South32 - Illawarra Coal

DENDROBIUM MINE

End of Panel Surface Water and Shallow Groundwater Assessment: Longwall 13 (Area 3B)

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Executive summary

This report summarises the observed, measured and estimated effects on hydrological features resulting from the extraction of Dendrobium Longwall 13.

Longwall 13 is the fifth panel to be extracted from Dendrobium Area 3B. Extraction began on 4 March 2017 and was completed on 19 April 2018. Weather conditions were unusually dry during the extraction of Longwall 13 with less than half of the annual average rainfall recorded in the 12 months prior to the end of the longwall. The dry conditions resulted in very low flow or no-flow conditions, and slightly elevated salinity (EC) relative to baseline conditions, in many creeks and pools across the plateau.

The Illawarra Coal Environmental Field Team (ICEFT) conducts monitoring and inspections on landscape features including watercourses and swamps within Dendrobium Area 3B. This monitoring is conducted in accordance with the:

- Dendrobium Area 3B Subsidence Management Plan (SMP);
- Dendrobium Area 3B Watercourse Impact, Monitoring, Management and Contingency Plan (WIMMCP) (October 2015);
- Dendrobium Subsidence, Landscape Monitoring and Management Plan (November 2012); and
- Dendrobium Area 3B Swamp, Impact, Monitoring, Management and Contingency Plan (SIMMCP) (October 2015).

The WIMMCP, SIMMCP and Landscape Trigger Action Response Plans (TARPs) form the basis of the impact assessments in this report.

A total of **43** new surface impacts were identified by the ICEFT within the zone of influence of Longwall 13 (within 400 m of the longwall footprint), of which **18** were in streambeds (LA4 [2], WC21 [7], WC15 [8] and Wongawilli Creek [1]).

This assessment has identified that mining-related effects on the flow regime have occurred in tributaries to Donalds Castle Creek (DCS2, DC13S1), and in Lake Avon tributary LA4 (see Table 1). Mining effects on flow in the Donalds Castle Creek tributaries may have contributed to the slightly elevated salinity in nearby pools. No change to catchment runoff flow characteristics is identified at the gauge downstream of Area 3B on Wongawilli Creek (WWL). There is a possible change to runoff characteristics at the downstream gauge of Donalds castle Creek (DCU), but not sufficient to trigger TARP level 1. Surface fracturing was noted in the channel of tributary WC15 during Longwall 13, however flow characteristics at the downstream gauge (WC15S1) are not significantly different from baseline.

The water level in Pool 43a on Wongawilli Creek has declined since 2012, and a TARP level 3 impact was recorded when water levels dropped below baseline on 20/11/2017, following the identification of a stream bed fracture in 2013. Assessment of the declining water levels in Pool 43 has been hindered by the unusually dry conditions during the extraction of Longwall 13 which has affected pools outside the influence of mining. However, the steady decline in water levels at Pool 43a since 2012 appears independent of the rainfall trends and, combined with observations of drawdown in groundwater pressures in the sandstone substrate, suggests that water level trends at Pool 43a may be due to induced baseflow reduction. Rainfall-runoff modelling of flows at the downstream gauge (WWL) indicates that baseflow reduction is less than predicted by numerical modelling. Further assessment of the trend is recommended.

One monitoring site at Swamp 11 showed a sharp decline in shallow groundwater level and an increase in recession rate after the passage of Longwall 13. Soil moisture at all sensors in Swamp 13 dropped below baseline after Longwall 13 passed within 400 m; however, dry conditions may have contributed to the decline. Seven swamps located above Area 3B longwalls are now at or above TARP Level 1 based on the observed groundwater level responses. These are Swamps 01a, 01b, 03, 05, 08, 10 and 11. These swamps are among those listed in earlier assessment as having the potential to be affected by subsidence.

Table 1. Summary of Surface Water TARPs – Longwall 13

CATCHMENT	CATCHMENT YIELD TARP ASSESSMENT			SURFACE WATER QUALITY TARP ASSESSMENT		
	SITE	TARP TRIGGER	REDUCTION IN TOTAL DISCHARGE*	SITE	TARP TRIGGER	COMMENT
Donalds Castle Creek	DCS2	Level 3	-22%	DC_Pool 22	N/A	
	DC13S1	Level 1	-7%	DC13_Pool 2b	N/A	
	DCU	not triggered	-2%	Donalds Castle Ck (FR6)	not triggered	
Wongawilli Creek	WC15S1	not triggered	+1%	WC15_Pool 9	N/A	
	WC21S1	not triggered	-2%	WC21_Pool 5	N/A*	
	WWL	not triggered	-3	Wongawilli Ck (FR6)	Level 3	DO and EC TARP exceeded on two and 3 occasions respectively
Lake Avon tributaries	LA4S1	Level 1	-6%	LA4_S1	not triggered	

* sometimes referred to as 'Catchment Yield' in previous End-of-Panel Surface Water Reports

FR6 = Fire Road 6. There are monitoring sites on both Wongawilli Creek and Donalds Castle Creek where they pass FR6.

1. Introduction

Illawarra Coal is required to submit regular reviews of the local hydrological data, including water quantity and quality, for watercourses and water bodies above and adjacent to Dendrobium Mine. These studies contribute to an assessment of the chemical and ecological impacts of longwall mining on surface water catchment areas, being tributaries of Lake Cordeaux and Lake Avon, and upland swamps in the Wongawilli Creek, Donalds Castle Creek and Sandy Creek catchments.

This report reviews available hydrographic and water quality data obtained for the Wongawilli Creek catchment, Upper Donalds Castle Creek catchment, and the Lake Avon sub-catchments LA4 and LA5 up to the completion of Longwall 13 (LW13).

Surface water monitoring has been undertaken by IC since 2003. Field parameter measurements and sampling for more detailed laboratory chemical analyses were collected by the ICEFT. Hydrographic gauging stations and piezometers were also installed and monitored.

1.1 Reporting Objectives

This End of Panel report has been prepared to satisfy Condition 3-9 of the Approval for Dendrobium Mine (DA 60-03-2001). The objectives are to provide an End-of-Panel report:

- of all subsidence effects (both individual and cumulative) for the panel and comparing subsidence effects with predictions;
- describing in detail all subsidence impacts (both individual and cumulative) for the panel;
- discussing the environmental consequences for watercourses, swamps, water yield, water quality, aquatic ecology, terrestrial ecology, groundwater, cliffs and steep slopes; and
- comparing subsidence impacts and environmental consequences with predictions.

1.2 Longwall 13

Extraction of Longwall 13 commenced on 4 March 2017 and was completed on 19/04/2018. Longwall 13 is the fifth panel to be extracted in Area 3B, with an extracted length of 2270 m, a void width of 305 m (including first workings) and a cutting height of between 3.7 and 3.95 m.

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2. Surface water and groundwater management

This section outlines the network of monitoring infrastructure and sites operated by Illawarra Coal at and around the Dendrobium Mine. Further details of monitoring sites and procedures are outlined in the Dendrobium Area 3B Watercourse Impact Monitoring Management and Contingency Plan (South32, 2015a).

2.1 Surface Water Monitoring

Monitoring includes a selection of sites downstream and within the mining area, as well as sites located away from the mining area to provide control sites and act as a comparison to impact sites. Pools within streams are monitored monthly before and following mining and weekly (when site access available) during active subsidence and in response to any observed impacts.

Figure 1 presents Longwall 13 in relation to the locations of surface water *flow* monitoring sites in Areas 3B and 3A. The surface water catchments used in the modelling of surface runoff are also shown.

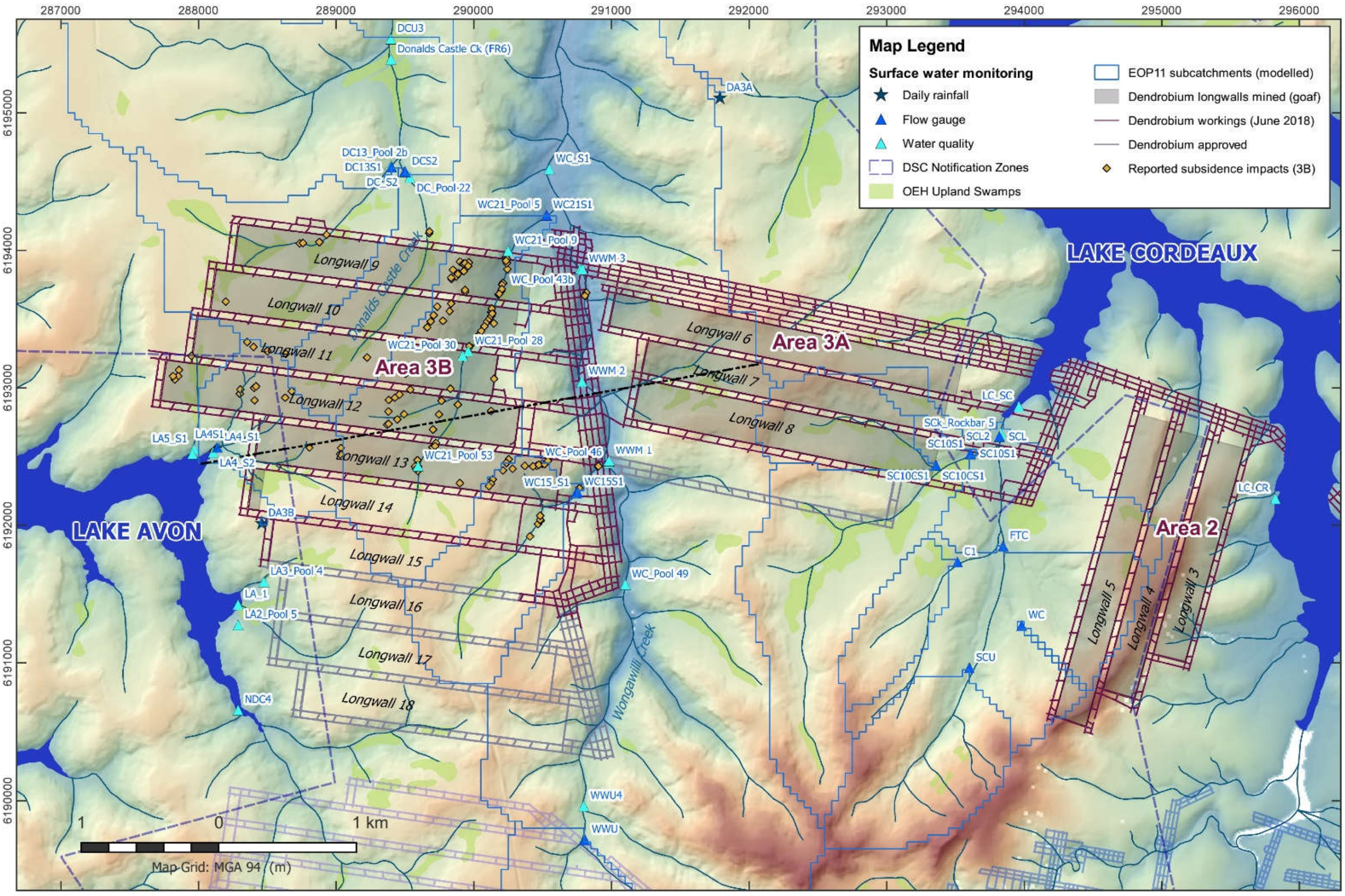

Figure 1. Monitoring sites – surface water flow and chemistry

A summary of these monitoring sites is presented in Table 2, ordered by mine area, catchment (watercourse) and then by approximate downstream order.

Table 2. Surface Water Flow Monitoring Sites

MINE AREA	LOGGER ID	SITE NAME	WATERCOURSE	EAST (MGA94)	NORTH (MGA94)	Catchment Area (km2)
Area 3B	300067	DC13S1	DC13 (Donalds Castle Creek tributary)	289397	6194613	1.64
Area 3B	300068	DCS2	Donalds Castle Creek	289496	6194574	1.08
Area 3B	300023	DCU	Donalds Castle Creek	289396	6195538	6.22
Area 3B	300071	WC15S1	WC15 (Wongawilli Creek tributary)	290743	6192232	1.19
Area 3B	300069	WC21S1	WC21	290555	6194270	2.43
Area 3B	300024	WWU	Wongawilli Creek	290814	6189769	3.21
Area 3B	300022	WWL	Wongawilli Creek	290979	6197544	20.08
Area 3B	300070	LA4S1	LA4 (Lake Avon tributary)	288138	6192567	0.82
Area 3A	300021	WC	SC6	293981	6191271	0.28
Area 3A	300026	C1	SC7	293515	6191732	0.78
Area 3A	300020	FTC	SC8	293846	6191848	0.69
Area 3A	300019	SC10CS1	SC10C	293358	6192433	0.82
Area 3A	300018	SC10S1	SC10	293609	6192519	2.77
Area 3A	300025	SCU	Sandy Creek	293602	6190964	1.25
Area 3A	300059	SCL2	Sandy Creek	293819	6192648	7.03

The monitoring of water quality parameters provides a means of detecting and assessing the effects of streambed fracturing or induction of ferruginous springs. Monitoring includes measurement of field parameters such as pH, Electrical Conductivity (EC), Dissolved Oxygen (DO), Oxygen Reduction Potential (ORP) and laboratory tested analytes (DOC, Na, K, Ca, Mg, Filt. SO_4, Cl, T. Alk., Total Fe, Mn, Al, Filt. Cu, Ni, Zn, Si). Water quality monitoring sites are shown in Figure 1.

2.2 Shallow Groundwater Monitoring

Figure 2 shows Longwall 13 in relation to the locations of shallow groundwater monitoring sites in Areas 3B and 3A. Typically, these sites are piezometers approximately 1 - 3 m deep that monitor groundwater levels within the swamp deposits located around the Dendrobium area.

Figure 2 also shows swamp areas: broadly mapped by NSW Office of Environment and Heritage (OEH) and refined through site-scale mapping for Illawarra Coal carried out by Biosis. Note that the TARP assessment relates only to those piezometers that are located within swamp sub-communities mapped as Banksia Thicket, Sedgeland-heath complex and Tea Tree Thicket; being listed as Costal Upland Swamp Endangered Ecological Community (EEC). Piezometers located within fringing Eucalypt Woodland are excluded from the TARP assessment as per the advice from OEH (dated 17/01/2014).

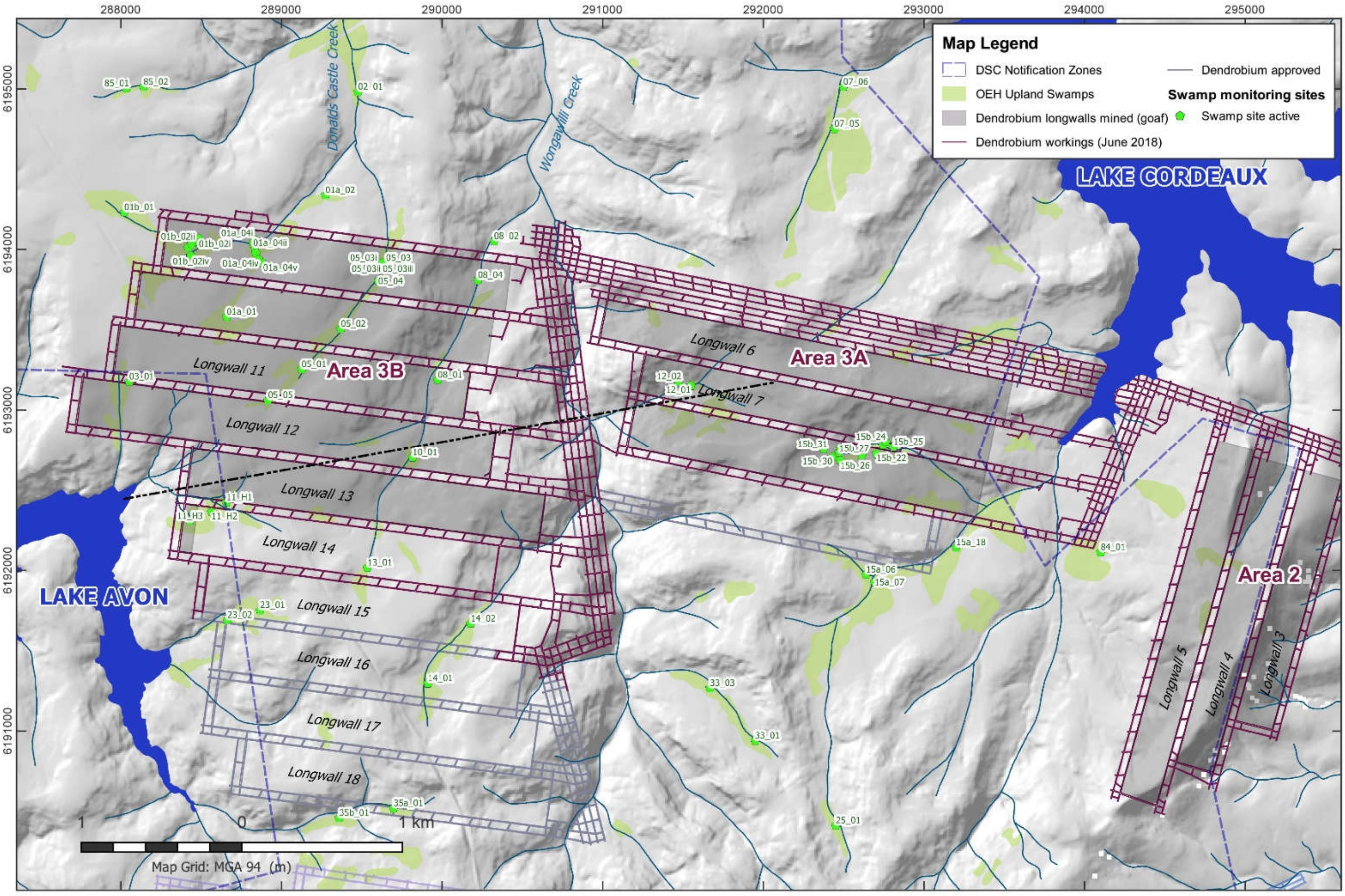

Figure 2. Monitoring Sites – 'Shallow' Groundwater (within swamps)

A summary of the shallow groundwater monitoring sites is presented in Table 3.

Table 3. Summary of Swamp Monitoring

Swamp	Site type	Number of piezometers		Undermined by longwalls	Comment
		Total	TARP (Within Coastal Upland Swamp EEC		
01a	Impact	9	6	LW9, LW10	Limited baseline data for 5 piezometers
01b	Impact	7	6	LW9	Limited baseline data for 5 piezometers
02	Reference	1	n/a	No	900 m from LW9
03	Impact	1	1	Pillar 11/12	3_01 Undermined by LW12 on 2/4/2016
05	Impact	9	6	LW9 to LW12	LW12 passed piezometer 5_05 within 400 m on 24/5/2016.
07	Reference	2	n/a	No	1.2 km from LW6
08	Impact	6	0	LW9, LW10 LW11	Limited baseline data for 1 piezometer, insufficient recent data for 1 piezometer

Swamp	Site type	Number of piezometers		Undermined by longwalls	Comment
		Total	TARP (Within Coastal Upland Swamp EEC		
10	Impact	1	1	LW12	Piezometer 10_01 undermined by LW12 on 15/11/2016
11	Impact	3	3	LW13, LW14	Partially mined under by LW13
13	Impact	1	1	LW14, [LW13]	LW13 mined under the northern extent of Swamp 13
14	Impact	2	2	LW15, LW16	Yet to be mined under
15a	Impact	16	7	LW8, LW19	Limited baseline data for 1 piezometer, yet to be mined under
15b	Impact	23	10	LW7, LW8	
22	Reference	2	n/a	No; Elouera Colliery	Limited baseline data
23	Impact	2	2	LW15, LW16	Yet to be mined under
25	Reference	1	n/a	No	1.4 km from LW5
33	Reference	2	n/a	No	1 km from LW16
84	Reference	1	n/a	No	500 m from LW5
85	Reference	2	n/a	No	900 m from LW9
86	Reference	2	n/a	No	3 km from LW9
87	Reference	2	n/a	No; Avon Colliery	Limited baseline data
88	Reference	2	n/a	No; Huntley Colliery	Limited baseline data
Notes:	Blue shading are reference swamps; Pink shading are those swamps directly mined under by Longwall 13				

2.3 Soil moisture monitoring

Soil moisture profiles are monitored at most swamps, with sensor arrays typically positioned near shallow piezometers (where possible). Where possible the monitoring arrays are numbered according to the corresponding piezometer (if present) with an 'S' prefix. At most locations, five sensors are installed at 20 cm depth intervals to a total depth of 1 m.

Soil moisture is measured using Sentek sensors which monitor changes in the dielectric constant within a cylinder of soil extending to a radial distance of 10 cm from the access tube. Soil moisture is reported as mm water per 100 mm soil depth (or volumetric % water) at each monitored depth (Sentek 2017). The most recent installations are equipped with automated data loggers set to record moisture levels every hour (S5_S01, S05_S08, S11_S01, S14_S01, S87_S02). The remaining installations are recorded manually during scheduled site visits.

2.4 Weather conditions during the assessment period

Rainfall data are collected from several gauging stations across the mining lease. Weather observations at Area 3B for the reporting period (Longwall 13) and the previous four years are summarized in Figure 3. Potential evapotranspiration (EVT) is calculated from SILO data (DSITI 2011) derived for Dendrobium Area 3B, using the FAO Penman-Monteith formula (Allen *et al.* 1998). The average annual rainfall for Dendrobium is 1033 mm (2002 – 2018). Rainfall events occur year-round but tend to be more frequent in the summer and early autumn months. It is common for a substantial proportion of the annual rainfall to be delivered in a small number of large rainfall events, during which significant surface water runoff and groundwater recharge is generated.

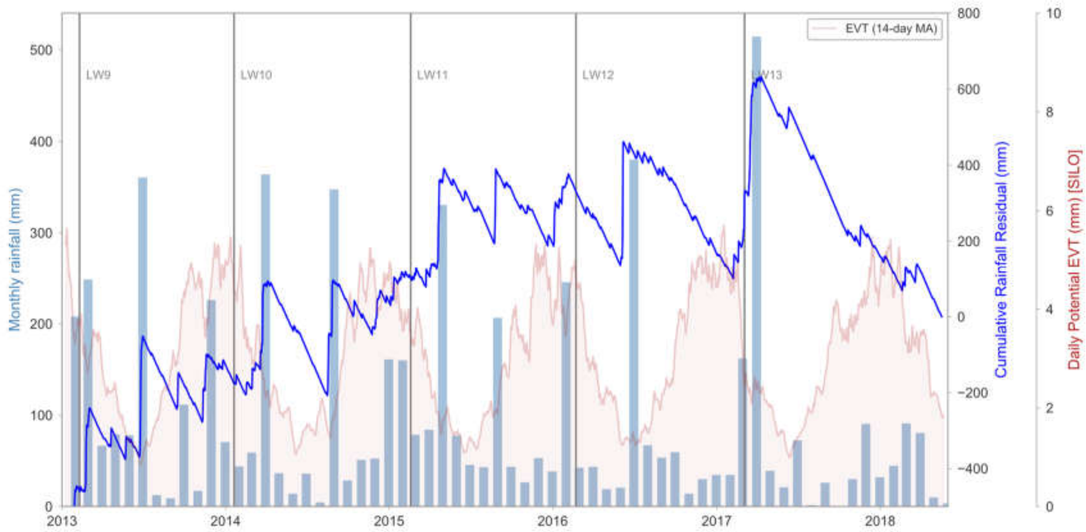

Figure 3. Rainfall and potential evapotranspiration (EVT) at Area 3 for the reporting period

Maximum daily temperature varies seasonally from approximately 20 °C in the winter months (June – August) to 40 °C or higher in the summer (December – February). Evapotranspiration varies seasonally in line with temperature and solar radiation, peaking during the summer months. Rainfall over the 12 months leading up to the end of Longwall 13 was less than half of the annual average at 496 mm). The prolonged dry period between winter 2017 and autumn 2018 was exacerbated by high summer evapotranspiration potential, resulting in very low flow or no-flow conditions in many creeks and pools across the plateau.

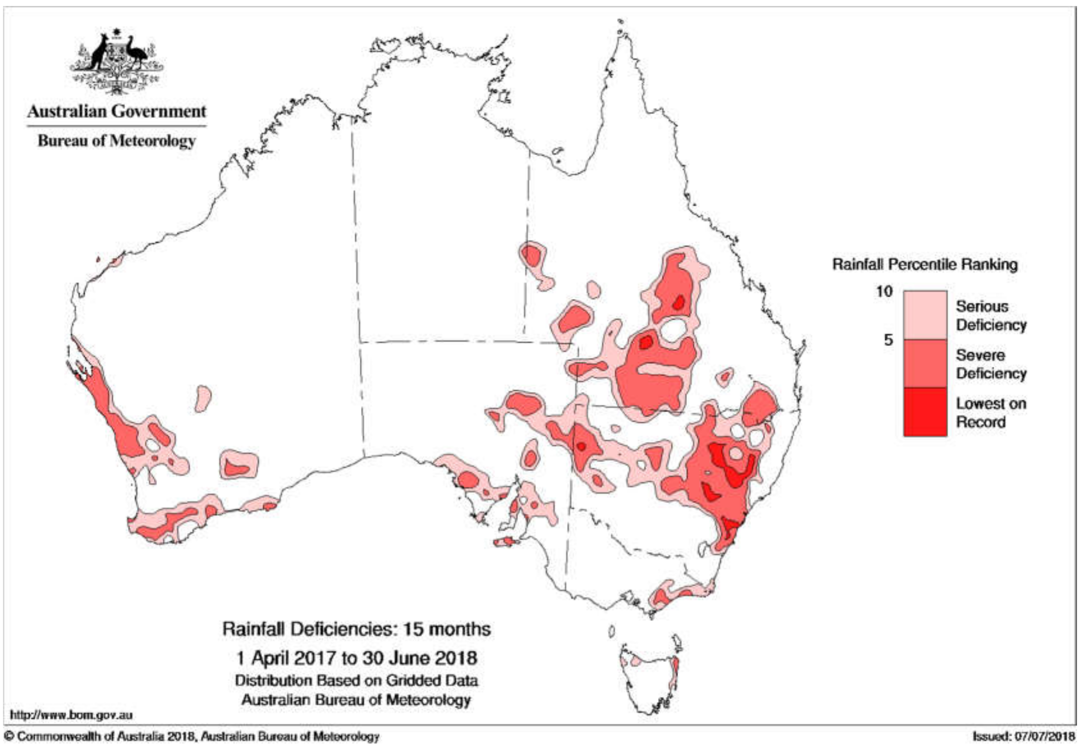

Figure 4. Rainfall deficiency map from April 2017 to June 2018

Weather data and analysis by Bureau of Meteorology (BoM) shows there was a 'failed' winter-spring season during 2017, and that rainfall totals for the mid-late 2017 were as low as any in the past 3 decades. This was on the back of another moderately dry year (2016). In their recent Drought Statement, BoM showed that the 15-month rainfall totals in the area around Dendrobium are the lowest on record (Figure 4). Therefore, surface water flows are expected to be as low as any recorded in the past decade or more. This conclusion is supported by the modelling of root zone soil moisture by BoM (Figure 5).

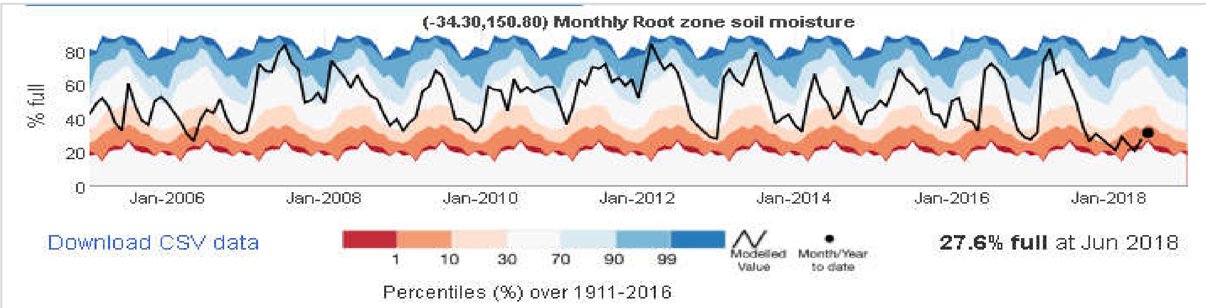

Figure 5. Calculated soil moisture from BOM's AWRA Landscape Model

Figure 6 shows longer term rainfall trends between 1960 and 2018 and is derived from SILO data (and is therefore slightly different from site measurements). Since 1960 there have been three periods of drought on the plateau (yellow shading), the last being the severe Millennium Drought, ending in 2004. The last decade has been characterized by relatively consistent rainfall as measured across calendar years. The plot shows that the period from 2002 for which rainfall data have been collected at Dendrobium is slightly below the long-term average (~1200 mm), accounting for the difference in appearance of the cumulative rainfall trends in Figure 3 (based on site data) and Figure 6 (based on long term SILO data).

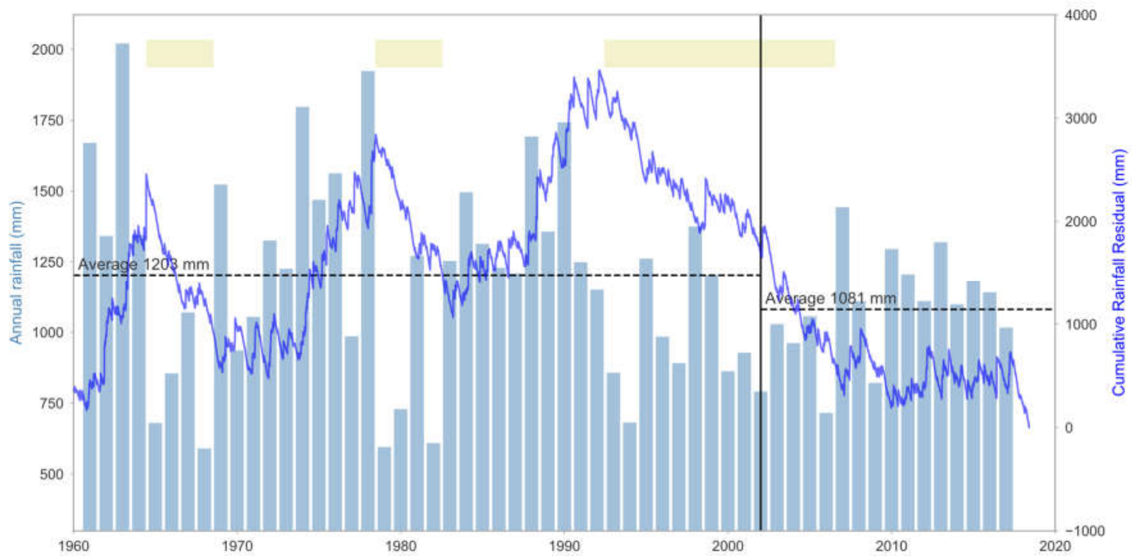

Figure 6. Long-term rainfall trends at Dendrobium (1960-2018)

3. Longwall subsidence effects

Figure 7 presents the total subsidence predicted by MSEC (2015) above Area 3B longwalls. This shows that Wongawilli Creek is outside the main area of subsidence (above the mains), although its tributaries WC21 and WC15 lie directly across the area of predicted maximum subsidence (from recent or future longwalls). The upper reaches of Donalds Castle Creek, its tributary DC13 as well as Lake Avon tributary LA4 lie across some or all of Longwalls 9-13, although are slightly westward of the area with the greatest predicted subsidence.

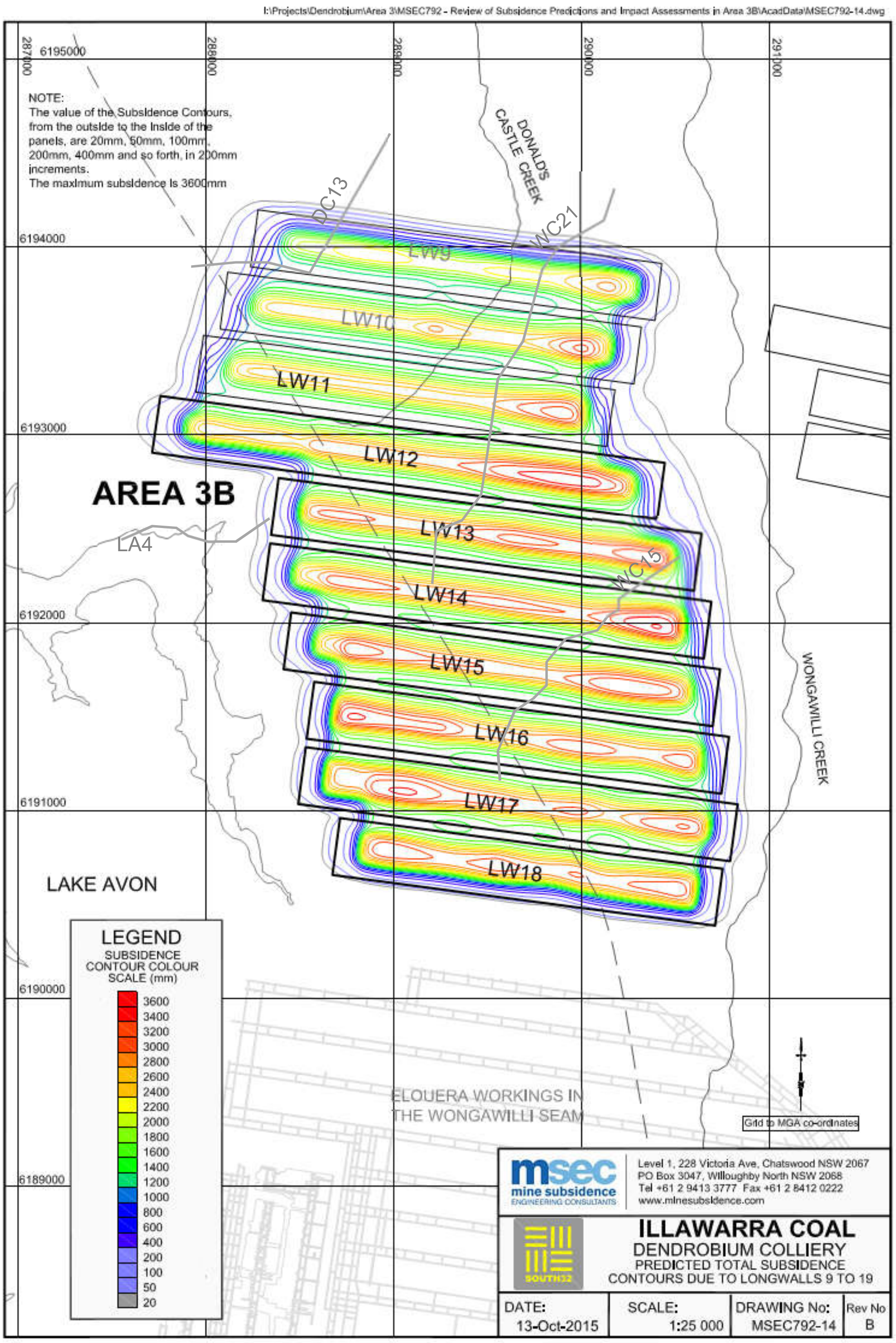

Figure 7. Predicted Subsidence above Area 3B (from MSEC, 2015)

3.1 Measured subsidence

Observed mine subsidence movements due to the extraction of Longwall 13 were reviewed by MSEC (2018). Mine subsidence effects were measured using the Wongawilli Creek closure lines, Avon Dam closure lines, Area 3B and Avon Dam 3D monitoring points, tributary cross lines, Donalds Castle Creek cross lines, swamp cross lines and airborne laser scans.

The review concluded that measured ground movements after the extraction of Longwall 13 were generally similar to or less than the predicted values based on the re-calibrated subsidence model outlined in reports MSEC792 (MSEC 2015). MSEC (2018)considered that the observed surface impacts on the natural and built features, resulting from the extraction of Longwall 13 (Table 5, below), are consistent with predictions.

3.2 Observed surface impacts

Surface watercourses and catchments undermined by Longwall 13 are listed in Table 4.

Table 4. Surface water features undermined by Longwall 13

Catchment / location	Approximate date	Monitoring locations (level and chemistry)	
		Upstream	Downstream
LA4 (upper reaches)	3/4/2018 to 6/5/2017	-	LA4 S1, LA4 S2
WC21 tributary, including Pools 46, 47, 48, 49, 51, 53 and 54	24/9/2017 to 14/10/2017	-	WC21S1 (Pool 5)

Observed subsidence impacts on the landscape, including surface fracturing and iron staining are monitored by the ICEFT and reported separately in the End of Panel Landscape Report (South32 2018). A total of **43** new surface impacts were noted within the zone of influence of Longwall 13 (within 400 m of the longwall footprint), of which **18** were in stream beds (Table 5), with the exception of DA3B_LW13_015, which was outside the zone of influence of Longwall 13

Table 5. Reported subsidence impacts to stream beds

Site ID	Report Dates	Description	Tarp Level
DA3B_LW13_001	3/05/2017	Rock fracturing and uplift to base of LA4S1, approx. 0.5m length, 0.01 m width.	2
DA3B_LW13_006	05/10/2017	Rock fracture to the base of WC21_Pool 48. 5 m length, 0.03 m width. Also associated with an absence of water in pool.	2
DA3B_LW13_007	05/10/2017	Iron staining at subsurface outflow, downstream from WC21_Pool 38, at BF37.	1
DA3B_LW13_009	24/10/2017	Rock fracturing to the downstream extent of WC21_Pool 54, 0.38 m long, 0.22 m wide, 0.37 m deep.	1
DA3B_LW13_010	24/10/2017	Rock fracturing to the step at the upstream extent of WC21_Pool 53, 2.5 m long, 0.01 m wide, and 0.03 m deep.	2
DA3B_LW13_011	24/10/2017	Rock fracturing to the base of WC21_Pool 47.	2
DA3B_LW13_015 (Wongawilli Creek)	28/11/2017 24/02/2018 31/05/2018	WC_Pool 43a water level below baseline. Fracture was identified in the pool during LW9.	3

Site ID	Report Dates	Description	Tarp Level
DA3B_LW13_017	09/01/2018	Rock fracturing across Pool 45 in tributary WC21, 2m long, 0.03 m wide and 0.22 m at its deepest measurable point.	2
DA3B_LW13_018	23/02/2018	Rock fracturing across Pool 46 in tributary WC21. Max, 0.5 m long, 0.01 m wide and 0.05 m.	2
DA3B_LW13_021	03/04/2018	Rock fracturing to the upstream extent of WC15_Rockbar 18, 5.7 m long, up to 0.015 m wide, depth 0.06 m.	2
DA3B_LW13_022	03/04/2018	Rock fracturing to WC15_Rockbar 18. Comprised of approx. 10 fractures. Max 3 m long, up to 0.015 m wide, depth 0.04 m.	2
DA3B_LW13_023	03/04/2018	Rock fracturing to WC15_Rockbar 18. Max 5.6 m long, up to 0.03 m wide, depth 0.16 m.	2
DA3B_LW13_028	06/04/2018	Rock fracturing to WC15_Pool 18. Max 1.4 m long, up to 0.018 m wide. No evidence of flow diversion.	1
DA3B_LW13_035	27/04/2018	Rock fracturing to WC15_Rockbar 21. Max 1.6 m long, up to 0.002 m wide. Small section of uplift and plating. No evidence of flow diversion.	1
DA3B_LW13_040	08/05/2018	Rock fracturing in WC15 and uplift zone of 20 m. Longest continuous fracture is 5.5 m, 0.05 m width, 0.24 m depth.	2
DA3B_LW13_041	08/05/2018	Rock fracturing across step on WC15, 12 m length, 0.05 m width. Rockfall 3 m x 3 m x 0.2 m. Ironing staining present	2
DA3B_LW13_042	17/05/2018	Impacts to WC15_Rockbar 7. Combination of rock fracturing, iron staining and a rock fall. Max length of fracturing is 4.5 m, depth 0.19 m and width 0.01 m. Multiple rock fractures under rockbar. Estimated to be 1 m x 1 m x 0.3 m.	2
DA3B_LW13_043	17/05/2018	Rock fracturing, rockfall and iron staining evident to the base of LA4_Step 0 on LA4. Fracture is 2 m length, 0.02 m width. rock fragment is 1.5 m in length, 0.5 m in width and 0.3 m in height.	2

Subsidence impacts of TARP level 2 or above require specialist advice in relation to possible Corrective Management Actions (CMAs). Advice in relation to subsidence impacts to watercourses is as follows:

- The observed impacts in the sandstone channel of the WC15 tributary and to LA4 tributary (Step 0) are in line with predicted subsidence effects above Longwall 13, being within 400 m of the extracted longwall (as assessed by MSEC, 2018). Routine monitoring is continuing, and no additional actions are recommended.

4. Assessment of surface water quality effects

Trigger values for water quality field parameters are defined in Attachment 1 of the Watercourse Impact Monitoring Management and Contingency Plan (South32 2015b). Trigger thresholds (TARPs) have been defined for three locations downstream of the mining area for which there is adequate high-quality baseline information (Wongawilli Creek (at Fire Road 6 [FR6]) and Donalds Castle Creek (at FR6) and Lake Avon (tributary site LA4_S1). The TARPs are based on the field parameters pH, EC and DO and defined by the value three standard deviations (SD) from the baseline mean (mean plus 3SD for EC and mean minus 3SD for pH and Dissolved Oxygen). TARP levels are defined as follows:

- Level 1: One exceedance during the monitoring period
- Level 2: Two exceedances during the monitoring period
- Level 3: Three exceedances during the monitoring period
- Exceeding prediction: Mining results in two consecutive exceedances during the monitoring period

During the 12-month reporting period between the start of Longwall 13 (03/04/2017) and one month after the end of Longwall 13 (19/04/2018), monitoring was carried out at 84 sites. Sites were monitored on an approximately weekly basis (46 monitoring events) for TARP sites and approximately monthly for other sites.

TARP triggers for the monitoring period are summarised in Table 6.

Table 6. Summary of Water Quality TARPs for the monitoring period

<table>
<tr><th>DATE</th><th>CATCHMENT / LOCATION</th><th>PARAMETER</th><th>VALUE</th><th>TARP</th><th>TRIGGER LEVEL</th></tr>
<tr><td>23/01/2018</td><td>Wongawilli Ck (FR6)</td><td>SpC</td><td>169</td><td>154.1</td><td rowspan="2">Level 2</td></tr>
<tr><td>12/02/2018</td><td>Wongawilli Ck (FR6)</td><td>SpC</td><td>174</td><td>154.1</td></tr>
<tr><td>02/01/2018</td><td>Wongawilli Ck (FR6)</td><td>DO</td><td>43.3</td><td>50.5</td><td rowspan="3">Level 3</td></tr>
<tr><td>23/01/2018</td><td>Wongawilli Ck (FR6)</td><td>DO</td><td>34.7</td><td>50.5</td></tr>
<tr><td>12/02/2018</td><td>Wongawilli Ck (FR6)</td><td>DO</td><td>30.4</td><td>50.5</td></tr>
</table>

Assessment of surface water quality effects is presented by catchment (watercourse) in the following subsections. Key figures are included in the text here, while a selection of plots (hydrographs) is available for all sites in **Appendix A**.

4.1 Donalds Castle Creek Catchment

Time series plots of key field parameters measured at Donalds Castle Creek at FR6 are shown in Figure 8, Figure 9 and Figure 10.

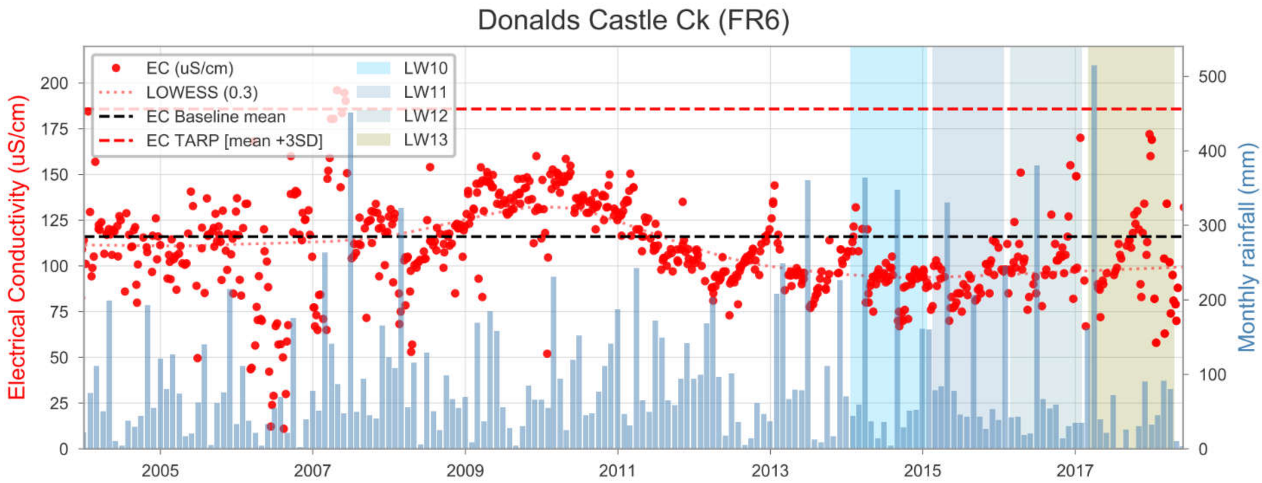

Figure 8. Field measured Electrical Conductivity (EC) at Donalds Castle Creek (FR6)

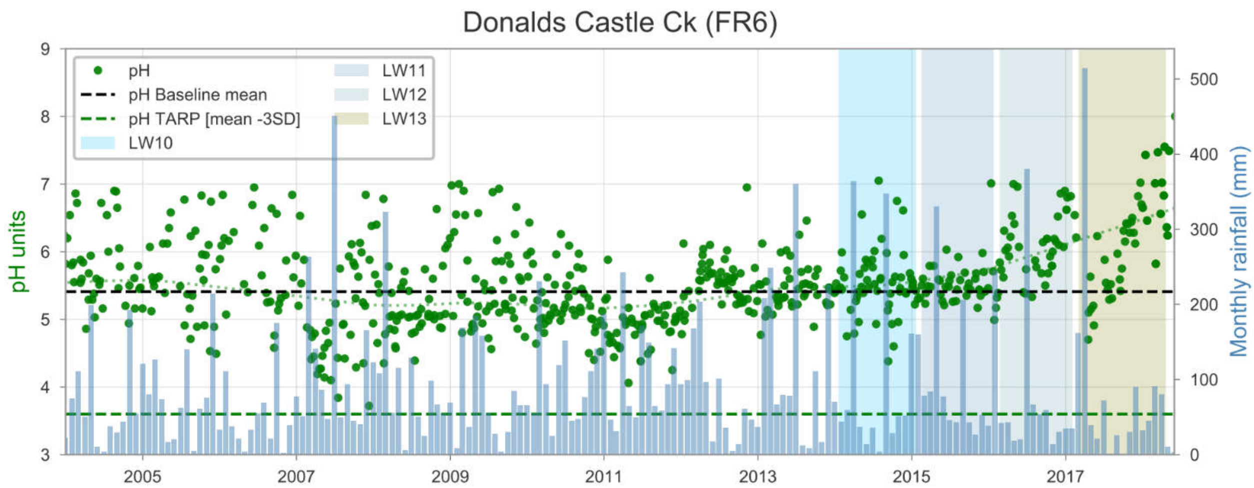

Figure 9. Field measured pH at Donald's Castle Creek (FR6)

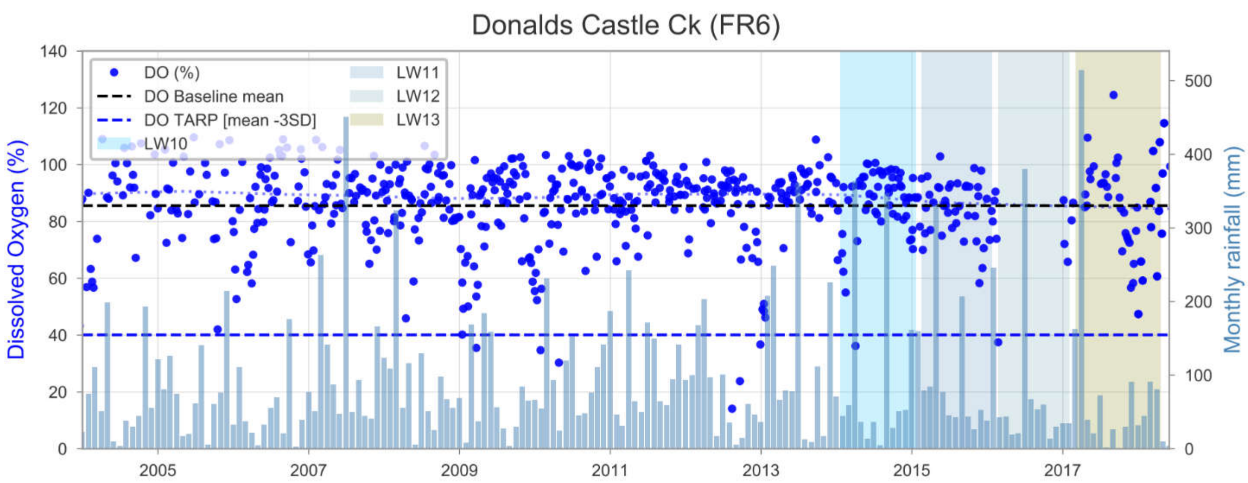

Figure 10. Field measured pH at Donald's Castle Creek (FR6)

At the Donalds Castle Creek site (at FR6), the stream EC increased from April 2017 through to early 2018 in response to the dry conditions over the winter and following summer months. The increase in EC, combined with an increase in pH and a decrease in DO was similar to responses to previous dry periods and no TARP was triggered for this site.

4.1.1 Donalds Castle Creek tributaries

Electrical conductivity of surface water has increased to levels significantly higher than baseline ranges at several pool monitoring sites across mining Area 3B during the extraction of Longwall 13, most notably at Pools 19 and 20 on the main first-order tributary of Donalds Castle Creek (e.g. Figure 11). The trend is accompanied by a decline in DO to levels lower than baseline range and a slight decline in water pH (Appendix A). This tributary crosses the previously mined Longwalls 9 to 11, but does not cross above Longwall 13.

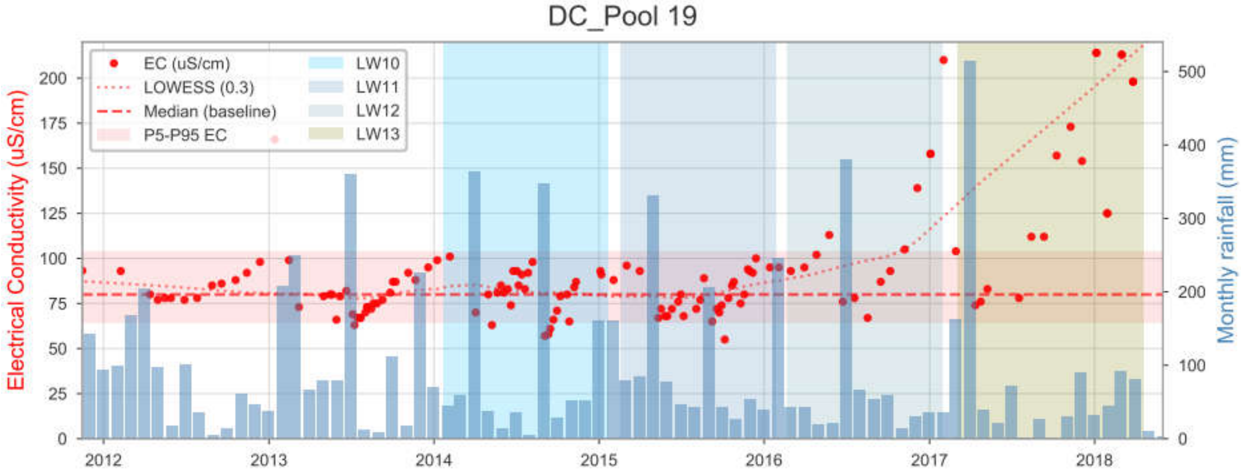

Figure 11. Field measured EC at Donald's Castle Creek Pool 19

The elevated EC levels during the extraction of Longwall 13 coincide with an unusually dry period on the plateau, during which, pool levels were low (or dry) and gauges record low-flow or no-flow conditions (e.g. at DCS2 located at Pool 20 and just 22 m upstream of Pool 19). The increase in pool salinity is considered to reflect higher than usual concentration of dissolved salts due to pool evaporation during the no-flow periods. Pool-water EC values above the baseline range have been noted in other pools across mining Areas 3A and 3B, including LA3_Pool 4 (860 m south of Longwall 13), WC15_Pool 28 (395 m from LW13), Sandy Creek SC10_S1 (no active mining beneath the catchment). Therefore, the effect is not restricted to this tributary, nor other tributaries that cross active or previously mined panels.

However, it is noted in Section 5.2.4 that measured tributary catchment yields at DCS2 have likely reduced, and cease-to-flow days have likely increased, since Longwall 9 passed beneath the tributary. Therefore, mine subsidence and stream diversions are likely to have contributed to and exacerbated the water quality effects at the DC_Pool 19 and Pool 20 sites. As noted in the previous section, EC levels at the downstream location DCU were also elevated but remain within the baseline range and did not trigger the EC TARP.

4.2 Wongawilli Creek Catchment

Plots of key field parameters from Wongawilli Creek at FR6 are shown in Figure 12, Figure 13 and Figure 14.

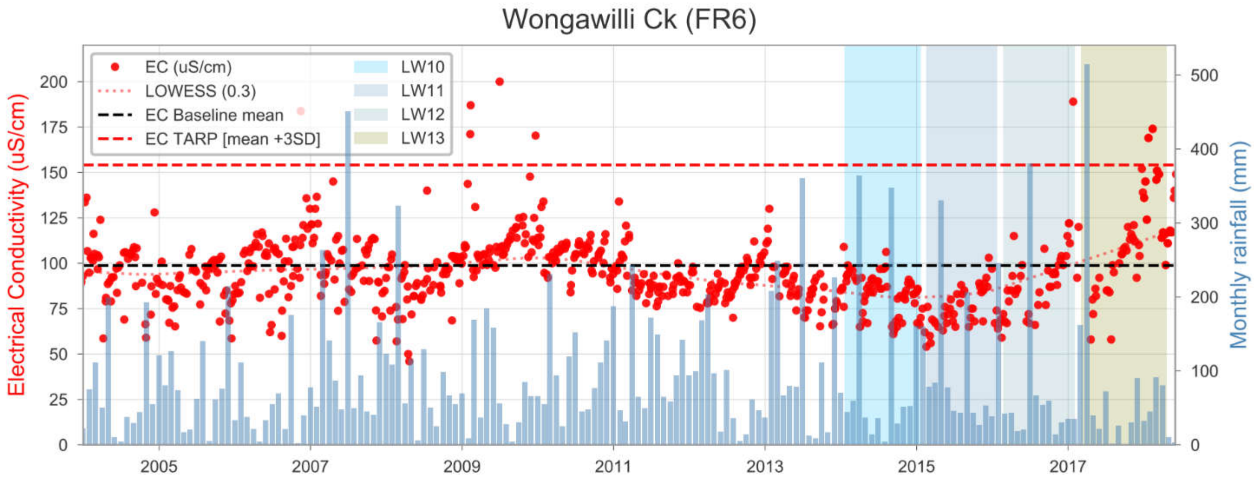

Figure 12. Field measured Electrical Conductivity (EC) at Wongawilli Creek (FR6)

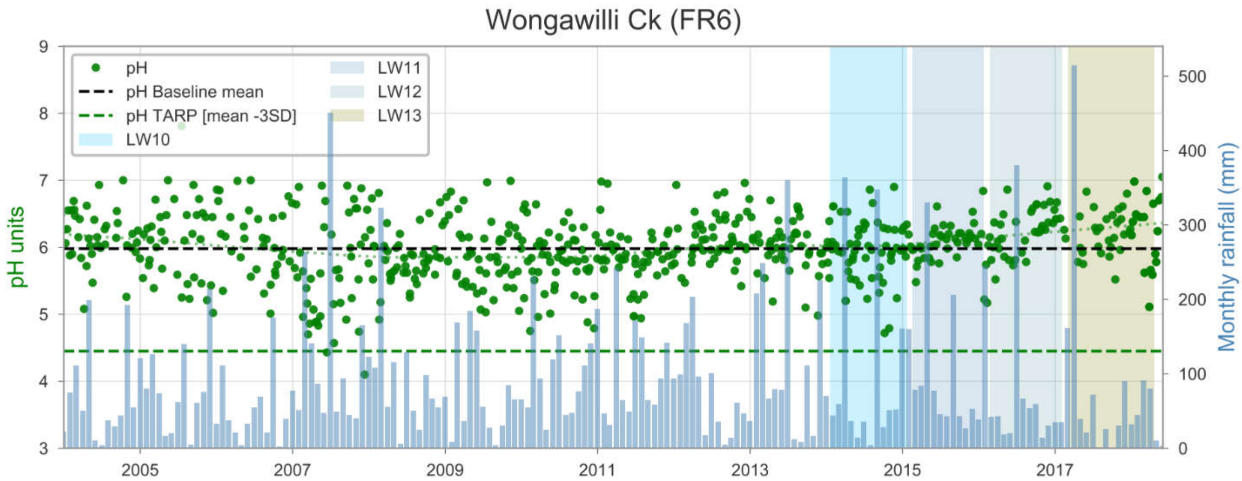

Figure 13. Field measured pH at Wongawilli Creek (FR6)

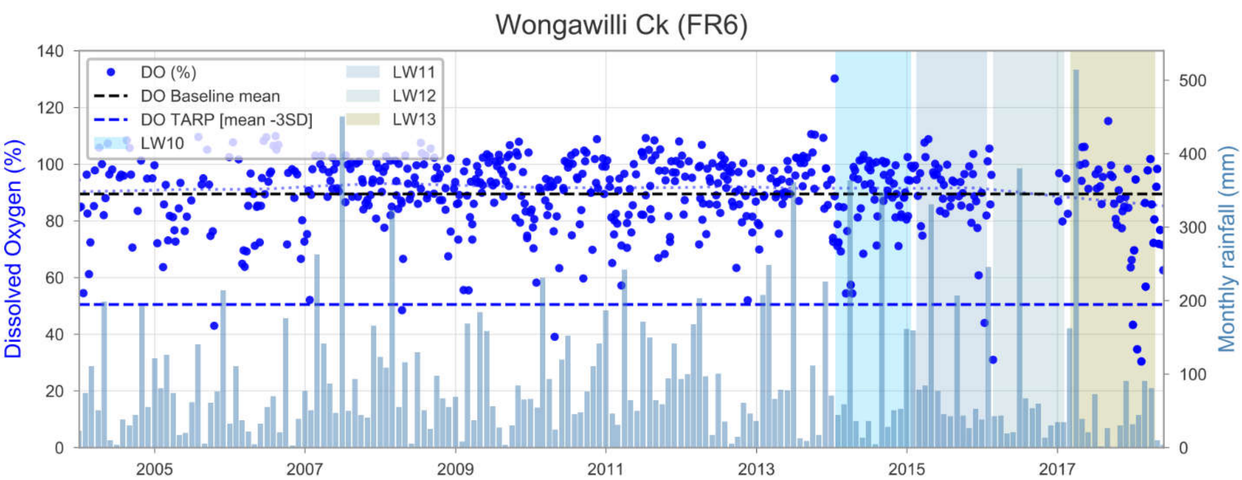

Figure 14. Field measured pH at Wongawilli Creek (FR6)

At the Wongawilli Creek site (at FR6), the TARP level for EC was triggered on two occasions and the DO trigger level was exceeded on three occasions (Table 6).

As with the Donalds Castle Creek site, elevated and apparently increasing EC values from mid-2017 to early 2018 are likely due to evaporation during that dry period (as concluded in the specialist report by HGEO 2018). Nearly all monitored pools along Wongawilli Creek, including those up-stream of Longwall 13 show a trend of increasing EC throughout Longwall 13. The same period is characterised by low pool water levels and low-flow or no-flow conditions at gauging stations. Similar responses are noted for previous periods with low rainfall and high evapotranspiration, and EC levels are seen to have decreased again following rainfall in early 2018. Nevertheless, it is recommended that stream water quality be monitored to determine if stream EC mean and range has shifted as a response to mining.

4.2.1 Subcatchment WC21

The DA3B Longwall 13 End of Panel Landscape Report (South32 2018) identifies surface cracking at seven locations in WC21 within the zone of influence for Longwall 13 (Table 5). The fractures range between Level 1 and Level 2 impacts in terms of the fracture length and width as defined in the TARP. All monitored pools on WC21 within the zone of influence of Longwall 13 were reported as dry from late September to early October, corresponding approximately to when Longwall 13 passed beneath the watercourse. As a consequence, water chemistry samples could not be collected from those pools. Water quality data for the WC21 catchment monitored at locations downstream of Area 3B (Pool 5) are discussed below.

Monitoring location WC21_Pool 5 is located downstream (to the north) of mining Area 3B. The EC of water at this location was elevated above the baseline P95 during Longwall 13 on three occasions (Figure 15). Water EC in WC21 at Pool 5 has remained slightly elevated above the baseline mean since Longwall 11. While low rainfall and high summer evaporation conditions can account for periods of elevated EC in the past, it is likely that subsidence impacts and redirection of water through fracture networks is contributing to the elevated EC in WC21 at Pool 5. It should be noted that the EC in Pool 5 is still well below the TARP level for the downstream site on Wongawilli Creek at FR6 (TARP level 154.1 µS/cm). Water pH in Pool 5 has also remained elevated above the baseline mean since Longwall 10, but remains in the near-neutral range (Figure 16).

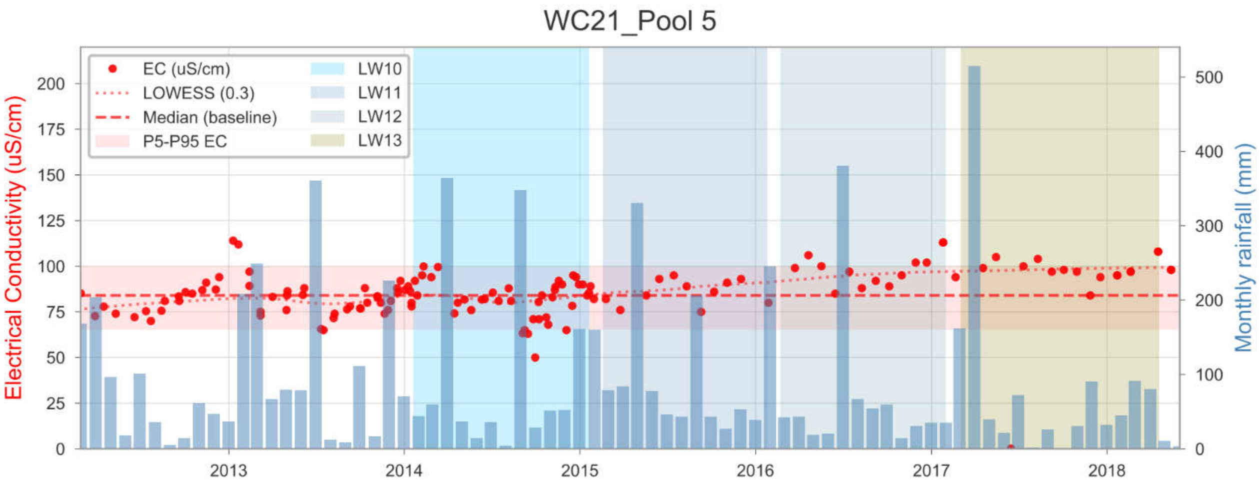

Figure 15. Field measured EC at WC21 Pool 5, downstream of Area 3B

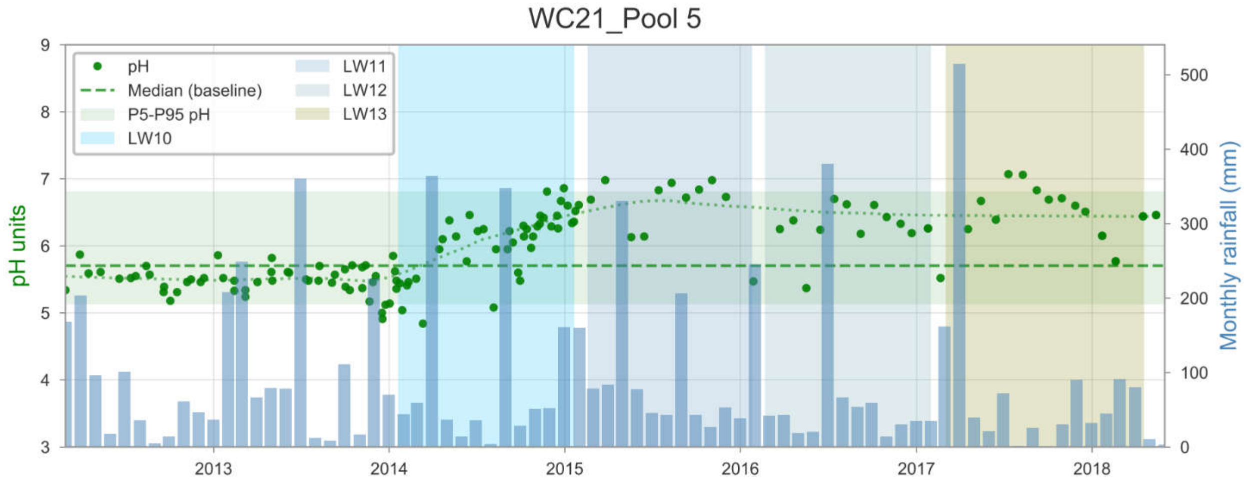

Figure 16. Field measured pH at WC21 Pool 5, downstream of Area 3B

Dissolved iron at WC21 Pool 5 increased to ~1.4 mg/L in early 2017, following a very heavy rainfall and runoff event. Similar transient increases in dissolved iron concentration were seen during Longwalls 10 to 12, typically associated with large rainfall-runoff events (Figure 17). Dissolved iron concentrations in Wongawilli Creek (at FR6), downstream of the WC21 confluence (Figure 18) remained within the baseline range.

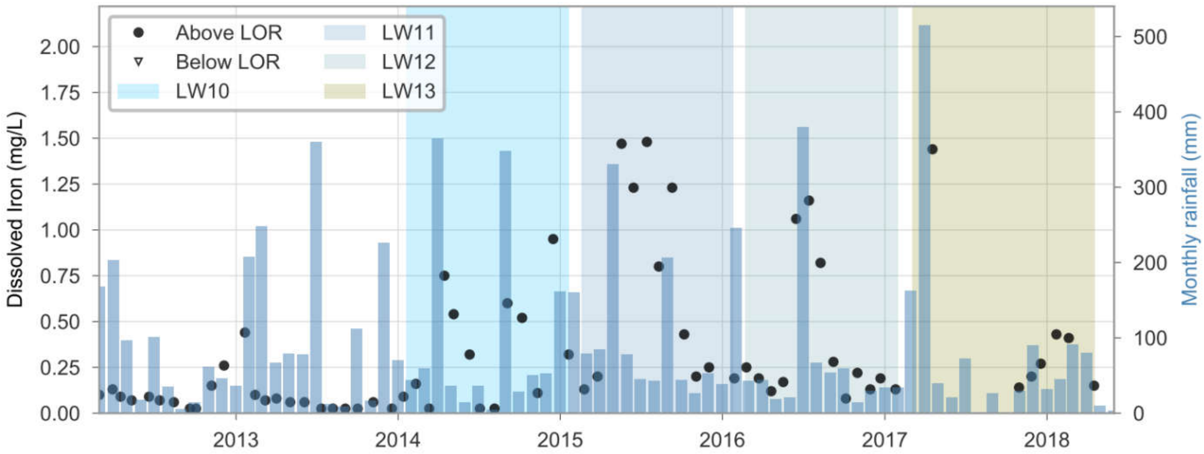

Figure 17. Dissolved iron in WC21 Pool 5, downstream of Area 3B

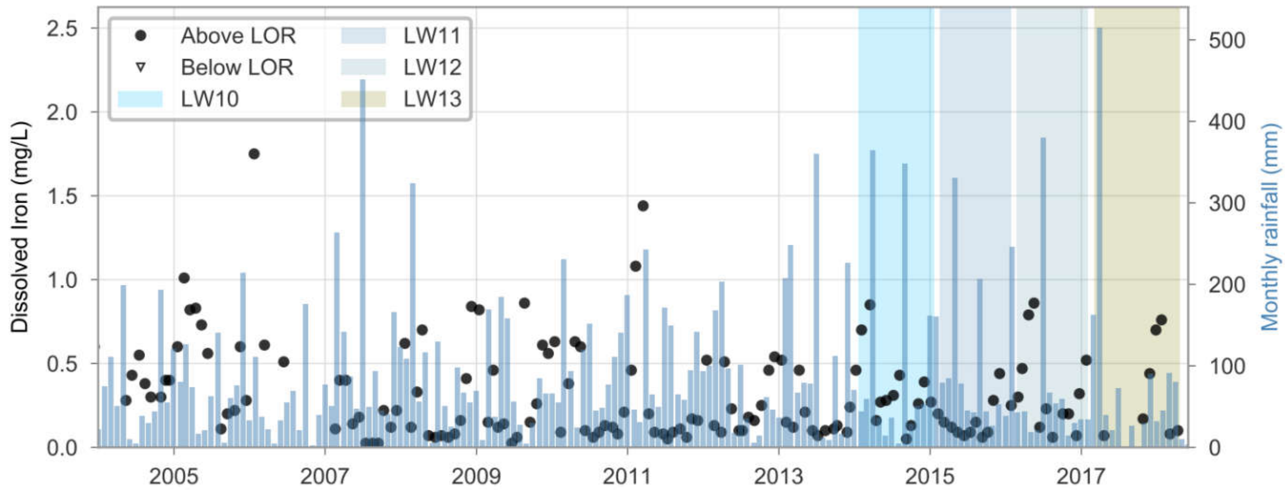

Figure 18. Dissolved iron in Wongawilli Creek (FR6), downstream of WC21

In summary, assessment of water quality at WC21 Pool 5 indicates anomalous trends in EC and dissolved iron during Longwall 13 (and the previous 2 longwalls). There are no similar or clear trends at locations immediately downstream of Longwall 13, nor at locations upstream of Longwall 13 and these trends are considered minor. The concentration of dissolved iron in Pool 5 declined to normal baseline levels after mid-2017.

4.3 Lake Avon

Ground subsidence associated with Longwalls 12 and 13 has resulted in the development of surface cracking of the stream bed of LA4 near the gauging station weir LA4_S1 (Table 5). This resulted in the diversion of flows just upstream of the LA4_S1 gauge and measurable reduction in flow at the gauge, as reported previously (HGEO 2017b; South32 2017), and in this report (Section 5.2). As a consequence of the flow diversion and the low rainfall during the extraction of Longwall 13, most of the pools and sampling points on the LA4 watercourse were dry and could not be sampled for water chemistry. Of the sampling events that were carried out, none triggered TARPs related to water chemistry (Figure 19). A time series plot of water EC measured at LA4_S1 near Lake Avon is shown in Figure 19.

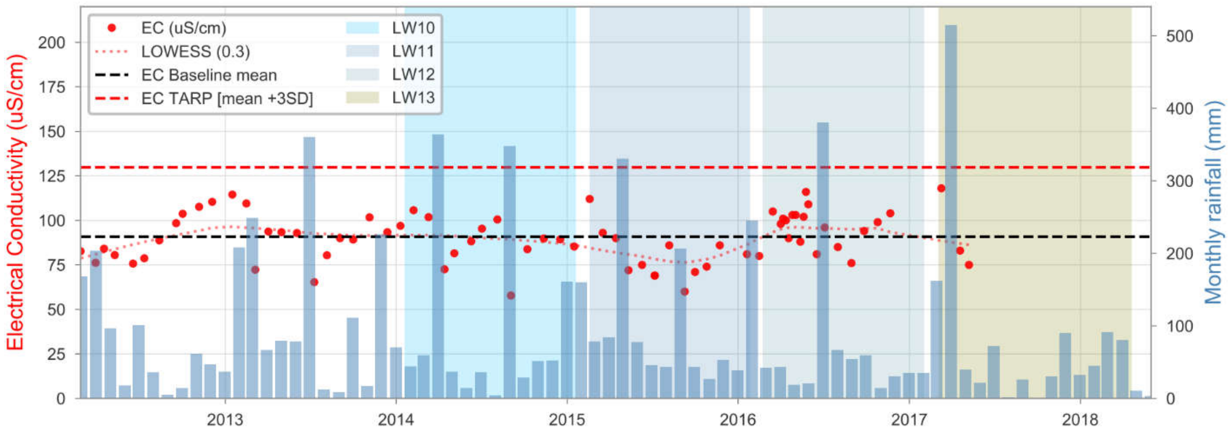

Figure 19. Field measured EC at Lake Avon tributary (LA4_S1)

At LA5_S1, water EC increased above the baseline P95 and DO declined below the baseline P5 level (to levels of around 30%) over the summer months (Appendix A).

5. Assessment of surface water flow effects

5.1 Assessment approach and criteria

As in previous End of Panel Reports (e.g. HGEO 2017a) the effects of mining subsidence on surface water hydrology is assessed by comparing observed stream flow at the WWL monitoring station on Wongawilli Creek against predictions of streamflow from a calibrated rainfall-runoff model. The model is calibrated to pre-mining baseline conditions using observed rainfall and stream flow such that modelled streamflow closely matches observed for the baseline period. The model is then run, using the baseline parameters, through the post-mining period, and variance between the model and the post-mining observed record are assessed to infer whether mining has had a discernible effect on flow. This approach is defined in Attachment 1 of the Watercourse Impact Monitoring Management and Contingency Plan (South32 2015b). Rainfall-runoff modelling was undertaken using the industry-standard Australian Water Balance Model (AWBM; Walter Boughton, 2009).

5.2 Modelling Assessment

As in HGEO (2018), the approach used for running the AWBM model has been changed slightly from earlier End of Panel Reports (e.g. HGEO, 2017a). Previously AWBM had been used through the eWater Source' (v4.1) modelling platform (eWater 2017), however this has been modified with the added functionality of allowing for evaporative losses from the shallow water table. Our experience is that this can be a critical part of the water balance, as there is typically an excess of potential evaporation compared to moisture (be that rainfall or soil moisture). This, plus some additional re-calibration, has resulted in an improvement in the fit between the model to pre-mining flows on Wongawilli Creek, particularly for low-flows which were critical to the assessment of HGEO (2018), and continue to be so, given the continuation of dry or drier-than-average conditions.

The AWBM approach and adopted parameters are presented in Appendix B.

5.2.1 Data Sources

Rainfall and potential evaporation inputs were obtained from Dendrobium's Centroid rainfall station and from SILO 'Data Drill' for the Dendrobium Mine location (DSITI 2011). Catchment areas were calculated in GIS from LiDAR ground elevation data. Daily flow data for the pre-mining period, from the surface water flow monitoring stations operated by Illawarra Coal, was used to calibrate AWBM model parameters for the baseline period. At the time of writing, flow data for the monitoring network around Ares 3B (Wongawilli Creek and Donalds Castle Creek and tributaries, Lake Avon tributary 4 (LA4) was available up to mid-May 2018.

5.2.2 Assessment

The assessment consists of calibrating the rainfall-runoff model to observed pre-mining flows and then reviewing whether flows have diverged from the model in the post-mining case. Differences in the pre- and -post-mining conditions are then highlighted and used to infer and quantify any effects that mining has had on the catchment. The critical behaviour that is investigated, is whether the recession limbs on the observed flow hydrograph in the post-mining periods fall consistently below the modelled hydrograph. This behaviour would suggest a reduction in flow in the catchment.

The modelling analysis is presented in four chart elements labelled A to D (e.g. in Figure 20 A to D):

A) is a correlation of observed and modelled flows, with the pre-mining calibration period presented as one series, and all the post-mining period presented as another series.

B) is a comparison of the calculated flow duration curves for observed and modelled flows for pre-mining (baseline / calibration) and post-mining periods.

C) presents a comparison of modelled and observed flow hydrographs, with longwall progression and mining dates for context. The hydrograph is on a log-scale to allow easier comparison of flows at the lower end of the scale.

D) presents a ratio of the modelled and observed flows as a timeseries, in order to provide a graphical estimate of any effect of mining on catchment outflow.

Chart A (the scattergram) shows R2 (the "coefficient of determination") as a measure of correlation. While R2 is presented here, it is a guide only – interpretations have relied far more heavily on the visual comparison of the scattergram (Chart A), the flow duration curves (Chart B), and the hydrographs (Charts C and D), alongside a comparison of the mean modelled flow and mean observed flow in the pre-mining period, to judge calibration.

As noted previously, TARPs are in place to assess effects on watercourse hydrology. With respect to flow in the watercourses, the Dendrobium A3B Watercourse Management Plan provides the TARP levels and these are listed in Table 7.

Table 7. Performance criteria related to catchment water balance

TARP Level	Criteria	Response
1	A change in measured discharge (between pre- and post-mining) **6-12%** less than average annual precipitation	See WIMMCP for details
2	A change in measured discharge (between pre- and post-mining) **12-18%** less than average annual precipitation	
3	A change in measured discharge (between pre- and post-mining) **>18%** less than average annual precipitation	

5.2.3 DC13S1 – tributary of Donalds Castle Creek

This tributary lies across the centre of several Area 3B panels. The catchment to DC13S1 was first mined under at the commencement of Longwall 9, and has been undermined by Longwall 10 and Longwall 11. Longwalls 12 and 13 did not directly mine under this sub-catchment.

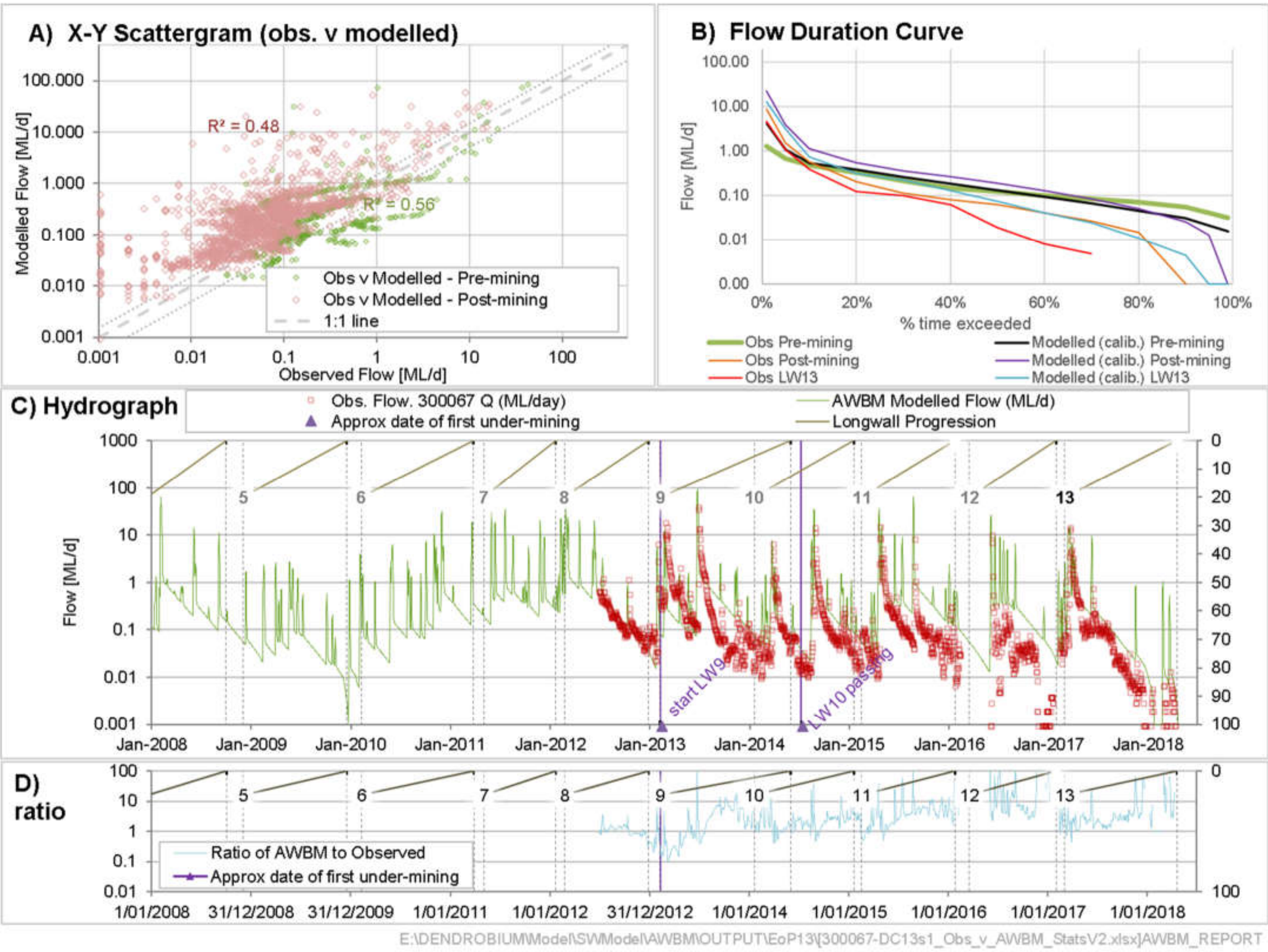

Figure 20. Comparison of observed and simulated flows in Tributary DC13S1

A	The scattergram shows that during the pre-mining period the model is a good fit to observed data, as shown by the graphical correlation to the 1:1 line and also the R2. This fit declines when the post-mining period is considered.
B	Confirms the good match between modelled and observed flows for the short pre-mining period and illustrates that the model over-estimates flow for the post-mining period, including throughout Longwall 13 (with the variance being at low flows).
C	The hydrograph shows a very good match between observed flows up until July 2013 (mid-way through Longwall 9). The range of flows is quite well matched, including the recessions. The fit declines significantly midway through Longwall 9, and from then on, the observed hydrograph remains consistently below that predicted by the model, except during the heaviest of rainfall events.
D	The pre-mining ratio of modelled to observed flows shows the ratio hovers at about 1, with deviation during short-term high flow events. The post-mining ratio oscillates around 4-10 to the end of Longwall 11, and then oscillates more during Longwall 12-13.

Assessment: Stream flow characteristics and sub-catchment yield as measured at DC13S1 appear to have been affected as a result of undermining of the watercourse midway through Longwall 9. The effect continues through Longwalls 10-13. Cease-to-flow conditions have occurred about 14% of the time since undermining, while the model suggested that under the pre-mining case this would have been about 2% of the time.

Catchment discharge for Longwall 13:	**TARP LEVEL 1**	Water balance [Qsim + ETsim] is 7% below average Pobs. (during Longwall 12 it was -21%, Level 3)

5.2.4 DCS2 – Donalds Castle Creek

The upper reach of Donalds Castle Creek lies across several Area 3B panels. The catchment to DCS2 was first mined under by Longwall 9 (in early July 2013), then by Longwall 10, 11, and again by Longwall 12. Longwall 13 passed within 250 m of the creek in May-2017.

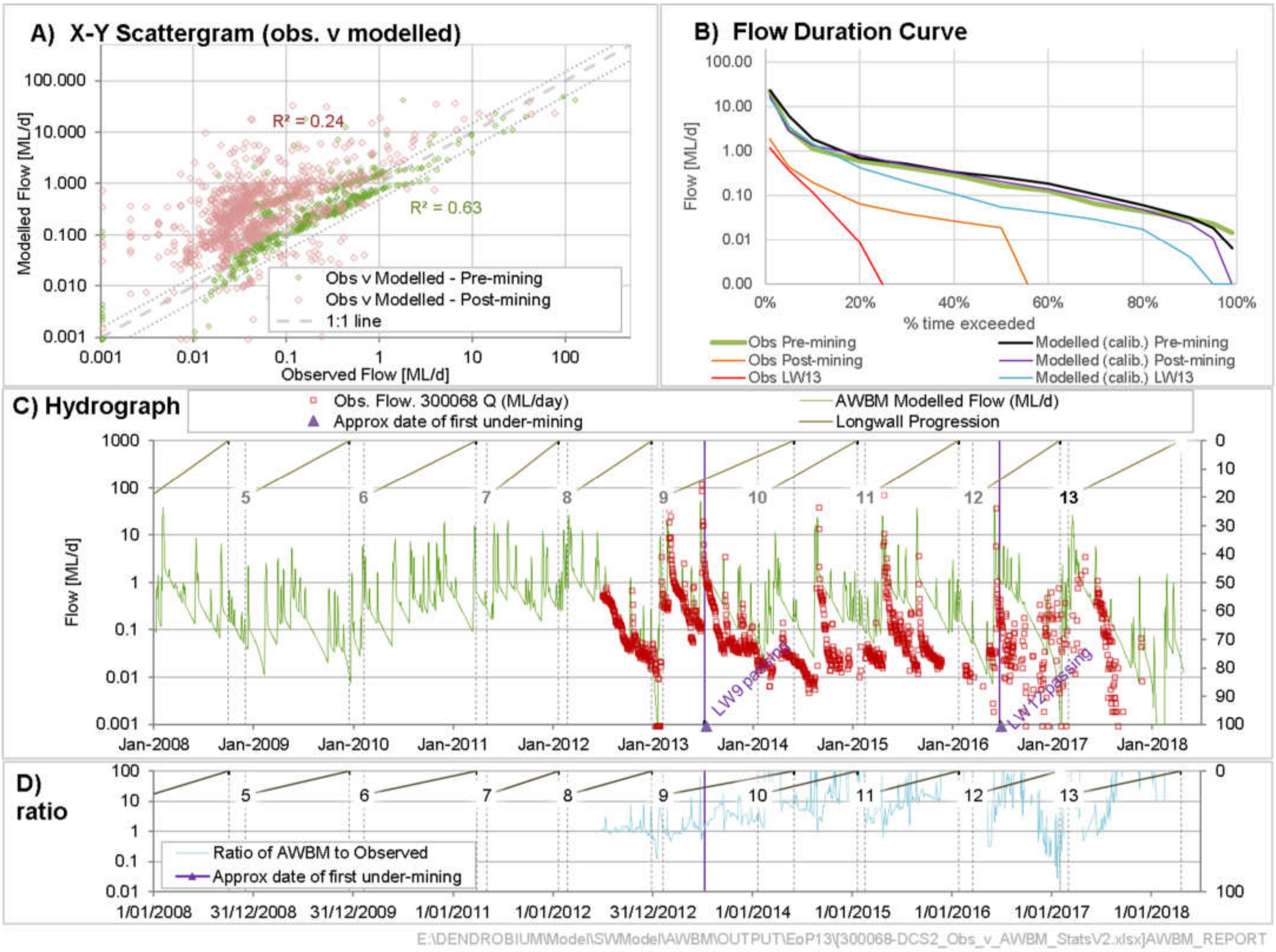

Figure 21. Comparison of observed and simulated flows at DCS2

A	The scattergram shows that during the pre-mining period the model is a good fit to observed data, as shown by the graphical correlation to the 1:1 line and also the R2. This correlation declines in the post-mining period.
B	Confirms the good match between modelled and observed flows for the pre-mining period and illustrates that the model over-estimates flow for the subsequent post-mining period, including after the passing of Longwall 12 and through Longwall 13.
C	The hydrograph shows a very good match between observed flows up until July 2013, including the very low flows in summer Jan-2013. After the initial undermining by Longwall 9, the observed hydrograph remains consistently below that predicted by the model, except during the heaviest of rainfall events. The model predicted some cease to flow periods in 2016-18, but the observed record has shown longer cease-to-flow periods.
D	The pre-mining ratio of modelled to observed flows shows the ratio hovers at about 1, with deviation during short-term high flow events. The post-mining ratio oscillates much more after mining, indicating greater variance between modelled and observed.
Assessment:	Evidence that undermining by Longwall 9 affected the sub-catchment yield, and this continues through Longwalls 10-12; as well as during Longwall 13. During Longwall 13 the effects have occurred across the full range of flows.

Catchment discharge for Longwall 13:	**TARP LEVEL 3**	Water balance [Qsim + ETsim] is 22% below average Pobs. (during Longwall 12 it was -21%, Level 3)

5.2.5 DCU – Donalds Castle Creek

This catchment incorporates DC13 and DCS2, and was therefore mined under at the commencement of Longwall 9, and again by Longwalls 10-12. Longwall 13 skirts the edge of the top of the catchment. About 60% of the DCU catchment lies downstream of Longwall 9, and is not directly mined under.

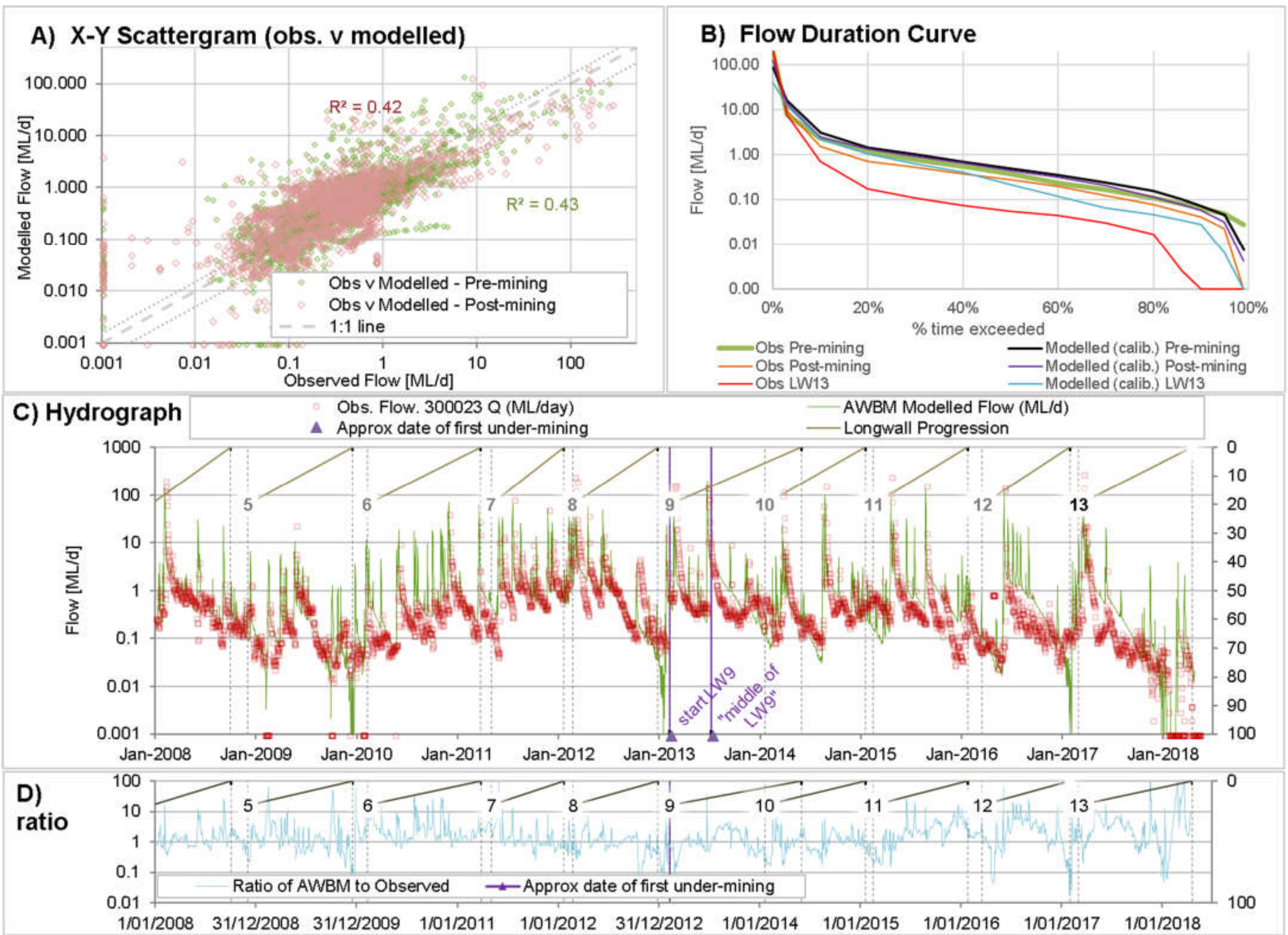

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Figure 22. Comparison of observed and simulated flows in Donalds Castle Creek to DCU

A	The scattergram shows that during the pre-mining period the model is a moderate fit to observed data, as shown by the graphical correlation to the 1:1 line and also the R^2. The fit is similar in the post-mining period.	
B	Confirms the reasonable match between modelled and observed flows (including the lowest of flows) for the pre-mining period and illustrates that the model tends to overpredict flows for the subsequent post-mining period, primarily during Longwalls 11-13.	
C	The hydrograph shows a good match between observed flows up until Feb-2013. Generally, the flow recessions are well matched, and the model does predict some extremely low flows in the pre-mining period. The hydrograph suggests that there is a deviation between modelled and observed flow in late 2015, mid-2016, and mid-2017.	
D	The pre-mining ratio of modelled to observed flows shows the ratio hovers at about 1 (i.e. a good match between observed and modelled). The post-mining ratio also oscillates around 1, but with exceptions during Longwalls 11-13.	
Assessment:	Evidence that undermining by recent longwalls affected the pattern of flow and the magnitude of recession flows at DCU through Longwalls 11-12; as well as during Longwall 13. Cease to flow conditions increased by about 6%.	
Catchment discharge for Longwall 13:	**TARP - NOT TRIGGERED**	Water balance [Qsim + ETsim] is -2% of average Pobs. (during Longwall 12 it was -5%)

5.2.6 WC15-S1 – Wongawilli Creek tributary

This tributary to Wongawilli Creek lies above Longwalls 13-17 of Area 3B, with its confluence with Wongawilli Creek approximately 320 m from Longwall 13. Prior to this, this sub-catchment had not been directly mined under, although Longwall 12 came within 100 m of the catchment.

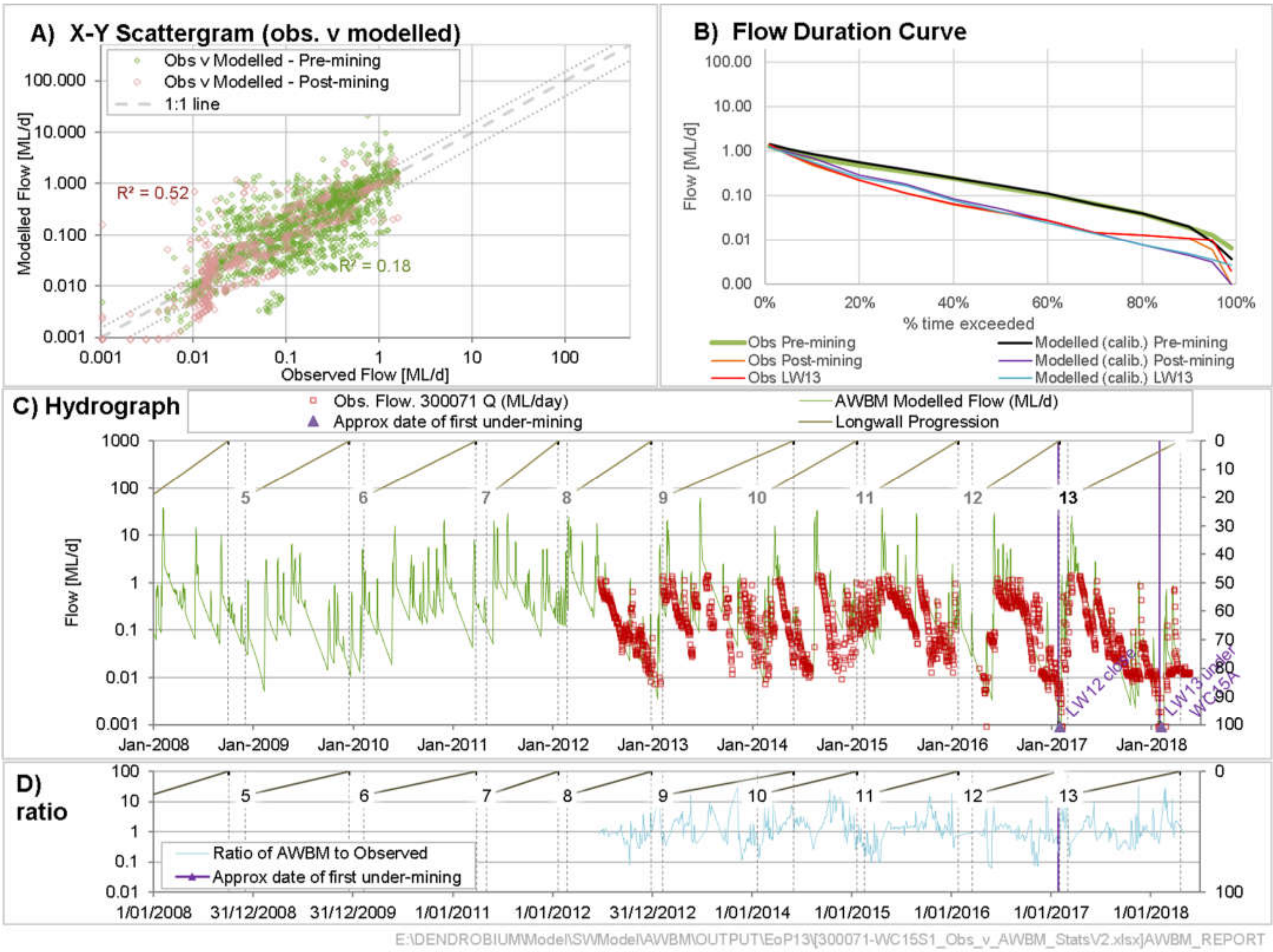

Figure 23. Comparison of observed and simulated flows in Tributary WC15S1

A	The scattergram shows that during the pre-mining period the model is a moderate fit to observed data, as shown by the clustering around the 1:1 line and also the R^2. The post-mining series is a better fit to the observed data.	
B	This chart confirms the good match between modelled and observed flows for the pre-mining period; the lower end of the curve has been improved from previous assessments. The modelled sequences are below the observed record for the period of Longwall 13 and since Longwall 12 passed, suggestive of no mining effect.	
C	The hydrograph shows the fit is better than represented on the scattergram (chart A), due in part to the truncation of the observed record above 1.6 ML/d. The rate of recession is represented well, and the model is able to capture recent periods of flow <=0.001 ML/d.	
D	The pre-mining ratio of modelled to observed flows shows the ratio hovers at about 1, with deviation during some periods, but returning to the baseline value of 1. The behaviour is similar in the post-mining period.	
Assessment:	No evidence that mining has affected flows in this sub-catchment, including during Longwall 13, noting that the period from mid-2017 is marked by dry conditions. Recent low flows and recession periods are consistent with the model.	
Catchment discharge for Longwall 13:	**TARP - NOT TRIGGERED**	Water balance [Qsim + ETsim] is within +1% of average Pobs.

5.2.7 WC21-S1 - Wongawilli Creek tributary

WC21, a tributary to Wongawilli Creek, flows above Longwalls 9-15, entering Wongawilli Creek just north of Longwall 9. This catchment was therefore mined under late in Longwall 9, has since been undermined by Longwalls 10-13, and it is planned to be mined under by Longwalls 14-15.

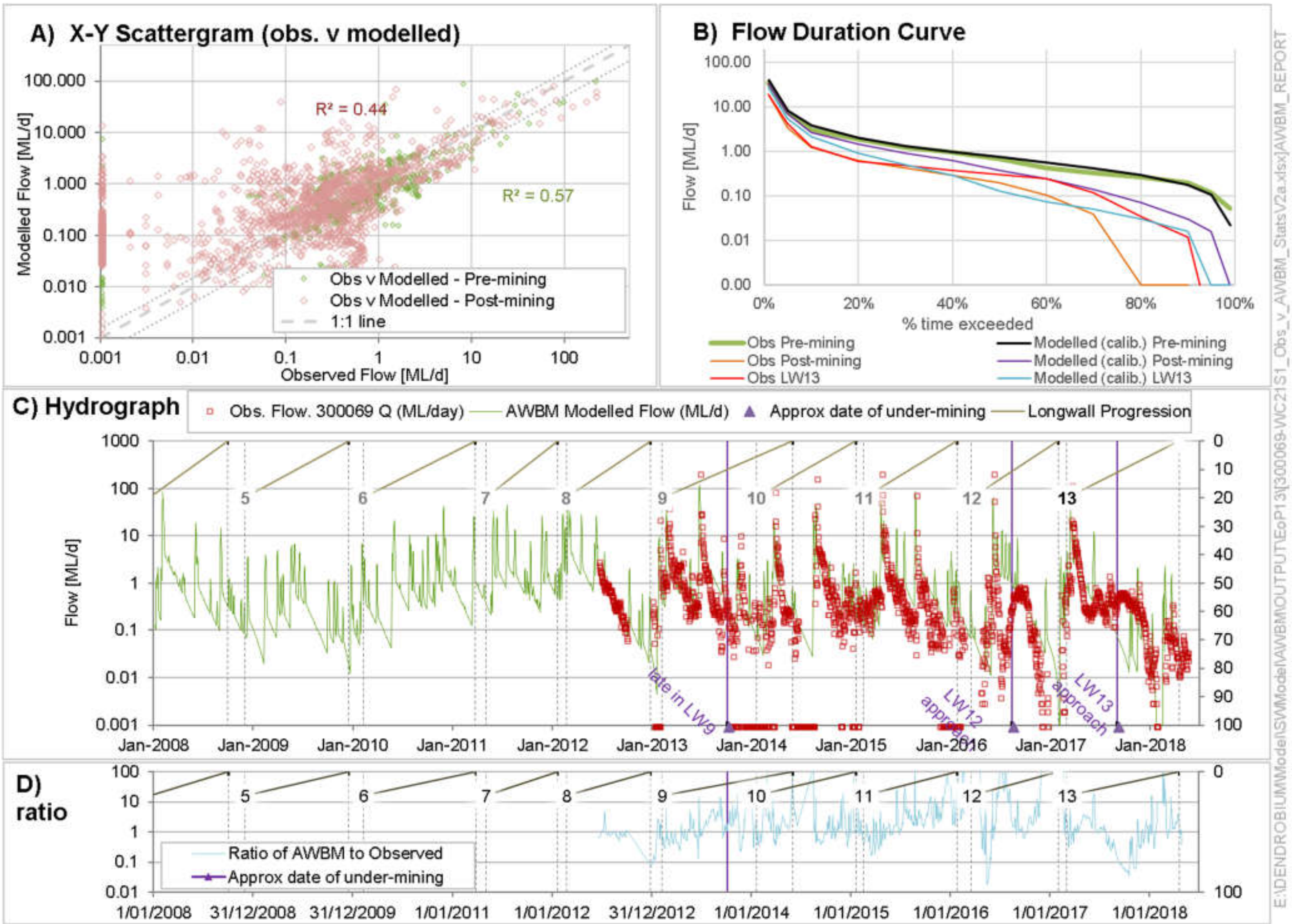

Figure 24. Comparison of observed and simulated flows in Tributary WC21S1

A	The scattergram shows that during the pre-mining period the model is a good fit to observed data, as shown by the graphical correlation to the 1:1 line and the R^2. This correlation declines somewhat in the post-mining period.
B	Confirms the good match between modelled and observed flows for the pre-mining period and illustrates that the observed flows have been below predicted flow for the subsequent post-mining period. During Longwall 13 the flows have had a different character to the model.
C	The hydrograph shows a good match between observed flows up until August-October 2013. After the initial undermining by Longwall 9, the observed recession limbs are consistently below that predicted by the model. During Sept-Oct 2018 the observed hydrograph shows an increase in flow and subsequent decline (without corresponding rainfall pattern) that is suggestive of compression of strata as Longwall 13 approached. A similar pattern was also observed during the approach of Longwall 12.
D	The pre-mining ratio of modelled to observed flows shows the ratio hovers at about 1, with deviation during short-term high flow events. The post-mining ratio oscillates around 2-5 through to the end of Longwalls 11-12, and has oscillated to a large degree during Longwall 13.

Assessment: The evidence is that recent undermining by Longwalls 10-12, and now Longwall 13 has modified the patterns of flow in this tributary. Mean flow has declined, but on average is less affected in Longwall 13 (-9%) than in previous longwalls (e.g. -20-40%). This is supported by field observation of the creek being dry upstream of the gauge. Since undermining occurred, the creek at the gauging station has been dry about 20% of the time, but during Longwall 13 the cease-to-flow period is similar to the model.

Catchment discharge for Longwall 13:	**TARP - NOT TRIGGERED**	Water balance [Qsim + ETsim] is within 2% below average Pobs. This is inconsistent with the review of modelled and observed flows (above).

5.2.8 WWL – Wongawilli Creek (lower)

Wongawilli Creek lies between Areas 3A and 3B and the main stream is not directly mined under (by longwalls), although some tributaries have been or will be mined under by panels in those areas, including during Longwall 13.

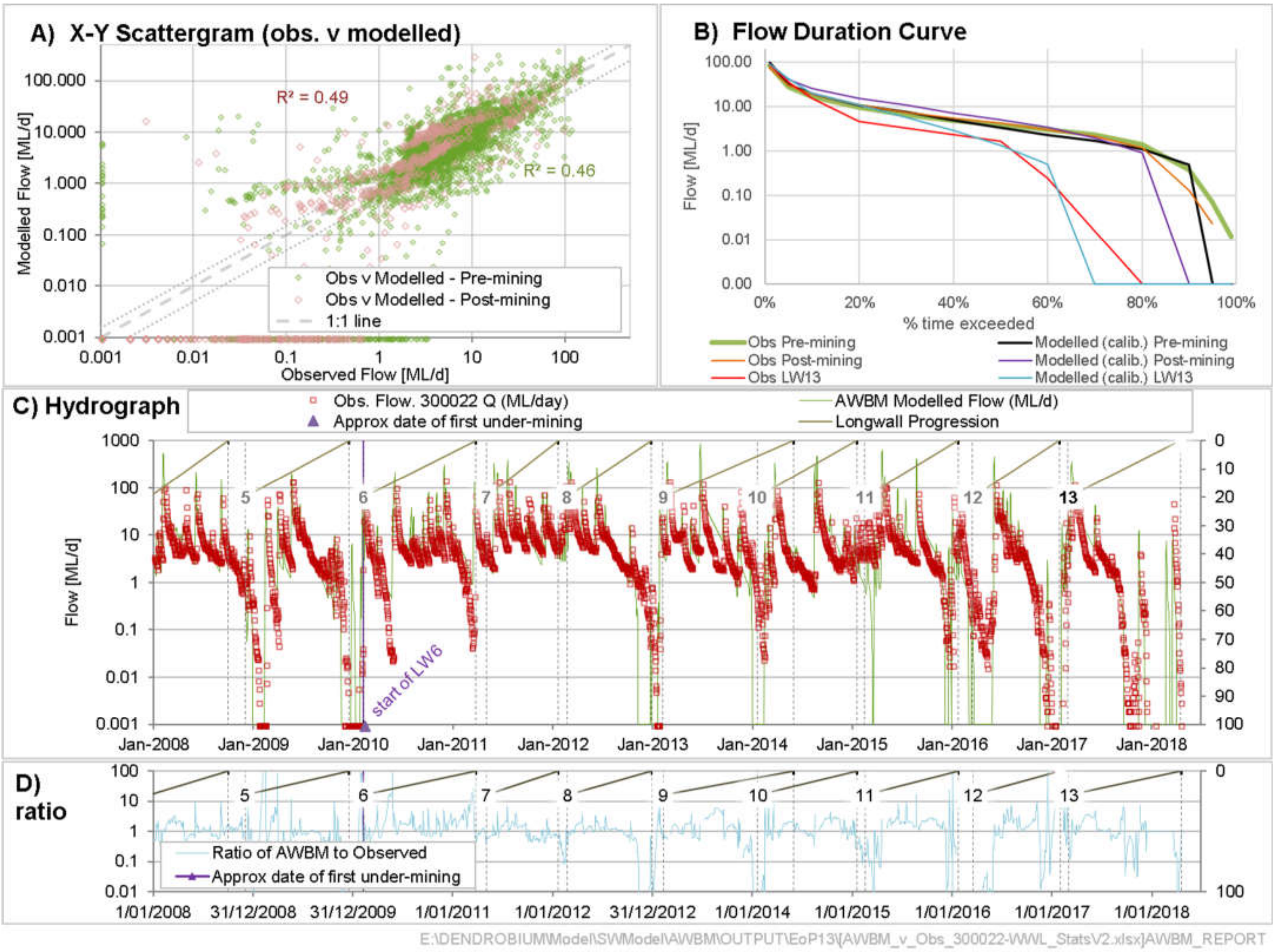

Figure 25. Comparison of observed and simulated flows in Wongawilli Creek to WWL

A	This shows that during the pre-mining period the model is a reasonable fit to observed data. This fit is essentially the same (even marginally better) in the post-mining period.
B	Confirms the reasonable match between modelled and observed flows for the pre-mining period, and illustrates that the model still predicts the range of flows reasonably well for the subsequent post-mining period. Observed flows during Longwall 13 are well simulated below about 2 ML/d, but above this the match is not so good (consistent with the 2-5 ML/d range of flows in the pre-mining period).
C	The hydrograph shows a reasonable match between observed flows up until Feb-2010 (the start of Longwall 6), including two periods of zero flow, and the match is the same after that time. Generally, the flow recessions are well matched, but some are over-estimated and some under-estimated in both the pre-mining and post-mining periods. There is no discernible systematic change in behaviour. The periods of low flow during Longwall 12 and again during Longwall 13 are well represented, and similar to those in the pre-mining period.
D	The pre-mining ratio of modelled to observed flows shows the ratio hovers at about 1 (i.e. a good match between observed and modelled). The post-mining ratio also oscillates around 1, and is similar to the pre-mining behaviour.

Assessment:	There is no evidence that undermining has affected recession behaviour or reduced sub-catchment flow / yield.	
Catchment discharge for Longwall 13:	**TARP – NOT TRIGGERED**	Water balance [Qsim + ETsim] is within 6% of average Pobs (-3%).

5.2.9 LA4-S1 – Lake Avon tributary

LA4, a tributary to Lake Avon lies above the western parts of four longwalls in Area 3B. It was directly mined under by Longwalls 11, 12 and 13 and is planned to be mined under by Longwall 14.

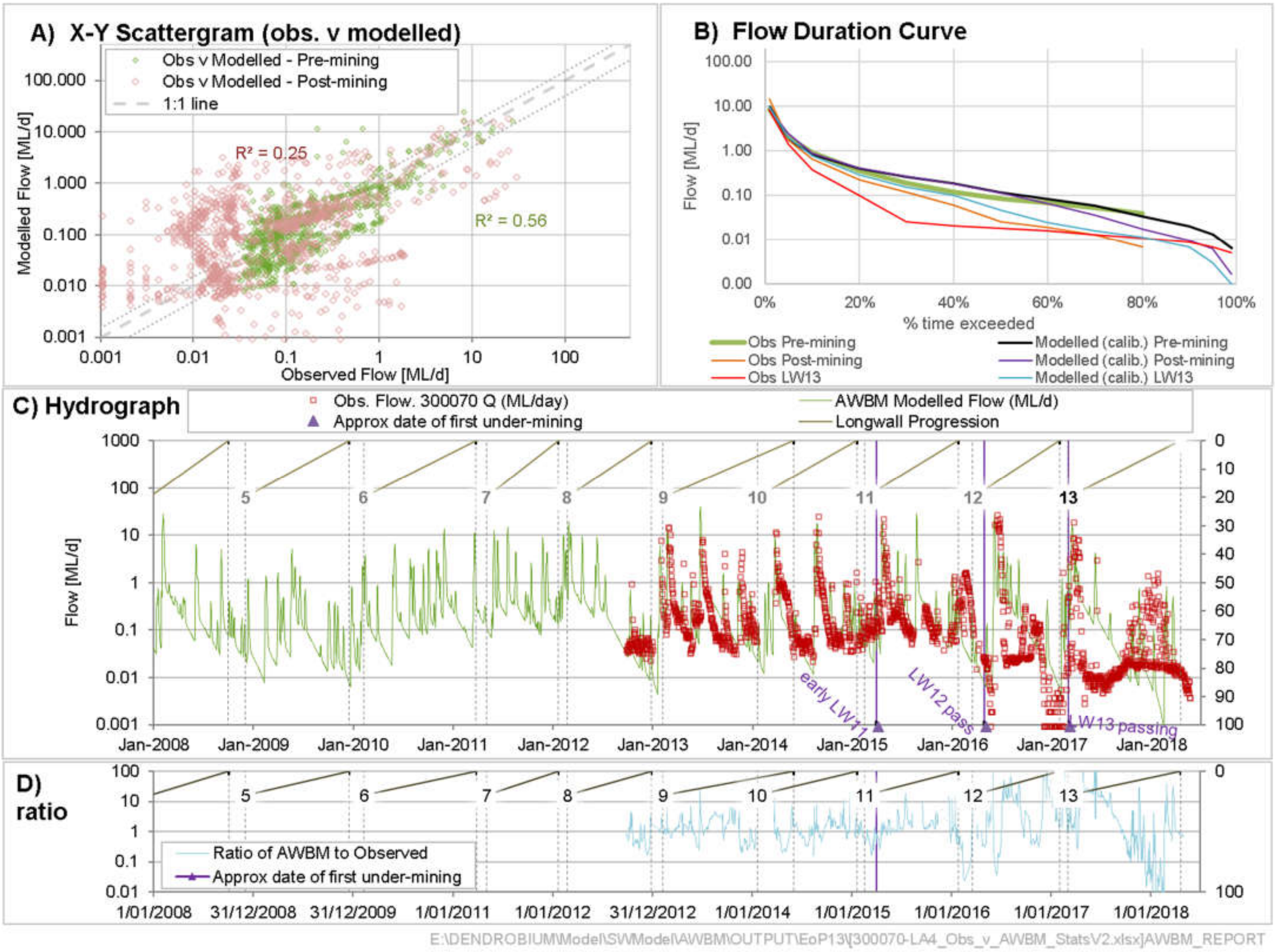

Figure 26. Comparison of observed and simulated flows in Tributary LA4

A The scattergram shows that during the pre-mining period the model is a reasonable fit to observed data, as shown by the graphical correlation to the 1:1 line and the R^2 (=0.56). This correlation has declined in the post-mining period (R^2 = 0.25).

B Confirms the reasonable match between modelled and observed flows for the pre-mining period, and illustrates that the model over-estimates flows for the subsequent post-mining period, including throughout Longwalls 12 and 13.

C The hydrograph shows a reasonable match between observed flows up until early Longwall 11, and the match is similar throughout Longwall 11. However, after the passing of Longwall 12, the model overestimates flow during subsequent recession periods. Observed flows during summer and autumn 2016-17 and 2017-18 are generally lower than previously recorded. The pattern of flow is noticeably different during March-August 2017 (lower than expected), and (flashy, higher) in late 2018.

D The pre-mining ratio of modelled to observed flows shows the ratio hovers at about 1 (i.e. a good match between observed and modelled), as well as during Longwall 11. However, the ratio oscillates significantly during Longwalls 12 and 1, specifically with a period of lower than expected flow during the first half of Longwall 13 then a period of higher flow during the second half.

Assessment: Flows in LA4 were affected by Longwall 13. During Longwall 13 average flow is approximately 5% lower than modelled but the hydrograph above shows periods when observed flows were significantly lower than and significantly higher than modelled. These variances were in the range of one order of magnitude in both directions.

Catchment discharge for Longwall 13:	**TARP – LEVEL 1**	Water balance [Qsim + ETsim] is 6% below average Pobs.

5.3 Wongawilli Creek Pool 43a

This section summarizes observations at Wongawilli Creek Pool 43a. Pool 43a is located on Wongawilli Creek, 348 m east of Longwall 9 in Area 3B (extracted between 9/2/2013 and 2/6/2014) and 315 m northwest of Longwall 6 in Area 3A (9/2/2010 - 28/3/2011). Pool 43a is controlled by a rock bar as shown in Figure 27 (pool overflowing) and Figure 28 (Pool dry at downstream end).

Figure 27. Pool 43a looking downstream to rock bar control on 26/07/2017

Figure 28. Pool 43a looking downstream to rock bar control on 27/12/2017

The photos are taken from slightly different locations, but note the fallen tree angled at about 30° from horizontal in both photos for reference.

On 20/11/2017, it was noted during a site visit that water levels in Pool 43a on Wongawilli Creek were below the baseline (impact number DA3B_LW13_015, dated 28/11/2017). The observation triggered a TARP Level 3 because a previously reported fracture (first observed on 18/12/2013) is present in the sandstone forming the pool base. No significant changes to the downstream control were noted by the ICEFT at Pool 43a. In response to the trigger, an assessment was carried out into the cause of the declining water levels in Pool 43a (HGEO 2018). The assessment concluded that:

- Pool water levels have declined in Pool 43a, starting in 2012, prior to the observation of the fracture. The decline was exacerbated by the severe rainfall deficit in the region during the extraction of Longwall 13 (see Figure 29; surveyed benchmark is at 281.949 mAHD). However, water level recession rates have not changed measurably, as might be expected if the pool substrate was fractured.
- Groundwater levels in Hawkesbury Sandstone and upper Bulgo Sandstone adjacent to and below Wongawilli Creek have declined as a result of mining in Areas 3A and 3B. Groundwater levels in the upper Hawkesbury Sandstone have not been affected to the same extent. Given that the Bald Hill Claystone and upper Bulgo Sandstone are exposed in the Wongawilli Creek valley upstream of Pool 43a, depressurisation of those strata are likely to result in a decrease in groundwater discharge (baseflow).
- Rainfall-runoff modelling (using the AWBM) did not indicate a significant deviation between the model (calibrated to pre-mining conditions) and observed flows at WWL on Wongawilli Creek (as is the case in this review). Therefore, local diversion and/or reduction in baseflow has not resulted in a detectible reduction in flow at the downstream gauge.

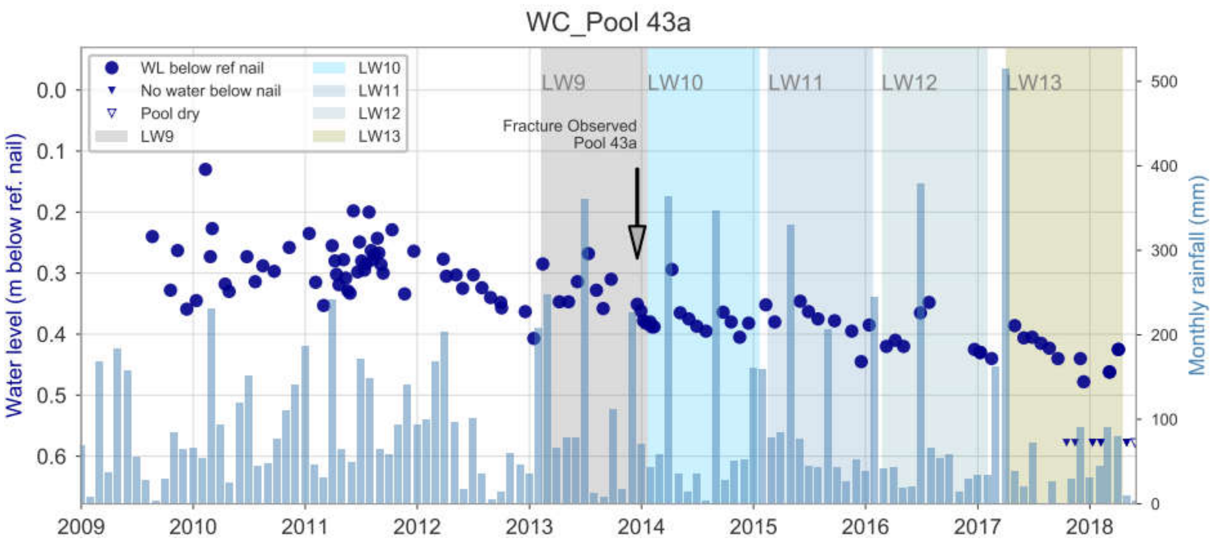

Figure 29. Time series plot of water level observations in Pool 43a

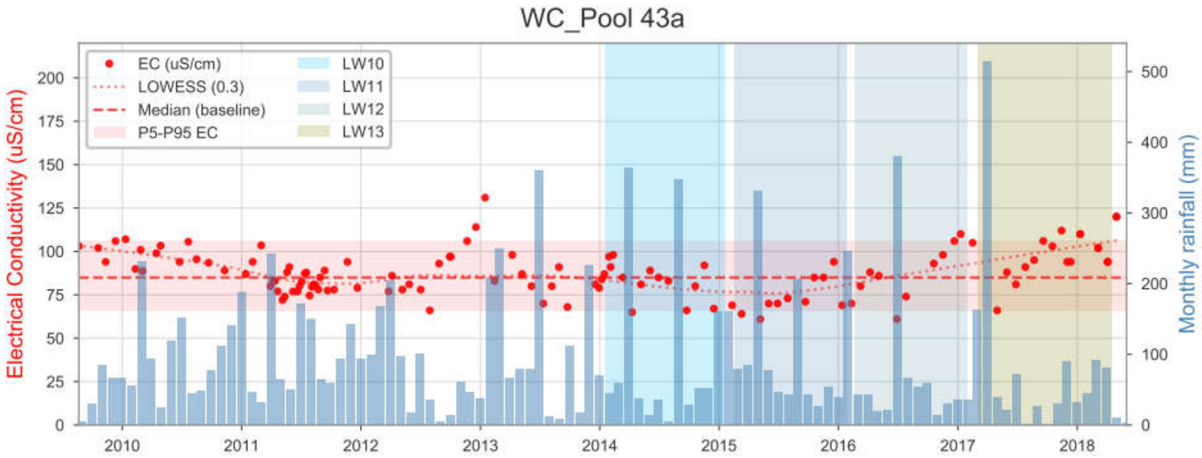

Figure 30. Time series plot of water EC in Pool 43a

Since the assessment carried out in February 2018, observations show a continued decline in water levels at Pool 43a, with the first observation of the pool being completely dry recorded on 28/5/2018 (Figure 29). Pool water EC was elevated above the baseline mean in most field measurements during the extraction of Longwall 13, with three observations above the baseline P95 level for Area 3B.

In late December 2017, water level dataloggers were installed in Pool 43a (logger location WCS2) and at WCS1, located 785 m downstream of Pool 43a (Pool 32), and downstream of Mining Area 3A and 3B. The dataloggers measure the water level at hourly intervals relative to a surveyed benchmark at the respective sites. Hydrographs for both sites are shown in Figure 31. Water levels at each site show different recession characteristics related to the geometry of the pools and their control points. The monitoring period is currently insufficient to assess time-series trends but will provide important high-resolution information for ongoing assessment.

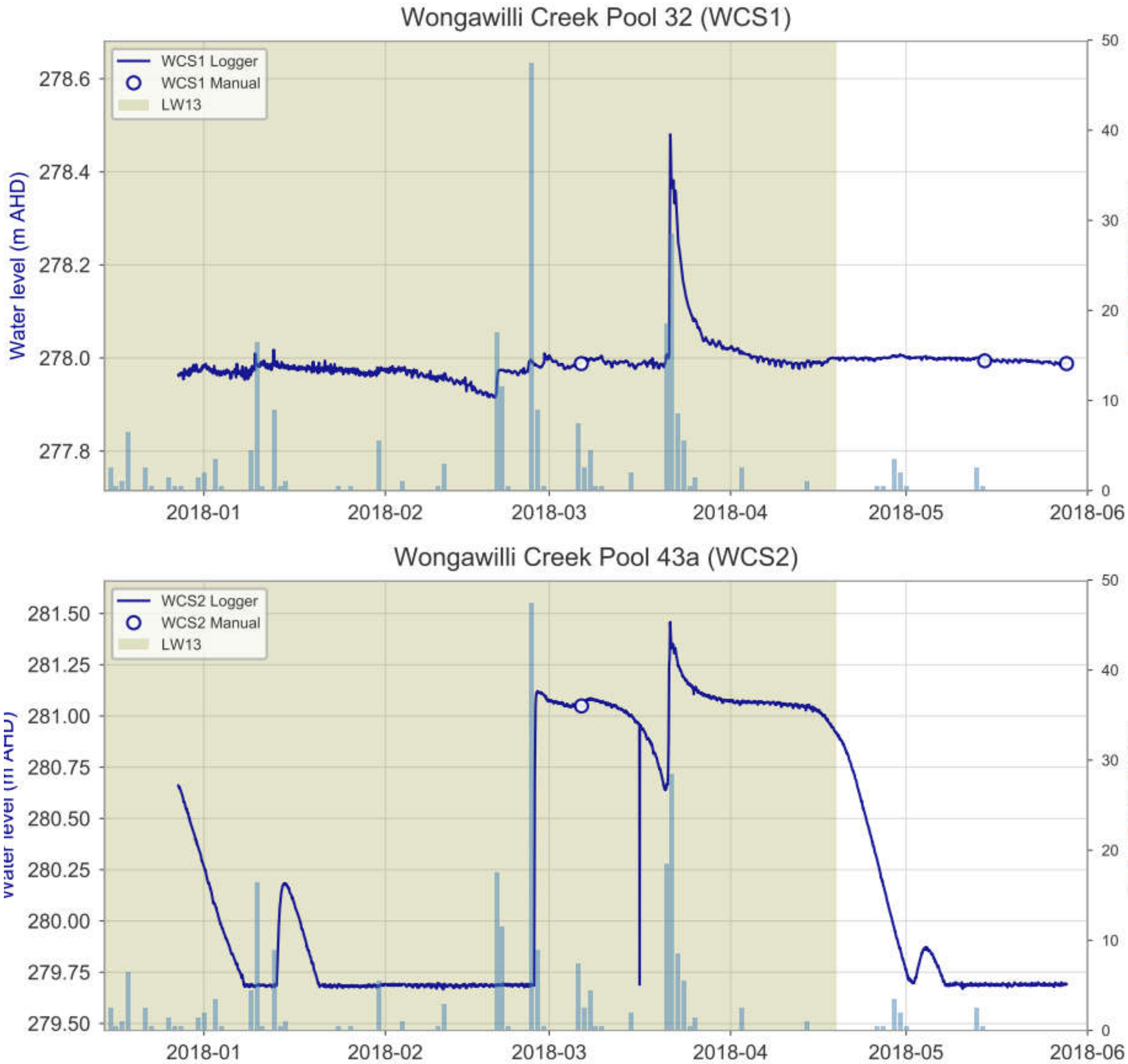

Figure 31. Water level hydrographs at WCS1 and WCS2 (Pool 43a)

Assessment of the declining water levels in Pool 43 has been hindered by the unusually dry conditions during the extraction of Longwall 13 (Section 2.4) compared with the baseline period. Observations at other pools that are outside the influence of mining (e.g. Pool 49; Figure 32) certainly suggest that the dry conditions contribute to the low water levels during Longwall 13. However, the steady decline in water levels at Pool 43a since 2012 appears independent of the rainfall trends and may indicate progressive local flow diversion and/or baseflow reduction. Based on the information reviewed here, the latter mechanism (baseflow reduction) may be dominant.

Pool water levels started to decline from 2012, towards the end of mining of Longwall 8 in Area 3A and just prior to the start of Longwall 9 in Area 3B (and prior to the observation of cracking in the stream substrate). Although the data are sparse, there does not appear to be a clear step-change in water levels associated with the fracturing event.

Groundwater monitoring bores located on both sides of Wongawilli Creek in the broad vicinity of Pool 43a (S1879, S1892, S1927, S1930, S1931), show depressurisation of the Bulgo Sandstone to piezometric levels below the creek bed and, to a lesser extent, the lower Hawkesbury Sandstone as a result of mining in Areas 3A and 3B. Depressurisation of groundwater level in the groundwater bearing formations exposed in and adjacent to the creek is likely to result in a gradual decline in groundwater discharge to the stream, which would be most noticeable during low-flow conditions and flow recessions. Numerical groundwater modelling by HydroSimulations (2016) predicts a potential decline in baseflow to Wongawilli Creek of up to 0.3 ML/d. AWBM modelling carried out as part of this assessment does not identify a significant decline in flow at the downstream gauge (WWL) compared with the baseline monitoring period. Losses of flow in the order of 0.3 ML/day should be identifiable, particularly during low rainfall periods when total flow falls below about 1 ML/day. The similarity of AWBM and observed flows, during low-flow conditions, suggests that a significant mining effect on surface water flows is not apparent at WWL, and that local flow diversions and baseflow losses are within the predicted magnitude.

Nevertheless, it is recommended that pool water levels and flows upstream and downstream of Area 3B be reassessed after a period containing moderate to heavy rainfall (at or above the mean) or after the end of Longwall 14, whichever occurs first.

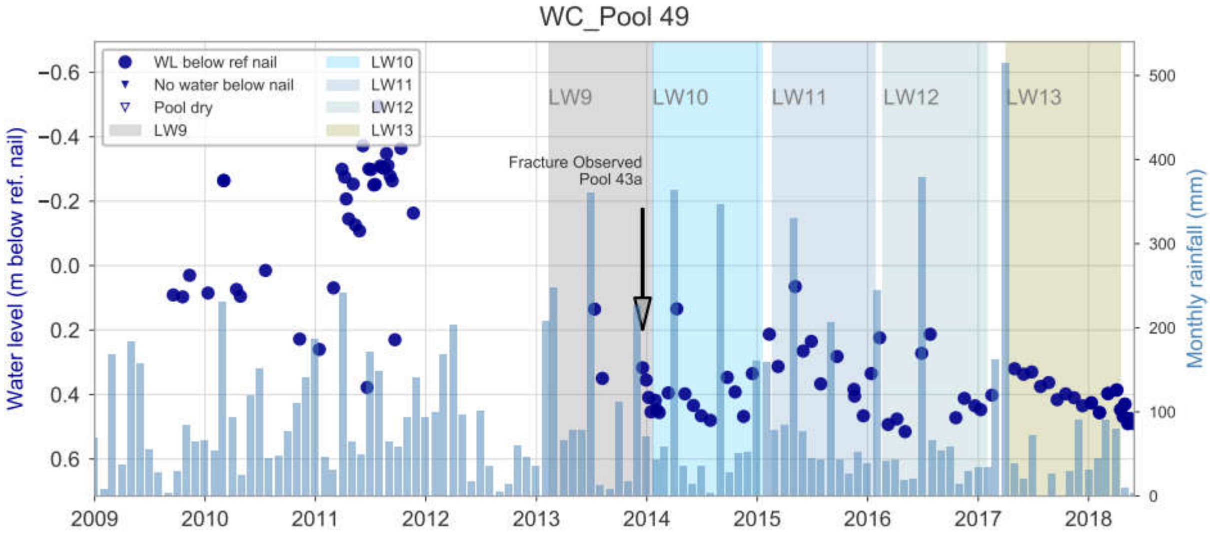

Figure 32. Time series plot of water level observations in Pool 49

6. Assessment of shallow groundwater (swamps)

6.1 Shallow groundwater levels

Trigger values for subsidence-induced decreases in groundwater levels, at surface and near-surface monitoring sites at Area 3B swamps, have been established within the most recent SIMMCP (South32 2015a). Shallow groundwater level has been identified as an indicator of potential changes in ecosystem functionality of the swamps. TARPS are defined as follows:

Table 8. Performance criteria related to shallow groundwater levels at swamp monitoring sites

TARP Level	Criteria	Response
1	Groundwater **level** lower than baseline level at **any** monitoring site within a swamp (in comparison to reference swamps); and/or; **Rate** of groundwater level reduction exceeds rate of groundwater level reduction during baseline period at **any** monitoring site (measured as average mm/ day during the recession curve).	Increased intensity and frequency of vegetation monitoring and/or further investigations of subsidence impacts on bedrock base and rockbars
2	Groundwater **level** lower than baseline level at **50%** of monitoring sites (within 400 m of mining) within a swamp (in comparison to reference swamps); and/or **Rate** of groundwater level reduction exceeds rate of groundwater level reduction during baseline period at **50%** of monitoring sites (within 400 m of mining) within the swamp.	
3	Groundwater **level** lower than baseline level at **>80%** of monitoring sites (within 400m of mining) within a swamp (in comparison to reference swamps); and/or **Rate** of groundwater level reduction exceeds rate of groundwater level reduction during baseline period at **>80%** of monitoring sites (within 400 m of mining) within the swamp.	

Groundwater level hydrographs for each shallow piezometer are presented in **Appendix C**. The hydrograph is plotted together with ground elevation and the elevation of the piezometer base, longwall timing, groundwater level recession rate (in mm/day), and the dates that longwalls pass under (if relevant) a piezometer. Assessment of mining effects is based on these hydrographs.

A summary of the hydrograph responses at Area 3B swamps is included in Table 9 for Impact Sites and Table 10 for Reference Sites. In accordance with the definition of the TARPs, the sites within 400 m of mining *and* within the mapped swamp areas are assessed for triggers related to mining impacts.

Longwall 13 passed within 400 m of piezometers in Swamps 11 and 13. The hydrograph for Swamp 11 piezometer H1 shows both a decline in shallow groundwater levels (dropping below the piezometer base for the first time) and a slight steepening of the groundwater recession curve following the closest passage of Longwall 13 in April 2017 (<10 m from H1). The hydrograph shows a clear change in groundwater level characteristics from mid-2017, compared with similar dry conditions during the extraction of Longwall 12. The change is almost certainly related to the subsidence effects of Longwall 13 and represents a Level 1 TARP trigger. Groundwater hydrographs for the other two Swamp 11 piezometers (S02 and S03) are not clearly different from previous dry periods.

