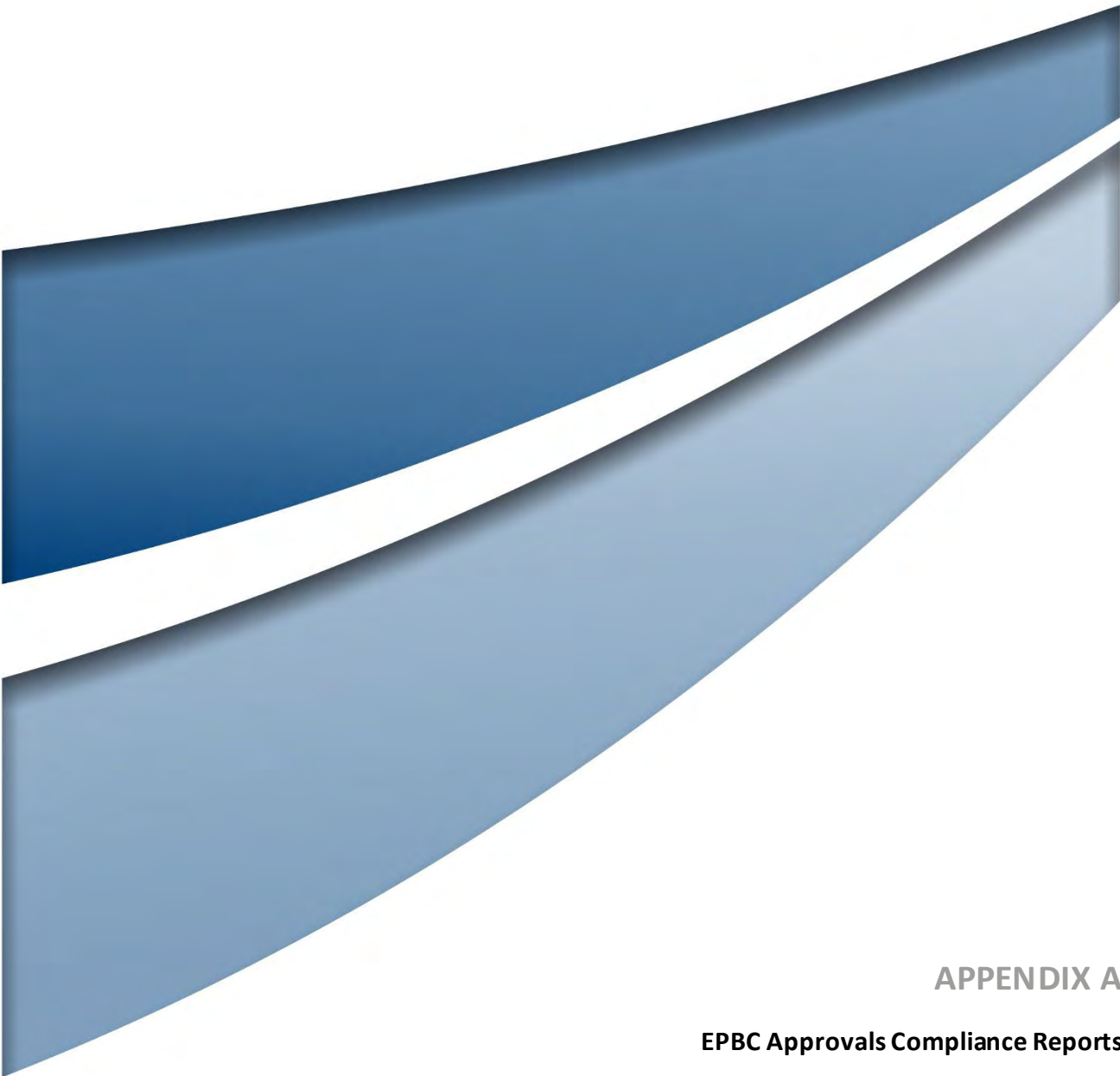




APPENDIX A

EPBC Approvals Compliance Reports

Table A.1 EPBC Approval 2012/6637 Compliance Report

Condition	Actions During the Reporting Period	Status
1. The approval holder must not clear more than 611 ha of native woodland vegetation.	498.15 ha of native woodland vegetation has been cleared to date as part of the Project.	Compliant
2. To compensate for the loss of approximately 557 ha of Regent Honeyeater, Swift Parrot and Grey Headed Flying Fox habitat, 611 ha of Large-eared Pied Bat habitat and approximately 65 Slaty Red Gum trees, the approval holder must provide for the protection of offset lands identified in the maps at Schedule 1 of this notice as: • Reedy Valley Offset Site • Wollombi Brook Conservation Area • Broke Road Offset Site. These offset lands must meet the requirements of the EPBC Offsets Policy and provide for the protection of threatened species habitat on these sites for the duration of the action's impact through a legally binding conservation covenant which must be in force within 3 years of the commencement of the action. Written evidence of compliance against this condition must be provided to the Department prior to the commencement of the action including evidence that action is being taken to put in place a suitable legally binding conservation covenant.	Not applicable, this occurred outside the reporting period. Bulga Coal has formerly established these offset sites as Conservation Agreements under the National Parks and Wildlife Act 1974. The Conservation Agreements were signed by the NSW Minister for the Environment on the 7th of May 2019.	Not Applicable
3. The approval holder must submit for the Minister's approval a Biodiversity Management Plan (BMP) which provides for the offsetting of residual impacts to matters of national environmental significance including but not limited to: • Regent Honeyeater; • Swift Parrot; • Large-eared Pied Bat; • Slaty Red Gum. The BMP must include:	The Biodiversity Management Plan was submitted to the former Department of Environment (now DCCEEW) on 23 February 2015. The DCCEEW provided comments on the draft plan in April 2016, December 2016 and April 2017 and subsequently approved the document in April 2017. A revised version of the Biodiversity Management Plan (following SSD-4960 Mod 3 approval) was submitted to DPE in November 2020 and approved by DPE on 14 October 2021. The revised BMP was then submitted to DCCEEW on 18 November 2021 and approved by DCCEEW on the 23 June 2022.	Compliant

Condition	Actions During the Reporting Period	Status
a). management actions designed to improve the ecological quality of habitat for the above species on offset lands identified in Condition 2 and protect these sites from ecological degradation for the duration of the action's impact on matters of national environmental significance;		
b). an ecological monitoring program to monitor the success of the management actions in the BMP and define measurable targets of management actions, performance indicators, and an adaptive management framework for the duration of the action's impact on habitat for matters of national environmental significance. Management actions prescribed by the BMP must be clear, measurable, auditable and time bound;	The Biodiversity Management Plan contains an ecological monitoring program. Program commenced in 2015. Results are summarised in this Annual Review.	Compliant
c). clear objectives and performance indicators as well as corrective actions for circumstances where a management action fails to meet its prescribed objective or performance indicator. The BMP must be approved in writing by the Minister within 3 months of approval of the action. The approved BMP must be implemented and must be published on the approval holder's website within one month of approval of the BMP and remain published on this website for the duration of the action.	The Biodiversity Management Plan meets the requirements of this condition. The Biodiversity Management Plan was approved by the former DCCEEW in April 2017. The Biodiversity Management Plan is available on the Bulga Coal website.	Compliant
4. The approval holder must submit for the Minister's approval a Water Management Plan (WMP) which provides for the avoidance, mitigation and offsetting of residual impacts to water resources. The WMP must include: a). management actions, mitigation measures and practices designed to limit impacts of the proposal on surface and groundwater resources;	The Water Management Plan was approved by the former DCCEEW in February 2017. A revised version of the Water Management Plan (following SSD-4960 Mod 3 approval) was submitted to DPE in November 2020 and approved by DPE on 14 October 2021. A copy of the revised WMP was then submitted to DCCEEW on 18 November 2021.	Compliant
b). surface and groundwater monitoring programs to monitor the success of the management actions in the WMP and define measurable targets of management actions, performance indicators, and an adaptive management framework for the duration of the action's impact on water resources. Management actions, mitigation measures and practices prescribed by the plan must be clear, measurable, auditable and time bound;	The Water Management Plan meets the requirements of this condition.	Compliant

Condition	Actions During the Reporting Period	Status
c). clear objectives and performance indicators, as well as corrective actions for circumstances where a management action, mitigation measure or practice fails to meet its prescribed objective or performance indicator. The WMP must be approved in writing by the Minister within 3 months of commencement of the action. The approved WMP or plan revised under condition 12 must be implemented.	The Water Management Plan meets the requirements of this condition.	Compliant
5. The approval holder must provide written evidence and detailed documentation relating to the conservation covenant specified in Condition 2 to the Department within one month of the conservation covenant coming into force. This must include offset attributes, shapefiles and textual descriptions and maps to clearly define the location and boundaries of the offset sites.	Not applicable, this occurred prior to the reporting period. Evidence and documentation was provided to the DCCEEW on 20 January 2020.	Not applicable
6. Unless otherwise agreed to in writing by the Minister, the approval holder must provide the approved plans referred to in these conditions of approval to members of the public upon request. Copies must be provided within 14 days of the request.	There have been no requests from members of the public to provide approved plans referred to in the conditions of approval. Notwithstanding, the approved plans are available to the public on the Bulga Coal website.	Not Applicable
7. Within 30 days after the commencement of the action, the approval holder must advise the Department in writing of the actual date of commencement of the action.	Not triggered within the audit period. Action under this approval commenced 3 December 2014. Notification of the commencement of the action was provided by Bulga Coal to the DCCEEW on 2 December 2014.	Not applicable
8. The approval holder must maintain accurate records substantiating all activities associated with or relevant to these conditions of approval, including measures taken to implement the management plans, and make them available upon request to the Department. Such records may be subject to audit by the Department or an independent auditor in accordance with section 458 of the EPBC Act, or used to verify compliance with the conditions of approval. Summaries of audits will be published on the Department's website. The results of audits may also be publicised through the general media.	Accurate records substantiating all activities associated with conditions of approval are maintained in accordance with the Bulga Coal Environmental Management System. Results are also summarised in the Bulga Coal Annual Review. There have been no audits to date.	Compliant

Condition	Actions During the Reporting Period	Status
9. By 31 March each year, the approval holder must publish a report on their website addressing compliance with each of the conditions of this approval including implementation of the management plans for the previous calendar year (i.e. 01 January to 31 December). Documentary evidence providing proof of the date of publication must be provided to the Department at the same time as the compliance report is published.	The 2021 Bulga Coal Annual Review was published on the website and provided to the DCCEEW on 30 March 2022.	Compliant
9A. Potential or actual contraventions of conditions of approval must be reported to the Department in writing within 2 business days of the approval holder becoming aware of the actual or potential contravention. All contraventions must also be included in the annual compliance report outlined in condition 9.	There have been no potential or actual contraventions of conditions of this approval within the reporting period.	Compliant
10. Upon the direction of the Minister, the approval holder must ensure that an independent audit of compliance with the conditions of approval is conducted and a report submitted to the Minister. The independent auditor must be approved by the Minister prior to the commencement of the audit. Audit criteria must be agreed to by the Minister and the audit report must address the criteria to the satisfaction of the Minister.	No directions for an independent audit of compliance with EPBC Ref: 2012/6637 have been received by Bulga Coal.	Not Applicable
11. If, at any time after five (5) years from the date of this approval, the approval holder has not commenced the action, then the approval holder must not commence the action without the written agreement of the Minister.	Action under EPBC Ref: 2012/6637 was commenced 3 December 2014.	Compliant
12. The approval holder may choose to revise a plan approved by the Minister under condition 4 without submitting it for approval under section 143A of the EPBC Act, if the taking of the action in accordance with the revised plan would not be likely to have a new or increased impact. If the approval holder makes this choice they must: i. notify the Department in writing that the approved plan has been revised and provide the Department with an electronic copy of the revised plan. ii. implement the revised plan from the date that the plan is submitted to the Department; and iii. for the life of this approval, maintain a record of the reasons the approval holder considers that taking the action in accordance with the revised plan would not be likely to have a new or increased impact.	A revised version of the Water Management Plan (following SSD-4960 Mod 3 approval) was submitted to DPE in November 2020 and approved by DPE on 14 October 2021. A copy of the revised WMP was then provided to DCCEEW on 18 November 2021 for their records.	Compliant

Condition	Actions During the Reporting Period	Status
12A. The approval holder may revoke their choice under condition 12 at any time by notice to the Department. If the approval holder revokes the choice to implement a revised plan, without approval under section 143A of the Act, the plan approved by the Minister must be implemented.	This condition was not triggered during the reporting period.	Not Applicable
12B. Condition 12 does not apply if the revisions to the approved plan include changes to environmental offsets provided under the plan in relation to a matter protected by the controlling provision for the action, unless otherwise agreed by the Minister. This does not otherwise limit the circumstances in which the taking of the action in accordance with a revised plan would, or would not, be likely to have new or increased impacts.	This condition was not triggered during the reporting period.	Not Applicable
12c. If the Minister gives a notice to the approval holder that the Minister is satisfied that the taking of the action in accordance with the revised plan would be likely to have a new or increased impact, then: i. Condition 12 does not apply, or ceases to apply, in relation to the revised plan; and ii. The approval holder must implement the plan approved by the Minister. To avoid any doubt, this condition does not affect any operation of conditions 12, 12A and 12B in the period before the day the notice is given. At the time of giving the notice the Minister may also notify that for a specified period of time that condition 12 does not apply for one or more of the specified plans required under the approval.	This condition was not triggered during the reporting period.	Not Applicable
12D. Conditions 12, 12A, 12B and 12C are not intended to limit the operation of section 143A of the EPBC Act which allows the approval holder to submit a revised plan, to the Minister for approval.	This condition was not triggered during the reporting period.	Not Applicable
13. Condition 13 has been revoked.	Noted.	Not Applicable

Condition	Actions During the Reporting Period	Status
14. Unless otherwise agreed to in writing by the Minister, the Approval holder must publish all management plans referred to in these conditions of approval on their website. Each Management plan must be published on the website within 1 month of being approved by the minister or being submitted under condition 12i, and remain published for the duration of the action.	The Biodiversity Management Plan was approved by the DCCEEW in April 2017. A revised version of the Biodiversity Management Plan (following SSD-4960 Mod 3 approval) was submitted to DPE in November 2020 and approved by DPE on 14 October 2021. The revised BMP was then submitted to DCCEEW on 18 November 2021 and approved by DCCEEW on the 23 June 2022. A copy of the revised Water Management (previously approved by DCCEEW in February 2017) was provided to DCCEEW on 18 November 2021 for their records, in accordance with Condition 12. The revised WMP plan is available on the Bulga Coal website.	Compliant

Table A.2 EPBC Approval 2018/8300 Compliance Report

Condition	Actions During the Reporting Period	Status
1. The approval holder must comply with State development consent conditions 24, 24A, 25, 26, 27 and 28 of Schedule 3.	Bulga Coal has reported non-compliances with SSD 4960 Schedule 3 Condition 26 and Schedule 3 Condition 27, as detailed in Section 1.0, Table 2 .	Non-Compliant
2. The approval holder must determine the extent and distribution of riparian vegetation (including EPBC Act listed ecological communities identified as being partially or wholly groundwater dependent, including the EPBC Act listed Warkworth Sands Woodland of the Hunter Valley) and potential for stygofauna within the alluvium that are likely to be affected by the action, through ground-truthing surveys. The approval holder must submit the findings of these surveys to the Department within 15 months of the date of this approval or prior to open cut mining below the Woodlands Hill Seam in the Modification Additional Coal Extraction Area (delineated by a blue boundary at Annexure 1).	Bulga Coal was granted a 3 month extension to the required timeframe to satisfy this condition, and the condition was varied on 9 September 2021. Bulga Coal submitted a Ecohydrological Assessment satisfying conditions 2 and 3 to the DCCEEW on 20 December 2021.	Compliant

Condition	Actions During the Reporting Period	Status
3. To investigate how changes in the rate of water movement through the environment may impact water-dependent ecosystems, the approval holder must develop ecohydrological conceptual models flora. the potential impacts to ephemeral streams and the Wollombi Brook. the EPBC Act listed Warkworth Sands Woodland of the Hunter Valley ecological community to show how the perched aquifer and associated groundwater dependent ecosystems may be affected by the action. The ecohydrological conceptual models must include potential changes to flow regimes (frequency, duration and timing of low- and zero-flow periods) and how this could impact biota, including through changes in refugial pool persistence. The approval holder must submit the ecohydrological models to the Minister for approval within 15 months of the date of this approval. The approval holder must not commence mining below the Woodlands Hill Seam unless the Minister has approved the ecohydrological models in writing.	Bulga Coal was granted a 3 month extension to the required timeframe to satisfy this condition, and the condition was varied on 9 September 2021. Bulga Coal submitted a Ecohydrological Assessment satisfying conditions 2 and 3 to the DCCEEW on 20 December 2021.	Compliant
4. Within the Modification Additional Disturbance Areas (delineated by a red boundary at Annexure 1), the approval holder must not clear more than: a. 16.4 hectares of Regent Honeyeater (<i>Anthochaera phrygia</i>) habitat, b. 16.4 hectares of Swift Parrot (<i>Lathamus discolor</i>) habitat, c. 16.4 hectares of the Central Hunter Valley Eucalypt Forest and Woodland EPBC Act listed ecological community.	A total of 0.39 ha of Central Hunter Valley Eucalypt Forest and Woodland has been cleared within the Modification additional disturbance area to date.	Compliant
5. The approval holder must comply with the State development consent conditions 29, 30, 33, 33A, 33B, 34 and 34A of Schedule 3.a. To compensate for the loss of the listed threatened species and ecological community habitat identified at condition 4, the approval holder must submit the Biodiversity Offset Strategy (specified at condition 29 of the State development consent) to the Minister for approval. i. The approval holder must not commence vegetation clearing within the modification additional disturbance area (delineated by a red boundary at Annexure 1) until the Biodiversity Offset Strategy has been approved by the Minister. ii. The approval holder must implement the Biodiversity Offset Strategy as approved by the Minister.	Noted. Bulga has been compliant with the relevant SSD-4960 State development consent conditions since EPBC Approval 2018/8300 was granted. The Biodiversity Offset Strategy is within the approved Biodiversity Management Plan. A revised version of the Biodiversity Management Plan (following SSD-4960 Mod 3 approval) was submitted to DPE in November 2020 and approved by DPE on 14 October 2021. The revised BMP was then submitted to DCCEEW on 18 November 2021 and approved by DCCEW on the 23 June 2022.	Compliant

Condition	Actions During the Reporting Period	Status
6. The approval holder must comply with the State development consent conditions 53, 54, 55 and 56.	Noted. Bulga Coal has been compliant with the relevant SSD-4960 State development consent conditions since EPBC Approval 2018/8300 was granted. The Mining Operations Plan was approved by the DPE on 9 September 2020, the Mining Operations Plan was revised and approved by the RR on 22 October 2021, a copy of the Mining Operations Plan Amendment A is available on the Bulga Coal Website.	Compliant
7. The approval holder must notify the Department in writing of the date of commencement of the action within 10 business days after the date of commencement of the action.	Not applicable, occurred before the reporting period. Bulga Coal commenced the action on 22 September 2020 and notified the DCCEEW on 24 September 2020.	Not Applicable
8. If the commencement of the action does not occur within 5 years from the date of this approval, then the approval holder must not commence the action without the prior written agreement of the Minister.	Not applicable, occurred before the reporting period. Bulga Coal commenced the action on 22 September 2020 and notified the DCCEEW on 24 September 2020.	Not Applicable
9. The approval holder must maintain accurate and complete compliance records.	Compliant. Accurate records substantiating all activities associated with conditions of approval are maintained in accordance with the Bulga Coal Environmental Management System. Results are also summarised in the Bulga Coal Annual Review.	Compliant
10. If the Department makes a request in writing, the approval holder must provide electronic copies of compliance records to the Department within the timeframe specified in the request. Note: Compliance records may be subject to audit by the Department or an independent auditor in accordance with section 458 of the EPBC Act, and or used to verify compliance with the conditions. Summaries of the result of an audit may be published on the Department's website or through the general media.	Noted. This has not been triggered to date. No requests have been received from the Department.	Not Applicable

Condition	Actions During the Reporting Period	Status
11. The approval holder must: a. Submit the ecohydrological models required under condition 3 and the Biodiversity Offset Strategy required under condition 5. an electronically to the Department for approval by the Minister, b. publish the ecohydrological models on the website within 20 business days of the date the ecohydrological models are approved by the Minister, unless otherwise agreed to in writing by the Minister, c. publish the Biodiversity Offset Strategy on the website within 20 business days of the date the Biodiversity Offset Strategy is approved by the Minister, unless otherwise agreed to in writing by the Minister, d. exclude or redact sensitive ecological data from the Biodiversity Offset Strategy published on the website or provided to a member of the public, and e. keep the ecohydrological models and Biodiversity Offset Strategy published on the website until the end date of this approval.	On 20 December 2021 the ecohydrological models report was submitted to the DCCEEW for approval. The revised BMP (inclusive of the Biodiversity Offset Strategy) was then submitted to DCCEEW on 18 November 2021 and approved by DCCEEW on the 23 June 2022.	Compliant
12. The approval holder must prepare a compliance report addressing compliance with each of the conditions of this approval, including implementation of any management plans and strategies from the State development consent that are referred to in this approval, for each 12 month period following the date of commencement of the action, or otherwise in accordance with an annual date that has been agreed to in writing by the Minister. The approval holder must: a. publish each compliance report on a website within 60 business days following the relevant 12 month period, b. notify the Department by email that a compliance report has been published on the website and provide the website's link for the compliance report within five business days of the date of publication, c. keep all compliance reports publicly available on the website until this approval expires, d. exclude or redact sensitive ecological data from compliance reports published on the website, and e. where any sensitive ecological data has been excluded from the version published, submit the full compliance report to the Department within 5 business days of publication. Note: Compliance reports may be published on the Department's website.	This is the compliance report. The 2021 compliance report was submitted to DCCEEW on 30 March 2022 (1 day late). Bulga reported this as a non-compliance at the same time, and also requested a modification to the approval condition. On the 21 April 2022 DCCEEW granted approval to change the reporting submission date to the 31 March each year to align with the Annual Review report submission date.	Non-Compliant
13. The approval holder must notify the Department in writing of any: incident, or non-compliance with the conditions, or non-compliance with the commitments made in plans. The notification must be given as soon as practicable, and no later than two business days after becoming aware of the incident or non-compliance. The notification must specify: a. any condition which is in breach, b. a short description of the incident and/or non-compliance, and c. the location (including co-ordinates), date, and time of the incident and/or non-compliance. In the event the exact information cannot be provided, provide the best information available.	There have not been any incidents or non-compliances with the conditions which have required notification.	Compliant

Condition	Actions During the Reporting Period	Status
14. The approval holder must provide to the Department the details of any incident or noncompliance with the conditions or commitments made in plans as soon as practicable and no later than 10 business days after becoming aware of the incident or non-compliance, specifying: a. any corrective action or investigation which the approval holder has already taken or intends to take in the immediate future, b. the potential impacts of the incident or non-compliance, and c. the method and timing of any remedial action that will be undertaken by the approval holder.	There have not been any incidents or non-compliances with the conditions which have required notification.	Compliant
15. The approval holder must ensure that independent audits of compliance with the conditions are conducted as requested in writing by the Minister.	This condition has not been triggered. No requests for an audit have been received by the Minister to date.	Not Applicable
16. For each independent audit, the approval holder must: a. provide the name and qualifications of the independent auditor and the draft audit criteria to the Department, b. only commence the independent audit once the audit criteria have been approved in writing by the Department, and c. submit an audit report to the Department within the timeframe specified in the approved audit criteria.	This condition has not been triggered. No requests for an audit have been received by the Minister to date.	Not Applicable
17. The approval holder must publish the audit report on the website within 10 business days of receiving the Department's approval of the audit report and keep the audit report published on the website until the end date of this approval.	This condition has not been triggered. No requests for an audit have been received by the Minister to date.	Not Applicable
18. The approval holder must comply with the State development consent condition 5 in Schedule 2.	Noted. Condition 5 in Schedule 2 states that the Applicant may carry out mining operations on site until 31 December 2039.	Compliant
19. Within 30 days after the completion of the action, the approval holder must notify the Department in writing and provide completion data.	This has not been triggered. The action has not been completed.	Not Applicable
20. The approval holder must notify the Department in writing of any proposed change to the State development consent conditions referred to in these conditions within 10 business days of formally proposing a change or becoming aware of any proposed change.	This condition has not been triggered. There has been no proposed changes to the relevant SSD-4960 consent conditions since EPBC Approval 2018/8300 was granted.	Not Applicable
21. The approval holder must notify the Department in writing of any change to the conditions of the State development consent referred to in these conditions, within 10 business days of a change to conditions being finalised.	This condition has not been triggered. There has been no changes to the relevant SSD-4960 consent conditions since EPBC Approval 2018/8300 was granted.	Not Applicable

Condition	Actions During the Reporting Period	Status
22. The approval holder may, at any time, apply to the Minister for a variation to an action management plan approved by the Minister under conditions 3 and 5.a, or as subsequently revised in accordance with these conditions, by submitting an application in accordance with the requirements of section 143A of the EPBC Act. If the Minister approves a revised action management plan (RAMP) then, from the date specified, the approval holder must implement the RAMP in place of the previous action management plan.	This condition has not been triggered during the reporting period.	Not Applicable
23. The approval holder may choose to revise an action management plan approved by the Minister under conditions 3 and 5.a, or as subsequently revised in accordance with these conditions, without submitting it for approval under section 143A of the EPBC Act, if the taking of the action in accordance with the RAMP would not be likely to have a new or increased impact.	This condition has not been triggered during the reporting period.	Not Applicable
24. If the approval holder makes the choice under condition 21 to revise an action management plan without submitting it for approval, the approval holder must: a. notify the Department in writing that the approved action management plan has been revised and provide the Department with: i. an electronic copy of the RAMP, ii. an electronic copy of the RAMP marked up with track changes to show the differences between the approved action management plan and the RAMP, iii. an explanation of the differences between the approved action management plan and the RAMP,1 Condition 5 in Schedule 2 states that the Applicant may carry out mining operations on the site until 31 December 2039.iv. the reasons the approval holder considers that taking the action in accordance with the RAMP would not be likely to have a new or increased impact, and written notice of the date on which the approval holder will implement the RAMP(RAMP implementation date), being at least 20 business days after the date of providing notice of the revision of the action management plan, or a date agreed to in writing with the Department. b. subject to condition 24, implement the RAMP from the RAMP implementation date.	This condition has not been triggered during the reporting period.	Not Applicable
25. The approval holder may revoke their choice to implement a RAMP under condition 21 at anytime by giving written notice to the Department. If the approval holder revokes the choice under condition 21, the approval holder must implement the action management plan in force immediately prior to the revision undertaken under condition 21.	This condition has not been triggered during the reporting period.	Not Applicable

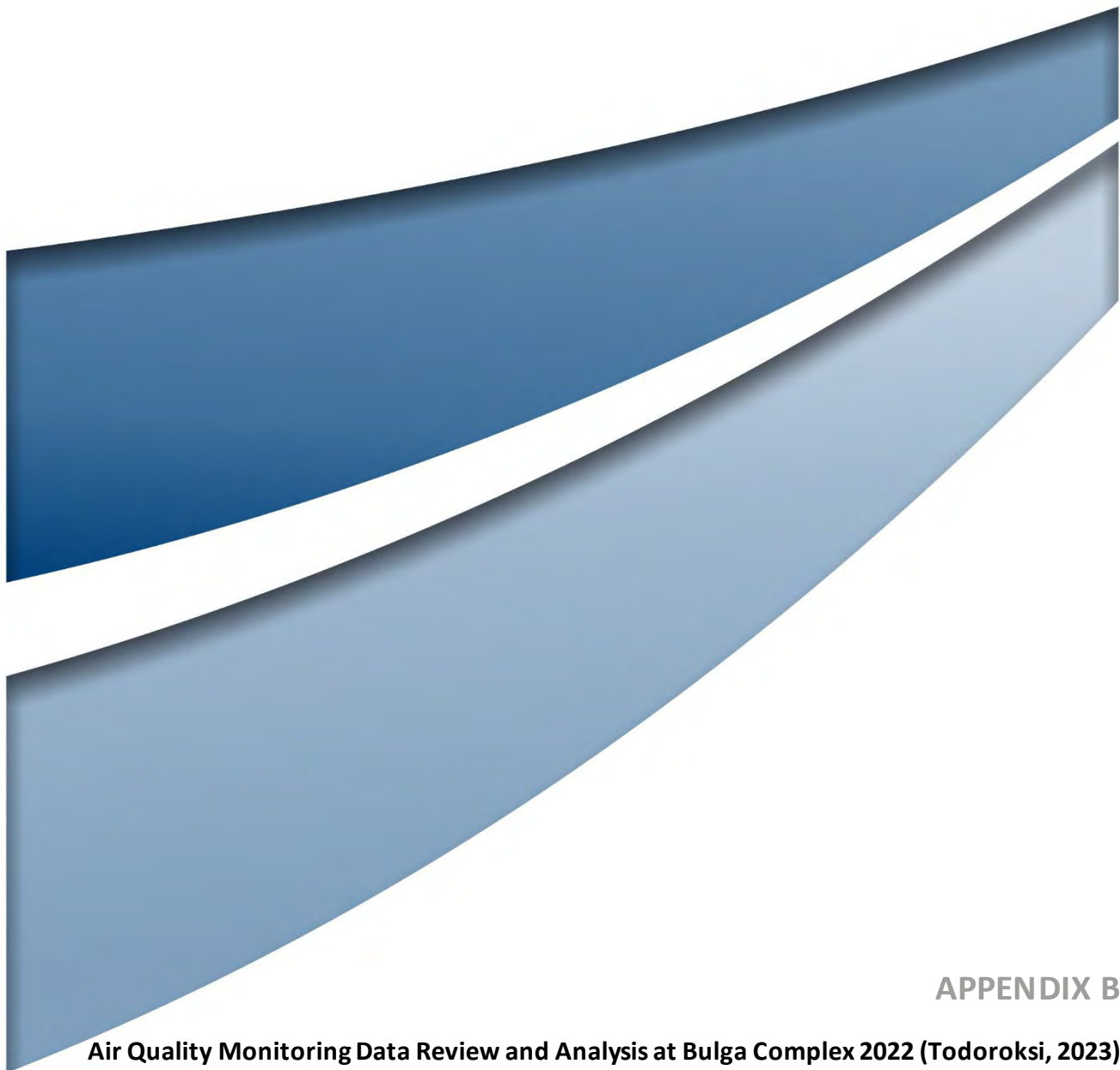
Condition	Actions During the Reporting Period	Status
26. If the Minister gives a notice to the approval holder that the Minister is satisfied that the taking of the action in accordance with the RAMP would be likely to have a new or increased impact, then: a. condition 21 does not apply, or ceases to apply, in relation to the RAMP; and b. the approval holder must implement the action management plan specified by the Minister in the notice.	This condition has not been triggered during the reporting period.	Not Applicable
27. At the time of giving the notice under condition 24, the Minister may also notify that for a specified period of time, condition 21 does not apply for one or more specified action management plans. Note: conditions 21, 22, 23 and 24 are not intended to limit the operation of section 143A of the EPBC Act which allows the approval holder to submit a revised action management plan, at any time, to the Minister for approval.	This condition has not been triggered during the reporting period.	Not Applicable

Table A.3 EPBC Approval 2002/773 Compliance Report

Condition	Actions During the Reporting Period	Status
1. Prior to the commencement of the mine expansion, the person taking the action must submit for the Minister's approval a plan for managing the impacts of subsidence on the environment on Commonwealth land. The plan must include: i. a full description, including maps, of the area that may be impacted by mining activity, including areas of environmental and heritage sensitivity; ii. predictions of the expected extent of subsidence; iii. a detailed outline of the potential environmental, heritage, land use and other impacts of subsidence; iv. proposals to minimise the impacts of surface subsidence, particularly in areas of environmental and heritage sensitivity; v. measures for ground and surface water monitoring and management; vi. proposals for any necessary rehabilitation and repair of subsidence impacts; vii. a process of stakeholder consultation, and; viii. a detailed and ongoing Subsidence Monitoring and Reporting Program. The plan must be submitted for the approval of the Minister within three years of the date of this approval.	Not Applicable in reporting period. Longwall operations commenced in Commonwealth Land in November 2015. Following completion of mining in Blakefield South Longwall 8 on 28 July 2017, all mining within the Commonwealth Land is now complete.	Not Applicable

Condition	Actions During the Reporting Period	Status
The approved plan must be implemented		
2. Within one year of the Commencement of mining activities on Commonwealth land and at the completion of mining activities, the person taking the action must ensure that an independent audit of compliance with the plan referred to in paragraph 1 is conducted and a report submitted to the Minister. The independent auditor must be approved by the Minister prior to the commencement of the audit. Audit criteria must be agreed to by the Minister and the audit report must address the criteria to the satisfaction of the Minister.	Not Applicable in reporting period. The initial audit was submitted on 9 March 2016 and was approved on 21 April 2017. The audit done upon completion of mining activities was submitted on the 15 March 2019 and was approved on 18 July 2019.	Not Applicable
3 The person taking the action may choose to revise a management plan approved by the Minister under Condition 1 without submitting it for approval under section 143A of the EPBC Act, if the taking of the action is accordance with the revised plan would not be likely to have a new of increased impact, If the person taking the action makes this choice they must: - notify the Department in writing that the approved plan has been revised and provide the Department with an electronic copy of the revised plan; - implement the revised plan from the date that the plan is submitted to the Department; and - for the life of this approval, maintain a record of the reasons the person taking the action considers that taking the action in accordance with the revised plan would not be likely to have a new or increased impact.	This condition was not triggered during the reporting period.	Not Applicable
3A. The person taking the action may revoke their choice under condition 3 or any time by notice to the Department. If the person taking the action revokes the choice to implement a revised plan, without approval under section 143A of the Act, the plan approved by the Minister must be implemented.	This condition was not triggered during the reporting period.	Not Applicable

Condition	Actions During the Reporting Period	Status
3B. If the Minister gives a notice to the person taking the action that the Minister is satisfied that the taking of the action in accordance with the revised plan would be likely to have a new of increased impact, then: - Condition 3 does not apply, or ceases to apply, in relation to the revised plan. - The person taking the action must implement the plan approved by the Minister. To avoid any doubt, the condition does not affect any operation of conditions 3l, 3A in the period before the date the notice is given. At the time of giving the notice the Minister may also notify that for a specified period of time that Condition 3 does not apply for one or more specified plans required under the approval.	This condition was not triggered during the reporting period.	Not Applicable
3C. Conditions 3, 3A and 3B are not intended to limit the operation of Section 143A of the EPBC Act which allows the person taking the action to submit a revised plan to the Minister for approval.	Noted. Conditions 3, 3A and 3B were not triggered during the reporting period.	Not Applicable
4. The Condition was revoked the day the Variation Notice was signed.	Noted.	Not Applicable
5. On 1 July of each year after the commencement of raining operations on Commonwealth land, the General Manager of Bulge Coal Management Pty Ltd must provide a certificate stating that the Bulga Coal Management Pty Ltd has complied with the conditions of this Approval.	This report and the Bulga Coal Annual Review details how Bulga Coal has complied with the conditions of the Approval. Approval from DCCEEW was granted on 17 March 2021 to align EPBC approval reporting dates to NSW state government compliance reporting obligations. An annual compliance report for 1 January 2022 to 31 December 2021 reporting period was submitted on 30 March 2022. No non-compliances were identified.	Compliant



APPENDIX B

Air Quality Monitoring Data Review and Analysis at Bulga Complex 2022 (Todoroksi, 2023)



AIR QUALITY MONITORING DATA REVIEW AND ANALYSIS AT BULGA COMPLEX 2022

Bulga Coal

27 January 2023

Job Number 14070348T

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Air Quality Monitoring Data Review and Analysis at Bulga Complex 2022

DOCUMENT CONTROL

Report Version	Date	Prepared by	Reviewed by
DRAFT - 001	24/01/2023	K Trahair	E Aragnou
DRAFT - 002	25/01/2023	K Trahair	
FINAL - 001	27/01/2023	K Trahair	

This report has been prepared in accordance with the scope of works between Todoroski Air Sciences Pty Ltd (TAS) and the client. TAS relies on and presumes accurate the information (or lack thereof) made available to it to conduct the work. If this is not the case, the findings of the report may change. TAS has applied the usual care and diligence of the profession prevailing at the time of preparing this report and commensurate with the information available. No other warranty or guarantee is implied in regard to the content and findings of the report. The report has been prepared exclusively for the use of the client, for the stated purpose and must be read in full. No responsibility is accepted for the use of the report or part thereof in any other context or by any third party.

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1 INTRODUCTION

This report has been prepared by Todoroski Air Sciences on behalf of Bulga Coal. The report presents a review and analysis of the dust monitoring data recorded at the Bulga Complex and includes a comparison between the dust levels measured in 2022 with the modelled predictions for the approximate year (Year 2022) per the *Bulga Coal Complex Modification 3 Air Quality Impact Assessment* (Jacobs, 2019) and a long-term trend analysis of air quality data from the beginning of monitoring to the end of 2022.

The review involved analysis of the monitoring data retrieved from:

- ✦ the Bulga Complex monitors including High Volume Air Samplers (HVAS), Tapered Element Oscillating Microbalances (TEOMs), Beta Attenuation Monitors (BAMs), E-BAMs and Dust Deposition Gauges; and,
- ✦ concurrent meteorological data from the Bulga Complex, Southern Extension and Flares weather stations collected over the same period.



2 PROJECT SETTING AND METEOROLOGY

Figure 2-1 presents the location of the Bulga Complex in the context of the Hunter Valley and the Upper Hunter Air Quality Monitoring Network (UHAQMN) monitoring locations.

Figure 2-2 shows the locations of the weather stations at the Bulga Complex, together with the 2022 annual wind distributions at the weather stations (refer to **Appendix A** for how to read a windrose plot).

The weather stations experienced generally similar wind patterns with winds from the south dominating the annual distribution. All stations recorded very few winds from the northeast. The Flares weather station experienced lower wind speeds compared to the other stations.

Figure 2-3 shows the seasonal windroses at the weather stations for 2022. The weather stations generally experienced similar seasonal wind patterns. The Bulga Met (Complex) weather station recorded fewer winds from the south/south-southwest in winter compared with the Southern Extension and Flares weather stations. The Flares station recorded a higher percentage of light and calm winds compared to the other weather stations most likely due to sheltering from vegetation.

Appendix B provides a summary of the percentage data capture for each weather station during 2022.

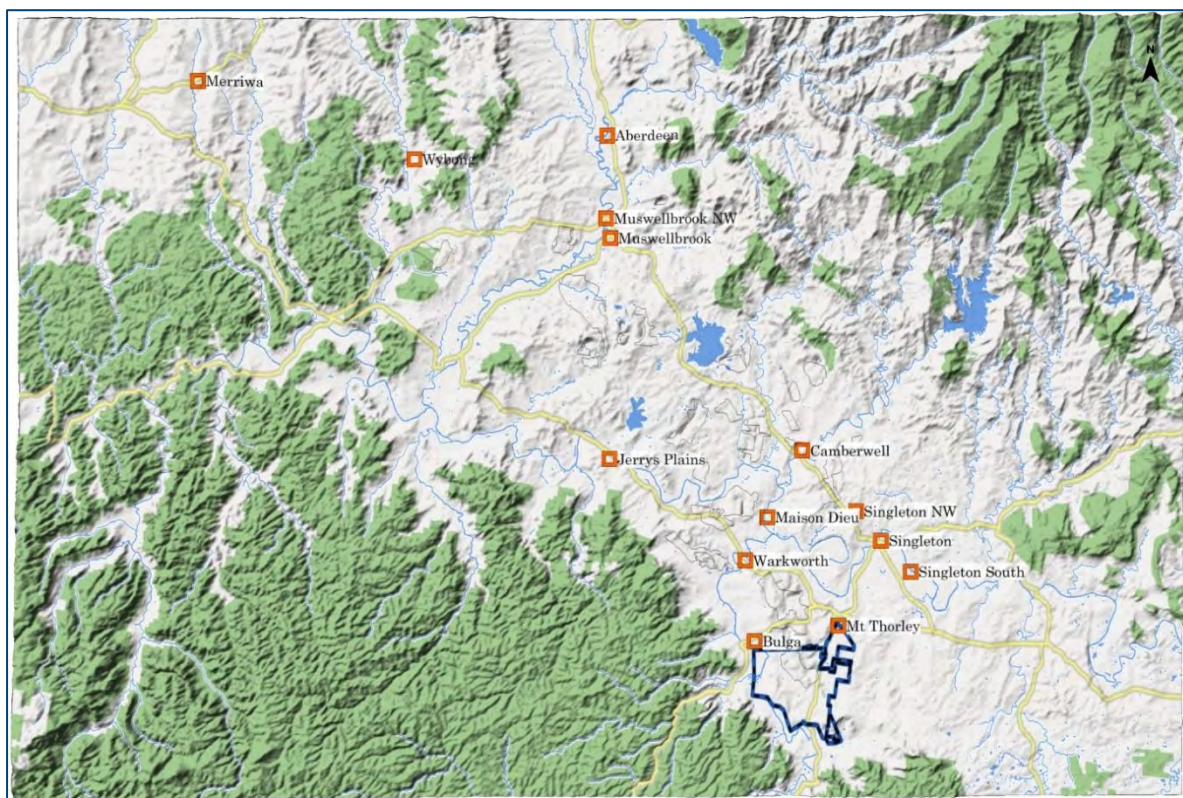
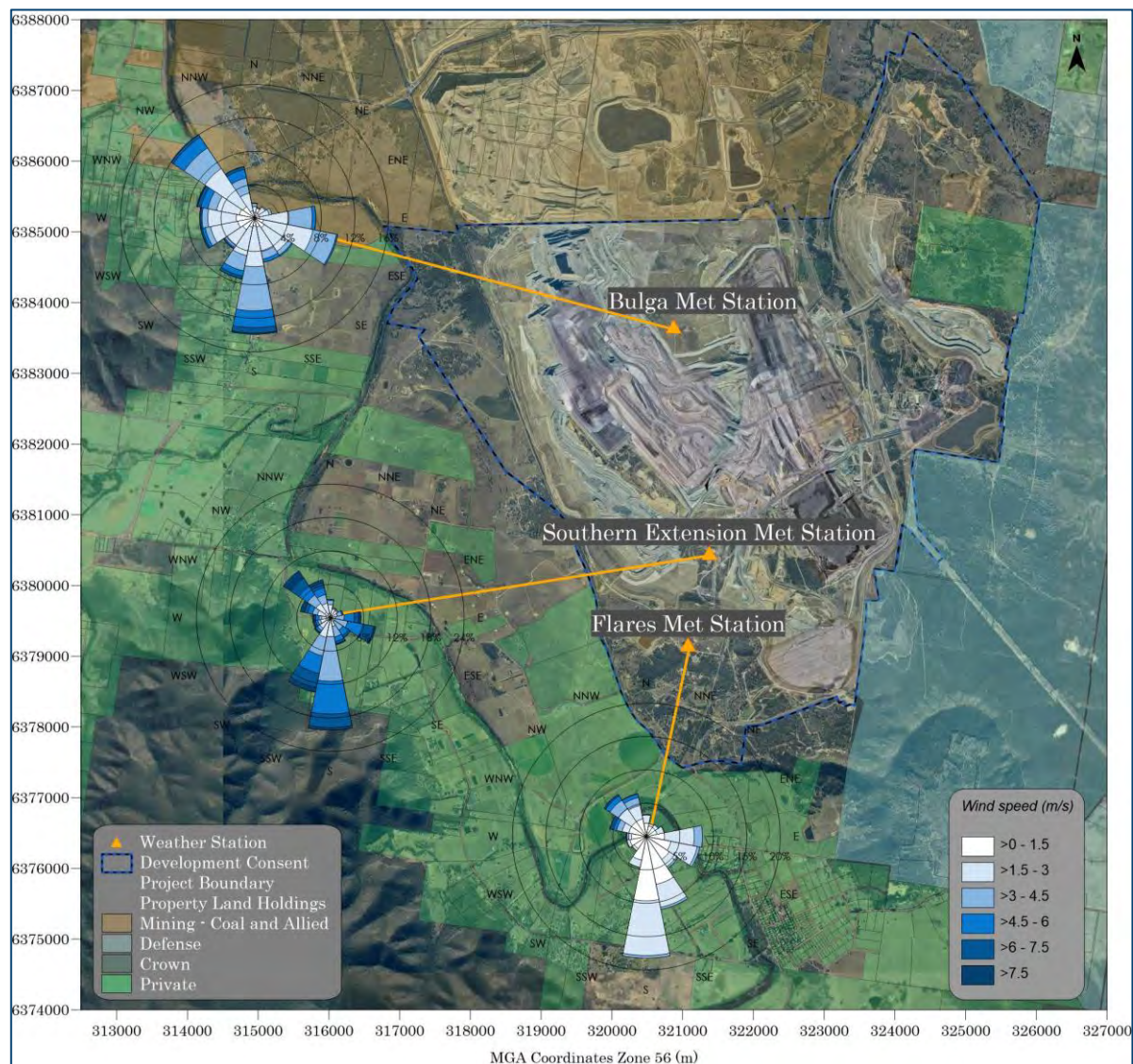


Figure 2-1: Site Location



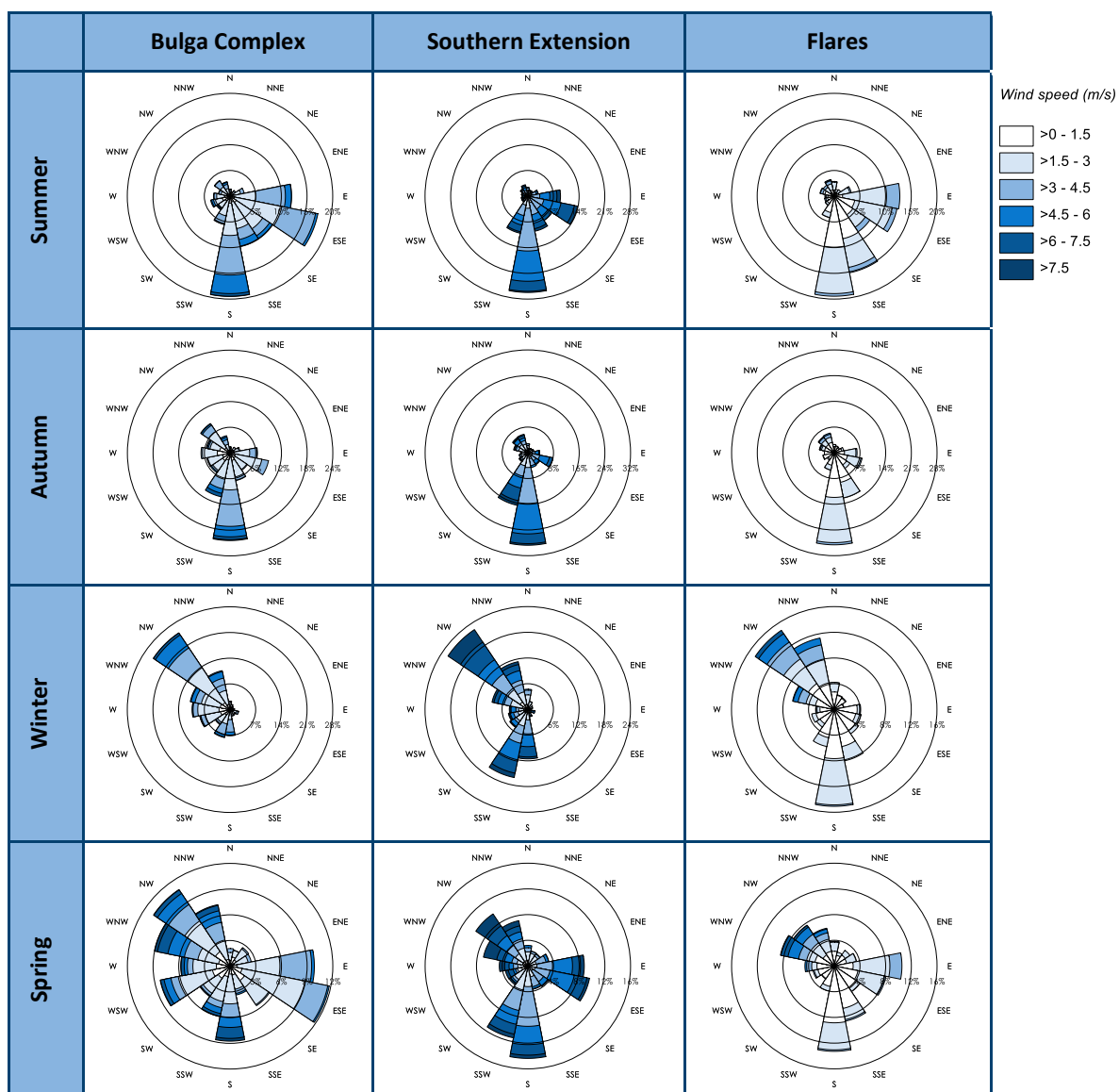


Figure 2-3: Windroses for each season of 2022 for the Bulga Complex, Southern Extension and Flares weather stations

3 COMPARISON OF MEASURED 2022 DATA AND MODEL PREDICTIONS

The locations of the HVAS, TEOM, BAM, E-BAM and deposited dust gauge monitors surrounding the Bulga Complex are shown in **Figure 3-1**.

