Appendix 3

Rehabilitation Tables

Annual Rehabilitation Report Form, Rehabilitation Maps and Rehabilitation Summary

Annual Rehabilitation Report Form – Mines
Year Ending: 2016
Mine: Mt Thorley Warkworth
Company: Rio Tinto Coal Australia – Coal and Allied
Plans Attached:
Mt Thorley Warkworth – AER 2016
Approved Mining Operations Plan:
MTW MOP (2015 – 2021) – Approval Date 05/02/2016
Total Area Covered by Mining Operations Plan:
MTW MOP – 6,185ha
Total Area Covered by Mining Lease for This Mine: 6,185ha

Table 1: Rehabilitation Progress 2016

Rehabilitation Activity Type	Domain Identifier	Primary Domain	Secondary Domain	Total Area Last Reported (ha)	Total Area to date (ha)
1.1 Active mining and infrastructure area, facilities, including roads and tracks	1A	Final Void	Final Void	138.96	189.1
	1C	Final Void	Rehabilitation Area - Grassland	0	0
	2A	Water Management Areas	Final Void	0	0
	2B	Water Management Areas	Water Management Areas	0	0
	2C	Water Management Areas	Rehabilitation Area - Grassland	34.97	34.97
	2D	Water Management Areas	Rehabilitation Area - Woodland	0	0
	2E	Water Management Areas	Rehabilitation Area - Woodland EEC	26.17	26.17
	3B	Infrastructure Area	Water Management Areas	0	0
	3C	Infrastructure Area	Rehabilitation Area - Grassland	100.65	100.65
	3D	Infrastructure Area	Rehabilitation Area - Woodland	0	0

	3E	Infrastructure Area	Rehabilitation Area - Woodland EEC	69.04	69.04
	4C	Tailings Storage Facility	Rehabilitation Area - Grassland	75.74	75.68
	4D	Tailings Storage Facility	Rehabilitation Area - Woodland	11.74	11.74
	4E	Tailings Storage Facility	Rehabilitation Area - Woodland EEC	95.38	88.31
	5A	Overburden Emplacement Area	Final Void	0	0
	5B	Overburden Emplacement Area	Water Management Areas	0.00	0.00
	5C	Overburden Emplacement Area	Rehabilitation Area - Grassland	332.01	328.86
	5D	Overburden Emplacement Area	Rehabilitation Area - Woodland	297.86	278.73
	5E	Overburden Emplacement Area	Rehabilitation Area - Woodland EEC	1296.29	1323.66
	Bulga Sublease Area	N/A - Outside Domain Boundary	N/A - Outside Domain Boundary	12.8	12.8
	Outside Domain Area	N/A - Outside Domain Boundary	N/A - Outside Domain Boundary	1.35	1.66
	Total Active			2492.9	2541.4
1.2 Decommissioning	Total - Decommissioning			0.0	0
1.3 Landform Establishment	Total - Landform Establishment			9.96 (Included in 1.1)	14.2 (Included in 1.1)
1.4 Growth Medium Development	Total - Growth Medium Development			29.73 (Included in 1.1)	14.5 (Included in 1.1)
1.5 Ecosystem and Land Use Establishment	2E	Water Management Areas	Rehabilitation Area - Woodland EEC	0	2.85
	4E	Tailings Storage Facility	Rehabilitation Area - Woodland EEC	0	3.97
	5C	Overburden Emplacement Area	Rehabilitation Area - Grassland	3.22	37.37

Rehabilitation Activity Type	Domain Identifier	Primary Domain	Secondary Domain	Total Area Last Reported (ha)	Total Area to date (ha)
	5D	Overburden Emplacement Area	Rehabilitation Area - Woodland	68.42	36.66
	5E	Overburden Emplacement Area	Rehabilitation Area - Woodland EEC	0	169.49
	Total - Ecosystem and Land Use Establishment			71.64	250.34
1.6 Ecosystem and Land Use Development	1A	Final Void	Final Void	0	1.08
	2C	Water Management Areas	Rehabilitation Area - Grassland	0	1.65
	2E	Water Management Areas	Rehabilitation Area - Woodland EEC	0	3.32
	3C	Infrastructure Area	Rehabilitation Area - Grassland	0	5.38
	4C	Tailings Storage Facility	Rehabilitation Area - Grassland	0	27.29
	4D	Tailings Storage Facility	Rehabilitation Area - Woodland	0	1.35
	4E	Tailings Storage Facility	Rehabilitation Area - Woodland EEC	0	35.45
	5C	Overburden Emplacement Area	Rehabilitation Area - Grassland	573.99	507.93
	5D	Overburden Emplacement Area	Rehabilitation Area - Woodland	348.16	11.57
	5E	Overburden Emplacement Area	Rehabilitation Area - Woodland EEC	13.76	221.93
	Total - Ecosystem and Land Use Development			935.91	816.97

