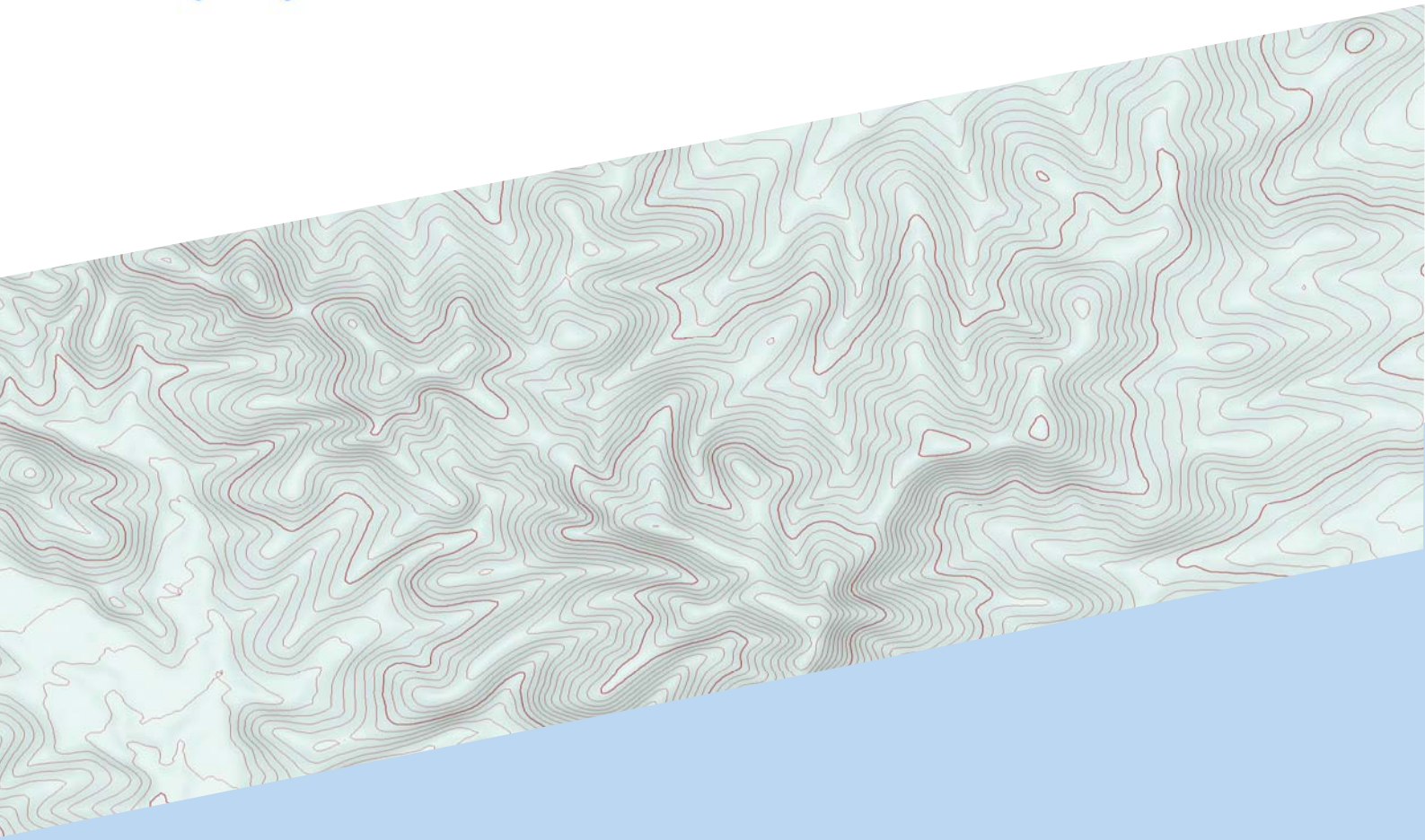
Appendix 12. Watershed (2019) Dendrobium Swamp Piezometer Analysis

WATERSHED HYDROGEO



South32 Illawarra Coal

Dendrobium Mine

Geographic review of mining effects on Upland Swamps at Dendrobium Mine

March 2019

DOCUMENT REGISTER

Rev/Issue	Description	Date	Comments
1	1st Draft	20/12/2018	Initial draft for comment
2	Second Draft	22/01/2019	Incorporating latest swamp data & swamp mapping
3	Third Draft	23/01/2019	Incorporating comments from Illawarra Coal and coordinating consultant
4	Final Draft	05/03/2019	Updated regarding piezometer 14_02
5	Final	08/03/2019	Incorporating comments from Illawarra Coal

FILE

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QUALITY CONTROL

Function	Staff	Signature	Date
Authors	Emily Barber, Will Minchin		08/03/2019
Approved	Will Minchin		

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ABBREVIATIONS

Abbreviation/Term	Meaning
DoI Water	Department of Industry – Crown Lands and Water Division
DPE	NSW Department of Planning and Environment
EPA	NSW Environment Protection Authority
GIS	Geographic Information Systems
ICEFT	Illawarra Coal Environmental Field Team
IEPMC	Independent Expert Panel for Mining in the Catchment (advising DPE)
km	kilometre
m	metre
mAHD	metres above Australian Height Datum (effectively elevation as metres above sea level)
mBG	metres below ground
ML/d	megalitres per day
MSEC	Mine Subsidence Engineering Consultants
NSW	New South Wales
OEH	Office of Environment and Heritage
PSM	Pells Sullivan Meynink
SIMMCP	Swamp, Impact, Monitoring, Management and Contingency Plan

1 Introduction

Dendrobium Mine is located 10 kilometres (km) west of Wollongong within the Sydney Basin, and specifically within the Southern Coalfield of NSW. The mine is operated by Illawarra Coal, and mining is done using longwall methods. The mine workings are located approximately 200-400 metres (m) beneath a plateau located inland (west) of the Illawarra Escarpment. **Figure 1** shows the location of Areas 2, 3A and 3B at Dendrobium.

The shallow geology of the area around Dendrobium is primarily outcropping Triassic Hawkesbury Sandstone, with some exposures of older Narrabeen Formation units. Isolated deposits of unconsolidated sediments have accumulated in some areas, and this different geology has led to the development of specific ecological communities, known as Coastal Upland Swamps. These swamps typically capture water from direct rainfall infiltration or runoff from upgradient.

Longwall mining is known to affect the ability of these shallow swamps to hold or store water. As a longwall is extracted, the strata above it subside, causing vertical movement as well as lateral movement (including valley closure) (Mine Subsidence Engineering Consultants [MSEC], 2019). These processes may crack the rock base of the swamp features, resulting in more rapid drainage of the swamps and/or modifying the ability to store water.

NSW Office of Environment and Heritage's (OEH's) (2016) *Addendum to NSW Biodiversity Offsets Policy for Major Projects Upland Swamps impacted by longwall mining subsidence* (Swamp Offset Policy) used 400 m as the specific distance to which effects on swamp hydrology are likely or possible.

PSM (2017) concluded that mining-related effects on swamps have occurred at Dendrobium at distances of up to 900 m. IEPMC (2018) note that at the Springvale Mine in the Western Coalfield, swamps have been observed to be affected at distances of 700-1,200 m from longwalls in cases where a lineament intersects the relevant panel and the swamp.

End of Panel reports prepared to date for Dendrobium Areas 2, 3A and 3B (the most recent of which is HGEO, 2018 for Longwall 13) have assessed when piezometers monitoring swamp water tables at Dendrobium show an effect of mining, in line with the *Dendrobium Area 3B Swamp, Impact, Monitoring, Management and Contingency Plan* [SIMMCP] (South32, 2017).

1.1 Scope

Illawarra Coal requested that Watershed HydroGeo ("Watershed") review the complete Dendrobium shallow piezometer water level dataset and previous assessments of impacts at piezometers falling within Illawarra Coal's latest mapping of Upland Swamps[1]. This includes consideration and documentation of the distance to the previous or concurrent longwall(s) either causing an impact at a piezometer, as noted in **Section 1.1.1** (below), or where no environmental effect is discerned.

In light of IEPMC (2018 and 2019) comments about the role of geological structure, specifically lineaments, in transmitting effects at greater distances from mine workings to water features such as swamps, the position of lineaments in relation to shallow piezometers has been considered by Watershed.

[1] ESA_IWC_UPLAND_SWAMPS.shp (provided by Illawarra Coal, December 2018) – upland swamp features extracted from Vegetation map for the Woronora, O'Hares and Metropolitan Catchments. Derived from API and Survey Points. Consultants Biosis and Niche have refined this data for selected swamps.

1.1.1 Impact definition

As in other studies at Dendrobium, the definition of 'impact' is consistent with the SIMMCP regarding how an impact or "greater than negligible environmental consequence" of mining is classified:

1. A shallow groundwater level within swamp sediments lower than the baseline level at any monitoring site within a swamp (in comparison to control swamps).
2. A rate of shallow groundwater level reduction post-mining that exceeds the rate of shallow groundwater level reduction during the baseline period at any monitoring site (measured as average millimetres per day during the recession curve).

- In some instances, both the above modes of impact may be observed at a single site, and in others, just one might be identified from the water level record.

2 Method

For this review, Watershed completed the following:

- Reviewed the dataset of shallow piezometers installed around Dendrobium Areas 2, 3A and 3B (**Appendix A**), identifying those that are within the boundaries of the latest mapping of Upland Swamp vegetation at Dendrobium.
- Review of the *Dendrobium Mine End of Panel Surface Water and Shallow Groundwater Assessment: Longwall 13* (Area 3B) HGEO (2018) and Illawarra Coal's shallow piezometer data to confirm or identify impacts on swamps within and around Dendrobium Areas 2, 3A and 3B (**Figure 1**). Hydrographs, as used in HGEO's End of Panel reporting have been updated with recent data from Illawarra Coal and reproduced in **Appendix B**.
- Impact date identified: reviewed piezometer data to identify impact (i.e., change in recession curve and water level dropping lower than observed during baseline conditions). Noted longwall number that caused this impact.
- Watershed obtained spatial data to compare piezometer position with mine layout and weekly longwall face position records. GIS was used to measure and record minimum distances between relevant piezometers and longwalls where no impact was recorded or inferred.
- Used GIS to measure and record distance from monitoring site to longwalls at the time of the identified impact (for both change in recession curve and drop in water level). This included reviewing the position of the longwall face at the time of impact, although the position of the nearest part of an extracted longwall was used, which may or may not have been the position of the face at the time, or some other part of the longwall.
- For selected sites where impacts are 'unclear' (as per HGEO, 2018), additional analysis was undertaken, which compared water table records and recession curves with reference or unaffected sites such as 02_01 or 13_01 (until 2018). Other sites were used as reference sites, depending on the similarity of their hydrograph to the pre-mining hydrograph of sites being assessed.
- Identification of piezometers that fall within 100 m of Illawarra Coal's mapping of lineaments (shown on **Figure 1**). We have ignored the orientation of the lineaments in relation to the mine footprint and whether these lineaments are correlated with other structures identified in the underground mine.
- Reviewed Area 3B Impact Report (Illawarra Coal, February 2019) and possible mining effect at piezometer 14_02.

3 Discussion

The following sections discuss the distribution piezometers where impacts have been identified and those where no effect from historical mining has been discerned. The effects of mining on some piezometers remains unclear, e.g. 11_H3 near Longwall 14 (this is likely to be clearer in the coming months) and 05_05 (between Longwalls 11 and 12 – this had a very short baseline record). This is in addition to piezometers that have not been instrumented with loggers and the record of periodic manual dips can make identification of effects uncertain.

3.1 Upland Swamp piezometers

There were 73 shallow piezometers located within the updated Upland Swamp mapping assessed in this review. 27 of which were considered to show one or both of the modes of impact (as defined in **Section 1.1.1**). 9 showed effects as water levels falling below pre-mining baseline, while 28 showed increased recession rates (**Table 1**).

The results have been summarised and charted on **Figure 2**. This shows distances between piezometers and the nearest longwall when an impact occurred (based on inspection of the hydrograph). The date on which an impact is detected is recorded in **Appendix A**. More importantly, **Figure 2** shows distances to longwalls at the time an impact was observed, noting that two series are presented for the two modes of impact (**Section 1.1.1**).

Figure 2 and **Table 1** illustrate that the majority of the impacts (shown in orange and purple on **Figure 2**) occur at piezometers that are undermined by a longwall. The green series shows the distance to the nearest longwall where no impact was observed. Some sites have both no-impact and impact information populated, e.g. **Figure 2** shows that piezometer 05_01 was approached to 180 m by Longwall 10 without effect and then subsequently undermined and impacted by Longwall 11.

Of the impacted sites within mapped Upland Swamps, most of the effects occur following the passing of a longwall, either directly beneath the site or just offset (i.e. within 60 m, as shown in **Table 1**). Note that Illawarra Coal (2019) recently reported s trigger at piezometer 14_02, at which a trigger was raised for a potential impact. Watershed has reviewed the recent data, and as described further in **Section 3.3** our analysis indicates that this piezometer has not yet been affected.

Table 1 Frequency of impacts by distance: swamp piezometers

Distance [m] from longwall panel when impact first observed	No. of swamp piezometers affected	
	Impact: baseline water level	Impact: recession rate
0 (impact occurred above mined goaf)	5	20
0-10 m	1	1
10-20 m	1	1
20-30 m	0	2
30-40 m	0	1
40-50 m	1	2
50-60 m	1	2
60-100 m	0	0
100-150 m	0	0
150-200 m	0	0
200-400 m	0	0
>400 m	0	0
Total affected	**9**	**29**

The maximum distance at which an impact has been observed at a piezometer within a mapped Upland Swamp area is 55 m, being where Longwall 7 passed to the north of piezometer 15bH3. This piezometer showed both modes of impact as Longwall 7 passed. Nearby piezometer 15b_H2 also showed both modes of impact as Longwall 7 passed 40 m to the north.

Swamp piezometer LC3_02 shows an increase in recession rate attributed to the passing of Longwall 6 at a distance of 55 m. Nearby piezometer LC3_01 displayed similar behaviour at a distance of 25 m.

Piezometer 03_01 showed effects of groundwater recession when Longwall 11 passed 40 m to the north.

It is likely to that site 01b_03 is affected (at 45 m from Longwall 9), however this piezometer has insufficient baseline to say definitively.

Only one site within 40 m of an extracted panel at Dendrobium showed no effects (15b_37) [**Figure 2**]. Sites in Swamp 36 are above or offset from Elouera Longwalls (as noted in Appendix A), and are distant from Dendrobium workings.

Figure 2 shows that there are 27 piezometers, which are within mapped Upland Swamp communities, that did not show an impact from mining while mining was 100-400 m away. No such piezometer displayed an impact at that distance. Of the 27, approximately half were later undermined and showed an impact at that time.

3.2 Piezometers in non-swamp sediments

Watershed carried out the same analysis for piezometers that are located outside of mapped Upland Swamp communities (shown as red dots on **Figure 1**). Many of these piezometers are installed in weathered rock or regolith, however Watershed identified a number of piezometers that are either in or likely to be in shallow deposits of unconsolidated sediments, i.e. not weathered rock. For instance, piezometer 08_01 lies outside the limits of mapped Upland Swamp communities, but the geological log from this site indicates approximately 2 m of organics, dark sand, lithologically similar to the deposits in an Upland Swamp. Not all shallow piezometers have available geological logs.

Table 2 summarises the distance at which effects were observed. **Figure 3** shows most non-swamp piezometers located between 60-400 m from longwalls are unaffected, with the exception of four piezometers.

Table 2 Frequency of impacts by distance: non-swamp piezometers

Distance [m] from longwall panel when impact first observed	No. of swamp piezometers affected	
	Impact: baseline water level	Impact: recession rate
0 (impact occurred above mined goaf)	3	17
0-10 m	0	0
10-20 m	0	1
20-30 m	0	0
30-40 m	1	1
40-50 m	0	0
50-60 m	0	1
60-100 m	1	2
100-150 m	1	0
150-200 m	0	0
200-400 m	0	0
Total affected	**6**	**22**

The most distant site for which an effect was observed was 08_01, mentioned above. As Longwall 10 passed to the north, water levels in this piezometer did not show any effect (see hydrograph in **Appendix B**). However, as Longwall 11 approached (but before reaching the piezometer) water levels showed an impact, with the previously extracted Longwall 10 being 125 m to the north.

Similarly, an impact at piezometer 08_04 was observed at 95 m as Longwall 9 approached (see hydrograph in **Appendix B**). No geological log is available for this piezometer, which is also outside mapped Upland Swamp areas.

While these piezometers are not technically within Upland Swamp communities, some (especially 08_01) appear geomorphologically similar to the lithological setting of swamp communities.

Considering other piezometers outside mapped Upland Swamps at similar distances to the two above:

- Piezometer 05_06 is located 134 m away from Longwall 9 but that piezometer did not exhibit either mode of impact.
- Piezometers 01a_03, 08_02, 08_05 and 08_06 are monitored manually, not via a logger, and is too difficult to state whether affected or not.
- One piezometer, 12_04, did not show an impact when undermined by Longwall 7, but then was affected by secondary subsidence when nearby Longwall 8 passed within 60 m).

Figure 3 shows that there are 28 piezometers, which are not within mapped Upland Swamp Communities, that did not show an impact from mining while mining was 100-400 m of the extracted longwall panels, compared to one such piezometer (08_01, described above) that was impacted at that distance (125 m). Of these, 6 were later undermined and showed an impact at that time.

3.3 Comparison to other Studies

Effects on swamp hydrology at Dendrobium has been discussed in three recent studies. The key points, including review of any swamp piezometers identified as impacted in those studies, is presented below.

PSM (2017)

PSM indicated “a consistent pattern of rapid drawdown of shallow groundwater within all swamps as they have been undermined, with no piezometer above or closely adjacent to a longwall having a response that was considered ‘normal or unchanged’”. The analysis here supports that statement, i.e. that piezometers above or closely adjacent to a longwall have exhibited an impact.

However, PSM (2017) stated that impacts at piezometers in Upland Swamps at Dendrobium could occur at up to 900 m. This distance is not supported by analysis of data in this report. Further analysis of the relevant piezometers identified as being impacted at significant distances by PSM is as follows:

- 01_02a and 01b_02 do not show the effects of mining (either type of impact defined in **Section 1.1.1**).
- 03_01 does respond to mining, but impacts occur at a distance of 40 m (i.e. mining was not 250 m away).
- D1-1 and D1-2 (now re-named as “01_01” and “01_02”) are affected by mining but this occurs when Longwalls 4 and 5 undermine them (i.e. mining is not 350 m away as stated by PSM).
- All other D1 piezometers (re-named “01_03”, “01_04” and “01_05”) are not in mapped Upland Swamps. They do respond to mining, but this occurs when Longwalls 4 and 5 undermine them (i.e. mining is not 350 m away by PSM).

- "D3" piezometers (which have been re-named to refer to nearby Swamp 84 as per **Appendix A**) are not located within mapped Upland Swamps, and nor do they show either of the defined responses (impacts) to mining) (see hydrographs in **Appendix B**),
- D5 piezometers (**Appendix A**) are not in mapped Upland Swamp communities, nor do they show a response to mining (as defined in **Section 1.1.1**) (see hydrographs in **Appendix B**).

IEPMC (2018)

The role of geological structures in transmitting effects over greater distances, over 700 m, at Springvale Mine (noted in IEPMC, 2018) is not evident at Dendrobium to date. On-going review of this aspect is recommended in monitoring plans (part of the SIMMCP) and in future End of Panel reports [**Section 4.1**]).

Illawarra Coal (2019)

Illawarra Coal issued an 'Impact Report' on 13 February 2019, which noted "a shallow groundwater trigger was recorded in Swamp 14". This was for piezometer 14_02, described as follows:

"*The post-mining rate of water level recession (0.89 mm/hour calculated between 29/01/2019 11:00 and 7/02/2019 14:00) has exceeded the rate recorded before mining (0.64 mm/hour calculated between 9/12/2017 15:00 and 22/12/2017 14:00*)". Longwall 14 was approximately 205 m away from the piezometer during the period 29/01-7/02/2019.

Watershed (2019a) reviewed the updated dataset for piezometer 14_02 and provide advice on the water level record at this site. The conclusion was "as of February 2019… this piezometer has not been affected." It is expected that the piezometer will be affected by Longwall 15 within the next year.