Monitoring data collected at these locations during 2022 were compared with modelling predictions for the approximate year (Year 2022) per the *Bulga Coal Complex Modification 3 Air Quality Impact Assessment* (**Jacobs, 2019**).

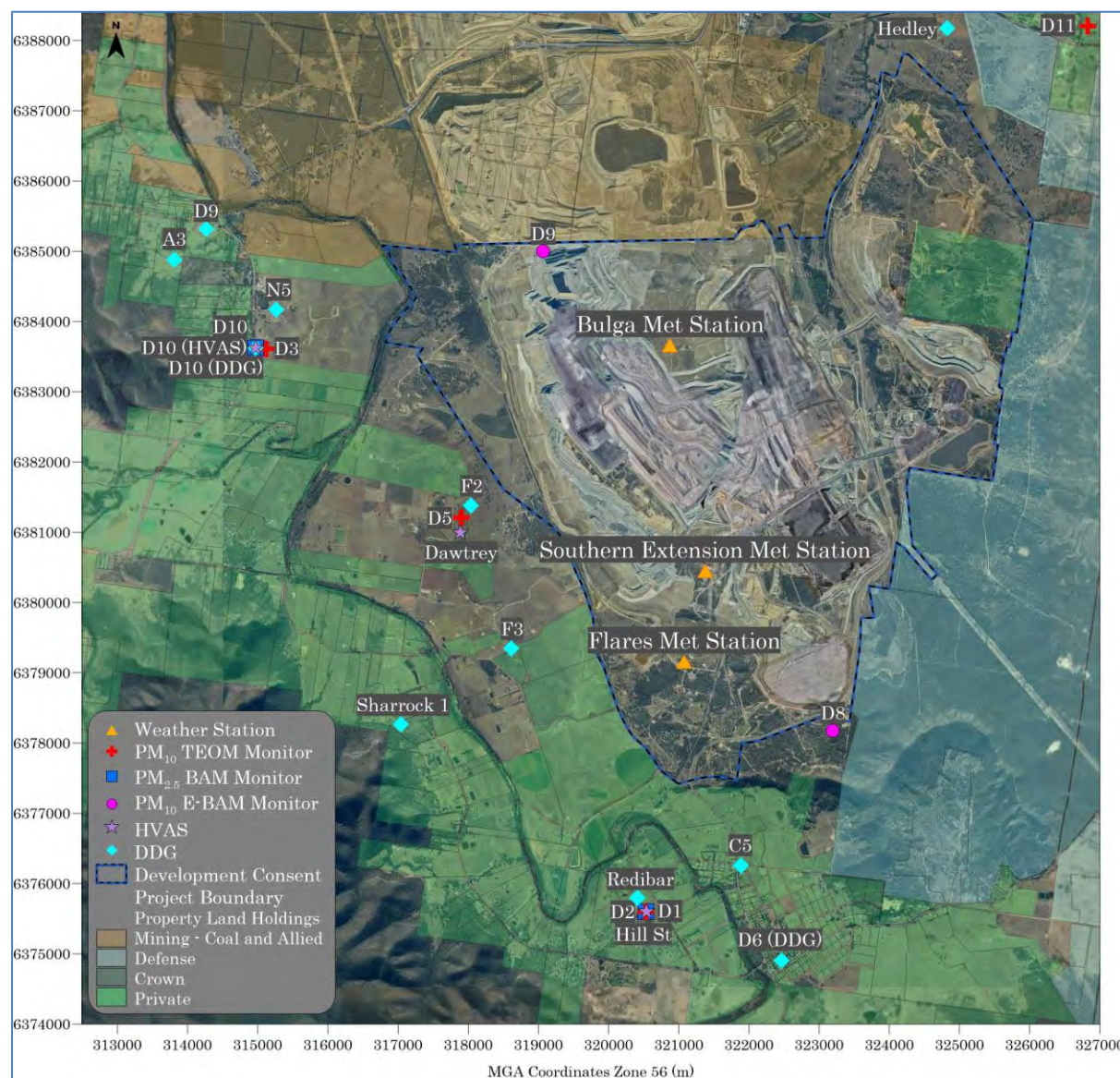


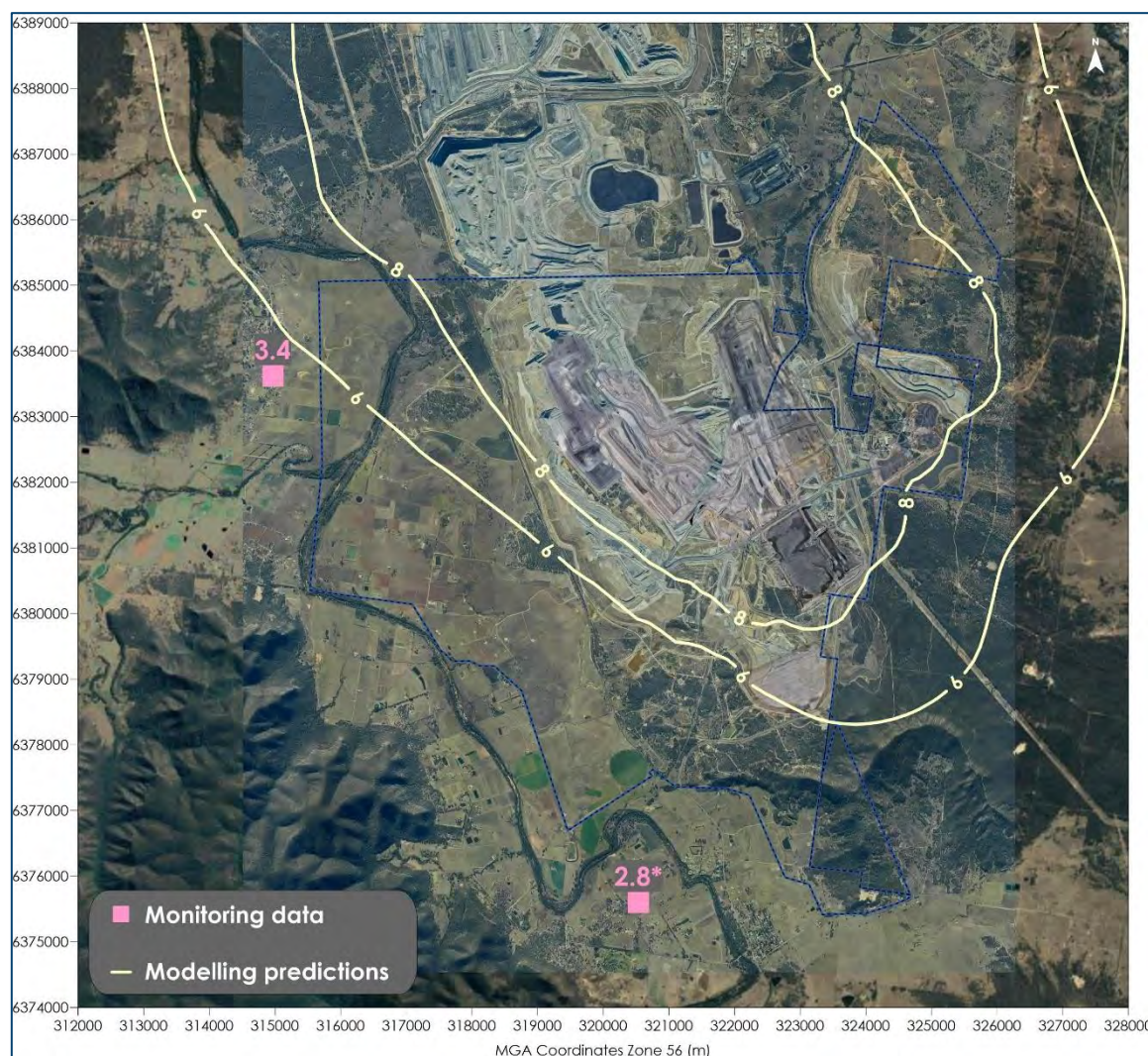
Figure 3-1: Air quality monitoring locations

3.1 Annual average PM_{2.5}

Figure 3-2 presents the measured 2022 annual average PM_{2.5} data superimposed over the dispersion modelling contours reproduced from the *Bulga Coal Complex Modification 3 Air Quality Impact Assessment* (Year 2022) (**Jacobs, 2019**). The measured and predicted data in the figures include dust levels from Bulga and other sources.

It is noted that there is insufficient data (less than 75%) at the D2 monitor in 2022 to calculate a valid annual average, however for the purpose of this comparison an average of the available data has been presented. There is no valid 24-hour average data available at the D2 monitor from the start of the reporting period until 29/04/2022 due to an issue identified with the heater which caused the monitor to record abnormally high PM_{2.5} levels. Bulga Coal investigated the issue and replaced the heater and temperature sensor cable.

Figure 3-2 indicates that the measured annual average PM_{2.5} levels in 2022 are approximately 2µg/m³ lower than the predicted levels for the Year 2022 modelling scenario.



* Insufficient data (less than 75%) for an annual average calculation

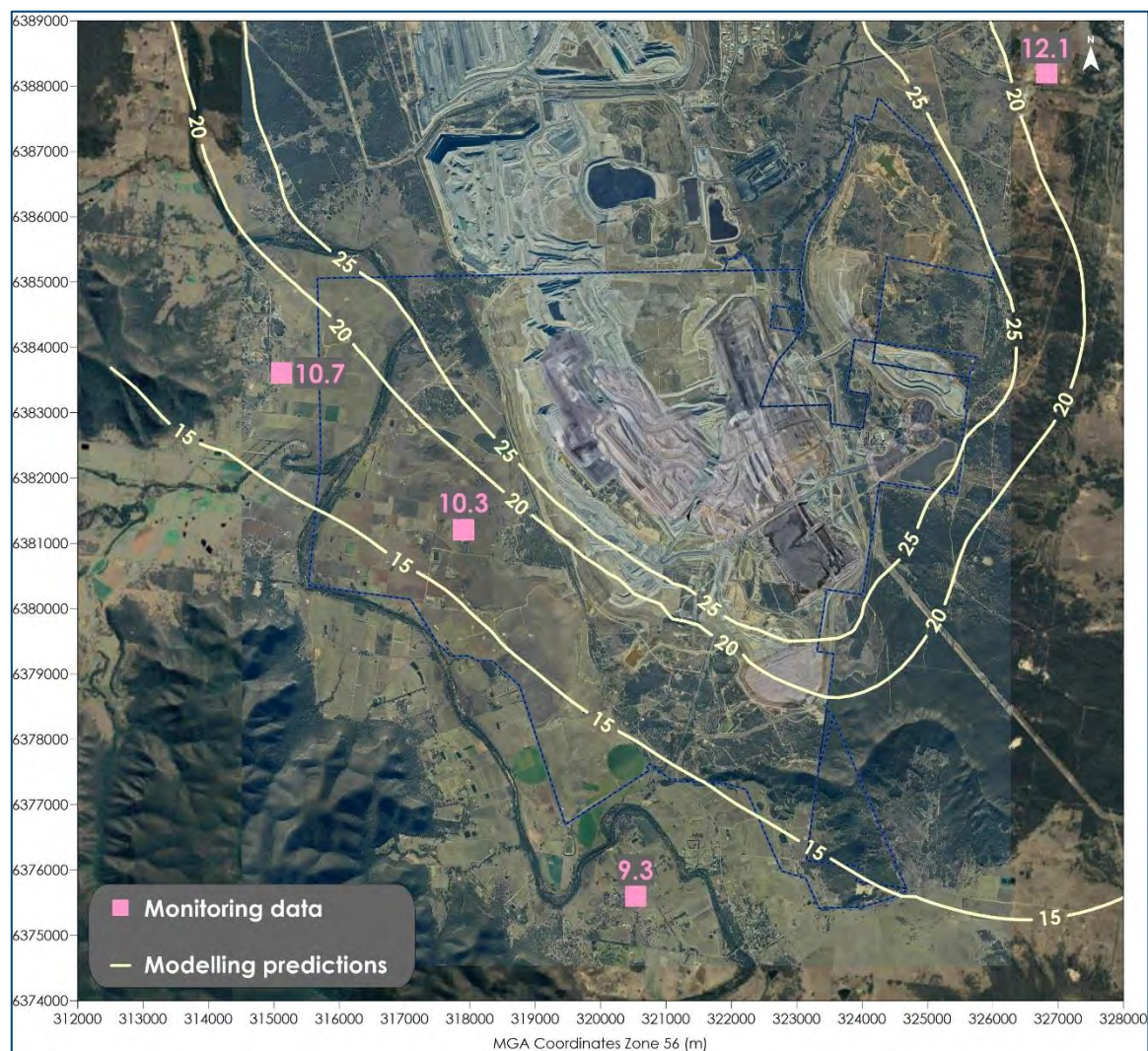
Source: **Jacobs, 2019**

Figure 3-2: 2022 PM_{2.5} annual average monitoring data superimposed over the predicted PM_{2.5} annual average modelling contour (Year 2022 cumulative)

3.2 Annual average PM₁₀

Figure 3-3 presents the measured 2022 annual average PM₁₀ data superimposed over the dispersion modelling contours reproduced from the *Bulga Coal Complex Modification 3 Air Quality Impact Assessment* (Year 2022) (**Jacobs, 2019**). The measured and predicted data in the figures include dust levels from Bulga and other sources.

Figure 3-3 indicates that the measured annual average PM_{10} levels in 2022 are approximately $5\mu\text{g}/\text{m}^3$ to $6\mu\text{g}/\text{m}^3$ lower than the predicted levels for the Year 2022 modelling scenario.



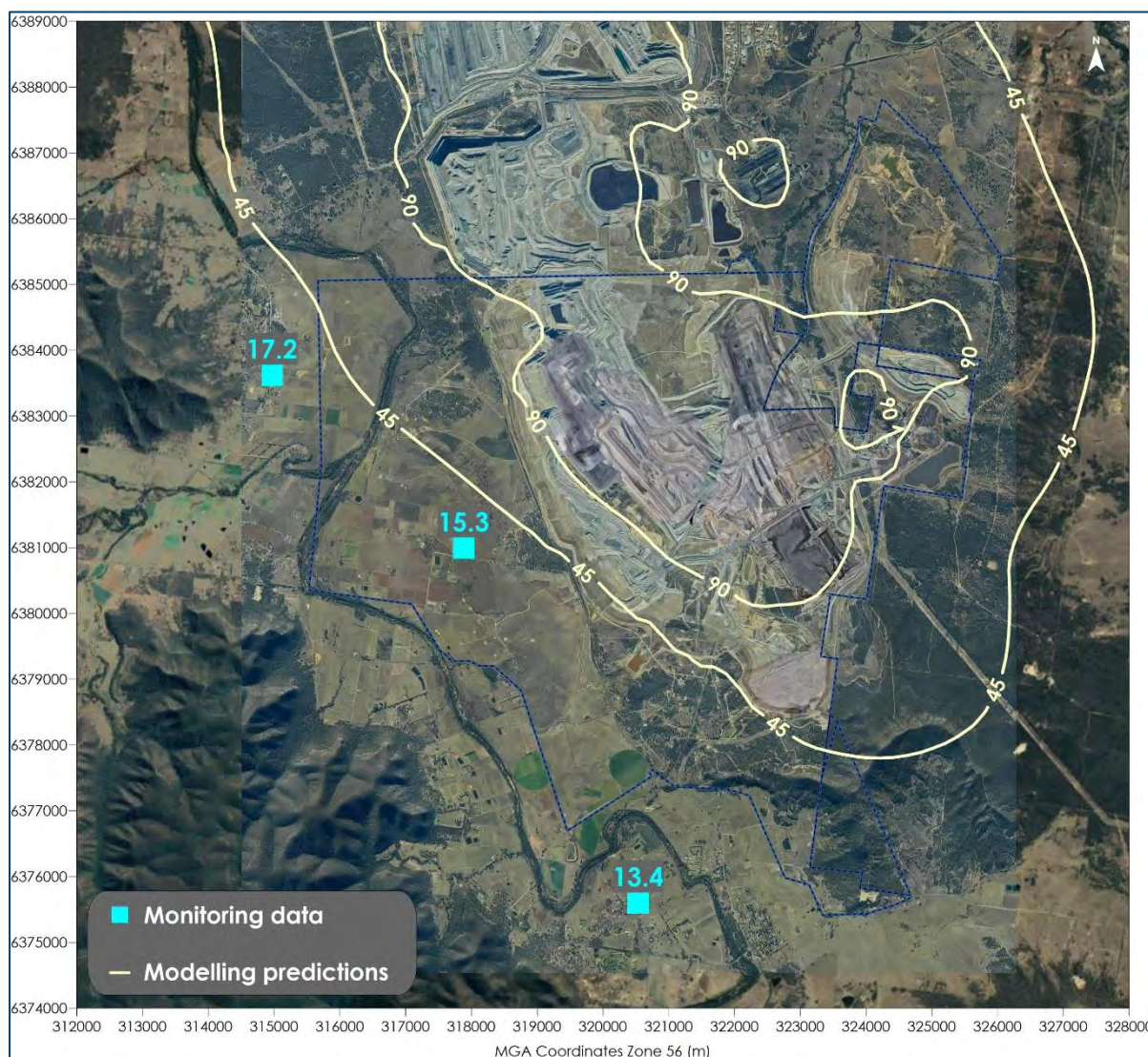
Source: **Jacobs, 2019**

Figure 3-3: 2022 PM_{10} annual average monitoring data superimposed over the predicted PM_{10} annual average modelling contour (Year 2022 cumulative)

3.3 Annual average TSP

Figure 3-4 presents the measured 2022 annual average TSP data superimposed over the dispersion modelling contours reproduced from the *Bulga Coal Complex Modification 3 Air Quality Impact Assessment* (Year 2022) (Jacobs, 2019). The measured and predicted data in the figures include dust levels from Bulga and other sources.

Figure 3-4 indicates that the measured annual average TSP levels in 2022 are approximately $25\mu\text{g}/\text{m}^3$ lower than the predicted levels for the Year 2022 modelling scenario.



Source: Jacobs, 2019

Figure 3-4: 2022 TSP annual average monitoring data superimposed over the predicted TSP annual average modelling contour (Year 2022 cumulative)

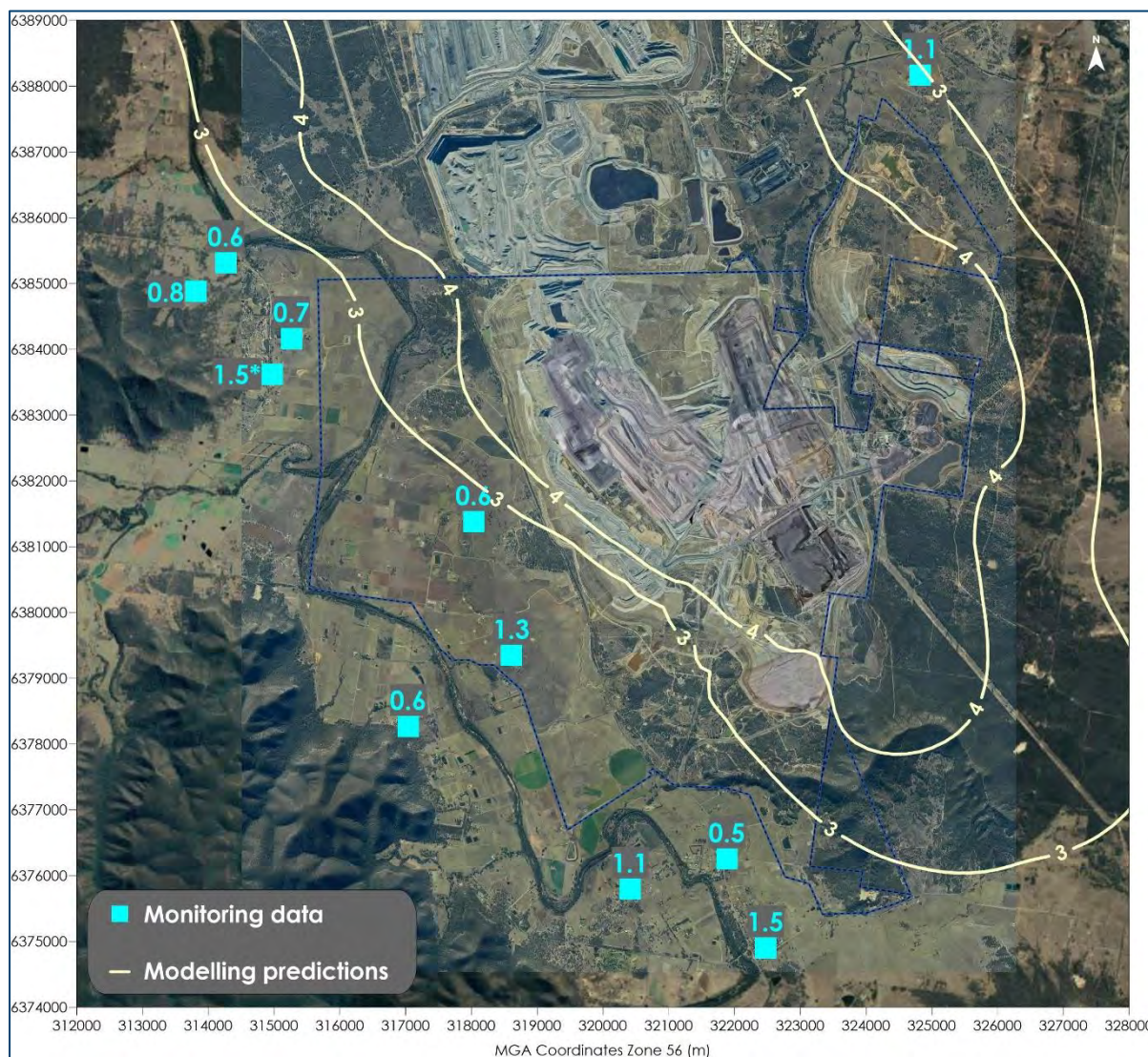
3.4 Annual average deposited dust

Figure 3-5 presents an overlay of the measured 2022 annual average deposited dust levels over the dispersion modelling contours reproduced from the *Bulga Coal Complex Modification 3 Air Quality Impact Assessment* (Year 2022) (Jacobs, 2019). The measured and predicted data in the figures include dust levels from Bulga and other sources.

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It is noted that there is insufficient data (less than 75%) at the D10 monitor in 2022 to calculate a valid annual average, however for the purpose of this comparison an average of the available data has been presented. There was one monthly D10 sample determined to be invalid as the funnel was found on the ground at the end of the sampling period and there were three monthly D10 samples deemed to be contaminated from excessive bird droppings in the latter part of 2022.

The measured levels in 2022 are all well below the 4g/m²/month contour as predicted for Year 2022.



* Insufficient data (less than 75%) for an annual average calculation

Source: **Jacobs, 2019**

Figure 3-5: 2022 deposited dust annual average monitoring data superimposed over the predicted deposited dust annual average modelling contour (Year 2022 cumulative)

4 AIR QUALITY CRITERIA

The sections below identify the key pollutants currently being monitored at the Bulga Coal air quality monitoring sites and the applicable air quality criteria.

4.1 Particulate Matter

Particulate matter consists of particles of varying size and composition. The total mass of all particles suspended in air is defined as the Total Suspended Particulate matter (TSP). The upper size range for TSP is nominally taken to be 30 micrometres (μm) as in practice particles larger than 30 to 50 μm will settle out of the atmosphere too quickly to be regarded as air pollutants.

The TSP is defined further into two sub-components. They are PM_{10} particles, particulate matter with aerodynamic diameters of 10 μm or less, and $\text{PM}_{2.5}$, particulate matter with aerodynamic diameters of 2.5 μm or less.

4.1.1 SSD-4960 air quality criteria

Table 4-1 to **Table 4-3** summarises the air quality goals that are relevant to particulate pollutants as outlined in the Bulga Coal Development Consent (SSD-4960).

The development consent outlines that the applicant shall ensure that all reasonable and feasible avoidance and mitigation measures are employed so that the particulate emissions generated by the Bulga mine complex do not exceed the criteria listed in **Table 4-1** to **Table 4-3** at any residence on privately-owned land. As the E-BAM monitors are located within the mine site, the Department of Planning and Environment (DPE) criteria are not directly applicable to these monitors.

Table 4-1: Long term criteria for particulate matter

Pollutant	Averaging Period	^{a,c} Criterion
Total suspended particulates (TSP)	Annual	90 $\mu\text{g}/\text{m}^3$
Particulate Matter < 10 μm (PM_{10})	Annual	25 $\mu\text{g}/\text{m}^3$
Particulate Matter < 2.5 μm ($\text{PM}_{2.5}$)	Annual	8 $\mu\text{g}/\text{m}^3$

Table 4-2: Short term criteria for particulate matter

Pollutant	Averaging Period	^b Criterion as per MOD 3
Particulate Matter < 10 μm (PM_{10})	24-hour	50 $\mu\text{g}/\text{m}^3$
Particulate Matter < 2.5 μm ($\text{PM}_{2.5}$)	24-hour	25 $\mu\text{g}/\text{m}^3$

Table 4-3: Long term criteria for deposited dust

Pollutant	Averaging Period	Maximum increase in deposited dust level	Maximum total deposited dust level
^d Deposited dust	Annual	^b 2g/m ² /month	^a 4g/m ² /month

Notes for **Table 4-1** to **Table 4-3**:

- ✦ ^a Total impact (i.e. incremental increase in concentrations due to the development plus background concentrations due to other sources);
- ✦ ^b Incremental impact (i.e. incremental increase in concentrations due to the development on its own);

-
- ✦ ^c Excludes extraordinary events such as bushfires, prescribed burning, dust storms, sea fog, fire incidents, illegal activities or any other activity agreed to by the Secretary; and
 - ✦ ^d Deposited dust is to be assessed as insoluble solids as defined by Standards Australia, AS/NZS 3580.10.1:2003 Methods for Sampling and Analysis of Ambient Air – Determination of Particulate Matter – Deposited Matter – Gravimetric Method.



5 LONG TERM REVIEW

Figure 5-1 to **Figure 5-9** show the long-term trends for PM_{2.5}, PM₁₀, TSP and deposited dust from the start of commissioning of the monitors up until the end of the 2022 calendar year. The data in the figures include extraordinary event days. These plots are discussed in more detail in the following sections. There were no days specifically considered to be extraordinary events at the Bulga Complex in 2022, and thus a single annual average for all days has been calculated for each monitor in 2022.

Appendix C presents a summary of the 24-hour average periods where there was less than 75% valid data for the TEOM and BAM monitors during the 2022 calendar year.

5.1 PM_{2.5} monitoring data

Table 5-1 presents a summary of the recorded PM_{2.5} levels at the BAM monitors.

It is noted that no valid 24-hour average data was available at the D2 monitor from the start of the reporting period until 29/04/2022 due to an issue identified with the heater which caused the monitor to record abnormally high PM_{2.5} levels. Bulga Coal investigated the issue and replaced the heater and temperature sensor cable.

The annual average PM_{2.5} concentrations at D2 and D10 were below the relevant criteria of 8µg/m³ in 2022. The maximum 24-hour average PM_{2.5} concentrations were below the relevant criterion of 25µg/m³ in 2022.

Table 5-1: Summary of recorded BAM PM_{2.5} levels

Year	Annual average PM _{2.5} (µg/m ³)			
	D2	D10	Criterion	
2012	5.9 (4%)	-	8	
2013	6.1 (72%)	-	8	
2014	5.5	5.4 (46%)	8	
2015	5.0	5.1	8	
2016	6.1 (52%)	5.7	8	
2017	5.2	5.0	8	
2018	5.5	5.5	8	
2019	11.2	*5.1	15.4 (73%)	*6.7
2020	5.1	*4.1	9.5	*6.1
2021	3.7	4.5	8	
2022	2.8 (65%)	3.4	8	
Year	Maximum 24-hour average PM _{2.5} (µg/m ³) (No. of days > criterion)			
	D2	D10	Criterion	
2012	10.2 (0)	-	25	
2013	60.8 (6)	-	25	
2014	25.3 (1)	21.3 (0)	25	
2015	32.9 (2)	31.2 (1)	25	
2016	22.5 (0)	19.4 (0)	25	
2017	24.7 (0)	30.2 (1)	25	
2018	46.5 (1)	23.9 (0)	25	
2019	188.7 (32)	*25.3 (1)	212.2 (33)	*25.9 (1)
2020	37.4 (8)	*17.3 (0)	226.8 (11)	*29.0 (1)
2021	14.0 (0)	16.5 (0)	25	
2022	9.1 (0)	12.3 (0)	25	

(#%) The recorded data are less than 75% complete for the year, (data availability %)

*Excluding extraordinary events

The numbers in **red** are concentrations that are above the relevant criterion.

Figure 5-1 presents the 24-hour average PM_{2.5} concentrations at the D2 and D10 BAM monitors. The data shows that elevated 24-hour average PM_{2.5} levels were recorded during the 2019/2020 bushfire season. The 24-hour average PM_{2.5} levels recorded in 2022 were broadly consistent with the levels recorded prior to 2019.

Figure 5-2 presents the annual average PM_{2.5} concentrations recorded at the BAM monitors including extraordinary events. The D2 and D10 monitors show generally similar annual average PM_{2.5} levels throughout the monitoring period until 2019 when the annual average at the D2 monitor is approximately double that of previous years. Note that there are insufficient data (less than 75%) for an annual average for the D10 monitor in 2019, however it would also have been elevated.

The annual average PM_{2.5} level at the D10 monitor in 2022 is lower than the levels in previous years. This decrease is likely due to 2022 being a relatively wet year and no extraordinary events. Note that there are insufficient data (less than 75%) for an annual average for the D2 monitor in 2022.

Figure 5-3 presents the 31-day running averages for the 24-hour average PM_{2.5} concentrations, daily rainfall and mean daily temperature recorded by the Bulga Complex weather station. In general, the figure indicates a trend in dust levels being lower during significant rainfall and/or colder temperatures, or dust levels being higher in dry and hot conditions. There was an increase in rainfall during 2022 from the previous years.



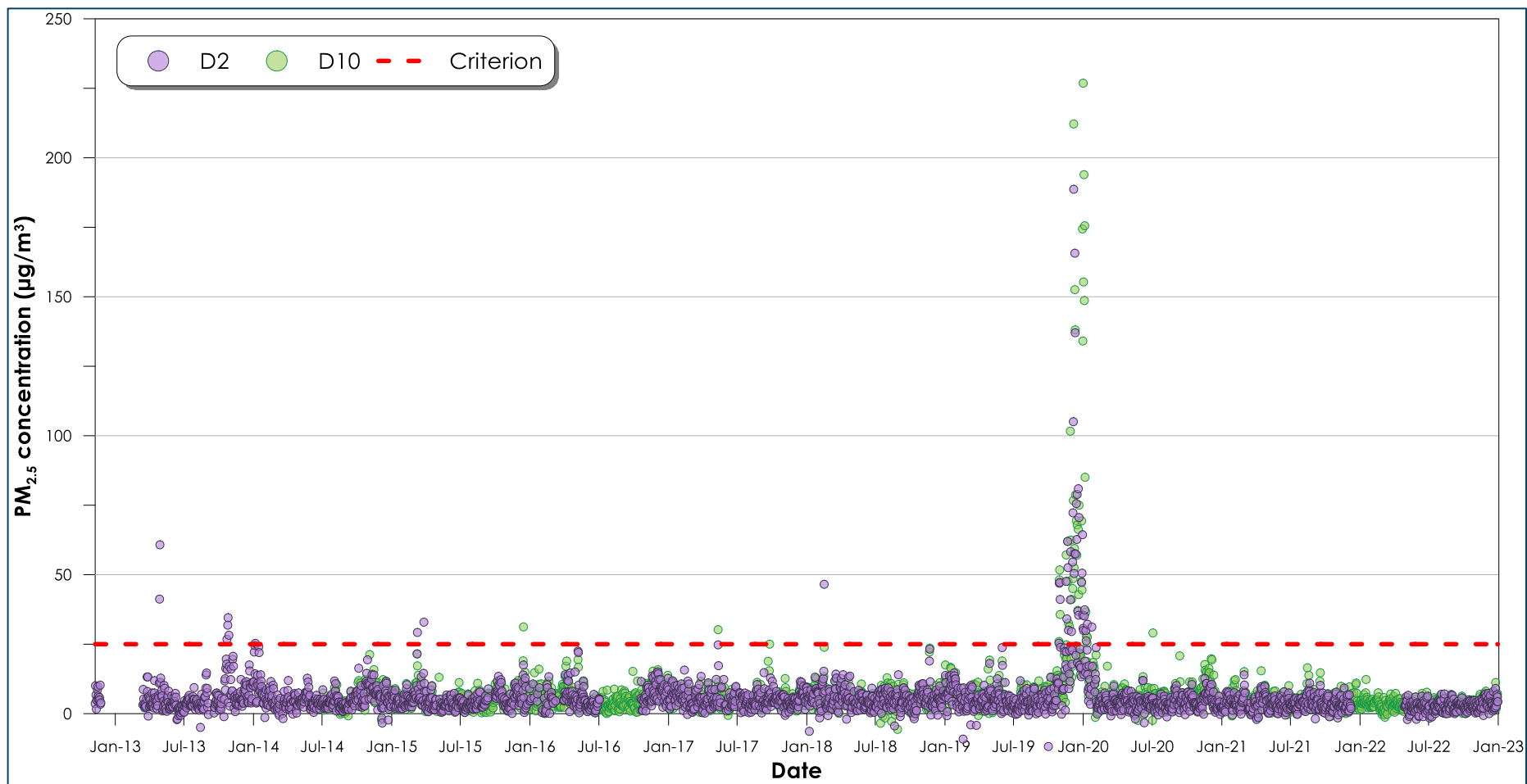


Figure 5-1: 24-hour average PM_{2.5} concentrations



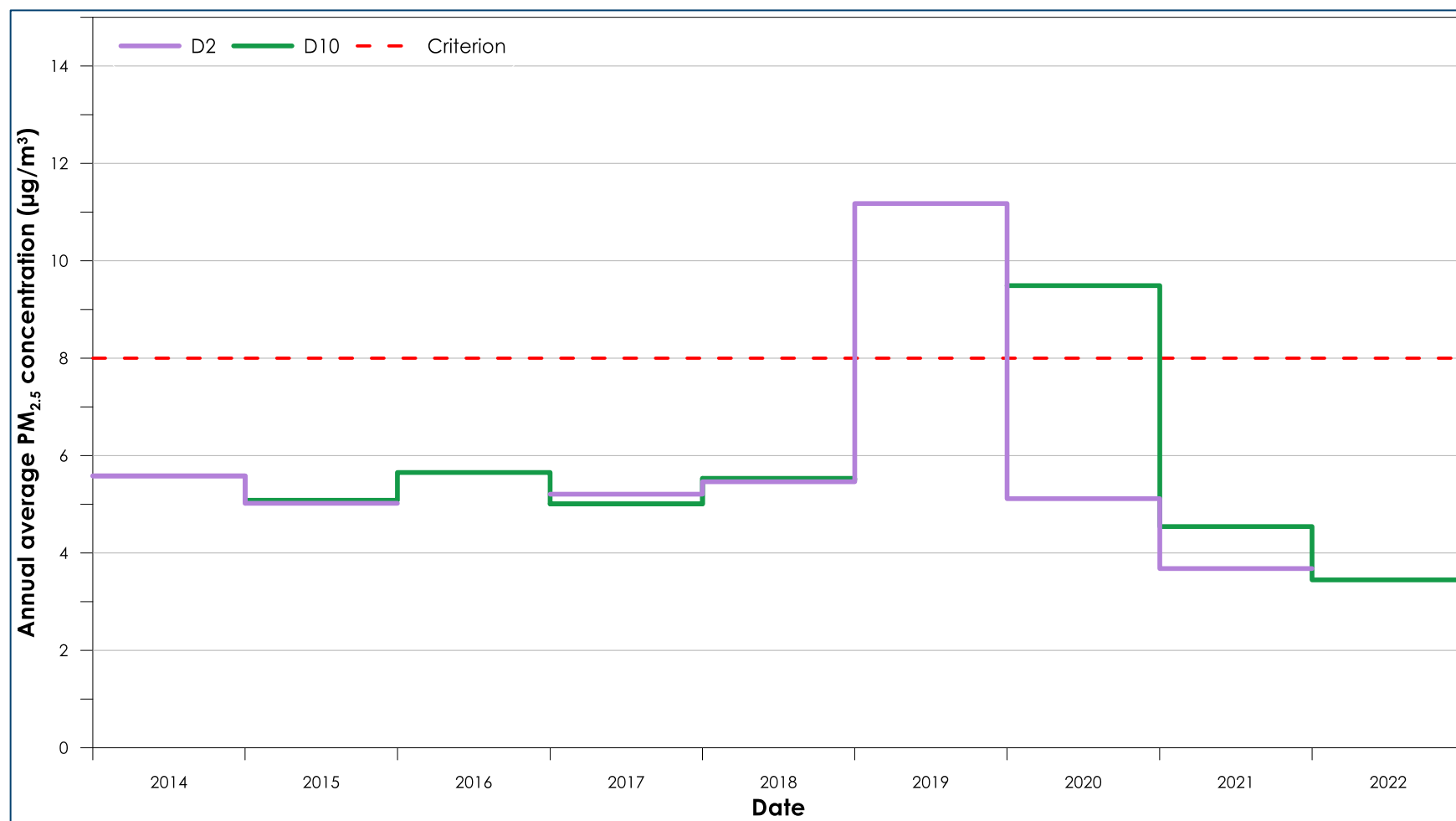


Figure 5-2: Annual average PM_{2.5} concentrations



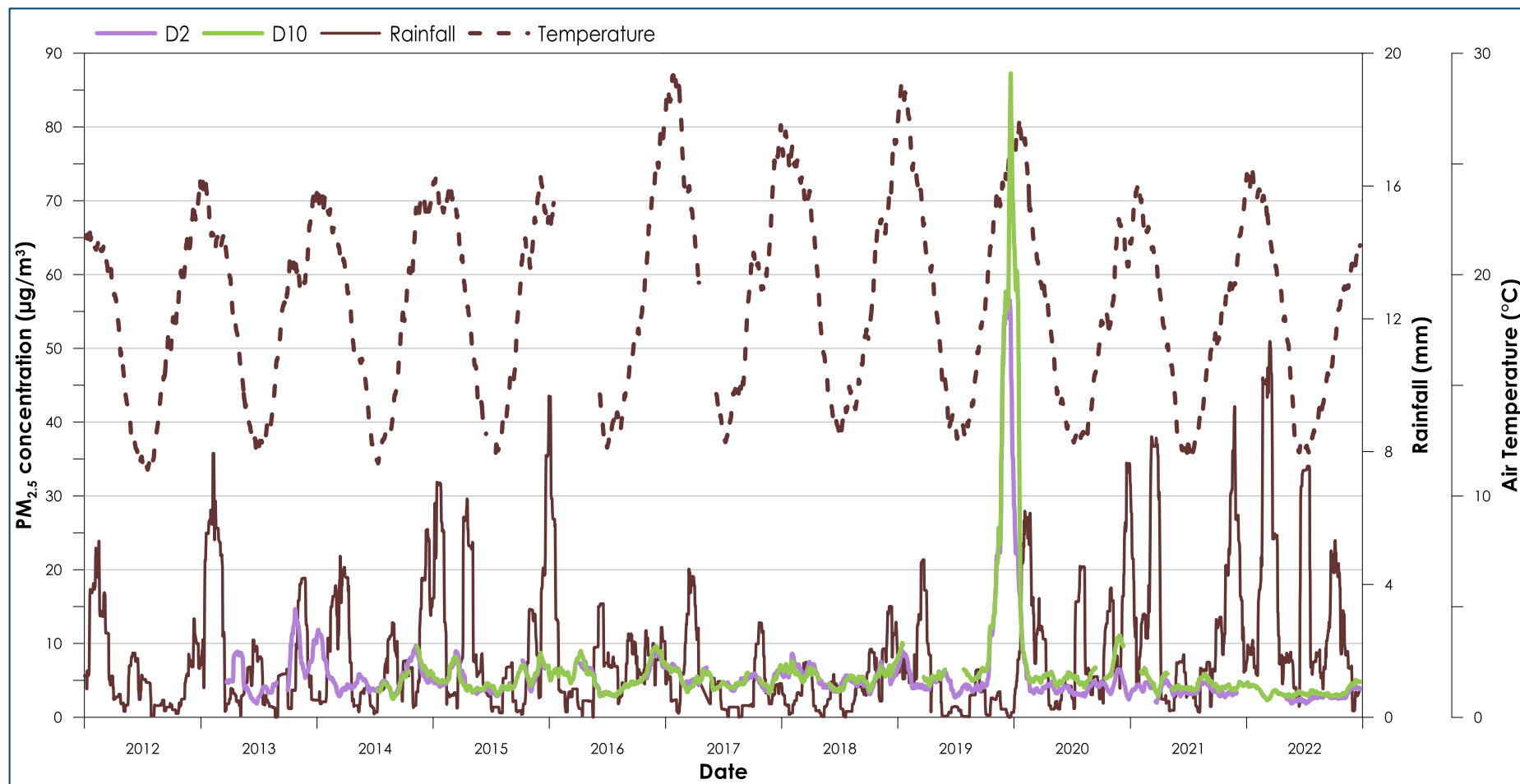


Figure 5-3: 31-day running average of the 24-hour average PM_{2.5} concentrations with the 31-day running average of daily rainfall and mean daily temperature



5.2 PM₁₀ monitoring data

Table 5-2 presents a summary of the recorded PM₁₀ levels at the TEOM monitors. Annual average PM₁₀ concentrations in 2022 were below the relevant criteria of 25µg/m³.

The maximum 24-hour average PM₁₀ concentrations were below the relevant criterion of 50µg/m³ in 2022.

Table 5-2: Summary of the recorded TEOM PM₁₀ levels

Year	Annual average PM ₁₀ (µg/m ³)								
	D1		D3		D5		D11		Criteria
2011	-		12.1 (7%)		-		-		25 / 30
2012	21.8 (9%)		14.8		14.3 (73%)		-		25 / 30
2013	16.1		15.8		15.7		-		25 / 30
2014	15.9		15.3		13.1		-		25 / 30
2015	10.7		11.2		10.7		-		25 / 30
2016	11.5		10.8		11.7		18.8 (44%)		25 / 30
2017	12.7		12.2		11.5		20.0		25 / 30
2018	15.4		19.9		18.9		22.3		25 / 30
2019	22.1	*14.7	28.0	*19.0	25.3	*17.1	27.8	*22.2	25 / 30
2020	14.0	*12.4	16.5	*14.6	16.6	*15.2	19.3	*17.5	25
2021	11.2		12.4		13.2		15.5		25
2022	9.3		10.7		10.3		12.1		25
Year	Maximum 24-hour average PM ₁₀ (µg/m ³) (No. of days > criterion)								
	D1		D3		D5		D11		Criterion
2011	-		17.7 (0)		-		-		50
2012	48.2 (0)		46.1 (0)		45.3 (0)		-		50
2013	70.0 (5)		75.3 (3)		65.0 (2)		-		50
2014	43.8 (0)		41.8 (0)		46.2 (0)		-		50
2015	61.2 (1)		59.3 (1)		61.6 (1)		-		50
2016	33.0 (0)		33.2 (0)		53.5 (2)		60.7 (1)		50
2017	36.4 (0)		37.1 (0)		37.7 (0)		67.5 (6)		50
2018	138.6 (5)		166.4 (7)		160.3 (7)		159.6 (15)		50
2019	172.1 (31)	*37.9 (0)	170.5 (44)	*60.4 (3)	177.4 (36)	*47.2 (0)	180.7 (33)	*53.8 (4)	50
2020	68.9 (4)	*37.2 (0)	94.9 (5)	*39.9 (0)	75.8 (4)	*41.0 (0)	105.9 (12)	*68.6 (4)	50
2021	34.3 (0)		33.6 (0)		34.1 (0)		65.4 (1)		50
2022	38.2 (0)		27.4 (0)		31.2 (0)		34.9 (0)		50

(#%) The recorded data are less than 75% complete for the year, (data availability %)

*Excluding extraordinary events

The numbers in **red** are concentrations that are above the relevant criterion.