Swamp 13 piezometer S01 was passed by Longwall 13 at a distance of 296 m on the 20/9/2017. The hydrograph for S01 shows no clear change in groundwater characteristics following the passage of Longwall 13; the groundwater recession during the extraction of Longwall 13 has a similar slope and depth to previous dry periods. Further monitoring during and after heavy rainfall events is required to determine whether shallow groundwater at S13_S01 has been affected by mining.

Table 9. Summary of shallow groundwater level TARP status at *Impact Sites*

SWAMP	TARP SITES	RELEVANT LONGWALLS	PIEZOMETERS WITH AN OBSERVED RESPONSE			OBSERVED BEHAVIOUR	COMMENT	TARP LEVEL
			YES	UNCLEAR	NO			
01a^	6	LW9, LW10	01, 04, 04i, 04ii, 04iii, 04iv, 04v		02	Groundwater levels lower than baseline and recession rate greater than baseline at greater than 50% to 90% of monitoring sites	Limited baseline data for five piezometers.	Level 3^
01b^	5	LW9	02, 02iii	02ii, 02iv	01	Groundwater levels lower than baseline and recession rate greater than baseline at greater than 50% of monitoring sites.	Limited baseline data for five piezometers	Level 2^
03	1	Pillar 11/12	01			Possible increase in recession rate and apparently reduced response to rainfall after LW11 passed and LW12 undermined.	Rapid recession after rain during LW13 supports impact at Swamp 3	Level 3
05	6	LW9, LW10, LW11	01, 02, 03, 03ii, 04	05		Groundwater levels lower than baseline and recession rate greater than baseline at >80% of monitoring sites	Unclear if piezometer 5_05 impacted by either LW11 or 12 due to limited baseline.	Level 3
08	0	LW9, LW10 LW11	*01, 04*	*02*		Groundwater levels lower than baseline and recession rate greater than baseline at a number of piezometers, not within swamp boundary.	Outside swamp boundary (Not subject to TARP)	n/a
10	1	LW12	01			Sharp decline in groundwater levels below base of the piezometer after LW12. Level and rate of decline anomalous compared with baseline.	Mined under by LW12	Level 3
11	3	LW13, LW14	H1		H2, H3	A sharp decline in shallow groundwater levels and slight increase recession rate in H1 after pass of LW13 in mid-April 2017. No clear change at H2, H3	Partially mined under by LW13	Level 1
13	1	LW14			01	Low water levels in 2017-2018 likely related to very dry conditions; no significant change in recession rate	Northern extent of Swamp 13 mined under by LW13	n/a
14	2	LW15, LW16			01, 02	n/a	Yet to be mined under; no change in characteristics	n/a
23	2	LW15, LW16			01, 02	n/a	Yet to be mined under; no change in characteristics	n/a
35a	1	LW18			01	n/a	Yet to be mined under	n/a
35b	1	LW18			01	n/a	Yet to be mined under	n/a

Note: “ i ” in site name (e.g. 04i) indicates installation during Longwall 9 extraction. These piezometers are of limited use diagnostically due to a lack of observations establishing baseline conditions (observations prior to mining). * at these swamps which are located away from active or recent mining areas the data has been logged (recorded) at the piezometer, but not collected since that time. ^ the *Longwall 13 End of Panel Landscape Assessment* assessed Swamps 01a+0b1 as a single entity, in which case the TARP Level would be L2. Either approach could be considered appropriate.

Table 10. Summary of shallow groundwater level trends at *Reference Sites*.

SWAMP	NUMBER OF PIEZO-METERS	PIEZOMETERS	PROXIMITY TO LONGWALLS	OBSERVED EFFECTS	COMMENT
02	1	01	900 m from LW9	n/a	900 m from LW9
07	2	01, 0	1.2 km from LW6	n/a	1.2 km from LW6
15a	3	06, 07	0.5 km south of LW8, 130 m south of LW19	n/a	0.5 km from LW8
22	2	01, 02	Elouera Colliery	n/a	Limited baseline data
25	1	01	1.4 km from LW5	n/a	1.4 km from LW5
33	2	01, 03	1 km from LW16	n/a	1 km from LW16
84	1	01	500 m from LW5	n/a	500 m from LW5
85	2	01, 02	900 m from LW9	n/a	900 m from LW9
86	2	01, 02	3 km from LW9	n/a	3 km from LW9
87	2	01, 02	Avon Colliery	n/a	Limited baseline data
88	2	2	Huntley Colliery	n/a	Limited baseline data

6.2 Soil moisture

Significant changes in soil moisture characteristics compared with baseline monitoring is identified as an indicator of potential changes in ecosystem functionality of the swamps. Performance criteria and response actions (TARP) related to soil moisture at swamp monitoring sites are listed in the SIMMCP (South32 2015a), and reproduced in Table 11.

Table 11. Performance criteria related to soil moisture at swamp monitoring sites

TARP Level	Criteria	Response
1	Soil moisture level lower than baseline level at **any** monitoring sites (within 400 m of mining) within a swamp (in comparison to reference swamps).	Increased intensity and frequency of vegetation monitoring and/or further investigations of subsidence impacts on bedrock base and rockbars
2	Soil moisture level lower than baseline level at **50%** of monitoring sites (within 400 m of mining) within a swamp (in comparison to reference swamps).	
3	Soil moisture level lower than baseline level at **>80%** of monitoring sites (within 400 m of mining) within a swamp (in comparison to reference swamps).	

The TARP has been assessed by comparing the average moisture content of the soil profile during the longwall assessment period against that of the baseline period. If the average soil moisture level drops below the minimum level recorded during the baseline period, a TARP is triggered. The TARP level increases according to the proportion of monitoring sites that exceed this criterion at each swamp within the area of mine influence (Table 11). This is the approach used by the ICEFT for regular impact reporting. The baseline period is the period of monitoring before the site is first undermined or passed within 400 m.

Soil moisture hydrographs for all active monitoring locations are presented in Appendix D. Assessment of soil moisture hydrographs for locations within Areas 3A and 3B zone of influence (< 400 m) are presented in Table 12. No soil moisture monitoring sites were directly mined under by Longwall 13. However, the longwall passed within 400 m of three sites at Swamp 11 (S01, S02 and S03) and three sites within Swamp 13 (S01, S02 and S03).

At Swamp 11, soil moisture dipped below baseline during Longwall 12 and Longwall 13 in all sensors, triggering a Level 3 TARP during Longwall 12. The decline in average soil moisture content is notable after Longwall 13 passed within 400 m of the sites, particularly at sensor S01 (Figure 33).

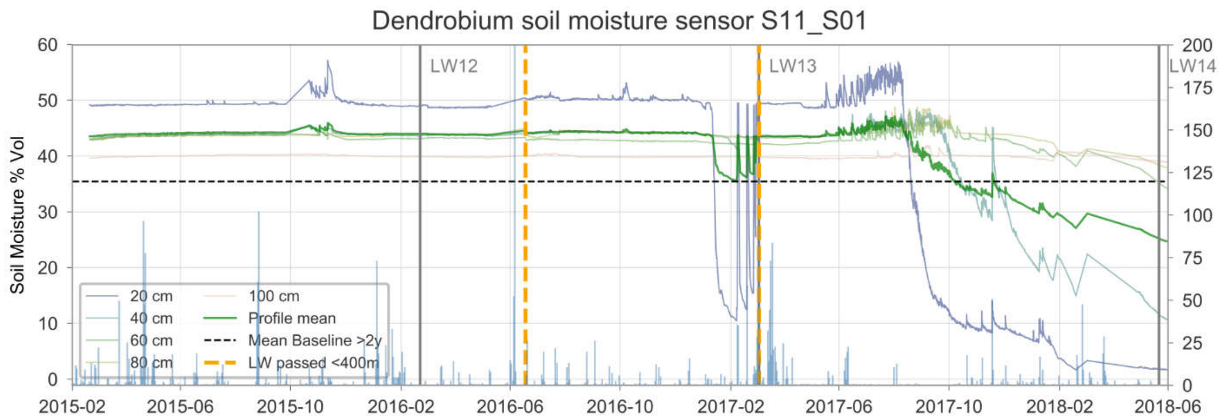

Figure 33. Soil moisture hydrograph for site S11_S01 at Swamp 11

Given the proximity of the sensor site to Longwall 13 and the magnitude of the decline compared with the baseline period, it is likely to be partly related to mining subsidence impacts. In addition, soil moisture readings become erratic in the months following the closest pass of Longwall 13 (April 2017 at <10 m), prior to the sharp decline in levels in July 2017.

At Swamp 13, soil moisture at all sensors dropped below baseline after Longwall 13 passed within 400 m. As with Swamp 11, this triggers a TARP Level 3 response and is possibly related to mine subsidence effects. However, it is noted that soil moisture levels at sensors in Swamps 23 and 14, that are more distant from Longwall 13 (>500 m), have also declined to their lowest levels since the start of monitoring. Therefore, it is likely that the unusually dry conditions during the extraction of Longwall 13, both prior to and during the summer months, have contributed to the decline in moisture levels in all swamps. Further monitoring during and after heavy rainfall events is required to determine whether, and to what extent, soil moisture levels at Swamps 11 and 13 have been affected by mining.

Table 12. Assessment of soil moisture hydrographs in Areas 3A and 3B

Swamp	Longwall	Sensors and TARP triggers			Comment	TARP Level
		Not triggered	Triggered	Not within mine influence		
05	LW9 – LW12		S05_S05, S05_S01, S05_S02, S05_S08		All four sites show SM decline below baseline after LW passes; baseline <2 y)	3
08	LW12	S08_S05			Soil moisture falls below baseline after undermining. *Not within mapped swamp boundary.*	n/a
11	LW13, LW14		S11_S01, S11_S02, S11_S05		Soil moisture at all sensors dropped below baseline after LW12 and LW13 passed within 400 m. Likely a mining effect at S01	3
13	LW14		S13_S01, S13_S02, S13_S03		Soil moisture at all sensors dropped below baseline after LW13 passed within 400 m. Possible mining effect, noting unusually dry conditions.	3
14	LW16			S14_S02, S14_S01	Not yet mined under; SM at S01 similar to previous low rainfall periods. S02 dropped slightly below baseline despite not being within zone of influence	-
15a	-			S15a_Piezo, S15a_S03, S15a_S01, S15a_S04, S15a_S06	Outside Area 3A Longwalls; Soil moisture in 3 sensors dropped below baseline due to dry conditions	-
23	LW15			S23_S01, S23_S02	Not yet mined under; SM dropped below baseline during LW13 probably due to dry conditions	-
35a	LW18			S35a_S01	Not yet mined under	-

Note: * Sites for which there are too few data points for a statistically valid assessment (<10)

7. Conclusions

7.1 Water Quality

Electrical conductivity of surface water increased at numerous stream monitoring sites across Dendrobium Areas 3A and 3B during the extraction of Longwall 13. The increase is considered to reflect the unusually dry conditions during the extraction of Longwall 13 and evaporative concentration of dissolved salts in disconnected pools during low-flow and no-flow conditions. EC increased to levels significantly higher than baseline ranges at several pool-monitoring sites across mining Area 3B during the extraction of Longwall 13, most notably at Pools 19 and 20 on the main first-order tributary of Donalds Castle Creek. Some of the high-EC pools are not near active mining and are unlikely to be related to mining. However, it is likely that subsidence has affected stream runoff in the upper Donalds Castle Creek tributaries and therefore may have contributed to the water quality effects at those sites (DC_Pool 19 and 20). The effect does not extend to the downstream monitoring sites.

7.1.1 Donalds Castle Creek

At the Donalds Castle Creek site (at FR6), the stream EC increased from April 2017 through to early 2018 in response to the dry conditions over the winter and following summer months. The increase in EC, combined with an increase in pH and a decrease in DO, was similar to responses to previous dry periods and no TARP was triggered for this site.

7.1.2 Wongawilli Creek

At the Wongawilli Creek site (at FR6), the TARP level for EC was triggered on two occasions and the DO trigger level was exceeded on three occasions, resulting in a TARP level 3. Nearly all monitored pools along Wongawilli Creek, including those upstream of Longwall 13, show a trend of increasing EC during the extraction of Longwall 13. The same period is characterised by low poolwater levels and low-flow or no-flow conditions at gauging stations. As with the Donalds Castle Creek site, elevated and apparently increasing EC values from mid-2017 to early 2018 are likely due to evaporation during that dry period.

All monitored pools on WC21 within the zone of influence of Longwall 13 were reported as dry from late September to early October, corresponding approximately to when Longwall 13 passed beneath the watercourse. As a consequence, water chemistry samples could not be collected from those pools. Monitoring location WC21_Pool 5 is located downstream (to the north) of mining Area 3B. Water EC in WC21 at Pool 5 has remained slightly elevated above the baseline mean since Longwall 11. It is likely that subsidence impacts and redirection of water through fractures is contributing to the elevated EC in WC21 at Pool 5, although, the EC in Pool 5 is still well below the TARP level for the downstream site on Wongawilli Creek at FR6 (TARP level 154.1 µS/cm).

7.1.3 Lake Avon tributaries

Ground subsidence associated with Longwalls 12 and 13 has resulted in the development of fracturing of the stream bed of LA4 near the gauging station weir LA4_S1. As a result of flow diversions and the low rainfall conditions, most of the pools and sampling points were dry and could not be sampled for water chemistry. Of the sampling events that were carried out, none triggered TARPs related to water chemistry.

7.2 Effects on Flow and Catchment 'Yield'

Rainfall-runoff modelling was carried out using the AWBM. The modelling assessment indicates that headwater catchments to Donalds Castle Creek (at DC13S1 and DCS2), are affected by mining, as is the tributary LA4 of Lake Avon (at LA4_S1). The flow characteristics at WC21_S1 appear to have altered as a result of mining, but the change is not sufficient to trigger TARP level 1. Modelling suggests that flows at the high range of flows in the mined under catchments are less affected than the lower, recession-limb flows. Surface fracturing was noted in the channel of tributary WC15 during Longwall 13, however flow characteristics at the downstream gauge (WC15S1) are not significantly different from baseline.

As in the Longwall 12 EoP report, modelling indicates that mining effects are probable, but not definitive at the Donalds Castle Creek downstream monitoring site (DCU), but the apparent flow depletion is insufficient to trigger a TARP. Changes to stream flow characteristics are not evident at the downstream gauge on Wongawilli Creek Lower (WWL). This suggests that some or all flow lost in headwater catchments is returned downgradient, or that upstream diversions are not significant when compared to the larger catchment water balance.

7.3 Swamps

It was predicted that Swamps 01a, 01b, 03, 04, 05, 08, 10, 11, 13, 14, 23, 35a and 35b would be affected by mine subsidence due to mining in Area 3B (South32 2015a). The assessment of shallow groundwater levels indicates that TARPs have been triggered at the following swamps, most of which, were found to have been triggered in previous End of Panel assessments:

- Swamp 01a Level 3
- Swamp 01b Level 2
- Swamp 03 Level 3 (because the only piezometer is affected)
- Swamp 05 Level 3
- Swamp 08 Level 2
- Swamp 10 Level 3 (because the only piezometer is affected)
- Swamp 11 Level 1 (this assessment)

Soil moisture hydrographs show that soil moisture has fallen below baseline levels in all the mined under sites, noting that the baseline period for soil moisture is limited at most sites. Soil moisture at all sensors in Swamp 13 dropped below baseline after Longwall 13 passed within 400 m; however, dry conditions may have contributed to the decline.

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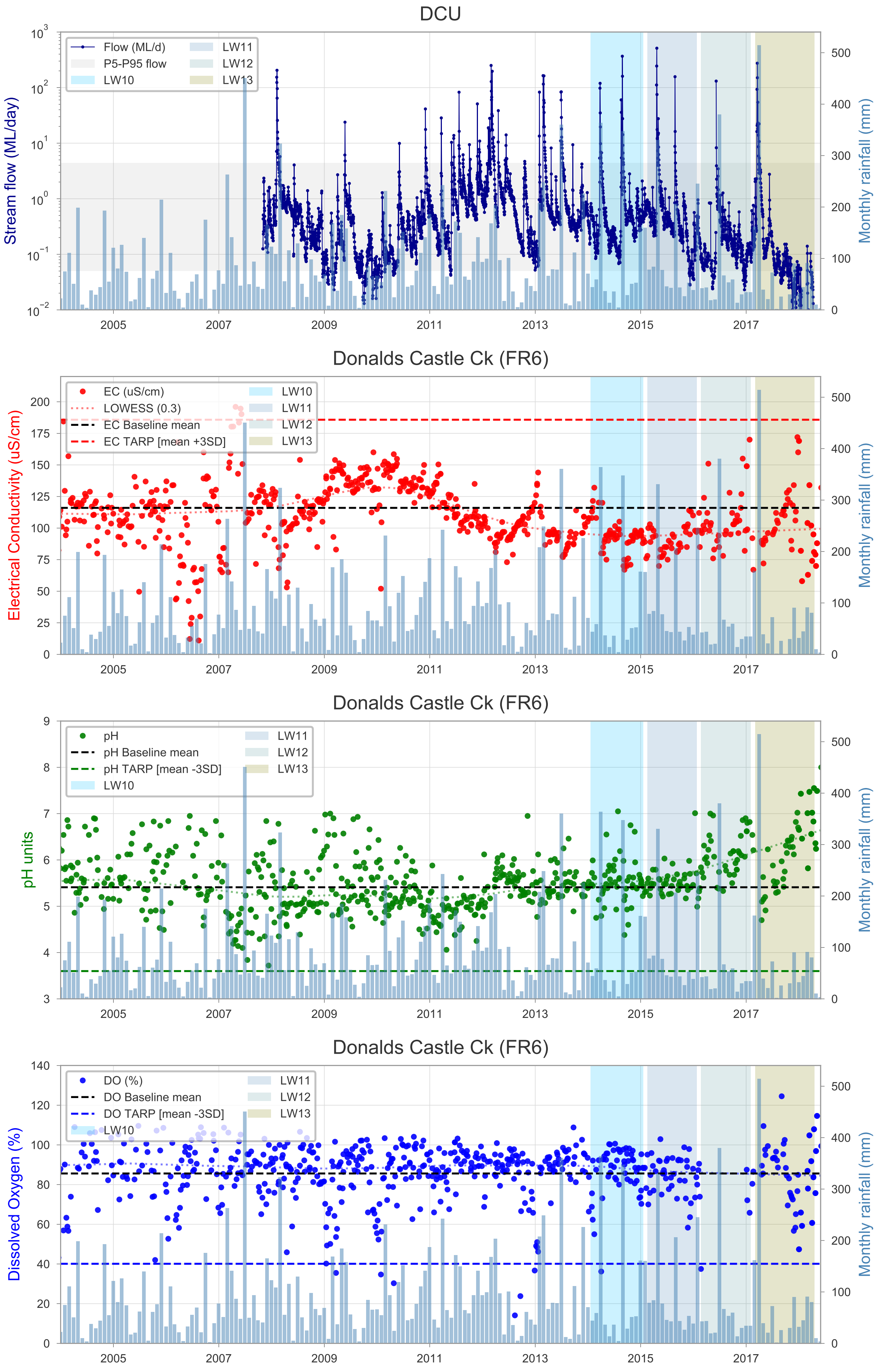
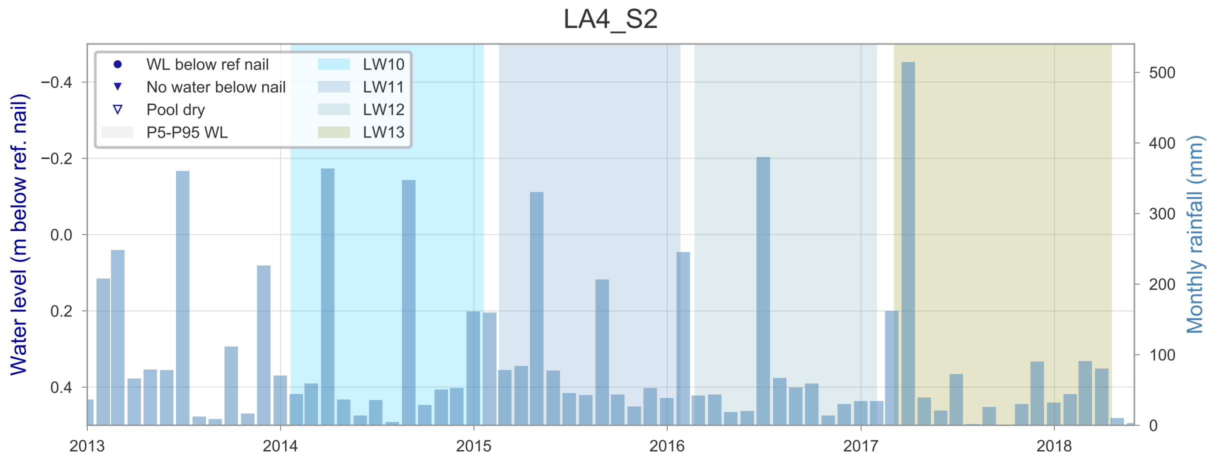
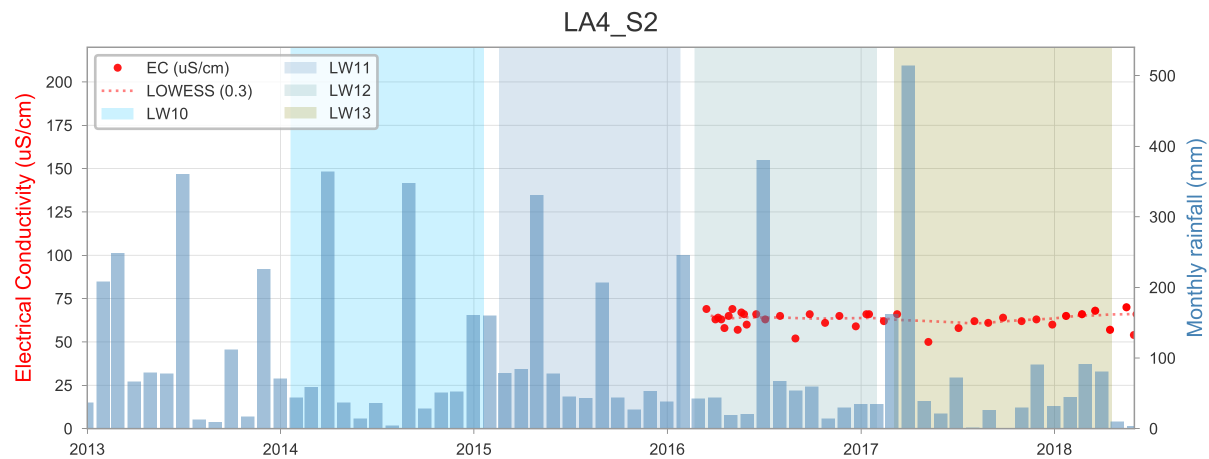
South32. 2018. *Dendrobium Longwall 13 End of Panel Landscape Report*. South32 Illawarra Coal, Report.

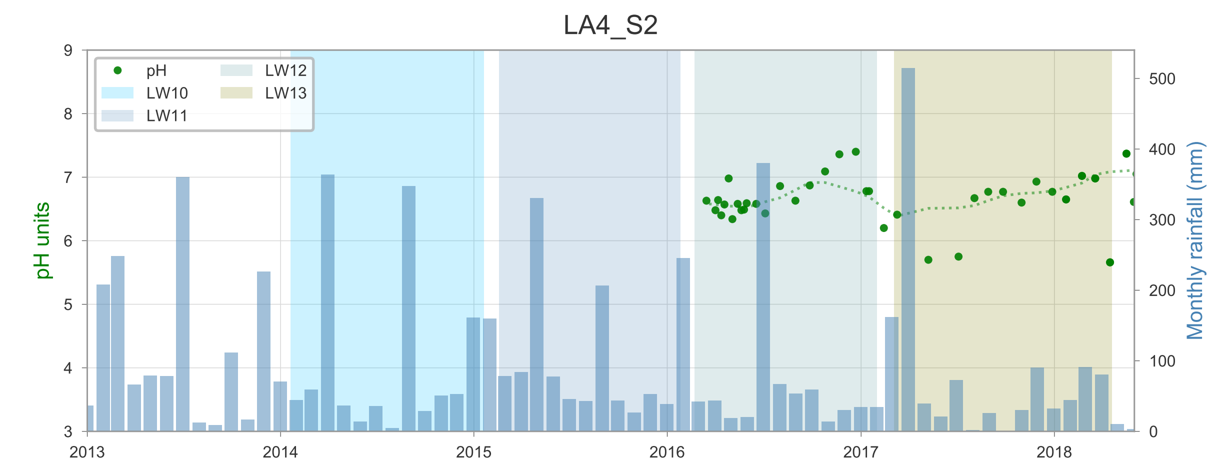
Appendix A

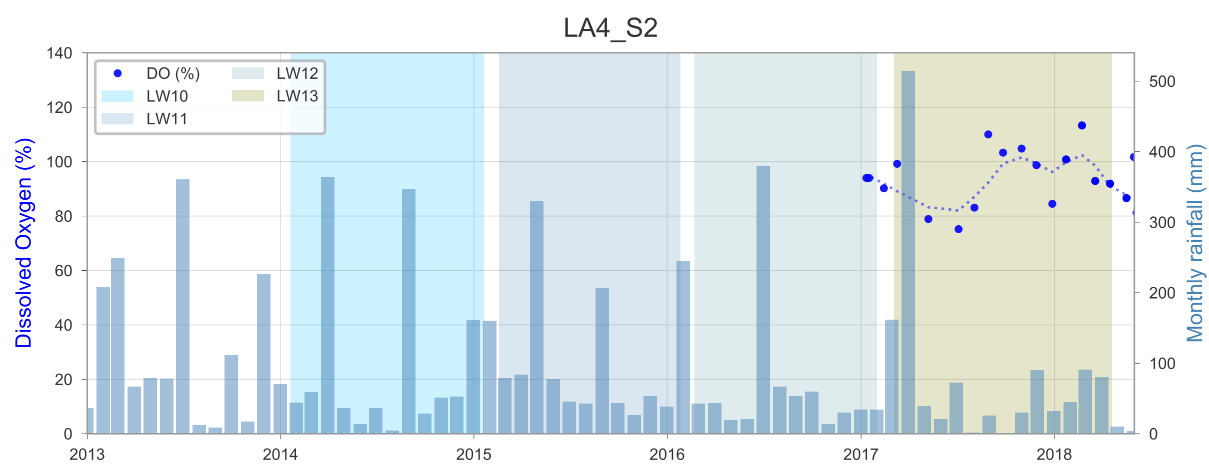
Water Quality Plots (Key Parameters) for all Monitoring Sites

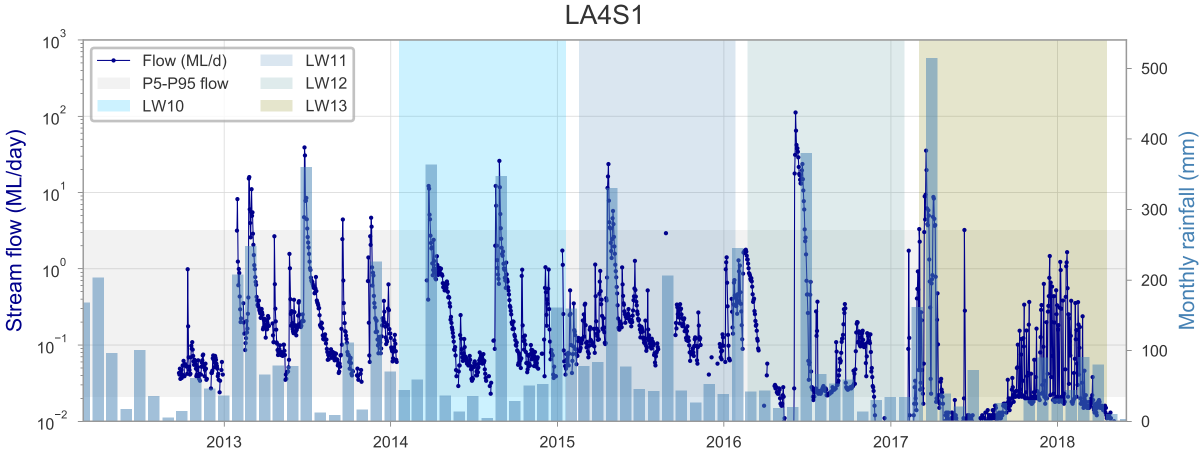

DCU
Flow (ML/d)
P5-P95 flow
LW10
LW11
LW12
LW13
Stream flow (ML/day)
Monthly rainfall (mm)
Donalds Castle Ck (FR6)
EC (uS/cm)
LOWESS (0.3)
EC Baseline mean
EC TARP [mean +3SD]
Electrical Conductivity (uS/cm)
Donalds Castle Ck (FR6)
pH
pH Baseline mean
pH TARP [mean -3SD]
pH units
Donalds Castle Ck (FR6)
DO (%)
DO Baseline mean
DO TARP [mean -3SD]
Dissolved Oxygen (%)
2005
2007
2009
2011
2013
2015
2017

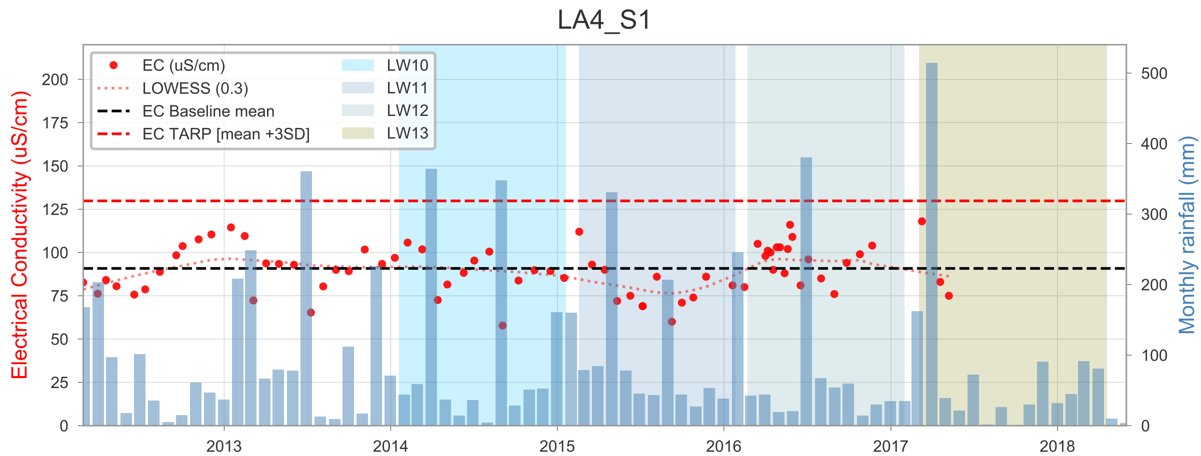

LA4_S2
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
−0.4
−0.2
0.0
0.2
0.4
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

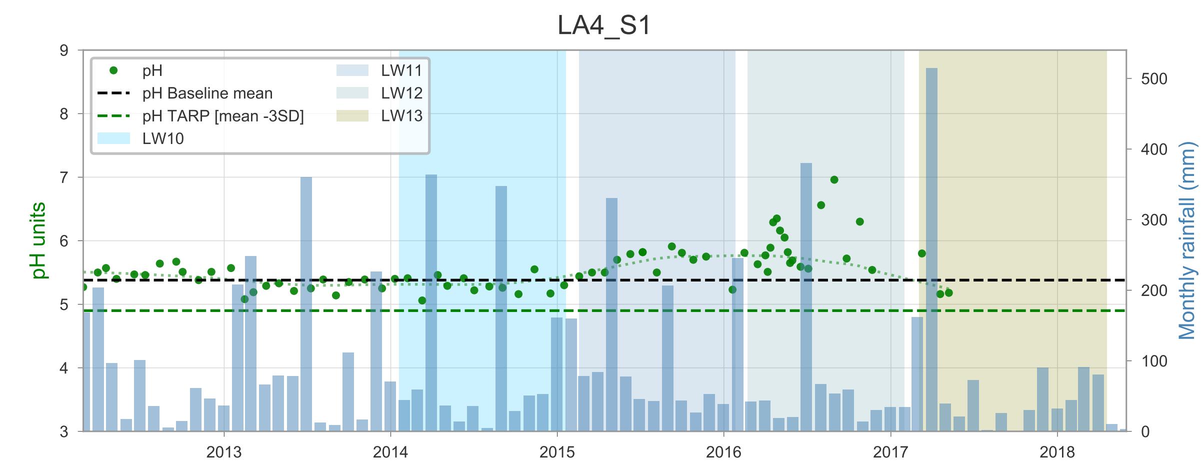

LA4_S2
EC (uS/cm)
LOWESS (0.3)
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

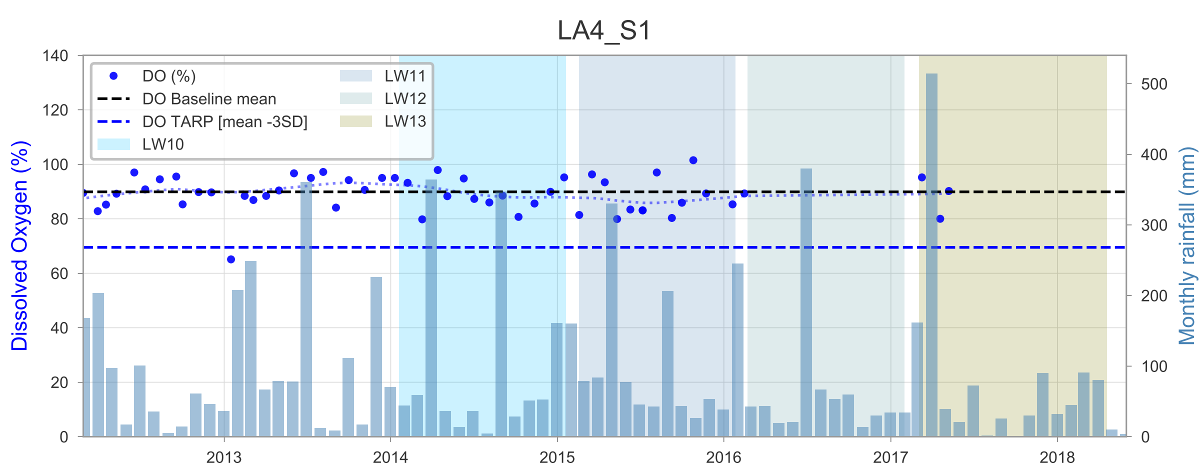

LA4_S2
pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
3
4
5
6
7
8
9
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

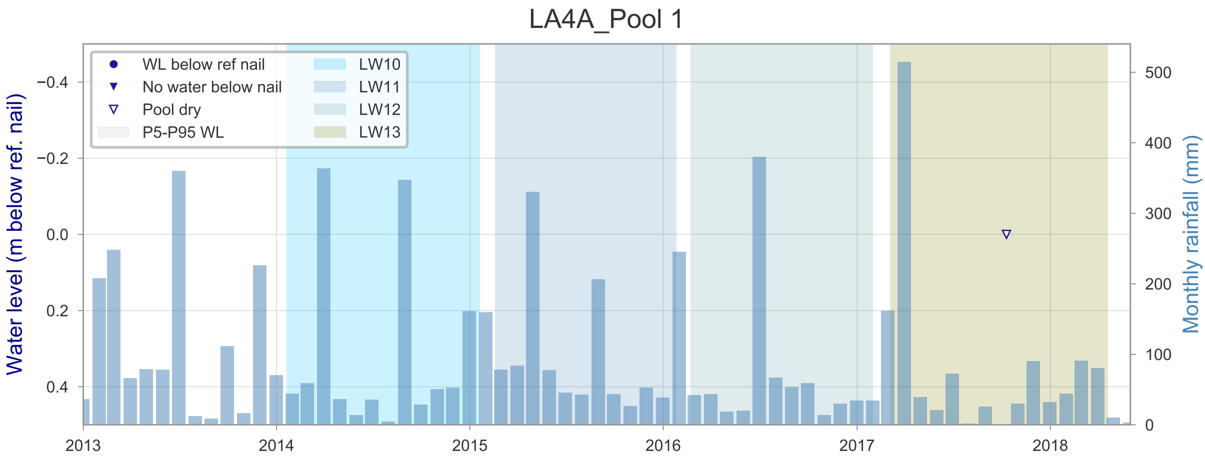

LA4_S2
DO (%)
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

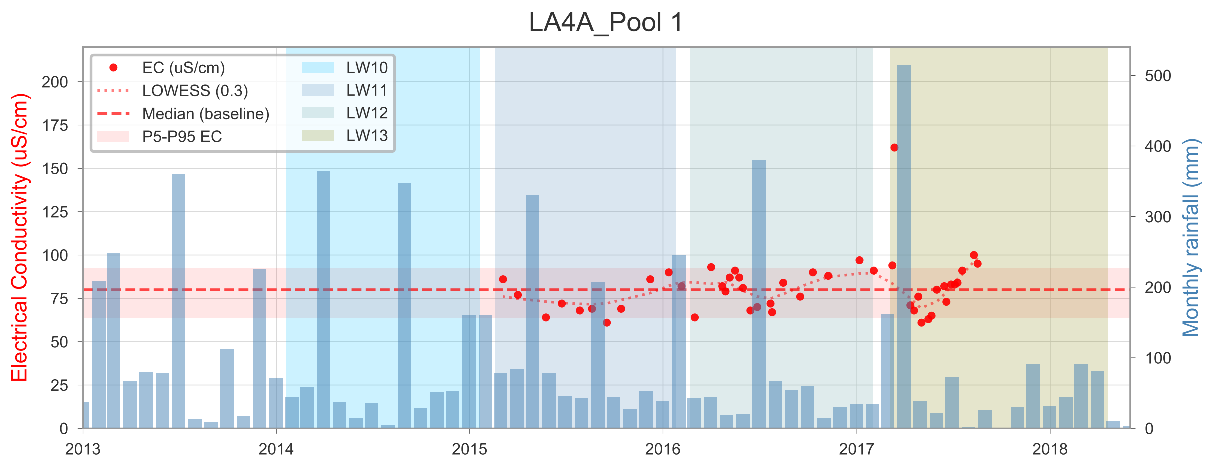

LA4S1
Flow (ML/d)
P5-P95 flow
LW10
LW11
LW12
LW13
Stream flow (ML/day)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

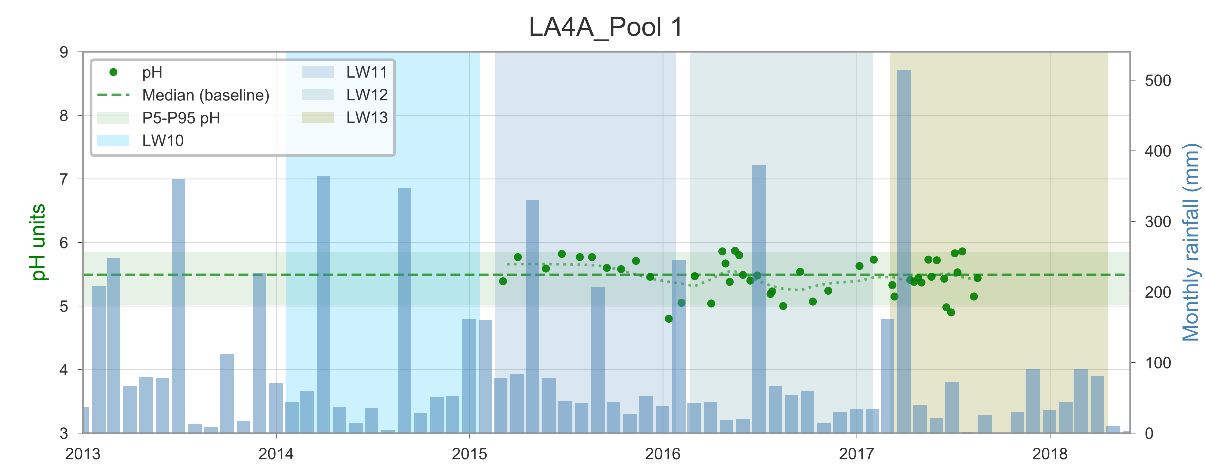

LA4_S1
EC (uS/cm)
LOWESS (0.3)
EC Baseline mean
EC TARP [mean +3SD]
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

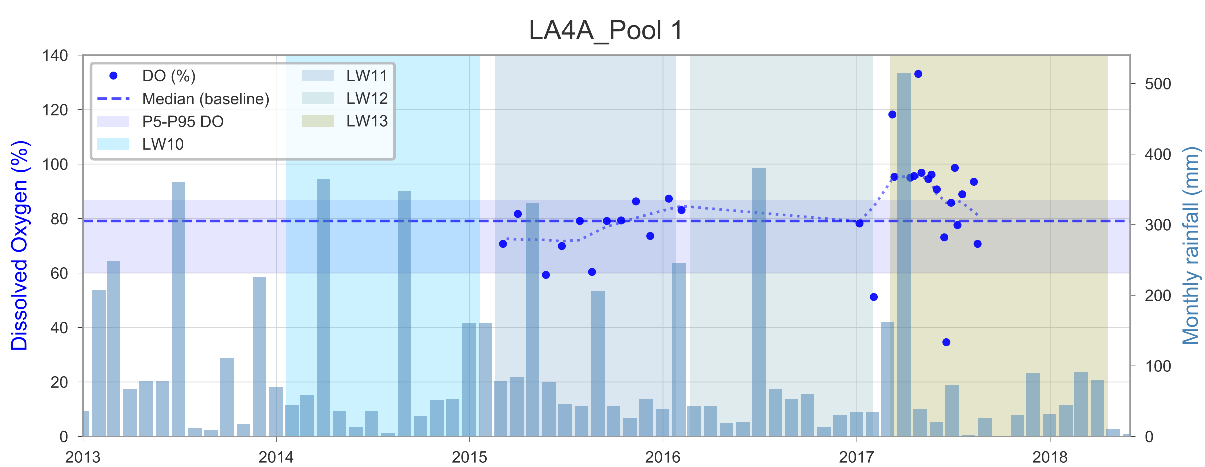

LA4_S1
pH
pH Baseline mean
pH TARP [mean -3SD]
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

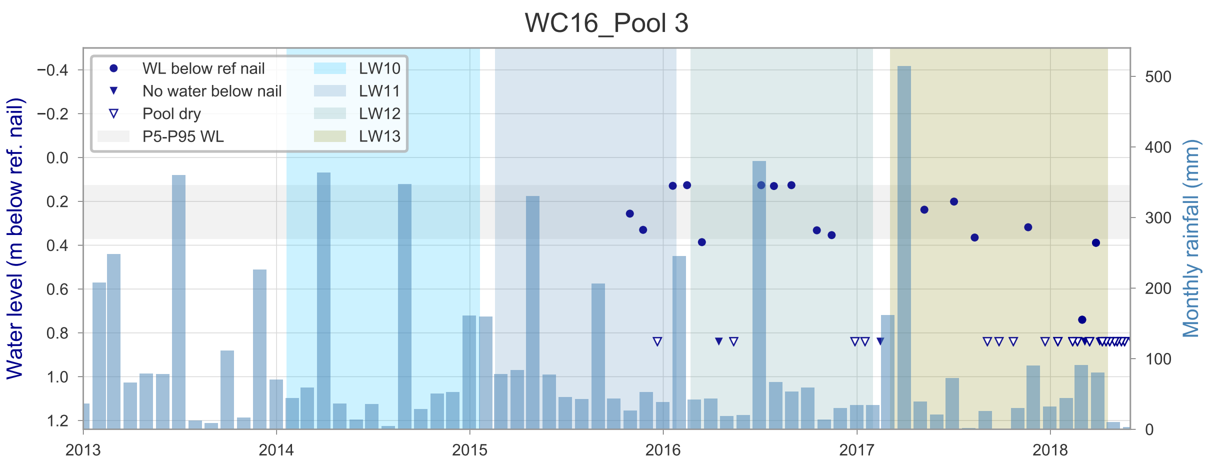

LA4_S1
DO (%)
DO Baseline mean
DO TARP [mean -3SD]
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

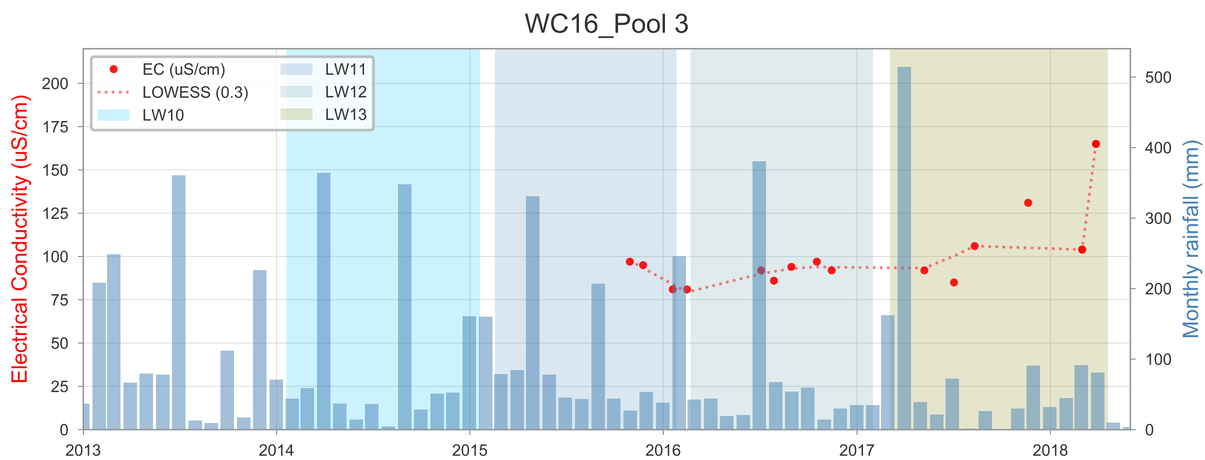

LA4A_Pool 1
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
−0.4
−0.2
0.0
0.2
0.4
Monthly rainfall (mm)
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

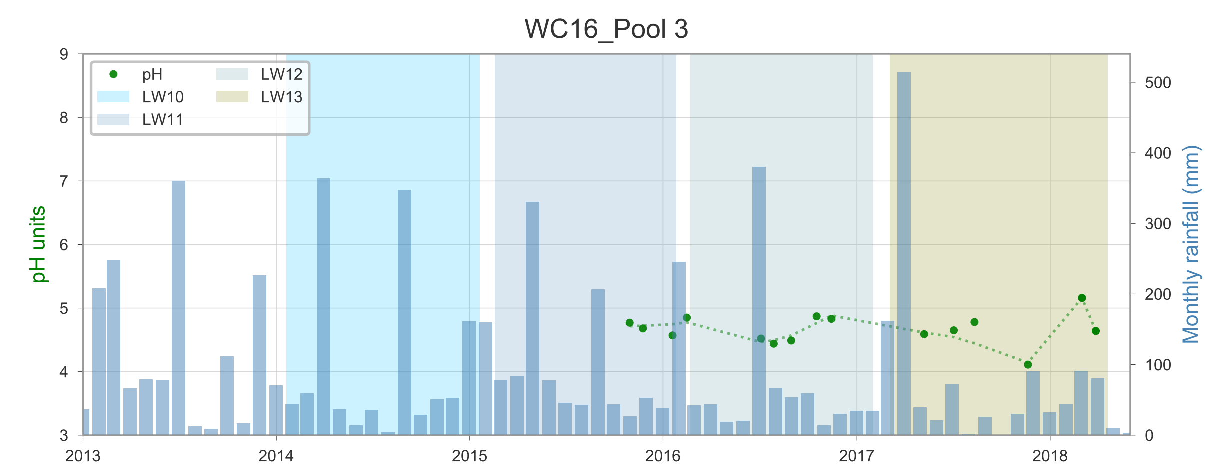

LA4A_Pool 1
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
0
25
50
75
100
125
150
175
200
Monthly rainfall (mm)
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

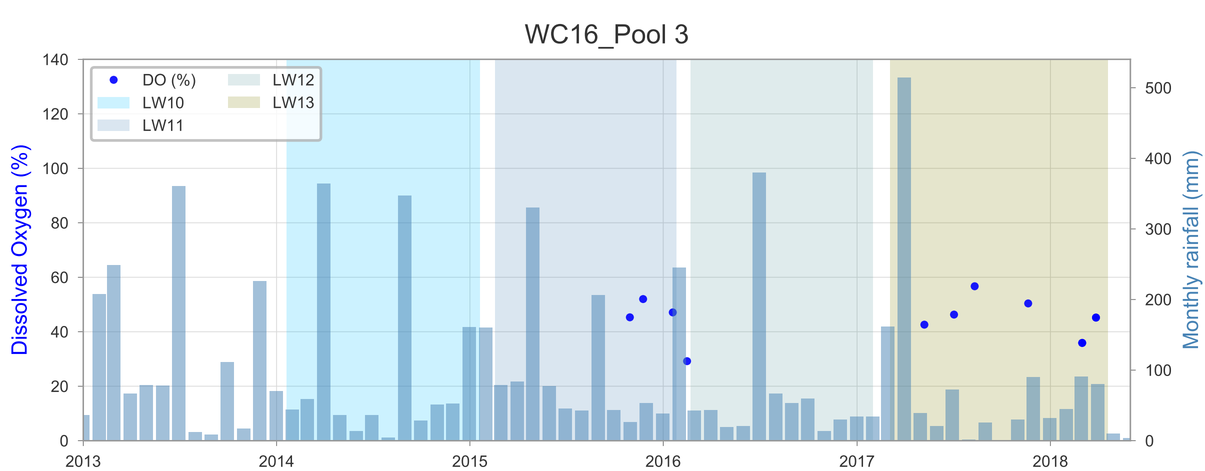

LA4A_Pool 1
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
pH units
3
4
5
6
7
8
9
Monthly rainfall (mm)
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

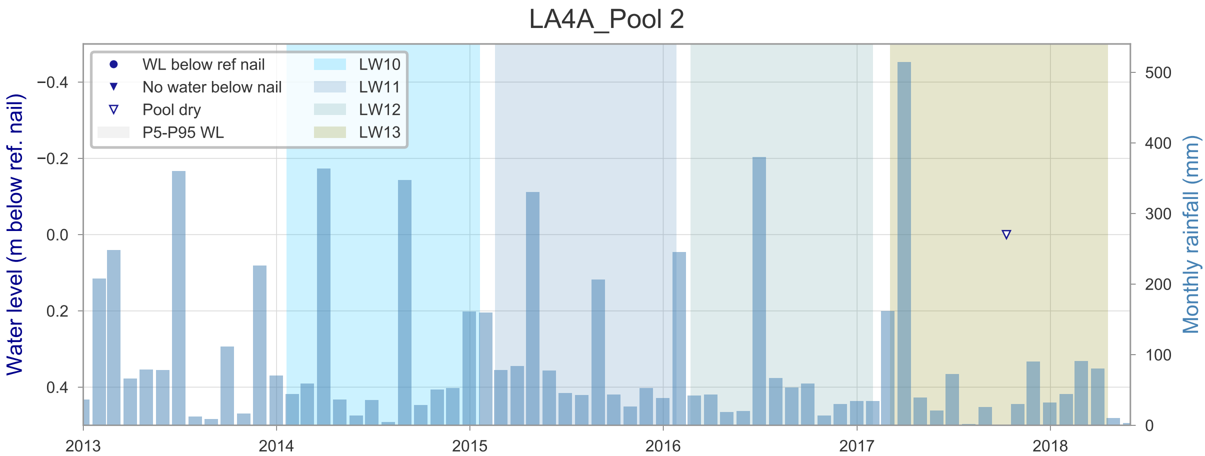

LA4A_Pool 1
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
0
20
40
60
80
100
120
140
Monthly rainfall (mm)
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

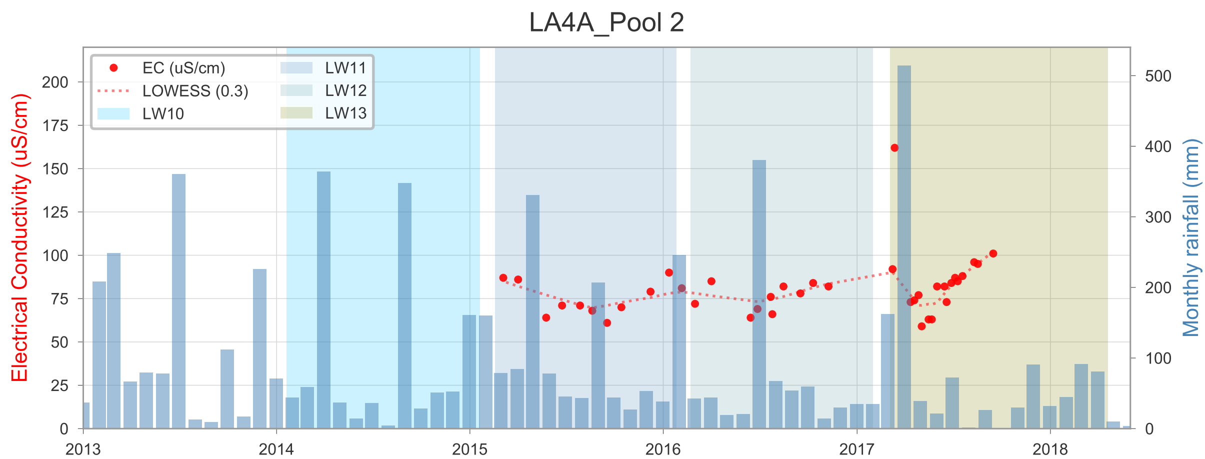

WC16_Pool 3
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
−0.4
−0.2
0.0
0.2
0.4
0.6
0.8
1.0
1.2
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

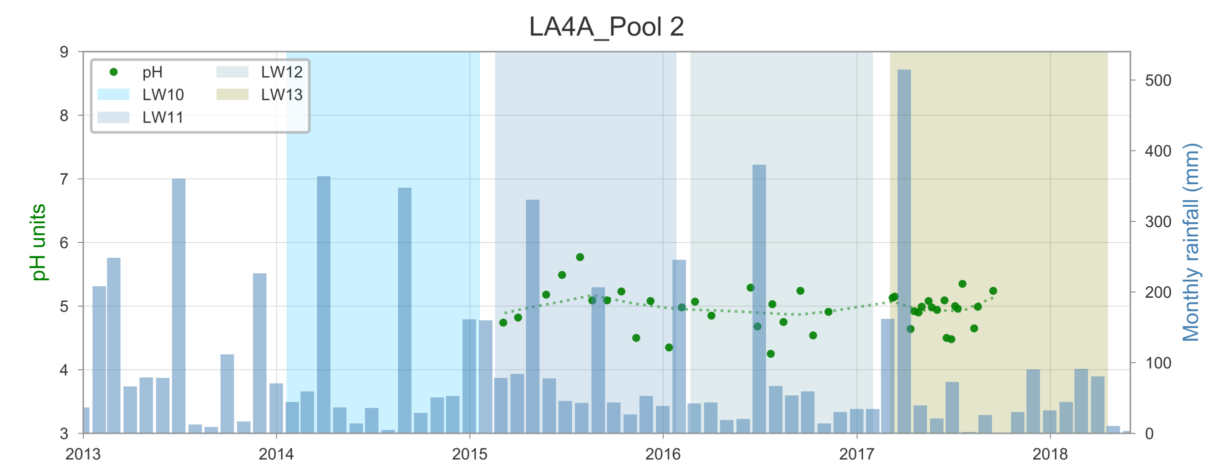

WC16_Pool 3
EC (uS/cm)
LOWESS (0.3)
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

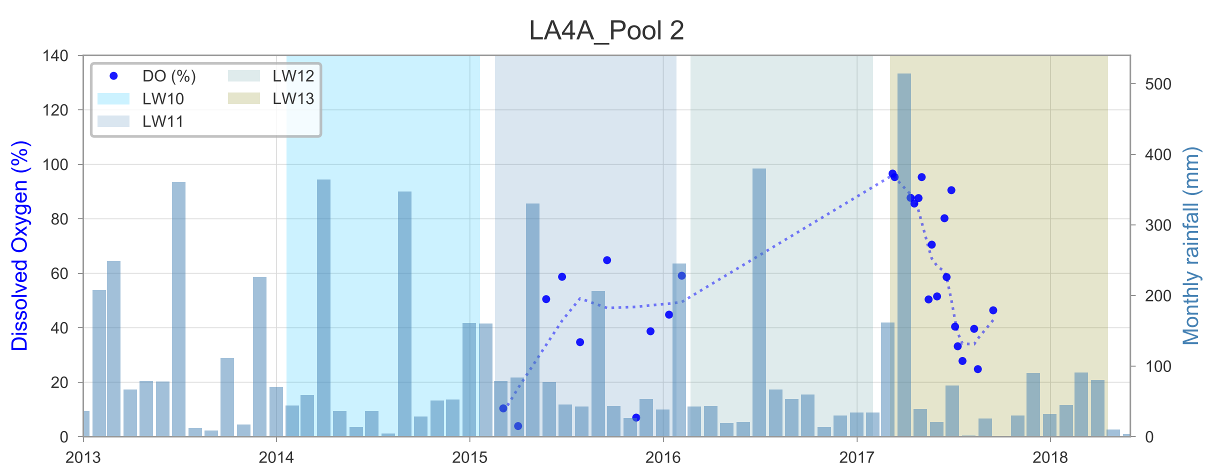

WC16_Pool 3
pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
3
4
5
6
7
8
9
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

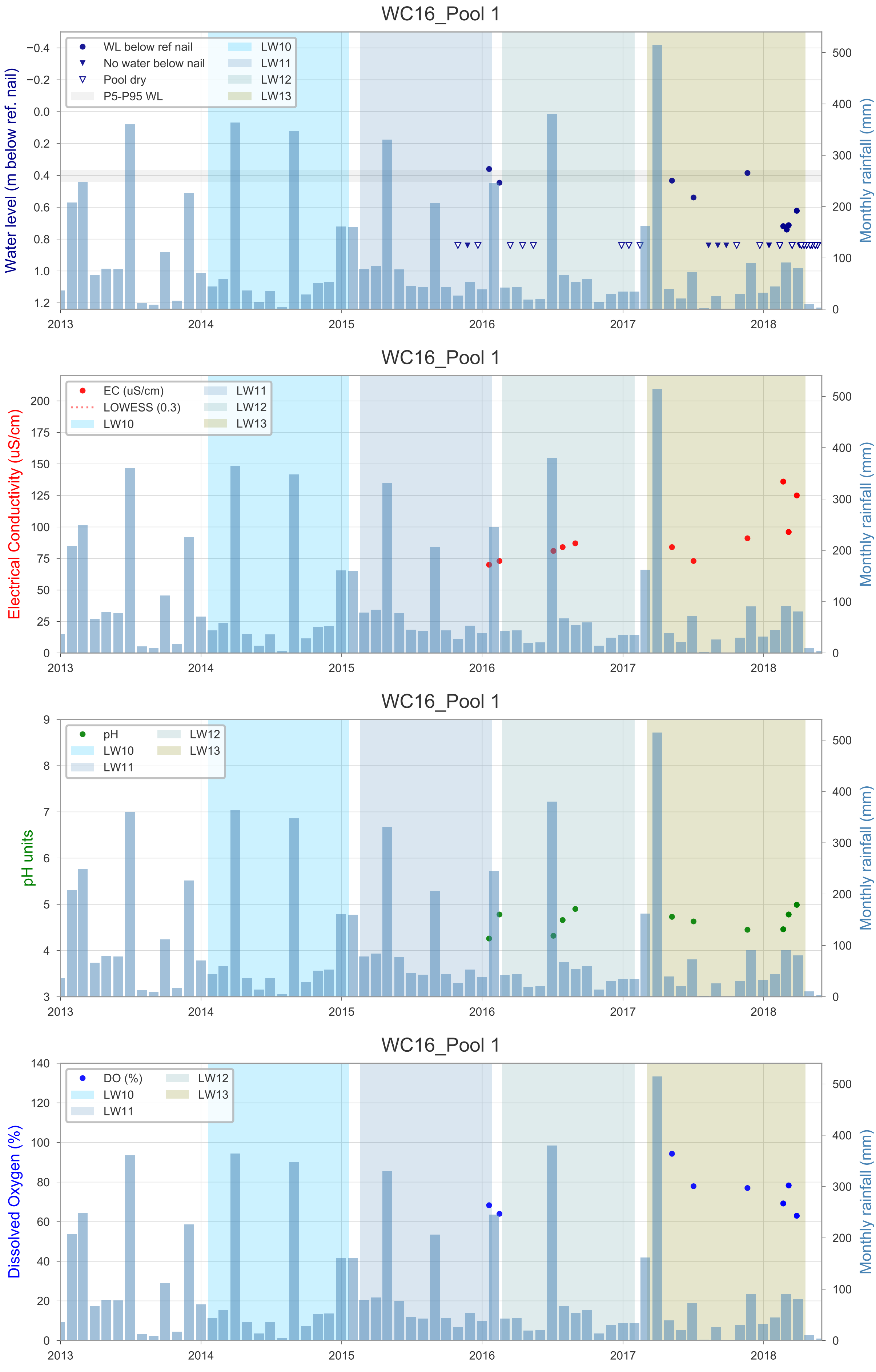

WC16_Pool 3
DO (%)
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

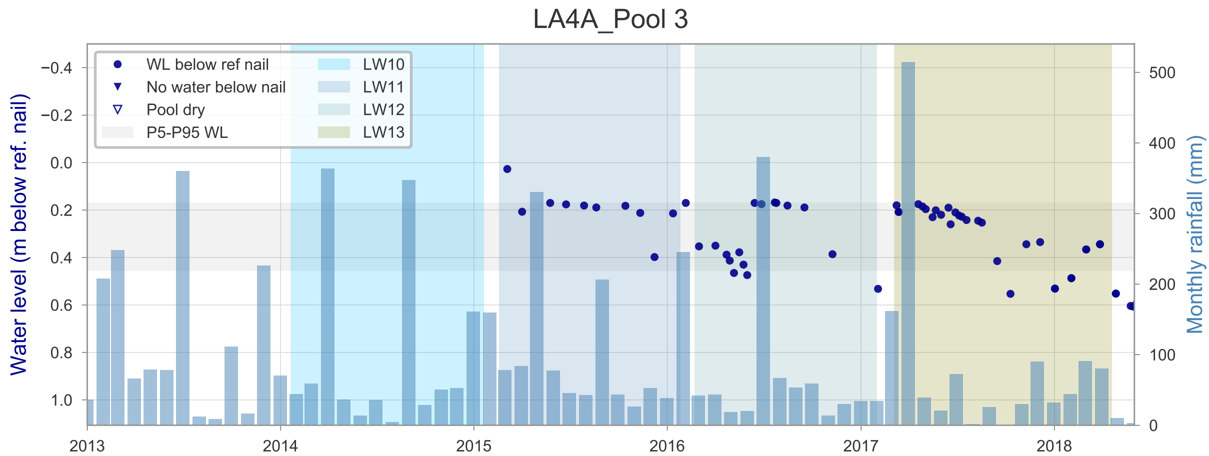

LA4A_Pool 2
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

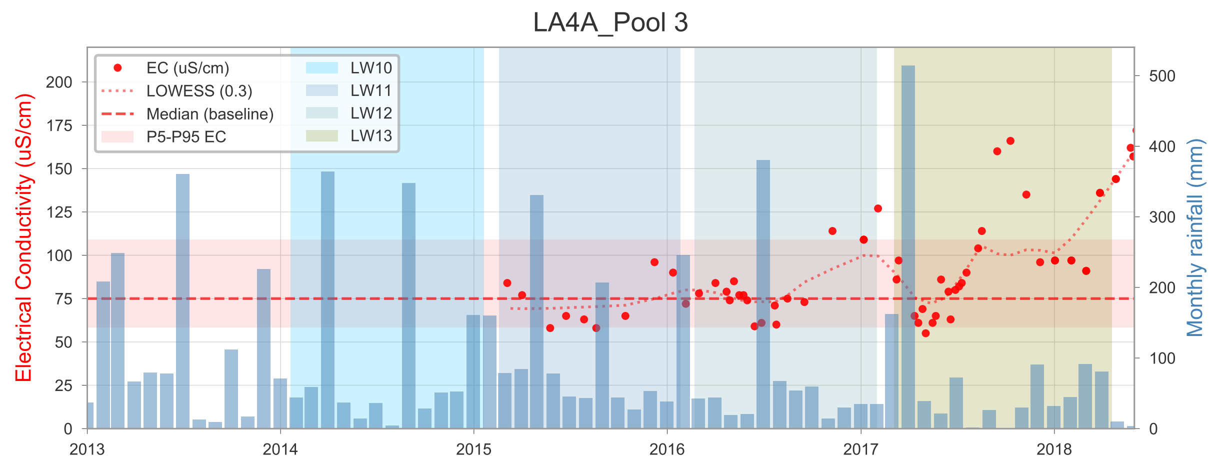

LA4A_Pool 2
EC (uS/cm)
LOWESS (0.3)
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

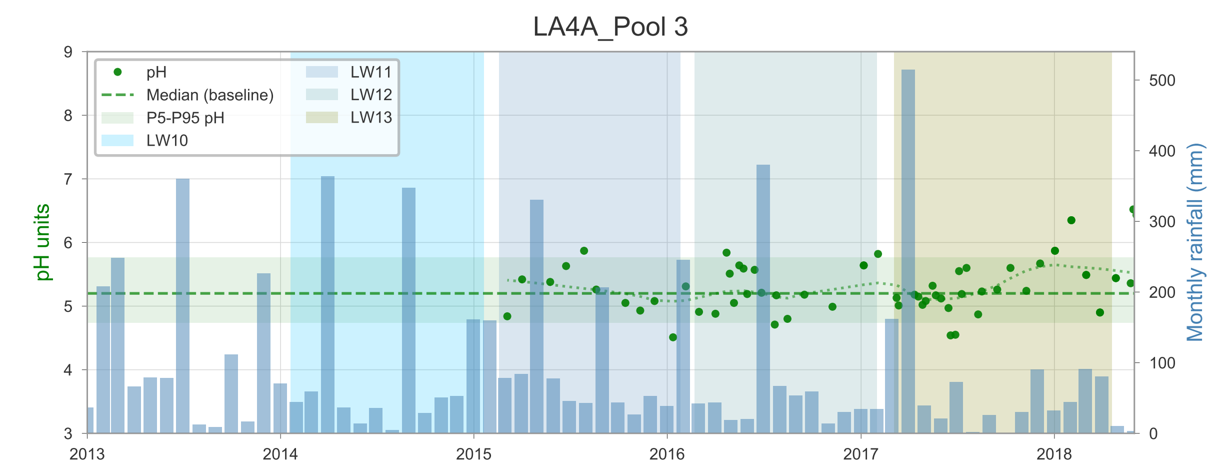

LA4A_Pool 2
pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

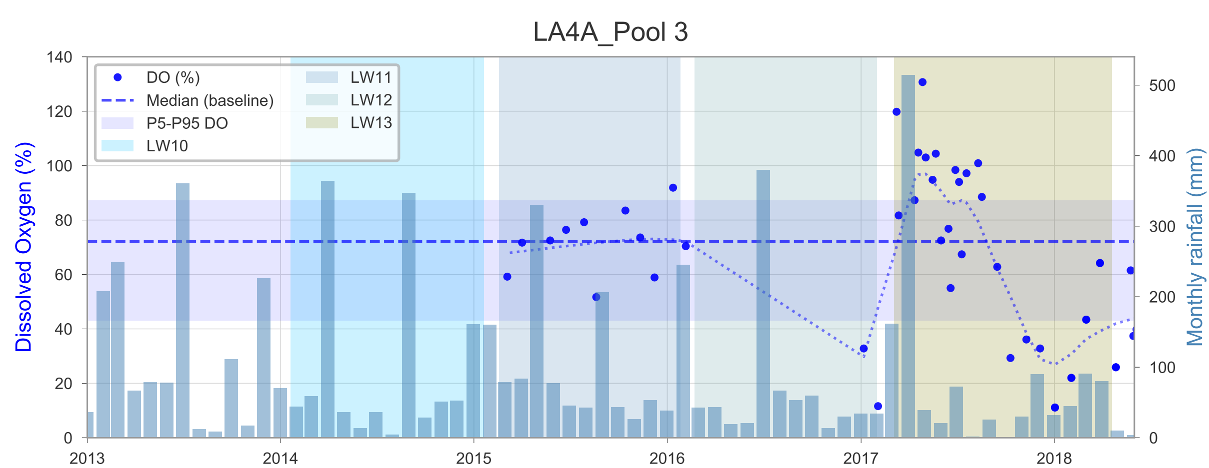

LA4A_Pool 2
DO (%)
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

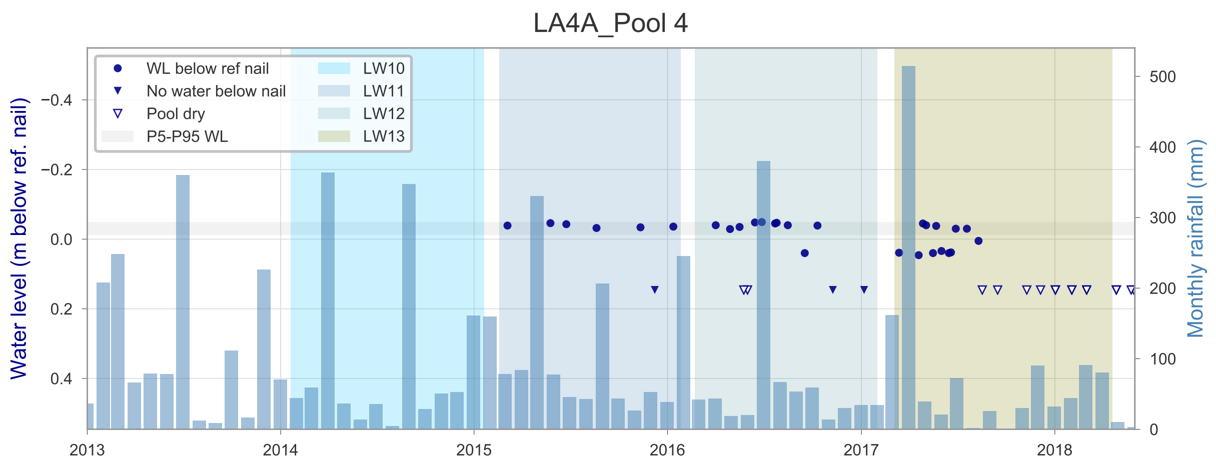

WC16_Pool 1
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
WC16_Pool 1
EC (uS/cm)
LOWESS (0.3)
Electrical Conductivity (uS/cm)
WC16_Pool 1
pH
pH units
WC16_Pool 1
DO (%)
Dissolved Oxygen (%)
2013
2014
2015
2016
2017
2018

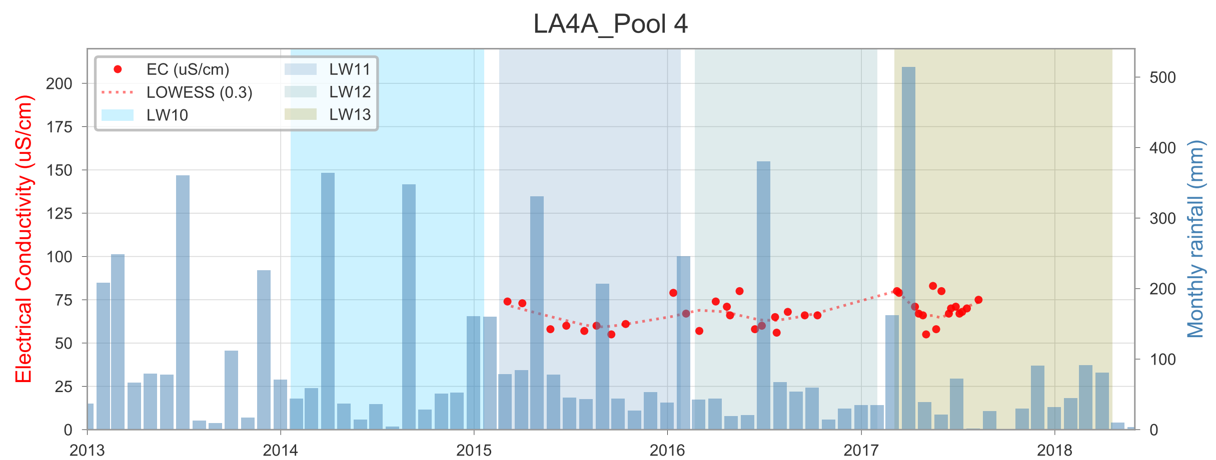

LA4A_Pool 3
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

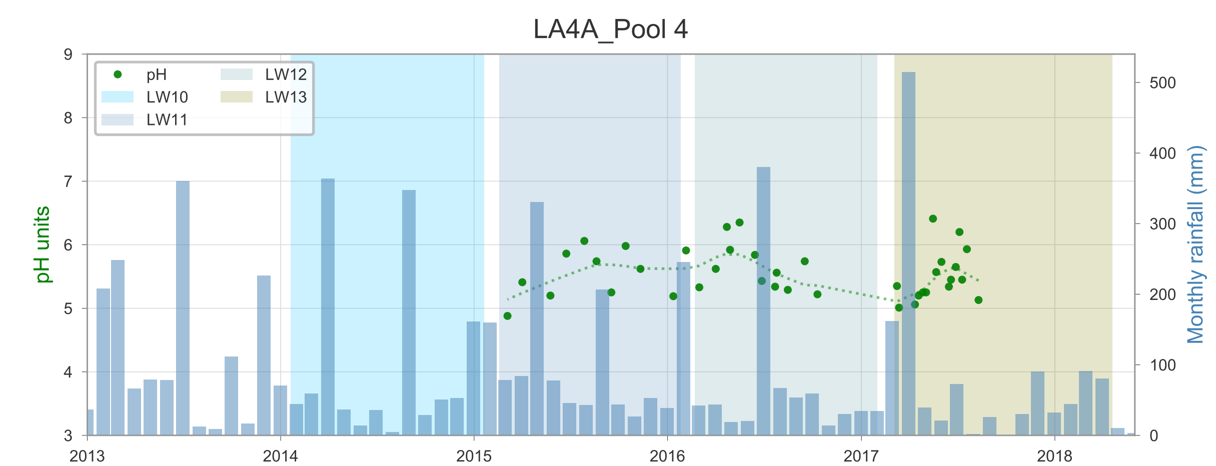

LA4A_Pool 3
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

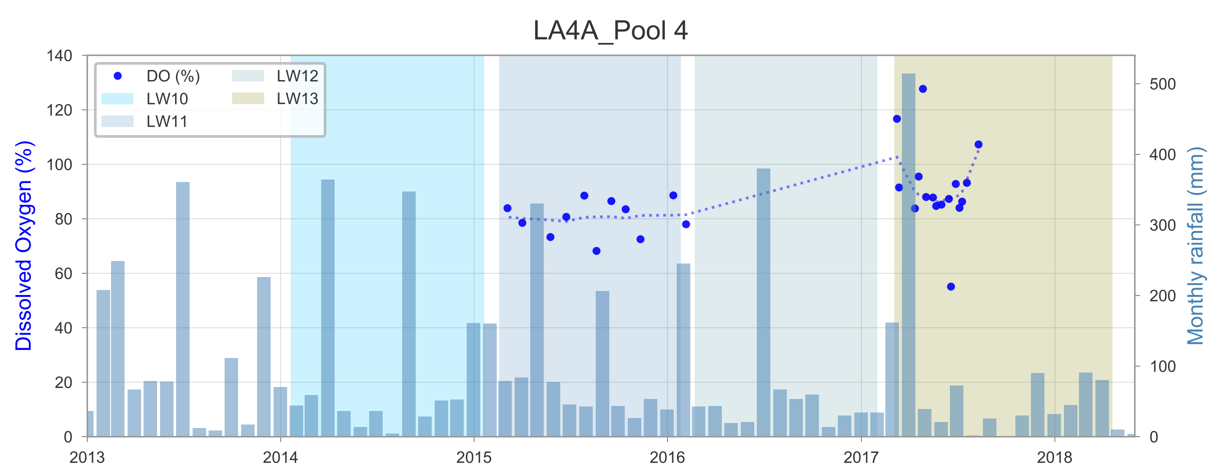

LA4A_Pool 3
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

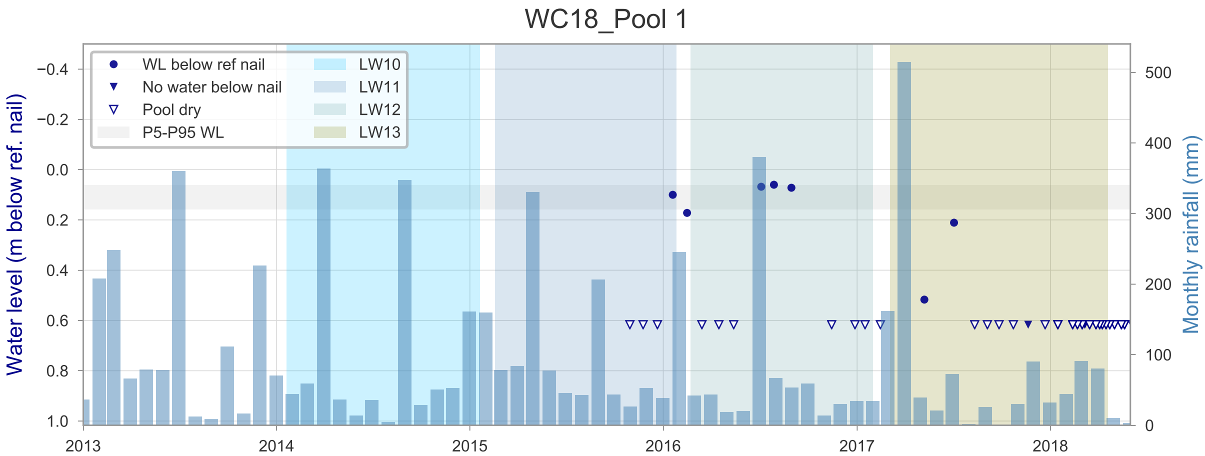

LA4A_Pool 3
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

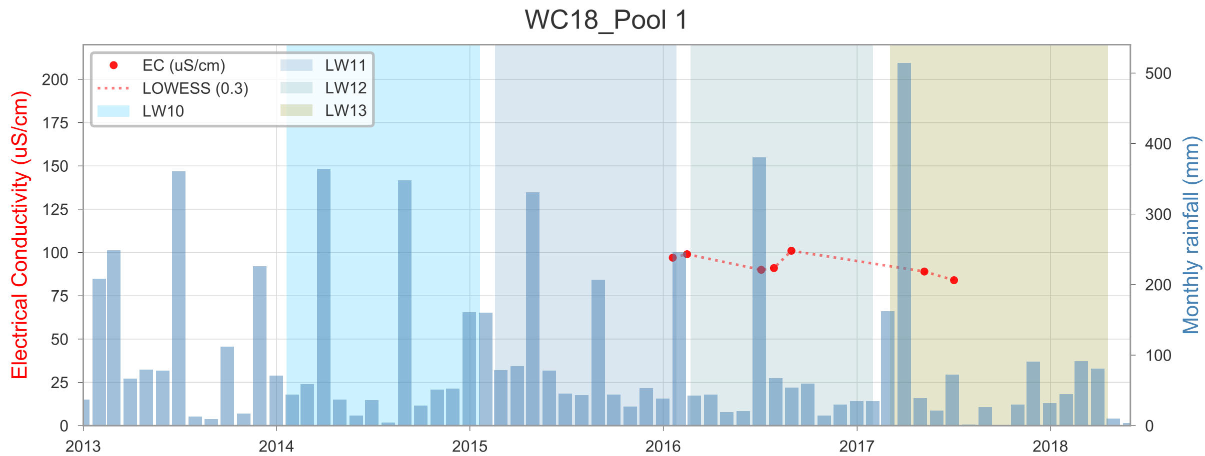

LA4A_Pool 4
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

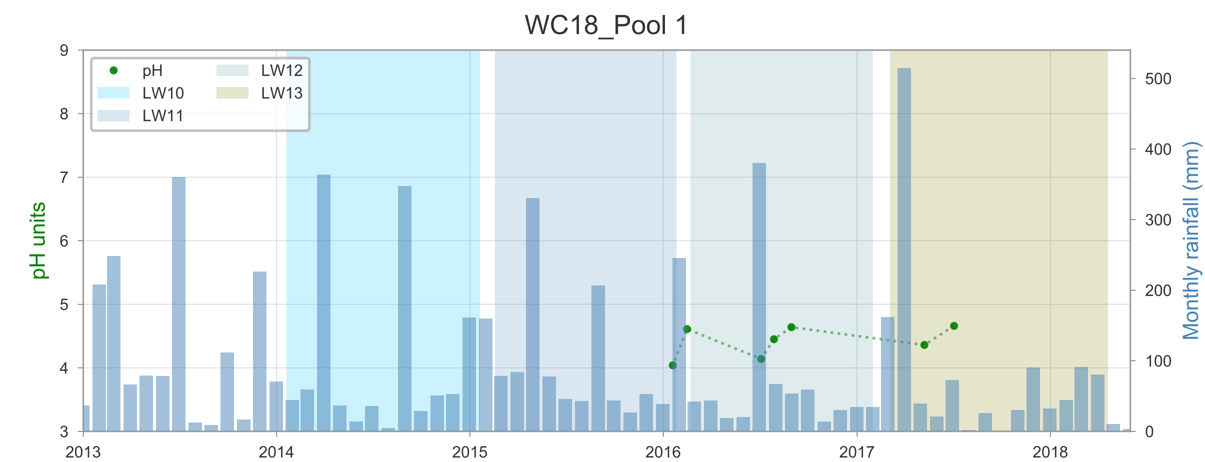

LA4A_Pool 4
EC (uS/cm)
LOWESS (0.3)
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

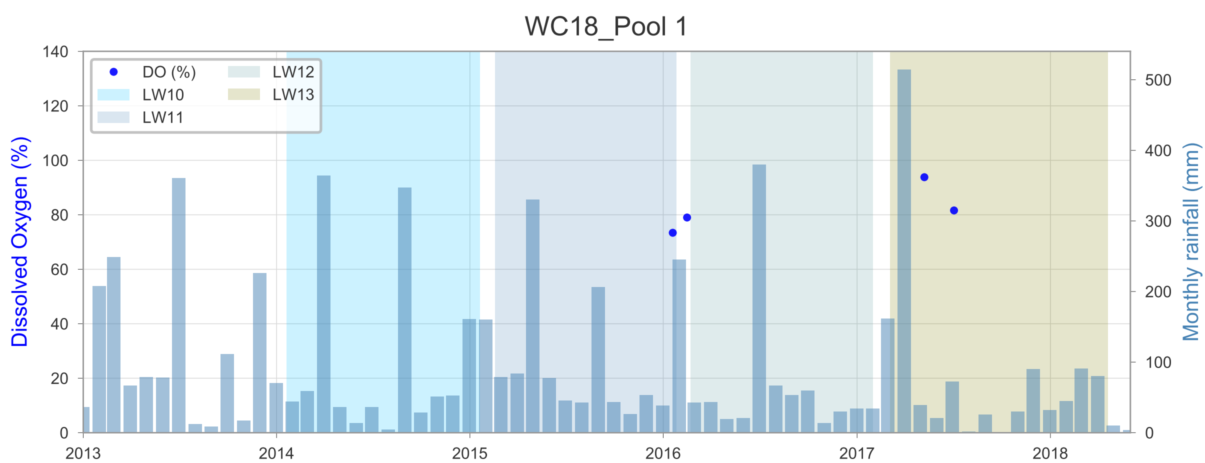

LA4A_Pool 4
pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

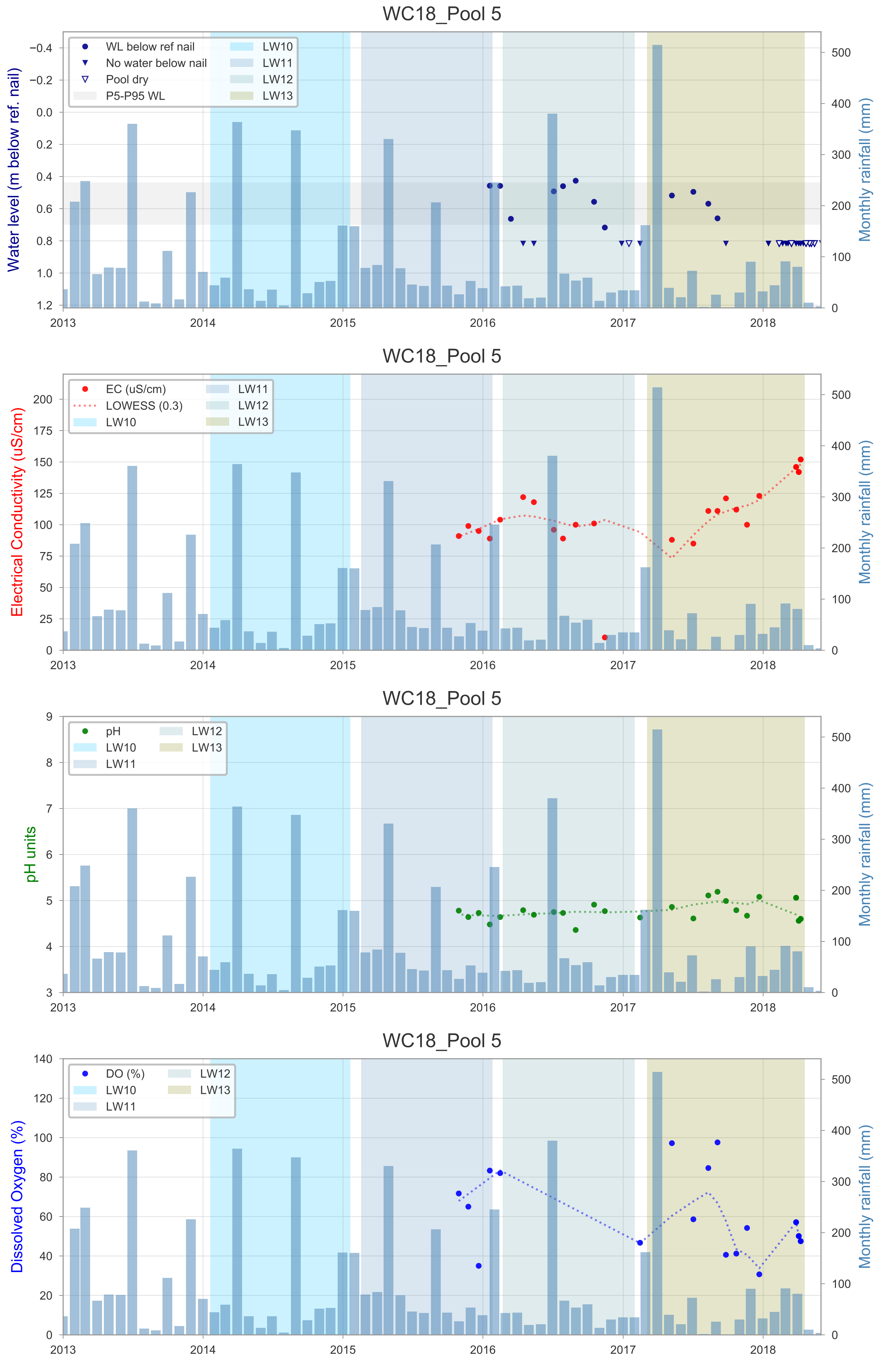

LA4A_Pool 4
DO (%)
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

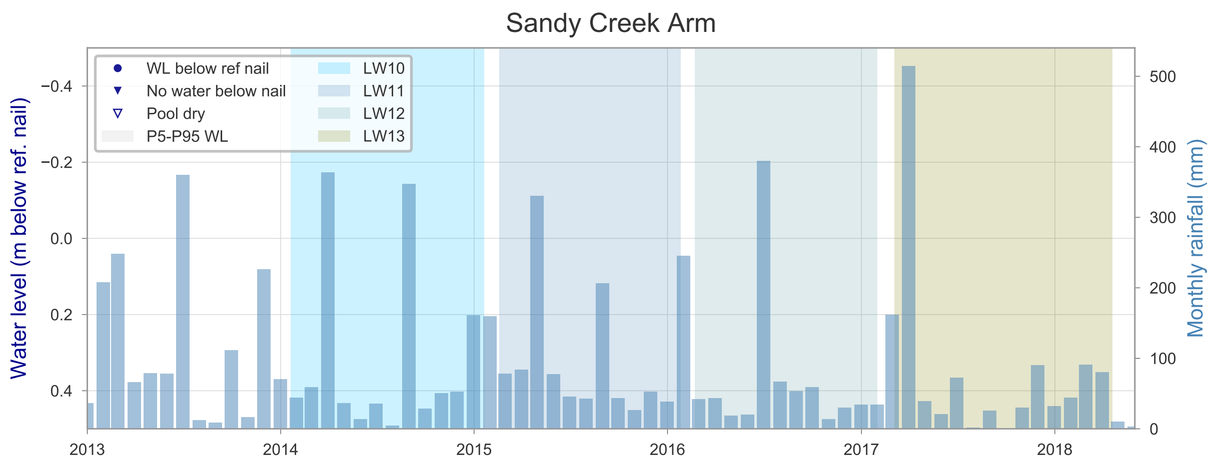

WC18_Pool 1
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
-0.4
-0.2
0.0
0.2
0.4
0.6
0.8
1.0
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

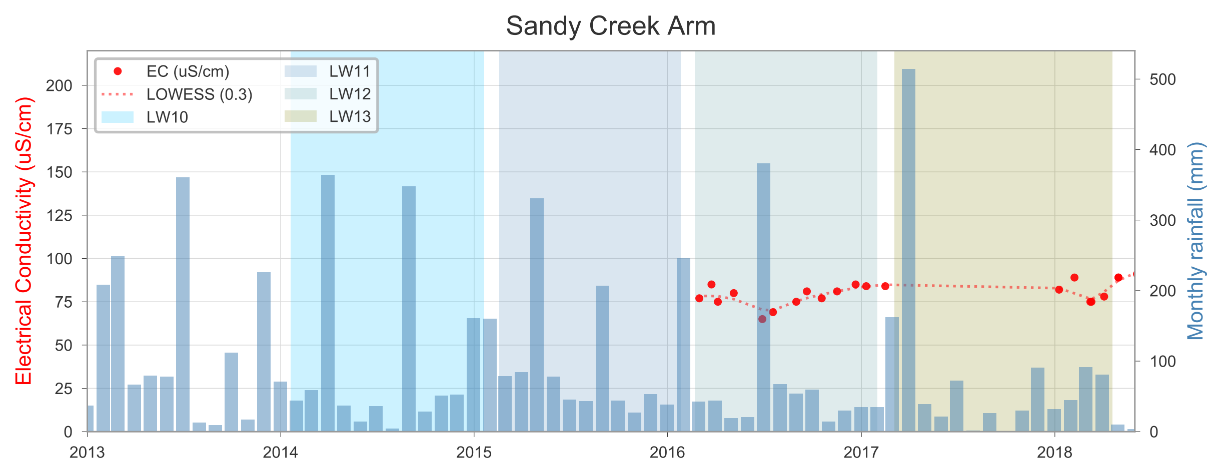

WC18_Pool 1
EC (uS/cm)
LOWESS (0.3)
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

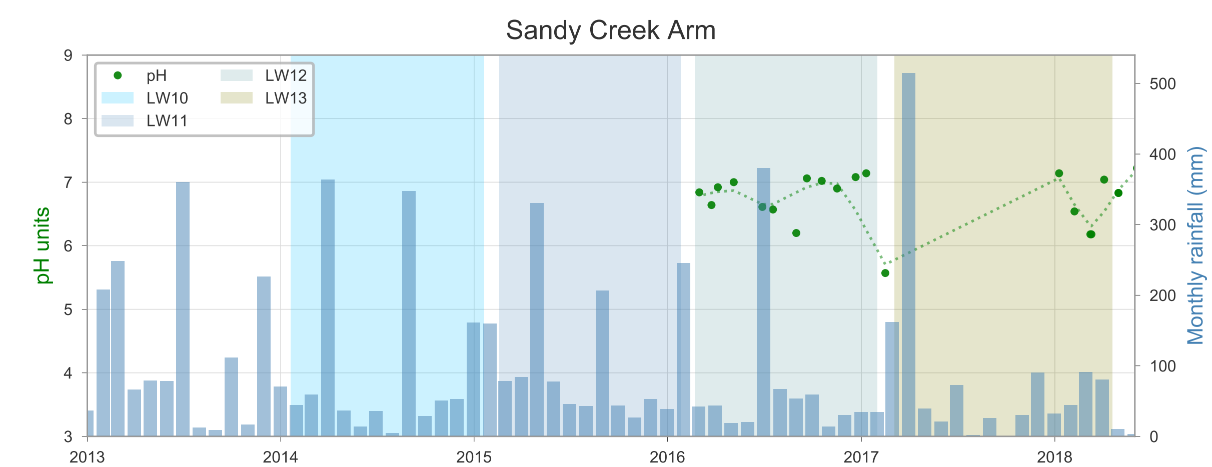

WC18_Pool 1
pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
3
4
5
6
7
8
9
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

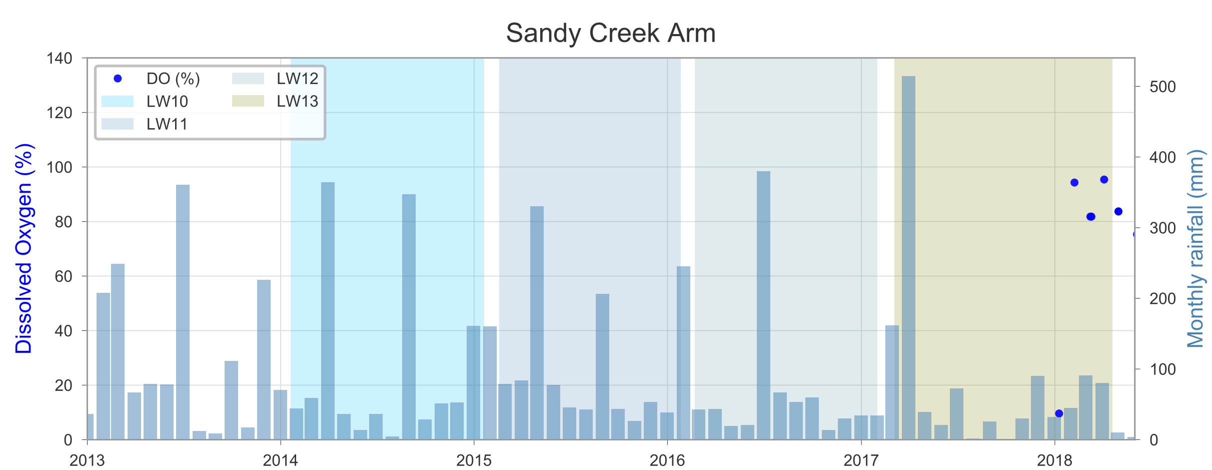

WC18_Pool 1
DO (%)
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

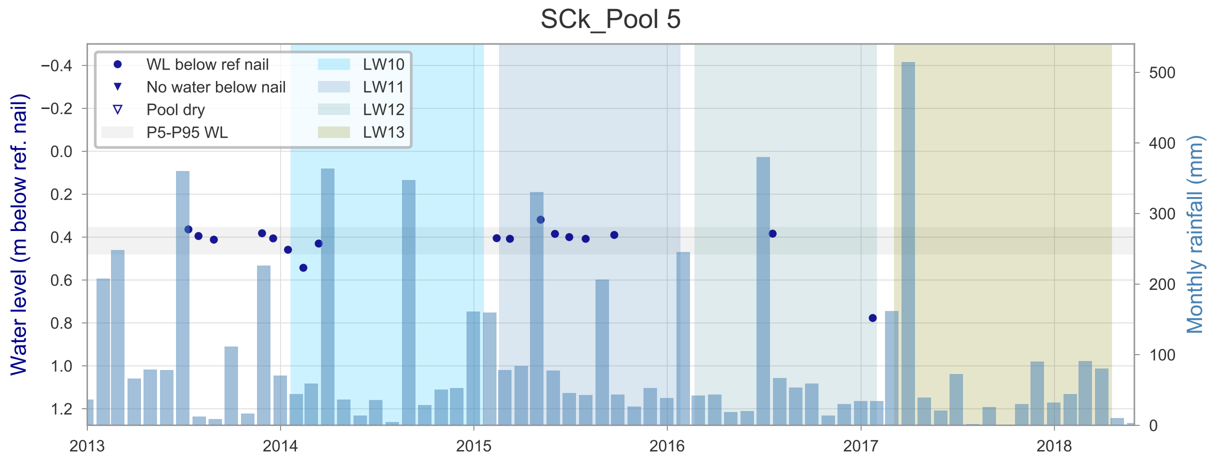

WC18_Pool 5
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
WC18_Pool 5
EC (uS/cm)
LOWESS (0.3)
Electrical Conductivity (uS/cm)
WC18_Pool 5
pH
pH units
WC18_Pool 5
DO (%)
Dissolved Oxygen (%)
2013
2014
2015
2016
2017
2018

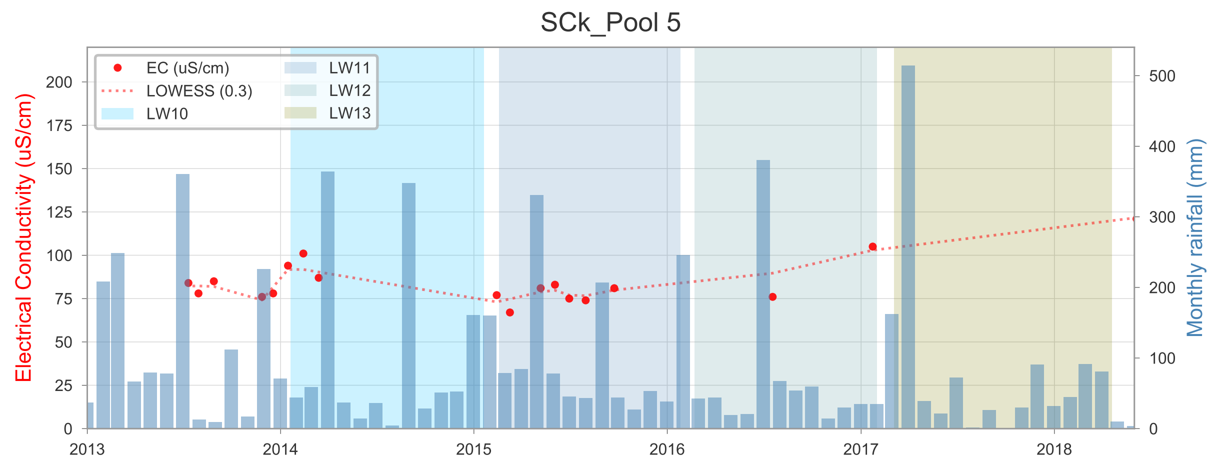

Sandy Creek Arm
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

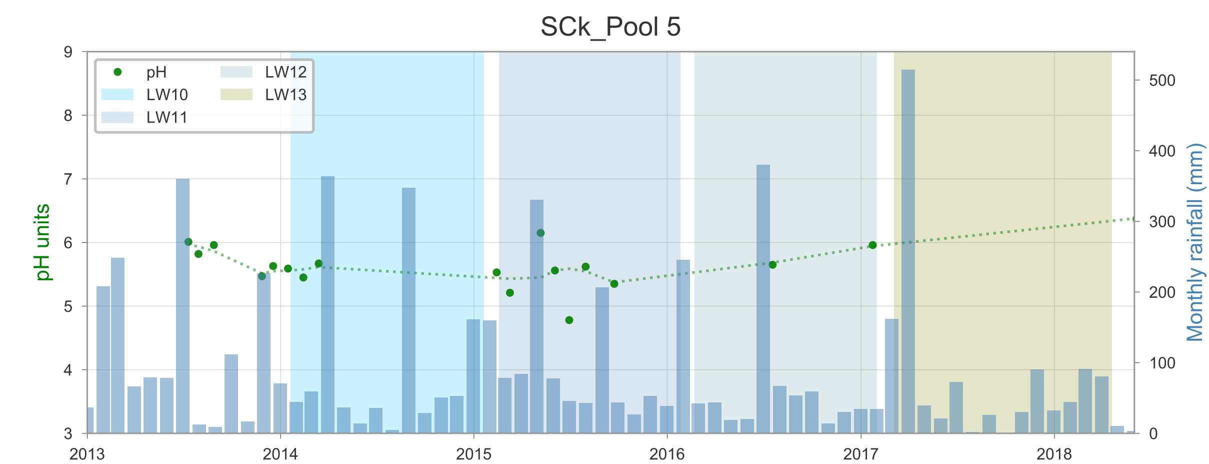

Sandy Creek Arm
EC (uS/cm)
LOWESS (0.3)
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

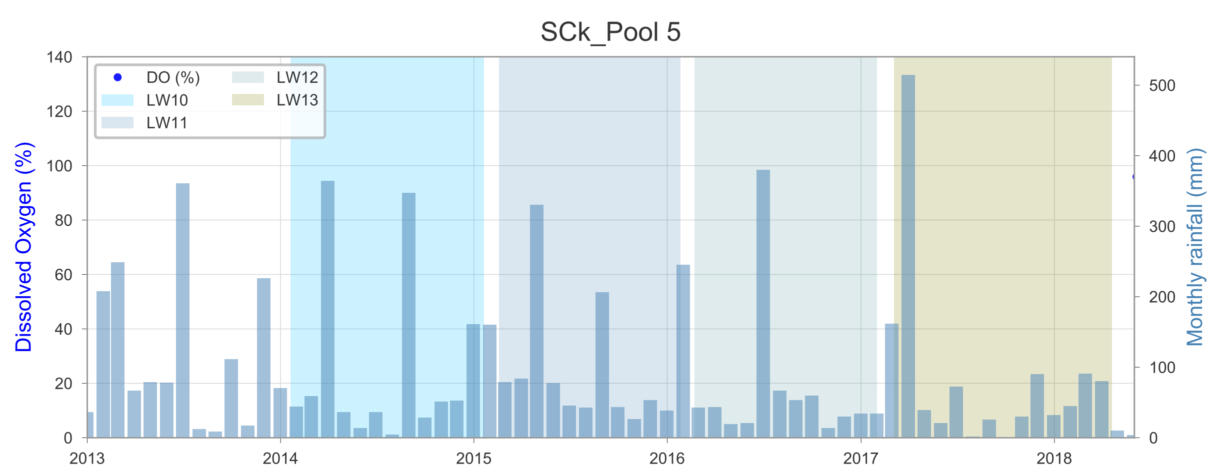

Sandy Creek Arm
pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

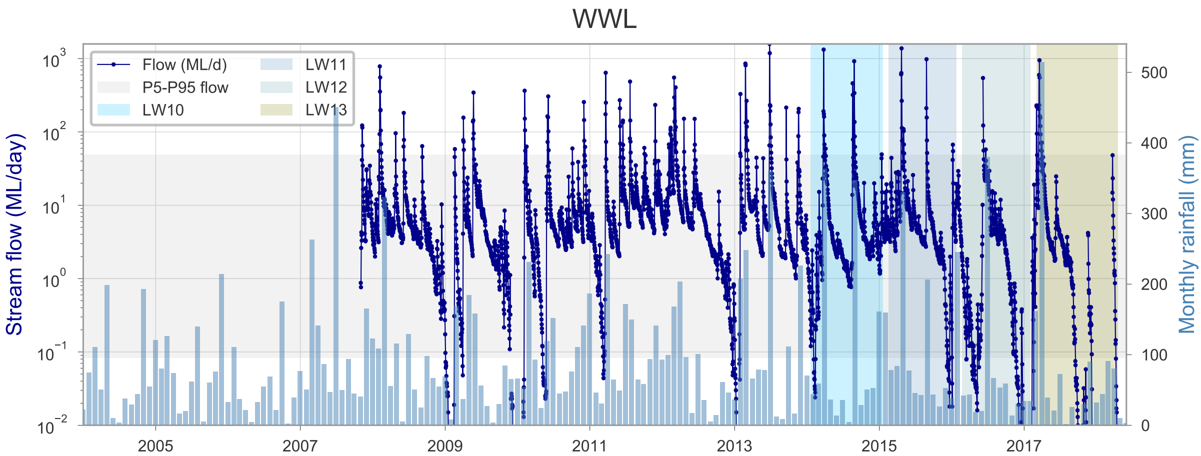

Sandy Creek Arm
DO (%)
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

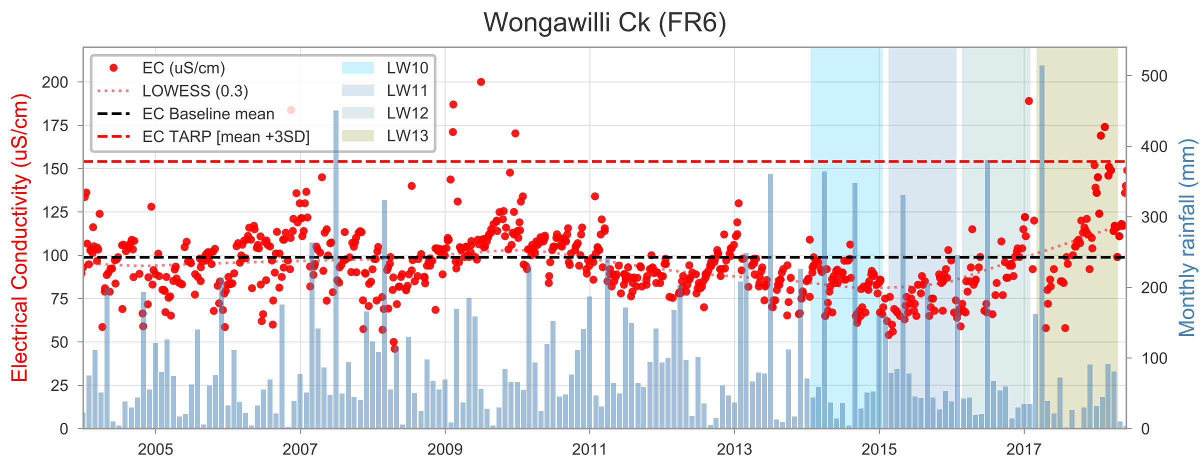

SCk_Pool 5
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

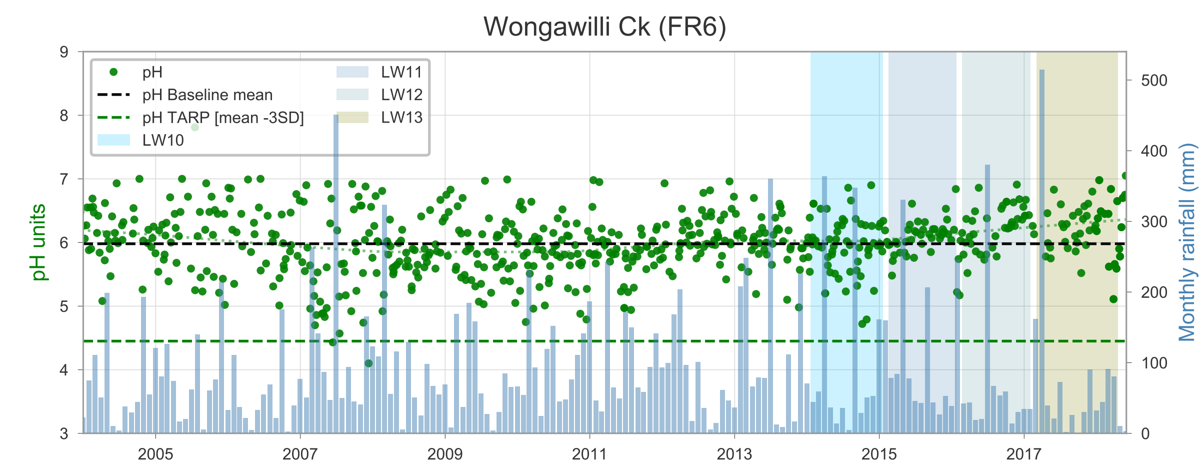

SCk_Pool 5
EC (uS/cm)
LOWESS (0.3)
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

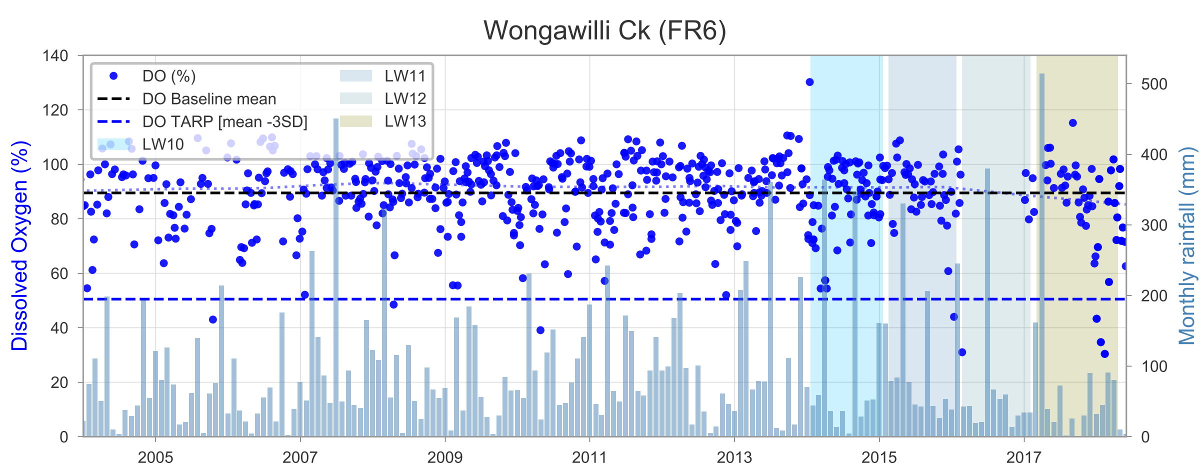

SCk_Pool 5
pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018


SCk_Pool 5
DO (%)
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

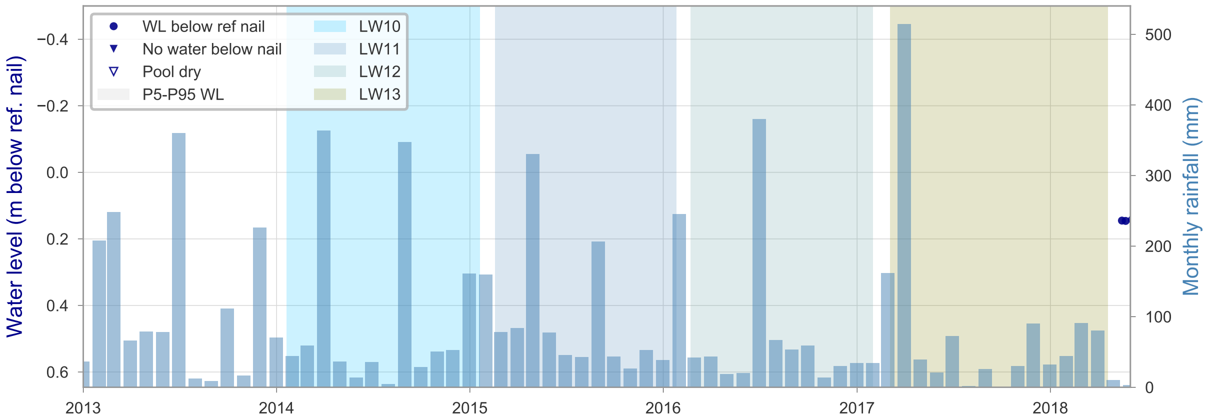

WWL
Flow (ML/d)
P5-P95 flow
LW10
LW11
LW12
LW13
Stream flow (ML/day)
Monthly rainfall (mm)
2005
2007
2009
2011
2013
2015
2017


Wongawilli Ck (FR6)
EC (uS/cm)
LOWESS (0.3)
EC Baseline mean
EC TARP [mean +3SD]
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)

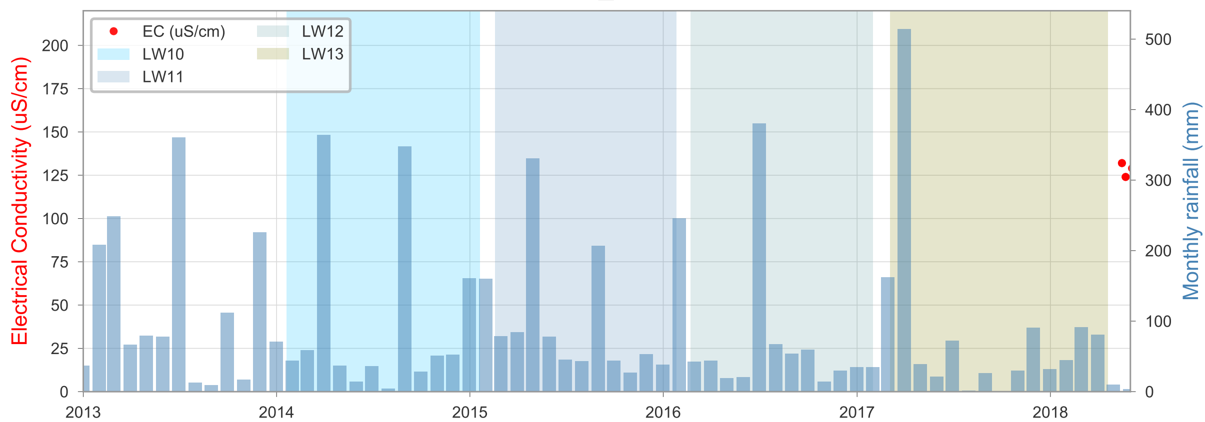

Wongawilli Ck (FR6)
pH
pH Baseline mean
pH TARP [mean -3SD]
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)


Wongawilli Ck (FR6)
DO (%)
DO Baseline mean
DO TARP [mean -3SD]
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)

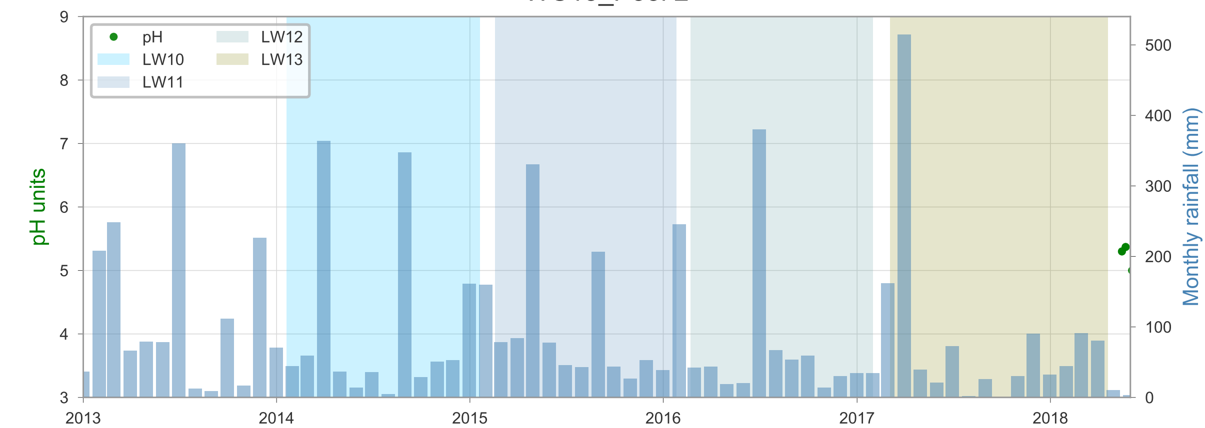
WC15_Pool 2



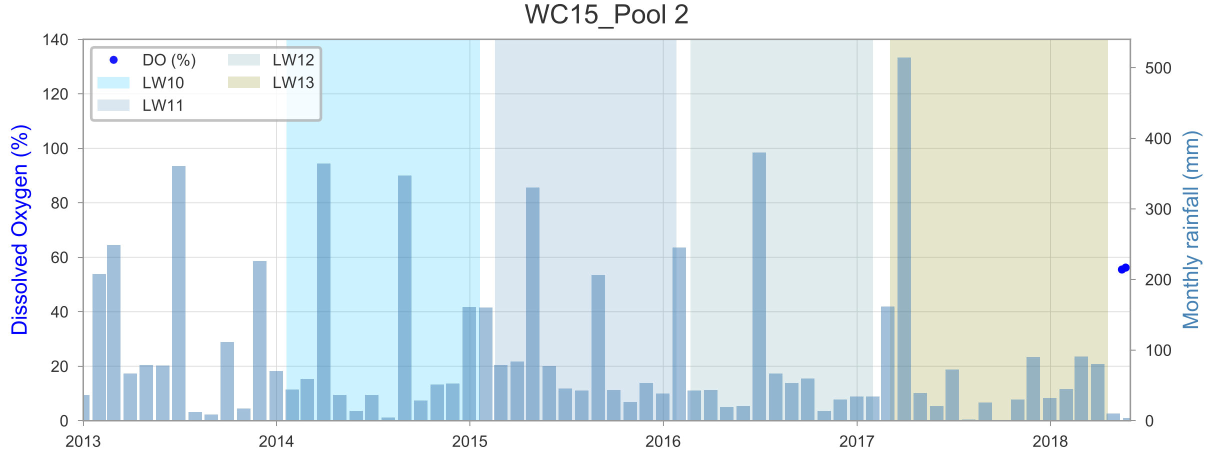
WC15_Pool 2

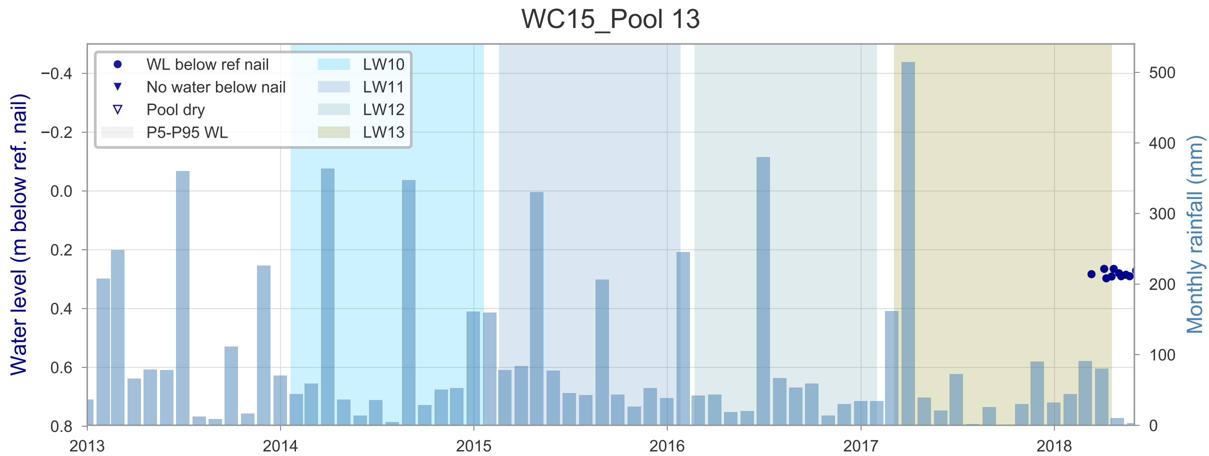


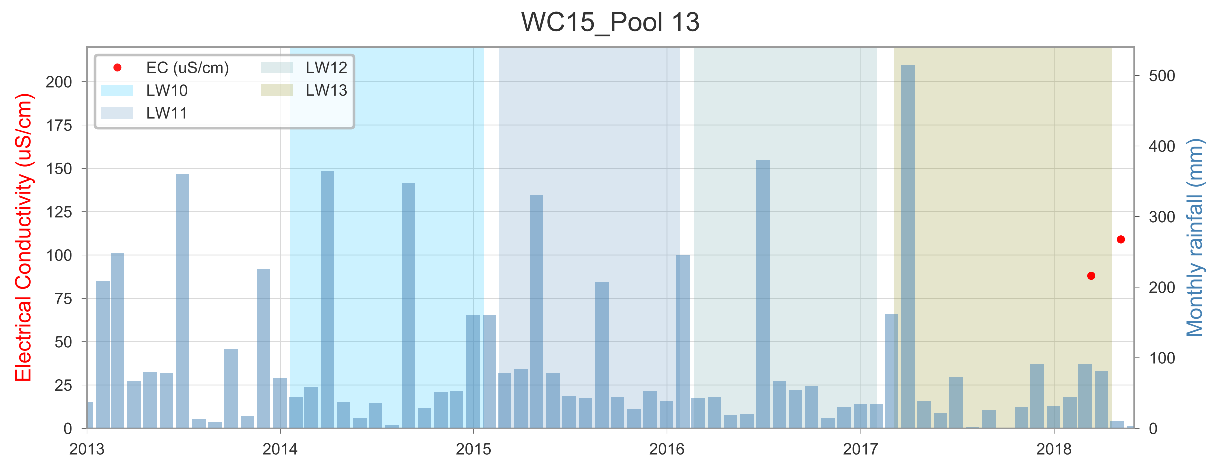
WC15_Pool 2

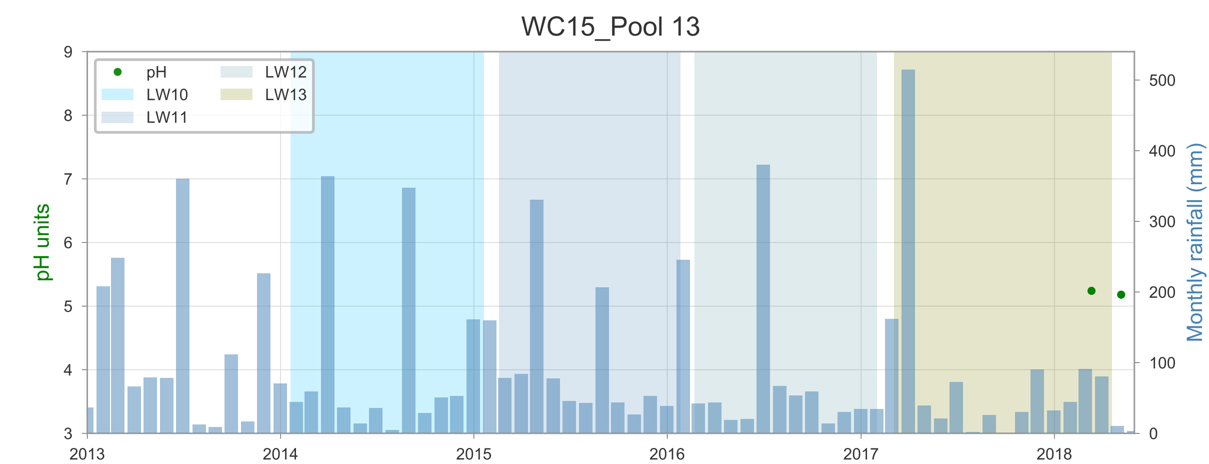


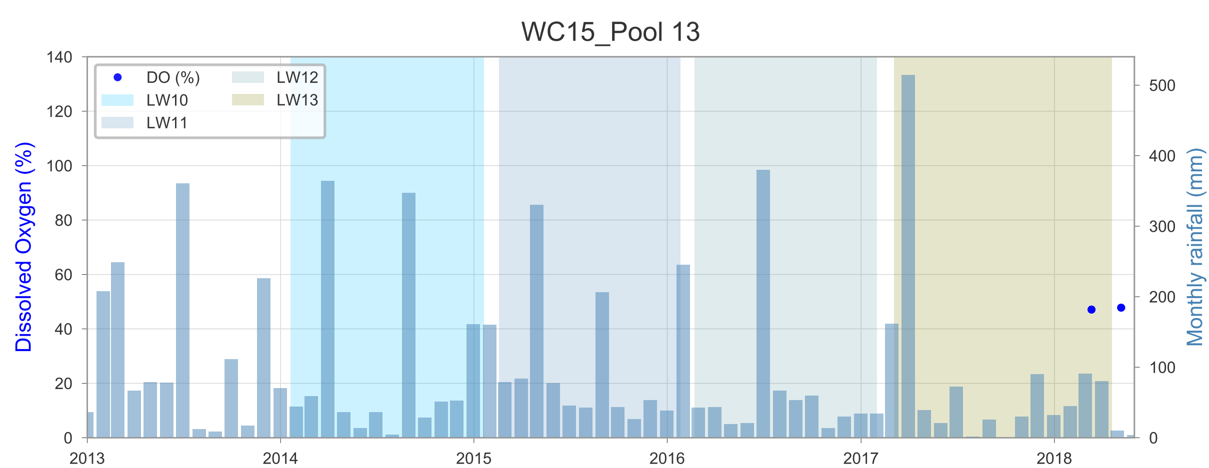
WC15_Pool 2

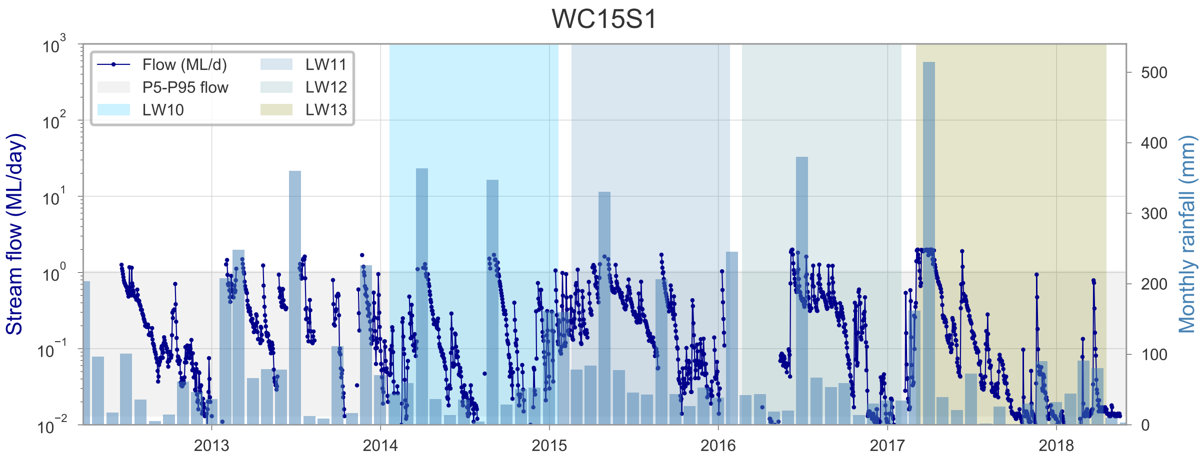


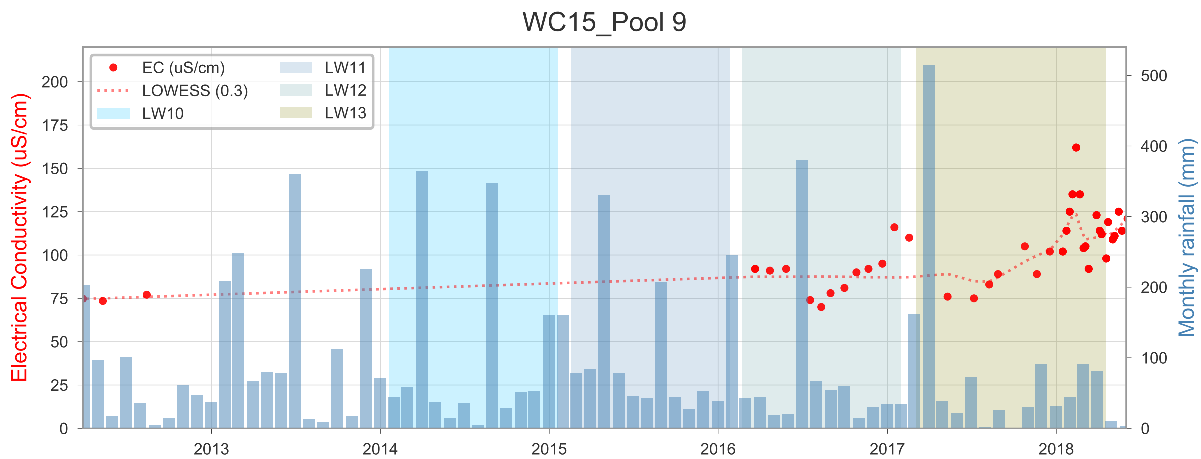

WC15_Pool 13
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
-0.4
-0.2
0.0
0.2
0.4
0.6
0.8
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

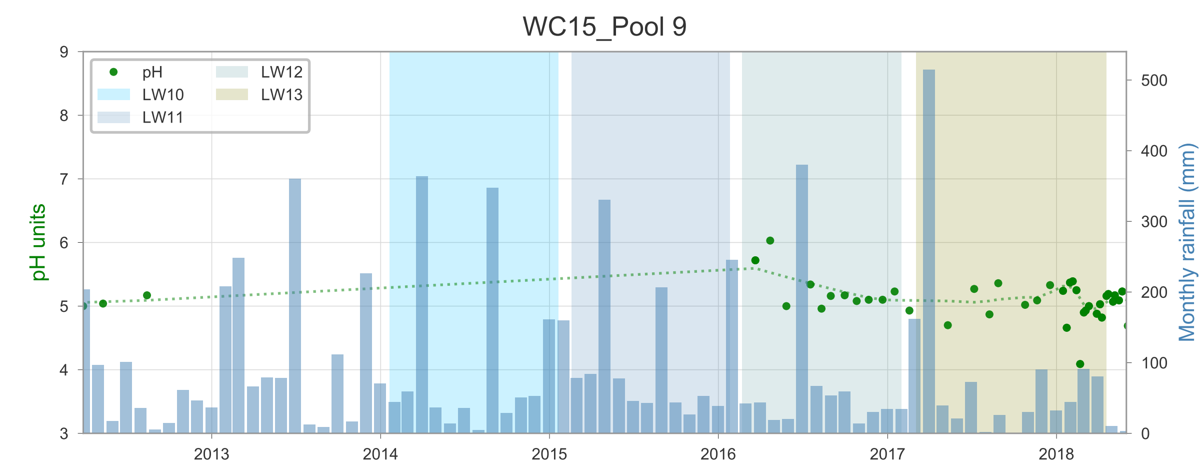

WC15_Pool 13
EC (uS/cm)
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

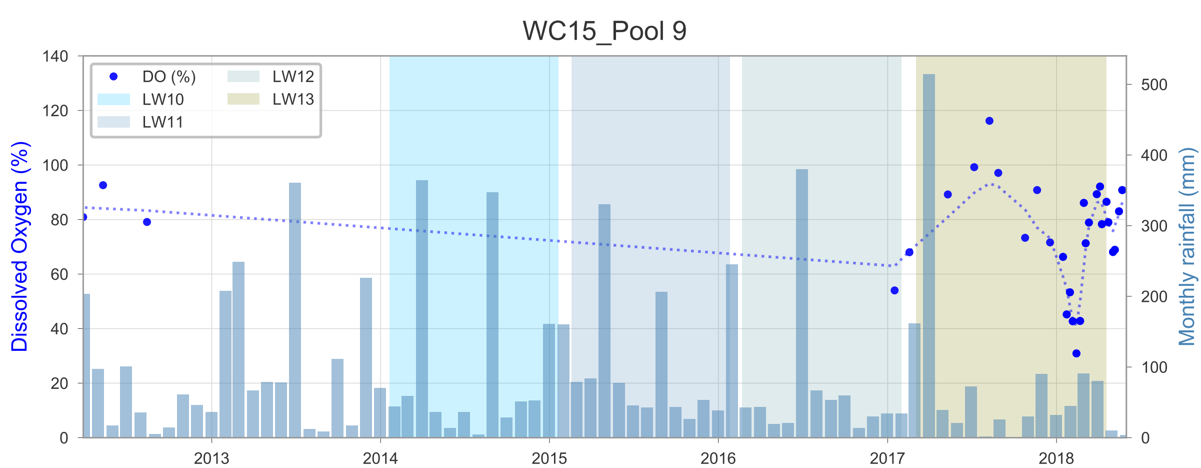

WC15_Pool 13
pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
3
4
5
6
7
8
9
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

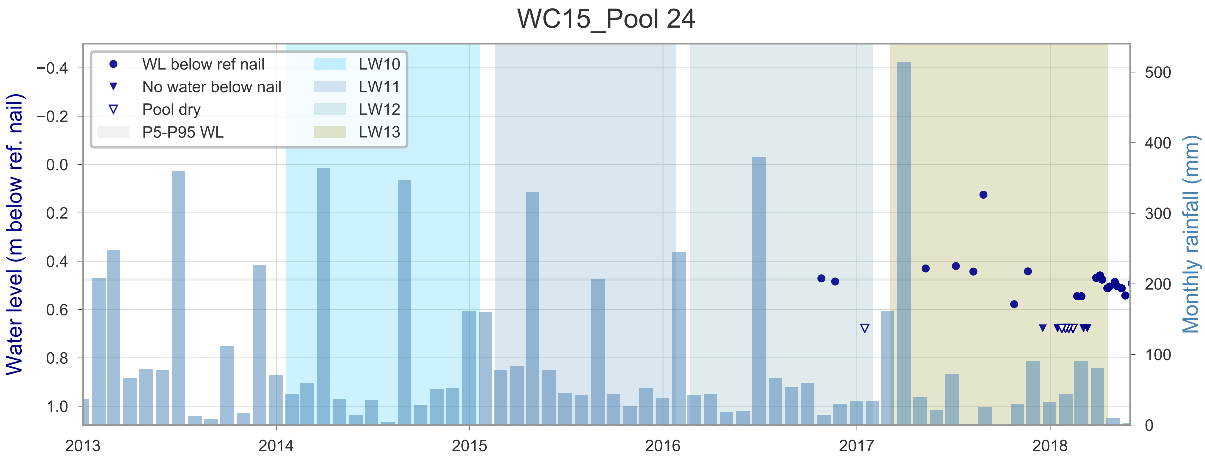

WC15_Pool 13
DO (%)
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018


WC15S1
Stream flow (ML/day)
Monthly rainfall (mm)
Flow (ML/d)
P5-P95 flow
LW10
LW11
LW12
LW13
2013
2014
2015
2016
2017
2018