3.4 Role of lineaments

A total of 13 shallow piezometers were identified as falling within 100 m of mapped lineaments. Of these 2 have not been assessed due to a lack of data (they are within Area 5). These piezometers have been circled on **Figure 2** and **Figure 3**. The small number of piezometers associated with lineaments means that definitive conclusions are difficult to make, however the shallow piezometers 01a_02, 01b_01 and 05_06 have had no impact recorded at distances of 275, 280 and 135 m respectively. Further, considering piezometers slightly further away, piezometer 23_02 and LC4_04 have had no impact recorded at distances of 385 and 340 m respectively. The lack of impacts at these piezometers suggests that ground movement or transmission of drawdown to these features has not occurred at this distances of up to 385 m, which is less than half the 700 m quoted by IEPMC (2018) in relation to effects at Springvale.

The implication of this is that the governing factor for impacts on shallow piezometers at Dendrobium Areas 2, 3A and 3B has been the distance to the panel footprint, not the presence of lineaments.

4 Conclusions

Watershed has carried out a review of effects on shallow piezometers at Dendrobium around Areas 2, 3A and 3B to late 2018. This is based on historical mine geometry (panel widths, cutting heights and depth of cover) and geological conditions.

Based on assessments of water levels and recession rates around existing mining in Areas 2, 3A and 3B, almost all hydrographs from Upland Swamp piezometers within 60 m exhibited a response to mining, be that through a reduction in the water table to below pre-mining levels and/or increased recession (drainage) rate. This is in agreement with IEPMC (2018) and PSM (2017). PSM indicated "*a*

consistent pattern of rapid drawdown of shallow groundwater within all swamps as they have been undermined, with no piezometer above or closely adjacent to a longwall having a response that was considered 'normal or unchanged".

Effects on water tables in mapped Upland Swamp have not been observed at distances greater than 60 m from a longwall panel.

The spatial distribution of impact piezometers is shown on **Figure 4**.

When considering piezometers that are lithologically similar, but lying outside of mapped Upland Swamp communities, impacts have been observed at 95 and 125 m in two piezometers in Area 3B. Most other such shallow piezometers within that distance (i.e. <125 m) have continued to record without showing effects.

The role of geological structures, specifically lineaments, in transmitting effects over greater distances (as noted in IEPMC, 2018 with respect to effects observed near the Springvale Mine) has not been evident at Dendrobium, but on-going review of this is recommended, i.e. considered in the placement of piezometers and in future End of Panel reports (below).

4.1 Recommendations

Sufficient baseline monitoring before mining approaches a swamp/piezometer improves the confidence in the identification of an impact or no impact. The NSW *Aquifer Interference Policy* recommends 2 years of baseline data for groundwater monitoring prior to an activity commencing, and this is recommended for future swamp monitoring at Dendrobium.

This is likely to occur already, but when (or before) shallow piezometers are installed, Illawarra Coal should commission ecologists to confirm whether the location is within an upland swamp ecological community. Watershed understands that this process was less rigorous earlier in the mine life (i.e. approx. 10 years ago, during Areas 2 and 3A).

Watershed recommended that the 'master list' of shallow piezometers maintained by Illawarra Coal contain more summary information, including whether a shallow piezometer is within in a mapped Upland Swamp (as above), but also a summary of the lithology encountered, as well as start and end dates for water level data. This would allow easier and consistent identification of piezometers monitoring swamp versus shallow piezometers installed in non-swamp areas. Illawarra Coal have commenced this process for the existing piezometers.

Future End-of-Panel reporting of effects on shallow piezometers should specify the nearest distance to an extracted longwall at the point when an impact is identified, and the location of any mapped geological structures that may connect workings with (or may exacerbate ground movements near) swamp features. This will allow for the dataset compiled here to be updated.

5 References

HGEO, 2018. *Dendrobium Mine End of Panel Surface Water and Shallow Groundwater Assessment: Longwall 13 (Area 3B)*. D18304, Report for South32 Illawarra Coal.

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OEH, 2016. *Addendum to the NSW Biodiversity Offsets Policy for Major Projects: Upland Swamps impacted by longwall mining subsidence*.

PSM, 2017. *Height of Cracking - Dendrobium Area 3B*. Report for the Department of Planning and Environment, doc PSM3021-002R.

South32 Illawarra Coal, 2017. *Dendrobium Area 3B Swamp, Impact, Monitoring, Management and Contingency Plan.*

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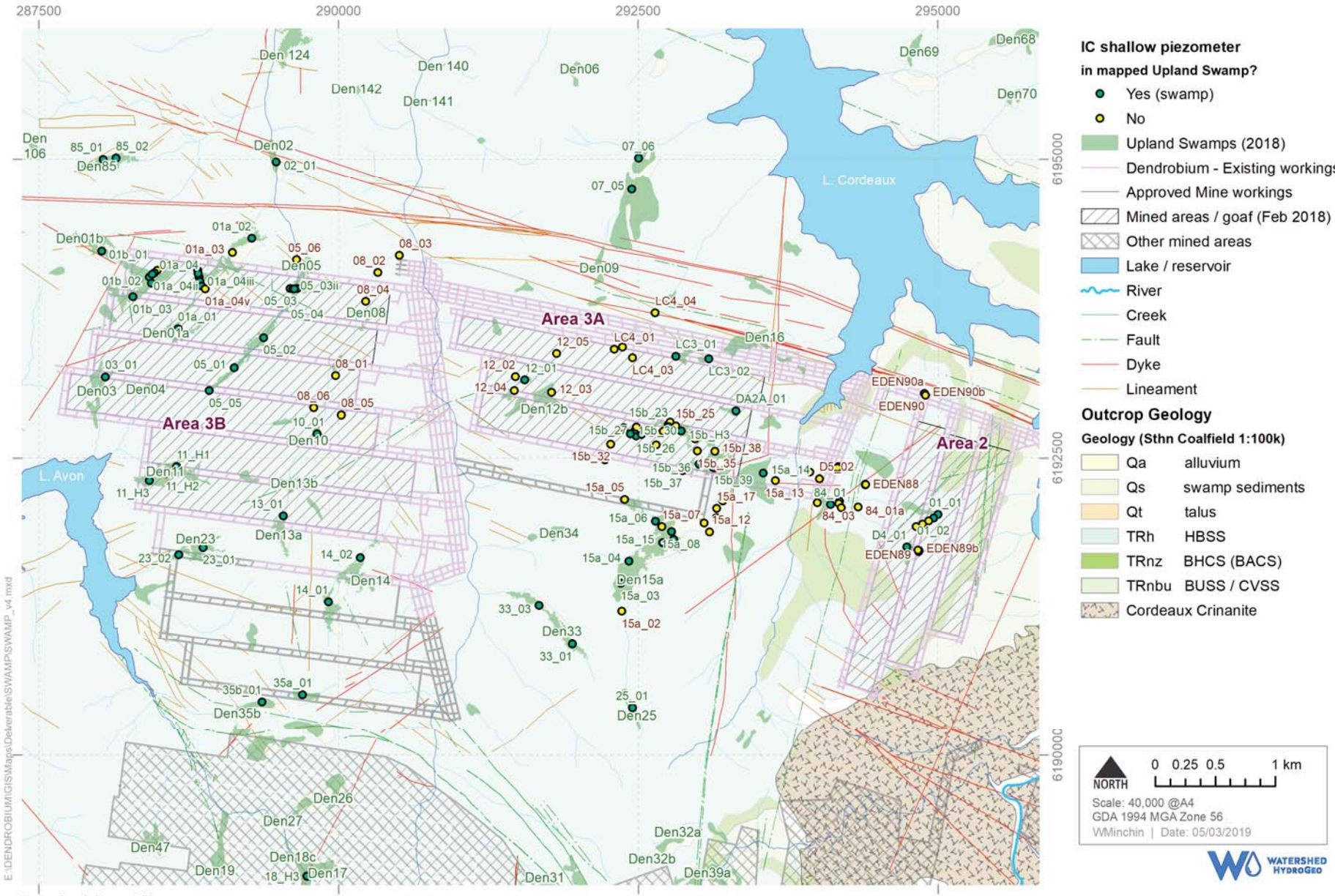
Watershed HydroGeo, 2019a. *Technical Advice regarding swamp water level trigger at 14_02*. Doc r009i1. 07/03/2019.



Dendrobium Mine

Figure 1 Shallow groundwater level monitoring sites

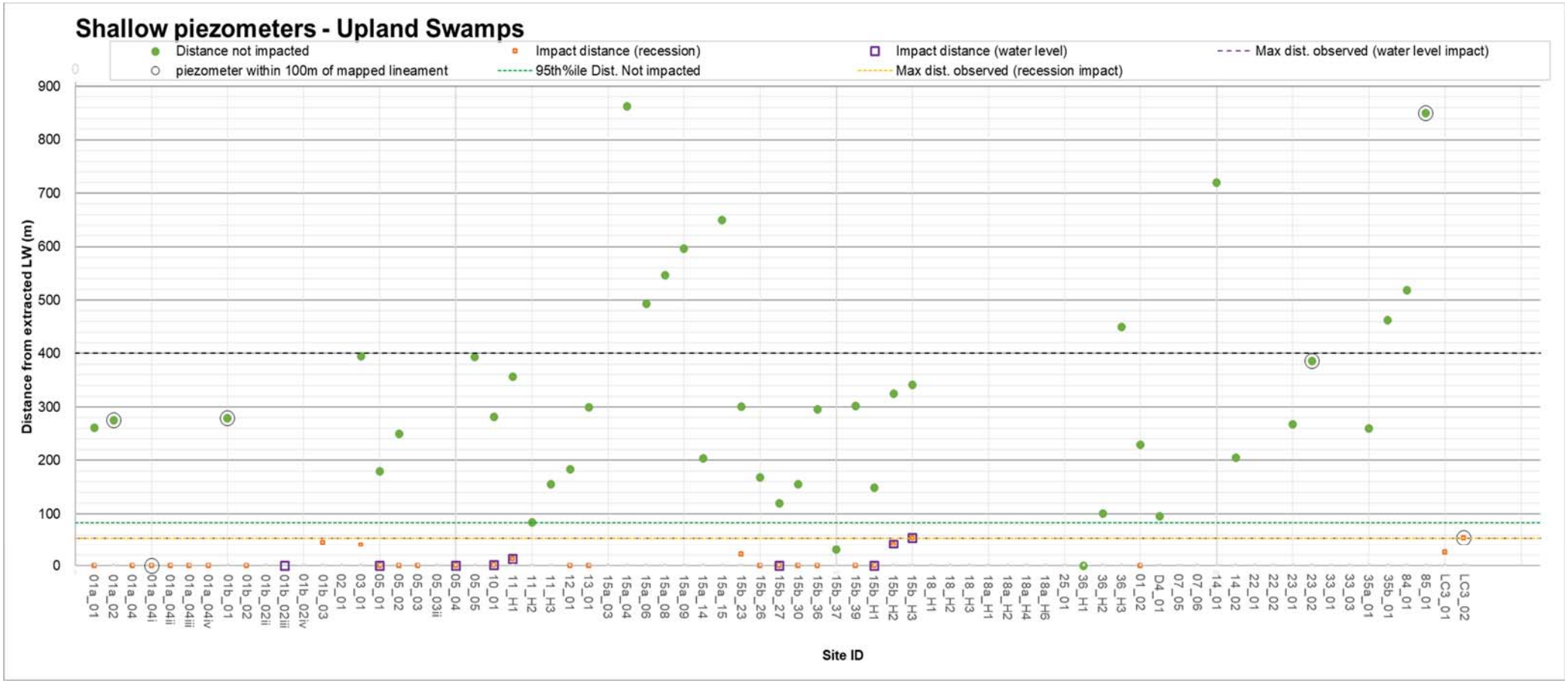


Figure 2 Summary of distances from longwall mining for impacts and unaffected piezometers within mapped Upland Swamps

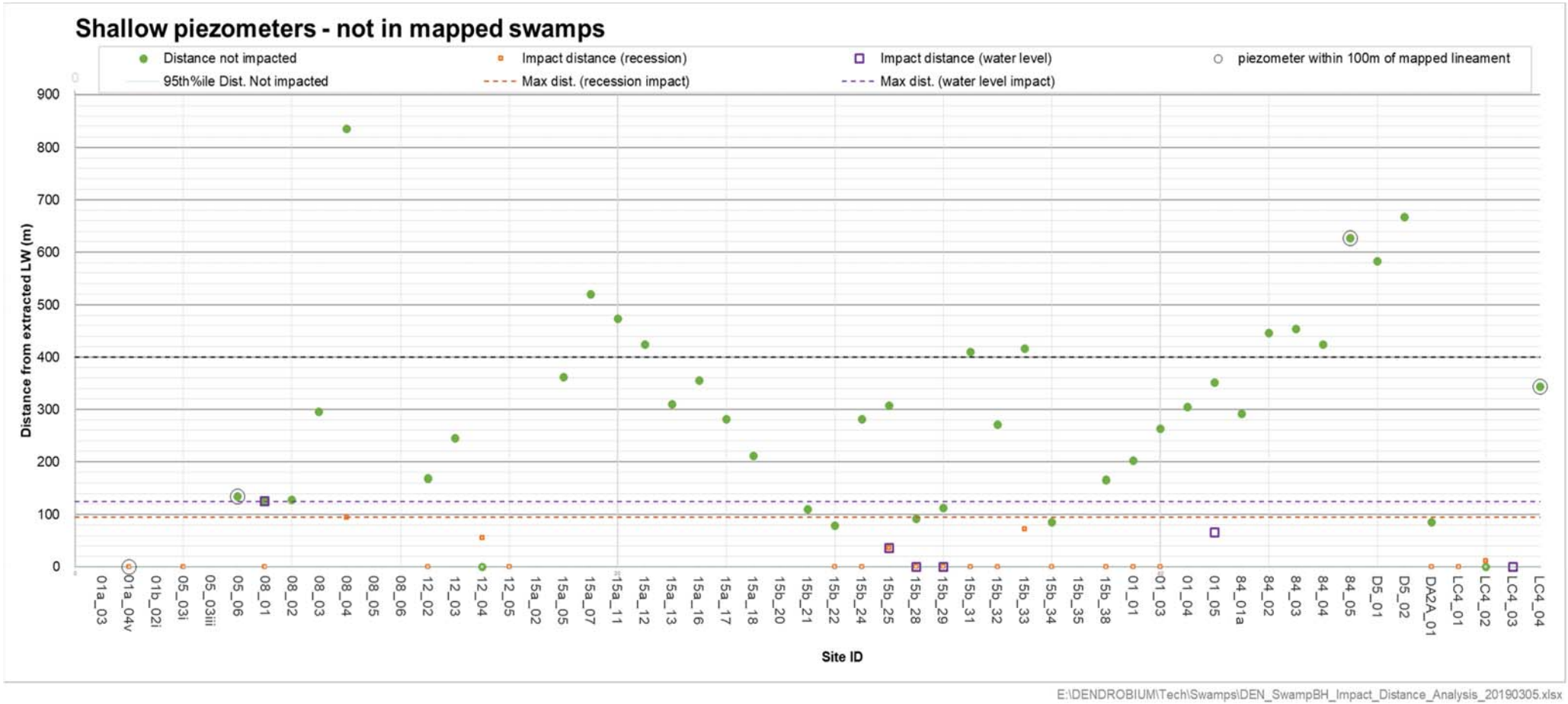


Figure 3 Summary of distances from longwall mining for impacts and unaffected piezometers: sites outside mapped Upland Swamps

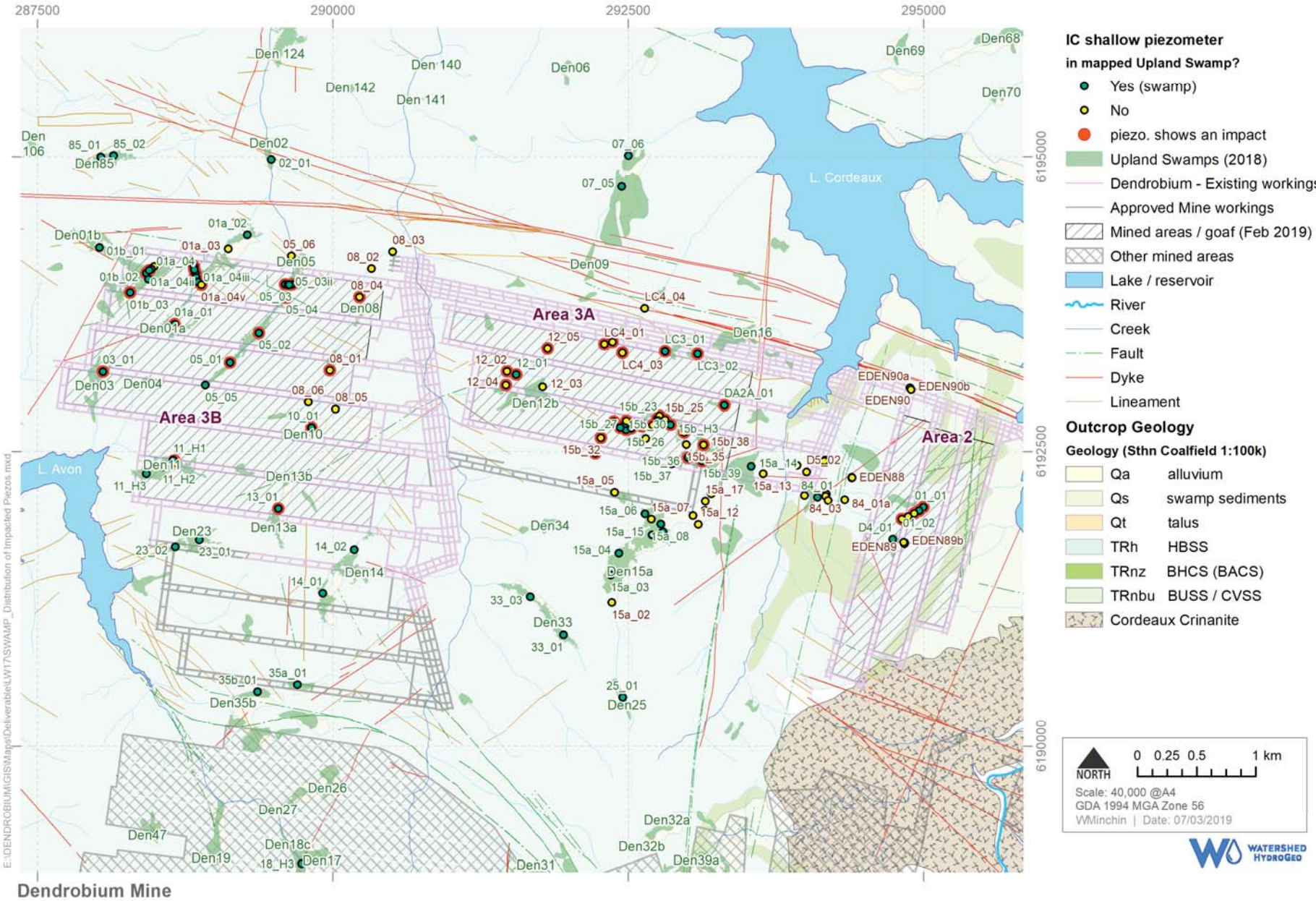


Figure 4 Distribution of affected shallow piezometers (February 2019)

