South32 - Illawarra Metallurgical Coal

DENDROBIUM MINE

End of Panel Surface Water and Shallow Groundwater Assessment: Longwall 17 (Area 3B)

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Cover photo: Cordeaux River tributary location CR29_S1, looking upstream on 27/10/2016

QUALITY CONTROL

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Approved	Stuart Brown		9/2/2022

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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 17.

Longwall 17 is the ninth panel to be extracted from Dendrobium Area 3B. Extraction of Longwall 17 commenced on 12/12/2020 and was completed on 13/10/2020. Rainfall during 2021 and during Longwall 17 extraction was well above average, totalling 1448 mm. Heavy rainfall was experienced in March, May and November 2021. This follows similarly high rainfall in 2020 (1436 mm), making 2020-21 the wettest two-year period since the start of mining at Dendrobium. As a result, there has been a broad recovery in stream flow, shallow groundwater levels, soil moisture and improvements stream water quality across all catchments since the severe drought of 2017-2019.

The Illawarra Metallurgical Coal Environmental Field Team (IMCEFT) 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) and monitoring and contingency plans contained therein. Trigger Action Response Plans (TARPs) contained in the SMP form the basis of the impact assessments in this report. A total of 41 new (or updated) surface impacts attributed to the extraction of Longwall 17 were recorded, of which 13 were in stream beds within the zone of mining influence.

Surface water quality

At many stream monitoring sites including reference sites, water electrical conductivity (EC) has decreased over the last two years due to higher-than-average rainfall and significant increase in runoff compared with the previous two years. The decreasing trend follows slightly more saline conditions at most locations during the 2017-2019 drought which resulted in low flows and evaporative concentration of salts. Similarly, Dissolved Oxygen (DO) has trended higher over the last two years period due to higher flows and stream turbulence.

Anomalous water quality effects are noted in watercourses that have been directly mined under by previous longwalls (e.g. WC21, SC10C, LA4, DCC). Those effects include transient or persistent increases in EC, increases (or decreases) in pH and increases in dissolved metal concentrations such as Fe, Mn, Al and Zn. Water quality TARPs were triggered at Lake Avon tributary site LA4_S1 for EC and pH. With the exception of Sandy Creek, adverse changes in water quality are not apparent at down-stream monitoring sites on 3rd order watercourses. No adverse changes in water quality are noted in Lake Avon and Lake Cordeaux.

Iron staining in creek beds is commonly associated with watercourses that have been directly mined beneath or are within the mining area of influence. Over the last two years, new or recurrent iron staining has been noted on Wongawilli Creek, WC21, LA5 and SC10C. The observations of iron staining are likely related to recovery of groundwater levels and the reactivation of iron-rich springs near creek channels.

Stream flow

Assessment of stream flow gauging records has identified mining-related effects on the flow regime in tributaries to Donalds Castle Creek (DCS2 and DC13S1 – Level 3), tributaries to Wongawilli Creek (WC21S1 and WC15S1 – Level 2 to 3) as well as in Lake Avon tributary sites - LA4S1 (Level 1 and 3), LA3S1 (Level 3) and LA2S1 (Level 1 and 3). No changes in flow characteristics were detected at WC12S1, which is close to the end of Longwall 16 and over the finishing end of Longwall 17.

No change to catchment flow characteristics was identified at the Wongawilli Creek gauge downstream of Area 3B (WWL). The TARP assessment methods indicate a continuation of modified low-flow characteristics at the downstream gauge of Donalds Castle Creek (DCU), which remains at TARP Level 1. Reductions in median flow (Q50) at sites upstream of DCU are obvious, and total approximately 40-60% of median flow at DCU, and so should be able to be detected at DCU, but no reduction in Q50 is apparent.

While noting 'no change' was detected, it is acknowledged that the scale of impacts in headwater streams overlying longwalls (e.g. WC21, DC13) may be impossible to detect further downstream given natural variability, larger contributing (and un-mined) catchments downstream at WWL, as well as the inherent uncertainties of the assessment methods. However, the assessments of WWL and DCU appear to indicate that there is clear potential for returned or re-emergent flow that has been identified as lost from upstream headwater catchments.

Table 1. Summary of Surface Water flow TARPs – Longwall 17

Site	Watercourse	Catchment Mined under?	Position of sub-catchment relative to mining	A) Low flow Q%ile outside Reference Site Q%ile	B) Change in cease-to-flow frequency (beyond natural)	C) Change in median flow, Q50 (beyond natural)	Comment
DC13S1	DC13	Yes	Above LWs	●●●Level 3	●●●Level 2	●●●Level 3	Similar to LW14-16.
DCS2	Donalds Castle Creek	Yes	Above LWs	●●●Level 3	●●●Level 3	●●●Level 3	Similar to LW14-16.
DCU	Donalds Castle Creek	Yes	Downstream	●●●Not triggered	●●●Level 1	●●●Not triggered	Similar to LW14-16. Findings supported by rainfall-runoff modelling.
WC21S1	WC21	Yes	Above LWs	●●●Level 3	●●●Level 2	●●●Level 3	Similar to LW14-16.
WC15S1	WC15	Yes	Above LWs	●●●Level 3	●●●Level 2	●●●Level 3	Similar to LW15-16. * Changes to low flow accuracy means that Method B assessment assess low flows, not true 'cease-to-flow'.
WC12S1	WC12	Yes	Above LWs	●●●Not triggered	●●●Not triggered	●●●Not triggered	Second panel under catchment. No discernible effect. Findings supported by rainfall-runoff modelling.
WWL	Wongawilli Creek	Yes	Downstream	●●●Not triggered	●●●Not triggered	●●●Not triggered	Similar to LW14-16. Findings supported by rainfall-runoff modelling.
LA4S1	LA4	Yes	Above LWs	●●●Level 1	●●●Level 2	●●●Level 3	Similar to LW14-16. * Changes to low flow accuracy means that Method B assessment assess low flows, not true 'cease-to-flow'.
LA3S1	LA3	Yes	Above LWs	●●●Level 3	●●●Level 3	●●●Level 3	Similar to LW16.
LA2S1	LA2	Yes	Above LWs	●●●Not triggered	●●●Level 1	●●●Level 3	LW16-17 mined under upper part of watercourse. Increase in cease-to-flow frequency.
NDS1	ND1	Yes	Headwater	●●● Not triggered	●●● Not triggered	●●● Not triggered	LW17 is first panel under this sub-catchment. No discernible effects. Findings supported by rainfall-runoff modelling.

●●●●● = result of previous longwalls (LW14-16)

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Site Watercourse	Position of sub-catchment relative to mining	D) Surface flow observations		Comment
Wongawilli Creek	Between A3A andA3B	All months	Not triggered	Refer to Performance Measures

Table 2. Summary of surface water flow Performance Measures– Longwall 17

Wongawilli Creek – minor environmental consequences	This Performance Measure is met.
Donalds Castle Creek – minor environmental consequences	This Performance Measure is met.
Lake Avon – negligible reduction in the quantity of surface water inflows to Lake Avon	This Performance Measure is met.
Cordeaux River – negligible reduction in the quantity of surface water inflow to the Cordeaux River at its confluence with Wongawilli Creek	This Performance Measure is met.

Pool levels

The water level in Pool 50 (previously Pool 43A) on Wongawilli Creek declined since 2012, and a TARP Level 3 impact was recorded when water levels were recorded below baseline on 20/11/2017, following the identification of a stream bed fracture in 2013. The decline in pool levels started prior to the formation of the fracture and was coincident with a decline of groundwater pressures in lower Hawkesbury Sandstone associated with mining in Area 3A and Area 3B. Piezometric levels in the sandstone substrate adjacent to Wongawilli Creek have recovered as mining in Area 3B moves south and away from Pool 50. Pool water levels trended higher during the Longwall 17 reporting period.

Wongawilli Creek tributary WC15 was approached within 40 m by Longwalls 13 and 14, and the upper reaches of WC15 were mined under by Longwalls 15 to 17, resulting in fracturing of the stream bed and diversion of flow at some locations. Routine field observations indicate that the level and flow at most pools upstream of Pool 13 have declined relative to baseline observations.

The LA2 watercourse was mined under by Longwall 16 in May 2020 and Longwall 17 between December and March 2021. A review of field observations indicates that water levels have declined in Pools 24 and 25 following the passage of Longwall 17. Mining effects at Pools 34 and Pool 5 are unclear.

No effects were detected in the pool level record at Waterfall 54 (WF54), compared to reference levels from the WWU pool upstream of the waterfall.

Swamps

At reference swamp sites, shallow groundwater levels recovered throughout 2020 and 2021 in response to high rainfall following the 2017-2019 drought period. However, shallow groundwater levels have not yet recovered to the same levels as prior to 2017 in several reference swamps (e.g. Swamps 02, 07, 33, 85, 87 and 88).

Longwall 17 passed beneath, or within 400 m of, Swamps 14, 23, 149 and 35a during 2021. Swamps 14 and 23 were previously mined under by Longwalls 15 and 16. Review of shallow groundwater hydrographs indicates likely mining related effects at both piezometers in Swamp 23 and represents a Level 3 TARP trigger (revised from Level 2 in the previous assessment). Shallow groundwater effects at Swamp 14 piezometers confirm a Level 3 TARP trigger, as assessed previously. Mine related effects are not observed at Swamp 35a following Longwall 17. TARPs were previously triggered at Swamps 01a, 01b, 03, 05, 10, 11 and 13. The observed effects at swamps are in line with impacts anticipated in the SMP.

Soil moisture levels have recovered significantly at reference and impact swamp sites during 2020 and 2021 following above-average rainfall. At Swamp 14, moisture levels at both sensors declined following passage of Longwalls 16 and 17, relative to reference sites. The effects are likely mining related, triggering TARP level 3 (revised from Level 2). At Swamp 23, soil moisture continues to vary within the pre-mining baseline range.

1. Introduction

Illawarra Metallurgical Coal (IMC) operates the Dendrobium underground coal mine, located approximately 12 km west of Wollongong (NSW) in the Southern Coalfield. IMC is required under the conditions of mining approval 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.

Surface water monitoring has been undertaken by IMC since 2003. Field parameter measurements and sampling for more detailed laboratory chemical analyses were collected by the IMC Environmental Field Team (IMCEFT). Field observation sites include hydrographic gauging stations, shallow groundwater piezometers, soil moisture sensors and surface water sampling sites.

This End of Panel (EoP) assessment reviews hydrographic and water quality data for the Wongawilli Creek catchment, upper Donalds Castle Creek catchment, Lake Avon sub-catchments and the Sandy Creek catchment up to one month after the completion of Longwall 17. Data are assessed against baseline and impact criteria defined in the Trigger Action Response Plan (TARP) which forms part of the Subsidence Management Plan for Area 3B (BHP Billiton, 2015) and the Swamp and Watercourse management plans contained therein.

1.1 Reporting Objectives

This EoP surface water assessment report has been prepared to form part of IMC's EoP Review which satisfies Condition 3-9 of the Approval for Dendrobium Mine (DA 60-03-2001). The EoP Review:

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

This report provides the following assessment for the EoP Review:

- Impacts to water flow, water levels and water quality in watercourses, including: Wongawilli Creek, Donalds Castle Creek, Sandy Creek, Native Dog Creek and relevant tributaries to Avon Reservoir.
- Impact to flows at Waterfall 54.
- Impacts to shallow groundwater levels and soil moisture levels in mapped Coastal Upland Swamps within the mining area of influence, compared with reference swamps.

1.2 Longwall 17

Longwall mining at Dendrobium has been carried out in three designated areas: Area 1 (east of Lake Cordeaux), Area 2 (west of Lake Cordeaux), and Areas 3A and 3B (between Lake Cordeaux and Lake Avon). Coal is extracted from the Wongawilli Seam in Areas 1 through 3B. Previous workings in the Wongawilli Seam are located to the south at Elouera and Nebo, and to the east at Kemira. The overlying Bulli Seam was mined previously at Mt Kembla to the east of and partially overlapping Area 1.

Extraction of Longwall 17 commenced on 12/12/2020 and was completed on 13/10/2021. Longwall 17 is the ninth panel to be extracted in Area 3B, with an extracted length of 1901 m, a void width of 305 m (including first workings) and a cutting height of up to 3.9 m.

1.3 Feedback from agencies on previous assessment

WaterNSW provided feedback to DPIE in relation to Surface Water components of the Longwall 16 End of Panel Reporting. WaterNSW was generally satisfied with the application of the amended surface water flow assessment methodology in the previous End of Panel report. However, they expressed concern regarding the increased cease to flow frequencies and flow reductions despite high rainfall during 2020. WaterNSW recommendations reflect comments made by the Independent Advisory Panel for Underground Mining (IAPUM) and are listed in Table 3.

Table 3. Comments on previous EOP assessment

WaterNSW comment	Response
That the pre-LW15 surface water flow TARPs be employed in parallel with the new surface water flow TARPs, and the most conservative outcome taken, until the new trigger metrics have undergone further assessment and peer review.	A comparison against the pre-LW15 method (comparison against rainfall-runoff modelling) for selected sites is presented in Appendix H.
A method of quantifying and reporting trends in key water quality indicators (both concentrations and loads) should be trialled in addition to applying the proposed water quality TARPs.	A trial study was carried out 2021 (HGEO, 2021a) and reviewed as satisfactory by WaterNSW. Water quality trend analysis is presented in Section 4.2.

2. Surface water and groundwater management

This section outlines the network of monitoring infrastructure and sites operated by IMC 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, 2020b).

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. Surface water monitoring sites fall into four categories:

- **Flow gauge sites** at which stream flow is monitored at a calibrated gauge or weir.
- **Water chemistry sites** at which samples are collected for laboratory analysis (DOC, Na, K, Ca, Mg, Filt. SO_4, Cl, T. Alk., Total Fe, Mn, Al, Filt. Cu, Ni, Zn, Si), in addition to water observations, field parameters.
- **Water field parameter sites** at which water quality field parameters are measured (pH, Electrical Conductivity (EC), temperature, Dissolved Oxygen (DO), Oxygen Reduction Potential (ORP), in addition to water observations.
- **Water observation sites** at which pool water levels and flow status are noted and photographs taken upstream and downstream.

At a subset of sites, data loggers are installed in pools to allow monitoring of pool water level and temperature at hourly intervals. The monitoring of water quality parameters provides a means of detecting and assessing the effects of streambed fracturing or induction of ferruginous springs.

Figure 1 shows the location of surface water monitoring and sampling sites in relation to the extracted and planned longwall panels. Figure 2 shows the locations of hydrographic gauging stations which extend beyond the mining lease.

A summary of water flow monitoring sites in Areas 3A and 3B is presented in Table 4 and a full list of all installations is included in Appendix B. Several more sites have been installed or are planned in Area 3C in advance of operations commencing there.

Table 4. Surface Water Flow Monitoring Sites in Area 3A and 3B

Area	Site	Installation	Catchment	Easting (MGA z56)	Northing	Catchment area (km2)
A3B	WWU	Natural control; Stainless Steel housing; Diver logger	Wongawilli Creek	290808	6189716	3.211
A3B	WWL	Natural control; Stainless Steel housing; Diver logger	Wongawilli Creek	290975	6197526	20.079
A3B	WWL_A	Recently installed - Weir and half pipe; PVC housing; Orpheus logger	Wongawilli Creek	290962	6197370	19.602
A3B	WC21S1	Natural control; Stainless Steel housing; Diver logger	Wongawilli Creek	290529	6194255	2.434
A3B	WC15S1	Natural control; PVC housing; Diver logger	Wongawilli Creek	290754	6192239	1.192

A3B	WC12S1	Weir and half pipe flume; Polypipe housing; Orpheus logger	Wongawilli Creek	290964	6191459	0.38
A3B	LA2S1	Weir and half pipe flume; Polypipe housing; Orpheus logger	Lake Avon	288364	6191364	0.824
A3B	LA3S1	Weir and half pipe flume; Polypipe housing; Orpheus logger	Lake Avon	288385	6191548	0.375
A3B	LA4S1	Modified control; Stainless Steel housing; Diver logger	Lake Avon	288134	6192565	0.817
A3B	NDT1S1	Weir and half pipe flume; Polypipe housing; Orpheus logger	Lake Avon	288607	6190491	1.13
A3B	DC13S1	Natural control; PVC housing; Diver logger	Donalds Castle Creek	289401	6194605	1.638
A3B	DCS2	Natural control; PVC housing; Diver logger	Donalds Castle Creek	289502	6194572	1.084
A3B	DCU	Natural control; Stainless Steel housing; Diver logger	Donalds Castle Creek	289407	6195577	6.219
A3A	SC10S1	Natural control; Stainless Steel housing; Diver logger	Sandy Creek	293608	6192516	2.771
A3A	SC10CS1	Natural control; Stainless Steel housing; Diver logger	Sandy Creek	293358	6192433	0.817
A3A	SCL2	Modified control; Stainless Steel housing; Diver logger	Sandy Creek	293819	6192648	7.029
A3A,C	LC5S1	Reference site until Area 3C is mined. Weir and half pipe flume; Polypipe housing; Orpheus logger	Lake Cordeaux	293043	6195327	1.861

2.2 Improvements to monitoring network in reporting period

Type of change / improvement	Description of recent change	Reference / comment
New surface water gauging sites	None in Area 3B during recent EOP period. New sites approved, and some installed.	None installed. Figure B1 (Appendix B) shows network.
Upgrade of existing sites	None during recent EOP period	
Gauge rating curves	More gaugings taken at most sites. Rating curves updated at most sites.	Details from ALS (hydrographic consultants) can be requested via IMC. Methods to estimate uncertainty in surface water flow estimation has been developed by hydrological consultant Enviromon, and is being rolled out to all sites. See Appendix C5 for sites assessed thus far.
Pool monitoring sites	Installation of additional water level data loggers in key pools.	Additional water level loggers installed in pools in Wongawilli Ck (more relevant to Area 3C).
Revision of assessment methods	Surface flow TARPs (Assessments A-D) not change since agreement in early 2020. IAPUM requested that old method (comparison of rainfall-runoff modelling) be re-instated.	Section 5.4, WIMMCP (IMC, 2020a) and Watershed HydroGeo, 2019a. Section 2.3.1. Peer-review of methods planned for early 2022.
WWL vs WWL_A correlation	No change. Enviromon analysed the common period of WWL and WWL_A records in order to allow cessation of monitoring at WWL. Due to the shorter record at WWL_A and uncertainties at WWL it is recommended to continue to rely on data from WWL until the end of Area 3A (Longwall 19), and use WWL_A thereafter.	See separate document (Enviromon, 2021).

2.3 Surface water flow data update

IMC's contract hydrographers, ALS, provided the most recent flow data for assessment for sites in and around Area 3B (details in Table C1 of Appendix C). This has been augmented by flow data from sites managed by WaterNSW, specifically one of the primary reference flow gauges (O'Hares Creek at Wedderburn) and for WaterNSW's Sandy Creek gauging station (GS 2122205). The WaterNSW Sandy Creek gauging station is co-located with IMC's SCL2 gauging site, but has a longer record and, based on comments from ALS, relies on higher accuracy monitoring equipment.

This data was then assessed based on the quality of records provided before some further processing was conducted. A discussion of this assessment is provided below. As is standard, data is available to agencies on request.

2.3.1 Re-rating of flow records

ALS updates the rating curves of flow monitoring sites as new manual gaugings are taken and added to the dataset that correlates 'stage' (water level at a monitoring site) and flow at the site. In recent times, WaterNSW has granted limited access to the Special Area during wetter periods in order to improve the moderate/high flow sections of the rating curves. This has meant that historical records of estimated flow can change when a rating curve is updated. ALS has confirmed that no sites were re-rated since November 2020 (prior to the Longwall 16 EOP).

Hydrographers ALS took over the contract for flow monitoring at Dendrobium on 11/05/2016. ALS provide the record of daily flow for each IMC site based on the latest rating curve and the historical record of stage (level) at each site. ALS do not provide re-rated data from before their contract date, i.e. before 11/05/2016.

Table 5. Stream gauges that have been re-rated

DATE	A3B GAUGES RE-RATED	OTHER GAUGES RE-RATED
October 2020	WWLA, DCU, WWU, DC13S1, DCS2, WC21S1, WC15S1	SCL2, SC10S1, SC10CS1
November 2020	LA2S1, LA3S1, WC12S1, NDTS1	AR31S1, AR32S1, LA13AS1, LA13S1, AR19S1, DC8S1, CR29S1, CR31S1, LC5S1, LA8S1, CR36S1

It is apparent from review of recent data obtained from WaterNSW for O'Hares Creek (WaterNSW site 213200) that a similar re-rating process occurs in WaterNSW data but has not been confirmed by WaterNSW.

There are two implications of the re-rating process:

1. Estimates of flow included in previous EOP reports may be different to that reported in the current (or future) EOP report. For example, median flow for sub-catchment WWU for the period May-2016 to June-2020 was 0.068 ML/d in the EOP for Longwall 15 but was revised to 0.202 ML/d EOP for Longwall 16 due to changes to the rating curve.
2. For gauging sites that commenced operation before the contract date of ALS (11/05/2016), time-series data prior to that date need to be adjusted to account for re-rating. This pre-processing step was accomplished by comparing the 'old' (pre-ALS) flow data and the new rating curve in order to derive a flow record that is based on a consistent rating curve across the entire record.

2.3.2 Data quality assessment

An analysis of the data received from ALS was performed to assess the reliability and continuity of data collected at each flow gauge. The data quality code recorded by ALS for flow measurements was used for this purpose. A summary of these data quality codes has been provided in Table C2 of Appendix C, alongside the data quality assessment of each flow gauge.

Each daily flow recorded is the average flow determined from multiple sub-daily (typically 15-minute interval) stage measurements. The Hydstra database maintained by ALS will assign the 'worst' data quality code from any of the sub-daily records to the aggregated or averaged daily record. It is for this reason that Hydstra will sometimes assign quality code 140 ("Level below cease-to-flow") to days where there is a small, non-zero average flow.

For each flow gauge the percentage of available daily flow measurements was calculated. This value indicates the number of measurements that exist between the first date of data collection and the last available date. From this the percentage of 'suspect' data was calculated. Based on the ALS quality codes, suspect data refers to any flow data with a code that falls between 104 and 255. A summary of the data quality assessment for each flow gauge is included in Table C3 and C4 of Appendix C.

Data processing was then undertaken for flow data where entries were blank or entered as text and these could be confidently infilled. These entries were associated with the following quality codes:

- 151 ("data not yet available"): associated with comments of 'rating exceeded', commonly following high regional rainfall events;
- 161 ("poor quality data from debris affecting sensor"): occurred only at flow gauge WWU for the period 23/01/2019 to 27/02/2019;
- 205 ("data lost"): associated with comments such as 'logger dead', 'data lost';
- 255 ("no data exists"): associated with comments of 'rating exceeded', 'logger dead'.

For these entries an infilling procedure was used to estimate the flow value, if the record could be confidently estimated (e.g. flows were consistent through time and compared to other gauging stations, especially at higher flows when the "rating exceeded" flag was assigned. Flow estimates were calculated using either the average flow from the preceding and following days, or the flow recorded at another gauged sub-catchment for the same day, scaled by catchment size. The percentage of infilled data is recorded for the relevant gauges in Appendix C. The results of processing, with comparison against 'raw' data are illustrated on charts in Appendix C.

2.4 Shallow Groundwater Monitoring

Figure 2 shows Longwall 17 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 IMC carried out by Biosis and Niche Environment and Heritage. 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 other areas, such as fringing Eucalypt Woodland, are excluded from the TARP assessment as per the advice from OEH (17/01/2014).

A summary of the shallow groundwater monitoring sites is presented in Table 6.

Table 6. Summary of Swamp Monitoring

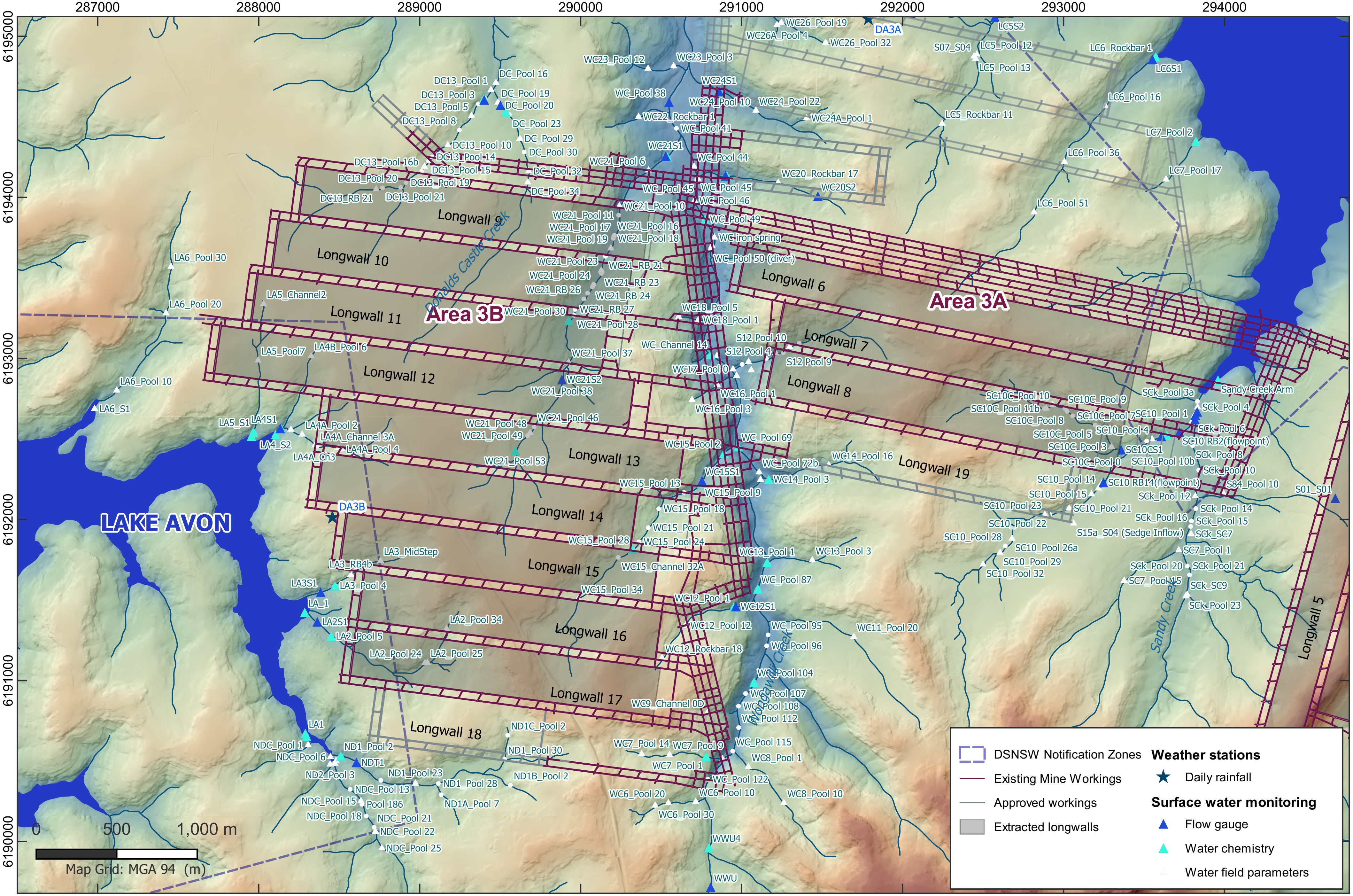
Swamp	Site type	Number of piezometers		Within mining area of influence (<400 m)
		Total	TARP (Within Coastal Upland Swamp EEC	
01a	Impact	9	6	Longwalls 9,10
01b	Impact	7	6	Longwall 9
02	Reference	1	n/a	No
03	Impact	1	1	Longwalls 11,12
05	Impact	9	6	Longwalls 9-12
07	Reference	2	n/a	No
08	Impact	6	0	Longwalls 9-11
10	Impact	1	1	Longwall 12
11	Impact	3	3	Longwall 13,14
13	Impact	1	1	Longwalls 13-16
14	Impact	2	2	Longwalls 15-17
15a	Impact (lower section within 400m mining area)	16	7	Longwall 8,19
15b	Impact	23	10	Longwall 7,8
22	Reference	2	n/a	No; Elouera Colliery
23	Impact	2	2	Longwalls 15-17
25	Reference	1	n/a	No
33	Reference	2	n/a	No
35a	Impact	1	1	Longwalls 17,18
35b	Impact	1	1	Longwall 18
84	Reference	1	n/a	No
85	Reference	2	n/a	No
86	Reference	2	n/a	No
87	Reference	2	n/a	No; Avon Colliery
88	Reference	2	n/a	No; Huntley Colliery
149	Impact	1	1	Longwalls 16-18
150	Impact	1	1	Longwall 18

Pink shading: swamps within mining area of influence of Longwall 17

2.5 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 the addition of an ‘S’ prefix. At most locations, sensors are installed up to a maximum depth of 1.2 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. The remaining installations are recorded manually during scheduled site visits.



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Dendrobium Mine End of Panel Surface Water Assessment

Surface water field monitoring sites

Figure 1

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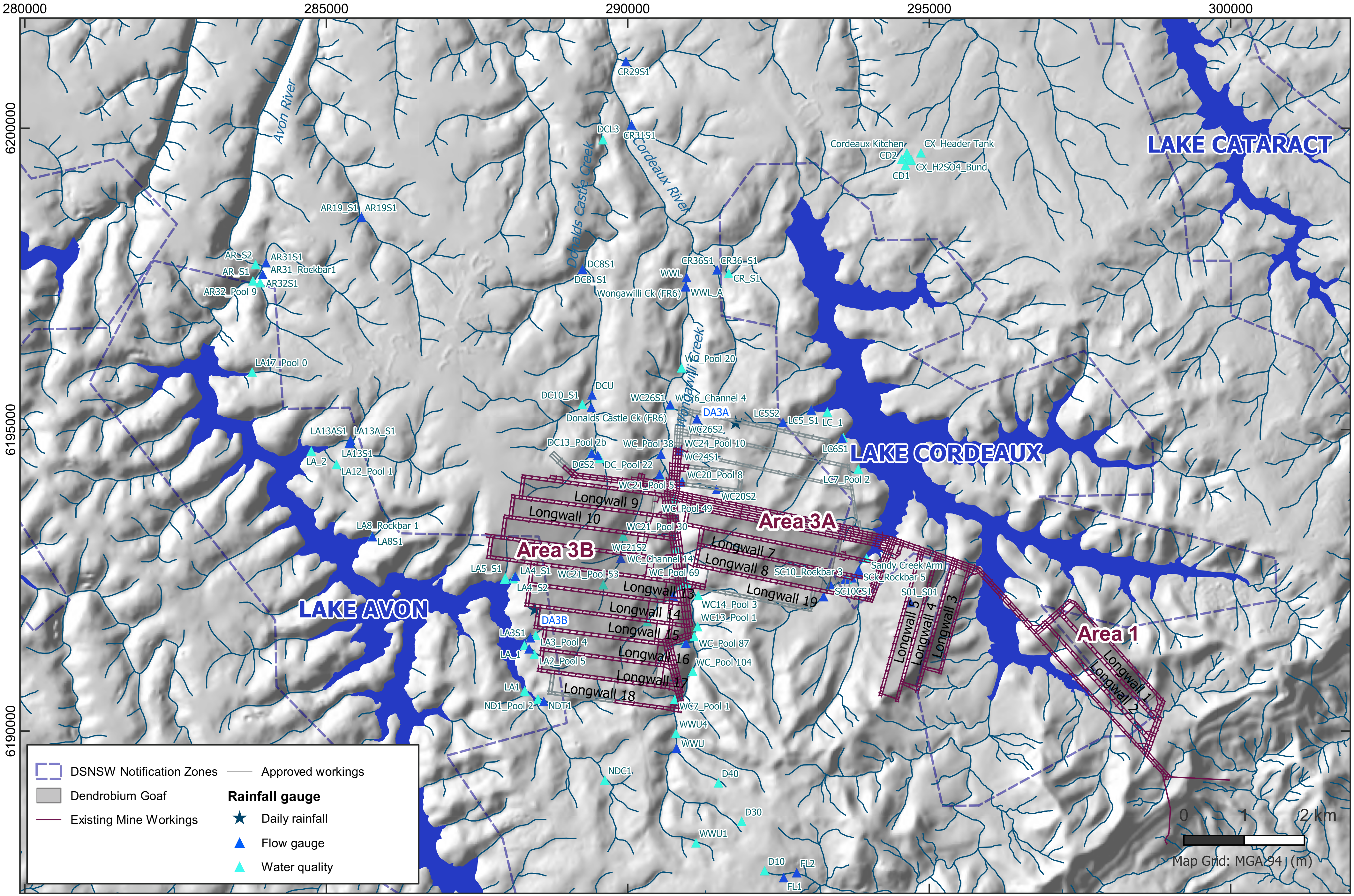

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Dendrobium Mine End of Panel Surface Water Assessment

Water level, flow and chemistry monitoring sites

Figure 2

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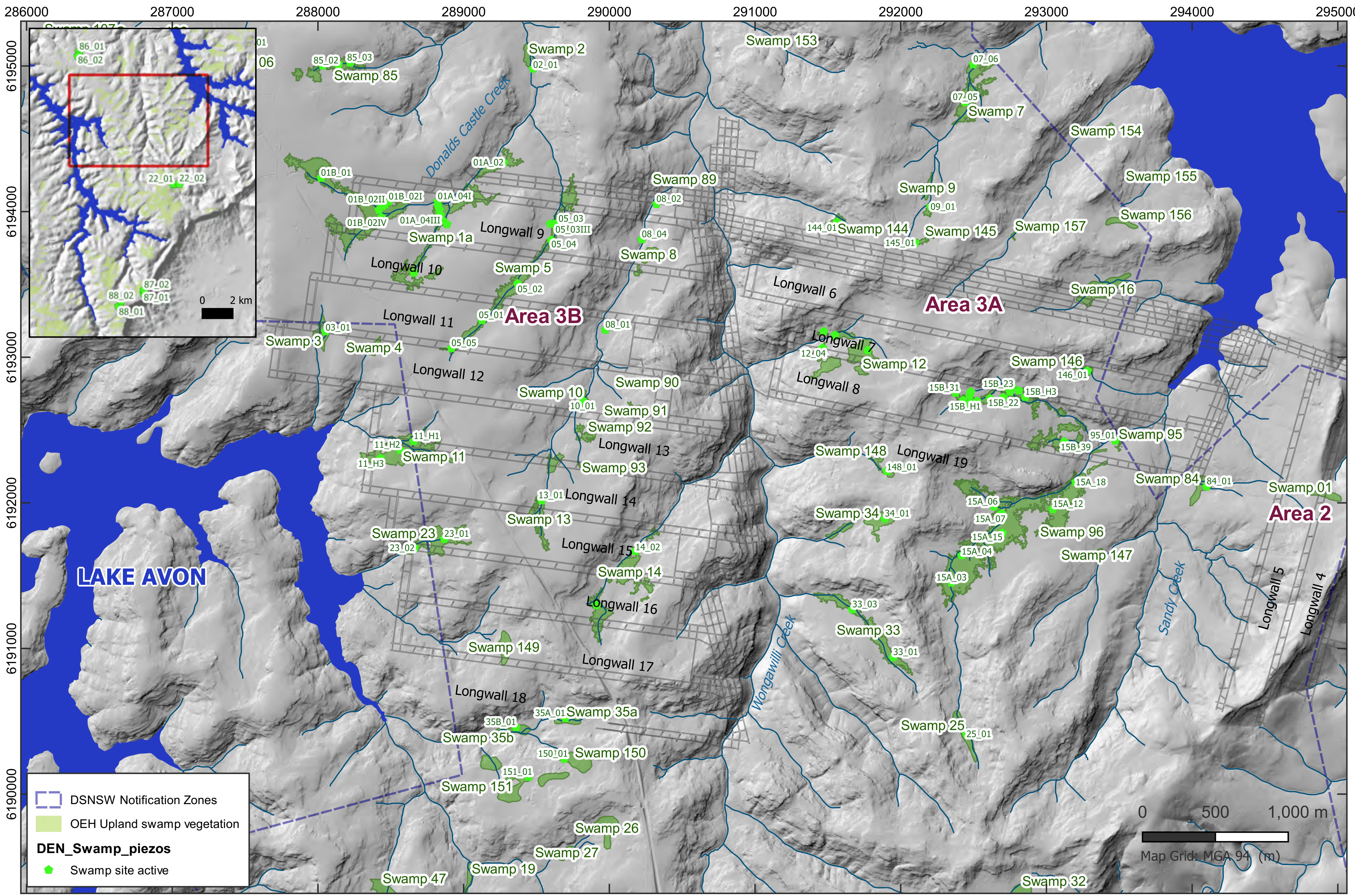

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Dendrobium Mine End of Panel Surface Water Assessment

Swamp monitoring sites

Figure 3

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2.6 Weather conditions during the assessment period

Rainfall data are collected from several gauging stations across the mining lease. Weather observations at Area 3B since the start of Longwall 9 are summarized in Figure 4. 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 1050 mm (2002 – 2021; Dendrobium site data). 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.

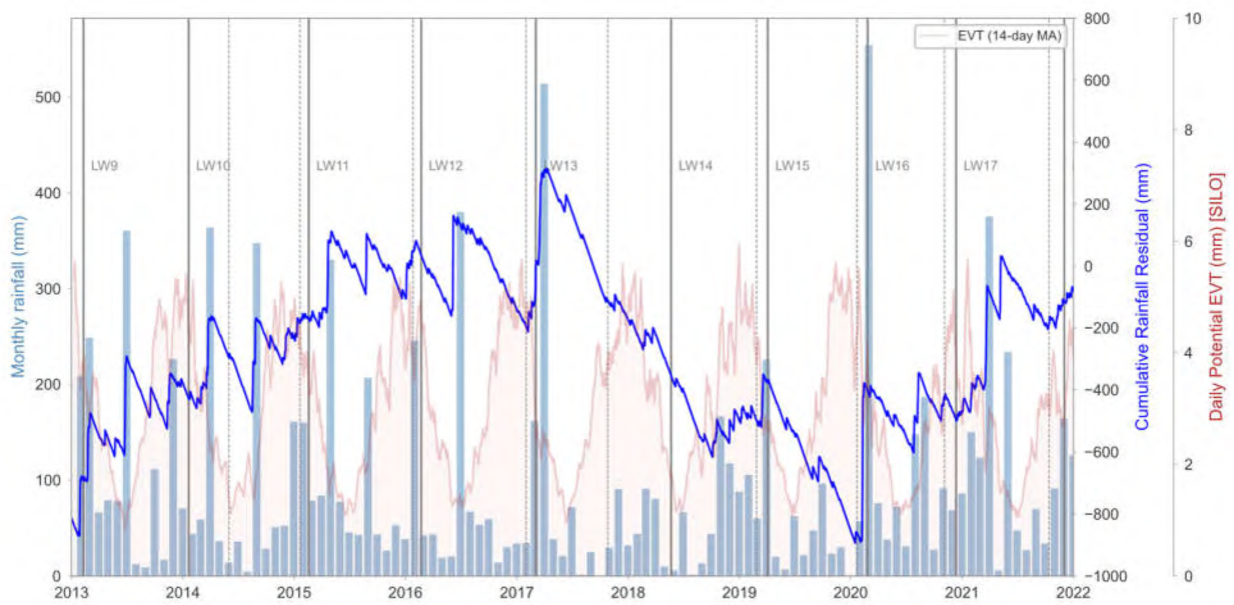


Figure 4. Rainfall and potential evapotranspiration (EVT) at Area 3 for the reporting period

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 during 2021 and during Longwall 17 extraction was well above average, totalling 1448 mm, the highest rainfall year since 2007. Heavy rainfall was experienced in March, May and November 2021. This follows similarly high rainfall in 2020 (1436 mm). As a result, there has been a broad recovery in stream flow, shallow groundwater levels and soil moisture across all catchments since the severe drought of 2017-2019.

Soil moisture levels derived from the Australian Water Resources Assessment Landscape model (AWRA-L) are published by the Bureau of Meteorology (BOM). A timeseries of estimated soil moisture storage for the Woronora Plateau in the vicinity of Dendrobium Mine is shown in Figure 5. The model calculated severely depleted soil moisture conditions during 2017-2019 drought period, with full recovery during 2020 and 2021.

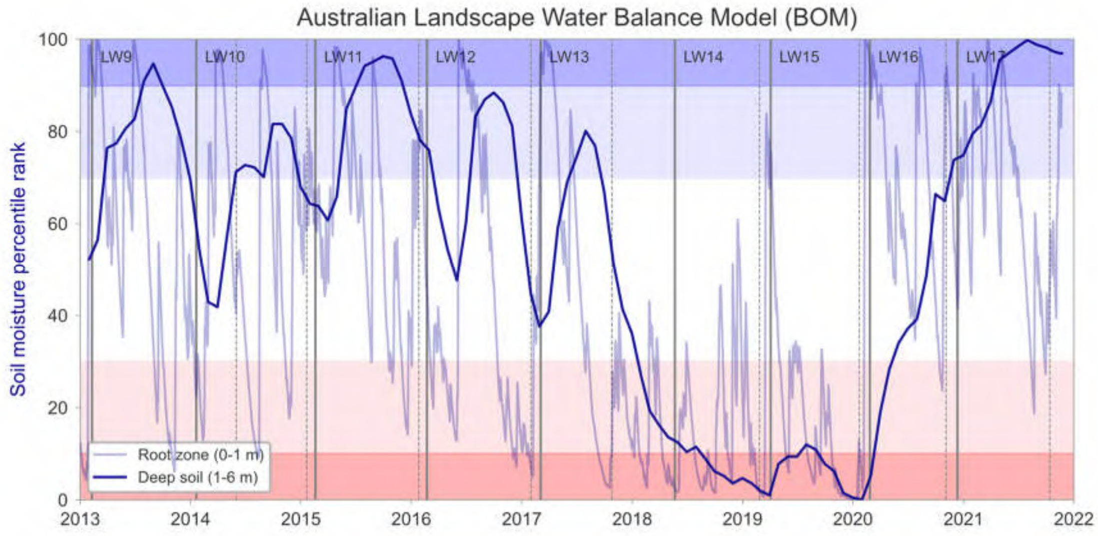


Figure 5. Calculated soil moisture from BOM's AWRA Landscape Model

Longer term rainfall trends for the plateau are shown in Figure 6 which is based on data from SILO (slightly different from site measurements). Since 1960 there have been four periods of drought on the plateau (yellow shading), the most severe being the Millennium Drought which ended in 2004. Severe drought conditions returned between 2017-2019. The plot shows that, in general, below average rainfall conditions prevailed since about 1991. The period from 2002 for which rainfall data have been collected at Dendrobium (vertical black line) is slightly below the long-term average (~1125 mm), accounting for the difference in appearance of the cumulative rainfall trends in Figure 4 (based on site data) and Figure 6 (based on long term SILO data).

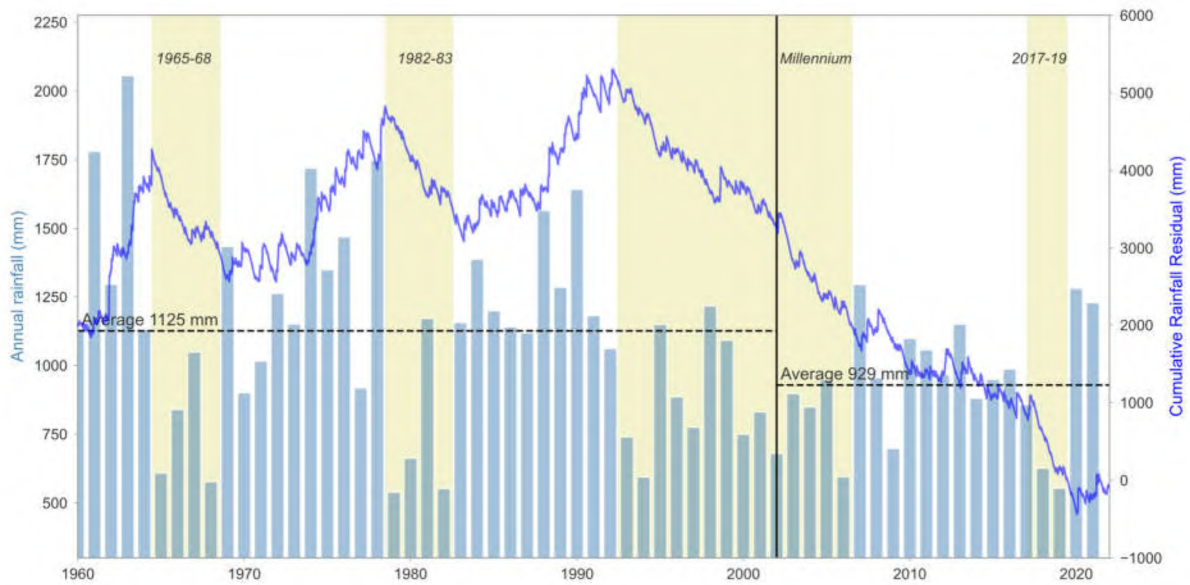


Figure 6. Long-term rainfall trends at Dendrobium (1960-2021)

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.

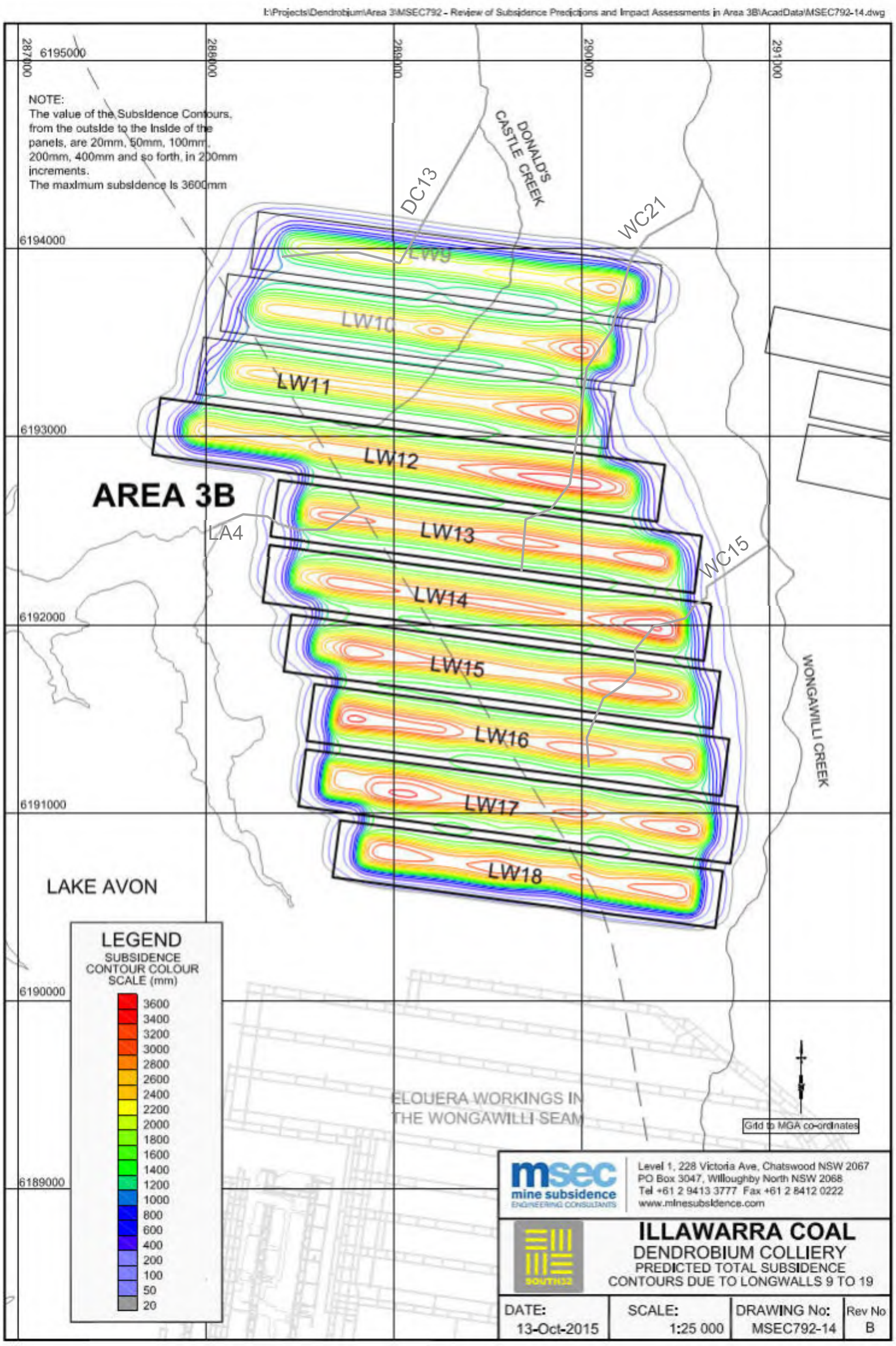


Figure 7. Predicted Subsidence above Area 3B (from MSEC, 2015)

3.1 Measured subsidence

Observed mine subsidence movements due to the extraction of Longwall 17 were reviewed by MSEC (2022). 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 17 were generally similar to or less than the predicted values based on the re-calibrated subsidence model outlined in reports MSEC792 (MSEC, 2015) and MSEC865 (MSEC, 2016) and MSEC992 (MSEC, 2018). MSEC (2022) considered that the observed surface impacts on natural and built features resulting from the extraction of Longwall 17 are consistent with predictions.

3.2 Observed surface impacts

Surface watercourses and catchments undermined by Longwall 17 are listed in Table 7.

Table 7. Surface water features mined under by Longwall 17

Catchment / location	Approximate dates	Monitoring locations (level and chemistry)	
		Upstream	Downstream
Lake Avon	Longwall 17 commenced at a distance of 308 m from Lake Avon FSL shoreline	-	LA, LA4S2
LA2	Longwall 17 passed beneath the main second-order LA2 watercourse between 13/12/2020 and 16/3/2021.	-	LA2_Pool 5, LA2S1
WC15 tributary	Longwall 17 passed beneath the upper reaches of WC15 (within Swamp 14) between 18/6/2021 and 27/6/2021.	-	WC15_Pool 34, WC15_Pool 28, WC15_Pool 24, WC15_S1
WC12 tributary	Longwall 17 passed beneath the upper reaches of WC12 on 12/9/2021.	-	WC12_Rockbar 18, WC12_Pool 12, WC12_Pool 1
Swamp 14	Longwall 17 passed beneath the southern fringes of the swamp between 13/6/2021 and 27/6/2021. The northern parts of the swamp was previously mined under by Longwalls 15 and 16.	Piezometers 14_01, 14_02 Soil moisture sensors	
Swamp 23	Longwall 17 commenced at a distance of ~350 m from the southern fringes of the swamp in early 2021. The swamp was previously mined under by Longwall 15 (early 2019) and Longwall 16 (March 2020).	Piezometers 23_01, 23_02 Soil moisture sensors	
Swamp 35a	Longwall 17 passed within 400m of the swamp between 18/4/2021 and 18/7/2021. The closest approach to piezometer 35a_01 was 325 m on 23/5/2021	Piezometer 35a_01 Soil moisture sensors	
Swamp 149	Longwall 17 passed beneath the swamp between 18/3/2021 and 1/4/2021	No piezometers installed 1 New soil moisture sensor (for Longwall 18 SMP)	

Observed subsidence impacts on the landscape, including surface fracturing and iron staining are monitored by the IMCEFT and reported separately in the EoP Landscape Report (South32, 2021). A total of 40 new ground surface impacts attributed to the extraction of Longwall 17 were recorded, of which **13** were in stream beds, including impact updates (Table 8). Ten impacts were associated with fracturing of the sandstone substrate within the watercourse channel or rockbars of tributary LA2 which was directly mined under. A further two impact sites are associated with iron-staining in Wongawilli Creek (LA17_031) and tributary LA5 (LW17_025), both outside the 400 m radius of mining influence. In addition to ground surface impacts, four water quality TARP triggers were recorded at LA4_S1 (Table 9). Those water quality triggers are discussed in Section 4.

The observation of increased iron staining in Wongawilli Creek, LA5 and WC21 follows the re-appearance of iron staining along the lower reaches of SC10C during Longwall 16 (a tributary to Sandy Creek). In all three cases, the iron staining originated at springs located well outside the zone of mining influence for the current Longwall. As discussed later in this report, the emergence of iron springs over a broad area is likely related to increasing shallow groundwater levels and discharge following higher than average rainfall over the last two years.

Table 8. Reported subsidence impacts to stream beds during Longwall 17

Site ID	Watercourse	Date Observed	Reported	Description	Tarp Level
LW17_001	LA2	5/02/2021	10/02/2021	Rock fracturing, uplift and fragmentation to LA2_Channel 6B.	2
LW17_002	LA2	10/03/2021 10/02/2021	16/02/2021 12/03/2021	Rock fracturing, uplift and fragmentation to LA2_Rockbar 25 and LA2_Pool 25.	2
LW17_003	LA2	10/02/2021 10/03/2021	16/02/2021, 12/03/2021, 14/04/2021	Rock fracturing, uplift and rockfall to LA2_Rockbar 24, LA2_Pool 24 and LA2_Step 24.	2
LW17_004	LA2	10/03/2021	12/03/2021	Rock fracturing and uplift to LA2_Rockbar 10.	2
LW17_005	LA2	10/03/2021	12/03/2021	Rock fracturing to LA2_Pool 12.	2
LW17_006	LA2	10/03/2021	12/03/2021	Rock fracturing, soil cracking and uplift to LA2_Pool 14.	2
LW17_007	LA2	10/03/2021	12/03/2021	Rock fracturing and uplift to LA2_Rockbar 14.	2
LW17_012	LA2	13/04/2021	14/04/2021	Rock fracturing and displacement around LA2_Pool 9 and upstream rockbar.	2
LW17_013	LA2	13/04/2021	14/04/2021	Rock fracturing to LA2_Channel 8.	2
LW17_025	LA5	1/07/2021	6/07/2021	Iron staining in tributary LA5.	1
LW17_031	Wongawilli Creek	2/08/2021	9/08/2021	Iron staining in Wongawilli Creek.	3
LW17_034	LA2	10/09/2021	21/09/2021	Rock fracturing and cracking to LA2 tributary.	2
LW9_019	WC21	24/12/2013 2/08/2021	9/08/2021	Recurrence of Iron staining in WC21 Pool 10 and at the confluence with Wongawilli Creek.	3

MSEC (2022) reported that:

1. *Rock fracturing was observed along LA2 causing likely loss of surface water flow (Type 3 impact) in three locations and possible loss of surface water flow in another seven locations. The fracturing occurred predominately above LW17 with only one physical impact site (i.e. fracturing or cracking) occurring outside the mining area and adjacent to the longwall commencing end. It was assessed that surface water diversions would occur along the drainage lines that are directly mined beneath with fracturing up to 400 m outside the mining area. And:*

2. *The observed impacts on the natural features due to the mining of LW17 are consistent with the MSEC assessments provided in [previous reports].*

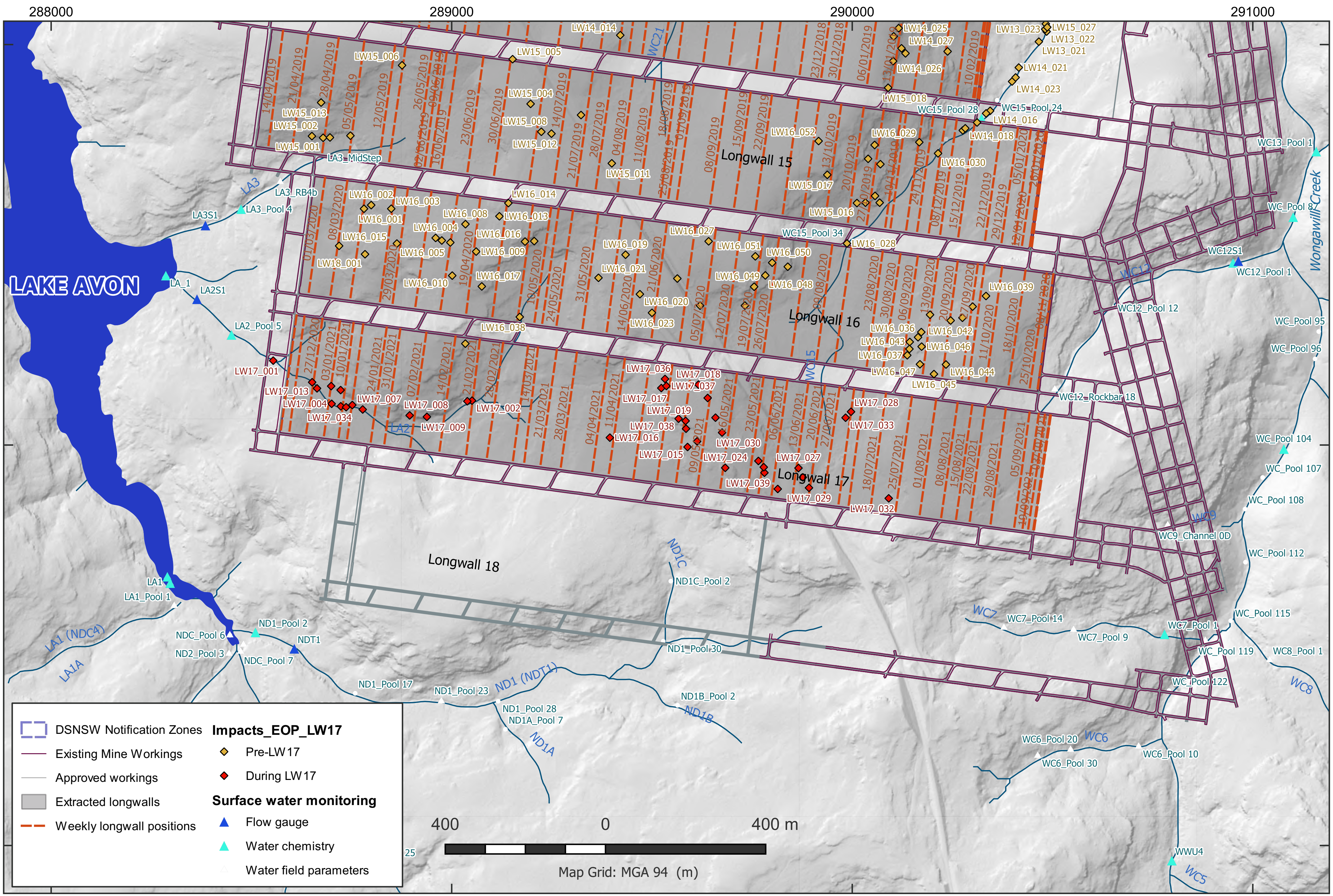
Subsidence impacts of TARP Level 2 or above require specialist advice in relation to possible Corrective Management Actions (CMAs), reporting and/or monitoring. Advice in relation to subsidence impacts to watercourses is as follows:

- **LA2**: Observed impacts in the sandstone channel of tributary LA2 is in line with predicted subsidence effects associated with Longwall 17, being above, or within 400 m of, the extracted longwall. Current routine monitoring is adequate, and no additional actions are recommended.
- **Wongawilli Creek**: IMC commissioned an assessment of iron staining in the creek (HGEO, 2021b). The assessment concluded that *the appearance of iron staining along Wongawilli Creek in August 2021 was caused by increasing groundwater levels and reactivation of slope springs in response to high rainfall and groundwater recharge events in March and May 2021*. It was recommended that additional water samples should be collected from the slope springs on Wongawilli Creek and WC12 during the next two monitoring rounds. Further details are provided in Section 4.5.

1. Valley closure at Waterfall 54

The mine subsidence effects for Waterfall 54 (WF54) along Wongawilli Creek have been measured by IMC using 2D survey techniques. Survey lines were established prior to the commencement of Longwall 16. MSEC (2022) noted that ground movements across the survey lines were less than the predicted. However, Longwall 17 finished at maingate cut-through 3 which is approximately 105 m short of the approved finishing location, to reduce the closure at the waterfall.

No surface impacts were reported on Wongawilli Creek near Waterfall 54. Monitoring of geological strata at monitoring bore S2478 (between Longwall 17 and Waterfall 54) using Time Domain Reflectometry (TDR) found no evidence for movement or development of basal shears that could intersect with the waterfall (HGEO, 2021c). Analysis of pool water levels at Waterfall 54 found that there was no mining effect on stream hydrology beyond natural variability (see Section 5.7.5).



Dendrobium Mine End of Panel Surface Water Assessment

Observed surface impact sites

Figure 8

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4. Assessment of surface water quality effects

Trigger values for water quality field parameters are defined in the Watercourse Impact Monitoring Management and Contingency Plan (WIMMCP) Attachment 1 (South32, 2020b). 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 within six months
- Level 2: Two non-consecutive exceedances within six months
- Level 3: Three exceedances within six months
- Exceeding prediction: Mining results in two consecutive exceedances during the monitoring period. Predicted impacts are summarised in the WIMMCP.

During the 12-month reporting period between the start of Longwall 17 (12/12/2020) and one month after the end of Longwall 17 (13/10/2021), monitoring was carried out at more than 230 sites. Sites were monitored on an approximately weekly or monthly basis, as per the WIMMCP.

TARP triggers for the monitoring period are summarised in Table 9.

Table 9. Summary of Water Quality TARPs for the monitoring period

DATE	CATCHMENT / LOCATION	PARAMETER	VALUE	TARP	TRIGGER LEVEL
17/3/2021	LA4_S1	pH	4.13	4.9	Level 2
17/3/2021	LA4_S1	EC	195	129.8 µS/cm	Level 2
9/6/2021	LA4_S1	pH	Min: 3.8	4.9	Level 3
6/7/2021	LA4_S1	EC	152	129.8 µS/cm	Level 3

Assessment of surface water quality effects, including TARP triggers is presented by catchment (watercourse) in the following subsections.

4.1 Overview of surface water quality

Hydrographs of stream field parameters (EC, pH and DO) are presented in Appendix A for 147 observation sites and hydrographs of dissolved sulfate, Fe, Mn, Al, Si and Zn are presented for 60 sites at which sampling and laboratory analysis are carried out. Due to the large volume of data, water quality trends (qualitative) for the review period are summarised for representative sites and sites at which significant or noteworthy trends are apparent in Table 10. A quantitative analysis of water quality trends is presented in Section 4.2, below.

In general, stream salinity (EC) has decreased over the last two years due to higher than average rainfall and significant increase in runoff compared with the previous two years. The decreasing trend follows slightly more saline conditions at most locations during the 2017-2019 drought which resulted in low flows and evaporative concentration of salts. Similarly, DO has trended higher over the last two years period due to higher flows and stream turbulence.

Anomalous water quality effects are noted in streams that have been directly mined under by previous longwalls (e.g. WC21, SC10C, LA4, DCC). Those effects include transient or persistent increases in EC, increases (or decreases) in pH and increases in dissolved metal concentrations such as Fe, Mn, Al and Zn. Iron staining in creek beds is commonly associated with watercourses that have been directly mined beneath or are within the mining area of influence. Over the last two years, new or recurrent iron staining has been noted on Wongawilli Creek (see Section 4.5), WC21, LA5 and SC10C.

Table 10. Summary of surface water quality observations and trends

Catchment	Field parameters (EC, pH and DO)	Dissolved metals
Wongawilli Creek	Downstream (WC_FR6): Baseline median EC = 99 µS/cm, pH = 6.0; DO = 92.8%. No adverse trends during reporting period compared with upstream control (WWU1). **Iron-staining** from Pool50 downstream to Rockbar12 in August 2021 (See Section 4.5, below) **WC_FR6 TARP: None in review period**	Downstream (WC_FR6): Baseline median Fe = 0.28, Mn = 0.04, Al = 0.04, Zn = 0.004 mg/L WC_FR6: No adverse trends WC_Pool38,49: Increasing trend in Fe, Mn in 2021 (Coincident with iron-staining)
Wongawilli Creek tributaries	WC7: No adverse trends WC12: No adverse trends WC15: No adverse trends WC21: Increasing trend in EC and increase in pH at Pool 5 after Longwall 10. Fracturing / Loss of flow.	WC7: No adverse trends WC12: No adverse trends WC15: Increasing Zn trend in Pools 2 and 9 WC21_Pool5: Elevated Fe and Mn in mid-2021; declined in late 2021; increasing sulfate from 2020.
Donalds Castle Creek	Downstream (DCC_FR6): Baseline median EC = 116 µS/cm, pH = 5.5; DO = 89.1%. Decline in EC and pH and decrease in DO in 2020-2021; No significant trends further downstream (at DCL3). Upstream tributary sites show decline in pH to ~4.5 after Longwall 13 (DC Pools 16, 19, 20, 32, 34) **DCC_FR6 TARP: None in review period**	DCC_FR6: Increase in Sulfate, Zn, Al and Mn after Longwall 14; Trends not evident further downstream at DCL3. Upstream sites: DC13_Pool2B and DC_Pool22; Transient increases in Fe, Mn, Al, Zn after Longwall 13; Declined to near baseline levels during 2020-2021.
Lake Avon tributaries	Lake Avon (LA5_S2): No adverse trends. LA4: Fracturing / loss of flow after Longwall 13; Increase in EC; decrease in pH and DO when flow returned in 2020-2021. LA2: Upper reaches mined under by Longwall 17 resulting in loss of flow; no adverse trends, although sampling sparse in 2021 due to low water levels. **LA4_S1 TARP: Level 3for EC and pH** (Section 4.4)	Lake Avon: Slight increase in Fe, Mn, Al and Zn associated with 2017-2019 drought. Declining trends in 2021. LA4: Increase in Fe, Mn, Al, Zn and Si when flow returned in 2020-2021. LA2: No adverse trends, although sampling sparse in 2021 due to low water levels.
Avon River	No adverse trends in EC, pH or DO. EC declined in 2020-2021 following 2017-2019 drought.	No significant adverse trends.
Lake Cordeaux tributaries	Lake Cordeaux (SANDY CREEK ARM): No adverse trends **Lake Avon (SC Arm) TARP: None in review period**	Small spike in concentrations of Fe and Mn associated with 2017-2019 drought. No other adverse trends.
Sandy Creek	SCk_Rockbar5: Baseline median EC = 88 µS/cm, pH = 5.2; DO = 81.4%. Slight increase in EC from 2017; no other adverse trends. SC10: Increase in EC from 2017; increase in pH to ~6.5 from 2020. SC10C: Increase in EC (to ~260 µS/cm), decrease in pH (to ~3.8) and DO in Pool 1 after Longwall 8 mined under tributary. pH returned to ~6.2 from 2019. EC declining. **SCk_Rockbar5 TARP: None in review period**	SCk_Rockbar5: Small increase in Fe, Mn from 2020; small increase in Zn from 2016. SC10_Rockbr3: Small increase in Fe, Mn from 2019; small increase in Zn from 2016. SC10C_Pool1: Increase in Fe, Mn, Al, Zn, Si and sulfate following Longwall 8. Declining trends since 2020.
Cordeaux River	No Adverse trends	CR_S1 and CR_S2: Slight increase in Fe, Mn, and Al from 2020.

4.2 Quantitative assessment of water quality trends

WaterNSW in its review of the Surface Water components of the Longwall 16 End of Panel Reporting, endorsed the recommendation of the Independent Advisory Panel for Underground Mining (IAPUM) that "*A method of quantifying and reporting trends in key water quality indicators (both concentrations and loads) should be trialled in addition to applying the proposed water quality TARPs.*"

During 2021 a methodology for trend analysis was developed and trialled at two monitoring locations on Wongawilli Creek and Donalds Castle Creek (HGEO, 2021a). The methodology was reviewed and considered appropriate by WaterNSW. Trend analysis is carried out as follows:

- Generate a flow-corrected residual timeseries by applying the LOWESS smoother to concentration versus stream discharge data.
- For each specified time period, calculate the Mann-Kendall test statistic for significance at the 5% significance level; the Theil-Sen slope; and compare the mean concentration during the period with the baseline period using the non-parametric Mann-Whitney U rank sum test statistic.
- Trend analysis should be carried out on field EC, pH and DO, and sulphate, dissolved Fe, Mn, Al, Zn.
- Tabulate and discuss significant trends, including comparison with control site(s). Trend analysis should be carried out for monitoring sites with associated flow gauges on the major 3rd order streams WC_FR6, DCC_FR6), SCk_Rockbar5 and an appropriate control site (O'Hares Creek, or WWU4).

4.2.1 Trend analysis results

Flow-corrected water quality time series and tabulated results are included in Appendix A2. A summary table, highlighting results of statistical significance is provided in Table 11, below.

Table 11. Summary of flow-corrected water quality trends

Parameter	WC_FR6	DCC_FR6	SCK_Rockbar5	WWU4 (Control)
EC (uS/cm)	↗ (1 yr, 3yr) ▲ (1 yr)	▲ (1 yr, 3 yr)		▲ (1 yr, 3 yr)
pH (field)		↘ (1 yr, 3 yr) ▼ (1 yr, 3 yr)		
DO (%)		▼ (3 yr)		
SO4 mg/L)	↗ (1 yr)	▲ (1 yr, 3 yr)	↗ (3 yr)	↗ (3 yr)
Fe (Dissolved, mg/L)			↗ (3 yr)	
Mn (Dissolved, mg/L)		▲ (1 yr, 3 yr)	↗ (3 yr)	
Zn (Dissolved, mg/L)		▲ (1 yr, 3 yr)		↗ (3 yr)
Al (Dissolved, mg/L)		▲ (1 yr, 3 yr)		
Tests:	Mann-Kendall nonparametric test for ordinal trend (flow-corrected concentration, time order)		Mann-Whitney U test (non-parametric) for difference in means of 2 independent samples	
Symbols:	↗ Increasing trend (5% Significance)	↘ Decreasing trend (5% Significance)	▲ Above BL mean (5% Significance)	▼ Below BL mean (5% Significance)

The trend analysis results reflect the qualitative assessment presented in the previous section. For example:

- At DCC_FR6, the analysis identifies a significant decrease in pH in the last 1 year and 3 years compared with the baseline period (in terms of trend and mean). The trend is obvious from a flow-corrected time-series plot (Figure 9, top-right plot) and in the non-corrected time-series plots in Appendix A. Increases in sulfate, Mn, Zn and Al are confirmed, noting that similar trends are not observed at DCL3 downstream of this location.
- At WC_FR6, trends in EC and sulfate are identified in flow-corrected data. With reference to the time-series plots in Appendix A it is noted that in both cases that both EC and sulfate remain within past observed ranges and similar trends are apparent in the upstream control site (WWU4).
- At SCk_Rockbar5, trends are identified over the last 1 year and three years for sulfate, Fe and Mn, reflecting observations in Table 10. These trends reflect contributions from tributary SC10C which was mined under by Longwall 8.

The plots in Figure 9 also show how trend analysis can produce apparently conflicting or non-intuitive results, depending on the time-period chosen. Results should therefore be interpreted with reference to both the flow-corrected and non-corrected hydrographs. For example, a combination of climatic and mining effects resulted in highly variable water quality at DCC_FR6 during the 2017-2019 drought. The Mann-Kendall trend analysis identifies significant declining trends in EC and sulfate over the last 1 year and 3 years. The Locally weighted regression trend (LOWESS trend) smooths over short-term fluctuations and reflects the broader post-baseline trend (which is slightly increasing). Furthermore, The Mann-Whitney test identifies significant differences in mean concentrations between periods independently of the underlying trends. For example, the analysis identifies a significant increase in EC at DCC_FR6 in the last year compared with the baseline, despite trending to within the baseline range during 2021. Nevertheless, the methods provide useful confirmation of observed trends.

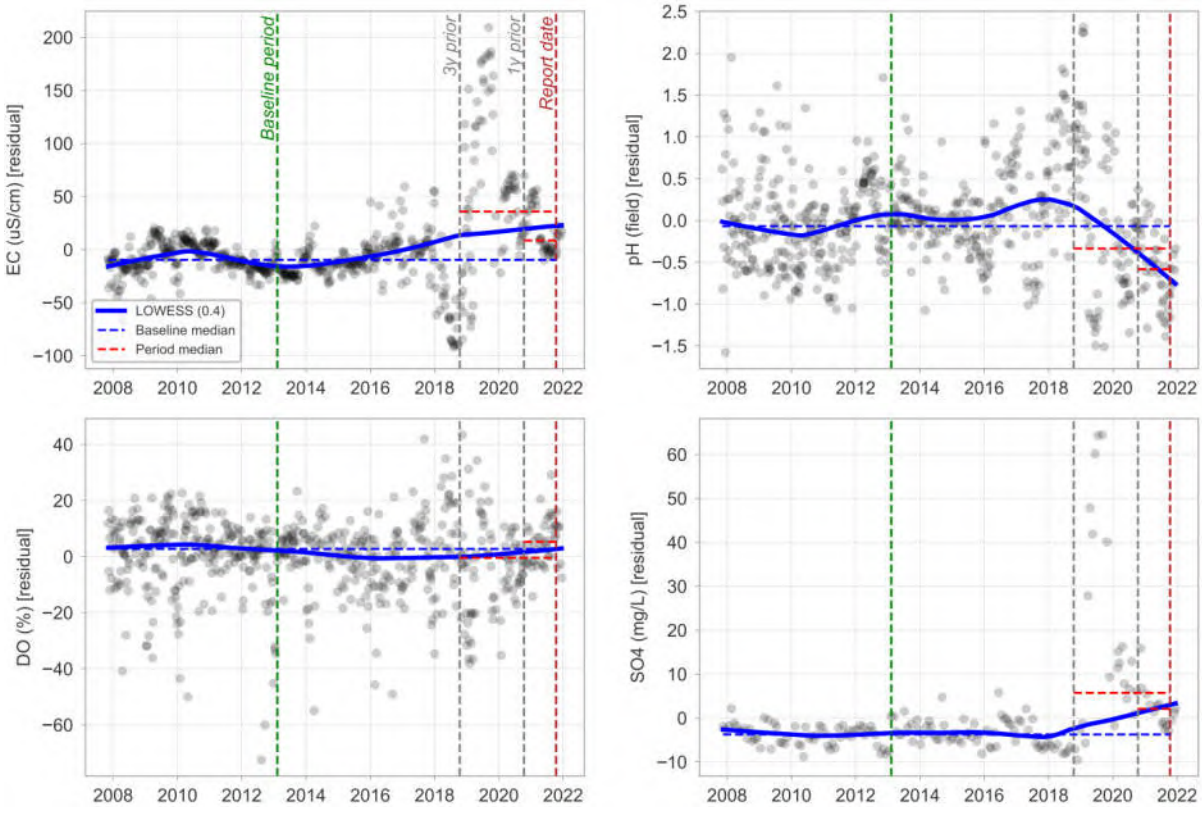

Figure 9. Flow-corrected time-series plots of selected water quality parameters at DCC_FR6

4.3 Catchments within Longwall 17 area of influence

Longwall 17 passed beneath the main second order watercourse, tributary LA2, between 13/12/2020 and 16/3/2021. No adverse trends in field parameters or dissolved metals are noted, although sampling in the latter part of 2021 was sparse due to low water levels following the passage of Longwall 17.

Longwall 17 passed beneath the upper reaches of WC15 (within Swamp 14) between 18/6/2021 and 27/6/2021. There are no adverse trends in field parameters; however, Zn shows an increasing trend at Pool 2 and Pool 9 from 2019 (Longwall 15).

Longwall 17 passed beneath the upper reaches of WC12 on 12/9/2021. No adverse trends are apparent, although monitoring of the watercourse started in 2018 after completion of Longwall 13.

4.4 TARP triggers at tributary LA4

LA4 is a tributary to Lake Avon. Its catchment overlaps with Longwalls 12 and 13 in Area 3B. Longwall 12 passed beneath the upper reaches of LA4B towards the end of April 2016. Longwalls 13 and 14 commenced at distances of 275 m and 295 m from LA4 monitoring site LA4_S1 on 4/3/2017 and 27/5/2018, respectively.

Impacts to the LA4 watercourse, including fracturing of the creek bed and diversion of flow were reported in End of Panel Reports for Longwalls 12, 13 and 15. At the gauging site LA4_S1, pooling was insufficient to collect samples between mid-2017 and mid-2020 due to a combination of mining related flow-diversions and low rainfall conditions. Sampling of the site resumed in mid-2020 following higher rainfall and more frequent ponding and flow since that time. Water quality TARP triggers were recorded in March, June, and July 2021, reflecting a sustained change in water quality since the return of flow to the site.

4.5 Iron-staining in Wongawilli Creek

In August 2021, an increase in iron staining was observed along reaches of Wongawilli Creek adjacent to Areas 3A and 3B during routine monitoring. The observations corresponded to a Level 3 trigger according to the Dendrobium Area 3B Watercourse Impact Monitoring, Management and Contingency Plan (WIMMCP). The observation was reported by IMC on 9/8/2021 and an assessment was carried out to determine the root cause of the impact and recommend appropriate management responses (HGEO, 2021b). The assessment included review of surface and groundwater monitoring along Wongawilli Creek and analysis of additional samples of creek and spring water and iron deposits. The main findings are as follows:

- The most noticeable iron-staining effects extended over a 2.9 km reach from WC_Pool 50 to WC_Rockbar 12. The source of the iron staining was identified as a spring located on the valley slope of Wongawilli Creek, approximately 35m to the east and upslope from WC_Pool 50.
- A review of water chemistry monitoring found that, since early 2021, the concentration of dissolved iron increased immediately downstream of the slope spring relative to pre-2021 levels. The concentration peaked in August 2021 and has decreased since. Dissolved iron concentration returns to below-median levels at, and downstream of, Pool 20, corresponding to the reach of creek bed affected by iron staining in August 2021 (Figure 10).
- Samples from the slope spring on Wongawilli Creek and another spring at WC12 have high dissolved iron concentrations (~20 mg/L) and manganese (1.8 mg/L) relative to samples

collected from Wongawilli Creek. Other metals are relatively low in concentration and mostly below relevant ANZECC guideline trigger levels for freshwater aquatic species.

- Samples of iron floc contain 6 to 8% iron by weight. Other elements such as manganese, aluminium and barium are present at lower concentrations. Most metals are below detection and/or below the ANZECC guideline for sediments in aquatic ecosystems.
- High rainfall since 2020 and individual high rainfall events in March and May 2021, have resulted in widespread recovery of groundwater levels and reactivation of springs along creek lines in several sub-catchments. Examples of groundwater recovery at monitoring bore S2220 installed above extracted Longwall 9, ~1 km from the iron spring is shown in Figure 11. Other evidence for recovering groundwater beneath Wongawilli Creek is shown in Figure 27.

It was concluded that the appearance of iron staining along Wongawilli Creek in August 2021 was caused by increasing groundwater levels and reactivation of slope springs in response to high rainfall and groundwater recharge events in March and May 2021. The groundwater discharge is naturally elevated in dissolved iron, resulting in visible iron staining and accumulation of iron floc (iron oxyhydroxides and iron bacteria) on exposure to air or on mixing with oxygenated water. Spring discharge is likely facilitated by fracturing associated with mine subsidence; however discharge via natural fractures is also possible (and was observed during baseline monitoring). It is likely that spring flow and iron staining will continue to decline over time as groundwater levels stabilise or decrease, and as the fractures weather and age. The extent of iron staining and elevated concentration of dissolved iron in Wongawilli Creek remain within the range of predicted impacts. The assessment recommended that additional water samples should be collected from the slope springs on Wongawilli Creek and WC12.

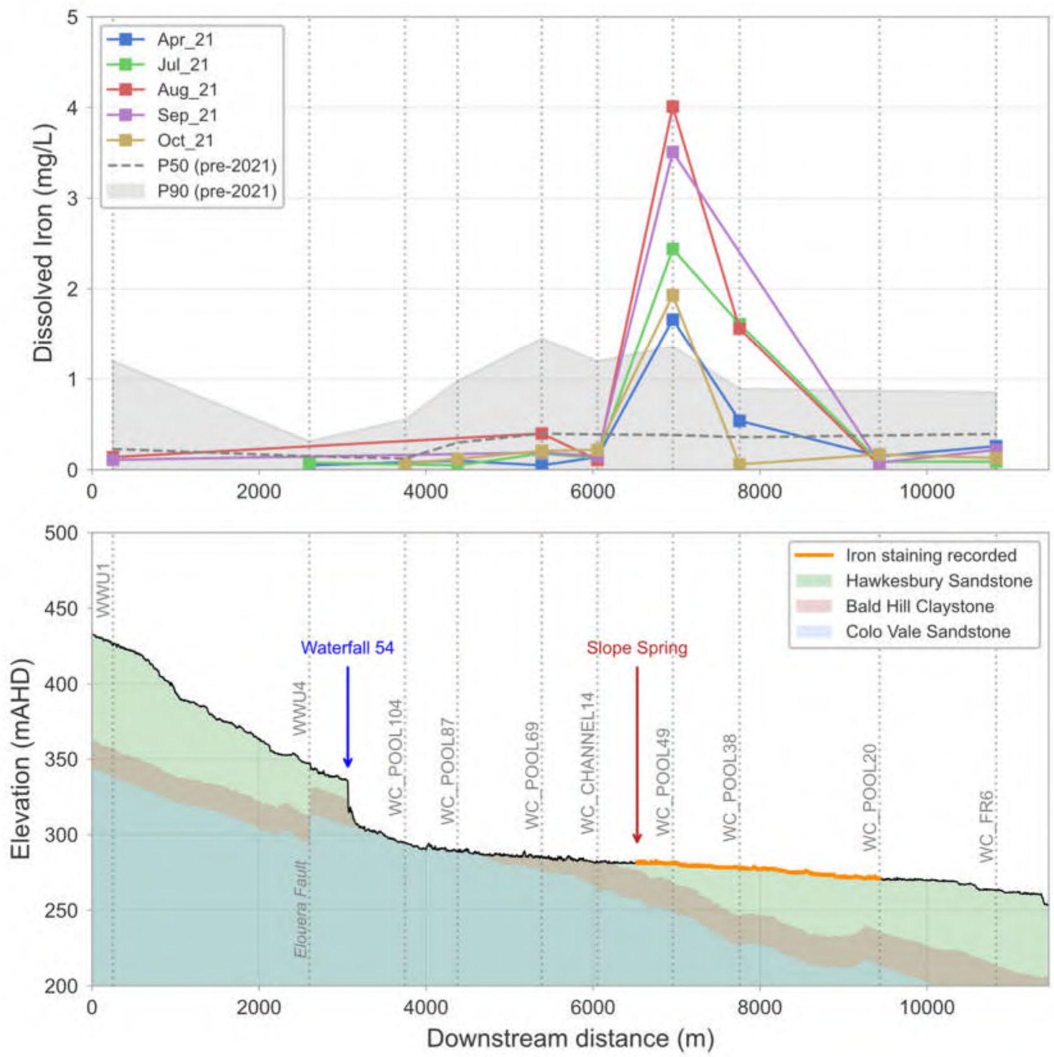

Figure 10. Dissolved iron concentration in Wongawilli Creek (from HGEO 2021)

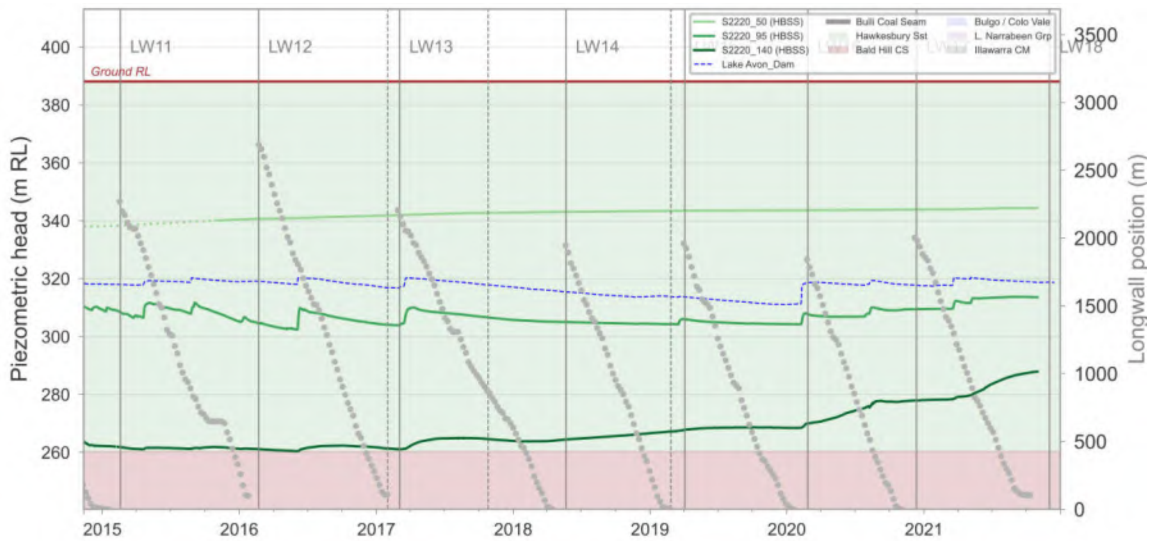

Figure 11. Groundwater hydrograph at monitoring bore S2220 (total piezometric head)

5. Assessment of surface water flow effects

5.1 Surface Water Flow TARPs

The surface water flow assessment and relevant TARPs have been modified from those used previously for Area 3B End of Panel reports. Consultation with agencies during 2018-2019 led to final agreement in early 2020 of new TARPs, as outlined in the WIMMCP (South32, 2020b).

This assessment of surface water flow in this End of Panel report relies on comparison against flows at Reference Sites, as recommended by the IEPMC (IEPMC, 2019, 2018). The revised and agreed assessment methods are described in more detail in (Watershed Hydrogeo, 2019a). Other recommendations of the IEPMC are addressed in this assessment, as listed in Table 12.

Table 12. Recommendations of the IEPMC (2018) (revised as IEPMC, 2019a)

RECOMMENDATION / COMMENT	RESPONSE / ACTION
Assessment of impacts to be made against the full post-mining period, not longwall by longwall.	**Implemented.** Assessment of effects is now reported for the complete post-mining period at each site, rather than for each longwall. This provides an assessment of cumulative effects.
The EOP reports to provide more information on the data sources for rainfall, evaporation and the monitoring sites.	**Implemented.** This is presented Appendix B and C, noting that rainfall and evaporation are not required for assessment against Reference Sites.
Document the specific sources of rainfall and evaporation data used in the rainfall-runoff modelling.	**Implemented.** The rainfall and evaporation data sources are documented in Appendix B, noting that rainfall and evaporation are not required for assessment against Reference Sites.
Discussion of flow monitoring errors and their impact on assessing compliance should be published and peer reviewed.	**Implemented** (On-going). IMC are progressing with a review of gauging station accuracy. This report has been issued (EnviroMon, 2019) but will be extended in the near future to include other sites.
Use techniques to supplement the rainfall-runoff modelling. This has been done in some EOP reports, including for LW11 but has been excluded from the LW12 and LW13 EOP reports	**Implemented**. The use of Reference Sites, as documented in WatershedHG (2019a) and agreed by agencies, is now adopted for this assessment.
There is no validation on flow measurements from outside the calibration period.	**Not yet implemented:** The use of Reference Sites as the basis for assessment was agreed by agencies in the approved WIMCCP. More recent feedback by IAPUM recommended that comparison against rainfall-runoff modelling should be re-instated (Section 1.3). This has been done so for a limited number of sites (Section 5.3.1), and if deemed necessary can be expanded in future.
Given the criticality of low flows for this project, attempts to improve the low flow modelling should continue, and should be reported and peer reviewed.	**Not yet implemented:** As above. Peer review to occur early 2022.

The agreed Assessments A, B, and C are respectively focussed on assessing:

- general hydrological behaviour compared with Reference Sites,
- the frequency and duration of ecologically-significant cease-to-flow events compared with Reference Sites; and
- changes to median flow compared with Reference Sites which is now the agreed measure of the water resource availability in each sub-catchment.

A further assessment, Assessment D is specific to Wongawilli Creek, relies on comparison of qualitative flow data from gauging stations and semi-quantitative field observations by IMCEFT along the "middle reach" of Wongawilli Creek, which has been shown in the recent past (e.g. in Watershed HydroGeo, (2018)) to be subject to baseflow loss due to depressurisation of groundwater systems as a result of mining activity.

5.2 Performance Measures

Performance Measures have also been agreed and are documented in the WIMMCP. These are outlined in Table 13. The assessment of these is presented in Section 5.4.

Table 13. Area 3B Surface flow Performance Measures

PERFORMANCE MEASURE	AGREED MEASURE
Wongawilli Creek – minor environmental consequences	Assessment Methods C and D, to be compared against predictions made in contemporary groundwater modelling conducted to the satisfaction of the Secretary to assess whether effects that cannot be explained by natural variability "exceed prediction".
Donalds Castle Creek – minor environmental consequences	Assessment Method C to be compared against predictions made in contemporary groundwater modelling conducted to the satisfaction of the Secretary to assess whether effects that cannot be explained by natural variability "exceed prediction".
Lake Avon – negligible reduction in the quantity of surface water inflows to Lake Avon	Surface water inflows calculation = [Impacts at gauged catchments (LA2 + LA3 + LA4 + NDT1) + estimated impacts at ungauged but undermined catchments (e.g. LA5)] / [total inflow to LA].
Cordeaux River – negligible reduction in the quantity of surface water inflow to the Cordeaux River at its confluence with Wongawilli Creek	Flow reduction as determined from measured flow gauging station WWL_A (or WWL, whichever gauge is being used).

5.3 Assessment for Longwall 17

The following sections present the analysis and results of the agreed Assessments A, B, and C for each sub-catchment relevant to Area 3B. This is followed by Assessment D for the mid-reach of Wongawilli Creek and then followed by assessment against the agreed Performance Measures. The detail and criteria for each assessment are outlined in the WIMMCP (South32, 2020b), as described in Section 5.1.

At the gauged sub-catchments around Area 3B, the assessment consists of a three-step approach (A, B, and C as listed below) to identify and assess any changes in hydrology at the assessment sites in relation to the agreed reference sites. A fourth assessment (D) is carried out for Wongawilli Creek.

The four assessment methods are as follows:

- Change in flow exceedance ("Q%ile") behaviour compared to Reference Sites. In essence, this aims to quantify an otherwise visual or qualitative assessment of flow behaviour (compared to normalised Reference Site flow). This test is considered a broad indicator of hydrological behaviour.

Greater proportion of time with lower flow than expected based on Reference Q%	Trigger level (Inference)
Proportion of time increased by < 10%	Not triggered – no evidence of impact (or impact below detection)
Proportion of time increased by >= 10%	Level 1
Proportion of time increased by >= 15%	Level 2
Proportion of time increased by >= 20%	Level 3

- Relative change in the frequency of cease-to-flow days compared to that at Reference Sites. This assessment is focussed on changes that are likely to be significant to ecological values.

Greater proportion (%) of time that cease-to-flow conditions occur	Inference
<= "natural variability" + 5%	No evidence of impact (or impact below detection)
> "natural variability" + 5%	Level 1
> "natural variability" + 10%	Level 2
> "natural variability" + 20%	Level 3

- Relative change in median flow ("Q50") compared to Reference Site flows. This assessment is focussed on a measure of the water resource potential of each sub-catchment, noting that 'average' flow is not used due to the high uncertainty associated with high flows. The uncertainty is typically less at moderate flows (EnviroMon, 2020) – see charts in Appendix C5, and the calculation of median flow is much less sensitive to uncertainties; and

Relative change in Q50	Inference
<= "natural variability" + 10%	No evidence of impact (or impact below detection)
> "natural variability" + 10%	Level 1
> "natural variability" + 15%	Level 2
> "natural variability" + 20%	Level 3

Note that this is calculated as a % reduction compared to measured pre-mining Q50 at the assessment site. It is proposed that this be changed to % reduction from 'expected Q50'.

- Assess whether observed dry pools and 'cease-to-flow' conditions along Wongawilli Creek between WWU and WWL gauging stations are anomalies, and indicative of mining-related drawdown along that valley (as described in Watershed HydroGeo, 2018).

Observations of no flow	Inference
Observation that the subject Creek has ceased to flow at spatially consecutive observation sites.	Level 2 → Carry out Assessment D.

If any of these indicate an impact is likely to have occurred, then the EOP will describe the Impact as it relates to one or more of the broad hydrological behaviours, a reduction in the water resource Indicator, or an effect that could modify or impact upon the ecological values of the stream.

5.4 Assessment against surface water flow TARPs

The following sub-sections (Sections 5.4.1 to 5.4.11) summarise the TARP Assessments A, B and C for each relevant sub-catchment using the criteria outlined in the previous section. A secondary check for sites that do not Trigger Level 3 for Assessment C is presented in Section 5.4.16.

TARP Assessment D for flow conditions along Wongawilli Creek is presented in Section 5.5.

5.4.1 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 again by Longwalls 10 and 11. Longwalls 12 to 17 did not directly mine under this sub-catchment.

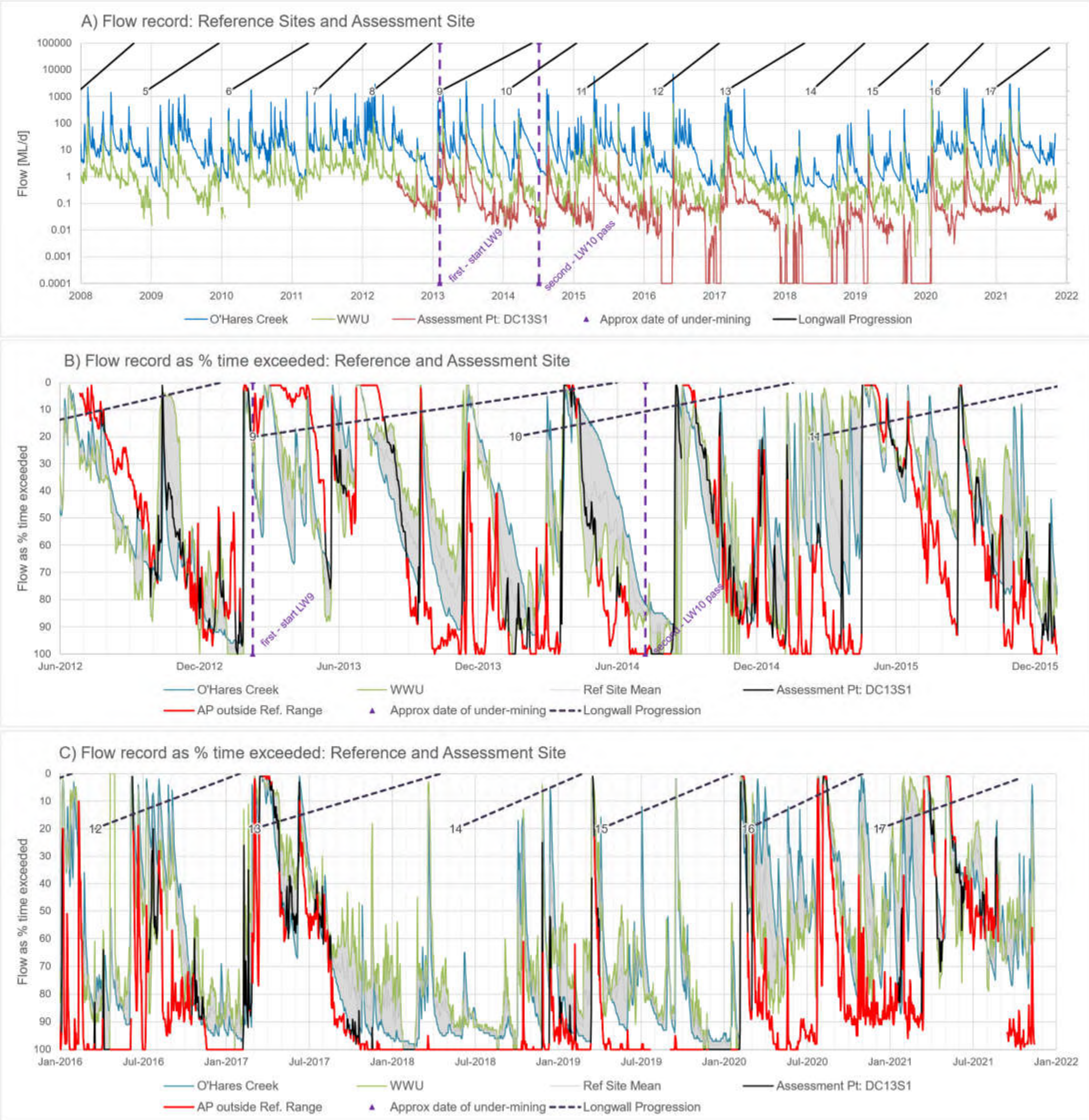

Figure 12. DC13S1 vs Reference Sites A) flows; B) and C) flow duration statistics [Q%iles]

Figures 12B and 12C show the Q%ile hydrograph for the DC13 Assessment Point versus the Q%ile hydrographs for the Reference Sites, O'Hares Creek and WWU. For this assessment 'natural variability' is defined as the range between the Q%ile for the Reference Sites on each day.

Table 14. Flow assessments A, B and C for the sub-catchment to DC13S1

DC13S1	Pre-mining	Post-mining	
	to start LW9	end LW17 + 30 days	
	27/06/2012	10/02/2013	
	9/02/2013	12/11/2021	
Method A:	**Assessment of flow variability:**		
Period	Compared to Reference Sites, gauge is at: Lower flow (higher Q%ile)		Higher flow (lower Q%ile)
Pre-mining	14%	59%	of the time
Post-mining	71%	10%	of the time
Change	57%	-49%	of the time
		Assessment A:	Level 3
Method B:	**Change in cease-to-flow frequency:**		
	Cease to flow as % of daily record during	pre- and post- mining periods	
Site	Pre-mining	Post-mining	Change
O'Hares Creek	0.0%	0.0%	0.0%
WWU	10.1%	4.9%	-5.1%
Average Ref. Site change (= natural variability):			-2.6%
DC13S1	0.0%	15.4%	15.4%
		no. of cease-to-flow days increased:	18.0%
		Assessment B:	Level 2
Method C:	**Change to median flow (Q50):**		
Reference Site Q50 [ML/d]	Q50 (pre-)	Q50 (post-)	% Change
O'Hares Creek	5.46	6.60	21%
WWU	0.40	0.41	-3%
Natural variability	Min	Mean	Max
from 2 x Ref. Sites	-3%	12%	21%
Assessment Site Q50 [ML/d]	Q50 (pre-)	Q50 (post-)	% Change
DC13S1	0.126	0.053	-58%
'Expected' post-mining Q50 at	Min	Mean	Max
DC13s1	0.129	0.140	0.152
Change beyond natural	Min	Mean	Max
% change (of pre-mining Q50)	-60.5%	-68.5%	-76.4%
% change (of 'expected' Q50)	-59%	-62%	-65%
ML/d change from natural	-0.076	-0.086	-0.096
		Assessment C:	Level 3

5.4.2 DCS2 – Donalds Castle Creek

The upper reach of Donalds Castle Creek lies across several Area 3B panels. This sub-catchment was first mined under by Longwall 9 (July 2013), then by Longwalls 10-12. Longwall 13 passed within 250 m of the creek in May-2017. Longwalls 14-17 have not mined directly under this catchment.

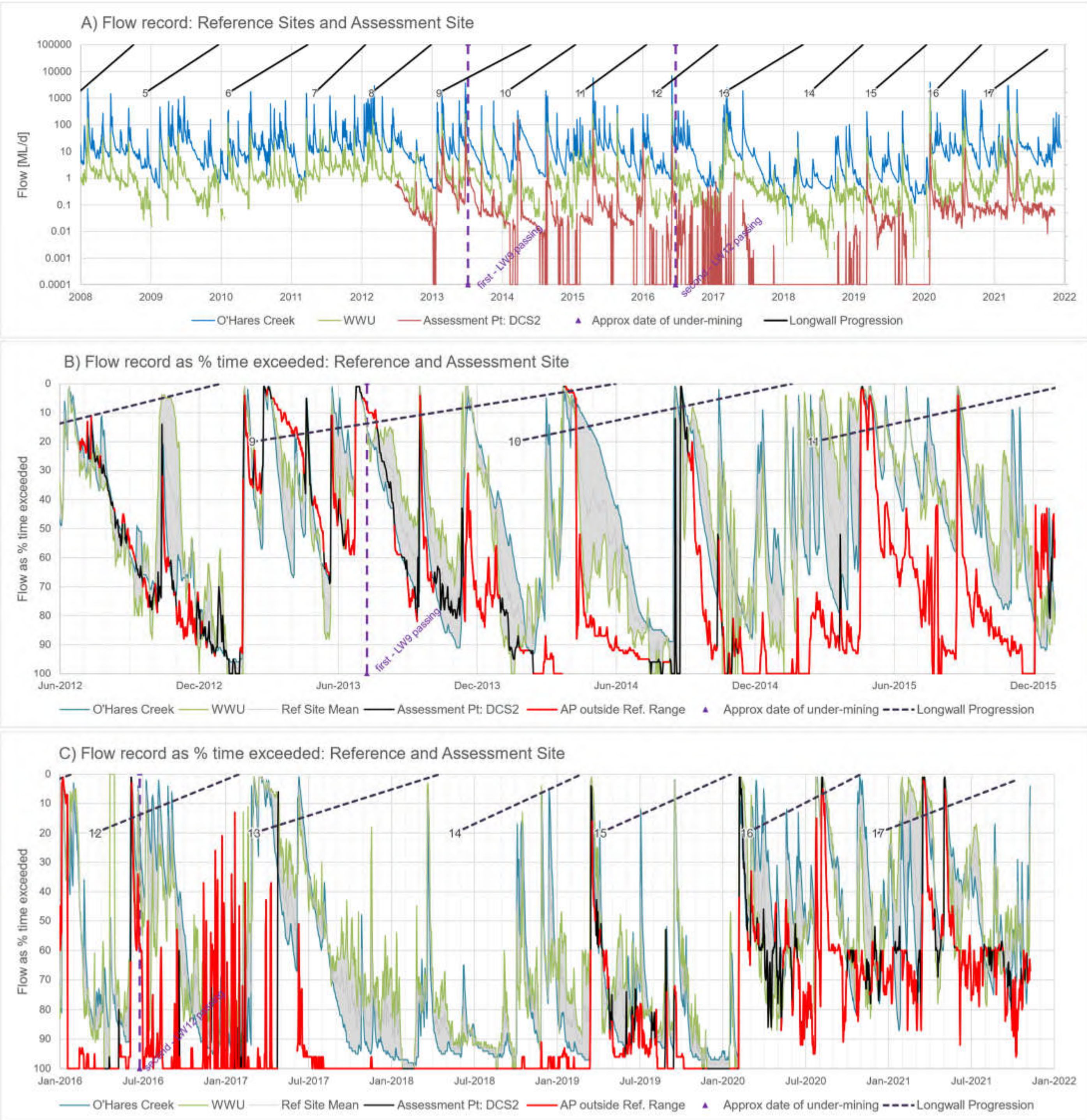

Figure 13. DCS2 vs Reference Sites A) flows; B) and C) flow duration statistics [Q%iles]

Figures 13B and 13C show the Q%ile hydrograph for the DCS2 Assessment Point versus the Q%ile hydrographs for the Reference Sites, O'Hares Creek and WWU. For this assessment 'natural variability' is defined as the range between the Q%ile for the Reference Sites on each day.

Table 15. Flow assessments A, B and C for the sub-catchment to DCS2

DCS2		Pre-mining	Post-mining	
		to LW9 passing	end LW17 + 30 days	
		27/06/2012	11/07/2013	
		10/07/2013	12/11/2020	
Method A:	Assessment of flow variability:			
Period	Compared to Reference Sites, gauge is at: Lower flow (higher Q%ile)			Higher flow (lower Q%ile)
Pre-mining	26%		34%	of the time
Post-mining	78%		5%	of the time
Change	51%		-28%	of the time
			Assessment A:	Level 3
Method B:	Change in cease-to-flow frequency:			
	Cease to flow as % of daily record during		pre- and post- mining periods	
Site	Pre-mining		Post-mining	Change
O'Hares Creek	0.0%		0.0%	0.0%
WWU	6.1%		5.2%	-0.9%
			Average Ref. Site change (= natural variability):	-0.1%
DCS2	2.9%		38.0%	35.1%
			no. of cease-to-flow days increased:	35.5%
			Assessment B:	Level 3
Method C:	Change to median flow (Q50)			
Reference Site Q50 [ML/d]		Q50 (pre-)	Q50 (post-)	% Change
O'Hares Creek		8.52	6.15	-28%
WWU		0.82	0.38	-54%
Natural variability		Min	Mean	Max
from 2 x Ref. Sites		-54%	-41%	-28%
Assessment Site Q50 [ML/d]		Q50 (pre-)	Q50 (post-)	% Change
DCS2		0.164	0.020	-88%
'Expected' post-mining Q50 at		Min	Mean	Max
DCS2		0.075	0.097	0.118
Change beyond natural		Min	Mean	Max
% change (of pre-mining Q50)		-33.7%	-46.9%	-60.0%
% change (of 'expected' Q50)		-73%	-79%	-83%
ML/d change from natural		-0.055	-0.077	-0.098
			Assessment C:	Level 3

5.4.3 DCU – Donalds Castle Creek

This catchment incorporates the headwater sub-catchments DC13 and DCS2 was mined under at the commencement of Longwall 9, and again by Longwalls 10-12, and marginally by Longwall 13. Longwalls 14-17 are beyond it (to the south). About 60% of the DCU catchment is not mined under.

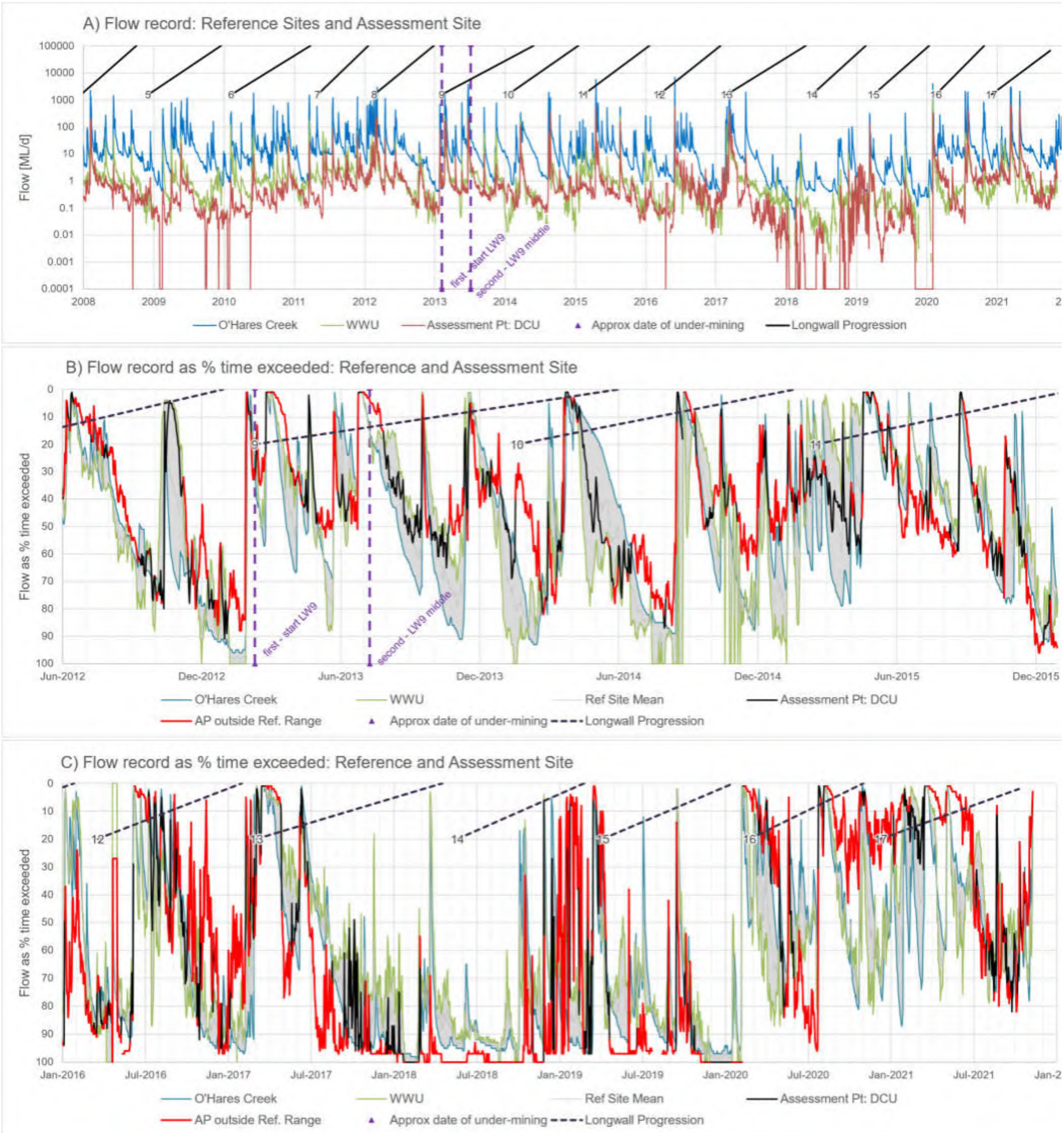

Figure 14. Comparison of DCU against Reference Sites A) flows; B) and C) flow duration statistics [Q%iles]

Figures 14B and 14C show the Q%ile hydrograph for the DCU Assessment Point versus the Q%ile hydrographs for the Reference Sites, O'Hares Creek and WWU. For this assessment 'natural variability' is defined as the range between the Q%ile for the Reference Sites on each day.

Table 16. Flow assessments A, B and C for the sub-catchment to DCU

DCU		Pre-mining	Post-mining	
		to LW9 passing	end LW17 + 30 days	
		27/06/2012	10/02/2013	
		9/02/2013	12/11/2020	
Method A:	Assessment of flow variability:			
Period		Compared to Reference Sites, gauge is at: Lower flow (higher Q%ile)	Higher flow (lower Q%ile)	
Pre-mining		47%	26%	of the time
Post-mining		38%	34%	of the time
Change		-9%	8%	of the time
			Assessment A:	Not triggered
Method B:	Change in cease-to-flow frequency:			
		Cease to flow as % of daily record during	pre- and post- mining periods	
Site		Pre-mining	Post-mining	Change
O'Hares Creek		0.0%	0.0%	0.0%
WWU		5.2%	4.9%	-0.3%
			Average Ref. Site change (= natural variability):	-0.2%
DCU		1.8%	9.3%	7.5%
			no. of cease-to-flow days increased:	7.7%
			Assessment B:	Level 1
Method C:	Change to median flow (Q50)			
Reference Site Q50 [ML/d]		Q50 (pre-)	Q50 (post-)	% Change
O'Hares Creek		11.64	6.60	-43%
WWU		1.03	0.41	-60%
Natural variability		Min	Mean	Max
from 2 x Ref. Sites		-60%	-52%	-43%
Assessment Site Q50 [ML/d]		Q50 (pre-)	Q50 (post-)	% Change
DCU		0.368	0.314	-15%
'Expected' post-mining Q50 at		Min	Mean	Max
DCU		0.146	0.177	0.209
Change beyond natural		Min	Mean	Max
% change (of pre-mining Q50)		45.7%	37.2%	28.6%
% change (of 'expected' Q50)		115%	77%	50%
ML/d change from natural		0.168	0.137	0.105
			Assessment C:	Not triggered

5.4.4 WC12S1 – Wongawilli Creek tributary

The end of Longwall 15 skirted the north-western edge of this sub-catchment and to within 250 m of the watercourse itself. Longwall 16 mined within 40 m of WC12, and Longwall 17 mined under this watercourse. No landscape impacts (cracking, iron-staining) have been reported by IMCEFT.

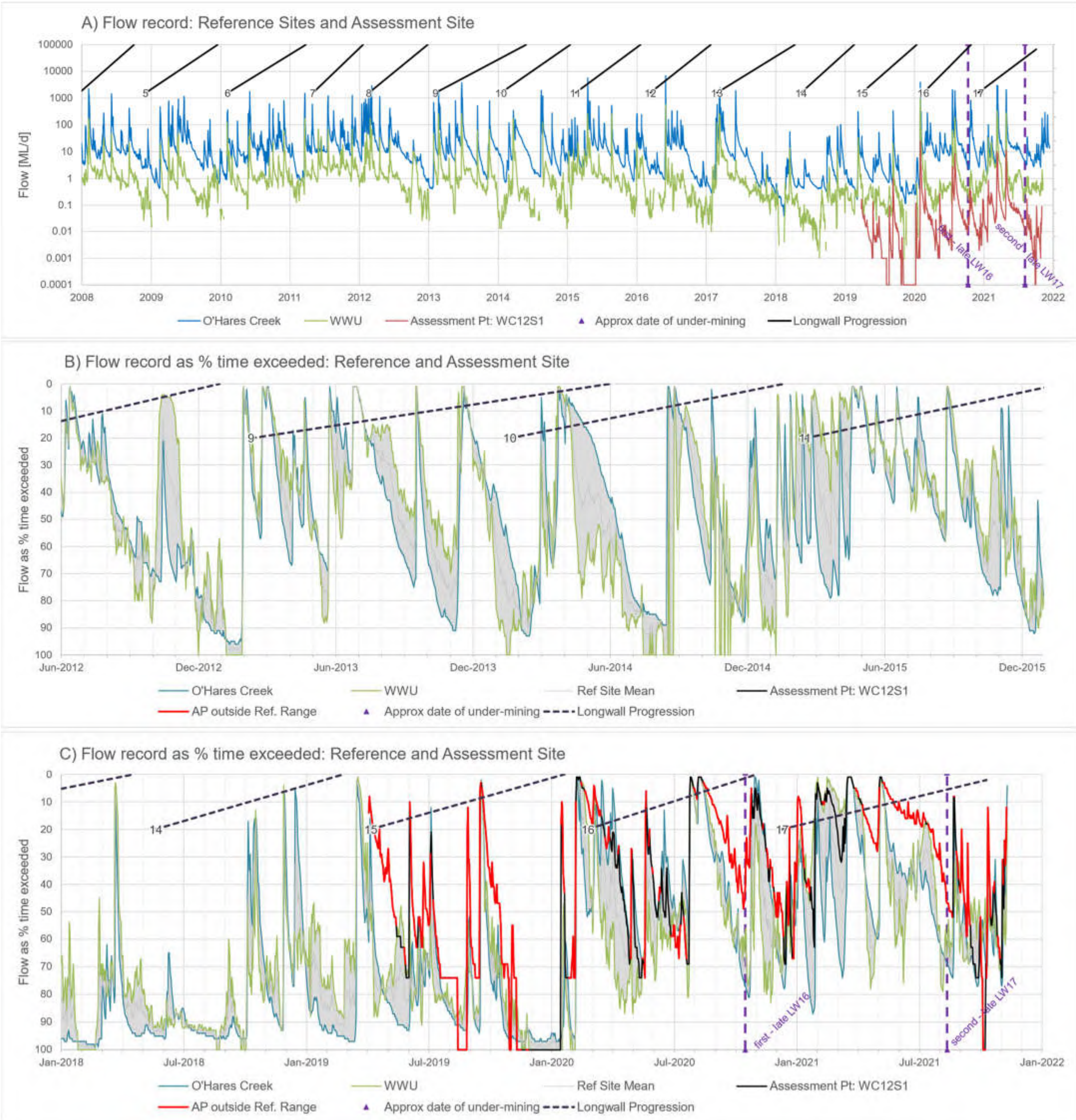

Figure 15. WC12S1 vs Reference Sites A) flows; B) and C) flow duration statistics [Q%iles]

Figures 15B and 15C show the Q%ile hydrograph for the WC12S1 Assessment Point versus the Q%ile hydrographs for the Reference Sites, O'Hares Creek and WWU. For this assessment 'natural variability' is defined as the range between the Q%ile for the Reference Sites on each day.

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Table 17. Flow assessments A, B and C for the sub-catchment to WC12S1

WC12S1	Pre-mining	Post-mining	
	to late LW16	end LW17 + 30days	
	5/04/2019	19/10/2020	
	18/10/2020	12/11/2021	
Method A:	**Assessment of flow variability:**		
Period	Compared to Reference Sites, gauge is at: Lower flow (higher Q%ile)		Higher flow (lower Q%ile)
Pre-mining	10%	57%	of the time
Post-mining	4%	62%	of the time
Change	-6%	5%	of the time
		Assessment A:	Not triggered
Method B:	**Change in cease-to-flow frequency:**		
	Cease to flow as % of daily record during	pre- and post- mining periods	
Site	Pre-mining	Post-mining	Change
O'Hares Creek	0.0%	0.0%	0.0%
WWU	11.0%	0.0%	-11.0%
		Average Ref. Site change (= natural variability):	-5.5%
WC12S1	14.7%	1.0%	-13.7%
		no. of cease-to-flow days increased:	-8.2%
		Assessment B:	Not triggered
Method C:	**Change to median flow (Q50)**		
Reference Site Q50 [ML/d]	Q50 (pre-)	Q50 (post-)	% Change
O'Hares Creek	5.09	10.26	102%
WWU	0.23	0.68	191%
Natural variability	Min	Mean	Max
from 2 x Ref. Sites	102%	146%	191%
Assessment Site Q50 [ML/d]	Q50 (pre-)	Q50 (post-)	% Change
WC12S1	0.009	0.036	300%
'Expected' post-mining Q50 at	Min	Mean	Max
WC12S1	0.018	0.022	0.026
Change beyond natural	Min	Mean	Max
% change (of pre-mining Q50)	198.4%	153.7%	109.1%
% change (of 'expected' Q50)	98%	62%	37%
ML/d change from natural	0.018	0.014	0.010
		Assessment C:	Not triggered

5.4.5 WC15S1 – Wongawilli Creek tributary

Longwall 12 came within 100 m of the sub-catchment. Longwall 13 mined under this catchment and approached to within about 20 m of this watercourse, and directly under the WC15A tributary). Longwall 14 approached to within 40 m of the watercourse. Longwalls 15-17 mined under WC15.

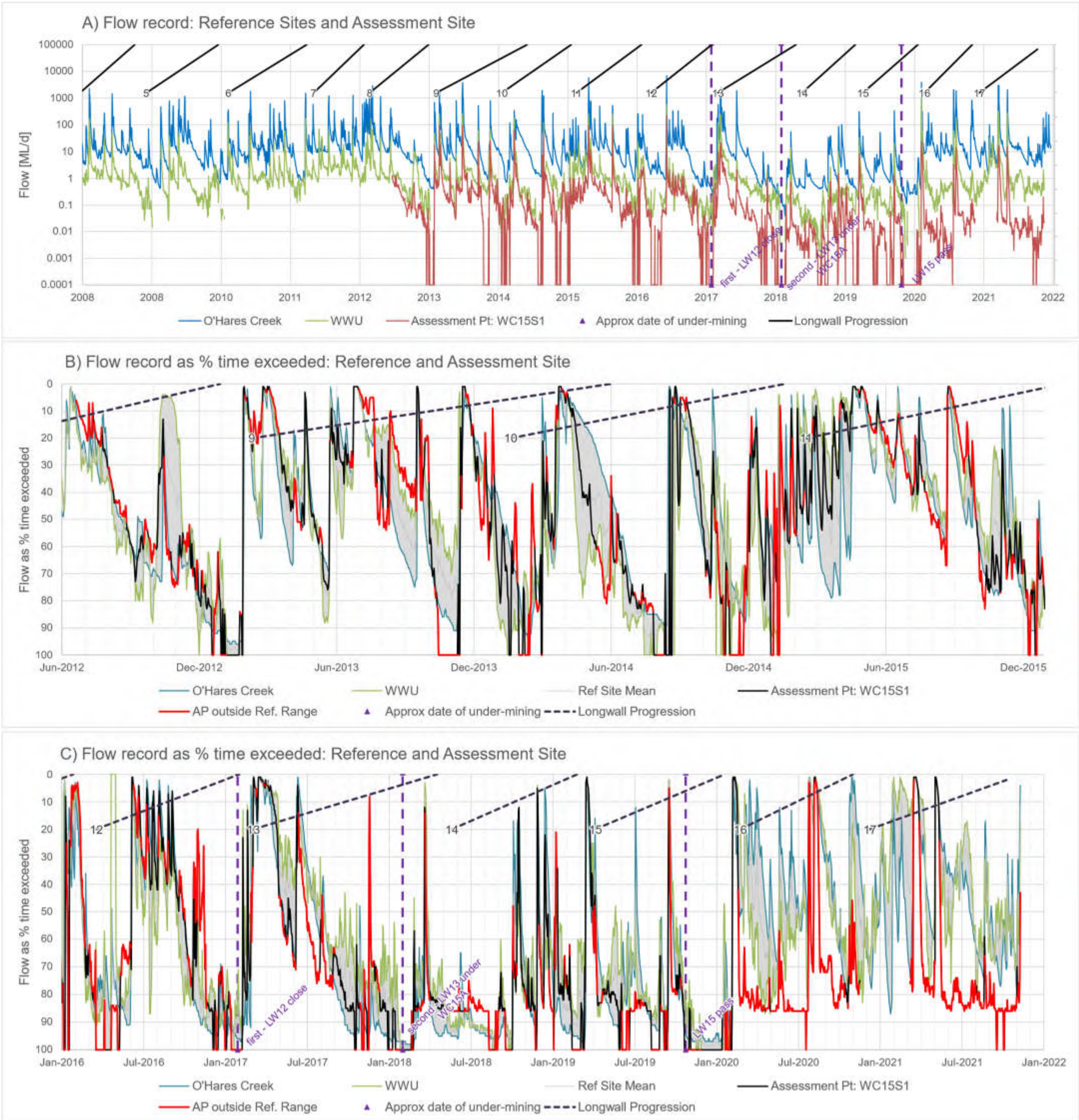

Figure 16. Comparison of WC15S1 against Reference Sites A) flows; B) and C) flow duration statistics [Q%iles]

Figures 16B and 16C show the Q%ile hydrograph for the WC15S1 Assessment Point versus the Q%ile hydrographs for the Reference Sites, O'Hares Creek and WWU. For this assessment 'natural variability' is defined as the range between the Q%ile for the Reference Sites on each day.

Table 18. Flow assessments A, B and C for the sub-catchment to WC15S1

WC15s1		Pre-mining	Post-mining	
		to LW12 approach	end LW17 + 30days	
		20/06/2012	29/01/2017	
		28/01/2017	12/11/2021	
Method A:	Assessment of flow variability:			
Period		Compared to Reference Sites, gauge is at: Lower flow (higher Q%ile)		Higher flow (lower Q%ile)
Pre-mining		23%	35%	of the time
Post-mining		56%	10%	of the time
Change		33%	-25%	of the time
			Assessment A:	Level 3
Method B:	Change in cease-to-flow frequency:			
		Cease to flow as % of daily record during	pre- and post- mining periods	
Site		Pre-mining	Post-mining	Change
O'Hares Creek		0.0%	0.0%	0.0%
WWU		4.8%	5.8%	1.0%
			Average Ref. Site change (= natural variability):	0.5%
WC15S1		12.1%	15.6%	3.5%
			no. of cease-to-flow days increased:	3.0%
			Assessment B:	Not triggered
Method C:	Change to median flow (Q50)			
Reference Site Q50 [ML/d]		Q50 (pre-)	Q50 (post-)	% Change
O'Hares Creek		8.46	4.52	-47%
WWU		0.58	0.33	-43%
Natural variability		Min	Mean	Max
from 2 x Ref. Sites		-47%	-45%	-43%
Assessment Site Q50 [ML/d]		Q50 (pre-)	Q50 (post-)	% Change
WC15s1		0.150	0.014	-91%
'Expected' post-mining Q50 at		Min	Mean	Max
WC15s1		0.080	0.083	0.086
Change beyond natural		Min	Mean	Max
% change (of pre-mining Q50)		-44.1%	-45.9%	-47.7%
% change (of 'expected' Q50)		-83%	-83%	-84%
ML/d change from natural		-0.066	-0.069	-0.072
			Assessment C:	Level 3

5.4.6 WC21S1 – Wongawilli Creek tributary

WC21, a tributary to Wongawilli Creek, was mined under late in Longwall 9, and has since been mined under by Longwalls 10-15. Longwalls 16 and 17 are located south of this sub-catchment.

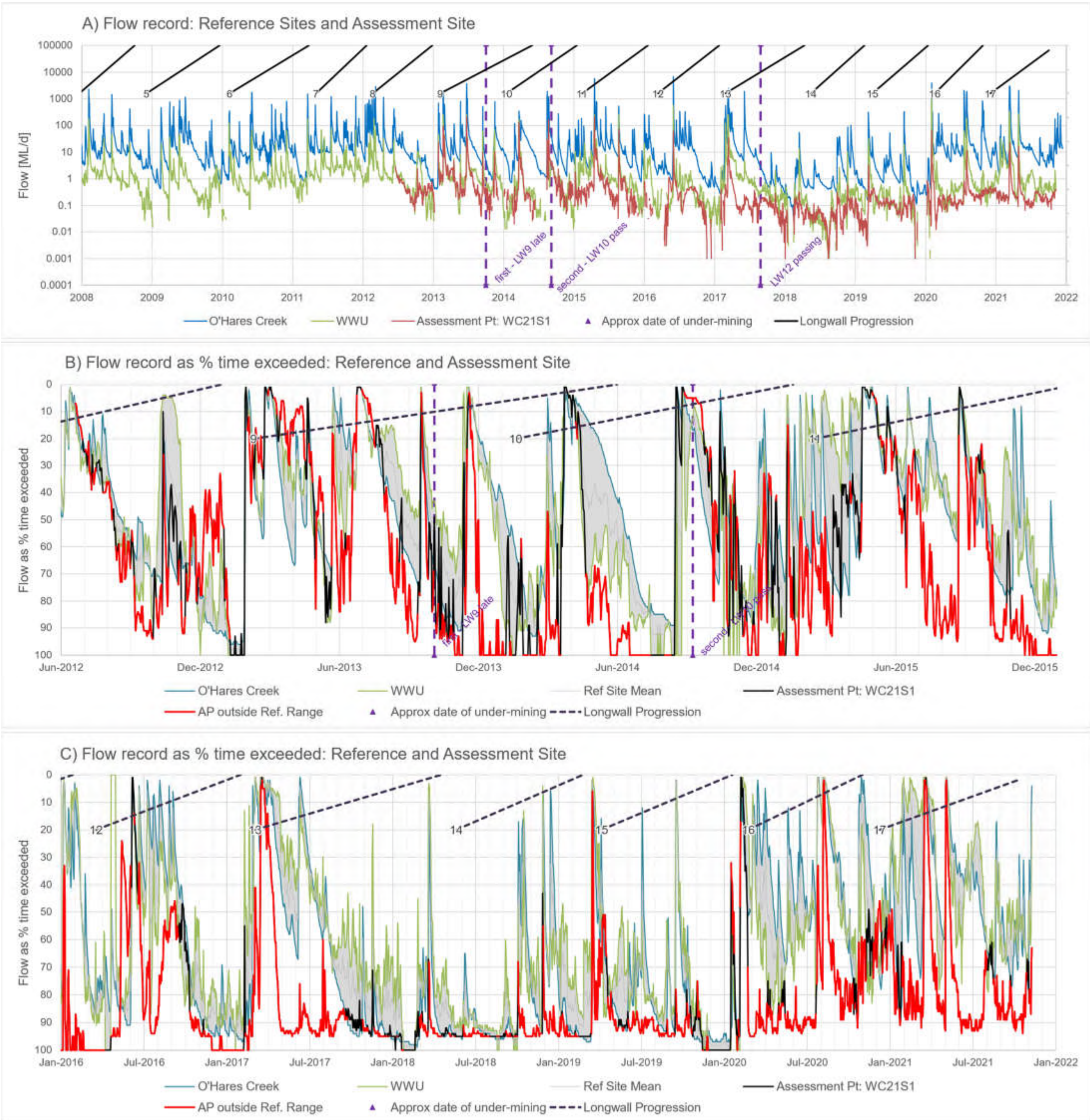

Figure 17. WC21S1 vs Reference Sites A) flows; B) and C) flow duration statistics [Q%iles]

Figures B and C show the Q%ile hydrograph for the WC21S1 Assessment Point versus the Q%ile hydrographs for the Reference Sites, O'Hares Creek and WWU. For this assessment 'natural variability' is defined as the range between the Q%ile for the Reference Sites on each day.

Table 19. Flow assessments A, B and C for the sub-catchment to WC21S1

WC21S1		Pre-mining	Post-mining	
		to LW9 late	end LW17 + 30days	
		20/06/2012	6/10/2013	
		5/10/2013	12/11/2021	
Method A:	Assessment of flow variability:			
Period		Compared to Reference Sites, gauge is at: Lower flow (higher Q%ile)		Higher flow (lower Q%ile)
Pre-mining		41%	34%	of the time
Post-mining		73%	5%	of the time
Change		31%	-29%	of the time
			Assessment A:	Level 3
Method B:	Change in cease-to-flow frequency:			
		Cease to flow as % of daily record during	pre- and post- mining periods	
Site		Pre-mining	Post-mining	Change
O'Hares Creek		0.0%	0.0%	0.0%
WWU		4.9%	5.3%	0.5%
			Average Ref. Site change (= natural variability):	0.2%
WC21S1		3.6%	14.6%	11.0%
			no. of cease-to-flow days increased:	10.8%
			Assessment B:	Level 2
Method C:	Change to median flow (Q50)			
Reference Site Q50 [ML/d]		Q50 (pre-)	Q50 (post-)	% Change
O'Hares Creek		8.90	5.93	-33%
WWU		0.90	0.36	-60%
Natural variability		Min	Mean	Max
from 2 x Ref. Sites		-60%	-46%	-33%
Assessment Site Q50 [ML/d]		Q50 (pre-)	Q50 (post-)	% Change
WC21S1		0.482	0.135	-72%
'Expected' post-mining Q50 at		Min	Mean	Max
WC21S1		0.195	0.258	0.321
Change beyond natural		Min	Mean	Max
% change (of pre-mining Q50)		-12.4%	-25.5%	-38.6%
% change (of 'expected' Q50)		-31%	-48%	-58%
ML/d change from natural		-0.060	-0.123	-0.186
			Assessment C:	Level 3

5.4.7 WWL – Wongawilli Creek (lower)

Wongawilli Creek lies between Areas 3A and 3B. The watercourse is not directly mined under by longwalls, but some tributaries (e.g. WC21, WC15 etc.) have been mined under by Area 3A and 3B longwalls, including by Longwall 17. Watercourseimpacts, e.g. cracking at Pool 43a, have been identified in the past.

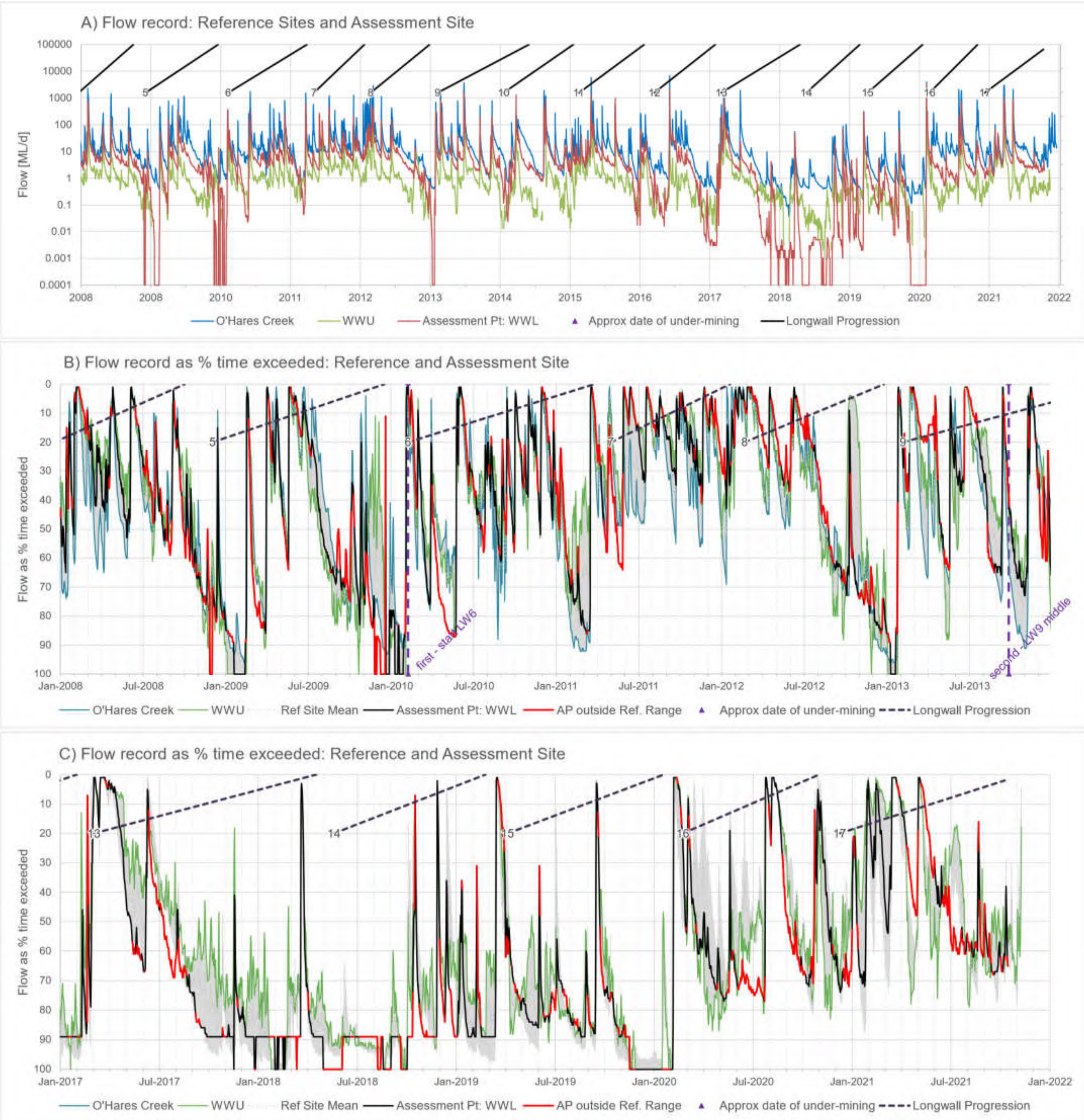

Figure 18. WWL vs Reference Sites A) flows; B) and C) flow duration statistics [Q%iles]

Figures 18B and 18C show the Q%ile hydrograph for the WWL Assessment Point versus the Q%ile hydrographs for the Reference Sites, O'Hares Creek and WWU. For this assessment 'natural variability' is defined as the range between the Q%ile for the Reference Sites on each day.

Table 20. Flow assessments A, B and C for the sub-catchment to WWL

WWL	Pre-mining	Post-mining	
	to start LW6	end LW17 + 30days	
	1/01/2008	10/02/2010	
	9/02/2010	12/11/2021	
Method A:	**Assessment of flow variability:**		
Period	Compared to Reference Sites, gauge is at: Lower flow (higher Q%ile)		Higher flow (lower Q%ile)
Pre-mining	22%	23%	of the time
Post-mining	21%	30%	of the time
Change	-1%	7%	of the time
		Assessment A:	Not triggered
Method B:	**Change in cease-to-flow frequency:**		
	Cease to flow as % of daily record during	pre- and post- mining periods	
Site	Pre-mining	Post-mining	Change
O'Hares Creek	0.0%	0.0%	0.0%
WWU	9.7%	4.2%	-5.5%
		Average Ref. Site change (= natural variability):	-2.8%
WWL	9.1%	4.0%	-5.1%
		no. of cease-to-flow days increased:	-2.3%
		Assessment B:	Not triggered
Method C:	**Change to median flow (Q50)**		
Reference Site Q50 [ML/d]	Q50 (pre-)	Q50 (post-)	% Change
O'Hares Creek	9.50	8.51	-10%
WWU	0.75	0.58	-23%
Natural variability	Min	Mean	Max
from 2 x Ref. Sites	-23%	-17%	-10%
Assessment Site Q50 [ML/d]	Q50 (pre-)	Q50 (post-)	% Change
WWL	3.372	2.955	-12%
'Expected' post-mining Q50 at	Min	Mean	Max
WWL	2.596	2.809	3.022
Change beyond natural	Min	Mean	Max
% change (of pre-mining Q50)	10.7%	4.3%	-2.0%
% change (of 'expected' Q50)	14%	5%	-2%
ML/d change from natural	0.359	0.146	-0.067
		Assessment C:	Not triggered

5.4.8 LA4S1 – Lake Avon tributary

LA4, a tributary to Lake Avon, lies above the western ends of Longwalls 11-14, but was not mined under by Longwalls 15-16. The gauging site was directly impacted during Longwall 13 with fractures and flow diversion. Issues with the logger mean that there is no data between Jul-2019 to Apr-2021.

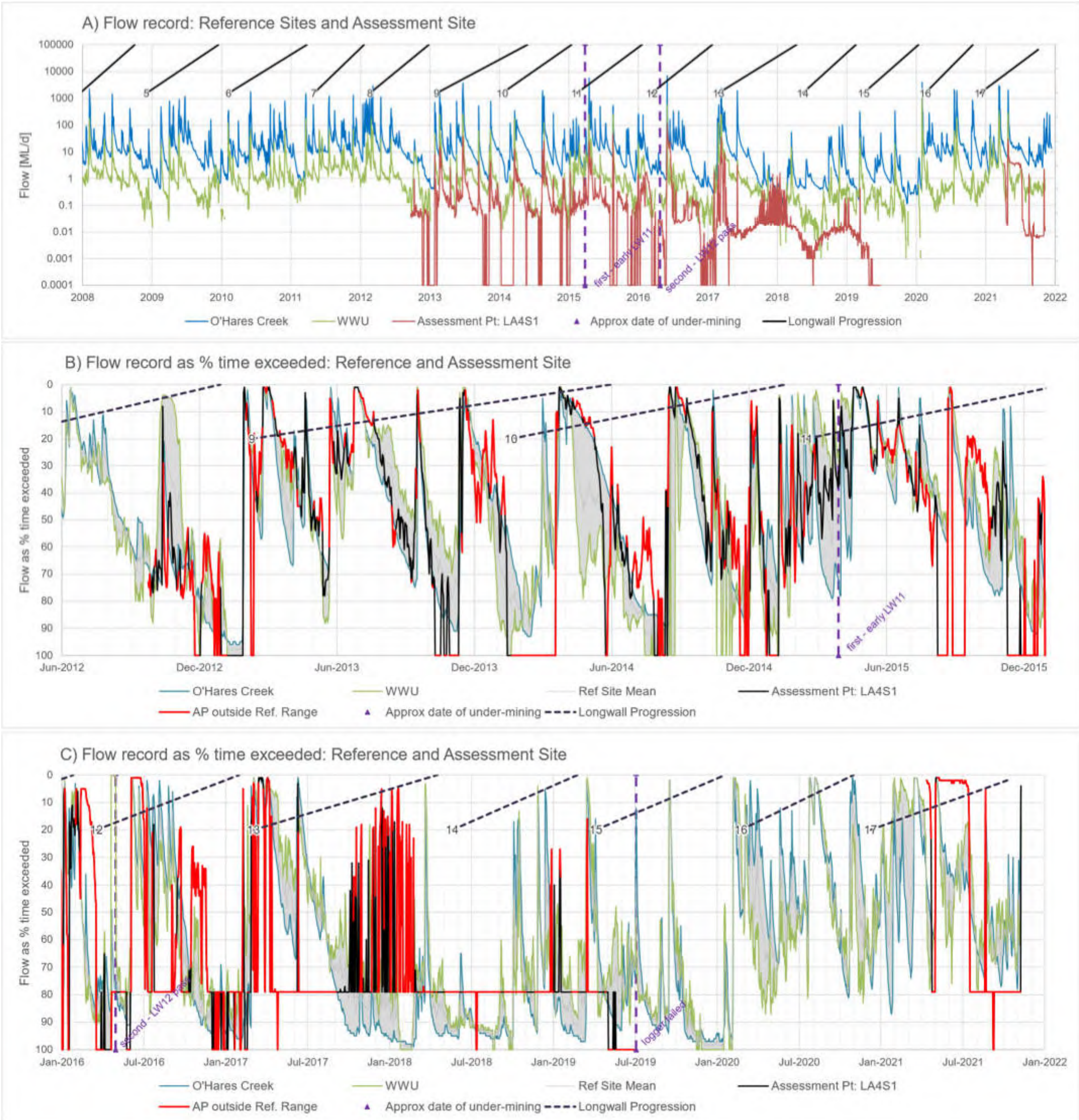

Figure 19. Comparison of LA4S1 against Reference Sites A) flows; B) and C) flow duration statistics [Q%iles]

Figures 19B and 19C show the Q%ile hydrograph for the LA4S1 Assessment Point versus the Q%ile hydrographs for the Reference Sites, O'Hares Creek and WWU. For this assessment 'natural variability' is defined as the range between the Q%ile for the Reference Sites on each day.

Table 21. Flow assessments A, B and C for the sub-catchment to LA4S1

LA4S1	Pre-mining	Post-mining	
	to early LW11	end LW17 + 30days	
	24/09/2012	2/04/2015	
	1/04/2015	12/11/2021	
Method A:	Assessment of flow variability:		
Period	Compared to Reference Sites, gauge is at: Lower flow (higher Q%ile)		Higher flow (lower Q%ile)
Pre-mining	28%	29%	of the time
Post-mining	42%	34%	of the time
Change	14%	5%	of the time
		Assessment A:	Level 1
Method B:	Change in cease-to-flow frequency:	**(this assessment uses 0.02 ML/d as 'cease-to-flow')**	
	Cease to flow as % of daily record during	pre- and post- mining periods	
Site	Pre-mining	Post-mining	Change
O'Hares Creek	14.5%	32.1%	17.6%
WWU	19.6%	17.5%	-2.1%
		Average Ref. Site change (= natural variability):	8.8%
LA4S1	19.3%	45.1%	25.7%
		no. of cease-to-flow days increased:	16.9%
		Assessment B:	Level 2
Method C:	Change to median flow (Q50)		
Reference Site Q50 [ML/d]	Q50 (pre-)	Q50 (post-)	% Change
O'Hares Creek	7.71	5.20	-33%
WWU	0.58	0.36	-38%
Natural variability	Min	Mean	Max
from 2 x Ref. Sites	-38%	-35%	-33%
Assessment Site Q50 [ML/d]	Q50 (pre-)	Q50 (post-)	% Change
LA4S1	0.081	0.016	-80%
'Expected' post-mining Q50 at	Min	Mean	Max
LA4S1	0.050	0.052	0.055
Change beyond natural	Min	Mean	Max
% change (of pre-mining Q50)	-42.3%	-45.0%	-47.6%
% change (of 'expected' Q50)	-68%	-69%	-71%
ML/d change from natural	-0.034	-0.036	-0.039
		Assessment C:	Level 3

5.4.9 LA3S1 – Lake Avon tributary

LA3 is a tributary to Lake Avon. The upstream end of the watercourse was directly mined under by the western end of Longwall 15, and Longwall 16 approached within 40 m. As shown in Table C4 in Appendix C, the pre-mining baseline period is only 2 months, and so the statistical assessment of impacts is considered somewhat unreliable, however mining effects on flows are obvious.

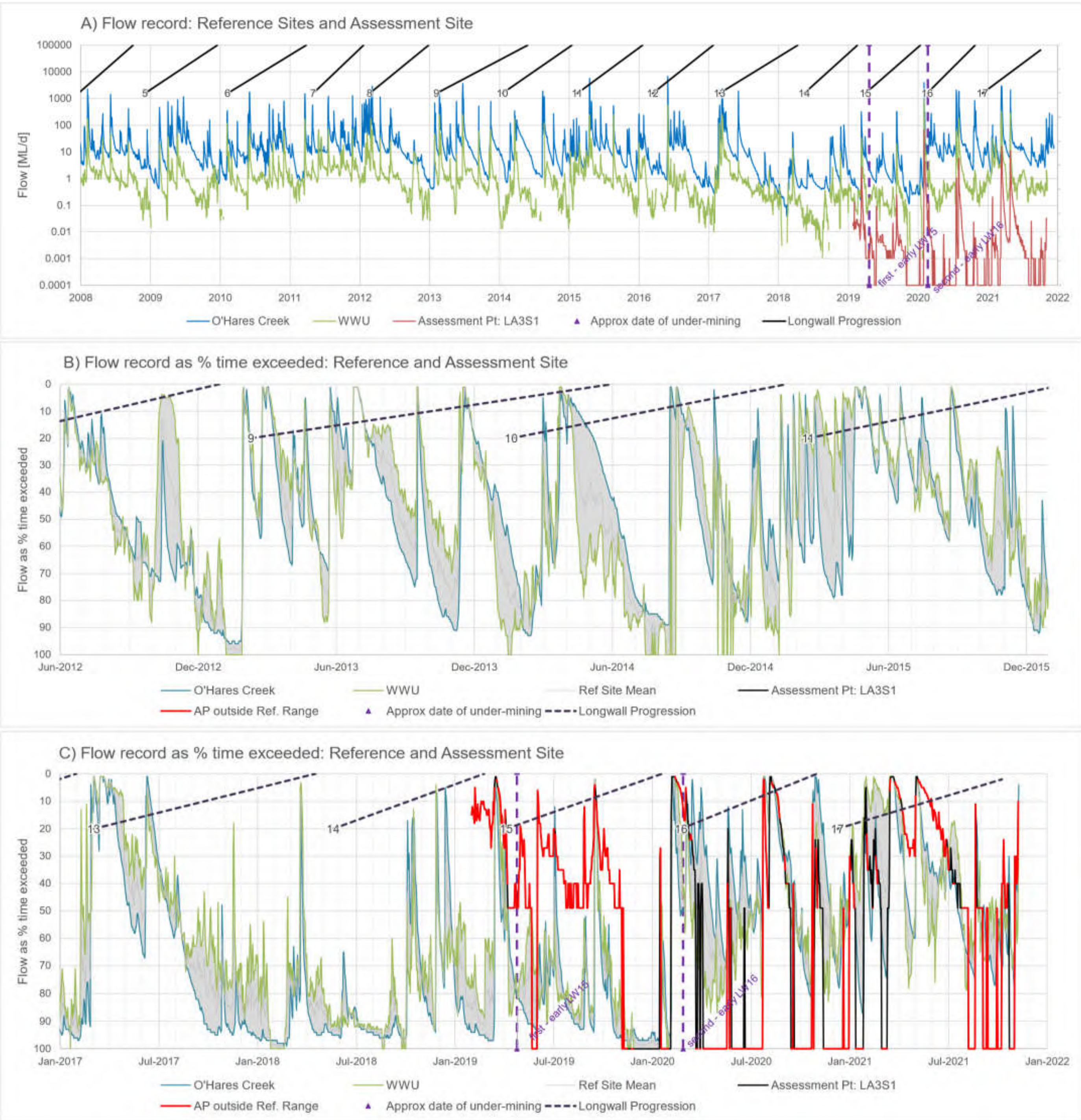

Figure 20. LA3S1 vs Reference Sites A) flows; B) and C) flow duration statistics [Q%iles]

Figures 20B and 20C show the Q%ile hydrograph for the LA3S1 Assessment Point versus the Q%ile hydrographs for the Reference Sites, O'Hares Creek and WWU. For this assessment 'natural variability' is defined as the range between the Q%ile for the Reference Sites on each day.

Table 22. Flow assessments A, B and C for the sub-catchment to LA3S1

LA3S1		Pre-mining	Post-mining	
		to early LW15	end LW17 + 30days	
		3/02/2019	29/04/2019	
		28/04/2019	12/11/2021	
Method A:	Assessment of flow variability:			
Period	Compared to Reference Sites, gauge is at: Lower flow (higher Q%ile)			Higher flow (lower Q%ile)
Pre-mining	0%		94%	of the time
Post-mining	40%		38%	of the time
Change	40%		-56%	of the time
			Assessment A:	Level 3
Method B:	Change in cease-to-flow frequency:			
	Cease to flow as % of daily record during		pre- and post- mining periods	
Site	Pre-mining		Post-mining	Change
O'Hares Creek	0.0%		0.0%	0.0%
WWU	0.0%		6.7%	6.7%
	Average Ref. Site change (= natural variability):			3.3%
LA3S1	0.0%		39.9%	39.9%
	no. of cease-to-flow days increased:			36.6%
			Assessment B:	Level 3
Method C:	Change to median flow (Q50)			
Reference Site Q50 [ML/d]		Q50 (pre-)	Q50 (post-)	% Change
O'Hares Creek		1.24	7.78	528%
WWU		0.21	0.40	92%
Natural variability		Min	Mean	Max
from 2 x Ref. Sites		92%	310%	528%
Assessment Site Q50 [ML/d]		Q50 (pre-)	Q50 (post-)	% Change
LA3S1		0.015	0.001	-93%
'Expected' post-mining Q50 at		Min	Mean	Max
LA3S1		0.029	0.062	0.094
Change beyond natural		Min	Mean	Max
% change (of pre-mining Q50)		-185.7%	-403.6%	-621.6%
% change (of 'expected' Q50)		-97%	-98%	-99%
ML/d change from natural		-0.028	-0.061	-0.093
			Assessment C:	Level 3

5.4.10 LA2S1 – Lake Avon tributary

Longwall 15 approached within approximately 160 m of LA2 and skirted the northern edge of this sub-catchment. Longwall 16 mined beneath the headwaters of LA2. Longwall 17 mined directly beneath approximately 60% of the length of LA2.

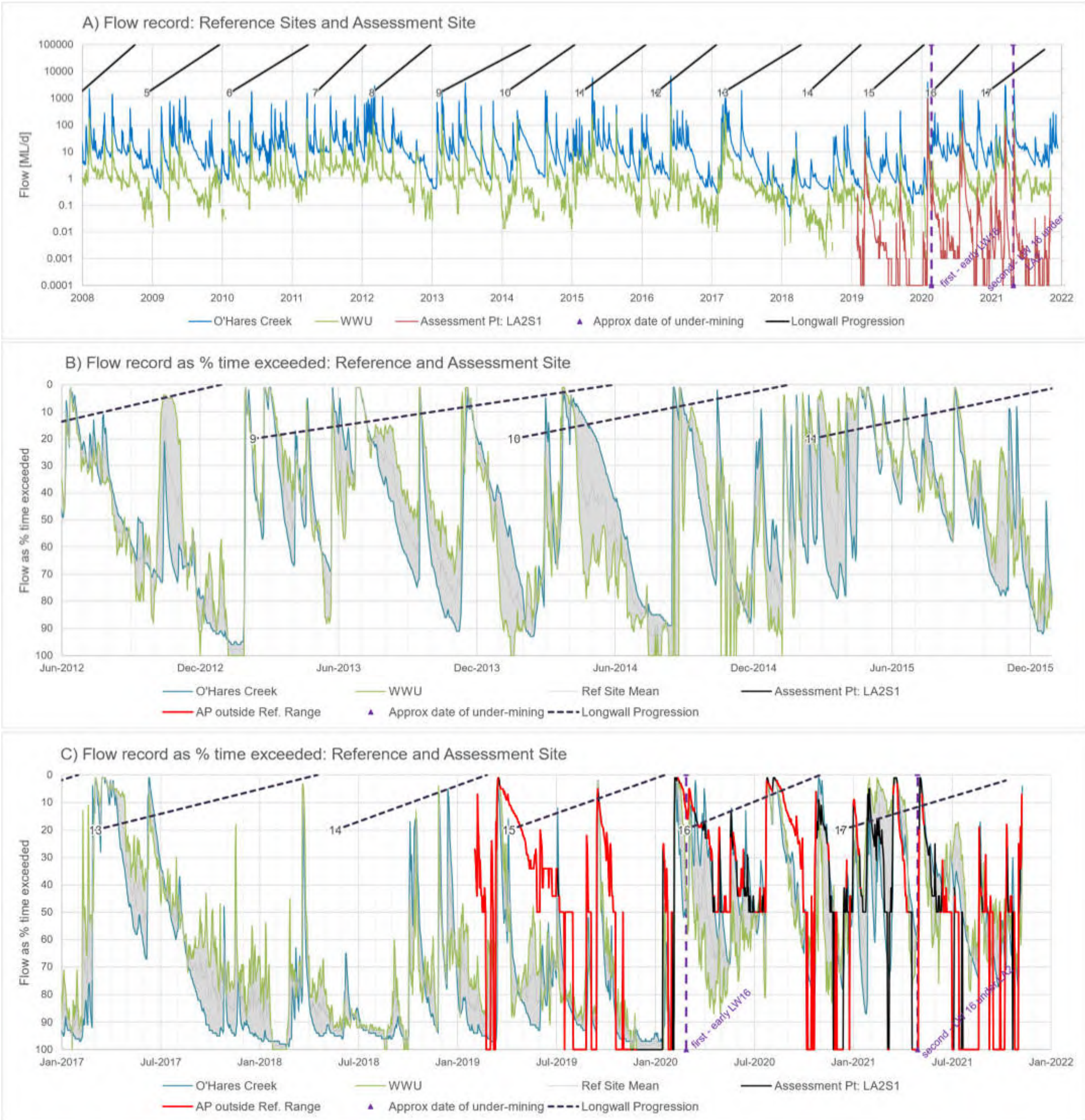

Figure 21. LA2S1 vs Reference Sites A) flows; B) and C) flow duration statistics [Q%iles]

Figures 21B and 21C show the Q%ile hydrograph for the LA2S1 Assessment Point versus the Q%ile hydrographs for the Reference Sites, O'Hares Creek and WWU. For this assessment 'natural variability' is defined as the range between the Q%ile for the Reference Sites on each day.

Table 23. Flow assessments A, B and C for the sub-catchment to LA2S1

LA2S1		Pre-mining	Post-mining	
		to early LW16	end LW17 + 30days	
		4/02/2019	2/03/2020	
		1/03/2020	12/11/2021	
Method A:	Assessment of flow variability:			
Period	Compared to Reference Sites, gauge is at: Lower flow (higher Q%ile)			Higher flow (lower Q%ile)
Pre-mining	23%		59%	of the time
Post-mining	29%		36%	of the time
Change	7%		-23%	of the time
			Assessment A:	Not triggered
Method B:	Change in cease-to-flow frequency:		(this assessment uses **0.002 ML**/d as 'cease-to-flow')	
	Cease to flow as % of daily record during		pre- and post- mining periods	
Site	Pre-mining		Post-mining	Change
O'Hares Creek	2.3%		0.0%	-2.3%
WWU	18.9%		0.0%	-18.9%
			Average Ref. Site change (= natural variability):	-10.6%
LA2S1	55.4%		51.9%	-3.5%
			no. of cease-to-flow days increased:	7.1%
			Assessment B:	Level 1
Method C:	Change to median flow (Q50)			
Reference Site Q50 [ML/d]		Q50 (pre-)	Q50 (post-)	% Change
O'Hares Creek		1.24	11.91	858%
WWU		0.14	0.54	288%
Natural variability		Min	Mean	Max
from 2 x Ref. Sites		288%	573%	858%
Assessment Site Q50 [ML/d]		Q50 (pre-)	Q50 (post-)	% Change
LA2S1		0.002	0.002	0%
'Expected' post-mining Q50 at		Min	Mean	Max
LA2S1		0.008	0.013	0.019
Change beyond natural		Min	Mean	Max
% change (of pre-mining Q50)		-287.7%	-572.7%	-857.7%
% change (of 'expected' Q50)		-74%	-85%	-90%
ML/d change from natural		-0.006	-0.011	-0.017
			Assessment C:	Level 3

5.4.11 ND1 – Native Dog Creek tributary

ND1 is a tributary to Native Dog Creek, which flows into Lake Avon. Elouera Colliery longwalls are within or close to this sub-catchment, but were not directly beneath this watercourse or its tributaries. ND1 is yet to be mined under by Dendrobium longwalls, but Longwall 17 mined under the northern edge of this sub-catchment.

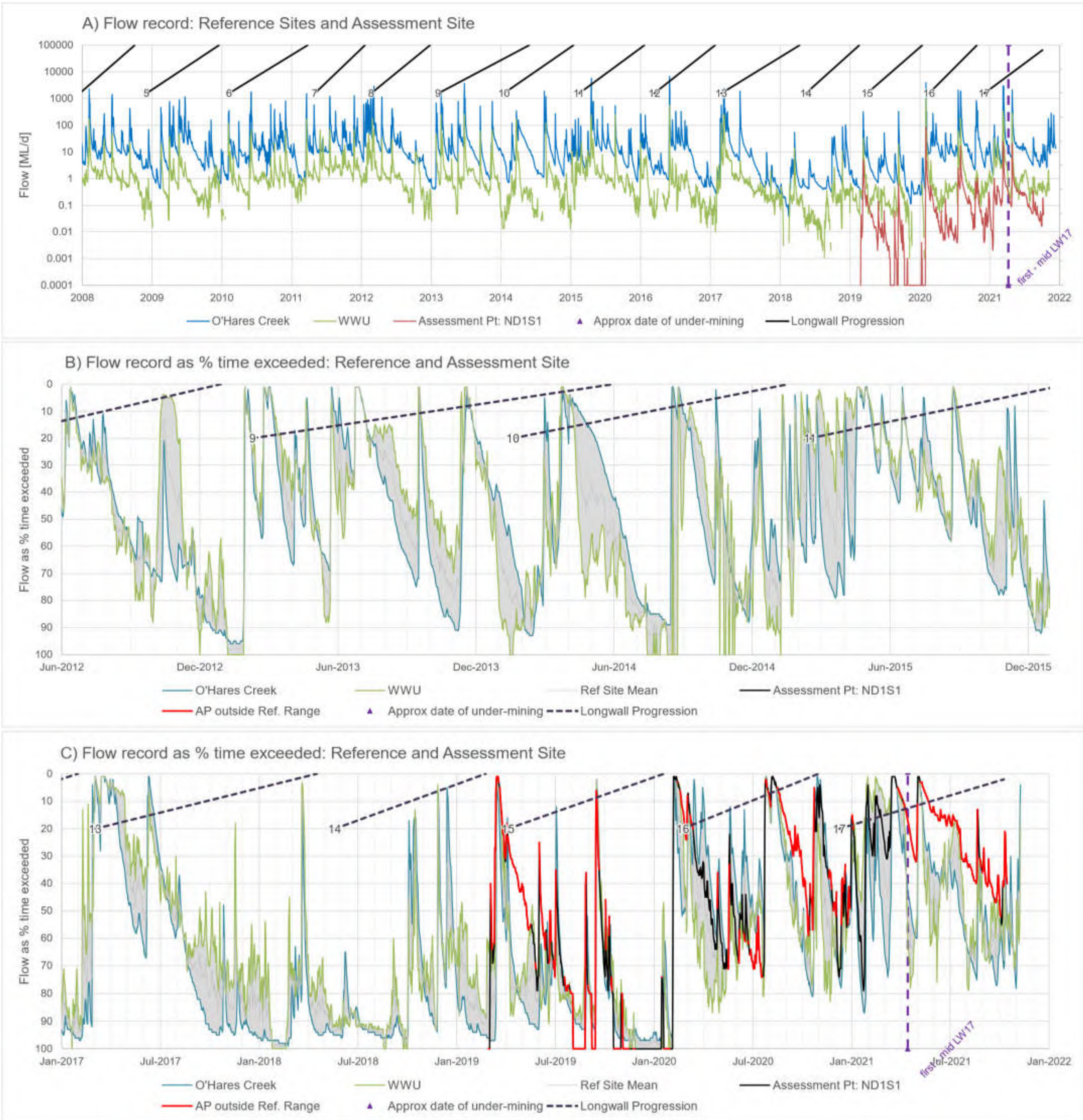

Figure 22. ND1 vs Reference Sites A) flows; B) and C) flow duration statistics [Q%iles]

Figures 22B and 22C show the Q%ile hydrograph for the ND1S1 Assessment Point versus the Q%ile hydrographs for the Reference Sites, O'Hares Creek and WWU. For this assessment 'natural variability' is defined as the range between the Q%ile for the Reference Sites on each day.

Table 24. Flow assessments A, B and C for the sub-catchment to ND1S1

ND1S1	Pre-mining	Post-mining	
	to mid LW17	end LW17 + 30days	
	3/03/2019	19/04/2021	
	18/04/2021	12/11/2021	

Method A:	Assessment of flow variability:		
Period	Compared to Reference Sites, gauge is at: Lower flow (higher Q%ile)		Higher flow (lower Q%ile)
Pre-mining	18%	35%	of the time
Post-mining	0%	94%	of the time
Change	-18%	59%	of the time
		Assessment A:	Not triggered

Method B:	Change in cease-to-flow frequency:		
	Cease to flow as % of daily record during	pre- and post- mining periods	
Site	Pre-mining	Post-mining	Change
O'Hares Creek	0.0%	0.0%	0.0%
WWU	8.0%	0.0%	-8.0%
		Average Ref. Site change (= natural variability):	-4.0%
ND1S1	17.5%	0.0%	-17.5%
		no. of cease-to-flow days increased:	-13.5%
		Assessment B:	Not triggered

Method C:	Change to median flow (Q50)		
Reference Site Q50 [ML/d]	Q50 (pre-)	Q50 (post-)	% Change
O'Hares Creek	6.99	9.06	30%
WWU	0.36	0.49	38%
Natural variability	Min	Mean	Max
from 2 x Ref. Sites	30%	34%	38%
Assessment Site Q50 [ML/d]	Q50 (pre-)	Q50 (post-)	% Change
ND1S2	0.023	0.146	533%
'Expected' post-mining Q50 at	Min	Mean	Max
ND1S2	0.030	0.031	0.032
Change beyond natural	Min	Mean	Max
% change (of pre-mining Q50)	503.1%	499.0%	494.9%
% change (of 'expected' Q50)	388%	373%	359%
ML/d change from natural	+0.116	+0.115	+0.114
		Assessment C:	Not triggered

5.4.12 SC10C – Sandy Creek minor tributary

This site is in Area 3A, but included in this report for information. SC10C is a minor tributary to Sandy Creek, which flows into Lake Cordeaux. Area 3A longwalls 7 and 8 mined beneath this watercourse.

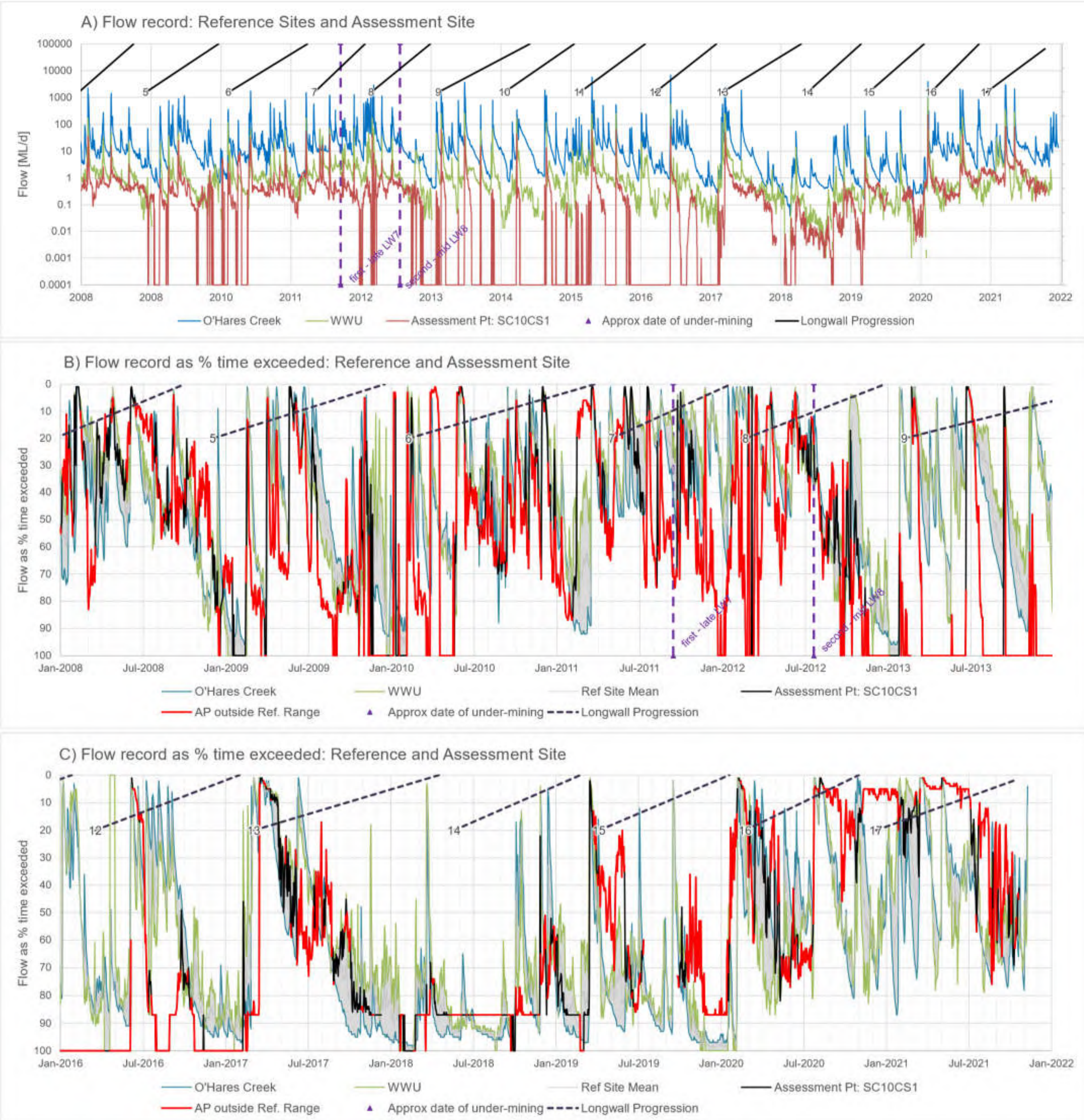

Figure 23. SC10C vs Reference Sites A) flows; B) and C) flow duration statistics [Q%iles]

Figures 23B and 23C show the Q%ile hydrograph for the SC10CS1 Assessment Point versus the Q%ile hydrographs for the Reference Sites, O'Hares Creek and WWU. For this assessment 'natural variability' is defined as the range between the Q%ile for the Reference Sites on each day.

Table 25. Flow assessments A, B and C for the sub-catchment to SC10C

SC10CS1		Pre-mining	Post-mining	
		to late LW7	end LW17 + 30days	
		1/01/2008	18/09/2011	
		17/09/2011	12/11/2021	
Method A:	Assessment of flow variability:			
Period	Compared to Reference Sites, gauge is at: Lower flow (higher Q%ile)			Higher flow (lower Q%ile)
Pre-mining	51%		22%	of the time
Post-mining	54%		25%	of the time
Change	3%		3%	of the time
			Assessment A:	Not triggered
Method B:	Change in cease-to-flow frequency:			
	Cease to flow as % of daily record during		pre- and post- mining periods	
Site	Pre-mining		Post-mining	Change
O’Hares Creek	0.0%		0.0%	0.0%
WWU	5.5%		4.9%	-0.7%
	Average Ref. Site change (= natural variability):			-0.3%
SC10CS1	11.8%		32.5%	20.7%
	no. of cease-to-flow days increased:			21.0%
			Assessment B:	Level 3
Method C:	Change to median flow (Q50)			
Reference Site Q50 [ML/d]		Q50 (pre-)	Q50 (post-)	% Change
O’Hares Creek		11.18	7.48	-33%
WWU		0.94	0.46	-51%
Natural variability		Min	Mean	Max
from 2 x Ref. Sites		-51%	-42%	-33%
Assessment Site Q50 [ML/d]		Q50 (pre-)	Q50 (post-)	% Change
SC10CS1		0.379	0.106	-72%
‘Expected’ post-mining Q50 at		Min	Mean	Max
SC10CS1		0.187	0.220	0.253
Change beyond natural		Min	Mean	Max
% change (of pre-mining Q50)		-21.6%	-30.3%	-39.0%
% change (of ‘expected’ Q50)		-44%	-52%	-58%
ML/d change from natural		-0.082	-0.115	-0.148
			Assessment C:	Level 3

Interestingly, at this site, if considering the period from Jan-2017 to now, the Assessments presented above are all ‘Not triggered’, which is consistent with the hydrograph shown in Figure 23A above. This is consistent with recovery of groundwater levels and the emergence of iron-staining in this watercourse.

5.4.13 SC10 – Sandy Creek tributary

SC10 is a tributary to Sandy Creek, which flows into Lake Cordeaux. Longwalls 7 and 8 mined beneath this catchment, and the south-eastern corner of Longwall 8 mined beneath the watercourse. Longwall 19 will also mine within 40 m of this watercourse.

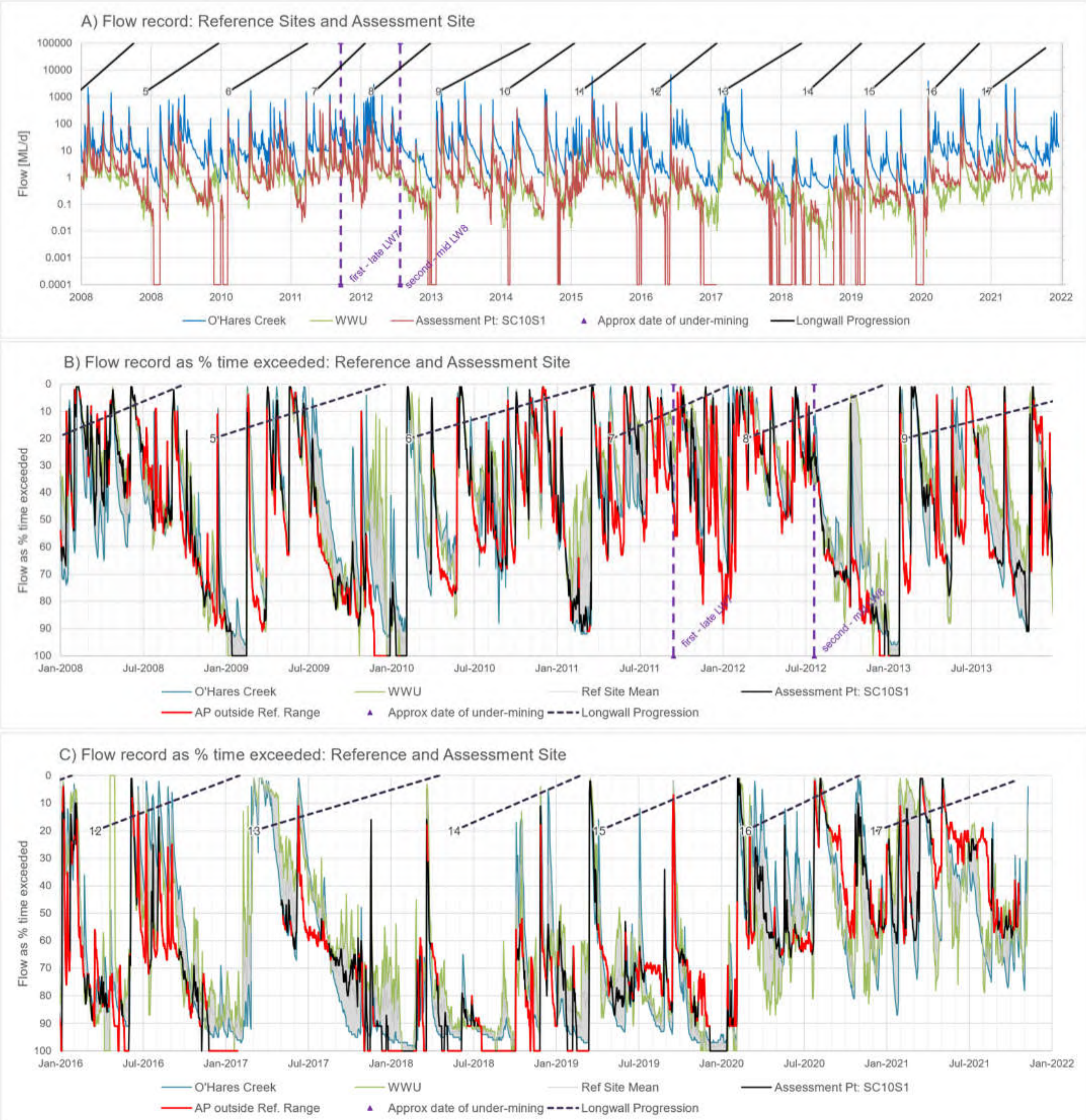

Figure 24. SC10 vs Reference Sites A) flows; B) and C) flow duration statistics [Q%iles]

Figures 24B and 24C show the Q%ile hydrograph for the SC10S1 Assessment Point versus the Q%ile hydrographs for the Reference Sites, O'Hares Creek and WWU. For this assessment 'natural variability' is defined as the range between the Q%ile for the Reference Sites on each day.

Table 26. Flow assessments A, B and C for the sub-catchment SC10

SC10S1		Pre-mining	Post-mining	
		to late LW7	end LW17 + 30days	
		1/01/2008	18/09/2011	
		17/09/2011	12/11/2021	
Method A:	Assessment of flow variability:			
Period	Compared to Reference Sites, gauge is at: Lower flow (higher Q%ile)			Higher flow (lower Q%ile)
Pre-mining		43%	13%	of the time
Post-mining		42%	17%	of the time
Change		-1%	4%	of the time
			Assessment A:	Not triggered
Method B:	Change in cease-to-flow frequency:			
	Cease to flow as % of daily record during		pre- and post- mining periods	
Site		Pre-mining	Post-mining	Change
O'Hares Creek		0.0%	0.0%	0.0%
WWU		5.7%	4.9%	-0.8%
			Average Ref. Site change (= natural variability):	-0.4%
SC10S1		7.0%	11.9%	4.9%
			no. of cease-to-flow days increased:	5.3%
			Assessment B:	Level 1
Method C:	Change to median flow (Q50)			
Reference Site Q50 [ML/d]		Q50 (pre-)	Q50 (post-)	% Change
O'Hares Creek		11.21	7.48	-33%
WWU		0.93	0.46	-50%
Natural variability		Min	Mean	Max
from 2 x Ref. Sites		-50%	-42%	-33%
Assessment Site Q50 [ML/d]		Q50 (pre-)	Q50 (post-)	% Change
SC10S1		1.254	0.586	-53%
'Expected' post-mining Q50 at		Min	Mean	Max
SC10S1S		0.623	0.730	0.836
Change beyond natural		Min	Mean	Max
% change (of pre-mining Q50)		-3.0%	-11.5%	-19.9%
% change (of 'expected' Q50)		-6%	-20%	-30%
ML/d change from natural		-0.037	-0.144	-0.250
			Assessment C:	Level 1

5.4.14 SCL2 / 2122205 – Sandy Creek

Sandy Creek flows into Lake Cordeaux near Area 3A. Area 2 Longwall 5 mined along the edge of this catchment, while Area 3A Longwalls 7 and 8 mined beneath this catchment. All these longwalls were at least 400 m from the watercourse. Longwall 19 will also mine within this sub-catchment.

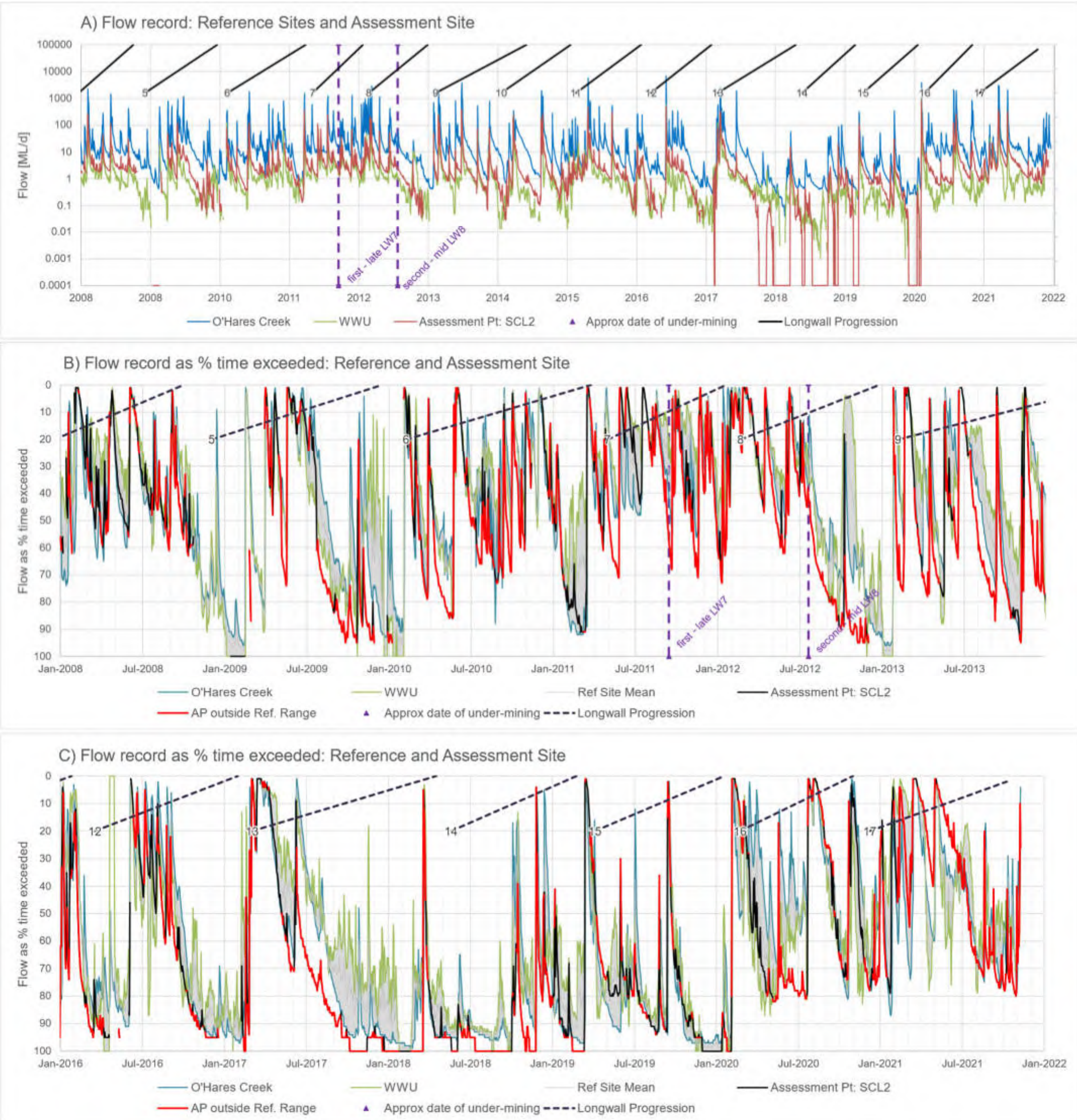

Figure 25. SCL2/2122205 vs Reference Sites A) flows; B) and C) flow duration statistics [Q%iles]

Figures 25B and 25C show the Q%ile hydrograph for the Sandy Creek Assessment Point versus the Q%ile hydrographs for the Reference Sites, O'Hares Creek and WWU. For this assessment 'natural variability' is defined as the range between the Q%ile for the Reference Sites on each day.

Table 27. Flow assessments A, B and C for the sub-catchment to SCL2/2122205

SCL2	Pre-mining	Post-mining	
	to late LW7	end LW17 + 30days	
	1/01/2008	18/09/2011	
	17/09/2011	12/11/2021	
Method A:	**Assessment of flow variability:**		
Period	Compared to Reference Sites, gauge is at: Lower flow (higher Q%ile)		Higher flow (lower Q%ile)
Pre-mining	56%	11%	of the time
Post-mining	58%	12%	of the time
Change	2%	1%	of the time
		Assessment A:	Not triggered
Method B:	**Change in cease-to-flow frequency:**		
	Cease to flow as % of daily record during	pre- and post- mining periods	
Site	Pre-mining	Post-mining	Change
O'Hares Creek	0.0%	0.0%	0.0%
WWU	6.5%	4.9%	-1.6%
		Average Ref. Site change (= natural variability):	-0.8%
SCL2	2.9%	8.8%	5.9%
		no. of cease-to-flow days increased:	6.7%
		Assessment B:	Level 1
Method C:	**Change to median flow (Q50)**		
Reference Site Q50 [ML/d]	Q50 (pre-)	Q50 (post-)	% Change
O'Hares Creek	10.98	7.48	-32%
WWU	0.83	0.46	-44%
Natural variability	Min	Mean	Max
from 2 x Ref. Sites	-44%	-38%	-32%
Assessment Site Q50 [ML/d]	Q50 (pre-)	Q50 (post-)	% Change
SCL2	2.196	1.210	-45%
'Expected' post-mining Q50 at	Min	Mean	Max
SCL2	1.225	1.360	1.496
Change beyond natural	Min	Mean	Max
% change (of pre-mining Q50)	-0.7%	-6.8%	-13.0%
% change (of 'expected' Q50)	-1%	-11%	-19%
ML/d change from natural	-0.015	-0.150	-0.286
		Assessment C:	Not triggered

5.4.15 Discussion of flow assessments A, B, C.

Comments are made here on specific sub-catchments and assessments where the above assessments required some further explanation.

LA4 (Section 5.4.8): there is an apparent modification to the accuracy in the estimation and/or reporting of low flows from 2016, approximately coincidental with pre- and post-mining periods. This includes a number of suspected 'false zeroes' from earlier in the record that we could not confidently 'process' or 'infill'. Our review of visual inspection records ("flow observations") by IMCEFT, such those summarised on the maps presented in Appendix G and considering the changes to the frequency of low flows above cease-to-flow. As such we have modified the 'cease-to-flow' to a very low flow (0.02 ML/d) and used this in Assessment B, giving a Level 2 trigger. A similar behaviour is apparent at:

1. WC15: based on assessment of recorded low flows, we have adopted a low-flow (0.005 ML/d) in place of true 'cease-to-flow' for Assessment B, and as a result a Level 2 TARP was considered more appropriate than 'Not triggered' (consistent with previous End of Panel reporting).

2. LA2: based on assessment of recorded low flows, we have adopted a low-flow (0.002 ML/d) in place of true 'cease-to-flow' for Assessment B, and as a result a Level 1 TARP was considered more appropriate than 'Not triggered'.

5.4.16 Comparison against rainfall-runoff modelling

Up until Longwall 14, effects of surface water flow quantity were assessed via comparison of observed flow against rainfall-runoff modelling, either the RUNOFF-2005 model (used by Ecoengineers up until 2015) and then AWBM (used for Longwalls 13 and 14). As discussed in Section 5.1, this was superseded in consultation with agencies, with comparison against Reference Sites preferred. The IAPUM (Section 1.3) has recently requested that this be re-instated, and the most conservative result (of the new, agreed TARPs and the rainfall-runoff comparison) be adopted as the finding.

While the use of rainfall-runoff modelling itself is valid (especially so if appropriate Reference Sites are not available), the issue is that the pre-Longwall 15 and now-agreed TARPs have multiple differences, including:

3. assessment period (longwall by longwall or cumulatively since mining);

4. the choice of indicator, being changes to 'catchment yield' expressed as a percentage of long-term average rainfall (as per the calculation recommended by Ecoengineers (2011) or changes to other flow indicators such as cease-to-flow frequency and median flow).

Therefore, while the rainfall-runoff method is used here for limited sites, as per IAPUM's request, this is only as a secondary check until further discussion with agencies has occurred.

Appendix H presents a summary of rainfall-runoff modelling using the superseded assessment methods. This is done specifically for those sub-catchments where Assessment C (for median flow) does not already trigger TARP Level 3, and so provides a secondary check on effects.

DCU: Section H1 presents a summary of rainfall-runoff modelling. Hydrographs and ratios for the pre- and post-mining periods do not clearly indicate a systematic or significant change in catchment behaviour during Longwall 17 (or post-mining in general). The calculation of catchment yield did not trigger the former TARP. This finding is consistent with the agreed TARPs.

WC12: Section H2 presents a summary of rainfall-runoff modelling. Hydrographs, ratios and flow duration curves for the pre- and post-mining periods do not clearly indicate a systematic or significant change in catchment behaviour. The calculation of catchment yield did not trigger the former TARP. These findings are consistent with the findings of agreed TARP Assessments B and C.

WWL: Section H3 presents a summary of rainfall-runoff modelling. Hydrographs, ratios and flow duration curves for the pre- and post-mining periods do not clearly indicate a systematic or significant change in catchment behaviour. Using the calculation of 'catchment yield' derived by Ecoengineers (2011) suggests that there could be a mild reduction in flow to the period ending with Longwall 17 but still fall just short of triggering Level 1 (-4% for the full post-mining period). The yield for the Longwall 17 in isolation does not show any sign of reduced yield.

ND1: Section H4 presents a summary of rainfall-runoff modelling. Hydrographs, ratios and flow duration curves for the pre- and post-mining periods do not clearly indicate a systematic or significant change in catchment behaviour. This finding is consistent with the agreed TARPs.

5.5 Assessment D: flow reduction Wongawilli Creek

Surface water flow observations made by IMCEFT are recorded in a semi-qualitative fashion. At each field site (such as at the upstream or downstream end of a pool), an observation of flow conditions is made as follows:

0	No flow visible
1	Subsurface flow observed
2	Surface seepage observed
3	Surface trickle observed
4	Surface flow observed

Field surveys typically make an observation at each of the nominated sites around Area 3A and 3B over the period of a month. The "Outflow" results of IMCEFT's surveys are plotted on the maps in Appendix G for each month during the period covering the extraction of Longwall 17. As noted on the maps, observations are limited in two months during Longwall 17 (January and February-2021) due to the heavy rainfall conditions and catchment closures.

Sites along the main channel of Wongawilli Creek are the subject of Assessment D, and these sites are shown with a hollow black circle in Appendix G to minimise confusion with sites on tributaries yet very close to the main branch of Wongawilli Creek.

While there are often "no flow" observations on the tributaries which flow into Wongawilli Creek, there are consistent observations of flow along Wongawilli Creek itself. Of the completed surveys, all months are "Not triggered". As a result, the further calculation of Assessment D is not required.

Table 28. Assessment D for Wongawilli Creek: Longwall 17

Assessment D	During Longwall 17	No triggers
No triggers for Longwall 17		

Any inferred loss of flow from Assessment D is then used in assessing compliance against Performance Measures for Wongawilli Creek.

5.6 Assessment against surface water flow Performance Measures

There are four agreed Performance Measures for surface water flows in the Area 3B WIMMCP.

Wongawilli Creek – minor environmental consequences	
Agreed measure:	*Methods C, D, to be compared against predictions made in contemporary groundwater modelling conducted to the satisfaction of the Secretary to assess whether effects that cannot be explained by natural variability "exceed prediction".*

Assessment C at WWL does not indicate a discernible reduction beyond natural variability in Q50 (Table 20). Therefore, this Performance Measure is met.

Assessment D for flows along the middle of Wongawilli Creek (Table 28) was not triggered. While loss of baseflow is highly likely to occur during the assessment period, weather conditions mask any effect.Therefore, the estimated losses cannot be assessed.

Donalds Castle Creek – minor environmental consequences	
Agreed measure:	*Method C to be compared against predictions made in contemporary groundwater modelling conducted to the satisfaction of the Secretary to assess whether effects that cannot be explained by natural variability "exceed prediction".*

Assessment C at DCU does not indicate a discernible reduction beyond natural variability in Q50 (Table 16). Therefore, this Performance Measure is met.

Cordeaux River – negligible reduction in the quantity of surface water inflow to the Cordeaux River at its confluence with Wongawilli Creek			
Agreed measure:	-	-	*Flow reduction as determined from measured at flow gauging station WWL_A.*

Assessment C at WWL does not indicate a reduction in Q50 (Table 20). Therefore, this Performance Measure is met.

Lake Avon – negligible reduction in the quantity of surface water inflows to Lake Avon		
Agreed measure:	-	*Surface water inflows calculation = [Impacts at gauged catchments (LA2 + LA3 + LA4 + NDT1) + estimated impacts at ungauged but undermined catchments (e.g. LA5)] / [total inflow to LA].*

The calculation is presented as follows. In mined-under but un-monitored catchments, "inferred" losses are calculated as the same % reduction as a nearby monitored and mined-under catchment. If not mined under directly, but adjacent or neighbouring mining, then 25% of the % loss in the nearest mined under catchment is applied as the inferred loss.

Sub-catchment	Gauged?	Mined under?	Catch area [km2]		"measured" loss at Q50	"inferred" loss at Q50	
LA1	N	N	0.29*			0	
LA2	Y	Neighbour	0.824		-0.011		
LA3	Y	Y	0.375		-0.061		
LA4	Y	Y	0.817		-0.036		
LA5	N	Y	0.53*			-0.023	
LA6	N	Neighbour	0.97*			-0.011	
ND1	Y	Y	1.13		0.000		

Sub-catchment	Gauged?	Mined under?	Catch area [km2]		"measured" loss at Q50	"inferred" loss at Q50	
ND	N	Elouera	3.85*				
Total for mined-under or neighbouring catchments			**2.08**			**-0.142**	**ML/d**
Lake Avon		N	142^	2%		Q50	Qmean
Inflow from catchment		(WaterNSW estimate)				18	124
Inferred mining loss as % of		total inflow				-0.79%	-0.12%

* catchment area estimated by WatershedHG from GIS.
^ catchment area from https://www.waternsw.com.au/supply/visit/avon-dam

The sub-catchments where mining effects related to Dendrobium are present or inferred constitute about 2% of the total catchment to Lake Avon. The “measured” + “inferred” reduction in Q50 flow in these LA catchments = 0.143 ML/d (52 ML/yr). This is 0.79% of median Lake Avon inflow or 0.12% of average Lake Avon inflow for the period 2015-2020, based on WaterNSW lake inflow data.

The estimated losses are equivalent to:

- 18% of predicted losses for the Lake Avon catchment made by groundwater modelling (281 ML/yr) from the approved Longwall 17 SMP Application); and
- 133% of low-end predicted losses for Lake Avon catchment made by groundwater modelling (39 ML/yr) and 38% of the high-end losses (137 ML/yr) from the approved Longwall 18 SMP Application).
- Therefore, the estimated losses are “within prediction”, and this Performance Measure is met.

5.7 Assessment of pool water levels

5.7.1 Wongawilli Creek Pool 50 (previously Pool43A)

This section summarizes observations at Wongawilli Creek Pool 50 (Previously Pool43A). Pool 50 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 50 is controlled by a rock bar.

On 20/11/2017, it was noted during a site visit that water levels in Pool 50 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 IMCEFT at Pool 50.

In response to the trigger, an assessment was carried out into the cause of the declining water levels in Pool 50 by Watershed (2018). The assessment concluded that the decline in pool levels was likely due to depressurisation of the underlying formations (HBSS and BGSS; Figure 27) due to mining adjacent to the creek, exacerbated by the very low rainfall and flow conditions during the 2017-2019 drought. The decline in pool levels started prior to the formation of the fracture (Figure 26) suggesting that water loss from the pool was not related to the formation of the fracture.

There is evidence that piezometric levels in the sandstone substrate adjacent to Wongawilli Creek are starting to recover as mining in Area 3B moves south and away from Pool 50. Hydrographs for piezometers in the lower HBSS closest to the pool (Figure 27) shows recovery since 2019 with piezometric levels rising above the elevation of the creek bed during Longwall 17 for the first time since 2016. Water levels in Pool 50 have trended higher over the last 2 years in response to both higher rainfall conditions and recovering groundwater levels.

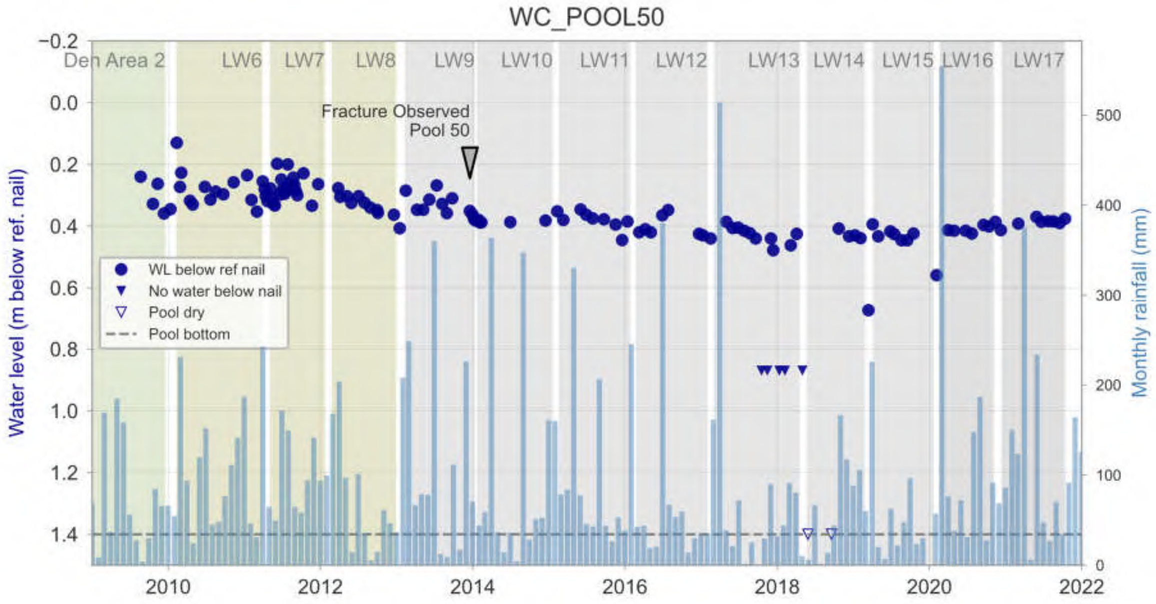

Figure 26. Time series plot of water level observations in Pool 50

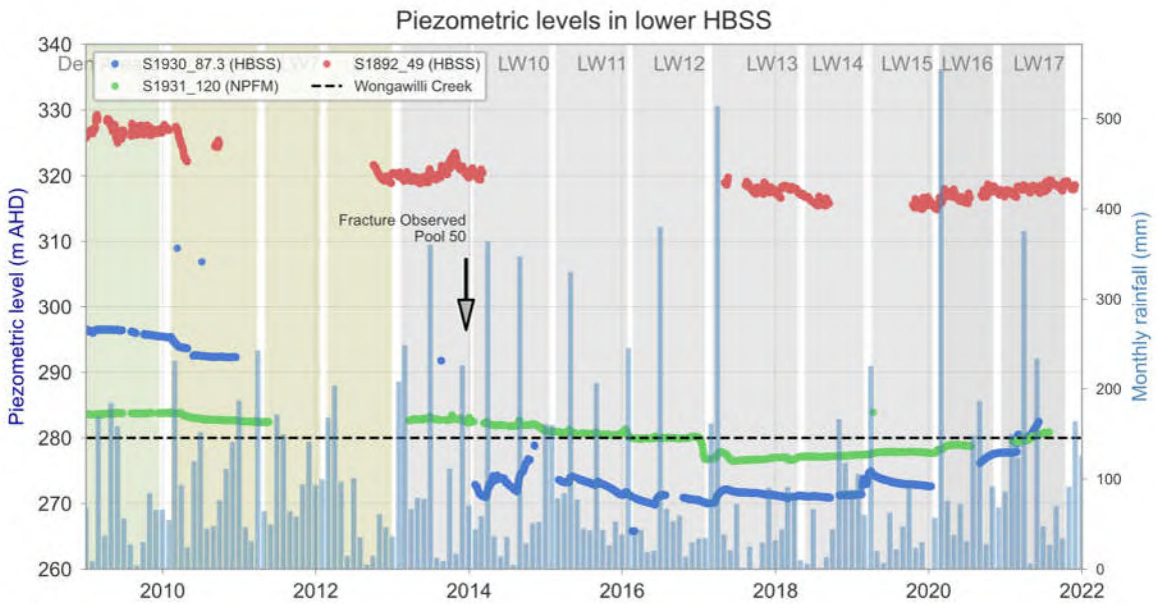

Figure 27. Groundwater hydrographs for lower HBSS adjacent to Wongawilli Creek

5.7.2 Pool level dataloggers in Wongawilli Creek

Pool level dataloggers are installed in seven pools along Wongawilli Creek adjacent to Area 3A and 3B: WWU, Waterfall 54,, Pool 45, Pool 49, Pool 50 (WCS2), Pool 41 (WCS1). The dataloggers measure the water level at hourly intervals relative to a surveyed benchmark at the respective sites. Hydrographs for the loggers are included in Appendix F.

Most of the loggers were installed in 2020 and therefore have limited baseline data. Loggers at Pools 50 and 41 were installed in 2018. The hydrographs for those pools show different recession characteristics that are related to the geometry of the pools and their control points:

No adverse trends related to mining are evident as of the end of the current reporting period.

5.7.3 Wongawilli Creek tributary WC15

WC15 is a second order stream that flows in a north-easterly direction across the eastern part of Area 3B and joins Wongawilli Creek at WC_Pool 69. The watercourse was approached within 40 m by Longwalls 13 and 14, and the upper reaches of WC15 were mined under by Longwalls 15 to 17.

Nine pools are routinely monitored along the WC15 watercourse. Figure 28 summarises observations of flow status of each pool for monthly monitoring periods prior to and following the passage or close approach of Longwalls 13 to 17 (red lines). Pools are arranged from upstream (bottom of the plot) to downstream (top), to correspond geographically if looking at a plan view of WC15. Observations are semi-quantitative, ranging from no observable flow through to observable outflow from the pool. In addition, observations of “no water in the pool” are overlain as “-“ symbols. Where more than one monitoring round was carried out in a month, the minimum condition was used in the figure. Baseline data, prior to Longwall 13 and the 2017-2018 drought, show that all monitored pools are filled and overflow for several months following large rainfall events (and near-continuously at Pool 9). All pools ceased to flow or became dry during prolonged low-rainfall conditions. As with other watercourses, pool levels and flow were affected by the 2017-2019 drought such that all pools were observed to have no flow and/or were dry on several occasions during the drought.

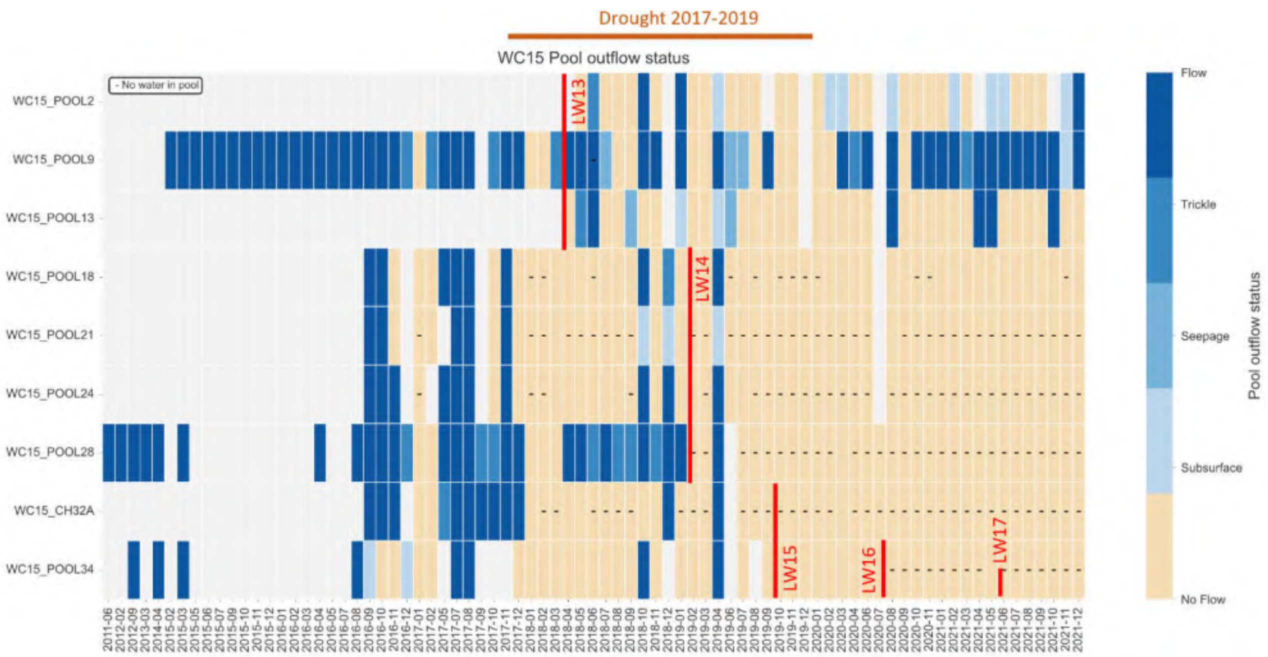

Figure 28. Flow status of pools on the WC15 watercourse

From observations shown in Figure 28, it is expected that all pools on WC15 would have filled and overflowed during 2020 and 2021 due to the higher-than-average rainfall. It is apparent that the pool level and flow status in all monitored pools upstream of Pool 13 during 2020 is different from baseline conditions and likely impacted by Longwalls 14 to 16. The upstream pools remained empty throughout 2021 and the review period (at the time of monitoring events).

Water level dataloggers are installed in WC15 Pools 2, 28 and 34. Rapid changes in average water level and recession rate were noted in Pools 2, 28 and 34 following the passage of Longwalls 14 to 16 (see Appendix F) and reported in previous EOP reviews. Pool hydrograph responses are consistent with field observations presented above.

5.7.4 Lake Avon tributary LA2

The LA2 watercourse was mined under by Longwall 16 in May 2020 and Longwall 17 between December and March 2021. Observations of flow status of each pool along the watercourse are summarised in Figure 29. Baseline monitoring of pools upstream of Pool 5 started in 2018. No water was recorded at Pools 24 and 25 following the passage of Longwall 17. Prior to Longwall 17 the pools typically contained water and occasionally overflowed. Pool 34 was empty of water during the review period; however, it is noted that the pool was seldom full prior to Longwall 16. Pool 5 was observed to have no water on four occasions following Longwall 17 which contrasts with conditions during 2019 and 2020. Further data may be required to confirm a mining effect at Pool 5.

The observed changes represent a mining effect at Pools 24 and 25. Mining effects are not clear at Pools 5 and 34 based on available data.

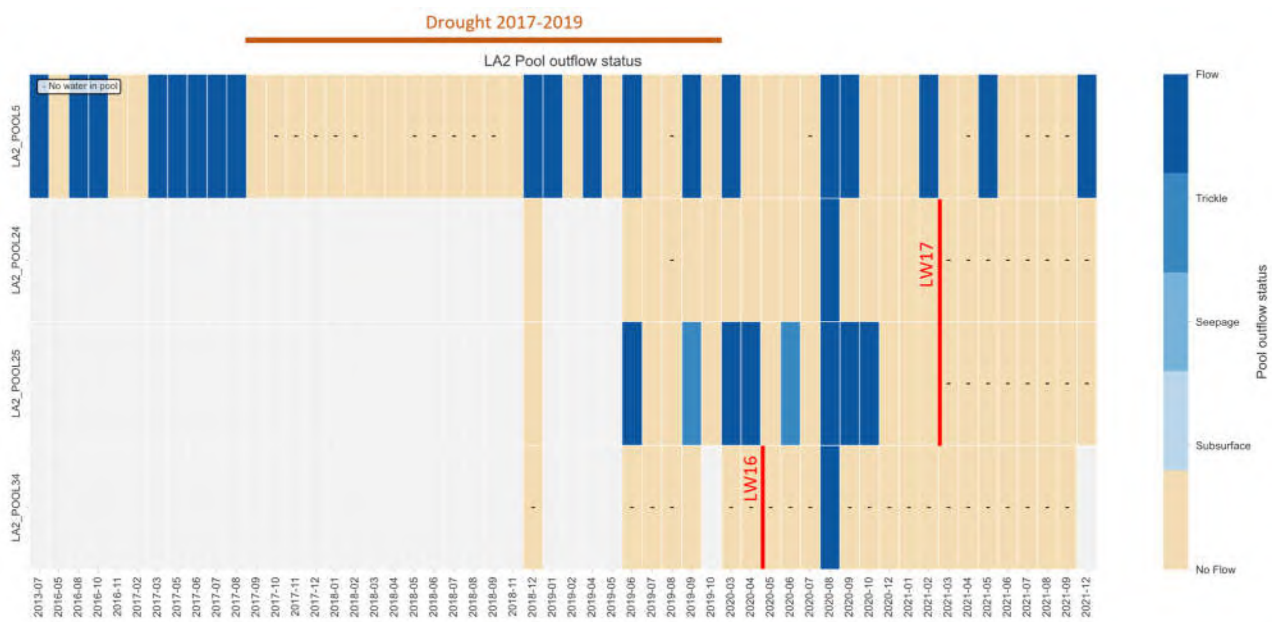

Figure 29. Flow status of pools on the LA2 watercourse

5.7.5 Wongawilli Creek Waterfall 54

There was a requirement for an adaptive management approach to the extraction of Longwall 17, with respect to subsidence and hydrology of WF54 on Wongawilli Creek. Assessments were agreed as part of the Wongawilli Creek and Waterfall 54 Management Strategy (Illawarra Metallurigcal Coal, 2021). During the extraction of Longwall 17, frequent analysis and assessment of hydrology at the waterfall was reported to DPIE (Watershed HydroGeo, 2021a).

Further analysis was carried out in this assessment, using the same assessment methods to analyse hydrological behaviour to present day (71 days after the end of Longwall 17).

An Orpheus sensor and logger measure water levels at the WF54 pool (above the waterfall) at five-minute intervals, and this has been recorded since 25/03/2020. The same type of equipment is used to measure pool levels upstream at WWU at the same interval (since 23/10/2020). This data is compared in a form of before-after-control-impact (BACI) assessment. Data is also recorded at WWU using a Diver sensor and logger, and that record is longer, but the Diver is not as accurate as the Orpheus, so the data from the Orpheus equipment is relied on. Manual water level measurements are taken regularly by IMCEFT staff at both sites to allow conversion from a measured water depth above each sensor to a mAHD, and a water level above the benchmark, and above the cease-to-flow control. We note that there is some inaccuracy in the manual measurements used to set the datum. During the first 7 months to November 2020, the error was up to 11 mm = 0.011 m, but procedures have improved since and the residual error is approximately 3 mm = 0.003 m.

The "pre-mining" period used for this assessment is from the beginning of the common data period; 23/10/2020 to 26/07/2021. The post-mining period is from 27/07/2021 until the last data available, which for this report is 23/12/2021.

A relationship in water levels at the two sites has been developed by plotting the data against one another for the pre-mining period as a natural and logarithmic relationship (detail on a log-scale is shown in Figure 30.

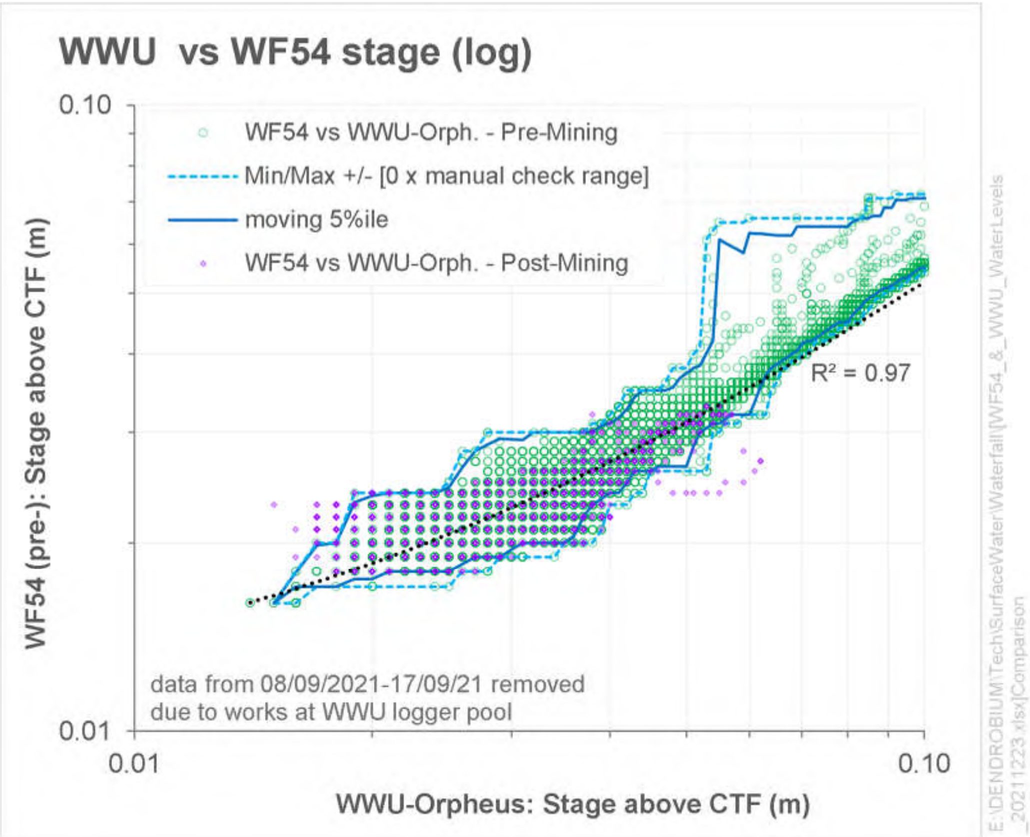

Figure 30. Relationship between water level (stage) at WWU and WF54

On Figure 30, the solid blue lines represent a moving 5%/95%ile (approximately), and the dashed blue lines show the minimum/maximum bounds on this relationship. These ranges do not consider the error in the manual measurements noted earlier. The solid blue lines are used for this analysis to represent 'expected' pool water level. The pre-mining data falls outside the solid blue lines 3.4% of the time (2,491 of 73,813 readings).

The “post-mining” data is plotted in purple on the charts in Figure 30. Currently, the post-mining data is in good agreement with the pre-mining relationship, i.e. the purple dots cluster between the blue lines (5%-95%iles). The purple dots fall outside the solid blue lines 3.17% of the time (1,243 out of 39,257 readings). A period of anomalous data was noted in previous reporting (where works were carried out at one of the monitoring site resulting a period of spurious data), and if this is removed, then the period of time that the post-mining data falls outside the expected range is 2.99%. In both cases (3.17% or 2.99%), the frequency of ‘extreme’ values in the post-mining data is slightly lower than in the pre-mining period (3.4%), suggesting no anomalous behaviour at WF54.

An alternative method of presenting the data above is in a timeseries. The upper and lower bounds of the “expected” WF54 stage are calculated from the upstream WWU stage, using the scatter or noise in the pre-mining data (i.e. the 5%-95%ile plot on Figure 30). This timeseries of the range in expected WF54 stage is shown on Figure 31.

This shows the pre-mining data (green) is generally within the orange lines but occasionally strays to or outside the orange line as expected.

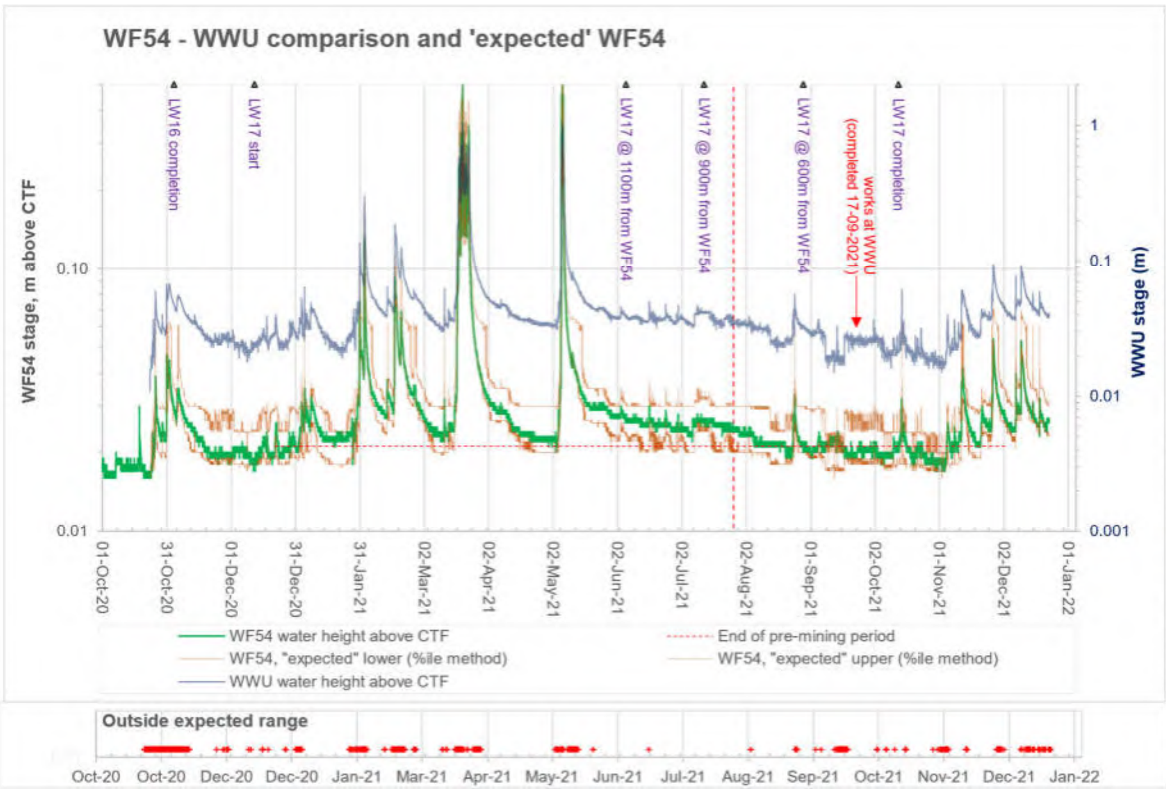

Figure 31. Comparison of WF54 stage with range in “expected” stage

Currently the post-mining data is tracking within the expected range (orange series), although toward the lower bound of expected stage. Comparison with similar stage in late 2020 and early 2021 confirms that this behaviour has occurred in the past.

The analysis above suggests, as of 23/12/2021, there is no mining effect beyond natural variability on the hydrology at WF54.

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 Swamp Impact Monitoring Management and Contingency Plan (SIMMCP) for Area 3B (South32, 2020b). Shallow groundwater level has been identified as an indicator of potential changes in ecosystem functionality of the swamps. TARPS are defined as follows:

Table 29. 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 D**. 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 hydrograph responses and cumulative effects at Area 3B swamps is included in Table 30 for Impact Sites and Table 31 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.

An overview of shallow groundwater levels and cumulative effects is shown in Figure 32 and Figure 33 as the monthly median % saturation at each reference and impact swamp piezometer. The % saturation is calculated as the level of groundwater within the swamp piezometer relative to the total thickness of the sediments at that location (from base of the piezometer to the ground surface).

6.1.1 Reference swamp sites

IMC maintains shallow groundwater monitoring sites at reference swamps located well outside the mining zone of influence. Those sites provide an important comparison when assessing swamp sites closer to the mine for possible shallow groundwater impacts. Shallow groundwater conditions at reference sites during the assessment period are summarised in Table 31. Shallow groundwater at all reference sites recovered during 2020 and 2021 following low shallow groundwater levels, including unsaturated conditions, during the 2017-2019 drought.

A review of shallow groundwater hydrographs for reference swamps in Appendix D (and evident in Figure 32) indicate two main hydrological end-member types:

1. Near-continuously saturated swamp sediments. Examples include Swamps 7, 22 and 25. Swamp sediments at these locations remain saturated during periods of prolonged drought. It is assumed that at these locations, groundwater levels within the swamp are sustained by discharge from adjacent and underlying sandstone substrate (groundwater-connected swamps).

2. Intermittently saturated swamp sediments. Examples include Swamps 33, 84, 85, 86 and 88. Swamp sediments at these locations saturate, typically to the ground surface, following large rainfall events and remain saturated for several weeks to months as shallow groundwater levels recede to below the base of the swamp. The duration of saturation and rate of recession vary between locations and likely depend on the characteristics of the swamp substrate, controlling rock-bar and contributions from adjacent or up-gradient perched sandstone aquifers. It is assumed that at these locations, the swamp sediments are likely perched above the water table in the sandstone substrate.

There is no consistent relationship between position on the catchment and degree of saturation; however, the continuously saturated locations tend to be within deep valleys where adjacent ridges rise ≥ 50 m above the swamp level. Intermittently saturated swamp locations tend to reside in shallow valleys where the adjacent ridges rise ≤ 20 m above the swamp level.

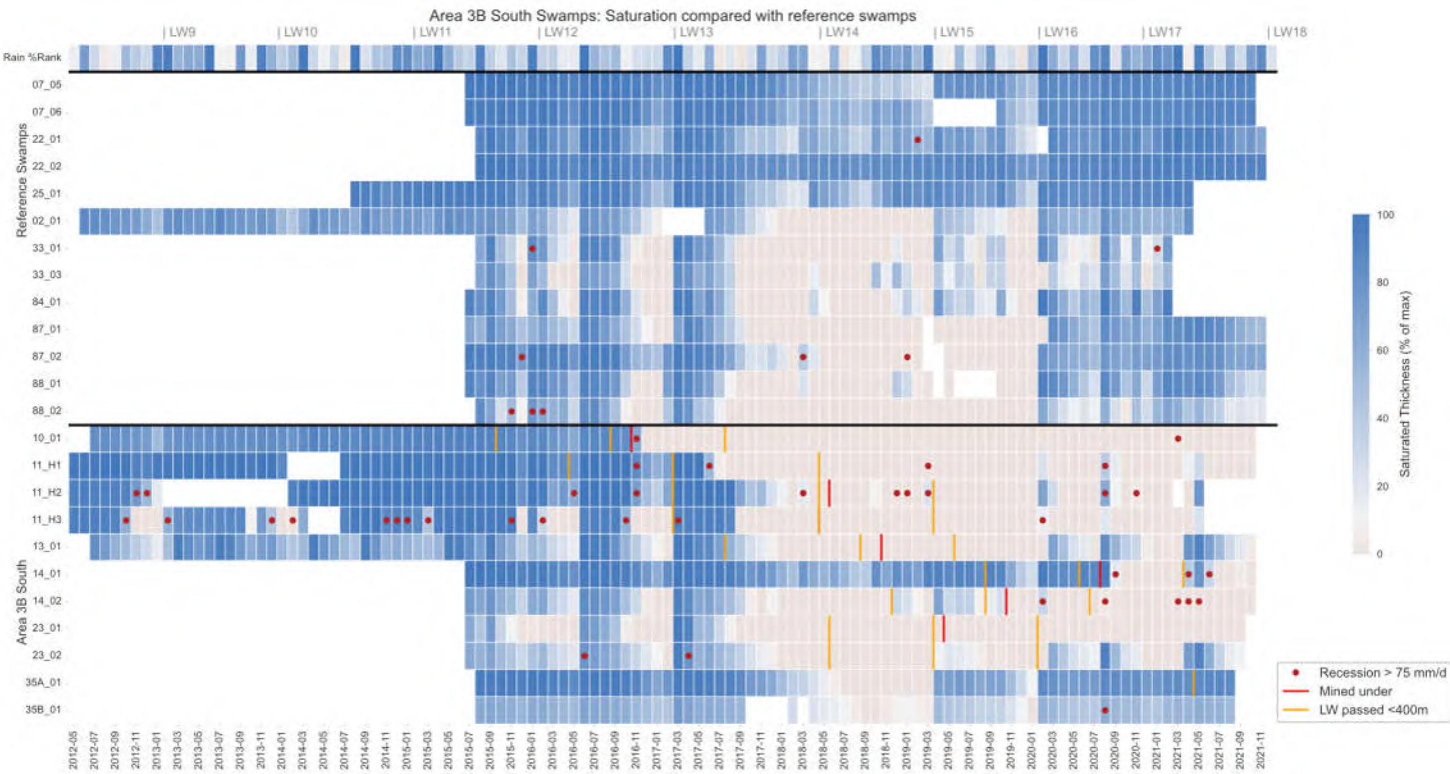

Figure 32. Overview of swamp saturation levels by month, Area 3B (south)

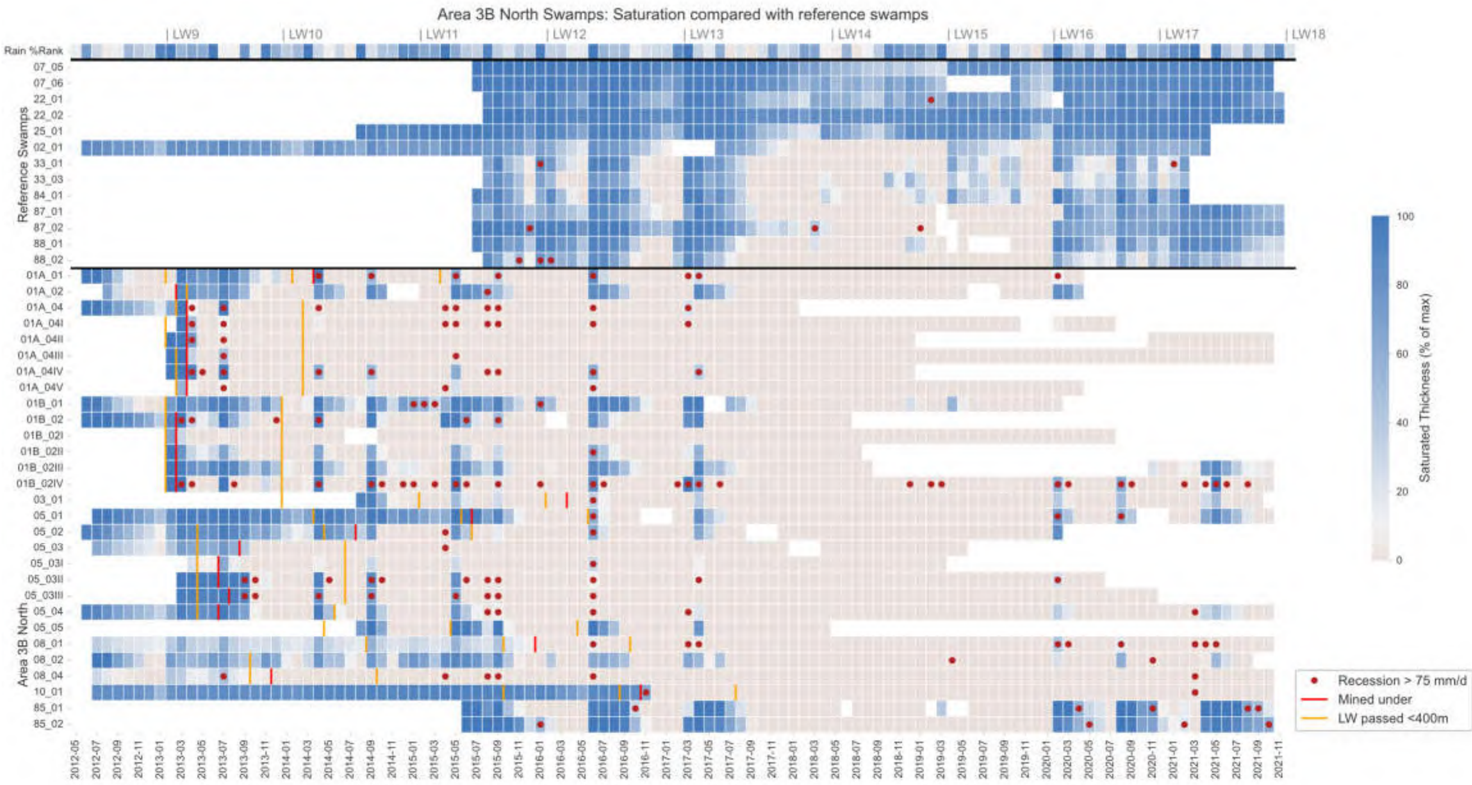

Figure 33. Overview of swamp saturation levels by month, Area 3B (north)

6.1.2 Impact swamp sites

During Longwall 17 passed beneath or within 400 m of:

- **Swamp 14**: Longwall 17 passed beneath the southern end of the swamp between 12/6/2021 and 27/6/2021. Piezometer 14_01 was passed by Longwall 17 at a distance of 140 m on ~13/6/2021 and was mined under by Longwall 16 on 8/8/2020. The northern extension of the swamp (and S14_S02) was previously mined under by Longwall 15 in the latter half of 2019.
- **Swamp 23**: Longwall 17 commenced at a distance of ~350 m from the southern fringes of the swamp in early 2021. Longwall 16 passed beneath the southern fringes of the swamp between 10/3/2020 and 23/3/2020. The northern half of the swamp was previously mined under by Longwall 15 during the first half of 2019.
- **Swamp 149**: Longwall 17 passed beneath the swamp between 20/3/2021 and 1/4/2021. There are no piezometers or soil moisture sensors at this swamp.
- **Swamp 35a**: Longwall 17 passed within 400m of the swamp between 18/4/2021 and 18/7/2021. The closest approach to piezometer 35a_01 was 325 m on 23/5/2021

Observed effects on shallow groundwater levels within these swamps is described below.

6.1.2.1 Swamp 14

Swamp 14 consists of ~5.9 ha of upland swamp vegetation, mostly Teatree and Banksia thicket and Cyperoid heath (sedgeland) surrounding the upper reaches of tributary WC15. The swamp vegetation is discontinuous along WC15 and consists of two main areas. Piezometer 14_01 is located between two minor watercourses within the upper (southern) Swamp 14 area which was mined beneath by Longwall 16 in August 2020. Piezometer 14_02 is located within the lower (northern) Swamp 14 area which was previously mined beneath by Longwall 15 in October-November 2019. The piezometers intersect 1.5 to 1.75 m of swamp sediment which overlies Hawkesbury Sandstone.

The WC15 watercourse hosts numerous pools within and downstream of the swamp and it is likely that drainage from the swamp, together with direct groundwater discharge from Hawkesbury Sandstone, sustains baseflow and pool levels for extended periods after rain.

Hydrographs for piezometers 14_01 and 14_02, screened within swamp sediments are shown in Figure 34 and Figure 35. The shallow groundwater hydrographs show slightly different baseline groundwater conditions within the two swamp areas prior to the approach of Longwalls 15 and 16. Piezometer 14_01 in the upper swamp area shows that sediments were continuously saturated since the start of monitoring in July 2015, including during the 2017-2019 drought. It is likely that Swamp 14 was sustained by groundwater in the underlying and adjacent sandstone substrate. Piezometer 14_02 in the lower Swamp 14 area shows saturated conditions most of the time between July 2015 and late 2017 and, like several reference sites, recorded groundwater levels below the base of the piezometer for more than 50% of the time during the 2017-2019 drought period. This behaviour indicates that lower swamp area groundwater levels were not sustained by groundwater in the sandstone substrate to the same extent as in the upper swamp area, despite being at a lower elevation (367 – 387 m AHD).

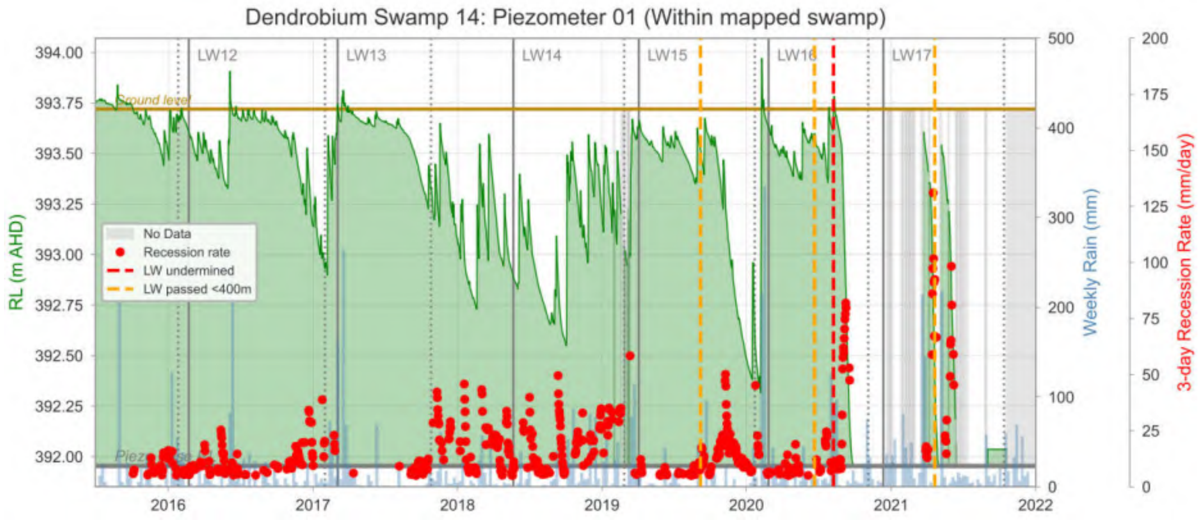

Figure 34. Shallow groundwater hydrograph for Swamp 14, piezometer 01

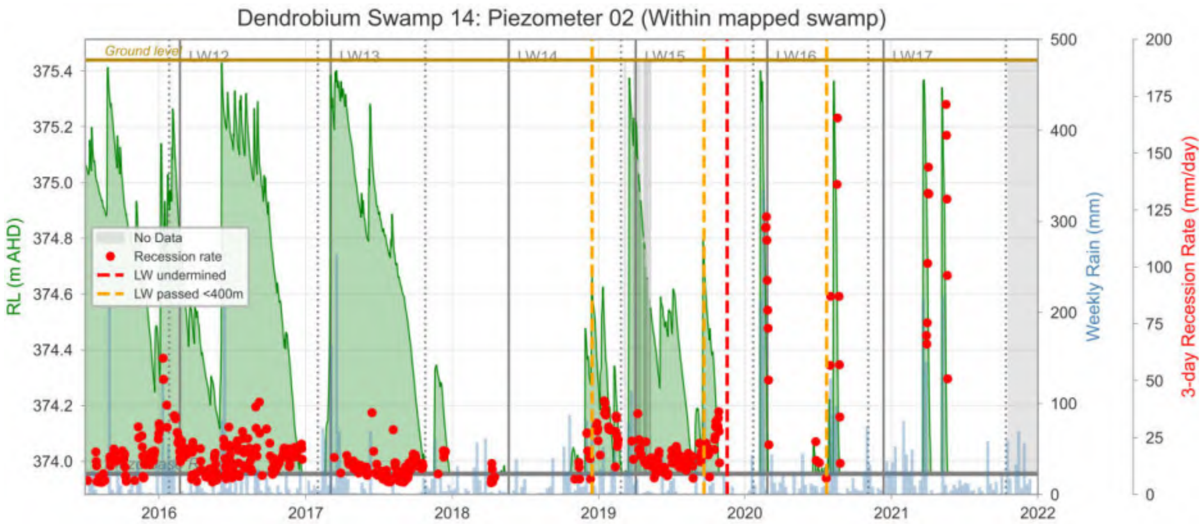

Figure 35. Shallow groundwater hydrograph for Swamp 14, piezometer 02

Both swamp piezometers were found to show evidence for shallow groundwater impact in the previous (Longwall 16) EOP report. Review of hydrographs following the passage of Longwall 17 confirms mining effects, with increased recession rates and decreases in durations of saturation following longwall passage, compared with baseline conditions at both piezometer sites. These effects represent a Level 3 TARP trigger at Swamp 14 (as for the previous assessment).

6.1.2.2 Swamp 23

Swamp 23 consists of ~3.9 ha of upland swamp vegetation, mostly Tea-tree and Banksia thicket and minor Cyperoid heath (sedgeland) surrounding the upper reaches of tributary LA3. Two shallow groundwater piezometers are installed in the Swamp; Piezometers 23_01 (headwater) and 23_02 (mid-slope). The piezometers intersect 1.1 to 2.25 m of swamp sediment (respectively) which overlies Hawkesbury Sandstone.

Both piezometers were intermittently saturated prior to Longwall 15. Piezometer 23_01 retained saturation for ~5 to 6 months following large rainfall events, whereas piezometer 23_02 remained partly saturated for longer periods (8 to 12 month) such that sediments became unsaturated only during prolonged low rainfall periods such as the 2017-2019 drought. Shallow groundwater conditions appear similar to those at reference swamps 84, 85 and 88.

The previous assessment concluded that groundwater levels at piezometer 23_01 were impacted due to the passage of Longwall 15, whereas groundwater impacts at piezometer 23_02 following Longwall 16 were not clear. Review of hydrographs in this assessment indicates the following (Figure 36, Figure 37, below):

- 23_01: Records very short periods of saturation following rainfall events in contrast to longer duration of saturation prior to Longwall 15 and compared with reference swamps 84, 85 and 86.
- 23_02: Records reduction in level and duration of saturation following rainfall events in 2020-2021, compared with pre-Longwall 15 baseline. The very high rainfall in 2020-2021 would be expected to result in saturation profiles similar to (or of longer duration than), those seen between 2016 and 2018.

These observations indicate mine related impacts to shallow groundwater at both piezometers, with the effects at 23_02 (located over a longwall pillar) being less severe than at 23_01. The observed impacts trigger a Level 3 TARP (previously Level 2). It should be noted that lower shallow groundwater levels have been observed in several reference swamps (e.g. Swamps 02, 07, 33, 85, 87 and 88) during 2020-2021 compared with pre-2017 and therefore this TARP level should be reassessed when more data become available.

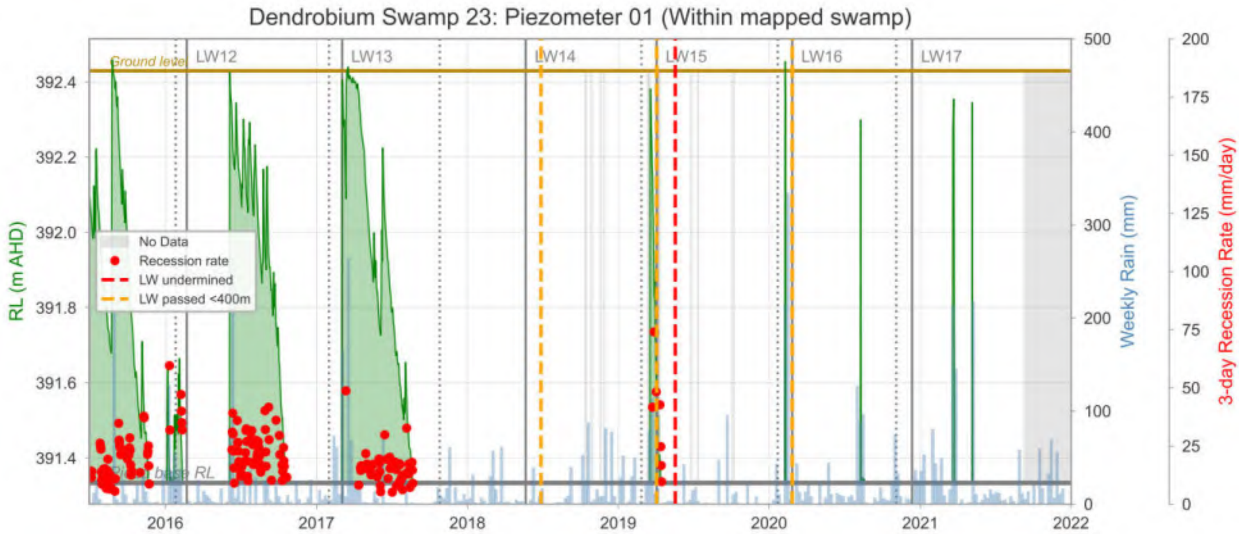

Figure 36. Shallow groundwater hydrograph for Swamp 23, piezometer 01

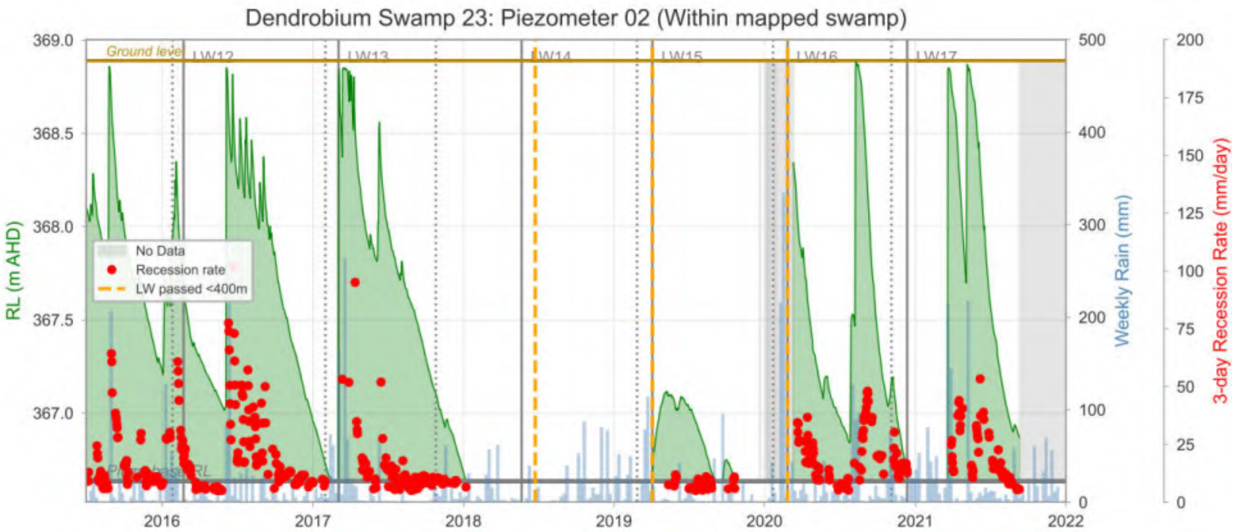

Figure 37. Shallow groundwater hydrograph for Swamp 23, piezometer 02

Swamp 35a

Swamp 35a consists of 1.2 Ha of swamp vegetation along the upper reaches of tributary ND1. The swamp is located on the southern edge of proposed Longwall 18. Longwall 17 passed within 225 m of the swamp in May 2021. One shallow piezometer (35a_01) intersects 2.18 m of swamp sediment ~20 m north of the tributary channel. A hydrograph for piezometer 35a_01 is shown in Figure 38, below. The hydrograph shows that the swamp sediments are saturated most of the time, becoming unsaturated for several months during the 2017-2019 drought. It is likely that the swamp is connected with, and sustained by, groundwater within the underlying and adjacent sandstone substrate, except during times of extreme drought.

Shallow groundwater levels in the swamp recovered from the drought during 2020 and 2021. Despite there being no obvious effects following the passage of Longwall 17, it is noted that shallow groundwater levels at both 35a_01 and 35b_01 have not recovered to the same levels as those prior to 2017. The lower groundwater levels were apparent prior to the passage of Longwall 17. The same behaviour is noted at reference Swamp 87 and at Swamp 7 both of which also appear to be connected to underlying HBSS groundwater systems. This suggests that swamp groundwater levels (and underlying sandstone groundwater) have not completely recovered from the drought, despite high rainfall in 2020 and 2021.

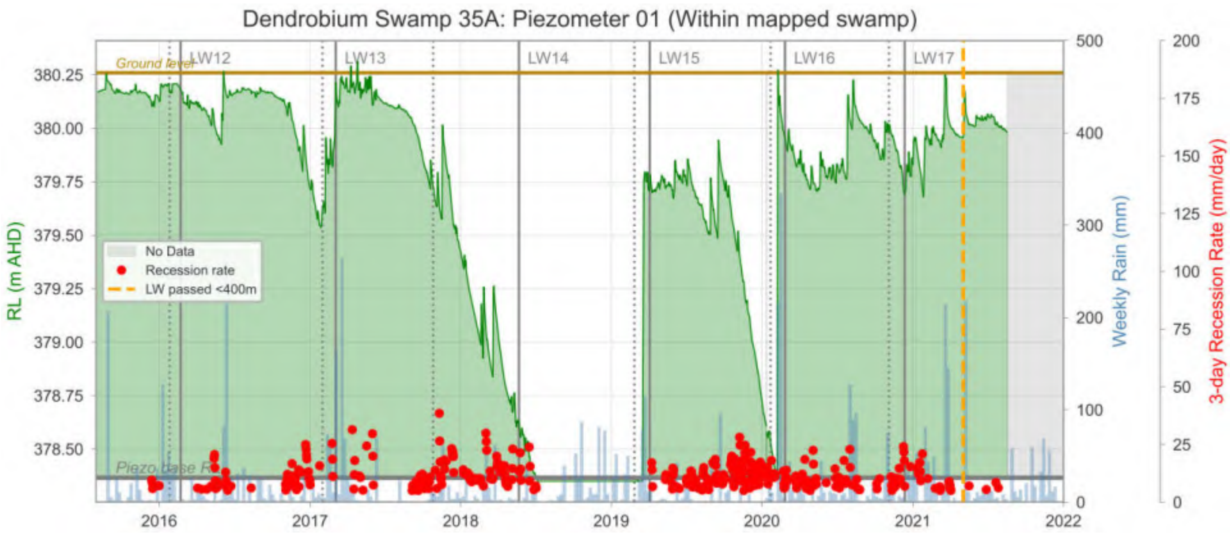

Figure 38. Shallow groundwater hydrograph for Swamp 35a, piezometer 01

Swamp 149

Swamp 149 comprises 1.4 Ha of swamp vegetation located on the mid- to upper slopes of the LA2 tributary catchment. The swamp area does not overlap with mapped tributary channels but likely contributes via seepage to baseflow of the upper reaches of the tributary. A single piezometer was installed within the mapped swamp area in 2021 and therefore no baseline data are available prior to the northern 85% of the swamp being mined under by Longwall 17 in late March 2021.

6.1.3 Spatial distribution of impacted swamps

Swamps that have been mined under commonly display hydrological changes shortly following the passage of the longwall beneath the monitoring site. An assessment of hydrological change at Upland Swamps was carried out at Dendrobium by Watershed (2019b) and recently updated (Watershed HydroGeo, 2021b). The study concluded that there was no evidence for hydrological change in shallow groundwater piezometers located more than 60 m from the extracted longwall margin. Although it is possible that impacts at greater distances from the mine may be caused by depressurisation along geological structures such as faults (as has been observed at the Springvale Mine in the Western Coalfield; Galvin *et al.* 2016), the Watershed assessment found no evidence for anomalous impacts associated with lineaments at Dendrobium.

Shallow groundwater responses to Longwall 17 discussed in the previous section are consistent with the Watershed review and similarly find no evidence for anomalous impacts at distances greater than 60 m attributable to lineaments.

Table 30. Summary of cumulative shallow groundwater effects and 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	Longwall 9, Longwall 10	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	Longwall 9	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 Longwall 11 passed and Longwall 12 undermined.	Rapid recession after rain during Longwall 13 supports impact at Swamp 3	Level 3
05	6	Longwall 9, Longwall 10, Longwall 11	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 Longwall 11 or 12 due to limited baseline.	Level 3
08	0	Longwall 9, Longwall 10 Longwall 11	*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	Longwall 12	01			Sharp decline in groundwater levels below base of the piezometer after Longwall 12. Level and rate of decline anomalous compared with baseline.	Mined under by Longwall 12	Level 3
11	3	Longwalls 13-14	H1, H2, H3			All three piezometers show mostly desaturated conditions following the passage of Longwall 14 with only brief periods of saturation following rainfall events.	Partially mined under by Longwall 13 and by Longwall 14	Level 3
13	1	Longwalls 13-14	01			Groundwater level below the piezometer base since early 2018; Impact apparent as of Longwall 15. Swamp re-saturated 2020-2021 but not to the same level as previously.	Partially mined under by Longwall 13 and by Longwall 14	Level 3
14	2	**Longwalls 15-17**	01, 02			Evidence for impact to swamp groundwater levels at 14_01 and 14_02 following Longwalls 16 and 15 respectively. Effects confirmed in post-Longwall 17 assessment.	Partially mined under by Longwalls 15, 16 and 17	**Level 3**
23	2	**Longwalls 15-17**	01, 02			Evidence for impact to swamp groundwater levels and duration of saturation at 23_01 and 23_02, following passage of Longwalls 15 and 16.	Partially mined under by Longwall 15, passed within 400 m by Longwalls 16 and 17.	**Level 3**

35a	1	**Longwalls 17,18**			01	No evidence of mining effects from Longwall 17. Groundwater levels slightly lower than pre-2017, similar to reference Swamp 87 and Swamp 7.	Longwall 17 closest approach 325 m. Longwall 18 will overlap the northern fringes of the swamp	n/a
35b	1	Longwall 18			01	No evidence of mining effects from Longwall 17. Groundwater levels slightly lower than pre-2017, similar to reference Swamp 87 and Swamp 7.	Longwall 17 closest approach 440 m. Longwall 18 with pass ~85 m from the swamp.	n/a
149	[1]	**Longwall 17**			[01]	No data available. Swamp likely to be affected.	Longwall 17 passed directly beneath swamp.	n/a
150	[1]	Longwall 18			[01]	Piezometer installed in 2021; no data available.	Longwall 18 will pass within 235 m of the swamp.	n/a

Note: " i " in site name (e.g. 04i) indicates installation during Longwall 9 extraction. * 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.