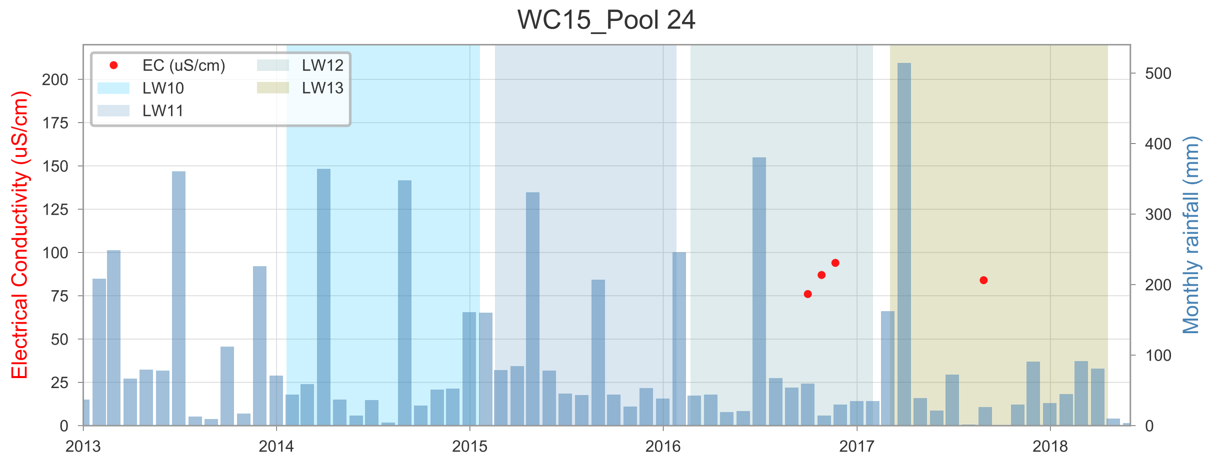

WC15_Pool 9
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
LW10
LW11
LW12
LW13
2013
2014
2015
2016
2017
2018


WC15_Pool 9
pH units
Monthly rainfall (mm)
pH
LW10
LW11
LW12
LW13
2013
2014
2015
2016
2017
2018

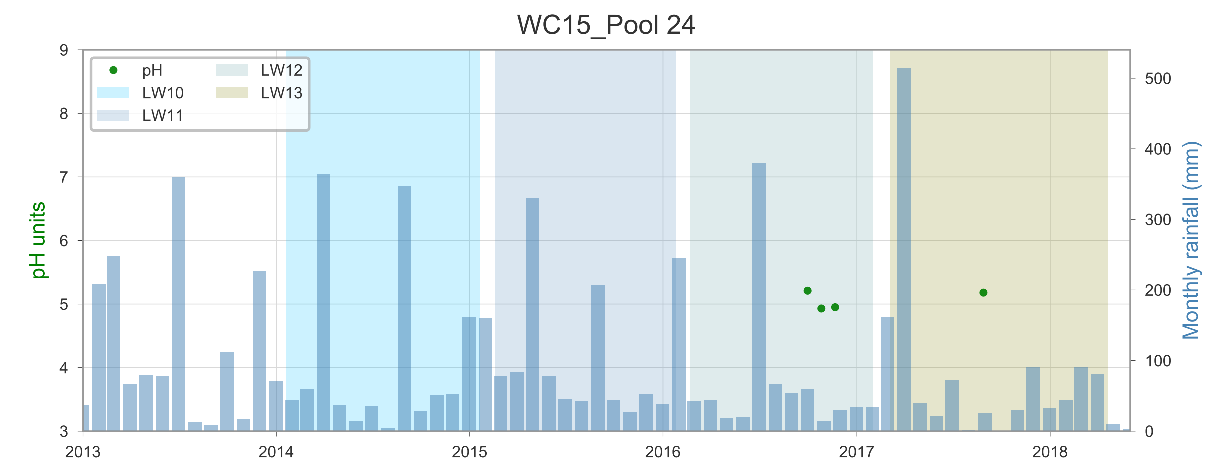

WC15_Pool 9
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
LW10
LW11
LW12
LW13
2013
2014
2015
2016
2017
2018



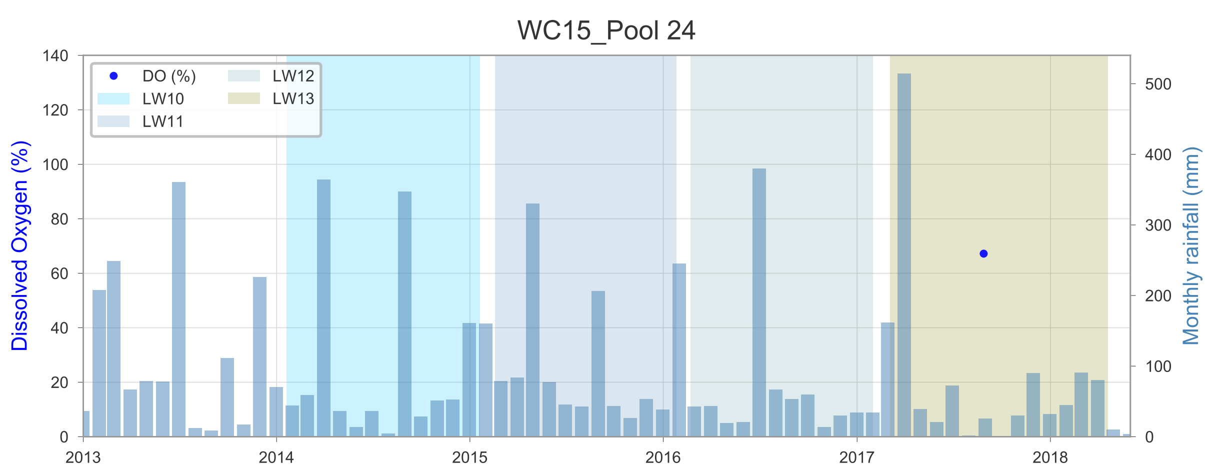
WC15_Pool 24
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018



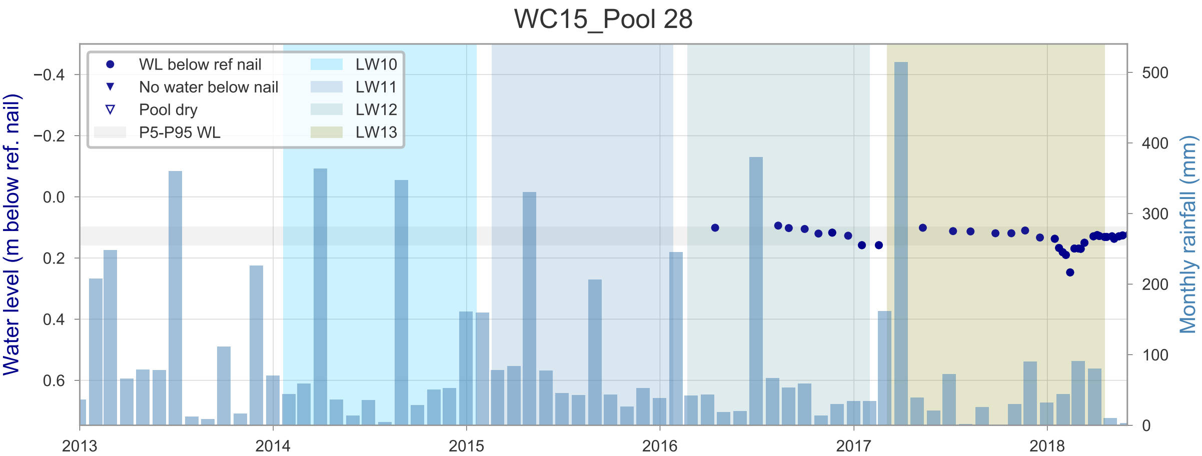
WC15_Pool 24
EC (uS/cm)
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

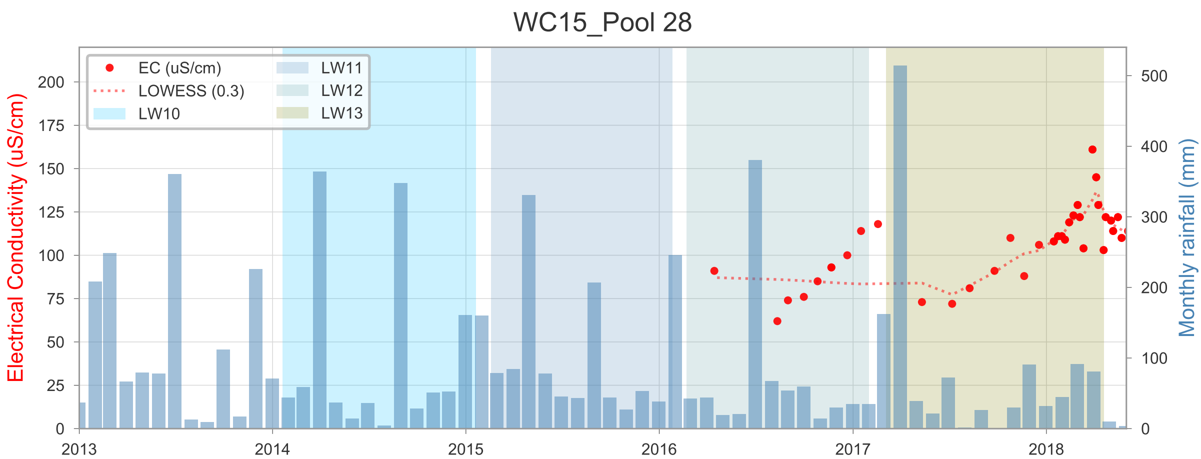


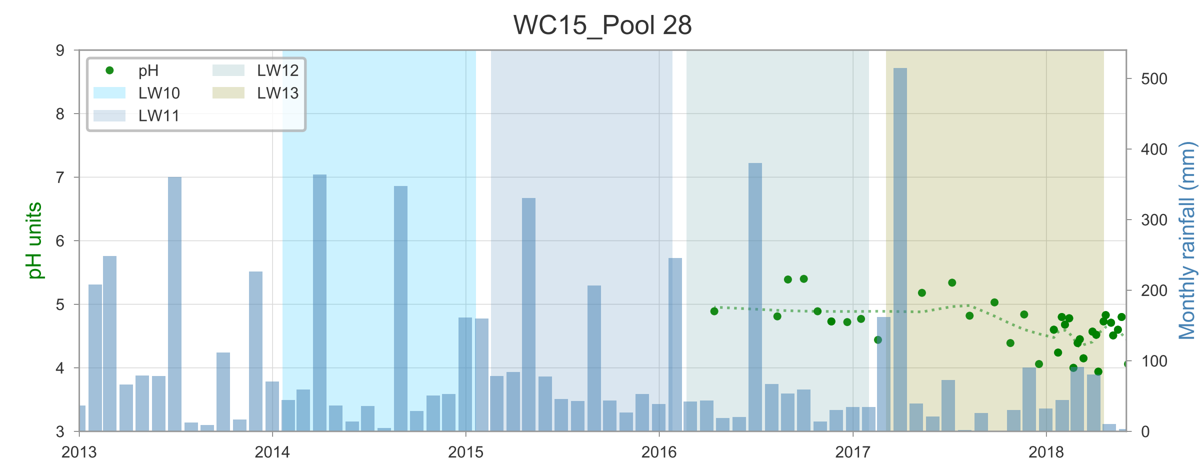
WC15_Pool 24
pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

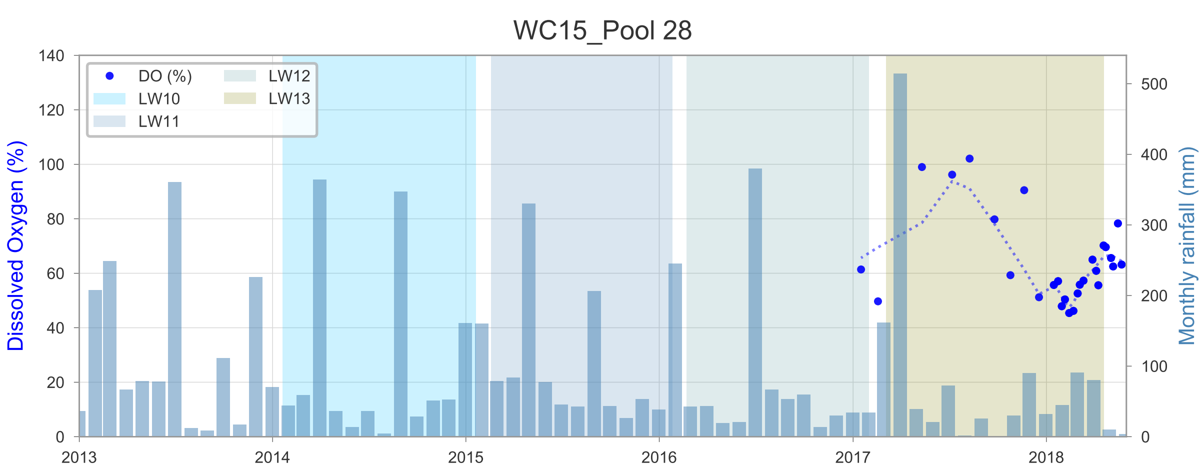


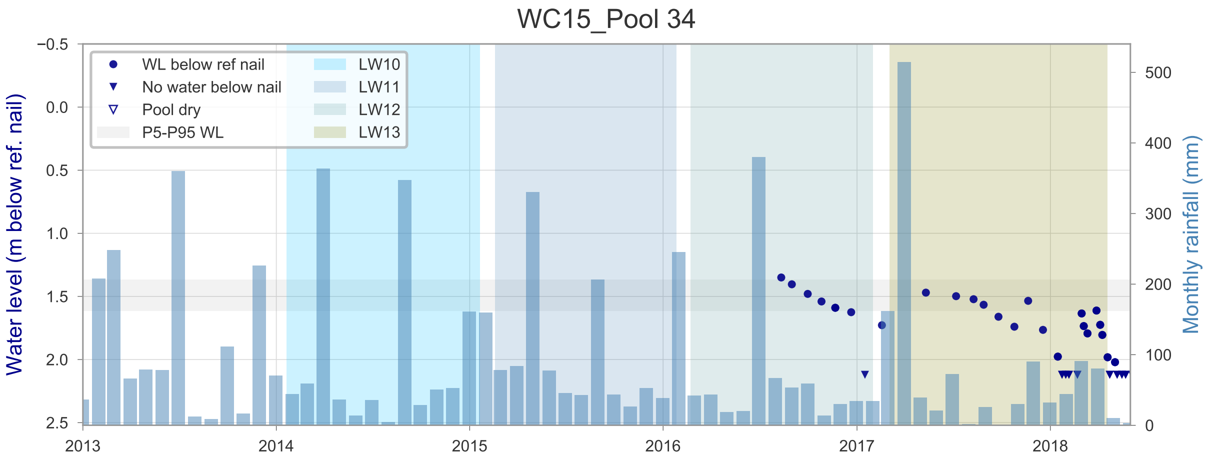
WC15_Pool 24
DO (%)
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018


WC15_Pool 28
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13

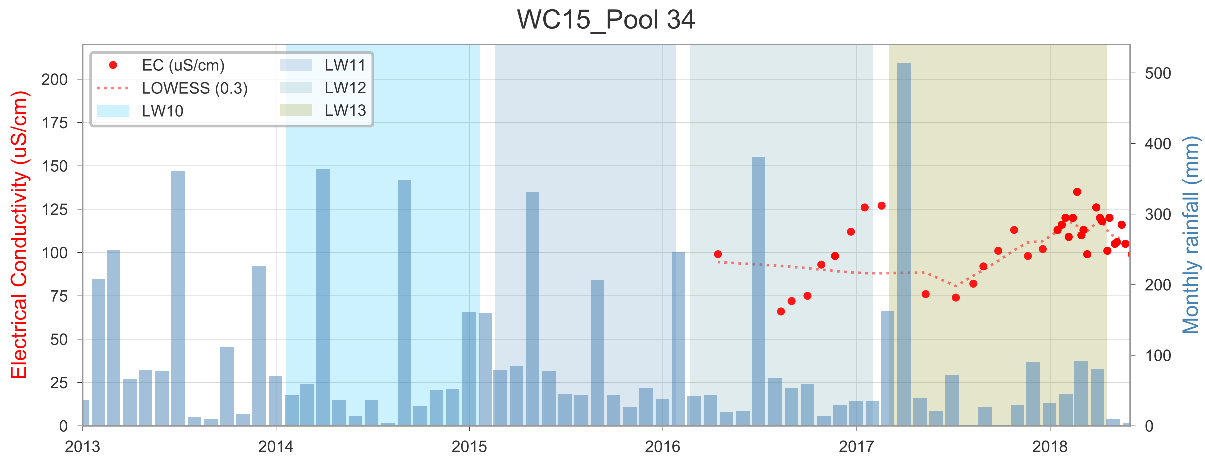

WC15_Pool 28
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
LW10
LW11
LW12
LW13


WC15_Pool 28
pH units
Monthly rainfall (mm)
pH
LW10
LW11
LW12
LW13

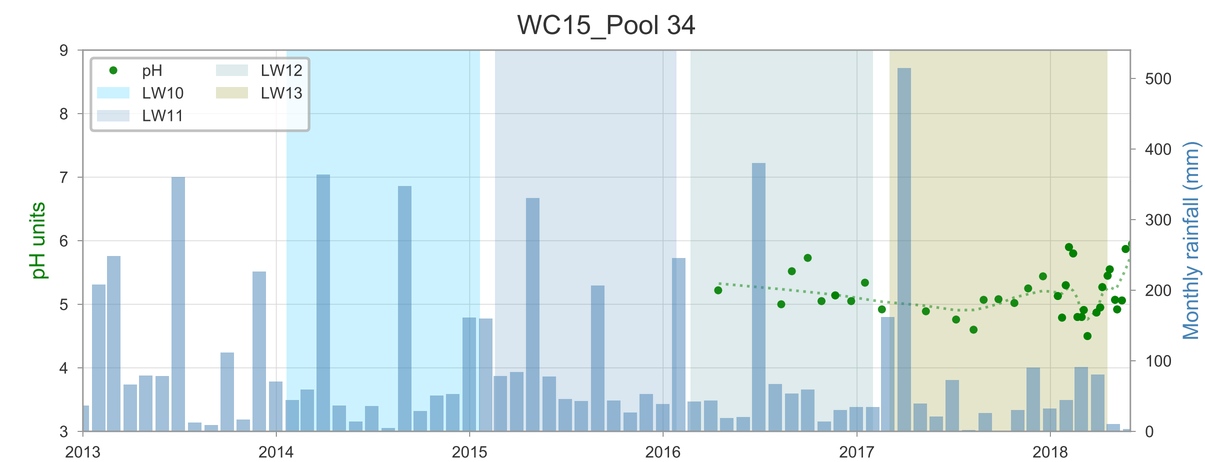

WC15_Pool 28
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
LW10
LW11
LW12
LW13



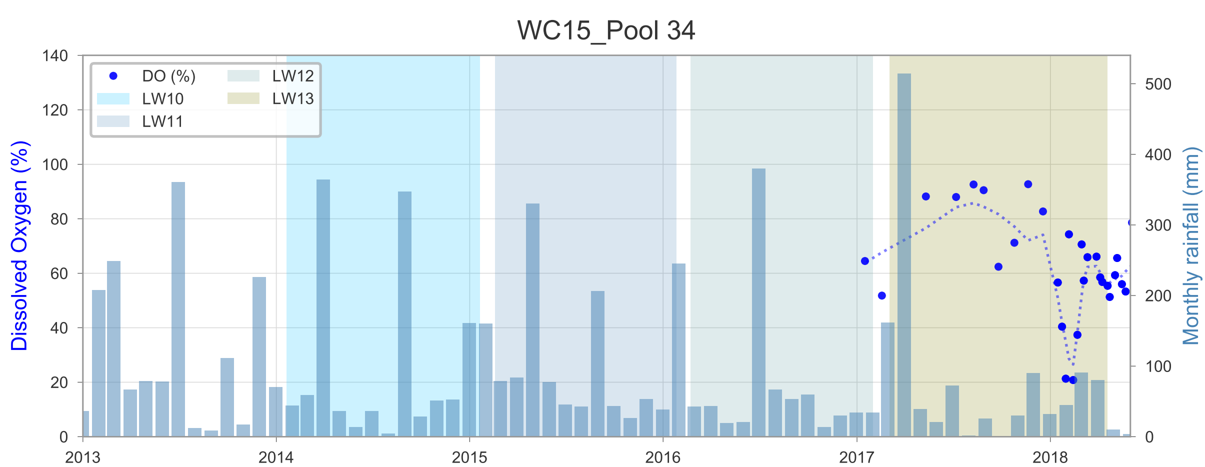
WC15_Pool 34
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)



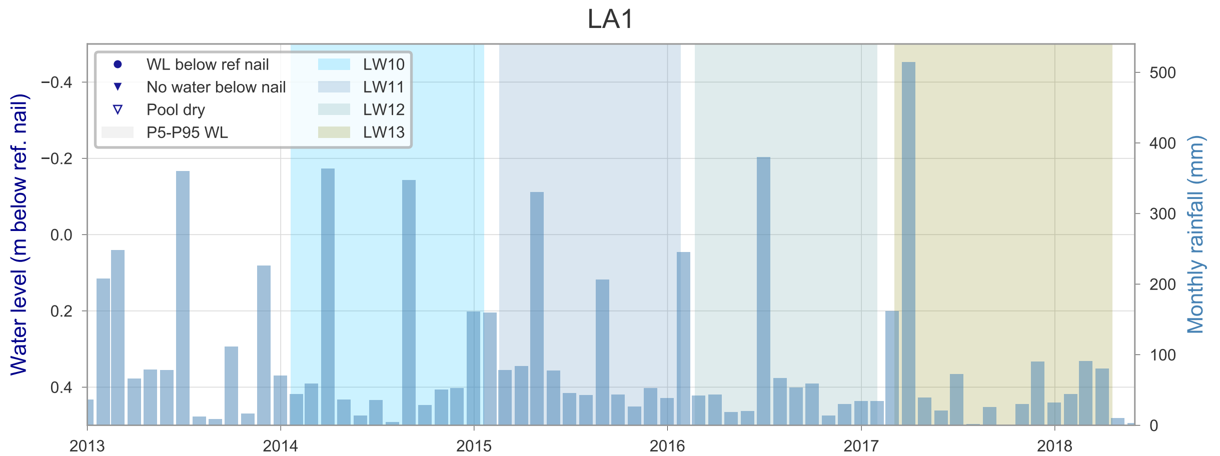
WC15_Pool 34
EC (uS/cm)
LOWESS (0.3)
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)

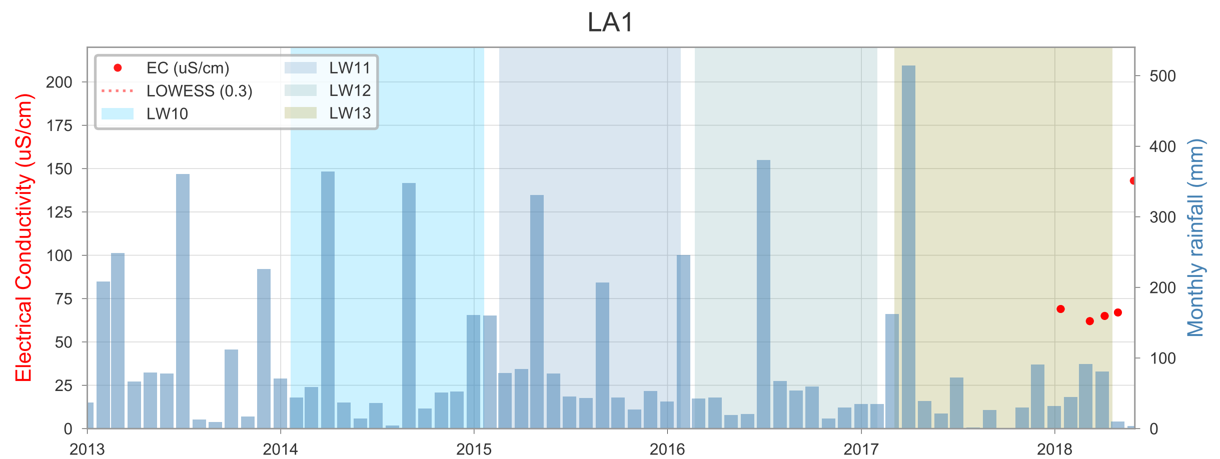


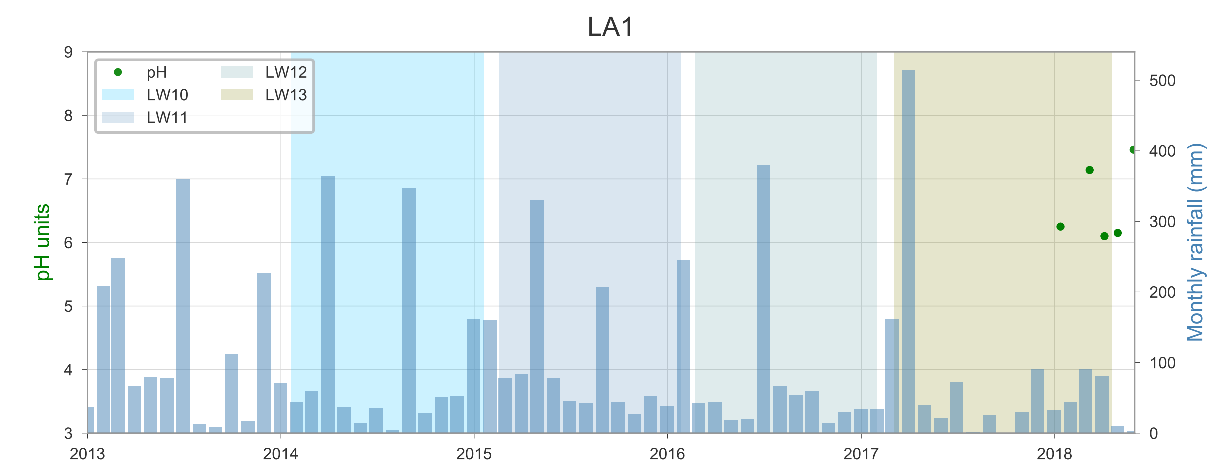
WC15_Pool 34
pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)

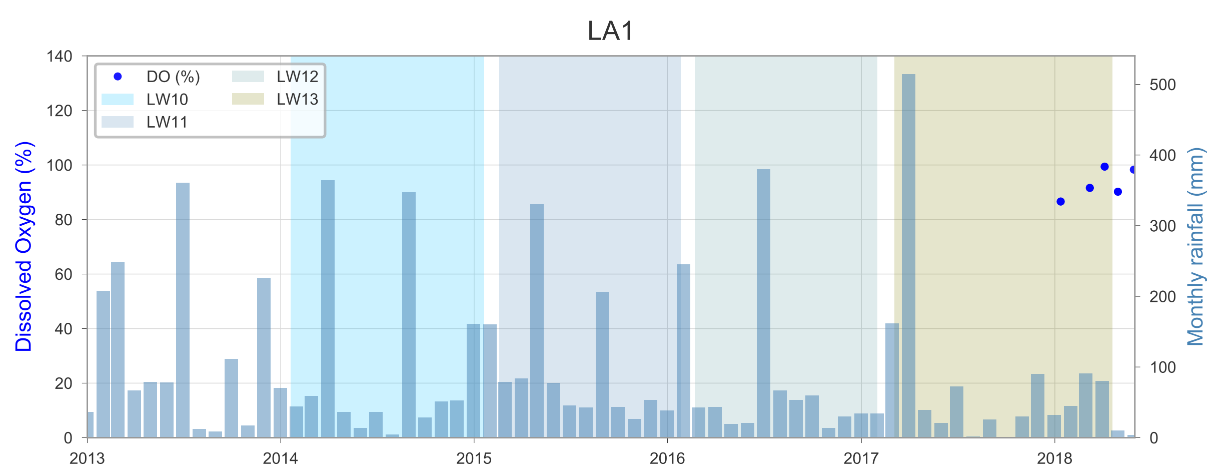


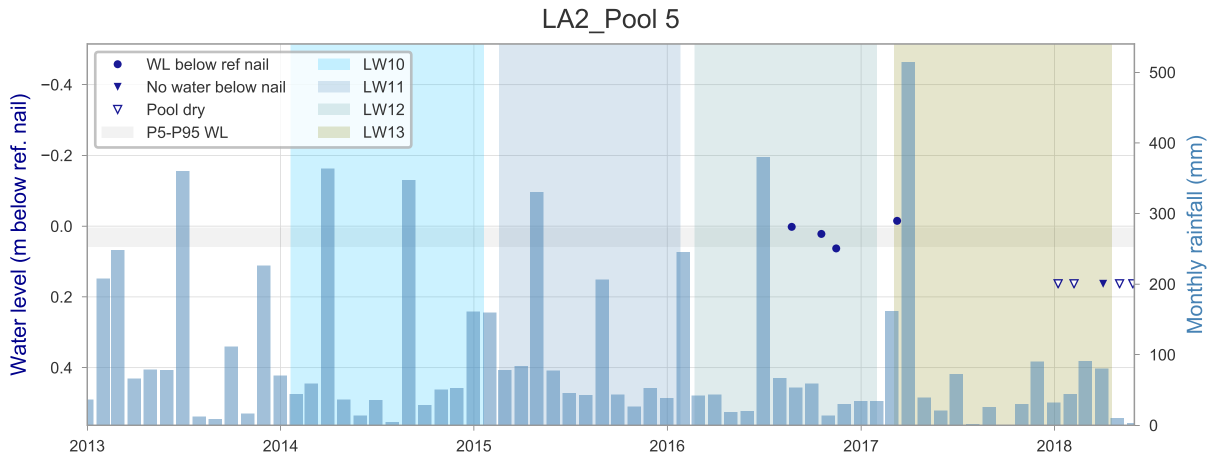
WC15_Pool 34
DO (%)
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)


LA1
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

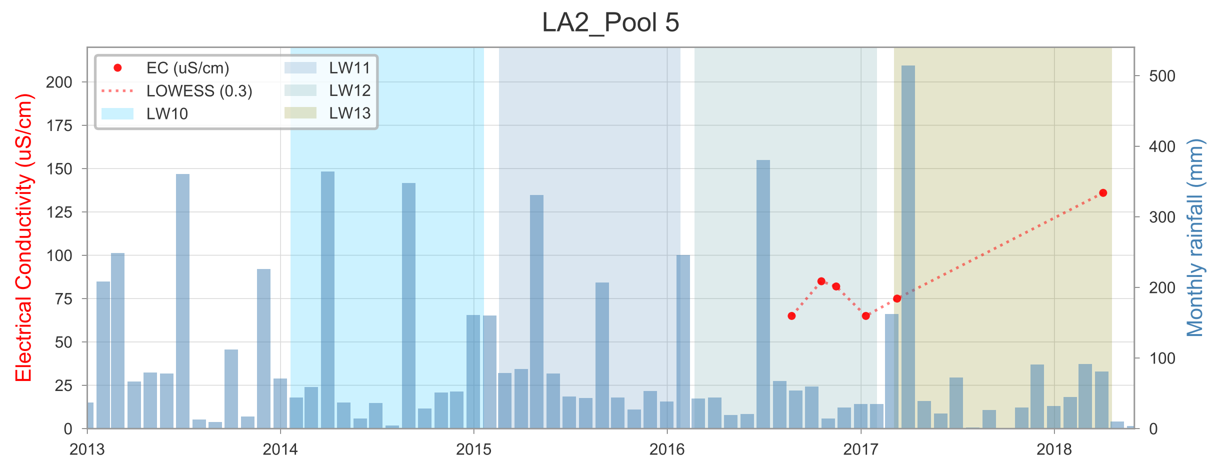

LA1
EC (uS/cm)
LOWESS (0.3)
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018


LA1
pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

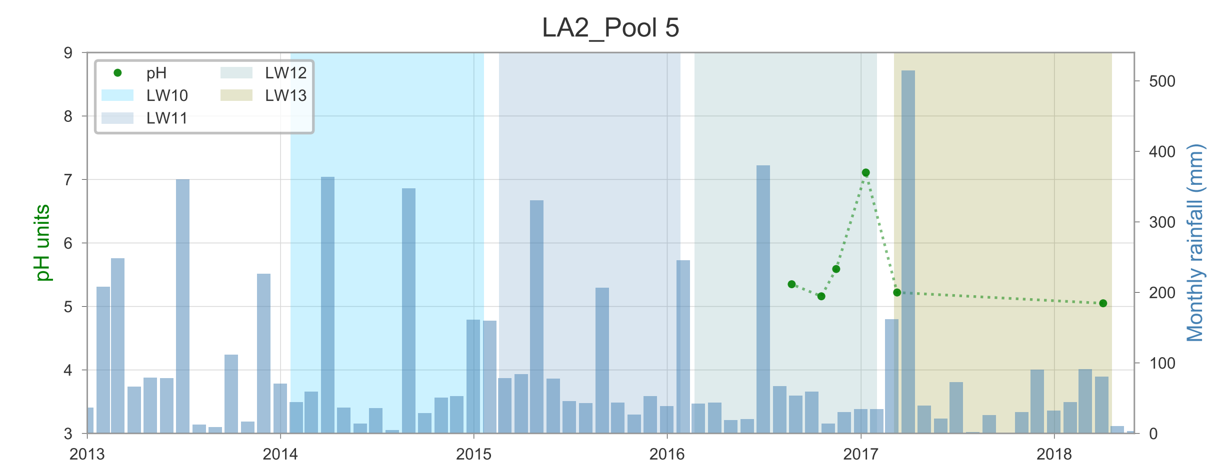

LA1
DO (%)
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018



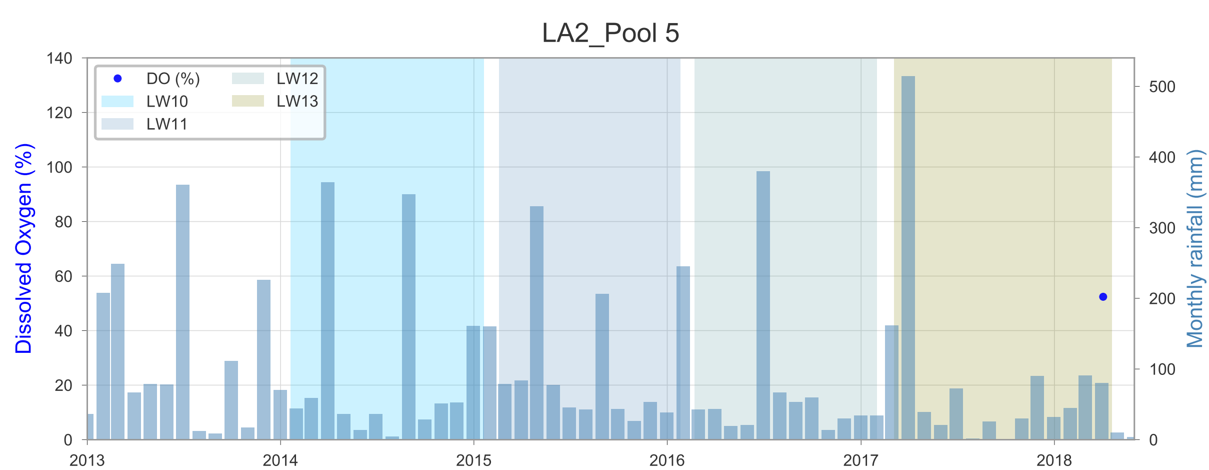
LA2_Pool 5
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)



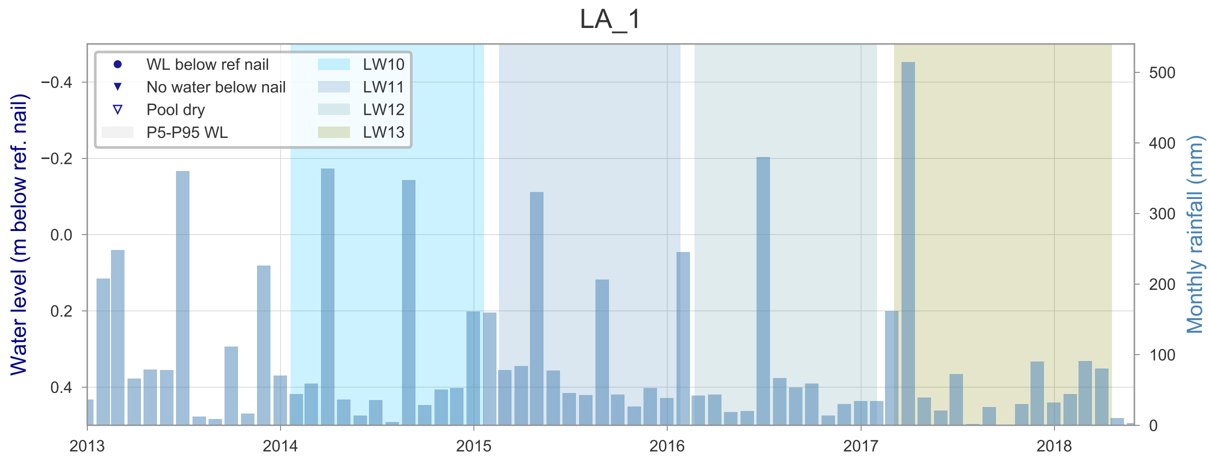
LA2_Pool 5
EC (uS/cm)
LOWESS (0.3)
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)

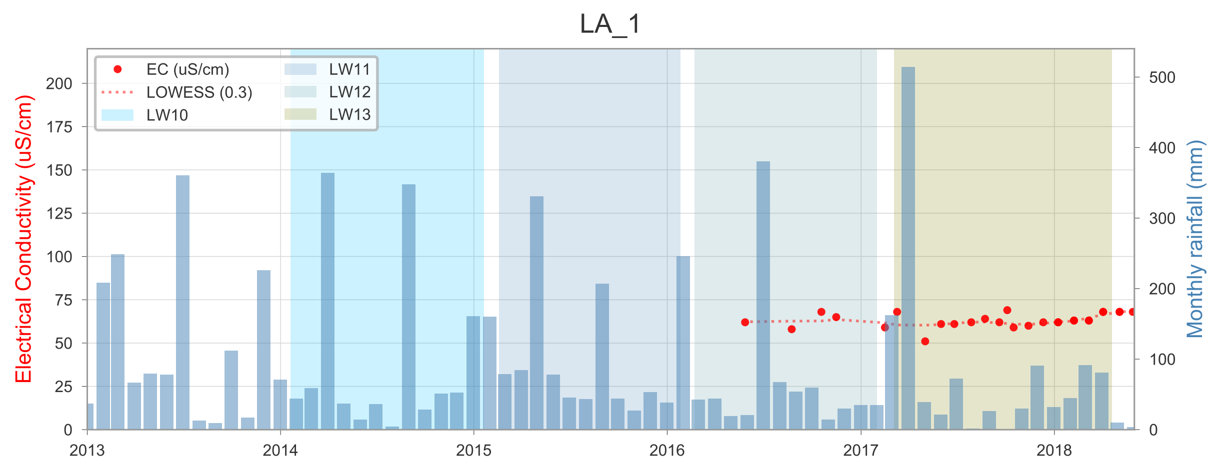


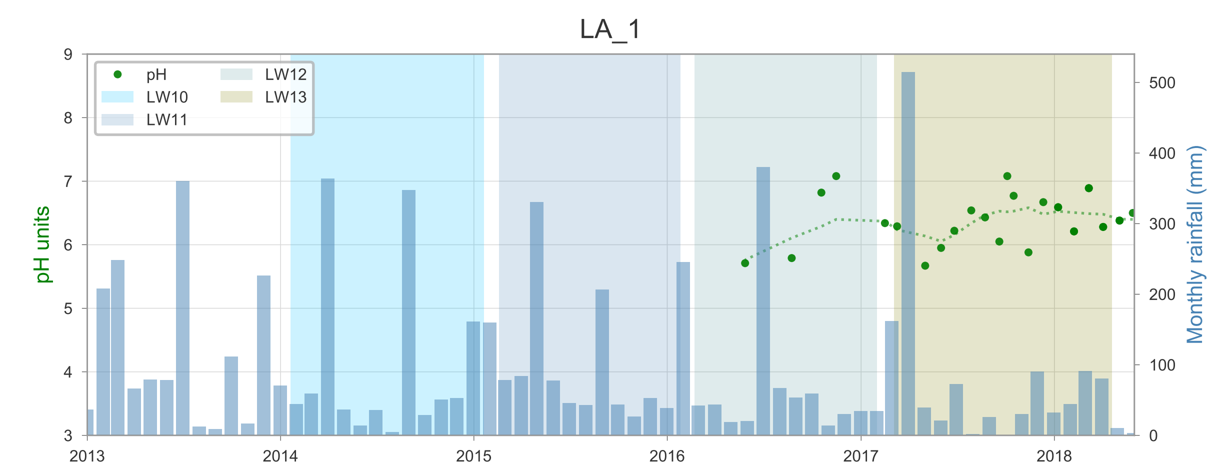
LA2_Pool 5
pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)

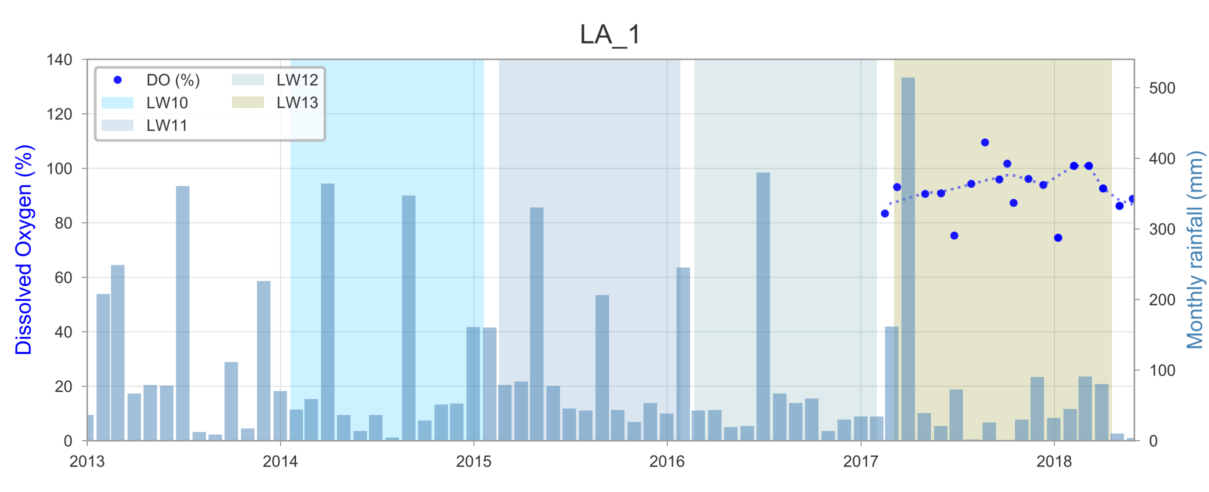


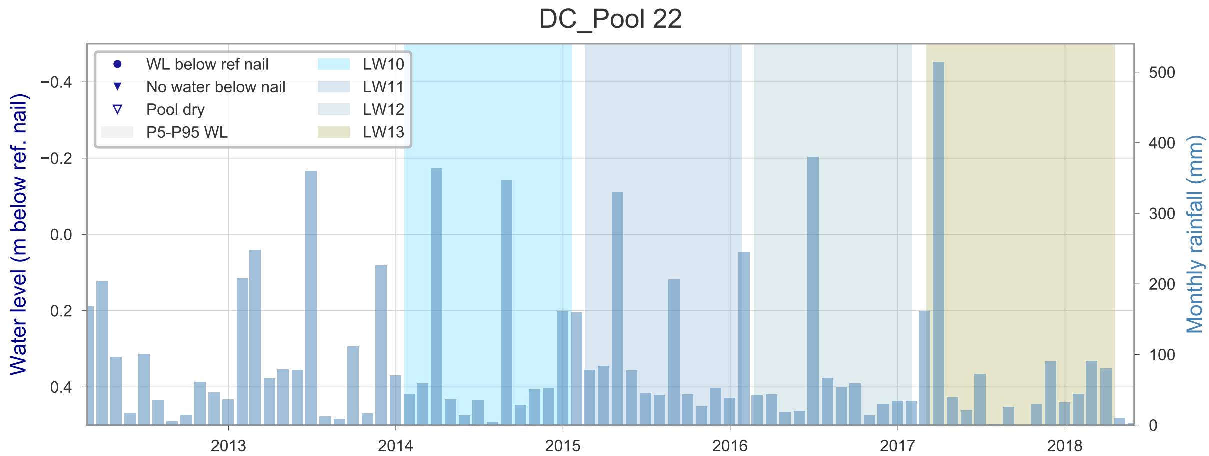
LA2_Pool 5
DO (%)
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)

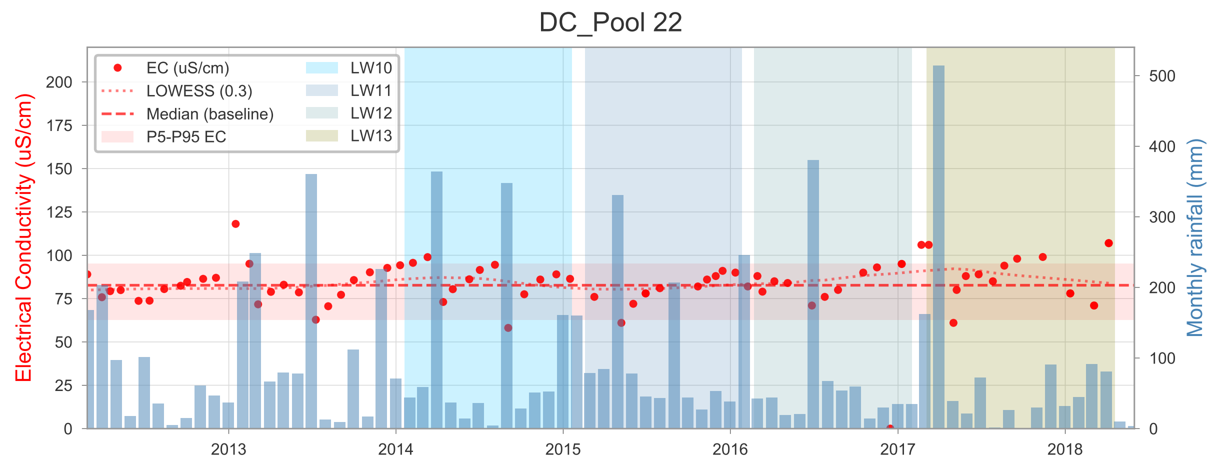

LA_1
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

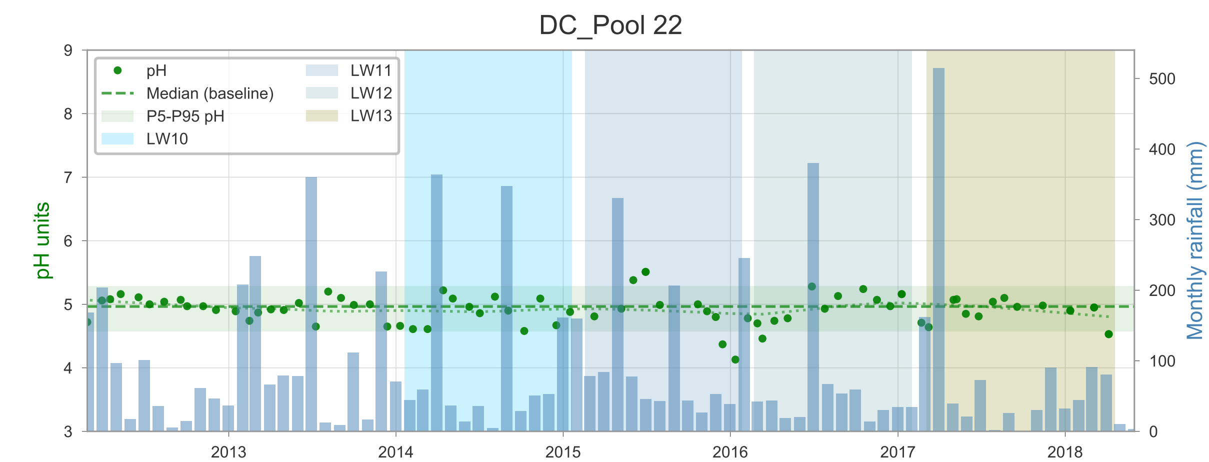

LA_1
EC (uS/cm)
LOWESS (0.3)
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

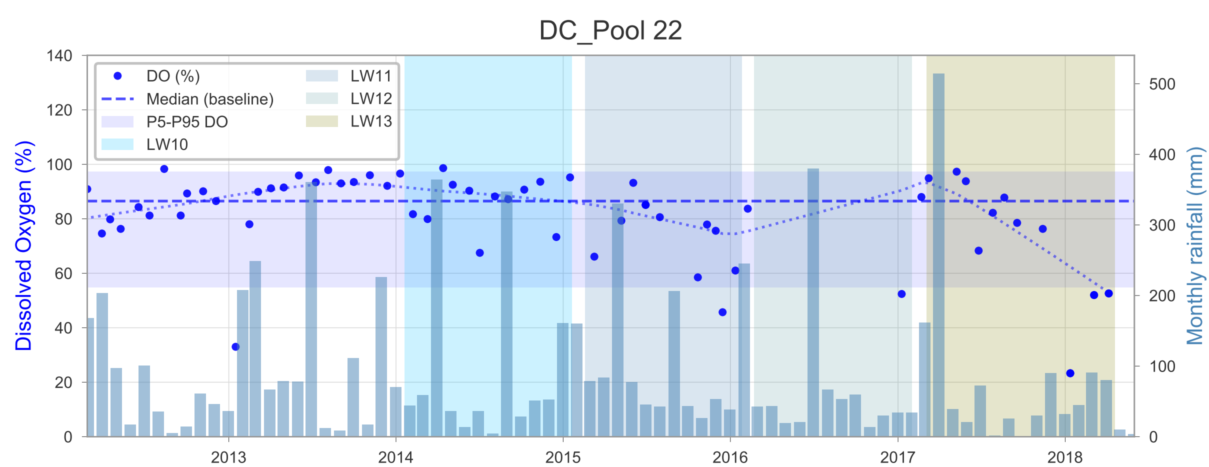

LA_1
pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

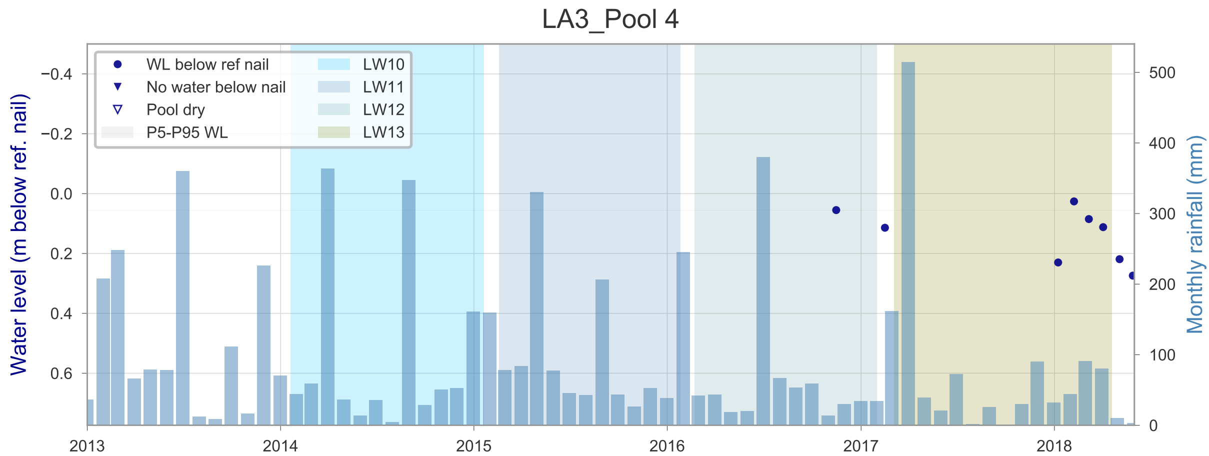

LA_1
DO (%)
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018


DC_Pool 22
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

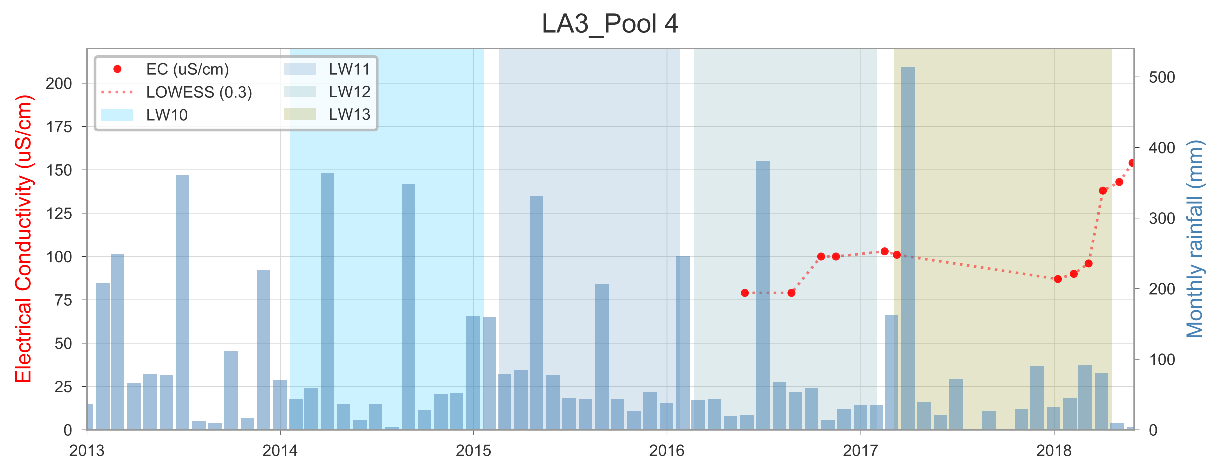

DC_Pool 22
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018


DC_Pool 22
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

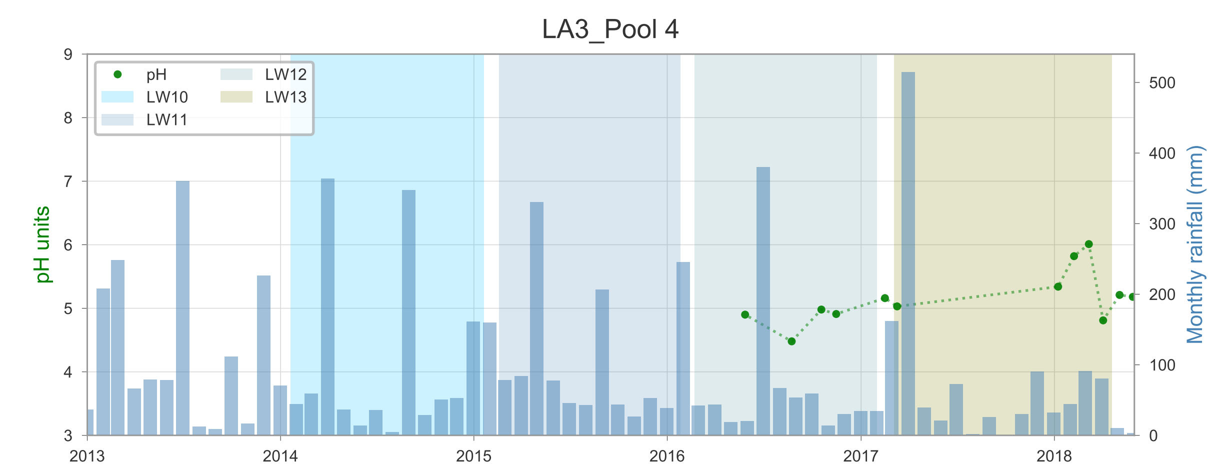

DC_Pool 22
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018



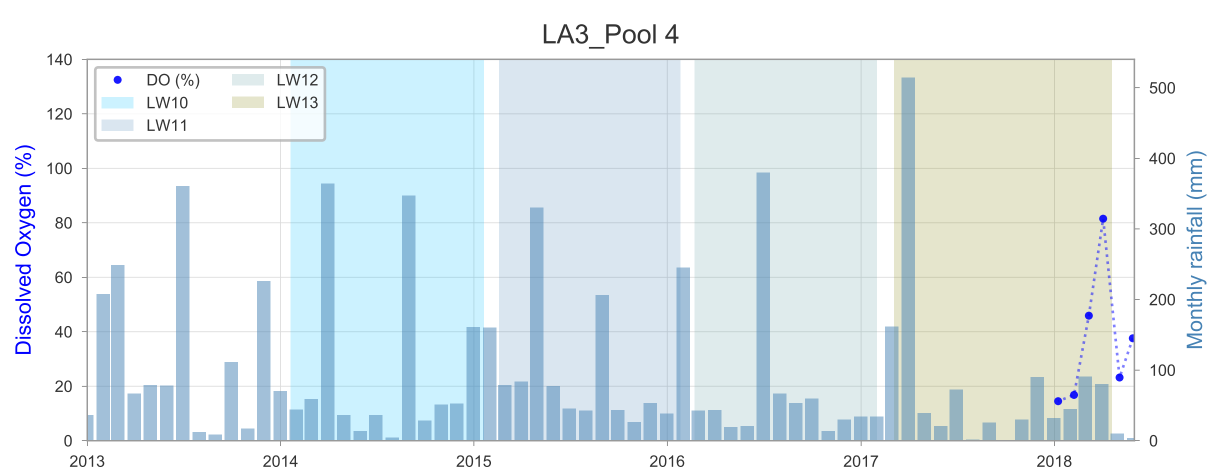
LA3_Pool 4
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
−0.4
−0.2
0.0
0.2
0.4
0.6
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018



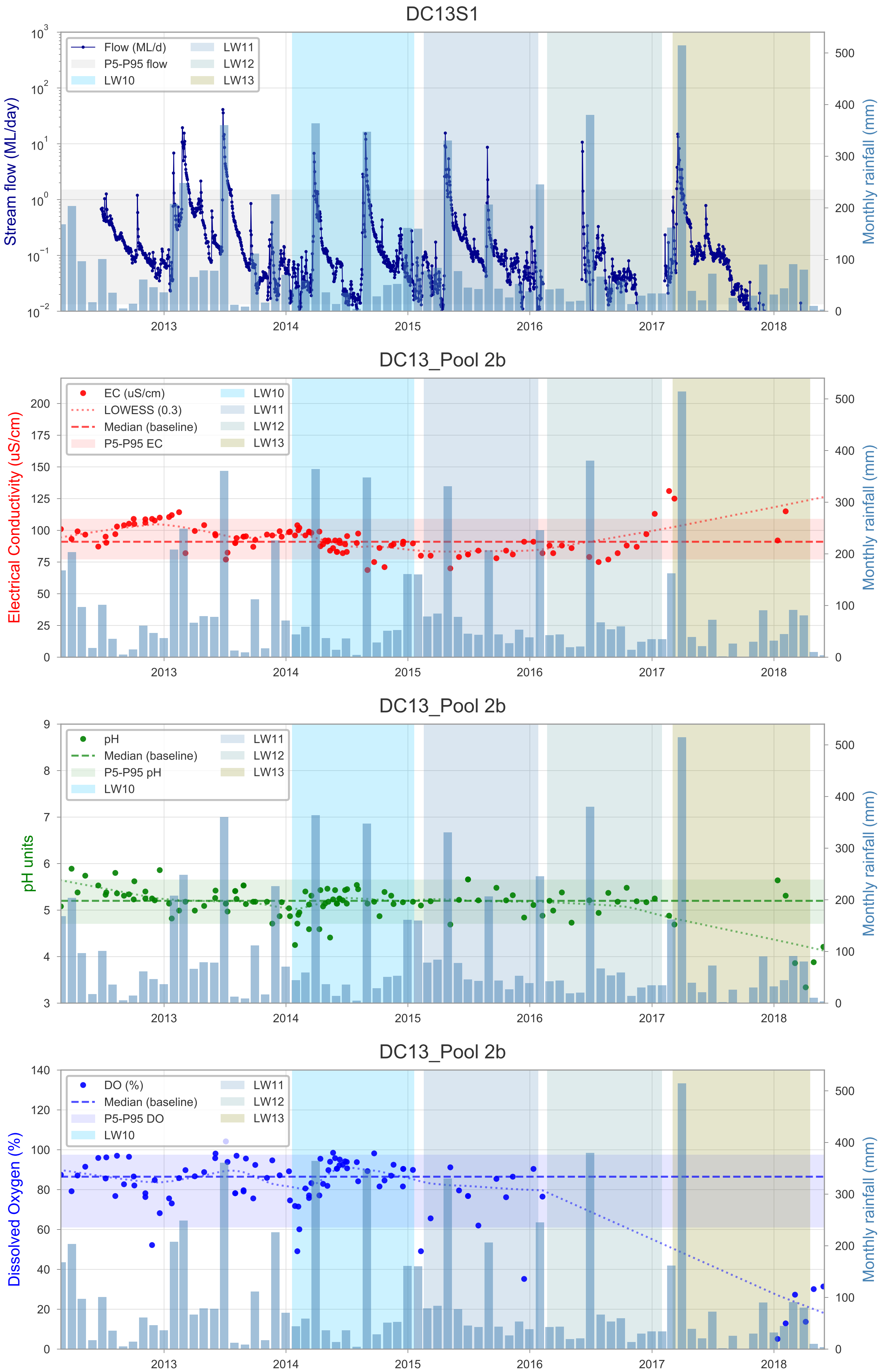
LA3_Pool 4
EC (uS/cm)
LOWESS (0.3)
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

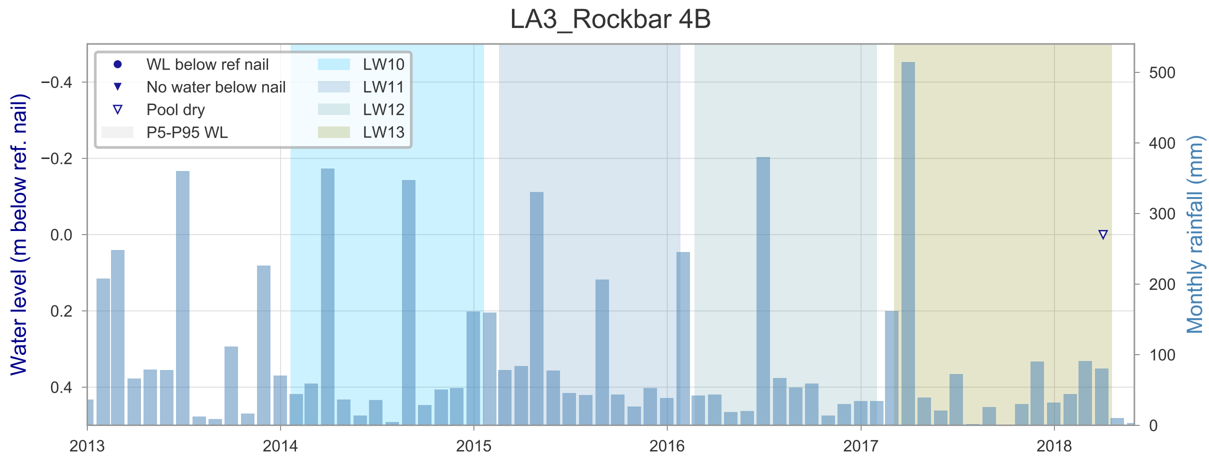


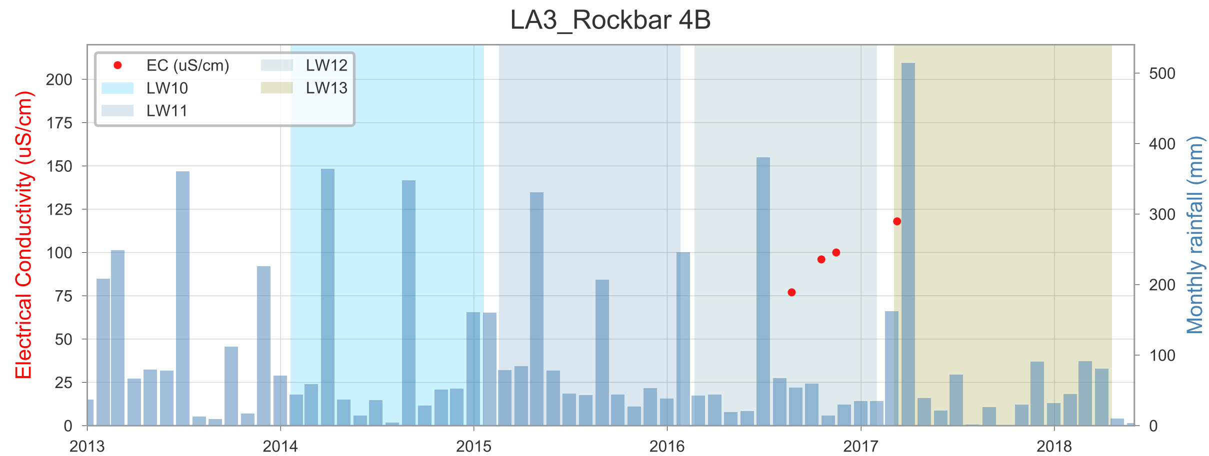
LA3_Pool 4
pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
3
4
5
6
7
8
9
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

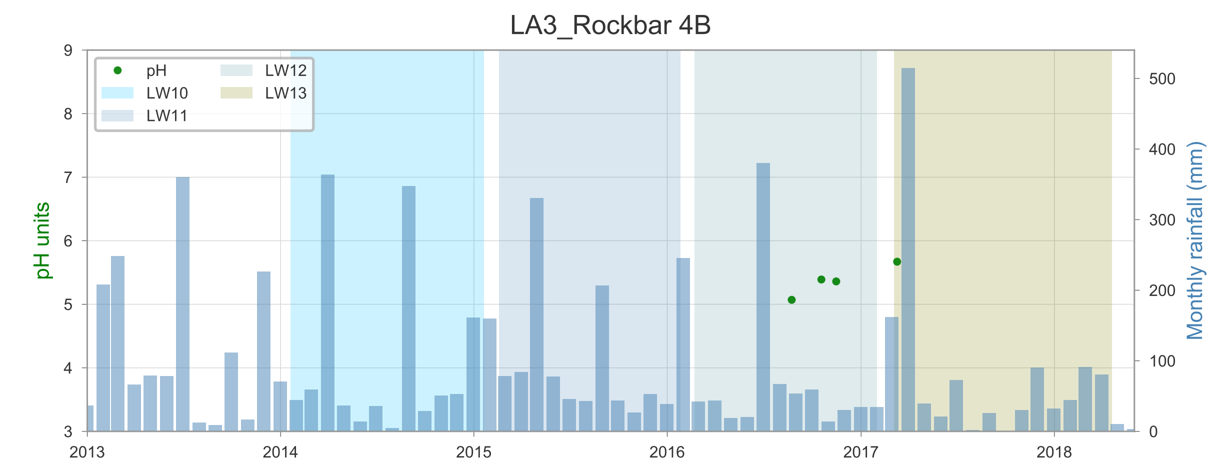


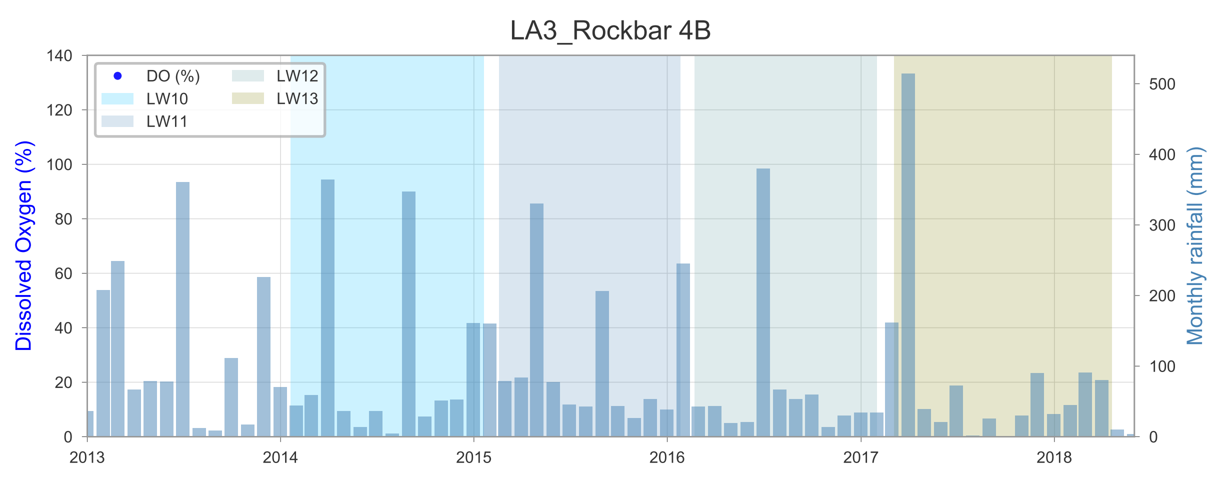
LA3_Pool 4
DO (%)
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

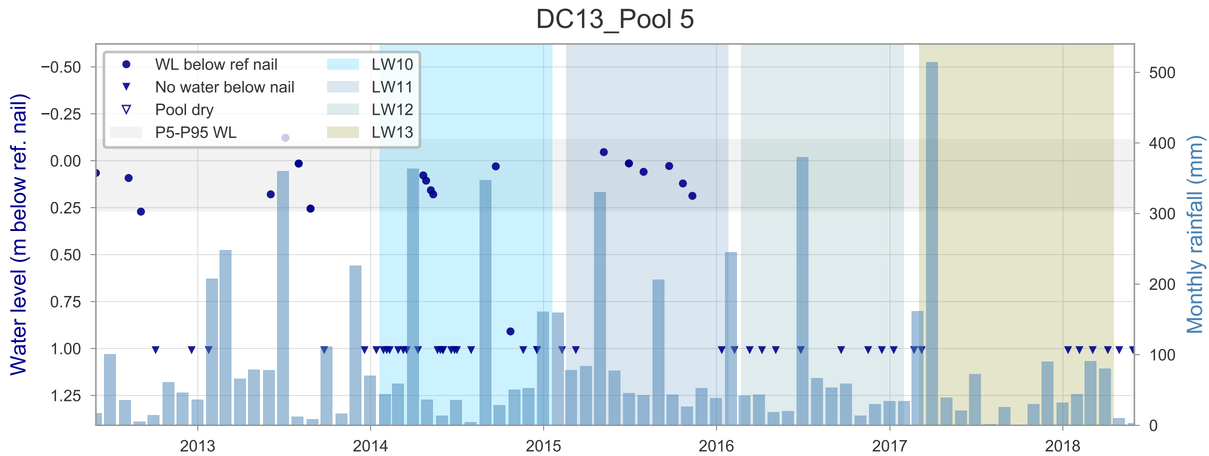

DC13S1
Flow (ML/d)
P5-P95 flow
LW10
LW11
LW12
LW13
Stream flow (ML/day)
Monthly rainfall (mm)
DC13_Pool 2b
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
Electrical Conductivity (uS/cm)
DC13_Pool 2b
pH
Median (baseline)
P5-P95 pH
pH units
DC13_Pool 2b
DO (%)
Median (baseline)
P5-P95 DO
Dissolved Oxygen (%)
2013
2014
2015
2016
2017
2018

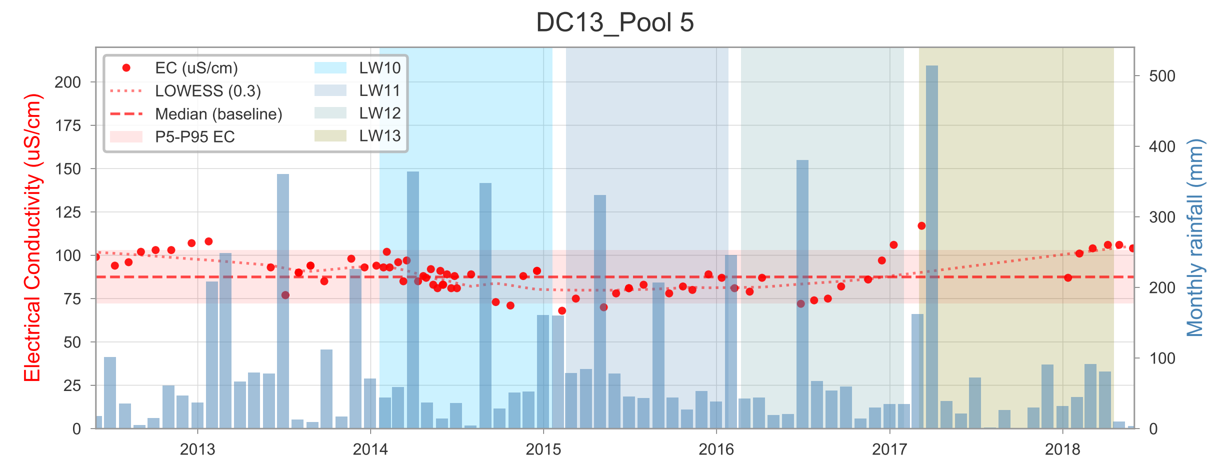

LA3_Rockbar 4B
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)

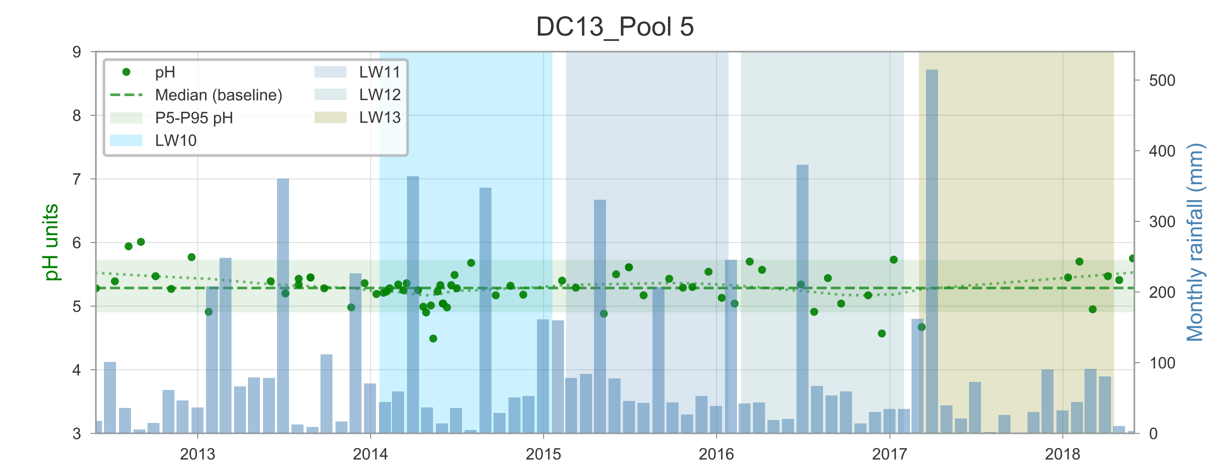

LA3_Rockbar 4B
EC (uS/cm)
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)

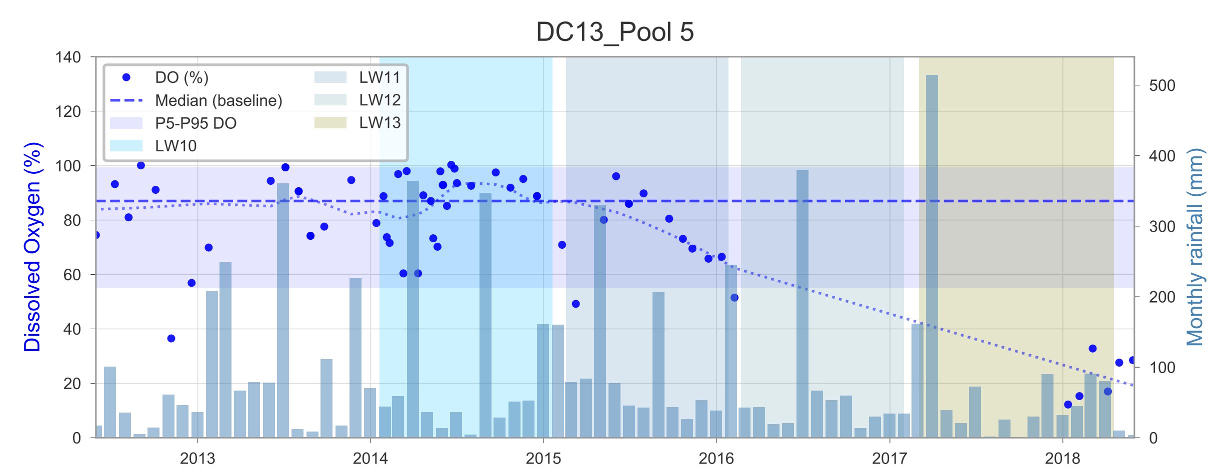

LA3_Rockbar 4B
pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)

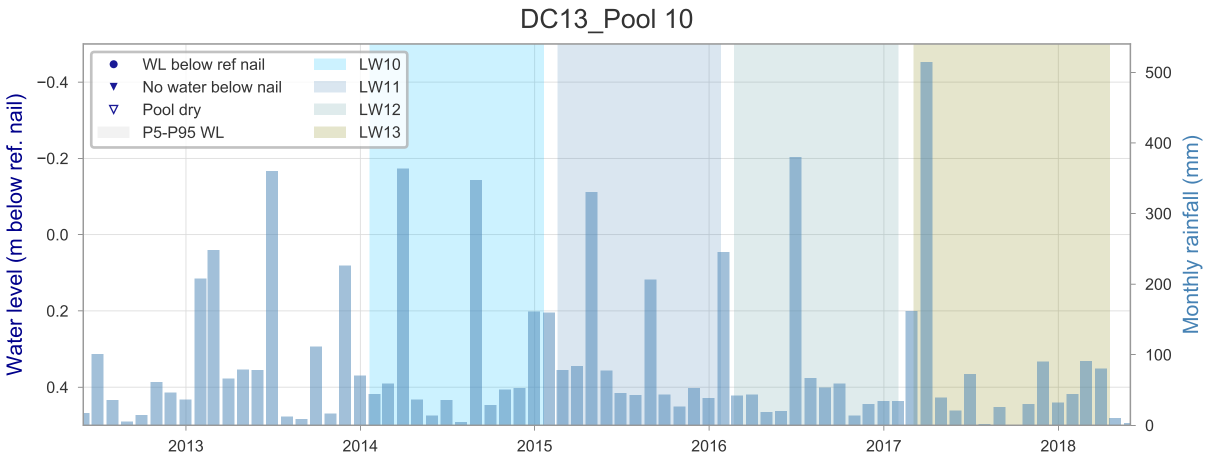

LA3_Rockbar 4B
DO (%)
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)

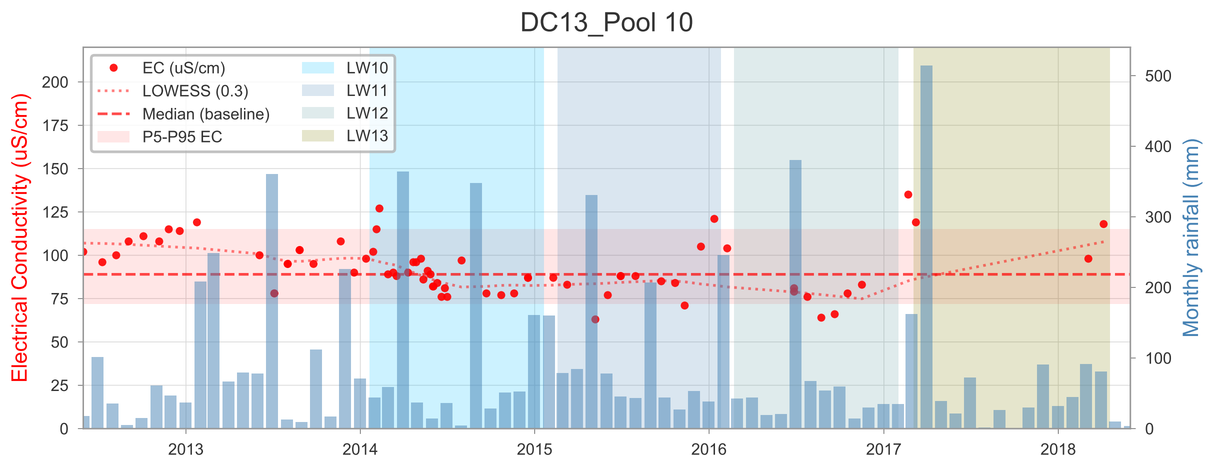

DC13_Pool 5
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

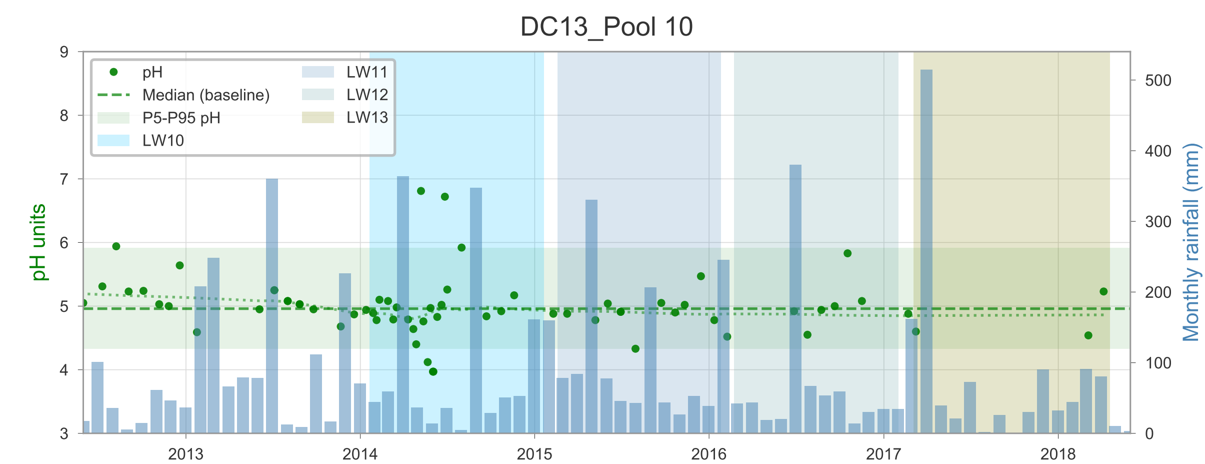

DC13_Pool 5
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

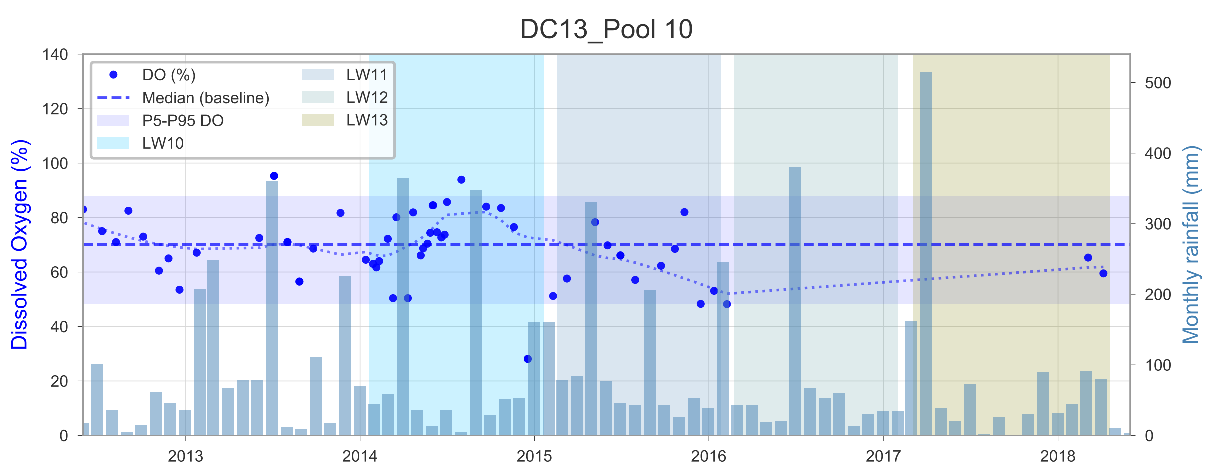

DC13_Pool 5
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

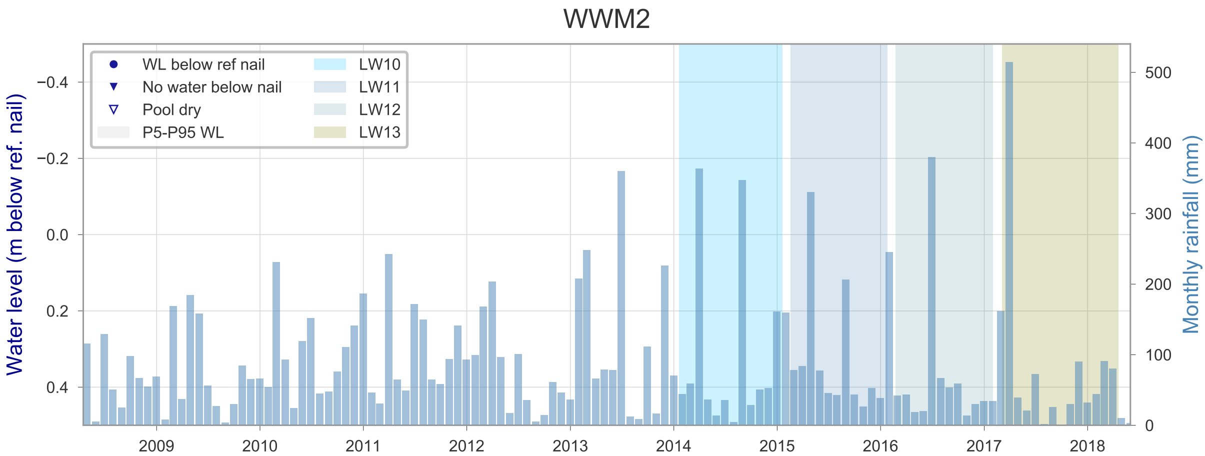

DC13_Pool 5
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

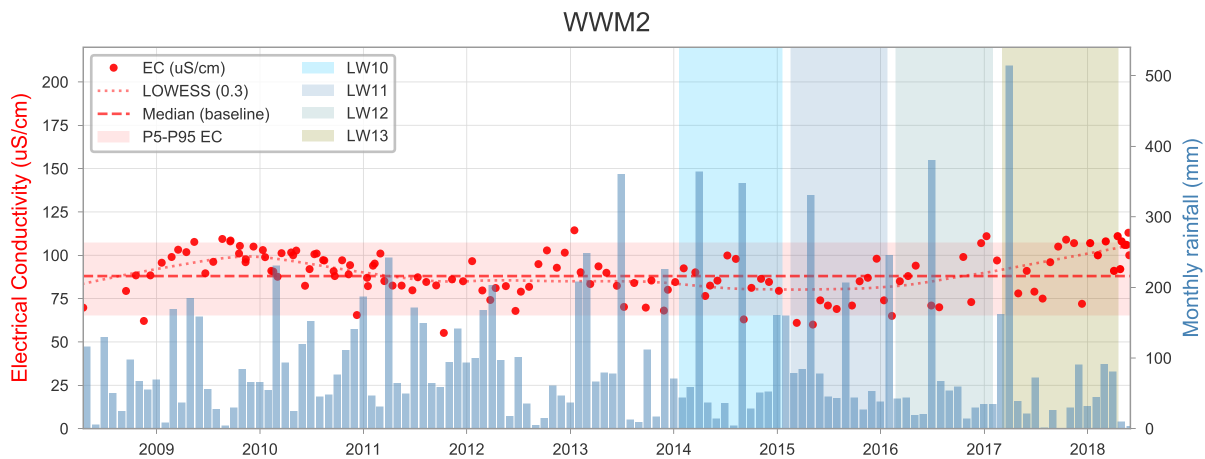

DC13_Pool 10
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
-0.4
-0.2
0.0
0.2
0.4
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

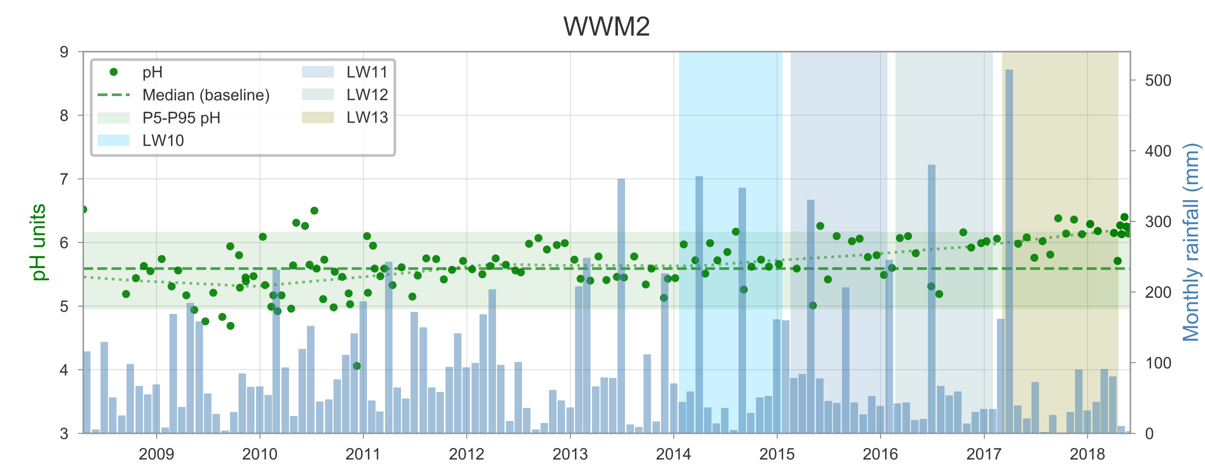

DC13_Pool 10
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

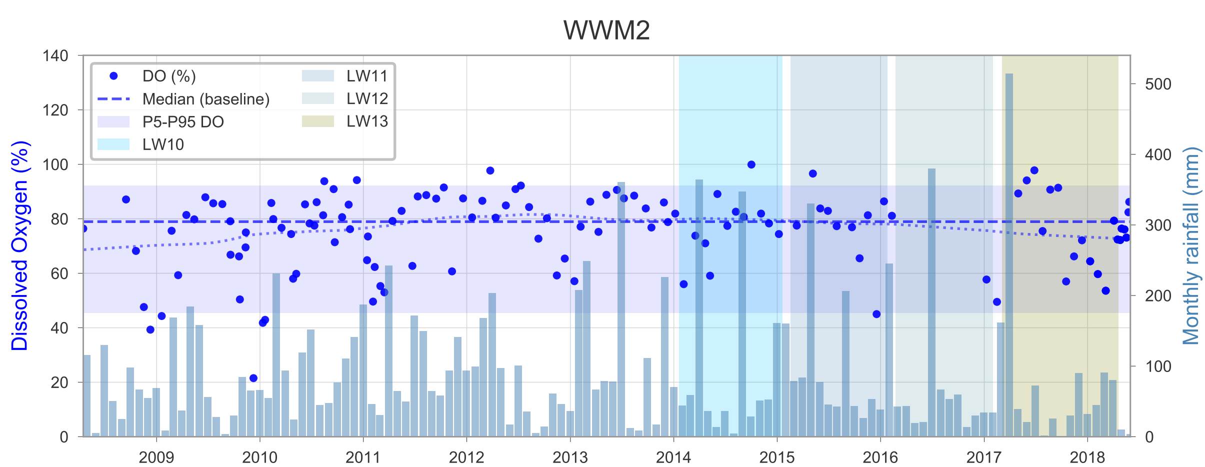

DC13_Pool 10
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
3
4
5
6
7
8
9
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

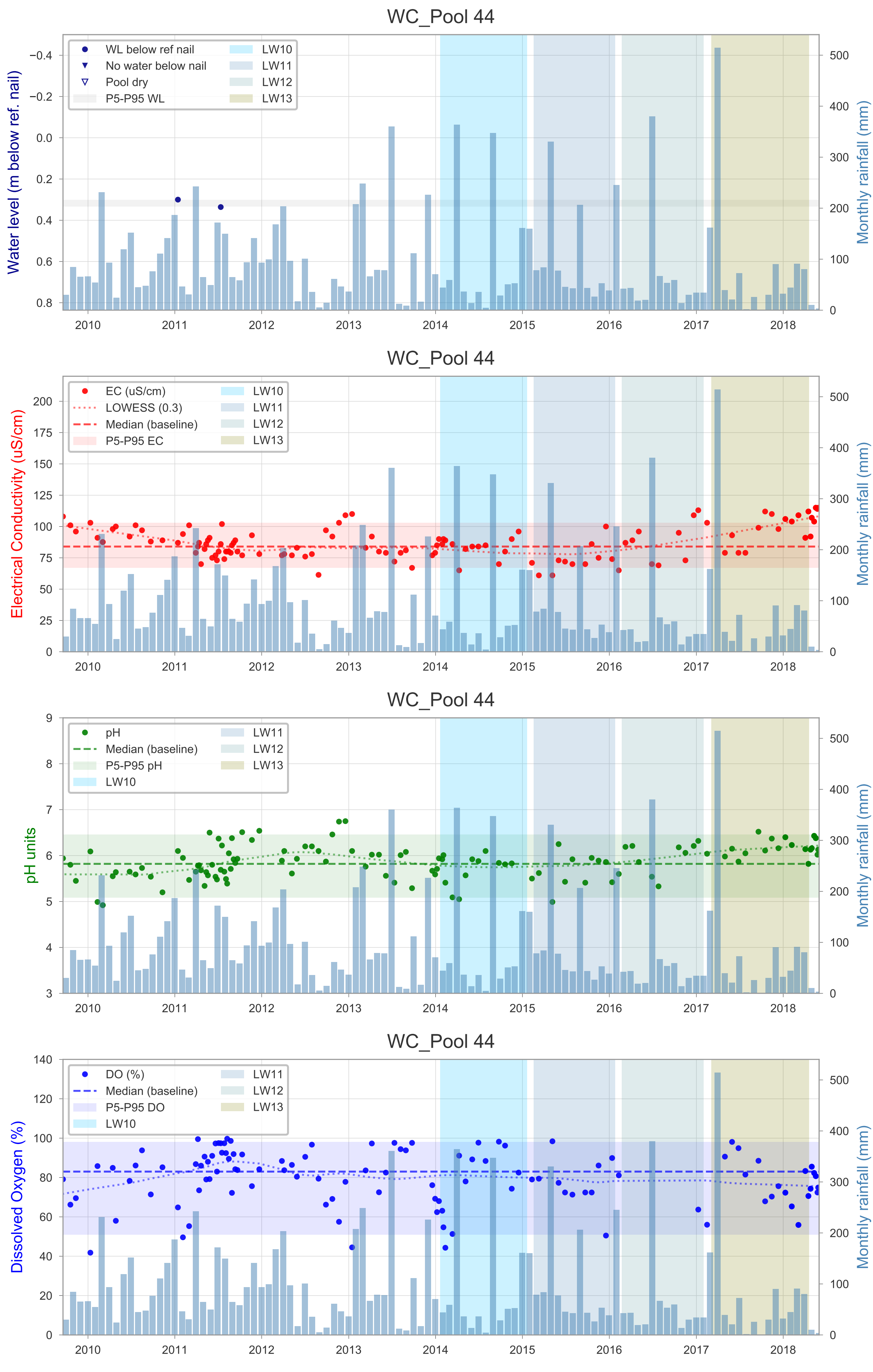

DC13_Pool 10
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018


WWM2
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13

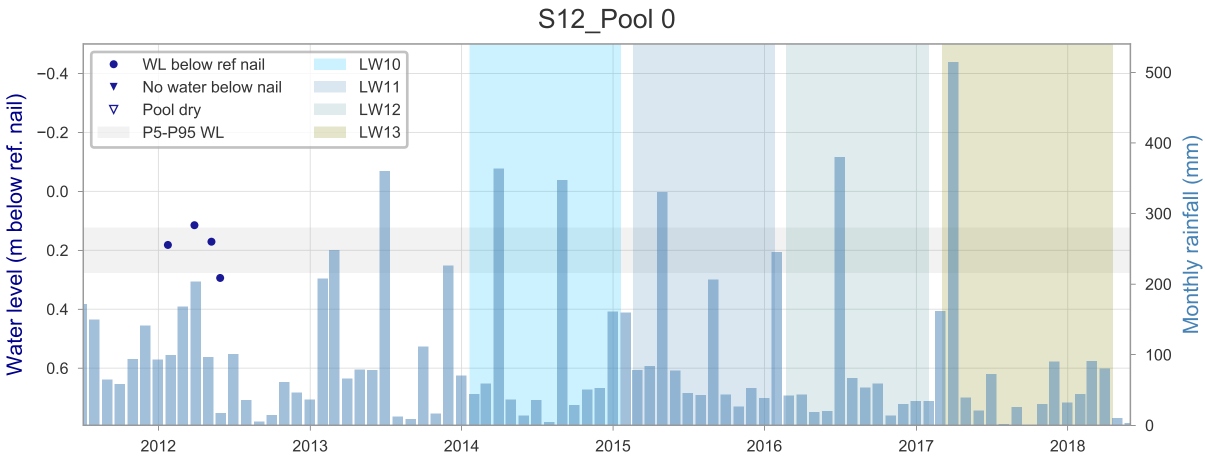

WWM2
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13

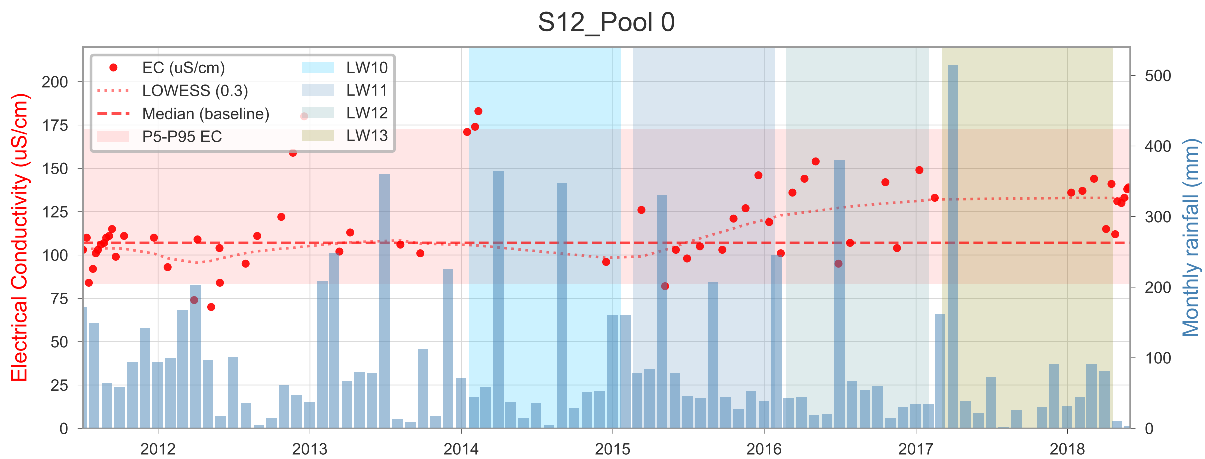

WWM2
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13

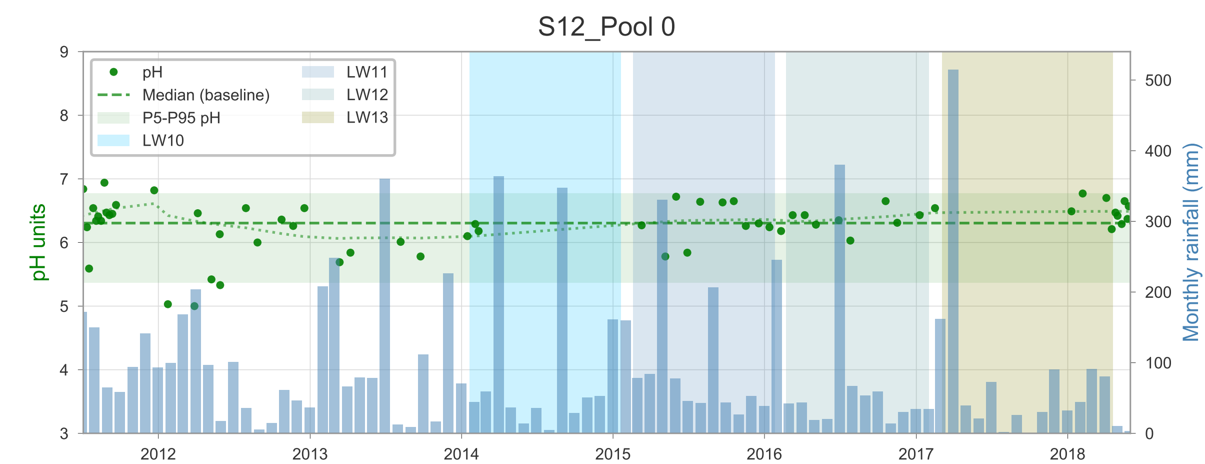

WWM2
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13

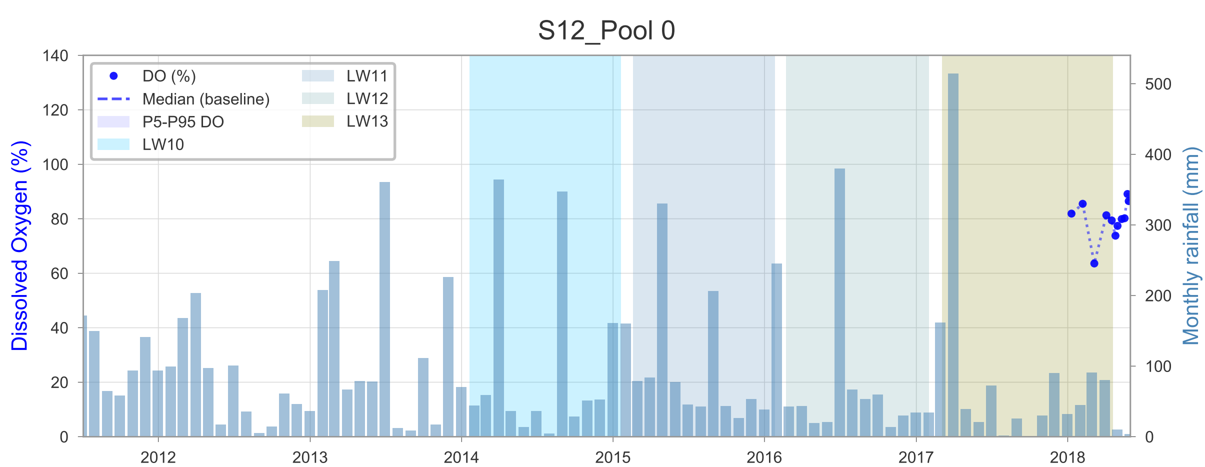


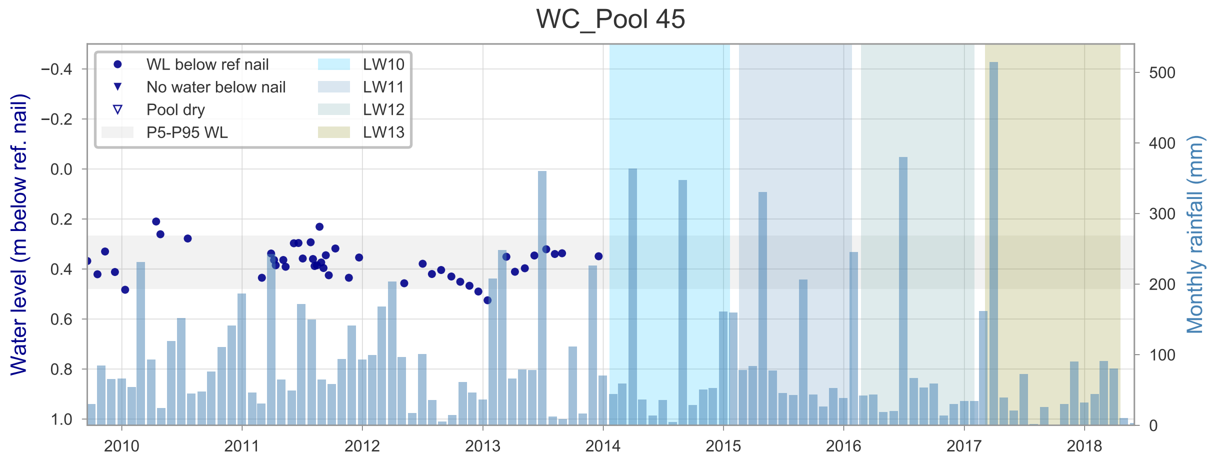
WC_Pool 44
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
WC_Pool 44
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
Electrical Conductivity (uS/cm)
WC_Pool 44
pH
Median (baseline)
P5-P95 pH
pH units
WC_Pool 44
DO (%)
Median (baseline)
P5-P95 DO
Dissolved Oxygen (%)

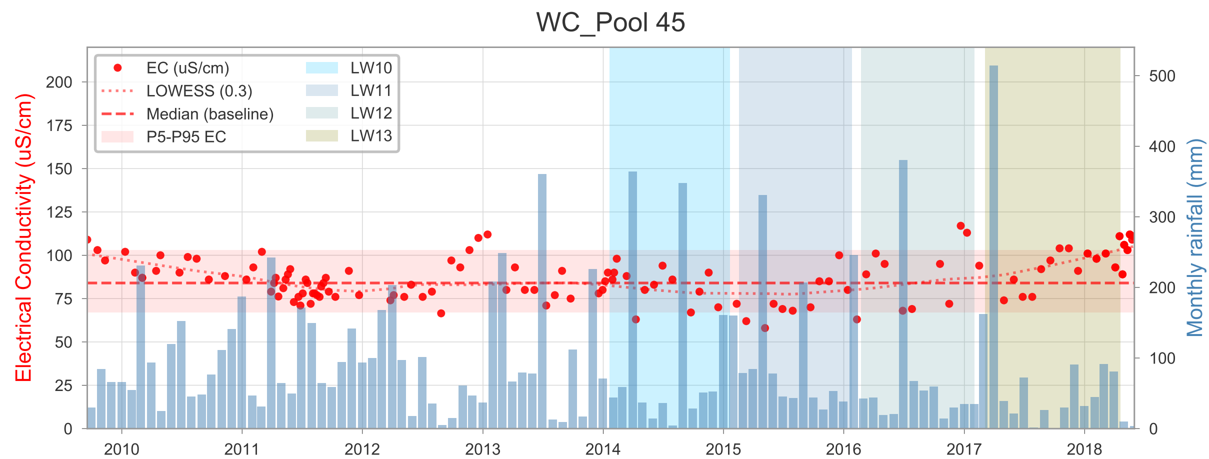

S12_Pool 0
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
−0.4
−0.2
0.0
0.2
0.4
0.6
0
100
200
300
400
500
2012
2013
2014
2015
2016
2017
2018

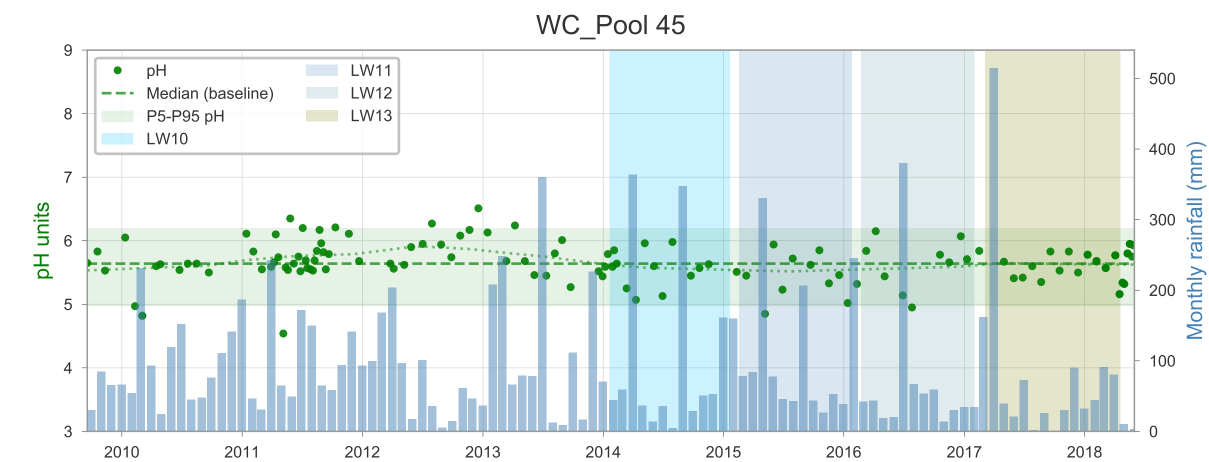

S12_Pool 0
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2012
2013
2014
2015
2016
2017
2018

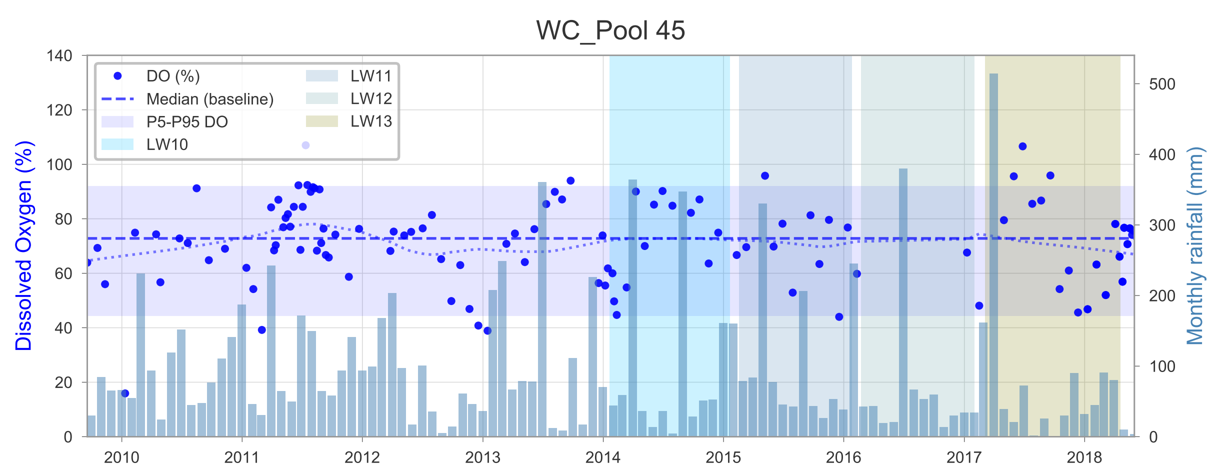

S12_Pool 0
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
3
4
5
6
7
8
9
0
100
200
300
400
500
2012
2013
2014
2015
2016
2017
2018

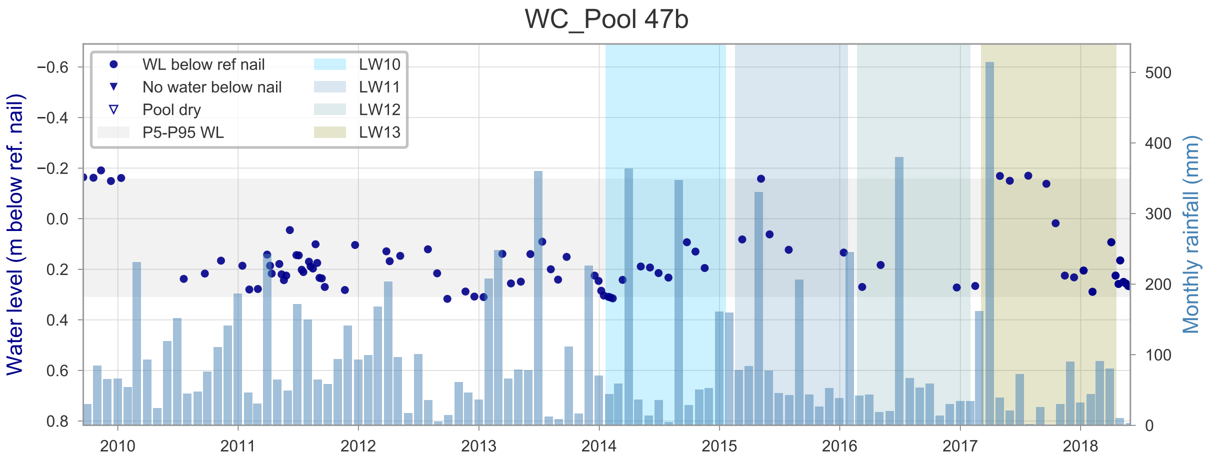

S12_Pool 0
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2012
2013
2014
2015
2016
2017
2018

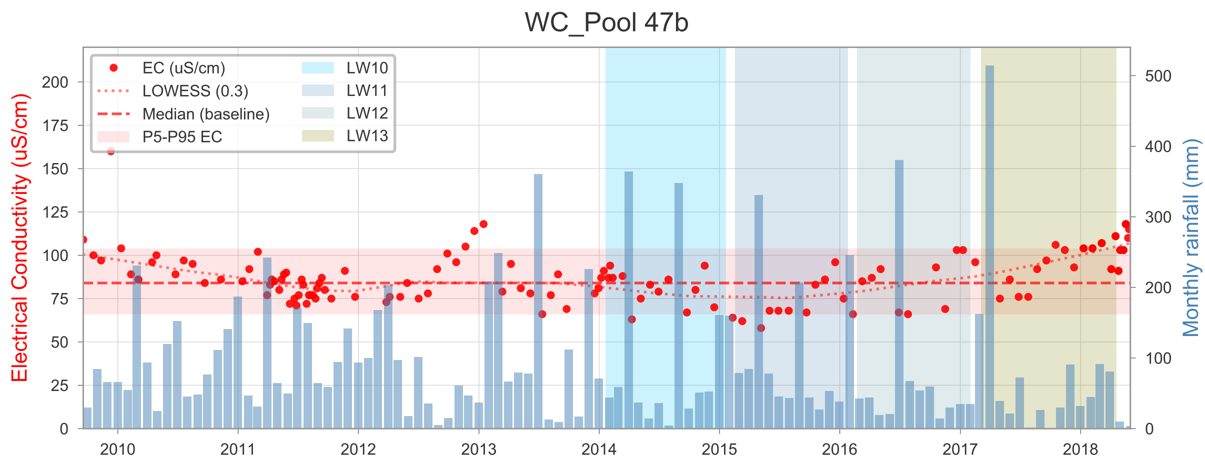

WC_Pool 45
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
2010
2011
2012
2013
2014
2015
2016
2017
2018

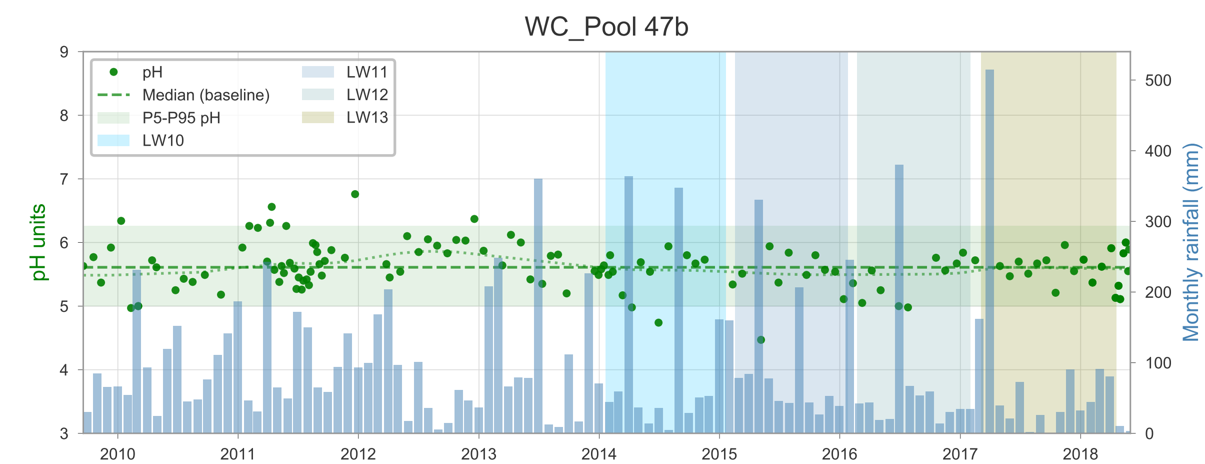

WC_Pool 45
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
2010
2011
2012
2013
2014
2015
2016
2017
2018

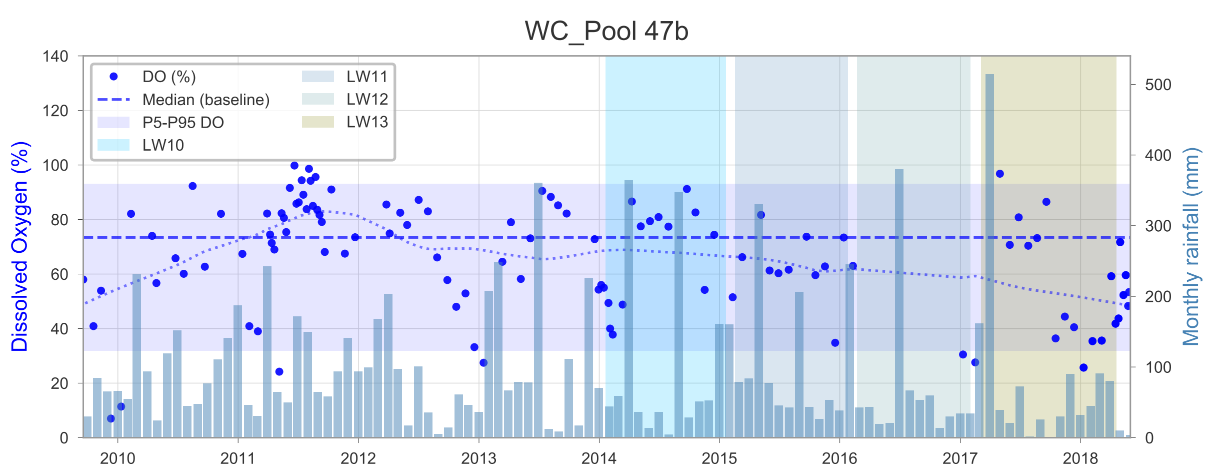

WC_Pool 45
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
2010
2011
2012
2013
2014
2015
2016
2017
2018

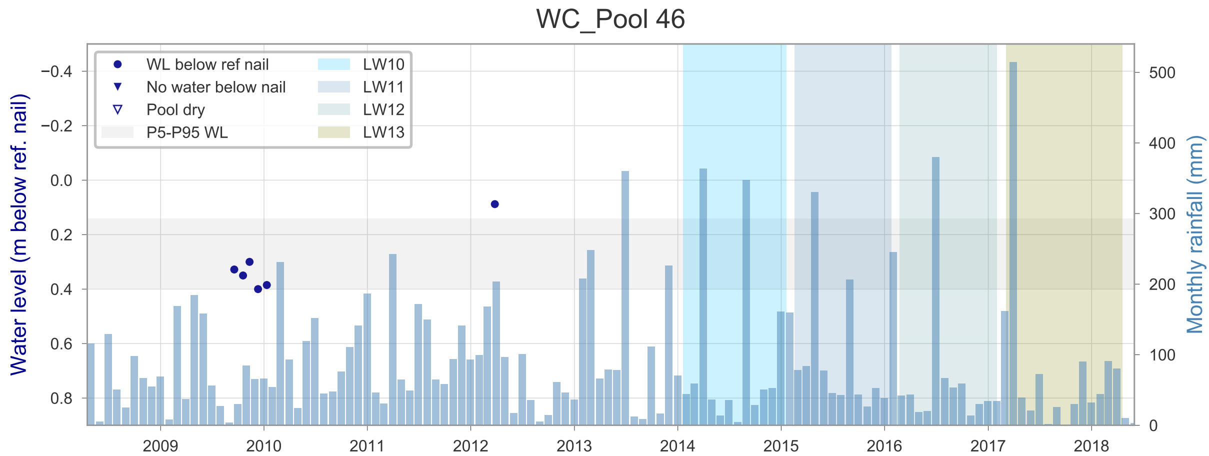

WC_Pool 45
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
2010
2011
2012
2013
2014
2015
2016
2017
2018

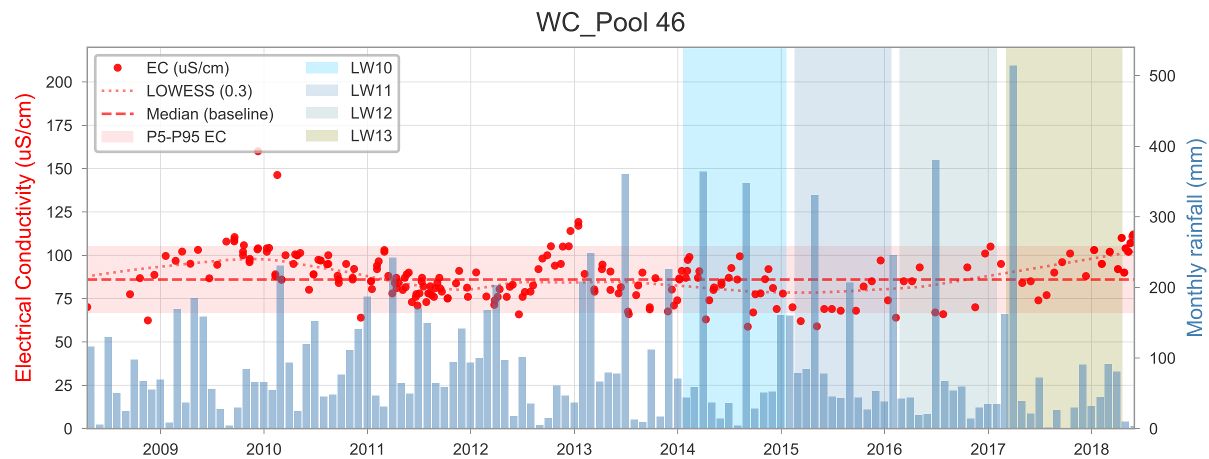

WC_Pool 47b
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
−0.6
−0.4
−0.2
0.0
0.2
0.4
0.6
0.8
0
100
200
300
400
500
2010
2011
2012
2013
2014
2015
2016
2017
2018

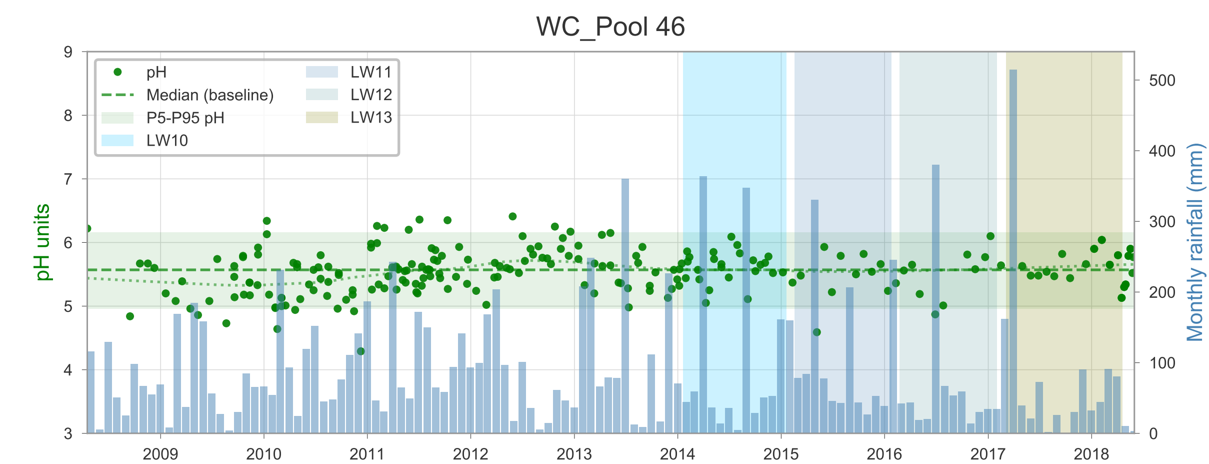

WC_Pool 47b
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2010
2011
2012
2013
2014
2015
2016
2017
2018

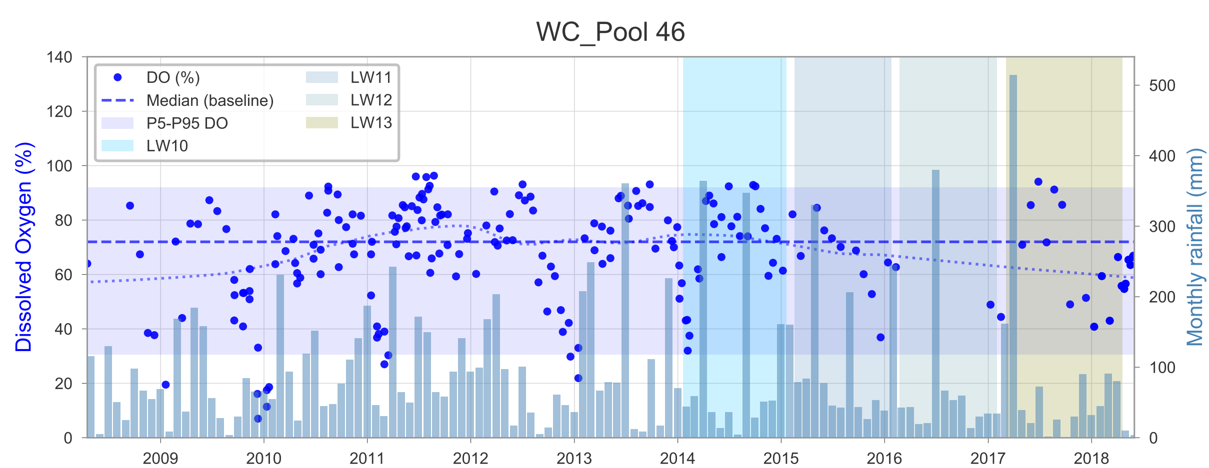

WC_Pool 47b
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
3
4
5
6
7
8
9
0
100
200
300
400
500
2010
2011
2012
2013
2014
2015
2016
2017
2018

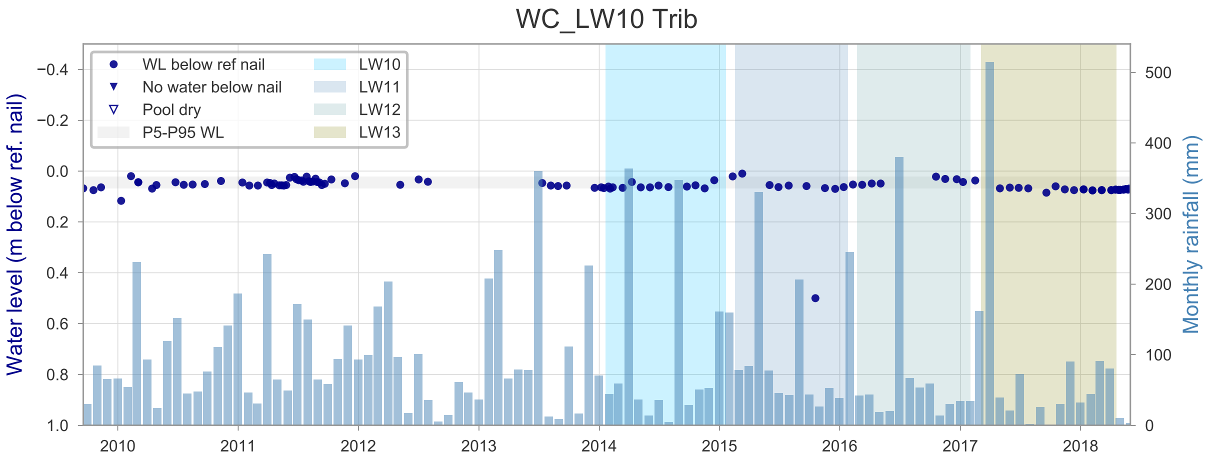

WC_Pool 47b
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2010
2011
2012
2013
2014
2015
2016
2017
2018

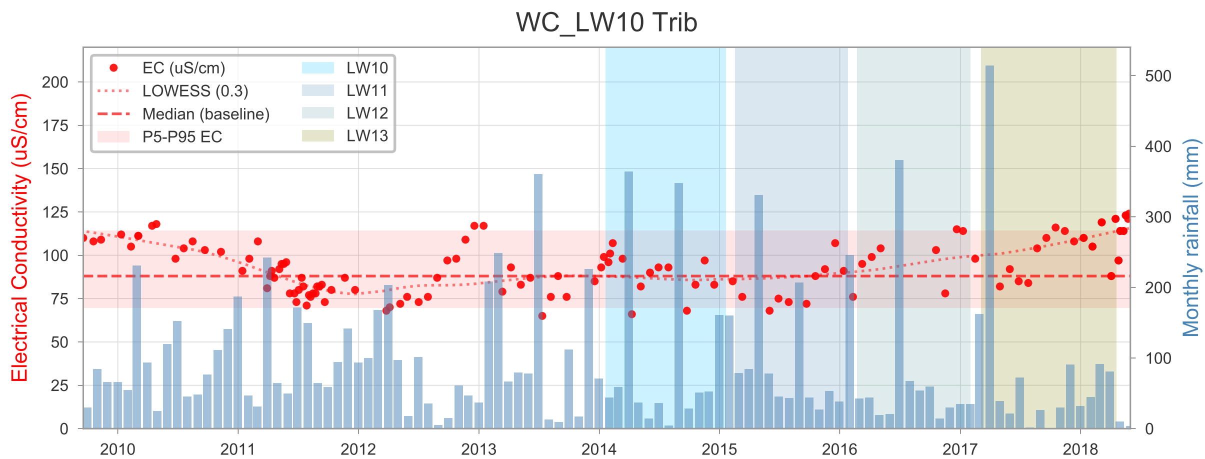

WC_Pool 46
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018

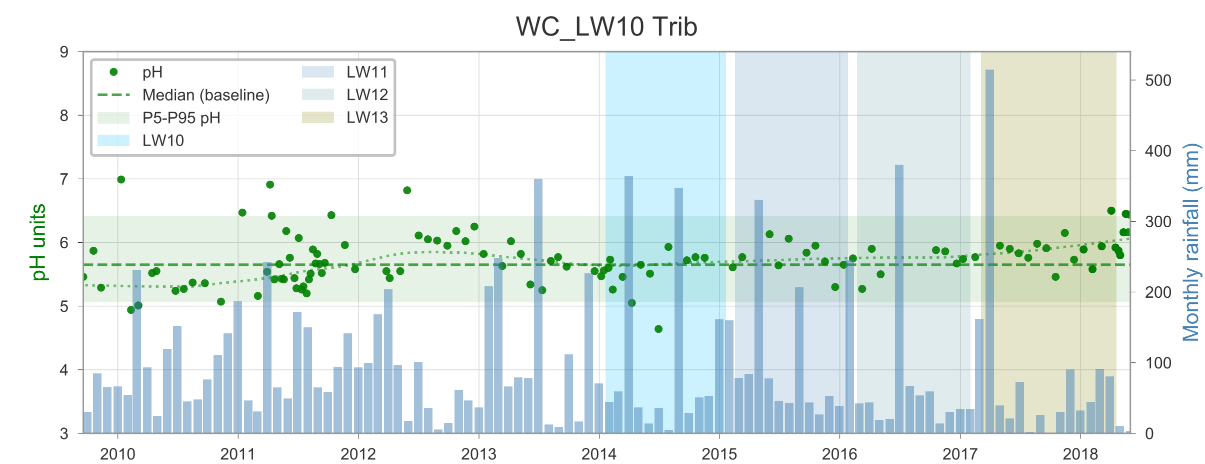

WC_Pool 46
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)

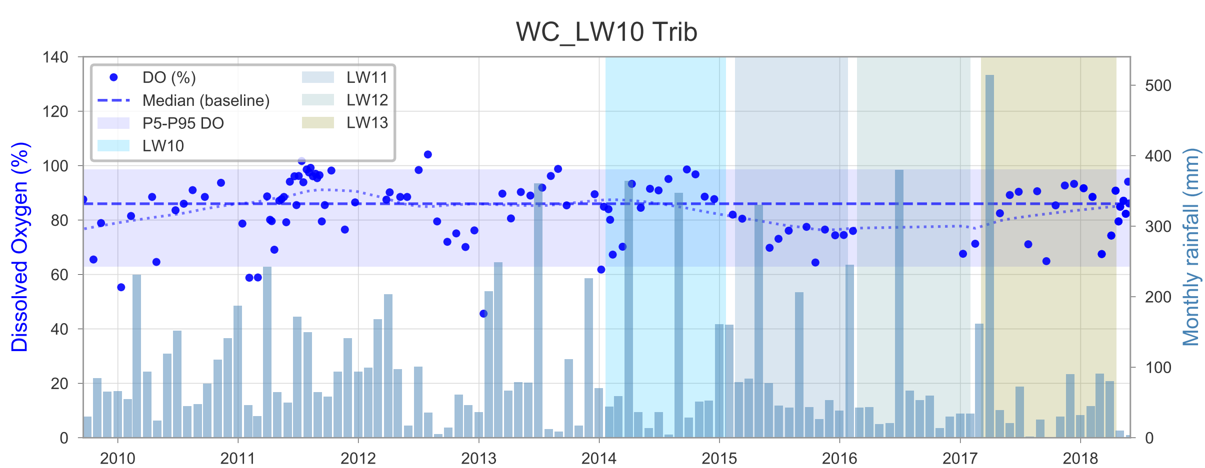

WC_Pool 46
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)