Appendix A – Piezometer sites

												Date of impact *(to late 2018)*	
Site_ID	Geology	In_Swamp?	**SwampID**	**MGA_E**	**MGA_N**	**Elev_m**	**Depth_m**	**StartDate**	**EndDate**	**Comment**	**Additional_Info**	1_baseline	2_recession
01a_01	sediment	swamp	Swamp 1a	288659	6193580	399.25	2.16	28/06/2012		active			19/04/2014
01a_02	sediment	swamp	Swamp 1a	289274	6194338	364.25	1.66	1/08/2012		active			
01a_03	sediment	not in swamp	Swamp 1a	289113	6194218	370.40	1.15			no instrumentation / manual			
01a_04	sediment	swamp	Swamp 1a	288834	6194013	381.70	1.37	28/06/2012		active			20/04/2013
01a_04i	sediment	swamp	Swamp 1a	288822	6194069	380.90	1.98	6/03/2013		active			21/04/2013
01a_04ii	sediment	swamp	Swamp 1a	288824	6194042	380.95	1.10	22/02/2013		active			23/04/2013
01a_04iii	sediment	swamp	Swamp 1a	288840	6193977	383.17	1.21	22/02/2013		active			21/04/2013
01a_04iv	sediment	swamp	Swamp 1a	288856	6193939	384.00	1.36	22/02/2013		active			23/04/2013
01a_04v	sediment	not in swamp	Swamp 1a	288886	6193913	385.66	1.44	6/03/2013		active			20/04/2013
01b_01	sediment	swamp	Swamp 1b	288021	6194231	406.00	1.76	28/06/2012		active			
01b_02	sediment	swamp	Swamp 1b	288418	6194011	394.50	1.80	27/06/2012		active			26/03/2013
01b_02i	sediment	not in swamp	Swamp 1b	288486	6194068	394.10	0.97	20/02/2013		active			
01b_02ii	sediment	swamp	Swamp 1b	288460	6194048	394.00	1.42	20/02/2013		active			
01b_02iii	sediment	swamp	Swamp 1b	288441	6194036	394.30	1.90	20/02/2013		active		23/02/2013	
01b_02iv	sediment	swamp	Swamp 1b	288436	6193960	393.43	1.43	20/02/2013		active			
01b_03	sediment	swamp	Swamp 1b	288283	6193848	398.60	1.40			no instrumentation / manual			7/03/2013
02_01	sediment	swamp	Swamp 2	289477	6194981	334.00	1.85	29/06/2012		active			
03_01	sediment	swamp	Swamp 3	288052	6193177	396.05	1.51	8/08/2014		active			6/05/2015
05_01	sediment	swamp	Swamp 5	289125	6193253	398.80	2.60	9/07/2012		active		24/10/2015	27/07/2015
05_02	sediment	swamp	Swamp 5	289370	6193505	391.30	1.87	26/06/2012		active			28/08/2014
05_03	sediment	swamp	Swamp 5	289651	6193915	379.50	1.77	9/07/2012		active			18/09/2013
05_03i	sediment	not in swamp	Swamp 5	289594	6193916	379.80	1.62	2/04/2013		active			29/08/2013
05_03ii	sediment	swamp	Swamp 5	289617	6193914	378.33	2.06	6/03/2013		active			
05_03iii	sediment	not in swamp	Swamp 5	289630	6193914	377.83	1.31	6/03/2013		active			
05_04	sediment	swamp	Swamp 5	289602	6193804	380.70	1.57	26/06/2012		active		20/10/2013	20/09/2013
05_05	sediment	swamp	Swamp 5	288916	6193061	403.30	1.17	5/07/2012		active			
05_06	sediment	not in swamp	Swamp 5	289648	6194159	366.40	1.65			no instrumentation / manual			
08_01	sediment	not in swamp	Swamp 8	289973	6193188	341.20	2.31	27/07/2012		active		6/12/2015	6/01/2016
08_02	sediment	not in swamp	Swamp 8	290323	6194051	308.60	1.02	10/07/2012		active			
08_03	sediment	not in swamp	Swamp 8	290503	6194193	296.80	1.59			no instrumentation / manual			
08_04	sediment	not in swamp	Swamp 8	290223	6193809	323.90	1.93	27/07/2012		active			23/11/2013
08_05	sediment	not in swamp	Swamp 8	290021	6192859	358.10	1.32			no instrumentation / manual			
08_06	sediment	not in swamp	Swamp 8	289789	6192919	358.80	1.07			no instrumentation / manual			
10_01	sediment	swamp	Swamp 10	289816	6192702	364.80	1.51	27/07/2012		active		16/11/2016	16/11/2016
11_H1	sediment	swamp	Swamp 11	288647	6192428	393.28	1.82	7/10/2003		active		1/06/2017	22/04/2017
11_H2	sediment	swamp	Swamp 11	288554	6192368	389.41	1.29	11/09/2003		active			
11_H3	sediment	swamp	Swamp 11	288420	6192311	382.40	0.55	7/10/2003		active			
12_01	sediment	swamp	Swamp 12	291548	6193152	368.00	1.61	8/07/2009	25/11/2017	end monitoring 25/11/2017			6/06/2011
12_02	sediment	not in swamp	Swamp 12	291471	6193177	366.45	1.08	8/07/2009		active			30/05/2011
12_03	sediment	not in swamp	Swamp 12	291774	6193048	390.70	0.53	15/07/2009	25/02/2015	end monitoring 25/02/2015			
12_04	sediment	not in swamp	Swamp 12	291464	6193063	365.40	0.84	8/07/2009	10/01/2013	end monitoring 10/01/2013			20/04/2012
12_05	sediment	not in swamp	Swamp 12	291815	6193373	398.50	1.57	15/07/2009	22/06/2014	end monitoring 22/06/2014			29/07/2010
13_01	sediment	swamp	Swamp 13	289535	6192016	403.30	2.60	30/07/2012		active			5/12/2018
15a_02	sediment	not in swamp	Swamp 15a	292360	6191219	382.61	3.63			no instrumentation / manual			
15a_03	sediment	swamp	Swamp 15a	292349	6191451	378.00	2.12	30/07/2009	22/09/2012	end monitoring 22/09/2012			
15a_04	sediment	swamp	Swamp 15a	292418	6191638	373.05	1.93			no instrumentation / manual			
15a_05	sediment	not in swamp	Swamp 15a	292384	6192155	387.70	1.45			no instrumentation / manual			
15a_06	sediment	swamp	Swamp 15a	292640	6191973	366.83	2.64	19/07/2012		active			
15a_07	sediment	not in swamp	Swamp 15a	292693	6191927	365.77	2.21	19/07/2012		active			
15a_08	sediment	swamp	Swamp 15a	292773	6191886	368.76	2.75			no instrumentation / manual			
15a_09	sediment	swamp	Swamp 15a	292793	6191818	371.13	2.39			no instrumentation / manual			

												Date of impact *(to late 2018)*	
Site_ID	Geology	In_Swamp?	SwampID	MGA_E	MGA_N	Elev_m	Depth_m	StartDate	EndDate	Comment	Additional_Info	1_baseline	2_recession
15a_11	sediment	not in swamp	Swamp 15a	293092	6191882	371.15	1.13			no instrumentation / manual			
15a_12	sediment	not in swamp	Swamp 15a	293045	6191956	367.33	1.50			no instrumentation / manual			
15a_13	sediment	not in swamp	Swamp 15a	293640	6192313	349.30	0.68			no instrumentation / manual			
15a_14	sediment	swamp	Swamp 15a	293540	6192376	343.70	0.79			no instrumentation / manual			
15a_15	sediment	swamp	Swamp 15a	292699	6191793	370.90	3.17			no instrumentation / manual			
15a_16	sediment	not in swamp	Swamp 15a	293149	6192001	366.00	0.62			no instrumentation / manual			
15a_17	sediment	not in swamp	Swamp 15a	293150	6192080	360.90	1.00	6/08/2009	27/02/2012	end monitoring 27/02/2012			
15a_18	sediment	not in swamp	Swamp 15a	293201	6192142	358.50	0.60	19/07/2012		active			
15b_20	sediment	not in swamp	Swamp 15b	292645	6192611	393.30	0.92			no instrumentation / manual			
15b_21	sediment	not in swamp	Swamp 15b	292681	6192703	384.48	1.21	7/07/2009	20/11/2012	end monitoring 20/11/2012			
15b_22	sediment	not in swamp	Swamp 15b	292705	6192724	383.21	2.12	21/10/2011		active			19/09/2012
15b_23	sediment	swamp	Swamp 15b	292748	6192781	380.96	2.65	19/10/2011		active			21/10/2011
15b_24	sediment	not in swamp	Swamp 15b	292763	6192801	382.37	3.22	19/10/2011		active			22/10/2011
15b_25	sediment	not in swamp	Swamp 15b	292810	6192770	381.10	3.19	19/10/2011		active		26/11/2011	26/11/2011
15b_26	sediment	swamp	Swamp 15b	292478	6192685	390.50	1.56	1/01/2011		active			27/08/2012
15b_27	sediment	swamp	Swamp 15b	292472	6192735	390.65	3.23	7/07/2009		active		6/09/2012	15/08/2012
15b_28	sediment	not in swamp	Swamp 15b	292481	6192762	391.40	3.73	21/10/2011		active		5/09/2012	15/08/2012
15b_29	sediment	not in swamp	Swamp 15b	292613	6192716	386.53	2.00	21/10/2011		active		13/10/2012	30/08/2012
15b_30	sediment	swamp	Swamp 15b	292430	6192705	391.86	1.83	1/11/2011		active			11/08/2012
15b_31	sediment	not in swamp	Swamp 15b	292377	6192755	395.20	1.36	1/01/2011		active			4/08/2012
15b_32	sediment	not in swamp	Swamp 15b	292266	6192618	399.80	1.24	7/07/2009	10/12/2013	end monitoring 10/12/2013			27/07/2012
15b_33	sediment	not in swamp	Swamp 15b	292217	6192486	415.44	0.86			no instrumentation / manual			25/07/2012
15b_34	sediment	not in swamp	Swamp 15b	292971	6192663	369.60	1.06			no instrumentation / manual			22/10/2012
15b_35	sediment	not in swamp	Swamp 15b	292989	6192560	371.32	0.70			no instrumentation / manual			
15b_36	sediment	swamp	Swamp 15b	293003	6192451	369.37	0.71			no instrumentation / manual			29/10/2012
15b_37	sediment	swamp	Swamp 15b	292868	6192395	380.90	2.39			no instrumentation / manual			
15b_38	sediment	not in swamp	Swamp 15b	293136	6192556	360.85	1.93			no instrumentation / manual			12/11/2012
15b_39	sediment	swamp	Swamp 15b	293123	6192419	361.89	0.70			no instrumentation / manual			14/11/2012
15b_H1	sediment	swamp	Swamp 15b	292523	6192699	388.72	1.30	11/09/2003	5/08/2015	end monitoring 05/08/2015		22/08/2012	22/08/2012
15b_H2	sediment	swamp	Swamp 15b	292751	6192762	380.69	1.74	11/09/2013	5/07/2015	end monitoring 05/07/2015		7/11/2011	7/11/2011
15b_H3	sediment	swamp	Swamp 15b	292855	6192727	379.03	0.86	11/09/2003	24/05/2015	end monitoring 24/05/2015		19/11/2011	11/11/2011
18_H1	sediment	swamp	Swamp 18	289681	6188572	392.70	0.32	7/10/2003	9/10/2012	end monitoring 09/10/2012			
18_H2	sediment	swamp	Swamp 18	289708	6188795	387.18	1.55	7/10/2003	18/01/2013	end monitoring 18/01/2013			
18_H3	sediment	swamp	Swamp 18	289734	6189012	381.55	1.17	2/04/2004	12/04/2011	end monitoring 12/04/2011			
18a_H1	sediment	swamp	Swamp 18a	290090	6188128	425.16	1.18	9/01/2004	23/02/2012	end monitoring 23/02/2012			
18a_H2	sediment	swamp	Swamp 18a	290042	6188147	423.19	1.80	9/01/2004	16/06/2012	end monitoring 16/06/2012			
18a_H4	sediment	swamp	Swamp 18a	290001	6188066	422.20	1.48	9/01/2004	7/06/2012	end monitoring 07/06/2012			
18a_H6	sediment	swamp	Swamp 18a	289923	6188076	418.80	1.80	20/01/2004	21/10/2011	end monitoring 21/10/2011			
25_01	sediment	swamp	Swamp 25	292451	6190412	415.80	2.46	30/07/2009		active	Reference Swamps, Formerly 15a_01		
36_H1	sediment	swamp	Swamp 36	289240	6188048	432.41	1.02	7/10/2003	16/05/2012	end monitoring 16/05/2012	Elouera		
36_H2	sediment	swamp	Swamp 36	289135	6188144	423.06	0.24	7/10/2003	19/04/2011	end monitoring 19/04/2011	Elouera		
36_H3	sediment	swamp	Swamp 36	288777	6188175	404.44	0.74	7/10/2003	29/12/2011	end monitoring 29/12/2011	Elouera		
01_01	sediment	not in swamp	Swamp 1	294997	6192028	437.24	1.32	30/10/2007	11/10/2014	end monitoring 11/10/2014	Formerly D1-1		21/06/2008
01_02	sediment	swamp	Swamp 1	294962	6191998	437.42	0.84	30/10/2007	12/10/2014	end monitoring 12/10/2014	Formerly D1-2		18/06/2008
01_03	sediment	not in swamp	Swamp 1	294920	6191976	437.42	0.62	30/10/2007	17/07/2014	end monitoring 17/07/2014	Formerly D1-3		17/06/2008
01_04	sediment	not in swamp	Swamp 1	294869	6191948	438.44	0.32	30/10/2007	3/09/2014	end monitoring 03/09/2014	Formerly D1-4		
01_05	sediment	not in swamp	Swamp 1	294815	6191928	435.31	1.65	30/10/2007	4/09/2014	end monitoring 04/09/2014	Formerly D1-5	4/07/2008	
84_01a	sediment	not in swamp	Swamp 84	294330	6192090	367.55	0.80	14/11/2007	12/09/2011	end monitoring 12/09/2011	Formerly D3-1		
84_02	sediment	not in swamp	Swamp 84	294175	6192139	352.42	1.83	13/11/2007	7/08/2012	end monitoring 07/08/2012	Formerly D3-2		
84_03	sediment	not in swamp	Swamp 84	294171	6192120	352.44	1.80	13/11/2007	17/05/2012	end monitoring 17/05/2012	Formerly D3-3		
84_04	sediment	not in swamp	Swamp 84	294191	6192086	353.90	1.27	13/11/2007	17/05/2012	end monitoring 17/05/2012	Formerly D3-4		

											Date of impact *(to late 2018)*	
Site_ID	Geology	In_Swamp?	**SwampID**	**MGA_E**	**MGA_N**	**Elev_m**	**Depth_m**	**StartDate**	**EndDate**	**Comment**	**Additional_Info**	1_baseline	2_recession
84_05	sediment	not in swamp	Swamp 84	293991	6192127	340.27	0.66	5/11/2007	20/07/2012	end monitoring 20/07/2012	Formerly D3-5		
D4_01	sediment	swamp	*n/a*	294737	6191757	442.88	1.21	31/10/2007	19/02/2013	end monitoring 19/02/2013			
D5_01	sediment	not in swamp	*n/a*	293928	6192383	338.88	0.80	31/10/2007	14/01/2012	end monitoring 14/01/2012	instrument failure Nov-2009, fixed Feb-2010, changed datum		
D5_02	sediment	not in swamp	*n/a*	294007	6192328	345.27	1.00	31/10/2007	8/08/2012	end monitoring 08/08/2012			
07_05	sediment	swamp	Swamp 7	292443	6194751	351.03	2.82	15/07/2015		active	Reference Swamps		
07_06	sediment	swamp	Swamp 7	292499	6195012	340.82	2.65	3/07/2015		active	Reference Swamps		
14_01	sediment	swamp	Swamp 14	289912	6191297	393.72	2.28	2/07/2015		active	Dendrobium Area 3b		
14_02	sediment	swamp	Swamp 14	290179	6191668	375.44	1.64	2/07/2015		active	Dendrobium Area 3b		
22_01	sediment	swamp	Swamp 22	292796	6188139	457.92	1.98	11/08/2015		active	Reference Swamps		
22_02	sediment	swamp	Swamp 22	293189	6188172	450.04	2.93	11/08/2015		active	Reference Swamps		
23_01	sediment	swamp	Swamp 23	288867	6191752	392.43	1.22	2/07/2015		active	Dendrobium Area 3b		
23_02	sediment	swamp	Swamp 23	288663	6191690	368.89	2.57	2/07/2015		active	Dendrobium Area 3b		
33_01	sediment	swamp	Swamp 33	291949	6190940	389.28	1.19	13/08/2015		active	Reference Swamps		
33_03	sediment	swamp	Swamp 33	291668	6191267	365.13	1.10	13/08/2015		active	Reference Swamps		
35a_01	sediment	swamp	Swamp 35a	289698	6190520	380.26	2.18	6/08/2015		active	Dendrobium Area 3b		
35b_01	sediment	swamp	Swamp 35b	289360	6190459	352.24	3.66	6/08/2015		active	Dendrobium Area 3b		
84_01	sediment	swamp	Swamp 84	294101	6192112	348.54	1.82	3/07/2015		active	Reference Swamps		
85_01	sediment	swamp	Swamp 85	288033	6195002	395.70	1.26	26/06/2015		active	Dendrobium - new Domains		
85_02	sediment	swamp	Swamp 85	288141	6195011	391.19	1.22	26/06/2015		active	Dendrobium - new Domains		
86_01	sediment	swamp	Swamp 86	286625	6196836	383.66	1.64	26/06/2015		active	Dendrobium - new Domains		
86_02	sediment	swamp	Swamp 86	286534	6196552	389.58	3.80	26/06/2015		active	Dendrobium - new Domains		
87_01	sediment	swamp	Swamp 87	290857	6180952	539.65	2.97	8/07/2015		active	Reference Swamps		
87_02	sediment	swamp	Swamp 87	290879	6181183	535.52	1.85	8/07/2015		active	Reference Swamps		
88_01	sediment	swamp	Swamp 88	289219	6180107	537.99	1.64	8/07/2015		active	Reference Swamps		
88_02	sediment	swamp	Swamp 88	289368	6180461	527.25	1.20	24/08/2015		active	Reference Swamps		
083_01	sediment	swamp	Swamp 83	290957	6201266	302.04	2.03	28/06/2017		active	Dendrobium - new Domains		
085_03	sediment	swamp	Swamp 85	288222	6195022	387.26	2.33	26/05/2017		active	Dendrobium - new Domains		
086_03	sediment	swamp	Swamp 86	286535	6196653	386.47	3.23	15/06/2017		active	Dendrobium - new Domains		
097_01	sediment	swamp	Swamp 97	286797	6197575	373.74	1.17	15/06/2017		active	Dendrobium - new Domains		
098_01	sediment	swamp	Swamp 98	289280	6196488	328.45	1.03	15/06/2017		active	Dendrobium - new Domains		
099_01	sediment	swamp	Swamp 99	285082	6196187	390.81	1.71	2/06/2017		active	Dendrobium - new Domains		
100_01	sediment	swamp	Swamp 100	286780	6197041	391.32	1.21	15/06/2017		active	Dendrobium - new Domains		
101_01	sediment	swamp	Swamp 101	285901	6196346	391.38	0.72	2/06/2017		active	Dendrobium - new Domains		
103_01	sediment	swamp	Swamp 103	285836	6196721	383.61	0.75	2/06/2017		active	Dendrobium - new Domains		
105_01	sediment	swamp	Swamp 105	285297	6196771	386.61	0.55	2/06/2017		active	Dendrobium - new Domains		
106_01	sediment	swamp	Swamp 106	287441	6195126	402.65	1.63	26/05/2017		active	Dendrobium - new Domains		
107_01	sediment	swamp	Swamp 107	286389	6195153	392.96	1.11	30/05/2017		active	Dendrobium - new Domains		
108_01	sediment	swamp	Swamp 108	286548	6194973	373.44	2.25	30/05/2017		active	Dendrobium - new Domains		
109_01	sediment	swamp	Swamp 109	286269	6195724	394.72	2.04	26/05/2017		active	Dendrobium - new Domains		
110_01	sediment	swamp	Swamp 110	285896	6195731	387.48	2.59	30/05/2017		active	Dendrobium - new Domains		
111_01	sediment	swamp	Swamp 111	285966	6195578	379.39	2.54	30/05/2017		active	Dendrobium - new Domains		
112_01	sediment	swamp	Swamp 112	292194	6200889	351.60	1.69	29/06/2017		active	Dendrobium - new Domains		
113_01	sediment	swamp	Swamp 113	291597	6200346	345.59	1.03	28/06/2017		active	Dendrobium - new Domains		
114_01	sediment	swamp	Swamp 114	285219	6195589	394.87	1.05	30/05/2017		active	Dendrobium - new Domains		
115_01	sediment	swamp	Swamp 115	291592	6198682	358.28	1.42	29/06/2017		active	Dendrobium - new Domains		
116_01	sediment	swamp	Swamp 116	292112	6199203	346.68	1.79	29/06/2017		active	Dendrobium - new Domains		
117_01	sediment	swamp	Swamp 117	291551	6199890	345.78	1.12	28/06/2017		active	Dendrobium - new Domains		
118_01	sediment	swamp	Swamp 118	291037	6201559	313.64	0.99	28/06/2017		active	Dendrobium - new Domains		
119_01	sediment	swamp	Swamp 119	290491	6201897	303.67	0.79	28/06/2017		active	Dendrobium - new Domains		
DA2A_01	sediment	not in swamp	*n/a*	293312	6192893	373.00	1.97	9/07/2009	30/08/2012	end monitoring 30/08/2012			17/12/2011
LC3_01	sediment	swamp	*n/a*	292809	6193350	401.40	1.67	9/07/2009	13/09/2012	end monitoring 13/09/2012			16/10/2010