Table 31. Summary of shallow groundwater level trends at *Reference Sites*.

SWAMP	NUMBER OF PIEZO-METERS	PIEZOMETERS	PROXIMITY TO LONGWALLS	COMMENT	OBSERVATIONS
02	1	01	900 m north of Longwall 9	900 m from Longwall 9	Swamp permanently saturated 2013-2017. Water level below piezometer for >60% of time between 2017 and 2019; saturated throughout 2020-2021 with mean levels slightly below pre-2016.
07	2	05, 06	1.2 km from Longwall 6	1.2 km from Longwall 6	Water level above base of piezometers for entire record including dry period between 2017 and 2019. Saturated throughout 2020-2021 with mean levels slightly below pre-2016..
15a	3	06, 07	0.5 km south of Longwall 8, 130 m south of Longwall 19	0.5 km from Longwall 8	n/a
22	2	01, 02	Elouera Colliery	Limited baseline data	Water level above base of piezometers for entire record including during the 2017-2019 drought. Saturated throughout 2020 and 2021.
25	1	01	1.4 km from Longwall 5	1.4 km from Longwall 5	Water level above base of piezometers for entire record including during the 2017-2019 drought. Data gap 2012-2014.Saturated 2020-2021.
33	2	01, 03	1 km from Longwall 16	1 km from Longwall 16	Transient but short duration peaks in water level following rain. Shorter duration peaks during 2018-2019 dry period. Saturated most of the time between 2020 and 2021, but to lower levels than pre-2017
84	1	01	500 m from Longwall 5	500 m from Longwall 5	Swamp 84 has typically been saturated 80-90% of time, except for the 2017-2019 dry period (<50%). Saturated most of 2020 and early 2021.

85	2	01, 02	900 m from Longwall 9	900 m from Longwall 9	Piezometers record saturation of swamp sediments for several months after heavy rainfall events. Swamp unsaturated late 2017 to early 2020 Saturated most of 2020 and 2021 but lower levels in 85_02 than pre-2018
86	2	01, 02	3 km from Longwall 9	3 km from Longwall 9	Piezometer 01 has similar characteristics to swamp 85. Piezometer 02 typically records saturated conditions except during 2019. Returned to saturated conditions throughout 2020 and 2021.
87	2	01, 02	Avon Colliery	Limited baseline data	Piezometer 01 saturated >90% of time and piezometer 02 100% of time prior to 2018. Piezometers dry most of 2018 to 2020. Saturated throughout 2020 and 2021, but to slightly lower levels in 87_02 than pre-2017.
88	2	2	Huntley Colliery	Limited baseline data	Both piezometers record WL above base for >80% of time prior to 2017. Both piezometers mostly dry 2017 – 2019. Mostly saturated in 2020-2021, , but to slightly lower levels in 88_02 than pre-2017.

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. Response trigger conditions related to soil moisture at swamp monitoring sites are listed in the SIMMCP (South32, 2020c), and reproduced in Table 32.

Table 32. TARP trigger conditions related to soil moisture at swamp monitoring sites

TARP Level	Trigger conditions	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 32). This is the same approach used by the IMCEFT for regular impact reporting. The baseline period is the period of monitoring before the site is first mined under or passed within 400 m.

Soil moisture hydrographs for all active monitoring locations are presented in **Appendix E**. Assessment of soil moisture hydrographs for locations within Areas 3A and 3B zone of influence (< 400 m) are presented in Table 33. Longwall 17 passed beneath or within 400 m of:

- **Swamp 14**: Longwall 17 passed beneath the southern end of the swamp between 12/6/2021 and 27/6/2021. Piezometer S14_S01 was passed by Longwall 17 at a distance of 140 m on ~13/6/2021 and was mined under by Longwall 16 on 8/8/2020. The northern extension of the swamp (and S14_S02) was previously mined under by Longwall 15 in the latter half of 2019.
- **Swamp 23**: Longwall 17 commenced at a distance of ~350 m from the southern fringes of the swamp in early 2021. Longwall 16 passed beneath the southern fringes of the swamp between 10/3/2020 and 23/3/2020. The swamp was previously mined under by Longwall 15 during the first half of 2019.
- **Swamp 149**: Longwall 17 passed beneath the swamp between 20/3/2021 and 1/4/2021. A soil moisture sensor was installed at Swamp 149 in 2021 as part of the Longwall 18 SMP.
- **Swamp 35a**: Longwall 17 passed within 400m of the swamp between 18/4/2021 and 18/7/2021. The closest approach to piezometer S35a_S01 was 355 m on 23/5/2021.

Soil moisture levels have recovered significantly at reference swamps sites and impact swamps during 2020 and 2021 following above-average rainfall. Average soil moisture declined at all sensors during the 2017-2019 drought, complicating interpretation of longwall subsidence effects over that period. Recovery in 2020 and 2021 led to revision of TARP triggers at Swamp 13 and 23. Table 33 summarises observations and cumulative TARP triggers at Area 3B swamps.

At Swamp 14 moisture levels at S14_S01 declined following passage of Longwall 16 which contrasts with the recovery in soil moisture at reference swamps. The decline in soil moisture is more apparent in 2021 during the passage of Longwall 17. Soil moisture at S14_S02 was highly variable during 2021 and fluctuated within a range similar to baseline. However, while the logger data baseline is short at this location, it is expected that moisture levels would have recovered, and remained elevated for longer durations after heavy rain events than observed (and as compared with reference sites; e.g. S85_S03). This is considered to represent a mining effect at S14_S02. Mining effects at both sensors represents a TARP Level 3 trigger (revised from Level 2).

At Swamp 23, soil moisture levels continued to vary within the baseline range in 2021, following depletion during the 2017-2019 drought. On this basis, the TARP is not triggered (unchanged from last assessment).

Table 33. Cumulative 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	9-11		S05_S05, S05_S01, S05_S02, S05_S08		All four sites show soil moisture decline below baseline after LW passed; baseline <2 y). Possible recovery at S05_S08.	3
08	9-11	S08_S05			Soil moisture falls below baseline after undermining. *Not within mapped swamp boundary.*	n/a
11	13,14		S11_S01, S11_S02, S11_S05		Soil moisture at all sensors dropped to lowest levels following LW13 and LW14. Likely mining effect, exacerbated by dry conditions. Some recovery in 2021.	3
13	13,14	S13_S03	S13_S01, S13_S02,		Soil moisture at all sensors dropped to lowest levels during 2017-2019 drought. Apparent recovery in 2020 and 2021 at S13_S03. Other sensors record lower moisture levels than baseline.	2
14	15-17		S14_S01, S14_S02		Soil moisture at S14_S01 below baseline in contrast to recovery at reference swamps 22, 85 and 86. S14_S02 shows lower moisture levels and durations compared with baseline and reference swamps.	**3**
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	15-17	S23_S01 S23_S02			No TARP trigger (previously Level 2). Both sensors show recovery in 2020 and 2021 with moisture levels varying within the baseline range.	-
35a	17,18			S35a_S01	No TARP trigger	-
149	17,18				Installed in 2021	-

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

7. Conclusions

Longwall 17 is the ninth panel to be extracted from Dendrobium Area 3B. Extraction of Longwall 17 commenced on 12/12/2020 and was completed on 13/10/2020. Rainfall during 2021 and during Longwall 17 extraction was well above average, totalling 1448 mm in 2021. Heavy rainfall was experienced in March, May and November 2021. This follows similarly high rainfall in 2020 (1436 mm), making 2020-21 the wettest two-year period since the start of mining at Dendrobium. As a result, there has been a broad recovery in stream flow, shallow groundwater levels, soil moisture and stream water quality across all catchments since the severe drought of 2017-2019.

In general, stream salinity (EC) has decreased over the last two years due to higher than average rainfall and significant increase in runoff compared with the previous two years. The decreasing trend follows slightly more saline conditions at most locations during the 2017-2019 drought which resulted in low flows and evaporative concentration of salts. Similarly, DO has trended higher over the last two years period due to higher flows and stream turbulence.

Anomalous water quality effects are noted in streams that have been directly mined under by previous longwalls (e.g. WC21, SC10C, LA4, DCC). Those effects include transient or persistent increases in EC, increases (or decreases) in pH and increases in dissolved metal concentrations such as Fe, Mn, Al and Zn. Iron staining in creek beds is commonly associated with watercourses that have been directly mined beneath or are within the mining area of influence. Over the last two years, new or recurrent iron staining has been noted on Wongawilli Creek, WC21, LA5 and SC10C. The observations of iron staining are likely related to recovery of groundwater levels and the reactivation of iron-rich springs near creek channels. This is supported by groundwater monitoring data.

Water quality TARPs were triggered at Lake Avon tributary site LA4_S1 for EC and pH. Impacts to the LA4 watercourse, including fracturing of the creek bed and diversion of flow were reported in End of Panel Reports for Longwalls 12, 13 and 15. Sampling of the site resumed in mid-2020 following higher rainfall and more frequent ponding. EC has increased and pH decreased since the resumption flow, resulting in TARP triggers. Dissolved metals Fe, Mn, Zn and Al increased over the same period. The water quality in Lake Avon remains unaffected.

7.1 Effects on surface water flow

Surface water flow TARPs were reviewed in 2019 in consultation with relevant government agencies and based on recommendations of the IEPMC (Watershed HydroGeo, 2019a). Key features of the updated TARPs are:

A. A move to rely on comparison of flows recorded at relevant sub-catchment monitoring sites around the Dendrobium mining area against selected reference sites, rather than relying on rainfall-runoff modelling.

B. Assessment of sub-catchment hydrology against a number of different indicators that are considered appropriate to identifying and quantifying potential effects on the broad hydrological behaviour within each sub-catchment, effects on cease-to-flow conditions that may be significant to ecological values, and effects on median flow which is a proxy for the water resource potential.

C. A further assessment has been implemented to analyse the mining effects on low-flows that are known to occur along the "middle reach" of Wongawilli Creek, between Area 3A and 3B.

The results of Assessments A, B and C are summarised on Table 34.

The assessments indicate that sub-catchments in the upper part of the Donalds Castle Creek catchment (i.e. DC13S1 and DCS2) have been and continue to be affected by mining, as are the tributaries LA4, LA3 and LA2 of Lake Avon. The findings for DC13S1, DCS2 (both at Level 3 for all three flow assessments) are similar to those for the EoP report for Longwalls 15-16.

Similarly, the flow characteristics at WC21S1 and WC15S1 within the Wongawilli Creek catchment have altered as a result of mining, with these sites at Levels 2 or 3 for the three assessments. As with the sub-catchments above, the effects at WC21 and WC15 are similar to those for the previous End of Panel reports. Despite Longwall 16 terminating within 50 m of and the end of Longwall 17 mining under WC12 respectively, no mining-related effects are discernible beyond natural variability/method accuracy.

As in recent EoP reports, analysis indicates that mild mining effects are probable at the Donalds Castle Creek downstream monitoring site (DCU). Specifically, the newly designed TARP assessments indicate that the general pattern of flow (Assessment A) and the median flows (Assessment C) do not trigger, which suggest that any mining effects or impacts on those indicators are of similar magnitude or less than natural variability. However, the new Assessment B, which examines cease-to-flow duration and frequency, indicates that the watercourse at DCU has been experiencing a mild increase in the number of cease-to-flow days compared to the Reference sites (TARP Level 1).

Changes to stream flow characteristics are not evident at the downstream gauge on Wongawilli Creek Lower (WWL), despite mining-related effects being clear and significant at upstream tributaries (e.g. WC21, WC15). This suggests that some or all flow lost in headwater catchments is returned downgradient, or that upstream diversions or losses are not significant in relation to the larger catchment water balance given the natural variability and the accuracy of flow measurements. These possible reasons are even more relevant at DCU, where the losses identified in upstream sites DC13S1 and DCS2 are 40-60% of median flow at Q50. Such losses should be clearly apparent at DCU if they were transmitted downstream, but the assessment has not detected a change in median flow at Q50 beyond natural variability (i.e. variability at two Reference sites).

Analysis of available surface water flow observation records for Wongawilli Creek did not trigger TARP Assessment D for any of the months assessed during the Longwall 17 period.

7.1.1 Effects at Waterfall WF54

Comparison of pool water levels measured above WF54 and a reference site at WWU was conducted throughout the latter half of Longwall 17, and a short period after its completion, as part of an Adaptive Management process. The same analysis has been repeated here to include the 2 months since the end of Longwall 17.

The analysis shows that post-mining behaviour of water levels at WF54 is consistent with pre-mining record, and therefore that Longwall 17 did not have an effect (either no effect or an effect that cannot be discerned beyond natural variability).

Table 34. Area 3B watercourse flow assessment summary

Site	Watercourse	Area	Date mining occurred under sub-catchment	A) Low flow Q%ile outside Reference Site Q%ile		B) Change in cease-to-flow frequency (beyond natural)		C) Change Q50 (beyond natural) as % of pre-mining Q50			Rainfall-runoff model comparison	Comment
				Change %	TARP Level	Change %	TARP Level	Change ML/d	Change %	TARP Level		
DC13S1	DC13	A3B	09/02/2013	57%	Level 3	15%	Level 2	-0.09	-70%	Level 3	n/a	Effects are similar to those in LW14-16.
DCS2	Donalds Castle Creek	A3B	10/07/2013	51%	Level 3	35%	Level 3	-0.08	-47%	Level 3	n/a	Effects are similar to those in LW14-16.
DCU	Donalds Castle Creek	A3B	09/02/2013	-9%	Not triggered	8%	Level 1	0.14	37%	Not triggered	Not triggered	Effects are similar to those in LW14-16. This is consistent with findings from rainfall-runoff modelling.
WC21S1	WC21	A3B	05/10/2013	31%	Level 3	11%	Level 2	-0.12	-26%	Level 3	n/a	Effects are similar to those in LW14-16.
WC15S1	WC15	A3B	28/01/2017	33%	Level 3	17%	Level 2	-0.07	-46%	Level 3	n/a	Similar to LW15-16.
WC12S1	WC12	A3B	18/10/2020	-6.4%	Not triggered	-14%	Not triggered	0.014	154%	Not triggered	Not triggered	Second panel under sub-catchment. No discernible effect This is consistent with findings from rainfall-runoff modelling.
WWL	Wongawilli Creek	d/s A3B	09/02/2010	-1%	Not triggered	-5%	Not triggered	0.15	4%	Not triggered	Not triggered	Effects are similar to those in LW14-16. This is consistent with findings from rainfall-runoff modelling.
WWLA	Wongawilli Creek	d/s A3B	09/02/2010									No pre-mining baseline record. Recommended to be assessed in future mining areas (e.g. A3C).
LA4S1	LA4	A3B	01/04/2015	14%	Level 1	22%	Level 2	-0.04	-45%	Level 3	n/a	Effects are similar to those in LW14-16.
LA3S1	LA3	A3B	28/04/2019	40%	Level 3	40%	Level 3	-0.06	-404%	Level 3	n/a	Effects are similar to those following LW16
LA2S1	LA2	A3B	01/03/2020	7%	Not triggered	-4%	Level 1	-0.011	-573%	Level 3	n/a	Effects are similar to those following LW16, but low-flow frequency has increased.
NDS1	ND1	A3B	18/04/2021	-18%	Not triggered	-17%	Not triggered	0.115	499%	Not triggered	Not triggered	LW17 is the first panel to mine beneath this sub-catchment. No discernible effect. This is consistent with findings from rainfall-runoff model.

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7.1.2 Performance Measures

The four Performance Measures for surface water flow were assessed (Section 5.6) as follows:

Wongawilli Creek – minor environmental consequences
This Performance Measure is met.

Donalds Castle Creek – minor environmental consequences
This Performance Measure is met.

Lake Avon – negligible reduction in the quantity of surface water inflows to Lake Avon
This Performance Measure is met.

Cordeaux River – negligible reduction in the quantity of surface water inflow to the Cordeaux River at its confluence with Wongawilli Creek
This Performance Measure is met.

7.2 Effects on 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, 2020c). Longwall 17 passed beneath, or within 400 m of Swamps 14, 23, 149 and 35a. The assessment of shallow groundwater levels indicates that TARPs have been triggered at the following swamps, most of which, were triggered during previous longwalls:

- Swamp 01a Level 3
- Swamp 01b Level 2
- Swamp 03 Level 3 (because the only piezometer is affected)
- Swamp 05 Level 3
- Swamp 10 Level 3 (because the only piezometer is affected)
- Swamp 11 Level 3
- Swamp 13 Level 3 (because the only piezometer is affected)
- Swamp 14 Level 3
- Swamp 23 Level 3 (**this assessment**)

Both shallow groundwater levels and soil moisture levels in reference swamps recovered throughout 2020 and 2021 in response to high rainfall following the 2017-2019 drought period. However, shallow groundwater levels have not yet recovered to the same levels as prior to 2017 in several reference swamps (e.g. Swamps 02, 07, 33, 85, 87 and 88).

At Swamp 14 moisture levels at S14_S01 declined following passage of Longwall 16 which contrasts with the recovery in soil moisture at reference swamps. The decline in soil moisture is more apparent in 2021 during the passage of Longwall 17. Soil moisture at S14_S02 was highly variable during 2021 and slightly lower on average than would be expected by comparison with reference sites. Mining effects are likely at both sensors, representing a TARP level 3 trigger (revised from Level 2).

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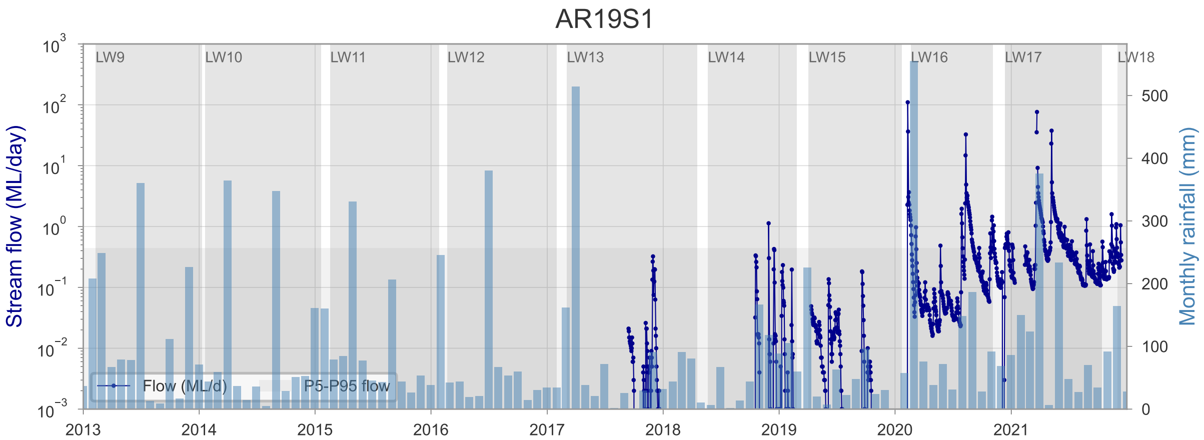
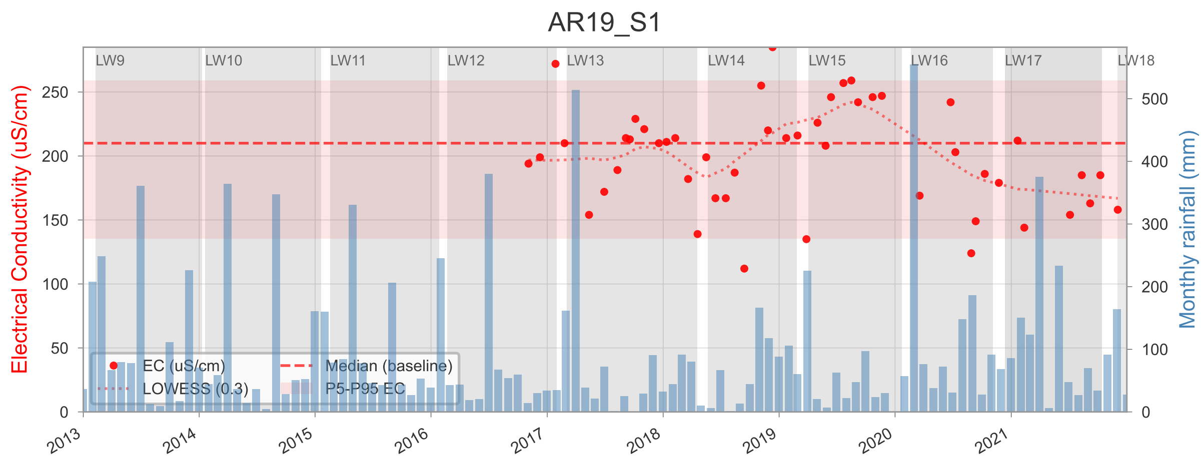
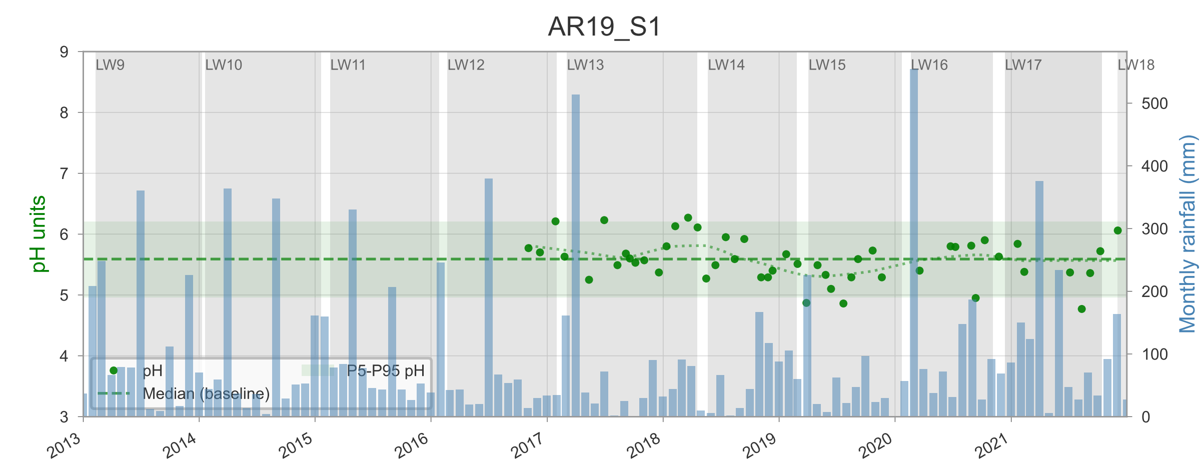
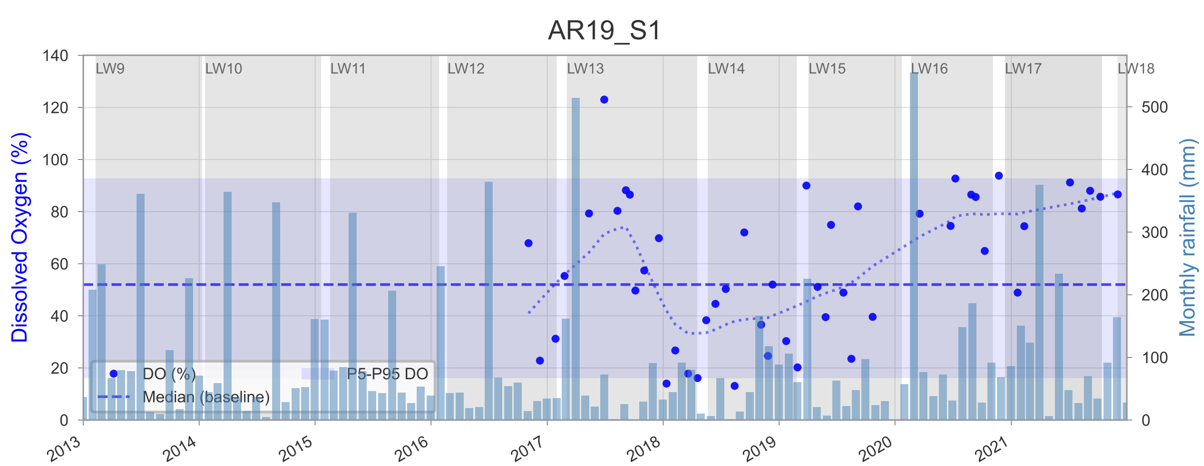
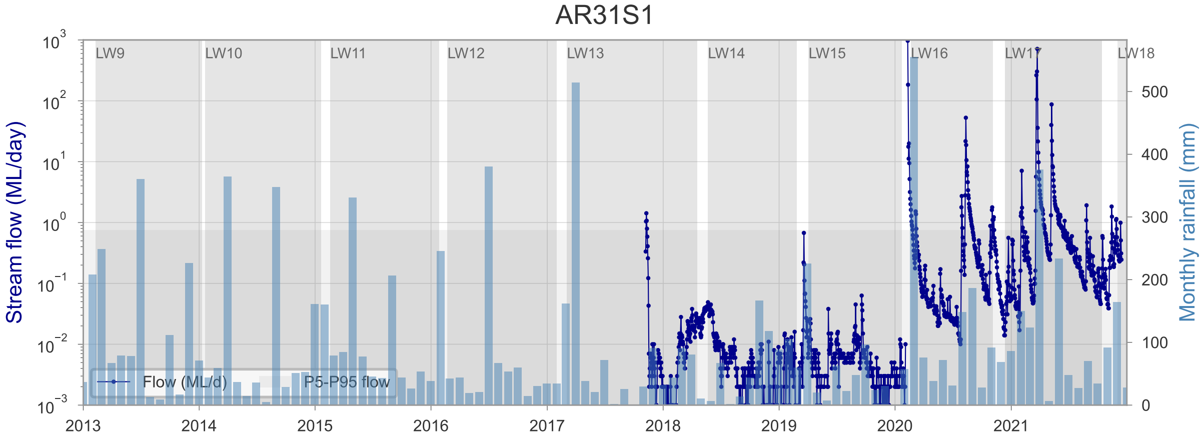
Appendix A1: Water quality hydrographs

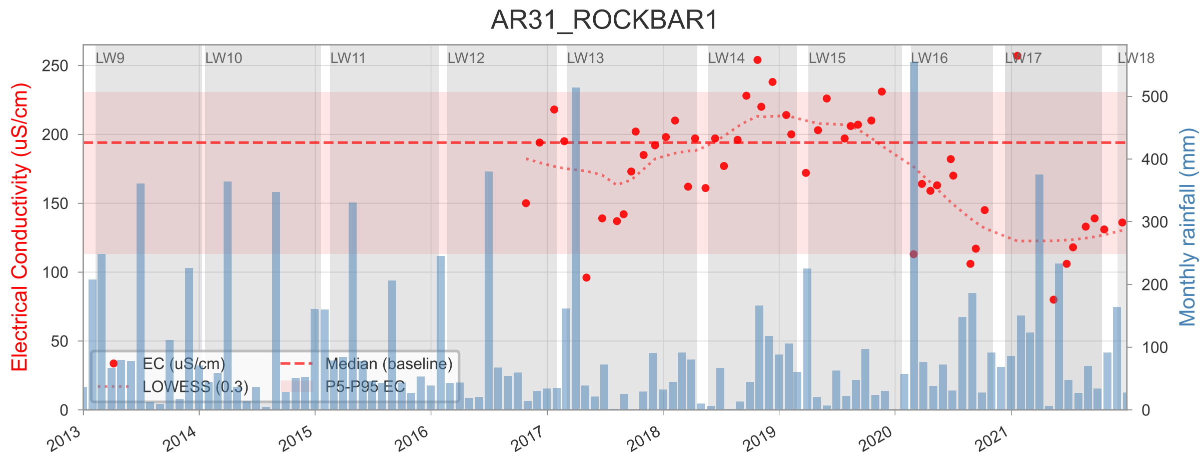

AR19S1
Stream flow (ML/day)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Flow (ML/d)
P5-P95 flow

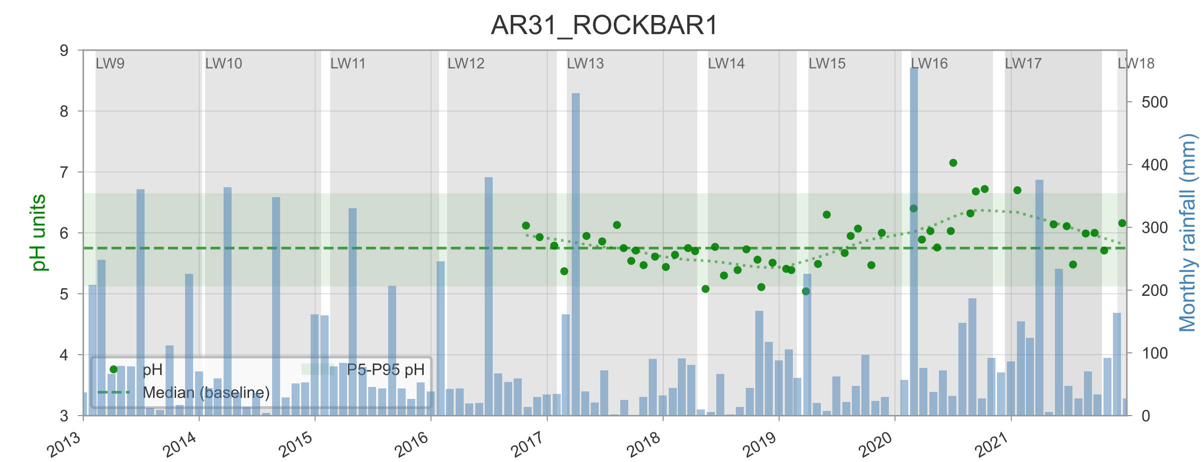

AR19_S1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

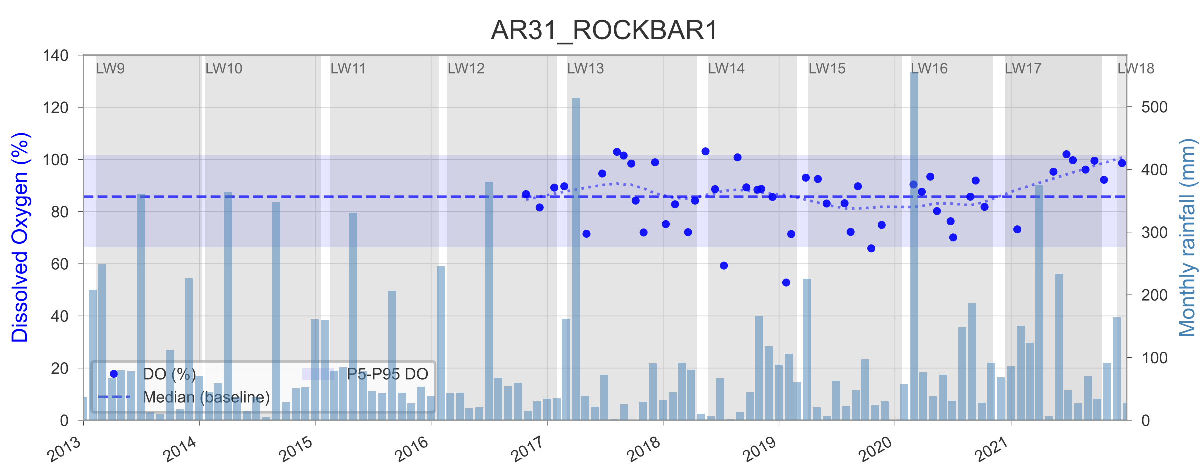

AR19_S1
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
Median (baseline)
P5-P95 pH


AR19_S1
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
Median (baseline)
P5-P95 DO

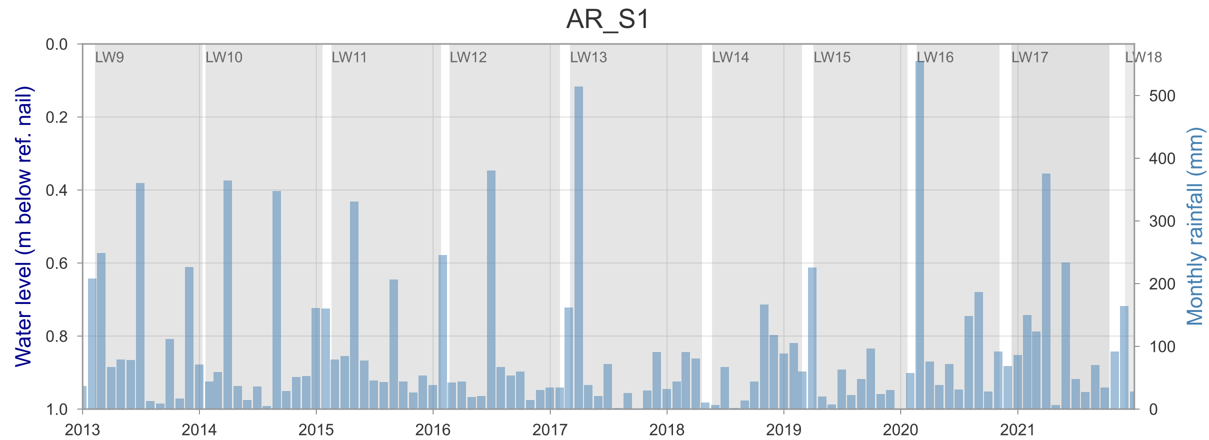

AR31S1
Stream flow (ML/day)
Monthly rainfall (mm)
LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
Flow (ML/d)
P5-P95 flow

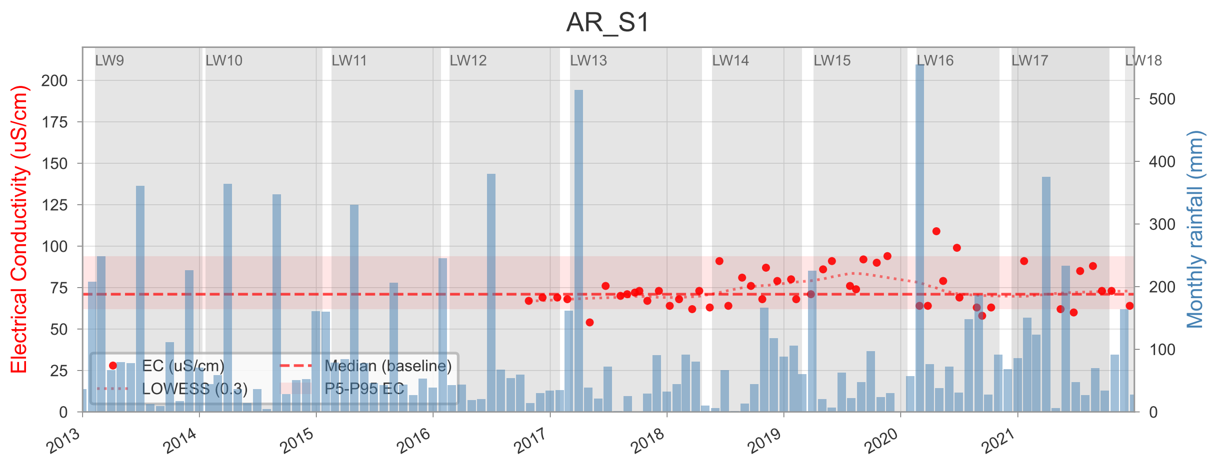

AR31_ROCKBAR1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

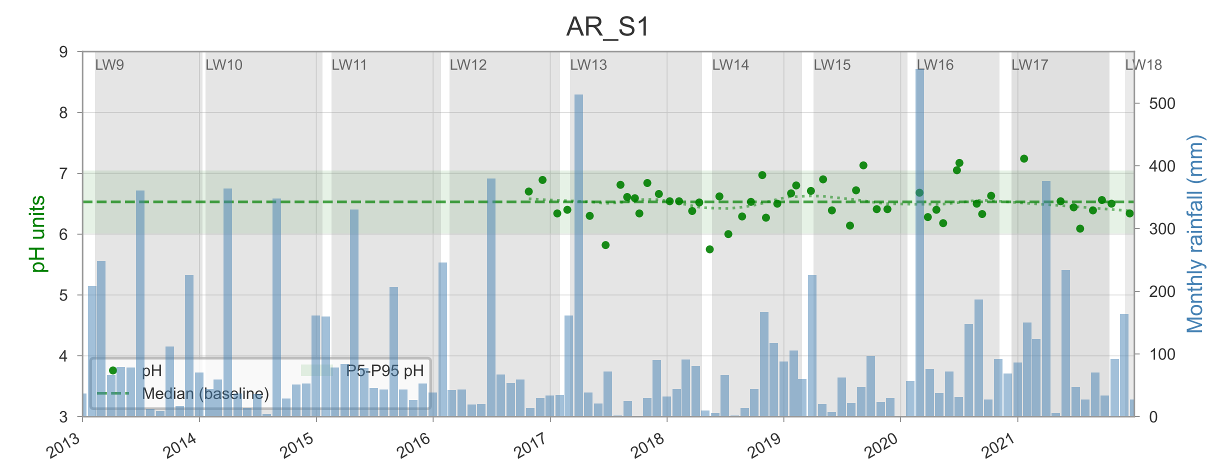

AR31_ROCKBAR1
pH units
Monthly rainfall (mm)
LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
pH
Median (baseline)
P5-P95 pH

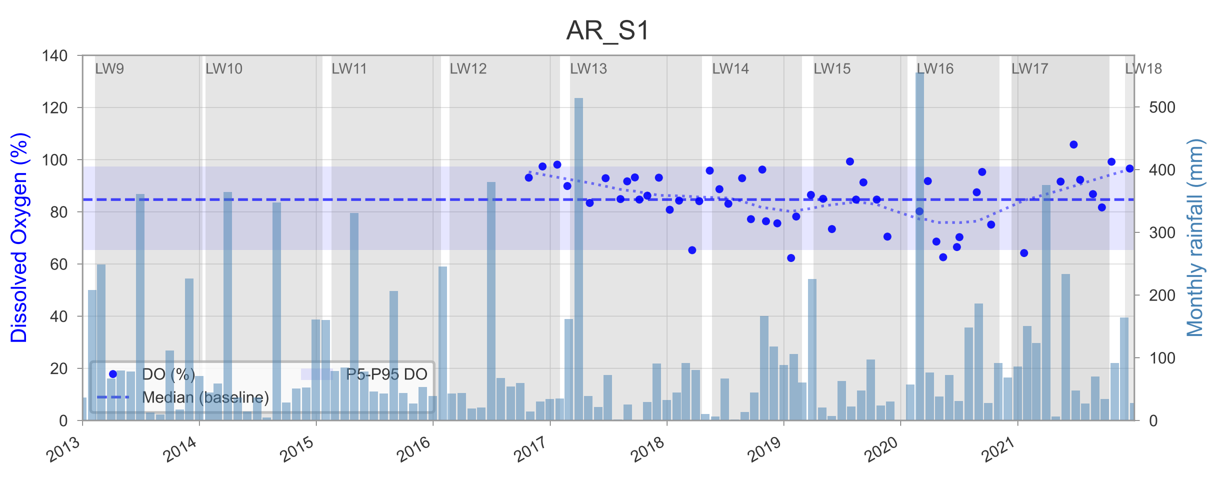

AR31_ROCKBAR1
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
DO (%)
Median (baseline)
P5-P95 DO

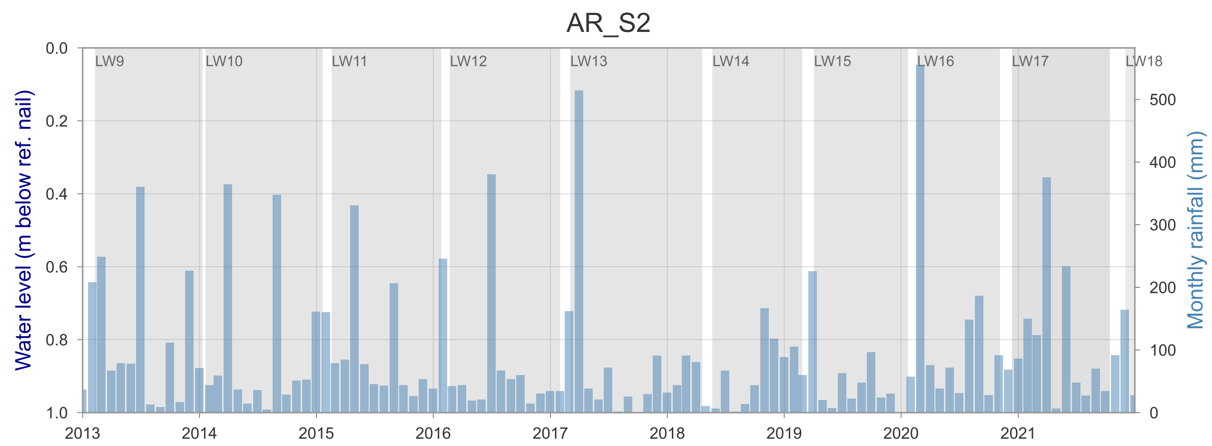
AR32S1
Stream flow (ML/day)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Flow (ML/d)
P5-P95 flow
AR32_POOL5
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
AR32_POOL5
pH units
pH
Median (baseline)
P5-P95 pH
AR32_POOL5
Dissolved Oxygen (%)
DO (%)
Median (baseline)
P5-P95 DO
2013
2014
2015
2016
2017
2018
2019
2020
2021

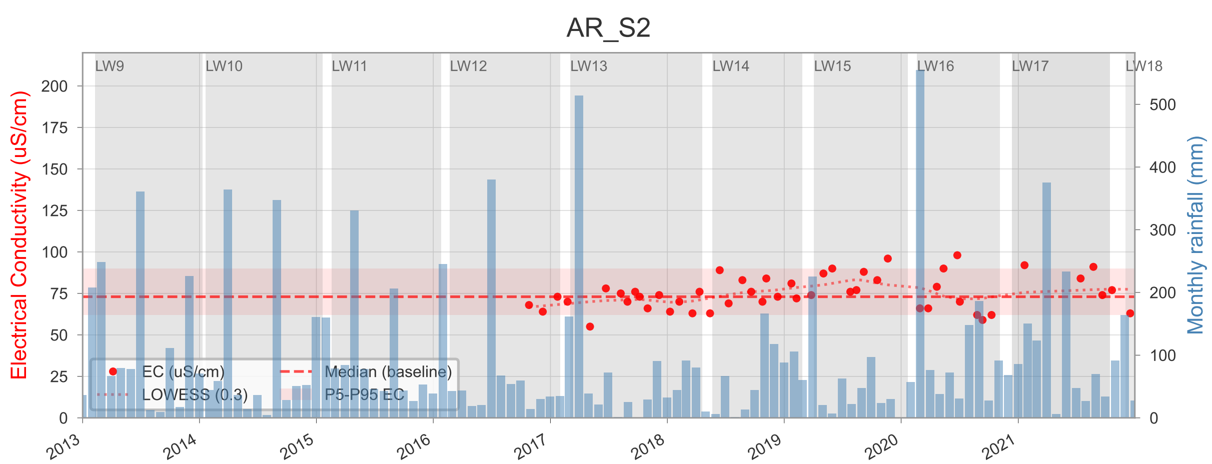

AR_S1
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
0.0
0.2
0.4
0.6
0.8
1.0
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

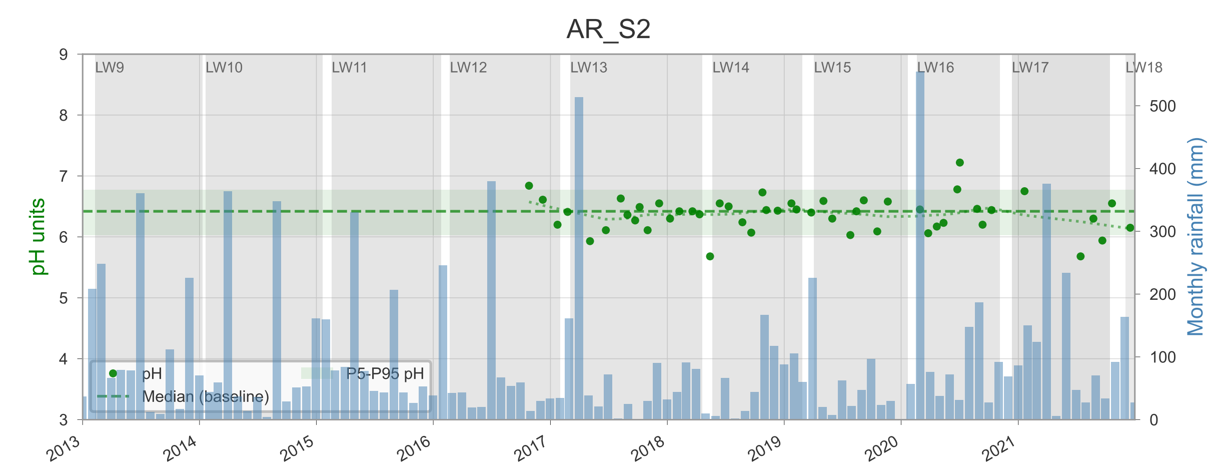

AR_S1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

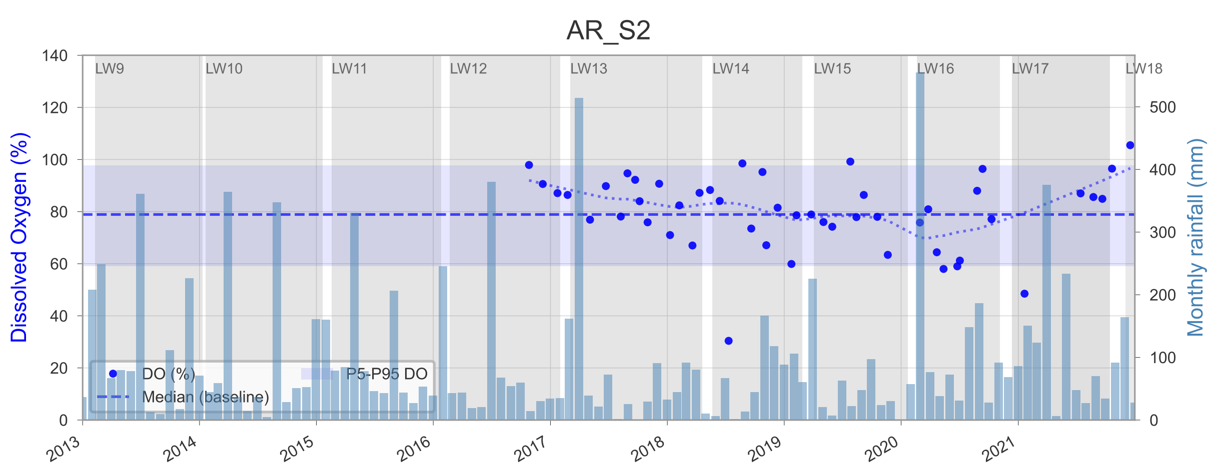

AR_S1
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
Median (baseline)
P5-P95 pH
3
4
5
6
7
8
9
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

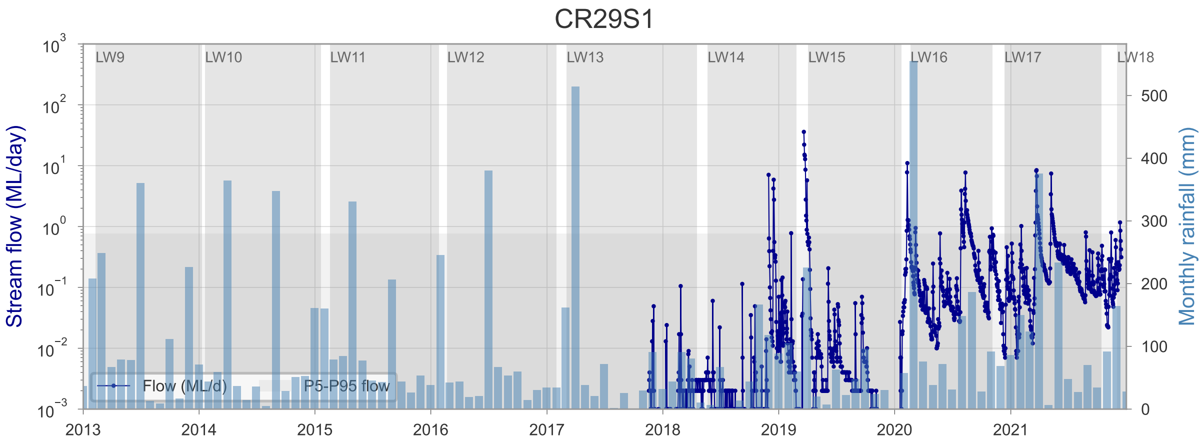

AR_S1
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
Median (baseline)
P5-P95 DO
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

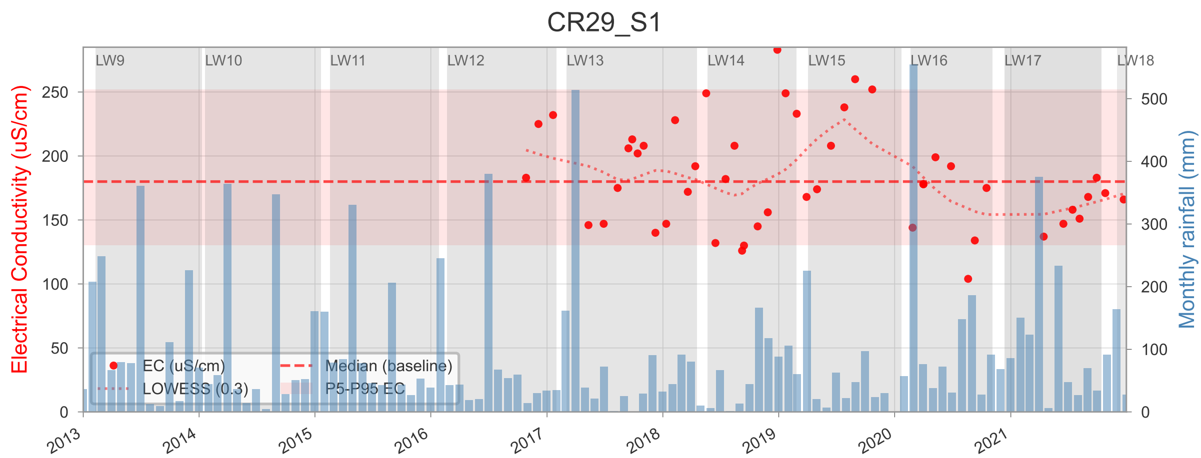

AR_S2
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

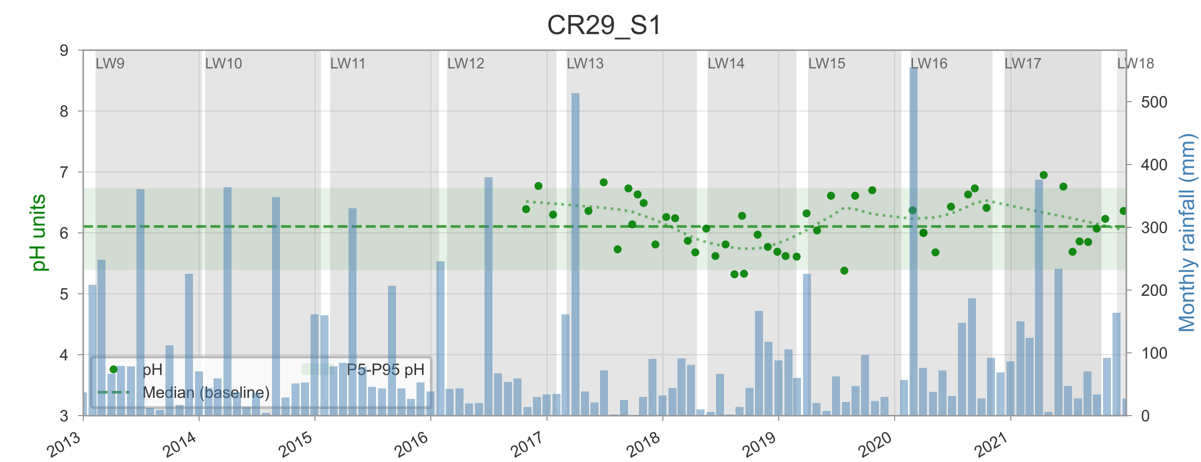

AR_S2
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

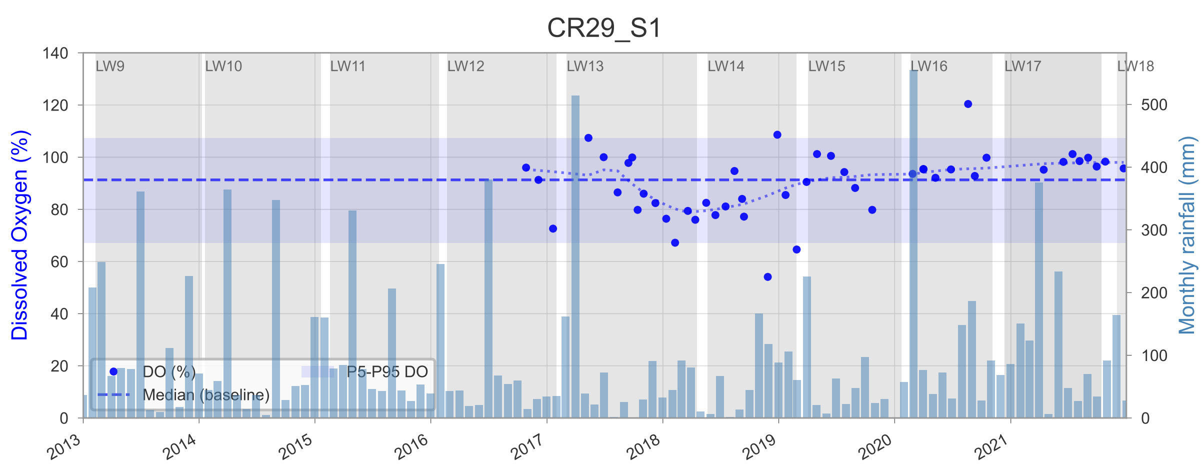

AR_S2
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
Median (baseline)
P5-P95 pH

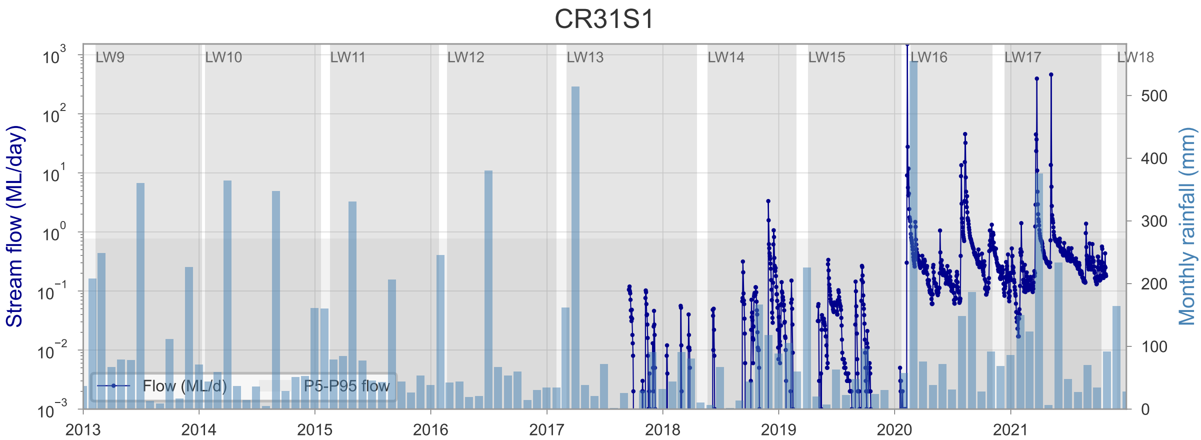

AR_S2
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
Median (baseline)
P5-P95 DO

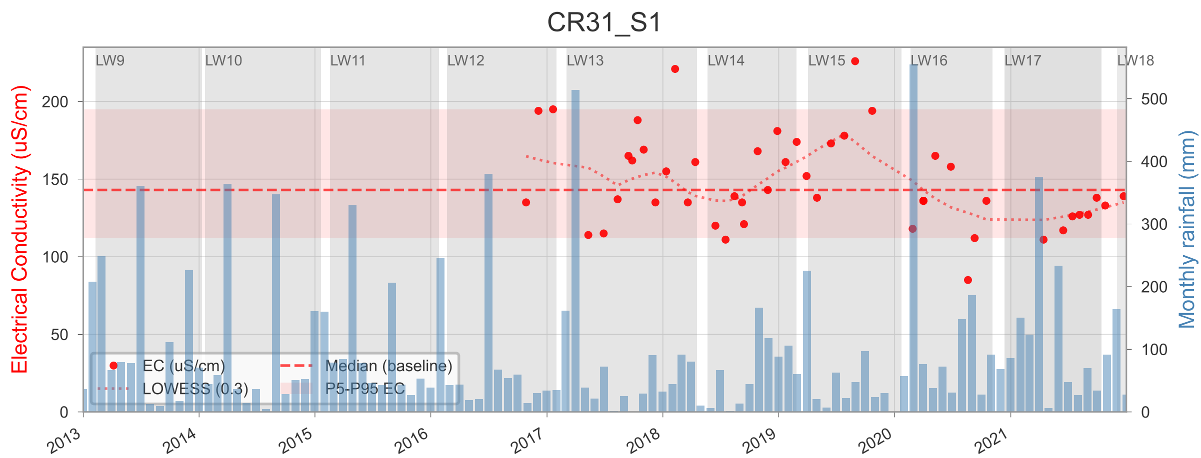

CR29S1
Stream flow (ML/day)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Flow (ML/d)
P5-P95 flow

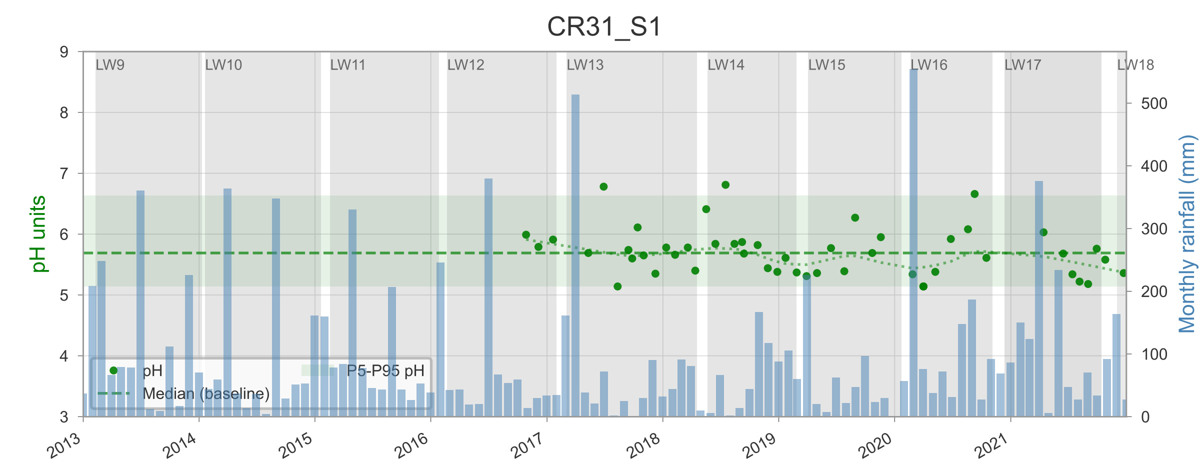

CR29_S1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

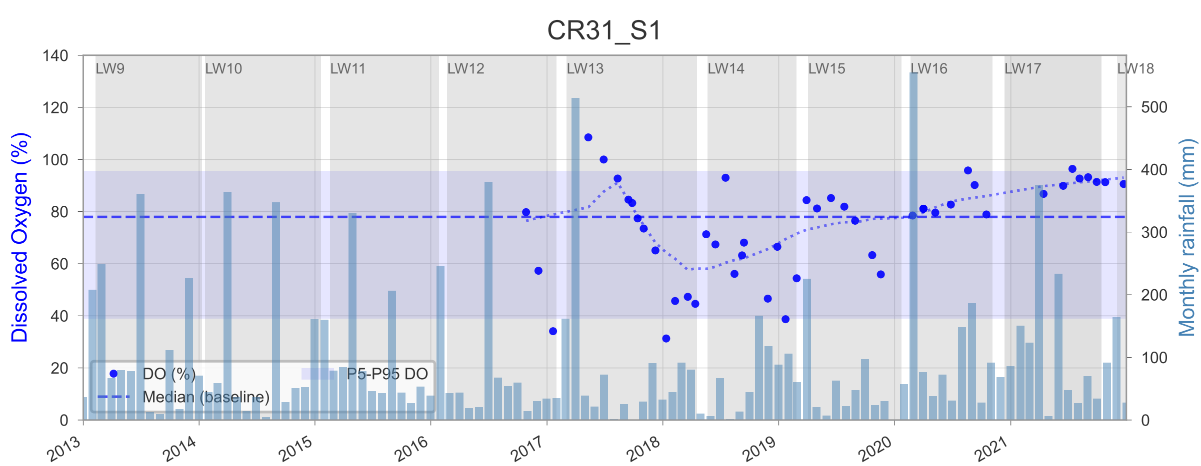

CR29_S1
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

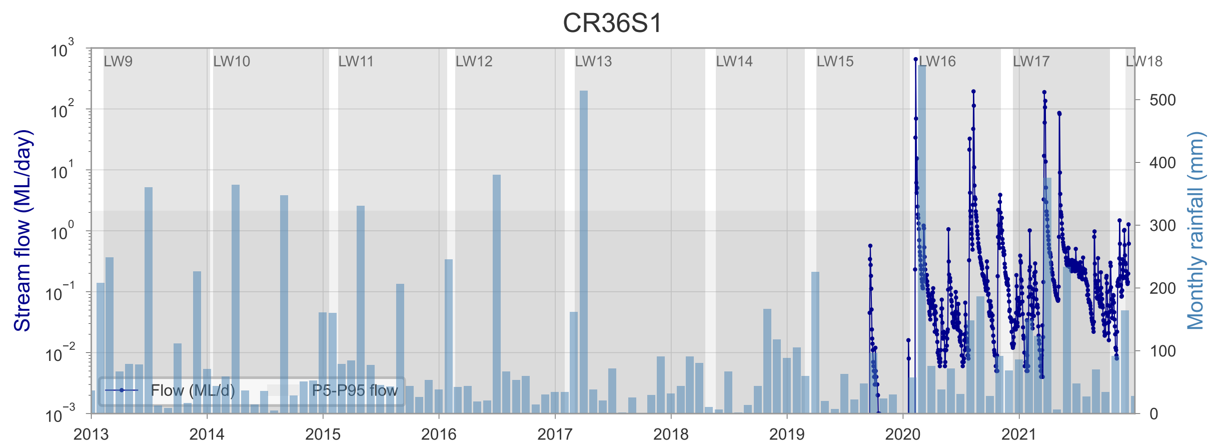

CR29_S1
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

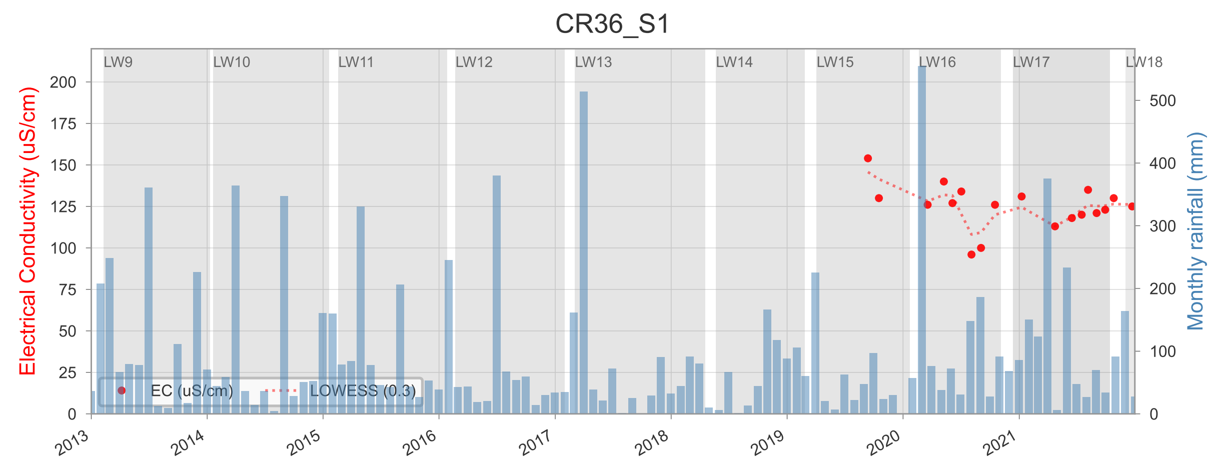

CR31S1
Stream flow (ML/day)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Flow (ML/d)
P5-P95 flow
2013
2014
2015
2016
2017
2018
2019
2020
2021

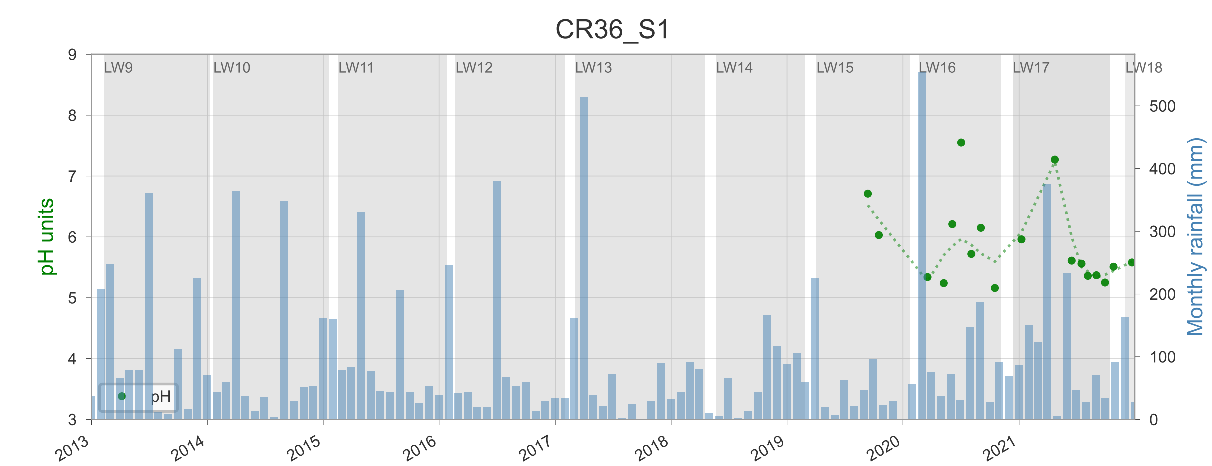

CR31_S1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

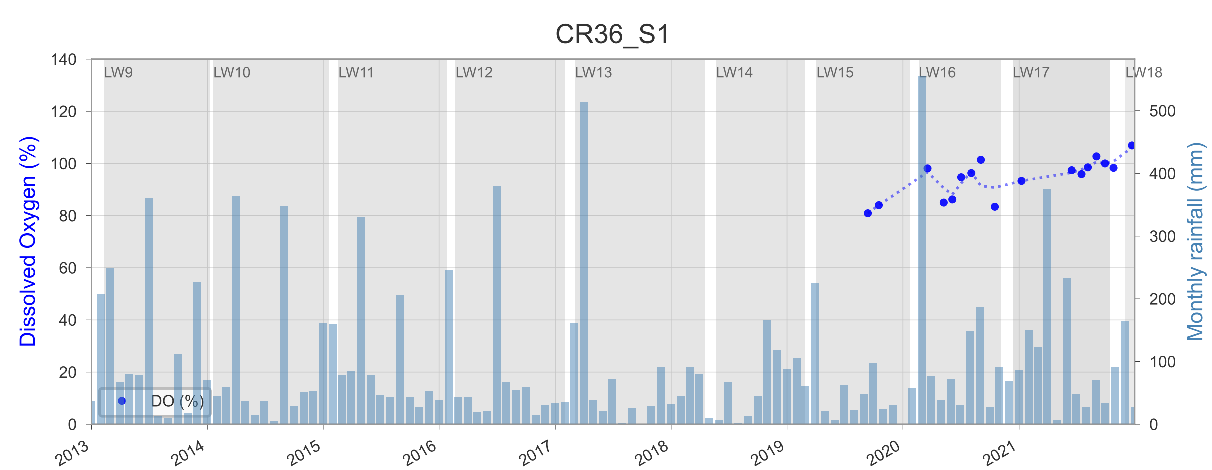

CR31_S1
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
Median (baseline)
P5-P95 pH

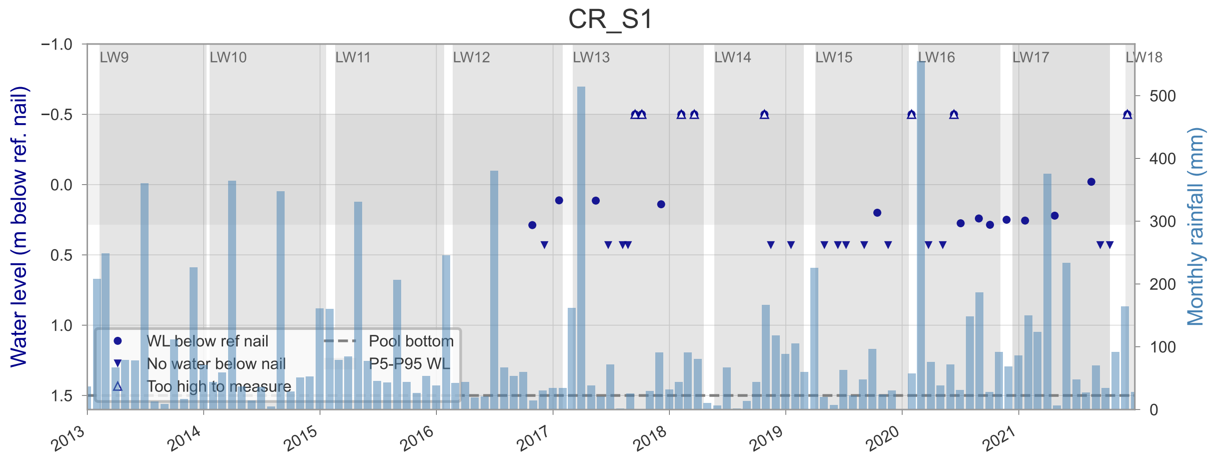

CR31_S1
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
Median (baseline)
P5-P95 DO

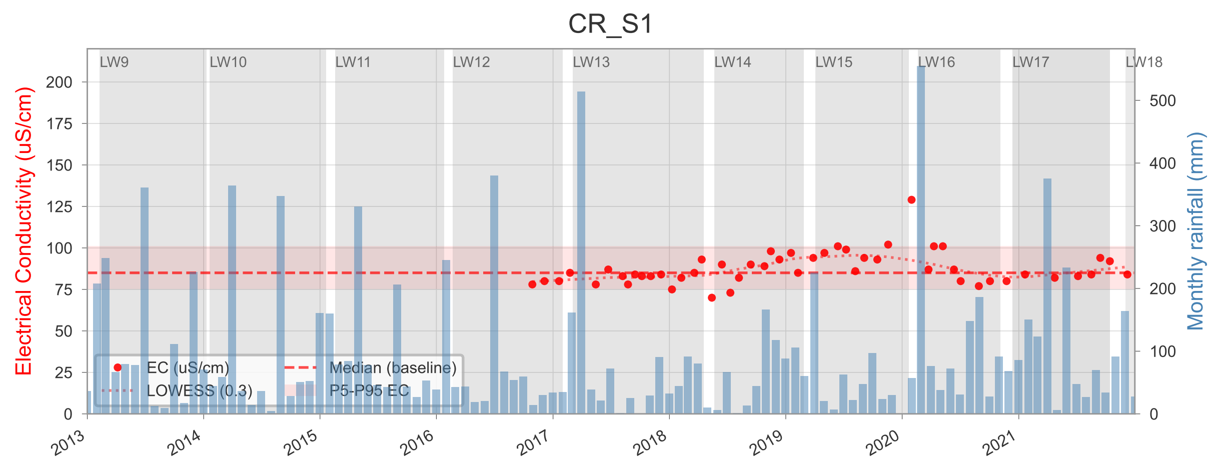

CR36S1
Stream flow (ML/day)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Flow (ML/d)
P5-P95 flow
2013
2014
2015
2016
2017
2018
2019
2020
2021

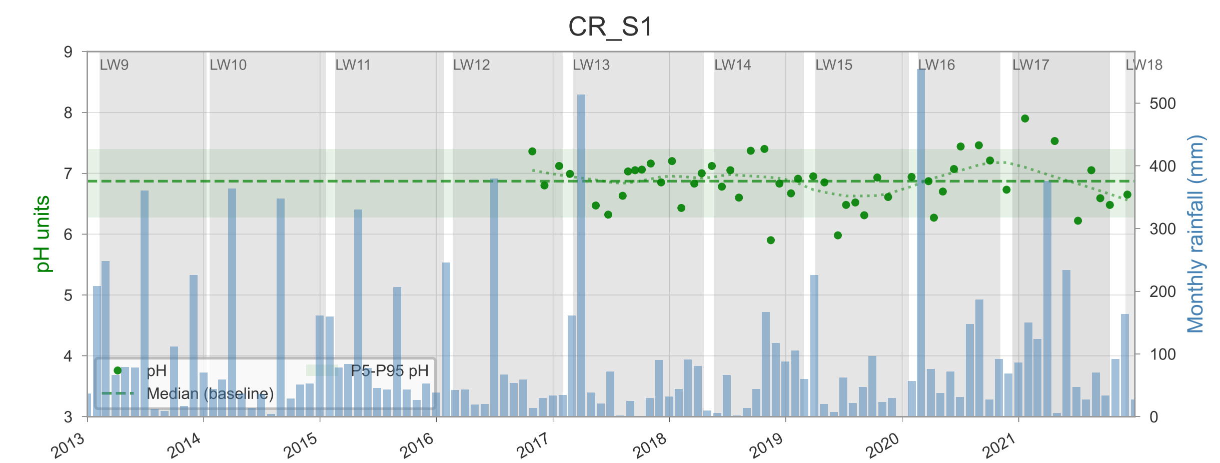

CR36_S1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)
2013
2014
2015
2016
2017
2018
2019
2020
2021

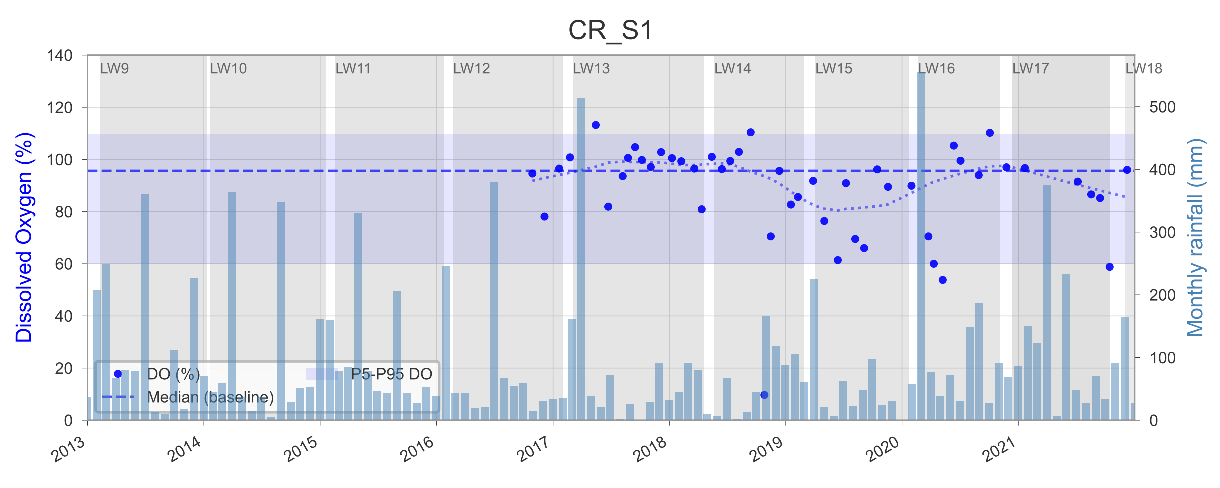

CR36_S1
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
2013
2014
2015
2016
2017
2018
2019
2020
2021

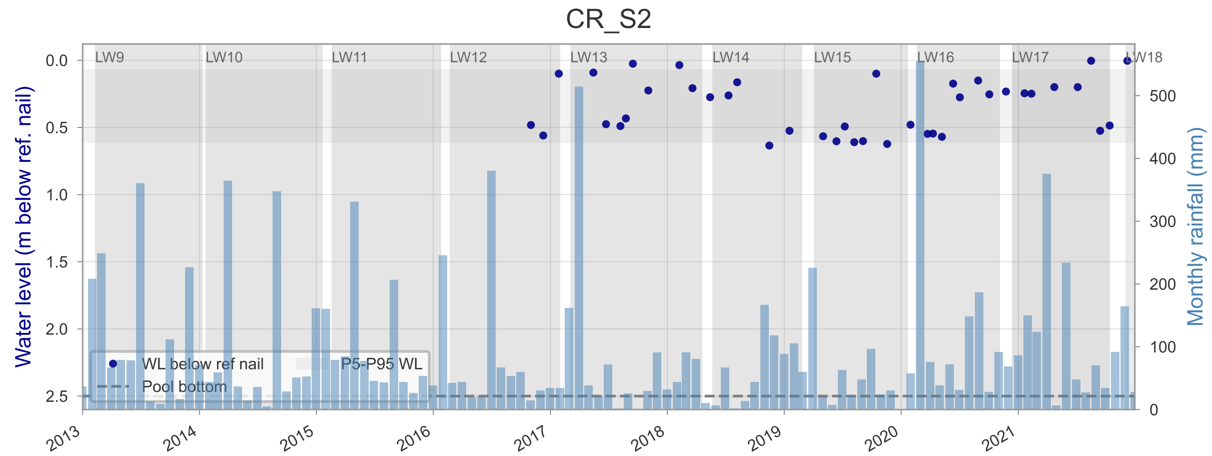

CR36_S1
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
2013
2014
2015
2016
2017
2018
2019
2020
2021


CR_S1
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WL below ref nail
No water below nail
Too high to measure
Pool bottom
P5-P95 WL
2013
2014
2015
2016
2017
2018
2019
2020
2021

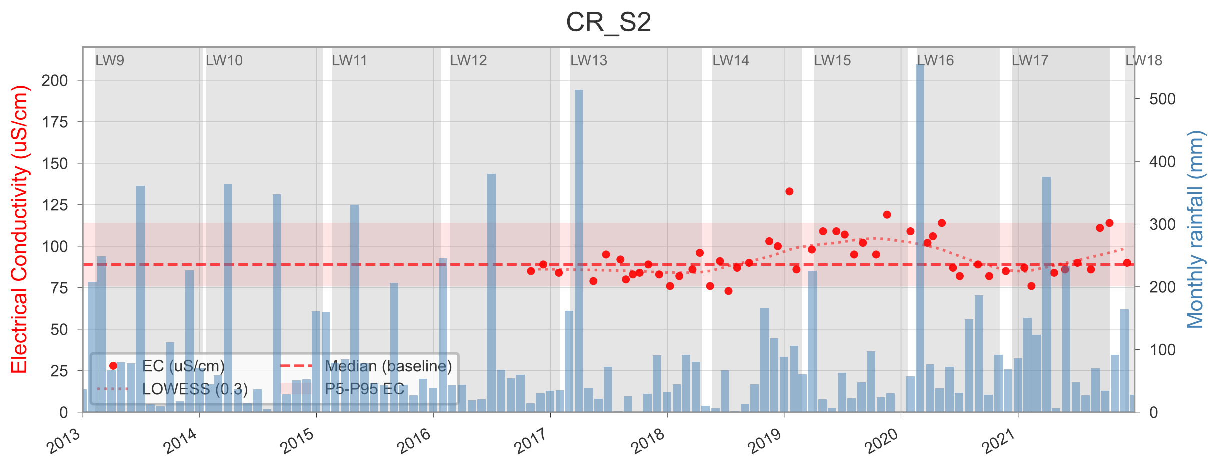

CR_S1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
2013
2014
2015
2016
2017
2018
2019
2020
2021


CR_S1
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
Median (baseline)
P5-P95 pH
2013
2014
2015
2016
2017
2018
2019
2020
2021

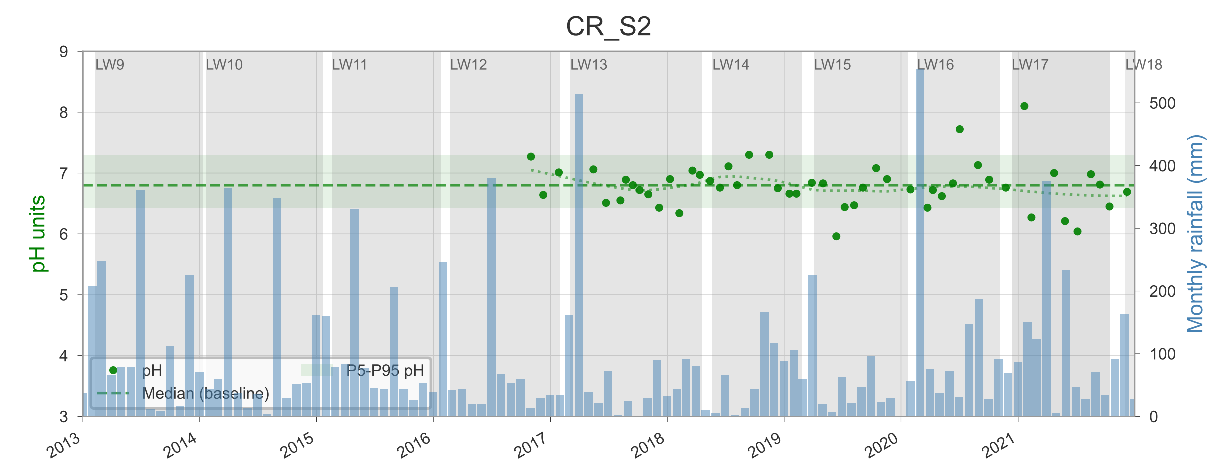

CR_S1
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
Median (baseline)
P5-P95 DO
2013
2014
2015
2016
2017
2018
2019
2020
2021



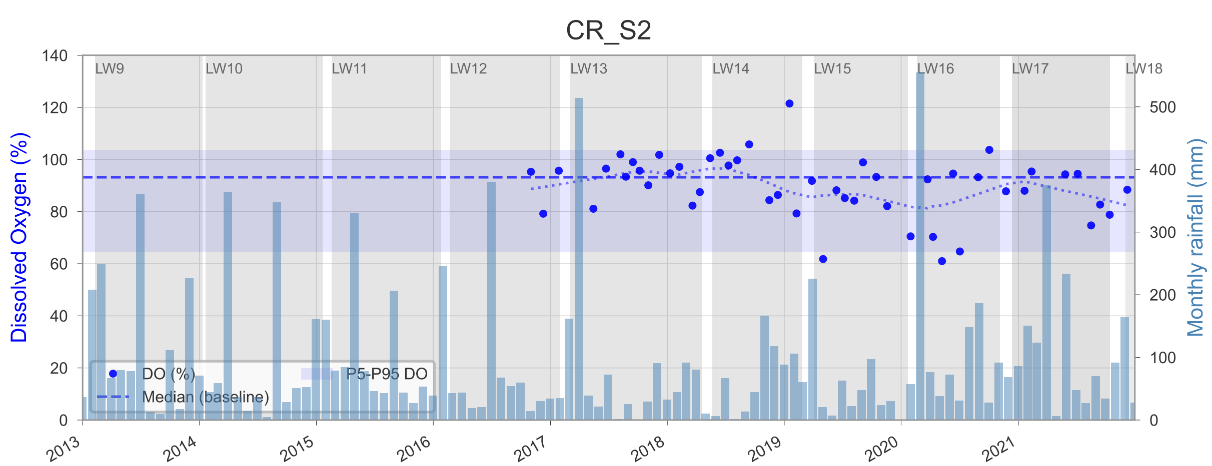
CR_S2
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WL below ref nail
P5-P95 WL
Pool bottom



CR_S2
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
Median (baseline)
LOWESS (0.3)
P5-P95 EC

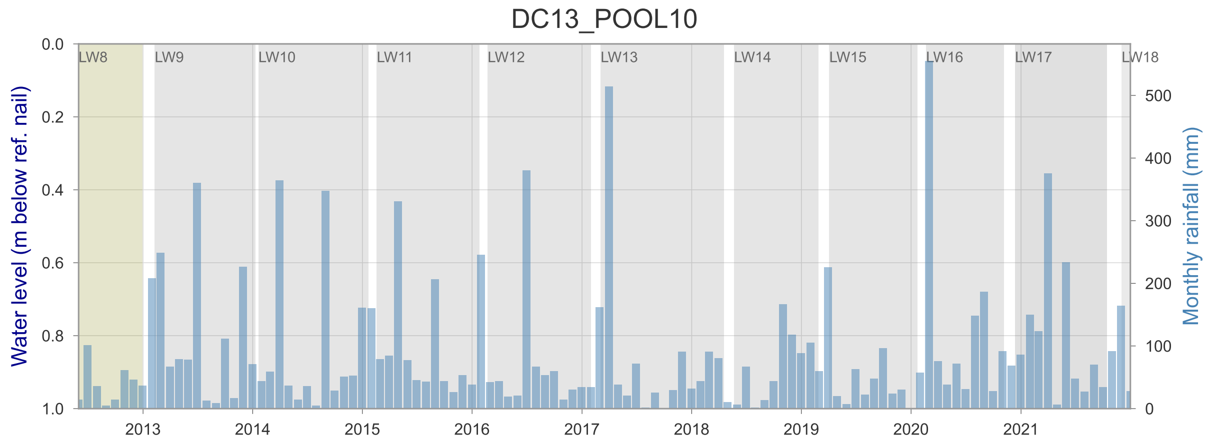


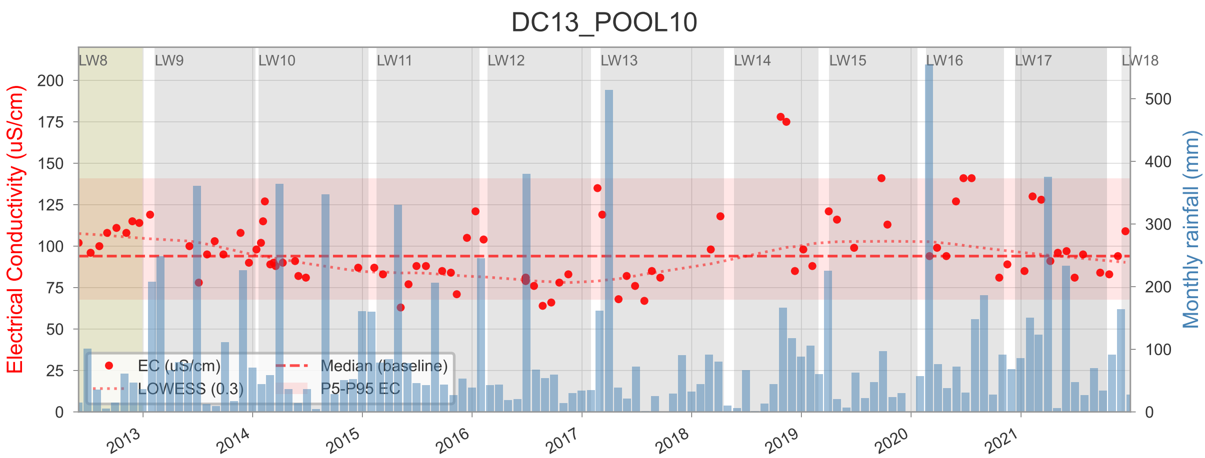
CR_S2
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
P5-P95 pH
Median (baseline)

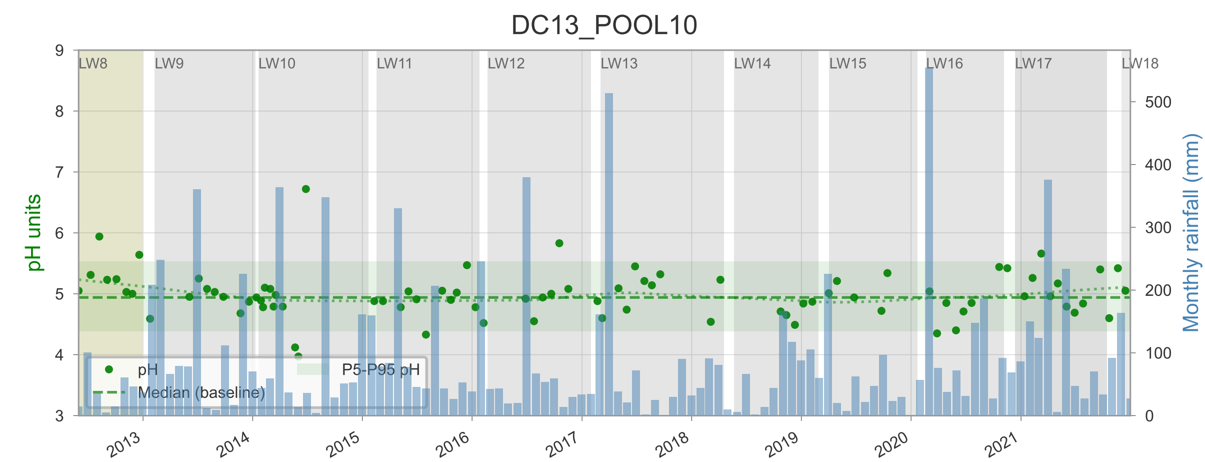


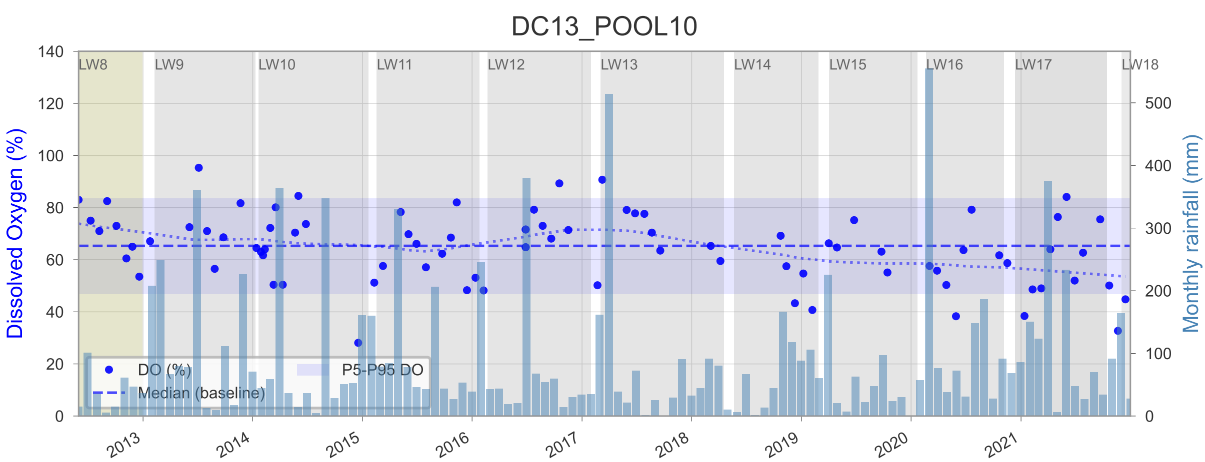
CR_S2
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
P5-P95 DO
Median (baseline)

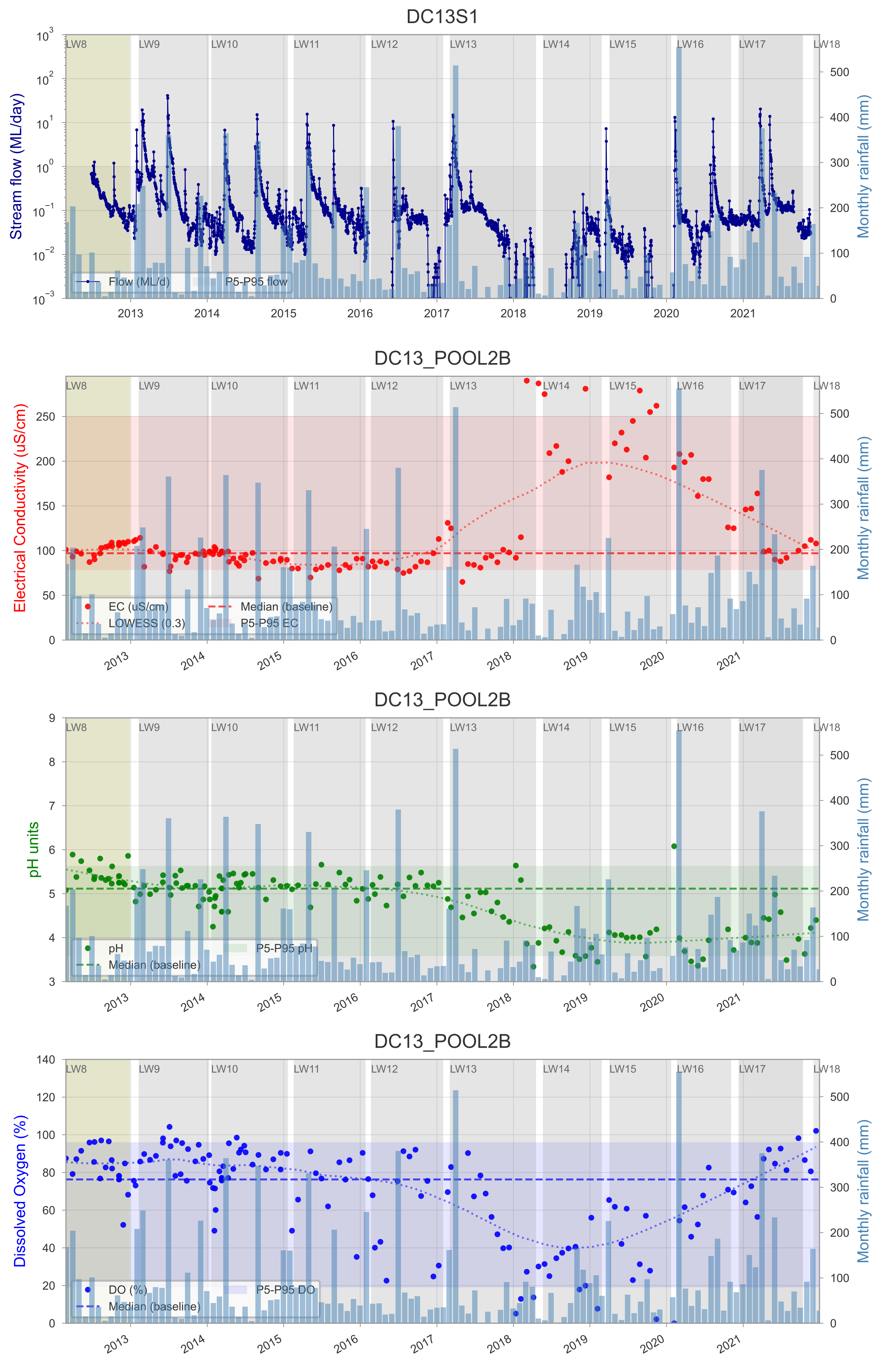

DC10_S1
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
Pool dry
Pool bottom
P5-P95 WL
DC10_S1
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
DC10_S1
pH units
pH
Median (baseline)
P5-P95 pH
DC10_S1
Dissolved Oxygen (%)
DO (%)
Median (baseline)
P5-P95 DO
2013
2014
2015
2016
2017
2018
2019
2020
2021

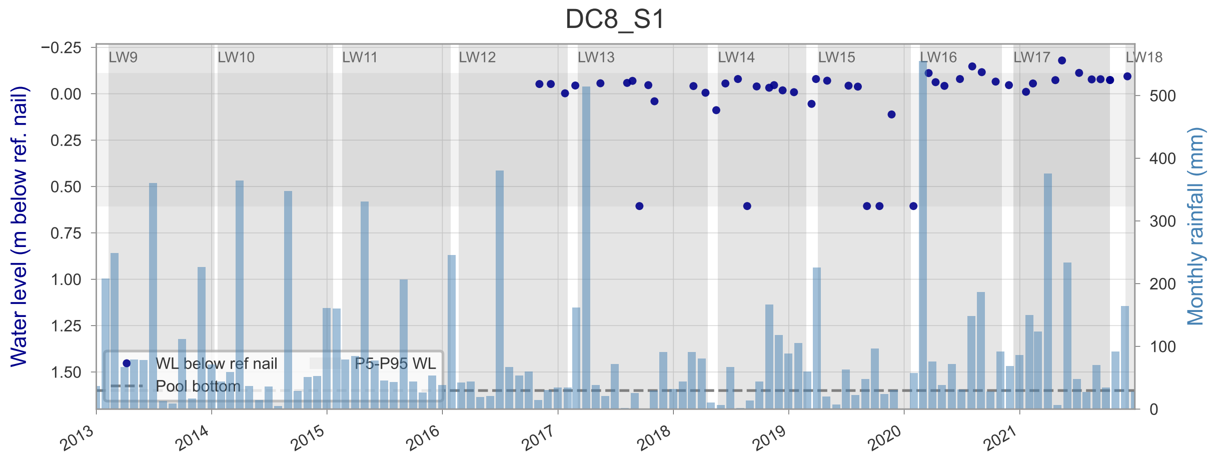

DC13_POOL10
Water level (m below ref. nail)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

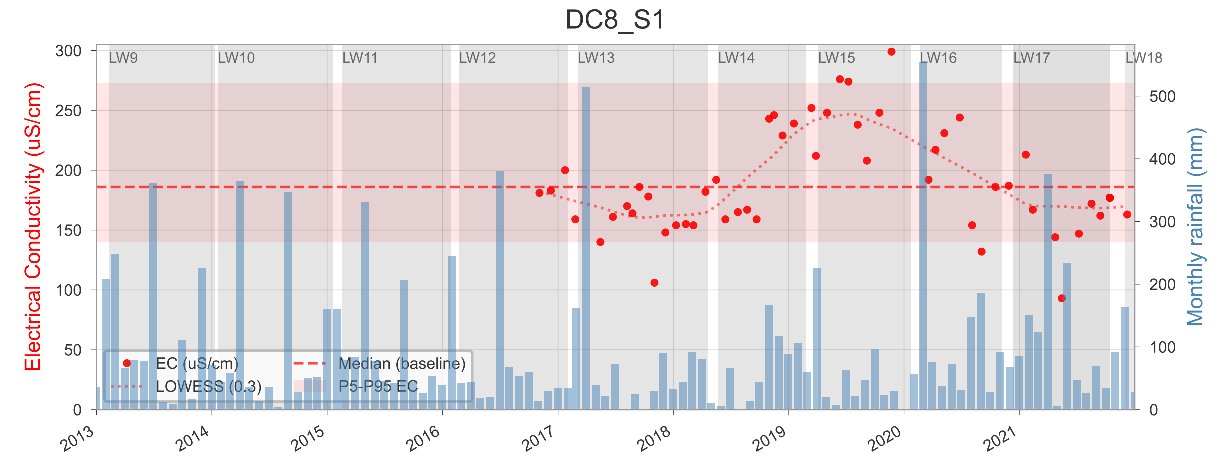

DC13_POOL10
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

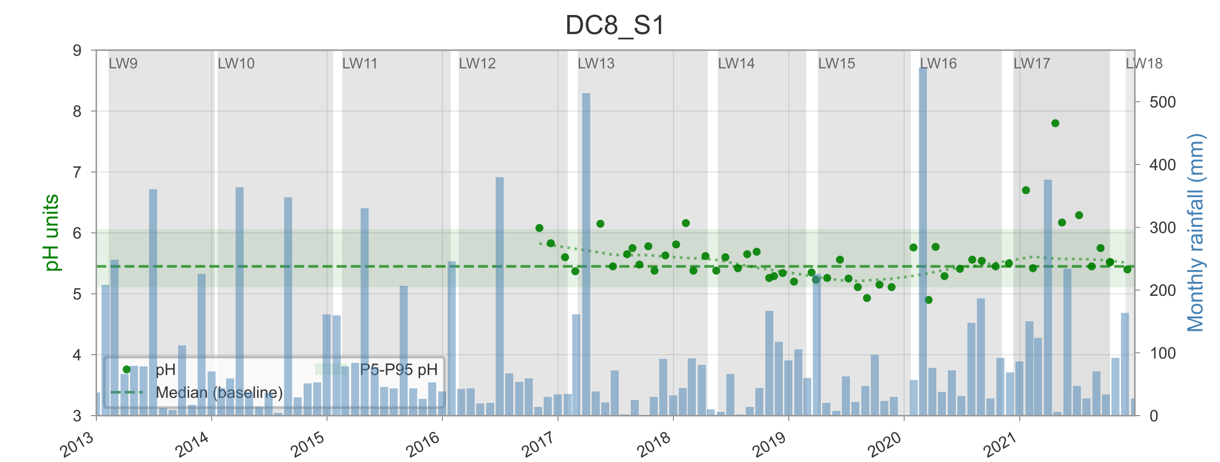

DC13_POOL10
pH units
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
Median (baseline)
P5-P95 pH

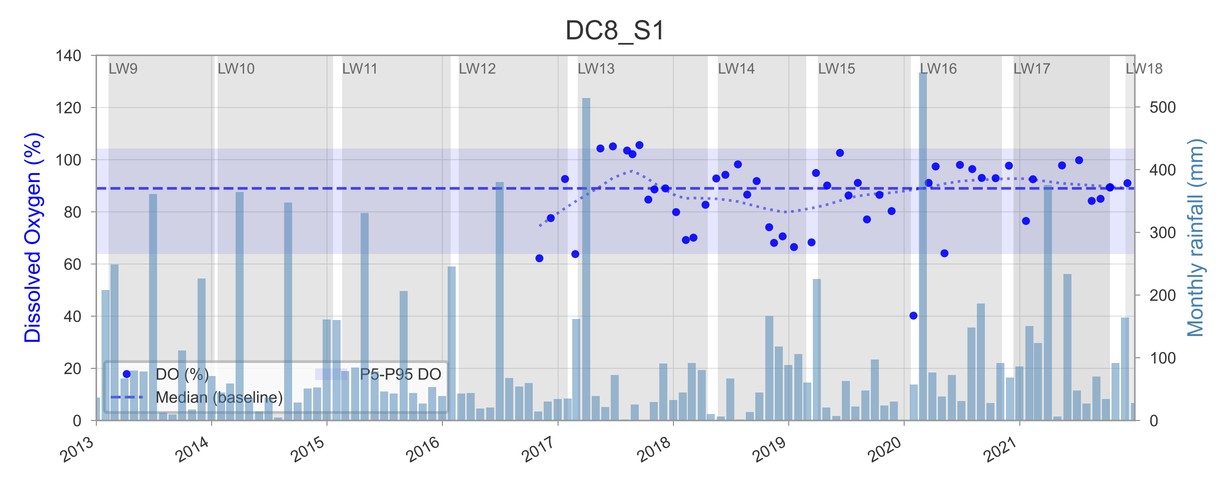

DC13_POOL10
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
Median (baseline)
P5-P95 DO

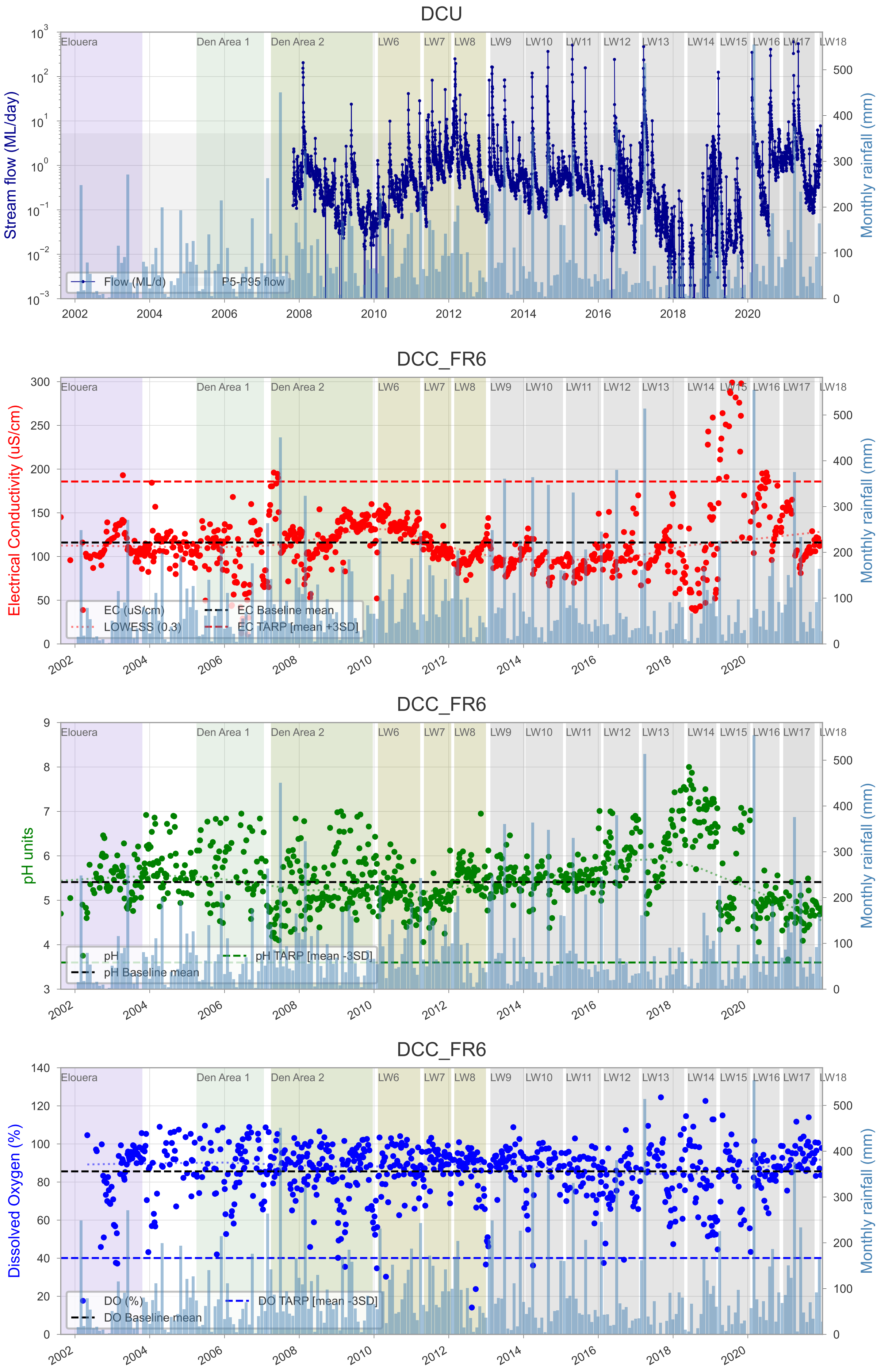

DC13S1
Stream flow (ML/day)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Flow (ML/d)
P5-P95 flow
DC13_POOL2B
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
DC13_POOL2B
pH units
pH
Median (baseline)
P5-P95 pH
DC13_POOL2B
Dissolved Oxygen (%)
DO (%)
Median (baseline)
P5-P95 DO


DC8_S1
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WL below ref nail
Pool bottom
P5-P95 WL
2013
2014
2015
2016
2017
2018
2019
2020
2021

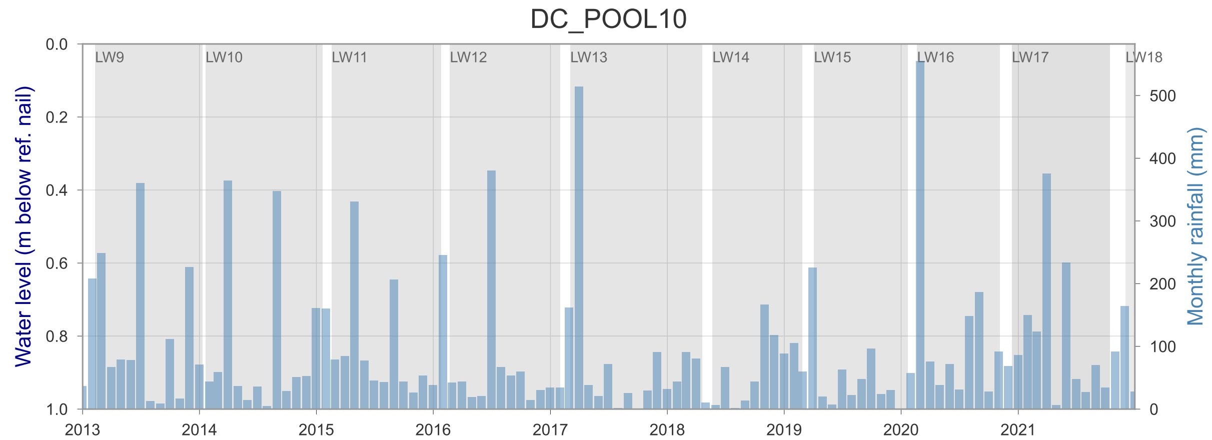

DC8_S1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
2013
2014
2015
2016
2017
2018
2019
2020
2021

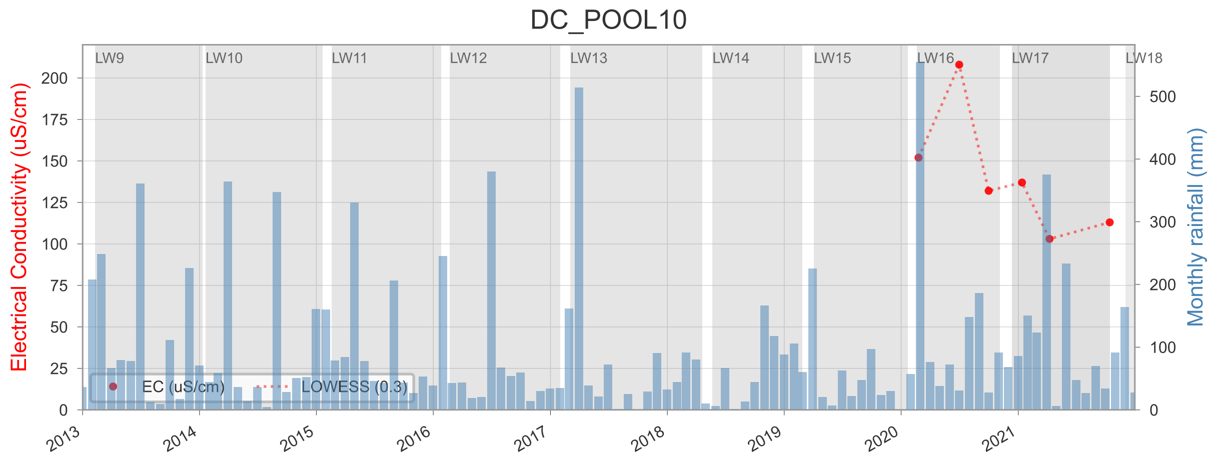

DC8_S1
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
Median (baseline)
P5-P95 pH
2013
2014
2015
2016
2017
2018
2019
2020
2021

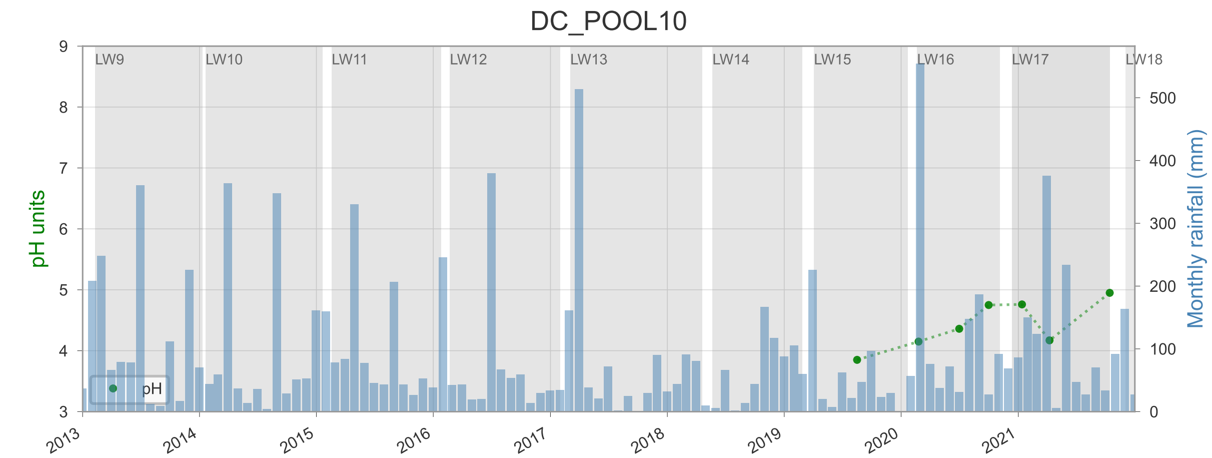

DC8_S1
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
Median (baseline)
P5-P95 DO
2013
2014
2015
2016
2017
2018
2019
2020
2021

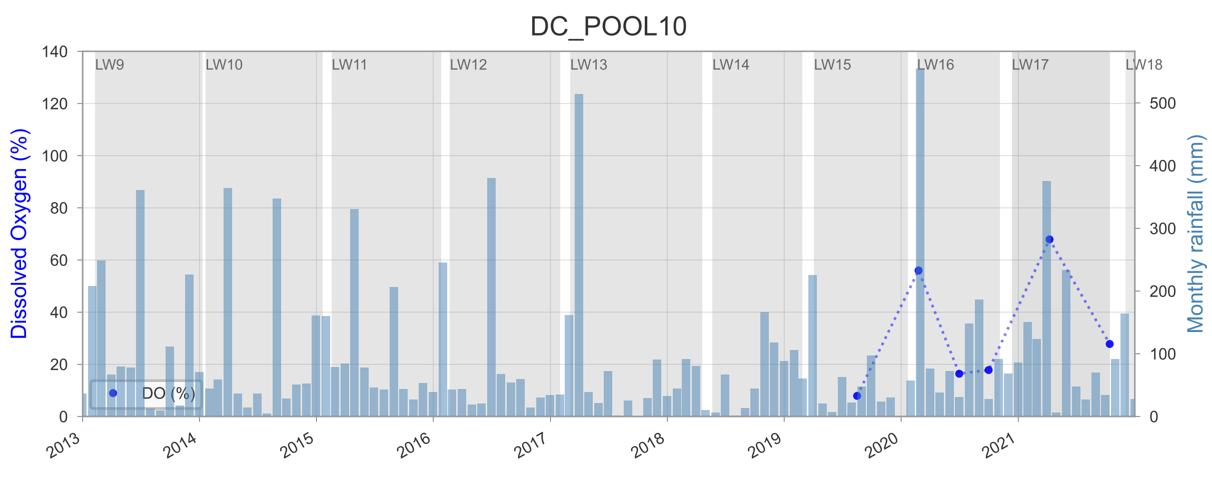

DCU
Stream flow (ML/day)
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Flow (ML/d)
P5-P95 flow
DCC_FR6
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
EC Baseline mean
EC TARP [mean +3SD]
DCC_FR6
pH units
pH
pH Baseline mean
pH TARP [mean -3SD]
DCC_FR6
Dissolved Oxygen (%)
DO (%)
DO Baseline mean
DO TARP [mean -3SD]

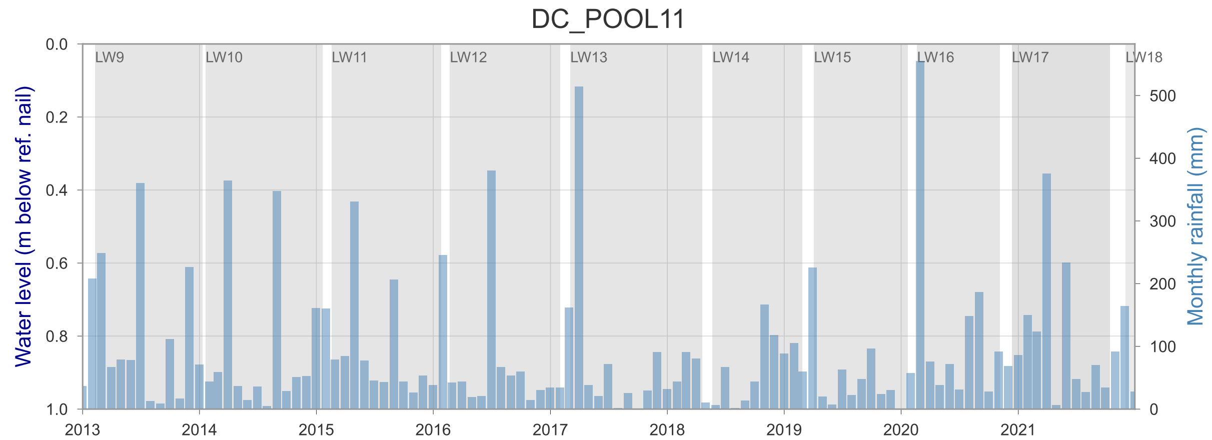
DCL3
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DCL3
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
DCL3
pH units
pH
Median (baseline)
P5-P95 pH
DCL3
Dissolved Oxygen (%)
DO (%)
Median (baseline)
P5-P95 DO

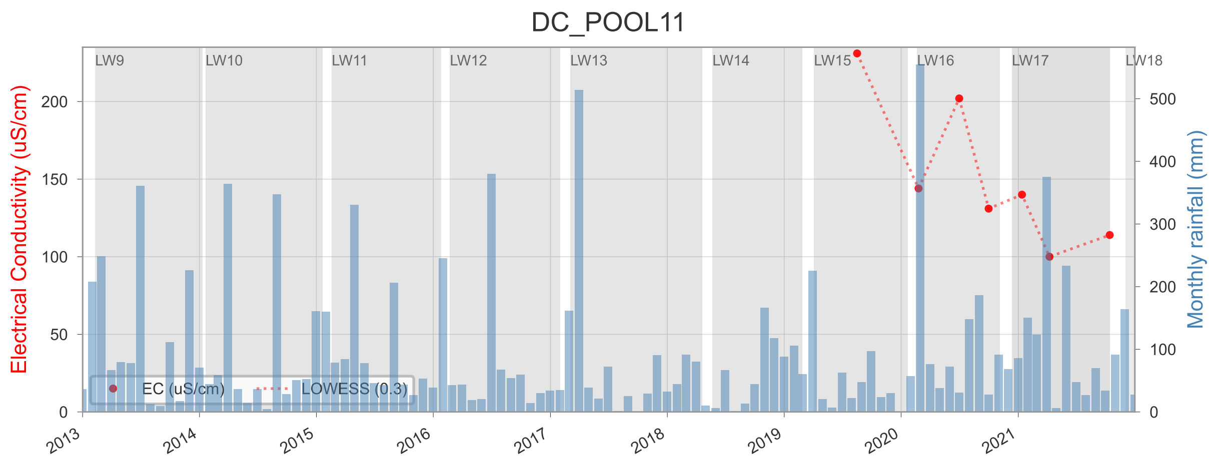

DC_POOL10
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
0.0 0.2 0.4 0.6 0.8 1.0
0 100 200 300 400 500
2013 2014 2015 2016 2017 2018 2019 2020 2021

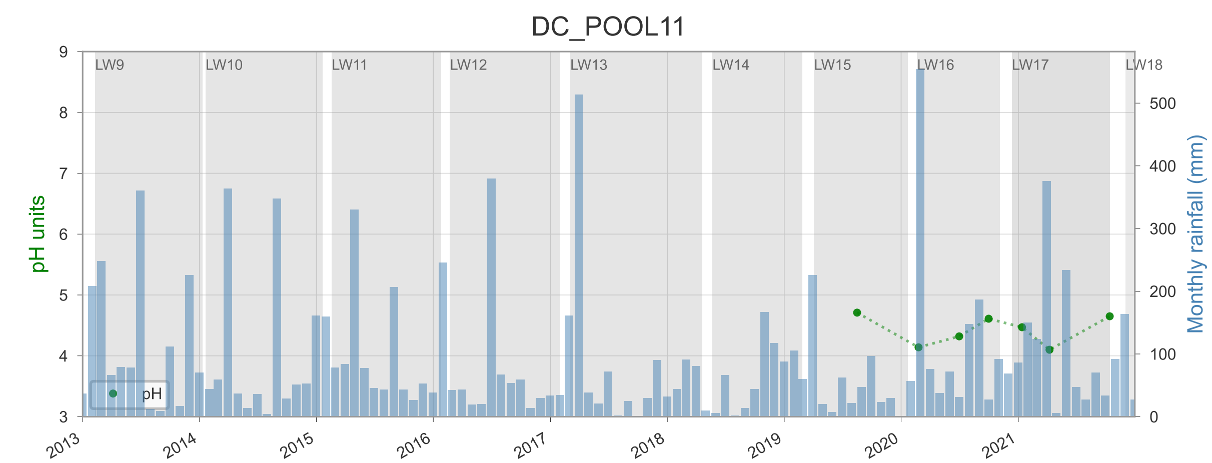

DC_POOL10
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
EC (uS/cm)
LOWESS (0.3)
0 25 50 75 100 125 150 175 200
0 100 200 300 400 500
2013 2014 2015 2016 2017 2018 2019 2020 2021

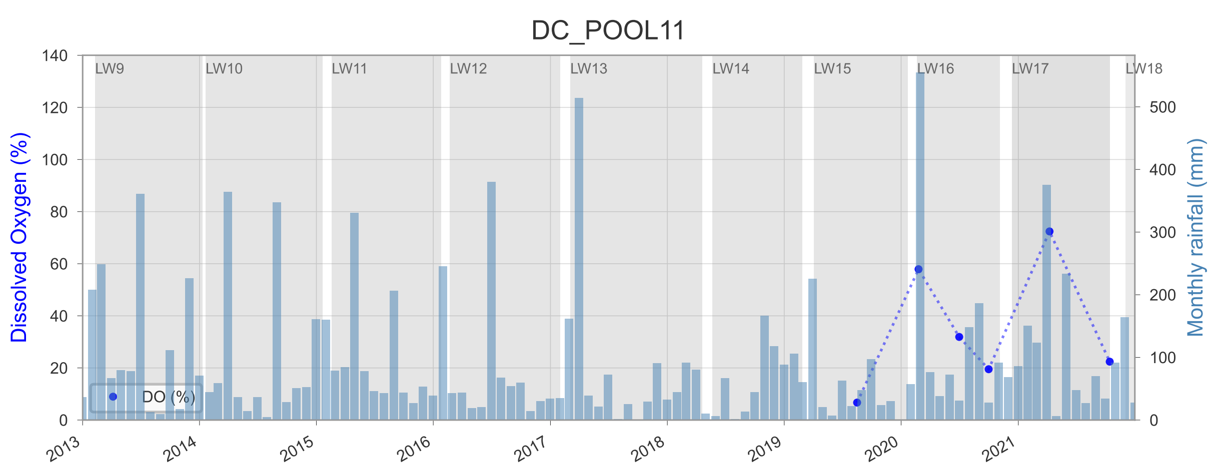

DC_POOL10
pH units
Monthly rainfall (mm)
LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
pH
3 4 5 6 7 8 9
0 100 200 300 400 500
2013 2014 2015 2016 2017 2018 2019 2020 2021

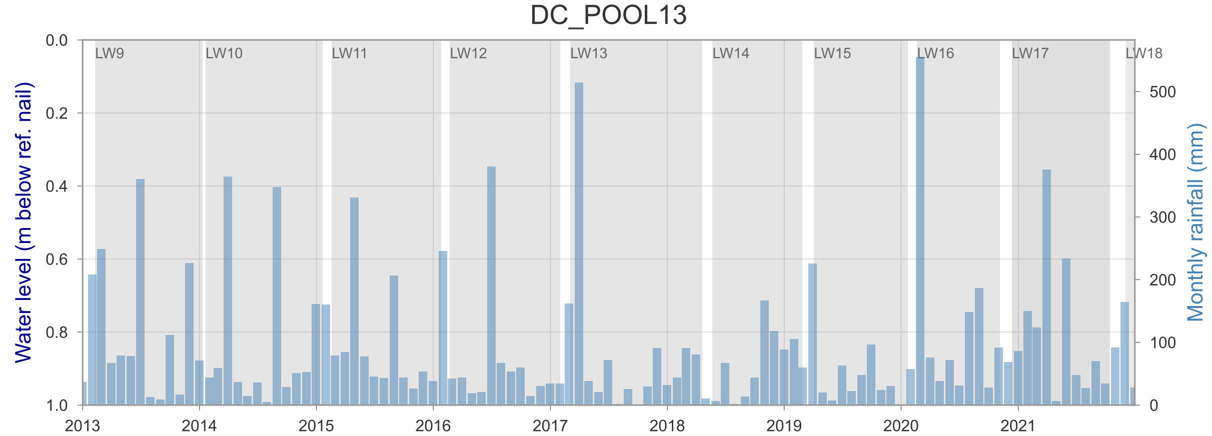

DC_POOL10
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
DO (%)
0 20 40 60 80 100 120 140
0 100 200 300 400 500
2013 2014 2015 2016 2017 2018 2019 2020 2021

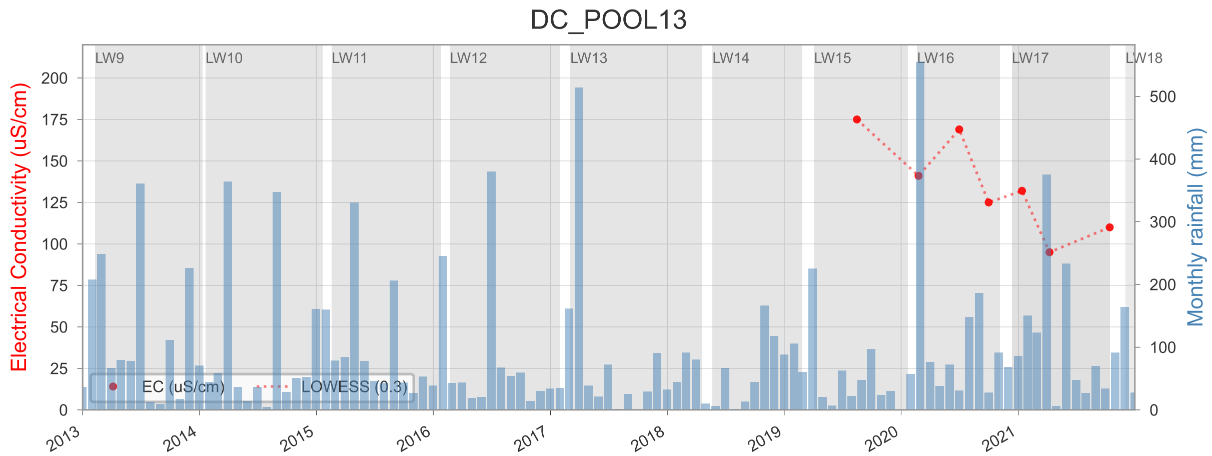

DC_POOL11
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

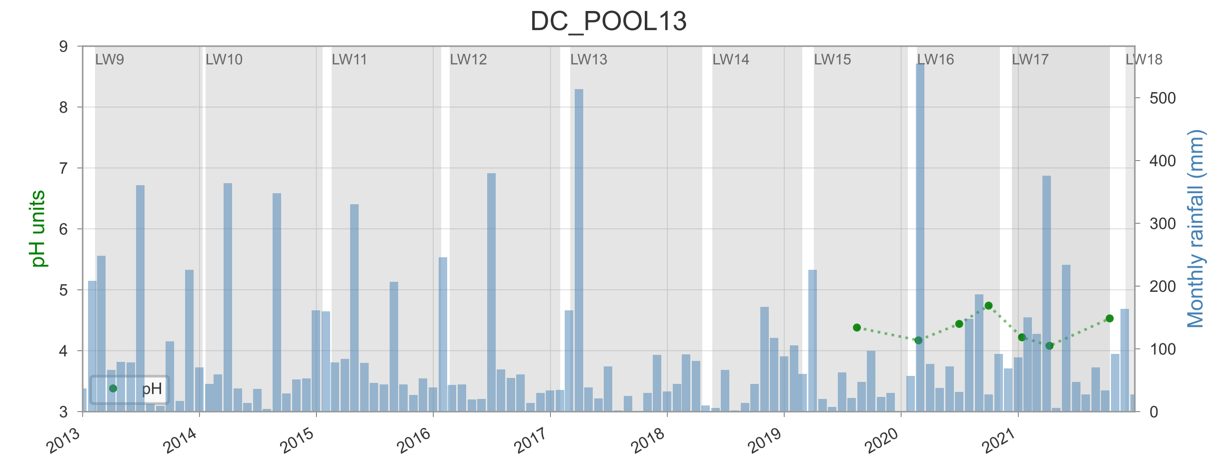

DC_POOL11
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

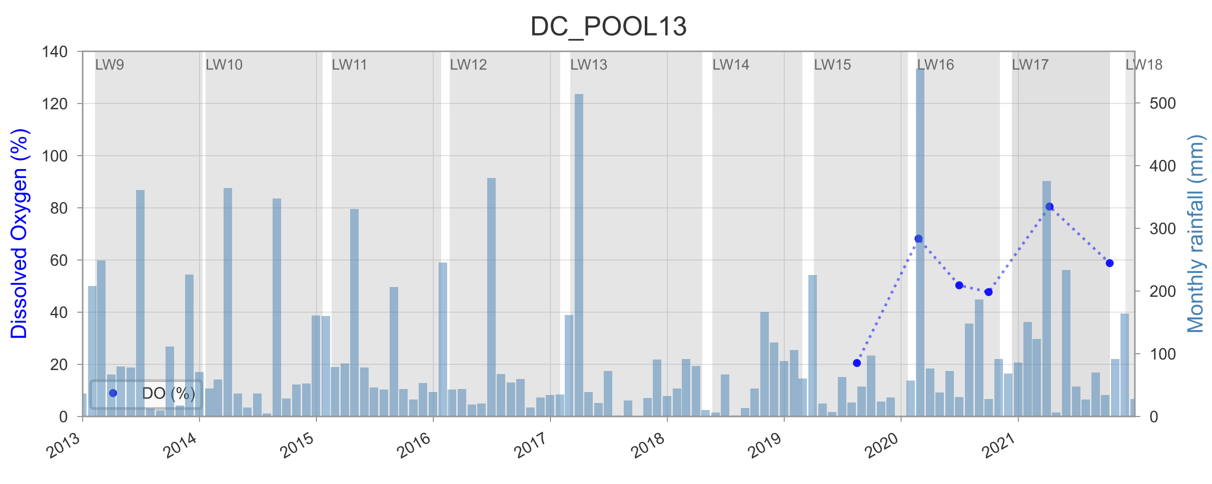

DC_POOL11
pH units
Monthly rainfall (mm)
pH
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

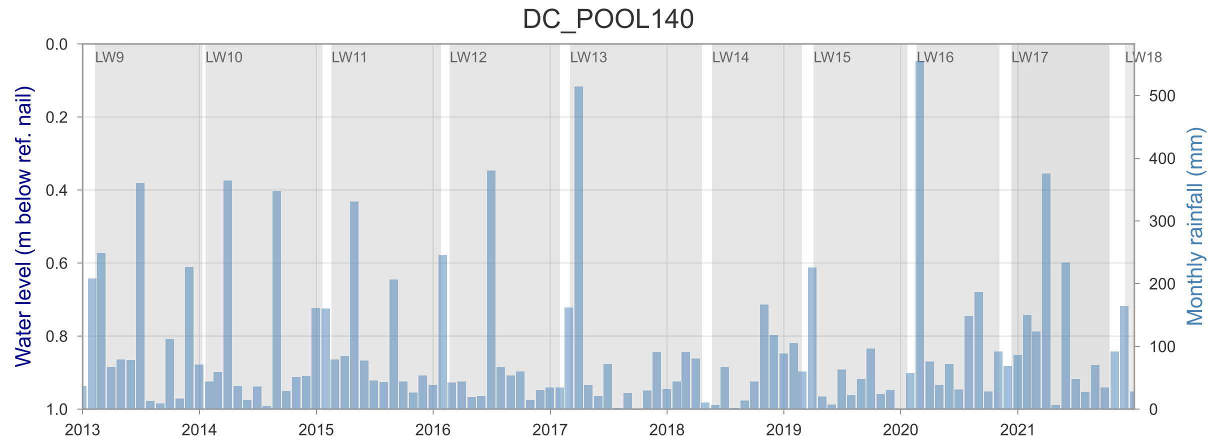

DC_POOL11
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

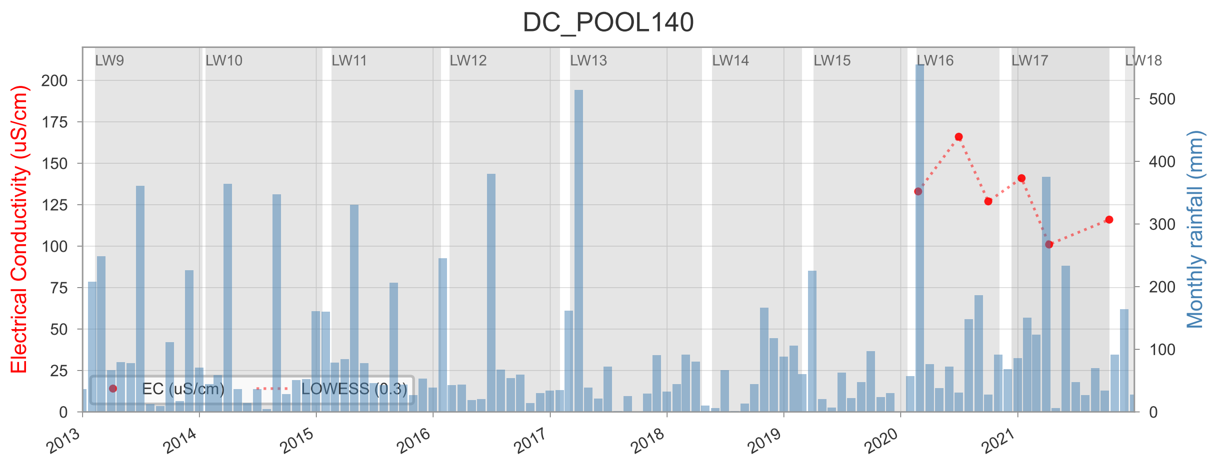

DC_POOL13
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

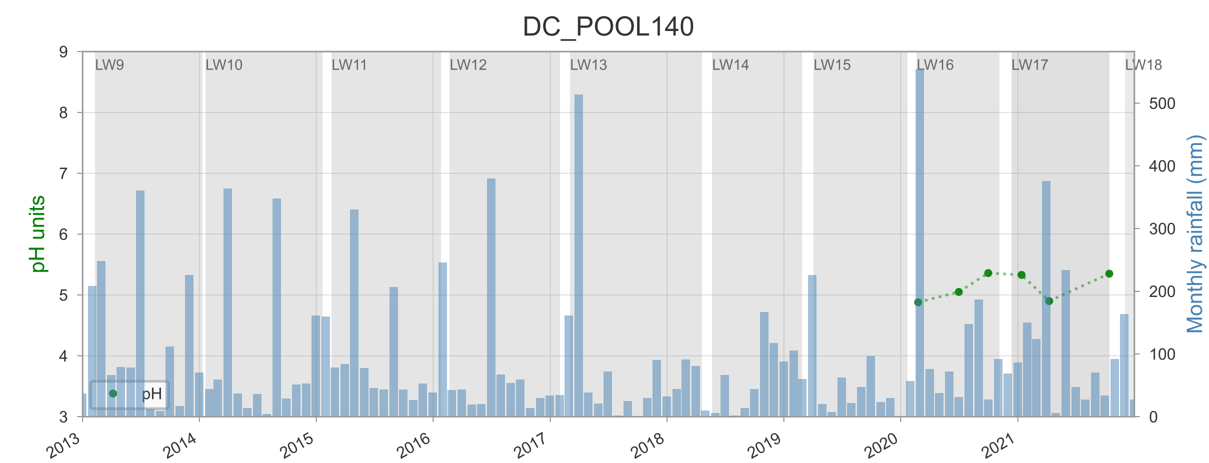

DC_POOL13
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)

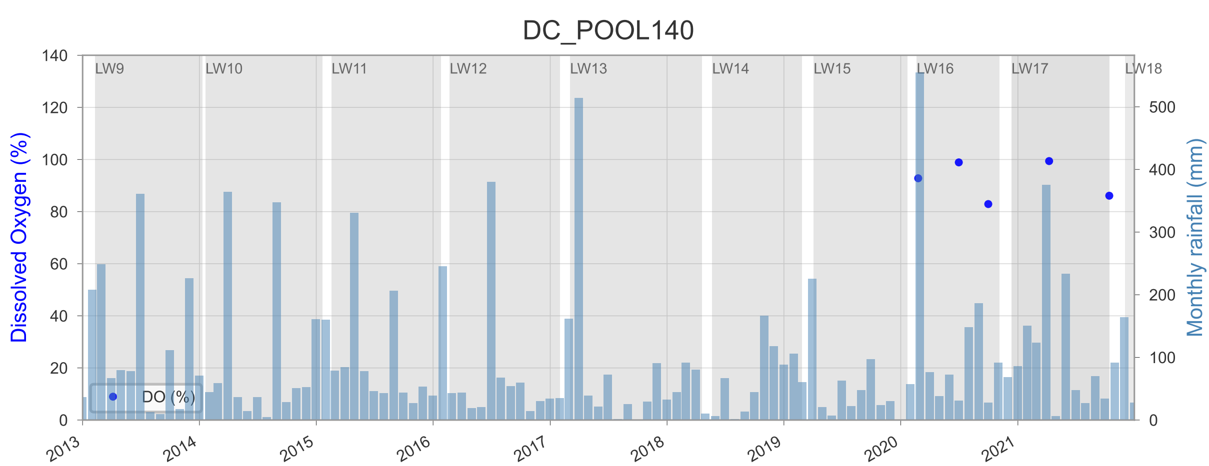

DC_POOL13
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH


DC_POOL13
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)

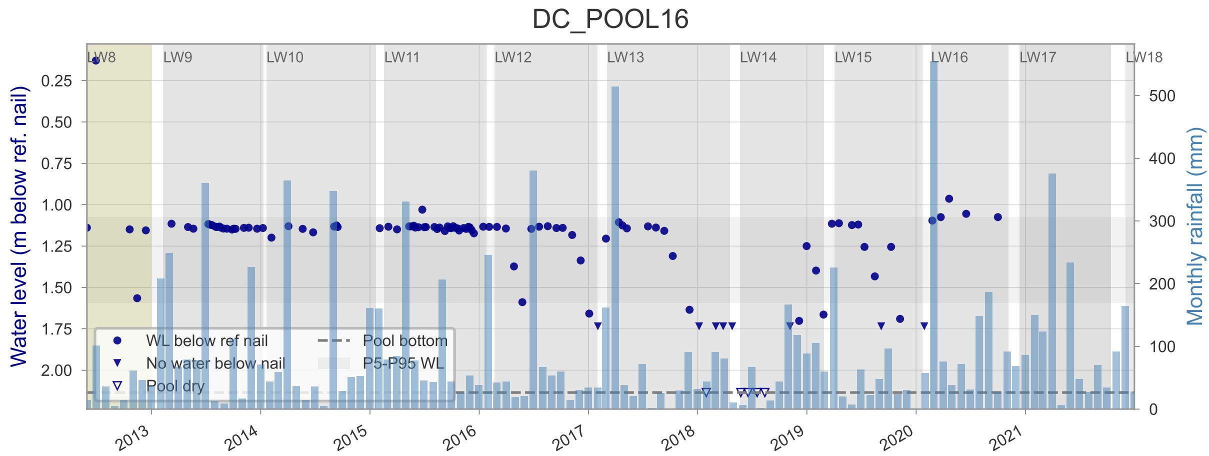

DC_POOL140
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

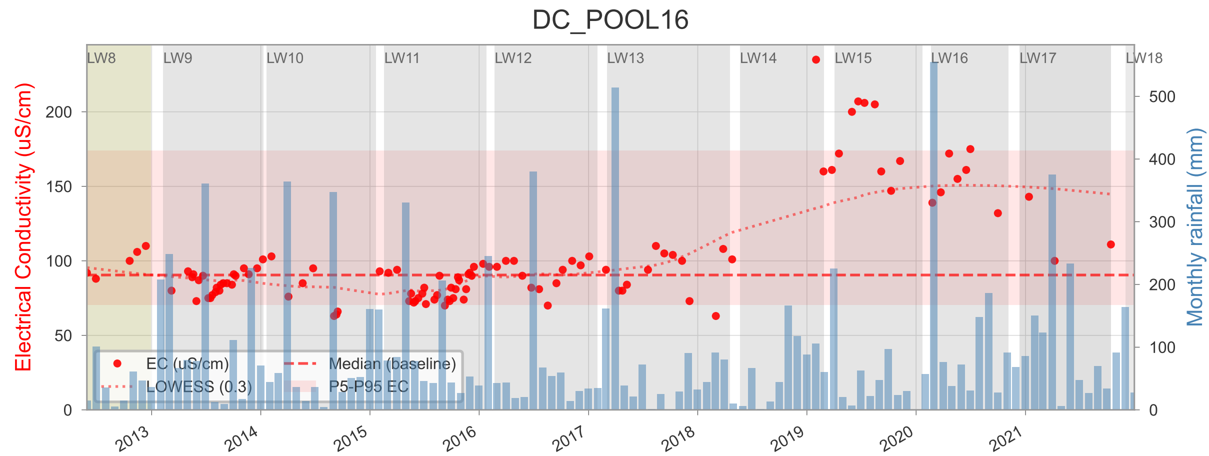

DC_POOL140
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

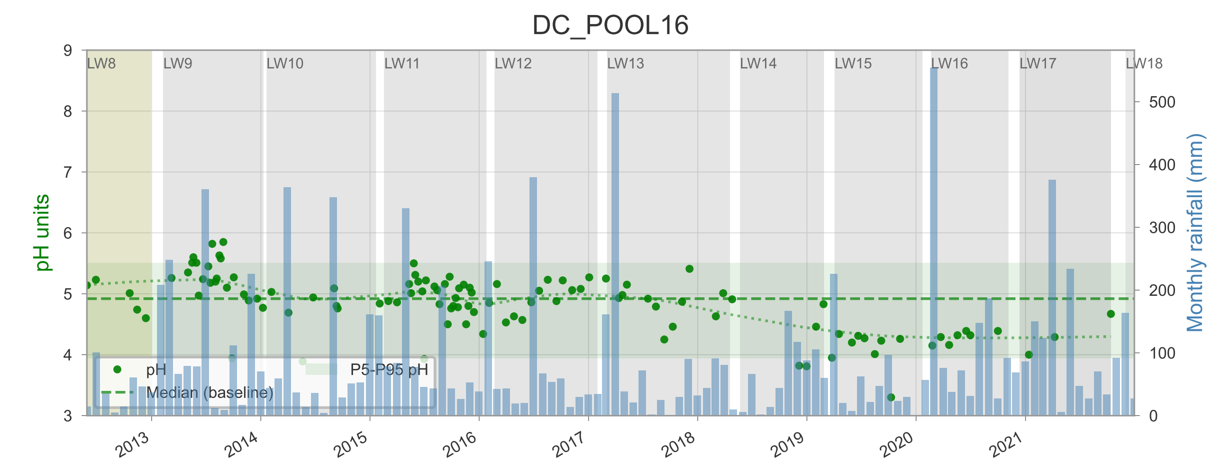

DC_POOL140
pH units
Monthly rainfall (mm)
pH
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

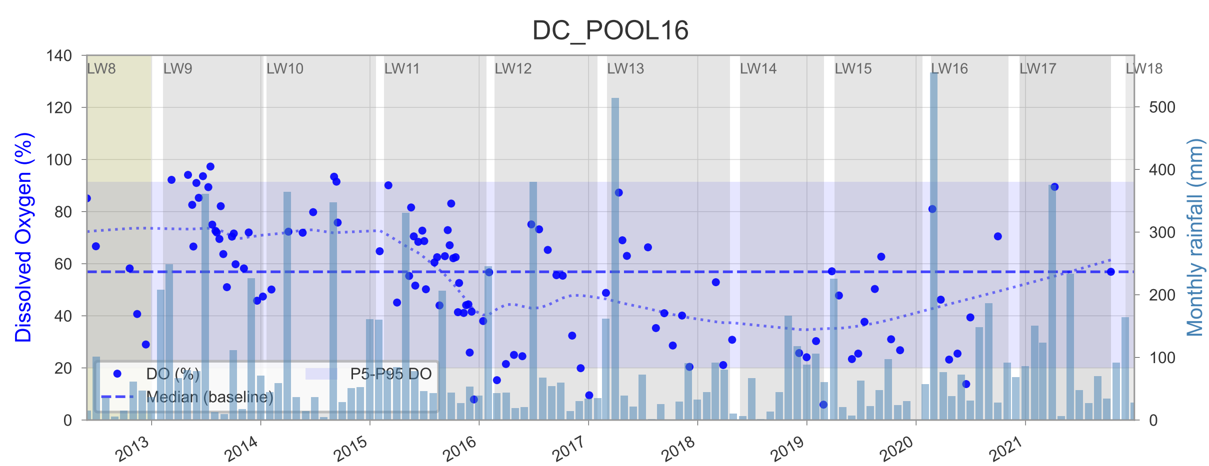

DC_POOL140
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

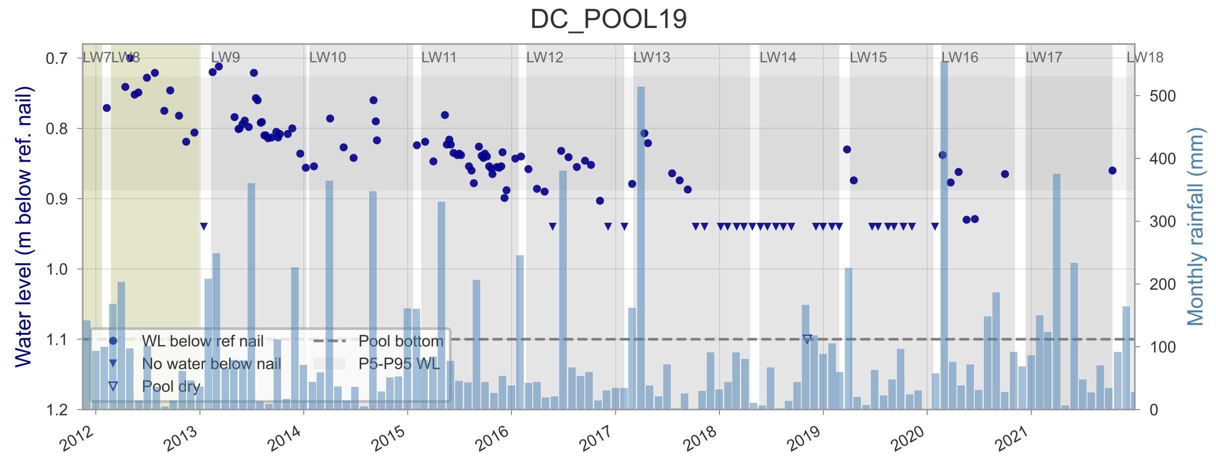

DC_POOL150
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DC_POOL150
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
DC_POOL150
pH units
pH
DC_POOL150
Dissolved Oxygen (%)
DO (%)

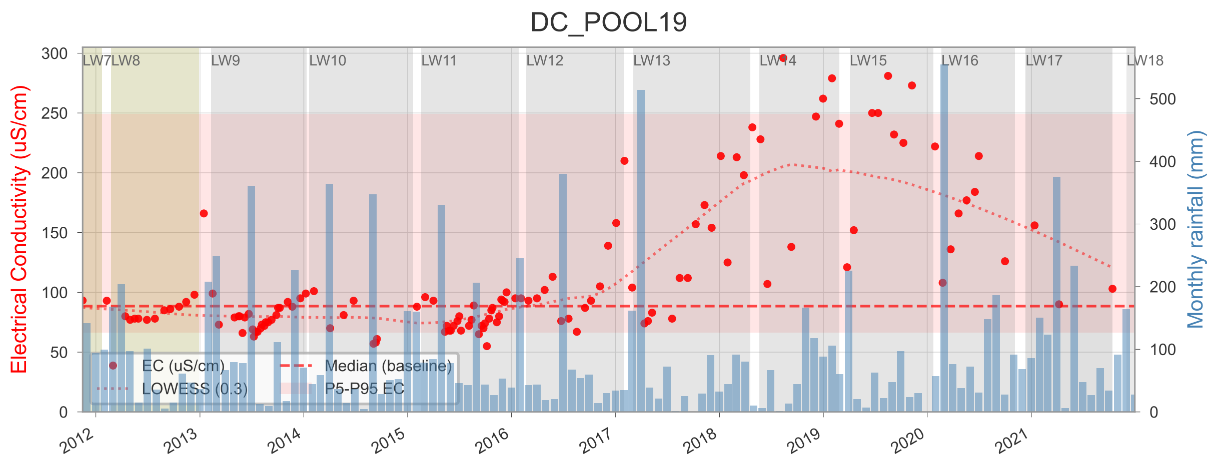

DC_POOL16
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

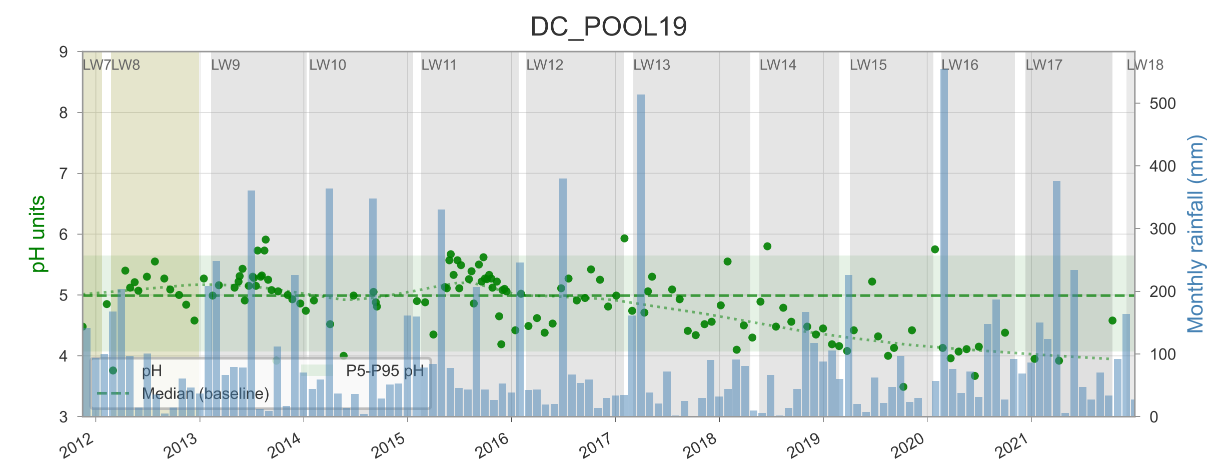

DC_POOL16
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
0
50
100
150
200
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

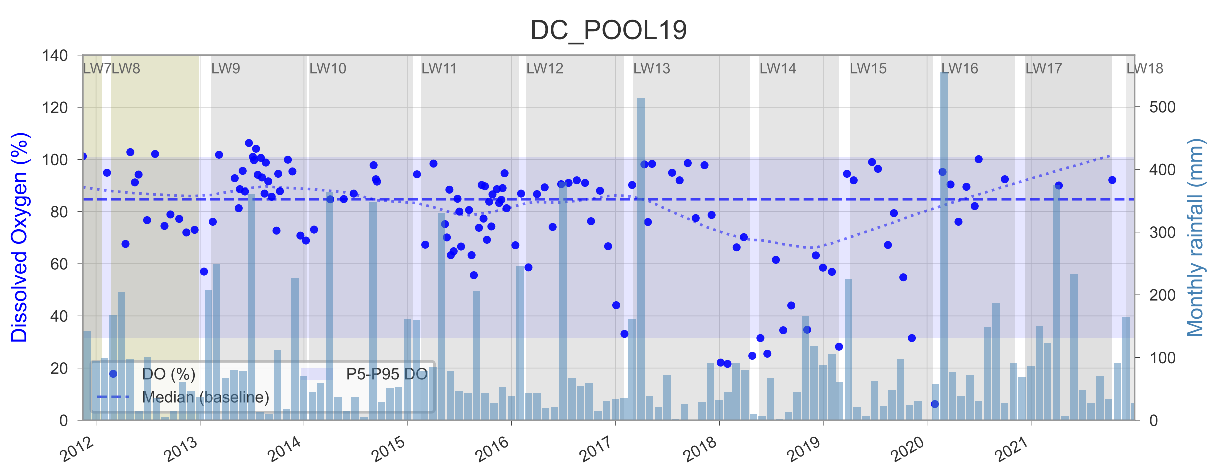

DC_POOL16
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
3
4
5
6
7
8
9
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021


DC_POOL16
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

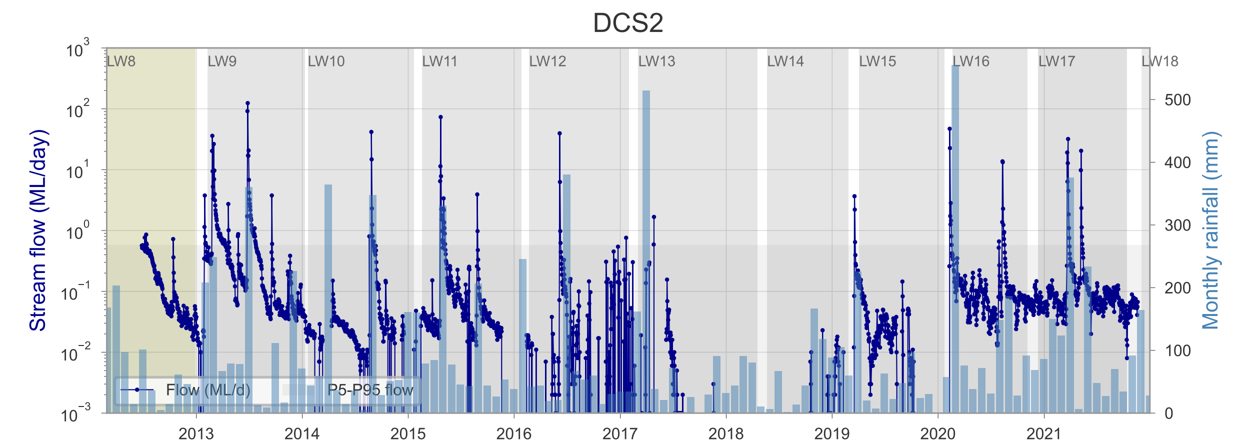

DC_POOL19
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18

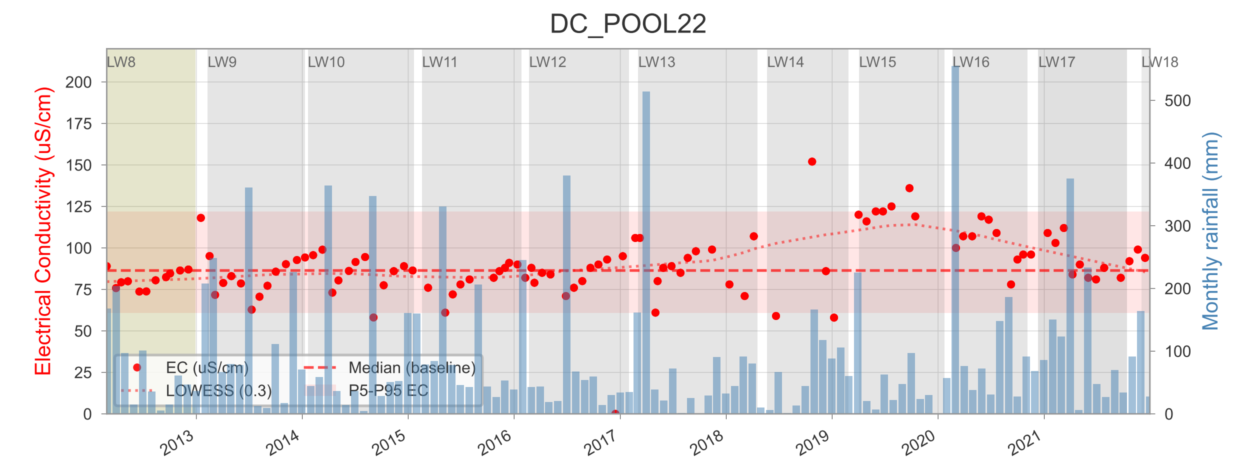

DC_POOL19
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18

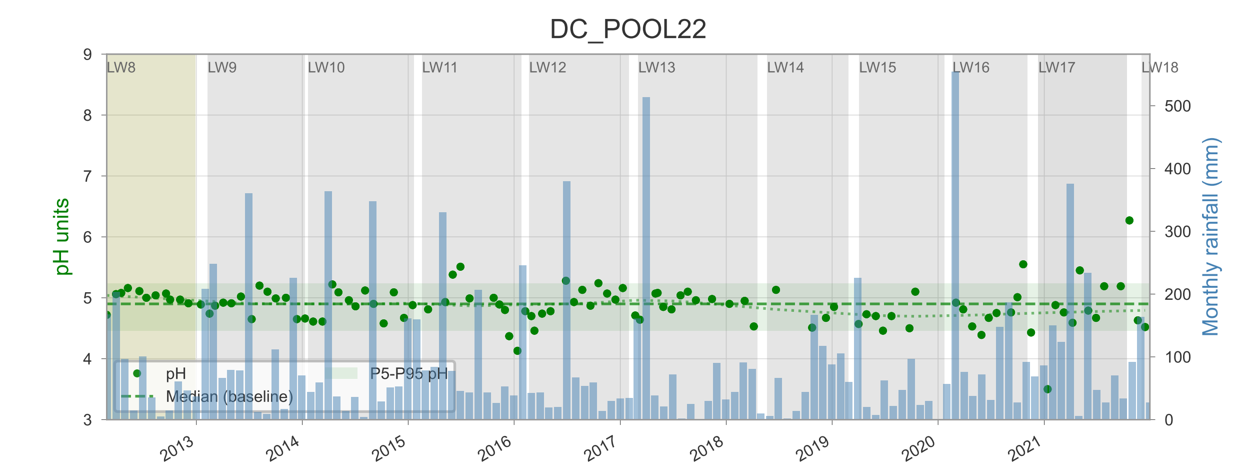

DC_POOL19
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18

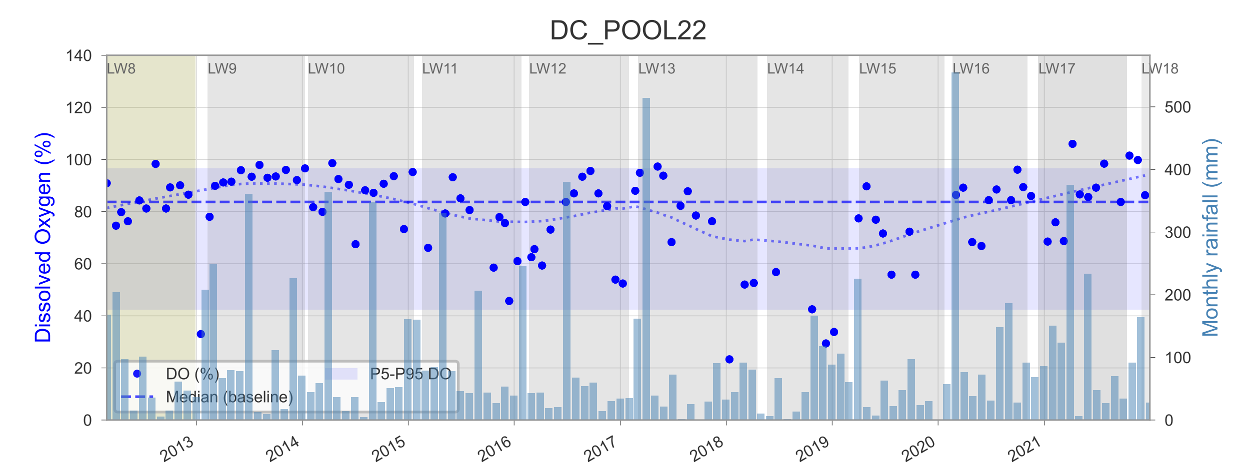

DC_POOL19
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18

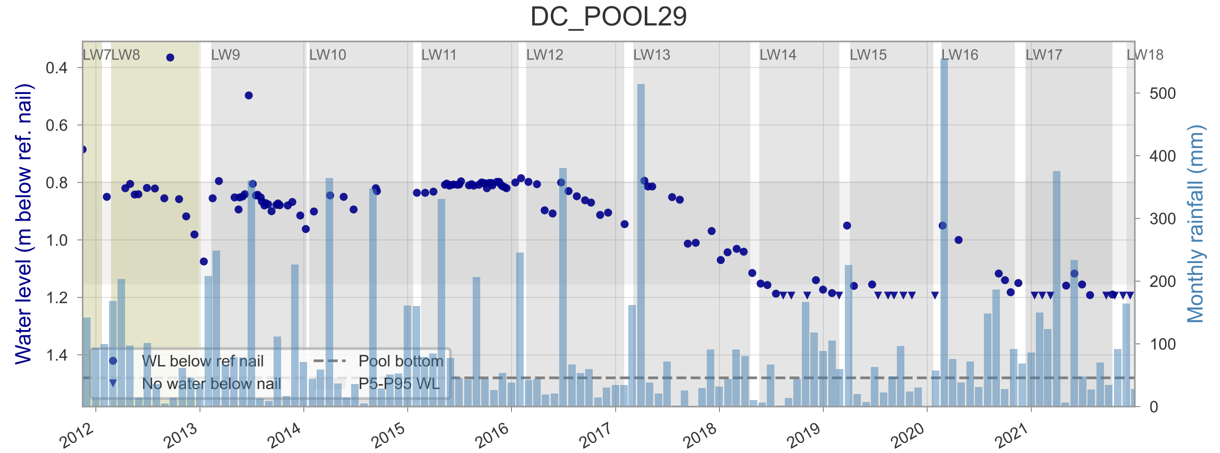
DCS2
Stream flow (ML/day)
Monthly rainfall (mm)
Flow (ML/d)
P5-P95 flow
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
DC_POOL20
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
DC_POOL20
pH units
pH
Median (baseline)
P5-P95 pH
DC_POOL20
Dissolved Oxygen (%)
DO (%)
Median (baseline)
P5-P95 DO
2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

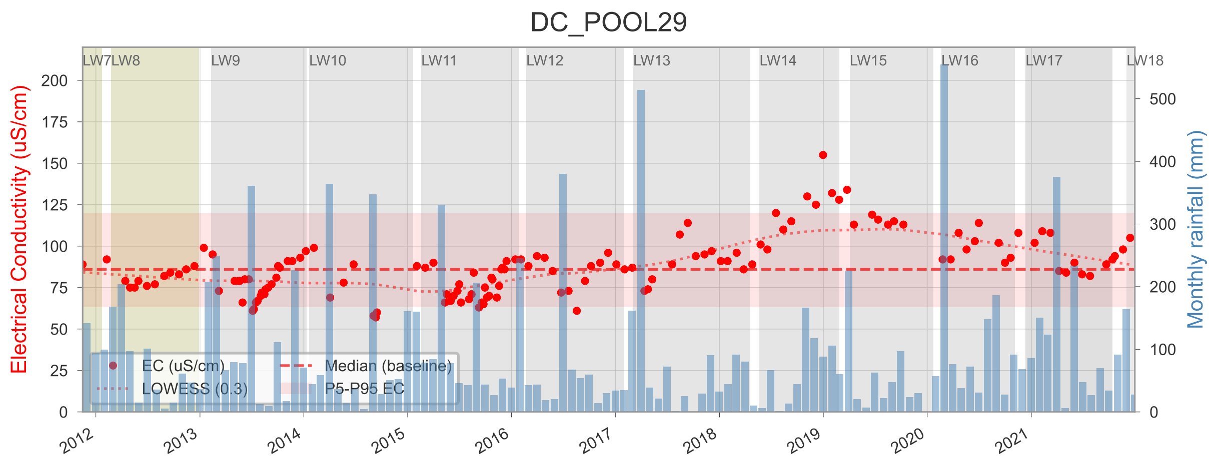

DCS2
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Stream flow (ML/day)
Monthly rainfall (mm)
Flow (ML/d)
P5-P95 flow
2013
2014
2015
2016
2017
2018
2019
2020
2021

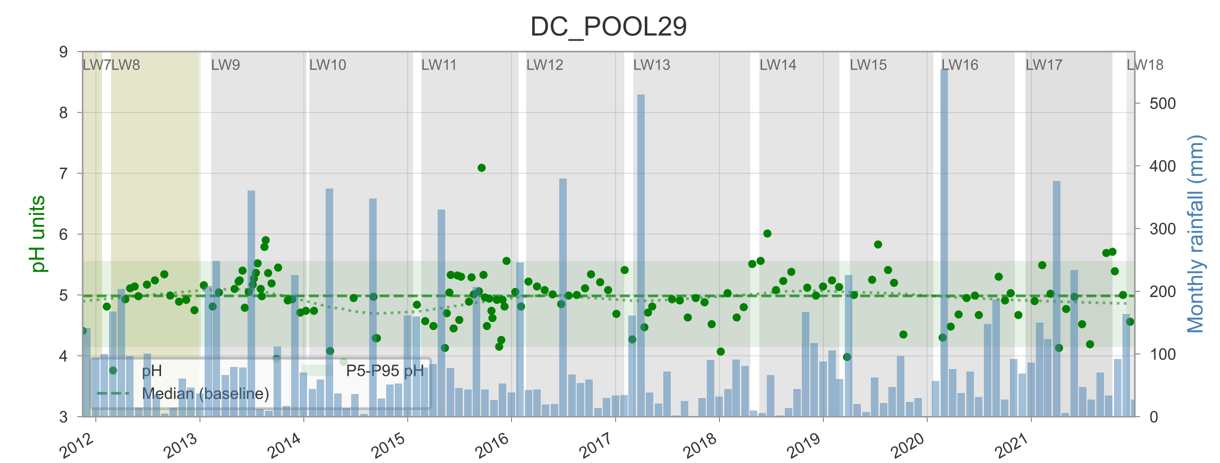

DC_POOL22
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
2013
2014
2015
2016
2017
2018
2019
2020
2021

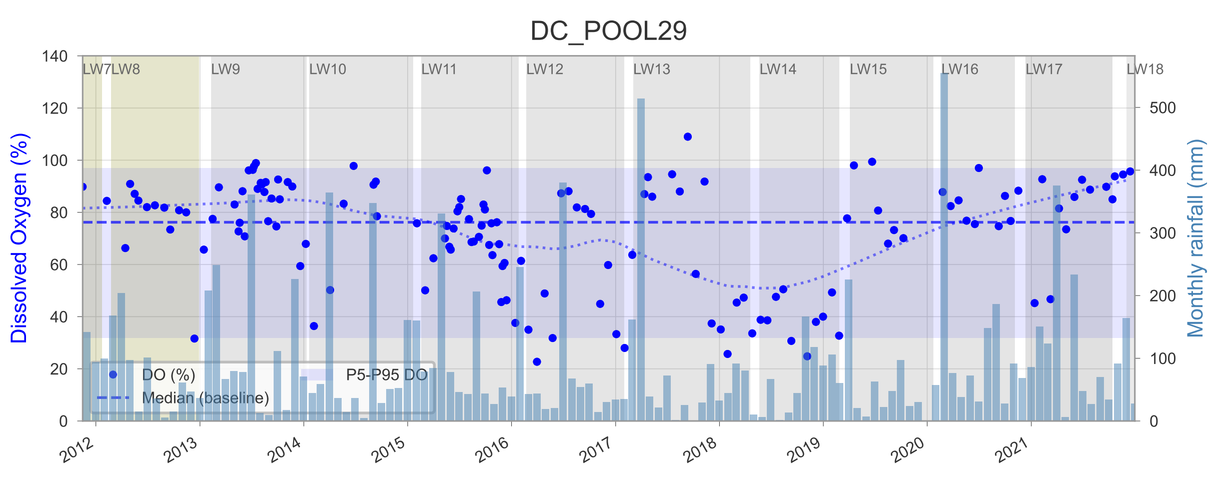

DC_POOL22
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
2013
2014
2015
2016
2017
2018
2019
2020
2021

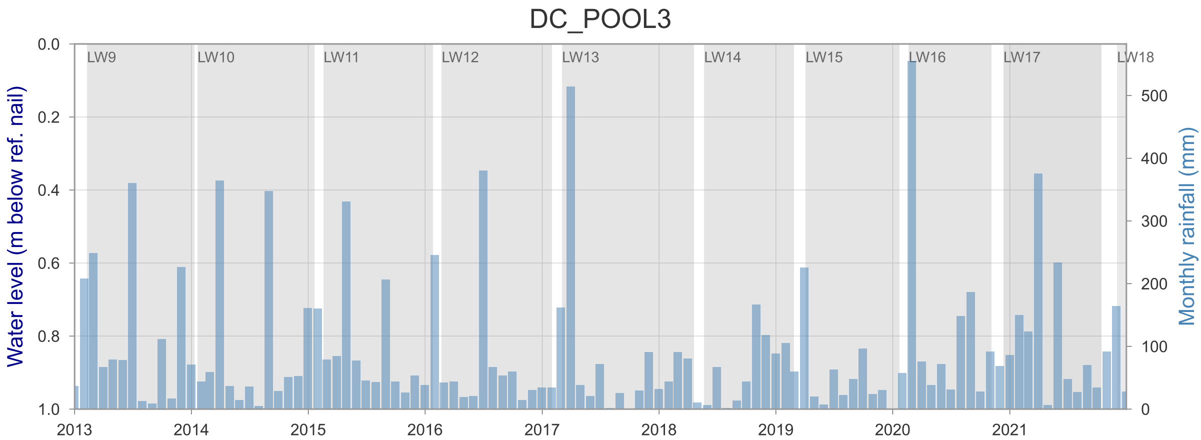

DC_POOL22
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
2013
2014
2015
2016
2017
2018
2019
2020
2021

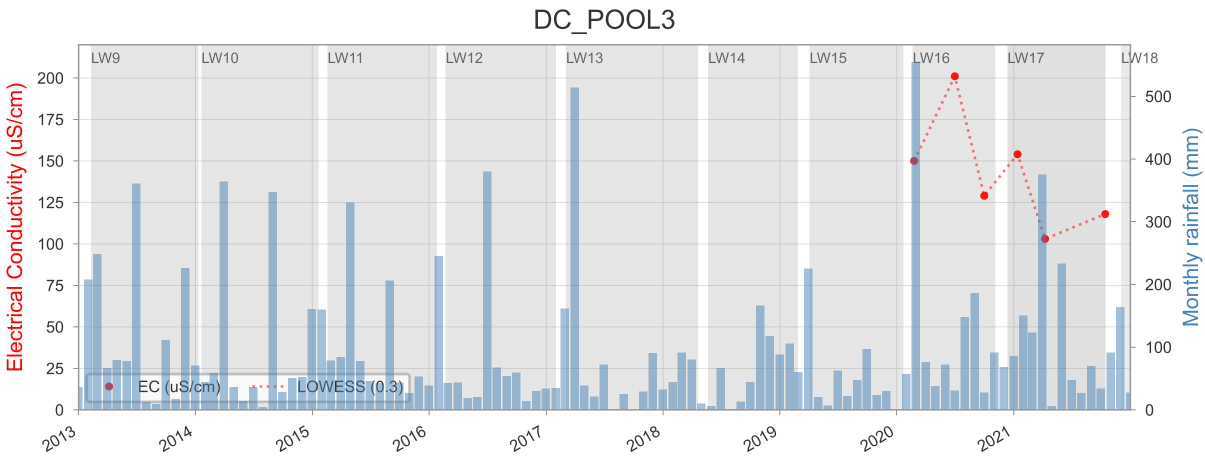

DC_POOL29
Water level (m below ref. nail)
Monthly rainfall (mm)
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
WL below ref nail
No water below nail
Pool bottom
P5-P95 WL

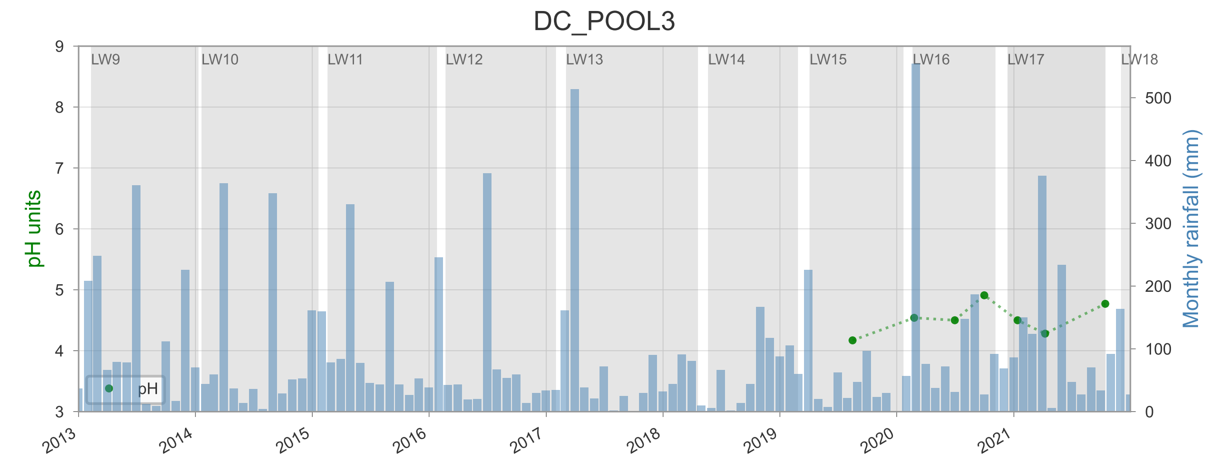

DC_POOL29
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

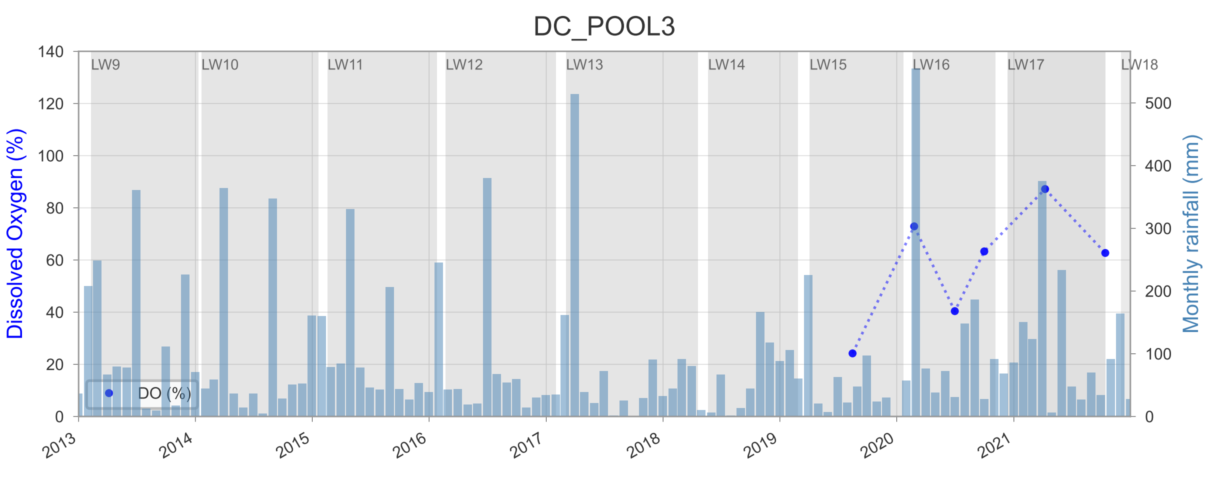

DC_POOL29
pH units
Monthly rainfall (mm)
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
pH
Median (baseline)
P5-P95 pH

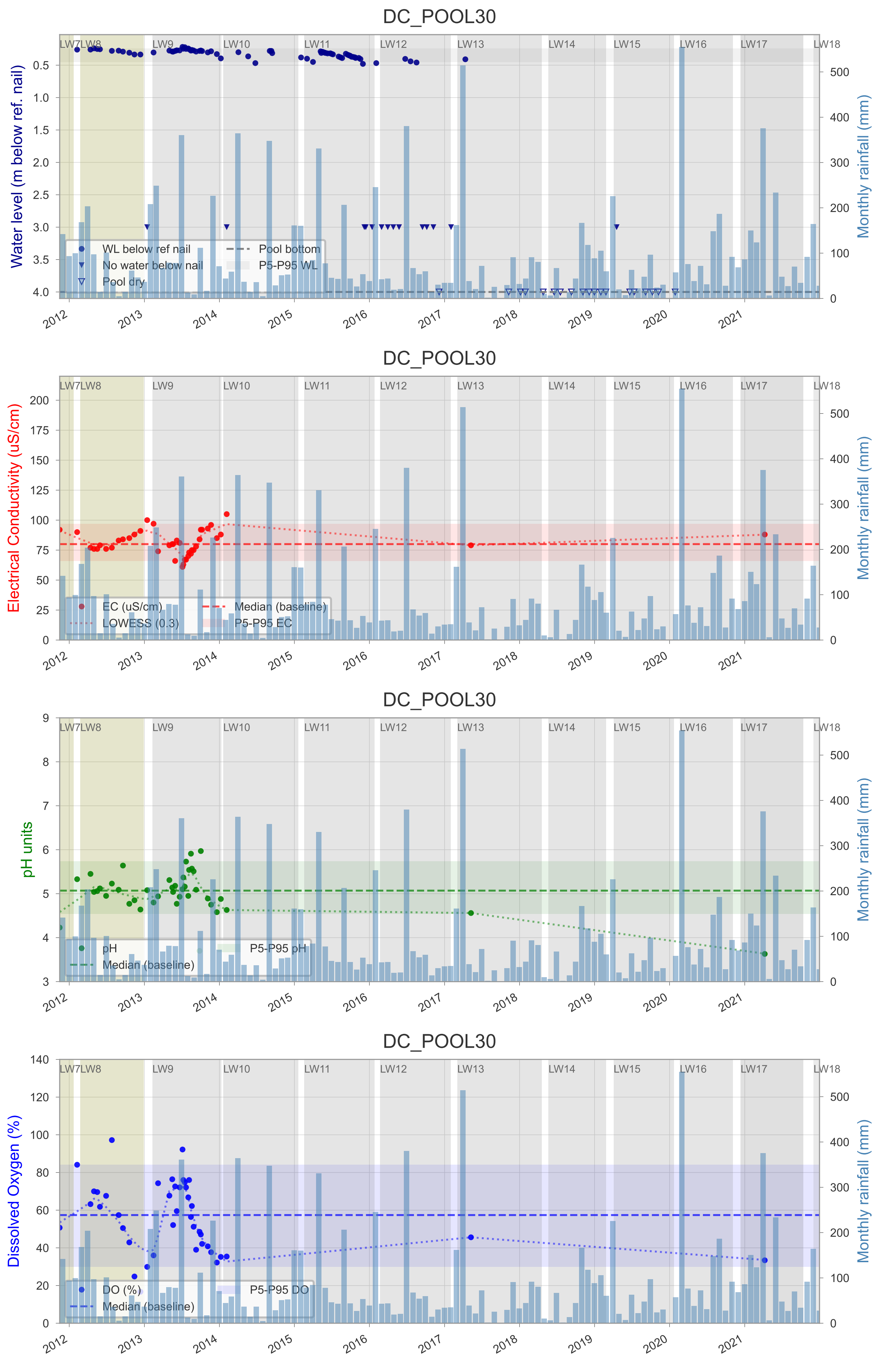

DC_POOL29
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
DO (%)
Median (baseline)
P5-P95 DO

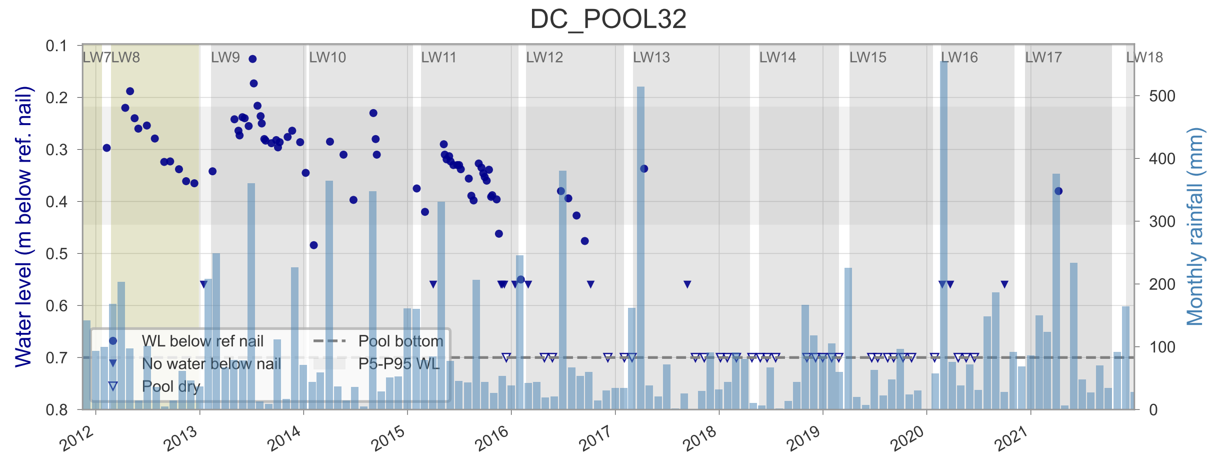

DC_POOL3
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

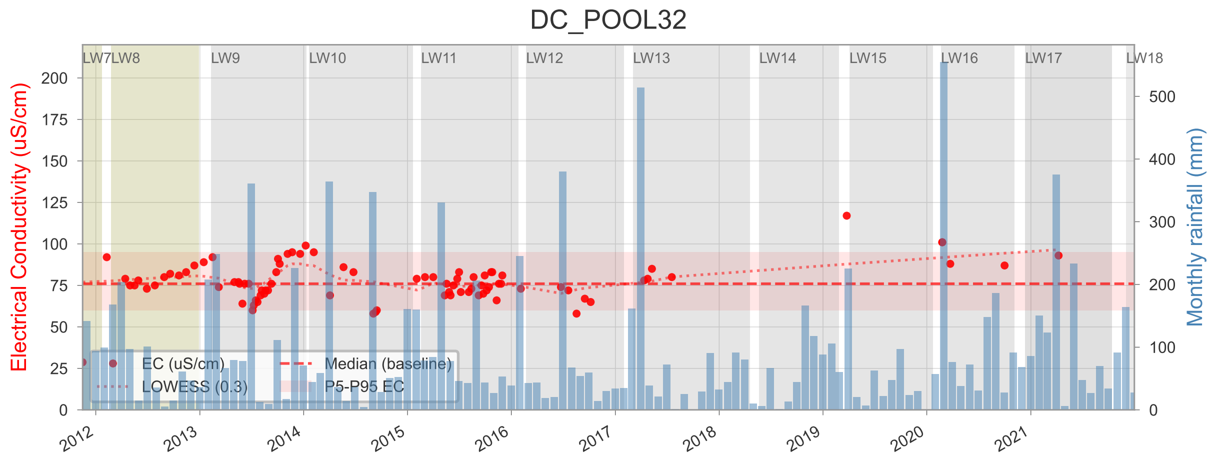

DC_POOL3
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

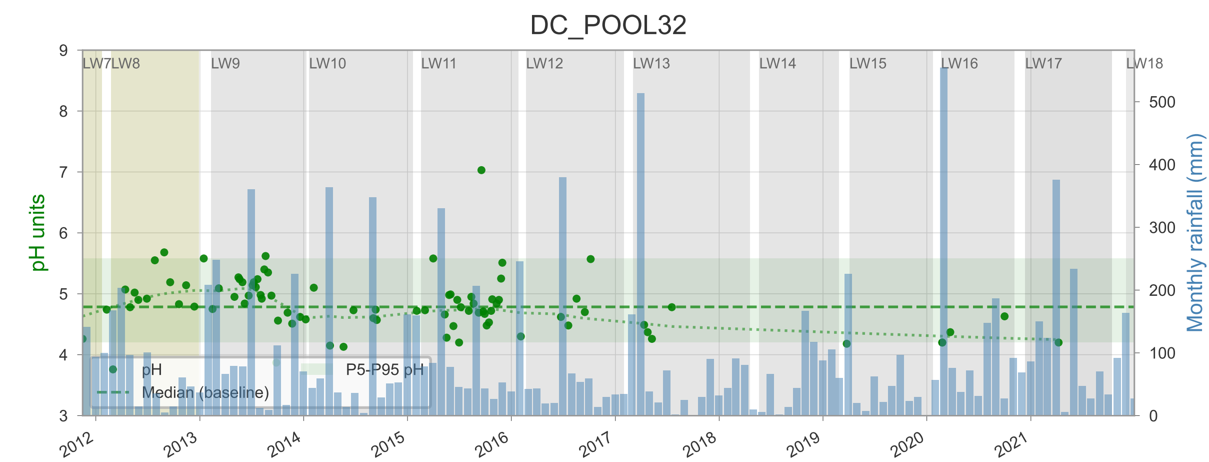

DC_POOL3
pH units
Monthly rainfall (mm)
pH
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

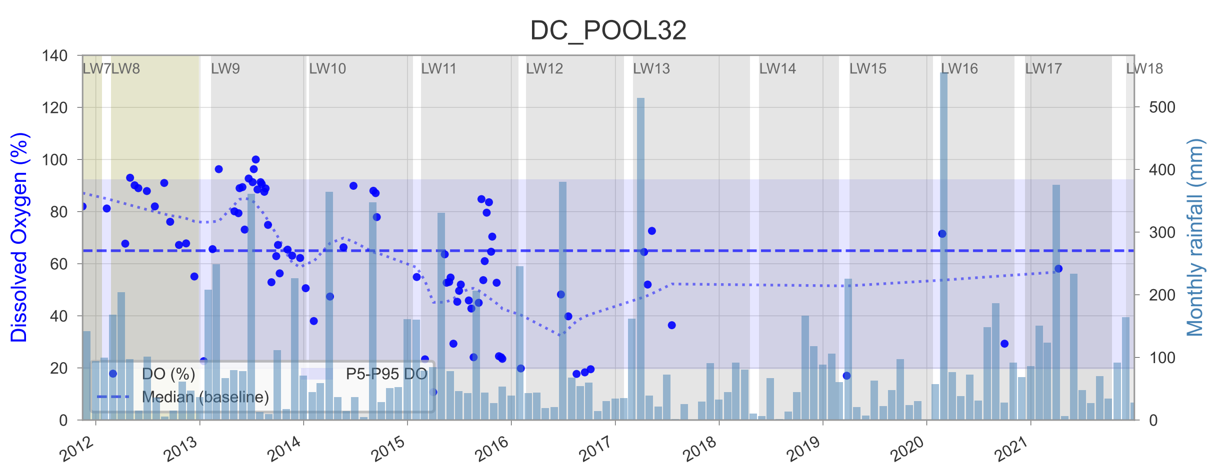

DC_POOL3
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

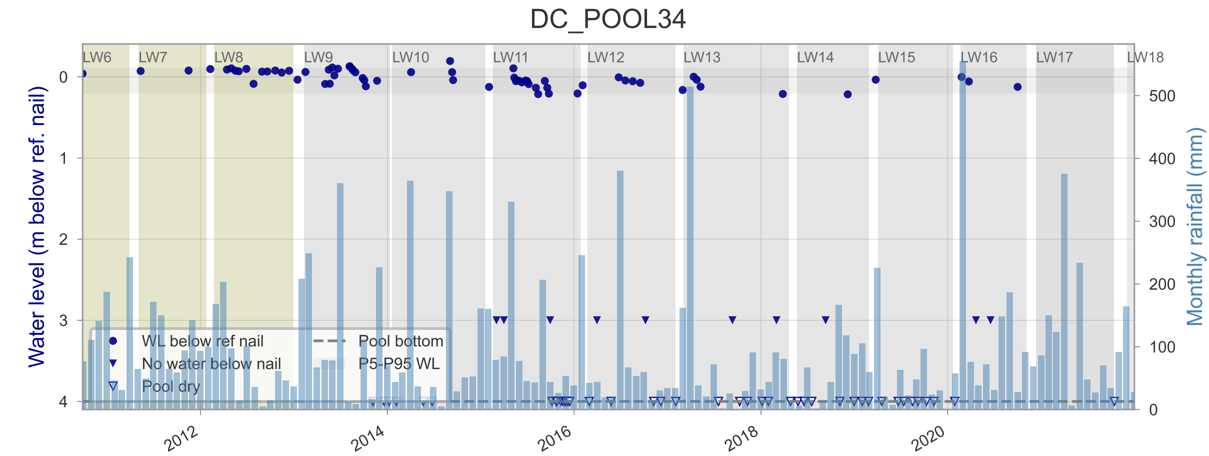

DC_POOL30
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL
DC_POOL30
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
DC_POOL30
pH units
pH
Median (baseline)
P5-P95 pH
DC_POOL30
Dissolved Oxygen (%)
DO (%)
Median (baseline)
P5-P95 DO
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

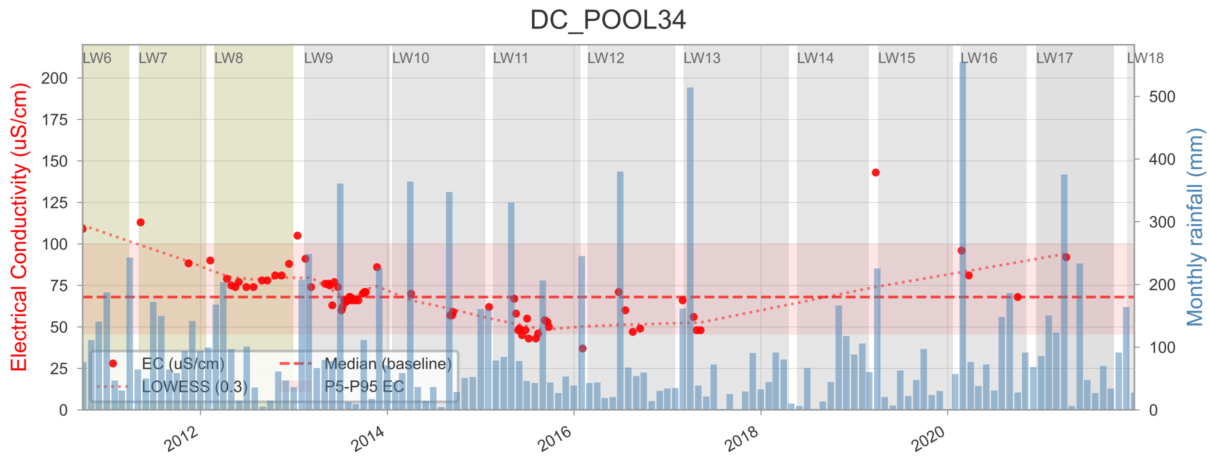

DC_POOL32
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18

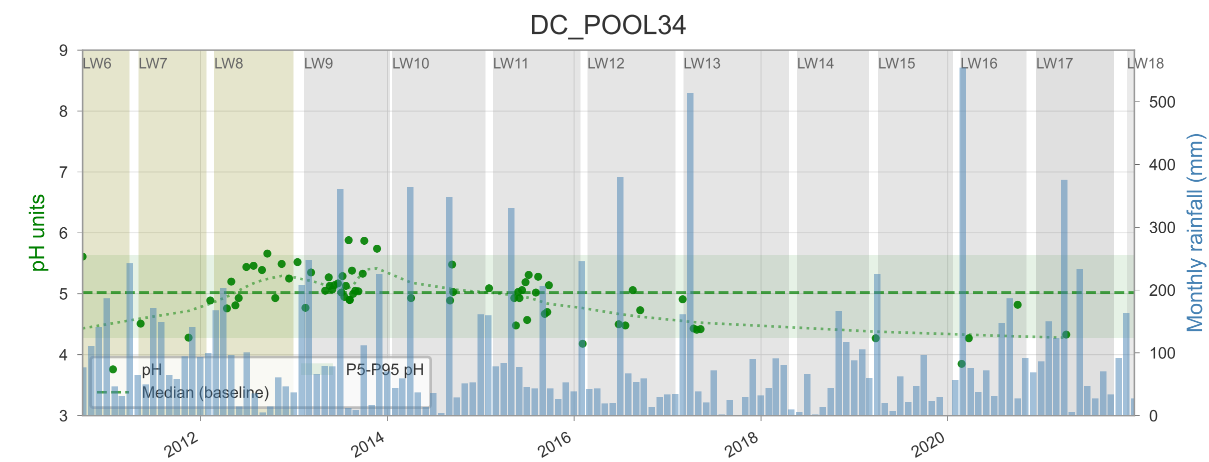

DC_POOL32
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18

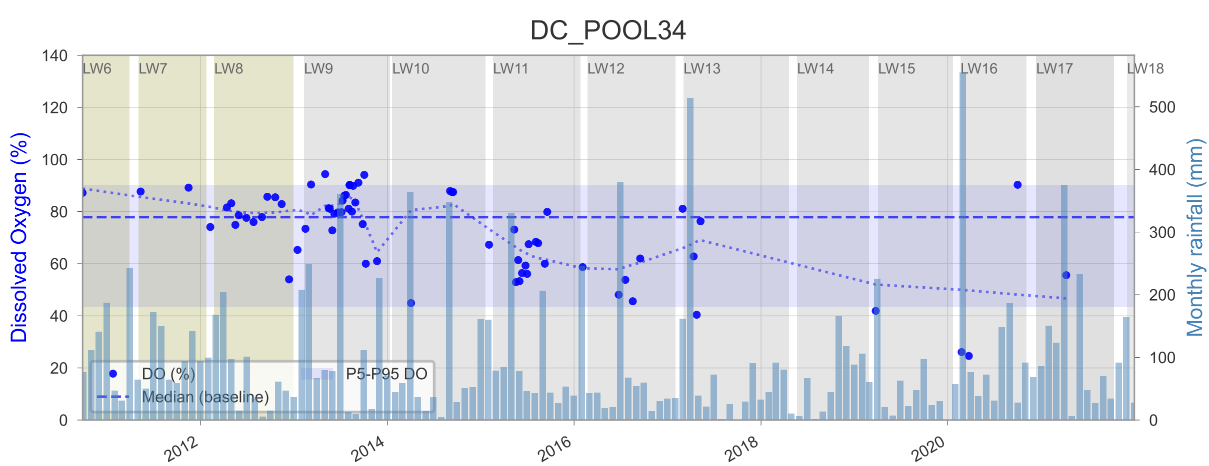

DC_POOL32
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18

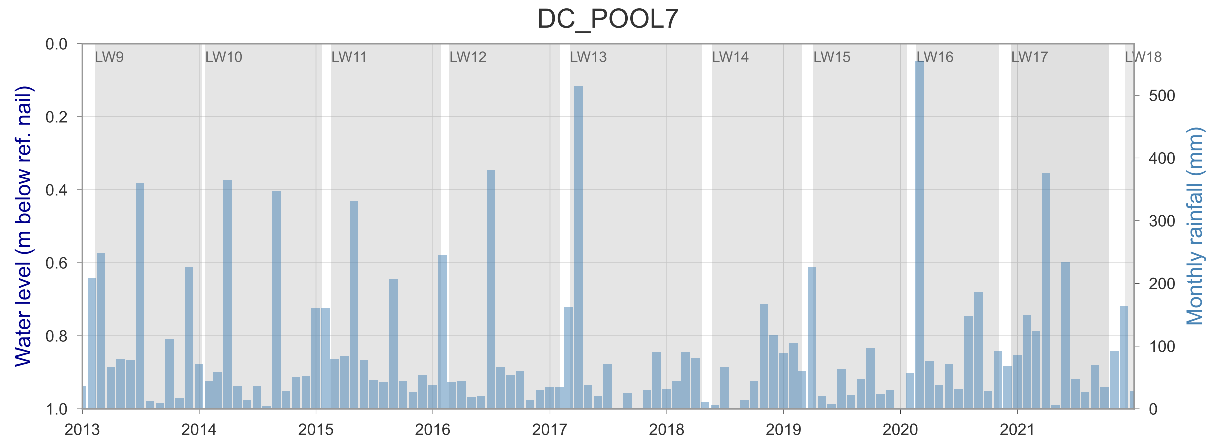

DC_POOL32
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18

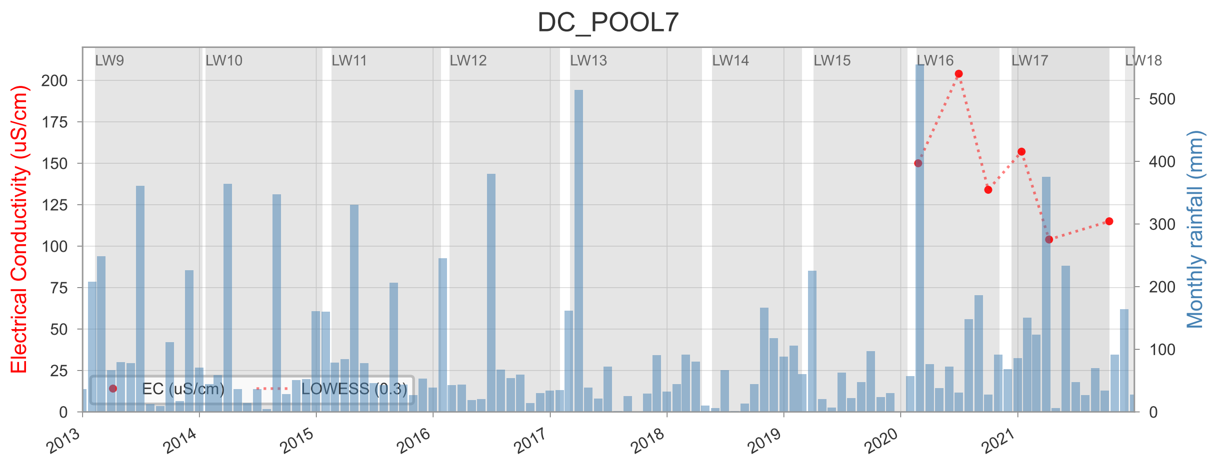

DC_POOL34
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL
2012
2014
2016
2018
2020

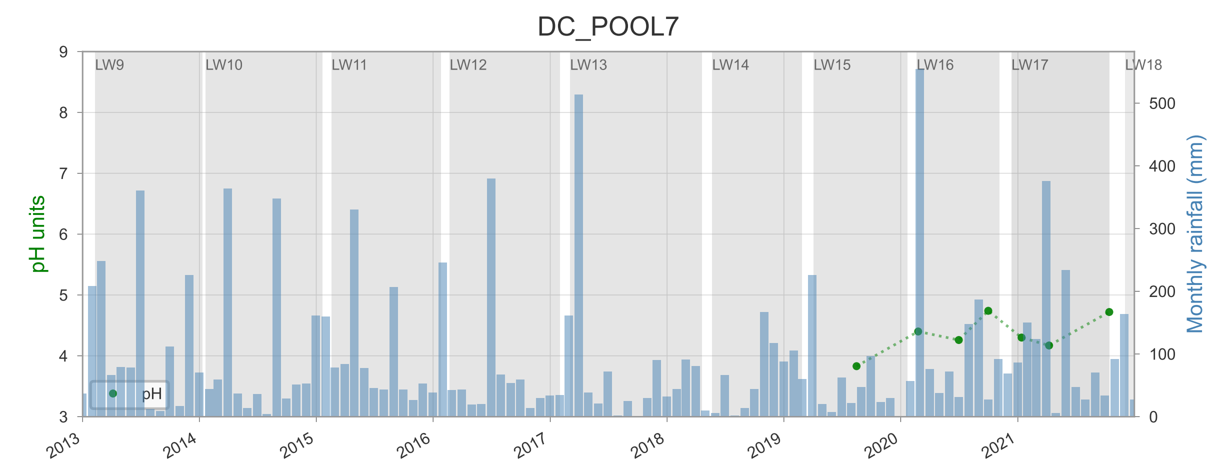

DC_POOL34
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
2012
2014
2016
2018
2020

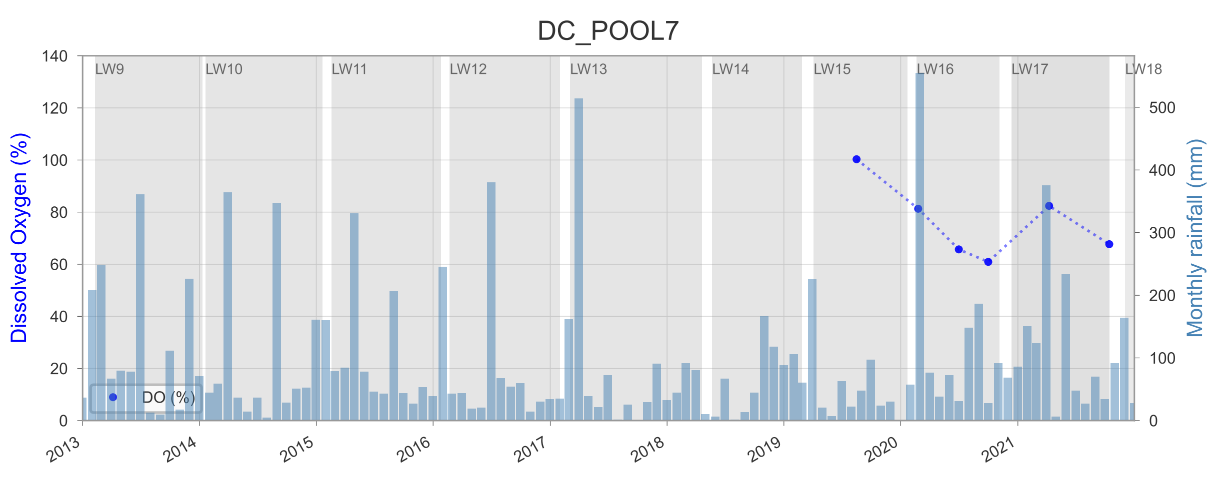

DC_POOL34
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
2012
2014
2016
2018
2020

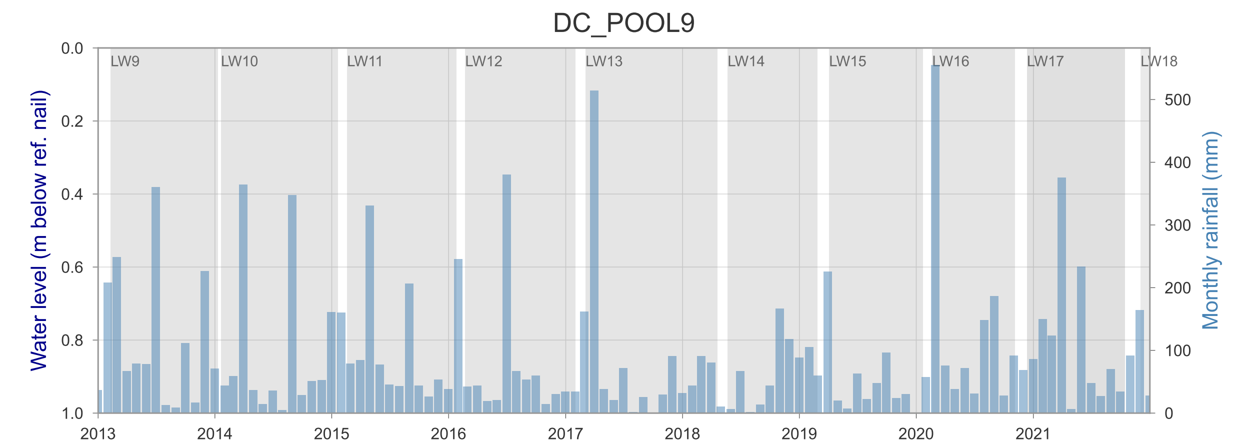

DC_POOL34
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
2012
2014
2016
2018
2020

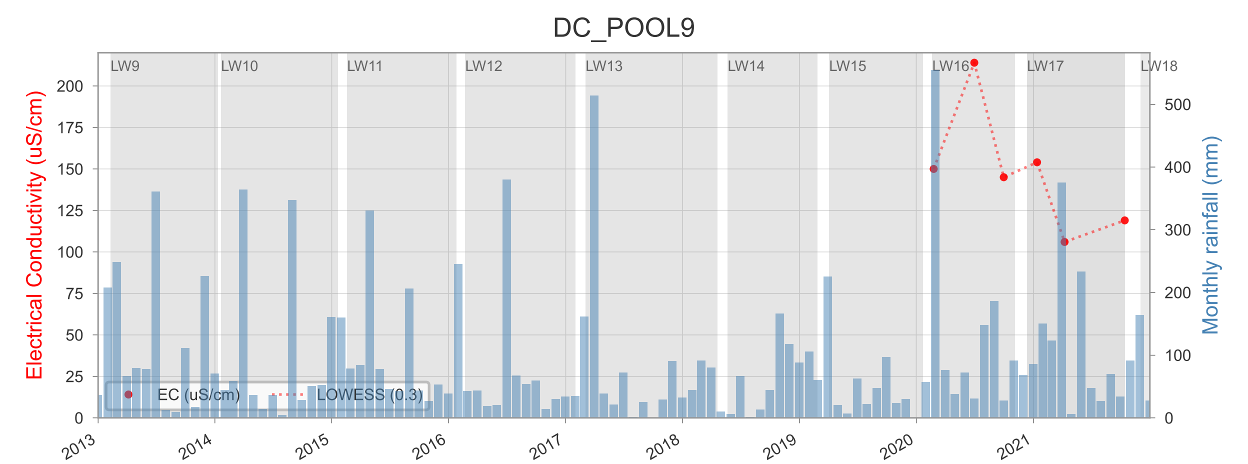

DC_POOL7
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
0.0
0.2
0.4
0.6
0.8
1.0
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

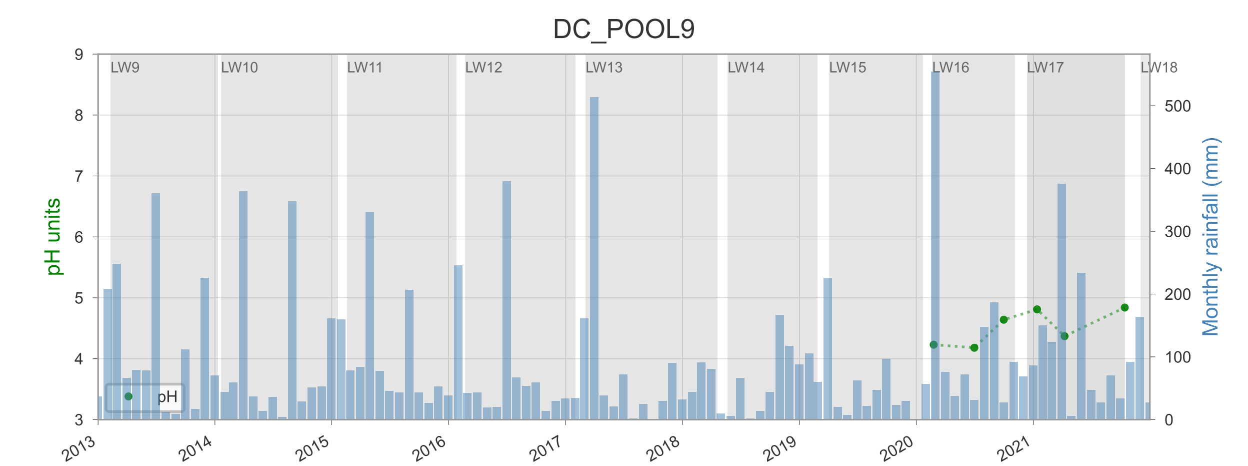

DC_POOL7
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

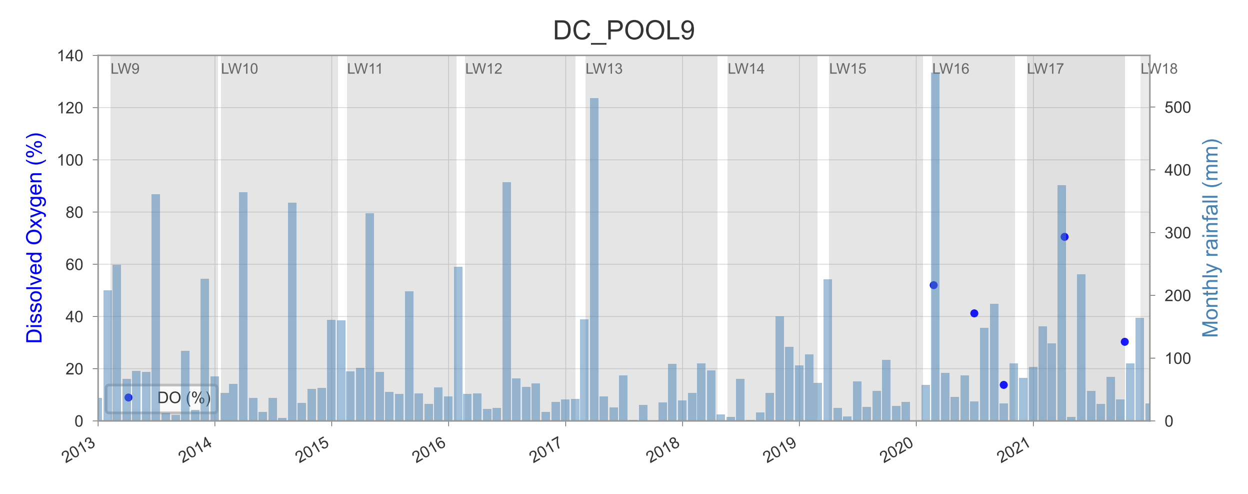

DC_POOL7
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
3
4
5
6
7
8
9
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

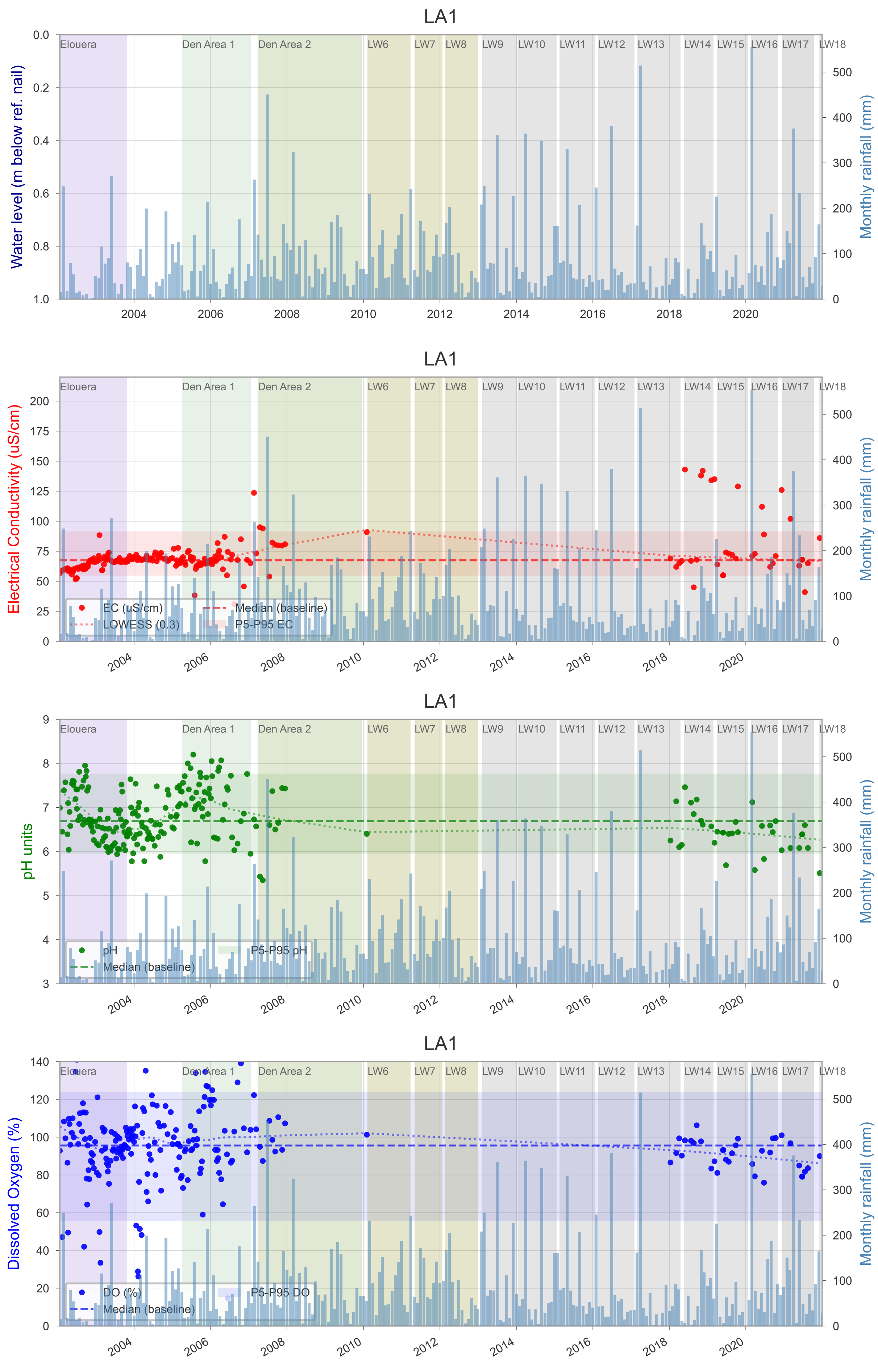

DC_POOL7
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021


DC_POOL9
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
0.0
0.2
0.4
0.6
0.8
1.0
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

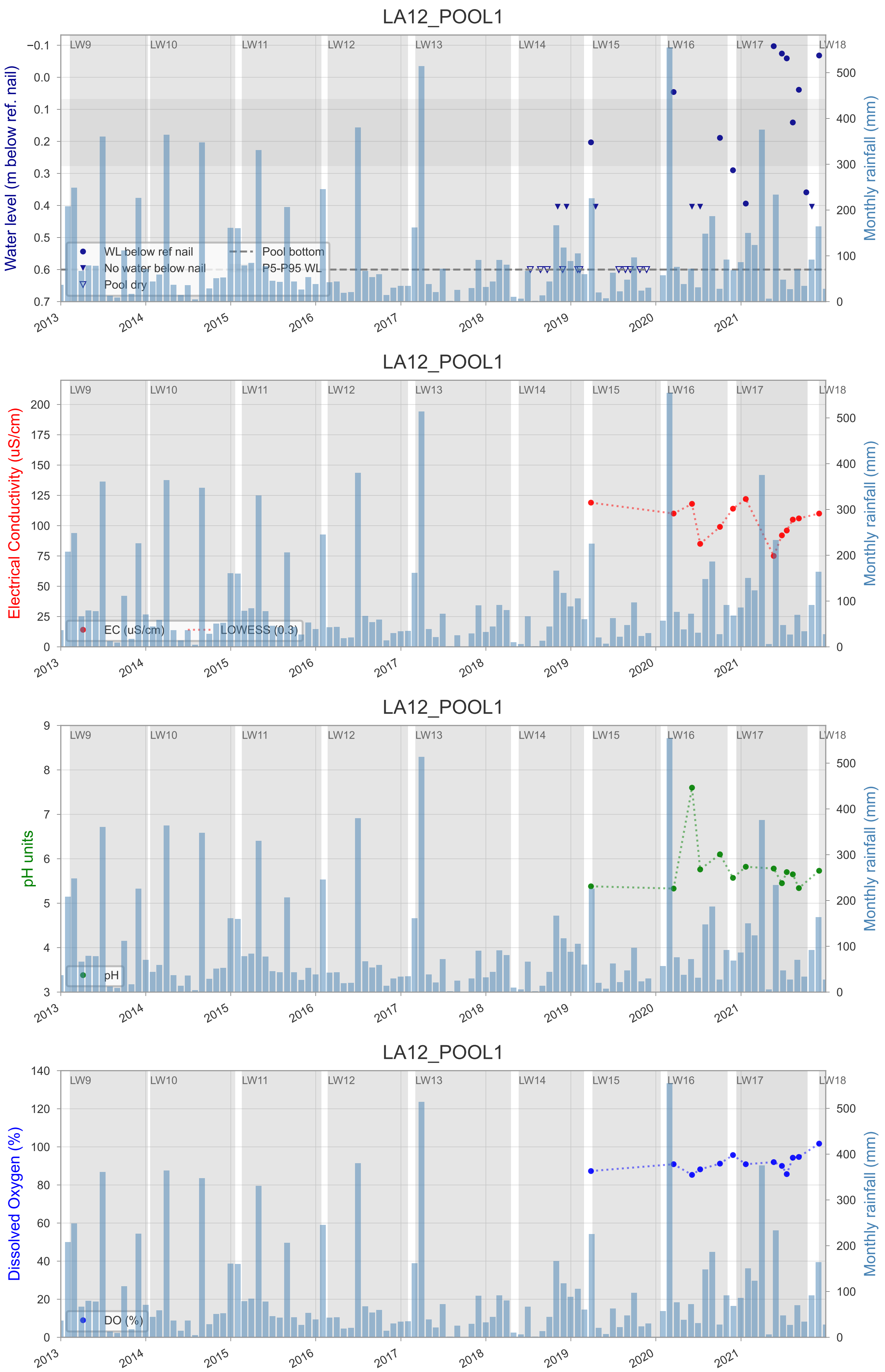

DC_POOL9
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

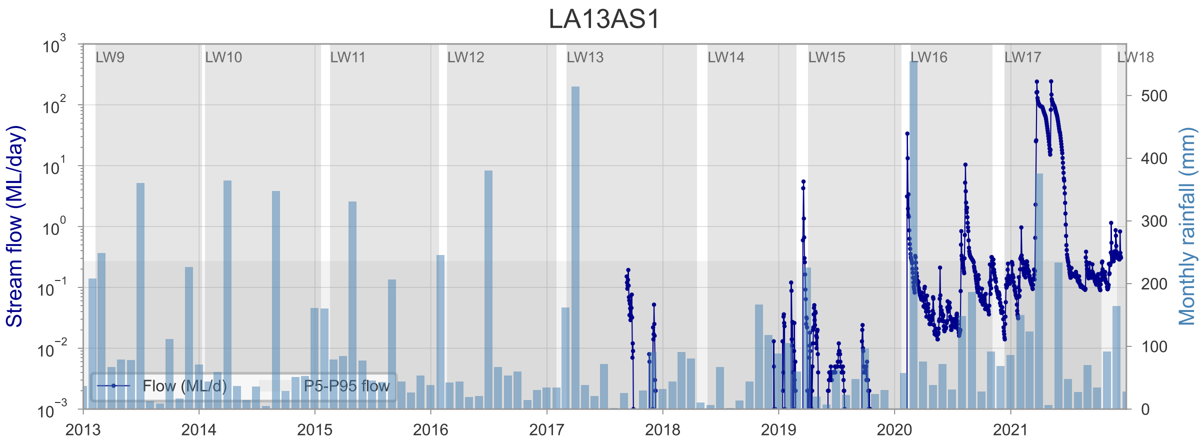

DC_POOL9
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
3
4
5
6
7
8
9
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

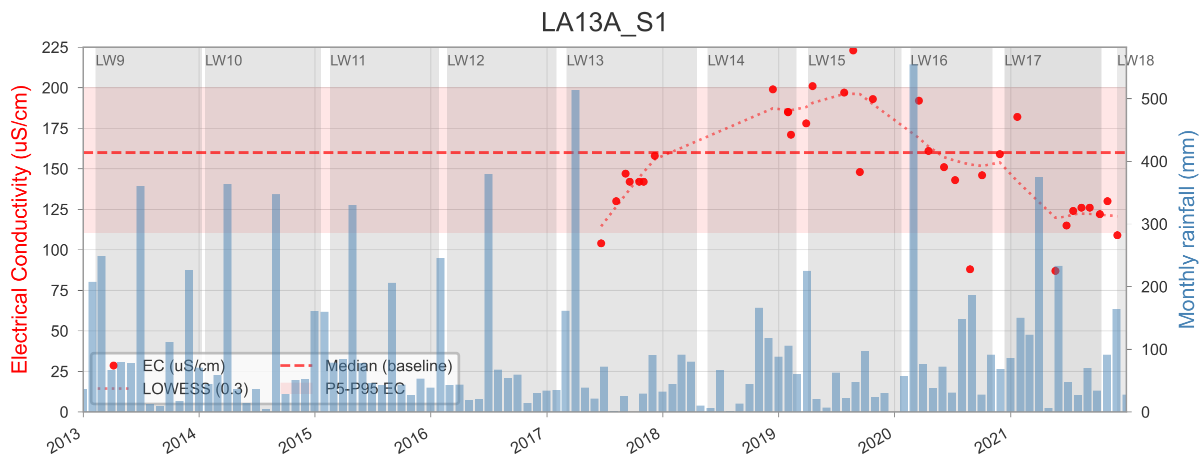

DC_POOL9
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

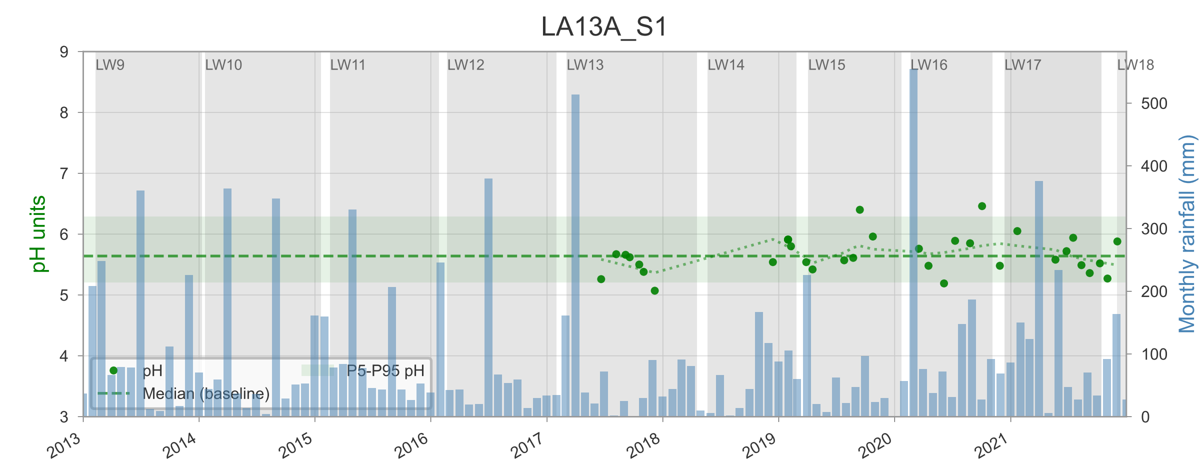


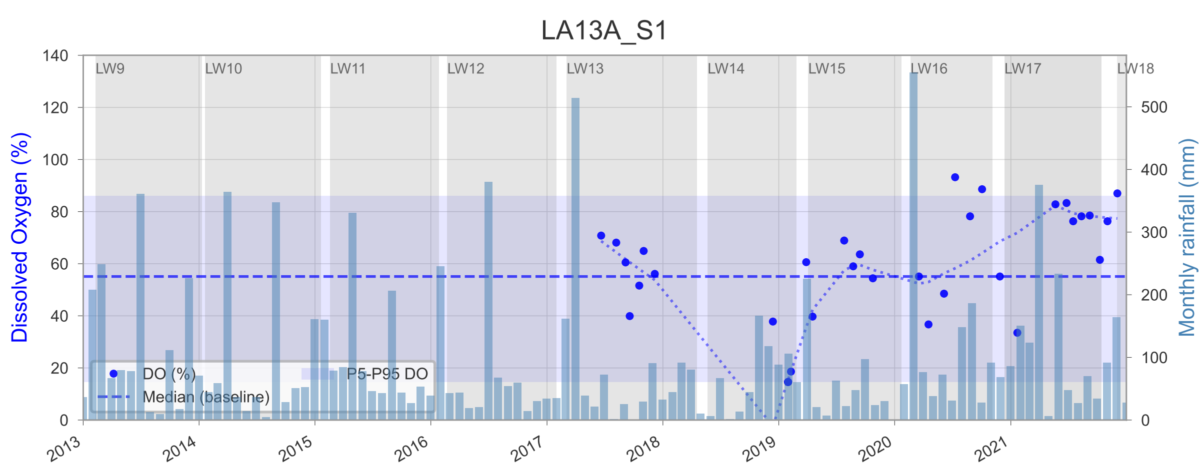
LA1
Water level (m below ref. nail)
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
LA1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LA1
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
LA1
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

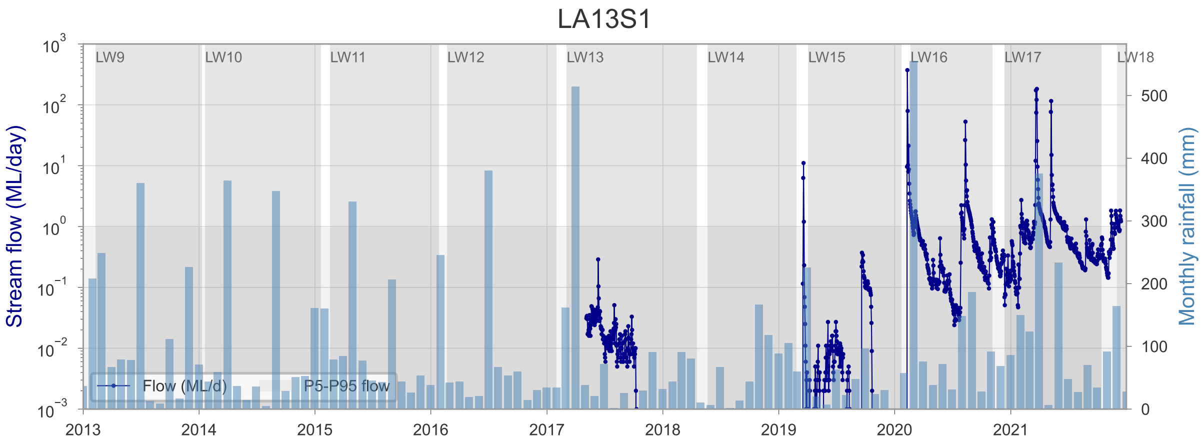

LA12_POOL1
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL
LA12_POOL1
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
LA12_POOL1
pH units
pH
LA12_POOL1
Dissolved Oxygen (%)
DO (%)
2013
2014
2015
2016
2017
2018
2019
2020
2021

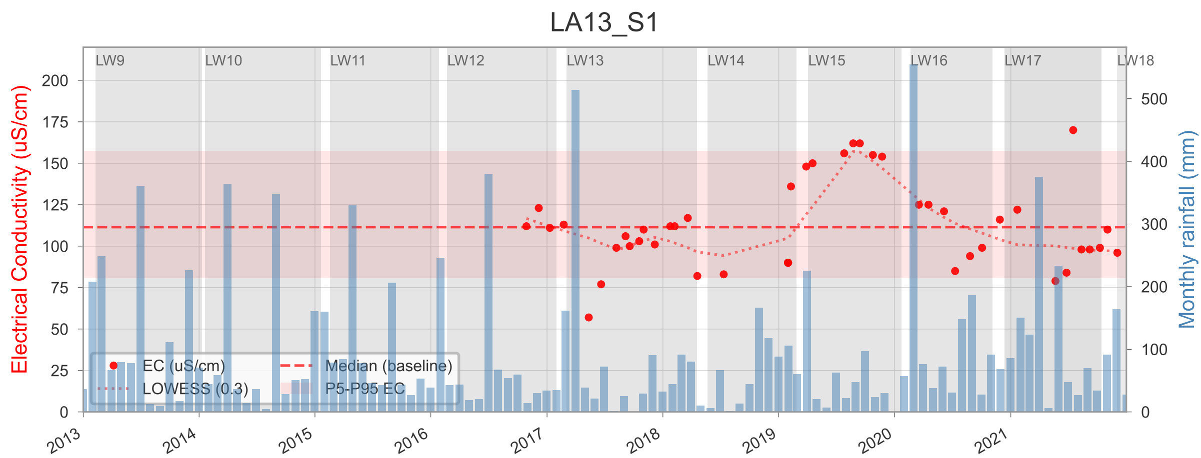

LA13AS1
Stream flow (ML/day)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Flow (ML/d)
P5-P95 flow
2013
2014
2015
2016
2017
2018
2019
2020
2021

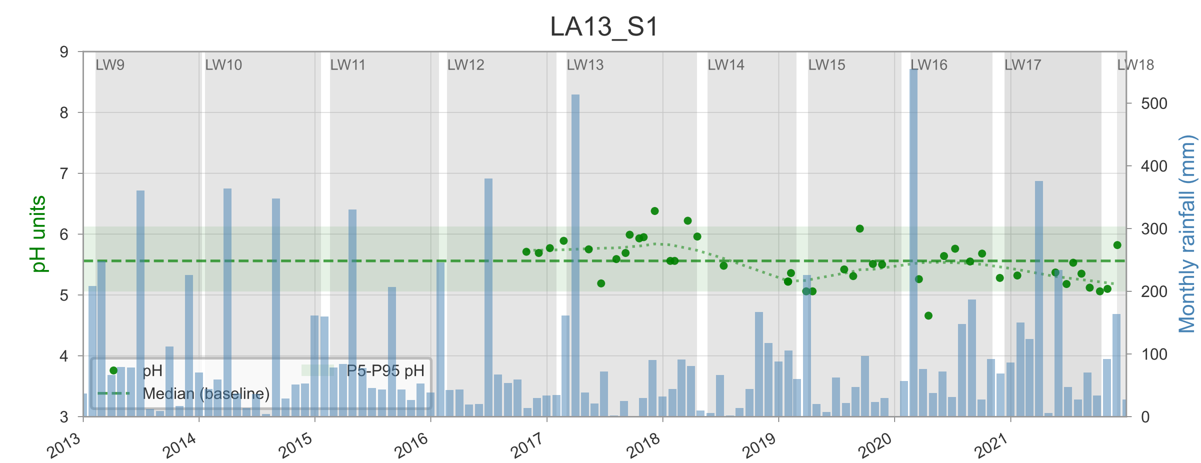

LA13A_S1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

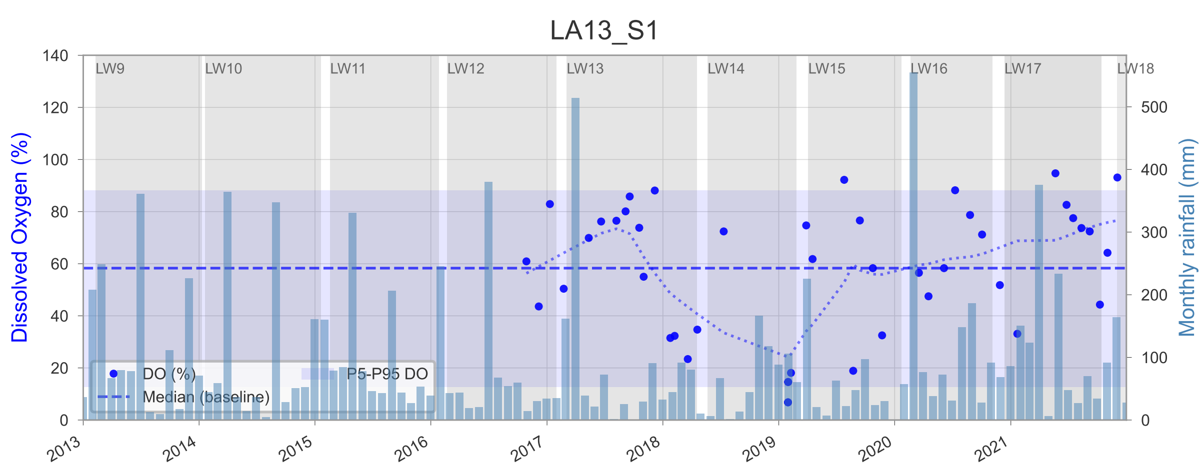

LA13A_S1
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
Median (baseline)
P5-P95 pH

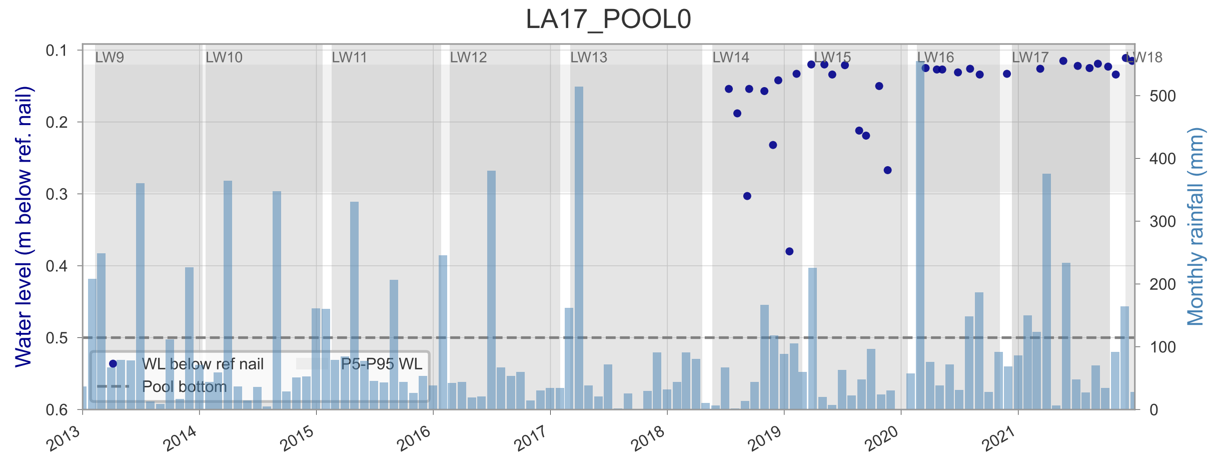

LA13A_S1
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
Median (baseline)
P5-P95 DO

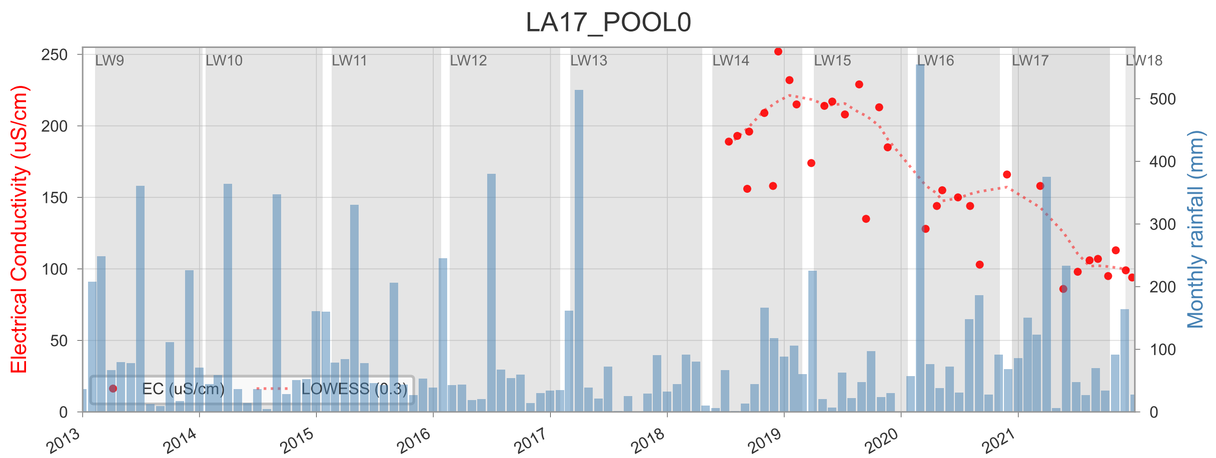

LA13S1
Stream flow (ML/day)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Flow (ML/d)
P5-P95 flow
2013
2014
2015
2016
2017
2018
2019
2020
2021

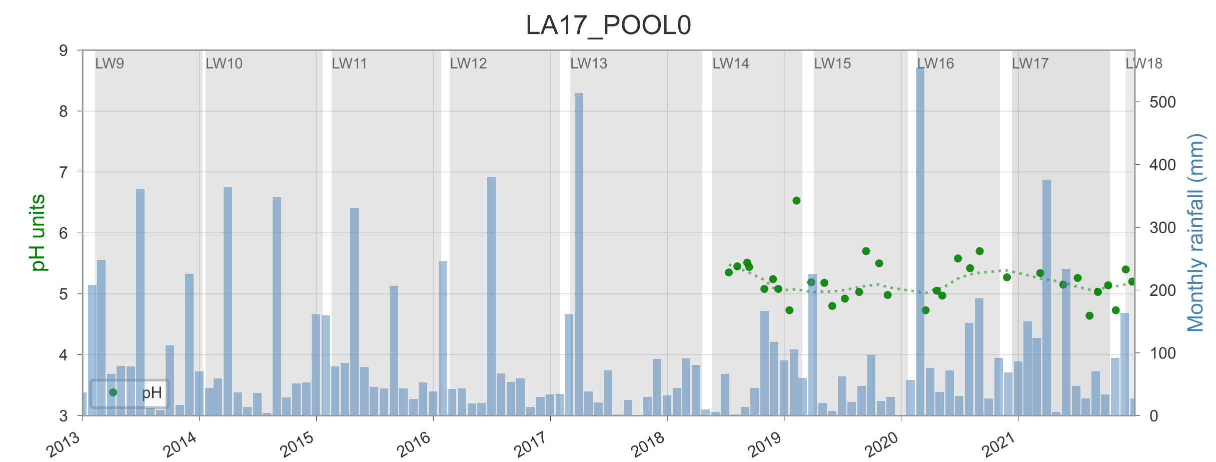

LA13_S1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

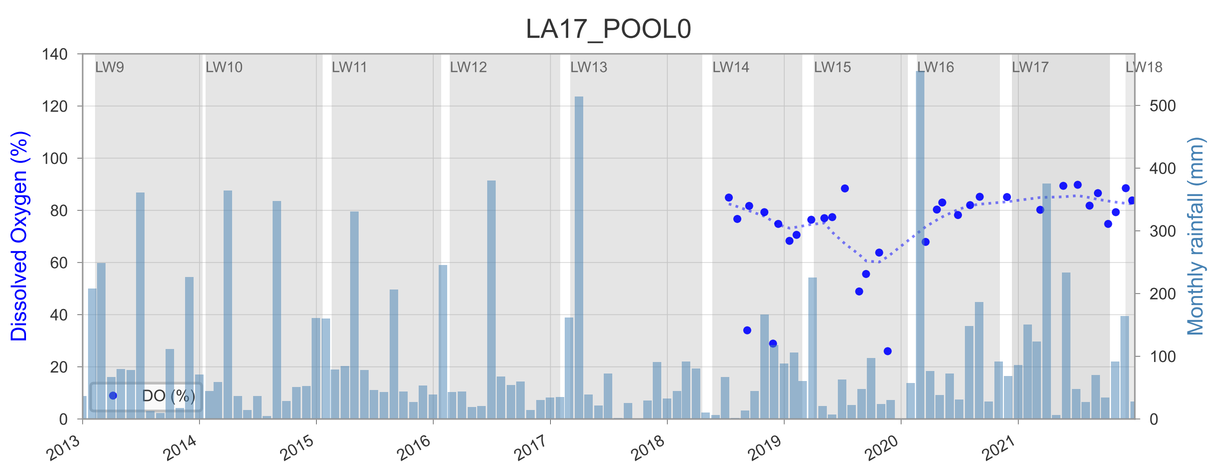

LA13_S1
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
Median (baseline)
P5-P95 pH

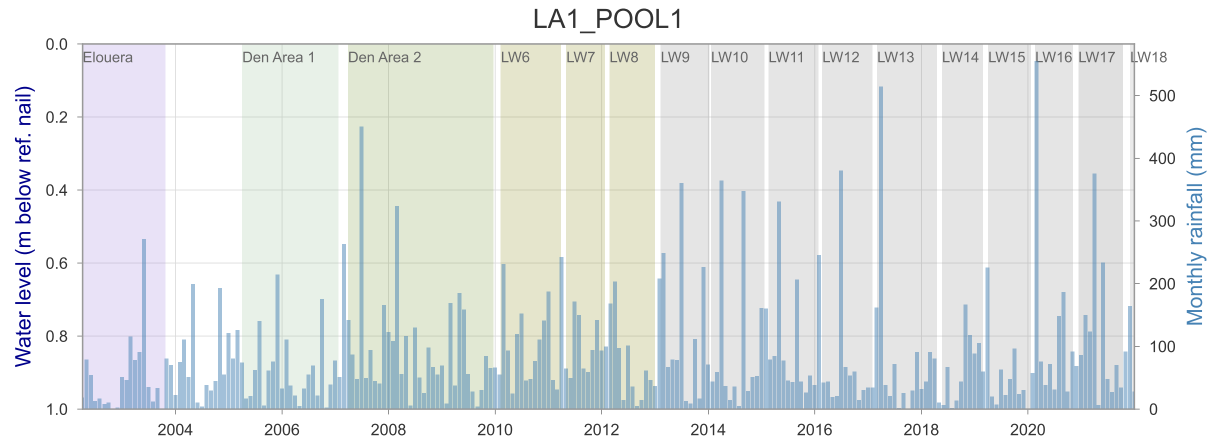

LA13_S1
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
Median (baseline)
P5-P95 DO

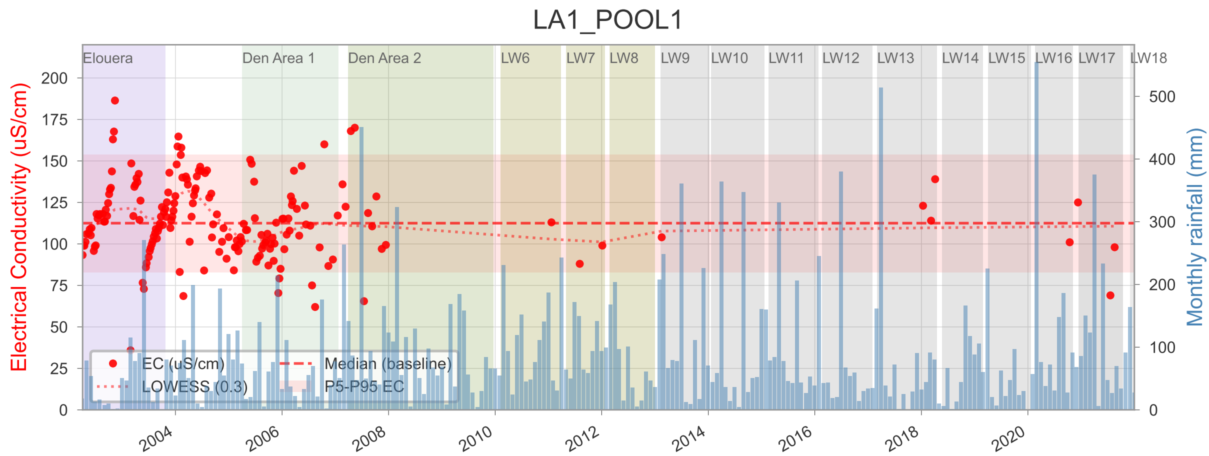

LA17_POOL0
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
P5-P95 WL
Pool bottom
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