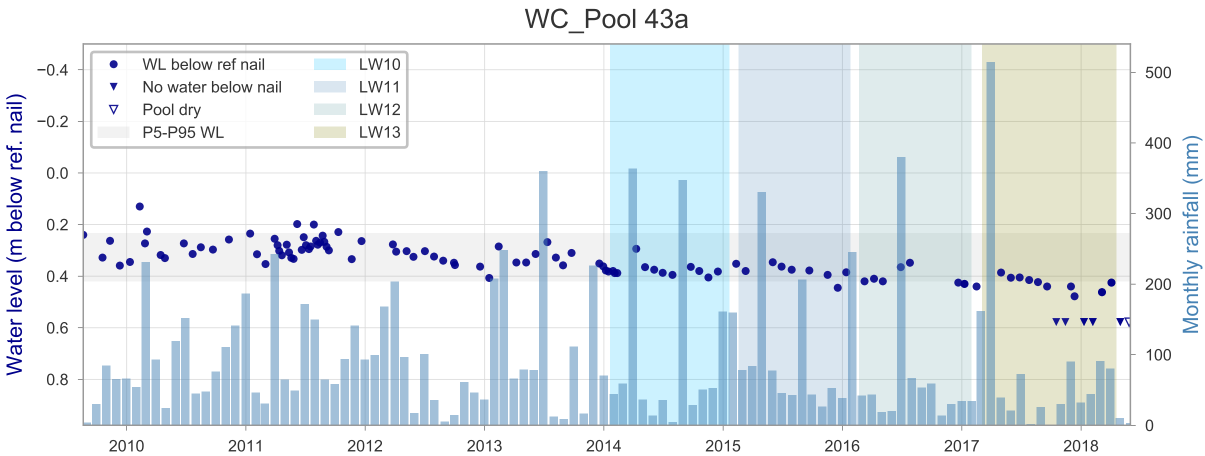

WC_Pool 46
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)

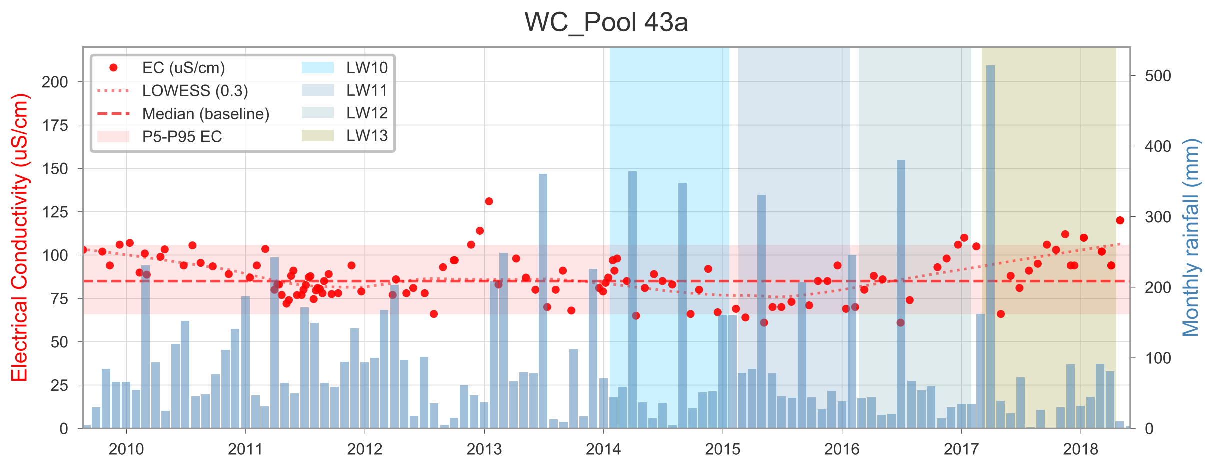

WC_LW10 Trib
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
-0.4
-0.2
0.0
0.2
0.4
0.6
0.8
1.0
0
100
200
300
400
500
2010
2011
2012
2013
2014
2015
2016
2017
2018

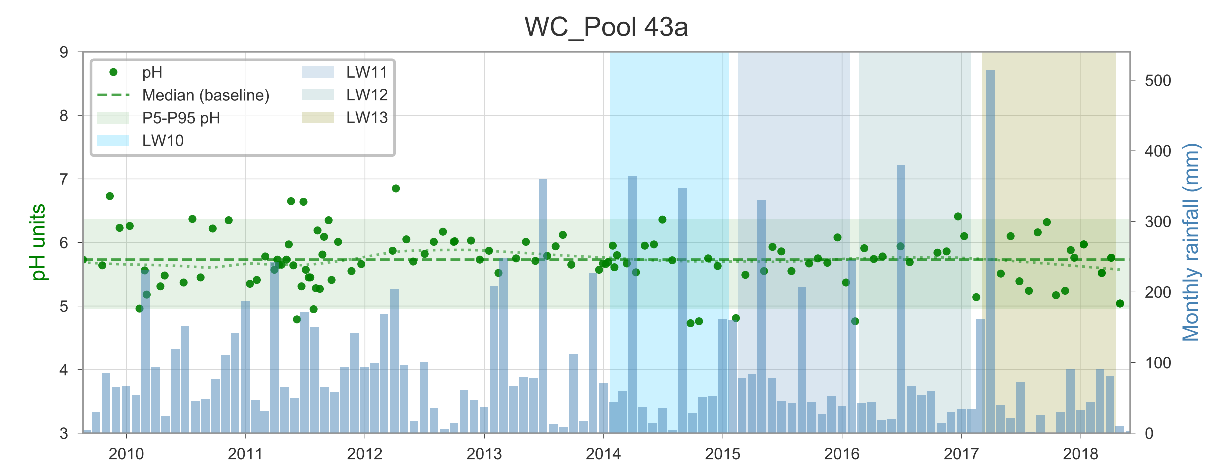

WC_LW10 Trib
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2010
2011
2012
2013
2014
2015
2016
2017
2018

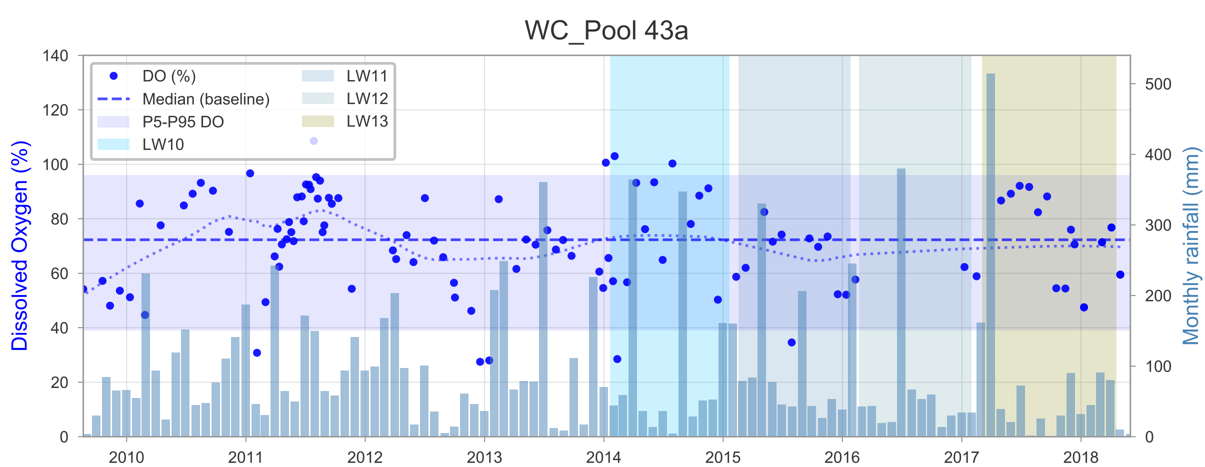

WC_LW10 Trib
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
3
4
5
6
7
8
9
0
100
200
300
400
500
2010
2011
2012
2013
2014
2015
2016
2017
2018

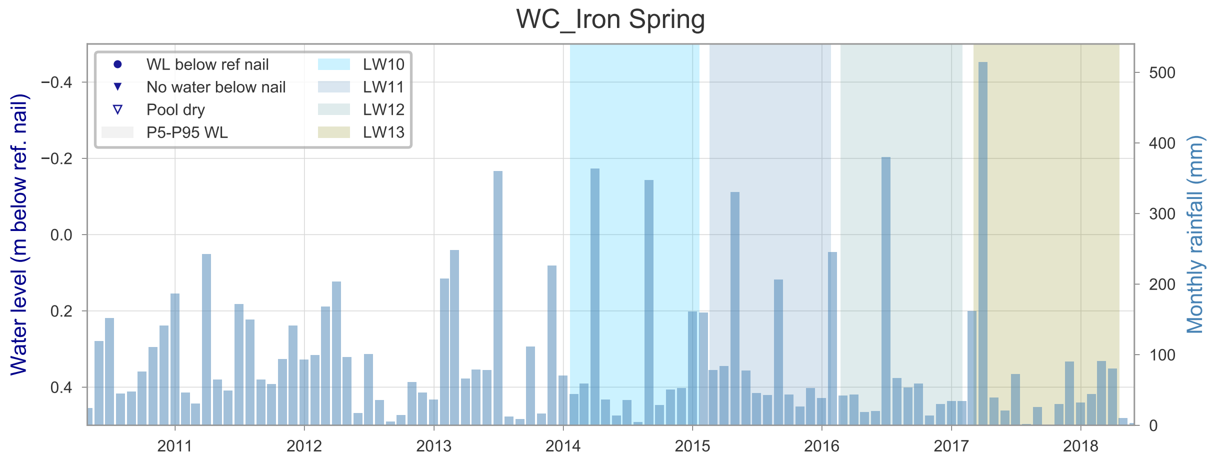

WC_LW10 Trib
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2010
2011
2012
2013
2014
2015
2016
2017
2018

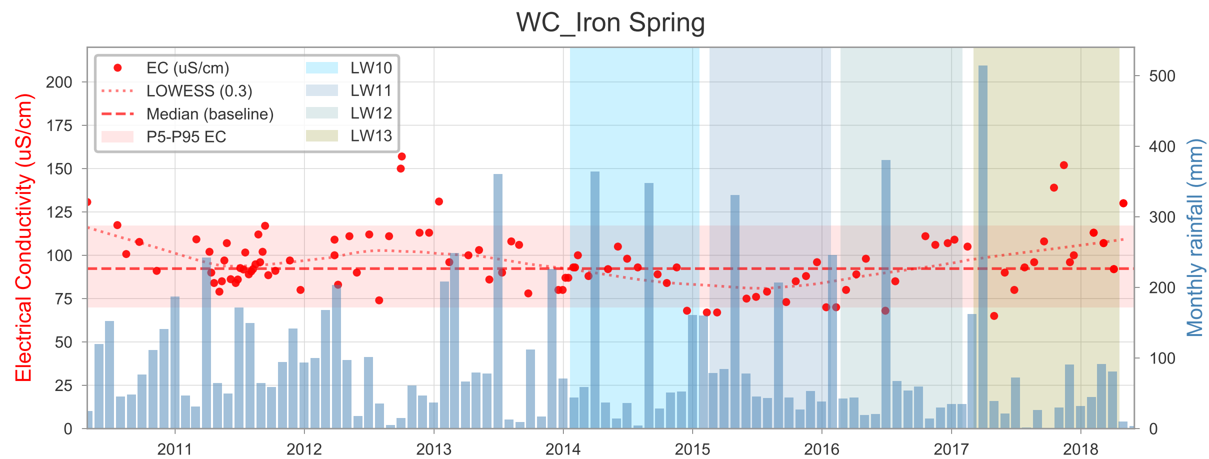

WC_Pool 43a
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
−0.4
−0.2
0.0
0.2
0.4
0.6
0.8
0
100
200
300
400
500
2010
2011
2012
2013
2014
2015
2016
2017
2018

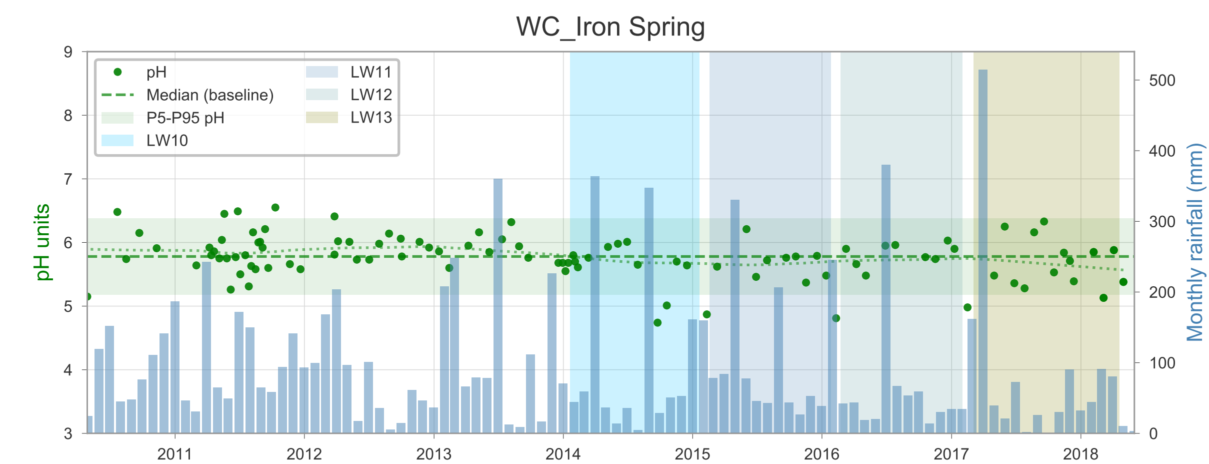

WC_Pool 43a
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2010
2011
2012
2013
2014
2015
2016
2017
2018

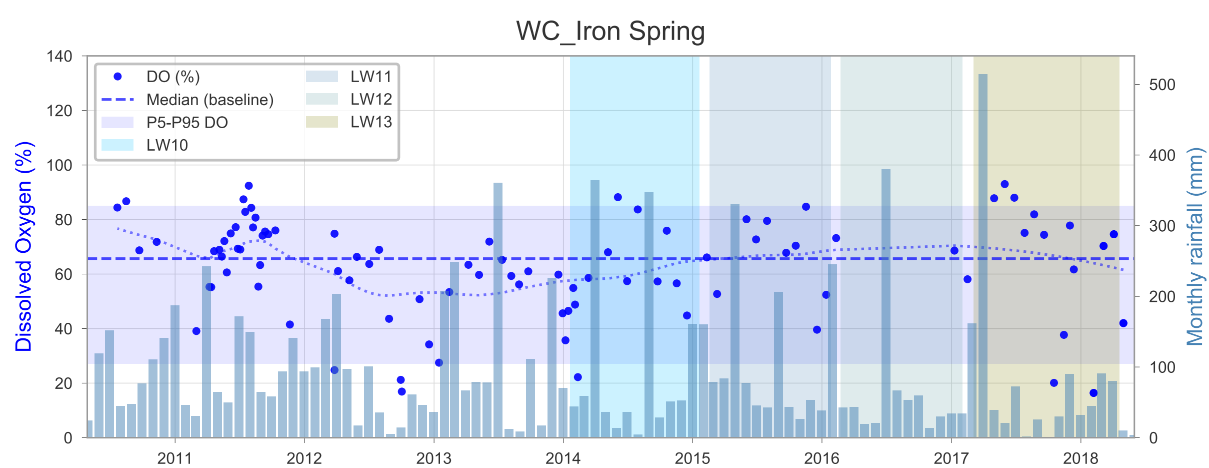

WC_Pool 43a
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
3
4
5
6
7
8
9
0
100
200
300
400
500
2010
2011
2012
2013
2014
2015
2016
2017
2018

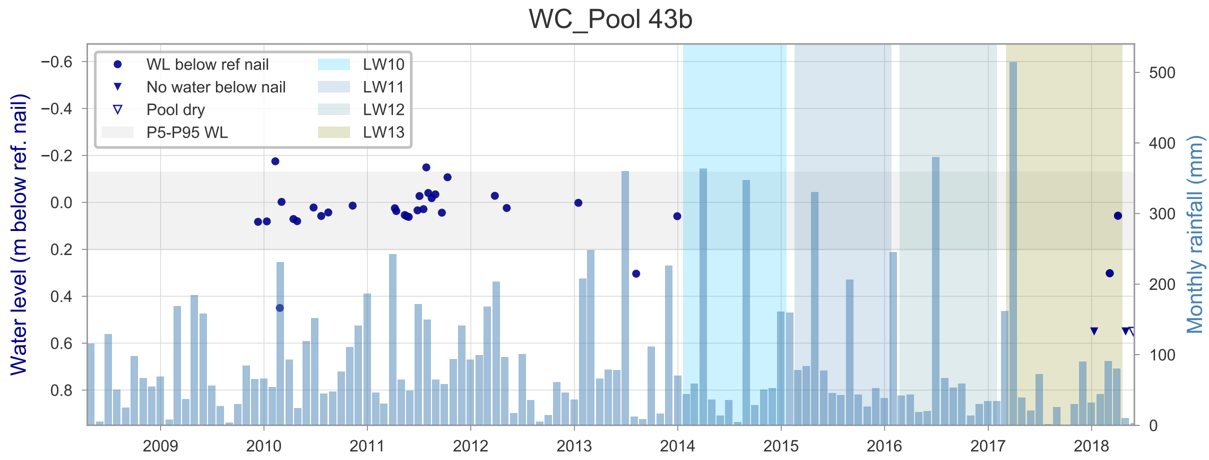

WC_Pool 43a
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2010
2011
2012
2013
2014
2015
2016
2017
2018

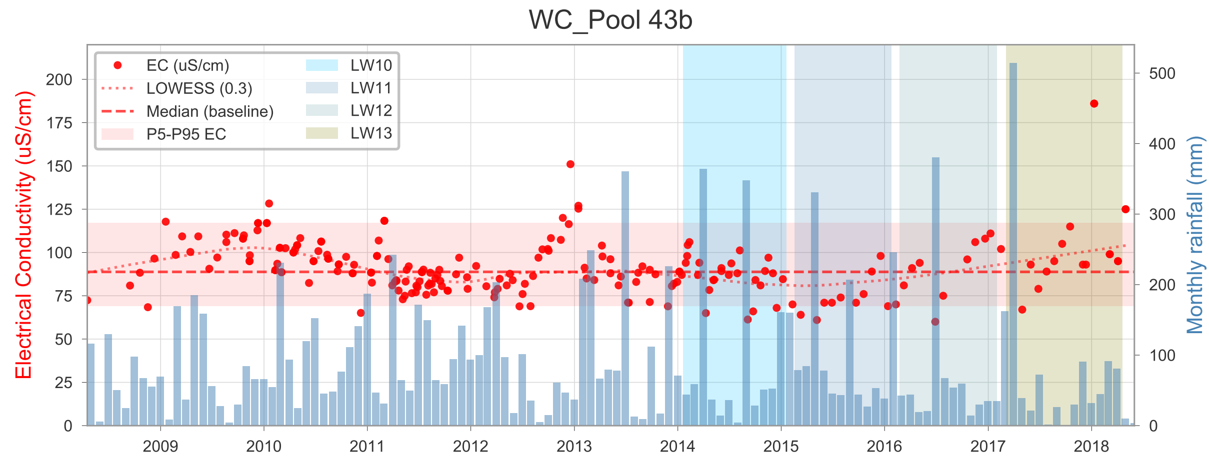

WC_Iron Spring
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)

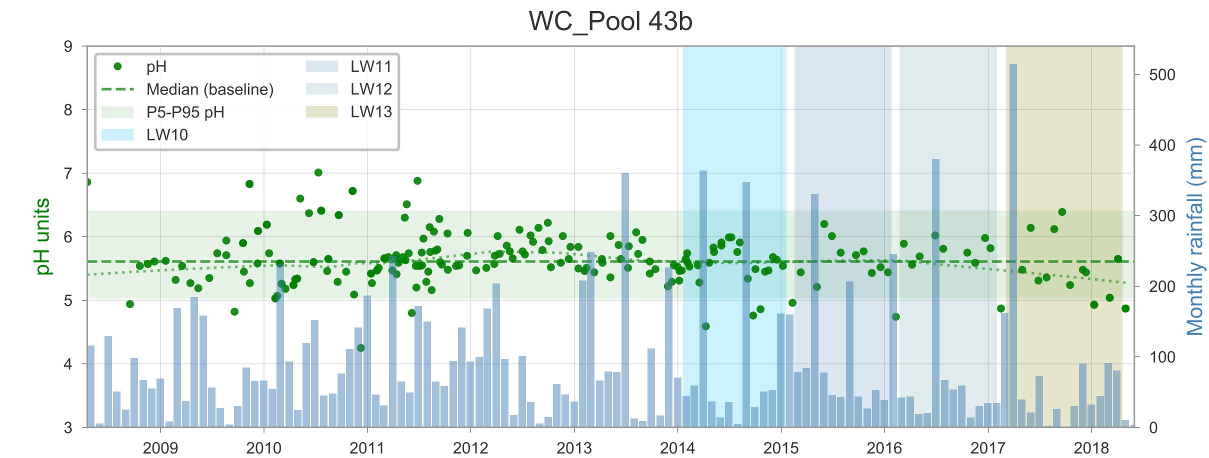

WC_Iron Spring
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)

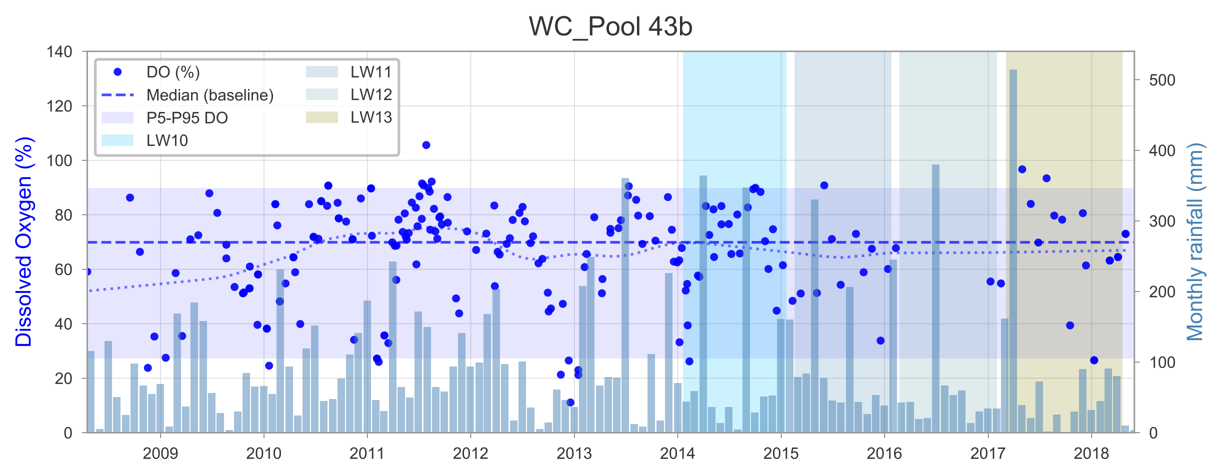

WC_Iron Spring
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)

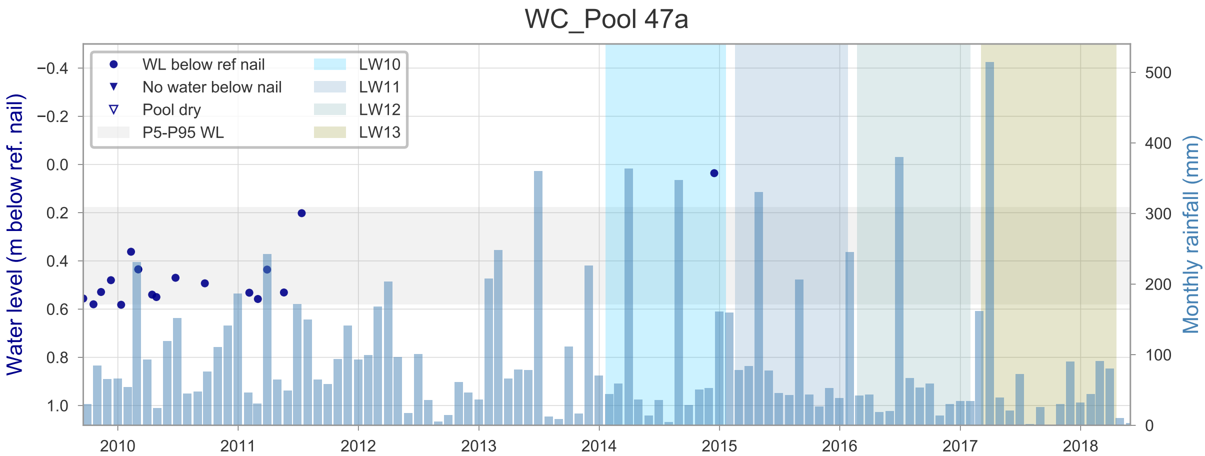

WC_Iron Spring
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)

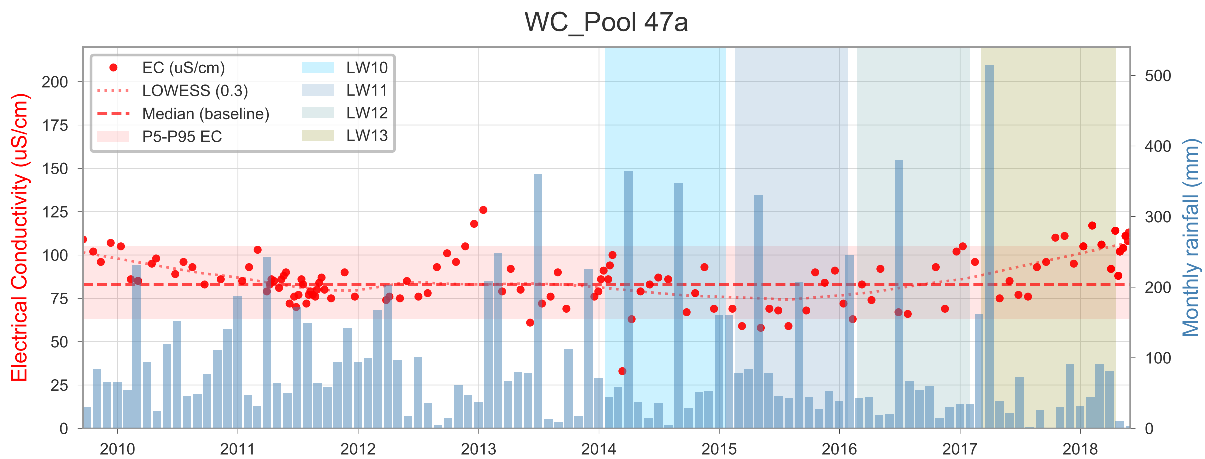

WC_Pool 43b
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018

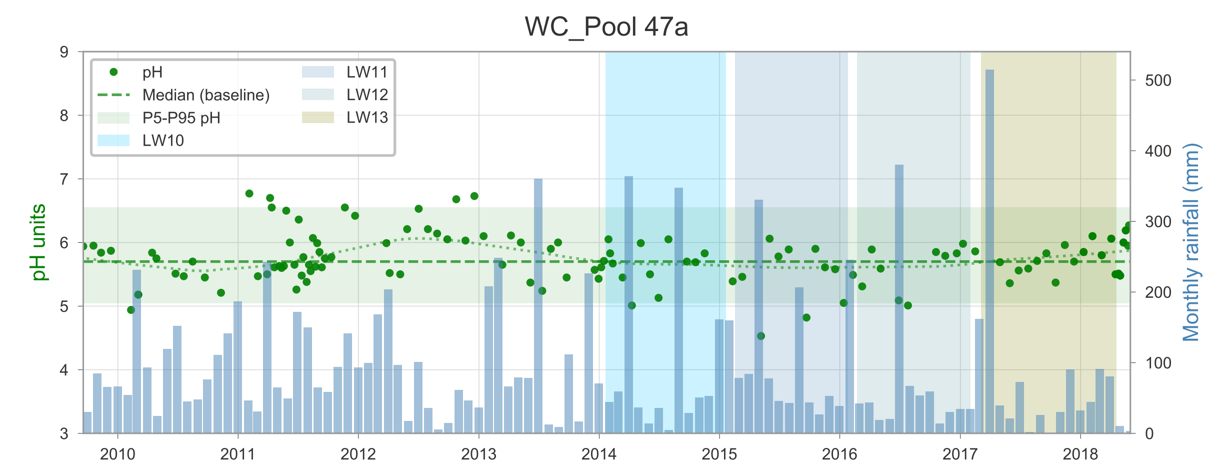

WC_Pool 43b
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)

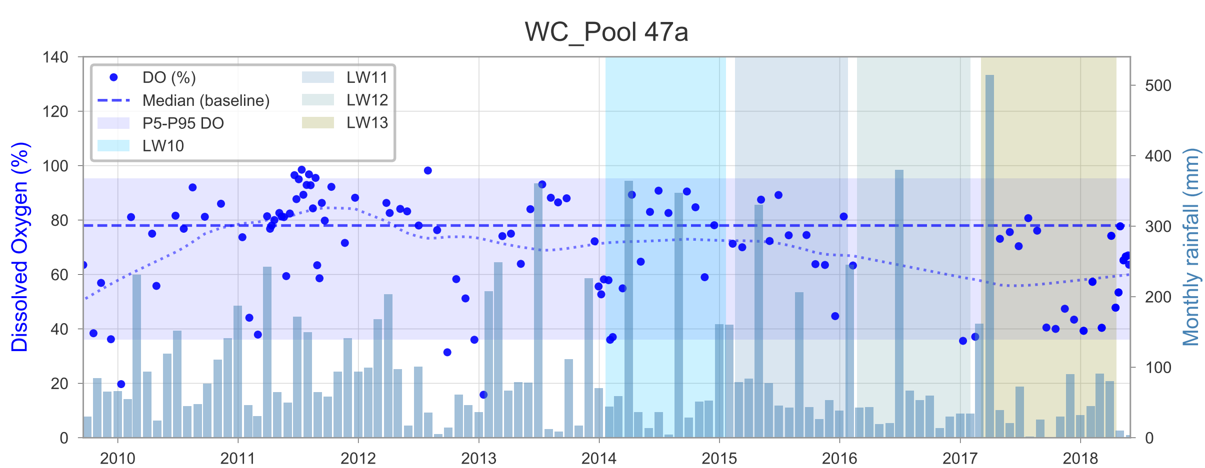

WC_Pool 43b
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)

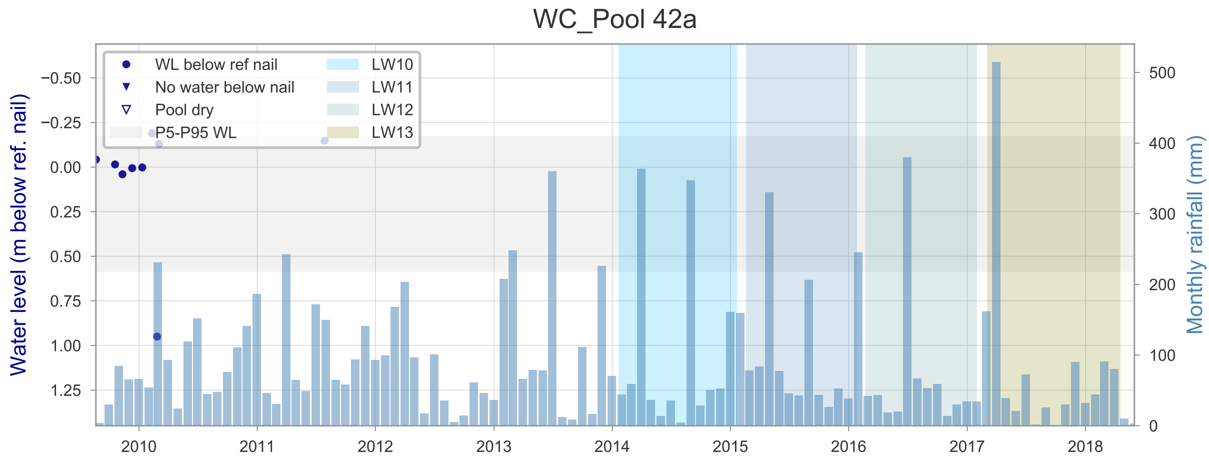
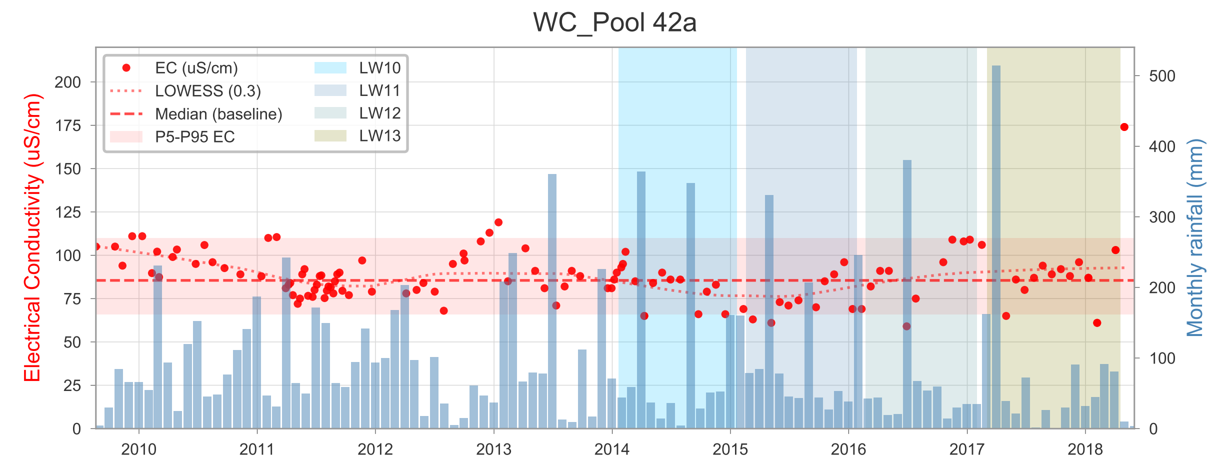
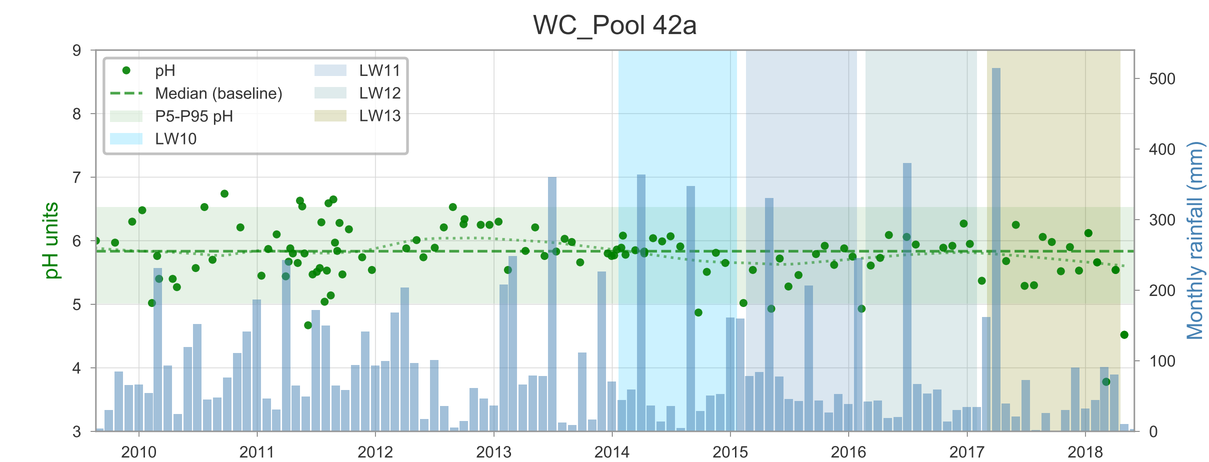
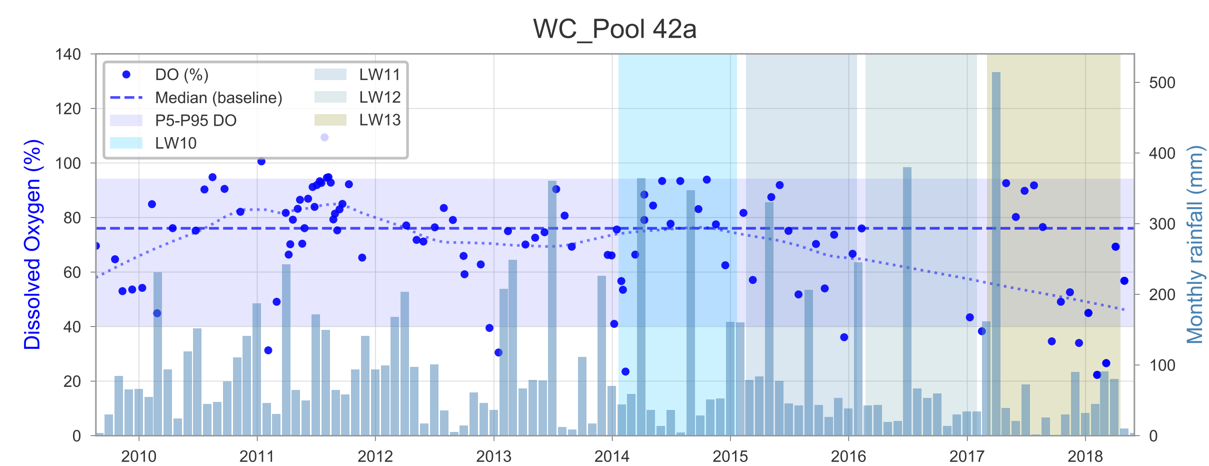

WC_Pool 43b
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)

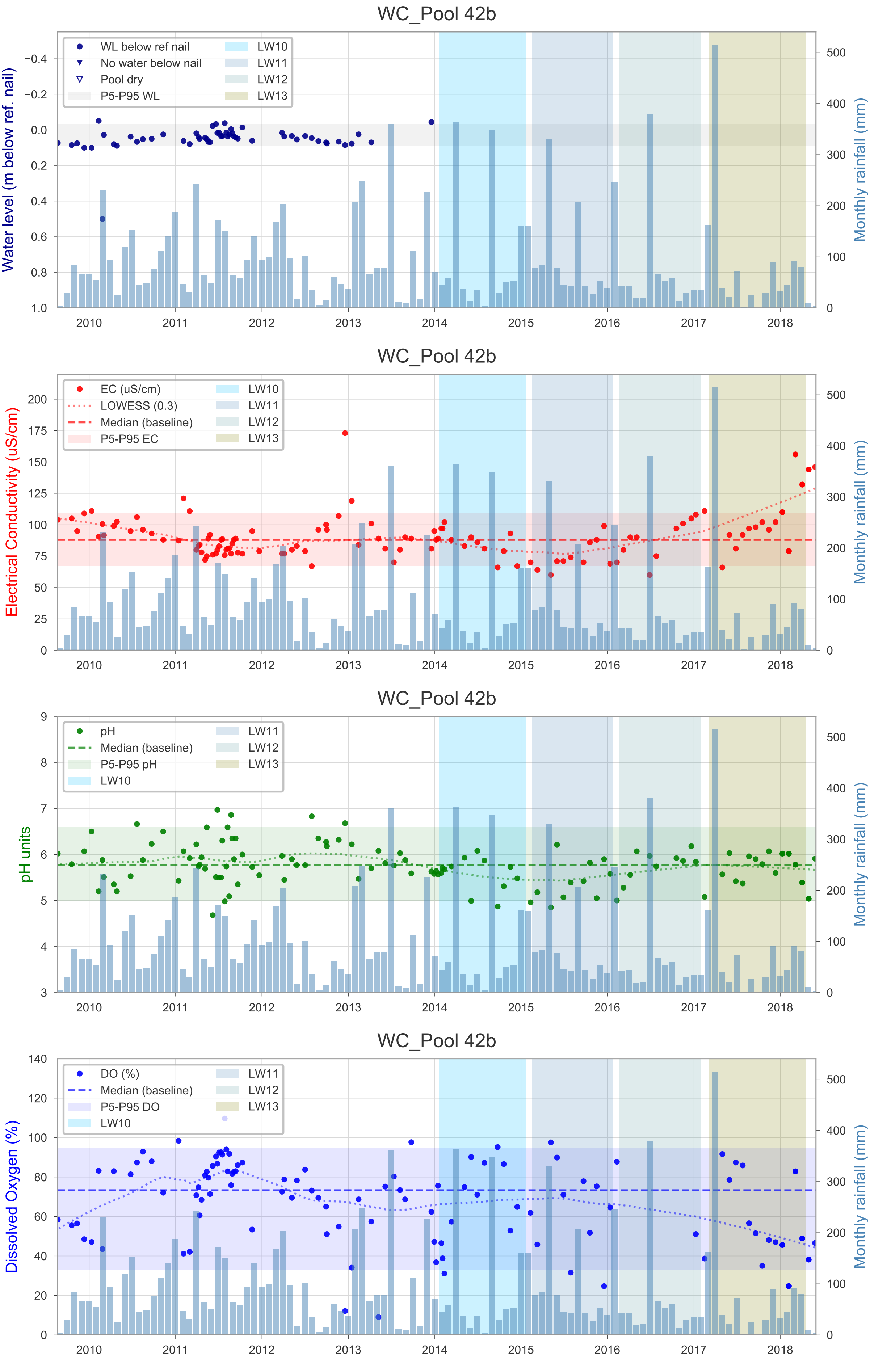

WC_Pool 47a
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
2010
2011
2012
2013
2014
2015
2016
2017
2018

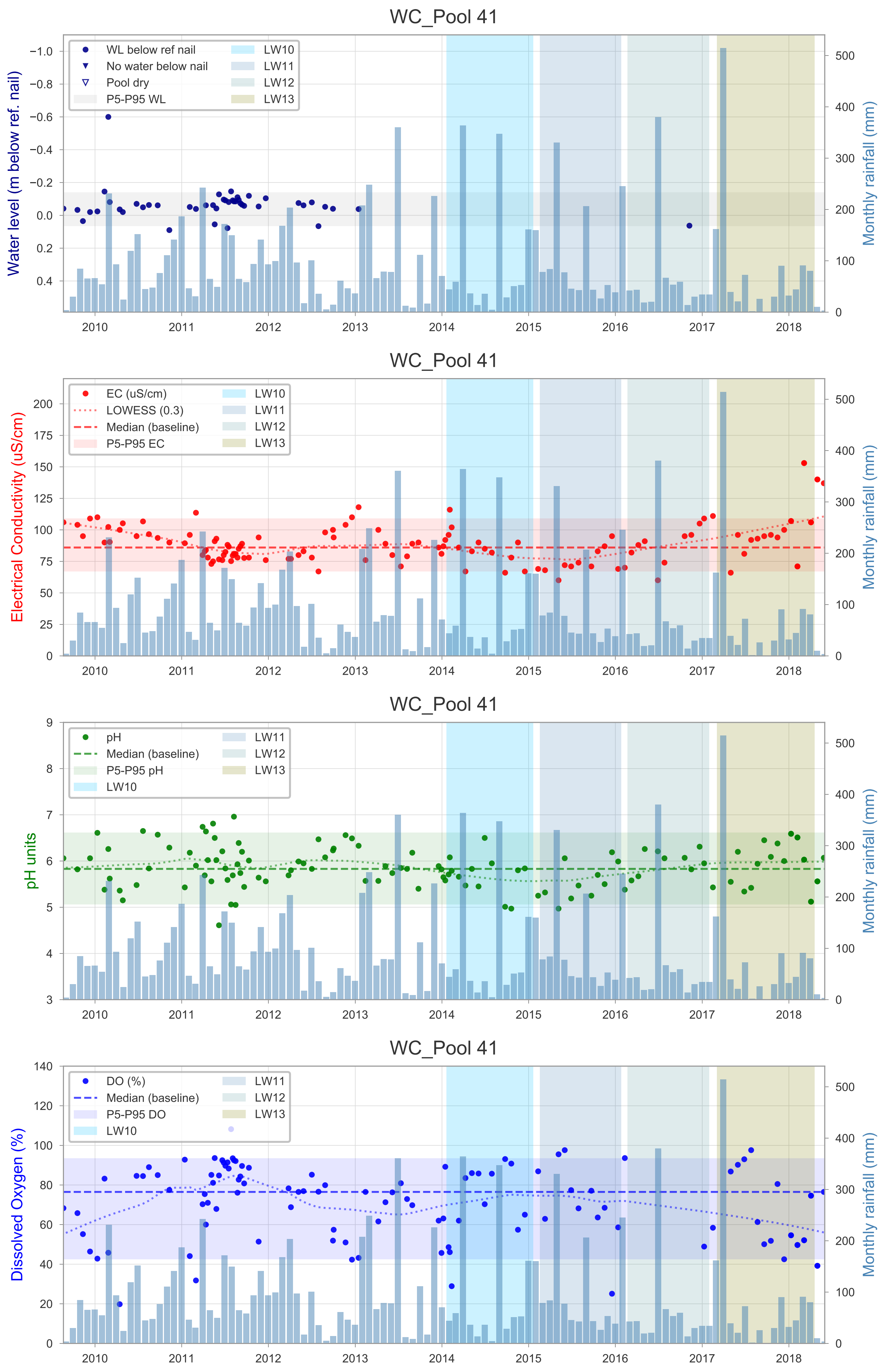

WC_Pool 47a
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
2010
2011
2012
2013
2014
2015
2016
2017
2018

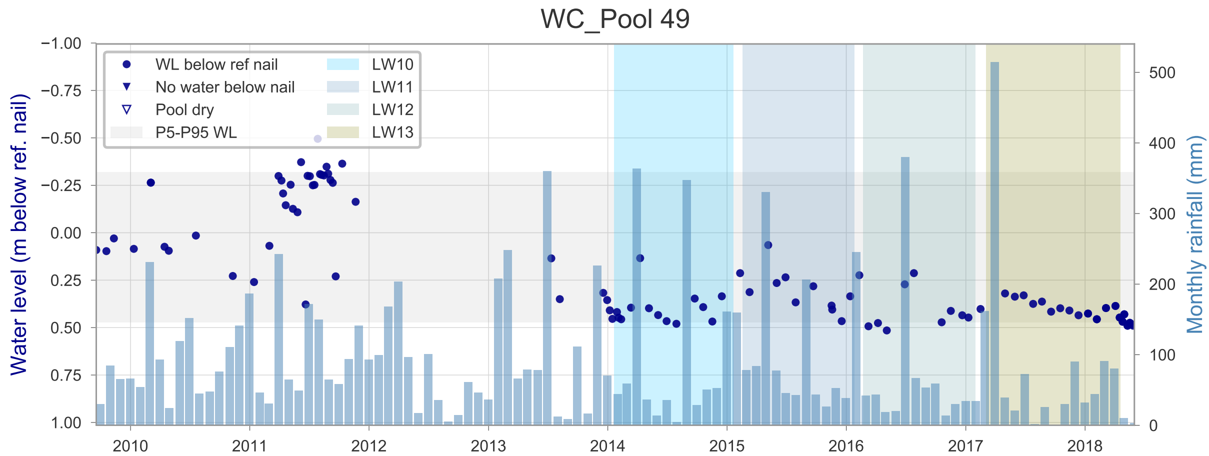

WC_Pool 47a
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
2010
2011
2012
2013
2014
2015
2016
2017
2018

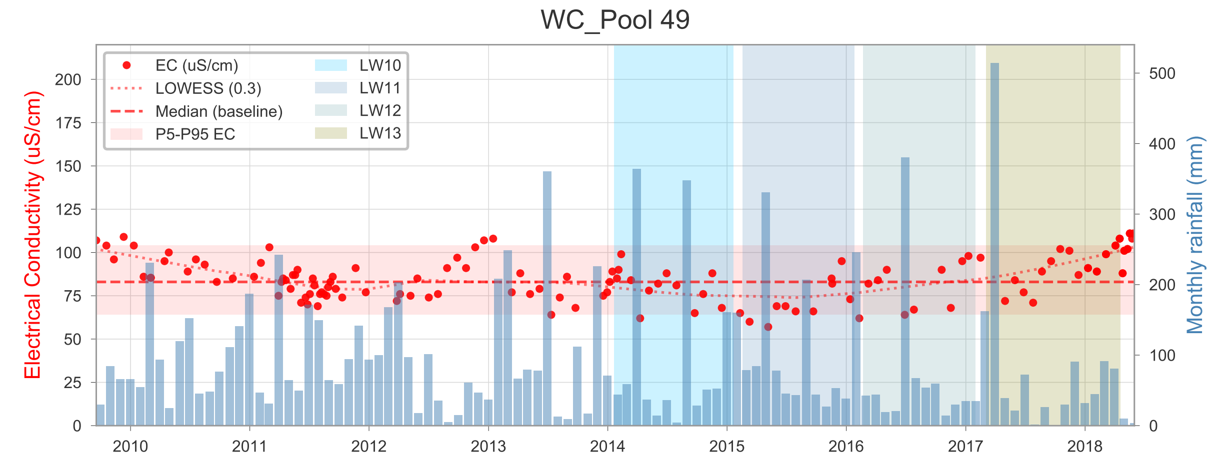

WC_Pool 47a
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
2010
2011
2012
2013
2014
2015
2016
2017
2018

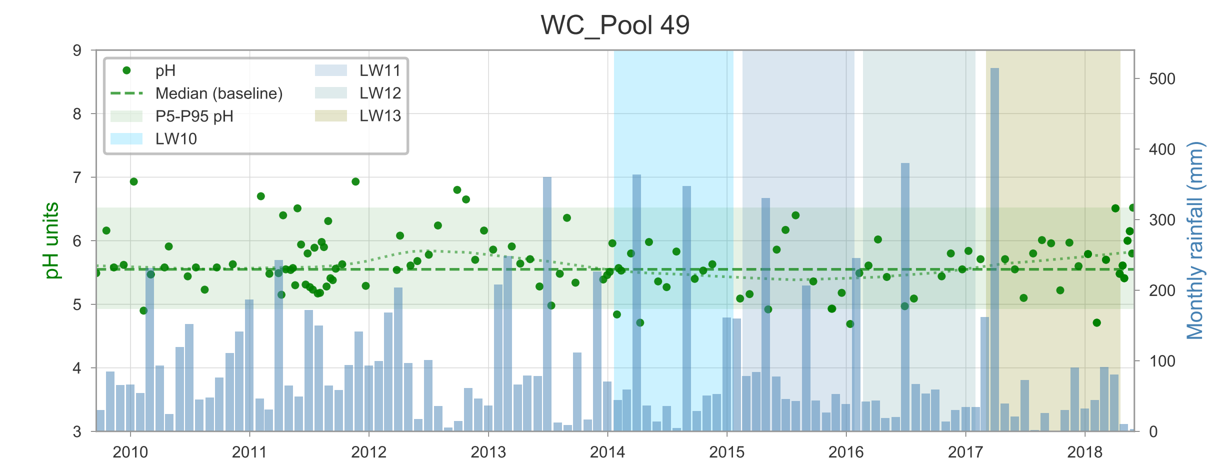

WC_Pool 42a
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
2010
2011
2012
2013
2014
2015
2016
2017
2018

WC_Pool 42a
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13

WC_Pool 42a
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13

WC_Pool 42a
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13

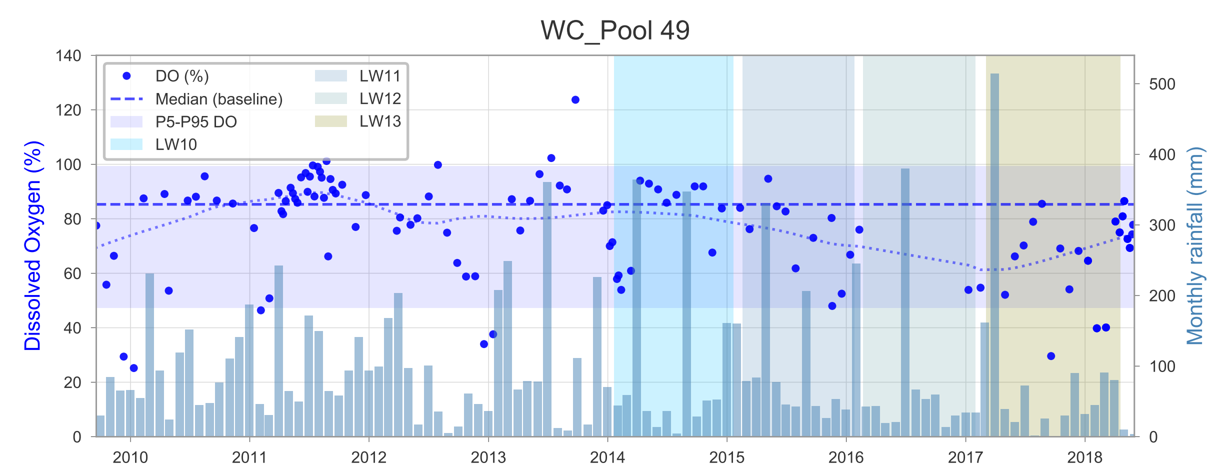

WC_Pool 42b
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
WC_Pool 42b
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
Electrical Conductivity (uS/cm)
WC_Pool 42b
pH
Median (baseline)
P5-P95 pH
pH units
WC_Pool 42b
DO (%)
Median (baseline)
P5-P95 DO
Dissolved Oxygen (%)

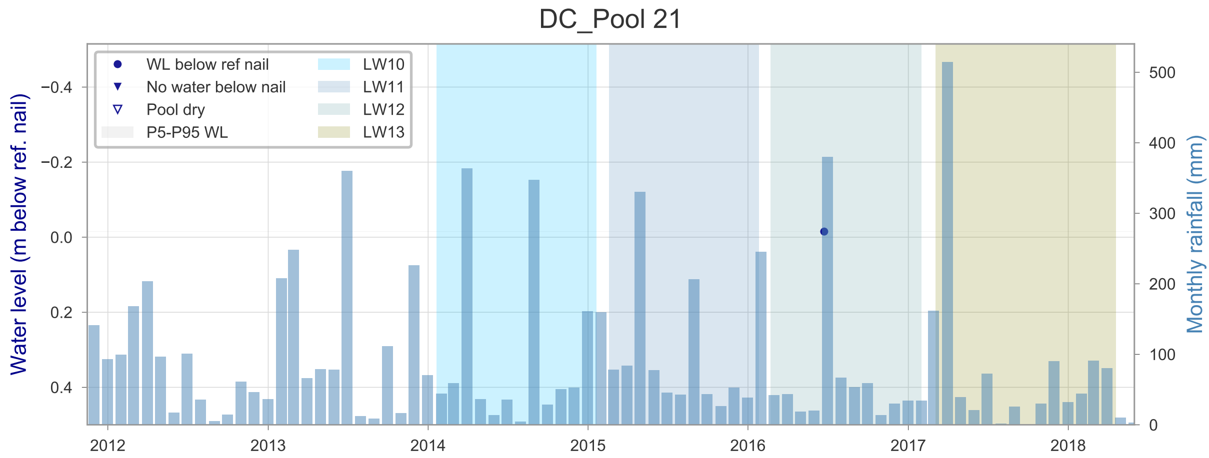

WC_Pool 41
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
WC_Pool 41
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
WC_Pool 41
pH units
pH
Median (baseline)
P5-P95 pH
WC_Pool 41
Dissolved Oxygen (%)
DO (%)
Median (baseline)
P5-P95 DO
2010
2011
2012
2013
2014
2015
2016
2017
2018

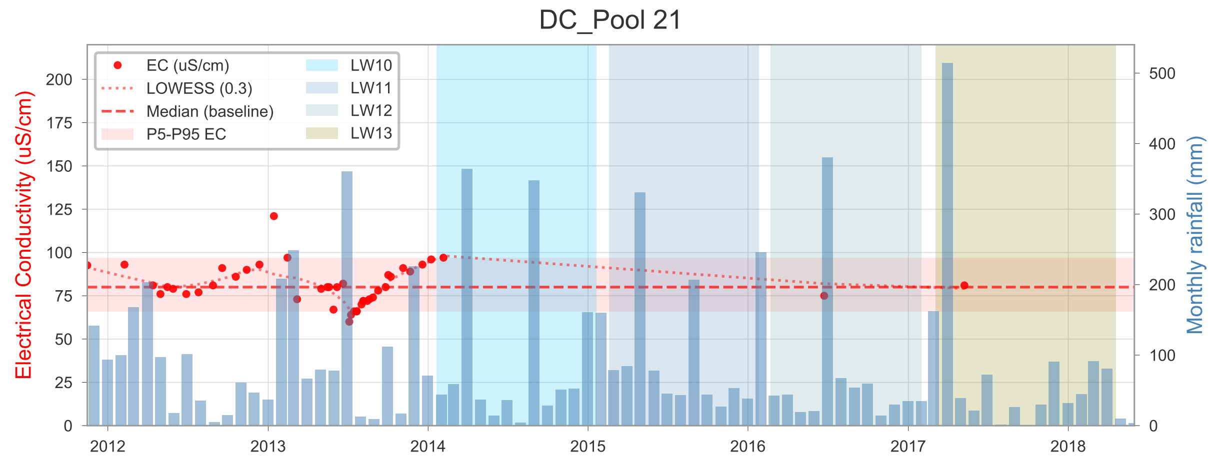

WC_Pool 49
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13

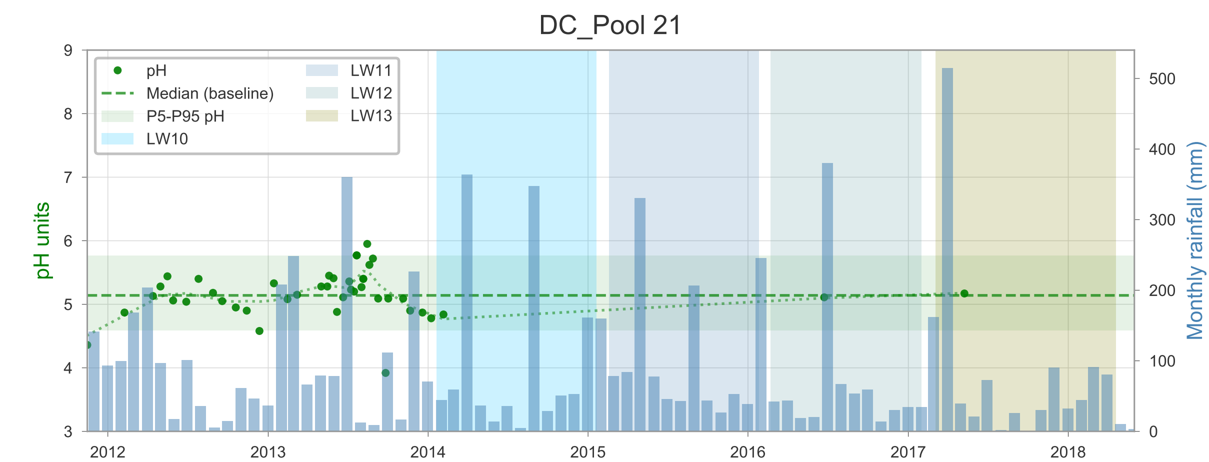

WC_Pool 49
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13

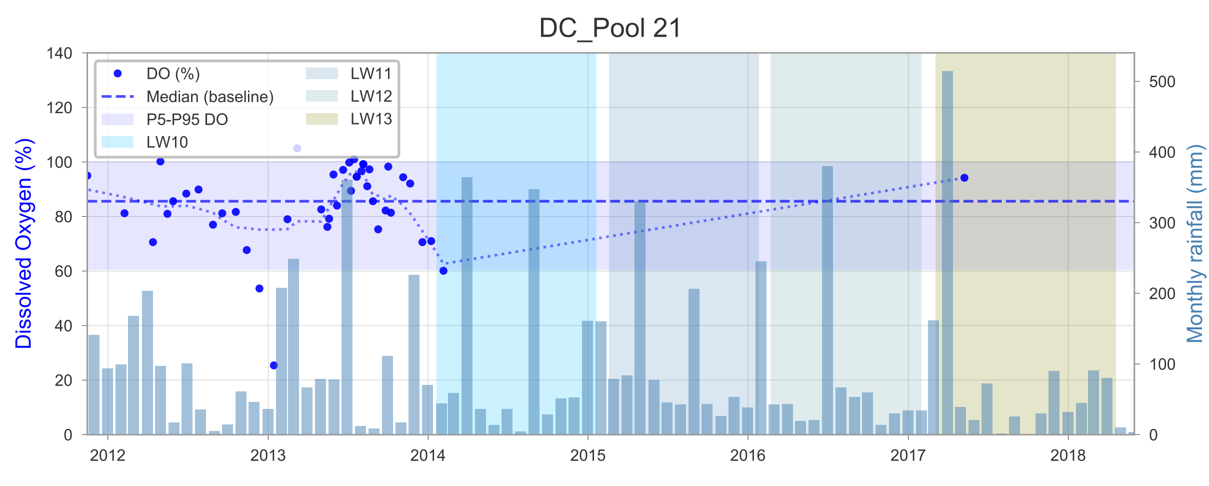

WC_Pool 49
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13


WC_Pool 49
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13

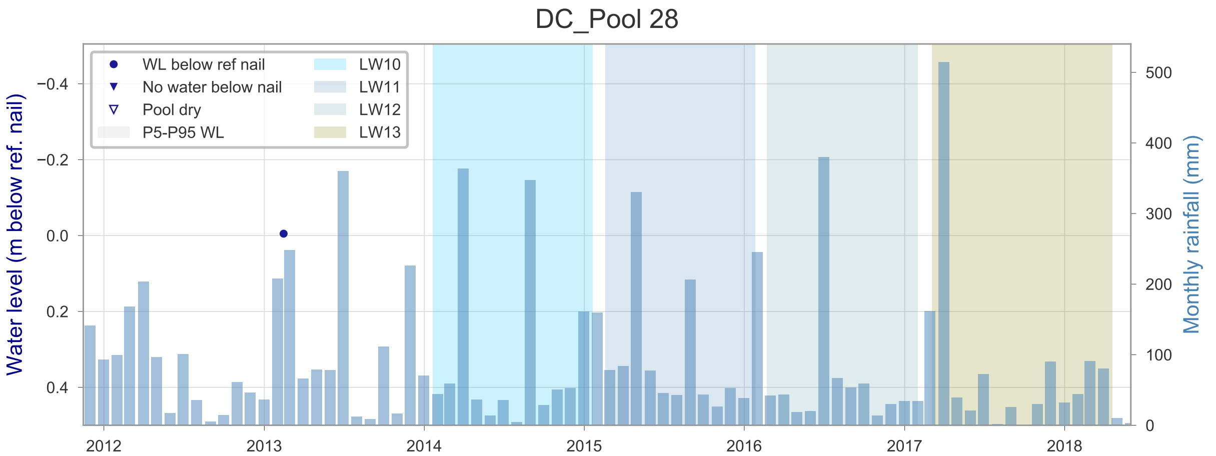

DC_Pool 21
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
−0.4
−0.2
0.0
0.2
0.4
0
100
200
300
400
500
2012
2013
2014
2015
2016
2017
2018

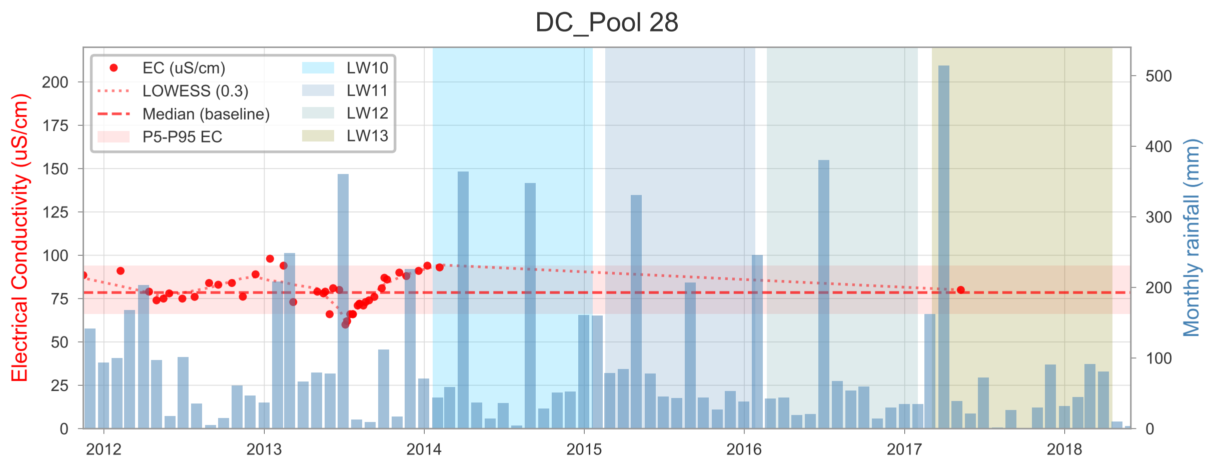

DC_Pool 21
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2012
2013
2014
2015
2016
2017
2018

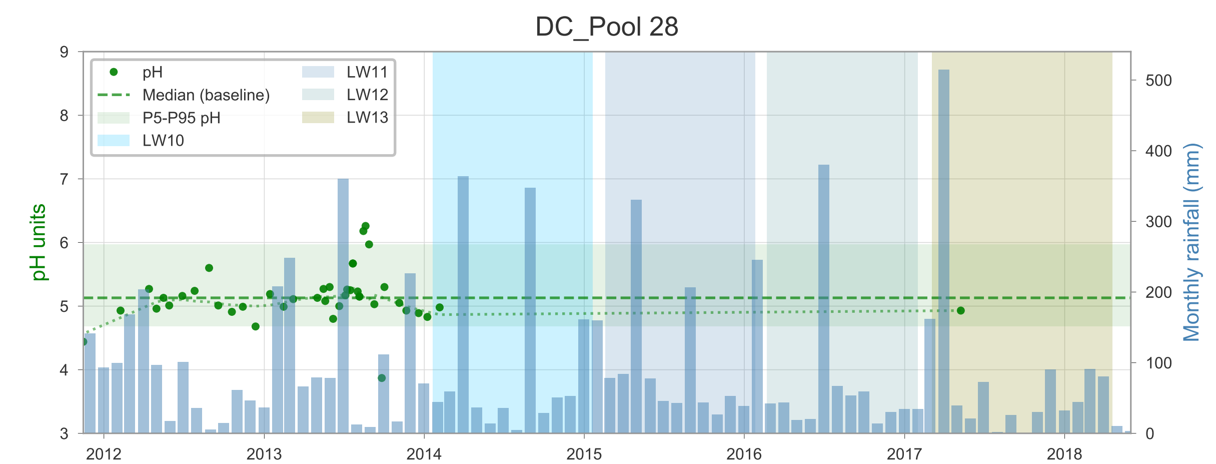

DC_Pool 21
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
3
4
5
6
7
8
9
0
100
200
300
400
500
2012
2013
2014
2015
2016
2017
2018

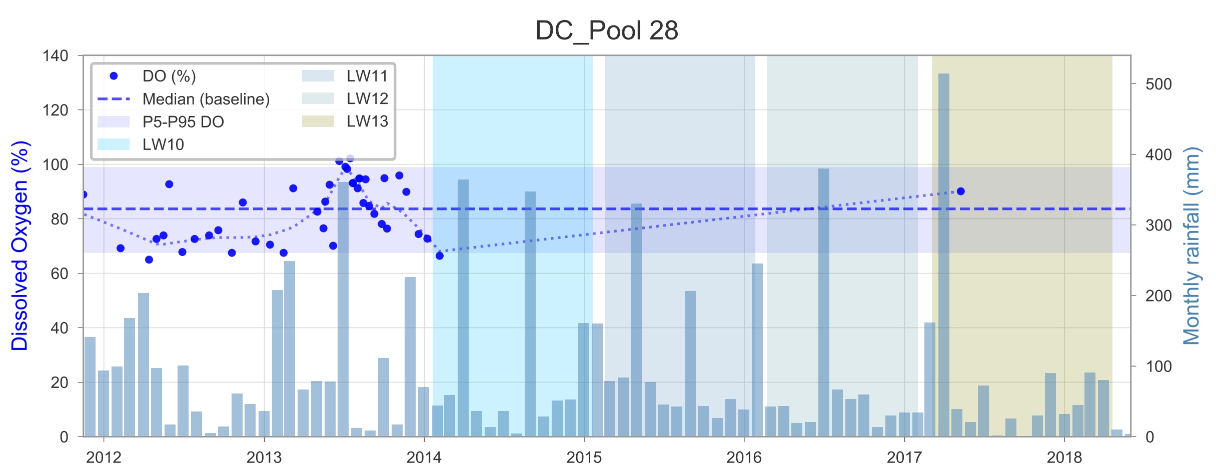

DC_Pool 21
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2012
2013
2014
2015
2016
2017
2018

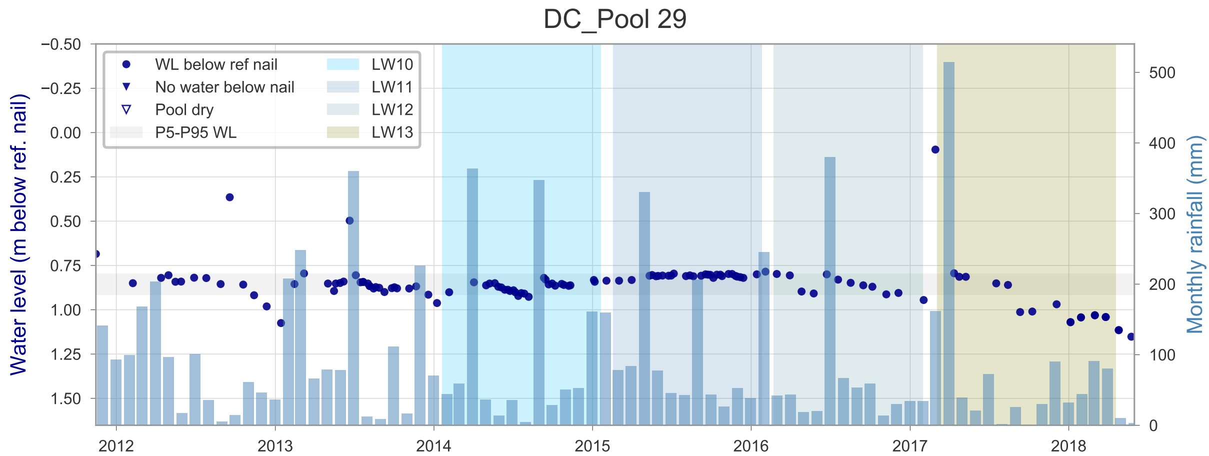

DC_Pool 23
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
DC_Pool 23
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
Electrical Conductivity (uS/cm)
DC_Pool 23
pH
Median (baseline)
P5-P95 pH
pH units
DC_Pool 23
DO (%)
Median (baseline)
P5-P95 DO
Dissolved Oxygen (%)
2012
2013
2014
2015
2016
2017
2018

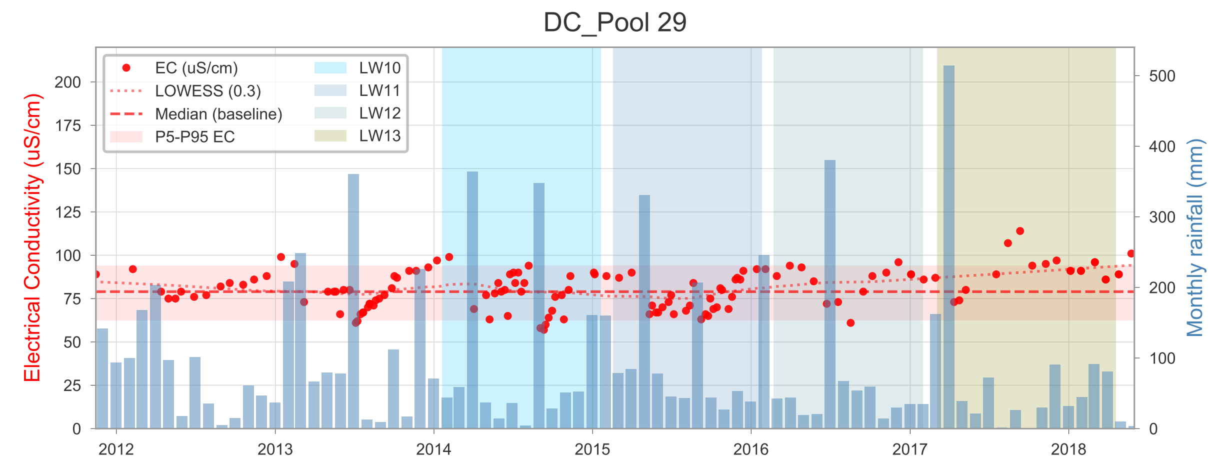

DC_Pool 28
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
2012
2013
2014
2015
2016
2017
2018

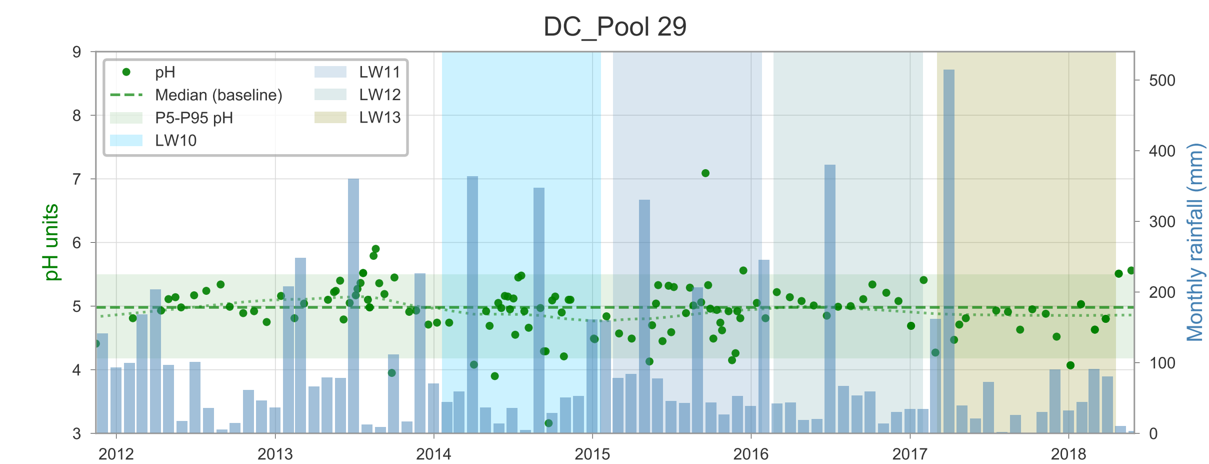

DC_Pool 28
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
2012
2013
2014
2015
2016
2017
2018

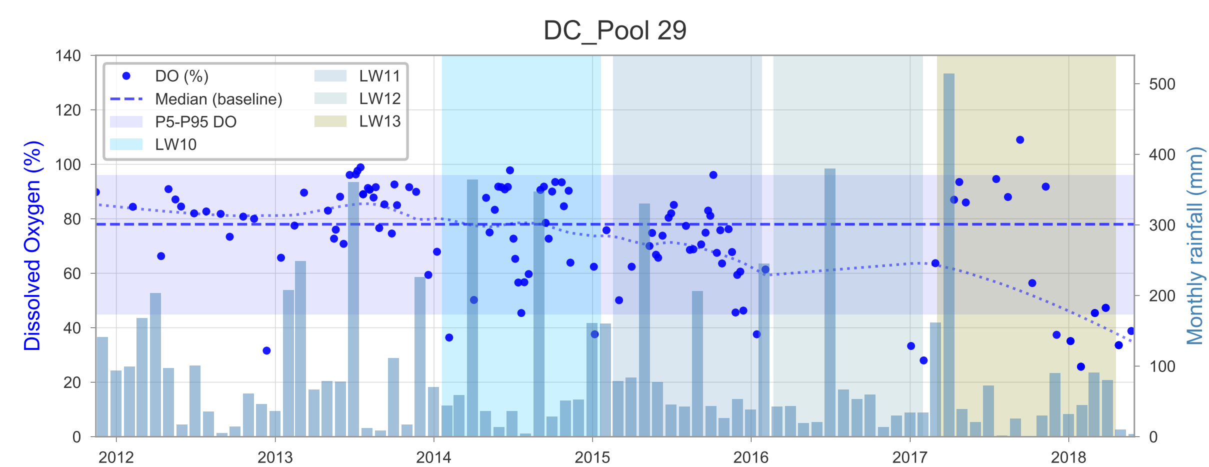

DC_Pool 28
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
2012
2013
2014
2015
2016
2017
2018

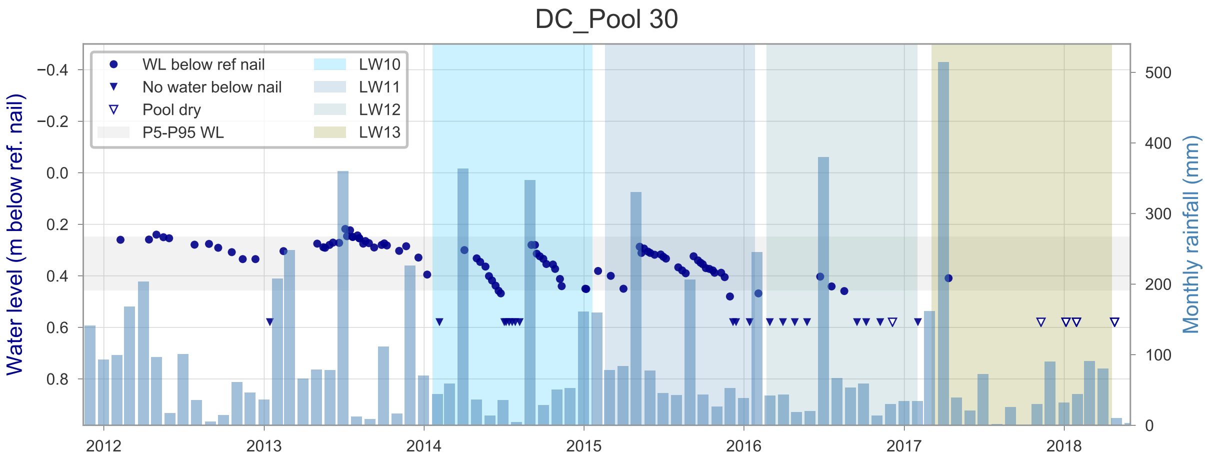

DC_Pool 28
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
2012
2013
2014
2015
2016
2017
2018

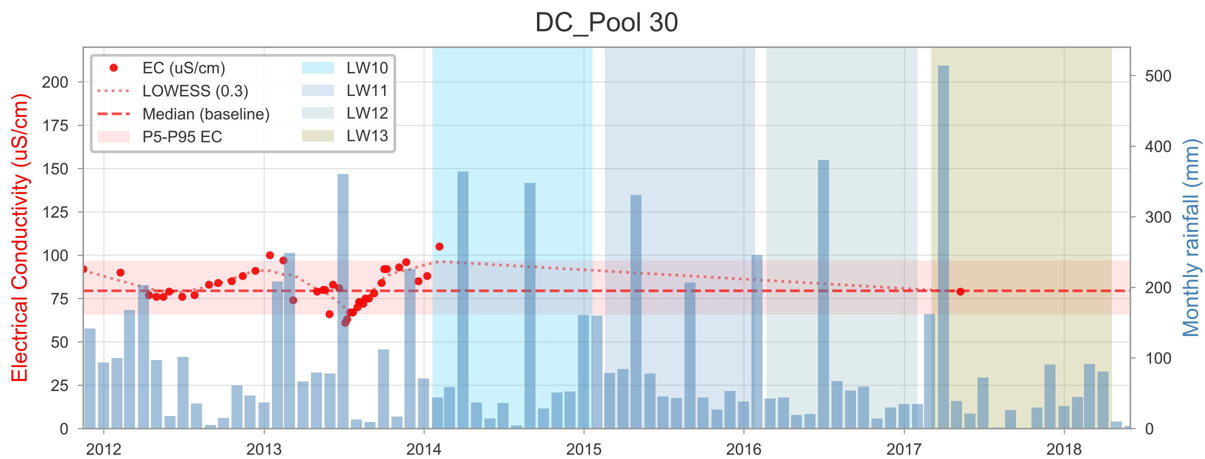

DC_Pool 29
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13

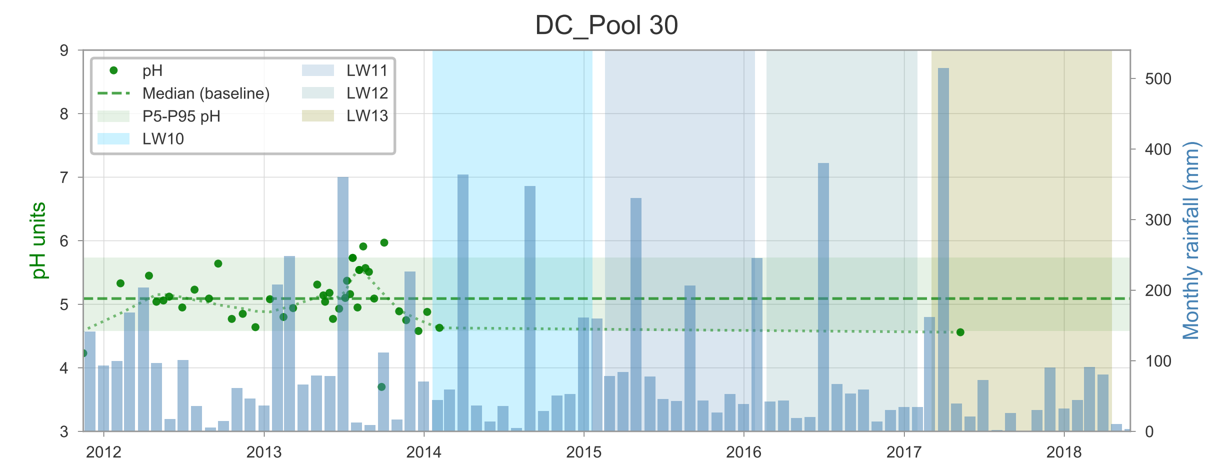

DC_Pool 29
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13

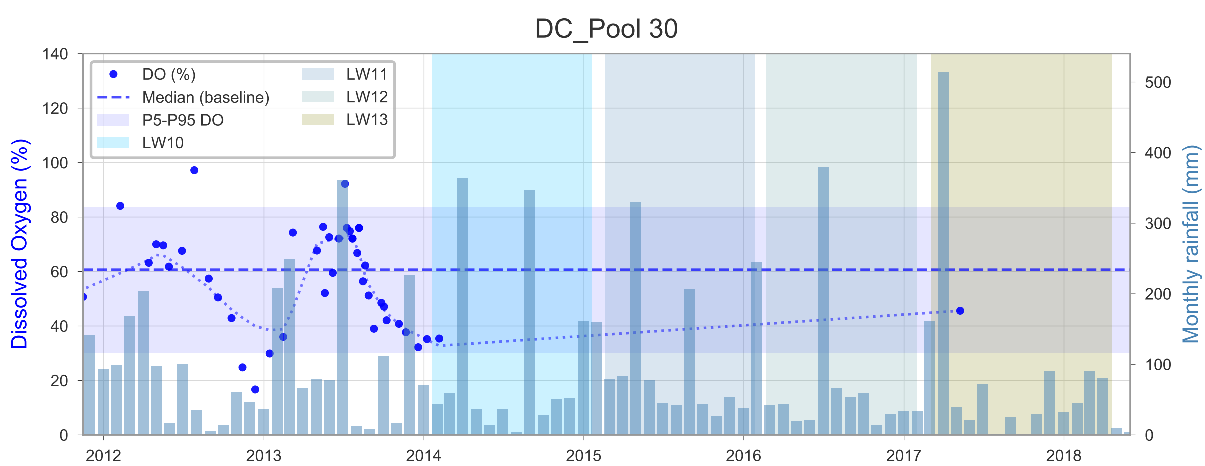

DC_Pool 29
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13

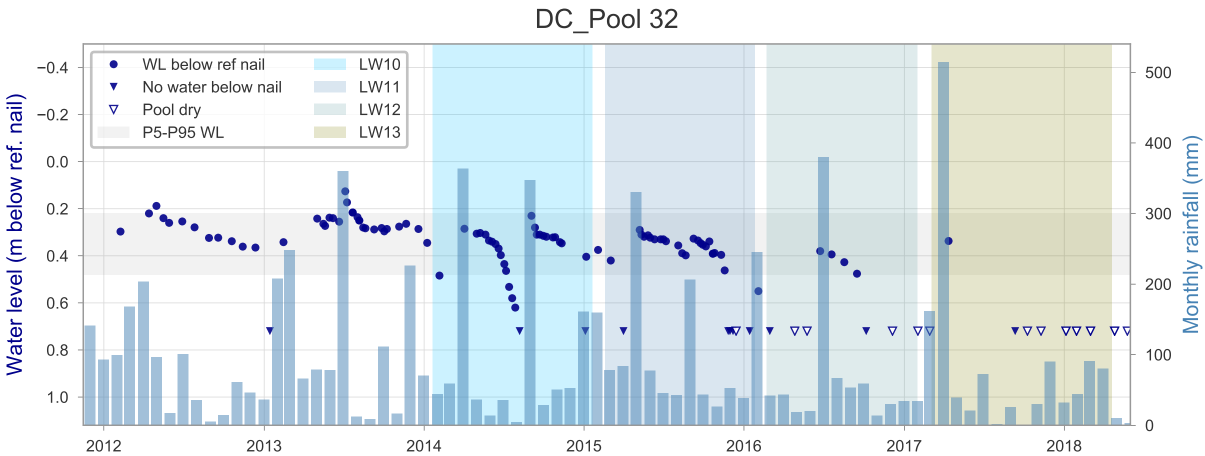

DC_Pool 29
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13

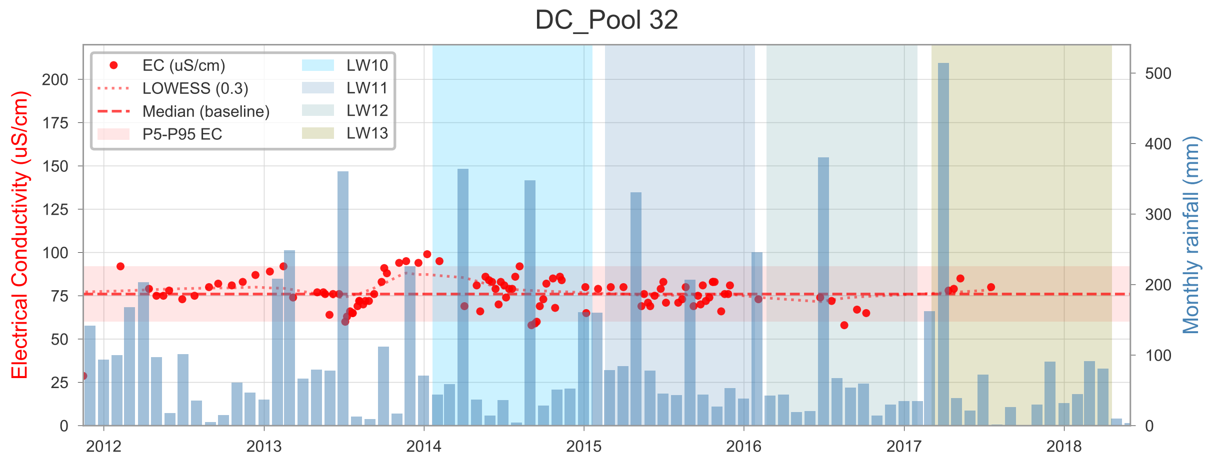

DC_Pool 30
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)

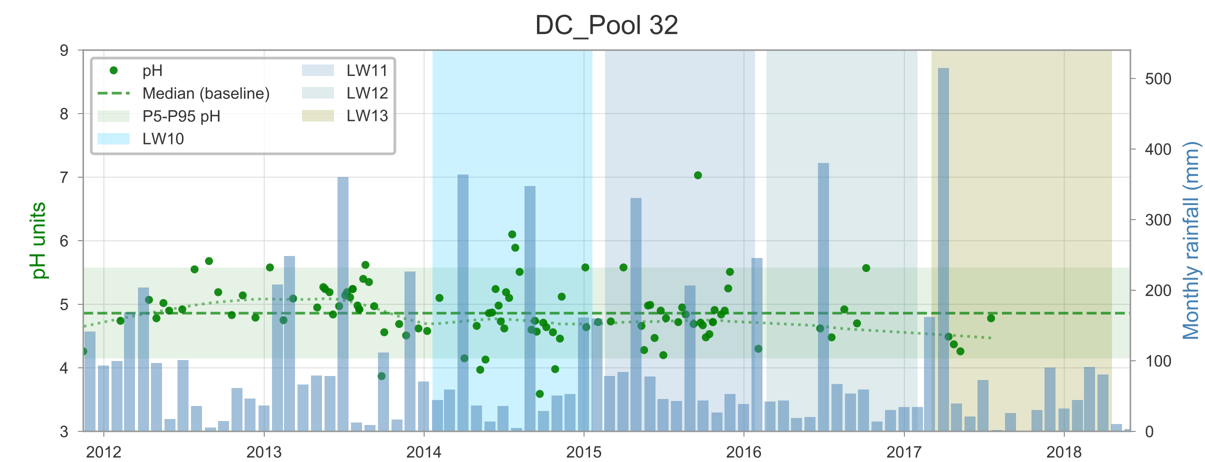

DC_Pool 30
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)

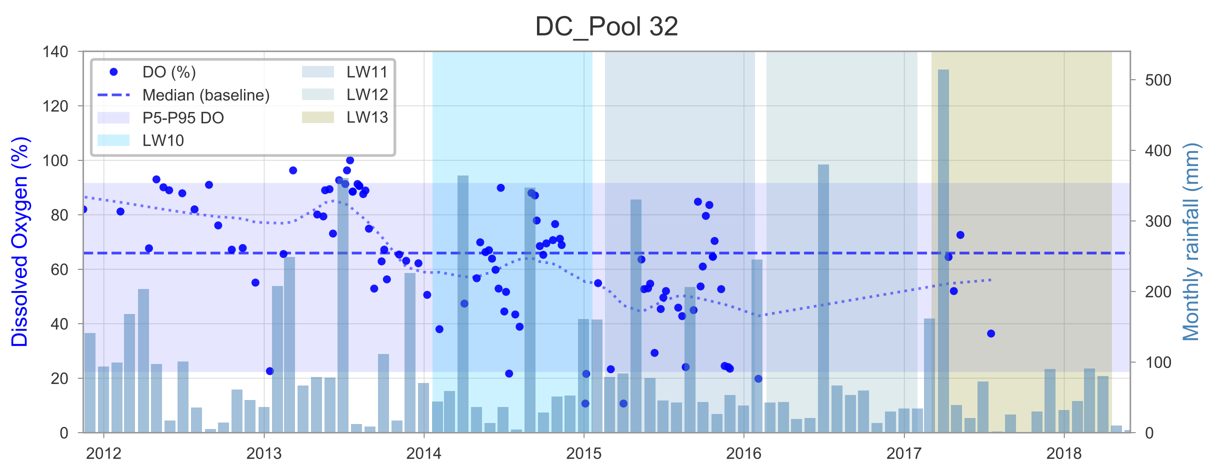

DC_Pool 30
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)

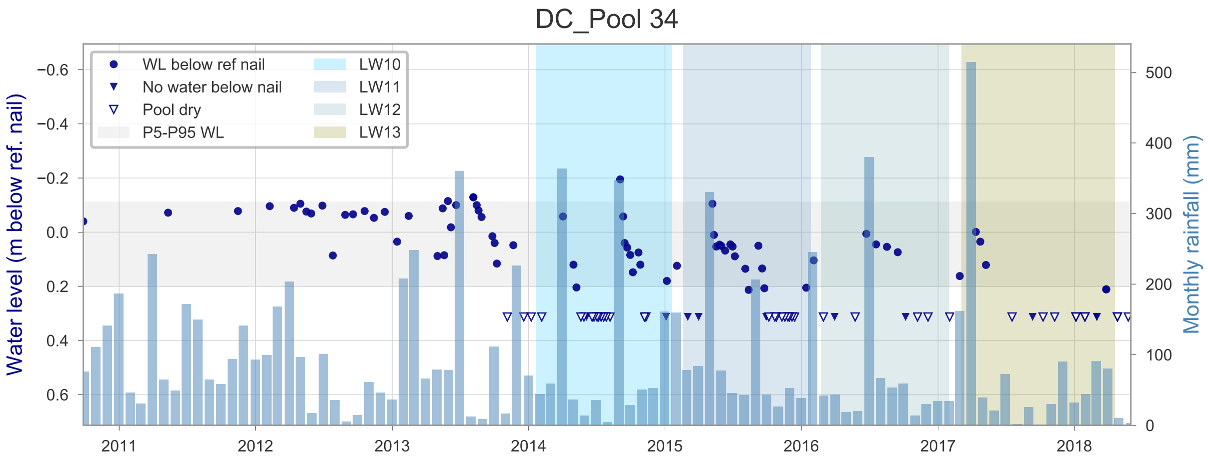

DC_Pool 30
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)

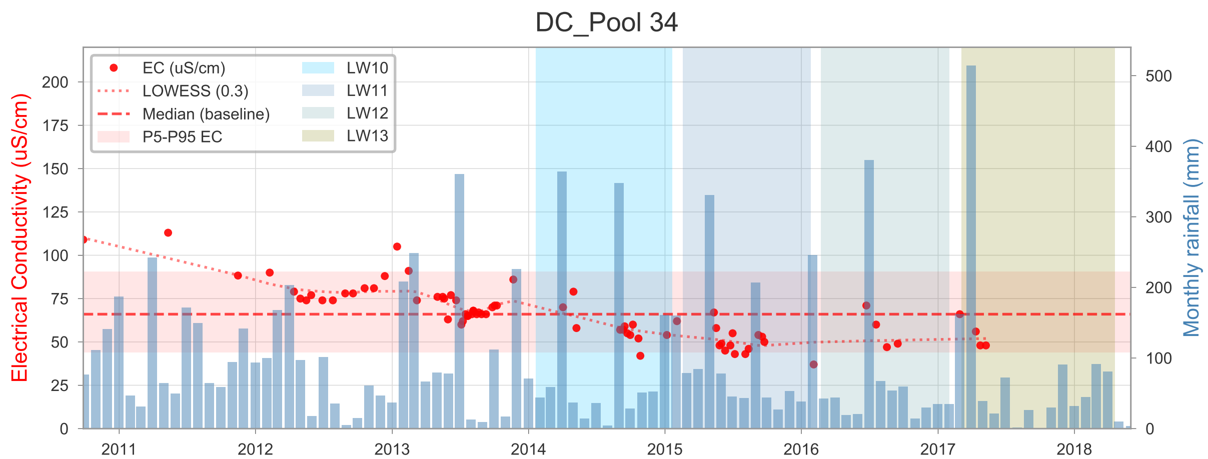

DC_Pool 32
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)

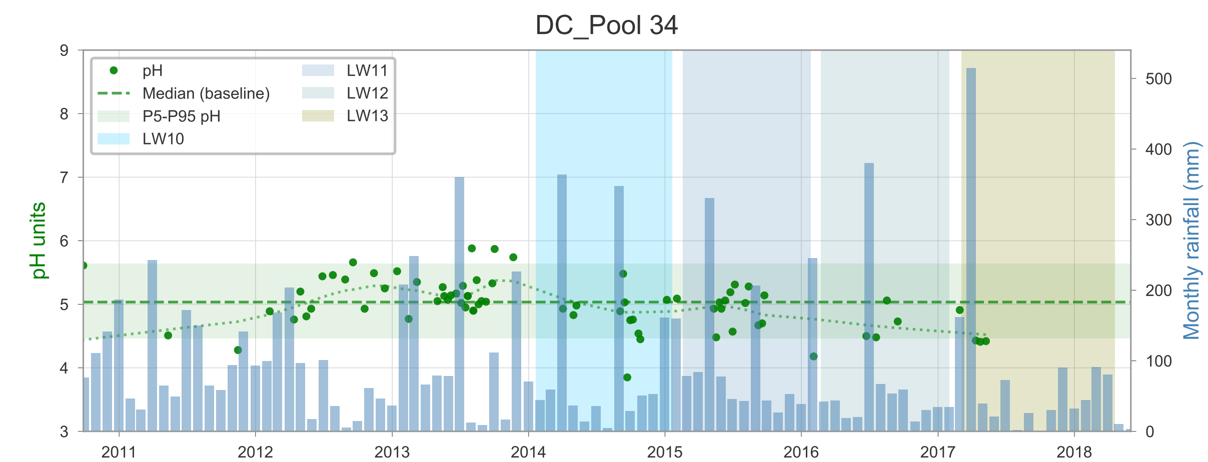

DC_Pool 32
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)

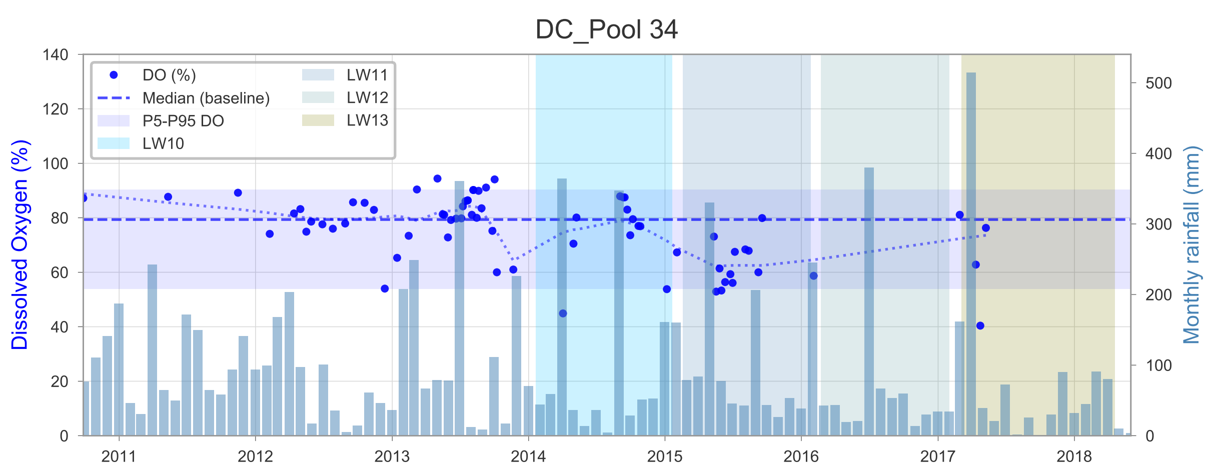

DC_Pool 32
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)

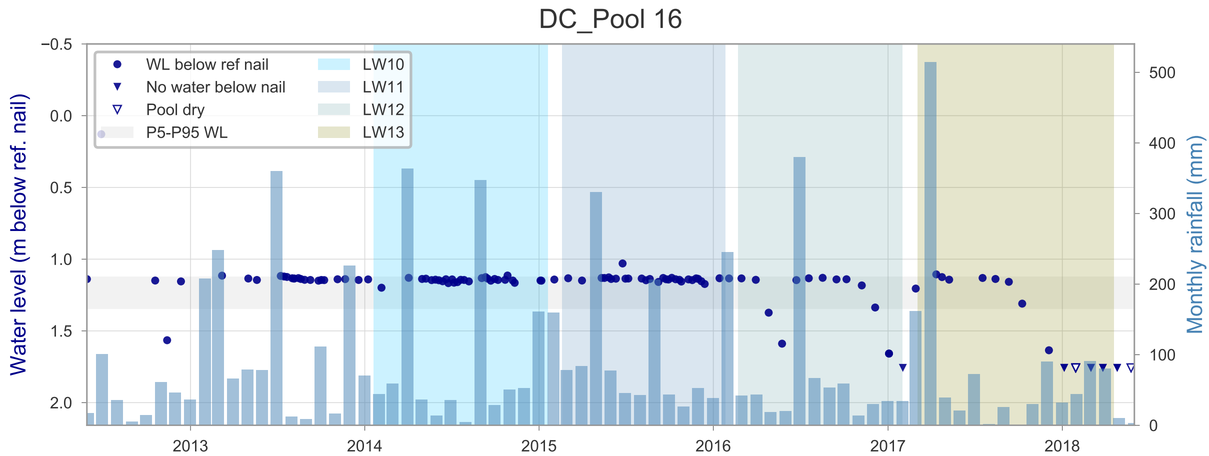

DC_Pool 32
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)

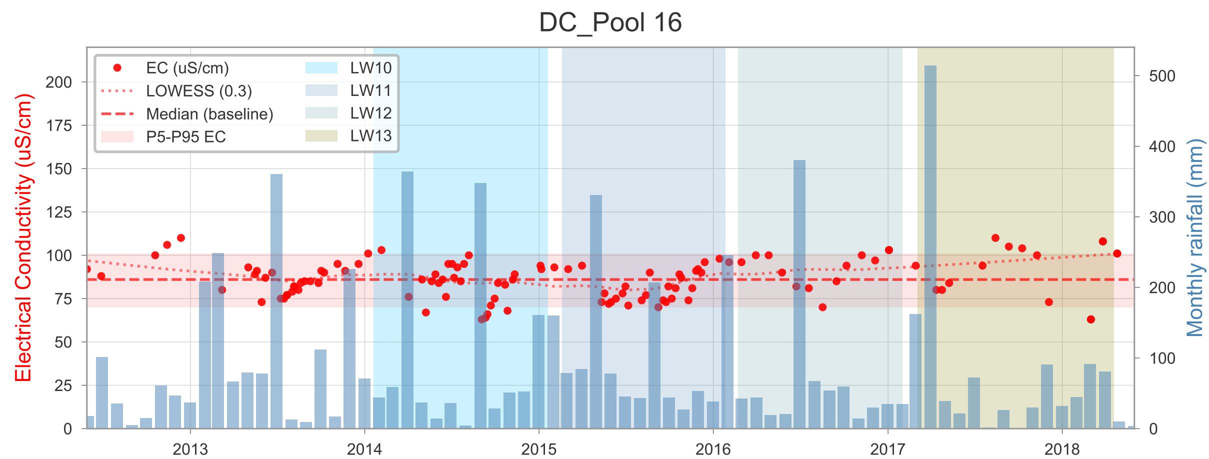

DC_Pool 34
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
−0.6
−0.4
−0.2
0.0
0.2
0.4
0.6
0
100
200
300
400
500
2011
2012
2013
2014
2015
2016
2017
2018

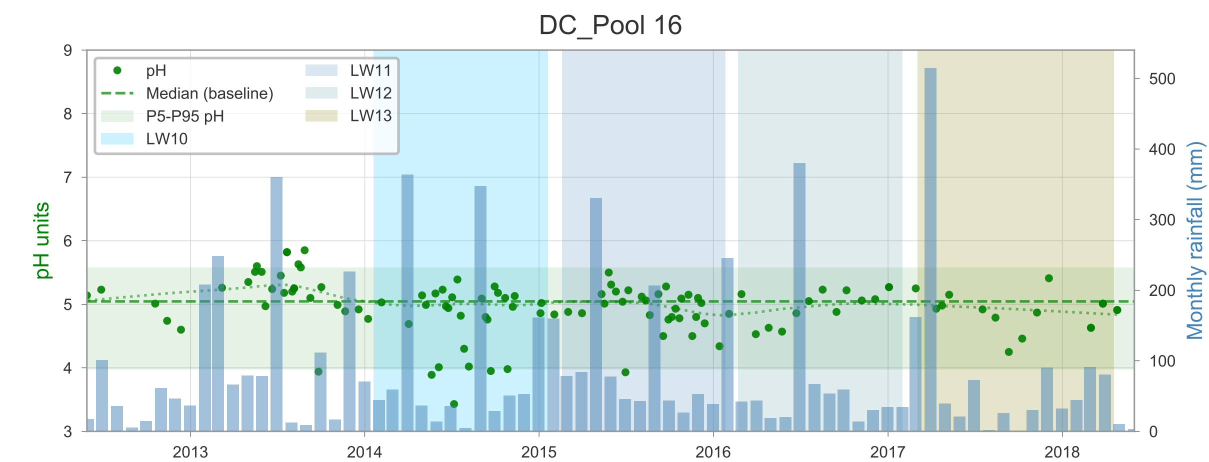

DC_Pool 34
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2011
2012
2013
2014
2015
2016
2017
2018

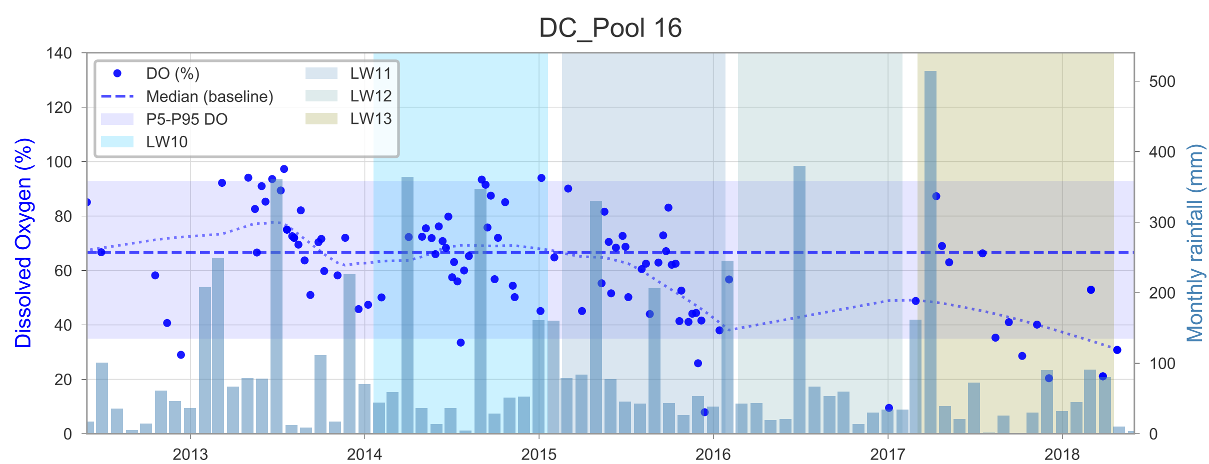

DC_Pool 34
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
3
4
5
6
7
8
9
0
100
200
300
400
500
2011
2012
2013
2014
2015
2016
2017
2018

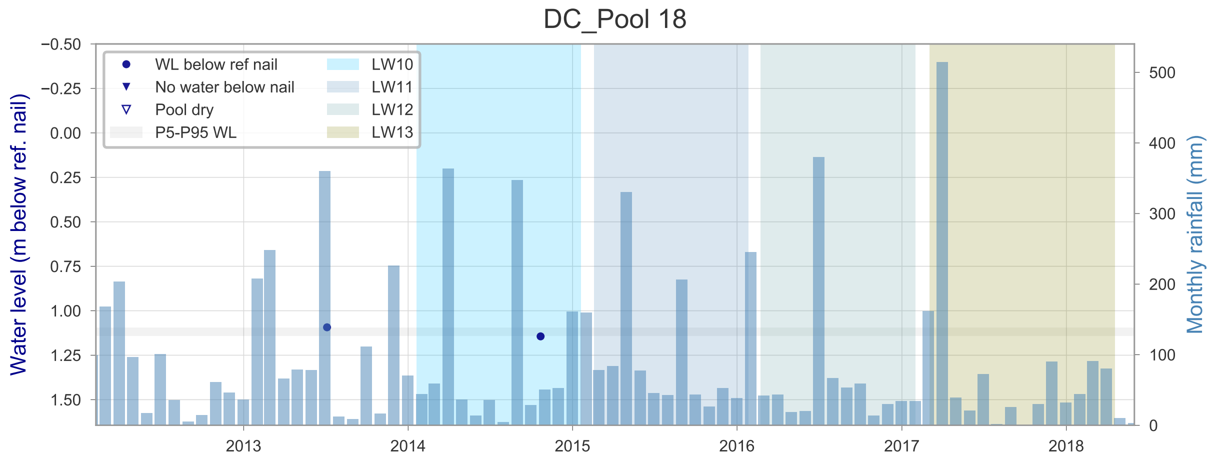

DC_Pool 34
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2011
2012
2013
2014
2015
2016
2017
2018

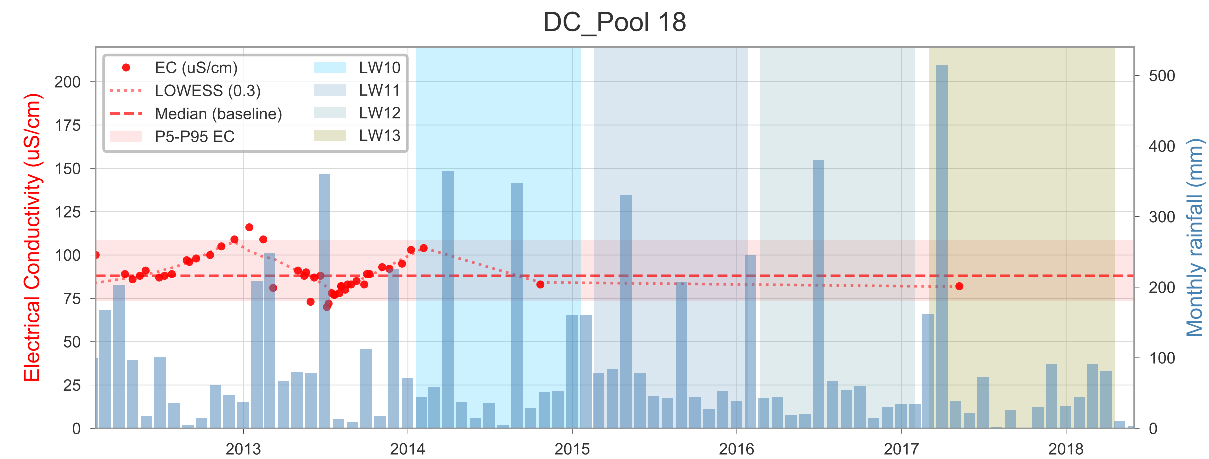

DC_Pool 16
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)

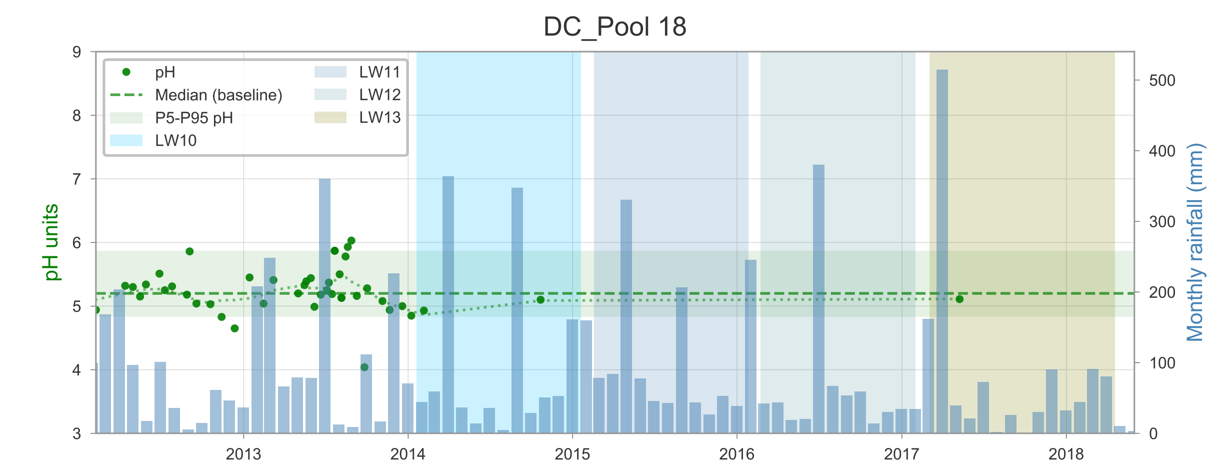

DC_Pool 16
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)

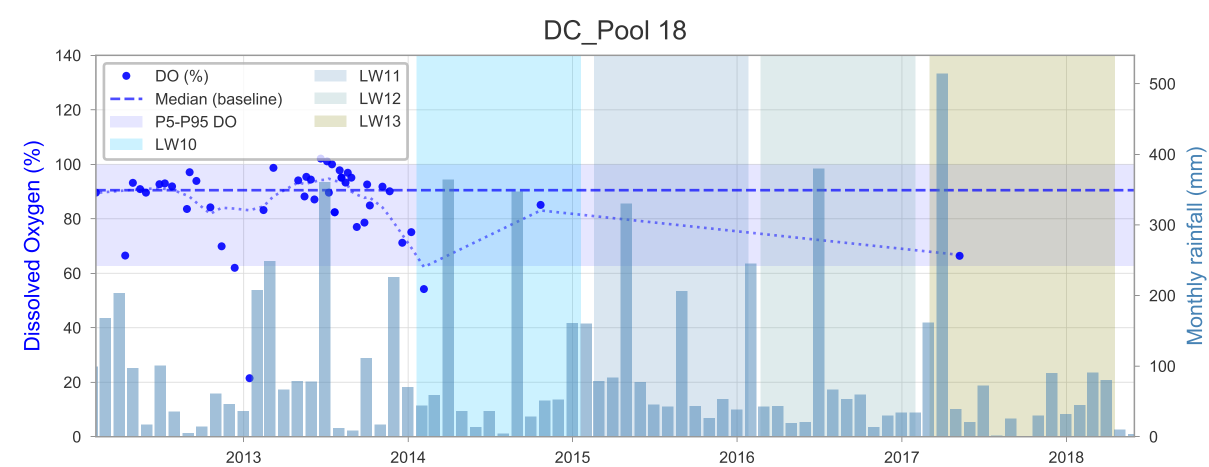

DC_Pool 16
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)

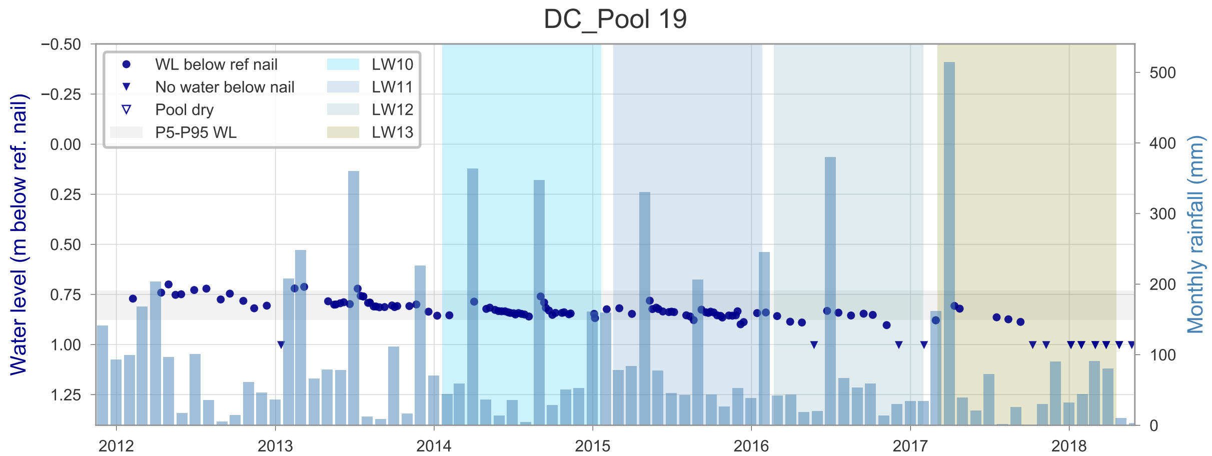

DC_Pool 16
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)

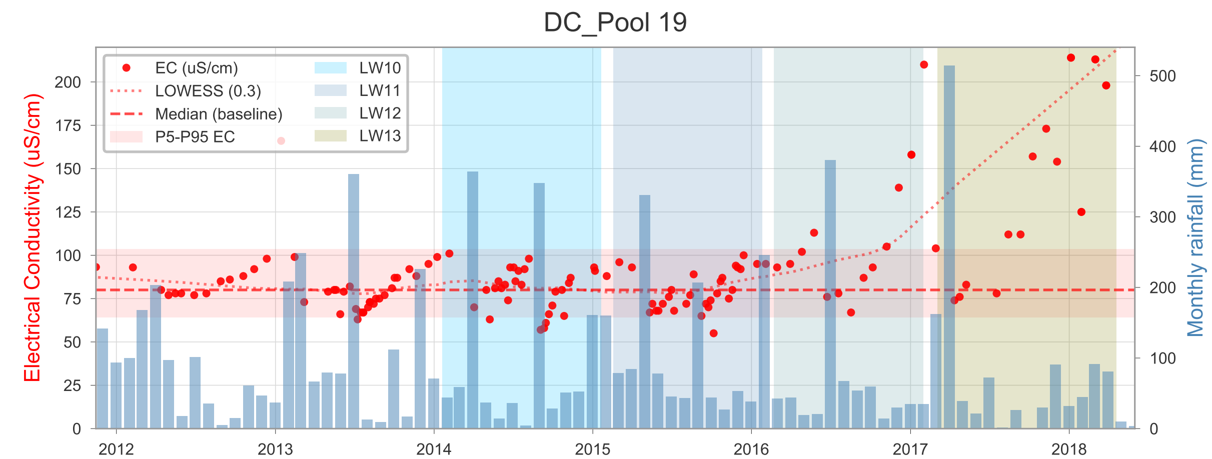

DC_Pool 18
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

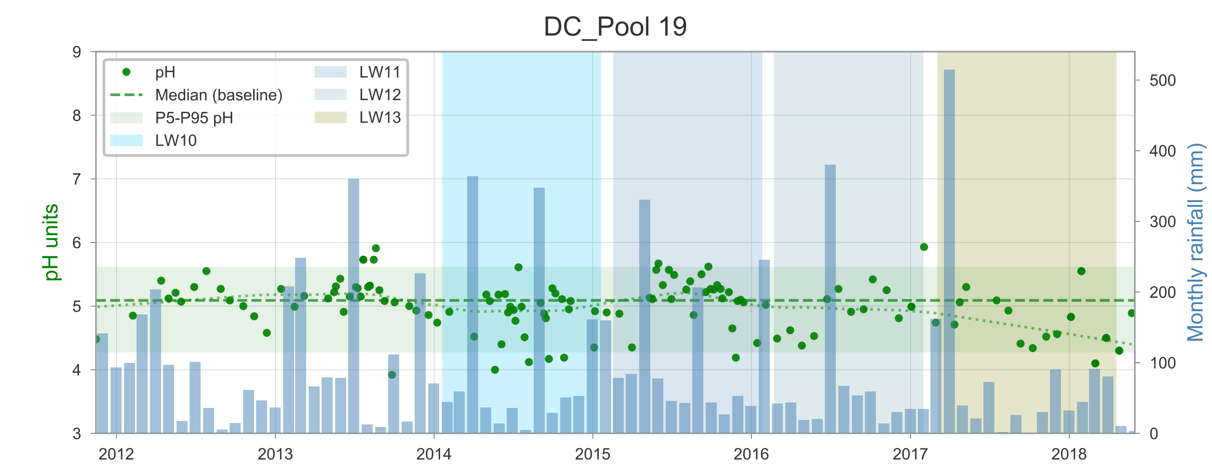

DC_Pool 18
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

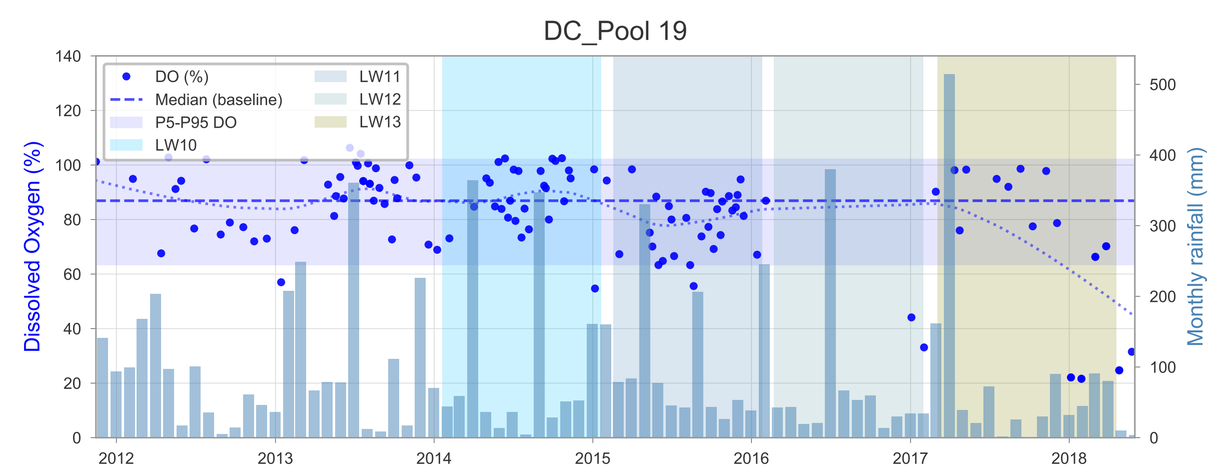

DC_Pool 18
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

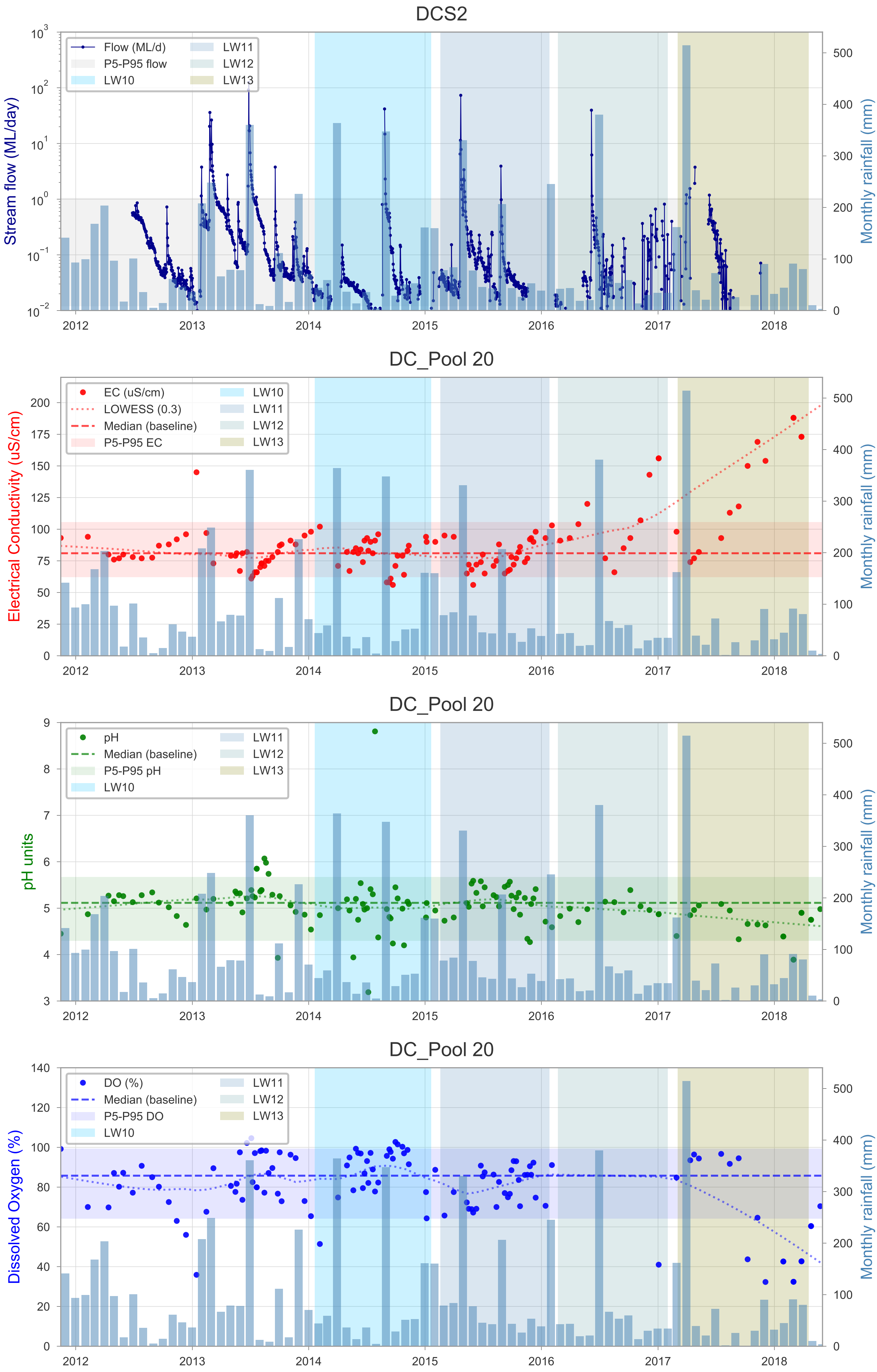

DC_Pool 18
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

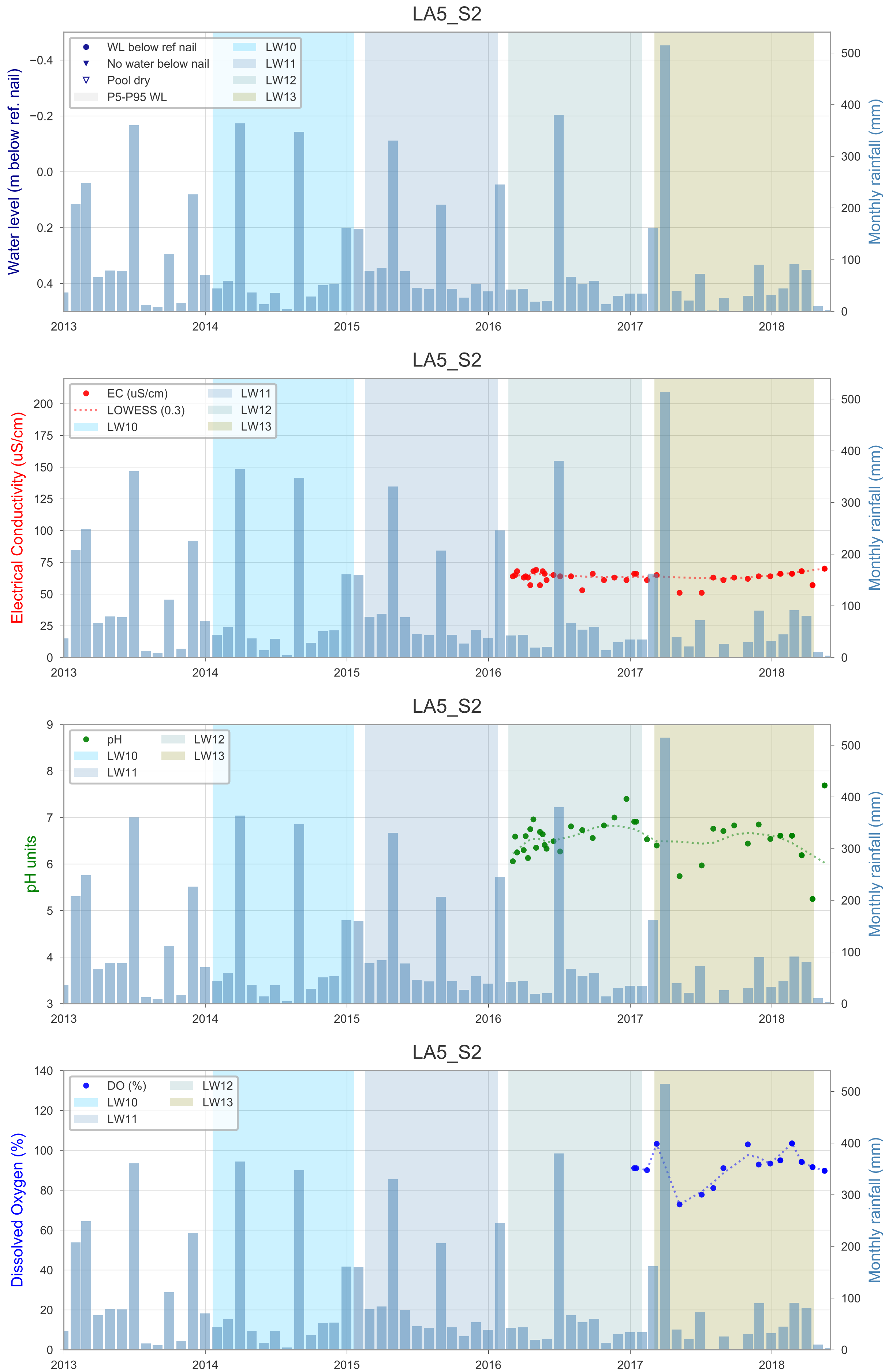

DC_Pool 19
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13

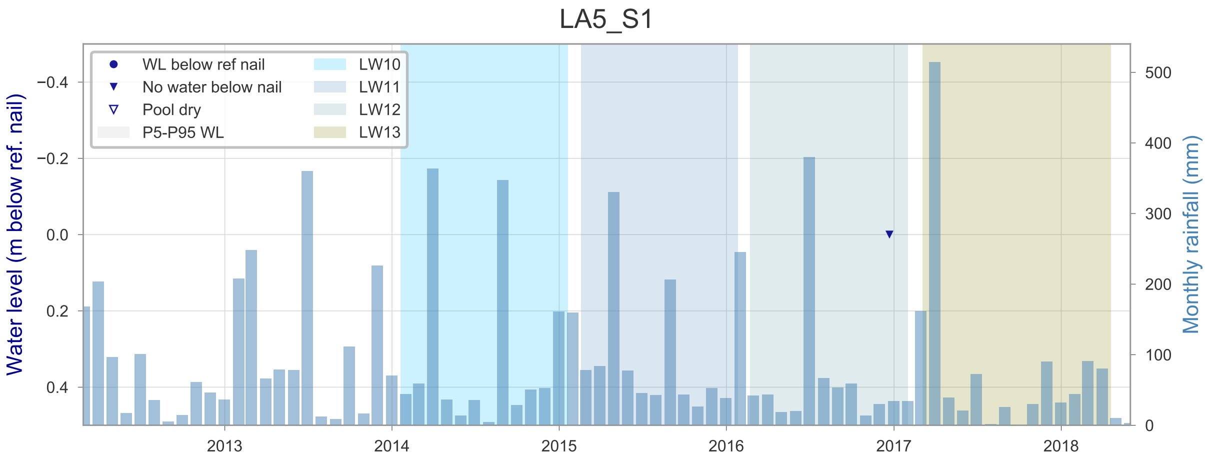

DC_Pool 19
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13


DC_Pool 19
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13

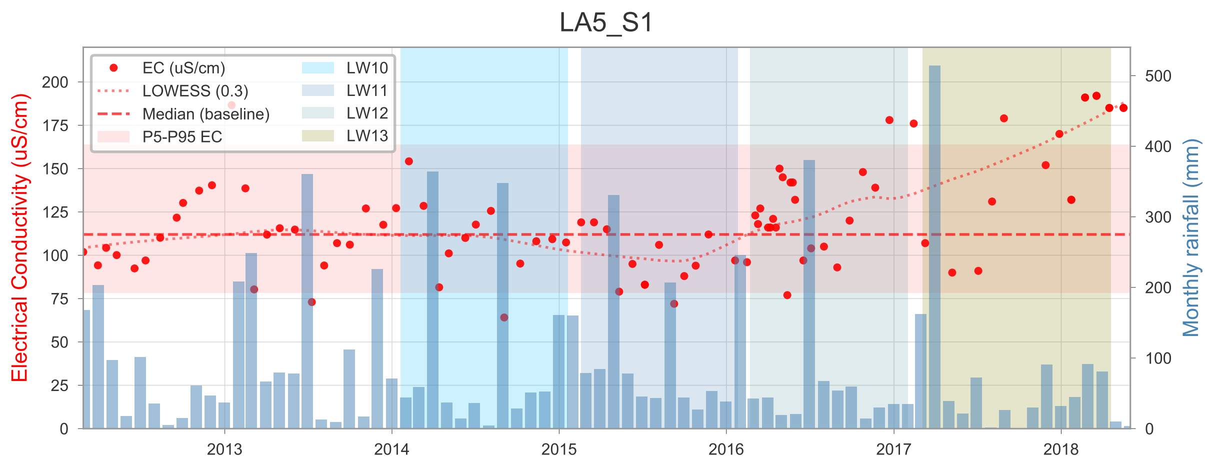

DC_Pool 19
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13


DCS2
Stream flow (ML/day)
Monthly rainfall (mm)
Flow (ML/d)
P5-P95 flow
LW10
LW11
LW12
LW13
DC_Pool 20
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
DC_Pool 20
pH units
pH
Median (baseline)
P5-P95 pH
DC_Pool 20
Dissolved Oxygen (%)
DO (%)
Median (baseline)
P5-P95 DO
2012
2013
2014
2015
2016
2017
2018