											Date of impact *(to late 2018)*	
Site_ID	Geology	In_Swamp?	**SwampID**	**MGA_E**	**MGA_N**	**Elev_m**	**Depth_m**	**StartDate**	**EndDate**	**Comment**	**Additional_Info**	1_baseline	2_recession
LC3_02	sediment	swamp	*n/a*	293084	6193327	384.80	1.58	15/07/2009	14/05/2012	end monitoring 14/05/2012			1/02/2011
LC4_01	sediment	not in swamp	*n/a*	292297	6193409	402.90	1.85	14/07/2009	22/05/2012	end monitoring 22/05/2012			10/09/2010
LC4_02	sediment	not in swamp	*n/a*	292364	6193425	401.00	2.34	14/07/2009	26/01/2012	end monitoring 26/01/2012			10/09/2010
LC4_03	sediment	not in swamp	*n/a*	292449	6193337	406.10	1.76	9/07/2009	27/08/2012	end monitoring 27/08/2012		4/09/2010	
LC4_04	sediment	not in swamp	*n/a*	292638	6193714	381.90	3.00	14/07/2009	13/09/2012	end monitoring 13/09/2012			
App07_01	sediment	swamp	Swamp A07	296831	6198760	368.41	3.15	25/05/2017		active	Dendrobium - new Domains		
App07_02	sediment	swamp	Swamp A07	296649	6199599	344.54	2.14	25/05/2017		active	Dendrobium - new Domains		
App07_03	sediment	swamp	Swamp A07	296191	6200330	331.41	1.26	26/05/2017		active	Dendrobium - new Domains		

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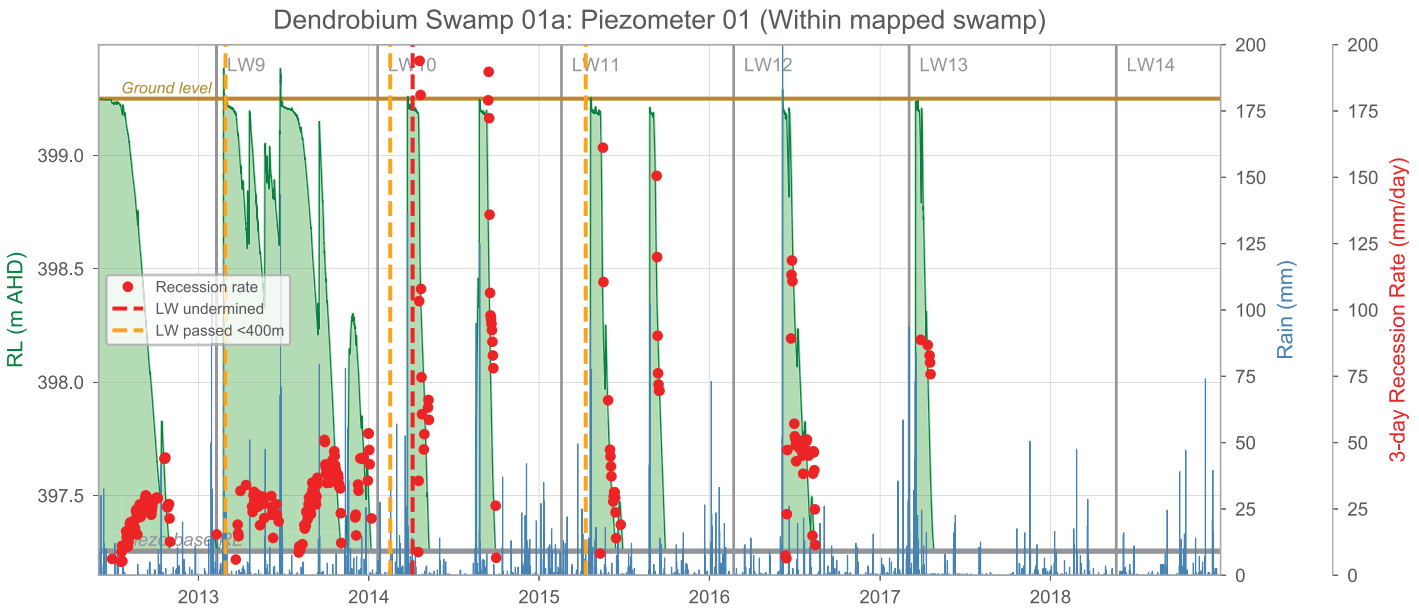
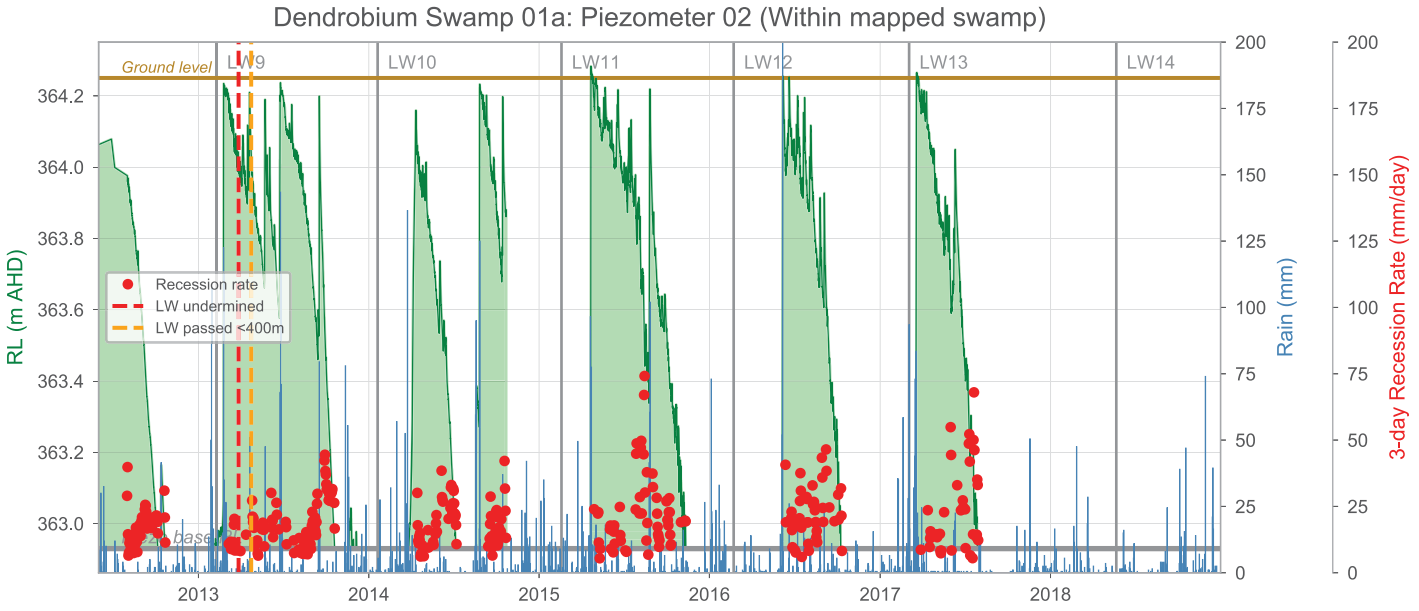
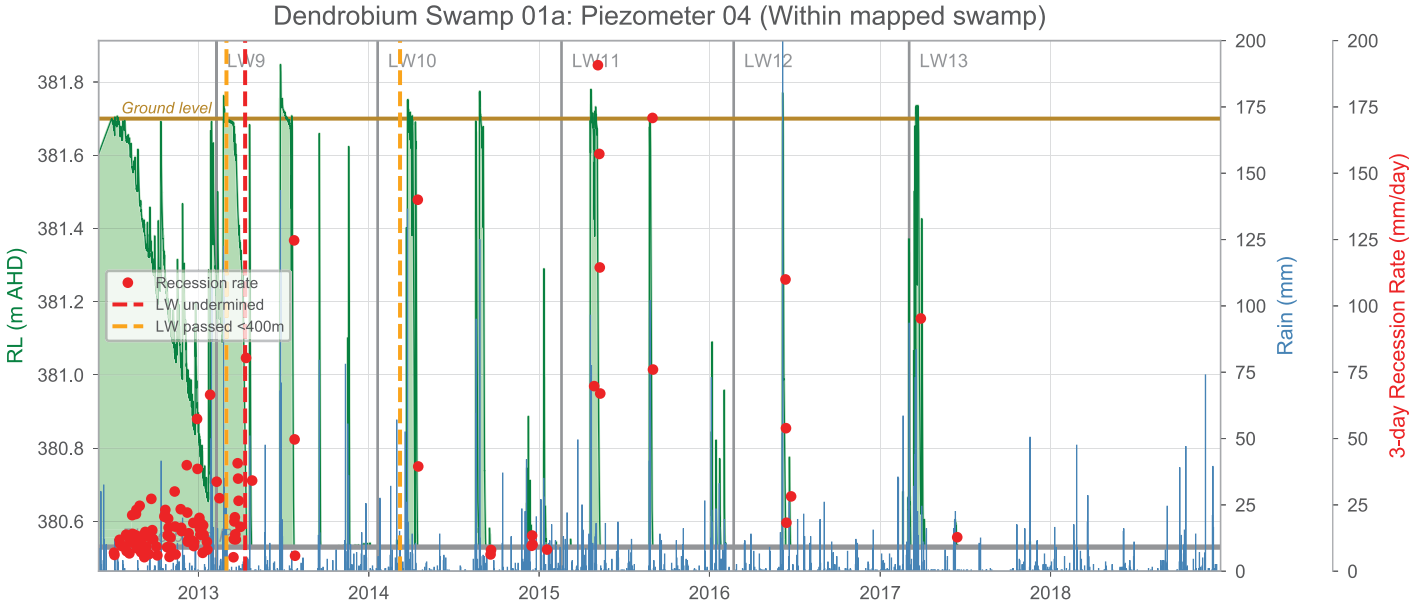
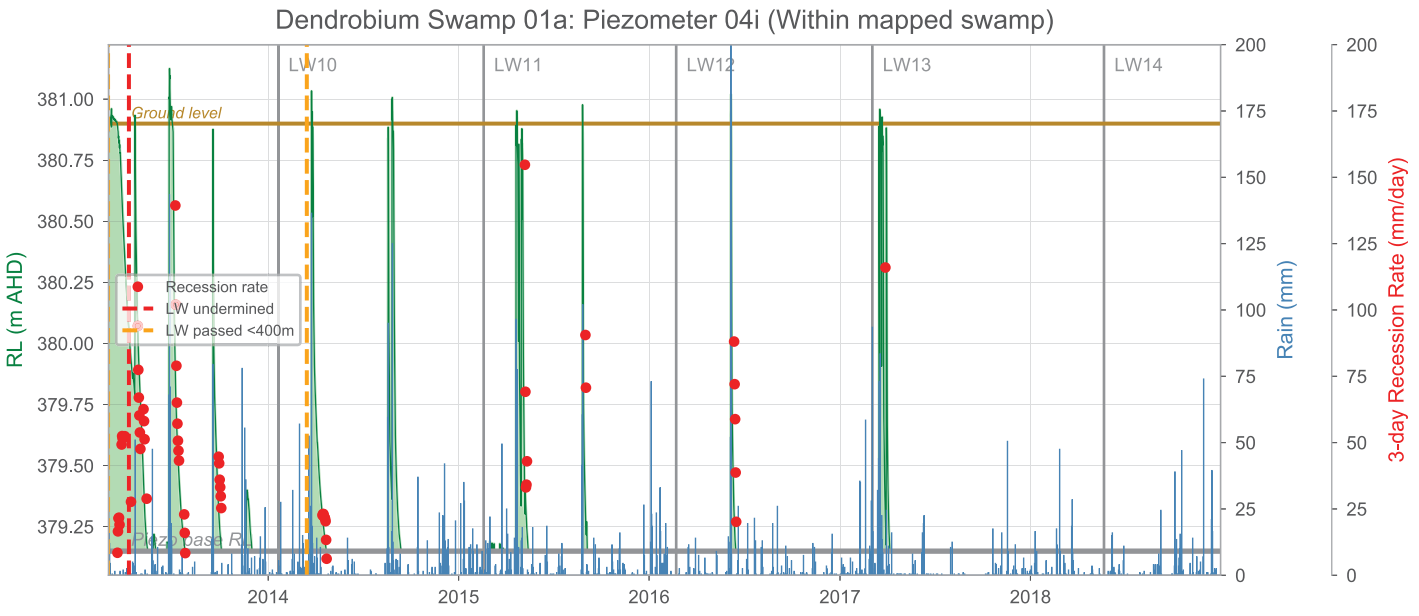
Appendix B – Piezometer hydrographs

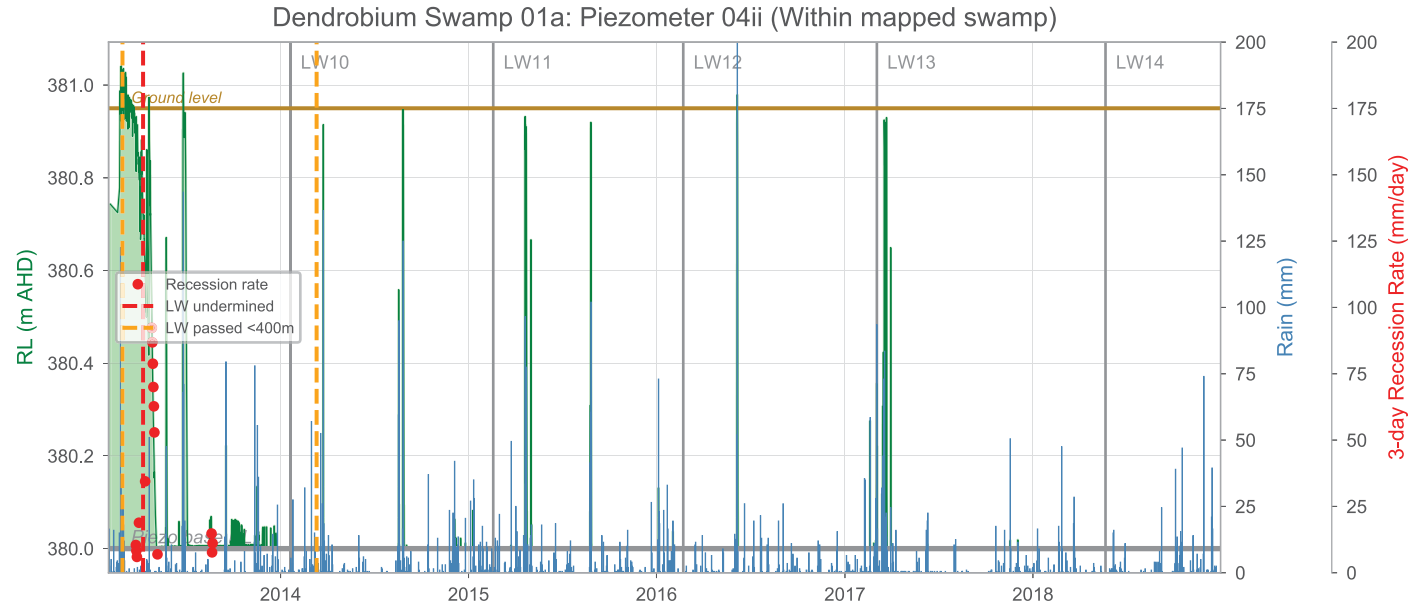
Hydrographs for all logged shallow piezometer sites presented on following pages (by HGEO)

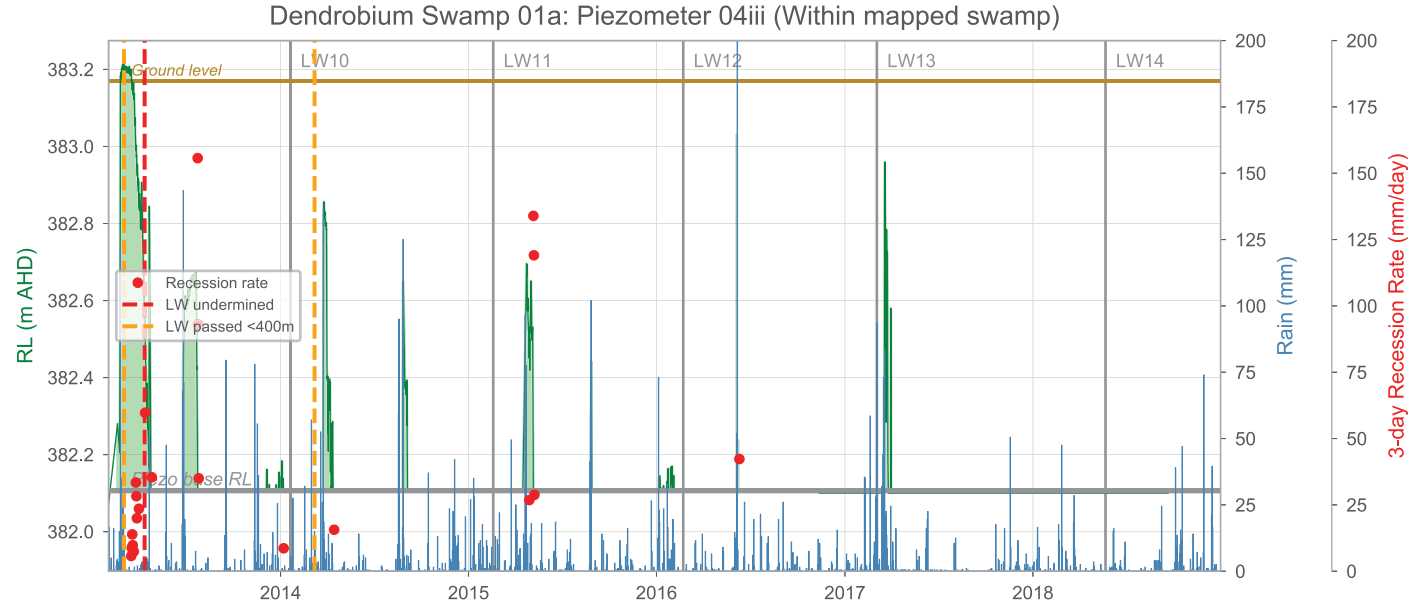

Dendrobium Swamp 01a: Piezometer 01 (Within mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
399.0
398.5
398.0
397.5
200
175
150
125
100
75
50
25
0
2013
2014
2015
2016
2017
2018