Rehabilitation Activity Type	Domain Identifier	Primary Domain	Secondary Domain	Total Area Last Reported (ha)	Total Area to date (ha)
1.7 Rehabilitation Complete	Total - Rehabilitation Complete			0	0
1.8 Total Area Disturbed (items 1.1 to 1.7)	1A	Final Void	Final Void	138.96	190.18
	2A	Water Management Areas	Final Void	0	0
	2B	Water Management Areas	Water Management Areas	0	0
	2C	Water Management Areas	Rehabilitation Area - Grassland	34.97	36.62
	2D	Water Management Areas	Rehabilitation Area - Woodland	26.17	0

2E	Water Management Areas	Rehabilitation Area - Woodland EEC	0	32.34
3B	Infrastructure Area	Water Management Areas	0	0
3C	Infrastructure Area	Rehabilitation Area - Grassland	100.65	106.03
3D	Infrastructure Area	Rehabilitation Area - Woodland	69.04	0
3E	Infrastructure Area	Rehabilitation Area - Woodland EEC	0	69.04
4C	Tailings Storage Facility	Rehabilitation Area - Grassland	75.74	102.97
4D	Tailings Storage Facility	Rehabilitation Area - Woodland	95.38	13.09
4E	Tailings Storage Facility	Rehabilitation Area - Woodland EEC	11.74	127.73
5A	Overburden Emplacement Area	Final Void	0	0
5B	Overburden Emplacement Area	Water Management Areas	0.00	0.00
5C	Overburden Emplacement Area	Rehabilitation Area - Grassland	909.22	874.16
5D	Overburden Emplacement Area	Rehabilitation Area - Woodland	1712.87	326.96
5E	Overburden Emplacement Area	Rehabilitation Area - Woodland EEC	311.62	1715.08
Bulga Sublease Area	N/A - Outside Domain Boundary	N/A - Outside Domain Boundary	12.8	12.8
Outside Domain Area	N/A - Outside Domain Boundary	N/A - Outside Domain Boundary	1.35	1.66
Total Footprint			3500.51	3608.66

Table 2: Soil Management and Erosion, 2016

Soil Stockpiling/ Use	Soil Used This Period (m3)	Soil Pre-stripped This Period (m3)	Soil Stockpiled to Date (m3)	Soil Stockpiled Last Report (m3)
	84,700	120,200	794,994	760,061
2.2 Erosion Treatment	**Total Area to Date (ha)**	**Total Area Last Report (ha)**	**Total Area This Report (ha)**	**Area Retreated This Period (ha)**
	Not Available	Not Available	5.0	0
Approx. area of sheet or gully erosion requiring reshaping topdressing and/or resowing	Not Available			

Table 3: Weed Control

	Area (ha)
3.1 Approx. area adversely affected by weeds as of the date of this report	Not Available
3.2 Area treated for weed control during the period covered by the report	311.4
3.3 Give summary of control strategies used and verification by approval agency(s)	
Species targeted in rehabilitation areas during 2016 included: galenia, Rhodes grass, green panic, couch grass, *Acacia saligna*, mustard weed (Brassica), farmers friend (*Bidens pilosa*) and paddys lucerne (*Sida rhombifolia*).	

Table 4: Management of Rehabilitation Areas

4.1 Area treated with maintenance fertiliser	65ha
4.2 Area treated by rotational grazing, cropping or slashing	90ha

Give Summary	90ha Warkworth rehabilitation area licence agreement in place for grazing.