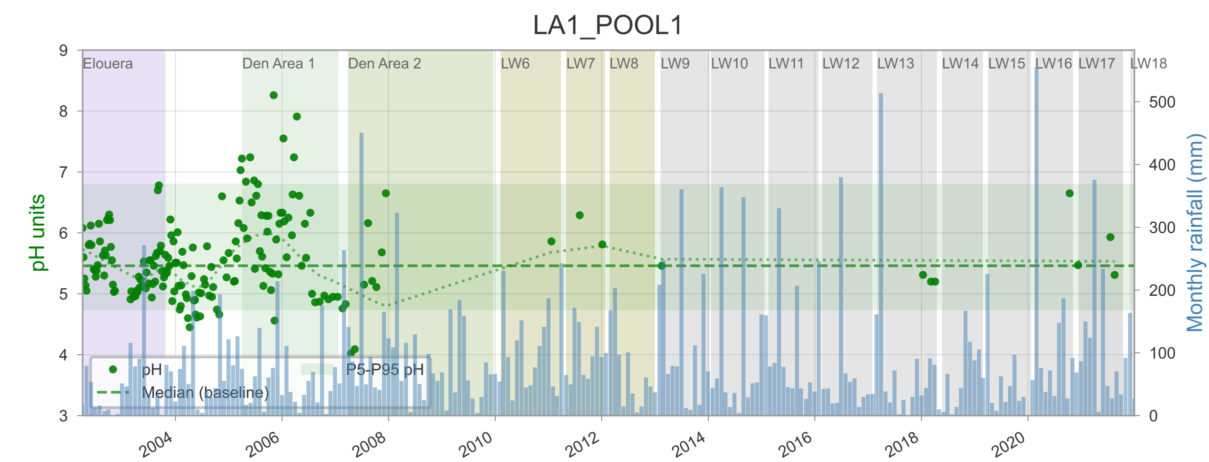

LA17_POOL0
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)

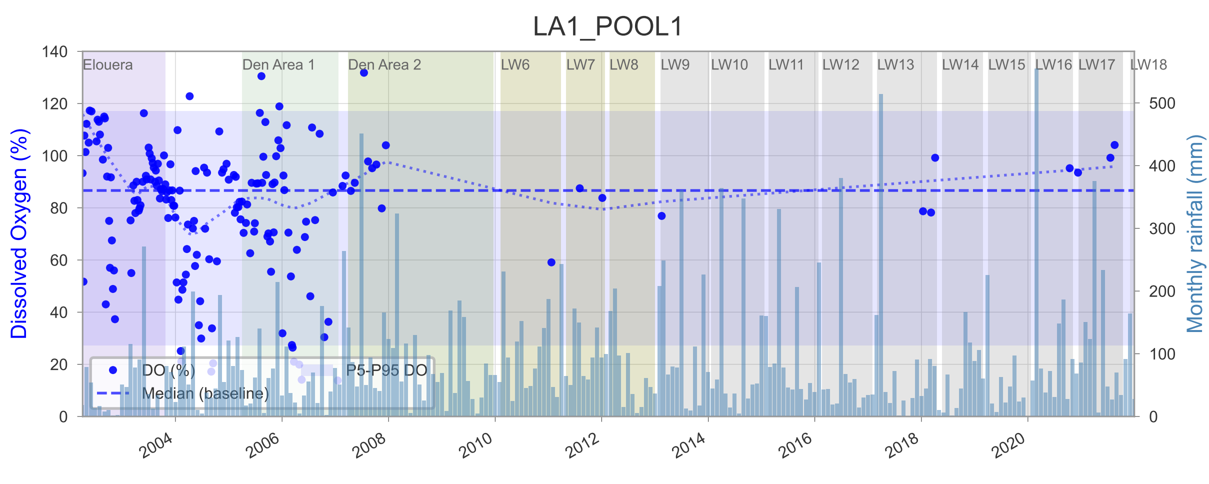

LA17_POOL0
pH units
Monthly rainfall (mm)
pH

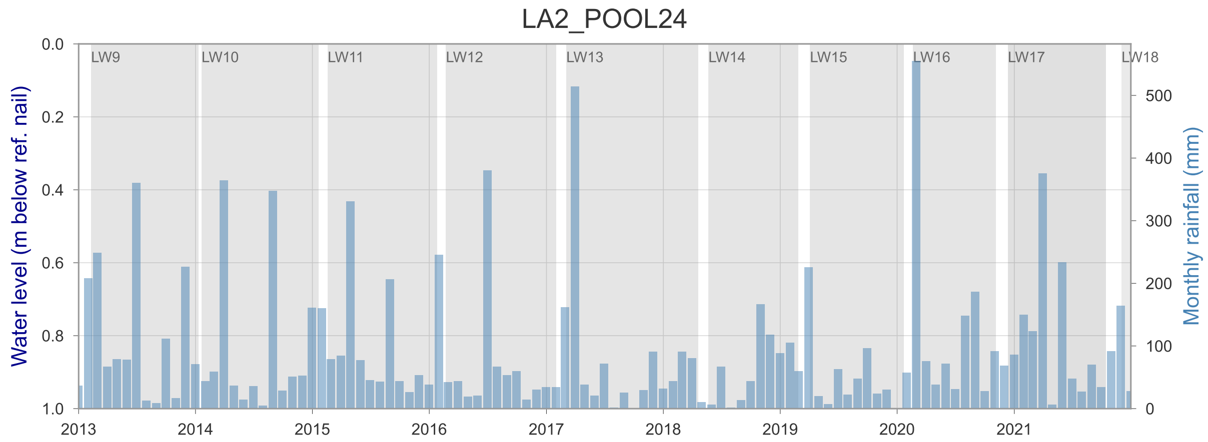

LA17_POOL0
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)

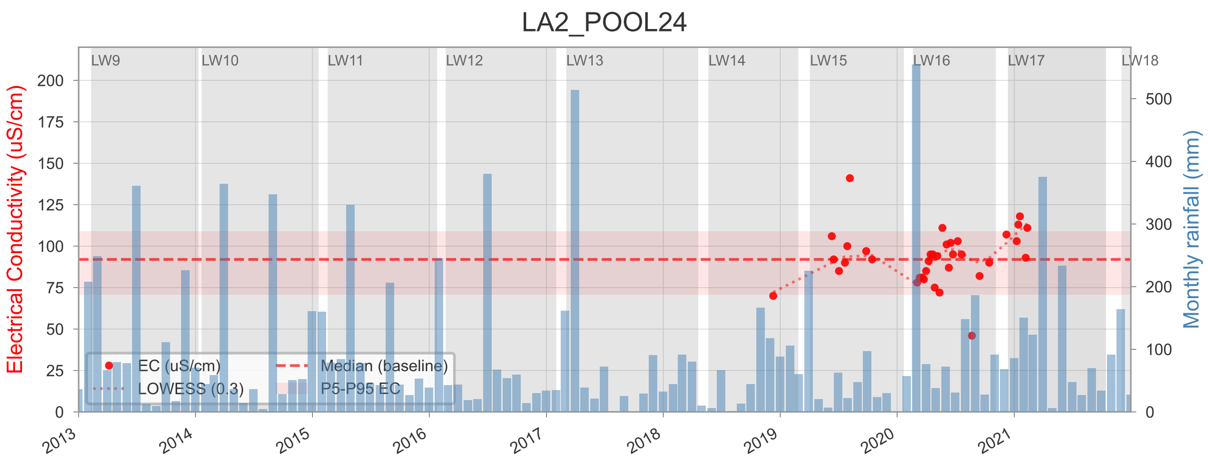

LA1_POOL1
Water level (m below ref. nail)
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

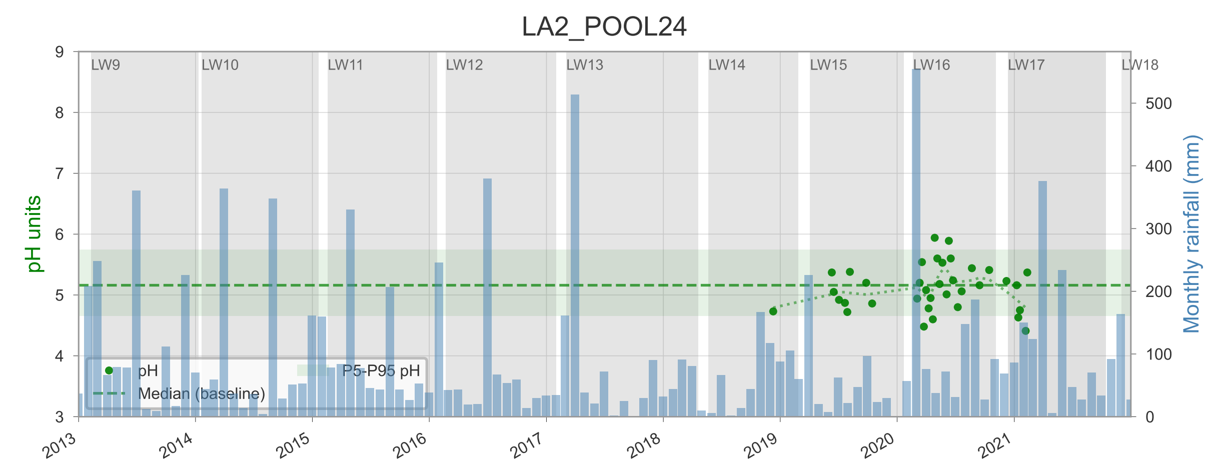

LA1_POOL1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

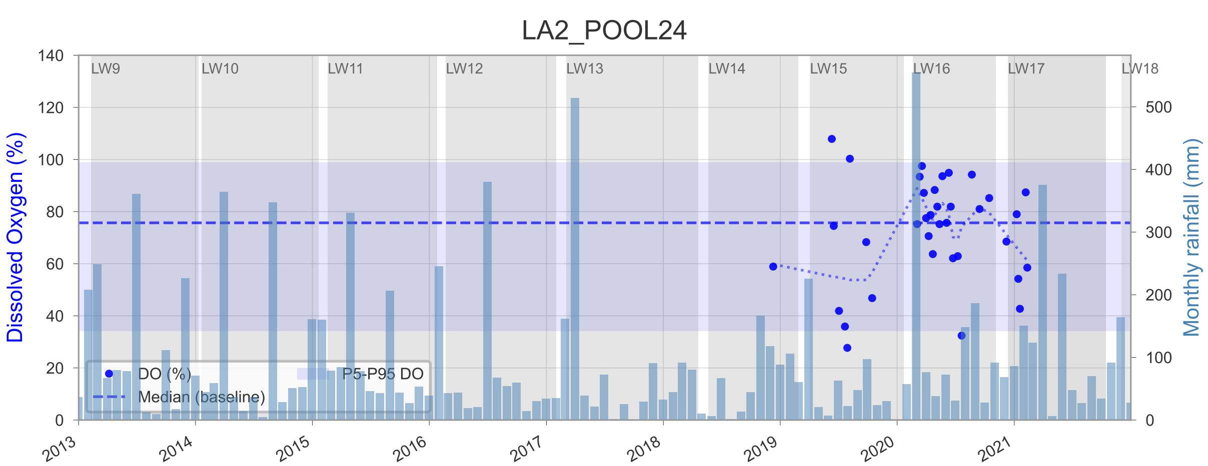

LA1_POOL1
pH units
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
Median (baseline)
P5-P95 pH

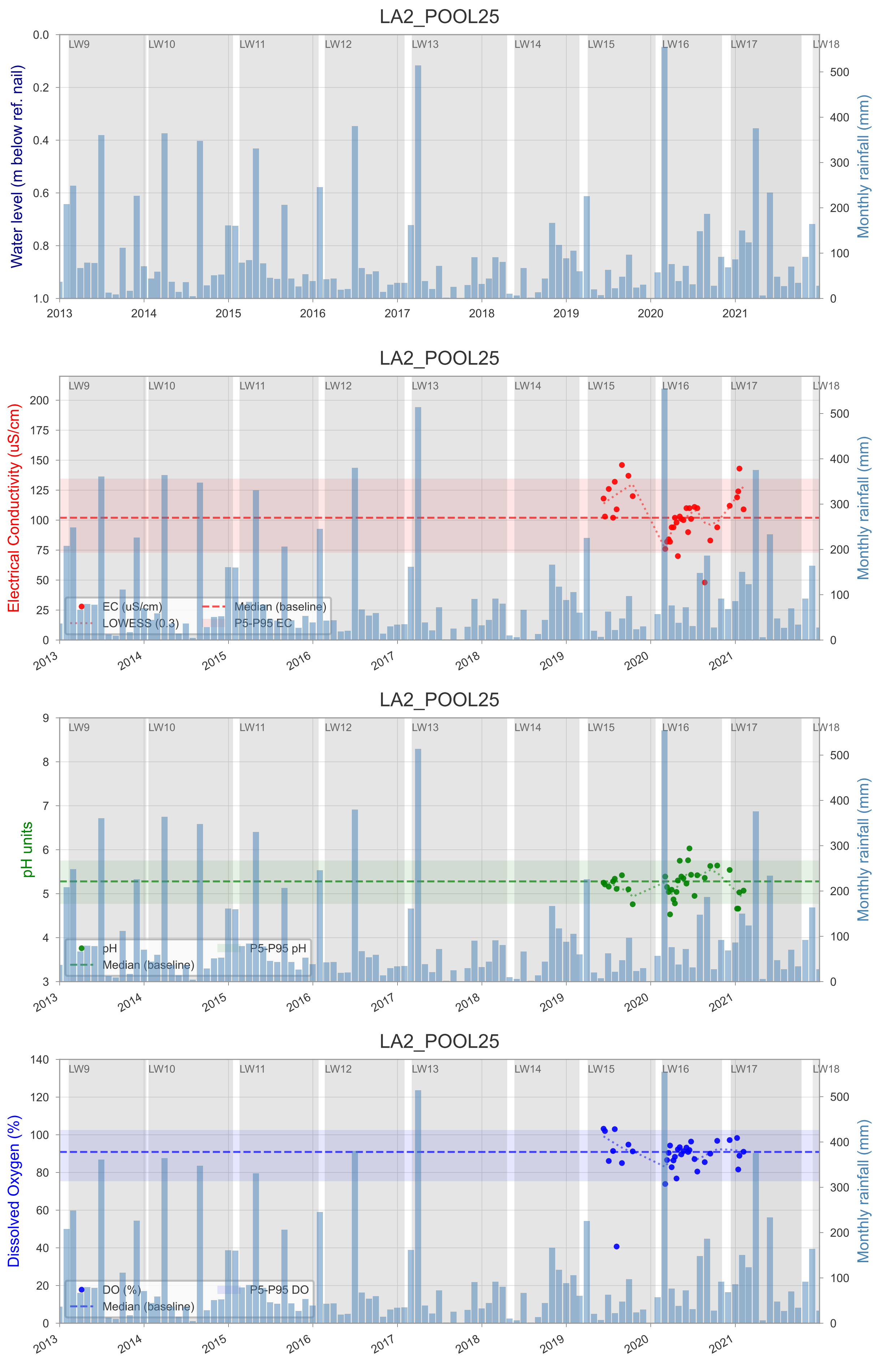

LA1_POOL1
Dissolved Oxygen (%)
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
Median (baseline)
P5-P95 DO


LA2_POOL24
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

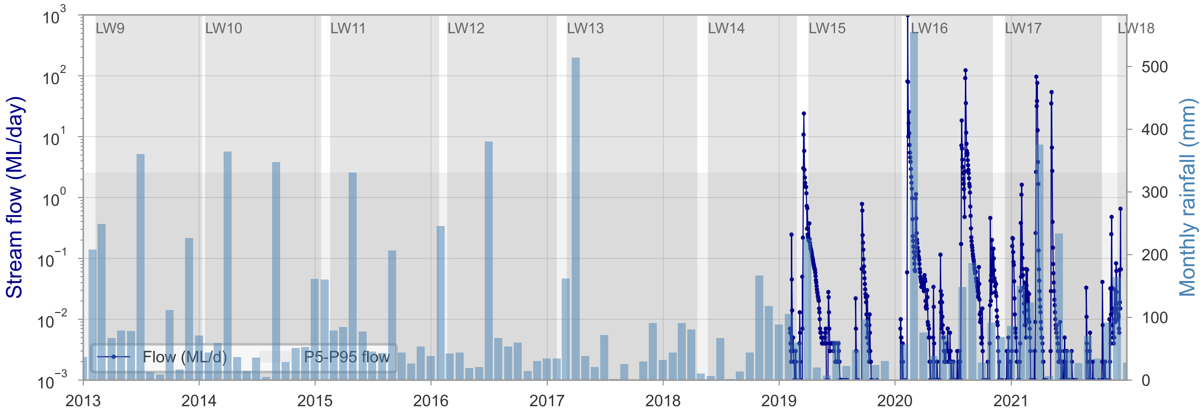

LA2_POOL24
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC


LA2_POOL24
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

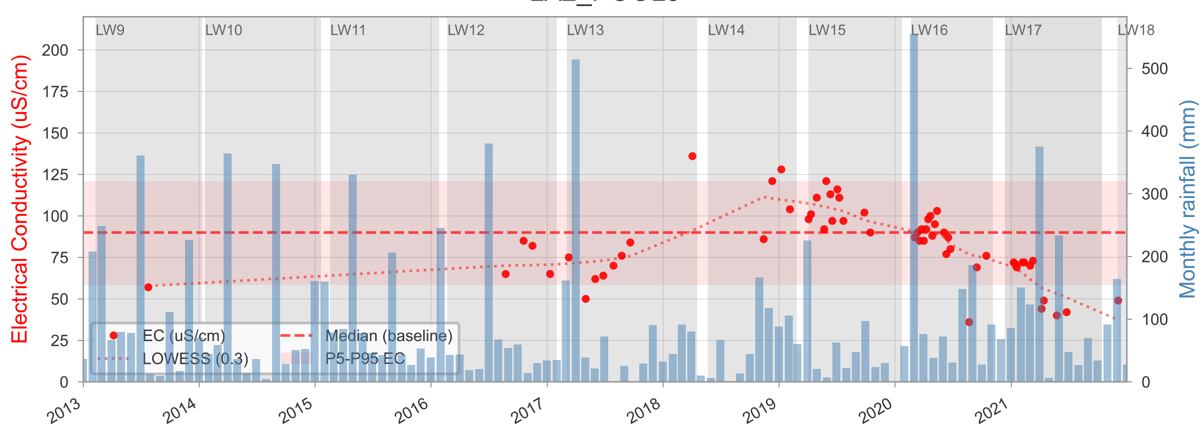

LA2_POOL24
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO


LA2_POOL25
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
LA2_POOL25
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LA2_POOL25
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
LA2_POOL25
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

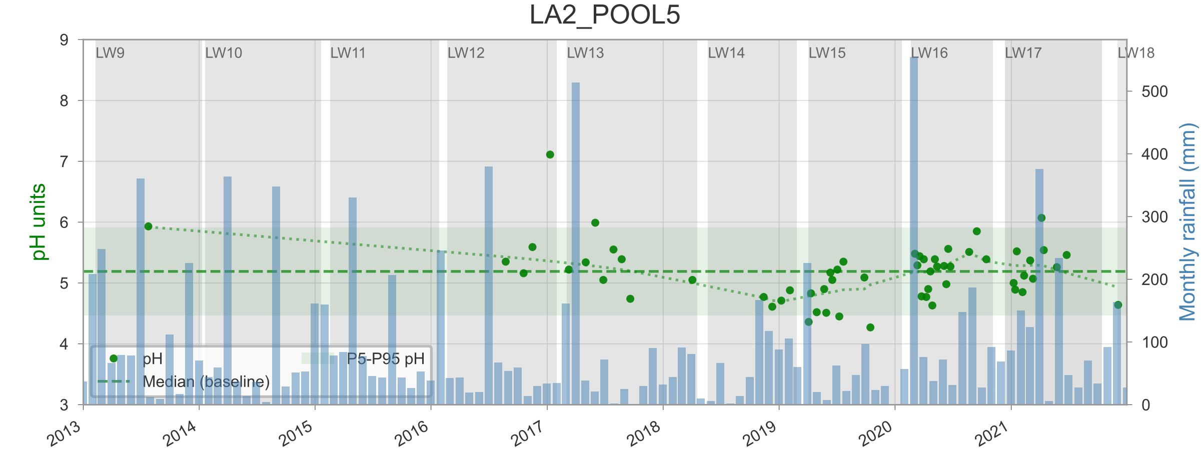
LA2S1



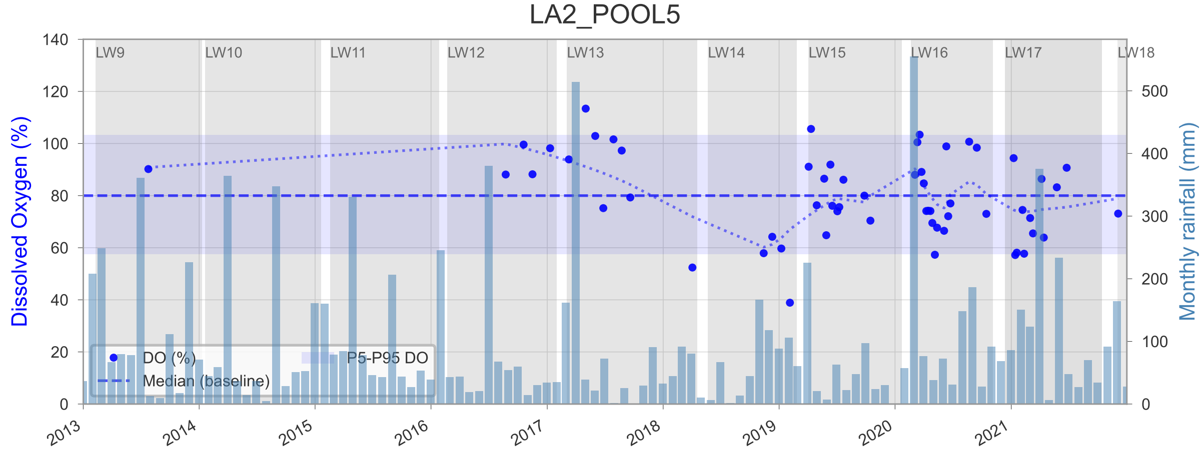
LA2_POOL5

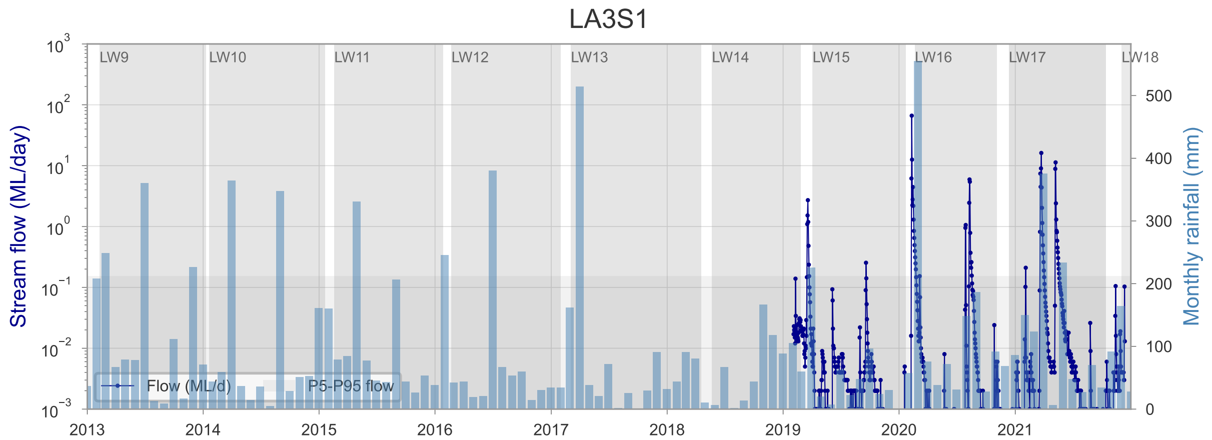


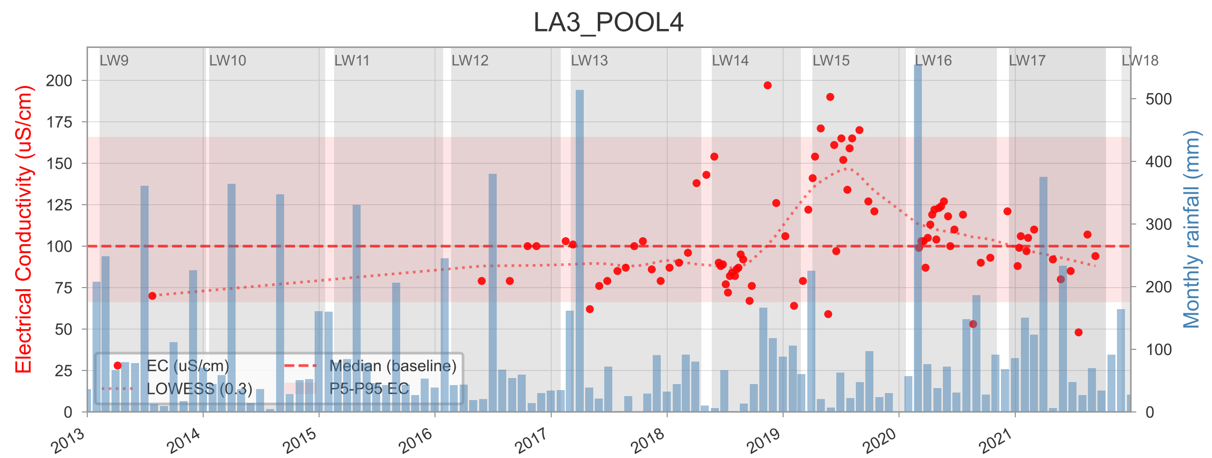
LA2_POOL5

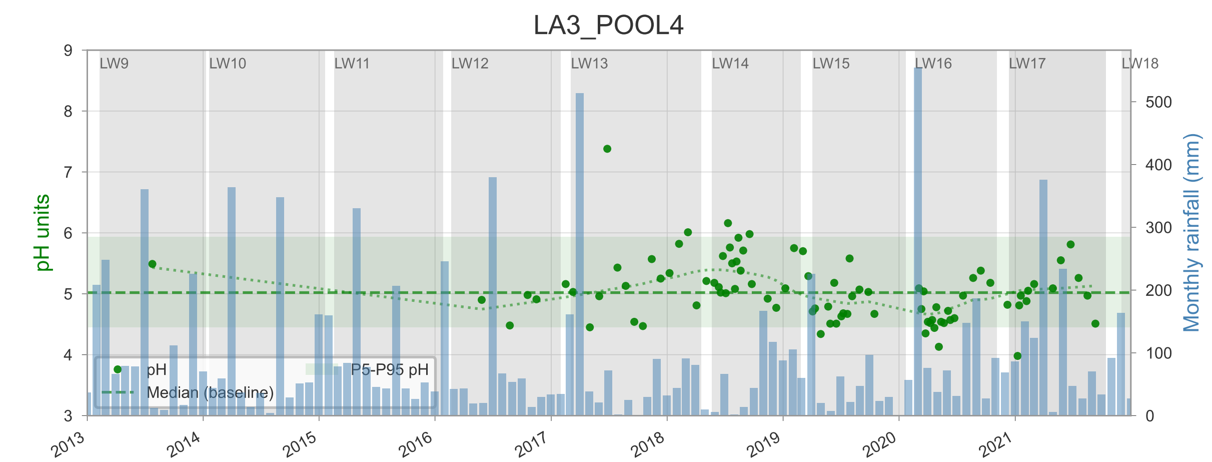


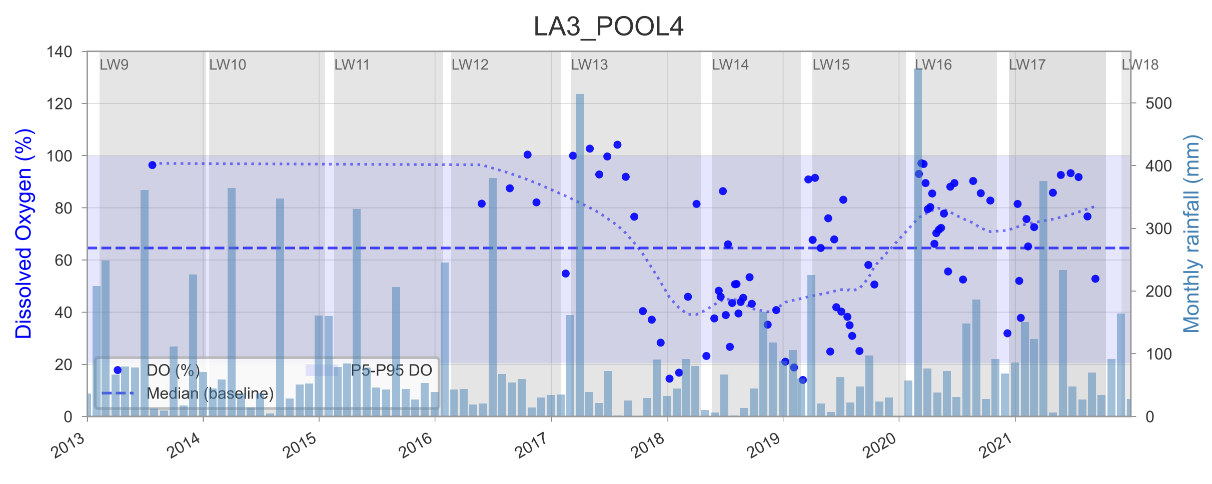
LA2_POOL5

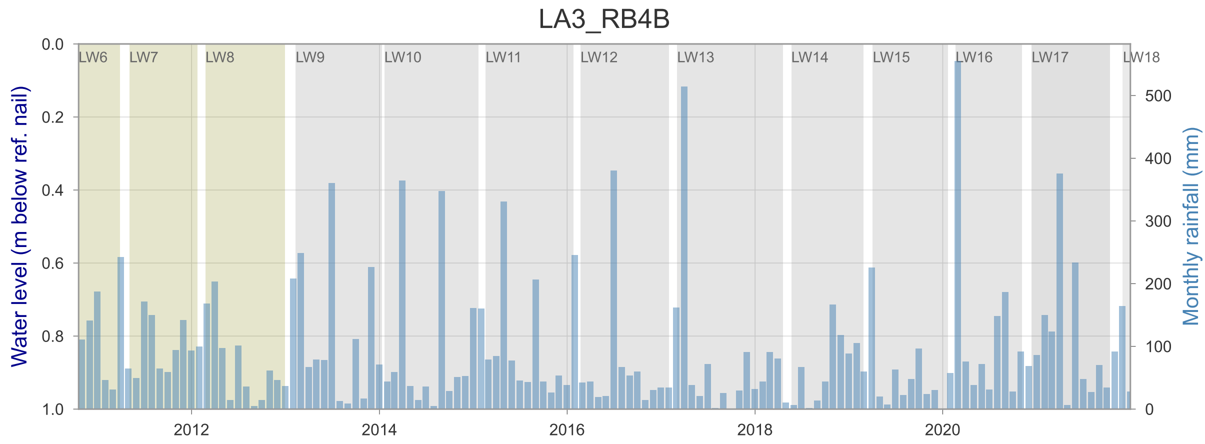


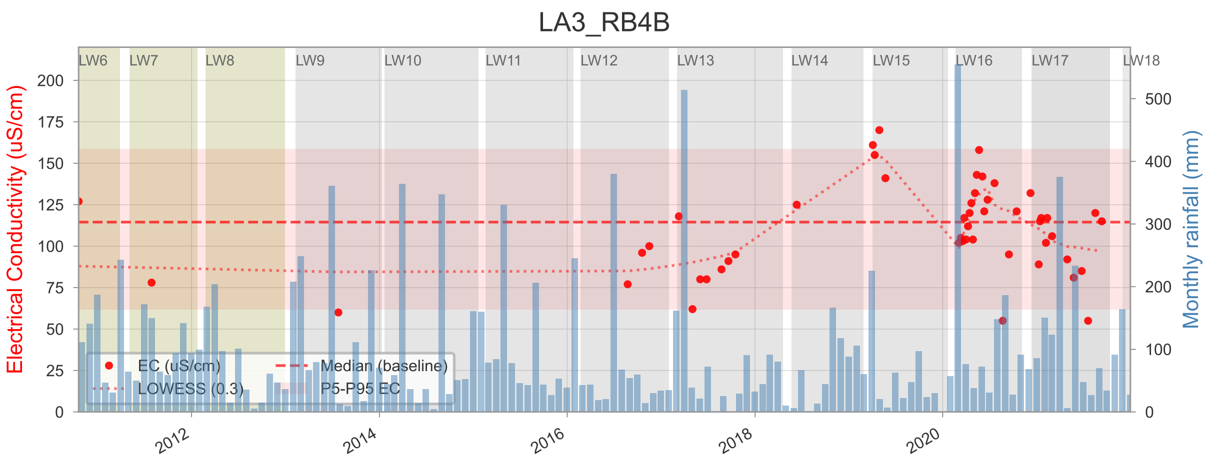

LA3S1
Stream flow (ML/day)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Flow (ML/d)
P5-P95 flow

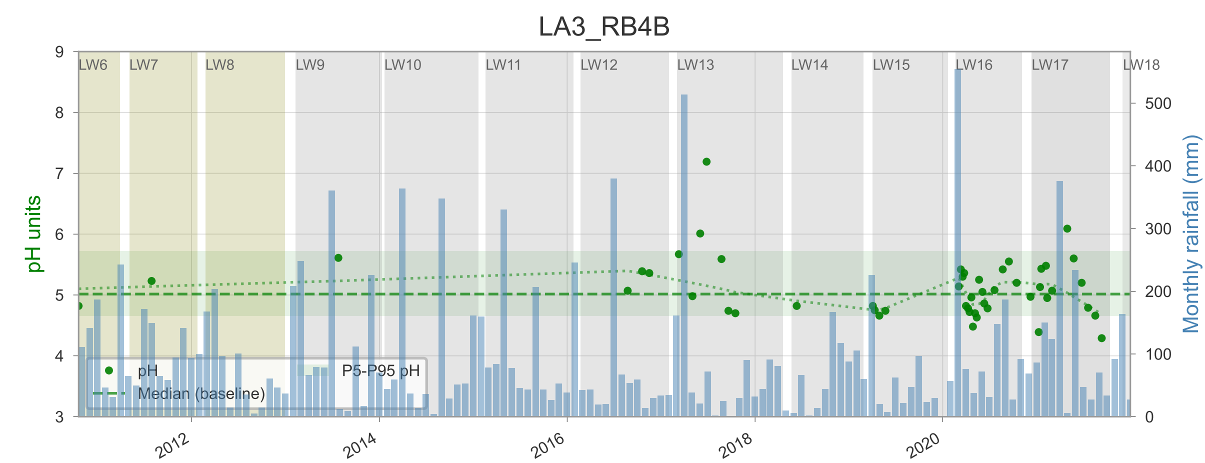

LA3_POOL4
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

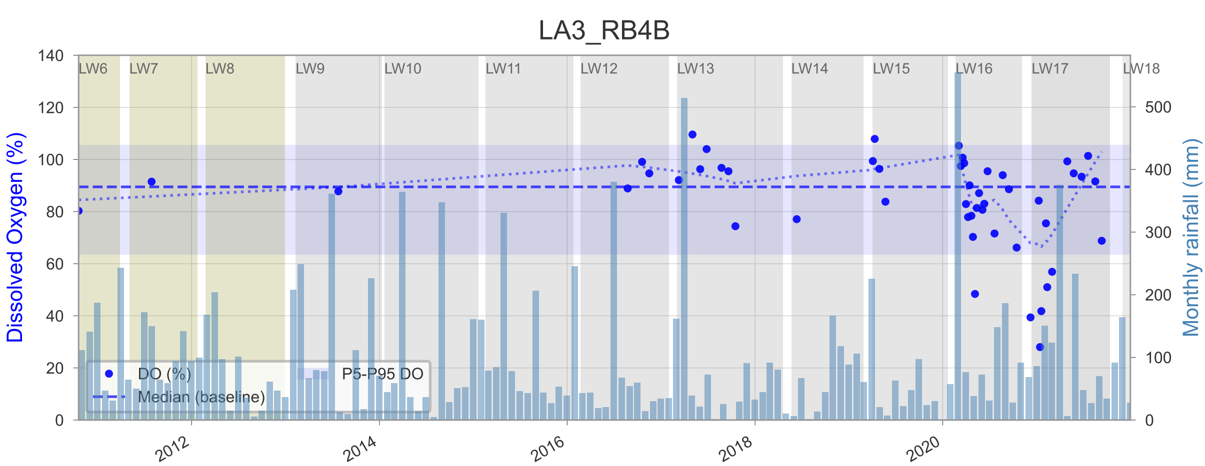

LA3_POOL4
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
Median (baseline)
P5-P95 pH

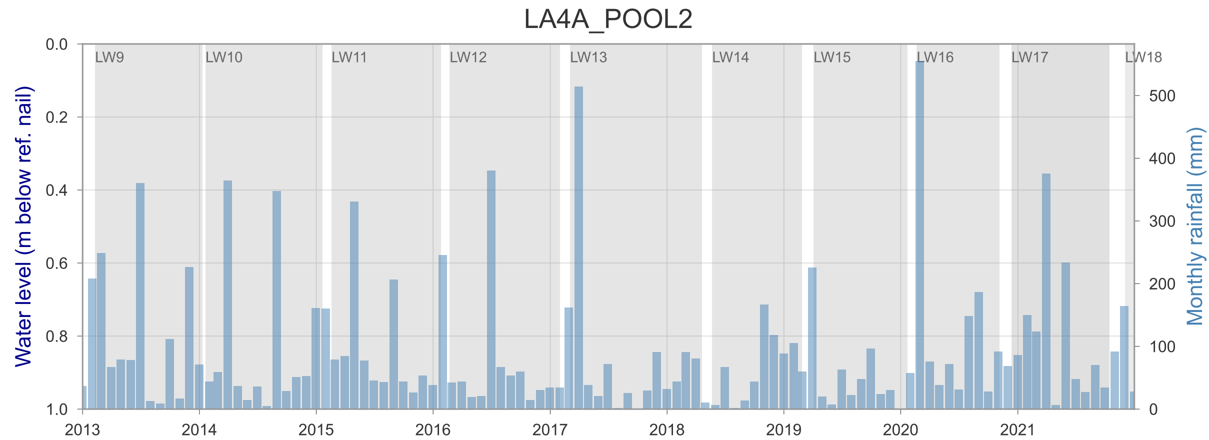

LA3_POOL4
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
Median (baseline)
P5-P95 DO

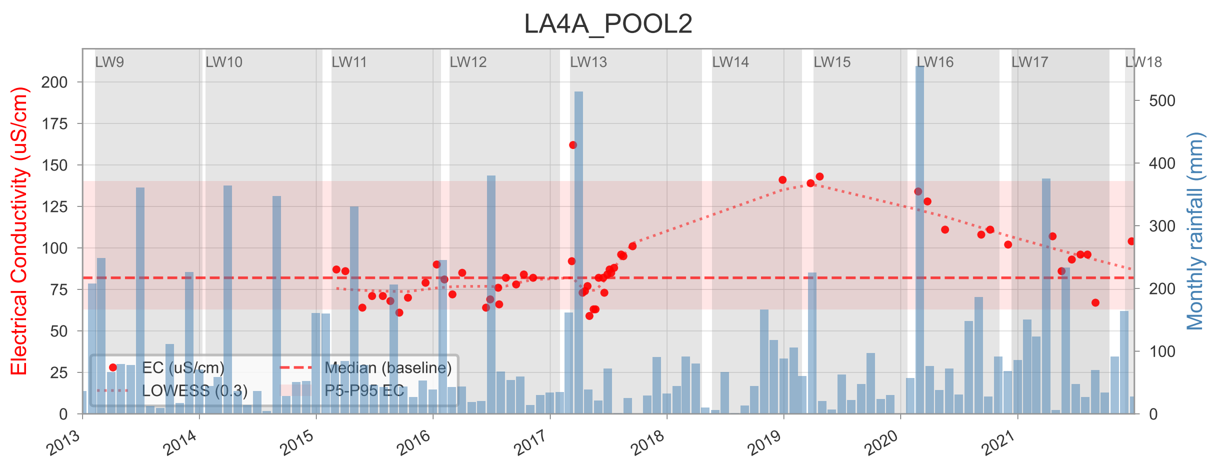

LA3_RB4B
Water level (m below ref. nail)
Monthly rainfall (mm)
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2012
2014
2016
2018
2020

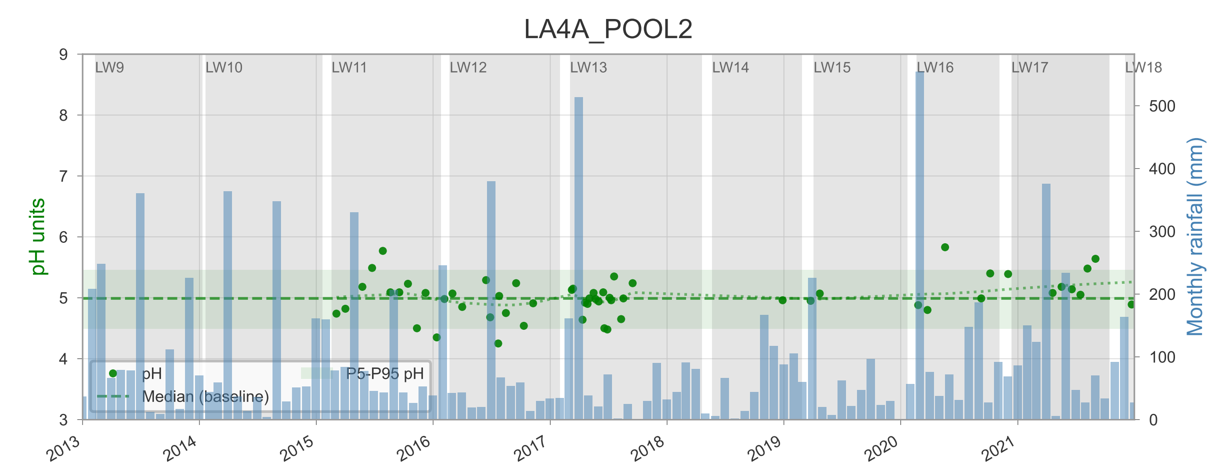

LA3_RB4B
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
2012
2014
2016
2018
2020

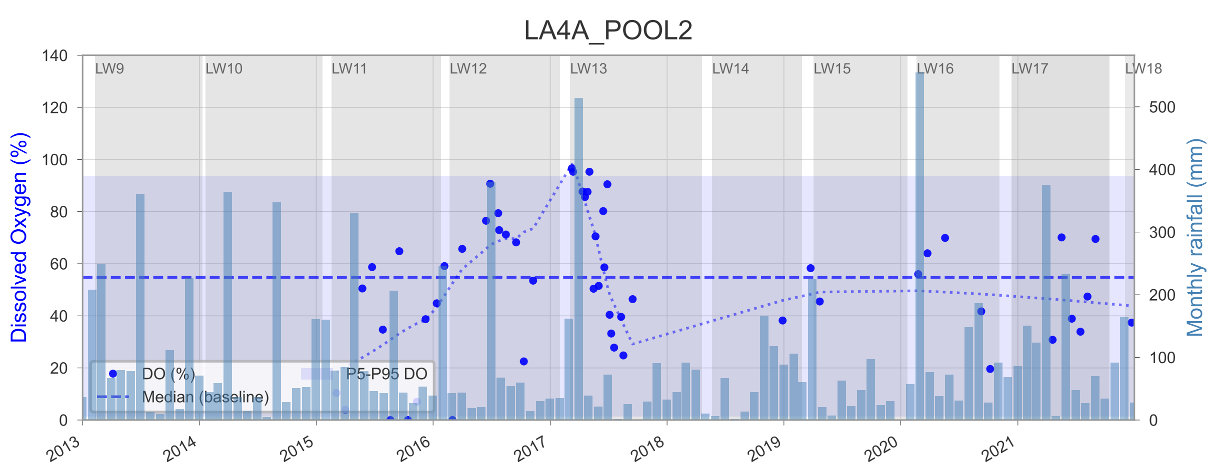

LA3_RB4B
pH units
Monthly rainfall (mm)
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
Median (baseline)
P5-P95 pH
2012
2014
2016
2018
2020


LA3_RB4B
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
Median (baseline)
P5-P95 DO
2012
2014
2016
2018
2020

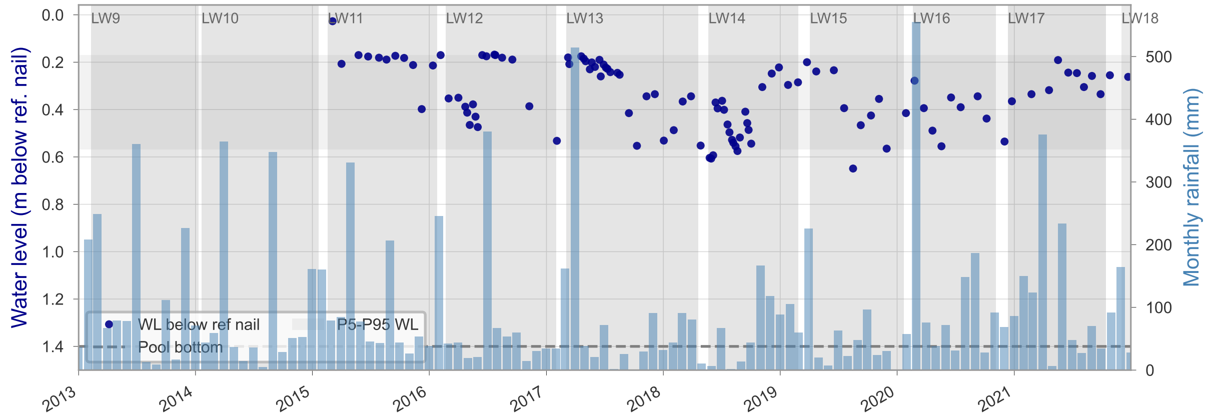

LA4A_POOL2
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Water level (m below ref. nail)
Monthly rainfall (mm)
0.0
0.2
0.4
0.6
0.8
1.0
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021


LA4A_POOL2
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

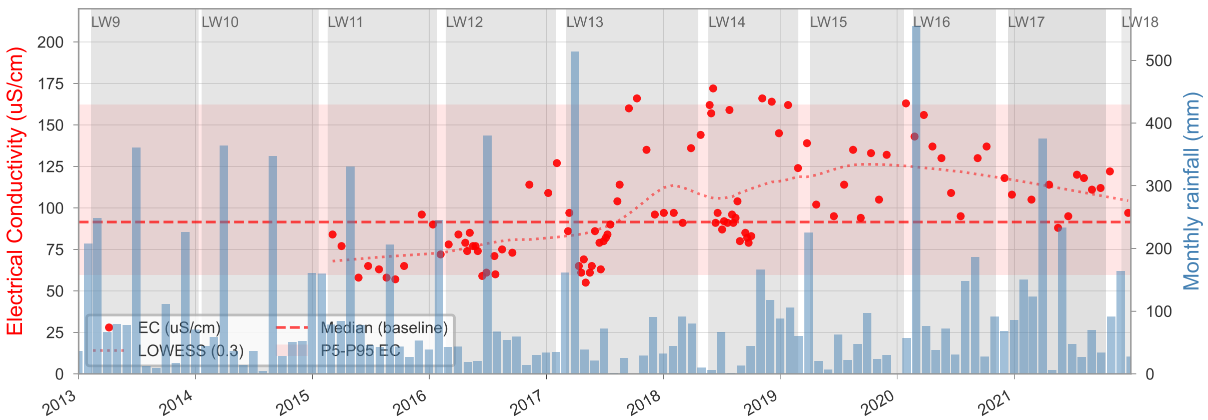

LA4A_POOL2
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
3
4
5
6
7
8
9
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021


LA4A_POOL2
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

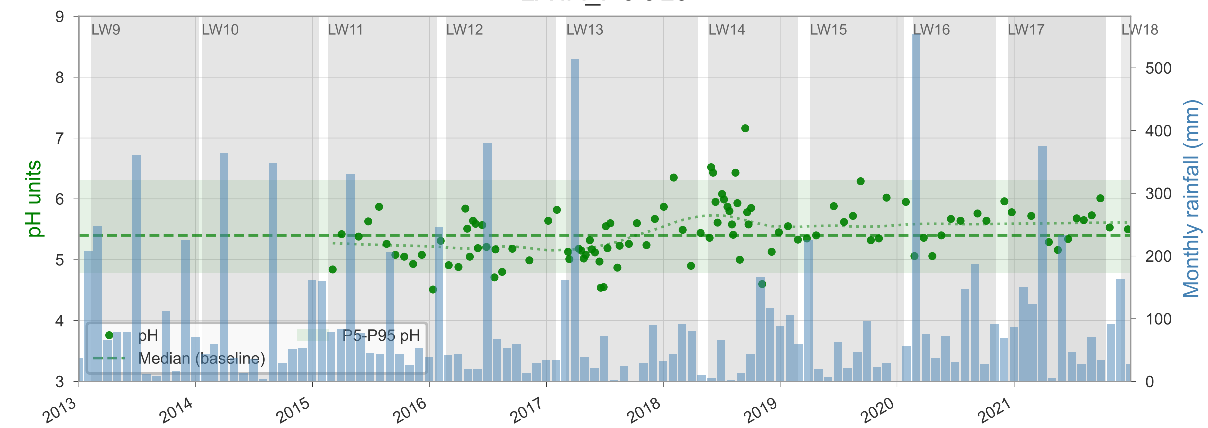
LA4A_POOL3



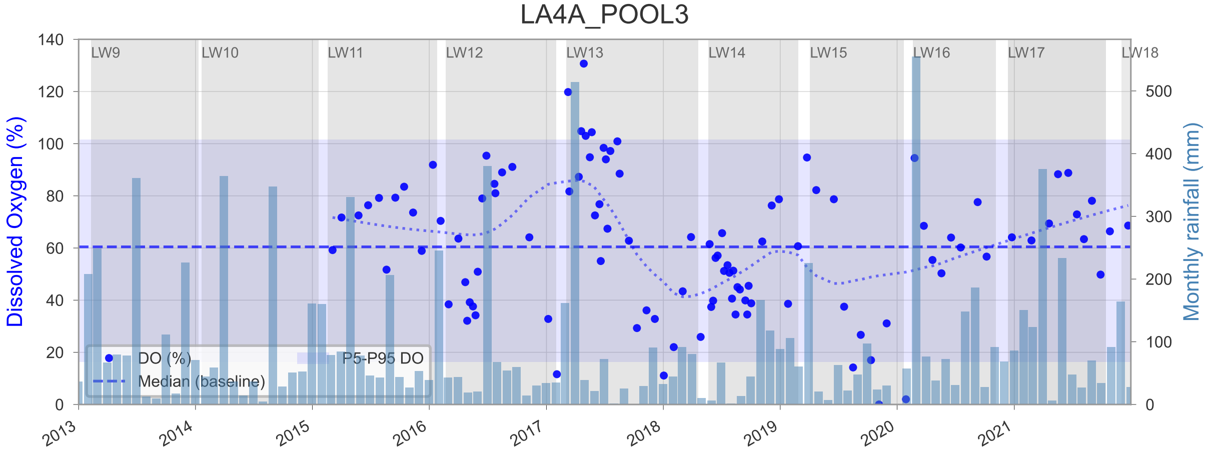
LA4A_POOL3

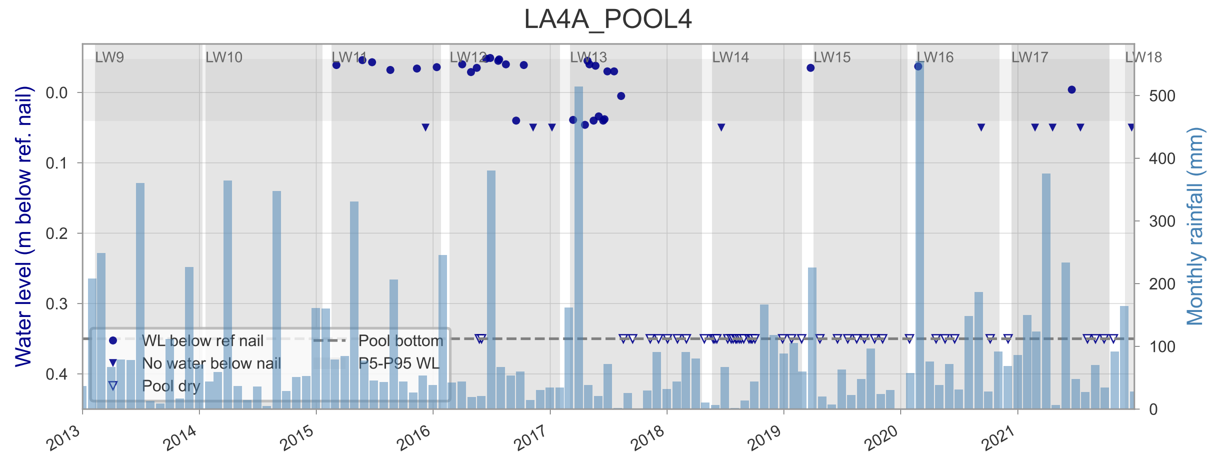


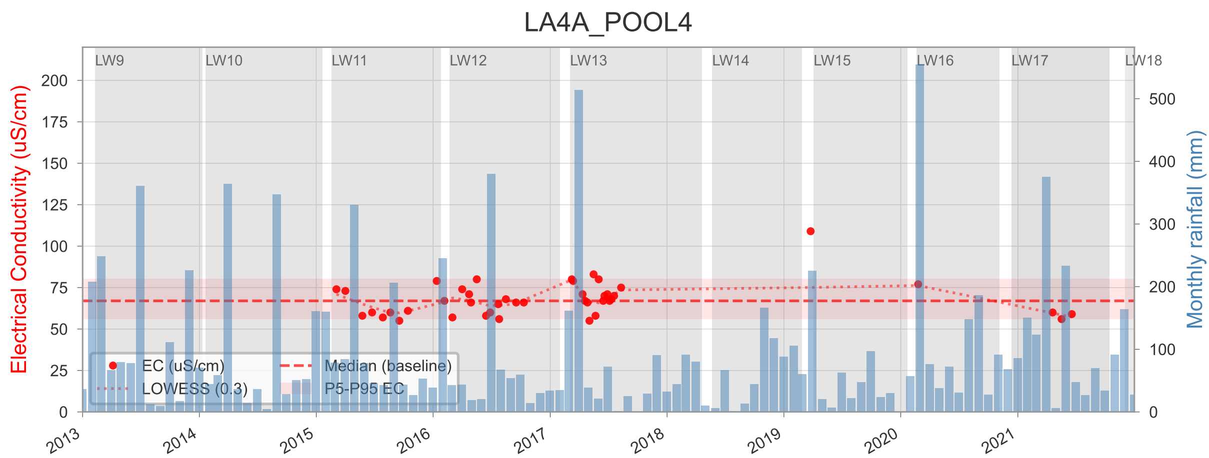
LA4A_POOL3

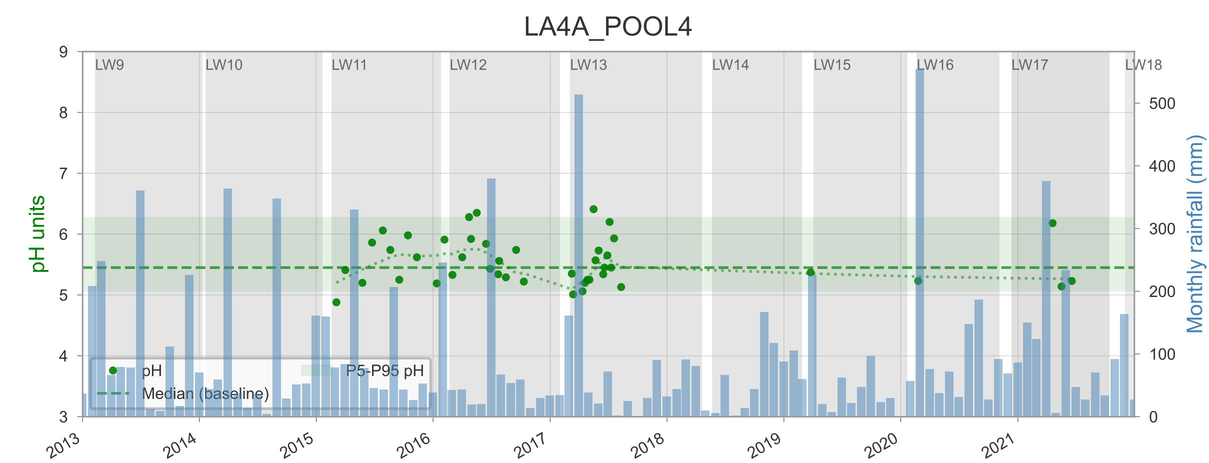


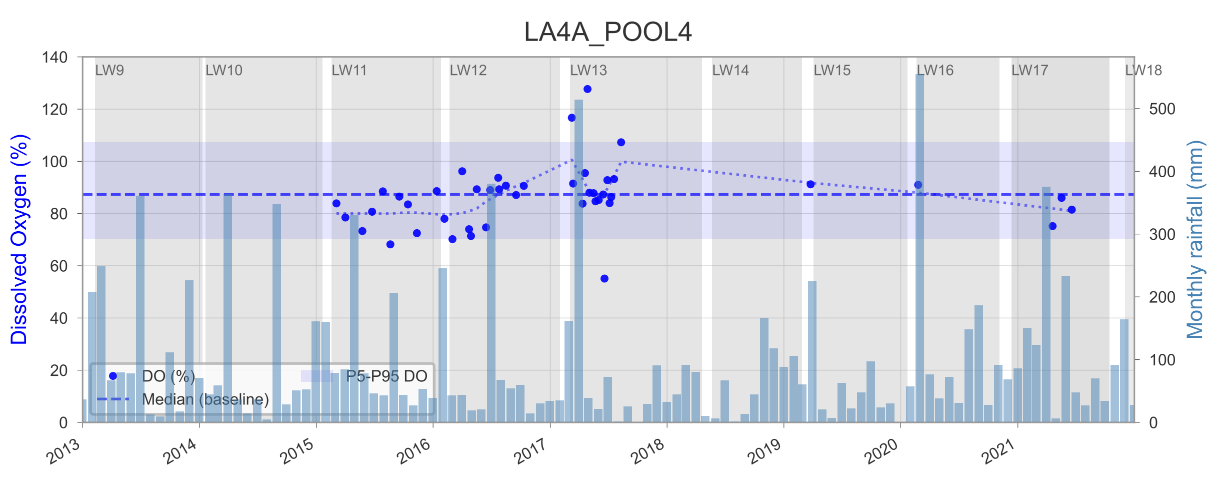
LA4A_POOL3

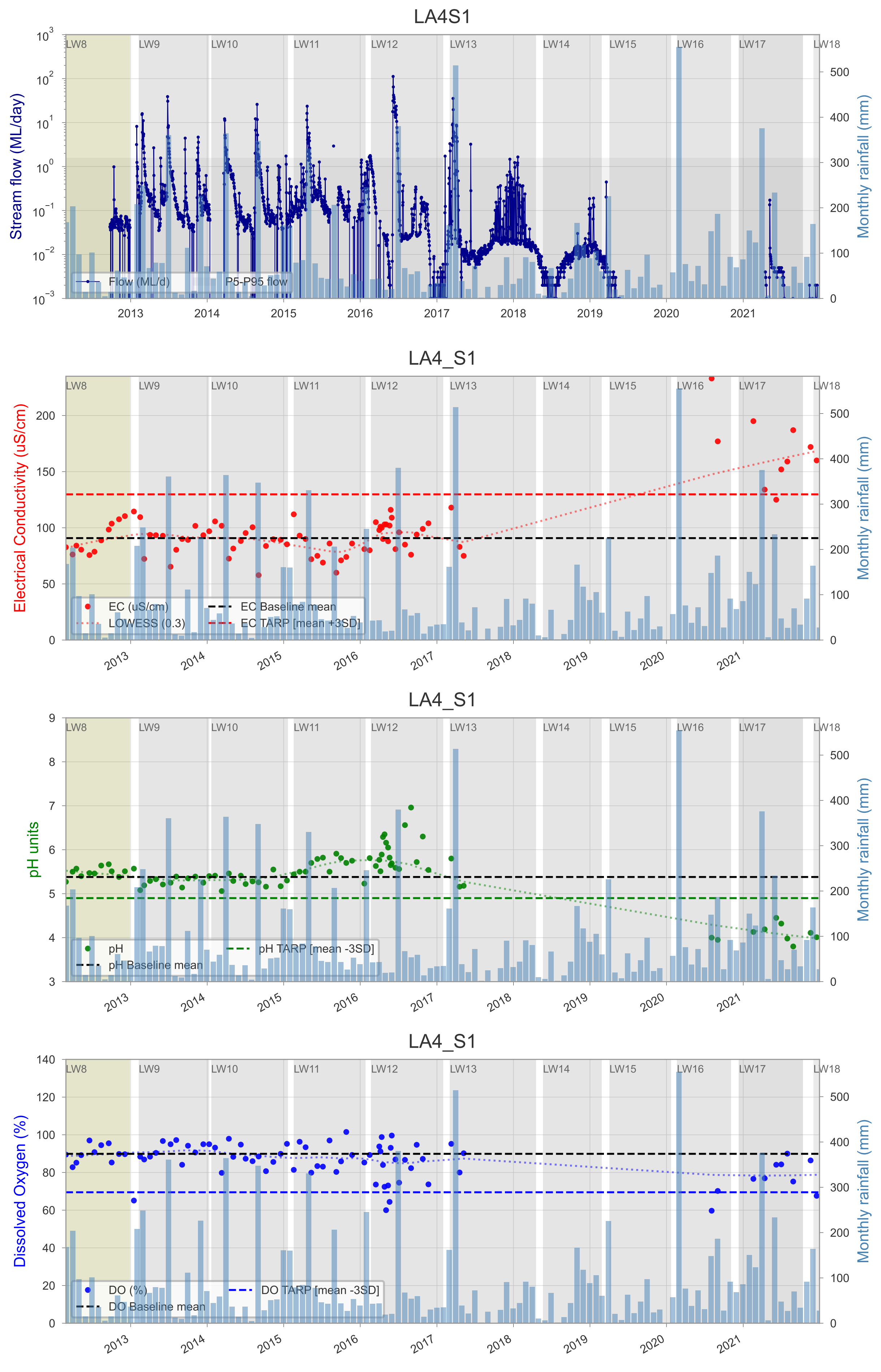


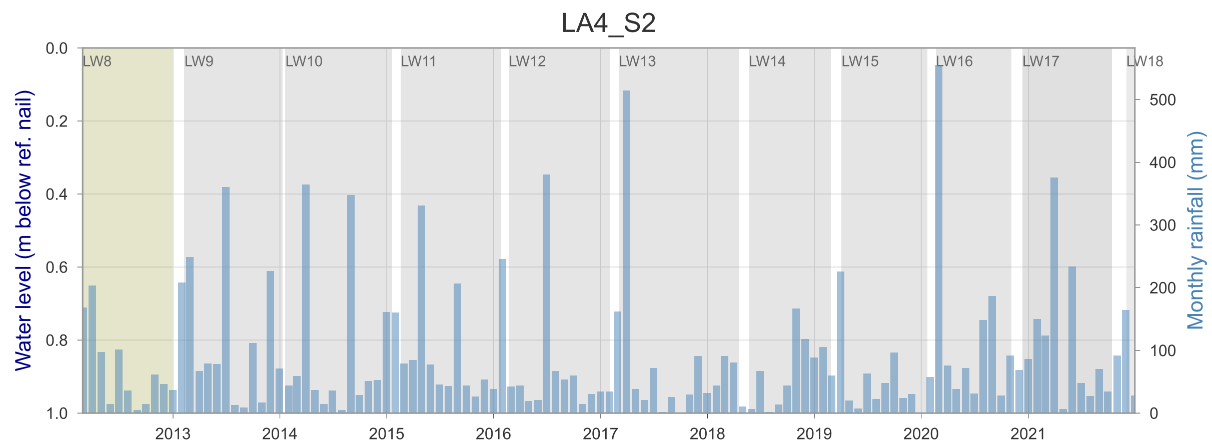

LA4A_POOL4
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL

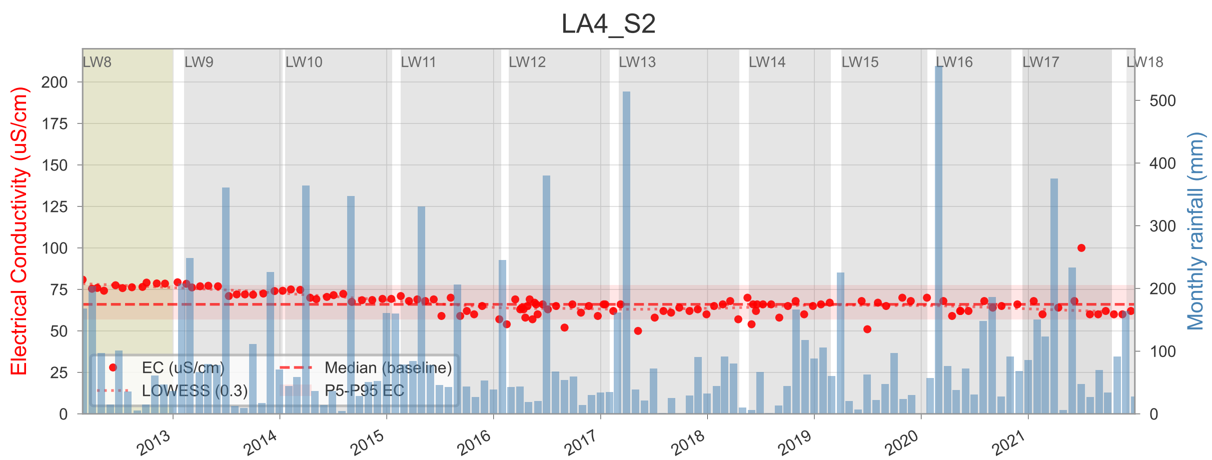

LA4A_POOL4
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

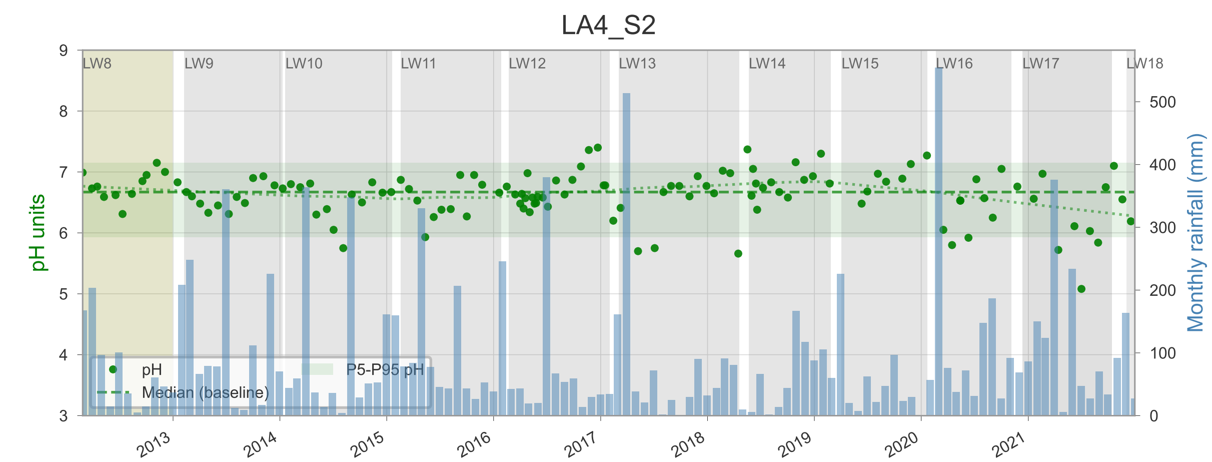

LA4A_POOL4
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
Median (baseline)
P5-P95 pH

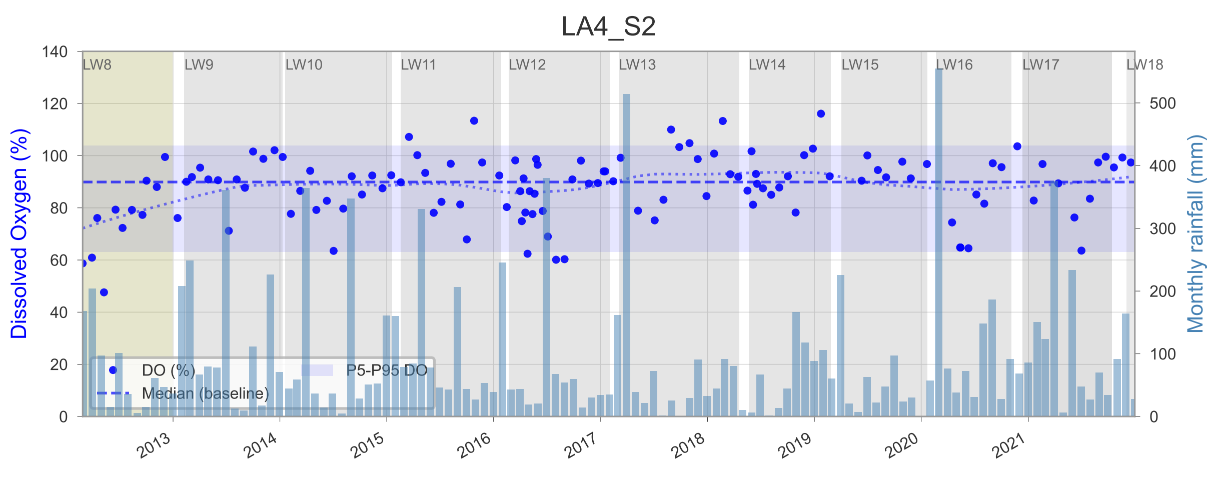

LA4A_POOL4
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
Median (baseline)
P5-P95 DO

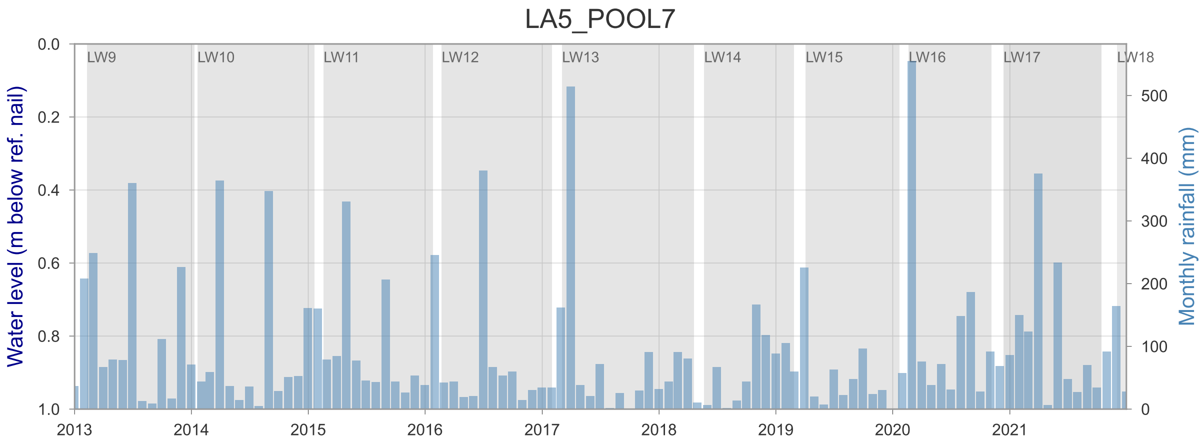

LA4S1
Stream flow (ML/day)
Monthly rainfall (mm)
Flow (ML/d)
P5-P95 flow
LA4_S1
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
EC Baseline mean
EC TARP [mean +3SD]
LA4_S1
pH units
pH
pH Baseline mean
pH TARP [mean -3SD]
LA4_S1
Dissolved Oxygen (%)
DO (%)
DO Baseline mean
DO TARP [mean -3SD]
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

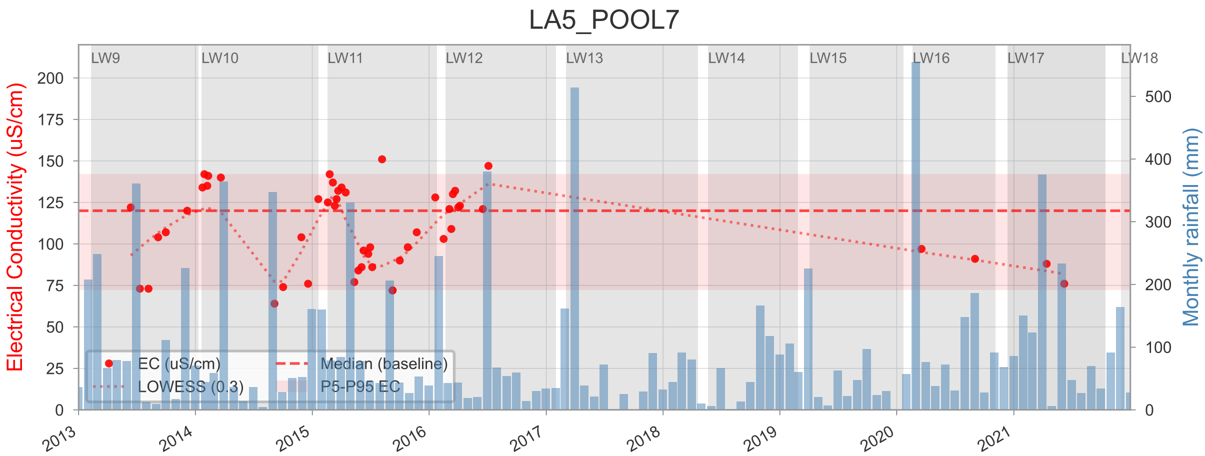

LA4_S2
Water level (m below ref. nail)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

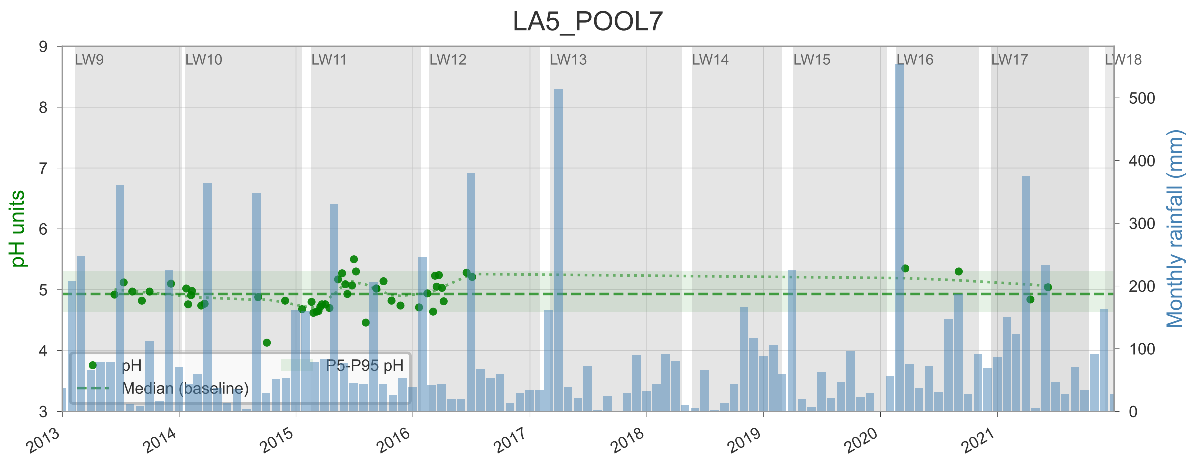

LA4_S2
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

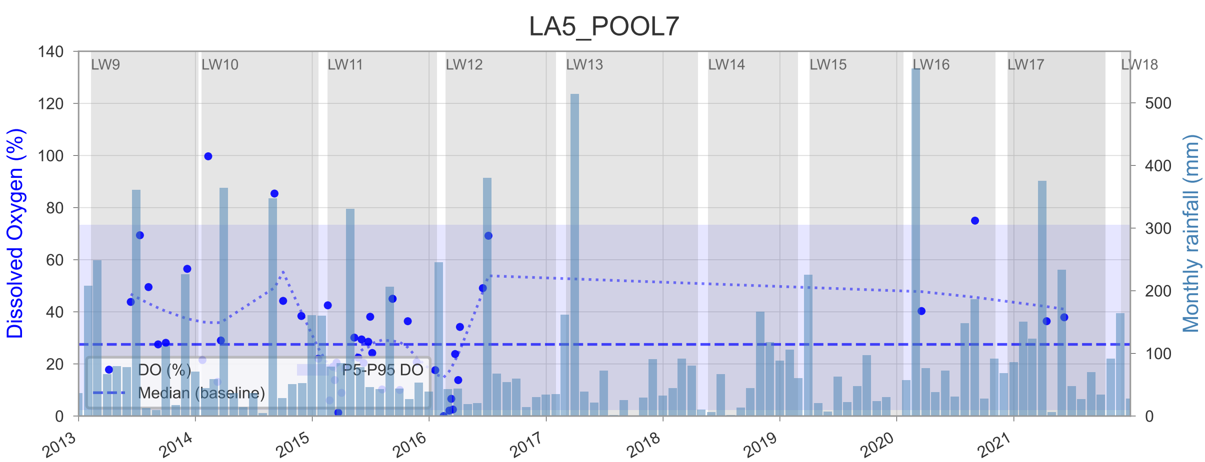

LA4_S2
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH


LA4_S2
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

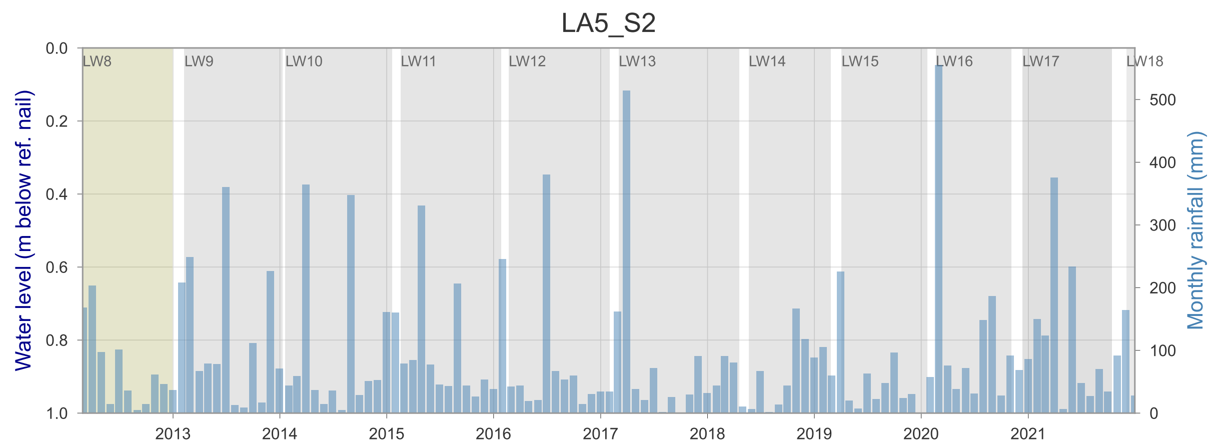

LA5_POOL7
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Water level (m below ref. nail)
Monthly rainfall (mm)

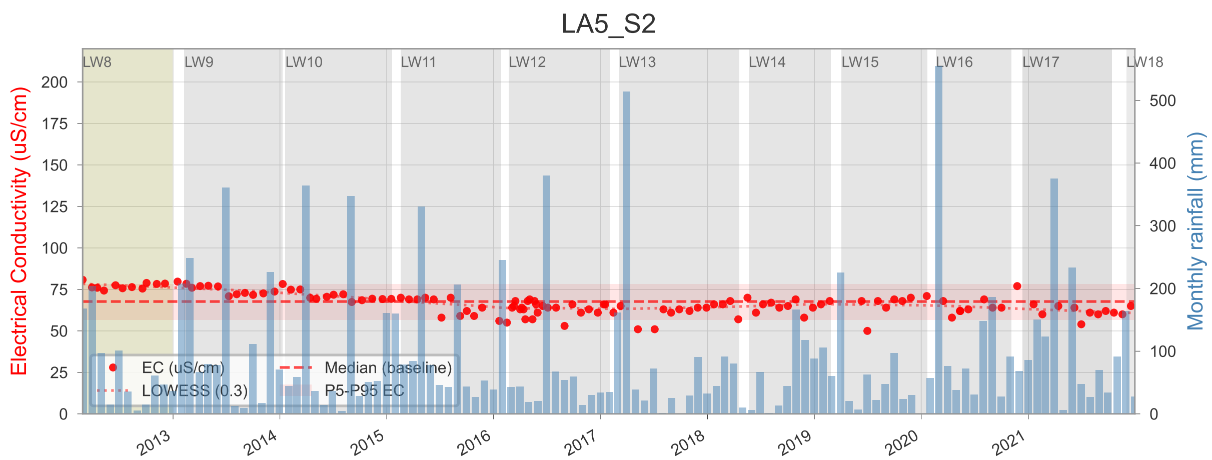

LA5_POOL7
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

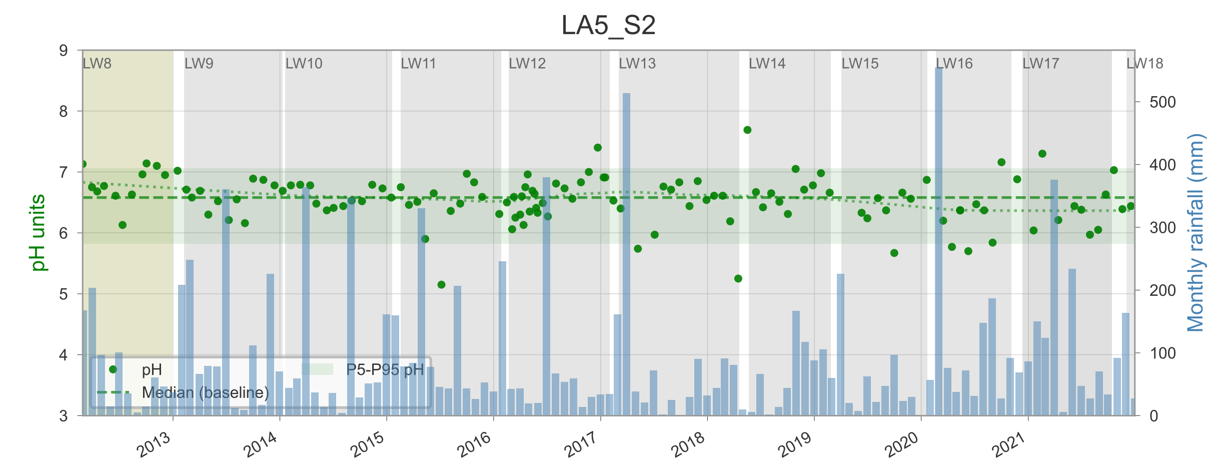

LA5_POOL7
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

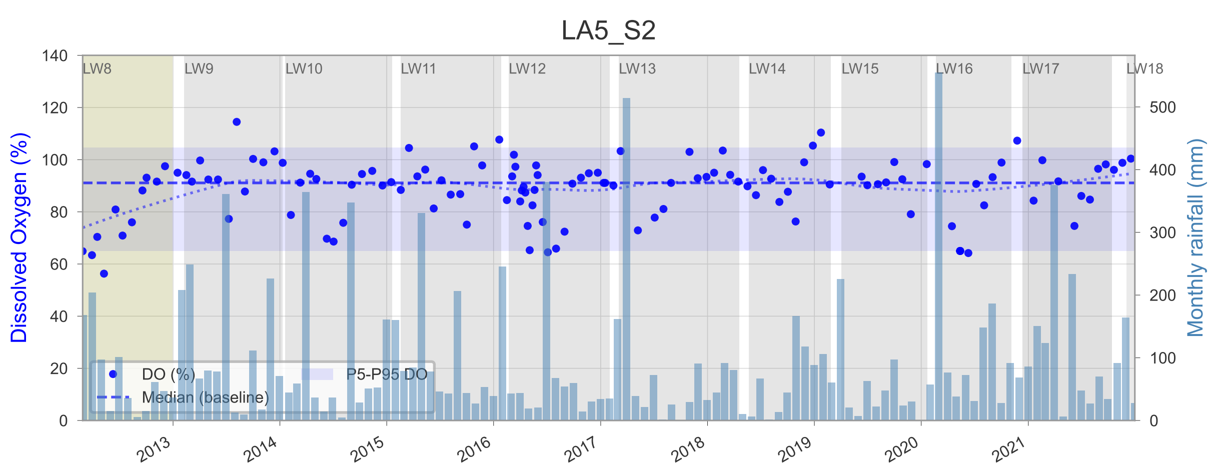

LA5_POOL7
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

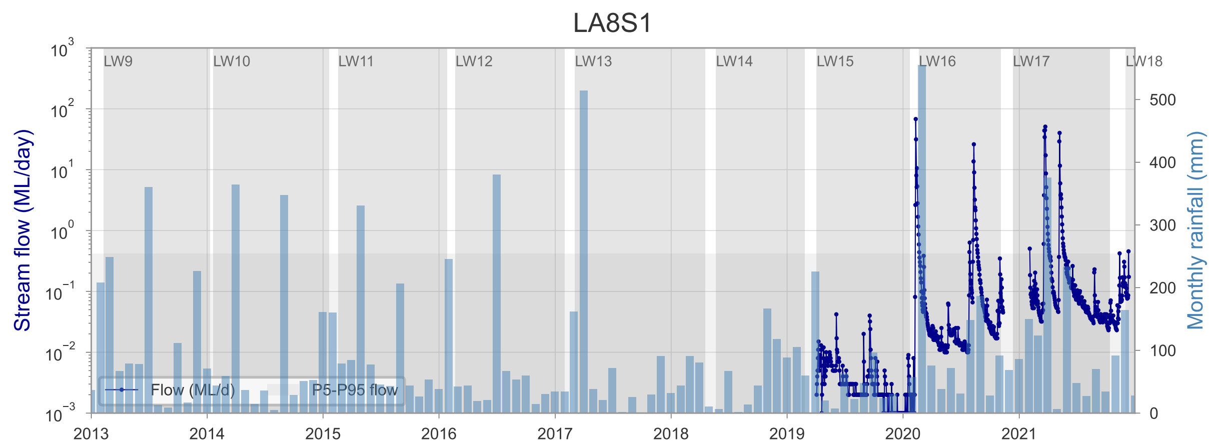

LA5_S1
Water level (m below ref. nail)
Monthly rainfall (mm)
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
pH units
pH
P5-P95 pH
Dissolved Oxygen (%)
DO (%)
P5-P95 DO
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021


LA5_S2
Water level (m below ref. nail)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
0.0
0.2
0.4
0.6
0.8
1.0
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

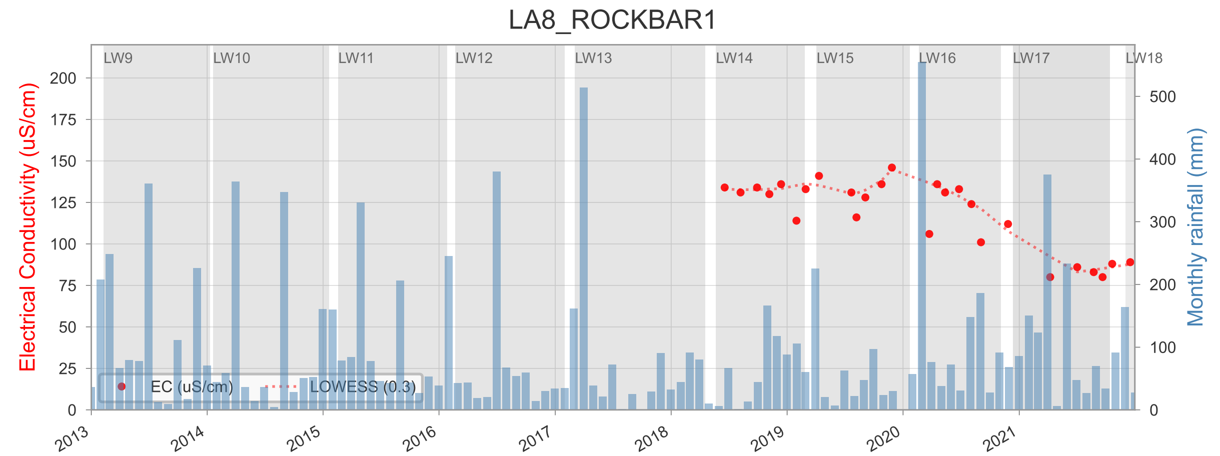

LA5_S2
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021


LA5_S2
pH units
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
Median (baseline)
P5-P95 pH
3
4
5
6
7
8
9
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

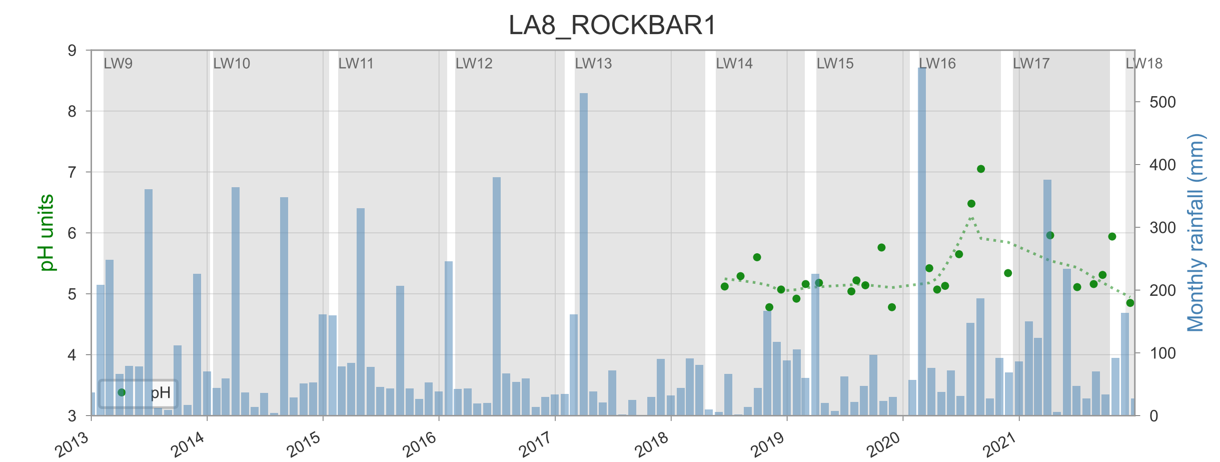

LA5_S2
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
Median (baseline)
P5-P95 DO
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021



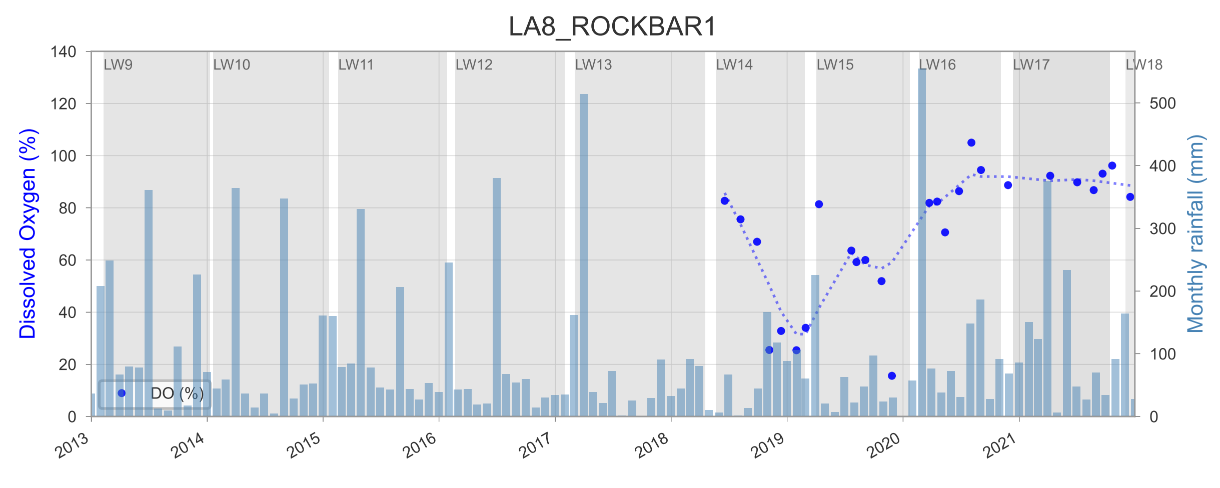
LA8S1
Stream flow (ML/day)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Flow (ML/d)
P5-P95 flow
2013
2014
2015
2016
2017
2018
2019
2020
2021



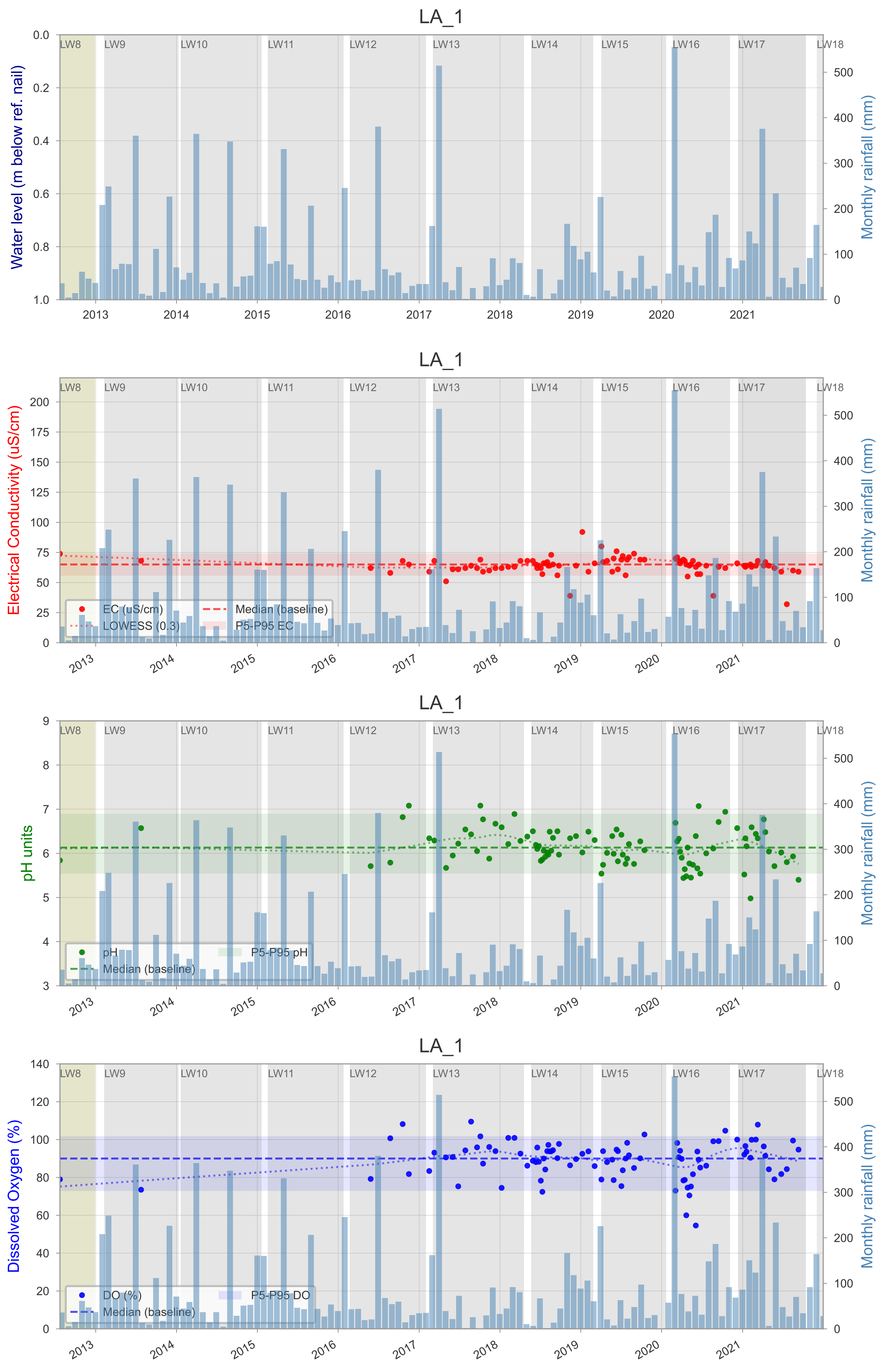
LA8_ROCKBAR1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)

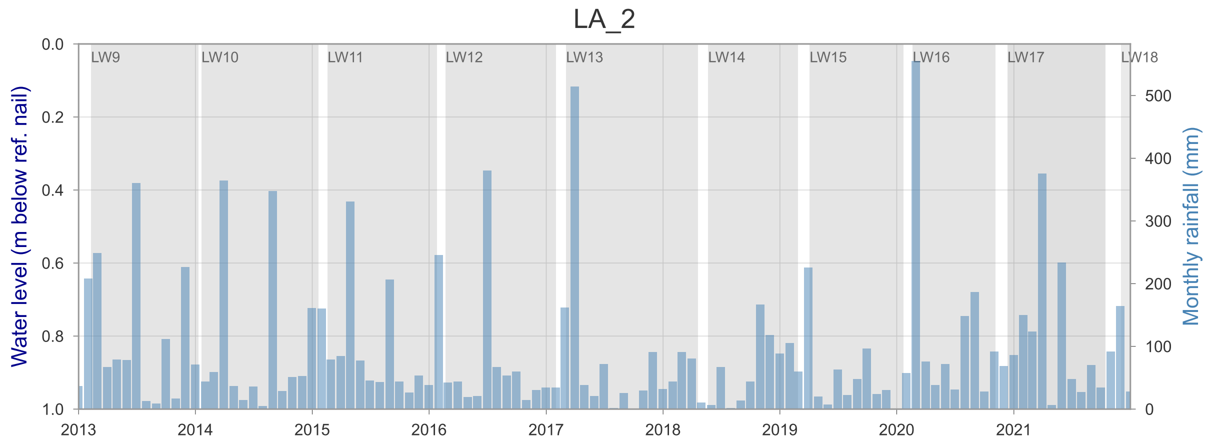


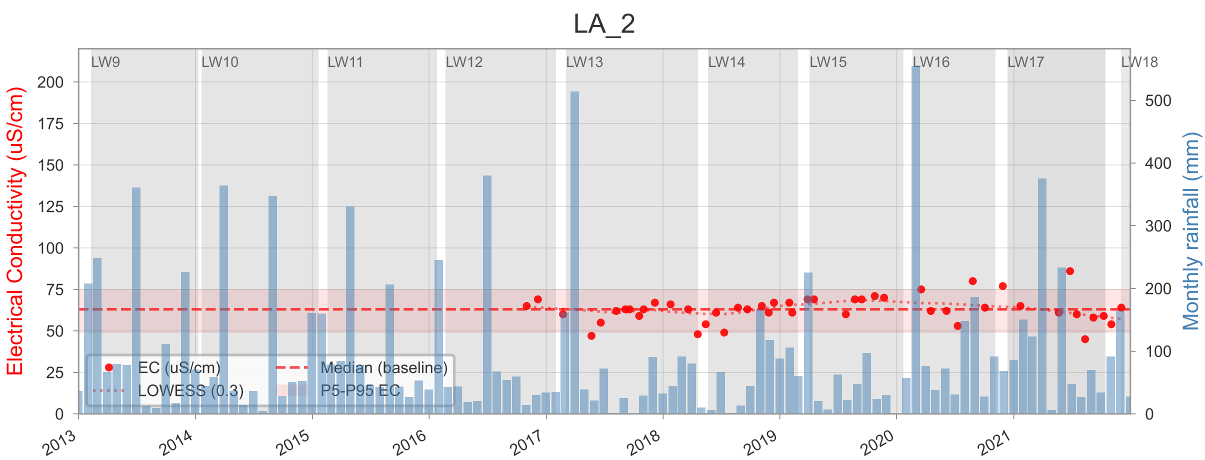
LA8_ROCKBAR1
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH

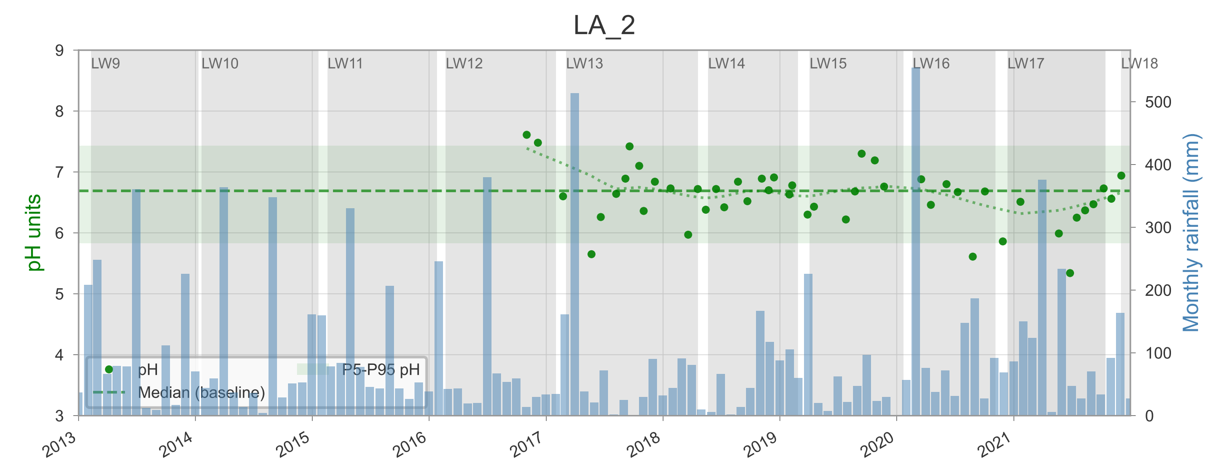


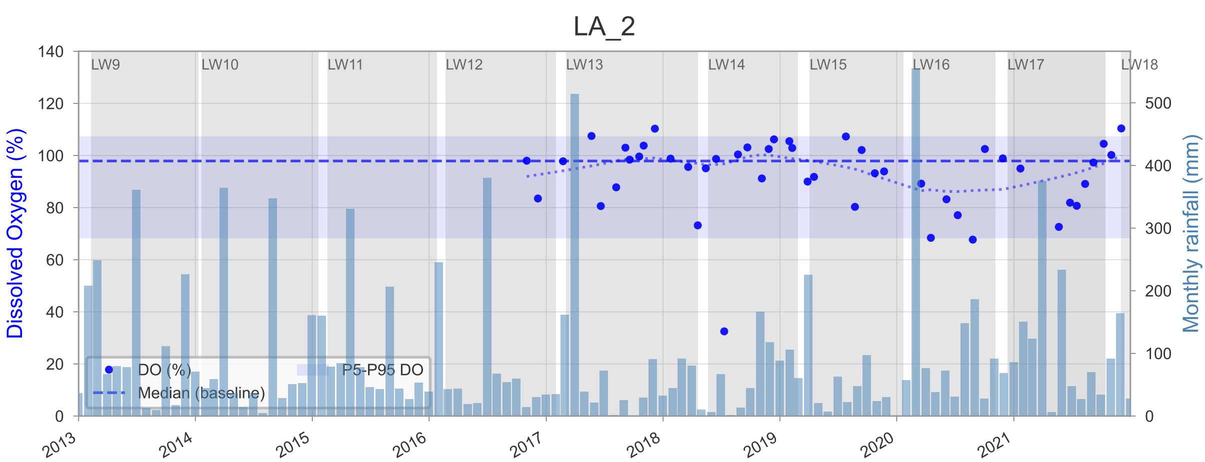
LA8_ROCKBAR1
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)

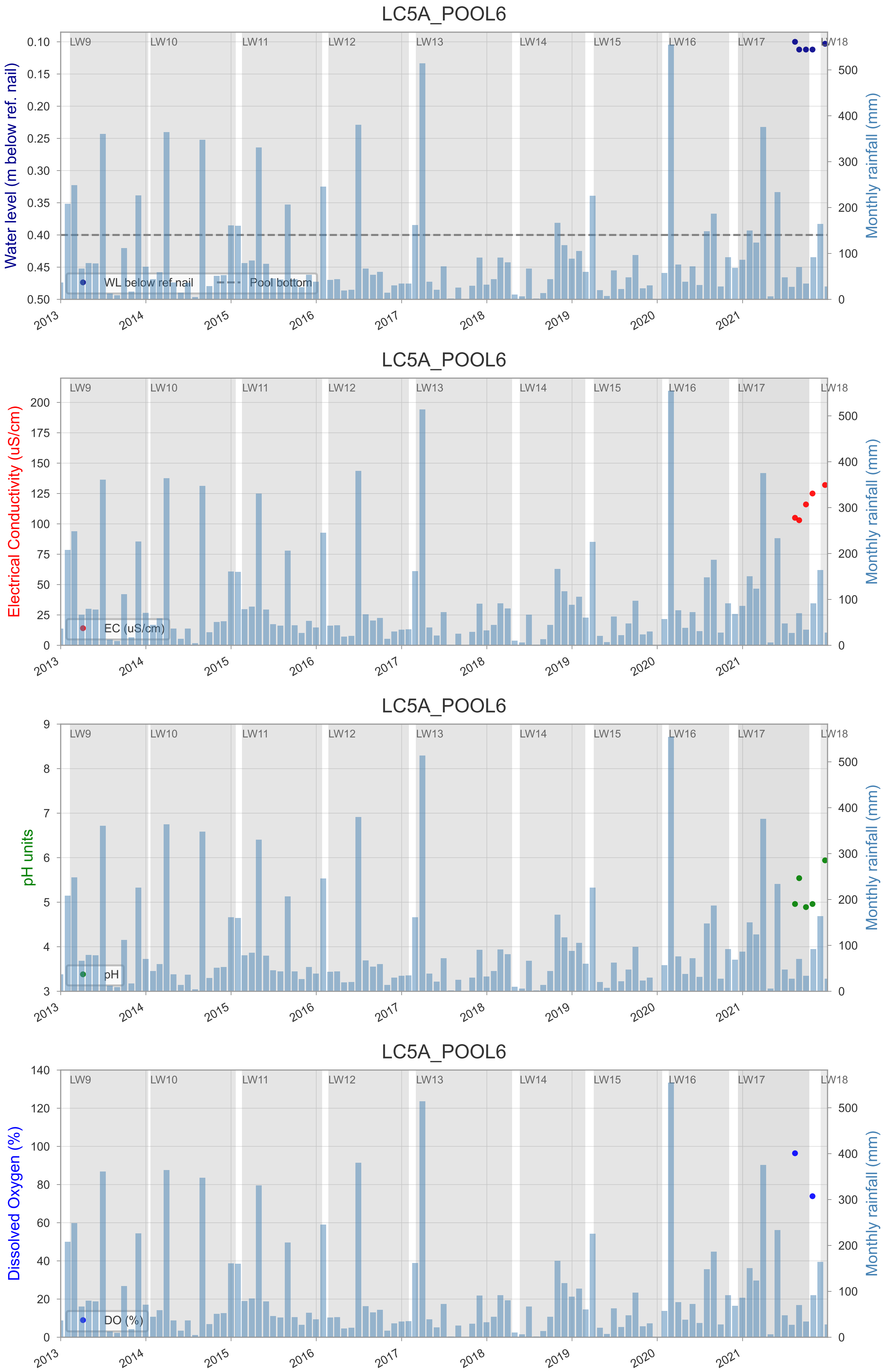

LA_1
Water level (m below ref. nail)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
0.0
0.2
0.4
0.6
0.8
1.0
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021
LA_1
Electrical Conductivity (uS/cm)
0
25
50
75
100
125
150
175
200
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LA_1
pH units
3
4
5
6
7
8
9
pH
Median (baseline)
P5-P95 pH
LA_1
Dissolved Oxygen (%)
0
20
40
60
80
100
120
140
DO (%)
Median (baseline)
P5-P95 DO


LA_2
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

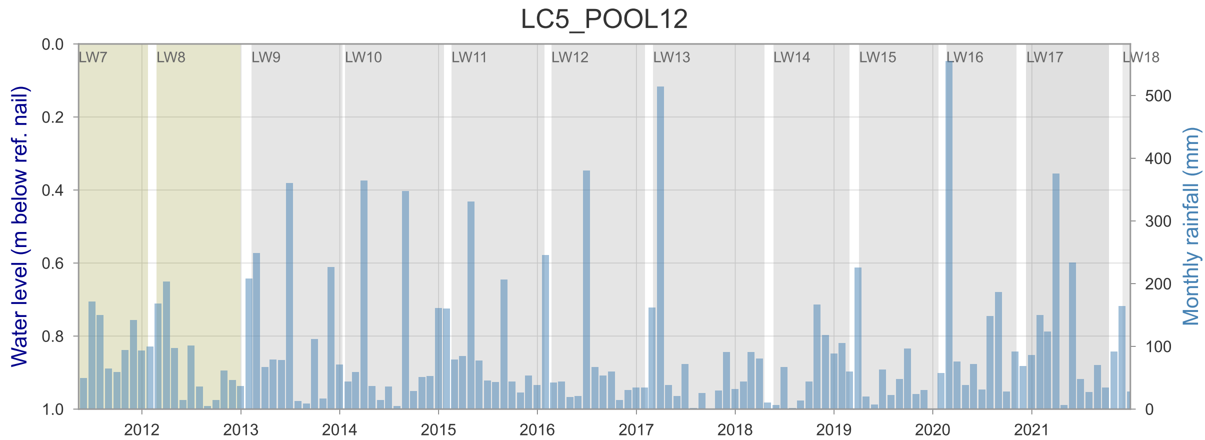

LA_2
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

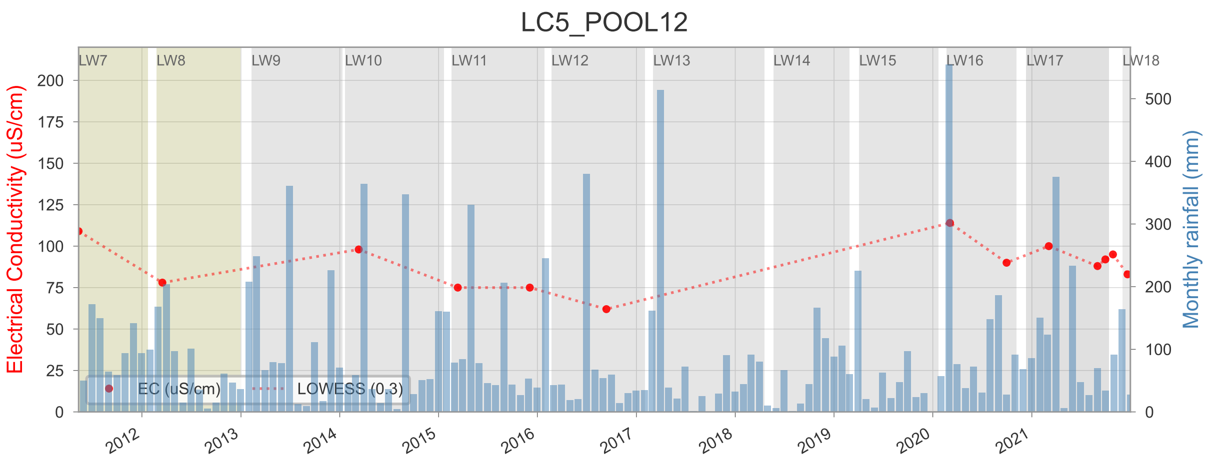

LA_2
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

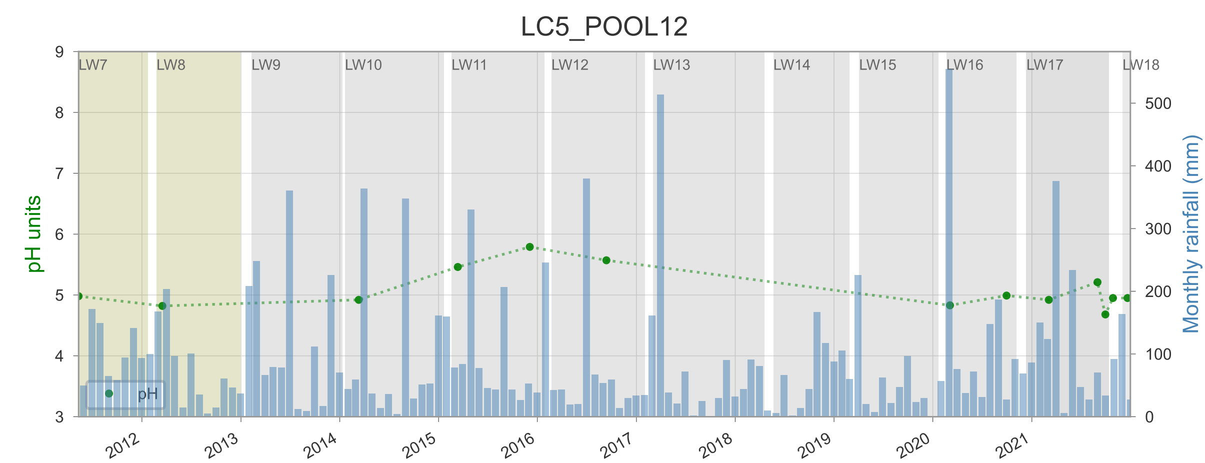

LA_2
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

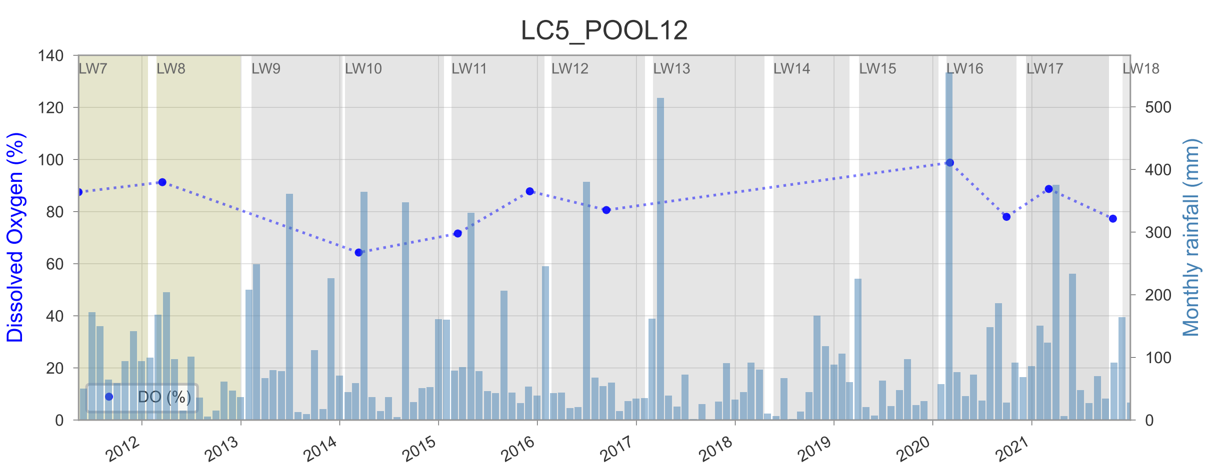


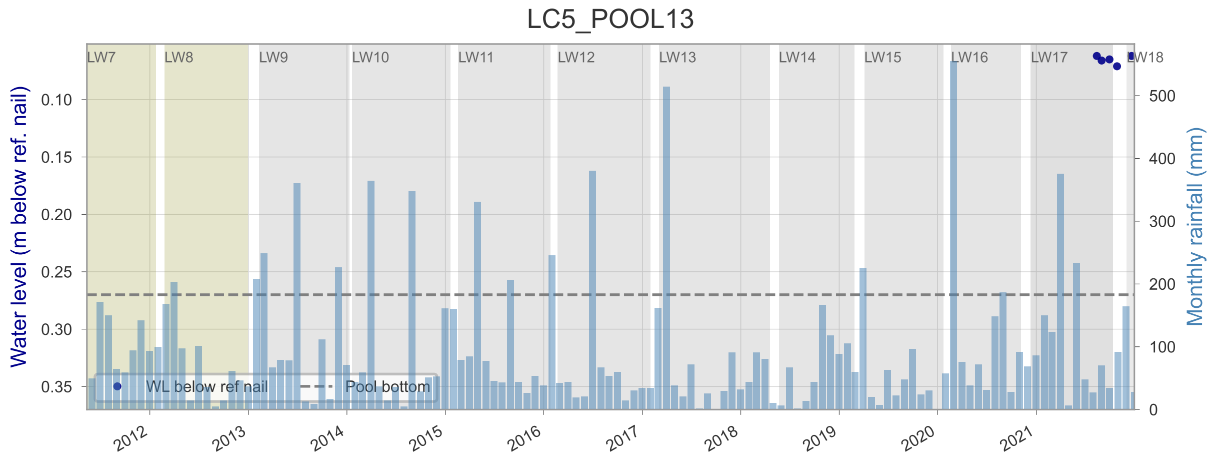
LC5A_POOL6
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
Pool bottom
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
LC5A_POOL6
Electrical Conductivity (uS/cm)
EC (uS/cm)
LC5A_POOL6
pH units
pH
LC5A_POOL6
Dissolved Oxygen (%)
DO (%)

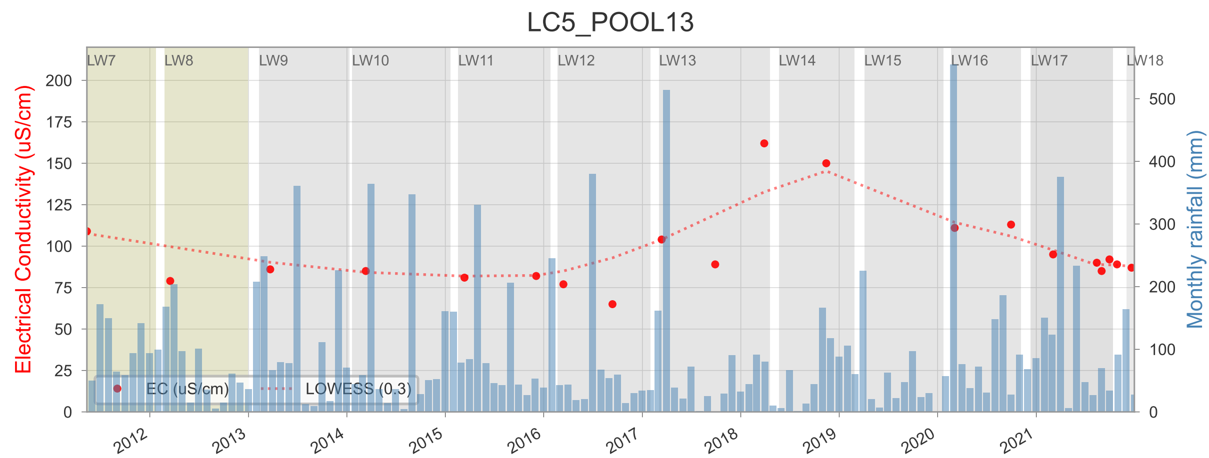

LC5_POOL12
Water level (m below ref. nail)
Monthly rainfall (mm)
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
0.0
0.2
0.4
0.6
0.8
1.0
0
100
200
300
400
500
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021

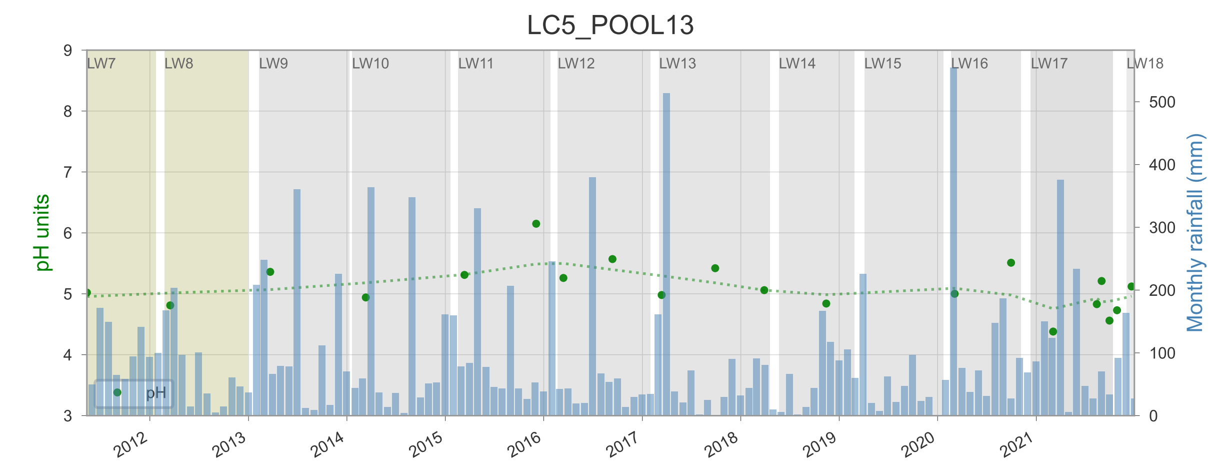

LC5_POOL12
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021

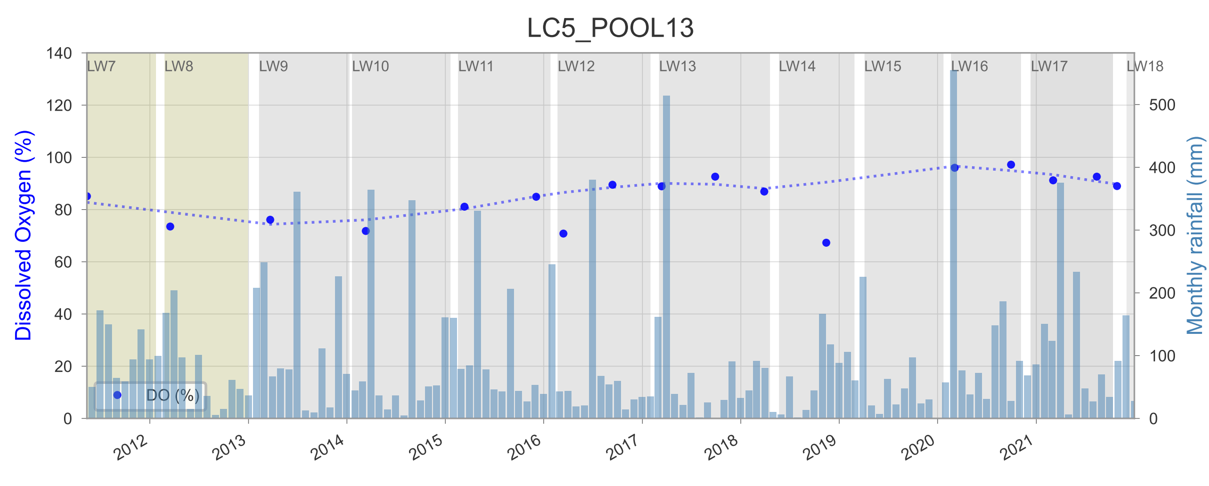

LC5_POOL12
pH units
Monthly rainfall (mm)
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
3
4
5
6
7
8
9
0
100
200
300
400
500
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021

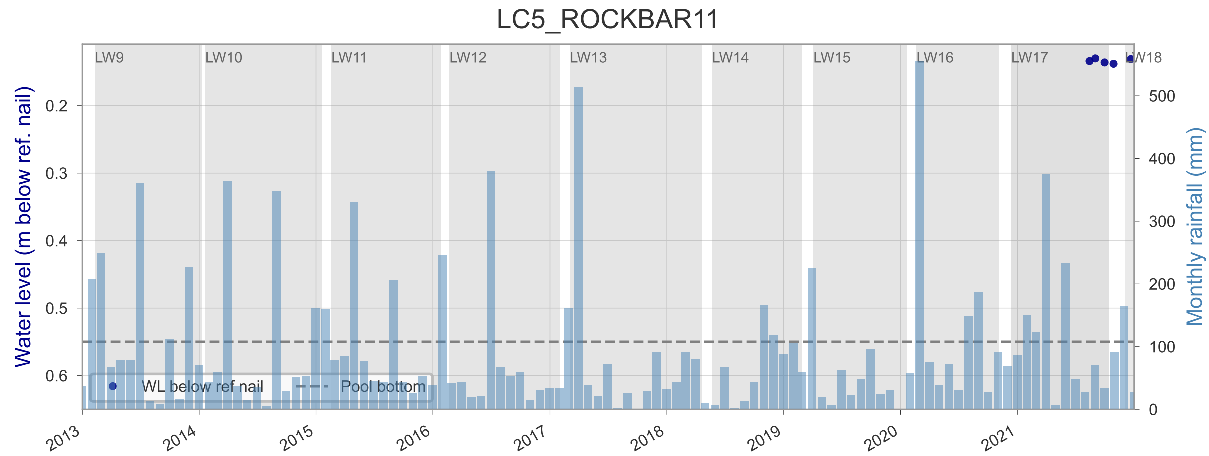

LC5_POOL12
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021

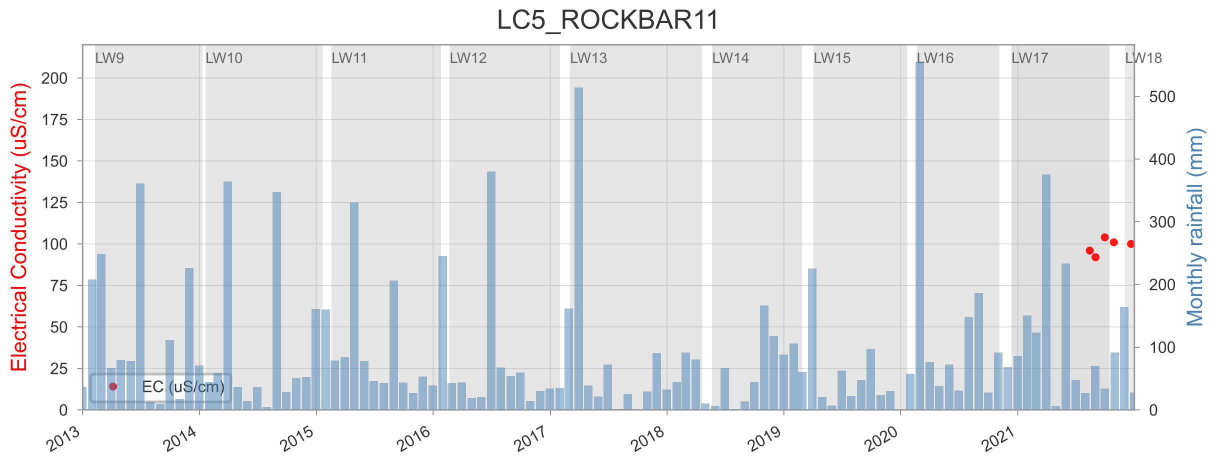

LC5_POOL13
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
Pool bottom
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021

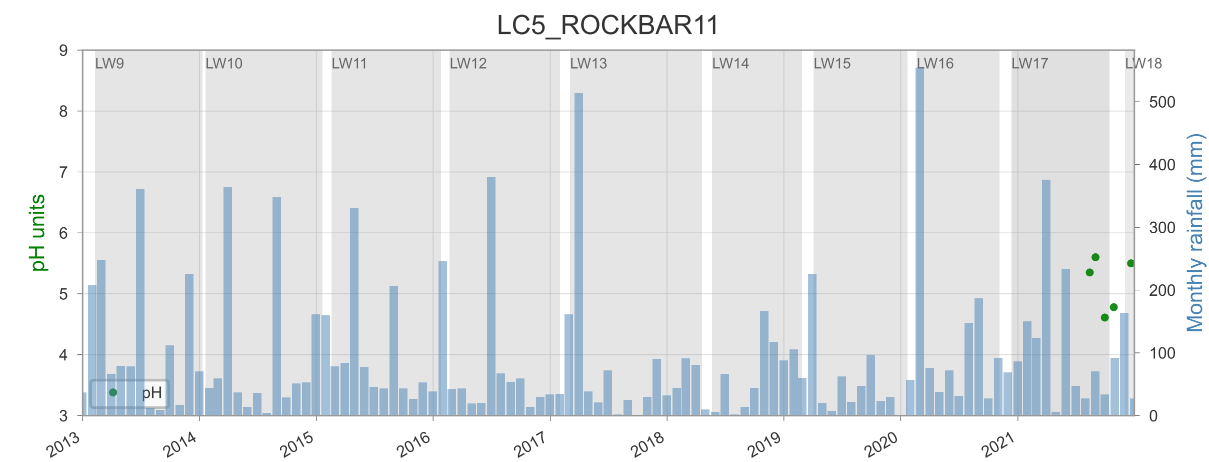

LC5_POOL13
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)

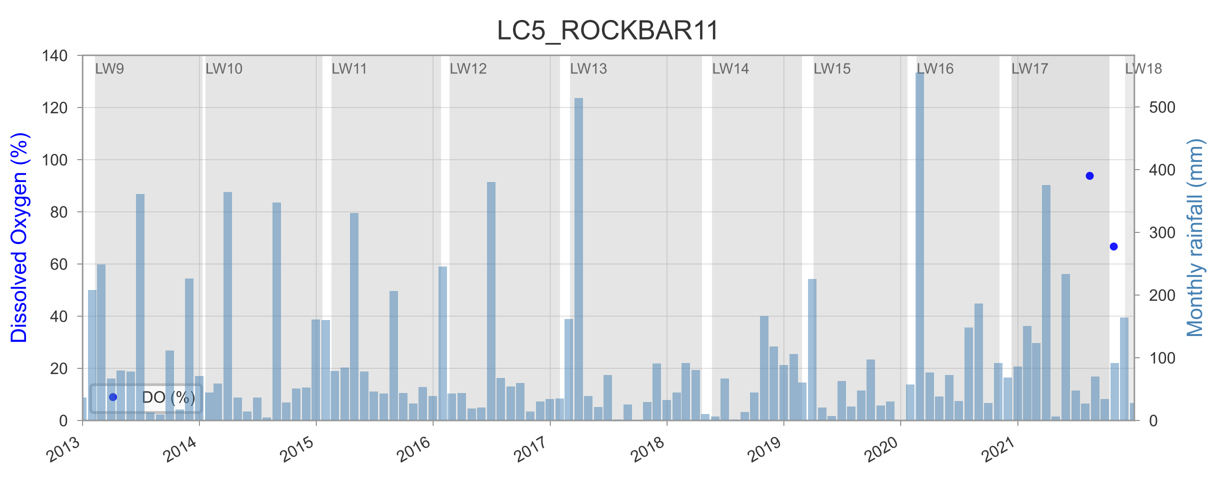

LC5_POOL13
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH units
Monthly rainfall (mm)
pH

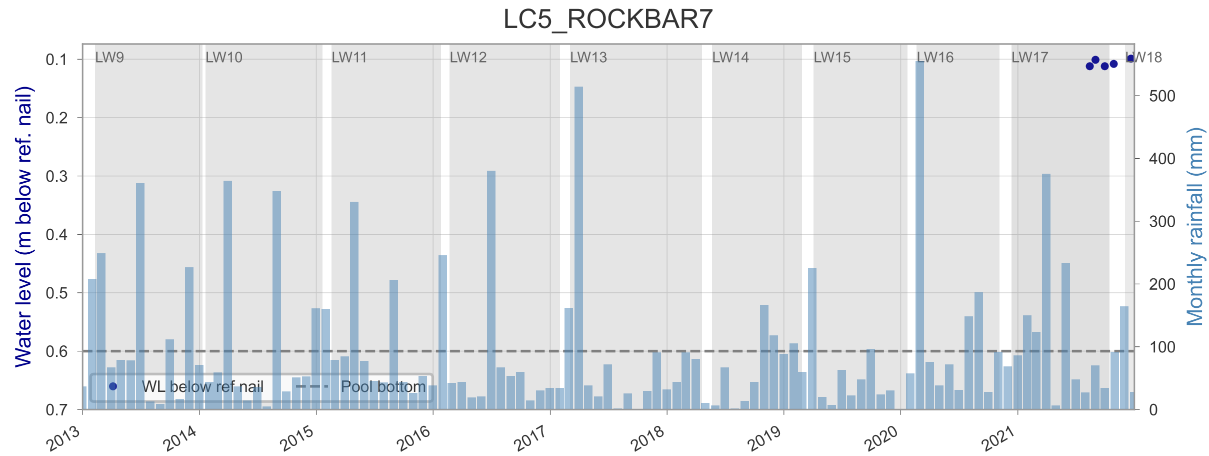

LC5_POOL13
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)


LC5_ROCKBAR11
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
Pool bottom

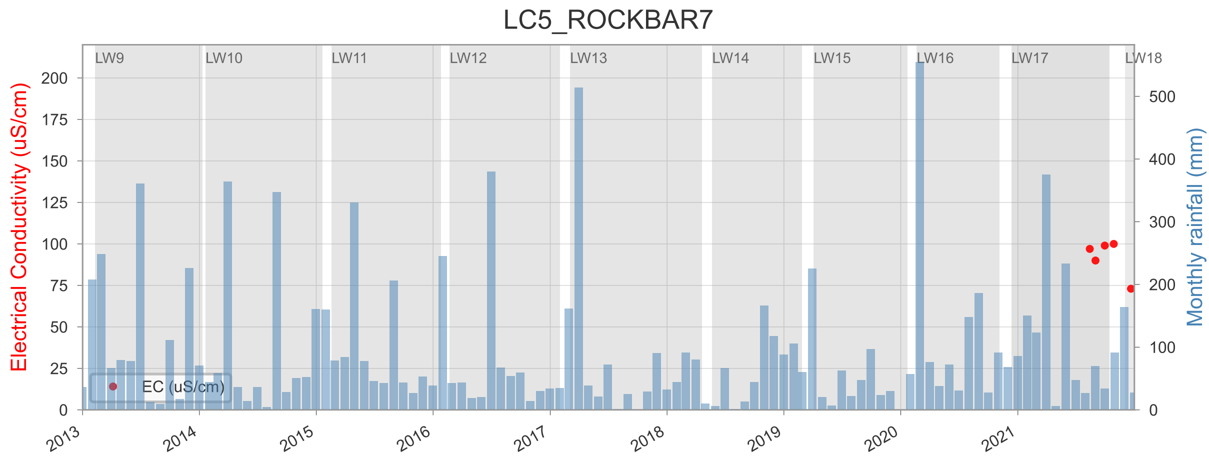

LC5_ROCKBAR11
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)


LC5_ROCKBAR11
pH units
Monthly rainfall (mm)
pH

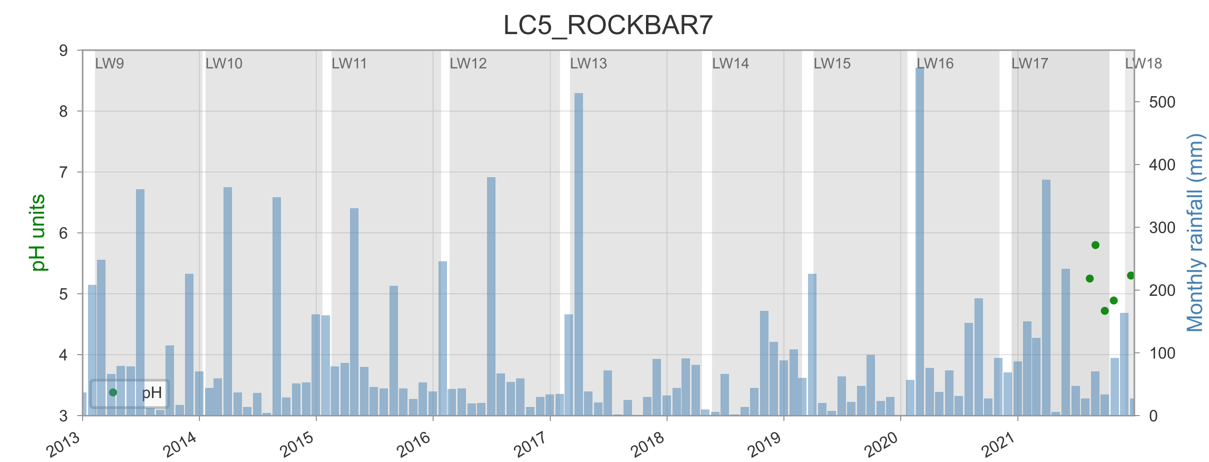

LC5_ROCKBAR11
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)



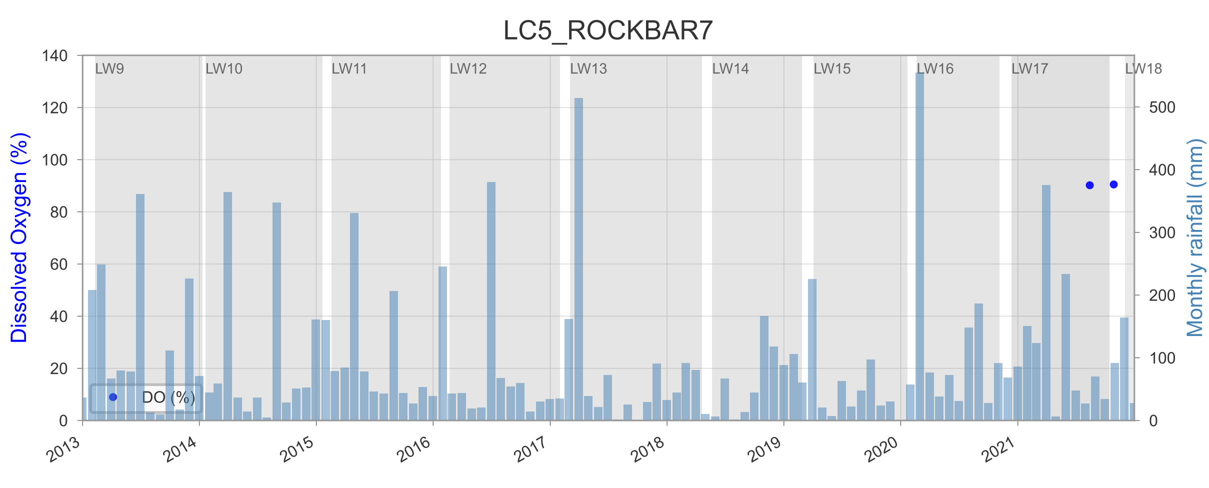
LC5_ROCKBAR7
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WL below ref nail
Pool bottom



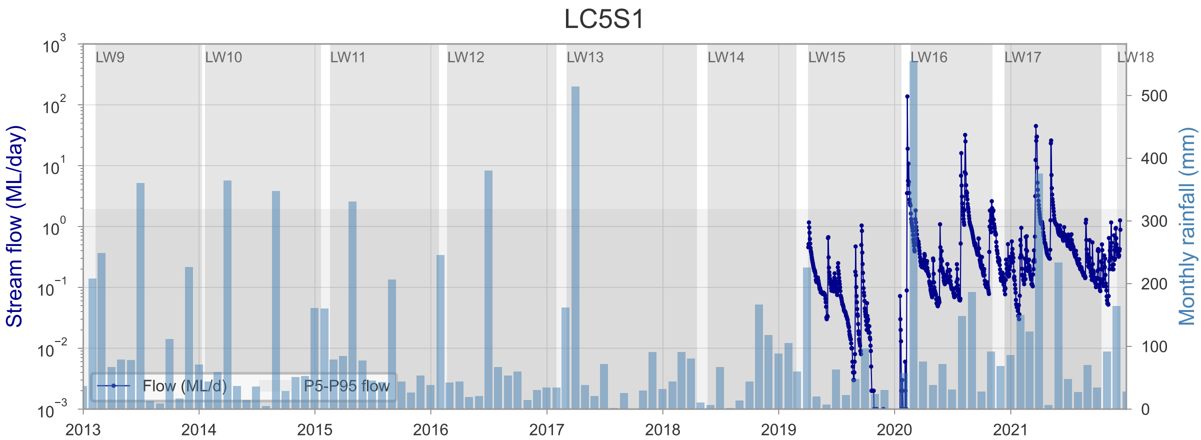
LC5_ROCKBAR7
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)

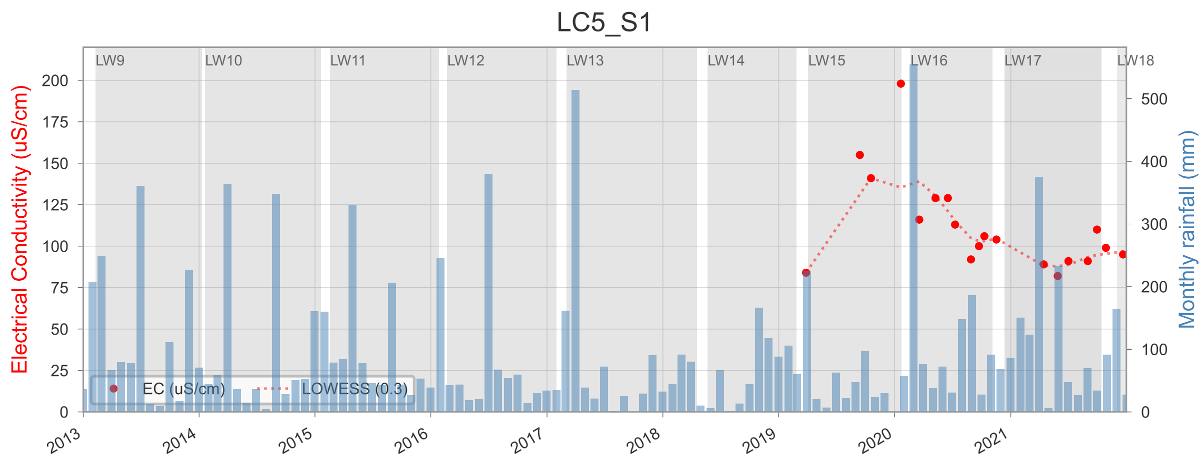


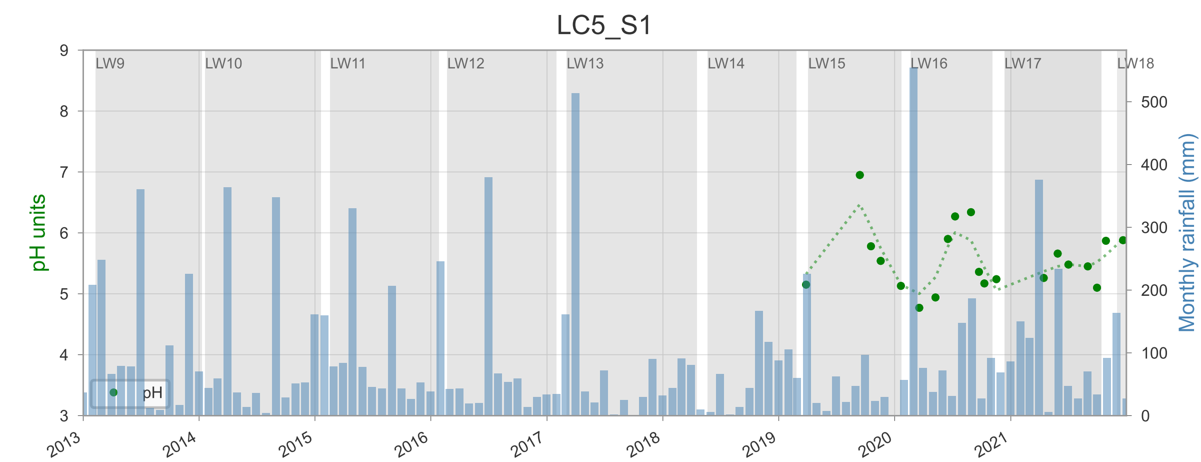
LC5_ROCKBAR7
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH

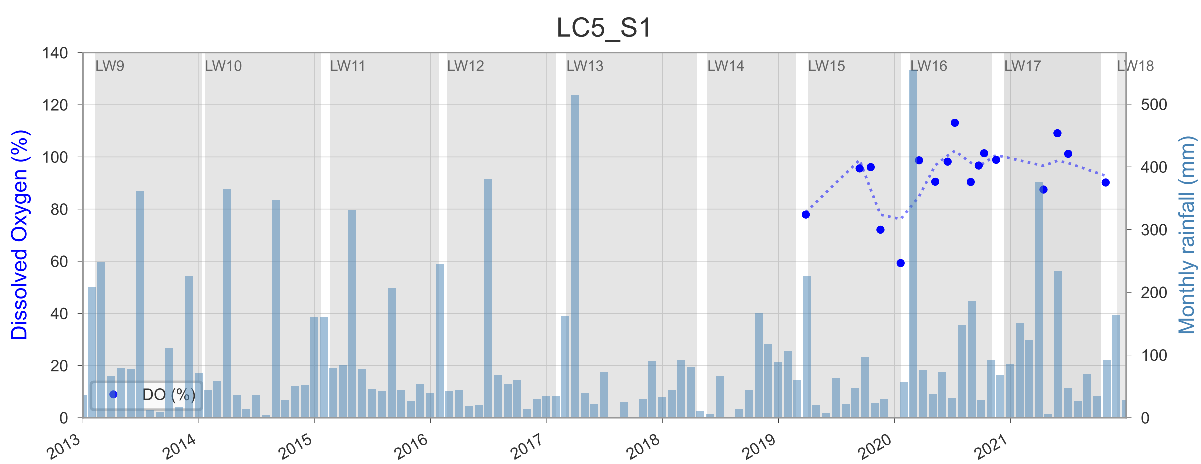


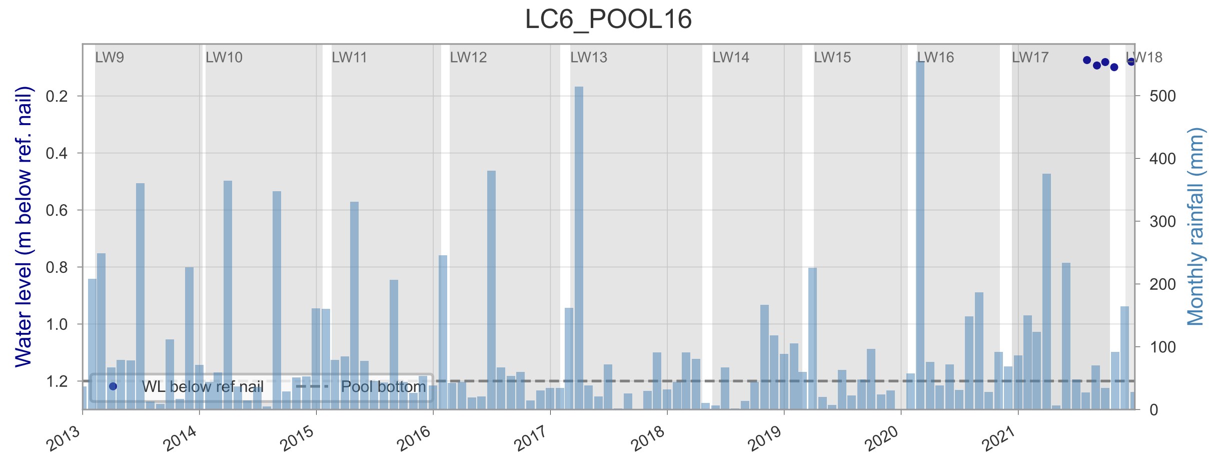
LC5_ROCKBAR7
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)

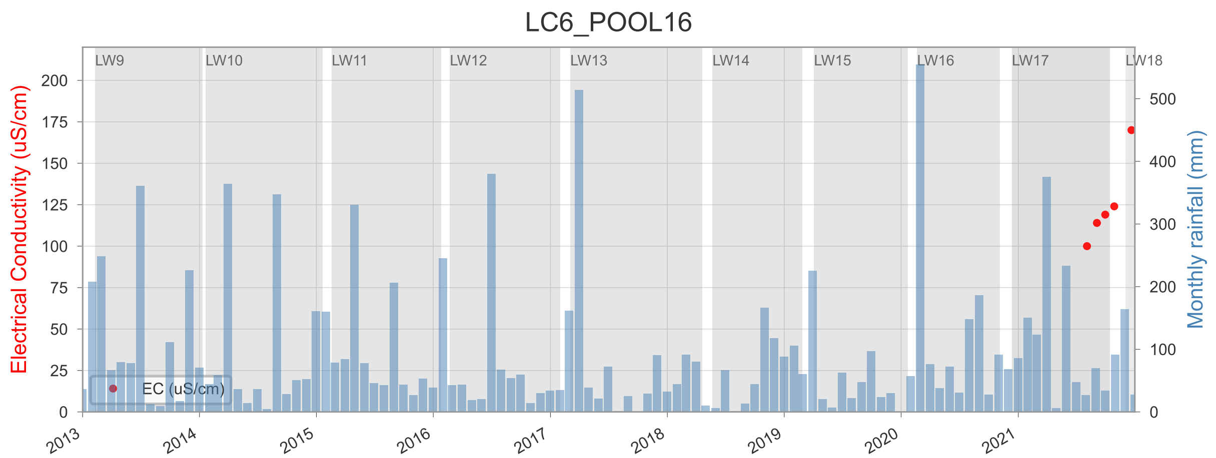

LC5S1
Stream flow (ML/day)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Flow (ML/d)
P5-P95 flow

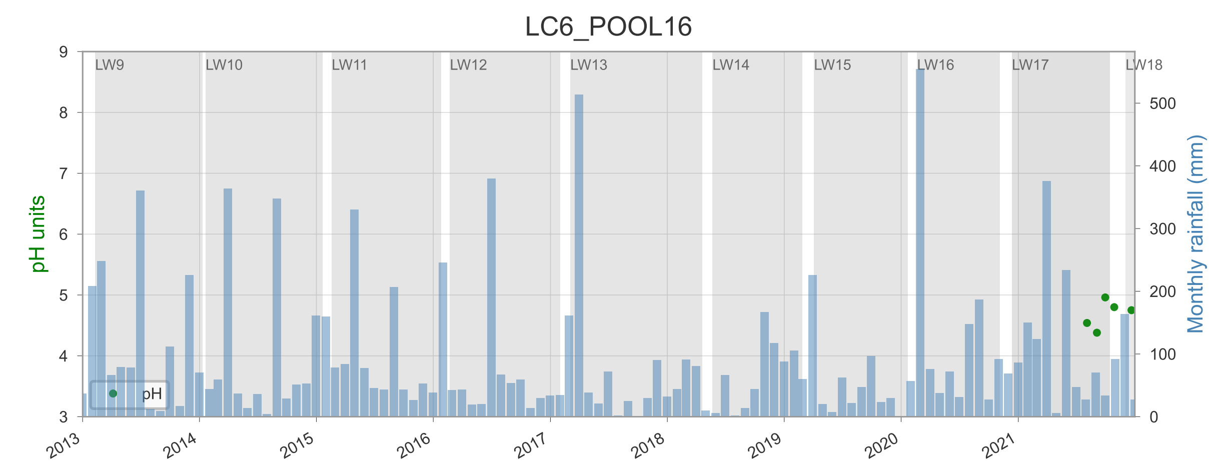

LC5_S1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)

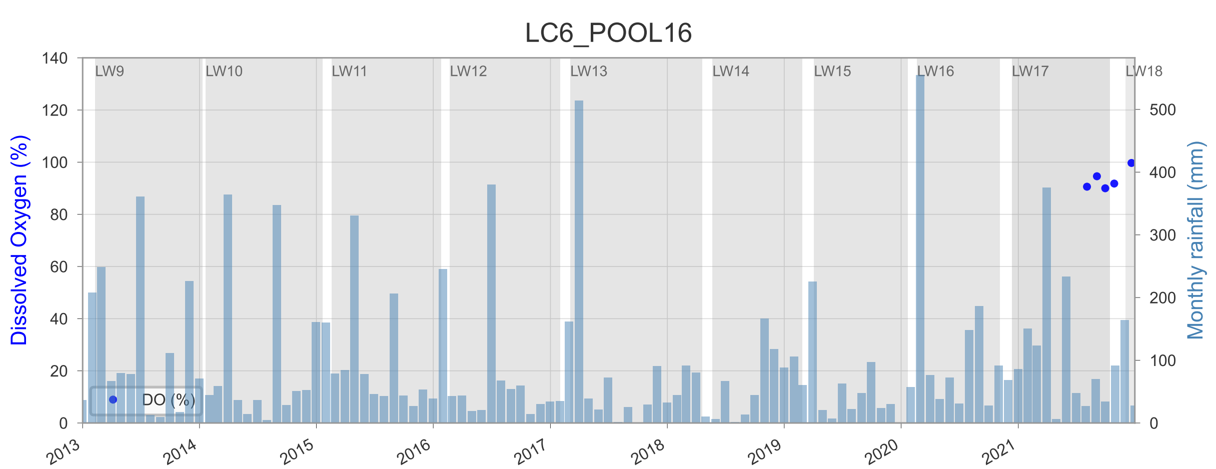

LC5_S1
pH units
Monthly rainfall (mm)
pH

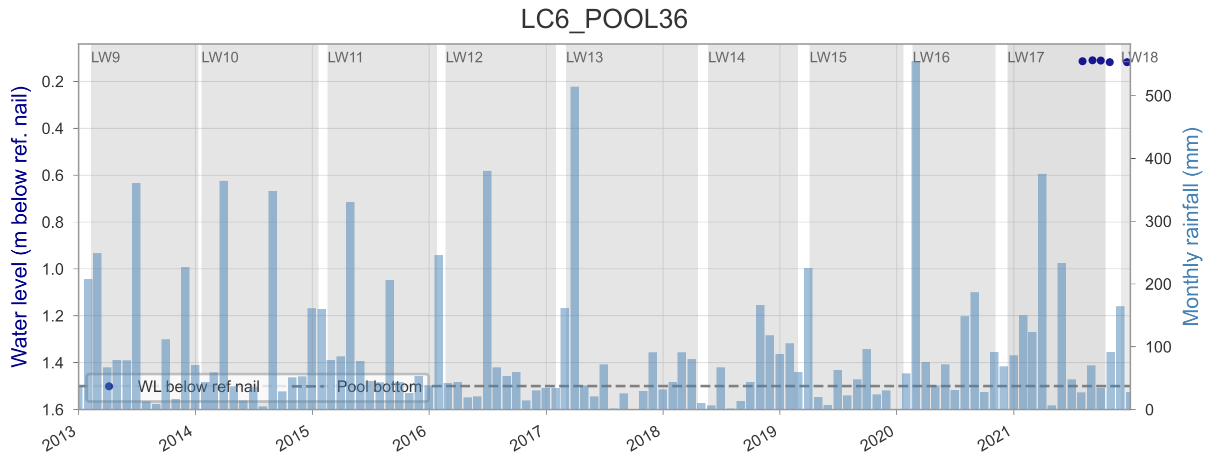

LC5_S1
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)

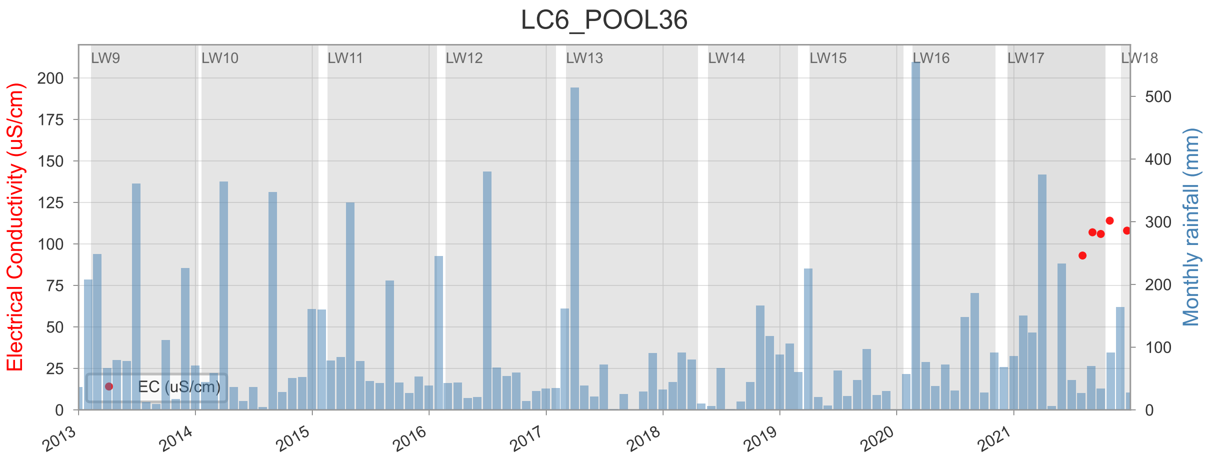

LC6_POOL16
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
Pool bottom
0.2
0.4
0.6
0.8
1.0
1.2
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

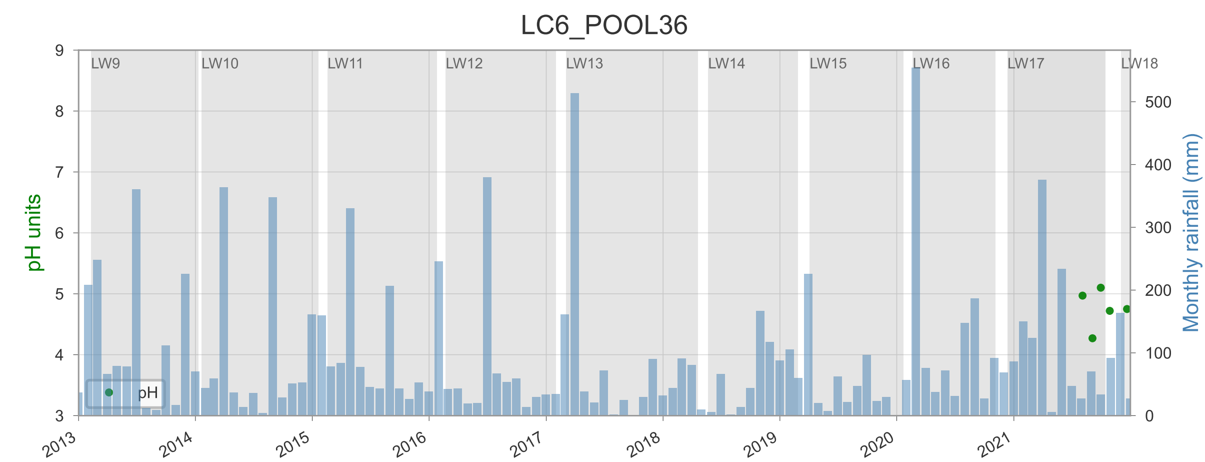

LC6_POOL16
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

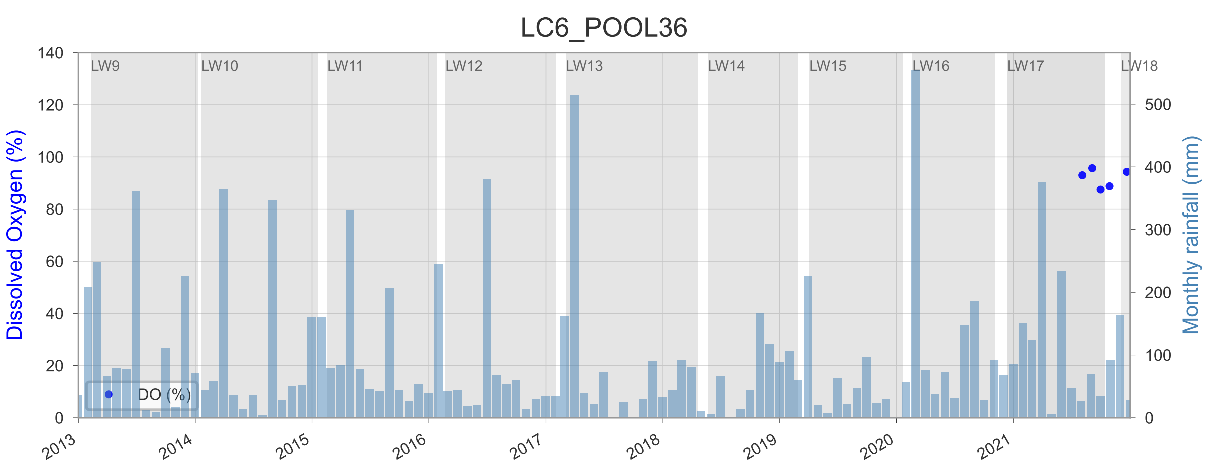

LC6_POOL16
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH units
Monthly rainfall (mm)
pH
3
4
5
6
7
8
9
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

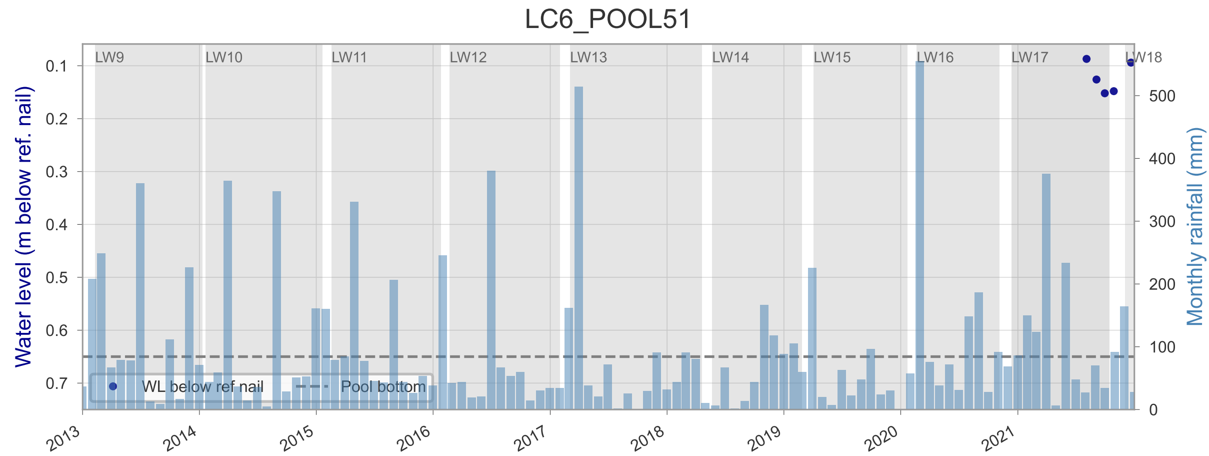

LC6_POOL16
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

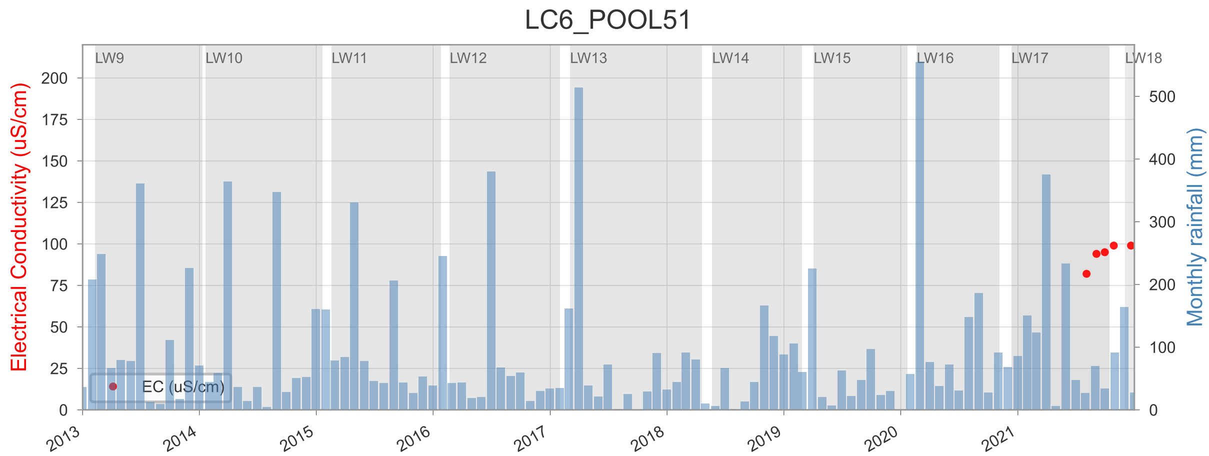

LC6_POOL36
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
Pool bottom

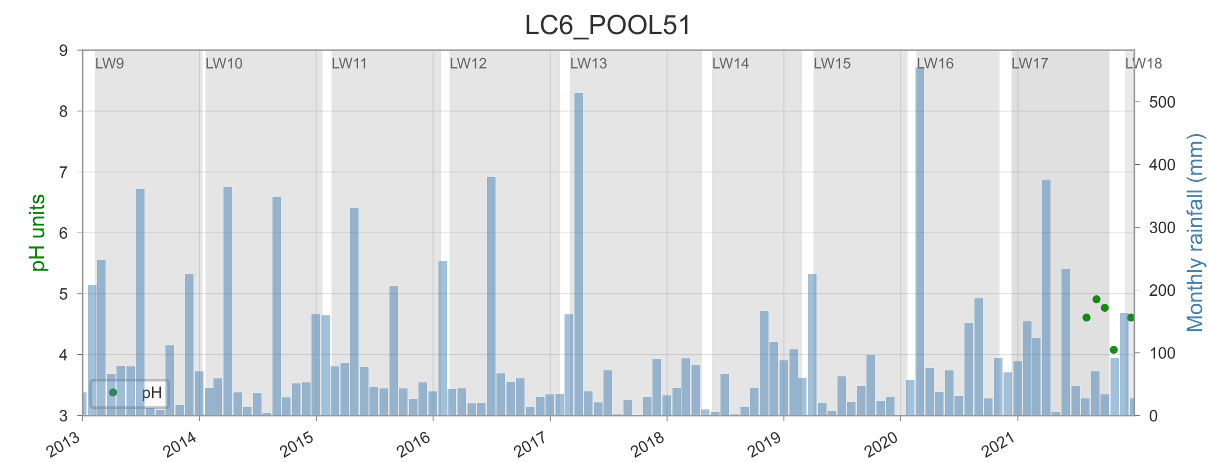

LC6_POOL36
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)

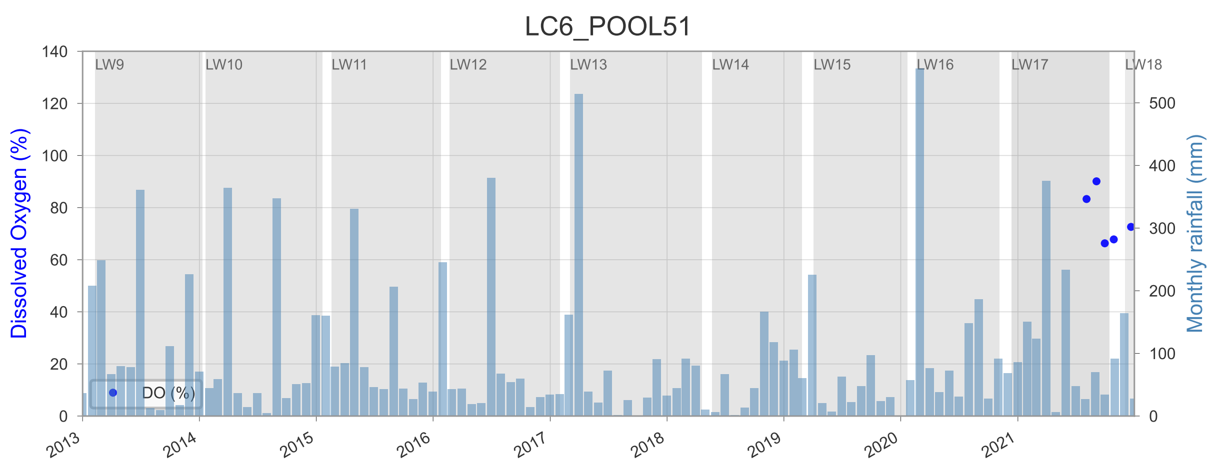

LC6_POOL36
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH units
Monthly rainfall (mm)
pH


LC6_POOL36
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)

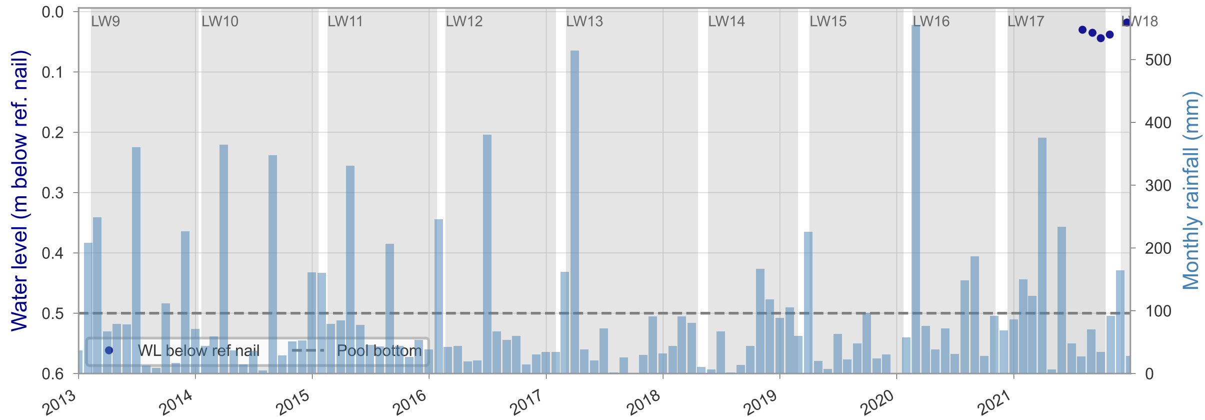

LC6_POOL51
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
Pool bottom
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18


LC6_POOL51
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

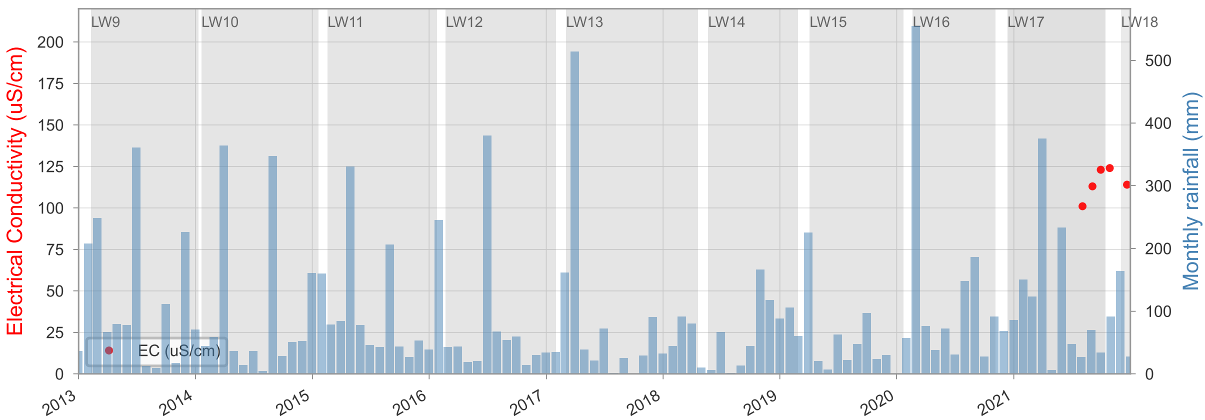

LC6_POOL51
pH units
Monthly rainfall (mm)
pH
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18


LC6_POOL51
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

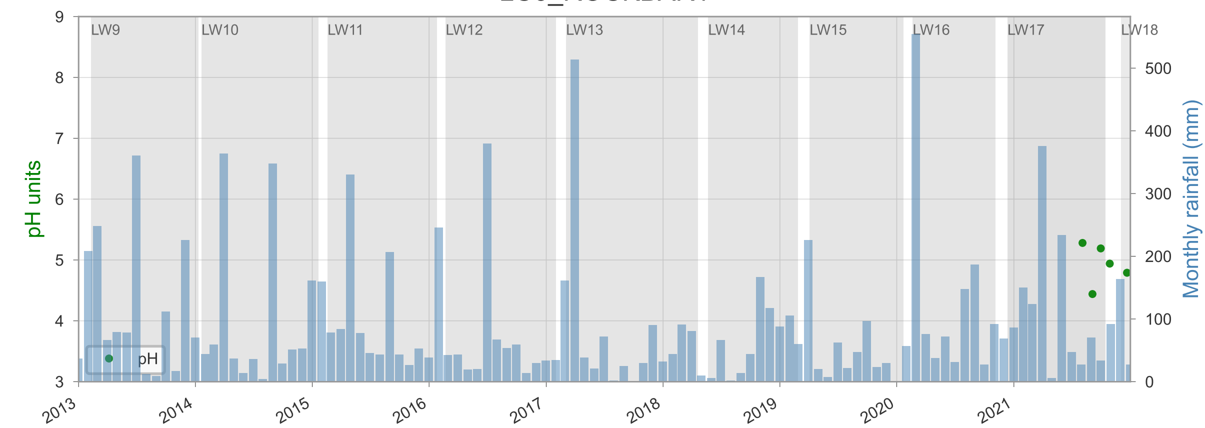
LC6_ROCKBAR1



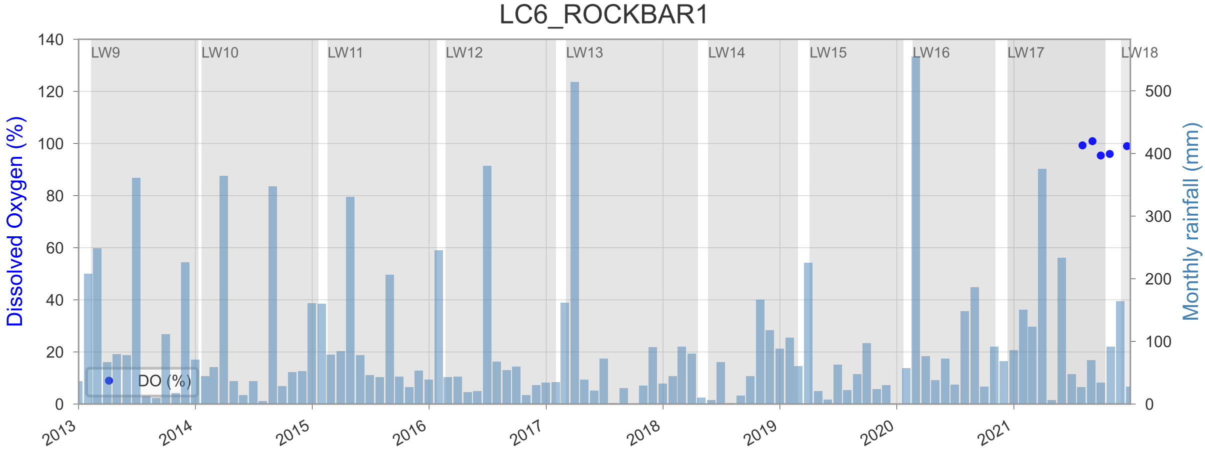
LC6_ROCKBAR1

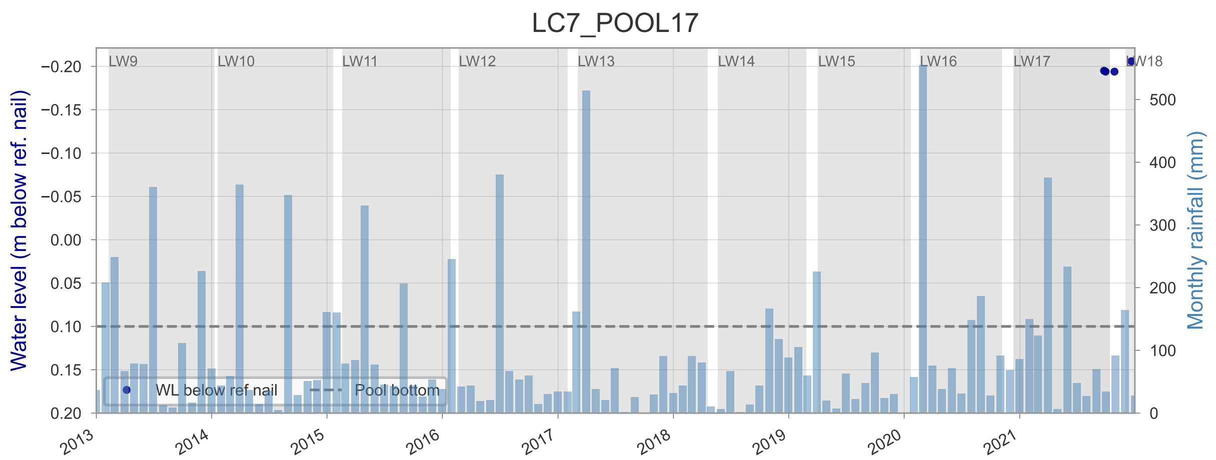


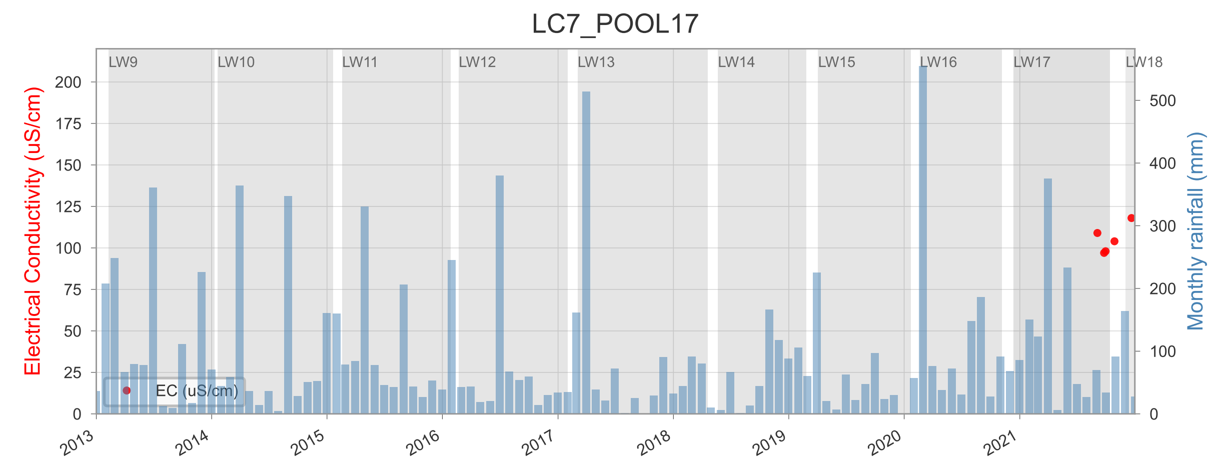
LC6_ROCKBAR1

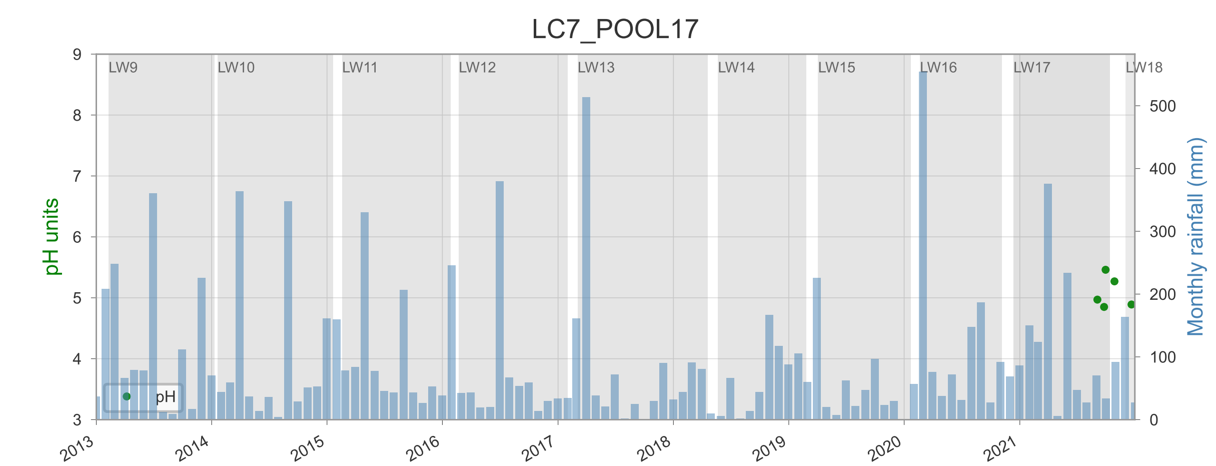


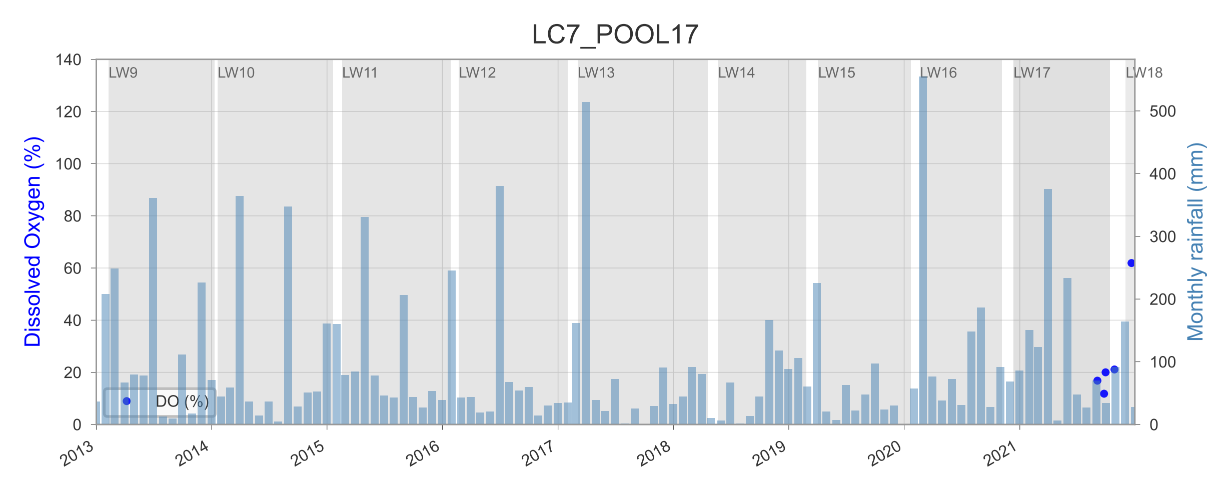
LC6_ROCKBAR1

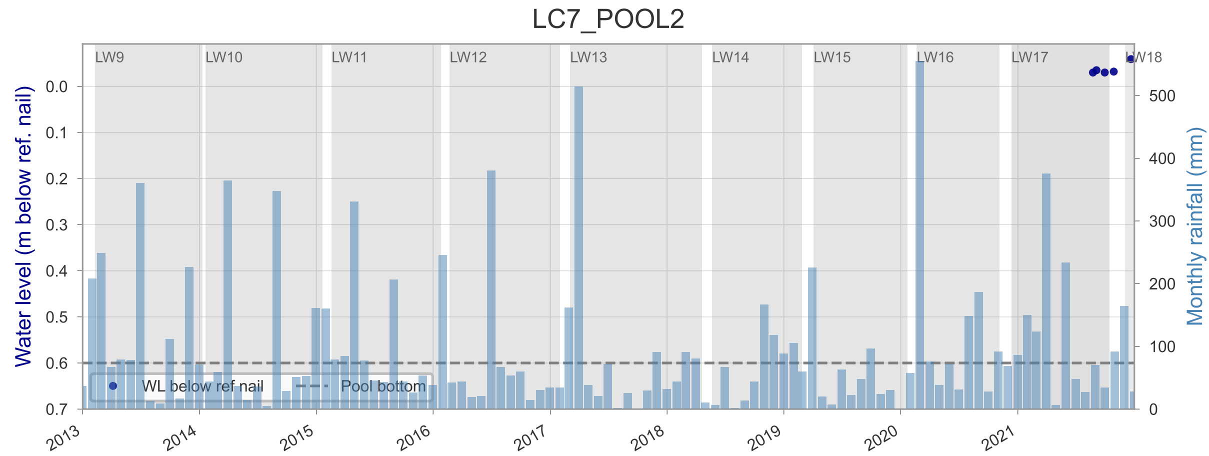


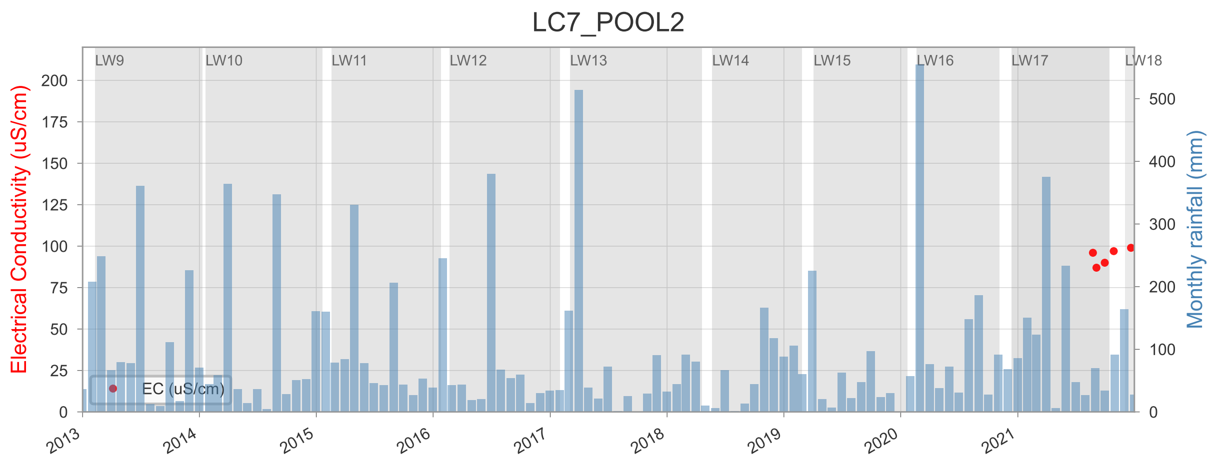

LC7_POOL17
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WL below ref nail
Pool bottom

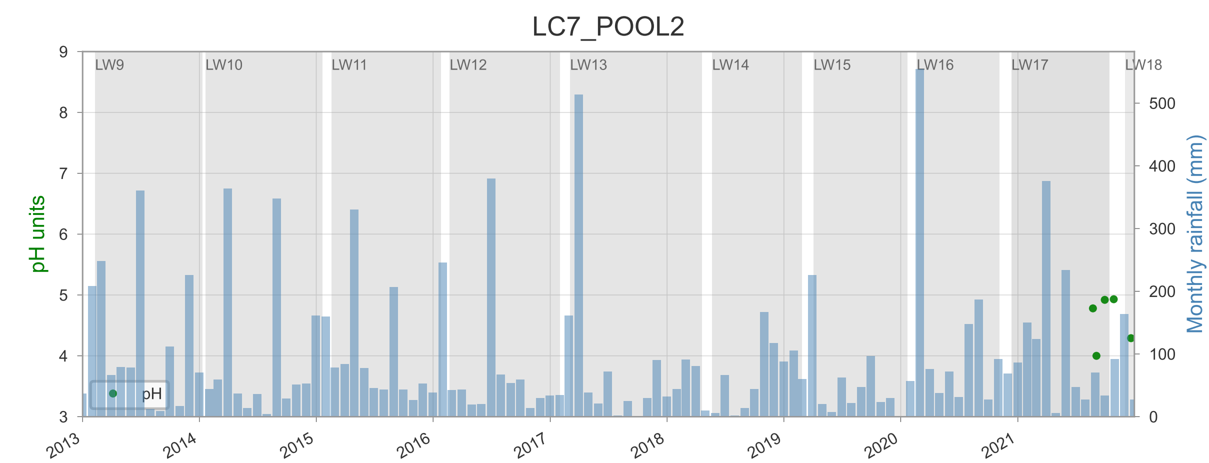

LC7_POOL17
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)

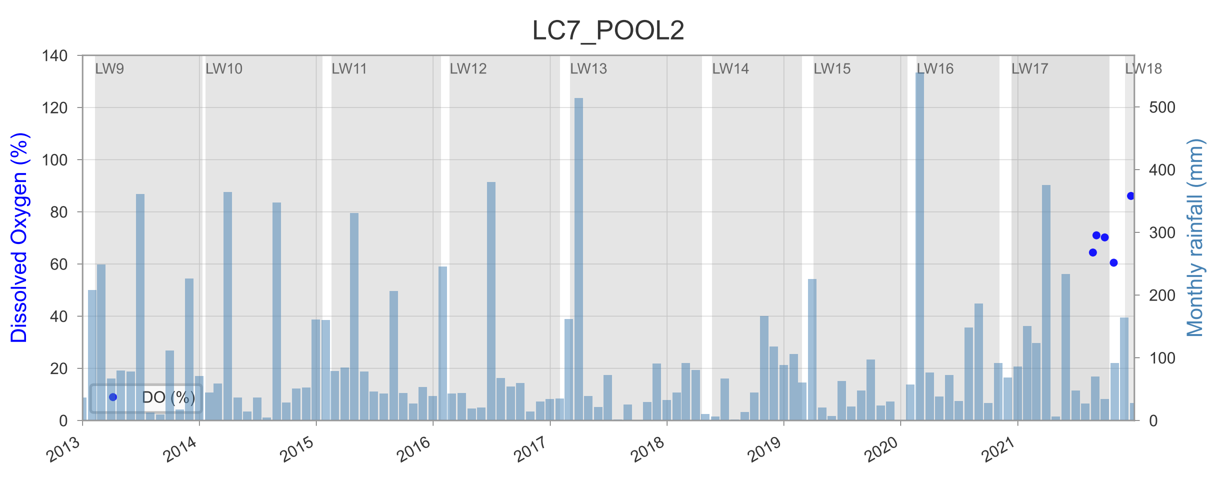

LC7_POOL17
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH

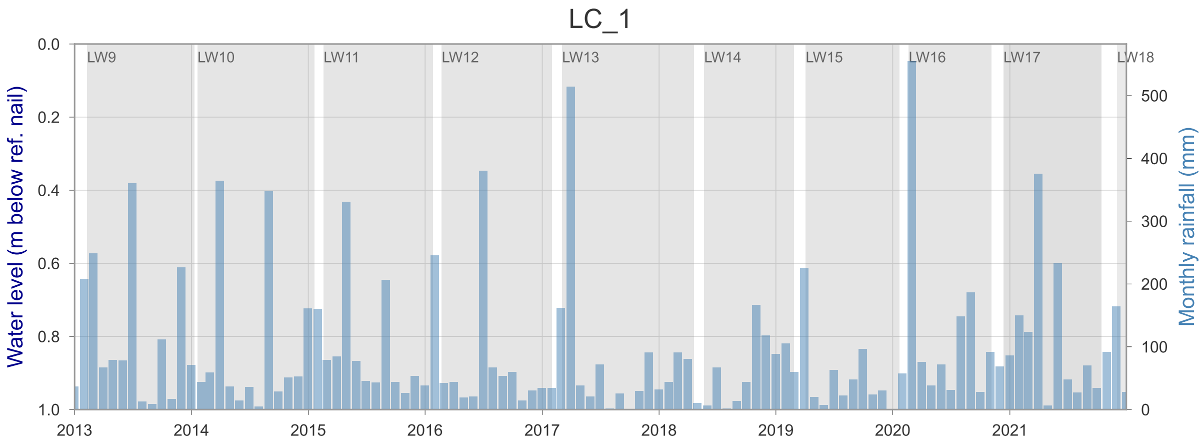

LC7_POOL17
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)

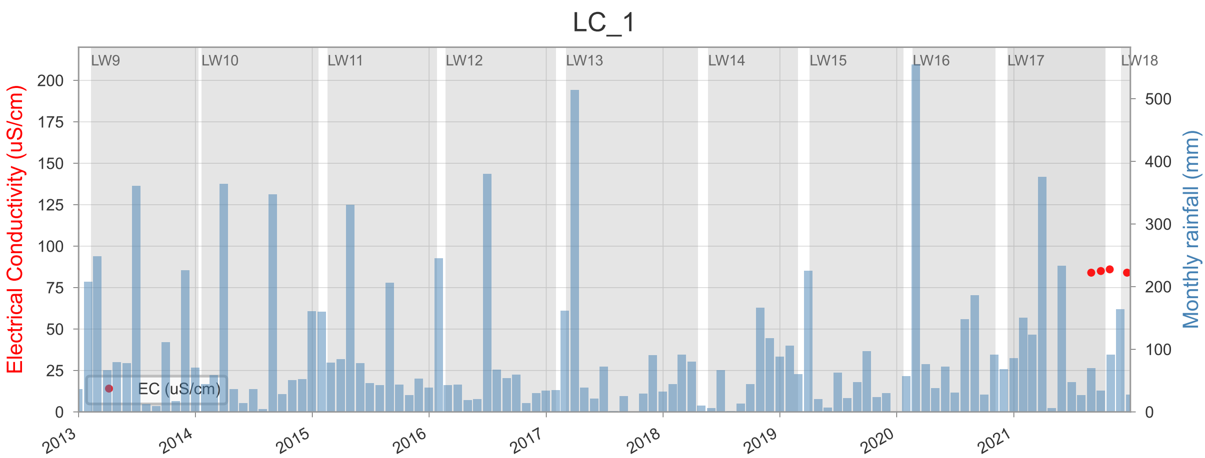

LC7_POOL2
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WL below ref nail
Pool bottom
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

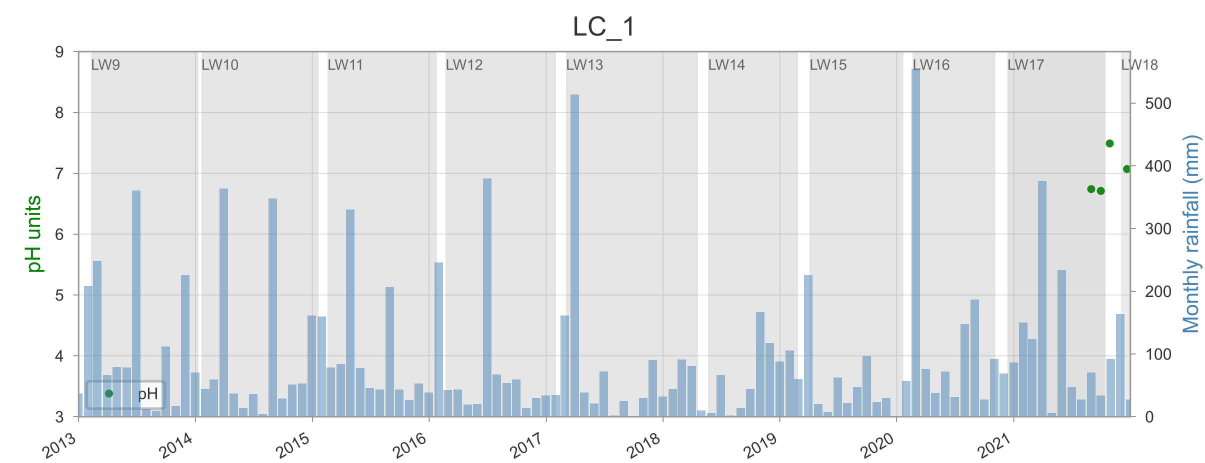

LC7_POOL2
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

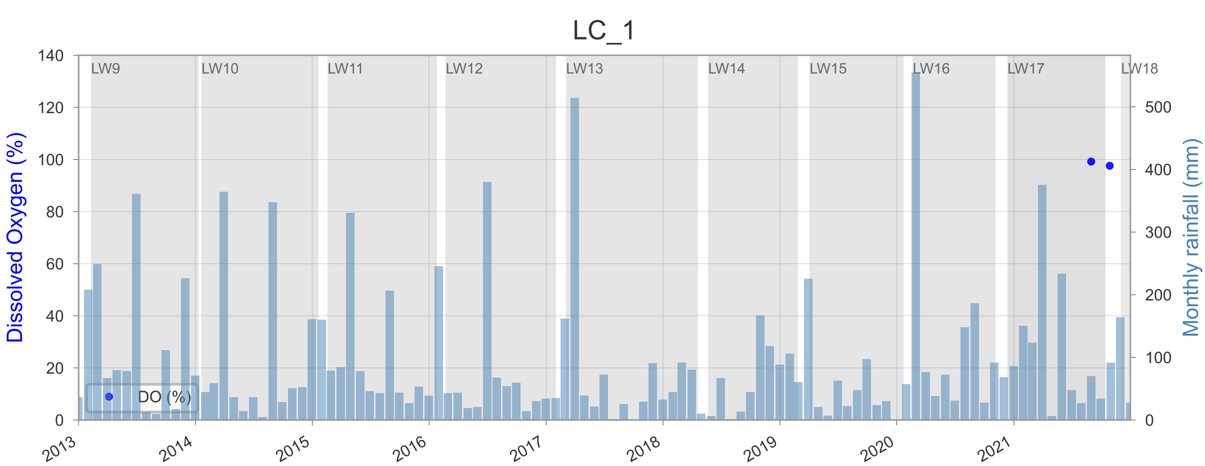

LC7_POOL2
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
3
4
5
6
7
8
9
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

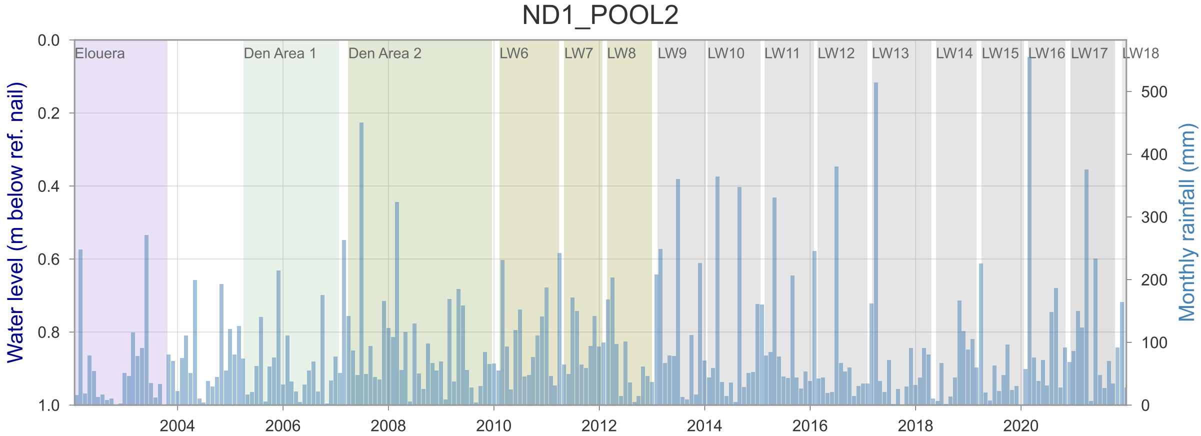

LC7_POOL2
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

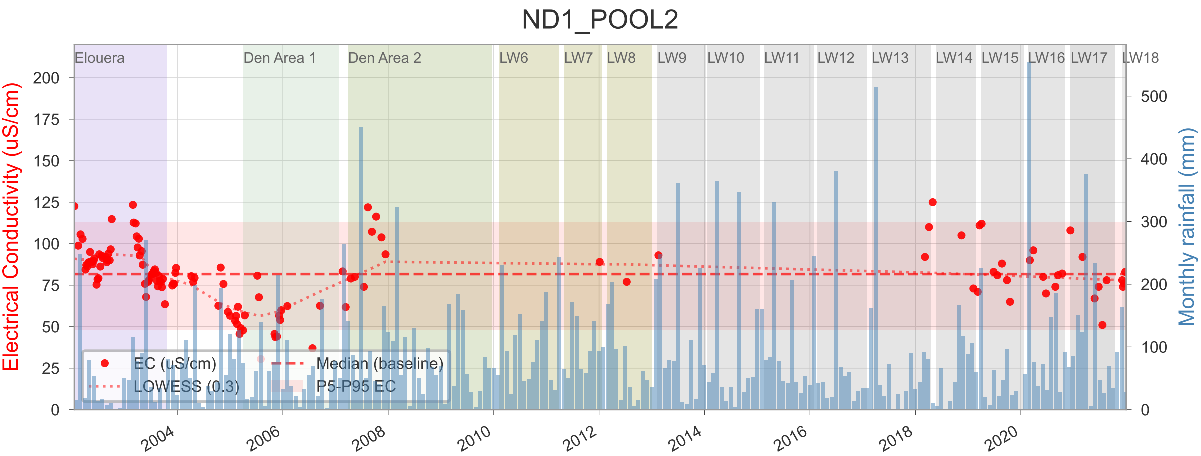

LC_1
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Water level (m below ref. nail)
Monthly rainfall (mm)

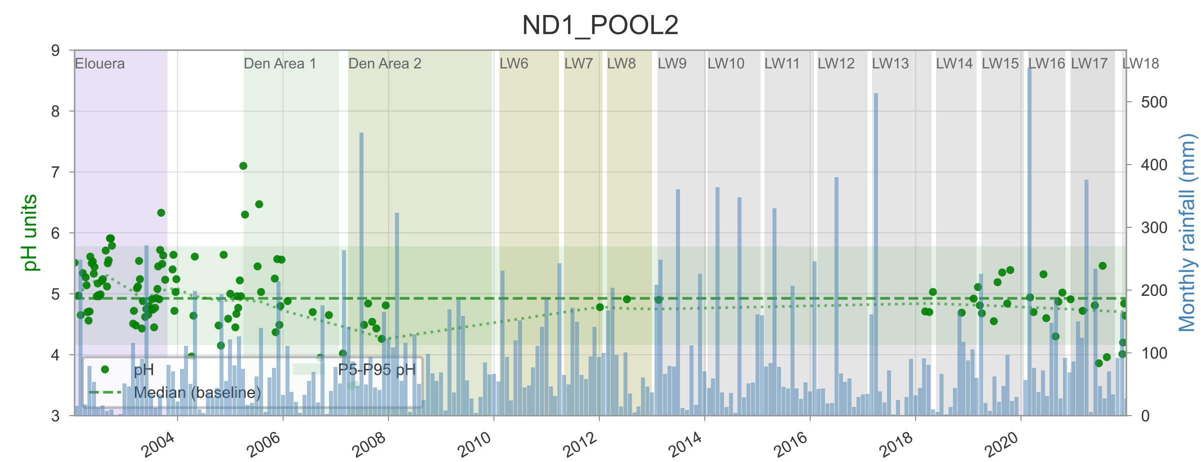

LC_1
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)

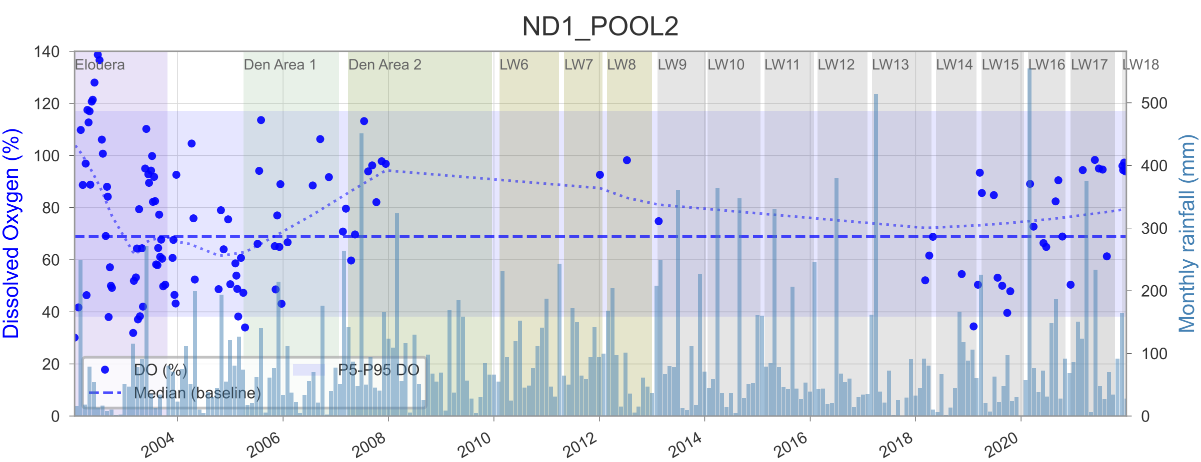

LC_1
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH units
Monthly rainfall (mm)
pH

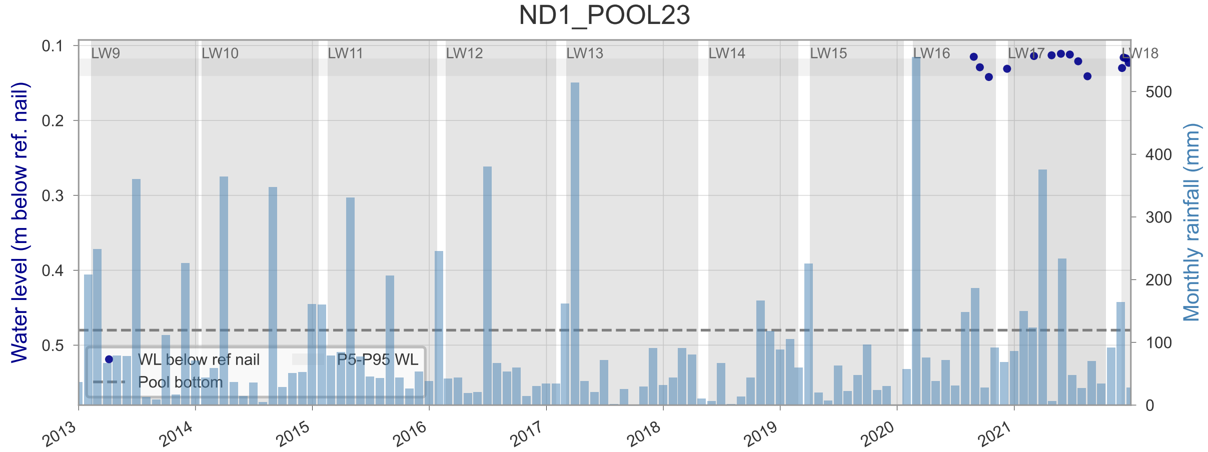

LC_1
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)

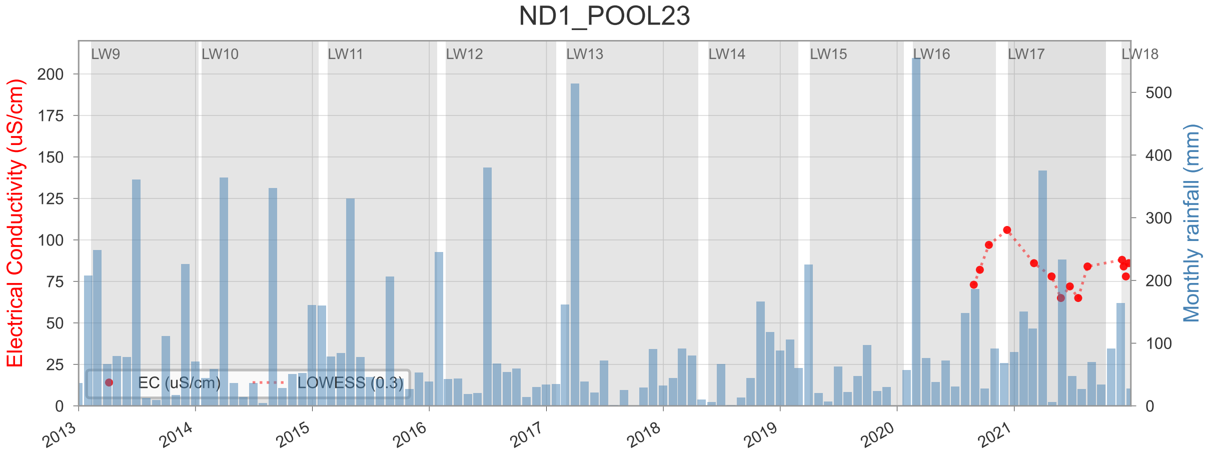

ND1_POOL2
Water level (m below ref. nail)
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

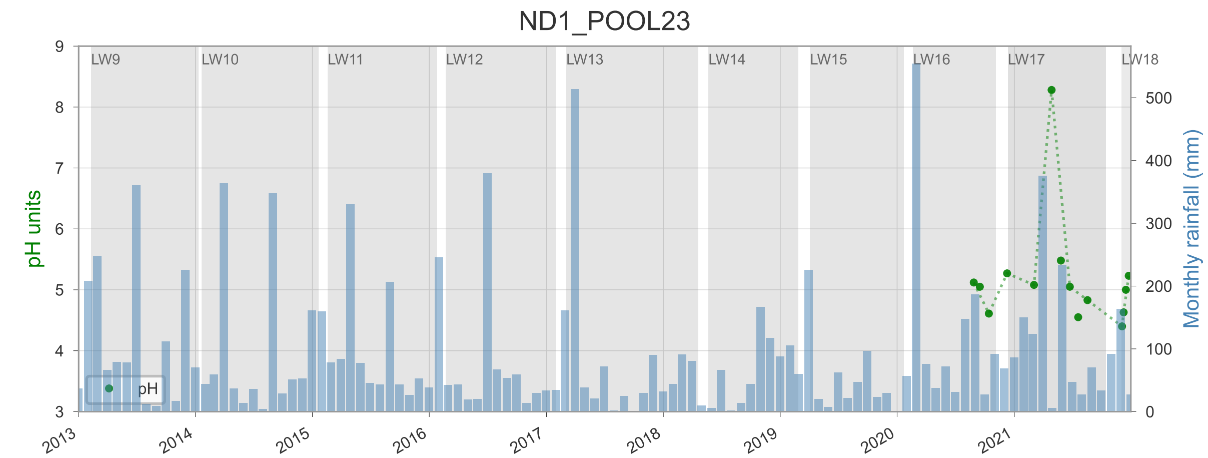

ND1_POOL2
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

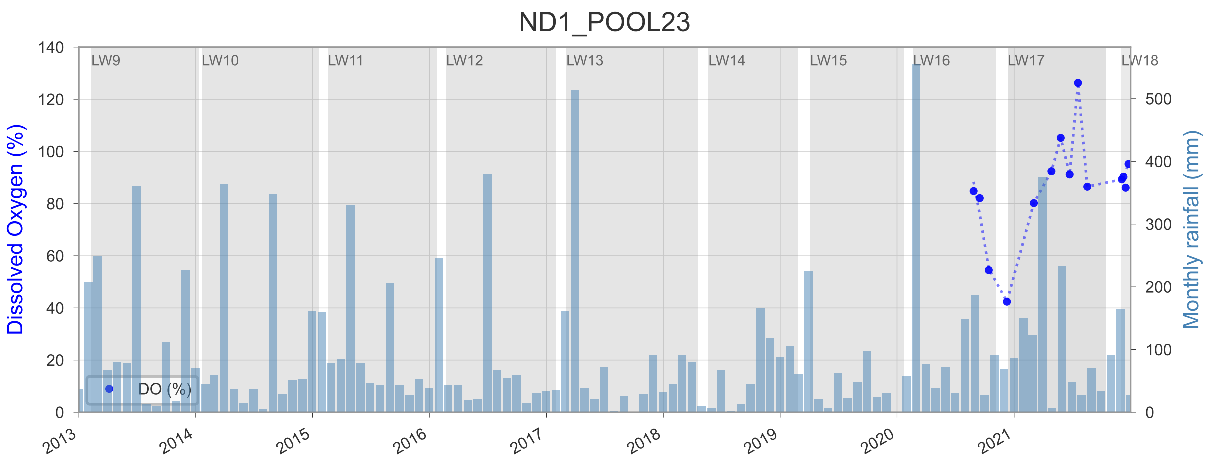

ND1_POOL2
pH units
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
Median (baseline)
P5-P95 pH

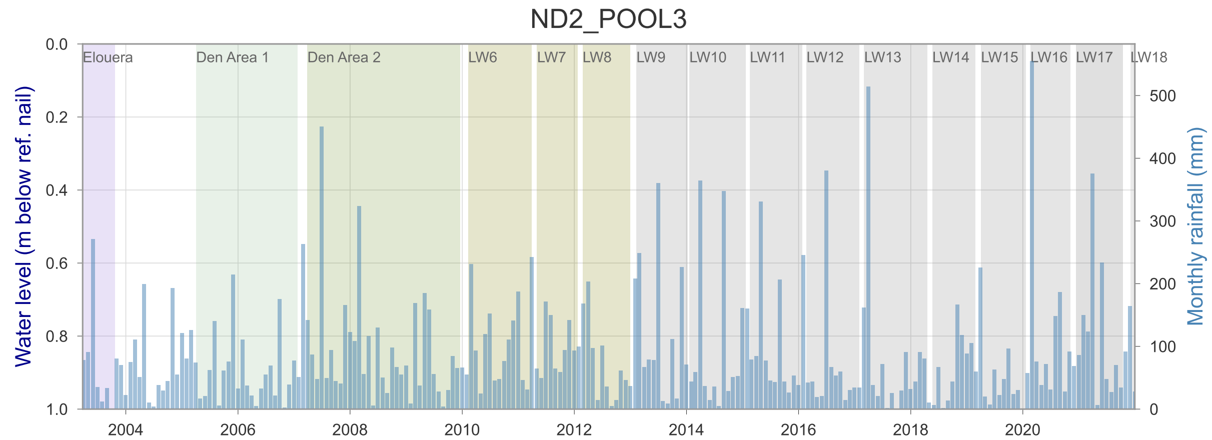

ND1_POOL2
Dissolved Oxygen (%)
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
Median (baseline)
P5-P95 DO

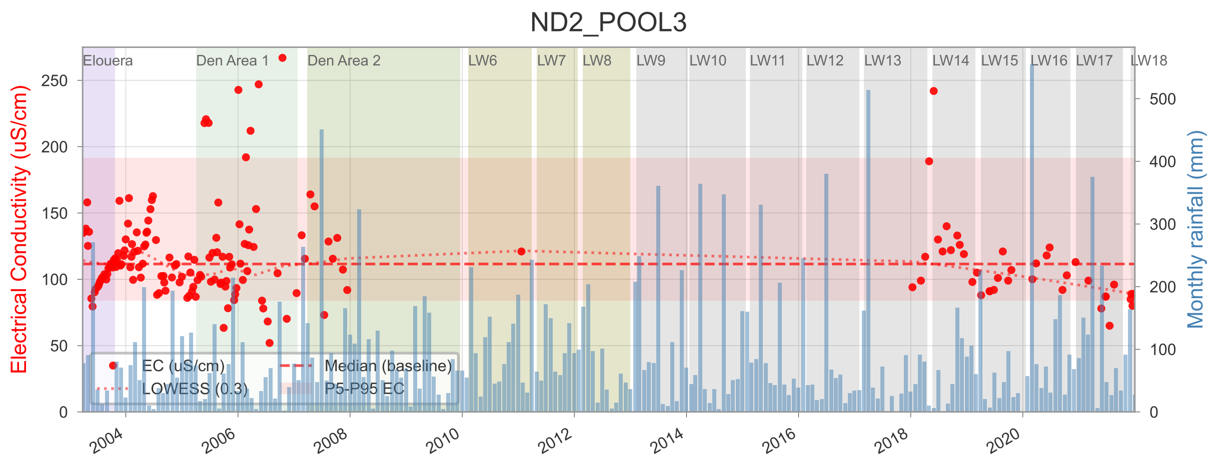

ND1_POOL23
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WL below ref nail
P5-P95 WL
Pool bottom

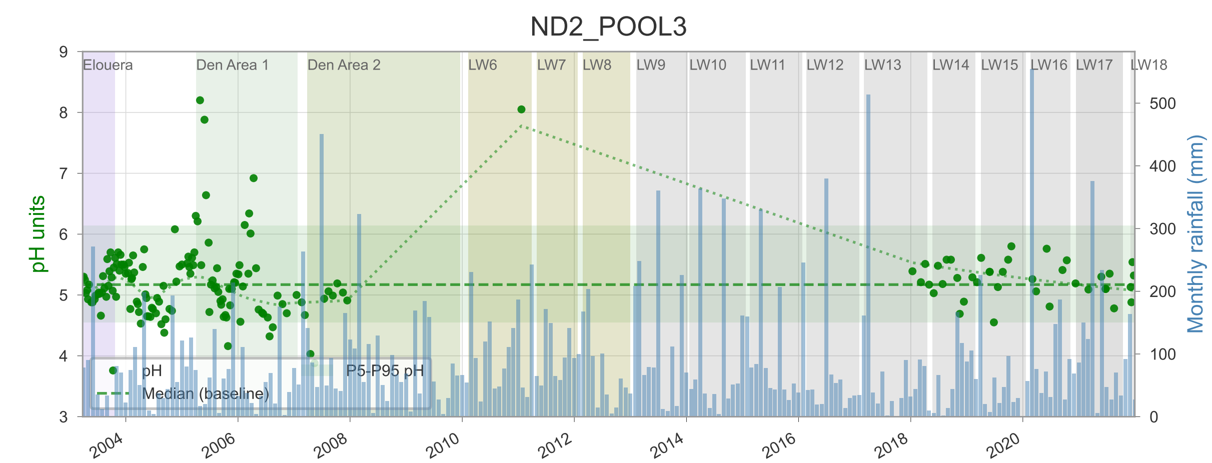

ND1_POOL23
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)

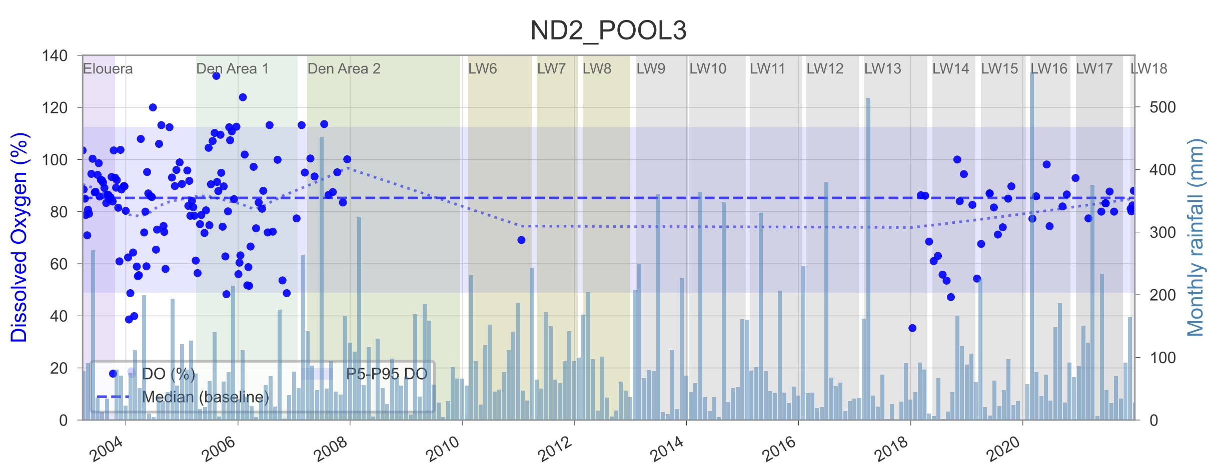

ND1_POOL23
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH

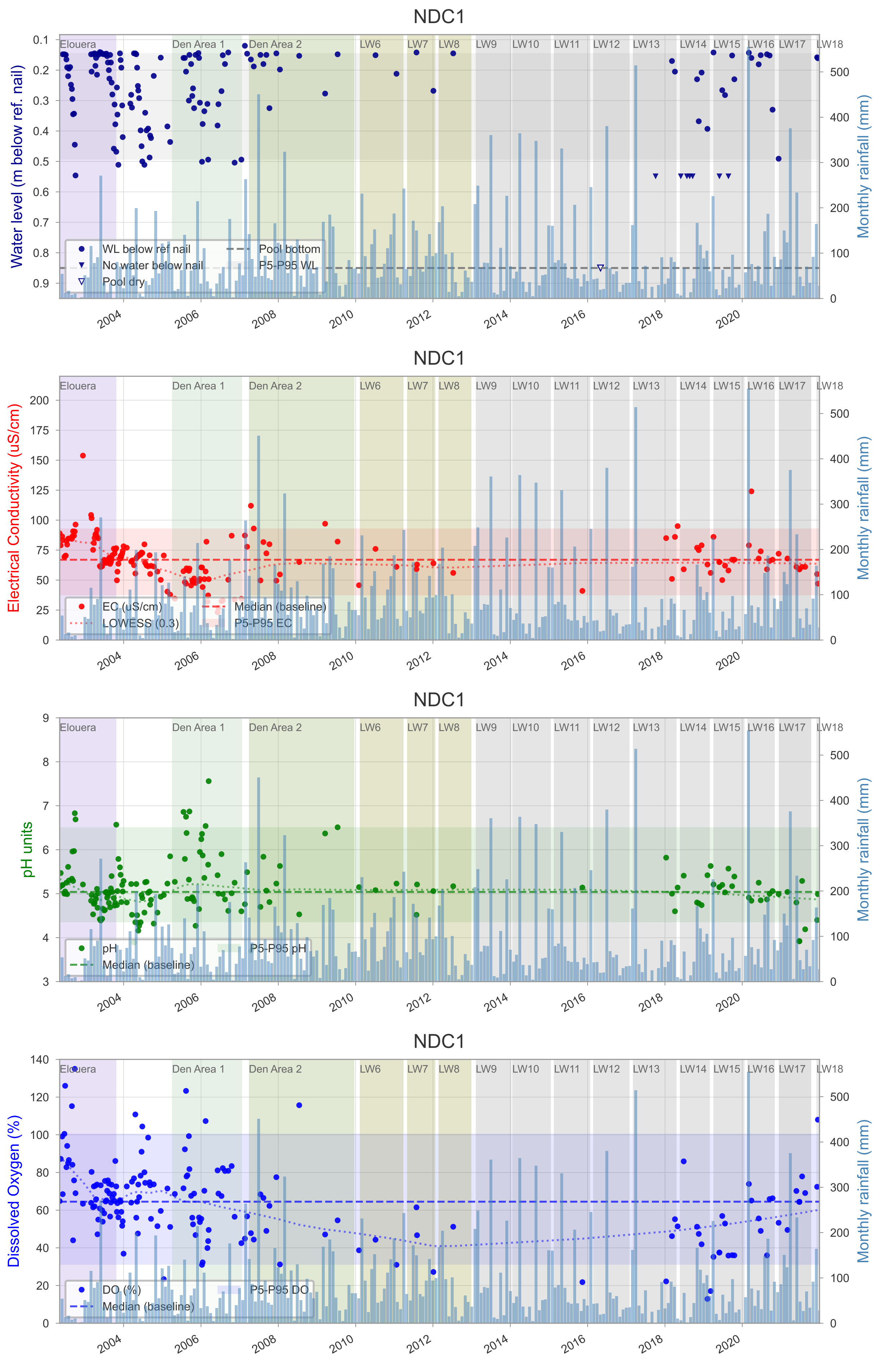

ND1_POOL23
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)

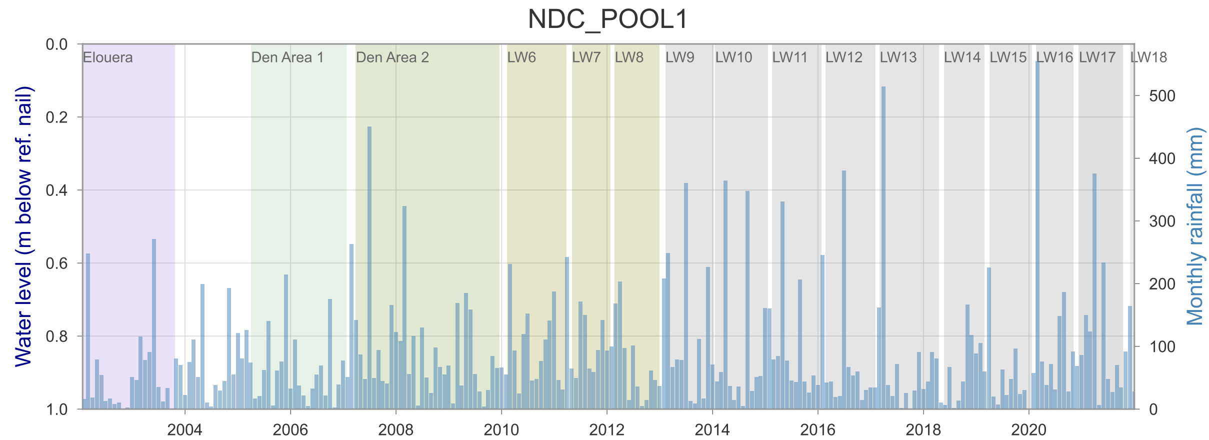

ND2_POOL3
Water level (m below ref. nail)
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

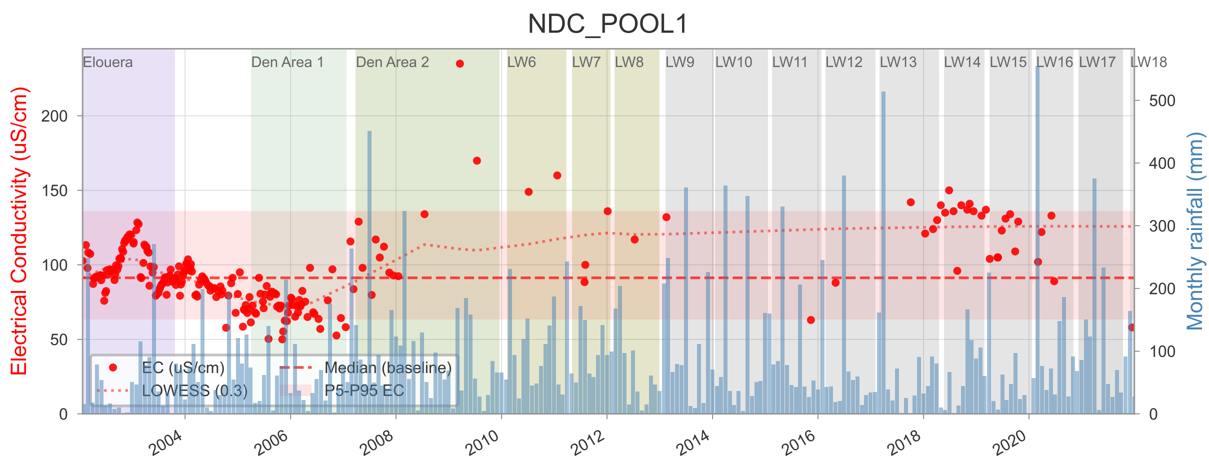

ND2_POOL3
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

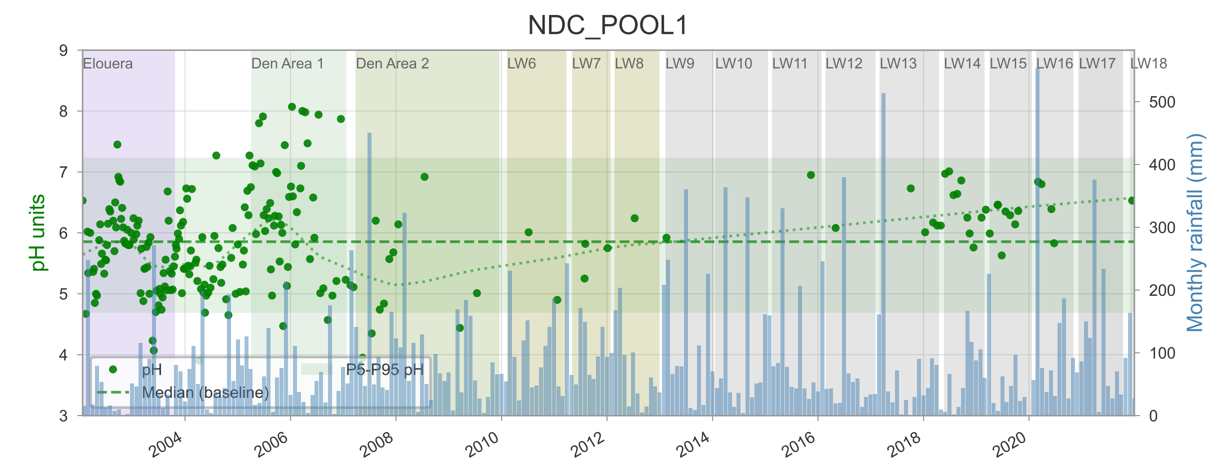

ND2_POOL3
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

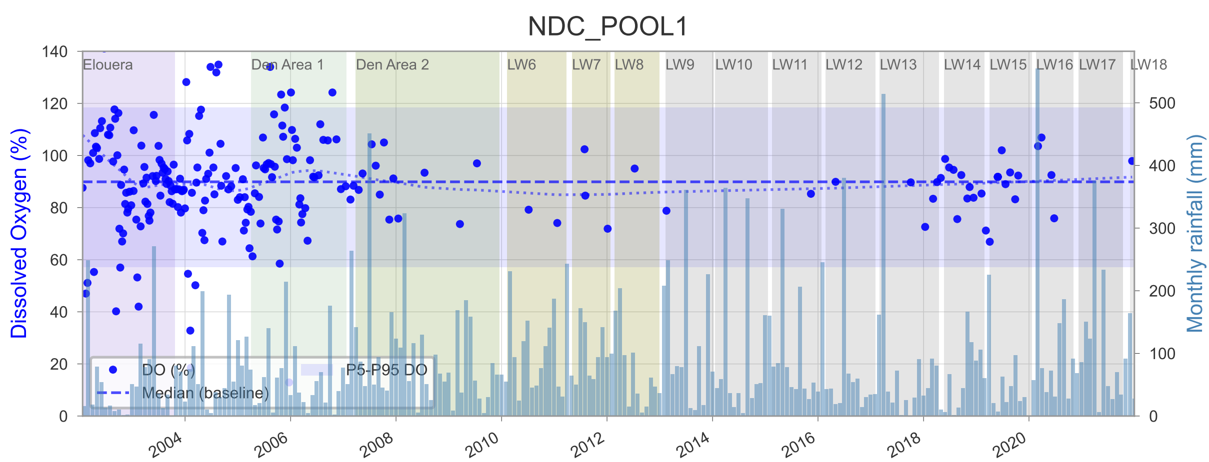

ND2_POOL3
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO


NDC1
Water level (m below ref. nail)
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL
NDC1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
NDC1
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
NDC1
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
2004
2006
2008
2010
2012
2014
2016
2018
2020

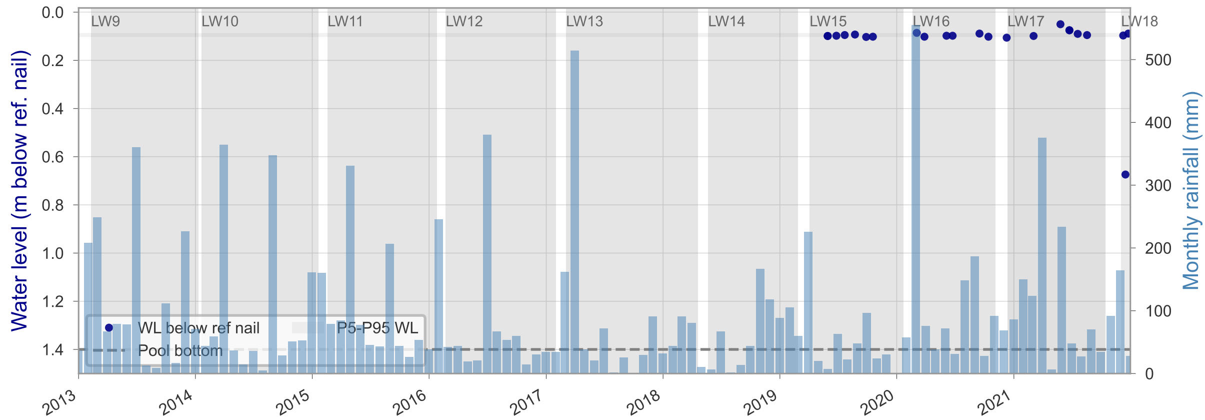

NDC_POOL1
Water level (m below ref. nail)
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18


NDC_POOL1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

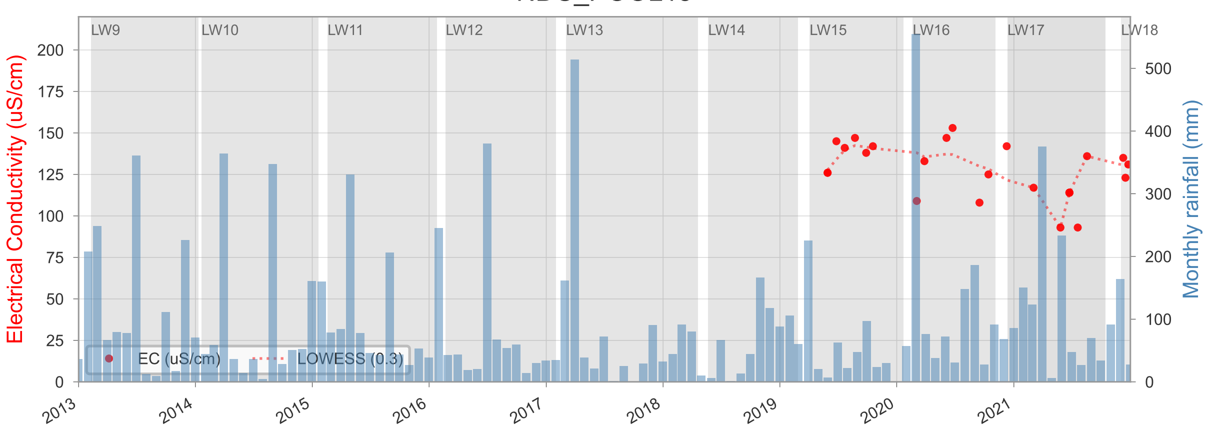

NDC_POOL1
pH units
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
Median (baseline)
P5-P95 pH


NDC_POOL1
Dissolved Oxygen (%)
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
Median (baseline)
P5-P95 DO

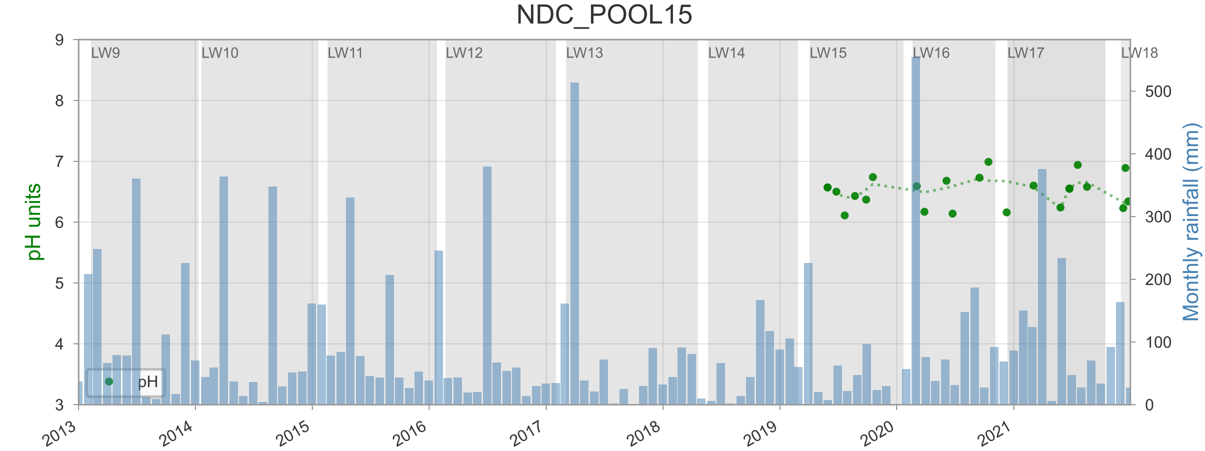
NDC_POOL15



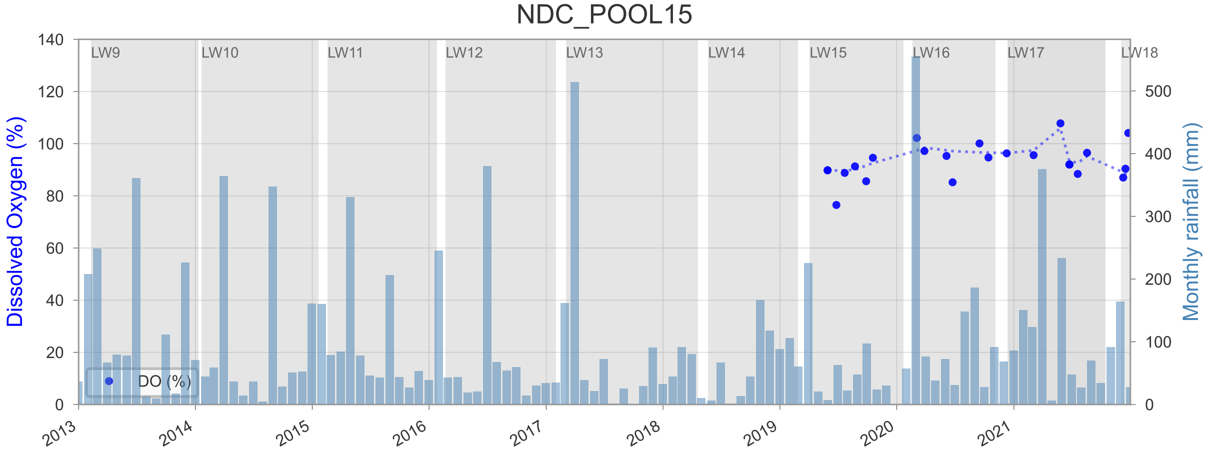
NDC_POOL15

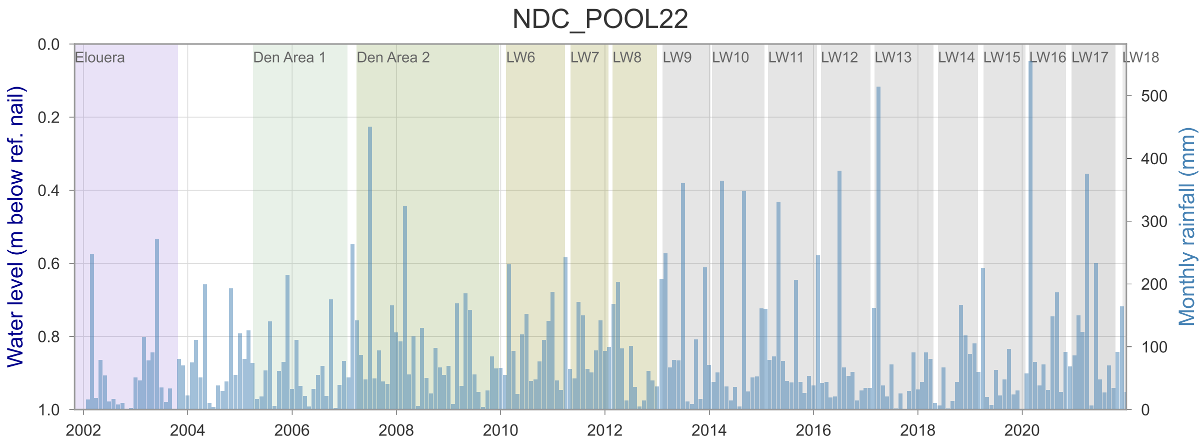


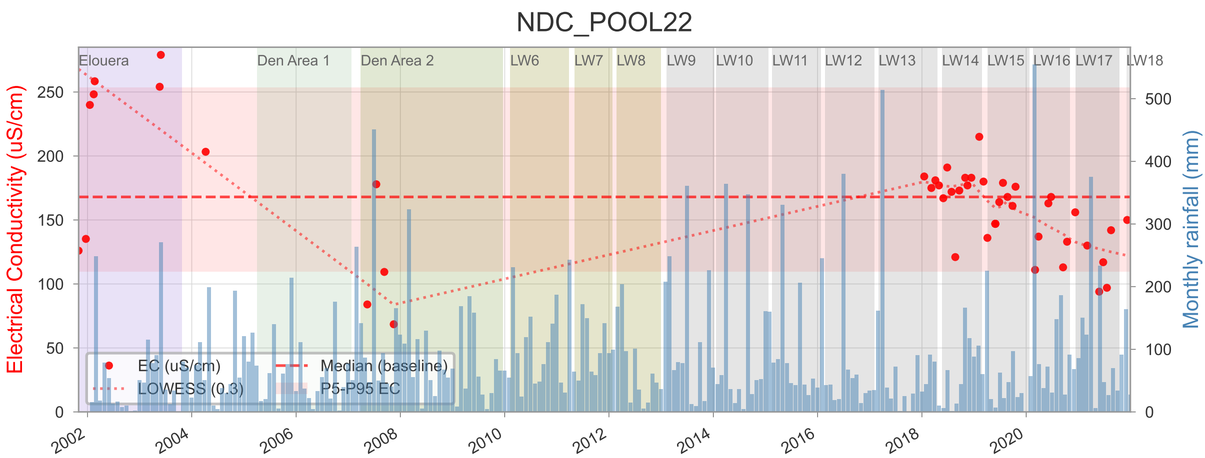
NDC_POOL15

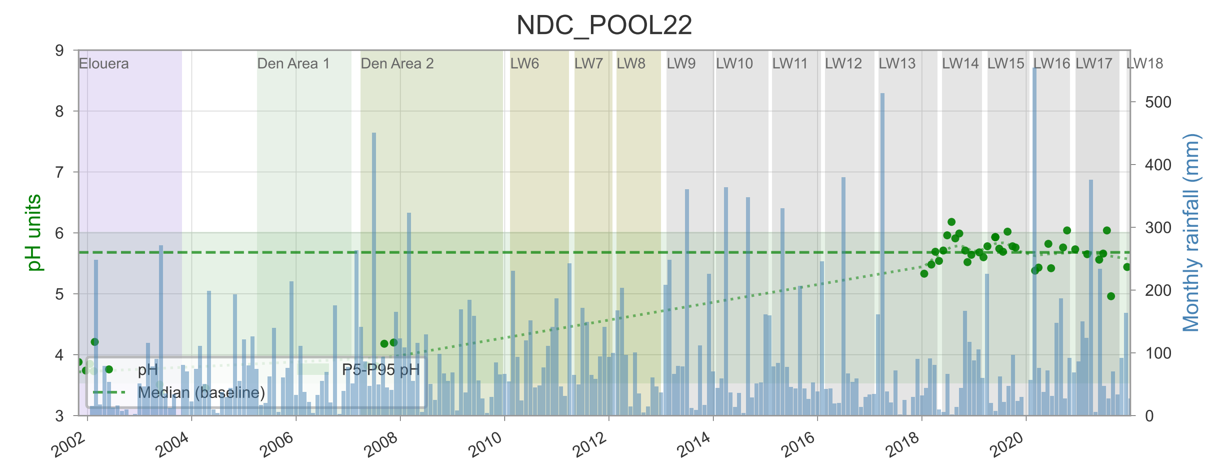


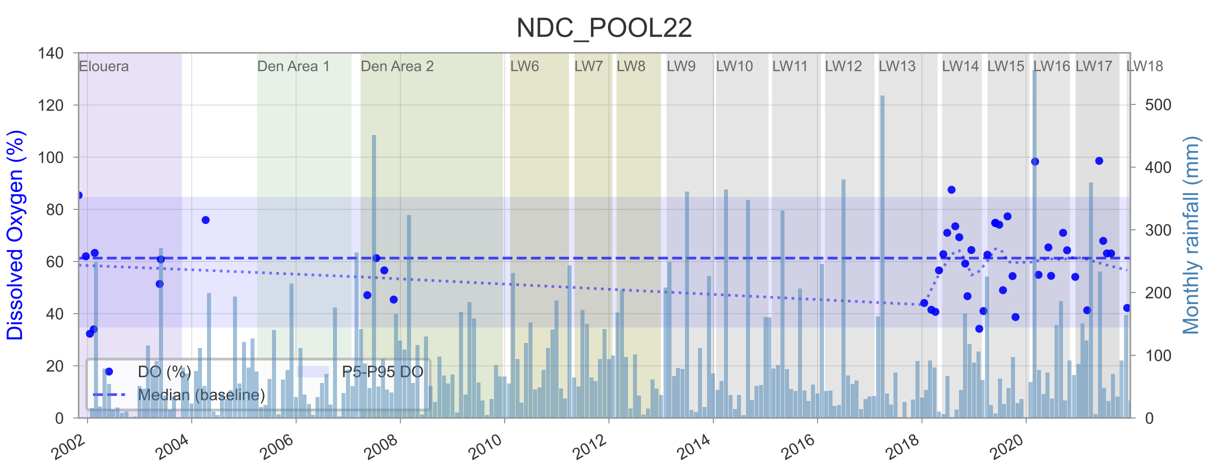
NDC_POOL15



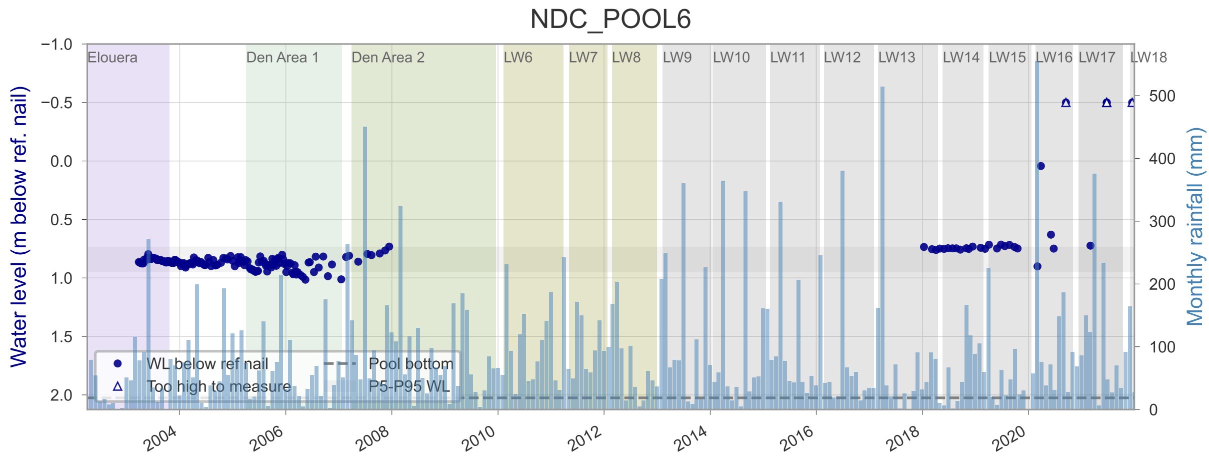

NDC_POOL22
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Water level (m below ref. nail)
Monthly rainfall (mm)