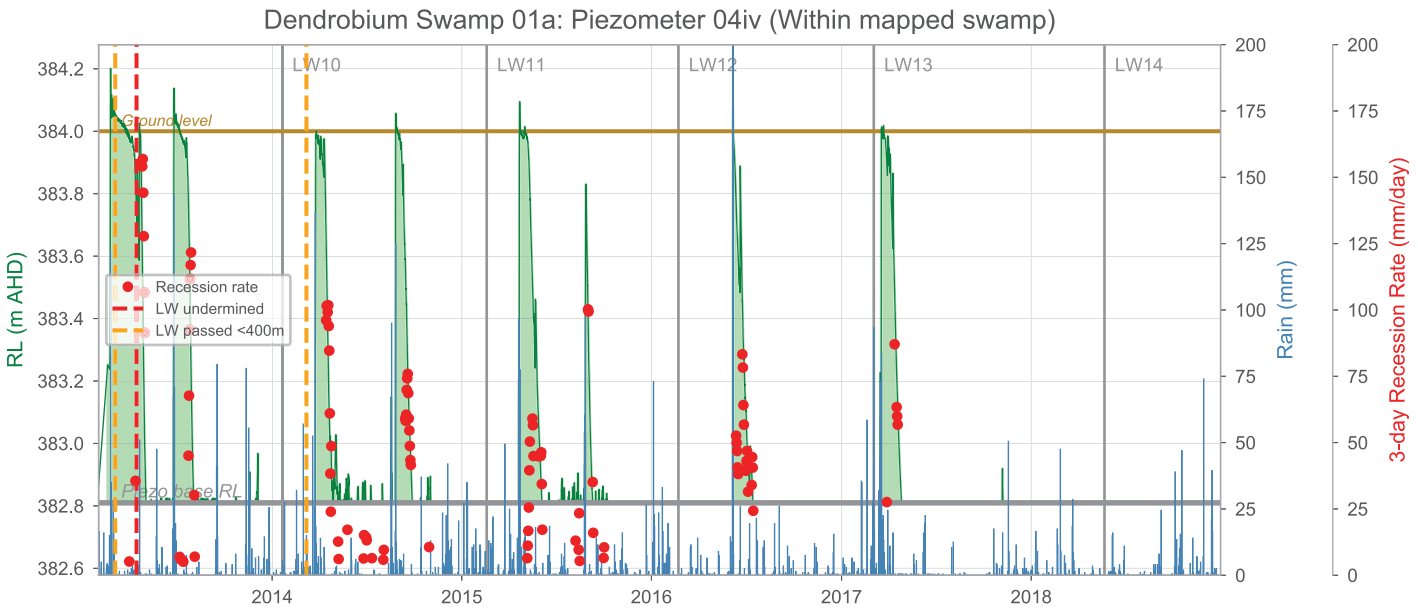

Dendrobium Swamp 01a: Piezometer 02 (Within mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
364.2
364.0
363.8
363.6
363.4
363.2
363.0
200
175
150
125
100
75
50
25
0
2013
2014
2015
2016
2017
2018

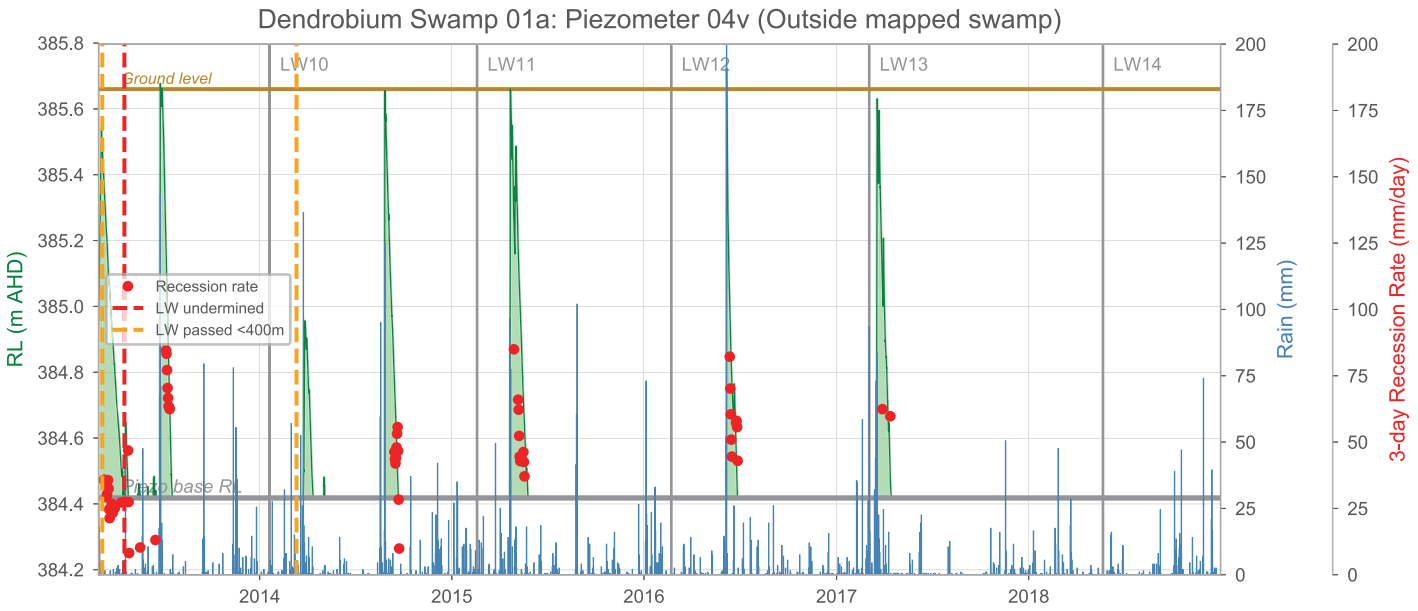

Dendrobium Swamp 01a: Piezometer 04 (Within mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
381.8
381.6
381.4
381.2
381.0
380.8
380.6
200
175
150
125
100
75
50
25
0
2013
2014
2015
2016
2017
2018

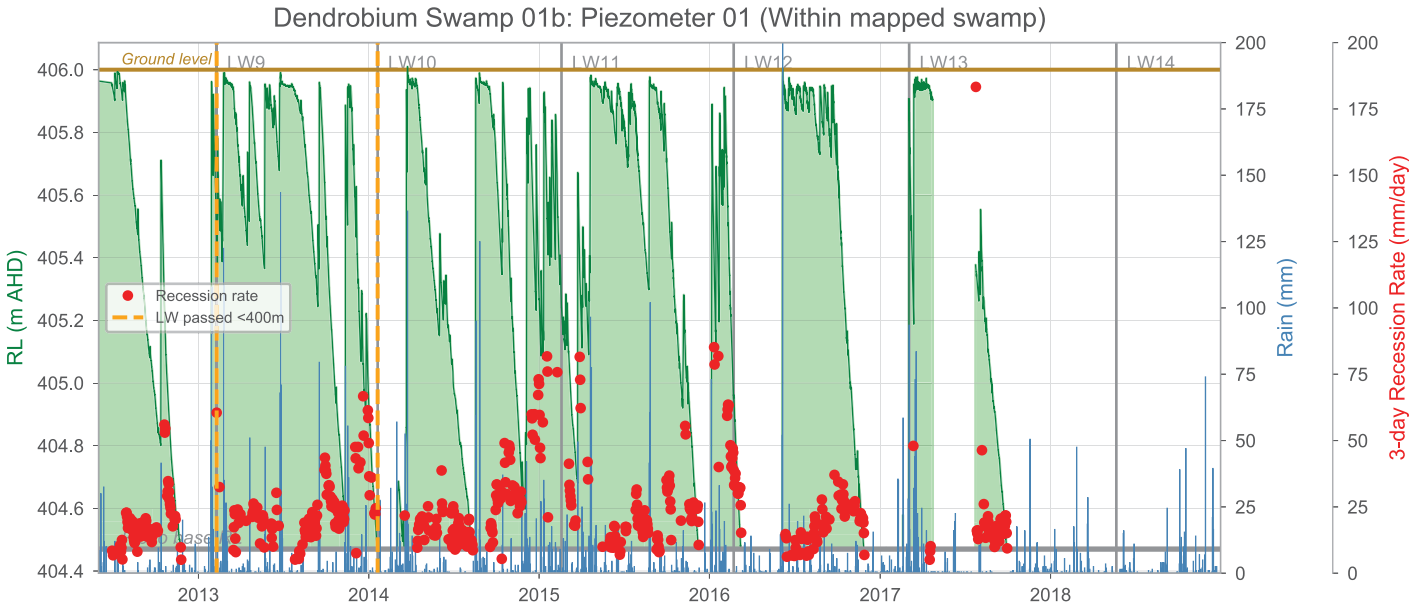

Dendrobium Swamp 01a: Piezometer 04i (Within mapped swamp)
LW10
LW11
LW12
LW13
LW14
Ground level
Piezo base RL
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
381.00
380.75
380.50
380.25
380.00
379.75
379.50
379.25
200
175
150
125
100
75
50
25
0
2014
2015
2016
2017
2018

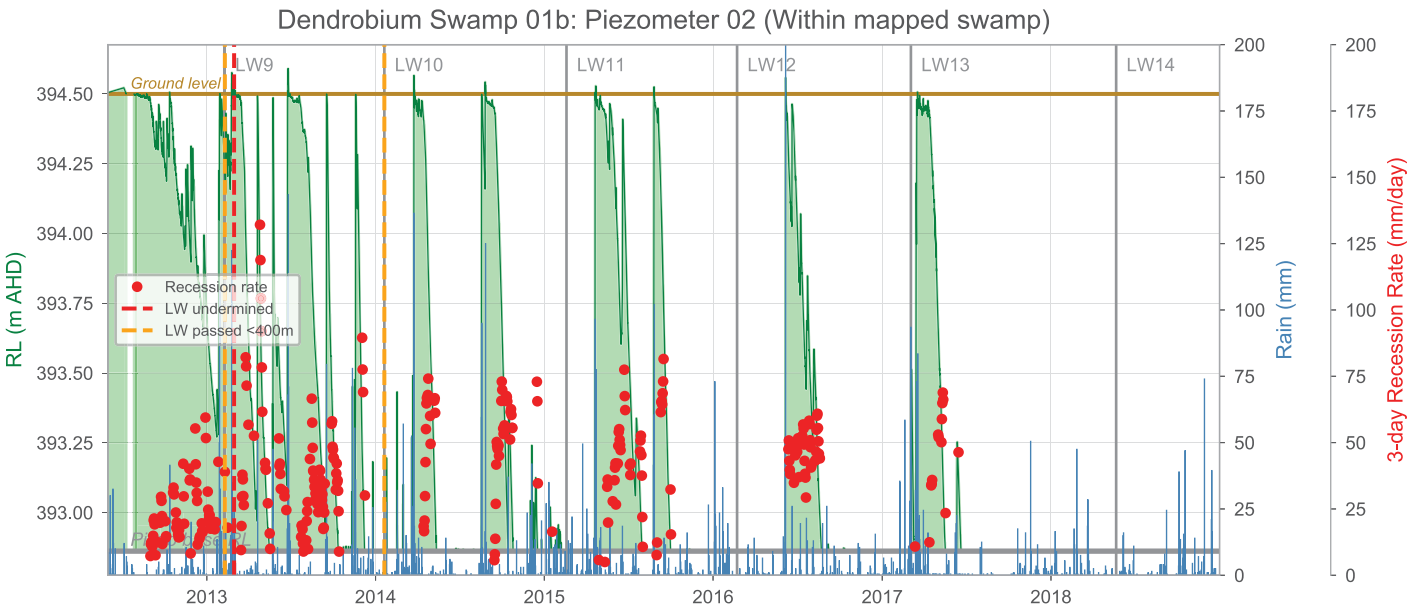

Dendrobium Swamp 01a: Piezometer 04ii (Within mapped swamp)
LW10
LW11
LW12
LW13
LW14
Ground level
Piezo base RL
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
381.0
380.8
380.6
380.4
380.2
380.0
200
175
150
125
100
75
50
25
0
2014
2015
2016
2017
2018

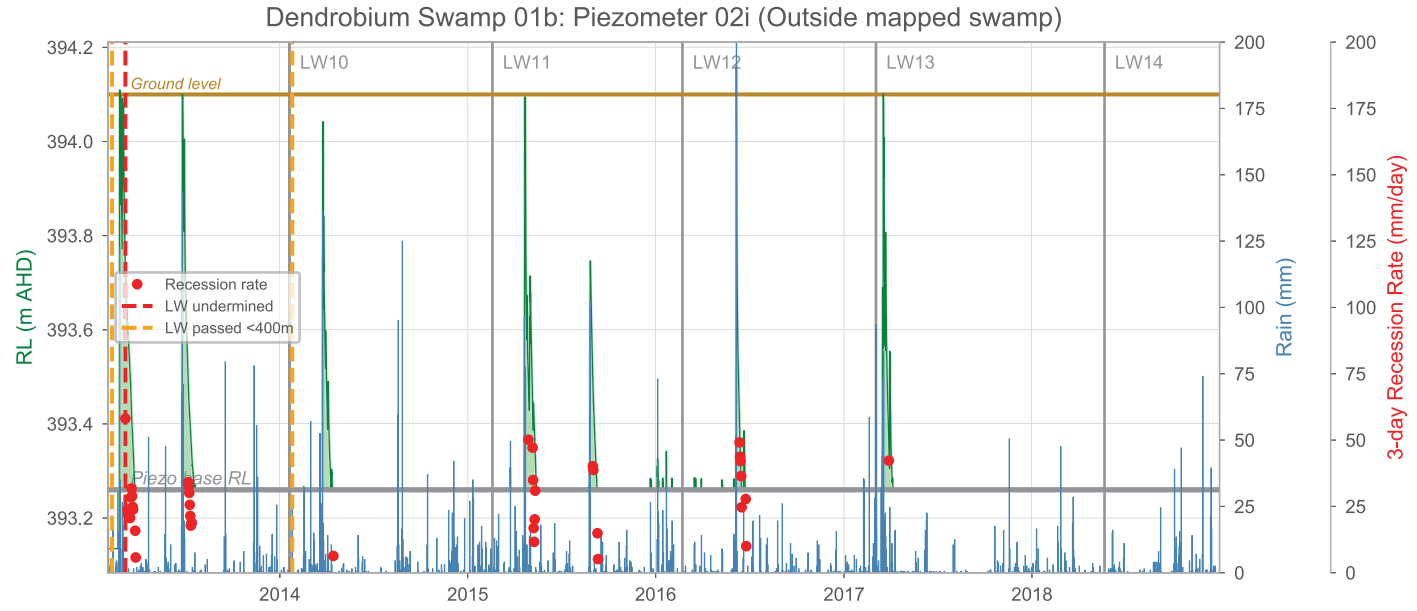

Dendrobium Swamp 01a: Piezometer 04iii (Within mapped swamp)
LW10
LW11
LW12
LW13
LW14
Ground level
Piezo base RL
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
383.2
383.0
382.8
382.6
382.4
382.2
382.0
200
175
150
125
100
75
50
25
0
2014
2015
2016
2017
2018

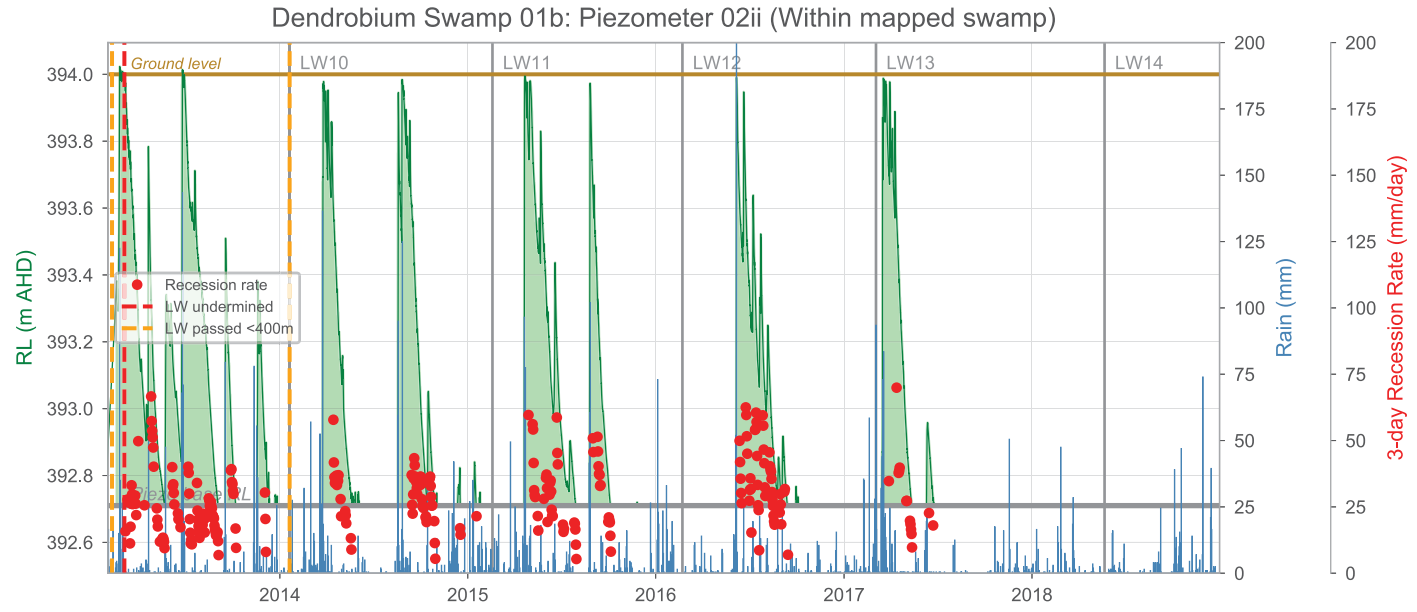

Dendrobium Swamp 01a: Piezometer 04iv (Within mapped swamp)
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
LW10
LW11
LW12
LW13
LW14
Ground level
Piezo base RL
Recession rate
LW undermined
LW passed <400m
2014
2015
2016
2017
2018

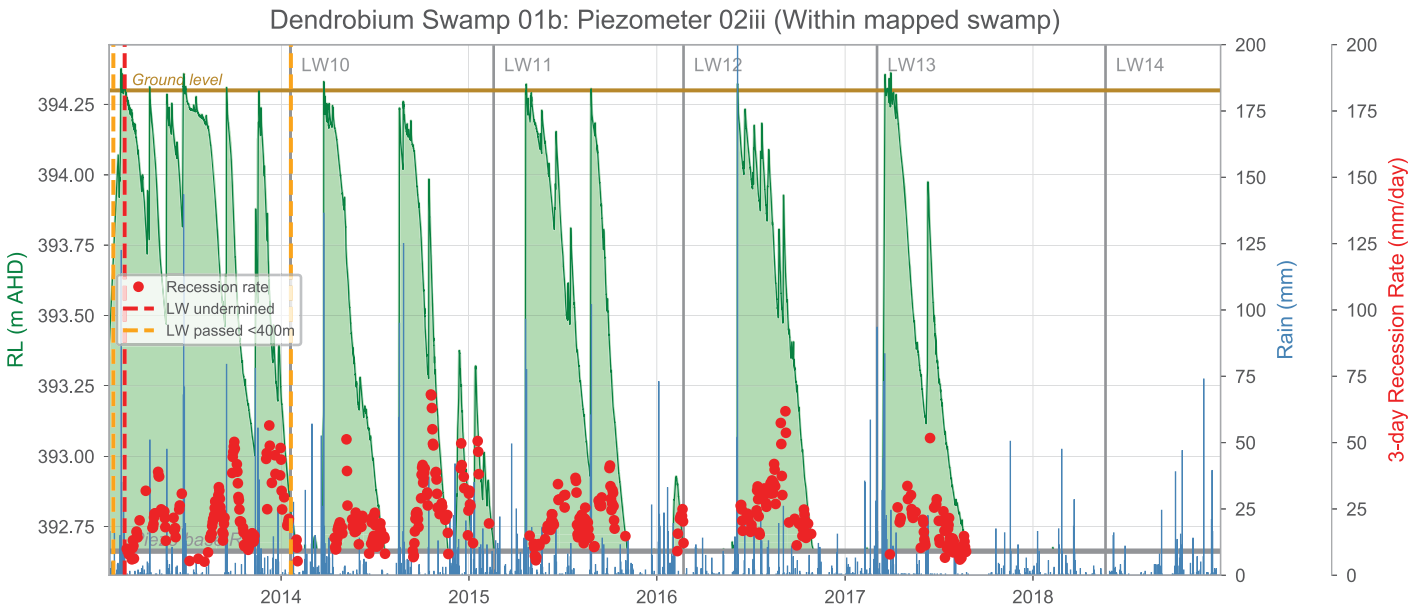

Dendrobium Swamp 01a: Piezometer 04v (Outside mapped swamp)
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
LW10
LW11
LW12
LW13
LW14
Ground level
Piezo base RL
Recession rate
LW undermined
LW passed <400m
2014
2015
2016
2017
2018