Table: 5 Variations to Rehabilitation Program

Has rehabilitation work proceeded generally in accordance with the conditions of an accepted Mining Operations Plan?	Yes
If not please cite any approval granted for variations, or briefly describe the seasonal conditions or other reasons for any changes and the nature of any changes which have been made.	NA

Table 6: Planned Operations During the Next Repot Period

6.1 Area estimated to be disturbed	88ha
6.2 Area estimated to be rehabilitated	122ha

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Appendix 4

Rehabilitation and Disturbance Summary and Maps

Rehabilitation Site Name	Type	Coordinates (GDA94)	Area (ha)	Rehabilitation Summary
Bulga Boundary	Diverse Cover Crop	320,759.1 E 6,385,387.3 N	28.4	▪ The landform was constructed from a waste emplacement. ▪ The area is flat to gently sloping (0-2 degrees) with predominantly eastern and southern aspects. ▪ Drainage is via overland flow to an engineered rock chute. ▪ Landform surface preparation comprised bulk shaping, deep ripping, rock raking, and removal of oversize rock material. ▪ Clay loam soil from existing topsoil stockpiles and from West Pit ahead of mine topsoil stripping was spread at a nominal thickness of 150mm. ▪ Gypsum was applied at a rate of 10t/ha. ▪ Mixed Waste Compost was applied at a rate of 100t/ha. ▪ Growth medium preparation included rock windrowing, rock picking and aerating. ▪ Late Winter Rebab Blend was drilled into 6.6ha of the area at 30kg/ha, with the remaining 21.8ha drilled with Summer Rehab Blend at 35kg/ha. All drilling was to an aerated pattern.
CD RL160	Diverse Cover Crop	320,207.6 E 6,390,028.7 N	2.0	▪ The landform was constructed from a waste emplacement. ▪ The area is flat to gently sloping (0-2 degrees) without dominant aspect. ▪ Drainage is via overland flow to an engineered rock chute. ▪ Landform surface preparation comprised bulk shaping, deep ripping, rock raking, and removal of oversize rock material. ▪ Clay loam soil from existing topsoil stockpile was spread at a nominal thickness of 100mm. ▪ Gypsum was applied at a rate of 10t/ha. ▪ Mixed Waste Compost was applied at a rate of 100t/ha. ▪ Growth medium preparation included rock windrowing, rock picking, aerating, and pre-sowing herbicide application. ▪ Summer Rehab Blend was drilled into an aerated pattern at 35kg/ha.
CD RL160 (East Slope)	Native Woodland	320,514.6 E 6,389,783.3 N	1.4	▪ The landform was constructed from a waste emplacement. ▪ The area is sloping (10 degrees) with an eastern aspect. ▪ Drainage is via north flowing contours reporting to an engineered rock

Rehabilitation Site Name	Type	Coordinates (GDA94)	Area (ha)	Rehabilitation Summary
				chute. ▪ Landform surface preparation comprised bulk shaping, deep ripping, rock raking, and removal of oversize rock material. ▪ Clay loam soil from recently stripped topsoil stockpile (c.2015) was spread at a nominal thickness of 100mm. ▪ Gypsum was applied at a rate of 10t/ha. ▪ Mixed Waste Compost was applied at a rate of 100t/ha. ▪ Growth medium preparation included rock windrowing, rock picking, aerating, and pre-sowing herbicide application. ▪ Native Woodland Mix was hydroseeded to an aerated pattern at 13.9kg/ha.
North Pit North (RL160)	Native Grass	317,626.7 E 6,391,761.1 N	1.2	▪ The landform was constructed as topsoil stockpile overlying a waste emplacement. ▪ The area is generally flat (0-2 degrees) and without dominant aspect. Topsoil stockpile batters are sloping (8-12 degrees) with aspect depending upon relative location. ▪ Drainage is via overland flow to preferential flow paths across the topographic surface, localised drainage swales and drainage depressions. ▪ Landform surface preparation beneath the topsoil stockpile comprised bulk shaping, deep ripping, rock raking, and removal of oversize rock material. ▪ Topsoil stockpile was constructed to approximately 3 metres in height from clay loam topsoil from ahead of mining topsoil clearance. ▪ Mixed Waste Compost was applied at a rate of 100t/ha. ▪ Growth medium preparation included rock picking, aerating, and pre-sowing herbicide application. ▪ Native Grass Mix was drilled to the stockpile surface at 25kg/ha.
South Pit North	Diverse Cover Crop	319,978.1 E 6,390,532.0 N	8.1	▪ The landform was constructed from a waste emplacement. ▪ The area is sloping (10 degrees) with north eastern aspect. ▪ Drainage is via south flowing contours reporting to an engineered rock