Figure 5-4 presents the 24-hour average PM₁₀ concentrations at the TEOM monitors. The data shows that elevated 24-hour average PM₁₀ levels were recorded during the 2019/2020 bushfire season. There were less elevated 24-hour average PM₁₀ levels recorded in 2022 compared with recent years.

Figure 5-5 presents the annual average PM₁₀ concentrations recorded at the TEOM monitors including extraordinary events. The annual average PM₁₀ level at the TEOM monitors in 2022 are lower than the levels in 2018 to 2021. This decrease is likely due to 2022 being a relatively wet year and no extraordinary events.

Figure 5-6 shows the 31-day running averages of the 24-hour average PM₁₀ concentrations at the TEOM monitors including extraordinary events, together with the 31-day running averages of daily rainfall and mean daily temperature recorded by the Bulga Complex weather station. The figure indicates a general trend in dust levels being lower during significant rainfall and/or colder temperatures, or dust levels being higher in dry and hot conditions. There was an increase in rainfall during 2022 from the previous years.



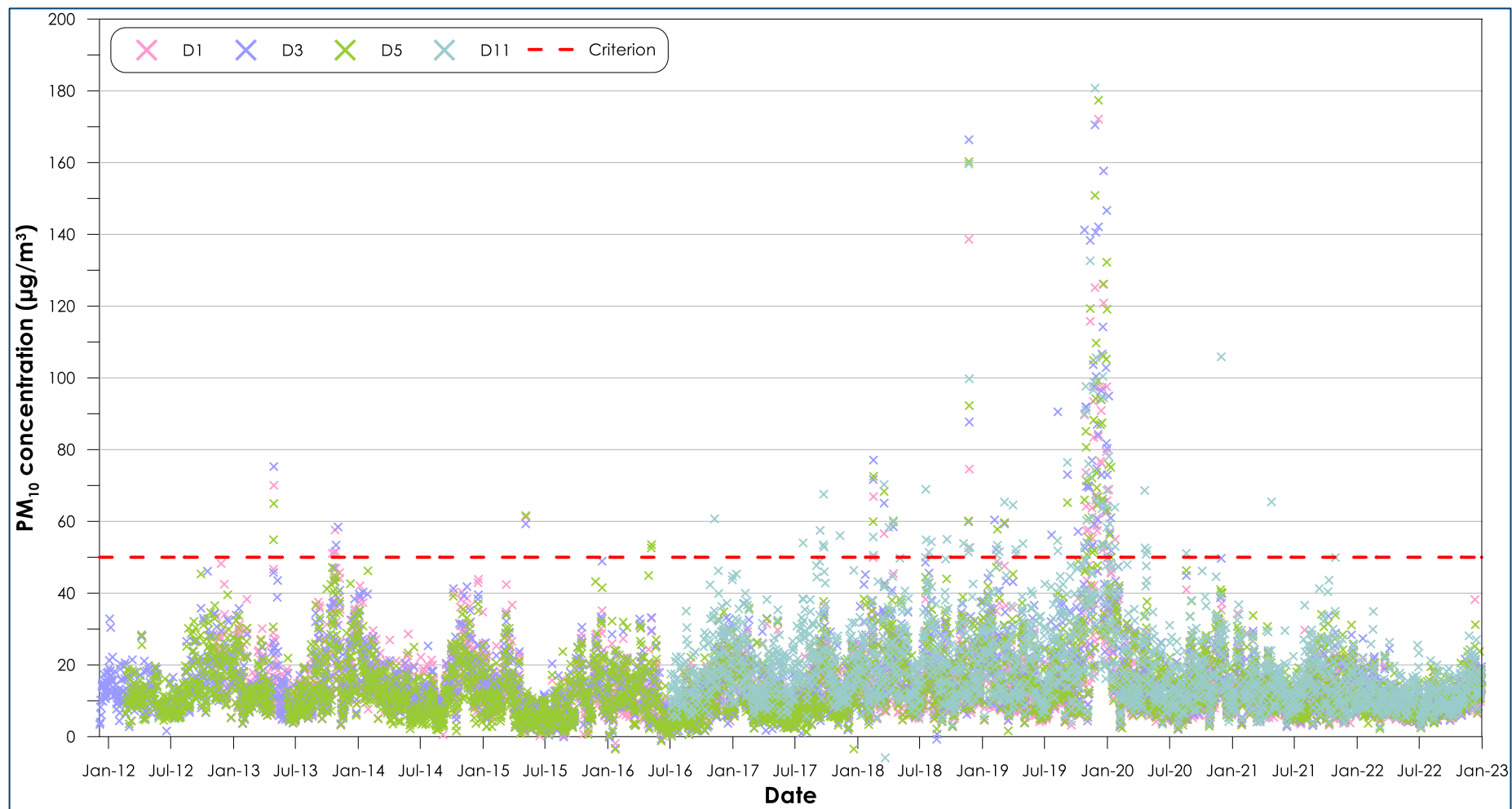


Figure 5-4: 24-hour average PM₁₀ concentrations at TEOM monitors



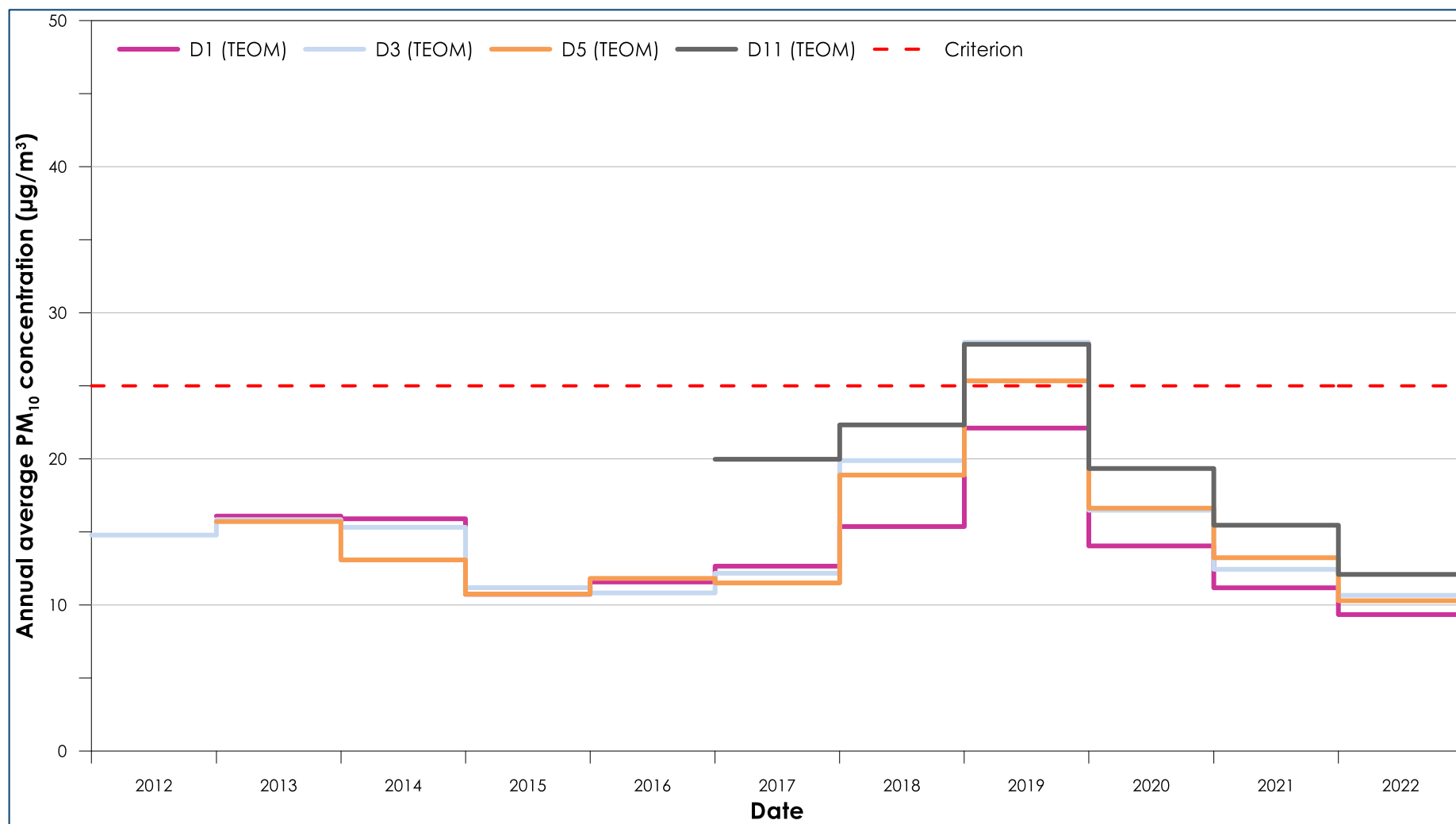


Figure 5-5: Annual average PM₁₀ concentrations at TEOM monitors



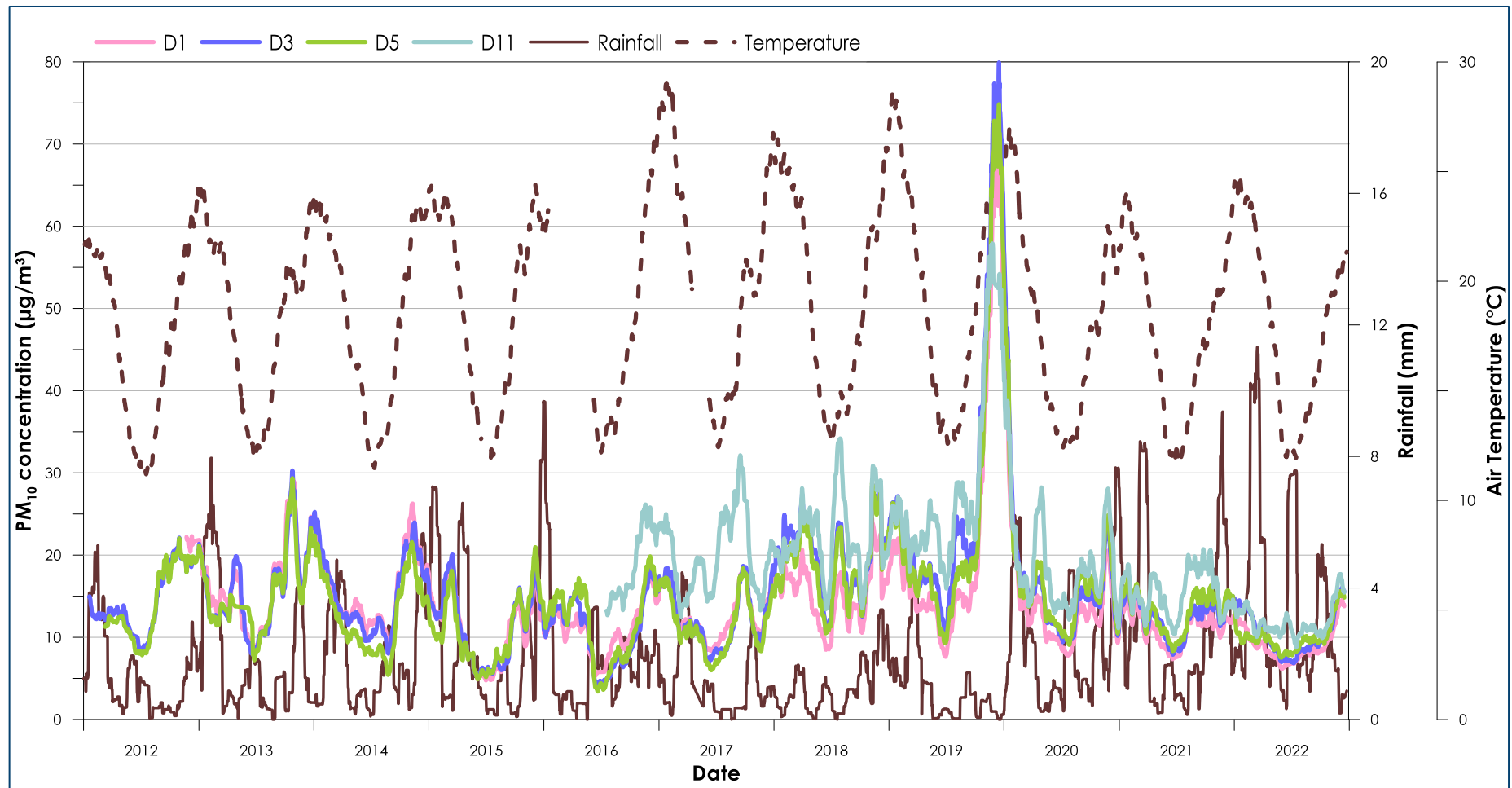


Figure 5-6: 31-day running average of the 24-hour average PM₁₀ concentrations at the TEOM monitors with the 31-day running average of daily rainfall and mean daily temperature

5.3 TSP monitoring data

Table 5-3 presents a summary of the recorded TSP levels at the HVAS monitors. Annual average TSP concentrations were below the relevant criterion of $90\mu\text{g}/\text{m}^3$ in 2022.

Table 5-3: Summary of the recorded HVAS TSP levels

Year	Annual average TSP (µg/m³)						
	Dawtrey		D10		Hill St		Criterion
2005	28.2 (74%)		32.3 (67%)		-		90
2006	35.0		36.2		-		90
2007	33.2		36.7		-		90
2008	33.3		34.8		-		90
2009	39.3		41.4		-		90
2010	26.9		29.2		-		90
2011	27.1		33.8		-		90
2012	26.2		34.5		-		90
2013	30.4		32.5		-		90
2014	34.5		40.0		-		90
2015	27.9		30.6		-		90
2016	31.7		36.9		23.3 (67%)		90
2017	29.8		36.5		26.0		90
2018	42.9		48.6		32.1		90
2019	56.0	*37.5	67.3	*46.3	50.7	*30.7	90
2020	38.5	*35.7	40.9	*36.3	31.8	*29.2	90
2021	22.6		21.0		18.9		90
2022	15.3		17.2		13.4		90

(#%) The recorded data are less than 75% complete for the year, (data availability %)

*Annual average excluding extraordinary events

Figure 5-7 shows the 24-hour and annual average TSP concentrations including extraordinary events at the HVAS monitors. The data shows that elevated 24-hour average TSP levels were recorded during the 2019/2020 bushfire season. The annual average data from the TSP HVAS monitors show that the levels remained below the criterion of $90\mu\text{g}/\text{m}^3$ throughout the period. There was a decrease in the annual average TSP levels during 2022 compared with the previous year. This decrease is likely due to 2022 being a relatively wet year and no extraordinary events.

Figure 5-8 shows the 30-day running average of the TSP concentrations including extraordinary events, rainfall readings and mean daily temperatures. The levels show a general trend of lower TSP concentrations during periods of higher rainfall and lower temperatures. There was an increase in rainfall during 2022 from the previous years.



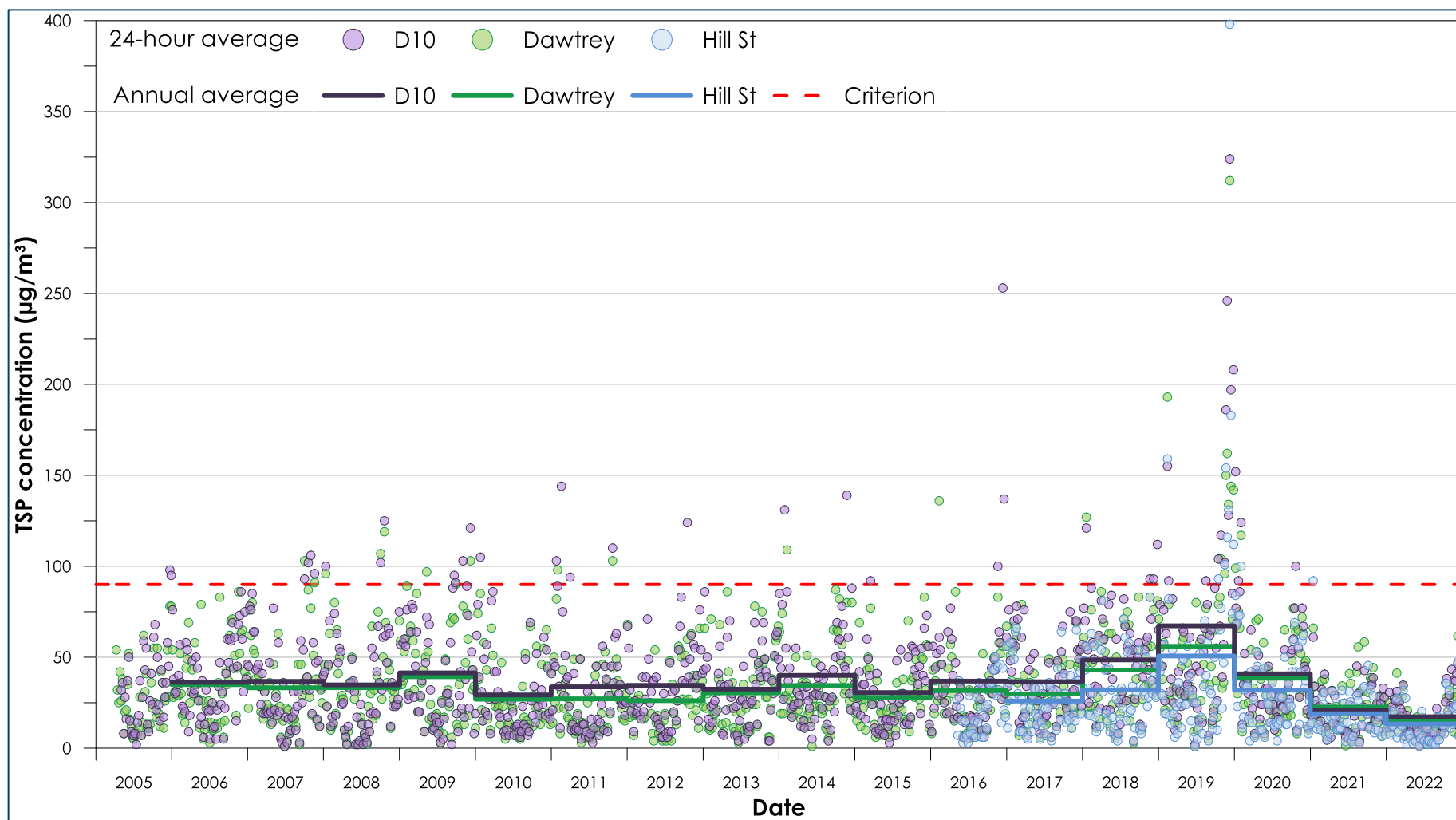


Figure 5-7: 24-hour and annual average TSP concentrations

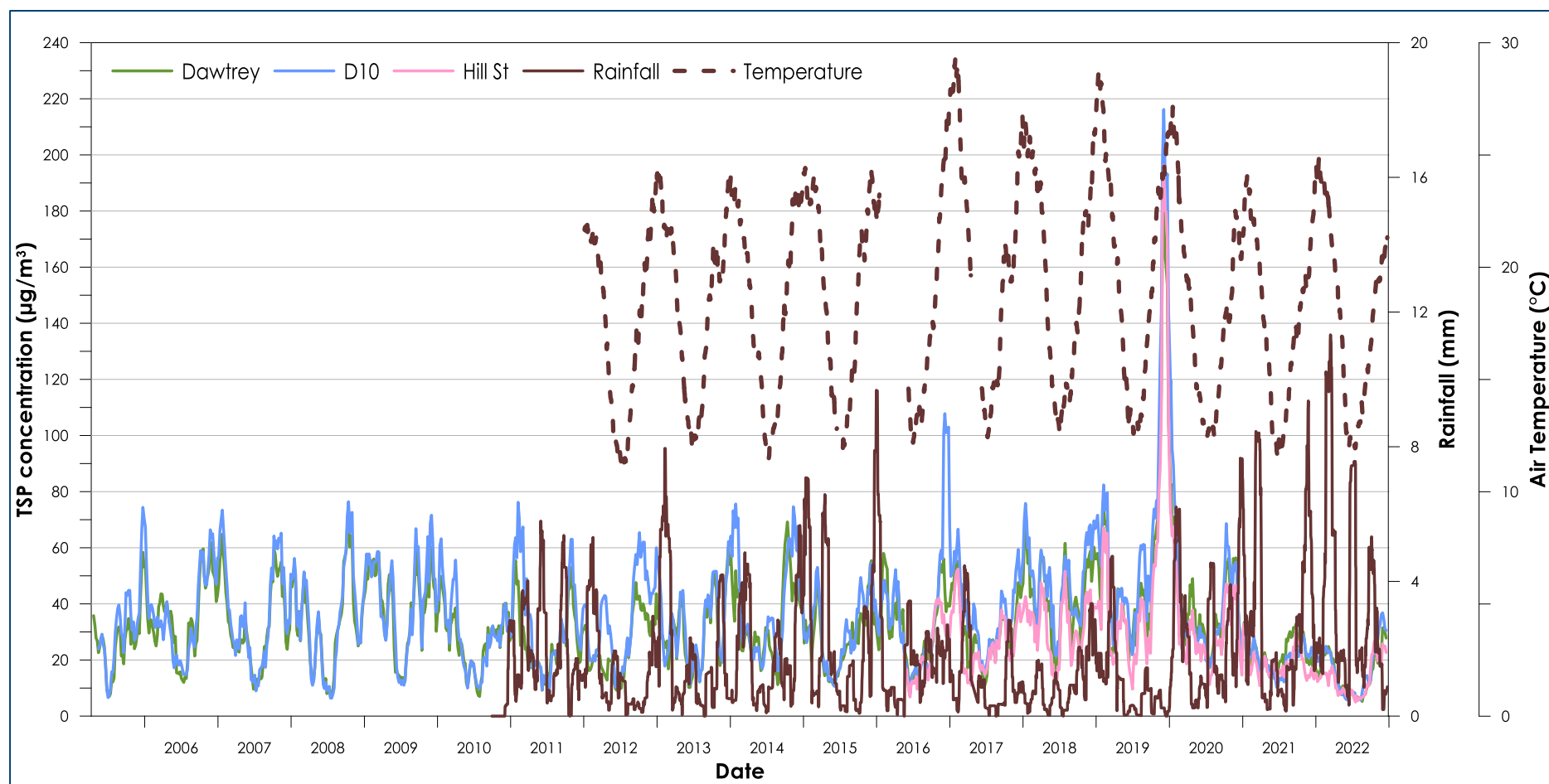


Figure 5-8: 30-day running average of the 24-hour average TSP concentrations with the 31-day running average of daily rainfall and mean daily temperature



5.4 Deposited dust data

Table 5-4 presents a summary of the annual average deposited dust levels at the statutory compliance dust gauges. The results show that in 2022 the deposited dust levels were below the annual average limit of 4g/m²/month at the compliance monitoring locations.

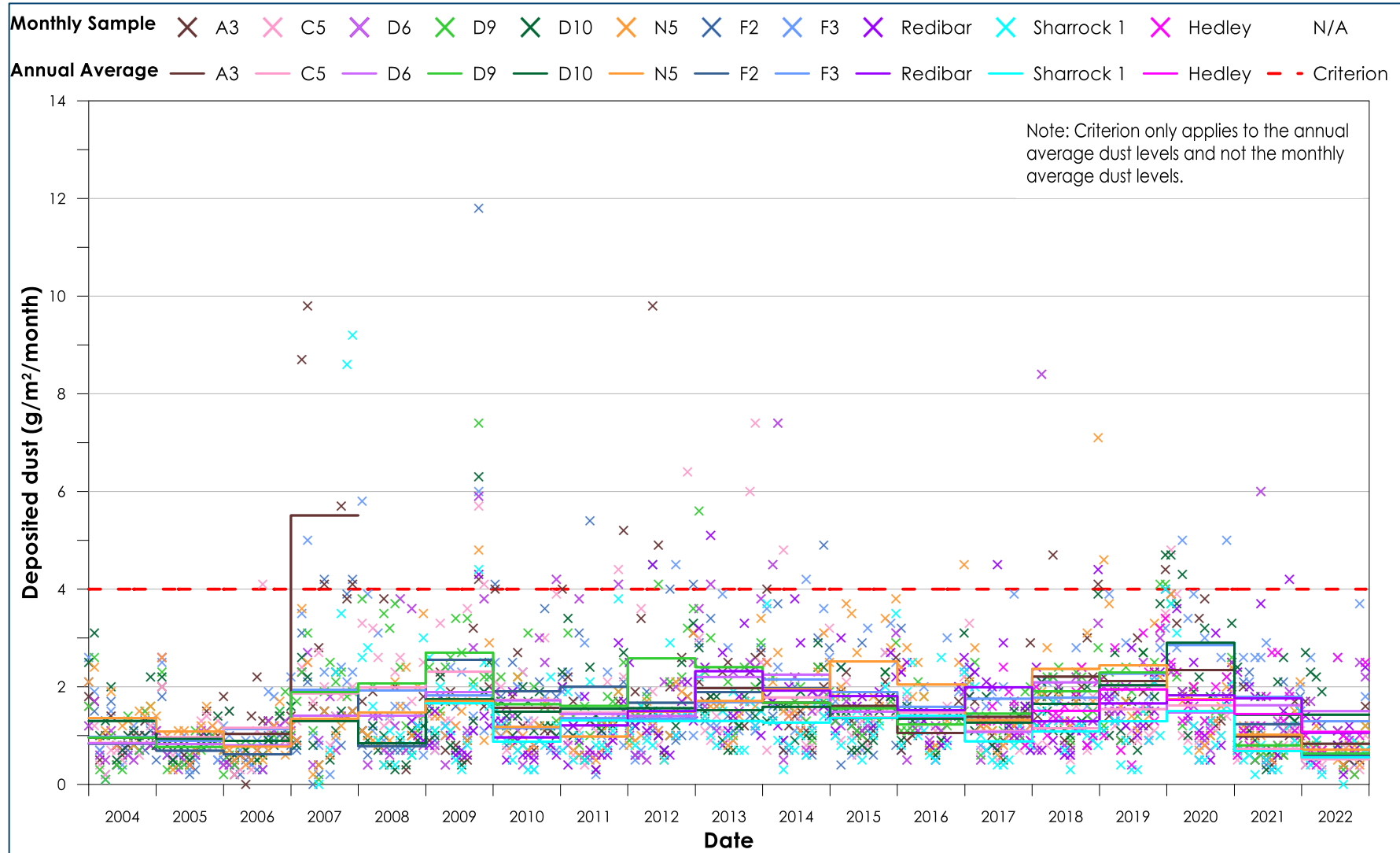
Table 5-4: Summary of the annual average deposited dust levels (g/m²/month) at compliance dust gauges

Year	A3	C5	D6	D9	D10	N5	F2	F3	Redibar	Sharrock 1	Hedley	Criterion
2004	1.0	0.9	0.8	1.0	1.3	1.4	0.8	1.0	-	-	-	4
2005	1.0	1.0	0.8	0.8	0.9	1.1	0.7	0.9	-	-	-	4
2006	1.0	1.2	0.8	0.9	0.9	0.8	0.6	1.1	-	-	-	4
2007	5.5	1.9	1.4	1.9	1.3	1.3	1.9	1.9	-	4.1 (50%)	-	4
2008	1.7 (67%)	2.0	1.4	2.1	0.8	1.5	0.8	1.9	1.1 (25%)	1.4	-	4
2009	1.9	2.3	1.9	2.7	1.7	1.7	2.6	1.8	1.3	1.7	-	4
2010	1.6	1.7	1.7	1.6	1.5	1.2	1.9	1.2	1.0	0.9	-	4
2011	1.8 (67%)	1.5	1.4	1.6	1.6	1.0	2.0	1.4	1.2	1.3	-	4
2012	3.3	2.3 (58%)	1.4	2.6	1.6	1.5	1.7	1.3	1.5	1.3	-	4
2013	2.0	2.7	2.2	2.4	1.5	1.7	1.9	1.7	2.3	1.3	-	4
2014	1.7	1.8	2.3	1.7	1.6	2.0	2.0	2.2	1.9	1.3	-	4
2015	1.6	1.4	1.5	1.6	1.4	2.5	-	1.9	1.8	1.4	-	4
2016	1.1	1.5	1.4	1.2	1.3	2.0	-	1.6	1.5	1.4	-	4
2017	1.4	1.1	1.1	1.5	1.3	1.3	-	1.8	2.0	0.9	1.4	4
2018	2.2	1.2	2.1	1.9	1.7	2.4	-	1.8	1.3	1.1	1.5	4
2019	2.1	1.5	2.0	2.3	2.0	2.4	-	2.3	1.7	1.3	1.9	4
2020	2.3	1.6	1.5	1.8	2.9	1.7	-	2.9	1.8	1.5	1.7	4
2021	1.0	0.7	1.6	0.8	1.4	1.0	1.2	1.8	1.8	0.7	1.4	4
2022	0.8	0.5	1.5	0.6	1.5 (67%)	0.7	0.6	1.3	1.1	0.6	1.1	4

Contaminated samples were not included in the computation of the average.

(#%) The recorded data are less than 75% complete for the year, (data availability %)

Figure 5-9 shows the monthly and annual average deposited dust levels at the Bulga Complex dust gauges. The deposited dust levels at the A3 monitor exceeded the cumulative annual average deposited dust criteria of 4g/m²/month in 2007. No other exceedance was recorded from the onset of monitoring until the end of the 2022 calendar year. The levels at the monitors generally show relatively similar trends over time. In general, there was a decrease in the deposited dust levels during 2022 compared with the previous year.



Note: Data are clipped at a maximum of $14\text{g}/\text{m}^2/\text{month}$. Only the A3 dust gauge measured a level above $14\text{g}/\text{m}^2/\text{month}$ (at $16.8\text{g}/\text{m}^2/\text{month}$).

Figure 5-9: Annual and monthly averages deposited dust at the statutory compliance dust gauges



6 POLLUTION ROSES

The following section presents an analysis of a hybrid of a pollution rose and back trajectory data for all $PM_{2.5}$ and PM_{10} data measured at the BAM and TEOM monitors for 2022. The meteorological data used in generating the figures are taken from the Bulga Complex weather station. Refer to **Appendix A** for guidance on how to interpret a pollution rose plot.

6.1 $PM_{2.5}$ data

Figure 6-1 and **Figure 6-2** present the pollution roses for the D2 and D10 $PM_{2.5}$ monitors respectively for 2022. The data do not indicate any significant impact on $PM_{2.5}$ dust levels from the direction of the Bulga Complex.

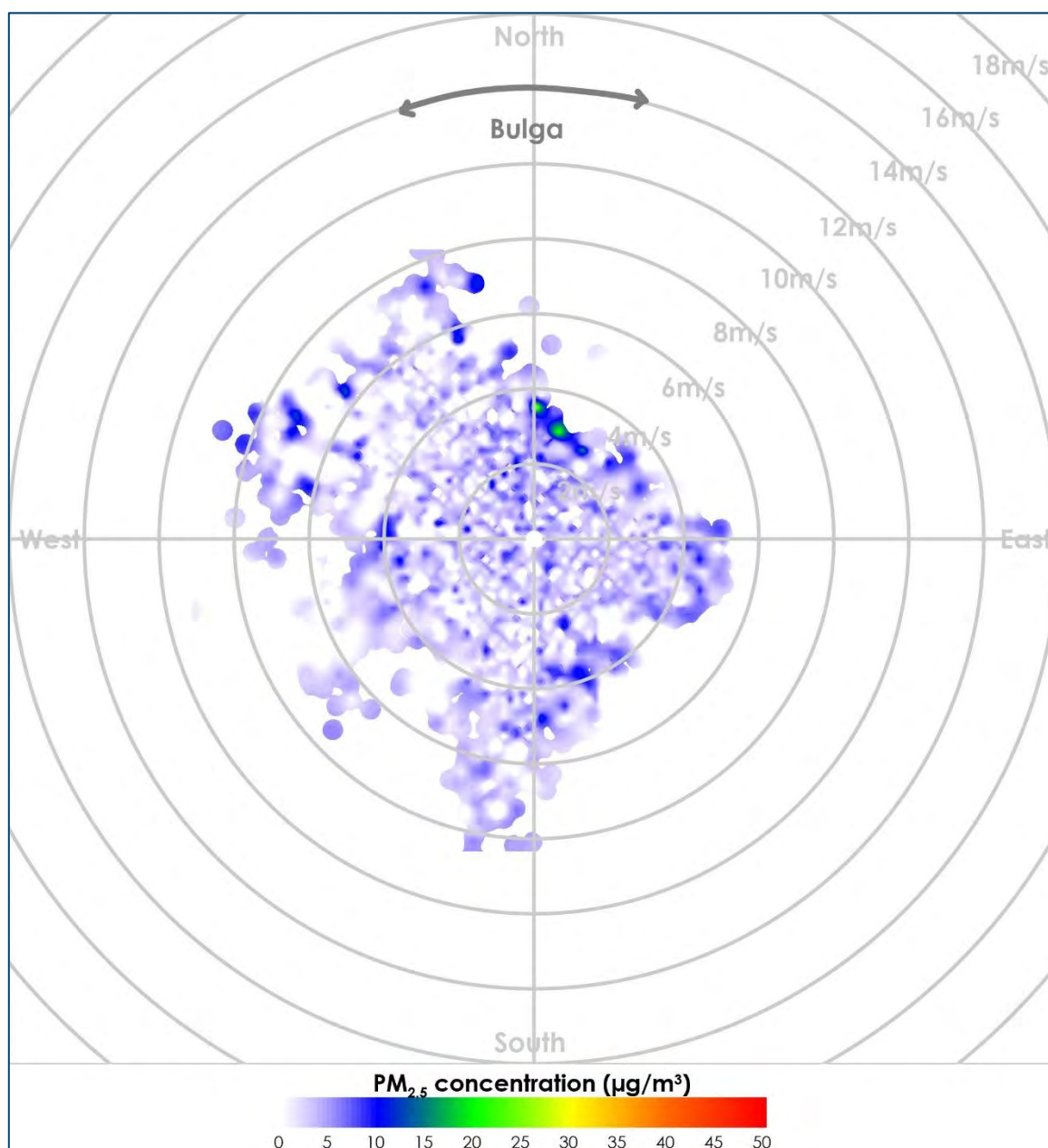


Figure 6-1: Pollution rose for D2 BAM $PM_{2.5}$ data (29/04/2022 to 31/12/2022)

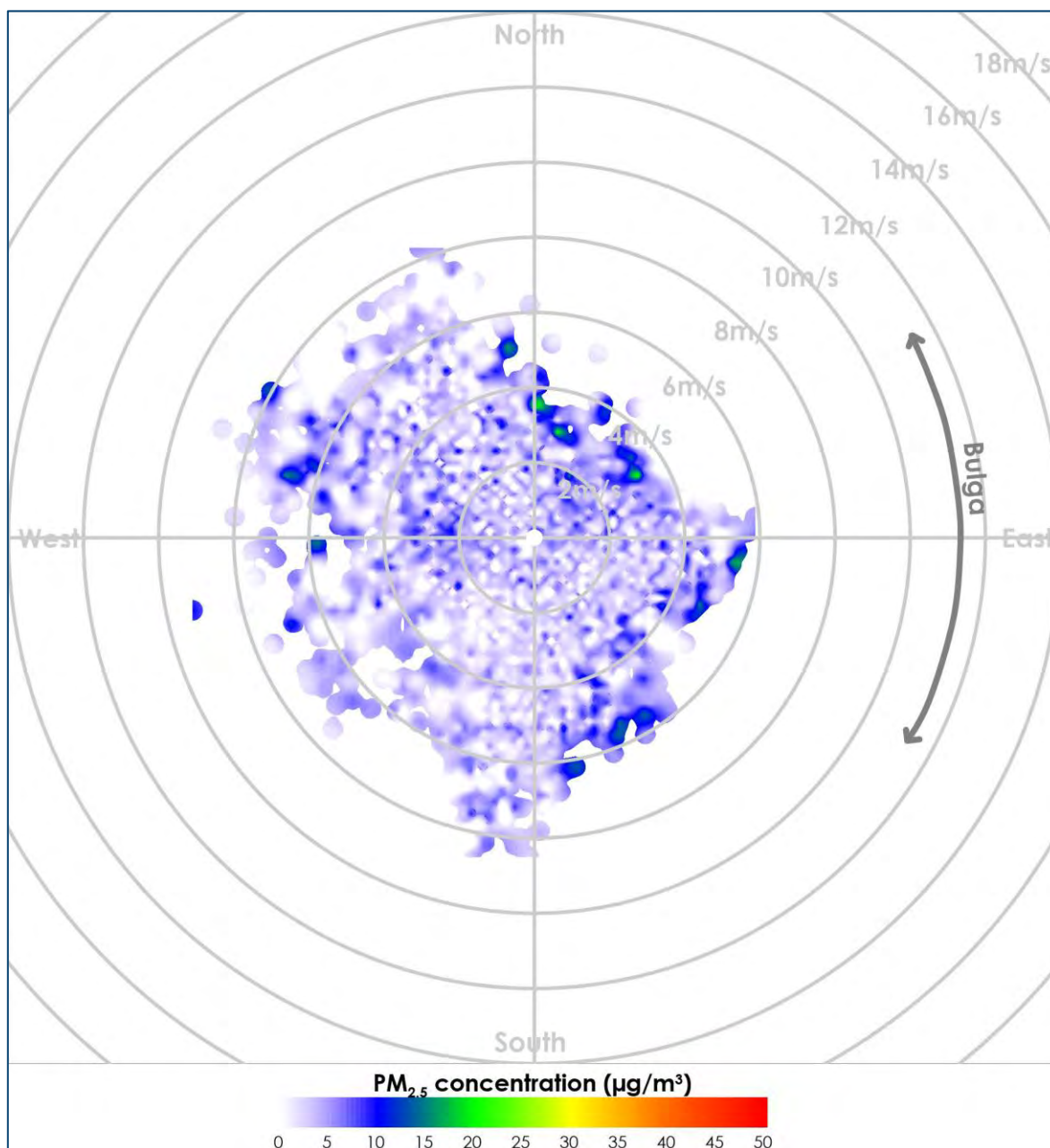


Figure 6-2: Pollution rose for D10 BAM PM_{2.5} data (2022)

6.2 PM₁₀ data

Figure 6-3 to **Figure 6-6** present the pollution roses for the D1, D3, D5 and D11 PM₁₀ TEOM monitors respectively for 2022. **Figure 6-7** and **Figure 6-8** present the pollution roses for the D8 and D9 PM₁₀ E-BAM monitors respectively for 2022.

Generally, the figures show a slight effect on dust levels from the direction of the Bulga mine.

The E-BAM monitors are not compliance or reference standard monitors such as the TEOM and HVAS monitors. They are located close to mining activities and are used to assist with mine operational management. As such the data may not be directly equivalent to the TEOM data. Some high levels occur in the direction of Bulga Complex at the D9 monitor however the monitor recorded a greater proportion

of high levels when winds were from the northwest quadrant during which the monitor would not have been downwind of Bulga Complex but would have been downwind of the neighbouring mining activities.