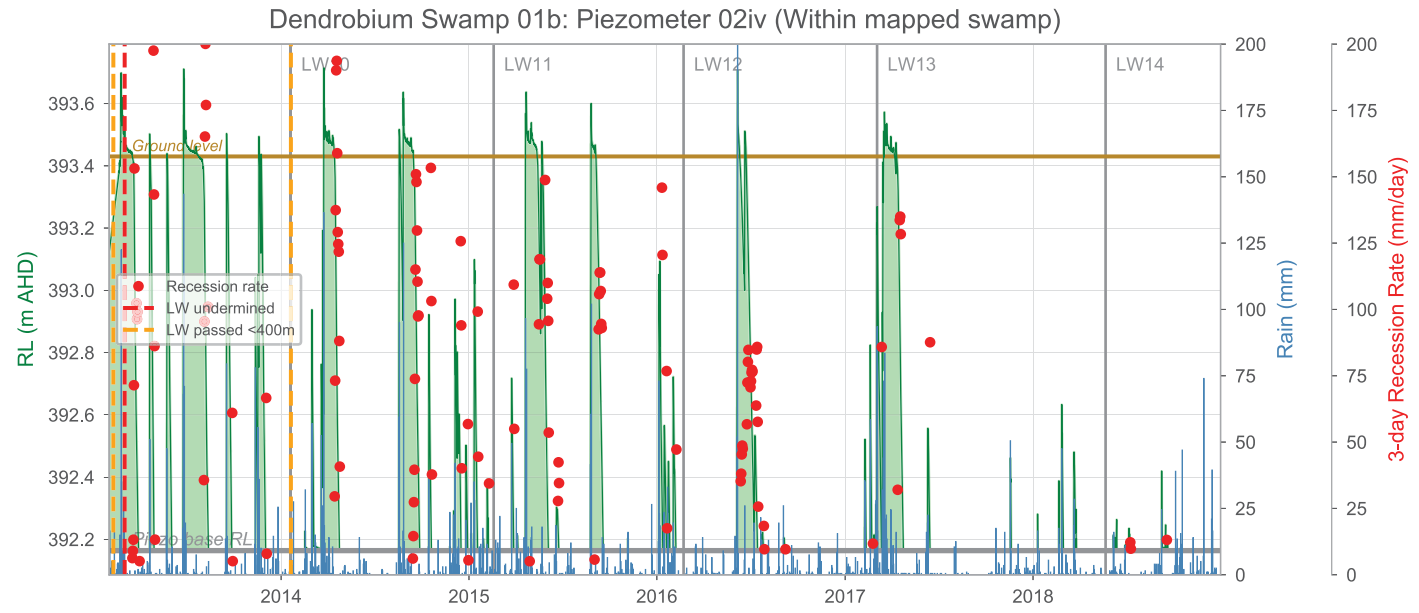

Dendrobium Swamp 01b: Piezometer 01 (Within mapped swamp)
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
LW9
LW10
LW11
LW12
LW13
LW14
Ground level
Recession rate
LW passed <400m
2013
2014
2015
2016
2017
2018

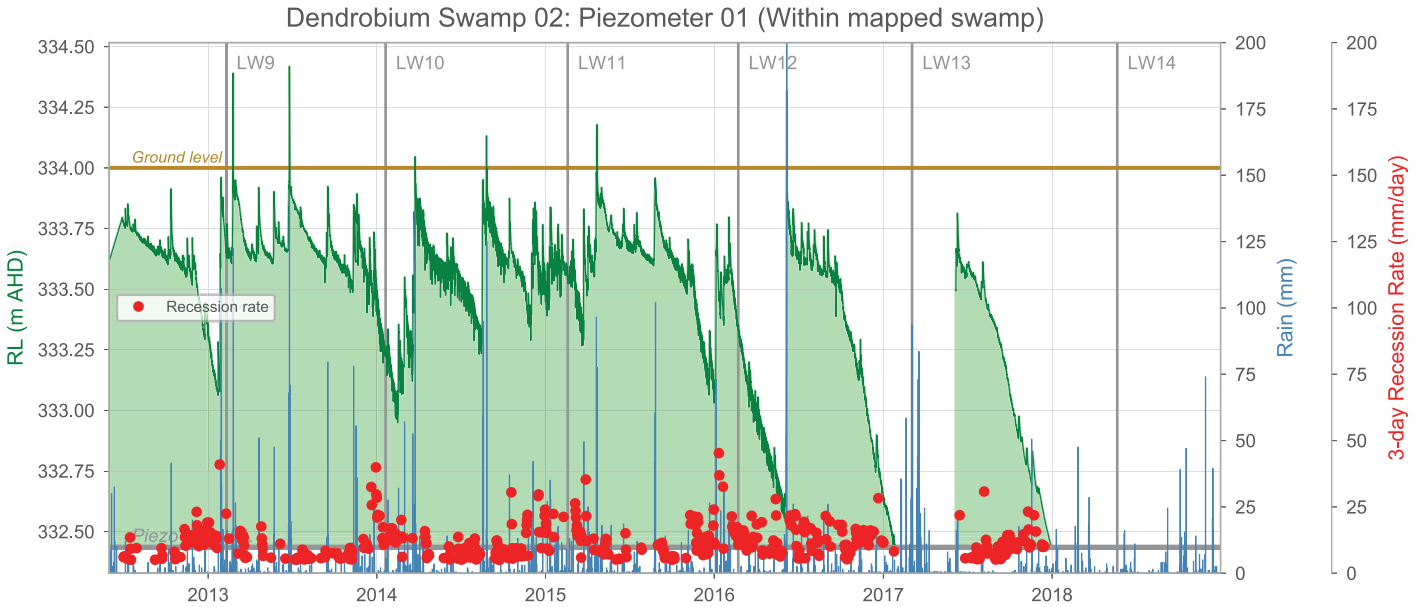

Dendrobium Swamp 01b: Piezometer 02 (Within mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)

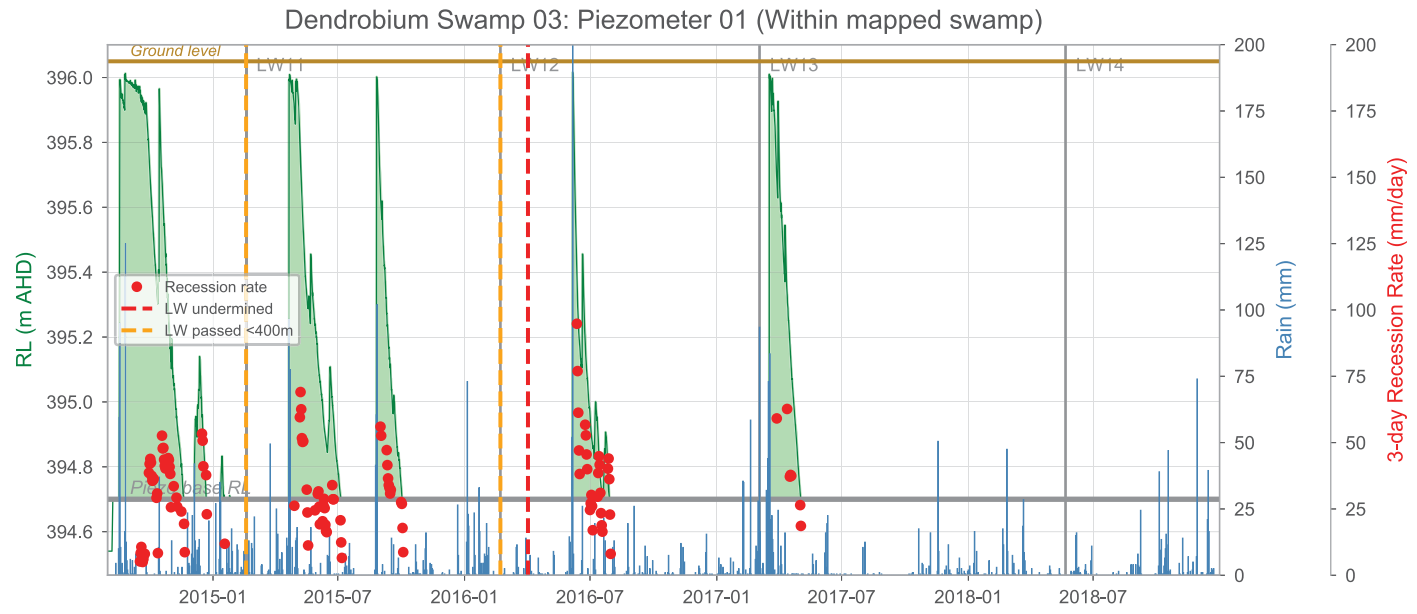

Dendrobium Swamp 01b: Piezometer 02i (Outside mapped swamp)
Ground level
LW10
LW11
LW12
LW13
LW14
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)

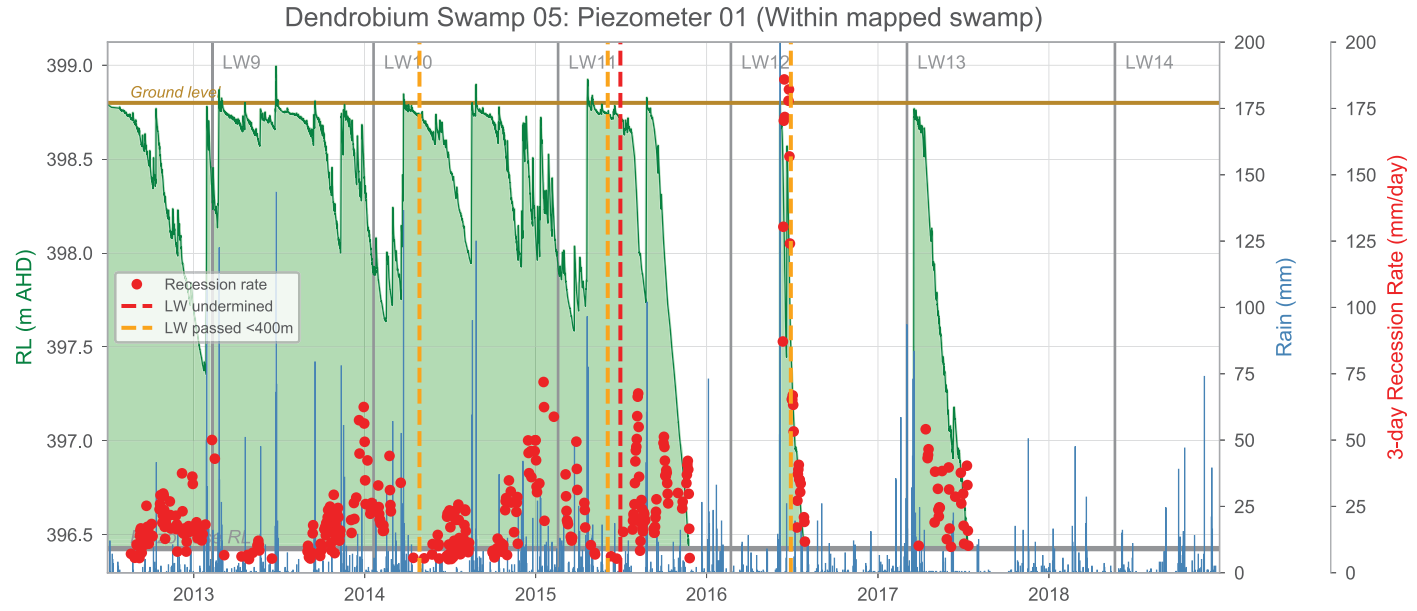

Dendrobium Swamp 01b: Piezometer 02ii (Within mapped swamp)
Ground level
LW10
LW11
LW12
LW13
LW14
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)

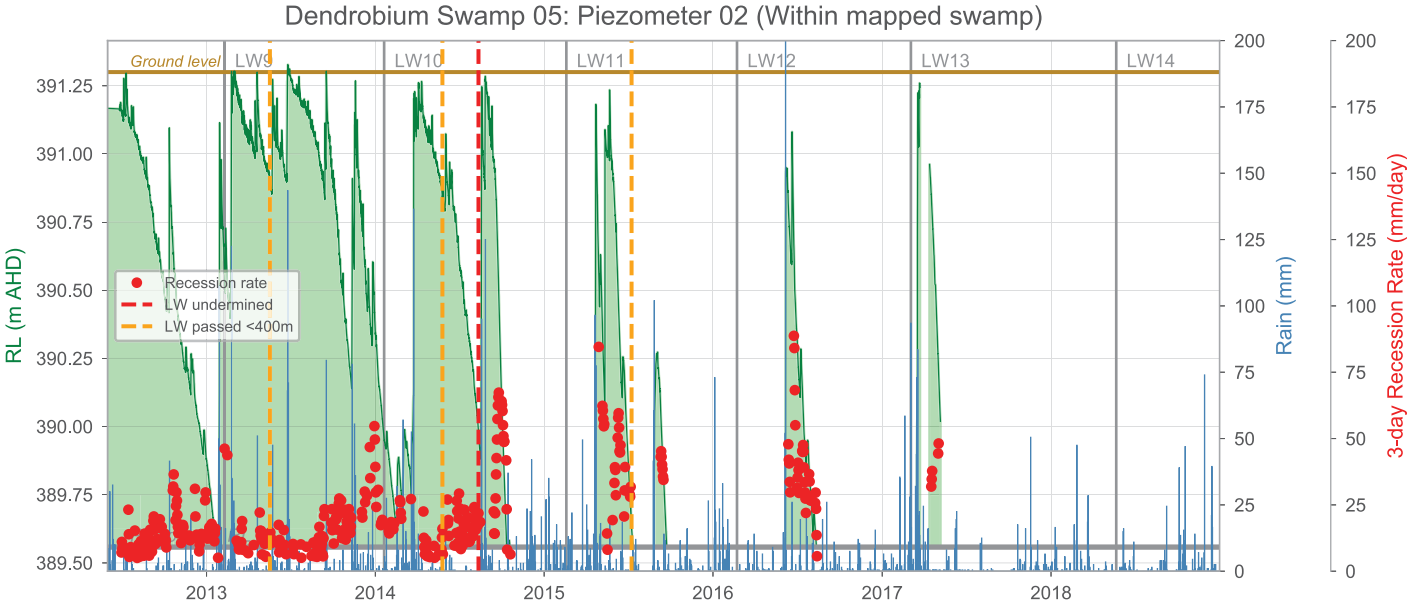

Dendrobium Swamp 01b: Piezometer 02iii (Within mapped swamp)
LW10
LW11
LW12
LW13
LW14
Ground level
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
394.25
394.00
393.75
393.50
393.25
393.00
392.75
200
175
150
125
100
75
50
25
0
2014
2015
2016
2017
2018

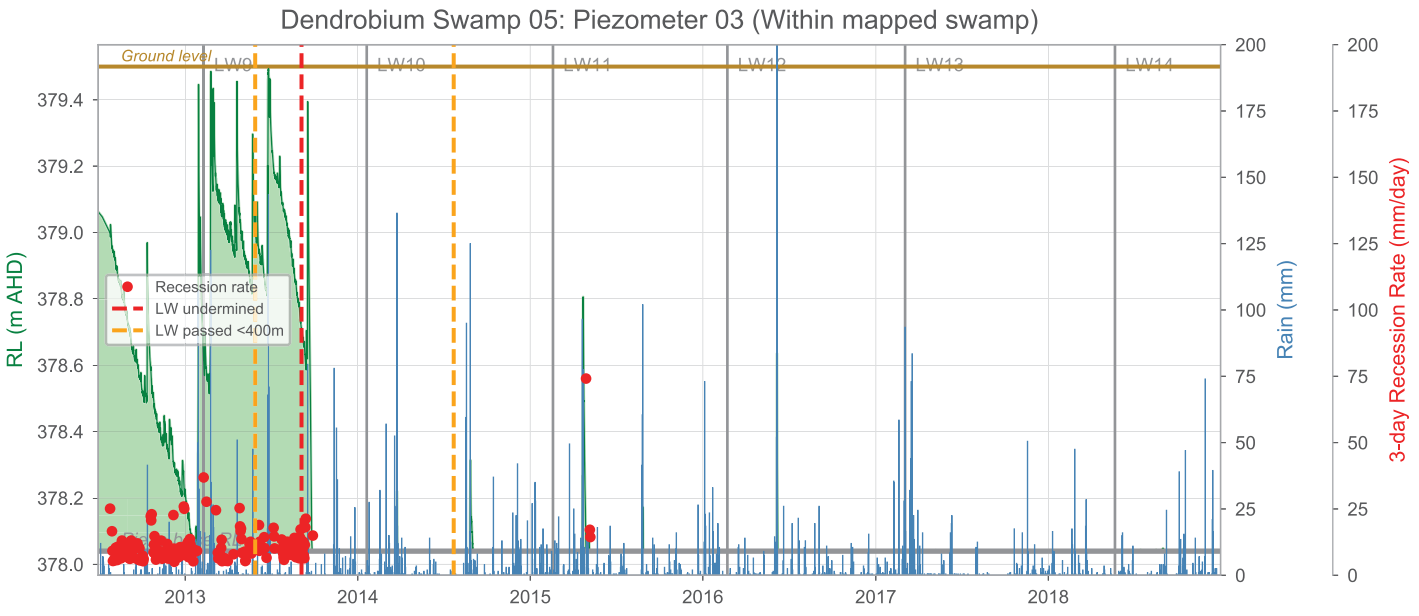

Dendrobium Swamp 01b: Piezometer 02iv (Within mapped swamp)
LW10
LW11
LW12
LW13
LW14
Ground level
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
393.6
393.4
393.2
393.0
392.8
392.6
392.4
392.2
200
175
150
125
100
75
50
25
0
2014
2015
2016
2017
2018

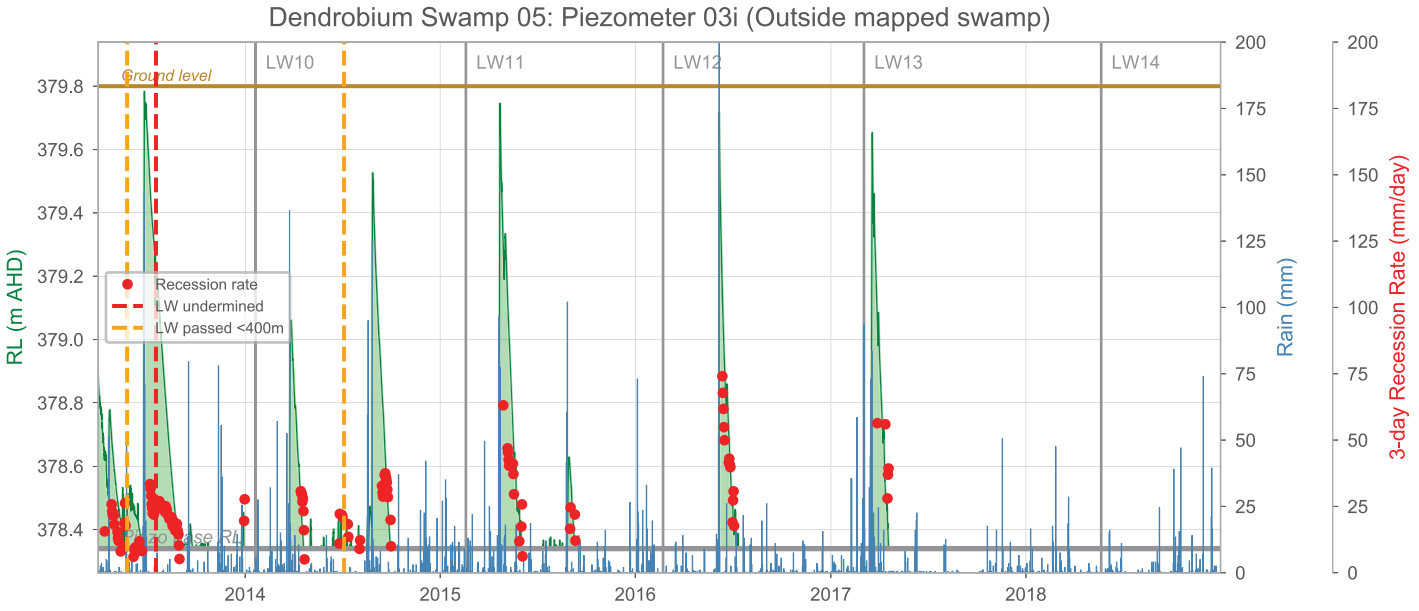

Dendrobium Swamp 02: Piezometer 01 (Within mapped swamp)
LW9
LW10
LW11
LW12
LW13
LW14
Ground level
Recession rate
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
334.50
334.25
334.00
333.75
333.50
333.25
333.00
332.75
332.50
200
175
150
125
100
75
50
25
0
2013
2014
2015
2016
2017
2018