Rehabilitation Site Name	Type	Coordinates (GDA94)	Area (ha)	Rehabilitation Summary
				chute. ▪ Landform surface preparation comprised bulk shaping, deep ripping, rock raking, and removal of oversize rock material. ▪ Clay loam soil from existing topsoil stockpiles was spread at a nominal thickness of 100mm. ▪ Gypsum was applied at a rate of 10t/ha. ▪ Mixed Waste Compost was applied at a rate of 100t/ha. ▪ Growth medium preparation included rock windrowing, rock picking, aerating, and pre-sowing herbicide application. ▪ Summer Rehab Blend was air-seeded into an aerated pattern at 35kg/ha.
South Pit South	Diverse Cover Crop	320,814.2 E 6,389,102.4 N	18.5	▪ The landform was constructed from a waste emplacement. ▪ The landform is sloping (10 degrees) with eastern aspect. ▪ Drainage is via contours draining to a series of engineered rock chutes which subsequently report to a storage dam. ▪ Landform surface preparation comprised bulk shaping, deep ripping, rock raking, and removal of oversize rock material. ▪ Clay loam topsoil from existing topsoil stockpiles was spread at a nominal thickness of 100mm. ▪ Gypsum was applied at a rate of 10t/ha. ▪ Mixed waste compost was applied at a rate of 100t/ha. ▪ Growth medium preparation included rock windrowing, rock picking, and aerating. ▪ An area of 5.0ha was air-seeded with Late Winter Rebab Blend at 30kg/ha. The remaining 13.5ha area was air-seeded with Summer Rehab Blend at 35kg/ha. All seeding was to an aerated pattern.
Swan Lake	Native Woodland & Diverse Cover Crop	Woodland (East) 319,559.8 E 6,391,143.5 N Woodland (West)	6.2	▪ The landform was constructed from a waste emplacement. ▪ The eastern area of the landform (2.3ha) is predominantly sloping (10 degrees) with eastern aspect while the remainder of the area (3.9ha) is flat plateau with localised variation and without dominant aspect. ▪ Drainage off the north-eastern area is via north flowing contours