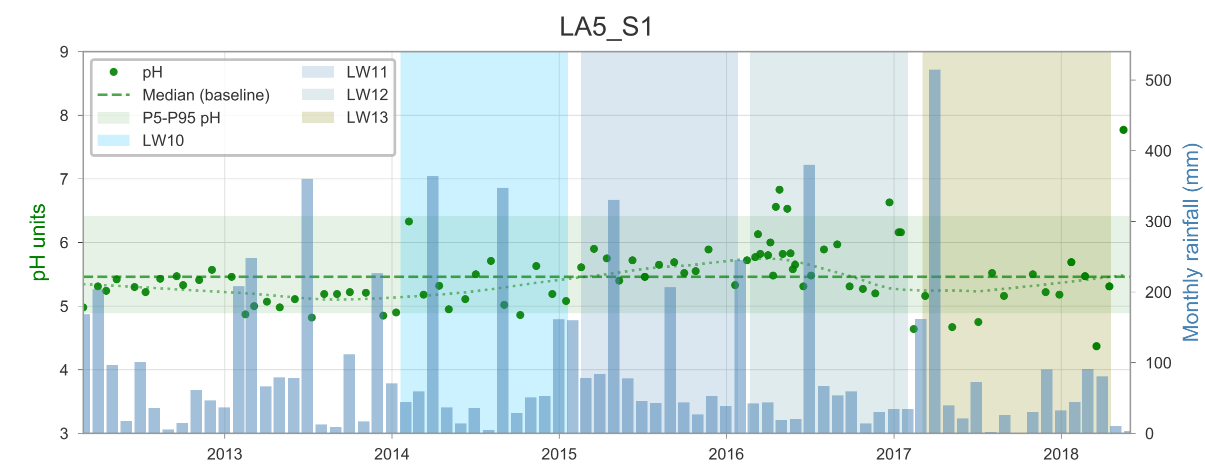

LA5_S2
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
LA5_S2
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
LW10
LW11
LW12
LW13
LA5_S2
pH units
Monthly rainfall (mm)
pH
LW10
LW11
LW12
LW13
LA5_S2
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
LW10
LW11
LW12
LW13
2013
2014
2015
2016
2017
2018



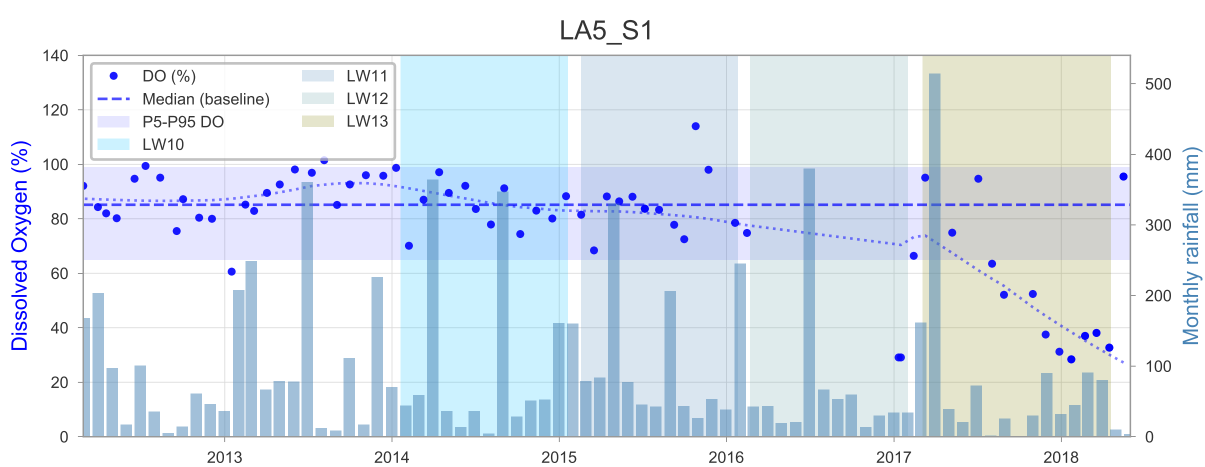
LA5_S1
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13



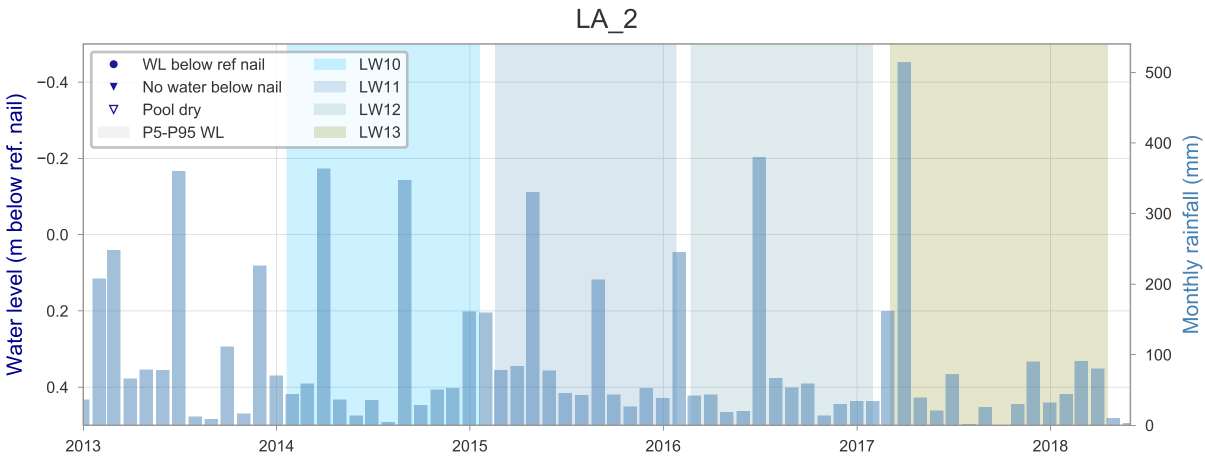
LA5_S1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13

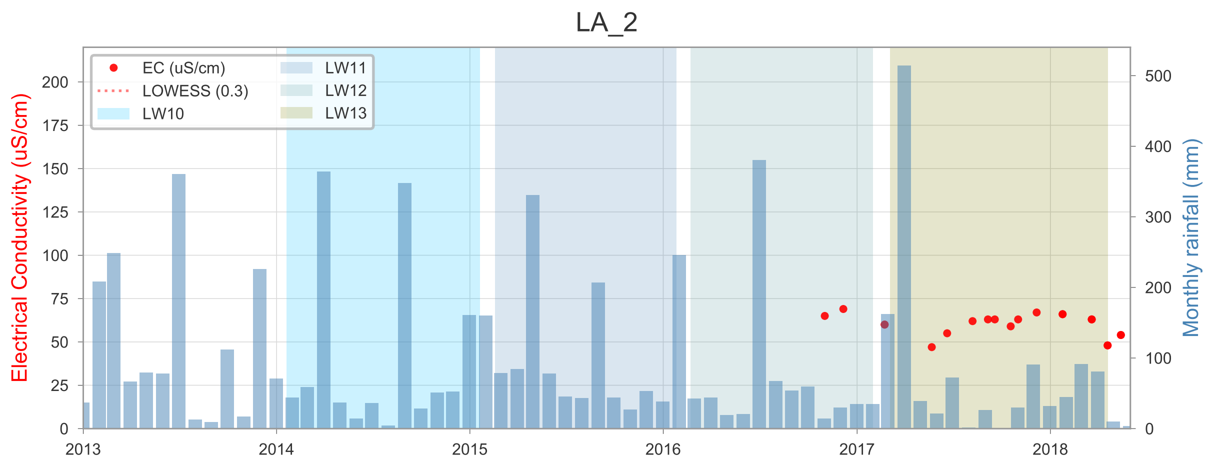


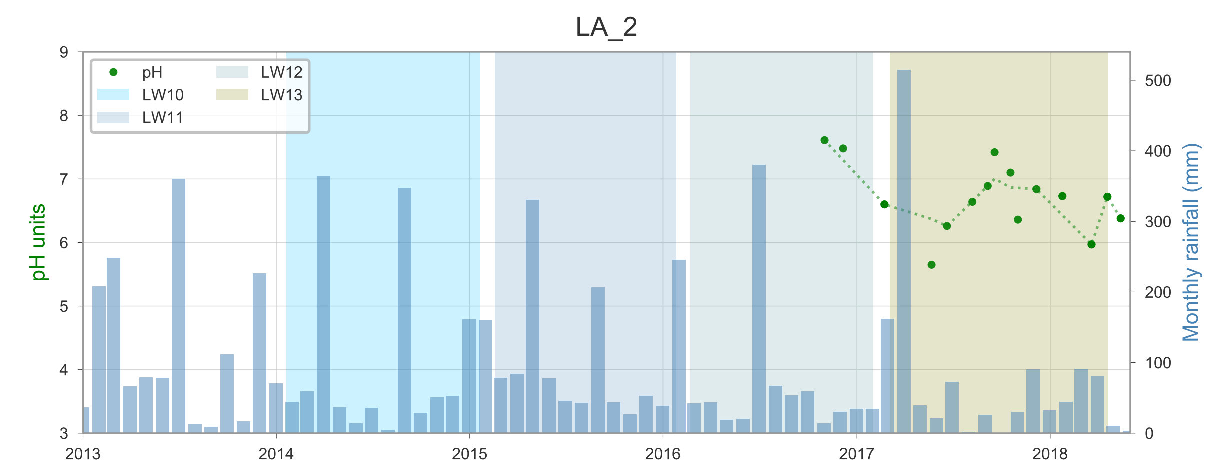
LA5_S1
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13

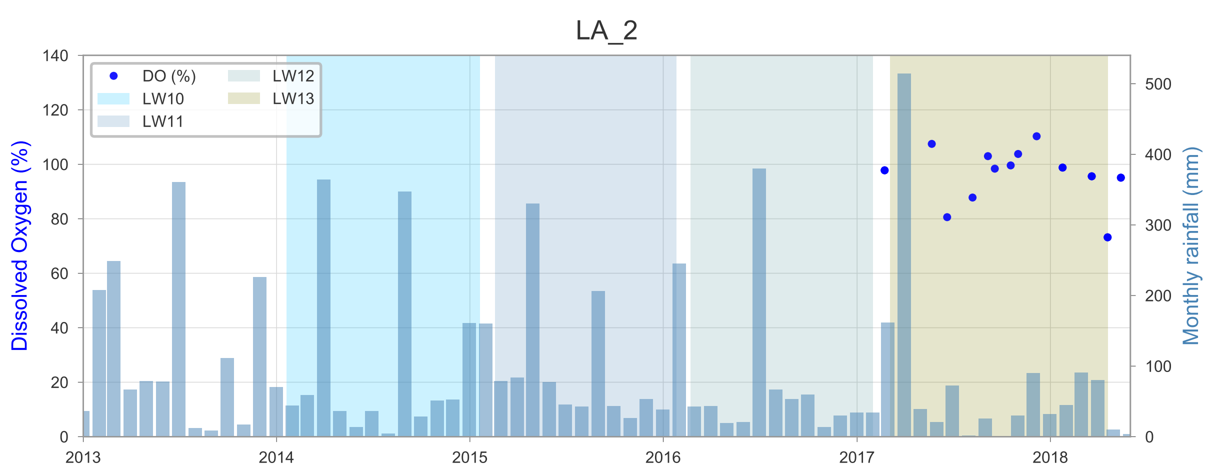


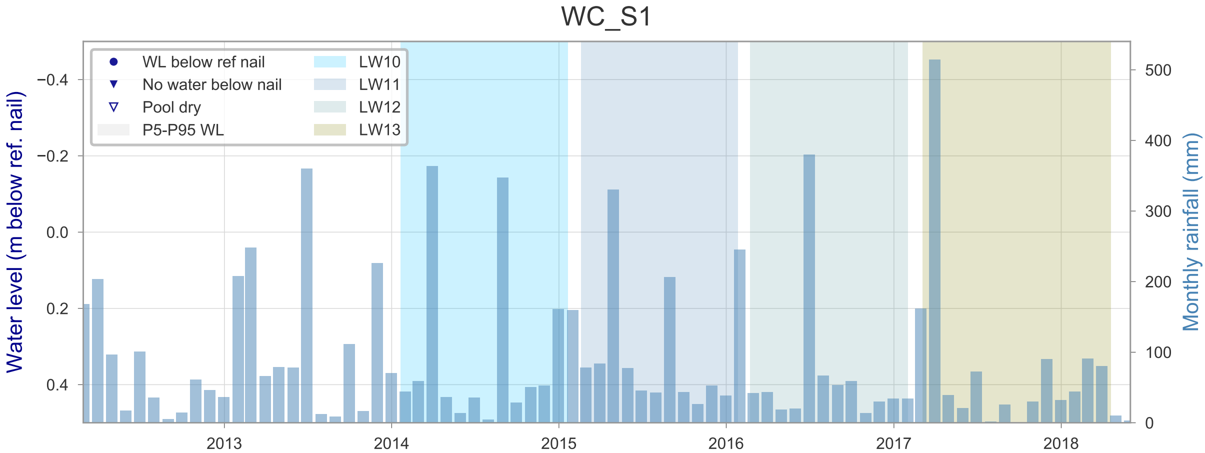
LA5_S1
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13

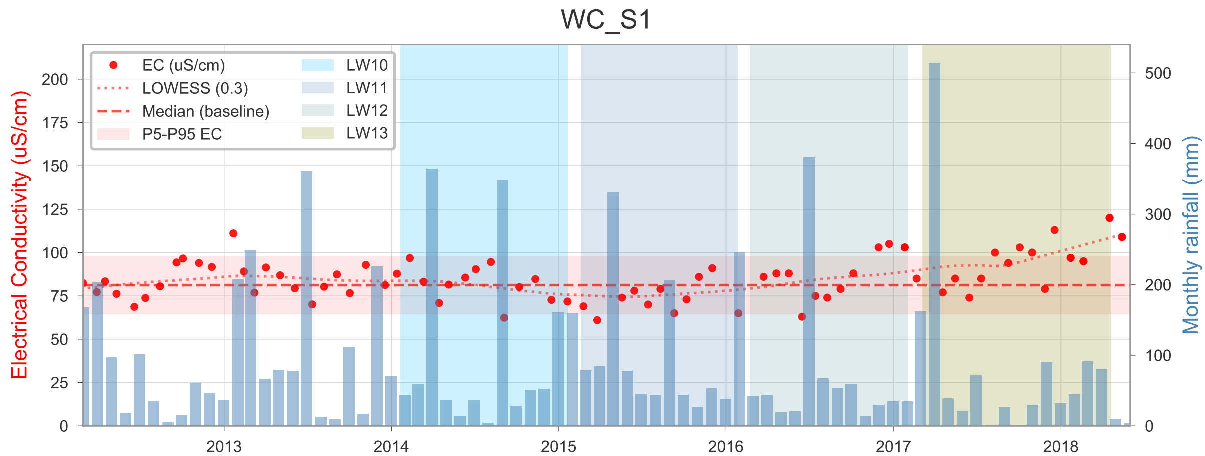

LA_2
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)

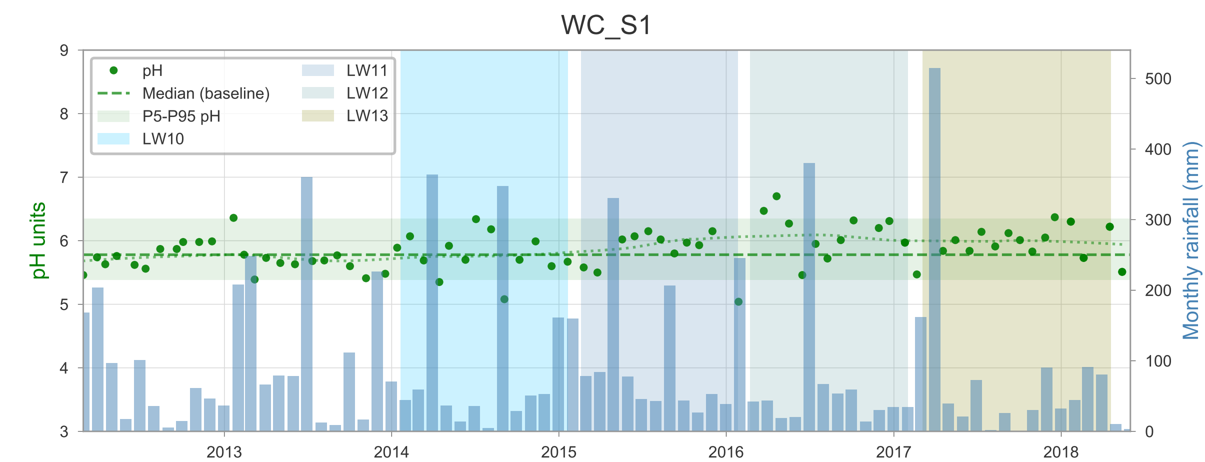

LA_2
EC (uS/cm)
LOWESS (0.3)
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)

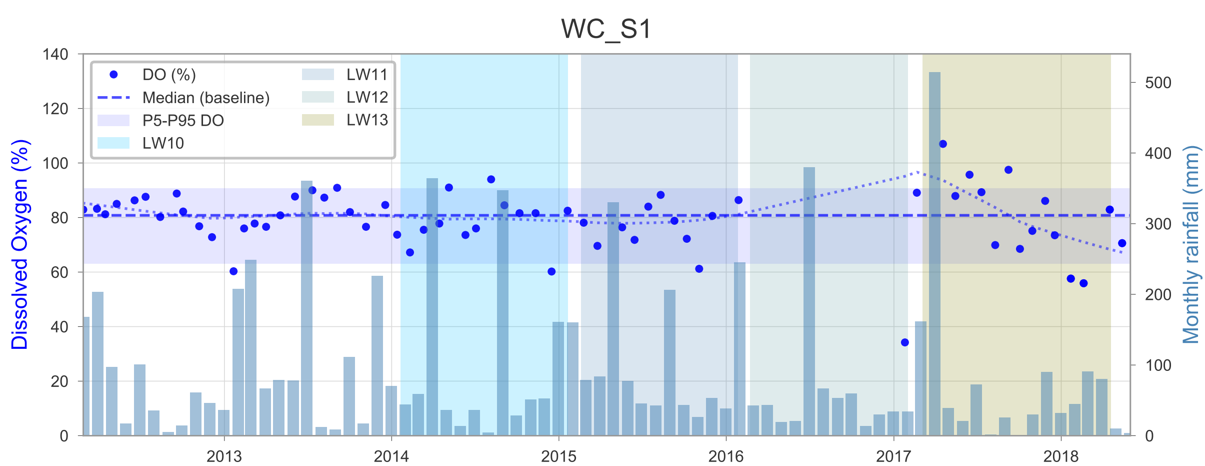

LA_2
pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)

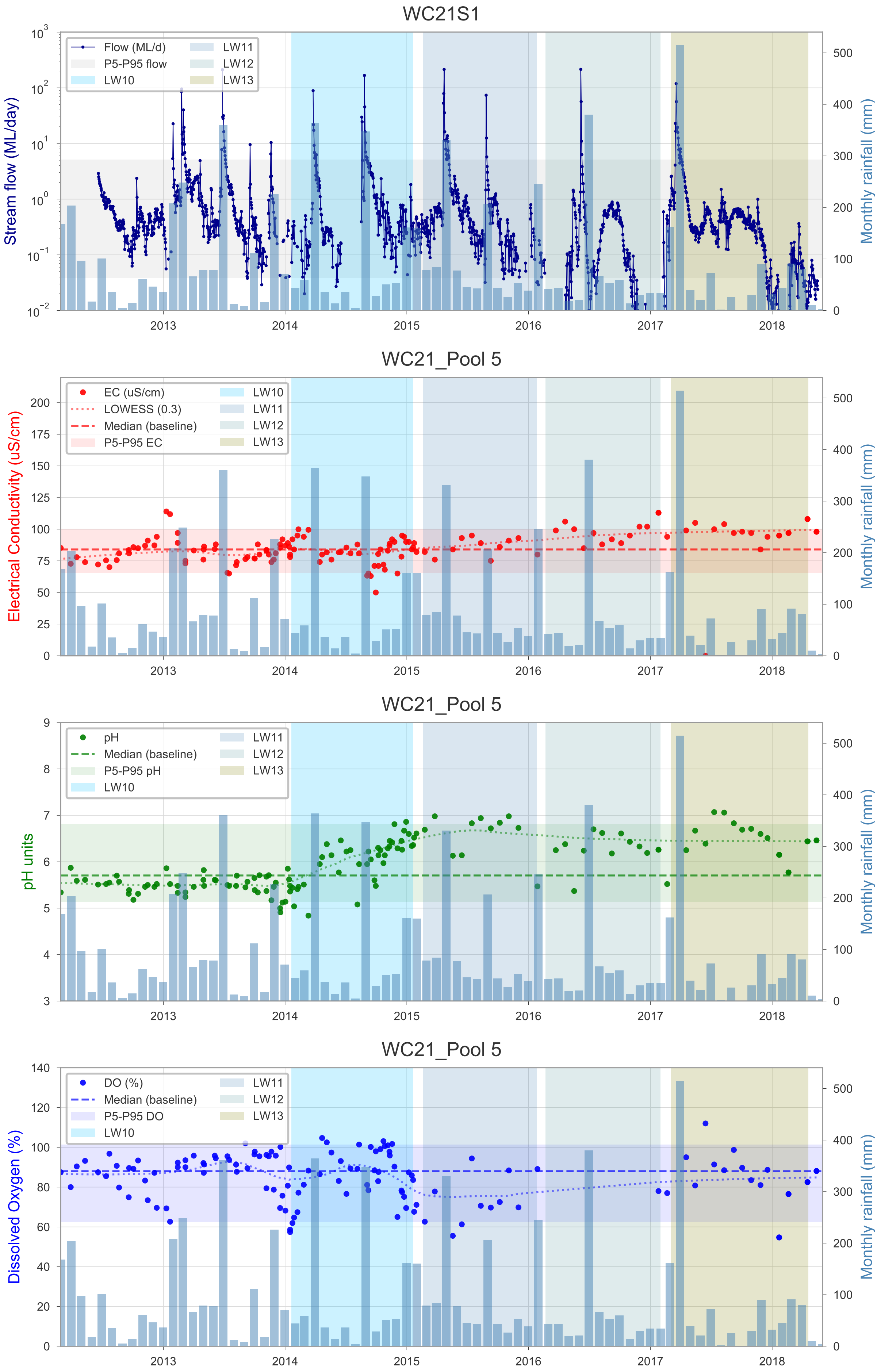

LA_2
DO (%)
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)


WC_S1
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

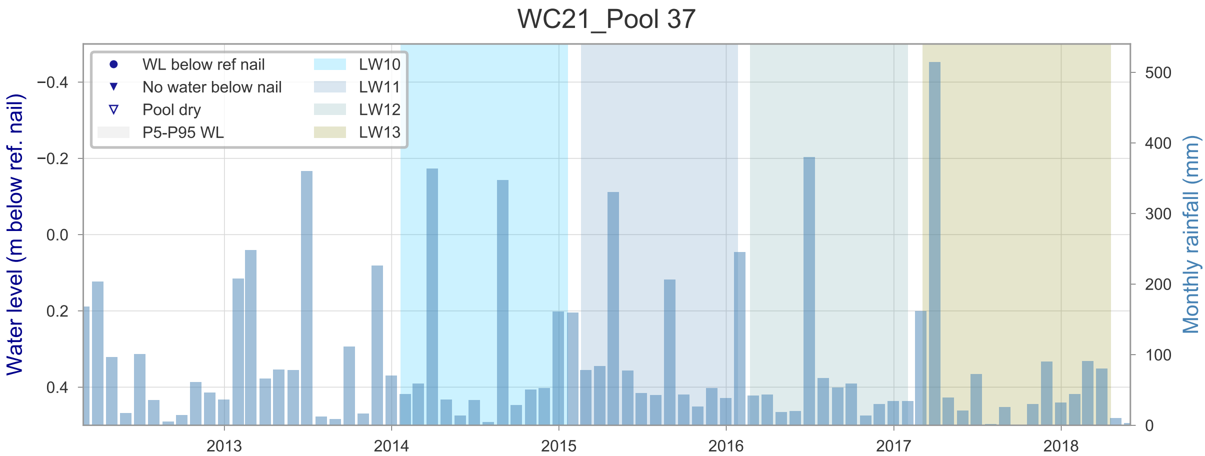

WC_S1
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

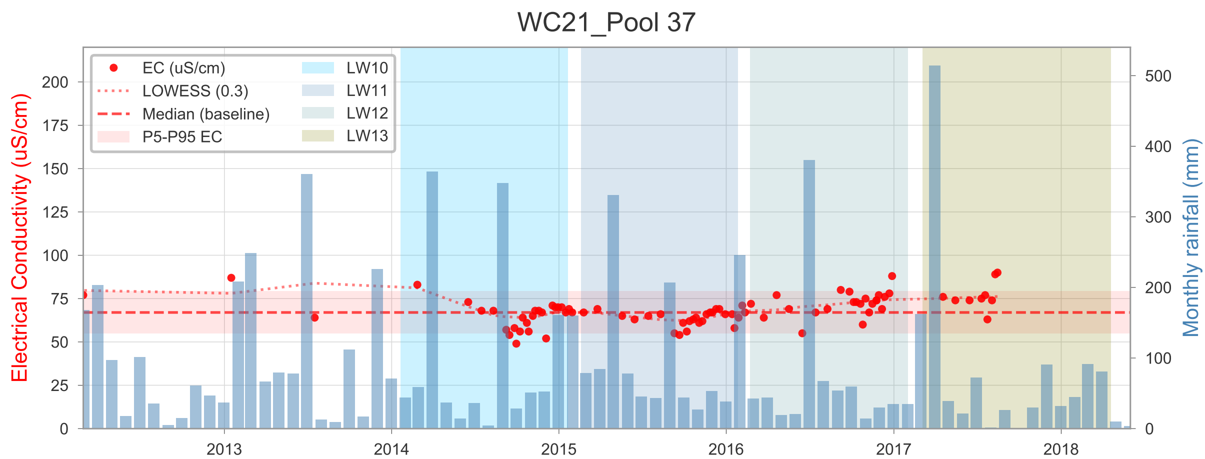

WC_S1
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

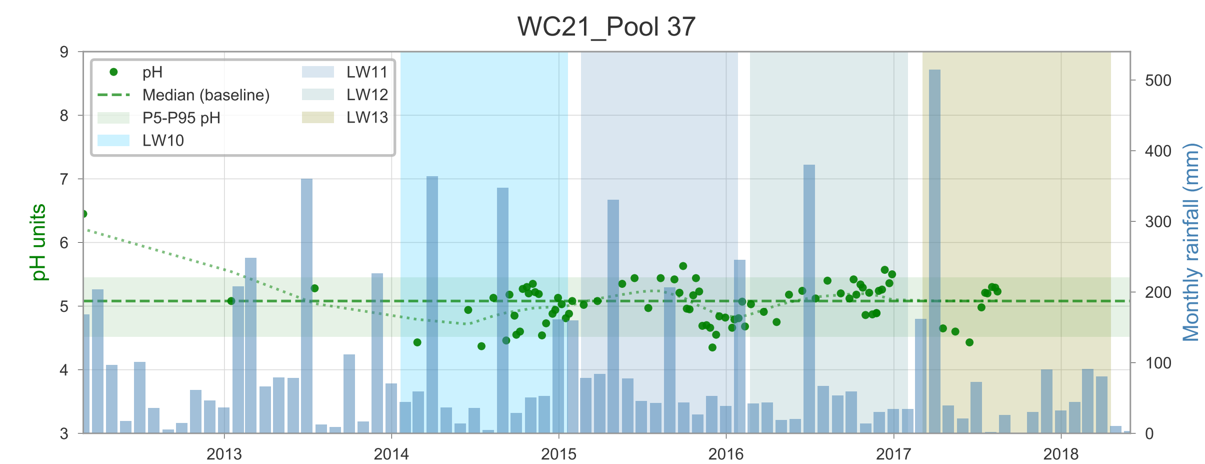

WC_S1
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

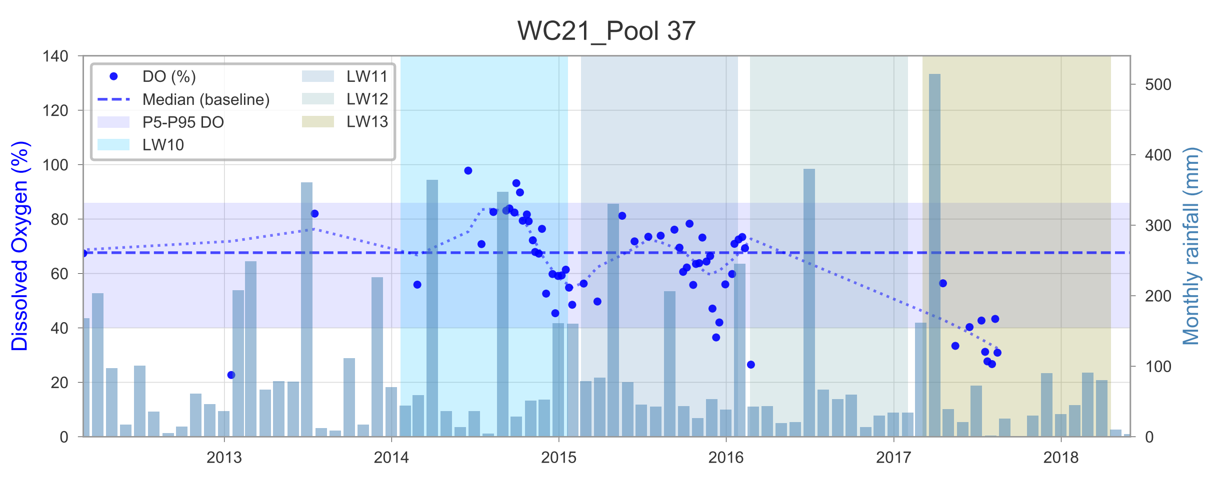


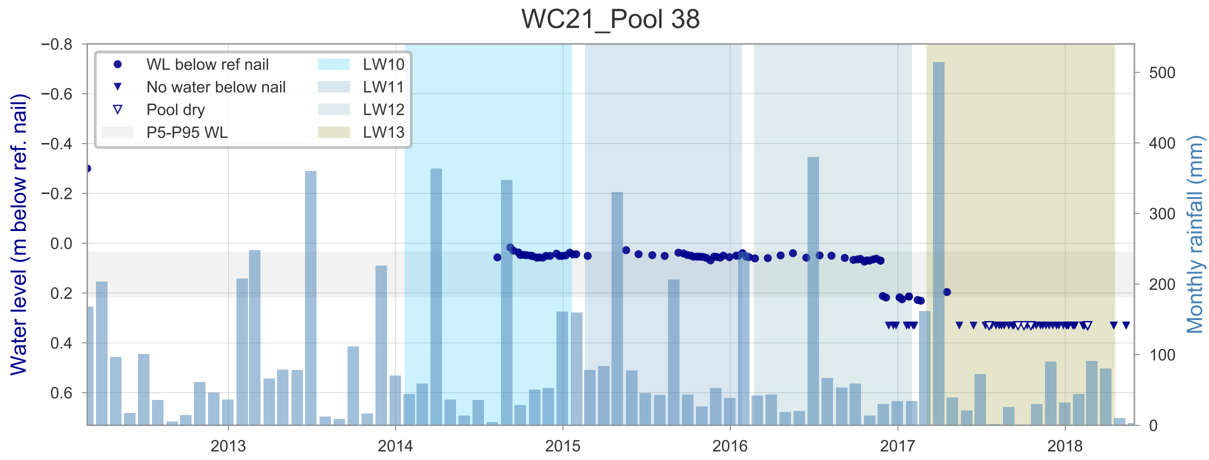
WC21S1
Stream flow (ML/day)
Monthly rainfall (mm)
Flow (ML/d)
P5-P95 flow
LW10
LW11
LW12
LW13
WC21_Pool 5
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
WC21_Pool 5
pH units
pH
Median (baseline)
P5-P95 pH
WC21_Pool 5
Dissolved Oxygen (%)
DO (%)
Median (baseline)
P5-P95 DO
2013
2014
2015
2016
2017
2018

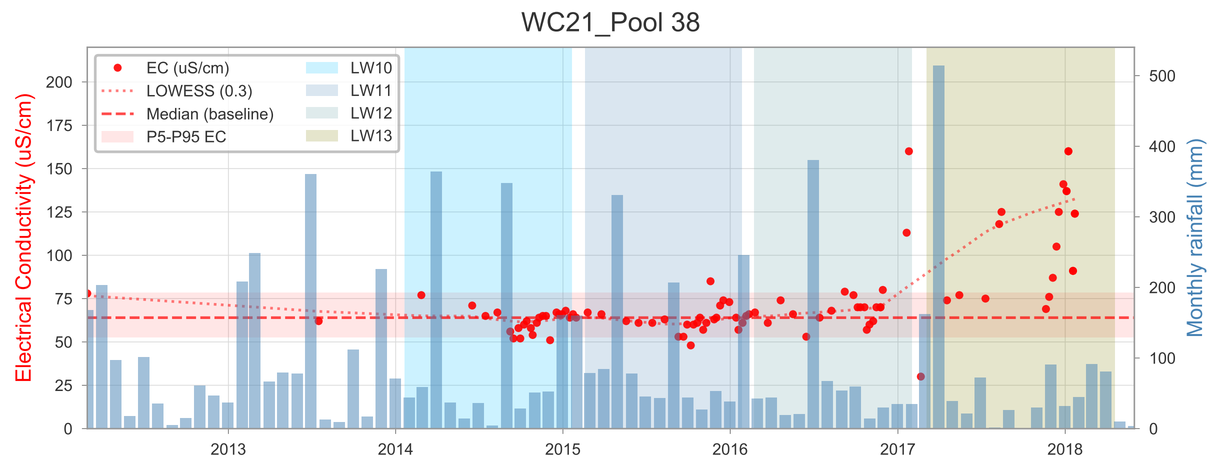

WC21_Pool 37
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

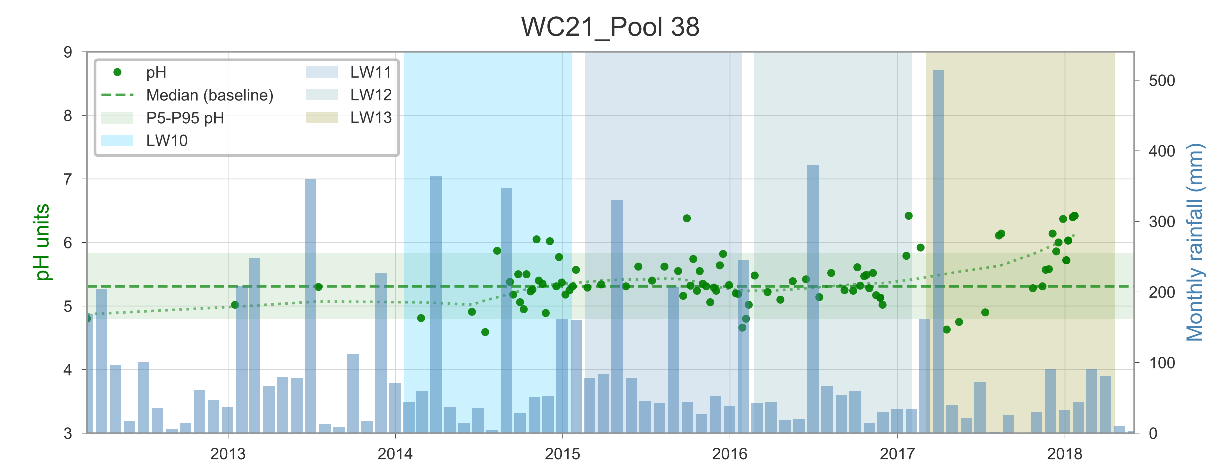

WC21_Pool 37
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

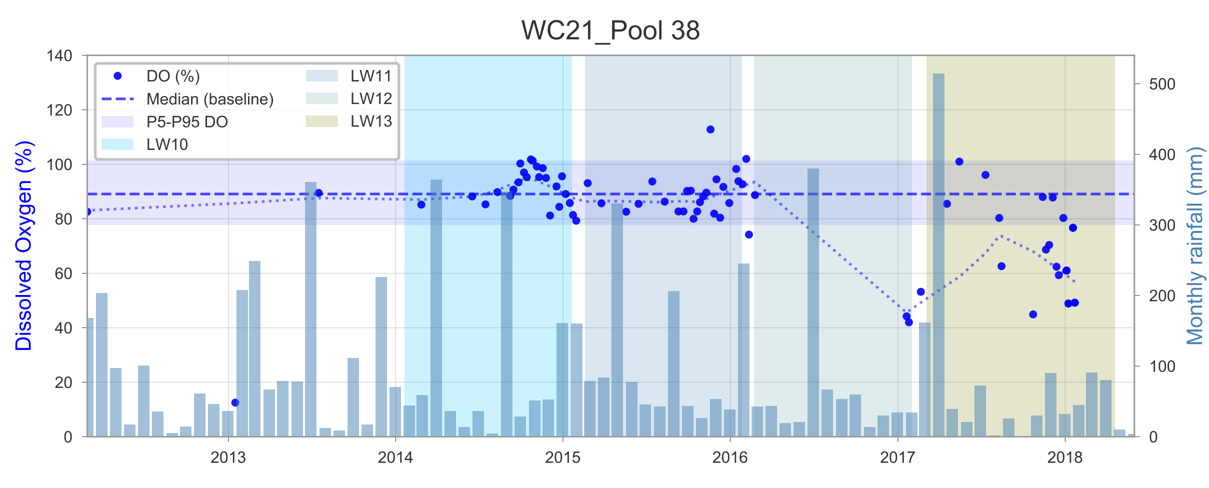

WC21_Pool 37
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

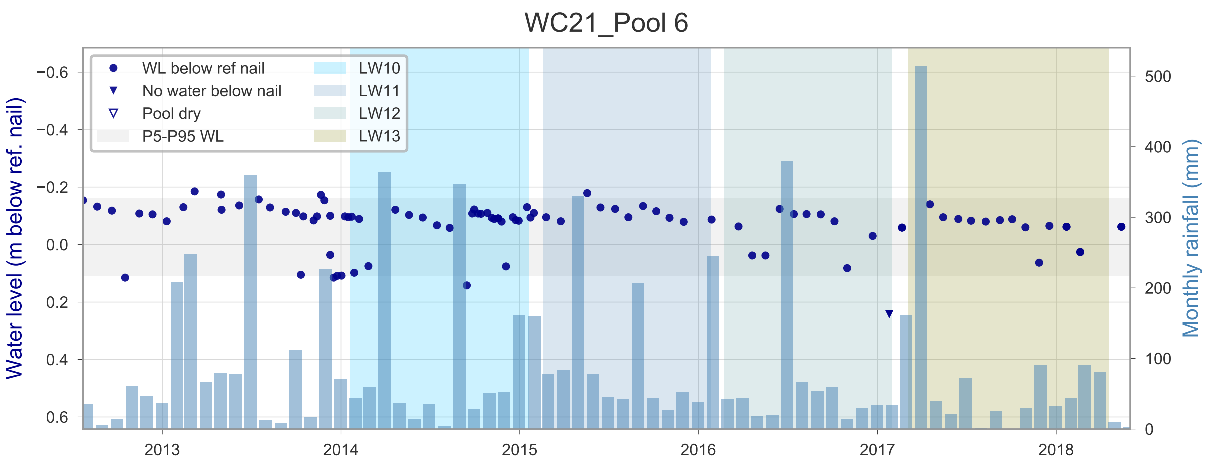

WC21_Pool 37
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

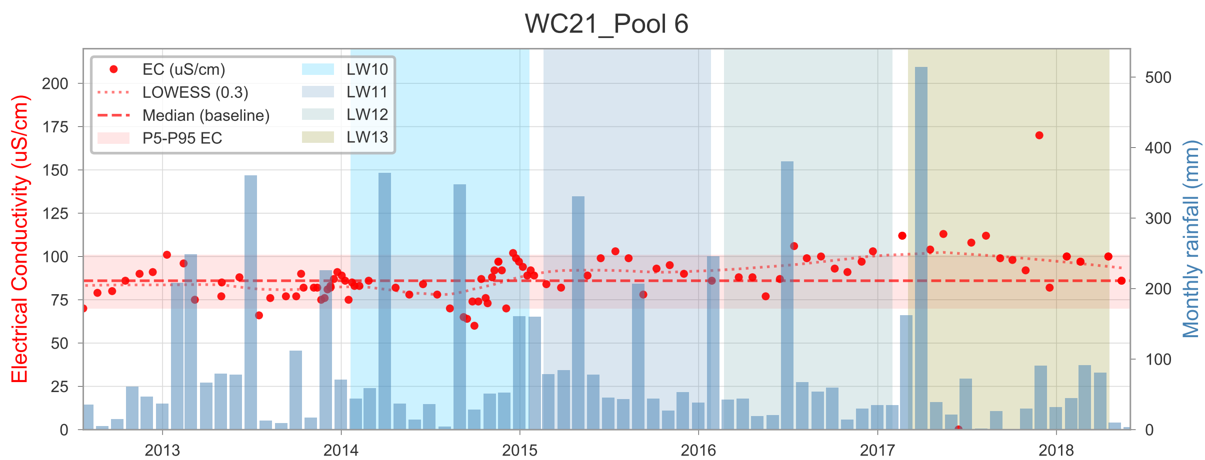

WC21_Pool 38
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

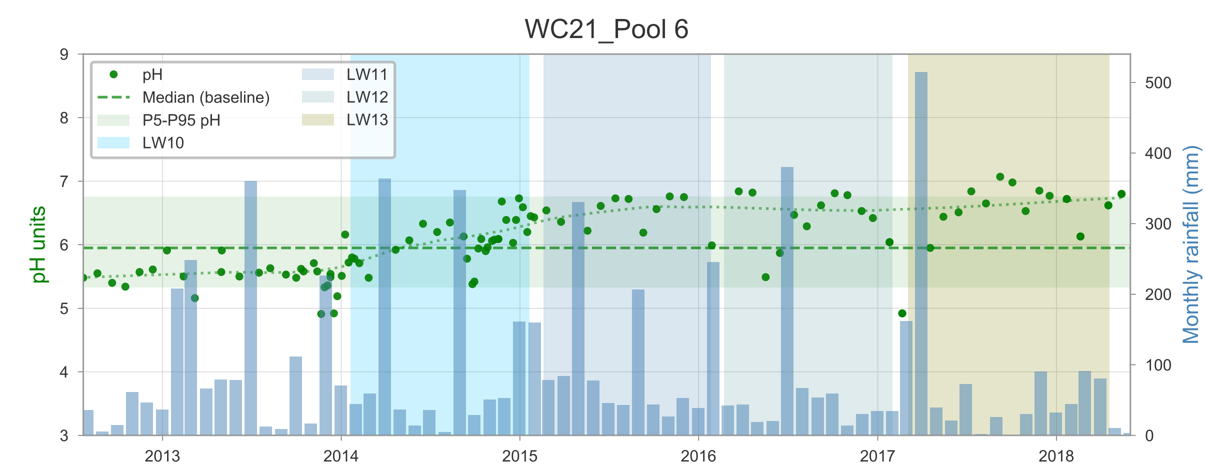

WC21_Pool 38
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

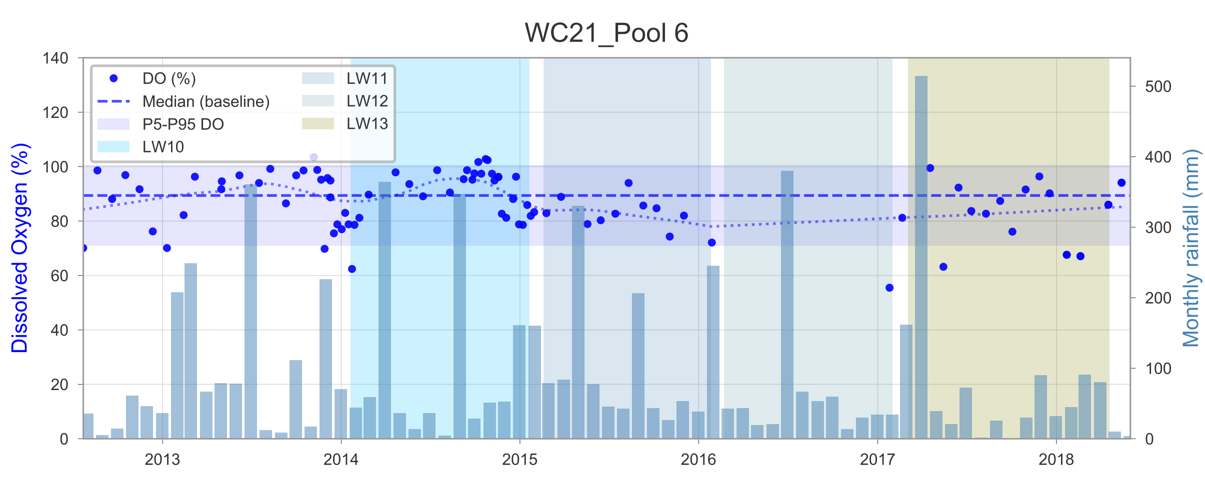

WC21_Pool 38
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

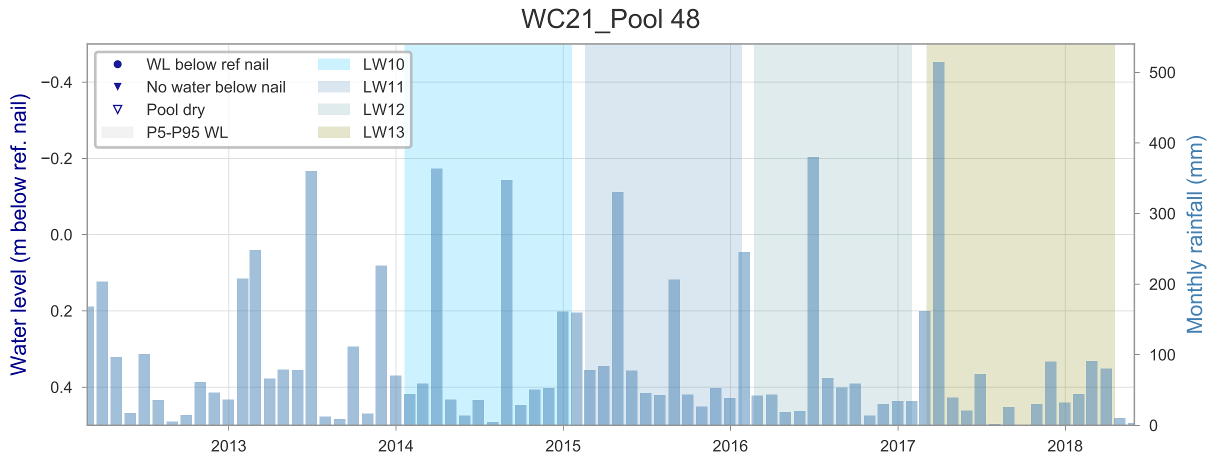

WC21_Pool 38
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

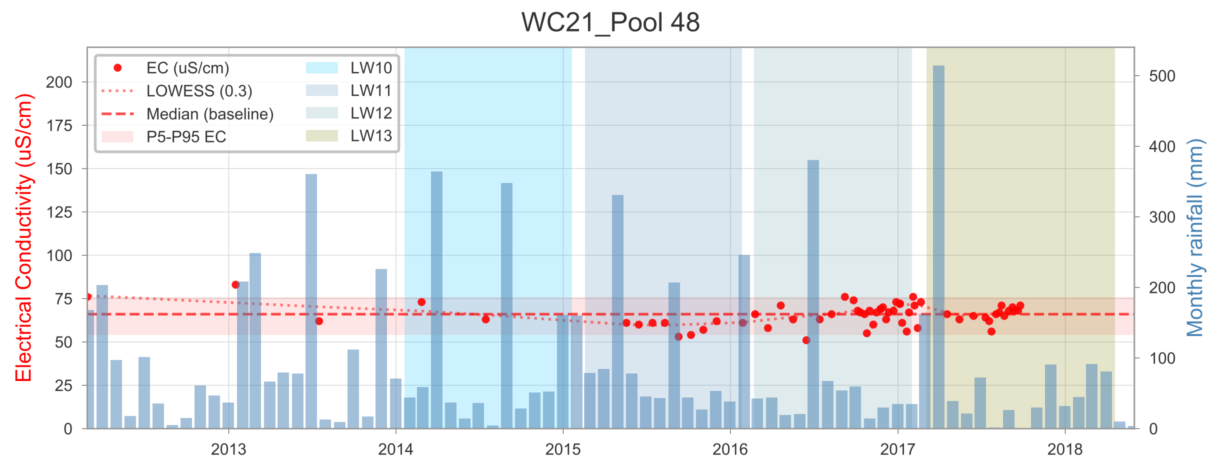

WC21_Pool 6
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
−0.6
−0.4
−0.2
0.0
0.2
0.4
0.6
500
400
300
200
100
0
2013
2014
2015
2016
2017
2018

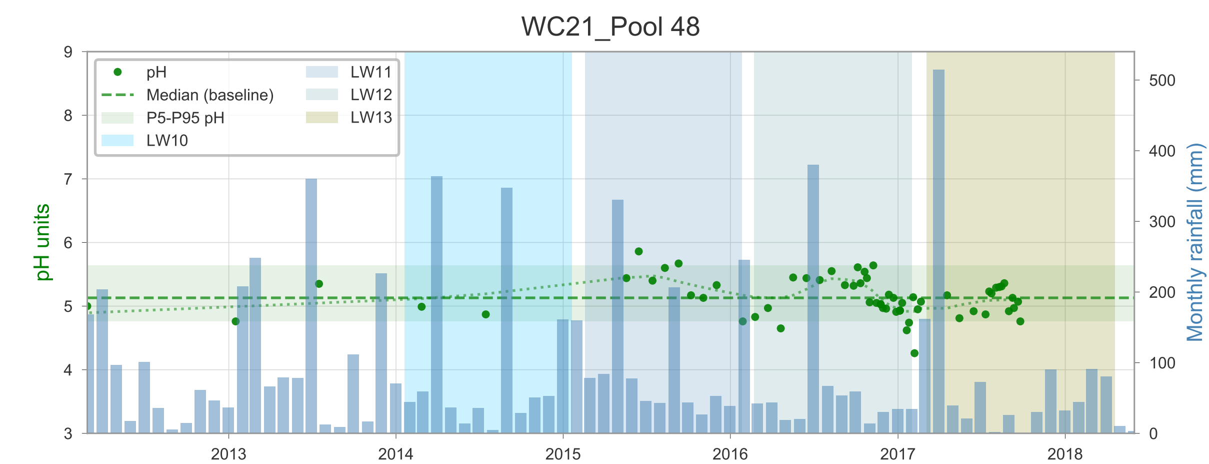

WC21_Pool 6
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
200
175
150
125
100
75
50
25
0
500
400
300
200
100
0
2013
2014
2015
2016
2017
2018

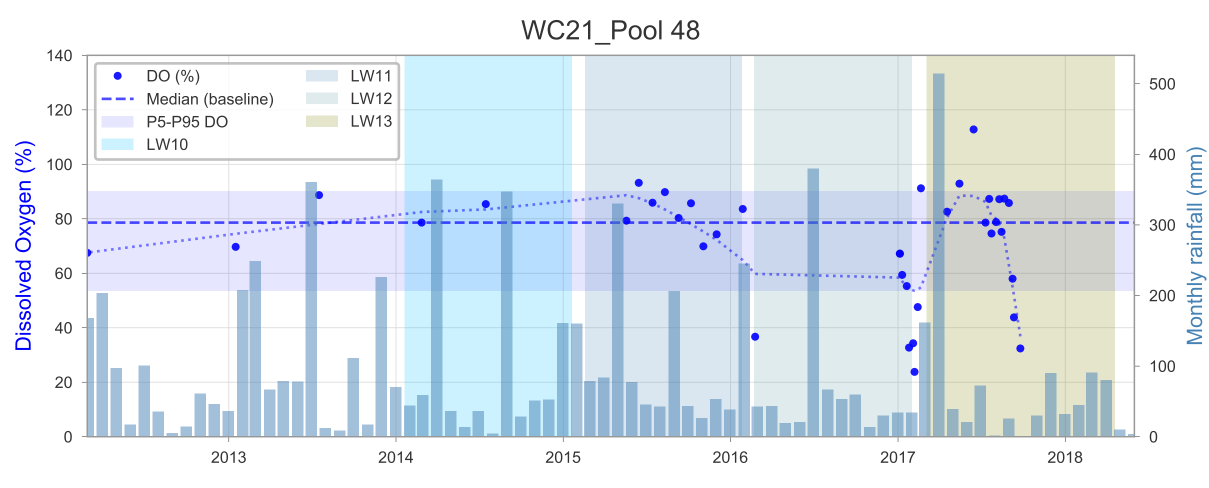

WC21_Pool 6
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
9
8
7
6
5
4
3
500
400
300
200
100
0
2013
2014
2015
2016
2017
2018

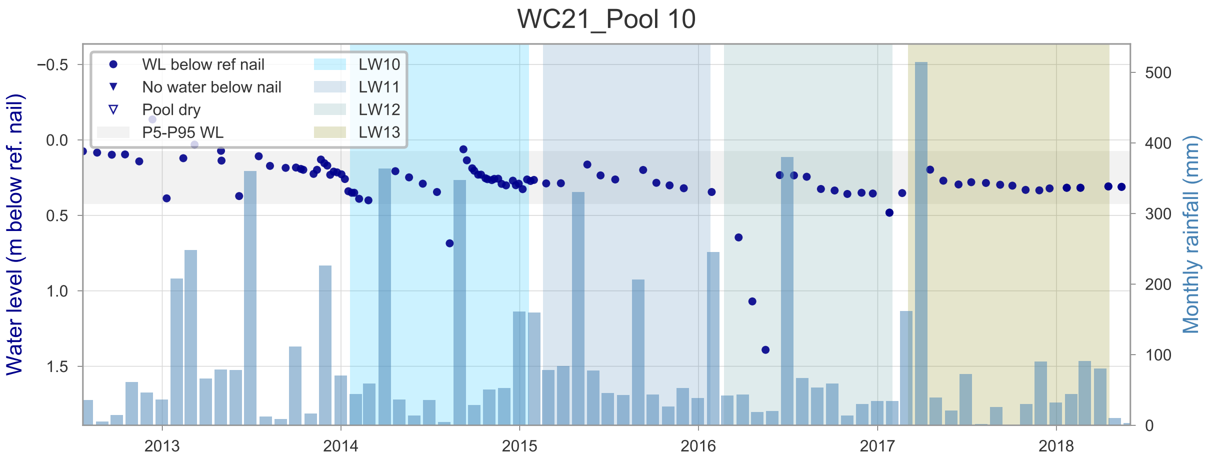

WC21_Pool 6
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
140
120
100
80
60
40
20
0
500
400
300
200
100
0
2013
2014
2015
2016
2017
2018

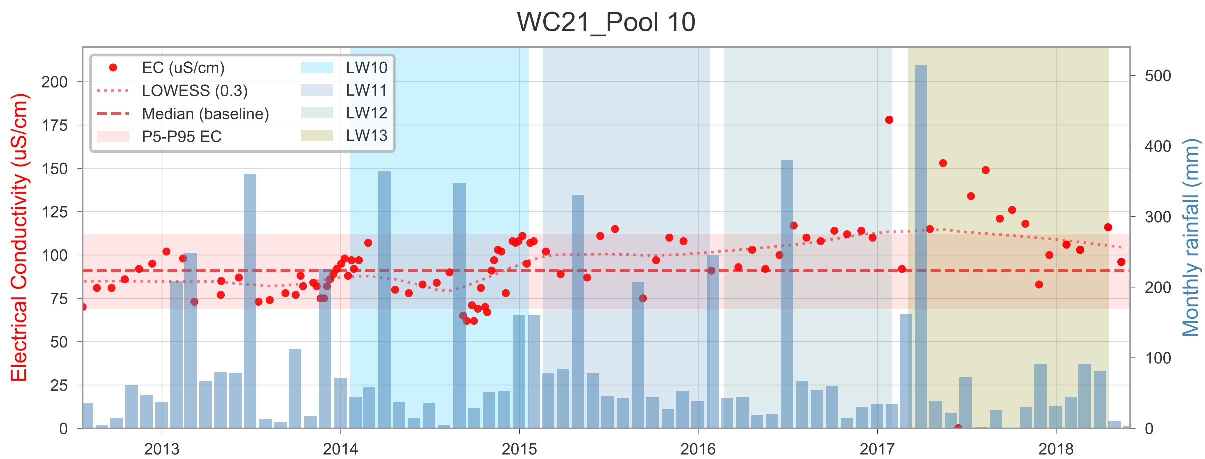

WC21_Pool 48
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
-0.4
-0.2
0.0
0.2
0.4
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

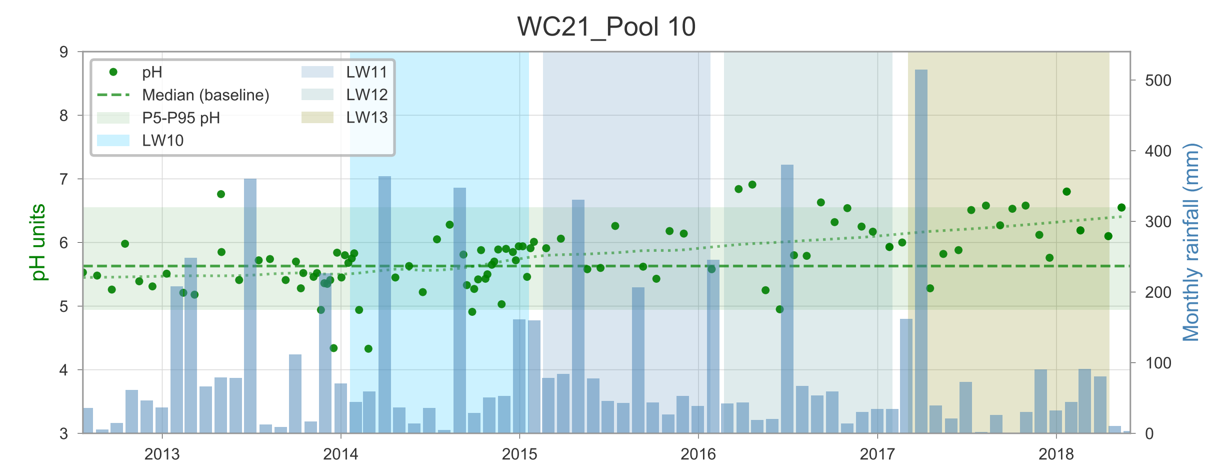

WC21_Pool 48
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

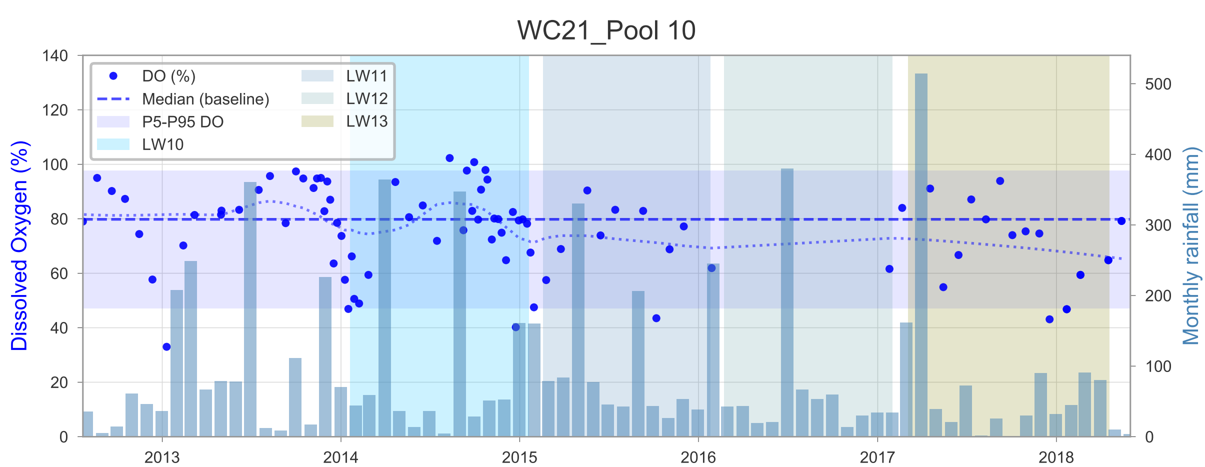

WC21_Pool 48
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
3
4
5
6
7
8
9
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

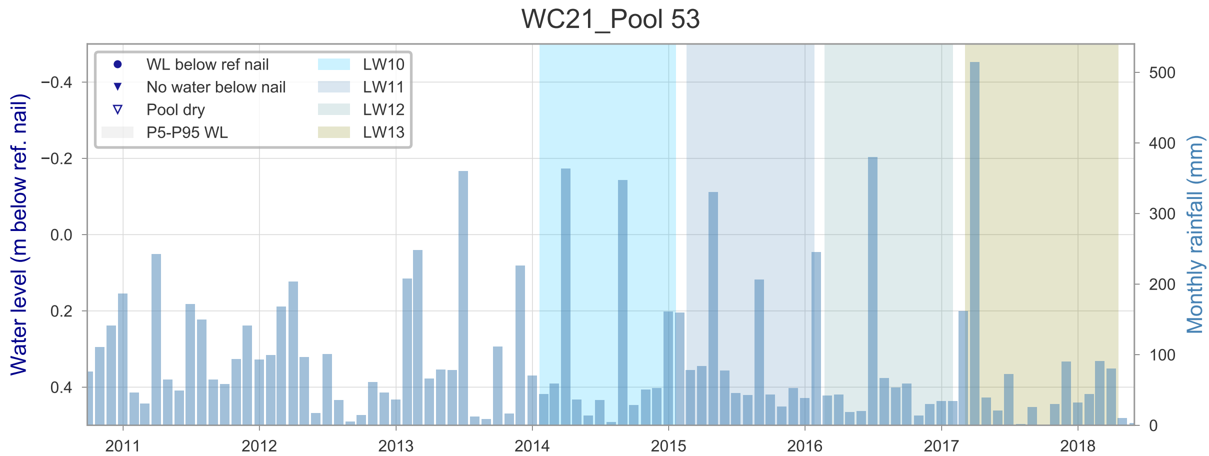

WC21_Pool 48
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

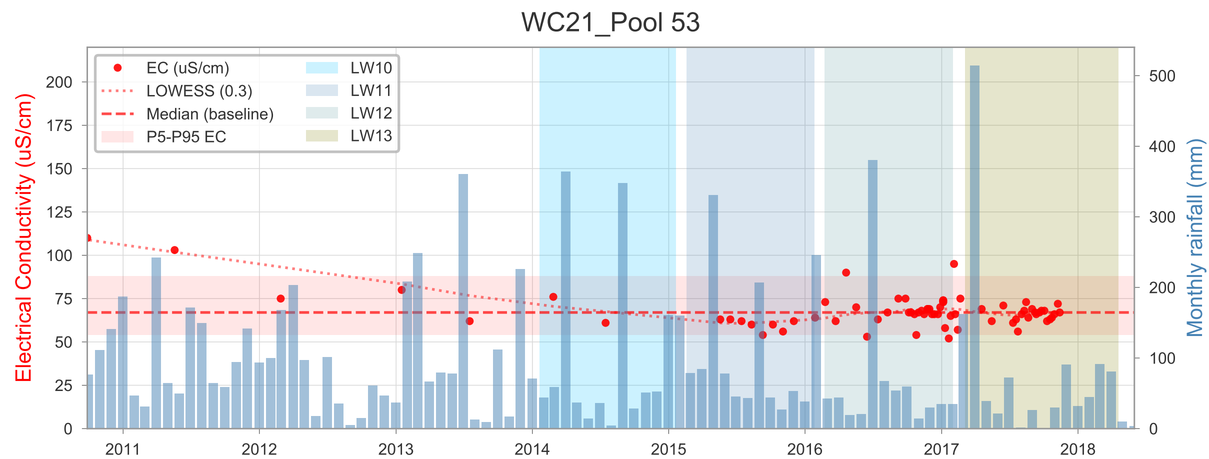

WC21_Pool 10
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
−0.5
0.0
0.5
1.0
1.5
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

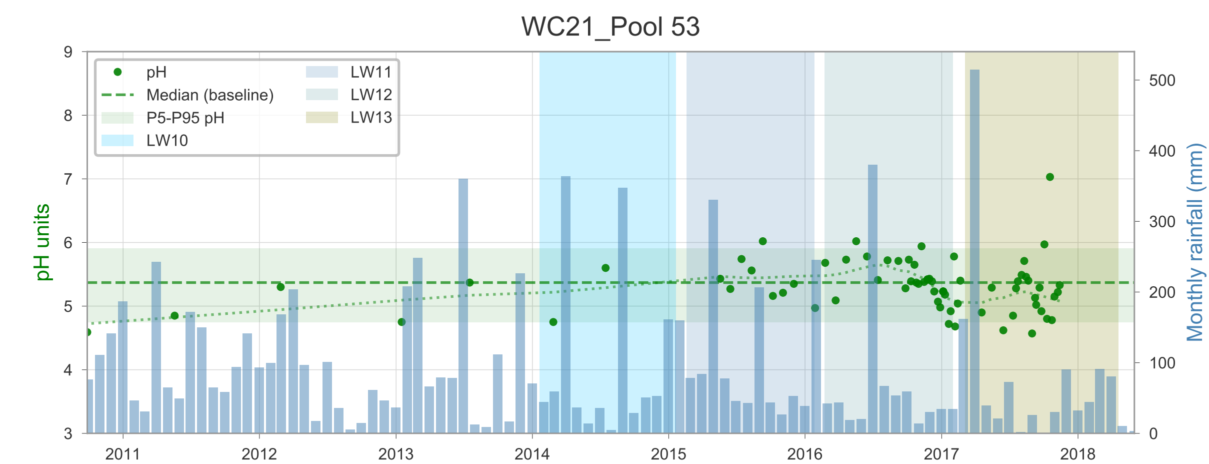

WC21_Pool 10
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

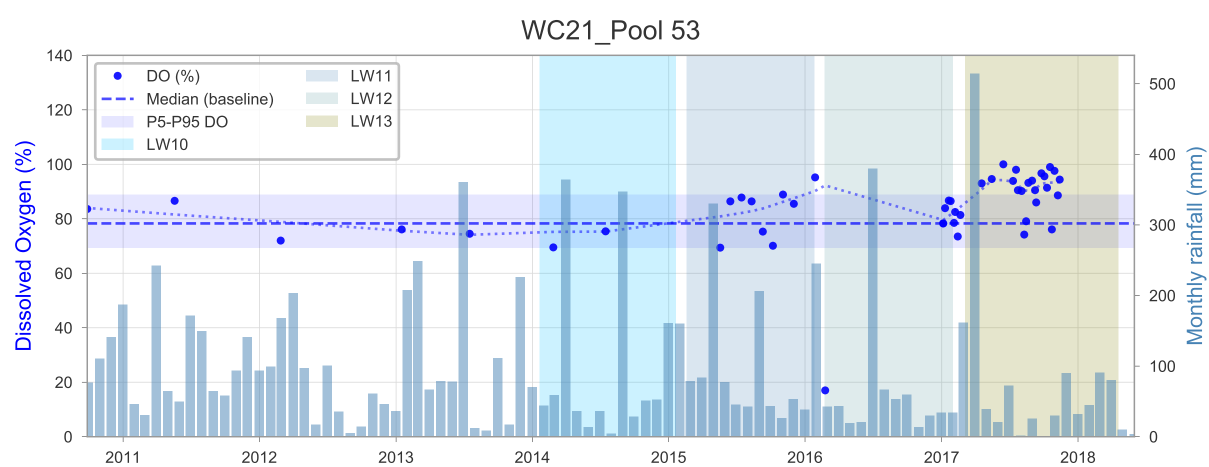

WC21_Pool 10
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
3
4
5
6
7
8
9
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

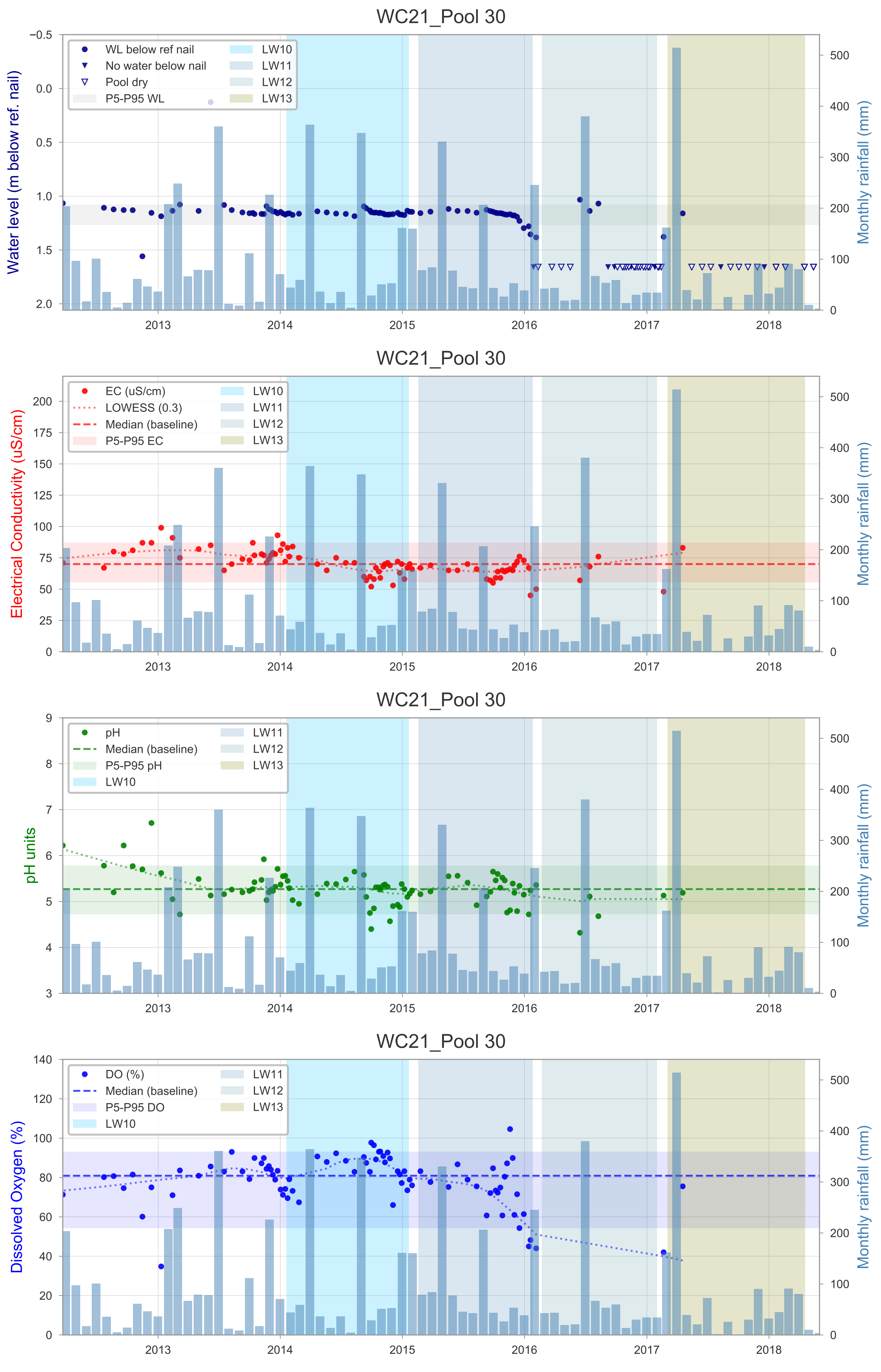

WC21_Pool 10
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

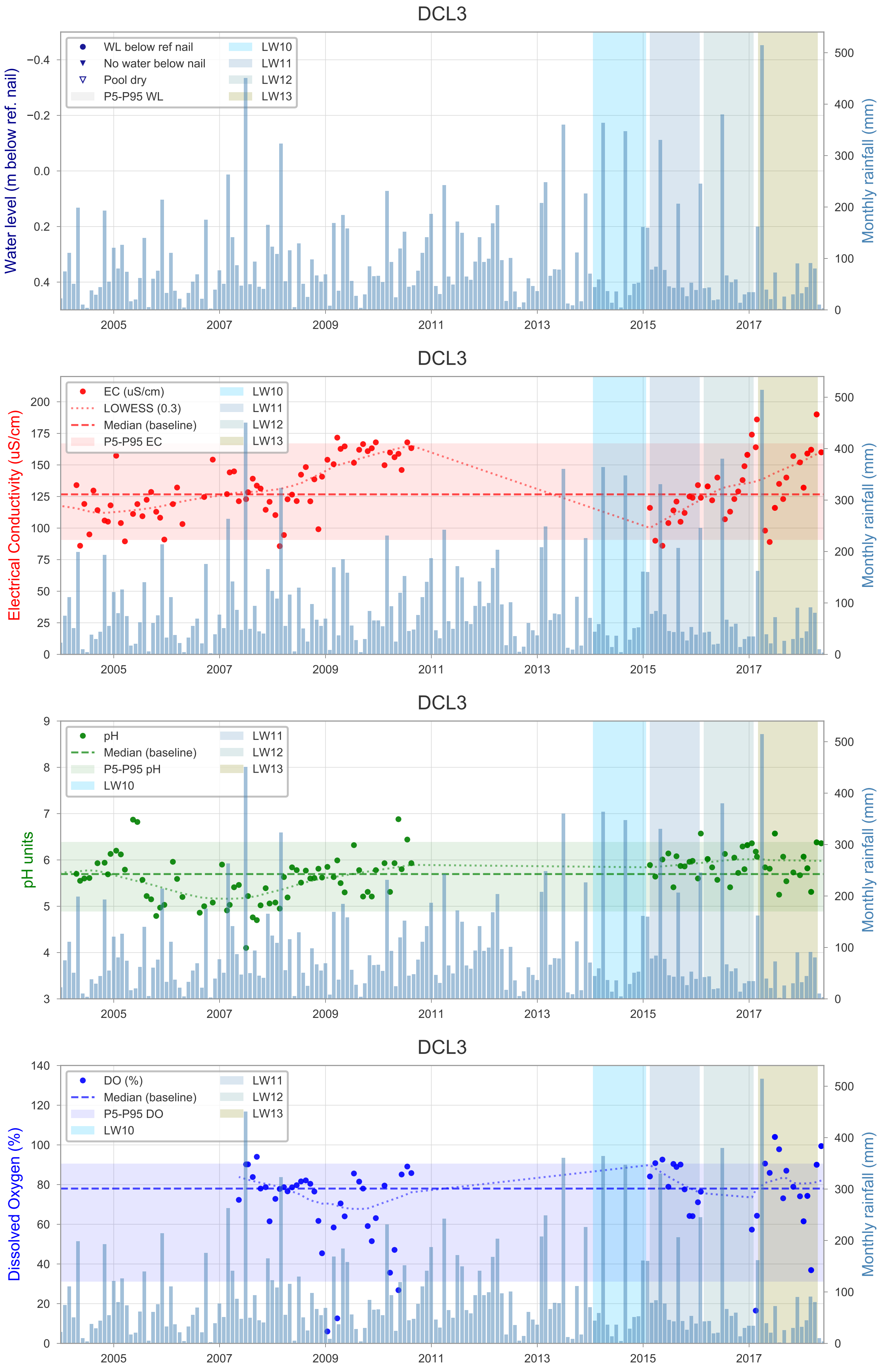

WC21_Pool 53
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
−0.4
−0.2
0.0
0.2
0.4
0
100
200
300
400
500
2011
2012
2013
2014
2015
2016
2017
2018

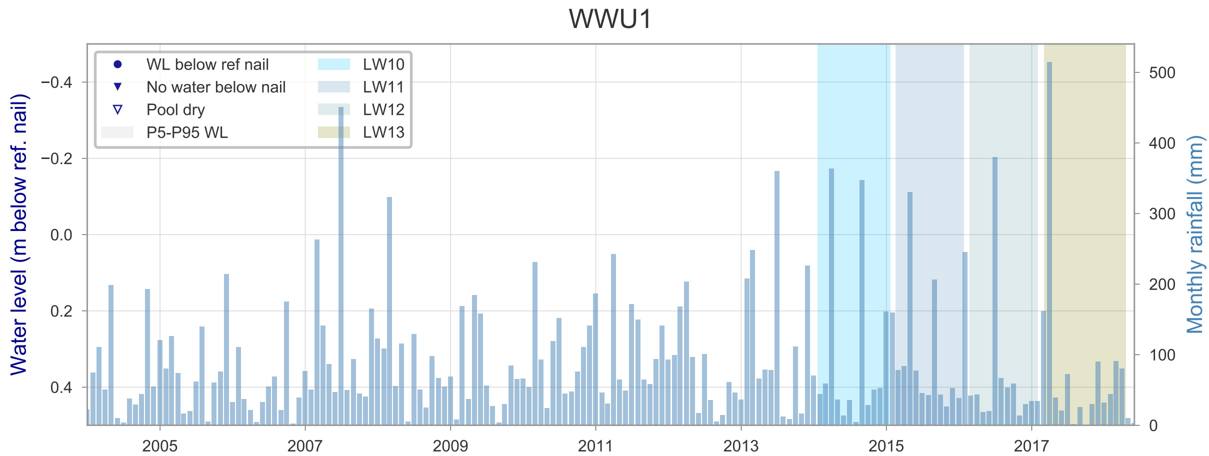

WC21_Pool 53
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2011
2012
2013
2014
2015
2016
2017
2018

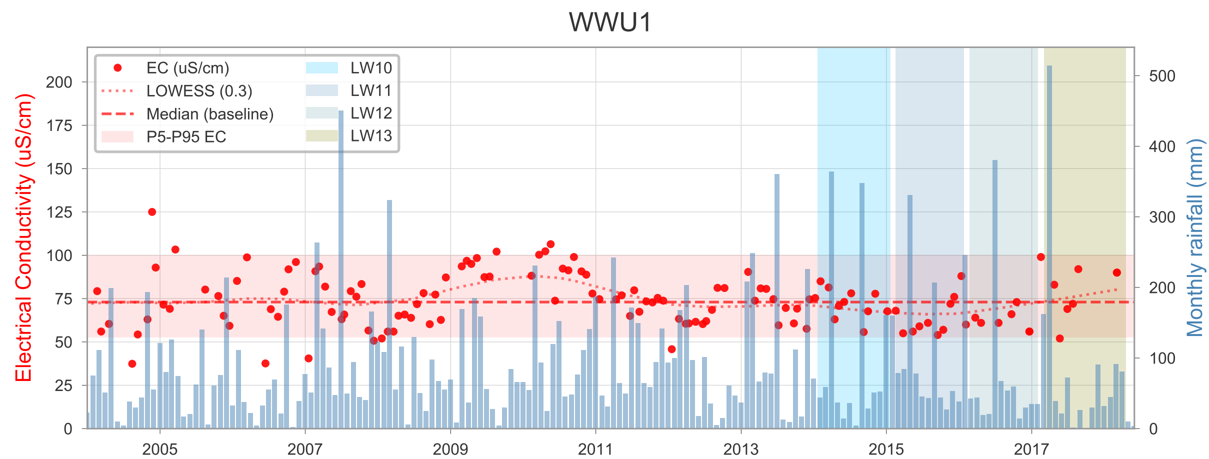

WC21_Pool 53
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
3
4
5
6
7
8
9
0
100
200
300
400
500
2011
2012
2013
2014
2015
2016
2017
2018

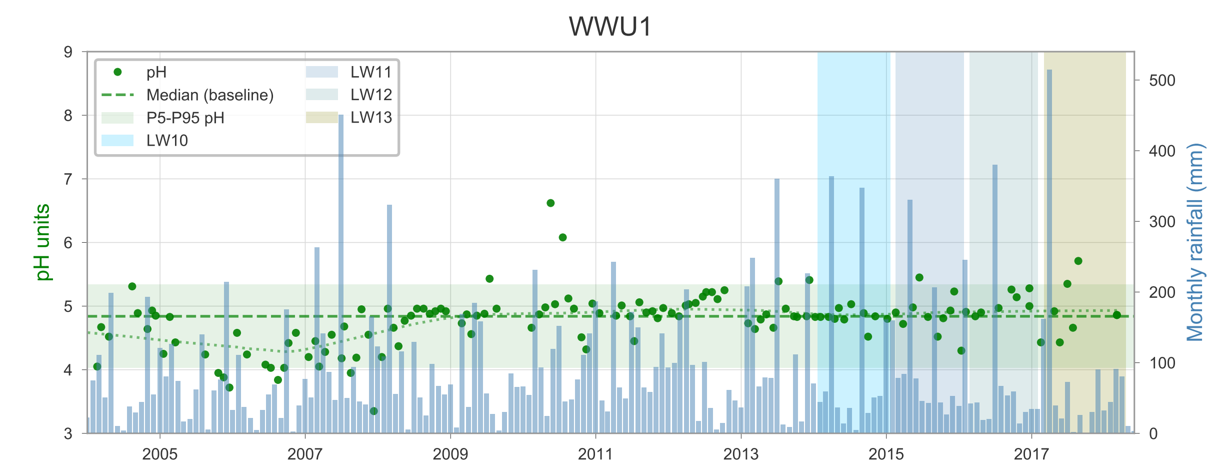

WC21_Pool 53
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2011
2012
2013
2014
2015
2016
2017
2018

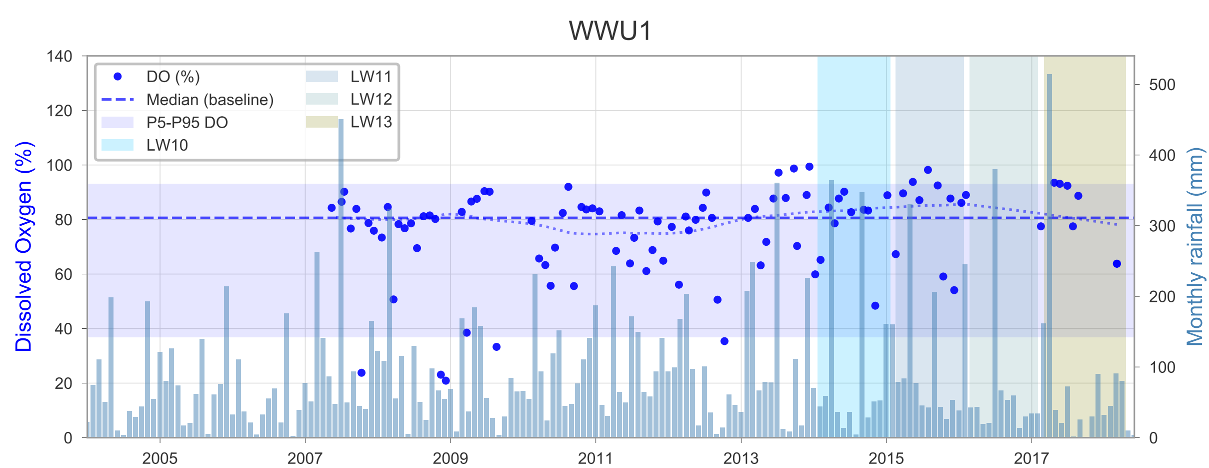

WC21_Pool 30
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
WC21_Pool 30
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
WC21_Pool 30
pH units
pH
P5-P95 pH
WC21_Pool 30
Dissolved Oxygen (%)
DO (%)
P5-P95 DO
2013
2014
2015
2016
2017
2018

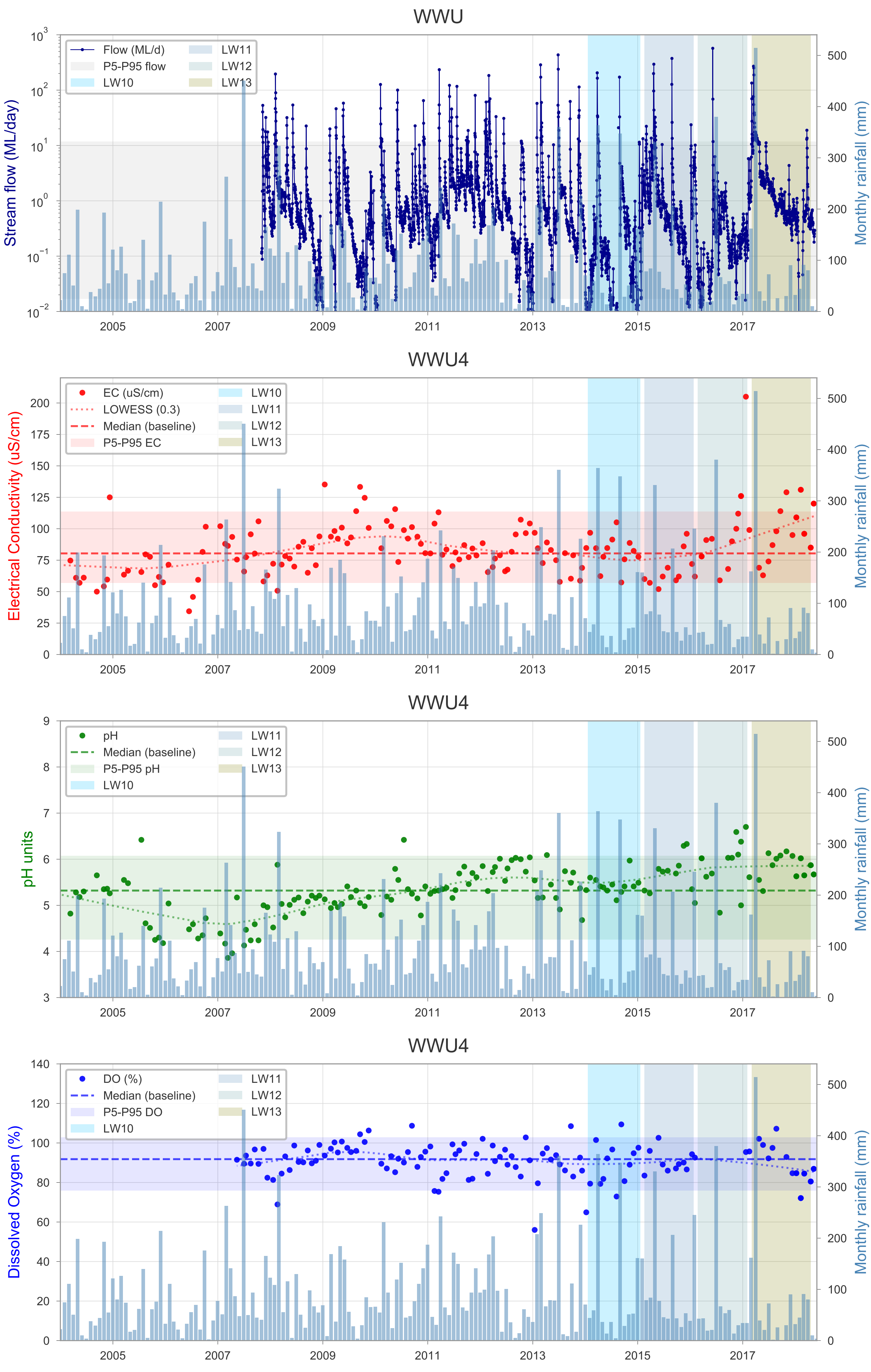

DCL3
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
DCL3
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
Electrical Conductivity (uS/cm)
DCL3
pH
Median (baseline)
P5-P95 pH
pH units
DCL3
DO (%)
Median (baseline)
P5-P95 DO
Dissolved Oxygen (%)
2005
2007
2009
2011
2013
2015
2017

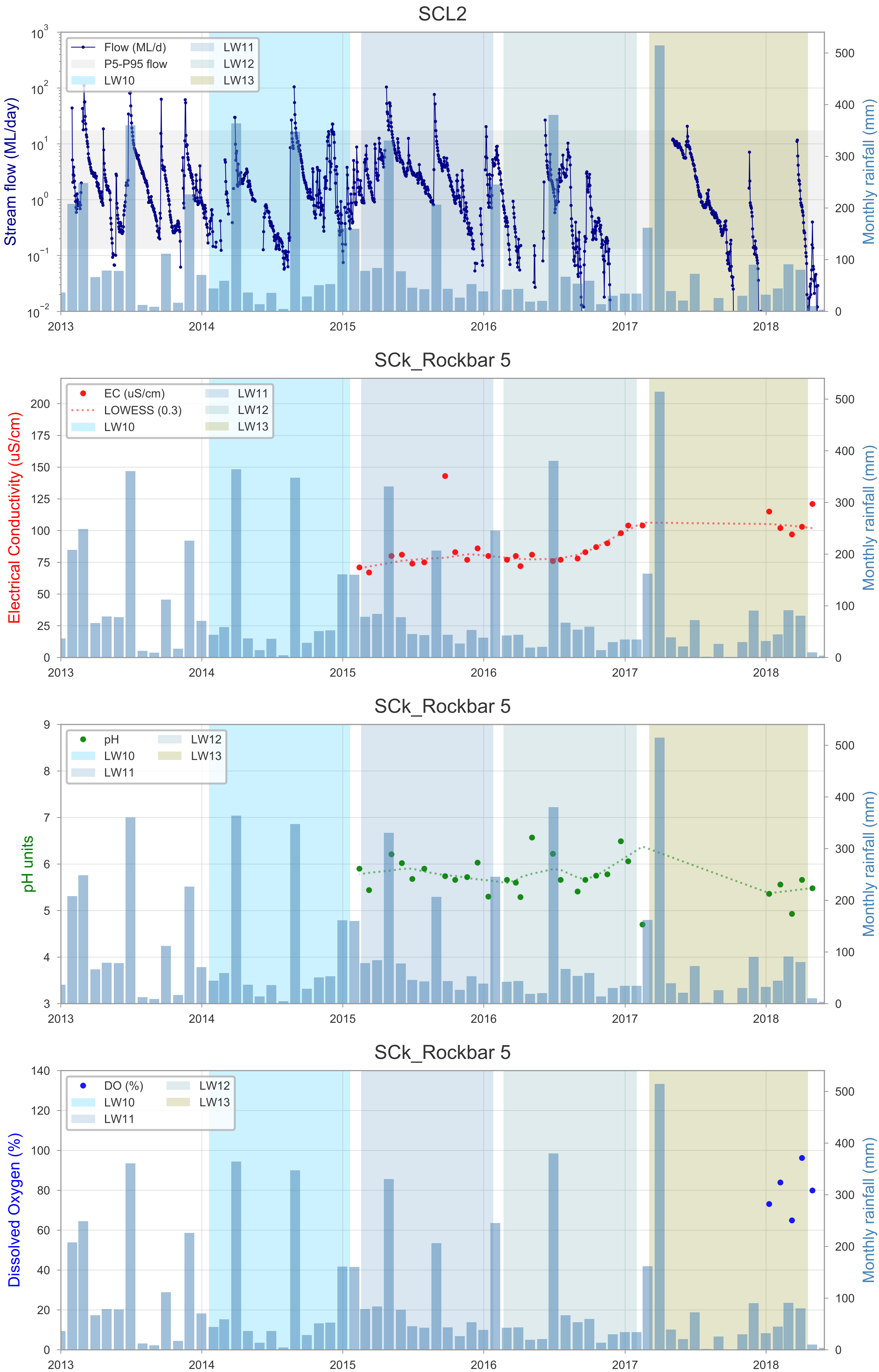

WWU1
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
−0.4
−0.2
0.0
0.2
0.4
0
100
200
300
400
500
2005
2007
2009
2011
2013
2015
2017

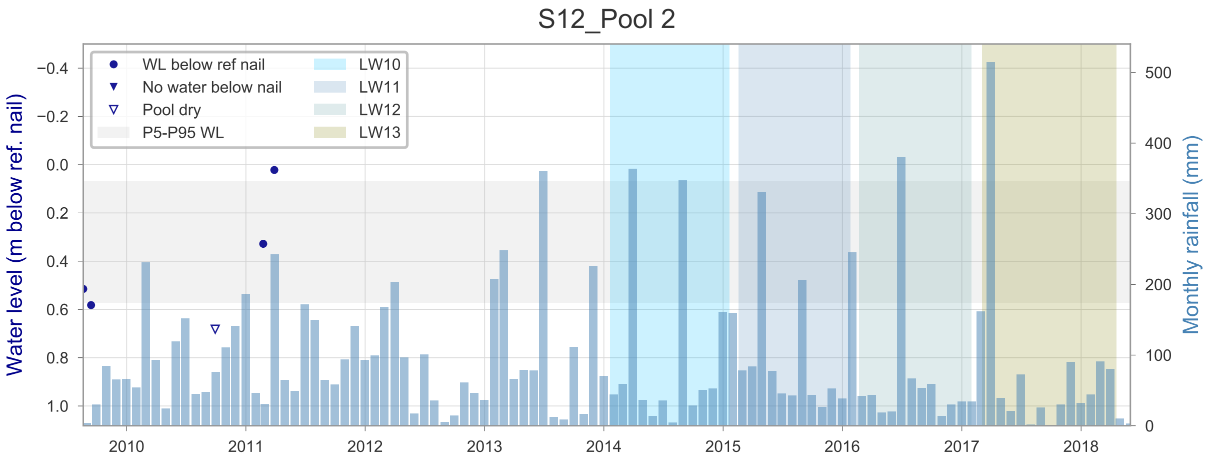

WWU1
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2005
2007
2009
2011
2013
2015
2017

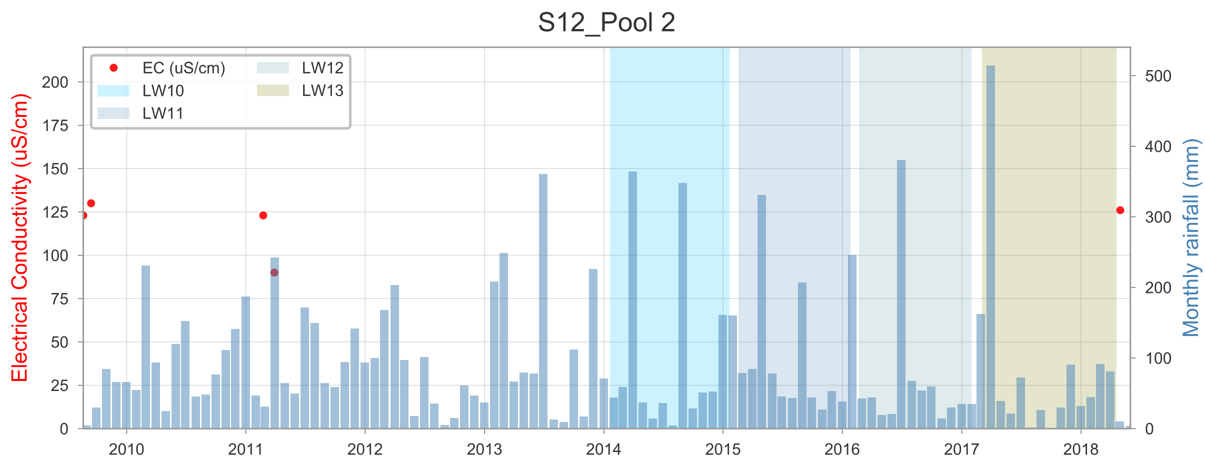

WWU1
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
3
4
5
6
7
8
9
0
100
200
300
400
500
2005
2007
2009
2011
2013
2015
2017

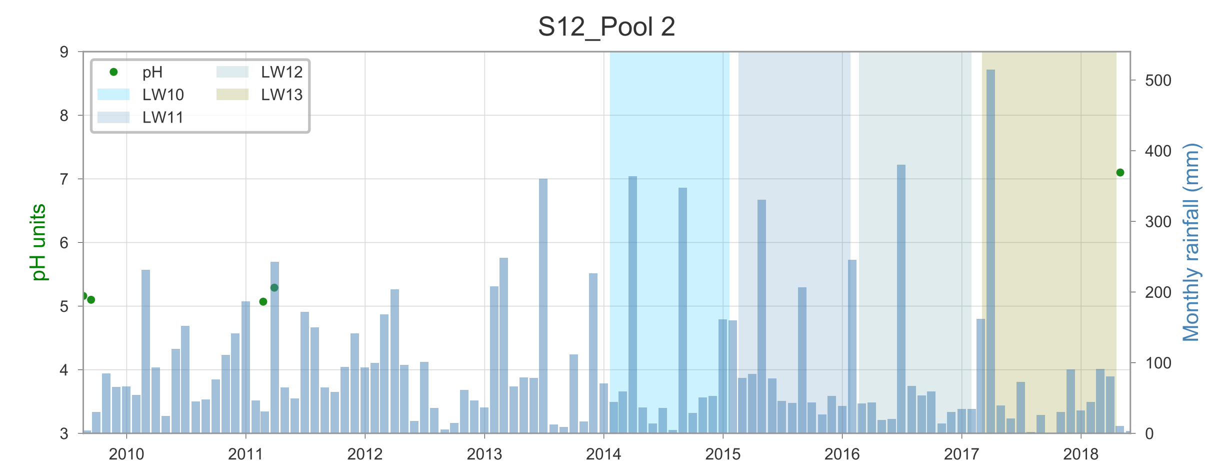

WWU1
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2005
2007
2009
2011
2013
2015
2017

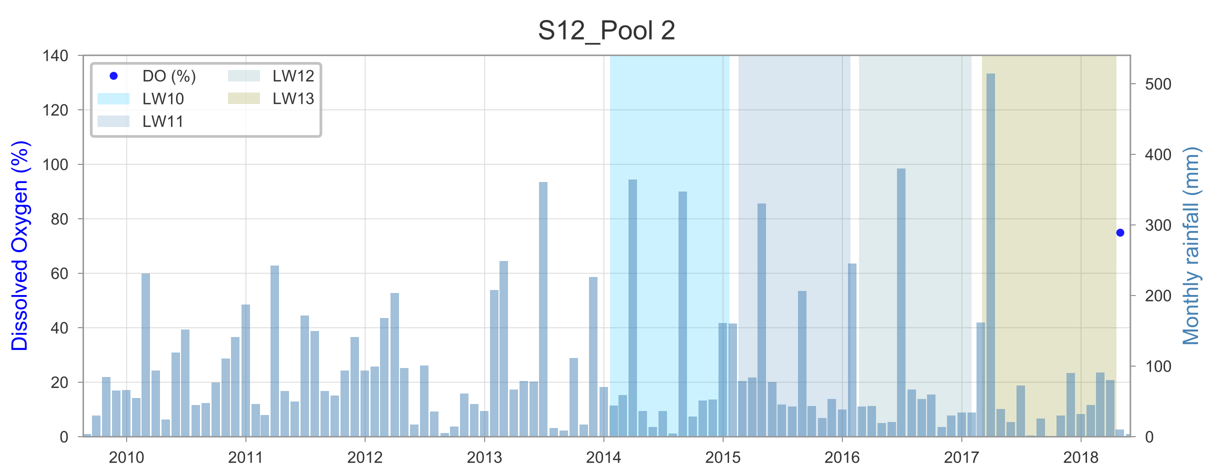

WWU
Flow (ML/d)
P5-P95 flow
LW10
LW11
LW12
LW13
Stream flow (ML/day)
Monthly rainfall (mm)
WWU4
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
Electrical Conductivity (uS/cm)
WWU4
pH
Median (baseline)
P5-P95 pH
pH units
WWU4
DO (%)
Median (baseline)
P5-P95 DO
Dissolved Oxygen (%)

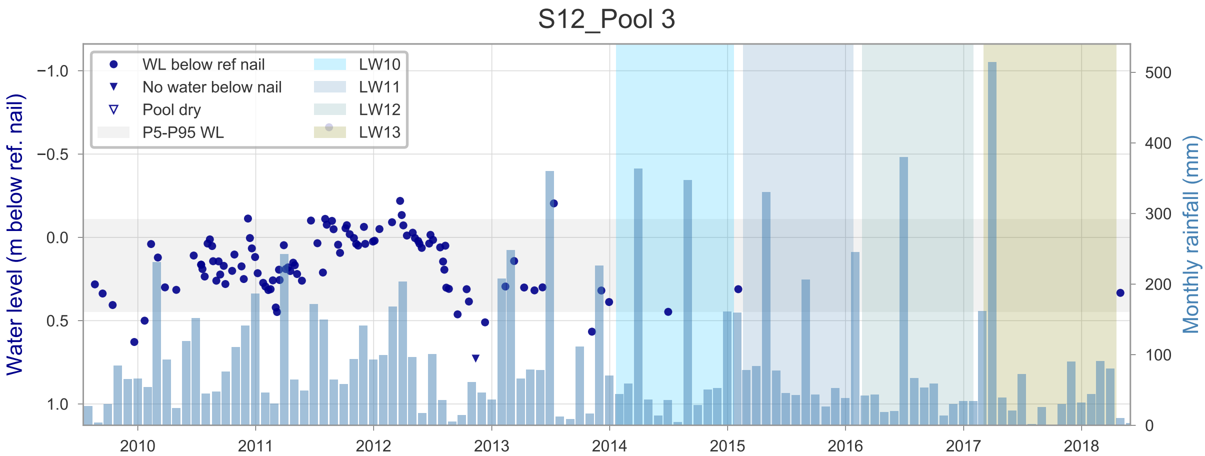

SCL2
Stream flow (ML/day)
Monthly rainfall (mm)
Flow (ML/d)
P5-P95 flow
LW10
LW11
LW12
LW13
SCk_Rockbar 5
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
SCk_Rockbar 5
pH units
pH
SCk_Rockbar 5
Dissolved Oxygen (%)
DO (%)
2013
2014
2015
2016
2017
2018


S12_Pool 2
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)

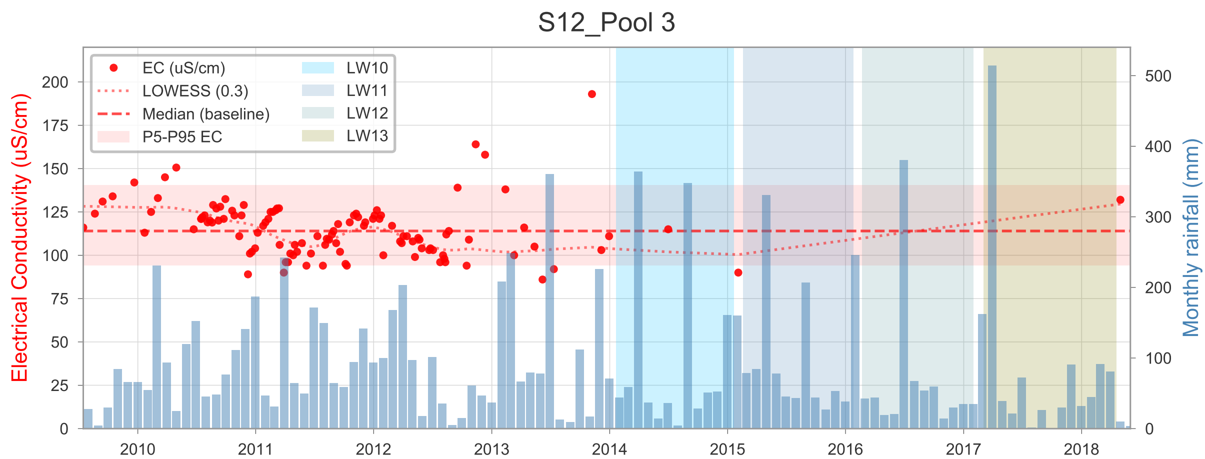

S12_Pool 2
EC (uS/cm)
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)


S12_Pool 2
pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)

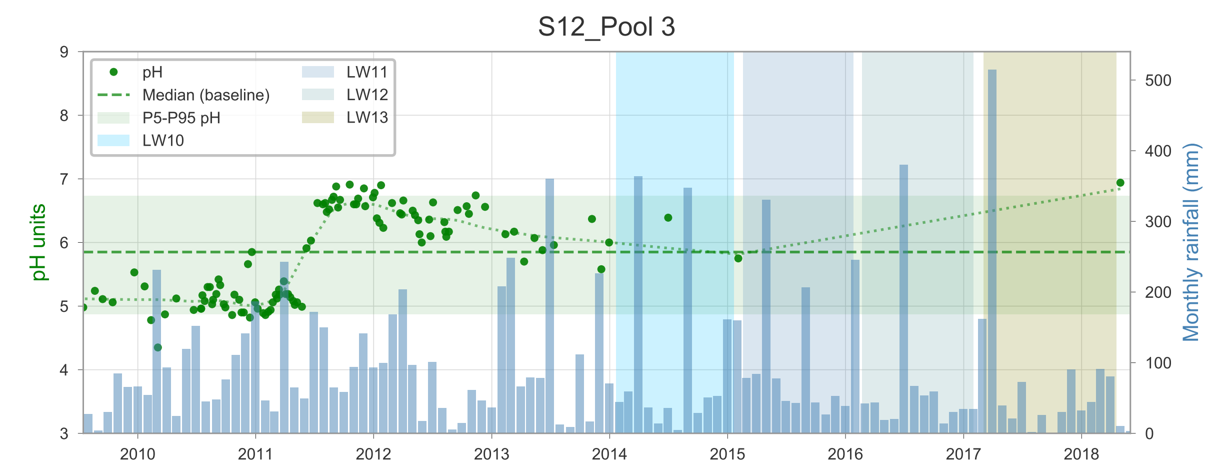

S12_Pool 2
DO (%)
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)



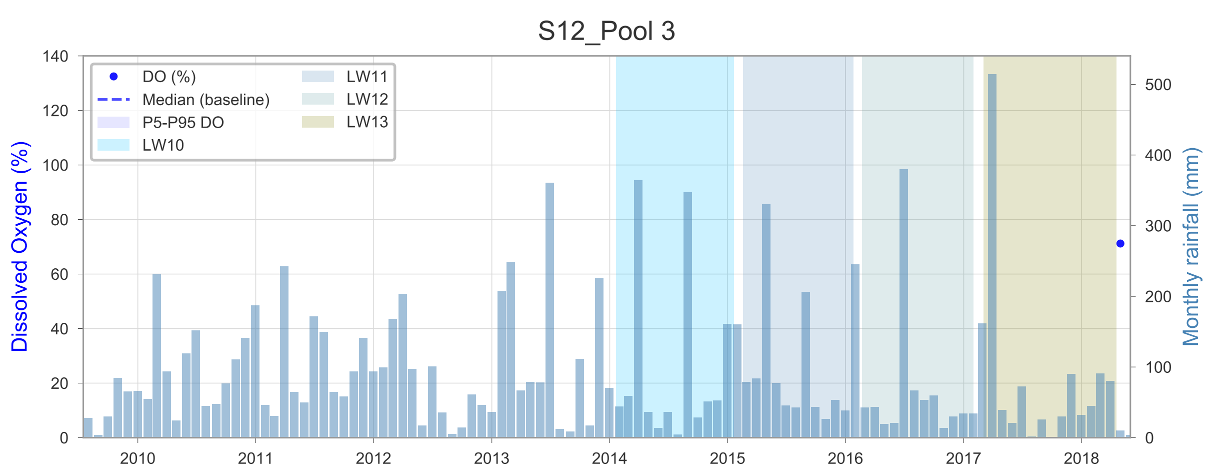
S12_Pool 3
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13



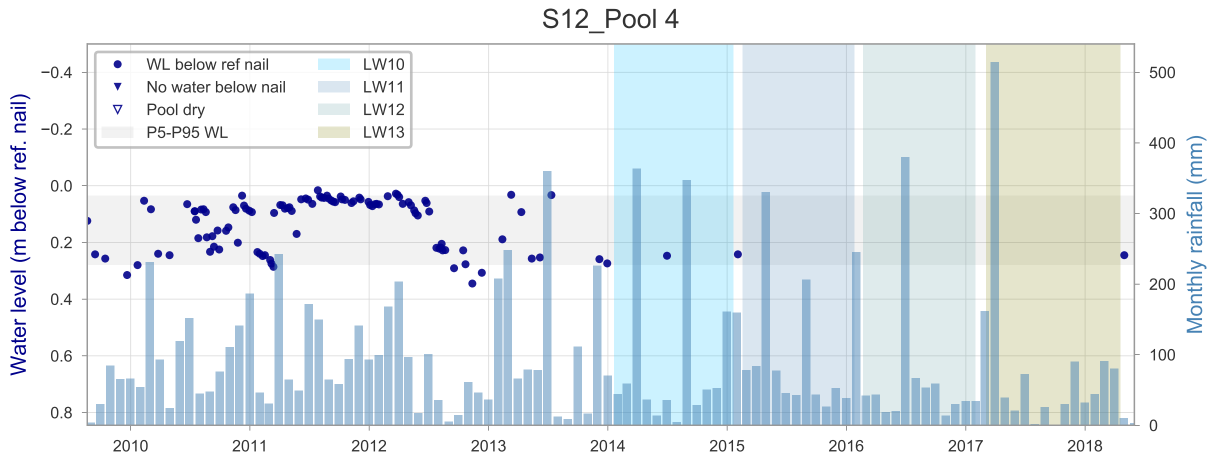
S12_Pool 3
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13

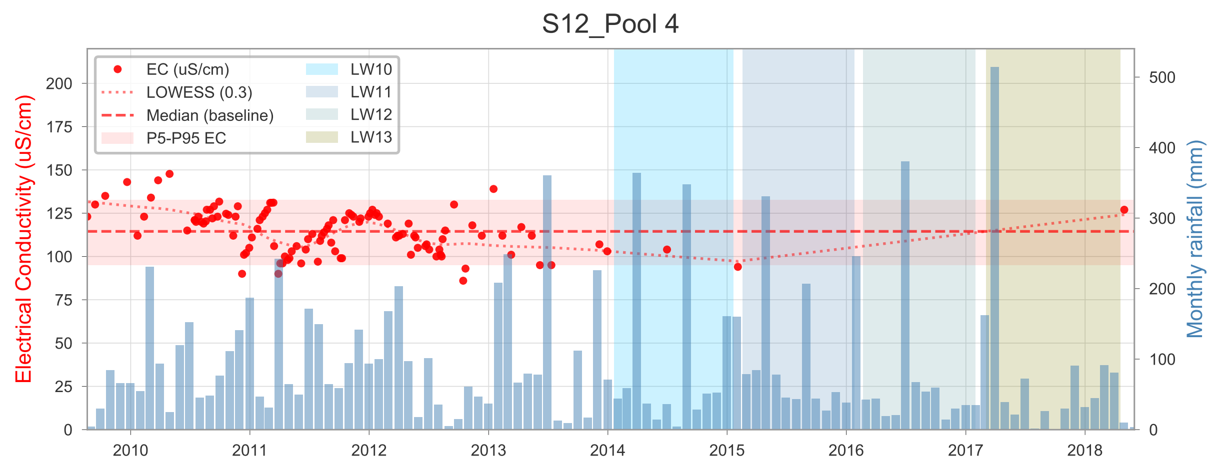


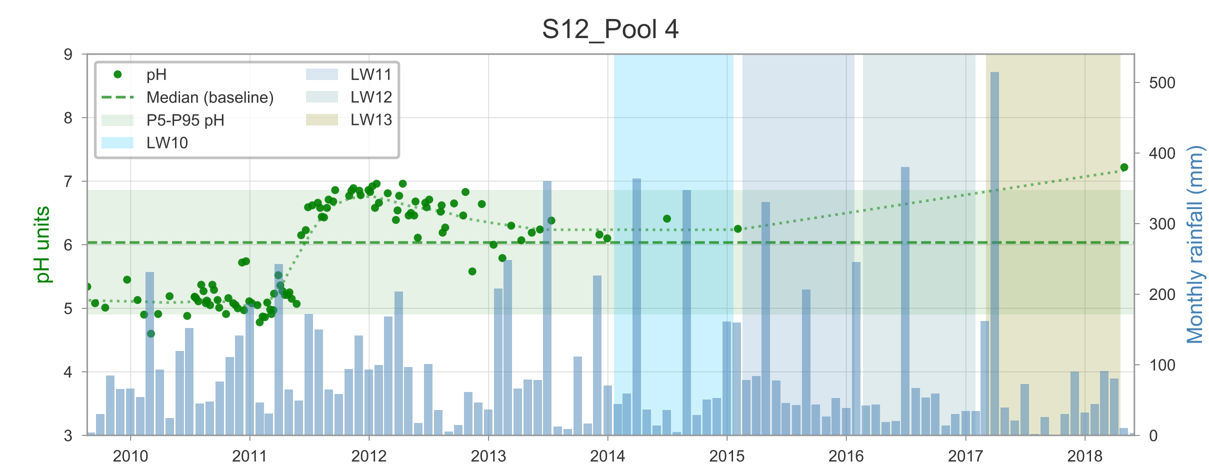
S12_Pool 3
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13

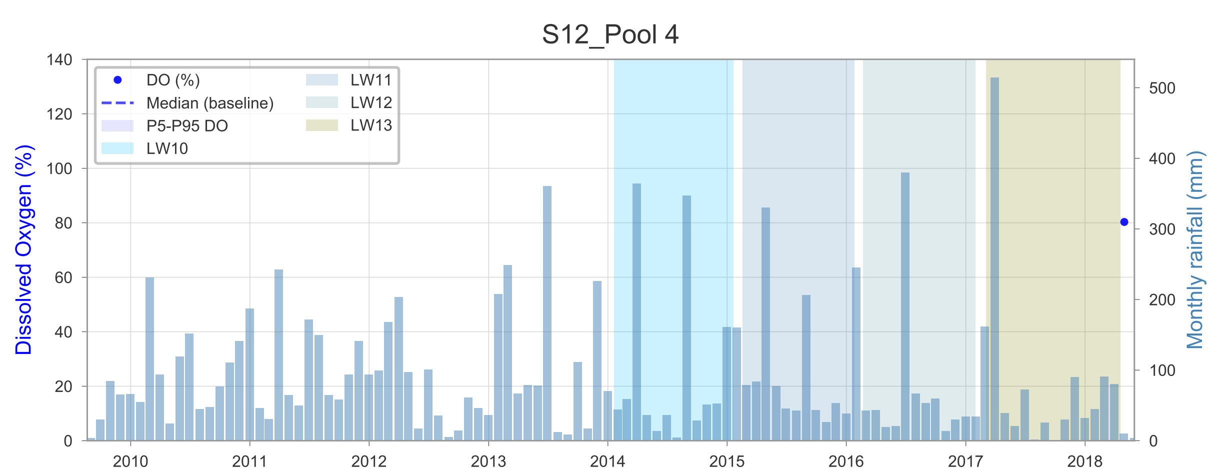


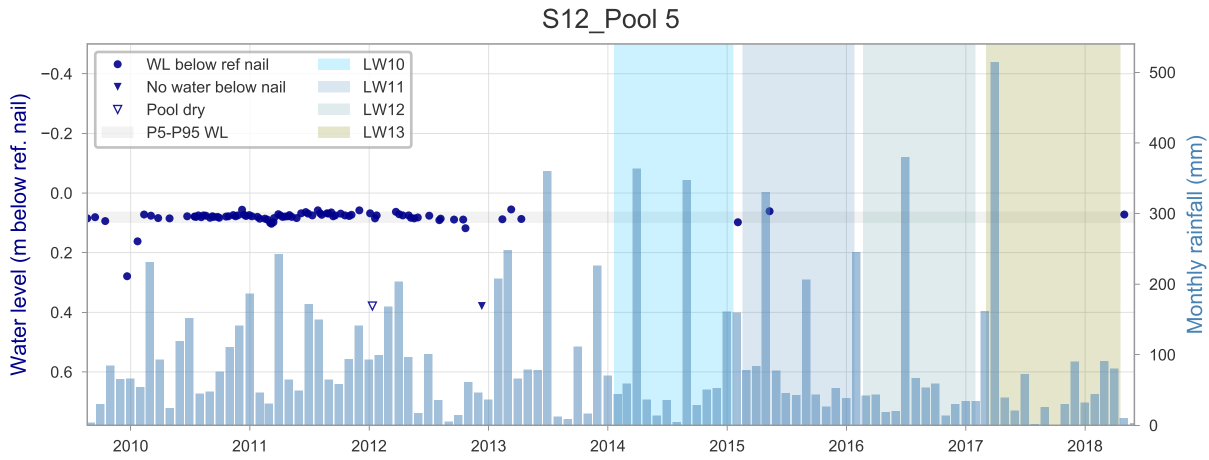
S12_Pool 3
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13

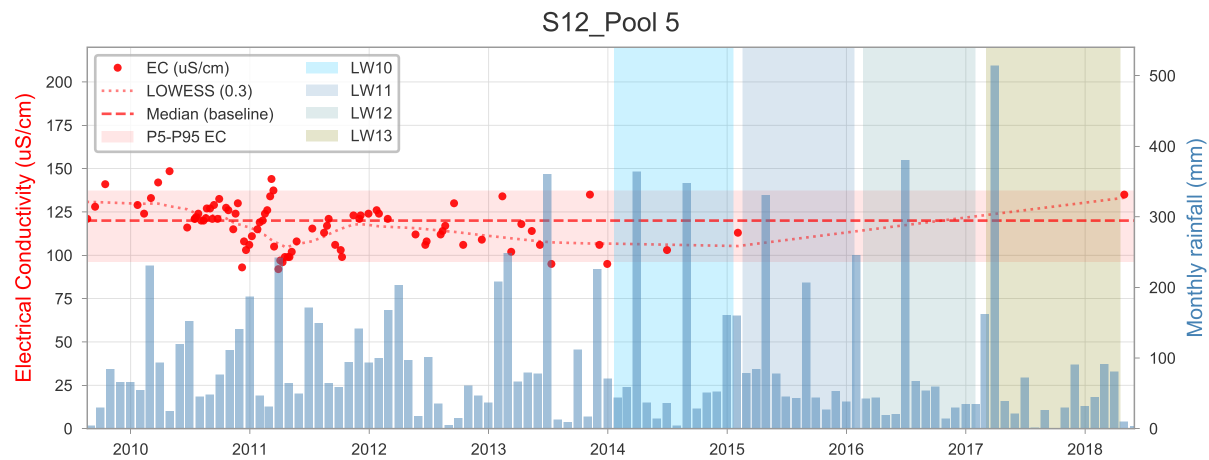

S12_Pool 4
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)

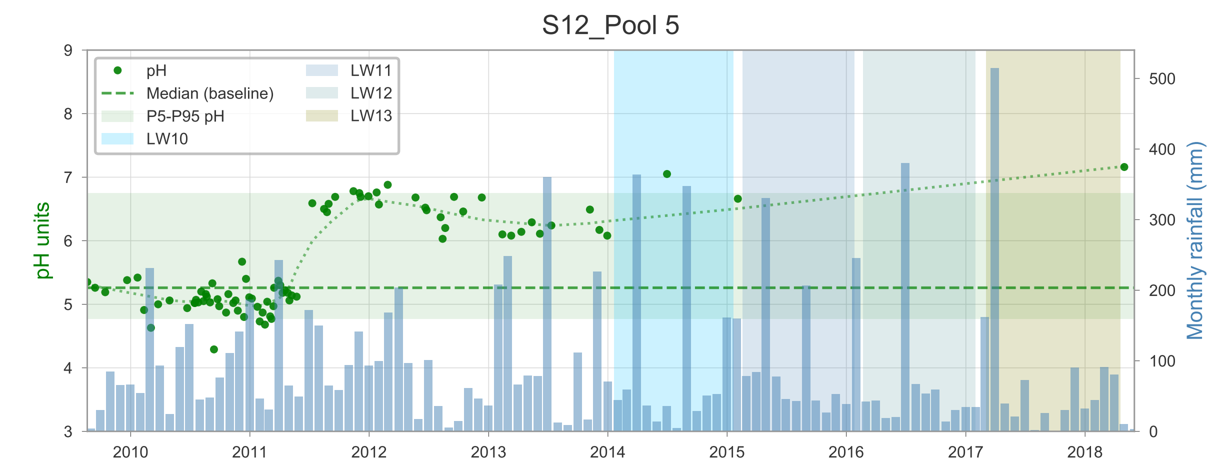

S12_Pool 4
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)

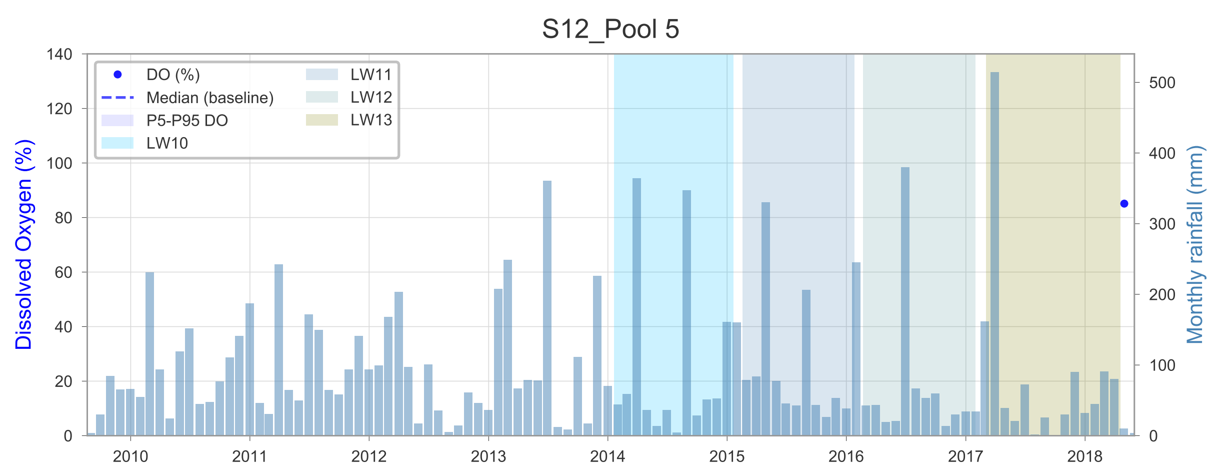

S12_Pool 4
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)

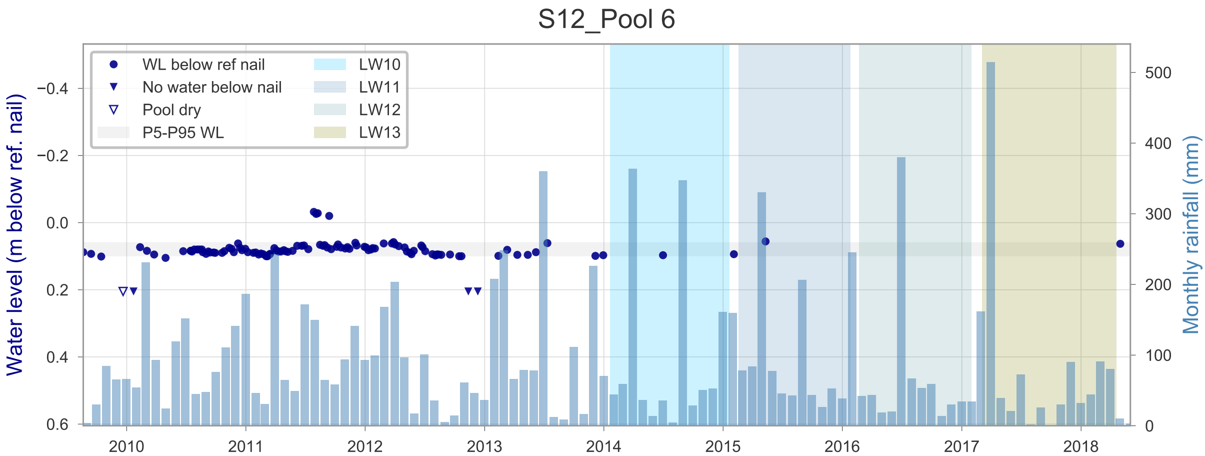

S12_Pool 4
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)

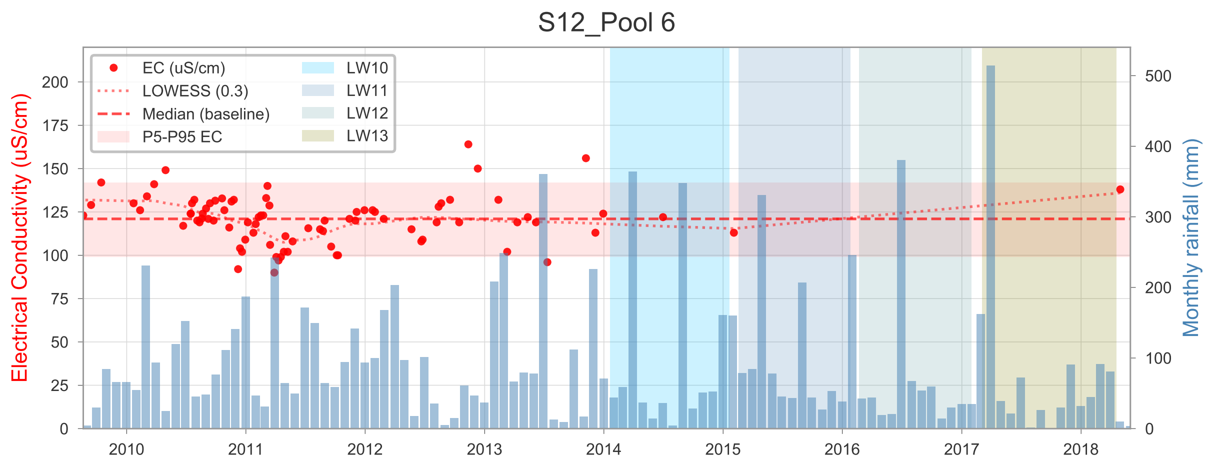

S12_Pool 5
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)

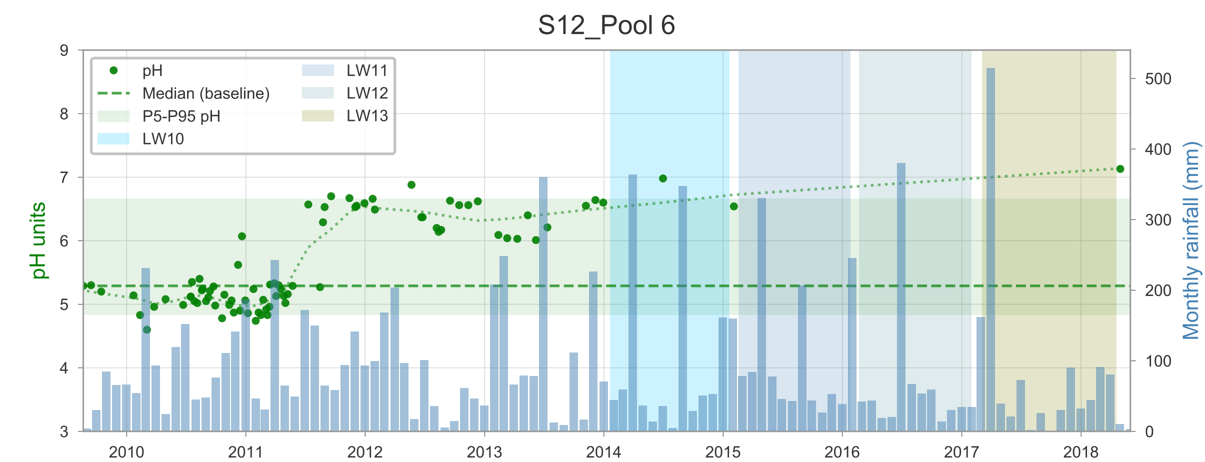

S12_Pool 5
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)

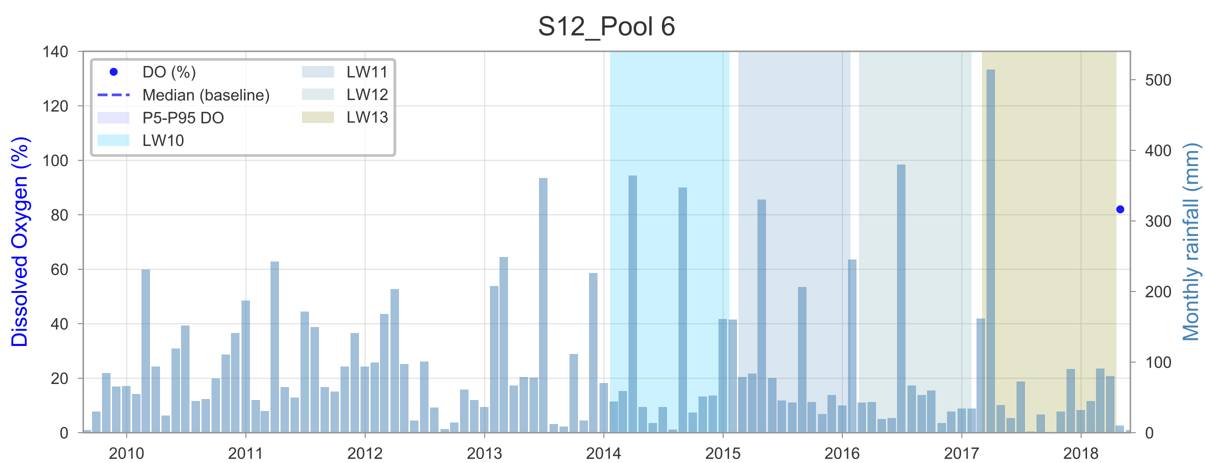

S12_Pool 5
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)

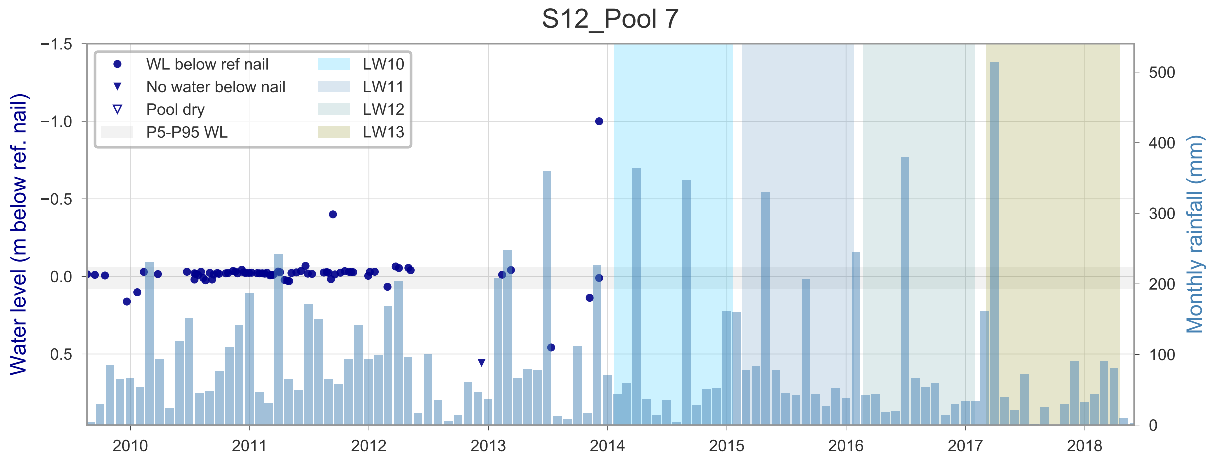

S12_Pool 5
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)

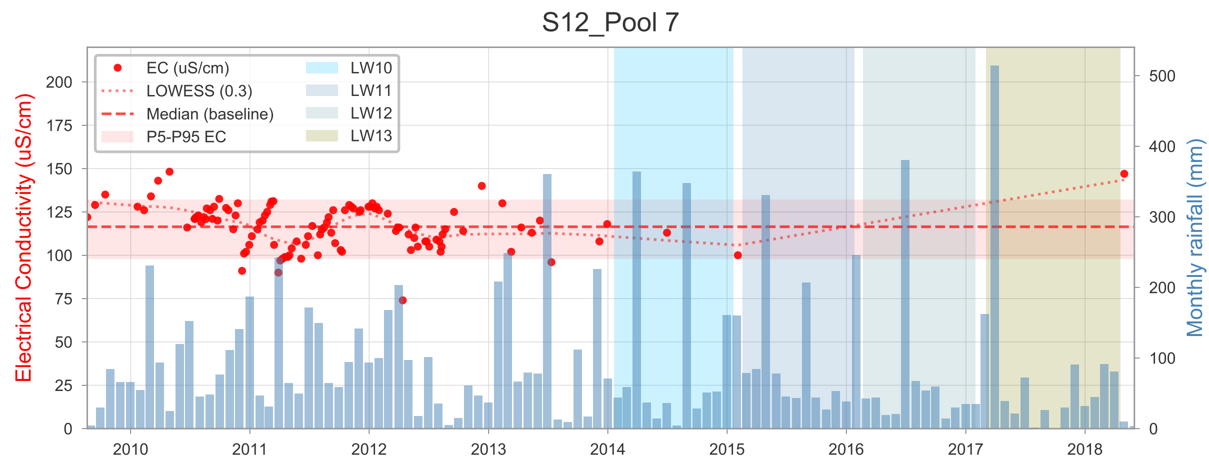

S12_Pool 6
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
2010
2011
2012
2013
2014
2015
2016
2017
2018

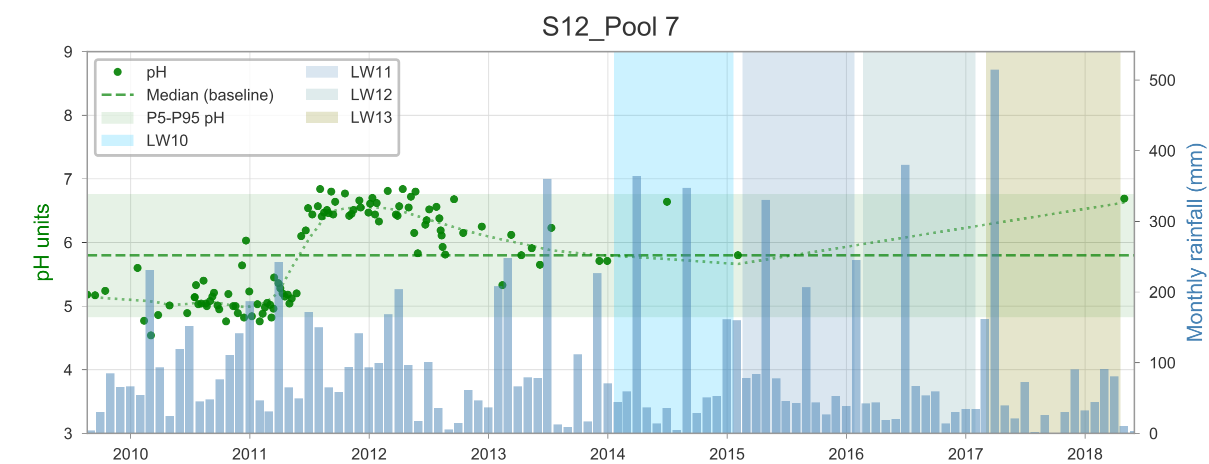

S12_Pool 6
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
2010
2011
2012
2013
2014
2015
2016
2017
2018