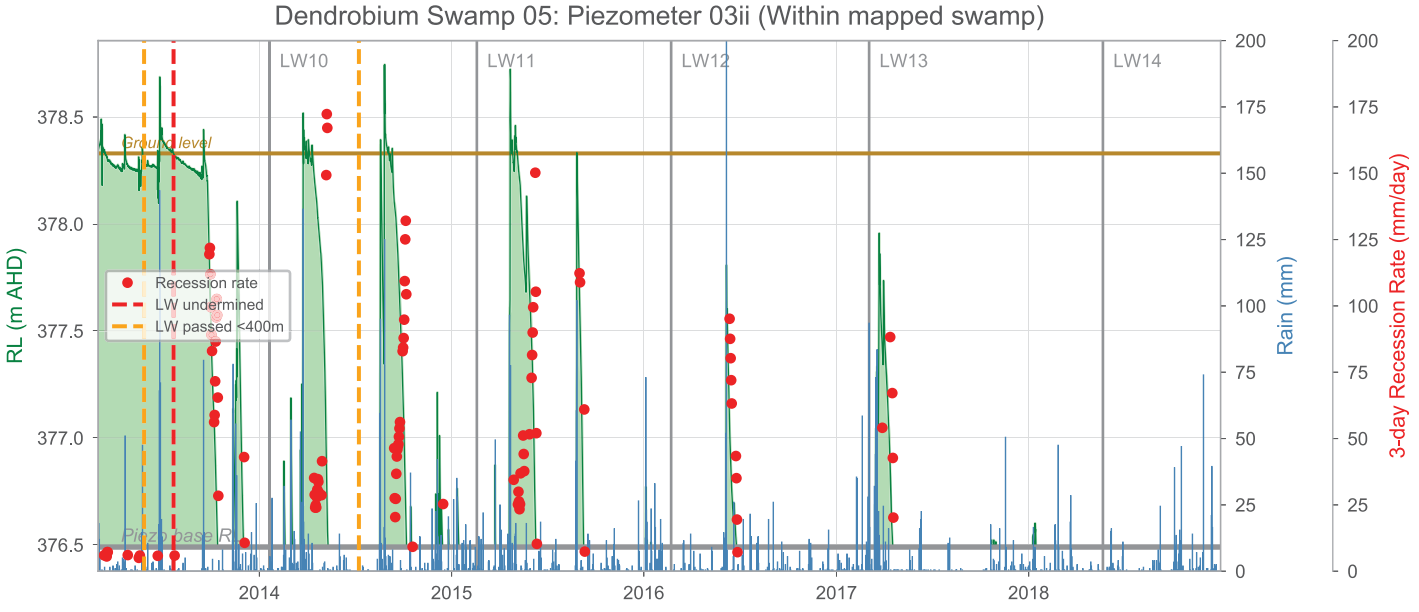

Dendrobium Swamp 03: Piezometer 01 (Within mapped swamp)
Ground level
LW11
LW12
LW13
LW14
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
2015-01
2015-07
2016-01
2016-07
2017-01
2017-07
2018-01
2018-07

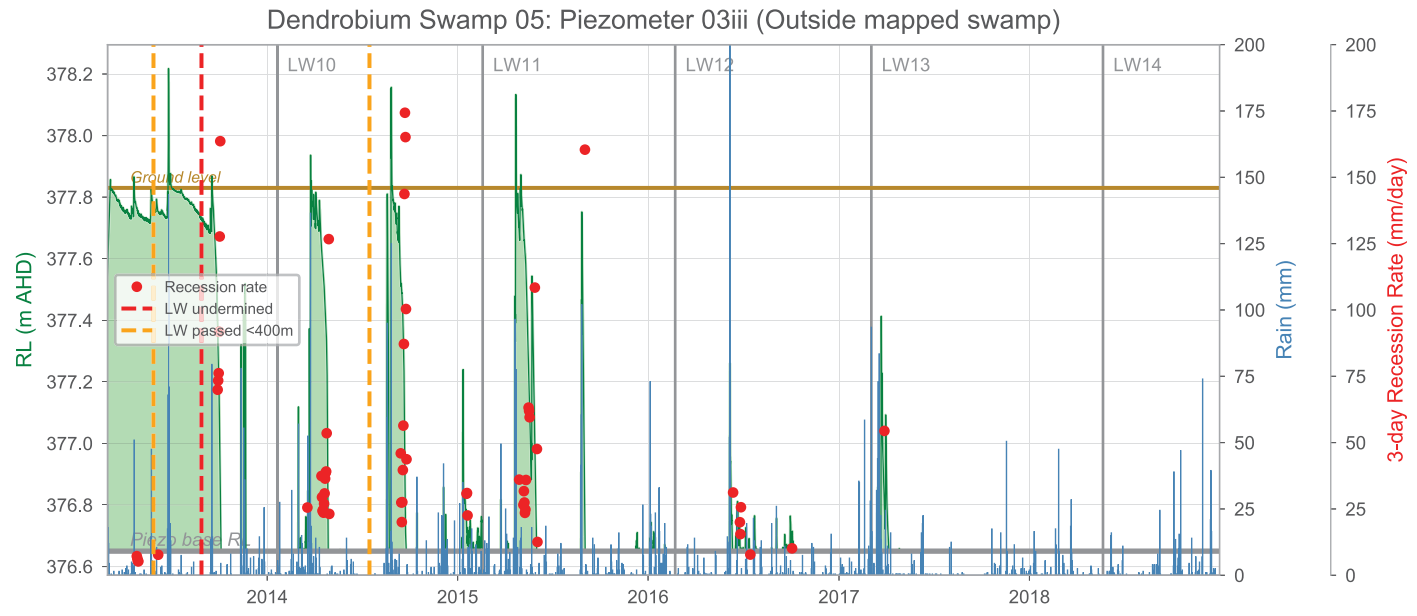

Dendrobium Swamp 05: Piezometer 01 (Within mapped swamp)
LW9
LW10
LW11
LW12
LW13
LW14
Ground level
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
2013
2014
2015
2016
2017
2018

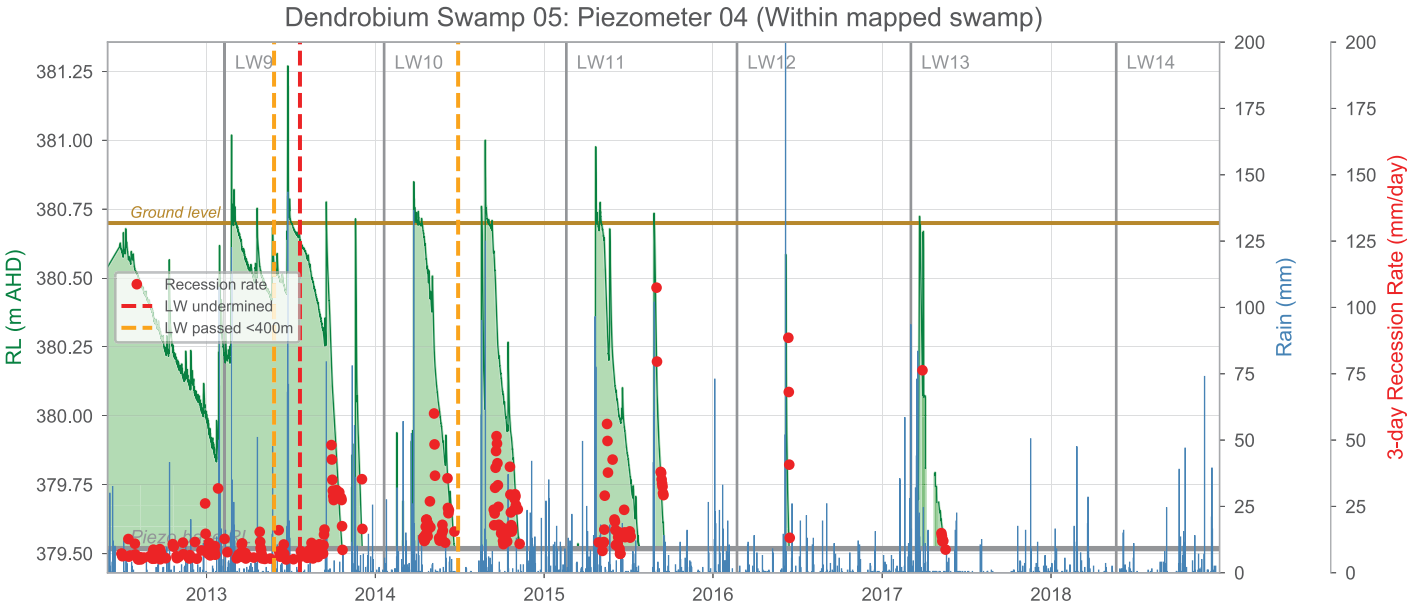

Dendrobium Swamp 05: Piezometer 02 (Within mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
2013
2014
2015
2016
2017
2018

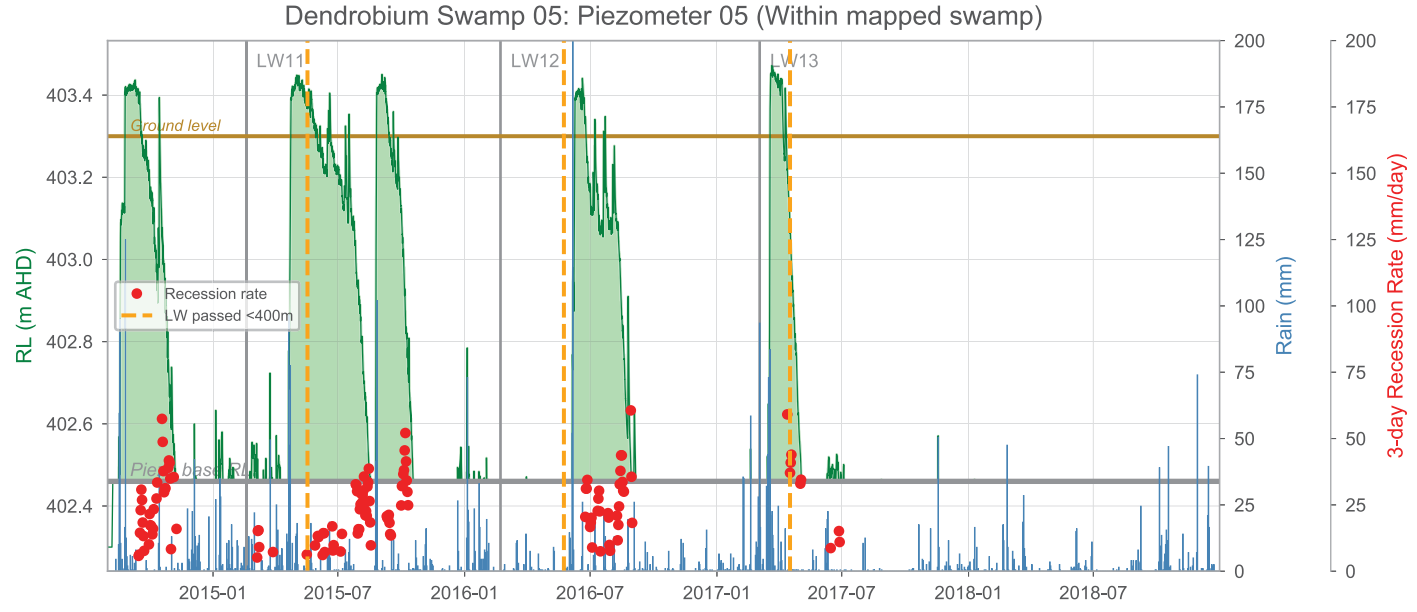

Dendrobium Swamp 05: Piezometer 03 (Within mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)

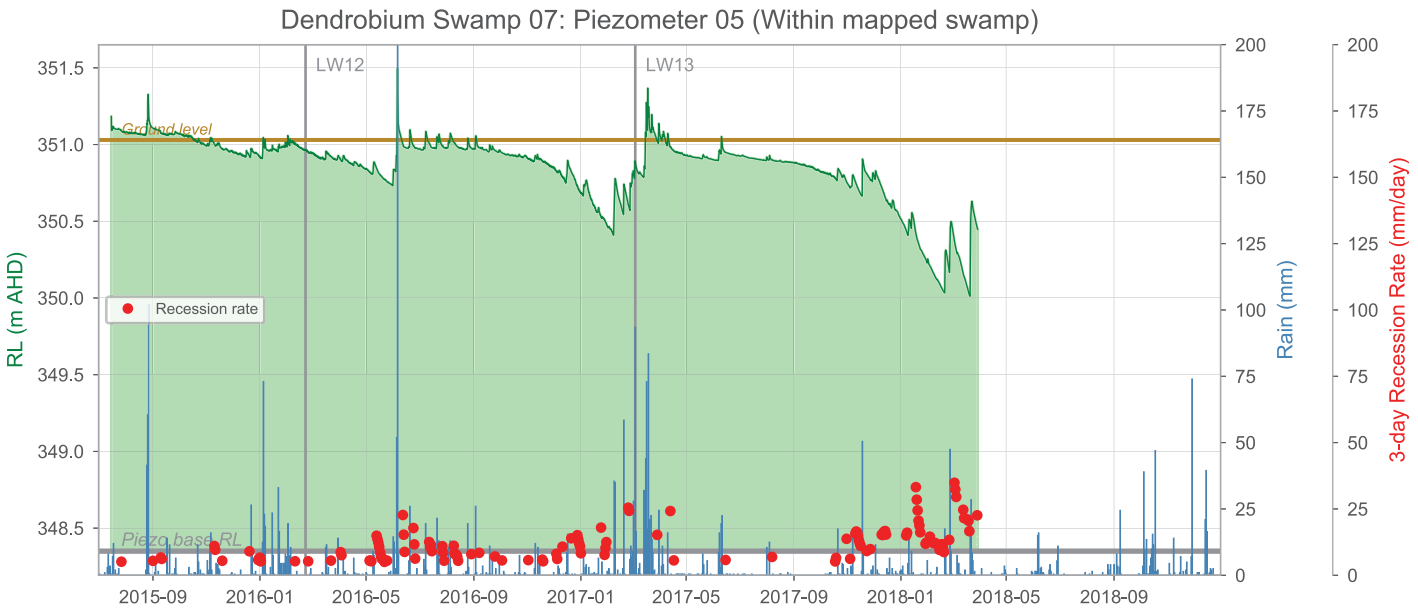

Dendrobium Swamp 05: Piezometer 03i (Outside mapped swamp)
Ground level
LW10
LW11
LW12
LW13
LW14
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)

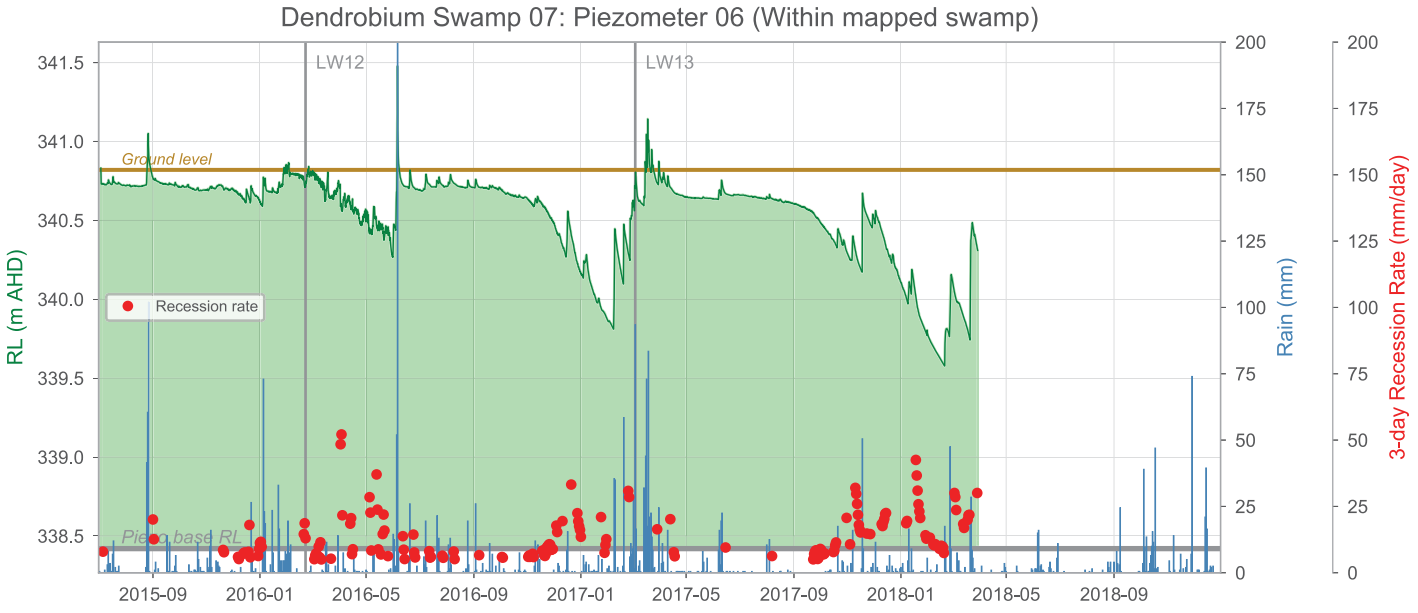

Dendrobium Swamp 05: Piezometer 03ii (Within mapped swamp)
Ground level
LW10
LW11
LW12
LW13
LW14
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)

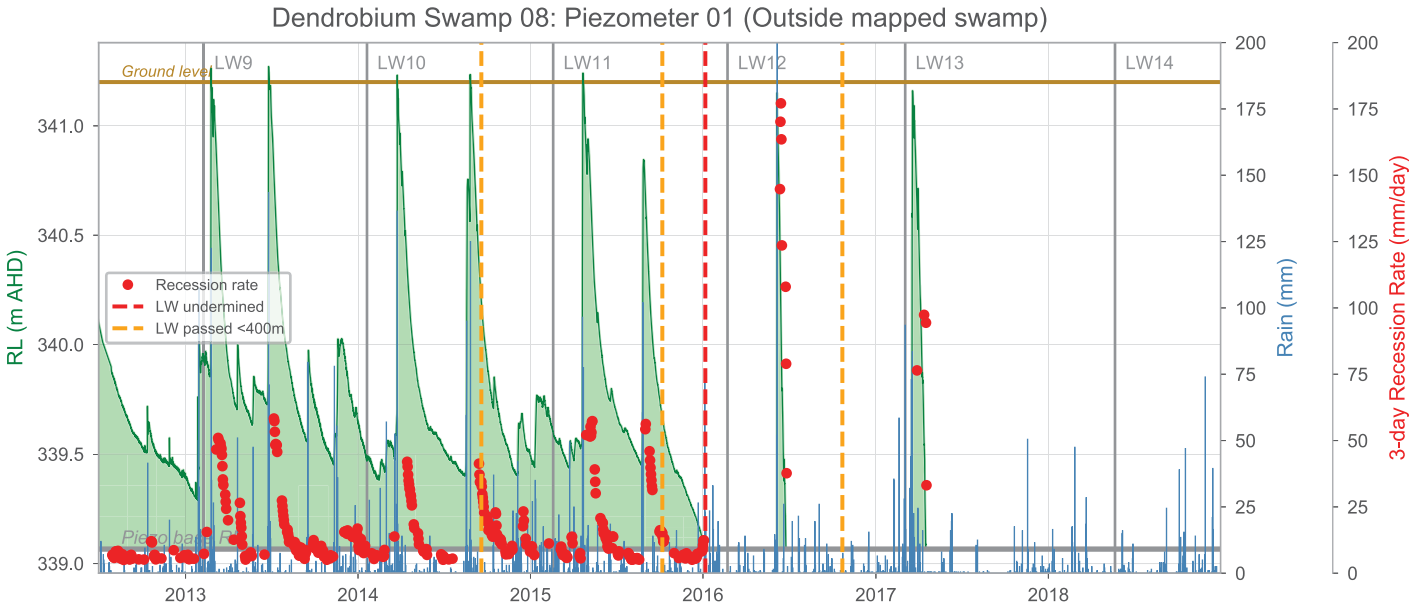

Dendrobium Swamp 05: Piezometer 03iii (Outside mapped swamp)
LW10
LW11
LW12
LW13
LW14
Ground level
Piezo base RL
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
378.2
378.0
377.8
377.6
377.4
377.2
377.0
376.8
376.6
200
175
150
125
100
75
50
25
0
2014
2015
2016
2017
2018