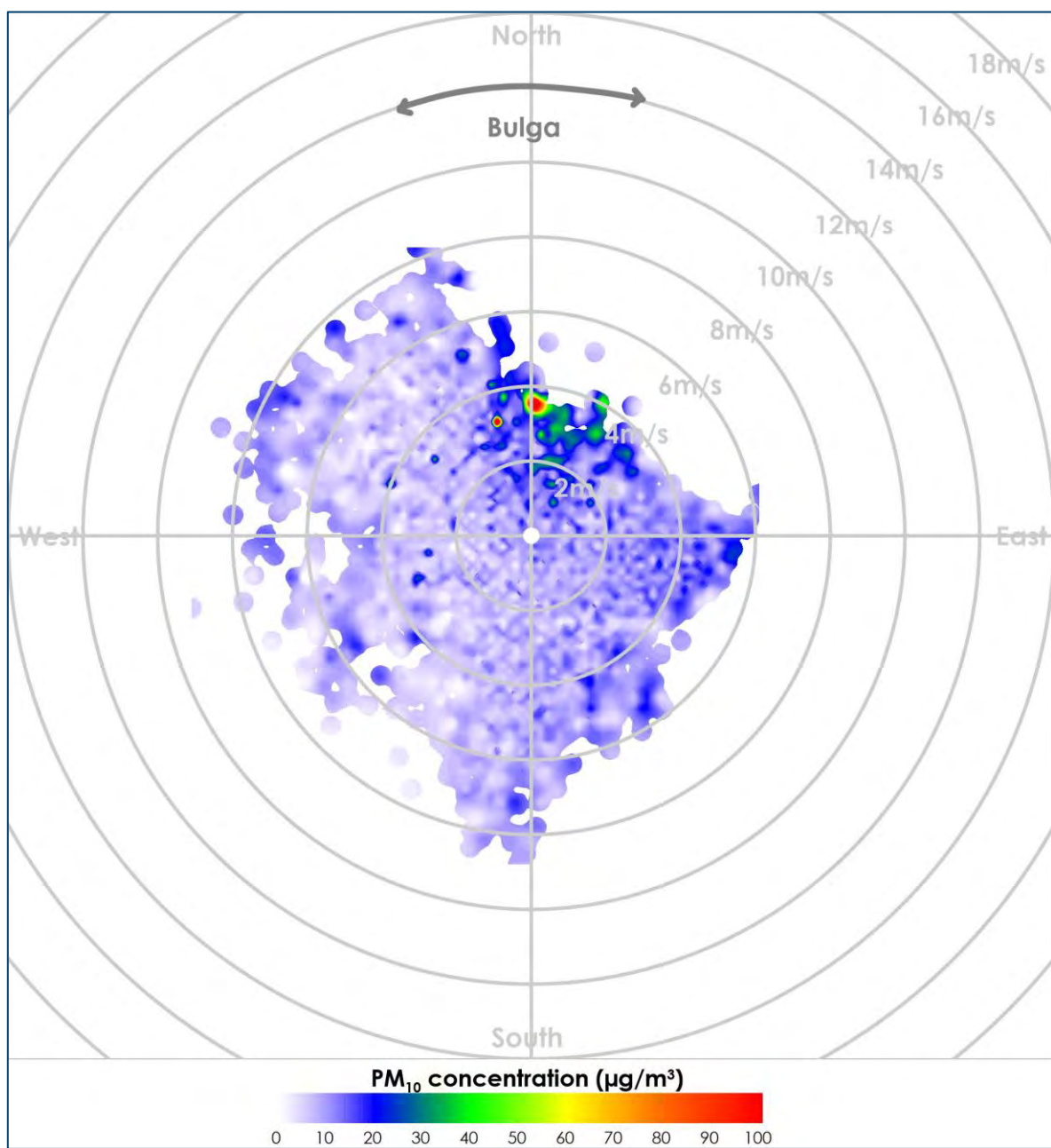


Figure 6-3: Pollution rose for D1 TEOM PM₁₀ data (2022)

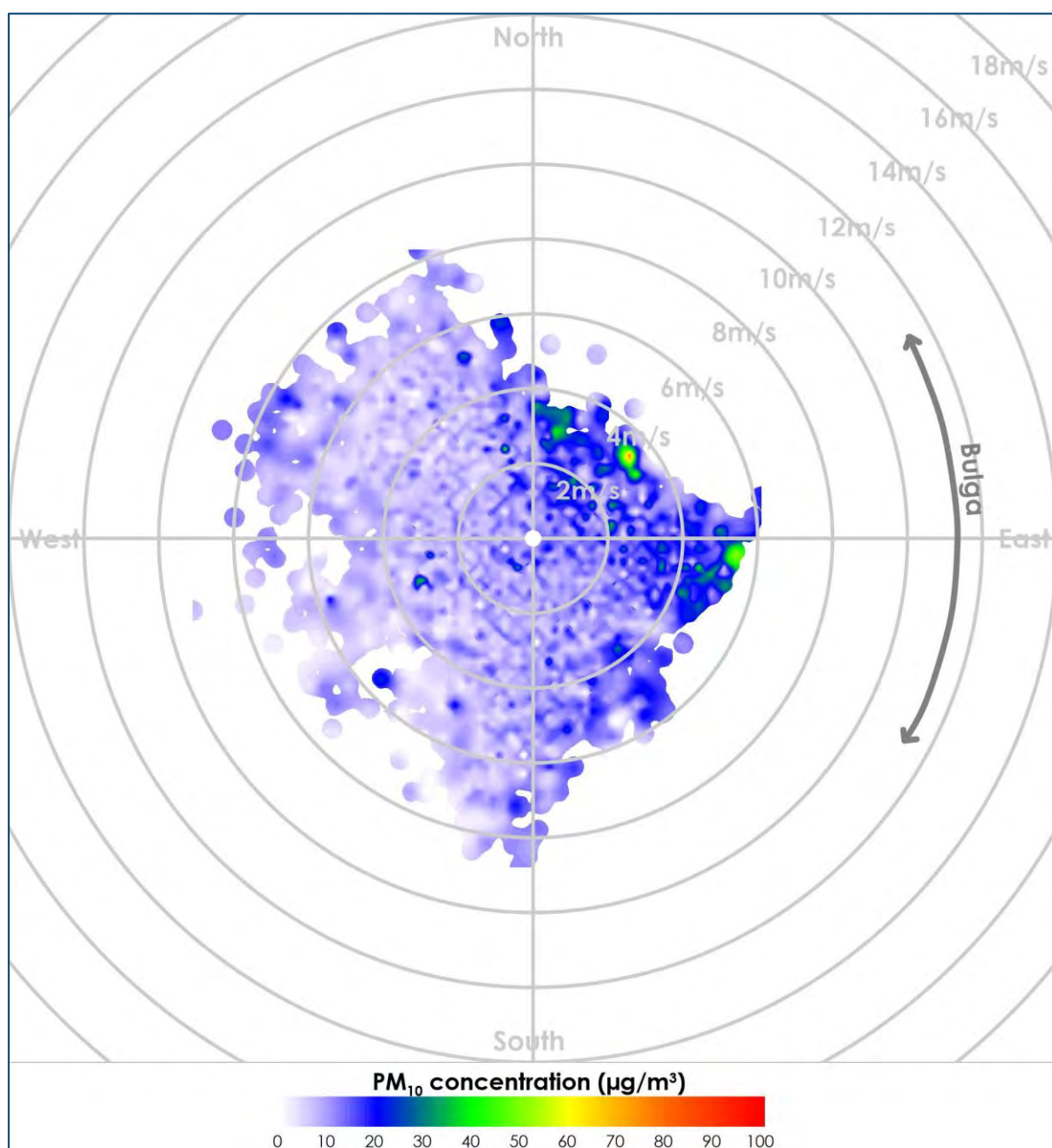


Figure 6-4: Pollution rose for D3 TEOM PM₁₀ data (2022)

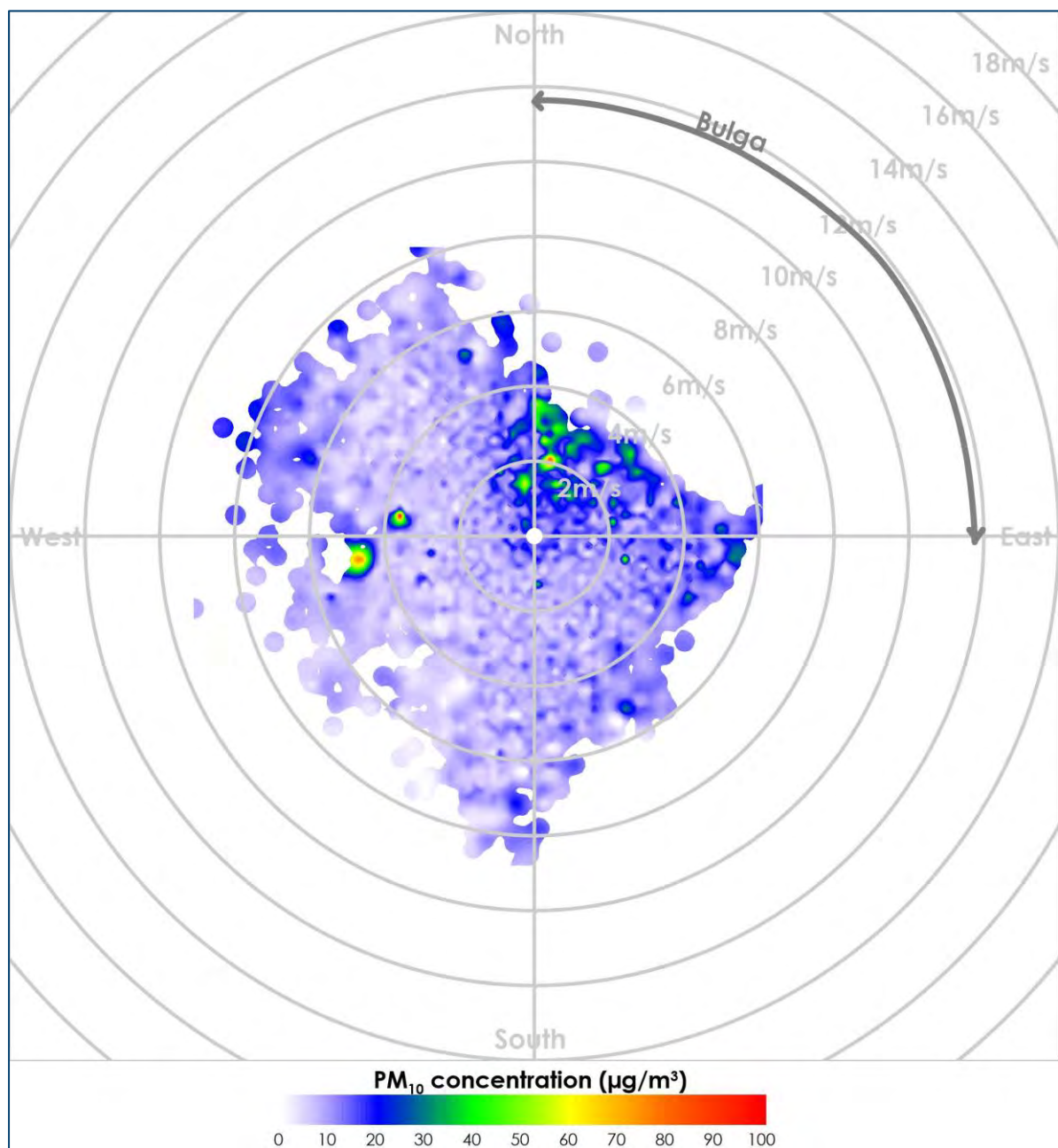


Figure 6-5: Pollution rose for D5 TEOM PM₁₀ data (2022)

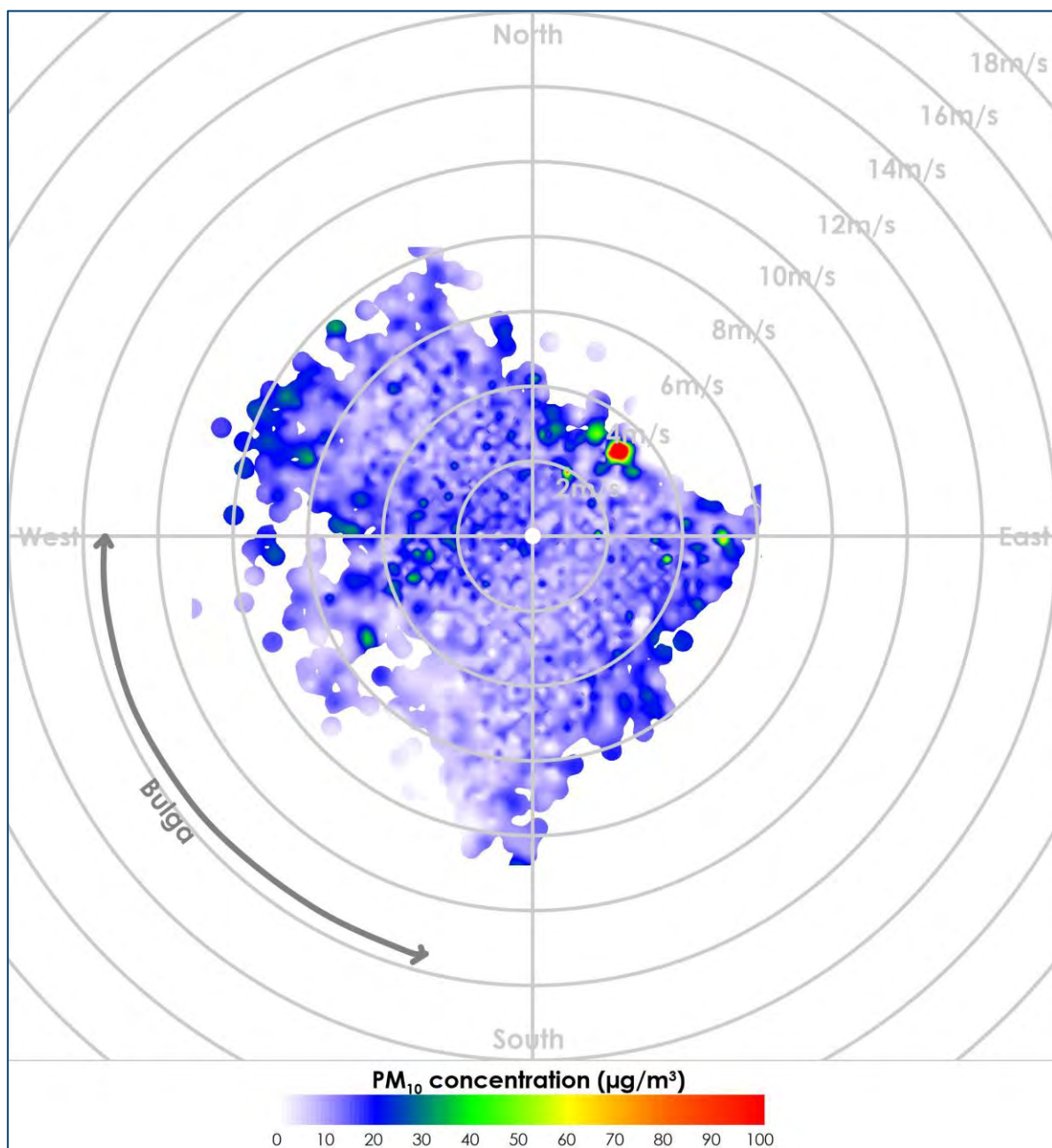


Figure 6-6: Pollution rose for D11 TEOM PM₁₀ data (2022)

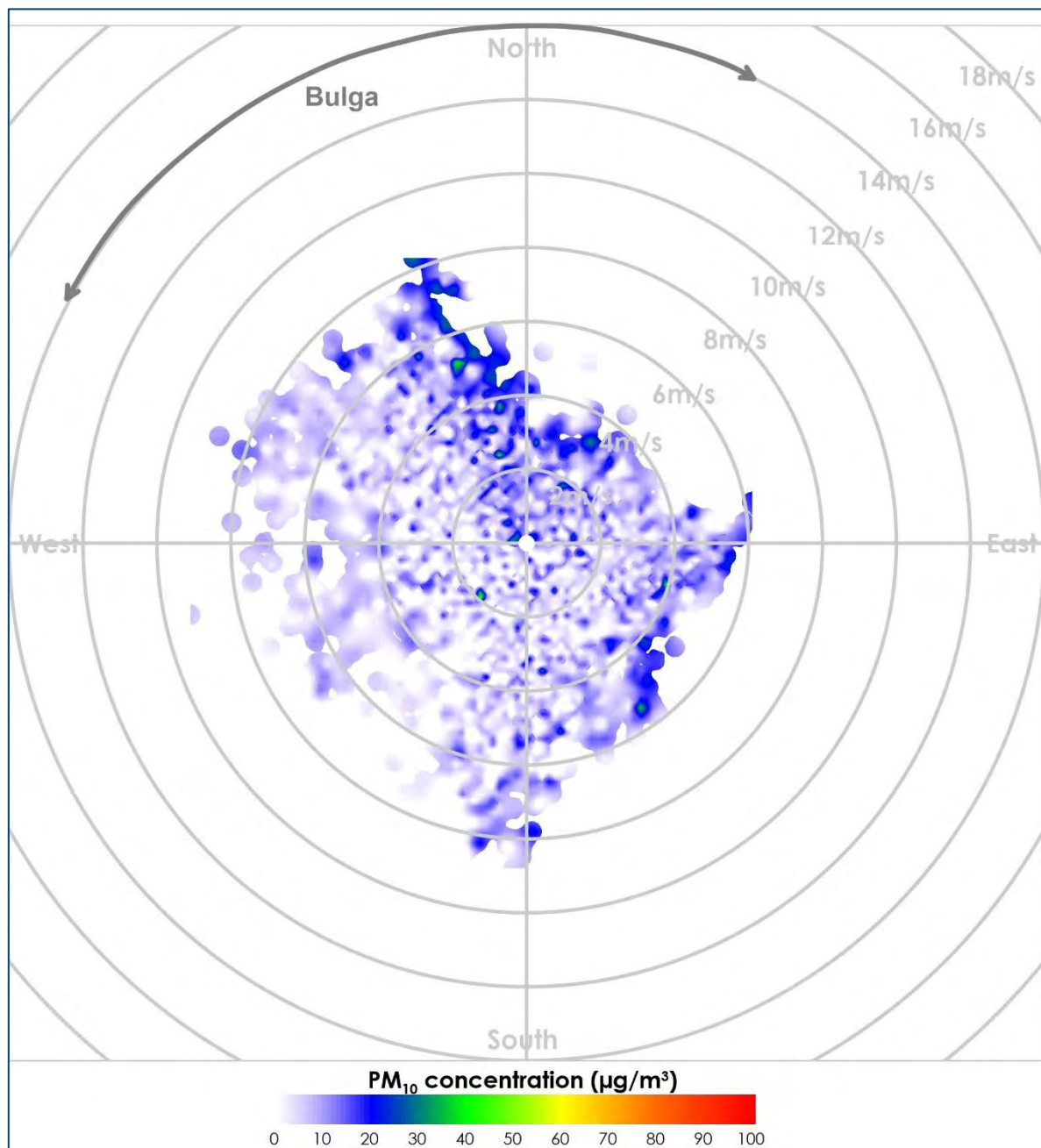


Figure 6-7: Pollution rose for D8 E-BAM PM₁₀ data (2022)

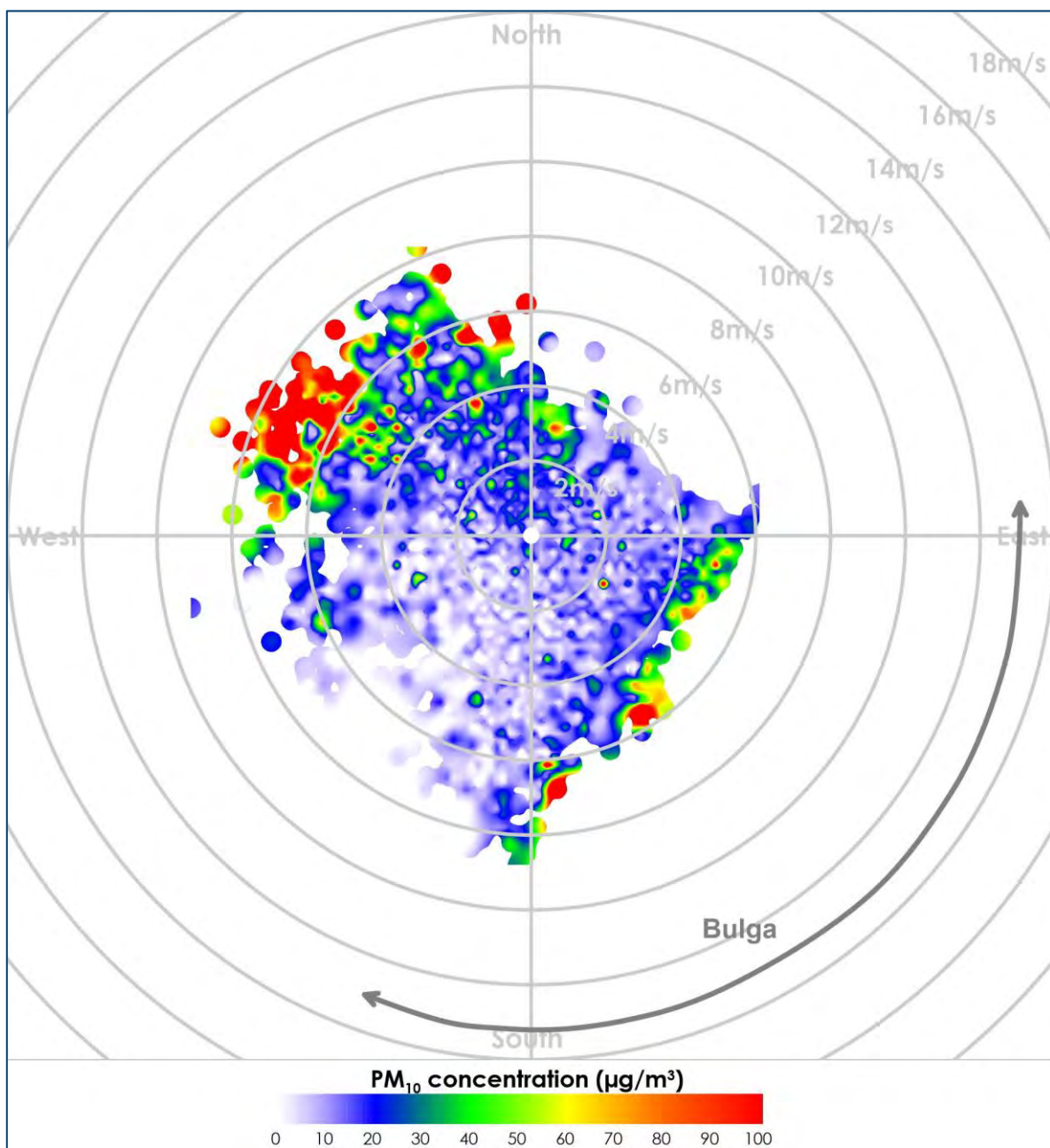


Figure 6-8: Pollution rose for D9 E-BAM PM₁₀ data (2022)

7 CONCLUSIONS

This report has analysed the dust monitoring data recorded at the Bulga Complex and provides a comparison between the dust levels measured in 2022 with the modelled predictions for that approximate year (Year 2022) per the *Bulga Coal Complex Modification 3 Air Quality Impact Assessment* (Jacobs, 2019).

The analysis shows that the annual average measured levels in 2022 were lower than the predictions for the representative modelling scenario. In general, it is considered that 2022 was a relatively cool and wet year for NSW which may have contributed to lower dust levels measured in 2022.

This report has also presented a review and long-term trend analysis of air quality data from the beginning of monitoring to the end of 2022. The analysis shows that the annual average levels were below the relevant criteria and were generally lower than previous years, likely due to an increase in rainfall in 2022.

An analysis of the pollution roses for 2022 generally shows minor effects from the direction of Bulga Complex on dust levels.



8 REFERENCES

Jacobs (2019)

“Bulga Coal Complex Modification 3 Air Quality Impact Assessment”, prepared by Jacobs Group (Australia) Pty Ltd for Bulga Coal Management Pty Ltd, 10 June 2016.



Appendix A How to read a windrose and pollution rose

Windrose

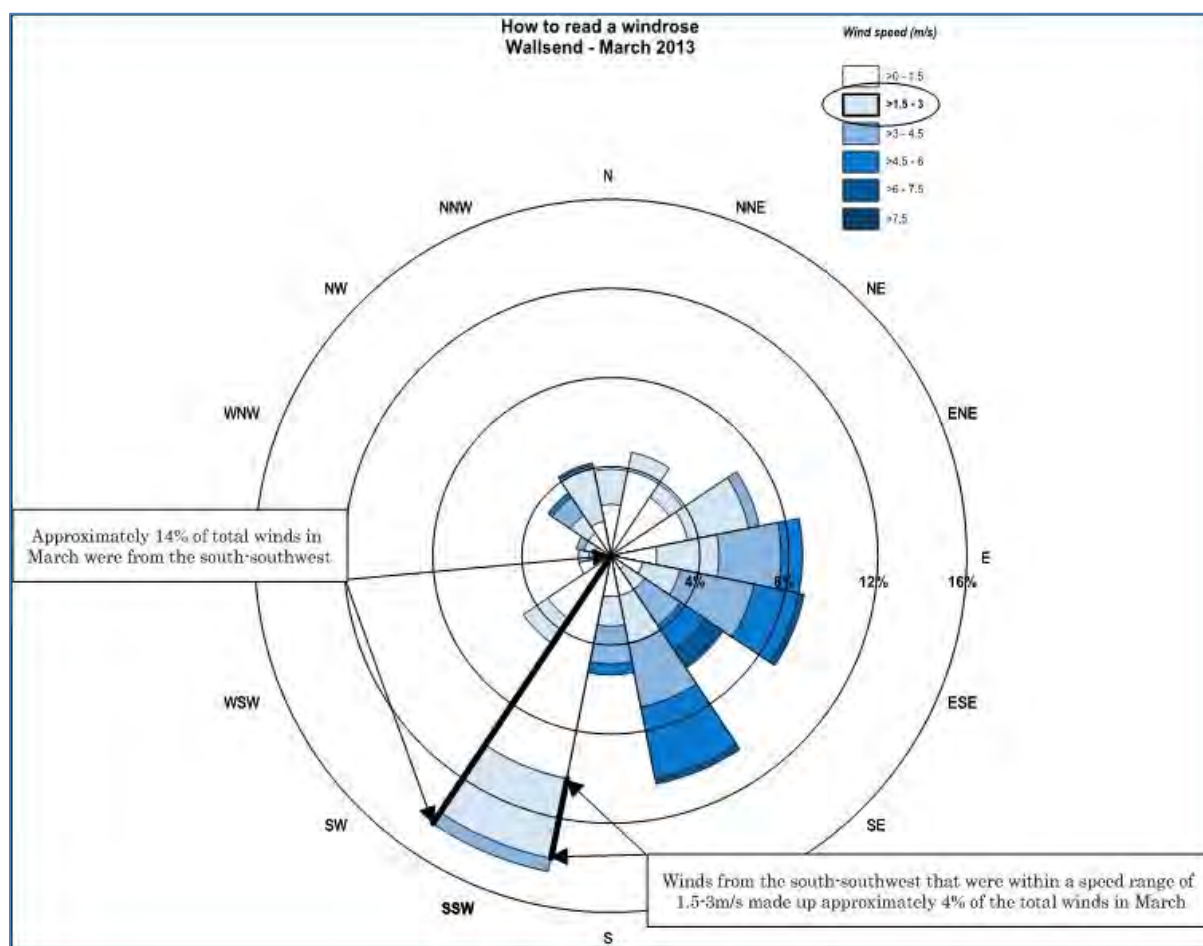


Figure A-1: How to read a windrose

Pollution rose

How to read a pollution rose:

- The colour indicates the pollutant concentration measured at the monitor.
- The position of pollutant concentration markings along the 360° axis indicate the corresponding direction from which pollutants arise from.
- The position of pollutant concentration markings relative to the banded rings indicate the wind speed for the corresponding hourly concentration.
- The arc labelled "Bulga" indicates the relative direction of Bulga Complex from the monitor.

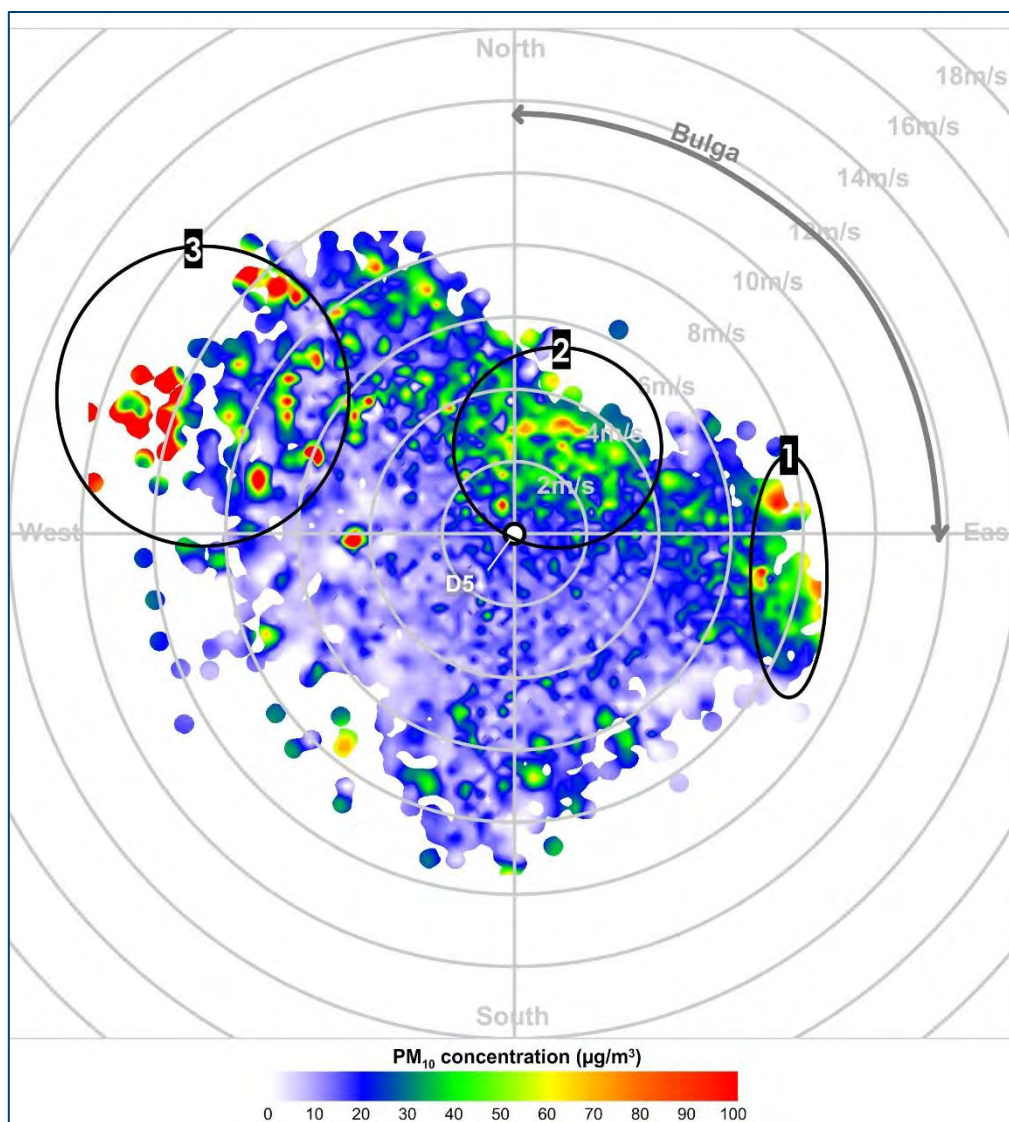


Figure A-2: Example Pollution Rose

- 1 - Moderate PM₁₀ levels tended to originate from the east under wind speeds around 8m/s.
- 2 - Moderate PM₁₀ levels were also recorded from the north and north-northeast direction under wind speeds generally between 2 m/s and 4 m/s.
- 3 - Some high levels were also recorded from the northwest under moderate wind speeds

Appendix B Meteorological data capture summary

This section presents a summary of the percentage data capture of the available 10-minute data from the Bulga Complex, Southern Extension and Flares meteorological stations for the 2022 calendar year.

There was greater than 90% valid data capture for all parameters with the exception of relative humidity at the Southern Extension station. An issue with the Southern Extension relative humidity sensor which resulted in fluctuations between very low and very high readings was investigated by Bulga Coal and has now been fixed.

Table B-1: Bulga Complex Weather Station summary of 10-minute data

Parameter	Temperature at 2m	Temperature at 10m	Wind speed at 10m	Wind direction at 10m	Relative humidity	Sigma Theta	Rainfall
Total data capture	99.7%	99.7%	99.7%	99.7%	99.7%	99.7%	99.7%
Missing data	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
Erroneous data	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%
Valid data	99.7%	99.7%	99.7%	99.7%	99.5%	99.7%	99.7%

Table B-2: Southern Extension Weather Station summary of 10-minute data

Parameter	Temperature at 2m	Temperature at 30m	Wind speed at 30m	Wind direction at 30m	Relative humidity	Sigma Theta	Rainfall
Total data capture	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Missing data	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Erroneous data	0.0%	0.0%	0.5%	0.5%	23.5%	0.5%	0.0%
Valid data	100.0%	100.0%	99.5%	99.5%	76.5%	99.5%	100.0%

Table B-3: Flares Weather Station summary of 10-minute data

Parameter	Temperature at 2m	Temperature at 10m	Wind speed at 10m	Wind direction at 10m	Relative humidity	Sigma Theta	Rainfall
Total data capture	99.4%	99.4%	99.4%	99.4%	99.4%	99.4%	99.4%
Missing data	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%
Erroneous data	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%
Valid data	99.4%	99.4%	99.4%	99.4%	99.2%	99.4%	99.4%



Appendix C TEOM and BAM 24-hour data capture summary

This section presents a summary of the 24-hour average periods where there was less than 75% valid data for the TEOM, BAM and E-BAM monitors during the 2022 calendar year.

Table C-1: Days with insufficient data (i.e. <75%) for a 24-hour average calculation - D1

Date	Cause/s	Action
1/02/2022 & 2/02/2022	Stopped 0730 1/2/22. Circuit breakers for P1 & P2 tripped.	-
9/02/2022 & 10/02/2022	Unit stopped 1420 9/2/22. AC was on. TEOM and modem were all off. P1 circuit was tripped.	Rebuilt D1 vacuum pump. Installed new power board into AC circuit. Plugged AC, TEOM, modem, D1 vacuum pump and met into power board.
25/02/2022	Unexplained power outage 0830 to 1250	-
6/05/2022	Unexplained power outage	-
6/07/2022 to 9/07/2022	Power outage due to extreme weather blackout	-

Table C-2: Days with insufficient data (i.e. <75%) for a 24-hour average calculation – D3

Date	Cause/s	Action
15/03/2022 & 16/03/2022	12M PM with zero noise filter overnight	-

Table C-3: Days with insufficient data (i.e. <75%) for a 24-hour average calculation – D5

Date	Cause/s	Action
13/01/2022 & 14/01/2022	Unit stopped 1240 13/1/22. UP was in fault mode.	Reset UPS 14/1/22.
15/03/2022 & 16/03/2022	12M PM with zero noise filter overnight	-
15/05/2022 & 16/05/2022	Stopped 1240 15/5/22 due to unexplained power failure. On arrival UPS was off. This powers the TEOM and the modem.	Turned UPS back on and operation was restored
5/07/2022	Multiple short power interruptions with subsequent TEOM stabilisation	-
7/07/2022 to 10/07/2022	Power outage due to extreme weather blackout	-
2/10/2022	Clock adjusted for DST	-
8/11/2022	Unexplained power outage	-
13/11/2022	Unexplained power outage	-

Table C-4: Days with insufficient data (i.e. <75%) for a 24-hour average calculation - D11

Date	Cause/s	Action
12/11/2022	Unexplained power interruption	-



Table C-5: Days with insufficient data (i.e. <75%) for a 24-hour average calculation – D2

Date	Cause/s	Action
1/01/2022 to 28/04/2022	Heater failure	Replaced and calibrated AT/RH sensor and cable and replaced heater
6/07/2022 to 9/07/2022	Power outage due to extreme weather blackout	-
28/09/2022	3M PM	-

Table C-6: Days with insufficient data (i.e. <75%) for a 24-hour average calculation - D10

Date	Cause/s	Action
7/01/2022	Negative result due to flow failures	-
24/01/2022	Negative result due to flow failures	-
11/02/2022	Insufficient data due to flow failures	-
13/03/2022	Insufficient data due to flow failures	-
16/03/2022 & 17/03/2022	Zero particle test.	Installed 1355 16/3/22 Removed 1400 17/3/22
12/07/2022 to 13/07/2022	12M PM with zero noise filter installed overnight	-

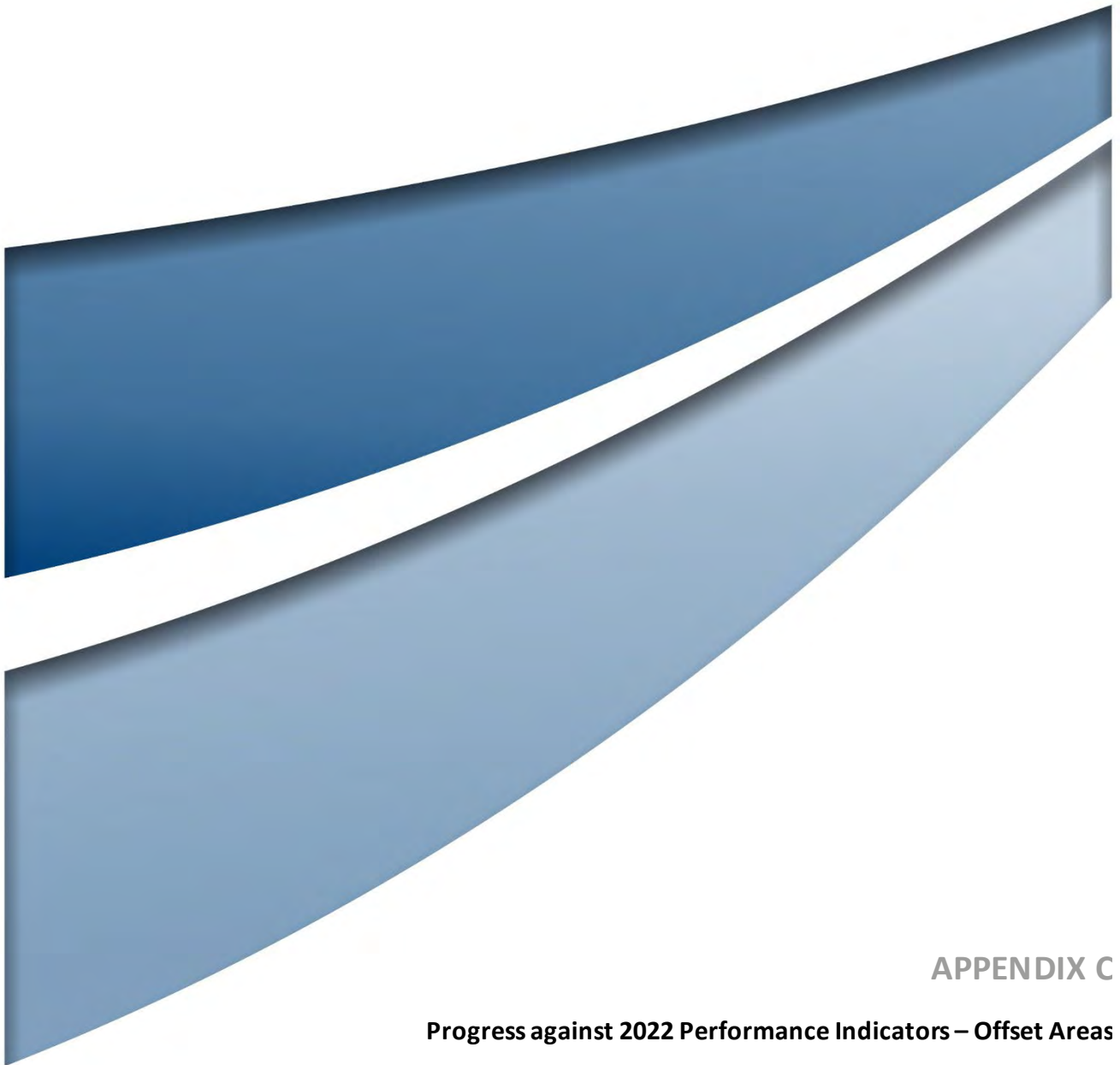
Table C-7: Days with insufficient data (i.e. <75%) for a 24-hour average calculation – D8

Date	Cause/s	Action
21/03/2022 & 22/03/2022	12M PM with zero noise filter overnight	-
24/04/2022 to 26/04/2022	Pump failed	Pump replaced
6/07/2022 to 8/07/2022	Power outage due to extreme weather	-
21/09/2022	Unexplained data outage	-
28/10/2022	Zero flow	Performed flow calibrations and checked solar panels and battery voltages. Unit restarted 1000 28/10/22

Table C-8: Days with insufficient data (i.e. <75%) for a 24-hour average calculation – D9

Date	Cause/s	Action
23/05/2022	Flow failure 0220. Hardware failure alarm on arrival (tape advance error)	-
5/07/2022 to 7/07/2022	Power outage due to extreme weather	-
22/10/2022 to 24/10/2022	A partially corrupted CF card on Datataker.	-
31/10/2022 & 1/11/2022	Flow failure	-





APPENDIX C

Progress against 2022 Performance Indicators – Offset Areas

Table C.1 Broke Road BOA

Number	Performance Indicator	Progress	Comments
1	Control of weeds in revegetation/regeneration areas – Weed control works are completed in accordance with this BOMP and actions recommended from monitoring recommendations.	No	Spot control of problem weeds is undertaken as required, focusing on high priority species (Table 3.2 in BOMP). However, Lantana is expanding and requires control.
2	Control of feral animals in revegetation/regeneration areas – Feral animal control works are completed, in accordance with this BOMP and actions recommended from monitoring recommendations.	Yes	Despite the favourable wet weather conditions for feral pigs during 2022. Feral animal activity is low across Broke Road and management will continue during 2023.
3	Confirmation of mapping of areas for regeneration, including appropriateness of target community – Completed prior to commencing 2020-2023 revegetation works.	Yes	Completed prior to revegetation.
4	Management of regeneration progress is responsive to monitoring outcomes – Monitoring of regeneration areas occurs. Management actions are implemented in response to monitoring.	Yes	Monitoring is completed annually and identifies required management actions. Additionally, a regeneration assessment was completed in 2022.
5	Review the need for assisted generation where outcomes of natural regeneration is deemed lacking – 20 hectares of revegetation as per GSS (2017). Continue to monitor progress of natural regeneration and need for management intervention.	Yes	A regeneration assessment was completed in 2022.
6	Slaty Red Gum (<i>Eucalyptus glaucina</i>) – Stands of slaty red gum (<i>Eucalyptus glaucina</i>) are in good condition and natural recruitment of seedlings is evident.	Yes	Slaty Red Gum distribution has been mapped, and monitoring. It continues to show increasing new recruitment.
7	Develop detailed performance criteria for all management zone types – Detailed criteria developed based on annual monitoring of analogue sites (including target species diversities, coverage and abundance for different strata).	No	Yet to be developed, however, 7 years of baseline data available for this.
8	Native flora species diversity – key indicator species present for target vegetation community.	Yes	All assessed areas support key indicator species of target communities.
9	Native flora species coverage – Native flora coverage is higher than introduced coverage in all strata.	Yes	Coverage of exotic species is <20% for all assessed regeneration areas, and <25% for revegetation areas.
10	Native canopy species abundance – Native canopy species present.	Yes	All assessed areas support native canopy species.
11	Formation of distinct vegetation strata – Native species are present that are capable of forming the strata of the target vegetation community.	Yes	All assessed areas support native species from canopy, shrub and ground, but this is limited in Grassland.

Number	Performance Indicator	Progress	Comments
12	Log coverage – Treed vegetation is increasing in DBH from previous monitoring year.	Yes	There is an increasing trend in DBH across most transects, particularly in the smaller classes.
13	Implement revegetation program – Implementation of plan.	Yes	Revegetation commenced in 2018, monitored annually since 2018.
14	Positive feedback loop from monitoring results – Feedback from monitoring is incorporated into ongoing review and improvement of plan.	Yes	Recommendations from monitoring are adopted in ongoing management.
15	Native fauna presence in rehabilitation/regeneration areas – Fauna monitoring completed. Native fauna utilising habitats present.	Yes	Monitoring in 2022 shows active use of nest boxes and diverse fauna observed during the monitoring program.
16	Collate data on actions implemented and results of inspections and monitoring into the AR – AR completed annually.	Yes	Monitoring results reported annually.
17	Weed inspections of remnant areas – Annual inspections are undertaken of vegetation to identify areas of weed infestation. Subsequent weed management actions of infestations are undertaken in accordance with current or other best practice approaches.	Yes	Weed inspections completed annually and detailed in this report. Control actions undertaken by Enright Land Management and reported separately.

Table C.2 Condran BOA

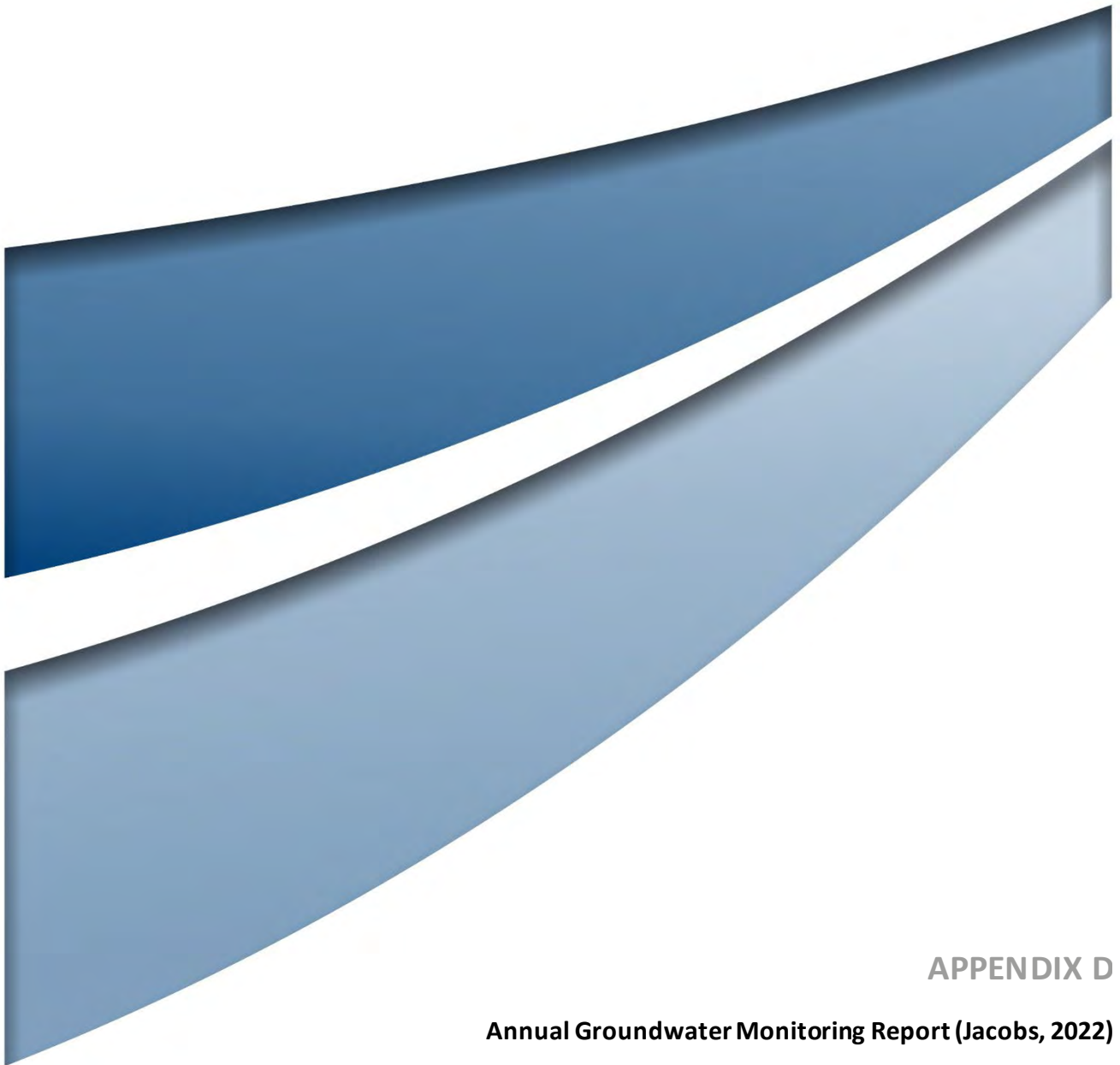
Number	Performance Indicator	Progress	Comments
1	Control of weeds in revegetation / regeneration areas – Weed control works are completed in accordance with this BOMP and actions recommended from monitoring recommendations.	Yes	Spot control of problem weeds is undertaken as required, focusing on high priority species Coolatai Grass and Whisky Grass.
2	Control of feral animals in revegetation/regeneration areas – Feral animal control works are completed, in accordance with this BOMP and actions recommended from monitoring recommendations.	Yes	Feral animal activity is low across Condran Offset. Annual wild dog and fox baiting program was completed in 2022 and management will continue during 2023.
3	Confirmation of mapping of areas for regeneration, including appropriateness of target community – Completed prior to commencing 2020–2023 revegetation works.	Yes	Completed prior to revegetation.
4	Management of regeneration progress is responsive to monitoring outcomes – Monitoring of regeneration areas occurs. Management actions are implemented in response to monitoring.	Yes	Monitoring is completed annually and identifies required management actions. Additionally, a regeneration assessment was completed in 2022.
5	Review need for assisted regeneration where outcomes of natural regeneration is deemed lacking – Natural regeneration.	Yes	A regeneration assessment was completed in 2022.

Number	Performance Indicator	Progress	Comments
6	Develop detailed performance criteria for all management zone types – Detailed criteria developed based on annual monitoring of analogue sites (including target species diversities, coverage and abundance for different strata).	No	Yet to be developed, however, 9 years of baseline data available for this.
7	Native flora species diversity – Key indicator species present for target vegetation community.	Yes	All assessed areas support key indicator species of target communities.
8	Native flora species coverage – Native flora coverage is higher than introduced coverage in all strata.	Yes	Coverage of exotic species is <20% for all assessed regeneration areas, and <30% for revegetation areas.
9	Native canopy species abundance – Native canopy species present.	Yes	All assessed areas support native canopy species.
10	Formation of distinct vegetation strata – Native species are present that are capable of forming the strata of the target vegetation community.	Yes	All assessed areas support native species from canopy, shrub and ground, but this is limited in Grassland Mus.
11	Log coverage – Treed vegetation is increasing in DBH from previous monitoring year.	Yes	There is an increasing trend in DBH across most transects, particularly in the smaller classes.
12	Implement revegetation program – Implementation of plan.	Yes	Revegetation commenced in 2016, monitored annually since 2018.
13	Positive feedback loop from monitoring results – Feedback from monitoring is incorporated into ongoing review and improvement of plan.	Yes	Recommendations from monitoring are adopted in ongoing management.
14	Native fauna presence in rehabilitation/regeneration areas – Fauna monitoring completed. Native fauna utilising habitats present.	Yes	Monitoring shows 25 birds, 6 mammals and 4 threatened species were recorded in 2022. Additionally, 16 nest boxes were installed in the offset.
15	Collate data on actions implemented and results of inspections and monitoring into the AR – AR completed annually.	Yes	Monitoring results reported annually.
16	Weed inspections of remnant areas – Annual inspections are undertaken of vegetation to identify areas of weed infestation. Subsequent weed management actions of infestations are undertaken in accordance with current or other best practice approaches.	Yes	Weed inspections completed annually and detailed in this report. Control actions undertaken by Enright Land Management and reported separately.