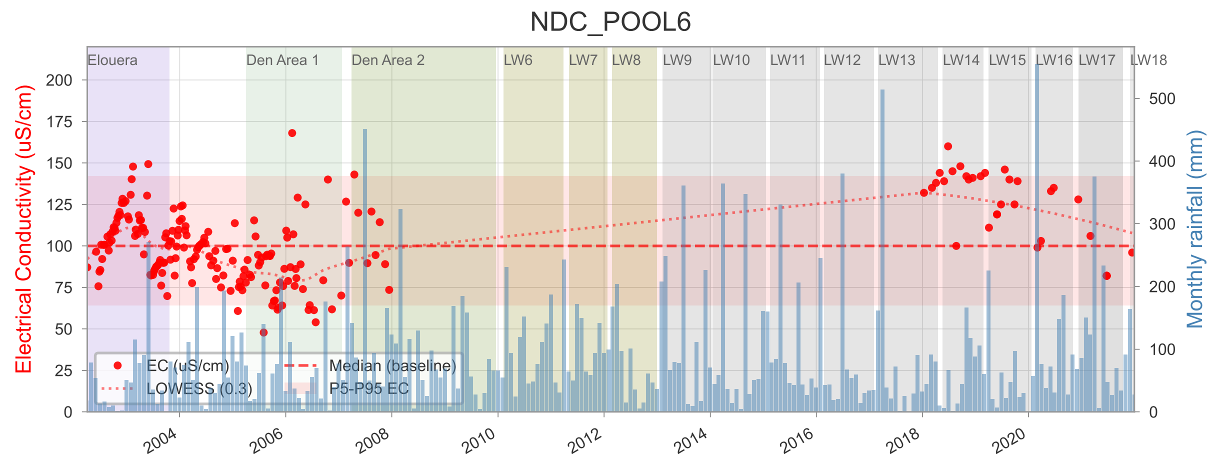

NDC_POOL22
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

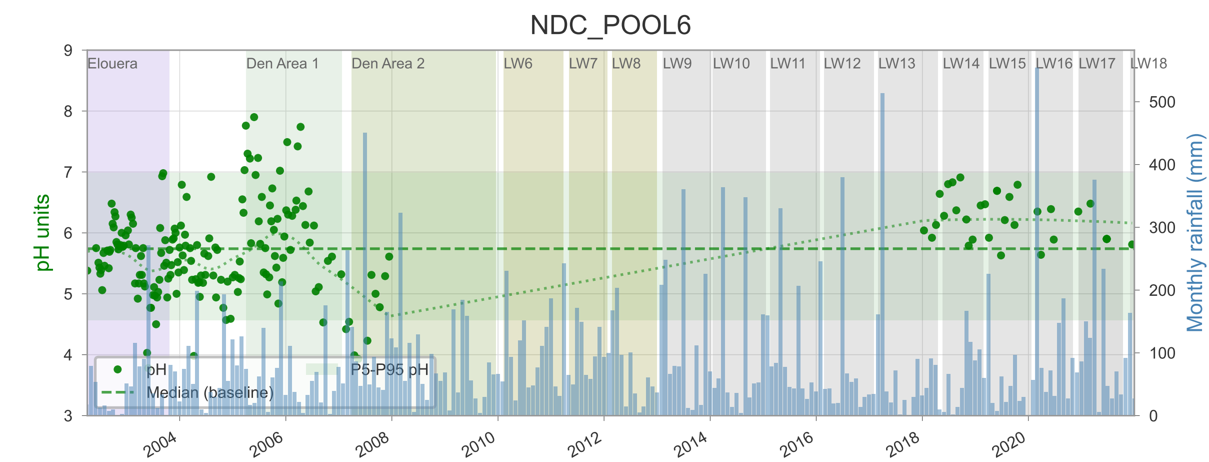

NDC_POOL22
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

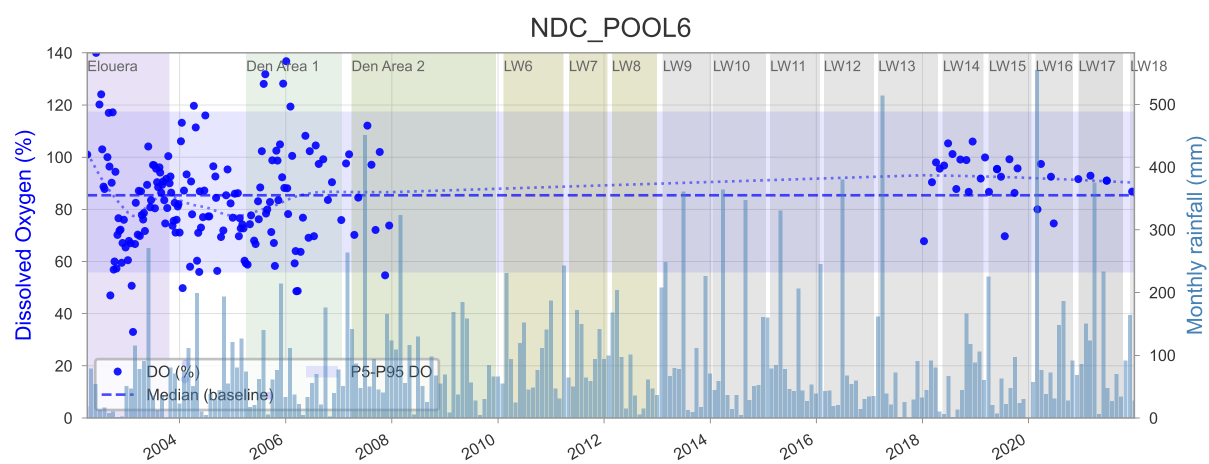

NDC_POOL22
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

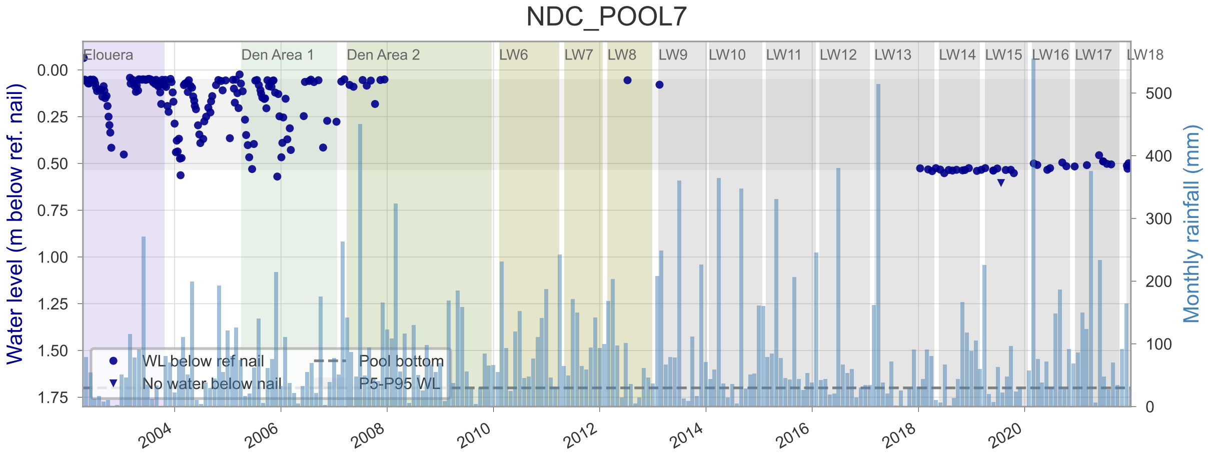
NDC_POOL25
Water level (m below ref. nail)
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
NDC_POOL25
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
NDC_POOL25
pH units
pH
Median (baseline)
P5-P95 pH
NDC_POOL25
Dissolved Oxygen (%)
DO (%)
Median (baseline)
P5-P95 DO

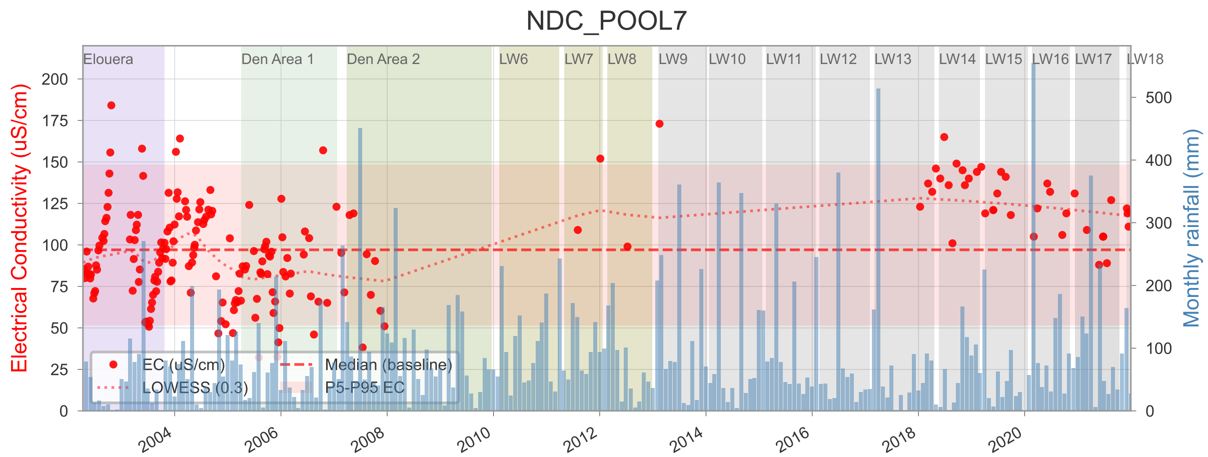

NDC_POOL6
Water level (m below ref. nail)
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WL below ref nail
Too high to measure
Pool bottom
P5-P95 WL
−1.0
−0.5
0.0
0.5
1.0
1.5
2.0
0
100
200
300
400
500
2004
2006
2008
2010
2012
2014
2016
2018
2020

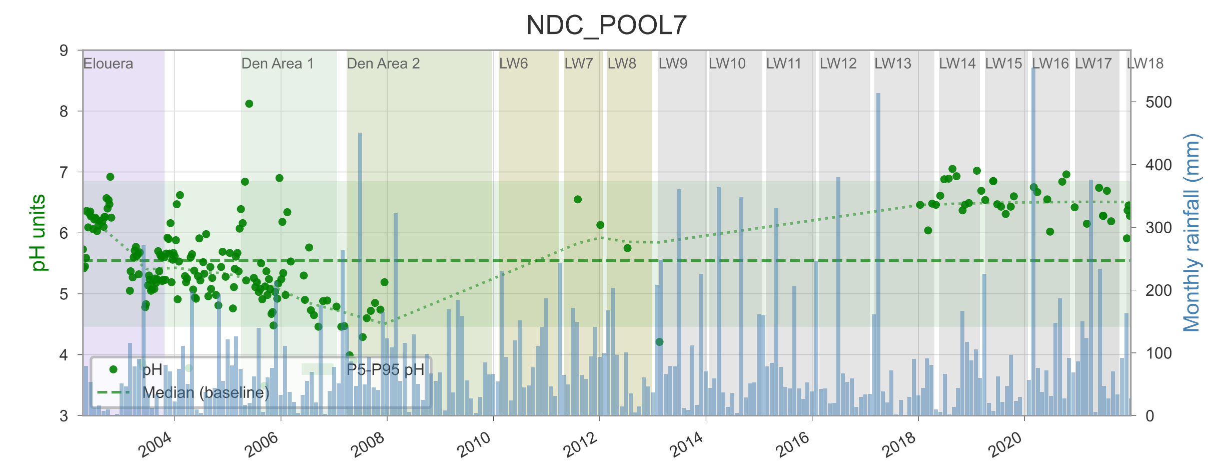

NDC_POOL6
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2004
2006
2008
2010
2012
2014
2016
2018
2020

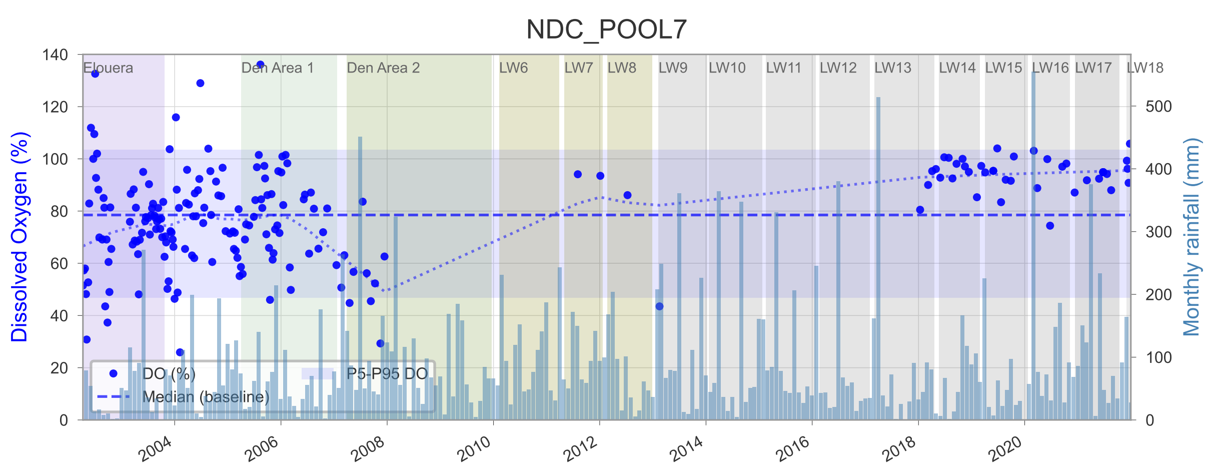

NDC_POOL6
pH units
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
Median (baseline)
P5-P95 pH
3
4
5
6
7
8
9
0
100
200
300
400
500
2004
2006
2008
2010
2012
2014
2016
2018
2020

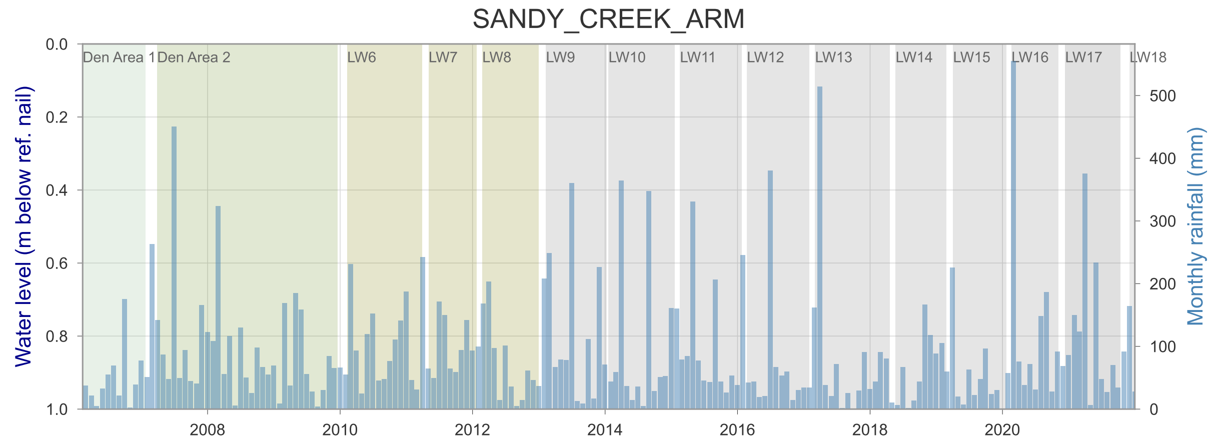

NDC_POOL6
Dissolved Oxygen (%)
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
Median (baseline)
P5-P95 DO
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2004
2006
2008
2010
2012
2014
2016
2018
2020

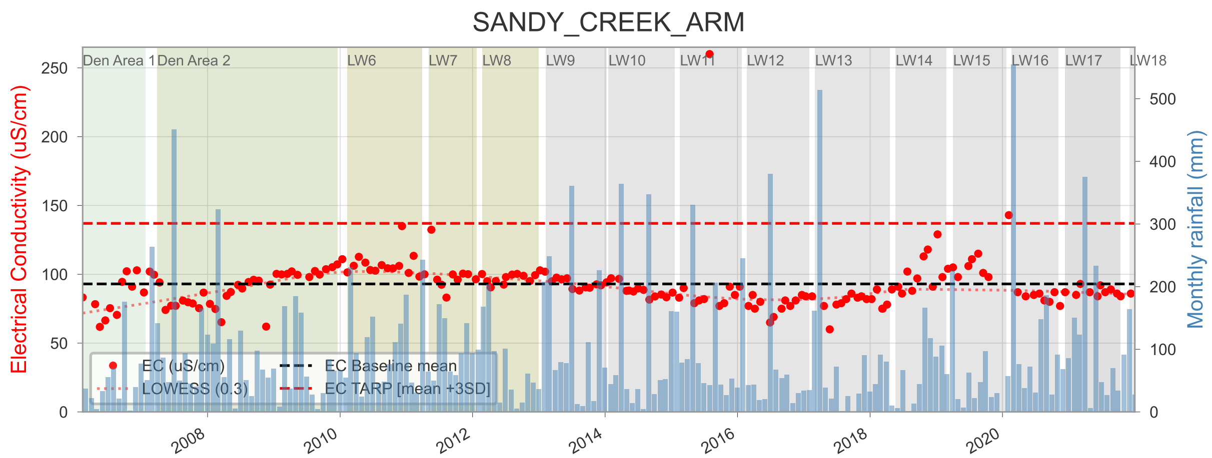

NDC_POOL7
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool bottom
P5-P95 WL

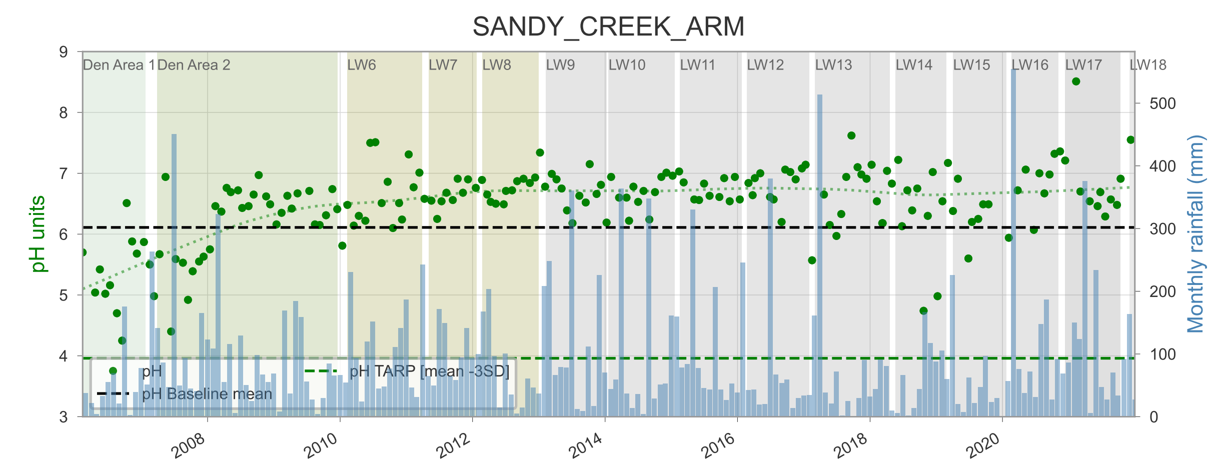

NDC_POOL7
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

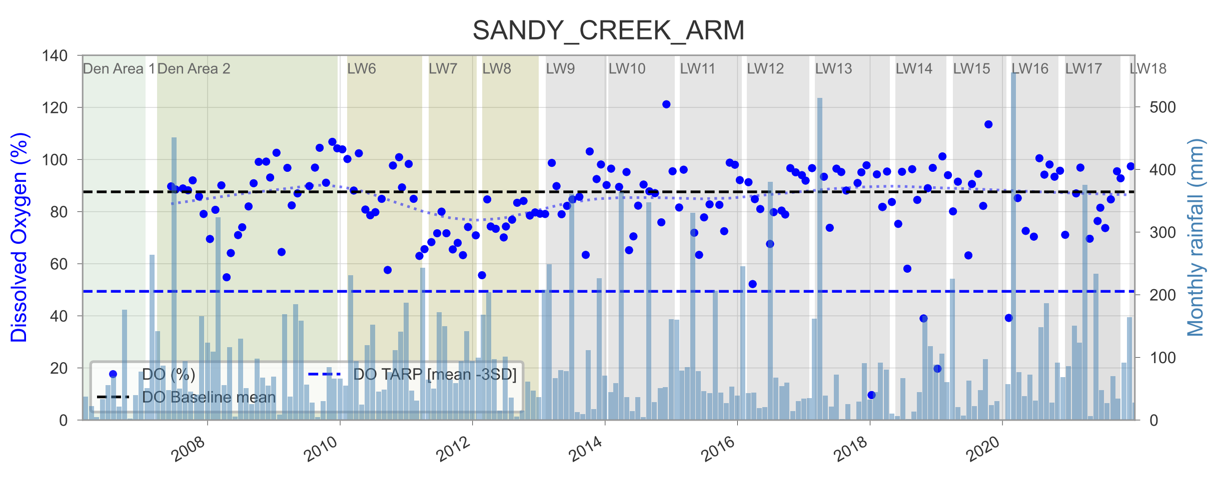

NDC_POOL7
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH


NDC_POOL7
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

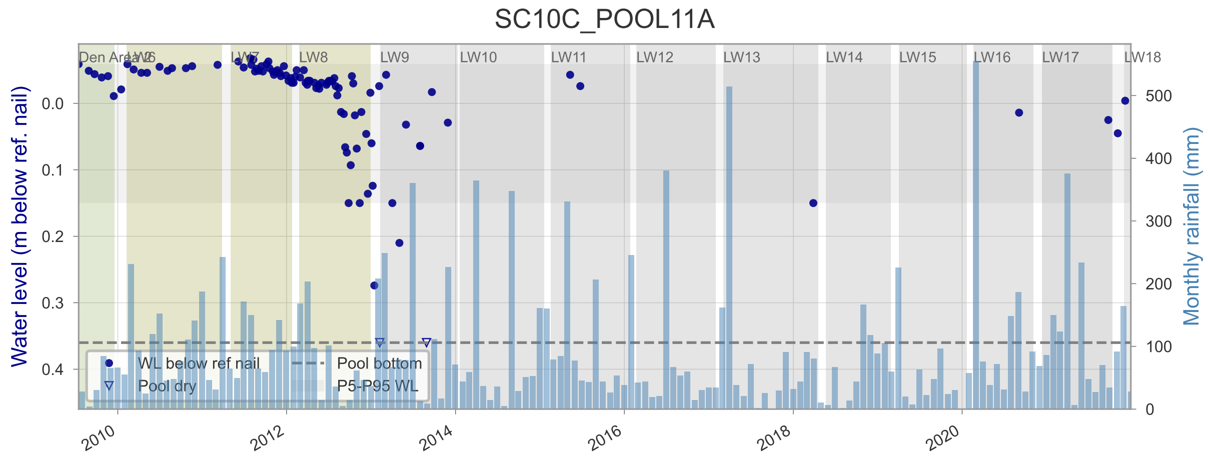

SANDY_CREEK_ARM
Water level (m below ref. nail)
Monthly rainfall (mm)
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

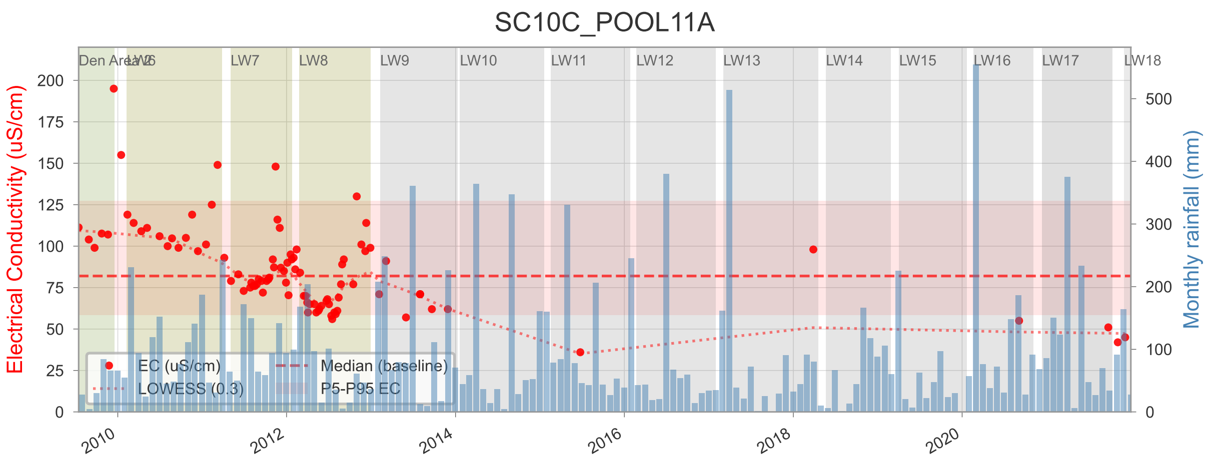

SANDY_CREEK_ARM
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)
EC Baseline mean
EC TARP [mean +3SD]

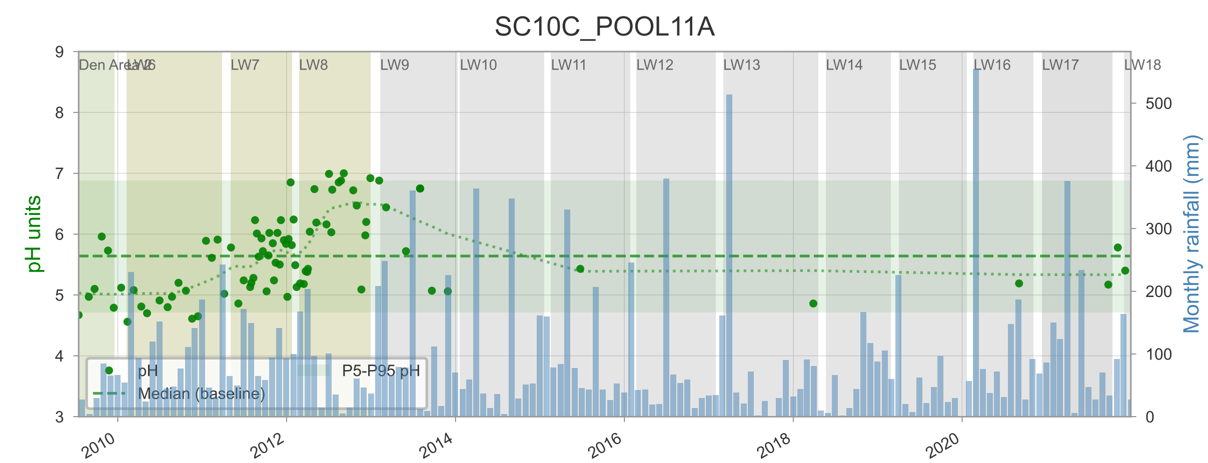

SANDY_CREEK_ARM
pH units
Monthly rainfall (mm)
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
pH Baseline mean
pH TARP [mean -3SD]

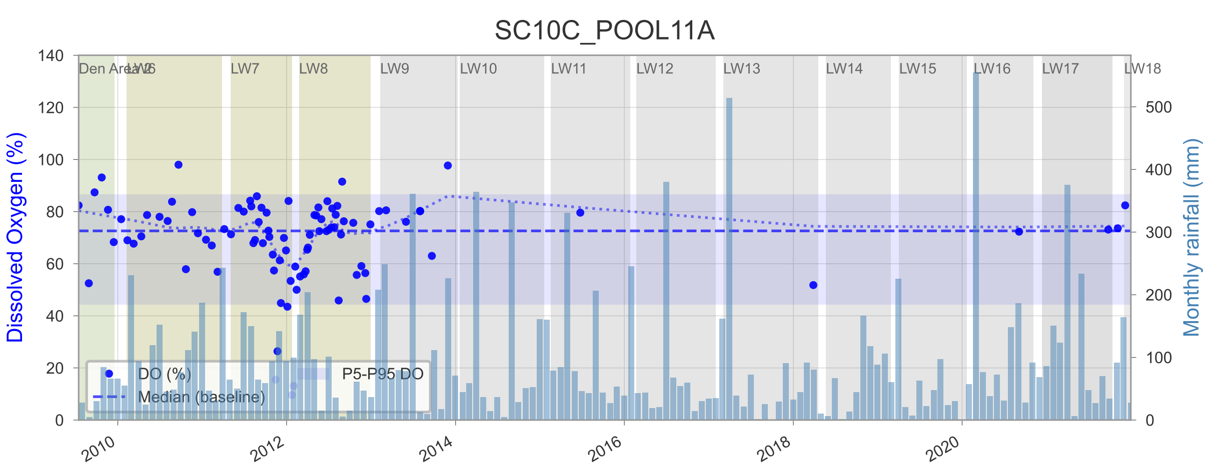

SANDY_CREEK_ARM
Dissolved Oxygen (%)
Monthly rainfall (mm)
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
DO Baseline mean
DO TARP [mean -3SD]

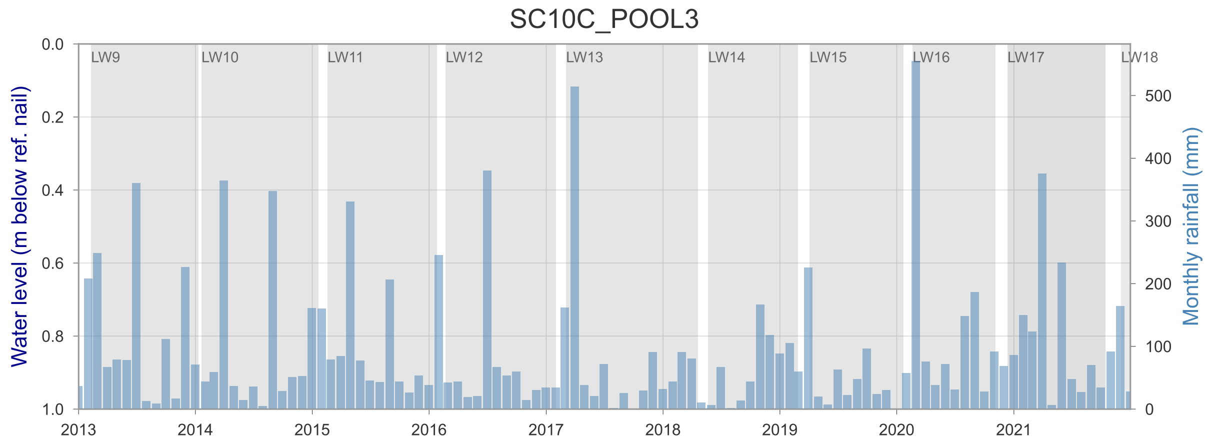
SC10CS1
Stream flow (ML/day)
Monthly rainfall (mm)
Flow (ML/d)
P5-P95 flow
SC10C_POOL1
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
pH units
pH
P5-P95 pH
Dissolved Oxygen (%)
DO (%)
P5-P95 DO
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

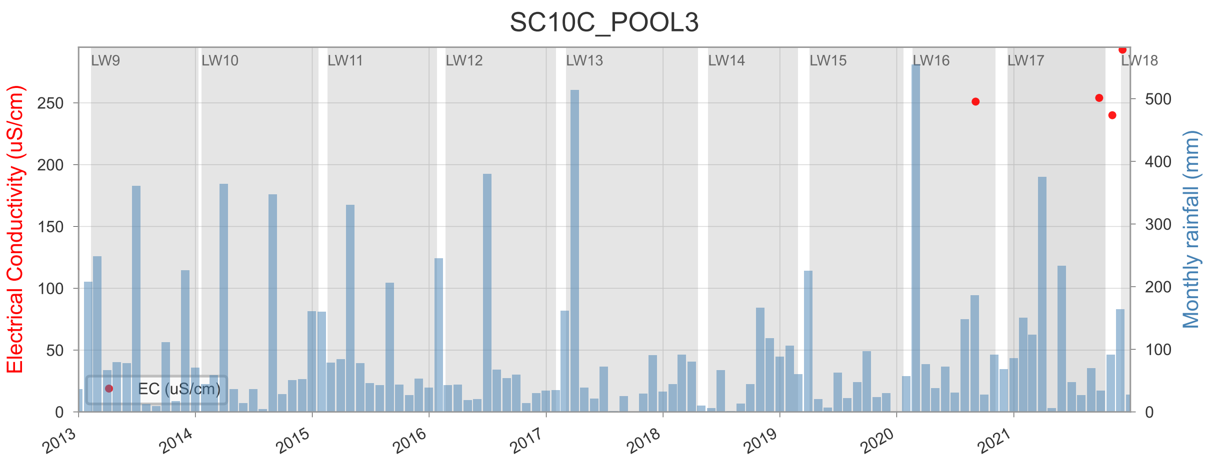

SC10C_POOL11A
Water level (m below ref. nail)
Monthly rainfall (mm)
Den Area2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WL below ref nail
Pool dry
Pool bottom
P5-P95 WL
2010
2012
2014
2016
2018
2020

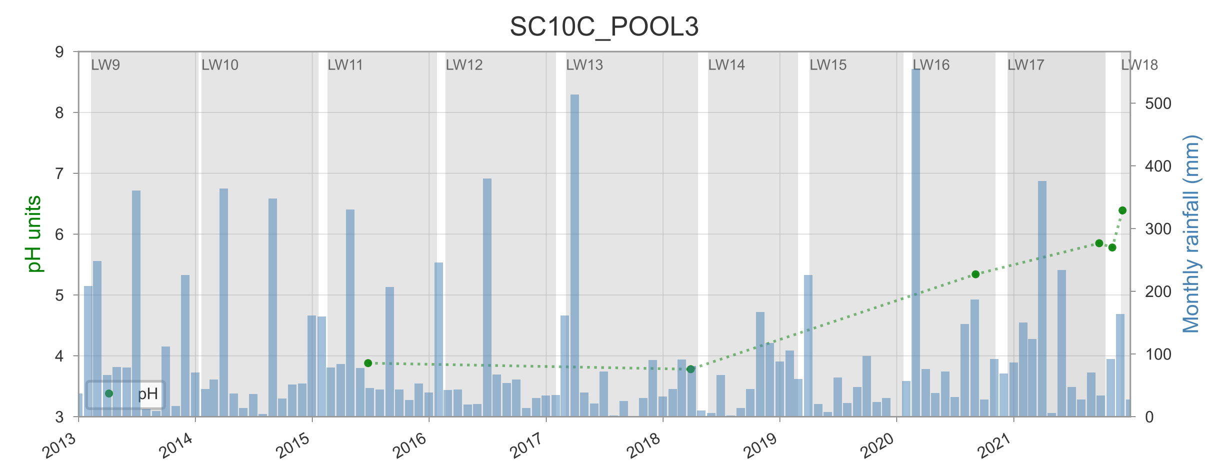

SC10C_POOL11A
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
Den Area2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
2010
2012
2014
2016
2018
2020

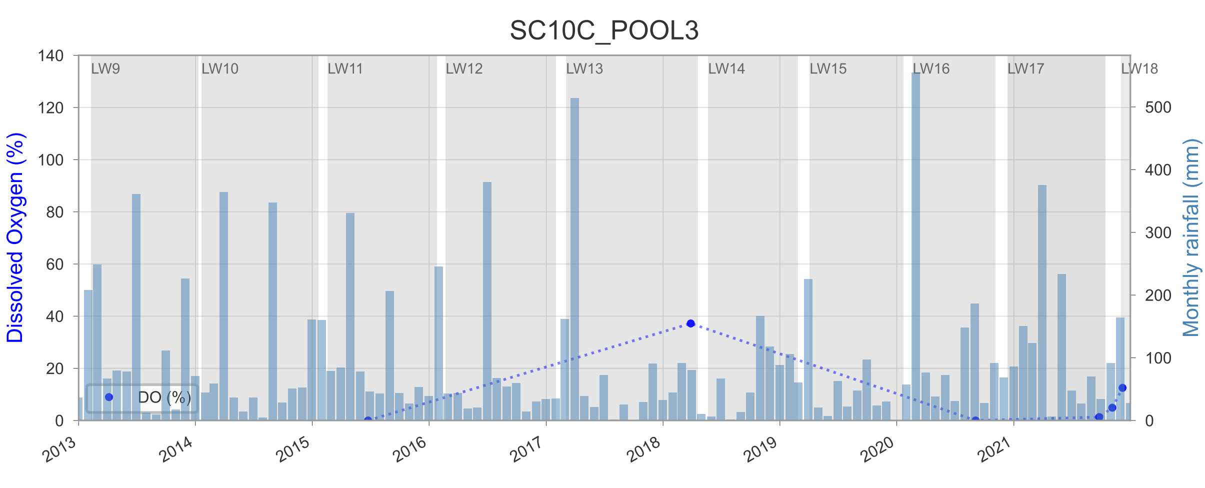

SC10C_POOL11A
pH units
Monthly rainfall (mm)
Den Area2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
Median (baseline)
P5-P95 pH
2010
2012
2014
2016
2018
2020

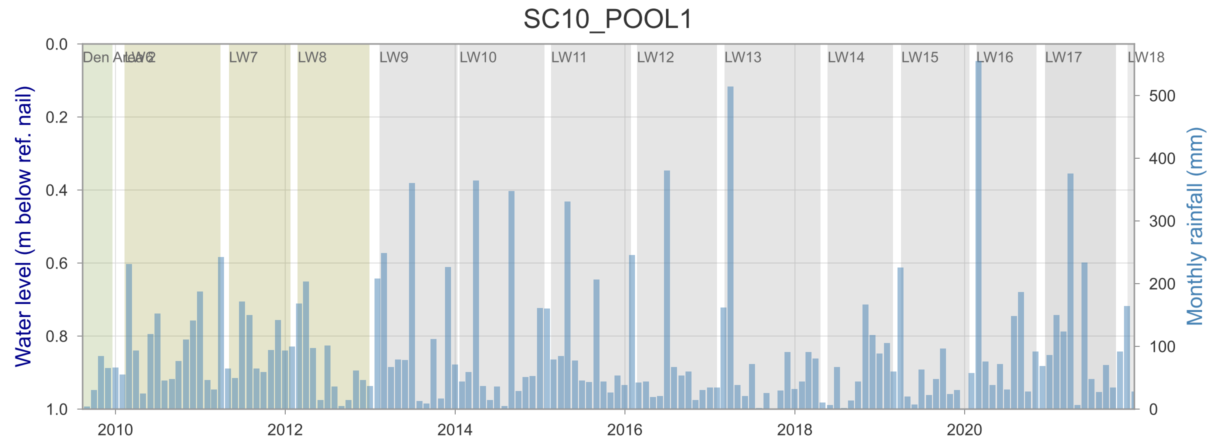

SC10C_POOL11A
Dissolved Oxygen (%)
Monthly rainfall (mm)
Den Area2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
Median (baseline)
P5-P95 DO
2010
2012
2014
2016
2018
2020

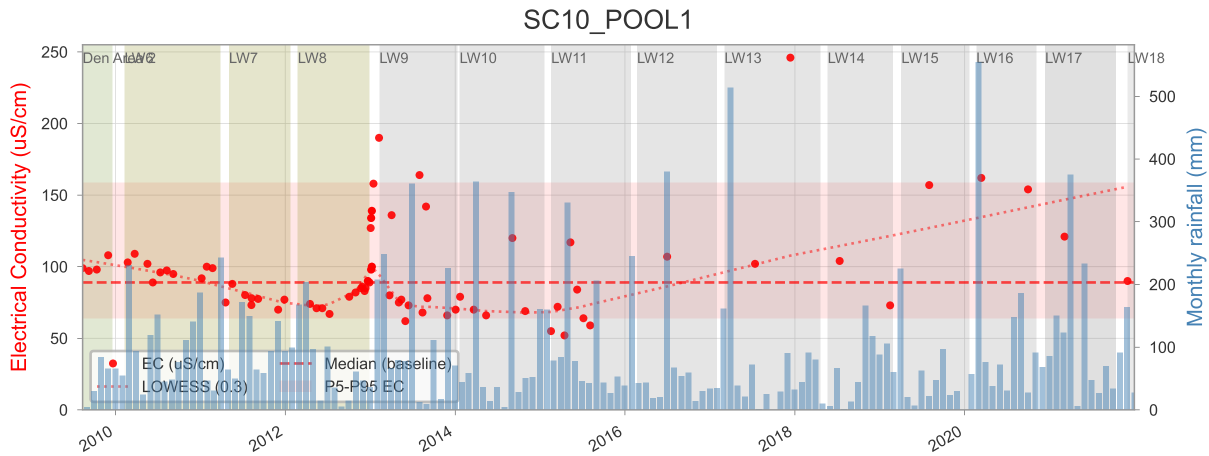

SC10C_POOL3
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

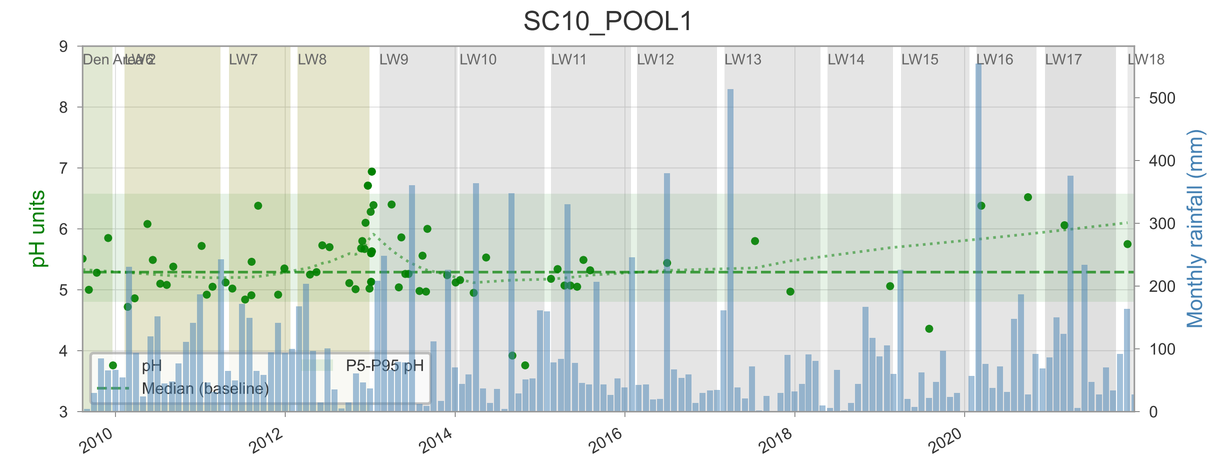

SC10C_POOL3
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

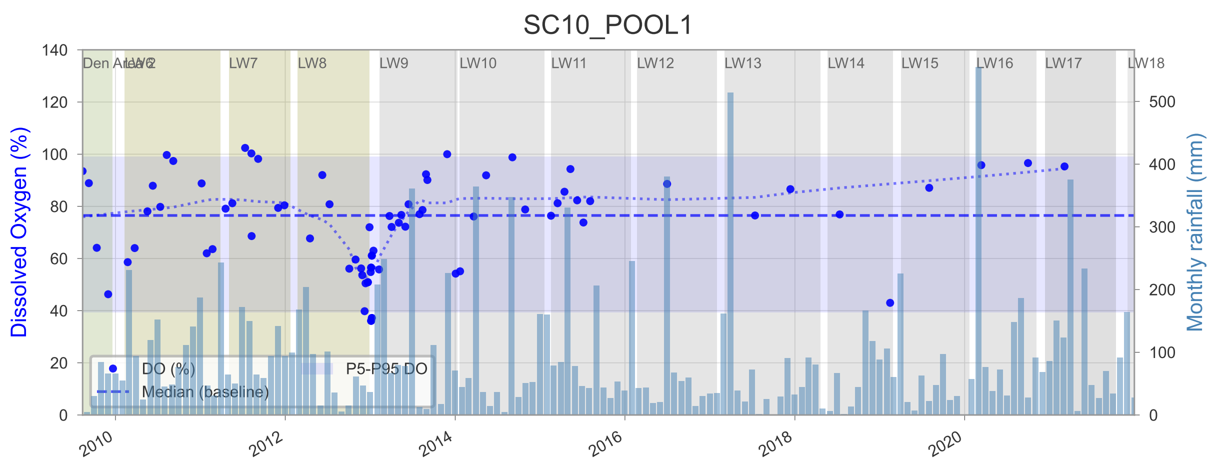

SC10C_POOL3
pH units
Monthly rainfall (mm)
pH
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

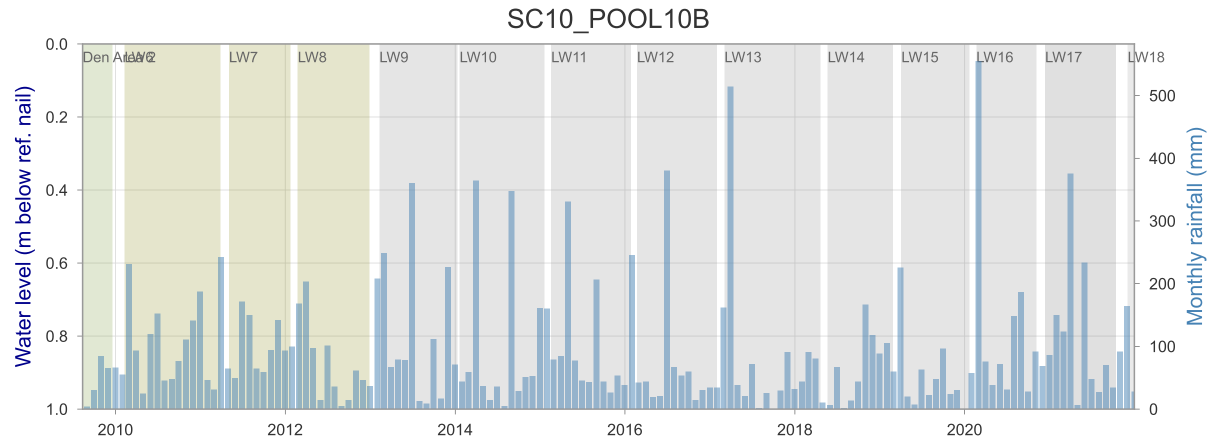

SC10C_POOL3
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

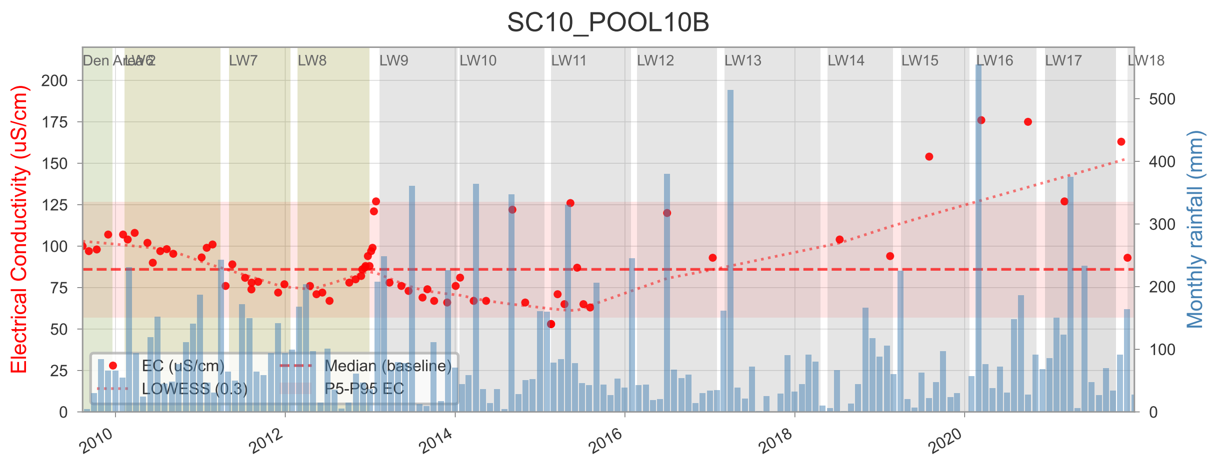

SC10_POOL1
Water level (m below ref. nail)
Monthly rainfall (mm)
Den Area
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

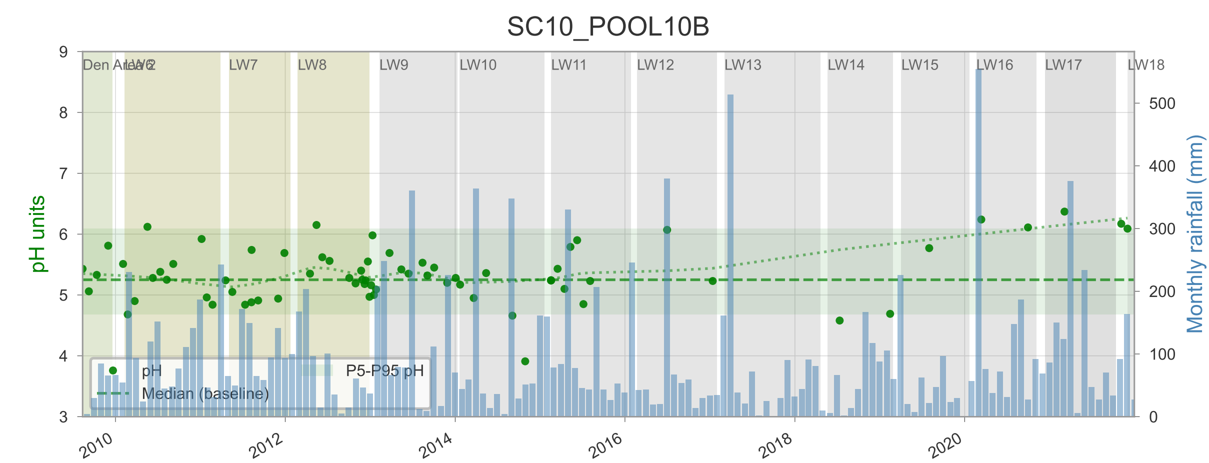

SC10_POOL1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

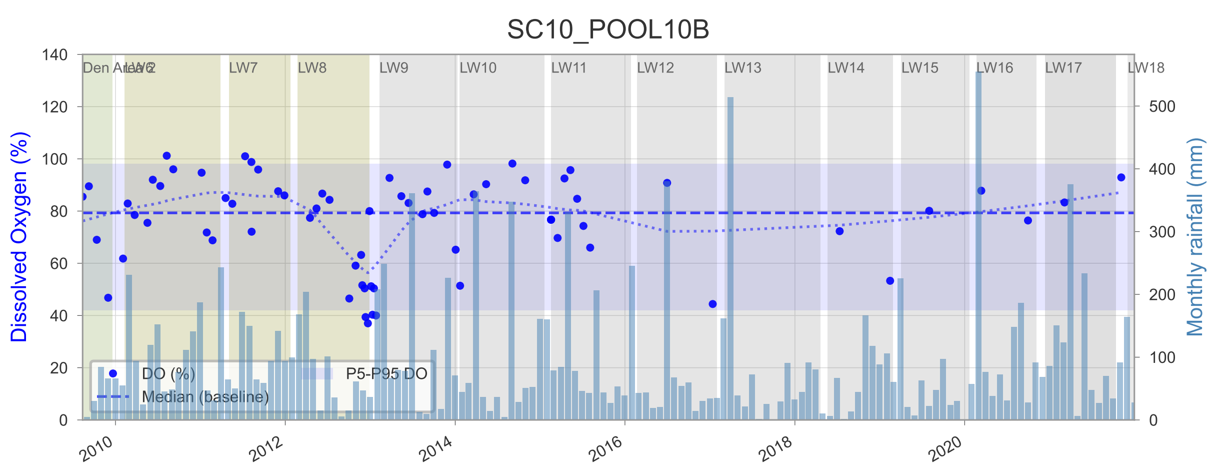

SC10_POOL1
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

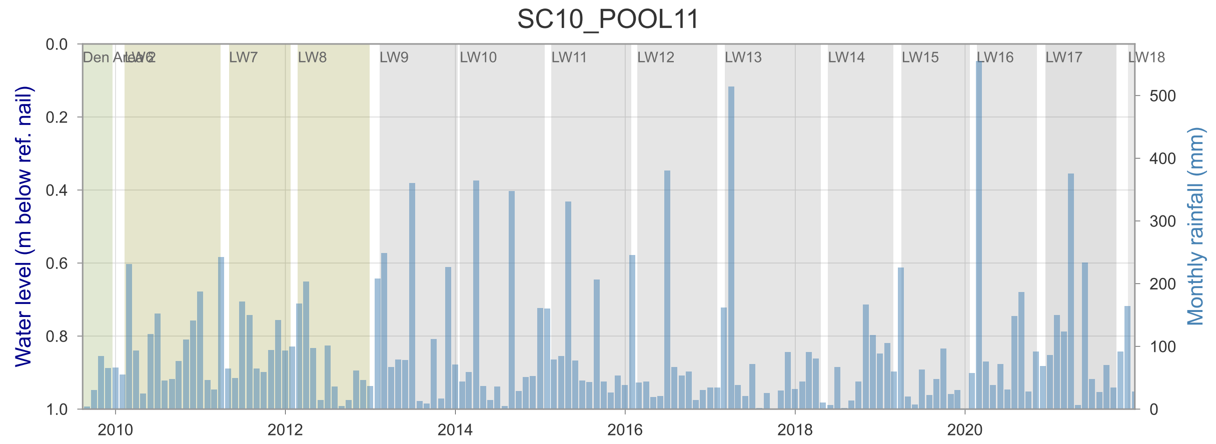

SC10_POOL1
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

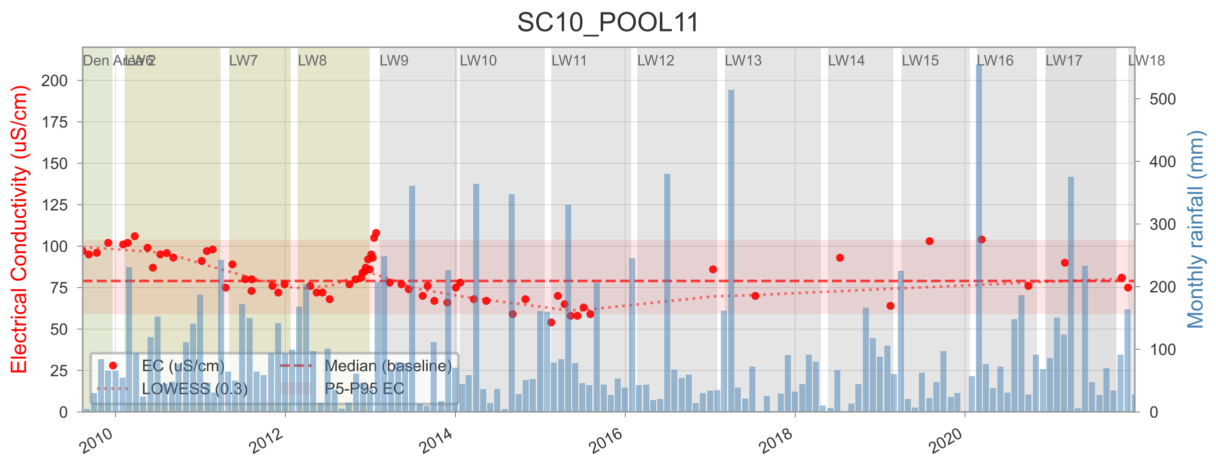

SC10_POOL10B
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Water level (m below ref. nail)
Monthly rainfall (mm)

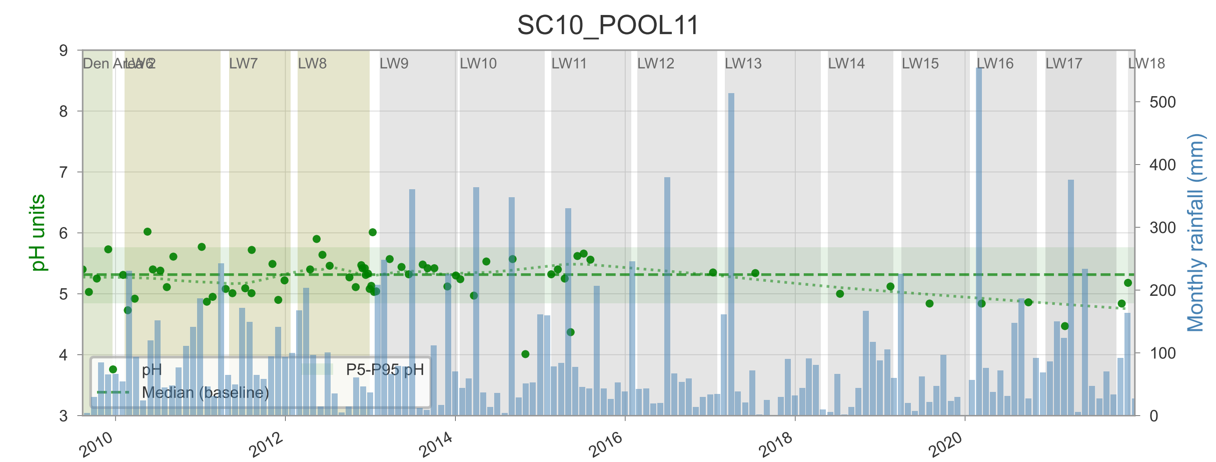

SC10_POOL10B
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

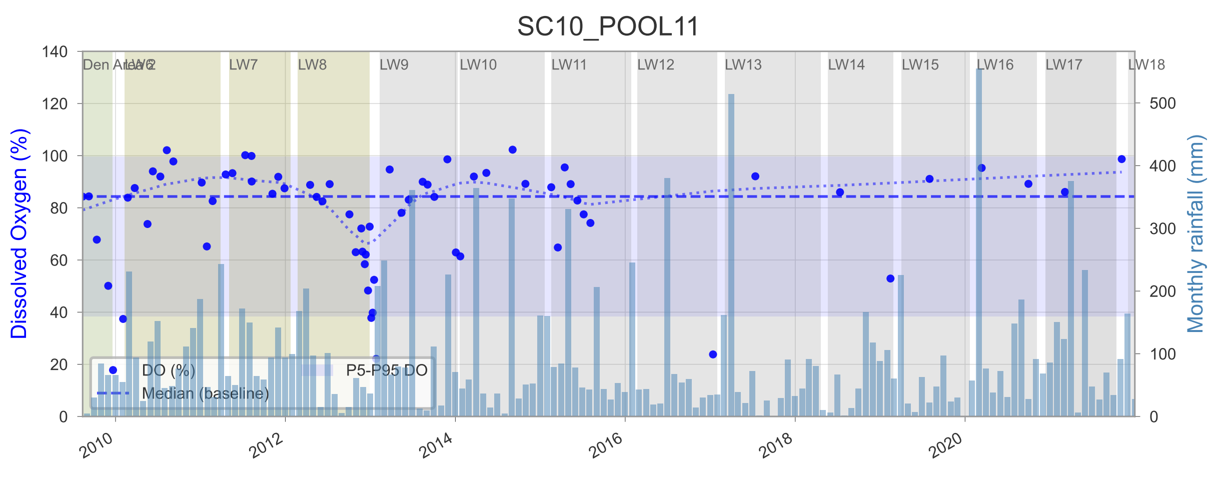

SC10_POOL10B
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

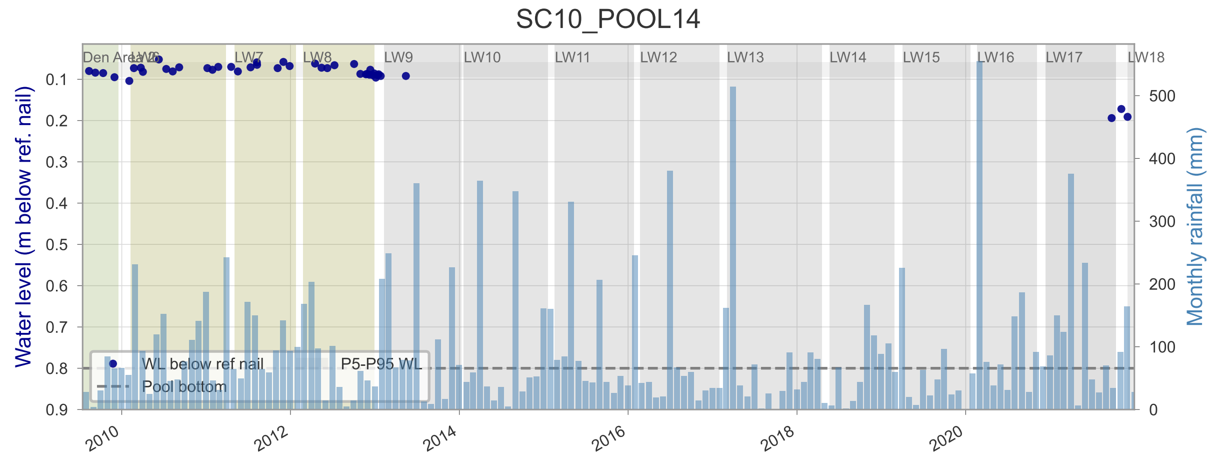

SC10_POOL10B
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

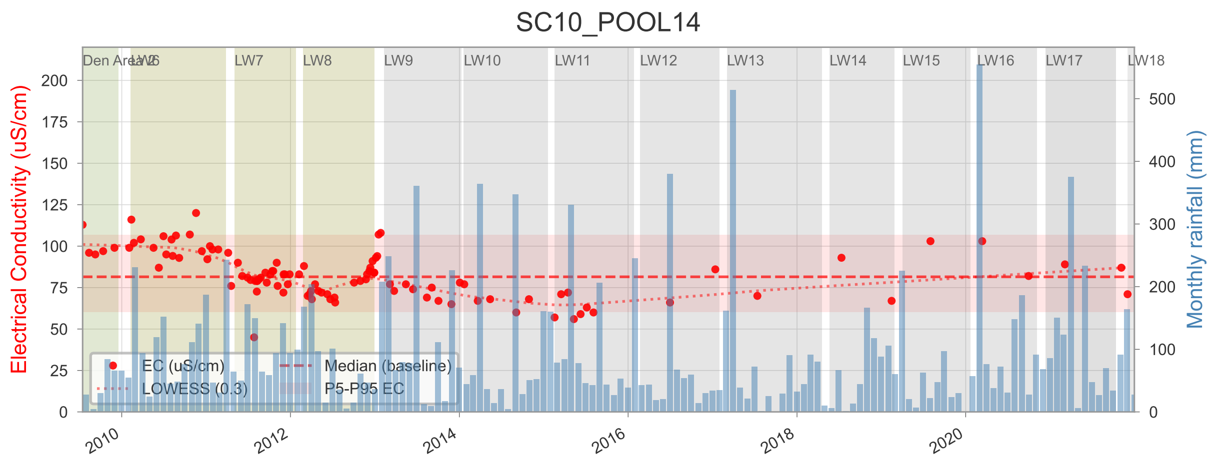

SC10_POOL11
Water level (m below ref. nail)
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

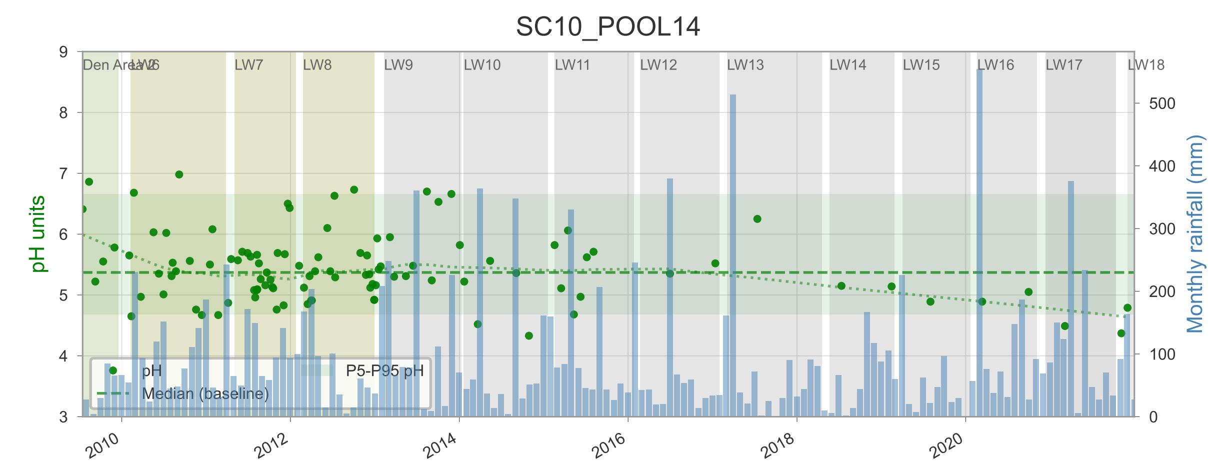

SC10_POOL11
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

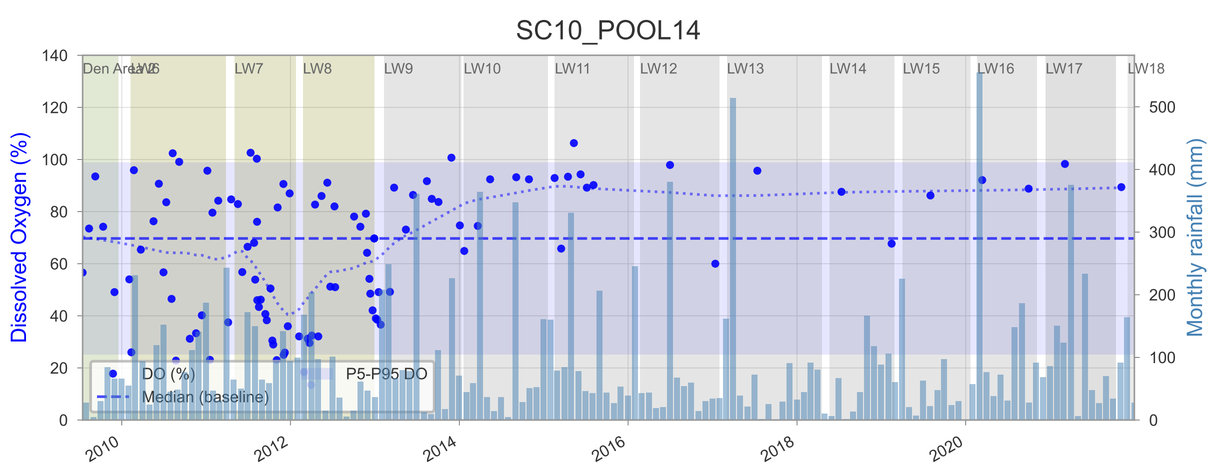

SC10_POOL11
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

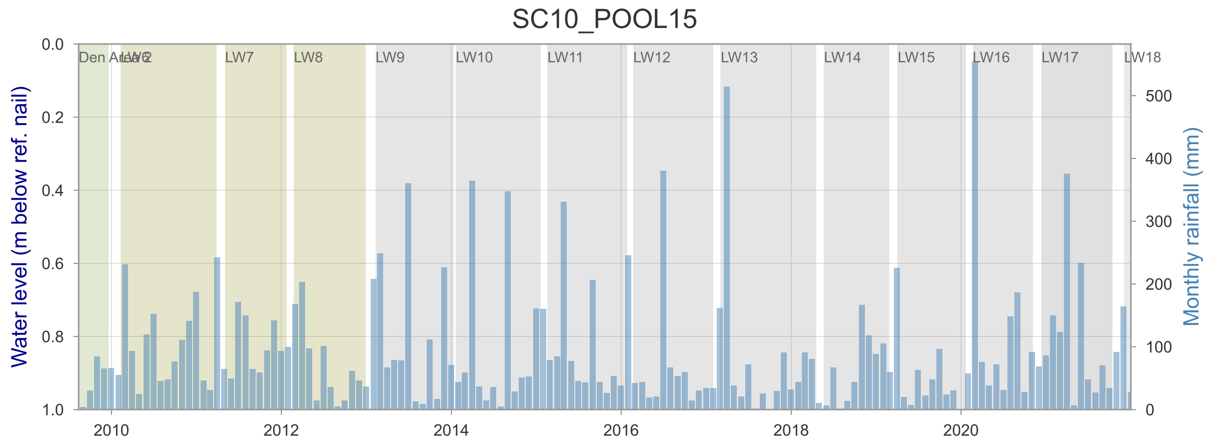

SC10_POOL11
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

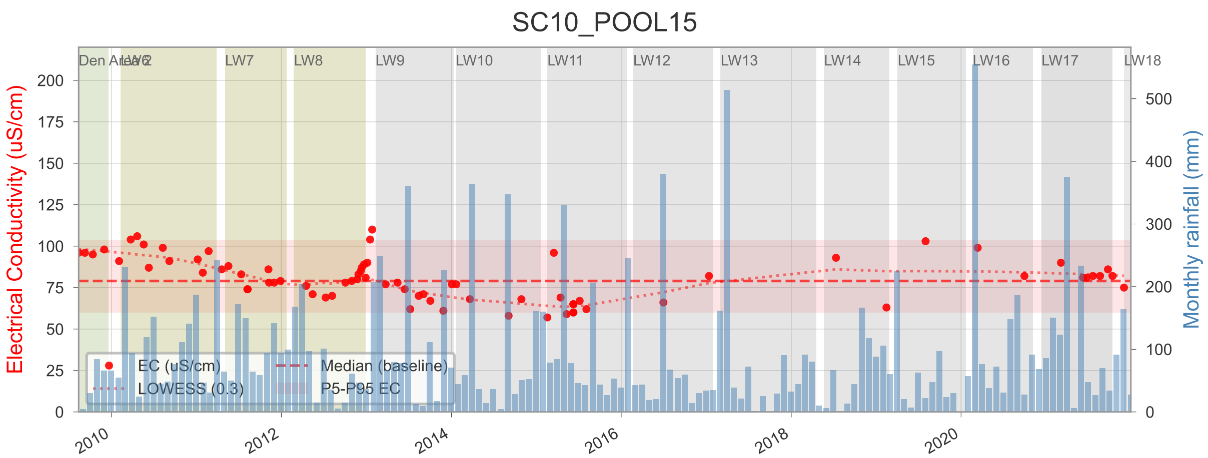

SC10_POOL14
Water level (m below ref. nail)
Monthly rainfall (mm)
Den Area LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WL below ref nail
Pool bottom
P5-P95 WL

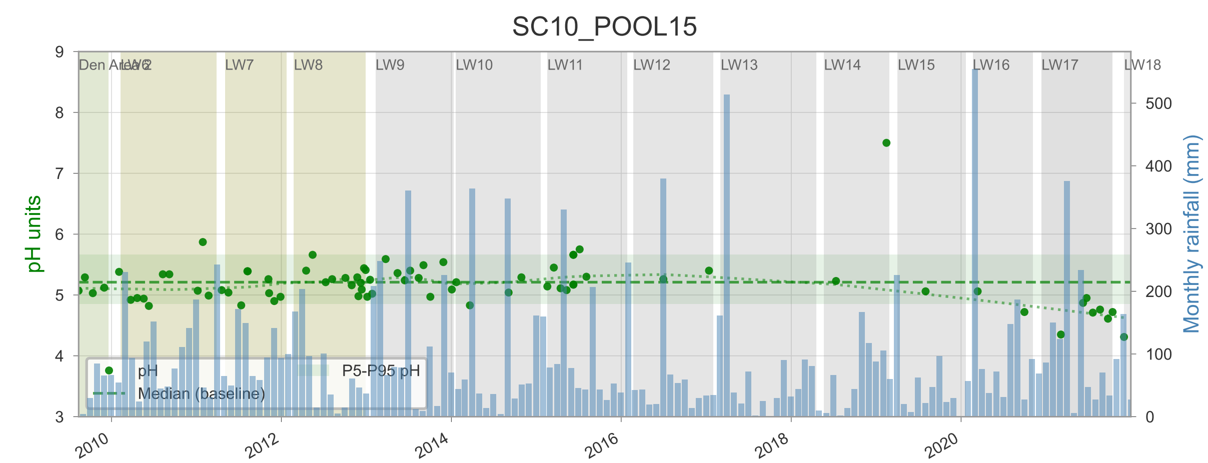

SC10_POOL14
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

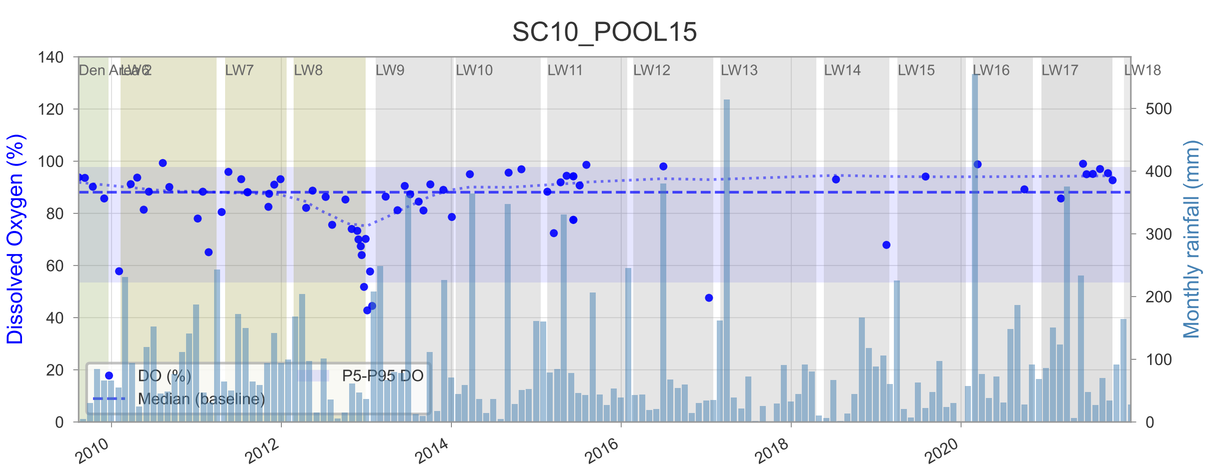

SC10_POOL14
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

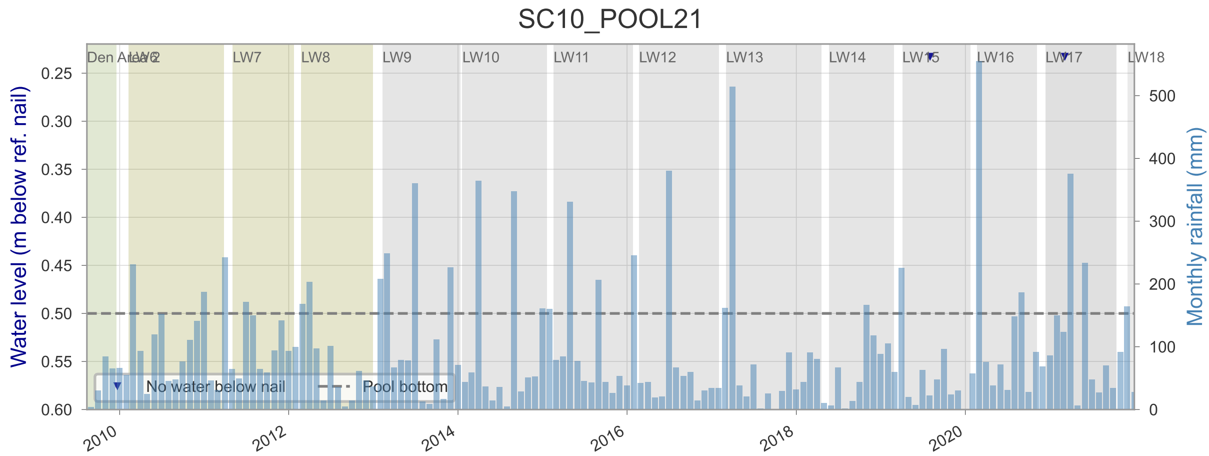

SC10_POOL14
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

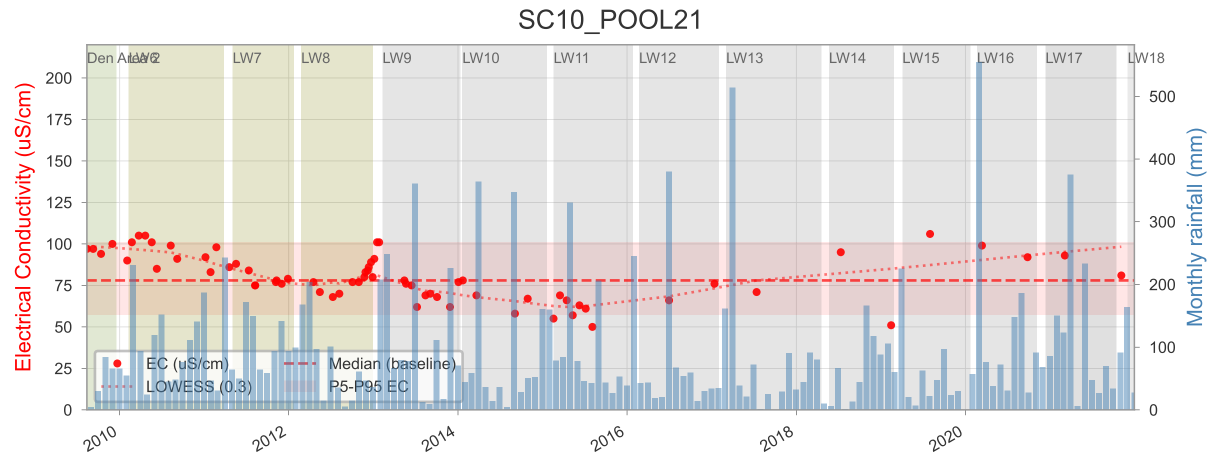

SC10_POOL15
Den Area
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Water level (m below ref. nail)
Monthly rainfall (mm)

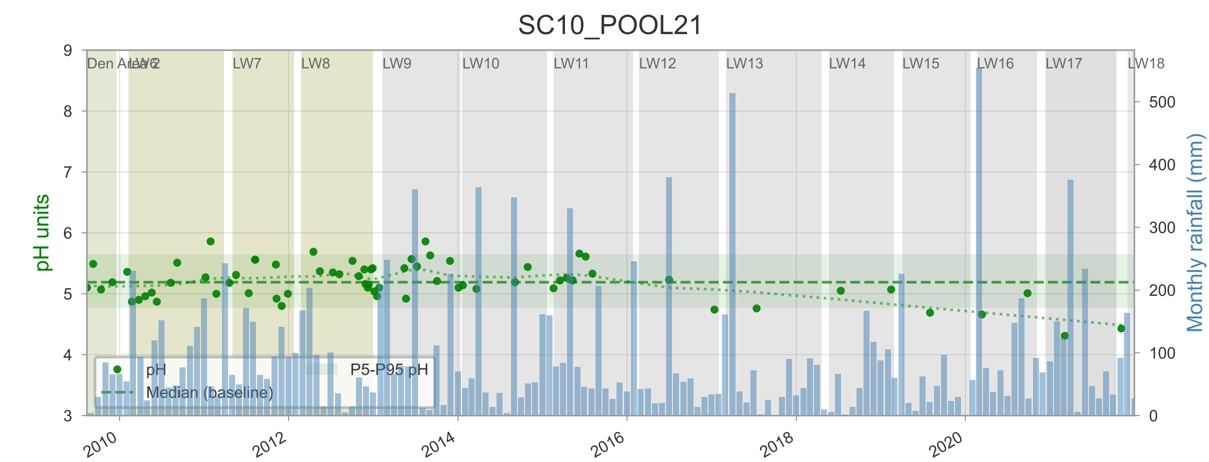

SC10_POOL15
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

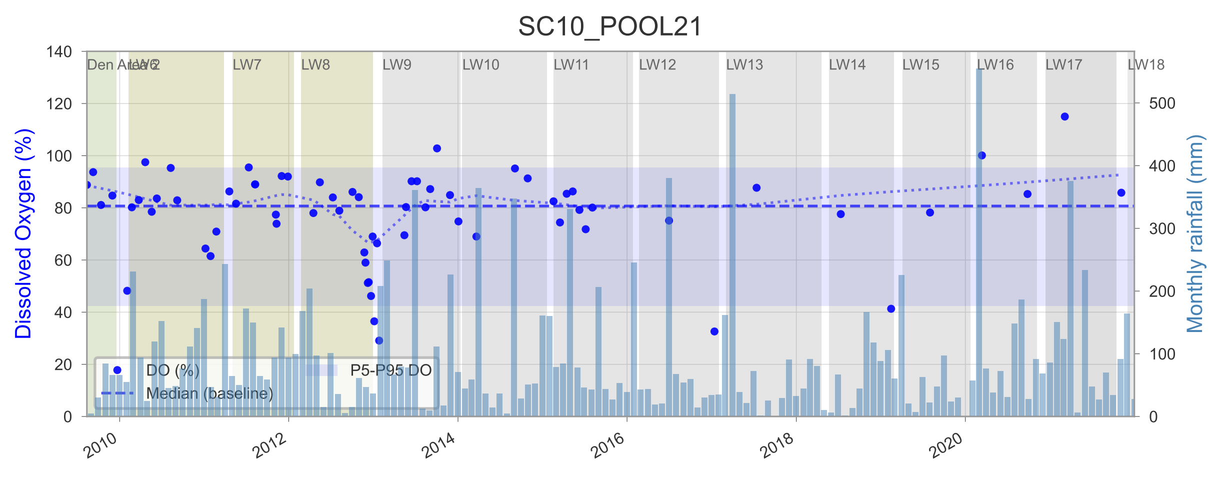

SC10_POOL15
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

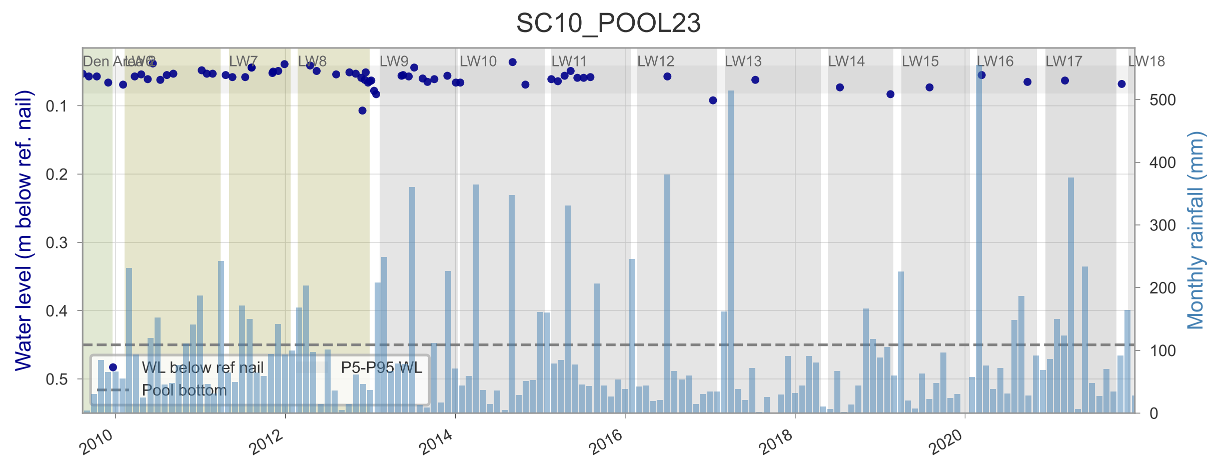

SC10_POOL15
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

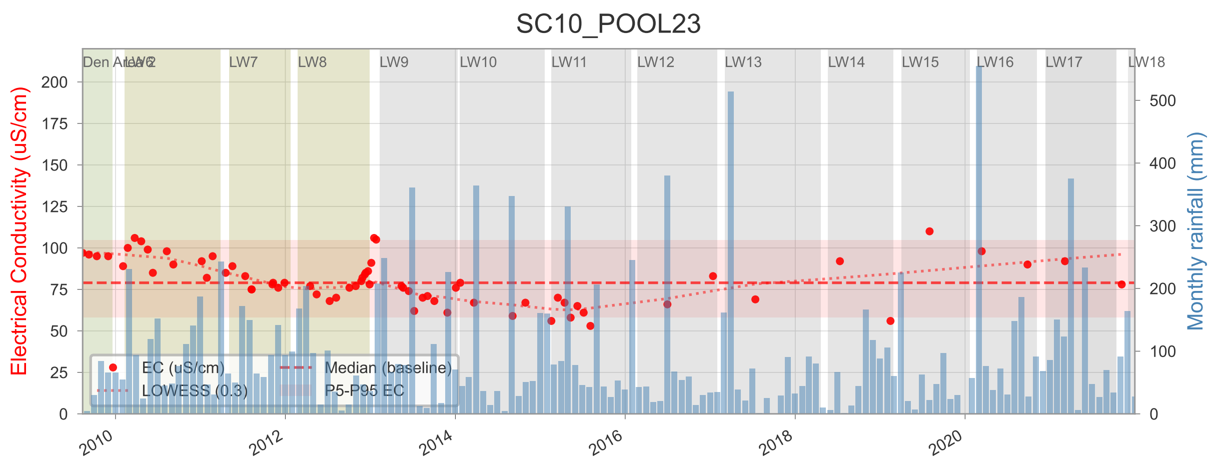

SC10_POOL21
Water level (m below ref. nail)
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
No water below nail
Pool bottom

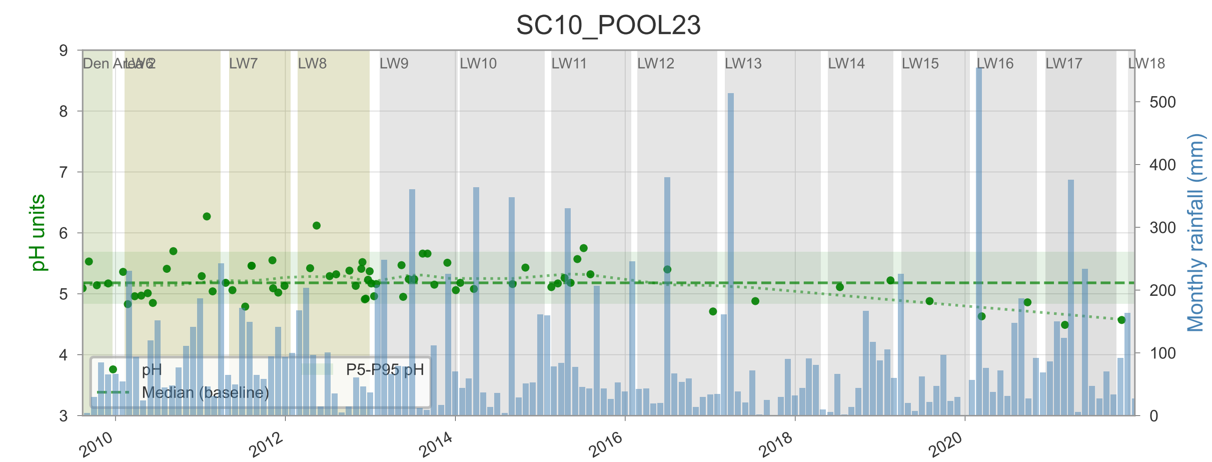

SC10_POOL21
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

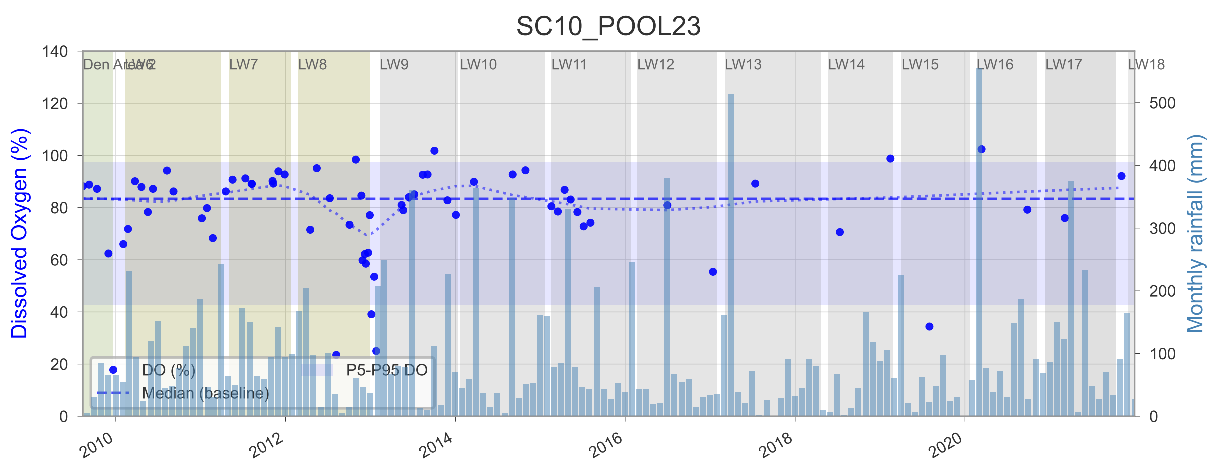

SC10_POOL21
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

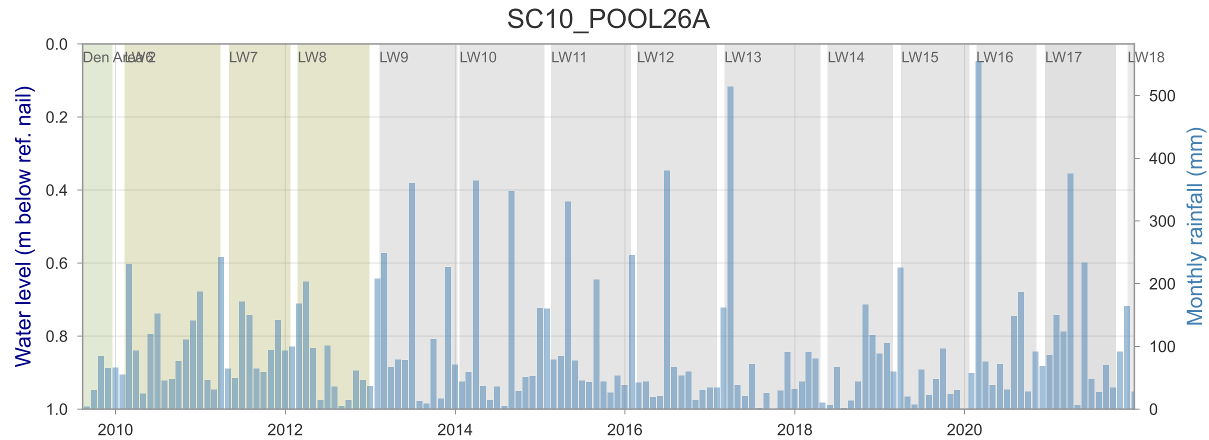

SC10_POOL21
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

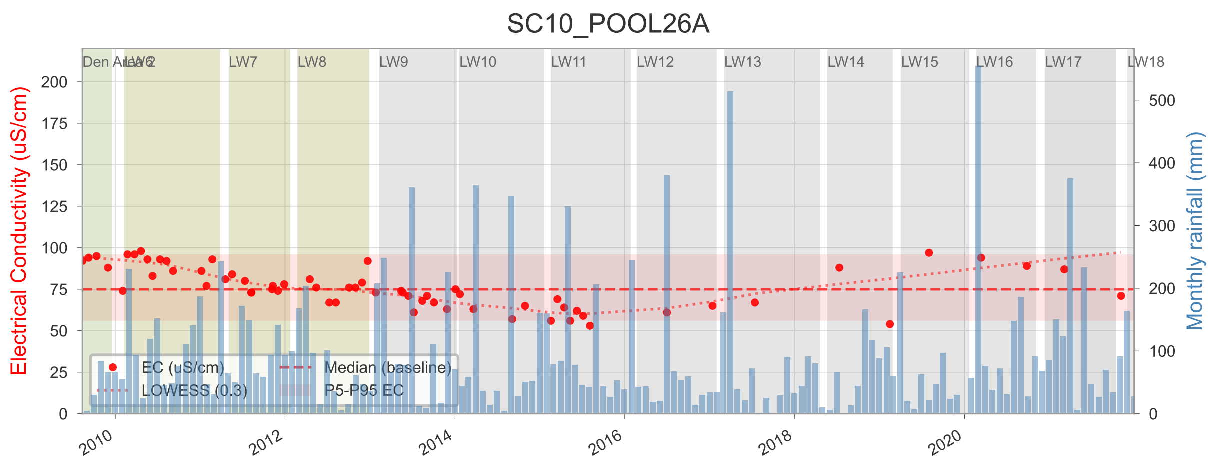

SC10_POOL23
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
Pool bottom
P5-P95 WL
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

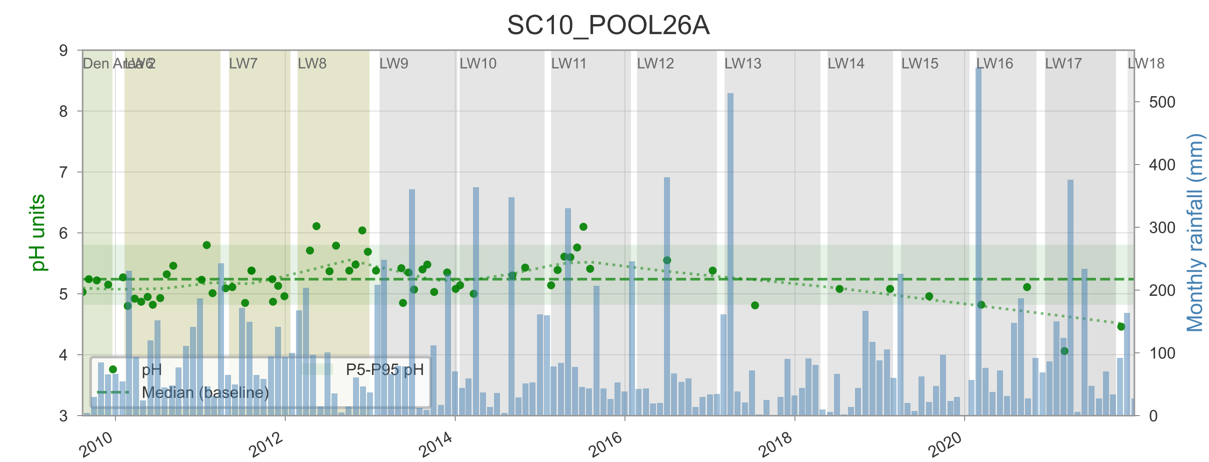

SC10_POOL23
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

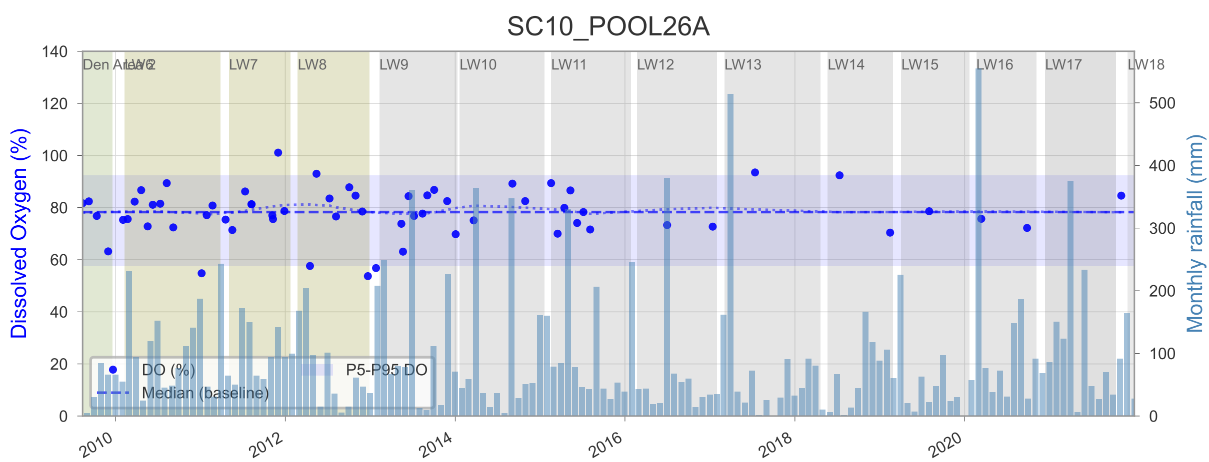

SC10_POOL23
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

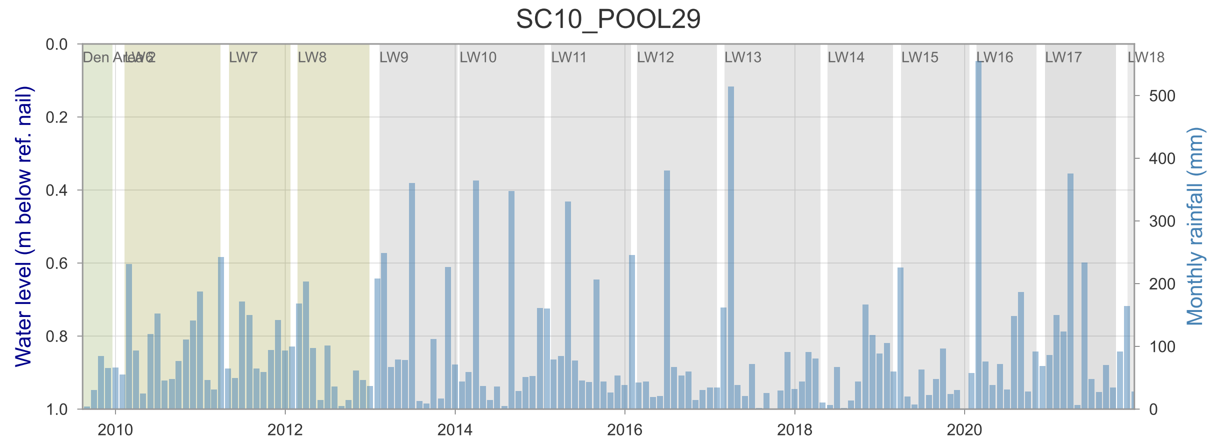

SC10_POOL23
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

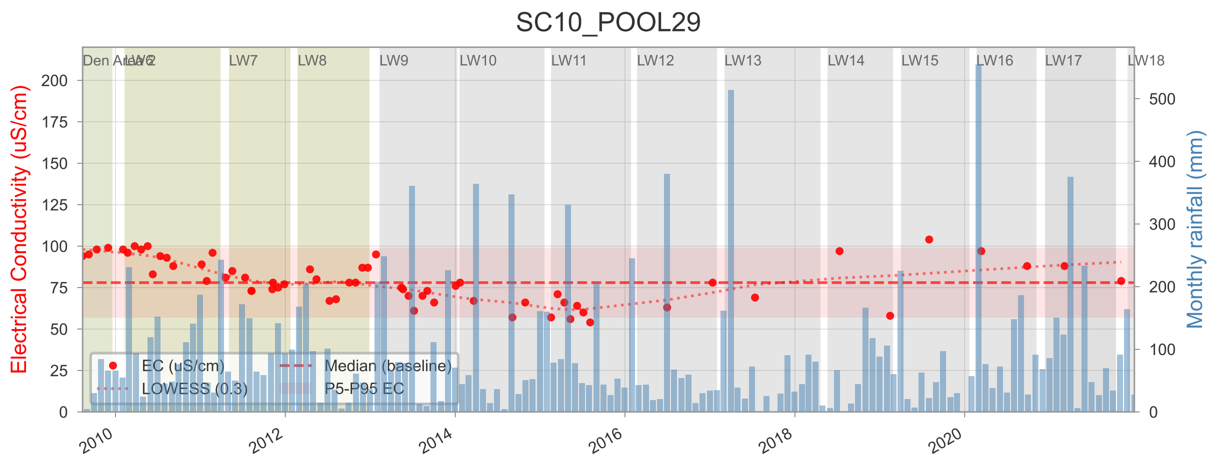

SC10_POOL26A
Water level (m below ref. nail)
Monthly rainfall (mm)
Den Area
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

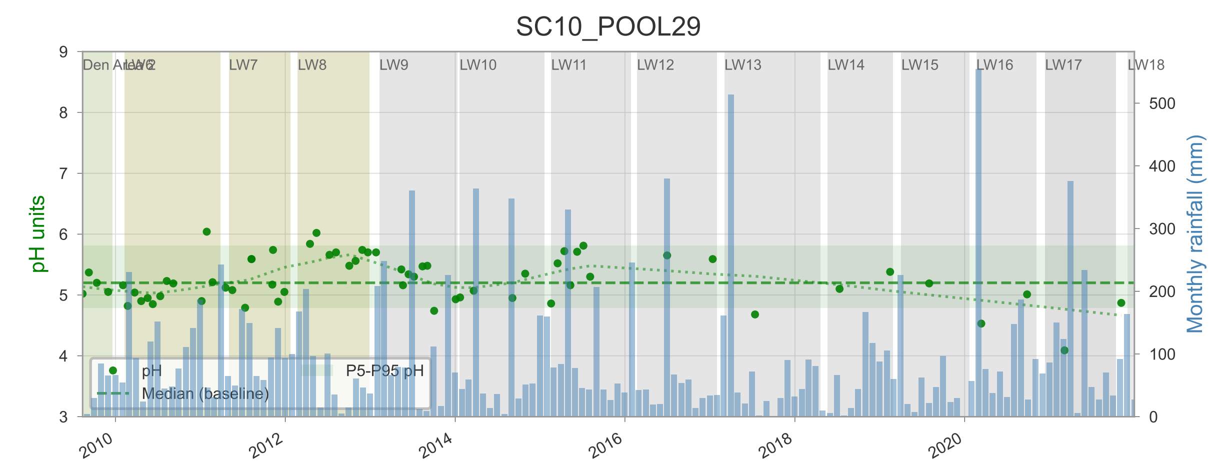

SC10_POOL26A
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

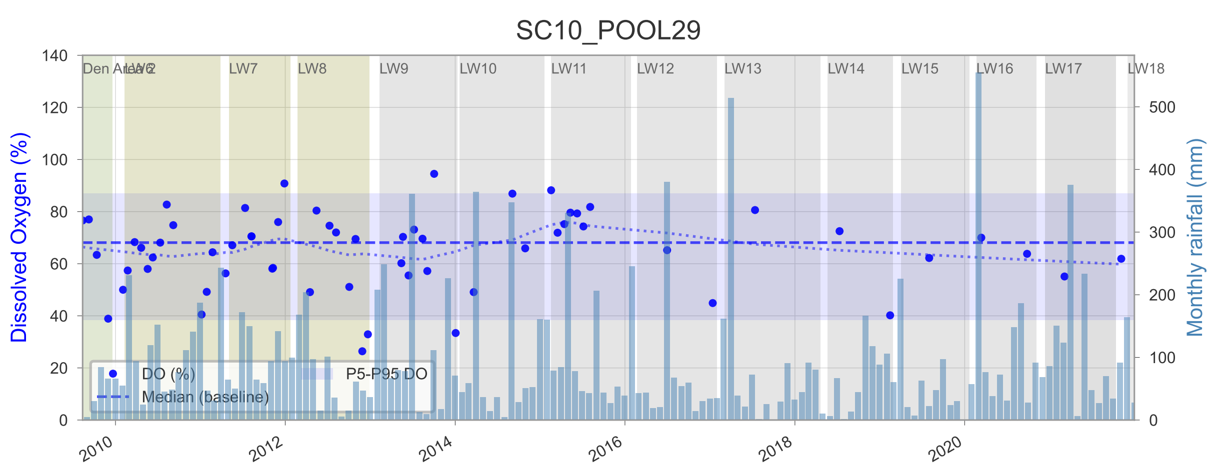

SC10_POOL26A
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH


SC10_POOL26A
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

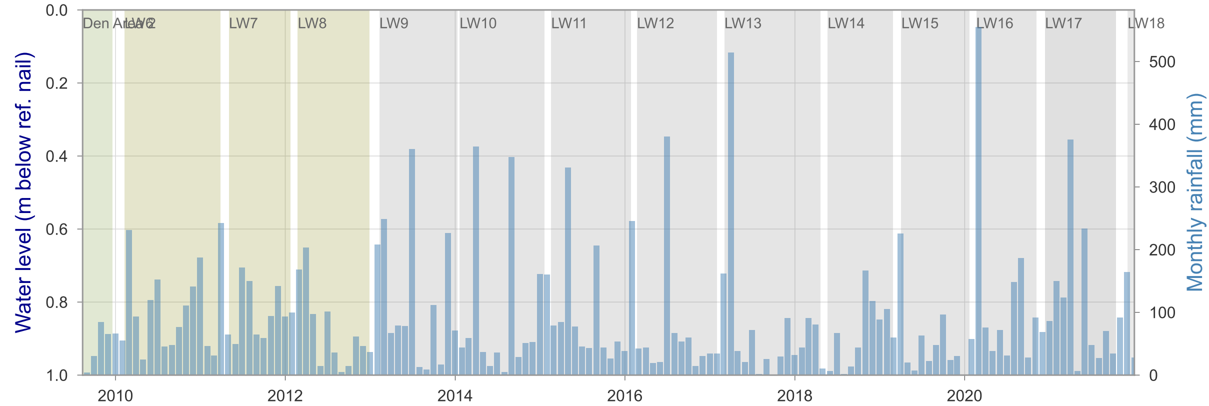

SC10_POOL29
Den Area
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Water level (m below ref. nail)
Monthly rainfall (mm)


SC10_POOL29
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

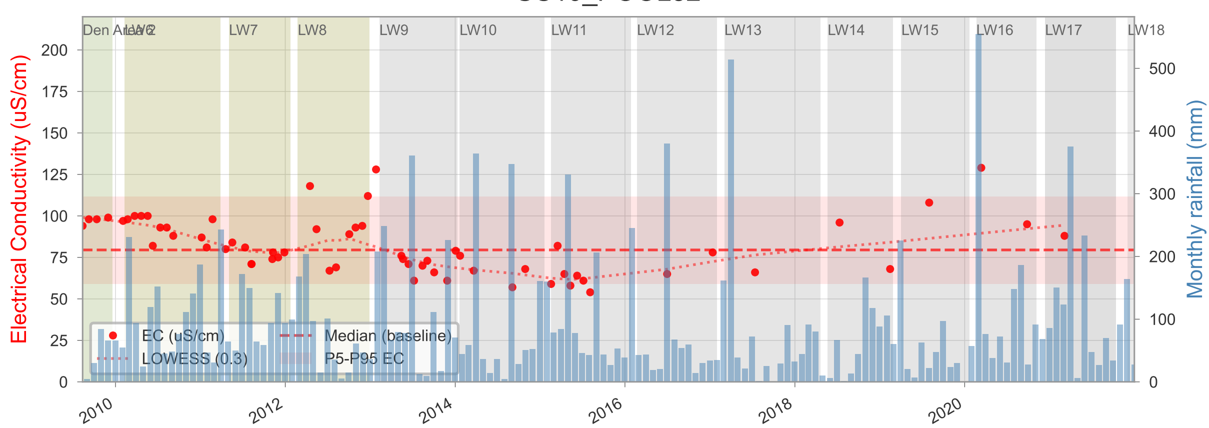

SC10_POOL29
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH


SC10_POOL29
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

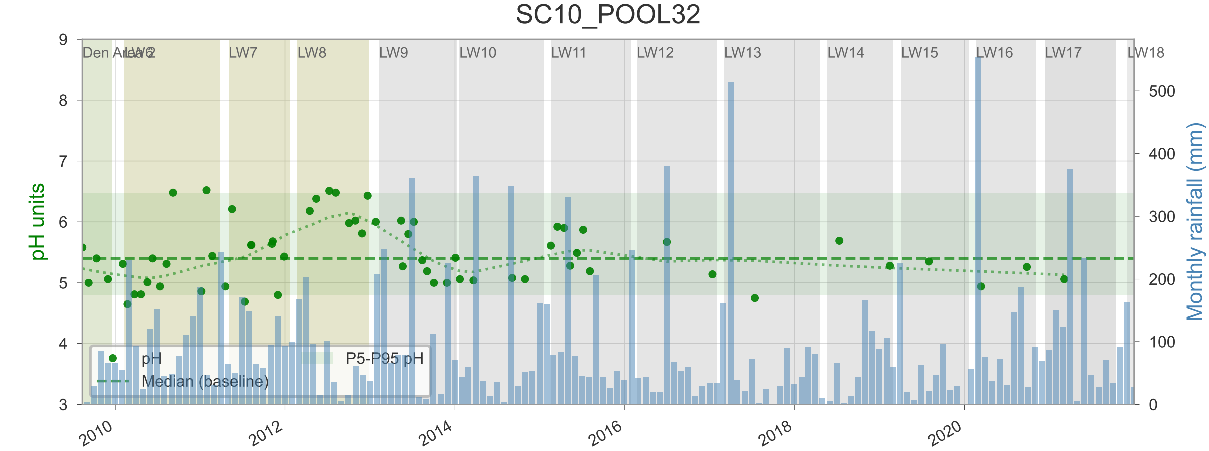
SC10_POOL32



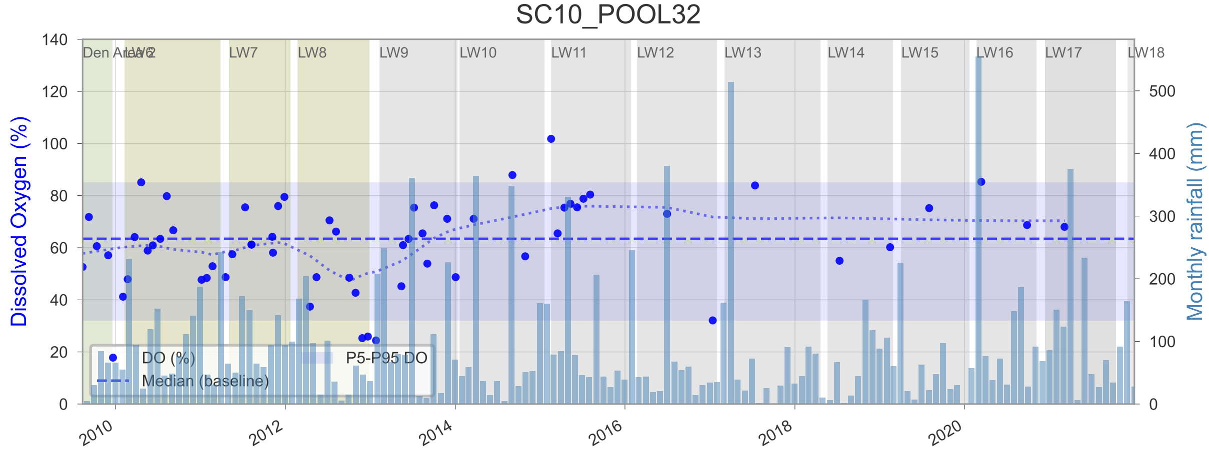
SC10_POOL32



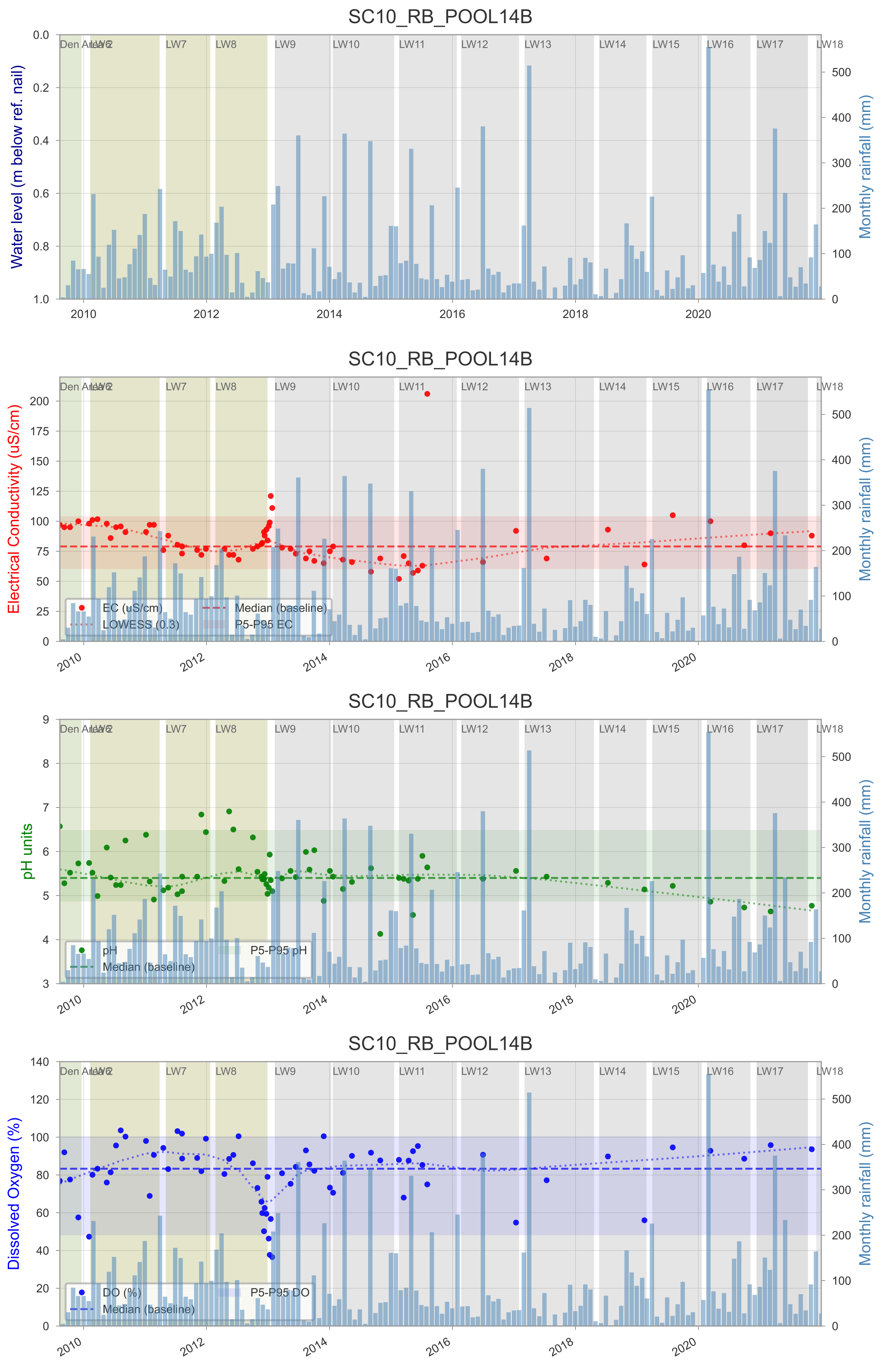
SC10_POOL32



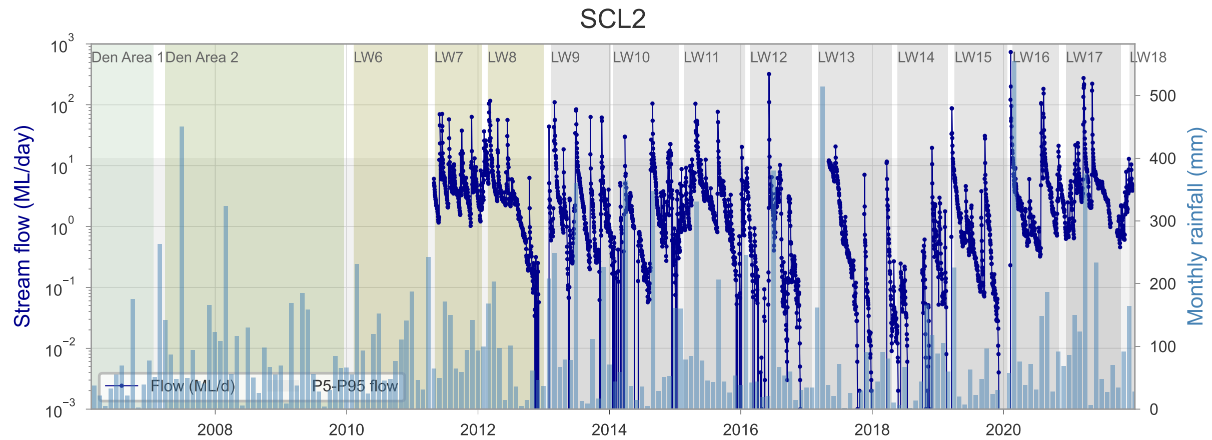
SC10_POOL32

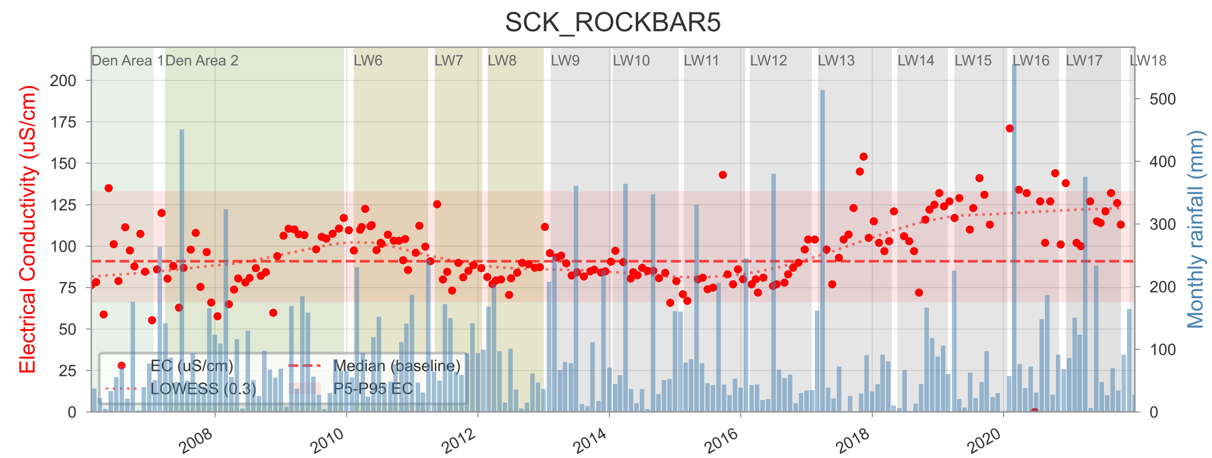


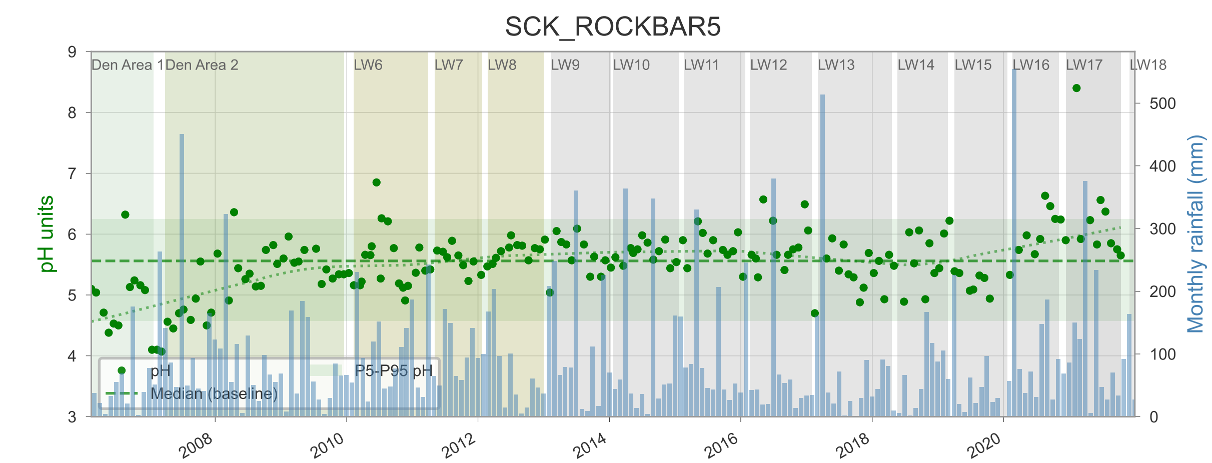

SC10_POOL4
Water level (m below ref. nail)
Monthly rainfall (mm)
Den Area
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
SC10_POOL4
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
SC10_POOL4
pH units
pH
Median (baseline)
P5-P95 pH
SC10_POOL4
Dissolved Oxygen (%)
DO (%)
Median (baseline)
P5-P95 DO

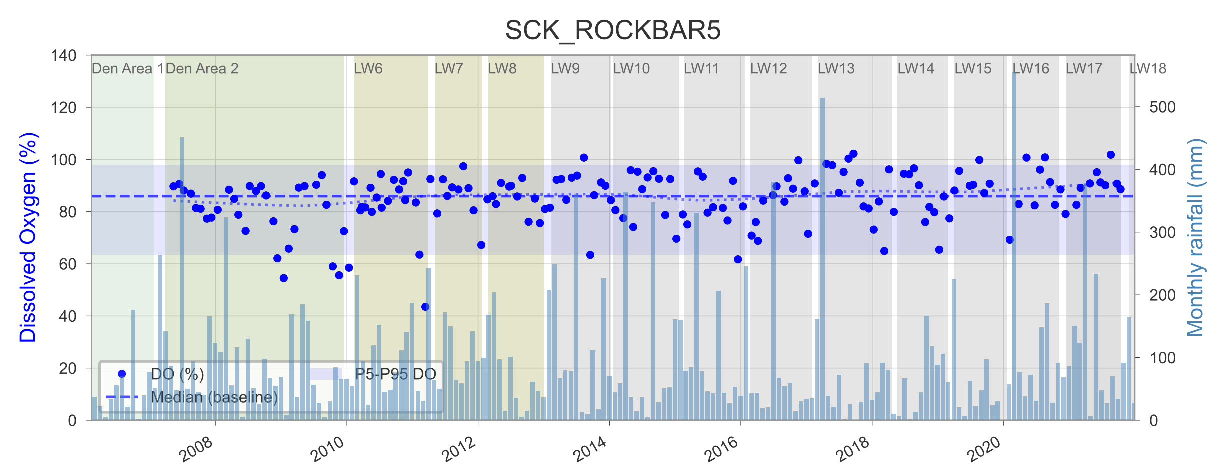

SC10_RB_POOL14B
Water level (m below ref. nail)
Monthly rainfall (mm)
Den Area
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
SC10_RB_POOL14B
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
SC10_RB_POOL14B
pH units
pH
Median (baseline)
P5-P95 pH
SC10_RB_POOL14B
Dissolved Oxygen (%)
DO (%)
Median (baseline)
P5-P95 DO

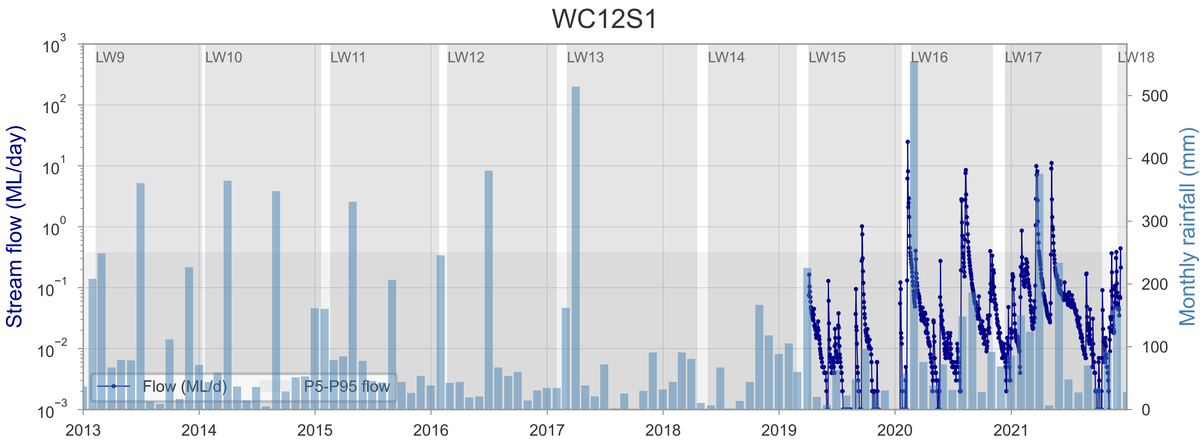

SC10S1
Stream flow (ML/day)
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Flow (ML/d)
P5-P95 flow
SC10_ROCKBAR3
Electrical Conductivity (uS/cm)
EC (uS/cm)
Median (baseline)
LOWESS (0.3)
P5-P95 EC
SC10_ROCKBAR3
pH units
pH
P5-P95 pH
Median (baseline)
SC10_ROCKBAR3
Dissolved Oxygen (%)
DO (%)
P5-P95 DO
Median (baseline)

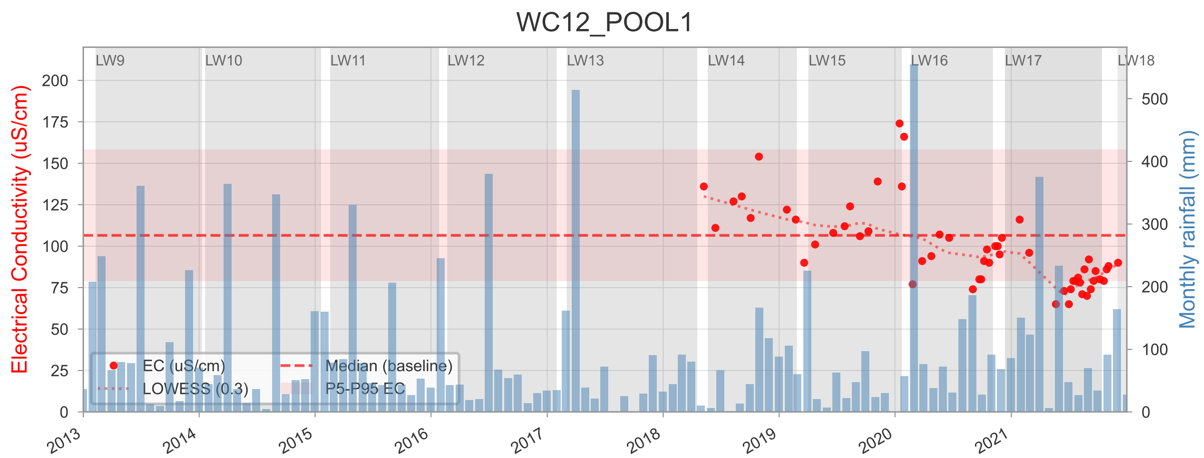

SCL2
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Stream flow (ML/day)
Monthly rainfall (mm)
Flow (ML/d)
P5-P95 flow
2008
2010
2012
2014
2016
2018
2020

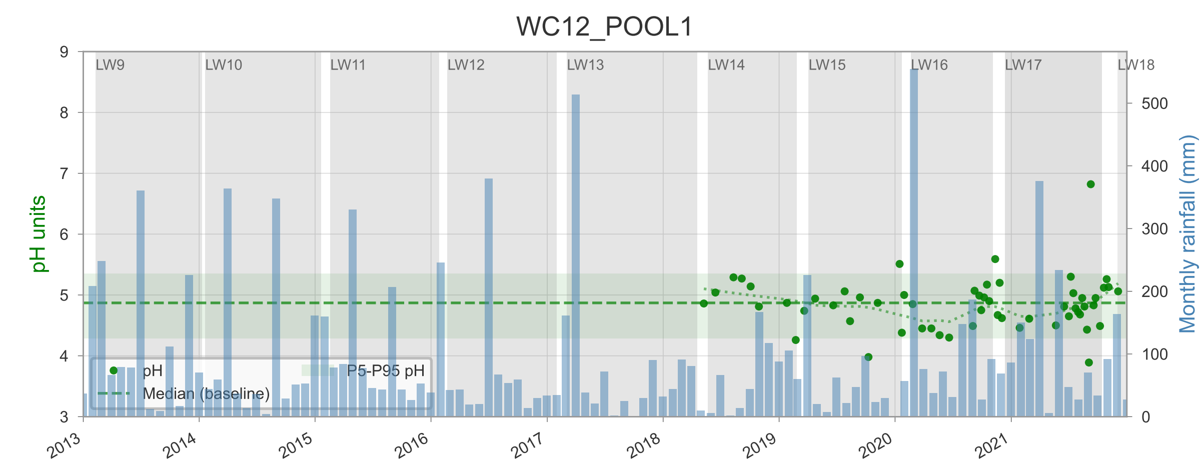

SCK_ROCKBAR5
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
2008
2010
2012
2014
2016
2018
2020

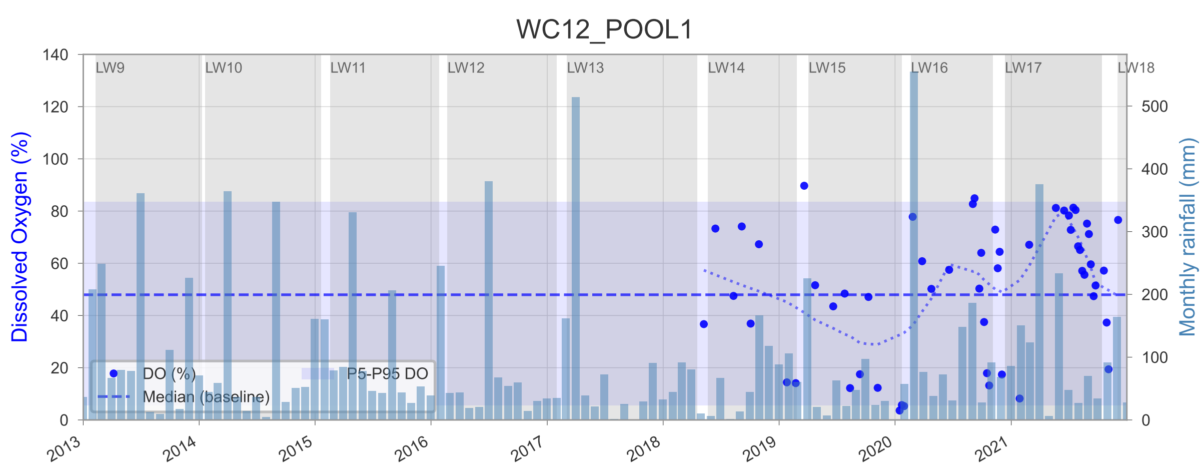

SCK_ROCKBAR5
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
2008
2010
2012
2014
2016
2018
2020

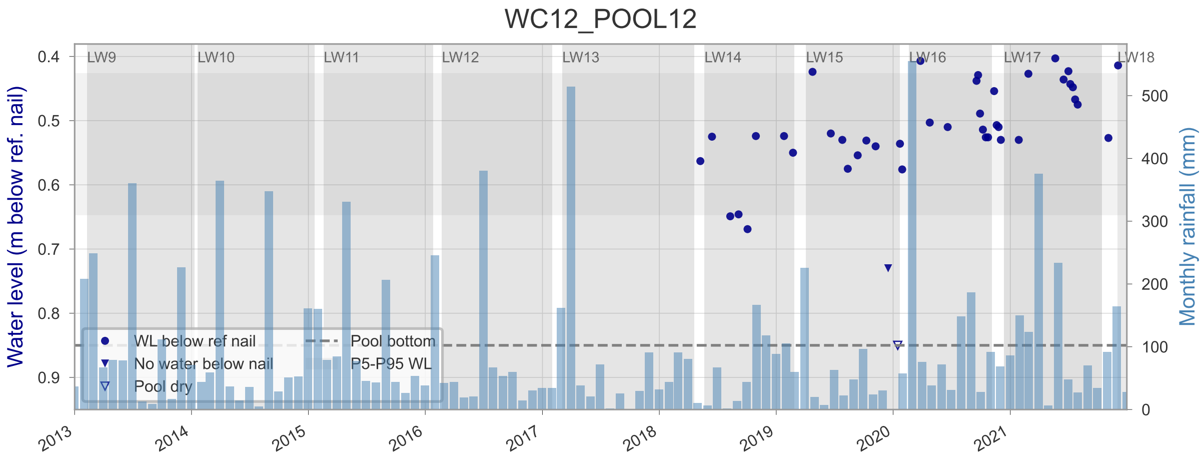

SCK_ROCKBAR5
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
2008
2010
2012
2014
2016
2018
2020

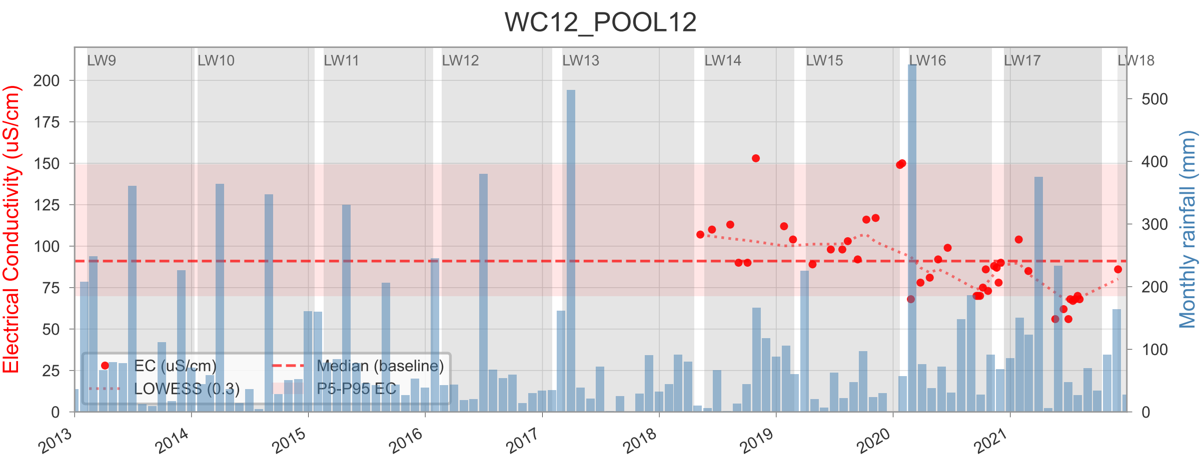

WC12S1
Stream flow (ML/day)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Flow (ML/d)
P5-P95 flow
2013
2014
2015
2016
2017
2018
2019
2020
2021

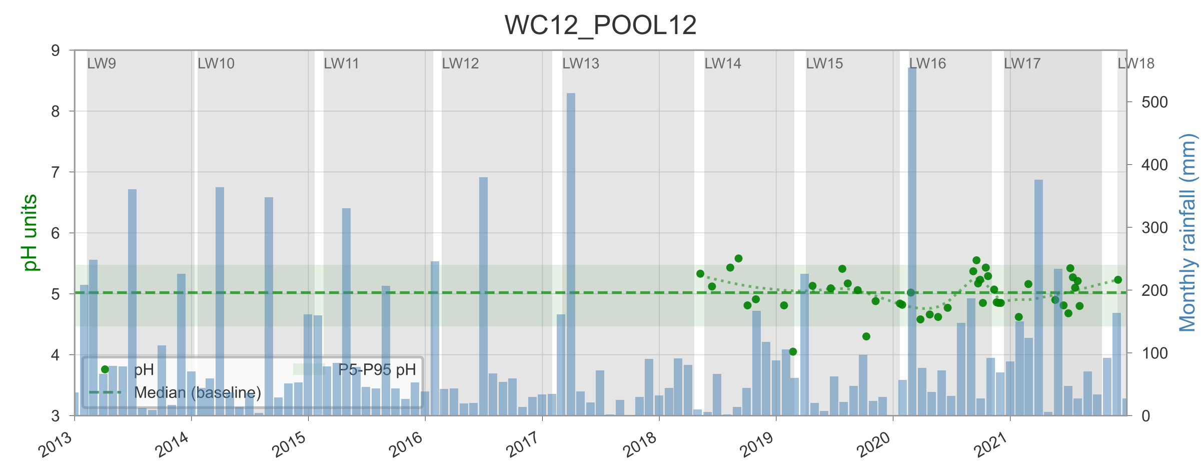

WC12_POOL1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

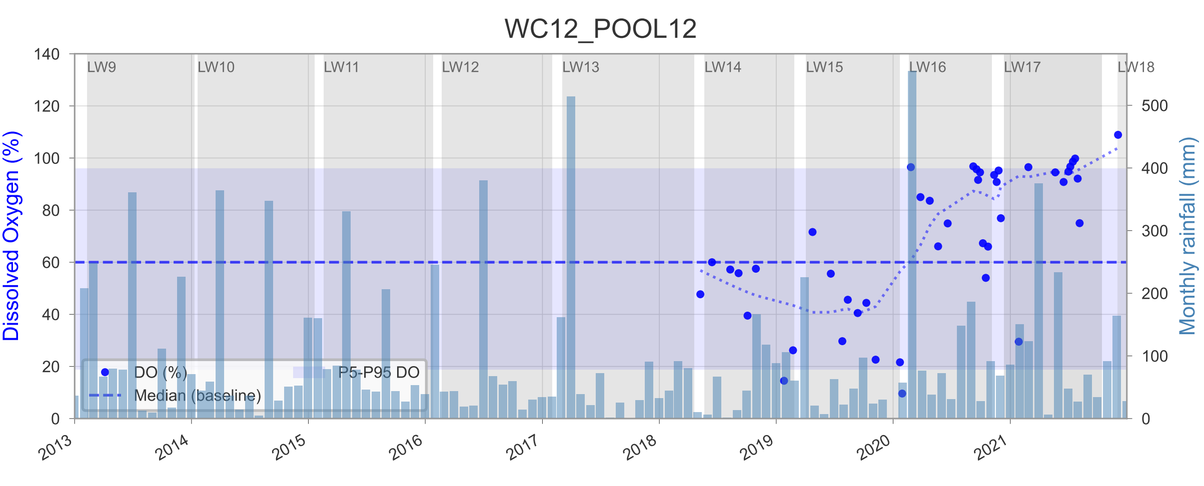

WC12_POOL1
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
Median (baseline)
P5-P95 pH

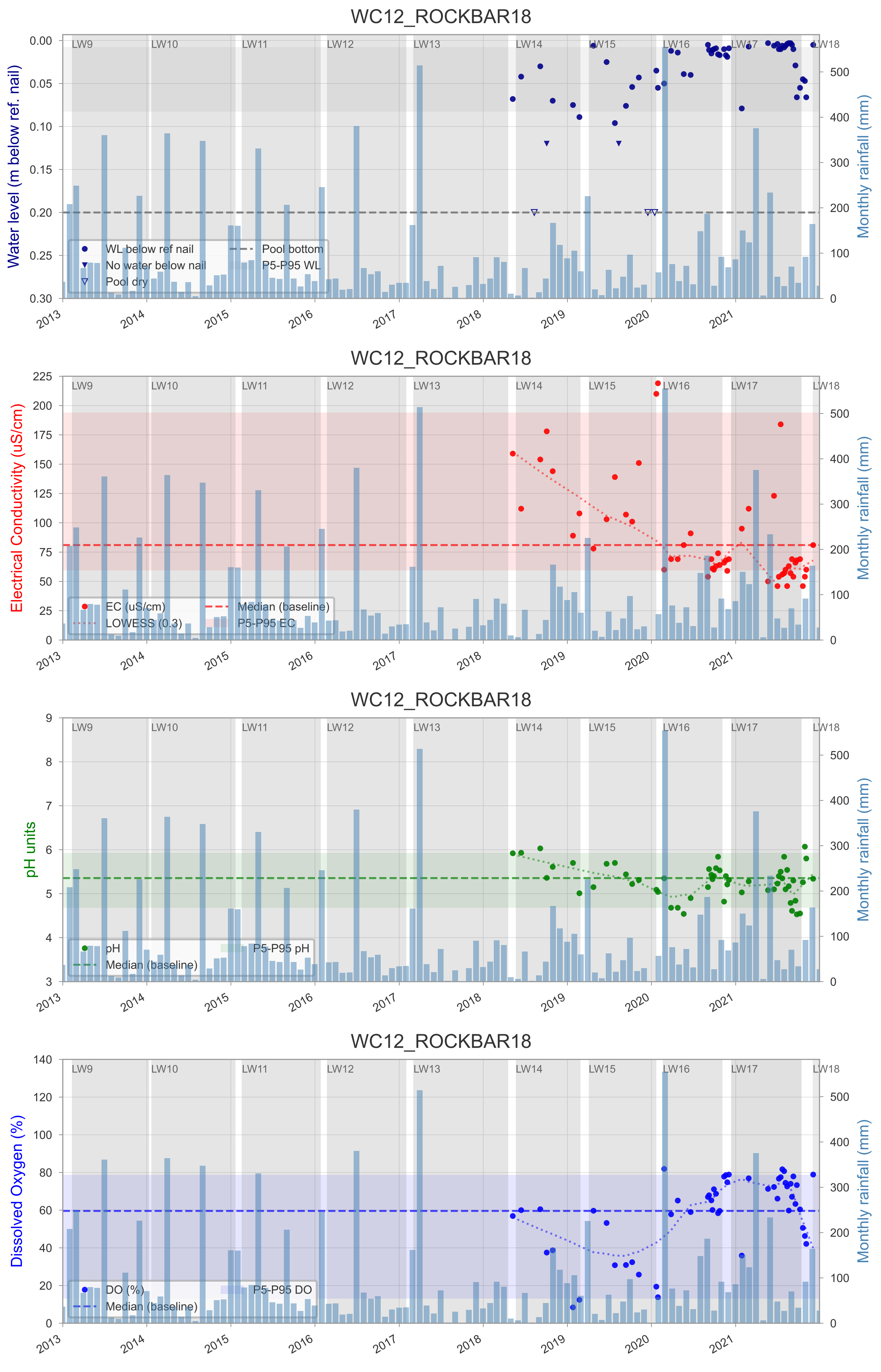

WC12_POOL1
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
Median (baseline)
P5-P95 DO


WC12_POOL12
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL
2013
2014
2015
2016
2017
2018
2019
2020
2021

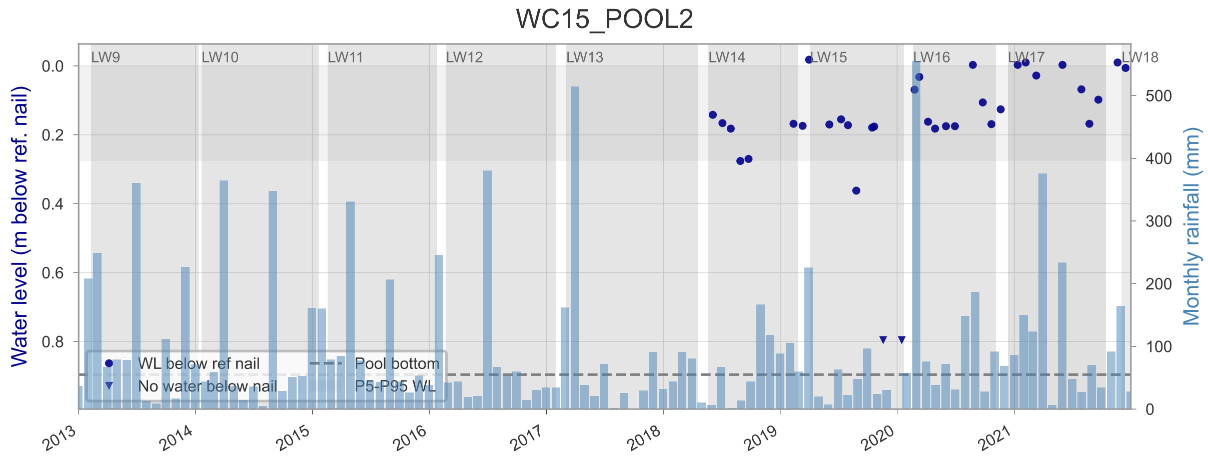

WC12_POOL12
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
2013
2014
2015
2016
2017
2018
2019
2020
2021

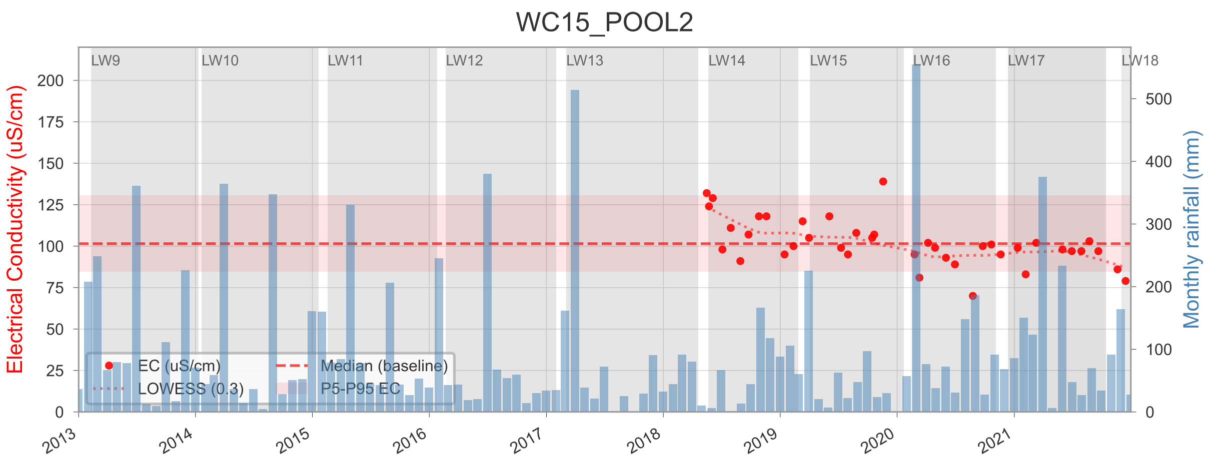

WC12_POOL12
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
Median (baseline)
P5-P95 pH
2013
2014
2015
2016
2017
2018
2019
2020
2021

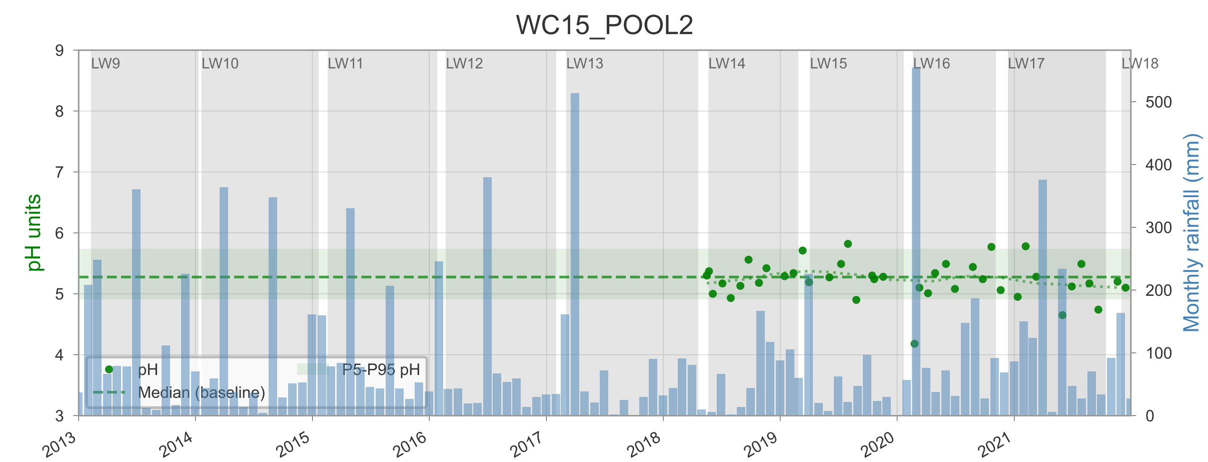

WC12_POOL12
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
Median (baseline)
P5-P95 DO
2013
2014
2015
2016
2017
2018
2019
2020
2021

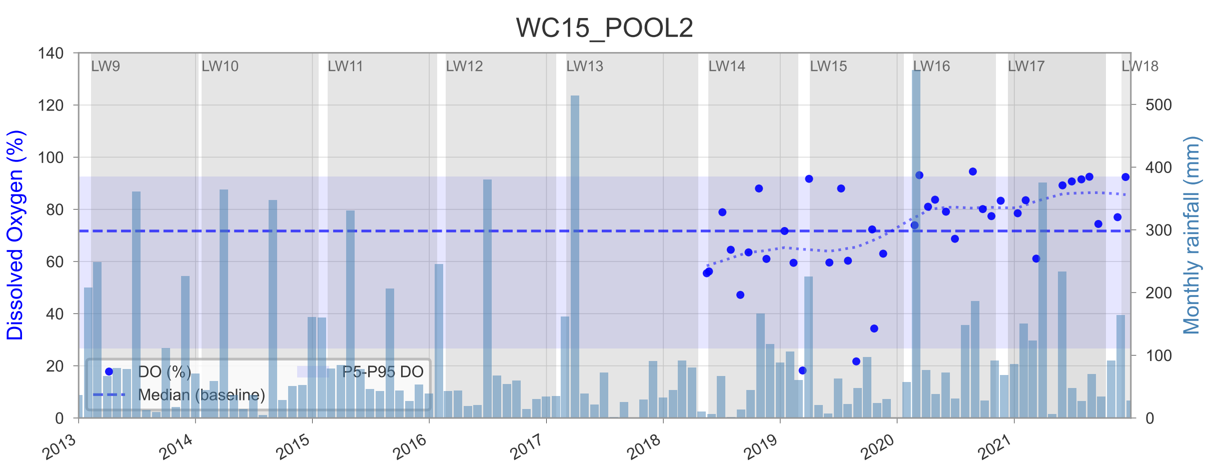


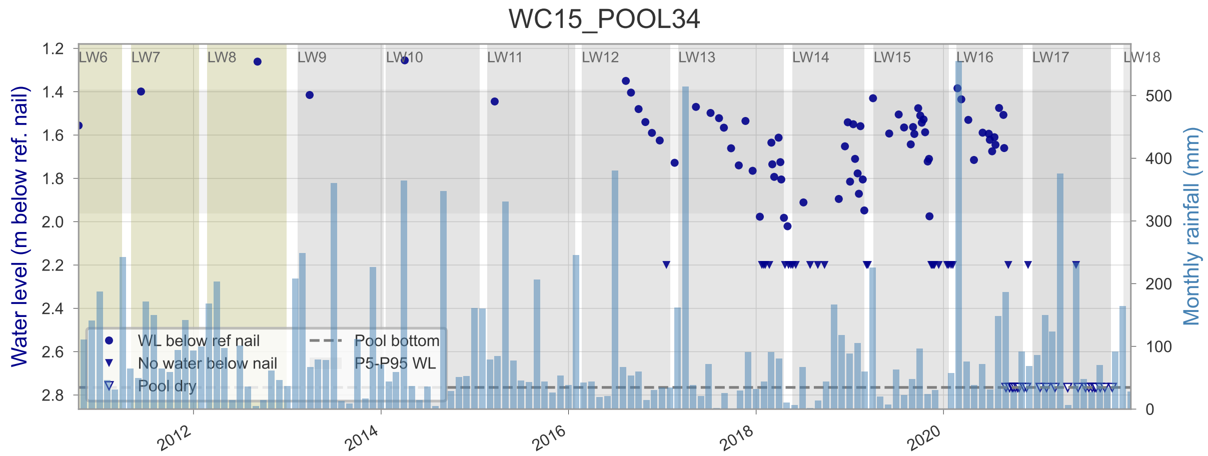
WC12_ROCKBAR18
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL
WC12_ROCKBAR18
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
WC12_ROCKBAR18
pH units
pH
Median (baseline)
P5-P95 pH
WC12_ROCKBAR18
Dissolved Oxygen (%)
DO (%)
Median (baseline)
P5-P95 DO

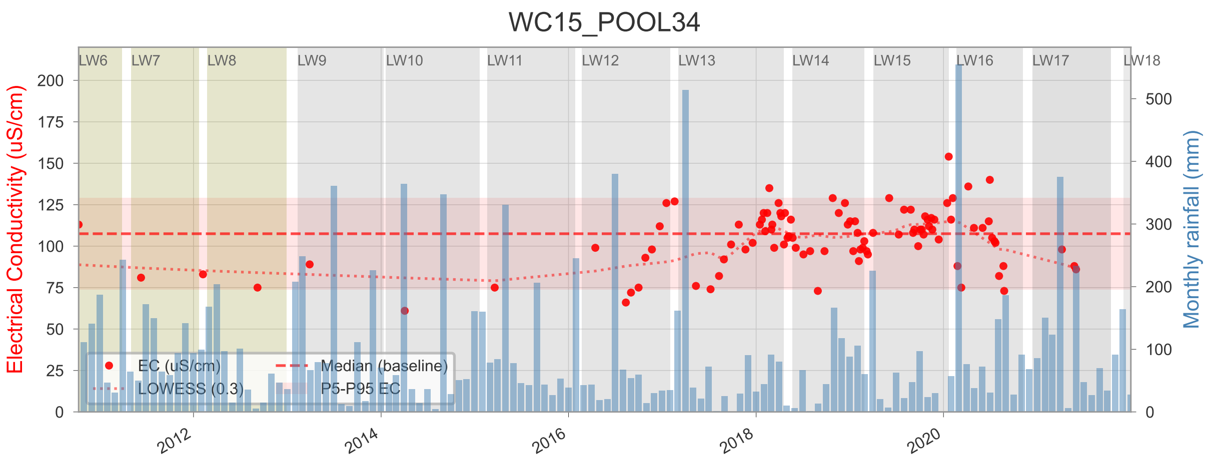

WC15_POOL2
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool bottom
P5-P95 WL

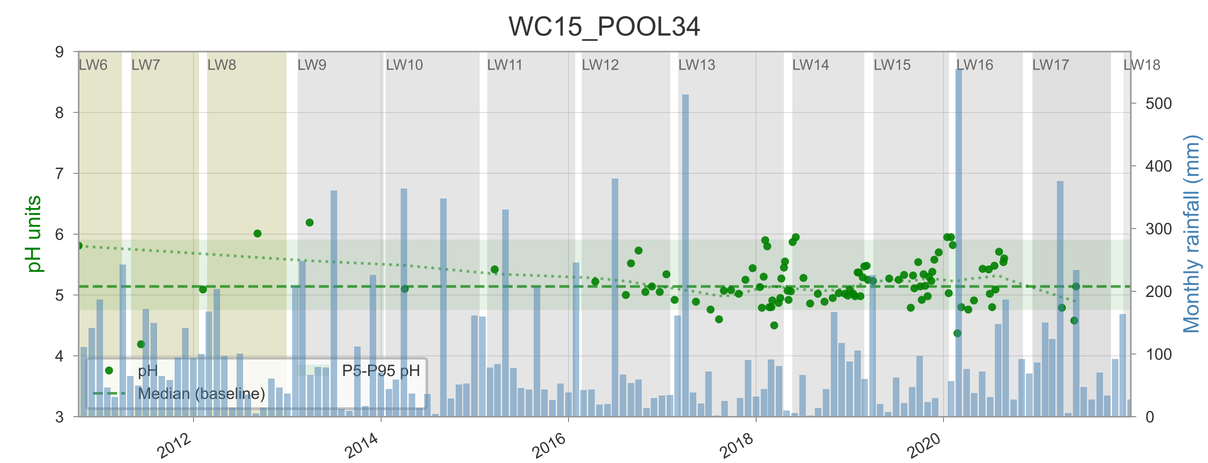

WC15_POOL2
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

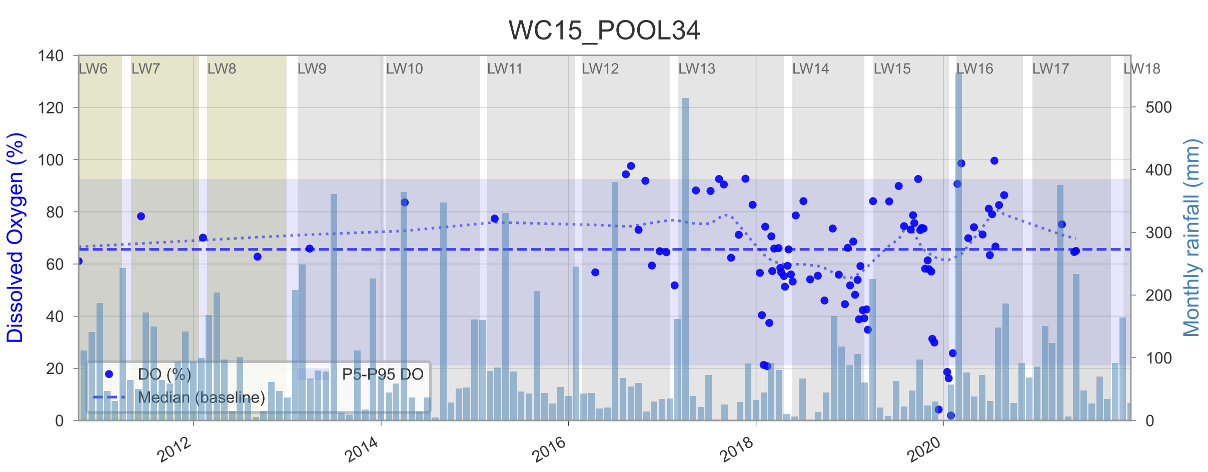

WC15_POOL2
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

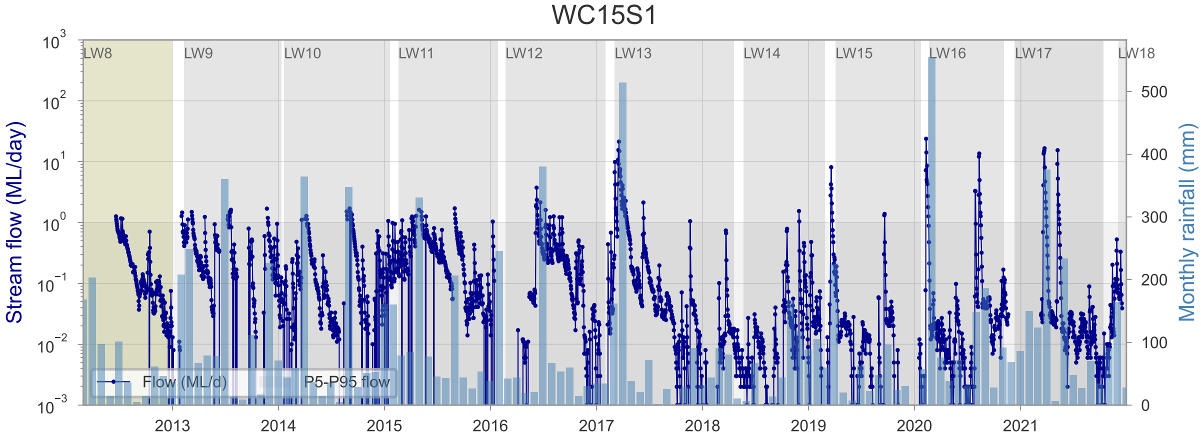

WC15_POOL2
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

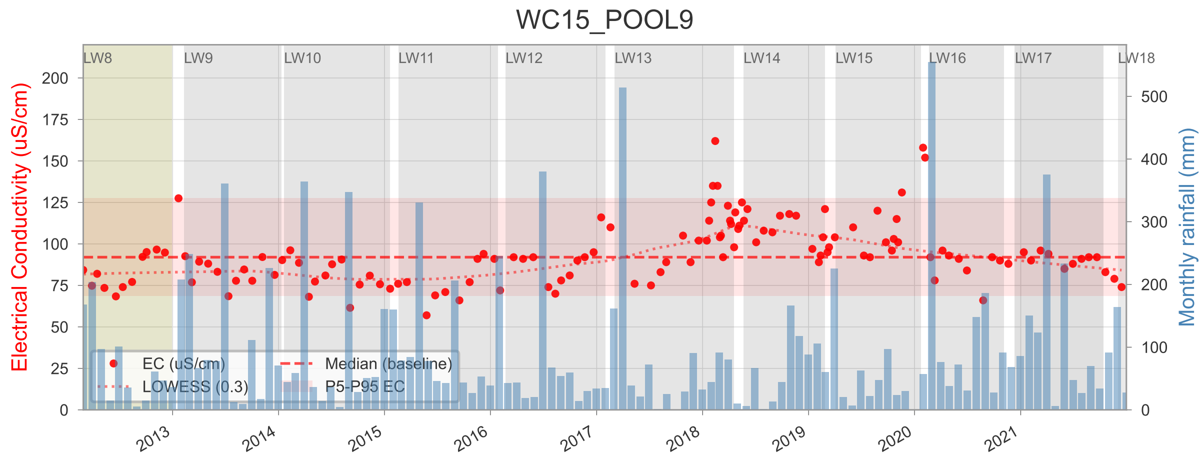

WC15_POOL34
Water level (m below ref. nail)
Monthly rainfall (mm)
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL
2012
2014
2016
2018
2020

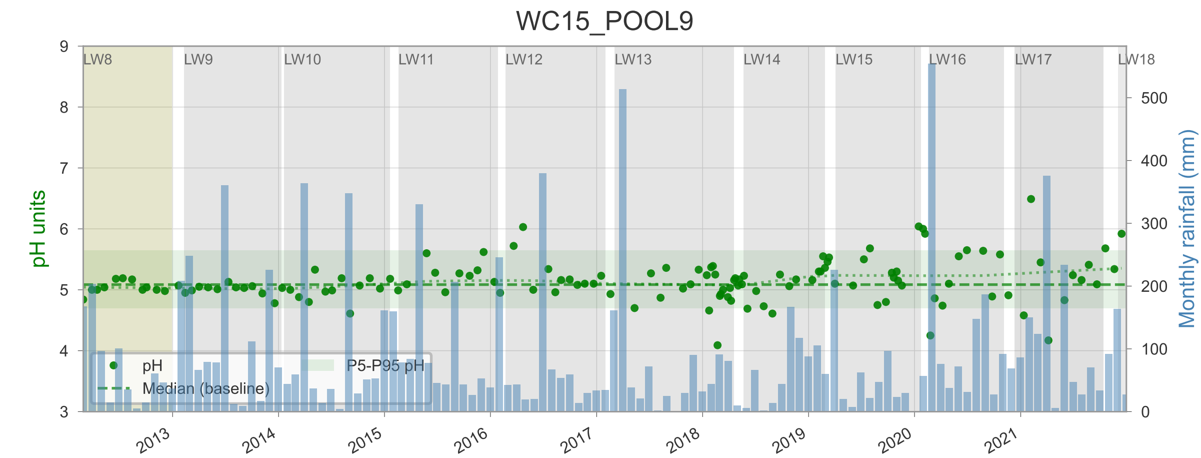

WC15_POOL34
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
2012
2014
2016
2018
2020

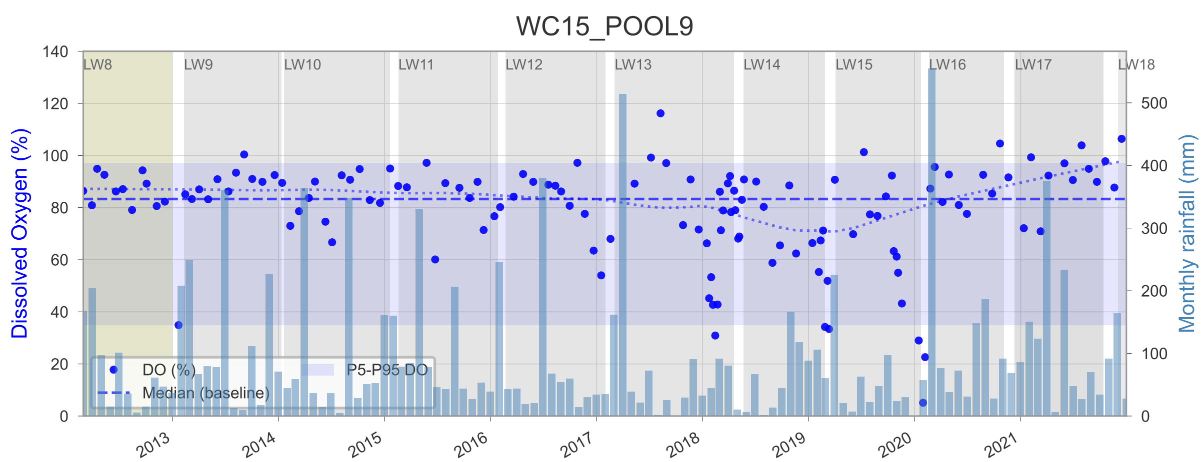

WC15_POOL34
pH units
Monthly rainfall (mm)
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
Median (baseline)
P5-P95 pH
2012
2014
2016
2018
2020

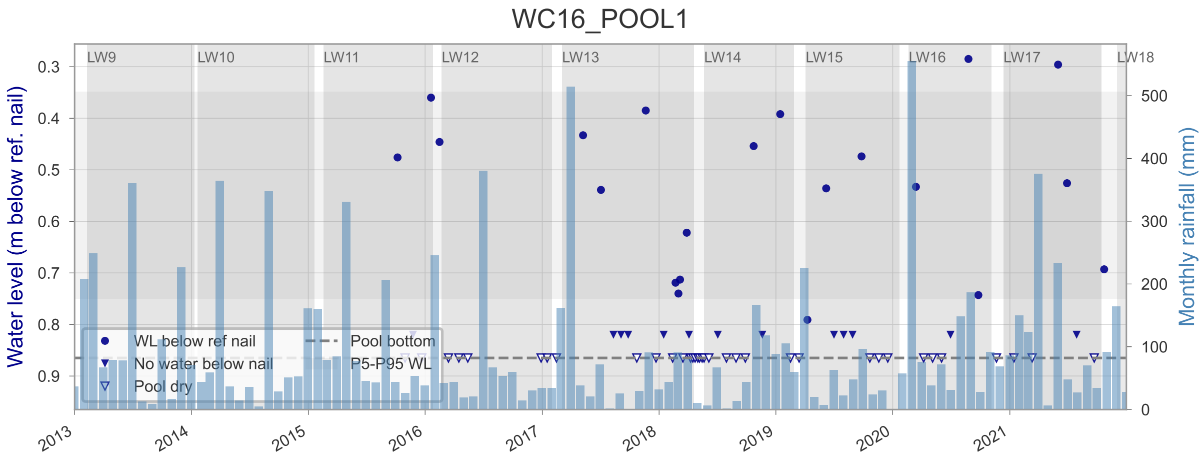

WC15_POOL34
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
Median (baseline)
P5-P95 DO
2012
2014
2016
2018
2020

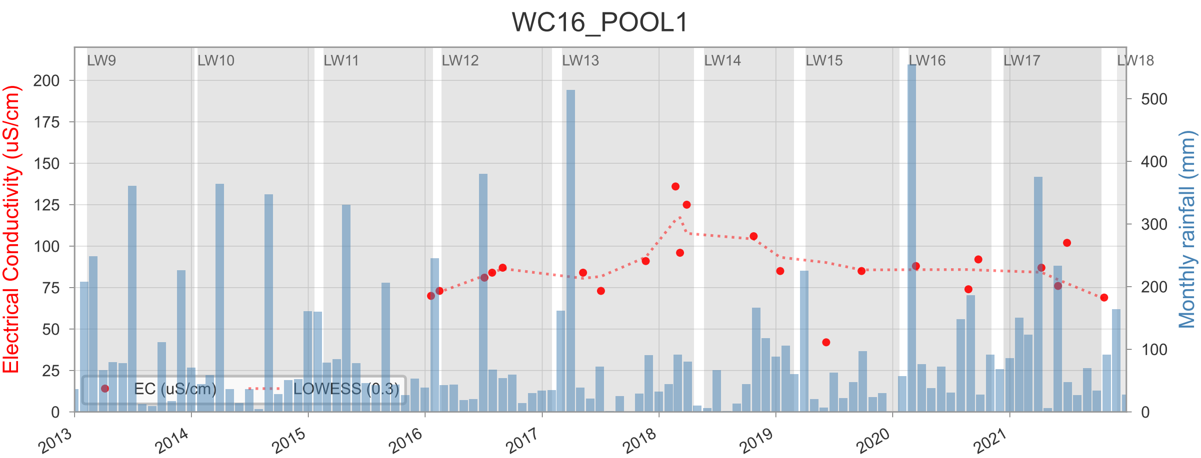

WC15S1
Stream flow (ML/day)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Flow (ML/d)
P5-P95 flow

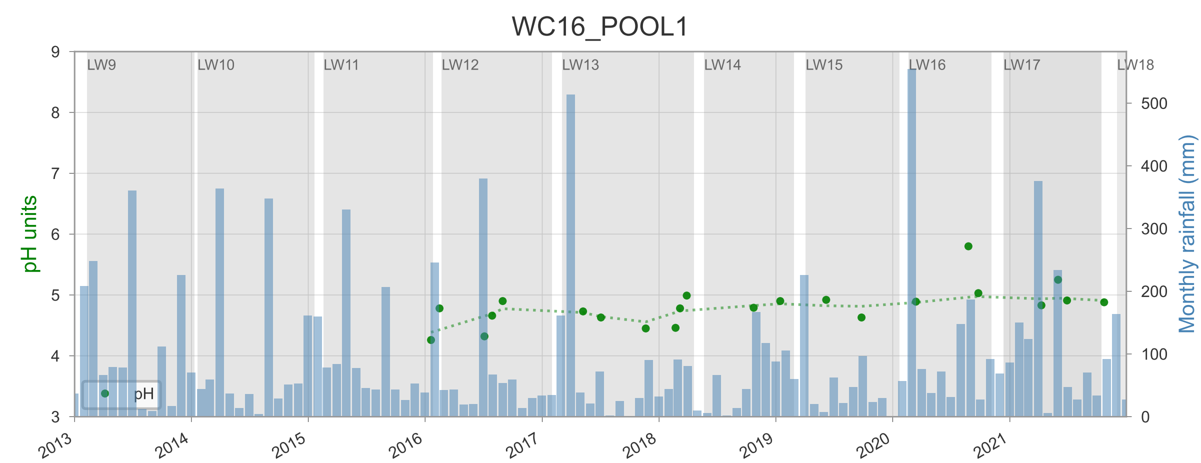

WC15_POOL9
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

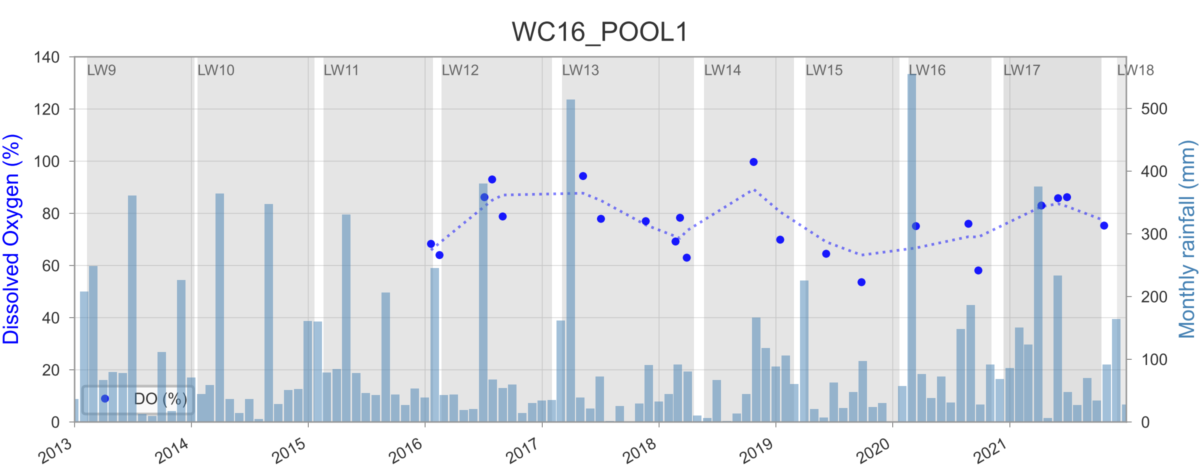

WC15_POOL9
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

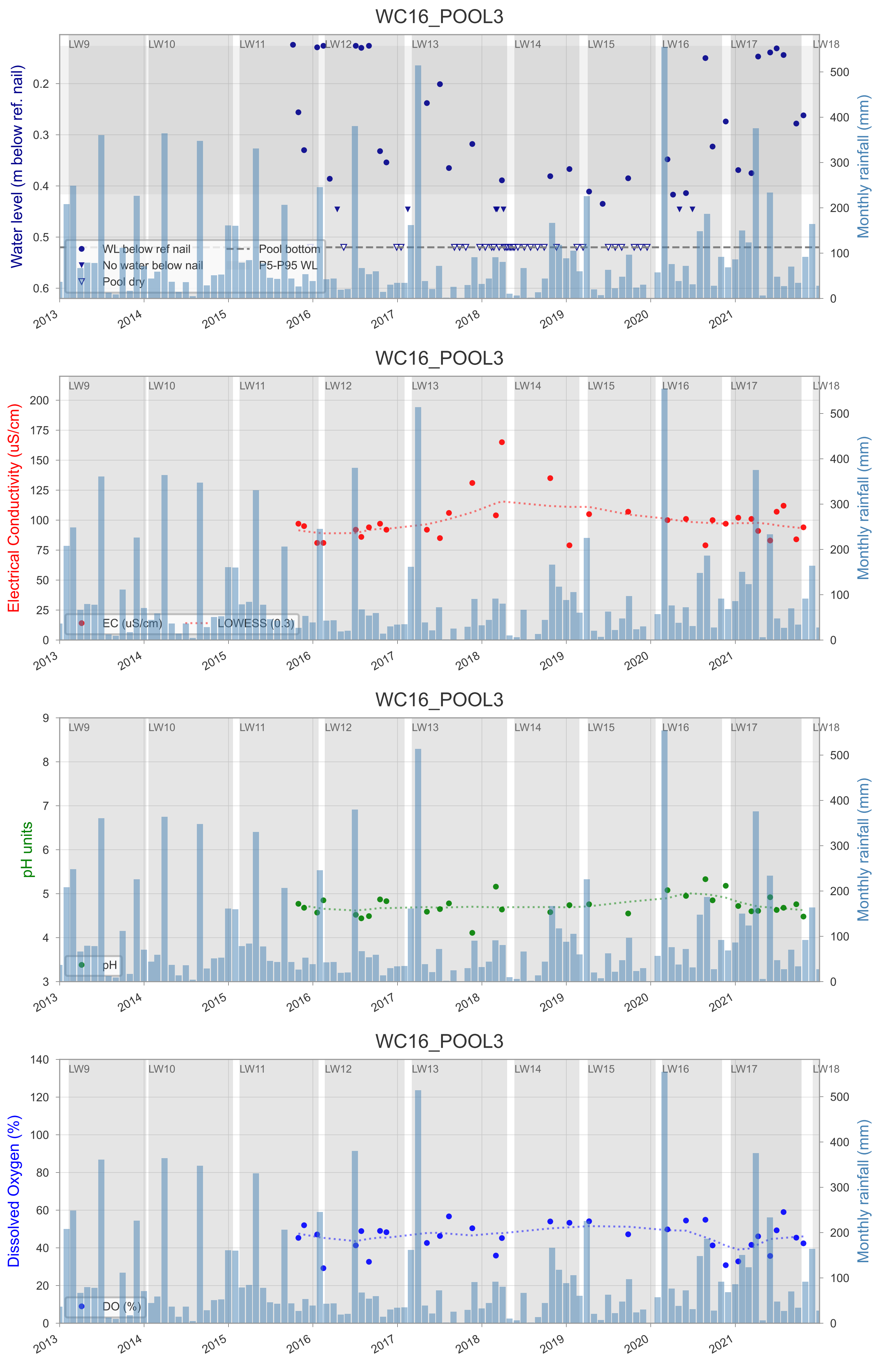

WC15_POOL9
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO


WC16_POOL1
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL

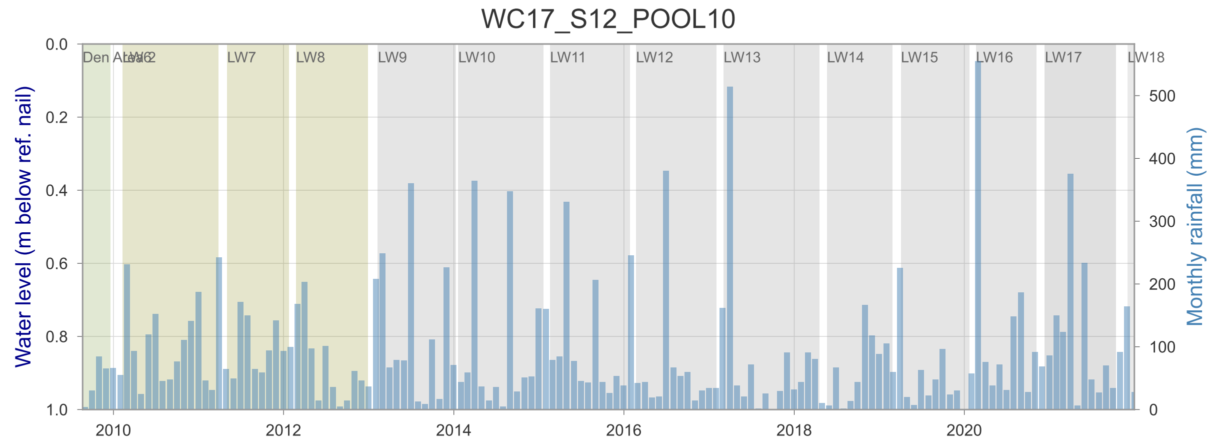

WC16_POOL1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)

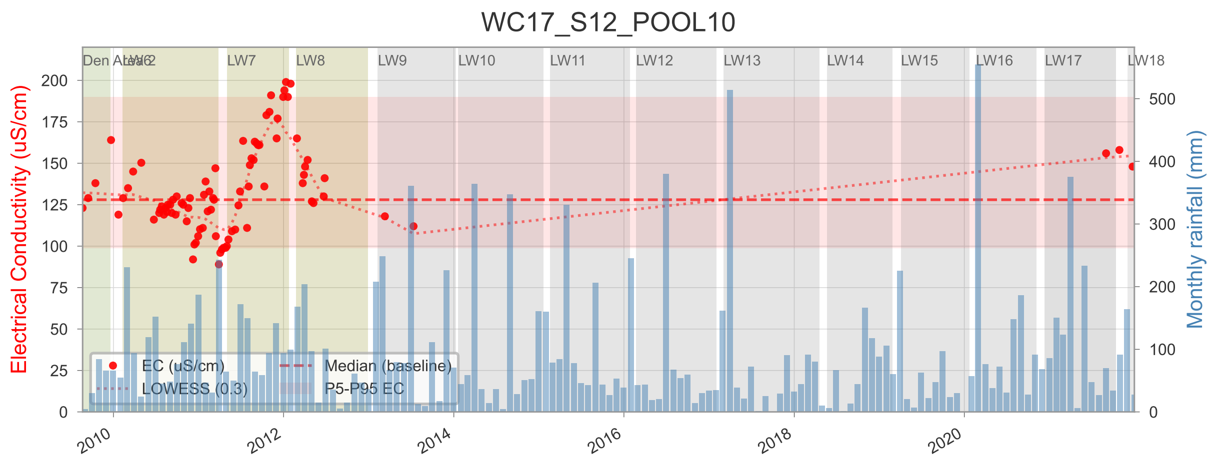

WC16_POOL1
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH

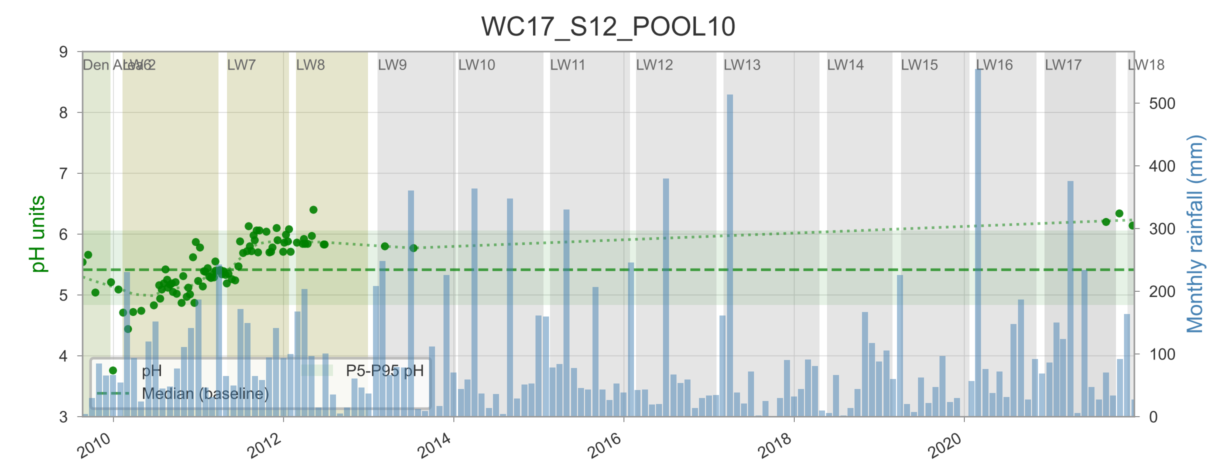

WC16_POOL1
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)

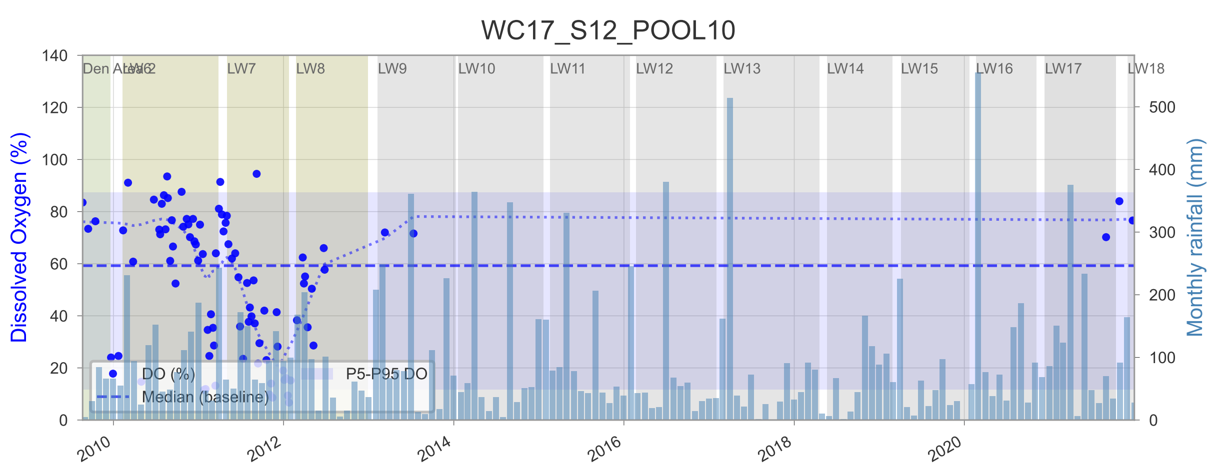


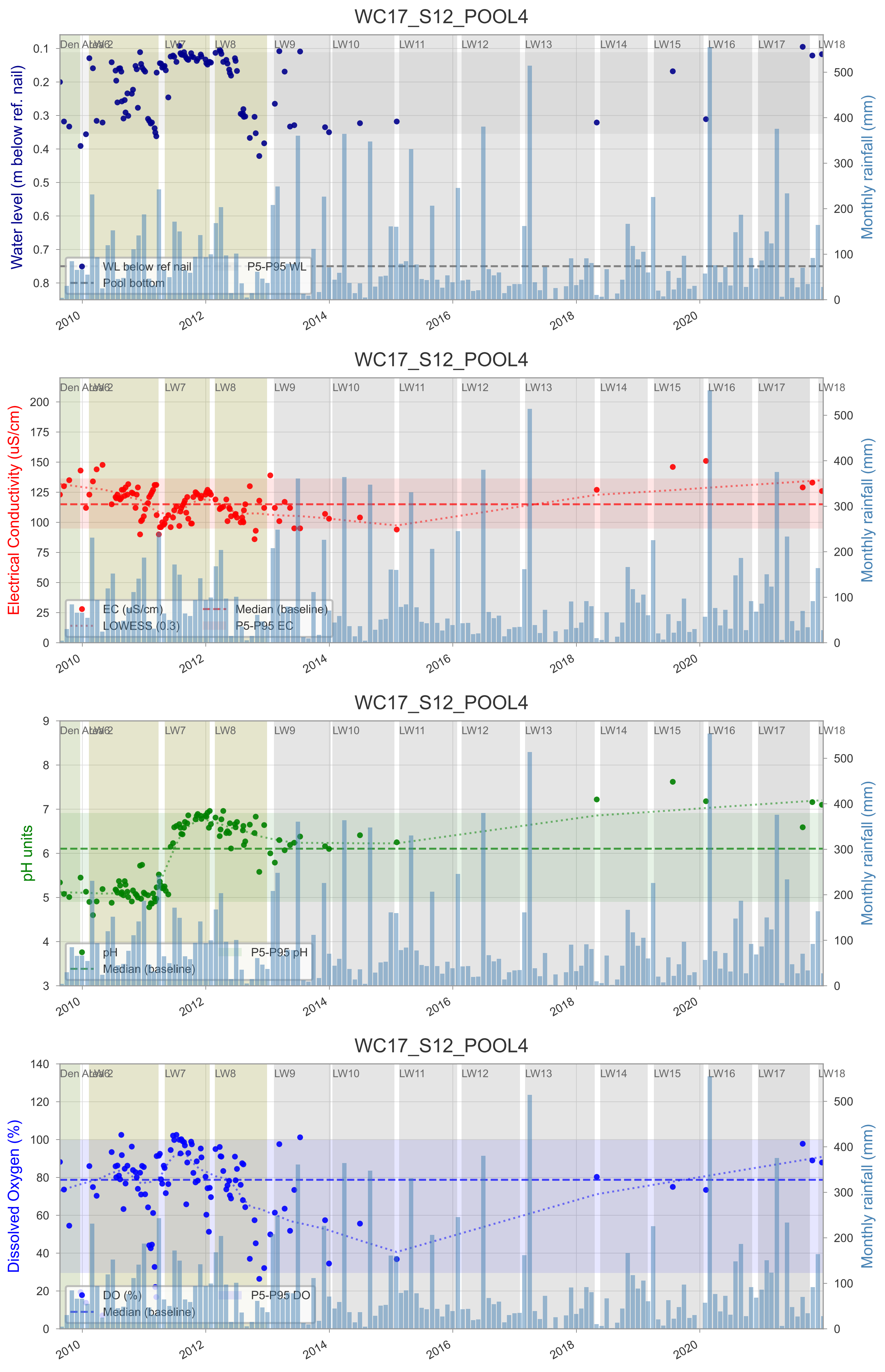
WC16_POOL3
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WC16_POOL3
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
WC16_POOL3
pH units
pH
WC16_POOL3
Dissolved Oxygen (%)
DO (%)


WC17_S12_POOL10
Water level (m below ref. nail)
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
0.0
0.2
0.4
0.6
0.8
1.0
0
100
200
300
400
500
2010
2012
2014
2016
2018
2020


WC17_S12_POOL10
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2010
2012
2014
2016
2018
2020

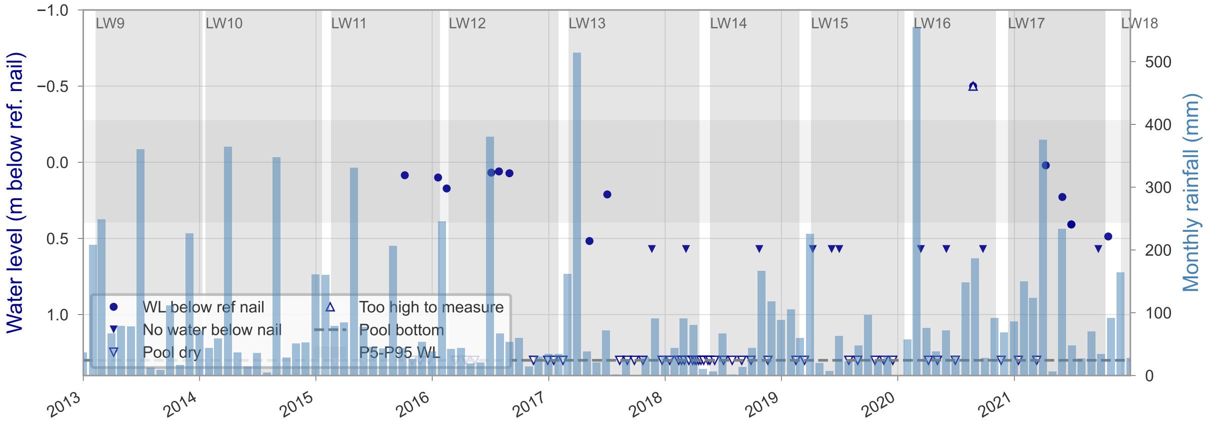

WC17_S12_POOL10
pH units
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
Median (baseline)
P5-P95 pH
3
4
5
6
7
8
9
0
100
200
300
400
500
2010
2012
2014
2016
2018
2020


WC17_S12_POOL10
Dissolved Oxygen (%)
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
Median (baseline)
P5-P95 DO
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2010
2012
2014
2016
2018
2020

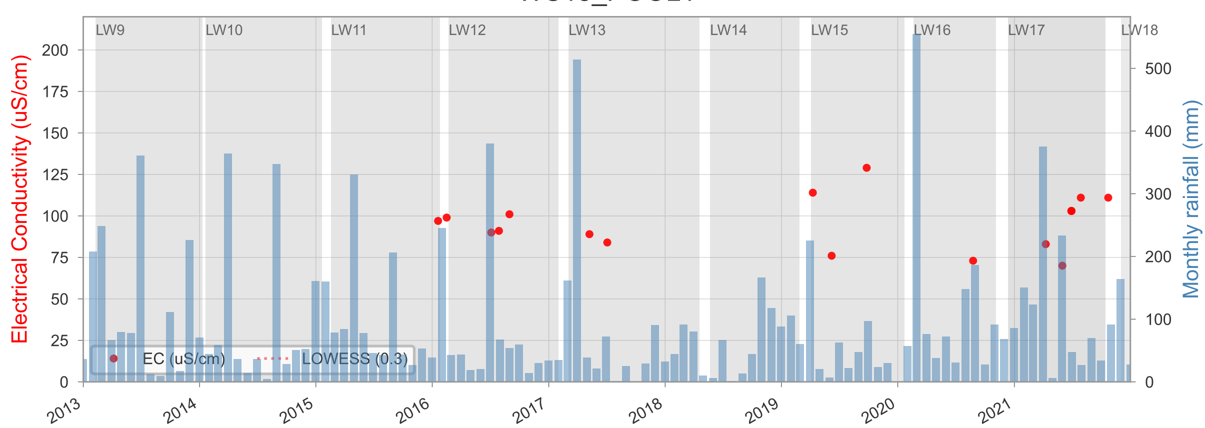


WC17_S12_POOL4
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
Pool bottom
P5-P95 WL
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WC17_S12_POOL4
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
WC17_S12_POOL4
pH units
pH
Median (baseline)
P5-P95 pH
WC17_S12_POOL4
Dissolved Oxygen (%)
DO (%)
Median (baseline)
P5-P95 DO

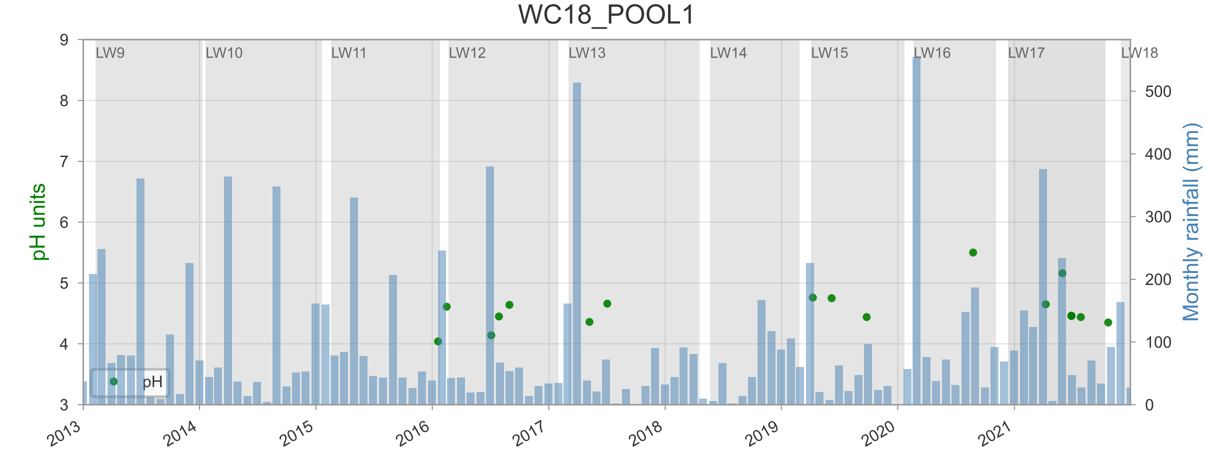
WC18_POOL1



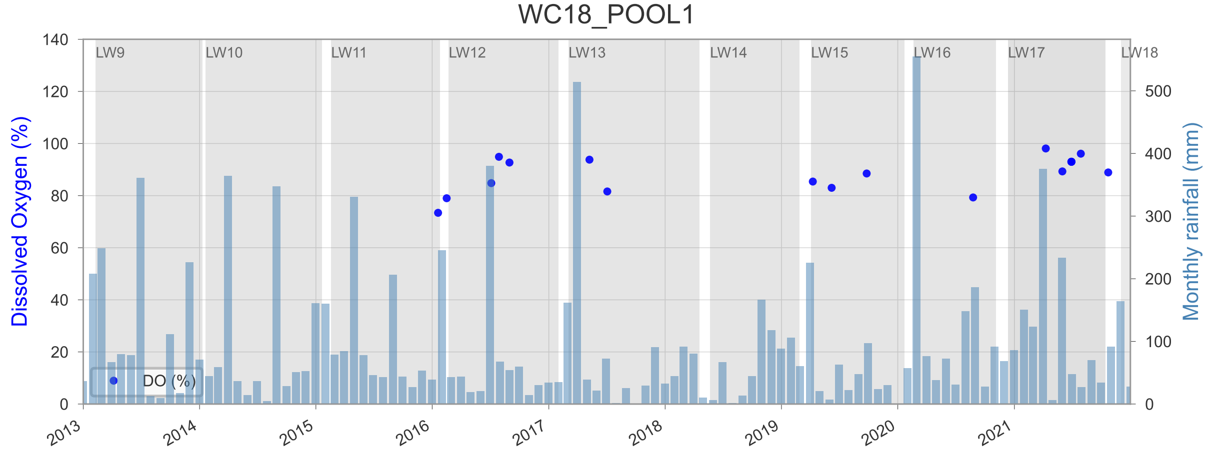
WC18_POOL1

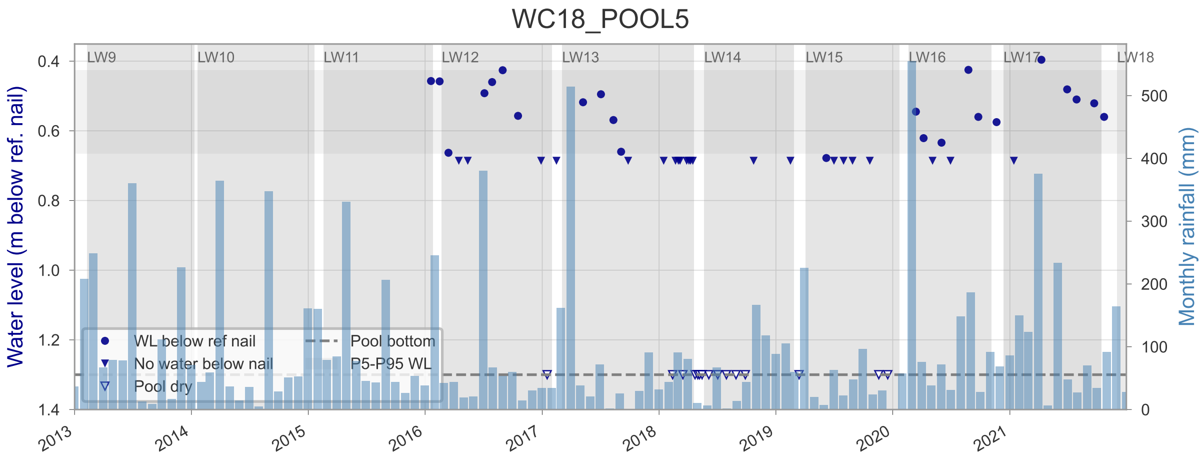


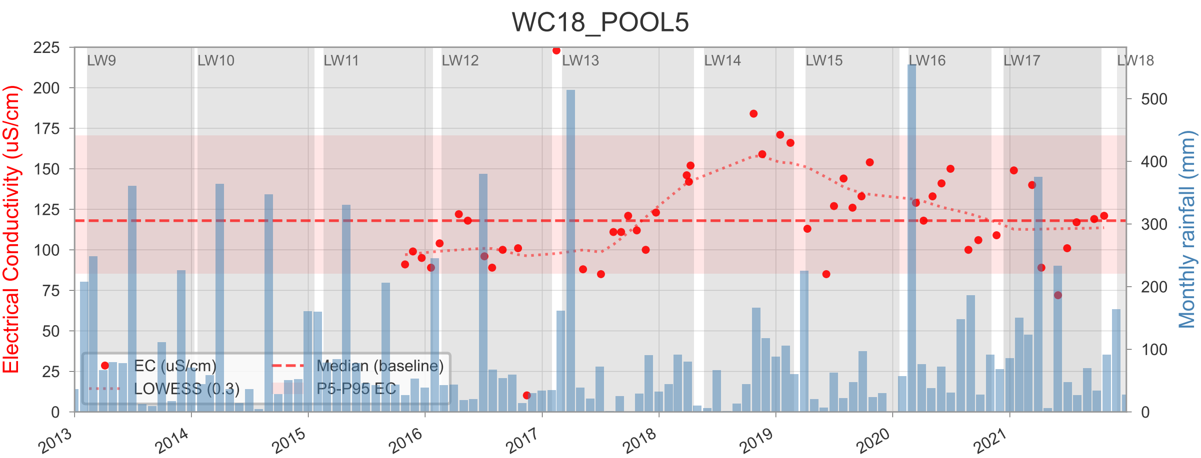
WC18_POOL1

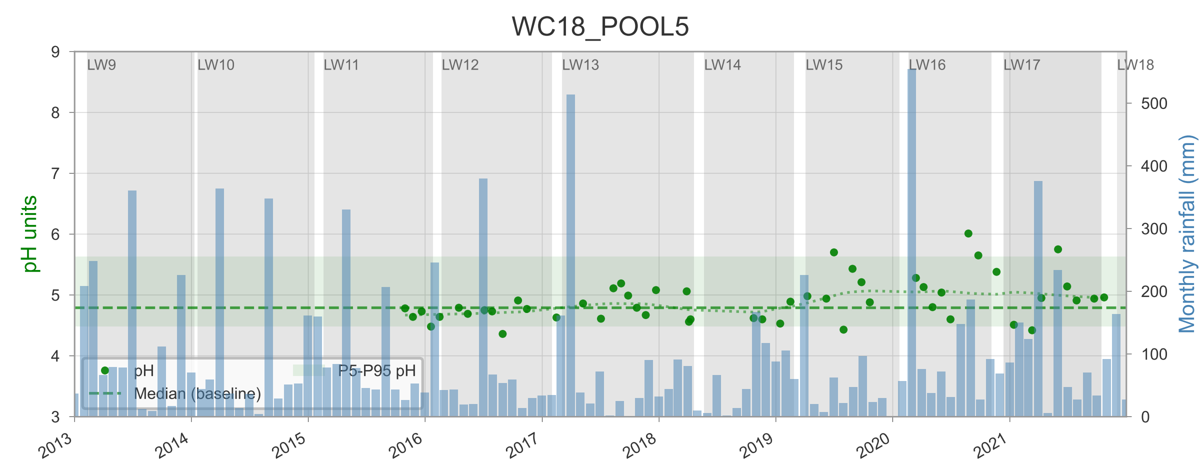


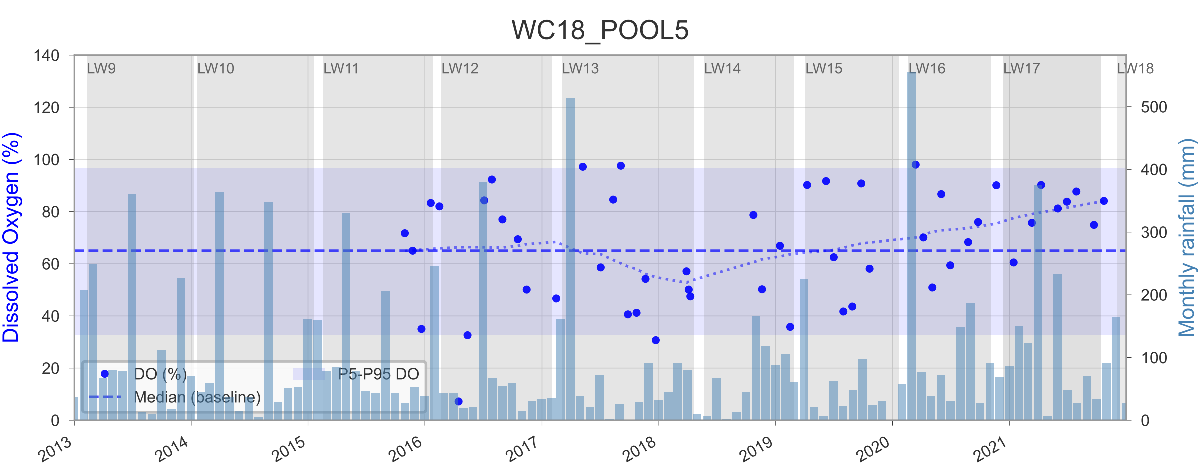
WC18_POOL1

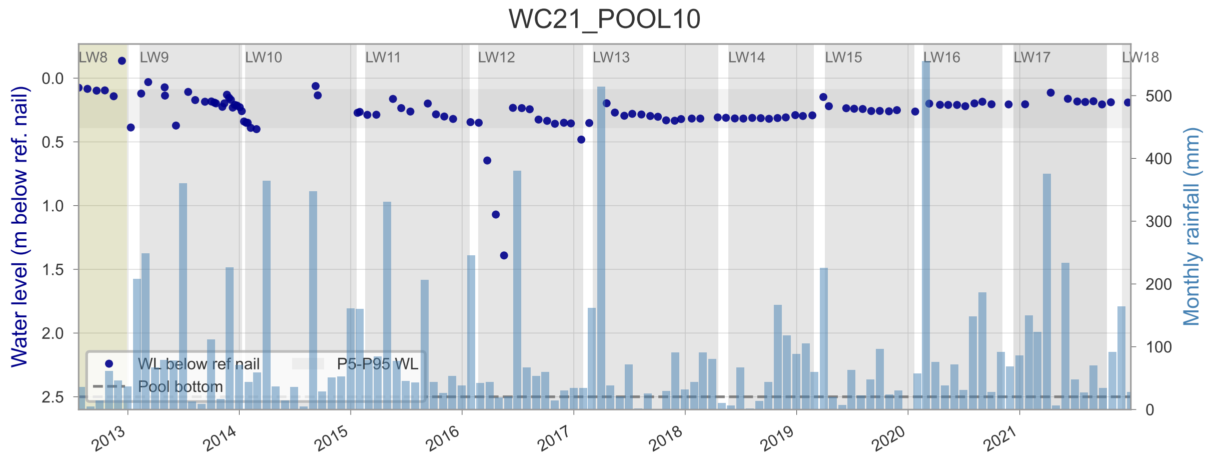


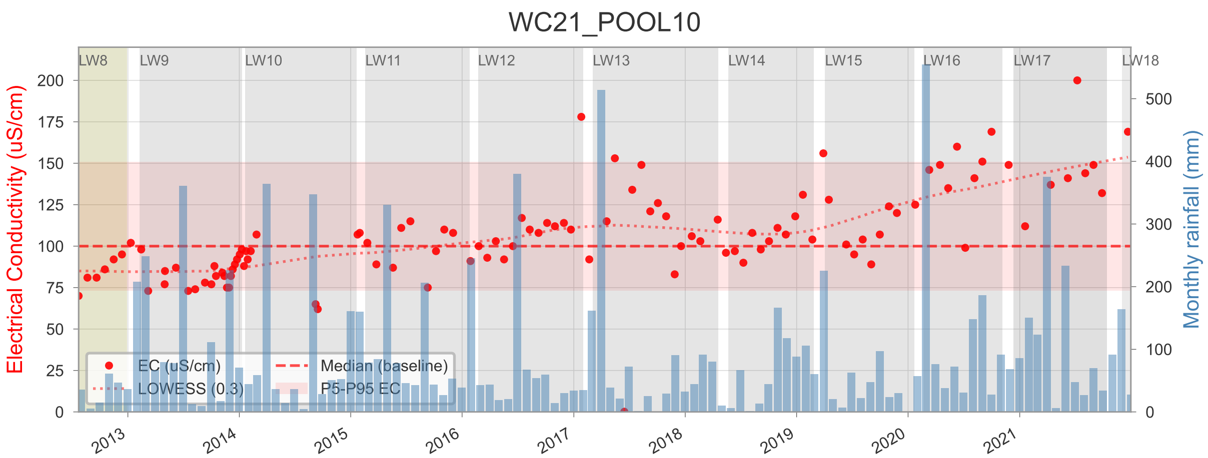

WC18_POOL5
LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL

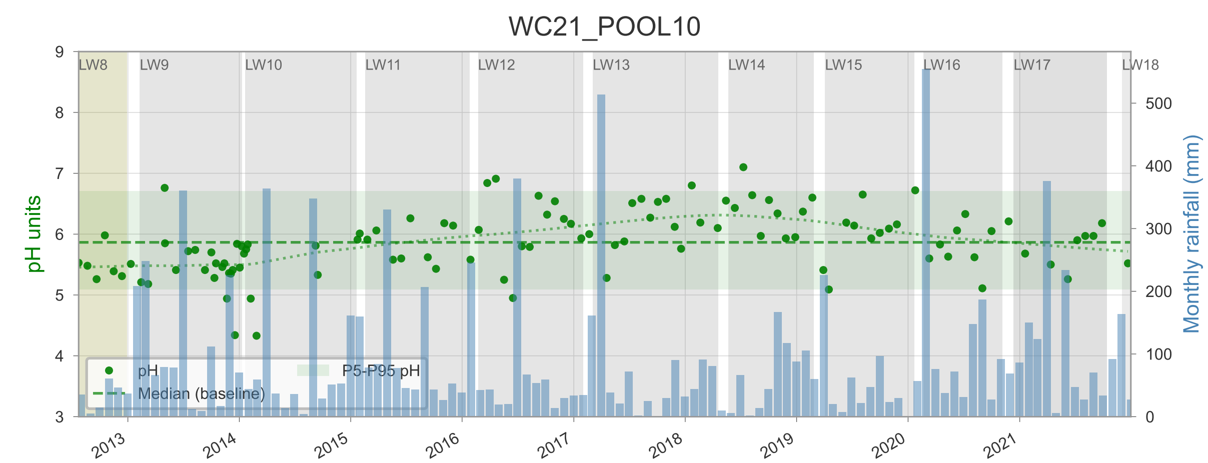

WC18_POOL5
LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

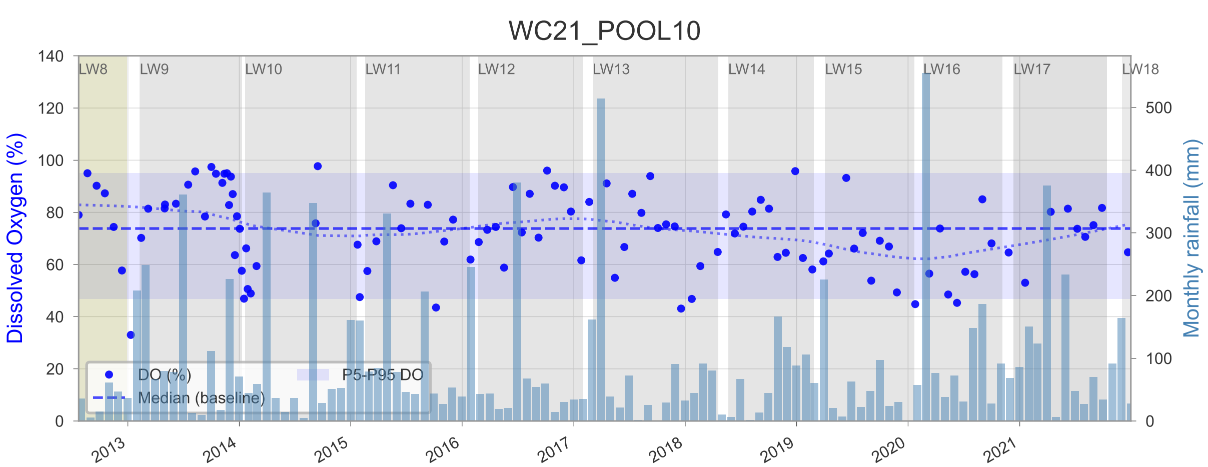

WC18_POOL5
LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

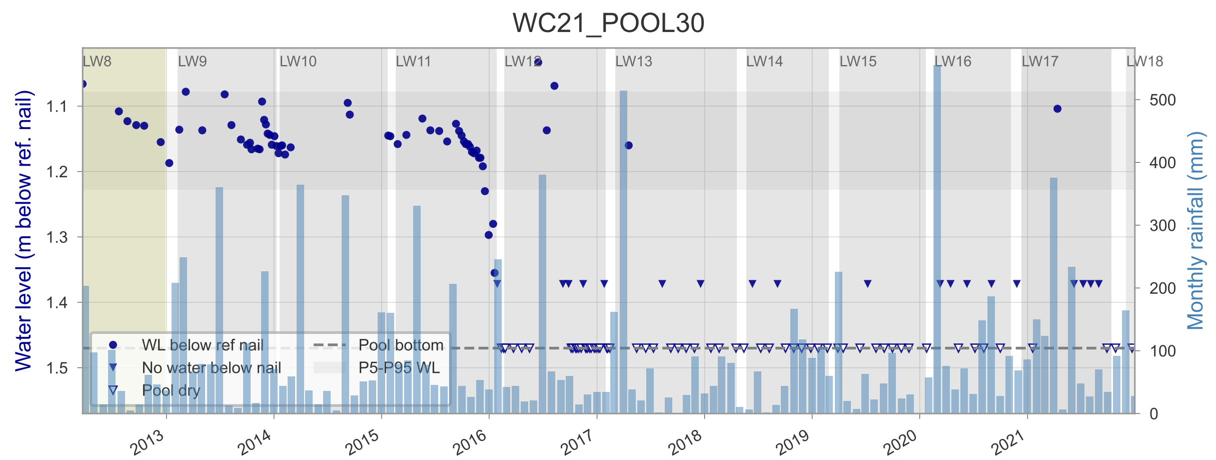

WC18_POOL5
LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

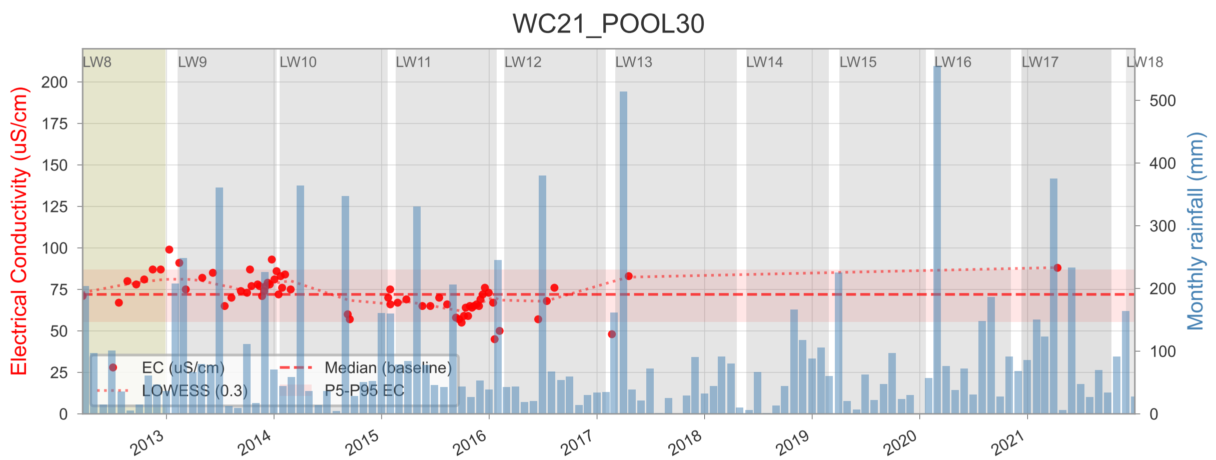

WC21_POOL10
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
Pool bottom
P5-P95 WL
2013
2014
2015
2016
2017
2018
2019
2020
2021

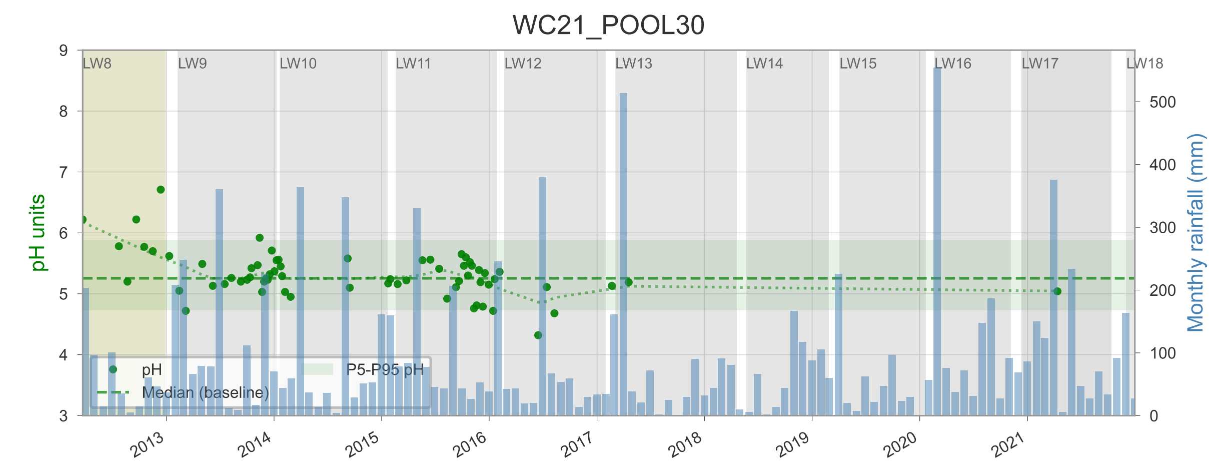

WC21_POOL10
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
2013
2014
2015
2016
2017
2018
2019
2020
2021

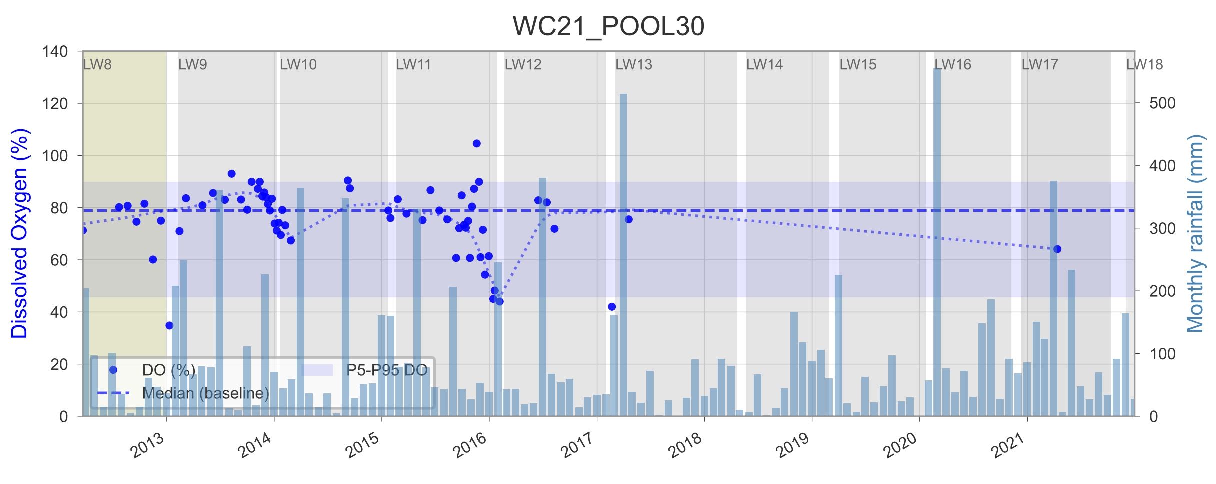

WC21_POOL10
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
2013
2014
2015
2016
2017
2018
2019
2020
2021

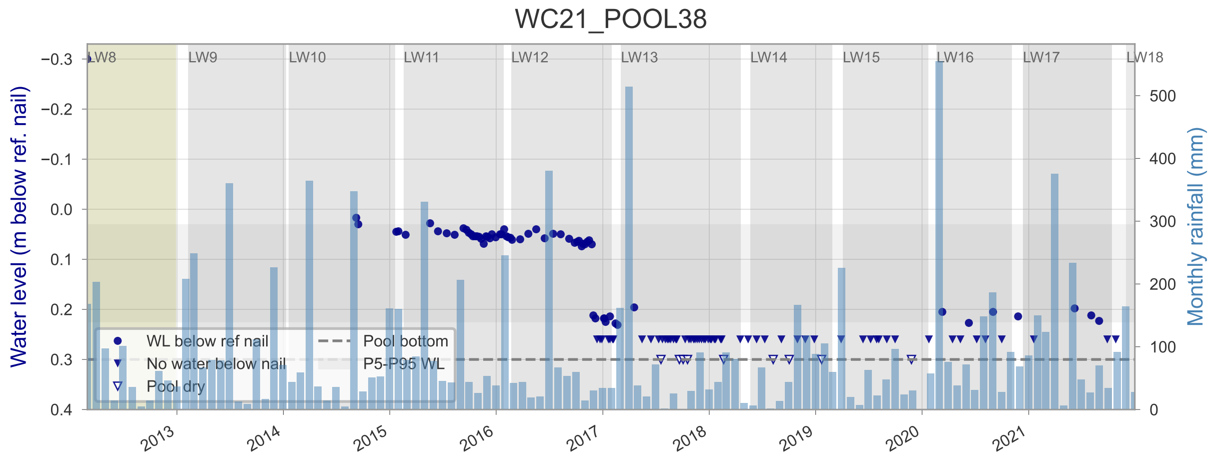

WC21_POOL10
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
2013
2014
2015
2016
2017
2018
2019
2020
2021

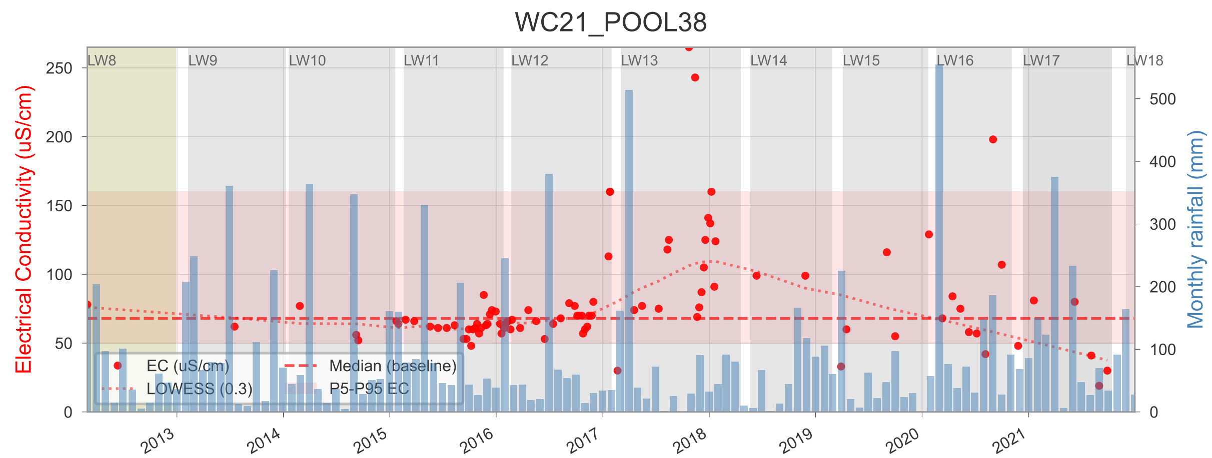

WC21_POOL30
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL

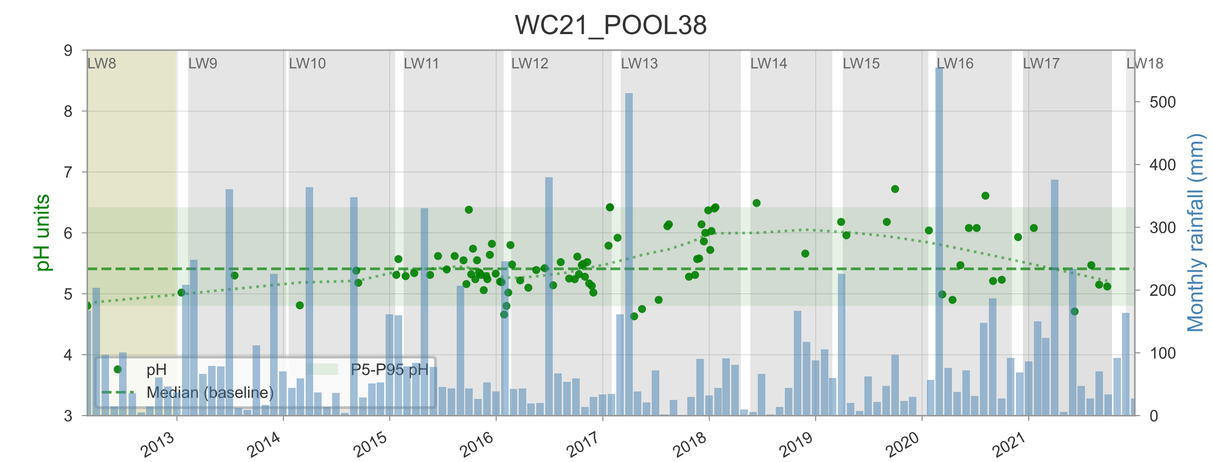

WC21_POOL30
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

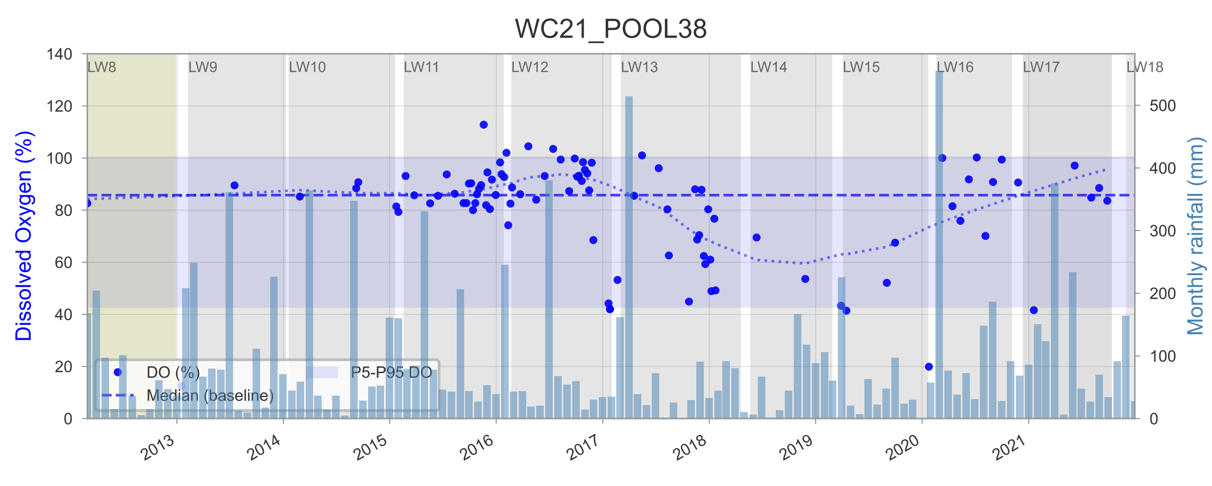

WC21_POOL30
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH


WC21_POOL30
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

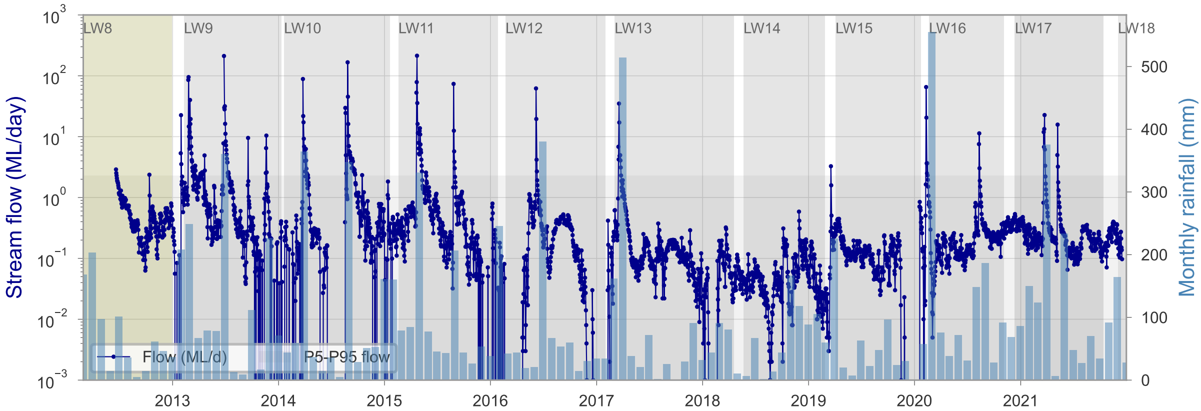

WC21_POOL38
Water level (m below ref. nail)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL


WC21_POOL38
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

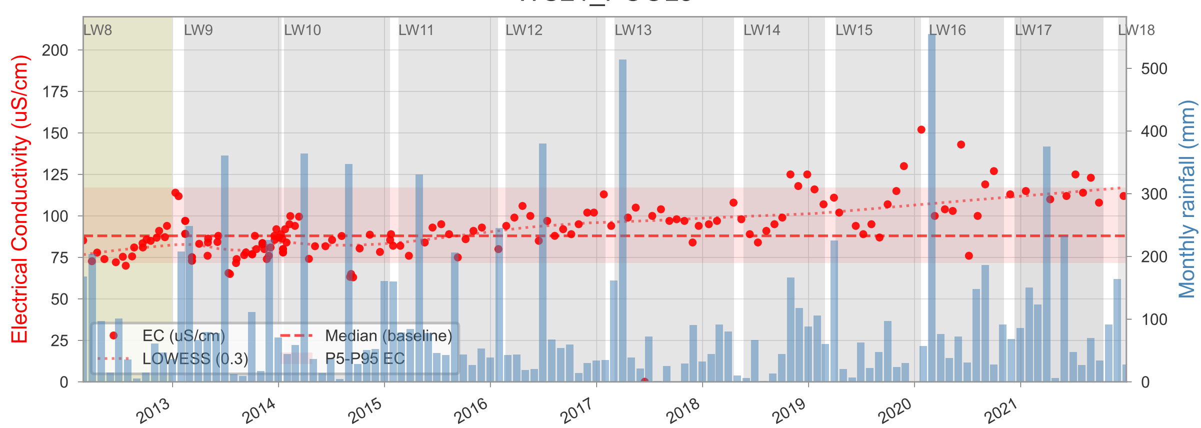

WC21_POOL38
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH


WC21_POOL38
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

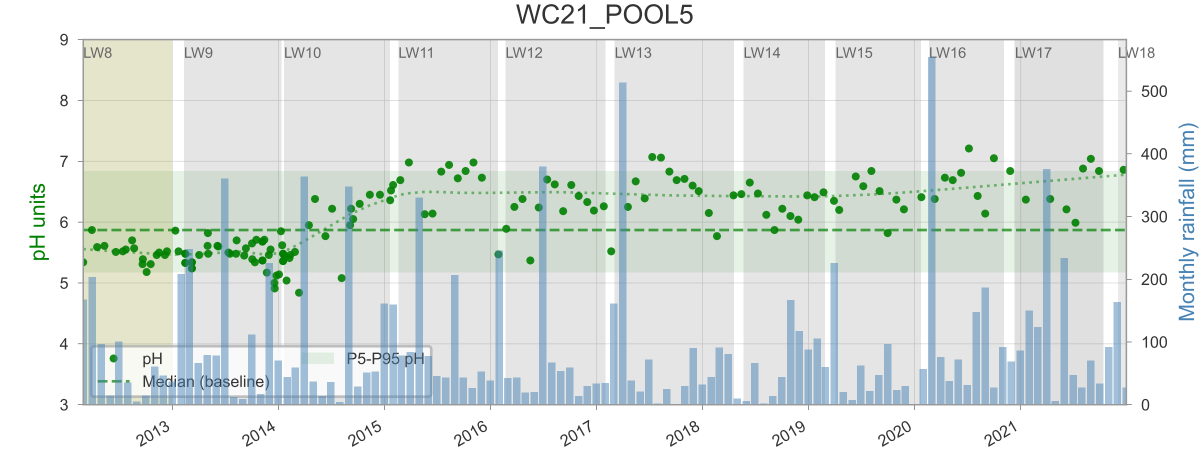
WC21S1



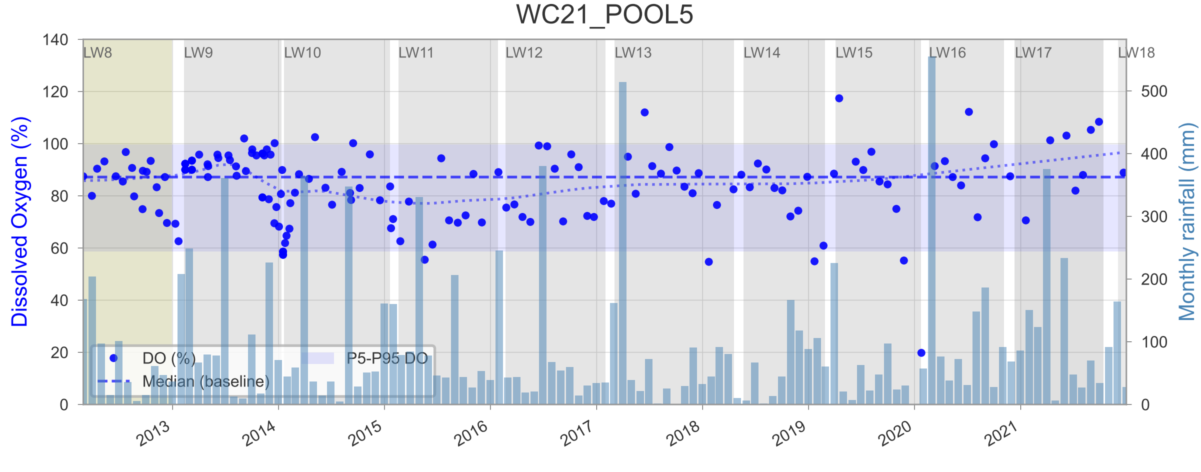
WC21_POOL5

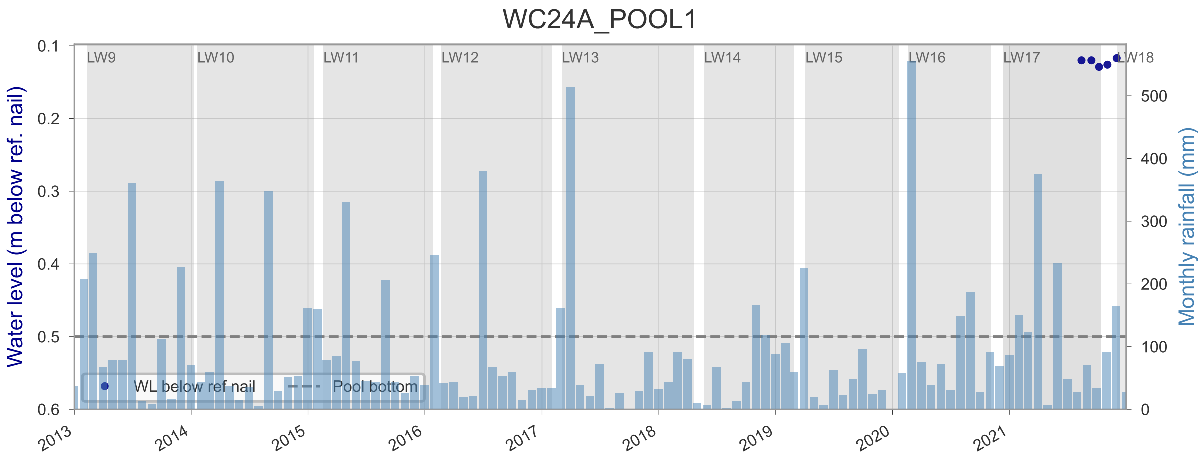


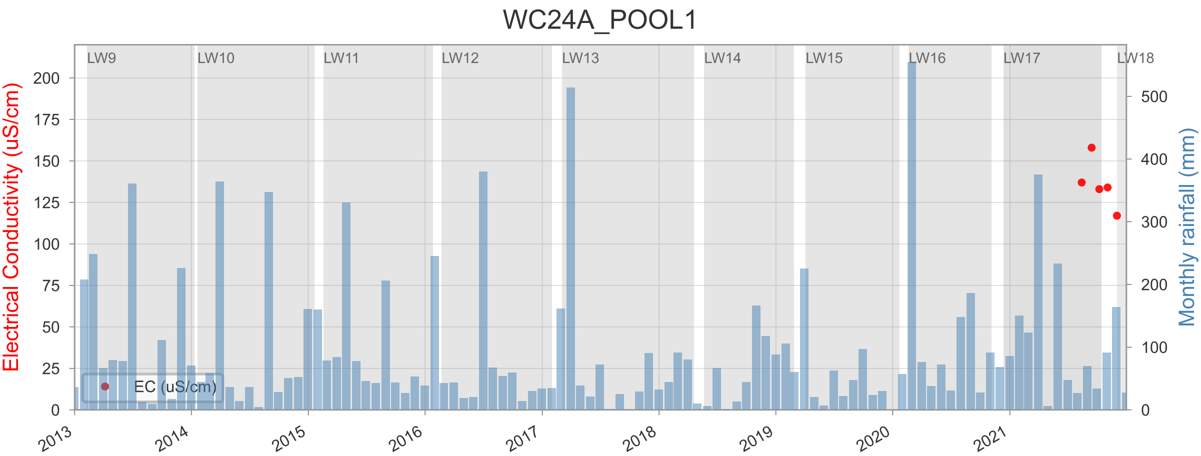
WC21_POOL5

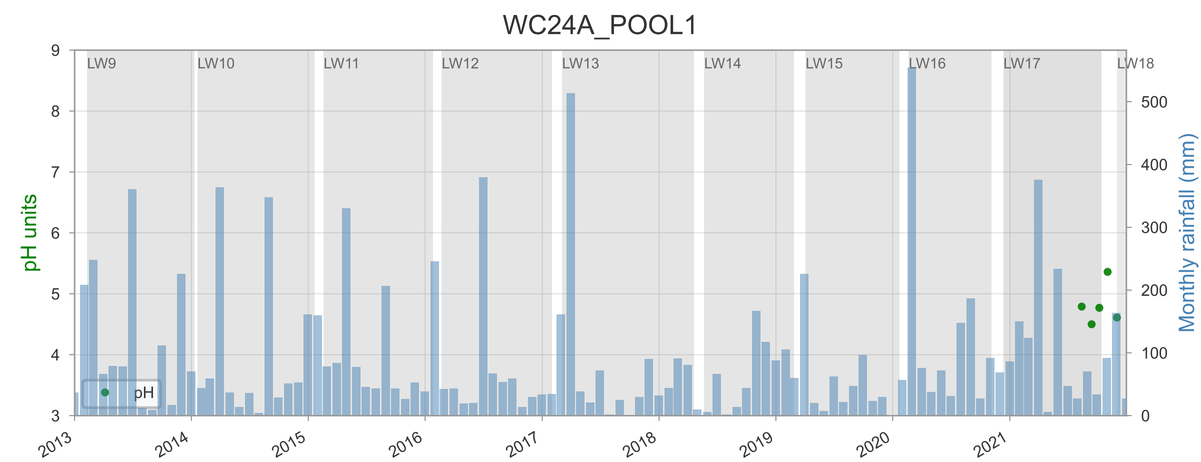


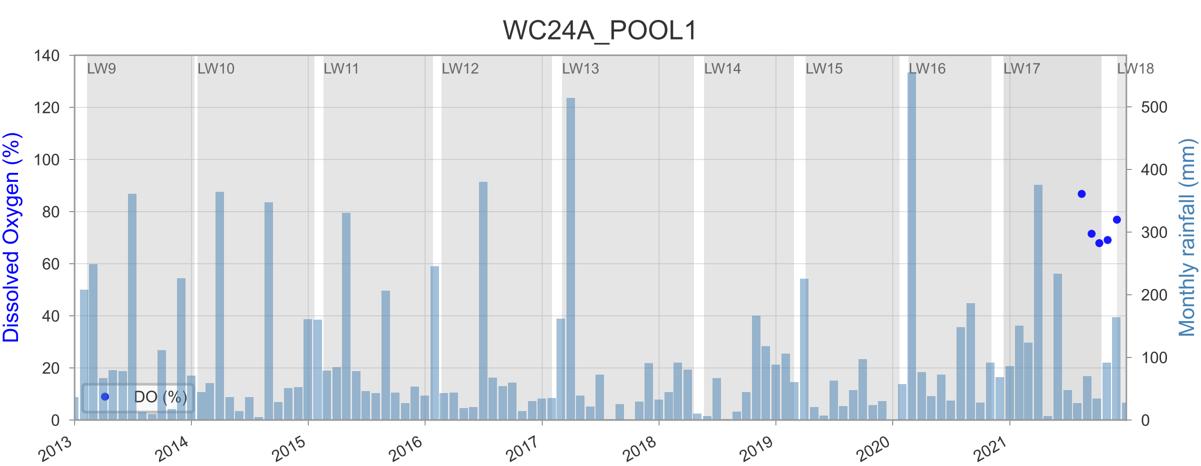
WC21_POOL5



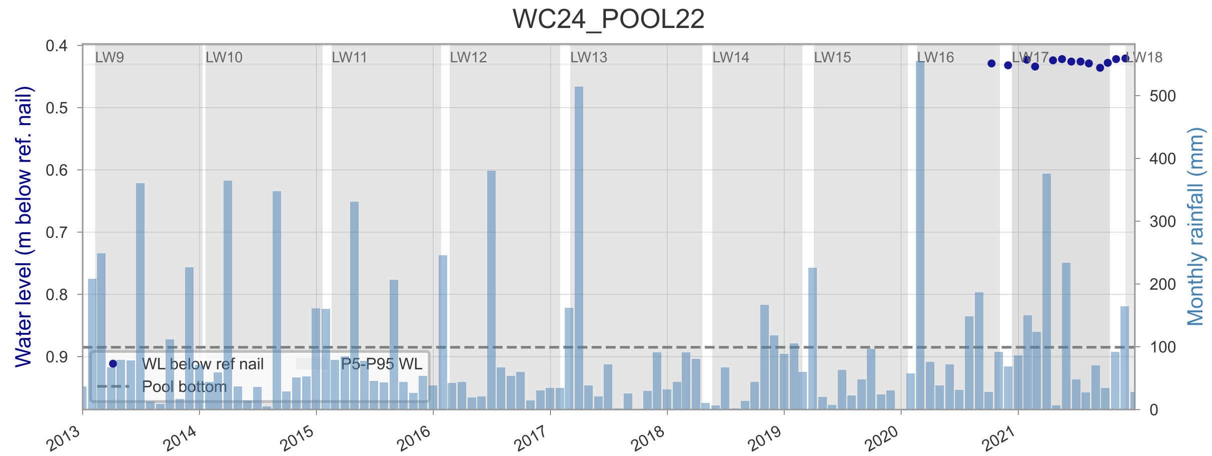

WC24A_POOL1
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WL below ref nail
Pool bottom

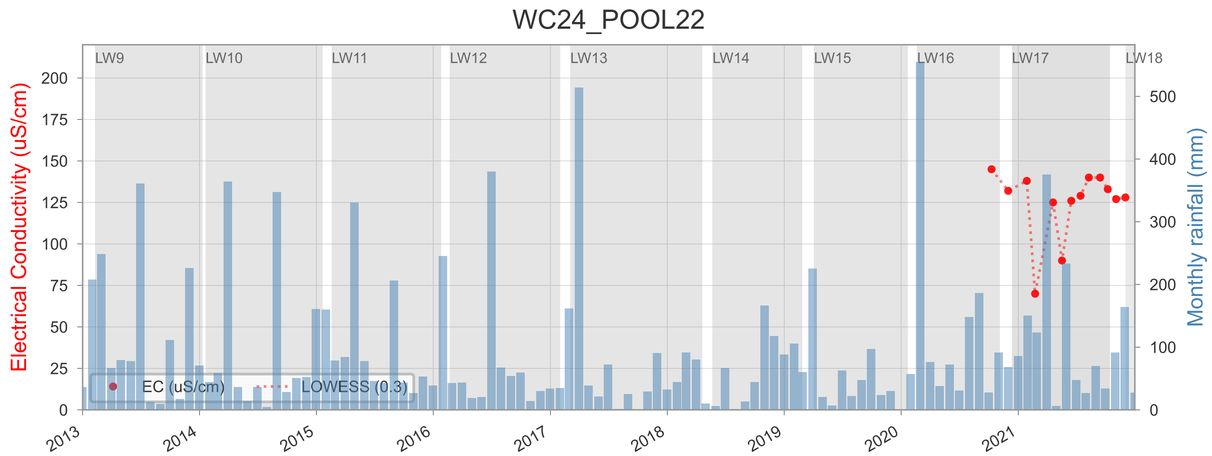

WC24A_POOL1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)