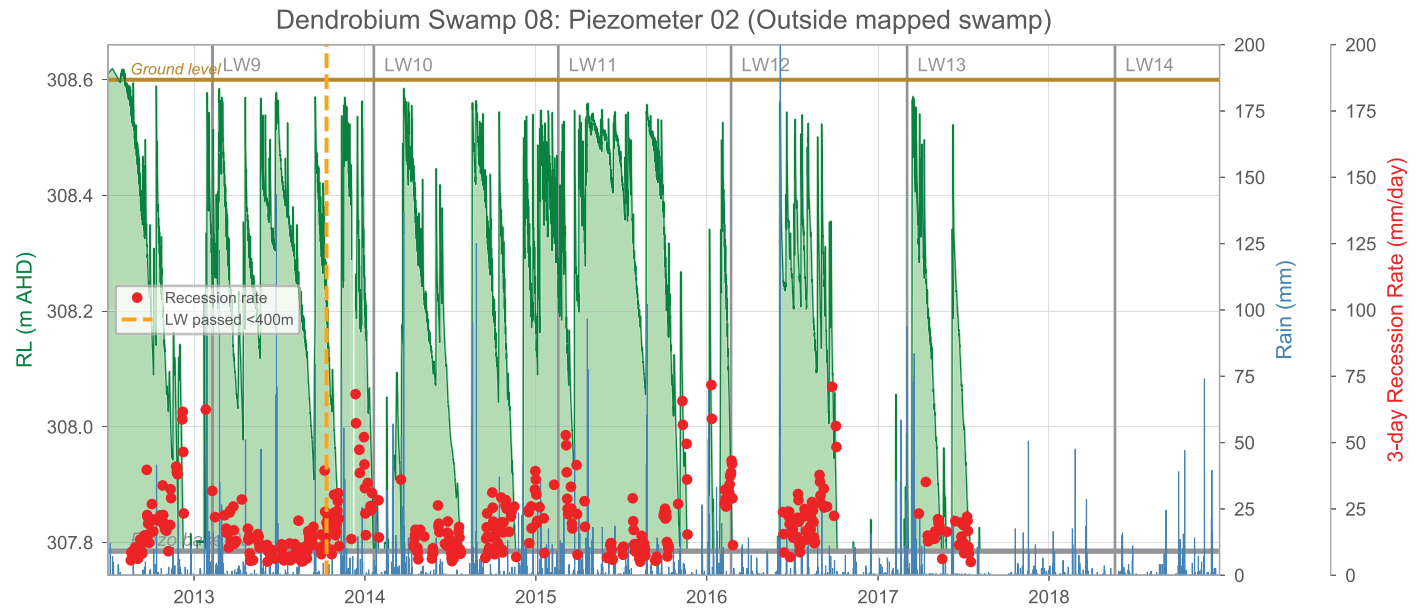

Dendrobium Swamp 05: Piezometer 04 (Within mapped swamp)
LW9
LW10
LW11
LW12
LW13
LW14
Ground level
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
381.25
381.00
380.75
380.50
380.25
380.00
379.75
379.50
200
175
150
125
100
75
50
25
0
2013
2014
2015
2016
2017
2018

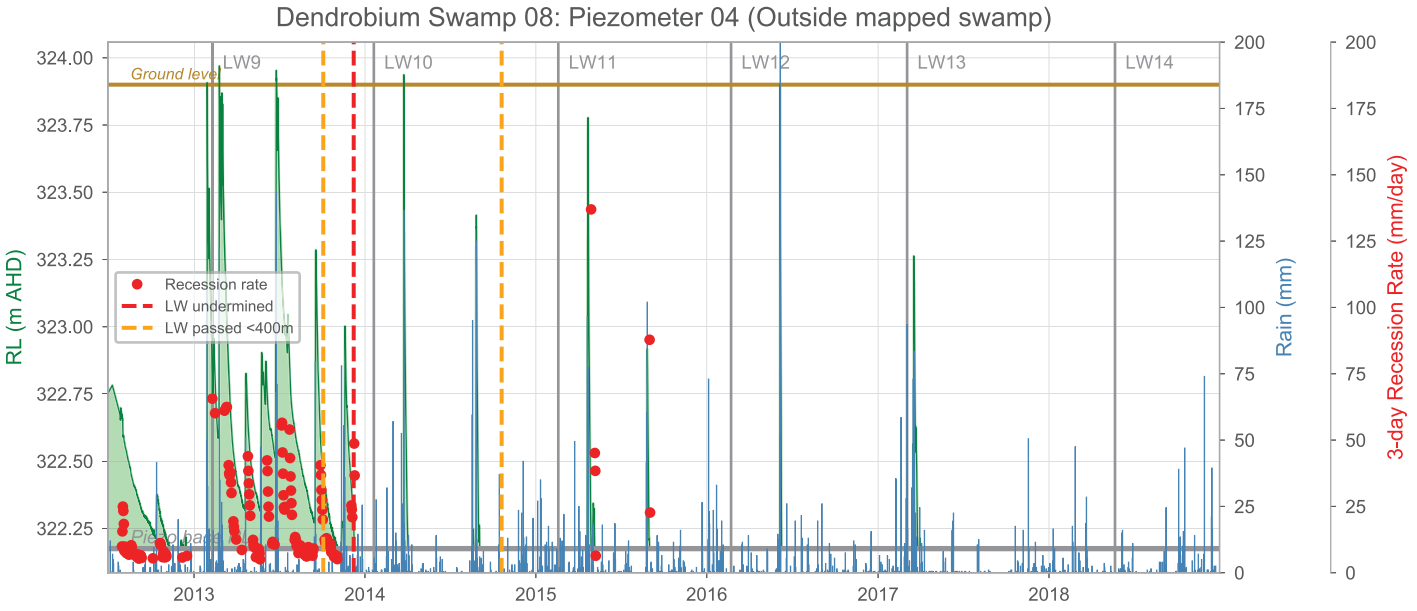

Dendrobium Swamp 05: Piezometer 05 (Within mapped swamp)
LW11
LW12
LW13
Ground level
Recession rate
LW passed <400m
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
403.4
403.2
403.0
402.8
402.6
402.4
200
175
150
125
100
75
50
25
0
2015-01
2015-07
2016-01
2016-07
2017-01
2017-07
2018-01
2018-07

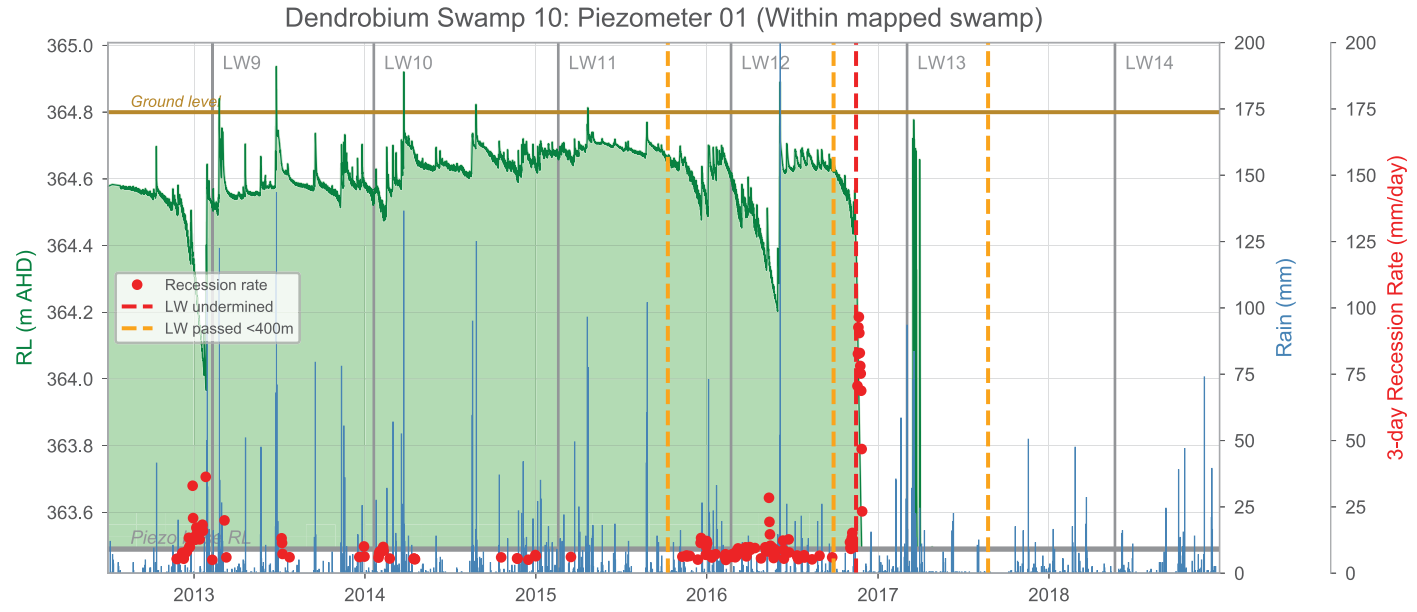

Dendrobium Swamp 07: Piezometer 05 (Within mapped swamp)
LW12
LW13
Ground level
Recession rate
Piezo base RL
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
351.5
351.0
350.5
350.0
349.5
349.0
348.5
200
175
150
125
100
75
50
25
0
2015-09
2016-01
2016-05
2016-09
2017-01
2017-05
2017-09
2018-01
2018-05
2018-09

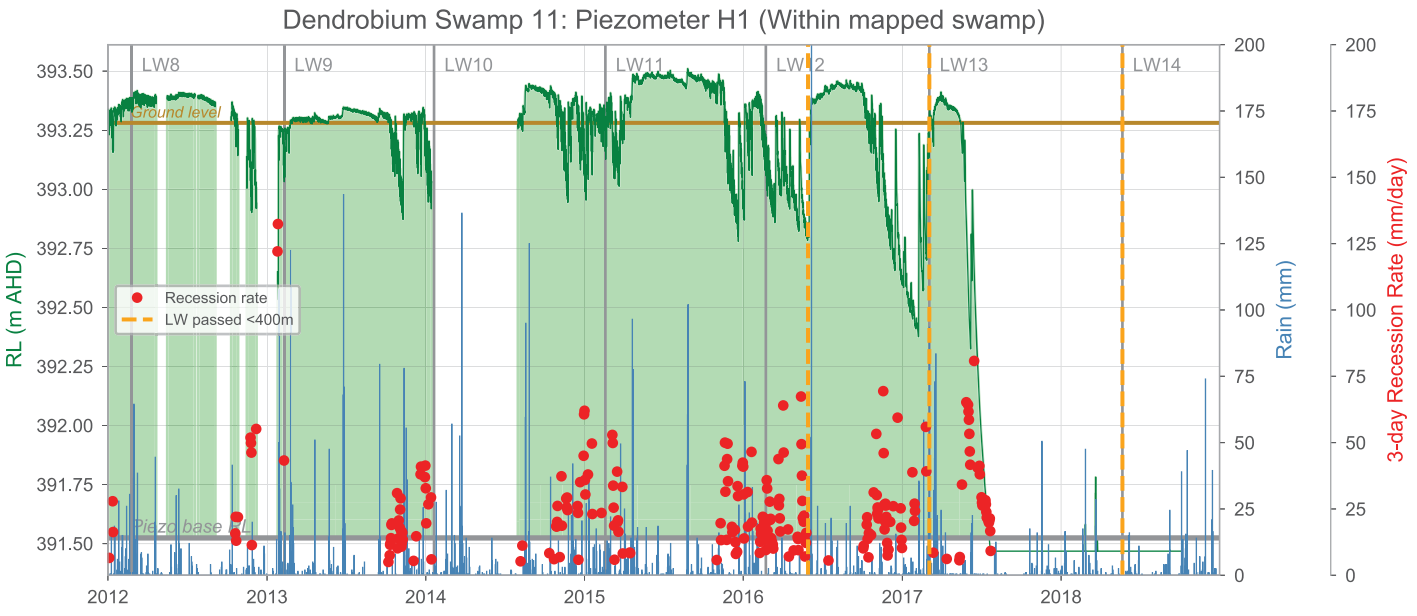

Dendrobium Swamp 07: Piezometer 06 (Within mapped swamp)
LW12
LW13
Ground level
Recession rate
Piezo base RL
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
341.5
341.0
340.5
340.0
339.5
339.0
338.5
200
175
150
125
100
75
50
25
0
2015-09
2016-01
2016-05
2016-09
2017-01
2017-05
2017-09
2018-01
2018-05
2018-09

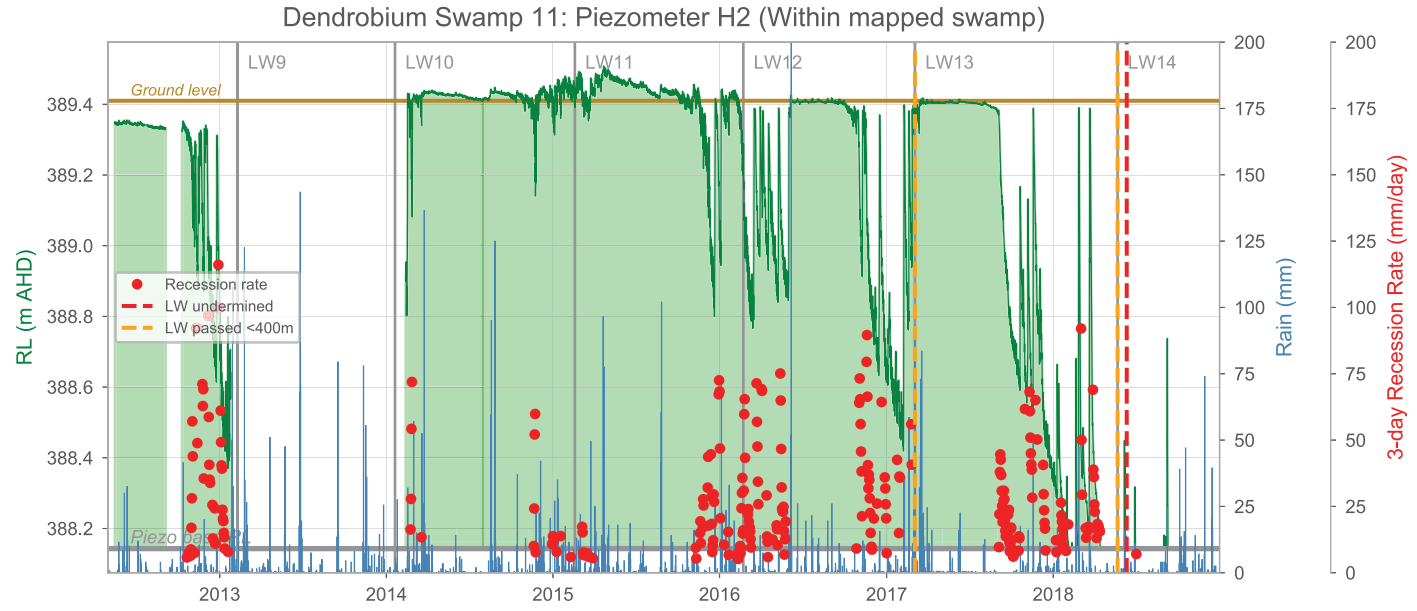

Dendrobium Swamp 08: Piezometer 01 (Outside mapped swamp)
LW9
LW10
LW11
LW12
LW13
LW14
Ground level
Recession rate
LW undermined
LW passed <400m
Piezo base RL
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
341.0
340.5
340.0
339.5
339.0
200
175
150
125
100
75
50
25
0
2013
2014
2015
2016
2017
2018

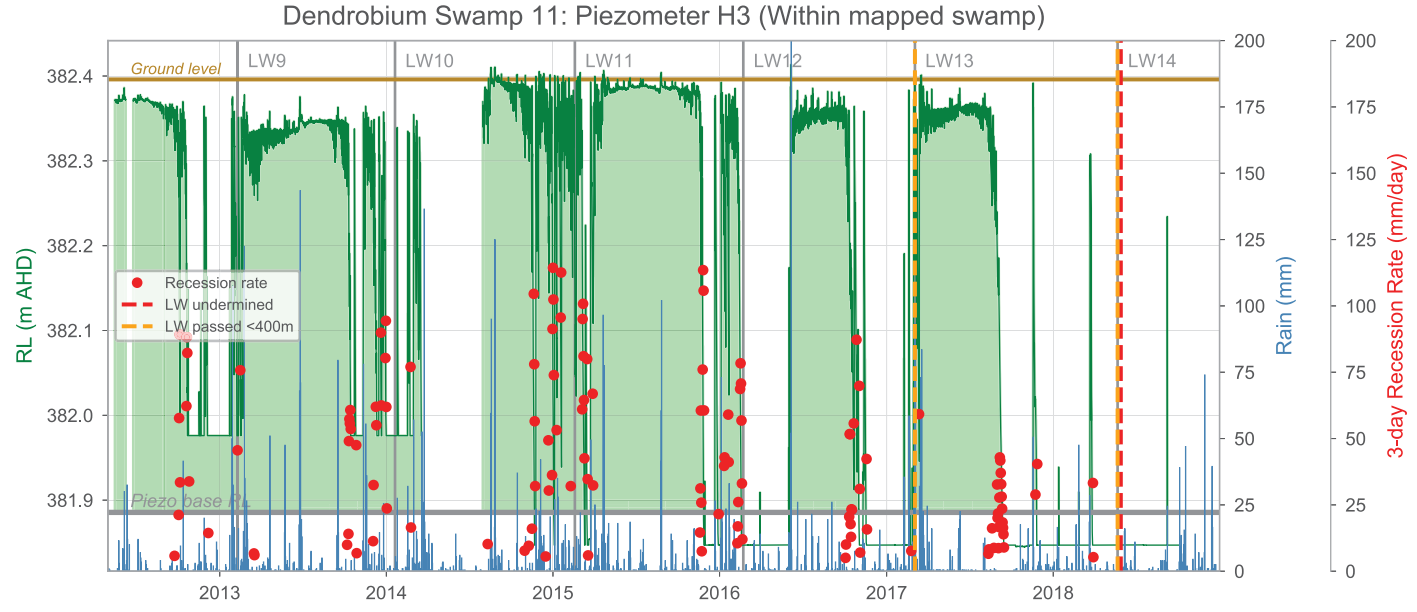

Dendrobium Swamp 08: Piezometer 02 (Outside mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
Recession rate
LW passed <400m
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
308.6
308.4
308.2
308.0
307.8
200
175
150
125
100
75
50
25
0
2013
2014
2015
2016
2017
2018


Dendrobium Swamp 08: Piezometer 04 (Outside mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
324.00
323.75
323.50
323.25
323.00
322.75
322.50
322.25
200
175
150
125
100
75
50
25
0
2013
2014
2015
2016
2017
2018


Dendrobium Swamp 10: Piezometer 01 (Within mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)
365.0
364.8
364.6
364.4
364.2
364.0
363.8
363.6
200
175
150
125
100
75
50
25
0
2013
2014
2015
2016
2017
2018


Dendrobium Swamp 11: Piezometer H1 (Within mapped swamp)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
Ground level
Piezo base RL
Recession rate
LW passed <400m
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)


Dendrobium Swamp 11: Piezometer H2 (Within mapped swamp)
LW9
LW10
LW11
LW12
LW13
LW14
Ground level
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)


Dendrobium Swamp 11: Piezometer H3 (Within mapped swamp)
LW9
LW10
LW11
LW12
LW13
LW14
Ground level
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Rain (mm)
3-day Recession Rate (mm/day)