Table C.3 Wollombi Brook BOA

Number	Performance Indicator	Progress	Comments
1	Control of weeds in revegetation/regeneration areas – Weed control works are completed in accordance with this BOMP and actions recommended from monitoring recommendations.	Yes	Sport control of problem weeds is undertaken as required, focusing on high/medium priority species (Table 3.2 in BOMP).
2	Control of feral animals in revegetation / regeneration areas – Feral animal control works are completed in accordance with this BOMP and actions recommended from monitoring recommendations.	Yes	Feral animal activity is low across Wollombi Brook. Annual wild dog and fox baiting and pig trapping program was completed in 2022 and management will continue during 2023.
3	Management of Bullock regeneration – Bullock regeneration is actively managed to improve condition of existing Warkworth Sands Woodland EEC variants and ensure it does not inhibit successful regeneration of this community.	Yes	Thinning trials have been underway since 2016 to monitor and assess impacts.
4	Confirmation of mapping of areas for regeneration, including appropriateness of target community – Completed prior to commencing 2020-2023 revegetation works.	Yes	Completed prior to revegetation.
5	Management of regeneration progress is responsive to monitoring outcomes – Monitoring of regeneration areas occurs. Management actions are implemented in response to monitoring.	Yes	Monitoring is completed annually and identifies required management actions. Additionally, a regeneration assessment was completed in 2022.
6	Review need for assisted regeneration where outcomes of natural regeneration is deemed lacking – Continue to monitor progress of natural regeneration and need for management intervention.	Yes	A regeneration assessment was completed in 2022.
7	Develop detailed performance criteria for all management zone types – Detailed criteria developed based on annual monitoring of analogue sites (including target species diversities, coverage and abundance for different strata).	No	Yet to be developed, however, 7 years of baseline data available for this.
8	Native flora species diversity – key indicator species present for target vegetation community.	Yes	All assessed areas support key indicator species of target communities.
9	Native flora species coverage – Native flora coverage is higher than introduced coverage in all strata.	Yes	Coverage of exotic species is <20% for all assessed areas.
10	Native canopy species abundance – Native canopy species present.	Yes	All assessed areas support native canopy species.
11	Formation of distinct vegetation strata – Native species are present that are capable of forming the strata of the target vegetation community.	Yes	All assessed areas support native species from canopy, shrub and ground, but this is limited in Grassland Mus.

Number	Performance Indicator	Progress	Comments
12	Log coverage – Treed vegetation is increasing in DBH from previous monitoring year.	Yes	There is an increasing trend in DBH across most transects, particularly in the smaller classes.
13	Implement revegetation program – Implementation of plan.	Yes	Revegetation commenced in 2019, monitored annually since then.
14	Positive feedback loop from monitoring results – Feedback from monitoring is incorporated into ongoing review and improvement of plan.	Yes	Recommendations from monitoring are adopted in ongoing management.
15	Native fauna presence in rehabilitation/regeneration areas – Fauna monitoring completed. Native fauna utilising habitats present.	Yes	Monitoring in 2022 shows 51 birds, 12 mammals, 4 threatened species and active use of nest boxes installed.
16	Collate data on actions implemented and results of inspections and monitoring into the AR – AR completed annually.	Yes	Monitoring results reported annually.
17	Weed inspections of remnant areas – Annual inspections are undertaken of vegetation to identify areas of weed infestation. Subsequent weed management actions of infestations are undertaken in accordance with current or other best practice approaches.	Yes	Weed inspections completed annually and detailed in this report. Control actions undertaken by Enright Land Management and reported separately.



APPENDIX D

Annual Groundwater Monitoring Report (Jacobs, 2022)



Bulga Coal Complex

Annual Surface and Groundwater Monitoring Report – 2022 Monitoring Period

23 March 2023



Bulga Coal Complex

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Important note about your report

The sole purpose of this report is to present a review of the groundwater data collected during 2022 for the Bulga Coal Complex, for Bulga Coal Management Pty Ltd (BCM).

In preparing this report, Jacobs has relied upon, and presumed accurate, any information provided by BCM and other publicly available sources.

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1. Introduction

This report was prepared to support the Annual Review Report for Bulga Coal Management (BCM). It documents surface and groundwater conditions during the 2022 reporting period, between 01 January 2022 and 31 December 2022.

1.1 Background

The Bulga Coal Complex (BCC) is located in the NSW Hunter Coalfield, approximately 12 km southwest of Singleton and 1 km north of Broke, NSW (refer Figure 1). BCC is managed by Bulga Coal Management Pty Ltd and comprises both Bulga Open Cut (BOC) and Bulga Underground Operations (BUO).

BUO previously comprised two operations, Blakefield South (BFS) which ceased operation in 2018 and historical Beltana No.1 mine. Beltana No.1 underground mine ceased operation in 2011 and extracted coal from the Whybrow Seam directly south-west of the open cut and north-west of BFS. In 2010, BFS operations commenced extraction of the Blakefield Seam that underlies the previously extracted Whybrow Seam. Mining operations at BUO were undertaken using the longwall retreat mining method. The BFS LW1A to BFS LW5 longwalls were extracted in the southwest to northeast direction, while longwalls BFS LW7 and BFS LW8 were extracted in the southeast-northwest direction (Figure 2.1).

1.2 Study Area

BFS is situated at the southern end of the BCC and just north of the Broke township. Wollombi Brook, flowing to the north-west, comes within 500 m south of BFS LW3. Monkey Place Creek, a tributary of Wollombi Brook, flows west and is located immediately to the south (100 m to 200 m) past BFS LW3 to BFS LW5.

1.3 Geology

Geologically, the BCC is located in the northern part of the Sydney Basin. A major structural feature is the Mt Thorley monocline, which is located to the east of the BCC. The BUO area is underlain by Late Permian age strata – the Wittingham Coal Measures, which are directly overlain by the Wollombi Coal Measures Group. The late Permian sequence is characterised by a series of sandstone, siltstone, conglomerate and coal formations.

The strata dip at approximately 2° to 5° to the south-west. Strata of Late Permian age outcrop across the site but are overlain in localised areas by alluvial deposits along Wollombi Brook and Monkey Place Creek. Table 1.1 shows the detailed stratigraphy of this part of the Sydney Basin and Table 1.2 presents the coals seams of the Jerrys Plains subgroup of the Wittingham Coal Measures.

Table 1.1: General stratigraphy of the Hunter Coalfields

Period	Stratigraphy		
Quaternary	Wollombi Brook alluvium, Monkey Place Creek alluvium		
Triassic	Hawkesbury Sandstone		
	Narrabeen Group	Terrigal Formation	
		Clifton Subgroup	Patonga Claystone
			Tuggerah Formation
			Widden Brook
Permian	Singleton Supergroup	Wollombi Coal Measures	Glen Gallic Subgroup
			Doyles Creek Subgroup
			Horseshow Creek Subgroup (Alcheringa Seam is the basal member)
			Apple Tree Flat Subgroup
			Watts Sandstone
		Wittingham Coal Measures	Denman Formation
			Jerrys Plains Subgroup (includes the Whybrow and Blakefield Seams)
			Archerfield Sandstone
			Vane Subgroup
			Saltwater Creek Formation

Table 1.2: Coal seams nomenclature of Jerrys Plains Subgroup (Beckett, 1988)

Subgroup	Coal Seams
Jerrys Plains	Whybrow
	Redbank Creek
	Wambo
	Whynot
	Blakefield
	Glen Munro
	Woodlands Hill
	Mount Arthur
	Piercefield
	Vaux
	Bayswater

1.4 Hydrogeology

1.4.1 Hydrostratigraphy

There are three broad groups of hydrostratigraphic units (HSUs):

- **Shallow groundwater system:** Alluvium (and underlying regolith) associated with Wollombi Brook and Monkey Place Creek and regolith
- **Interburden and shallow coal measures:** Weathered and fractured shallow sandstone and coal measures
- **Coal seams:** Wollombi Coal Measures and the Wittingham Coal Measures, which may be regarded as a fractured rock aquifer

The alluvium and regolith have low to moderate hydraulic conductivity and supports local water supplies with around 20 private bores within a 3 km radius of BFS. This aquifer is used for a variety of purposes including stock and domestic, water supply and irrigation. Water quality is generally fresh.

The intermediate depth shallow coal measures exhibit relatively low hydraulic conductivity.

The coal measures fractured rock aquifer comprises sandstone, siltstone and coal seams with varying degree of fracturing and hydraulic conductivity. This hydrostratigraphic unit is characterised by generally poor-quality groundwater and low hydraulic conductivity. There are no private bores extracting from the shallow coal measures within the vicinity of BFS.

1.4.2 Recharge and Discharge

Recharge to the alluvium and shallow weathered coal measures is mainly via ephemeral streamflow and rainfall infiltration with topography driving the shallow groundwater flow direction. As evidenced from water pressure monitoring and water quality data, the deeper hydrostratigraphic units are confined and are recharged from vertical leakage where depressurisation induces sufficient hydraulic gradient, and also from recharge zones some distance away from the BUO.

Discharge from the shallow groundwater system occurs via abstraction, evapotranspiration, leakage to deeper strata, and as baseflow to local watercourses. Discharge from deeper units occurs via mine dewatering and local horizontal and vertical flow driven by migration towards depressurised zones. Regional outflow may occur via horizontal migration and outflow at some distance away from the mining operation.

The 2022 reporting period recorded 1,200 mm of rain with substantial flooding in February, March and July followed by November and December being dryer than usual. The surface and groundwater monitoring data reflects the natural response to a second year of greater than average rainfall, surface flows and groundwater recharge.

2. Monitoring network

2.1 Groundwater Monitoring Network

The groundwater monitoring network for the BUO comprises a number of dedicated monitoring bores, nested monitoring bores and multi-level vibrating wire piezometers (VWP) (Figure 2.1). These are distributed throughout the three broad hydrostratigraphic groups (Section 1.4.1).

Groundwater monitoring is undertaken in accordance with the Bulga Coal Water Management Plan. Over the past 15 years a number of monitoring points have been abandoned or destroyed and new ones installed as the underground workings progressed. A summary of currently operational monitoring bores is provided in Table 2.1 for standpipes and Table 2.2 for VWP, respectively. The locations of all currently monitored monitoring bores are shown on Figure 2.1.

The following provides a summary of the formations monitored, grouped under the three broad hydrostratigraphic groups outlined in Section 1.4.1:

Shallow Groundwater System:

- **Wollombi Alluvium** – twelve standpipe monitoring bores are located to the south and west of BFS. Three of the twelve monitoring bores are equipped with dataloggers
- **Monkey Place Creek Alluvium** - ten monitoring bores are installed to a maximum depth of 16 m to the south BFS. Nine are equipped with dataloggers
- **Loders Creek Alluvium** – two monitoring bores installed in November 2019, located to the northeast of BFS
- **Regolith/alluvium** - two standpipe monitoring bores are installed in regolith/volcanic sill/alluvium of which one was equipped with a datalogger in late 2017

Interburden and shallow coal measures:

- **Interburden sandstone** - six standpipe monitoring bores are installed in shallow interburden sandstone to a depth of up to 52 m to the west and northwest of BFS
- **Shallow Permian and Coal Measures (undifferentiated)** - eight standpipe monitoring bores are installed to the northwest and the southwest of BFS. Two monitoring bores were equipped with dataloggers from 2017 and 2018

Coal Seams:

- **Alcheringa Seam** (Wollombi Coal Measures) – five standpipe monitoring bores are currently monitored to the northwest of BFS at depths ranging from 10-42 m. Monitoring of a sixth bore ceased in 2018. Four of the five currently monitored standpipes have dataloggers installed
- **Lower Whybrow Seam** (Wittingham Coal Measures) - three standpipe monitoring bores, one of which has a datalogger installed

In addition, four VWP arrays are installed west, northwest and east of the BFS to a depth of 220 m to 367.7 m (up to 176 m below the mined Blakefield Seam). The VWP installation, including depth setting of sensors, are presented on Table 2.2.

Table 2.1: Summary of standpipe monitoring bores

Site Name	Easting (MGA56)	Northing (MGA56)	Formation monitored	Depth of installation (m bgl)	Continuous loggers
Dwyers	317704.52	6379357.94	Wollombi Alluvium	<30	
F1	316152	6381601	Wollombi Alluvium	17.4	Y
F2	317916	6379142	Wollombi Alluvium	14	Y
Fernance	317697.38	6379366.74	Wollombi Alluvium	Unknown	
V1	316720.3	6380086.18	Wollombi Alluvium	<30	
V2	316959.49	6383505.26	Wollombi Alluvium	<30	
V3	321479.59	6377087.42	Wollombi Alluvium	<30	
WBD160	316435	6380857	Wollombi Alluvium	18	
WBR181	316735.26	6383229.55	Wollombi Alluvium	9	
WBR182	316570.5	6382623.04	Wollombi Alluvium	11.5	
White1	318248.9	6378942.98	Wollombi Alluvium	Unknown	
WBR241	316931.63	6383671.92	Wollombi Alluvium	13.5	Y
GW1	326035.56	6375616.55	Monkey Place Creek alluvium	Unknown	Y
GW10	322177.66	6376728.28	Monkey Place Creek alluvium	16	Y
GW2	325328.77	6375636.4	Monkey Place Creek alluvium	Unknown	Y
GW3	323342.37	6375423.79	Monkey Place Creek alluvium	13.2	Y
GW4	324107.37	6375104.12	Monkey Place Creek alluvium	Unknown	Y
GW5	324731.96	6375152.53	Monkey Place Creek alluvium	Unknown	Y
GW6	322800.98	6375050.58	Monkey Place Creek alluvium	13.3	
GW7	322738.39	6375581.53	Monkey Place Creek alluvium	10	Y
GW8	322120.98	6375817.87	Monkey Place Creek alluvium	16	Y
GW9	322319.08	6376212.93	Monkey Place Creek alluvium	13	Y
LC1	322,855	6,384,876	Loders Creek Alluvium	5	
LC2	323727	6387928	Loders Creek Alluvium	7.6	
McG1	317425.87	6381405.39	Regolith /sill/ alluvium	Unknown	
WBR15	317578.48	6379805.69	Regolith /sill/ alluvium	24	Y
WBR240	317495	6383685	Shallow Permian	9	Y
WBR50A	317619.47	6383700.52	Shallow Permian	18	Y
P2	321283.35	6377492.59	Shallow coal measures	52	
P5A	321682.07	6376660.68	Shallow coal measures	<100	
P6A	322839.83	6376615.27	Shallow coal measures	<100	
SBD196	320164.75	6377155.89	Shallow coal measures	Unknown	
WBR180	316926.13	6383123.84	Shallow coal measures	46	
WBR183	316802.5	6382733.61	Shallow coal measures	30.6	
NPZ3-B	318116.79	6379199.73	Interburden Sandstone	51.4	
NPZ4-B	316824.26	6380615.32	Interburden Sandstone	63.3	
NPZ5-B	316448.35	6381790.37	Interburden Sandstone	51.3	
NPZ7-1	317566.2	6379556.28	Interburden Sandstone	50	
NPZ7-2B	317623.98	6379598.15	Interburden Sandstone	57.5	
NPZ7-3B	317680.71	6379639.51	Interburden Sandstone	54	
NPZ3-A***	318117.71	6379200.51	Alcheringa Seam	17	
NPZ4-A	316820.6	6380615.83	Alcheringa Seam	42.4	Y
NPZ5-A	316448.35	6381790.37	Alcheringa Seam	15.7	Y
NPZ7-2A	317623.98	6379598.15	Alcheringa Seam	10	Y
NPZ7-3A	317680.71	6379639.51	Alcheringa Seam	17	Y
WBD62A	316593.58	6381282.77	Alcheringa Seam	27	Y
P6B	322839.83	6376615.27	Lower Whybrow Seam	390	
P7B*	-	-	Lower Whybrow Seam	-	
P8	324628.23	6375708.24	Lower Whybrow Seam	392.4	
WBR50	317604.5	6383719.6	Lower Whybrow Seam	125	Y
WWS1	317737.27	6384291.33	Warkworth Sands	2.15	
WWS2a	637639.41	6384540.53	Warkworth Sands	1.5	
WWS2b	637639.41	6384540.53	Warkworth Sands	2.6	

Site Name	Easting (MGA56)	Northing (MGA56)	Formation monitored	Depth of installation (m bgl)	Continuous loggers
WWS3a	317728.96	6384886.79	Warkworth Sands	1.4	
WWS3b	317728.96	6384886.79	Warkworth Sands	2.0	
MB1A shallow	318544.83	6384967.25	Shallow Permian**	25.5	Y
MB1B deep	318544.83	6384967.25	Deep Permian**	136	Y
MB2	318017.67	6384363.33	Whybrow Seam**	43	Y
MB3 shallow	318297.2	6383709.03	Shallow Permian**	23.5	Y
MB3 deep	318297.2	6383709.03	Deep Permian**	192	Y

Note: *Bore P7B has not been monitored since 2012 (not accessible)

**Northern Tailings emplacement facility piezometers

*** Bore NPZ3-A has not been monitored since 2015

Table 2.2: Details of vibrating wire monitoring bores

VWP ID	Easting (MGA94z56)	Northing (MGA94z56)	Ground Level (m AHD)	Depth Drilled (m)	VWP Depth (m bgl)	Formation	Stratigraphy
WBD170	317164.3	6380768.3	93.9	220	60	Undifferentiated coal measures	-
					110		
					160		
					220	Whybrow Seam	
WBD171	316939.8	6380797.6	85.3	223	60	Undifferentiated coal measures	-
					110		
					160		
					223	Whybrow Seam	
SBD194	320162.1	6377154.6	73.0	367.6	35.3	Shallow Coal	-
					90.8	Watts Sandstone	
					171.4	Whybrow Seam	Jerry's Plains Subgroup (Wittingham Coal Measures)
					197.3	Redbank Creek Seam	
					227.0	Wambo Seam	
					265.9	300/301 (Blakefield) Seam	
					278.8	Glen Munro Seam	
					321.3	Woodlands Hill Seam	
					367.7	Piercefield A and B Seam	
SBFOW15*	322380.2	6380379.1	89.1	383	96	Redbank Creek Seam	Jerry's Plains Subgroup (Wittingham Coal Measures)
					122	Wambo Seam	
					158	Blakefield Seam	
					184	Glen Munro Seam	
					224	Woodlands Hill Seam	
					334	Piercefield C Seam	

*data not available for 2019-2022

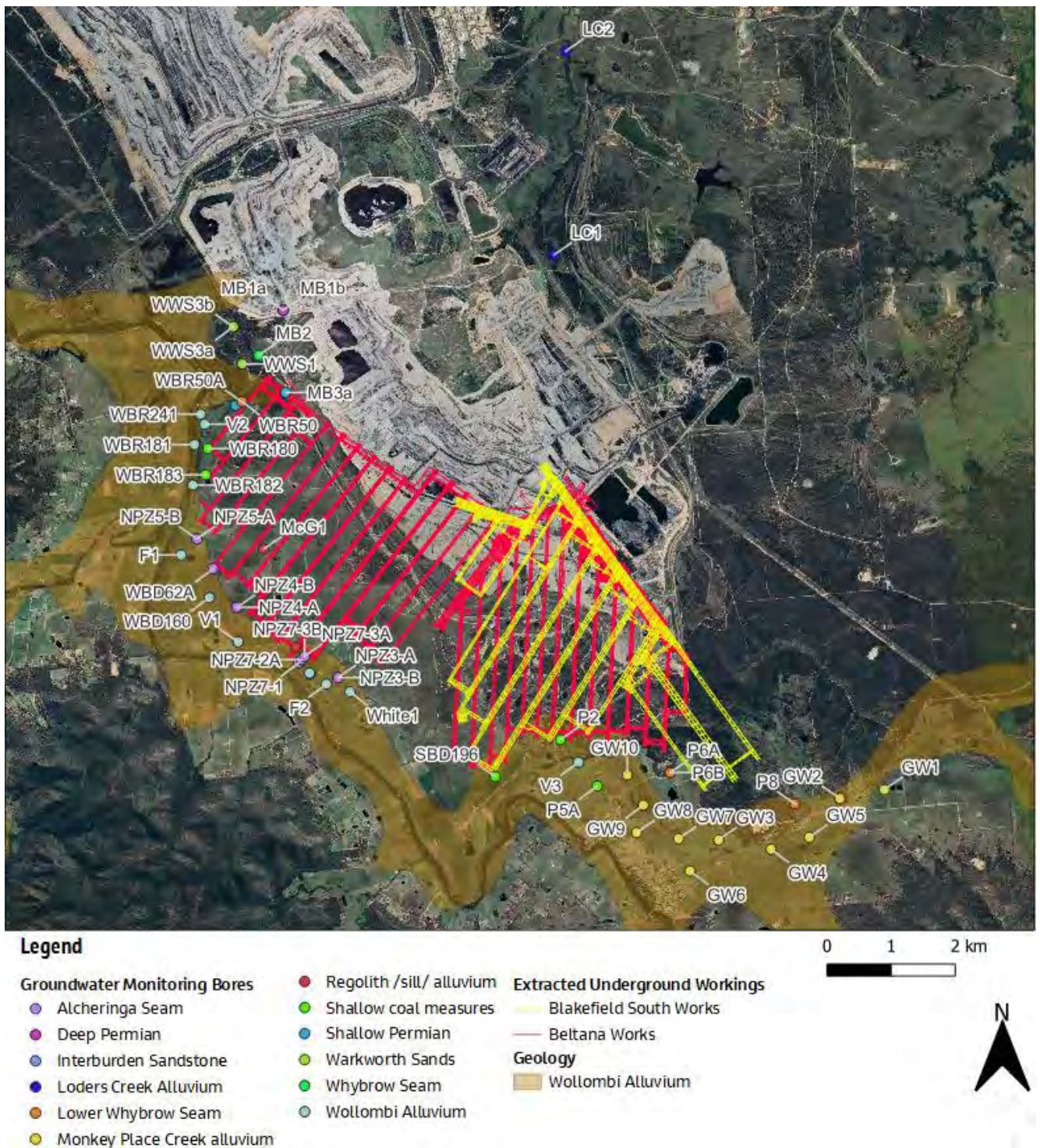


Figure 2.1 Groundwater Monitoring locations and general site features (2022)

2.2 Surface Water monitoring Network

Surface water quality monitoring is conducted at selected waterway sites in and around the Bulga Coal Complex (key waterways shown Figure 2.1), in accordance with Bulga Coal Water Management Plan (WMP) (Bulga 2021).

As per the current WMP (Bulga 2021), surface water quality is monitored monthly. Electrical conductivity (EC), potential for hydrogen (pH) and total suspended solids (TSS) are monitored. Water is collected using an extendible water sampler (or swing sampler) and transferred into bottles for analysis. Some water quality parameters are measured on site (such as water depth and temperature), while others are performed by a NATA accredited laboratory (pH, EC and TSS). Surface waters are sampled in accordance with Australian Standards AS5667.4 (1998) "Water Quality Sampling—Guidance on sampling from lakes, natural and man-made" and AS5667.6 (1998) "Water Quality Sampling—Guidance on sampling of rivers and streams".

Sampling was undertaken at ten selected points along waterways in the vicinity of the BCC. The approved monitoring locations are screening the following watercourses:

- **Wollombi Brook** (W2, W4, LR1, and LR5);
- **Loders Creek** (W9 and W10);
- **Monkey Place Creek** (LR2);
- **Southern Drainage Line** (SDL1);
- **Northern Drainage Line** (NDL1); and
- **Nine Mile Creek** (NMC1).

Monitoring locations LR1 and LR5 are considered representative of water quality upstream of the Bulga Coal Complex mining operations, while W4 is downstream. NDL1 represents the Northern Drainage Line and SDL1 represents the Southern Drainage Line. The specific locality details of the selected surface water monitoring sites are displayed below in Table 2.3 and Figure 2.2.

Table 2.3: Summary of standpipe monitoring bores

Site Name	Easting (MGA56)	Northing (MGA56)	Watercourse / Location	Data available since
LR1	322199.6	6375169.6	Wollombi Brook upstream of the village of Broke.	January 2004
LR5	317026.5	6379753.0	Wollombi Brook downstream of the confluence with the Southern Drainage Line.	January 2004
LR2	321055.5	6377232.7	Monkey Place Creek at Broke Road.	January 2004
W2	316561.4	6382591.4	Wollombi Brook downstream of LR5, and upstream of W4.	January 2004
W4	317205.1	6384357.9	Wollombi Brook downstream of the confluence with Northern Drainage Line.	January 2004
SDL1	319368.5	6378195.8	Northern Drainage line west of BOC – tributary of Wollombi Brook	July 2018
NDL1	318437.7	6383072.8	Southern Drainage Line west of BOC – tributary of Wollombi Brook	July 2018
W9	323769.7	6388099.2	Loder Creek upstream of the New England highway	July 2018
W10	322311.4	6385238.3	Loder Creek upstream of confluence with Nine Mile Creek and just upstream of Mining Lease Boundary	July 2018
NMC1	324166.3	6381069.8	Nine Mile Creek adjacent to Broke Rd	July 2018

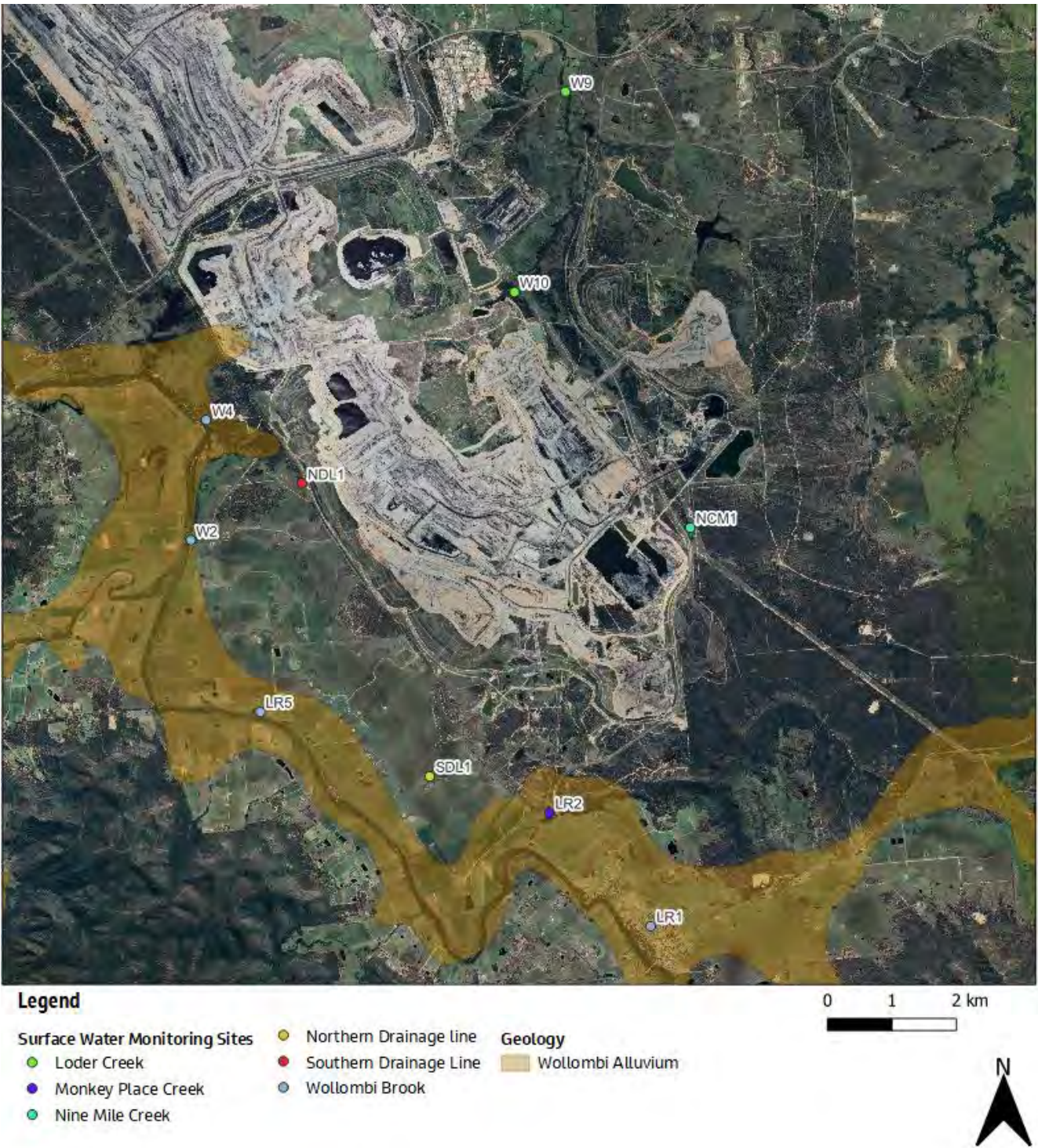


Figure 2.2 Surface water monitoring site localities (2022)

3. Results

3.1 Groundwater levels

3.1.1 Groundwater level responses during 2022

Groundwater level and quality data collected during the reporting period have been reviewed to assess the groundwater response to underground mining and to natural effects. The reporting period data is viewed in the context of the historic dataset extending back as far as 2003 where data is available. Hydrographs to the end of the reporting period are attached in Appendix A.

3.1.1.1 Shallow Groundwater System

Groundwater levels for the alluvium are shown in Appendix A and compared to the rainfall excess / deficit (also known as Cumulative Rainfall Departure, (CRD), which is calculated as the cumulative difference between actual rainfall over the monitoring period and long term mean average rainfall. A rising trend on the rainfall excess / deficit plot represents periods of above average rainfall and falling trends represent periods of below average rainfall. Comparison of hydrographs to the rainfall excess / deficit trend helps interpretation of groundwater level fluctuations in the context of seasonal rainfall variations vs other potential influences.

Rainfall data for the calculation of the excess / deficit trend was sourced from Bureau of Meteorology (BOM) station 061100 (Broke), located approximately 3.5 km south of the BFS workings. Rainfall data for the last 129 years from station 061100 were used to calculate the long-term monthly average rainfall. Recent data (2013-2022) from the BCC weather station was used to fill gaps in the BOM record for the Broke gauge. In 2022 the CRD identified a significant period of above average rainfall for the length of the year. This continues from above average rainfall throughout 2021 with the CRD indicating a rainfall excess in December 2022 for the first time since 2016-19 drought conditions (refer Figure 3.1).

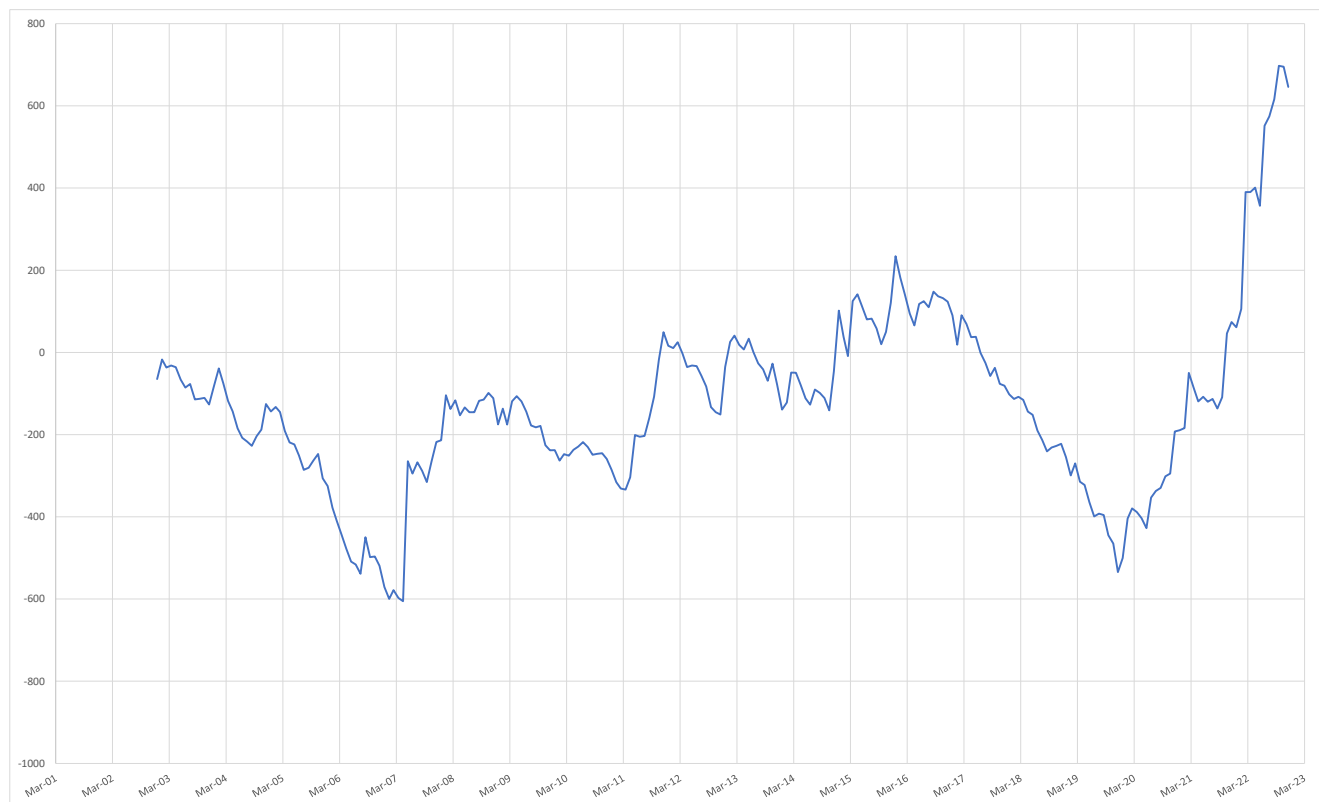


Figure 3.1 CRD

In the 2018, annual groundwater monitoring report the HARTT method (hydrograph analysis using rainfall and time trend (Ferdowsian, 2001) was used to assess groundwater level changes at selected alluvium monitoring bores. The HARTT methodology was developed to statistically analyse and estimate trends in groundwater levels. The method aims to separate the effect of rainfall events and the lag between rainfall and groundwater response from other underlying trends. The method is essentially a simple analytical modelling technique and produces a fitted curve through the observed groundwater level data using two variables, rainfall: Accumulative Monthly (or annual) Residual Rainfall (AMRR), and time. These variables can differentiate between the effect of rainfall fluctuations and other groundwater level trends.

The HARTT analysis aims to assess the influence of rainfall on groundwater level fluctuations relative to other (unspecified) influences, and is a somewhat subjective analytical tool, it was not adopted for the 2021 or 2022. groundwater level analysis. Trends in most alluvial bores show a clear reflection of the increasing rainfall excess during the reporting period and to historical fluctuations in rainfall excess / deficit. Many alluvium bores have recorded water levels that are more than 1 m above historic maxima.

3.1.1.2 Wollombi Brook Alluvium

In 2022, all Wollombi Brook alluvial bore groundwater levels increased slightly or remained steady over the year and bore water levels remained at or exceeded pre-2016 to 2019 drought levels. Bore groundwater levels within the Wollombi alluvium generally decreased from 2016 to January 2020, coincident with drought conditions experienced in the region over the period. Rainfall trends are reflected in the rainfall excess/deficit plot, shown through hydrographs in Appendix A.

Many bores exceeded pre-drought water levels for the first time in April 2022, continuing the rising trend seen over 2021; for example, WBD160 showed an increase of approximately 3 m over 2022. All Wollombi Brook alluvium bore values for 2022 are at or in excess of historic water level maxima.

3.1.1.3 Monkey Place Creek Alluvium

There is a network of ten monitoring bores installed to monitor groundwater levels in the Monkey Place Creek alluvium, located to the south and south-east of the BFS (Figure 2.1). All but one of these bores are equipped with dataloggers, although several of the dataloggers show departures from the more consistent manual readings and some show anomalous levels, which are likely to be error/electronic drift as the manual readings continue along the expected trend.

Between January and December 2022, groundwater levels in the Monkey Place Creek alluvial monitoring bores remained relatively stable or increased slightly. All groundwater levels in the Monkey Place Creek alluvium have returned to pre-2016 from 2019 drought groundwater levels or greater.

3.1.1.4 Loders Creek Alluvium

Loders Creek alluvial bores LC1 (5 mBGL) and LC2 (7.6 mBGL) were installed in November 2019. Groundwater levels in the Loders Creek alluvial bore LC2 ranged between 41.2 mAHD and 43.7 mAHD since monitoring began in 2020. Groundwater levels in LC2 increased between January and April 2022 and remained stable for the remainder of 2022.

LC1 has recorded groundwater elevations between 53.0 mAHD and 53.1 mAHD and was measured as dry for four out of six monitoring events in 2021. LC1 was recorded as dry for the entirety of 2022.

3.1.1.5 Warkworth Sands

In June 2021, five shallow monitoring bores were installed to monitor the Warkworth Sands (WWS1, WWS2A, WWS2B, WWS3A and WWS3B). Bore depths range from 1.4 m to 2.6 m. The bores are located within the northwest section of the Bulga mining lease, to the north of Beltana underground workings.

All bores were recorded as dry following drilling (June – October 2021), however all bores have recorded consistent groundwater levels throughout 2022. All bores remained generally stable between January and December 2022 with a minimum level of 86.6 m AHD, measured at WWS3B in June (refer Appendix A). As the bores are not included in the site WMP, no investigation triggers have been adopted for these bores.

3.1.1.6 Regolith/volcanic sill/alluvium

McG1 and WBR15 monitoring bores are installed in regolith/volcanic sill/alluvium and are located west of BFS.

Monitoring bore McG1 recorded steady groundwater levels throughout 2022. In previous years groundwater levels in the bore have shown high responsiveness to rainfall and have typically shown a similar order of seasonal variation to rainfall since the end of the Millennium Drought in 2007, before which levels were very steady. Steady groundwater levels observed throughout 2022 indicate a return to historic norms in drought free conditions and water levels in excess of historic maxima.

Groundwater levels in WBR15 increased steadily over the year, reaching a peak of 75.0 m AHD by October 2022. Groundwater levels in the bore increased by approximately 7.4 m over the monitoring period. The bore is equipped with a datalogger, and shows little immediate response to rainfall, but follows the rainfall excess/deficit trend with more gradual changes in groundwater levels.

3.1.2 Interburden and shallow coal measures

3.1.2.1 Interburden Sandstone

The shallow Permian interburden sandstone monitoring bores are installed to depths of <20 m and the sandstone bores at a range of depths between 50 m to 65 m

Most sandstone monitoring showed similar groundwater level trends over the monitoring period with the exception of NPZ4-B and NPZ5-B. All bores increased significantly over 2022, increasing between 3-8m between January 2022 and December 2022. Groundwater level trends in these bores follow CRD trends long-term. Groundwater levels recovered to pre-2016 to 2019 drought levels by the end of 2021 and this trend has continued throughout 2022.

The two sandstone monitoring bores located further north (NPZ4-B and NPZ5-B), to the north-west of BFS, show a sharp decline following installation in 2005 followed by a general increase since 2010. These bores are directly west of the Beltana No.1 underground workings where extraction of coal from the Whybrow Seam ceased in 2011 and appear to show a clear recovery response. In 2022, NPZ4-B showed significant (~8.7 m) increase in groundwater levels, continuing the trend observed in 2021. This period of increase follows a long-term decline that corresponds to the 2016-2019 drought. Levels in NPZ5-B also show an increase that is likely related to the increasing excess / deficit curve. The impact of the 2016-2019 drought on NPZ5-B water levels is visible but is only a minor impact, acting to attenuate water level recovery rather than resulting in a decline.

3.1.2.2 Undifferentiated Coal Measures

Shallow coal measure monitoring bores are located to the south of BFS (P2, P5A, P6A and SBD196) with two (WBR180 and WBR183) located at to the northwest at a distance of over 2 km, north-east of the northern end of the Beltana No.1 underground workings.

WBR180, SBD196, P6A and P2 remained generally stable throughout 2022 after increases in groundwater level in 2021. Groundwater levels in the bores previously showed a declining trend since 2016, with significant increase throughout 2021. The increase in water levels seen in P6A during 2021 was the first observed response in the bore to recovering groundwater levels in the region, and this trend was seen to have continued throughout 2022. Groundwater levels in WBR183 increased gradually over the reporting period which is likely a continuation of the rising trend seen in 2021.

Bore P5A reported groundwater levels consistent with historic records in February 2022, however no additional data for the remainder of 2022 was made available at the time of reporting due to bore being inaccessible due to the flood events in Broke.

3.1.3 Coal Seams

3.1.3.1 Alcheringa Seam (Wollombi coal measures)

Monitoring bores targeting the Alcheringa Seam are installed to the west of BFS and at the eastern edge of the Wollombi Brook alluvium. Groundwater levels in the Alcheringa Seam increased over the period, with varying

level increases between bores. Groundwater levels in WBD62A, NPZ4-A, NPZ7-2A and NPZ7-3A showed similar trends and increased between approximately 3 m to 9 m over the period. This trend follows rainfall excess/deficit trends for the year.

Bore NPZ5-A shows a subdued response to rainfall trends. Water levels in the bore increased for the first half of 2022, however fluctuated for the remainder of the year, showing significantly less response to rainfall than other bores within the Alcheringa Seam.

The trend in WBD62A for the most part reflects the rainfall excess / deficit plot with the exception of a steep decline through 2008 and 2009 against the trend of rainfall excess. In 2022, this monitoring bore continued to show response to the rainfall excess and increasing groundwater levels in 2021 and throughout 2022.

Following a significant decline in 2008-2011, NPZ3-A began to recover slowly, although no data is available for 2019-2022.

3.1.3.2 Lower Whybrow (Wittingham Coal Measures)

As a result of either Beltana and/or South Bulga operations in the Whybrow Seam, a portion of the coal measures have been depressurised to various degrees in the past. This is observed in three monitoring bores (P6B and P8 to the south of BFS, and WBR50 4 km north-west of BFS and just north of the Beltana workings).

In 2021, groundwater levels in P6B declined gradually to October and declined suddenly from -15 m AHD to -62 m AHD in December of that year, which is likely a reading/measurement error. The bore recorded depressurisation from 60 m AHD to -20 m AHD between 2013 and the end of 2018, remaining generally stable from 2019 through Q3 2021. Since Q3 2021 the bore has recovered to June 2021 levels, rising gradually from January 2022 until October 2022. Groundwater levels in the bore then dropped suddenly to -21.2 m AHD in December 2022, which is also potentially another reading/measurement error

In P8, levels have been somewhat erratic over the course of the record with large step increases in 2005 and 2008 with water levels following the CRD. Since 2016, approximately 15 m of depressurisation had been recorded coinciding with the rainfall deficit over the period, water levels have recovered somewhat in line with the rapidly increasing CRD trend. Groundwater levels in the bore remained stable from 2021 monitoring and remained relatively stable until June 2022, where groundwater levels increased for the remainder of the year.

Groundwater levels at WBR50 increased over 2022, commensurate with 2021 trends and the above average rainfall trends in the area. Depressurisation of the Whybrow Seam at this location occurred between 2008 and 2011 and the monitoring bore has not yet shown any significant recovery to pre-mining levels.

3.1.4 Clustered Standpipe Monitoring bores

The change in vertical hydraulic gradients and connectivity between different formations is monitored by seven clustered standpipe monitoring bores. The charts showing the hydrographs for each pair of monitoring bores are attached in Appendix A and the detailed of targets are summarised below:

- One pair (P6A and P6B) installed in the shallow coal measures and Lower Whybrow Seam, respectively, southwest of BFS.
- Five pairs (NPZ3-A/ NPZ3-B, NPZ4-A/ NPZ4-B, NPZ5-A/ NPZ5-B, NPZ7-2A/ NPZ7-2B and NPZ7-3A/ NPZ7-3B) installed in the Alcheringa Seam (monitoring bore -A), and the underlying interburden sandstone (monitoring bore -B) to the west of the BFS. Note that data collection at NPZ3-A ceased in 2016, whereas NPZ3-B continues to be monitored.
- One pair (WBR50A and WBR50), installed 5 km northwest of BFS and just northwest of the Beltana workings, target the shallow coal measures and Lower Whybrow Seam, respectively.

3.1.4.1 Alcheringa Seam and Interburden Sandstone Connectivity

During 2022, the vertical hydraulic gradients at these nested monitoring bores were as follows:

NPZ3 – the upward vertical hydraulic gradient was steadily returned to an **increasing** trend with recovery in pressure in the sandstone and a slowly increasing pressure trend in the Alcheringa Seam up to 2016 when monitoring stopped. It is likely that the rainfall in 2020 - 2022 recharged both units; however, the Alcheringa

Seam was depressurised in 2006–2009 and has been recovering slowly since then. Groundwater levels in NPZ3-B (sandstone) have recovered to pre-2016 to 2019 drought conditions.

NPZ4 – the downward vertical hydraulic gradient remained relatively **constant** with the pressure reduction in both units continuing to recover due to the elevated rainfall over 2020–2022.

NPZ5 – the downward vertical hydraulic gradient **decreased** slightly with a continued gradual pressure recovery in the Alcheringa Seam and pressure increase in the sandstone. Water levels in both units have increase slightly as a result of elevated rainfall in the reporting period.

NPZ7-2 – the downward vertical hydraulic gradient which started increasing in 2016 ceased in 2020 with the recharge to both units due to elevated rainfall in 2020–2021. in mid-2022, the reading for NPZ7-2b was over 1m greater than the measurement NPZ7-2a. where previously the two bores had equal heads, the gradient has now switch to a gradient from NPZ7-2b to NPZ7-2a .

NPZ7-3 – the downward vertical hydraulic gradient which started increasing in 2016 ceased in 2020 with the recharge to both units due to elevated rainfall from 2020 throughout the current monitoring period. Over 2022, the gradient has switched from downward to an upward gradient with the sandstone head being greater than the Alcheringa Seam head.

The vertical hydraulic gradients between the Alcheringa Seam and the underlying interburden sandstone are generally downward with the vertical head difference between these units ranging between 5 m and 15 m. At NPZ3 and NPZ7-3, there is an upward vertical gradient, from the sandstone to the Alcheringa Seam, at with a head difference of approximately 2 m in both cases.

3.1.4.2 Shallow and Deep Coal Measures Connectivity

There has been little change in the downward vertical hydraulic gradient (~34m pressure difference) between the shallow coal measures at WBR50A and the Lower Whybrow Seam (WBR50), since depressurisation of the Whybrow Seam between 2008 and 2011. The hydraulic gradient has remained steady over 2022, with both bores recovering slightly from the elevated rainfall of 2022.

There is a downward vertical gradient between the shallow coal measures (P6A) and the Lower Whybrow Seam (P6B), which started to develop in 2016 presumably due to the depressurisation of the Blakefield Seam at BFS to the north. The depressurisation appears to have stopped with little net change in the levels in P6B during 2021 and 2022, aside from the recovery observed in 2020 that is likely due to the rainfall trends. Levels in P6A increased between December 2021 and have remained stable over 2022.