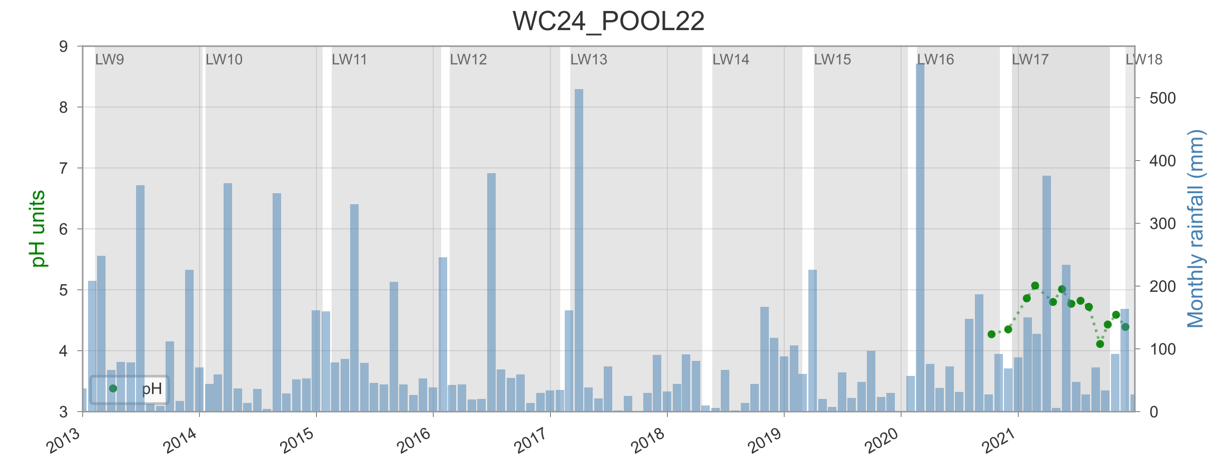

WC24A_POOL1
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH

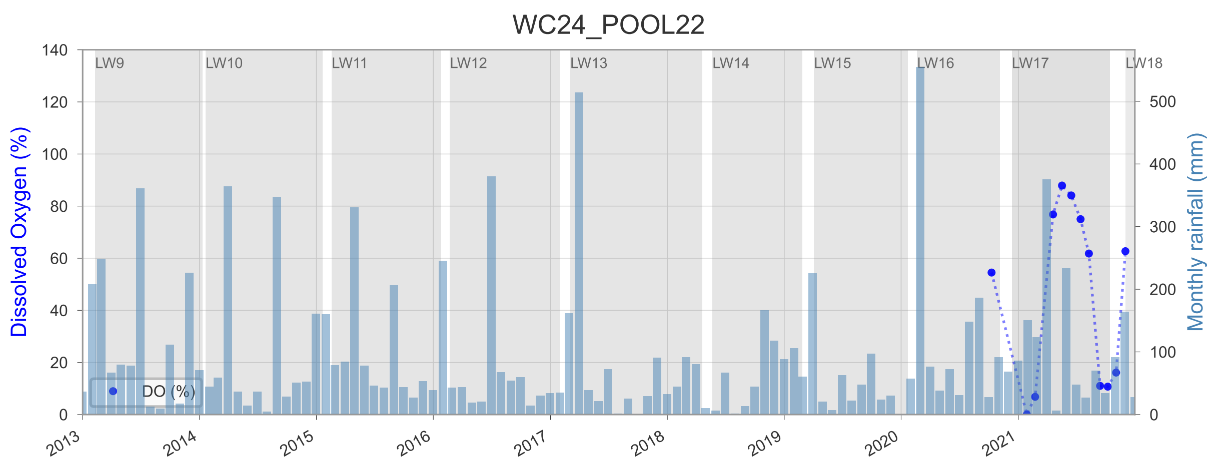

WC24A_POOL1
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)

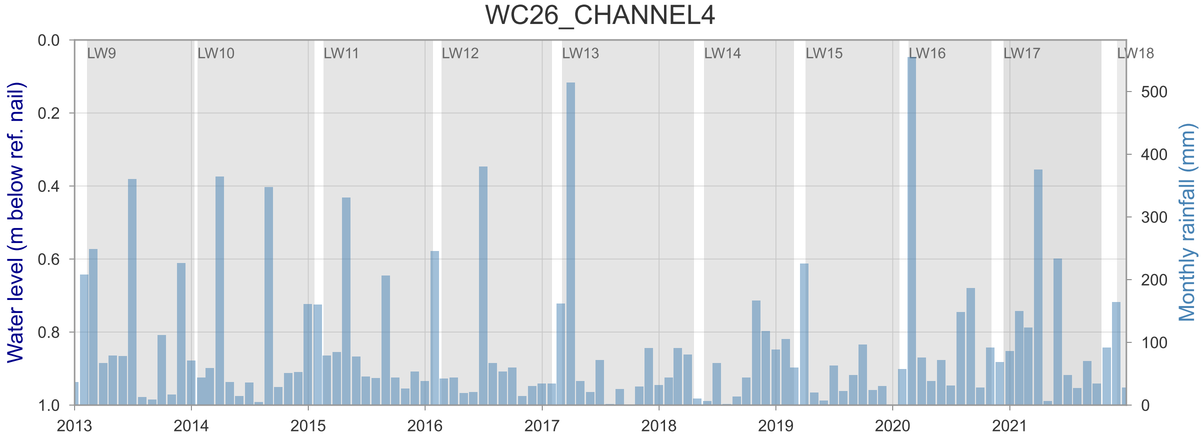

WC24_POOL10
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
P5-P95 WL
Pool bottom
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
pH units
pH
Dissolved Oxygen (%)
DO (%)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

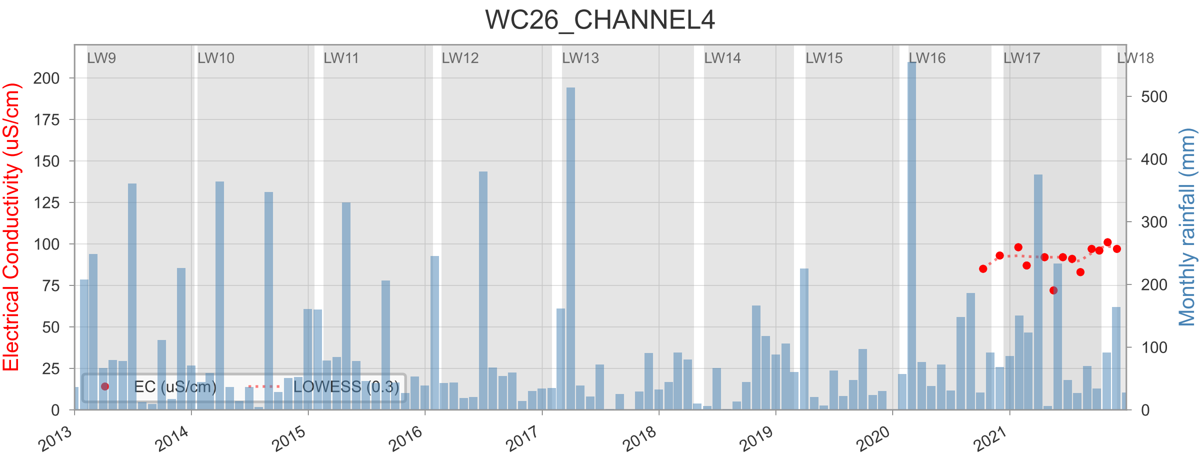

WC24_POOL22
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WL below ref nail
Pool bottom
P5-P95 WL
2013
2014
2015
2016
2017
2018
2019
2020
2021

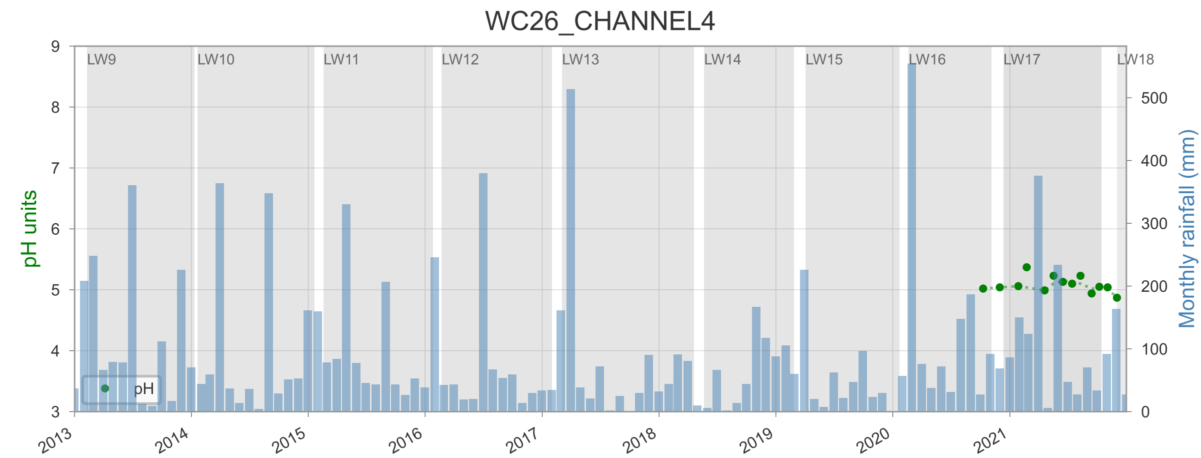

WC24_POOL22
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)
2013
2014
2015
2016
2017
2018
2019
2020
2021

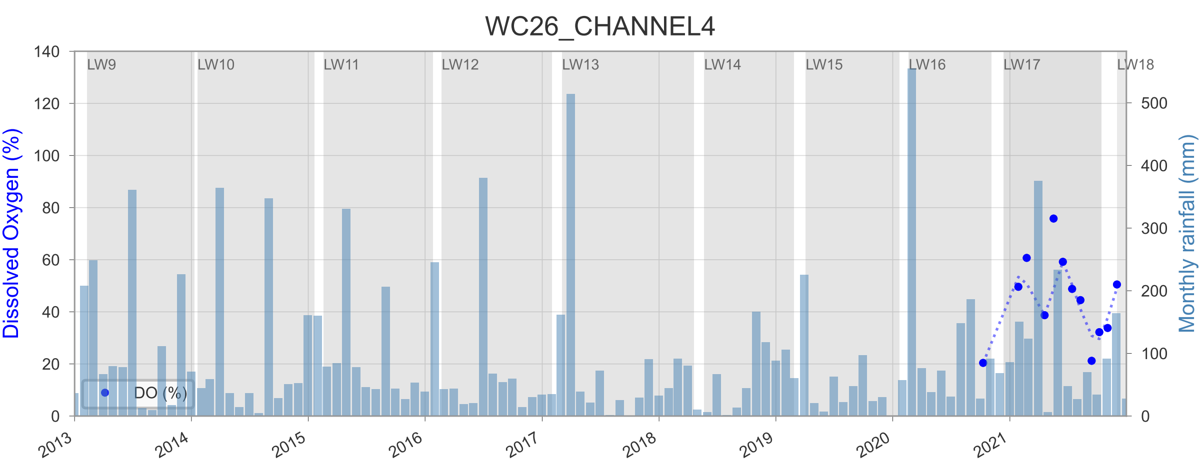

WC24_POOL22
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
2013
2014
2015
2016
2017
2018
2019
2020
2021

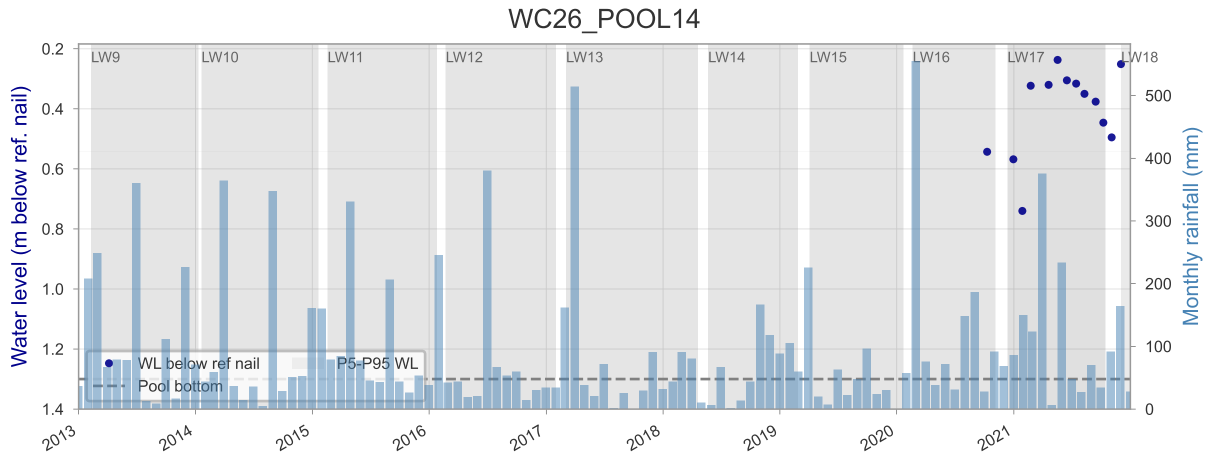

WC24_POOL22
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
2013
2014
2015
2016
2017
2018
2019
2020
2021

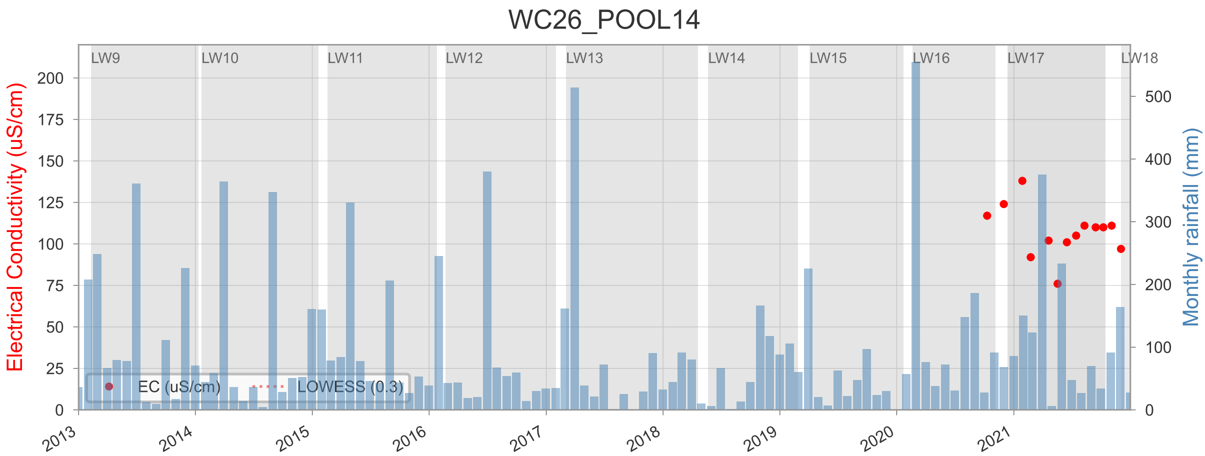

WC26_CHANNEL4
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
0.0
0.2
0.4
0.6
0.8
1.0
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

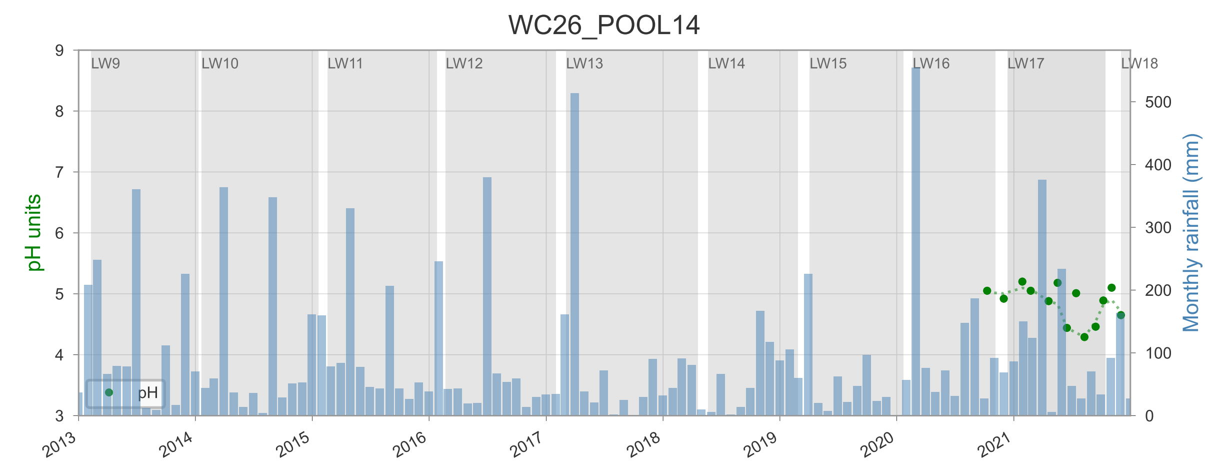

WC26_CHANNEL4
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

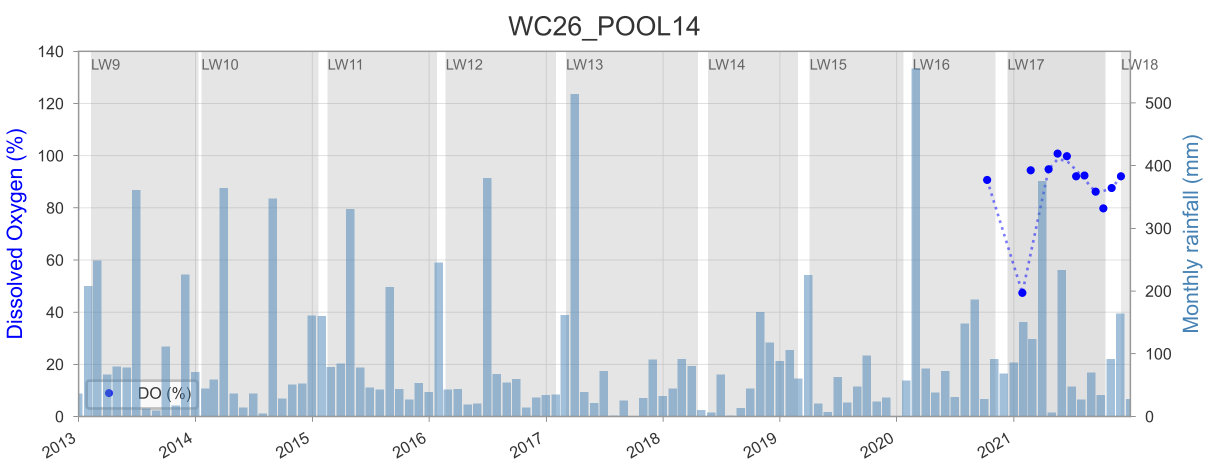

WC26_CHANNEL4
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
3
4
5
6
7
8
9
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

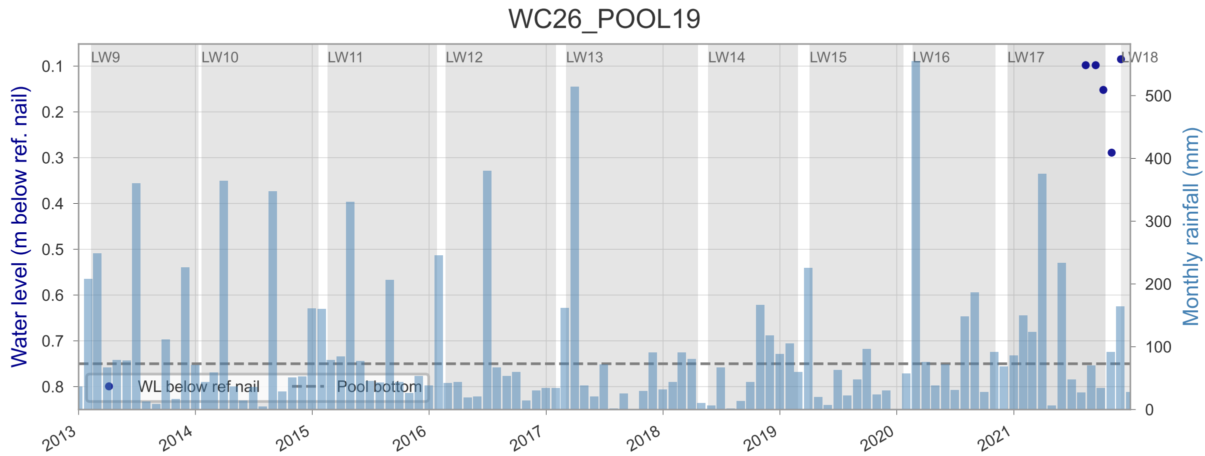

WC26_CHANNEL4
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

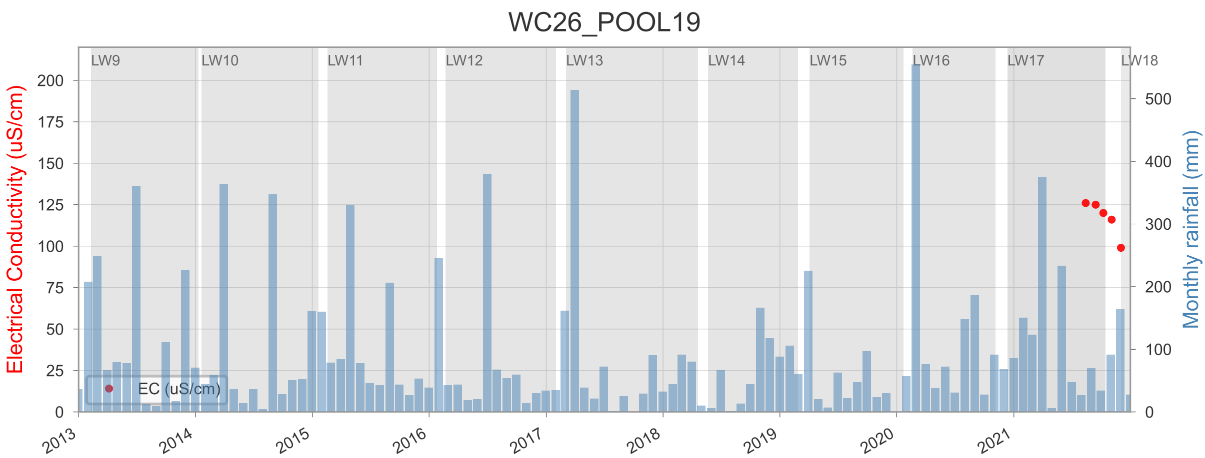

WC26_POOL14
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WL below ref nail
P5-P95 WL
Pool bottom

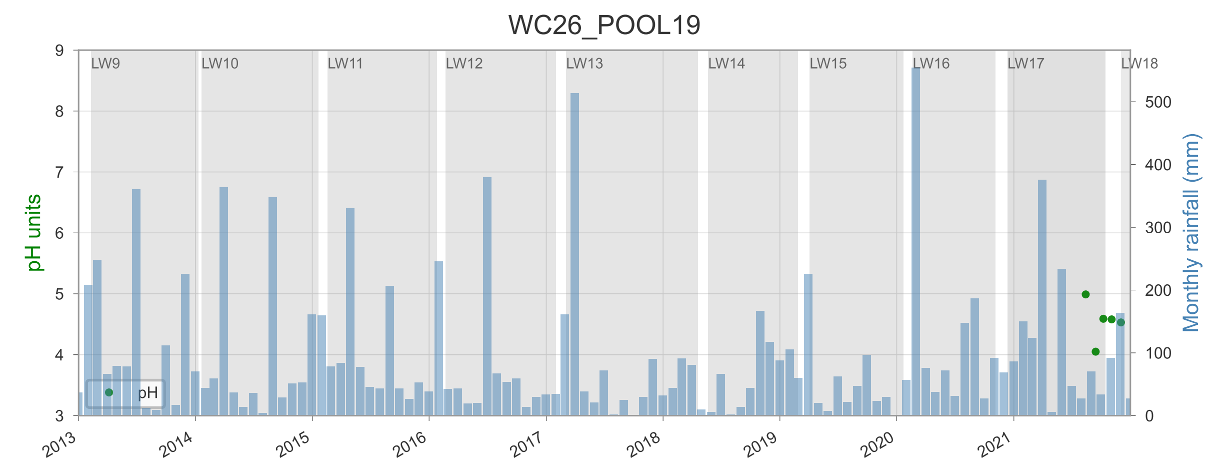

WC26_POOL14
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)

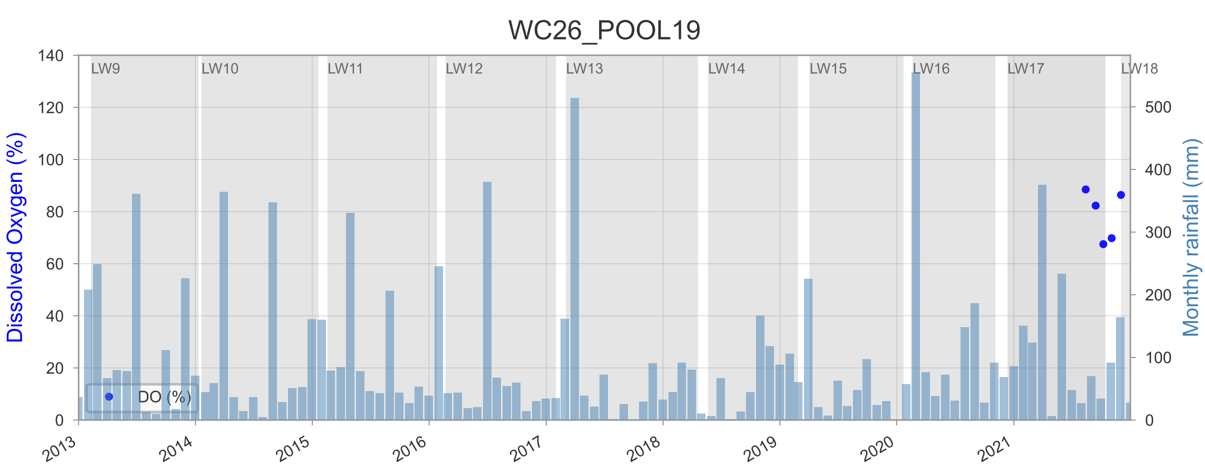

WC26_POOL14
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH


WC26_POOL14
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)

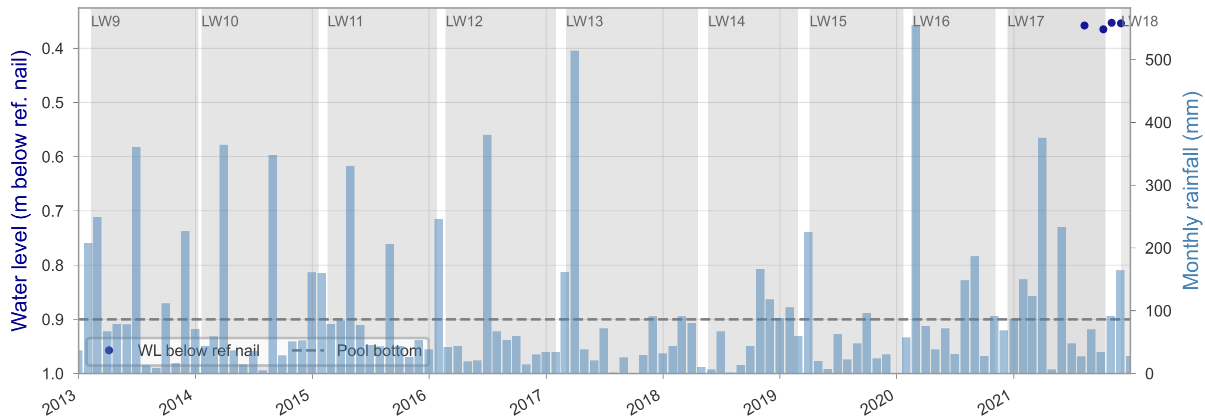

WC26_POOL19
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WL below ref nail
Pool bottom
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021


WC26_POOL19
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

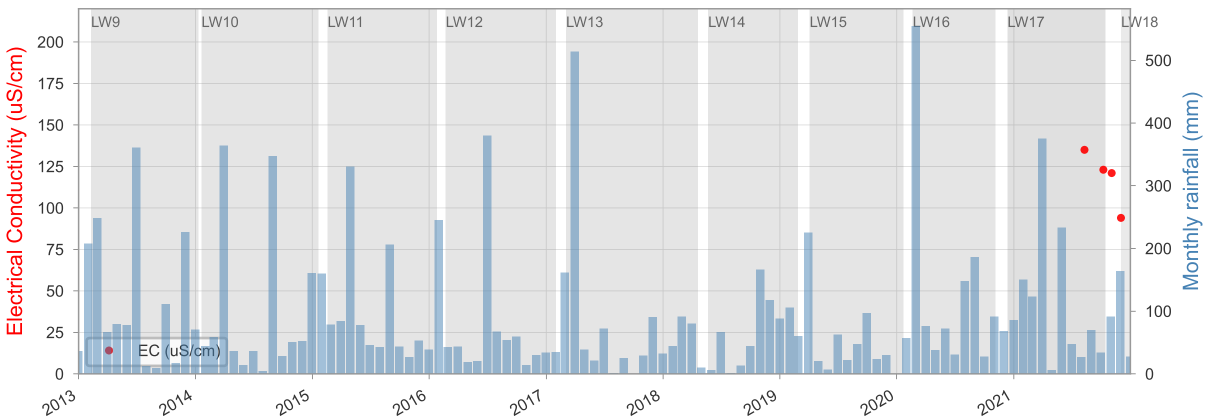

WC26_POOL19
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
3
4
5
6
7
8
9
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021


WC26_POOL19
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

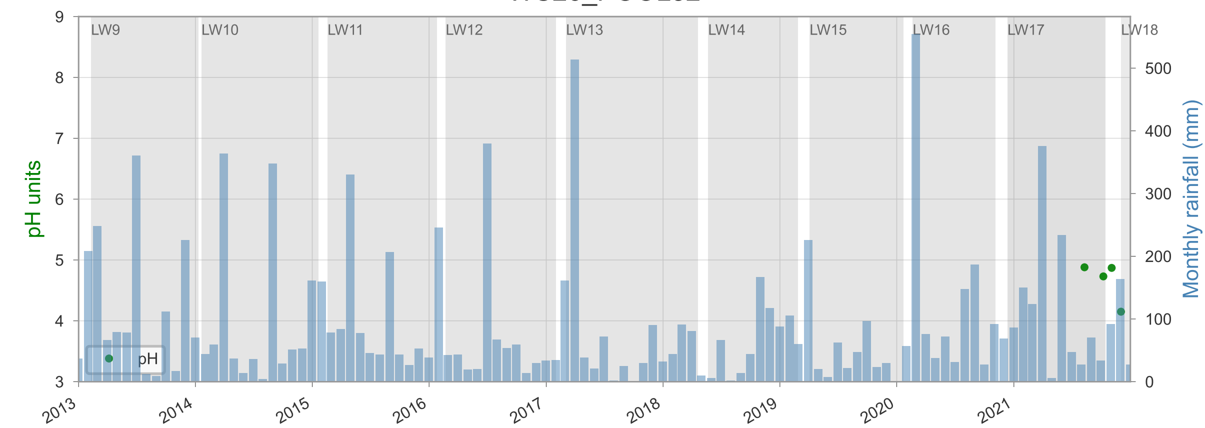
WC26_POOL32



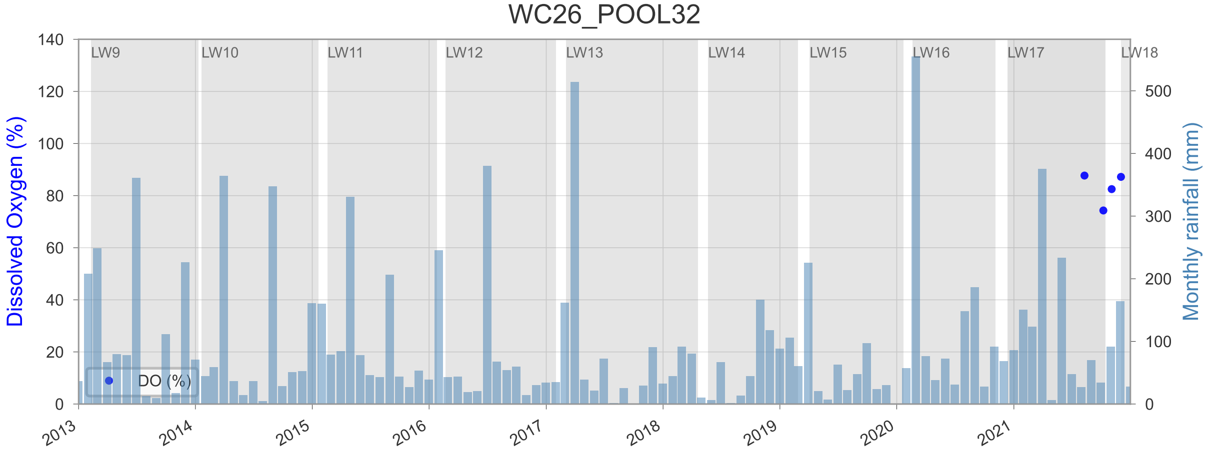
WC26_POOL32

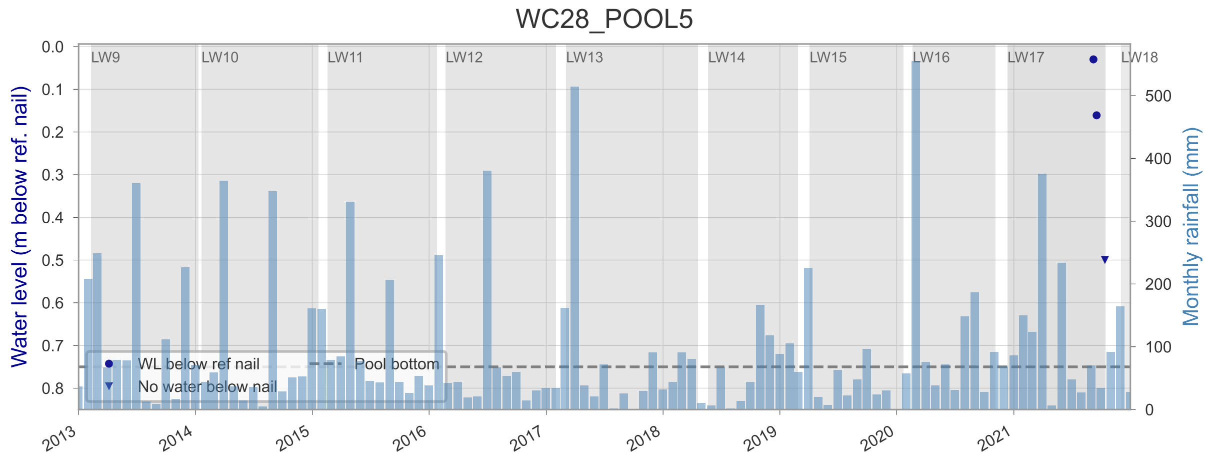


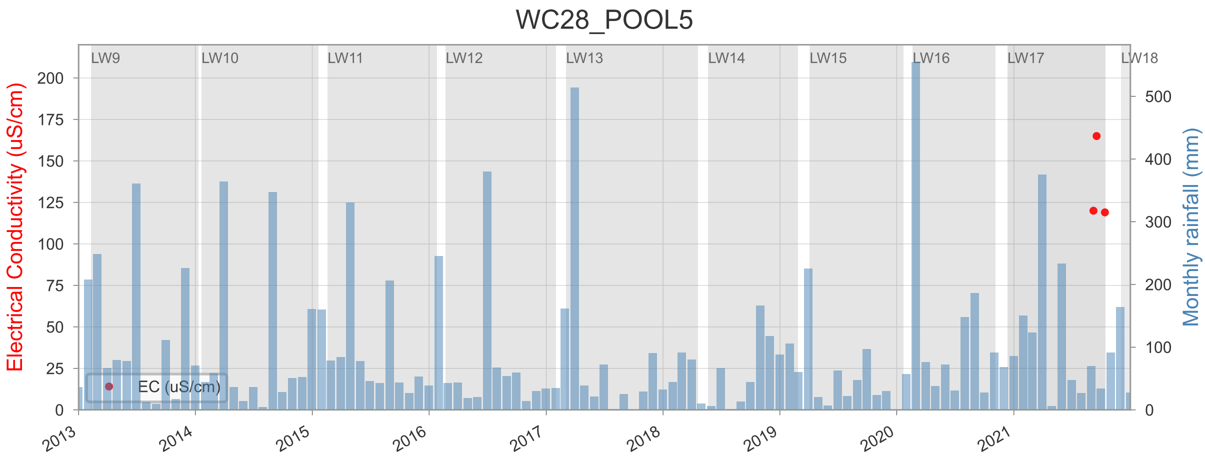
WC26_POOL32

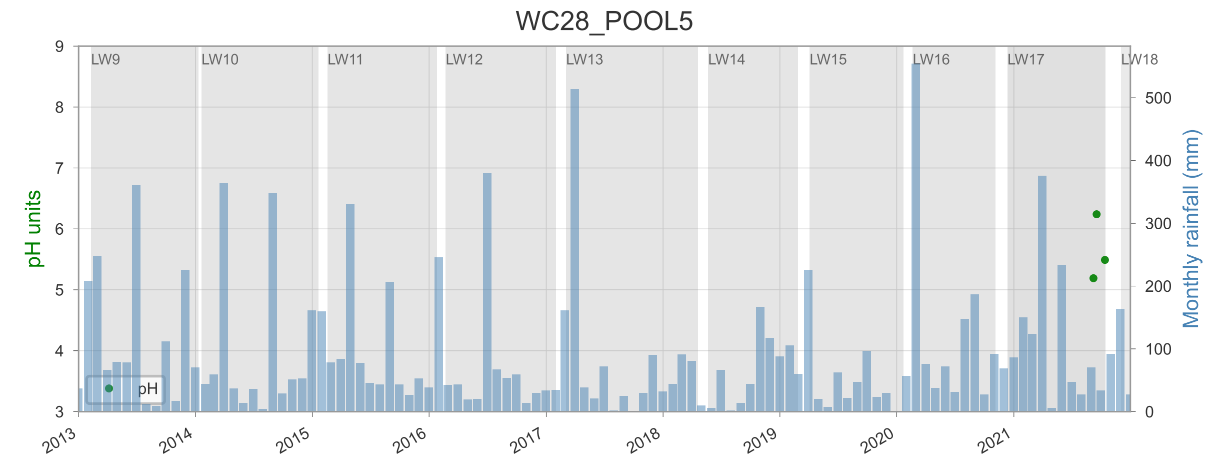


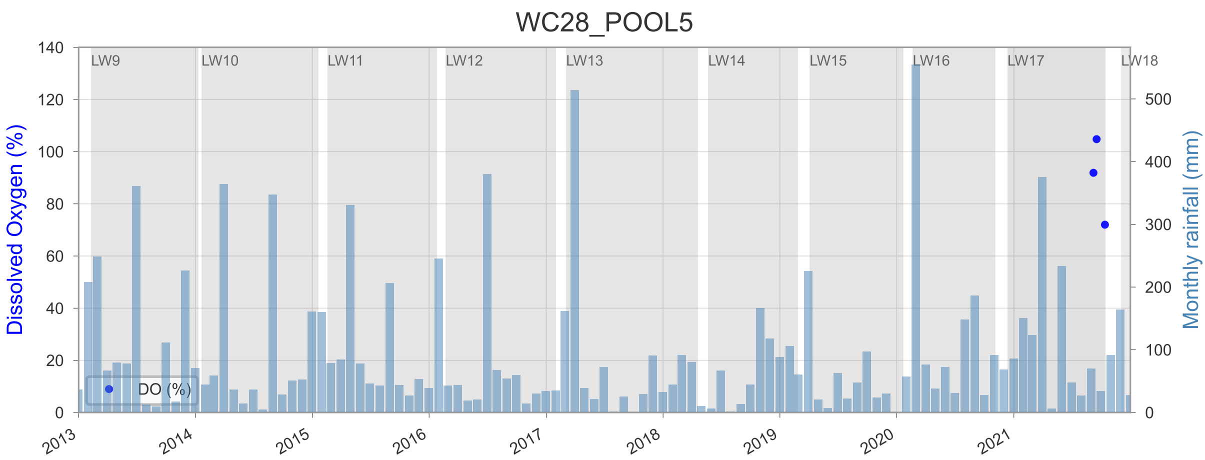
WC26_POOL32



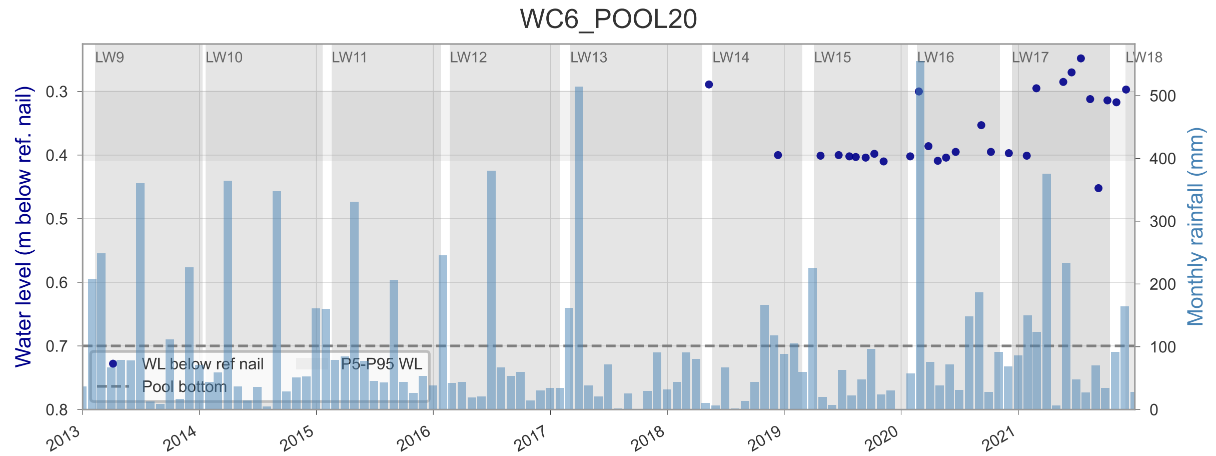

WC28_POOL5
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WL below ref nail
No water below nail
Pool bottom


WC28_POOL5
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)

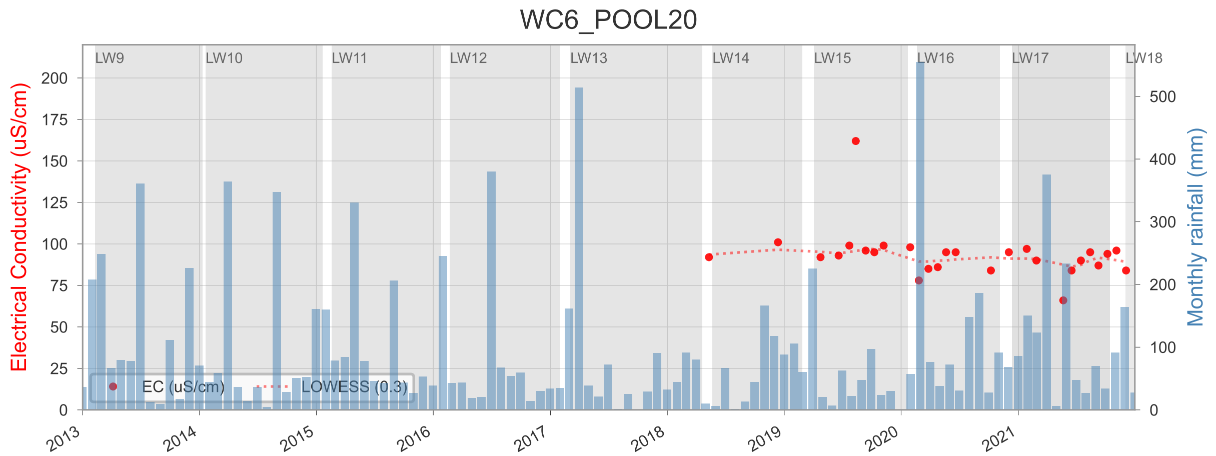

WC28_POOL5
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH


WC28_POOL5
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)

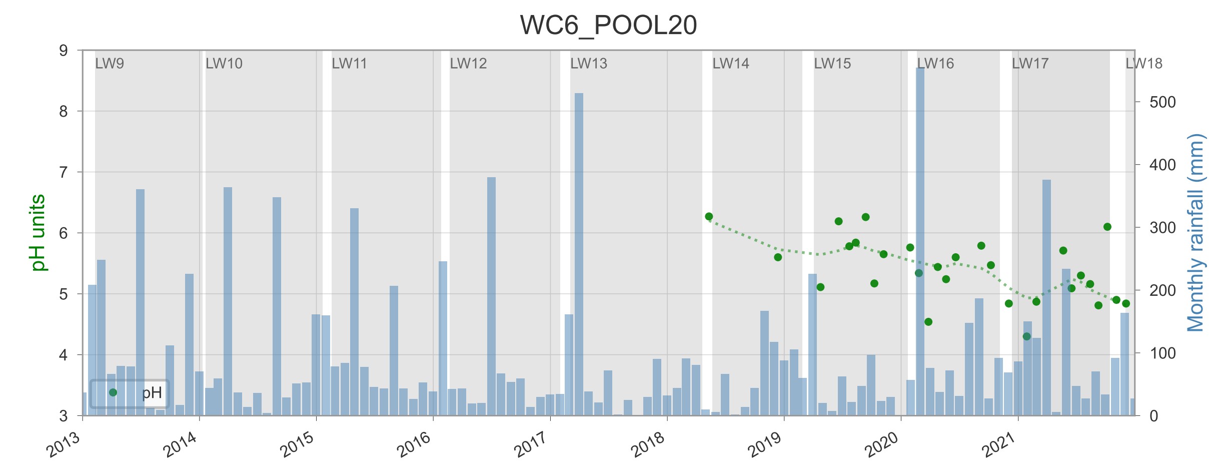

WC6_POOL10
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
P5-P95 WL
Pool bottom
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WC6_POOL10
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
WC6_POOL10
pH units
Monthly rainfall (mm)
pH
WC6_POOL10
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
2013
2014
2015
2016
2017
2018
2019
2020
2021



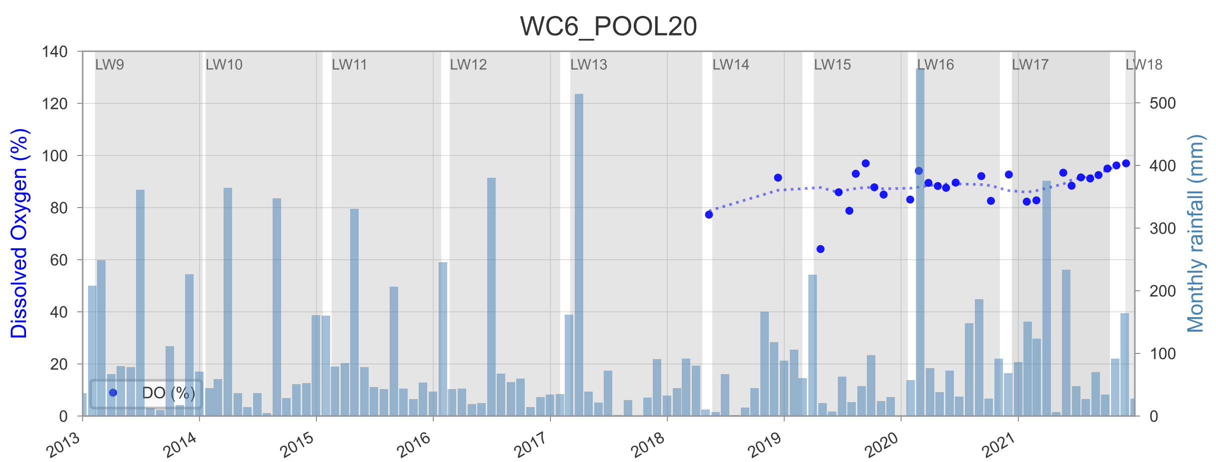
WC6_POOL20
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
Pool bottom
P5-P95 WL



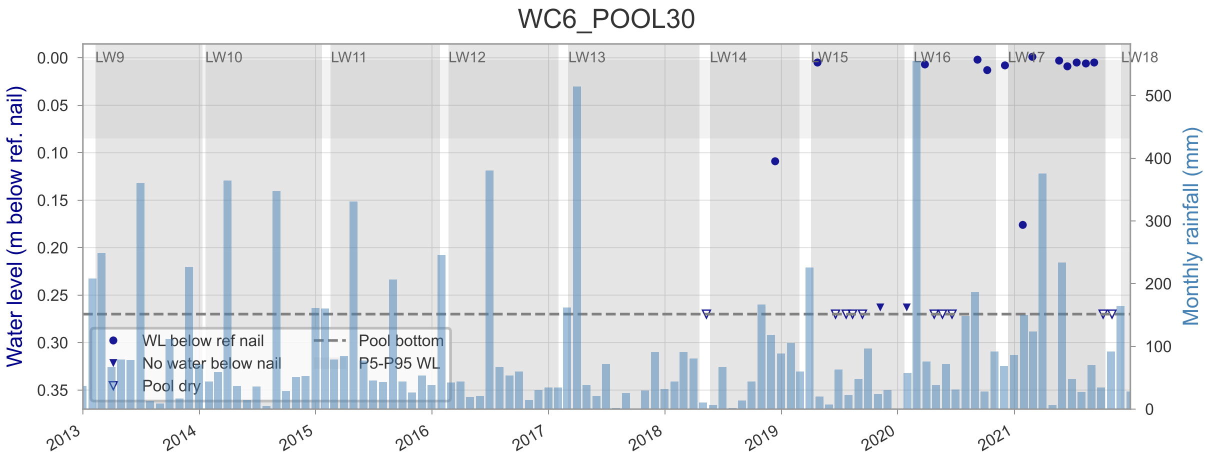
WC6_POOL20
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)

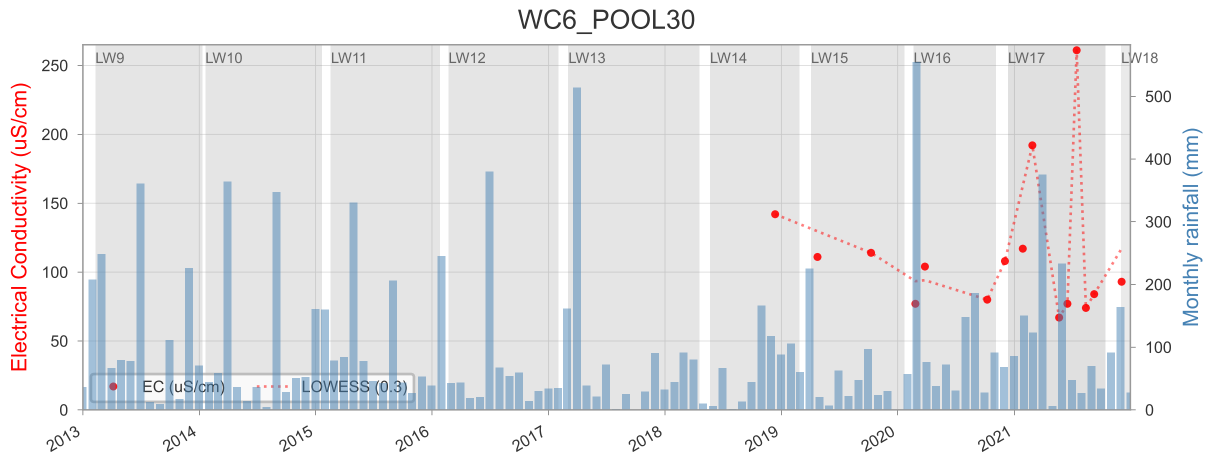


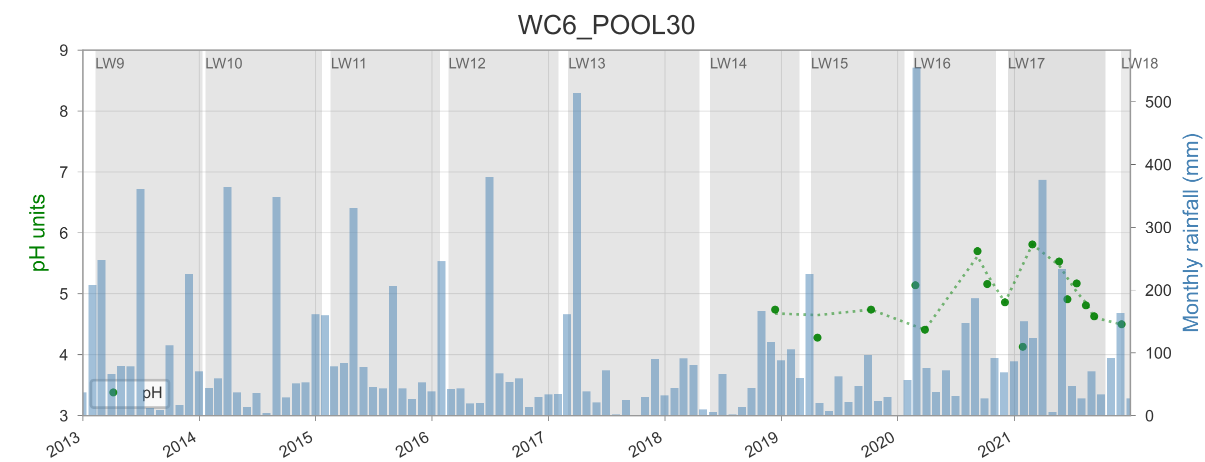
WC6_POOL20
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH units
Monthly rainfall (mm)
pH

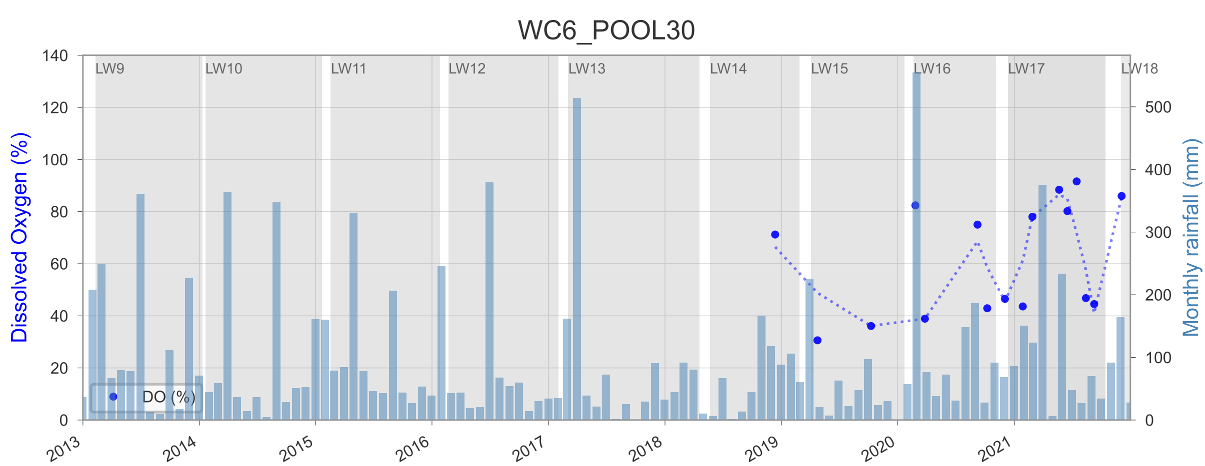


WC6_POOL20
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)

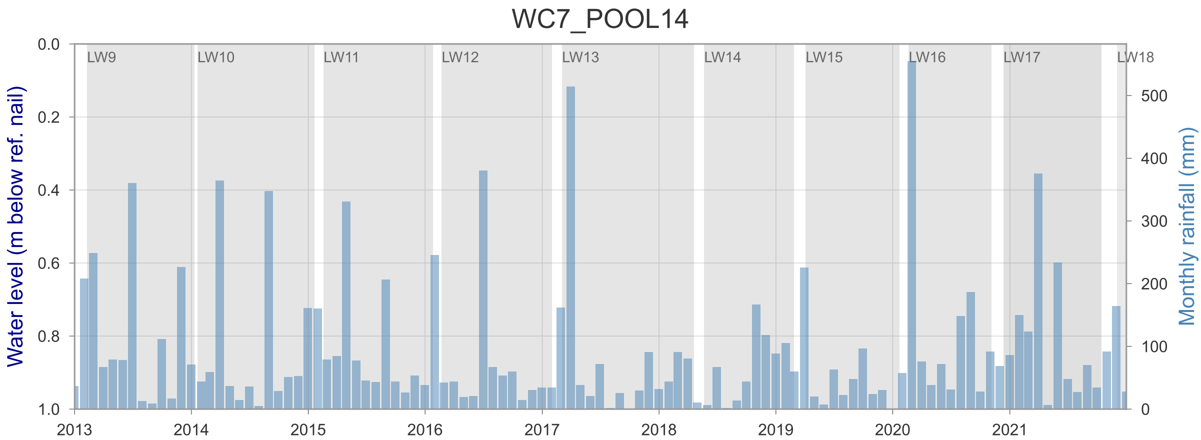

WC6_POOL30
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL

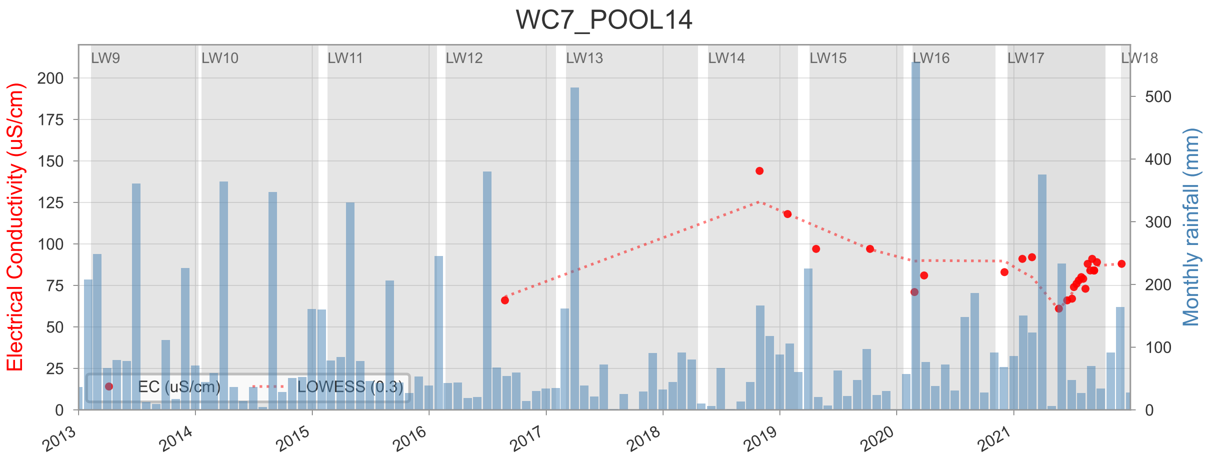

WC6_POOL30
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)

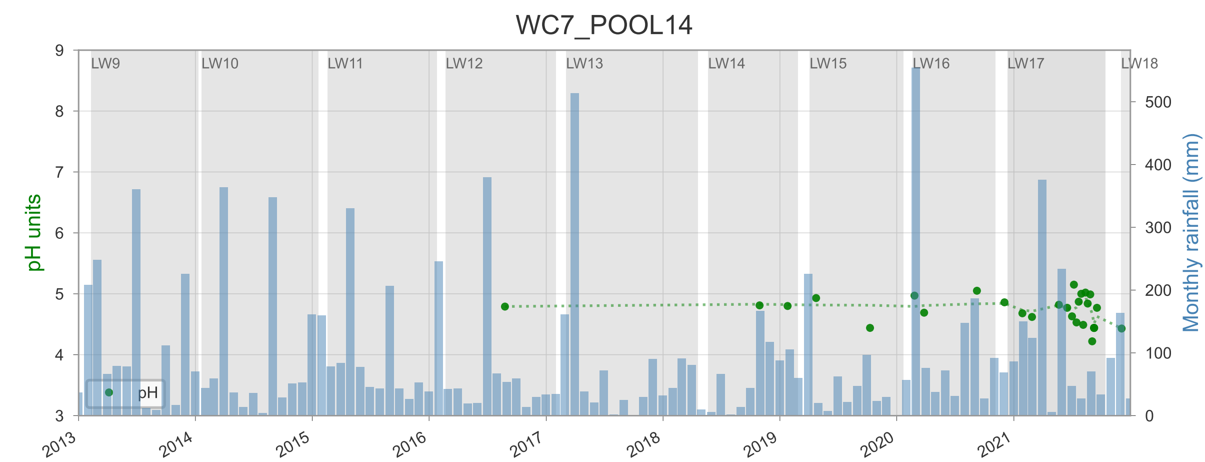

WC6_POOL30
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH

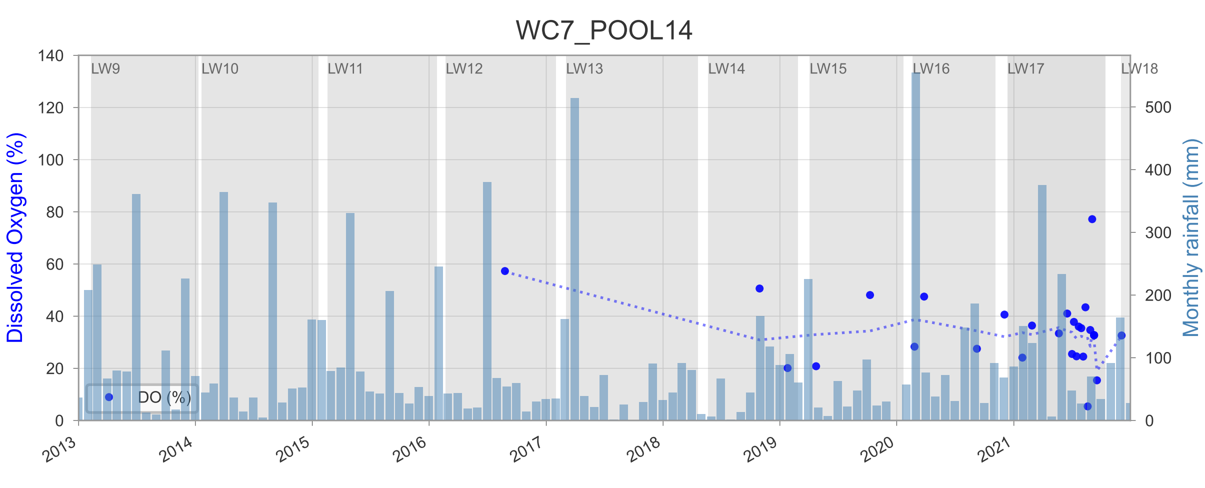

WC6_POOL30
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)

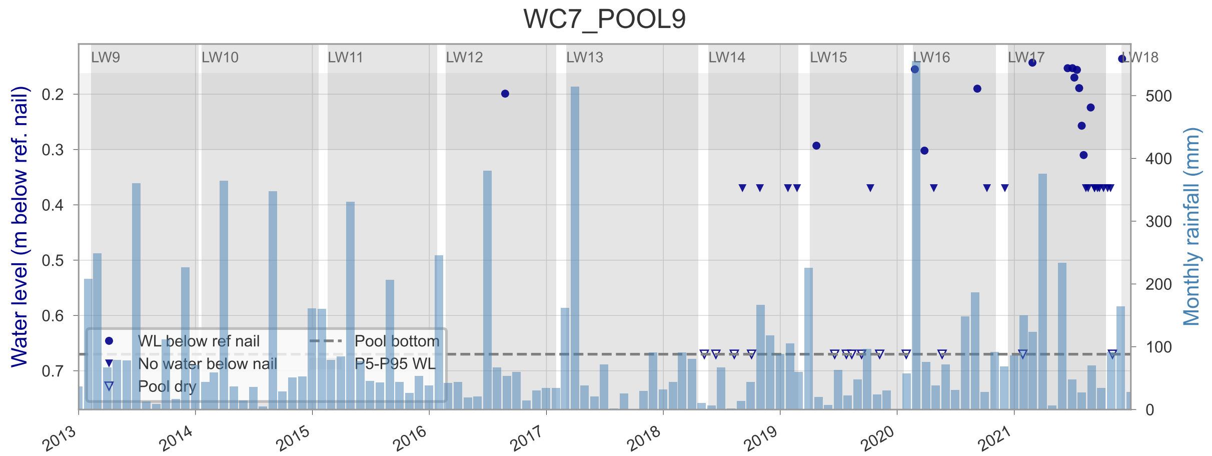
WC7_POOL1
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
pH units
pH
Dissolved Oxygen (%)
DO (%)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

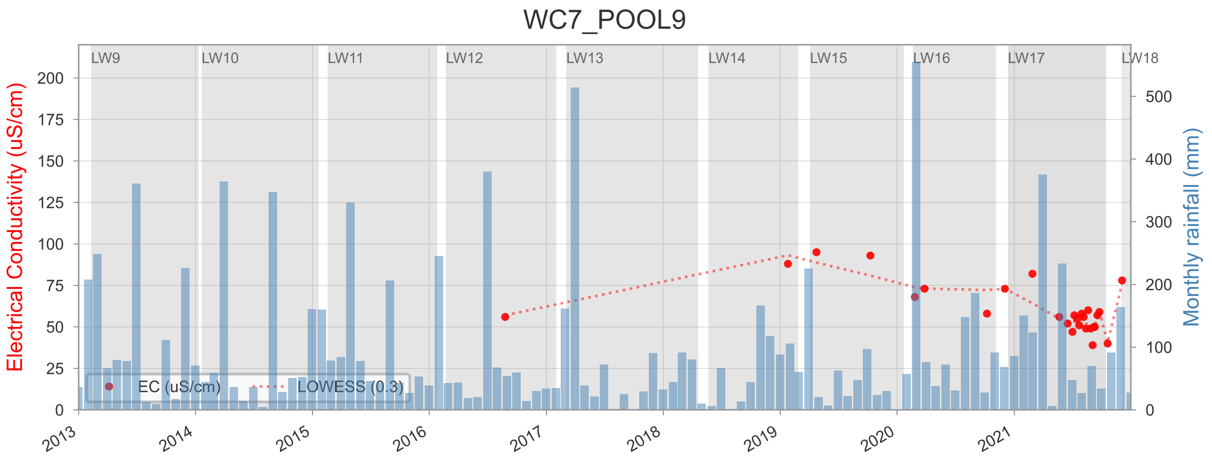

WC7_POOL14
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
0.0
0.2
0.4
0.6
0.8
1.0
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

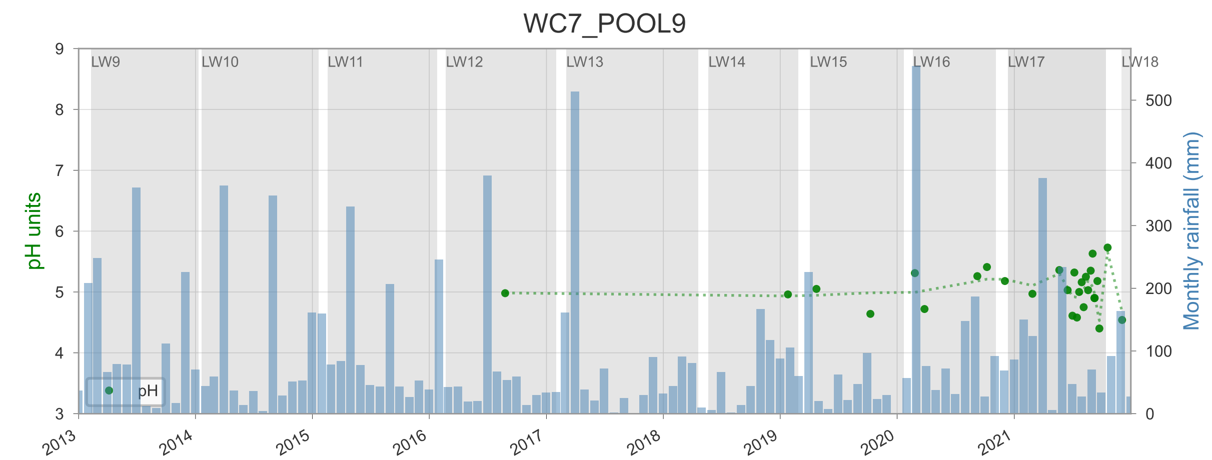

WC7_POOL14
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

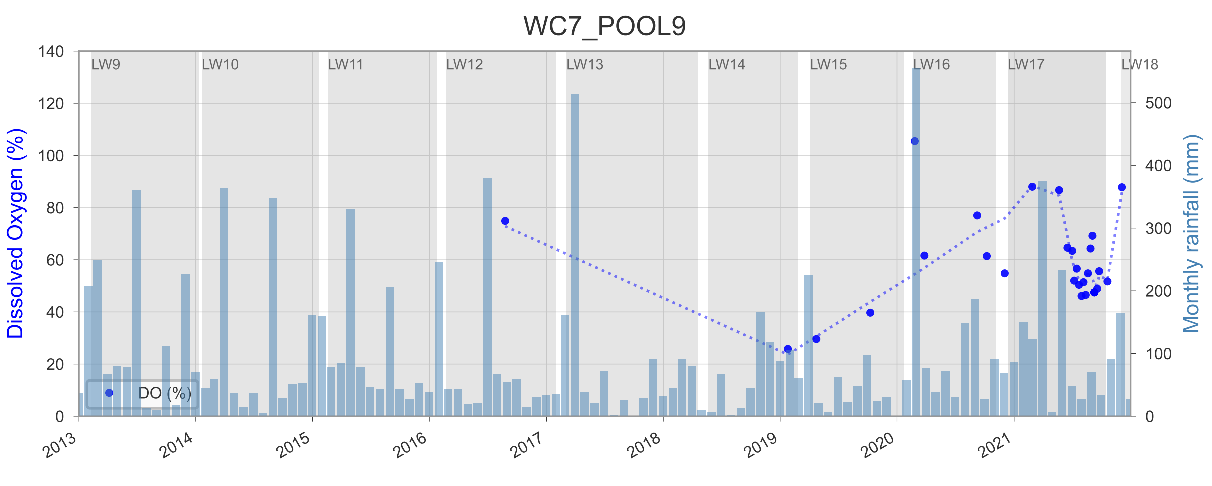

WC7_POOL14
pH units
Monthly rainfall (mm)
pH
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
3
4
5
6
7
8
9
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

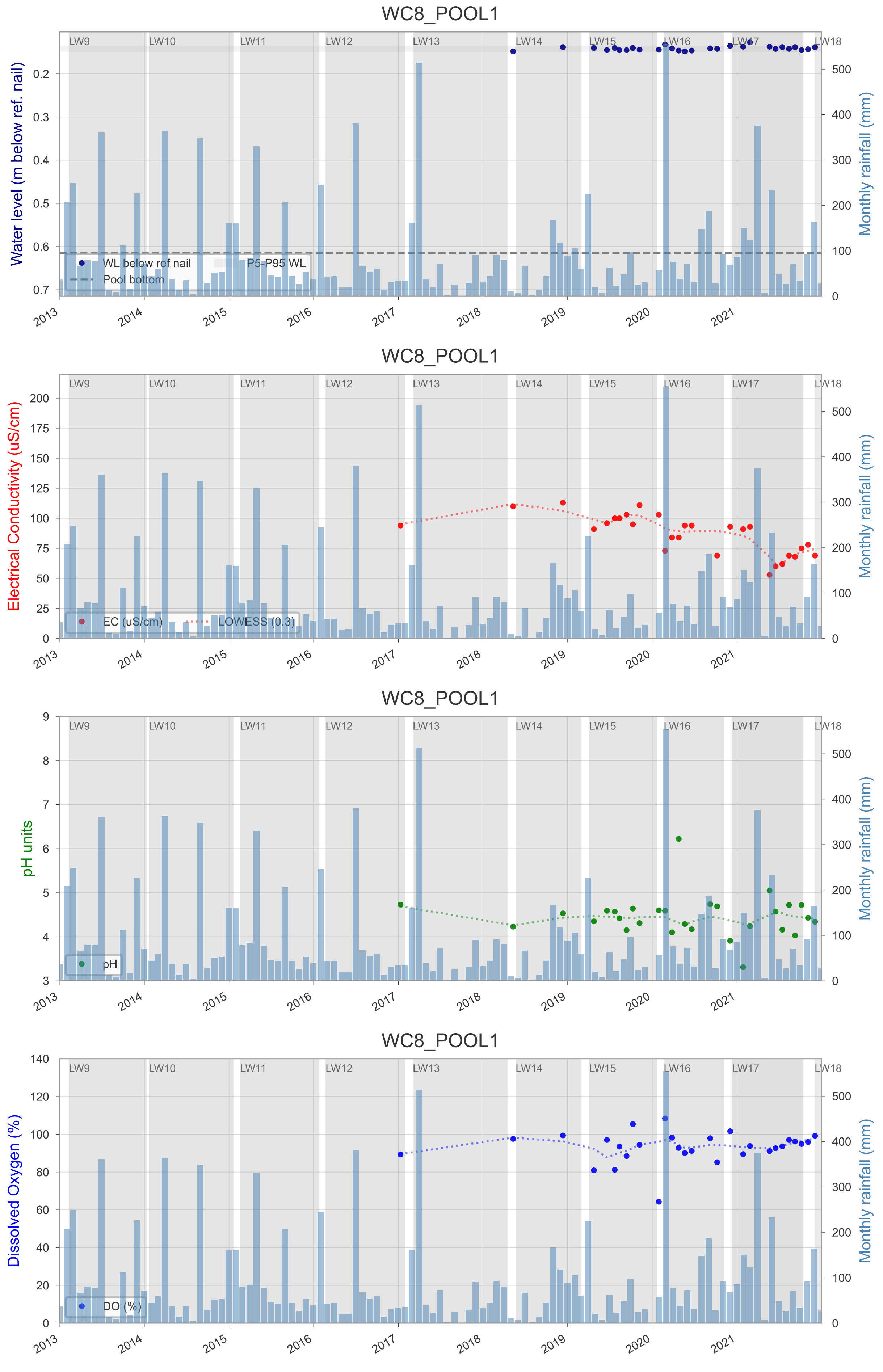

WC7_POOL14
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

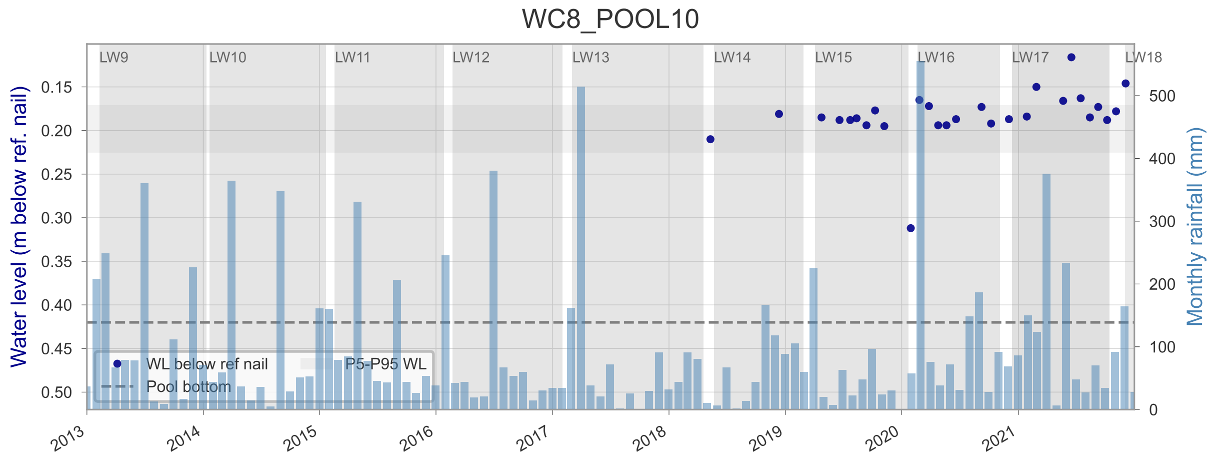

WC7_POOL9
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL
2013
2014
2015
2016
2017
2018
2019
2020
2021

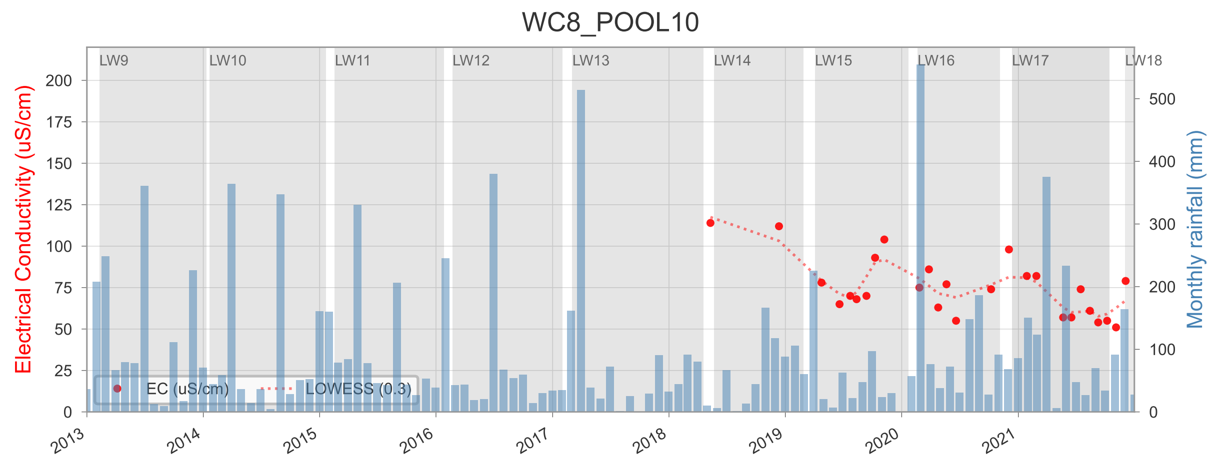

WC7_POOL9
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)

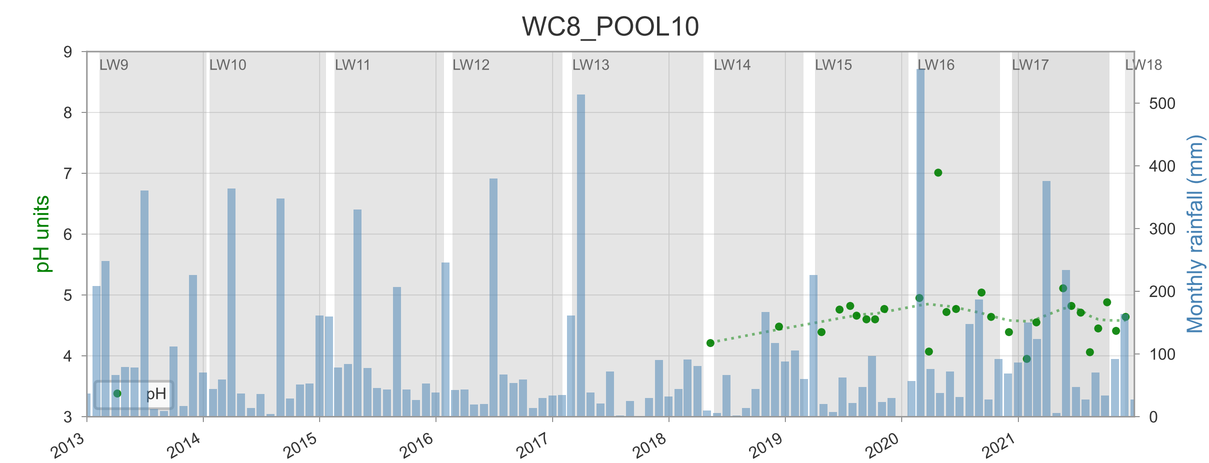

WC7_POOL9
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH units
Monthly rainfall (mm)
pH

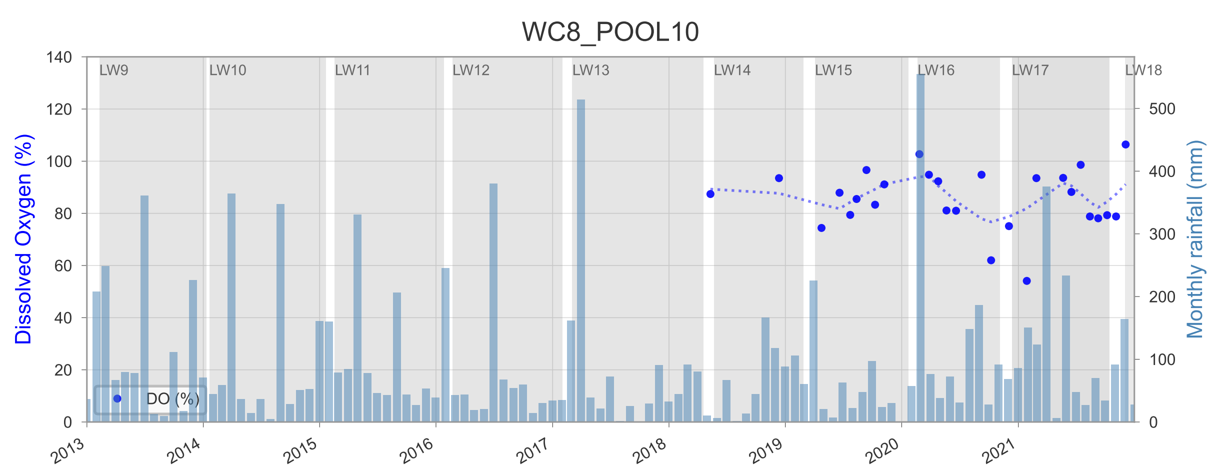

WC7_POOL9
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)

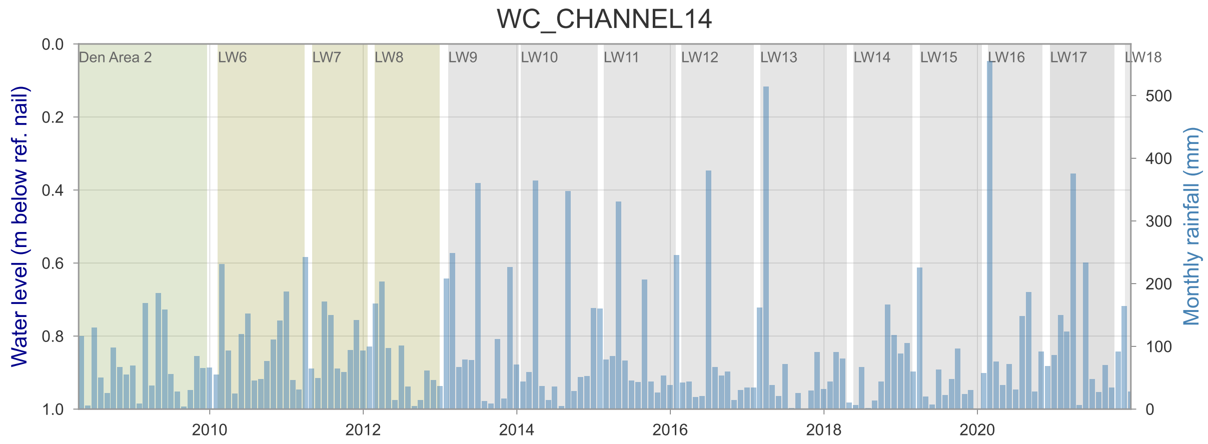

WC8_POOL1
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
P5-P95 WL
Pool bottom
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WC8_POOL1
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
WC8_POOL1
pH units
pH
WC8_POOL1
Dissolved Oxygen (%)
DO (%)
2013
2014
2015
2016
2017
2018
2019
2020
2021

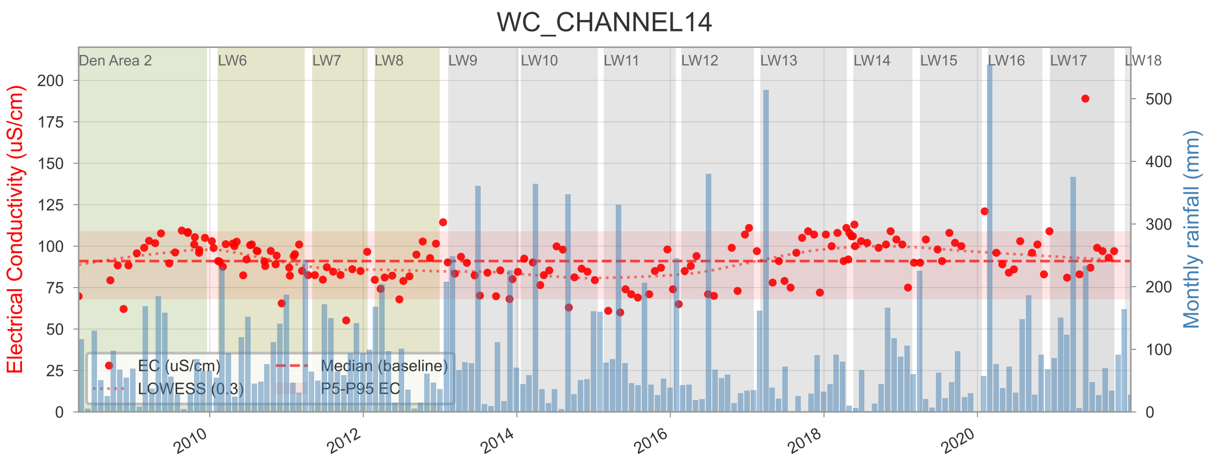

WC8_POOL10
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
Pool bottom
P5-P95 WL

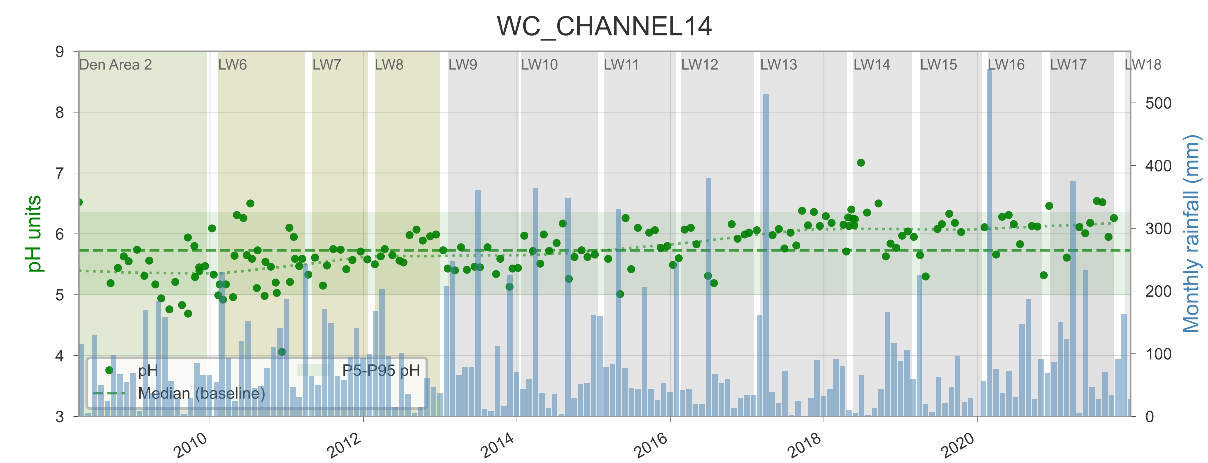

WC8_POOL10
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)

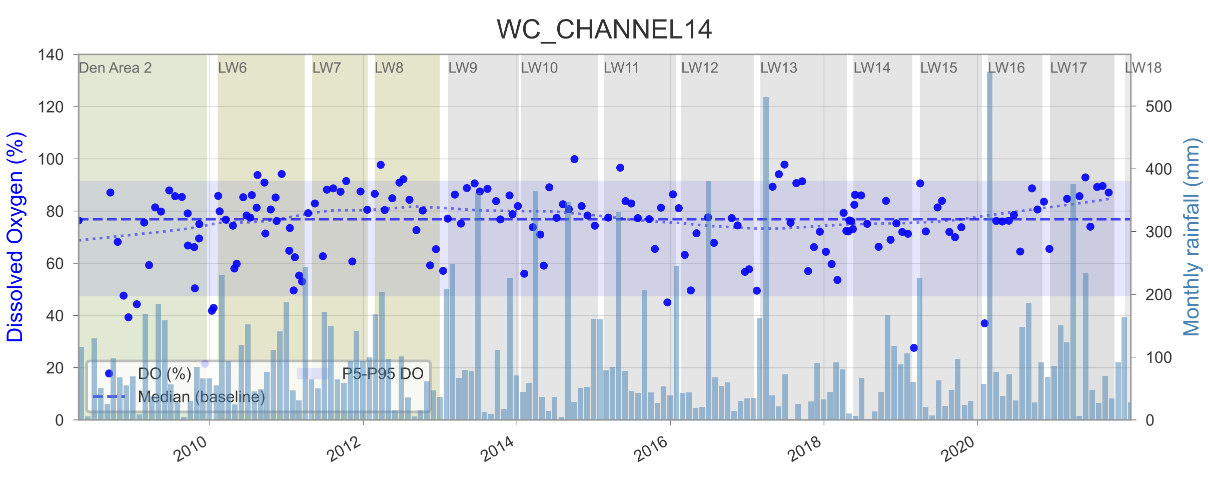

WC8_POOL10
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH units
Monthly rainfall (mm)
pH

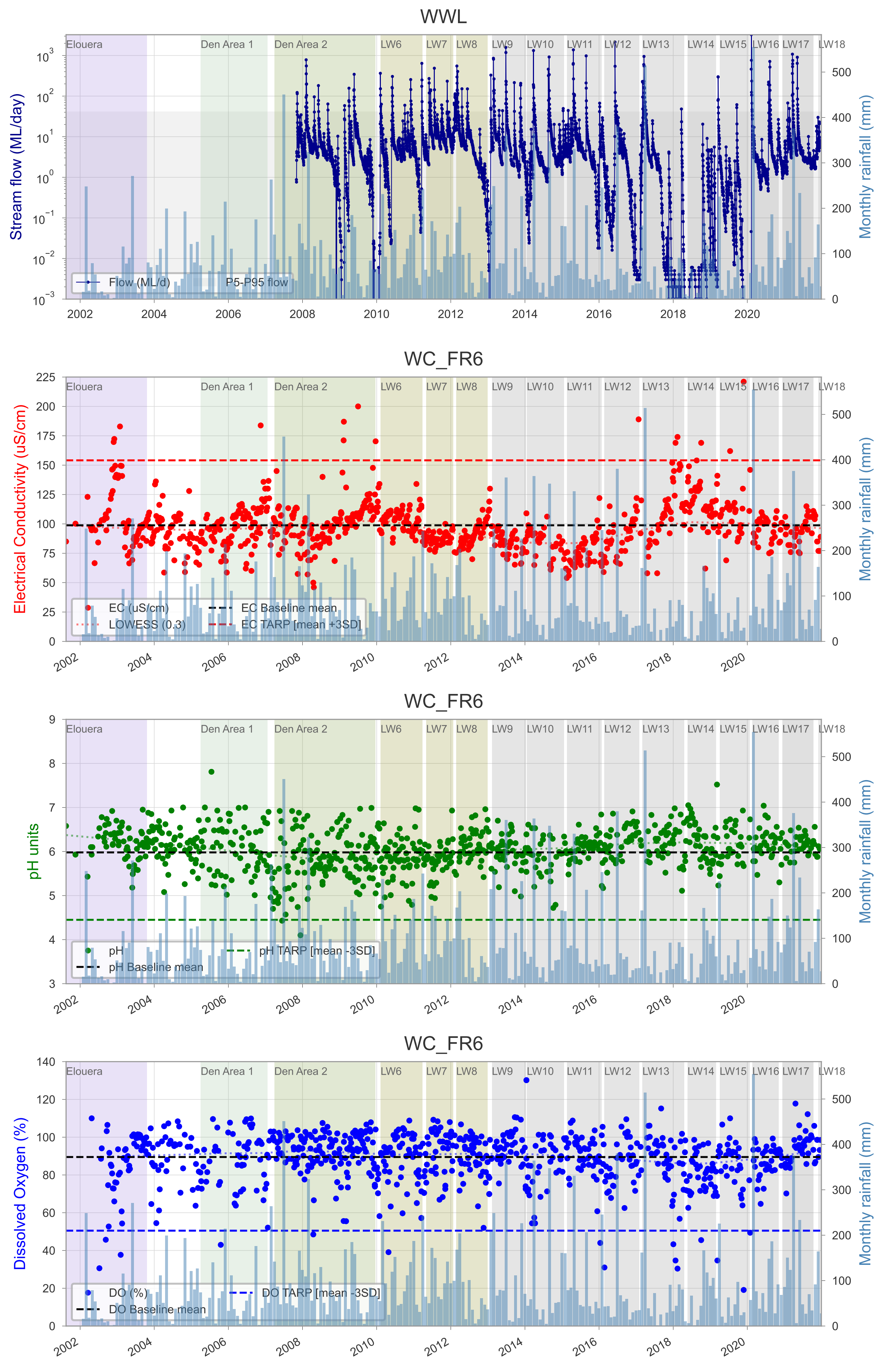

WC8_POOL10
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)

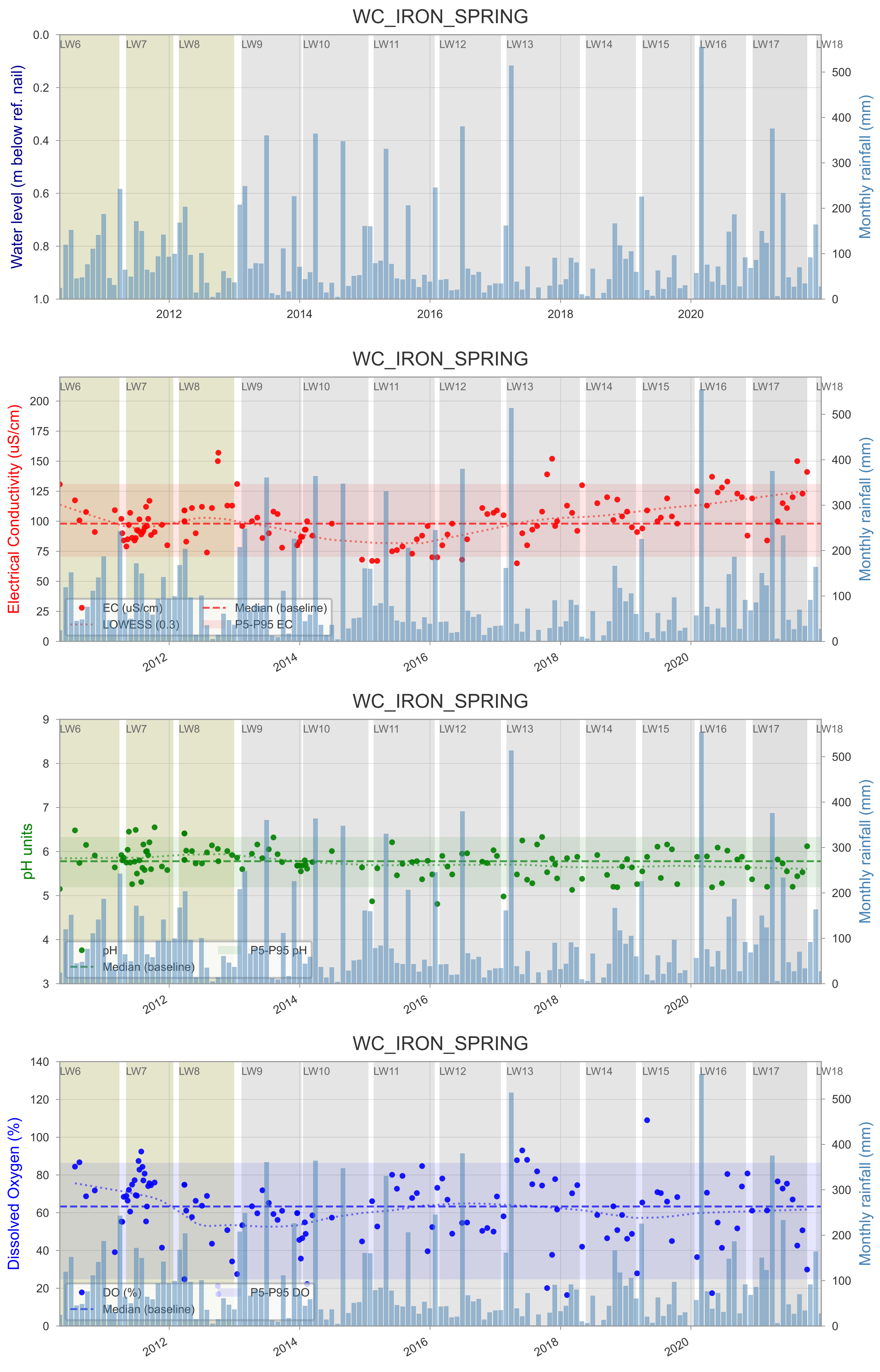

WC_CHANNEL14
Water level (m below ref. nail)
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18


WC_CHANNEL14
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

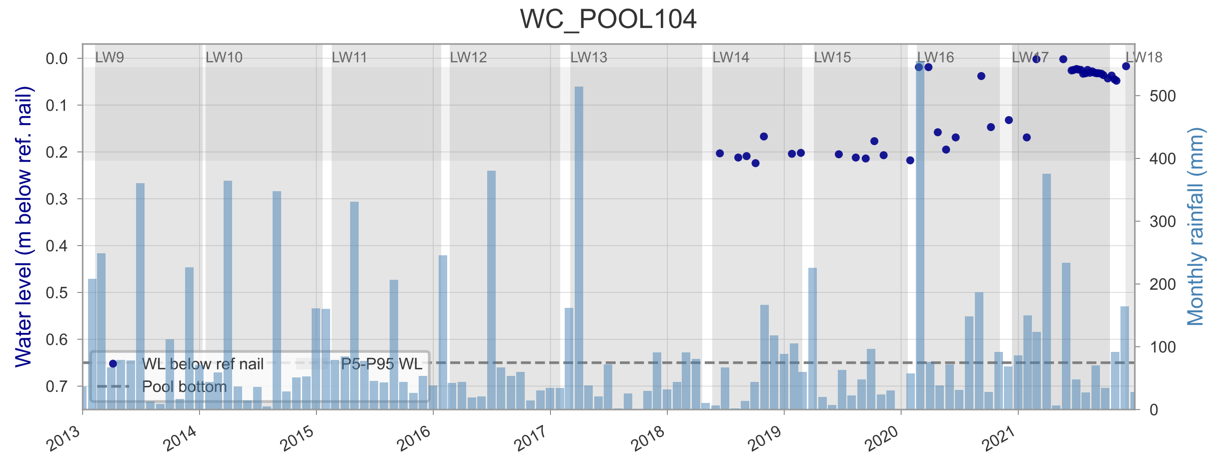

WC_CHANNEL14
pH units
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
Median (baseline)
P5-P95 pH

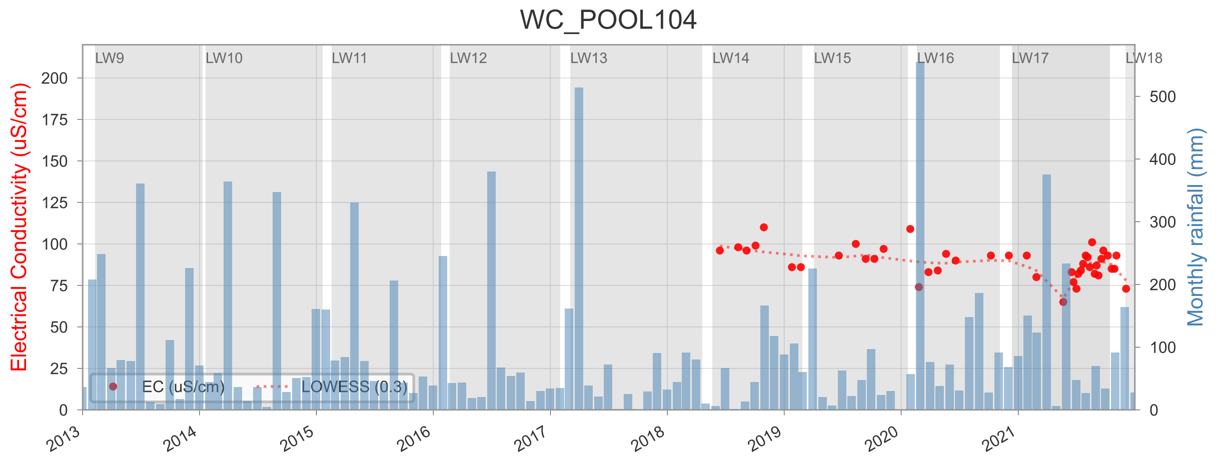

WC_CHANNEL14
Dissolved Oxygen (%)
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
Median (baseline)
P5-P95 DO

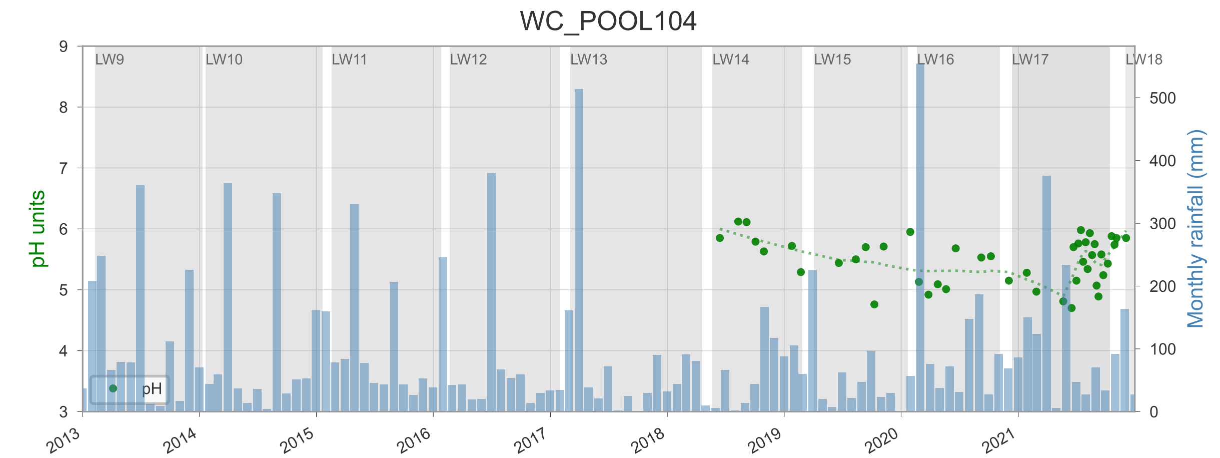

WWL
Stream flow (ML/day)
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Flow (ML/d)
P5-P95 flow
WC_FR6
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
EC Baseline mean
EC TARP [mean +3SD]
WC_FR6
pH units
pH
pH Baseline mean
pH TARP [mean -3SD]
WC_FR6
Dissolved Oxygen (%)
DO (%)
DO Baseline mean
DO TARP [mean -3SD]

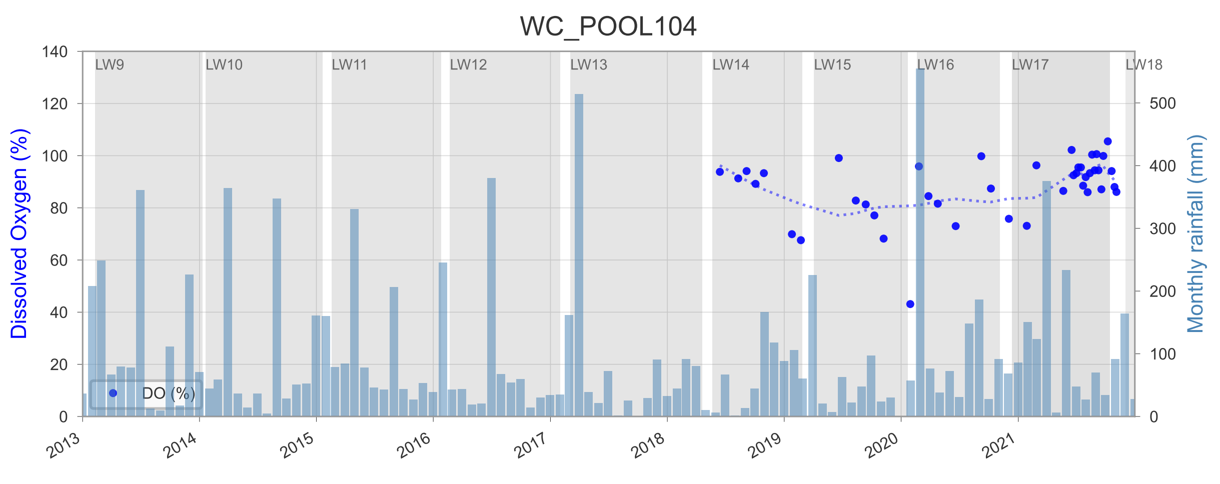


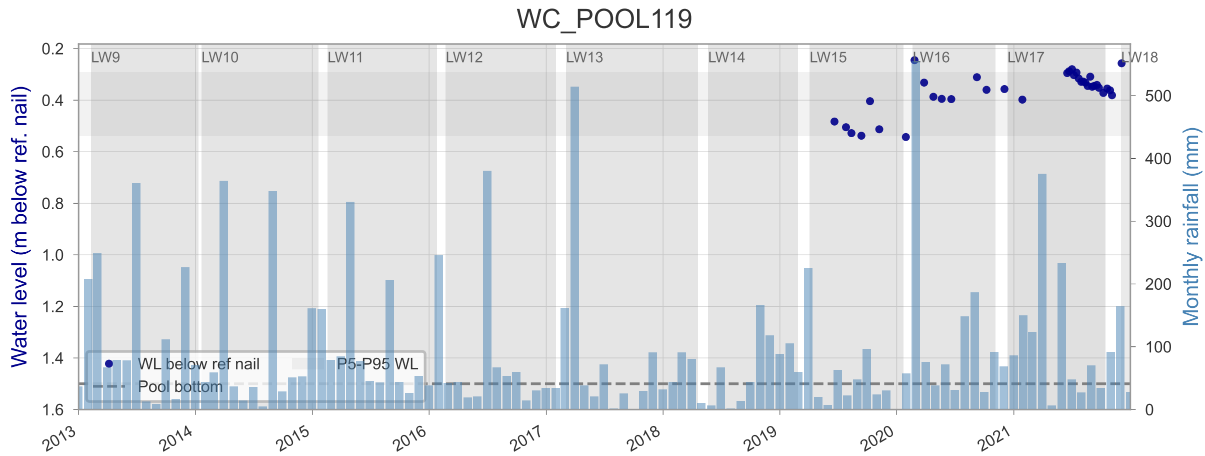
WC_IRON_SPRING
Water level (m below ref. nail)
Monthly rainfall (mm)
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WC_IRON_SPRING
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
WC_IRON_SPRING
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
WC_IRON_SPRING
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO


WC_POOL104
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WL below ref nail
P5-P95 WL
Pool bottom
2013
2014
2015
2016
2017
2018
2019
2020
2021

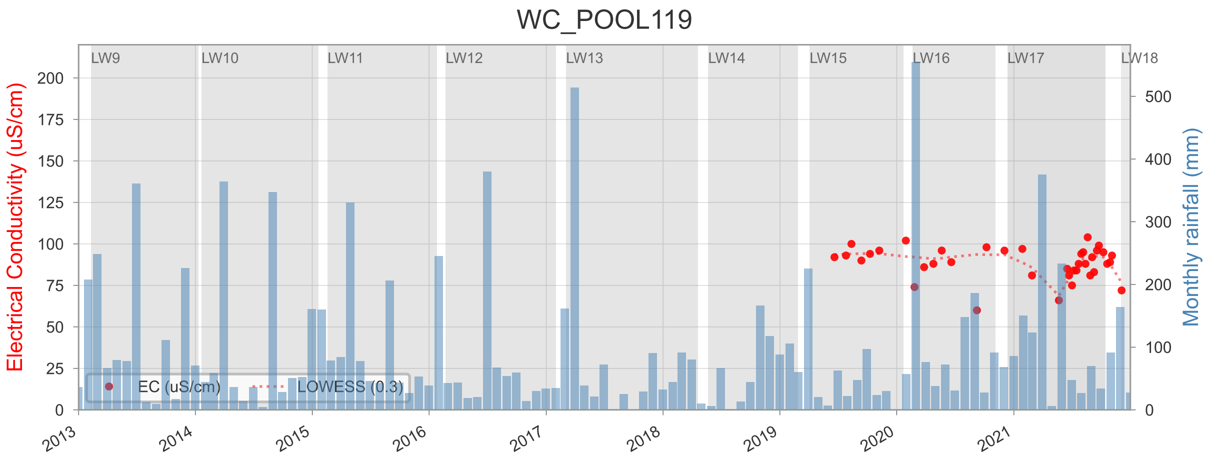

WC_POOL104
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)
2013
2014
2015
2016
2017
2018
2019
2020
2021


WC_POOL104
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
2013
2014
2015
2016
2017
2018
2019
2020
2021

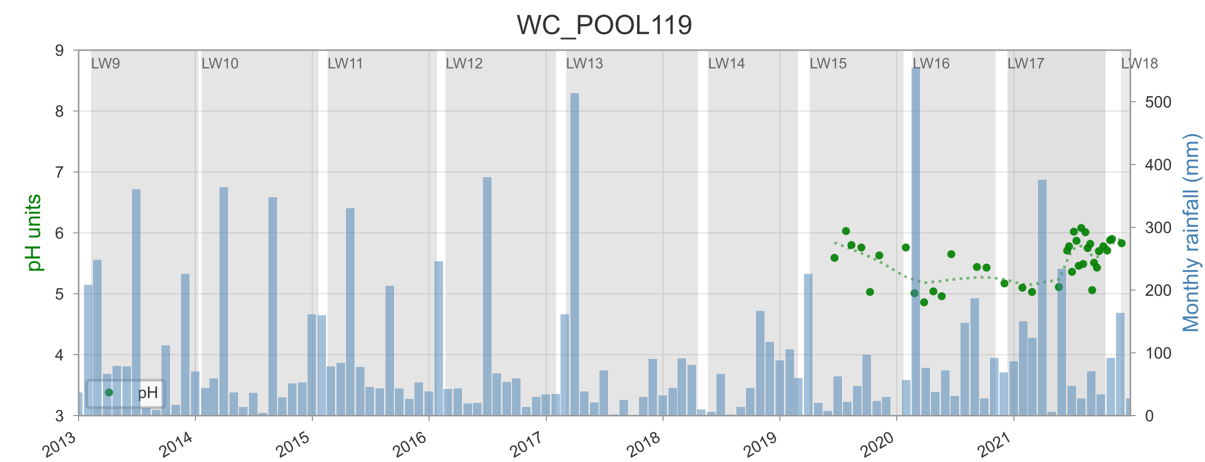

WC_POOL104
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
2013
2014
2015
2016
2017
2018
2019
2020
2021



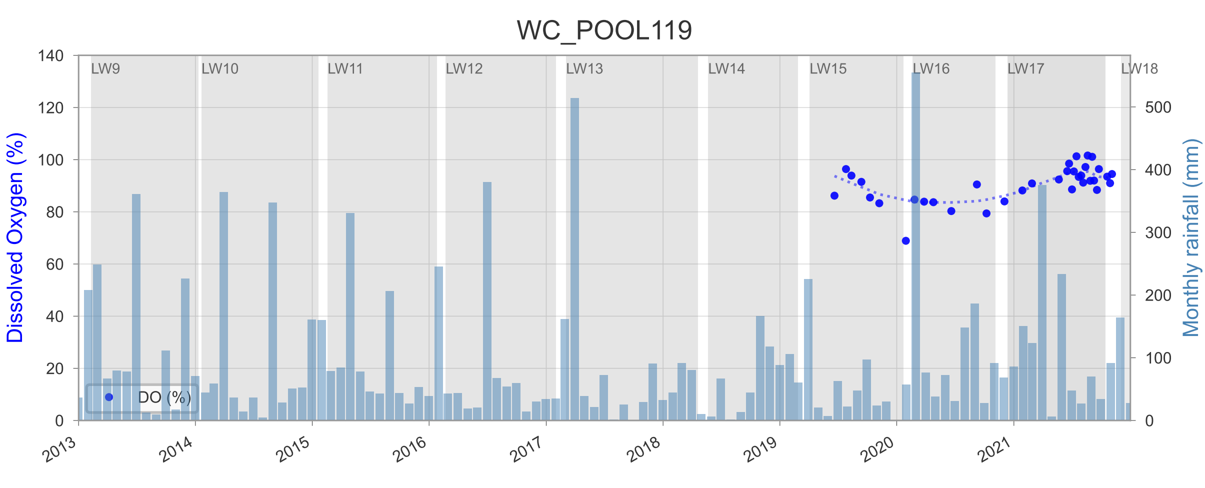
WC_POOL119
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WL below ref nail
P5-P95 WL
Pool bottom



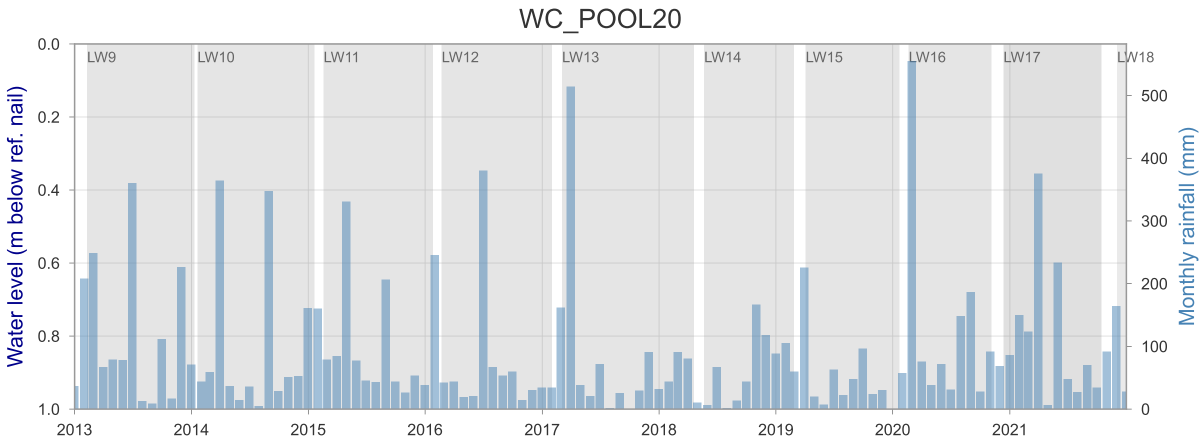
WC_POOL119
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)

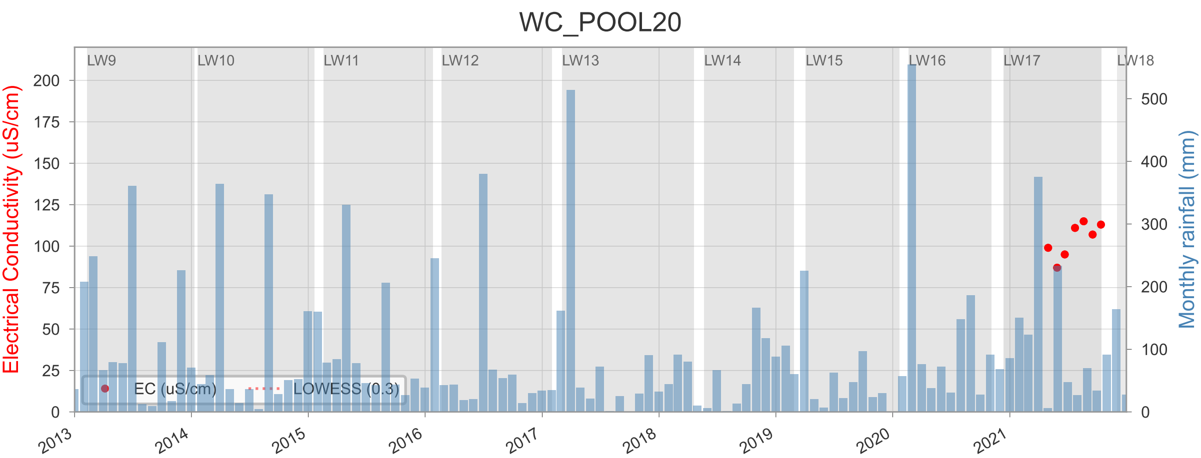


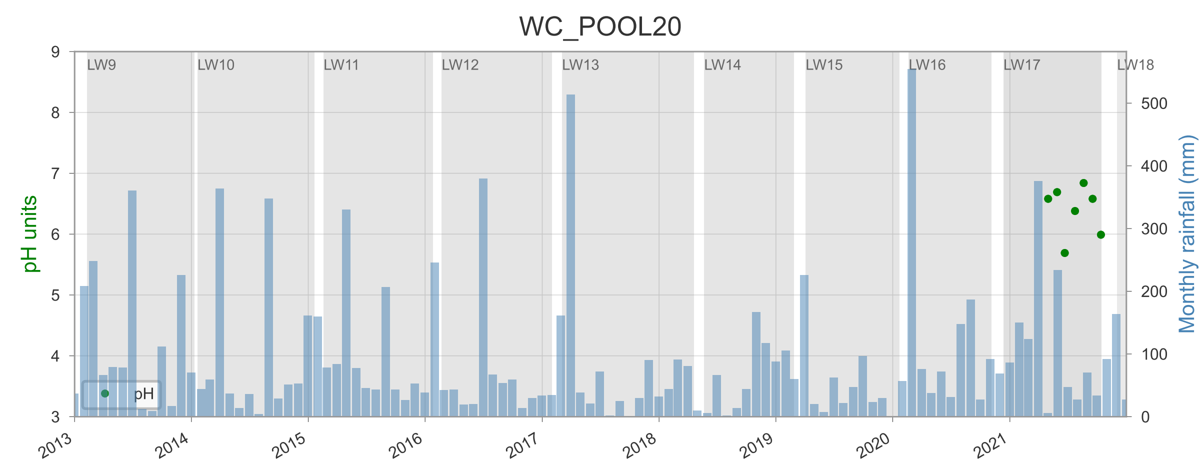
WC_POOL119
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH

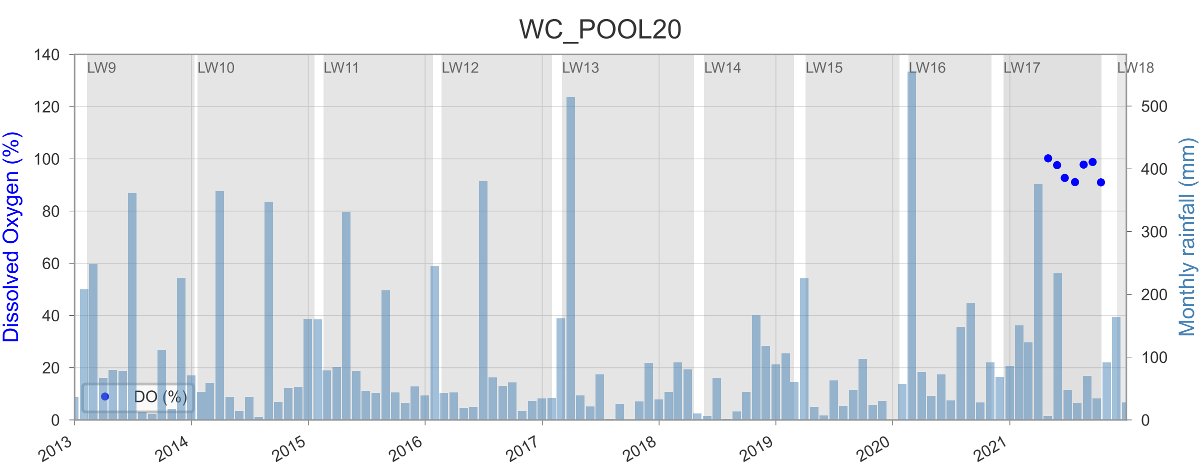


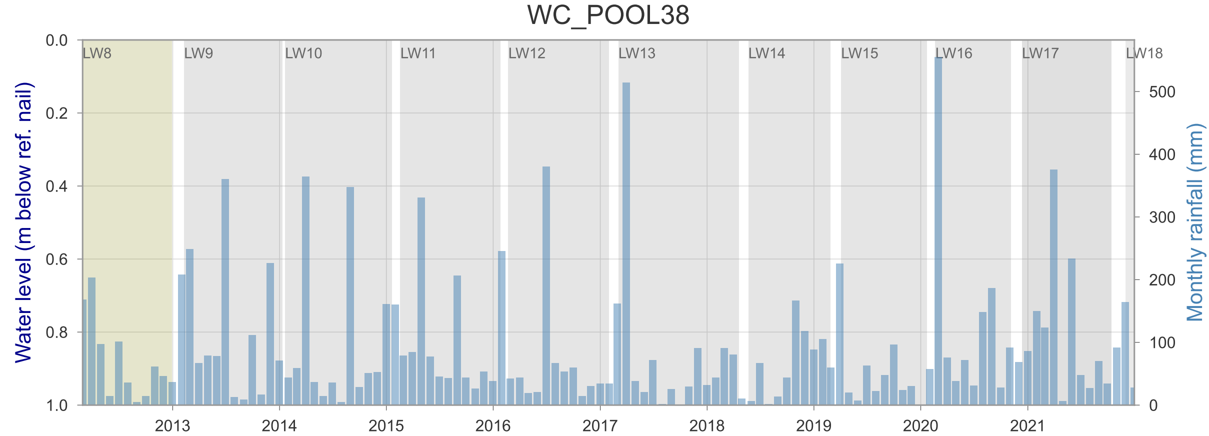
WC_POOL119
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)

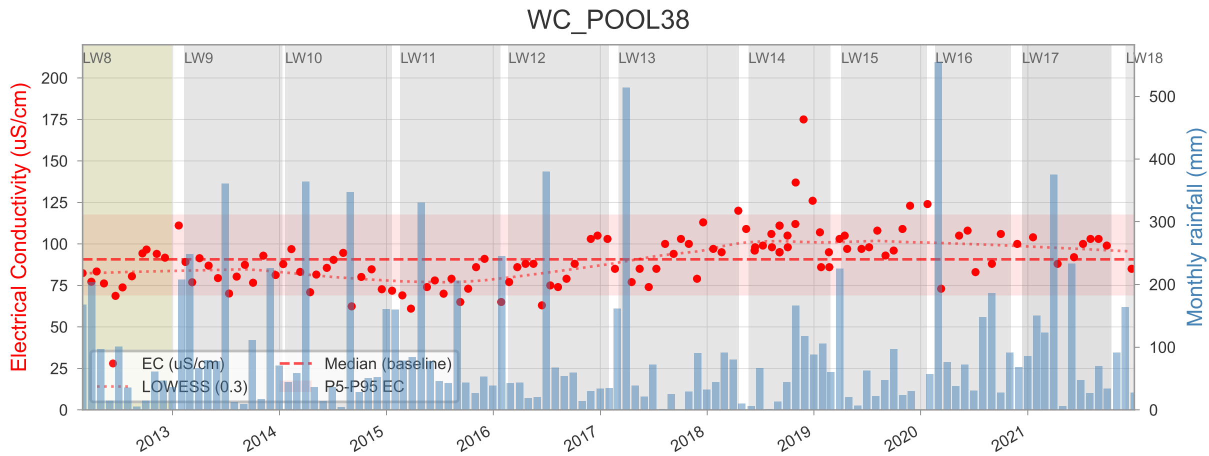

WC_POOL20
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

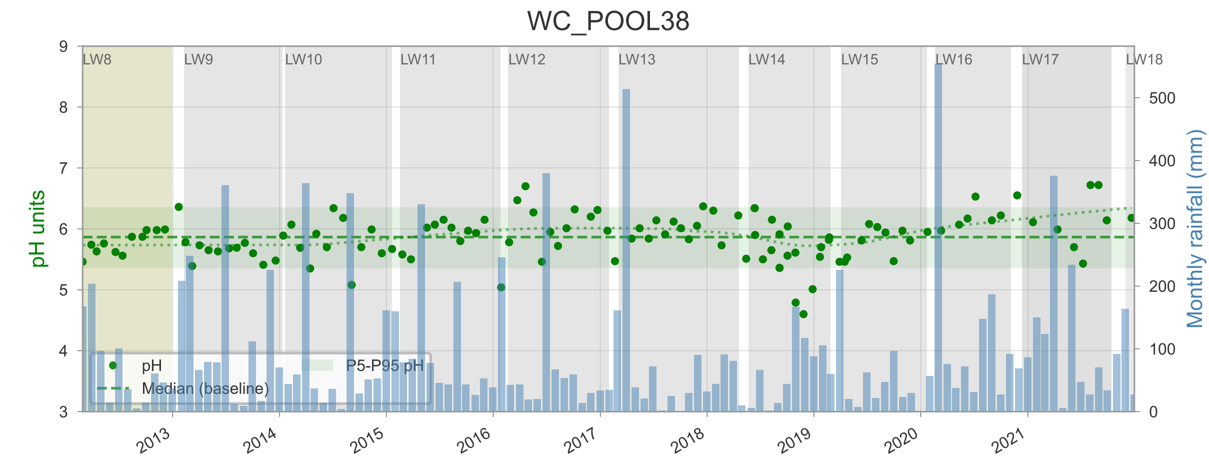

WC_POOL20
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

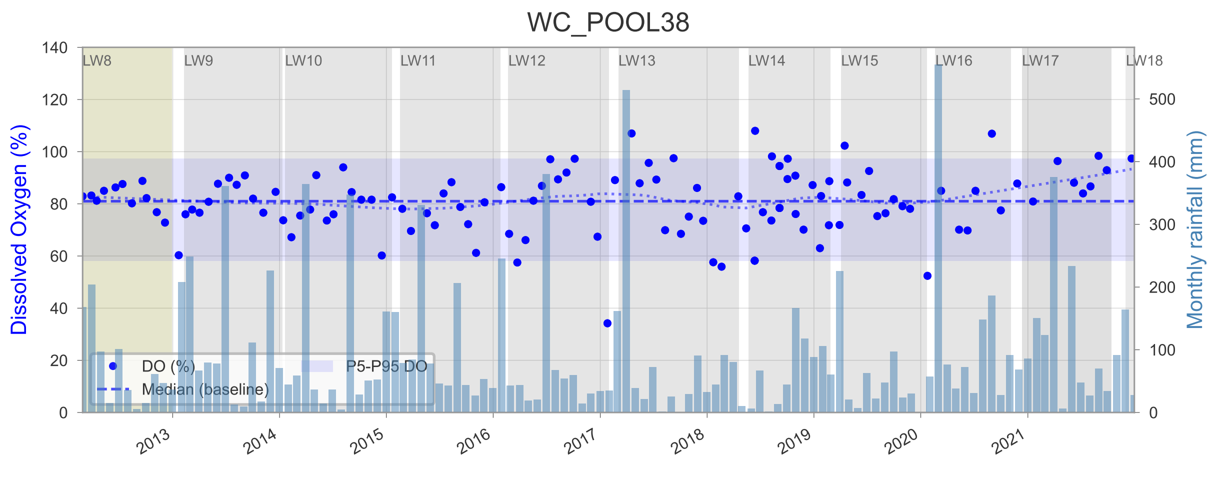

WC_POOL20
pH units
Monthly rainfall (mm)
pH
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

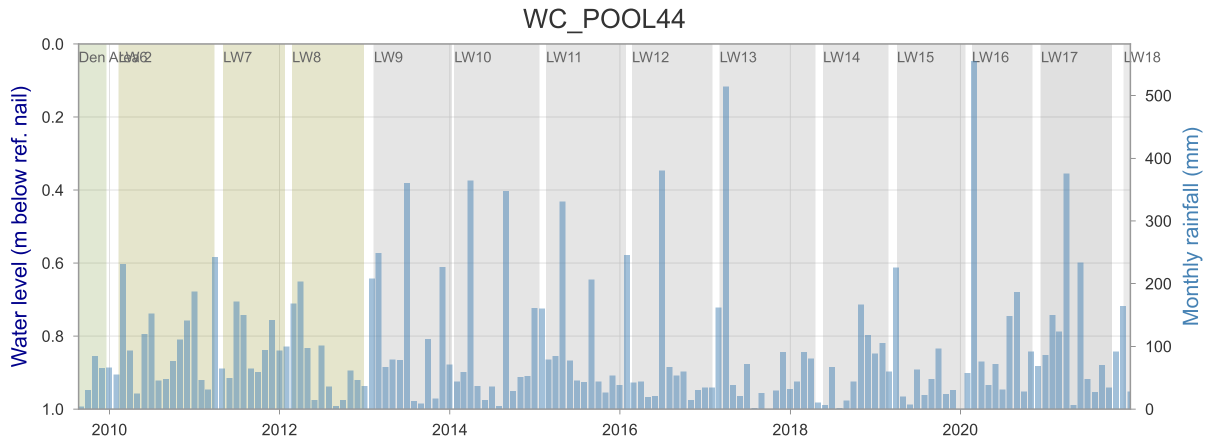

WC_POOL20
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

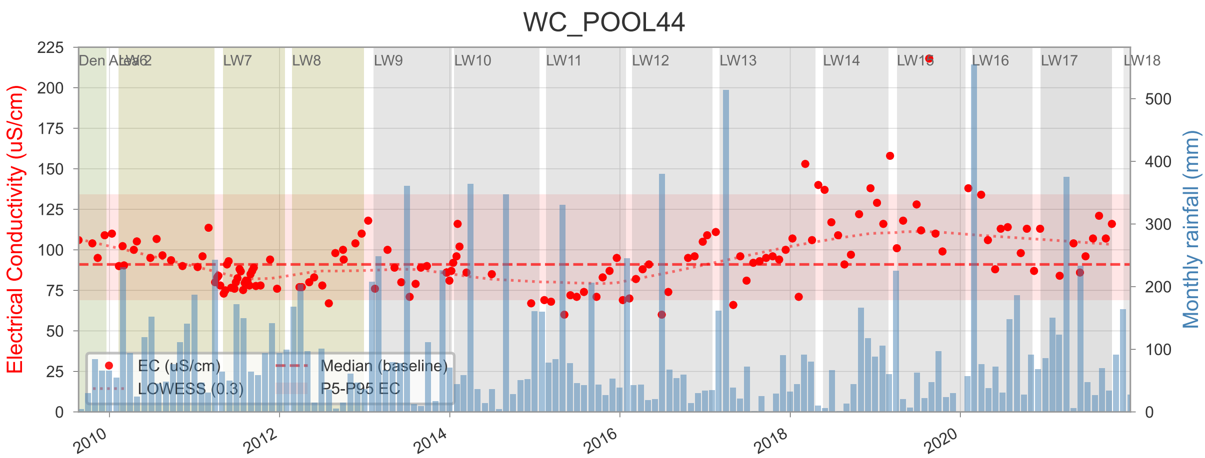

WC_POOL38
Water level (m below ref. nail)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

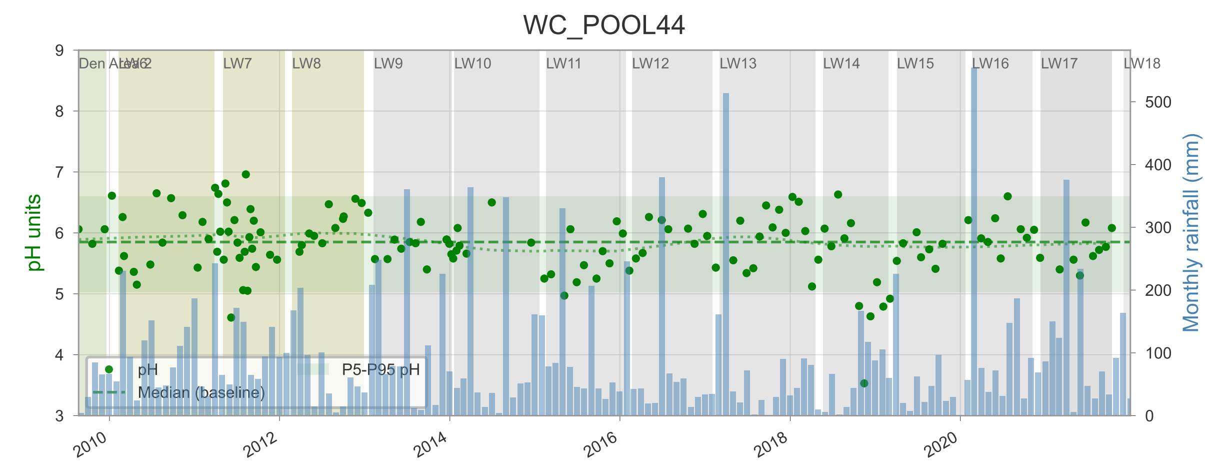

WC_POOL38
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

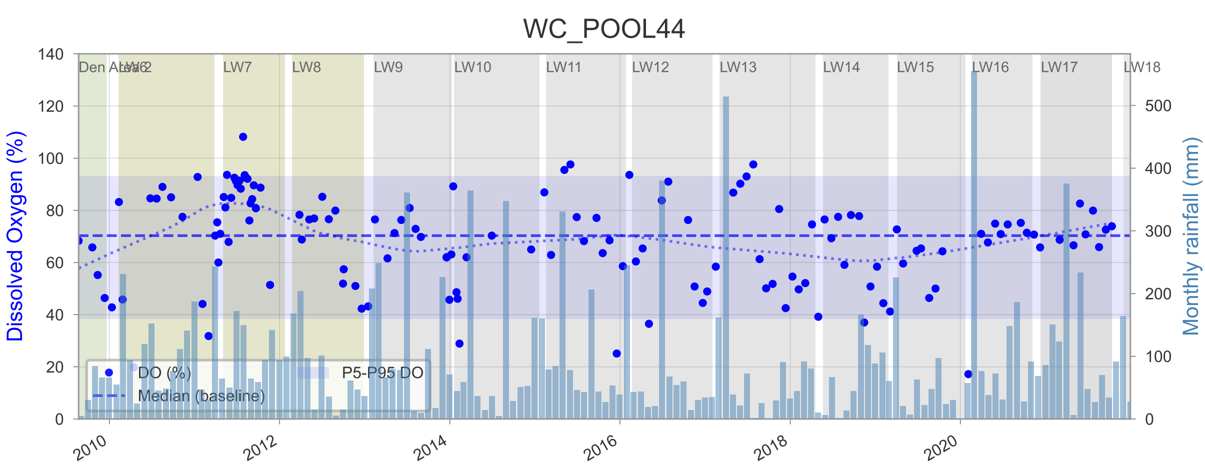

WC_POOL38
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

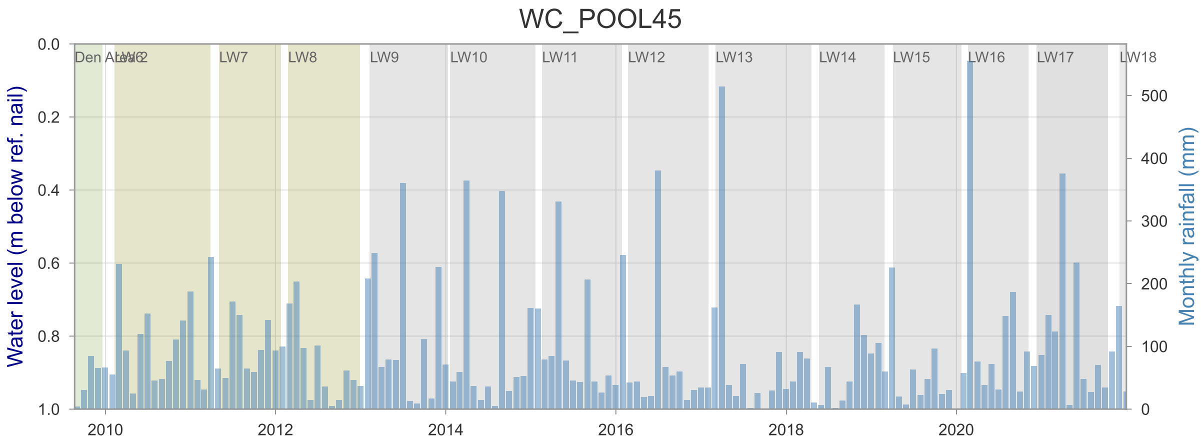

WC_POOL38
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

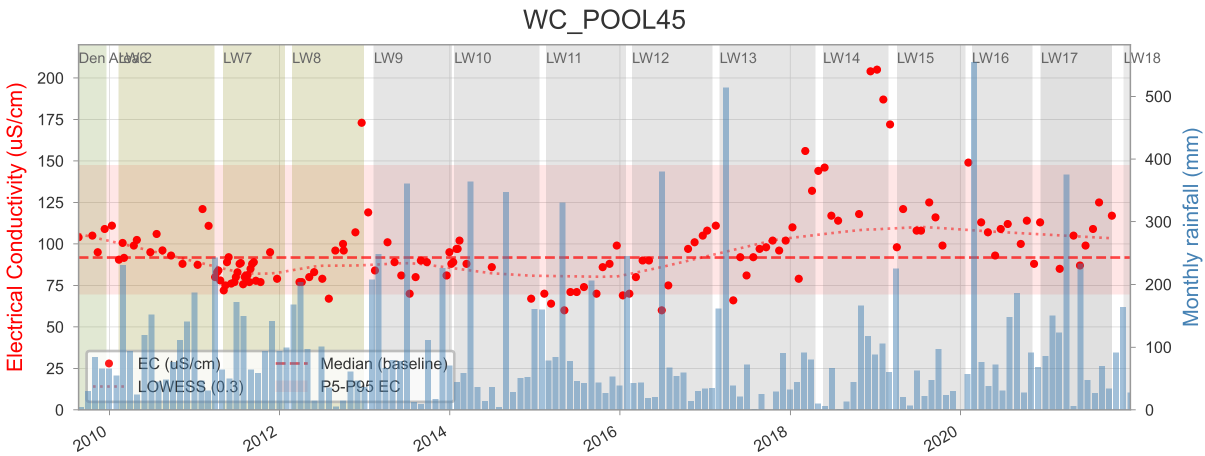

WC_POOL44
Den Area 6
LW6 2
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Water level (m below ref. nail)
Monthly rainfall (mm)
0.0
0.2
0.4
0.6
0.8
1.0
0
100
200
300
400
500
2010
2012
2014
2016
2018
2020

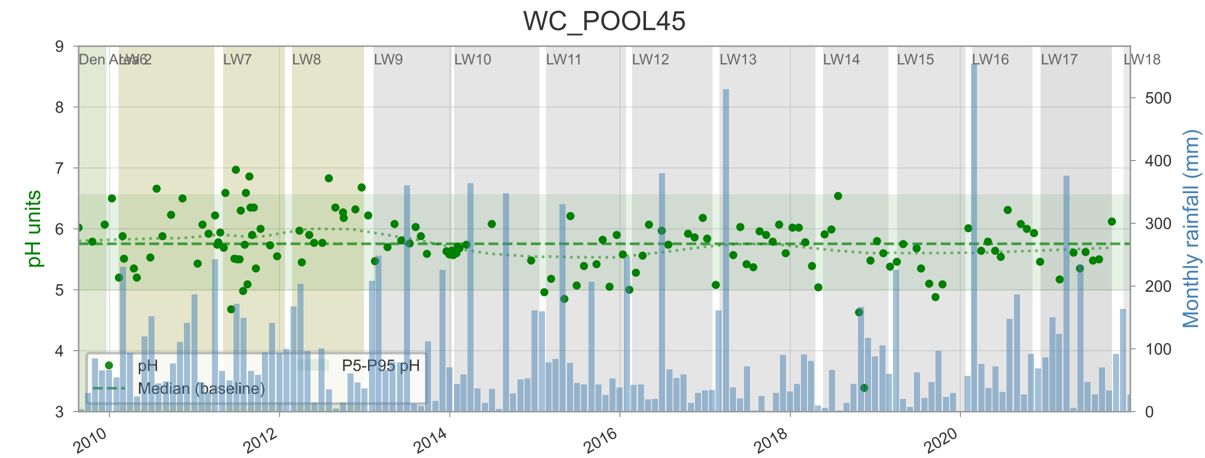

WC_POOL44
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
0
25
50
75
100
125
150
175
200
225
2010
2012
2014
2016
2018
2020

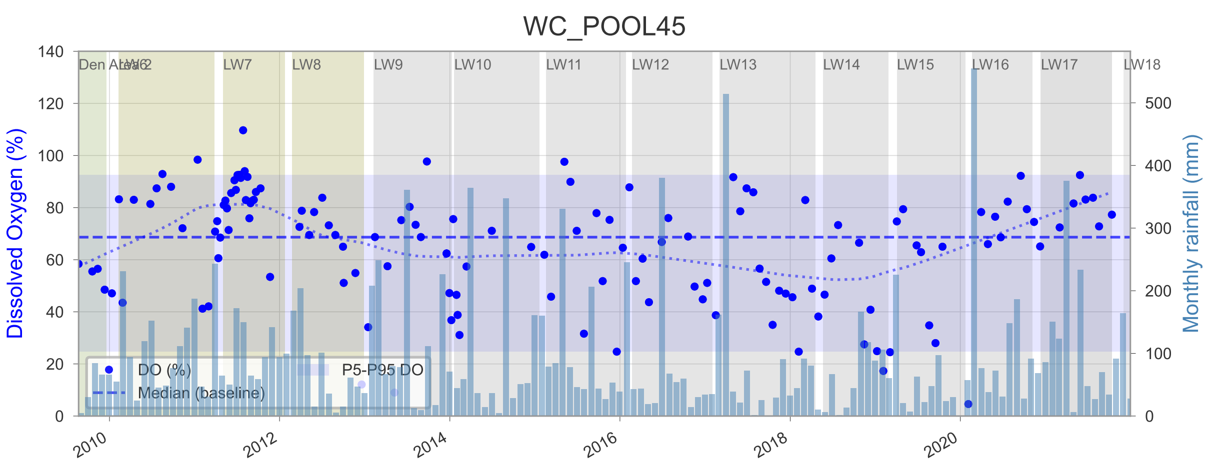

WC_POOL44
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
3
4
5
6
7
8
9
2010
2012
2014
2016
2018
2020

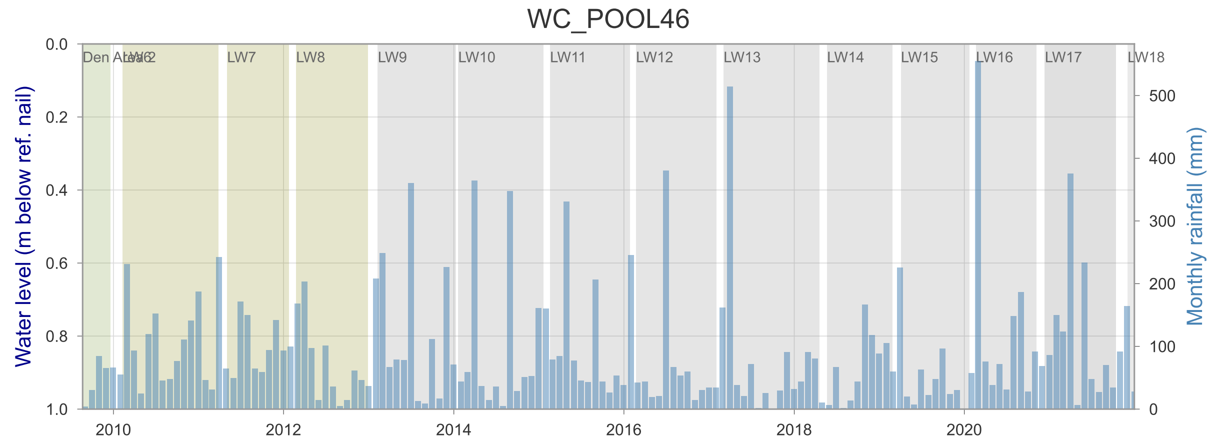

WC_POOL44
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
0
20
40
60
80
100
120
140
2010
2012
2014
2016
2018
2020

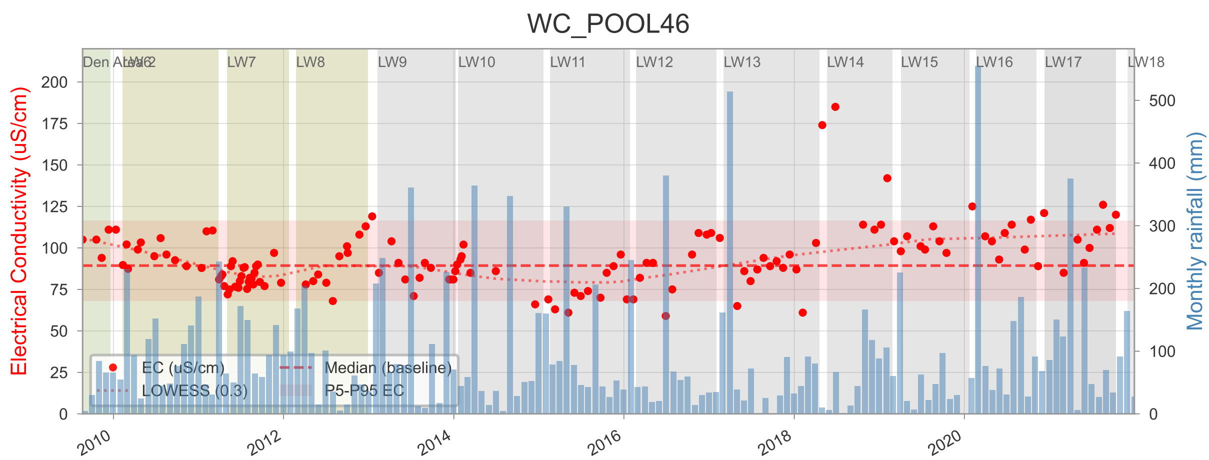

WC_POOL45
Water level (m below ref. nail)
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
0.0
0.2
0.4
0.6
0.8
1.0
0
100
200
300
400
500
2010
2012
2014
2016
2018
2020

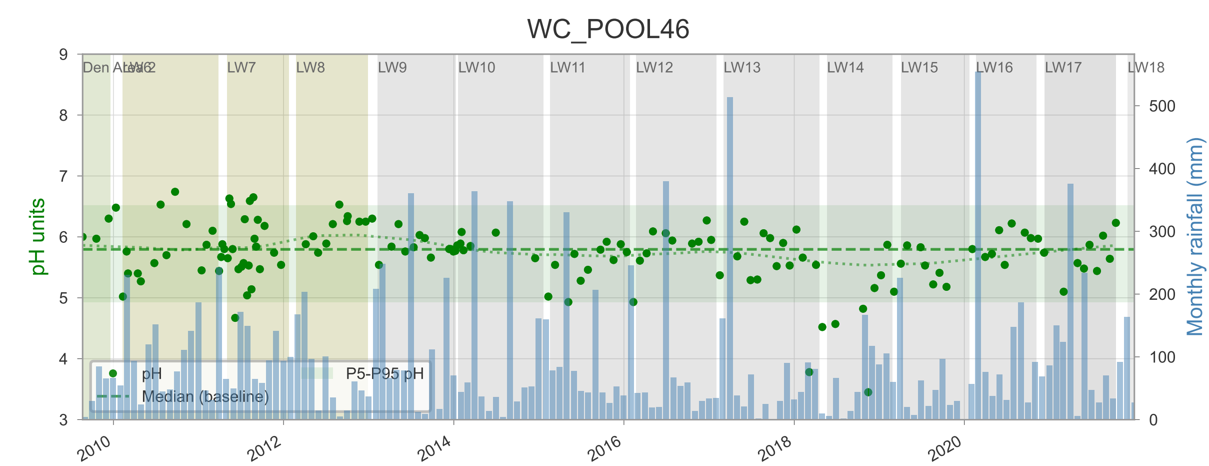

WC_POOL45
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
2010
2012
2014
2016
2018
2020

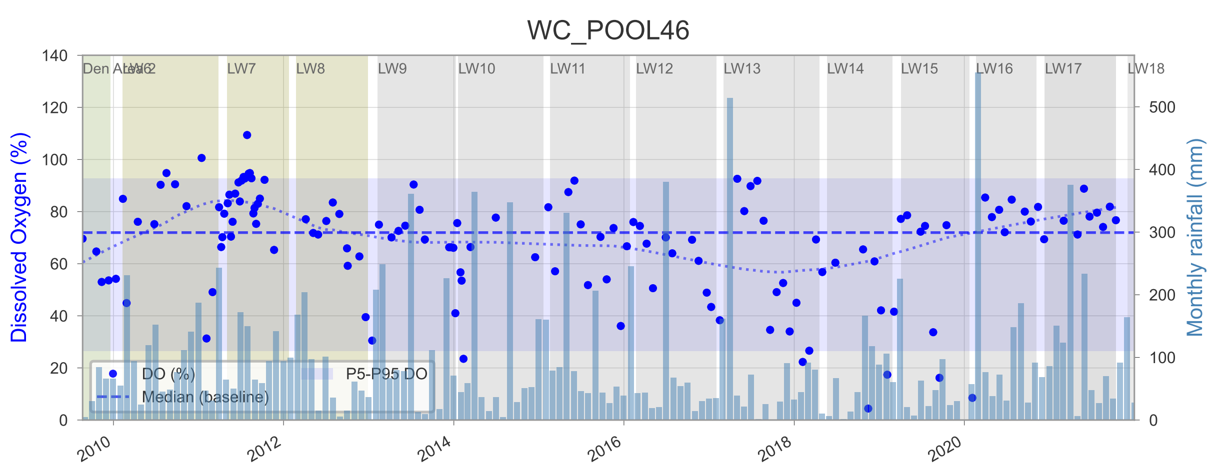

WC_POOL45
pH units
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
3
4
5
6
7
8
9
0
100
200
300
400
500
pH
Median (baseline)
P5-P95 pH
2010
2012
2014
2016
2018
2020

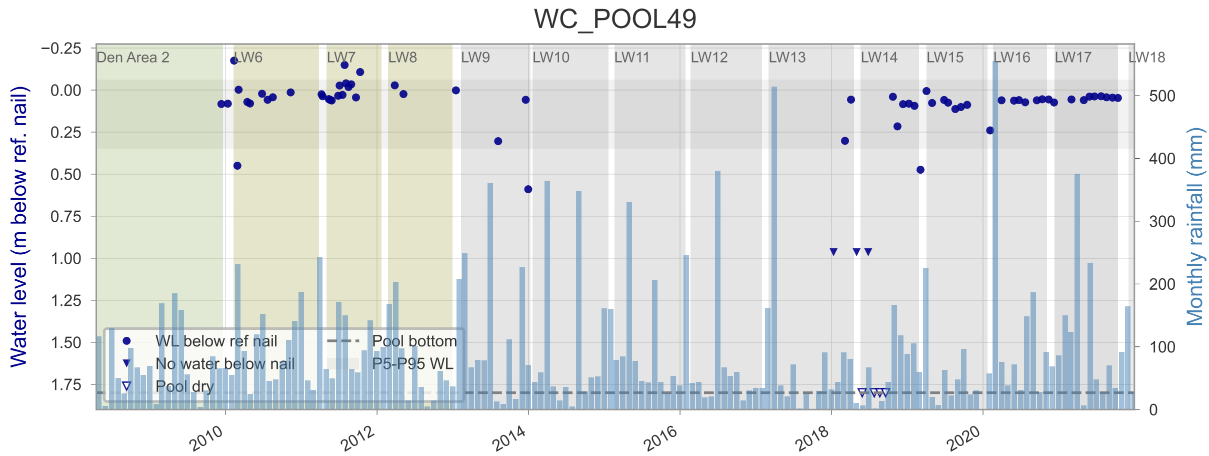

WC_POOL45
Dissolved Oxygen (%)
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
0
20
40
60
80
100
120
140
0
100
200
300
400
500
DO (%)
Median (baseline)
P5-P95 DO
2010
2012
2014
2016
2018
2020

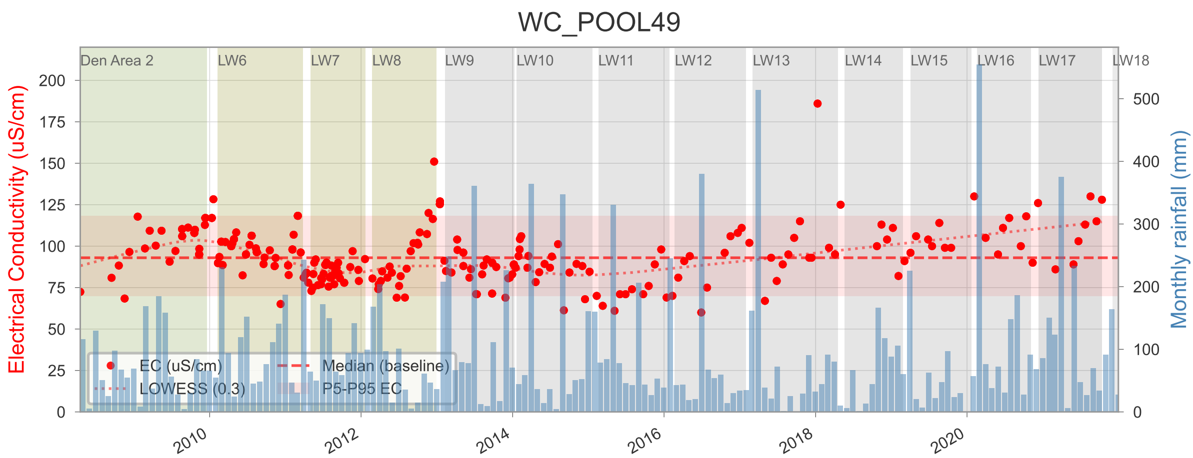

WC_POOL46
Den Area
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Water level (m below ref. nail)
Monthly rainfall (mm)

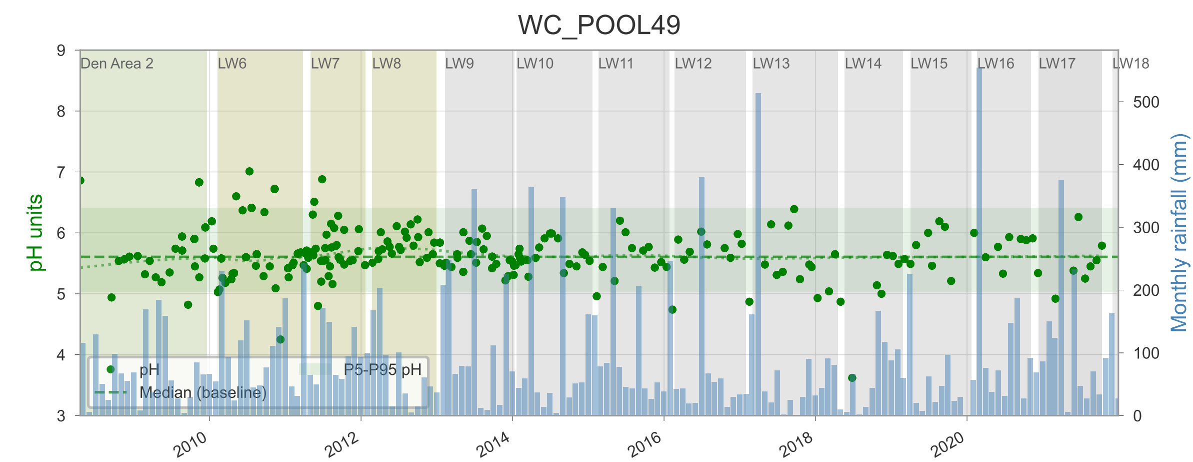

WC_POOL46
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

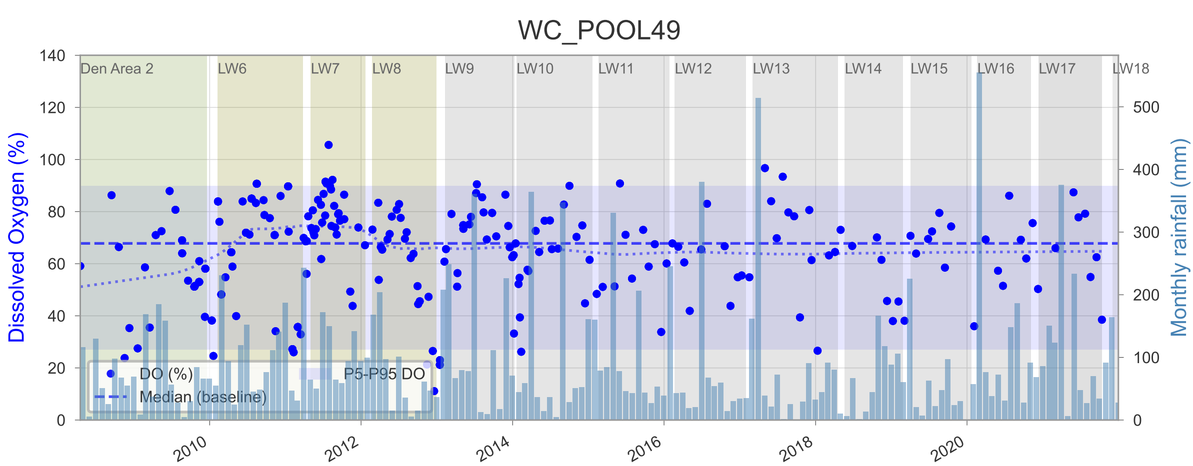

WC_POOL46
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

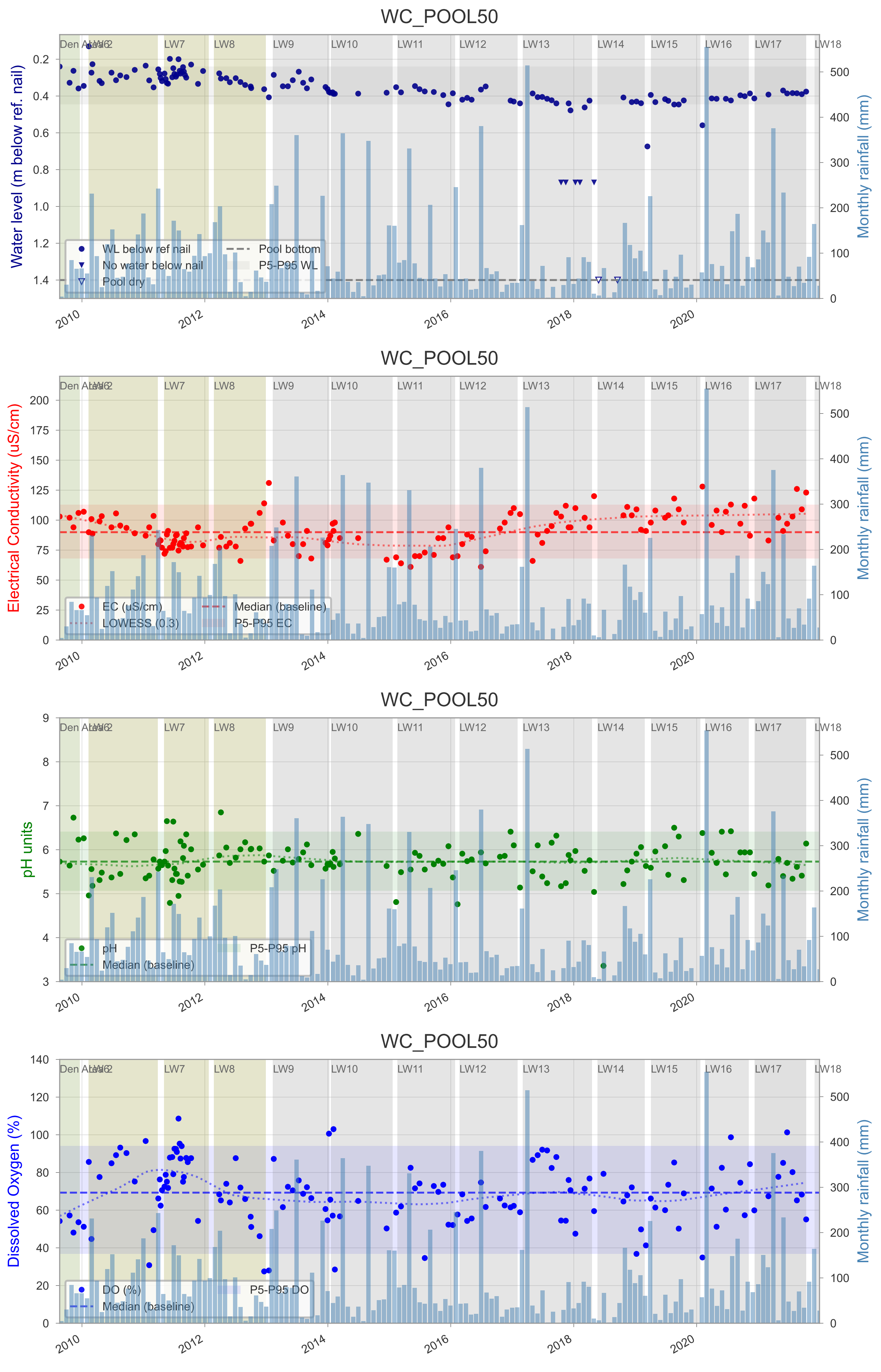

WC_POOL46
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO


WC_POOL49
Water level (m below ref. nail)
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL

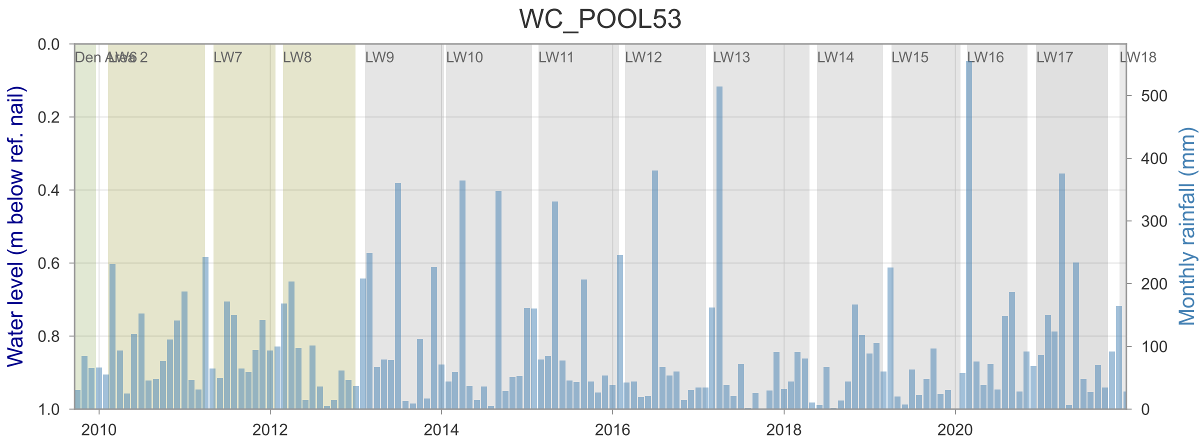

WC_POOL49
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

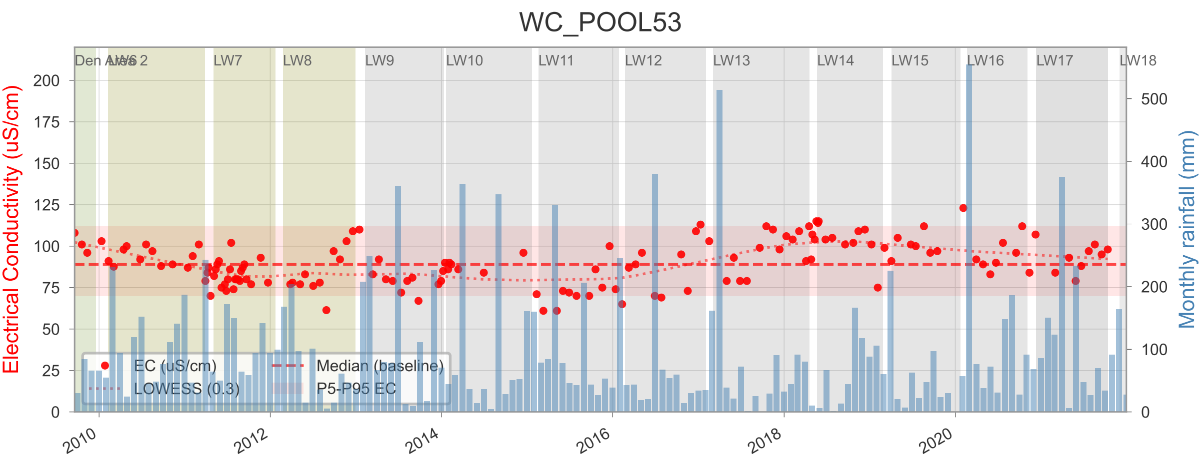

WC_POOL49
pH units
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
Median (baseline)
P5-P95 pH

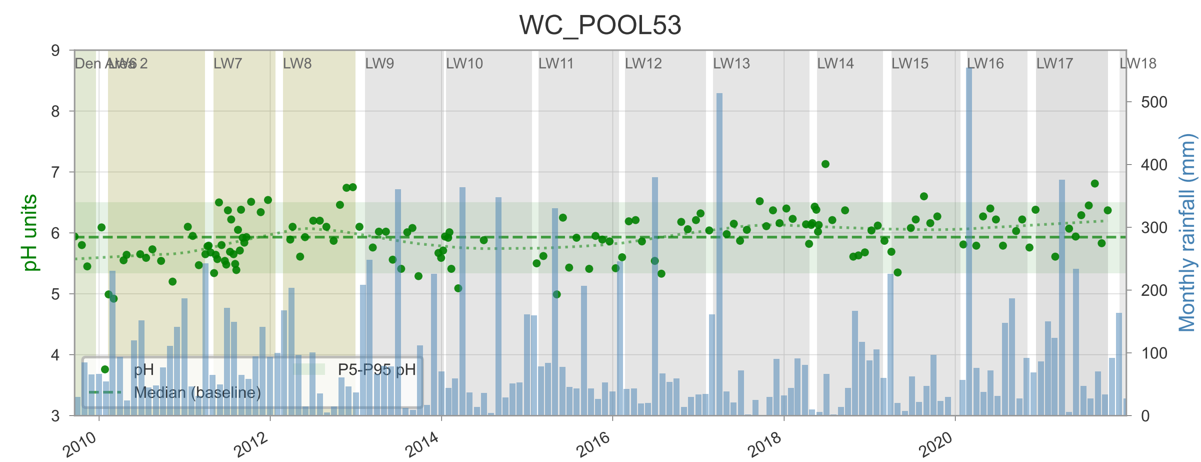

WC_POOL49
Dissolved Oxygen (%)
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
Median (baseline)
P5-P95 DO

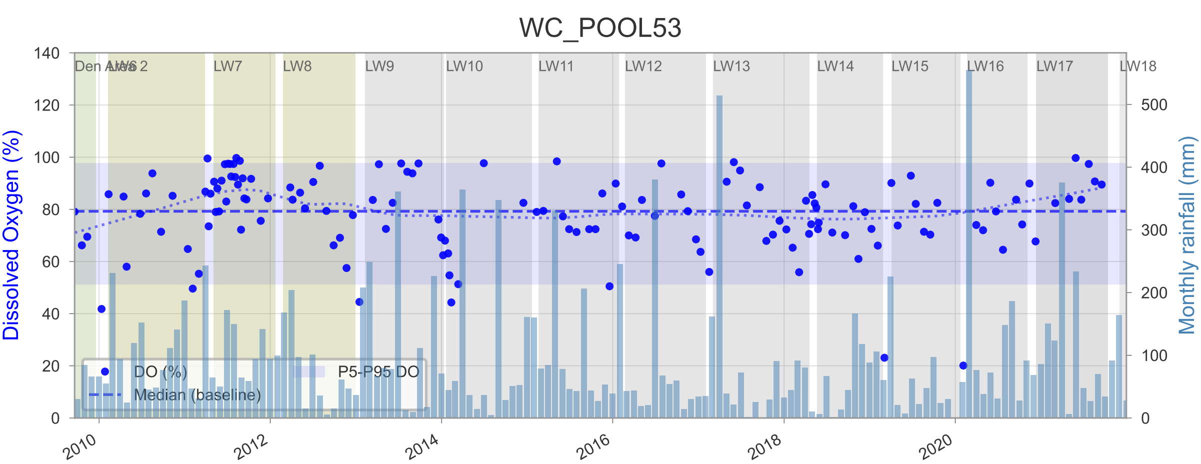


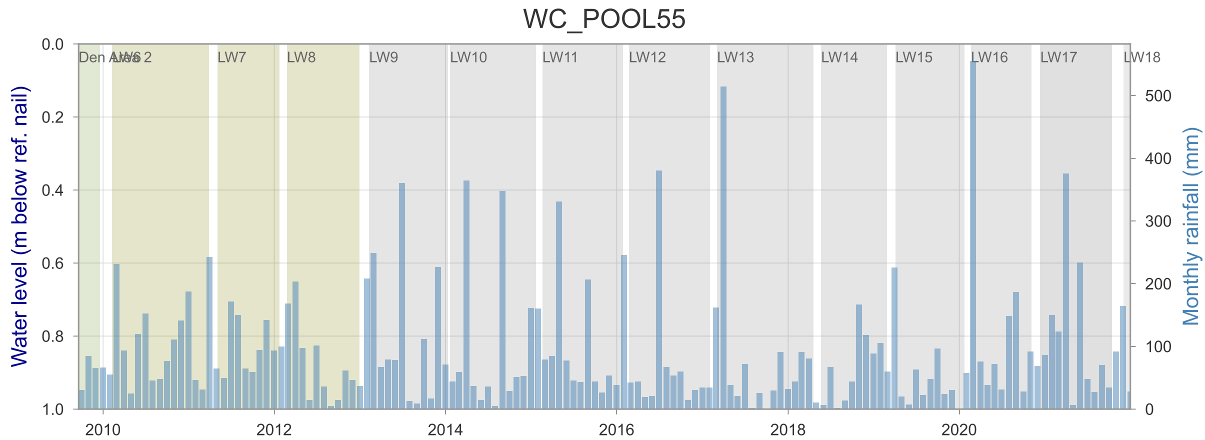
WC_POOL50
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL
WC_POOL50
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
WC_POOL50
pH units
pH
Median (baseline)
P5-P95 pH
WC_POOL50
Dissolved Oxygen (%)
DO (%)
Median (baseline)
P5-P95 DO
2010
2012
2014
2016
2018
2020

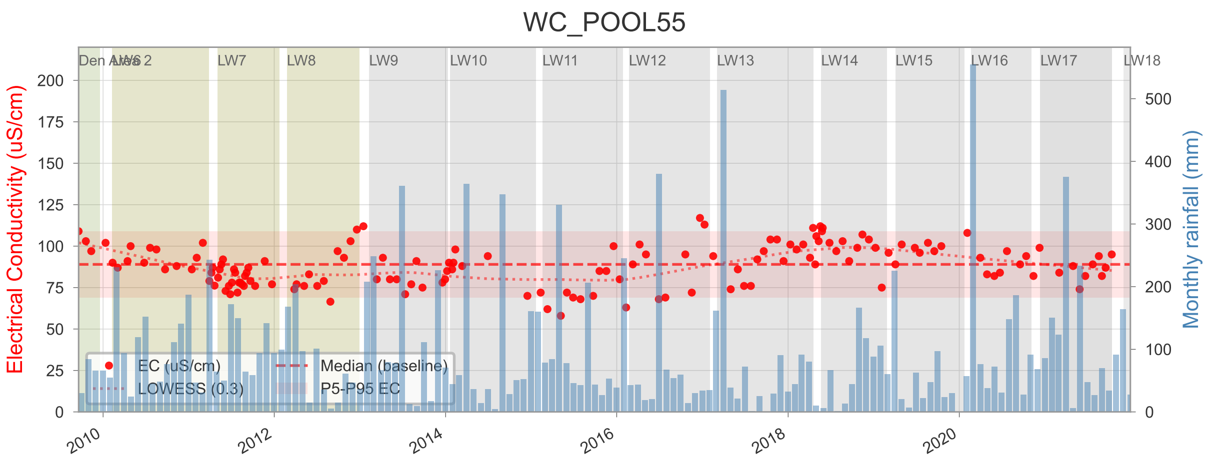

WC_POOL53
Den Area 2
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Water level (m below ref. nail)
Monthly rainfall (mm)

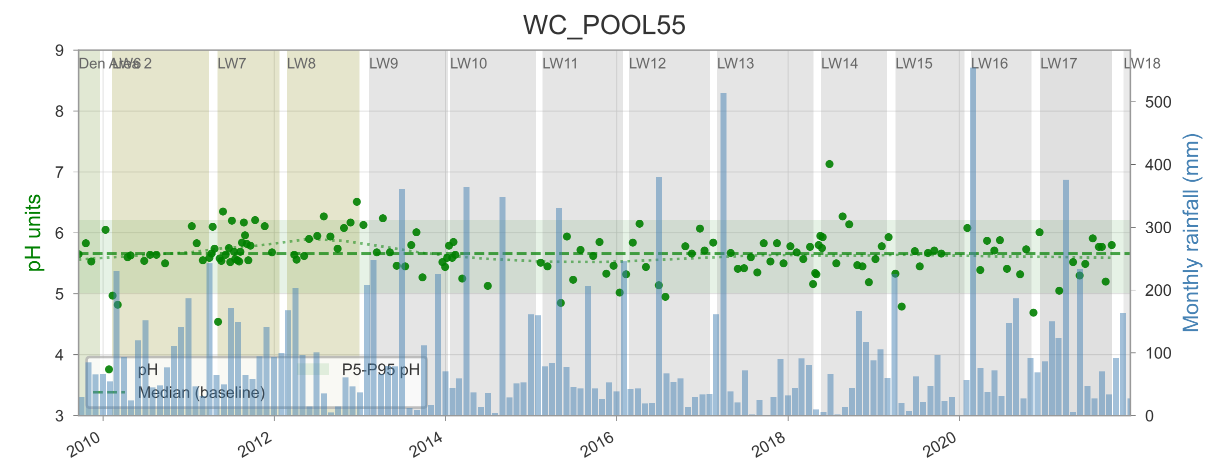

WC_POOL53
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

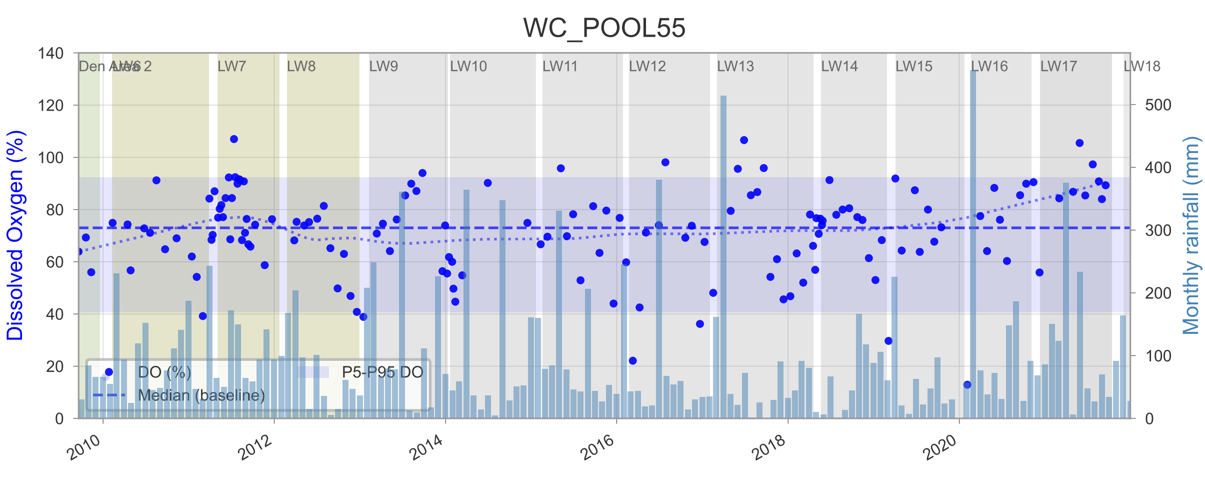

WC_POOL53
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

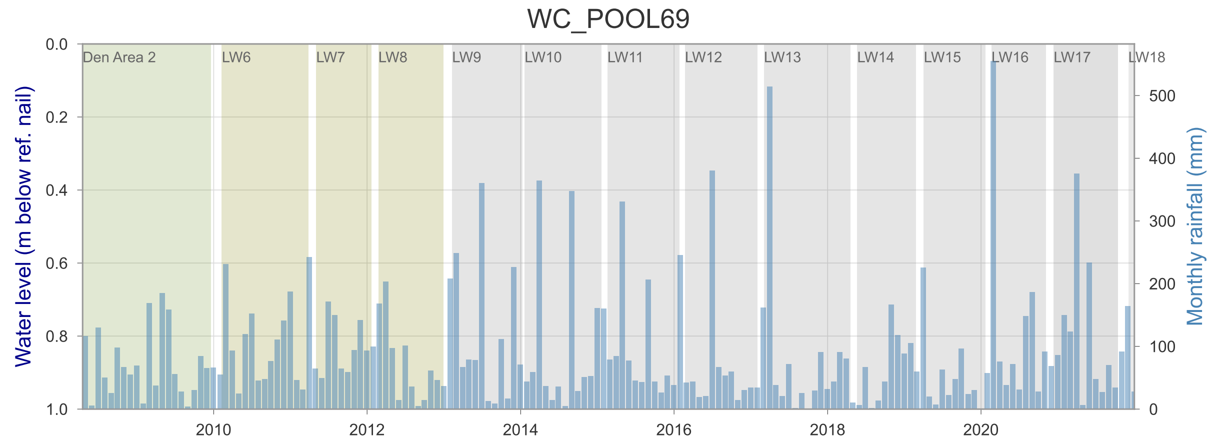

WC_POOL53
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

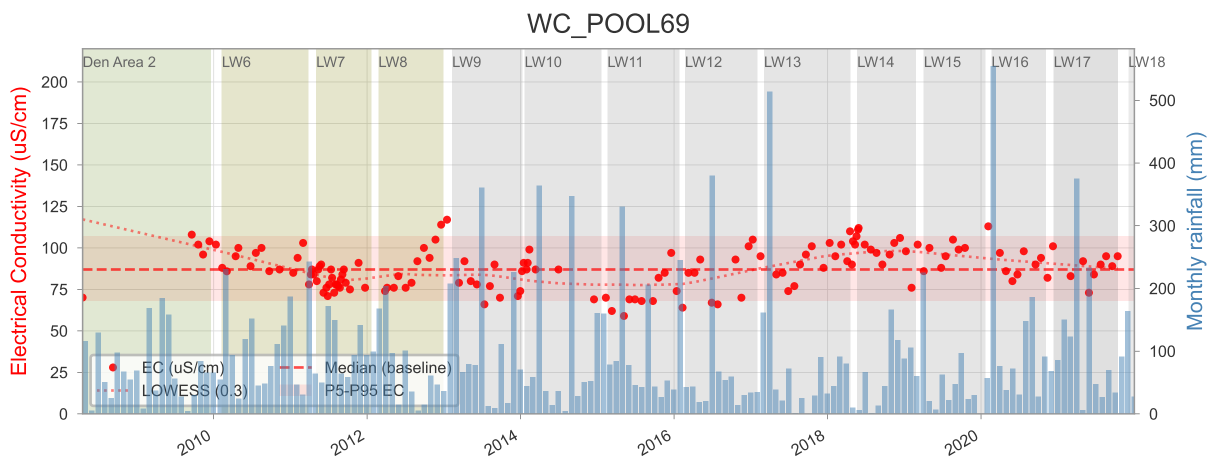

WC_POOL55
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Water level (m below ref. nail)
Monthly rainfall (mm)

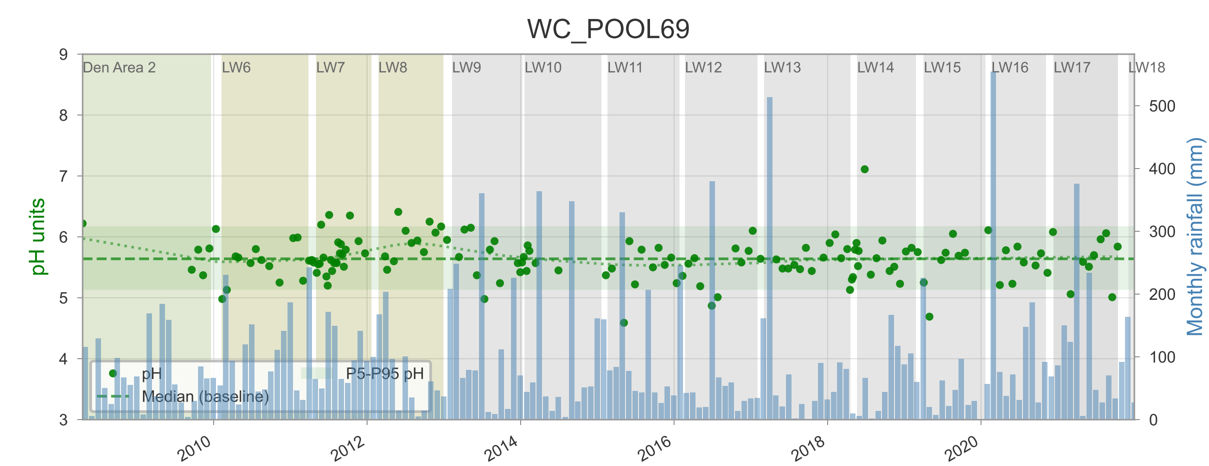

WC_POOL55
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

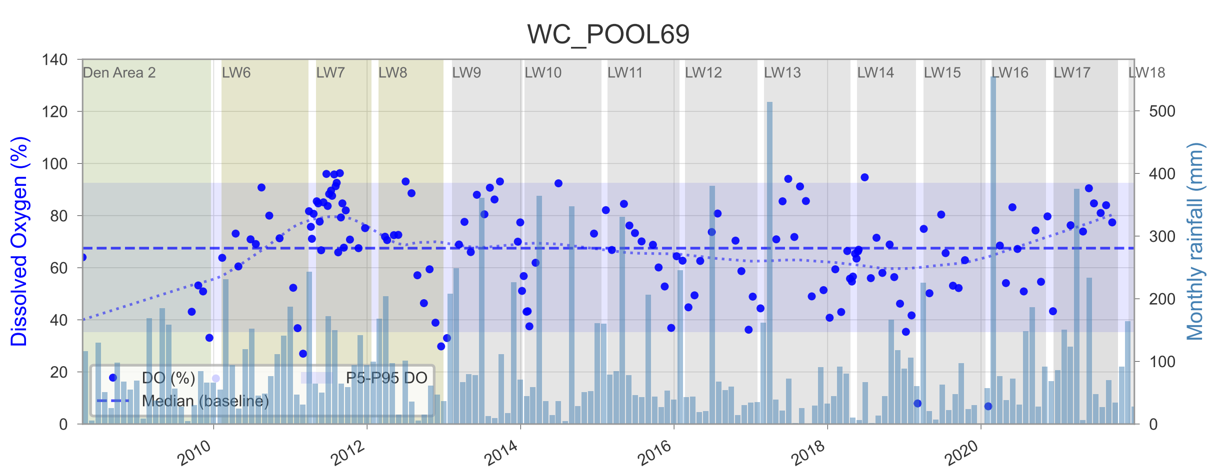

WC_POOL55
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

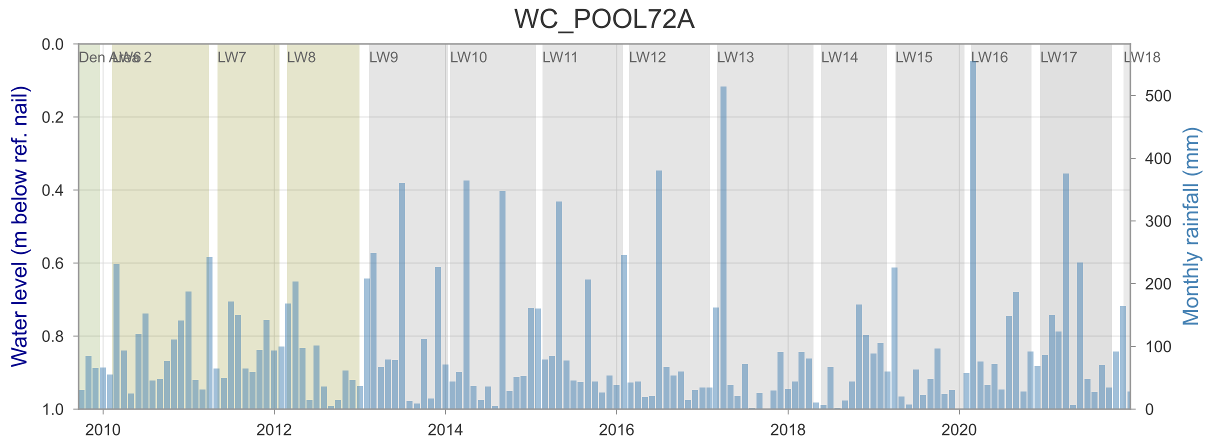

WC_POOL55
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

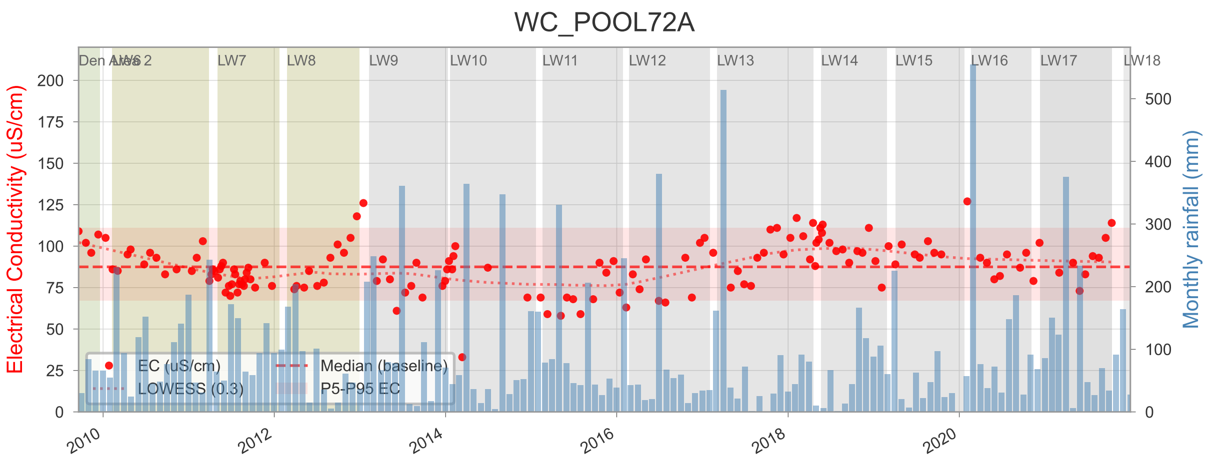

WC_POOL69
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Water level (m below ref. nail)
Monthly rainfall (mm)

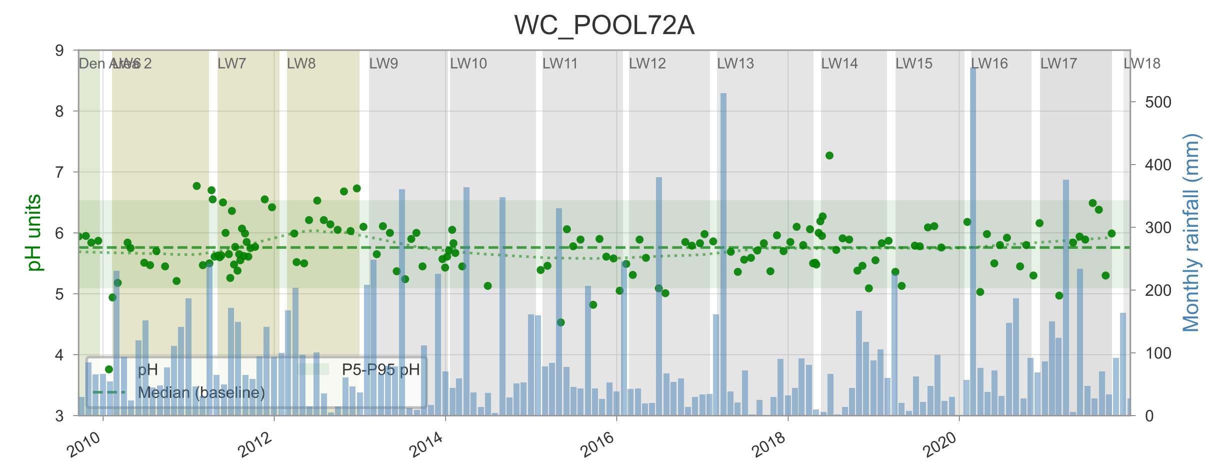

WC_POOL69
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

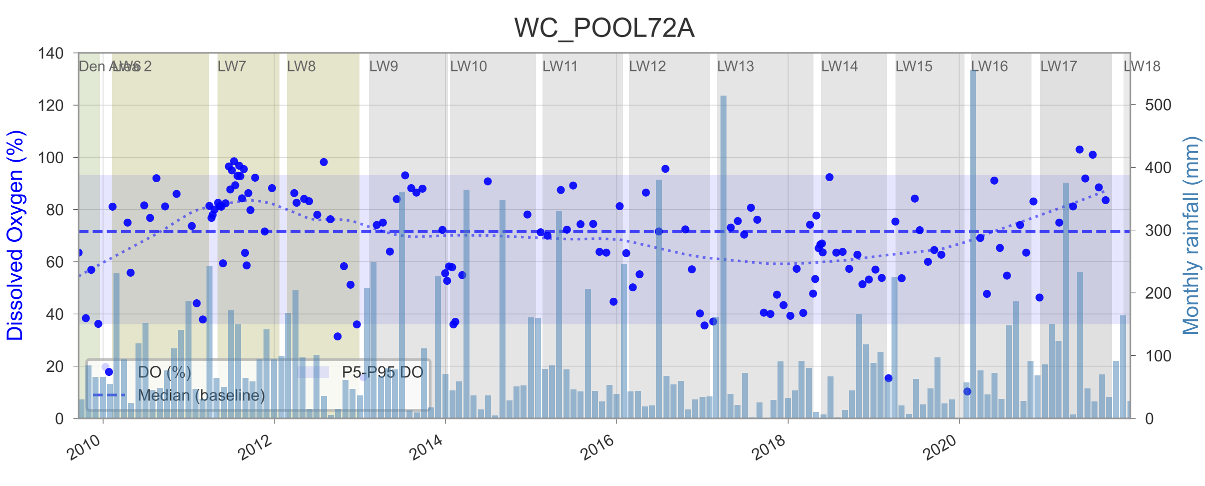

WC_POOL69
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

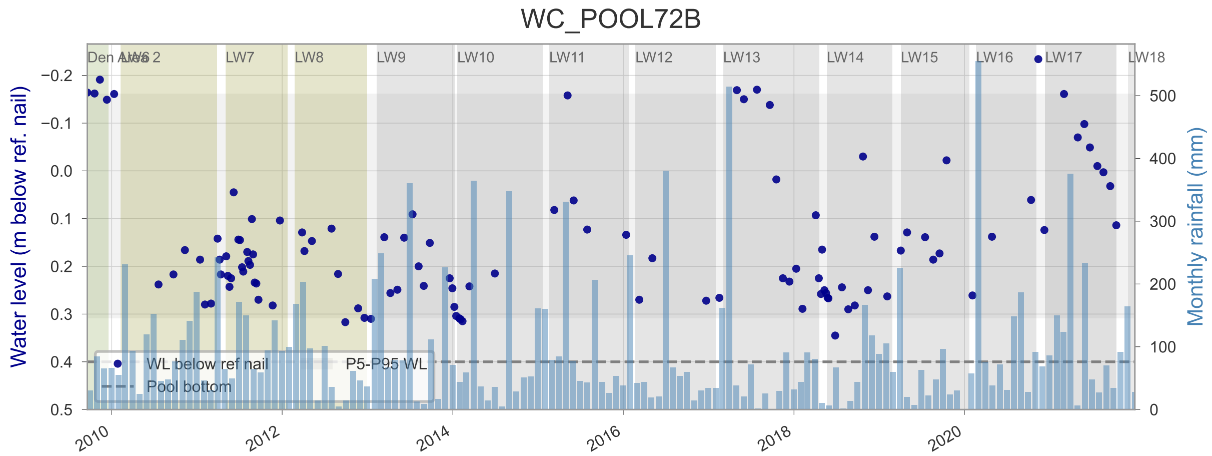

WC_POOL69
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

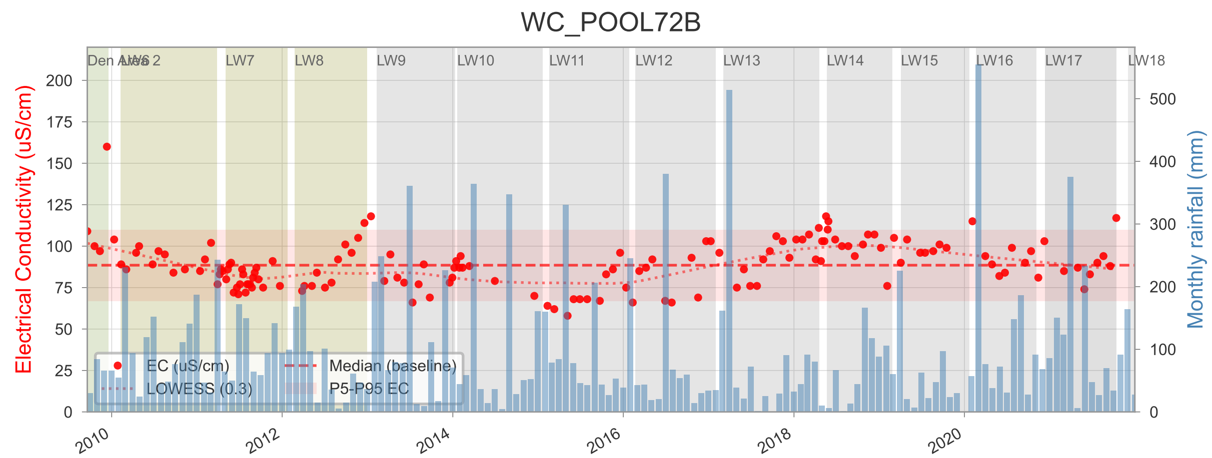

WC_POOL72A
Water level (m below ref. nail)
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

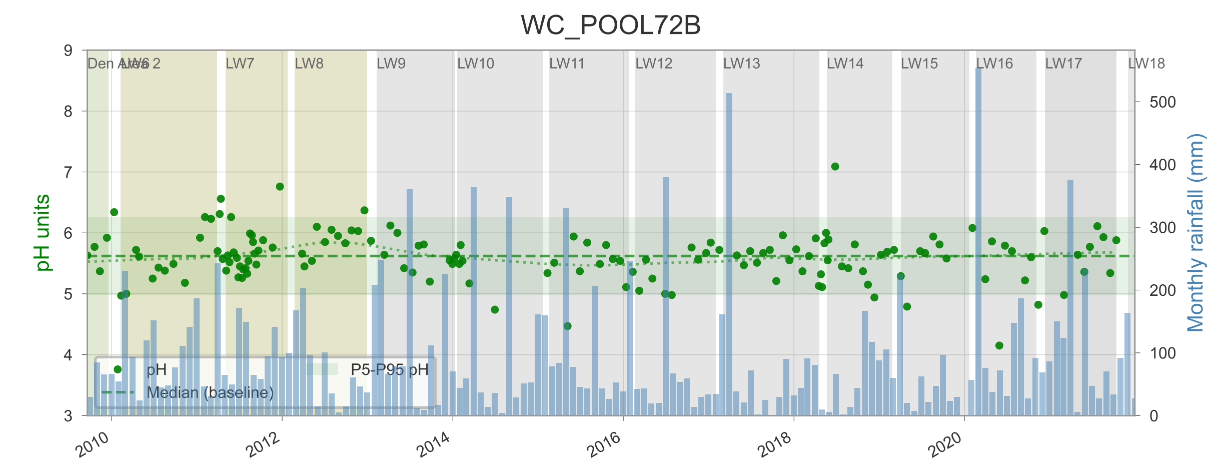

WC_POOL72A
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

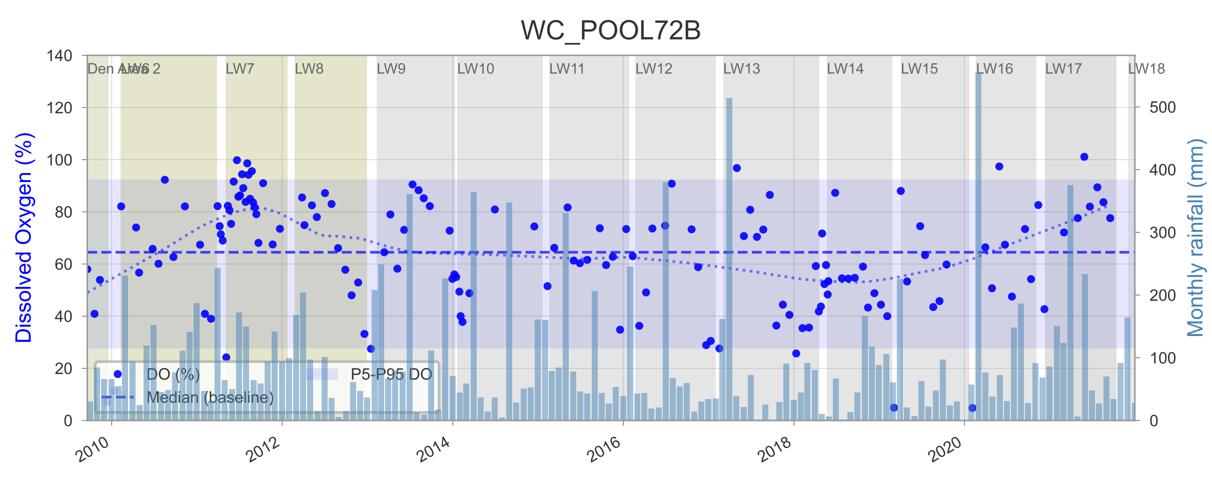

WC_POOL72A
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

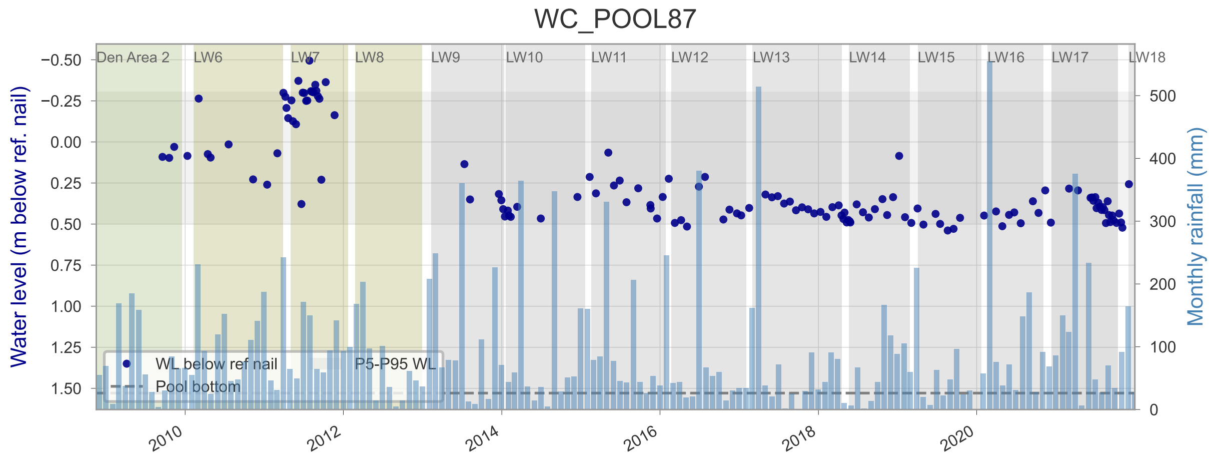

WC_POOL72A
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

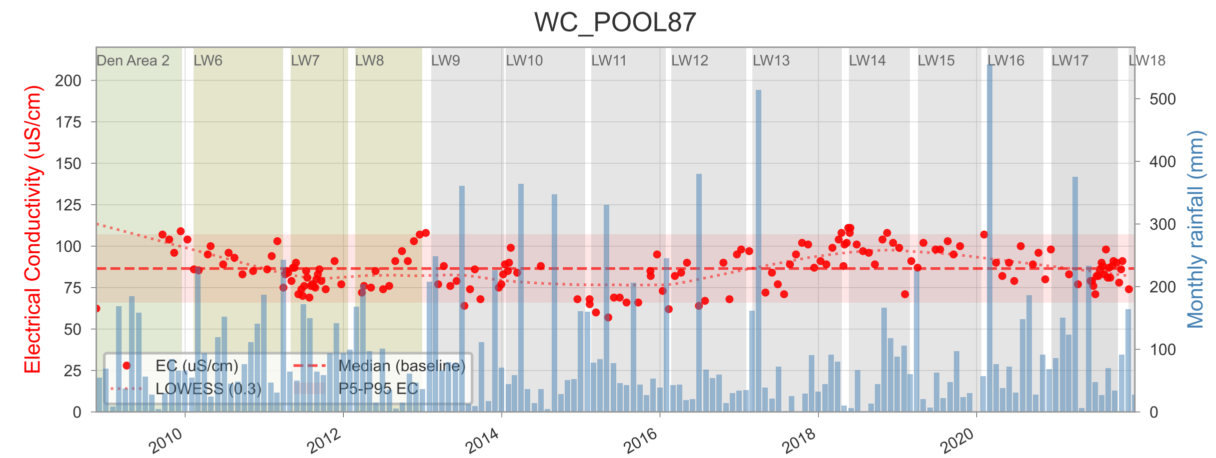

WC_POOL72B
Den Aus
LW6 2
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
Pool bottom
P5-P95 WL

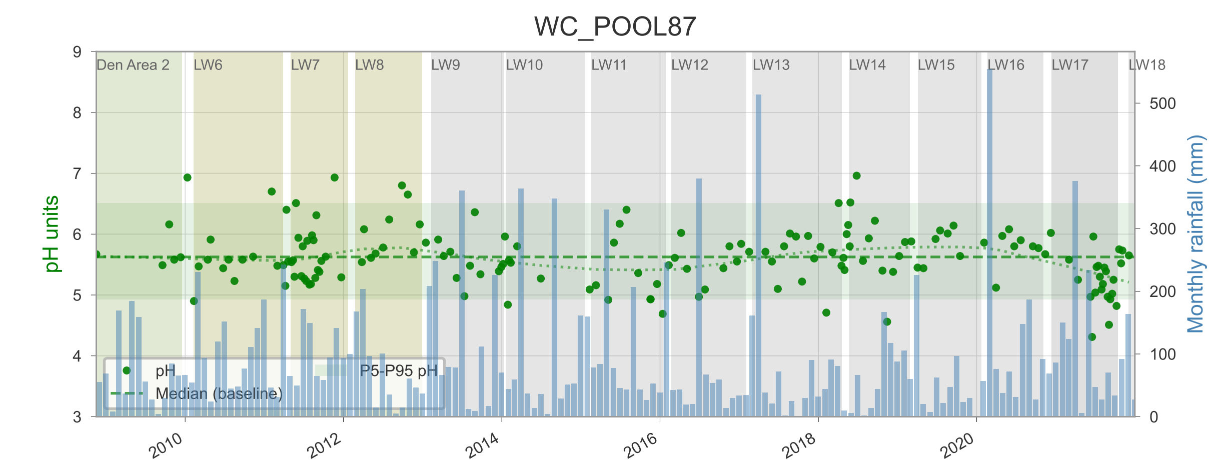

WC_POOL72B
Den Aus
LW6 2
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

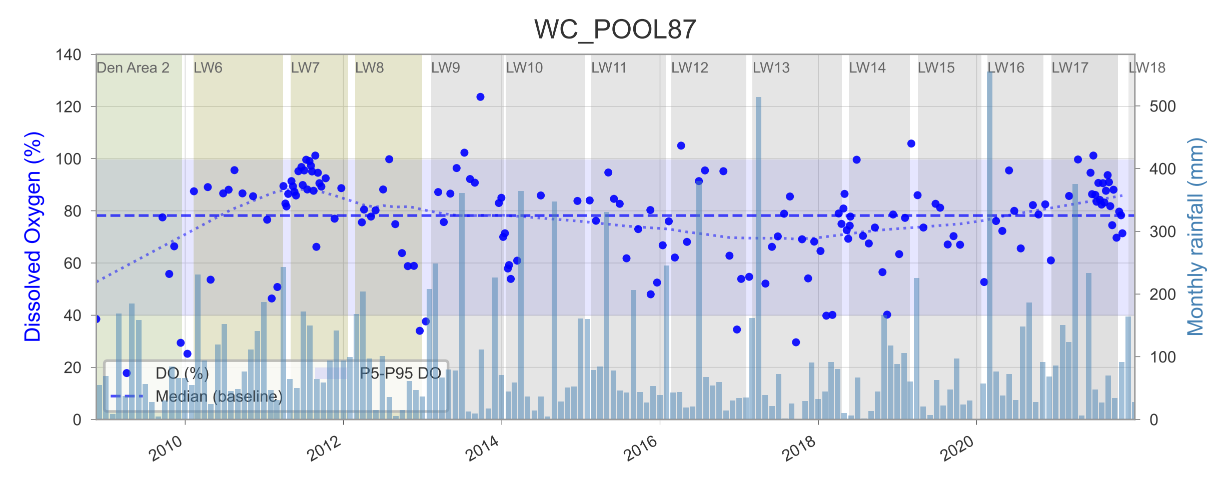

WC_POOL72B
Den Aus
LW6 2
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

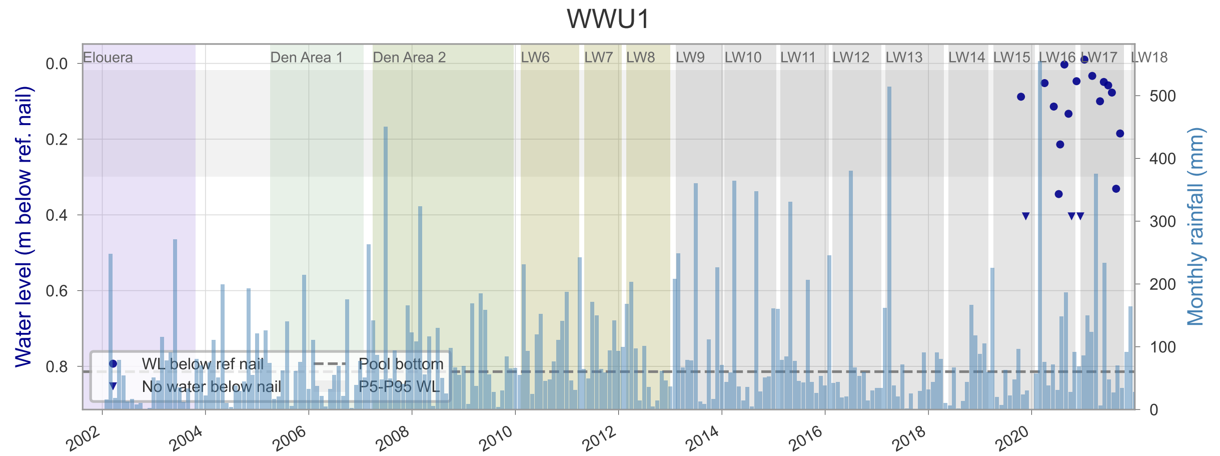

WC_POOL72B
Den Aus
LW6 2
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

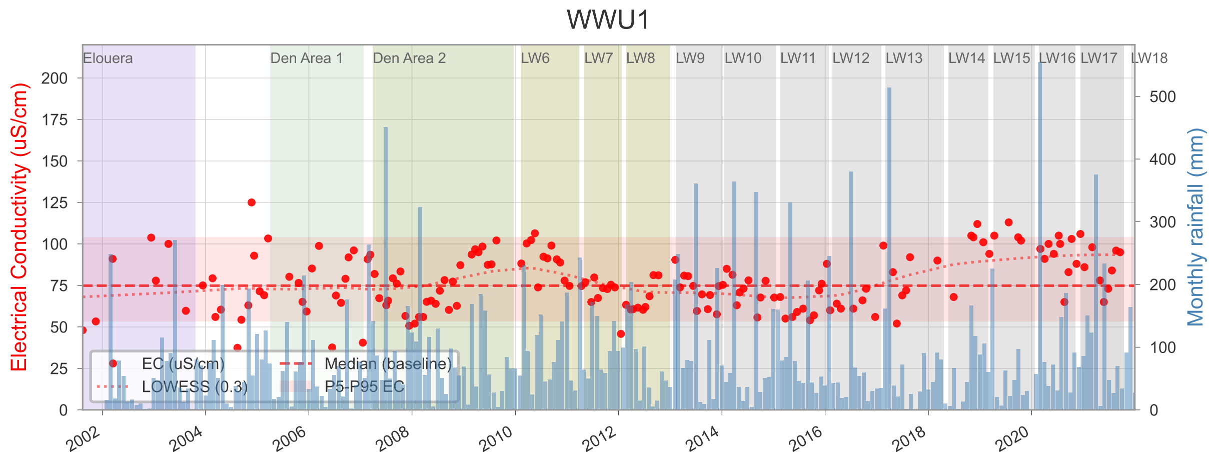

WC_POOL87
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
Pool bottom
P5-P95 WL

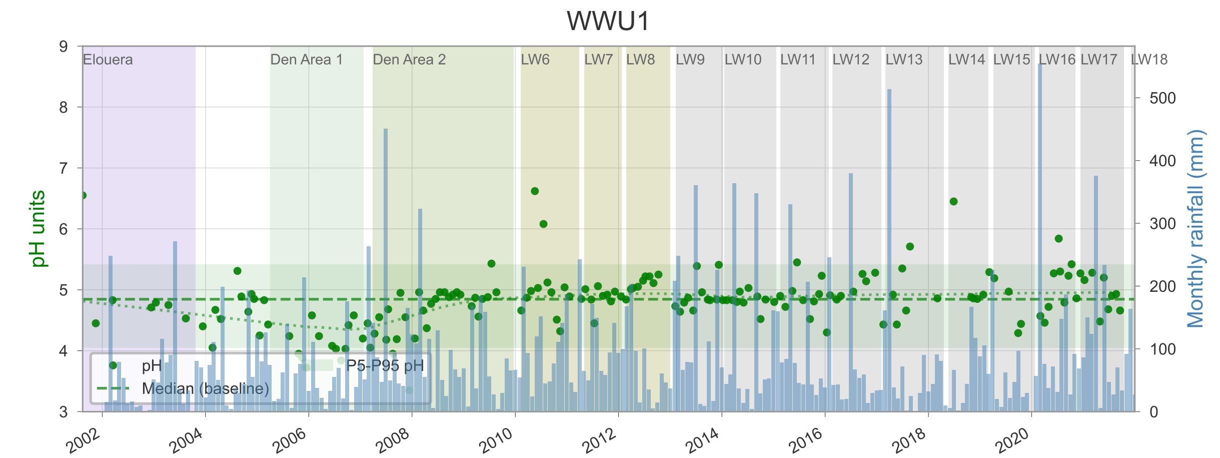

WC_POOL87
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

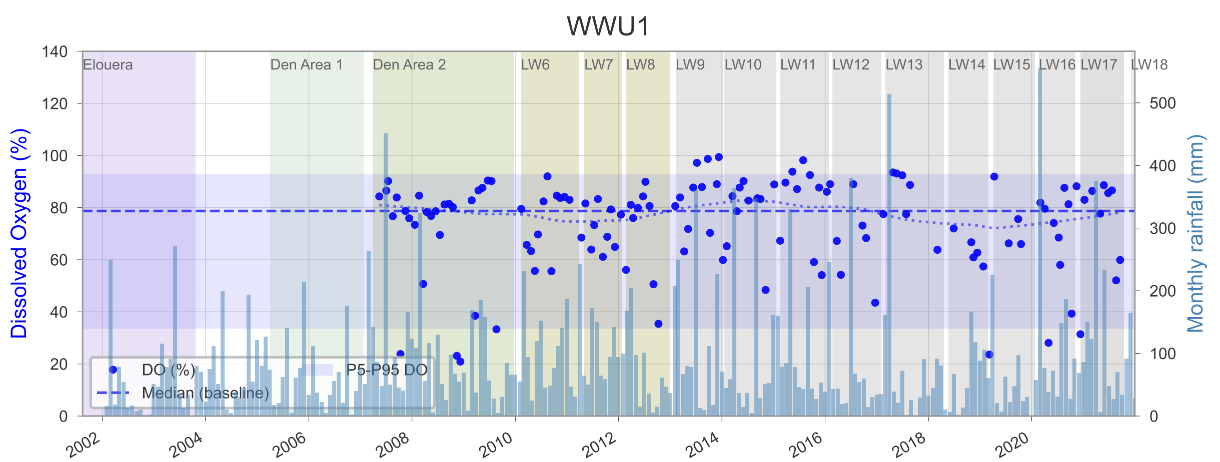

WC_POOL87
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

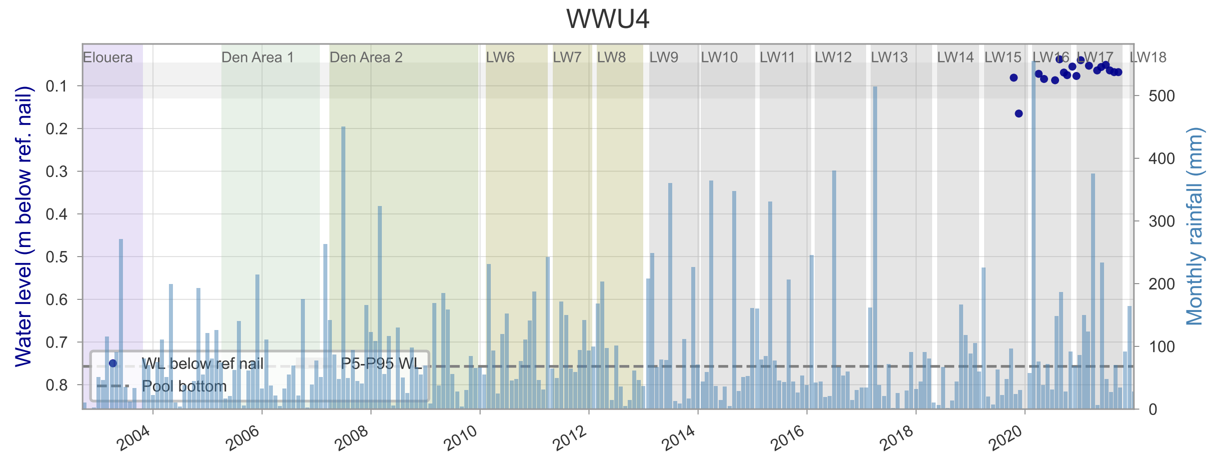

WC_POOL87
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

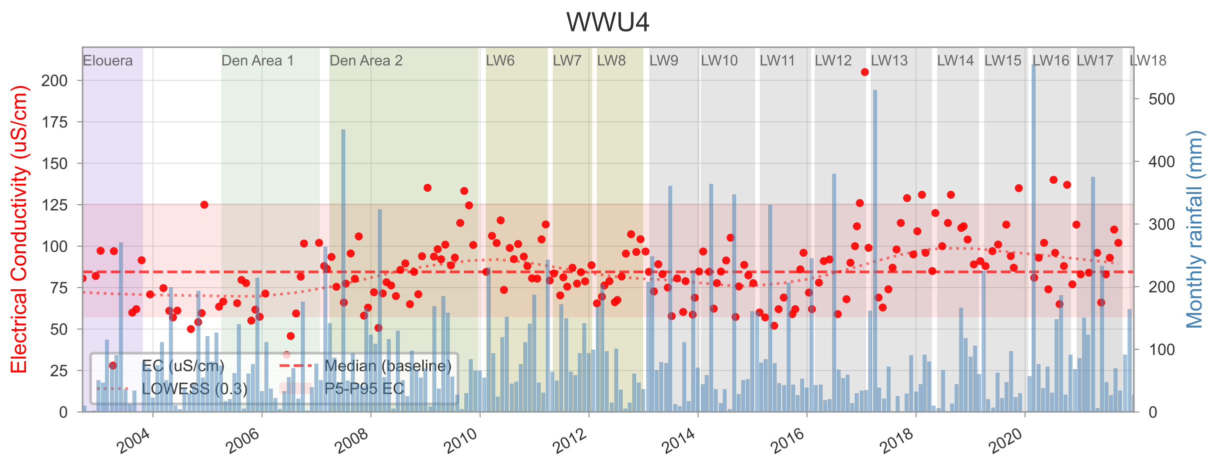

WWU1
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool bottom
P5-P95 WL

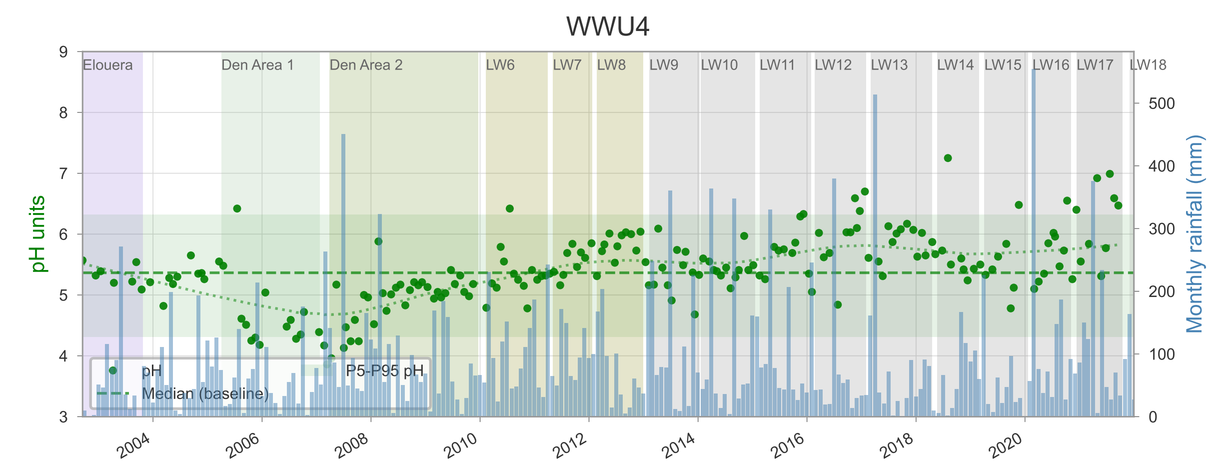

WWU1
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

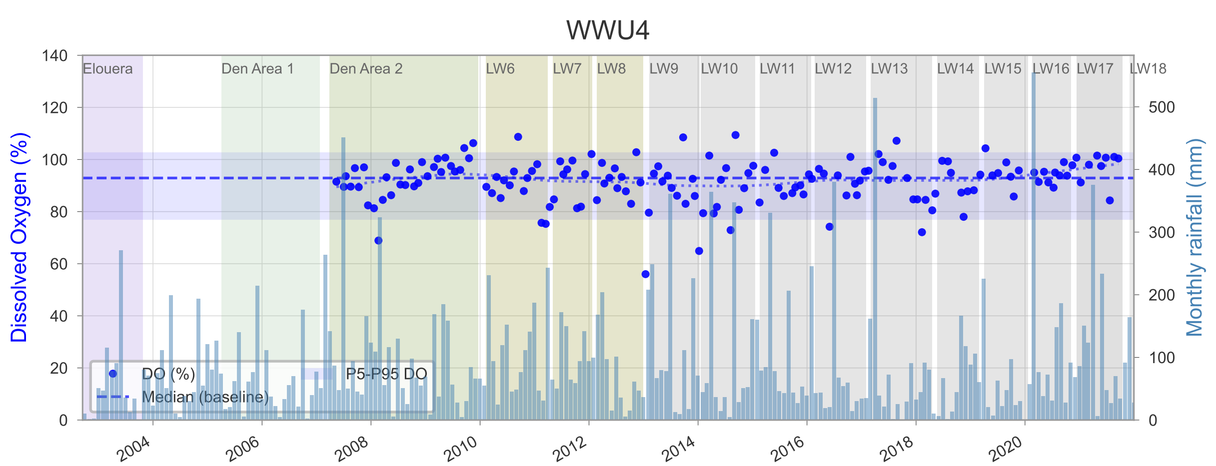

WWU1
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

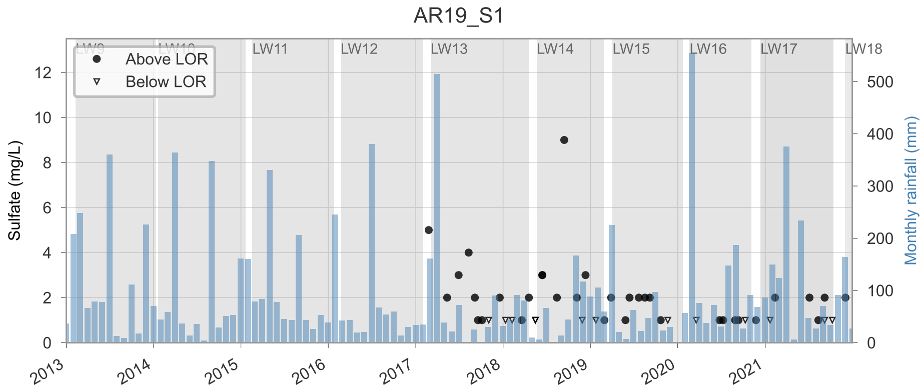

WWU1
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

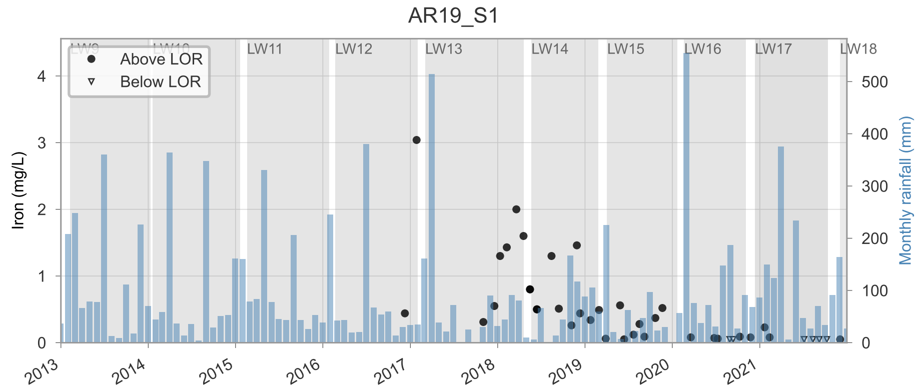

WWU4
Water level (m below ref. nail)
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WL below ref nail
Pool bottom
P5-P95 WL

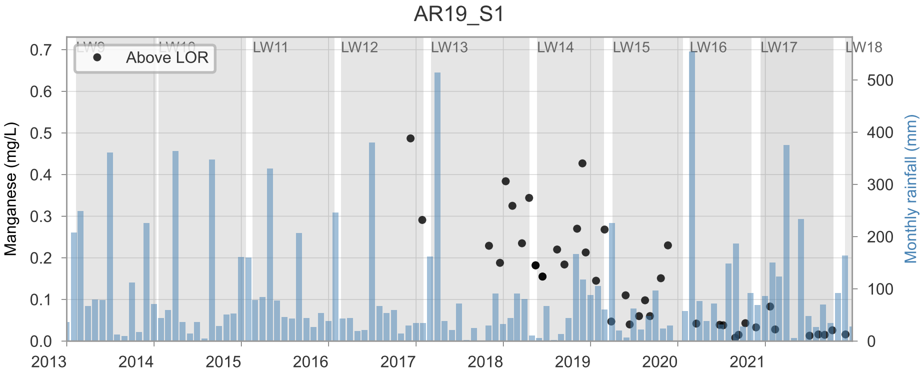

WWU4
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

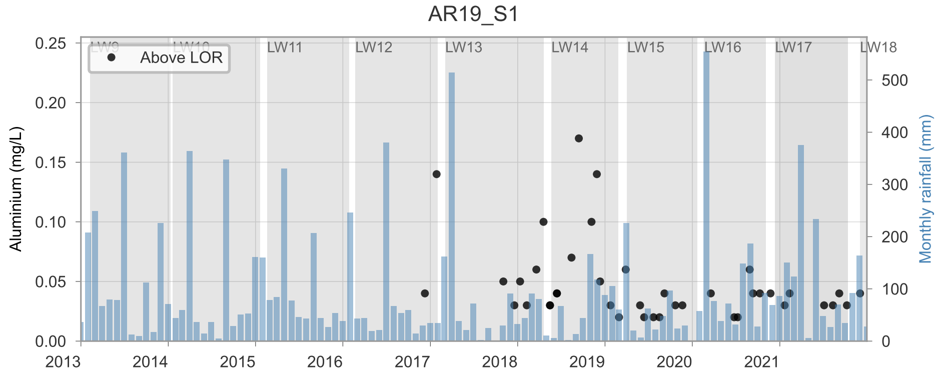

WWU4
pH units
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
pH
Median (baseline)
P5-P95 pH

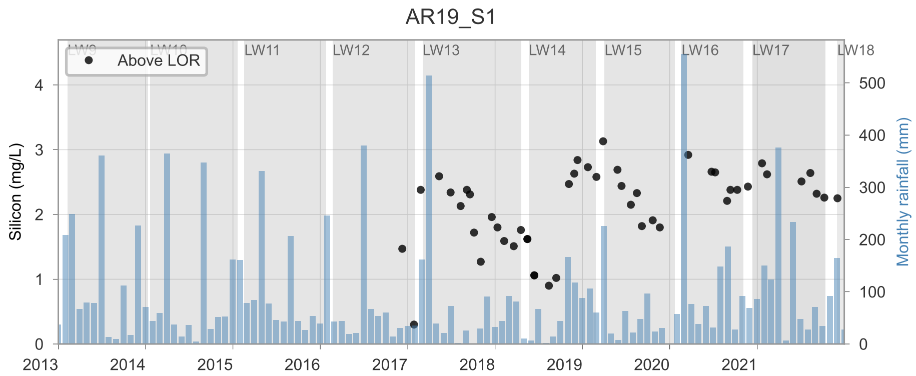

WWU4
Dissolved Oxygen (%)
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
DO (%)
Median (baseline)
P5-P95 DO

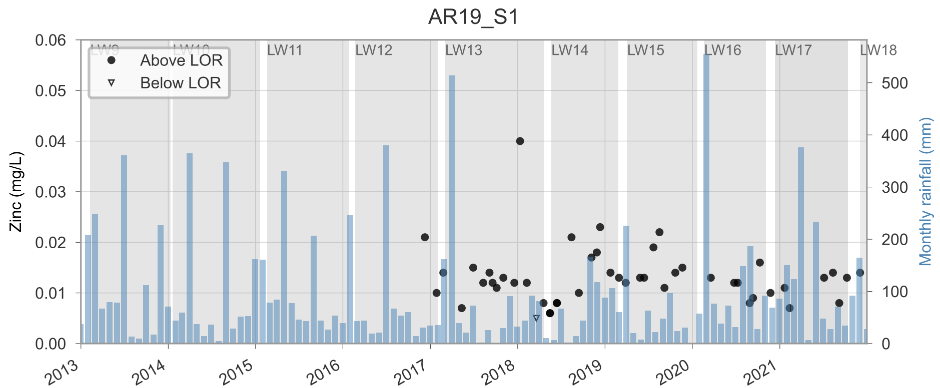

AR19_S1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Sulfate (mg/L)
Monthly rainfall (mm)
0
2
4
6
8
10
12
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

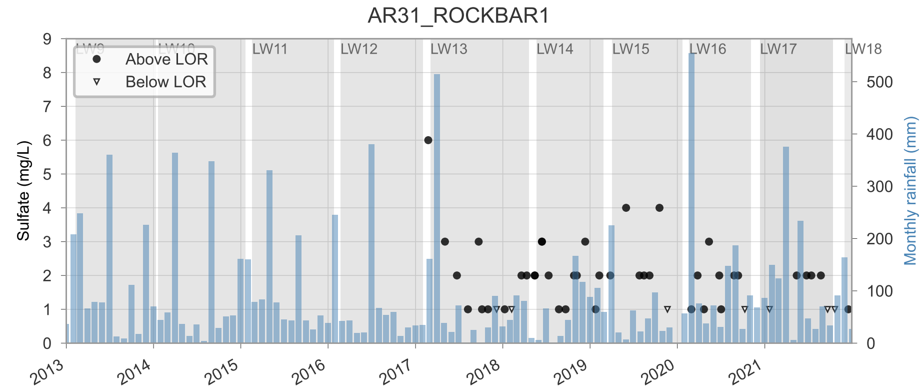

AR19_S1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Iron (mg/L)
Monthly rainfall (mm)
0
1
2
3
4
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

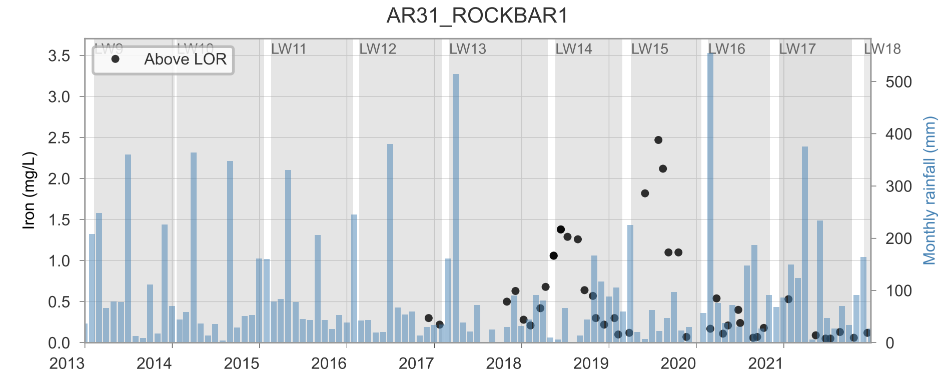

AR19_S1
Above LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Manganese (mg/L)
Monthly rainfall (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

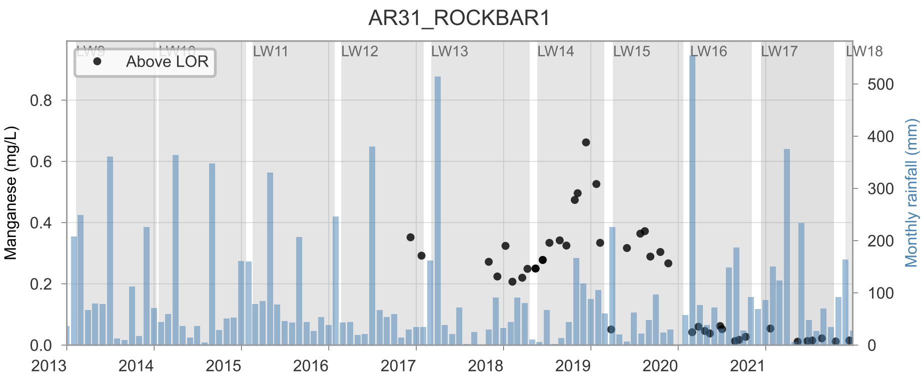

AR19_S1
Above LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Aluminium (mg/L)
Monthly rainfall (mm)
0.00
0.05
0.10
0.15
0.20
0.25
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

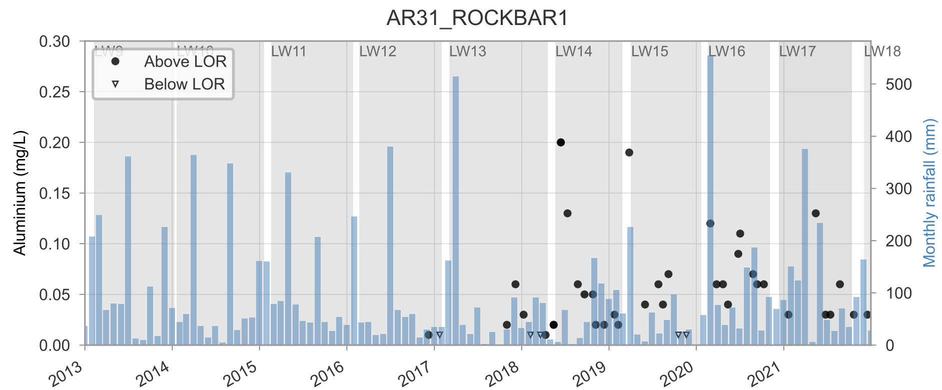

AR19_S1
Above LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Silicon (mg/L)
Monthly rainfall (mm)
0
1
2
3
4
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

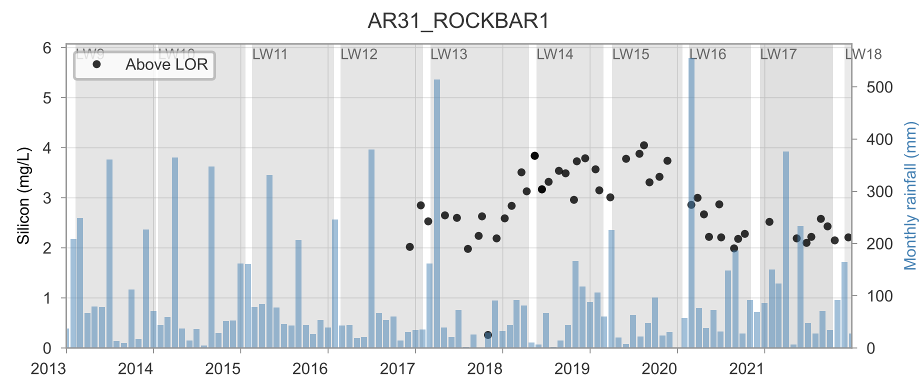

AR19_S1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Zinc (mg/L)
Monthly rainfall (mm)
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021

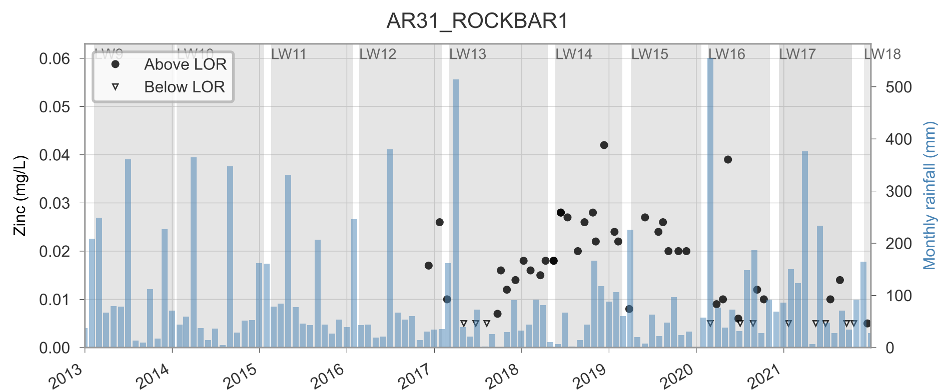

AR31_ROCKBAR1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Sulfate (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020
2021

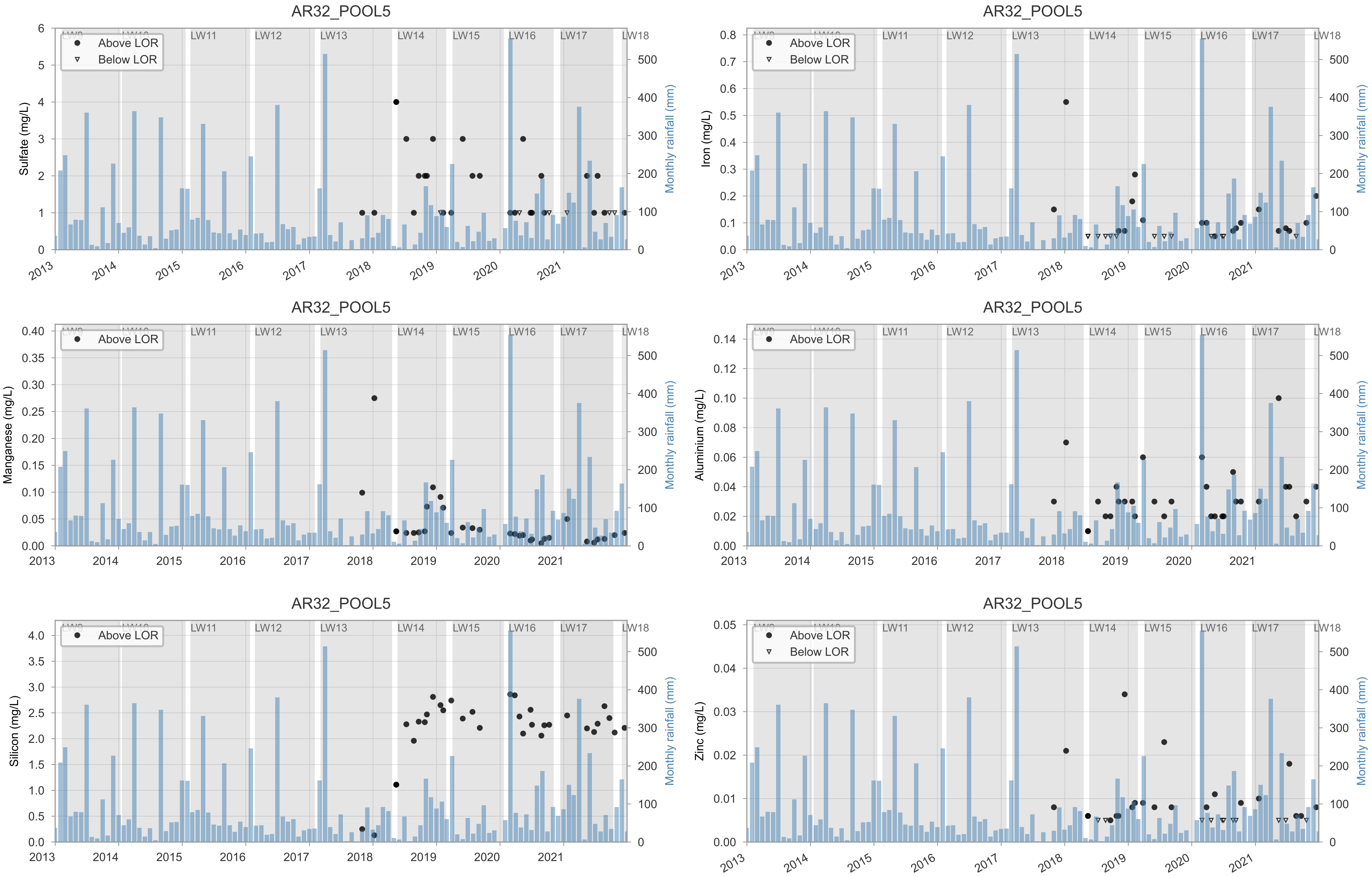

AR31_ROCKBAR1
Above LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Iron (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020
2021

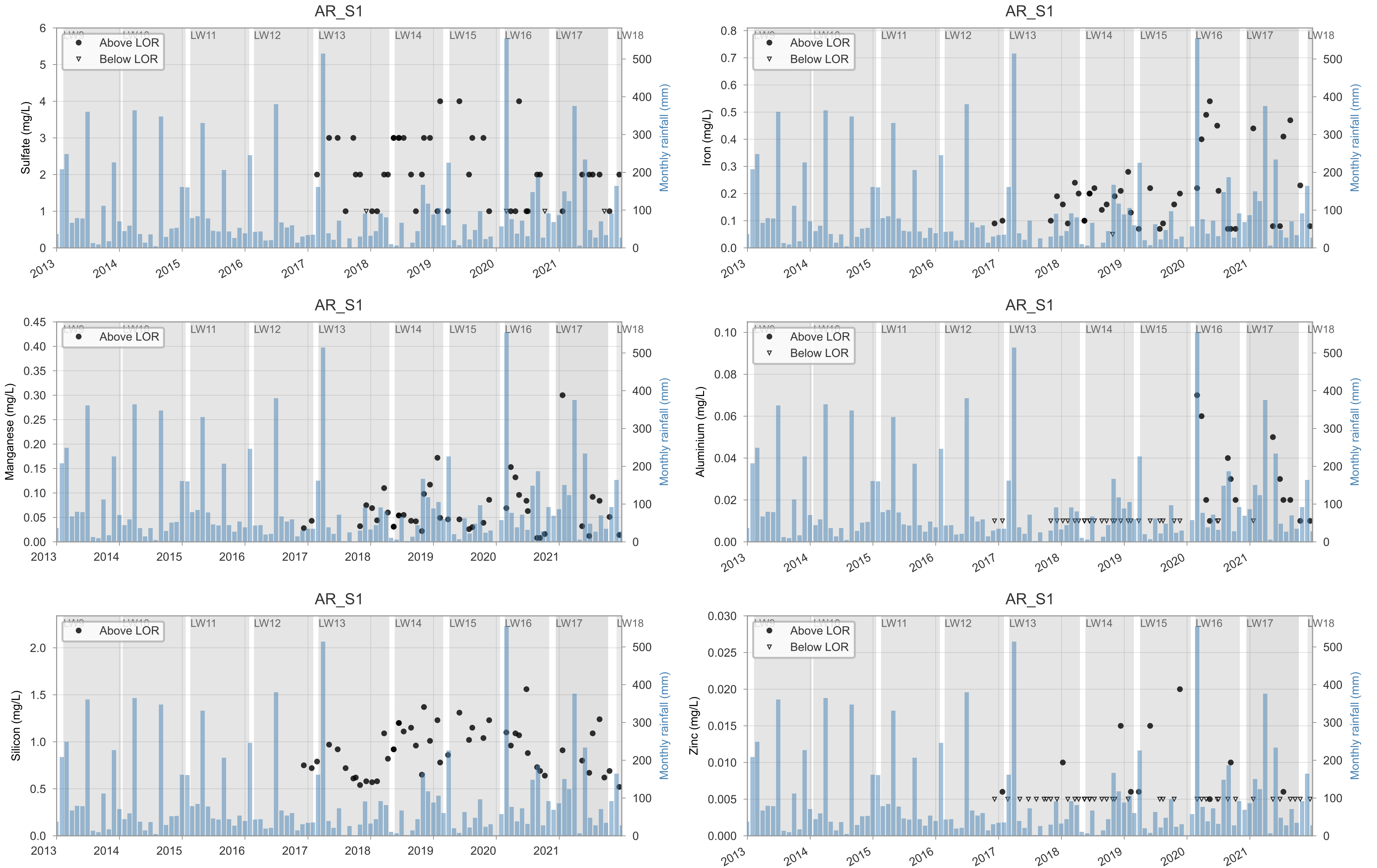

AR31_ROCKBAR1
Above LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Manganese (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020
2021


AR31_ROCKBAR1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Aluminium (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020
2021

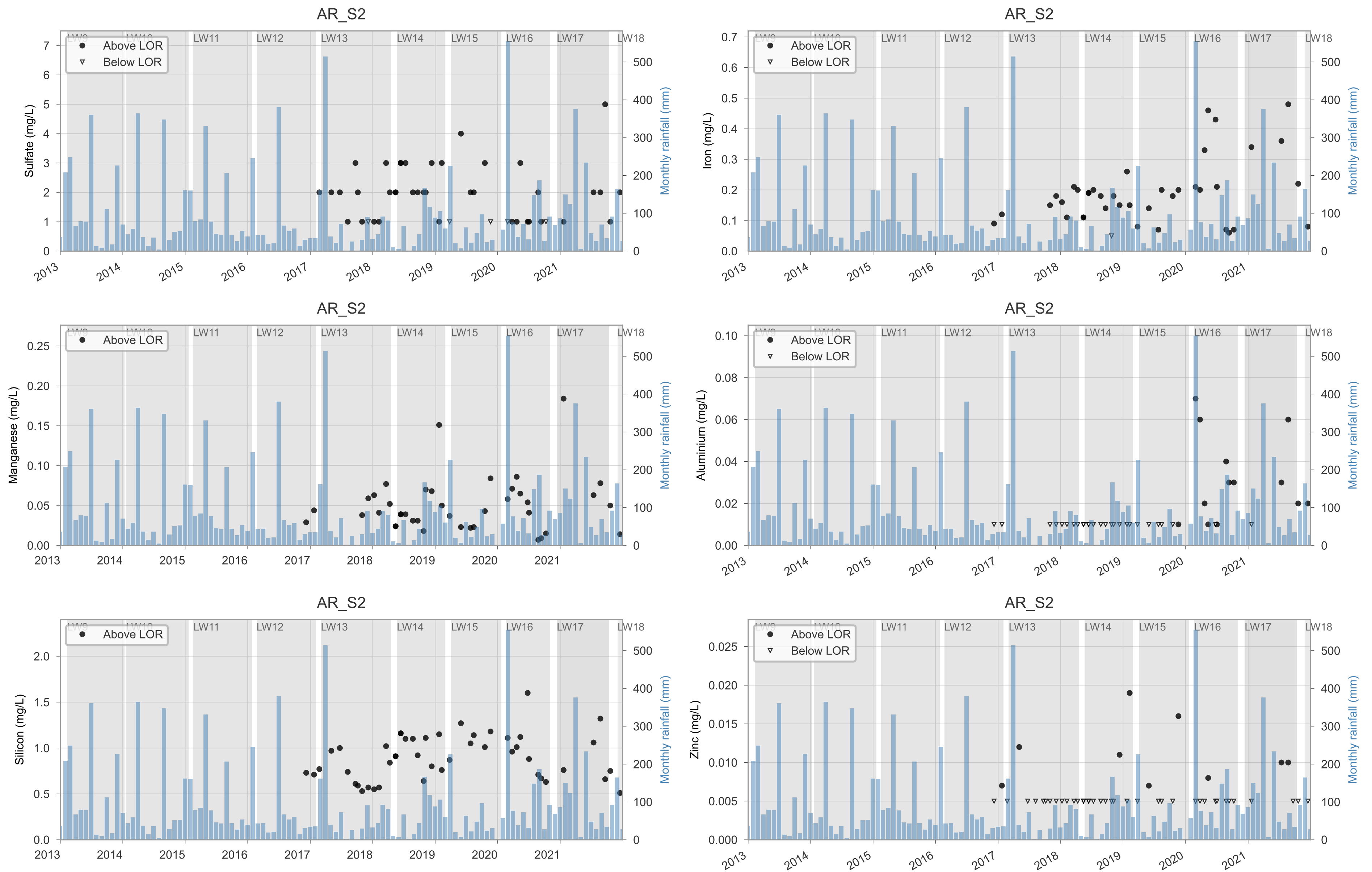

AR31_ROCKBAR1
Above LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Silicon (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020
2021