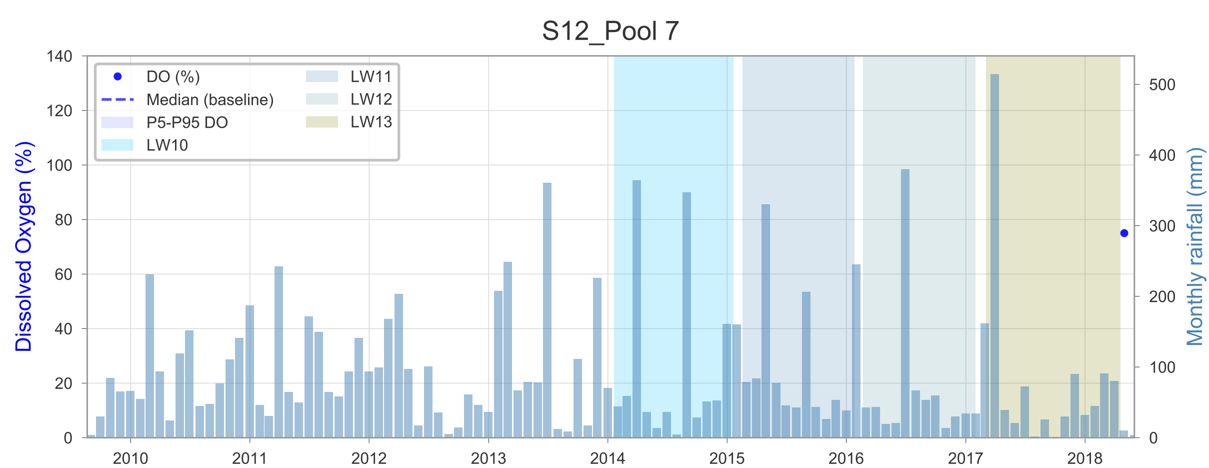

S12_Pool 6
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
2010
2011
2012
2013
2014
2015
2016
2017
2018

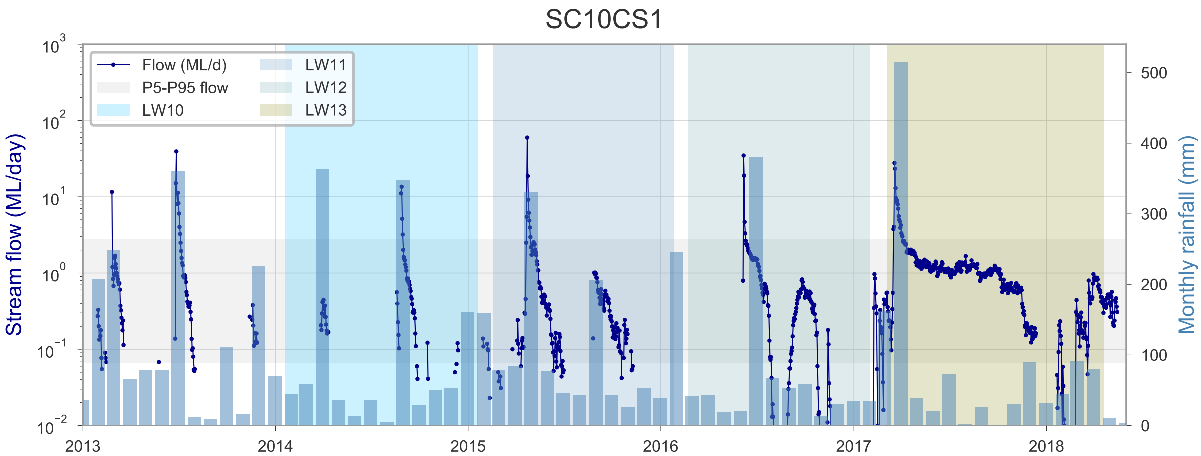

S12_Pool 6
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
2010
2011
2012
2013
2014
2015
2016
2017
2018

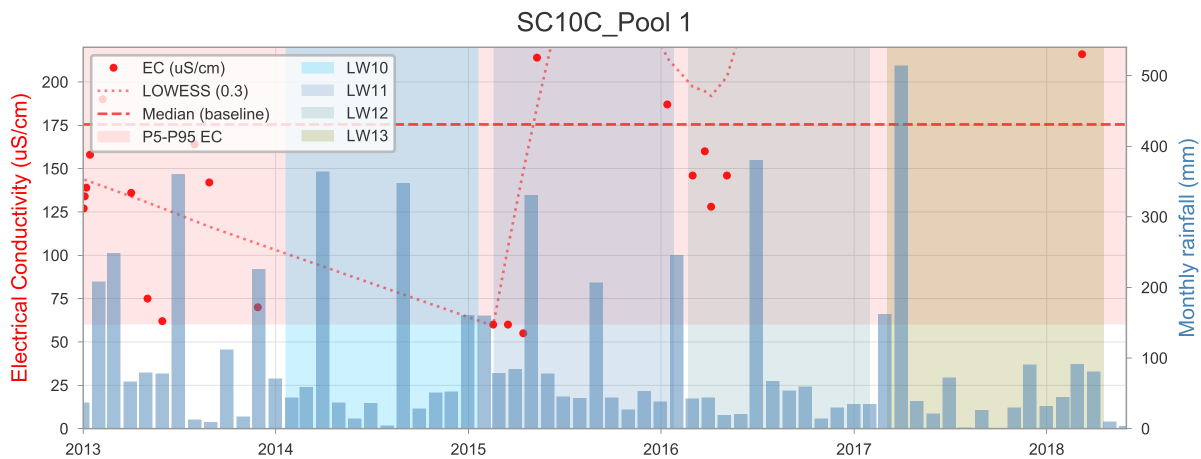

S12_Pool 7
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
2010
2011
2012
2013
2014
2015
2016
2017
2018

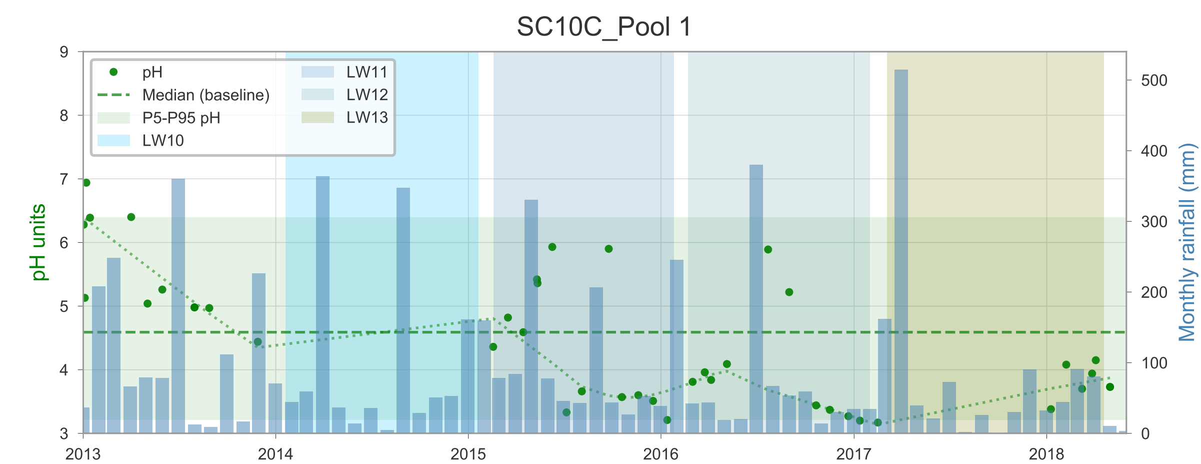

S12_Pool 7
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13

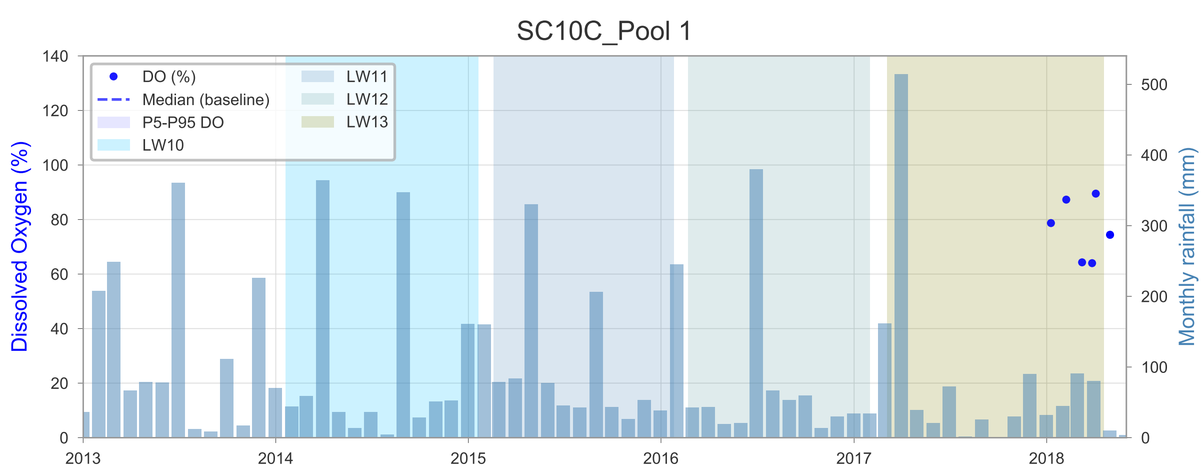

S12_Pool 7
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13

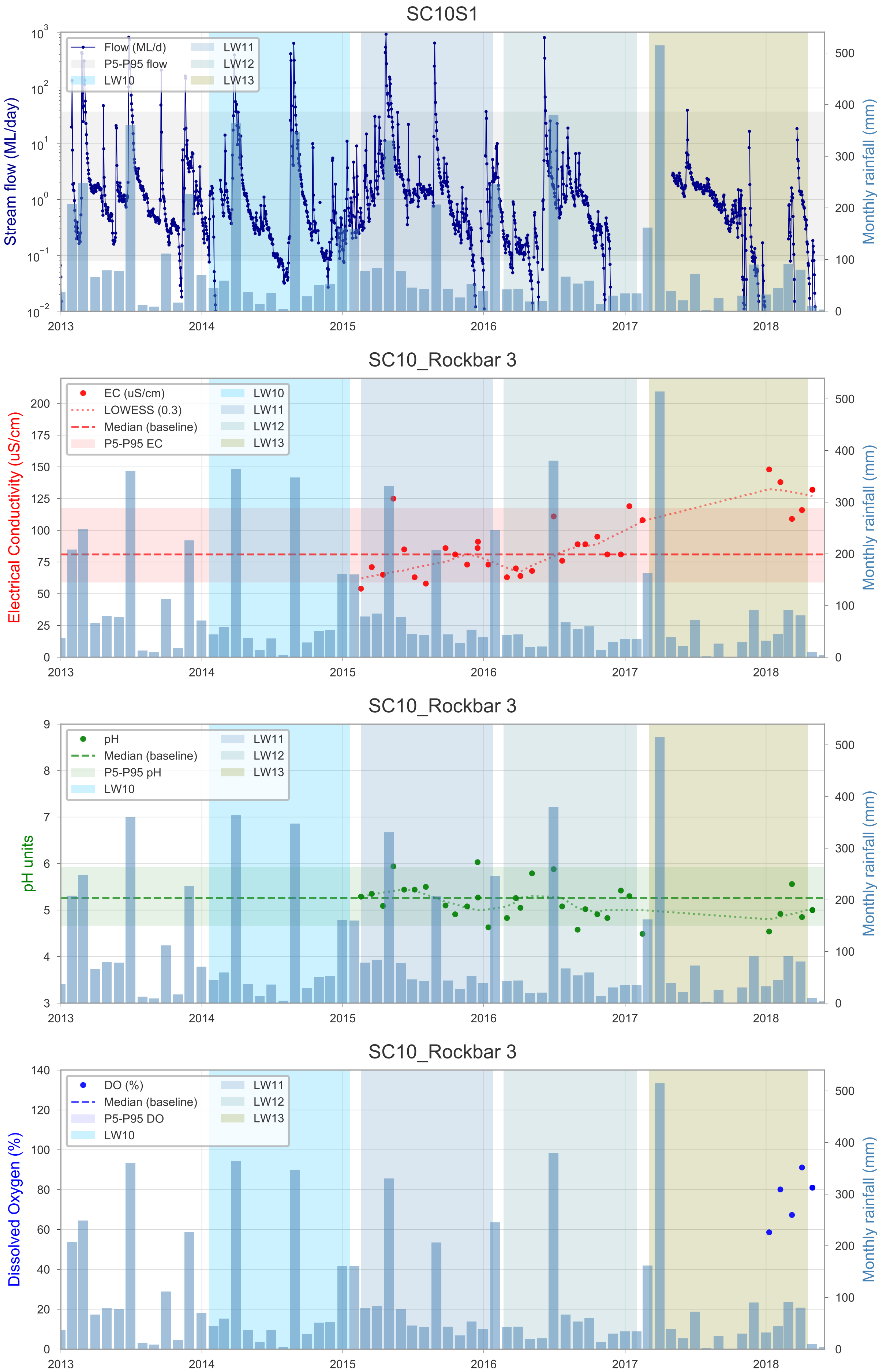

S12_Pool 7
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13

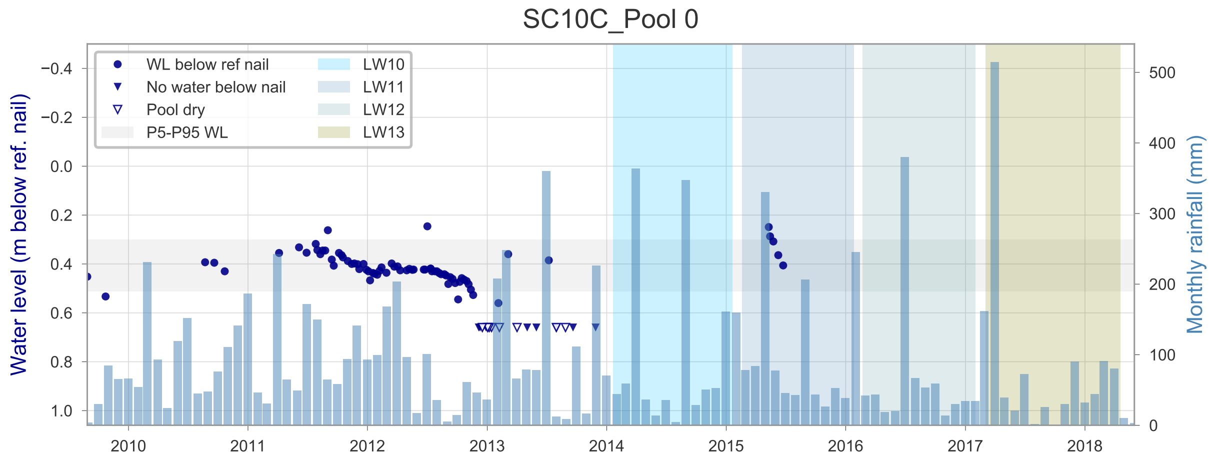

SC10CS1
Flow (ML/d)
P5-P95 flow
LW10
LW11
LW12
LW13
Stream flow (ML/day)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

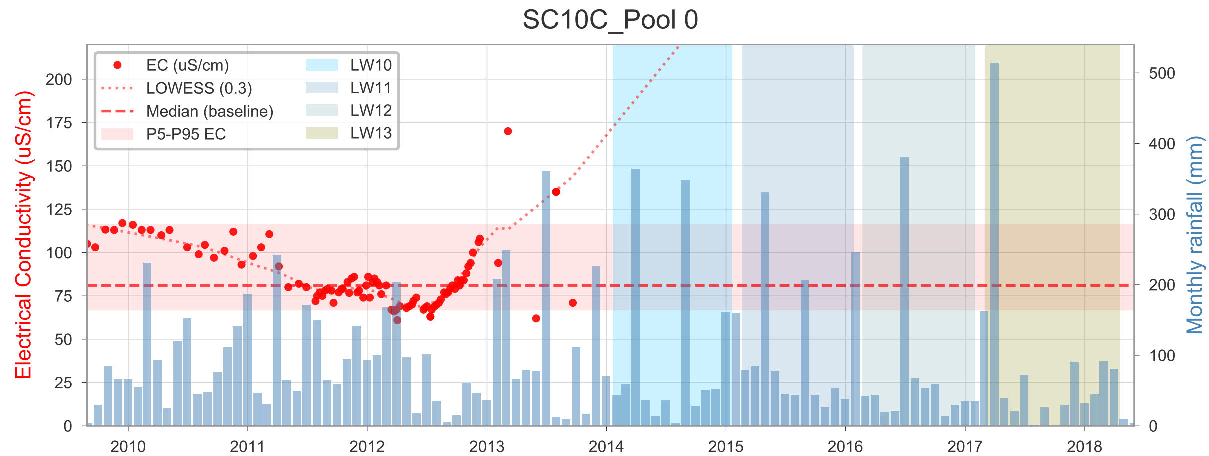

SC10C_Pool 1
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

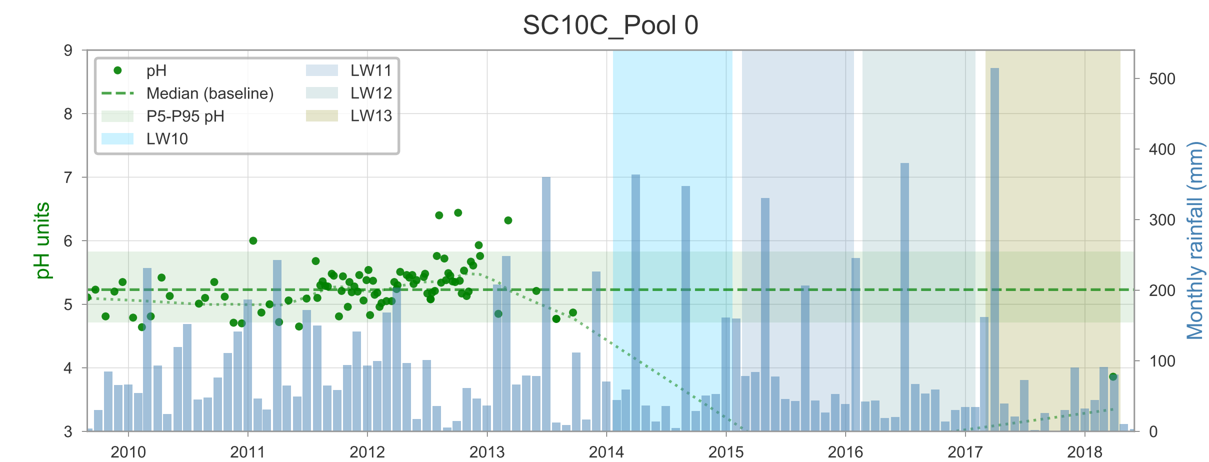

SC10C_Pool 1
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

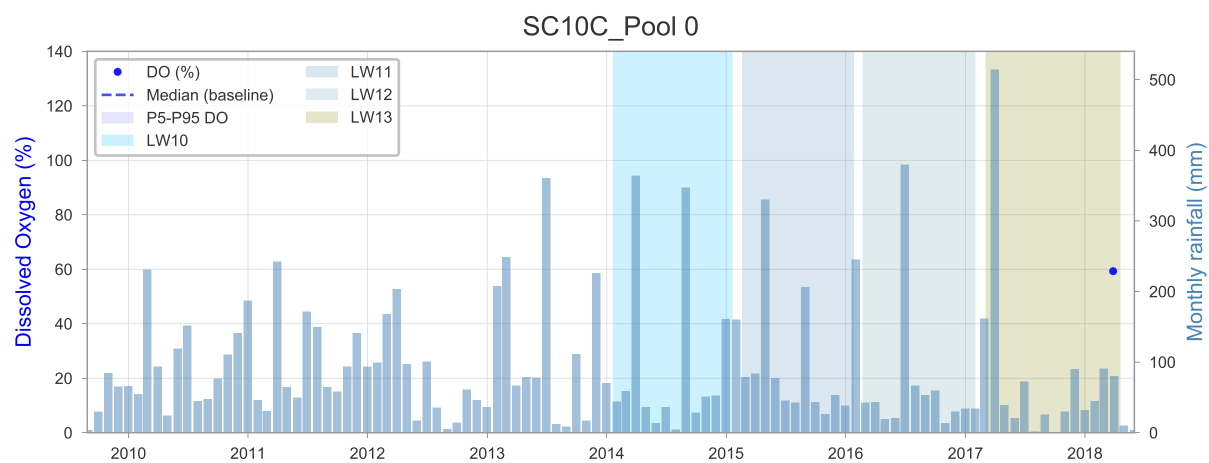

SC10C_Pool 1
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

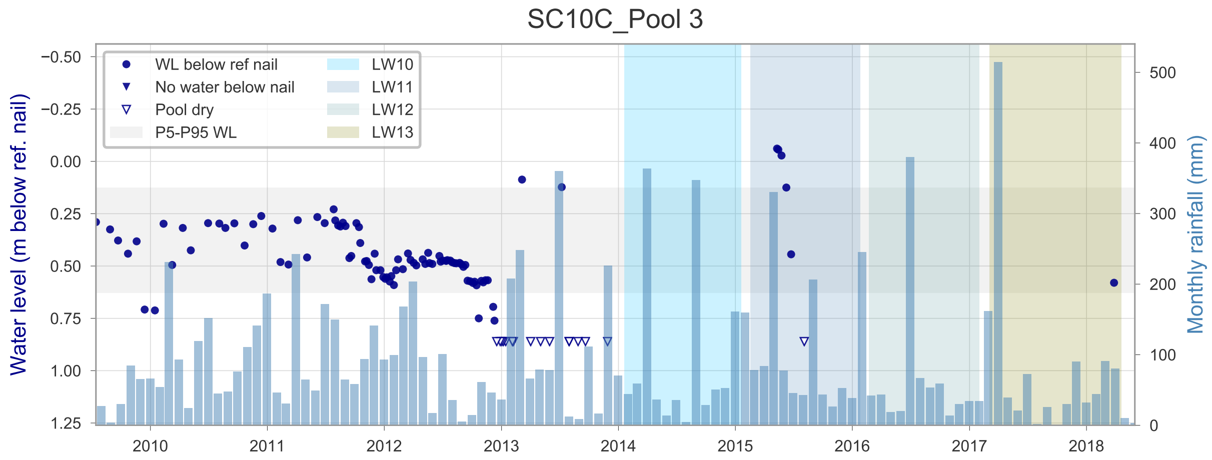

SC10S1
Stream flow (ML/day)
Monthly rainfall (mm)
Flow (ML/d)
P5-P95 flow
LW10
LW11
LW12
LW13
SC10_Rockbar 3
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
SC10_Rockbar 3
pH units
pH
Median (baseline)
P5-P95 pH
SC10_Rockbar 3
Dissolved Oxygen (%)
DO (%)
Median (baseline)
P5-P95 DO
2013
2014
2015
2016
2017
2018

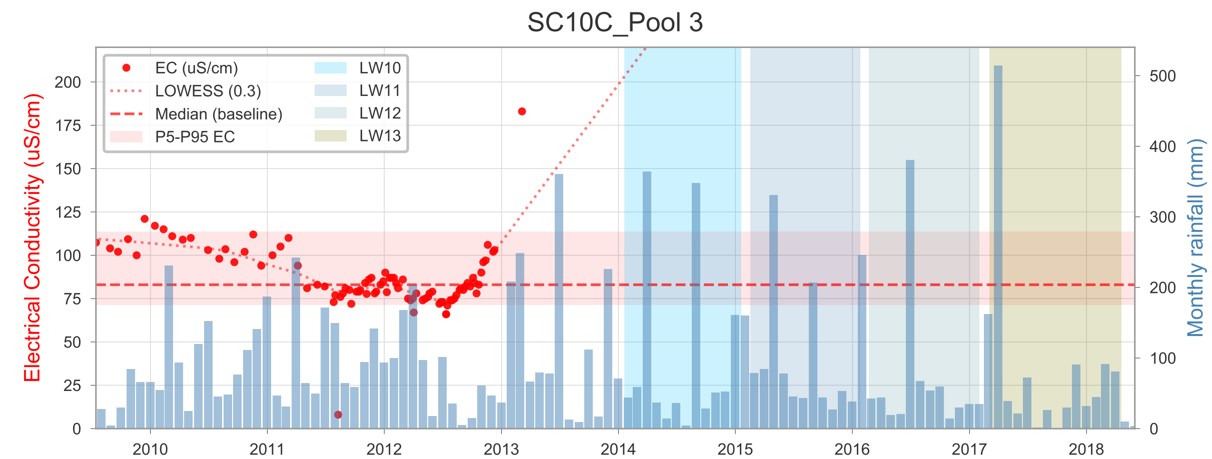

SC10C_Pool 0
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)

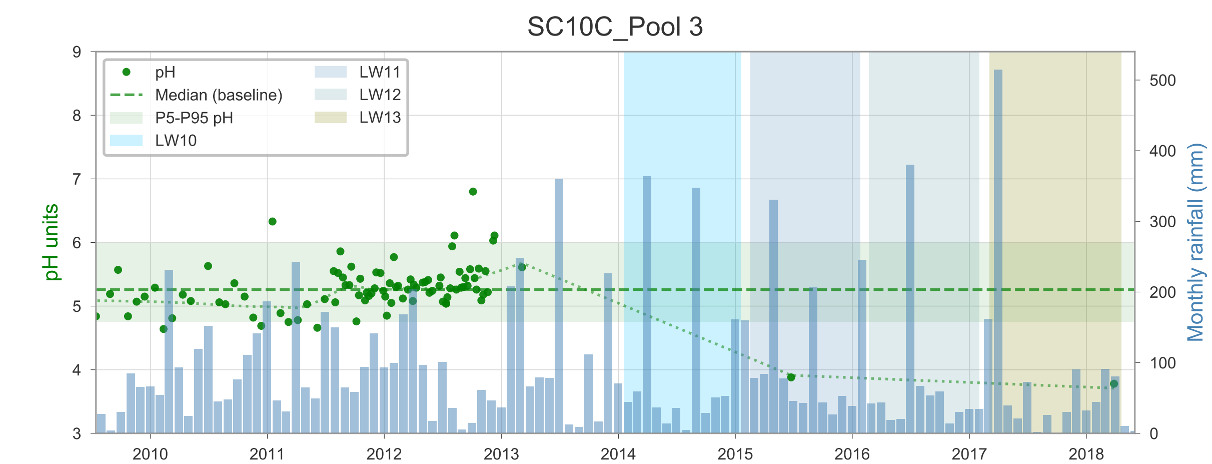

SC10C_Pool 0
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)

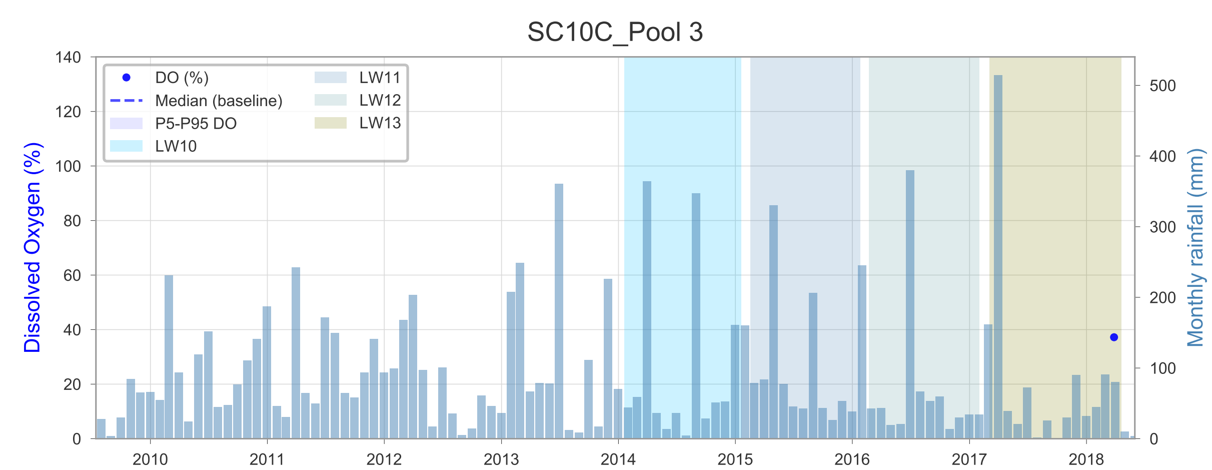

SC10C_Pool 0
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)

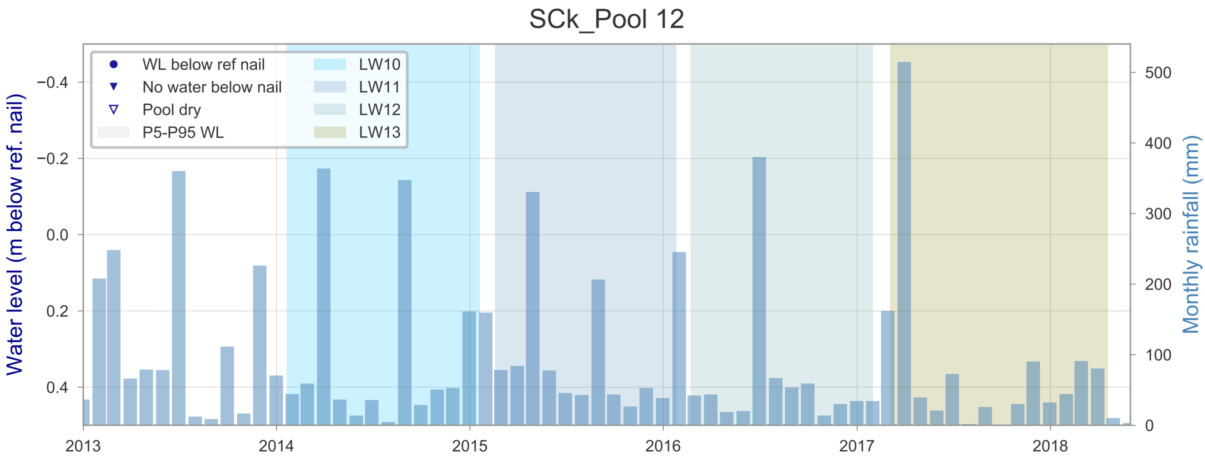

SC10C_Pool 0
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)

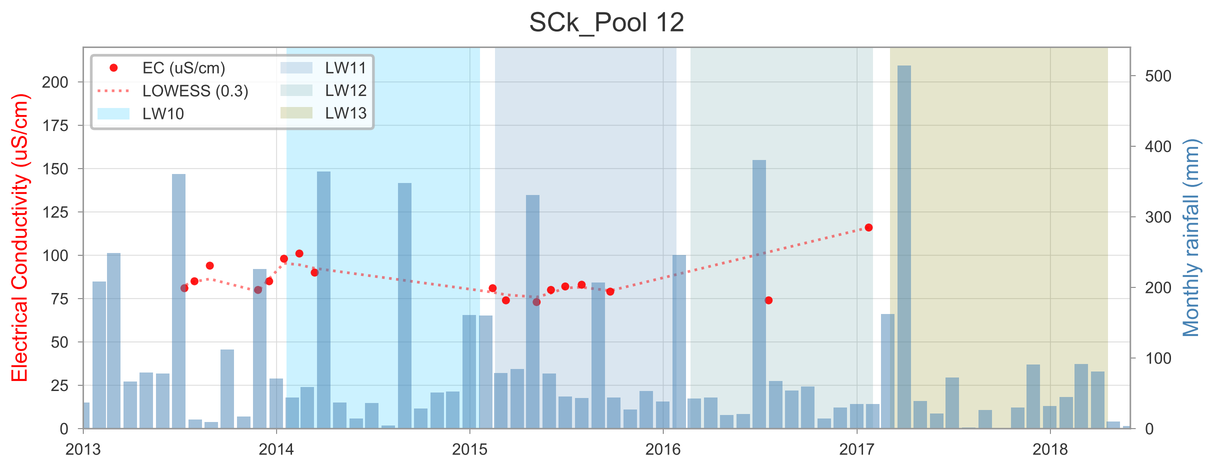

SC10C_Pool 3
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)

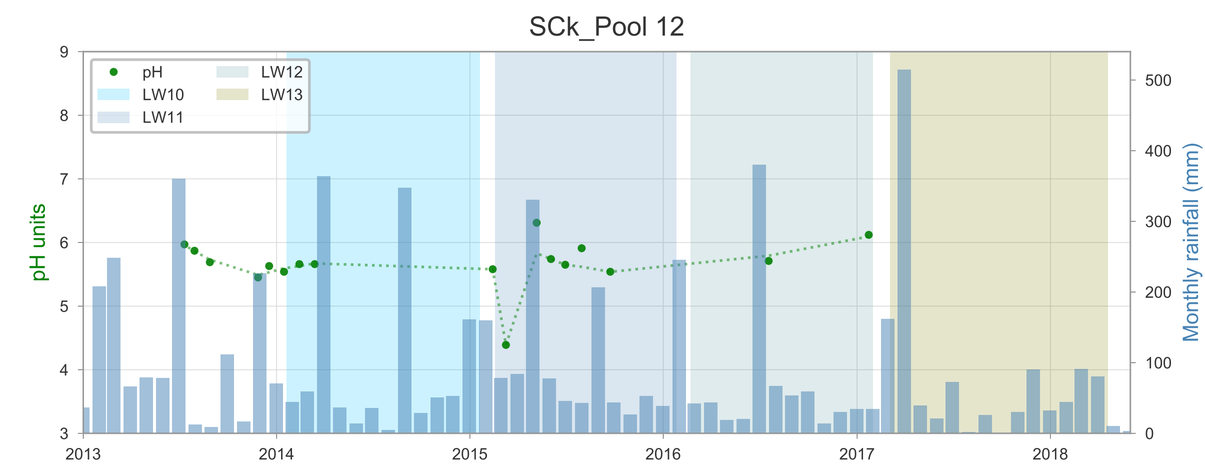

SC10C_Pool 3
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)

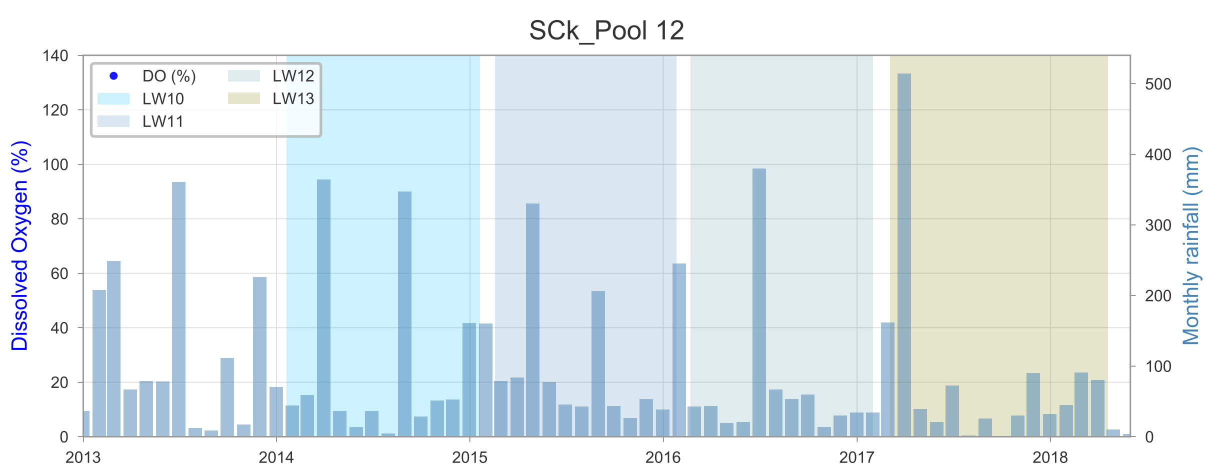

SC10C_Pool 3
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)

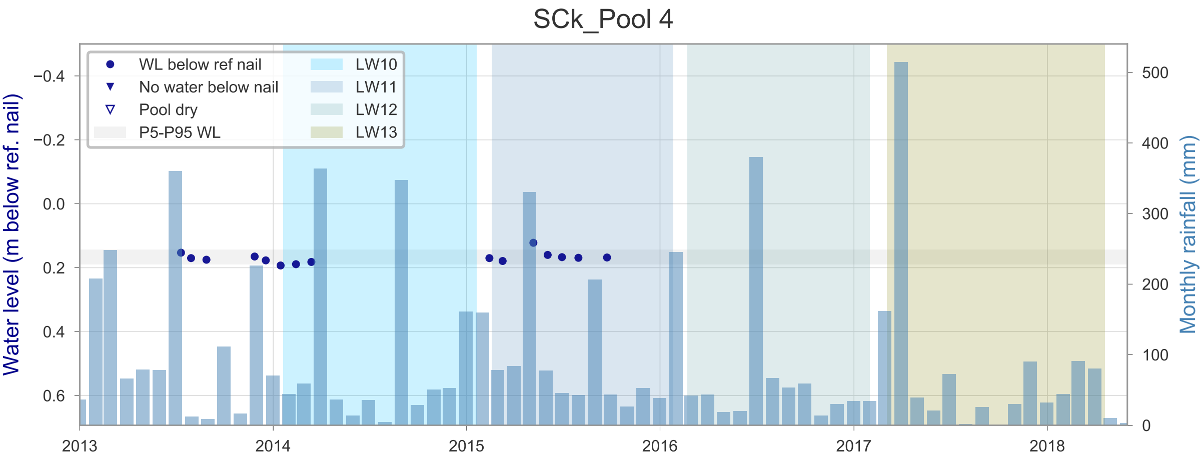

SC10C_Pool 3
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)

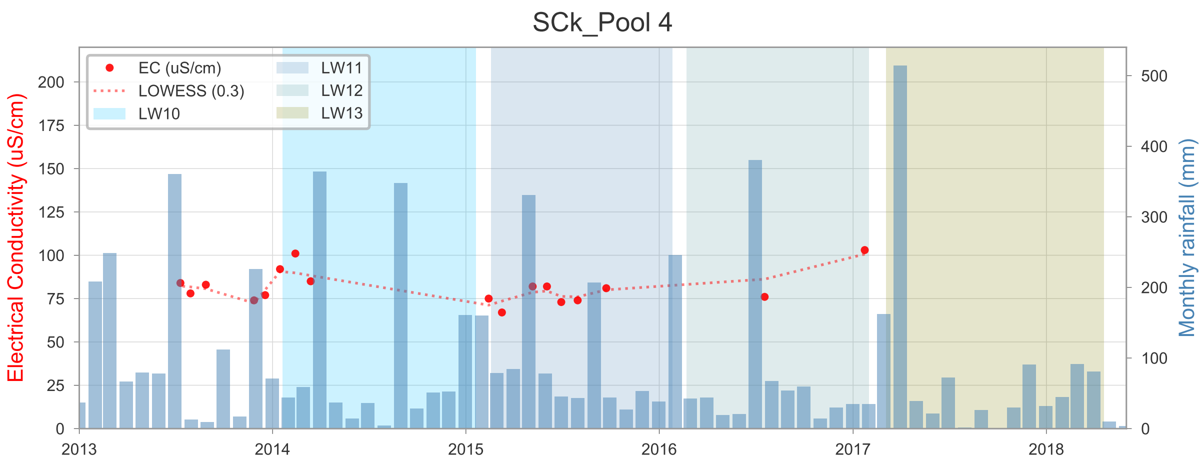

SCk_Pool 12
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13

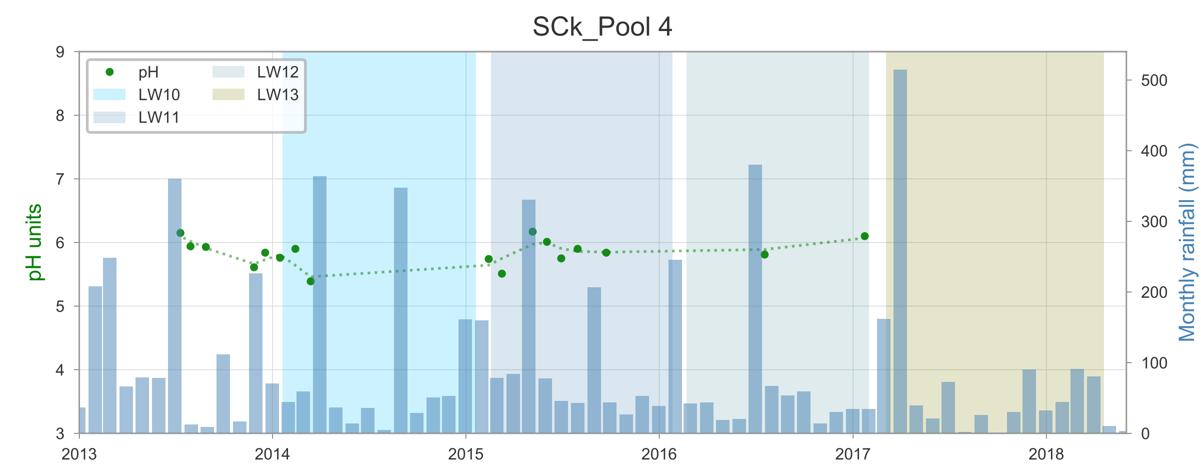

SCk_Pool 12
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
LW10
LW11
LW12
LW13

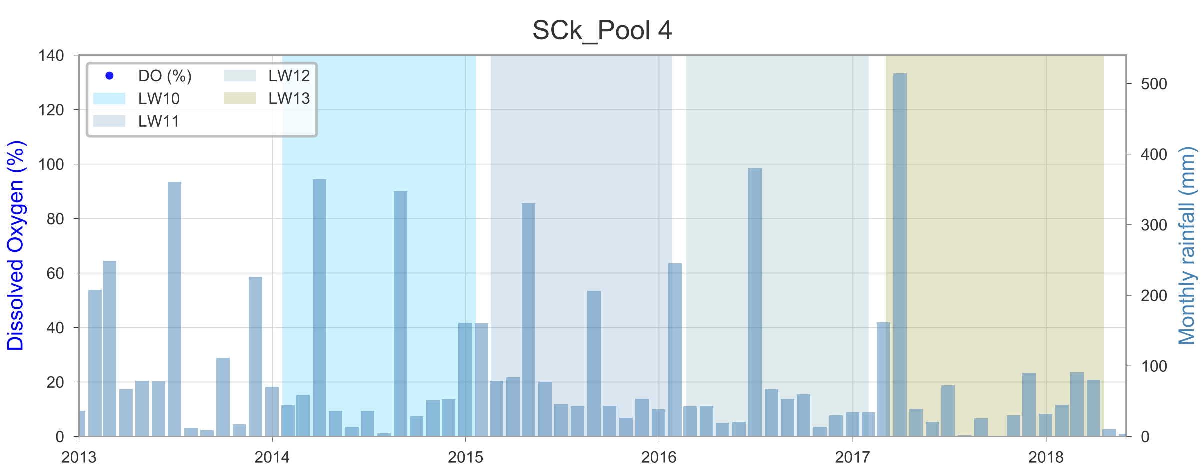

SCk_Pool 12
pH units
Monthly rainfall (mm)
pH
LW10
LW11
LW12
LW13

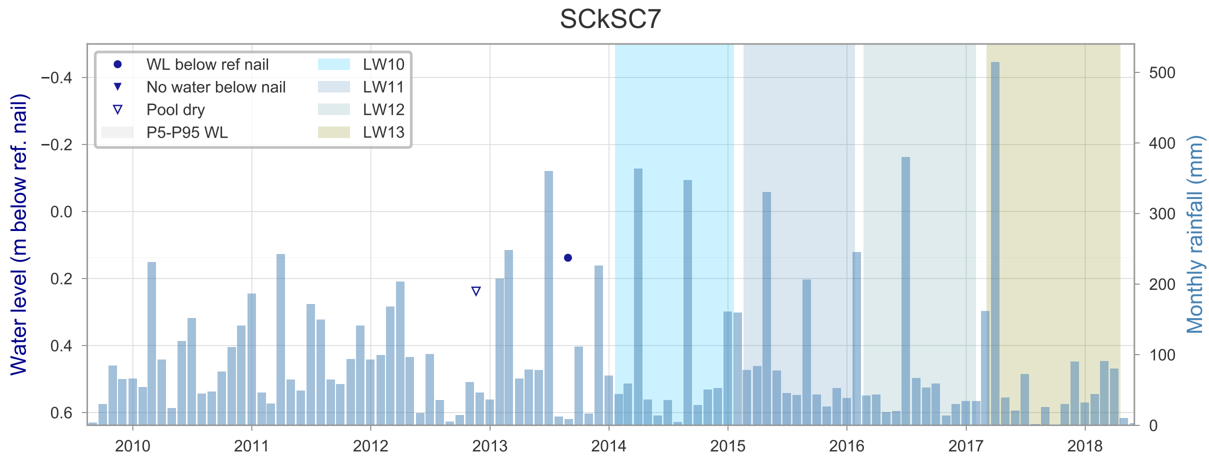

SCk_Pool 12
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
LW10
LW11
LW12
LW13

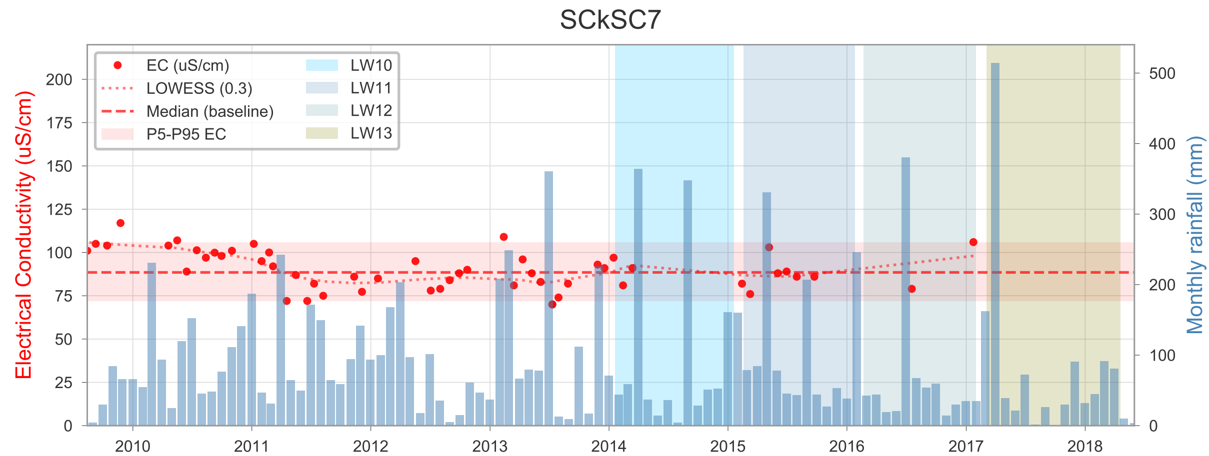

SCk_Pool 4
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

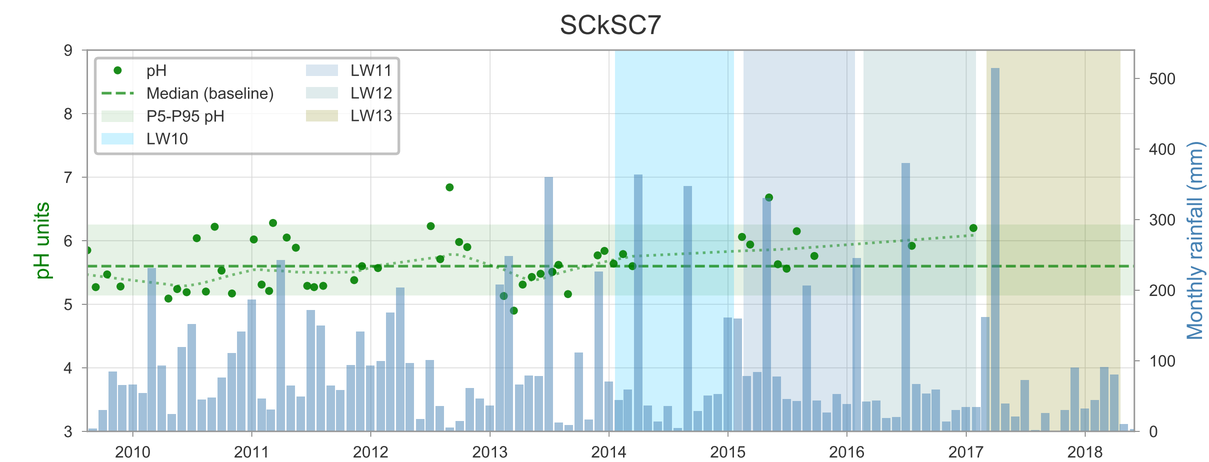

SCk_Pool 4
EC (uS/cm)
LOWESS (0.3)
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)

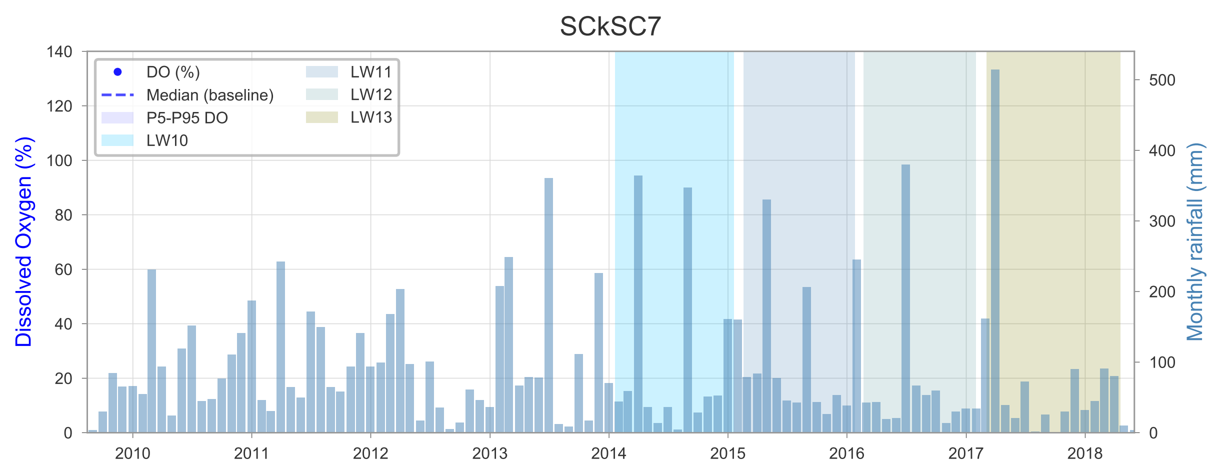

SCk_Pool 4
pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)

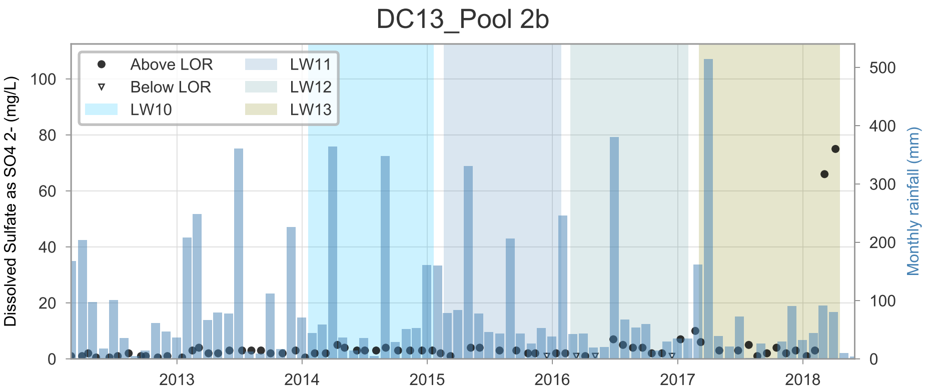

SCk_Pool 4
DO (%)
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)

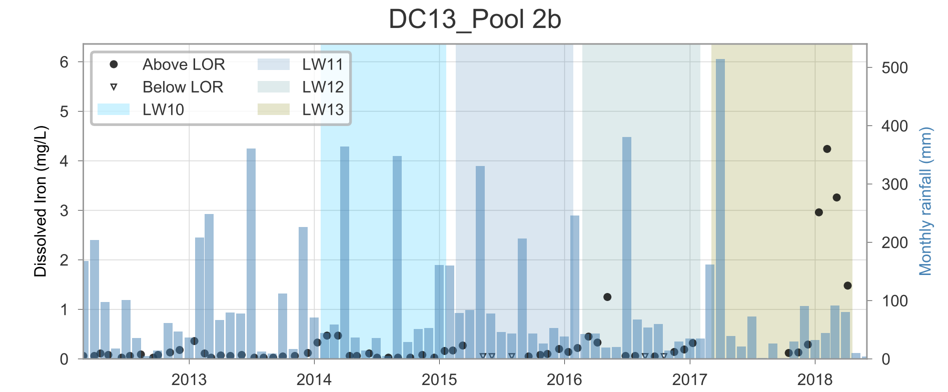

SCkSC7
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW10
LW11
LW12
LW13
Water level (m below ref. nail)
Monthly rainfall (mm)

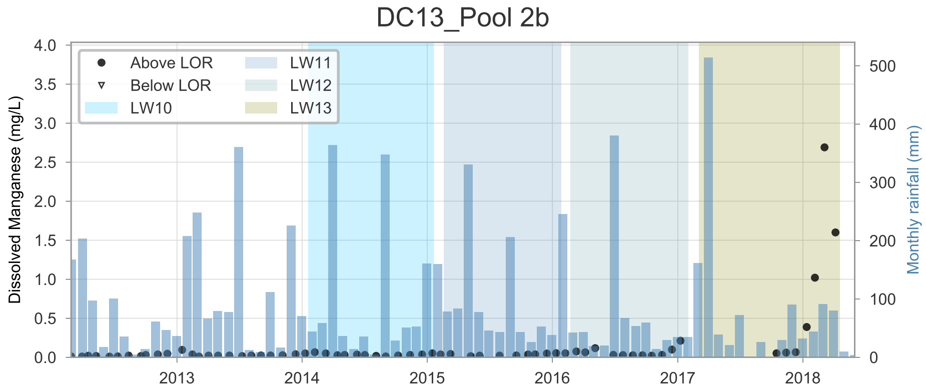

SCkSC7
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW10
LW11
LW12
LW13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)

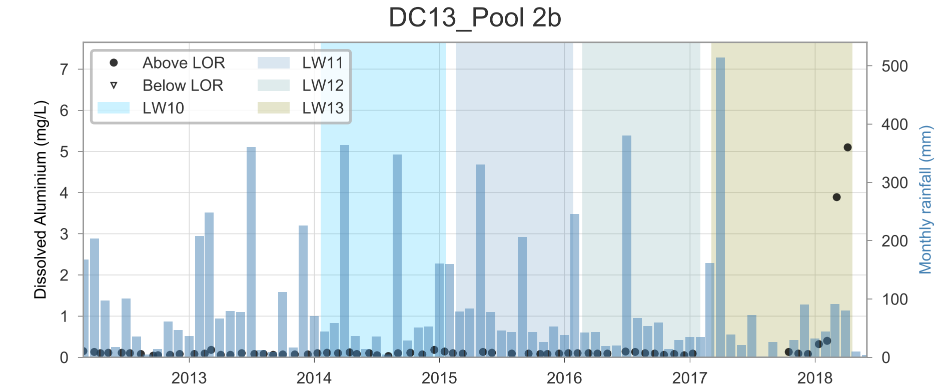

SCkSC7
pH
Median (baseline)
P5-P95 pH
LW10
LW11
LW12
LW13
pH units
Monthly rainfall (mm)

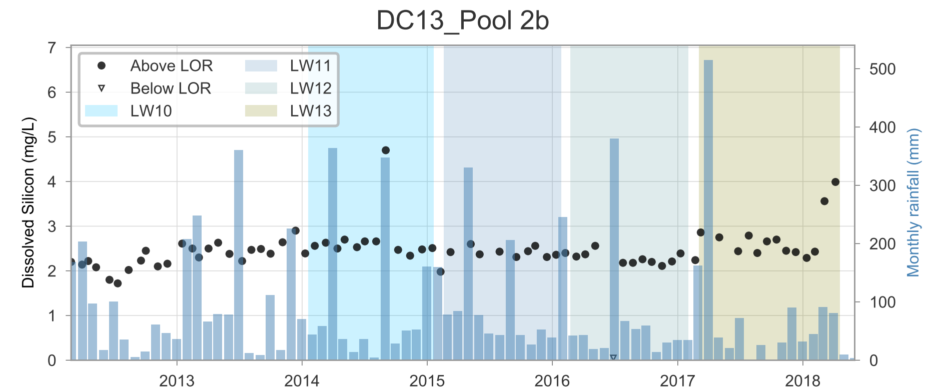

SCkSC7
DO (%)
Median (baseline)
P5-P95 DO
LW10
LW11
LW12
LW13
Dissolved Oxygen (%)
Monthly rainfall (mm)

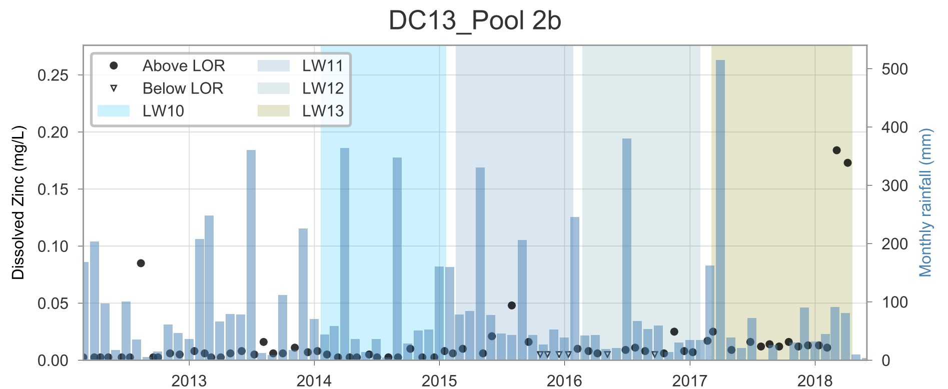

DC13_Pool 2b
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Sulfate as SO4 2- (mg/L)
Monthly rainfall (mm)
0
20
40
60
80
100
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

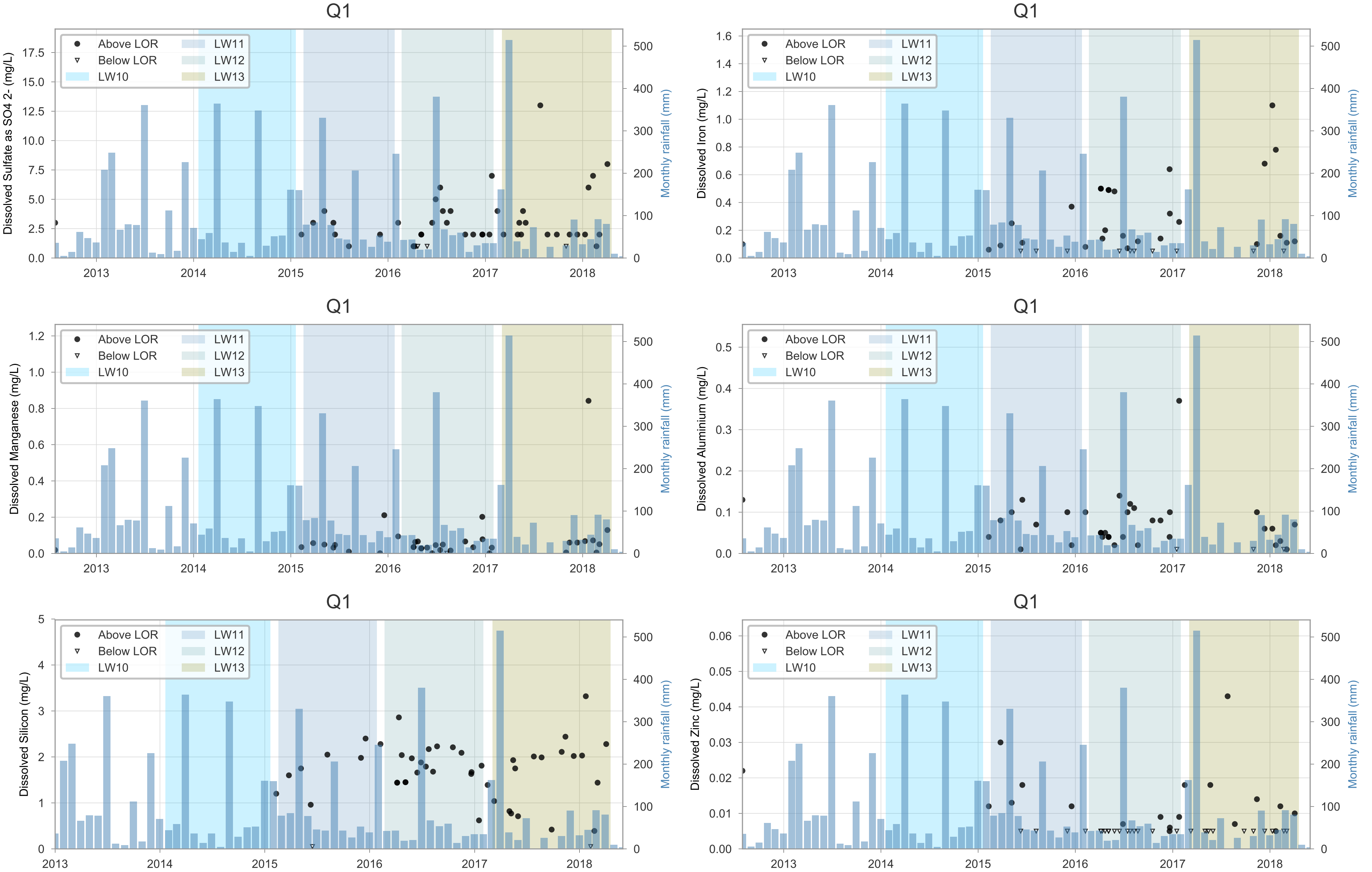

DC13_Pool 2b
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Iron (mg/L)
Monthly rainfall (mm)
0
1
2
3
4
5
6
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

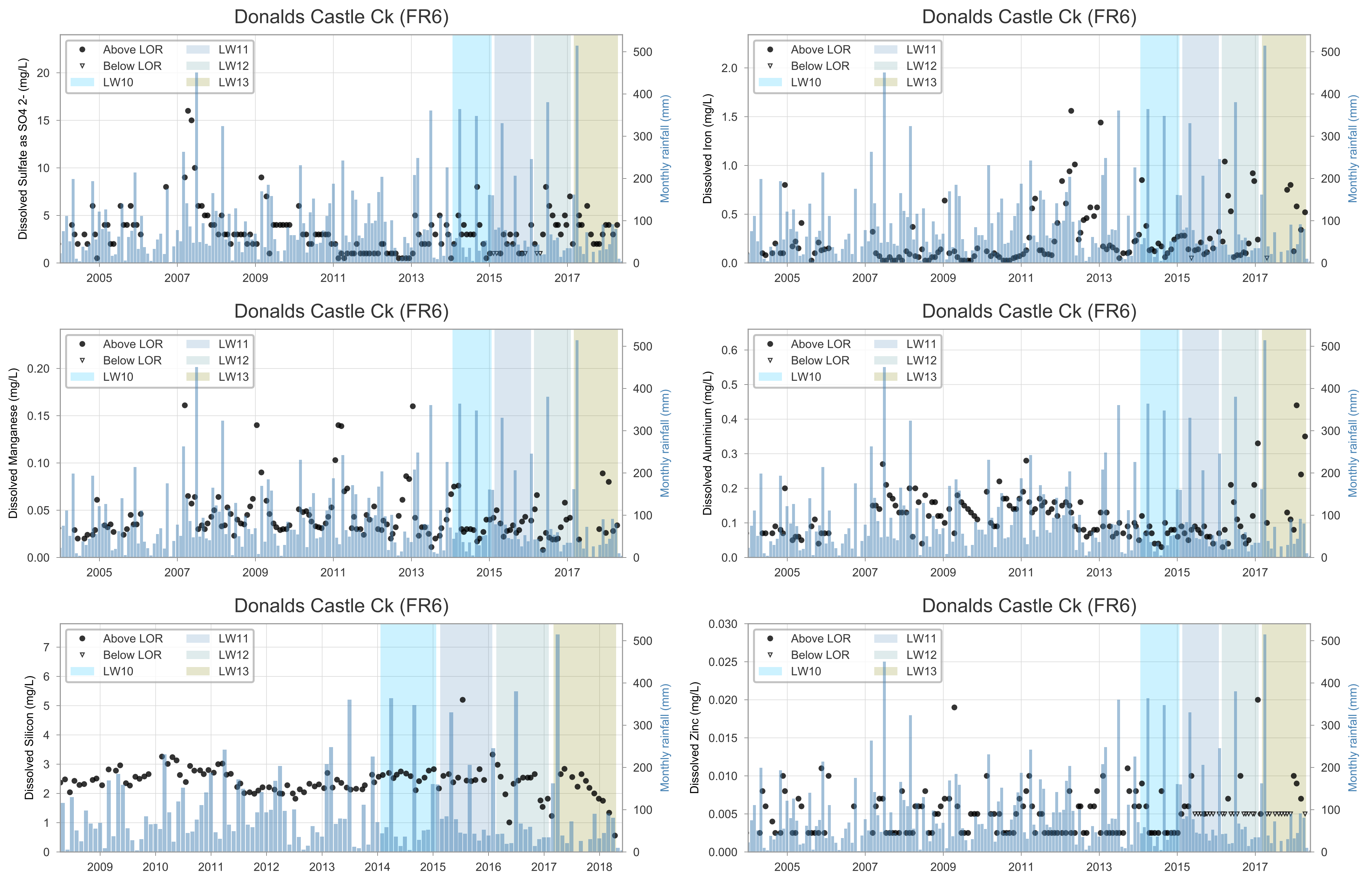

DC13_Pool 2b
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Manganese (mg/L)
Monthly rainfall (mm)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

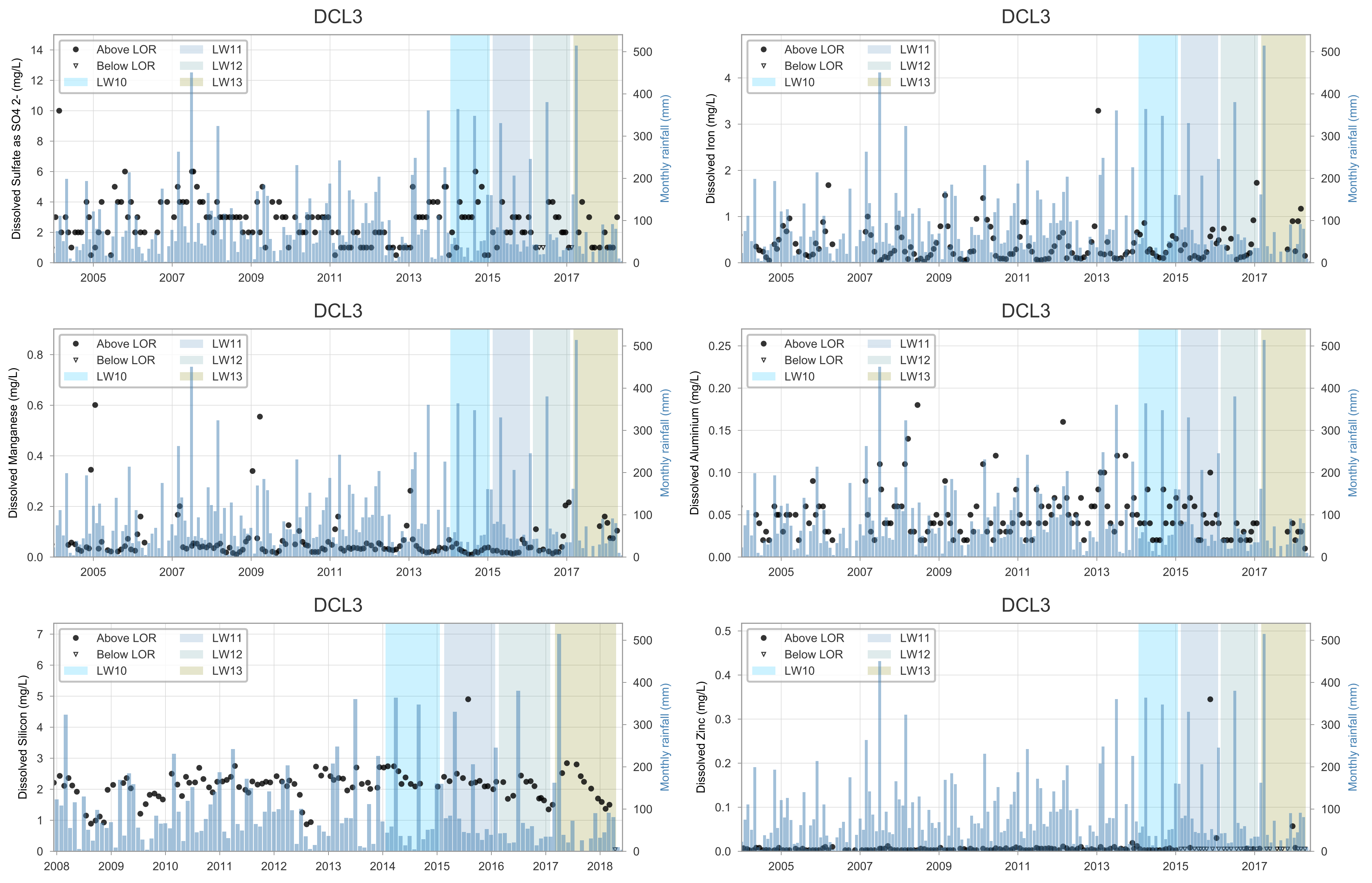

DC13_Pool 2b
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Aluminium (mg/L)
Monthly rainfall (mm)
0
1
2
3
4
5
6
7
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

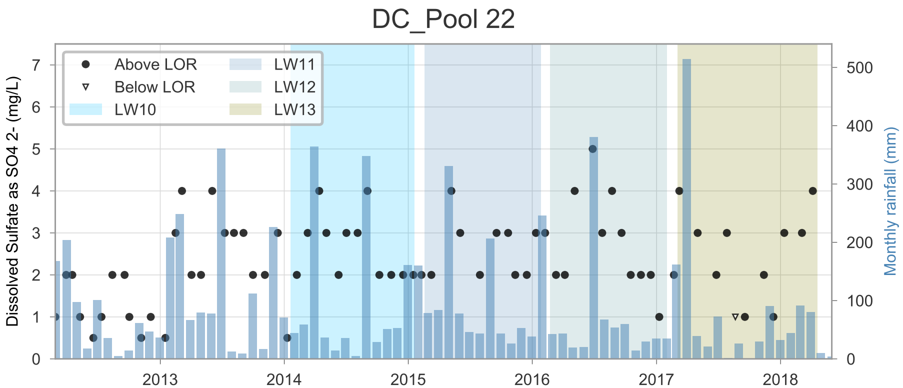

DC13_Pool 2b
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Silicon (mg/L)
Monthly rainfall (mm)
0
1
2
3
4
5
6
7
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

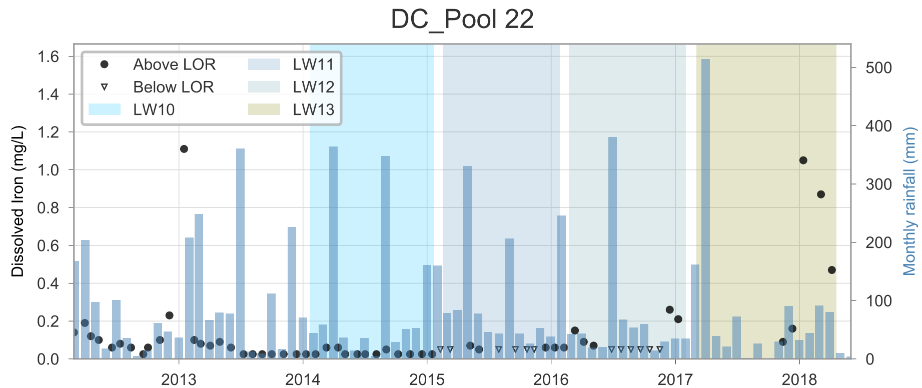

DC13_Pool 2b
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Zinc (mg/L)
Monthly rainfall (mm)
0.00
0.05
0.10
0.15
0.20
0.25
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

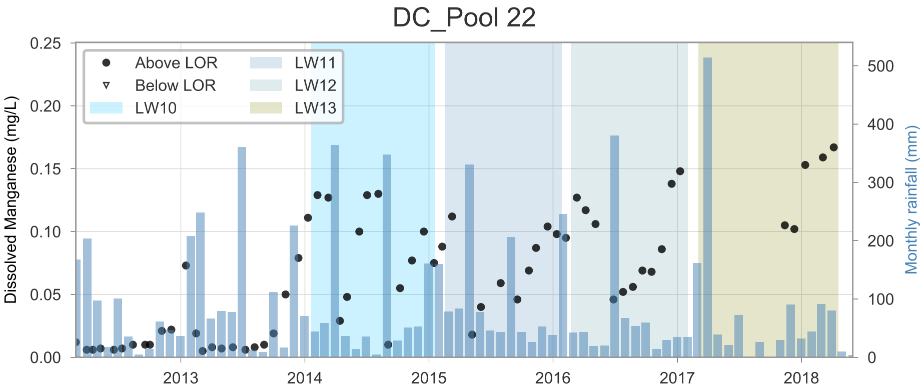

Q1
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Sulfate as SO4 2- (mg/L)
Dissolved Iron (mg/L)
Dissolved Manganese (mg/L)
Dissolved Aluminium (mg/L)
Dissolved Silicon (mg/L)
Dissolved Zinc (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

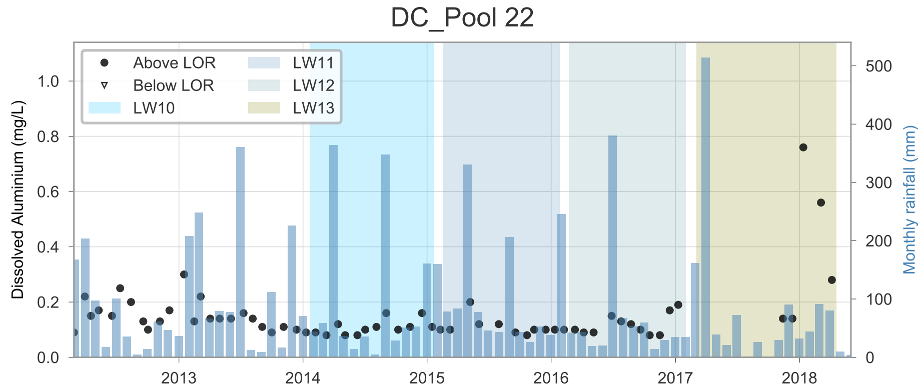

Donalds Castle Ck (FR6)
Dissolved Sulfate as SO4 2- (mg/L)
Donalds Castle Ck (FR6)
Dissolved Iron (mg/L)
Donalds Castle Ck (FR6)
Dissolved Manganese (mg/L)
Donalds Castle Ck (FR6)
Dissolved Aluminium (mg/L)
Donalds Castle Ck (FR6)
Dissolved Silicon (mg/L)
Donalds Castle Ck (FR6)
Dissolved Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
2005
2007
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018

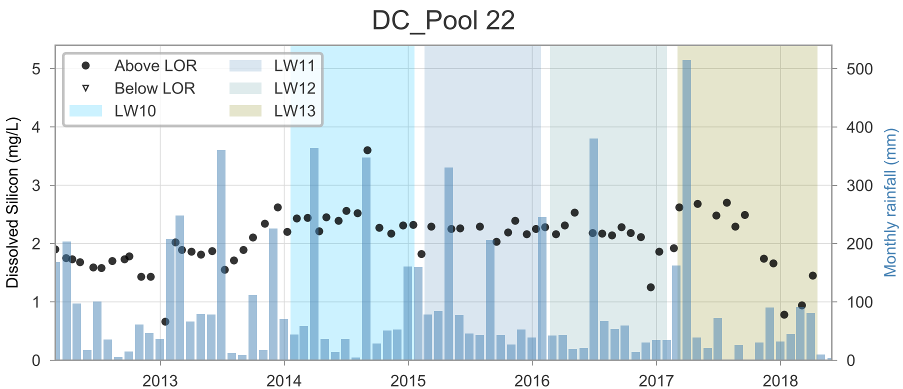

DCL3
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Sulfate as SO4 2- (mg/L)
Monthly rainfall (mm)
DCL3
Dissolved Iron (mg/L)
Monthly rainfall (mm)
DCL3
Dissolved Manganese (mg/L)
Monthly rainfall (mm)
DCL3
Dissolved Aluminium (mg/L)
Monthly rainfall (mm)
DCL3
Dissolved Silicon (mg/L)
Monthly rainfall (mm)
DCL3
Dissolved Zinc (mg/L)
Monthly rainfall (mm)

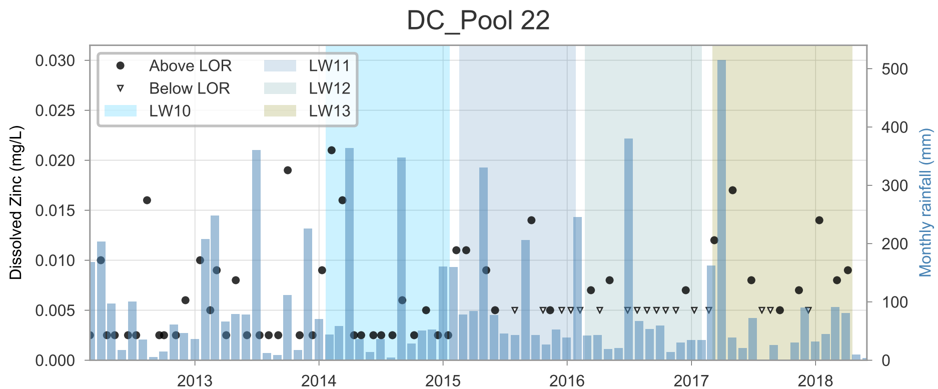

DC_Pool 22
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Sulfate as SO4 2- (mg/L)
Monthly rainfall (mm)
0
1
2
3
4
5
6
7
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

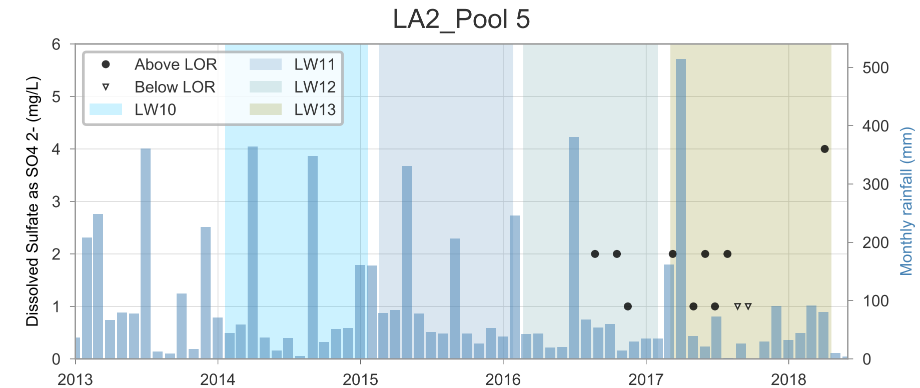

DC_Pool 22
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Iron (mg/L)
Monthly rainfall (mm)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

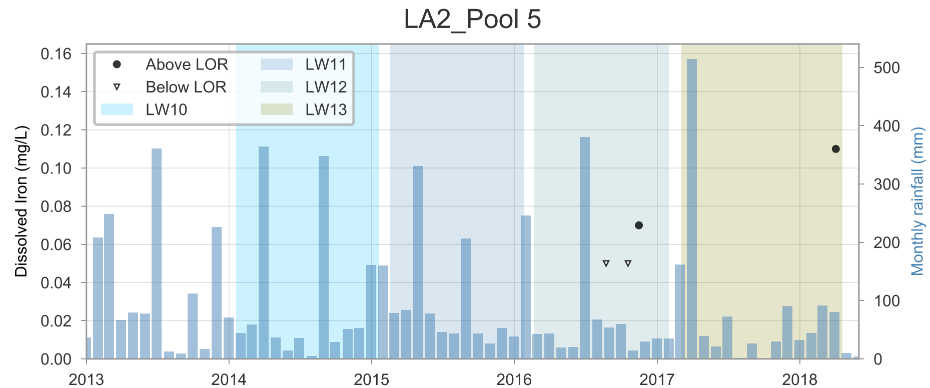

DC_Pool 22
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Manganese (mg/L)
Monthly rainfall (mm)
0.00
0.05
0.10
0.15
0.20
0.25
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

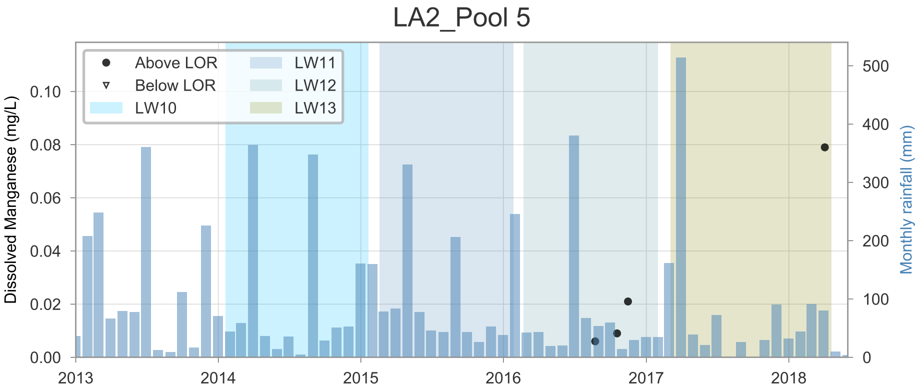

DC_Pool 22
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Aluminium (mg/L)
Monthly rainfall (mm)
0.0
0.2
0.4
0.6
0.8
1.0
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

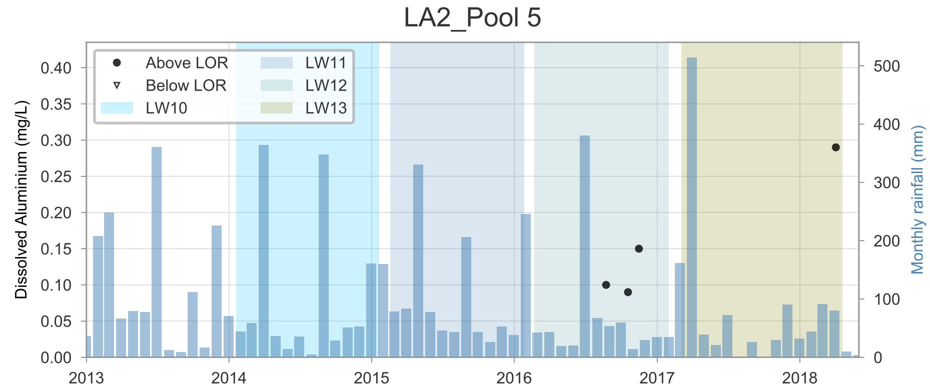

DC_Pool 22
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Silicon (mg/L)
Monthly rainfall (mm)
0
1
2
3
4
5
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

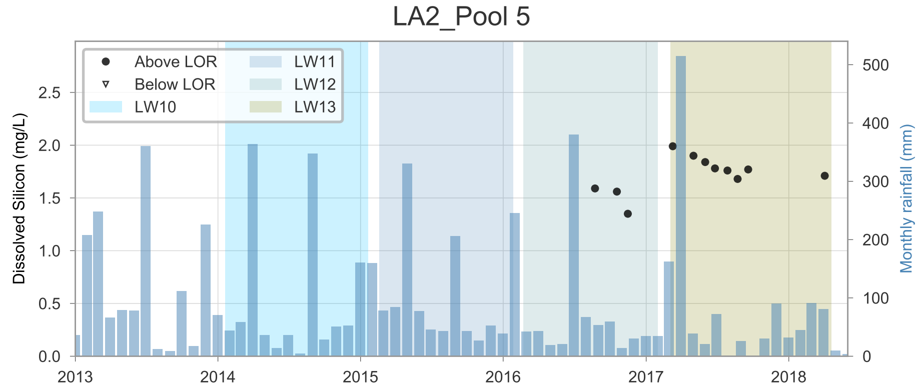

DC_Pool 22
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Zinc (mg/L)
Monthly rainfall (mm)
0.000
0.005
0.010
0.015
0.020
0.025
0.030
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

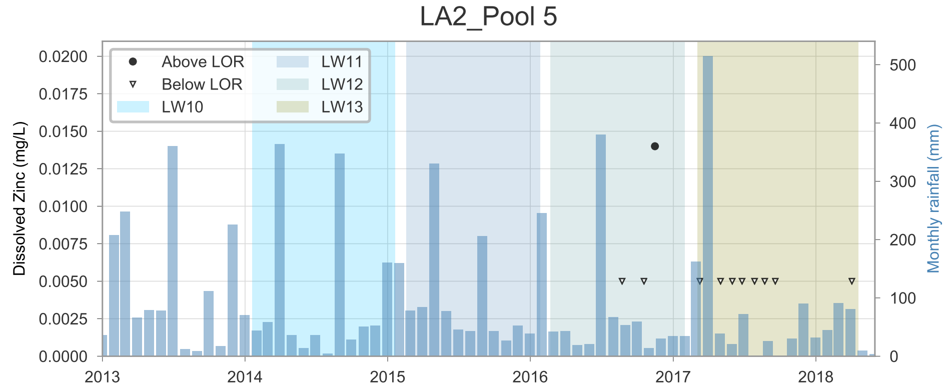

LA2_Pool 5
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Sulfate as SO4 2- (mg/L)
Monthly rainfall (mm)
0
1
2
3
4
5
6
100
200
300
400
500
2013
2014
2015
2016
2017
2018

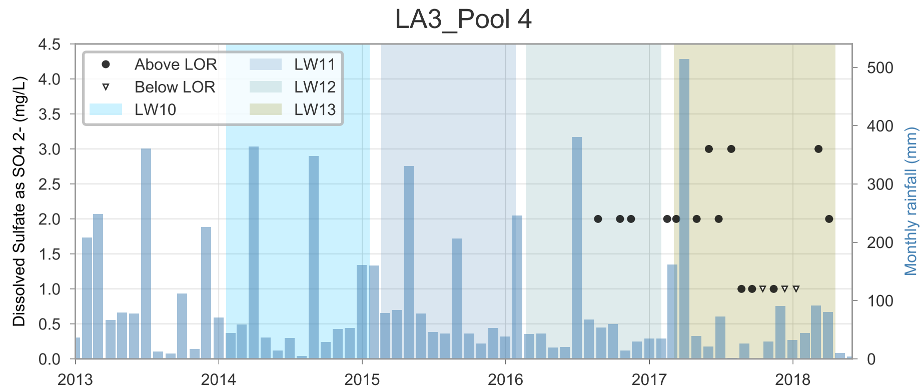

LA2_Pool 5
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Iron (mg/L)
Monthly rainfall (mm)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

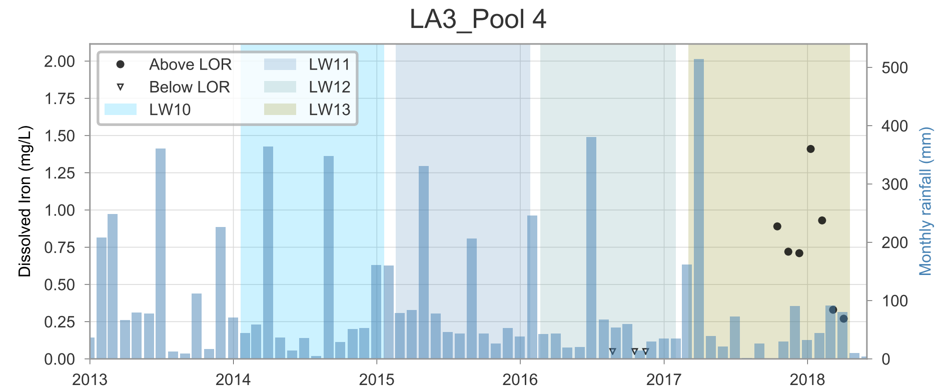

LA2_Pool 5
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Manganese (mg/L)
Monthly rainfall (mm)
0.00
0.02
0.04
0.06
0.08
0.10
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

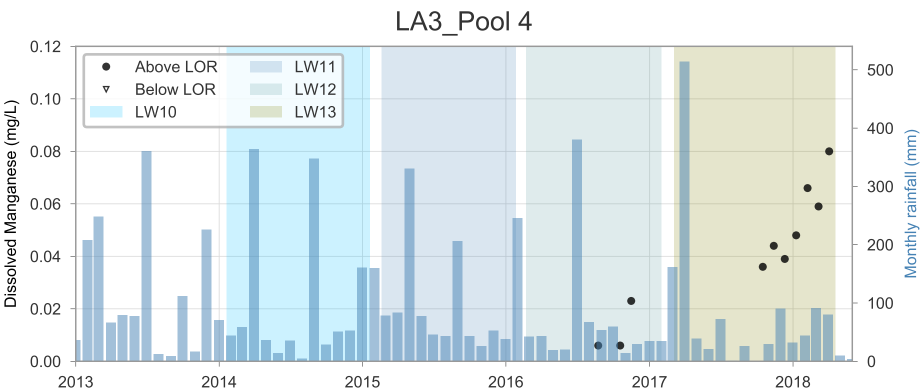

LA2_Pool 5
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Aluminium (mg/L)
Monthly rainfall (mm)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

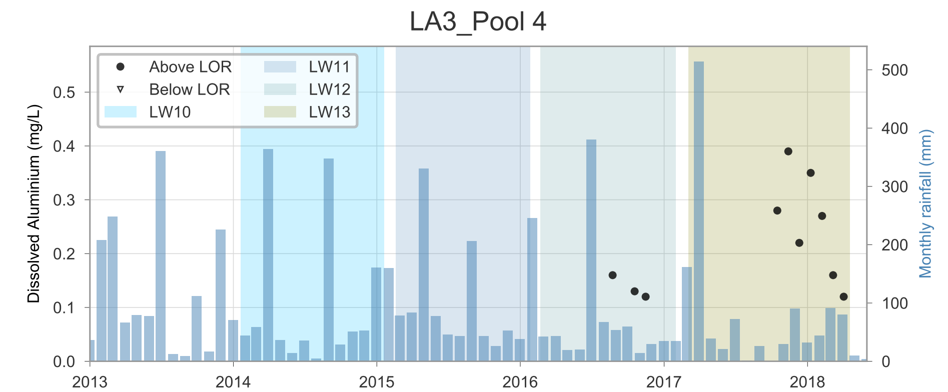

LA2_Pool 5
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Silicon (mg/L)
Monthly rainfall (mm)
0.0
0.5
1.0
1.5
2.0
2.5
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

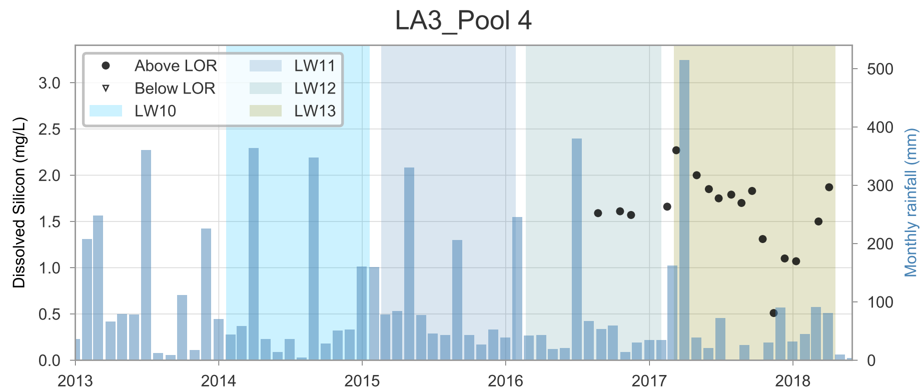

LA2_Pool 5
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Zinc (mg/L)
Monthly rainfall (mm)
0.0000
0.0025
0.0050
0.0075
0.0100
0.0125
0.0150
0.0175
0.0200
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

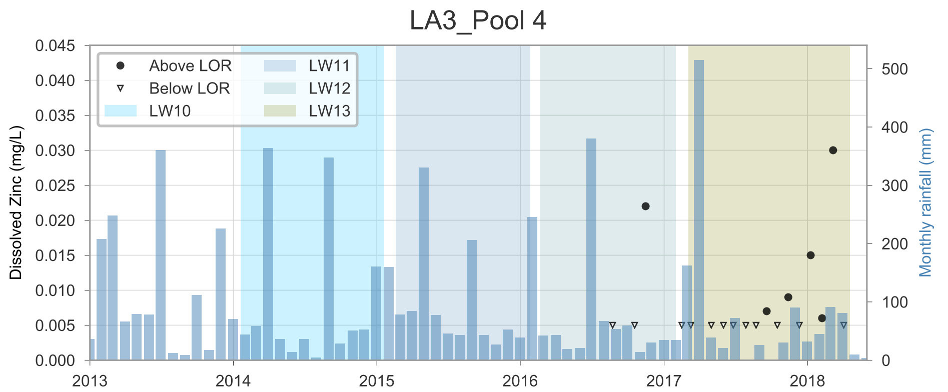

LA3_Pool 4
Dissolved Sulfate as SO4 2- (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13

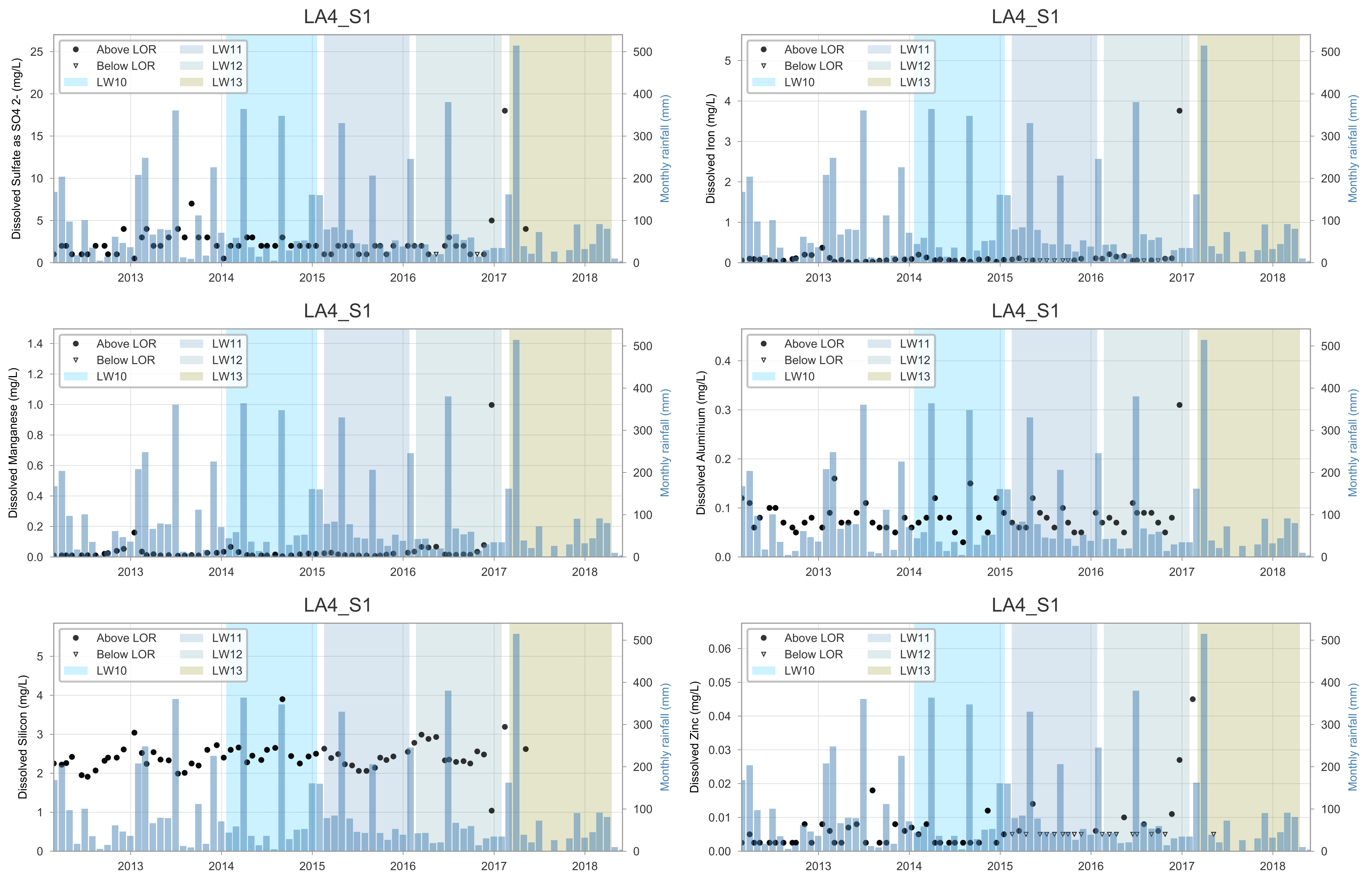

LA3_Pool 4
Dissolved Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13

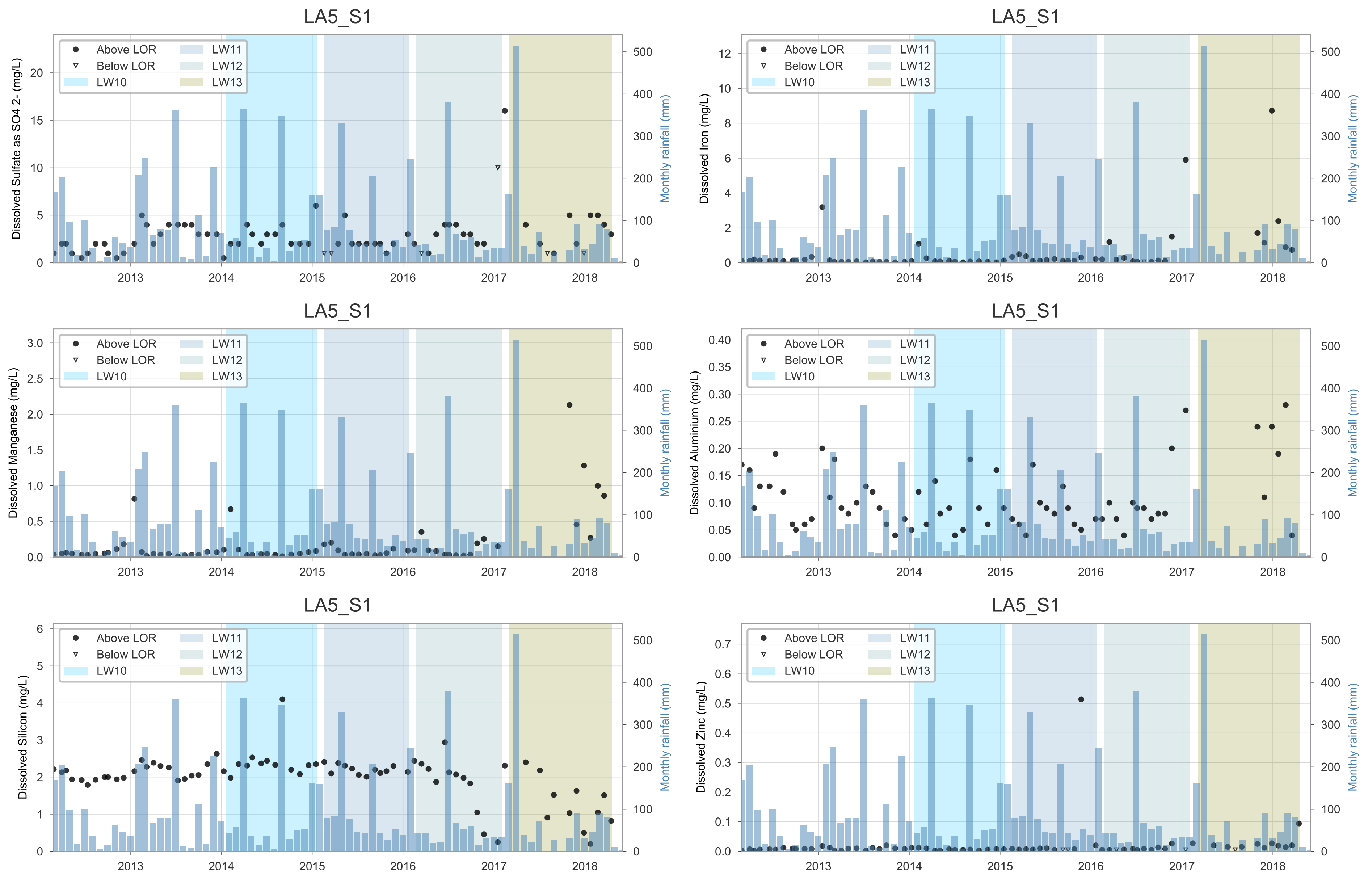

LA3_Pool 4
Dissolved Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13

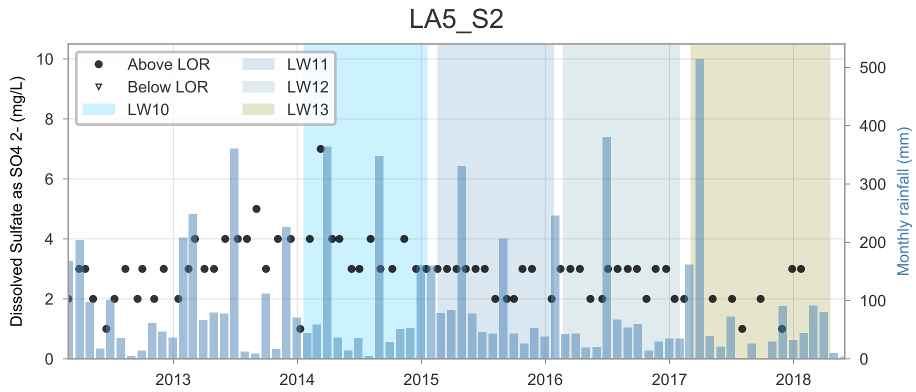

LA3_Pool 4
Dissolved Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13

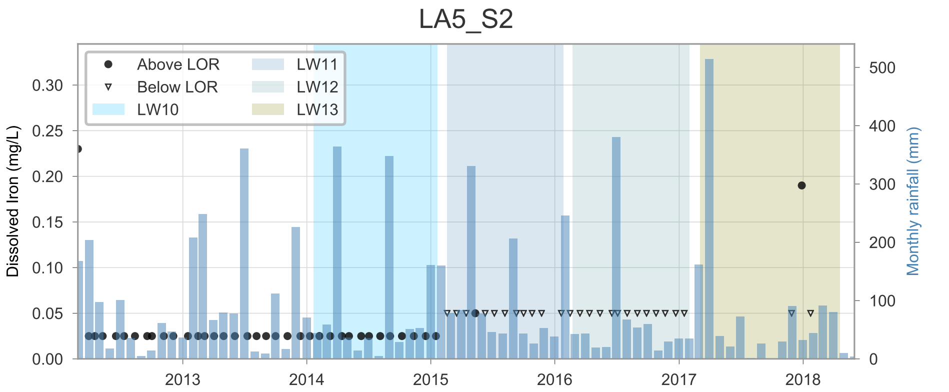

LA3_Pool 4
Dissolved Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13

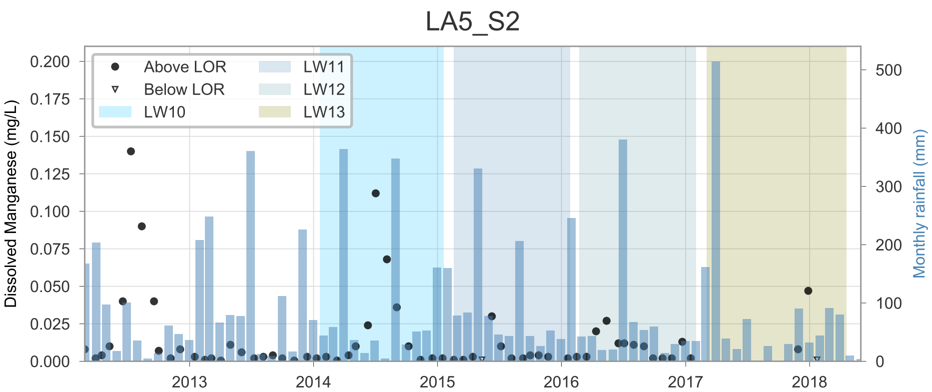

LA3_Pool 4
Dissolved Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13

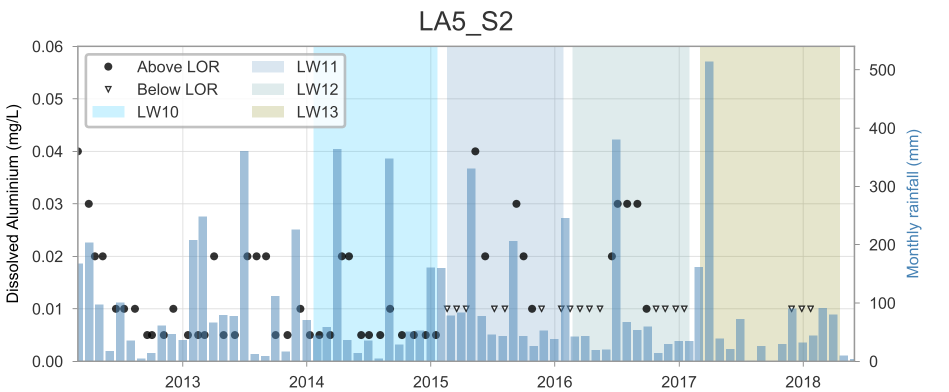

LA4_S1
Dissolved Sulfate as SO4 2- (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
0
5
10
15
20
25
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
LA4_S1
Dissolved Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
0
1
2
3
4
5
LA4_S1
Dissolved Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
LA4_S1
Dissolved Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
0.0
0.1
0.2
0.3
0.4
LA4_S1
Dissolved Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
0
1
2
3
4
5
LA4_S1
Dissolved Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
0.00
0.01
0.02
0.03
0.04
0.05
0.06

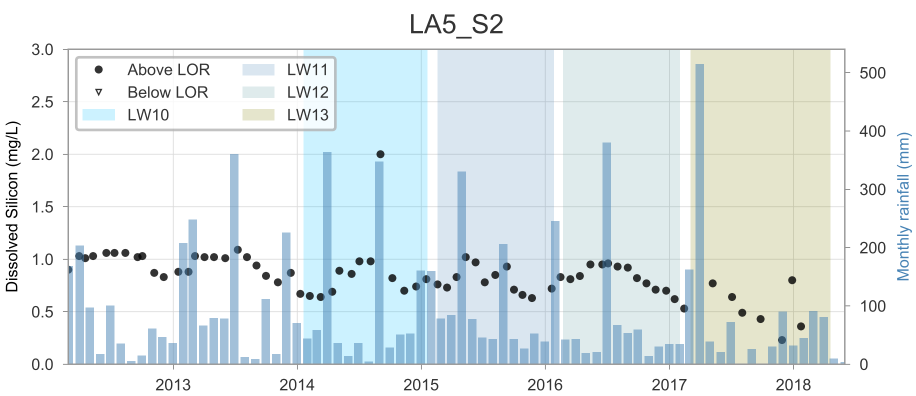

LA5_S1
Dissolved Sulfate as SO4 2- (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
2013
2014
2015
2016
2017
2018
LA5_S1
Dissolved Iron (mg/L)
Monthly rainfall (mm)
LA5_S1
Dissolved Manganese (mg/L)
Monthly rainfall (mm)
LA5_S1
Dissolved Aluminium (mg/L)
Monthly rainfall (mm)
LA5_S1
Dissolved Silicon (mg/L)
Monthly rainfall (mm)
LA5_S1
Dissolved Zinc (mg/L)
Monthly rainfall (mm)

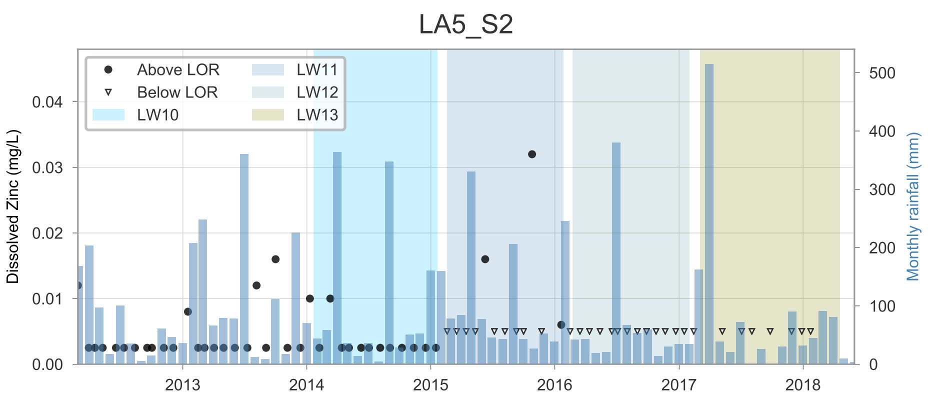

LA5_S2
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Sulfate as SO4 2- (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

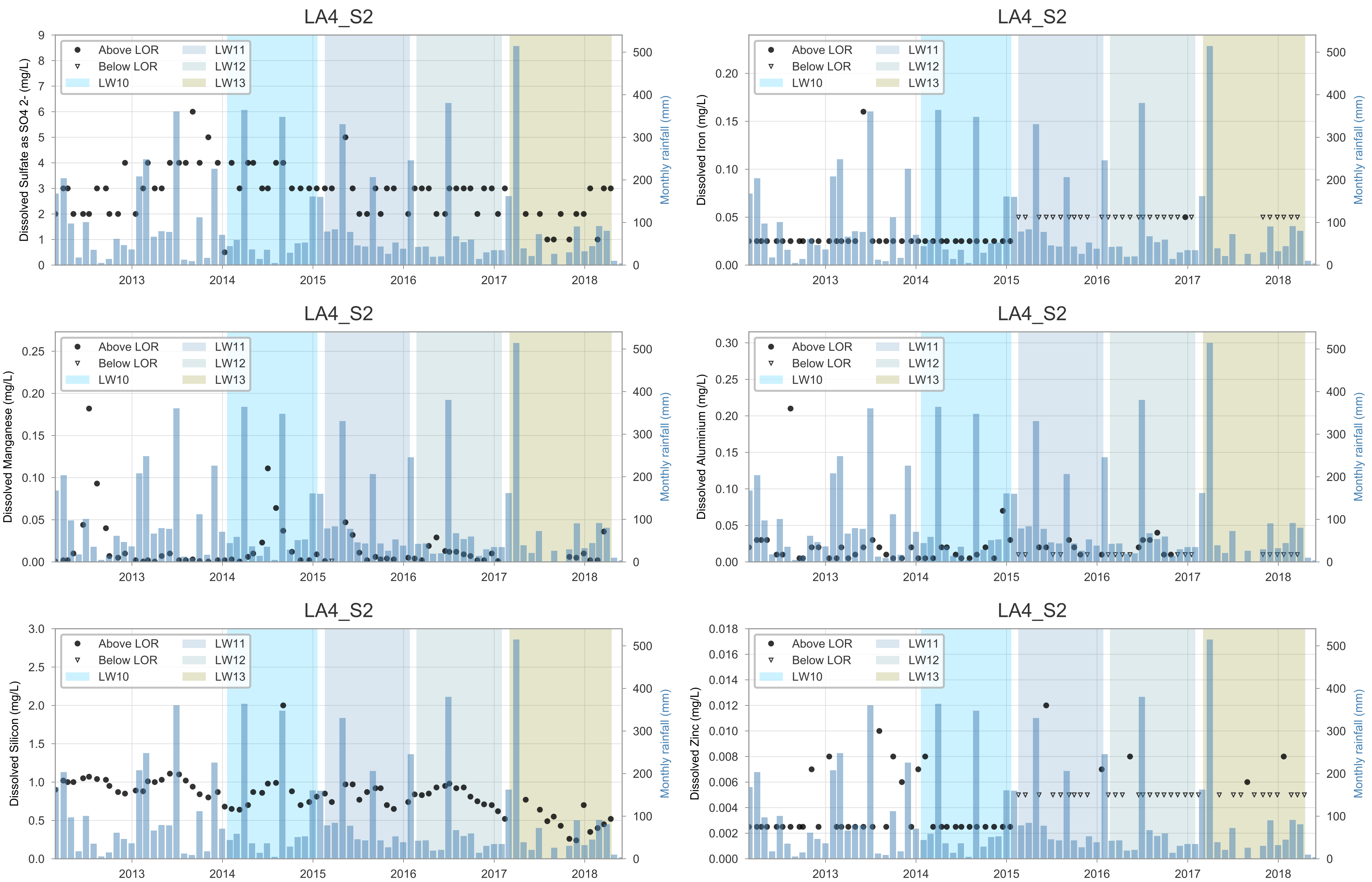

LA5_S2
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Iron (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

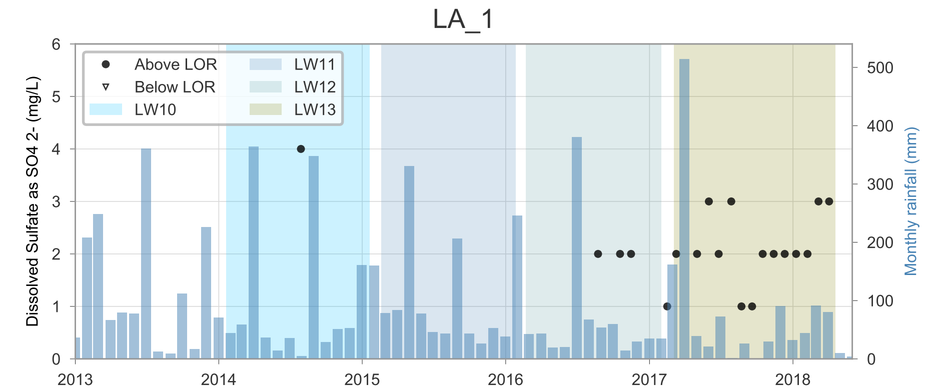

LA5_S2
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Manganese (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

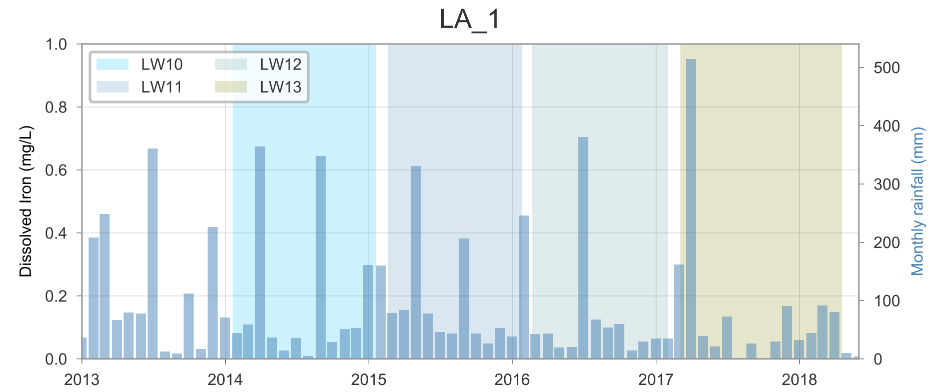

LA5_S2
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Aluminium (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

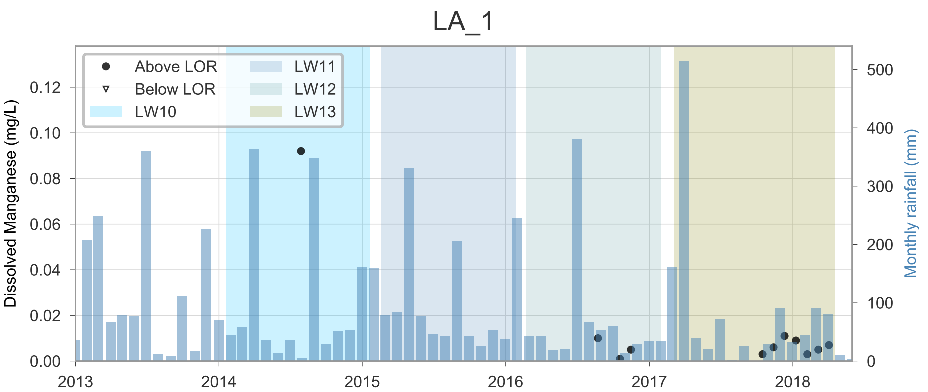

LA5_S2
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Silicon (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

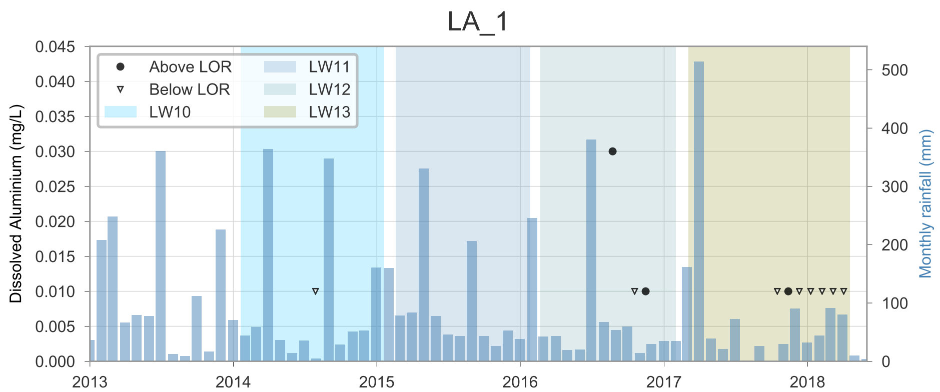

LA5_S2
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Zinc (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

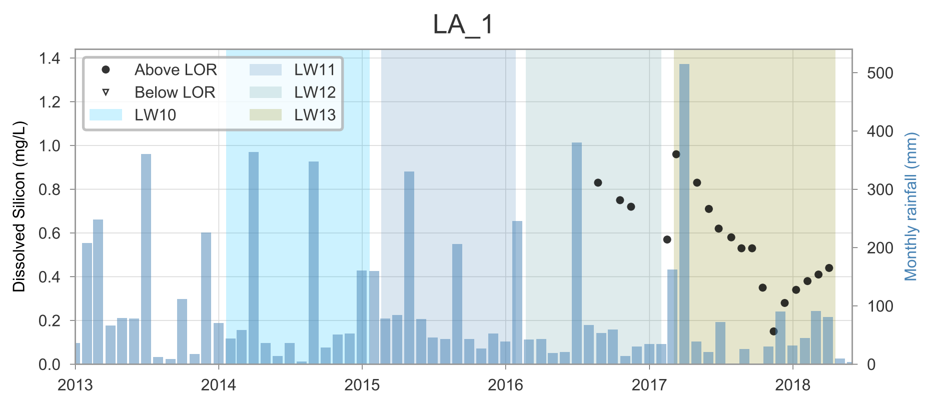

LA4_S2
Dissolved Sulfate as SO4 2- (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
2013
2014
2015
2016
2017
2018
LA4_S2
Dissolved Iron (mg/L)
Monthly rainfall (mm)
LA4_S2
Dissolved Manganese (mg/L)
Monthly rainfall (mm)
LA4_S2
Dissolved Aluminium (mg/L)
Monthly rainfall (mm)
LA4_S2
Dissolved Silicon (mg/L)
Monthly rainfall (mm)
LA4_S2
Dissolved Zinc (mg/L)
Monthly rainfall (mm)

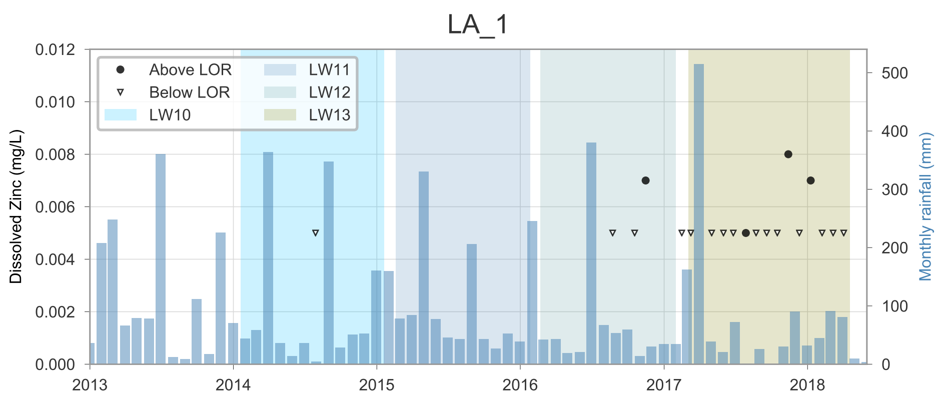

LA_1
Dissolved Sulfate as SO4 2- (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
2013
2014
2015
2016
2017
2018

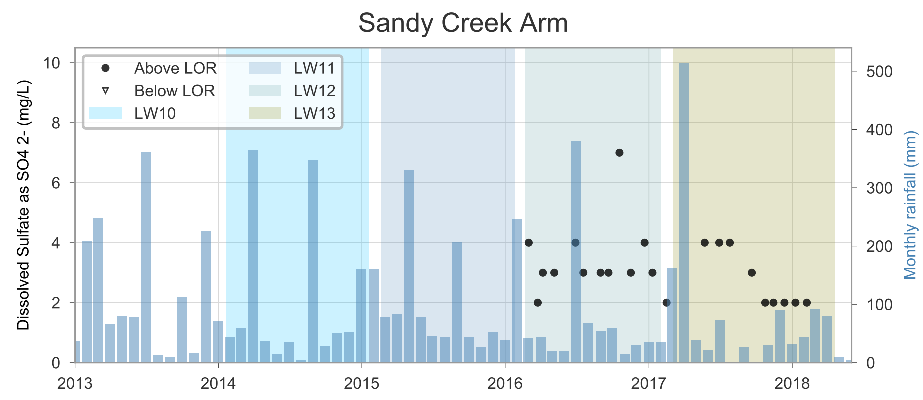

LA_1
Dissolved Iron (mg/L)
Monthly rainfall (mm)
LW10
LW11
LW12
LW13
2013
2014
2015
2016
2017
2018

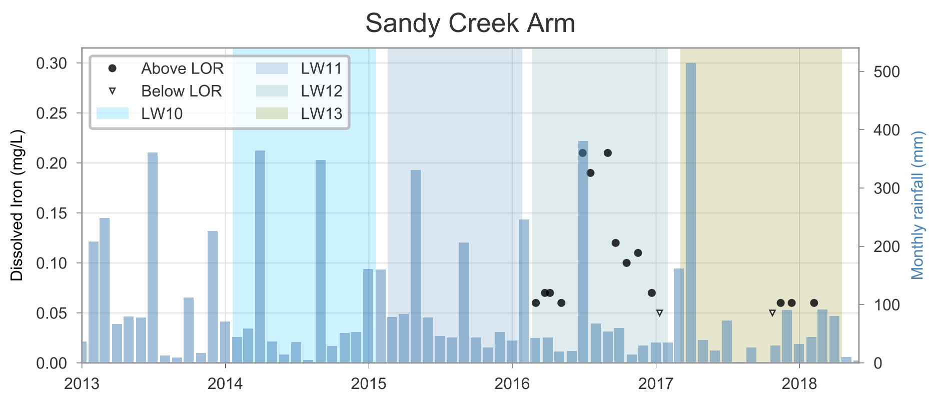

LA_1
Dissolved Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
2013
2014
2015
2016
2017
2018

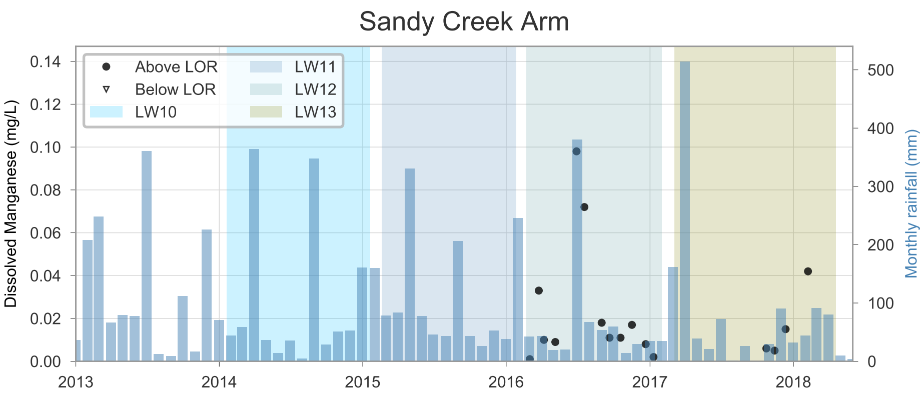

LA_1
Dissolved Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
2013
2014
2015
2016
2017
2018

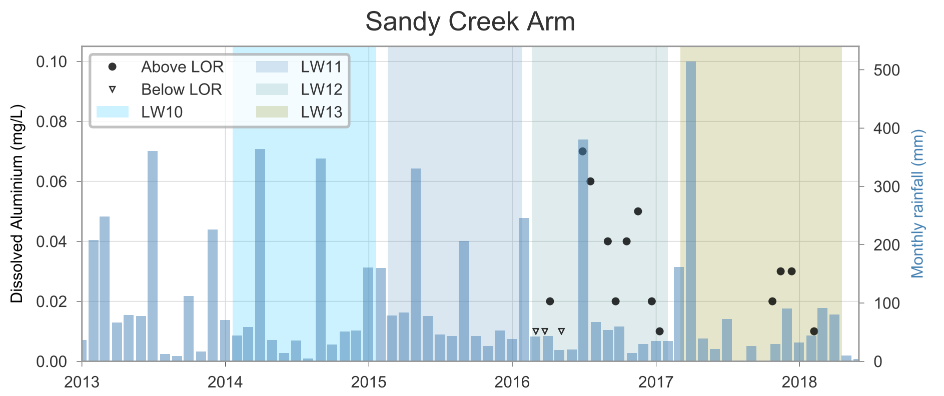

LA_1
Dissolved Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
2013
2014
2015
2016
2017
2018

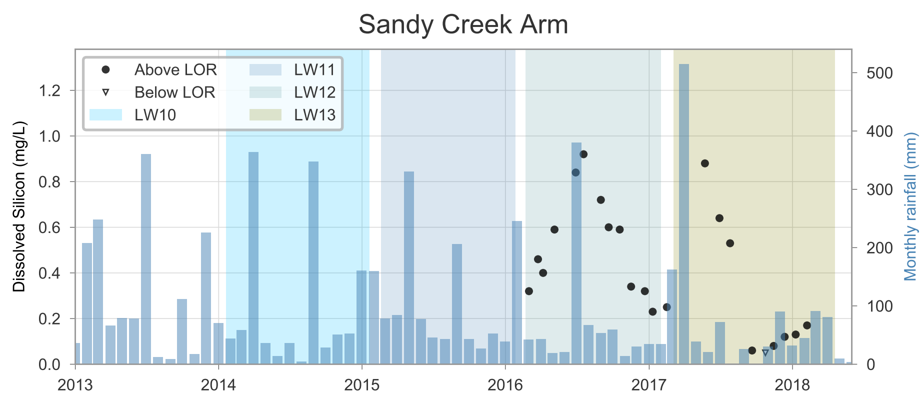

LA_1
Dissolved Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
2013
2014
2015
2016
2017
2018

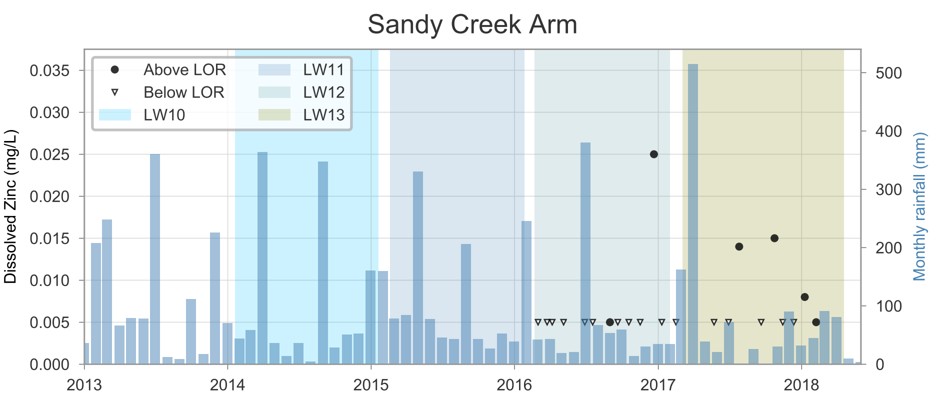

Sandy Creek Arm
Dissolved Sulfate as SO4 2- (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
0
2
4
6
8
10
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

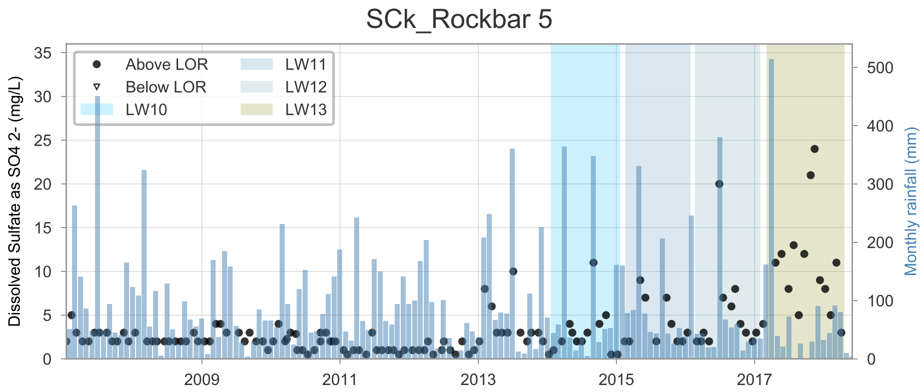

Sandy Creek Arm
Dissolved Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

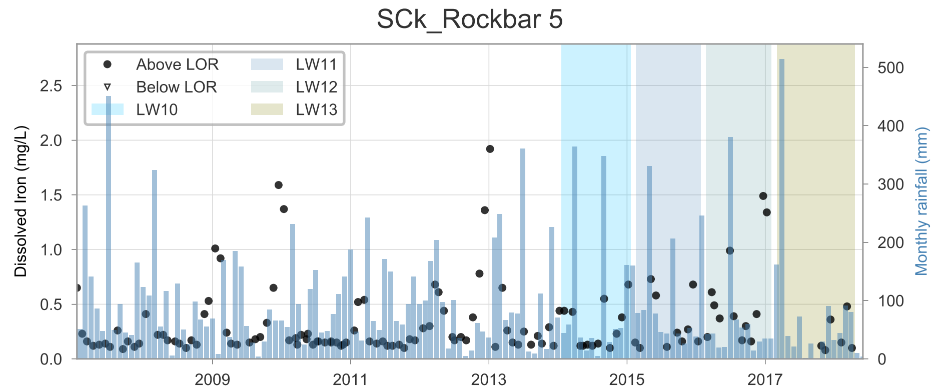

Sandy Creek Arm
Dissolved Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

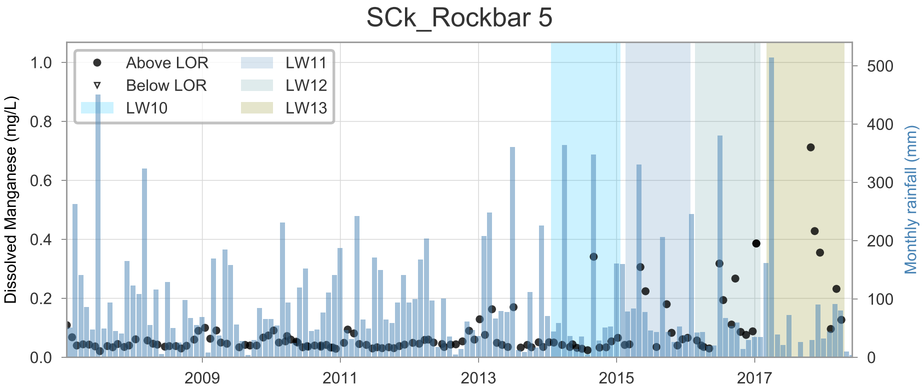

Sandy Creek Arm
Dissolved Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
0.00
0.02
0.04
0.06
0.08
0.10
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

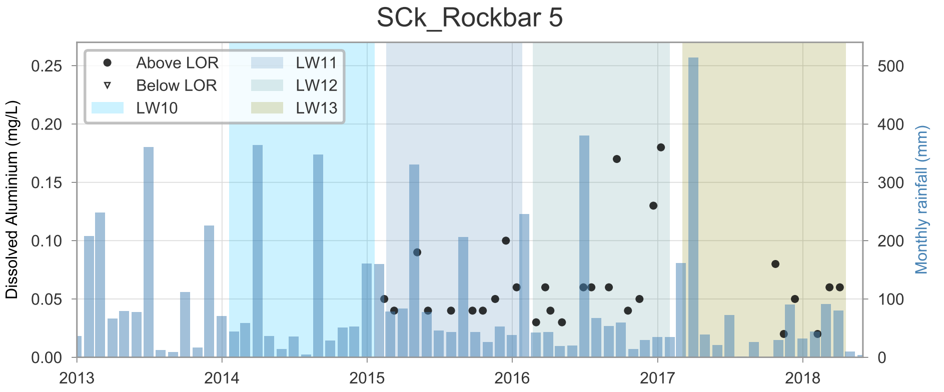

Sandy Creek Arm
Dissolved Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
0.0
0.2
0.4
0.6
0.8
1.0
1.2
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