Based on the data collected, including the lack of significant response in the shallow coal measures during the initial depressurisation of the Whybrow Seam, there appears to be little evidence of significant hydraulic connection between these units at these two monitoring locations.

3.1.5 Northern Tailings Emplacement Piezometers

Five piezometers are located to the west and north of the northern tailings emplacement facility (MB1a shallow and deep, MB2 and MB3 shallow and deep). The piezometers generally show few sudden changes in water levels, with the exception of MB2. MB2 showed two sudden increases in pressure head, in November 2021, March and July 2022. Also, MB1a shows a steady increasing trend, and data from the paired piezometer - MB1b – appear erroneous and has been excluded. MB3a shows that heads have remained relatively unchanged over 2022; whereas, MB3b heads show a steady decline.

3.1.6 Groundwater Flow in Alluvium

Groundwater contours for the Wollombi Alluvium and Monkey Place Creek Alluvium, based on data for December 2022, are presented in Figure 3.2. Groundwater flow in alluvium is essentially parallel to the flow of the creek lines and generally in the direction to the west and then north-west along the body of alluvium. Groundwater levels have generally recovered compared to previous drought years. The hydraulic gradient along the Monkey Place Creek alluvium is a steeper than that along the Wollombi Brook alluvium suggesting lower hydraulic conductivity or steeper topography. The groundwater drawdown inferred in the vicinity of 'Fernance' in December 2021 is still visible on the groundwater level contours in 2022, but has reduced in magnitude.

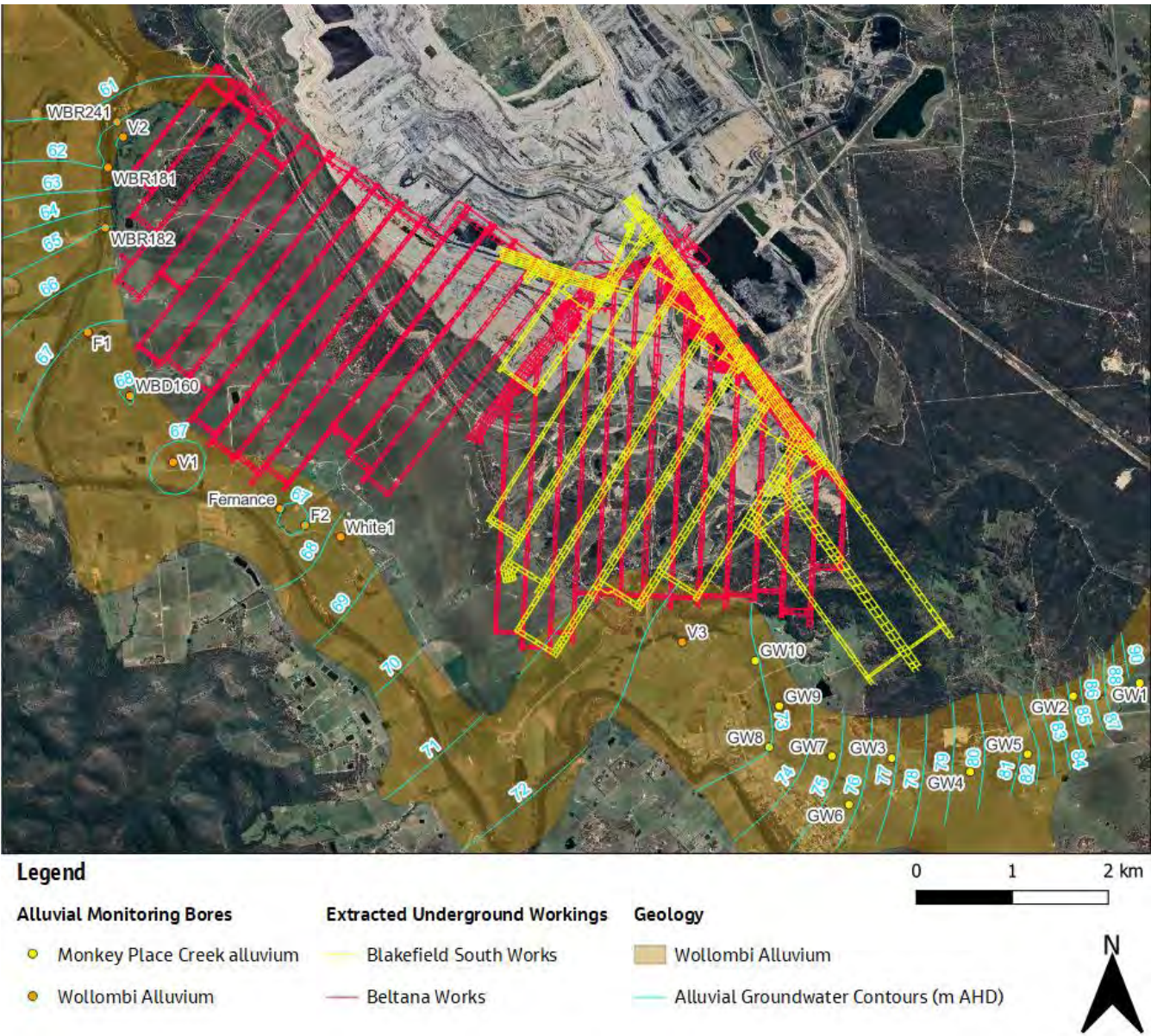


Figure 3.2 Groundwater contours in the alluvium (December 2022)

3.2 Groundwater monitoring results

Historically, groundwater quality in the Bulga Mine area is generally mixed and typical of coal measure geology, with moderate salinity and pH between 6 and 8. The following sections outline the groundwater quality trends over 2022. Groundwater exceedances are discussed in Section 4.

3.2.1 EC trends

Historic surface water EC trends mostly continued into 2022, as all sites show significant variability in EC over the 2022 monitoring period. Measured EC for the alluvium ranged from 21,400 $\mu\text{S}/\text{cm}$ at P2, to a minimum of 70 $\mu\text{S}/\text{cm}$ at WBR50A. Measured EC for the coal measure monitoring bores ranged from 21,400 $\mu\text{S}/\text{cm}$ at WBR180, to 90 $\mu\text{S}/\text{cm}$ at WBR50; however, the measured EC at WBR50 is likely to be highly influenced by the proximity of the bore screen to the alluvium. Graphs of EC trends to the end of the reporting period are attached in Appendix B.

EC trends were mostly constant with some changes that were associated with rainfall events. No changes in EC were clearly attributable to mining at Bulga. Specific site trigger values and exceedances are further detailed in Section 4.2 of this report.

3.2.2 pH trends

Groundwater pH trends mostly continued from 2021 through 2022, with pH generally remaining stable over the year and showing no distinct trends between differing strata. While all bores showed variations, groundwater pH in all bores was recorded within historical ranges. Measured pH for the alluvium ranged from 8.6 at GW3, to 6.6 at GW8. Measured pH for coal measure monitoring bores ranged from 8.6 at P6B, to 4 at P8. The low pH result for P8 appears to be a laboratory error as the field measurement of pH for that sample was 6.7 which is much more consistent with the expected result. pH trends to the end of the reporting period are attached in Appendix B.

pH levels in most measured bores did not show a significant correlation with regional CRD estimates, remaining relatively stable over 2022. NPZ7-3A showed constant increase in pH over 2022, rising from 7.3 in February to 8.6 in December 2022. Conversely, pH at Bore P8 fell dramatically in 2022, from 6.9 in February to 4.0 in December of 2022. As discussed previously, likely due to a laboratory error as field measurements for pH were 6.7 and recent monitoring (February 2023) for pH was 6.4. Therefore, for this sample date the measure field pH of Bore P8 was adopted.

pH trends were mostly constant with some variation attributed to rainfall events and usual seasonal variability. No changes in pH were clearly attributable to mining at Bulga. Specific site trigger values and exceedances are further detailed. Specific site trigger values and exceedances are further detailed in Section 4.2 of this report.

3.3 Surface water monitoring results

Historically, water quality in Wollombi Brook is generally good with low salinity and neutral pH. Monkey Place Creek, Loders Creek, Nine Mile Creek and the minor ephemeral drainage lines within the mining lease typically have poorer quality water, which is alkaline and saline, except during high rainfall events (Mackie, 2003). In the 1980 EIS, the salinity was attributed to seepage from the Saltwater Creek coal measures, which subcrop in areas of Loders Creek (MER 2013).

3.3.1 EC trends

Historic surface water EC trends mostly continued into 2022, as all sites show significant variability in EC over the 2022 monitoring period. Measured EC ranged from a maximum of 24,000 $\mu\text{S}/\text{cm}$ at W10 west of the BCC, to a minimum of 134 $\mu\text{S}/\text{cm}$ at SDL1, south-west of the BCC. Graphs of EC trends to the end of the reporting period are attached in Appendix B.

Most monitored watercourses remained within both the adopted trigger range and historic ranges, with some exceptions such as Loders Creek at W10. EC exceeded the adopted trigger range and the previous historic maximum for the site at multiple sampling times in 2022. W10 was also reported to be above the adopted trigger values for the entirety of 2021. W10 is located within refugial pools that typically have poor quality water, being alkaline and highly saline, and EC remained high despite continually elevated rainfall in 2022.

EC measured at the northern drainage line (NDL1) rose steadily over the length of 2022, reaching 11,200 $\mu\text{S}/\text{cm}$ in December 2022, significantly above the adopted trigger, continuing the trend seen in 2021.

Other erratic changes in waterway EC seen across the investigated area can be attributed to high rainfall from 2021 extending into 2022, contributing to heterogeneous waterway conditions throughout the year as well as usual seasonal variability. Specific site trigger values and exceedances are further detailed in Section 4.2 of this report.

3.3.2 pH trends

Historic pH trends mostly continued into 2022 with all sites showing similar variability in pH as previously reported. Measured pH ranged from a maximum of 8.61 at NDL1 west of the BCC, to a minimum of 6.62 at LR1 south of the BCC. pH trends to the end of the reporting period are attached in Appendix B.

pH in Wollombi Creek remained generally neutral, while all other watercourses remained slightly alkaline in accordance with historic trends. pH in Loders Creek, measured from W9, which showed elevated alkalinity for the length of 2022, reached a maximum of 8.85 in December of that year.

pH measured at the northern drainage line (NDL1) rose steadily over the length of 2022, reaching 8.27 in December 2022. This increase is well correlated with rising EC seen at the site over 2022, with both values rising rapidly and peaking in December.

All monitored watercourses remained within historic pH ranges. Erratic changes in waterway pH can be attributed to high rainfall from 2021-2022 contributing to heterogeneous waterway conditions throughout the year as well as usual seasonal variability. Specific site trigger values and exceedances are further detailed in Section 4.2 of this report.

3.3.3 TSS trends

Historic TSS trends mostly continued into 2022 with all sites showing similar variability in TSS, as previously reported. Graphs of TSS trends to the end of the reporting period are attached in Appendix B.

TSS in Wollombi Creek was highly variable, with multiple trigger exceedances at different times throughout the year. In accordance with historic trends, TSS at most other sites was significantly higher than those at Wollombi Brook; however, below the adopted WMP trigger values for the length of the reporting period.

All monitored watercourses remained within historic TSS ranges. Erratic changes in waterway TSS can be attributed to high rainfall in early 2022 contributing to heterogeneous waterway conditions throughout the year as 4.2 of this report.

4. Exceedances

4.1 Groundwater exceedances

4.1.1 Groundwater exceedances

Groundwater impact assessment criteria are outline in the Bulga Coal Water Management Plan [WMP] (Bulga 2021). Site-specific trigger values have been derived using water level and water quality data, including EC and pH in accordance with ANZECC (2000) guidelines. The trigger values are not assessment criteria but are used to initiate investigations into groundwater quality as reported by the monitoring program (Bulga, 2021). Groundwater conditions across the site were compared against the WMP trigger values, the findings are described in detail below.

Monitoring data exists for BCC since 1998 providing a dataset that is sufficiently long and of good quality to define site specific trigger levels. Trigger values for pH have been determined by using 80th and 20th percentile, while the trigger levels for EC are provided by calculating the 80th percentile, i.e. upper trigger level in accordance with the ANZECC (2000) guidelines and statistical analysis.

The baseline water level data was also analysed to derive trigger levels for the bores installed in the strata other than Permian coal measures such that they represent 5% reduction of saturated thickness, based on the minimum of the historical baseline monitoring. The confined Permian strata will be depressurised as a result of mining and therefore the trigger levels for those bores are not considered relevant.

4.1.2 Groundwater levels trigger exceedances

Groundwater levels have been compared against impact assessment trigger values for piezometers and scheduled sampling events in 2022. Well specific groundwater level triggers from the adopted WMP are displayed below alongside groundwater levels measured in the respective monitoring bore are presented below in Table 4.1. No bores were measured to be below the adopted trigger level during any sampling events in 2022.

Table 4.1 Groundwater level exceedances (compared to Bulga Coal WMP 2021)

Bore ID	Groundwater Level Trigger value (Bulga 2021)	Groundwater level (m AHD)					
		Feb/Mar	Apr	Jun	Aug	Oct	Dec
Broke Area Alluvials							
GW1	84.37	89.98	91.44	91.3	91.67	91.61	91.09
GW2	NA	85.18	85.88	85.76	85.92	85.88	85.27
GW3	74.48	76.63	77.33	77.22	77.38	77.38	76.82
GW4	NA	79.42	80.14	80.09	80.23	80.17	79.65
GW5	NA	81.35	81.57	81.53	81.52	81.59	81.17
GW6	72.21	75.19	76	75.85	76.31	76.26	75.7
GW7	63.21	74.4	-	-	-	75.11	74.7
GW8	66.86	72.42	73.58	73.35	74.26	73.93	73.38
GW9	70.83	72.62	73.48	72.94	73.55	73.47	72.92
GW10	69.76	72.59	-	-	-	73.32	72.93
V3	65.49	69.26	71.46	71.47	74.08	73.87	72.55
Broke Area Wollombi Seam							
P2	67.10	69.17	69.84	69.45	69.81	69.8	69.51
P5A	67.84	70.72	-	-	-	-	-
P6A	63.40	66.98	67.35	68.02	68.72	70.34	69.43
Northern Area Shallow Alluvials							
F1	61.26	63.86	64.44	64.67	65.68	66.47	67.1

Bore ID	Groundwater Level Trigger value (Bulga 2021)	Groundwater level (m AHD)					
		Feb/Mar	Apr	Jun	Aug	Oct	Dec
F2	63.30	65.54	67.18	66.75	67.43	67.25	66.88
V1	63.14	65.03	67.07	66.23	-	67.14	66.64
V2	58.56	61.45	63.8	-	-	63.11	62.4
WBR50A	56.98	60.24	60.92	60.82	-	61.17	60.88
SBC/Broke Area Lower Whybrow Seam							
P6B	-24.84	-13.98	-12.66	-12.98	-12.84	-12.7	-21.15
P8	63.30	73.9	71.9	70.57	72.16	77.1	78.22
Northern Area Lower Whybrow Seam							
WBR50	24.30	29.64	30.76	30.1	-	-	31.27
Beltana Area Miscellaneous Bores and Wells							
WBR15	59.32	66.48	69.55	72	74.16	74.79	73.91
Dwyers	60.90	63.91	65.85	65.49	66.97	67.03	66.43
Fernance	59.74	65.38	66.82	66.94	68.47	68.51	67.91
McG1	89.86	94.22	97.92	97.79	99.13	97.79	95.71
White 1	63.36	65.45	67.12	67.51	68.75	68.9	68.5
Beltana Area NPZ							
NPZ3-B	56.01	66.18	68.96	71.7	72.76	72.76	
NPZ4-A	58.54	65.2	67.46	70.8	73.43	74.77	74.33
NPZ4-B	45.32	53.36	54.63	57.13	59.38	61.6	61.96
NPZ5-A	60.90	63.78	64.17	72.51	65.76	67.69	68.9
NPZ5-B	41.16	50.92	51.78	52.11	53	53.41	53.59
NPZ7-1	53.47	64.89	67.59	-	-	68.99	68.99
NPZ7-2A	62.04	65.27	66.9	67.47	69.4	70.01	69.52
NPZ7-2B	45.36	61.88	65.78	70.02	70.26	70.26	70.26
NPZ7-3A	62.0	65.26	66.85	68.05	69.97	71.31	70.93
NPZ7-3B	53.7	66.28	69.7	-	73.62	73.62	73.62
Wollombi Alluvials and Shallow Coal Measures							
SBD196	NA	68.97	70.4	70.1	70.77	70.42	70.11
WBD160	63.83	64.71	65.04	65.69	66.38	67.27	68.15
WBR180	34.30	35.54	35.74	35.97	36.43	36	36.12
WBR181	59.41	61.44	62.2	61.78	62.44	62.31	61.73
WBR182	61.70	62.99	63.58	63.73	64.52	65.16	65.15
WBR183	58.96	62.02	62.97	63.14	63.86	63.94	63.81
WBR240	58.36	60.66	61.24	61.18	62.03	61.98	61.62
WBR241	59.63	61.45	63.55	62.14	-	62.53	61.78
Loder Creek							
LC1	NA	-	-	-	-	-	-
LC2	NA	42.98	43.63	43.47	43.75	43.69	43.21
Warkworth Sands							

Bore ID	Groundwater Level Trigger value (Bulga 2021)	Groundwater level (m AHD)					
		Feb/Mar	Apr	Jun	Aug	Oct	Dec
WWS1	NA	93.99	94.42	93.98	94.46	94.09	93.97
WWS2a	NA	94.44	94.93	94.67	95.03	94.86	94.49
WWS2b	NA	94.29	94.9	94.62	94.99	94.89	94.45
WWS3a	NA	-	83.9	-	84.24	83.77	83.75
WWS3b	NA	83.13	-	83.63	84.2	84.07	83.58
Northern Tailings emplacement facility piezometers							
MB1a	NA	63.18	63.72	64.19	64.45	64.84	65.24
MB1b	NA	Data Corrupted at Time of Reporting					
MB2	NA	64.19	67.95	67.13	68.82	68.37	67.29
MB3a	NA	53.72	53.70	53.75	53.76	53.75	53.79
MB3b	NA	-9.61	-9.72	-10.01	-10.18	-10.3	-10.53

4.1.3 Groundwater electrical conductivity trigger exceedances

Groundwater electrical conductivity (EC) has been compared trigger values from the adopted site WMP (Bulga 2021).

Various EC exceedances of the assigned trigger values occurred between Jan 2022 and Dec 2022, with 13 bores recording EC higher than respective trigger values. Groundwater EC exceedances are summarised in Table 4.2, and graphs for all bores and respective trigger levels are provided in Appendix B.

Broke Area alluvial bores remained within historical ranges for EC, and most bores recorded values below trigger criteria over the year, except for GW7, which remained above trigger values throughout the period. Additionally, bore V3 was exceeding over the first six months of the monitoring period, while recording lower EC values subsequent to the July 2022 floods. Bore GW9 EC increased above the accepted trigger briefly in August before falling below the trigger level for the rest of 2022.

Northern Area Shallow alluvial bores showed generally consistent EC trends over the year, apart from Bore F1. In Bore F1, EC remained elevated for the first six months of the monitoring period; however, remained below the trigger value and within historic ranges for the bore for remaining monitored period, commensurate with CRD trends. Bore F2 EC dropped to below 150 $\mu\text{S}/\text{cm}$ in April, far below the Q1 record of 1,380 $\mu\text{S}/\text{cm}$. In all other bores EC generally increased over the year, remaining below trigger values.

SBC/Broke Area Lower Whybrow Seam monitoring bore P6B exceeded the trigger values in all sampling events of 2022. The bore remained stable from 2018 - 2021, with EC ranging between 6,000 and 7,000 $\mu\text{S}/\text{cm}$. EC in the bore dropped significantly from December 2021, recording a value of 1,390 $\mu\text{S}/\text{cm}$. The bore remained slightly elevated above the adopted trigger value for the duration of 2022; however, remained significantly lower than historic trends. EC recorded in Bore P6B ranged from 1,590 $\mu\text{S}/\text{cm}$ in April 2022 to 5,800 $\mu\text{S}/\text{cm}$ in December 2022. The EC value in P8 in April 2022 is an order of magnitude higher than the other measured values. Rainfall was particularly high in the March April period and may have contributed to the elevated value due to a flushing effect.

Beltana Area Miscellaneous bore WBR15 recorded only one EC exceedance in December 2022. Historically the bore has recorded values above the trigger since July 2018 and EC generally shows a delayed response to CRD; EC was seen to have increased over the drought period ending in 2020 and has declined since mid-2020 to within trigger limits for the whole observation period until December 2022.

Beltana Area NPZ bores generally stable EC over the year. The bores are within historic ranges for EC. Bore NPZ4-B slightly exceeded adopted trigger values in April and December 2022. Bore NPZ7-2B also exceeded the trigger value in December 2022.

Wollombi Alluvial and Shallow Coal Measure bores WBR180, WBR181, WBR182 and WBR183 recorded exceedances over the year. Wollombi alluvial bore WBR182 EC increased with a similar trend to groundwater levels in the bore and CRD, which both increased throughout the year. WBR180, WBR181 and WBR183, while above assigned trigger values, remained within historic values for EC in 2022.

Table 4.2 Groundwater electrical conductivity exceedances (compared to Bulga Coal WMP 2021)

Bore ID	EC trigger values	Lab EC (µs/cm)					
	EC trigger 2021 (µs/cm)	Feb/Mar	Apr	Jun	Aug	Oct	Dec
Broke Area Alluvials							
GW1	3,634	2,950	1,580	1,510	860	1,490	1,430
GW3	6,010	2,040	187	208	288	1,200	1,310
GW6	7,900	7,440	6,840	7,480	116	295	344
GW7	3,946	4,270	4,540	4,340	-	4,290	4,250
GW8	5,936	5,240	5,360	5,350	285	454	503
GW9	4,458	798	3,940	4,270	4,510	4,340	4,410
GW10	10,252	5,610	-	6,450	-	7,160	7,180
V3	1,744	2,050	2,140	1,940	763	802	1,020
Broke Area Wollombi Seam							
P2	12,834	11,600	11,600	12,300	147	181	241
P5A	6,242	-	-	-	-	-	3,880
P6A	2,740	1,980	1,770	1,420	692	1,440	1,590
Northern Area Shallow Alluvials							
F1	1,025	1,320	1,230	1,200	1,010	980	-
F2	1,720	1,380	110	116	800	1,380	1,620
V1	1,570	1,190	756	1,050	-	523	641
V2	922	111	157	225	-	155	188
WBR50A	14,000	3,060	70	116	-	136	228
SBC/Broke Area Lower Whybrow Seam							
P6B	1,353	2,550	1,590	2,560	2,380	3,330	5,800
P8	5,076	248	7,230	498	273	140	187
Northern Area Lower Whybrow Seam							
WBR50	8,382	330	85	99	-	91	114
Beltana Area Miscellaneous Bores and Wells							
WBR15	924	710	621	842	748	883	943
Dwyers	1,476	1,030	273	478	434	672	951
Fernance	1,473	1,010	746	730	344	615	959
McG1	918	224	190	532	479	487	727
White 1	2,444	1,960	538	567	159	309	356
Beltana Area NPZ							
NPZ3-B	921	847	239	257	745	729	-
NPZ4-A	729	713	702	683	439	672	679
NPZ4-B	1,342	1,290	1,370	1,230	1,230	1,240	1,360
NPZ5-A	886	848	827	814	833	774	789
NPZ5-B	2,760	2,710	2,670	2,600	2,490	2,640	2,710
NPZ7-1	1,240	1,200	67	1,180	-	1,170	1,240
NPZ7-2A	2,250	1,220	171	1,310	74	276	1,340

Bore ID	EC trigger values	Lab EC (µs/cm)					
NPZ7-2B	1,307	1,280	137	130	1,300	1,230	1,310
NPZ7-3A	2,540	1,930	1,930	1,790	1,930	1,210	1,310
NPZ7-3B	1,316	1,240	1,250	1,190	1,170	1,210	1,290
Wollombi Alluvials and Shallow Coal Measures							
WBD160	1,310	187	356	394	536	748	996
WBR180	20,850	20,000	21,400	19,900	19,800	19,500	20,100
WBR181	2,670	3,100	2,690	1,940	2,000	2,100	1,220
WBR182	1,512	1,470	1,610	1,510	1,440	1,500	1,600
WBR183	3,484	3,620	3,710	3,620	3,610	3,610	3,660
WBR240	26,800	13,300	14,300	14,200	22,400	21,400	11,400
WBR241	435	385	336	312	308	343	259

Notes: "1000" Refers to EC values below assigned trigger
"1000" Refers to EC values above assigned trigger

4.1.4 Groundwater pH exceedances

Groundwater pH has been compared to trigger values from the revised site WMP values effective from 15/10/2021 (Bulga 2021). Trigger values for pH have been determined by using 80th and 20th percentile of previously recorded values and are summarised in the Bulga Coal WMP (Bulga 2021).

39 of the 40 sampled bores recorded values outside of respective groundwater pH trigger levels throughout the year. The exceedances are outlined in Table 4.3, and graphs showing pH trends are provided in Appendix B. Groundwater pH values generally remained stable over the year, showing no distinct trends between differing strata. Groundwater pH in all bores was recorded either within or slightly beyond trigger levels. Deviance from trigger range is attributed to natural variation in the bores. Bore WBR240 was the only measured bore to remain within the adopted trigger values for the length of 2022. None of the exceedances are associated with significant spikes that may indicate mining related groundwater impact.

Table 4.3 Groundwater pH exceedances (compared to Bugla Coal WMP, 2021)

Bore ID	pH trigger values		Lab pH value					
	pH 2021, lower	Ph 2021, higher	Feb/ Mar	Apr	Jun	Aug	Oct	Dec
Broke Area Alluvials								
GW1	6.7	7.3	7.1	7.4	7.5	7.5	7.0	7.2
GW3	6.7	7.2	8.6	6.8	7.3	7.1	7.4	8.0
GW6	7.3	7.8	7.4	7.3	7.9	6.8	6.9	6.8
GW7	6.7	7.4	7.0	6.8	6.8	-	6.6	6.8
GW8	6.6	7.0	6.7	7.4	7.1	6.6	7.0	6.9
GW9	6.7	7.2	7.0	6.7	6.8	6.8	6.7	7.0
GW10	7.1	7.6	7.6	-	7.0	-	7.1	7.5
V3	7.1	7.6	7.2	7.4	7.2	7.3	7.2	7.2
Broke Area Wollombi Seam								
P2	7.4	8	7.6	7.5	7.7	6.6	6.4	6.5
P5A	7.5	8.2	7.7	-	-	-	-	-
P6A	7	8.1	7.3	7.2	7.7	7.9	7.3	7.1
Northern Area Shallow Alluvials								
F1	7.2	7.6	7.3	7.6	7.6	7.5	7.4	-

Bore ID	pH trigger values		Lab pH value					
F2	7.1	7.4	7.1	7.0	6.9	7.0	6.9	7.0
WBR50A	7.1	7.7	7.8	6.5	6.7	-	6.7	6.7
V1	7.3	7.7	7.6	7.2	7.5	-	7.2	7.3
V2	6.4	7.1	6.8	6.1	6.3	-	-	6.3
SBC/Broke Area Lower Whybrow Seam								
P6B	6.7	7.3	8.1	7.9	8.1	8.3	8.2	8.6
P8	7.3	9.3	6.9	6.7	7.1	7.3	6.9	6.7 #1
Northern Area Lower Whybrow Seam								
WBR50	6.7	8	6.4	6.4	6.6	-	6.5	6.4
Beltana Area Miscellaneous Bores and Wells								
Dwyers	7.3	7.6	7.6	7.6	7.5	7.4	7.5	7.6
Fernance	7.3	8	8.2	7.3	7.6	7.7	7.6	7.9
McG1	7.5	8	7.6	7.5	7.4	7.4	7.4	7.4
White1	7	7.4	7.6	7.4	7.7	7.2	7.4	7.4
WBR15	6.8	7.3	7.1	7.1	7.5	7.7	7.4	7.6
Beltana Area NPZ								
NPZ3-B	7.3	7.5	7.5	7.0	7.2	7.3	6.9	-
NPZ4-A	6.9	7.3	7.0	7.1	7.2	7.1	7.4	7.0
NPZ4-B	7.3	7.8	7.5	7.2	7.5	7.5	7.8	7.3
NPZ5-A	6.9	7.3	7.1	7.0	6.9	6.8	6.7	6.9
NPZ5-B	7.1	7.6	7.4	7.4	7.4	7.4	7.4	7.6
NPZ7-1	6.7	7.7	7.6	6.7	7.6	-	7.5	7.6
NPZ7-2A	7.1	7.6	7.5	6.6	7.1	7.1	7.1	7.9
NPZ7-2B	6.8	7.8	7.9	6.4	6.8	8.0	7.9	8.0
NPZ7-3A	7	7.5	7.3	7.2	7.2	7.8	8.1	8.6
NPZ7-3B	7.4	7.8	7.7	7.6	7.7	7.7	7.7	7.8
Wollombi Alluvials and Shallow Coal Measures								
WBD160	6.9	7.3	6.8	6.4	7.1	7.1	7.0	7.1
WBR180	7.1	7.5	7.3	7.4	7.3	7.3	7.4	7.2
WBR181	7.2	7.5	7.0	7.3	7.2	7.2	7.1	7.3
WBR182	7.3	8.3	7.2	7.2	7.2	7.3	7.2	7.3
WBR240	7.0	7.5	7.5	7.5	7.4	7.3	7.1	7.4
WBR241	6.4	6.9	6.6	6.5	6.7	6.7	6.8	6.4

Notes: "7.0" Refers to pH values below assigned trigger

"7.0" Refers to pH values above assigned trigger

#1 Field pH was adopted for bore P8 in December 2022 as discussed in Section 3.2 of this Report

4.2 Surface water exceedances

Surface water impact assessment criteria are outlined in the Bulga Coal Water Management Plan [WMP] (Bulga 2021). Site-specific trigger values have been derived using water level and water quality data, including EC, pH and TSS in accordance with ANZECC (2000) guidelines. The trigger values are not assessment criteria but are used to initiate investigations into surface water quality as reported by the monitoring program (Bulga, 2021).

Surface water conditions across the site were compared against the WMP trigger values, the findings are described in detail below.

4.2.1 Surface Water EC Exceedances

Surface water electrical conductivity (EC) has been compared to trigger values from the adopted WMP (Bulga 2021). Six of nine monitored sites were measured to be below the adopted trigger level during sampling events in 2022.

Measured EC in Loder Creek at W9 and W10, upstream of confluence with Nine Mile Creek, exceeded the adopted trigger value for most of 2022. W9 and W10 are located within refugial pools which typically have poor quality water, being alkaline and highly saline. EC was measured at 19,600 $\mu\text{S}/\text{cm}$ at W10, vastly exceeding the adopted trigger of 691 $\mu\text{S}/\text{cm}$. It should be noted this was also greater than the 2021 historic high of 16,724 $\mu\text{S}/\text{cm}$, and greatly above the 2019-2020 historic high of 1,280 $\mu\text{S}/\text{cm}$.

EC at the Northern Drainage line (NDL1) also increased rapidly over 2022, rising from 1,940 $\mu\text{S}/\text{cm}$ in January to 11,200 $\mu\text{S}/\text{cm}$ in December 2022. Extreme rainfall events are likely to account for significantly lower EC at NDL1 as seen in October of 2022.

EC of surface water measured at all other sample points was found to be below trigger values and/or well within historic ranges for the length of 2022. Site specific surface water EC triggers from the adopted WMP and measured surface water EC are presented below in Table 4.4.

Surface water locations with exceedances are consistently exceeding the established criteria and show no spikes in values, hence the elevated values are unlikely to be due to mining impacts.

Table 4.4 Surface water electrical conductivity exceedances (compared to Bulga Coal WMP 2021)

Site ID	Surface Water EC level (µs/cm)												
	EC trigger 2021 (µs/cm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wollombi Brook													
LR1	944	432	340	142	156	372	402	107	371	382	169	383	465
LR5	1,350	658	474	336	183	524	570	314	501	497	186	523	659
W2	836	702	571	226	171	517	582	-	474	596	187	504	663
W4	947	690	597	226	172	514	576	-	-	621	190	500	667
Northern Drainage Line													
NDL1	399	-	-	1,940	1,880	8,690	2,390	538	654	9,820	389	9,330	11,200
Southern Drainage Line													
SDL1	285	229	-	134	160	217	194	180	206	200	260	302	278
Loder Creek													
W9	1,970	9,610	8,100	4,250	2,750	5,460	9,350	3,640	3,430	7,250	2,300	4,300	6,820
W10	691	24,000	17,000	15,100	15,900	23,500	16,700	1,250	14,000	16,800	6,850	20,500	19,600
Nine Mile Creek													
NMC1	NA	-	-	1,490	660	1,400	1,130	122	1,150	1,030	325	955	-
Monkey Place Creek													
LR2	4,924	1,630	1,910	401	552	2,100	2,570	540	1,420	2,710	494	1,490	2,310

Notes: #1 Due to the ephemeral nature of the watercourses there is insufficient data to develop triggers in accordance with the guidelines for sites other than LR2. Hence no trigger values have been adopted.

4.2.2 Surface Water pH Exceedances

Surface water pH has been compared to trigger values from the adopted WMP (Bulga 2021). Trigger values for pH have been determined by using 80th and 20th percentile of previously recorded values and are summarised in the Bulga Coal WMP (Bulga 2021). Eight of the nine sample locations recorded values outside of respective surface water pH trigger levels throughout the year. The exceedances are outlined in Table 4.3.

pH at NDL1 increased gradually over 2022, from 7.38 in March to 8.27 in December of 2022. pH values in all other monitored watercourses generally remained stable over the year, showing no distinct trends. Surface water pH in all waterways varied slightly from acceptable ranges at some point during 2022. Most sites on where beyond trigger levels for the majority of 2022, but are well within historical ranges. Deviance from trigger range is attributed to natural variations in watercourse conditions throughout the year.

Site specific surface water pH triggers from the adopted WMP and measured surface water pH from respective waterway sites are presented below in Table 4.5.

Table 4.5 Surface water pH exceedances (compared to Bulga Coal WMP, 2021)

Site ID	Trigger		Surface Water pH											
	pH 2021, lower	pH 2021, higher	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wollombi Brook														
LR1	7.12	7.81	7.22	7.19	6.62	6.64	7.21	7.27	6.83	7.20	7.20	6.71	7.11	7.11
LR5	7.41	7.98	7.30	7.22	6.81	6.69	7.09	7.30	6.77	7.23	7.30	6.82	7.15	7.14
W2	7.13	7.67	7.25	7.22	6.86	6.79	7.17	7.33	--	7.24	7.37	6.78	7.22	7.18
W4	7.33	7.87	7.24	7.22	6.81	6.73	7.14	7.25		-	7.31	6.80	7.25	7.39
Northern Drainage Line														
NDL1	7.14	7.26	-	-	7.38	7.25	7.26	7.12	7.62	7.58	7.20	7.68	8.10	8.27
Southern Drainage Line														
SDL1	6.70	7.24	7.50	-	6.82	7.03	7.51	7.30	7.36	7.48	7.53	7.26	7.58	7.42
Loder Creek														
W9	7.36	7.92	7.84	8.07	8.95	8.86	7.79	7.95	8.83	8.84	8.06	8.61	8.90	8.11
W10	7.00	7.64	8.28	8.68	7.84	7.68	7.69	7.65	7.55	7.82	7.61	7.55	7.66	8.10
Nine Mile Creek														
NMC1	NA#1		-	-	8.22	7.81	8.59	8.48	6.82	8.52	8.55	7.48	8.42	-
Monkey Place Creek														
LR2	7.39	7.91	7.43	7.51	6.92	6.92	7.50	7.69	7.17	7.65	7.80	7.12	7.46	7.39

Notes: #1 Due to the ephemeral nature of the watercourses there is insufficient data to develop triggers in accordance with the guidelines for sites other than LR2. Hence no trigger values have been adopted.

4.2.3 Surface Water TSS Exceedances

Surface water Total suspended solids (TSS) has been compared to trigger values from the adopted WMP (Bulga Coal WMP 2021).

All monitoring locations remained within trigger ranges and historic ranges during the year, with the exception of the Wollombi Brook locations. Wollombi Creek showed significant variation over the measured period, exceeding the adopted triggers for extended periods at multiple sites in 2022. Significant fluctuations generally correlated with elevated rainfall events in March, July, and October 2022. TSS values at all other sites were the most part within the trigger ranges assigned by the adopted WMP. TSS triggers from the adopted WMP and measured surface water TSS are presented below in Table 4.6.

Table 4.6 Surface water TSS exceedances (compared to Bulga Coal WMP 2021)

Site ID	Surface Water TSS level (mg/L)												
	Surface Water TSS trigger (µs/cm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wollombi Brook													
LR1	12	6.0	<5.0	24	16	31	<5.0	51	8.0	18	42	9	21
LR5	12	13	14	17	28	11	<5.0	45	<5.0	19	36	18	16
W2	12	12	8.0	16	16	5.0	5.0	-	8.0	14	43	8.0	12
W4	10	10	9.0	20	10	<5.0	<5.0	-	-	8.0	40	8.0	9.0
Northern Drainage Line													
NDL1	70	-	-	18.0	17.0	<5.0	6.0	18.0	43.0	<5.0	17.0	7.0	14.0
Southern Drainage Line													
SDL1	39	14.0	-	43	10.0	5.0	12.0	12.0	16.0	17.0	15.0	28.0	44
Loder Creek													
W9	157	<5.0	9.0	18.0	30.0	7.0	18.0	14.0	34.0	9.0	34.0	12.0	8.0
W10	102	<5.0	<5.0	15.0	15.0	<5.0	41.0	86.0	-	31.0	28.0	25.0	6.0
Nine Mile Creek													
NMC1	NA#1	-	-	11.0	33.0	10.0	11.0	54.0	14.0	8.0	12.0	18.0	-
Monkey Place Creek													
LR2	40	15.0	12.0	27.0	6.0	<5.0	7.0	11.0	7.0	8.0	13.0	8.0	13.0

Notes: #1 Due to the ephemeral nature of the watercourses there is insufficient data to develop triggers in accordance with the guidelines for sites other than LR2. Hence no trigger values have been adopted.

5. Groundwater chemistry

Groundwater quality sampling and analysis is undertaken on a six-monthly basis, while field water quality data (EC and pH) is collected every 2 months from all monitoring bores. EC data has been used as an early indicator of water chemistry change in selected Wollombi Creek and Monkey Place Creek alluvial bores and to assist interpretation of the groundwater system changes, plotted EC data is presented in Appendix B.

Major ion chemistry data for groundwater samples from bores screened in alluvium, coal seams and sandstone/regolith, collected in December 2022, presented in Figure 5.1, present the relative concentrations (as milliequivalents per litre) of common ions in water samples and group samples by their major ion chemistry into facies. The results of the Piper plot analysis are summarised as follows:

- The alluvium water samples plot as having predominantly sodium-chloride water types. Several alluvial water samples plot as mixed type, and some plotted as magnesium bicarbonate type. This indicates that the groundwater is close to the recharge source and the water is most likely recharge from rainfall.
- The water samples from bores targeting the coal seam units plot as a wide range of water types, from sodium-chloride water type to sodium-bicarbonate, mixed type and magnesium bicarbonate water type. This indicates that recharge sources are varied and likely dependent on the depth of the bore and the geology.
- The water samples from bores targeting the sandstone units plot as having predominantly sodium-bicarbonate water type, with one bore classified as sodium-chloride water type and two classified as mixed type in December 2022. In accordance with historical data, the sodium-bicarbonate water type indicated that the sandstone units are not recharged directly from rainfall, and potentially the alluvium. The recharge likely is stored in another HSU prior to transmission to the sandstone units.
- Water chemistry types remain constant to December 2022, and likewise correspond to results from groundwater bores in 2021.

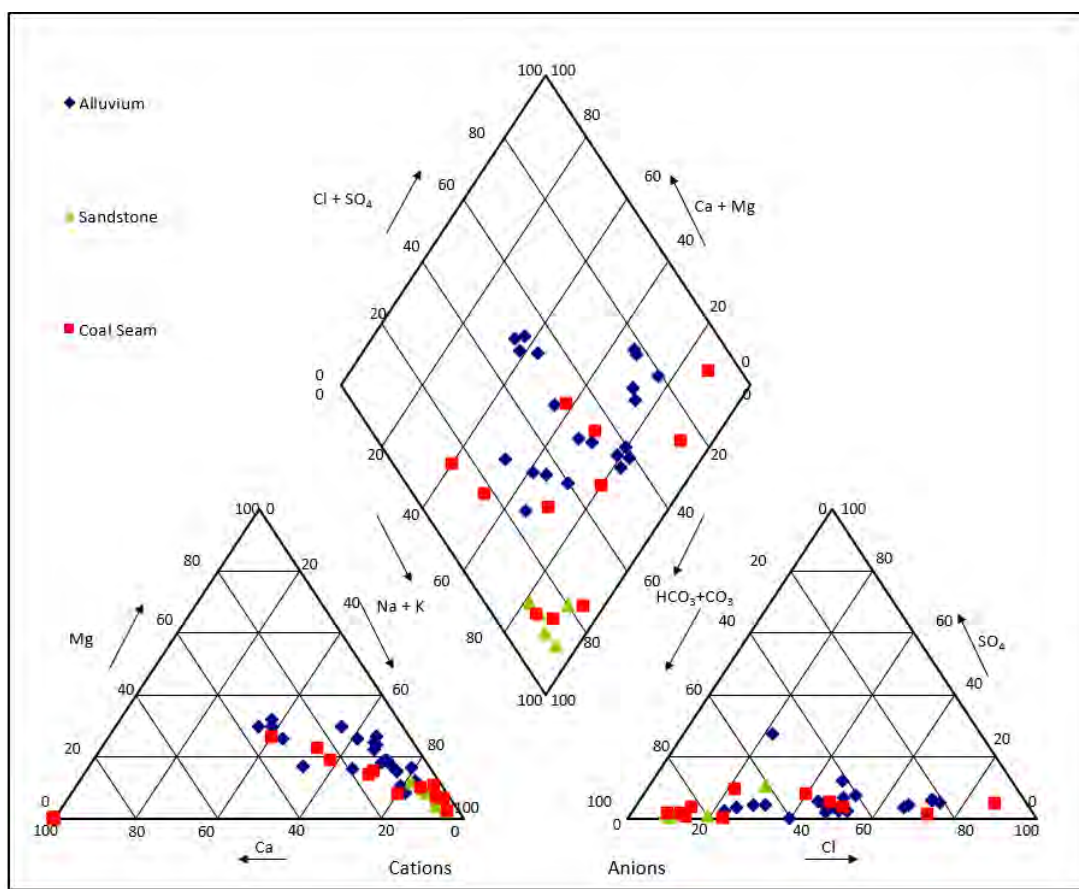


Figure 5.1 Piper plot comparison of major ion groundwater chemistry for the alluvium, coal seams and sandstone interburden (samples collected December 2022)

6. Summary and Conclusions

This surface and groundwater report documents the 2022 monitoring and assess the potential impact of the mining operations.. The study found the following:

- The groundwater monitoring network covers the area along the Wollombi Brook and Monkey Place Creek to the west and south and extends 5 km to the north and northwest of the BFS footprint. The current groundwater monitoring network is comprehensive and includes 50 monitoring locations in the alluvium, overburden strata (sandstone and coal seams), Whybrow Seam, Blakefield Seam and underlying and overlying strata;
- Overburden pressures in the top 50 m to 100 m from surface have recorded generally increasing groundwater levels in 2021 following the cessation of extraction at BFS in 2018. Recovery observed in various bores is likely related to the increasing rainfall between 2020 through 2022.
- Groundwater levels in SBD196 (Blakefield Seam) have recovered over the monitoring period, returning to near-2015 pressures. Re-pressurisation in the Alcheringa Seam is observed through hydrographs for numerous bores monitoring the seam. Groundwater levels in most monitoring bores targeting the Alcheringa Seam increased significantly over the period. The majority of recovery in the seam has occurred since the start of 2020 and is related to the cessation of extraction in 2018 and prevailing climatic conditions since 2020.
- Shallow groundwater levels in the alluvium (Wollombi Creek and Monkey Place Creek) continued to increase or remained stable over the period, continuing the recovering to pre-2016 to 2019 drought conditions observed in 2021/2022. Rainfall continues to be the major influence on alluvium groundwater levels with no apparent influence from mining operations.
- Groundwater quality (EC and pH) trigger values were exceeded for several monitoring bores over the monitoring period. While the trigger values are not assessment criteria, exceedances are used to initiate investigations into groundwater quality. Groundwater pH exceedances were within ranges of natural variation, and do not show impacts attributable to Bulga Coal over the period.
- Surface Water pH at NDL1 increased gradually over 2022, from 7.38 in March to 8.27 in December of 2022. pH values in all other monitored watercourses generally remained stable over the year, showing no distinct trends. Surface water pH in all waterways varied slightly from acceptable ranges at some point during 2022. Most sites monitored where beyond trigger levels for the majority of 2022 but are well within historical ranges.
- Surface Water TSS in all measured waterways remained significantly within historic ranges (2004 -2021) during the year. Wollombi Creek showed significant variation over the measured period, exceeding the adopted triggers for extended periods at multiple sites in 2022. Significant fluctuations generally correlated with elevated EC and rainfall events, occurring at the same time. TSS values at all other sites were the most part within the trigger ranges assigned by the adopted WMP
- Surface water quality (EC, pH and TSS) was variable through 2022, with exceedances generally related to periods of rainfall. Surface water exceedances were consistent through 2022 and do not show significant spikes in values that would indicate mining related impacts. Surface water quality is generally within or in line with historic ranges.
- The major ion chemistry for groundwater samples collected in June and December 2022 are similar to December 2020 and 2021 data. The alluvium and sandstone water samples typically plot as different water types, with some minor over-lap, indicating different recharge mechanisms and residence times. The water type interpretation indicates that the alluvium and coal seam water samples may predominantly receive recharge directly or indirectly from rainfall and/or have shorter transmission times from the recharge point.
- The 2022 reporting period recorded 1,200 mm of rain with substantial flooding in February, March and July followed by November and December being dryer than usual. The surface and groundwater monitoring data reflects the natural response to a second year of greater than average rainfall, surface flows and groundwater recharge.