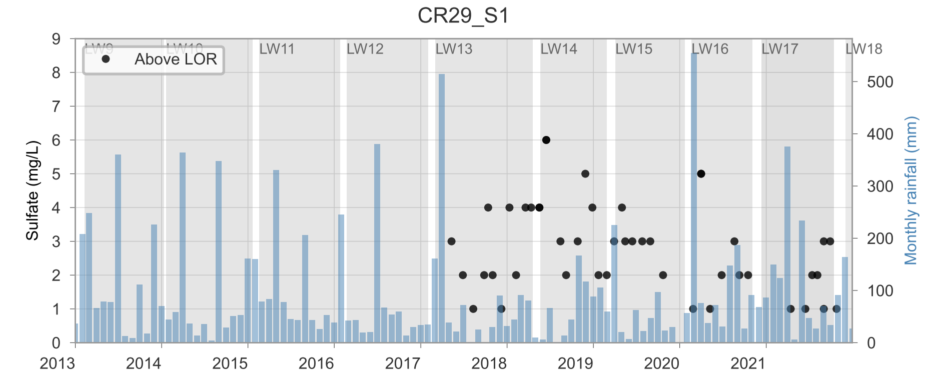

AR31_ROCKBAR1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Zinc (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020
2021

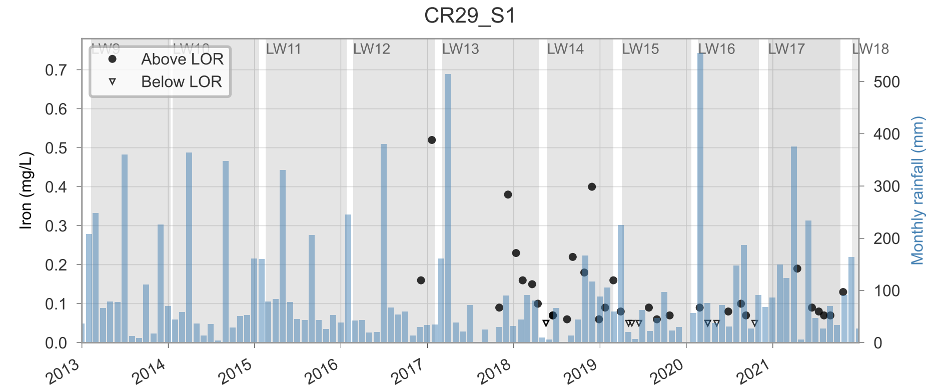

AR32_POOL5
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
AR32_POOL5
Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
AR32_POOL5
Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
AR32_POOL5
Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
AR32_POOL5
Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
AR32_POOL5
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
2013
2014
2015
2016
2017
2018
2019
2020
2021

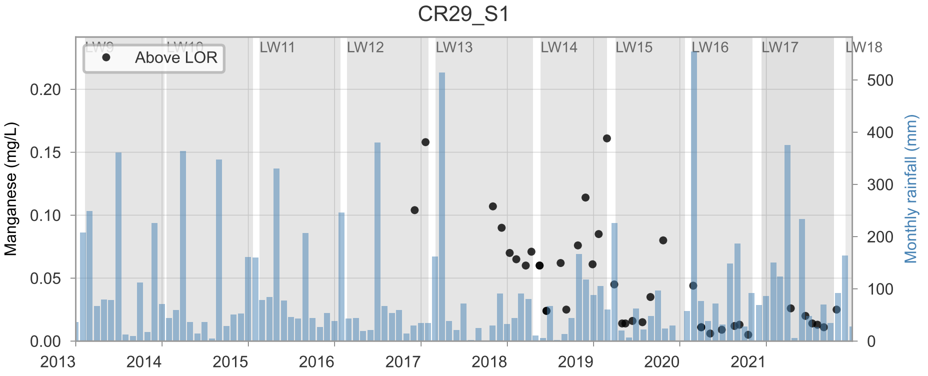


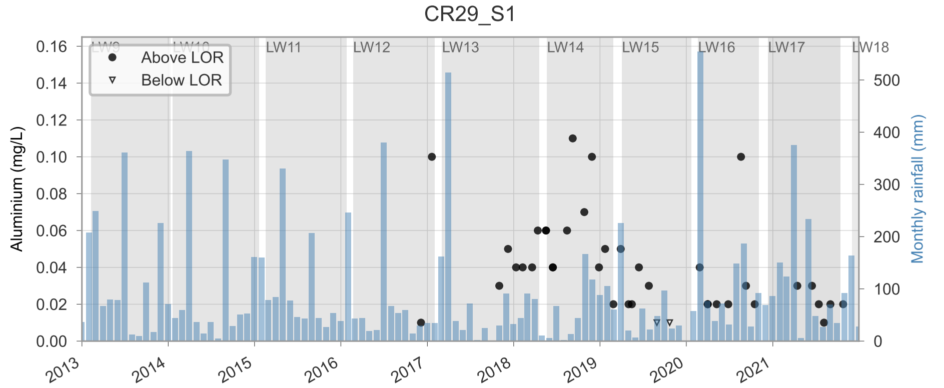
AR_S1
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
AR_S1
Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
AR_S1
Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
AR_S1
Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
AR_S1
Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
AR_S1
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
2013
2014
2015
2016
2017
2018
2019
2020
2021

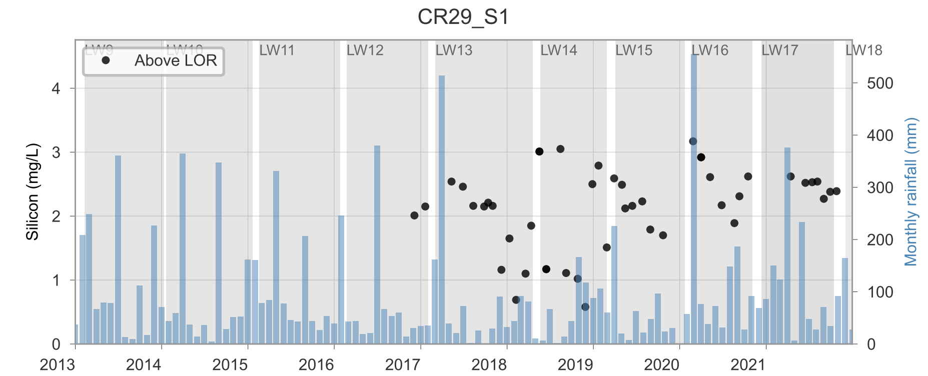

AR_S2
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021
AR_S2
Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
AR_S2
Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
AR_S2
Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
AR_S2
Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
AR_S2
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR

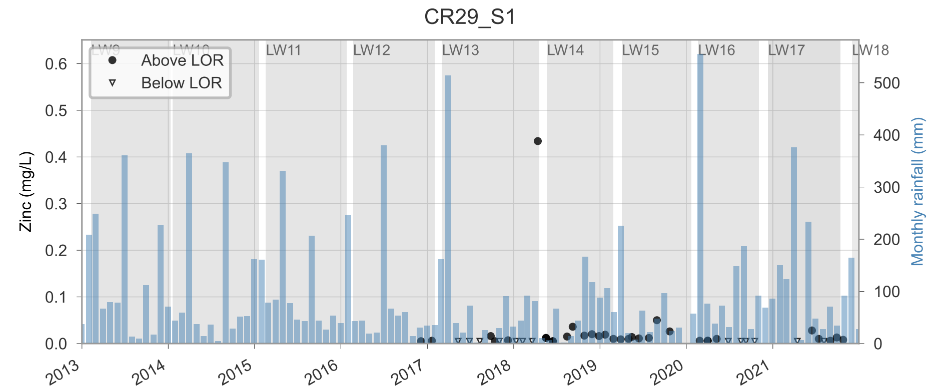

CR29_S1
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

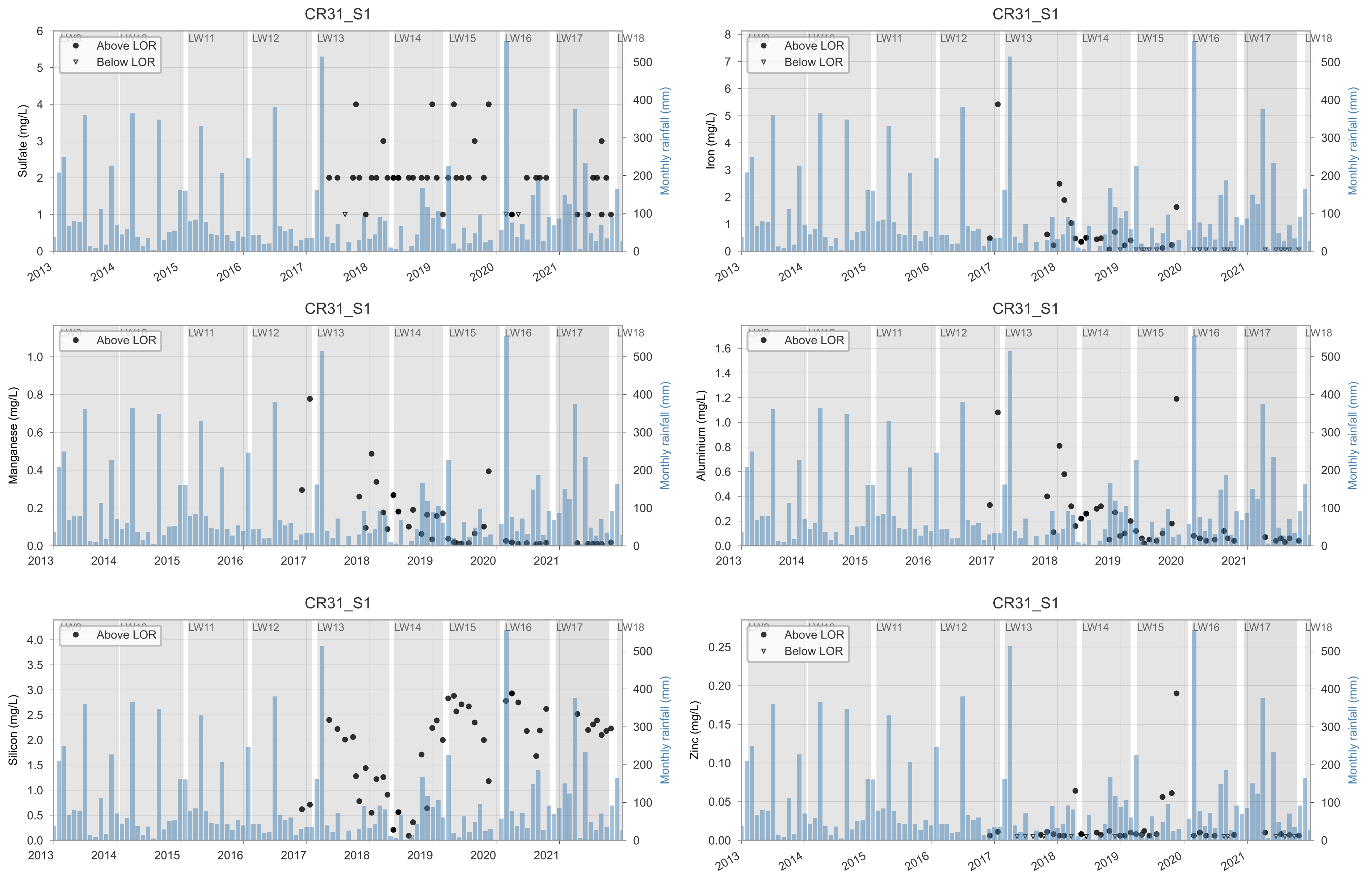

CR29_S1
Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18


CR29_S1
Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

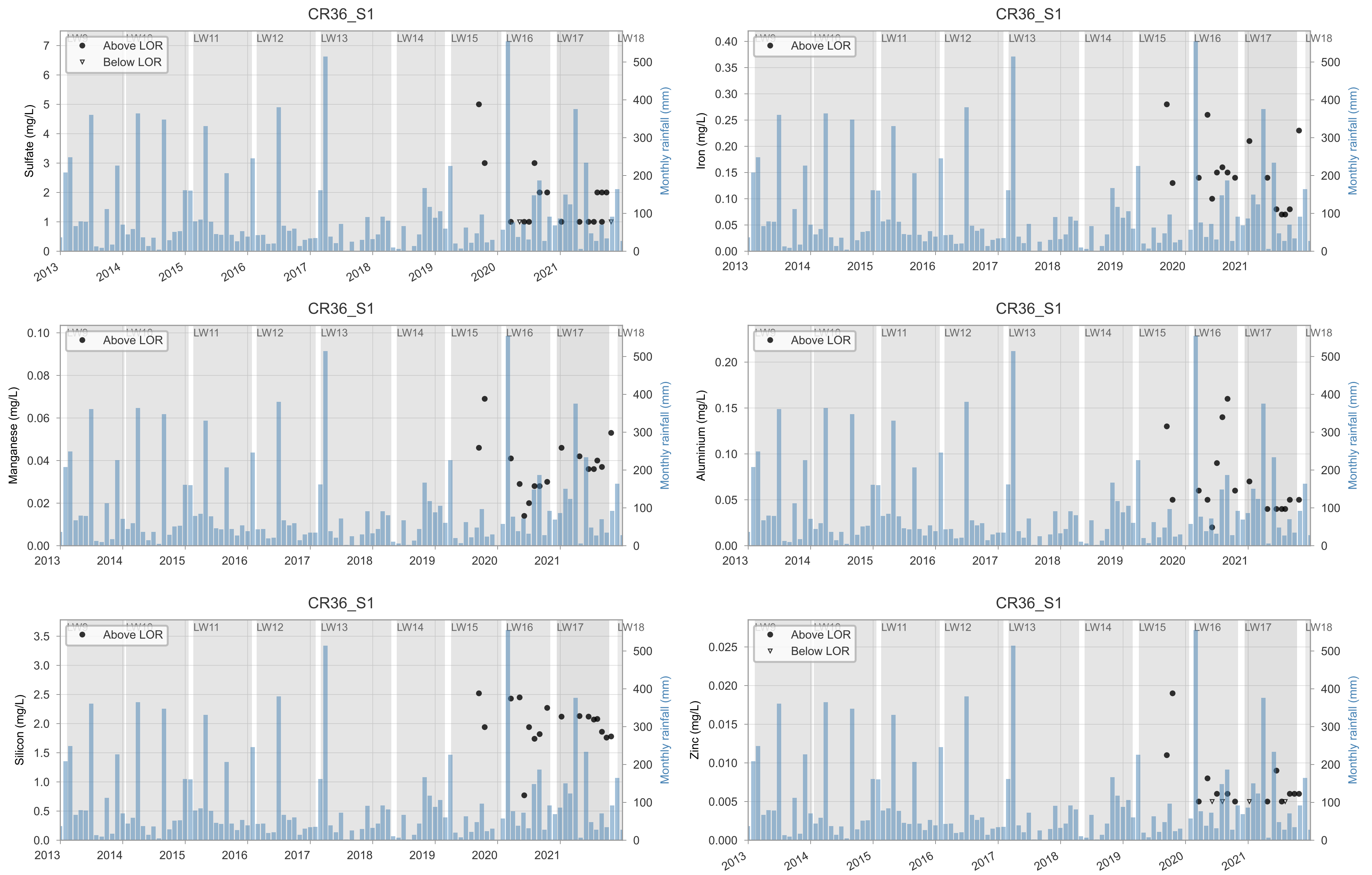

CR29_S1
Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18


CR29_S1
Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

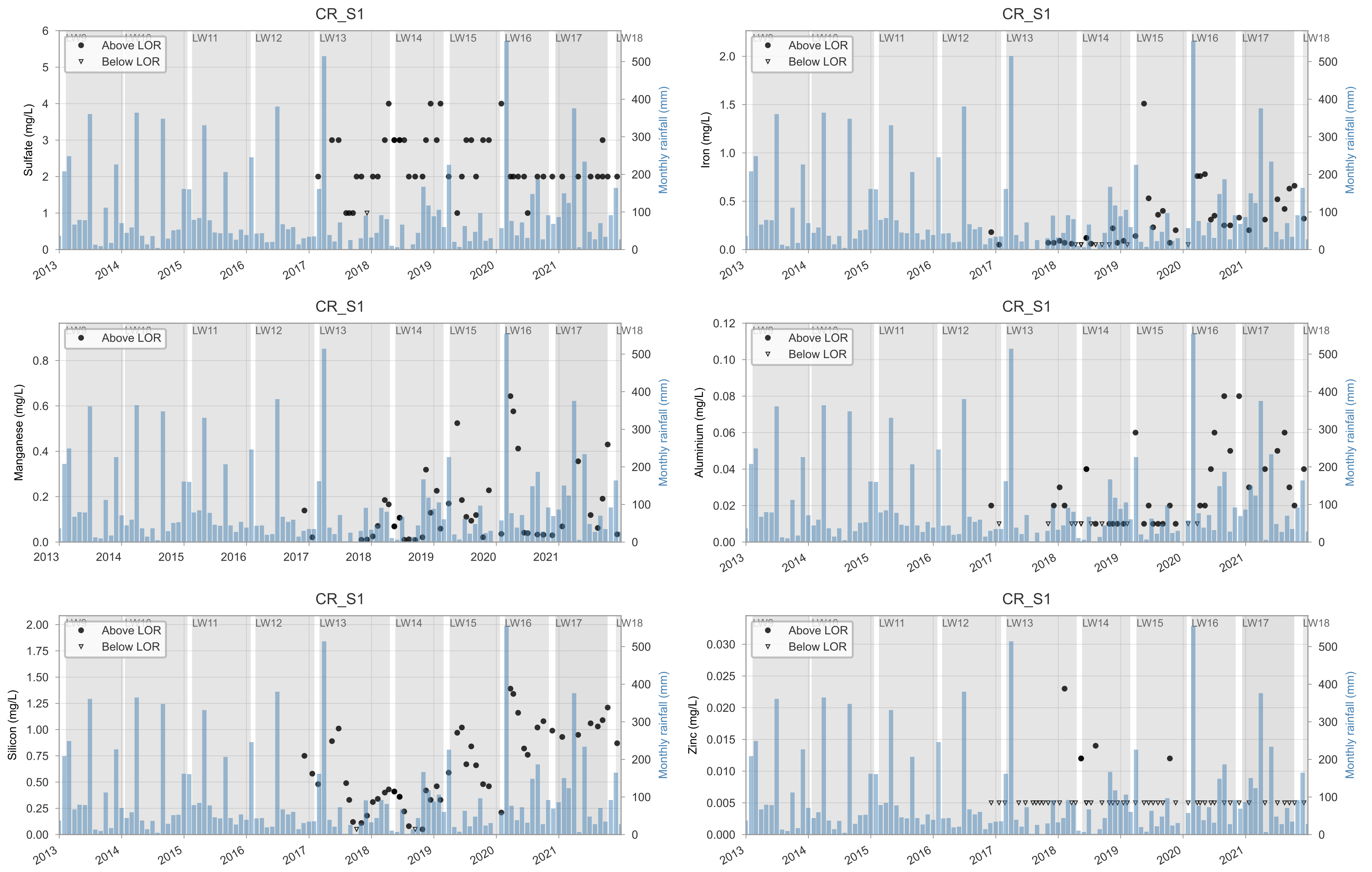

CR29_S1
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

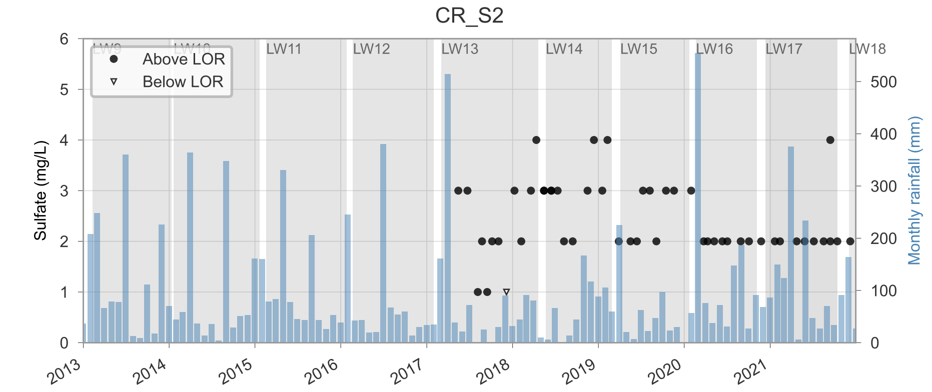


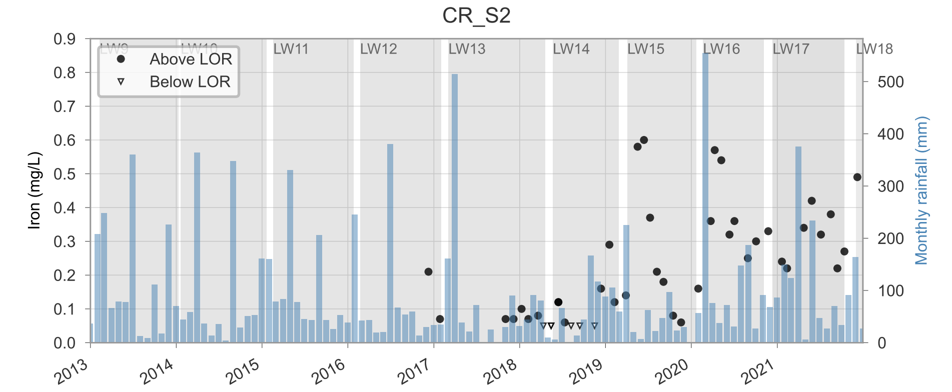
CR31_S1
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

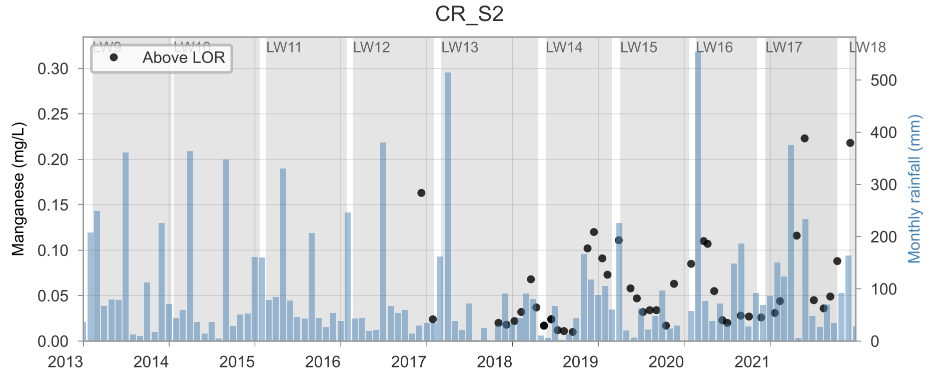


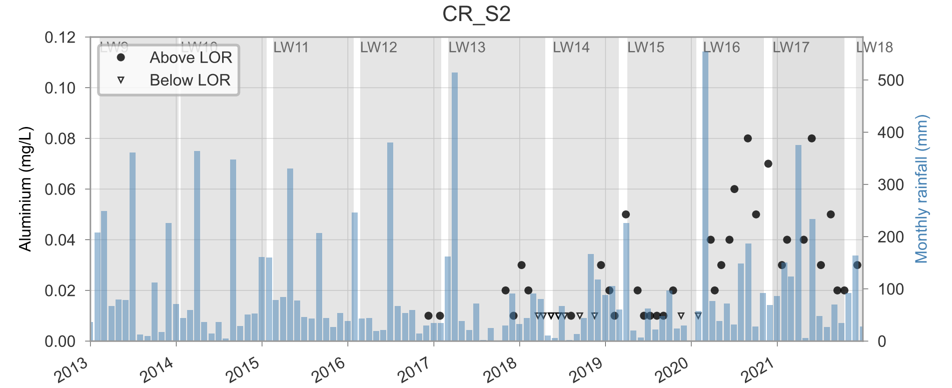
CR36_S1
Above LOR
Below LOR
Sulfate (mg/L)
Monthly rainfall (mm)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

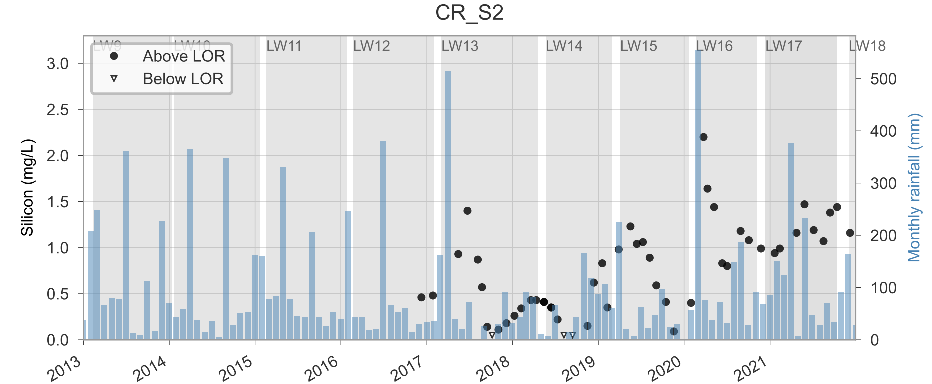

CR_S1
Above LOR
Below LOR
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

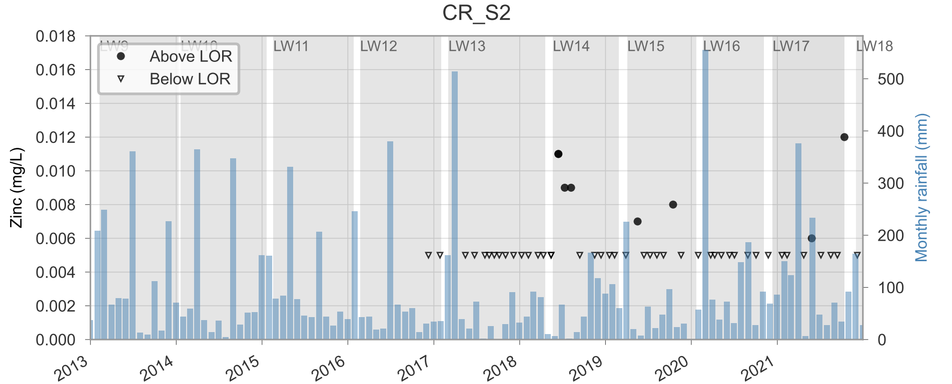

CR_S2
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Sulfate (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020
2021

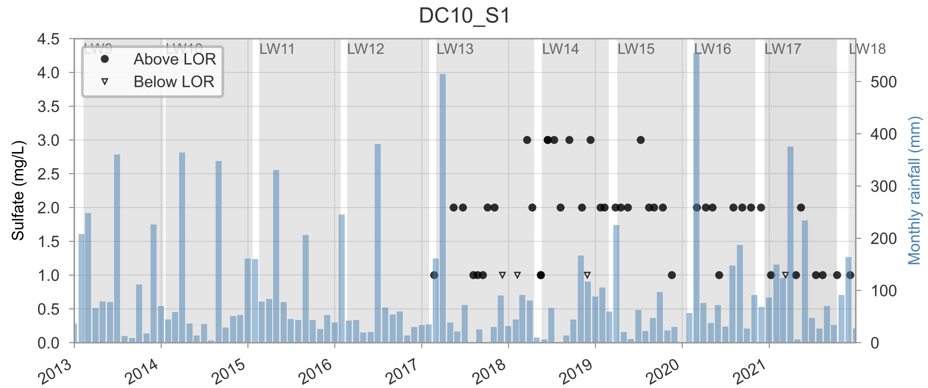

CR_S2
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Iron (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020
2021

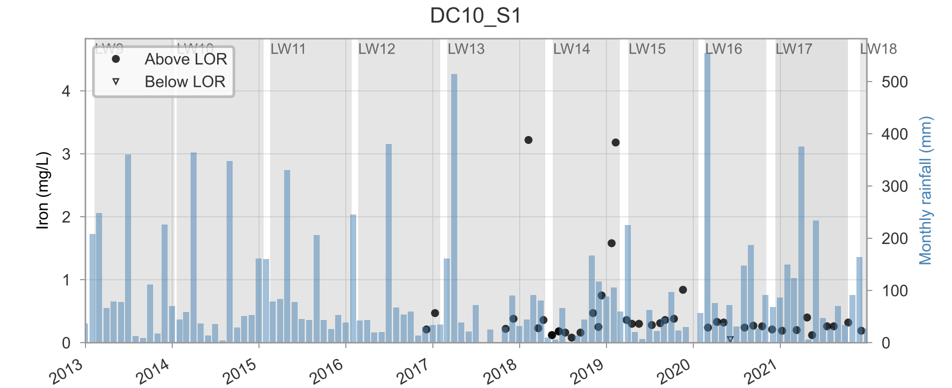

CR_S2
Above LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Manganese (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020
2021

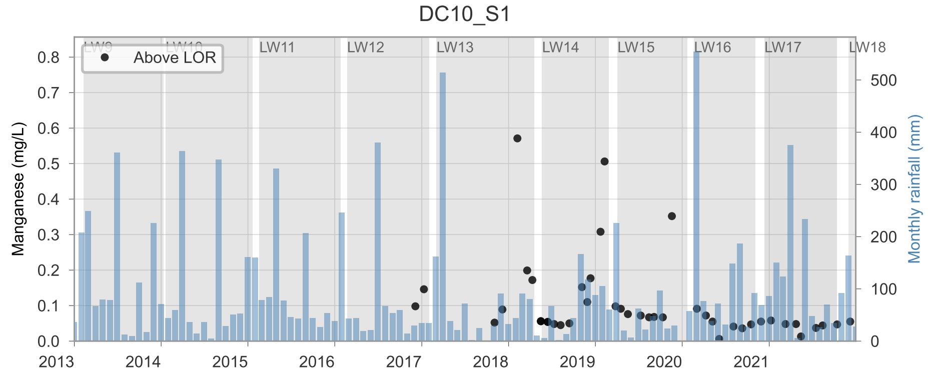

CR_S2
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Aluminium (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020
2021

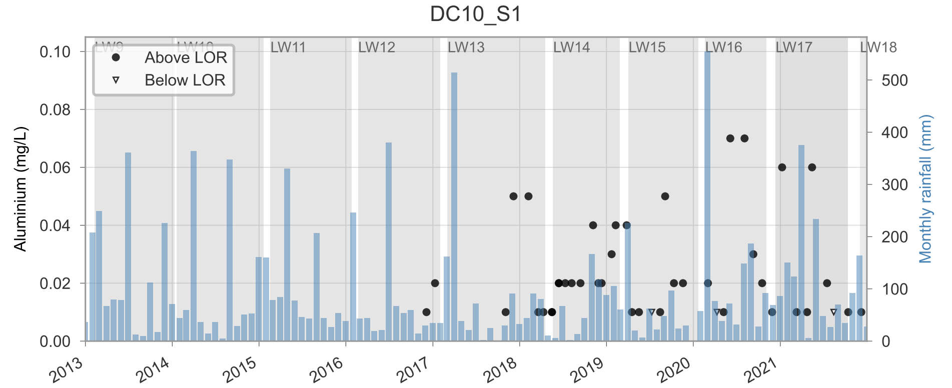

CR_S2
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Silicon (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020
2021

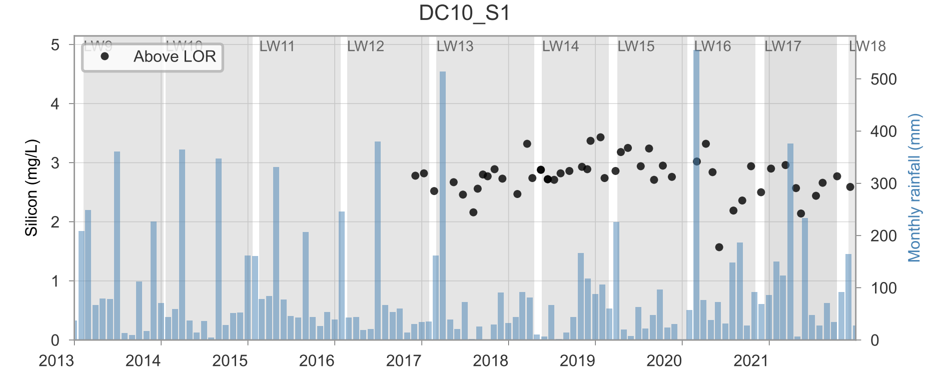

CR_S2
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Zinc (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020
2021

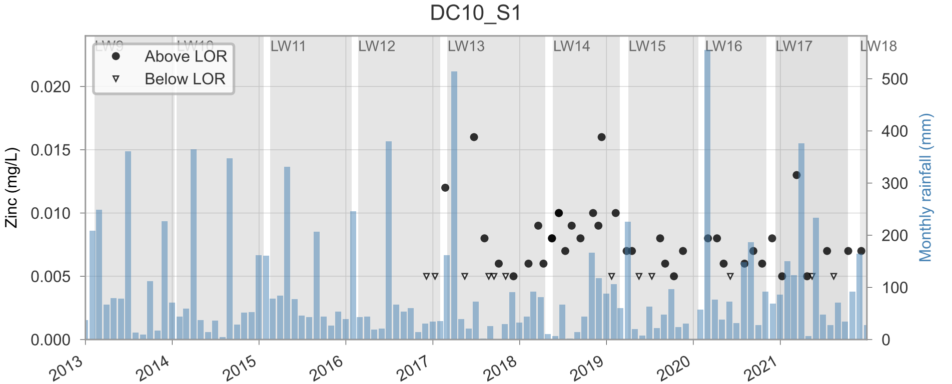

DC10_S1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Sulfate (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020
2021

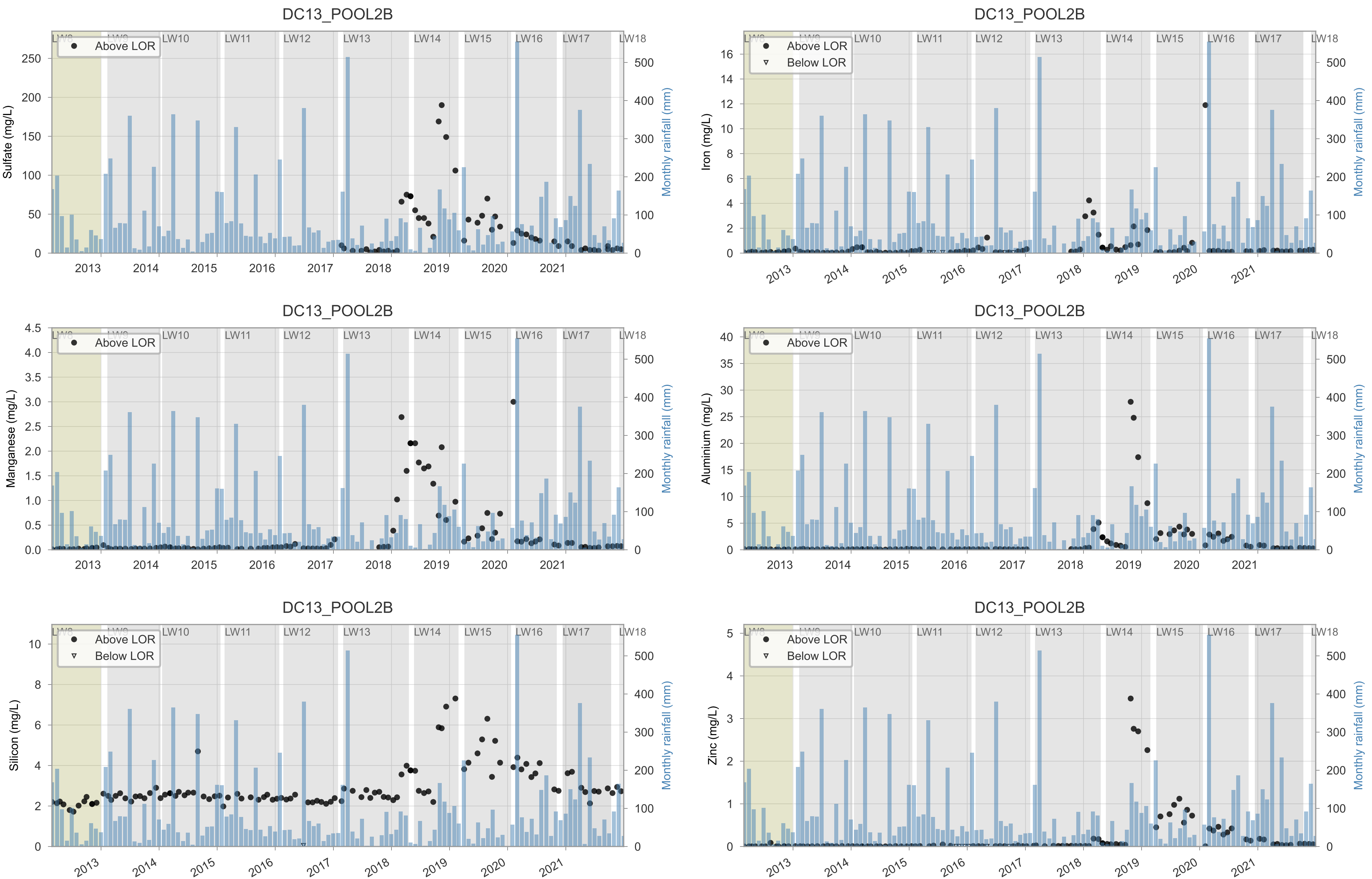

DC10_S1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Iron (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020
2021


DC10_S1
Above LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Manganese (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020
2021

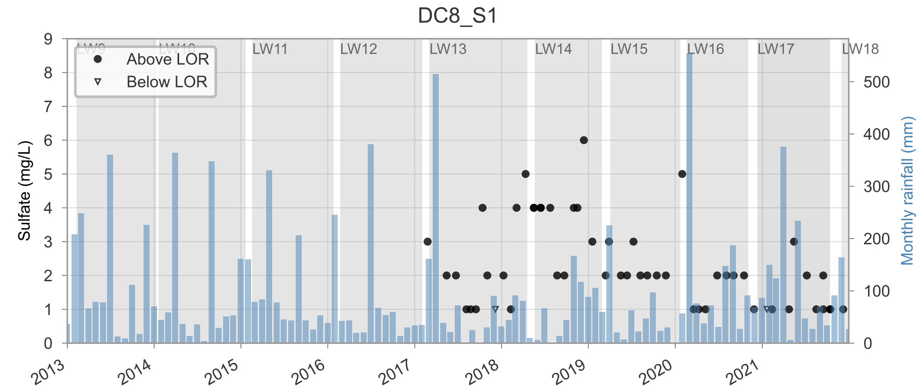

DC10_S1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Aluminium (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020
2021

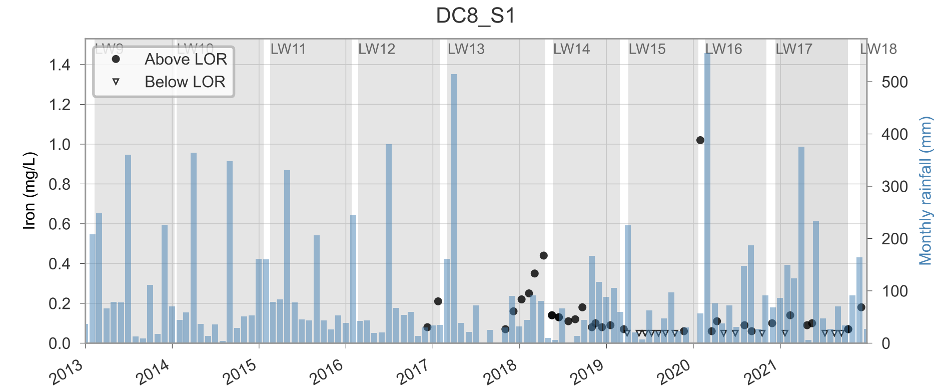

DC10_S1
Above LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Silicon (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020
2021

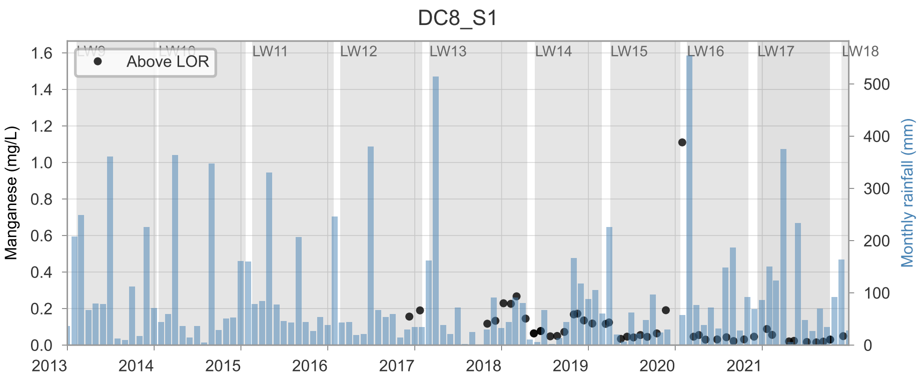

DC10_S1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Zinc (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020
2021

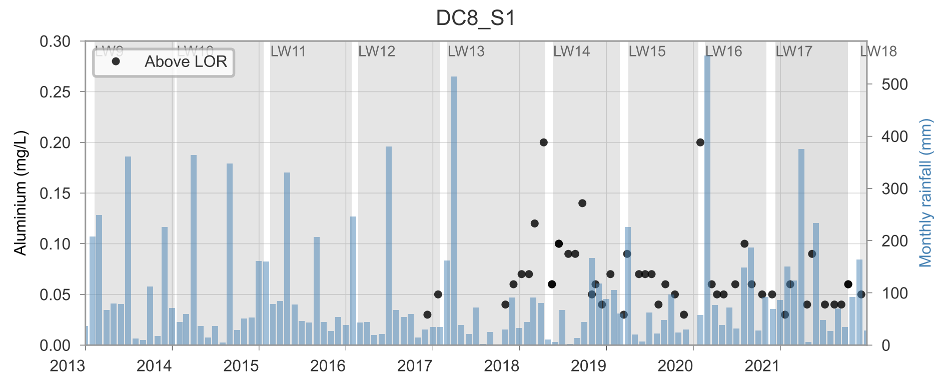


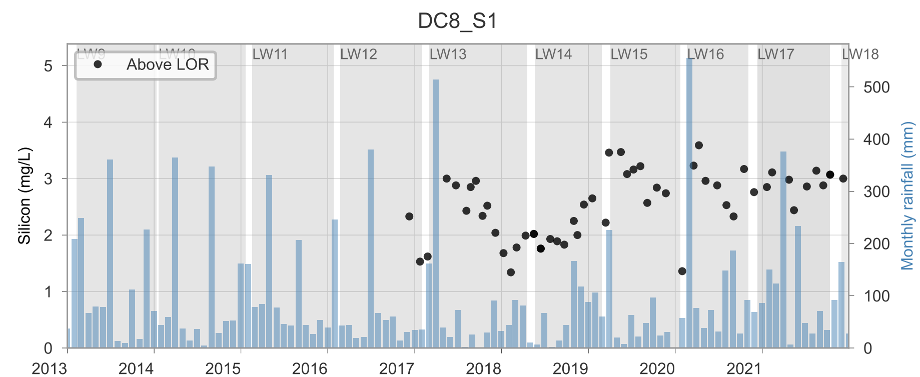
DC13_POOL2B
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021
DC13_POOL2B
Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
DC13_POOL2B
Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
DC13_POOL2B
Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
DC13_POOL2B
Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
DC13_POOL2B
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR

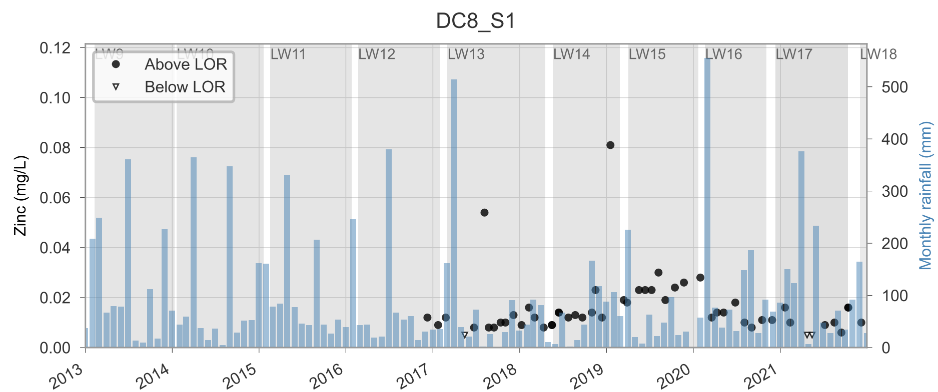

DC8_S1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Sulfate (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020
2021

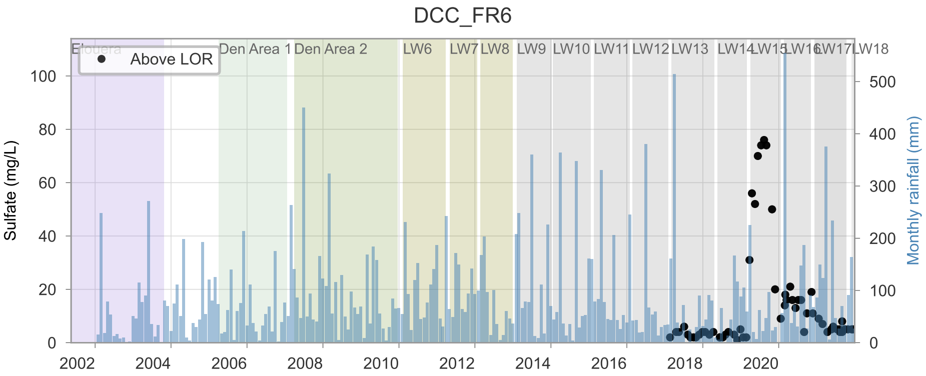

DC8_S1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Iron (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020
2021

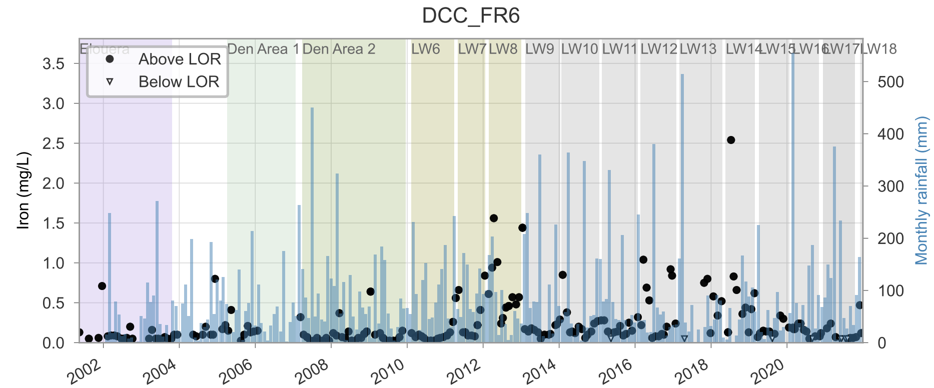

DC8_S1
Above LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Manganese (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020
2021

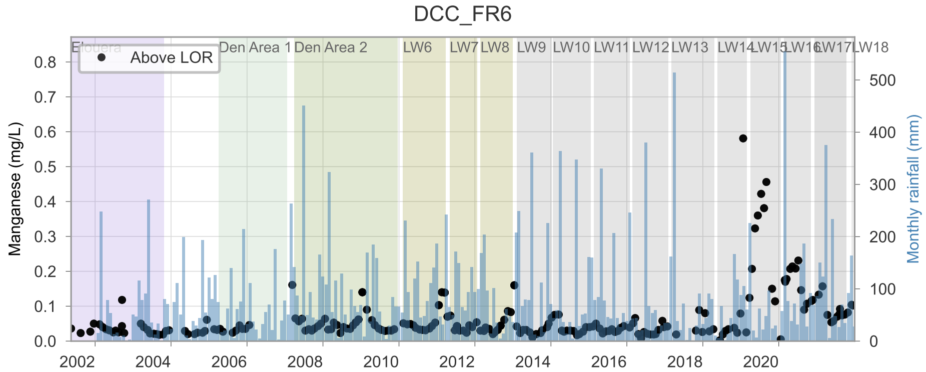

DC8_S1
Above LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Aluminium (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020
2021

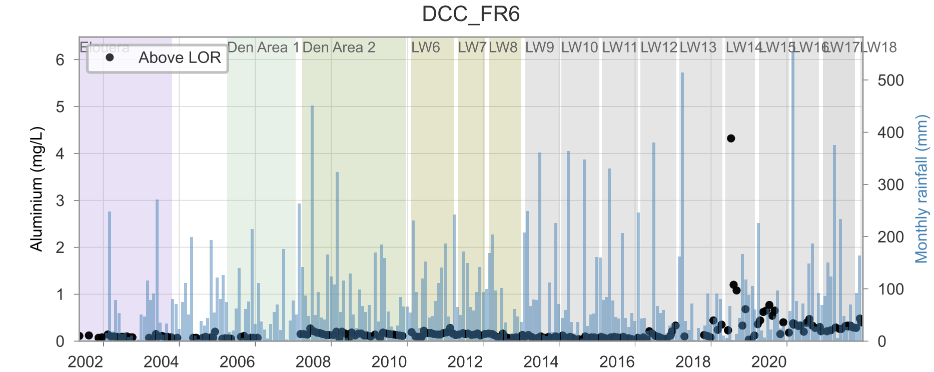

DC8_S1
Above LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Silicon (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020
2021

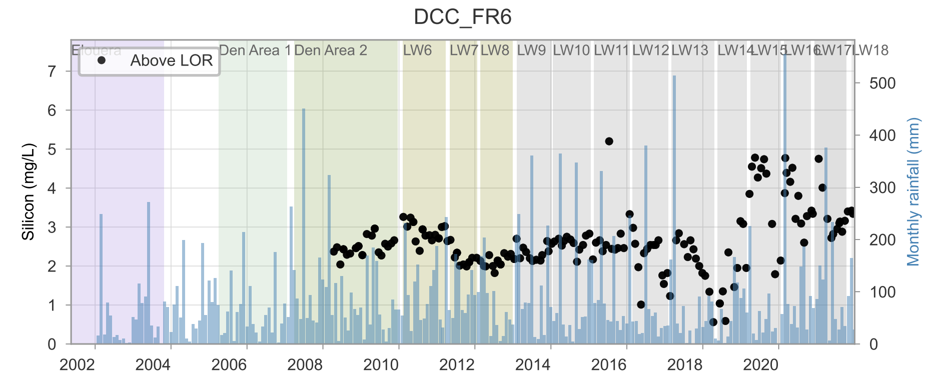

DC8_S1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Zinc (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020
2021

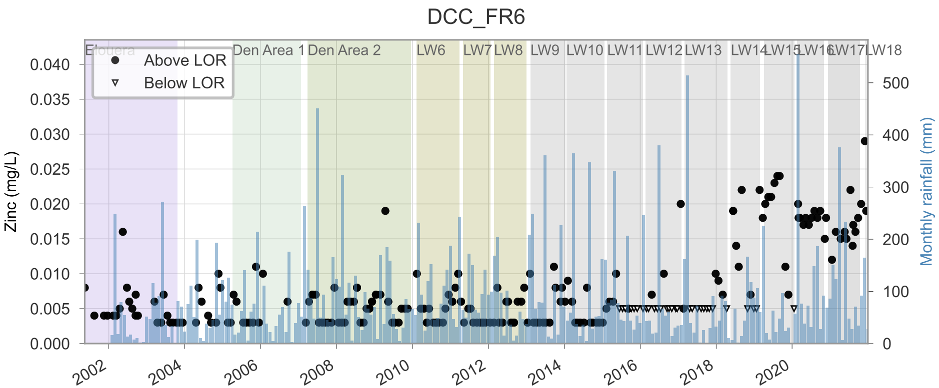

DCC_FR6
Above LOR
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Sulfate (mg/L)
Monthly rainfall (mm)
0
20
40
60
80
100
0
100
200
300
400
500
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020

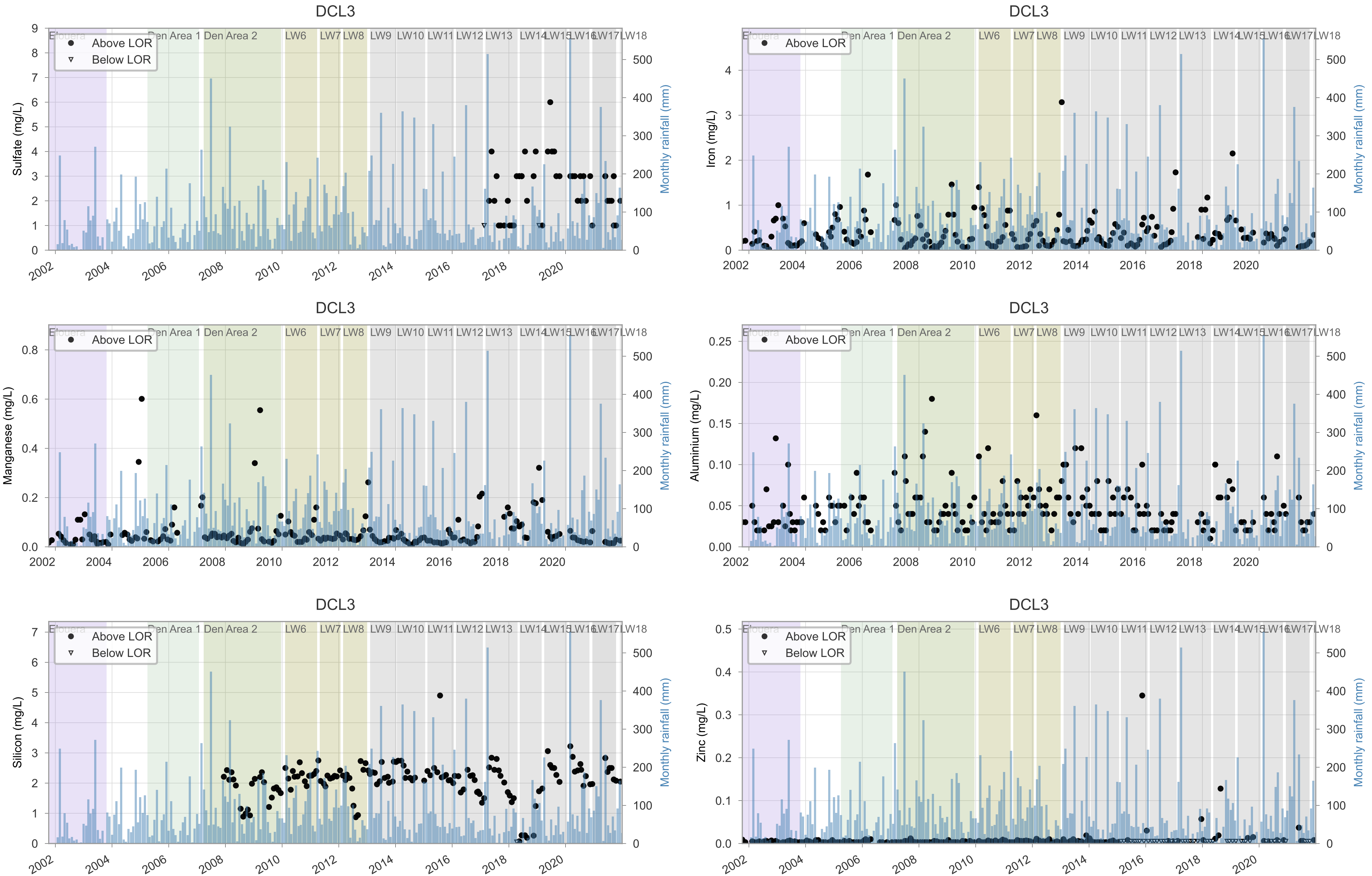

DCC_FR6
Above LOR
Below LOR
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Iron (mg/L)
Monthly rainfall (mm)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
0
100
200
300
400
500
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020

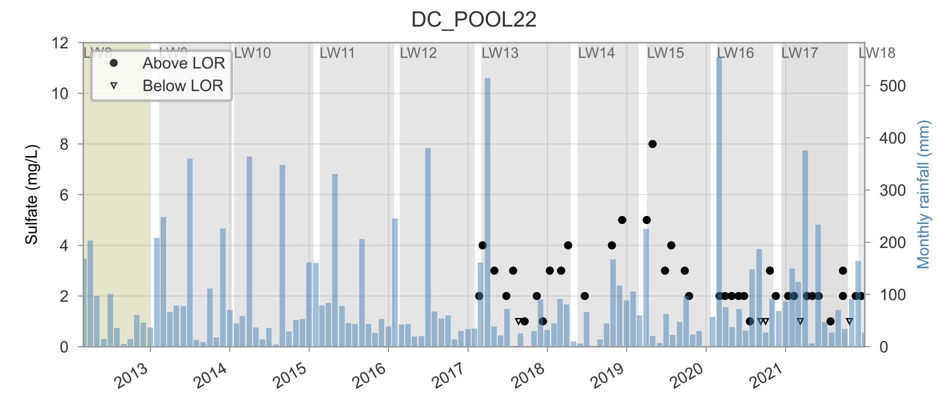

DCC_FR6
Above LOR
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Manganese (mg/L)
Monthly rainfall (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0
100
200
300
400
500
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020

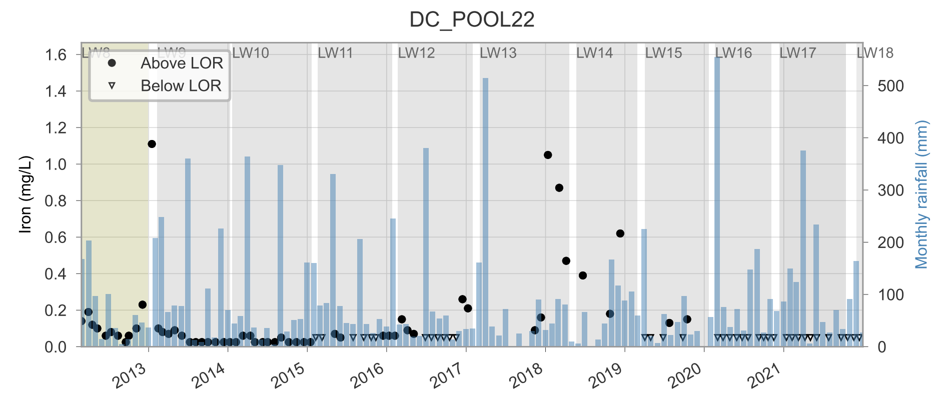

DCC_FR6
Above LOR
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Aluminium (mg/L)
Monthly rainfall (mm)
0
1
2
3
4
5
6
0
100
200
300
400
500
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020

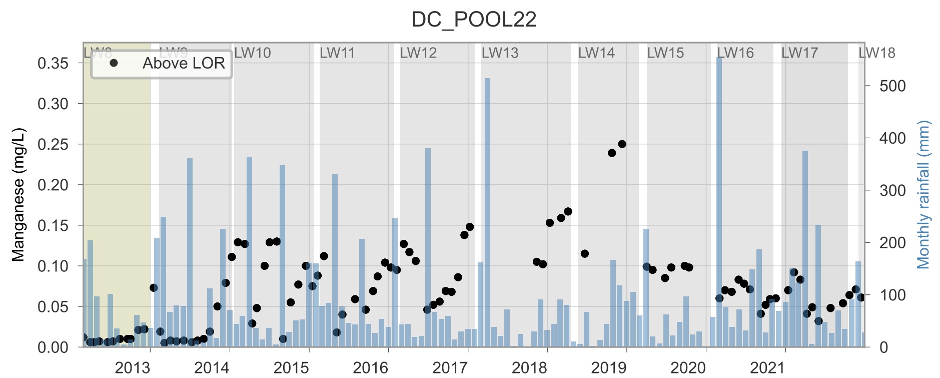

DCC_FR6
Above LOR
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Silicon (mg/L)
Monthly rainfall (mm)
0
1
2
3
4
5
6
7
0
100
200
300
400
500
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020

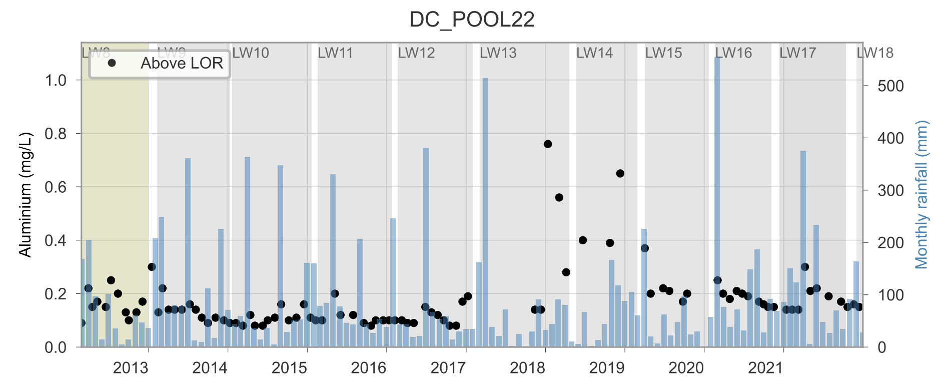

DCC_FR6
Above LOR
Below LOR
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Zinc (mg/L)
Monthly rainfall (mm)
0.000
0.005
0.010
0.015
0.020
0.025
0.030
0.035
0.040
0
100
200
300
400
500
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020

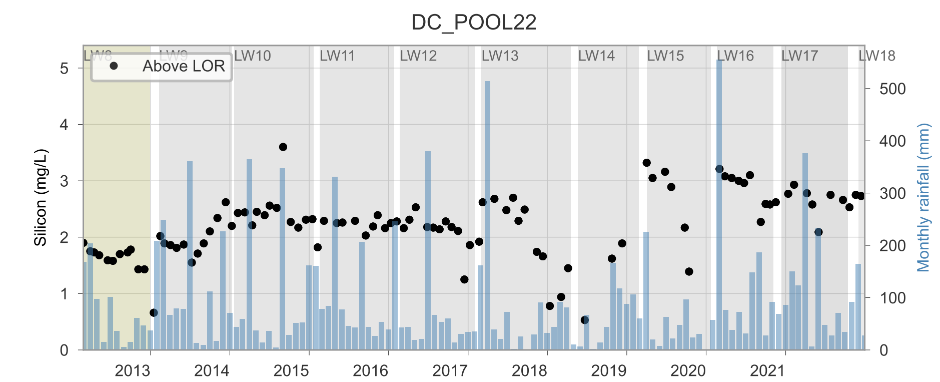

DCL3
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
DCL3
Iron (mg/L)
Monthly rainfall (mm)
Above LOR
DCL3
Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
DCL3
Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
DCL3
Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
DCL3
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

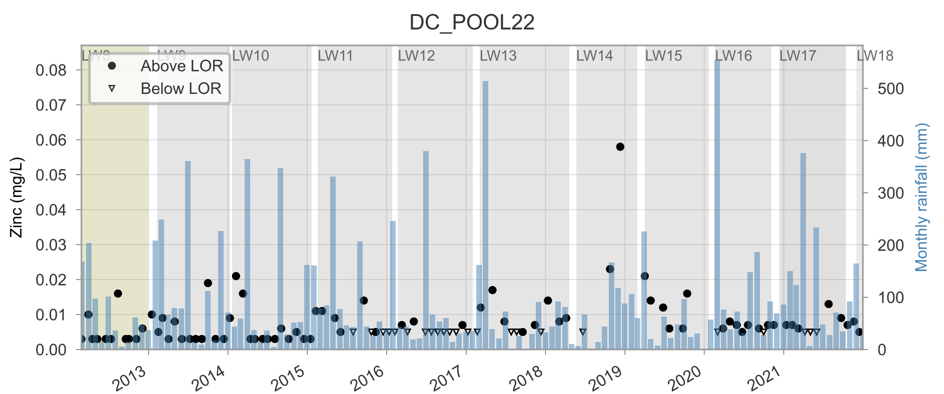

DC_POOL22
Above LOR
Below LOR
LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
Sulfate (mg/L)
Monthly rainfall (mm)
2013 2014 2015 2016 2017 2018 2019 2020 2021

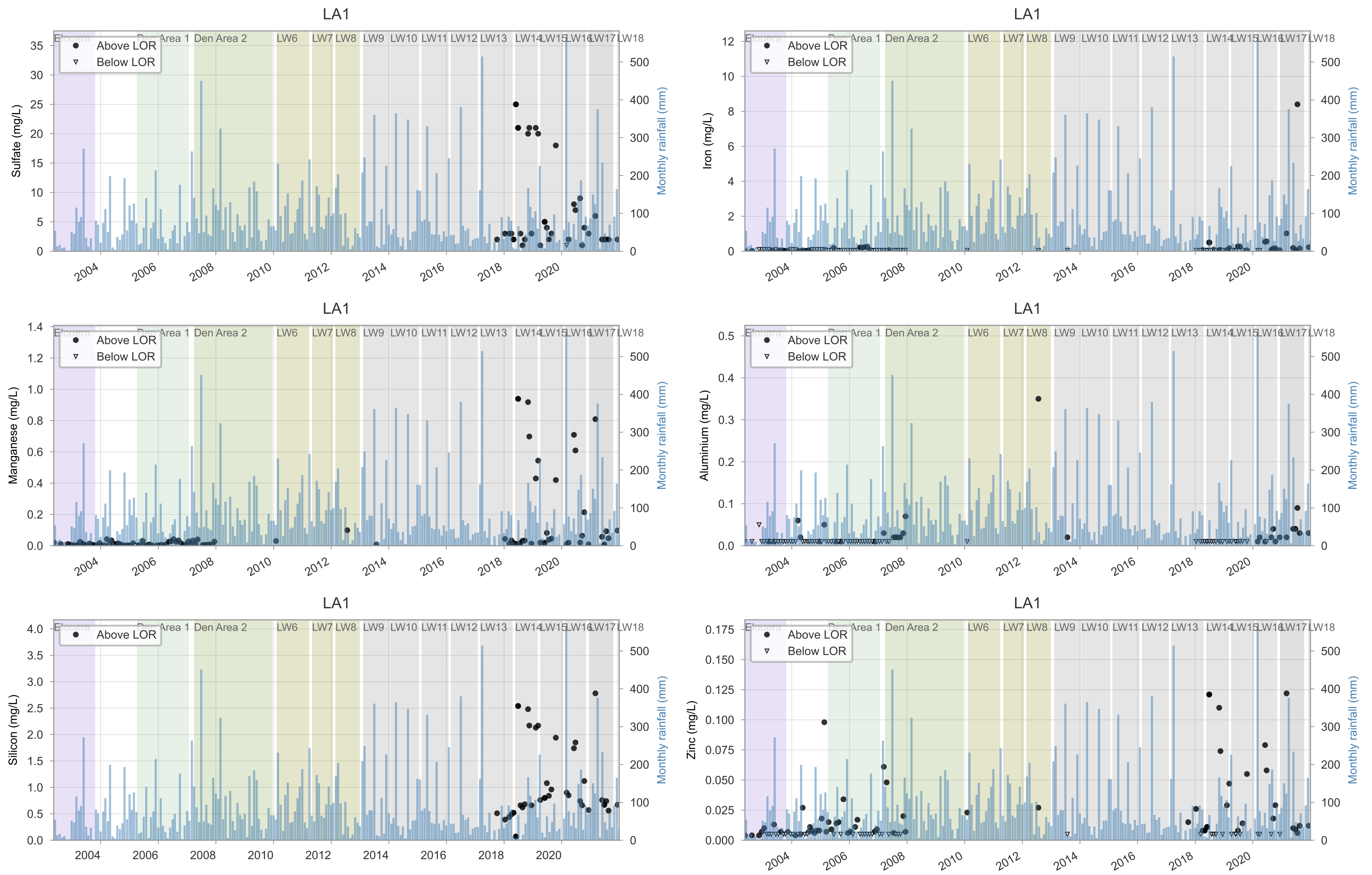

DC_POOL22
Above LOR
Below LOR
LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
Iron (mg/L)
Monthly rainfall (mm)
2013 2014 2015 2016 2017 2018 2019 2020 2021

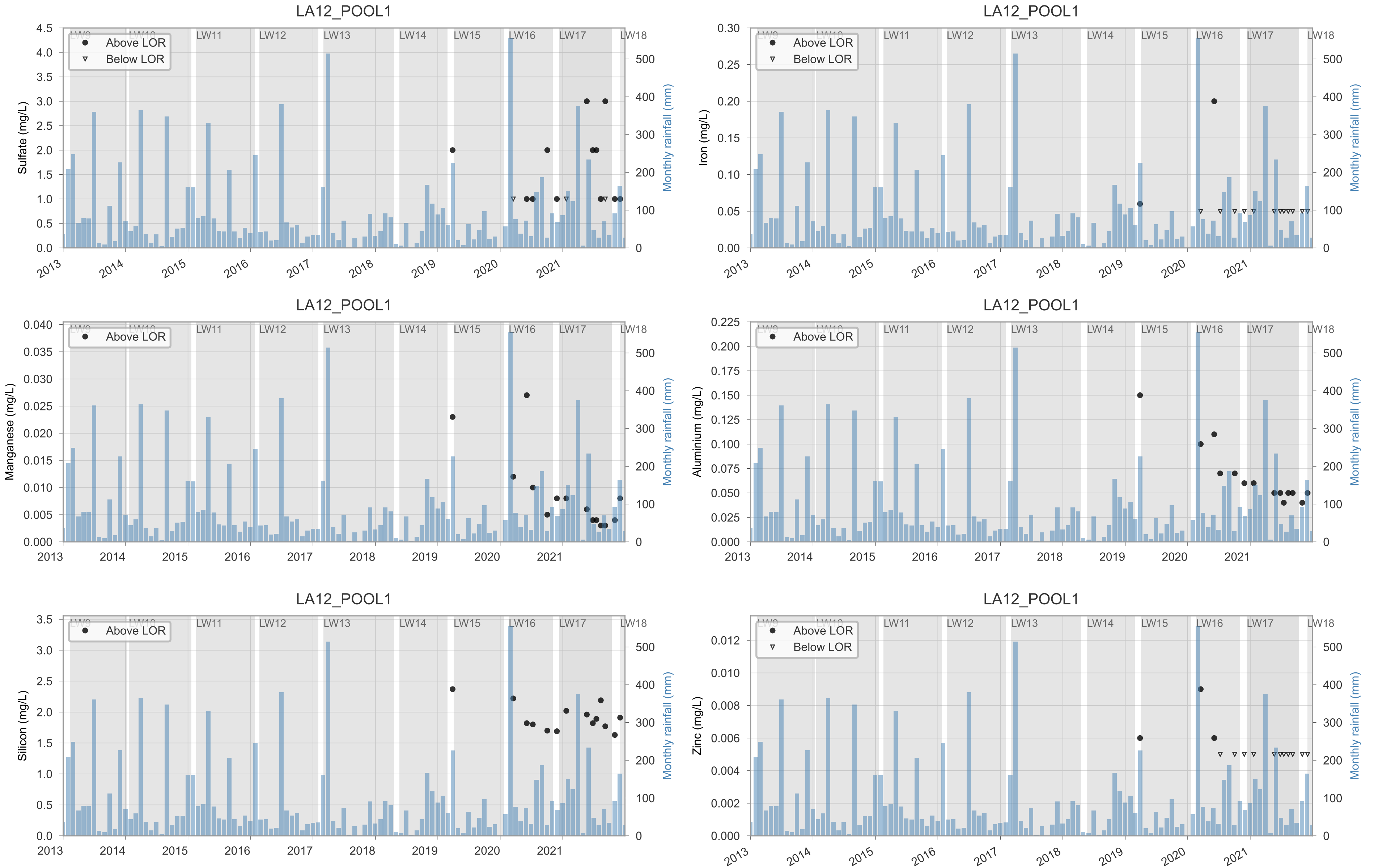

DC_POOL22
Above LOR
LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
Manganese (mg/L)
Monthly rainfall (mm)
2013 2014 2015 2016 2017 2018 2019 2020 2021


DC_POOL22
Above LOR
LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
Aluminium (mg/L)
Monthly rainfall (mm)
2013 2014 2015 2016 2017 2018 2019 2020 2021

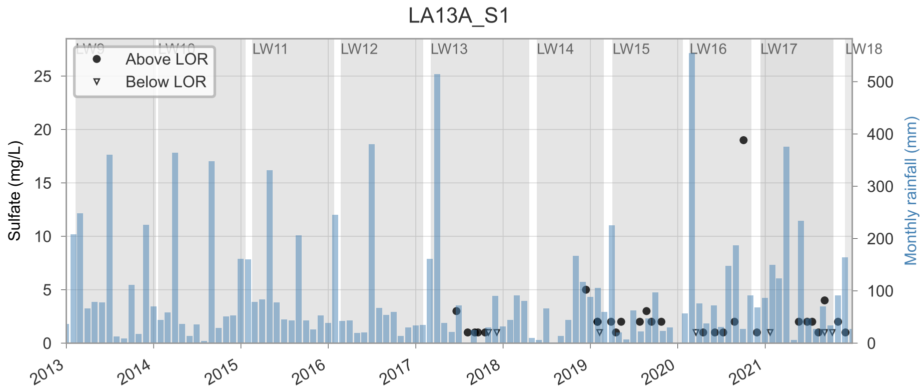

DC_POOL22
Above LOR
LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
Silicon (mg/L)
Monthly rainfall (mm)
2013 2014 2015 2016 2017 2018 2019 2020 2021

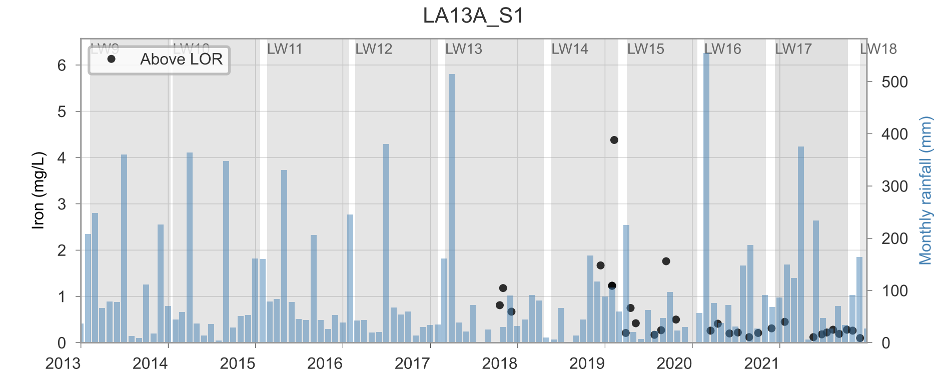

DC_POOL22
Above LOR
Below LOR
LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
Zinc (mg/L)
Monthly rainfall (mm)
2013 2014 2015 2016 2017 2018 2019 2020 2021

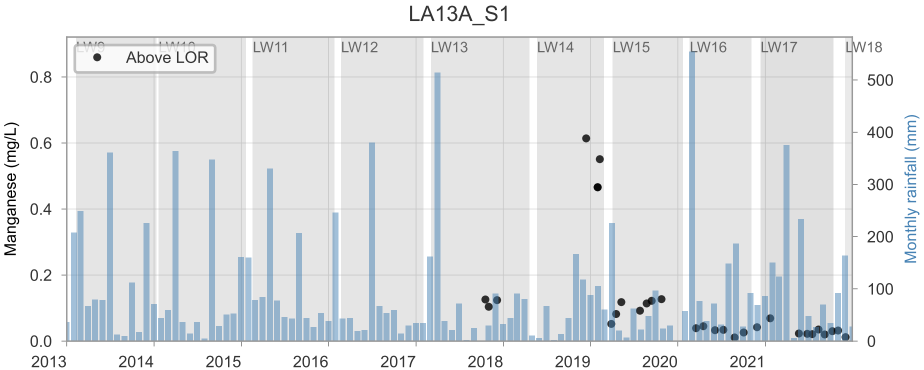

LA1
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2004
2006
2008
2010
2012
2014
2016
2018
2020

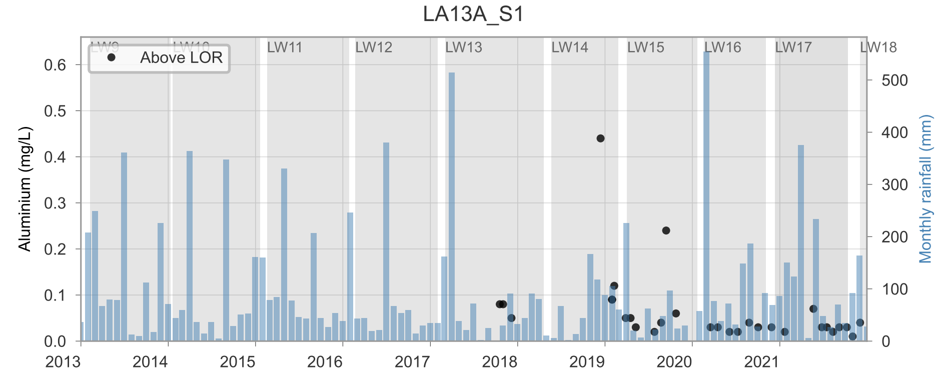


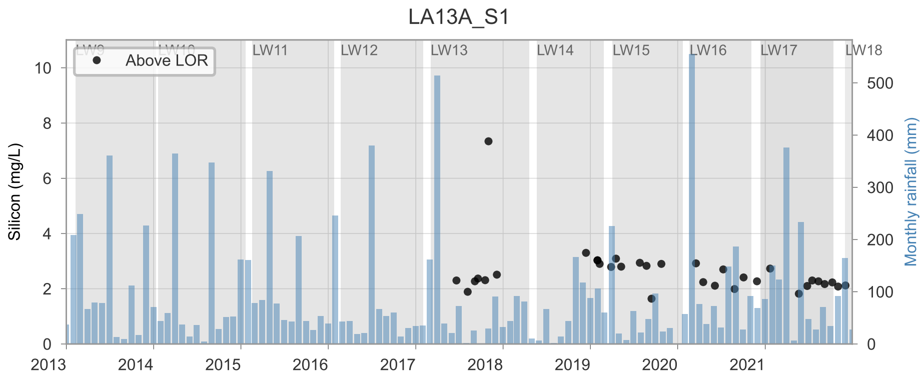
LA12_POOL1
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
LA12_POOL1
Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LA12_POOL1
Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
LA12_POOL1
Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
LA12_POOL1
Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
LA12_POOL1
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR

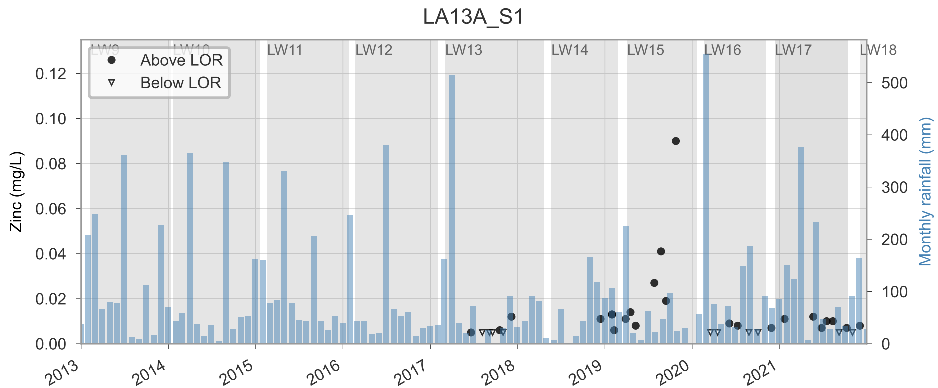

LA13A_S1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Sulfate (mg/L)
Monthly rainfall (mm)

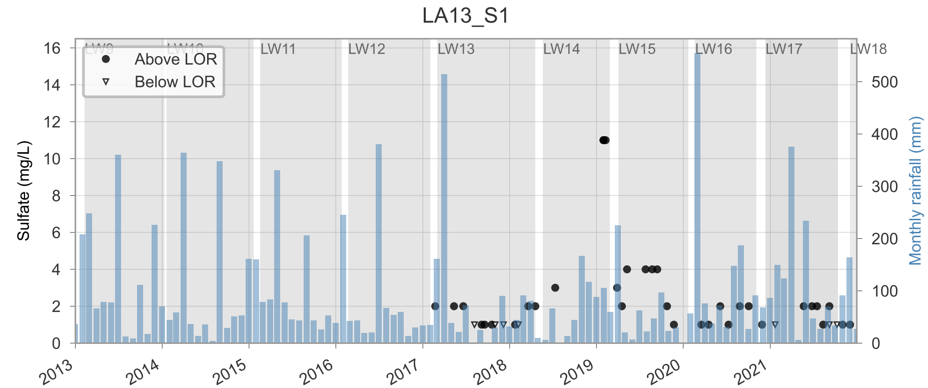

LA13A_S1
Above LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Iron (mg/L)
Monthly rainfall (mm)

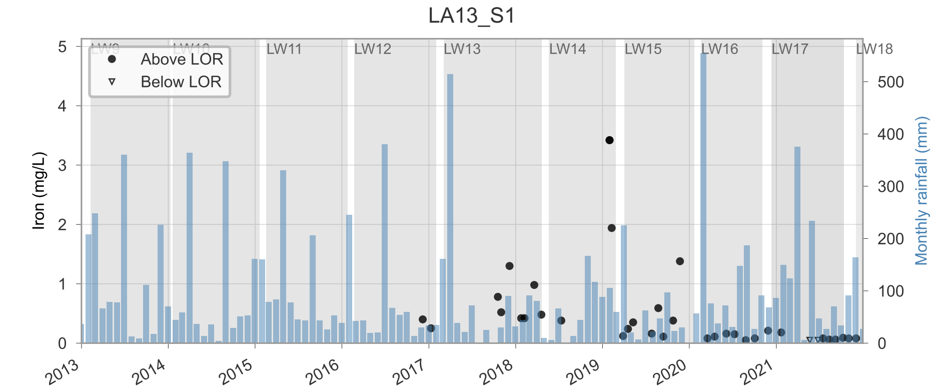

LA13A_S1
Above LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Manganese (mg/L)
Monthly rainfall (mm)

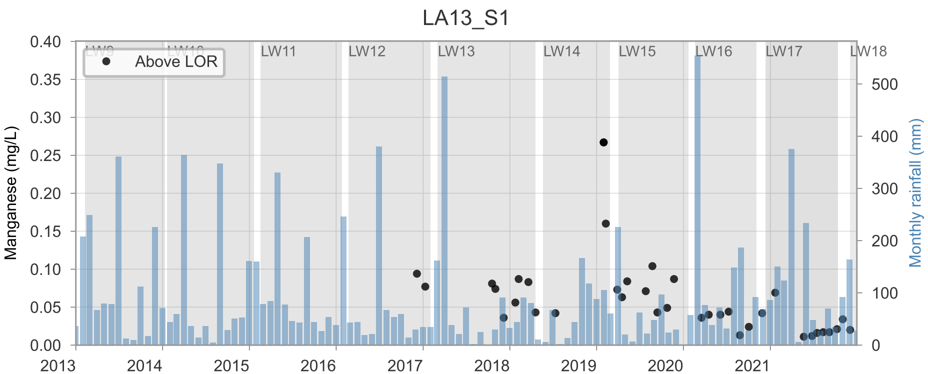

LA13A_S1
Above LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Aluminium (mg/L)
Monthly rainfall (mm)

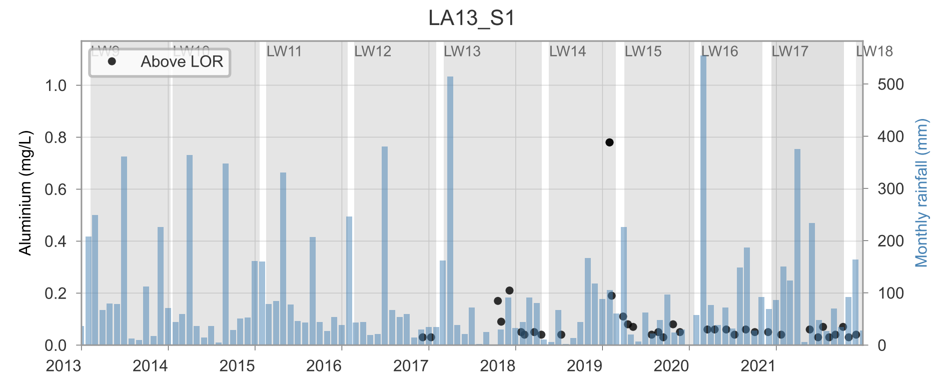

LA13A_S1
Above LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Silicon (mg/L)
Monthly rainfall (mm)

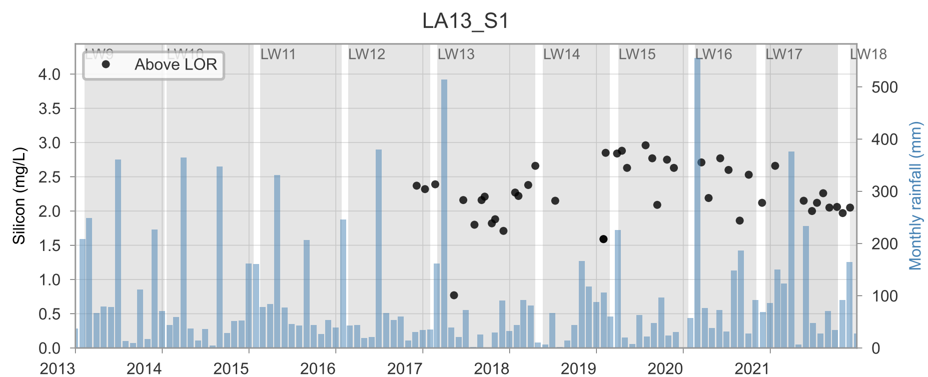

LA13A_S1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Zinc (mg/L)
Monthly rainfall (mm)

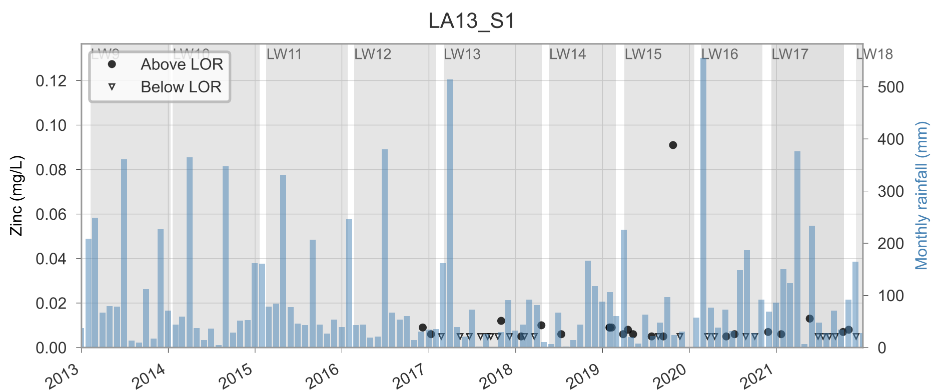

LA13_S1
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

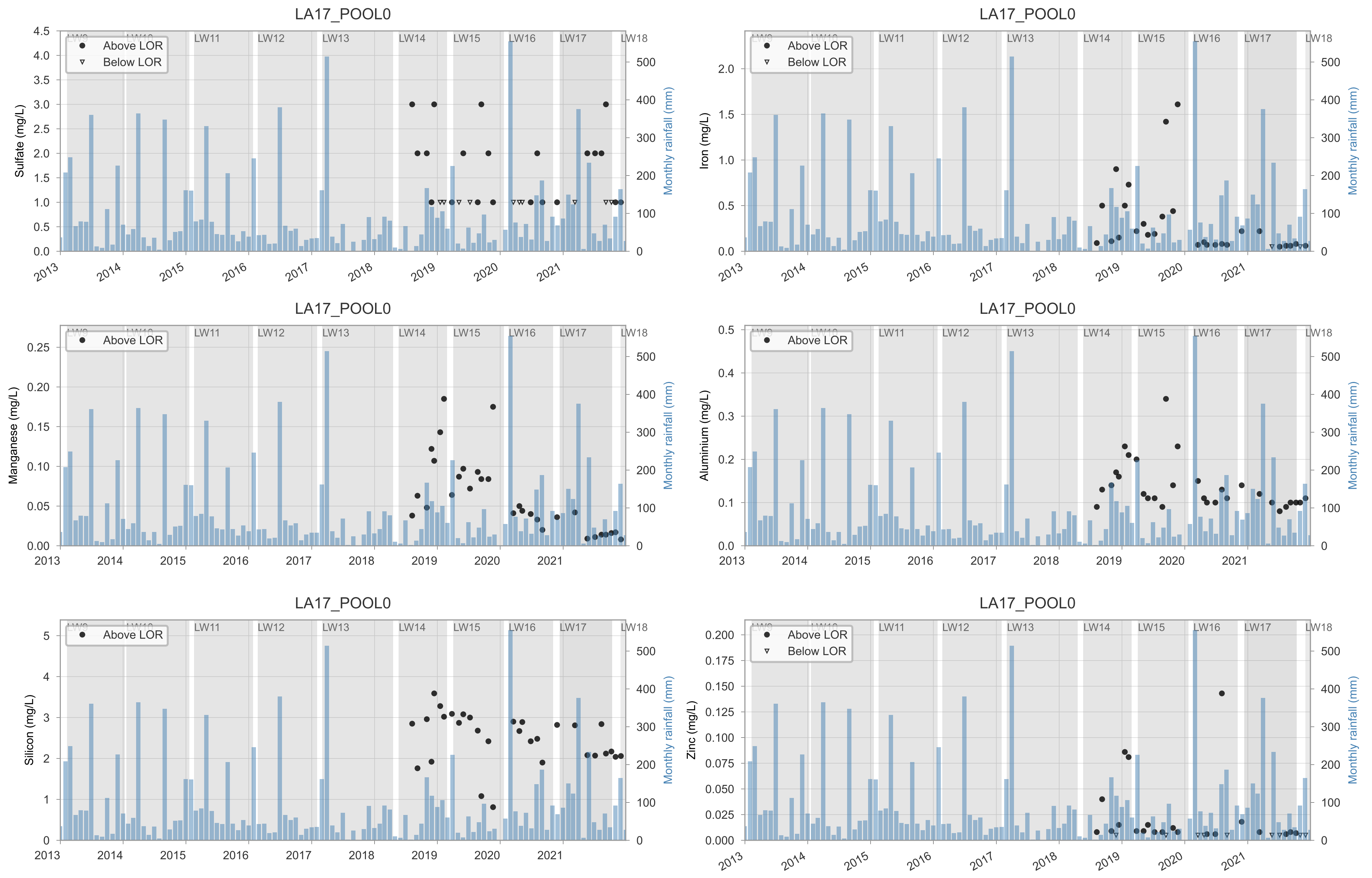

LA13_S1
Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

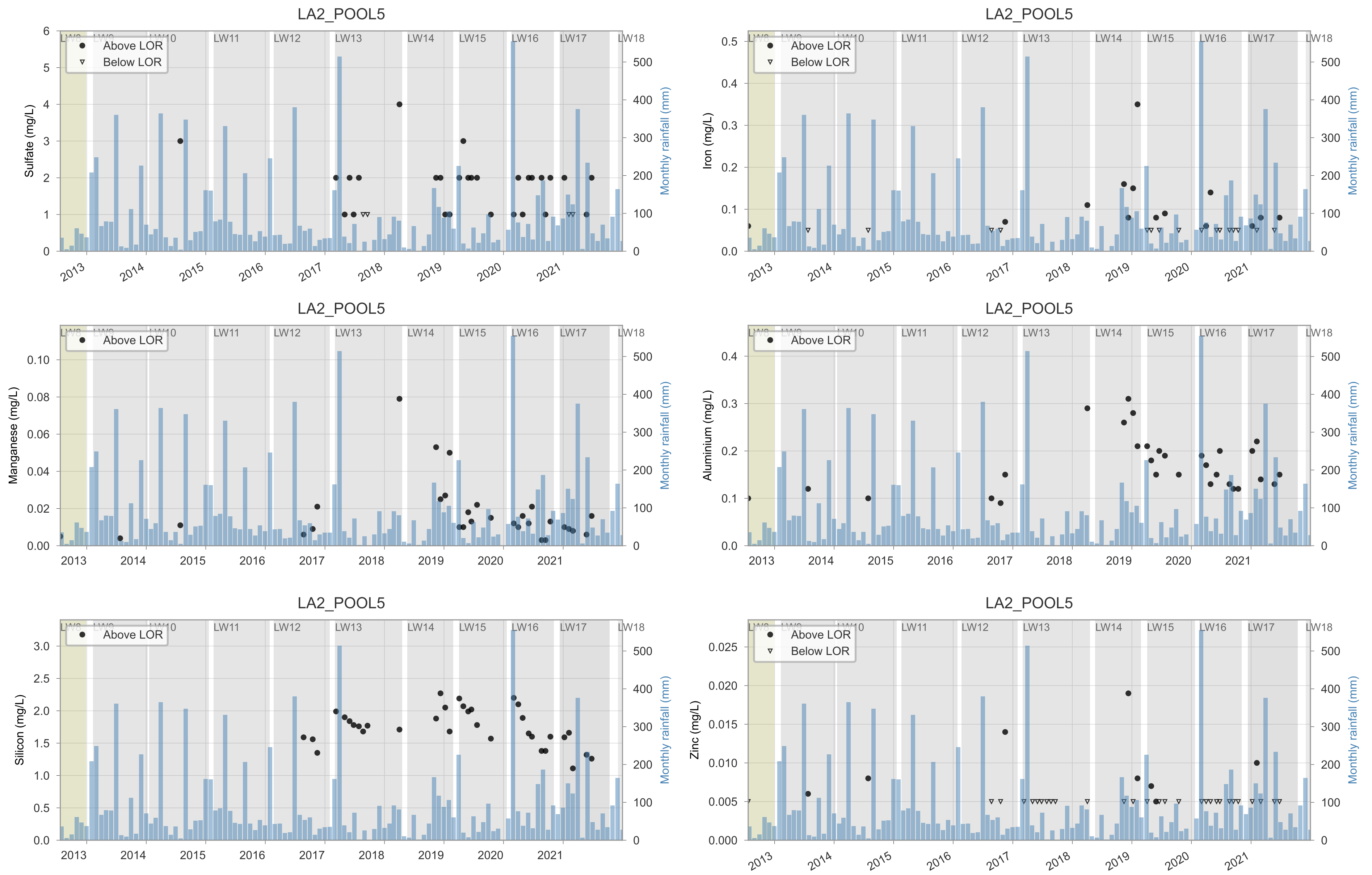

LA13_S1
Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021


LA13_S1
Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

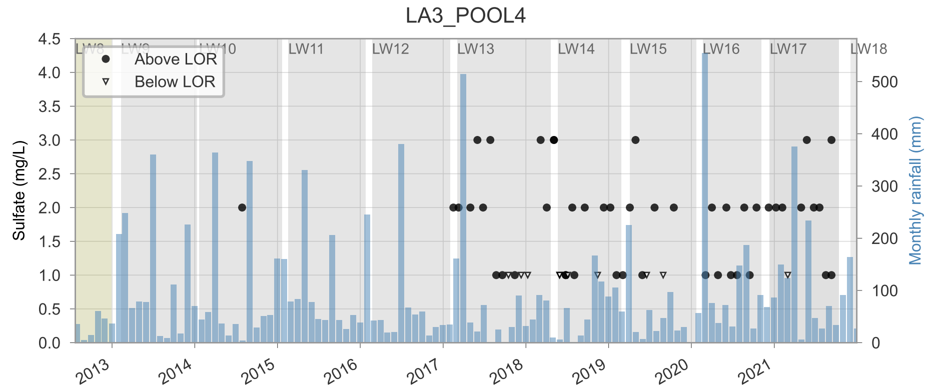

LA13_S1
Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

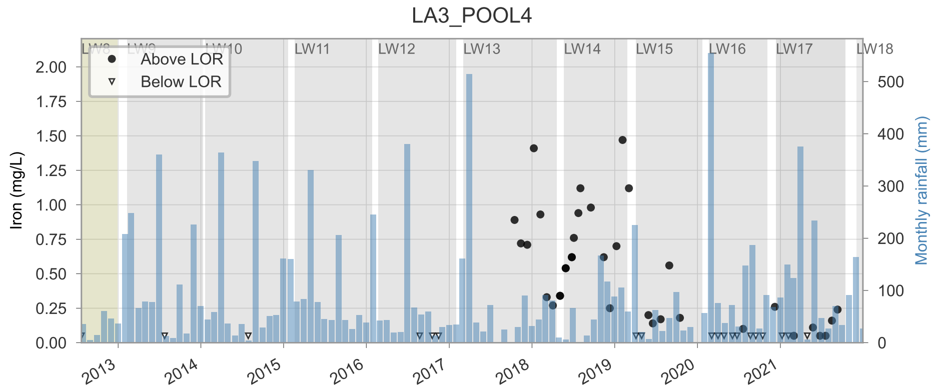

LA13_S1
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

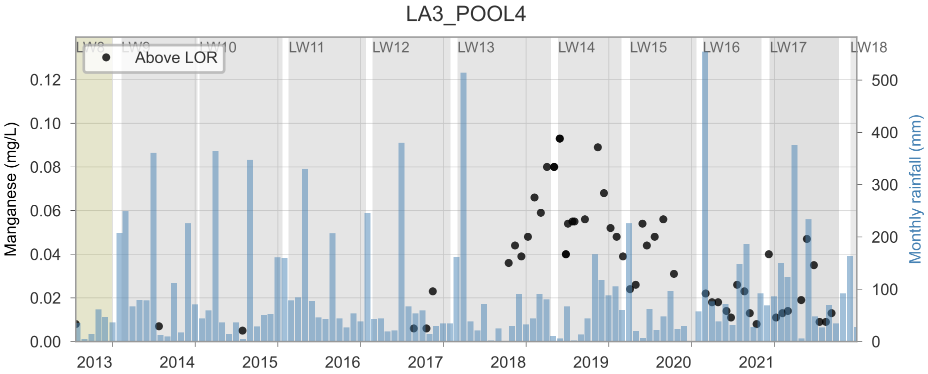

LA17_POOL0
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

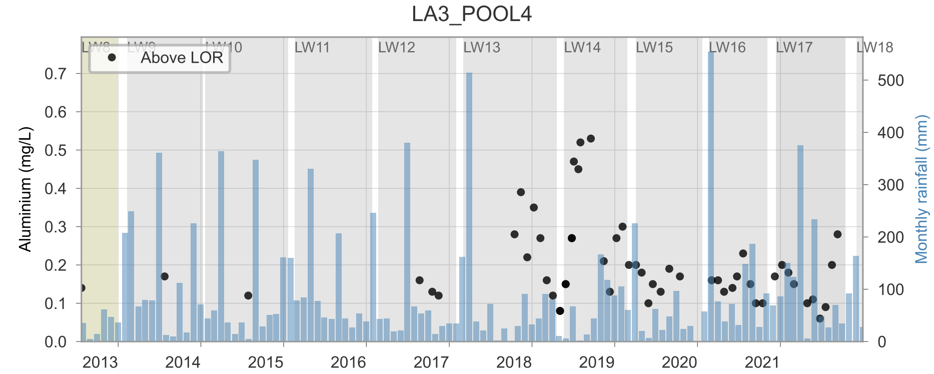


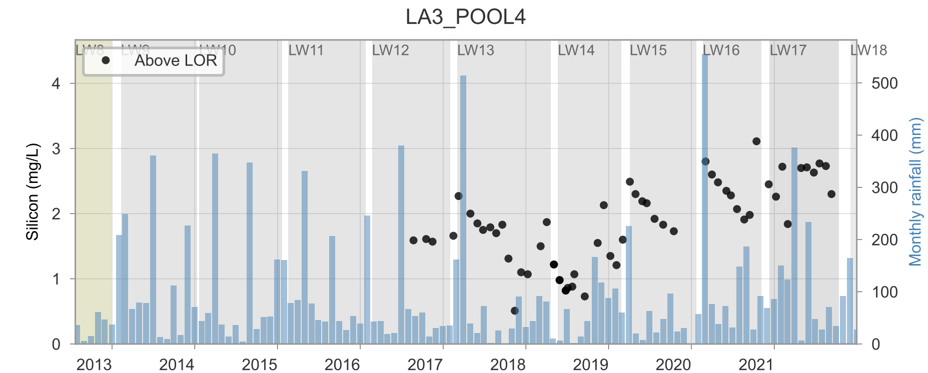
LA2_POOL5
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

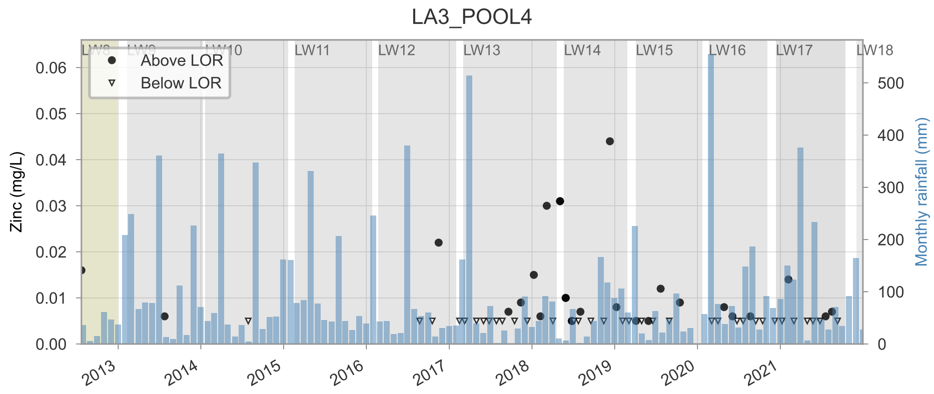

LA3_POOL4
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

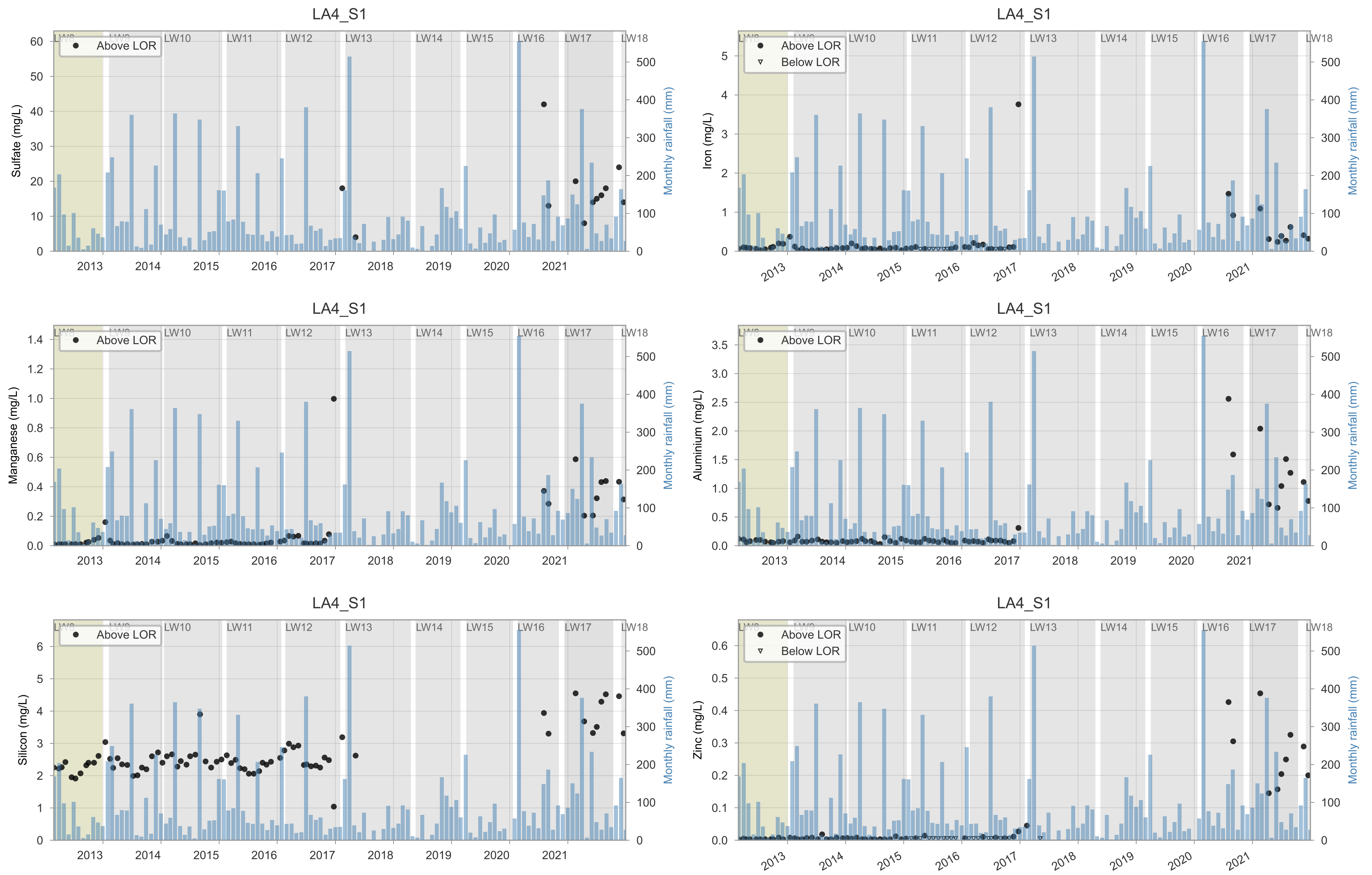

LA3_POOL4
Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

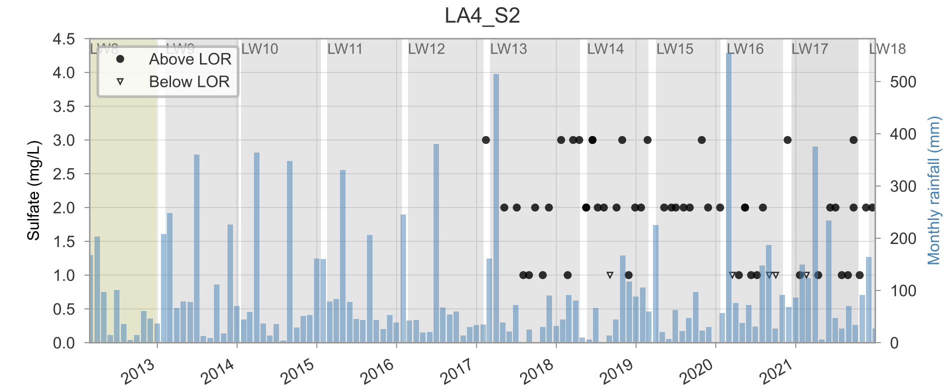

LA3_POOL4
Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

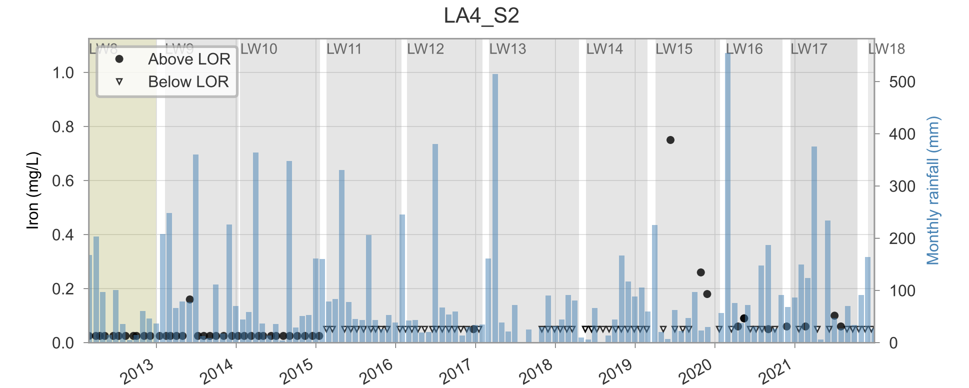

LA3_POOL4
Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

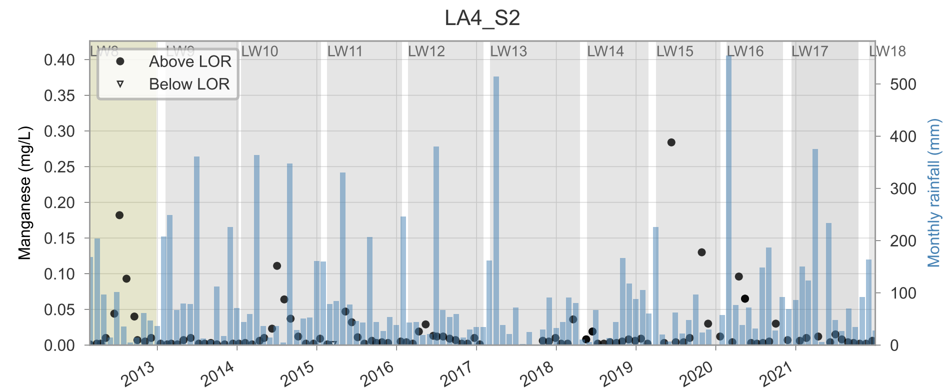

LA3_POOL4
Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

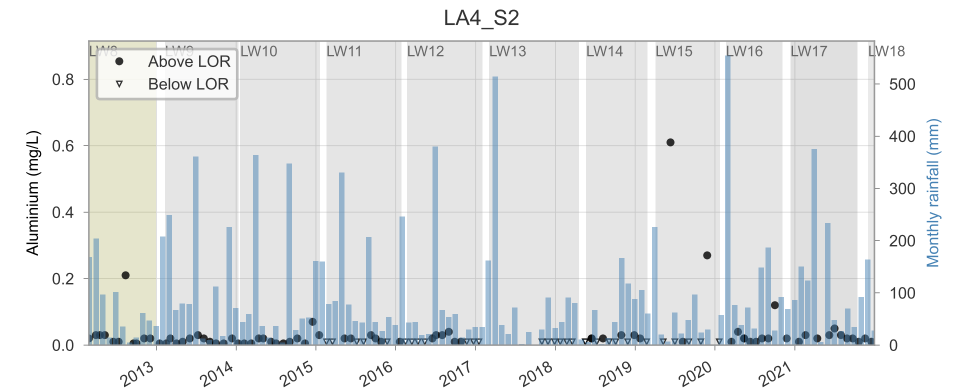

LA3_POOL4
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

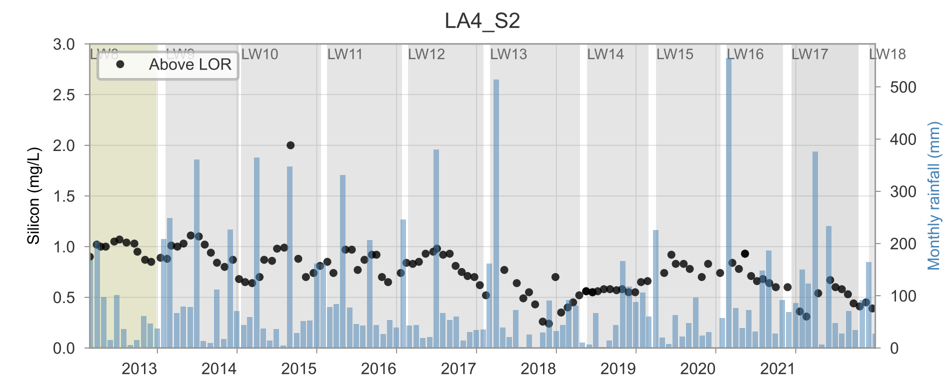

LA4_S1
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
LA4_S1
Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LA4_S1
Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
LA4_S1
Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
LA4_S1
Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
LA4_S1
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

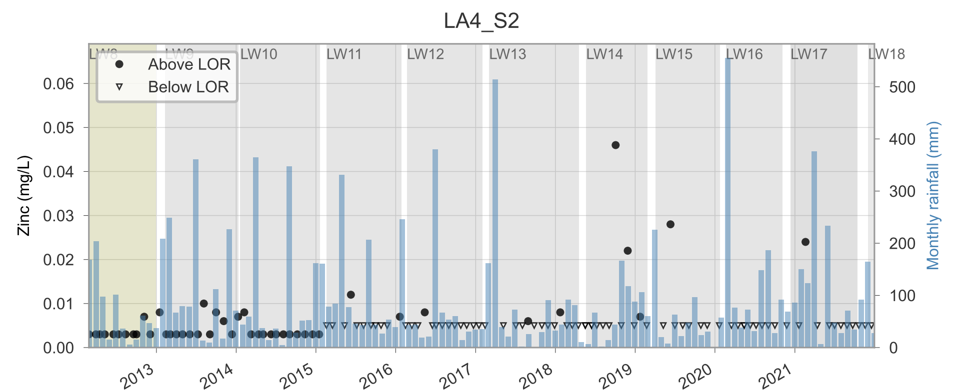

LA4_S2
Above LOR
Below LOR
Sulfate (mg/L)
Monthly rainfall (mm)
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

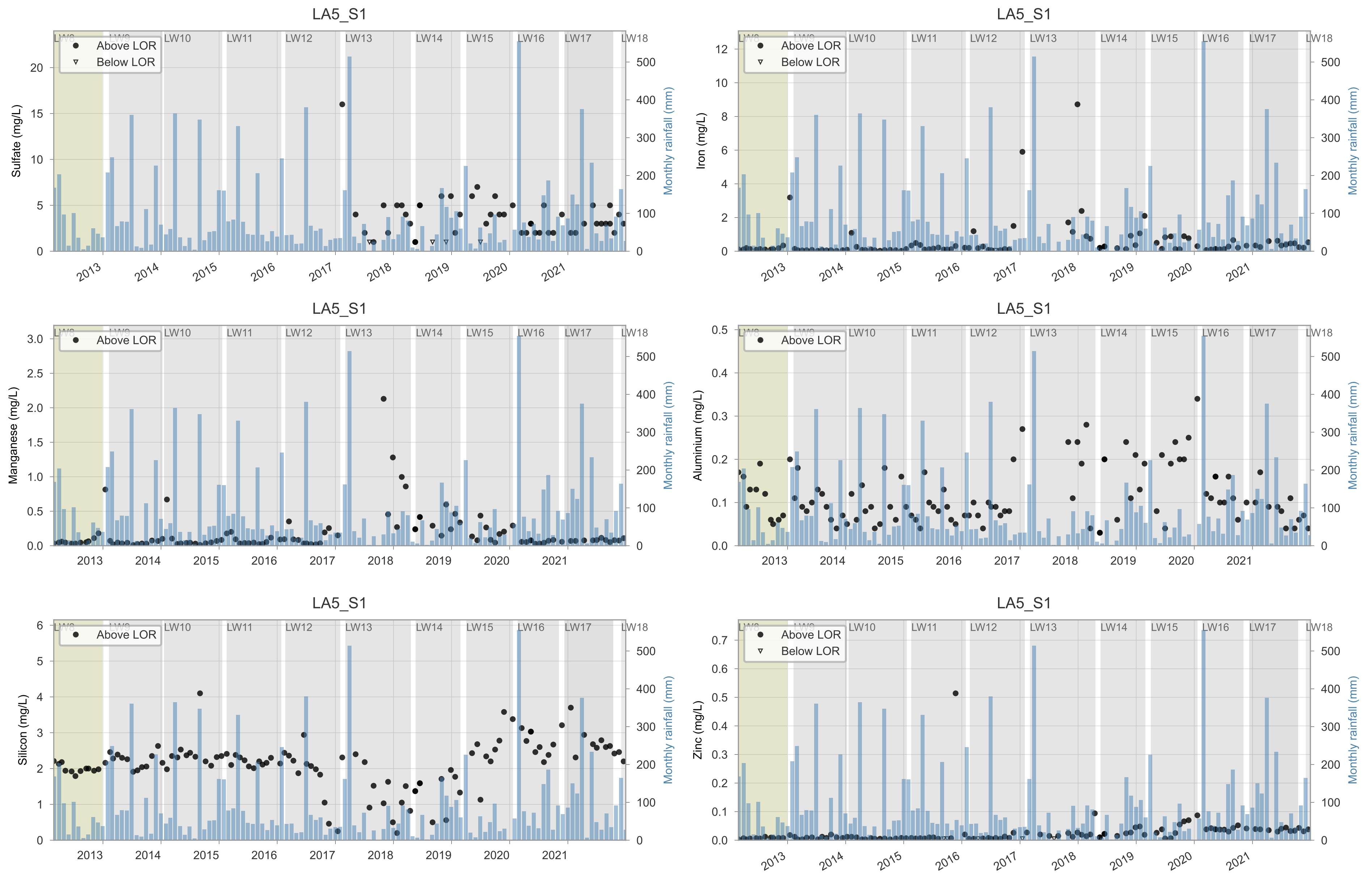

LA4_S2
Above LOR
Below LOR
Iron (mg/L)
Monthly rainfall (mm)
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

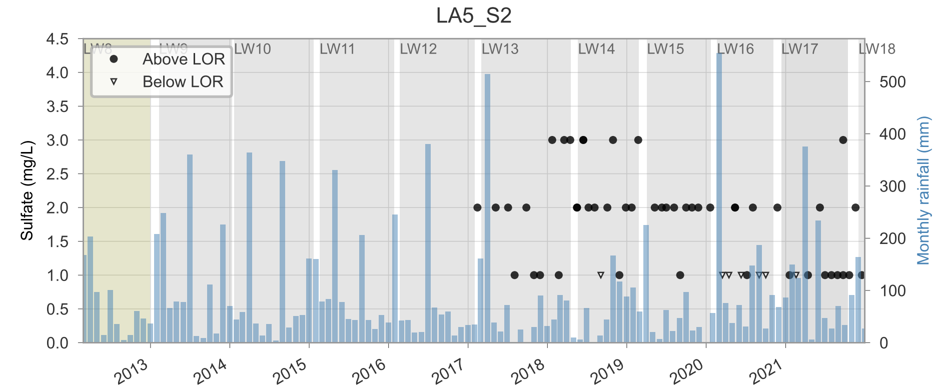

LA4_S2
Above LOR
Below LOR
Manganese (mg/L)
Monthly rainfall (mm)
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

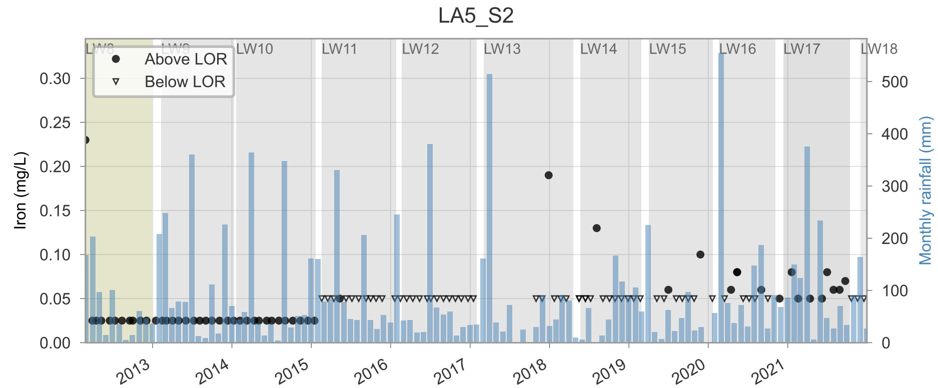

LA4_S2
Above LOR
Below LOR
Aluminium (mg/L)
Monthly rainfall (mm)
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

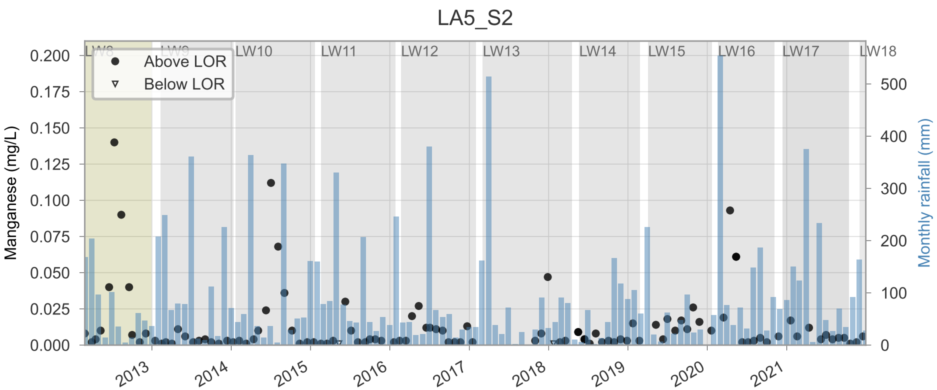

LA4_S2
Above LOR
Silicon (mg/L)
Monthly rainfall (mm)
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

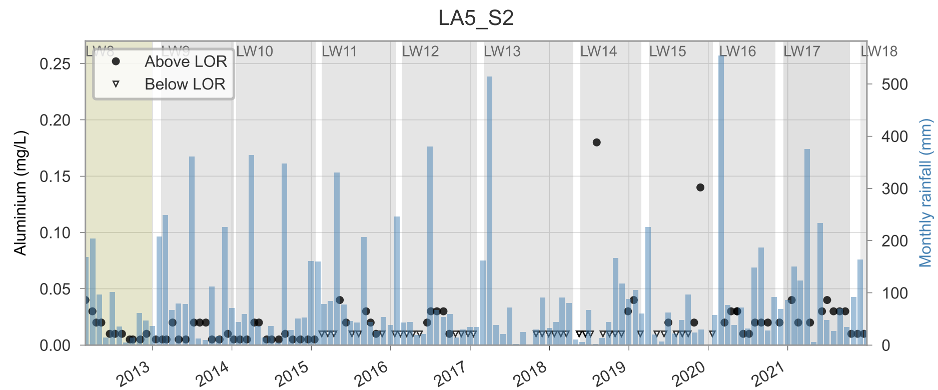

LA4_S2
Above LOR
Below LOR
Zinc (mg/L)
Monthly rainfall (mm)
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

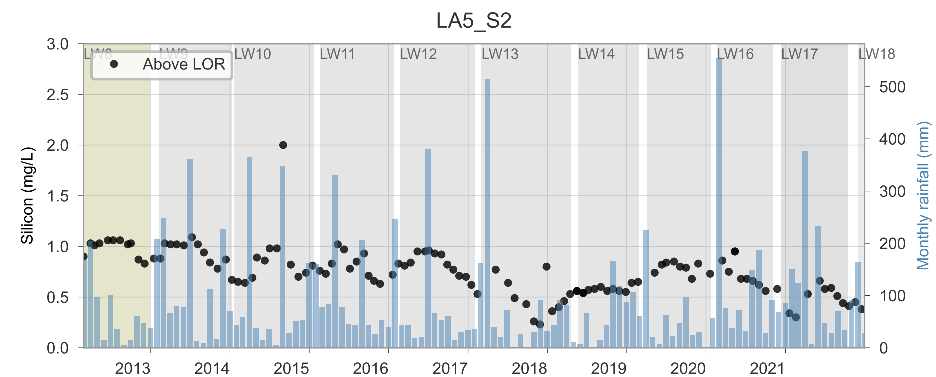

LA5_S1
Above LOR
Below LOR
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020
2021

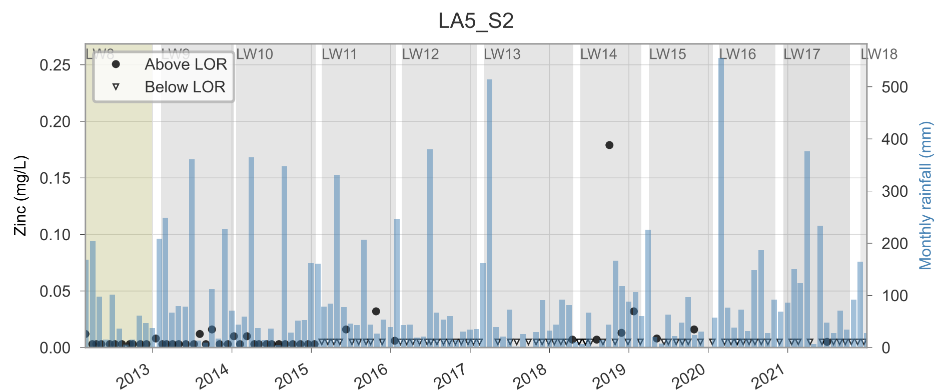

LA5_S2
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

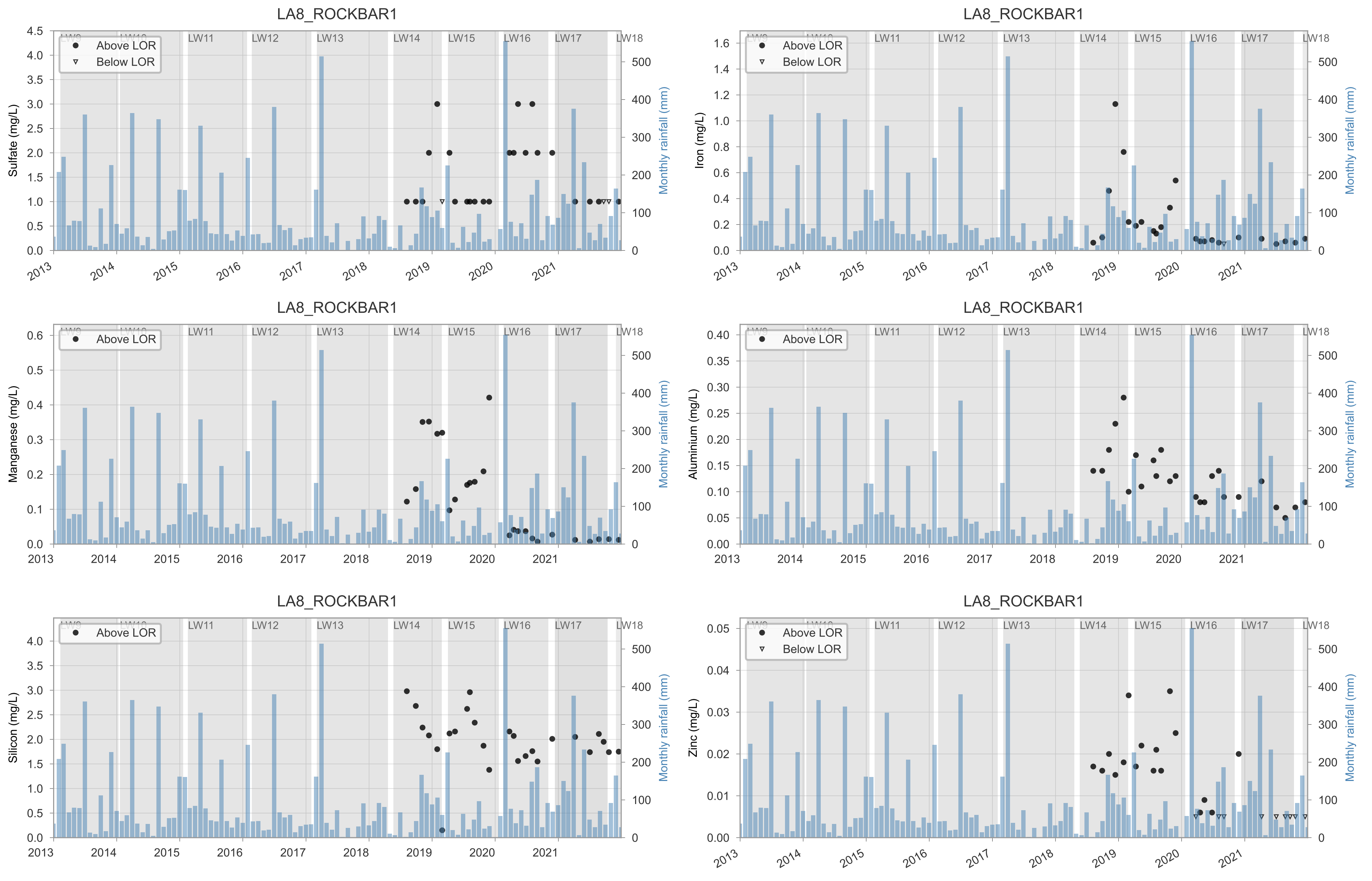

LA5_S2
Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

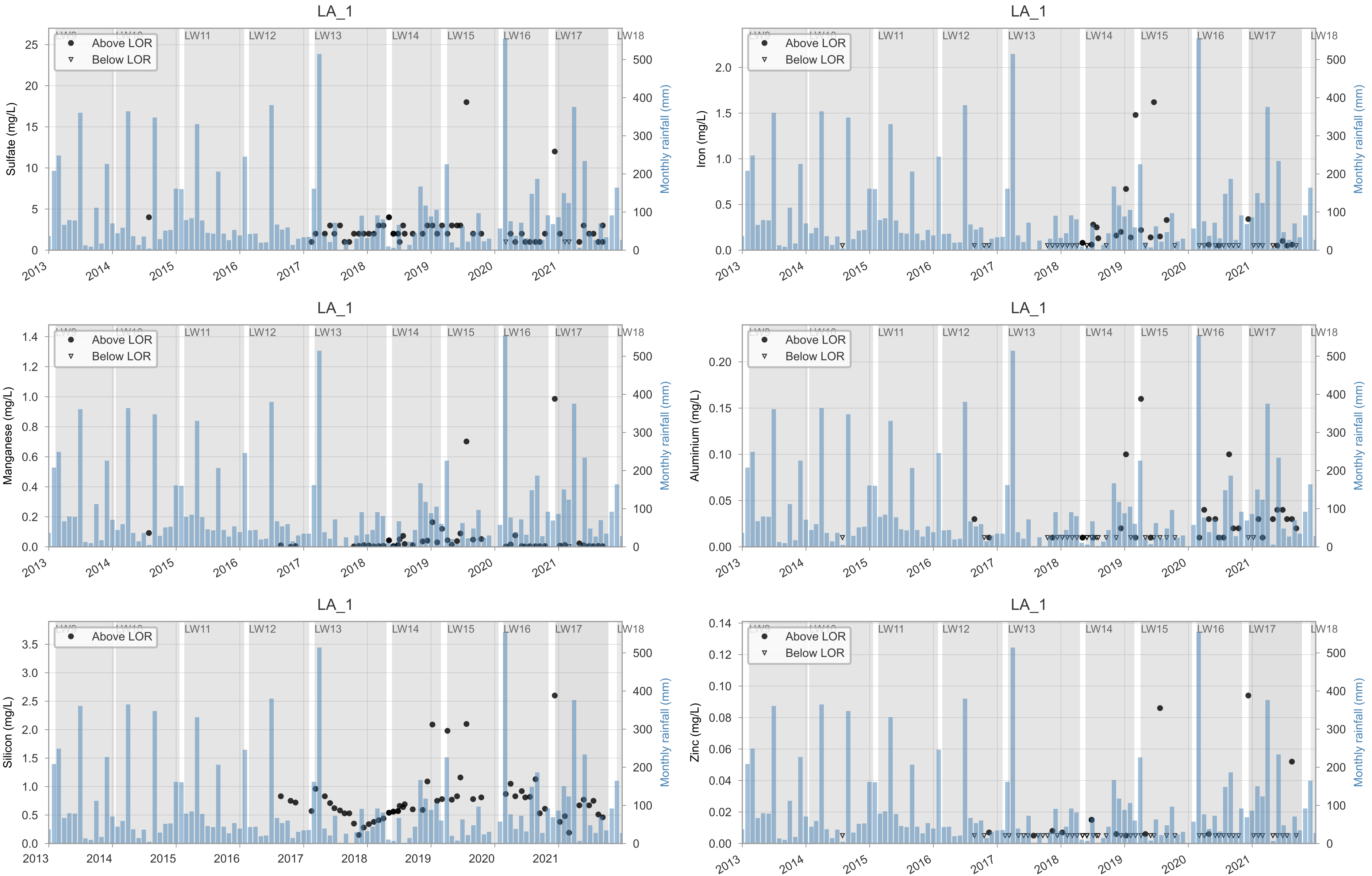

LA5_S2
Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

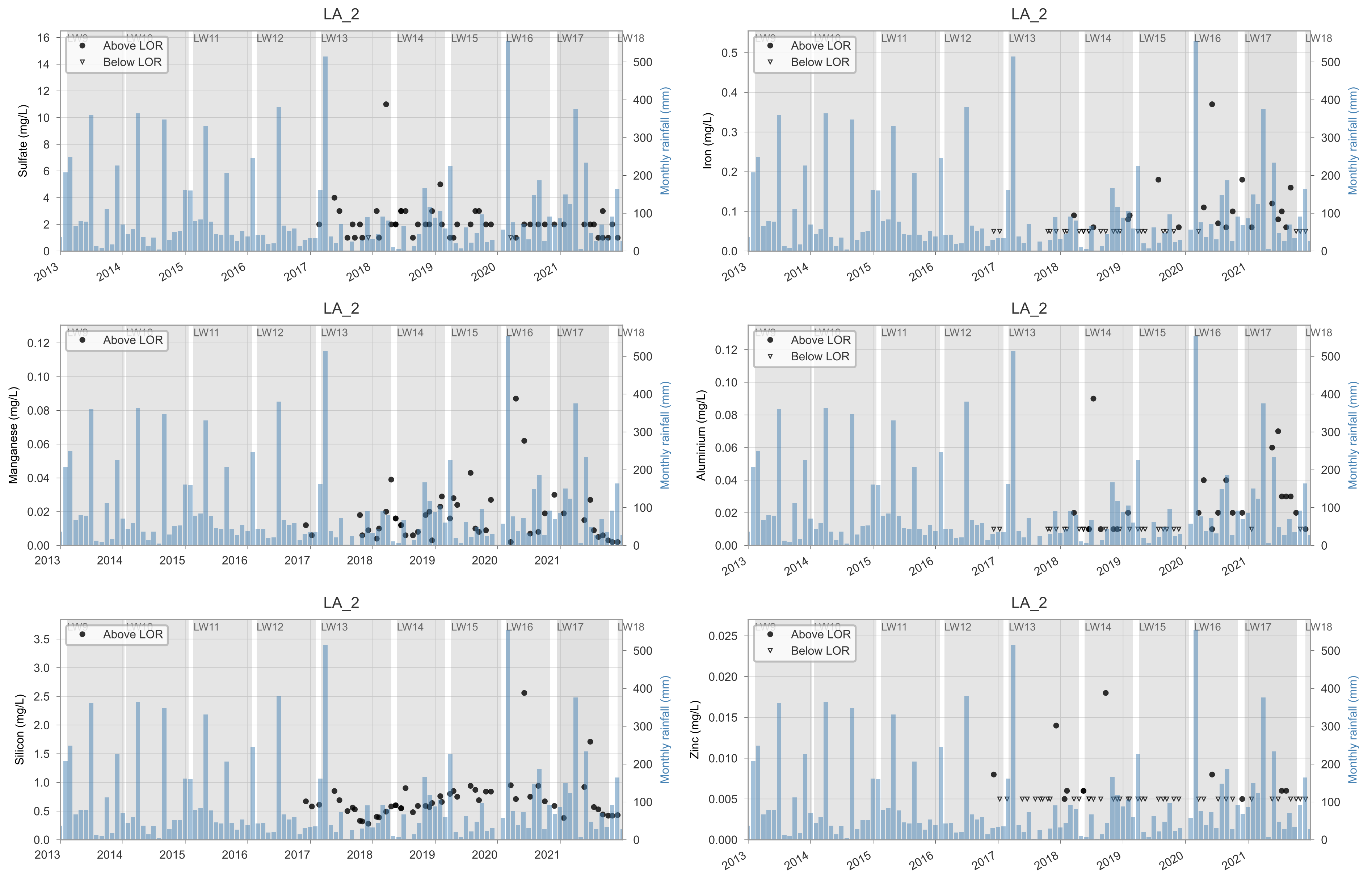

LA5_S2
Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

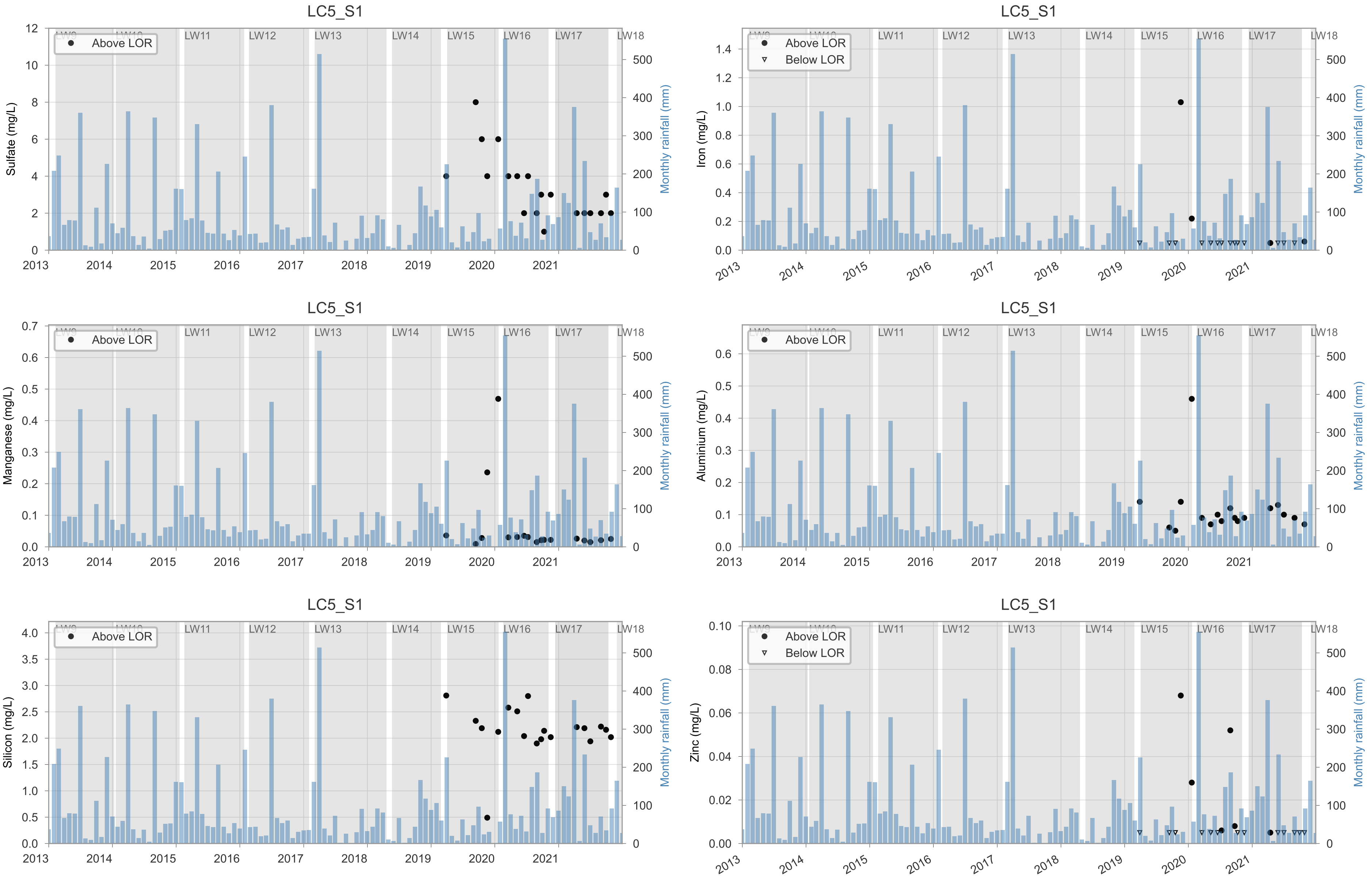

LA5_S2
Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

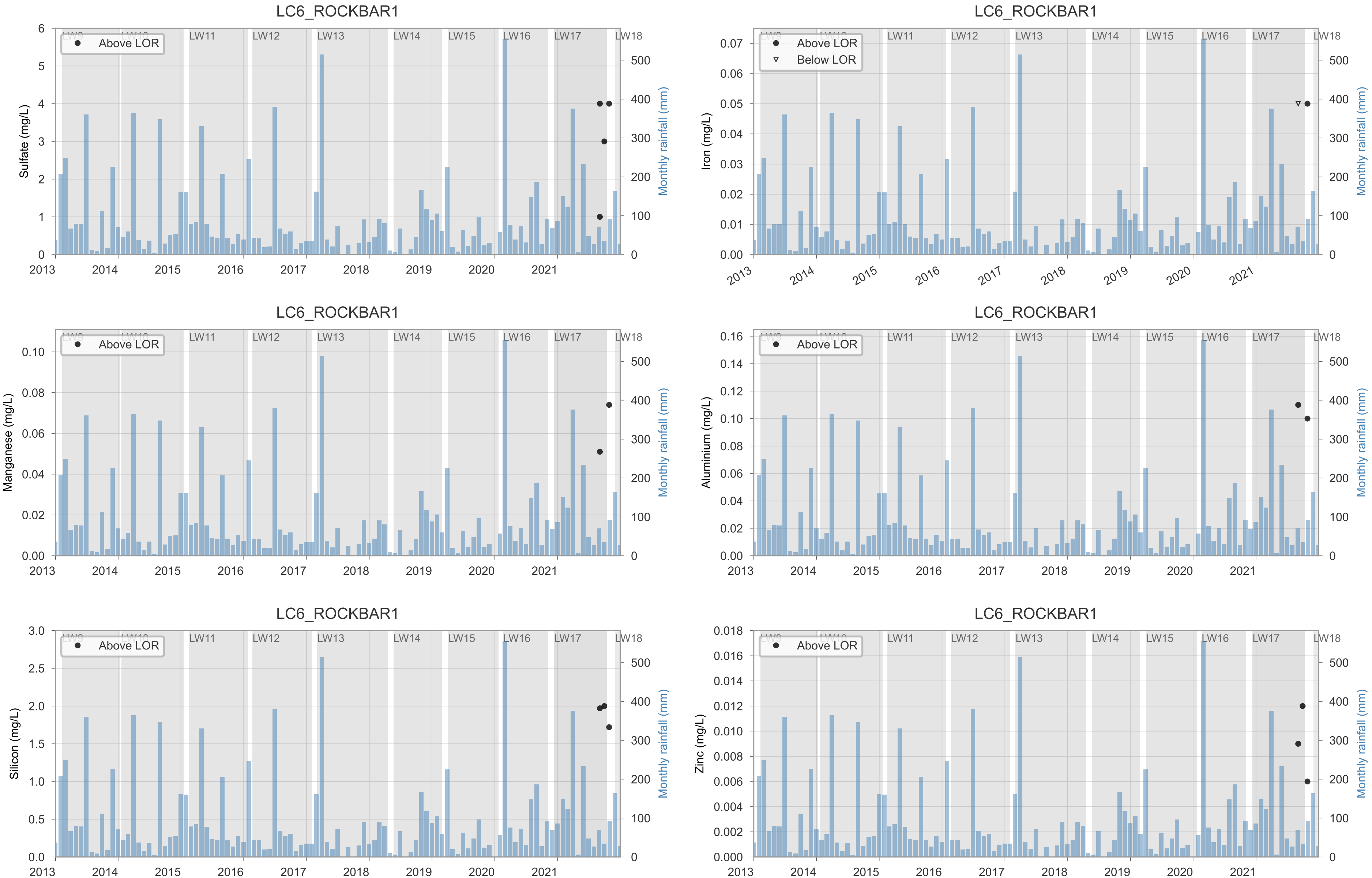

LA5_S2
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

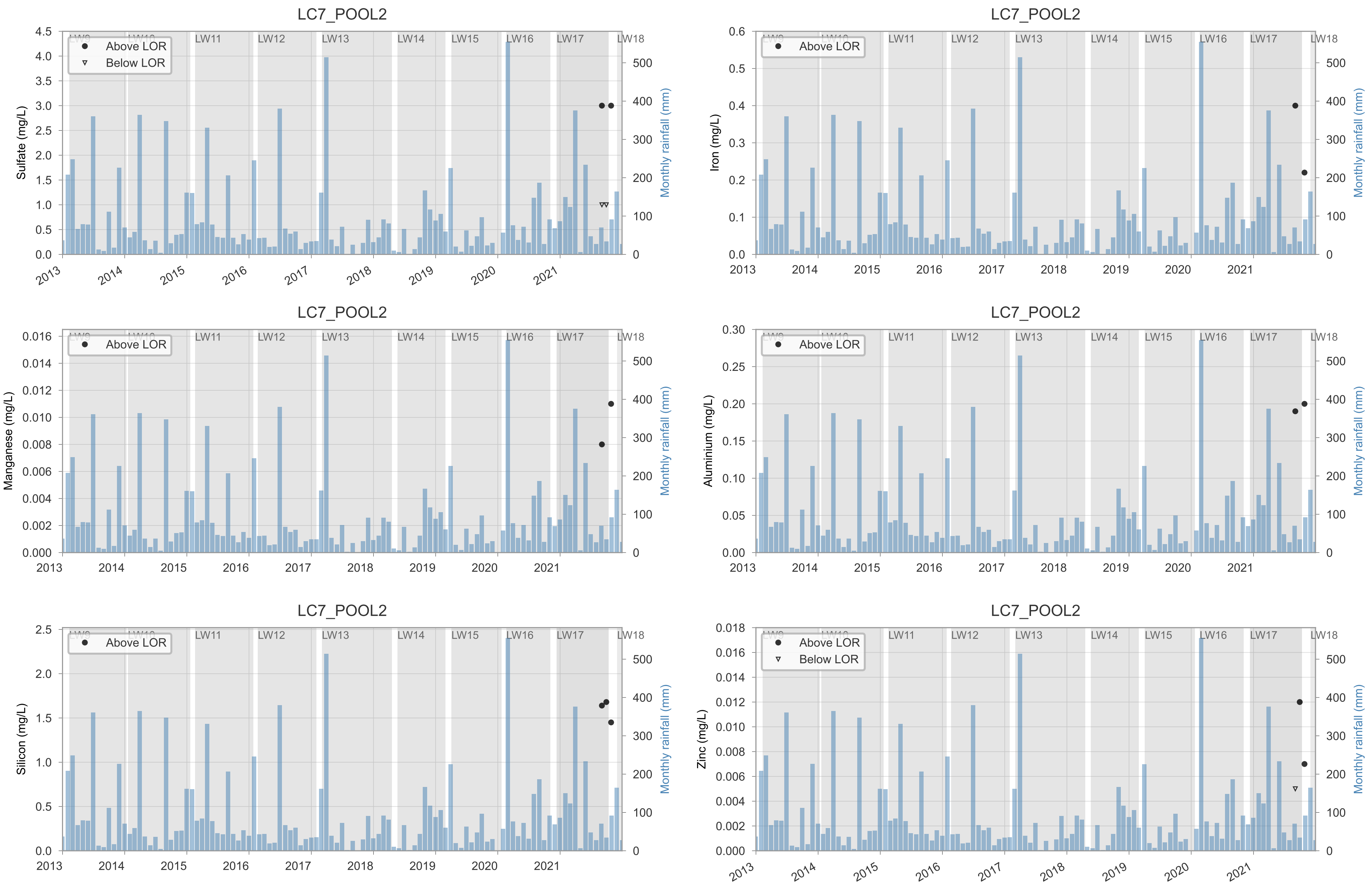

LA8_ROCKBAR1
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021


LA_1
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

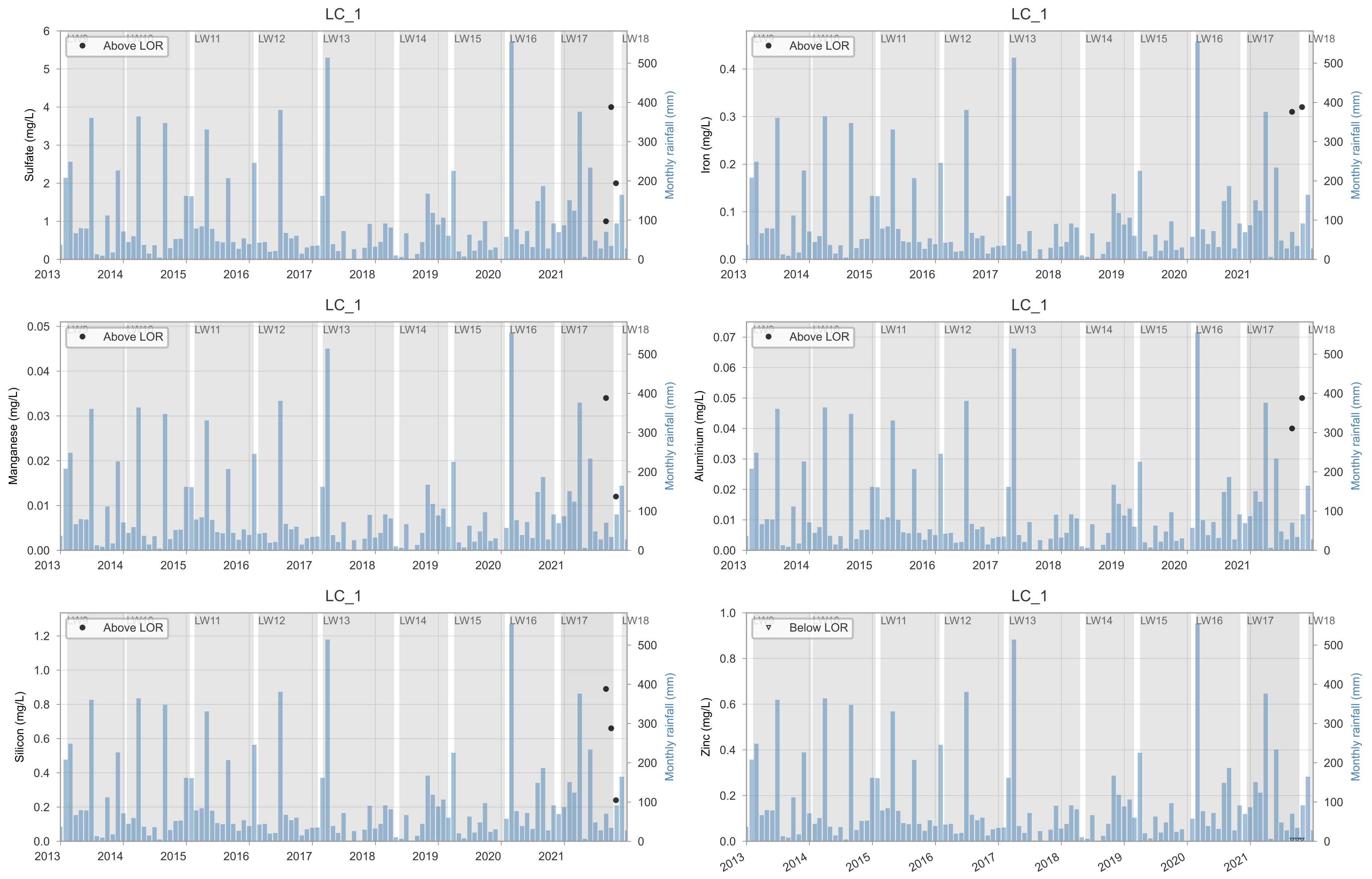

LA_2
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

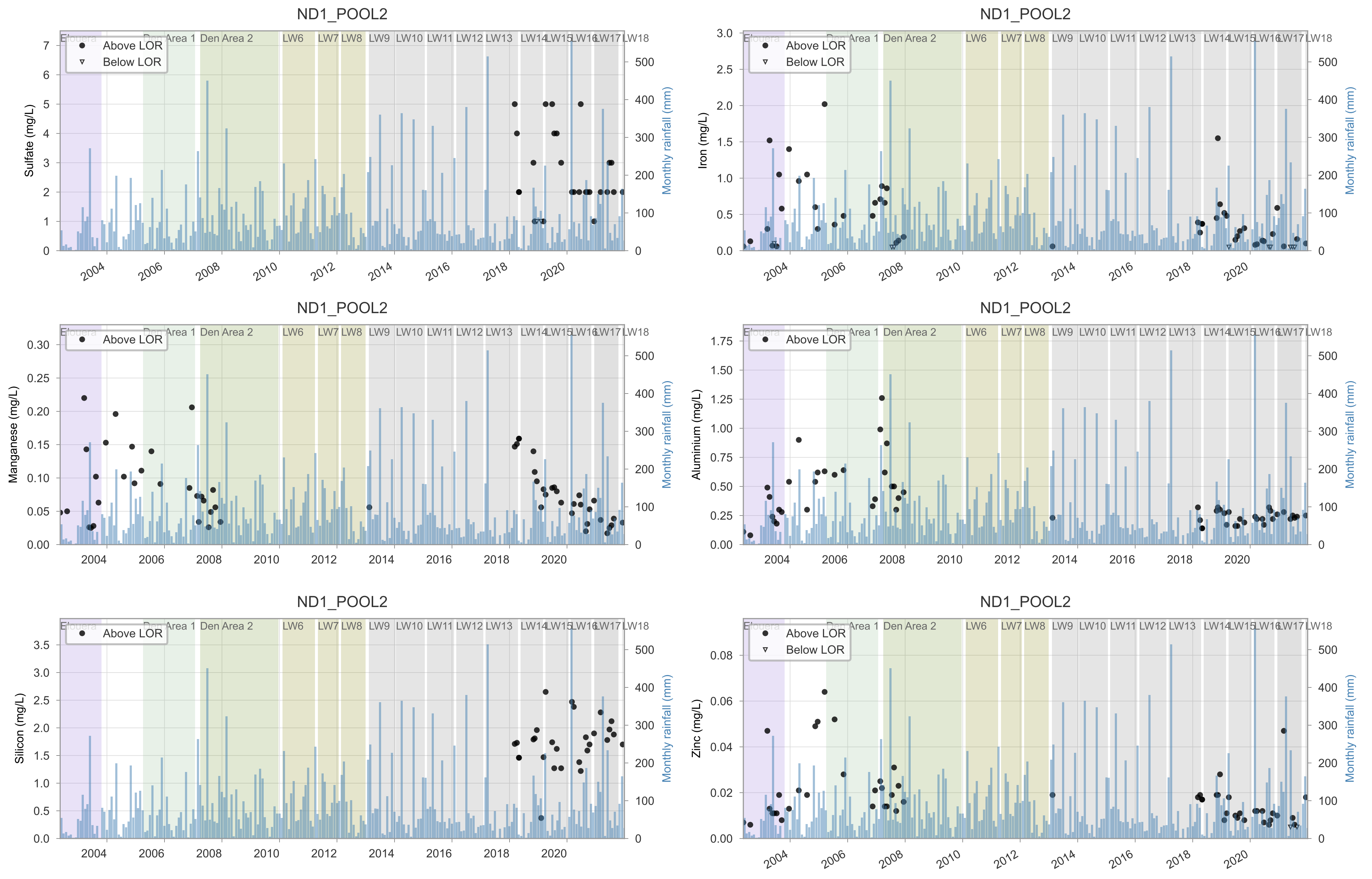

LC5_S1
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
LC5_S1
Iron (mg/L)
Above LOR
Below LOR
LC5_S1
Manganese (mg/L)
LC5_S1
Aluminium (mg/L)
LC5_S1
Silicon (mg/L)
LC5_S1
Zinc (mg/L)
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

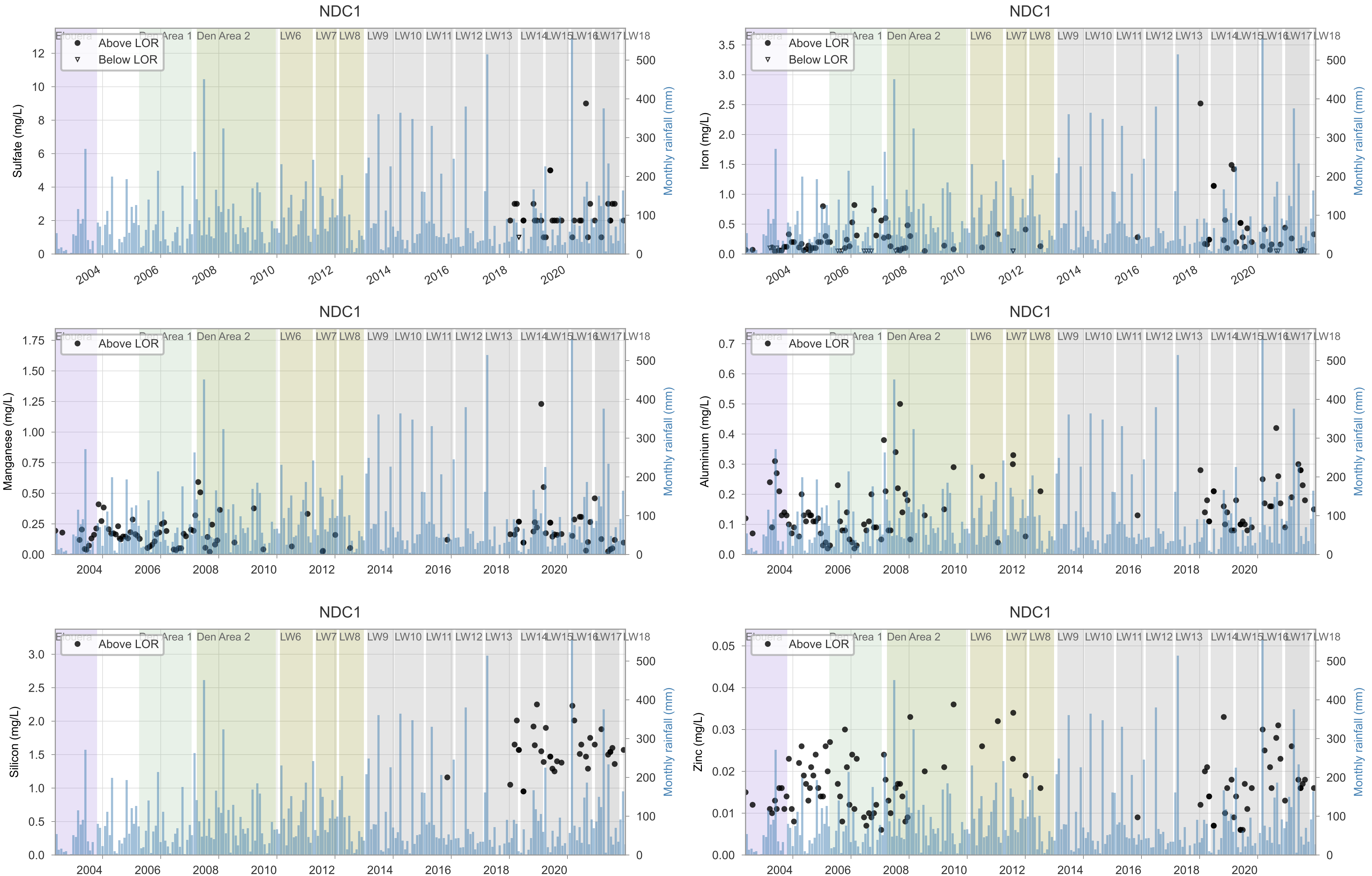

LC6_ROCKBAR1
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
LC6_ROCKBAR1
Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LC6_ROCKBAR1
Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
LC6_ROCKBAR1
Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
LC6_ROCKBAR1
Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
LC6_ROCKBAR1
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

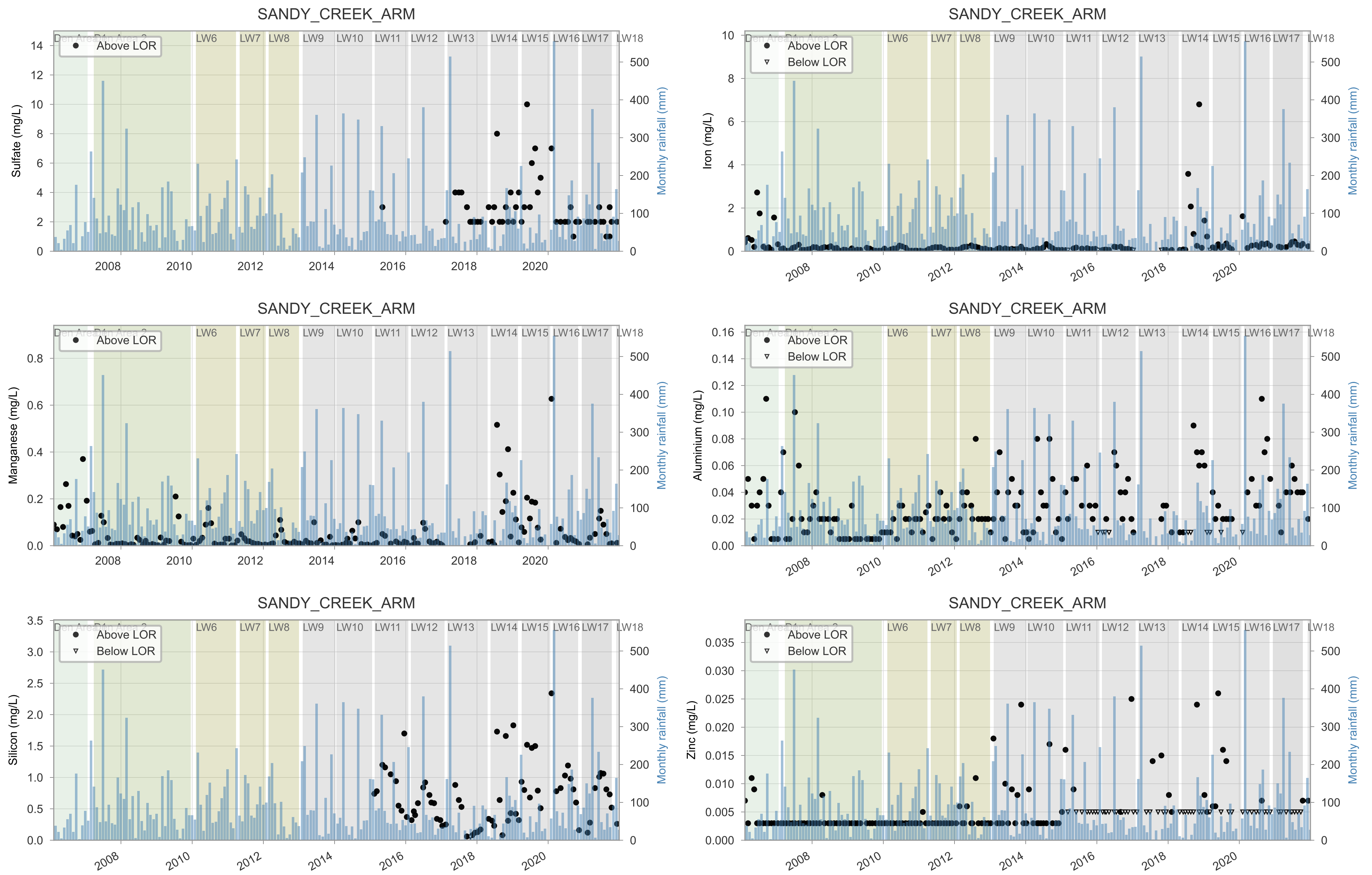


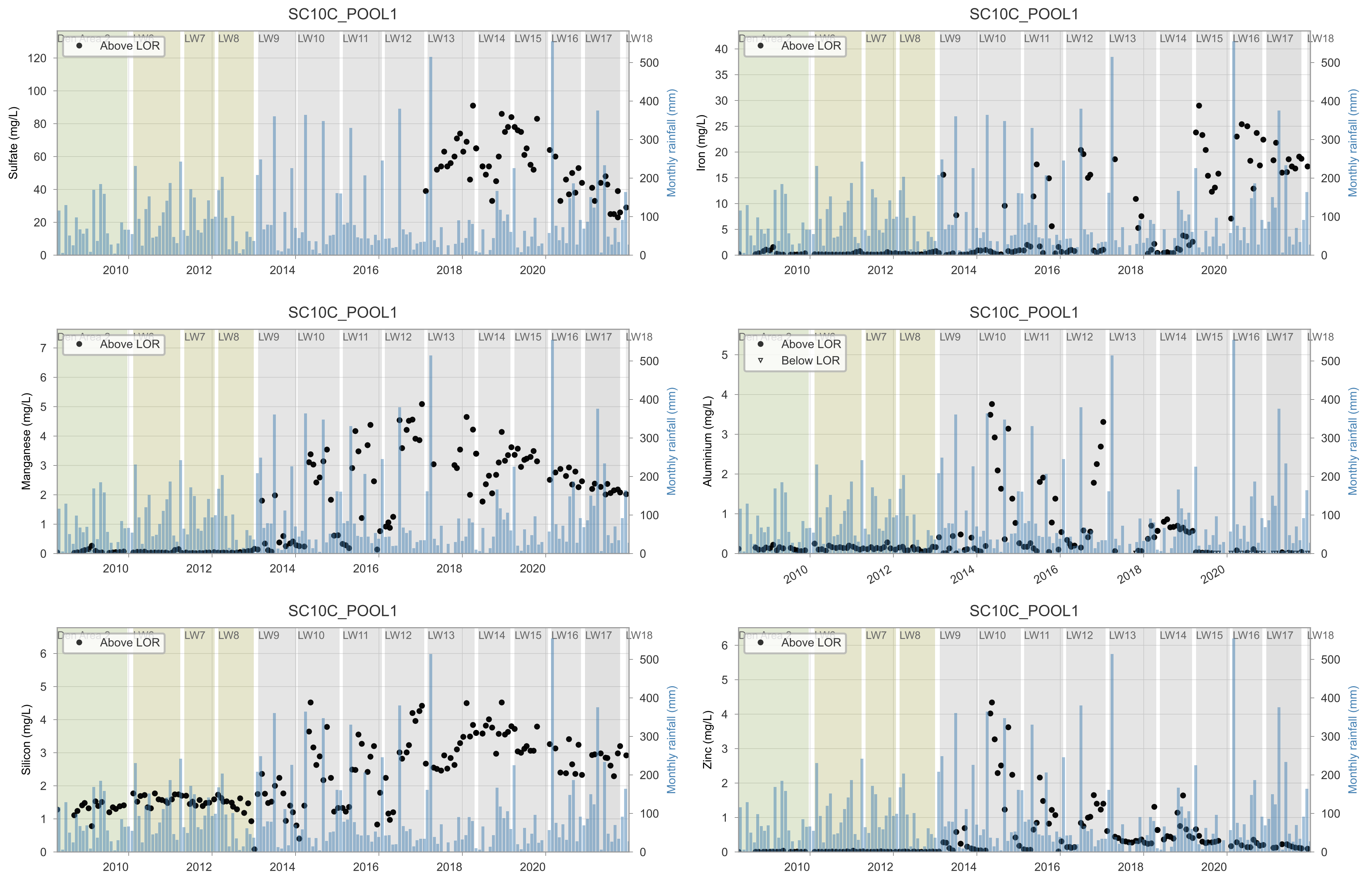
LC7_POOL2
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021


LC_1
Above LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Sulfate (mg/L)
Monthly rainfall (mm)
0
1
2
3
4
5
6
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020
2021
LC_1
Above LOR
Iron (mg/L)
Monthly rainfall (mm)
0.0
0.1
0.2
0.3
0.4
LC_1
Above LOR
Manganese (mg/L)
Monthly rainfall (mm)
0.00
0.01
0.02
0.03
0.04
0.05
LC_1
Above LOR
Aluminium (mg/L)
Monthly rainfall (mm)
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
LC_1
Above LOR
Silicon (mg/L)
Monthly rainfall (mm)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
LC_1
Below LOR
Zinc (mg/L)
Monthly rainfall (mm)
0.0
0.2
0.4
0.6
0.8
1.0

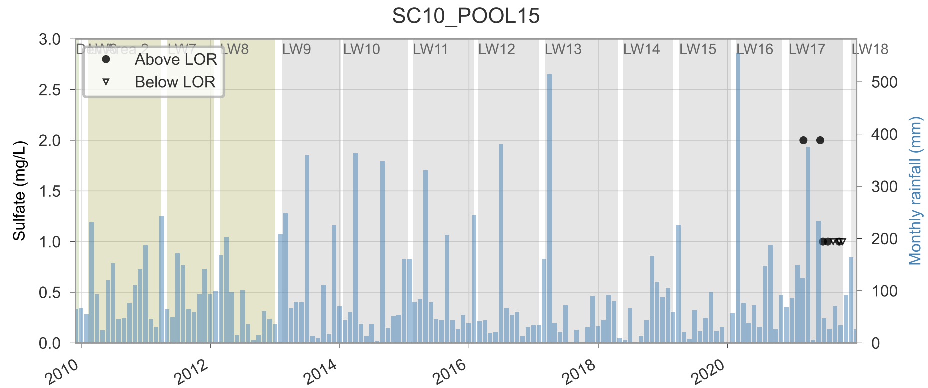

ND1_POOL2
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2004
2006
2008
2010
2012
2014
2016
2018
2020

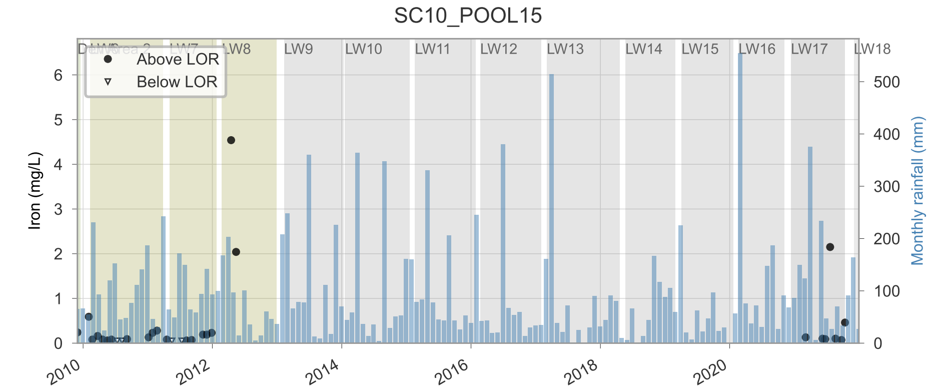

NDC1
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
NDC1
Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
NDC1
Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
NDC1
Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
NDC1
Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
NDC1
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR

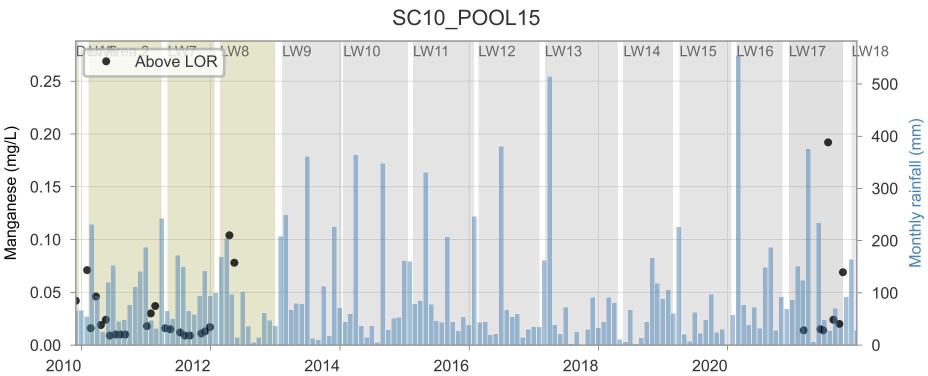

SANDY_CREEK_ARM
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2008
2010
2012
2014
2016
2018
2020

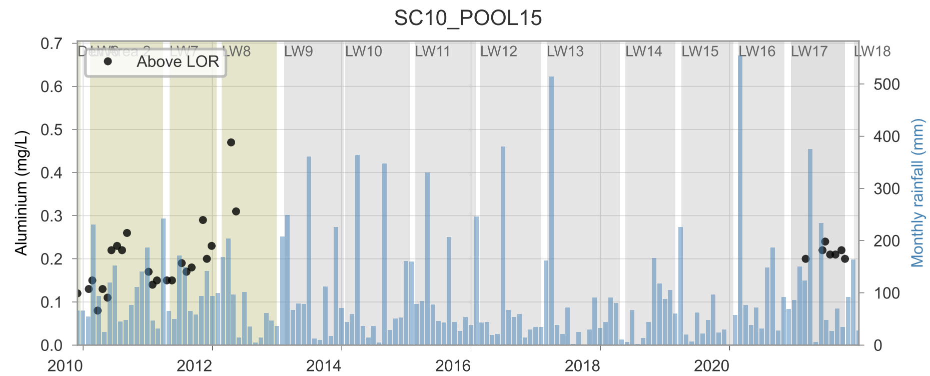


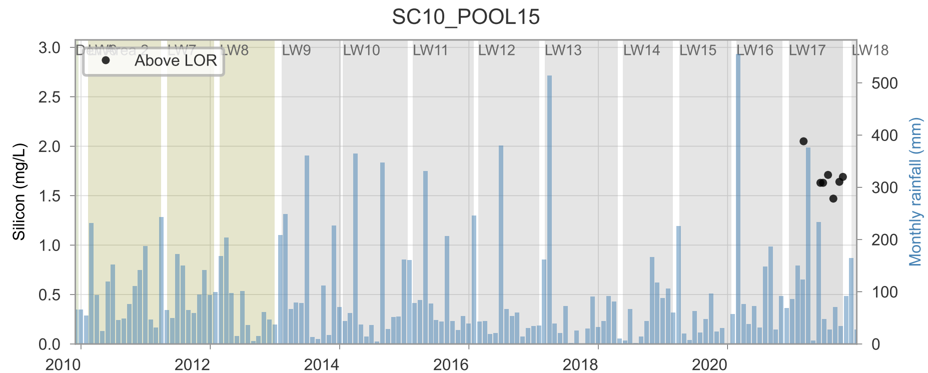
SC10C_POOL1
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
SC10C_POOL1
Iron (mg/L)
Monthly rainfall (mm)
Above LOR
SC10C_POOL1
Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
SC10C_POOL1
Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
SC10C_POOL1
Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
SC10C_POOL1
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR

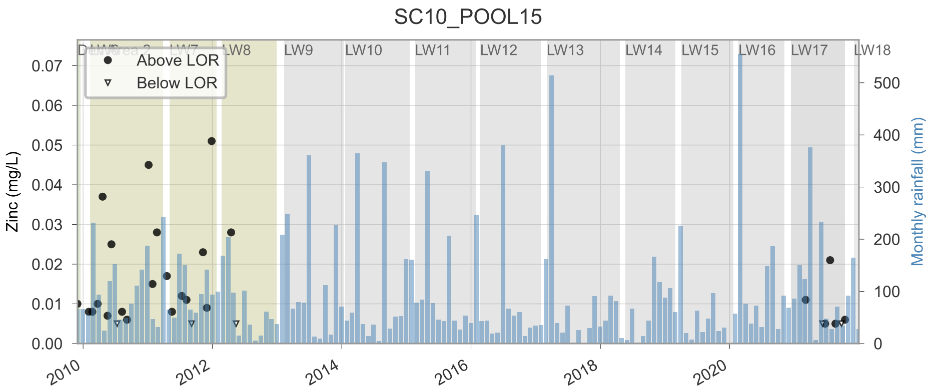

SC10_POOL15
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18

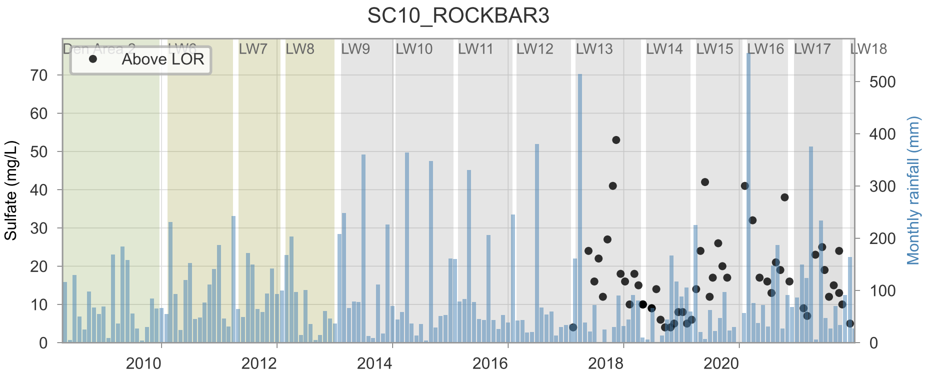

SC10_POOL15
Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18

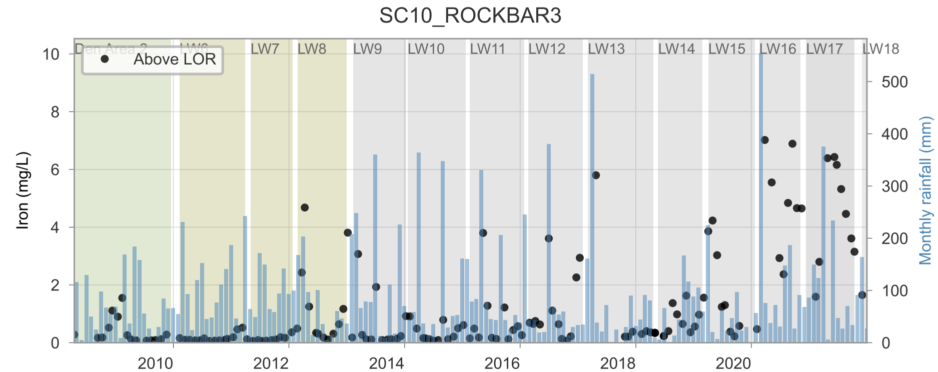

SC10_POOL15
Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18

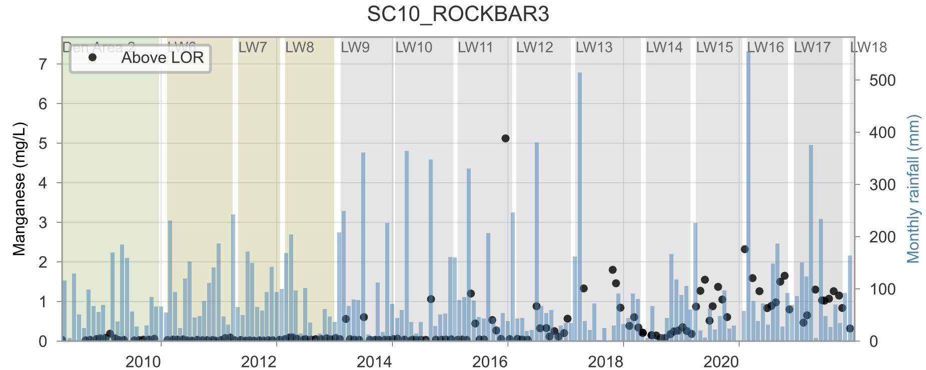

SC10_POOL15
Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18

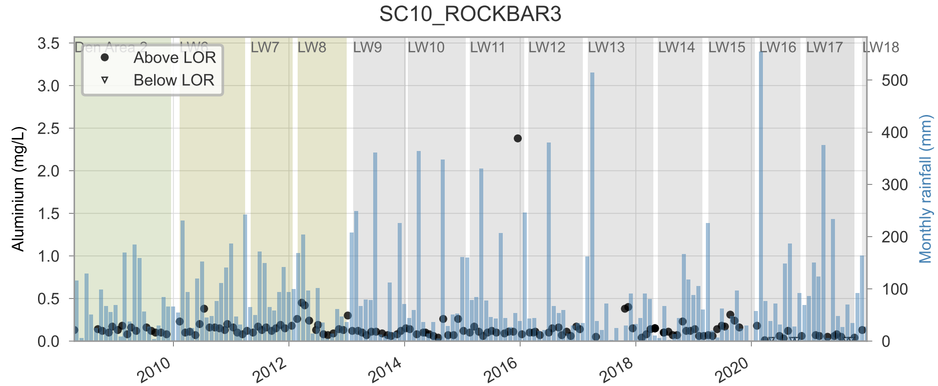

SC10_POOL15
Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18

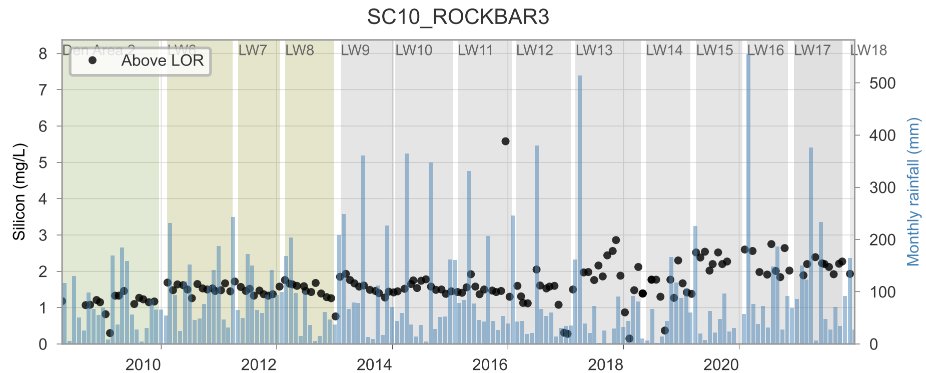

SC10_POOL15
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18

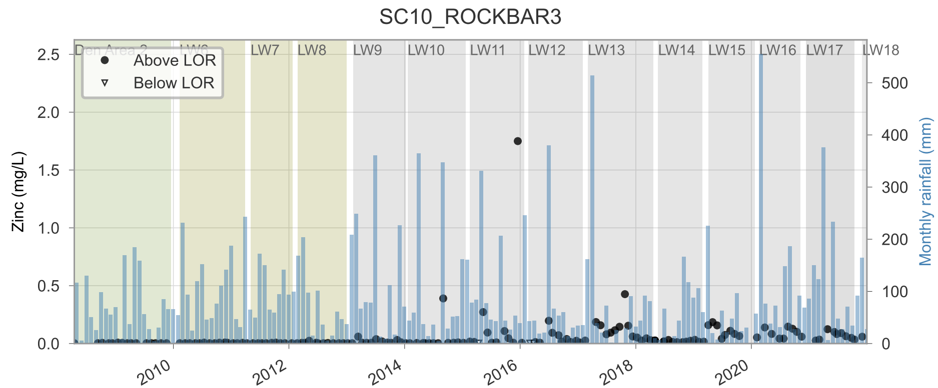

SC10_ROCKBAR3
Above LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Sulfate (mg/L)
Monthly rainfall (mm)
2010
2012
2014
2016
2018
2020

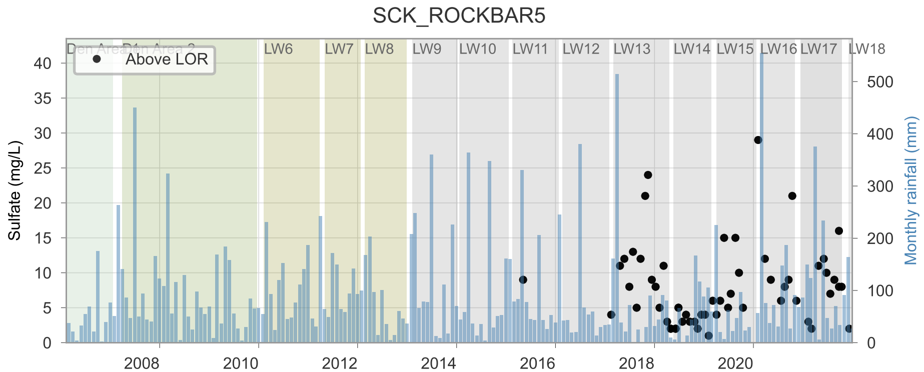

SC10_ROCKBAR3
Above LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Iron (mg/L)
Monthly rainfall (mm)
2010
2012
2014
2016
2018
2020

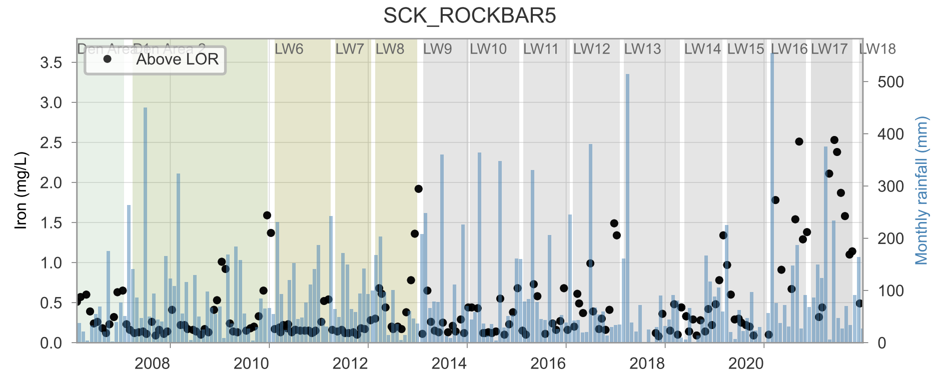

SC10_ROCKBAR3
Above LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Manganese (mg/L)
Monthly rainfall (mm)
2010
2012
2014
2016
2018
2020

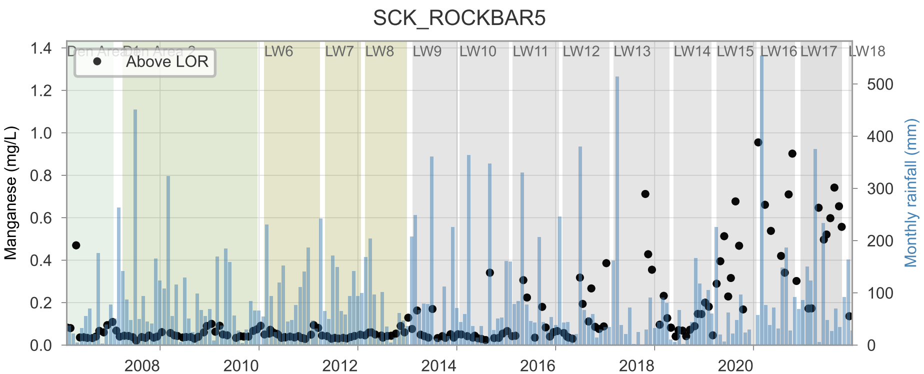

SC10_ROCKBAR3
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Aluminium (mg/L)
Monthly rainfall (mm)
2010
2012
2014
2016
2018
2020

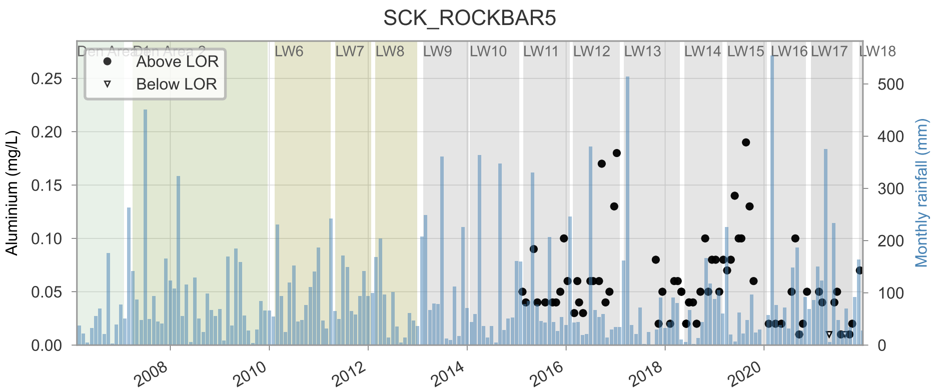

SC10_ROCKBAR3
Above LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Silicon (mg/L)
Monthly rainfall (mm)
2010
2012
2014
2016
2018
2020

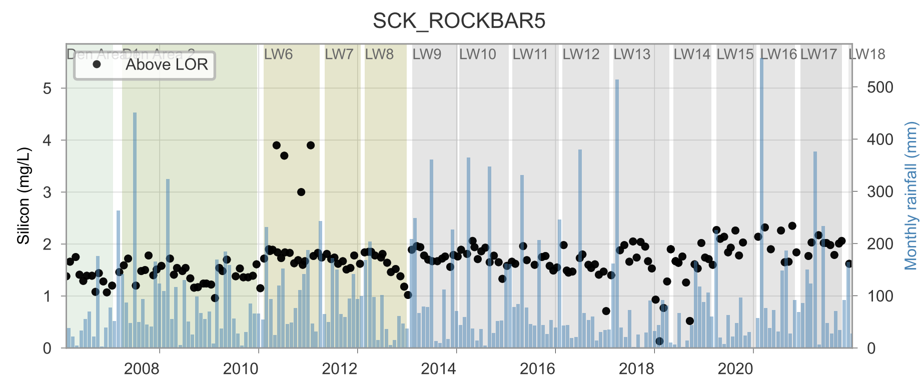

SC10_ROCKBAR3
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Zinc (mg/L)
Monthly rainfall (mm)
2010
2012
2014
2016
2018
2020

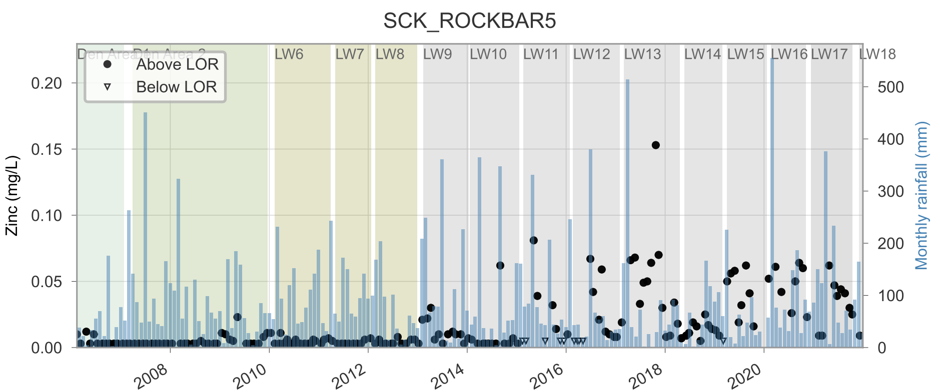

SCK_ROCKBAR5
Above LOR
Sulfate (mg/L)
Monthly rainfall (mm)
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

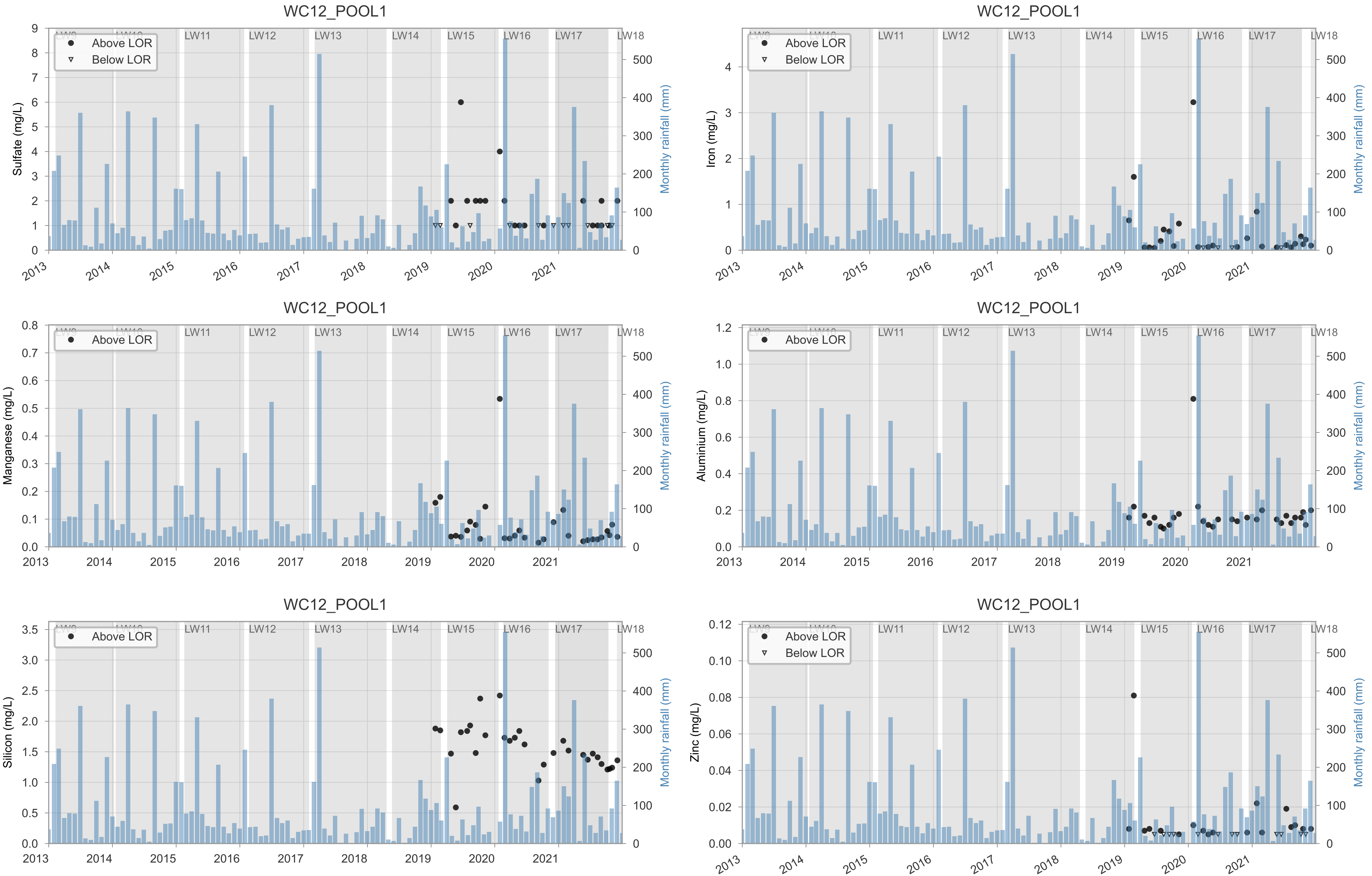

SCK_ROCKBAR5
Above LOR
Iron (mg/L)
Monthly rainfall (mm)
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

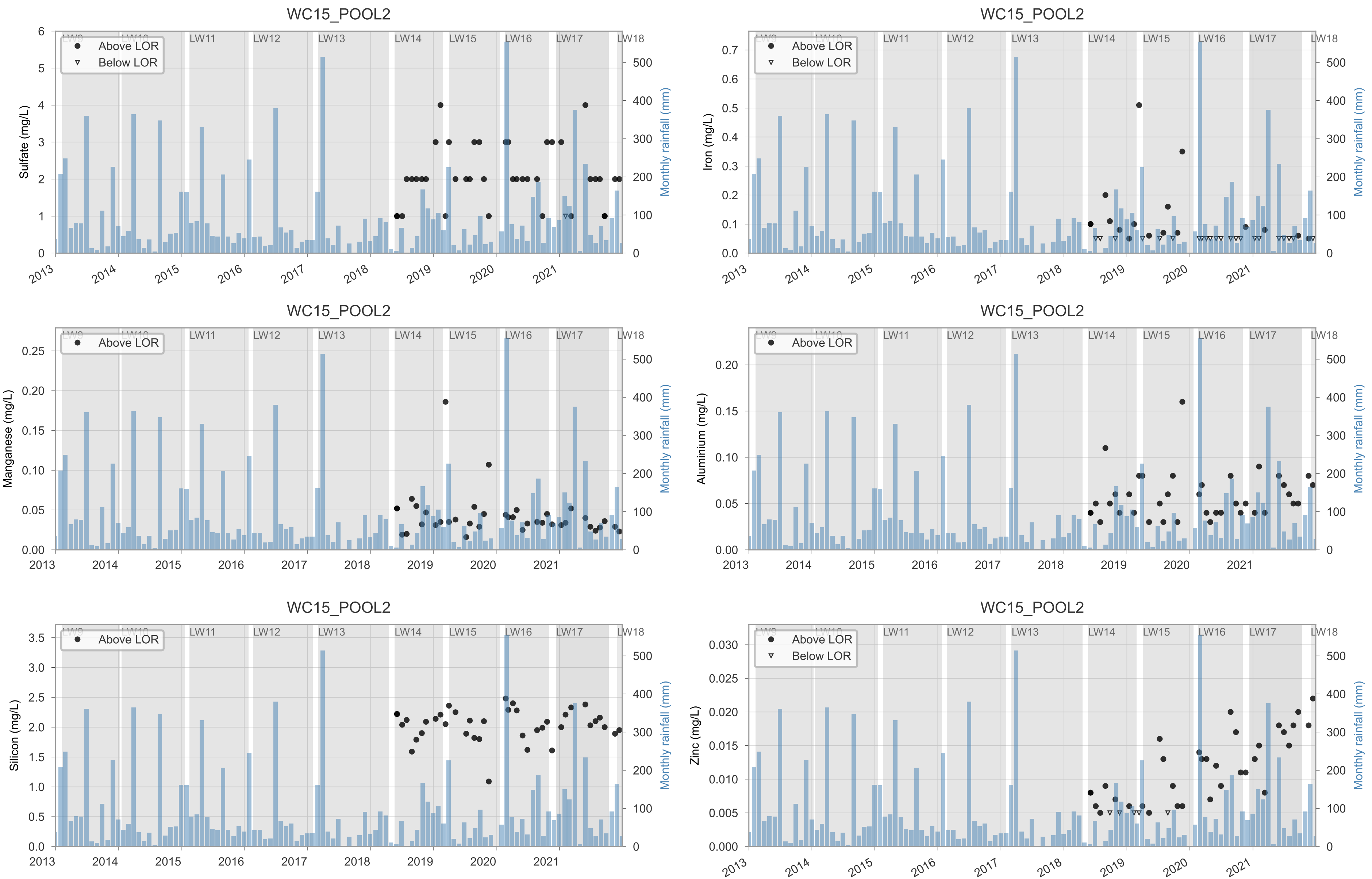

SCK_ROCKBAR5
Above LOR
Manganese (mg/L)
Monthly rainfall (mm)
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18


SCK_ROCKBAR5
Above LOR
Below LOR
Aluminium (mg/L)
Monthly rainfall (mm)
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

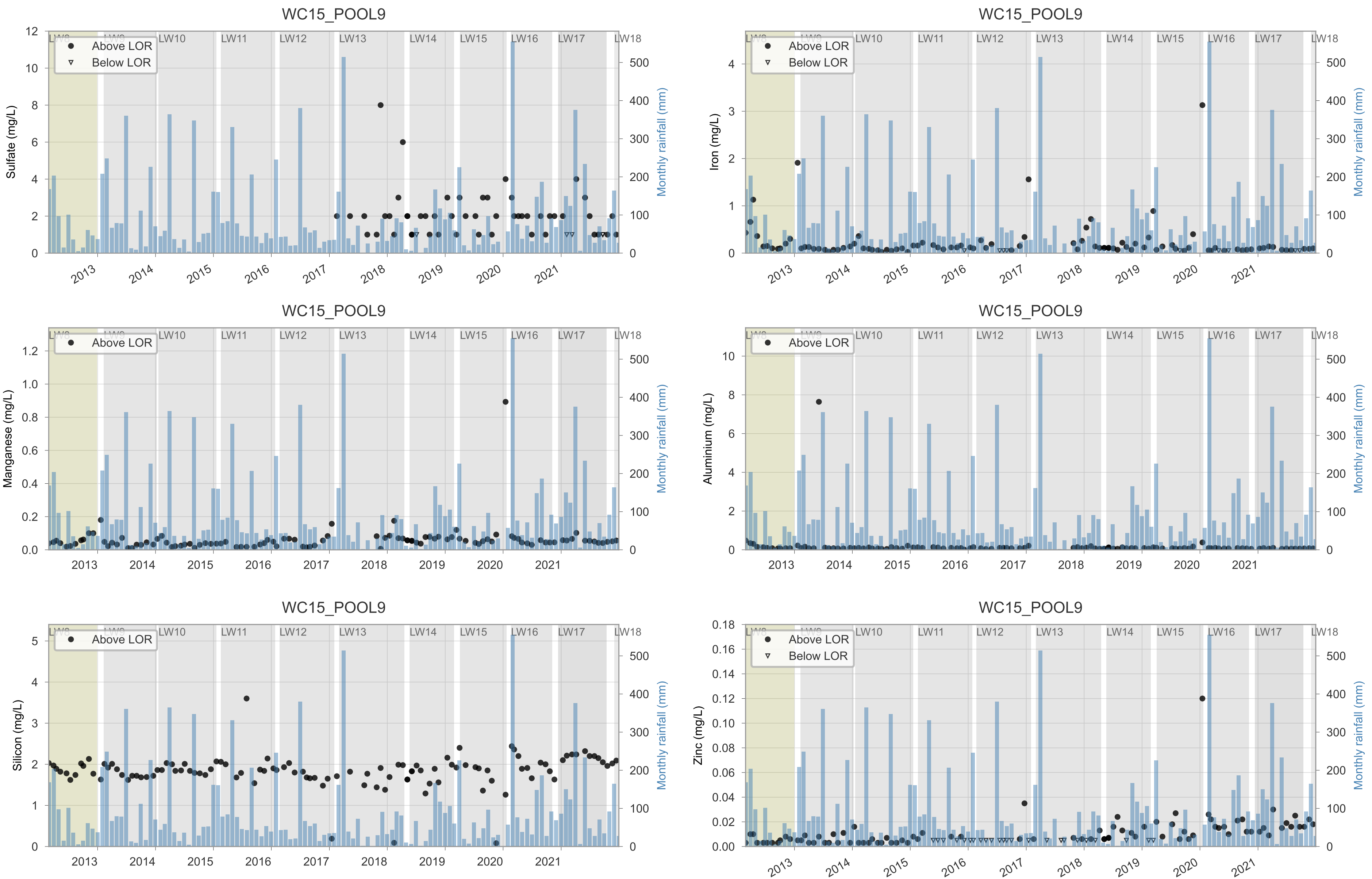

SCK_ROCKBAR5
Above LOR
Silicon (mg/L)
Monthly rainfall (mm)
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

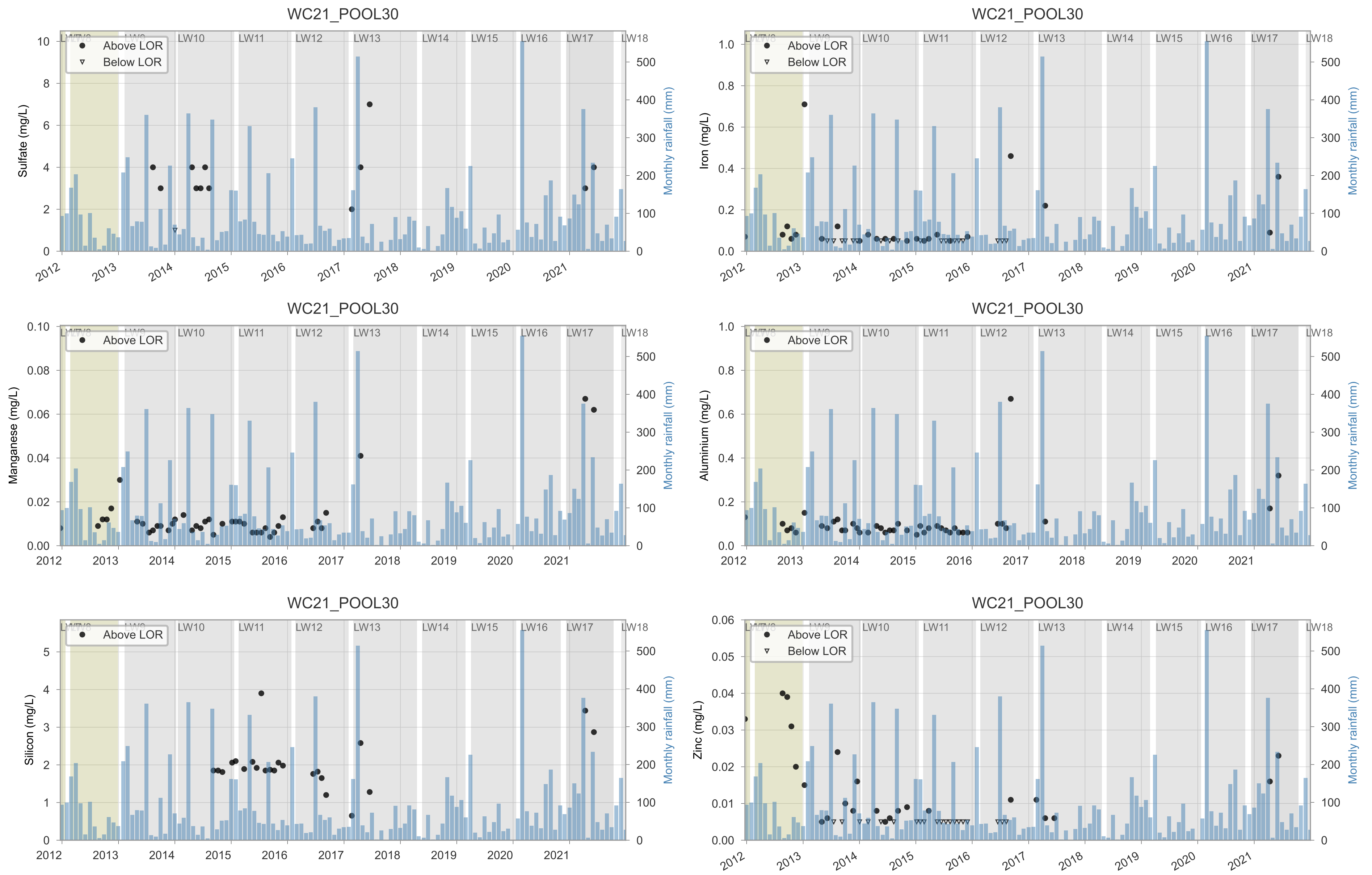

SCK_ROCKBAR5
Above LOR
Below LOR
Zinc (mg/L)
Monthly rainfall (mm)
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18


WC12_POOL1
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

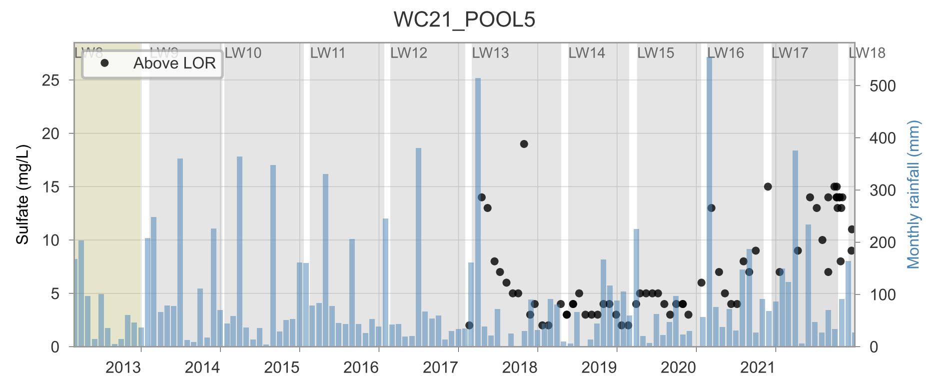


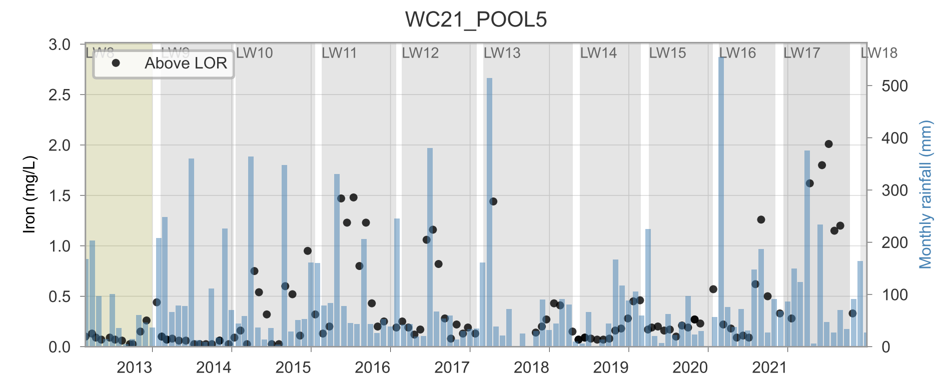
WC15_POOL2
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WC15_POOL2
Iron (mg/L)
WC15_POOL2
Manganese (mg/L)
WC15_POOL2
Aluminium (mg/L)
WC15_POOL2
Silicon (mg/L)
WC15_POOL2
Zinc (mg/L)

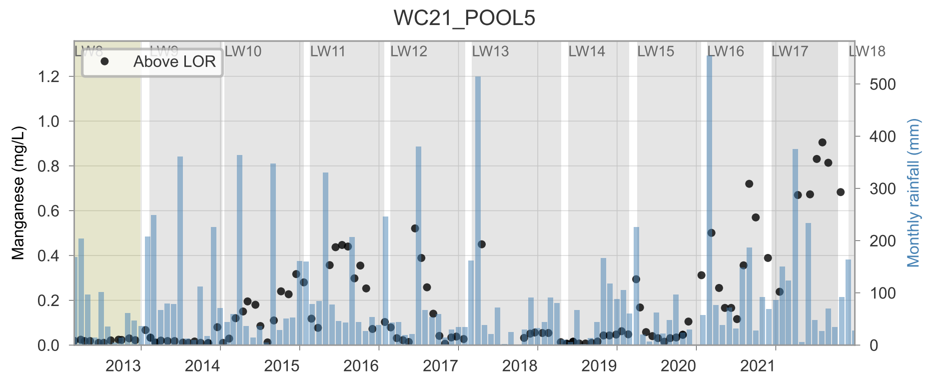

WC15_POOL9
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

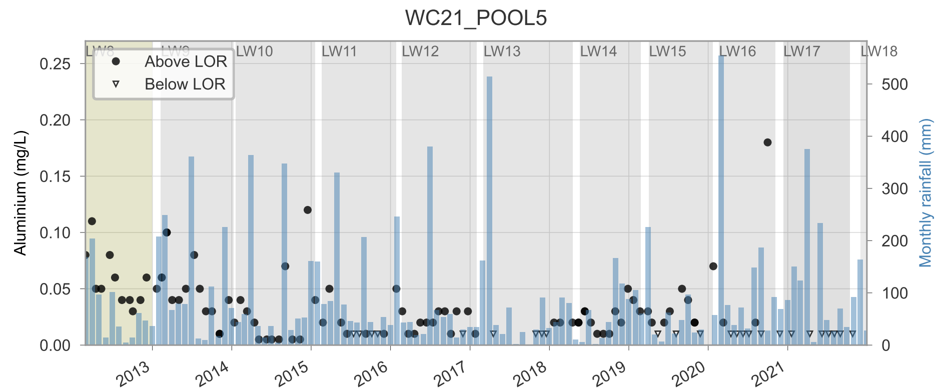


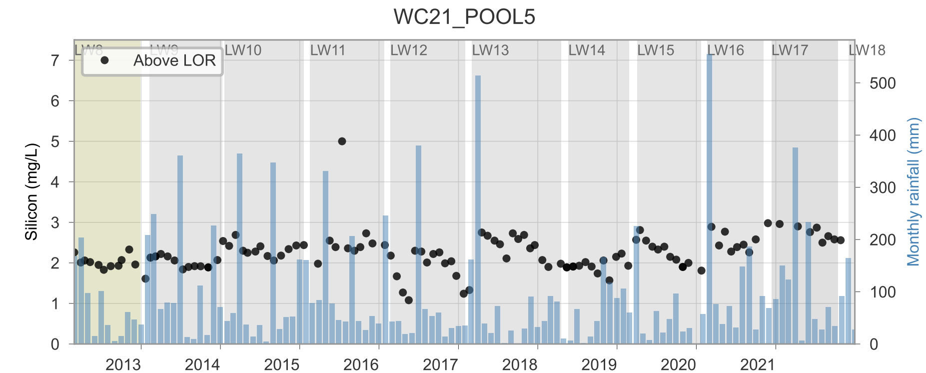
WC21_POOL30
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021

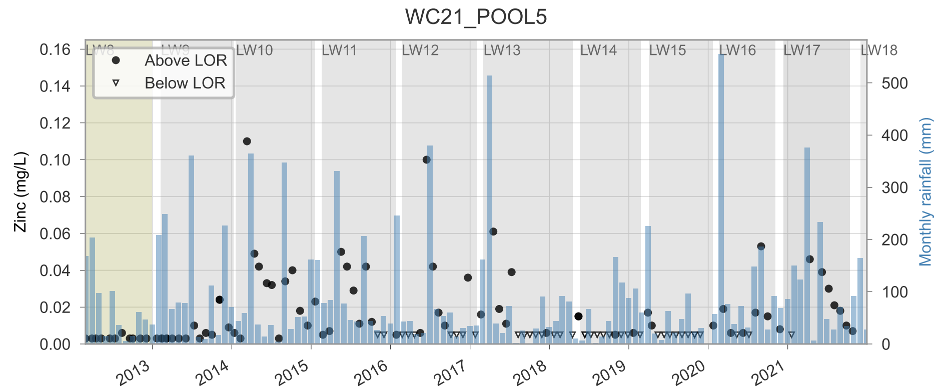

WC21_POOL5
Above LOR
Sulfate (mg/L)
Monthly rainfall (mm)
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

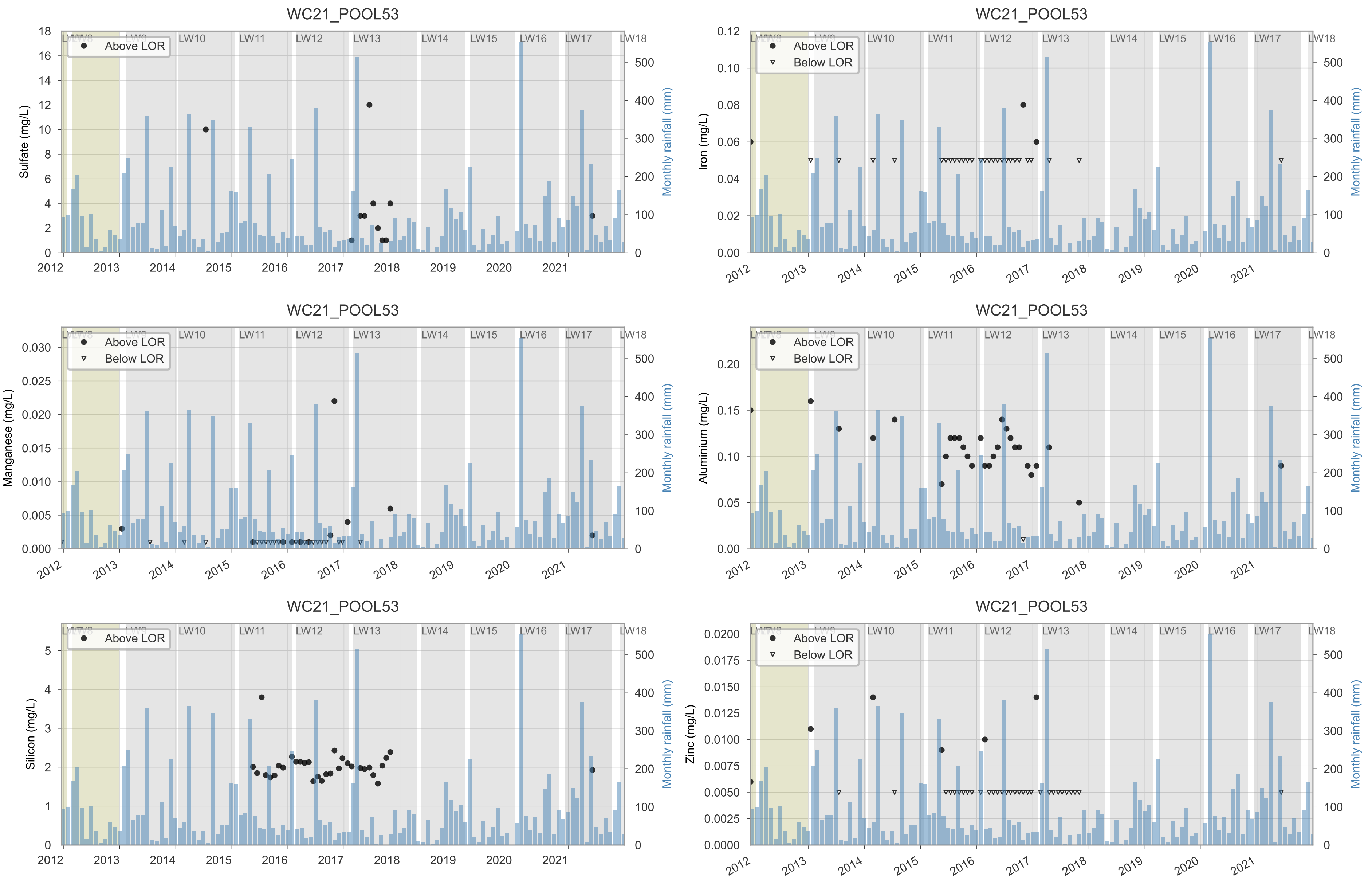

WC21_POOL5
Above LOR
Iron (mg/L)
Monthly rainfall (mm)
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021


WC21_POOL5
Above LOR
Manganese (mg/L)
Monthly rainfall (mm)
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

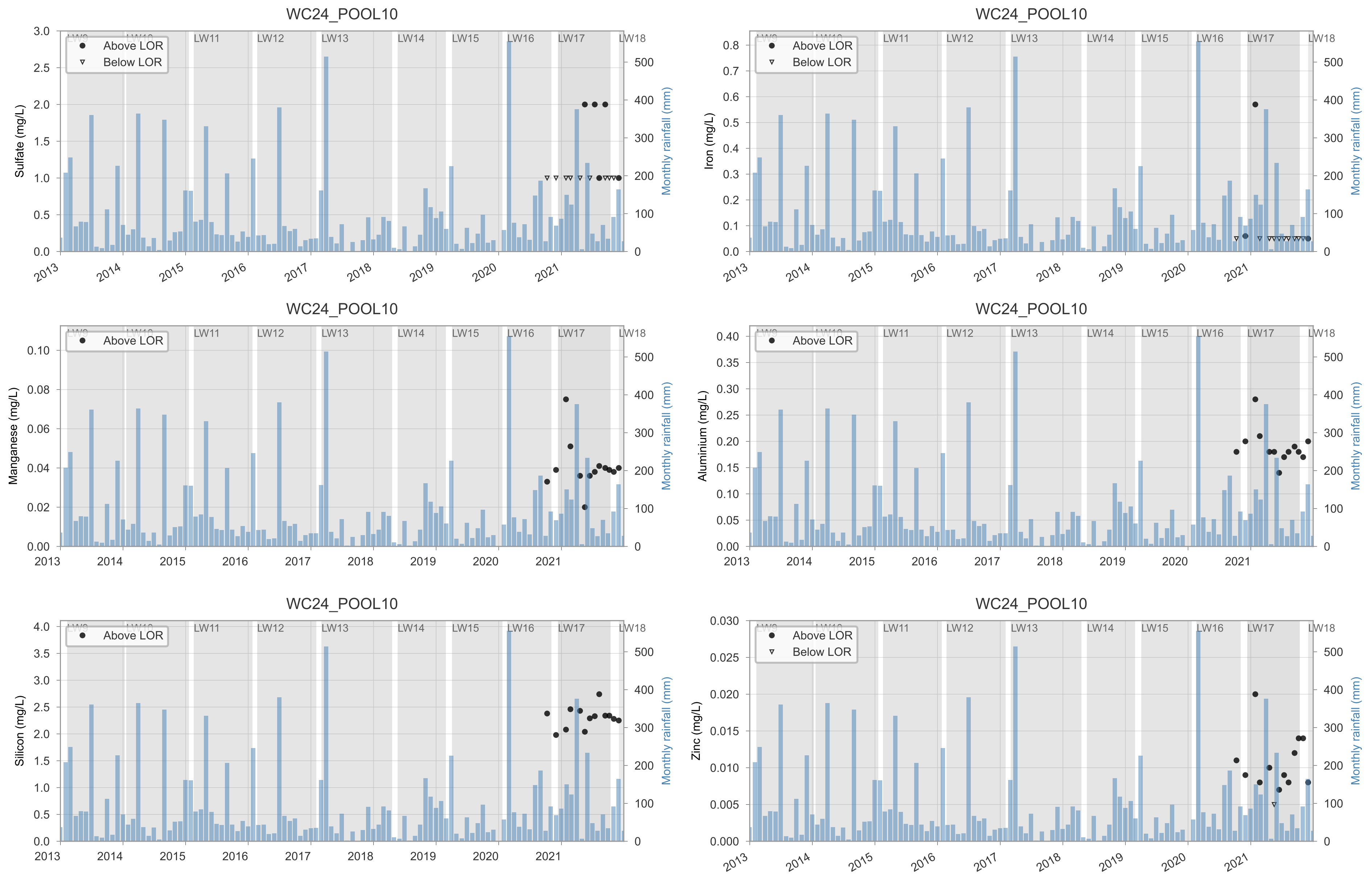

WC21_POOL5
Above LOR
Below LOR
Aluminium (mg/L)
Monthly rainfall (mm)
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

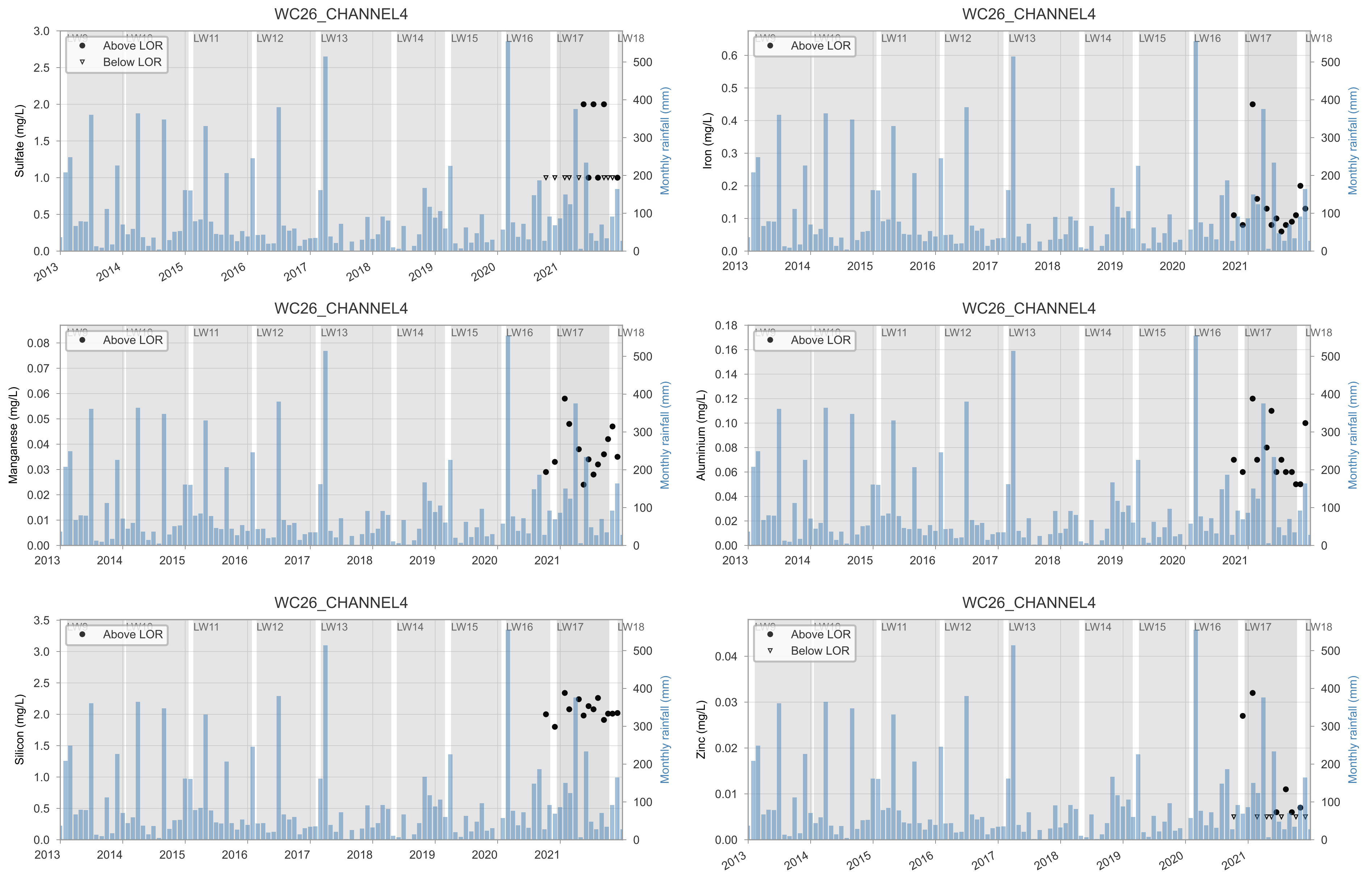

WC21_POOL5
Above LOR
Silicon (mg/L)
Monthly rainfall (mm)
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021


WC21_POOL5
Above LOR
Below LOR
Zinc (mg/L)
Monthly rainfall (mm)
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

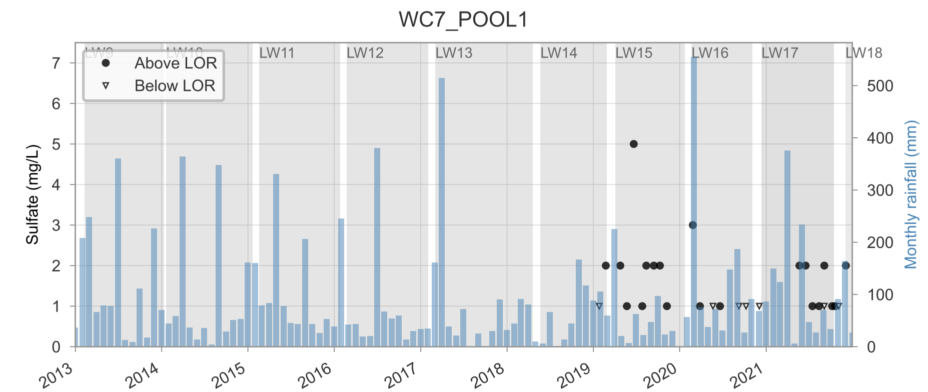


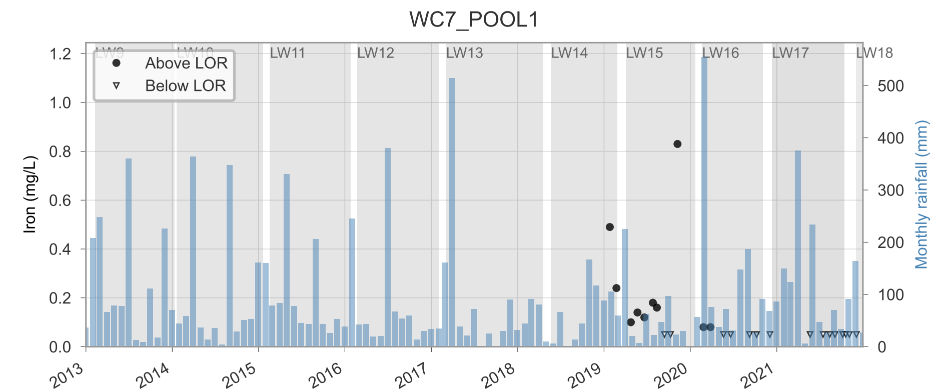
WC21_POOL53
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WC21_POOL53
Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
WC21_POOL53
Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
WC21_POOL53
Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
WC21_POOL53
Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
WC21_POOL53
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021

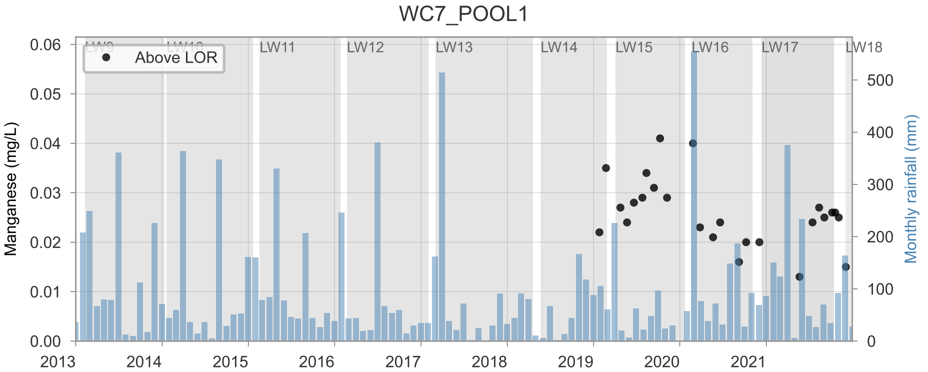

WC24_POOL10
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

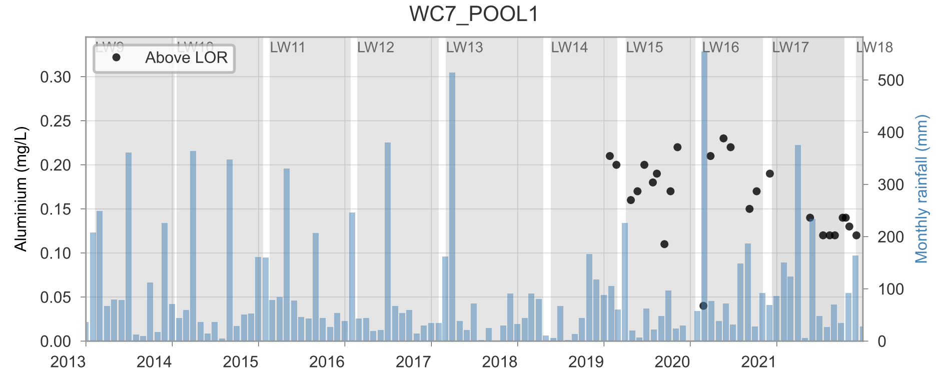


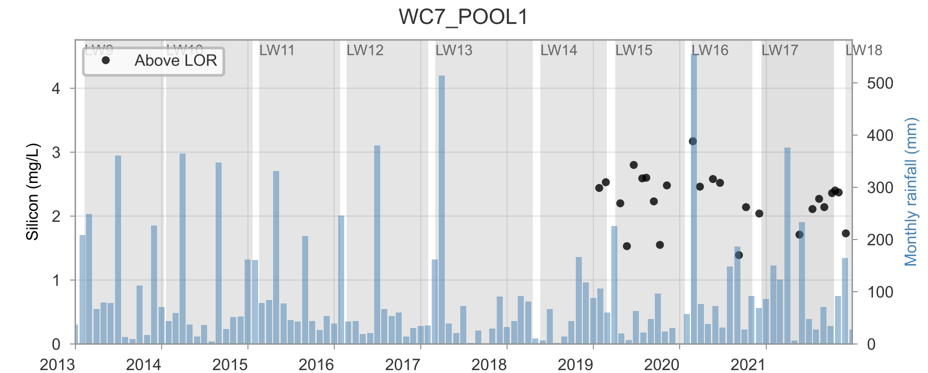
WC26_CHANNEL4
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021

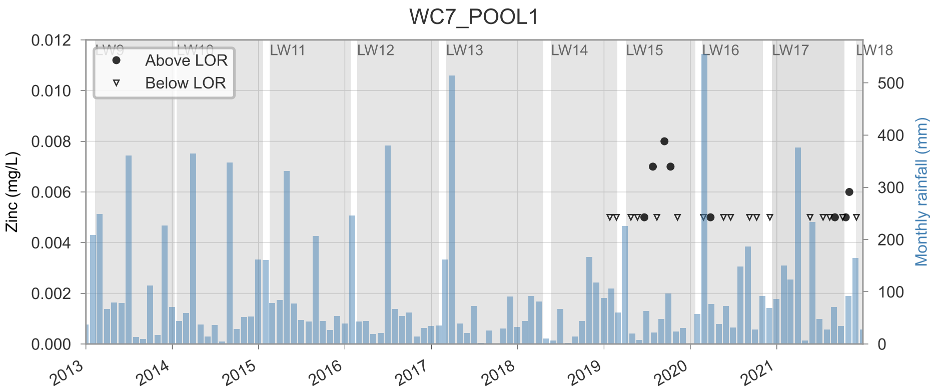

WC7_POOL1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Sulfate (mg/L)
Monthly rainfall (mm)

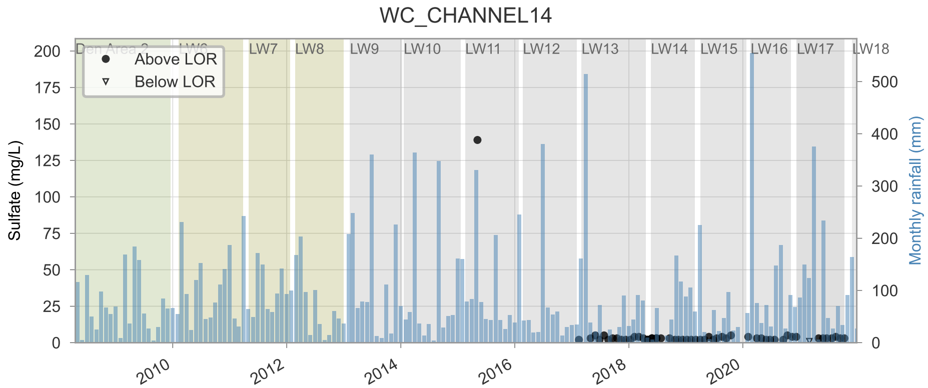

WC7_POOL1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Iron (mg/L)
Monthly rainfall (mm)

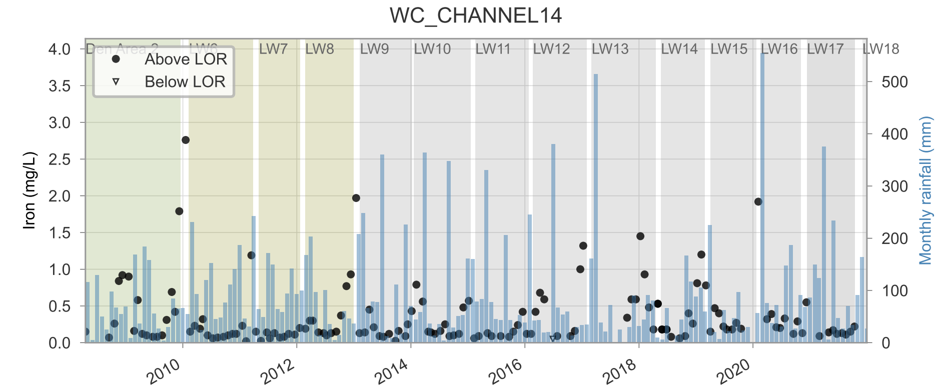

WC7_POOL1
Above LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Manganese (mg/L)
Monthly rainfall (mm)

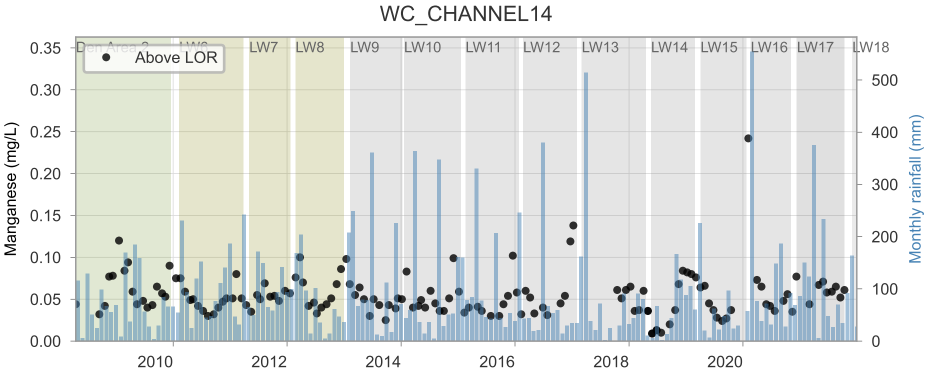

WC7_POOL1
Above LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Aluminium (mg/L)
Monthly rainfall (mm)

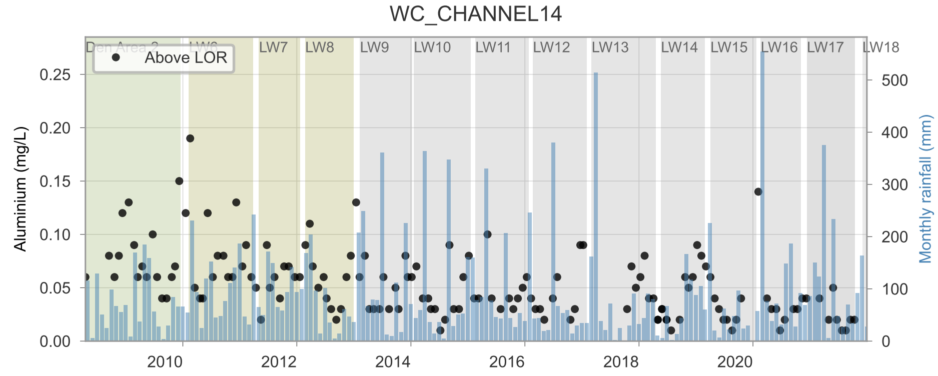

WC7_POOL1
Above LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Silicon (mg/L)
Monthly rainfall (mm)

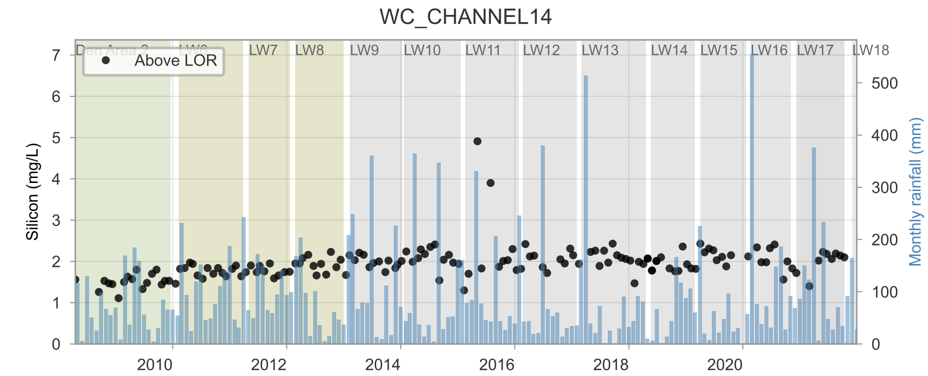

WC7_POOL1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Zinc (mg/L)
Monthly rainfall (mm)

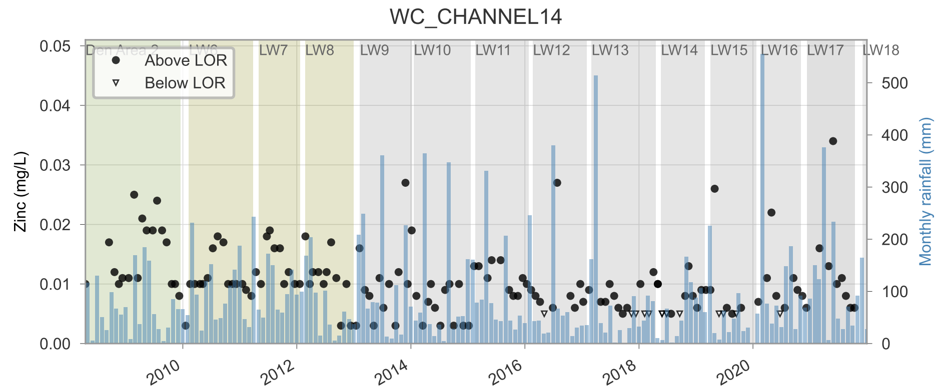

WC_CHANNEL14
Above LOR
Below LOR
Sulfate (mg/L)
Monthly rainfall (mm)
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
2010 2012 2014 2016 2018 2020

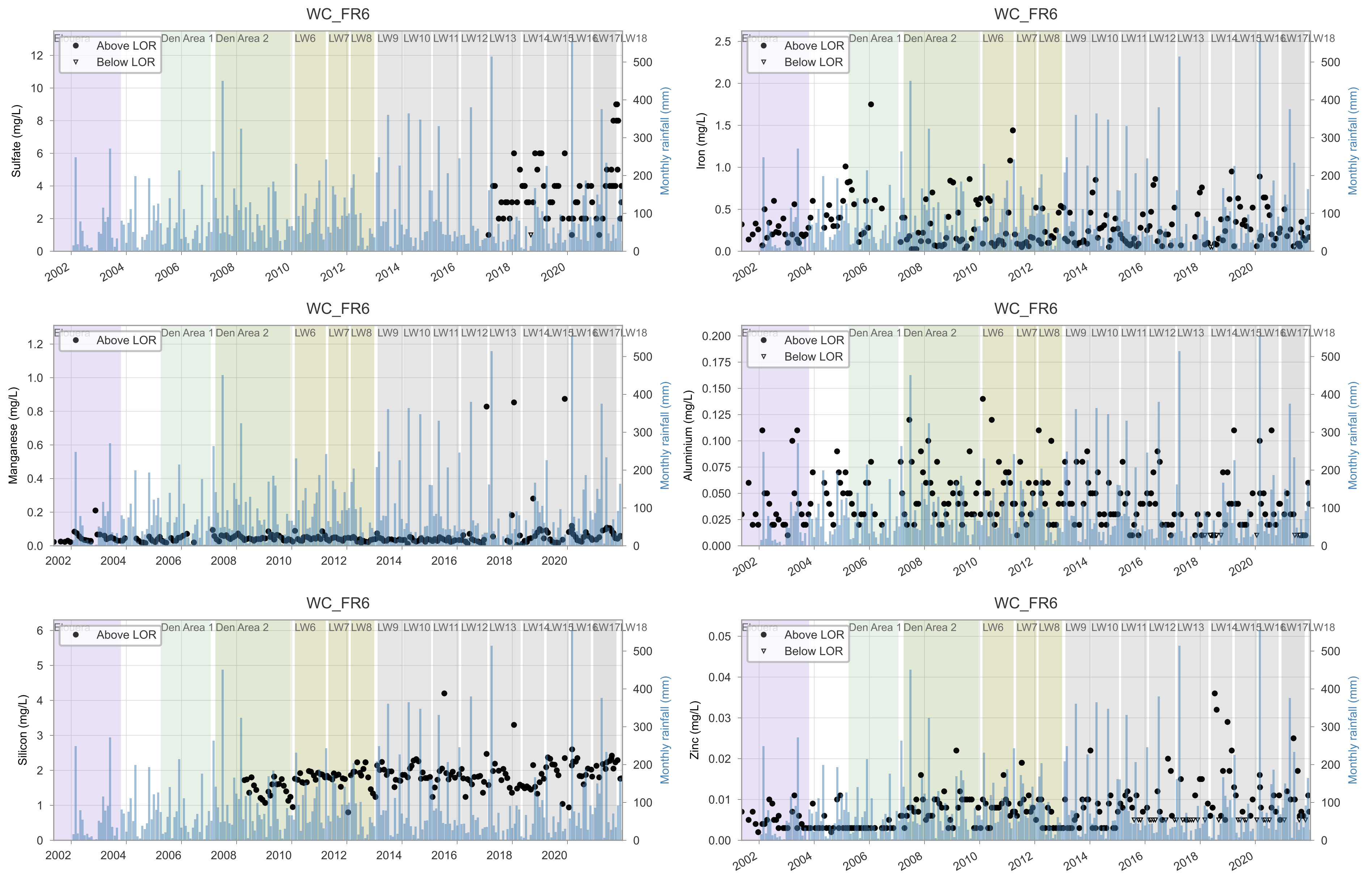

WC_CHANNEL14
Above LOR
Below LOR
Iron (mg/L)
Monthly rainfall (mm)
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
2010 2012 2014 2016 2018 2020