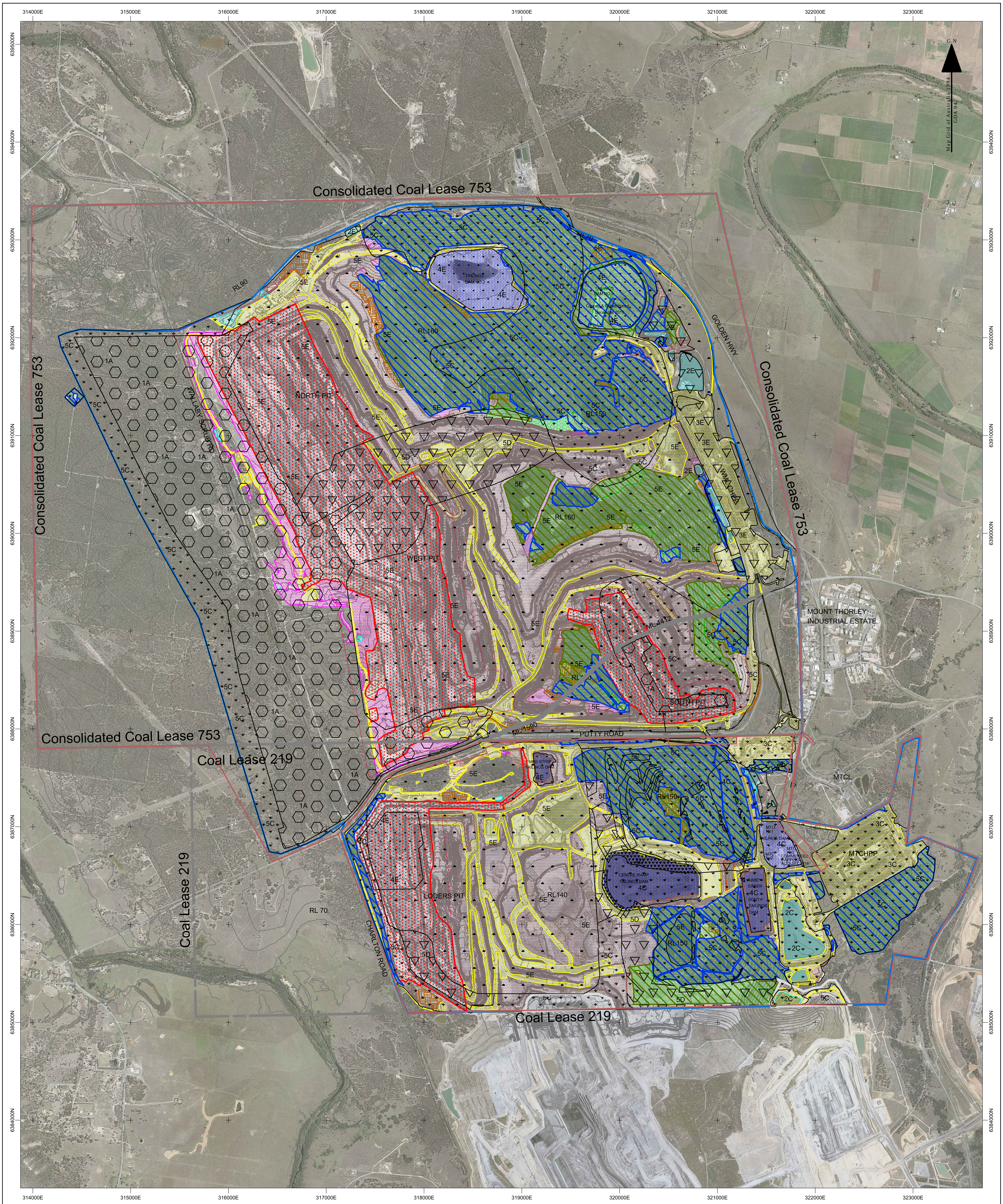
Rehabilitation Site Name	Type	Coordinates (GDA94)	Area (ha)	Rehabilitation Summary
		318,552.2 E 6,391,253.8 N Cover Crop 318,877.5 E 6,391,224.3 N		reporting to a series of engineered rock chutes and associated dams. Drainage from the plateau areas is overland flow across to adjoining rehabilitation and mine areas. ▪ Landform surface preparation comprised bulk shaping, deep ripping and rock raking where needed, and removal of oversize rock material. ▪ Reclaimed clay loam topsoils from North Pit North rehabilitation disturbance stripping were spread at a nominal thickness of 100mm across 3.3ha of the plateau area. An area of 0.6ha of the plateau comprised prepared (rocky) mine spoil. Mined (sandy clay) subsoil waste was shaped to provide the growth medium for the 2.3ha slope. ▪ Gypsum was applied at a rate of 10t/ha to each area. ▪ Mixed waste compost was applied at a rate of 100t/ha to each area. ▪ Growth medium preparation included windrowing, rock picking and aerating. ▪ Summer Rehab Blend was drilled to the 3.3ha topsoil area at 35kg/ha. Native Woodland Mix was hydroseeded to the areas of rock and clay mine spoil at 16.4kg/ha. All sowing was to an aerated pattern.
Tailings Dam 1	Native Pasture / Light Woodland & Diverse Cover Crop	319,815.2 E 6,392,320.3 N	9.5	▪ The landform was constructed from a capped former tailings storage facility (TSF). ▪ The area is primarily flat plateau (5.3ha) without dominant aspect. Additional area (4.2ha) around the rim of the former TSF has eastern and northern aspect. ▪ The plateau area drains by overland flow to an engineered drainage channel, while the batter slopes drain down-slope and into adjacent local drainage depending upon actual location. ▪ Landform surface preparation comprised bulk shaping, deep ripping, rock raking, and removal of oversize rock material. ▪ Stockpiled clay loam topsoils were spread to batter areas at a nominal thickness of 100mm. Plateau areas were comprised of mine spoil. ▪ Gypsum was applied at a rate of 10t/ha. ▪ Mixed waste compost was applied at a rate of 100t/ha.

Rehabilitation Site Name	Type	Coordinates (GDA94)	Area (ha)	Rehabilitation Summary
				▪ Growth medium preparation included windrowing, rock picking, aerating, and pre-sowing herbicide and manual weed treatment. ▪ Summer Rehab Blend was air-seeded to the topsoiled batter areas at 35kg/ha. Native Pasture/Light Woodland Mix was sown to plateau spoil/compost areas at 12.7kg/ha by a combination of seed drill, hydroseeding, and cone broadcaster. All seeding was to an aerated pattern.
Woodlands	Native Woodland	319,935.9 E 6,388,337.46	1.4	▪ The landform was constructed from a waste emplacement. ▪ The area is sloping with south eastern aspect. ▪ The area comprises the immediate surrounds (0.8ha) of an engineered rock chute (completed 2015) and a dam at the base of the chute (0.6ha). Chute surrounds drain via contour to the chute and then to the dam which spill to current active mine area. ▪ Landform surface preparation comprised bulk shaping, deep ripping, rock raking, and removal of oversize rock material. Dam construction was by excavation. ▪ Clay loam topsoil from an existing stockpile was spread adjacent the chute and to the outer areas of the dam at a nominal thickness of 100mm. ▪ Gypsum was applied at a rate of 10t/ha to topsoil areas. ▪ Mixed waste compost was applied at a rate of 100t/ha to topsoil areas. ▪ Growth medium preparation of topsoils included windrowing, rock picking and aerating. ▪ Native Woodland Mix was drilled to the topsoil areas at 13.7kg/ha.
Bulga Boundary Glencore (former sub-lease area)	Cover Crop	321,424.9 E 6,385,292.1 N	8.1	▪ The landform was constructed from a waste emplacement while subleased to neighbouring mine, Bulga Open Cut (Glencore). ▪ Typical slope of the landform is 10 degrees with an eastern aspect. ▪ Drainage is via south draining contours reporting to an engineered rock chute which in turn reports to an engineered dam. ▪ Landform surface preparation comprised bulk shaping and contour ripping.