7. Recommendations

The following recommendations are based on the outcomes of this report:

- Given the number of trigger level exceedances due to natural hydrological processes it is recommended that relevant trigger levels are reviewed for future monitoring events

8. References

(Bulga 2021). Bulga Mine Water Management Plan (Effective: 15/10/2021).

David, K. March 2019. Annual Groundwater Report for Blakefield South [2018], for Bulga Underground Operation Pty Ltd. Report KD2018/11 March 2019.

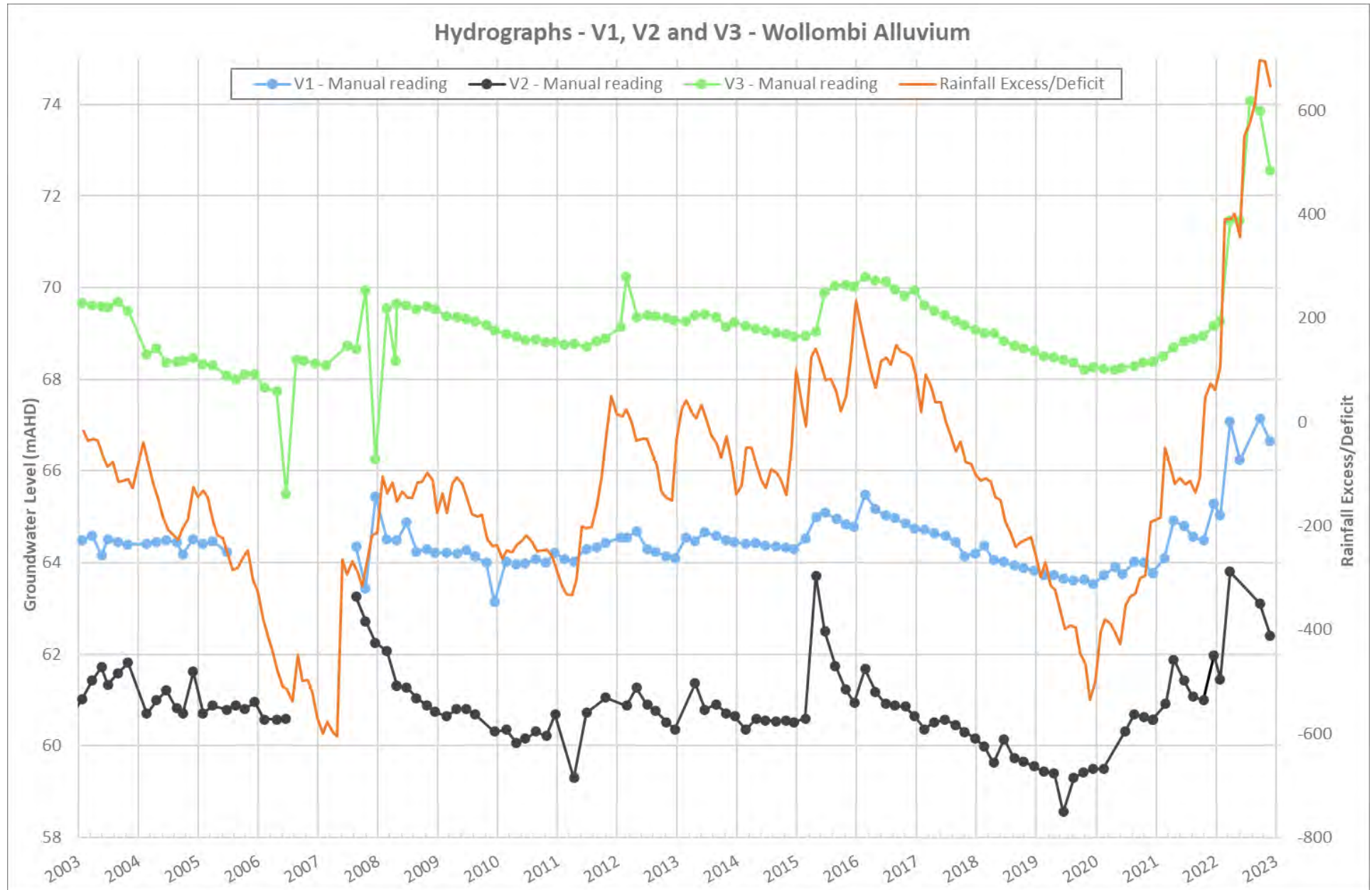
Ferdowsian, R., Pannell, D.J., McCarron, C., Ryder, A.T., Crossing, L. 2001. Explaining Groundwater Hydrographs: Separating Atypical Rainfall Events from Time Trends. AJSR vol. 39, 4.

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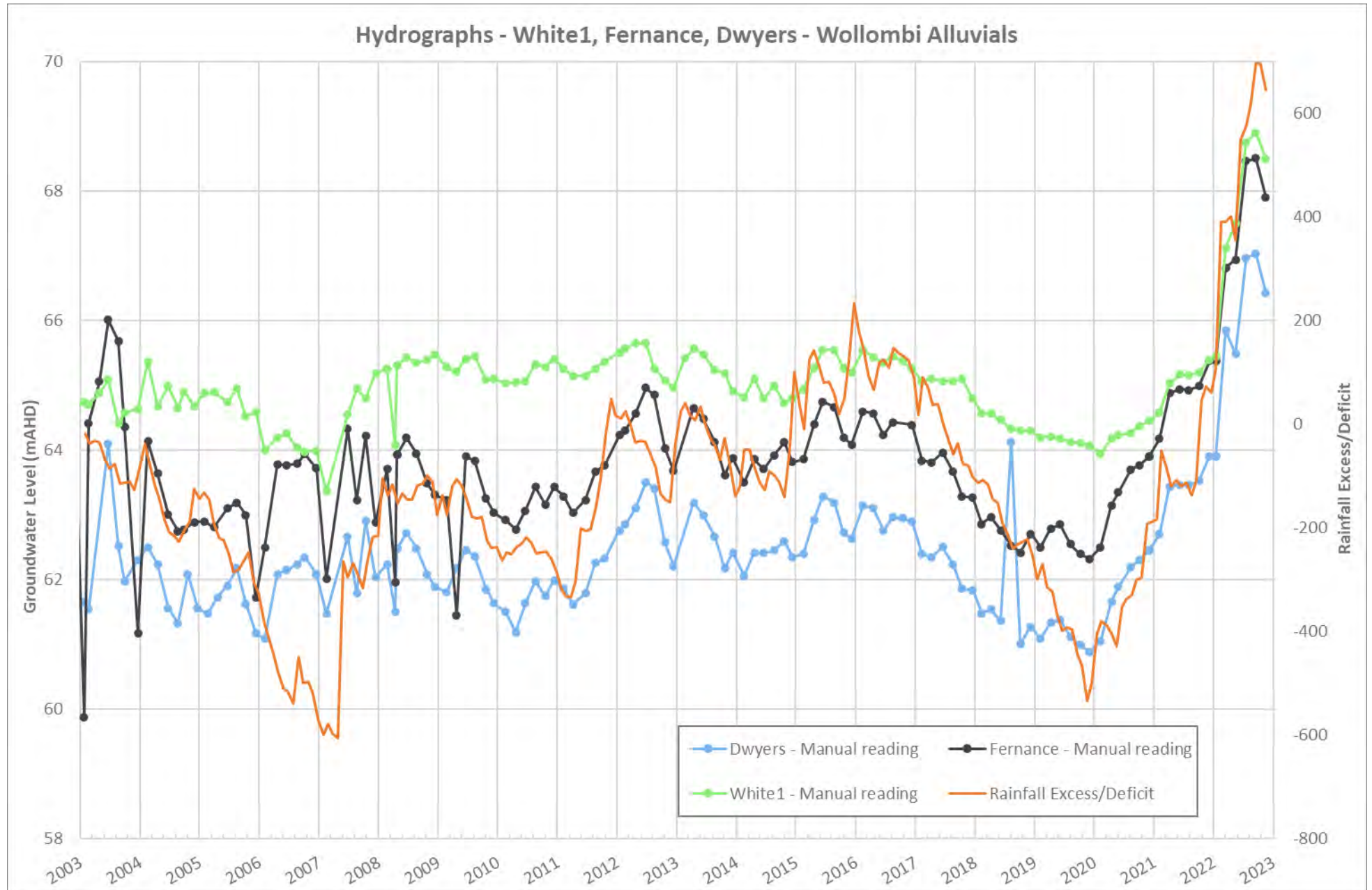
Mackie Environmental Research 2013. Assessment of groundwater related impacts arising from the proposed Bulga optimisation project, Appendix 11 of the EIS, report prepared for Bulga Coal Management.

Appendix A. Groundwater hydrographs

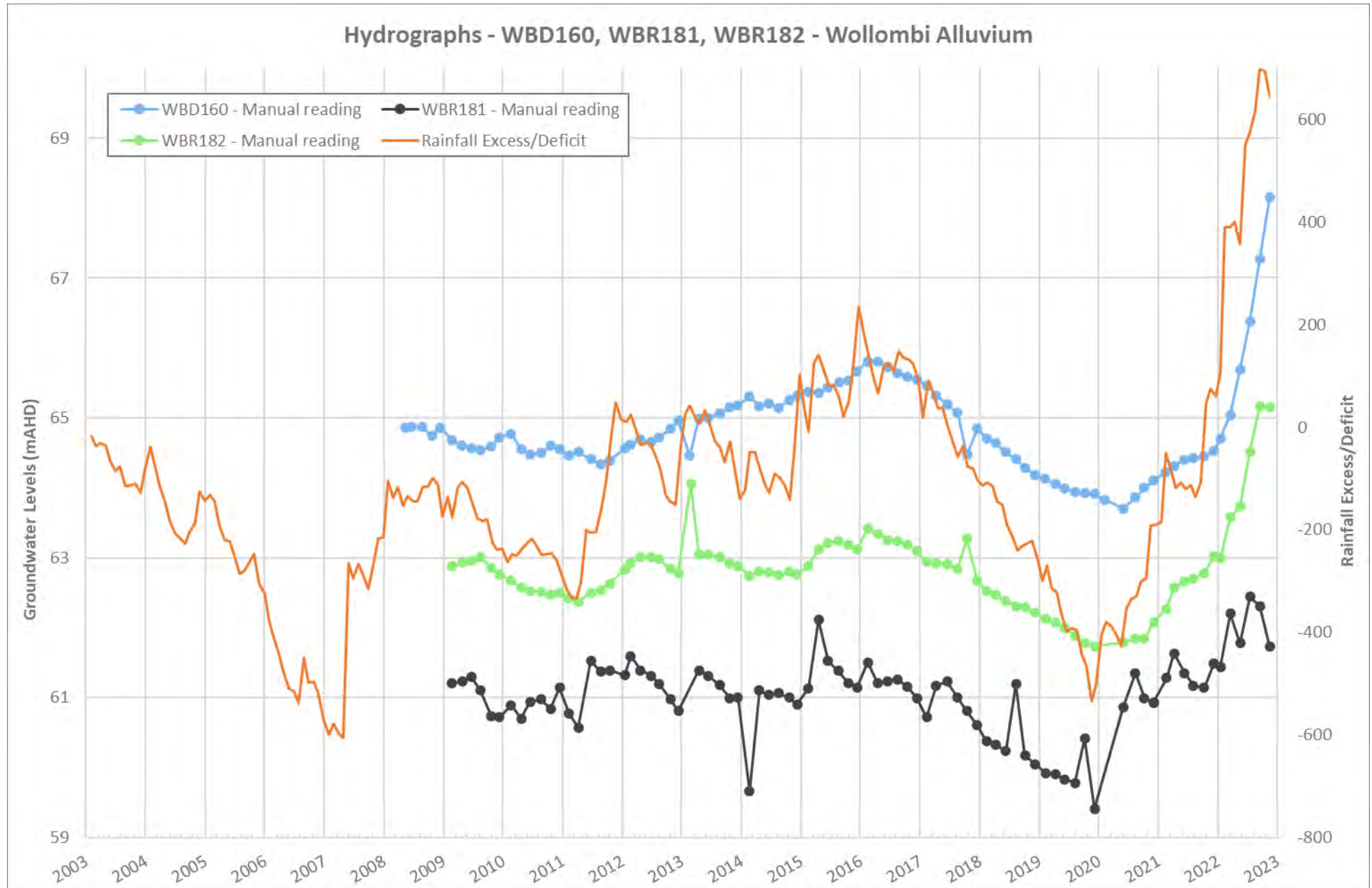
Appendix A - Groundwater Hydrographs



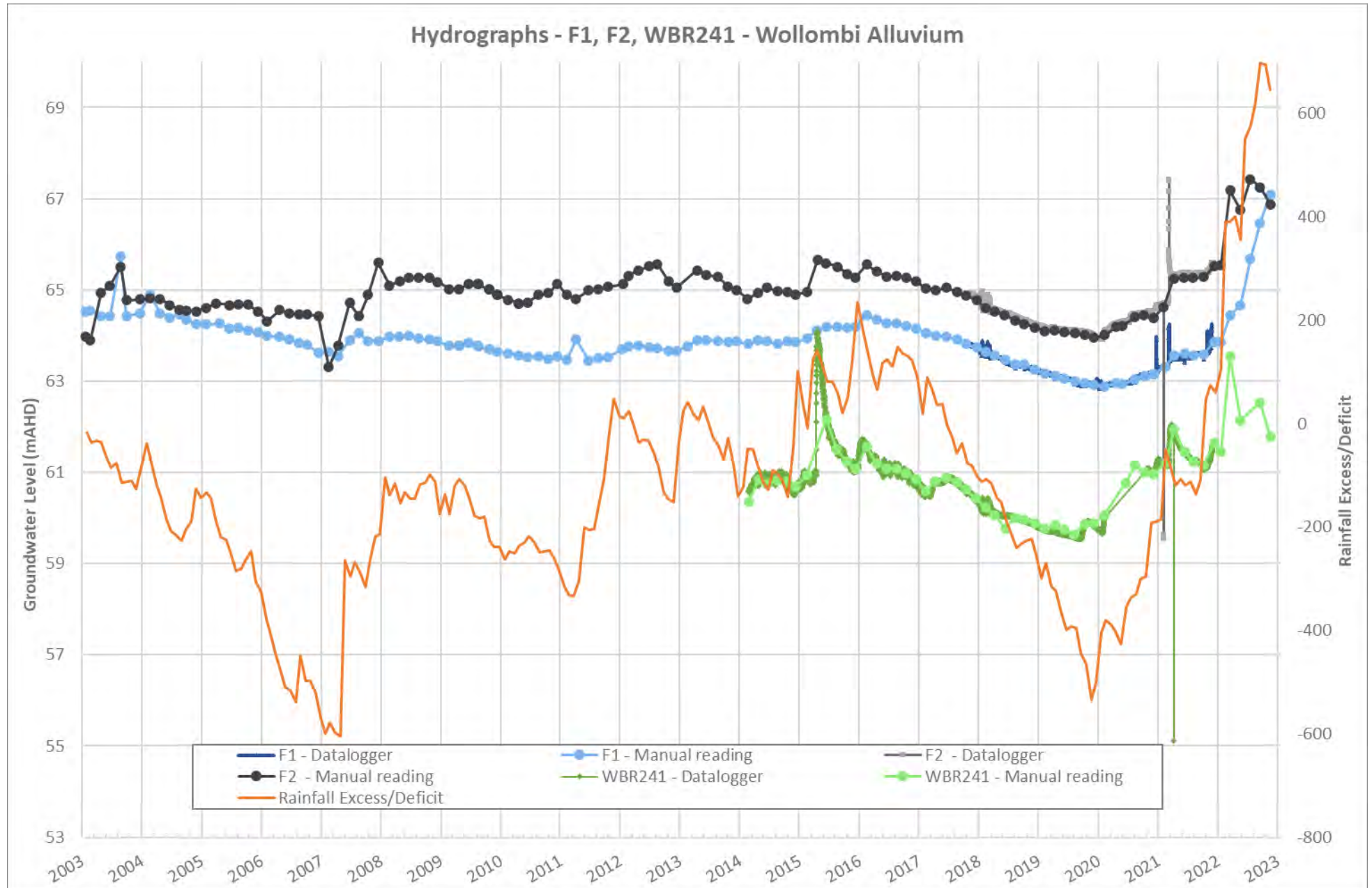
Appendix A - Groundwater Hydrographs



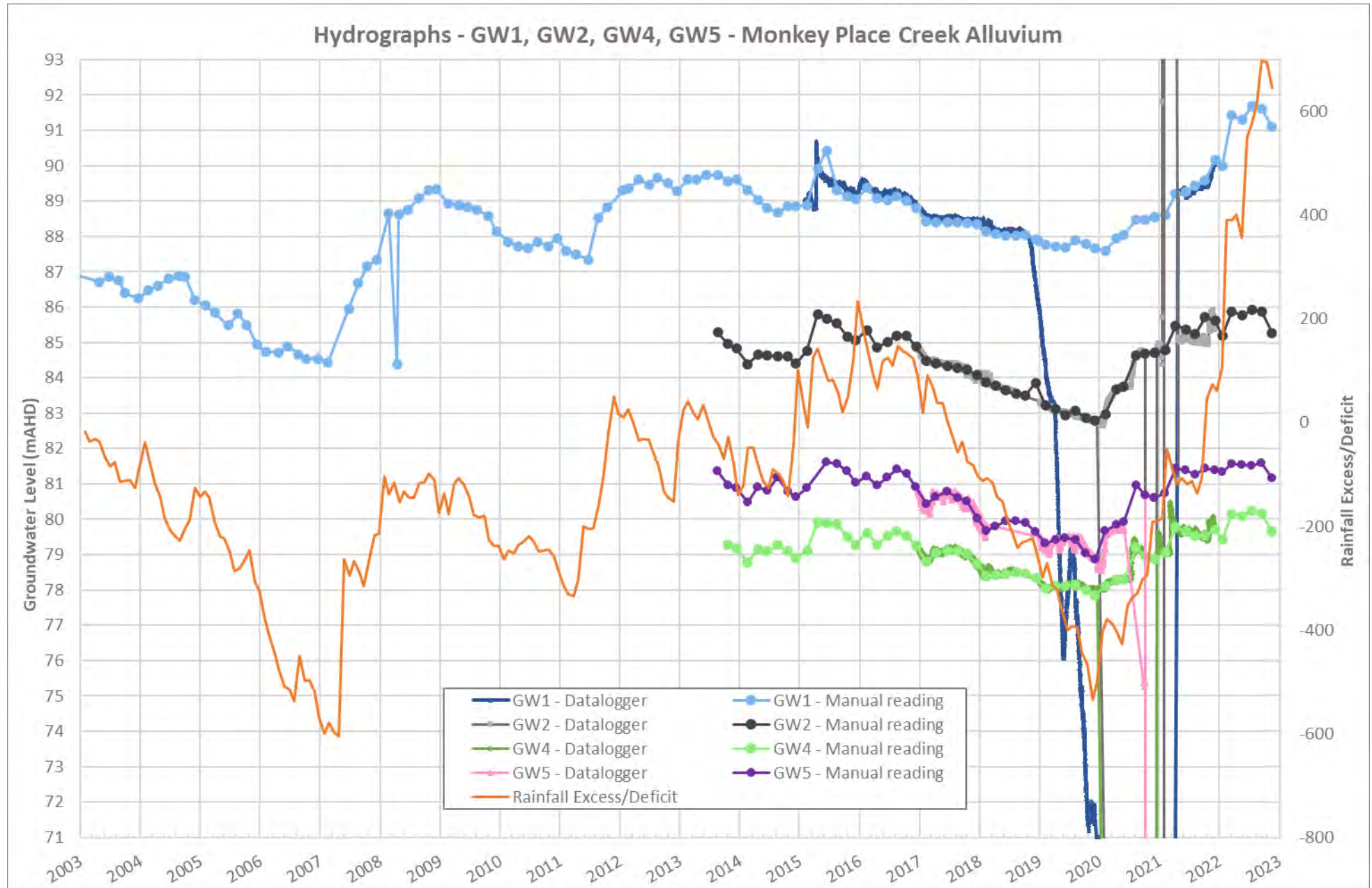
Appendix A - Groundwater Hydrographs



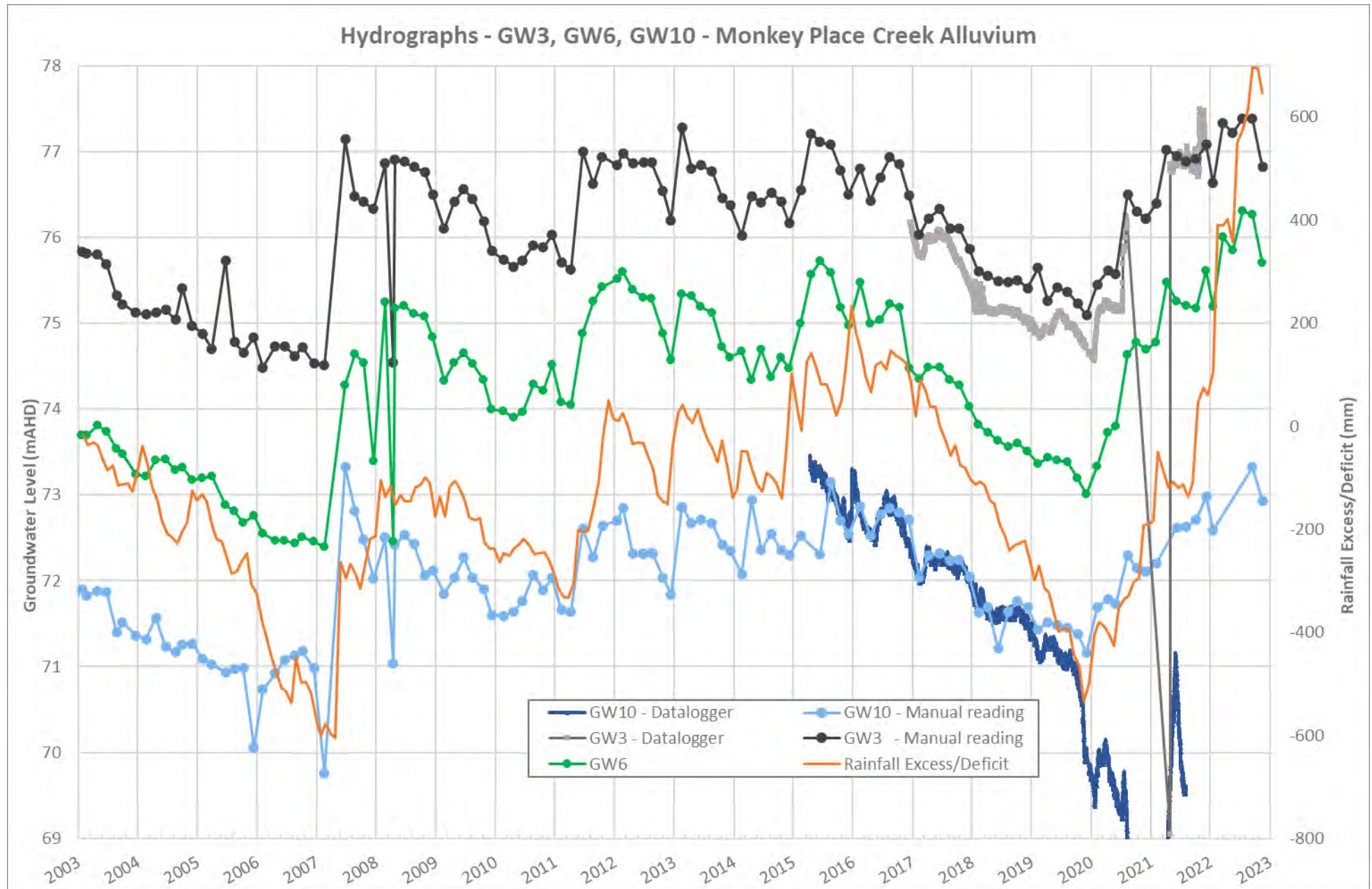
Appendix A - Groundwater Hydrographs



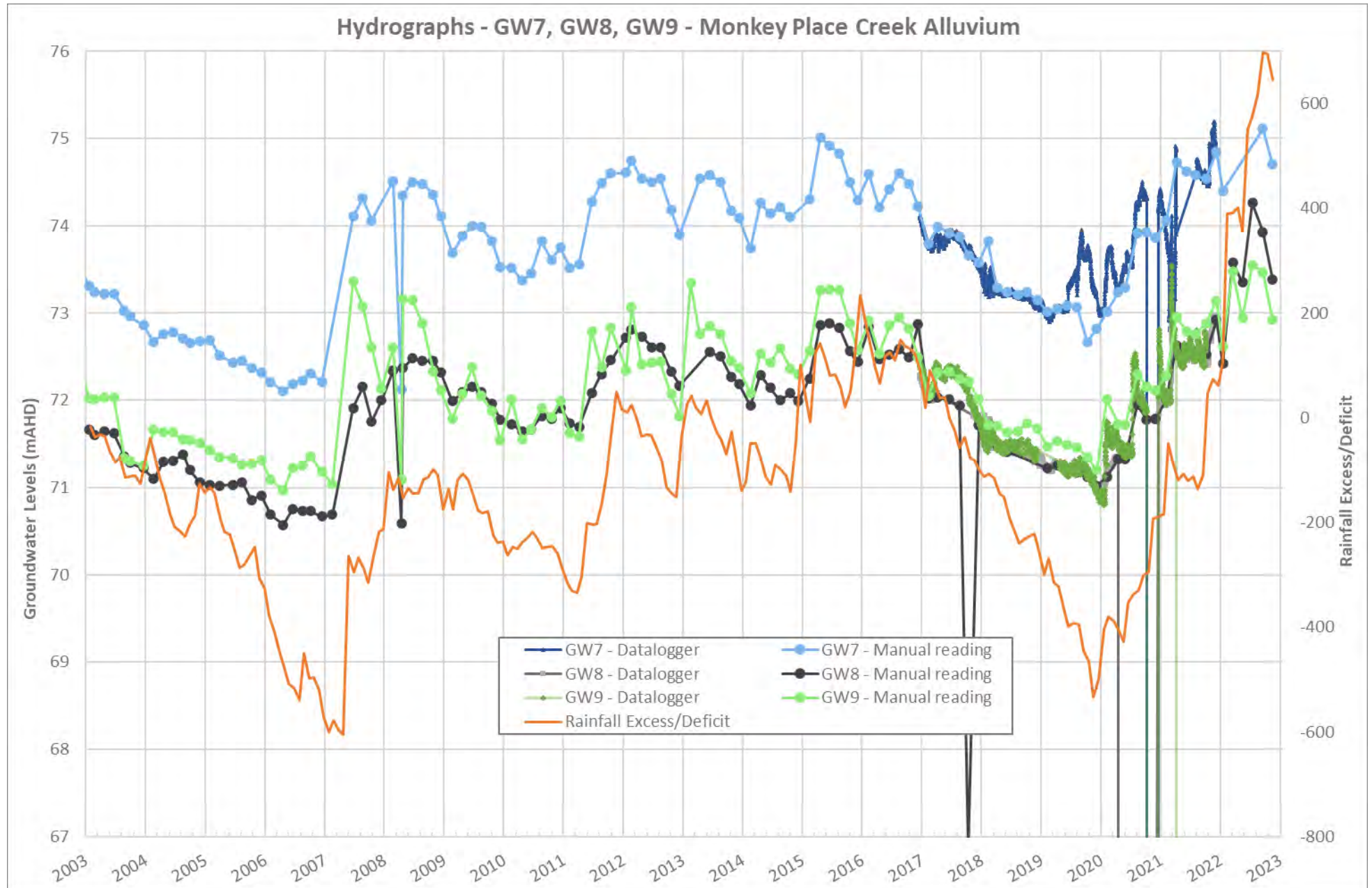
Appendix A - Groundwater Hydrographs



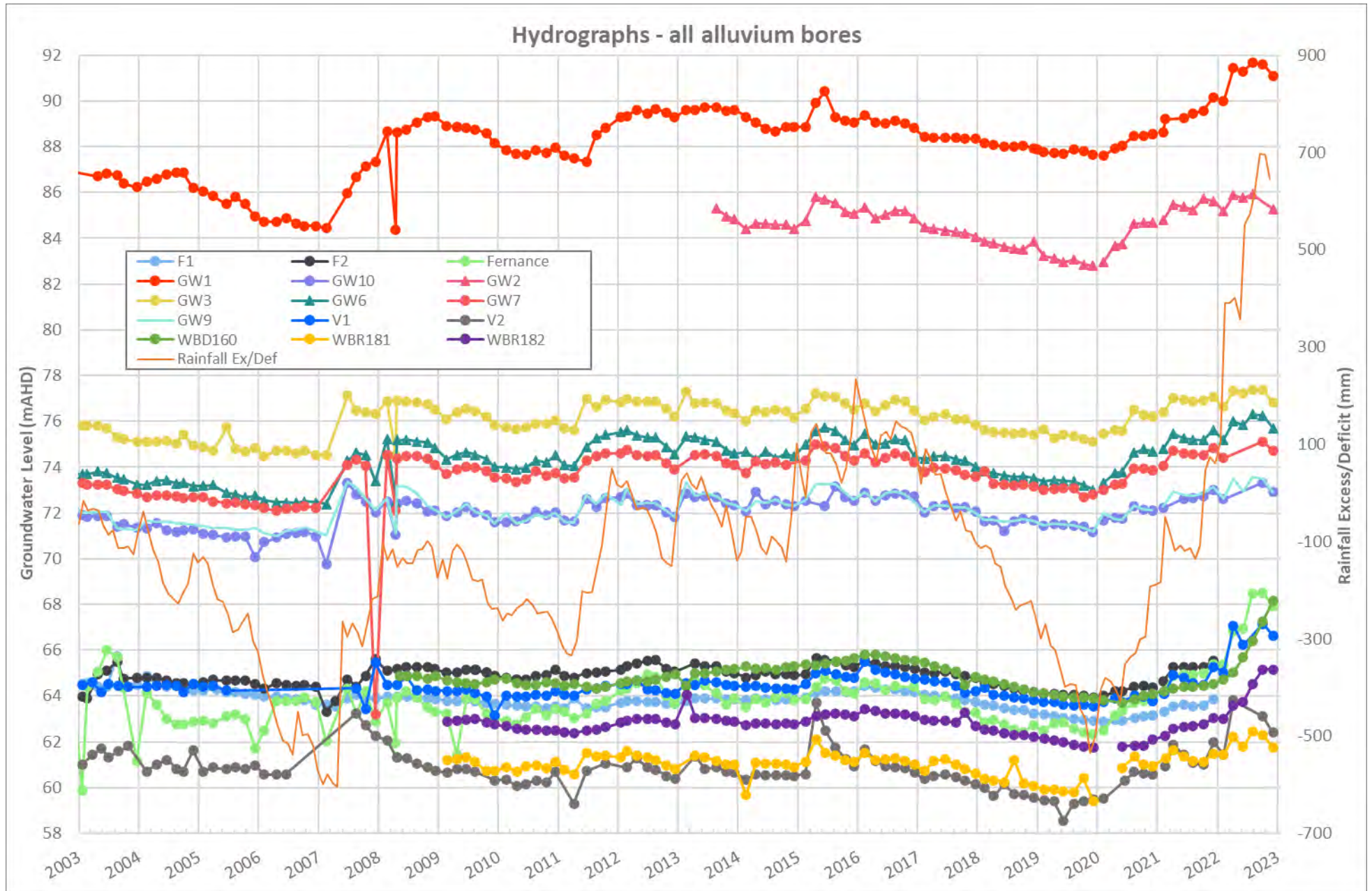
Appendix A - Groundwater Hydrographs



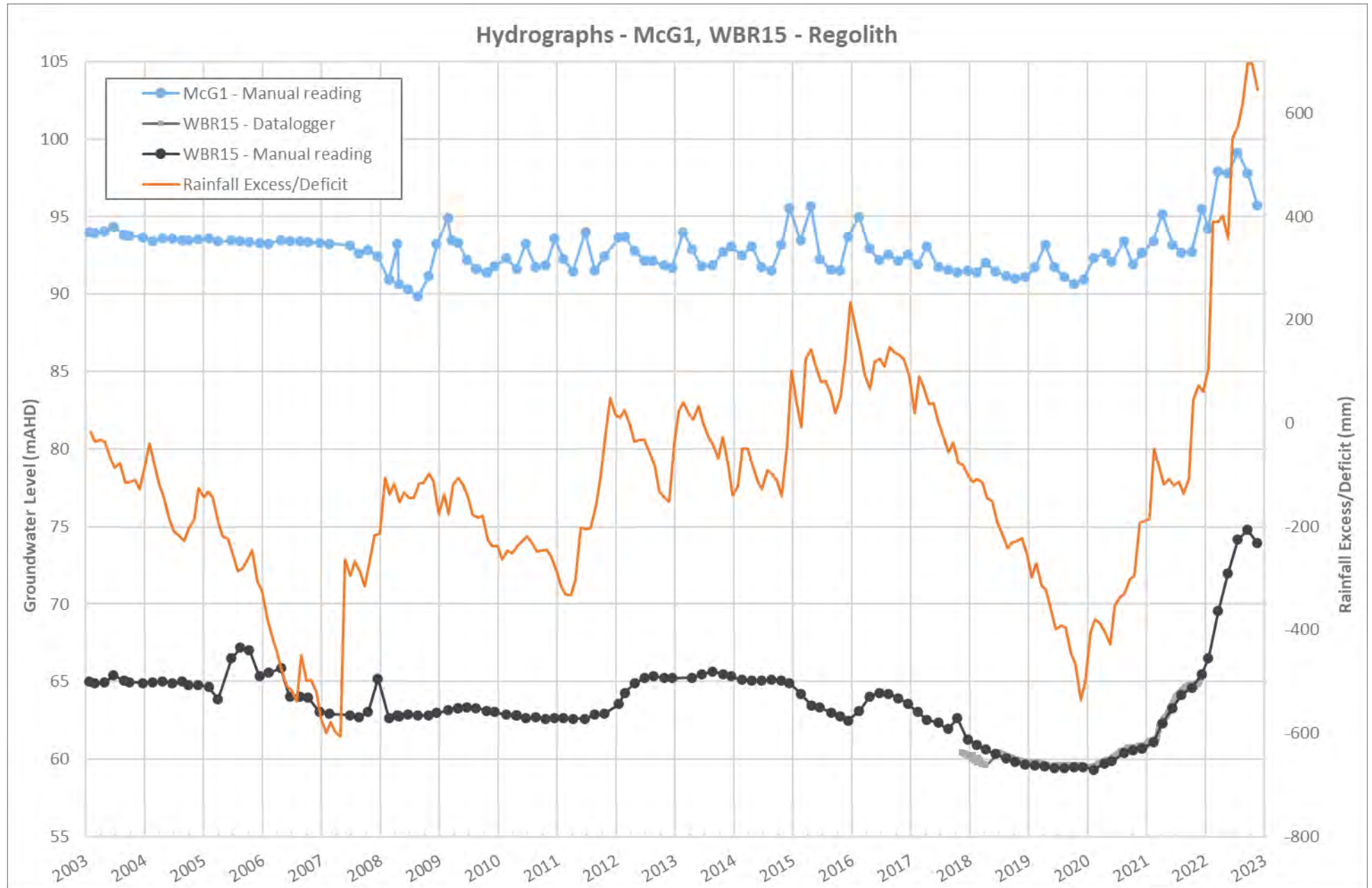
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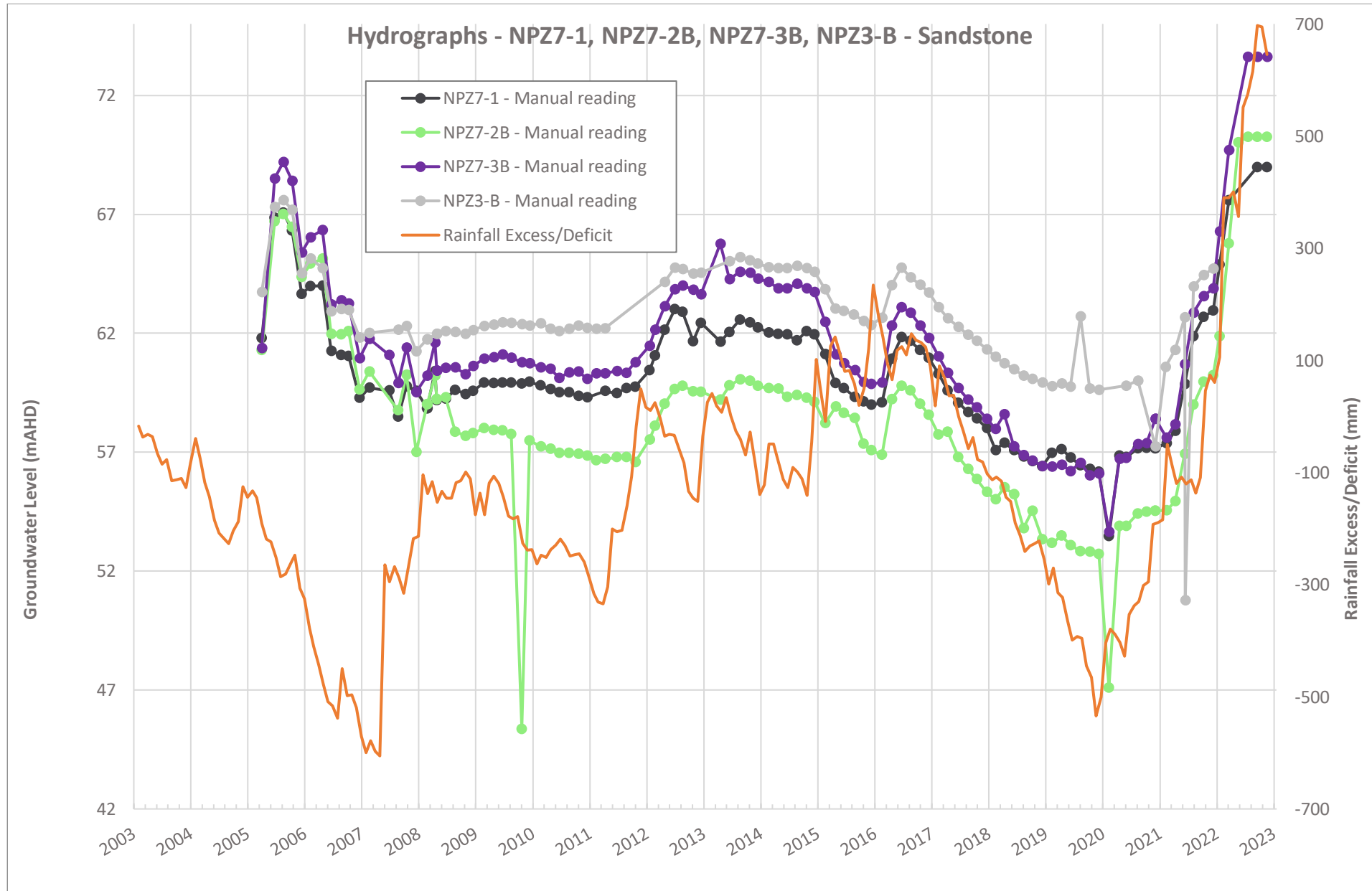
Appendix A - Groundwater Hydrographs