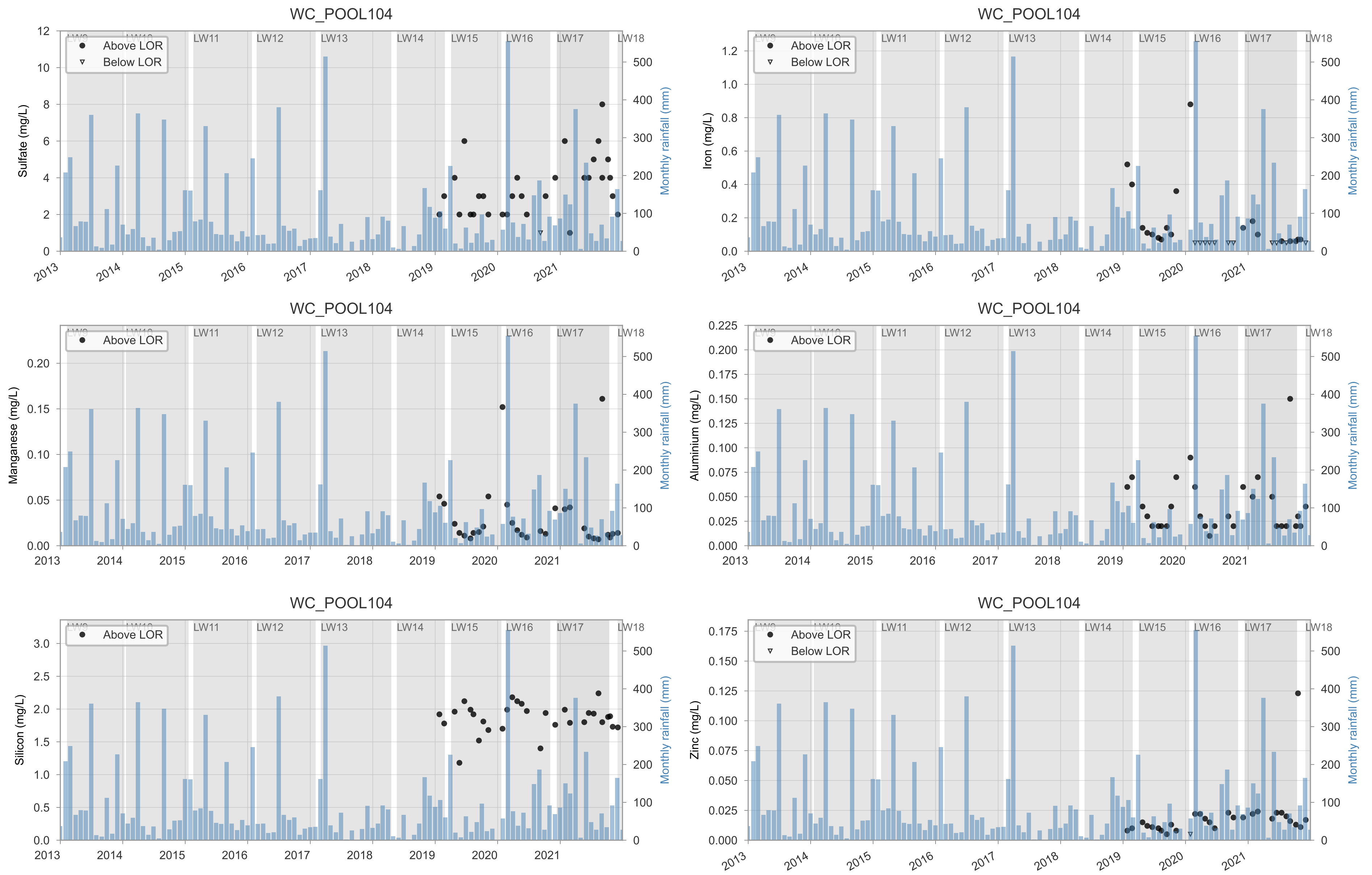

WC_CHANNEL14
Above LOR
Manganese (mg/L)
Monthly rainfall (mm)
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
2010 2012 2014 2016 2018 2020

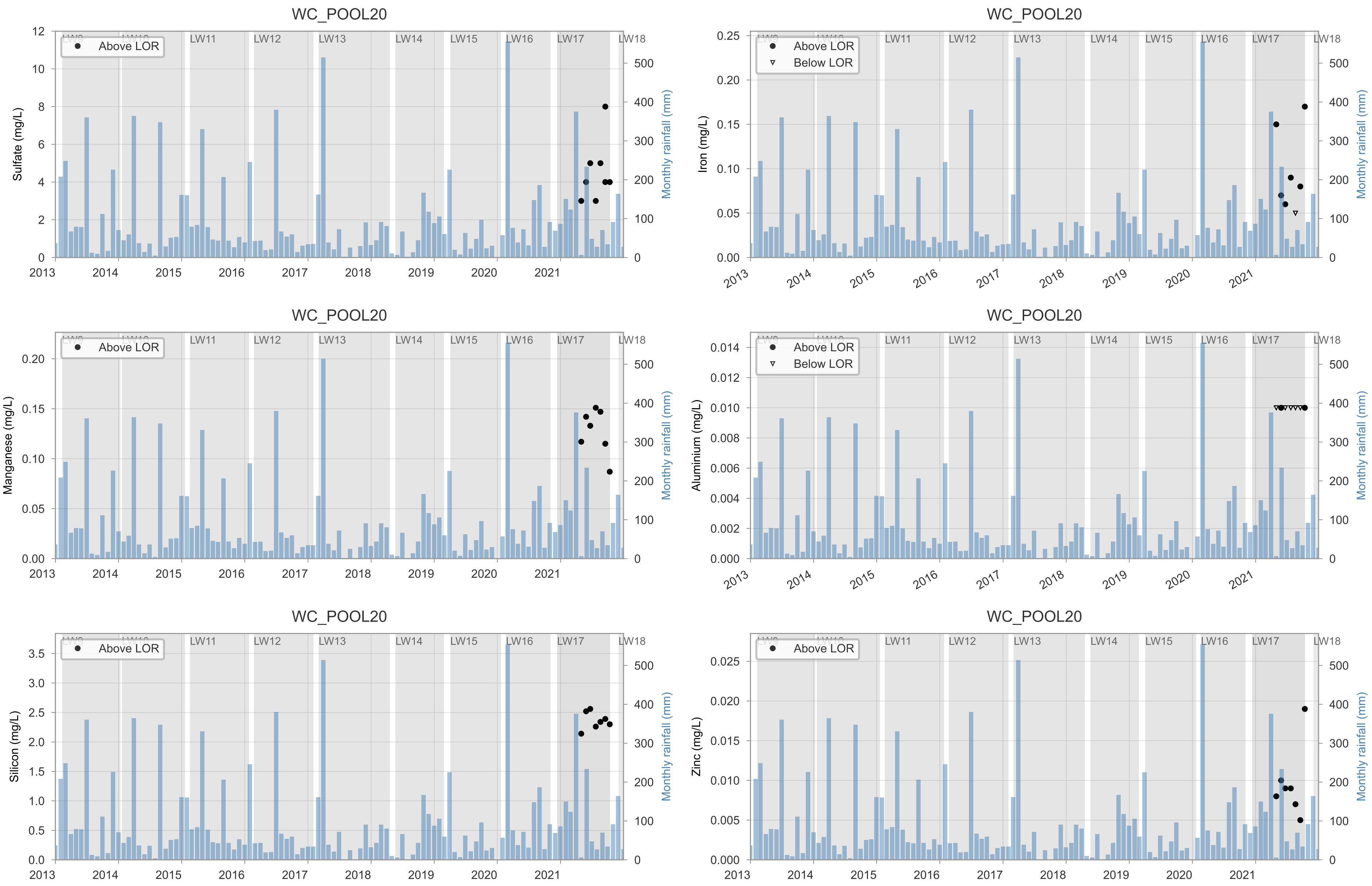

WC_CHANNEL14
Above LOR
Aluminium (mg/L)
Monthly rainfall (mm)
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
2010 2012 2014 2016 2018 2020

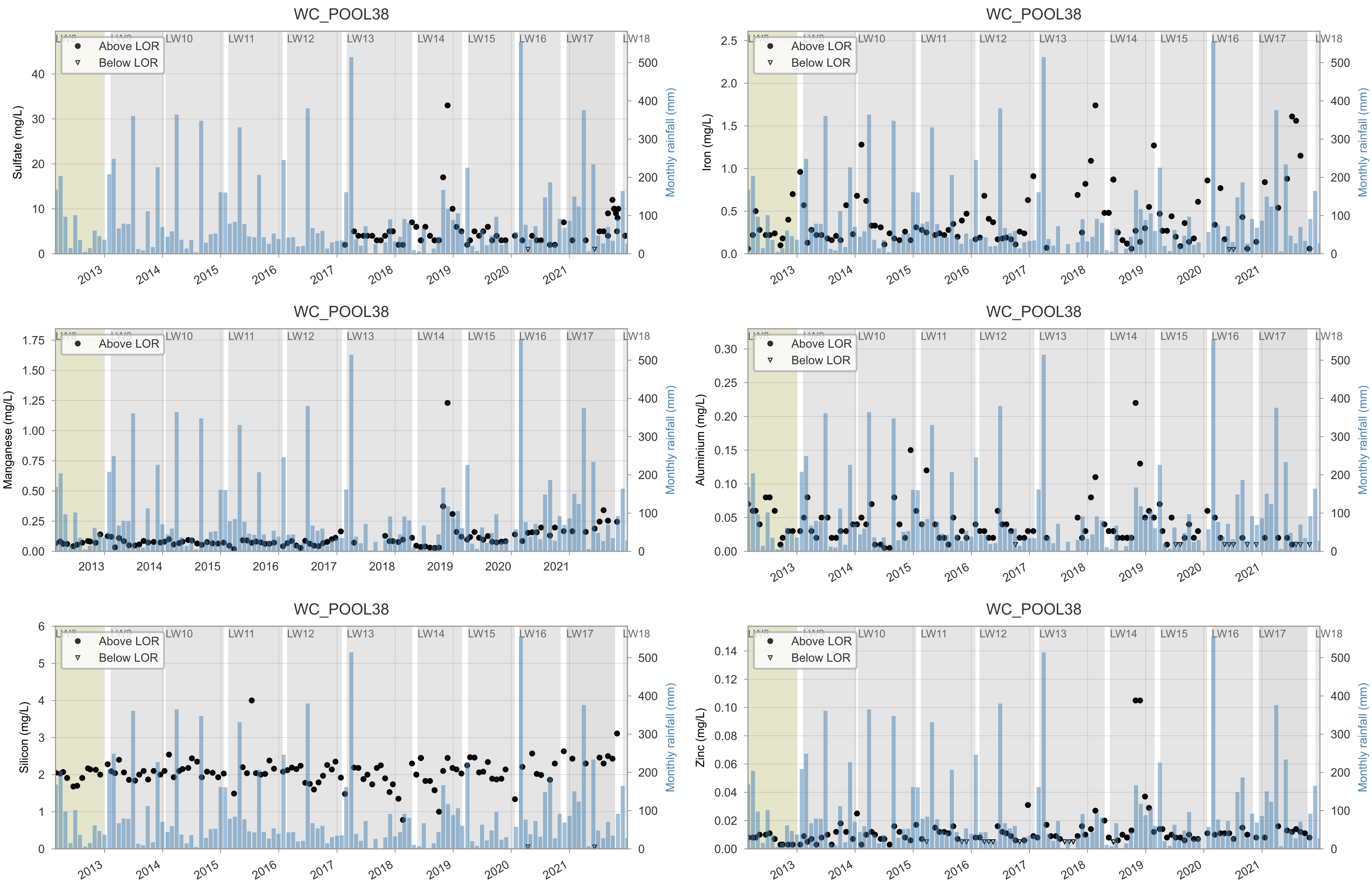

WC_CHANNEL14
Above LOR
Silicon (mg/L)
Monthly rainfall (mm)
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
2010 2012 2014 2016 2018 2020

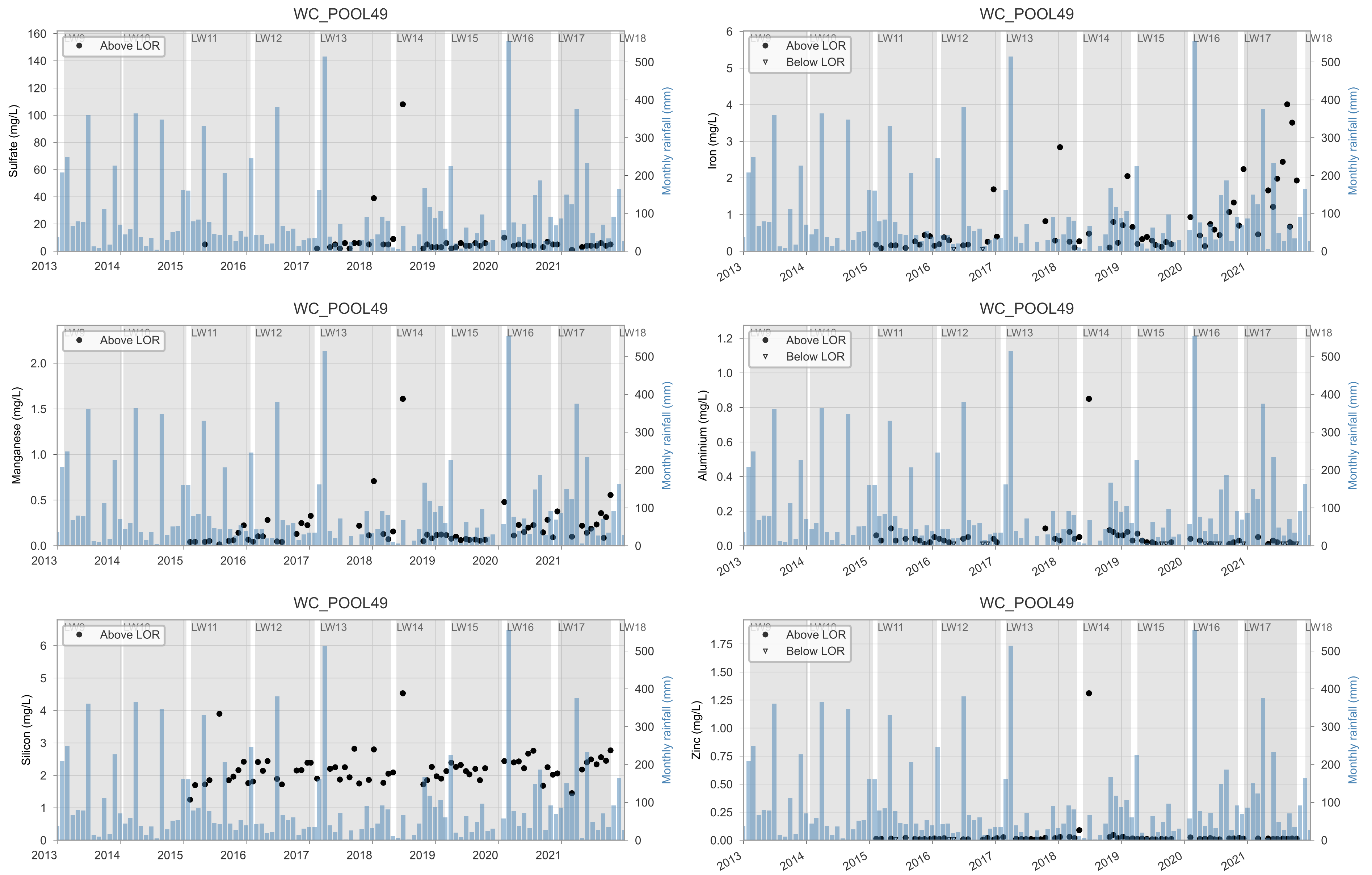

WC_CHANNEL14
Above LOR
Below LOR
Zinc (mg/L)
Monthly rainfall (mm)
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
2010 2012 2014 2016 2018 2020

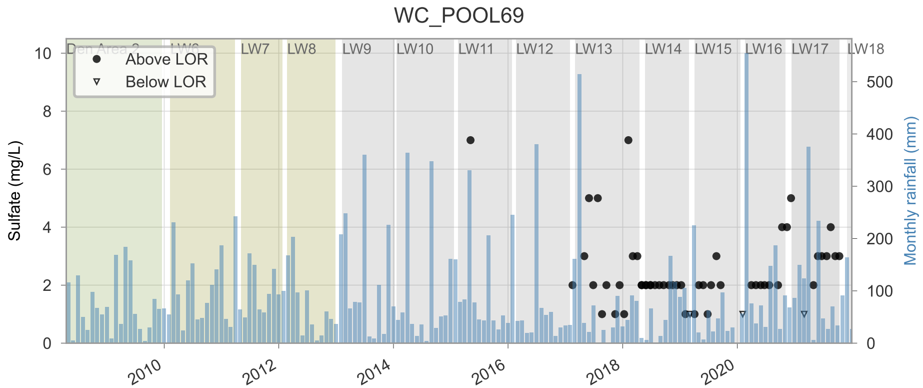
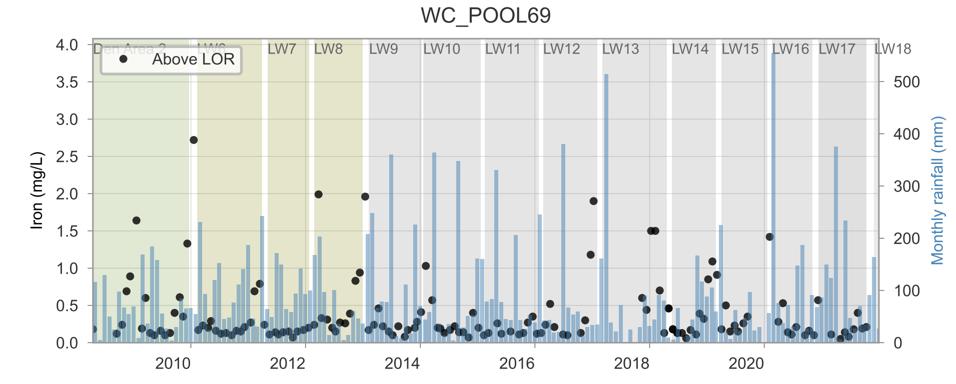
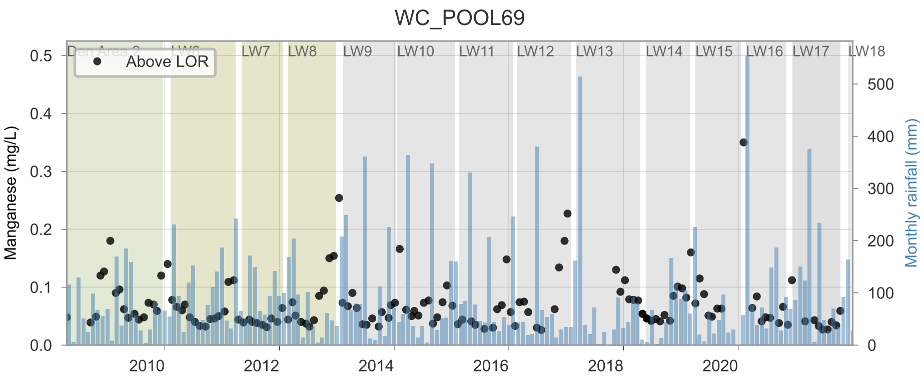
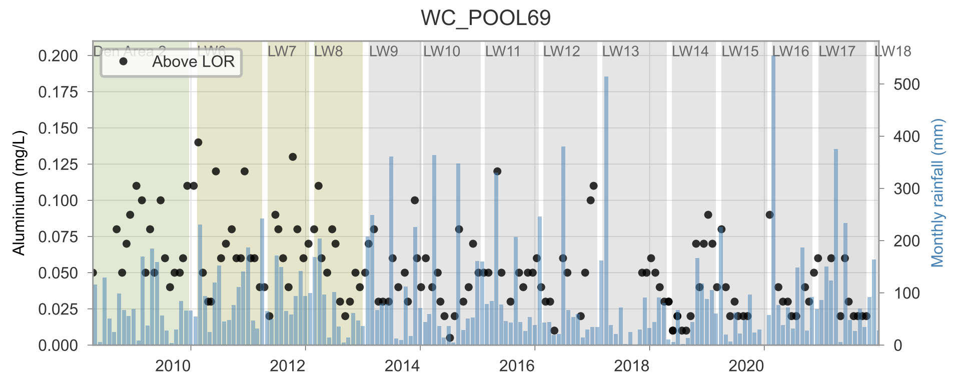
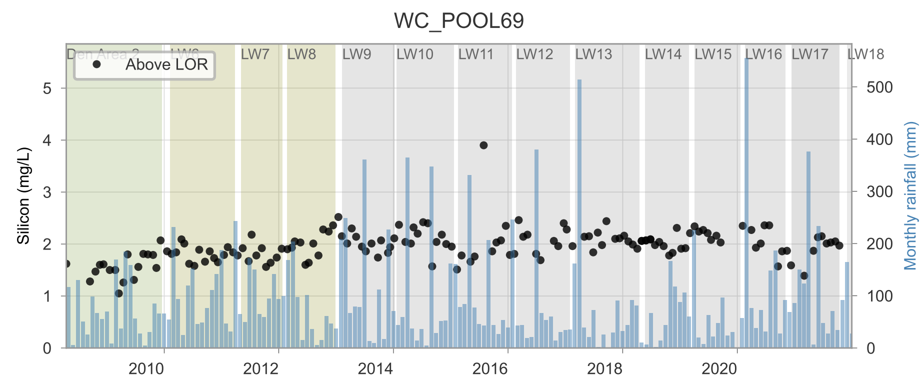

WC_FR6
Above LOR
Below LOR
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020


WC_POOL104
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021


WC_POOL20
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
WC_POOL20
Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
WC_POOL20
Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
WC_POOL20
Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
WC_POOL20
Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
WC_POOL20
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
2013
2014
2015
2016
2017
2018
2019
2020
2021


WC_POOL38
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021
WC_POOL38
Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
WC_POOL38
Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
WC_POOL38
Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
WC_POOL38
Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
WC_POOL38
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR


WC_POOL49
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
WC_POOL49
Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
WC_POOL49
Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
WC_POOL49
Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
WC_POOL49
Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
WC_POOL49
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
2013
2014
2015
2016
2017
2018
2019
2020
2021


WC_POOL69
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

WC_POOL69
Iron (mg/L)
Monthly rainfall (mm)
Above LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

WC_POOL69
Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

WC_POOL69
Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

WC_POOL69
Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
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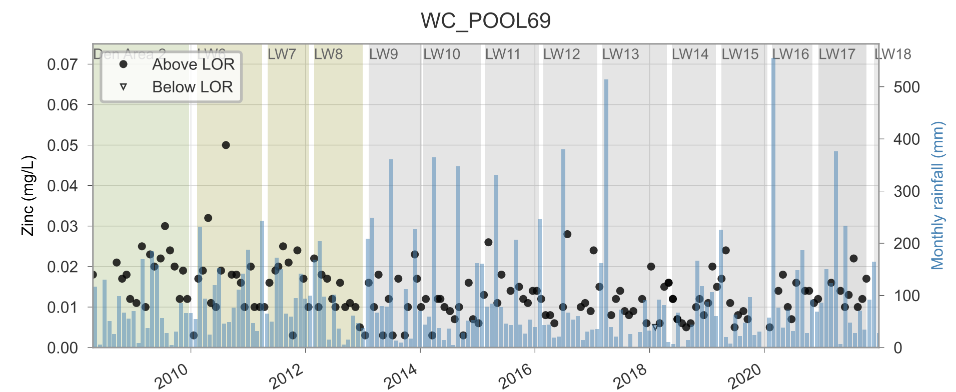
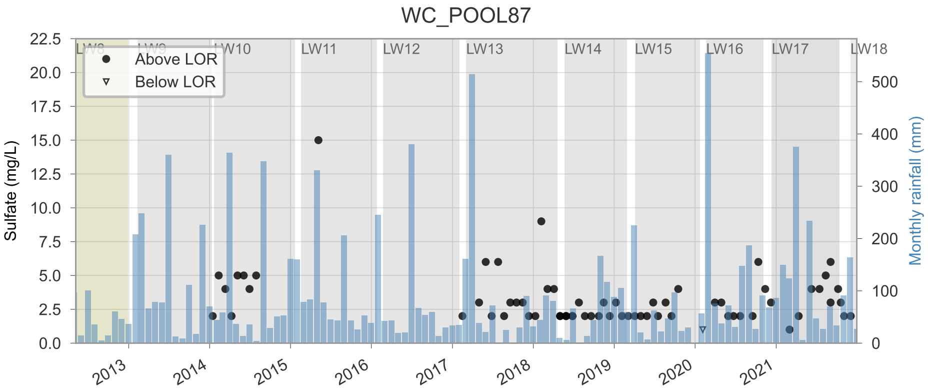
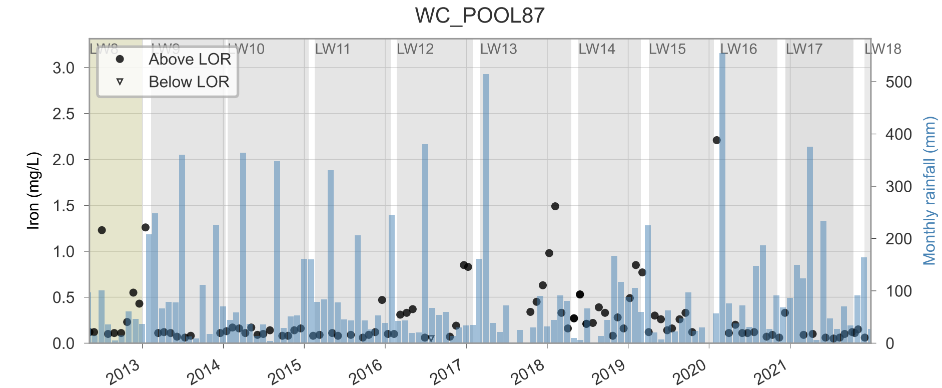
LW15
LW16
LW17
LW18

WC_POOL69
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18


WC_POOL87
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5
0 100 200 300 400 500
2013 2014 2015 2016 2017 2018 2019 2020 2021


WC_POOL87
Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
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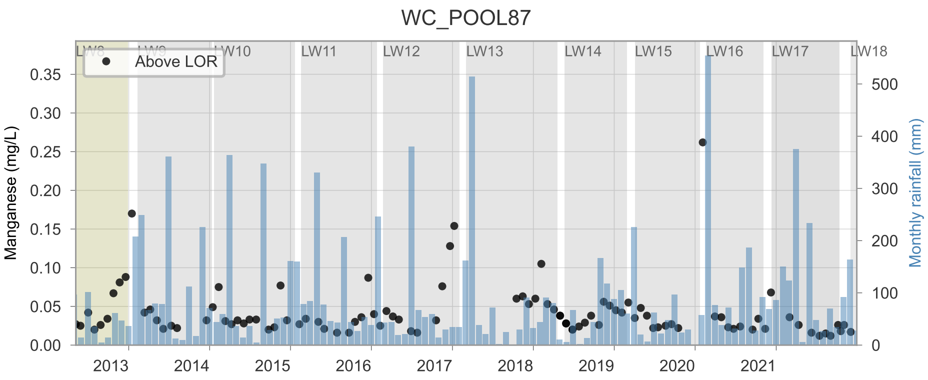
0 100 200 300 400 500
2013 2014 2015 2016 2017 2018 2019 2020 2021


WC_POOL87
Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
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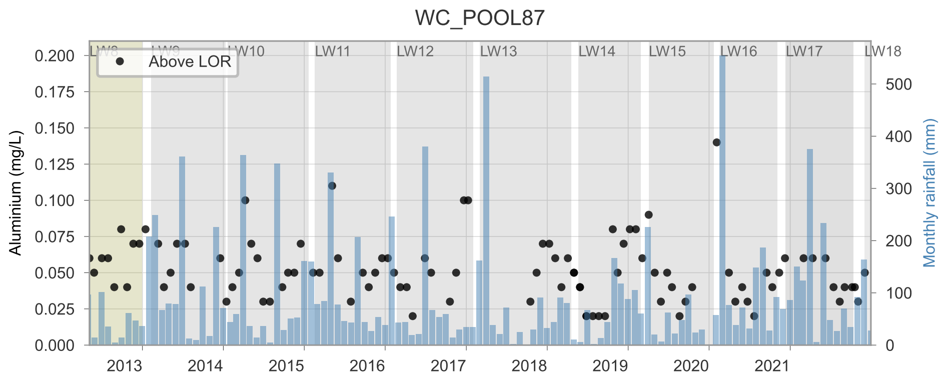
0 100 200 300 400 500
2013 2014 2015 2016 2017 2018 2019 2020 2021


WC_POOL87
Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
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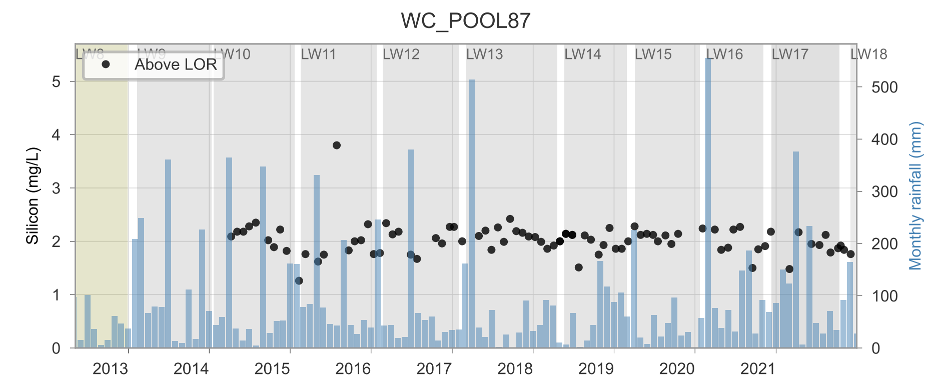
0 100 200 300 400 500
2013 2014 2015 2016 2017 2018 2019 2020 2021


WC_POOL87
Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
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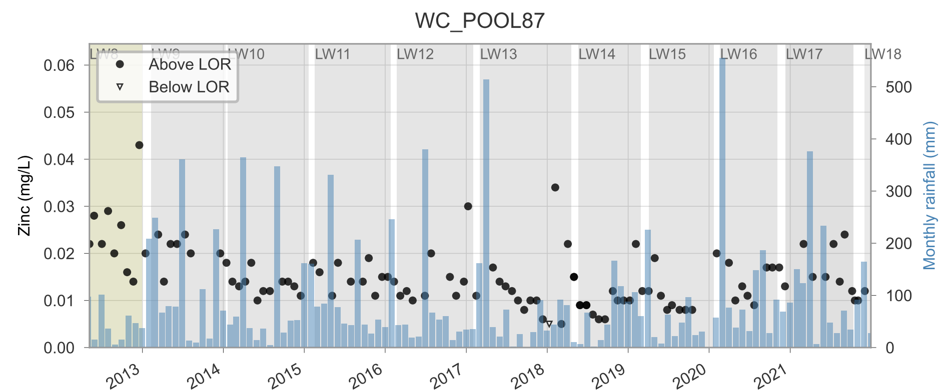
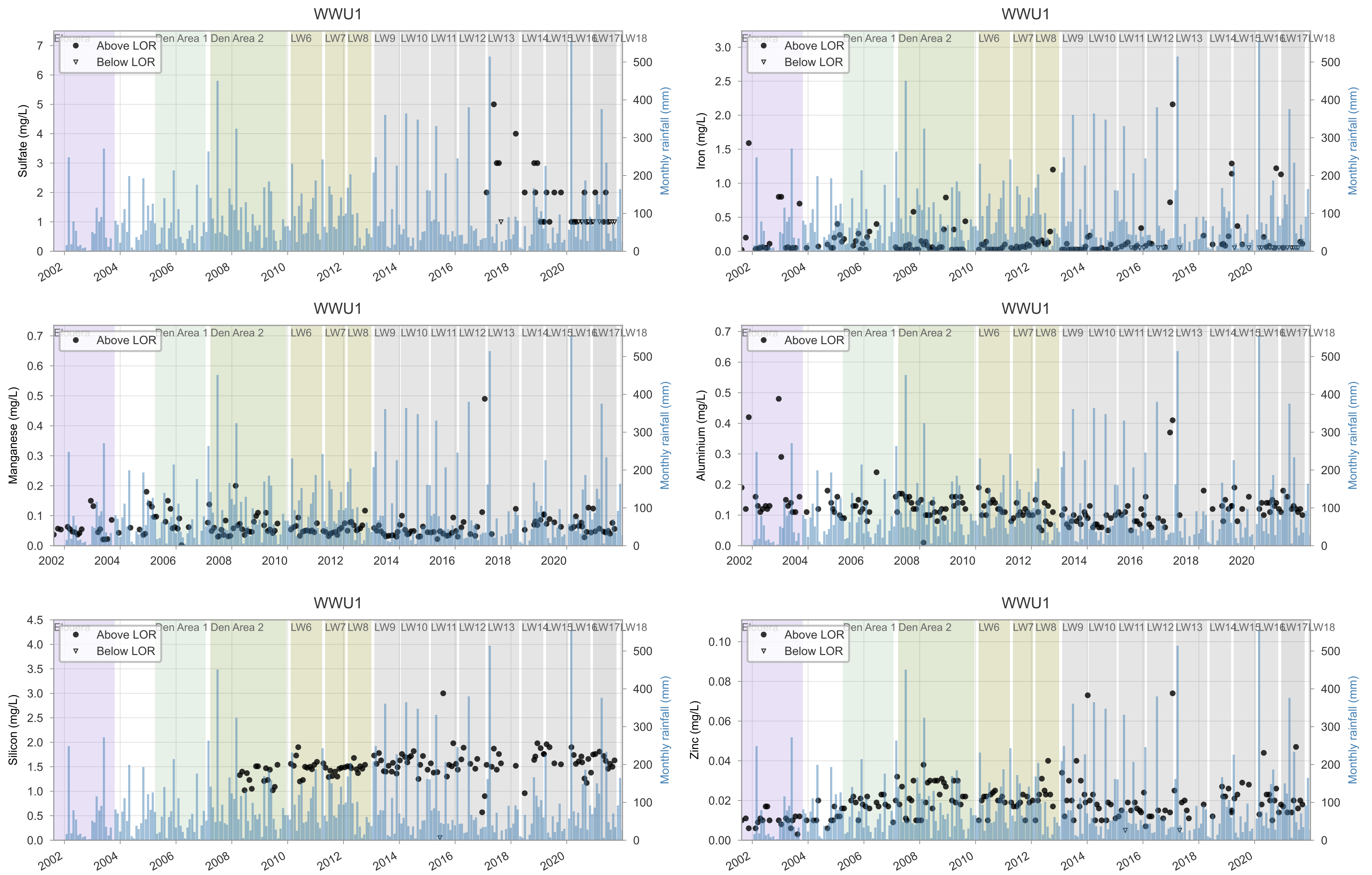
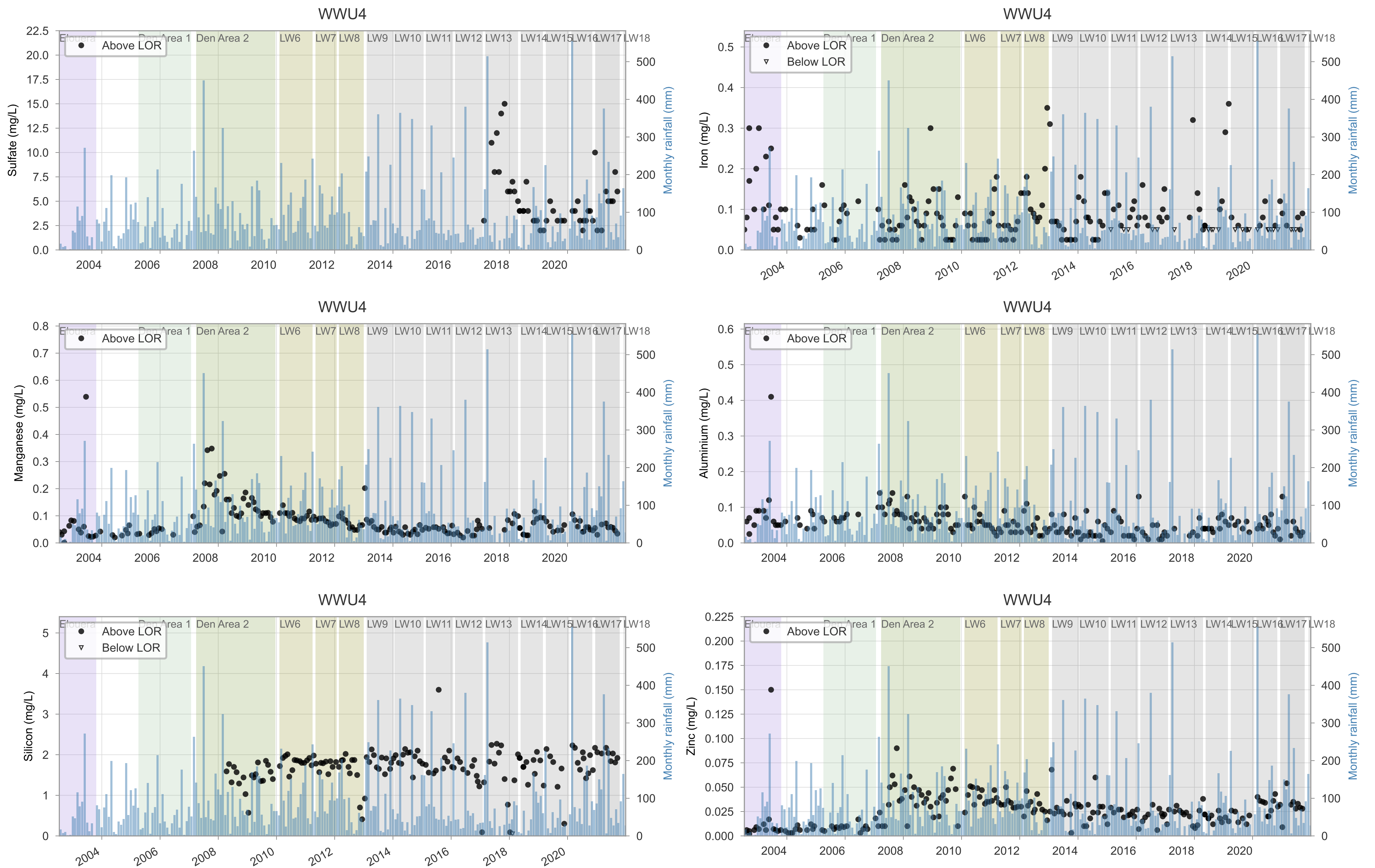
0 100 200 300 400 500
2013 2014 2015 2016 2017 2018 2019 2020 2021


WC_POOL87
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18
0.00 0.01 0.02 0.03 0.04 0.05 0.06
0 100 200 300 400 500
2013 2014 2015 2016 2017 2018 2019 2020 2021

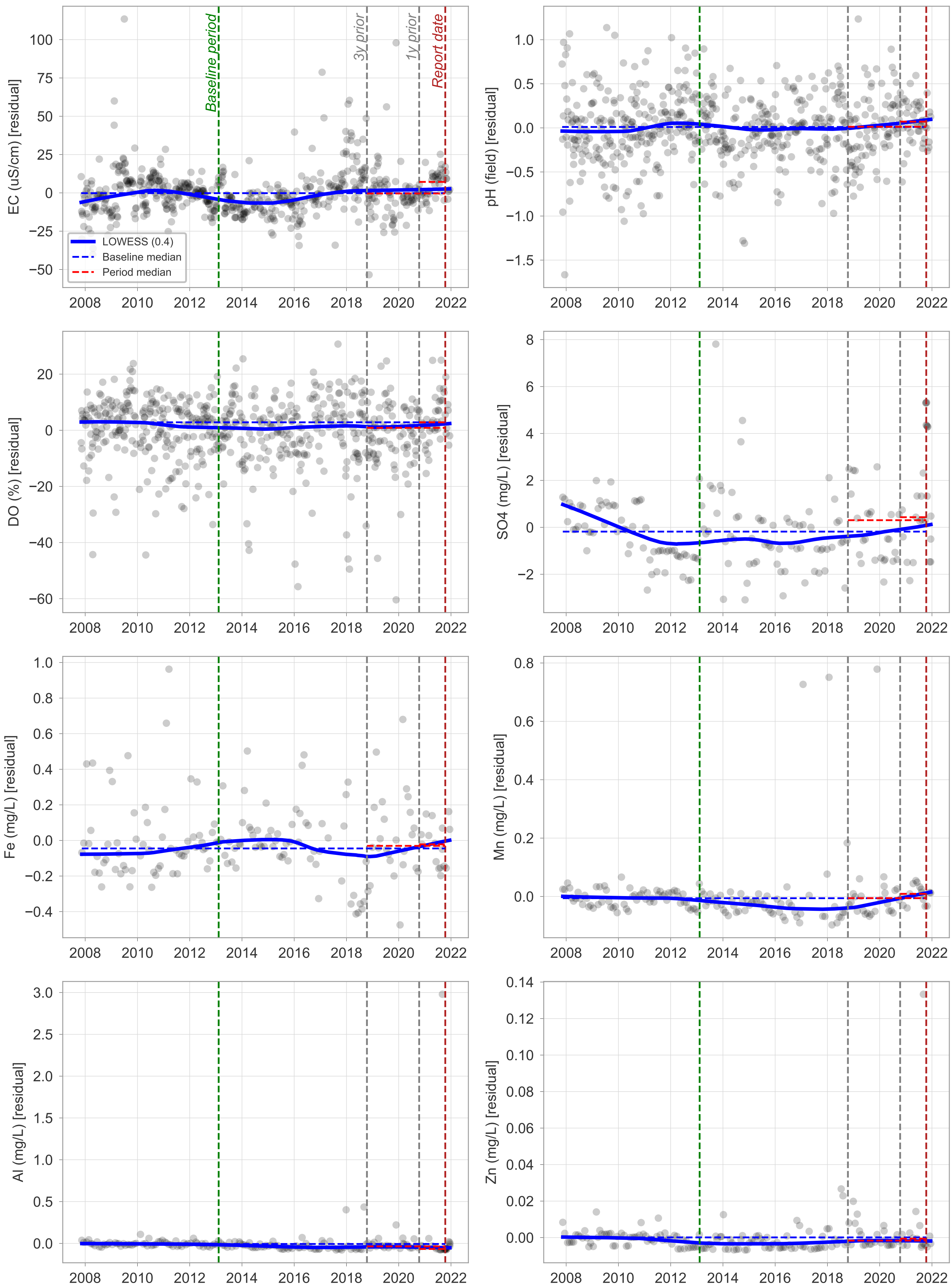

WWU1
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18
Above LOR
Below LOR
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020


WWU4
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW18

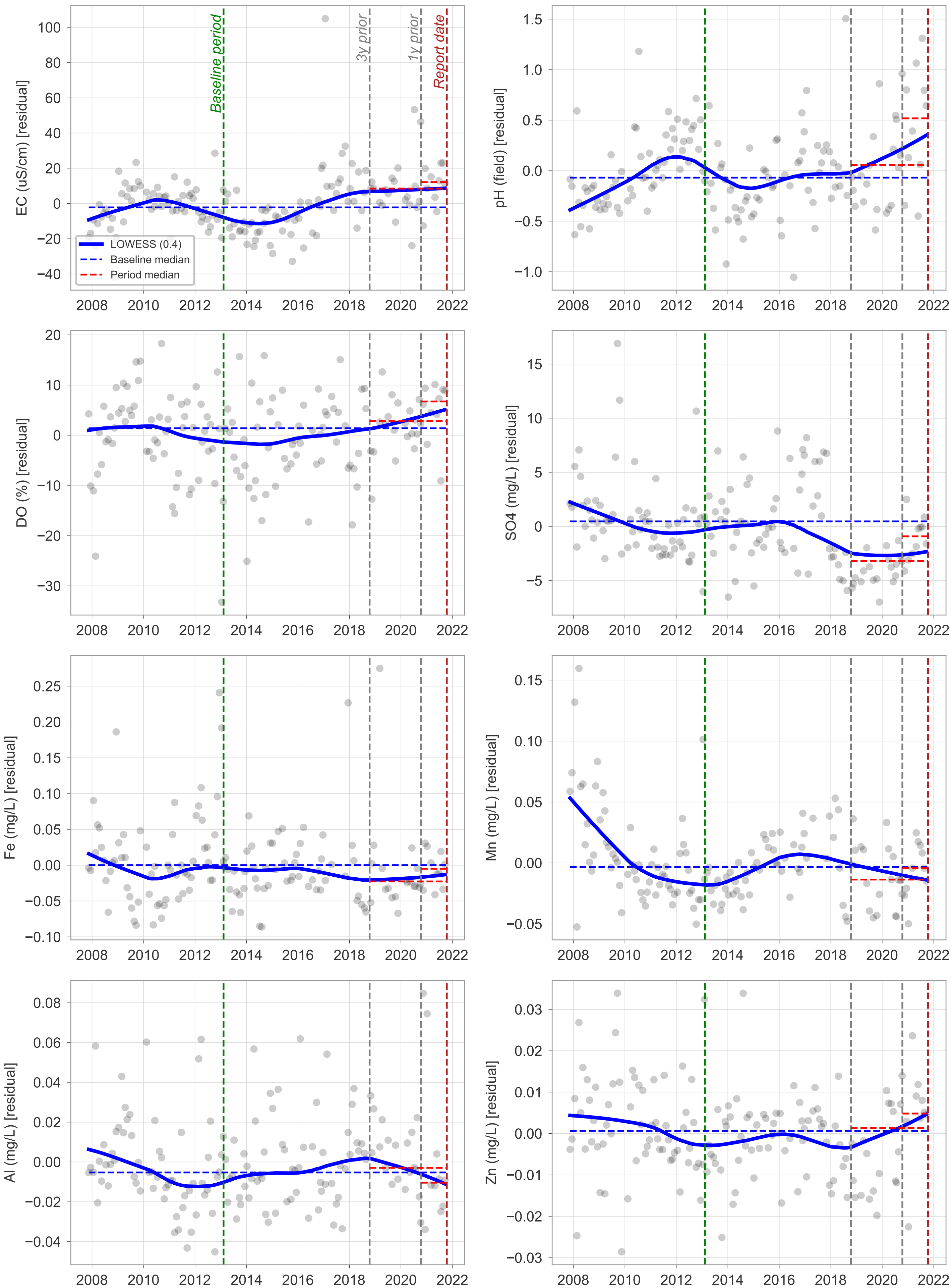
Appendix A2: Water quality trend analysis

Analysis of water quality trends in flow-corrected data															
WQ_site	**Stream_gauge**	**Param**	**Theil-Sen slope**		**Mann-Kendall serial correlation**		**1-year_trend**	**3-year_trend**	**median_BL**	**median_1y**	**median_3y**	**Mann-Whitney U test**		**1-year mean test**	**3-year mean test**
			1-year slope	**3-year slope**	**1-year**	**3-year**						**1-year**	**3-years**		
WC_FR6	WWL	EC_uS/cm	4.71E-02	1.06E-02	**1.19E-03**	**9.59E-04**	Increasing	Increasing	95	95.5	100.5	**0.000**	0.218	Higher than BL	
WC_FR6	WWL	pH_field	-2.80E-04	3.03E-04	5.13E-01	**1.16E-03**			5.94	6.17	6.13	0.464	0.621		
WC_FR6	WWL	DO_%	4.41E-02	7.27E-03	**5.98E-04**	**5.85E-03**			93.4	93.45	87.55	0.267	0.214		
WC_FR6	WWL	SO4_mg/L	1.54E-02	4.64E-04	**5.90E-03**	5.92E-01	Increasing		3	4	4	0.076	0.536		
WC_FR6	WWL	Fe_mg/L	-5.71E-04	-6.43E-05	7.63E-02	4.74E-01			0.15	0.18	0.26	0.839	0.605		
WC_FR6	WWL	Mn_mg/L	-1.03E-04	3.20E-05	6.75E-01	1.22E-01			0.04	0.076	0.062	0.183	0.600		
WC_FR6	WWL	Zn_mg/L	5.48E-08	-1.57E-06	1.00E+00	1.79E-01			0.008	0.01	0.0075	0.780	0.551		
WC_FR6	WWL	Al_mg/L	-1.31E-04	-5.10E-05	7.88E-02	**9.59E-04**			0.06	0.025	0.045	**0.000**	**0.000**		
DCC_FR6	DCU	EC_uS/cm	-1.49E-01	-5.43E-02	**8.08E-06**	**7.77E-03**			116	110	149	**0.000**	**0.000**		Higher than BL
DCC_FR6	DCU	pH_field	-2.73E-03	-1.51E-03	**1.14E-04**	**2.59E-09**	Decreasing	Decreasing	5.25	4.745	4.97	**0.000**	**0.001**	Lower than BL	Lower than BL
DCC_FR6	DCU	DO_%	3.26E-02	1.63E-02	**2.63E-03**	**2.31E-04**			89.3	92.7	86.55	0.193	**0.029**		Lower than BL
DCC_FR6	DCU	SO4_mg/L	-3.66E-02	-2.30E-02	**1.63E-05**	**2.06E-02**			2	5.5	11	**0.000**	**0.000**	Higher than BL	Higher than BL
DCC_FR6	DCU	Fe_mg/L	-1.13E-03	-1.53E-04	**1.07E-04**	**2.55E-02**			0.12	0.06	0.14	**0.026**	0.054		
DCC_FR6	DCU	Mn_mg/L	-1.68E-04	-1.16E-04	6.29E-02	**4.98E-02**			0.04	0.0765	0.121	**0.000**	**0.000**	Higher than BL	Higher than BL
DCC_FR6	DCU	Zn_mg/L	-1.01E-09	-1.88E-06	1.00E+00	5.49E-01			0.005	0.016	0.0175	**0.000**	**0.000**	Higher than BL	Higher than BL
DCC_FR6	DCU	Al_mg/L	-1.46E-03	-3.20E-06	**5.38E-03**	9.57E-01			0.15	0.3075	0.3525	**0.002**	**0.000**	Higher than BL	Higher than BL
SCK_ROCKBAR5	SCL2	EC_uS/cm	-3.17E-02	5.88E-03	6.48E-01	4.79E-01			N/A	115	124	N/A	N/A	Insufficient baseline	
SCK_ROCKBAR5	SCL2	pH_field	-1.57E-03	6.86E-04	2.18E-01	**1.22E-02**			N/A	6.23	5.83	N/A	N/A	Insufficient baseline	
SCK_ROCKBAR5	SCL2	DO_%	1.75E-02	3.61E-03	**2.64E-02**	3.80E-01			N/A	89.1	88.6	N/A	N/A	Insufficient baseline	
SCK_ROCKBAR5	SCL2	SO4_mg/L	7.68E-04	4.88E-03	1.00E+00	**2.60E-02**		Increasing	N/A	9	7	N/A	N/A	Insufficient baseline	
SCK_ROCKBAR5	SCL2	Fe_mg/L	1.53E-03	8.48E-04	8.62E-01	**9.35E-03**		Increasing	N/A	1.335	0.725	N/A	N/A	Insufficient baseline	
SCK_ROCKBAR5	SCL2	Mn_mg/L	7.49E-04	3.49E-04	4.84E-01	**4.17E-03**		Increasing	N/A	0.539	0.4075	N/A	N/A	Insufficient baseline	
SCK_ROCKBAR5	SCL2	Zn_mg/L	-4.57E-05	-9.58E-07	3.81E-01	9.16E-01			N/A	0.0345	0.0355	N/A	N/A	Insufficient baseline	
SCK_ROCKBAR5	SCL2	Al_mg/L	-2.48E-05	-4.96E-05	7.27E-01	**3.70E-03**			N/A	0.05	0.08	N/A	N/A	Insufficient baseline	
WWU4	WWU	EC_uS/cm	4.42E-02	5.49E-03	2.91E-01	3.76E-01			84.5	88.5	95	**0.006**	**0.000**	Higher than BL	Higher than BL
WWU4	WWU	pH_field	2.27E-03	9.13E-04	4.84E-01	**7.48E-03**			5.28	6.12	5.615	**0.032**	0.466		
WWU4	WWU	DO_%	4.85E-03	6.91E-03	1.00E+00	**4.12E-02**			93.1	99.2	94.9	**0.033**	0.138		
WWU4	WWU	SO4_mg/L	1.27E-02	4.64E-03	7.26E-02	**2.75E-06**		Increasing	6.5	5	3	0.133	**0.000**		
WWU4	WWU	Fe_mg/L	-3.69E-05	1.63E-05	7.27E-01	4.45E-01			0.07	0.055	0.05	0.911	0.215		
WWU4	WWU	Mn_mg/L	7.83E-05	-2.83E-06	6.01E-01	7.52E-01			0.0955	0.0555	0.058	0.782	0.622		
WWU4	WWU	Zn_mg/L	9.49E-06	1.82E-05	6.01E-01	**9.29E-03**		Increasing	0.035	0.031	0.028	0.118	0.595		
WWU4	WWU	Al_mg/L	-1.13E-04	-3.01E-05	3.81E-01	**1.04E-02**			0.0625	0.0425	0.06	0.681	0.293		

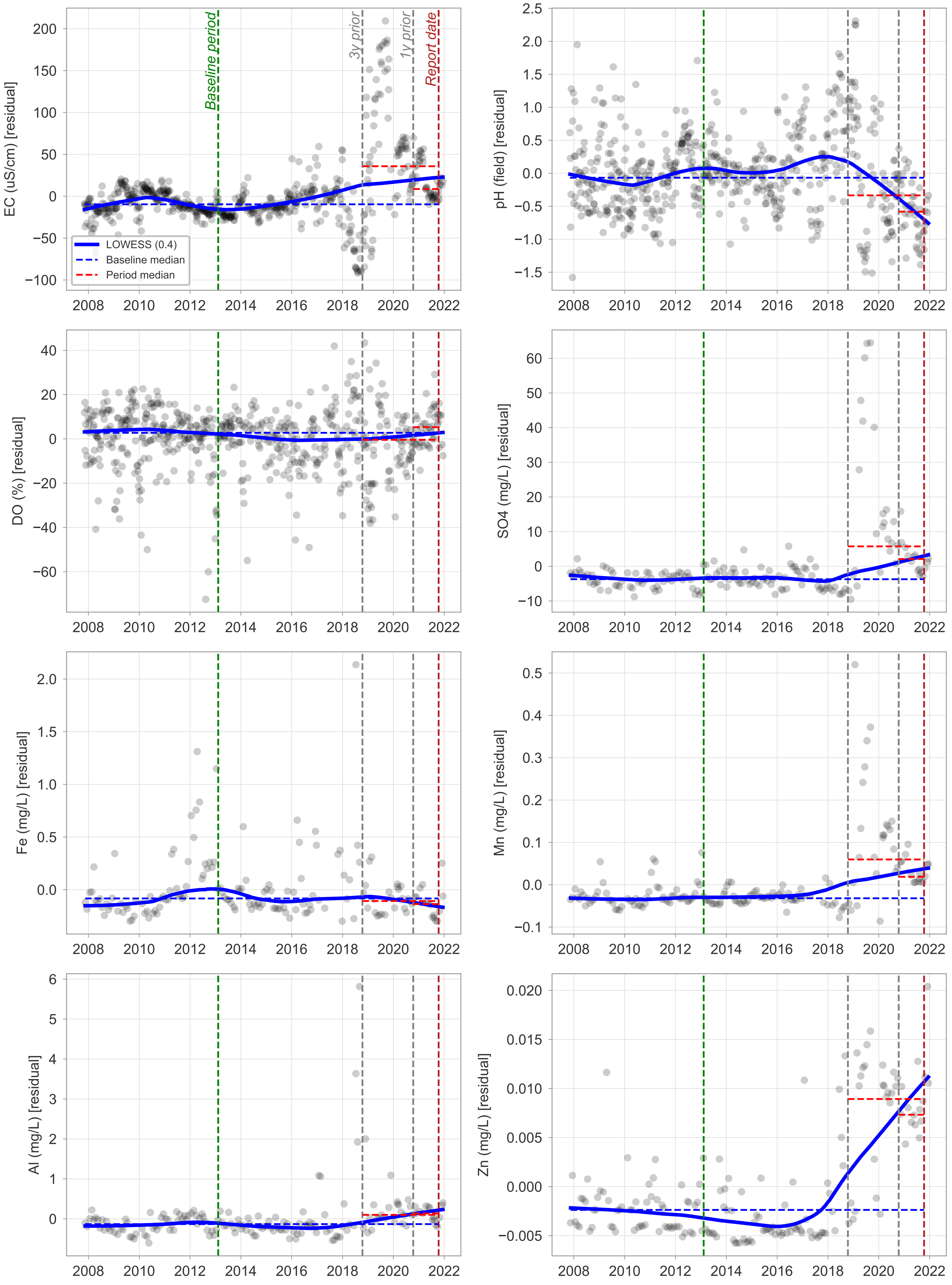
WC_FR6 Flow-corrected time series



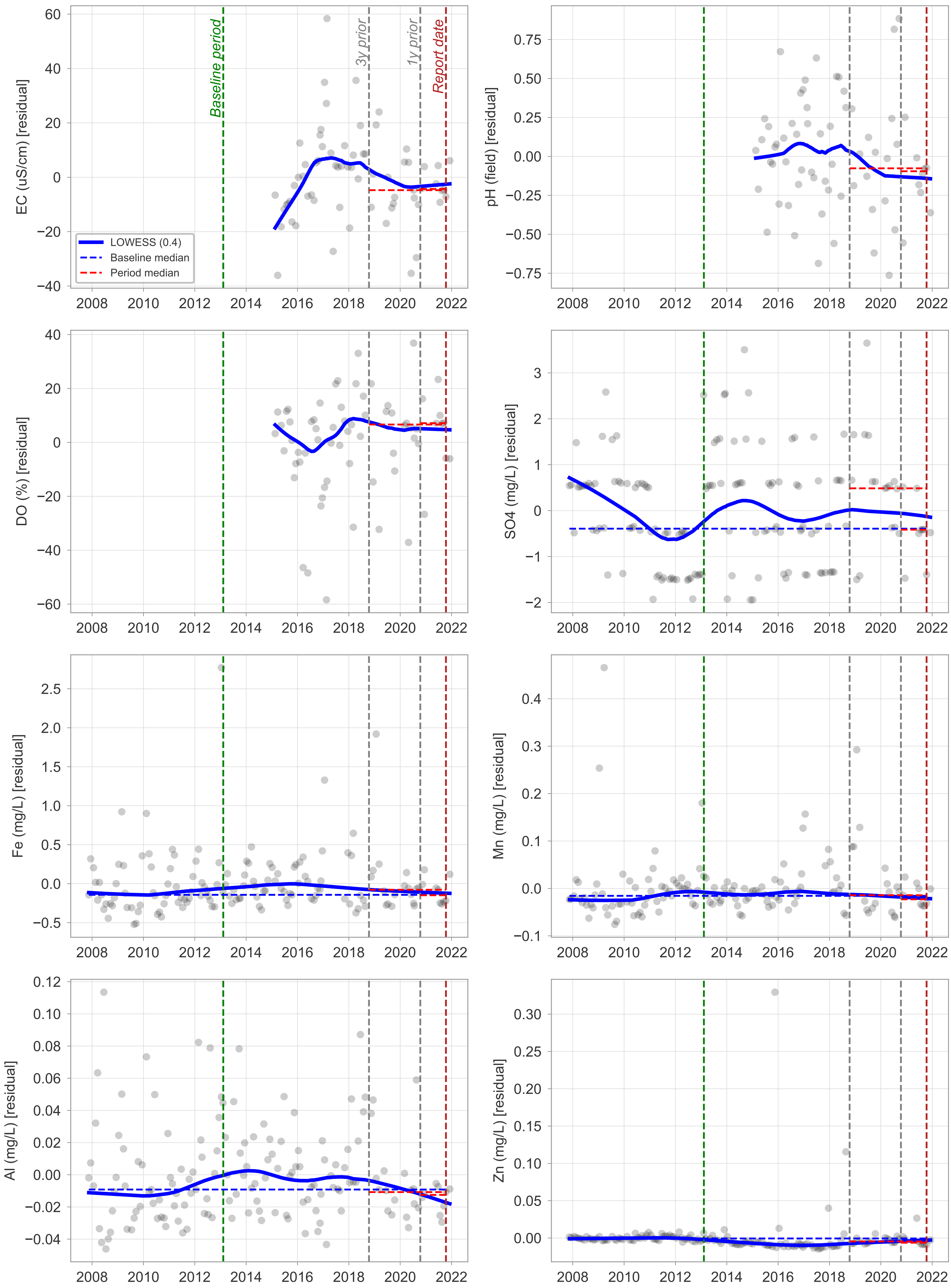
WWU4 Flow-corrected time series



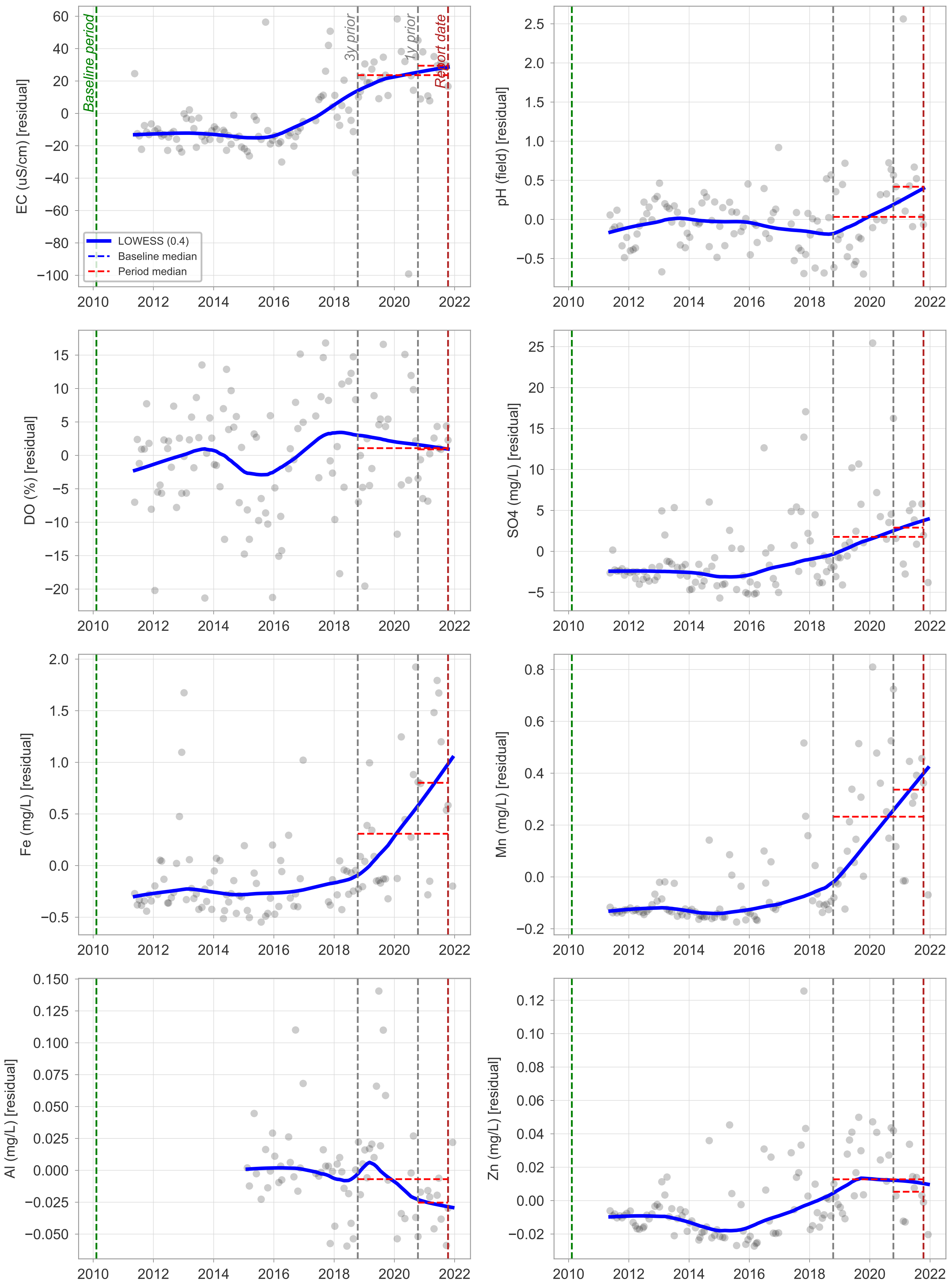
DCC_FR6 Flow-corrected time series



DCL3 Flow-corrected time series



SCK_ROCKBAR5 Flow-corrected time series



Appendix B: Rainfall data

Monitoring Data

The geographic distribution of the various data sources at which rainfall and stream flow is measured around Dendrobium are shown on Figure B1.

Rainfall data

Rainfall data for the Dendrobium area is available from three primary sources (Figure B1):

- A series of rainfall gauges owned by IMC ("site data") and currently operated by the hydrographic consultants ALS;
- A rainfall gauge ("Browns Road") operated by WaterNSW (located within Area 3B); and
- Series of "infilled" data available from the SILO service, a cooperative initiative of the Queensland Government's Department of Environment and Science (DES) and the Australian Bureau of Meteorology (BoM).

The details of the various data sources is summarised in Table B1.

Measurement uncertainty

Based on manufacturers specifications[1], "*the Hyquest Solutions TB3 Model Tipping Bucket Rain Gauge is recognised as the world standard for measuring rainfall and precipitation in remote and unattended locations. The TB3 is the rain gauge of choice to the Australian Bureau of Meteorology and other organisations world wide*."

ALS have instructed that the manufacturer's stated accuracy is:

Rainfall intensity	Accuracy
0-250 mm per hour	+/-2%
250-500 mm per hour	+/-3%
Measurement range	700 mm per hour

These accuracies are independent of the siting of the gauge itself. ALS have stated that the siting of the gauges has been carried out consistent with RMS, 2016[2], which is itself compiled from Australian Standards. ALS can provide further information on request.

[1] https://www.hyquestsolutions.com/products-services/products-hardware/meteorology/model-tb3-tipping-bucket-rain-gauge/

[2] NSW RMS, 2016. Automatic weather stations: QA specification R272. Edition 1, rev 1, May 2016.

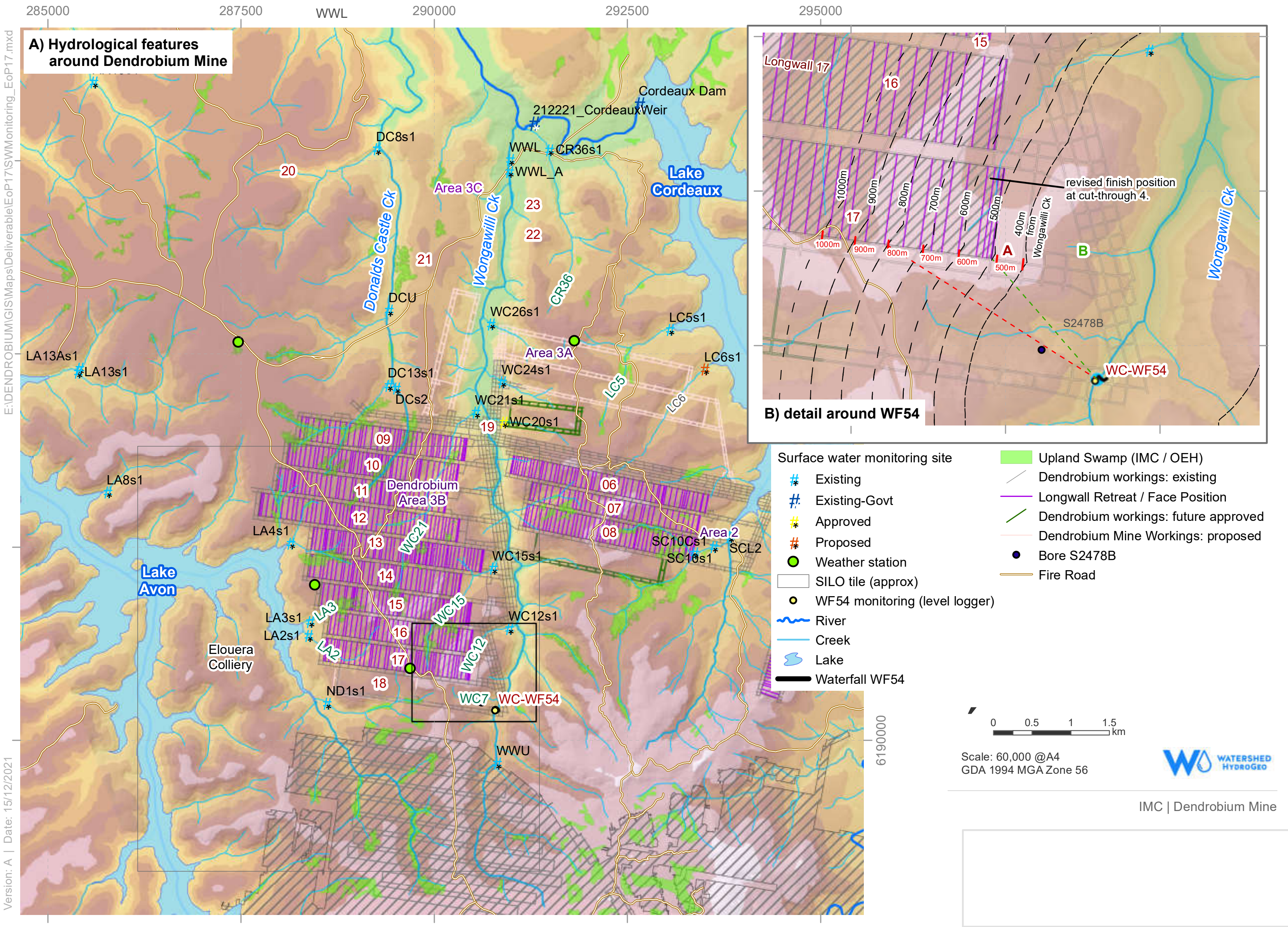


Figure B1 Location of rainfall and flow data sources

Table B1 Rainfall data sources

SITE_NAME	ID	EASTING (Z56)	NORTHING (Z56)	Z_ELEVATION [MAHD]	OPERATOR	START DATE	MEASUREMENT FREQUENCY	GAUGE TYPE	LOGGER
Dendrobium "Centroid" A3A		291815	6195170	403.1	IMC	28/10/2007	event based and midnight timestamp	Hyquest Tipping Bucket Rain Gauge model TB3 / 0.5mm	Hyquest Minilog
DA3B Weather Station		288458	6192012	413.4	IMC	1/06/2012	event based and midnight timestamp, 15 minute on CR800	Hyquest Tipping Bucket Rain Gauge model TB3 / 0.5mm	Hyquest Minilog and Campbells Scientific CR800
DA5 Rainfall Gauge		287468	6195153	401.6	IMC	19/07/2017	event based and midnight timestamp	Hyquest Tipping Bucket Rain Gauge model TB3 / 0.5mm	Hyquest Minilog
DA6 Rainfall Gauge		291749	6200383	352.4	IMC	17/06/2017	event based and midnight timestamp	Hyquest Tipping Bucket Rain Gauge model TB3 / 0.5mm	Hyquest Minilog
Cordeaux Site Rain Gauge		294658	6199531	373.5	IMC	1/01/2002	data recorded @ 00:00 for previous 24 hrs		
Browns Road	568061	289690	6190930	442.0	WaterNSW	31/03/1983	data recorded @ 00:00 for previous 24 hrs		
SILO Data drill - **"A3B"**		Long: 150.70	Lat: -34.40		SILO	1/01/1900	24hr total to 9am, interpolated and averaged for 0.05x0.05 degree tile		

Notes:

IMC sites maintained by ALS.

Browns Road data obtained from WaterNSW.

SILO data from https://www.longpaddock.qld.gov.au/silo/datadrill/

A comparison of the recent data from these sources is presented below.

Figure B2 shows recent annual totals (since the commencement of Dendrobium Mine). For these, the SILO and Dendrobium site records are 100% complete, while the Browns Road record is 96% complete.

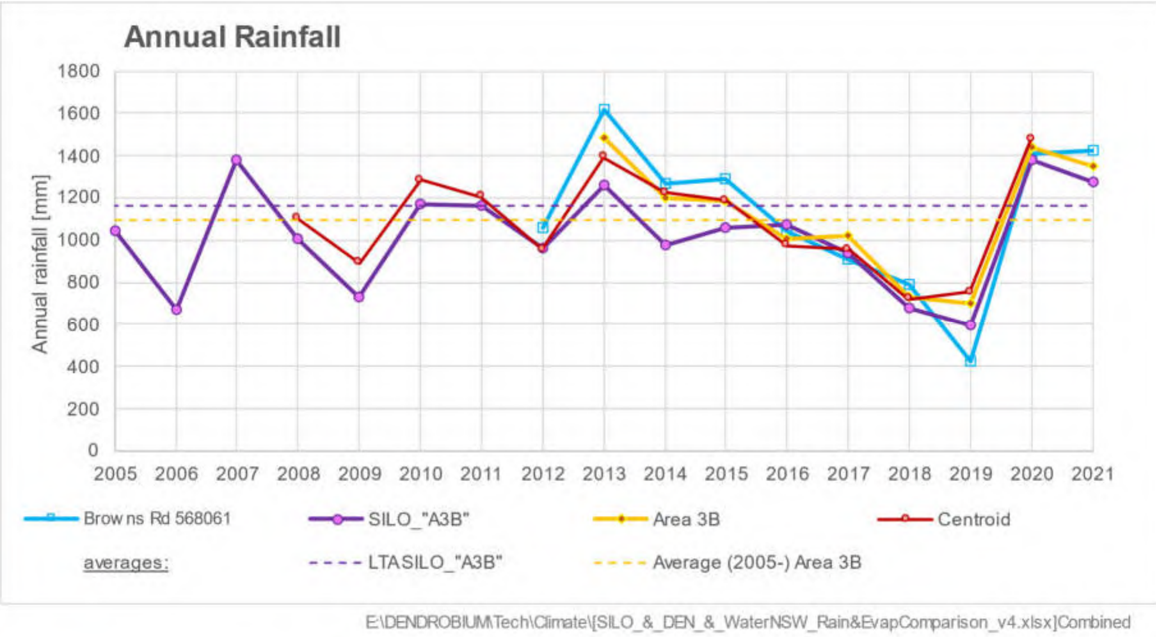


Figure B2 Annual rainfall totals

Figure B2 shows that the different records show some variability in annual totals. 2013, 2020 and 2021 were the wettest years of the recent period. In those two wet years, the variability between the different monitoring records shown above, from minimum to maximum, was 14%, 7% and 12% in 2013, 2020 and 2021 respectively. In 2019 (the driest of the selected years), the variability was 40%. All stations show the same broad trends across those selected years, including the severe and persistent rainfall deficit in 2017-2019, and the high rainfall in 2020-21.

There was variation in which station or data source was wettest or driest in each year but in terms of cumulative rainfall 2013-2021 (excluding 2012 because the Area 3B gauge did not commence until May that year), there is 10% difference between the four monitoring records shown on Figure B2.

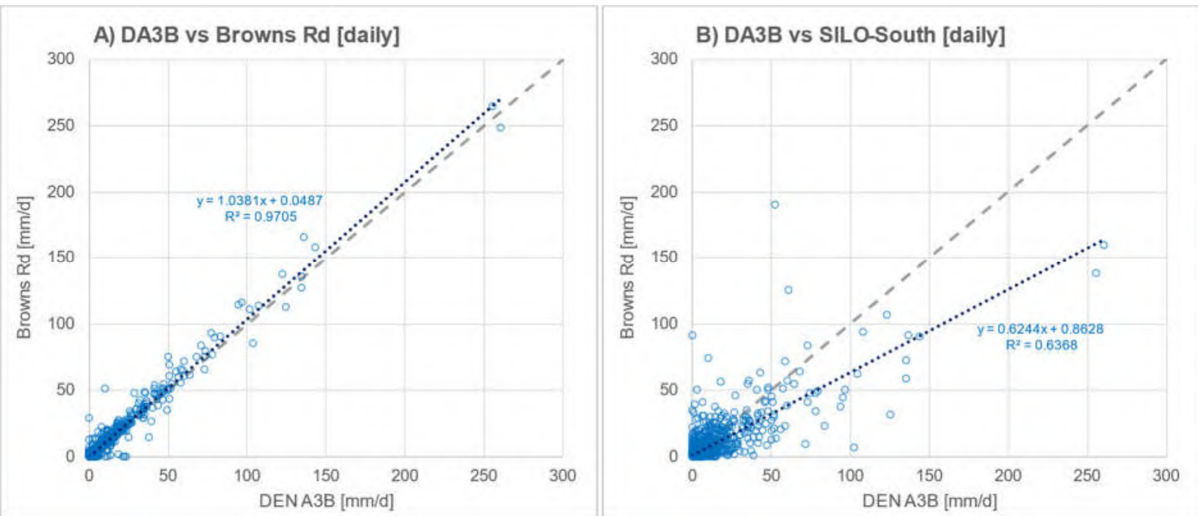


Figure B3 Correlation of daily rainfall around Area 3B

Figure B3 shows a comparison of daily totals for the three stations most relevant to Area 3B.

Figure B3a shows that the A3B station and the Browns Road station, which are 1.6 km apart, are highly correlated (R^2 = 0.97). Figure B3b shows that there is a substantially weaker correlation between the local SILO record and the Browns Road station (and therefore, also with the A3B record) (R^2 = 0.62).

To assess this further, the accumulated rainfall for the available record during the period 2005-2020 is plotted on Figure B4. The A3B rainfall is not included here due to that record beginning in 2012.

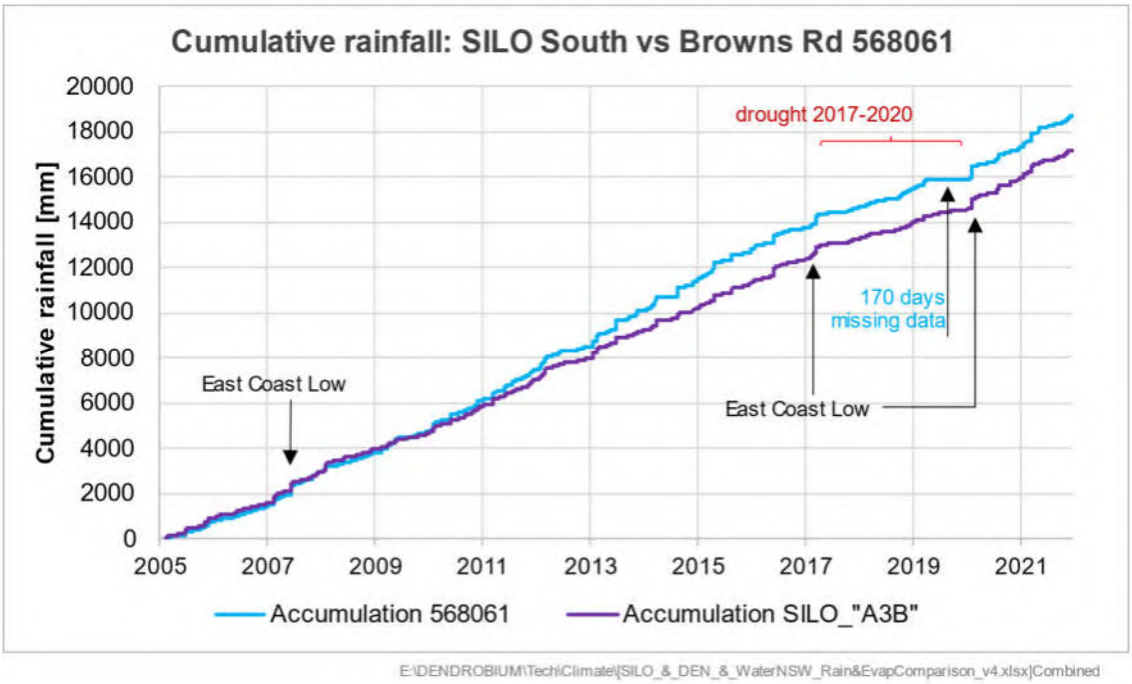


Figure B4 Rainfall accumulation near to the Area 3B domain

Figure B4 indicates that while there is a weaker correlation on a daily basis, and some significant variances in total rainfall on specific days (Figure B3b), the correlation is strong overall. That is, the accumulation shows very similar trends through the 17 year record, and the overall total accumulated rainfall varies by 8%.

This analysis of the data indicates that broadly there is general agreement in the data on a monthly or annual timeframe, but that short-term differences exist. These differences may be due to:

- Measurement error (in the case of the site data, Browns Road and the raw BoM data behind the SILO "Data Drill" record);
- Mismatch in timing between totals to midnight (site and Browns Road data) versus totals to 9am (BoM / SILO records);
- Interpolation or infilling errors due to temporal or spatial infilling or averaging (in the SILO data);
- True variations in rainfall in space and time due to weather patterns, e.g. topographic effects and/or the effects of localised weather systems.

These measurement errors or true variations will propagate into any rainfall-runoff modelling and simulation of daily flow around Area 3B. Smaller catchments will be less prone to spatial variation in rainfall across the catchment, but maybe affected by not having a truly local rainfall record. Therefore, while the rainfall gauging network at Dendrobium (including SILO and WaterNSW data) is considered adequate, the potential localisation of rainfall patterns will result in some unavoidable discrepancies between modelled and observed flows.

Appendix C: Flow gauge data

Flow data for the Dendrobium area is available from a series of flow gauges owned by IMC and currently operated by the hydrographic consultants ALS. The details of these are summarised in Table C1.

These gauging stations provide estimates of stream flow via:

(A) A structure behind which water pools and flows over. Structures can be:
   a. natural, e.g. a rock bar, or
   b. man-made, e.g. a half-pipe flume.

(B) A sensor and logger that measure and record the water level ("stage") in the pool at 15-minute intervals

(C) A "rating curve" which is a chart or graph of discharge (flow) versus stage for each gauging station. The rating curve is developed via periodic measurements of flow in the channel at a known water level.

(D) Estimates of mean daily flow are then provided.

IMC commissioned an independent hydrologist (Enviromon) to systematically identify and quantify the accuracy or error involved in each part of the process (Enviromon, 2019 and Enviromon, 2020). This process has been carried out for a selection of gauging sites (provided in C5, below), and is currently being applied to the remaining in gauging sites, with some fine-tuning of the method for gauging sites where 'underflow' occurs (i.e. flow beneath the monitoring structure). The objective is to re-assess each gauging station for each future End of Panel report, and to use the results to reduce uncertainty where practicable (i.e. additional data-gathering and improved measurement methods).

Table C1 Flow gauge information

Watercourse	Site	Area	Easting (z56)	Northing (z56)	Z_Elevation [mAHD]	Catchment area [km^2]	Installation	Structure type		Logger
Wongawilli Ck	WWU	u/s A3B	290808	6189716	352.94	3.211	Stainless Steel housing	Natural control		Orpheus
Wongawilli Ck	WWL	d/s A3A,B	290975	6197526	261.86	20.079	Stainless Steel housing	Natural control		Diver
Wongawilli Ck	WWL_A	d/s A3A,B	290962	6197370	263.22	19.602	PVC housing	Half pipe	225 mm	Orpheus
WC21	WC21S1	A3B	290529	6194255	283.07	2.434	Stainless Steel housing	Natural control		Diver
WC15	WC15S1	A3B	290754	6192239	324.71	1.192	PVC housing	Natural control		Diver
WC12	WC12S1	A3B	290964	6191459	322.34	0.380	Polypipe housing	Weir and half pipe flume	150 mm	Orpheus
LA2	LA2S1	A3B	288364	6191364	324.65	0.824	Polypipe housing	Weir and half pipe flume	150 mm	Orpheus
LA3	LA3S1	A3B	288385	6191548	323.82	0.375	Polypipe housing	Weir and half pipe flume	150 mm	Orpheus
LA4	LA4S1	A3B	288134	6192565	322.98	0.817	Stainless Steel housing	Modified control	150 mm	Diver
ND1	ND1S1	A3B	288607	6190491	325.11	1.130	Polypipe housing	Weir and half pipe flume	150 mm	Orpheus
DC13	DC13S1	A3B	289401	6194605	339.50	1.638	PVC housing	Natural control		Diver
Donalds Castle	DCS2	A3B	289502	6194572	341.27	1.084	PVC housing	Natural control		Diver
Donalds Castle	DCU	A3B	289407	6195577	322.42	6.219	Stainless Steel housing	Natural control		Diver
SC10	SC10S1	A3A	293608	6192516	333.03	2.771	Stainless Steel housing	Natural control		Diver, recently updated to Orpheus
SC10C	SC10CS1	A3A	293358	6192433	340.78	0.817	Stainless Steel housing	Natural control		Diver
Sandy Ck	SCL2	A3A	293819	6192648	328.61	7.029	Stainless Steel housing	Modified control (leaky)		Diver
	2022205	A3A	293819	6192648	328.61	7.029	WaterNSW site	Modified control (leaky)		Unknown
LC5	LC5S1	A3A,C	293043	6195327	318.10	1.861	Polypipe housing	Weir and half pipe flume	225 mm	Orpheus
LA8	LA8S1	A5	285764	6193225	331.56	0.93	Polypipe housing	Weir and half pipe flume	150 mm	Orpheus
LA13A	LA13AS1	A5	285401	6194826	319.93	1.04	Polypipe housing	Weir and half pipe flume	150 mm	Orpheus level, Diver EC
LA13	LA13S1	A5	285384	6194777	320.35	2.79	PVC housing	Weir and half pipe flume	*225 mm*	Orpheus

Watercourse	Site	Area	Easting (z56)	Northing (z56)	Z_Elevation [mAHD]	Catchment area [km^2]	Installation	Structure type		Logger
AR31	AR31S1	A5	283999	6197770	270.70	2.96	Polypipe housing	Weir and half pipe flume	225 mm	Orpheus level, Diver EC
AR32	AR32S1	A5	283945	6197576	266.10	1.5	PVC housing	Weir and half pipe flume	150 mm	Orpheus
AR19	AR19S1	A5	285584	6198528	382.91	3.53	Polypipe housing	Weir and half pipe flume	225 mm	Orpheus level, Diver EC
DC8	DC8S1	A5	289249	6197663	301.20	2.61	Polypipe housing	Weir and half pipe flume	225 mm	Orpheus level, Diver EC
CR29	CR29S1	A6	289969	6201109	257.13	2.33	Polypipe housing	Weir and half pipe flume	225 mm	Orpheus level, Diver EC
CR31	CR31S1	A6	290062	6200056	248.33	2.55	Polypipe housing	Weir and half pipe flume	225 mm	Orpheus level, Diver EC
CR36	CR36S1	A3C	291487	6197650	272.82	1.7	PVC housing	Weir and half pipe flume	*225 mm*	Orpheus
WC20	WC20s1	A3C	290906	6194133	303.86	0.44	Approved, not installed	Weir and half pipe flume	*150 mm*	Orpheus
WC24	WC24s1	A3C	290863	6194658	286.90	0.5	*PVC housing*	Weir and half pipe flume	*150 mm*	Orpheus
WC26	WC26s1	A3C	290703	6195411	277.85	0.55	*PVC housing*	Weir and half pipe flume	*150 mm*	Orpheus
LC6	LC6s1	A3C	293495	6194813	328	1.16	Awaiting approval			
Reference Sites										
O'Hares Ck	213200	Wedderburn	300657	6217589	166.87	73.0		V-notch		
alternative Reference Sites										
Bomaderry Ck	215016	Bomaderry	279354	6142065	25.822	31.0	Vandalised, stolen 2019	Natural rock bar and boulders		Vandalised, stolen 2019*
Cordeaux R	2122204	Cordeaux Dam No.1	295413	6188702		9.3^				

Notes:

IMC gauging stations operated by ALS. *Italicised text* = to be confirmed.

Reference gauge data from WaterNSW.

* WaterNSW advise that Bomaderry Creek gauging site repeatedly vandalised, equipment stolen (2019-20) and not yet replaced.

^ not from WaterNSW - estimated in GIS

Table C2 ALS data quality codes

DATA QUALITY CODE	DESCRIPTION	
1	Good continuous records	Notes:
2	Reliable Edited Data	Negative values of these codes may be shown on the data quality charts shown later in this Appendix. These indicate where a record has been processed or infilled.
3	Unreliable Edited Data	
5	Non-Continuous Data	
55	Fair quality data	
69	Fair Quality Rating Extrapolated	
104	Records estimated	
109	Poor quality data	
140	Level below CTF (cease-to-flow)	
145	Discharge not reliable Rating under review	
150	Rating table extrapolated due to inadequate gauging information	
151	Data not yet available	
160	Water level below sensor	
161	Poor quality data from debris affecting sensor	
205	Data lost	
255	No data exists	

Table C3 Data quality assessment for Reference Gauges

Watercourse	Gauge Id	Gauge Name	Start Date	End Date	No. of Records	% available	% suspect	% infilled	Status
Wongawilli Ck	300024	WWU	2/11/2007	18/11/2021	5071	99.8%	2.1%	0.9%	Primary Reference
O'Hares Creek	213200	O'Hares at Wedderburn (213200)	2/02/1978	21/12/2021	16029	99.9%	0.1%	0.1%	Primary Reference
Bomaderry Creek	215016	Bomaderry Creek at Bomaderry (215016)	4/07/2003	10/05/2020*	6156	99.0%	1.0%		Alternative Reference – **equipment vandalised**
Woronora River	2132101	Woronora River Fire Rd (2132101)	21/02/2007	27/03/2020	4784	81.3%	35.9%		Alternative Reference **(low quality)**
LC5	300094	LC5S1	4/04/2019	11/01/2021	649	100.0%	2.6%	0.0%	Future Reference site

* WaterNSW advise that Bomaderry Creek gauging site repeatedly vandalised, equipment stolen (2019-20) and after May-2020, not yet replaced.

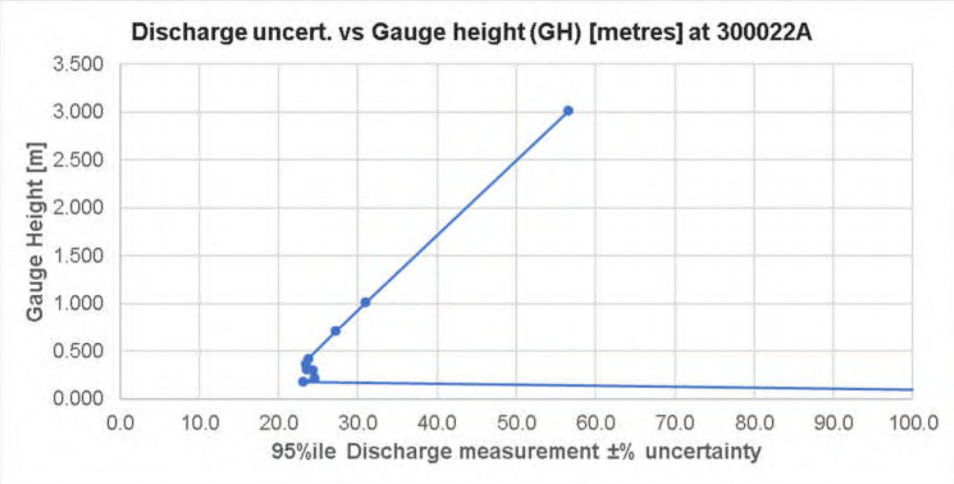
Table C4 Data quality assessment for Area 3B and relevant Assessment Sites

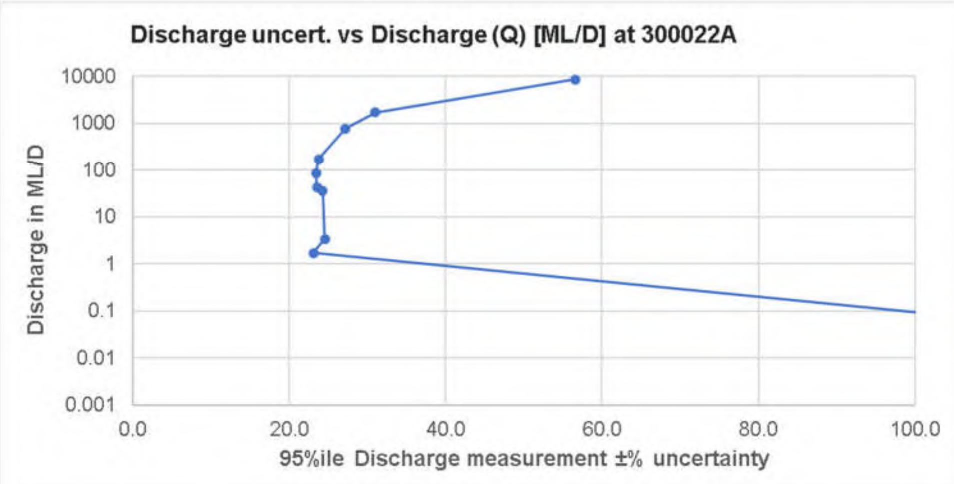
Assessment Sites			Summary - Pre-Mining						Summary - Post-Mining					
Watercourse	Hydstra No.	Gauge Name	Start Date	End Date	No. of Records	% available	% suspect	% infilled	Start Date	End Date	No. of Records	% available	% suspect	% infilled
Donalds Castle Creek	300023	DCU	2/11/2007	8/02/2013	1926	100.0%	0.0%	0.0%	9/02/2013	19/11/2021	3206	99.8%	14.6%	0.2%
DC13	300067	DC13S1	27/06/2012	8/02/2013	227	100.0%	0.0%	0.0%	9/02/2013	19/11/2021	3206	97.8%	4.3%	2.2%
Donalds Castle Creek	300068	DCS2	27/06/2012	9/07/2013	378	100.0%	0.0%	0.0%	10/07/2013	19/11/2021	3055	98.0%	9.9%	2.0%
Wongawilli Creek	300022	WWL	2/11/2007	8/02/2010	830	96.4%	3.8%	3.6%	9/02/2010	29/11/2021	4312	100.0%	1.0%	0.1%
Wongawilli Creek	300022A	WWLA							23/08/2018	29/11/2021	1195	100.0%	5.8%	1.0%
WC21	300069	WC21S1	20/06/2012	4/10/2013	472	99.8%	0.2%	0.2%	5/10/2013	18/11/2021	2967	100.0%	0.1%	0.0%
WC15	300071	WC15S1	20/06/2012	27/01/2017	1683	91.2%	15.9%	9.0%	28/01/2017	18/11/2021	1756	100.0%	17.4%	0.0%
WC12	300092	WC12S1	5/04/2019	17/10/2020	562	100.0%	5.0%	0.0%	18/10/2020	12/11/2021	391	100.0%	4.9%	0.0%
LA4	300070	LA4S1	24/09/2012	31/03/2015	919	100.0%	0.0%	0.0%	1/04/2015	19/11/2021	2425	77.3%	35.1%	0.3%
LA3	300091	LA3S1	3/02/2019	27/04/2019	84	100.0%	2.4%	0.0%	28/04/2019	12/11/2021	930	100.0%	7.3%	0.2%
LA2	300090	LA2S1	4/02/2019	29/02/2020	391	100.0%	14.6%	0.0%	1/03/2020	12/11/2021	622	100.0%	1.61%	0.0%
ND1	300093	NDS1	3/03/2019	17/04/2021	777	100.0%	8.8%	0.0%	18/04/2021	27/11/2021	224	100.0%	1.79%	0.0%

E:\DENDROBIUM\Tech\SurfaceWater\SWFlowData_Compiled_Wshed_20211217_v4.xlsx

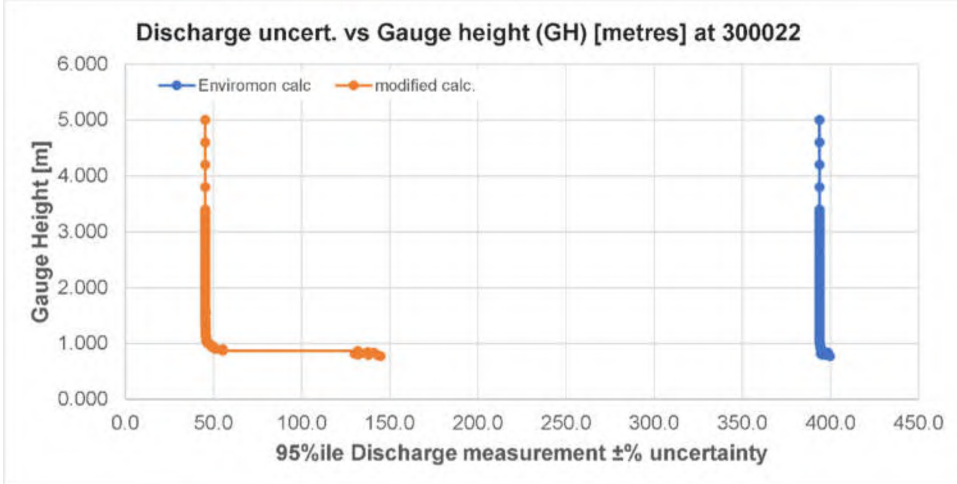
“Suspect” data based on raw data assigned ALS quality codes >145.

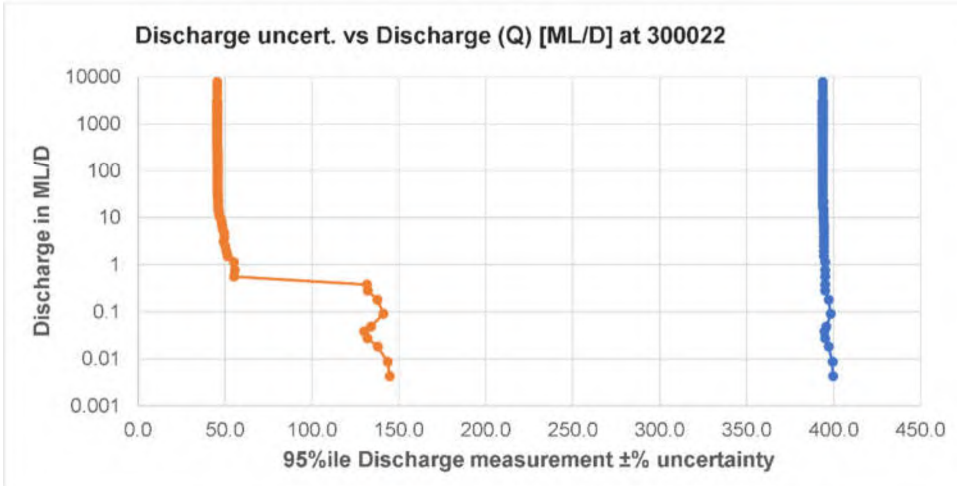
C5) Flow gauge uncertainty (assessed by Enviromon)



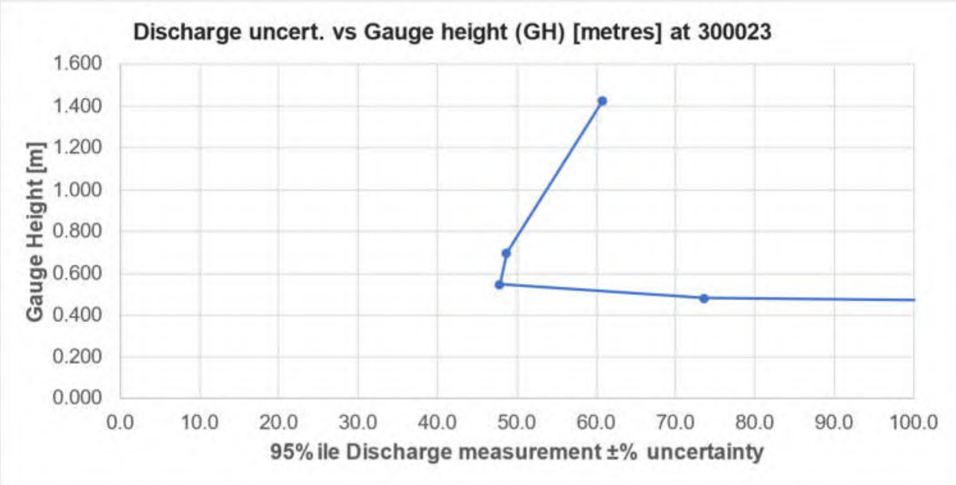


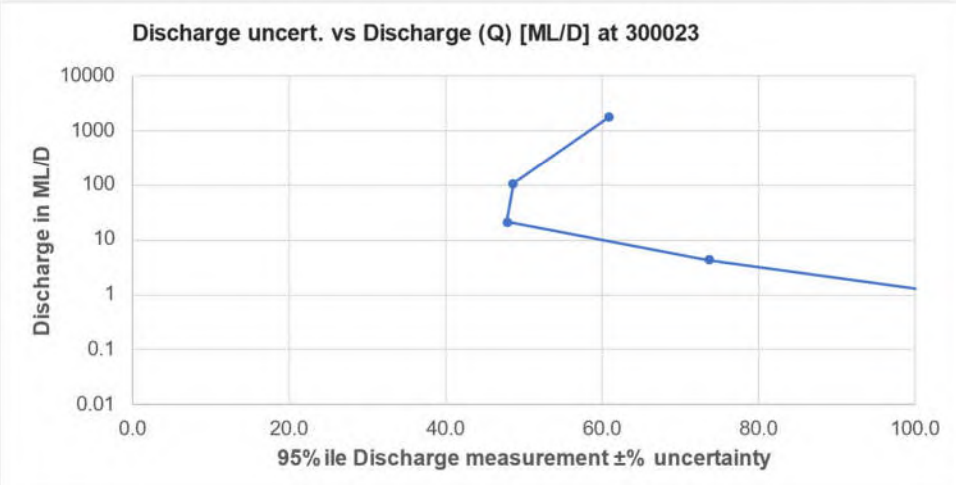
Gauge 300022A – WWL_A



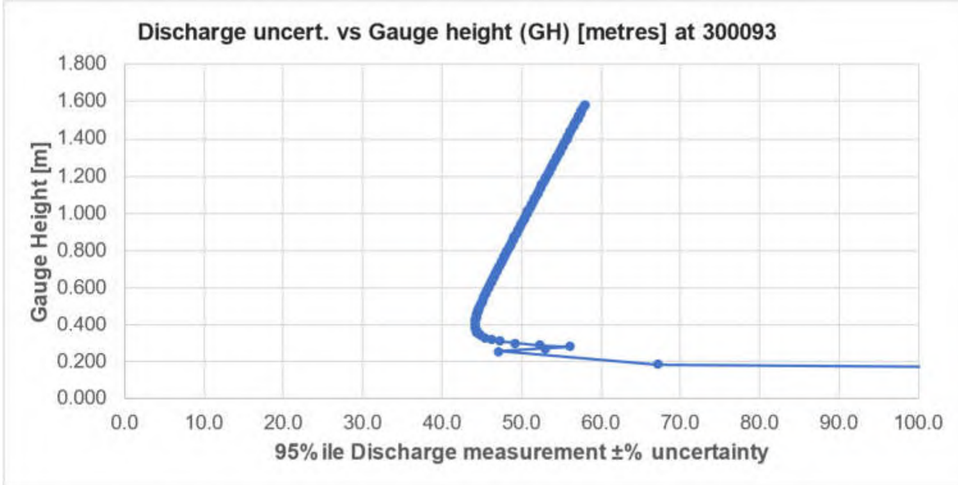


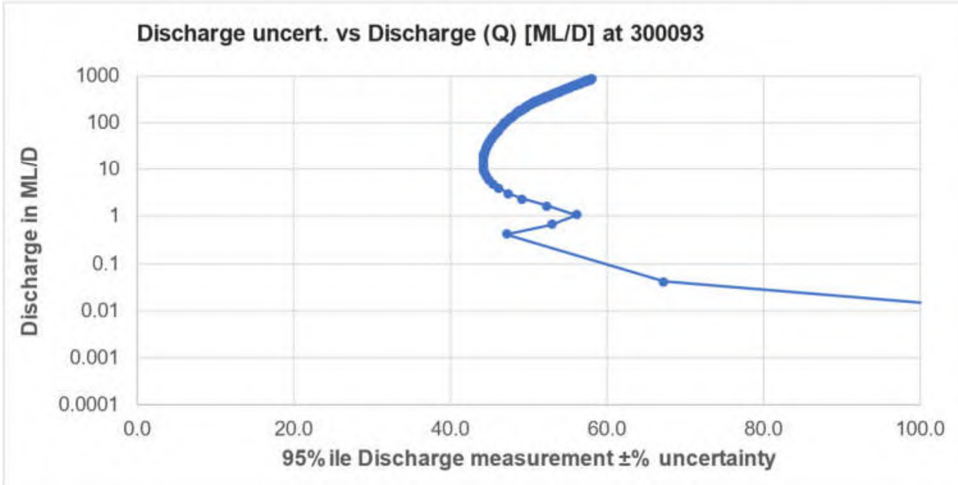
Gauge 300022 – WWL (two estimates provided – tbc)



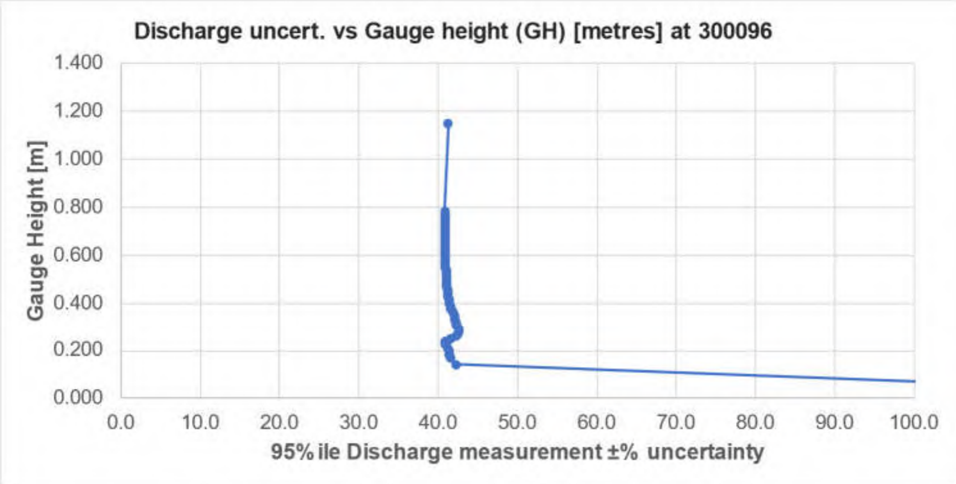


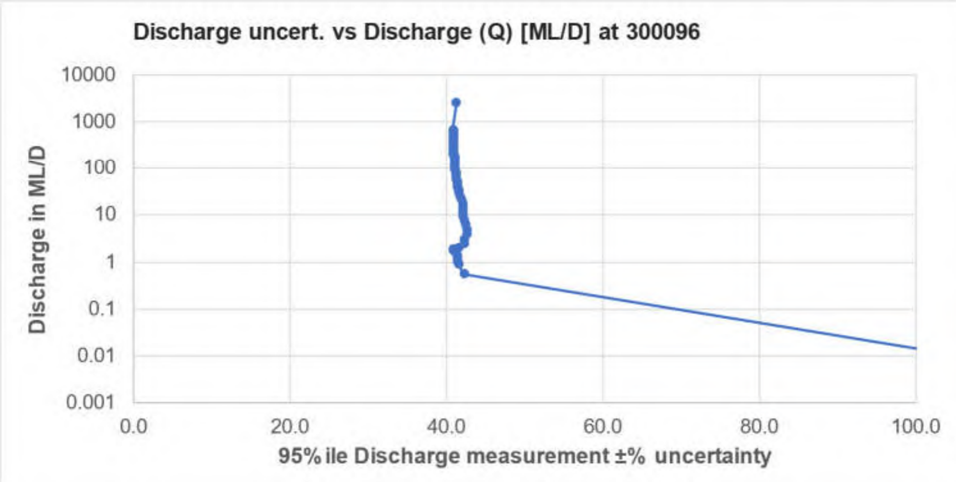
Gauge 300023 – DCU





Gauge 300022A – ND1

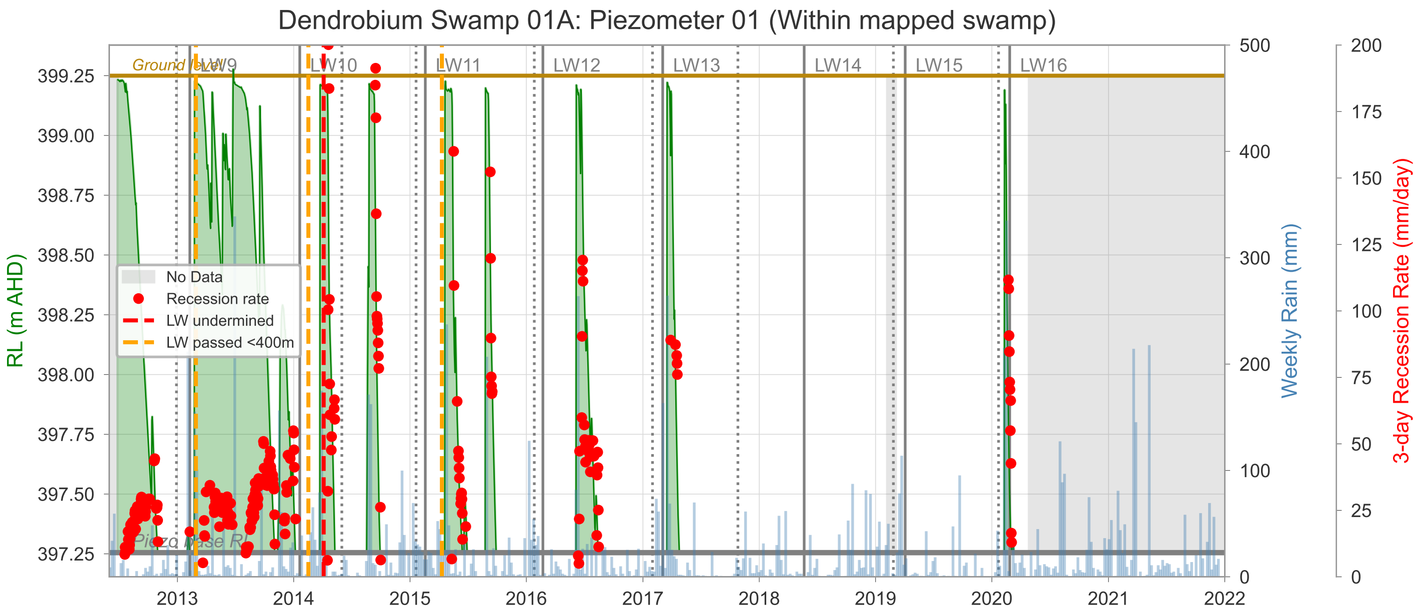




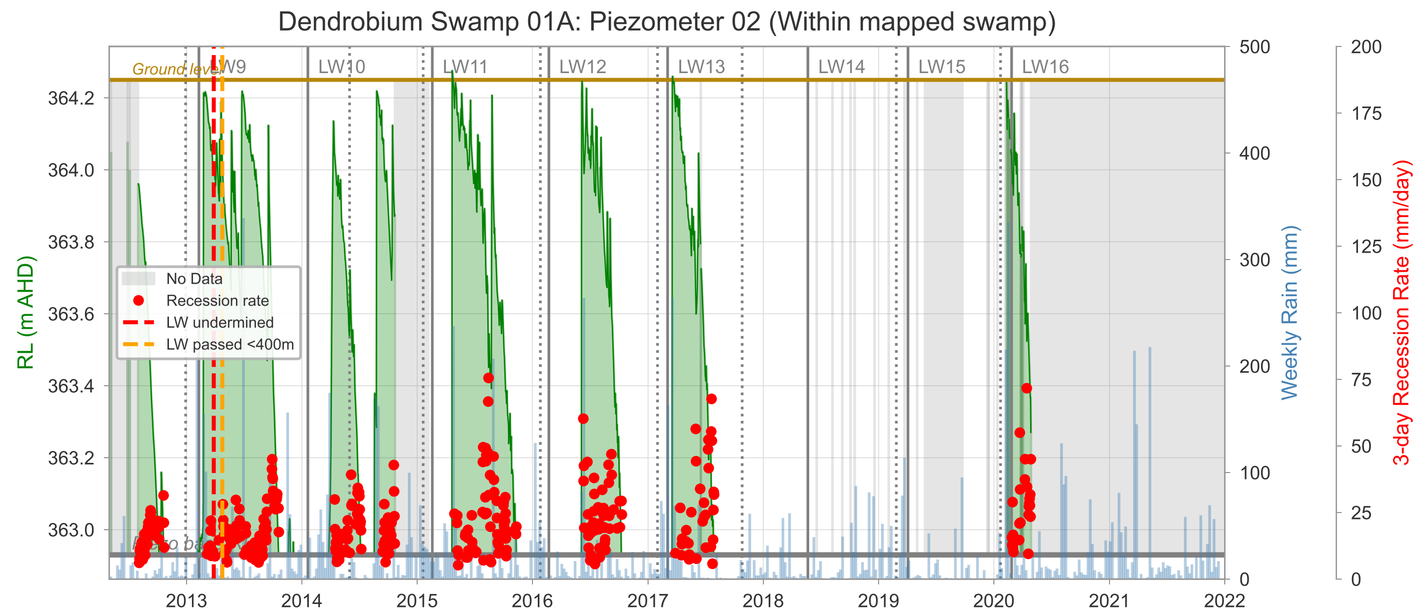
Gauge 300096 – CR36

C6) Summary charts illustrating 'raw' flow data and processed flow data used for TARP Assessments

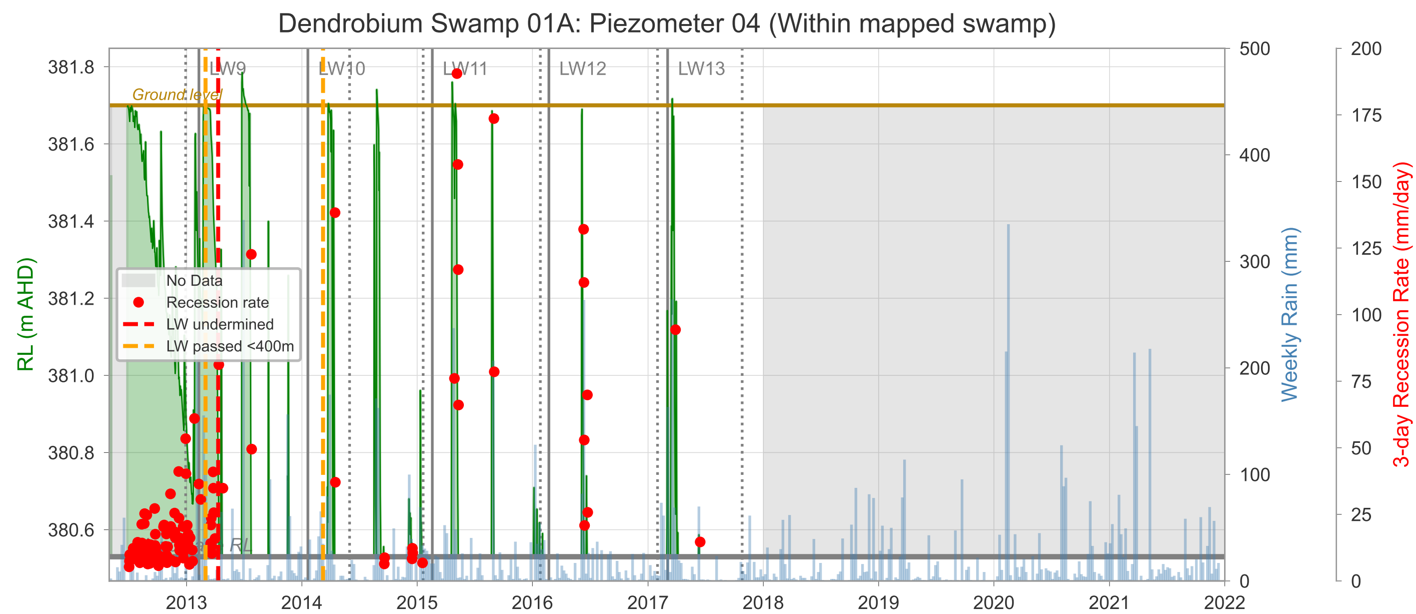
Appendix D: Shallow groundwater hydrographs



Dendrobium Swamp 01A: Piezometer 01 (Within mapped swamp)
Ground level
Piezo base RL
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

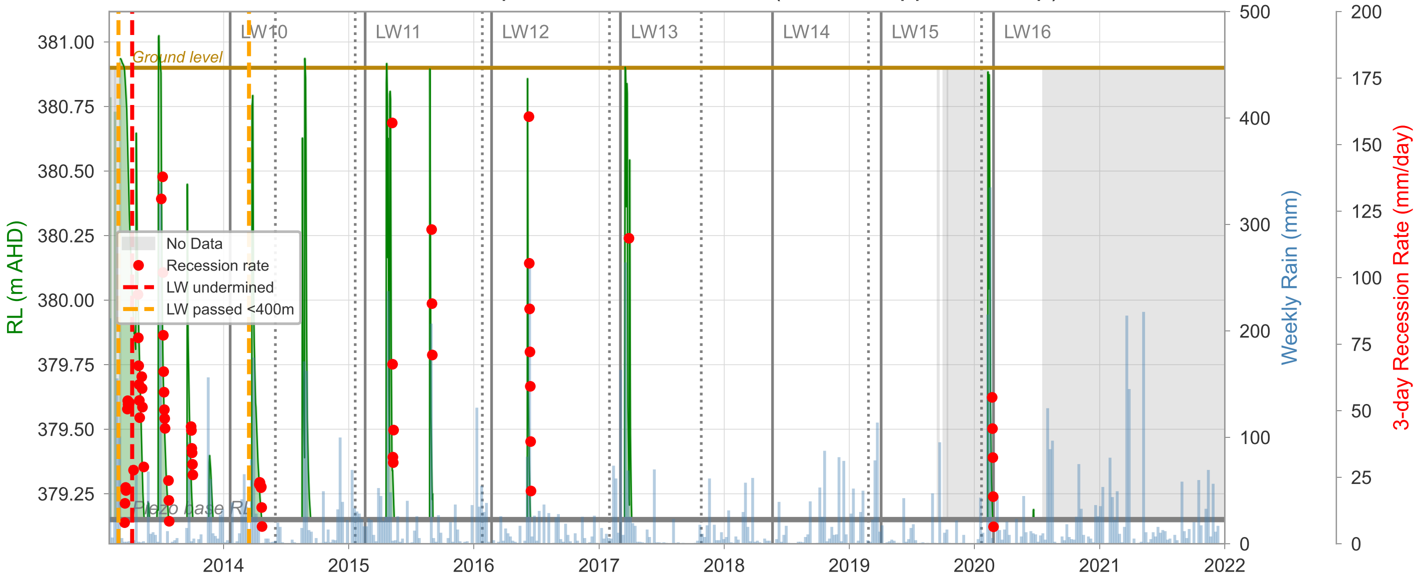


Dendrobium Swamp 01A: Piezometer 02 (Within mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

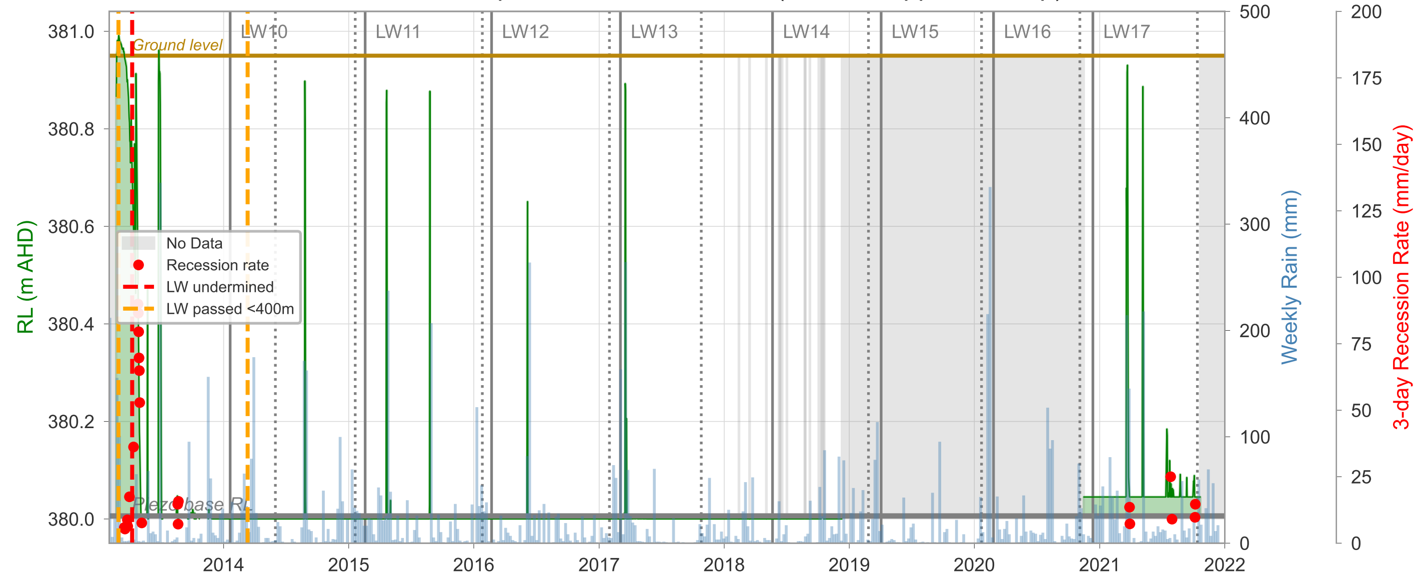


Dendrobium Swamp 01A: Piezometer 04 (Within mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

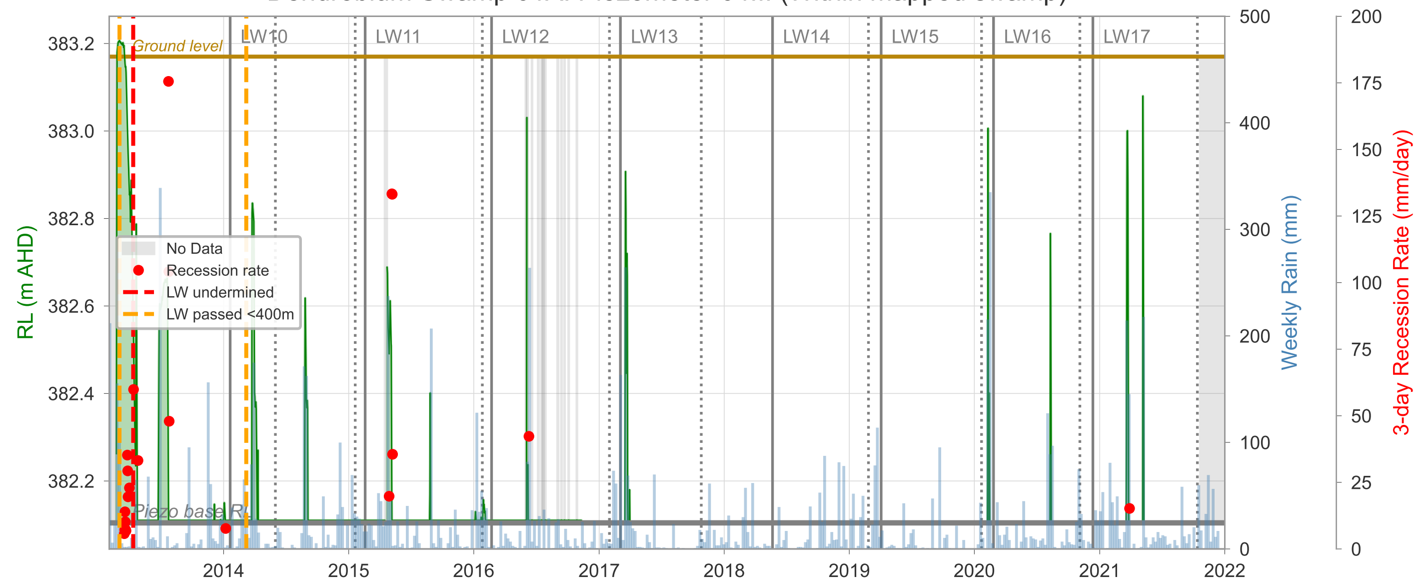
Dendrobium Swamp 01A: Piezometer 04I (Within mapped swamp)



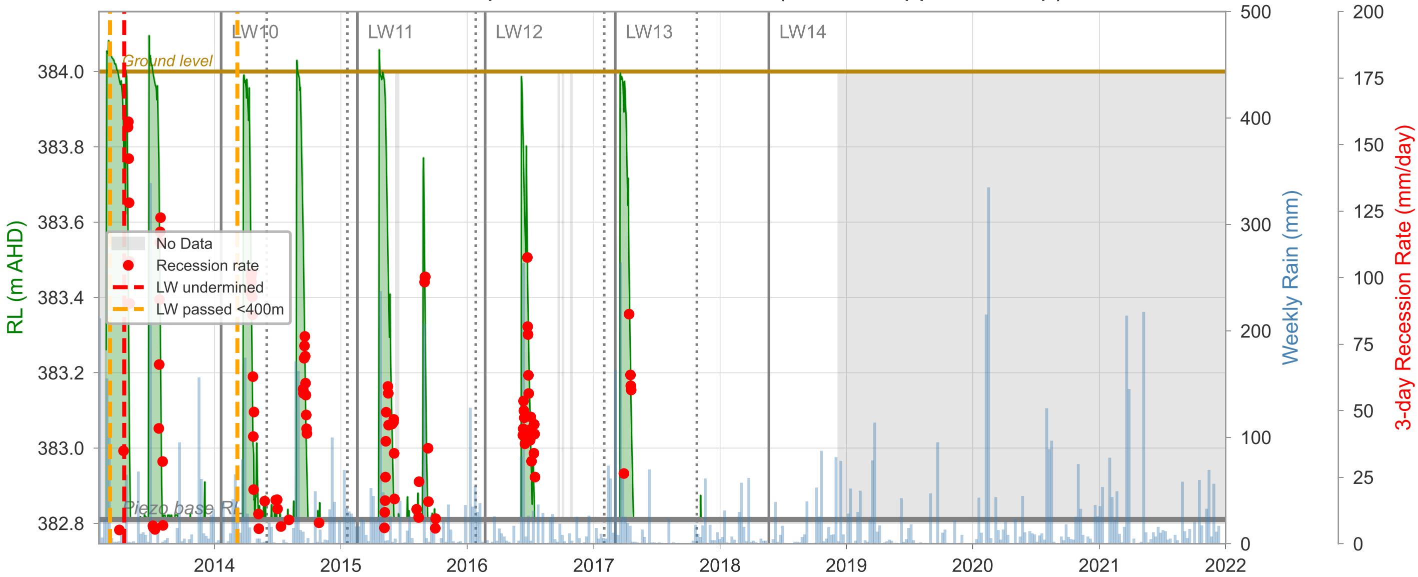
Dendrobium Swamp 01A: Piezometer 04II (Within mapped swamp)



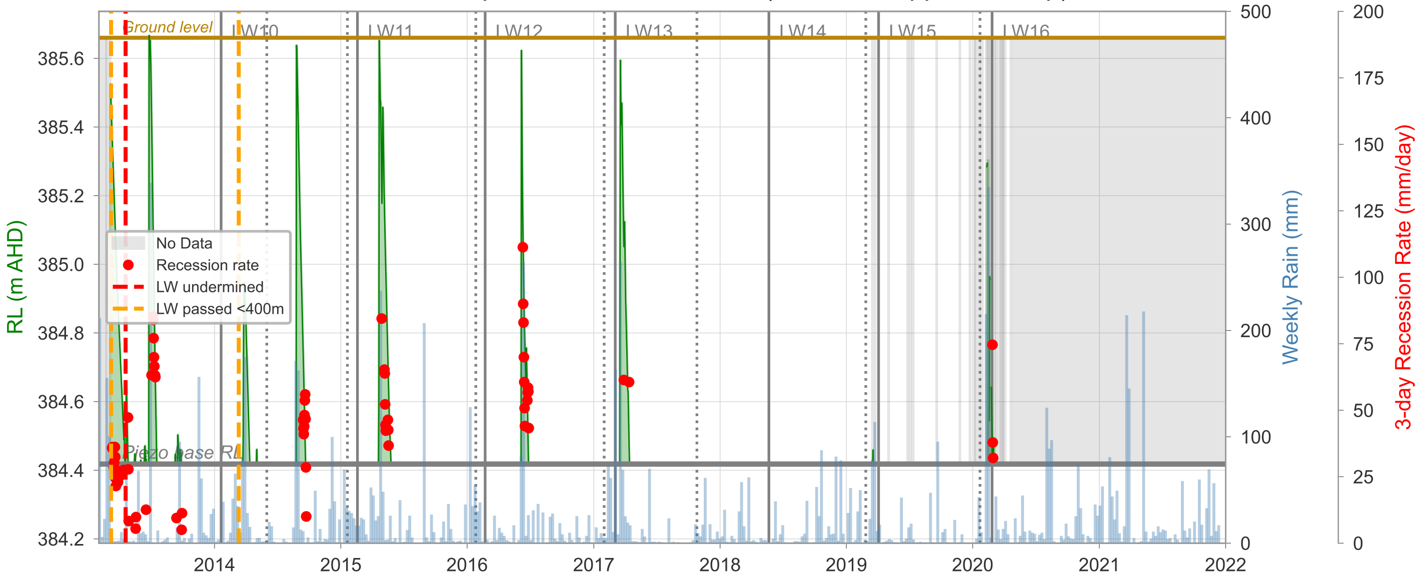
Dendrobium Swamp 01A: Piezometer 04III (Within mapped swamp)



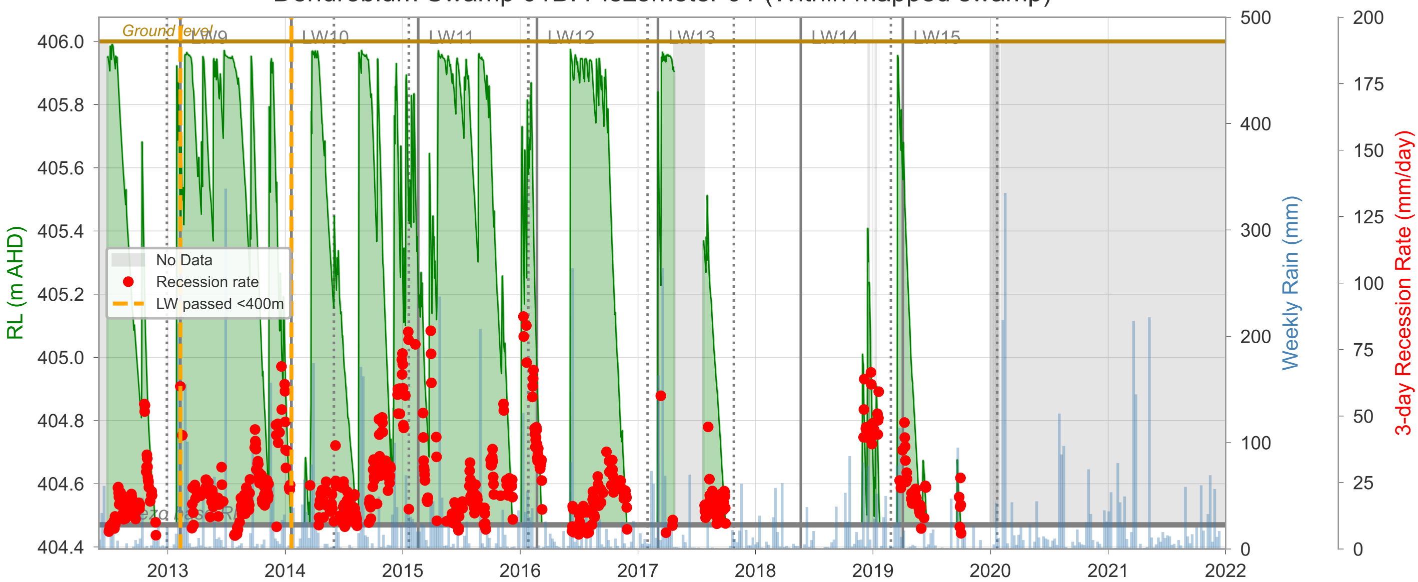
Dendrobium Swamp 01A: Piezometer 04IV (Within mapped swamp)

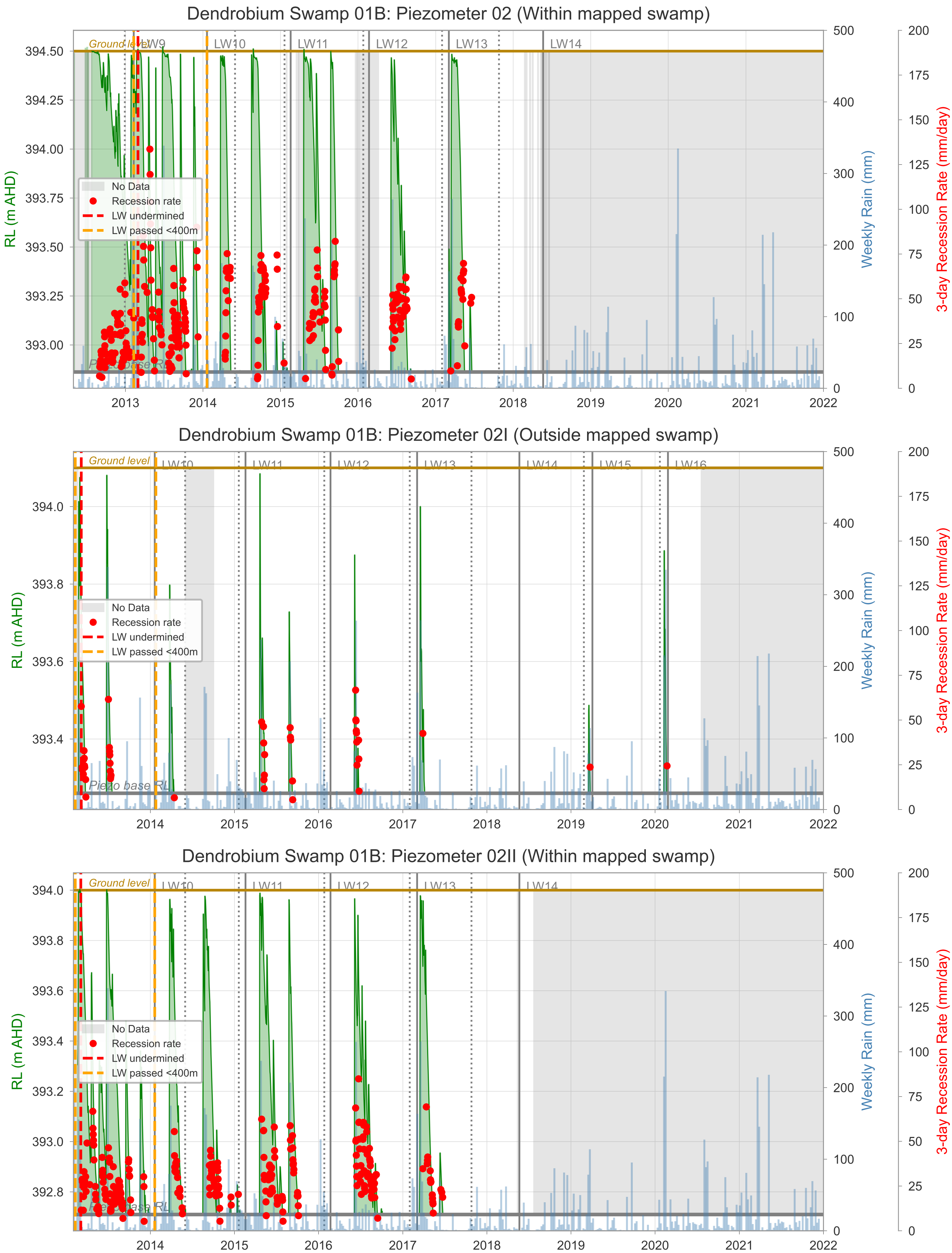


Dendrobium Swamp 01A: Piezometer 04V (Outside mapped swamp)

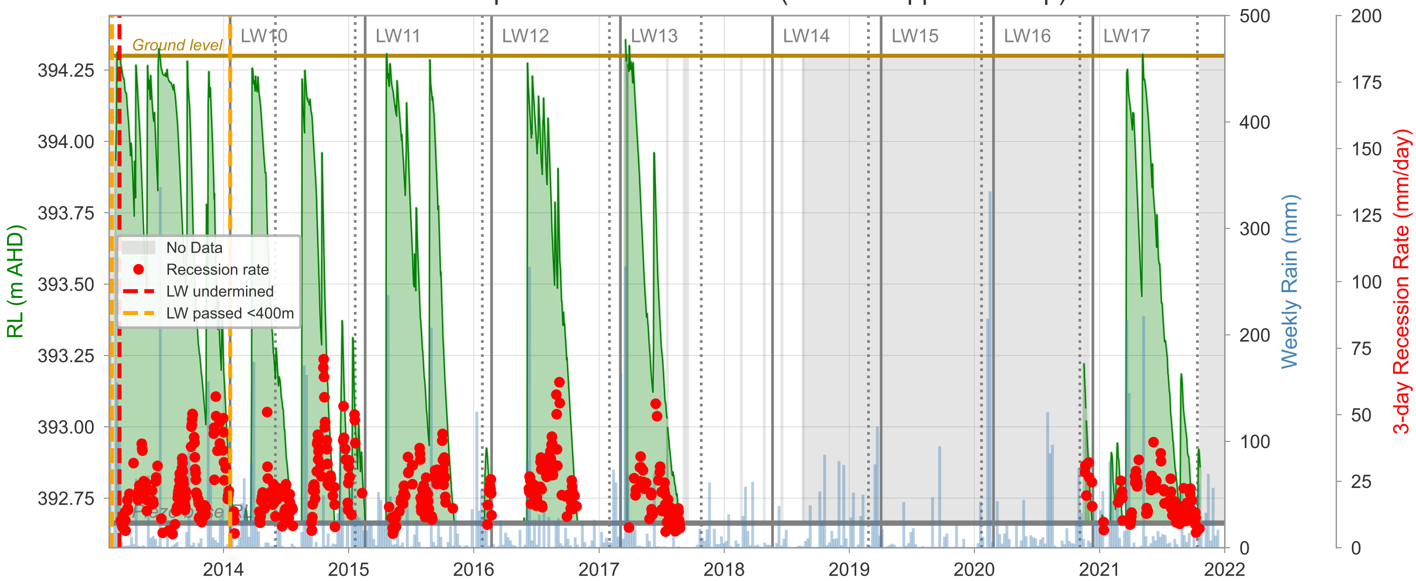


Dendrobium Swamp 01B: Piezometer 01 (Within mapped swamp)

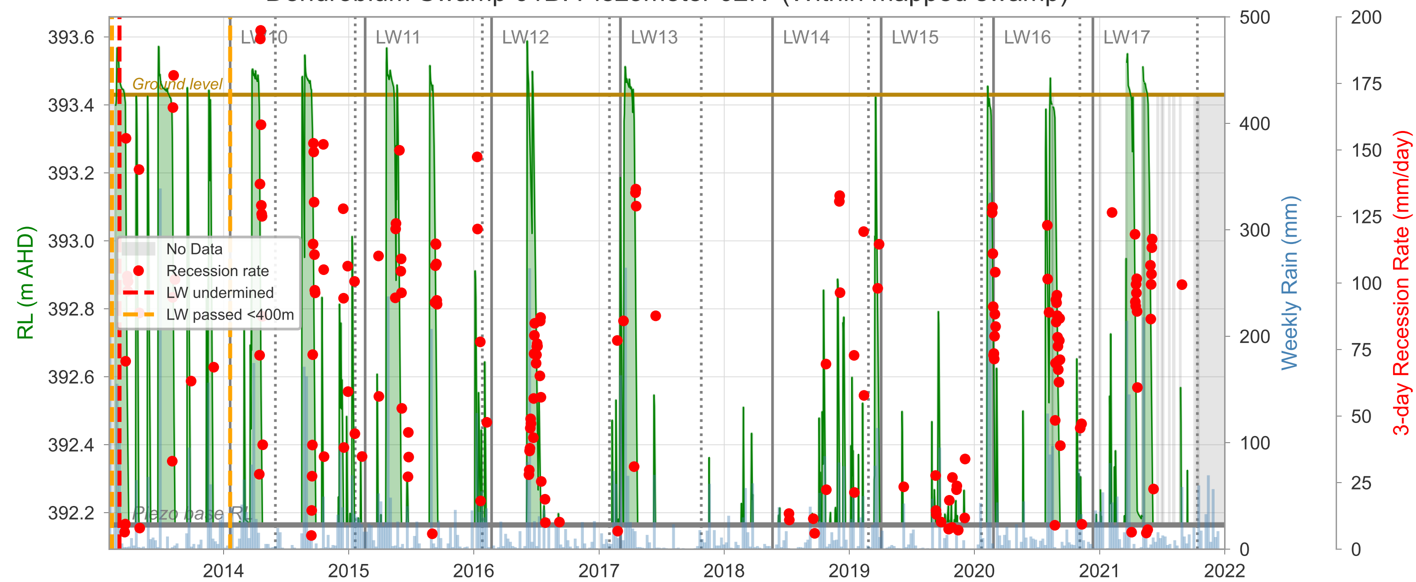



Dendrobium Swamp 01B: Piezometer 02 (Within mapped swamp)
Ground level
Piezo base RL
LW9
LW10
LW11
LW12
LW13
LW14
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
Dendrobium Swamp 01B: Piezometer 02I (Outside mapped swamp)
LW15
LW16
Dendrobium Swamp 01B: Piezometer 02II (Within mapped swamp)

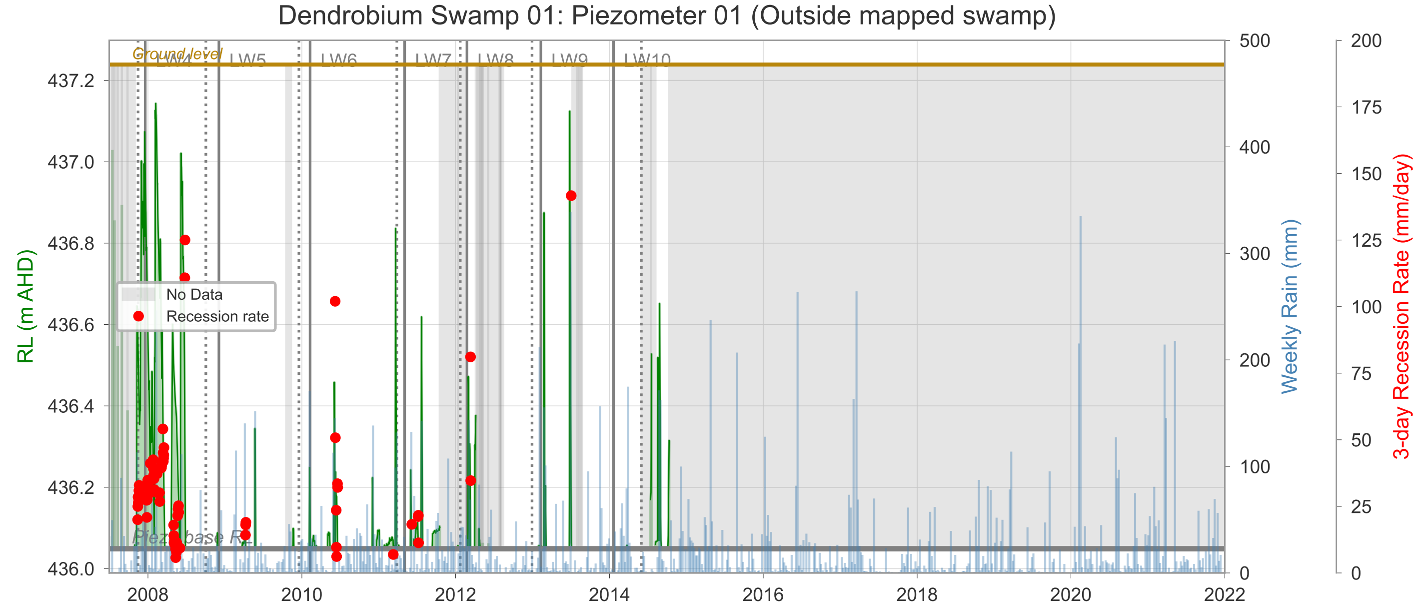
Dendrobium Swamp 01B: Piezometer 02III (Within mapped swamp)



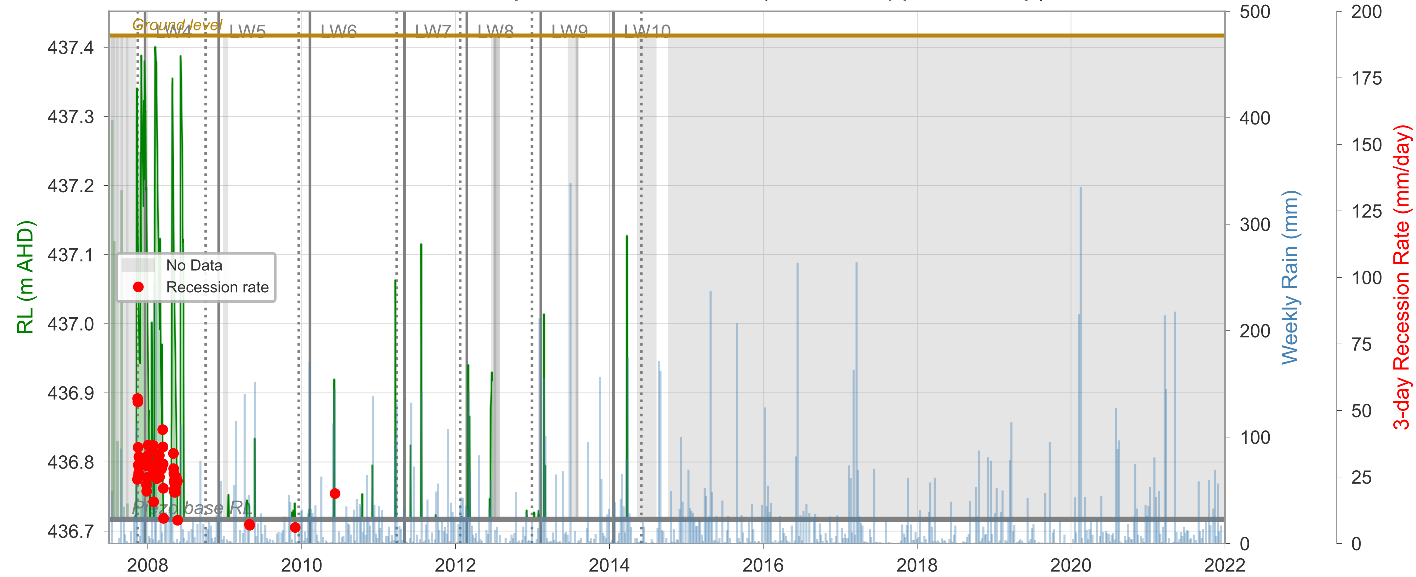
Dendrobium Swamp 01B: Piezometer 02IV (Within mapped swamp)



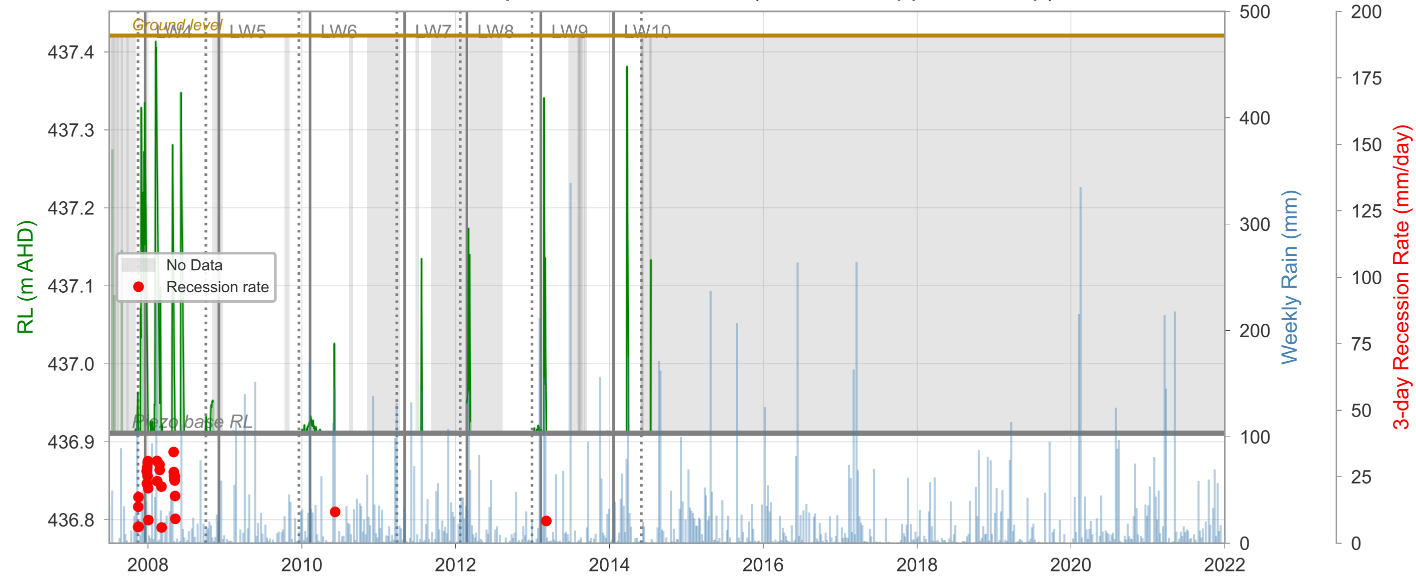
Dendrobium Swamp 01: Piezometer 01 (Outside mapped swamp)



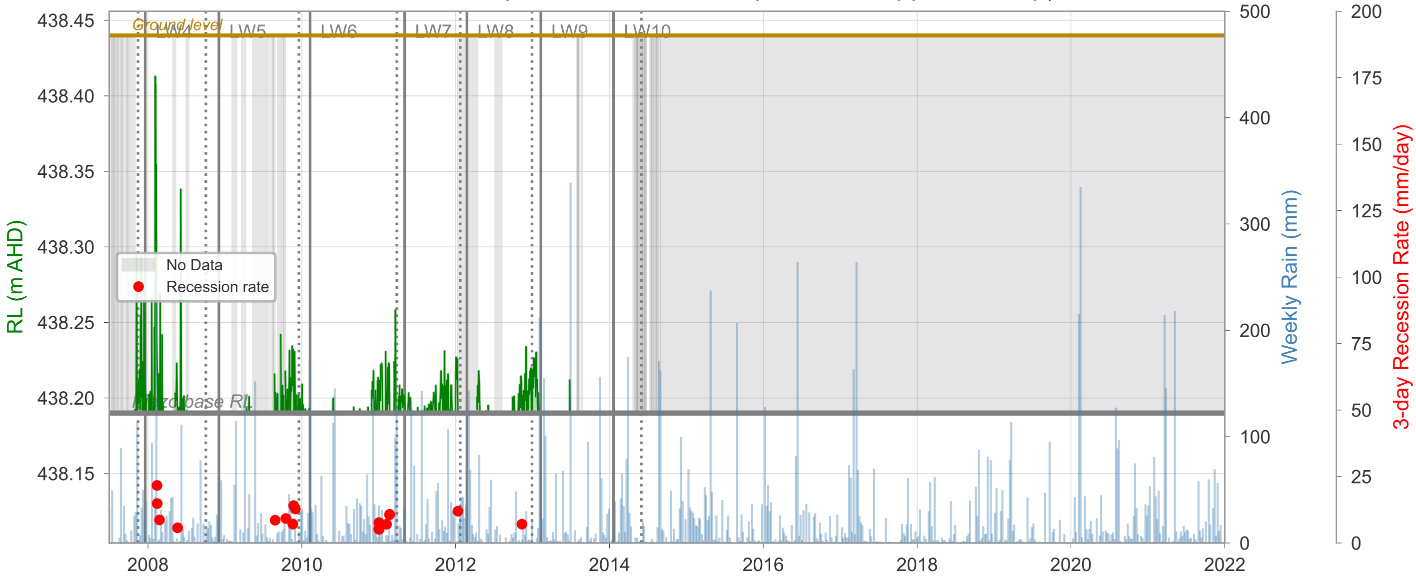
Dendrobium Swamp 01: Piezometer 02 (Within mapped swamp)



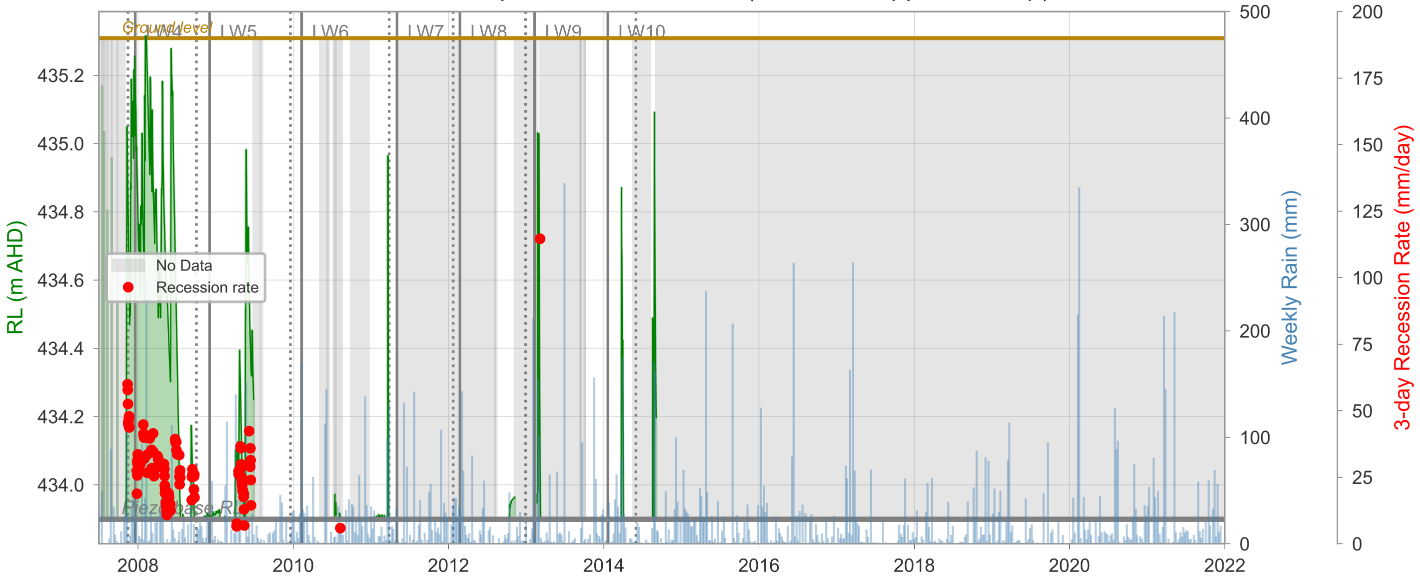
Dendrobium Swamp 01: Piezometer 03 (Outside mapped swamp)



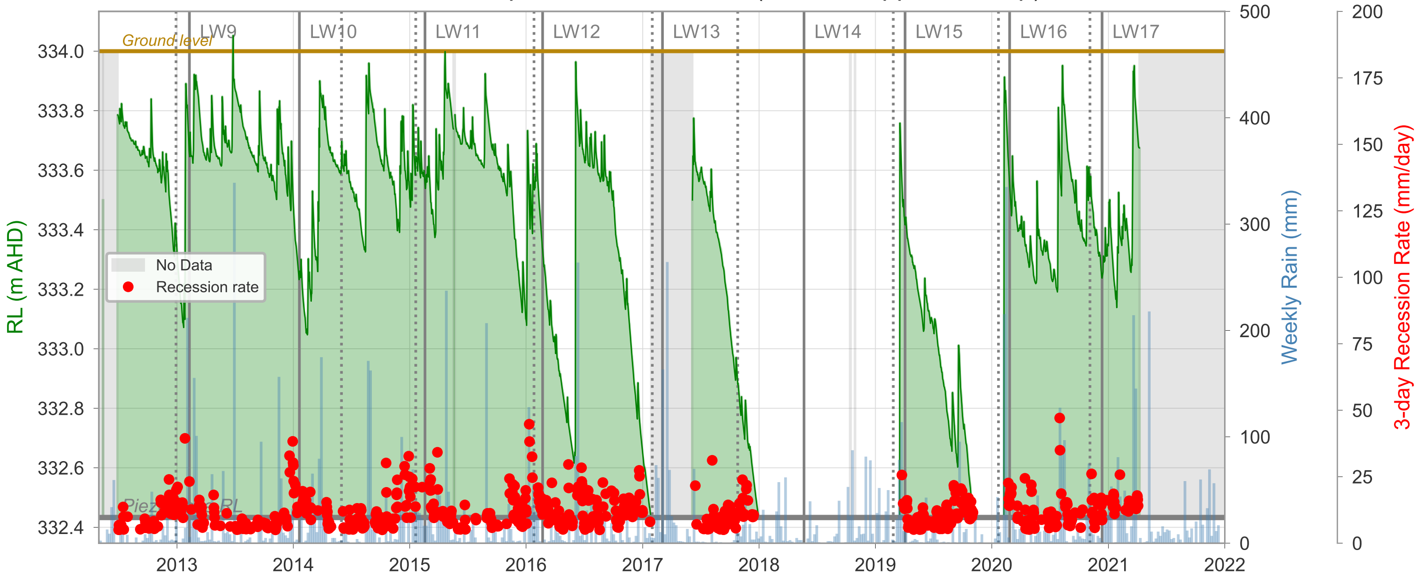
Dendrobium Swamp 01: Piezometer 04 (Outside mapped swamp)



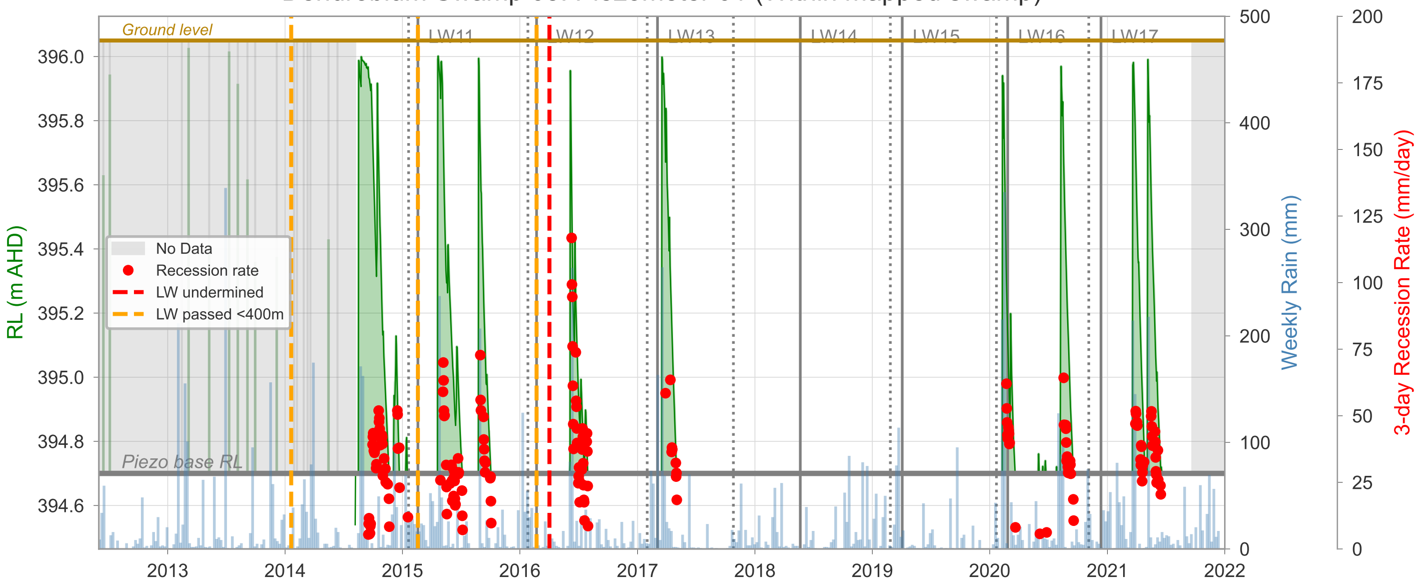
Dendrobium Swamp 01: Piezometer 05 (Outside mapped swamp)



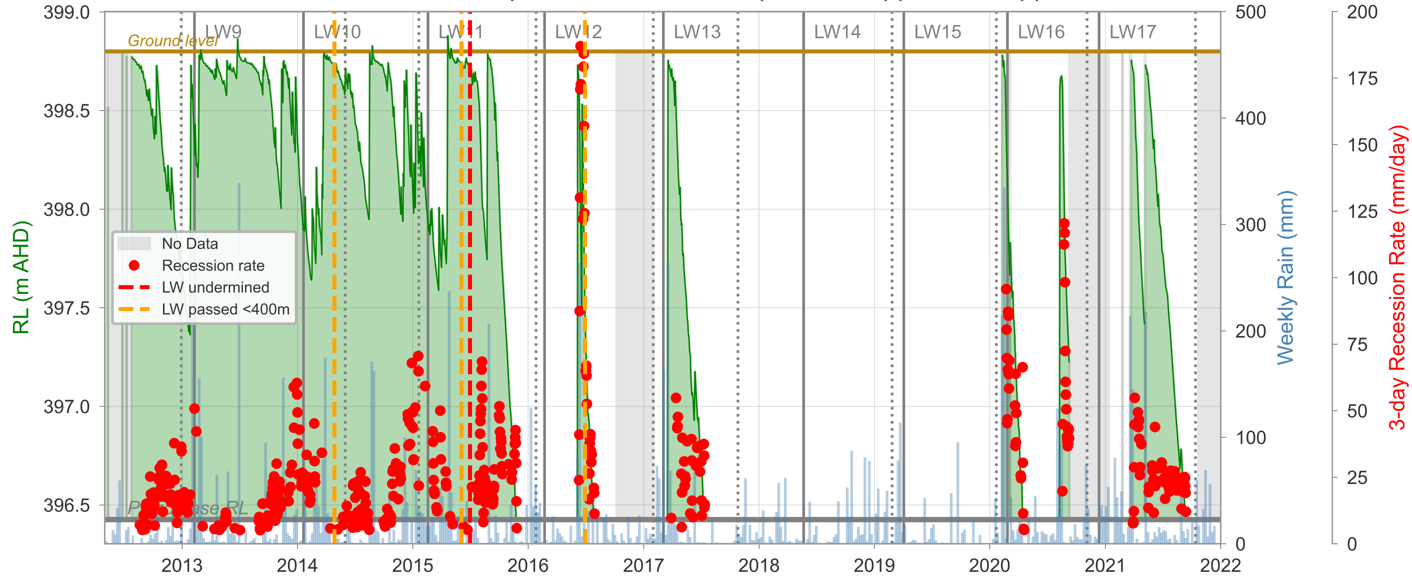
Dendrobium Swamp 02: Piezometer 01 (Within mapped swamp)



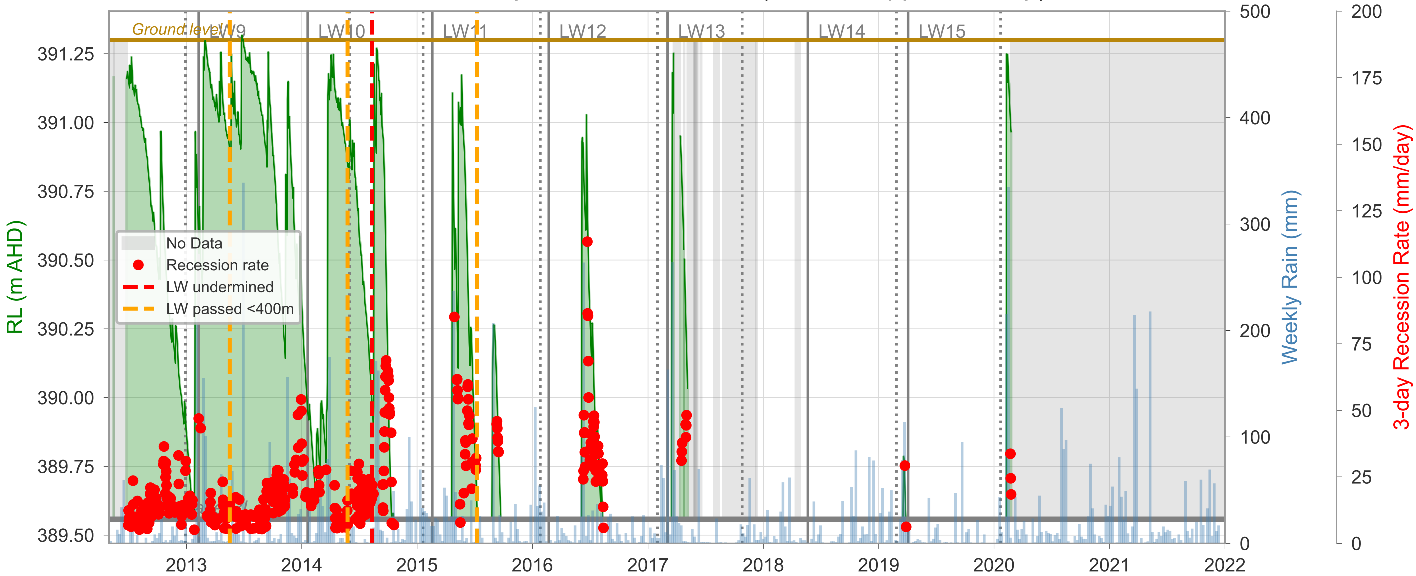
Dendrobium Swamp 03: Piezometer 01 (Within mapped swamp)



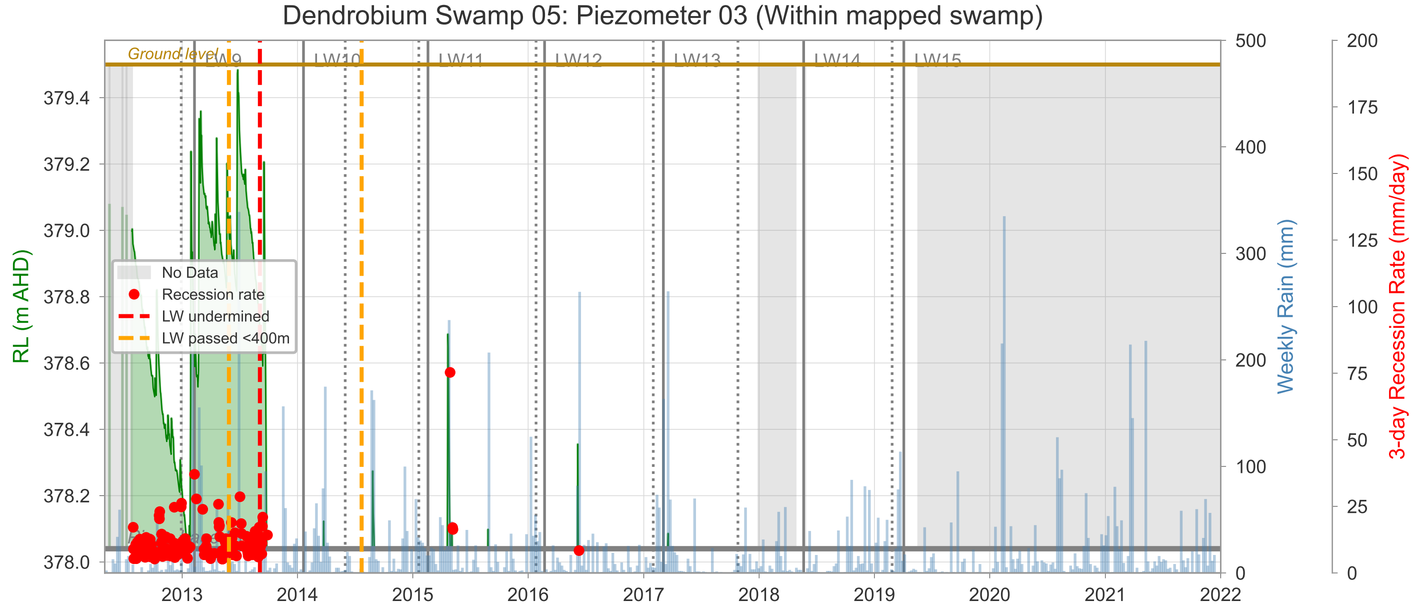
Dendrobium Swamp 05: Piezometer 01 (Within mapped swamp)

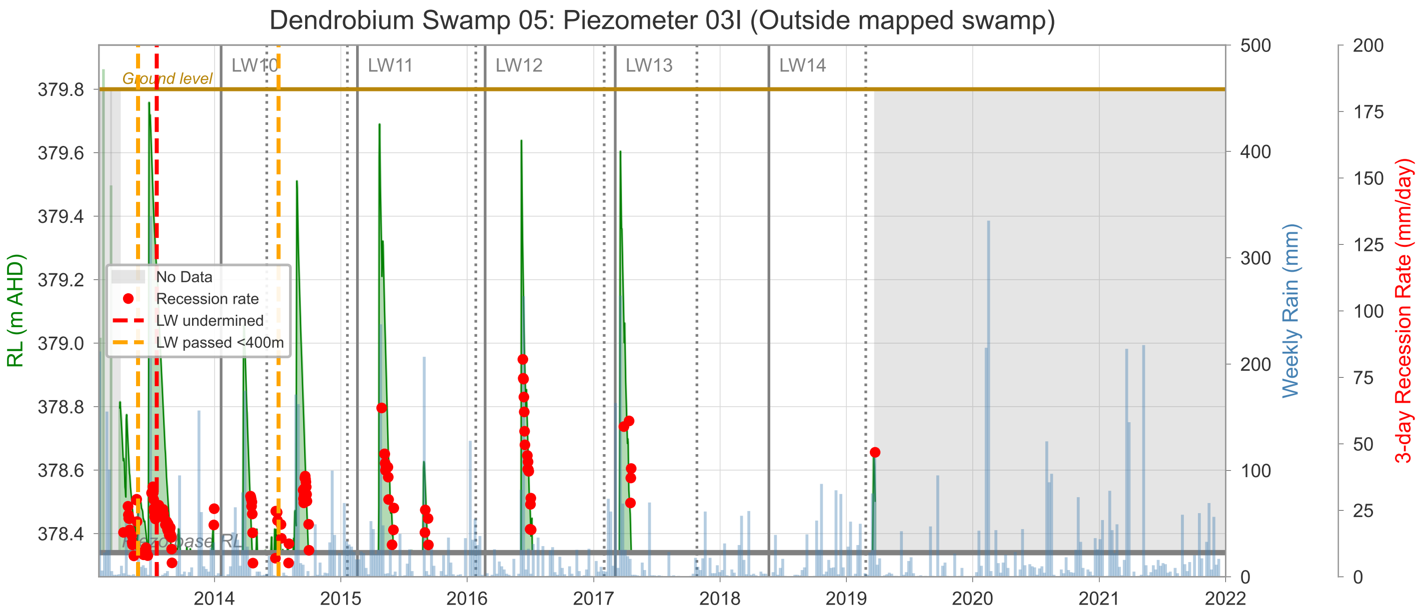


Dendrobium Swamp 05: Piezometer 02 (Within mapped swamp)

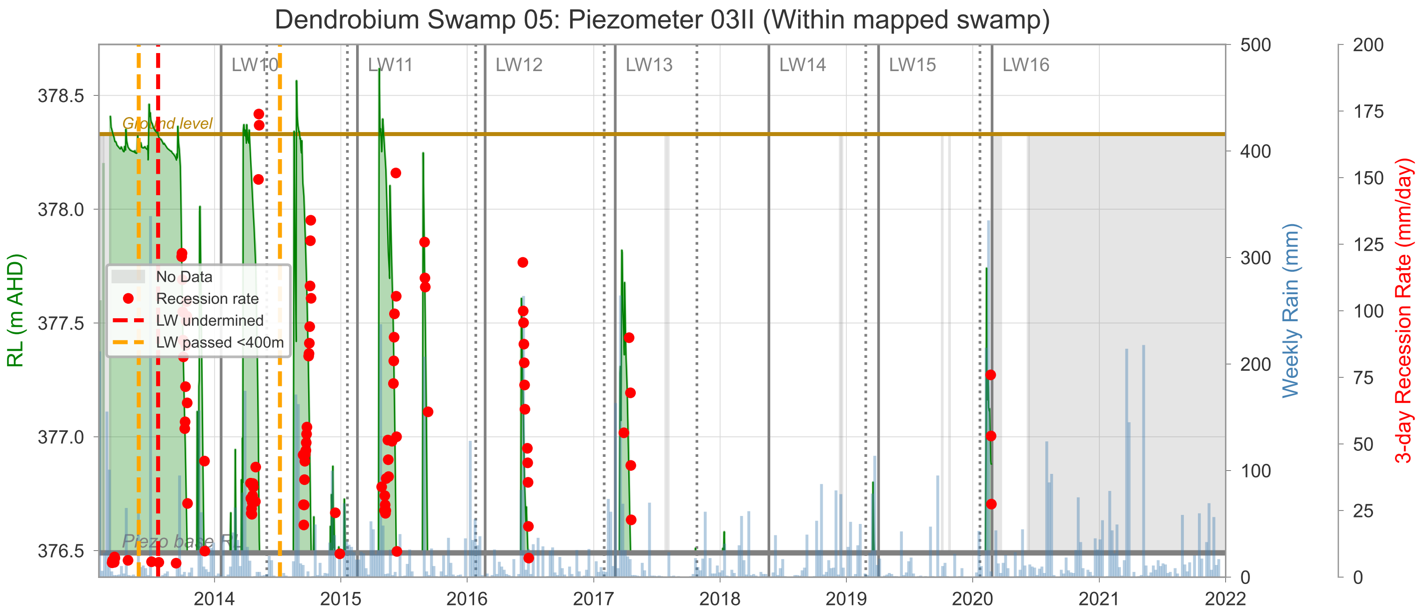


Dendrobium Swamp 05: Piezometer 03 (Within mapped swamp)

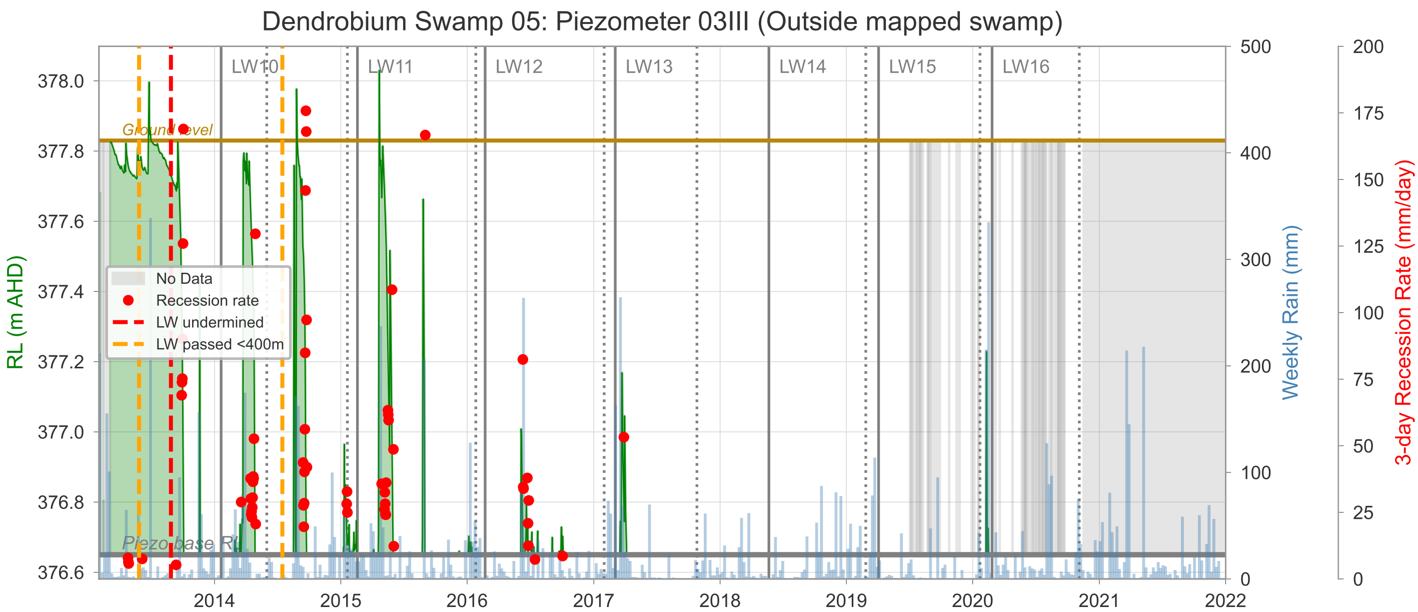




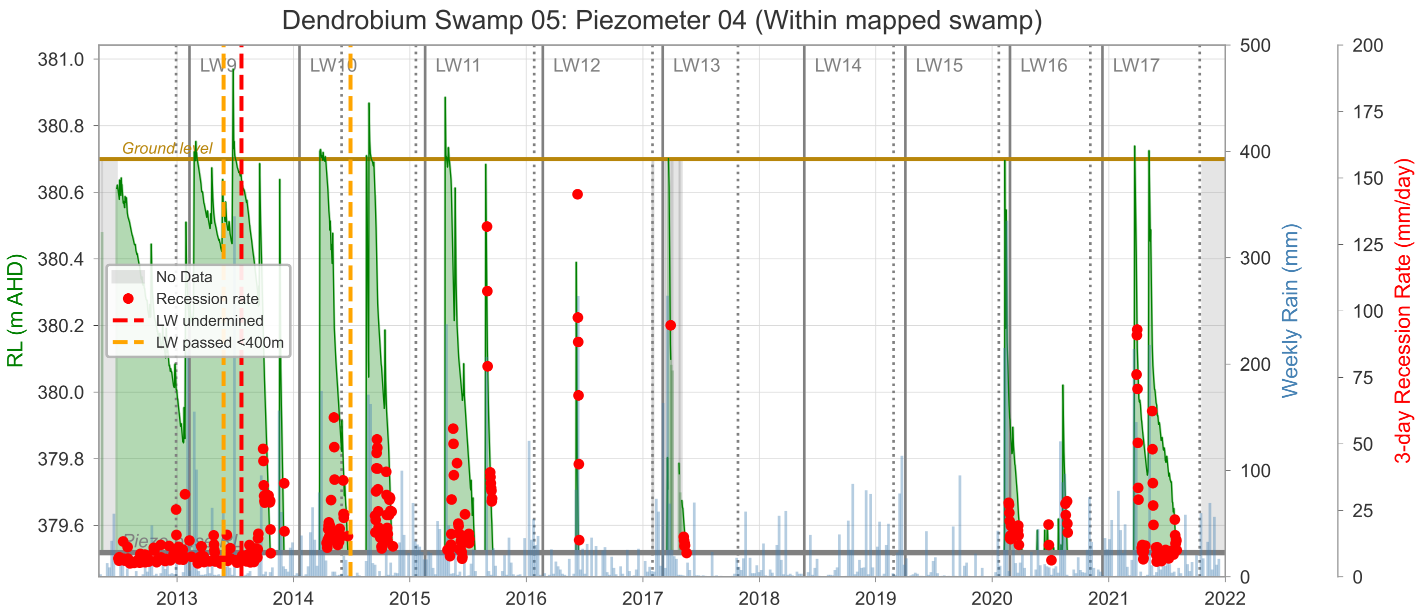
Dendrobium Swamp 05: Piezometer 03I (Outside mapped swamp)
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
Ground level
Piezo base RL
LW10
LW11
LW12
LW13
LW14
No Data
Recession rate
LW undermined
LW passed <400m
379.8
379.6
379.4
379.2
379.0
378.8
378.6
378.4
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2014
2015
2016
2017
2018
2019
2020
2021
2022



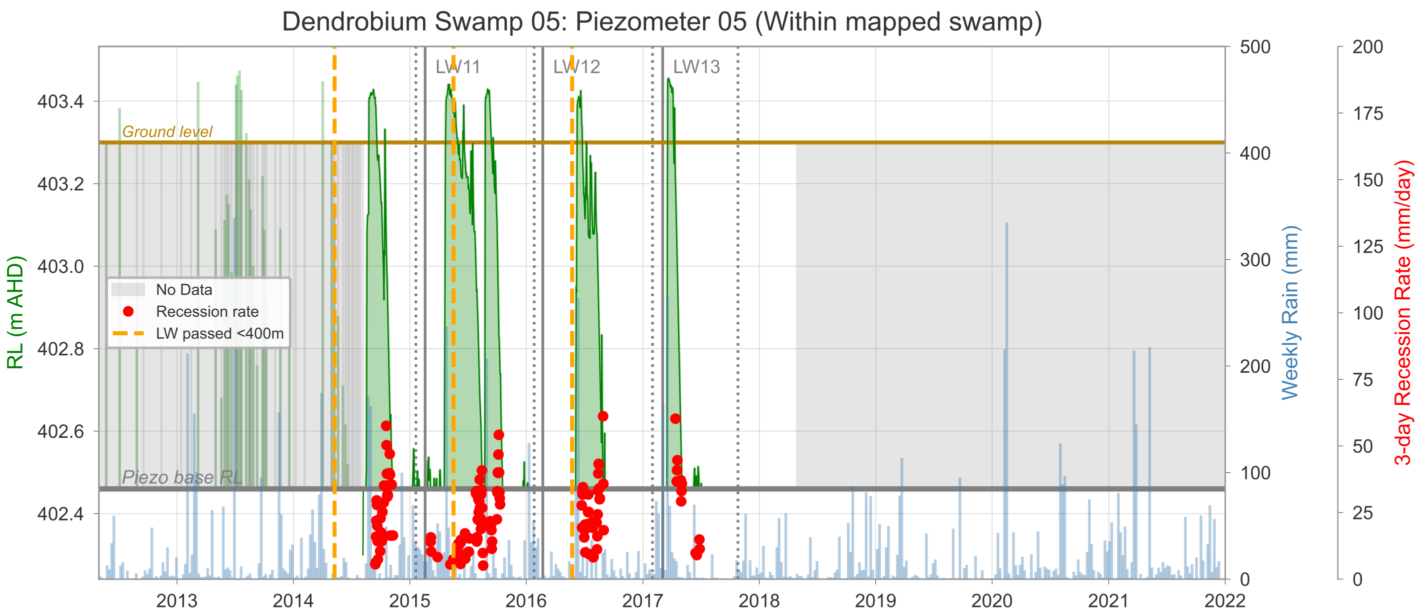
Dendrobium Swamp 05: Piezometer 03II (Within mapped swamp)
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
Ground level
Piezo base RL
LW10
LW11
LW12
LW13
LW14
LW15
LW16
No Data
Recession rate
LW undermined
LW passed <400m
378.5
378.0
377.5
377.0
376.5
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2014
2015
2016
2017
2018
2019
2020
2021
2022



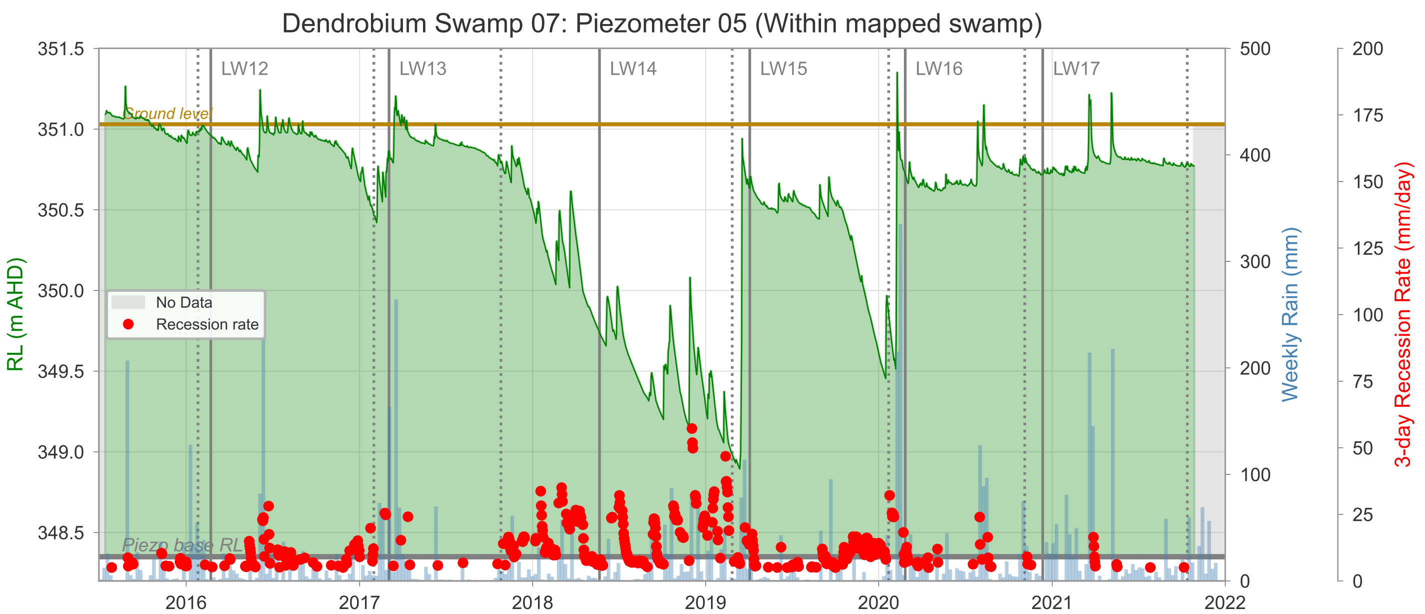
Dendrobium Swamp 05: Piezometer 03III (Outside mapped swamp)
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
Ground level
Piezo base RL
LW10
LW11
LW12
LW13
LW14
LW15
LW16
No Data
Recession rate
LW undermined
LW passed <400m
378.0
377.8
377.6
377.4
377.2
377.0
376.8
376.6
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2014
2015
2016
2017
2018
2019
2020
2021
2022



Dendrobium Swamp 05: Piezometer 04 (Within mapped swamp)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Ground level
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
381.0
380.8
380.6
380.4
380.2
380.0
379.8
379.6
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

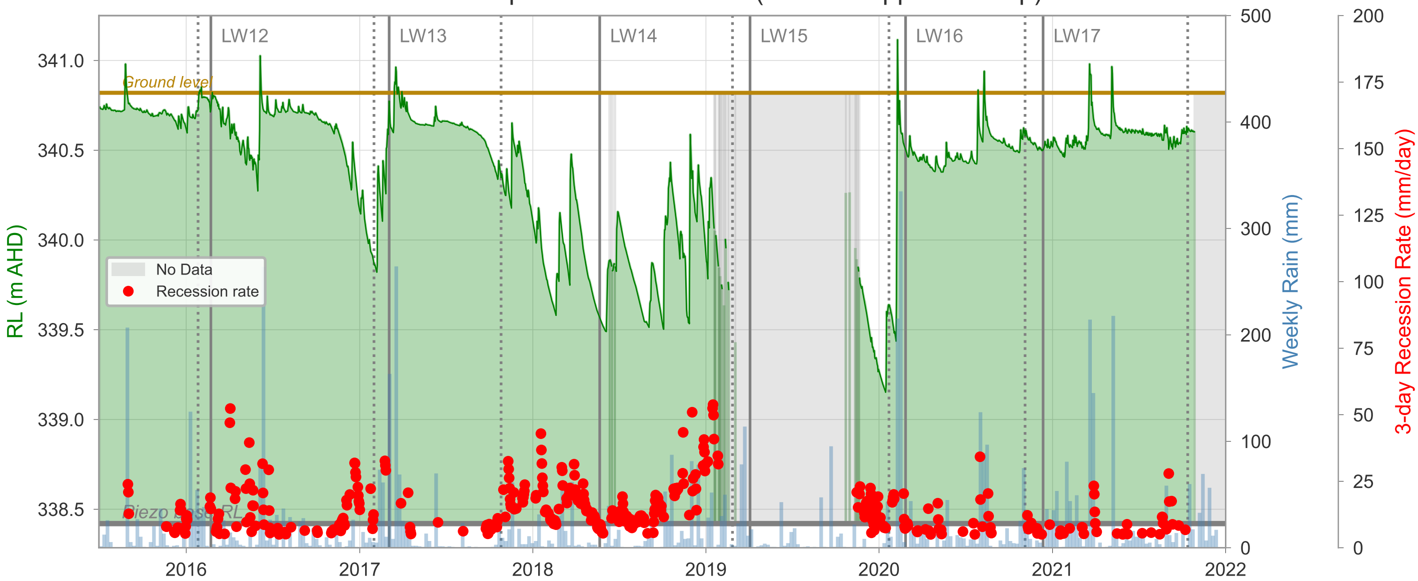


Dendrobium Swamp 05: Piezometer 05 (Within mapped swamp)
LW11
LW12
LW13
Ground level
Piezo base RL
No Data
Recession rate
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
403.4
403.2
403.0
402.8
402.6
402.4
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

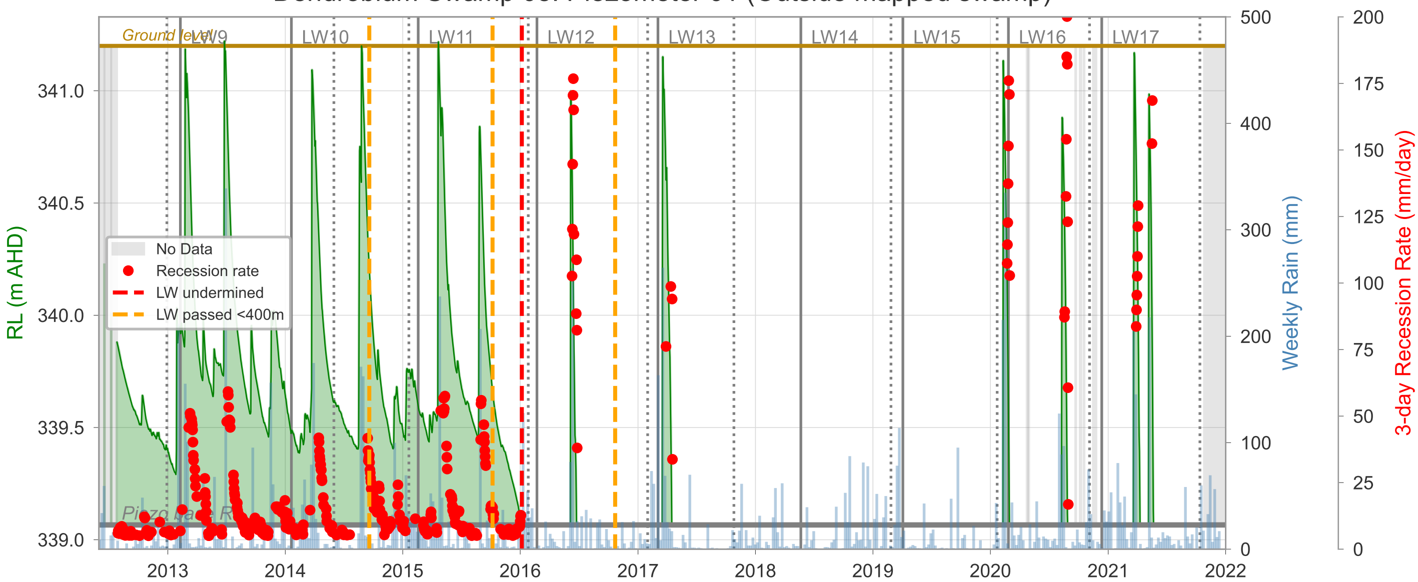


Dendrobium Swamp 07: Piezometer 05 (Within mapped swamp)
LW12
LW13
LW14
LW15
LW16
LW17
Ground level
Piezo base RL
No Data
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
351.5
351.0
350.5
350.0
349.5
349.0
348.5
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2016
2017
2018
2019
2020
2021
2022

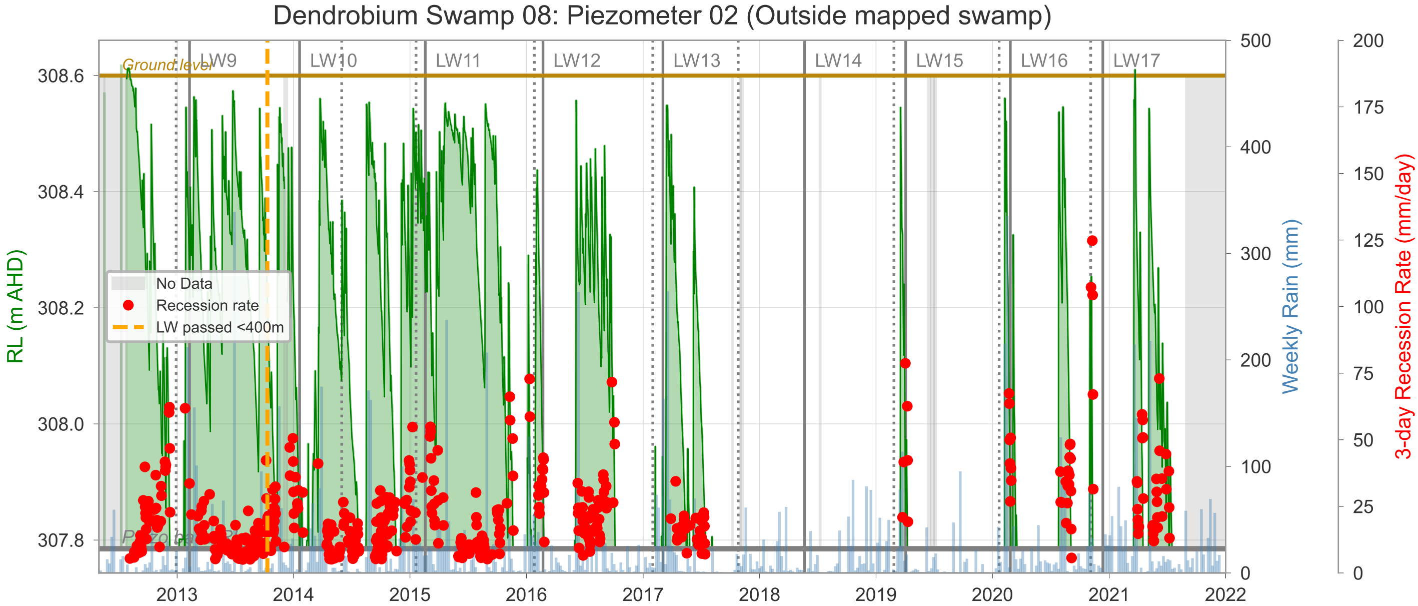
Dendrobium Swamp 07: Piezometer 06 (Within mapped swamp)



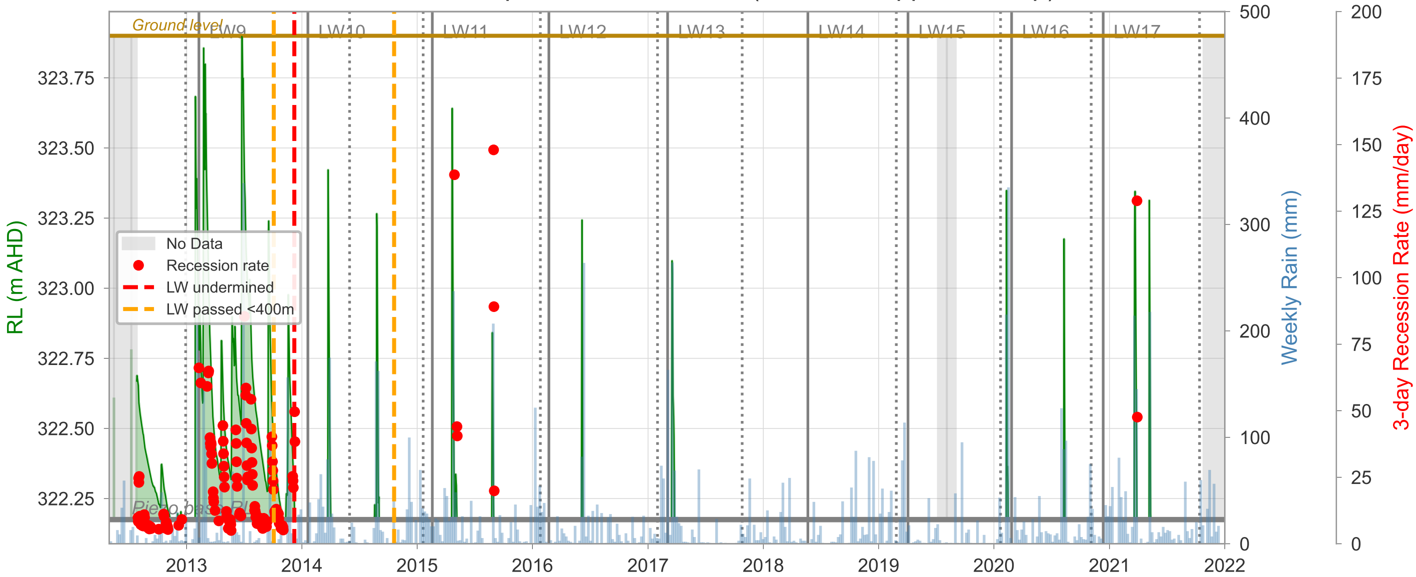
Dendrobium Swamp 08: Piezometer 01 (Outside mapped swamp)



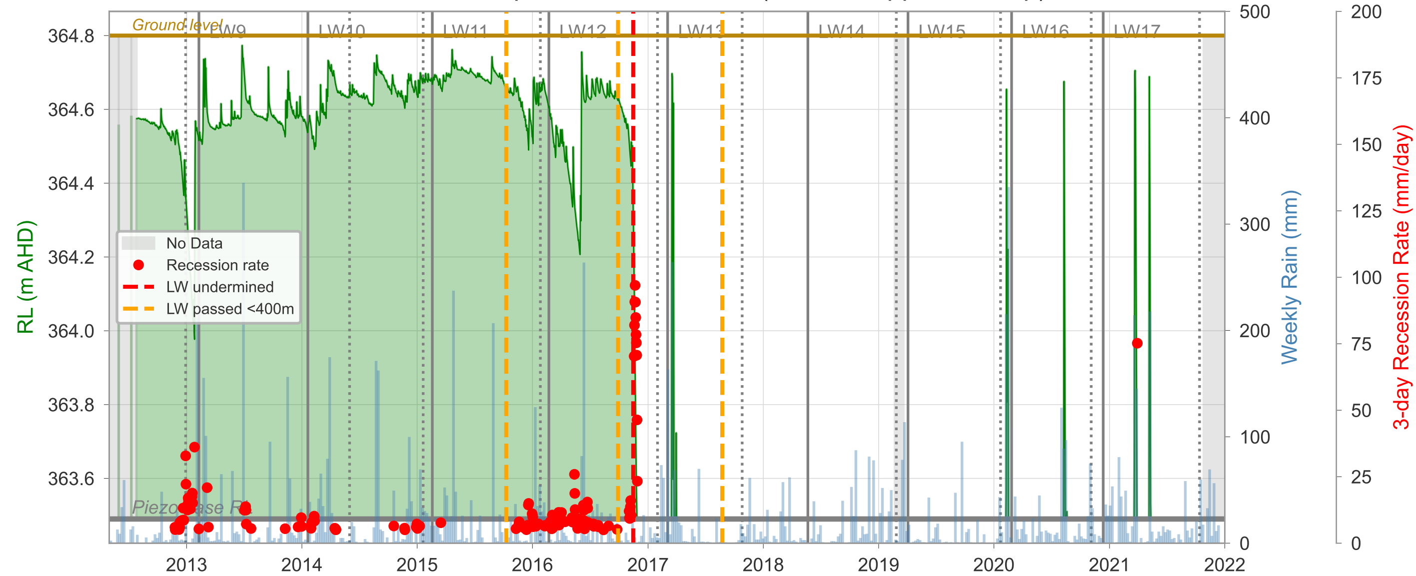
Dendrobium Swamp 08: Piezometer 02 (Outside mapped swamp)



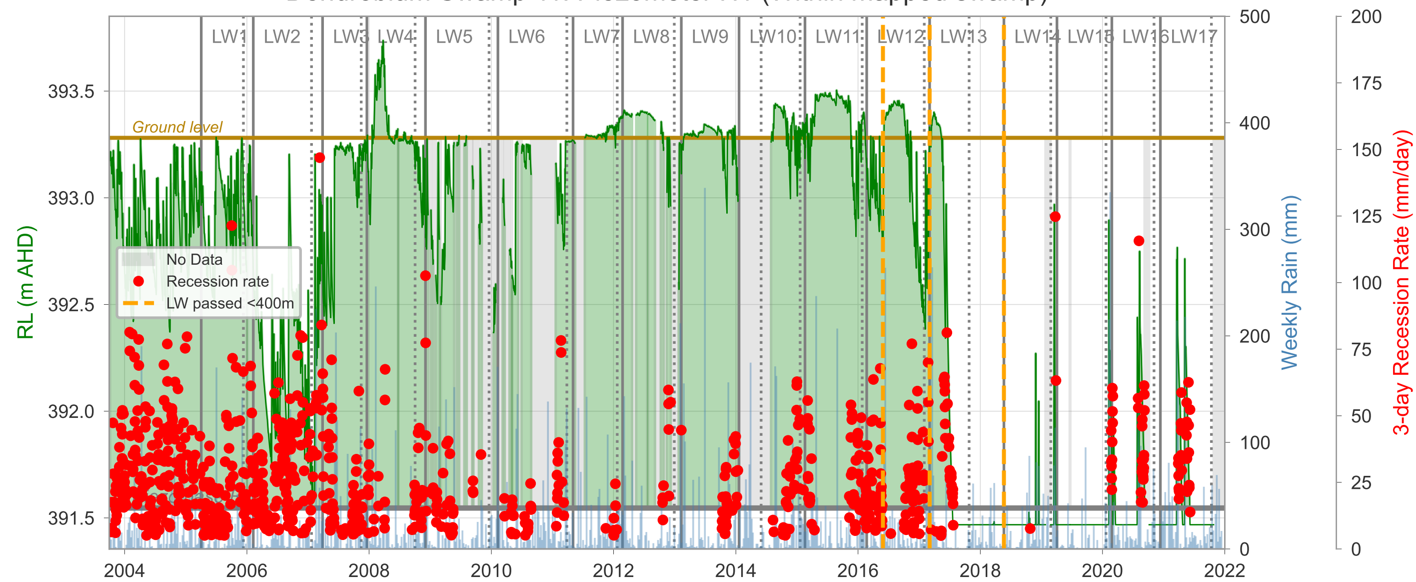
Dendrobium Swamp 08: Piezometer 04 (Outside mapped swamp)



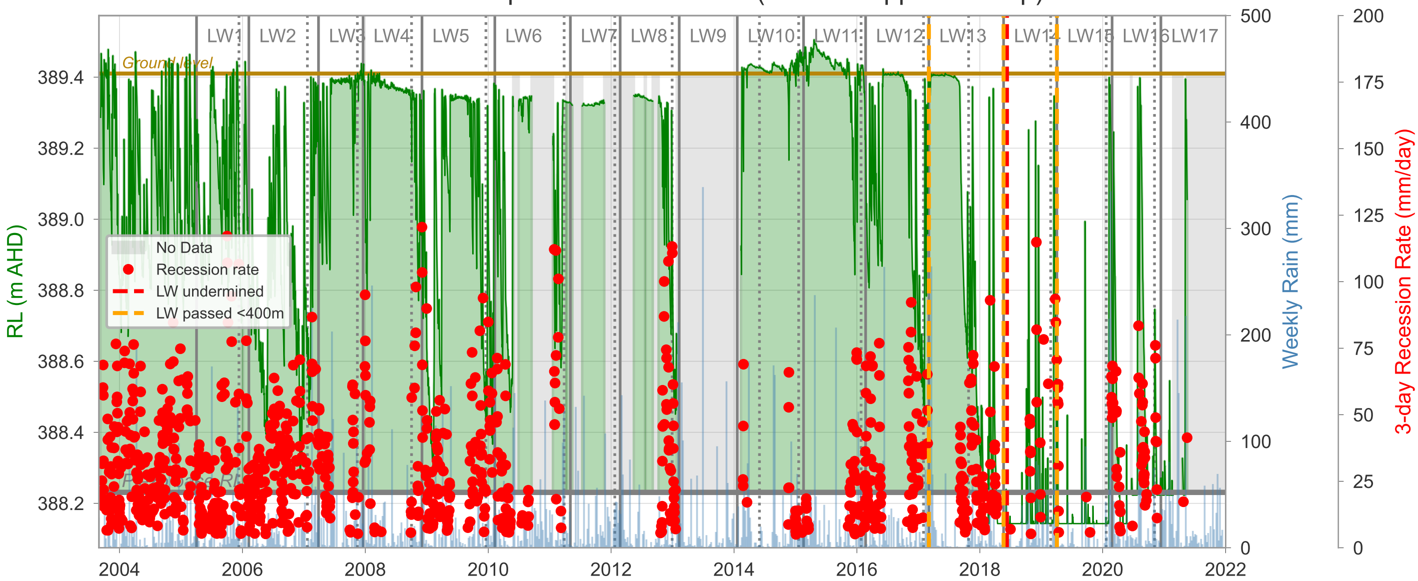
Dendrobium Swamp 10: Piezometer 01 (Within mapped swamp)



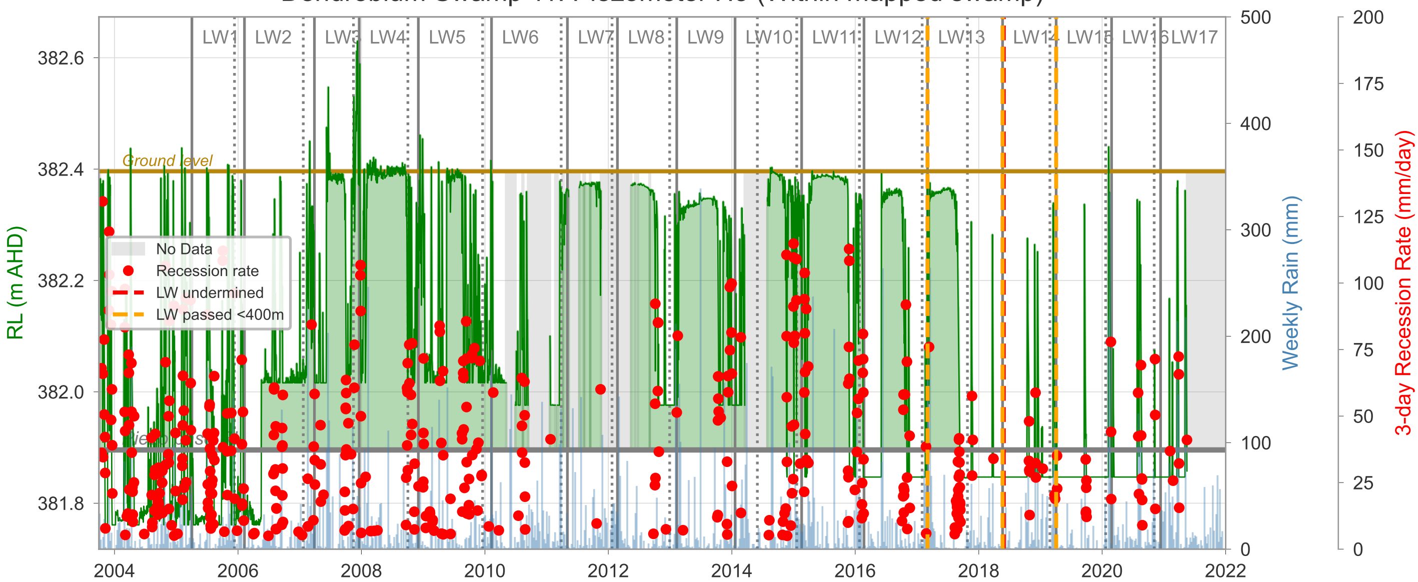
Dendrobium Swamp 11: Piezometer H1 (Within mapped swamp)



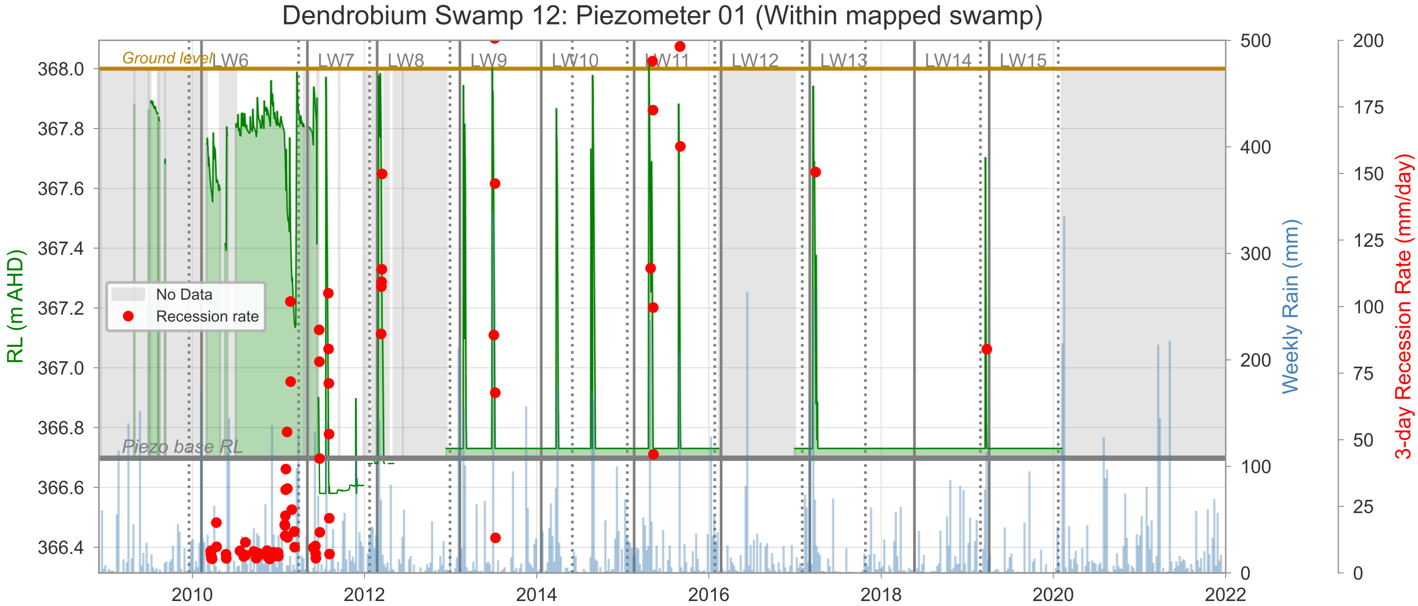
Dendrobium Swamp 11: Piezometer H2 (Within mapped swamp)

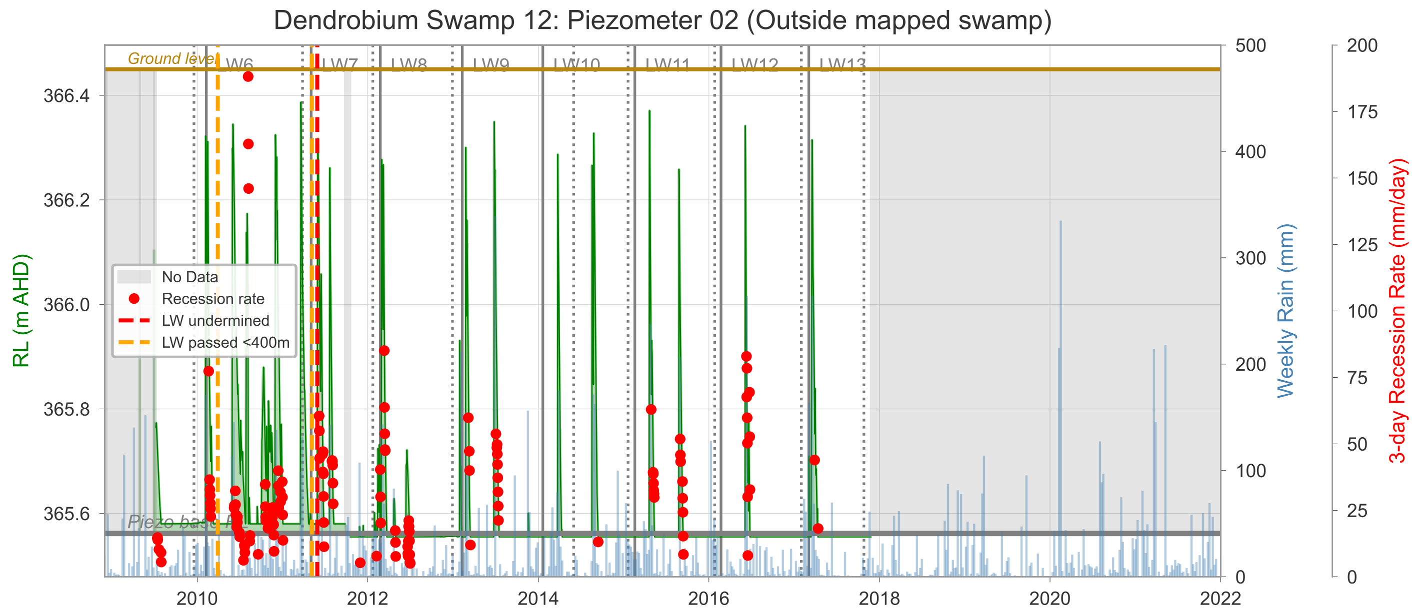


Dendrobium Swamp 11: Piezometer H3 (Within mapped swamp)

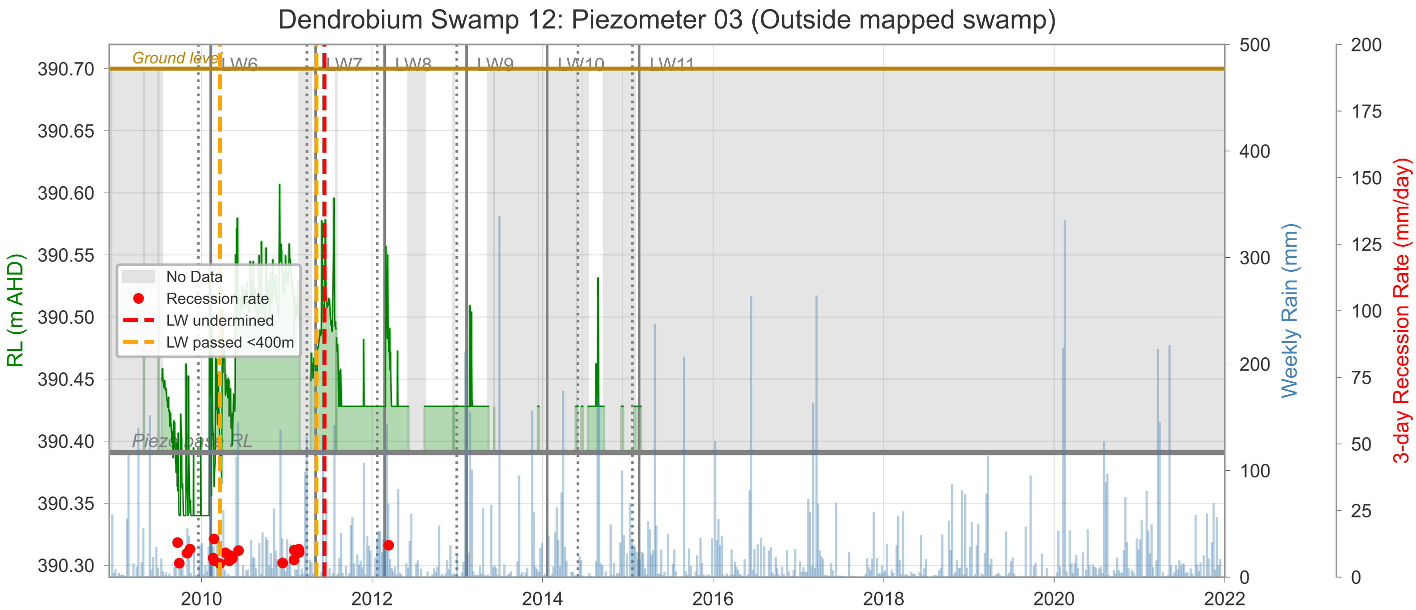


Dendrobium Swamp 12: Piezometer 01 (Within mapped swamp)

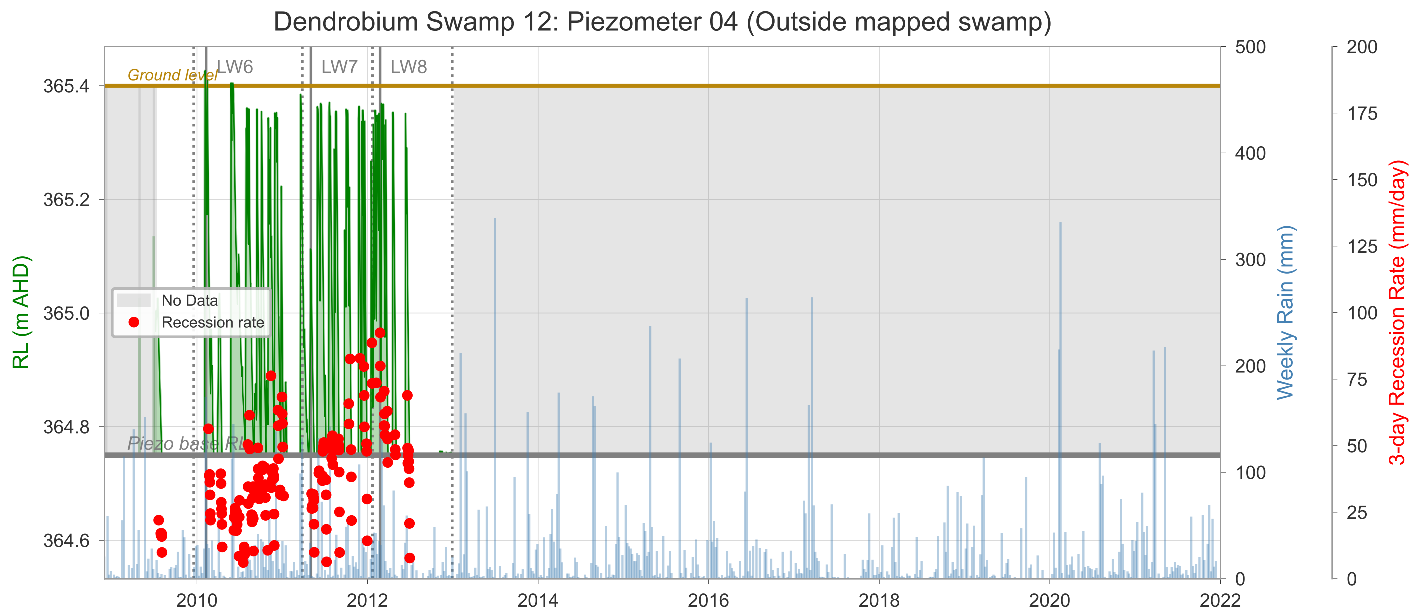




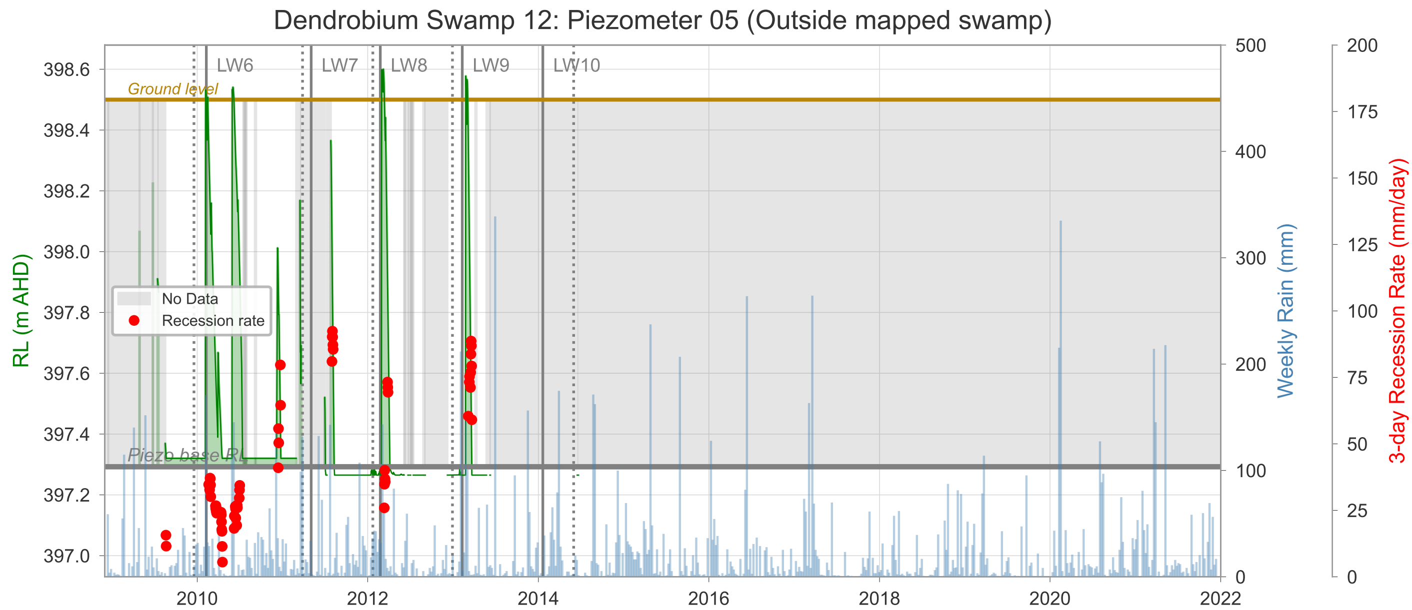
Dendrobium Swamp 12: Piezometer 02 (Outside mapped swamp)
Ground level
Piezo base RL
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)



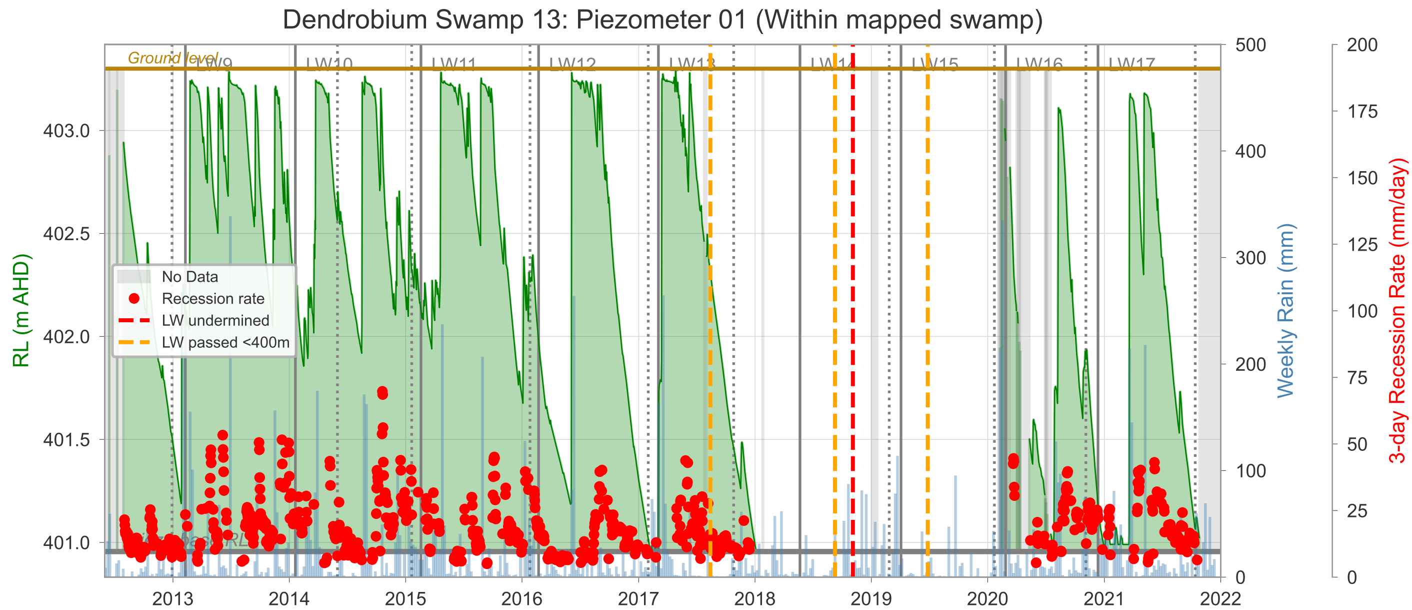
Dendrobium Swamp 12: Piezometer 03 (Outside mapped swamp)
Ground level
Piezo base RL
LW6
LW7
LW8
LW9
LW10
LW11
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)



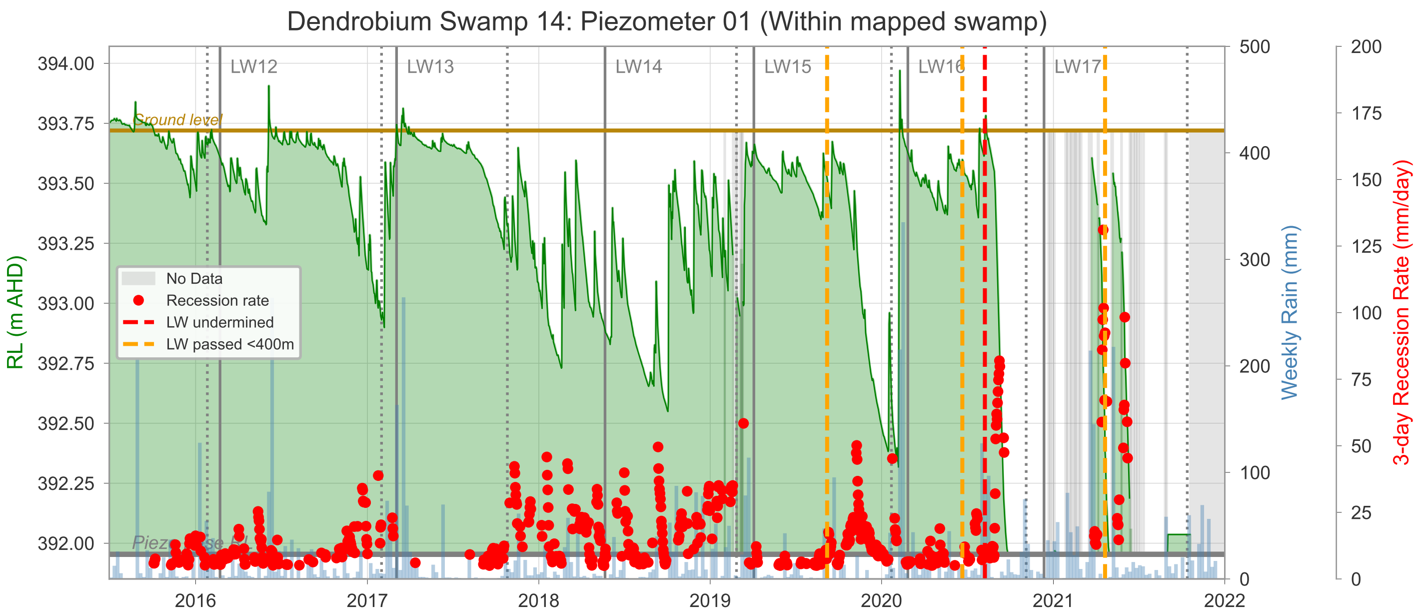
Dendrobium Swamp 12: Piezometer 04 (Outside mapped swamp)
Ground level
Piezo base RL
LW6
LW7
LW8
No Data
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)



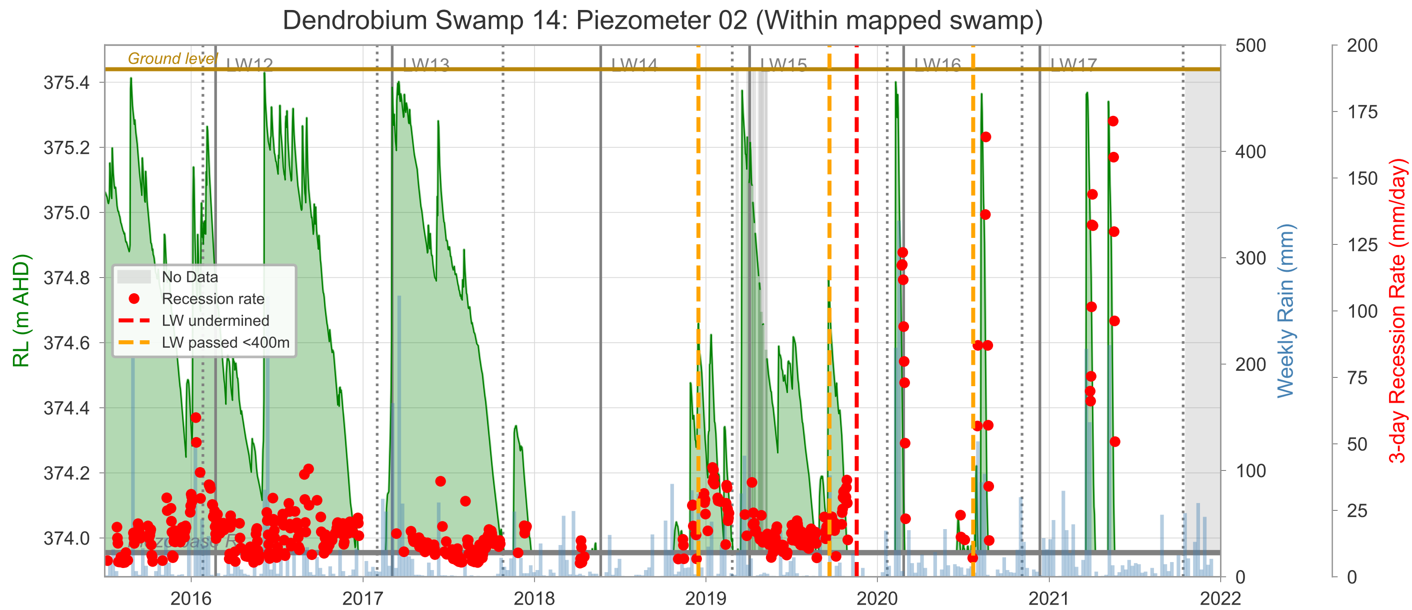
Dendrobium Swamp 12: Piezometer 05 (Outside mapped swamp)
LW6
LW7
LW8
LW9
LW10
Ground level
Piezo base RL
No Data
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

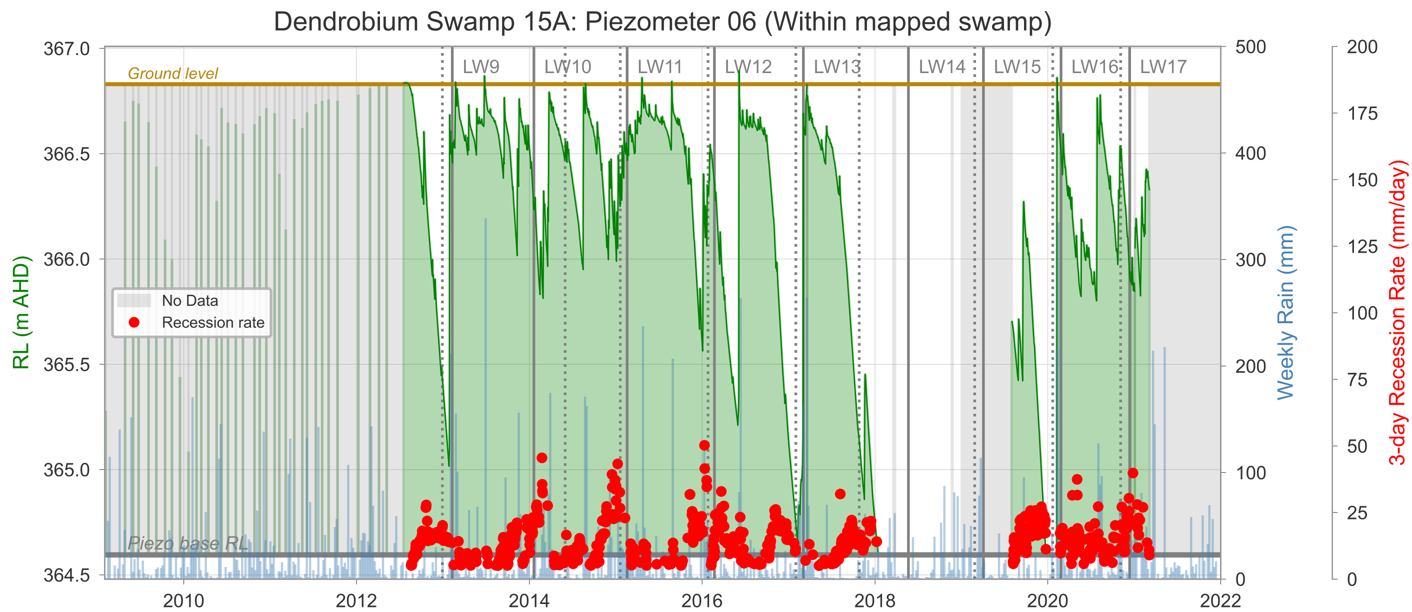


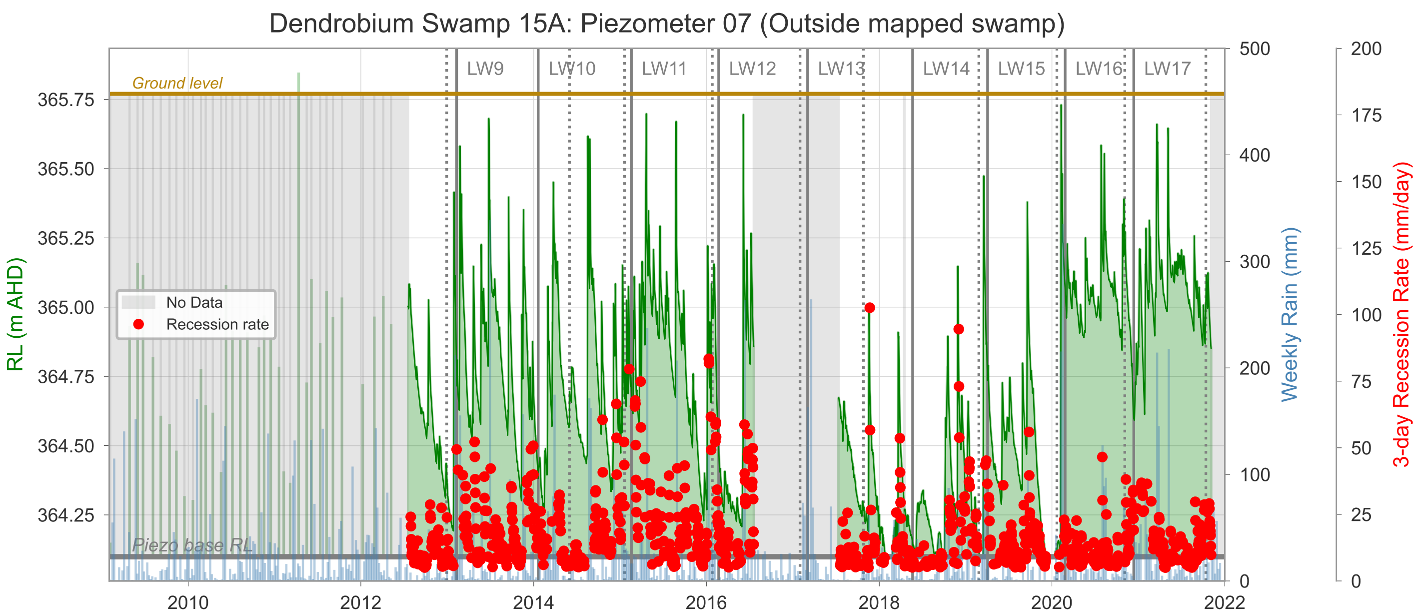
Dendrobium Swamp 13: Piezometer 01 (Within mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)



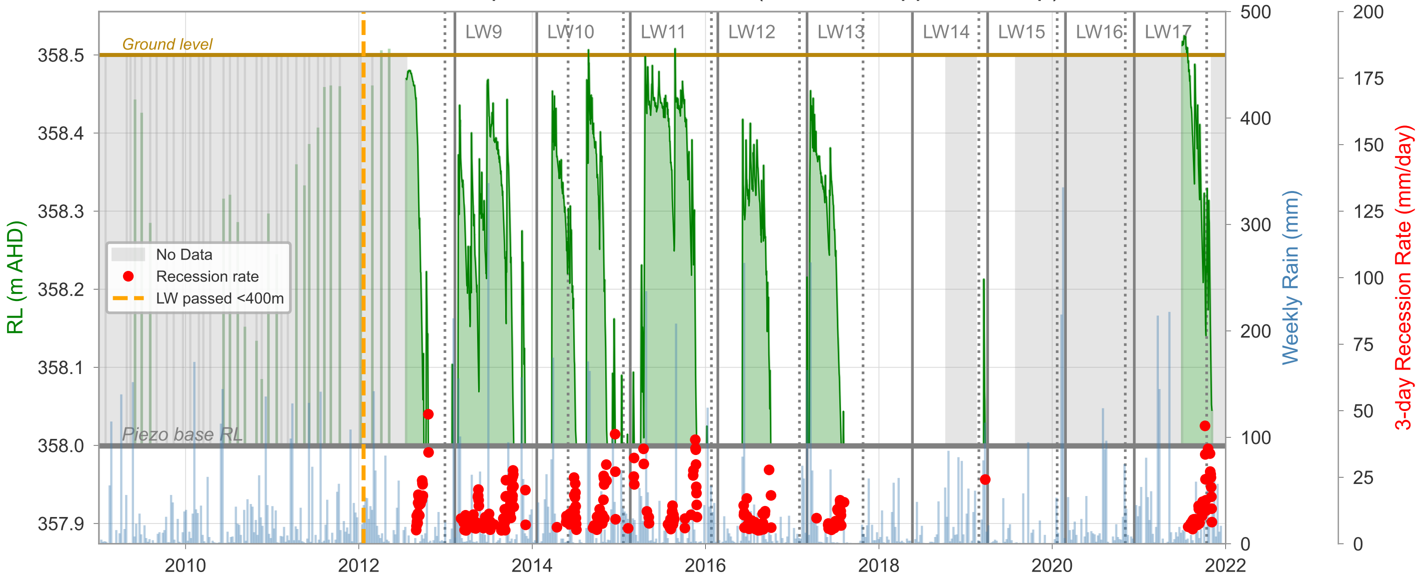
Dendrobium Swamp 14: Piezometer 01 (Within mapped swamp)
LW12
LW13
LW14
LW15
LW16
LW17
Ground level
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)


Dendrobium Swamp 14: Piezometer 02 (Within mapped swamp)
Ground level
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
LW undermined
LW passed <400m
Piezo base RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
375.4
375.2
375.0
374.8
374.6
374.4
374.2
374.0
2016
2017
2018
2019
2020
2021
2022
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0

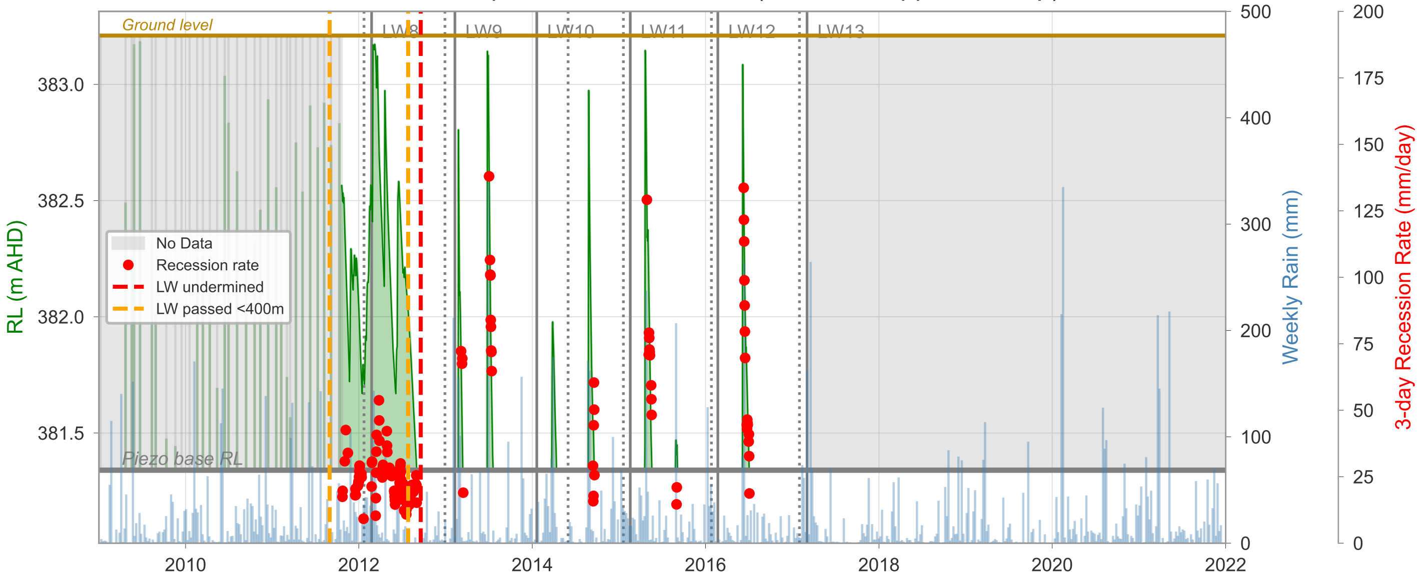

Dendrobium Swamp 15A: Piezometer 06 (Within mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
Piezo base RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
367.0
366.5
366.0
365.5
365.0
364.5
2010
2012
2014
2016
2018
2020
2022
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0


Dendrobium Swamp 15A: Piezometer 07 (Outside mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
Piezo base RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
365.75
365.50
365.25
365.00
364.75
364.50
364.25
2010
2012
2014
2016
2018
2020
2022
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0

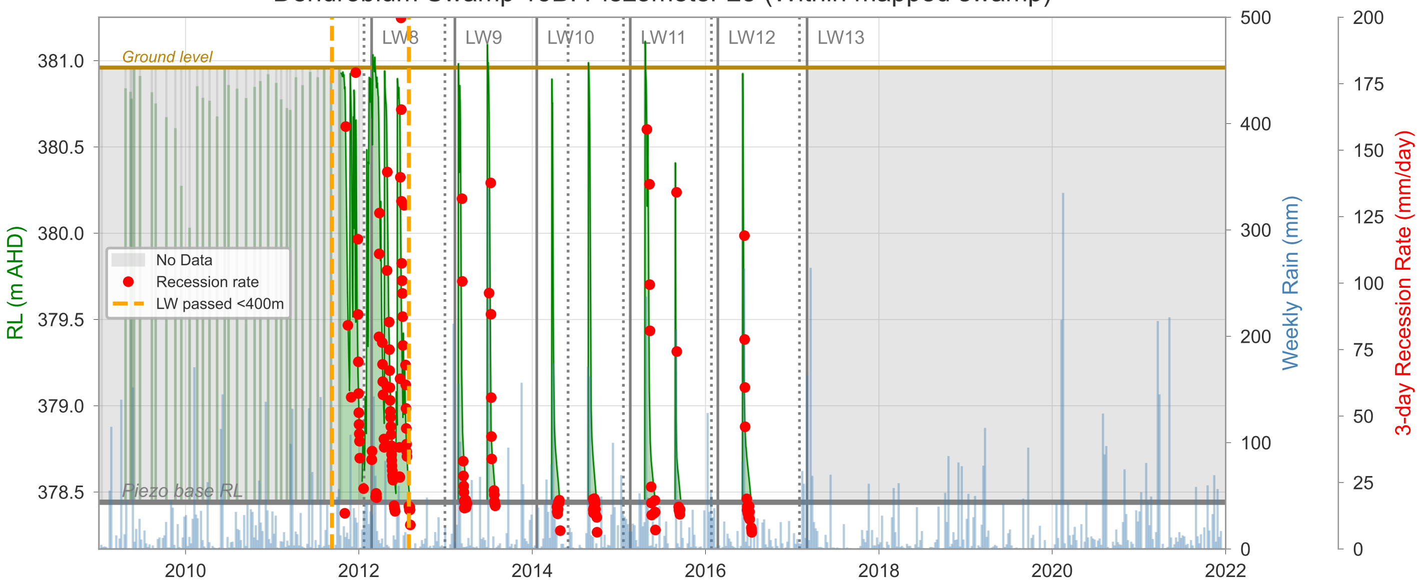
Dendrobium Swamp 15A: Piezometer 18 (Outside mapped swamp)