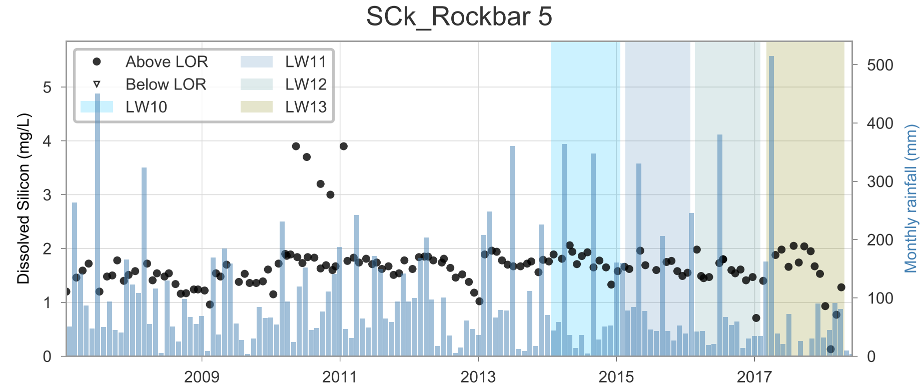

Sandy Creek Arm
Dissolved Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
0.000
0.005
0.010
0.015
0.020
0.025
0.030
0.035
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018

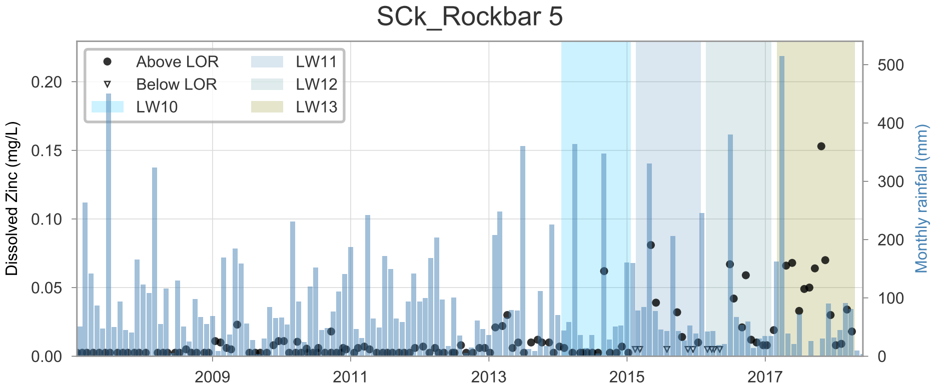

SCk_Rockbar 5
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Sulfate as SO4 2- (mg/L)
Monthly rainfall (mm)
2009
2011
2013
2015
2017

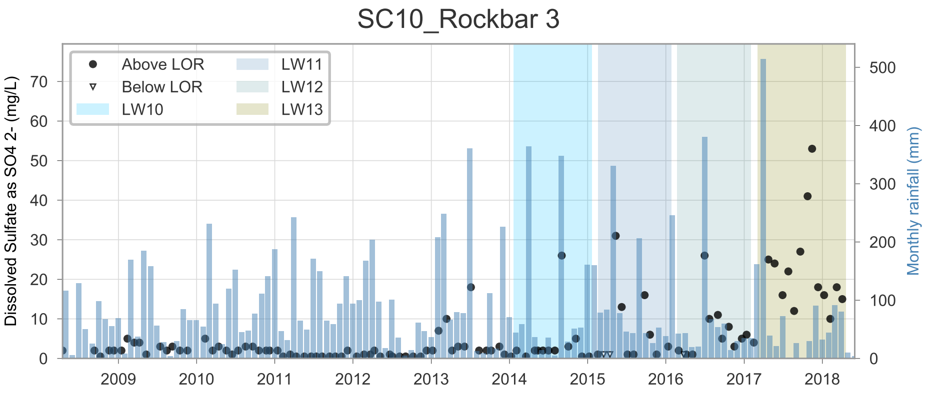

SCk_Rockbar 5
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Iron (mg/L)
Monthly rainfall (mm)
2009
2011
2013
2015
2017

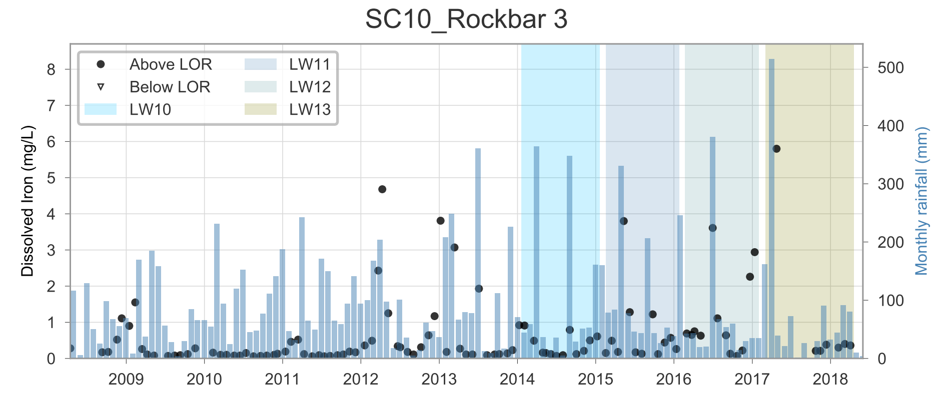

SCk_Rockbar 5
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Manganese (mg/L)
Monthly rainfall (mm)
2009
2011
2013
2015
2017

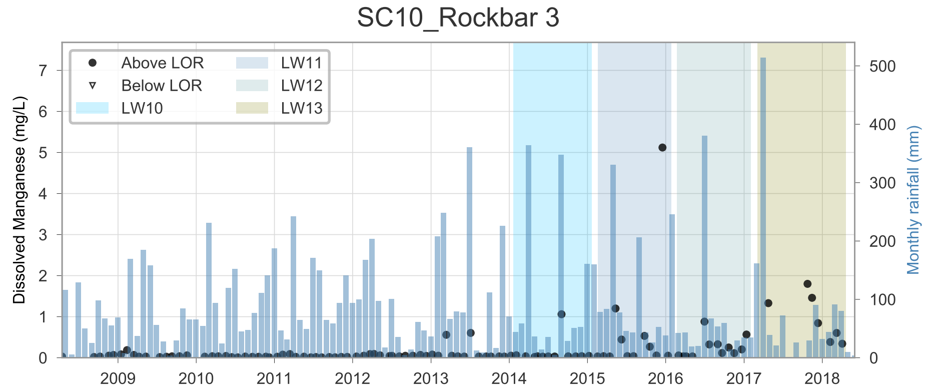

SCk_Rockbar 5
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Aluminium (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018

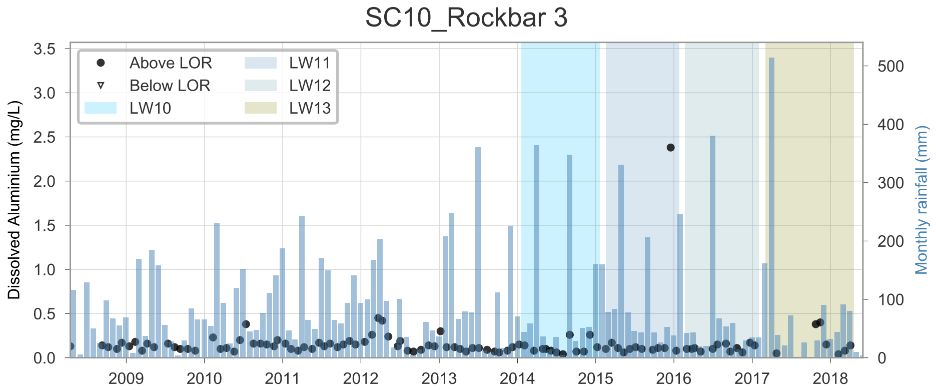

SCk_Rockbar 5
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Silicon (mg/L)
Monthly rainfall (mm)
2009
2011
2013
2015
2017

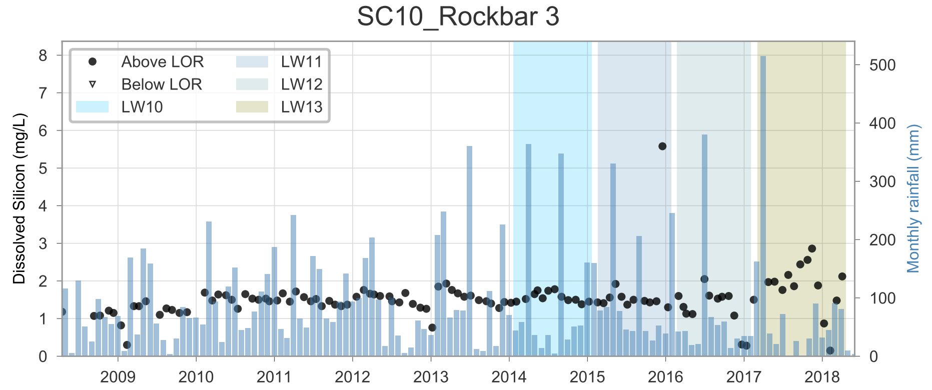

SCk_Rockbar 5
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Zinc (mg/L)
Monthly rainfall (mm)
2009
2011
2013
2015
2017

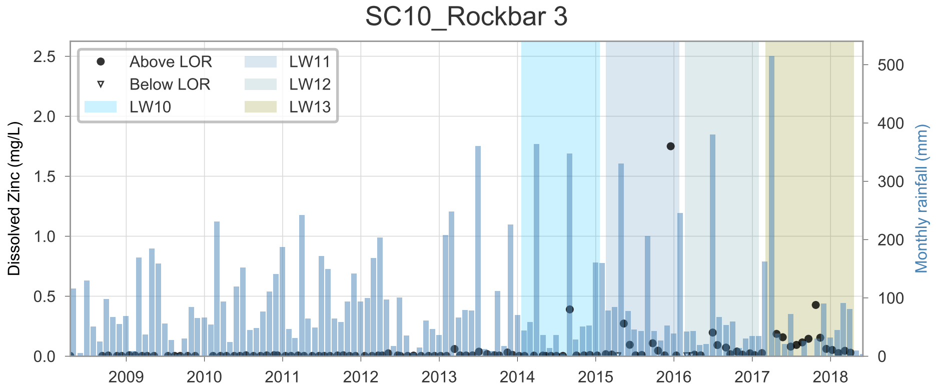

SC10_Rockbar 3
Dissolved Sulfate as SO4 2- (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018

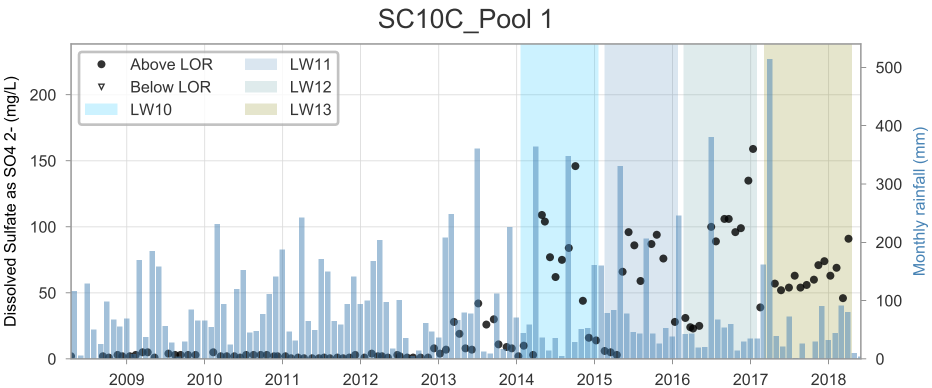

SC10_Rockbar 3
Dissolved Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018

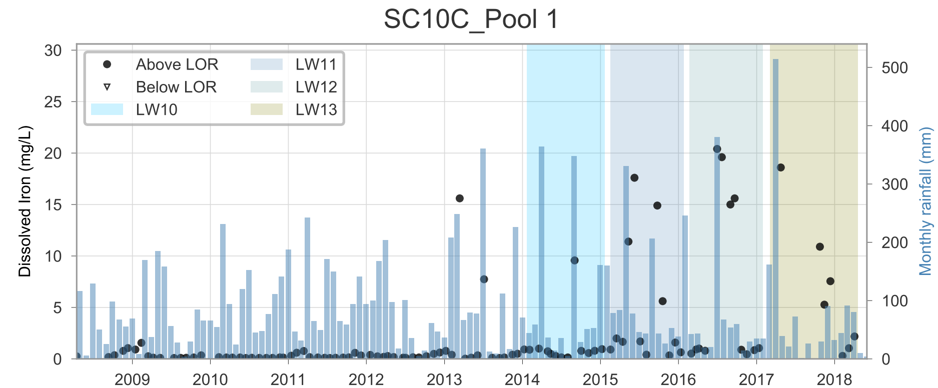

SC10_Rockbar 3
Dissolved Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018

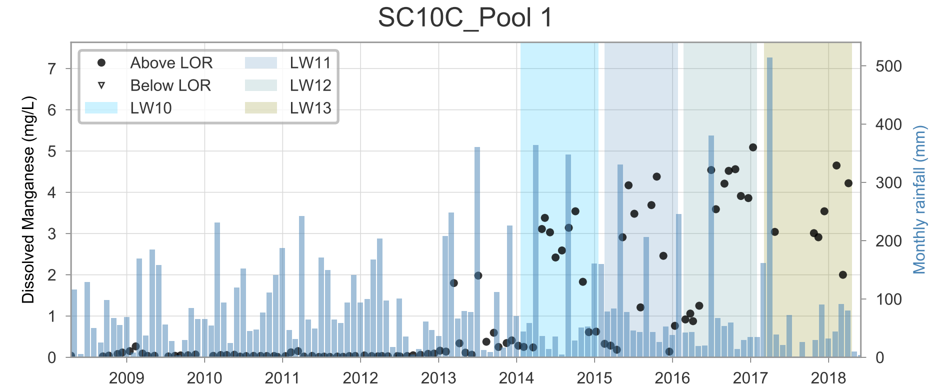

SC10_Rockbar 3
Dissolved Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018

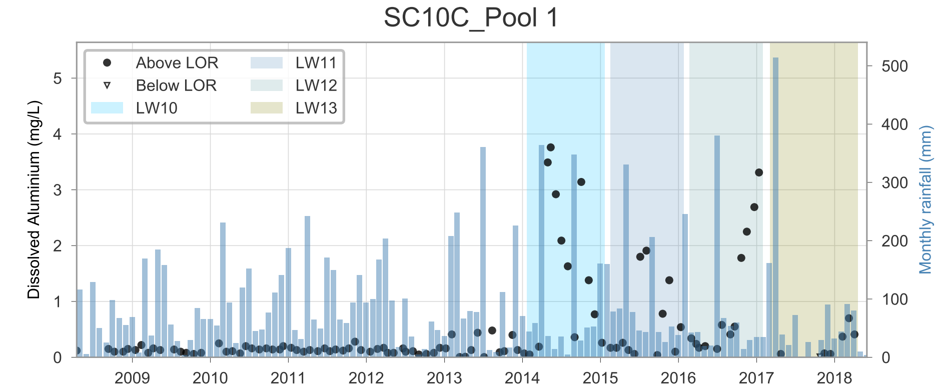

SC10_Rockbar 3
Dissolved Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018

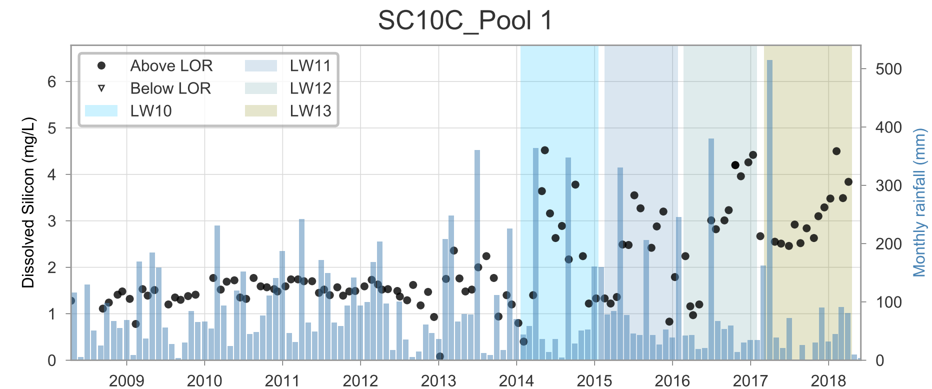

SC10_Rockbar 3
Dissolved Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018

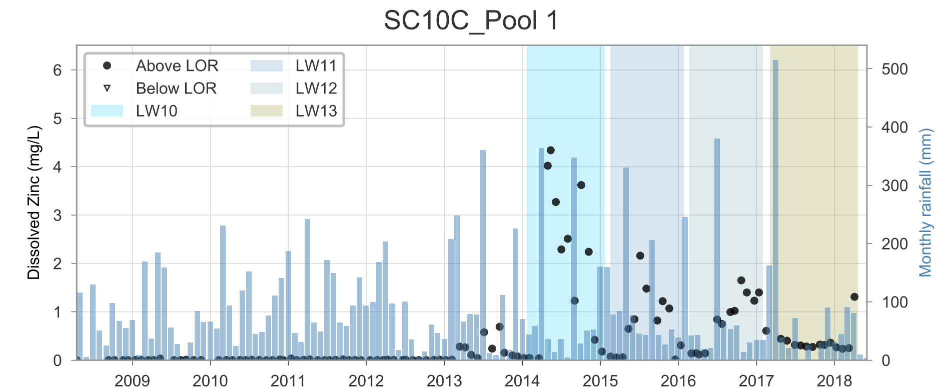

SC10C_Pool 1
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Sulfate as SO4 2- (mg/L)
Monthly rainfall (mm)
2009 2010 2011 2012 2013 2014 2015 2016 2017 2018

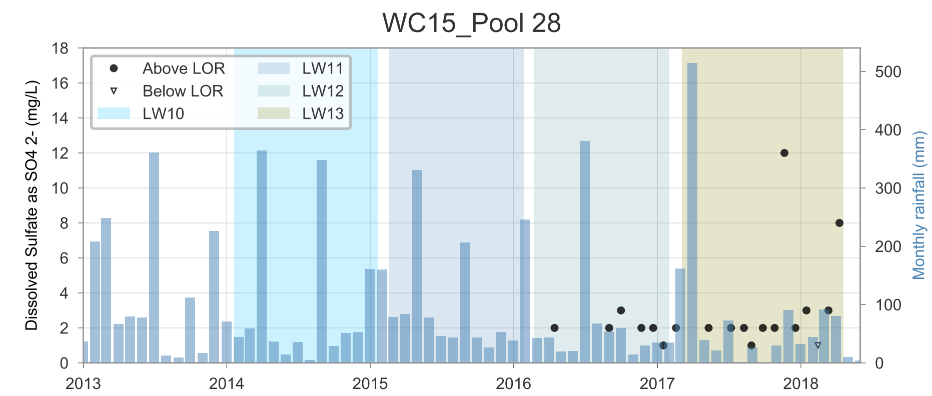

SC10C_Pool 1
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Iron (mg/L)
Monthly rainfall (mm)
2009 2010 2011 2012 2013 2014 2015 2016 2017 2018

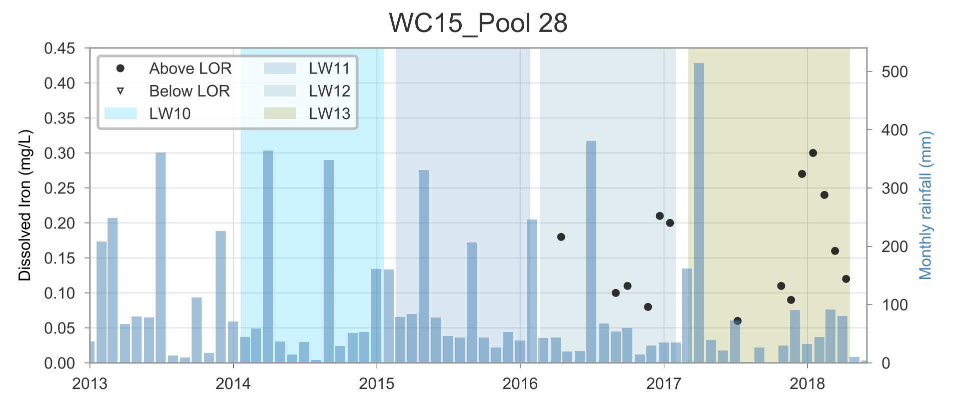

SC10C_Pool 1
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Manganese (mg/L)
Monthly rainfall (mm)
2009 2010 2011 2012 2013 2014 2015 2016 2017 2018

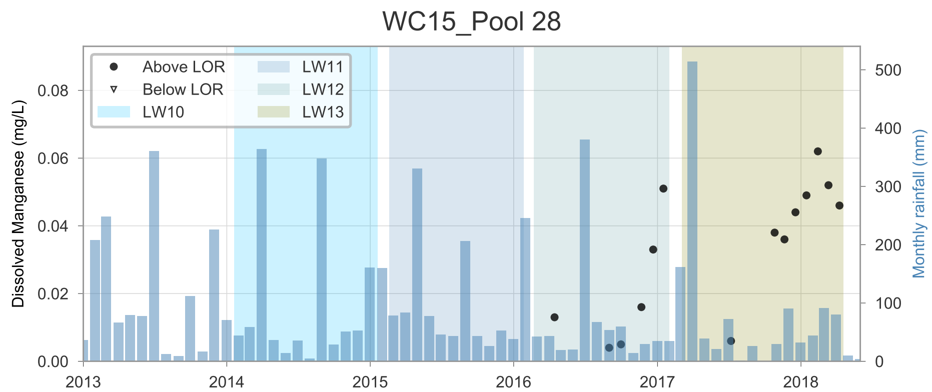

SC10C_Pool 1
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Aluminium (mg/L)
Monthly rainfall (mm)
2009 2010 2011 2012 2013 2014 2015 2016 2017 2018

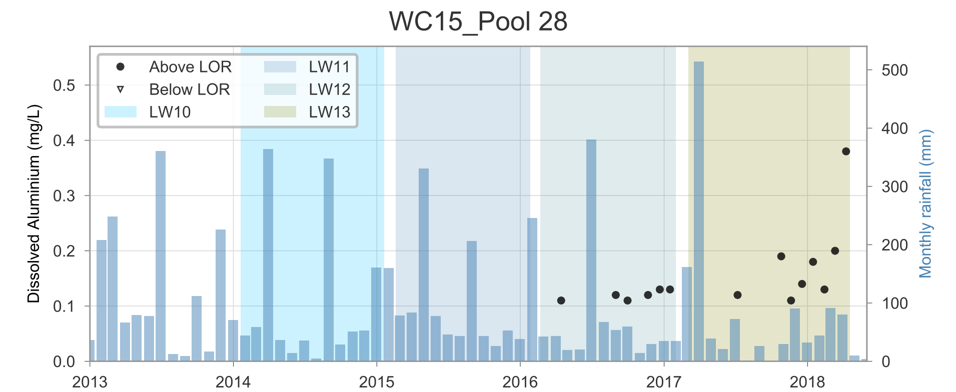

SC10C_Pool 1
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Silicon (mg/L)
Monthly rainfall (mm)
2009 2010 2011 2012 2013 2014 2015 2016 2017 2018

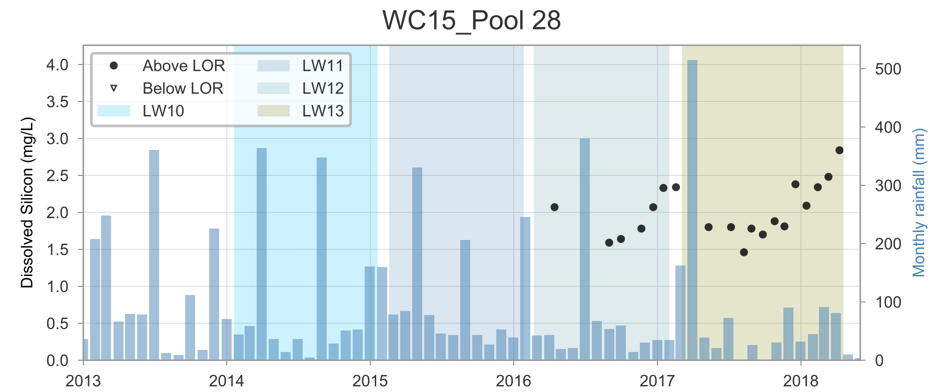

SC10C_Pool 1
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Zinc (mg/L)
Monthly rainfall (mm)
2009 2010 2011 2012 2013 2014 2015 2016 2017 2018

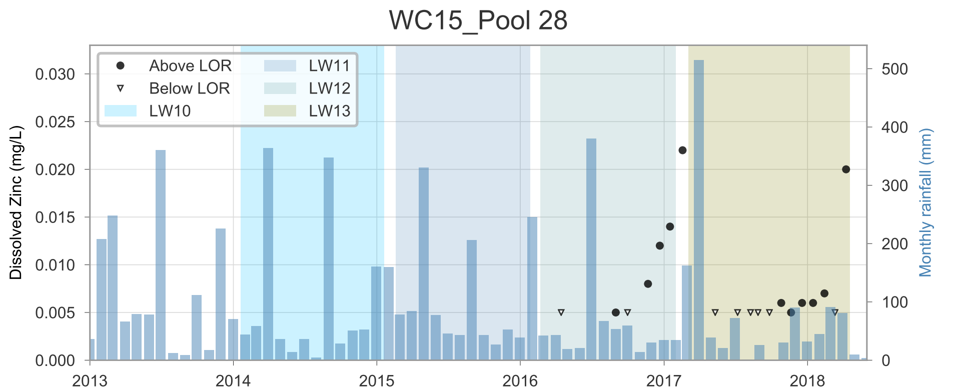

WC15_Pool 28
Dissolved Sulfate as SO4 2- (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13

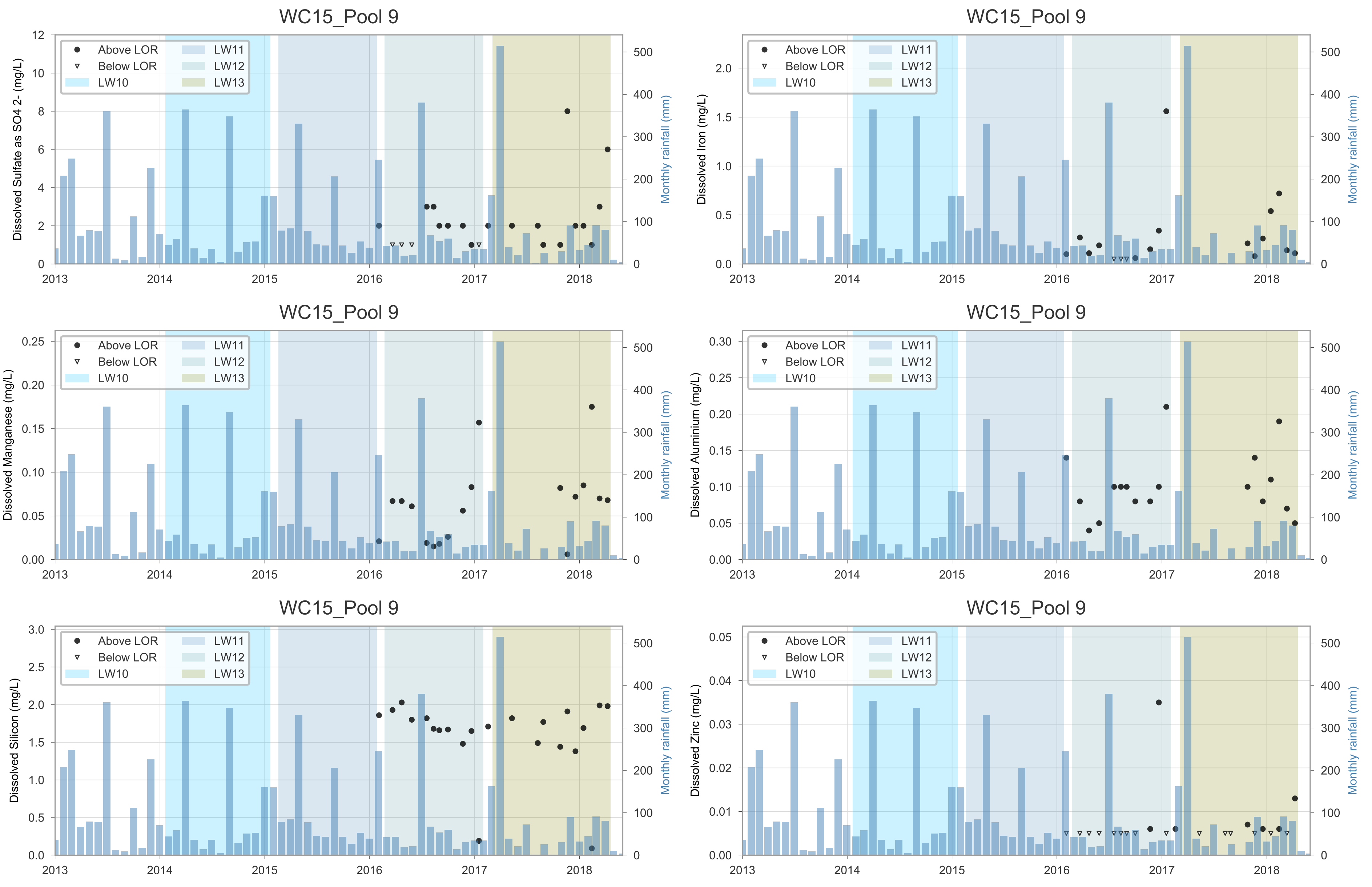

WC15_Pool 28
Dissolved Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13

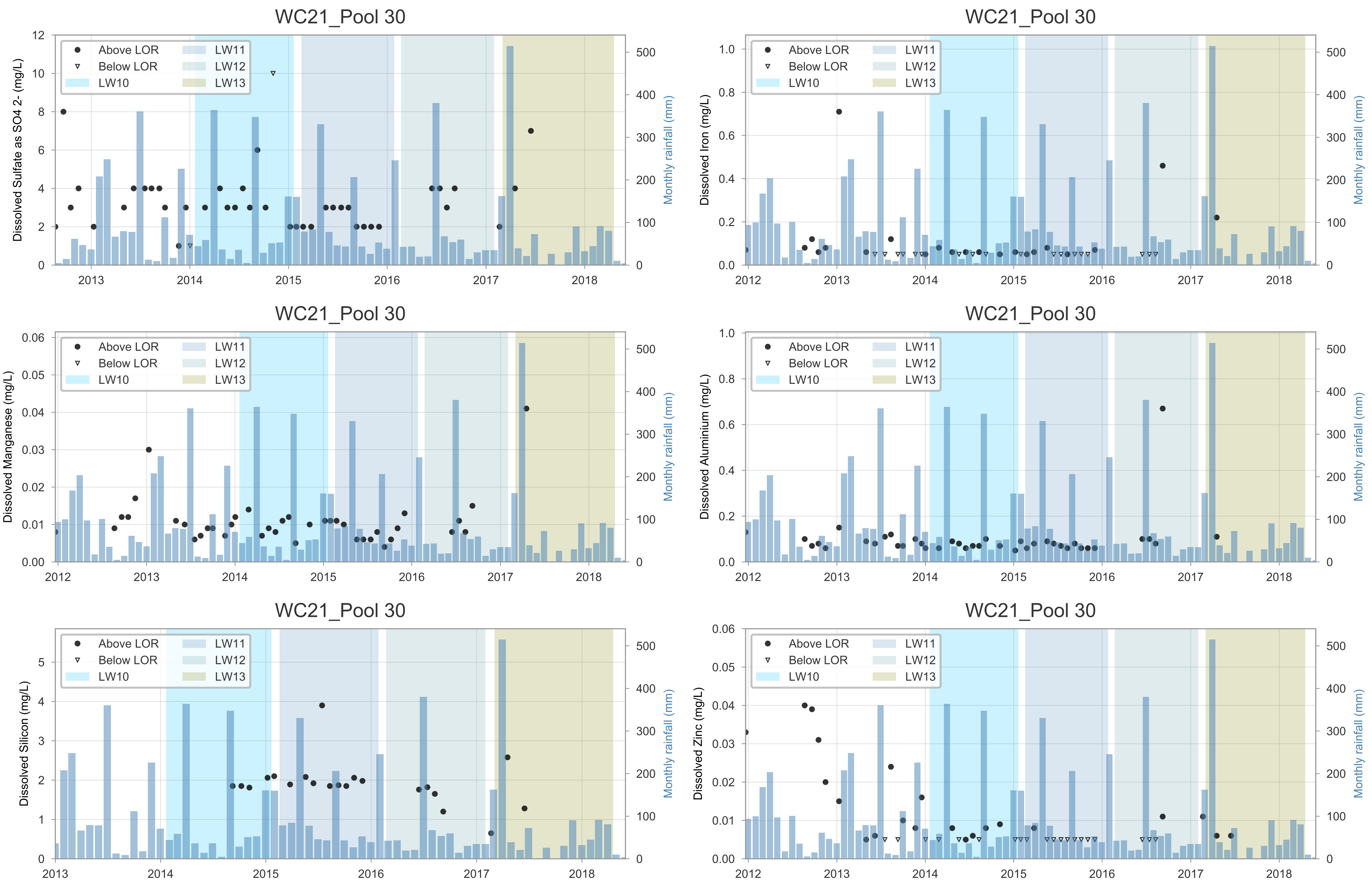

WC15_Pool 28
Dissolved Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13

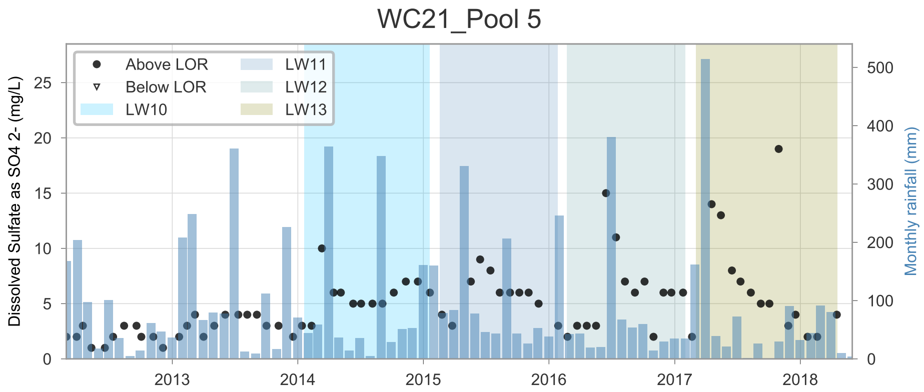

WC15_Pool 28
Dissolved Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13

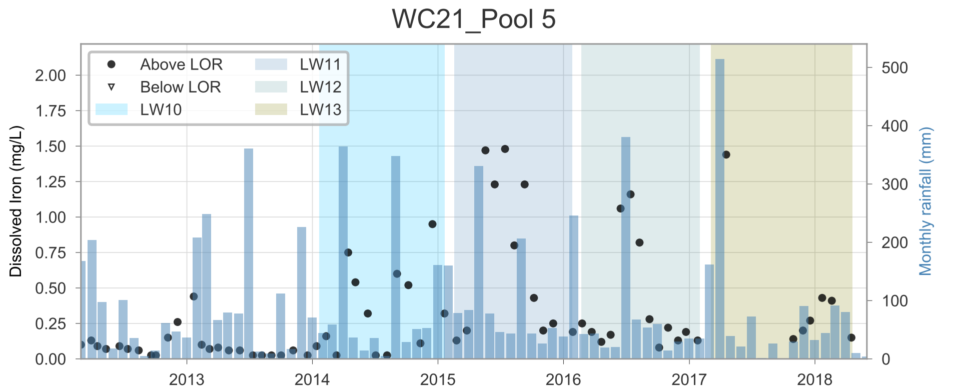

WC15_Pool 28
Dissolved Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13

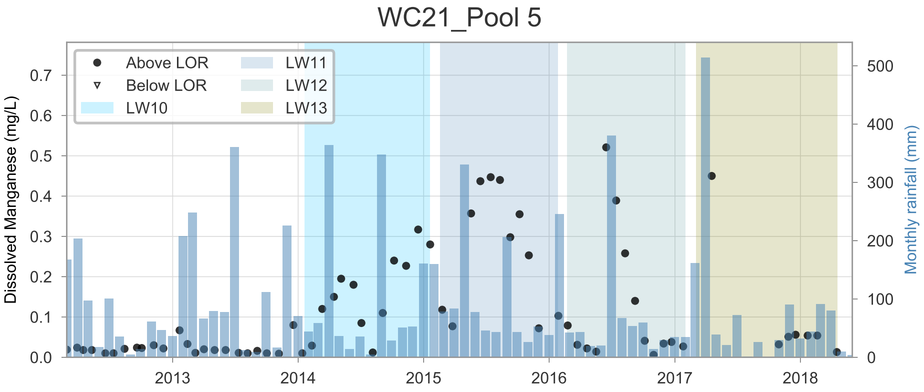

WC15_Pool 28
Dissolved Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13

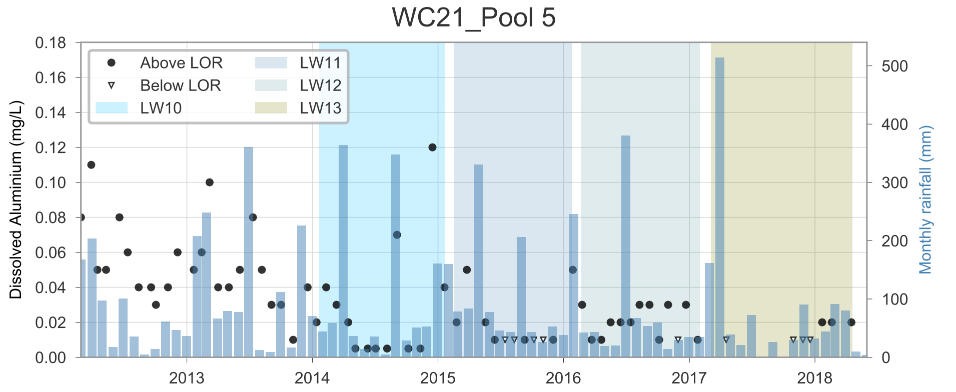

WC15_Pool 9
Dissolved Sulfate as SO4 2- (mg/L)
Dissolved Iron (mg/L)
Dissolved Manganese (mg/L)
Dissolved Aluminium (mg/L)
Dissolved Silicon (mg/L)
Dissolved Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
2013
2014
2015
2016
2017
2018

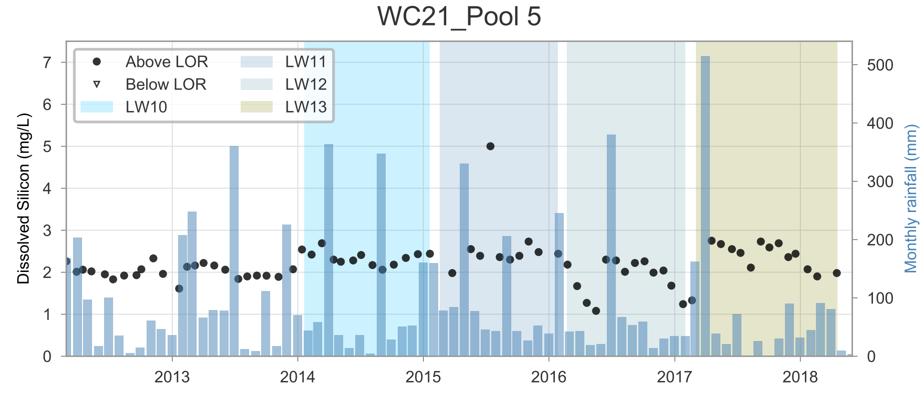

WC21_Pool 30
Dissolved Sulfate as SO4 2- (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
0
2
4
6
8
10
12
100
200
300
400
500
2013
2014
2015
2016
2017
2018
WC21_Pool 30
Dissolved Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
0.0
0.2
0.4
0.6
0.8
1.0
2012
2013
2014
2015
2016
2017
2018
WC21_Pool 30
Dissolved Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
0.00
0.01
0.02
0.03
0.04
0.05
0.06
2012
2013
2014
2015
2016
2017
2018
WC21_Pool 30
Dissolved Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
0.0
0.2
0.4
0.6
0.8
1.0
2012
2013
2014
2015
2016
2017
2018
WC21_Pool 30
Dissolved Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
0
1
2
3
4
5
2013
2014
2015
2016
2017
2018
WC21_Pool 30
Dissolved Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
0.00
0.01
0.02
0.03
0.04
0.05
0.06
2012
2013
2014
2015
2016
2017
2018

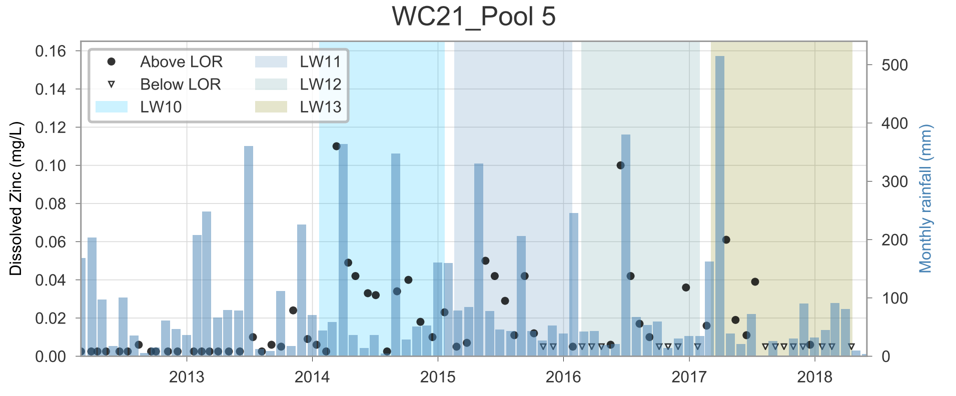

WC21_Pool 5
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Sulfate as SO4 2- (mg/L)
Monthly rainfall (mm)

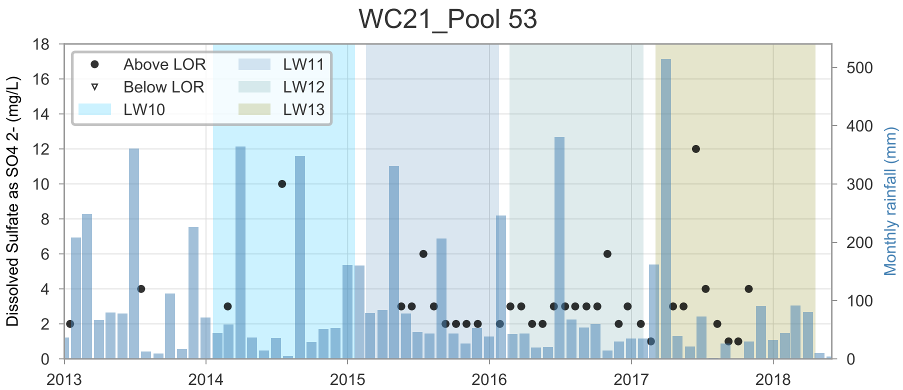

WC21_Pool 5
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Iron (mg/L)
Monthly rainfall (mm)

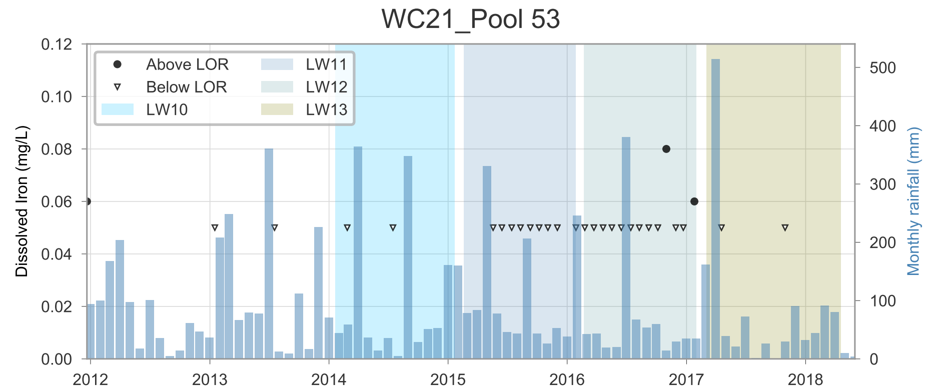

WC21_Pool 5
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Manganese (mg/L)
Monthly rainfall (mm)

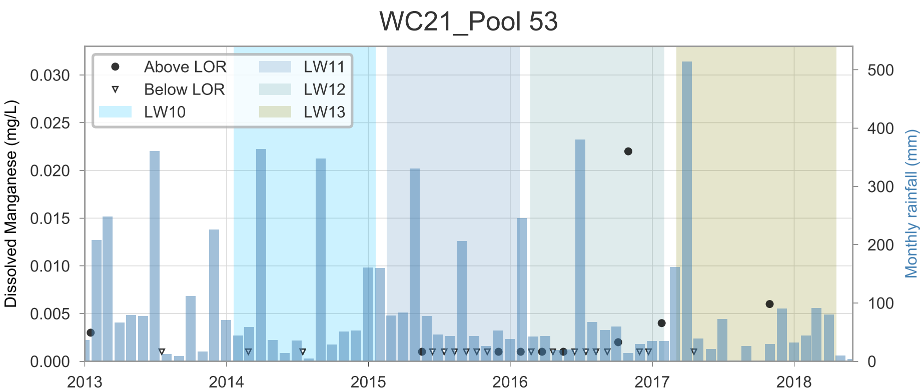

WC21_Pool 5
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Aluminium (mg/L)
Monthly rainfall (mm)

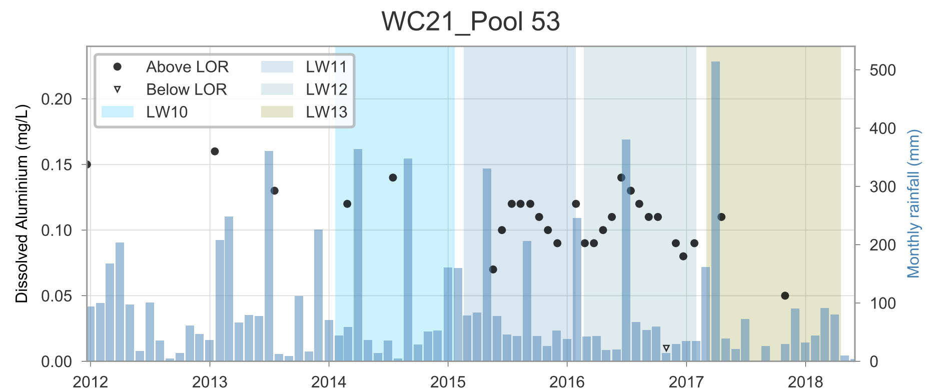

WC21_Pool 5
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Silicon (mg/L)
Monthly rainfall (mm)

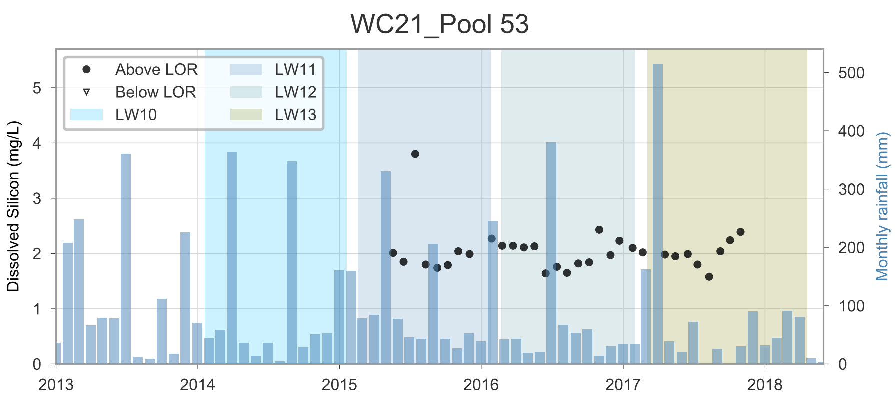

WC21_Pool 5
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Zinc (mg/L)
Monthly rainfall (mm)

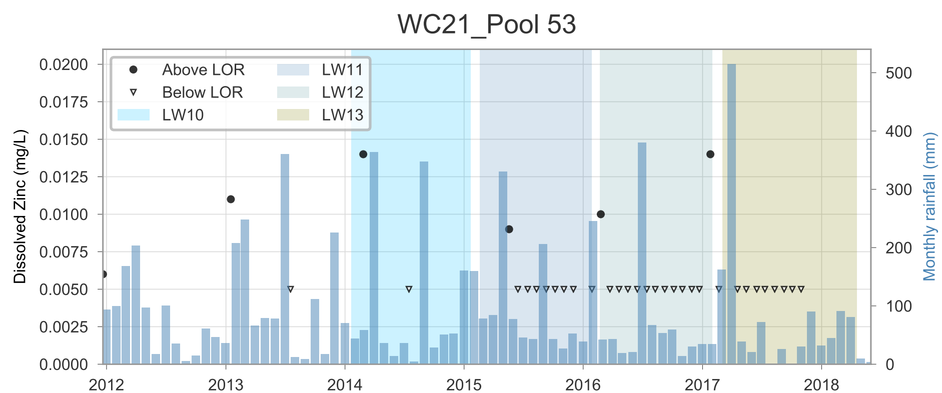

WC21_Pool 53
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Sulfate as SO4 2- (mg/L)
Monthly rainfall (mm)
0 2 4 6 8 10 12 14 16 18
0 100 200 300 400 500
2013 2014 2015 2016 2017 2018

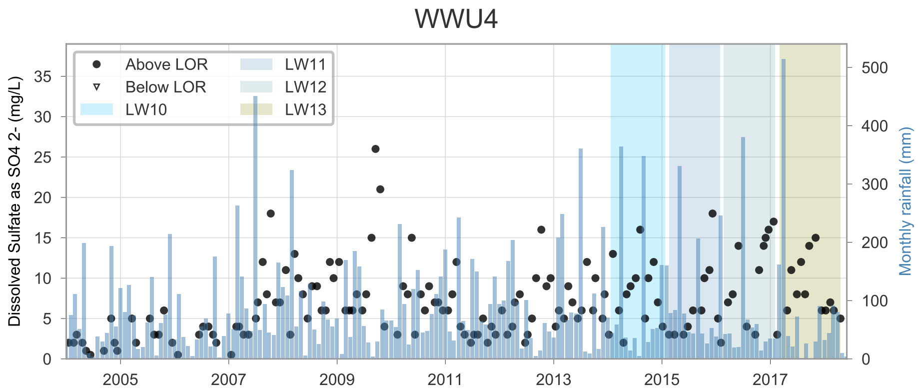

WC21_Pool 53
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Iron (mg/L)
Monthly rainfall (mm)
0.00 0.02 0.04 0.06 0.08 0.10 0.12
0 100 200 300 400 500
2012 2013 2014 2015 2016 2017 2018

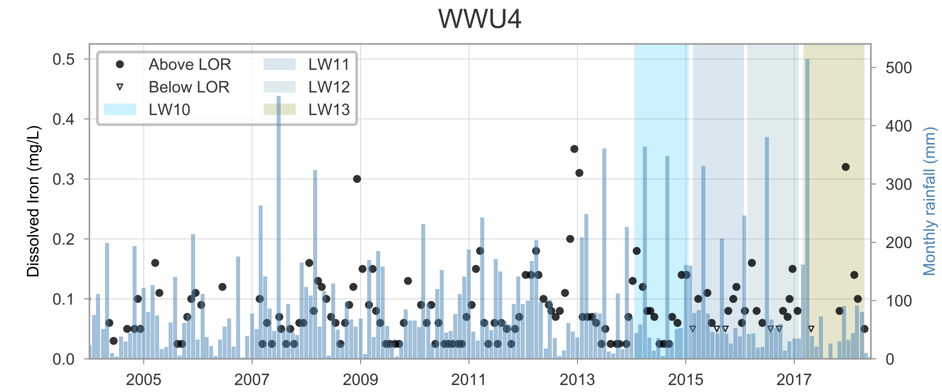

WC21_Pool 53
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Manganese (mg/L)
Monthly rainfall (mm)
0.000 0.005 0.010 0.015 0.020 0.025 0.030
0 100 200 300 400 500
2013 2014 2015 2016 2017 2018

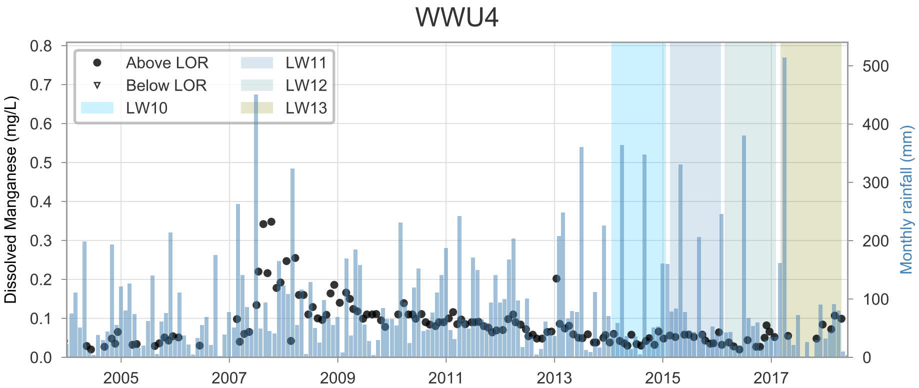

WC21_Pool 53
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Aluminium (mg/L)
Monthly rainfall (mm)
0.00 0.05 0.10 0.15 0.20
0 100 200 300 400 500
2012 2013 2014 2015 2016 2017 2018

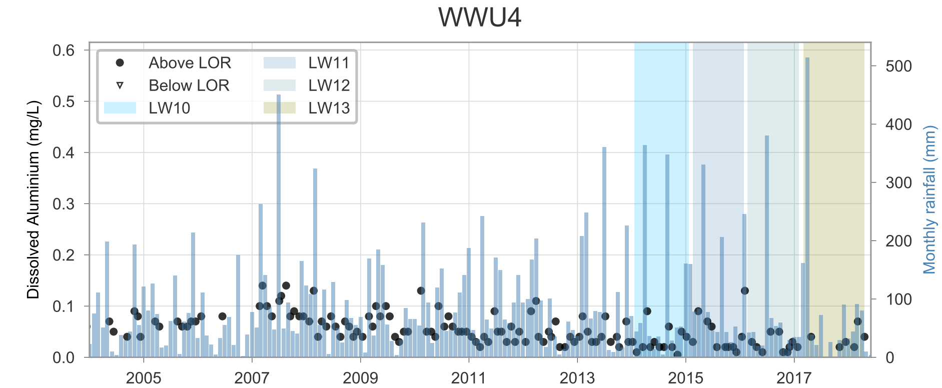

WC21_Pool 53
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Silicon (mg/L)
Monthly rainfall (mm)
0 1 2 3 4 5
0 100 200 300 400 500
2013 2014 2015 2016 2017 2018

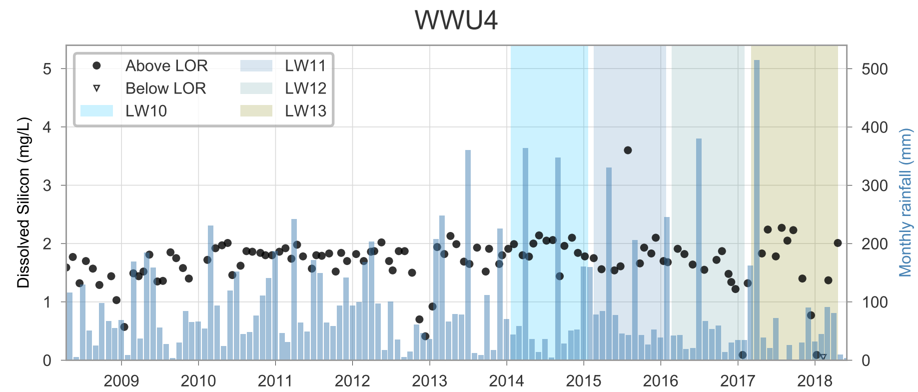

WC21_Pool 53
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Zinc (mg/L)
Monthly rainfall (mm)
0.0000 0.0025 0.0050 0.0075 0.0100 0.0125 0.0150 0.0175 0.0200
0 100 200 300 400 500
2012 2013 2014 2015 2016 2017 2018

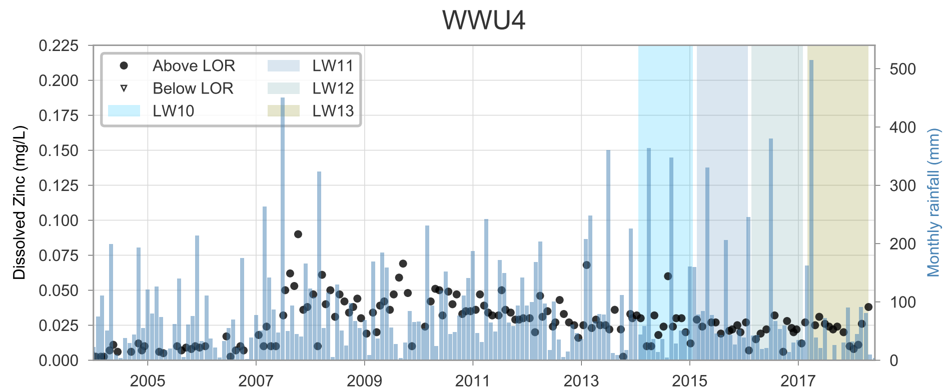

WWU4
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Sulfate as SO4 2- (mg/L)
Monthly rainfall (mm)

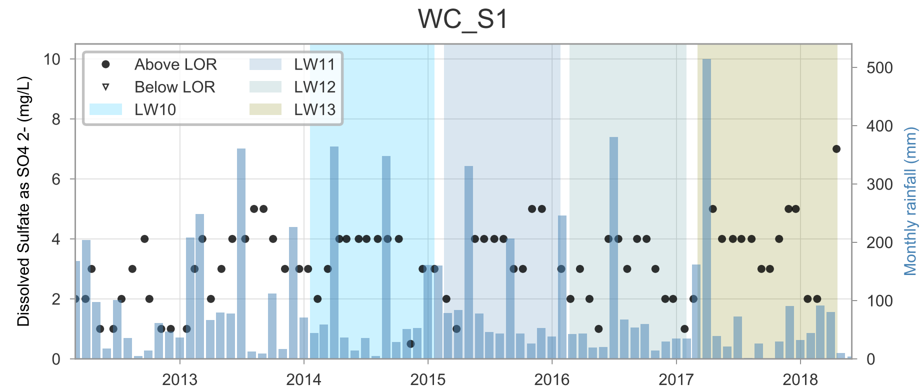

WWU4
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Iron (mg/L)
Monthly rainfall (mm)

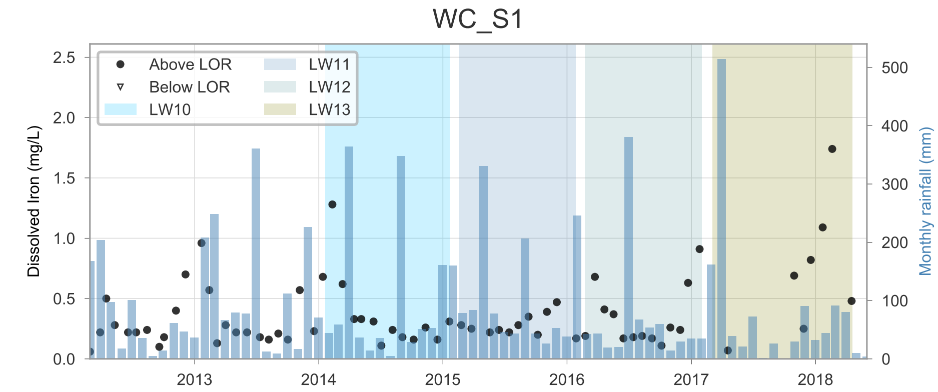

WWU4
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Manganese (mg/L)
Monthly rainfall (mm)

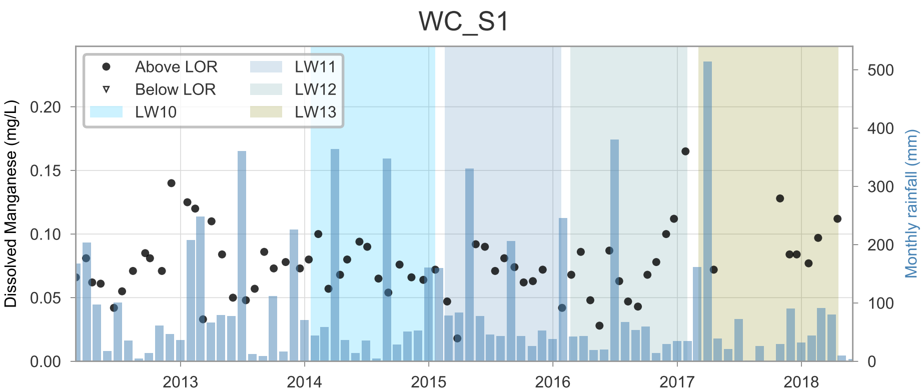

WWU4
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Aluminium (mg/L)
Monthly rainfall (mm)

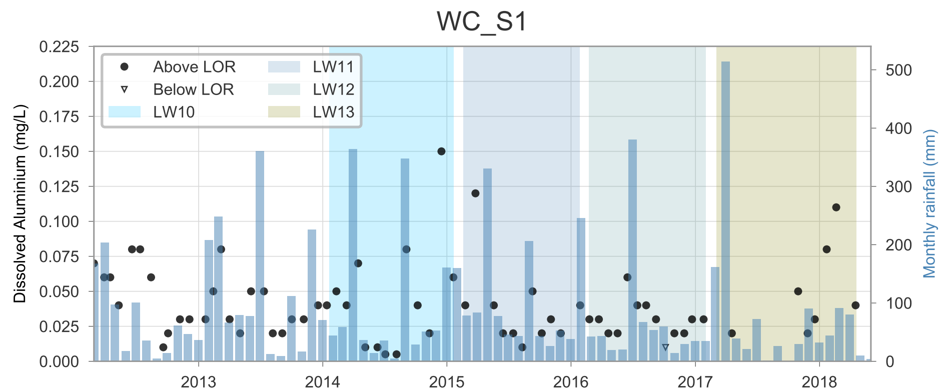

WWU4
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Silicon (mg/L)
Monthly rainfall (mm)

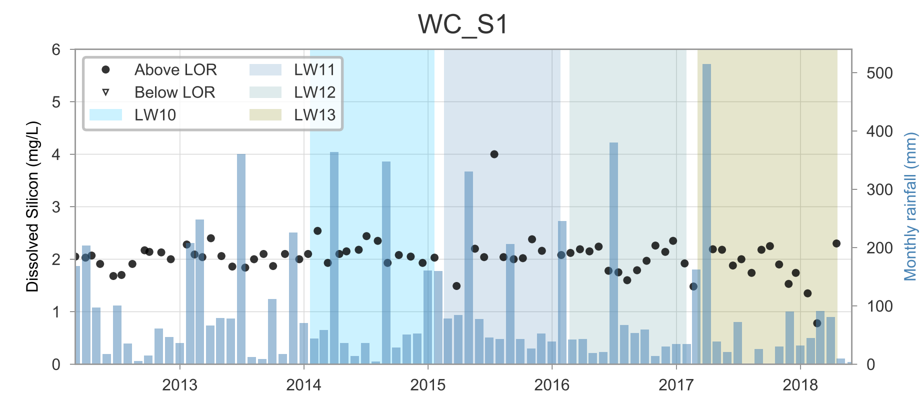

WWU4
Above LOR
Below LOR
LW10
LW11
LW12
LW13
Dissolved Zinc (mg/L)
Monthly rainfall (mm)

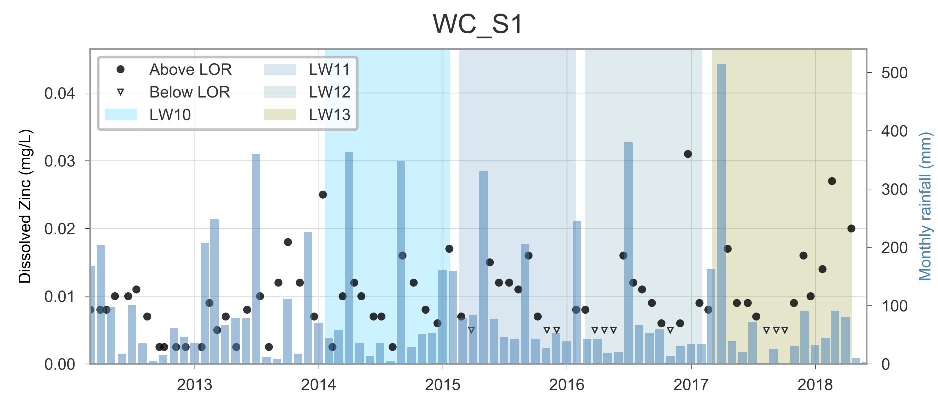

WC_S1
Dissolved Sulfate as SO4 2- (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
2013
2014
2015
2016
2017
2018

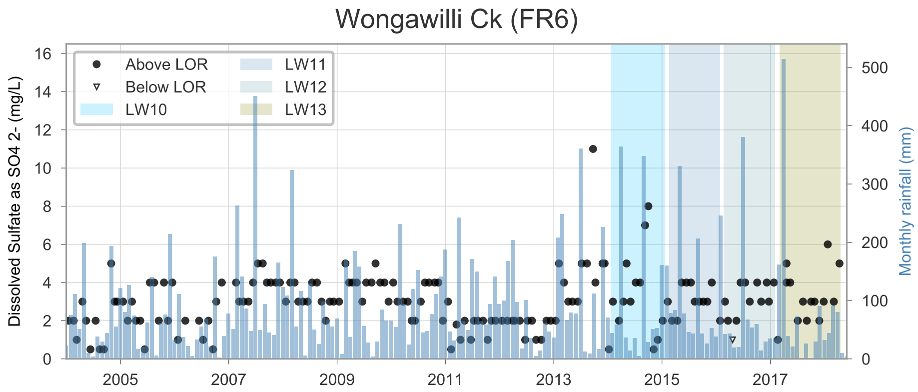

WC_S1
Dissolved Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
2013
2014
2015
2016
2017
2018

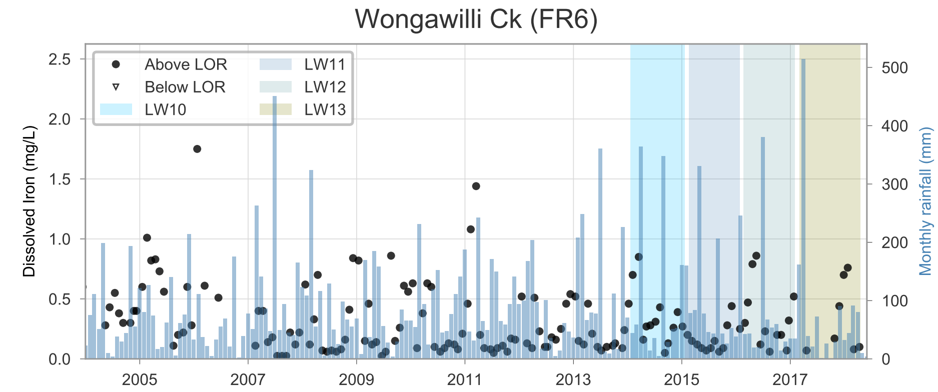

WC_S1
Dissolved Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
2013
2014
2015
2016
2017
2018

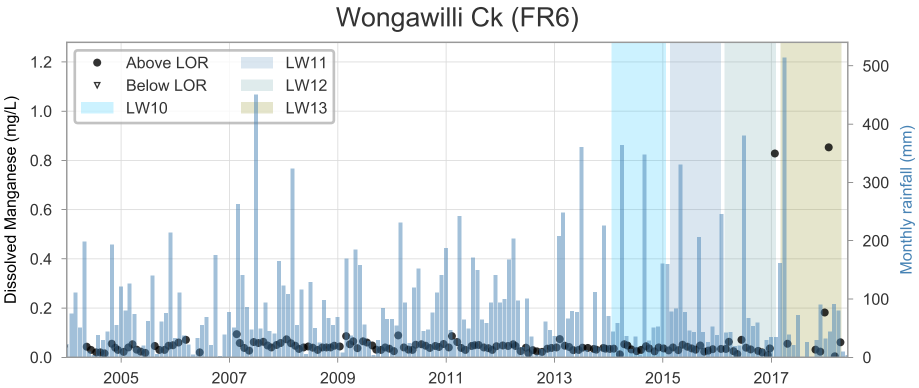

WC_S1
Dissolved Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
2013
2014
2015
2016
2017
2018

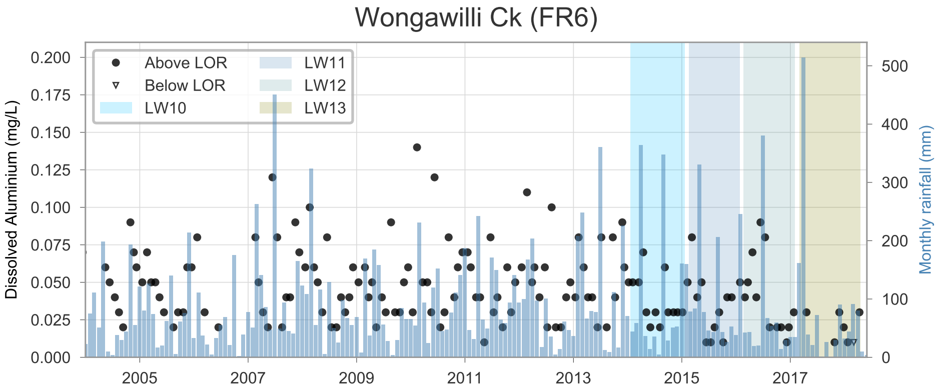

WC_S1
Dissolved Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
2013
2014
2015
2016
2017
2018

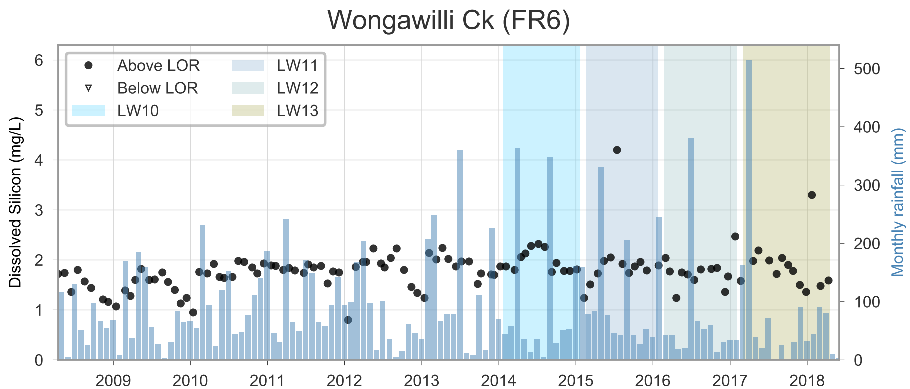

WC_S1
Dissolved Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
2013
2014
2015
2016
2017
2018

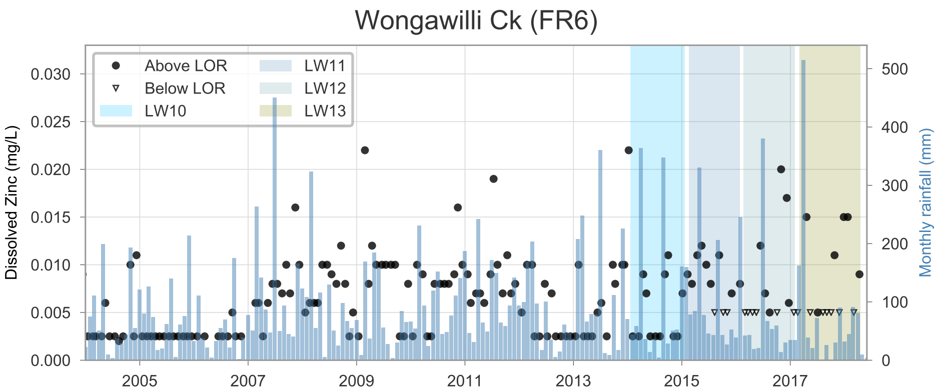

Wongawilli Ck (FR6)
Dissolved Sulfate as SO4 2- (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
0
2
4
6
8
10
12
14
16
0
100
200
300
400
500
2005
2007
2009
2011
2013
2015
2017

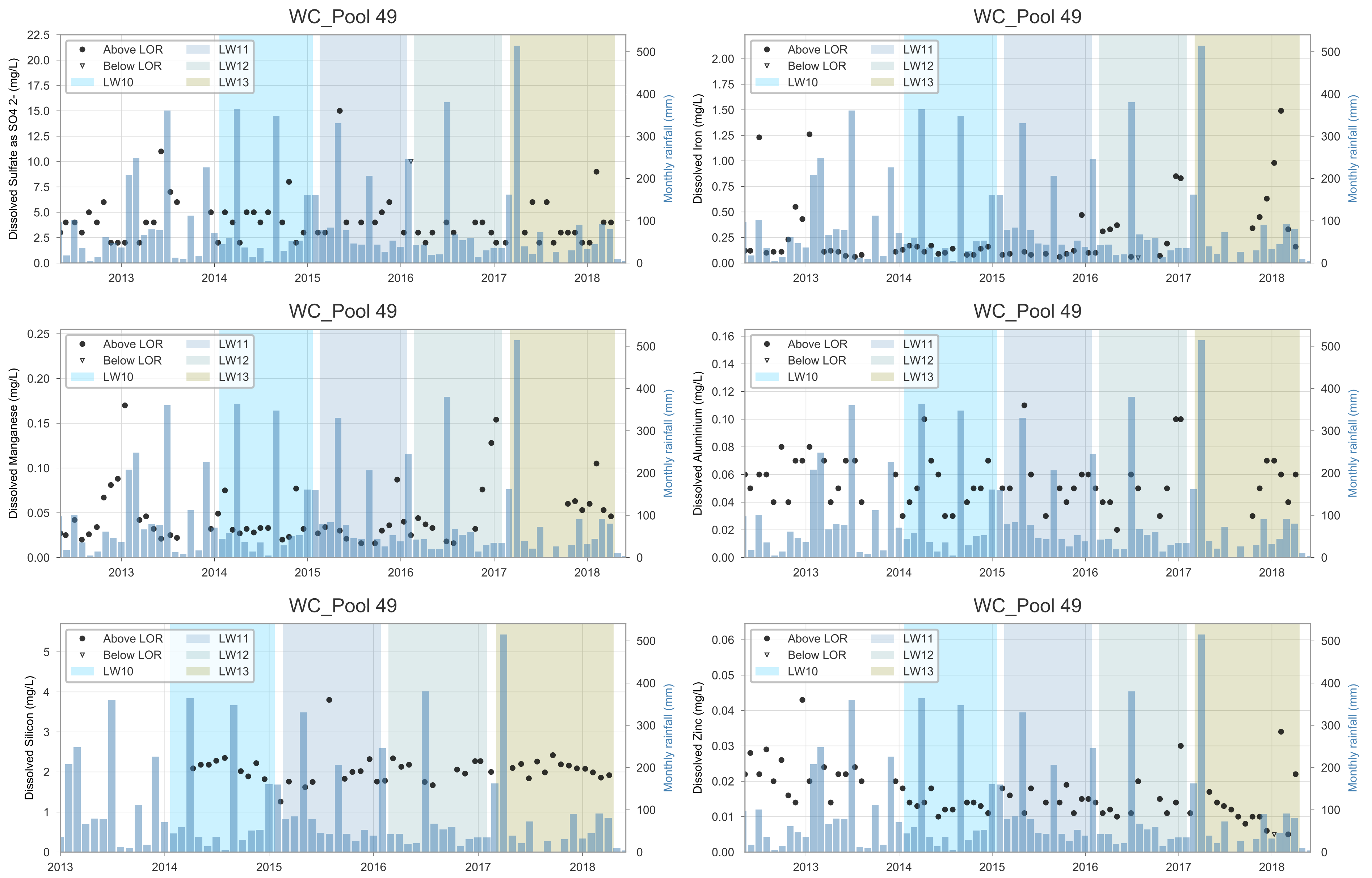

Wongawilli Ck (FR6)
Dissolved Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
0.0
0.5
1.0
1.5
2.0
2.5
0
100
200
300
400
500
2005
2007
2009
2011
2013
2015
2017


Wongawilli Ck (FR6)
Dissolved Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
0.0
0.2
0.4
0.6
0.8
1.0
1.2
0
100
200
300
400
500
2005
2007
2009
2011
2013
2015
2017

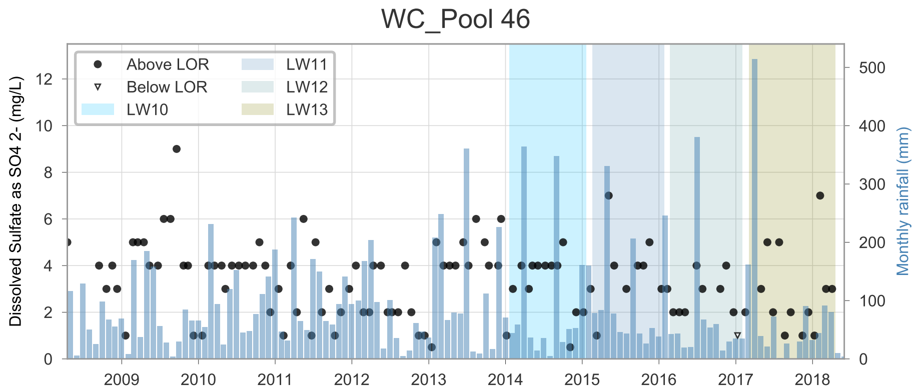

Wongawilli Ck (FR6)
Dissolved Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
0.000
0.025
0.050
0.075
0.100
0.125
0.150
0.175
0.200
0
100
200
300
400
500
2005
2007
2009
2011
2013
2015
2017

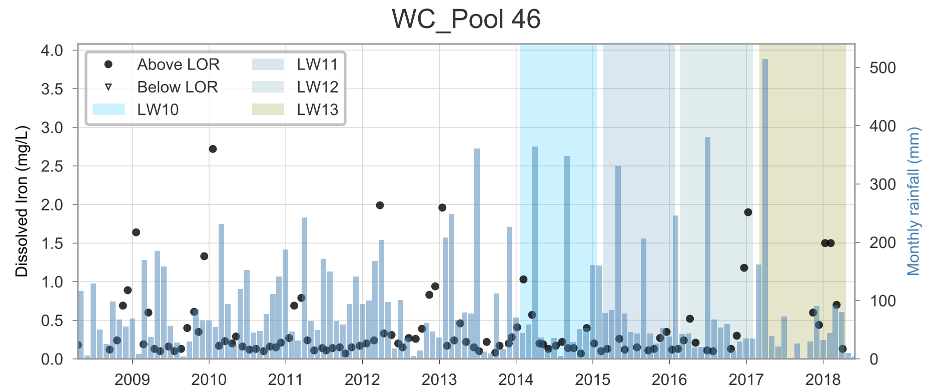

Wongawilli Ck (FR6)
Dissolved Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
0
1
2
3
4
5
6
0
100
200
300
400
500
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018

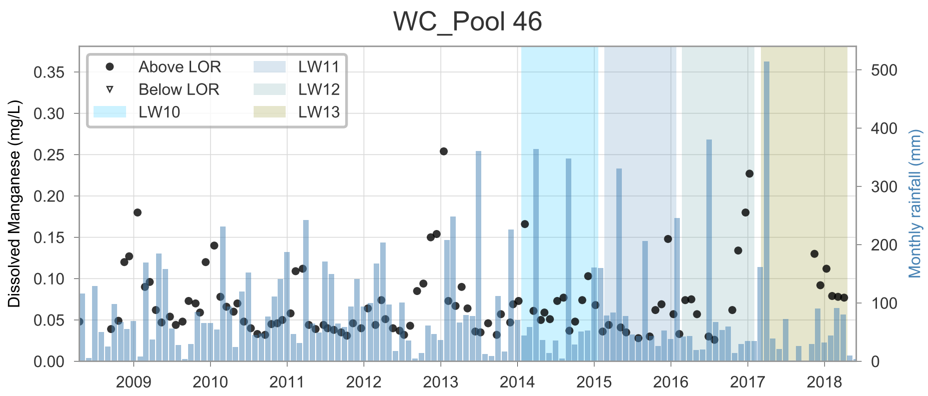

Wongawilli Ck (FR6)
Dissolved Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
0.000
0.005
0.010
0.015
0.020
0.025
0.030
0
100
200
300
400
500
2005
2007
2009
2011
2013
2015
2017

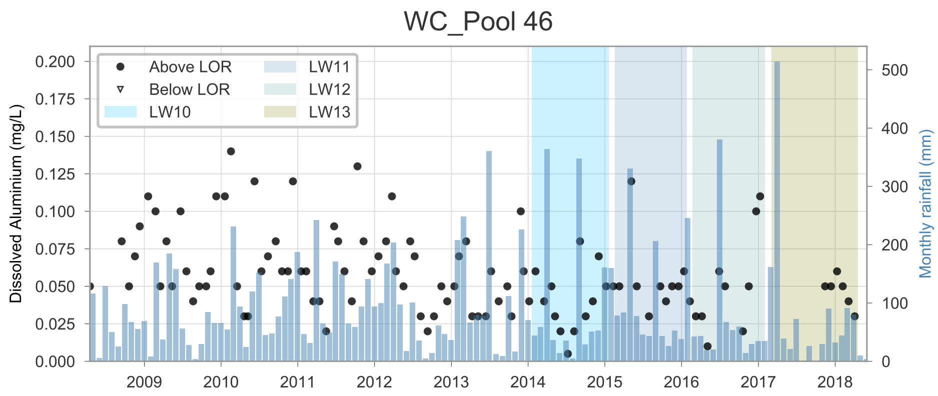


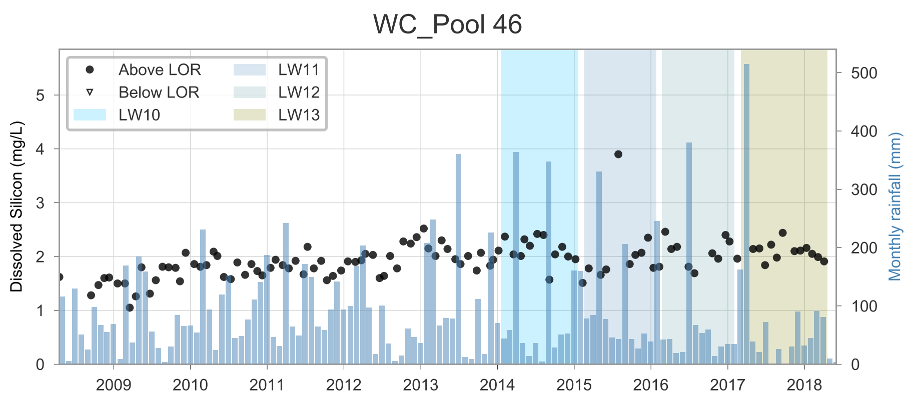
WC_Pool 49
Dissolved Sulfate as SO4 2- (mg/L)
Dissolved Iron (mg/L)
Dissolved Manganese (mg/L)
Dissolved Aluminium (mg/L)
Dissolved Silicon (mg/L)
Dissolved Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
2013
2014
2015
2016
2017
2018

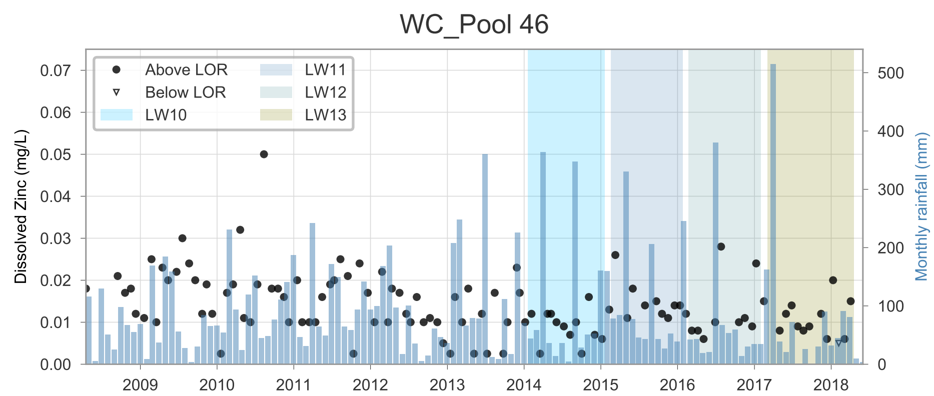

WC_Pool 46
Dissolved Sulfate as SO4 2- (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13

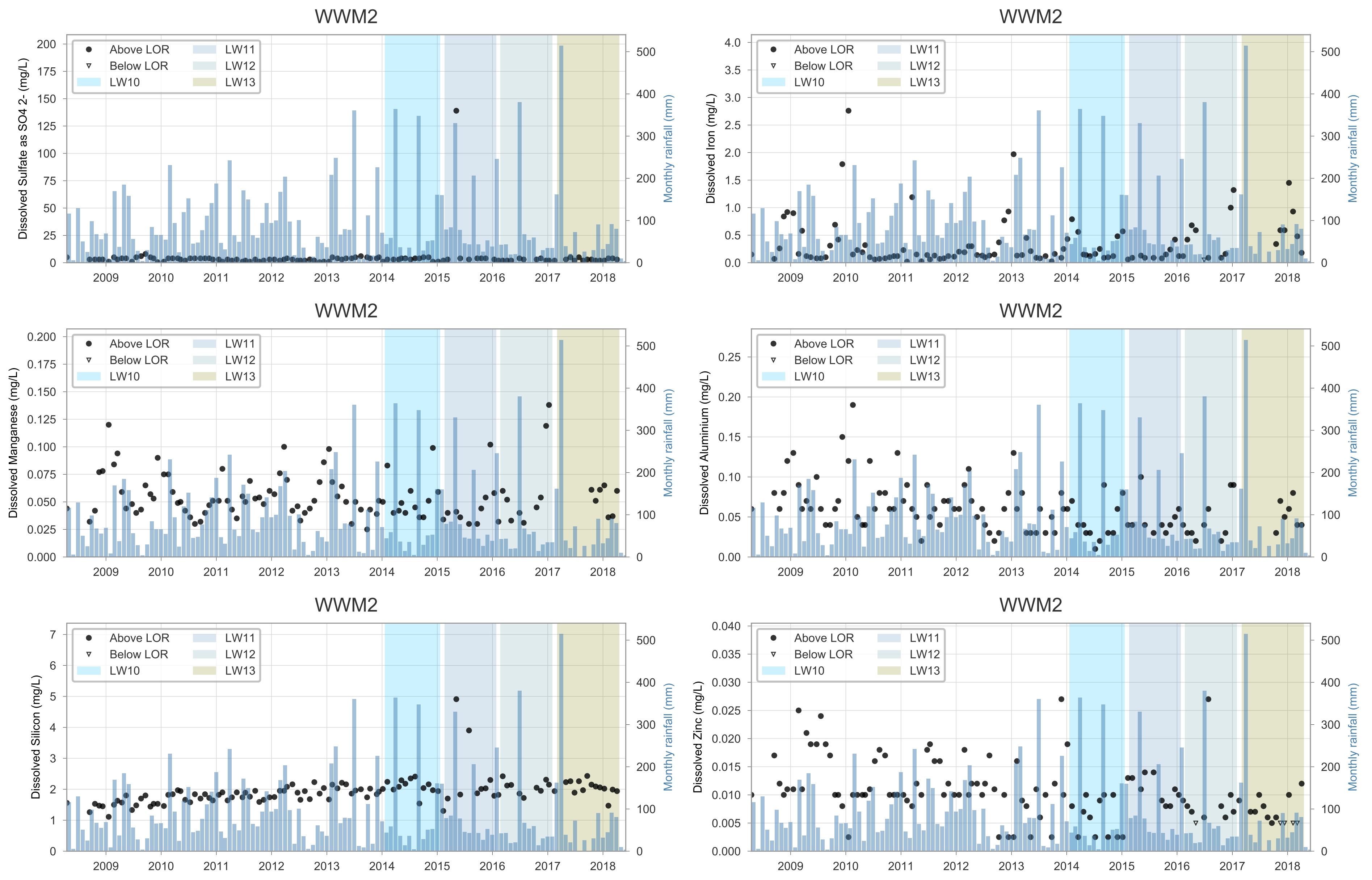

WC_Pool 46
Dissolved Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13


WC_Pool 46
Dissolved Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13

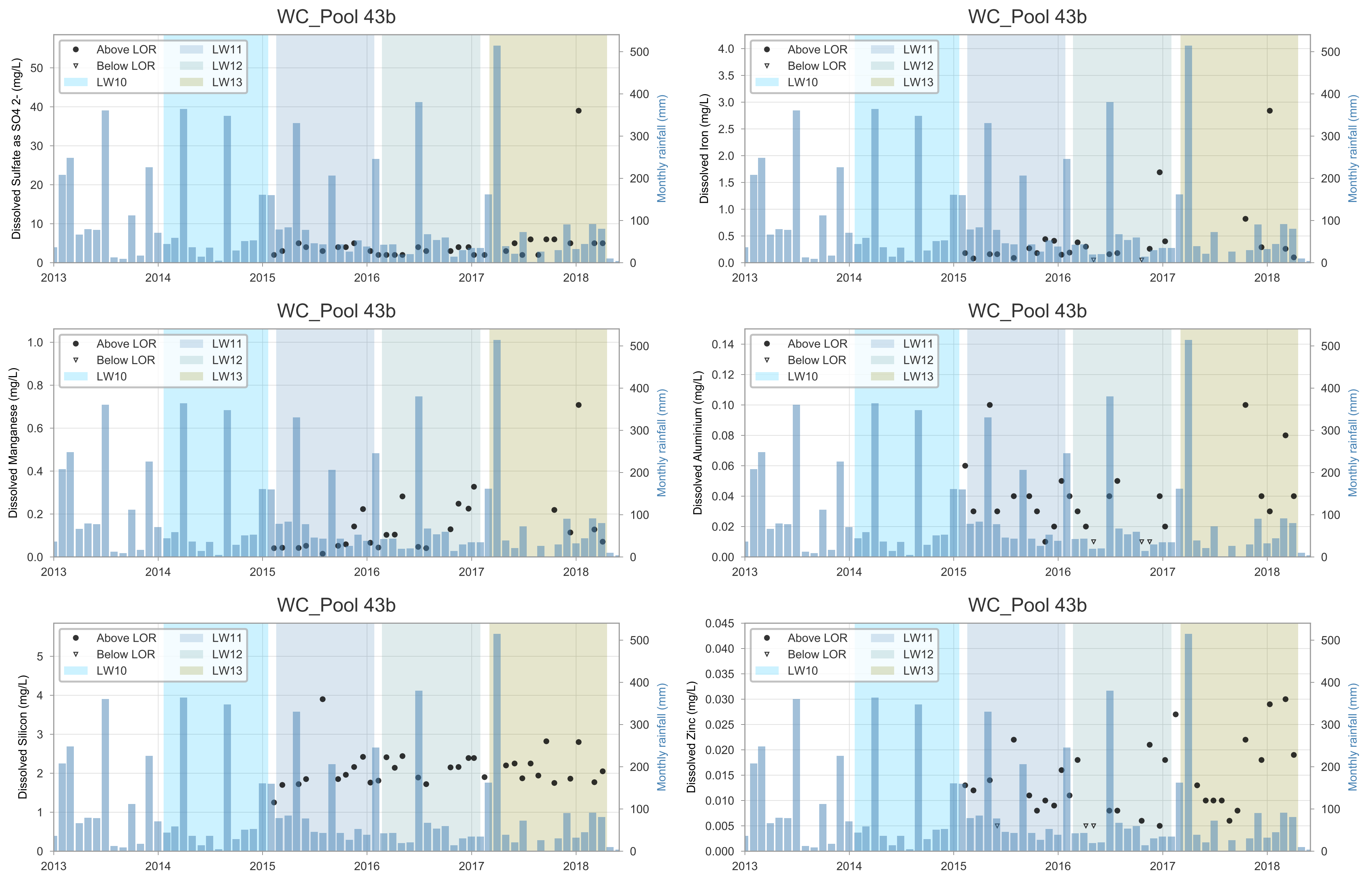

WC_Pool 46
Dissolved Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13


WC_Pool 46
Dissolved Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13

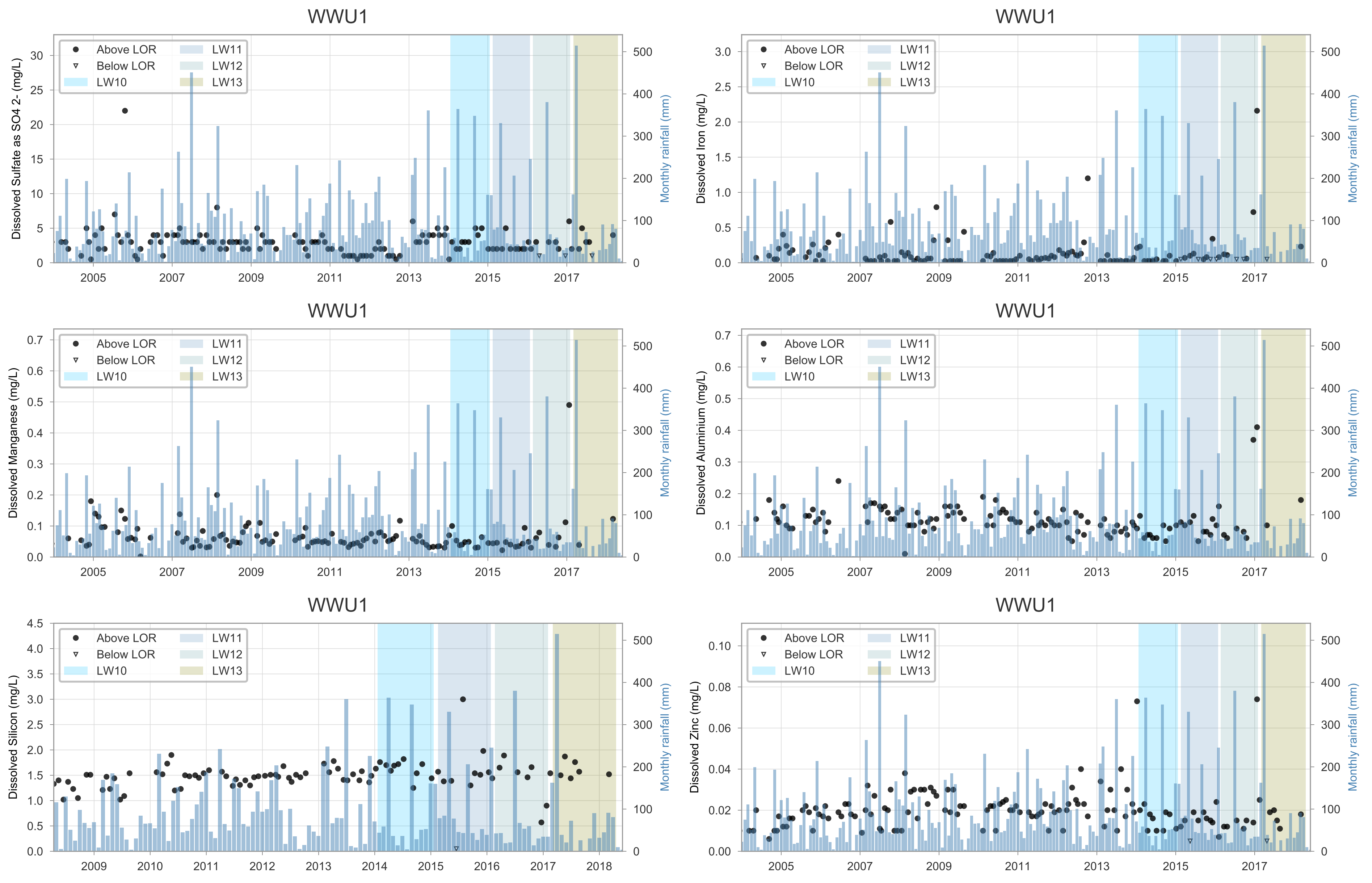

WC_Pool 46
Dissolved Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13



WWM2
Dissolved Sulfate as SO4 2- (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
WWM2
Dissolved Iron (mg/L)
Monthly rainfall (mm)
WWM2
Dissolved Manganese (mg/L)
Monthly rainfall (mm)
WWM2
Dissolved Aluminium (mg/L)
Monthly rainfall (mm)
WWM2
Dissolved Silicon (mg/L)
Monthly rainfall (mm)
WWM2
Dissolved Zinc (mg/L)
Monthly rainfall (mm)
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018



WC_Pool 43b
Dissolved Sulfate as SO4 2- (mg/L)
Monthly rainfall (mm)
Dissolved Iron (mg/L)
Dissolved Manganese (mg/L)
Dissolved Aluminium (mg/L)
Dissolved Silicon (mg/L)
Dissolved Zinc (mg/L)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
2013
2014
2015
2016
2017
2018



WWU1
Dissolved Sulfate as SO4 2- (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
0
5
10
15
20
25
30
100
200
300
400
500
2005
2007
2009
2011
2013
2015
2017
WWU1
Dissolved Iron (mg/L)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
WWU1
Dissolved Manganese (mg/L)
0.1
0.2
0.3
0.4
0.5
0.6
0.7
WWU1
Dissolved Aluminium (mg/L)
WWU1
Dissolved Silicon (mg/L)
3.5
4.0
4.5
2009
2010
2012
2014
2016
2018
WWU1
Dissolved Zinc (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10

Appendix B

8.1.1 Parameters used for AWBM by modelled catchment

AWBM was first developed by W. Boughton in the early 1990s (Boughton & Chiew 2003; Boughton 2004). The model takes average rainfall and potential evaporation across a catchment as inputs on a daily timestep. The user provides parameters to describe the relative area and soil moisture storage capacity of three stores covering the catchment (Figure 34. AWBM Rainfall-runoff model flow diagram). Based on these inputs and parameters, surface runoff and baseflow are calculated and then released from the relevant storage using a linear decay (*Ksurf* or *Kbase*). These decayed flows are summed to estimate total catchment outflow on a daily basis.

Most of the parameters relate in part to the simulated connected groundwater system in the catchment. For this project, AWBM has been populated and run via the eWater 'Source' platform (eWater 2017).

Table 13. AWBM parameters for Dendrobium catchment models

SITE	A1	A2	A3	Kbase	Ksurf	BFI	C1	C2	C3
	area - fraction	area - fraction	area - fraction	fraction	fraction	fraction	mm	mm	mm
Donalds Castle Creek catchments									
DCS2	0.15	0.20	0.65	0.97	0.26	0.32	0.008	0.12	0.27
DC13	0.08	0.433	0.487	0.982	0.22	0.34	0.015	0.14	0.37
DCU	0.08	0.20	0.72	0.98	0.75	0.4	0.015	0.10	0.40
Wongawilli Creek catchments									
WC15	0.15	0.20	0.65	0.945	0.26	0.32	0.008	0.20	0.27
WC21	0.134	0.433	0.433	0.974	0.35	0.42	0.001	0.12	0.25
WWL	0.134	0.433	0.433	0.97	0.26	0.32	0.01	0.10	0.25
Lake Avon tributaries									
LA4	0.10	0.433	0.467	0.96	0.26	0.25	0.05	0.1	0.20

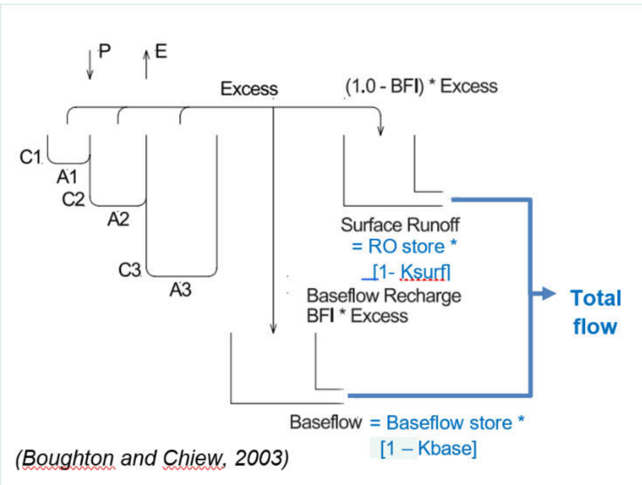
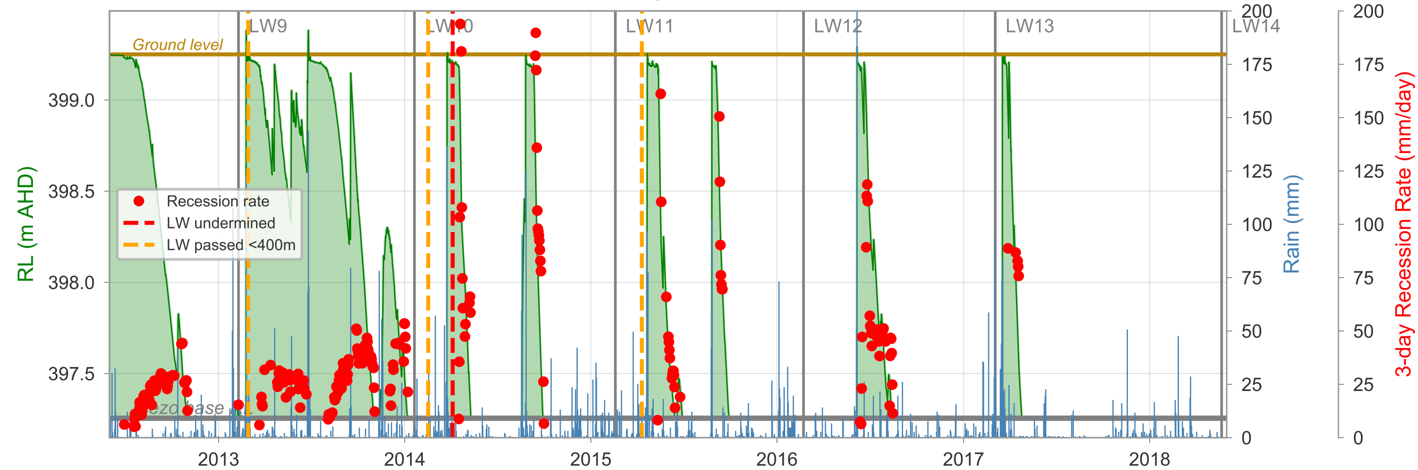


Figure 34. AWBM Rainfall-runoff model flow diagram

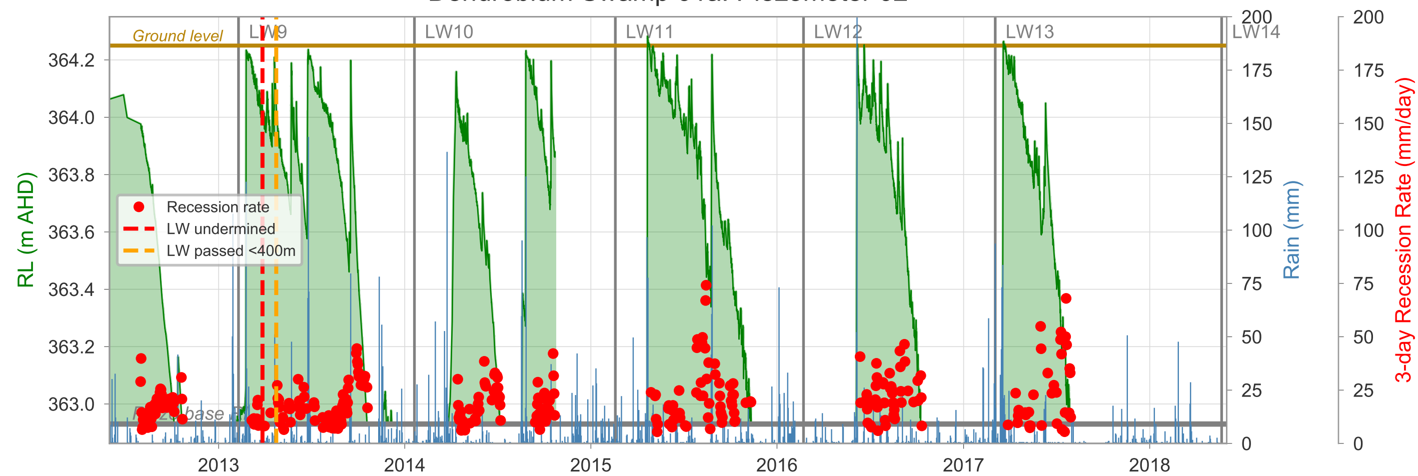
Appendix C

Shallow groundwater (swamp) hydrographs

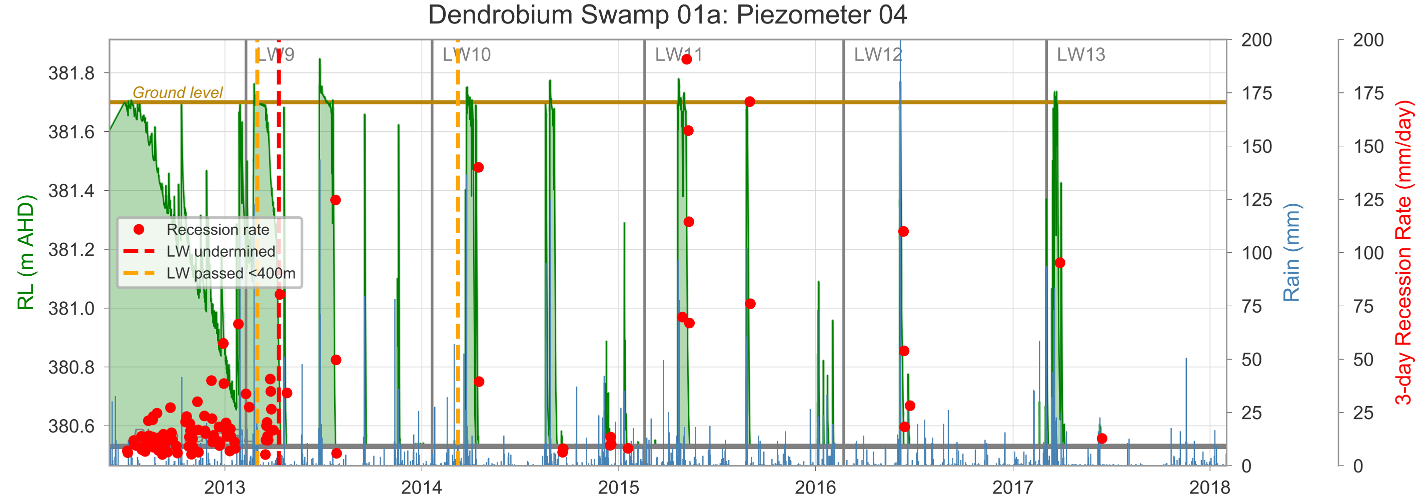
Dendrobium Swamp 01a: Piezometer 01



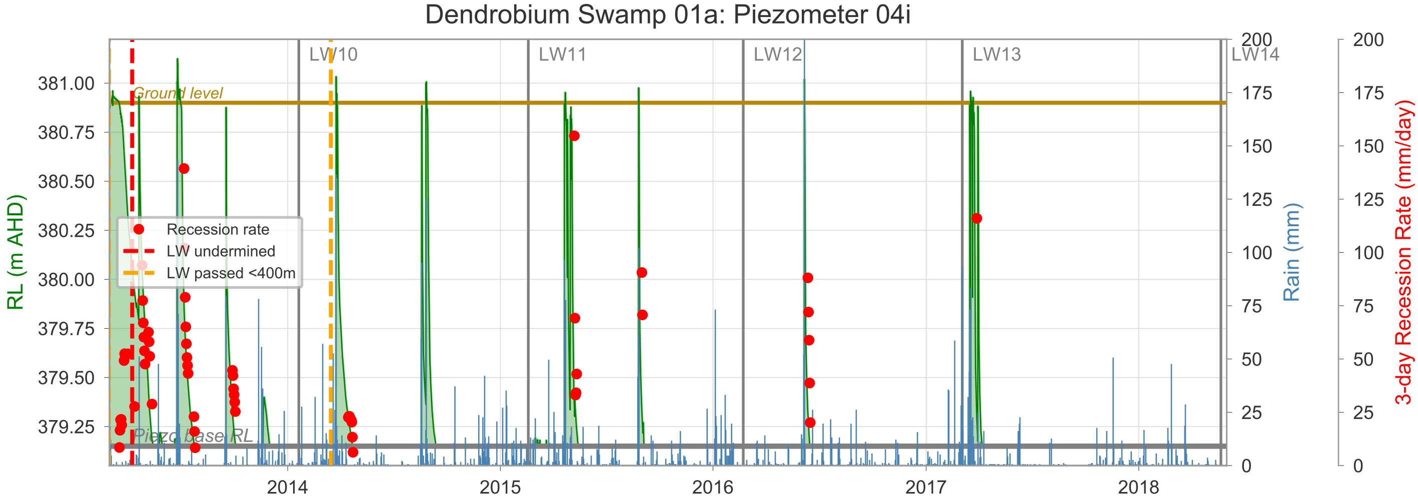
Dendrobium Swamp 01a: Piezometer 02



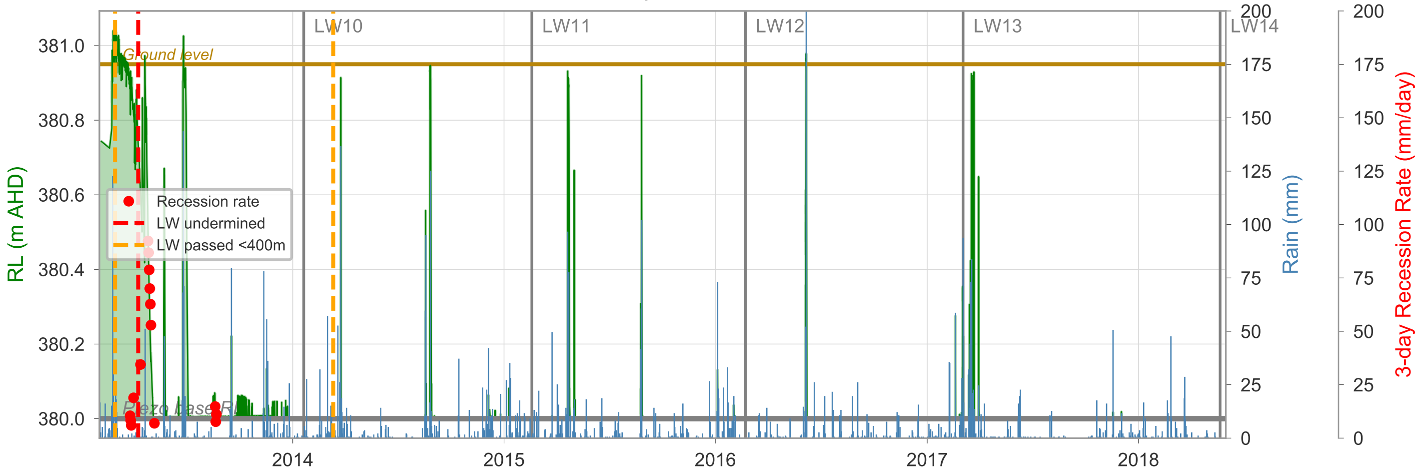
Dendrobium Swamp 01a: Piezometer 04



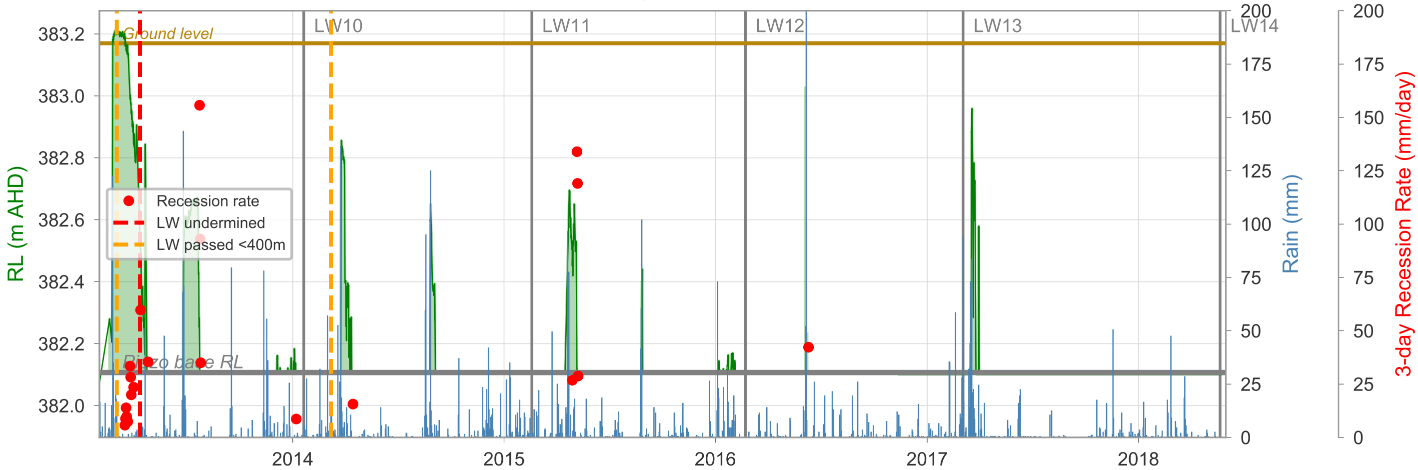
Dendrobium Swamp 01a: Piezometer 04i



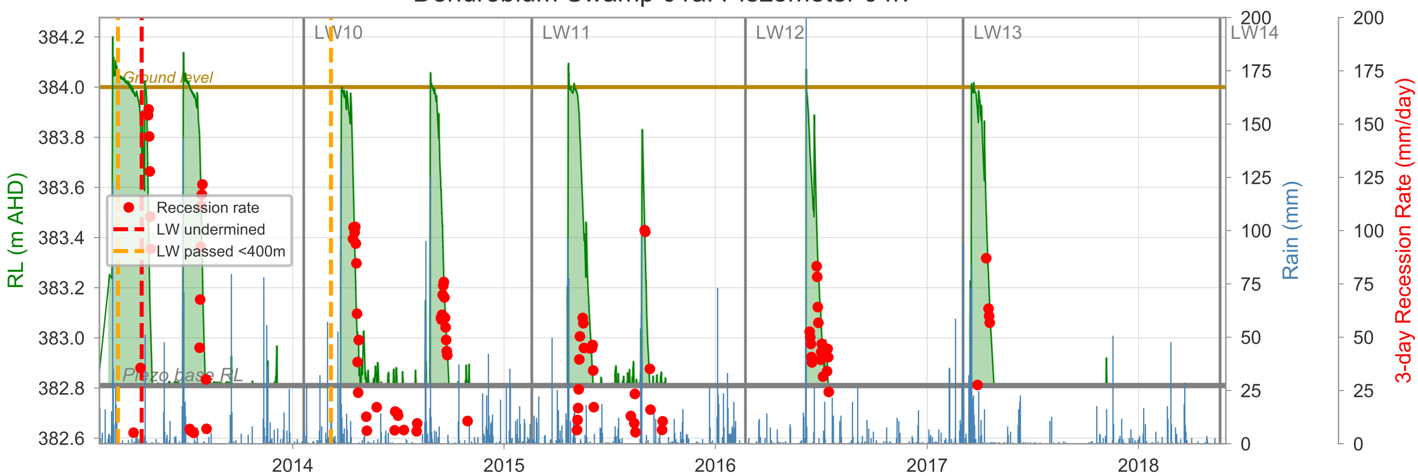
Dendrobium Swamp 01a: Piezometer 04ii



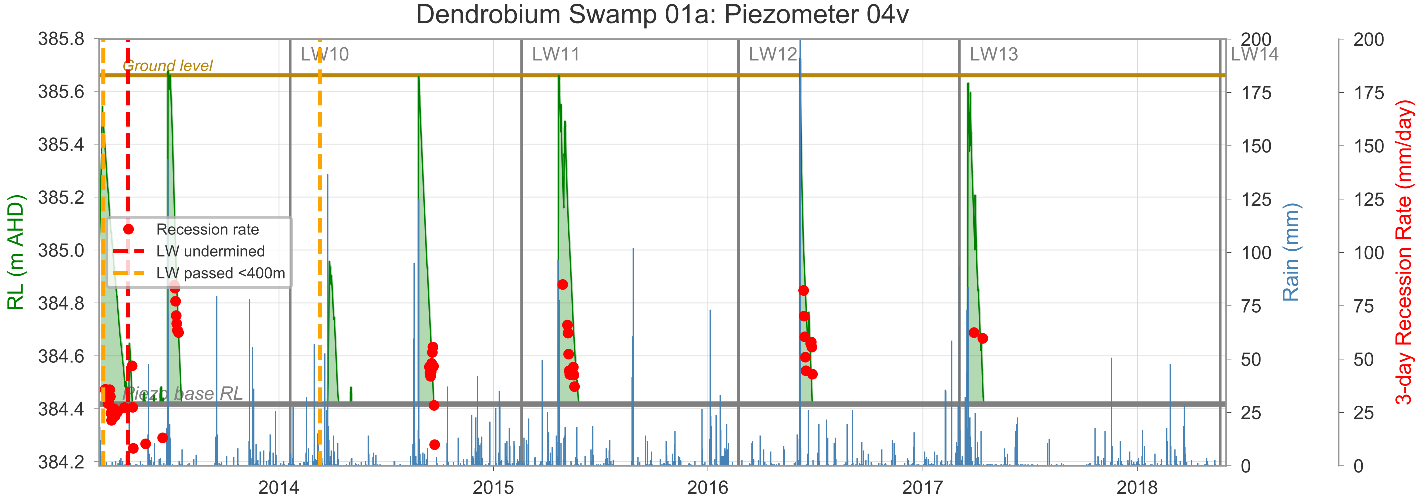
Dendrobium Swamp 01a: Piezometer 04iii



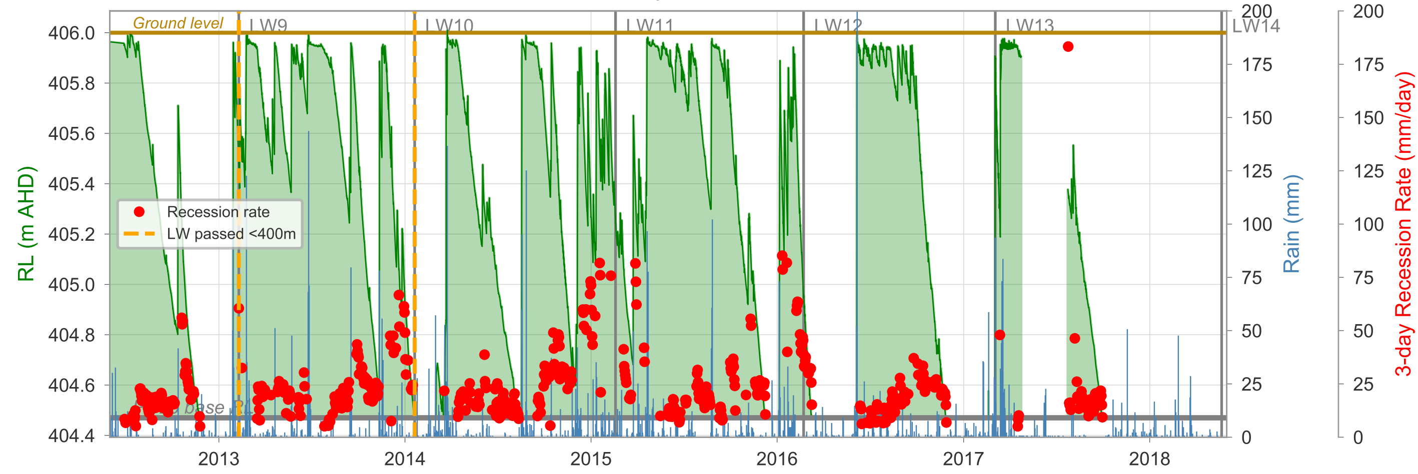
Dendrobium Swamp 01a: Piezometer 04iv



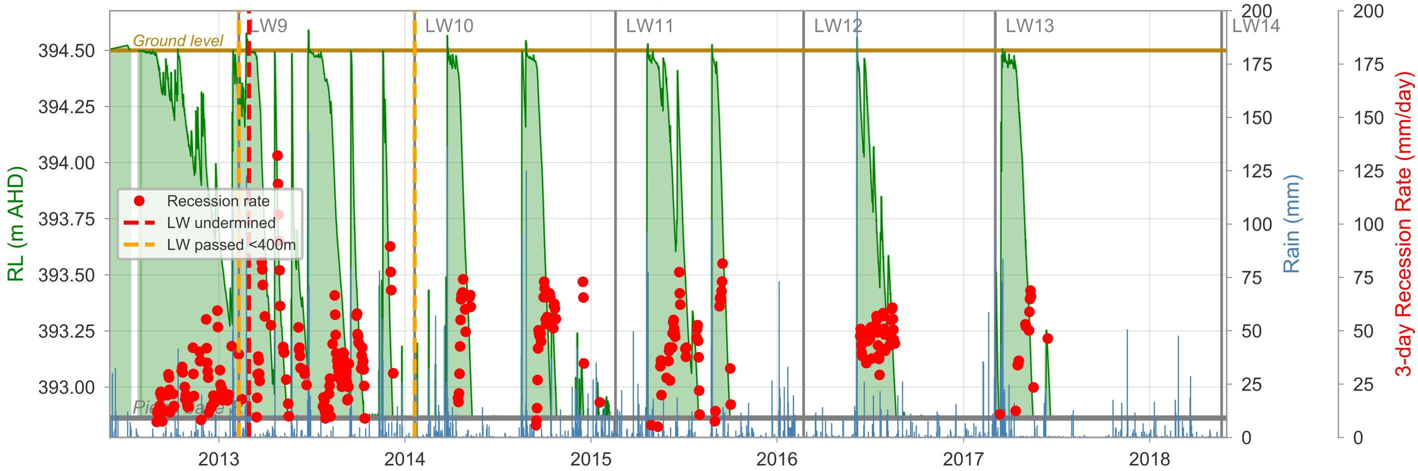
Dendrobium Swamp 01a: Piezometer 04v



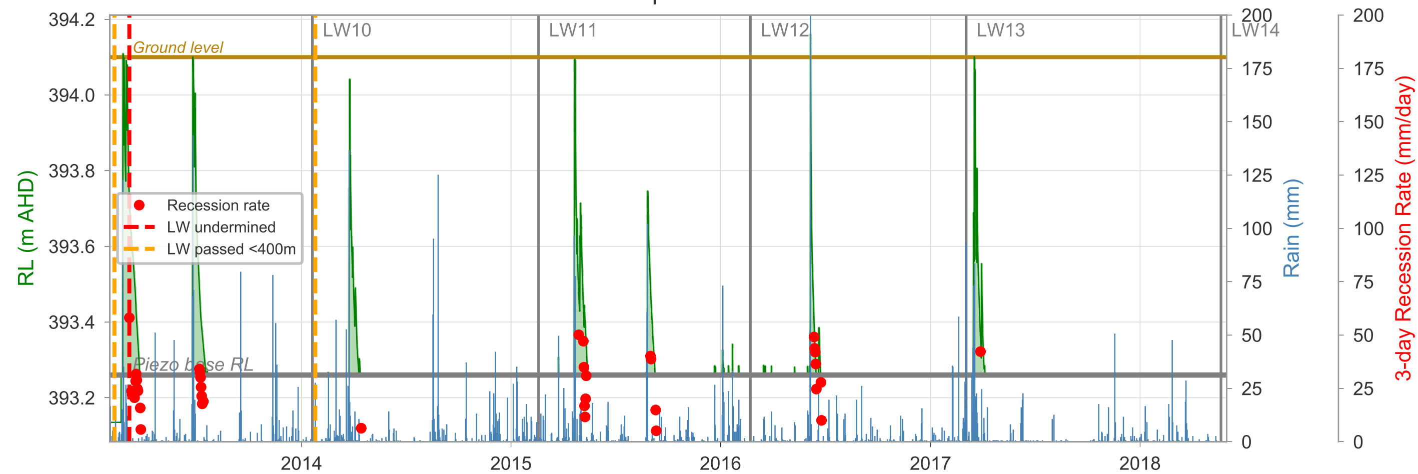
Dendrobium Swamp 01b: Piezometer 01



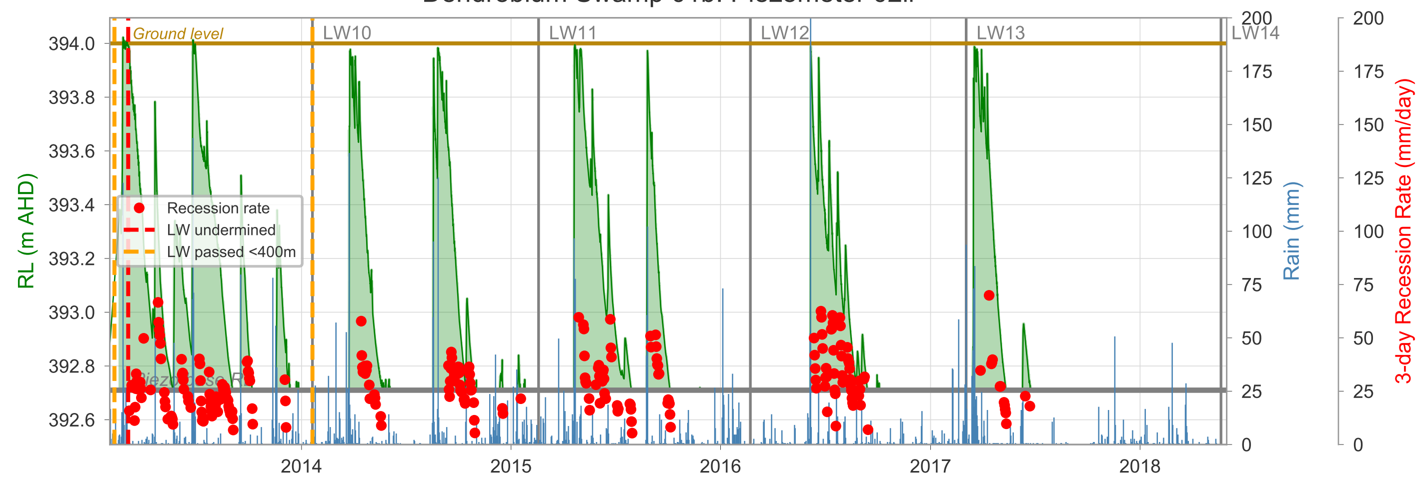
Dendrobium Swamp 01b: Piezometer 02



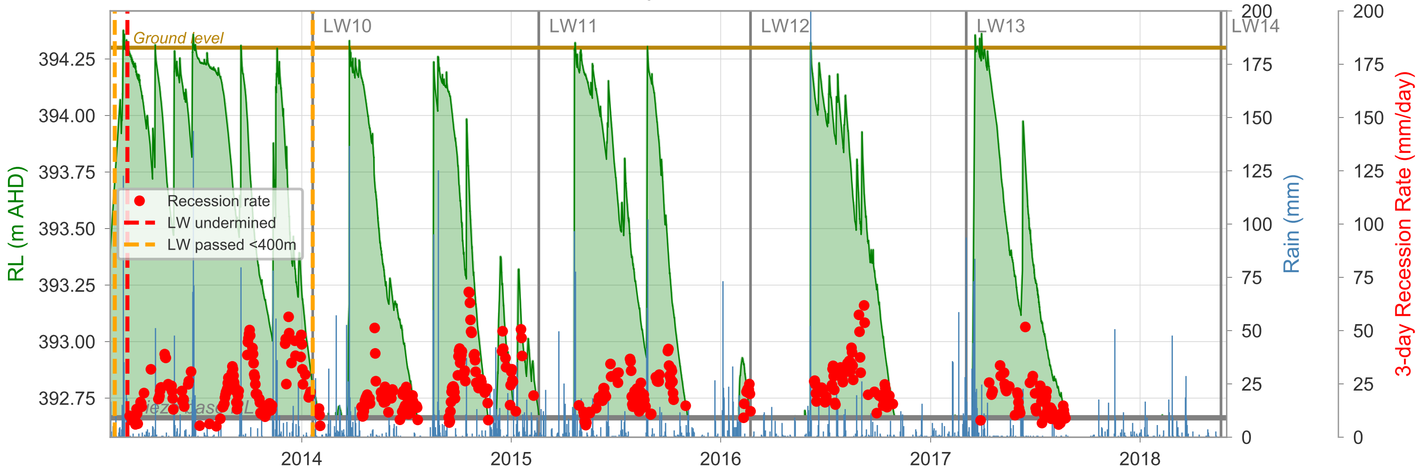
Dendrobium Swamp 01b: Piezometer 02i



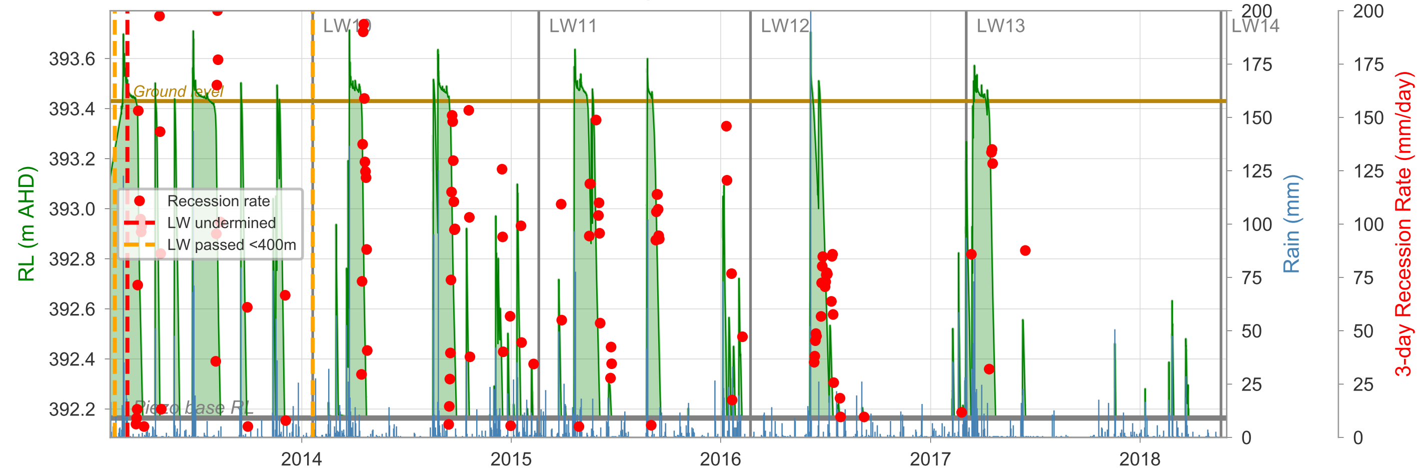
Dendrobium Swamp 01b: Piezometer 02ii



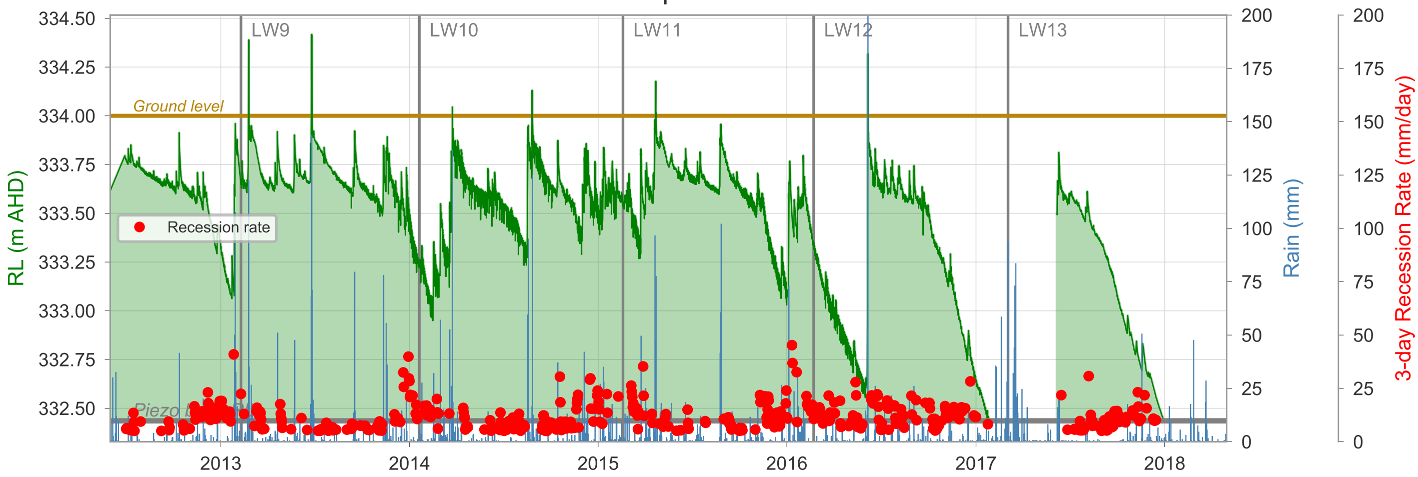
Dendrobium Swamp 01b: Piezometer 02iii



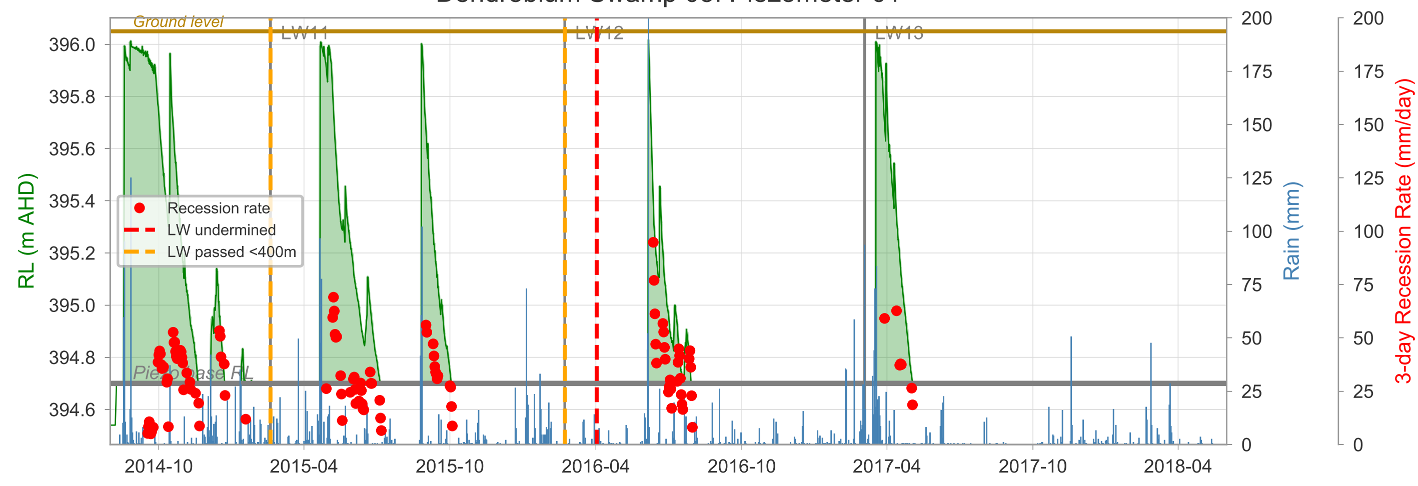
Dendrobium Swamp 01b: Piezometer 02iv

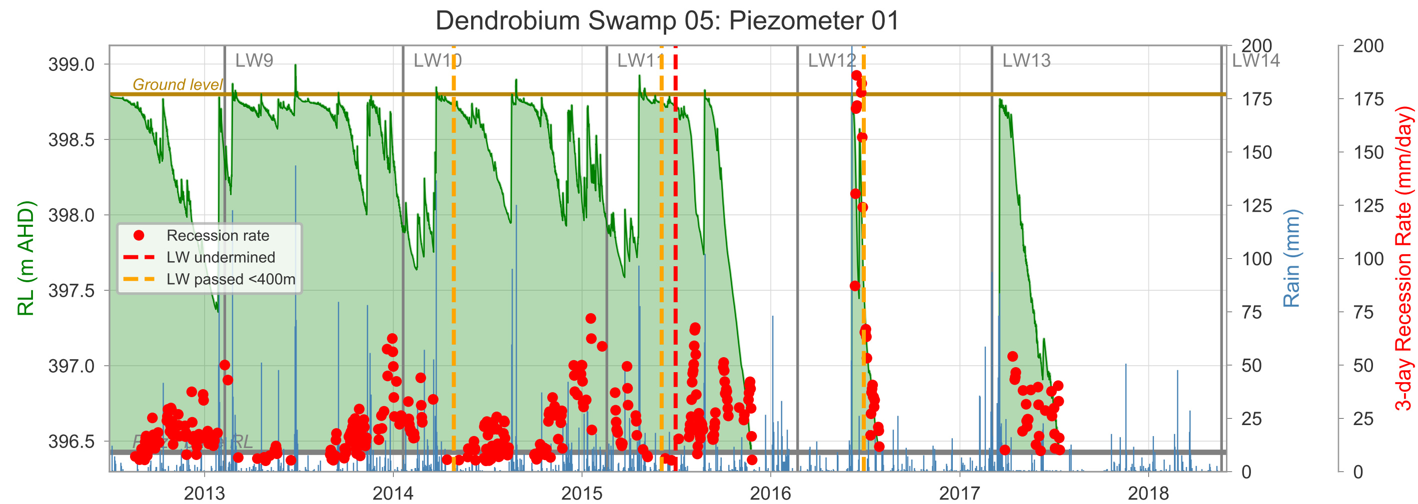


Dendrobium Swamp 02: Piezometer 01

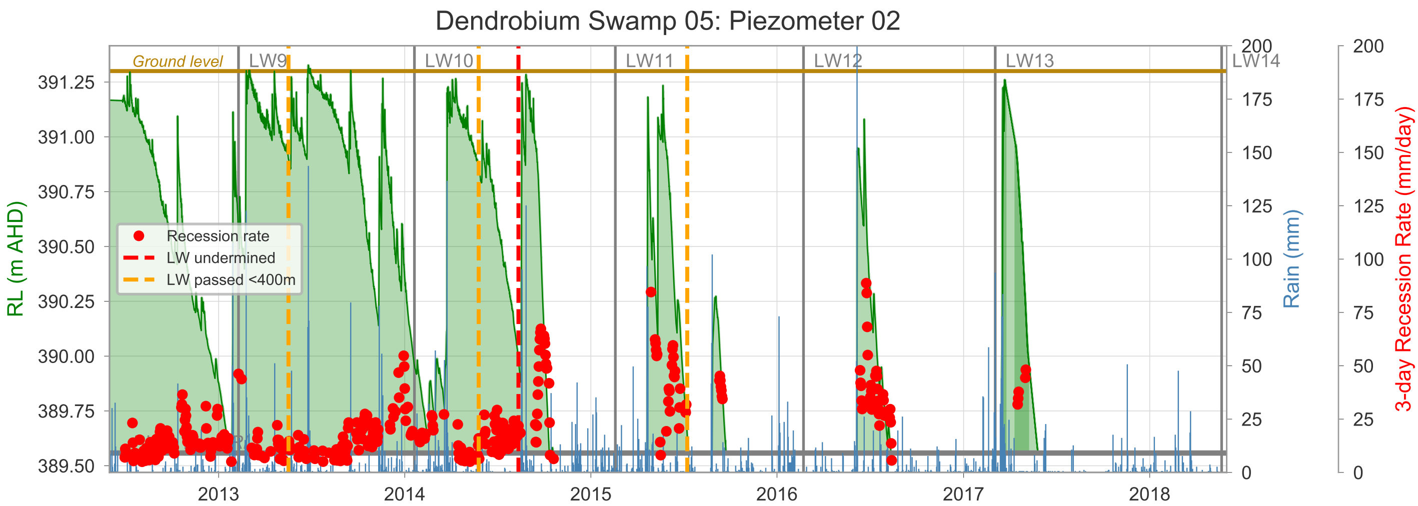


Dendrobium Swamp 03: Piezometer 01

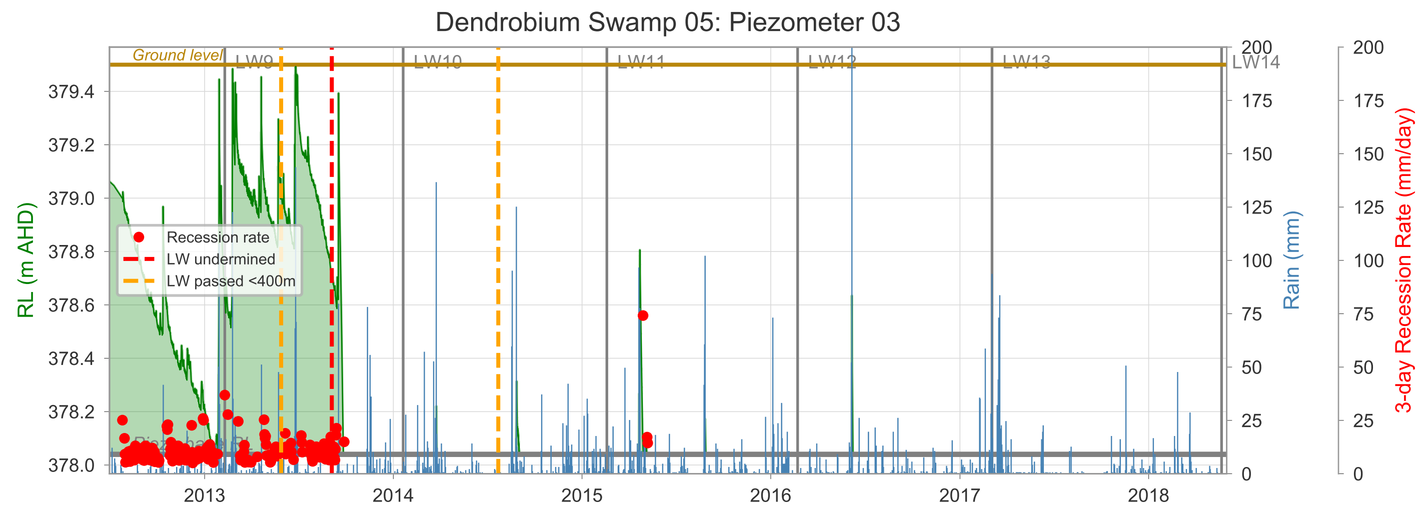




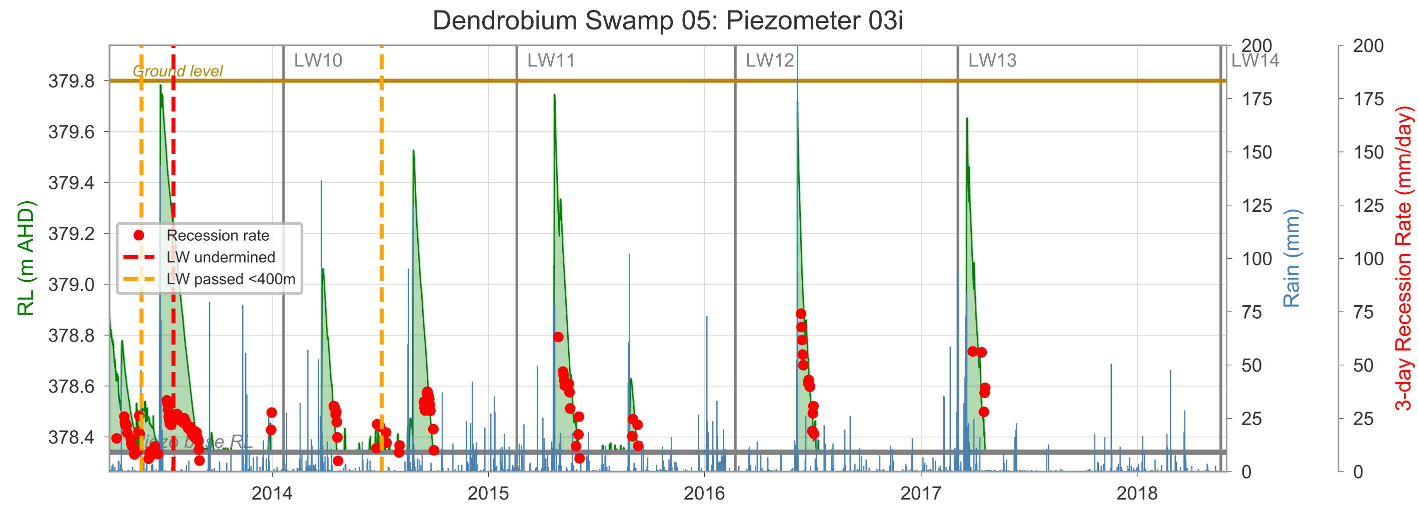
Dendrobium Swamp 05: Piezometer 01
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
Ground level
Piezometer RL
LW9
LW10
LW11
LW12
LW13
LW14
Recession rate
LW undermined
LW passed <400m
2013
2014
2015
2016
2017
2018