Rehabilitation Site Name	Type	Coordinates (GDA94)	Area (ha)	Rehabilitation Summary
				▪ Topsoil was spread at a nominal thickness of 100mm. ▪ A seasonal cover crop was sown to the area prior to conclusion of sub-lease.

Late Winter Rehab Blend	Composition (% by weight)
Rye	33
Lucerne	27
Clovers	20
Chicory	10
Plantain	10

Spring Summer Rehab Blend	Composition (% by weight)
Millet	57
Chicory	6
Clover	7
Lucerne	21
Bean	9



Mining Tenement
- Project Approval Area
- Sublease Boundary
- Area of disturbance
- Expected mining area - 2016

Rehabilitation Phases
- Ecosystem and Land Use Establishment
- Ecosystem and Land Use Sustainability
- Lease Boundary
- 2016- 5m Contours (AHD)

Primary Domains
- 1 - Final Void
- 2 - Water Management Area
- 3 - Infrastructure Area
- 4 - Tailings Storage Facility
- 5 - Overburden Emplacement

Secondary Domains
- A - Final Void
- B - Water Management Area
- C - Rehabilitation Area- Grassland
- D - Rehabilitation Area- Woodland Other
- E - Rehabilitation Area- Woodland EEC

Note: For plan clarity only, black polygons have been used for primary & secondary domains. Plan has been labeled with text.

AEMR 2016 Areas
- Active Mining
- Shaped Spoils
- Unshaped Spoils
- Topsoil Stripped
- Topsoil Spread > 18°
- Topsoil Spread
- New Rehabilitation
- Rehabilitation
- Infrastructure
- Infrastructure Tailings
- Water Structures
- Topsoil Stockpile
- Compost Spread

SCHEDULE OF ENDORSEMENTS

REF	DATE	DESCRIPTION/REFERENCES	SIGNED
Full Plan	17-02-2017	Mine surveying content depicted on the plan is sourced from RT 769	A.WALL
Full Plan	17-02-2017	Domain boundaries supplied by others.	A.WALL
Full Plan	17-02-2017	Disturbance limits supplied by others.	A.WALL
Full Plan	17-02-2017	Mining tenement & lease boundaries supplied by others.	A.WALL
Full Plan	17-02-2017	Expected mining areas supplied by others.	A.WALL
Full Plan	7-03-2017	Rehabilitation data & phases supplied by others.	A.WALL

0m 100m 250m 500m 1000m 1500m 2000m

Aerial photo date: 28th December 2016

UNCONTROLLED IF PRINTED

COAL & ALLIED
Managed by Rio Tinto Coal Australia

I, Adrian Wall, Registered Mining Surveyor, No. 8443, certify that to the best of my knowledge and belief the survey information on this plan conforms to the accuracy and standards required by the Department of Trade & Investment Resources & Energy, NSW.

Registered Mining Surveyor

08/03/2017
Date

MOUNT THORLEY OPERATIONS / WARKWORTH MINING Ltd.

Annual Environmental Management Plan 2016

REDUCTION RATIO: 1 : 12,500	A0
DRAWN BY: S BRADLY	DATE: 08/03/2017
APPROVED BY: B BAXTER	
PLAN No. MTW-1058	

Appendix 5

Rehabilitation Monitoring Report

The results of the rehabilitation monitoring programme for native vegetation areas have been compared against the target levels to determine if rehabilitation has been successful or if additional intervention is needed. The full report is available via the Rio Tinto website (http://www.riotinto.com/documents/Appendix%205%20Rehabilitation%20Monitoring%20Report.pdf).