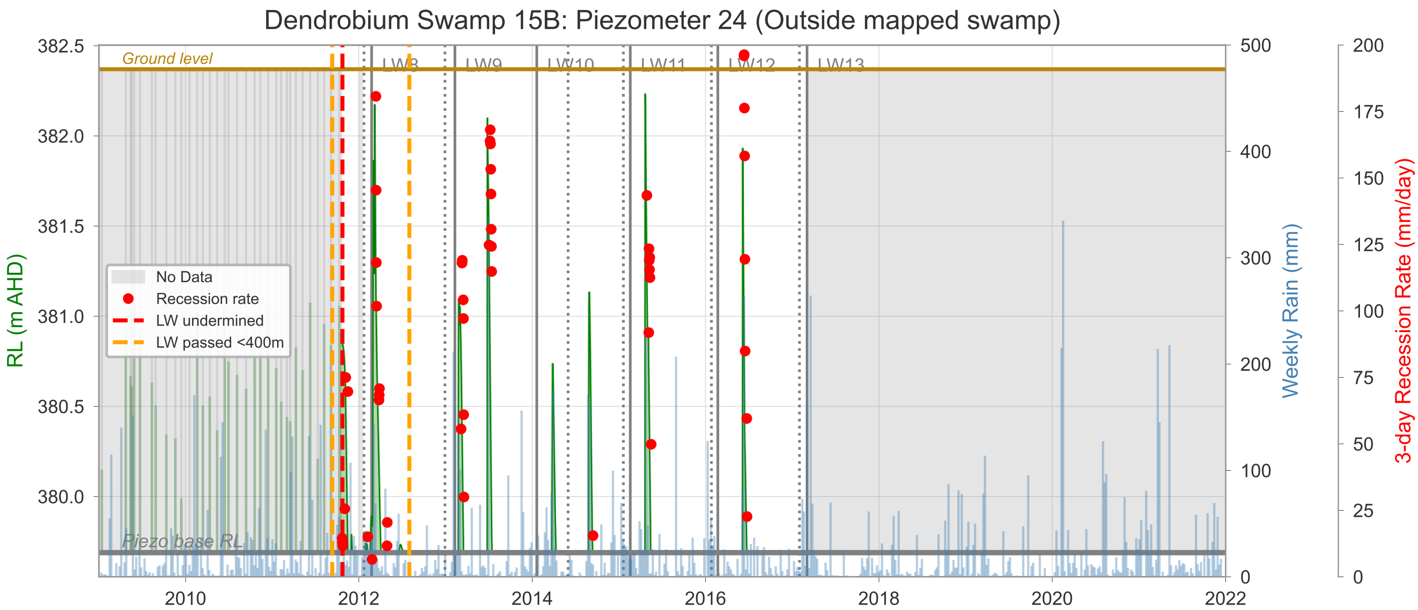


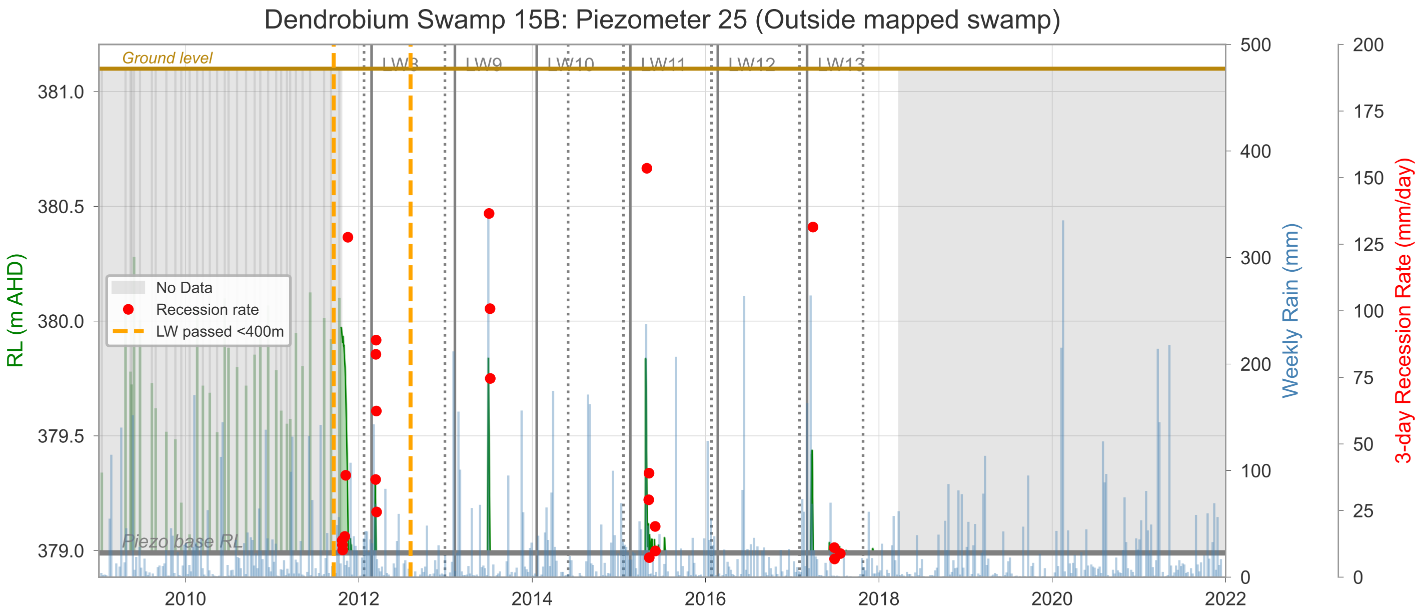
Dendrobium Swamp 15B: Piezometer 22 (Outside mapped swamp)

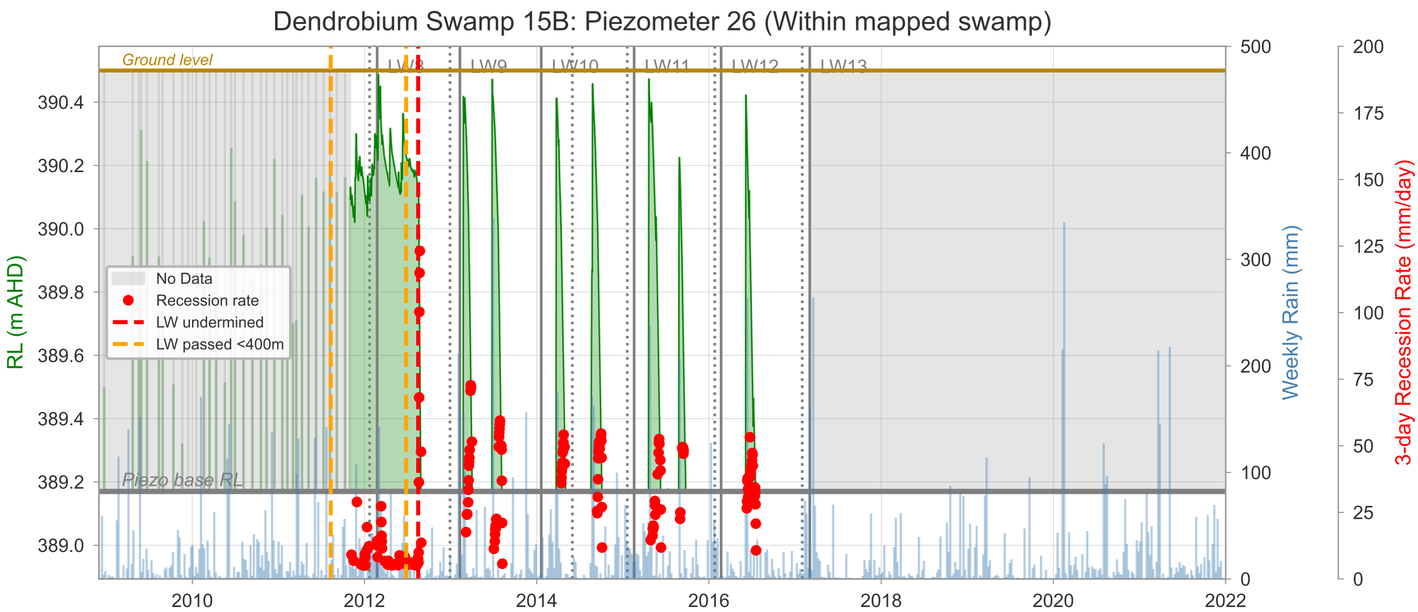


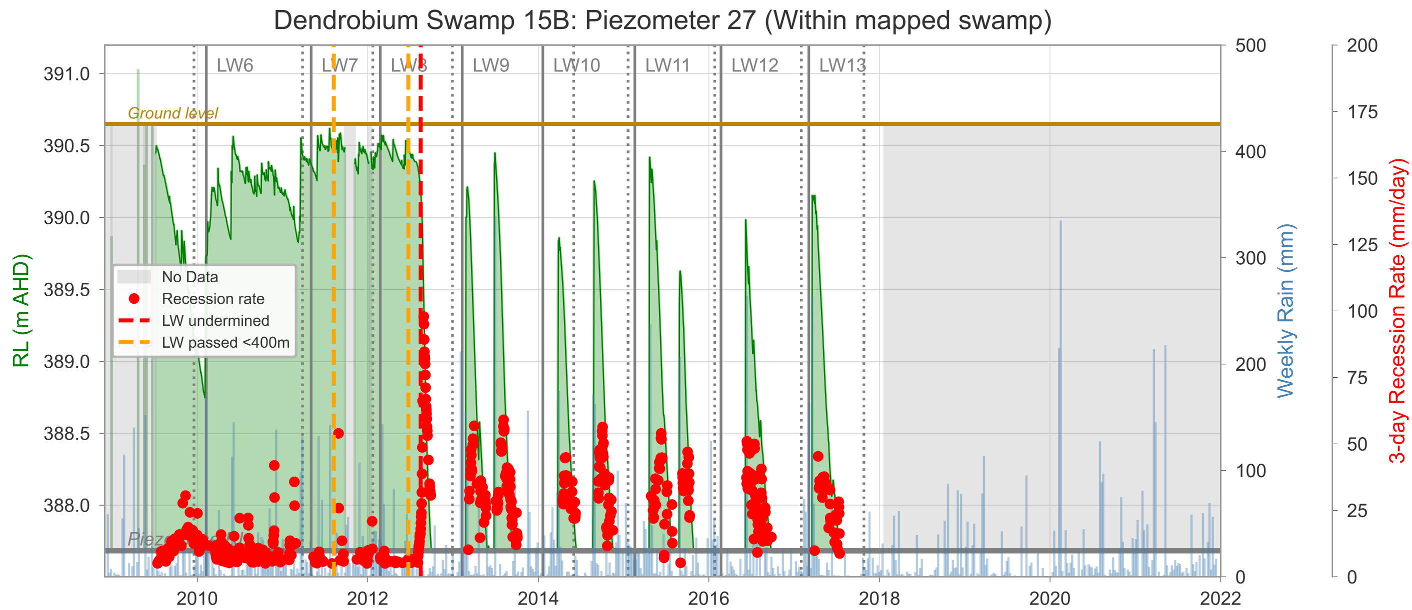
Dendrobium Swamp 15B: Piezometer 23 (Within mapped swamp)

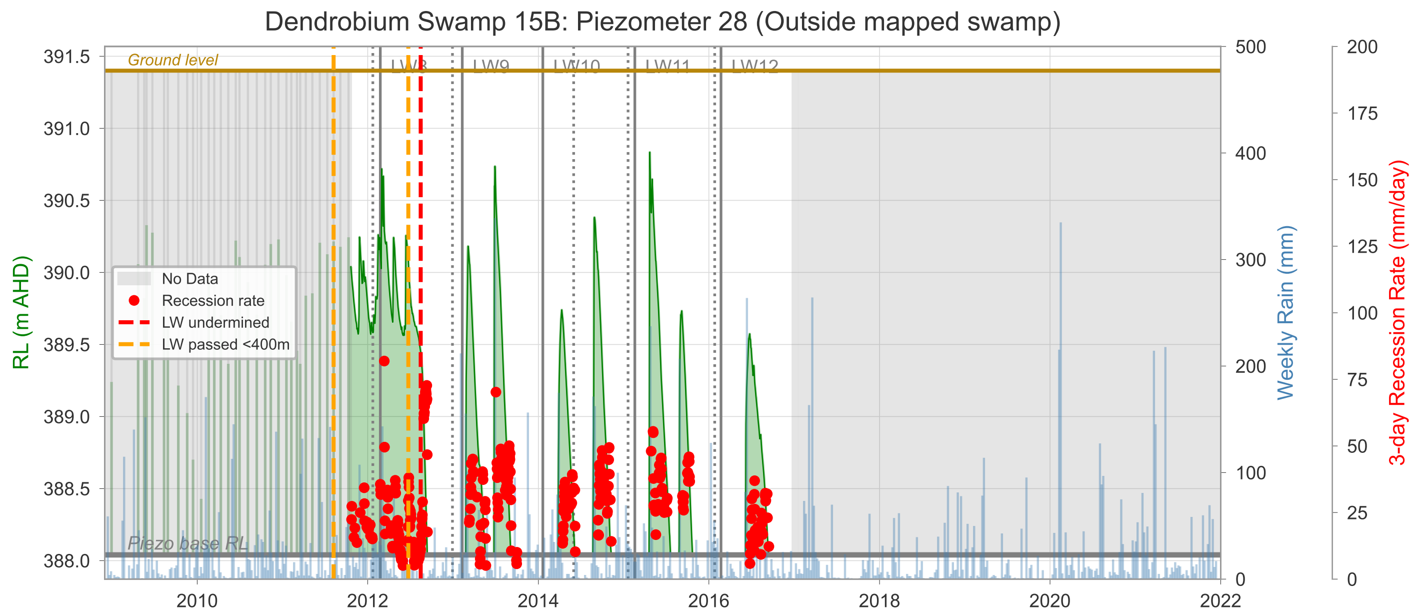


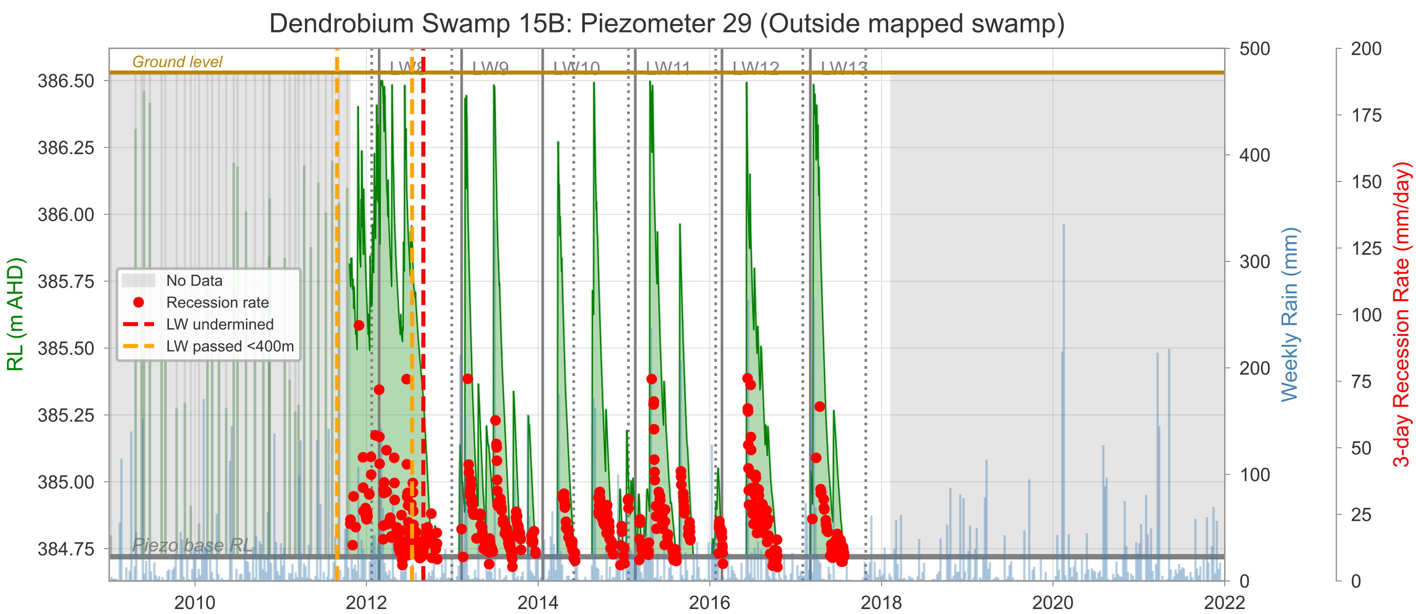

Dendrobium Swamp 15B: Piezometer 24 (Outside mapped swamp)
Ground level
Piezo base RL
LW8
LW9
LW10
LW11
LW12
LW13
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)


Dendrobium Swamp 15B: Piezometer 25 (Outside mapped swamp)
Ground level
Piezo base RL
LW8
LW9
LW10
LW11
LW12
LW13
No Data
Recession rate
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

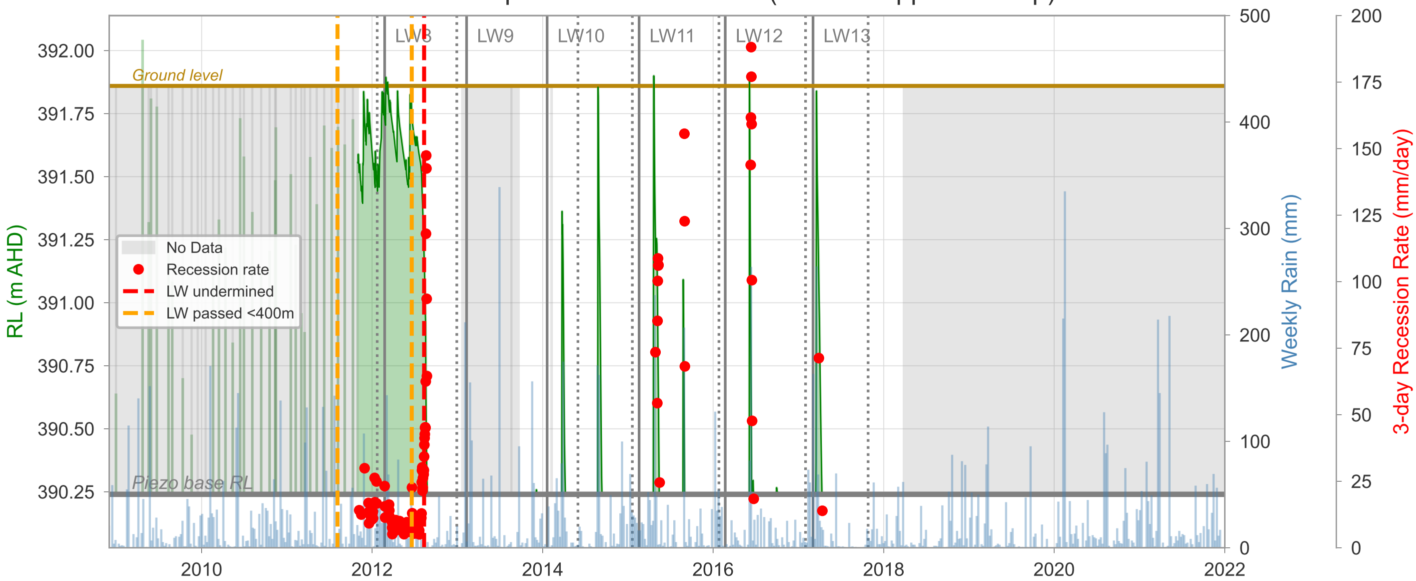

Dendrobium Swamp 15B: Piezometer 26 (Within mapped swamp)
Ground level
Piezo base RL
LW8
LW9
LW10
LW11
LW12
LW13
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)


Dendrobium Swamp 15B: Piezometer 27 (Within mapped swamp)
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
Ground level
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

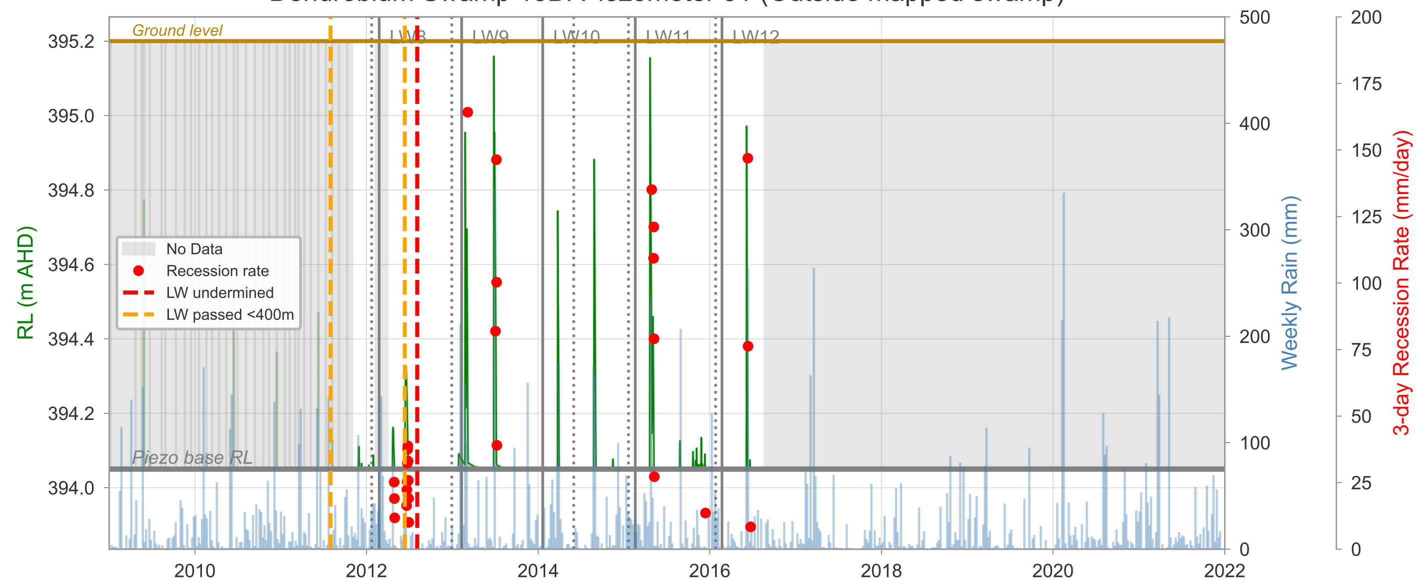

Dendrobium Swamp 15B: Piezometer 28 (Outside mapped swamp)
LW8
LW9
LW10
LW11
LW12
Ground level
Piezo base RL
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)


Dendrobium Swamp 15B: Piezometer 29 (Outside mapped swamp)
LW8
LW9
LW10
LW11
LW12
LW13
Ground level
Piezo base RL
No Data
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

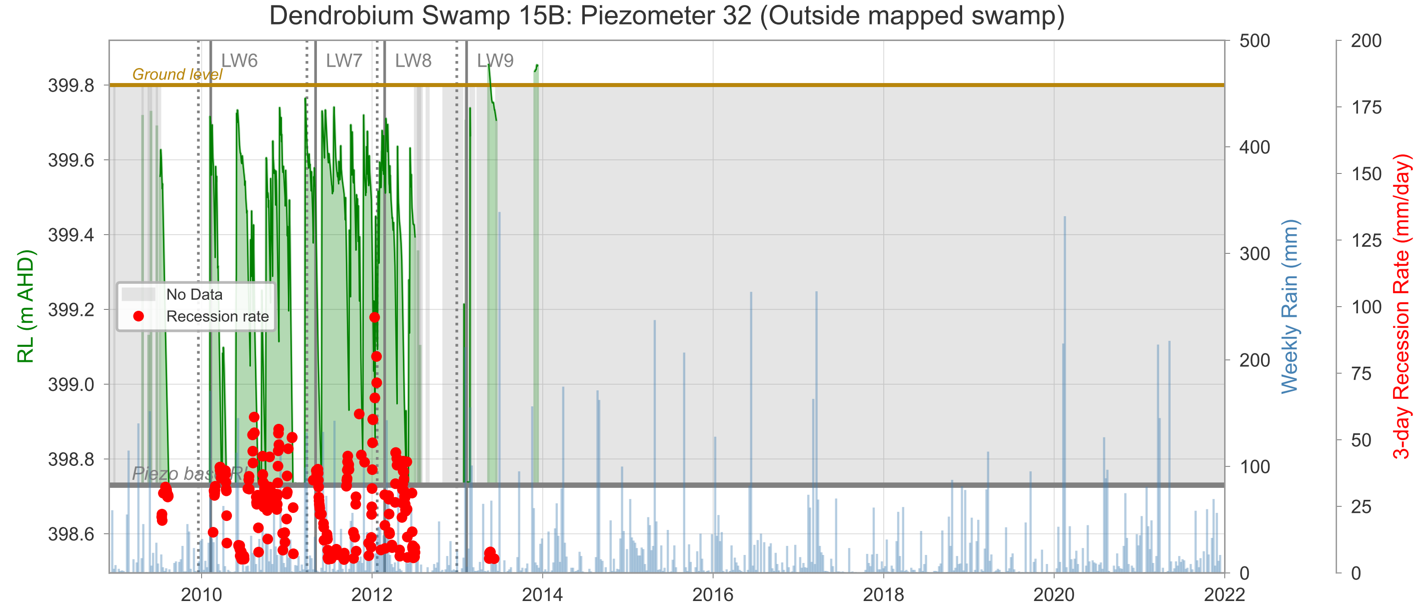
Dendrobium Swamp 15B: Piezometer 30 (Within mapped swamp)



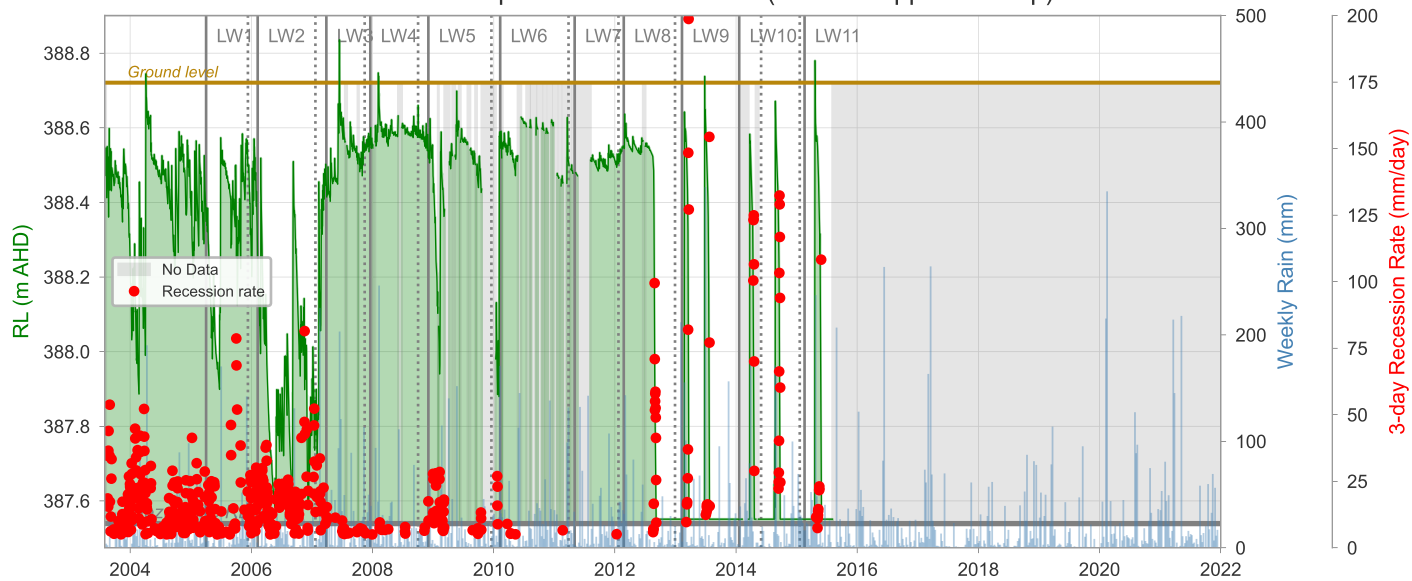
Dendrobium Swamp 15B: Piezometer 31 (Outside mapped swamp)



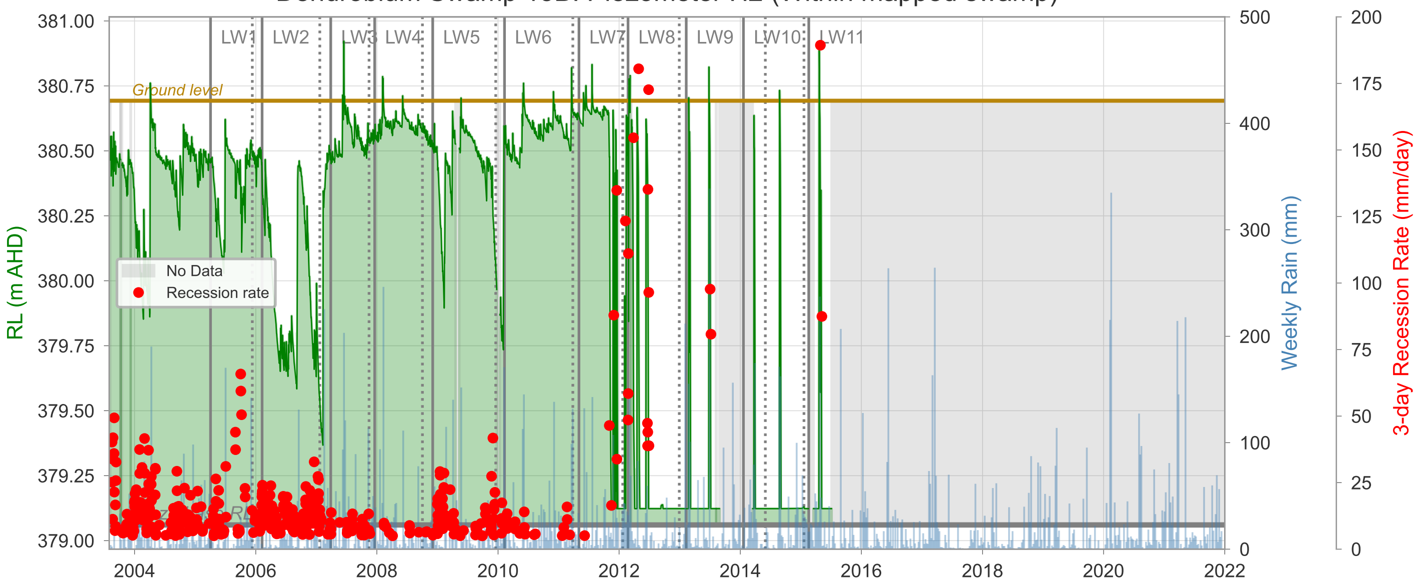
Dendrobium Swamp 15B: Piezometer 32 (Outside mapped swamp)



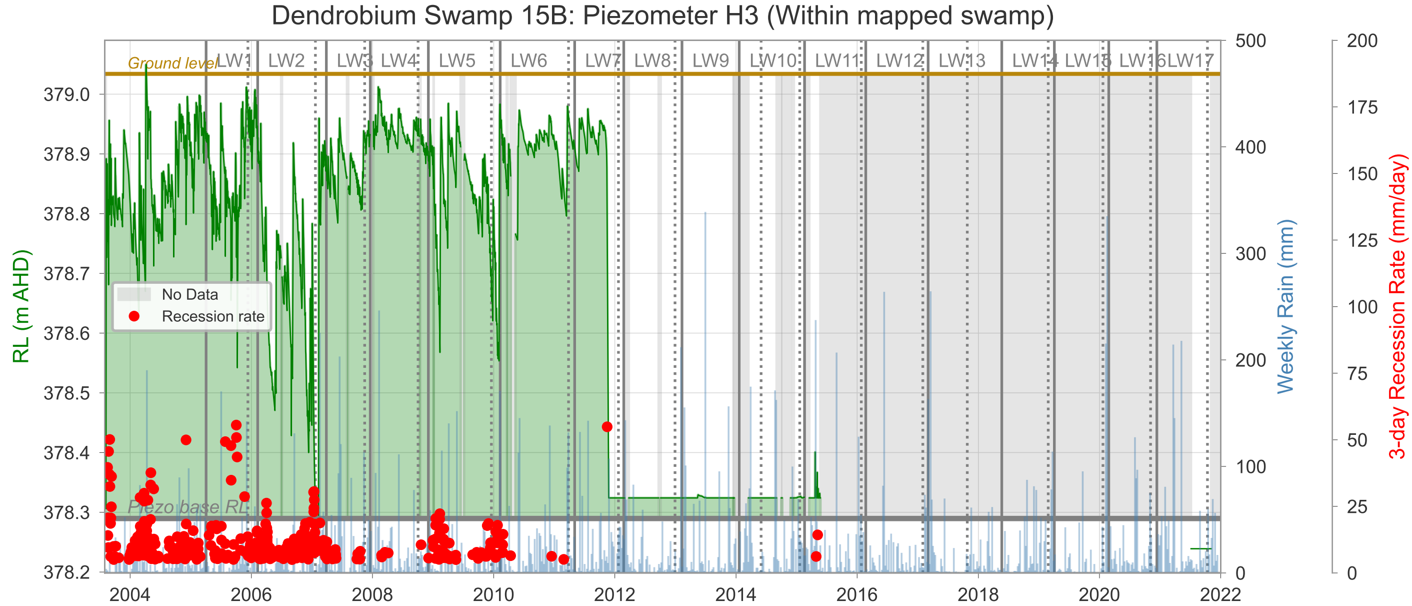
Dendrobium Swamp 15B: Piezometer H1 (Within mapped swamp)



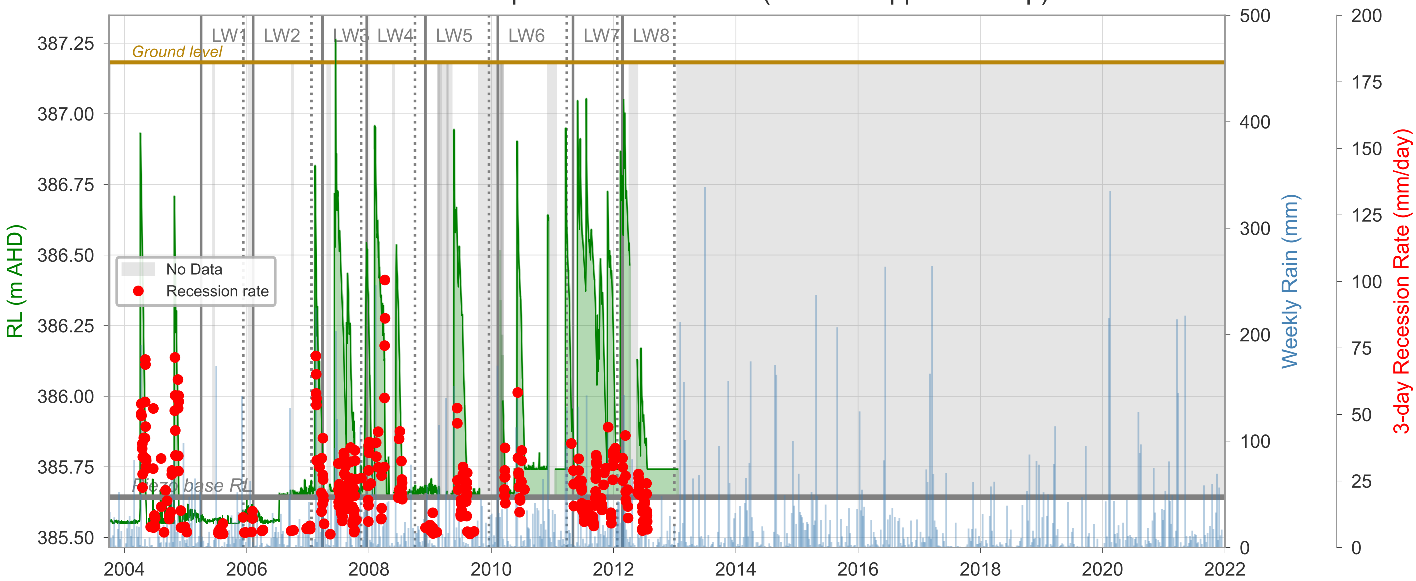
Dendrobium Swamp 15B: Piezometer H2 (Within mapped swamp)



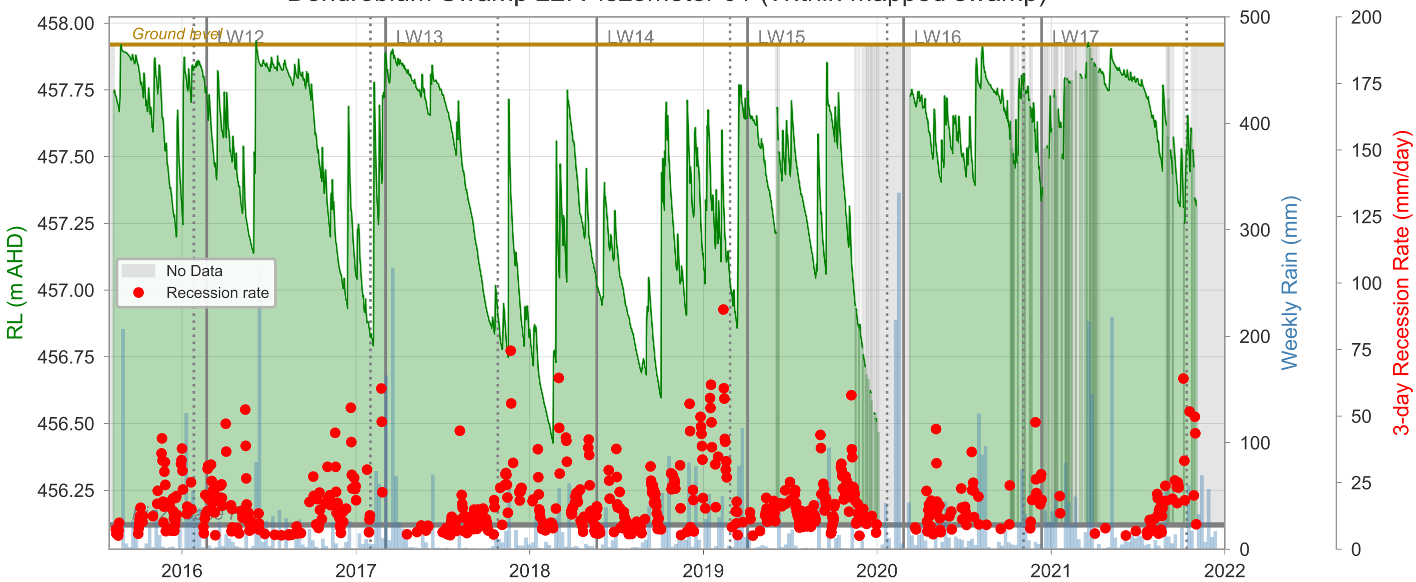
Dendrobium Swamp 15B: Piezometer H3 (Within mapped swamp)



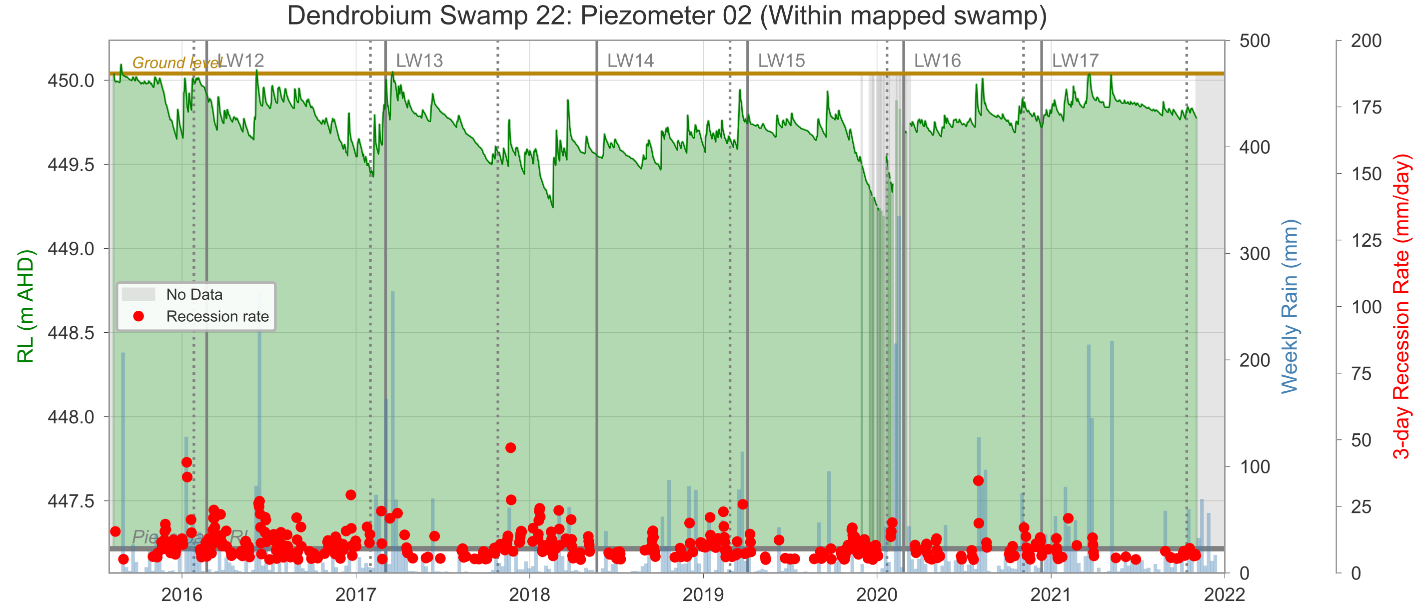
Dendrobium Swamp 18: Piezometer H2 (Within mapped swamp)



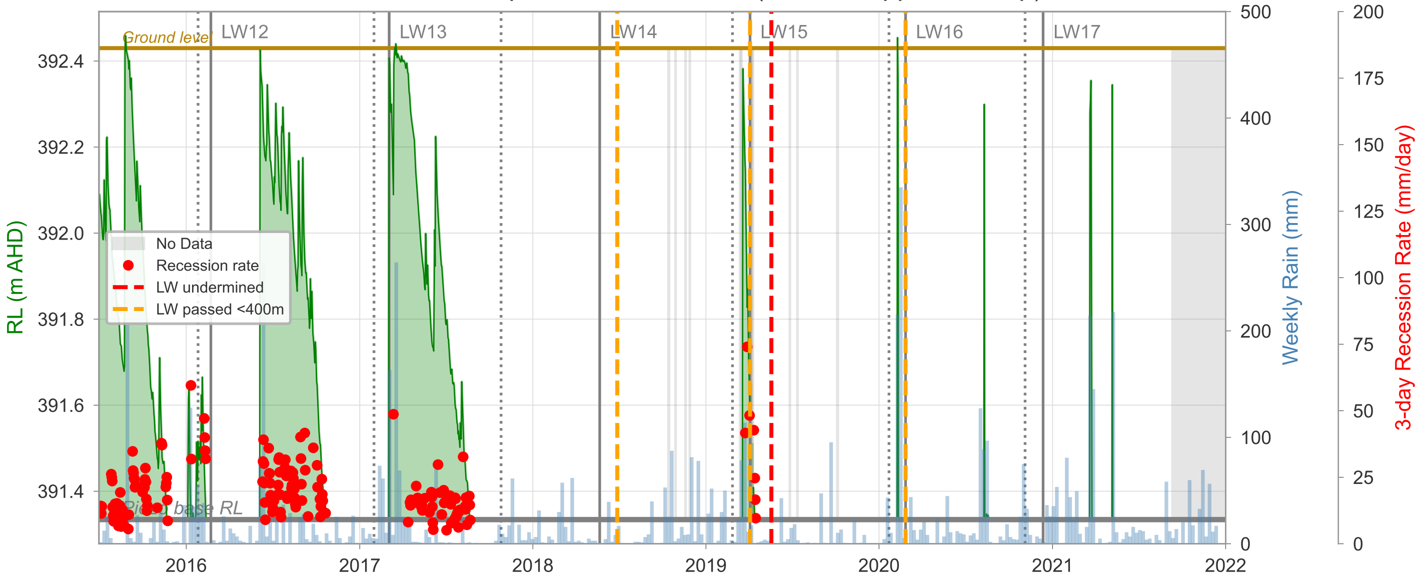
Dendrobium Swamp 22: Piezometer 01 (Within mapped swamp)



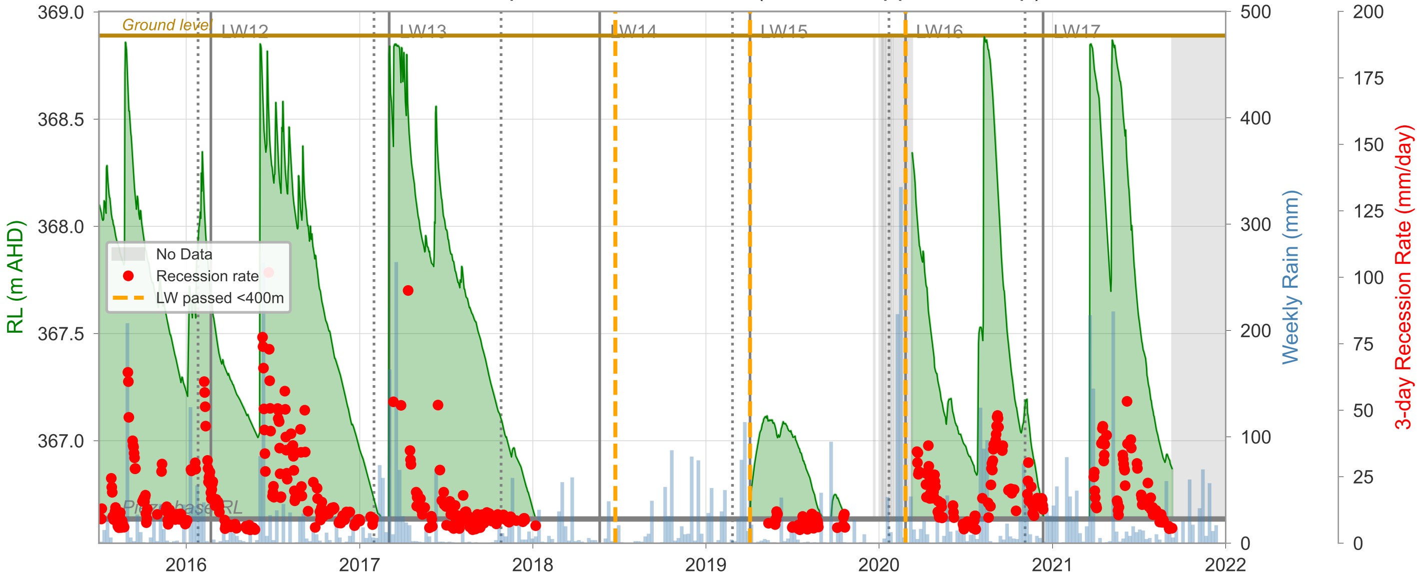
Dendrobium Swamp 22: Piezometer 02 (Within mapped swamp)



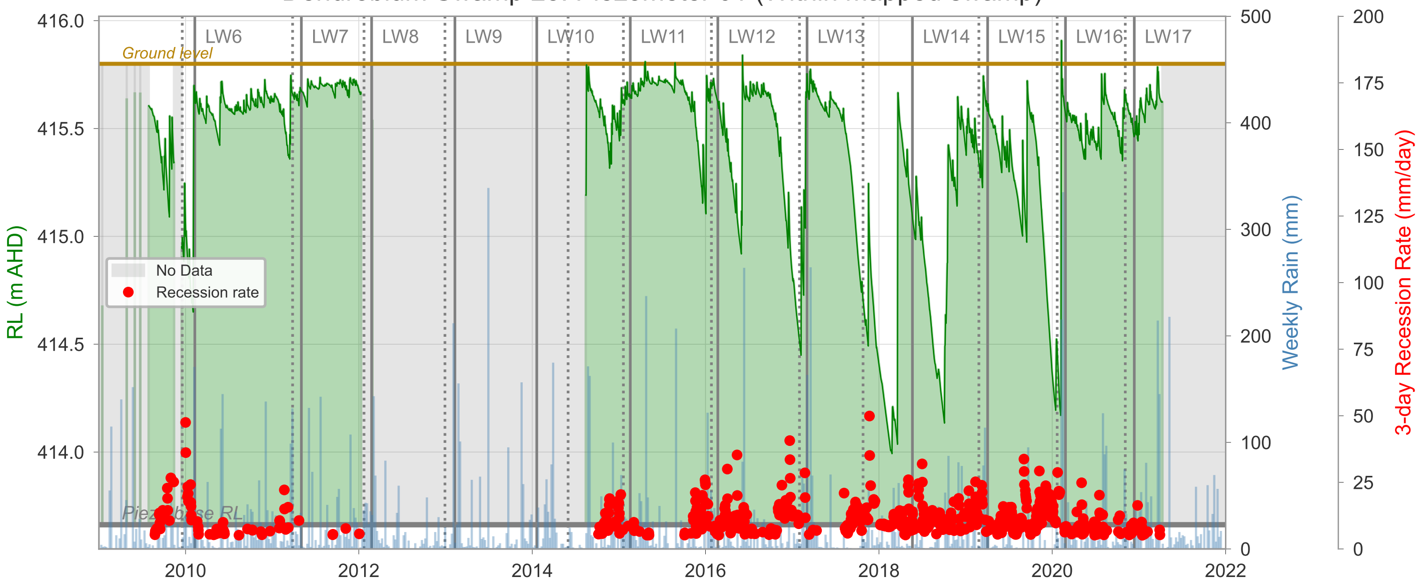
Dendrobium Swamp 23: Piezometer 01 (Within mapped swamp)



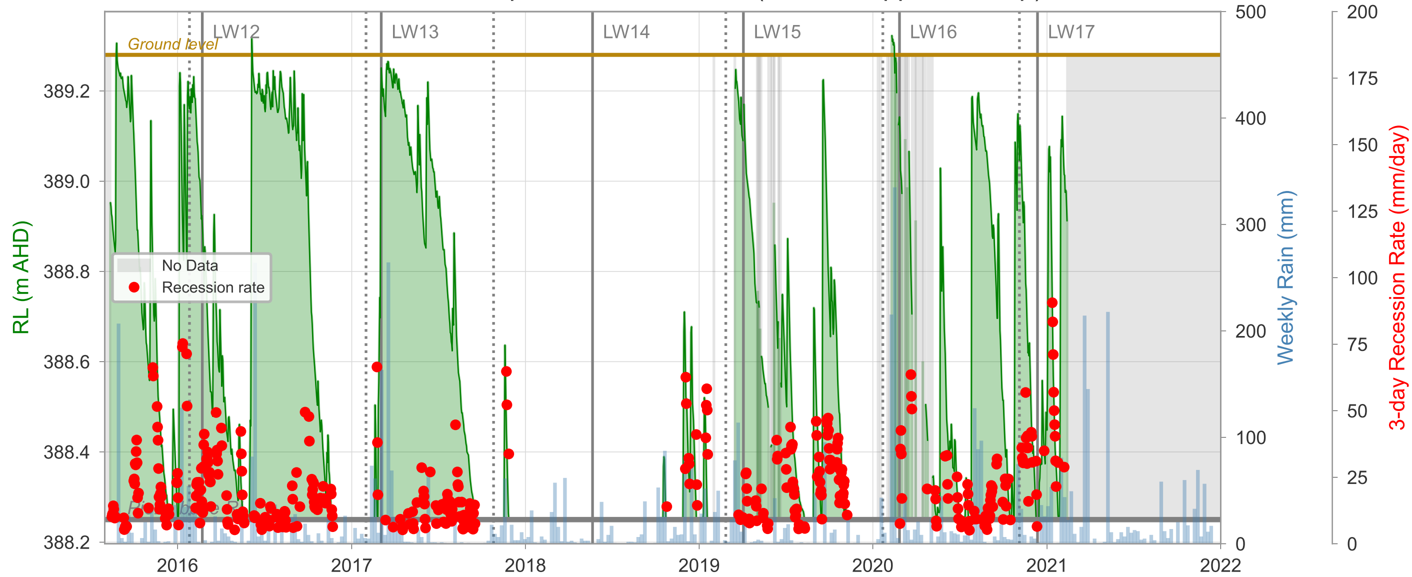
Dendrobium Swamp 23: Piezometer 02 (Within mapped swamp)



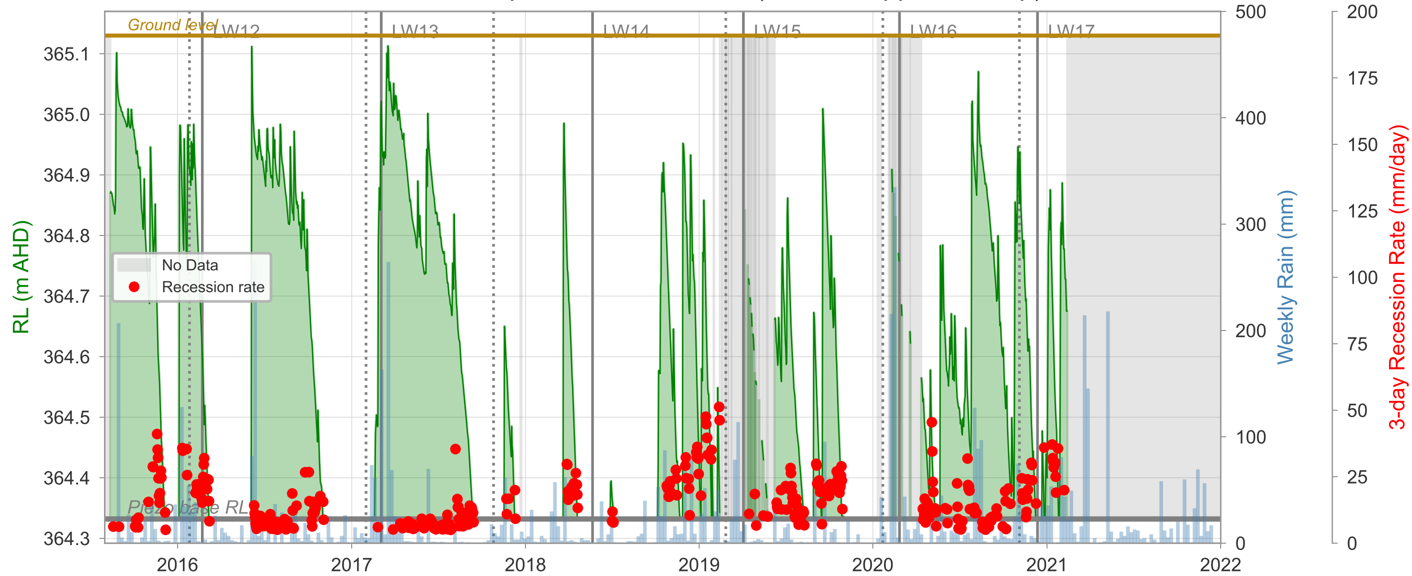
Dendrobium Swamp 25: Piezometer 01 (Within mapped swamp)



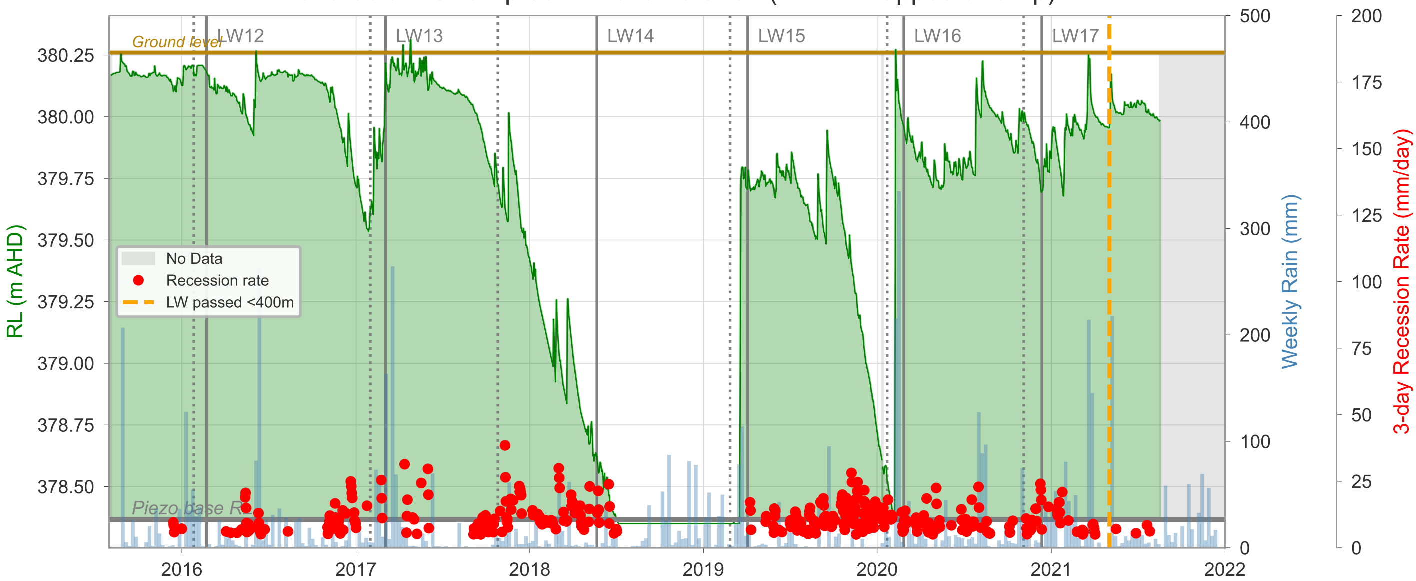
Dendrobium Swamp 33: Piezometer 01 (Within mapped swamp)

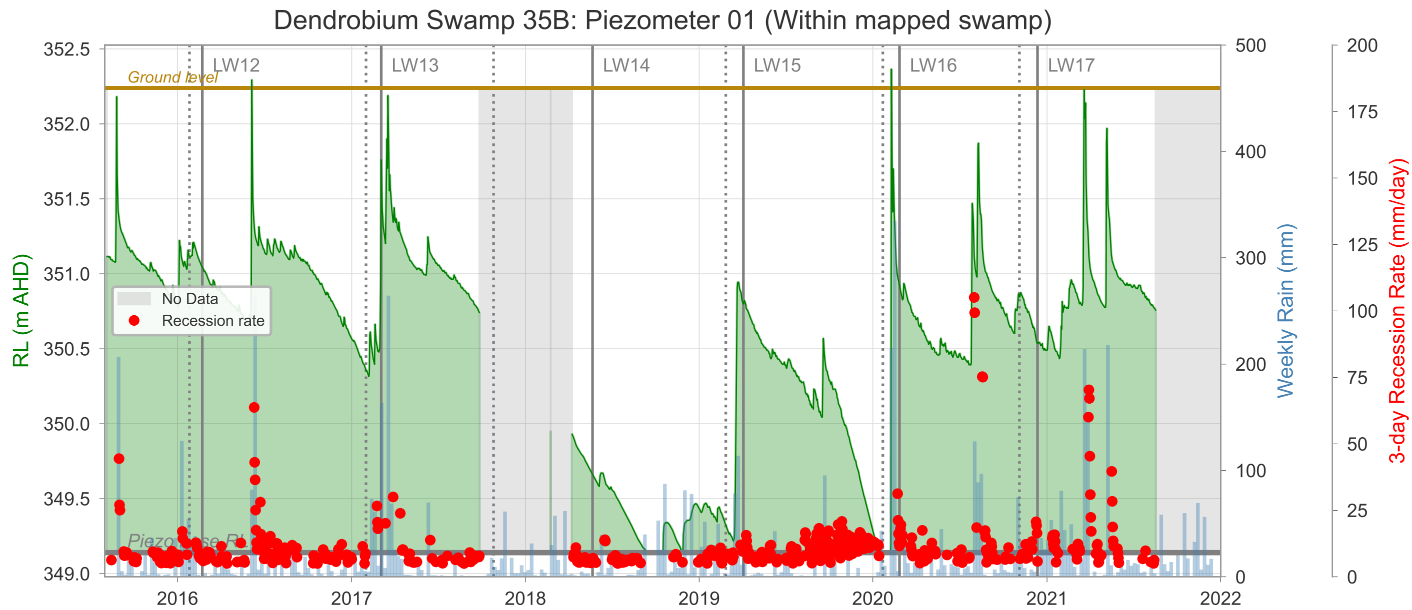


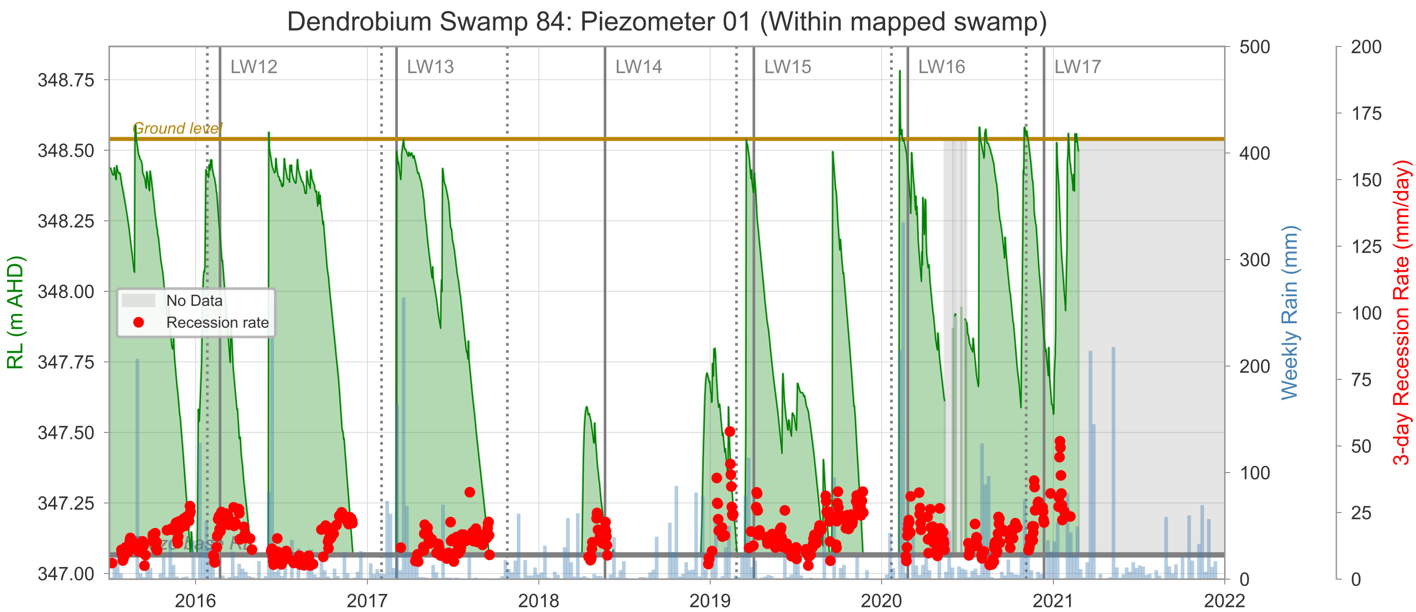
Dendrobium Swamp 33: Piezometer 03 (Within mapped swamp)

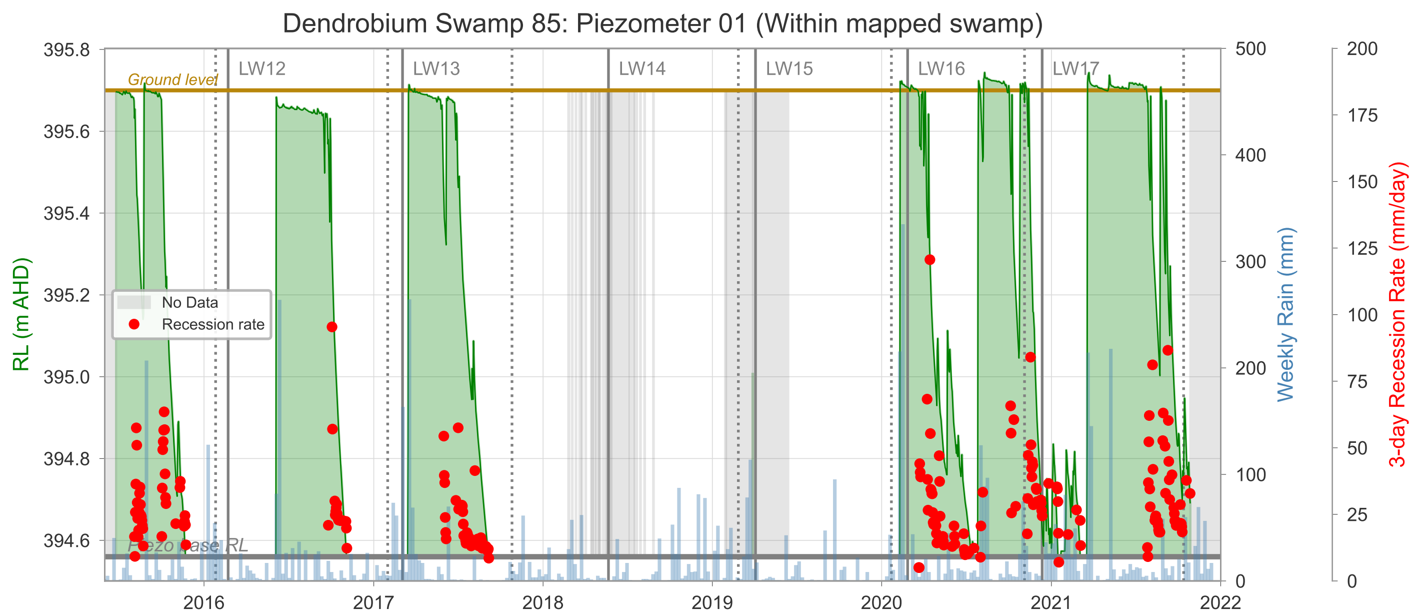


Dendrobium Swamp 35A: Piezometer 01 (Within mapped swamp)

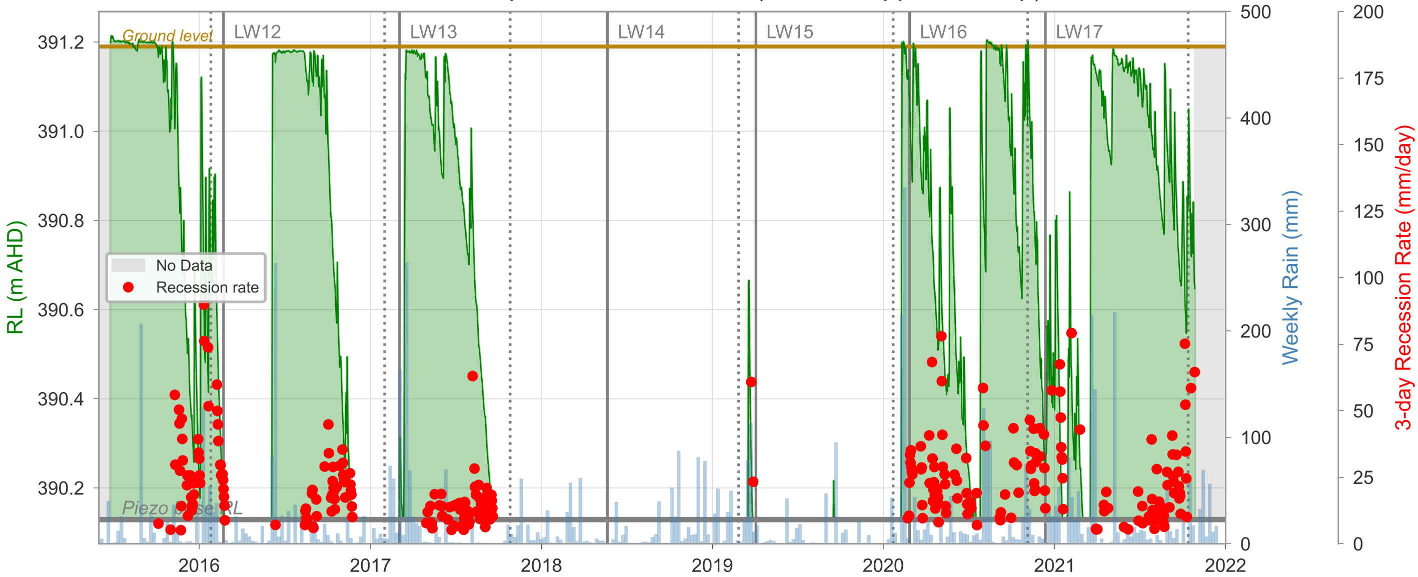



Dendrobium Swamp 35B: Piezometer 01 (Within mapped swamp)
Ground level
Piezo base RL
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
352.5
352.0
351.5
351.0
350.5
350.0
349.5
349.0
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2016
2017
2018
2019
2020
2021
2022

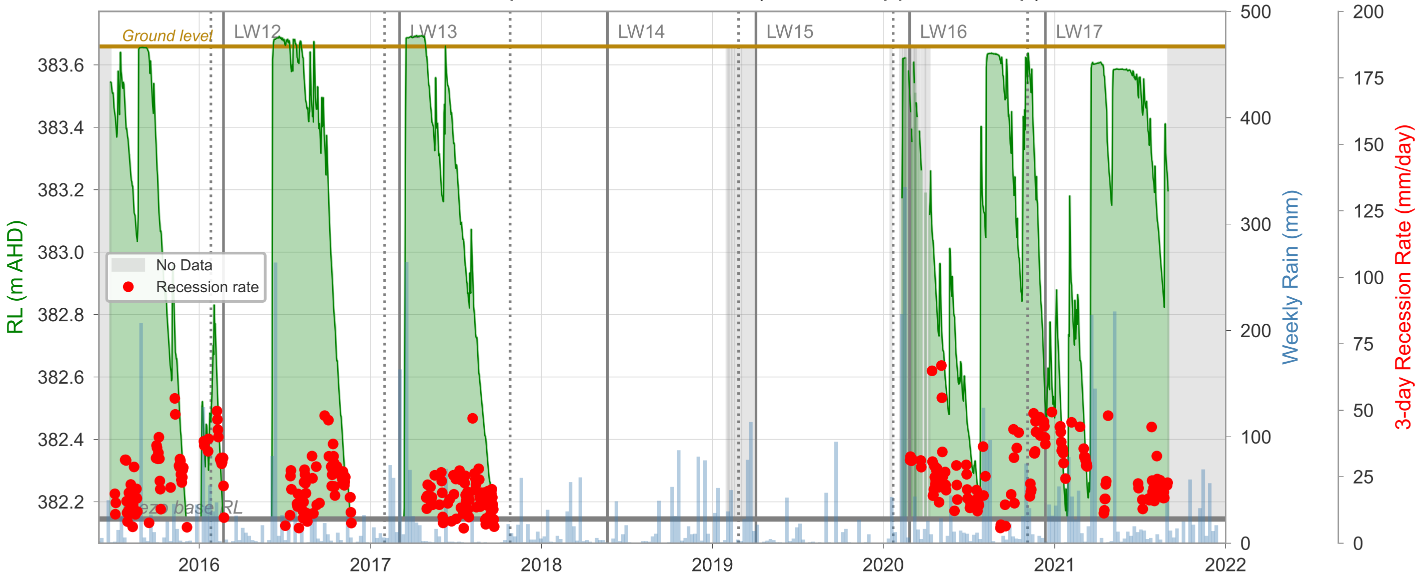

Dendrobium Swamp 84: Piezometer 01 (Within mapped swamp)
Ground level
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
348.75
348.50
348.25
348.00
347.75
347.50
347.25
347.00
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2016
2017
2018
2019
2020
2021
2022


Dendrobium Swamp 85: Piezometer 01 (Within mapped swamp)
Ground level
Piezo base RL
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
395.8
395.6
395.4
395.2
395.0
394.8
394.6
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2016
2017
2018
2019
2020
2021
2022

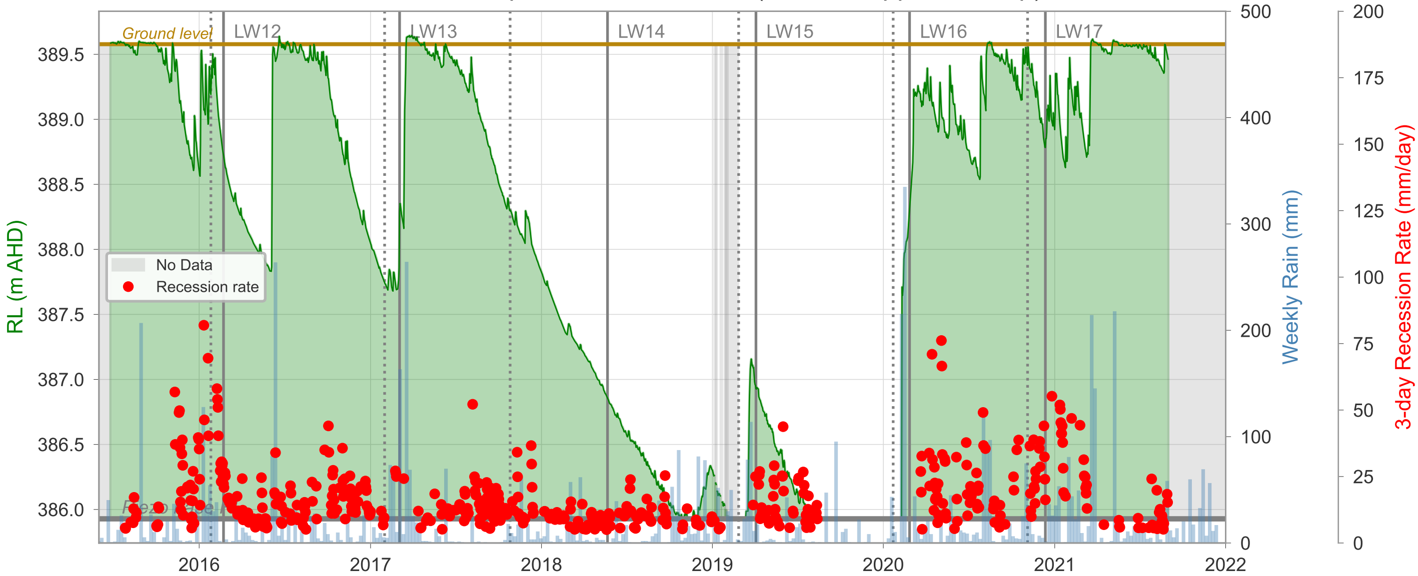
Dendrobium Swamp 85: Piezometer 02 (Within mapped swamp)

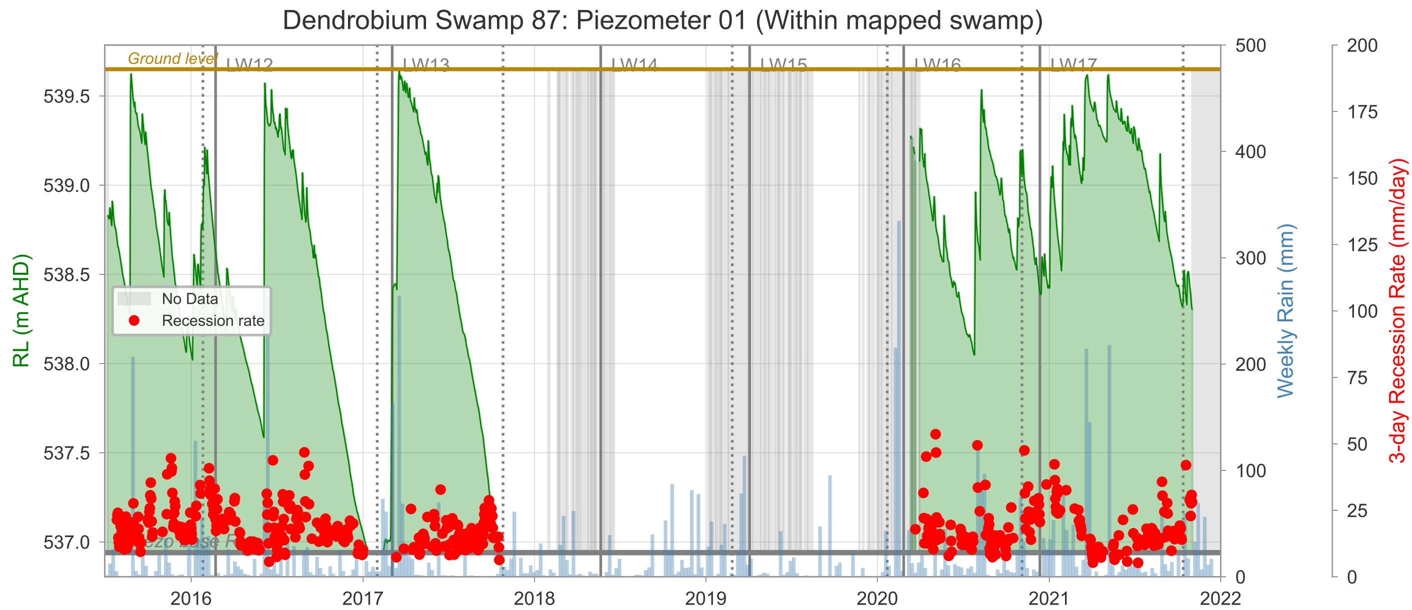


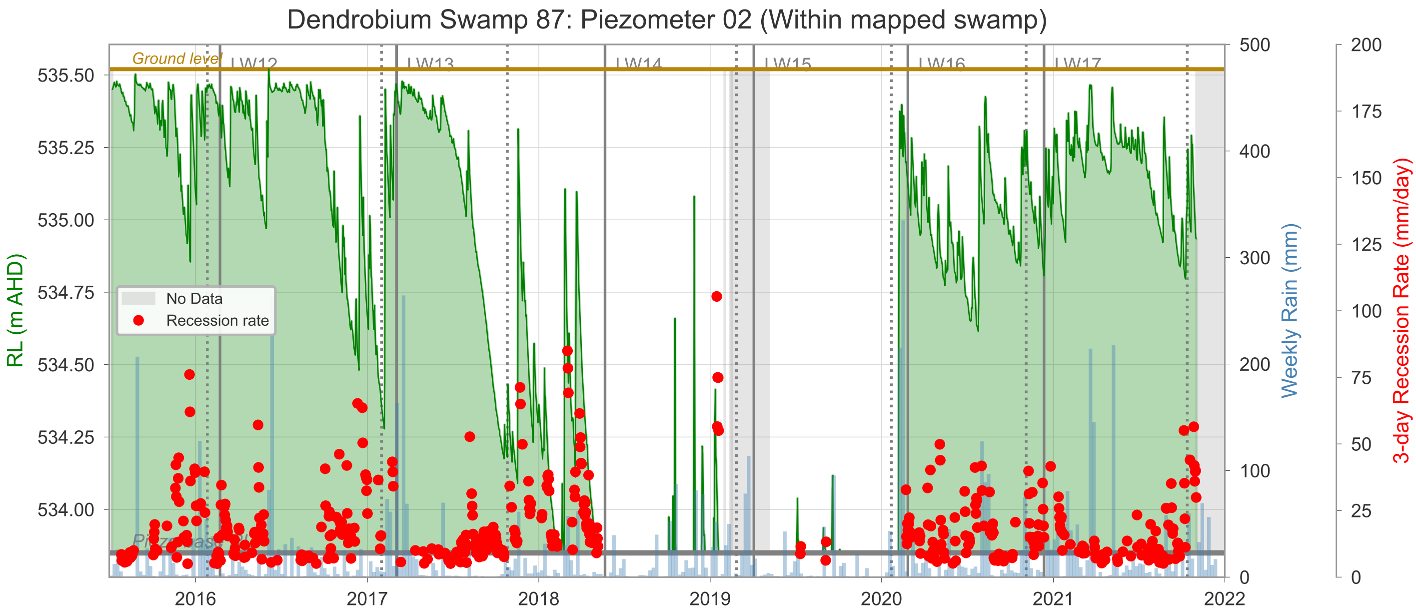
Dendrobium Swamp 86: Piezometer 01 (Within mapped swamp)

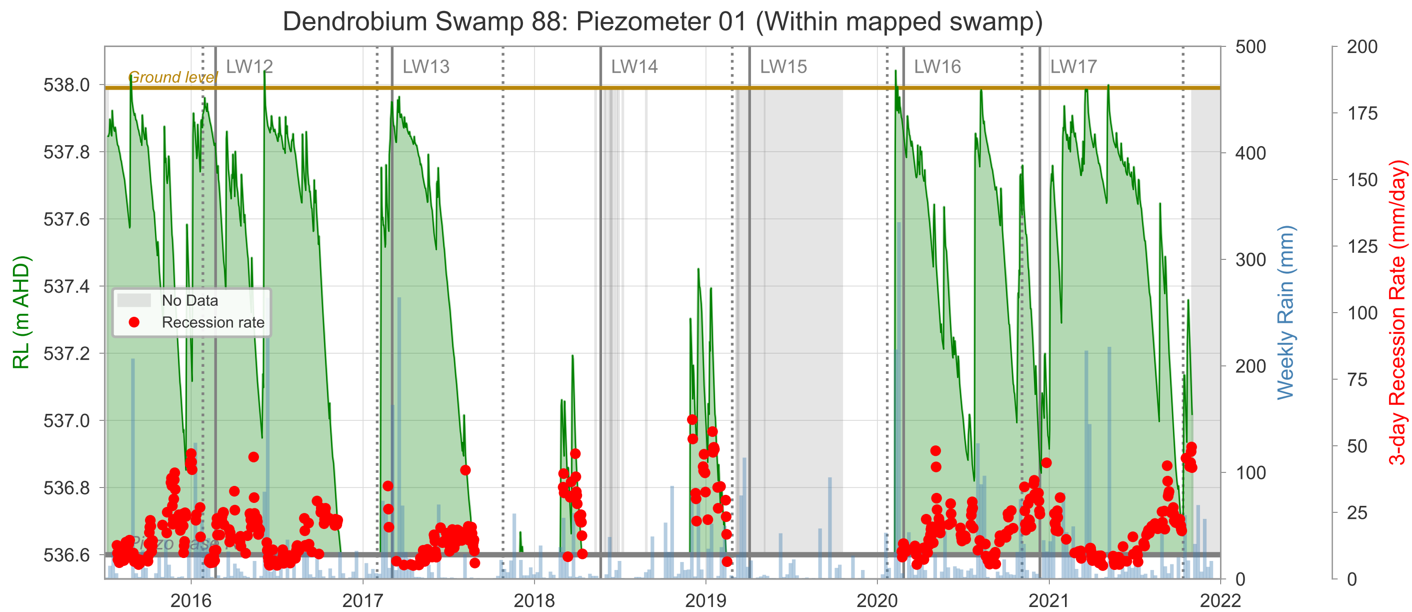


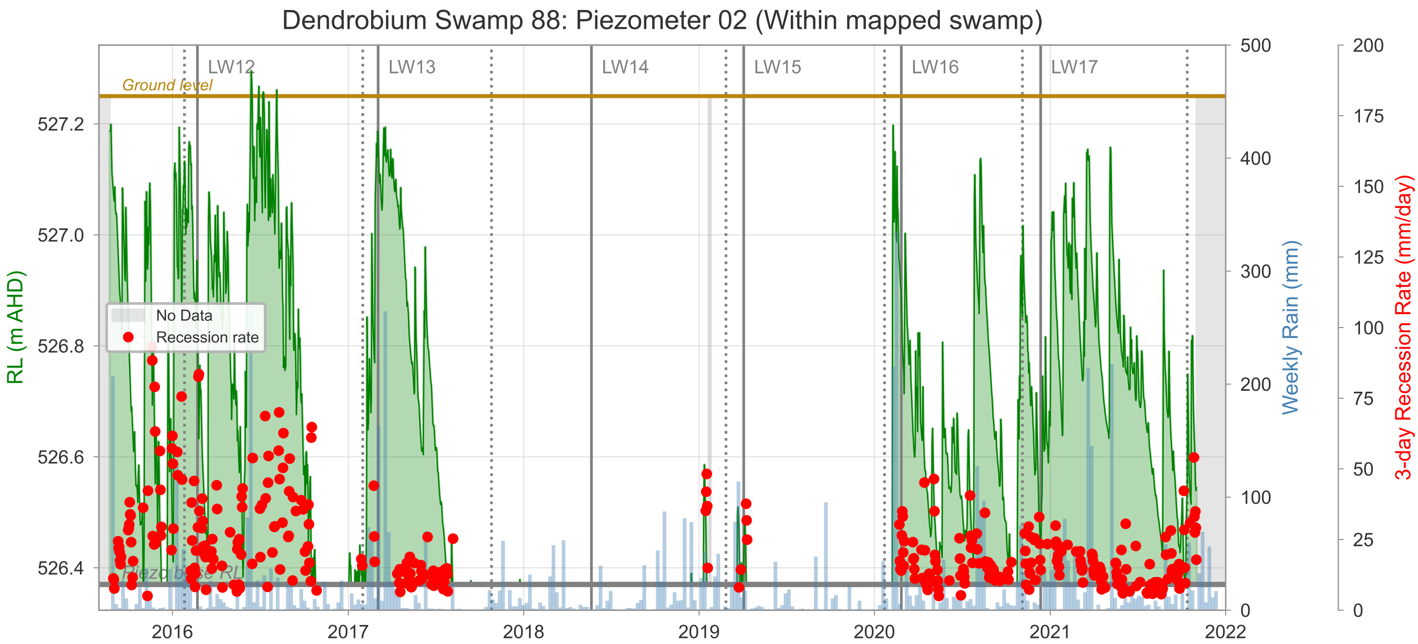
Dendrobium Swamp 86: Piezometer 02 (Within mapped swamp)




Dendrobium Swamp 87: Piezometer 01 (Within mapped swamp)
Ground level
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
Piezo base RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

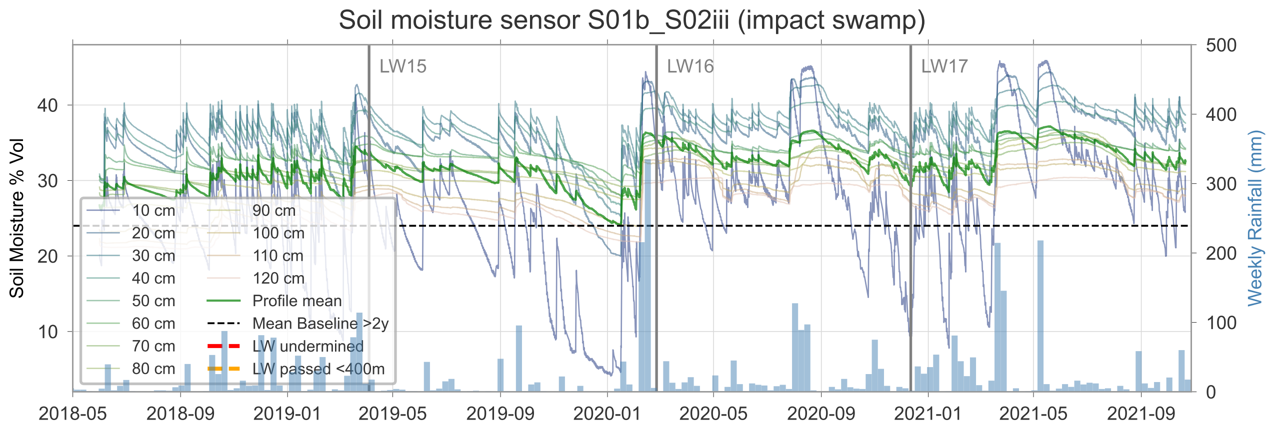

Dendrobium Swamp 87: Piezometer 02 (Within mapped swamp)
Ground level
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
Piezo base RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

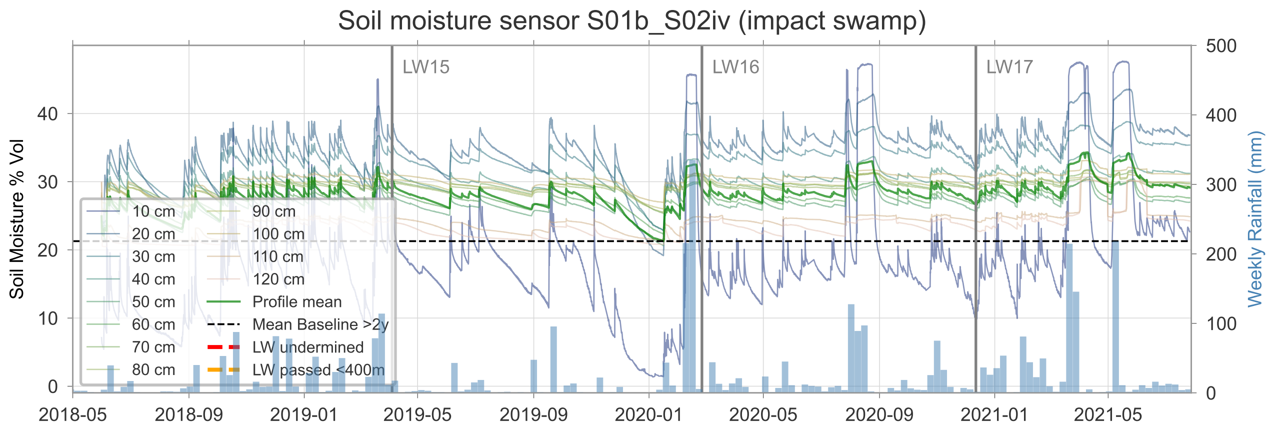

Dendrobium Swamp 88: Piezometer 01 (Within mapped swamp)
Ground level
LW12
LW13
LW14
LW15
LW16
LW17
No Data
Recession rate
Piezo base RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

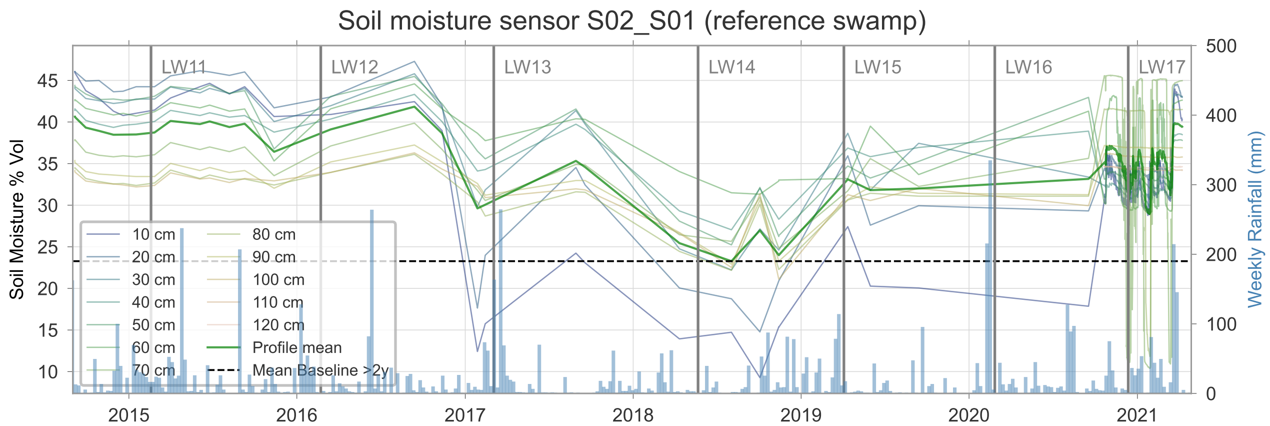


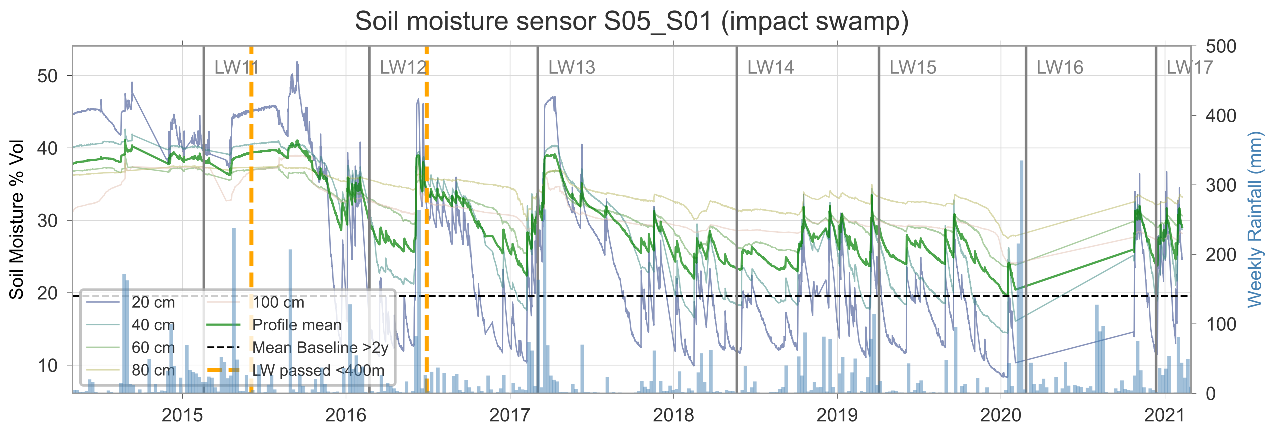
Dendrobium Swamp 88: Piezometer 02 (Within mapped swamp)
LW12
LW13
LW14
LW15
LW16
LW17
Ground level
Piezo base RL
No Data
Recession rate
RL (m AHD)
527.2
527.0
526.8
526.6
526.4
Weekly Rain (mm)
500
400
300
200
100
0
3-day Recession Rate (mm/day)
200
175
150
125
100
75
50
25
0
2016
2017
2018
2019
2020
2021
2022

Appendix E: Soil moisture hydrographs

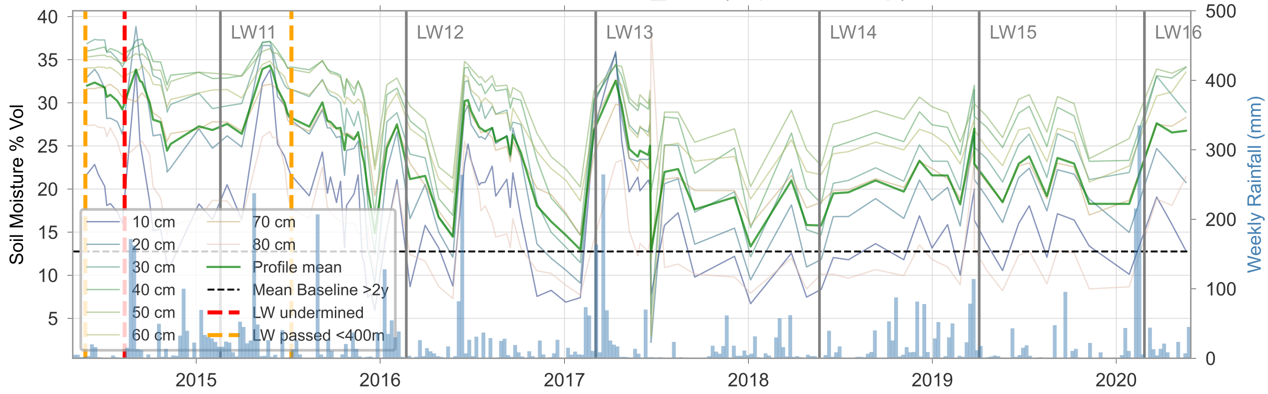

Soil moisture sensor S01b_S02iii (impact swamp)
Soil Moisture % Vol
Weekly Rainfall (mm)
LW15
LW16
LW17
10 cm
20 cm
30 cm
40 cm
50 cm
60 cm
70 cm
80 cm
90 cm
100 cm
110 cm
120 cm
Profile mean
Mean Baseline >2y
LW undermined
LW passed <400m
2018-05
2018-09
2019-01
2019-05
2019-09
2020-01
2020-05
2020-09
2021-01
2021-05
2021-09


Soil moisture sensor S01b_S02iv (impact swamp)
Soil Moisture % Vol
Weekly Rainfall (mm)
LW15
LW16
LW17
10 cm
20 cm
30 cm
40 cm
50 cm
60 cm
70 cm
80 cm
90 cm
100 cm
110 cm
120 cm
Profile mean
Mean Baseline >2y
LW undermined
LW passed <400m
2018-05
2018-09
2019-01
2019-05
2019-09
2020-01
2020-05
2020-09
2021-01
2021-05

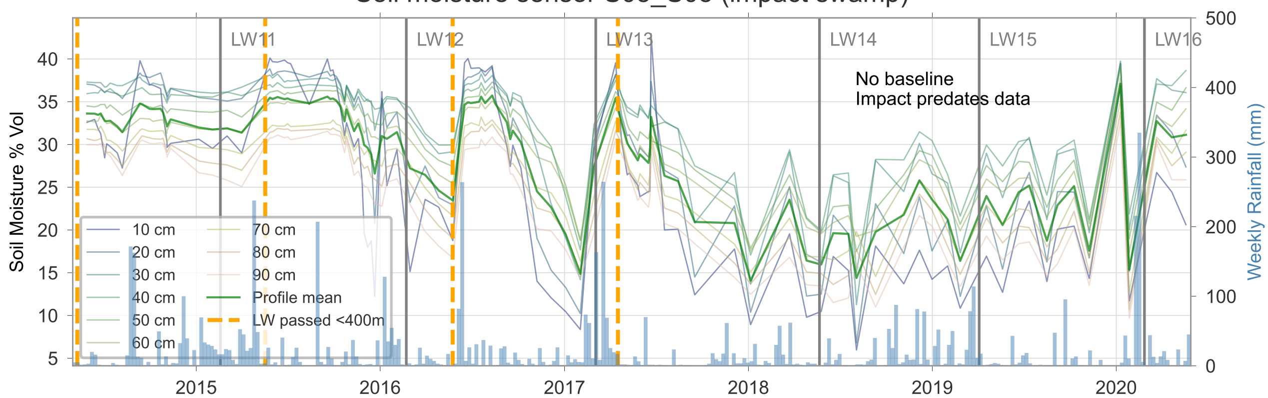

Soil moisture sensor S02_S01 (reference swamp)
Soil Moisture % Vol
Weekly Rainfall (mm)
LW11
LW12
LW13
LW14
LW15
LW16
LW17
10 cm
20 cm
30 cm
40 cm
50 cm
60 cm
70 cm
80 cm
90 cm
100 cm
110 cm
120 cm
Profile mean
Mean Baseline >2y
2015
2016
2017
2018
2019
2020
2021


Soil moisture sensor S05_S01 (impact swamp)
Soil Moisture % Vol
Weekly Rainfall (mm)
LW11
LW12
LW13
LW14
LW15
LW16
LW17
20 cm
40 cm
60 cm
80 cm
100 cm
Profile mean
Mean Baseline >2y
LW passed <400m
2015
2016
2017
2018
2019
2020
2021

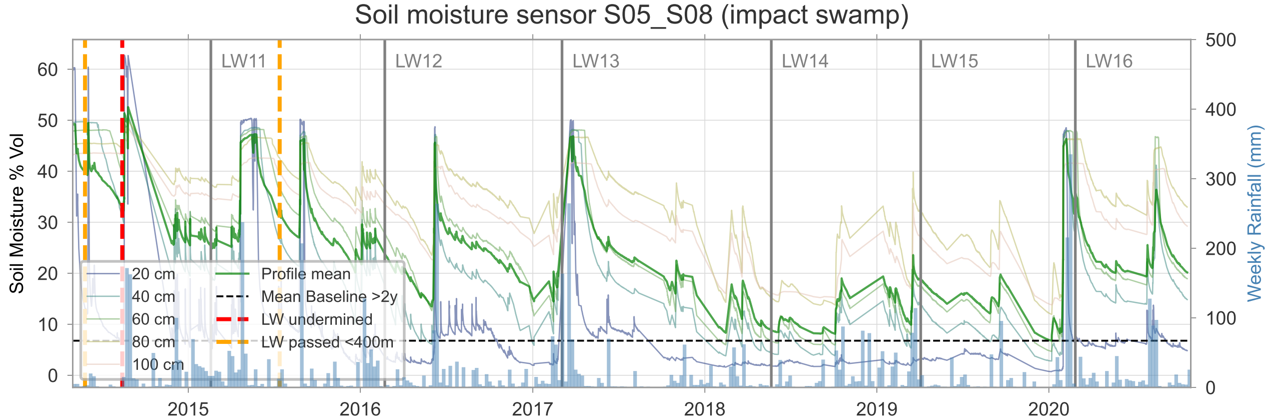
Soil moisture sensor S05_S02 (impact swamp)



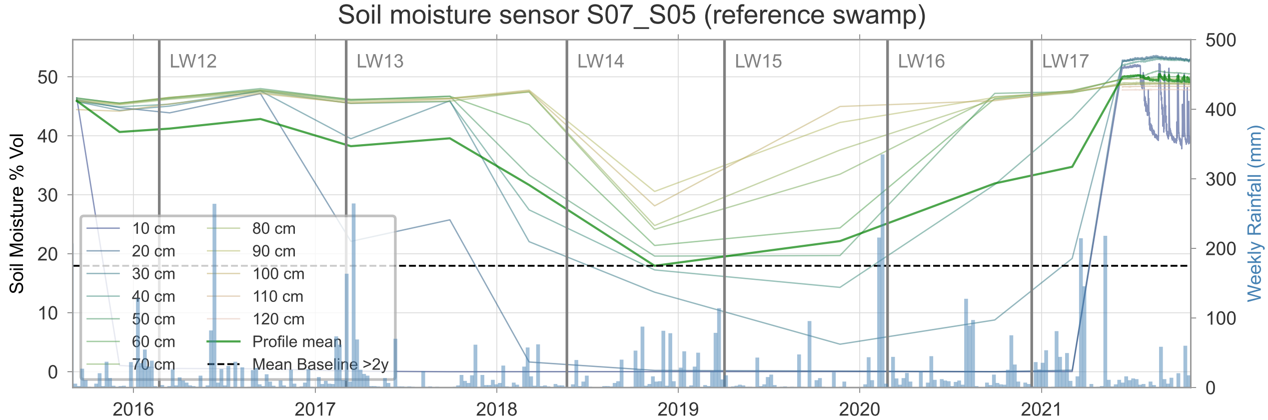
Soil moisture sensor S05_S05 (impact swamp)



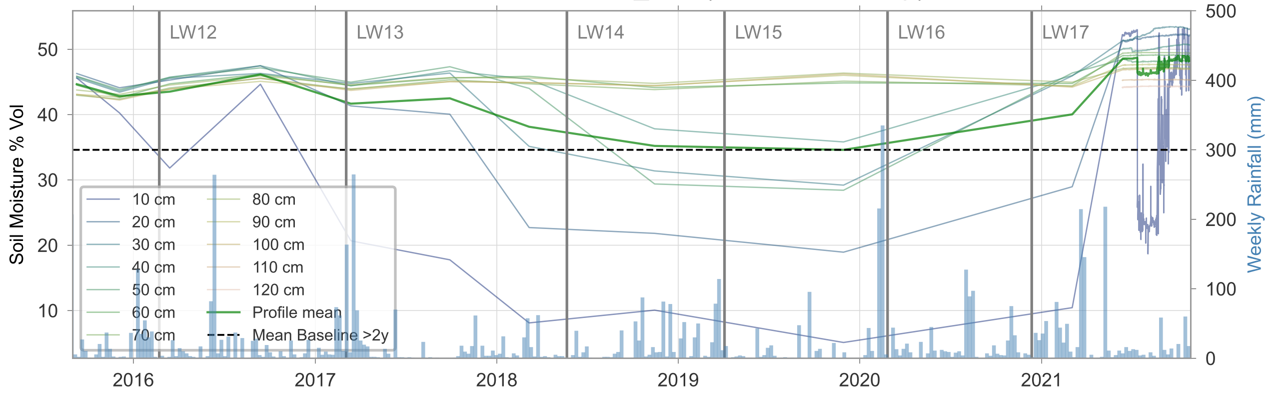
Soil moisture sensor S05_S08 (impact swamp)



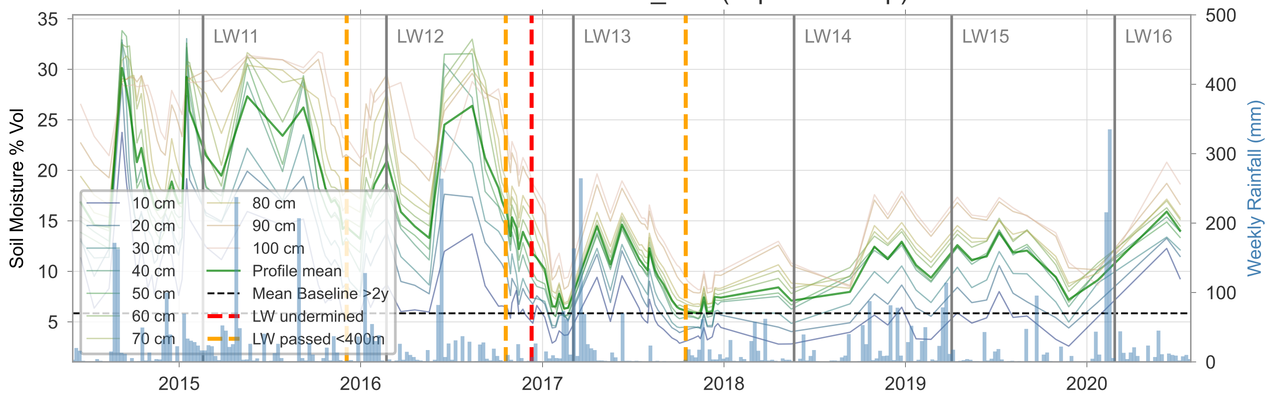
Soil moisture sensor S07_S05 (reference swamp)



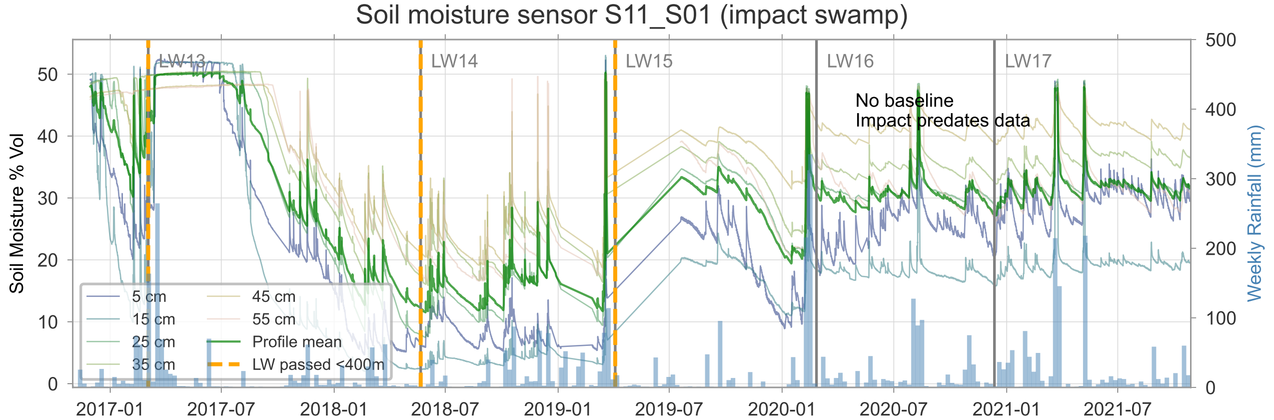
Soil moisture sensor S07_S06 (reference swamp)



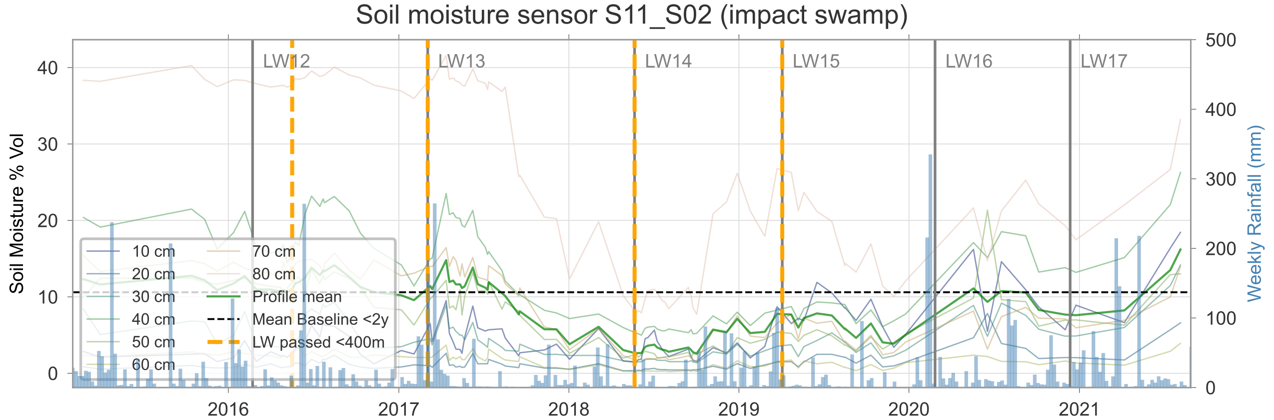
Soil moisture sensor S08_S05 (impact swamp)

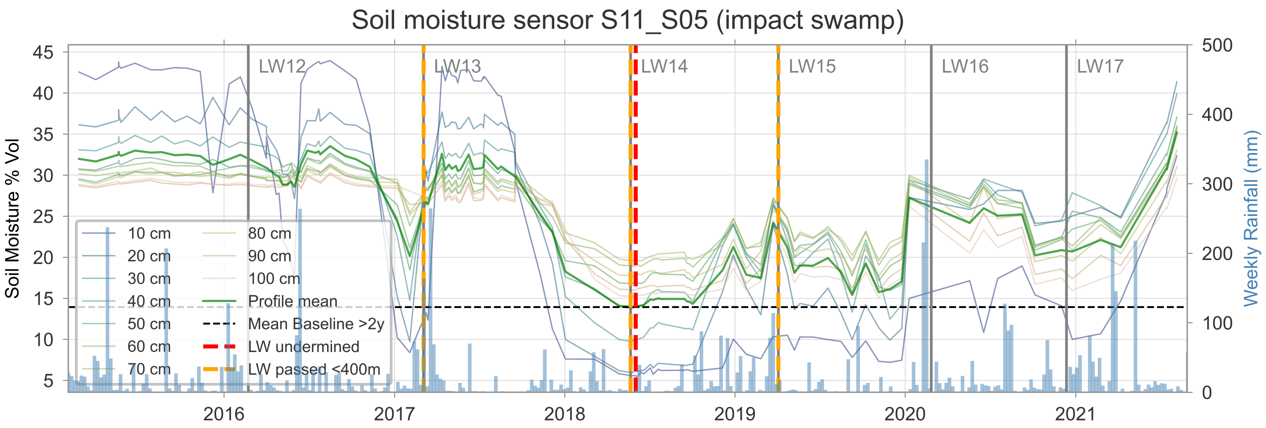


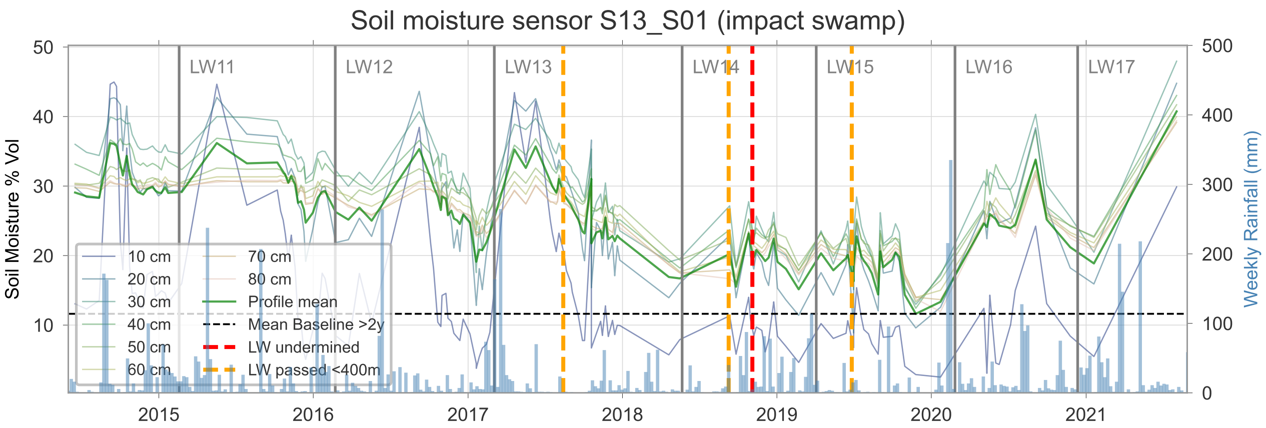
Soil moisture sensor S11_S01 (impact swamp)

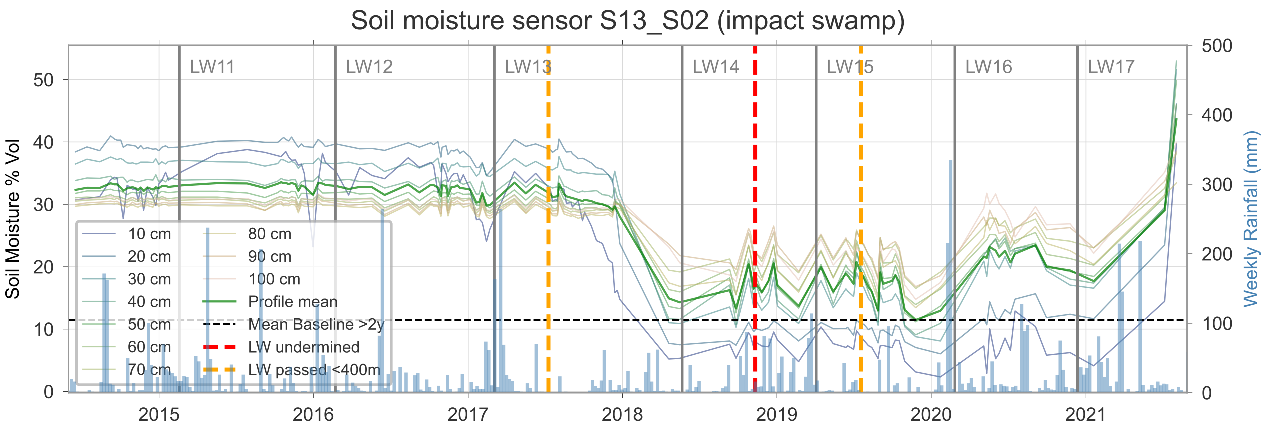


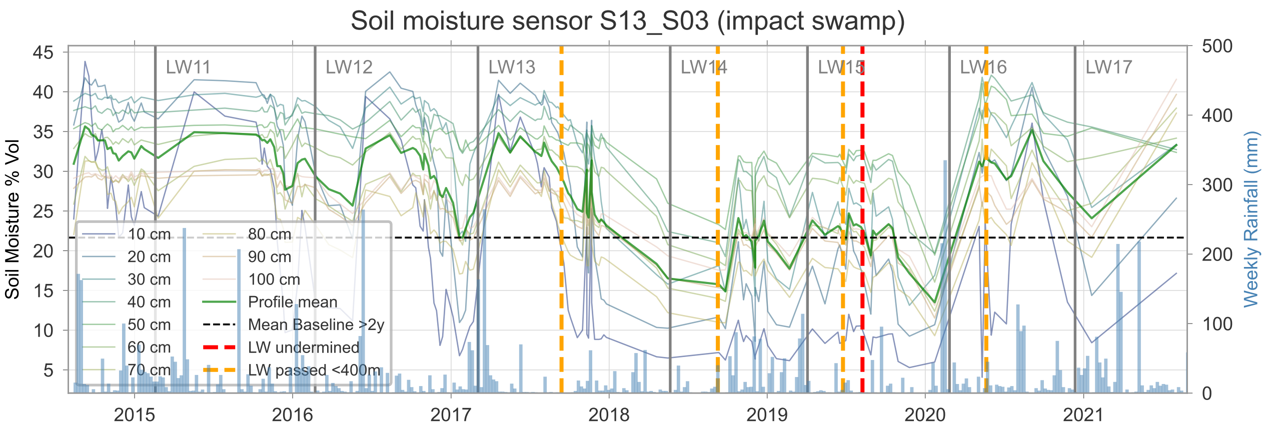
Soil moisture sensor S11_S02 (impact swamp)

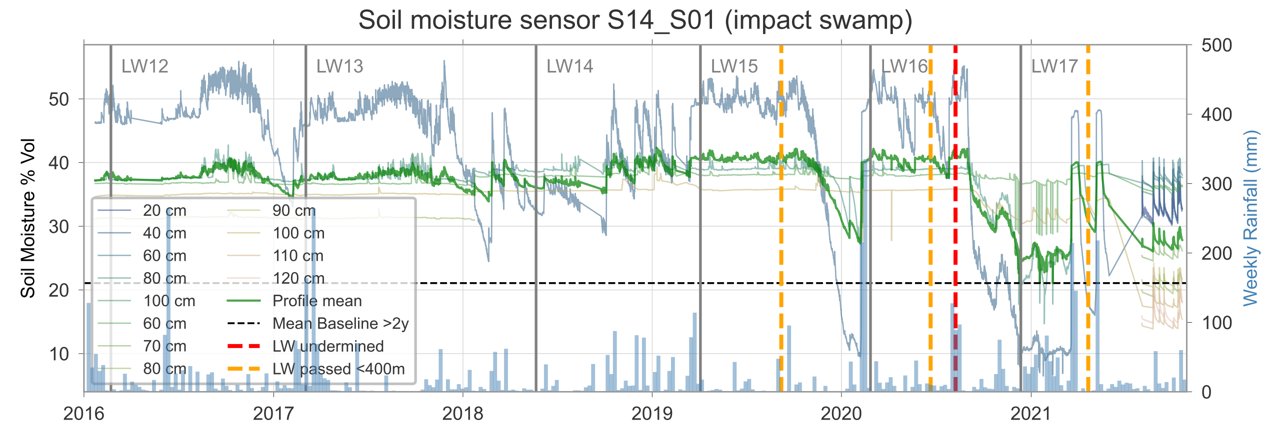


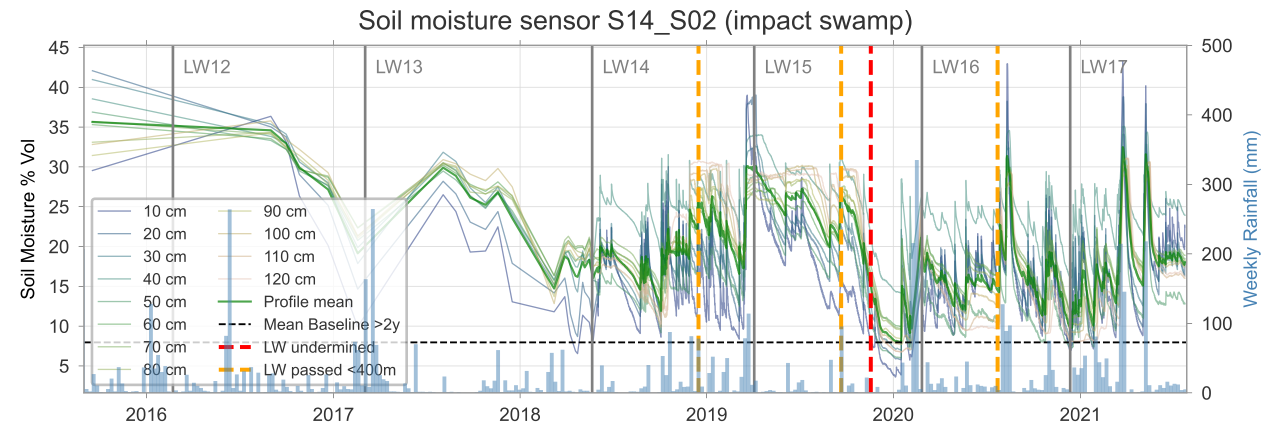

Soil moisture sensor S11_S05 (impact swamp)
LW12
LW13
LW14
LW15
LW16
LW17
Soil Moisture % Vol
Weekly Rainfall (mm)
10 cm
20 cm
30 cm
40 cm
50 cm
60 cm
70 cm
80 cm
90 cm
100 cm
Profile mean
Mean Baseline >2y
LW undermined
LW passed <400m
2016
2017
2018
2019
2020
2021

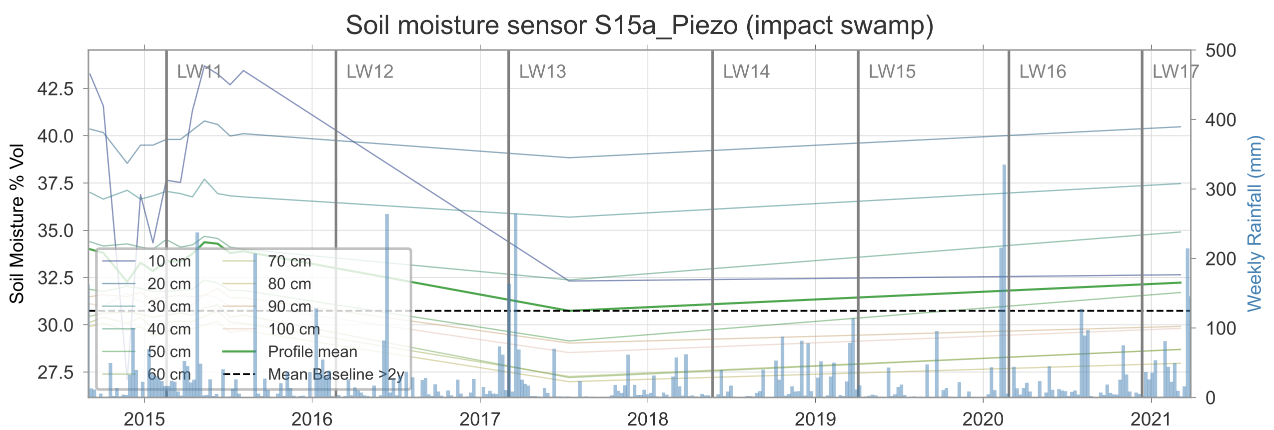

Soil moisture sensor S13_S01 (impact swamp)
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Soil Moisture % Vol
Weekly Rainfall (mm)
10 cm
20 cm
30 cm
40 cm
50 cm
60 cm
70 cm
80 cm
Profile mean
Mean Baseline >2y
LW undermined
LW passed <400m
2015
2016
2017
2018
2019
2020
2021

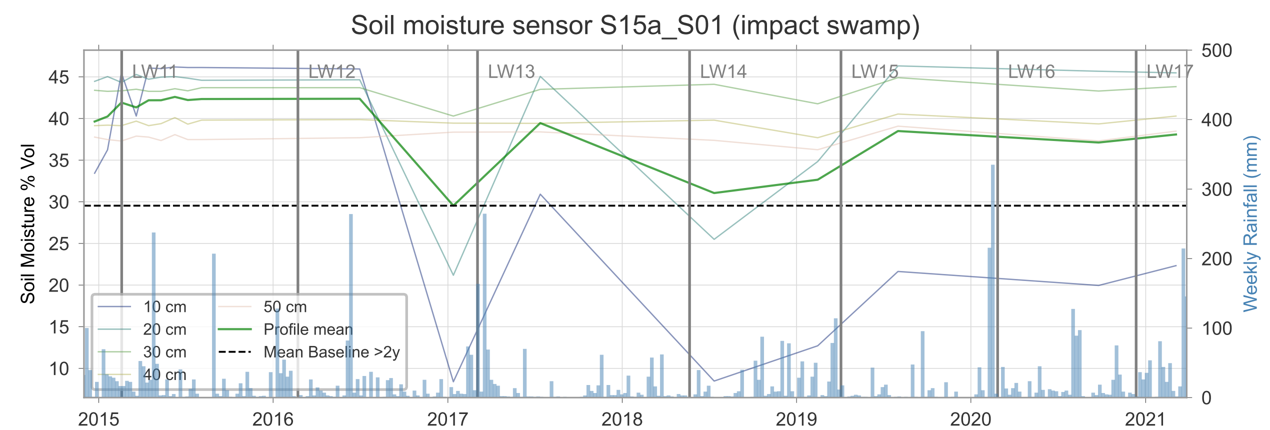

Soil moisture sensor S13_S02 (impact swamp)
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Soil Moisture % Vol
Weekly Rainfall (mm)
10 cm
20 cm
30 cm
40 cm
50 cm
60 cm
70 cm
80 cm
90 cm
100 cm
Profile mean
Mean Baseline >2y
LW undermined
LW passed <400m
2015
2016
2017
2018
2019
2020
2021


Soil moisture sensor S13_S03 (impact swamp)
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Soil Moisture % Vol
Weekly Rainfall (mm)
10 cm
20 cm
30 cm
40 cm
50 cm
60 cm
70 cm
80 cm
90 cm
100 cm
Profile mean
Mean Baseline >2y
LW undermined
LW passed <400m
2015
2016
2017
2018
2019
2020
2021

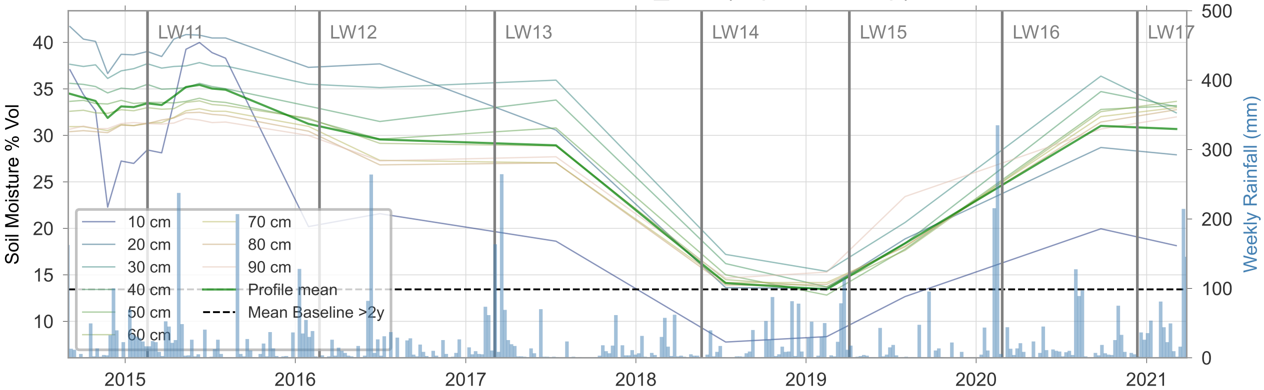

Soil moisture sensor S14_S01 (impact swamp)
LW12
LW13
LW14
LW15
LW16
LW17
Soil Moisture % Vol
Weekly Rainfall (mm)
20 cm
40 cm
60 cm
80 cm
100 cm
60 cm
70 cm
80 cm
90 cm
100 cm
110 cm
120 cm
Profile mean
Mean Baseline >2y
LW undermined
LW passed <400m
2016
2017
2018
2019
2020
2021


Soil moisture sensor S14_S02 (impact swamp)
LW12
LW13
LW14
LW15
LW16
LW17
Soil Moisture % Vol
Weekly Rainfall (mm)
10 cm
20 cm
30 cm
40 cm
50 cm
60 cm
70 cm
80 cm
90 cm
100 cm
110 cm
120 cm
Profile mean
Mean Baseline >2y
LW undermined
LW passed <400m
2016
2017
2018
2019
2020
2021


Soil moisture sensor S15a_Piezo (impact swamp)
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Soil Moisture % Vol
Weekly Rainfall (mm)
10 cm
20 cm
30 cm
40 cm
50 cm
60 cm
70 cm
80 cm
90 cm
100 cm
Profile mean
Mean Baseline >2y
2015
2016
2017
2018
2019
2020
2021

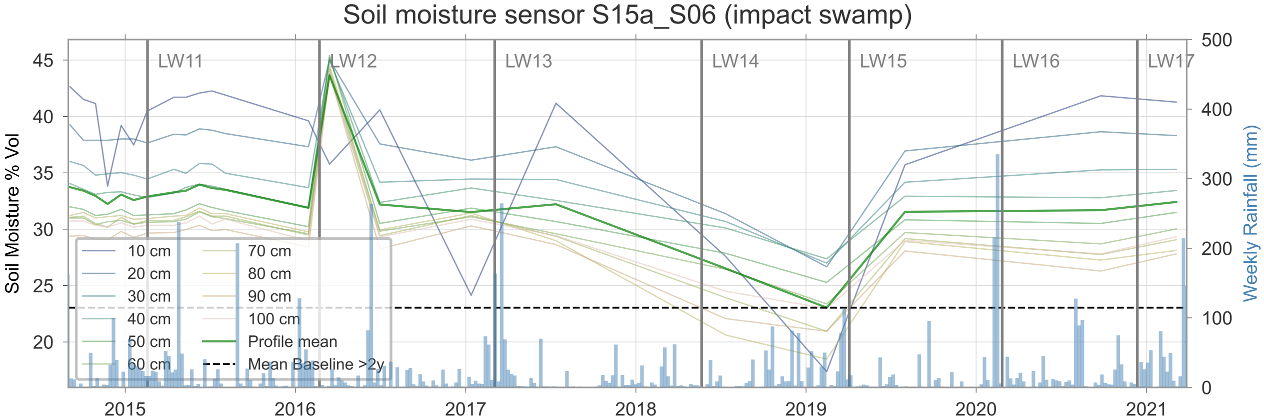

Soil moisture sensor S15a_S01 (impact swamp)
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Soil Moisture % Vol
Weekly Rainfall (mm)
10 cm
20 cm
30 cm
40 cm
50 cm
Profile mean
Mean Baseline >2y
2015
2016
2017
2018
2019
2020
2021

Soil moisture sensor S15a_S03 (impact swamp)

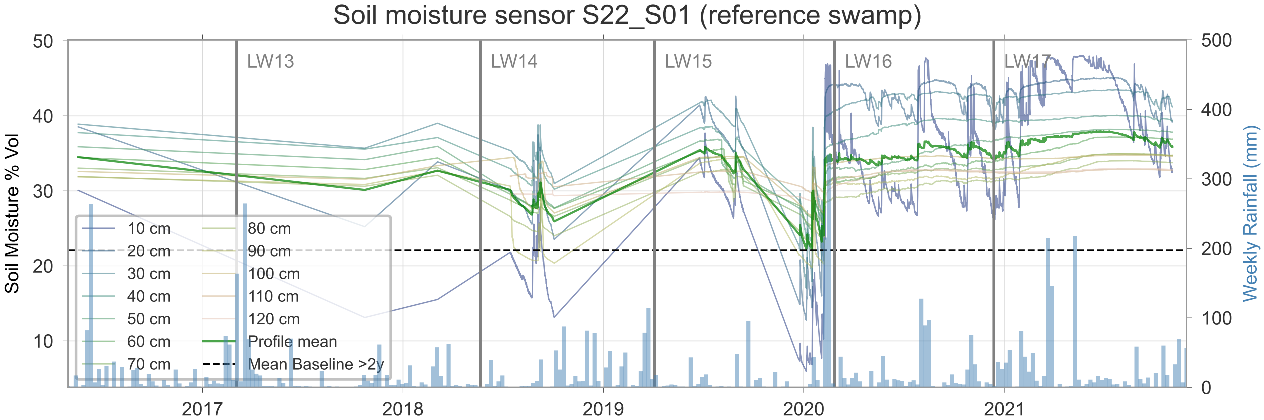


Soil moisture sensor S15A_S04_SEDGEINFLOW (impact swamp)

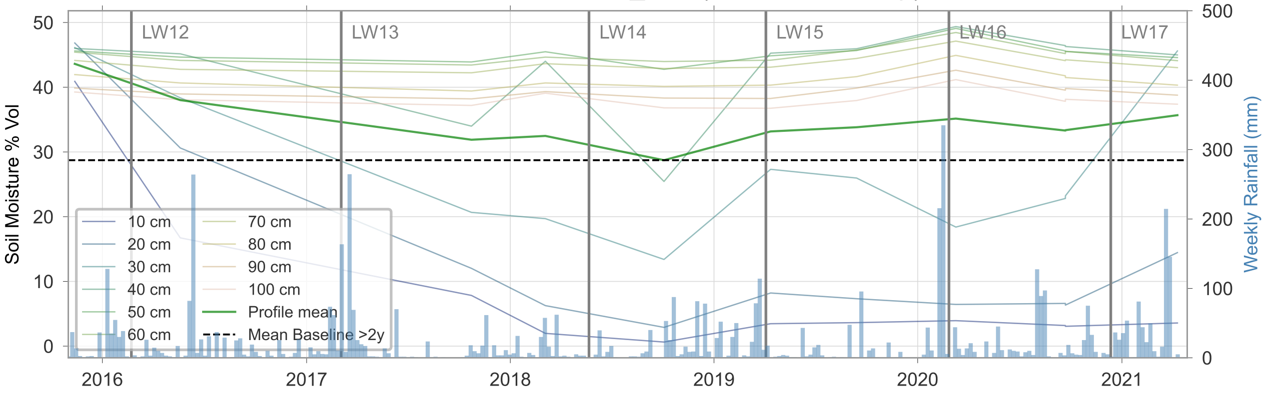
Soil moisture sensor S15a_S06 (impact swamp)



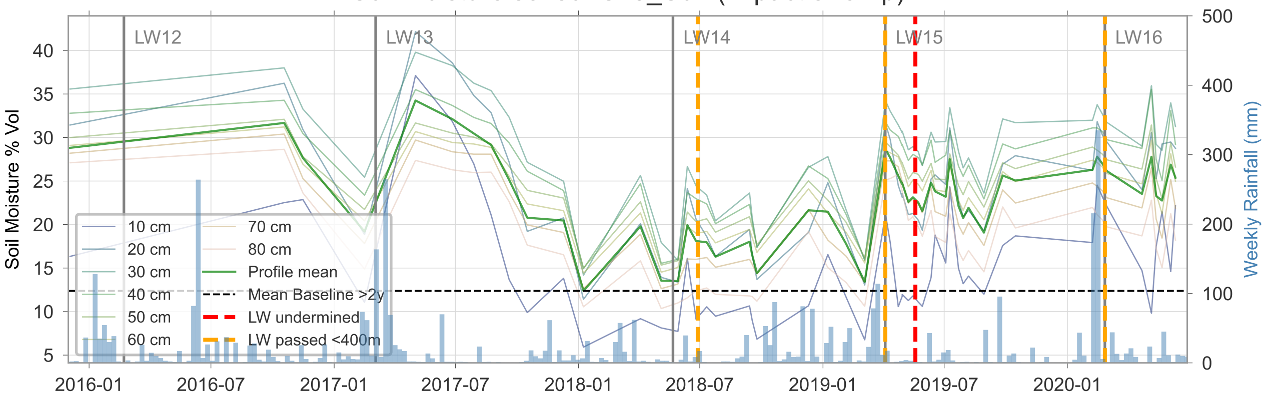
Soil moisture sensor S22_S01 (reference swamp)



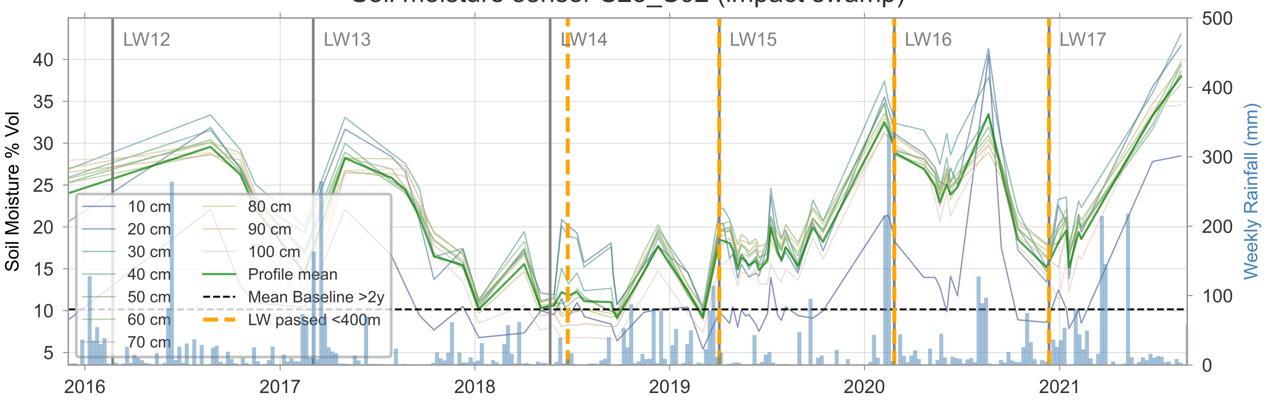
Soil moisture sensor S22_S02 (reference swamp)



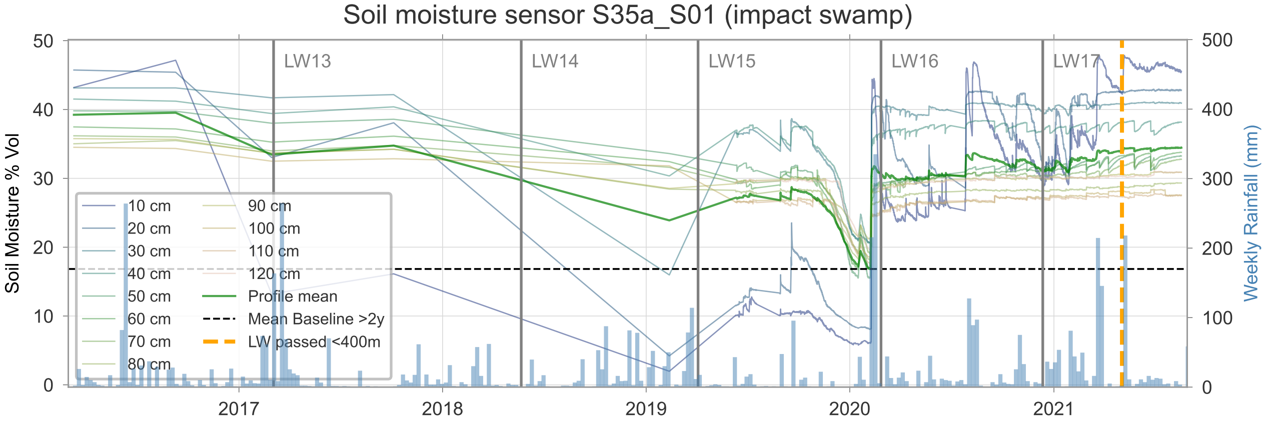
Soil moisture sensor S23_S01 (impact swamp)



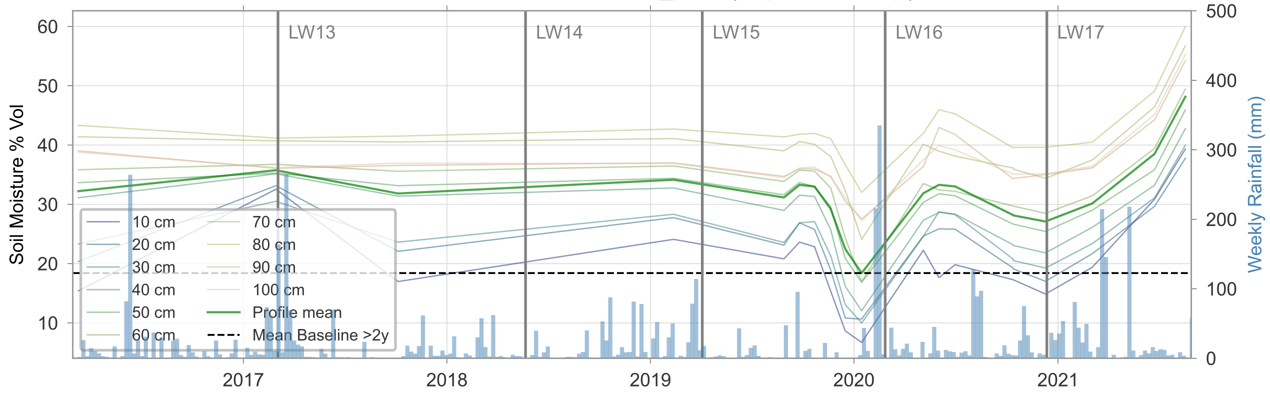
Soil moisture sensor S23_S02 (impact swamp)



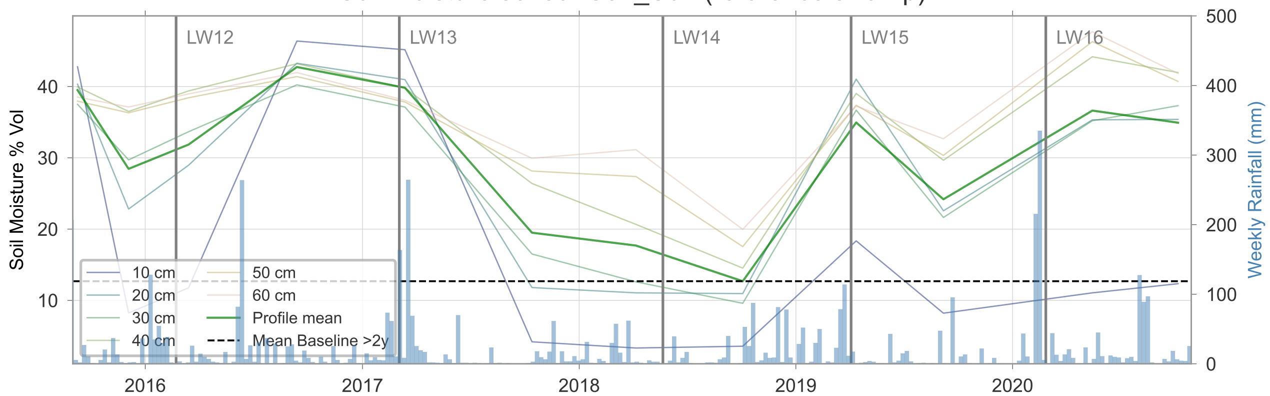
Soil moisture sensor S35a_S01 (impact swamp)



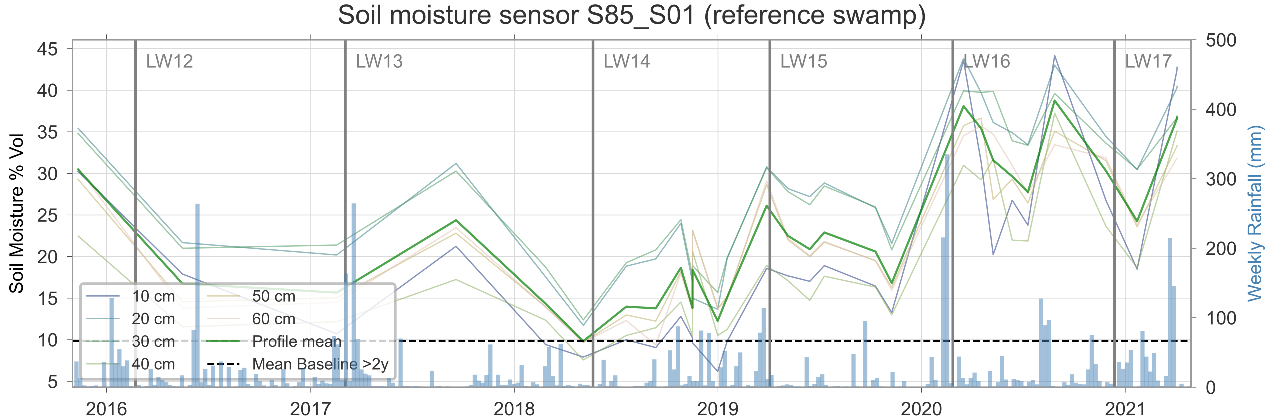
Soil moisture sensor S35b_S01 (impact swamp)



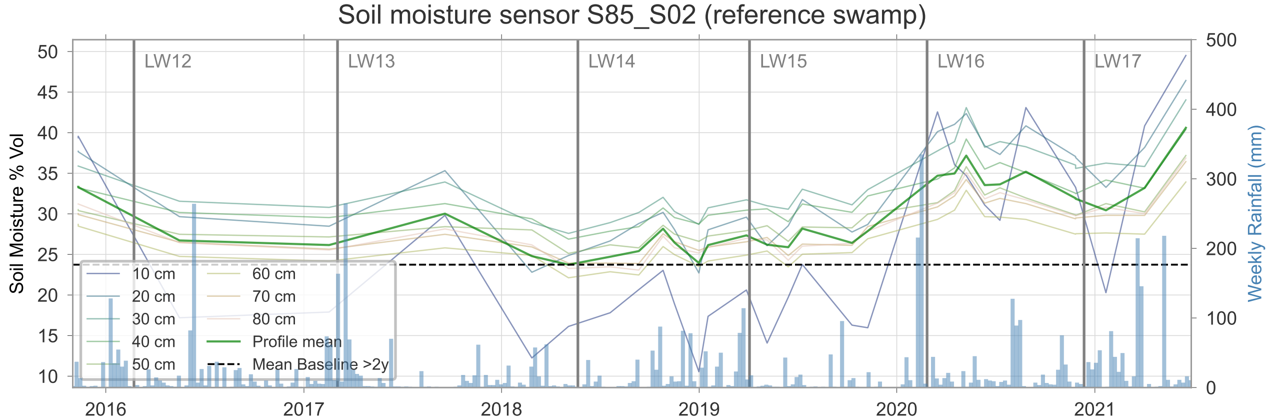
Soil moisture sensor S84_S01 (reference swamp)



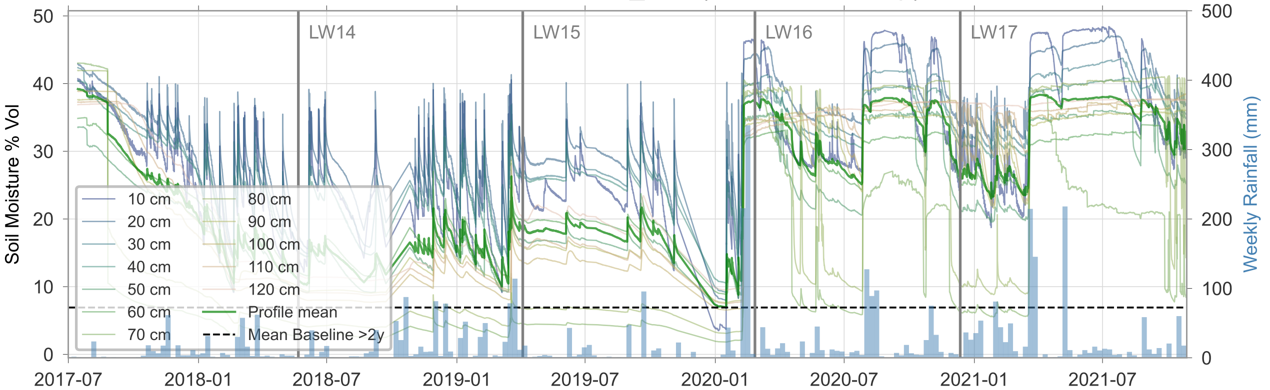
Soil moisture sensor S85_S01 (reference swamp)



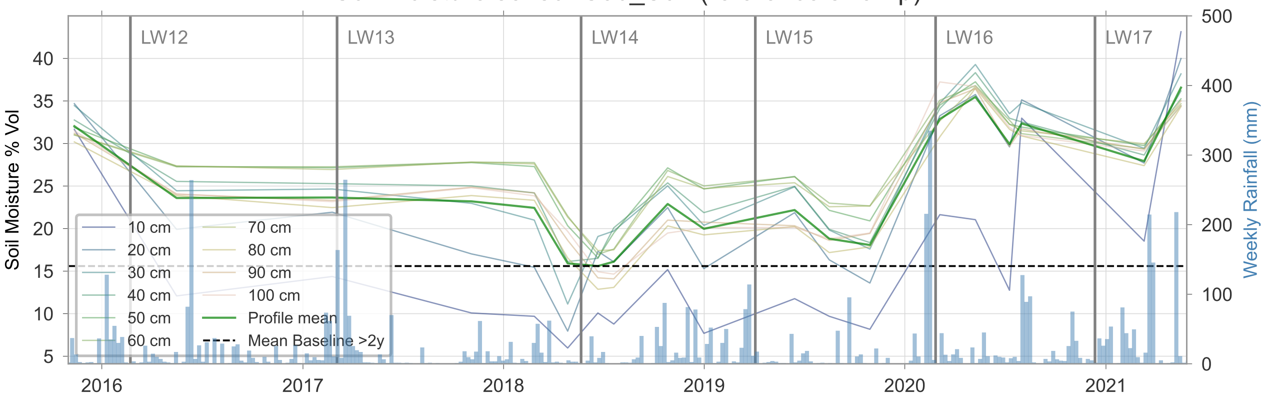
Soil moisture sensor S85_S02 (reference swamp)



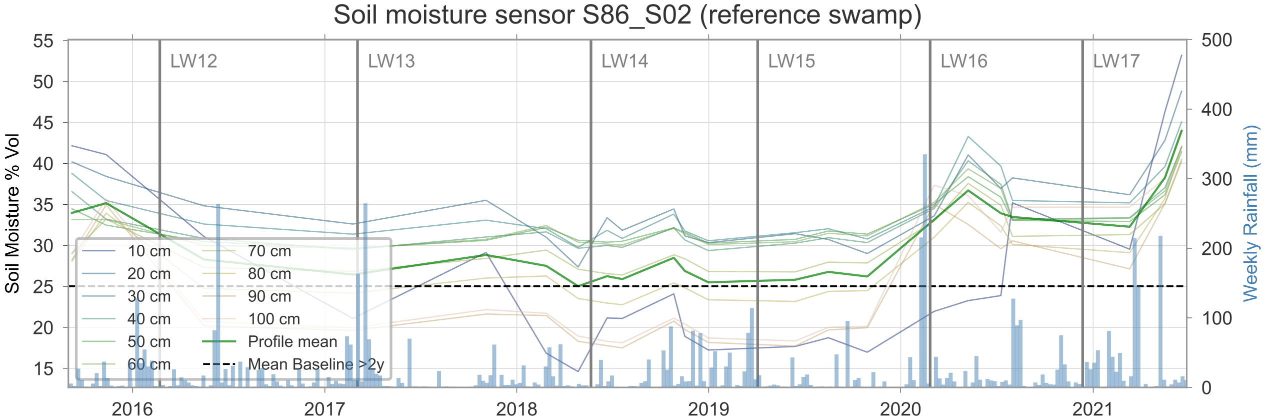
Soil moisture sensor S85_S03 (reference swamp)



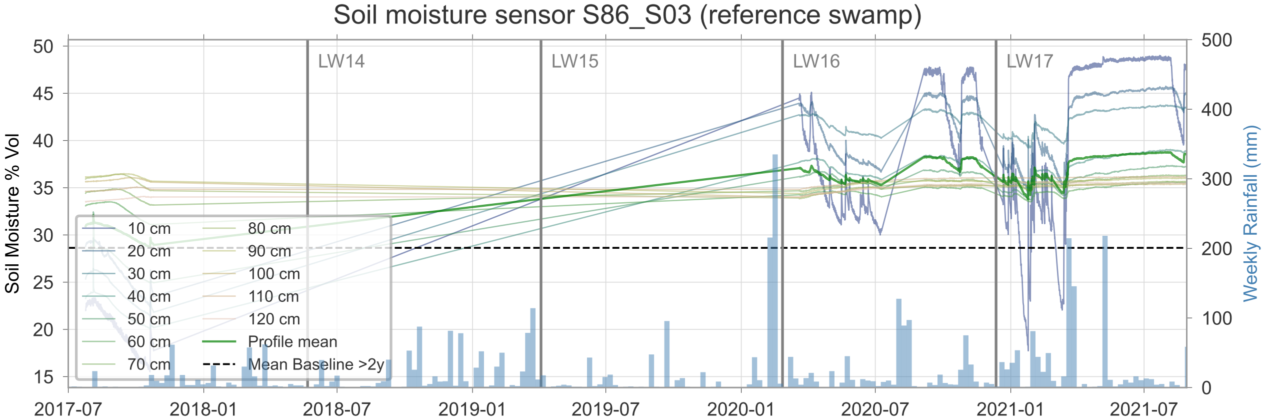
Soil moisture sensor S86_S01 (reference swamp)

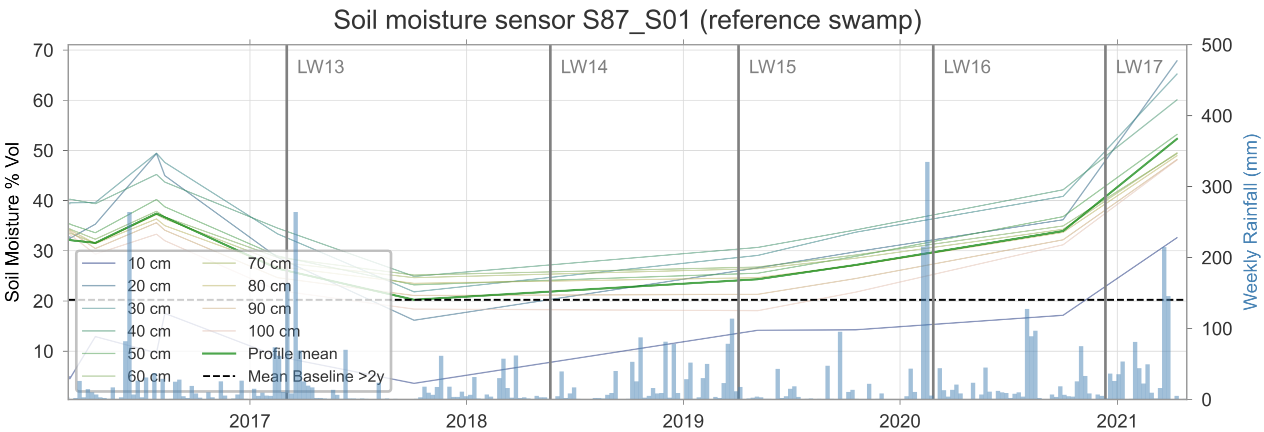


Soil moisture sensor S86_S02 (reference swamp)

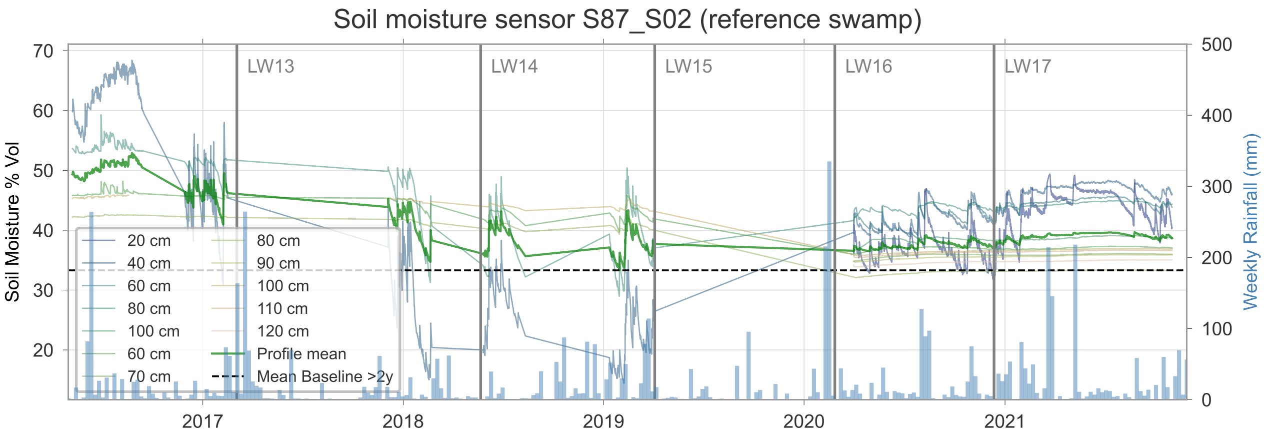


Soil moisture sensor S86_S03 (reference swamp)

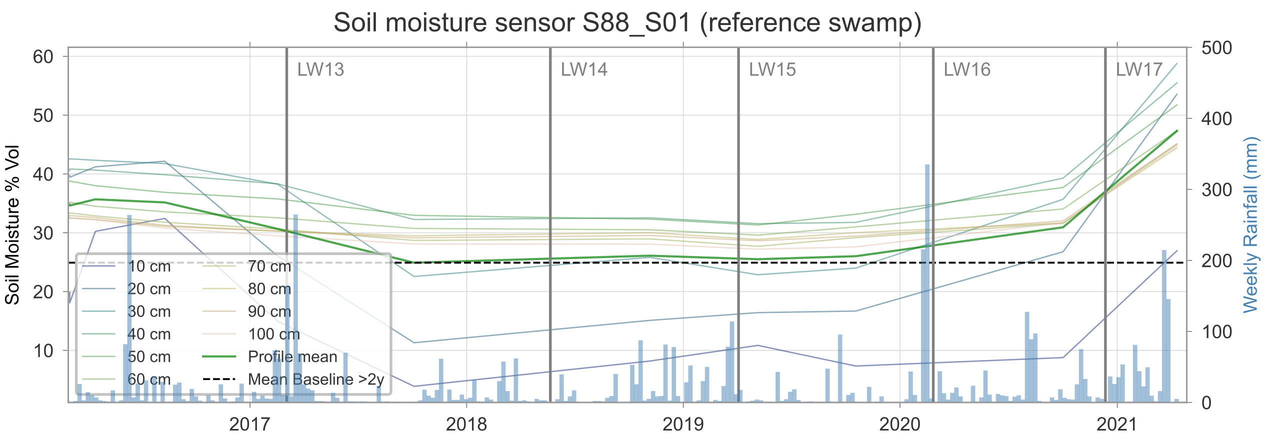




Soil moisture sensor S87_S01 (reference swamp)
Soil Moisture % Vol
Weekly Rainfall (mm)
LW13
LW14
LW15
LW16
LW17
10 cm
20 cm
30 cm
40 cm
50 cm
60 cm
70 cm
80 cm
90 cm
100 cm
Profile mean
Mean Baseline >2y
2017
2018
2019
2020
2021

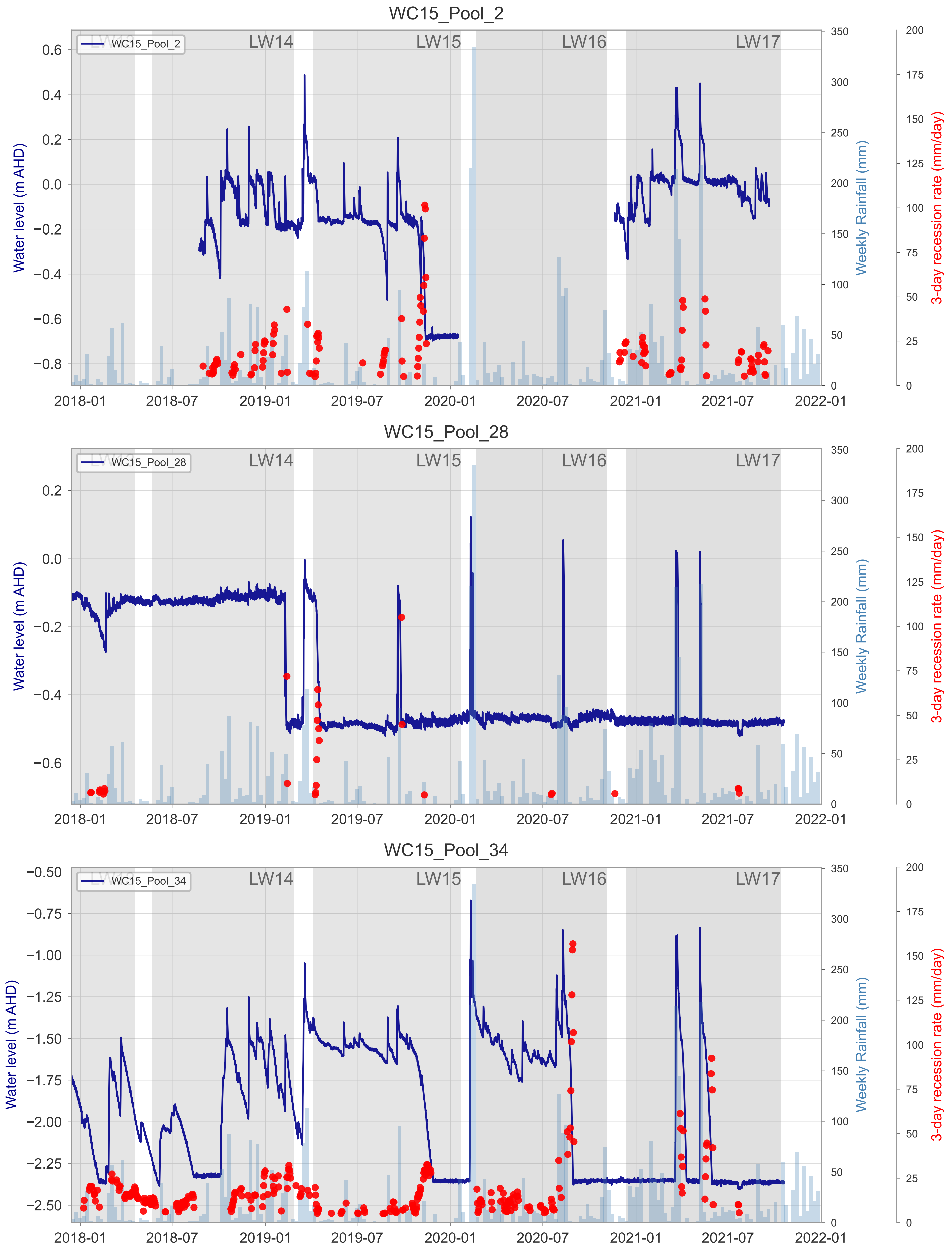


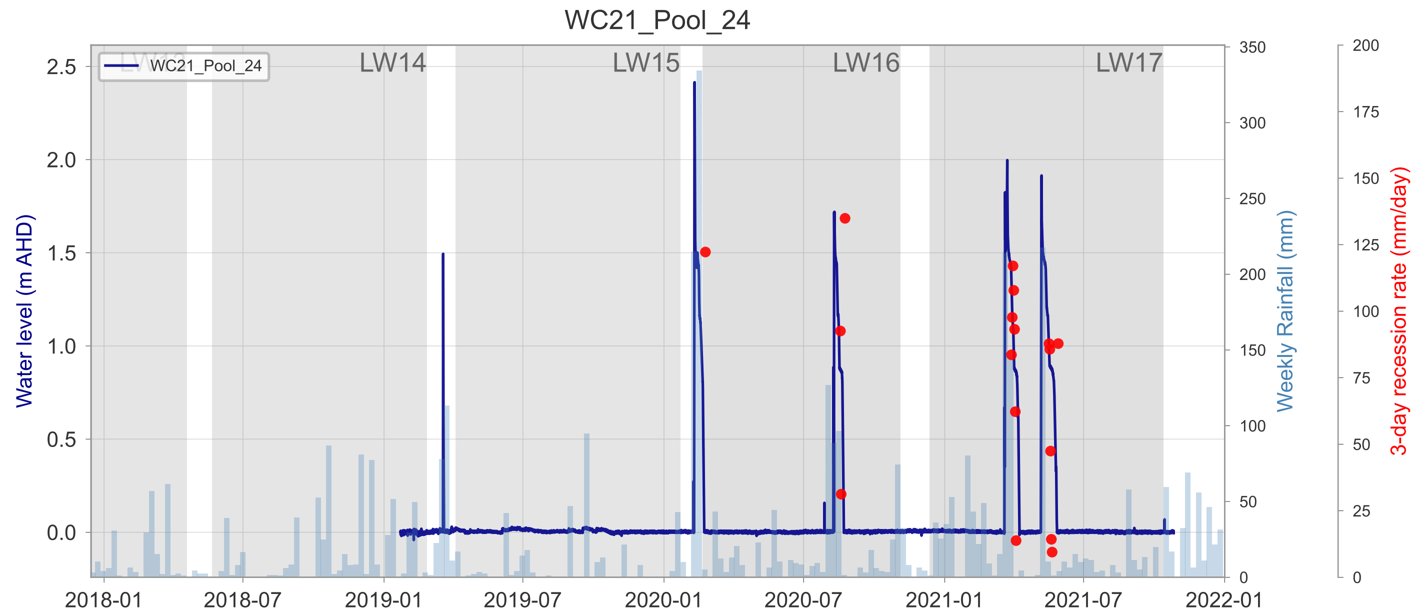
Soil moisture sensor S87_S02 (reference swamp)
Soil Moisture % Vol
Weekly Rainfall (mm)
LW13
LW14
LW15
LW16
LW17
20 cm
40 cm
60 cm
80 cm
100 cm
60 cm
70 cm
80 cm
90 cm
100 cm
110 cm
120 cm
Profile mean
Mean Baseline >2y
2017
2018
2019
2020
2021

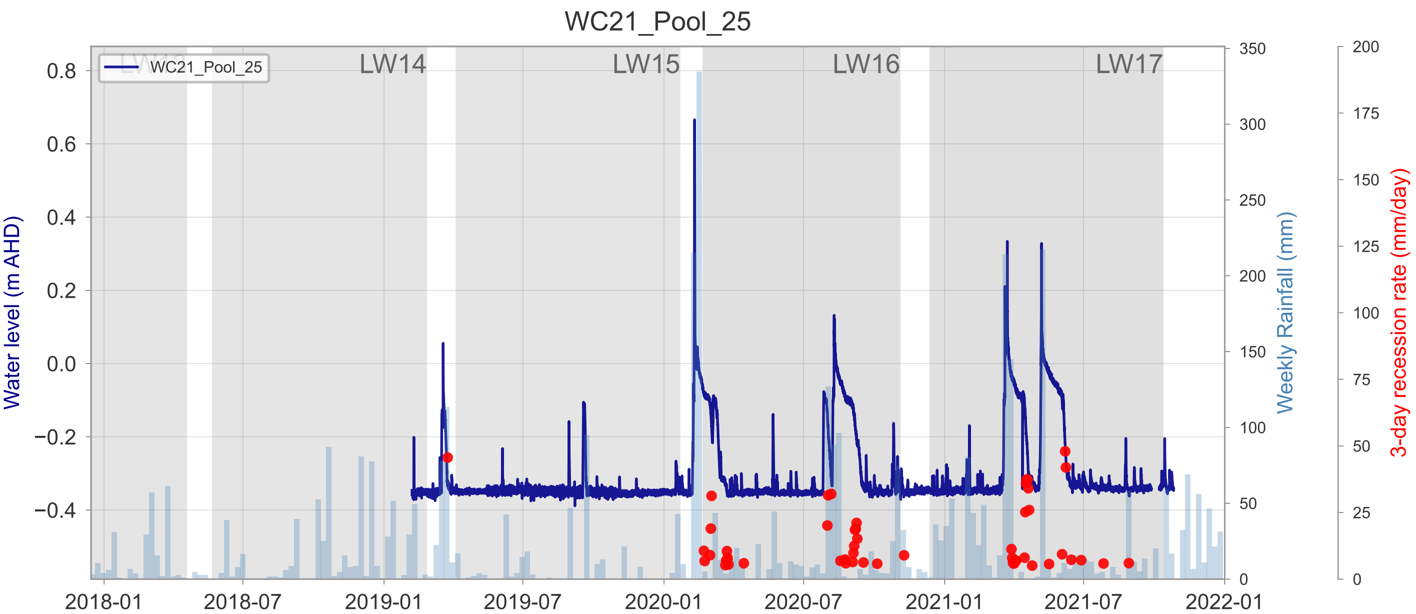


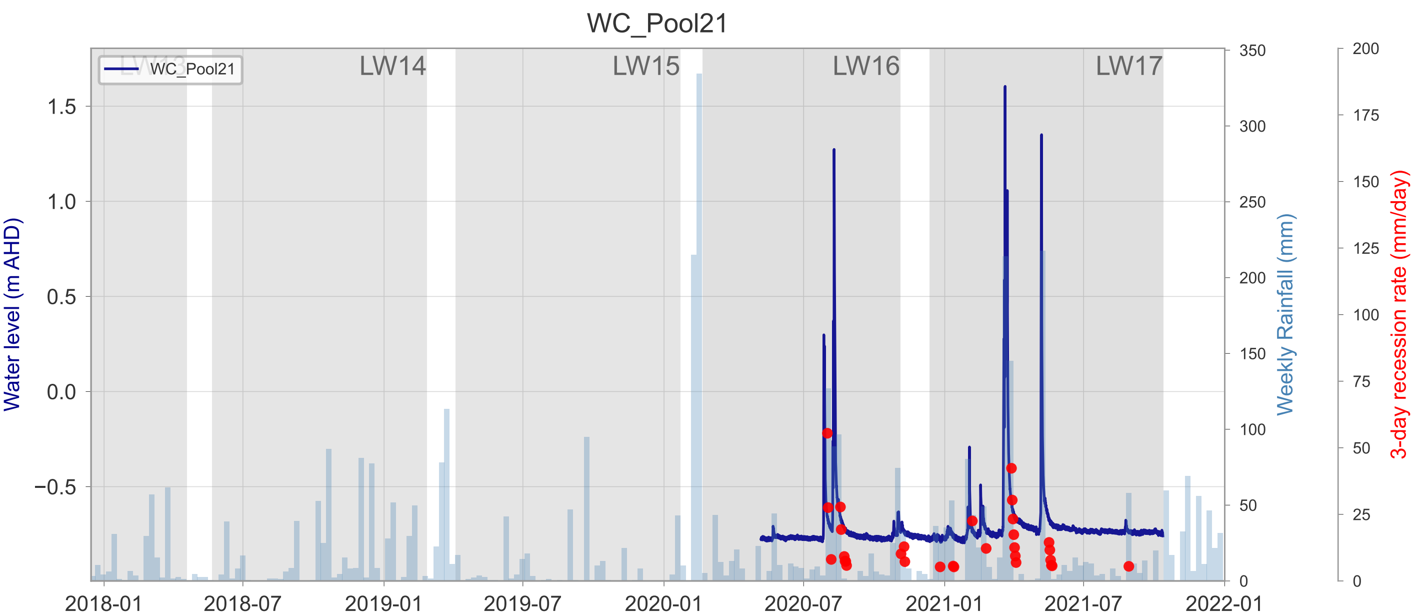
Soil moisture sensor S88_S01 (reference swamp)
Soil Moisture % Vol
Weekly Rainfall (mm)
LW13
LW14
LW15
LW16
LW17
10 cm
20 cm
30 cm
40 cm
50 cm
60 cm
70 cm
80 cm
90 cm
100 cm
Profile mean
Mean Baseline >2y
2017
2018
2019
2020
2021

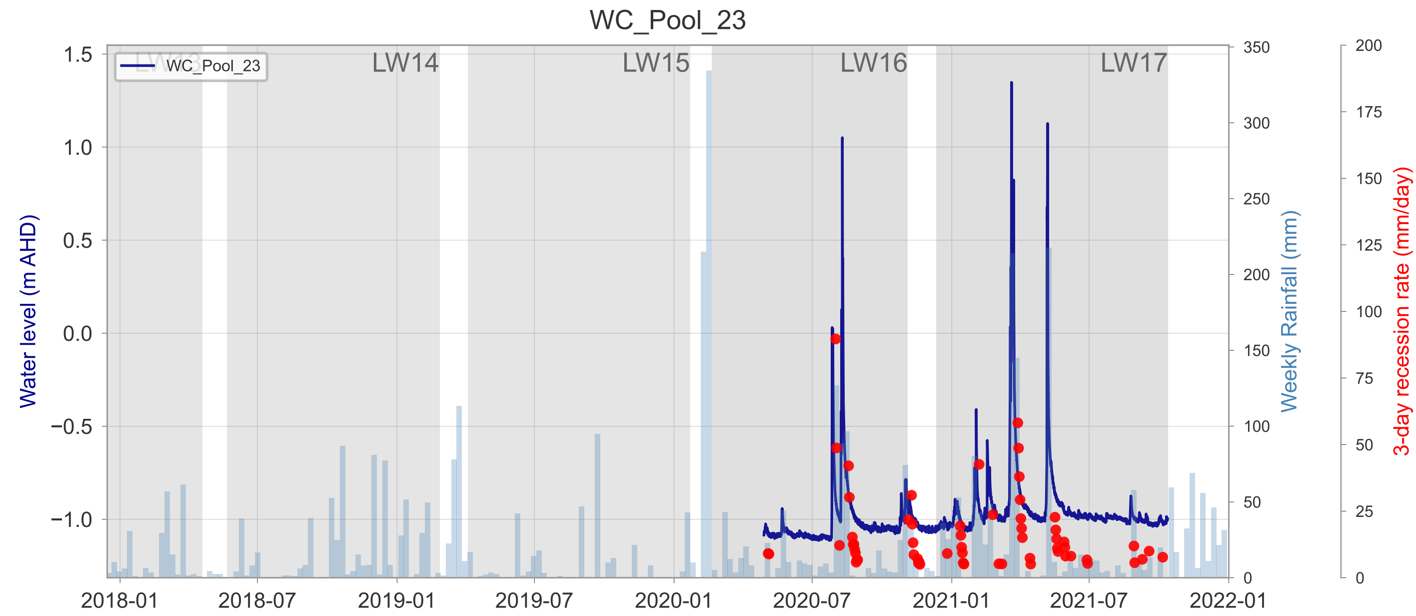
Appendix F: Stream pool level hydrographs

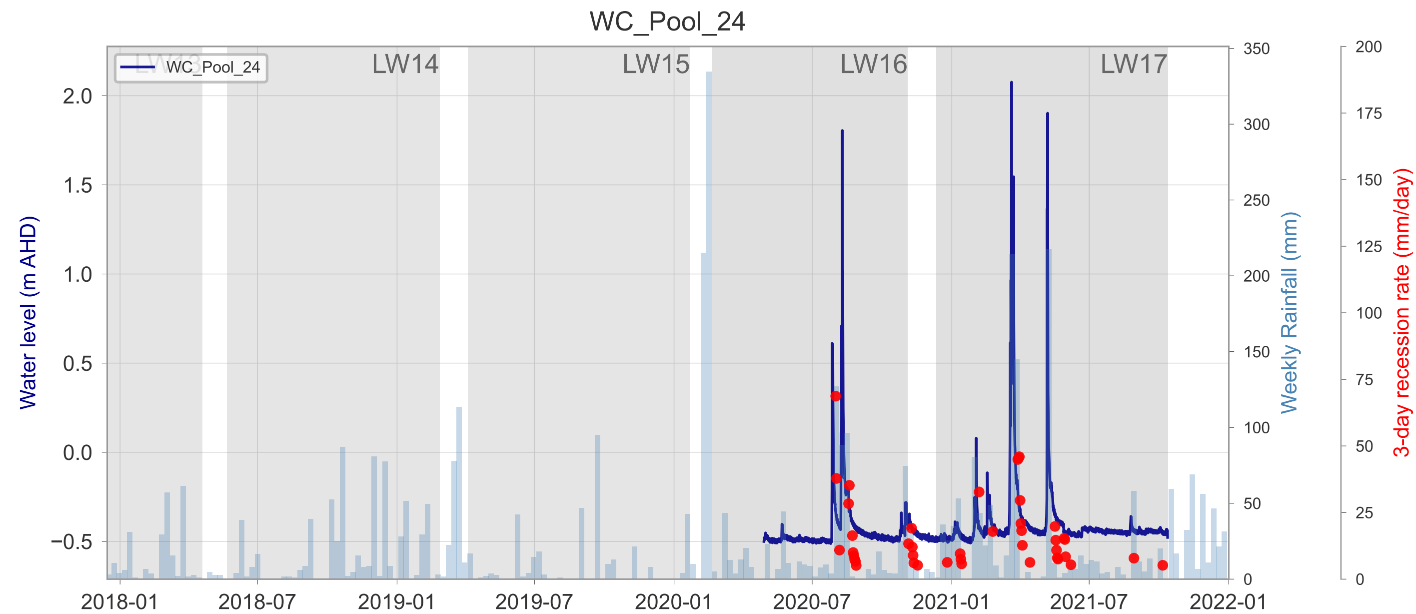

WC15_Pool_2
WC15_Pool_2
LW14
LW15
LW16
LW17
Water level (m AHD)
Weekly Rainfall (mm)
3-day recession rate (mm/day)
2018-01
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
WC15_Pool_28
WC15_Pool_28
WC15_Pool_34
WC15_Pool_34

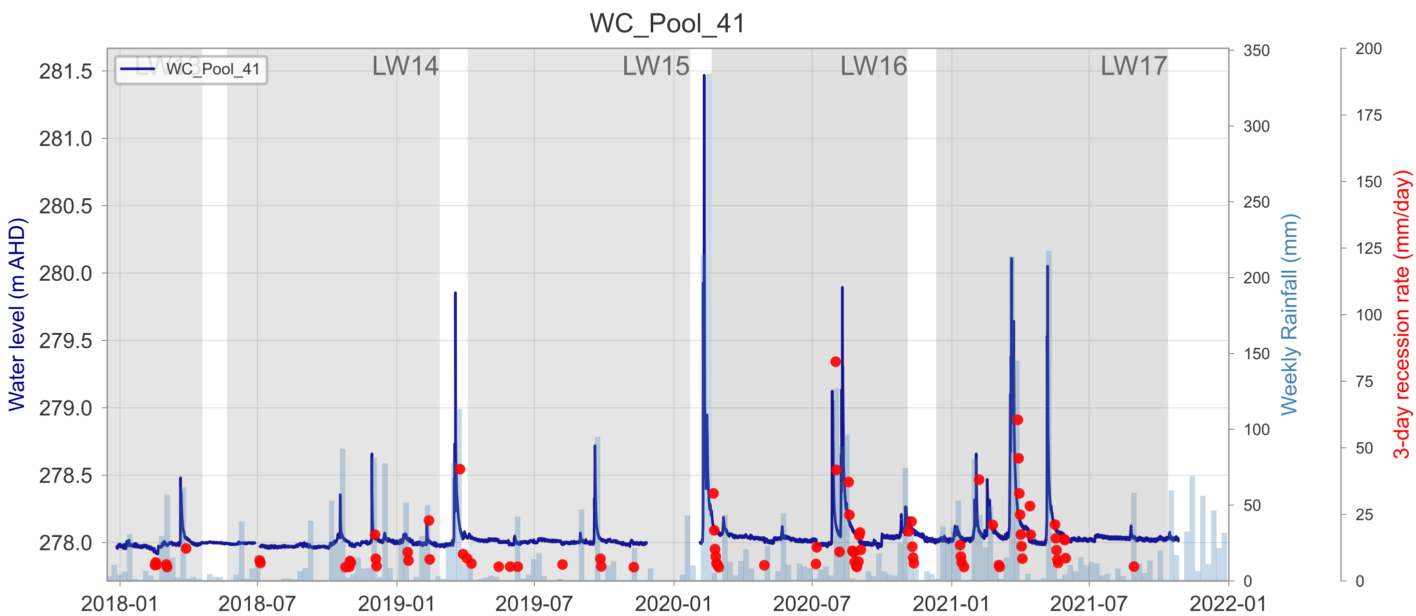

WC21_Pool_24
WC21_Pool_24
LW14
LW15
LW16
LW17
Water level (m AHD)
Weekly Rainfall (mm)
3-day recession rate (mm/day)
2018-01
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01


WC21_Pool_25
WC21_Pool_25
LW14
LW15
LW16
LW17
Water level (m AHD)
Weekly Rainfall (mm)
3-day recession rate (mm/day)
2018-01
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01

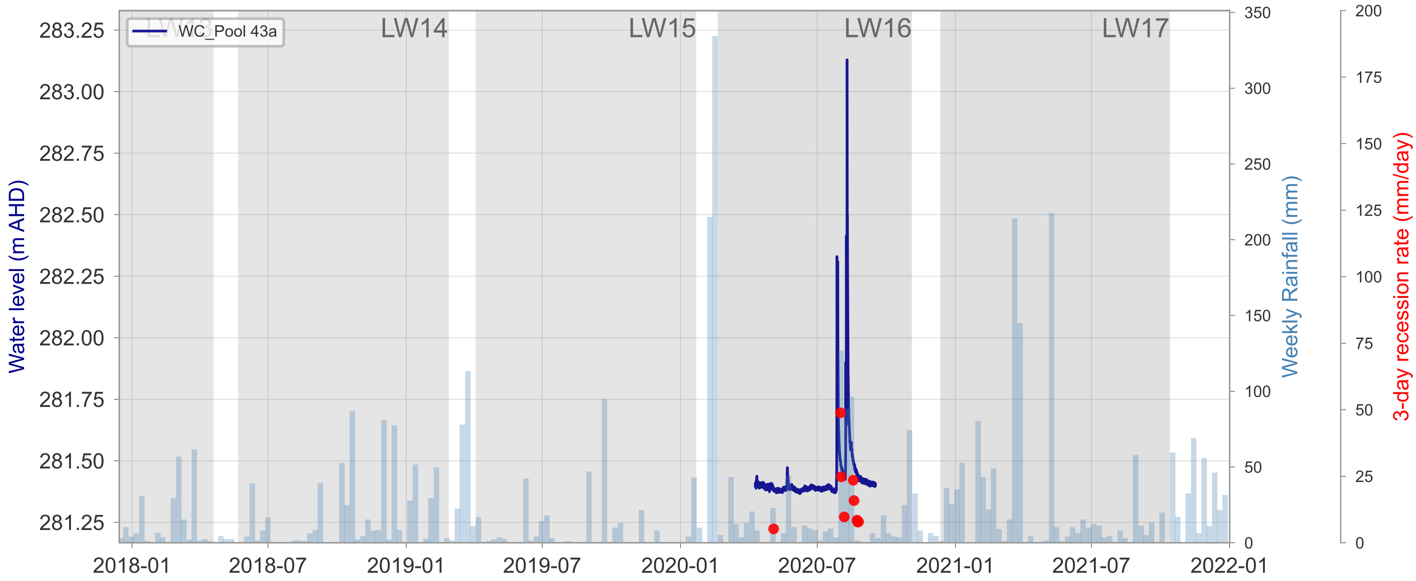

WC_Pool21
WC_Pool21
LW14
LW15
LW16
LW17
Water level (m AHD)
Weekly Rainfall (mm)
3-day recession rate (mm/day)
2018-01
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01


WC_Pool_23
WC_Pool_23
LW14
LW15
LW16
LW17
Water level (m AHD)
Weekly Rainfall (mm)
3-day recession rate (mm/day)

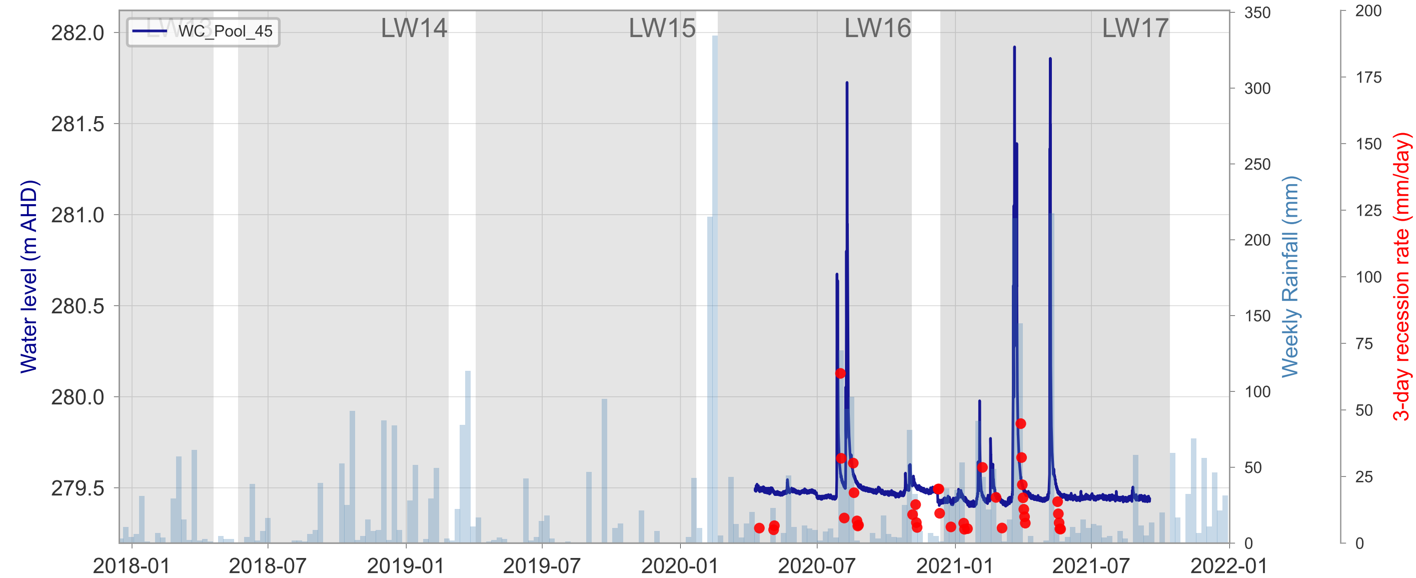

WC_Pool_24
WC_Pool_24
LW14
LW15
LW16
LW17
Water level (m AHD)
Weekly Rainfall (mm)
3-day recession rate (mm/day)


WC_Pool_41
WC_Pool_41
LW14
LW15
LW16
LW17
Water level (m AHD)
Weekly Rainfall (mm)
3-day recession rate (mm/day)

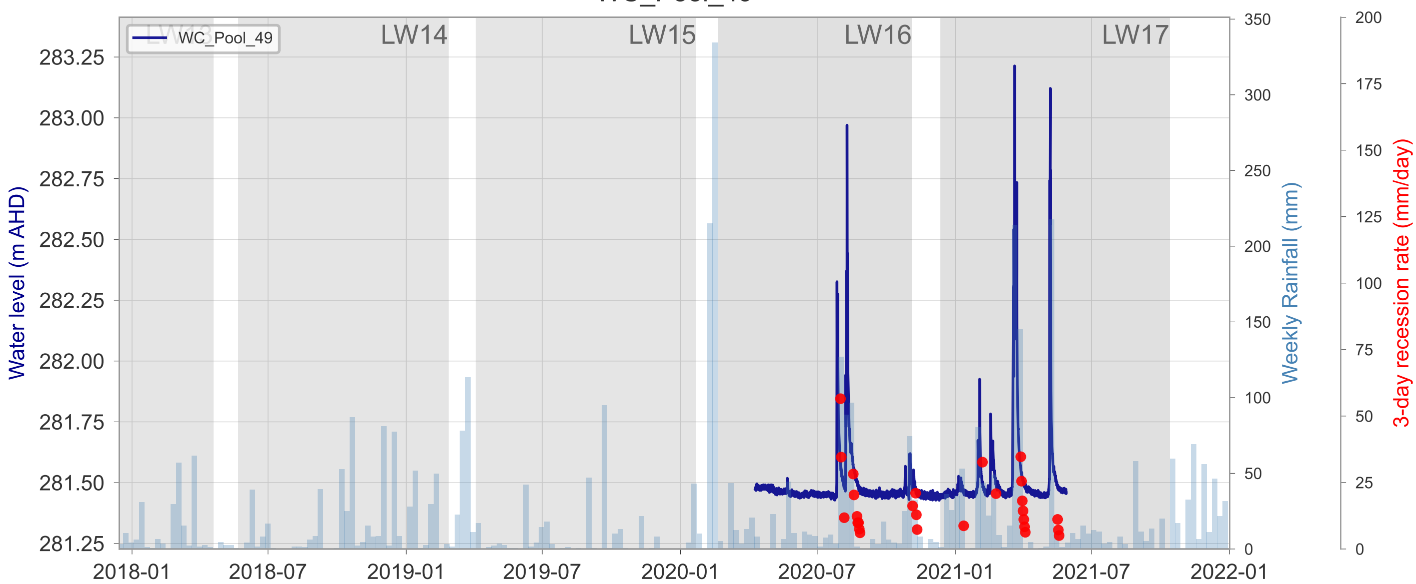
WC_Pool 43a

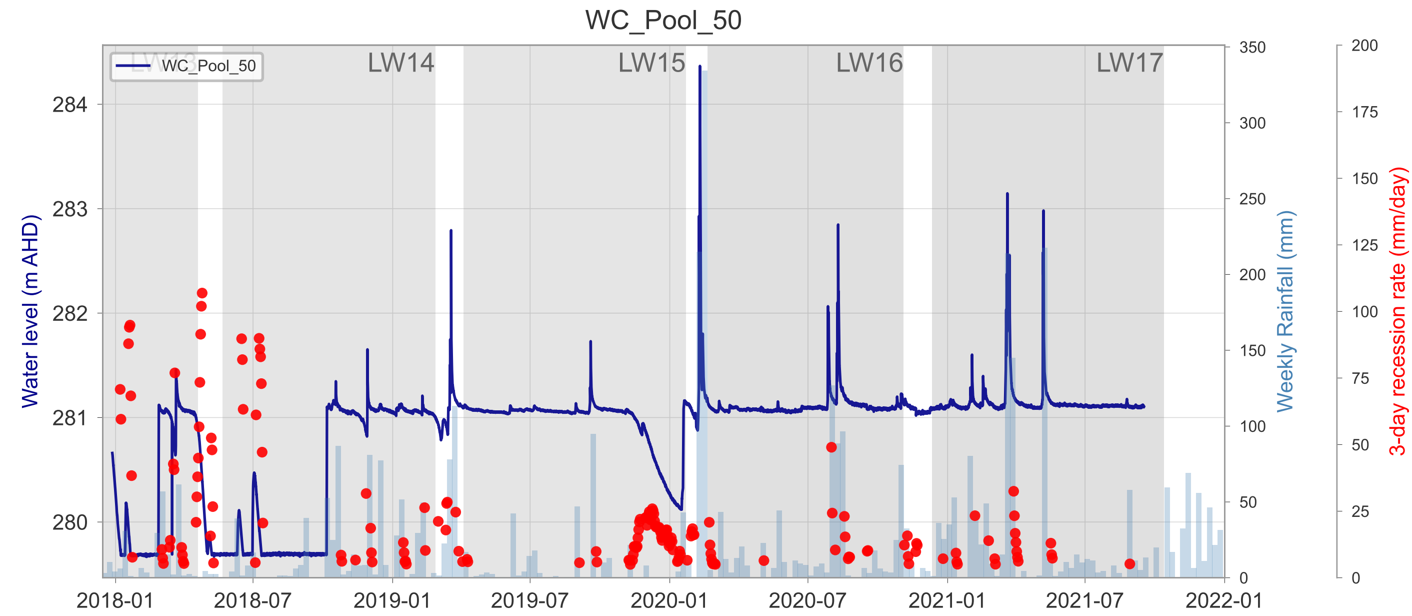


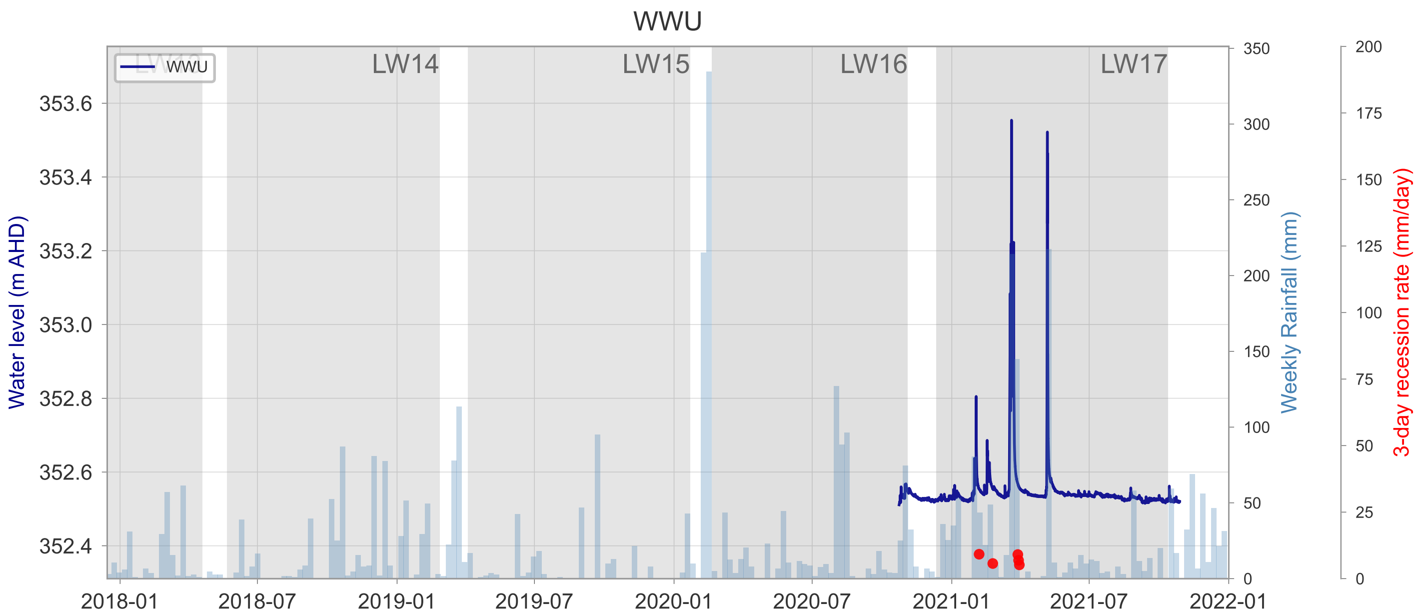
WC_Pool_45

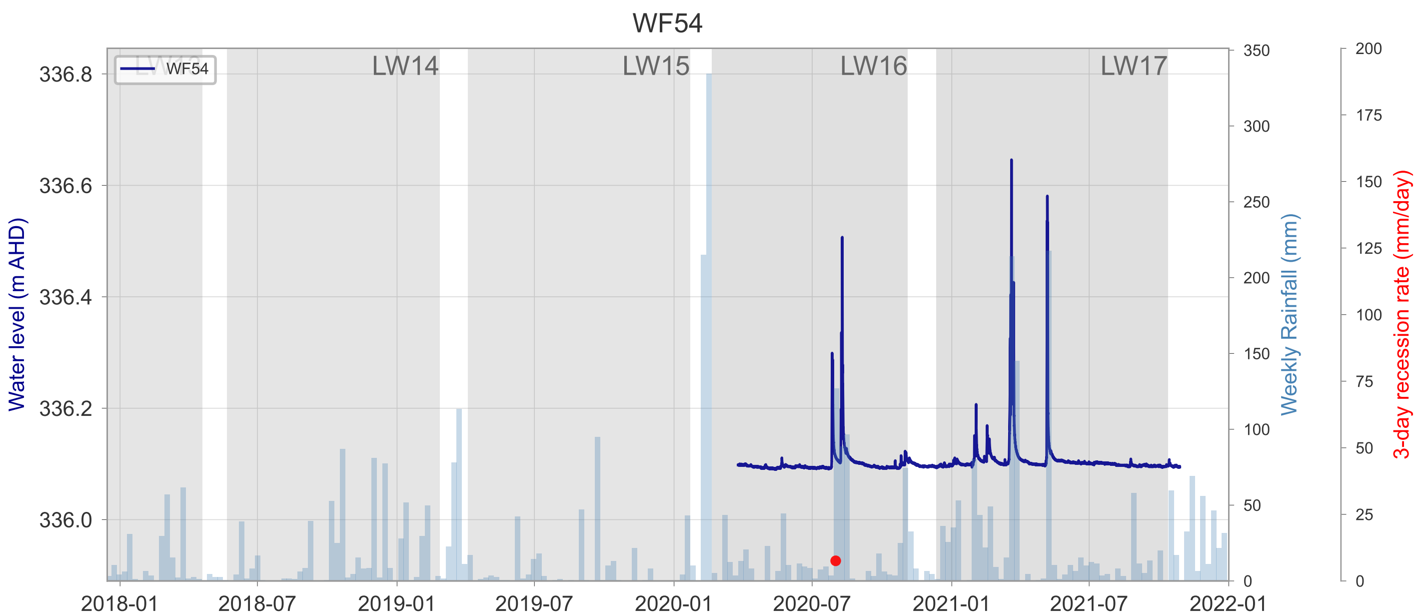


WC_Pool_49

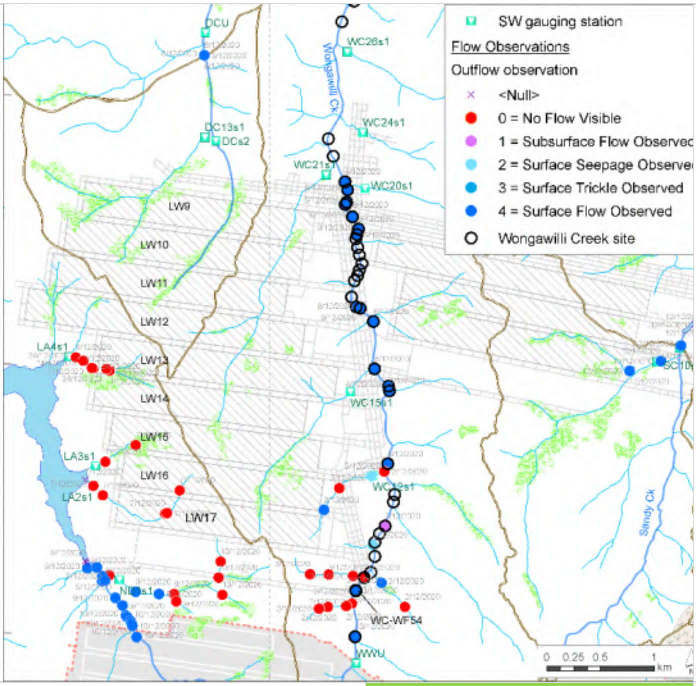



WC_Pool_50
WC_Pool_50
LW14
LW15
LW16
LW17
Water level (m AHD)
Weekly Rainfall (mm)
3-day recession rate (mm/day)

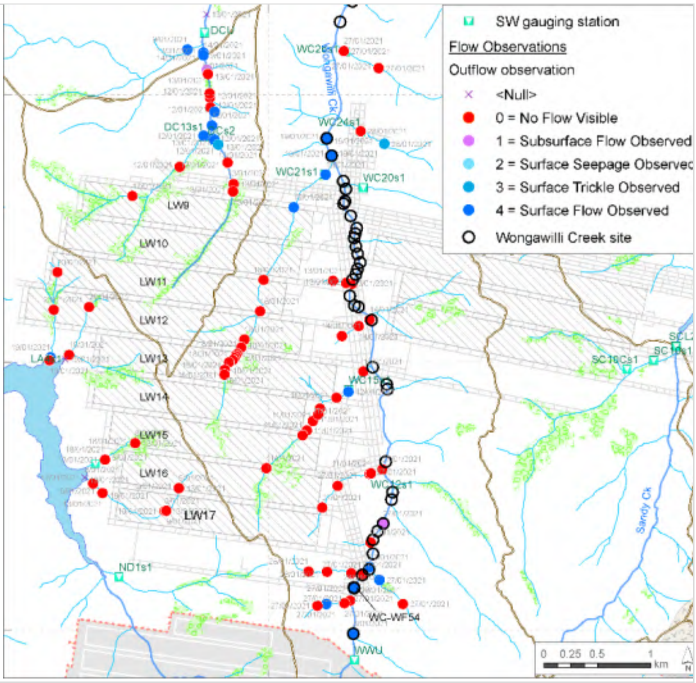

WWU
WWU
LW14
LW15
LW16
LW17
Water level (m AHD)
Weekly Rainfall (mm)
3-day recession rate (mm/day)


WF54
WF54
LW14
LW15
LW16
LW17
Water level (m AHD)
Weekly Rainfall (mm)
3-day recession rate (mm/day)

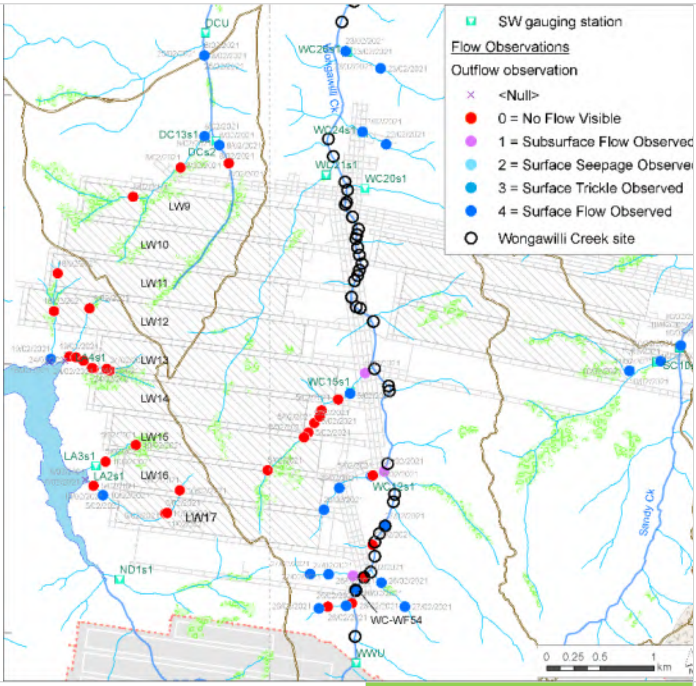
Appendix G: Watercourse flow observations



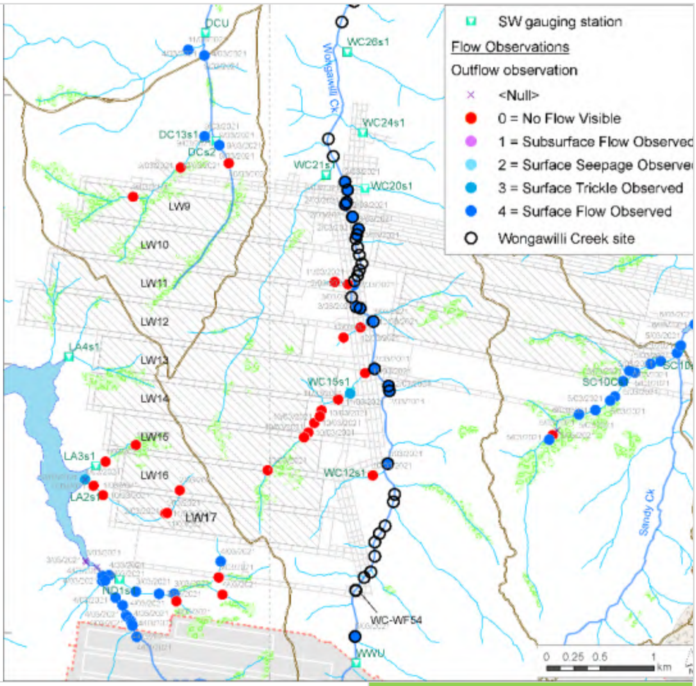
Flow observations: Dec-2020 | Assessment D not triggered



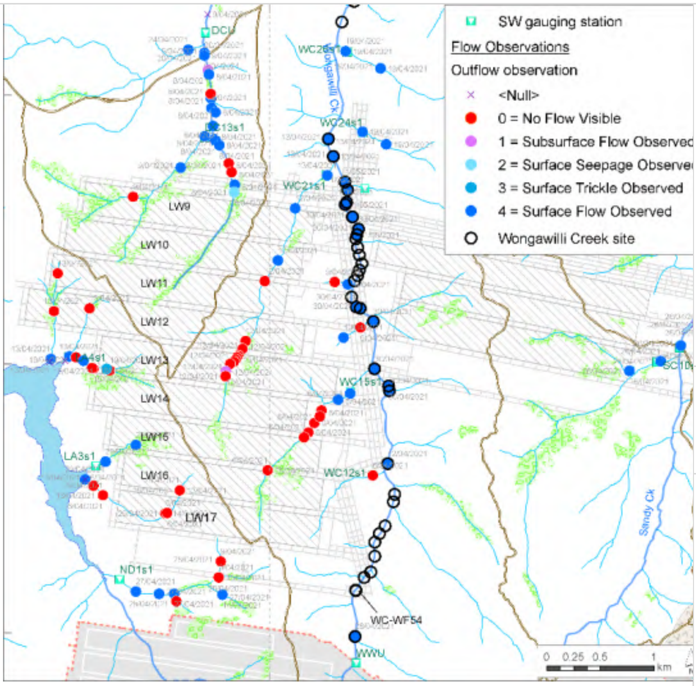
Flow observations: Jan-2021 | Assessment D not triggered*



Flow observations: Feb-2021 | Assessment D not triggered*



Flow observations: Mar-2021 | Assessment D not triggered



Flow observations: Apr-2021 | Assessment D not triggered

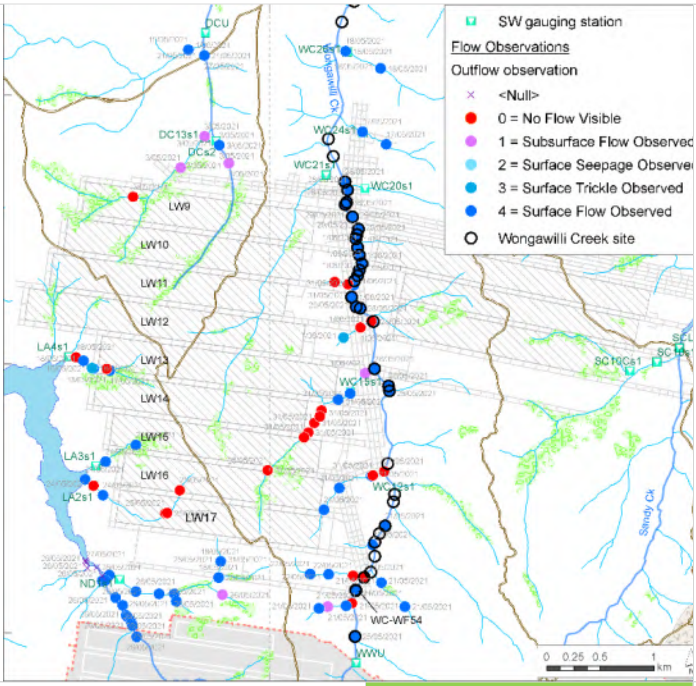
Outflow observation

- × <Null>
- 0 = No Flow Visible
- 1 = Subsurface Flow Observed
- 2 = Surface Seepage Observed
- 3 = Surface Trickle Observed
- 4 = Surface Flow Observed
- Wongawilli Creek site

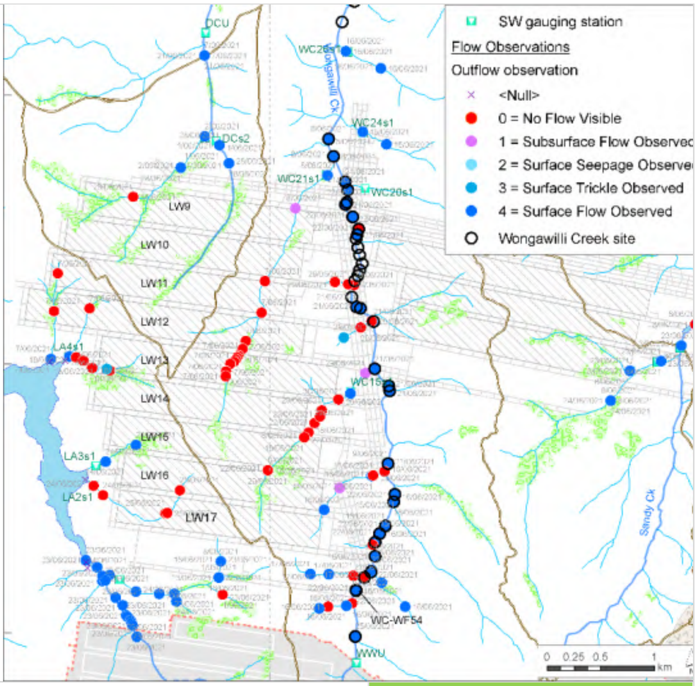
* No or limited observations along Wongawilli Ck because of catchment closure due to high rainfall.

E:\DENDROBIUM\Reports\HGE013\SW Flow observations during LW17.docx
E:\DENDROBIUM\GIS\Maps\Deliverable\EoP17\SWobservations_EOP17.mxd

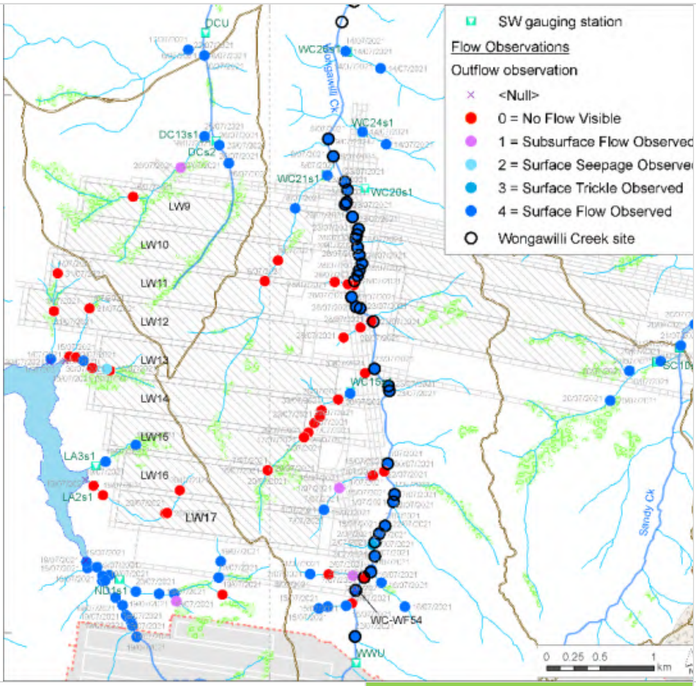
WATERSHED HYDROGEO



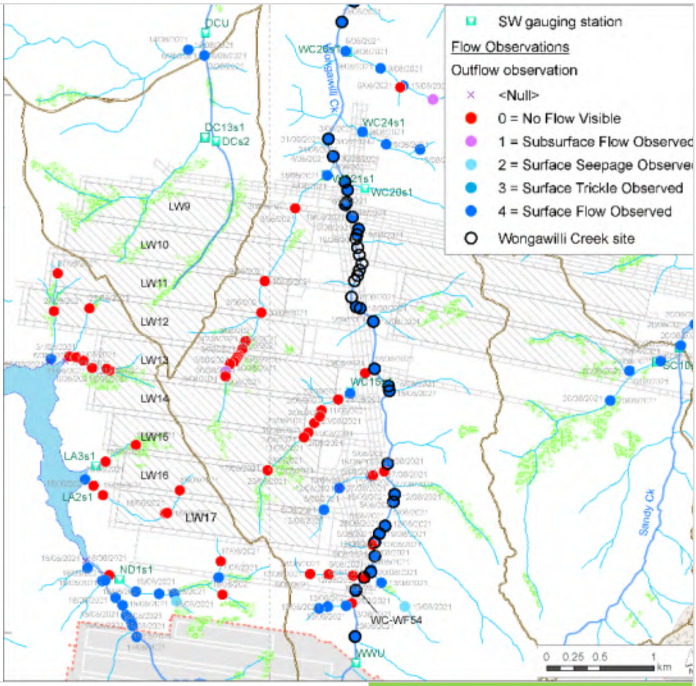
Flow observations: May-2021 | Assessment D not triggered



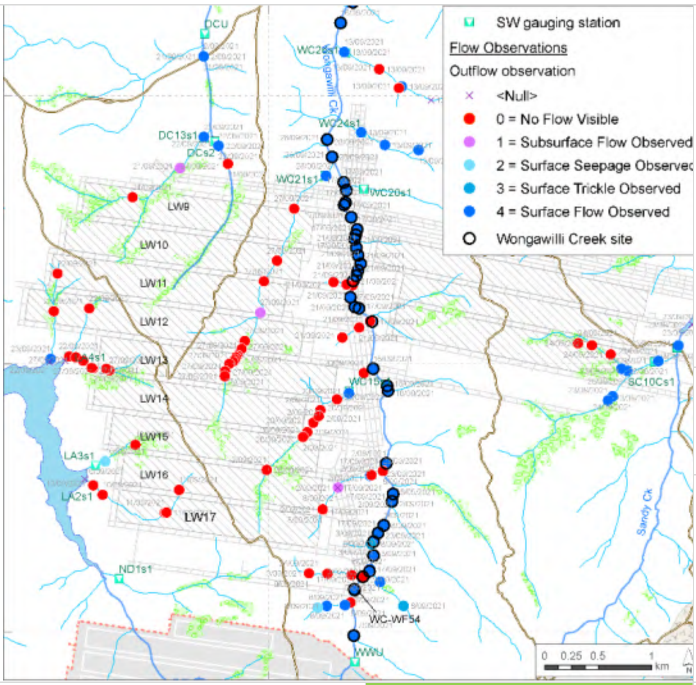
Flow observations: Jun-2021 | Assessment D not triggered



Flow observations: Jul-2021 | Assessment D not triggered



Flow observations: Aug-2021 | Assessment D not triggered



Flow observations: Sept-2021 | Assessment D not triggered

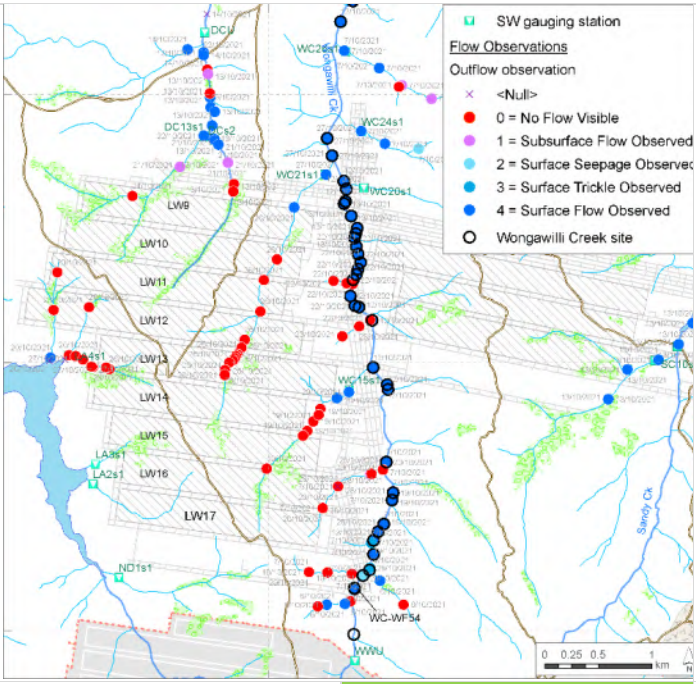
Outflow observation

- × <Null>
- 0 = No Flow Visible
- 1 = Subsurface Flow Observed
- 2 = Surface Seepage Observed
- 3 = Surface Trickle Observed
- 4 = Surface Flow Observed
- Wongawilli Creek site

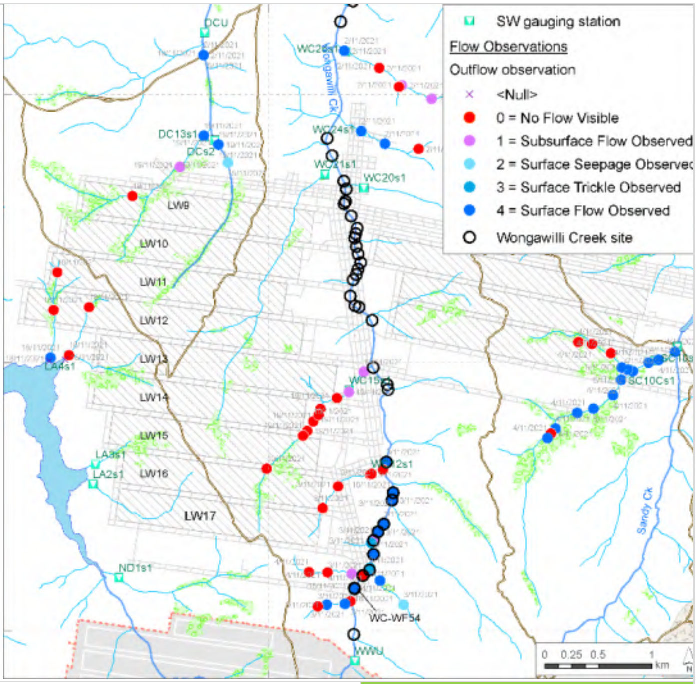
* No or limited observations along Wongawilli Ck because of catchment closure due to high rainfall.

E:\DENDROBIUM\Reports\HGE013\SW Flow observations during LW17.docx
E:\DENDROBIUM\GIS\Maps\Deliverable\EoP17\SWobservations_EOP17.mxd

WATERSHED HYDROGEO



Flow observations: Oct-2021 | Assessment D not triggered



Flow observations: Nov-2021 | Assessment D not triggered

Outflow observation

- × <Null>
- 0 = No Flow Visible
- 1 = Subsurface Flow Observed
- 2 = Surface Seepage Observed
- 3 = Surface Trickle Observed
- 4 = Surface Flow Observed
- Wongawilli Creek site

* No or limited observations along Wongawilli Ck because of catchment closure due to high rainfall.

E:\DENDROBIUM\Reports\HGE013\SW Flow observations during LW17.docx
E:\DENDROBIUM\GIS\Maps\Deliverable\EoP17\SWobservations_EOP17.mxd

WATERSHED HYDROGEO

Appendix H: Rainfall-runoff modelling

H1. AWBM comparison: DCU – Donalds Castle Creek

This catchment incorporates the headwater sub-catchments DC13 and DCS2, and was mined under at the commencement of Longwall 9, and again by Longwalls 10-12, and marginally by Longwall 13. Longwalls 14-17 are beyond it (to the south). About 60% of the DCU catchment is not mined under.

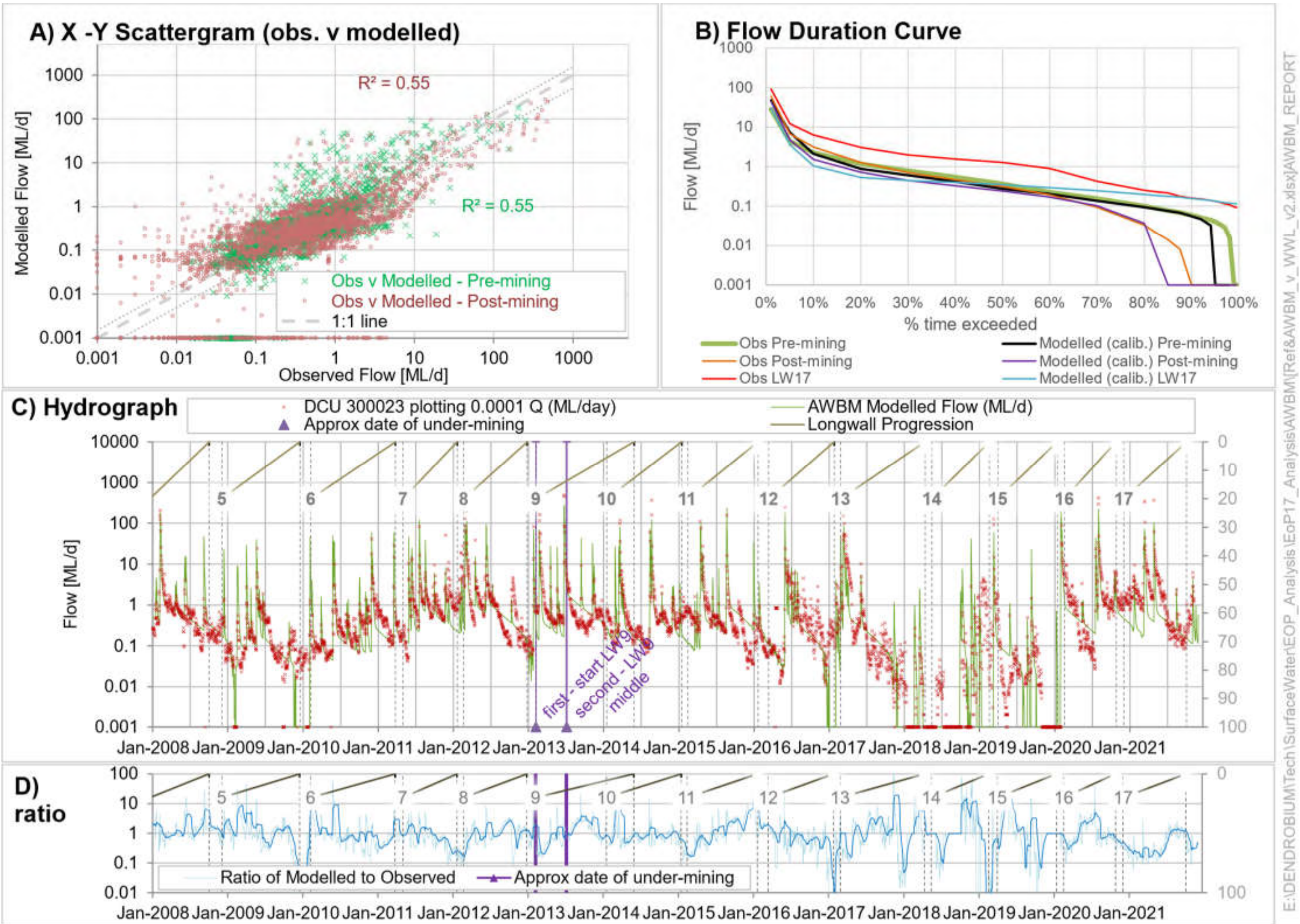


Figure H1 Comparison of observed flow against AWBM simulated flow: DCU

A	This shows that during the pre-mining period the model is a reasonable fit to observed data. This fit is essentially the same in the post-mining period. Simulation of the very lowest flows remains the main weakness.
B	Confirms the reasonable match between modelled and observed flows for the pre-mining period (black vs green) and illustrates that the model still predicts the range of flows reasonably well for the subsequent post-mining period (purple vs orange). The model underestimates higher flows during Longwall 17, but the observed low-flows (below Q75) are well simulated in 2021 (Longwall 17) (blue vs red).
C	The hydrograph shows a reasonable match between observed flows up until early 2013 (the start of Longwall 9), including periods of zero flow, and the match is the same after that time. The model is considered to capture the 2017-19 drought and flow in the subsequent wetter 2020-21 period quite well. Generally, the flow recessions are matched to a reasonable degree, but there is scope for more improvement in this catchment (it remains the most difficult hydrograph to match. There is no discernible systematic change in behaviour.
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, including during Longwall 17, oscillates around 1, and is similar to the pre-mining behaviour.

Catchment discharge after Longwall 17:	For the complete post-mining period, the water balance [Q*sim* + ET*sim*] is >= -6% of average P*obs* (+8%)	**former TARP – Not triggered**
	for the Longwall 17 assessment period, the water balance [Q*sim* + ET*sim*] is >= -6% of average P*obs* (+25%)	**former TARP – Not triggered**
Assessment:	The flow duration curves suggest that there is no systematic reduction in flow, especially at low flows, during Longwall 17. This is in agreement with the agreed TARP assessment using Reference Sites.	

H2. AWBM comparison: WC12 – Wongawilli Creek tributary

The end of Longwall 15 skirted the north-western edge of this sub-catchment and to within 250 m of the watercourse itself. Longwall 16 mined within 40 m of WC12, and Longwall 17 mined under this watercourse. No landscape impacts (cracking, iron-staining) have been reported by IMCEFT.

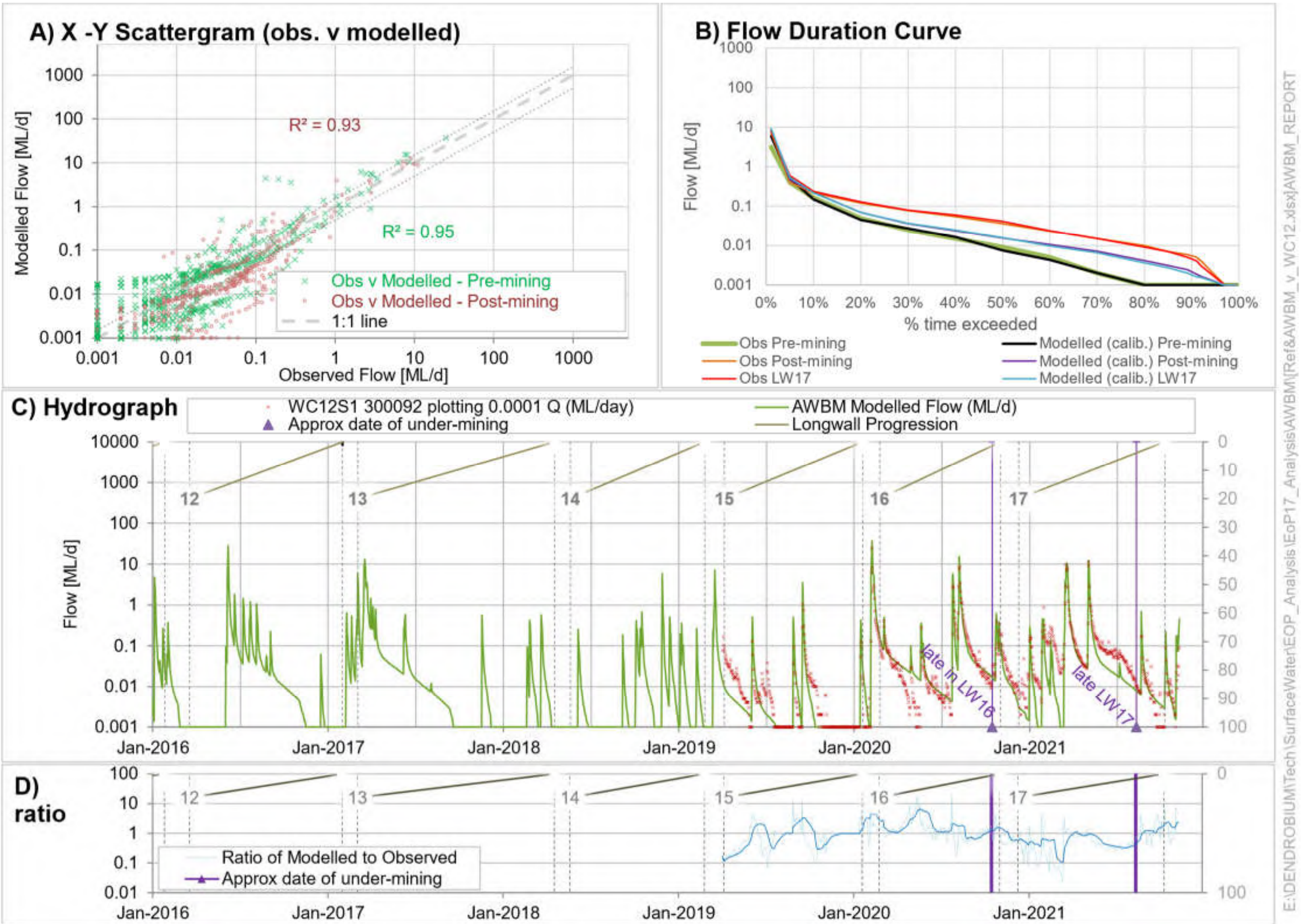


Figure H2 Comparison of observed flow against AWBM simulated flow: WC12

A	This shows that during the short (560 day) pre-mining period the model is a reasonable fit to observed data, with the fit only marginally weaker in the shorter (390-day) post-mining period, but still good (R^2 = 0.93).
B	Confirms the moderate match between modelled and observed flows for the pre-mining period (black vs green) and illustrates that the model simulates flow well for the subsequent post-mining period (purple vs orange) and the Longwall 17 period (red vs blue).
C	The hydrograph shows a reasonable match between observed flows up until Oct-2020 (as Longwall 16 approaches WC12), including two periods of zero flow during the 2019 drought, and the match is the similar after that time. The model is considered to capture flow in the subsequent wetter 2020-21 period moderately well. 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.
D	The pre-mining ratio of modelled to observed flows shows the ratio oscillates at approximately 1 (i.e. a good match between observed and modelled). The post-mining ratio in the first half of Longwall 17 is also near to 1, and has not deviated later in Longwall 17 as the panel approaches WC12.

Catchment discharge after Longwall 17:	For the complete post-mining period, the.water balance [Q*sim* + ET*sim*] is >= -6% of average P*obs* (-0.6%)	**former TARP – Not triggered**
	for the Longwall 17 assessment period, the water balance [Q*sim* + ET*sim*] is >= -6% of average P*obs* (+9%)	**former TARP – Not triggered**
Assessment:	This assessment suggests that mining effects on surface water flows are not present or cannot yet detected in this sub-catchment, This is consistent with the agreed TARP assessment using Reference Sites.	

H3. AWBM comparison: WWL – Wongawilli Creek (lower)

Wongawilli Creek lies between Areas 3A and 3B. The watercourse is not directly mined under by longwalls, but some tributaries (e.g. WC21, WC15, among others) have been mined under by Area 3A and 3B longwalls, including by Longwall 17.

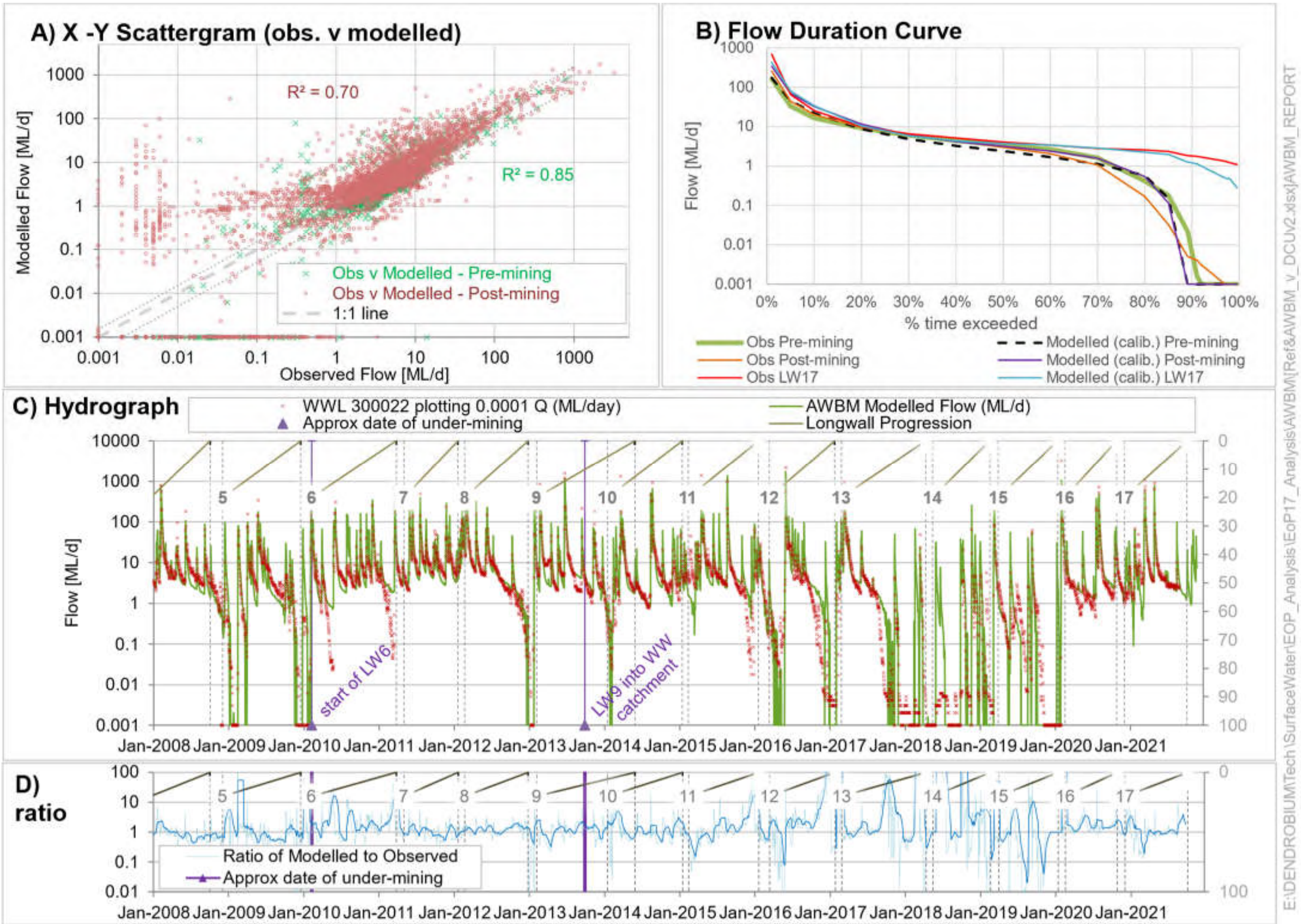


Figure H3 Comparison of observed flow against AWBM simulated flow: WWL

A	This shows that during the pre-mining period the model is a good fit to observed data. This fit is slightly weaker, but still good (R^2 = 0.7), in the post-mining period.
B	Confirms the reasonable match between modelled and observed flows for the pre-mining period (black vs green) and illustrates that the model still predicts the range of flows reasonably well for the subsequent post-mining period (purple vs orange) as well as during Longwall 17.
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. The model is considered to capture the 2017-19 drought and flow in the subsequent wetter 2020-21 period quite well. 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.
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, including during Longwall 17, oscillates around 1, and is similar to the pre-mining behaviour, although during droughts (when flows were frequently close to 0), the ratio is more variable.

Catchment discharge after Longwall 17:	For the complete post-mining period, the.water balance [Q*sim* + ET*sim*] is >= -6% of average P*obs* (-4%)	**former TARP – Not triggered**
	for the Longwall 17 assessment period, the water balance [Q*sim* + ET*sim*] is >= -6% of average P*obs* (+7%)	**former TARP – Not triggered**
Assessment:	The above analysis does not suggest any reduced sub-catchment flow / yield that can be discerned beyond natural variability or model/method accuracy. This is consistent with the agreed TARP assessment using Reference Sites.	

H4. AWBM comparison: ND1S1 on Native Dog tributary ND1

ND1 is a tributary to Native Dog Creek, which flows into Lake Avon. Elouera Colliery longwalls are within or close to this sub-catchment, but were not directly beneath this watercourse or its tributaries. Dendrobium Longwall 17 mined under the edge of the ND1 catchment, but not under the watercourse.

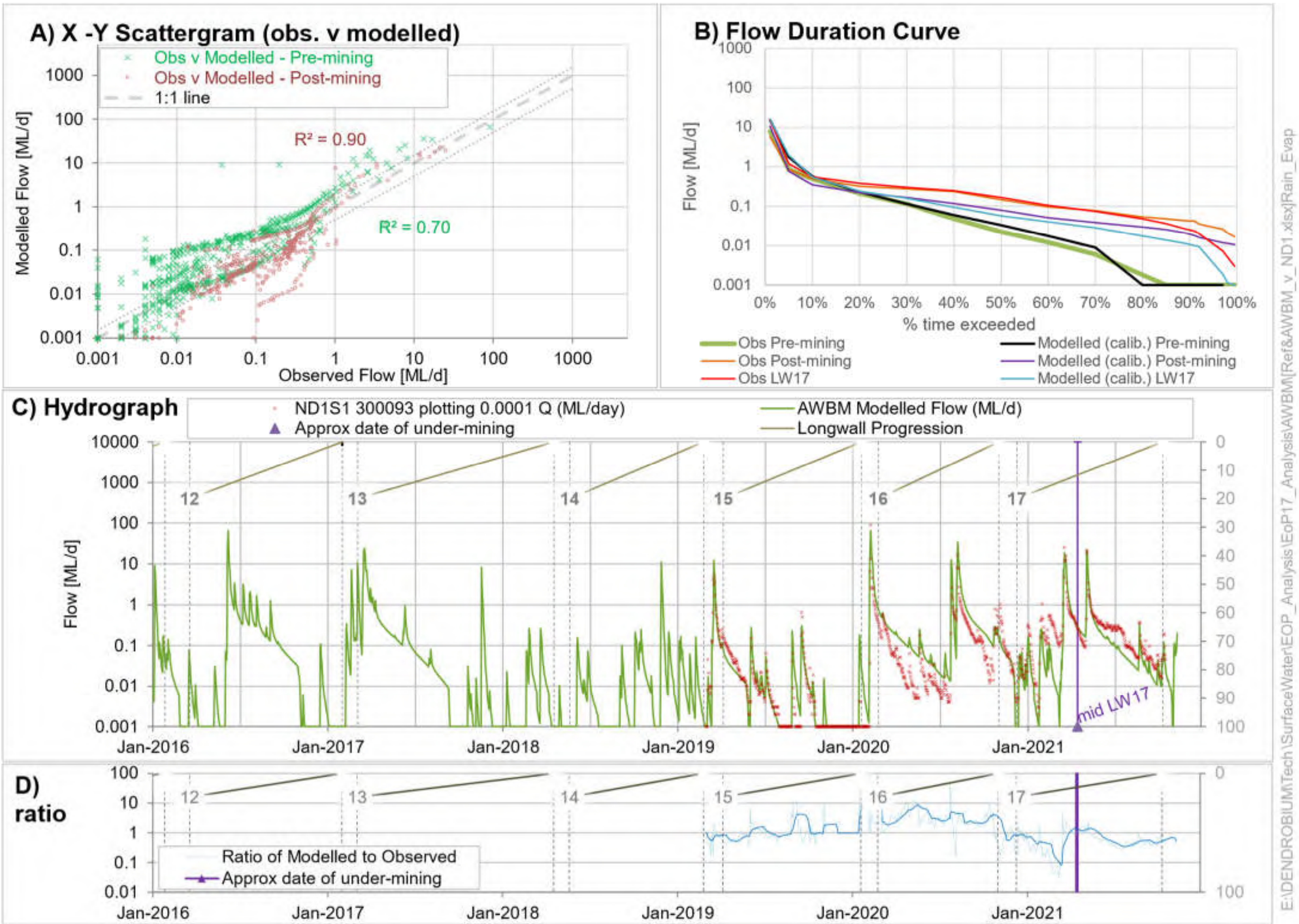


Figure H3 Comparison of observed flow against AWBM simulated flow: ND1

A	This shows that during the pre-mining period the model is a good fit to observed data. The fit is actually better (R^2 = 0.9) in the post-mining period.
B	Confirms the reasonable match between modelled and observed flows for the pre-mining period (black vs green) and illustrates that the model still tends to under-estimate flows for the subsequent post-mining period (purple vs orange) as well as during Longwall 17.
C	The hydrograph shows a reasonable match between observed flows up until Apr-2021 (middle of Longwall 17), including two periods of zero flow, and the match is the same after that time. The model is considered drought conditions during 2019 and flow in the subsequent wetter 2020-21 period quite well. 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.
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), but tends to >1 during 2020. The post-mining ratio, including during Longwall 17, oscillates around 1, but frequently <1 (model flow < observed). This does not suggest a reduction in flow due to mining.

Catchment discharge after Longwall 17:	For the complete post-mining period, the.water balance [Q*sim* + ET*sim*] is >= -6% of average P*obs* (+0.3%)	**former TARP – Not triggered**
	for the Longwall 17 assessment period, the water balance [Q*sim* + ET*sim*] is >= -6% of average P*obs* (+6.4%)	**former TARP – Not triggered**
Assessment:	The above analysis does not suggest any reduced sub-catchment flow / yield that can be discerned beyond natural variability or model/method accuracy. This is consistent with the agreed TARP assessment using Reference Sites.	

H5. Parameters used for AWBM by modelled sub-catchment

AWBM was first developed by W. Boughton in the early 1990s (Boughton, 2004; Boughton and Chiew, 2003). 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 H5**).

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 a spreadsheet version of the AWBM model.

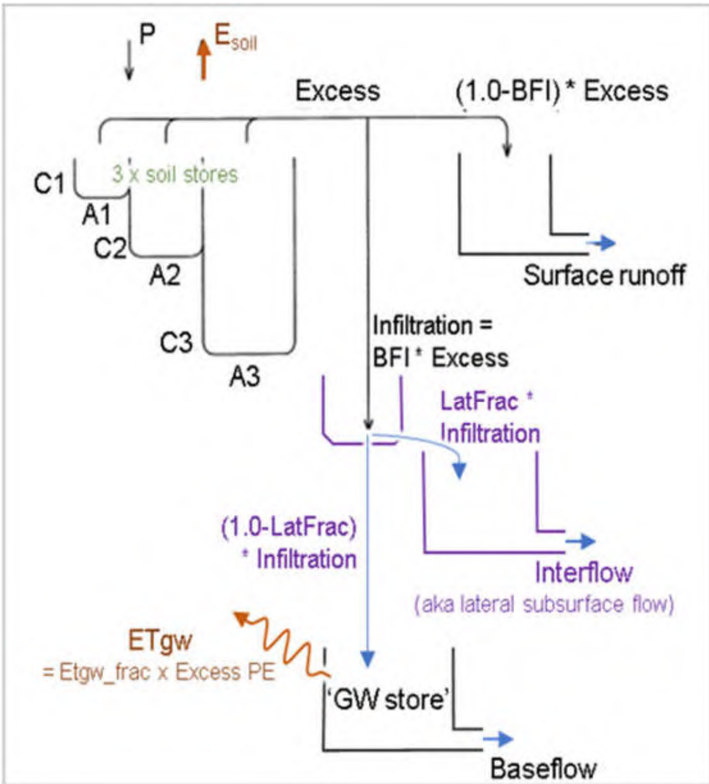


Figure H5. AWBM Rainfall-runoff model flow diagram

(modified from Boughton, 2004)

Table H1. AWBM parameters and inputs for selected Dendrobium catchment models

SITE	A1	A2	A3	Kbase	Klat	Ksurf	BFI	LatFrac	C1	C2	C3	ETgw
	area - fraction	area - fraction	area - fraction	fraction	fraction	fraction	fraction	fraction	mm	mm	mm	fraction
Donalds Castle Creek catchments												
DCU	0.08	0.20	0.72	0.99	0.7	0.30	0.60	0.7	0.04	0.25	0.40	0.006
Wongawilli Creek catchments												
WC12	0.1	0.55	0.35	0.98	0.8	0.35	0.32	0.7	0.015	0.175	0.35	0.01
WWL	0.3	0.35	0.35	0.992	0.8	0.20	0.60	0.7	0.015	0.15	0.25	0.04
Lake Avon catchments												
ND1	0.02	0.40	0.58	0.975	0.85	0.5	0.5	0.5	0.06	0.15	0.40	0.06

SITE	DAILY RAINFALL INPUT	EVAPORATION INPUTS
Donalds Castle Creek catchments		
DCU	Daily SILO Data Drill “DEN-South” to Oct-2007. Average of Dendrobium Centroid and A3B rainfall records used for Oct-2007-2021.	Daily SILO “DEN-South” Pan Evaporation (‘Evap’). Pan factor of 1. ET_{Gw} simulated from 0.6% of this sub-catchment.
Wongawilli Creek catchments		
WC12	Daily SILO Data Drill “DEN-South” to Oct-2007. Average of Dendrobium Centroid and A3B rainfall records used for Oct-2007-2021.	Daily SILO “DEN-South” Pan Evaporation (‘Evap’). Pan factor of 1. ET_{Gw} simulated from 1% of this sub-catchment.
WWL	Daily SILO Data Drill “DEN-South” to Oct-2007. Average of Dendrobium Centroid, A3B and SILO “DEN-South” rainfall records used for Oct-2007-2021.	Daily SILO “DEN-South” Pan Evaporation (‘Evap’). Pan factor of 1. ET_{Gw} simulated from 1% of this sub-catchment.
ND1	Average of Daily SILO Data Drill “DEN-South” and WaterNSW Browns Road to Oct-2007. Average of Dendrobium Centroid, A3B, Browns Rd and SILO “DEN-South” rainfall records used for Oct-2007-2021.	Daily SILO “DEN-South” Pan Evaporation (‘Evap’). Pan factor of 1. ET_{Gw} simulated from 6% of this sub-catchment.