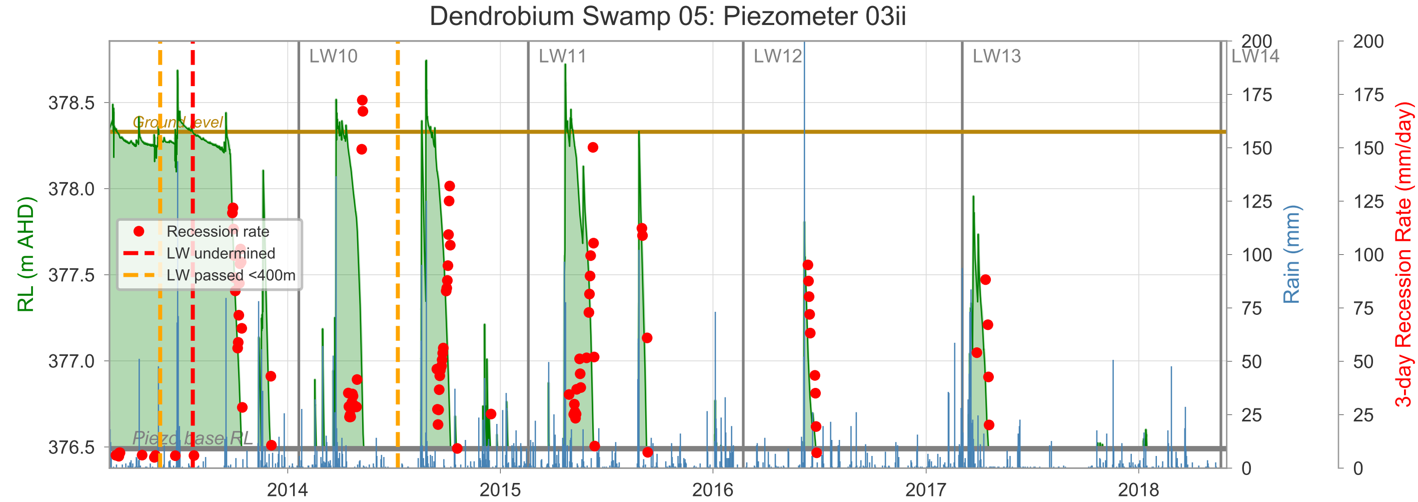
Dendrobium Swamp 05: Piezometer 02
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
Recession rate
LW undermined
LW passed <400m
2013
2014
2015
2016
2017
2018

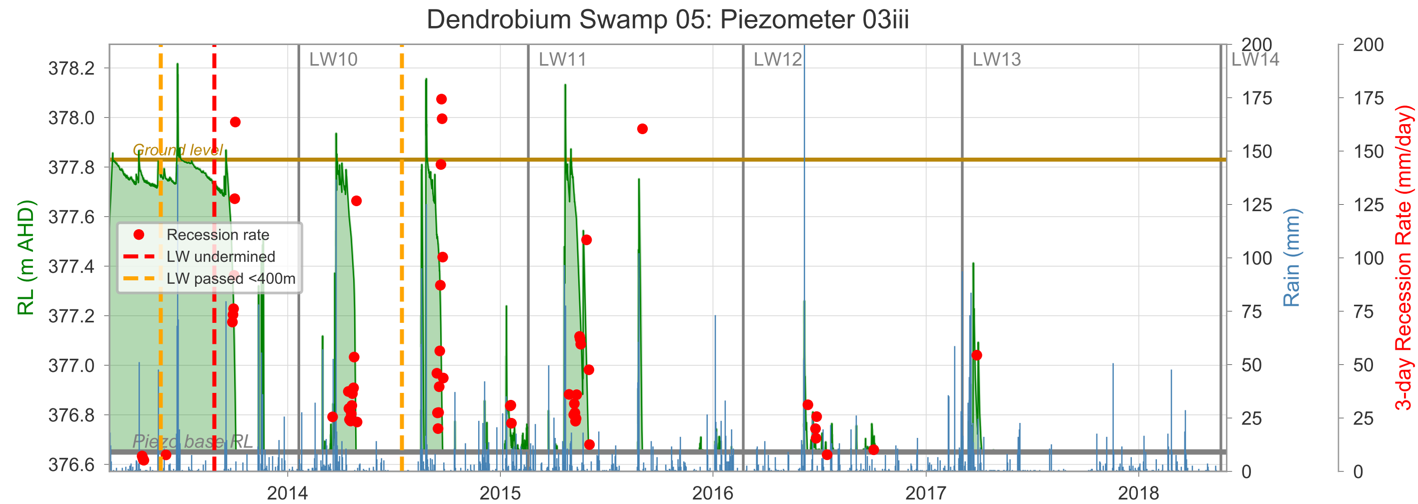


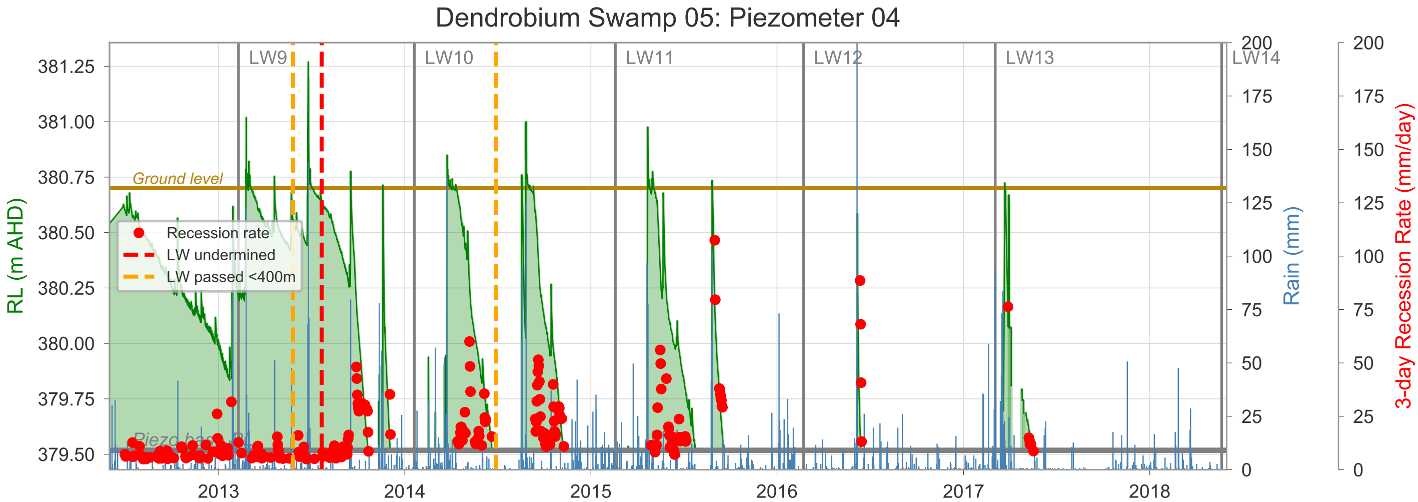
Dendrobium Swamp 05: Piezometer 03
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
Ground level
Piezometer RL
LW9
LW10
LW11
LW12
LW13
LW14
Recession rate
LW undermined
LW passed <400m
2013
2014
2015
2016
2017
2018

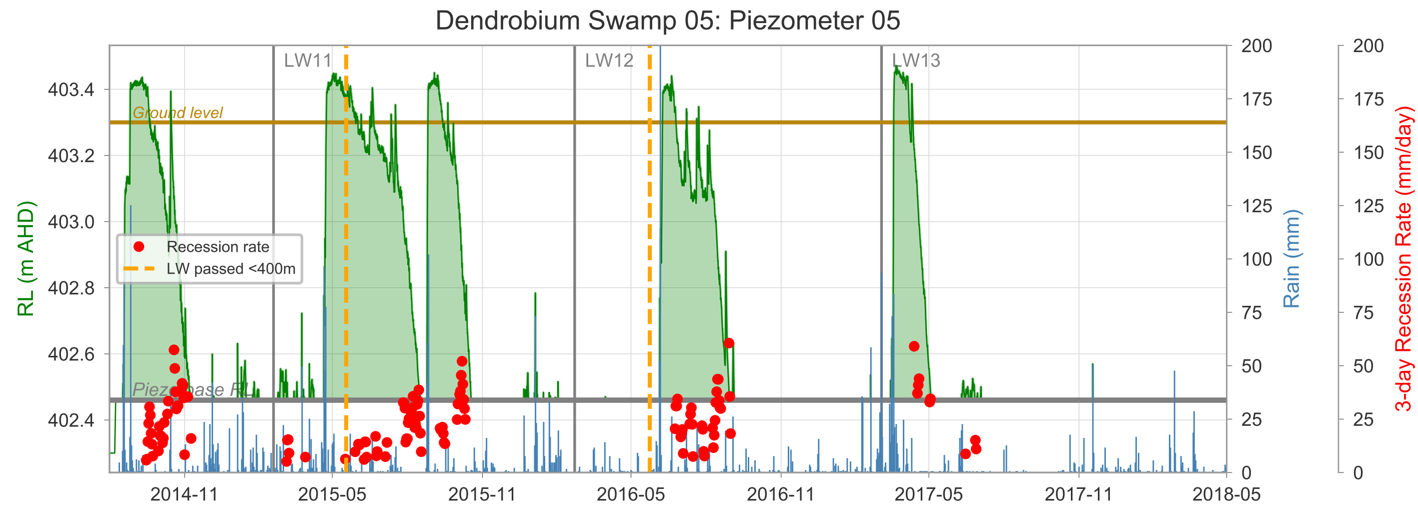


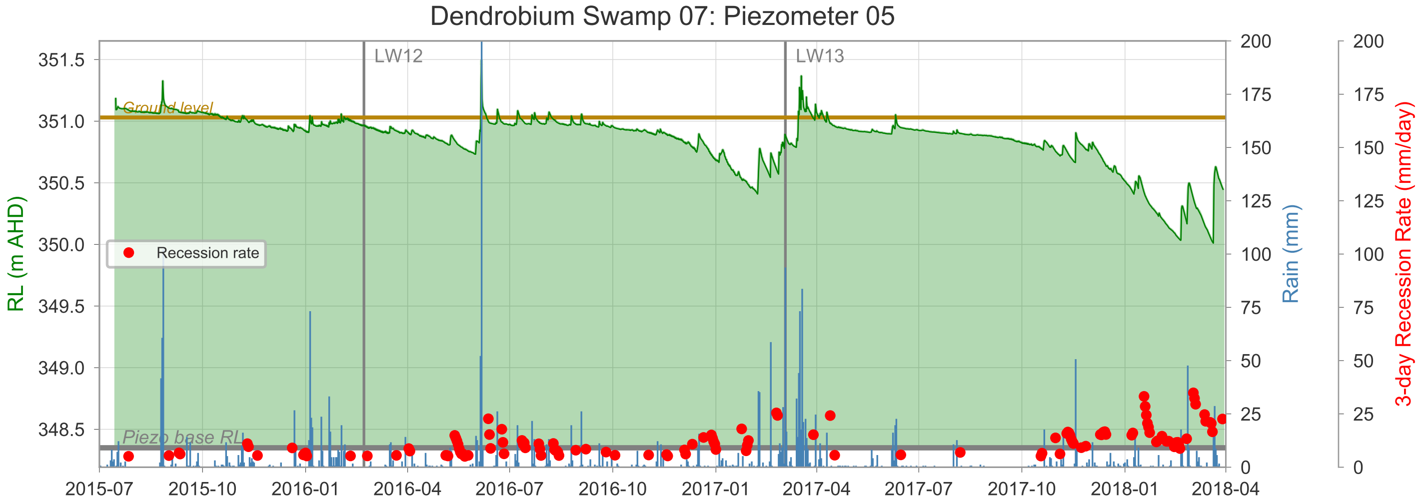
Dendrobium Swamp 05: Piezometer 03i
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
Ground level
Piezometer RL
LW10
LW11
LW12
LW13
LW14
Recession rate
LW undermined
LW passed <400m
2014
2015
2016
2017
2018

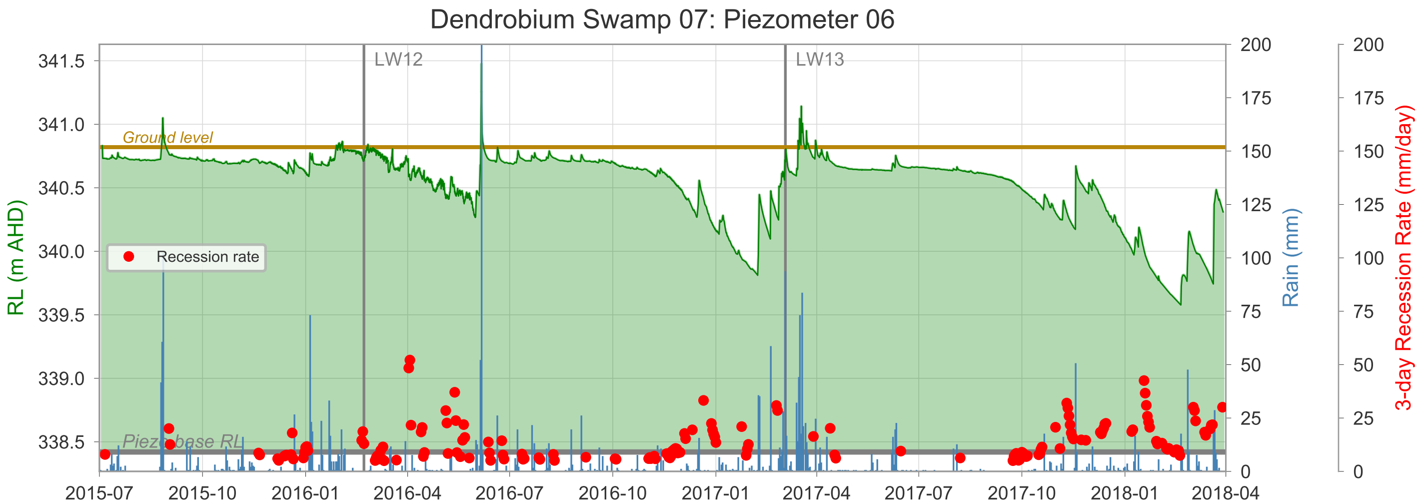

Dendrobium Swamp 05: Piezometer 03ii
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
Ground level
Piezo base RL
LW10
LW11
LW12
LW13
LW14
Recession rate
LW undermined
LW passed <400m
2014
2015
2016
2017
2018

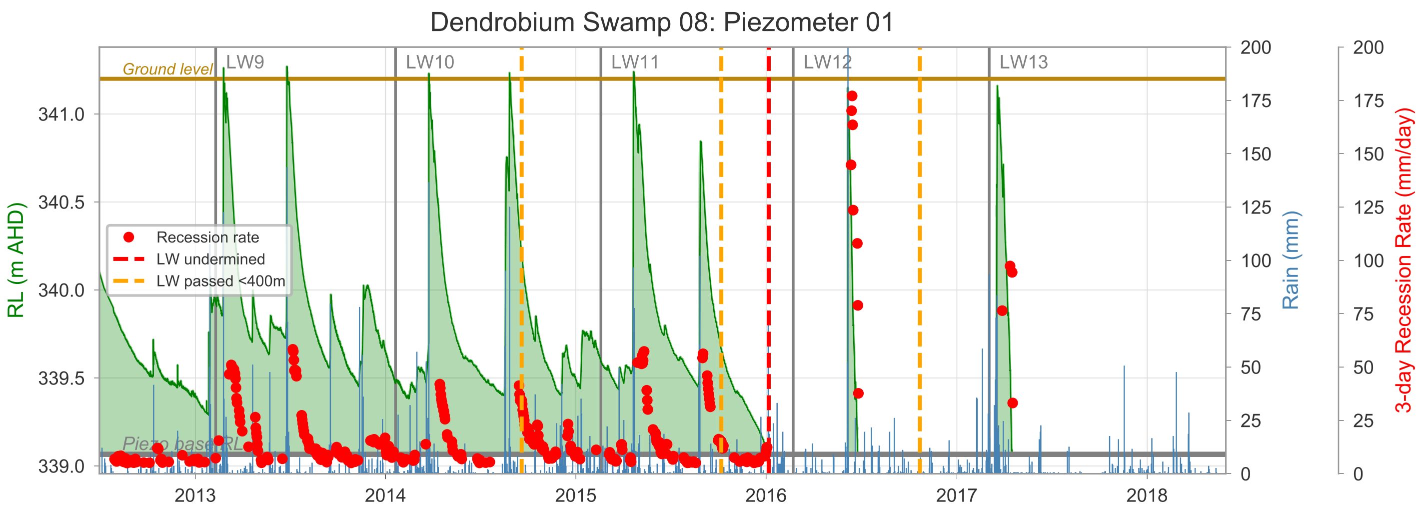

Dendrobium Swamp 05: Piezometer 03iii
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
Ground level
Piezo base RL
LW10
LW11
LW12
LW13
LW14
Recession rate
LW undermined
LW passed <400m
2014
2015
2016
2017
2018

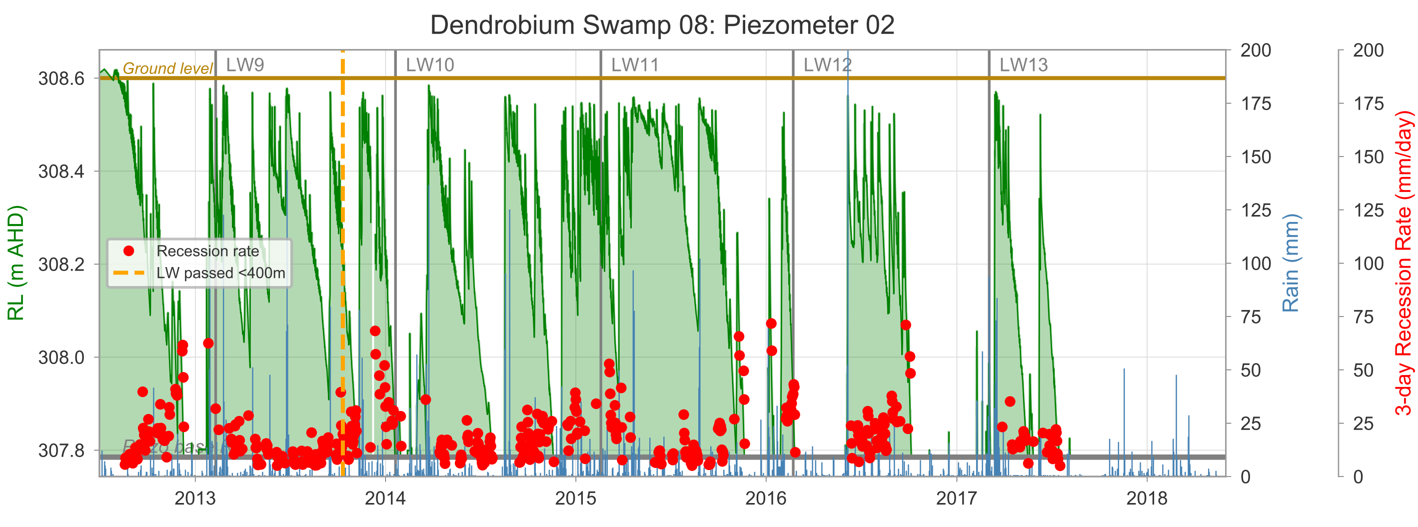

Dendrobium Swamp 05: Piezometer 04
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
Ground level
Piezo base RL
LW9
LW10
LW11
LW12
LW13
LW14
Recession rate
LW undermined
LW passed <400m
2013
2014
2015
2016
2017
2018

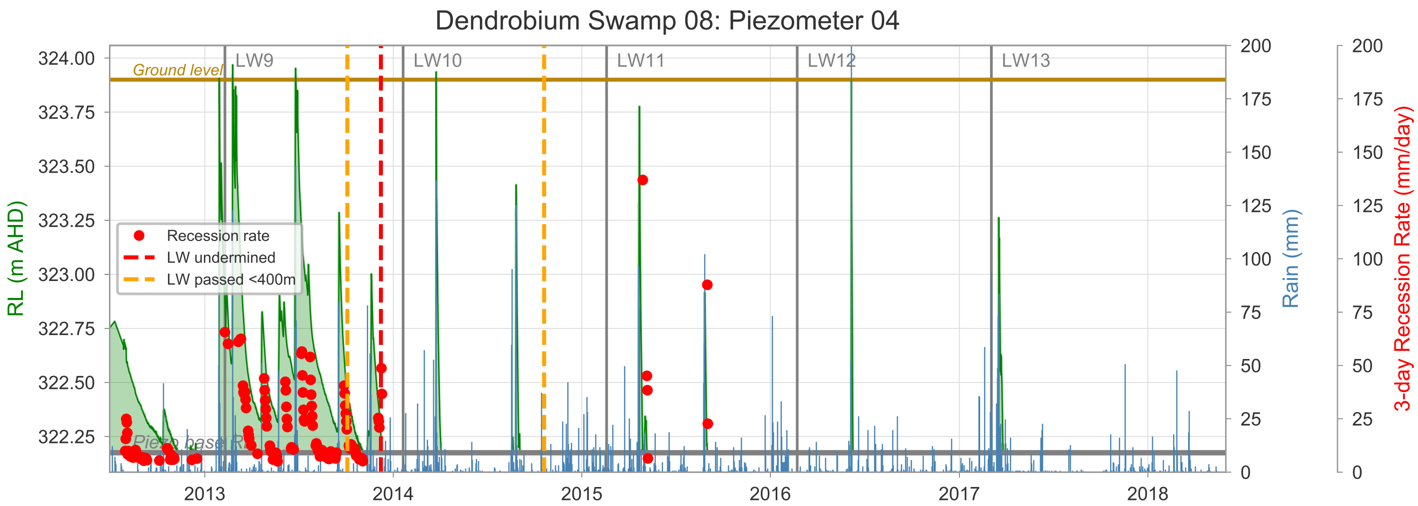

Dendrobium Swamp 05: Piezometer 05
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
Ground level
Piezo base RL
LW11
LW12
LW13
Recession rate
LW passed <400m
2014-11
2015-05
2015-11
2016-05
2016-11
2017-05
2017-11
2018-05

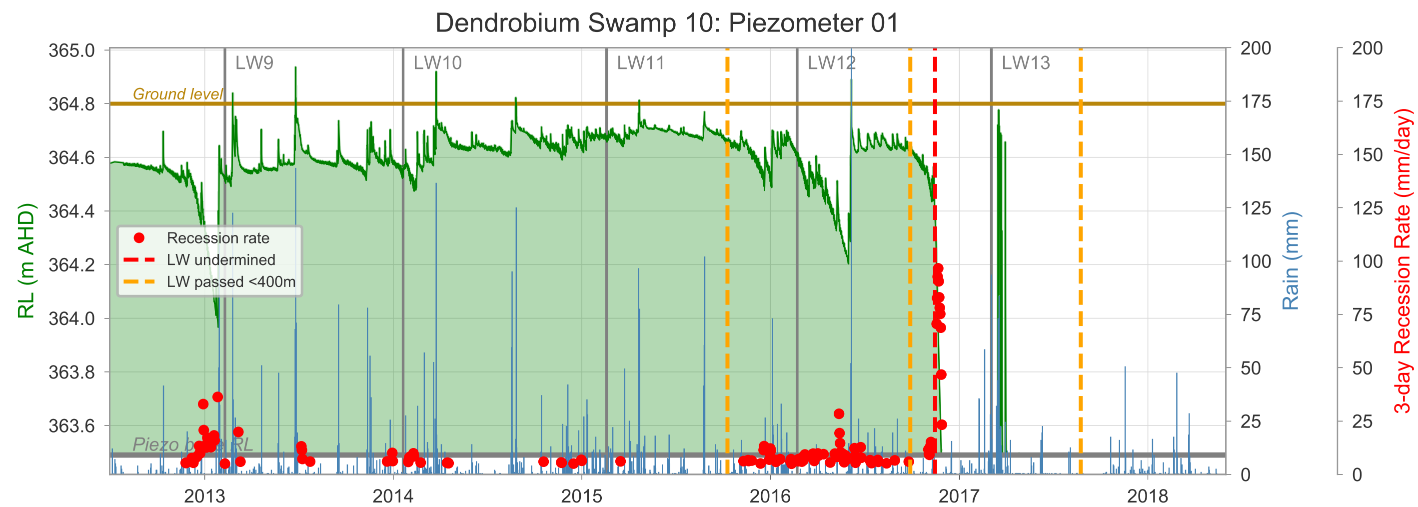

Dendrobium Swamp 07: Piezometer 05
LW12
LW13
Ground level
Piezo base RL
Recession rate
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
2015-07
2015-10
2016-01
2016-04
2016-07
2016-10
2017-01
2017-04
2017-07
2017-10
2018-01
2018-04

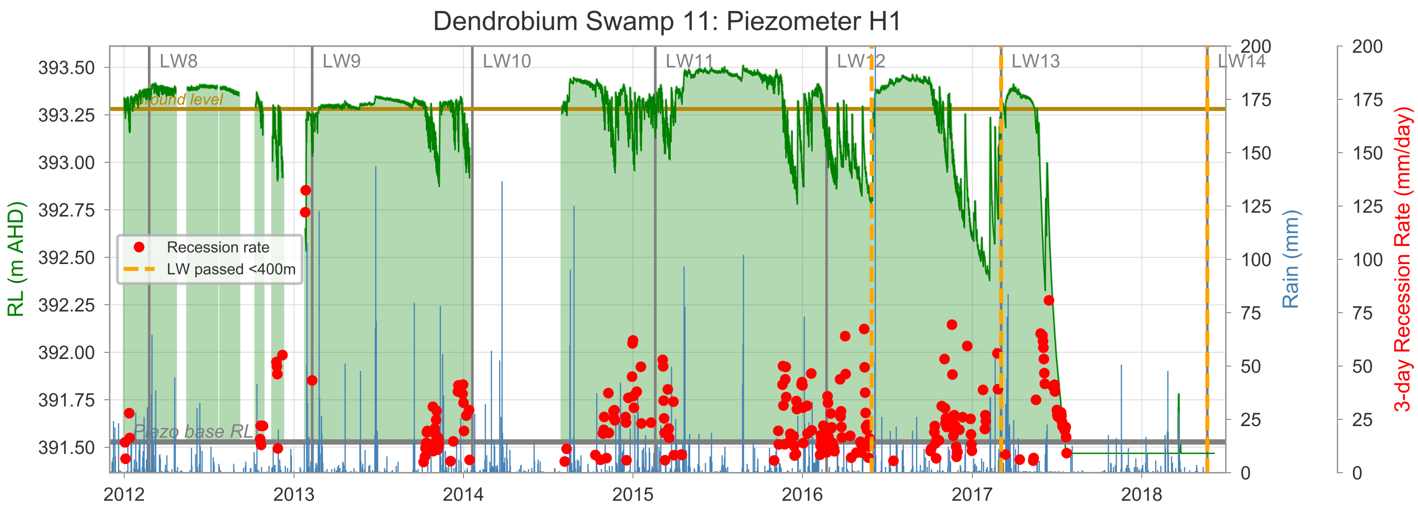

Dendrobium Swamp 07: Piezometer 06
LW12
LW13
Ground level
Piezo base RL
Recession rate
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
2015-07
2015-10
2016-01
2016-04
2016-07
2016-10
2017-01
2017-04
2017-07
2017-10
2018-01
2018-04

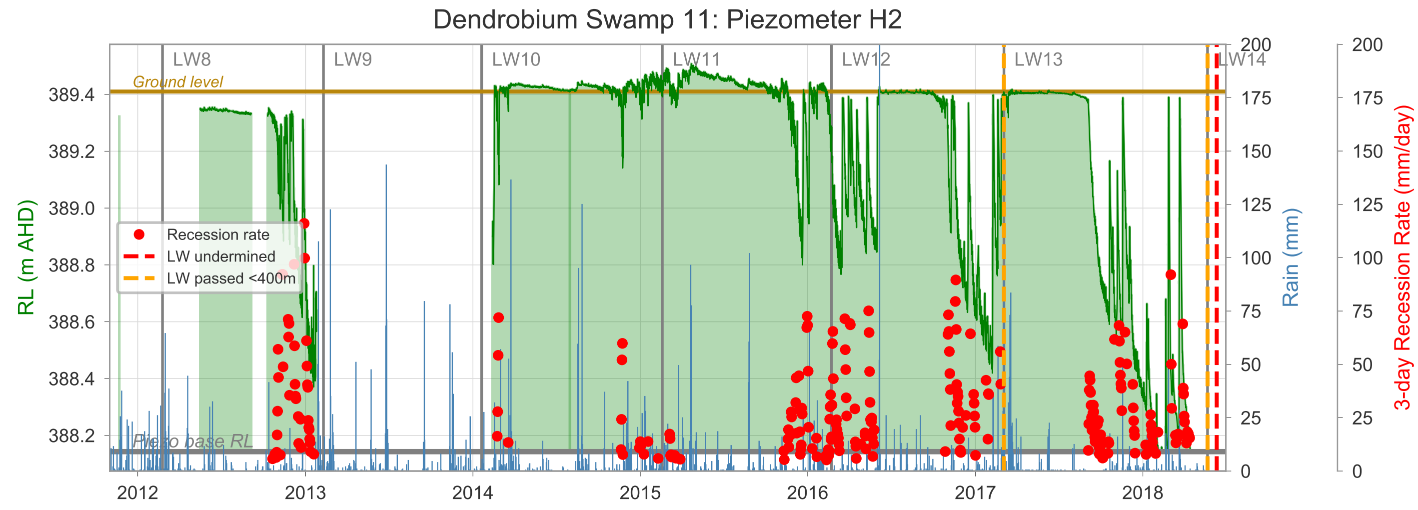

Dendrobium Swamp 08: Piezometer 01
Ground level
LW9
LW10
LW11
LW12
LW13
Piezo base RL
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
2013
2014
2015
2016
2017
2018

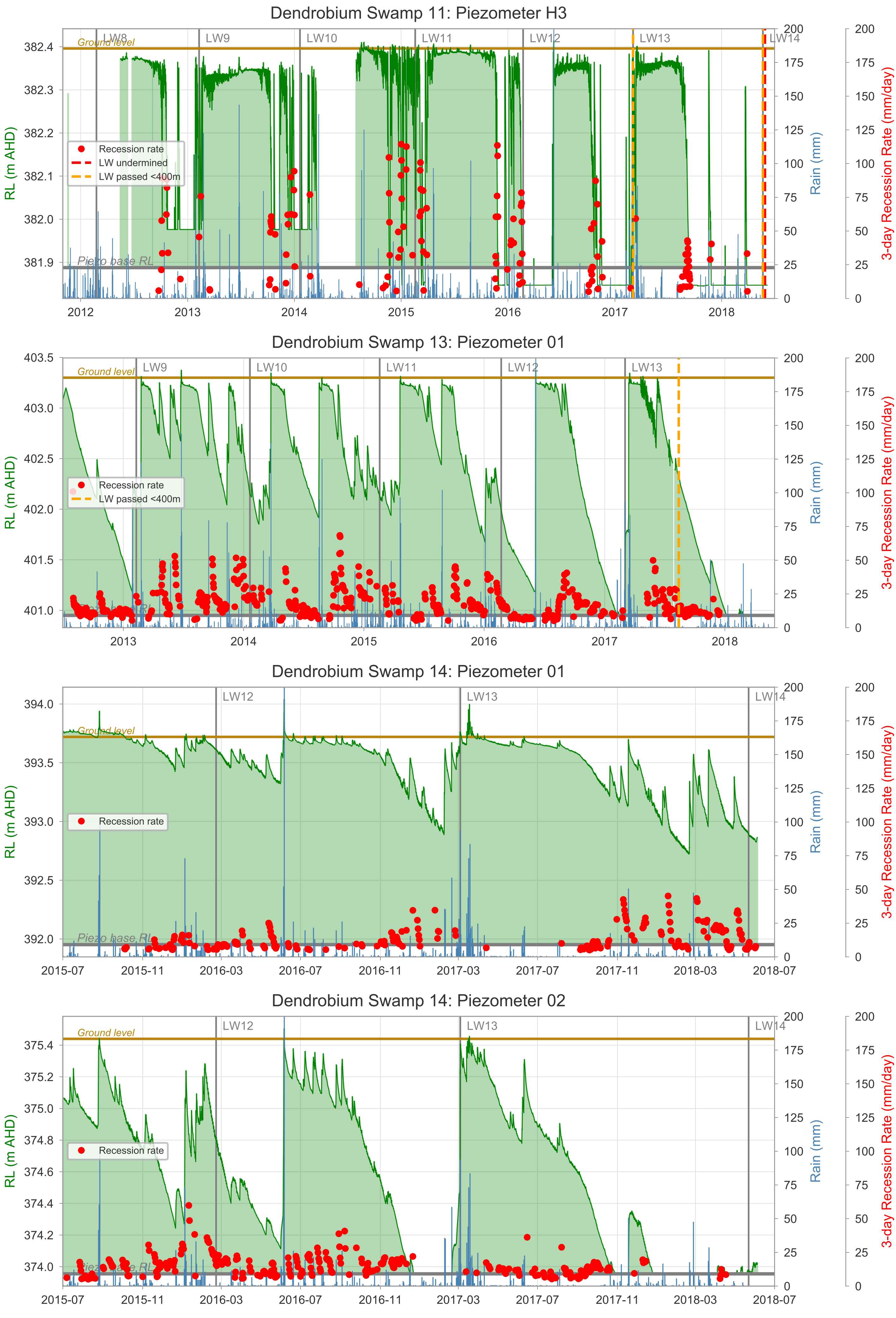

Dendrobium Swamp 08: Piezometer 02
Ground level
LW9
LW10
LW11
LW12
LW13
Recession rate
LW passed <400m
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
2013
2014
2015
2016
2017
2018

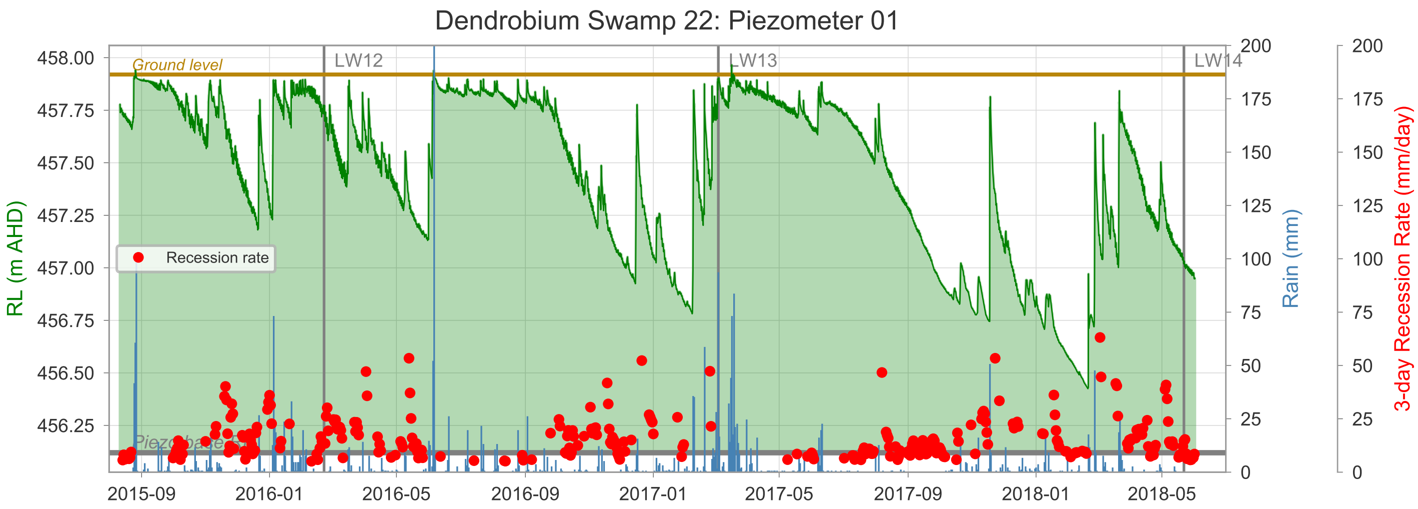

Dendrobium Swamp 08: Piezometer 04
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
LW9
LW10
LW11
LW12
LW13
Ground level
Piezo base RL
Recession rate
LW undermined
LW passed <400m
2013
2014
2015
2016
2017
2018

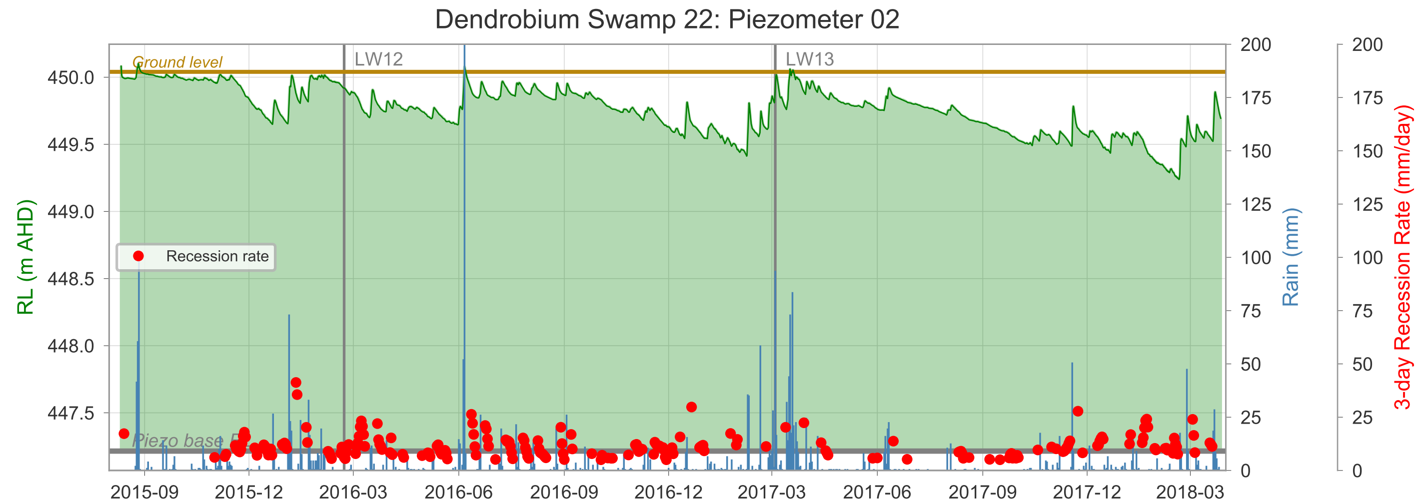

Dendrobium Swamp 10: Piezometer 01
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
LW9
LW10
LW11
LW12
LW13
Ground level
Piezo base RL
Recession rate
LW undermined
LW passed <400m
2013
2014
2015
2016
2017
2018

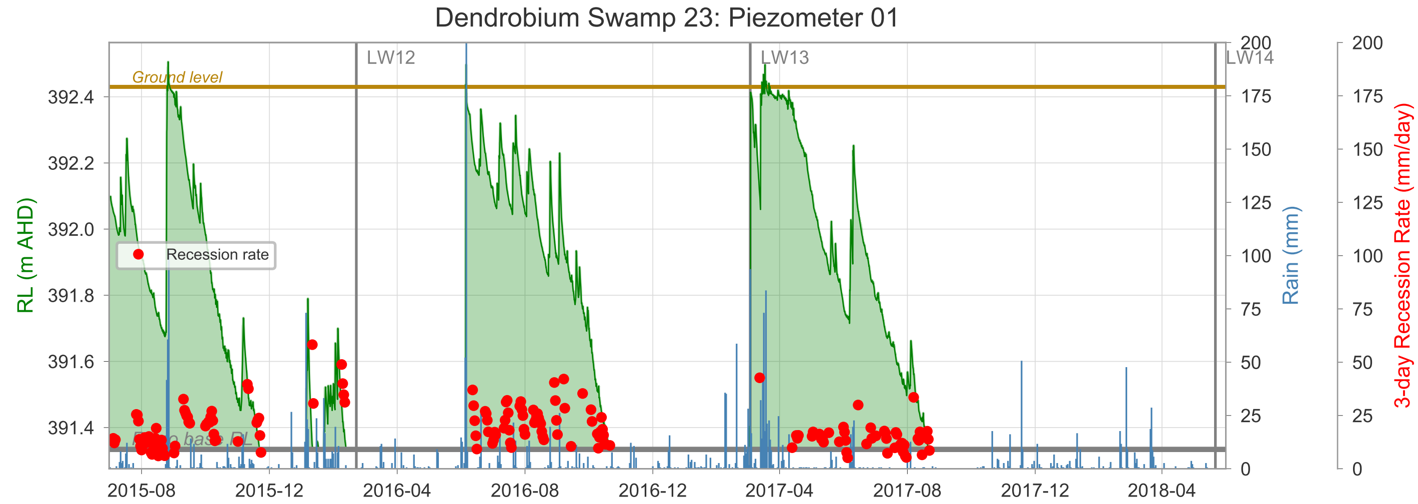

Dendrobium Swamp 11: Piezometer H1
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
Ground level
Piezo base RL
Recession rate
LW passed <400m
2012
2013
2014
2015
2016
2017
2018

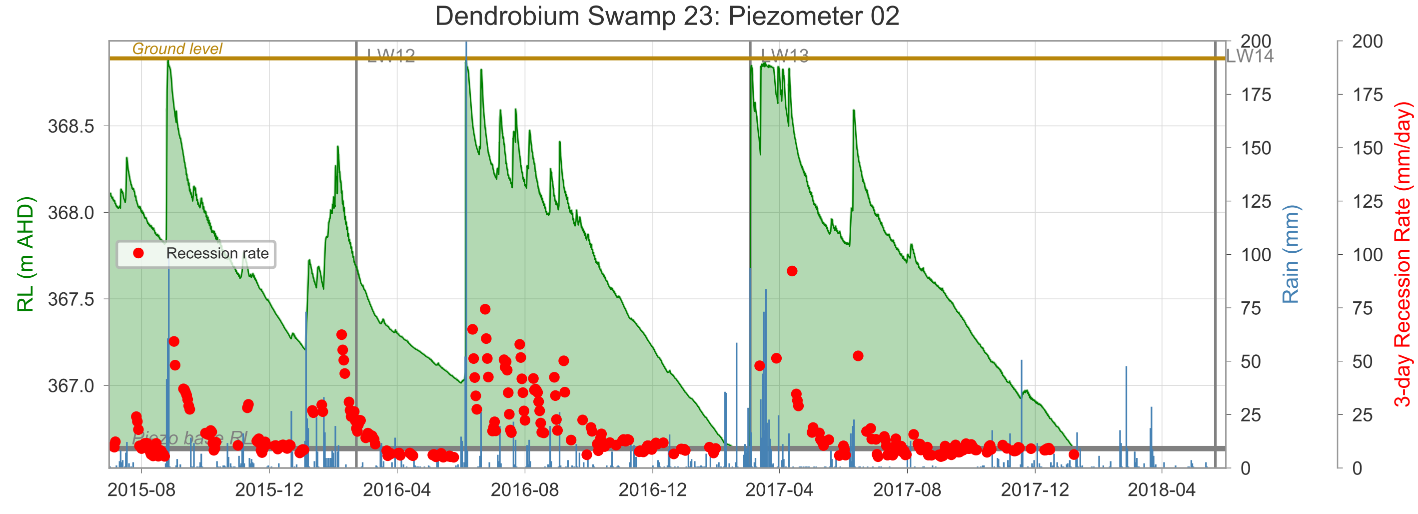

Dendrobium Swamp 11: Piezometer H2
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
Ground level
Piezo base RL
Recession rate
LW undermined
LW passed <400m
2012
2013
2014
2015
2016
2017
2018

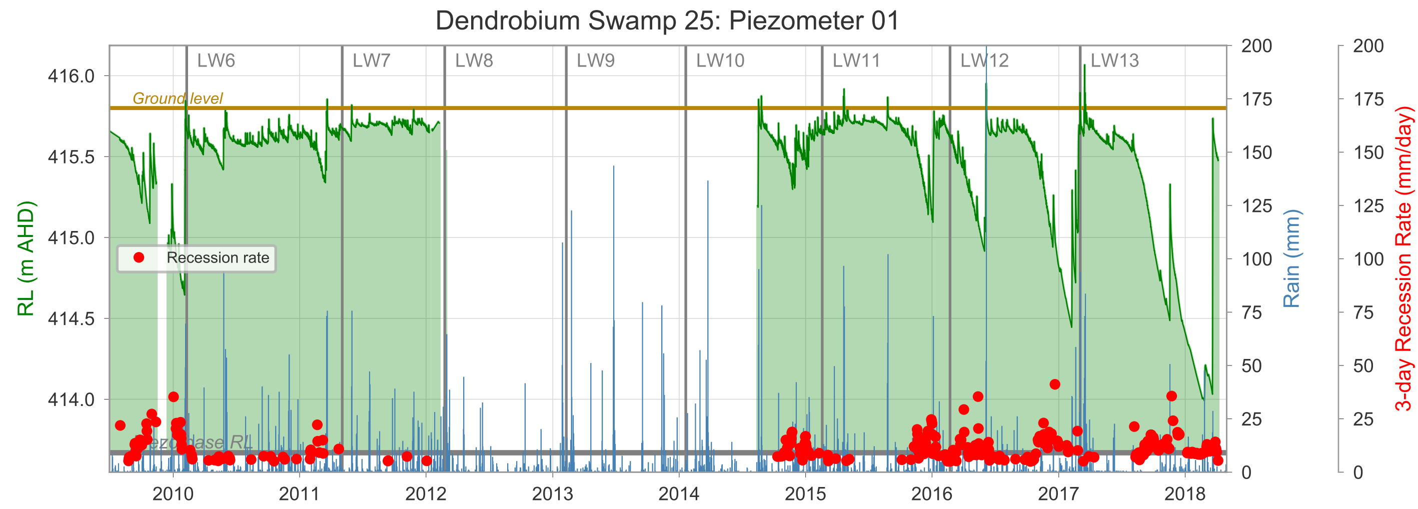

Dendrobium Swamp 11: Piezometer H3
Ground level
Piezo base RL
Recession rate
LW undermined
LW passed <400m
LW8
LW9
LW10
LW11
LW12
LW13
LW14
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
Dendrobium Swamp 13: Piezometer 01
Dendrobium Swamp 14: Piezometer 01
Dendrobium Swamp 14: Piezometer 02

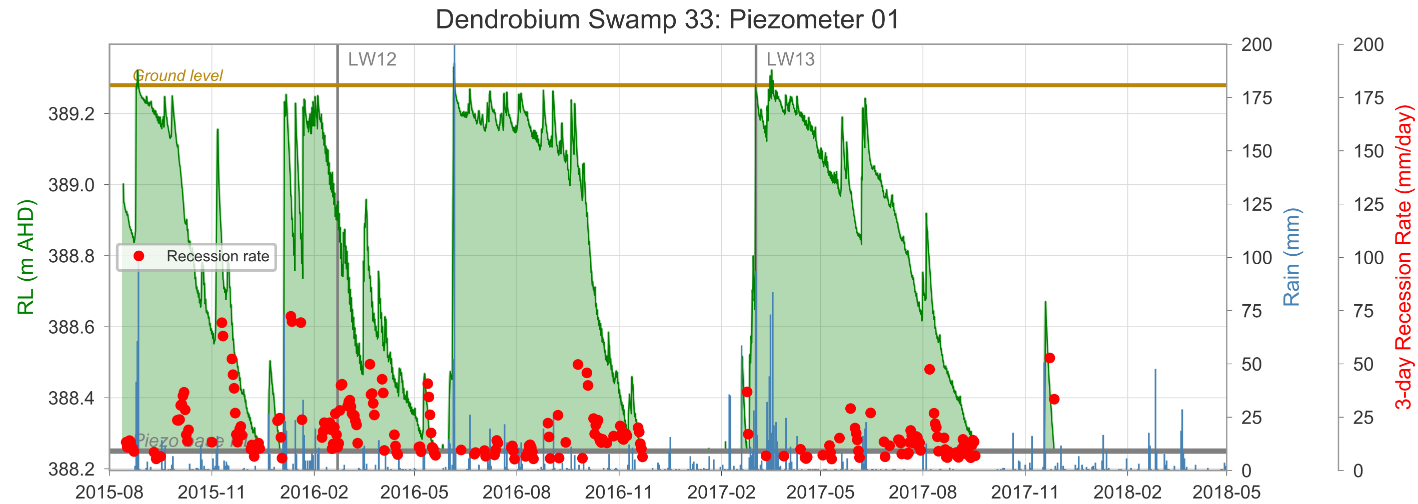

Dendrobium Swamp 22: Piezometer 01
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
Ground level
Recession rate
LW12
LW13
LW14
2015-09
2016-01
2016-05
2016-09
2017-01
2017-05
2017-09
2018-01
2018-05

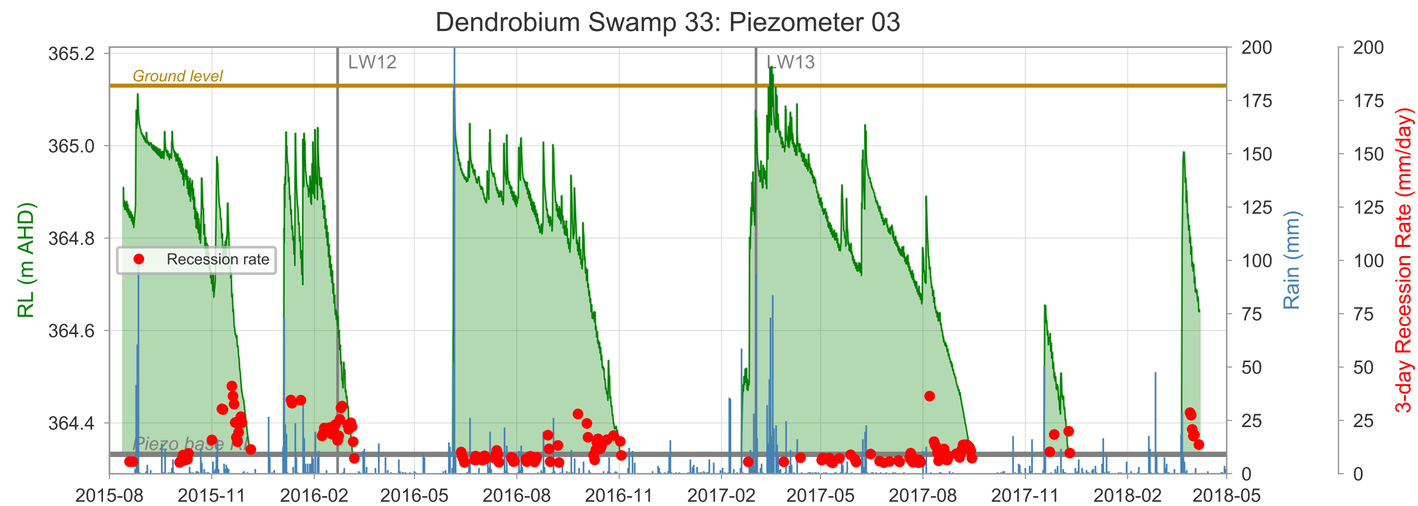

Dendrobium Swamp 22: Piezometer 02
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
Ground level
Piezo base
Recession rate
LW12
LW13
2015-09
2015-12
2016-03
2016-06
2016-09
2016-12
2017-03
2017-06
2017-09
2017-12
2018-03

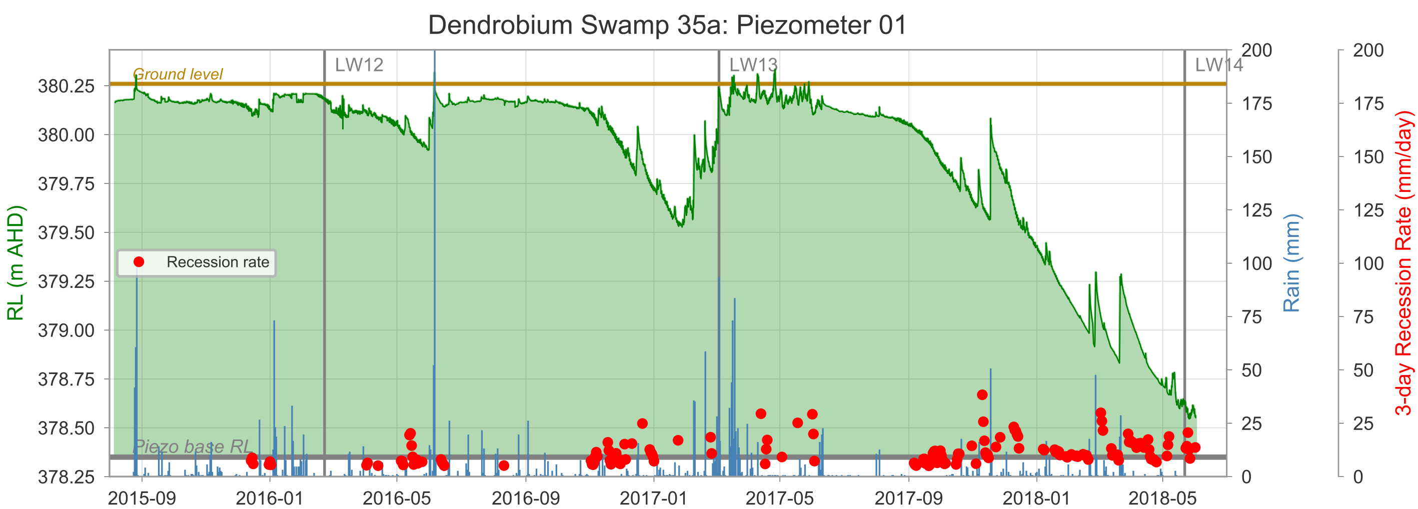

Dendrobium Swamp 23: Piezometer 01
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
Ground level
Recession rate
LW12
LW13
LW14
2015-08
2015-12
2016-04
2016-08
2016-12
2017-04
2017-08
2017-12
2018-04

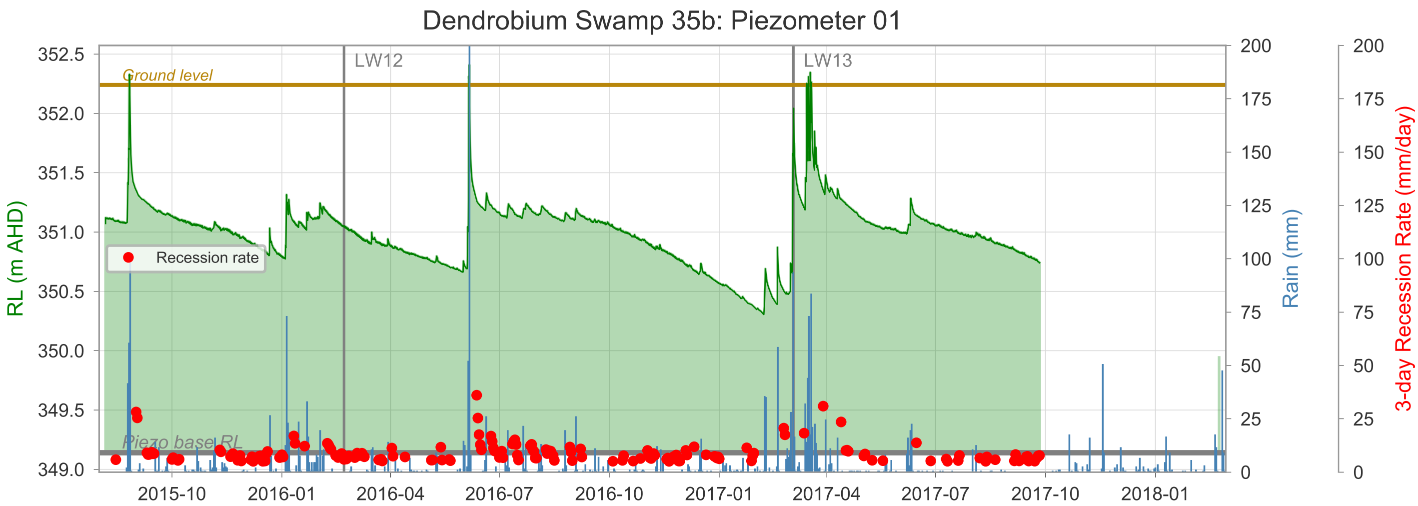

Dendrobium Swamp 23: Piezometer 02
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
Ground level
Recession rate
LW12
LW13
LW14
2015-08
2015-12
2016-04
2016-08
2016-12
2017-04
2017-08
2017-12
2018-04

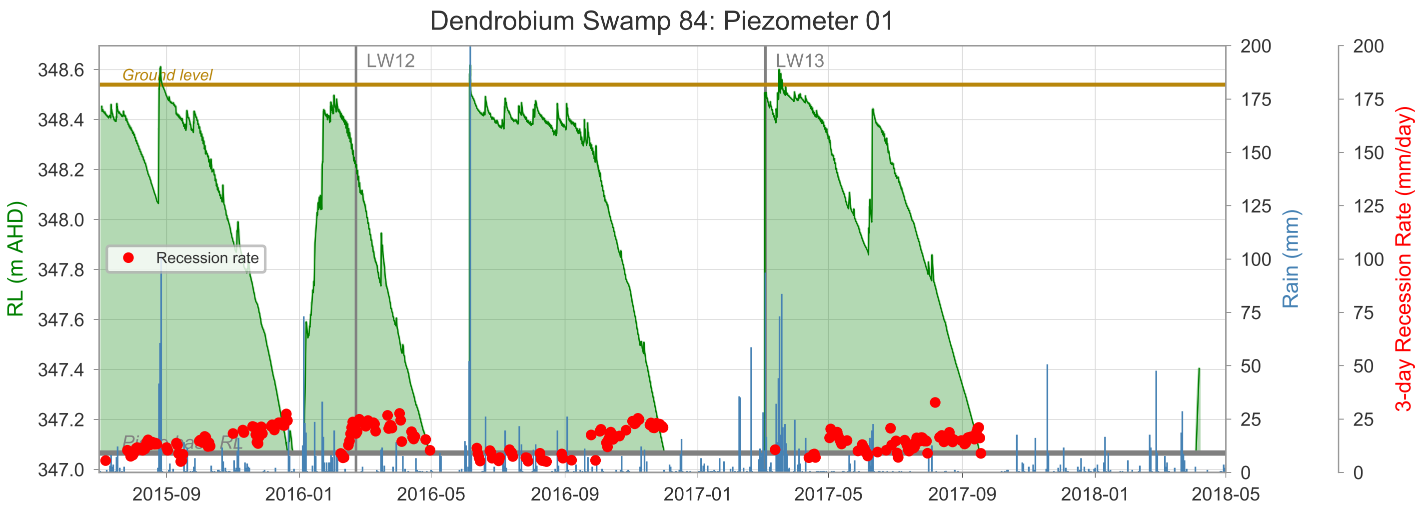

Dendrobium Swamp 25: Piezometer 01
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
Ground level
Recession rate
Piezo base RL
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
2010
2011
2012
2013
2014
2015
2016
2017
2018

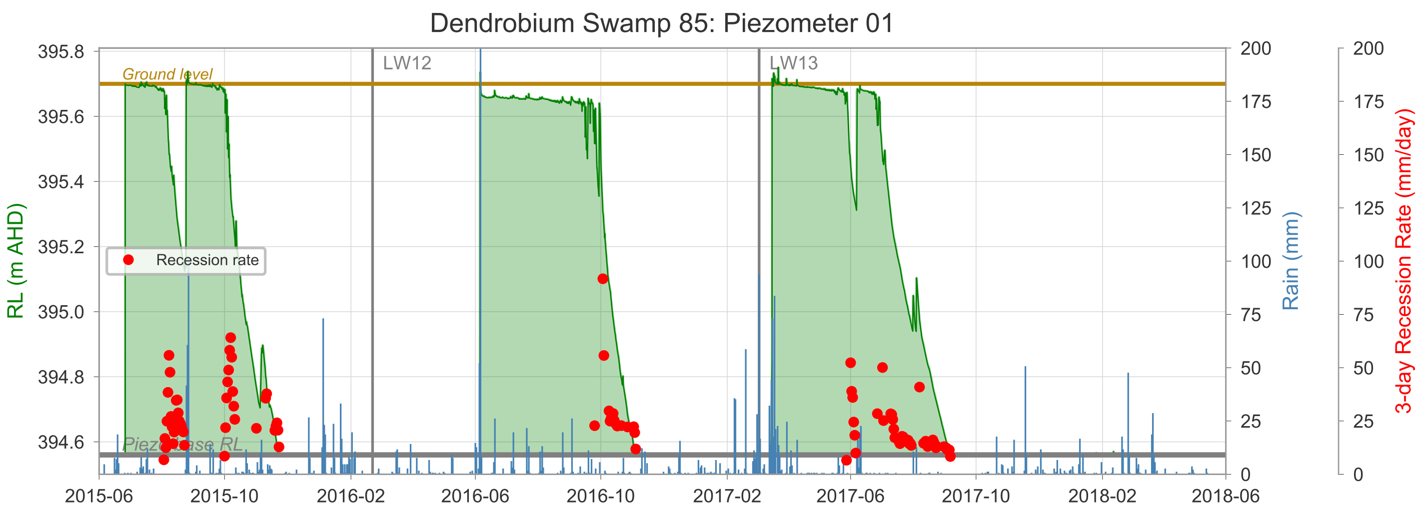

Dendrobium Swamp 33: Piezometer 01
LW12
LW13
Ground level
Recession rate
Piezo base RL
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
2015-08
2015-11
2016-02
2016-05
2016-08
2016-11
2017-02
2017-05
2017-08
2017-11
2018-02
2018-05

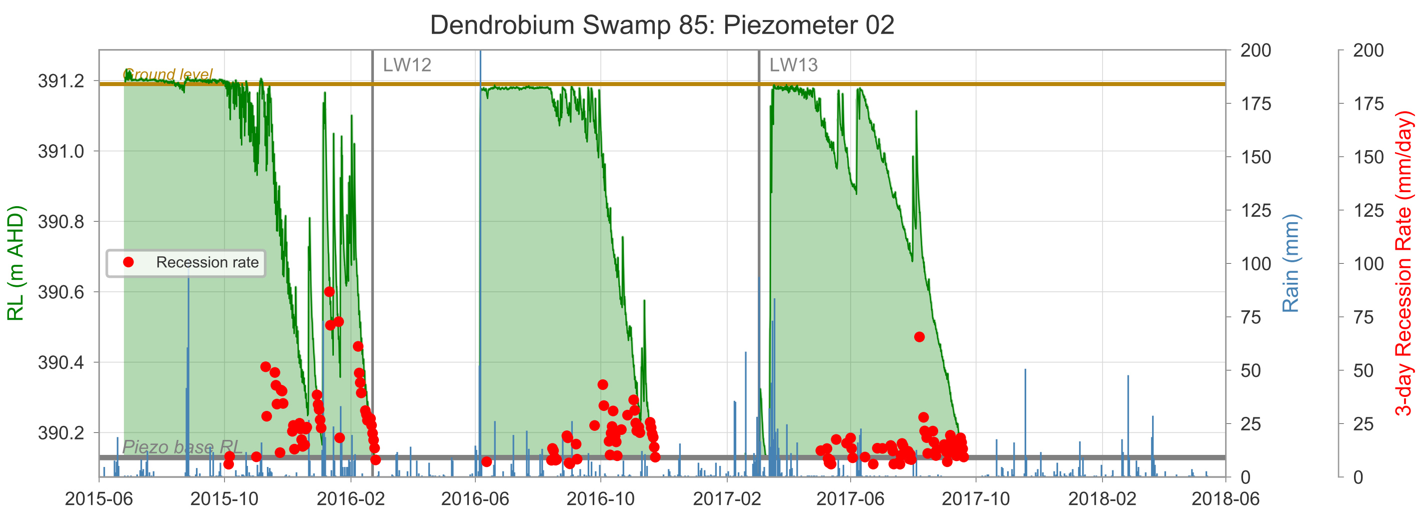

Dendrobium Swamp 33: Piezometer 03
LW12
LW13
Ground level
Recession rate
Piezo base RL
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
2015-08
2015-11
2016-02
2016-05
2016-08
2016-11
2017-02
2017-05
2017-08
2017-11
2018-02
2018-05

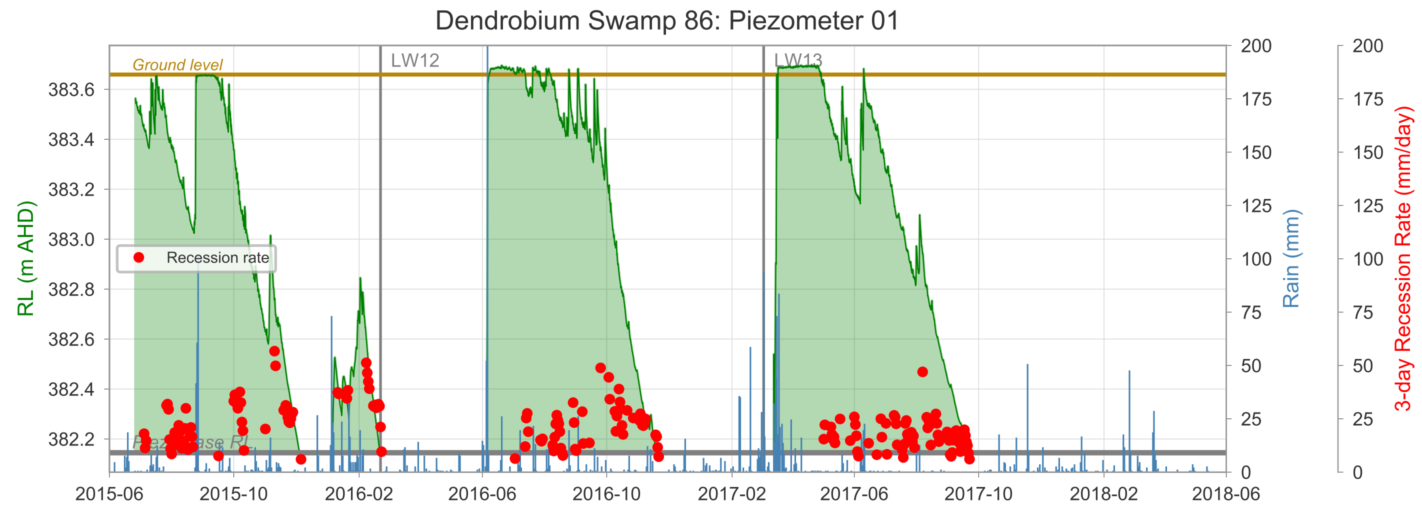

Dendrobium Swamp 35a: Piezometer 01
LW12
LW13
LW14
Ground level
Recession rate
Piezo base RL
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
2015-09
2016-01
2016-05
2016-09
2017-01
2017-05
2017-09
2018-01
2018-05

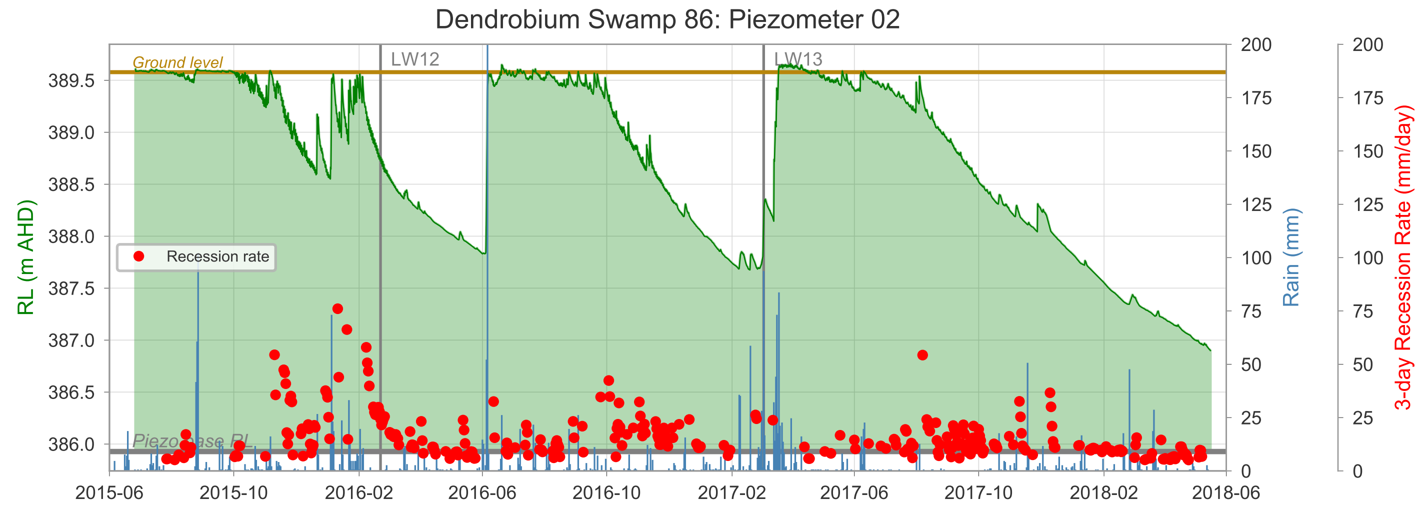

Dendrobium Swamp 35b: Piezometer 01
LW12
LW13
Ground level
Recession rate
Piezo base RL
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
352.5
352.0
351.5
351.0
350.5
350.0
349.5
349.0
200
175
150
125
100
75
50
25
0
2015-10
2016-01
2016-04
2016-07
2016-10
2017-01
2017-04
2017-07
2017-10
2018-01

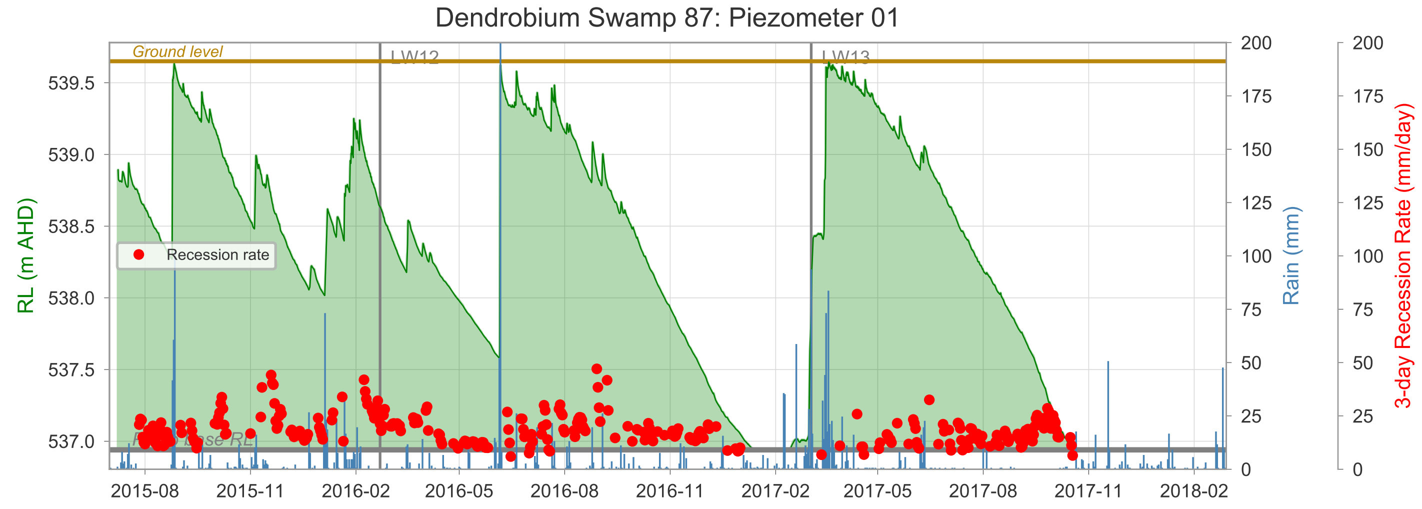

Dendrobium Swamp 84: Piezometer 01
LW12
LW13
Ground level
Recession rate
Piezo base RL
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
348.6
348.4
348.2
348.0
347.8
347.6
347.4
347.2
347.0
200
175
150
125
100
75
50
25
0
2015-09
2016-01
2016-05
2016-09
2017-01
2017-05
2017-09
2018-01
2018-05

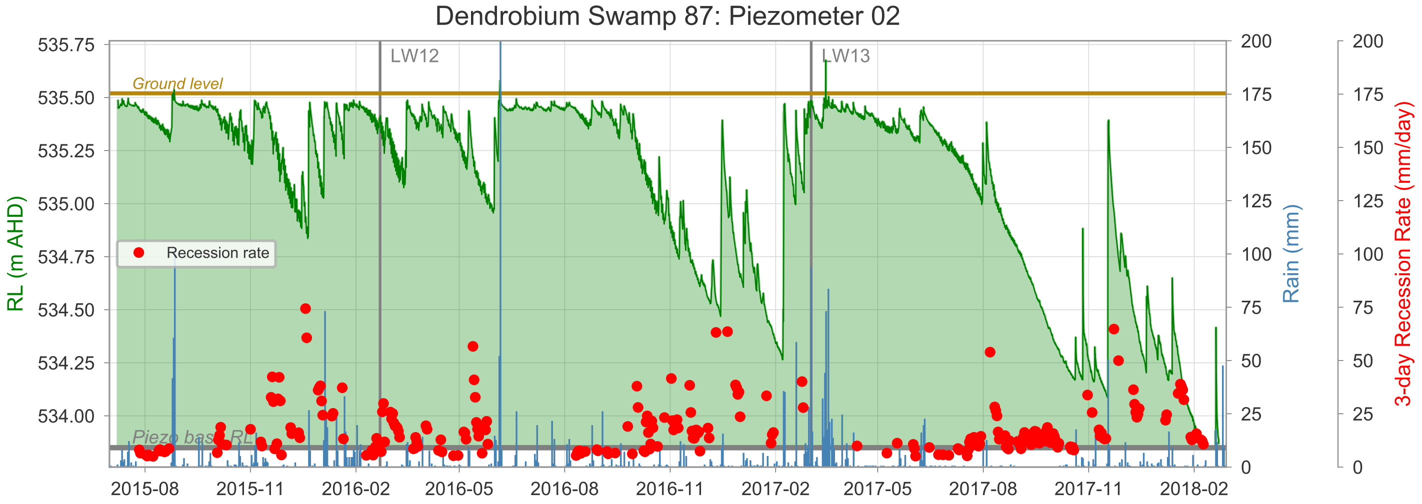

Dendrobium Swamp 85: Piezometer 01
LW12
LW13
Ground level
Recession rate
Piezo base RL
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
395.8
395.6
395.4
395.2
395.0
394.8
394.6
200
175
150
125
100
75
50
25
0
2015-06
2015-10
2016-02
2016-06
2016-10
2017-02
2017-06
2017-10
2018-02
2018-06

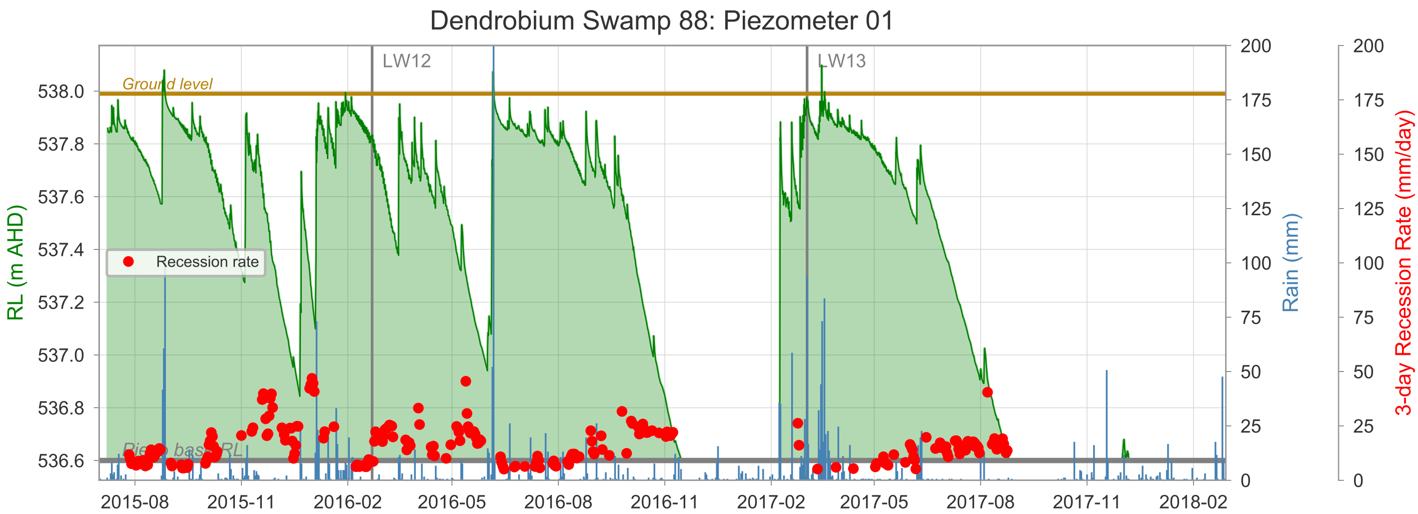

Dendrobium Swamp 85: Piezometer 02
LW12
LW13
Ground level
Recession rate
Piezo base RL
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
391.2
391.0
390.8
390.6
390.4
390.2
200
175
150
125
100
75
50
25
0
2015-06
2015-10
2016-02
2016-06
2016-10
2017-02
2017-06
2017-10
2018-02
2018-06

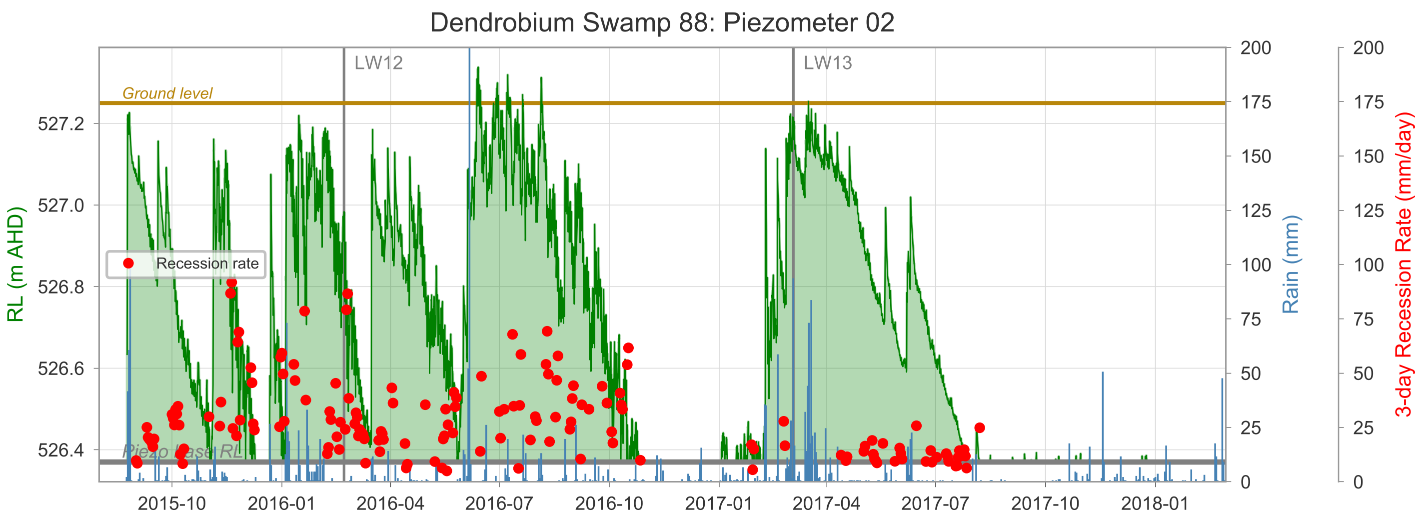

Dendrobium Swamp 86: Piezometer 01
Ground level
LW12
LW13
Recession rate
Piezo base RL
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
383.6
383.4
383.2
383.0
382.8
382.6
382.4
382.2
200
175
150
125
100
75
50
25
0
2015-06
2015-10
2016-02
2016-06
2016-10
2017-02
2017-06
2017-10
2018-02
2018-06


Dendrobium Swamp 86: Piezometer 02
Ground level
LW12
LW13
Recession rate
Piezo base RL
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
389.5
389.0
388.5
388.0
387.5
387.0
386.5
386.0
200
175
150
125
100
75
50
25
0
2015-06
2015-10
2016-02
2016-06
2016-10
2017-02
2017-06
2017-10
2018-02
2018-06


Dendrobium Swamp 87: Piezometer 01
Ground level
LW12
LW13
Recession rate
Piezo base RL
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
539.5
539.0
538.5
538.0
537.5
537.0
200
175
150
125
100
75
50
25
0
2015-08
2015-11
2016-02
2016-05
2016-08
2016-11
2017-02
2017-05
2017-08
2017-11
2018-02

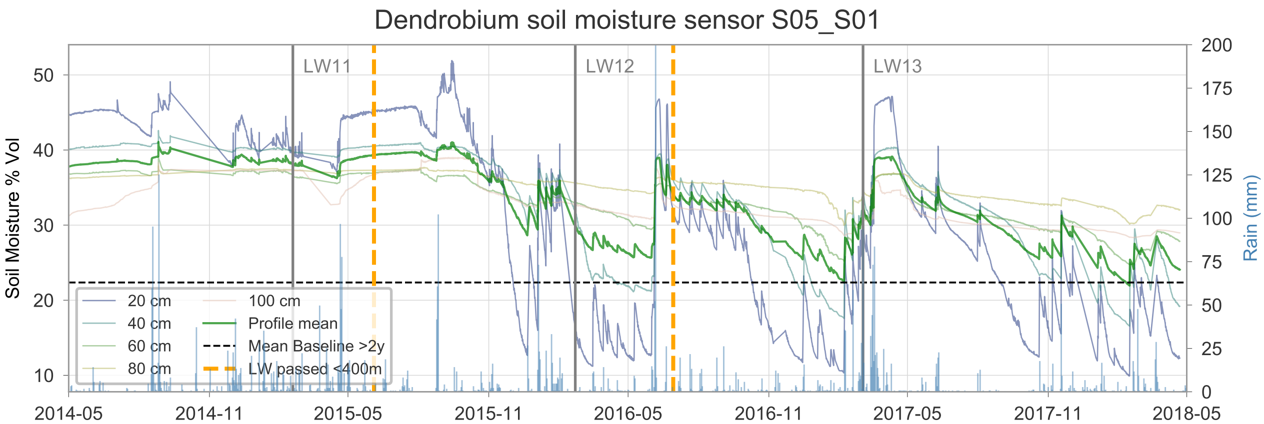

Dendrobium Swamp 87: Piezometer 02
Ground level
LW12
LW13
Recession rate
Piezo base RL
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
535.75
535.50
535.25
535.00
534.75
534.50
534.25
534.00
200
175
150
125
100
75
50
25
0
2015-08
2015-11
2016-02
2016-05
2016-08
2016-11
2017-02
2017-05
2017-08
2017-11
2018-02

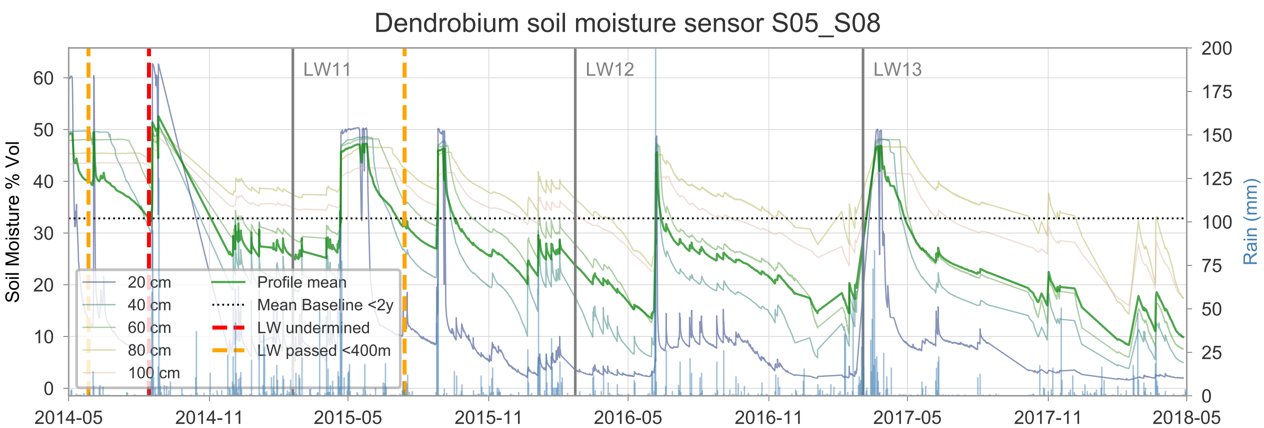

Dendrobium Swamp 88: Piezometer 01
LW12
LW13
Ground level
Piezo base RL
Recession rate
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
538.0
537.8
537.6
537.4
537.2
537.0
536.8
536.6
200
175
150
125
100
75
50
25
0
2015-08
2015-11
2016-02
2016-05
2016-08
2016-11
2017-02
2017-05
2017-08
2017-11
2018-02

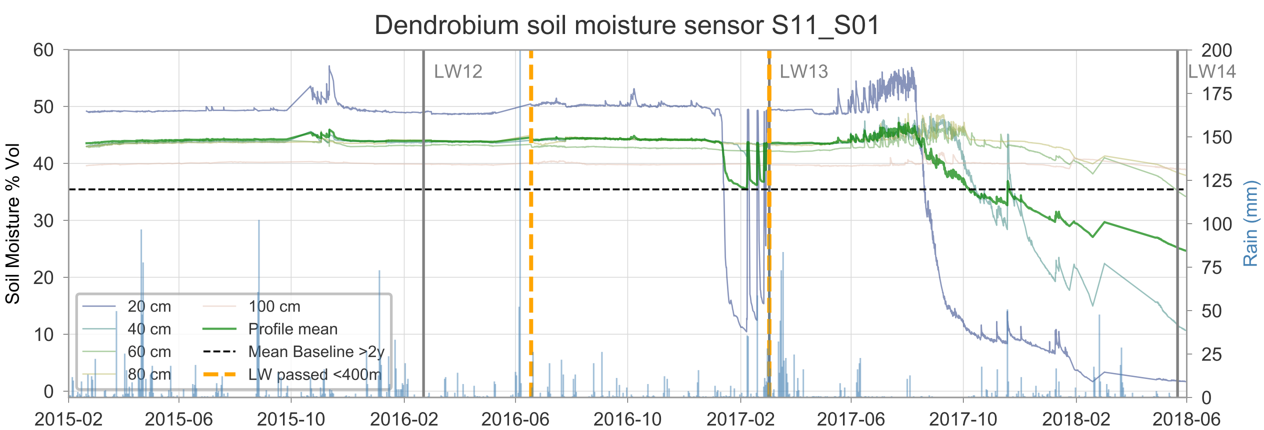

Dendrobium Swamp 88: Piezometer 02
LW12
LW13
Ground level
Piezo base RL
Recession rate
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
527.2
527.0
526.8
526.6
526.4
200
175
150
125
100
75
50
25
0
2015-10
2016-01
2016-04
2016-07
2016-10
2017-01
2017-04
2017-07
2017-10
2018-01

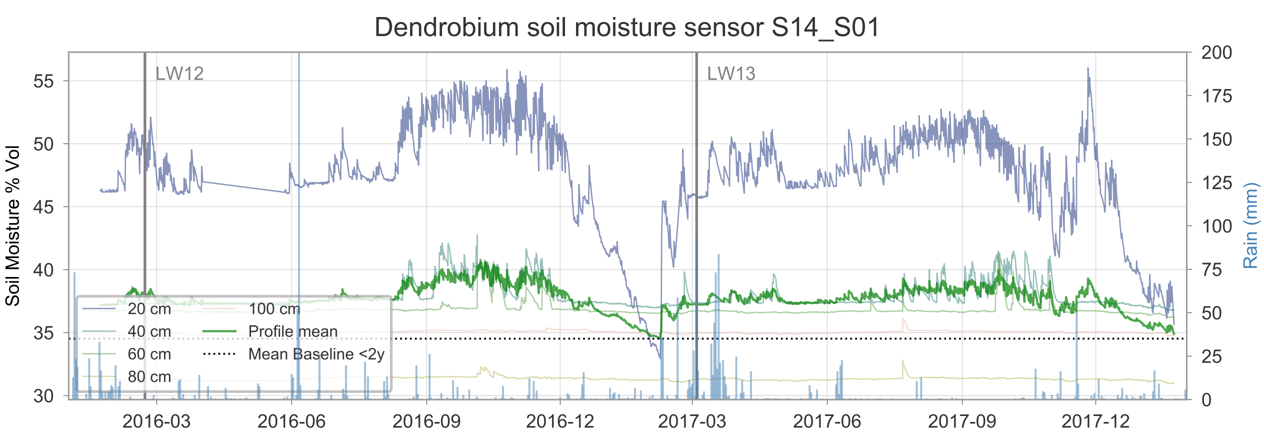
Appendix D

Soil moisture hydrographs

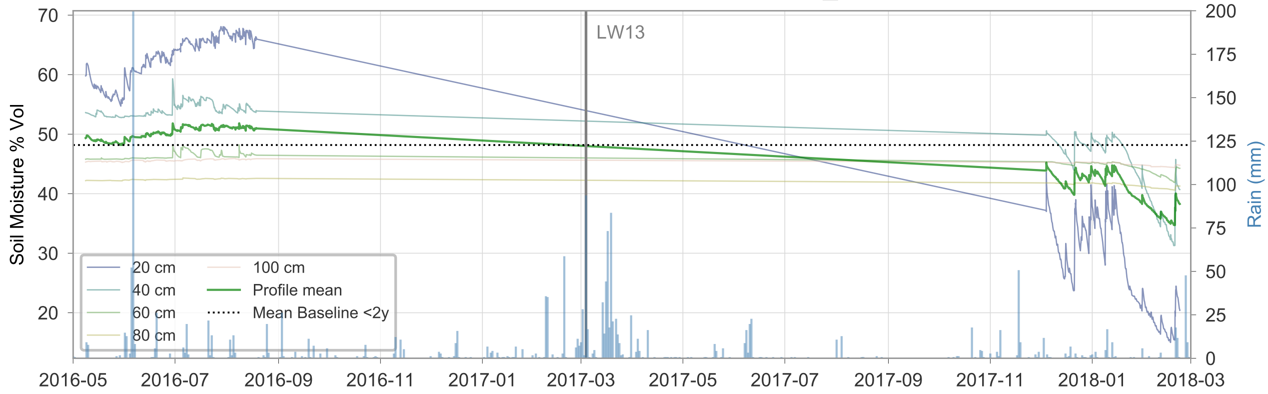

Dendrobium soil moisture sensor S05_S01
Soil Moisture % Vol
Rain (mm)
LW11
LW12
LW13
20 cm
40 cm
60 cm
80 cm
100 cm
Profile mean
Mean Baseline >2y
LW passed <400m
2014-05
2014-11
2015-05
2015-11
2016-05
2016-11
2017-05
2017-11
2018-05


Dendrobium soil moisture sensor S05_S08
Soil Moisture % Vol
Rain (mm)
LW11
LW12
LW13
20 cm
40 cm
60 cm
80 cm
100 cm
Profile mean
Mean Baseline <2y
LW undermined
LW passed <400m
2014-05
2014-11
2015-05
2015-11
2016-05
2016-11
2017-05
2017-11
2018-05

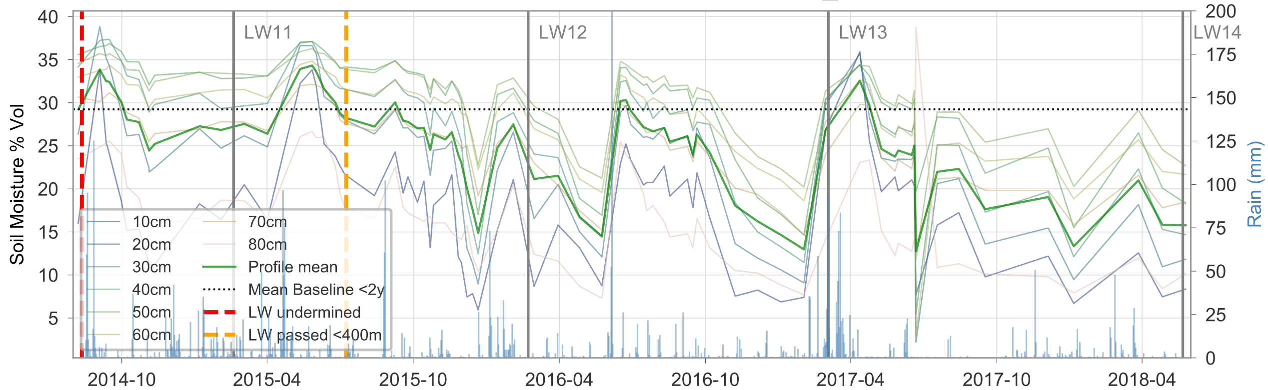

Dendrobium soil moisture sensor S11_S01
Soil Moisture % Vol
Rain (mm)
LW12
LW13
LW14
20 cm
40 cm
60 cm
80 cm
100 cm
Profile mean
Mean Baseline >2y
LW passed <400m
2015-02
2015-06
2015-10
2016-02
2016-06
2016-10
2017-02
2017-06
2017-10
2018-02
2018-06


Dendrobium soil moisture sensor S14_S01
Soil Moisture % Vol
Rain (mm)
LW12
LW13
20 cm
40 cm
60 cm
80 cm
100 cm
Profile mean
Mean Baseline <2y
2016-03
2016-06
2016-09
2016-12
2017-03
2017-06
2017-09
2017-12

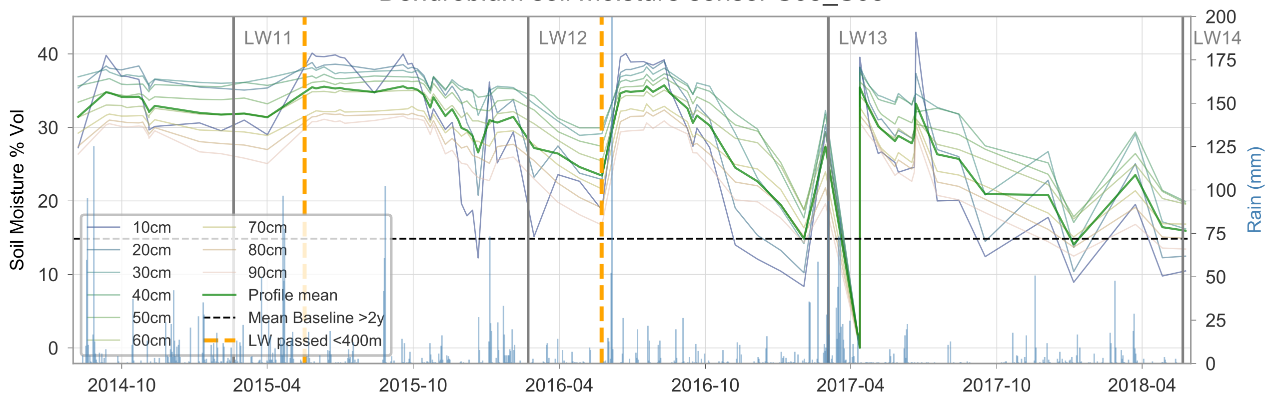
Dendrobium soil moisture sensor S87_S02



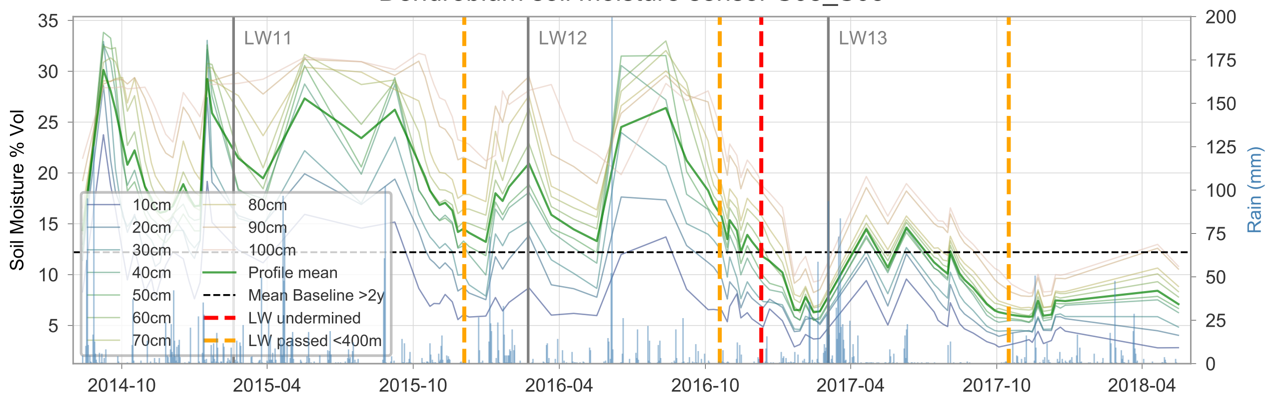
Dendrobium soil moisture sensor S05_S02



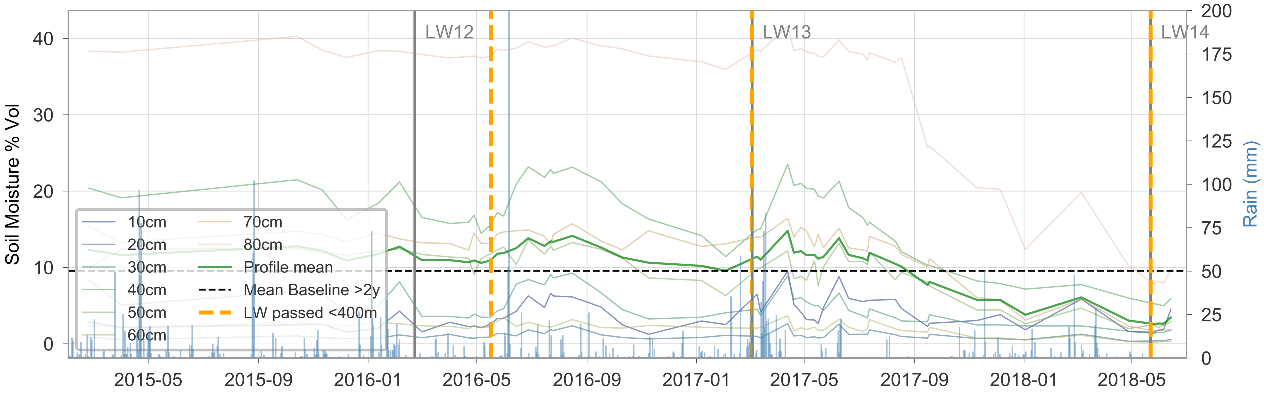
Dendrobium soil moisture sensor S05_S05



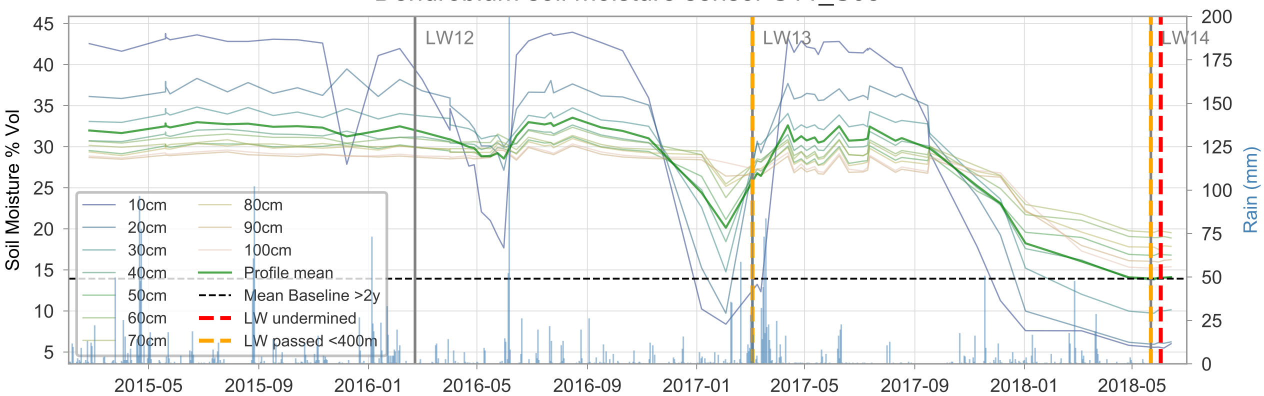
Dendrobium soil moisture sensor S08_S05



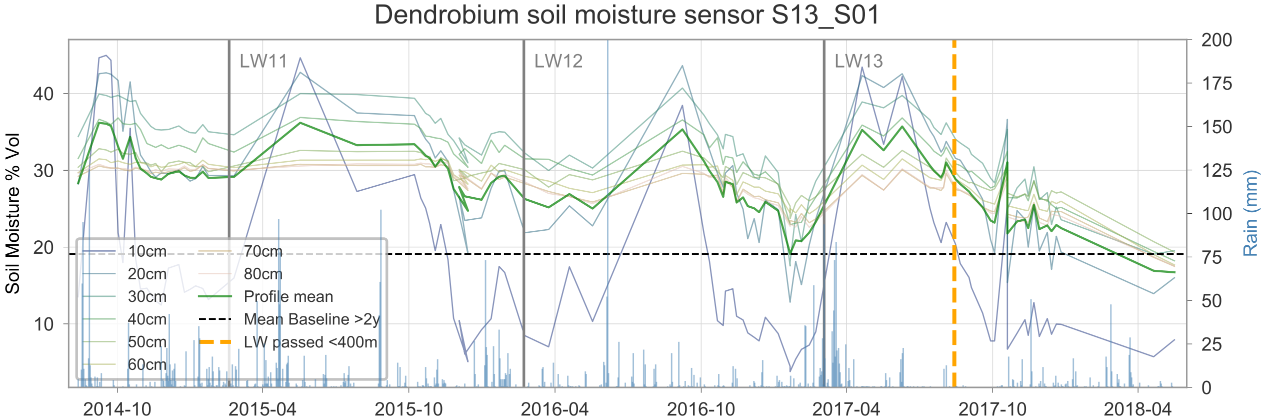
Dendrobium soil moisture sensor S11_S02



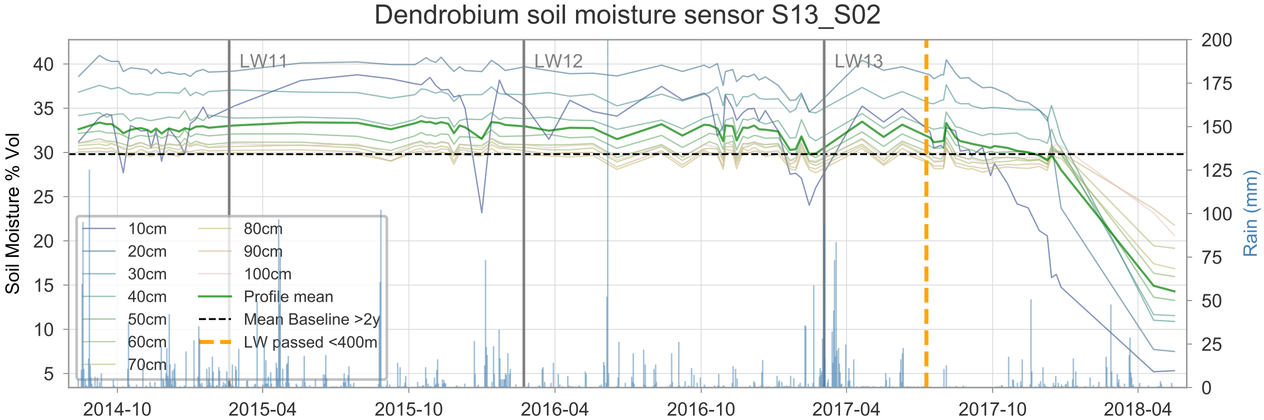
Dendrobium soil moisture sensor S11_S05



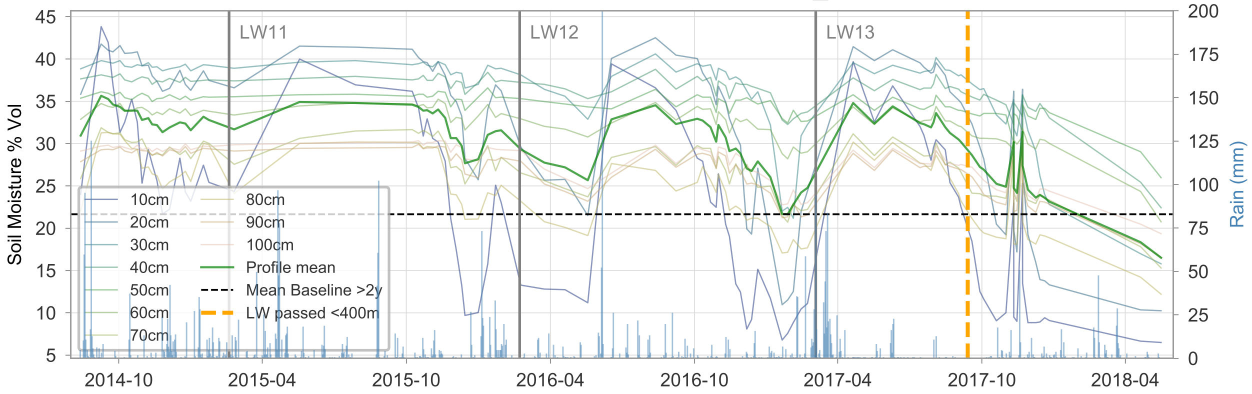
Dendrobium soil moisture sensor S13_S01



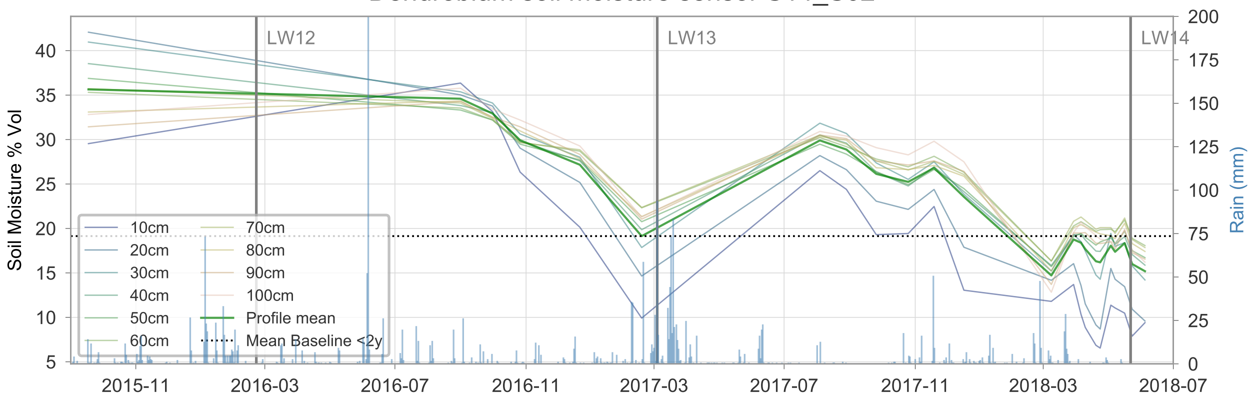
Dendrobium soil moisture sensor S13_S02



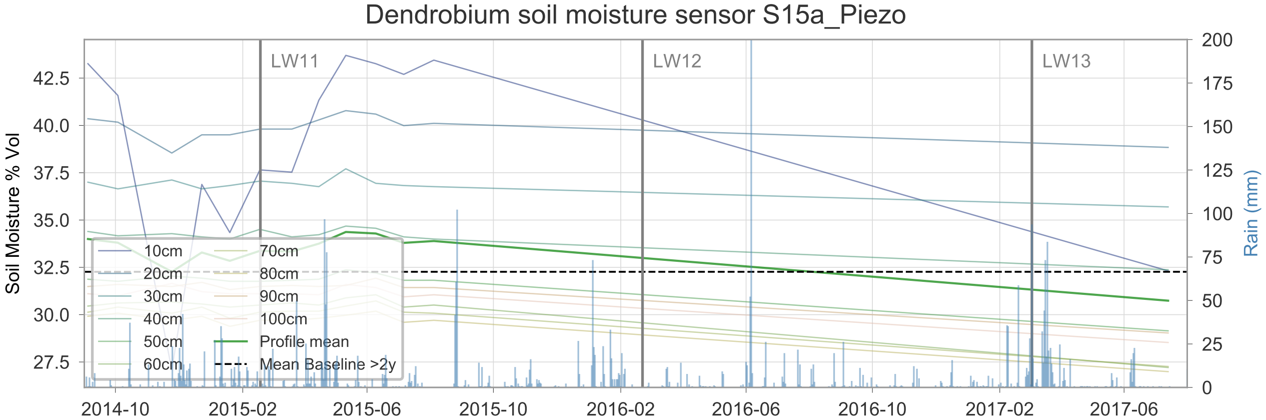
Dendrobium soil moisture sensor S13_S03



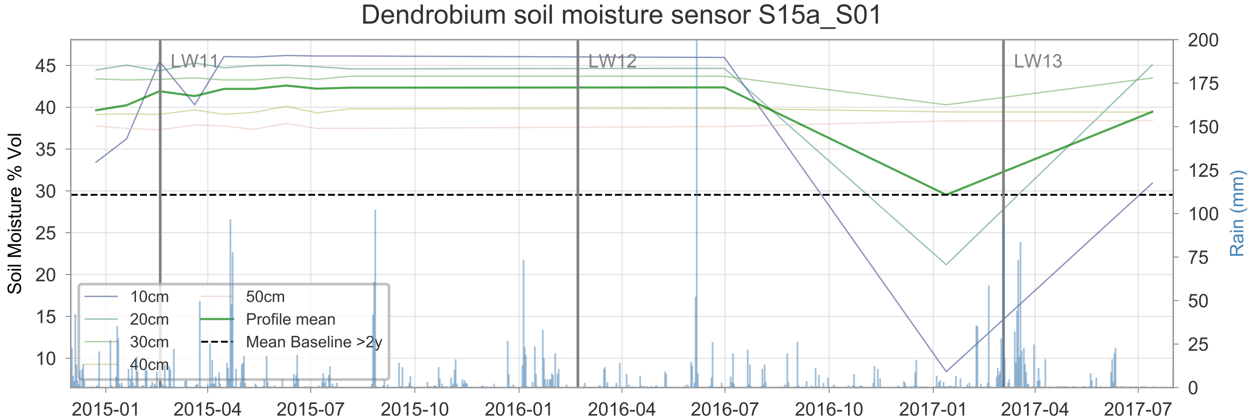
Dendrobium soil moisture sensor S14_S02

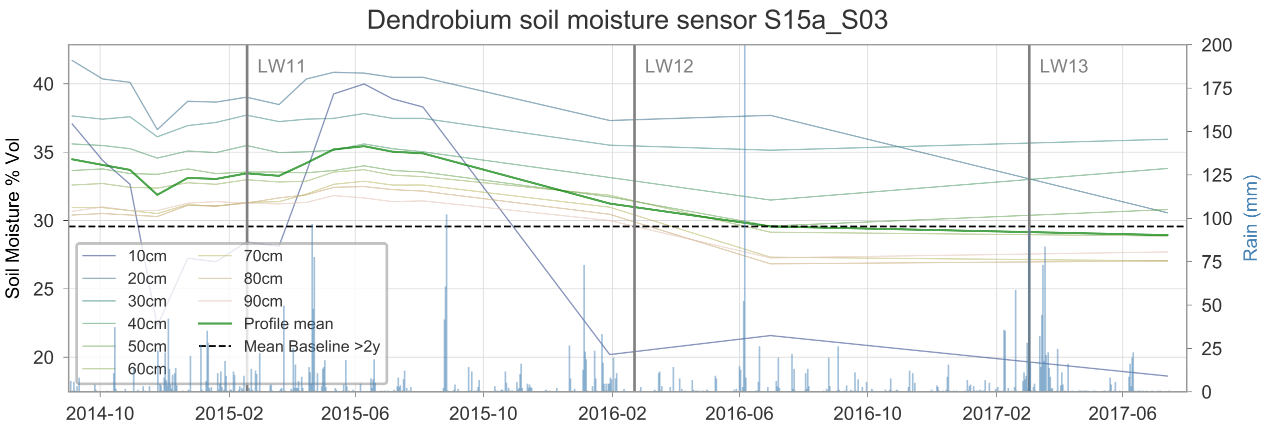


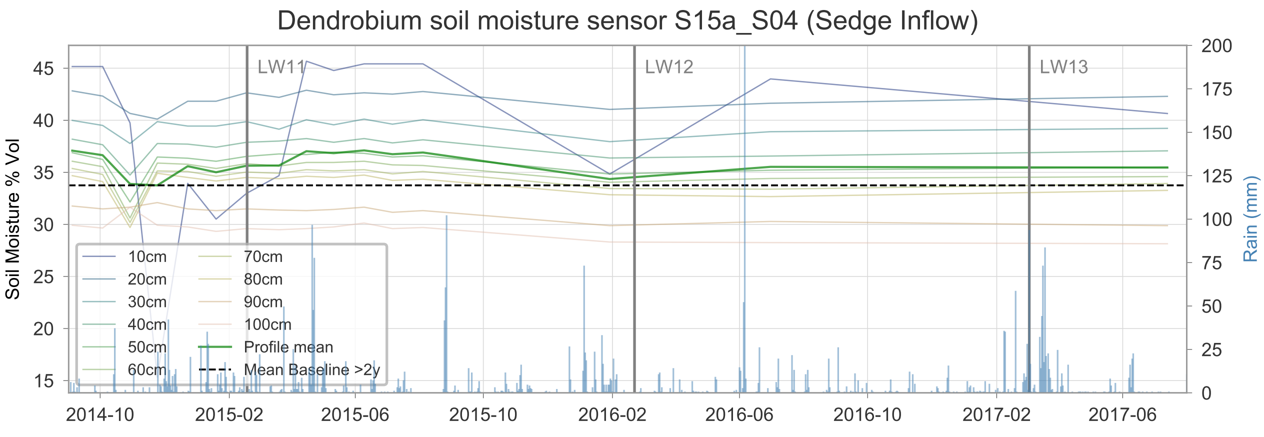
Dendrobium soil moisture sensor S15a_Piezo

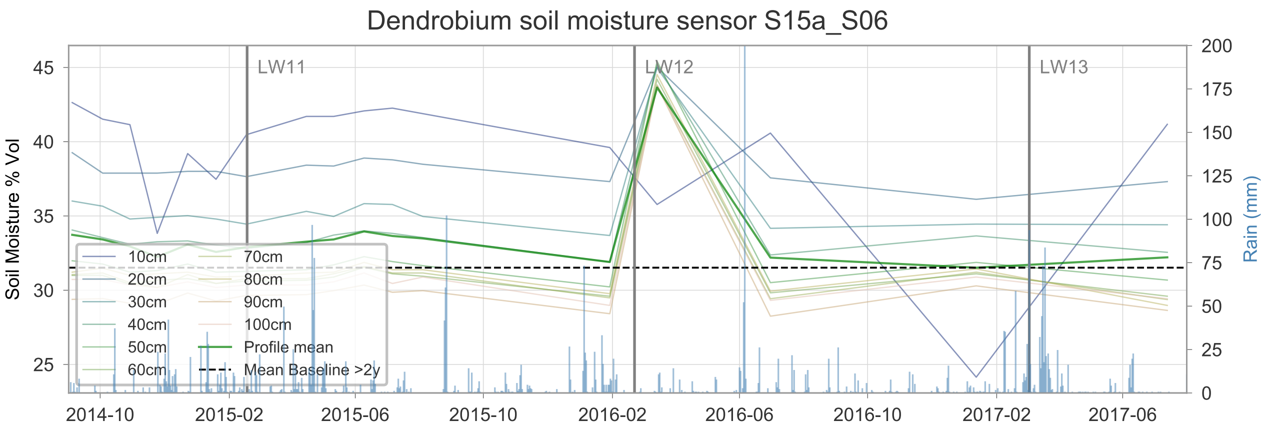


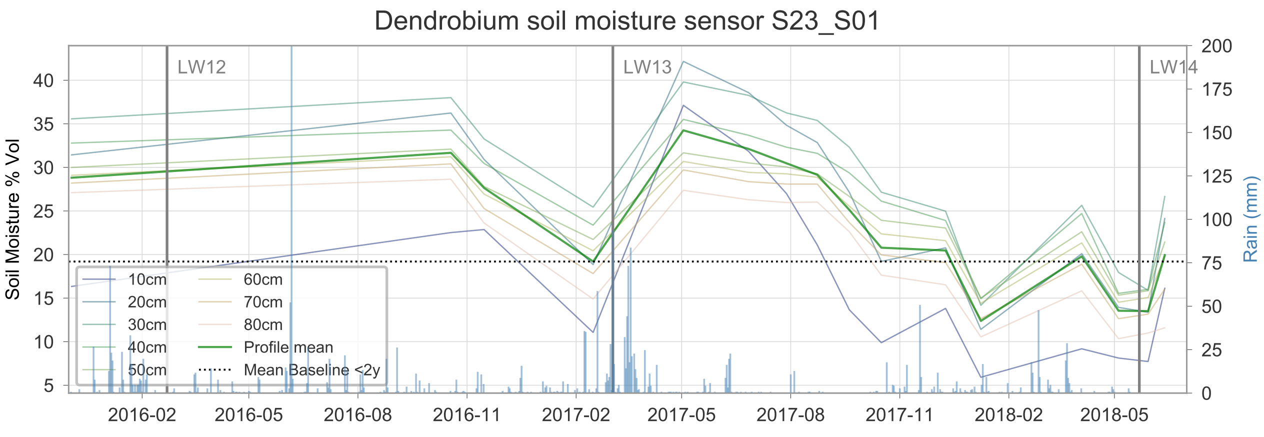
Dendrobium soil moisture sensor S15a_S01

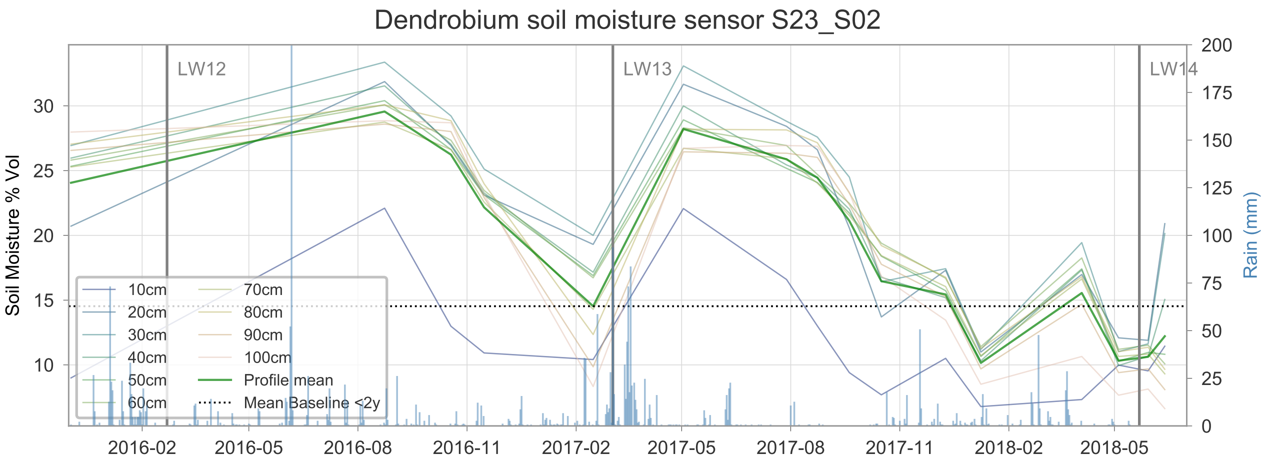



Dendrobium soil moisture sensor S15a_S03
LW11
LW12
LW13
Soil Moisture % Vol
Rain (mm)
10cm
20cm
30cm
40cm
50cm
60cm
70cm
80cm
90cm
Profile mean
Mean Baseline >2y
2014-10
2015-02
2015-06
2015-10
2016-02
2016-06
2016-10
2017-02
2017-06


Dendrobium soil moisture sensor S15a_S04 (Sedge Inflow)
LW11
LW12
LW13
Soil Moisture % Vol
Rain (mm)
10cm
20cm
30cm
40cm
50cm
60cm
70cm
80cm
90cm
100cm
Profile mean
Mean Baseline >2y
2014-10
2015-02
2015-06
2015-10
2016-02
2016-06
2016-10
2017-02
2017-06


Dendrobium soil moisture sensor S15a_S06
LW11
LW12
LW13
Soil Moisture % Vol
Rain (mm)
10cm
20cm
30cm
40cm
50cm
60cm
70cm
80cm
90cm
100cm
Profile mean
Mean Baseline >2y
2014-10
2015-02
2015-06
2015-10
2016-02
2016-06
2016-10
2017-02
2017-06


Dendrobium soil moisture sensor S23_S01
LW12
LW13
LW14
Soil Moisture % Vol
Rain (mm)
10cm
20cm
30cm
40cm
50cm
60cm
70cm
80cm
Profile mean
Mean Baseline <2y
2016-02
2016-05
2016-08
2016-11
2017-02
2017-05
2017-08
2017-11
2018-02
2018-05


Dendrobium soil moisture sensor S23_S02
LW12
LW13
LW14
Soil Moisture % Vol
Rain (mm)
10cm
20cm
30cm
40cm
50cm
60cm
70cm
80cm
90cm
100cm
Profile mean
Mean Baseline <2y
2016-02
2016-05
2016-08
2016-11
2017-02
2017-05
2017-08
2017-11
2018-02
2018-05