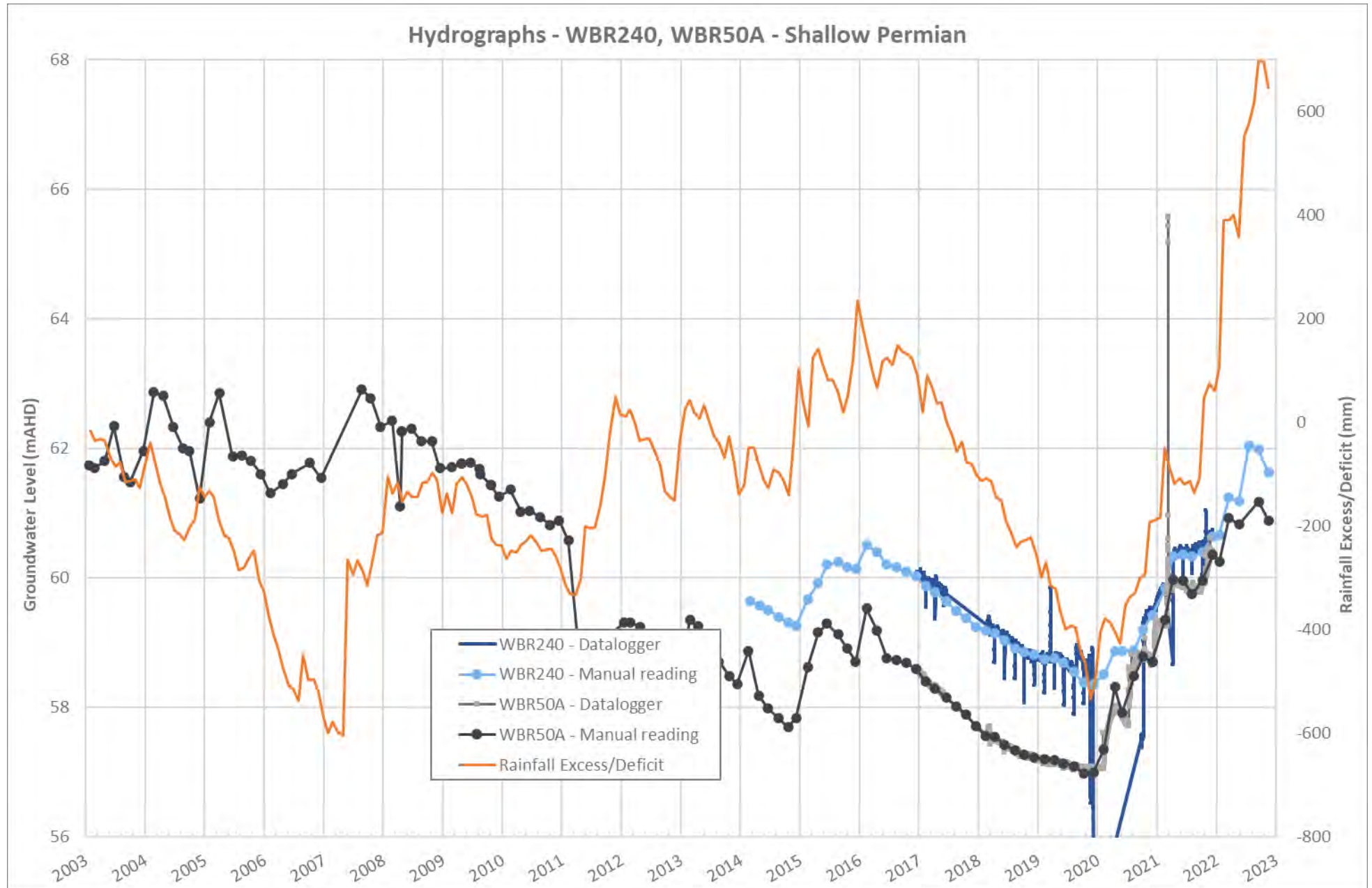
Appendix A - Groundwater Hydrographs



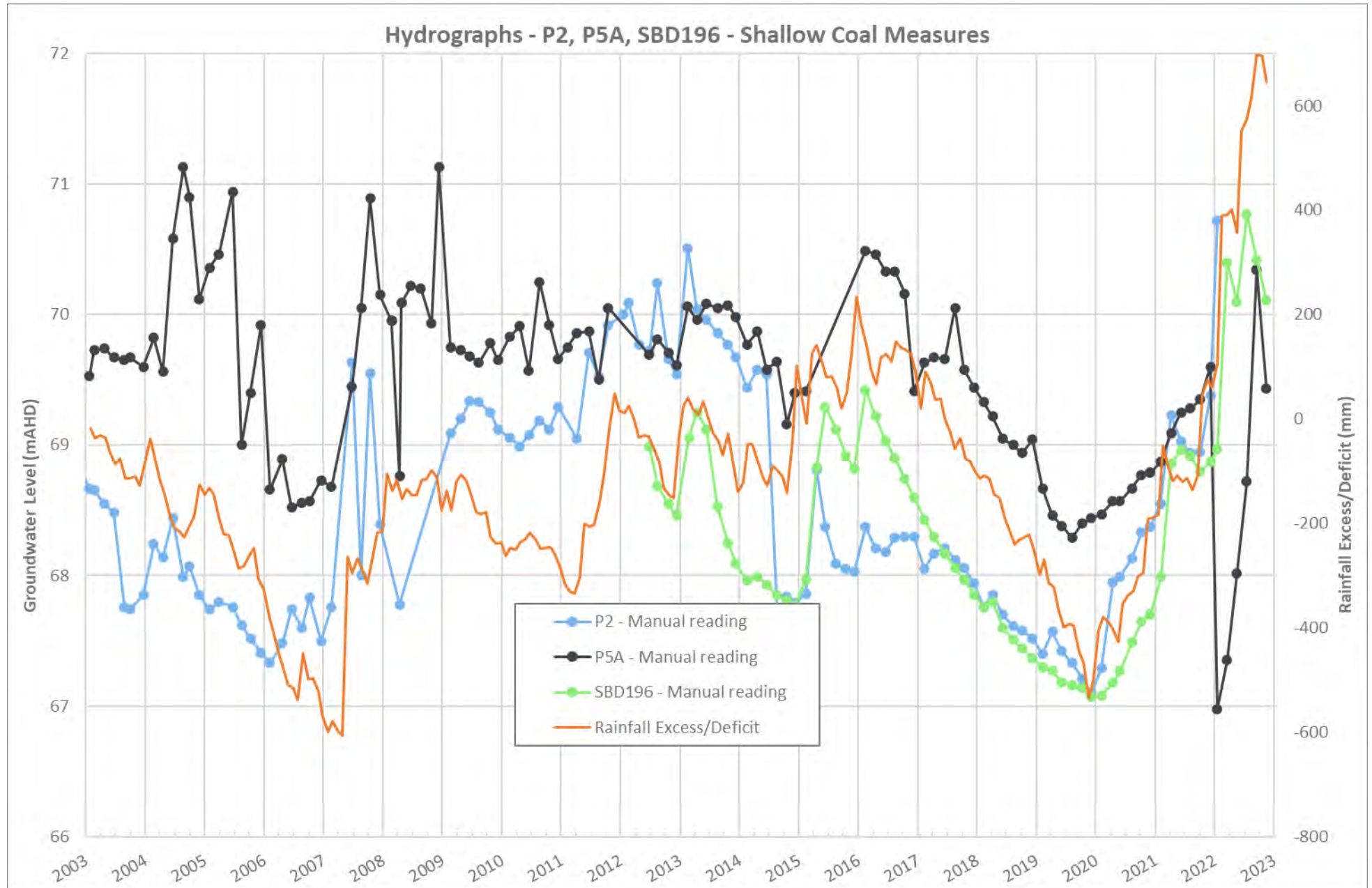
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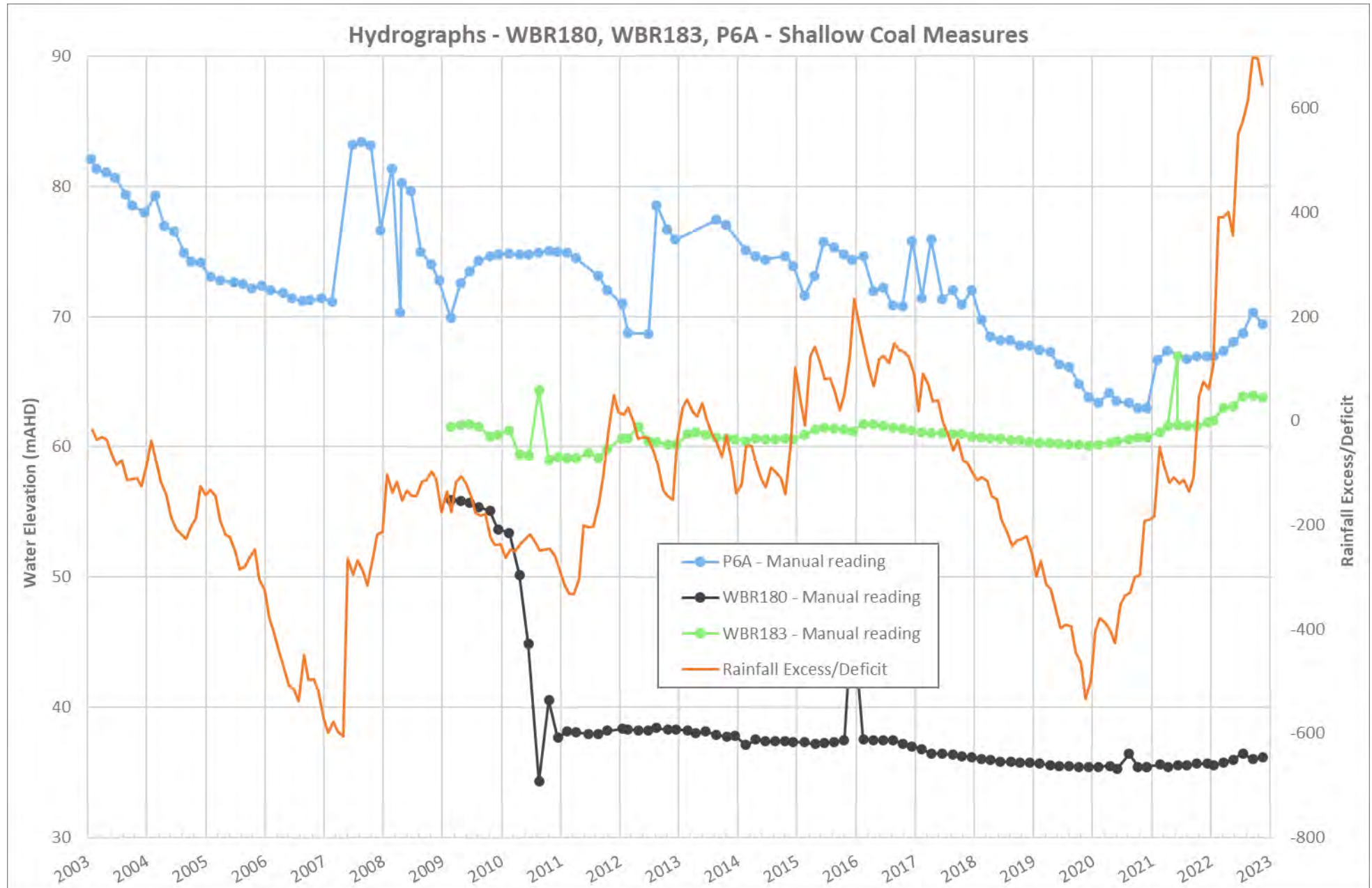
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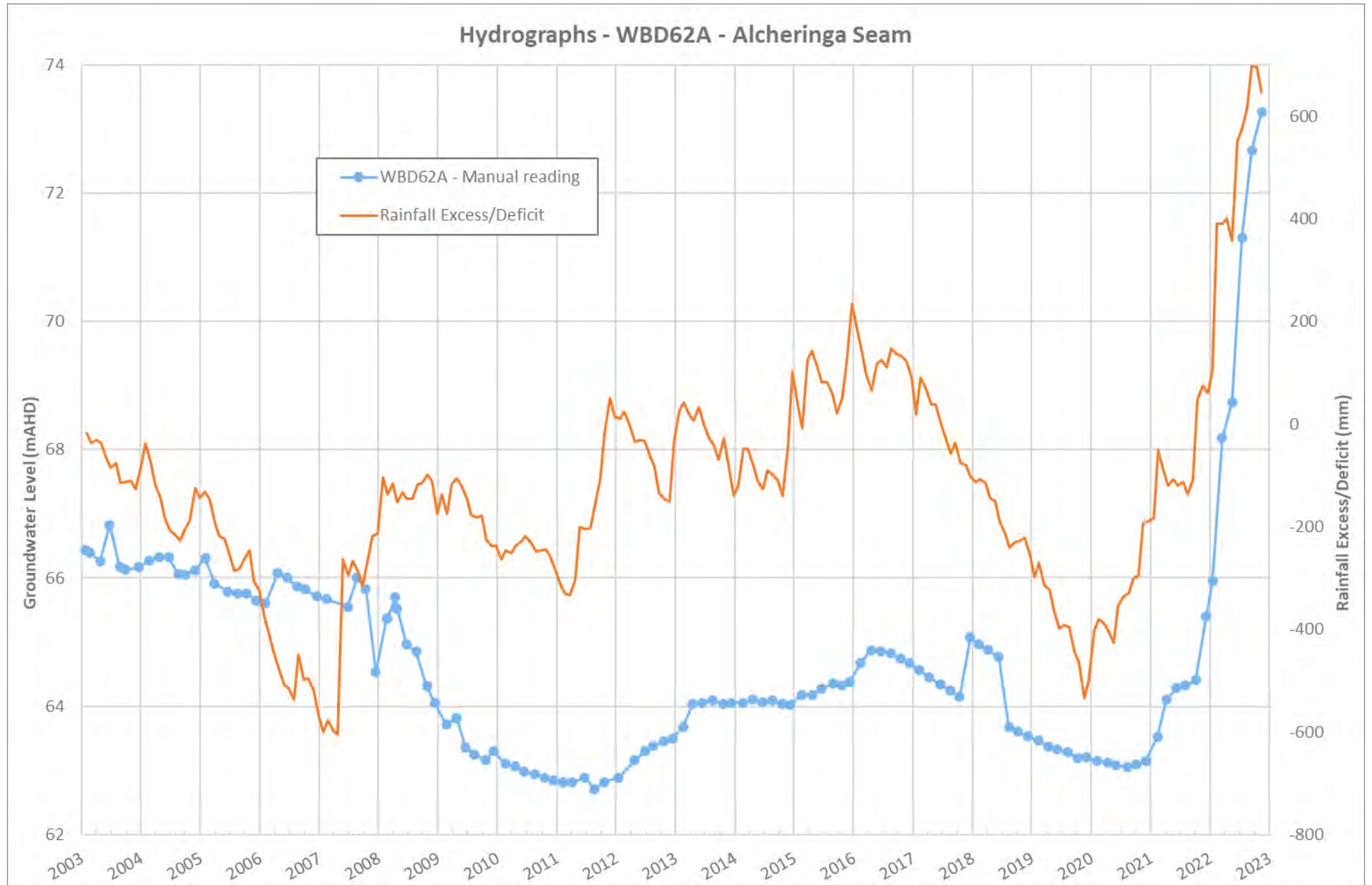
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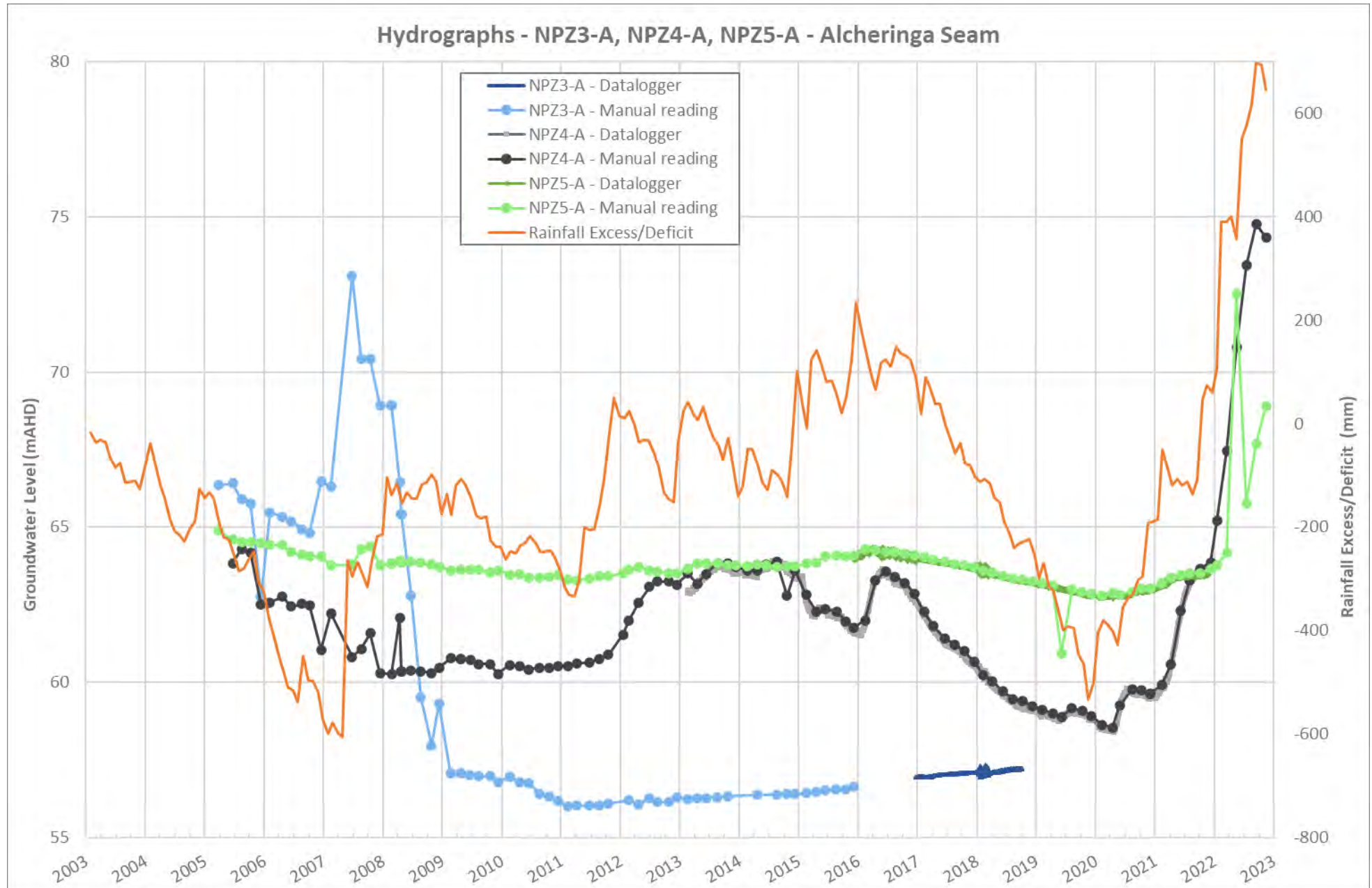
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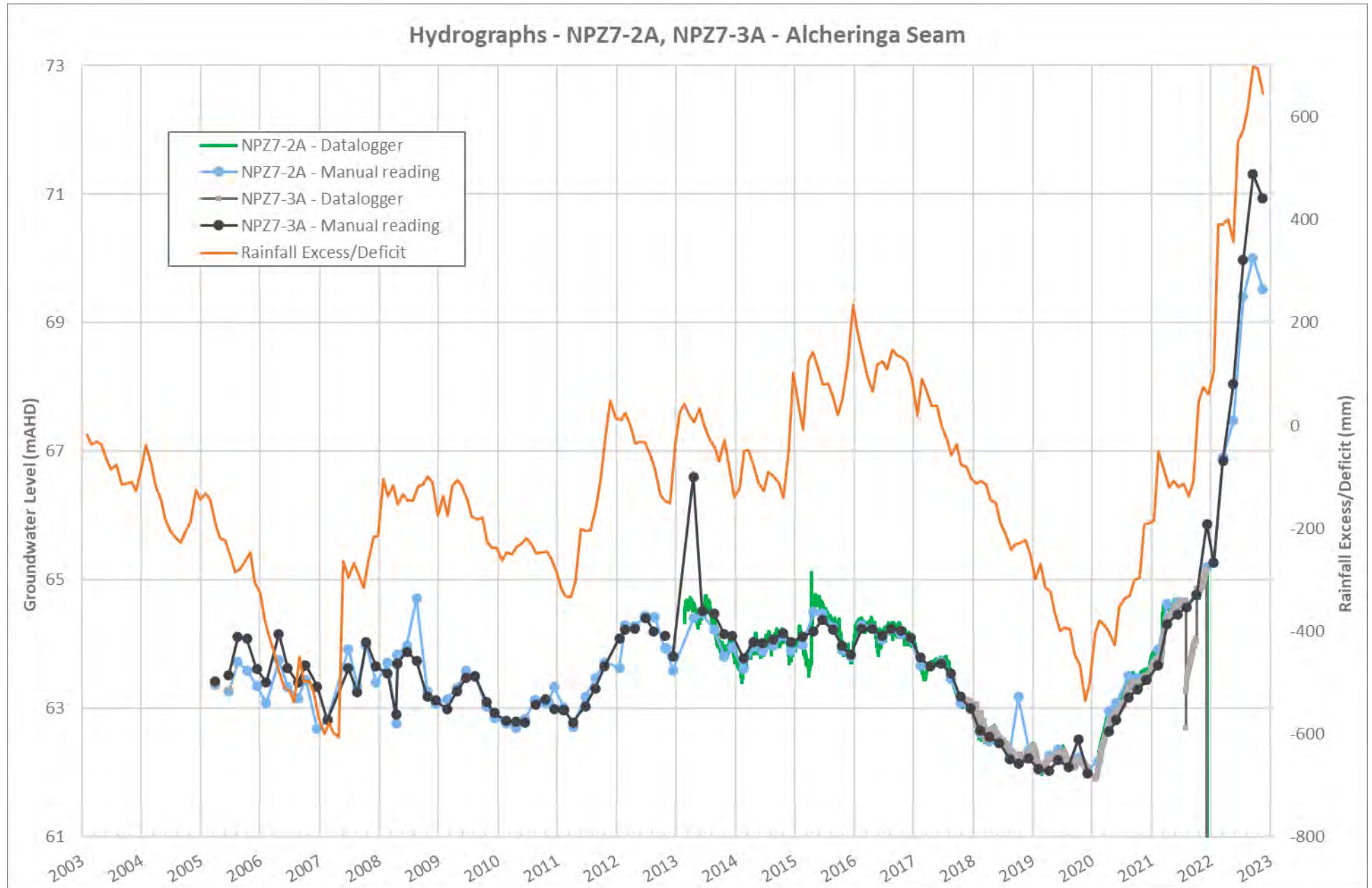
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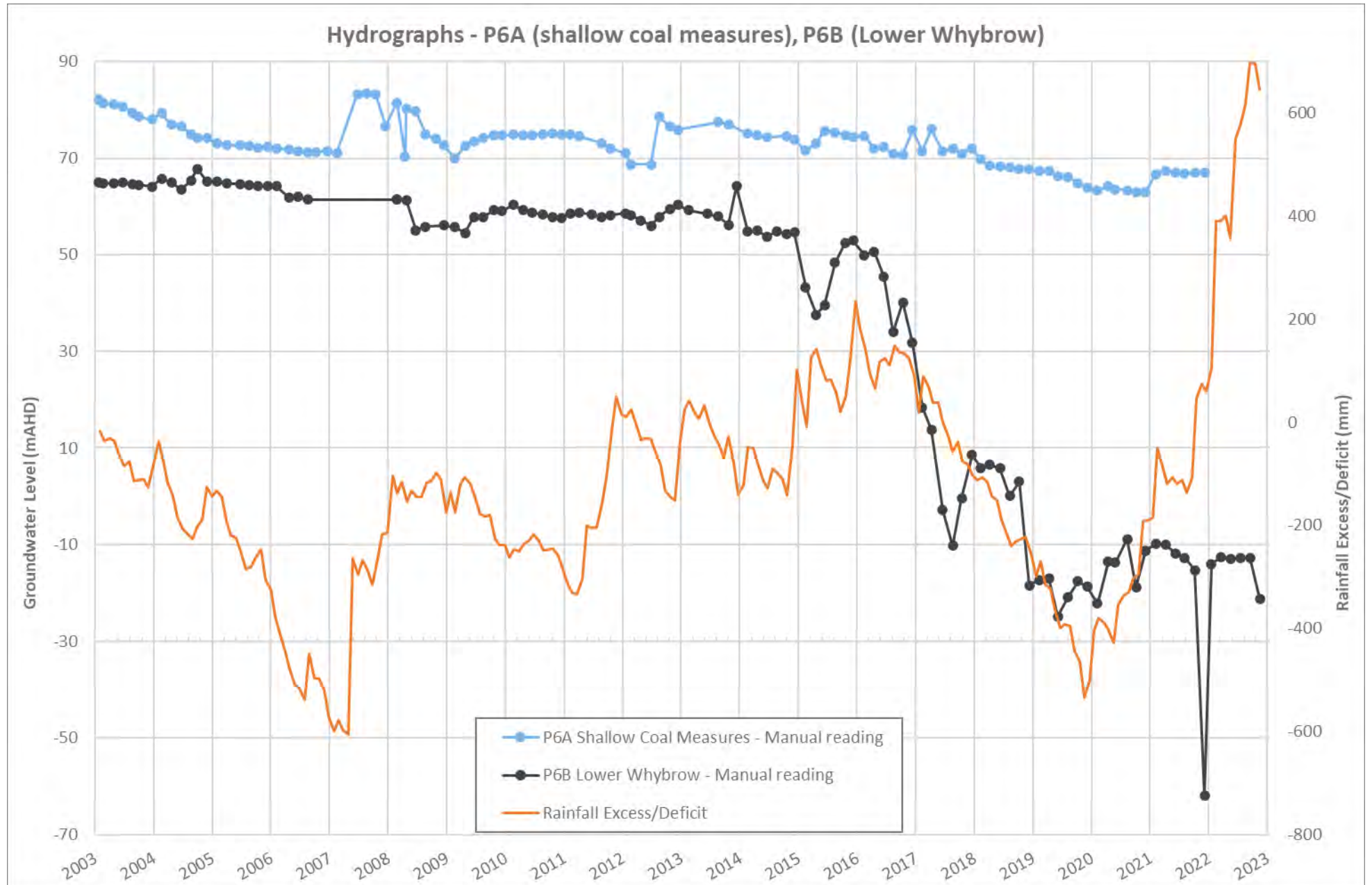
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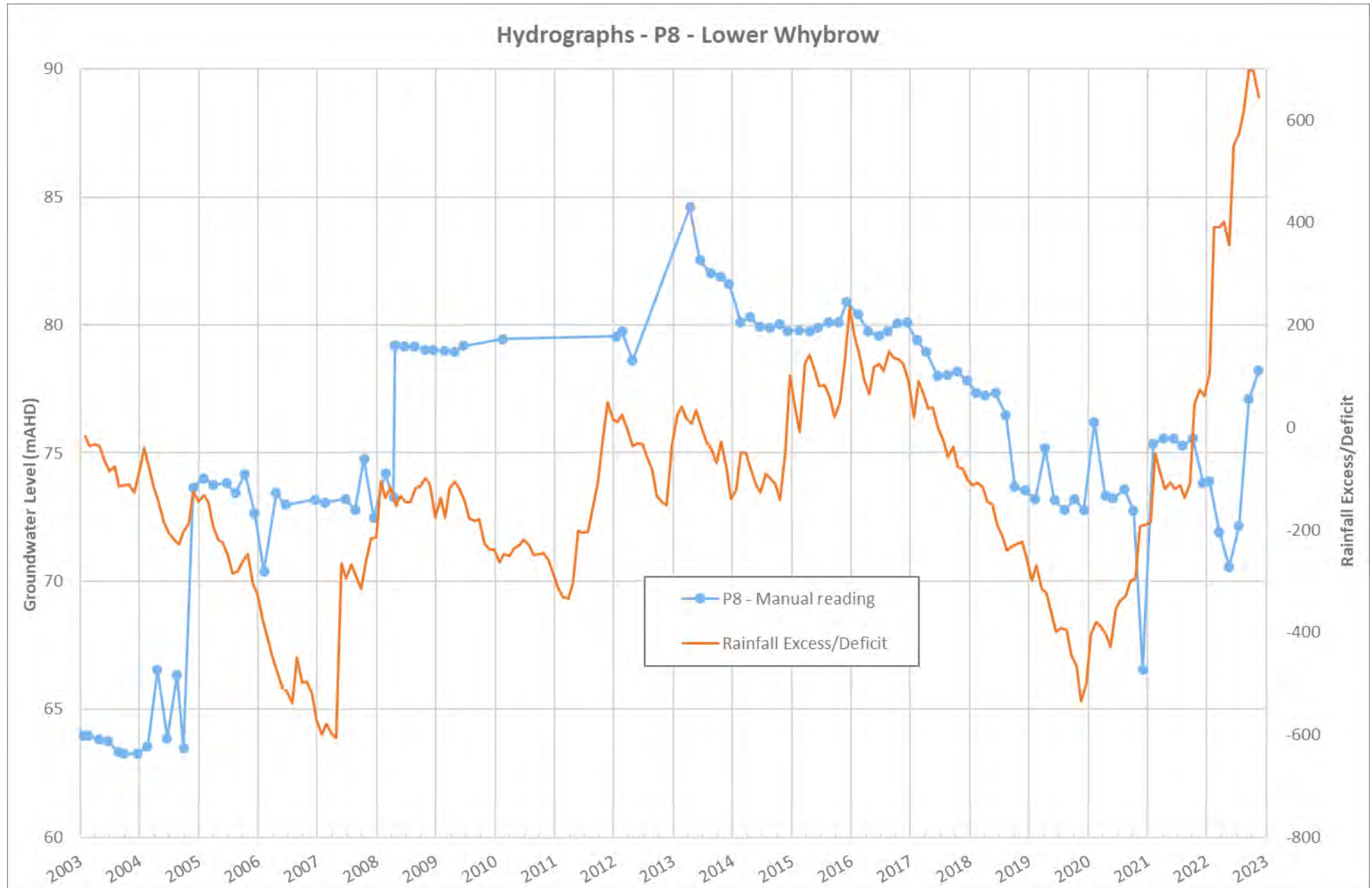
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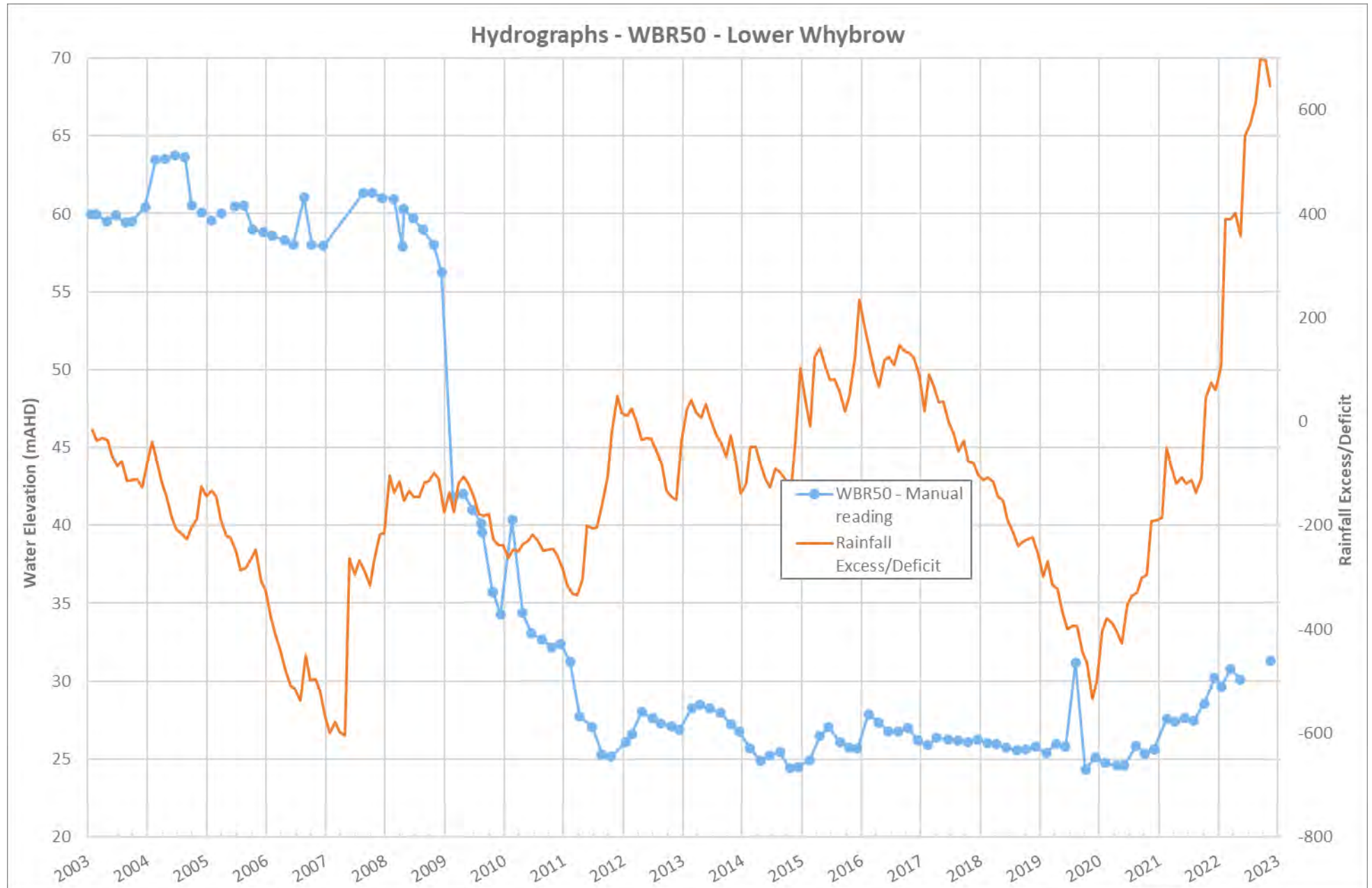
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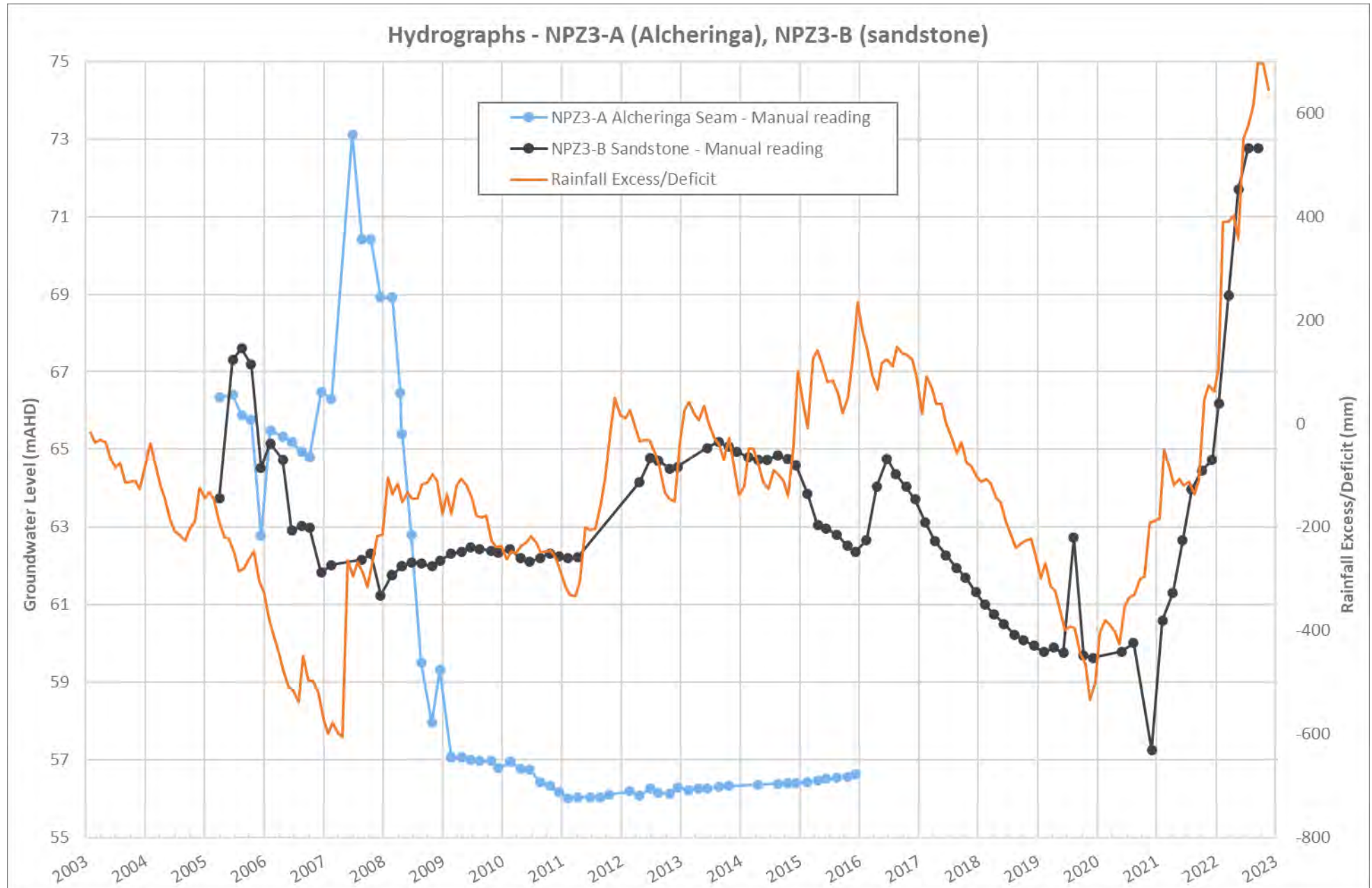
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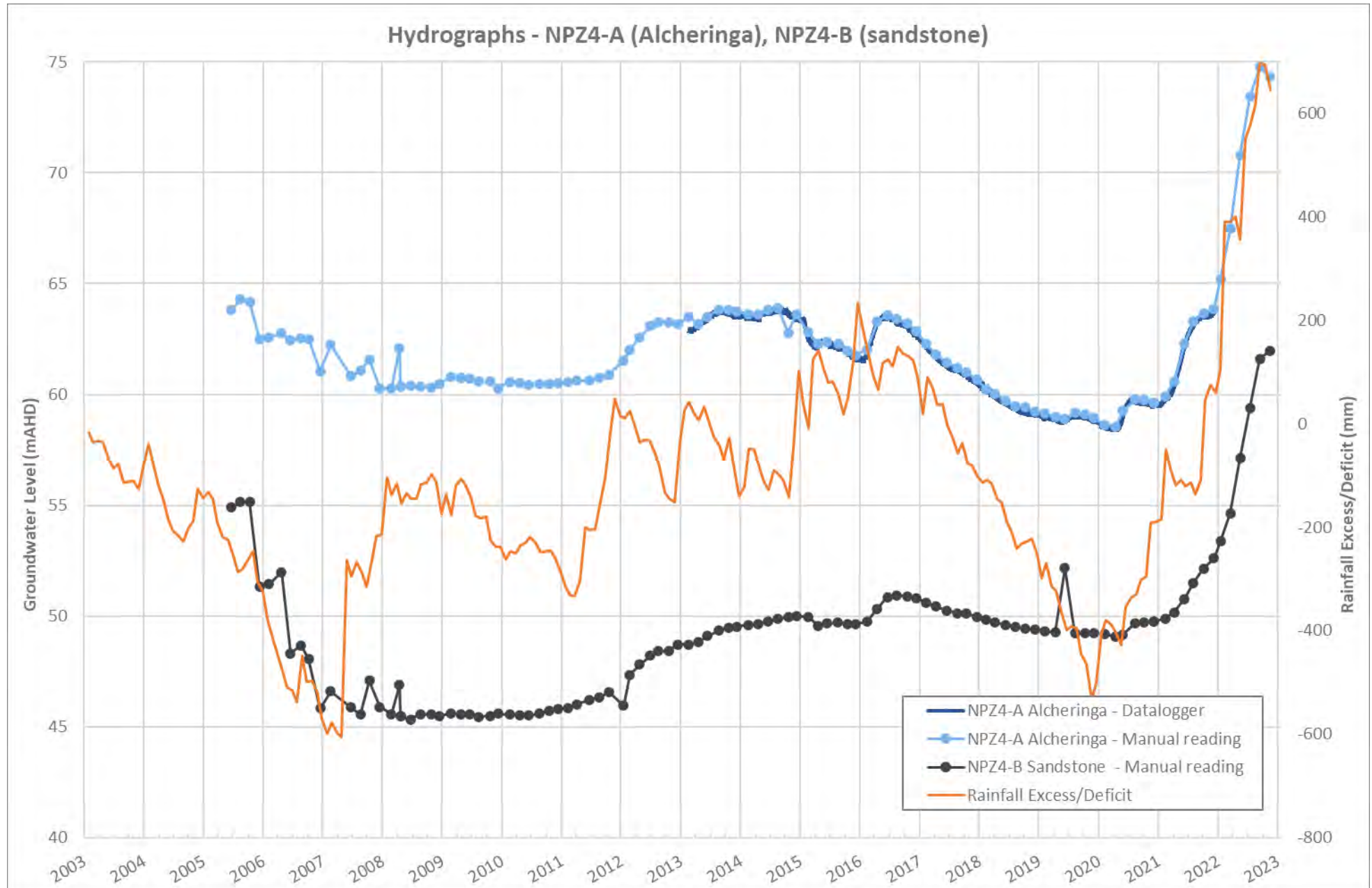
Appendix A - Groundwater Hydrographs



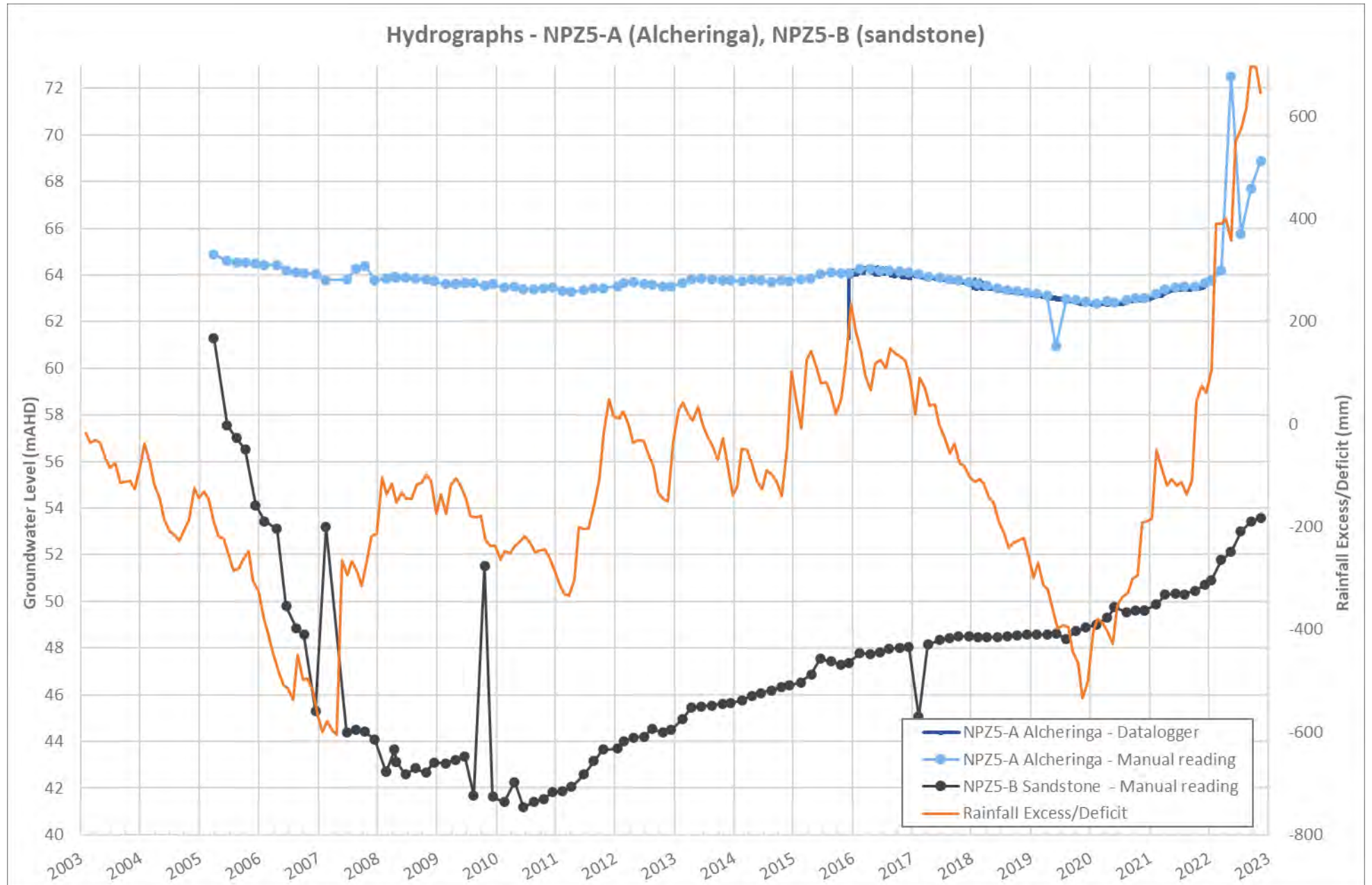
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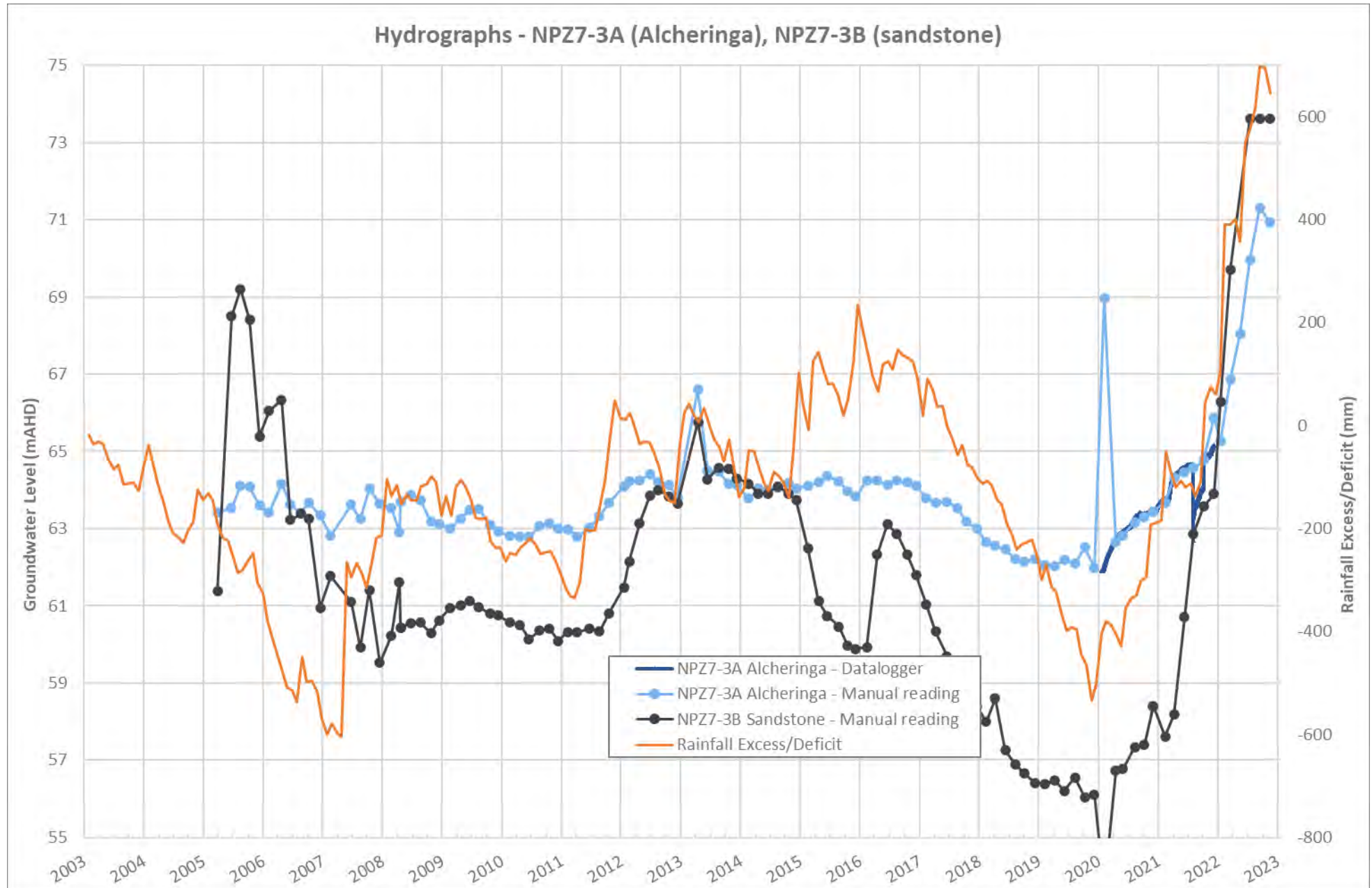
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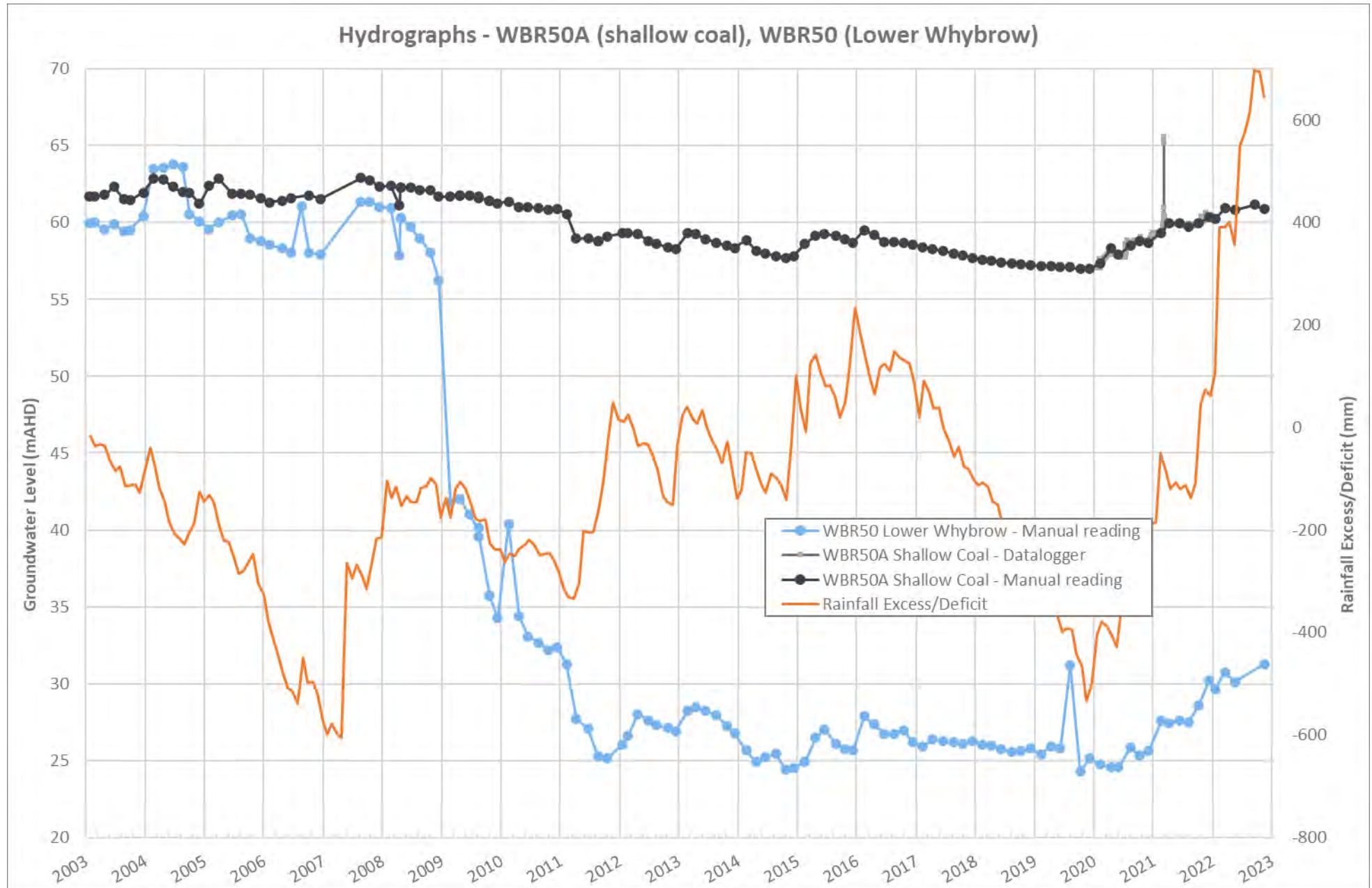
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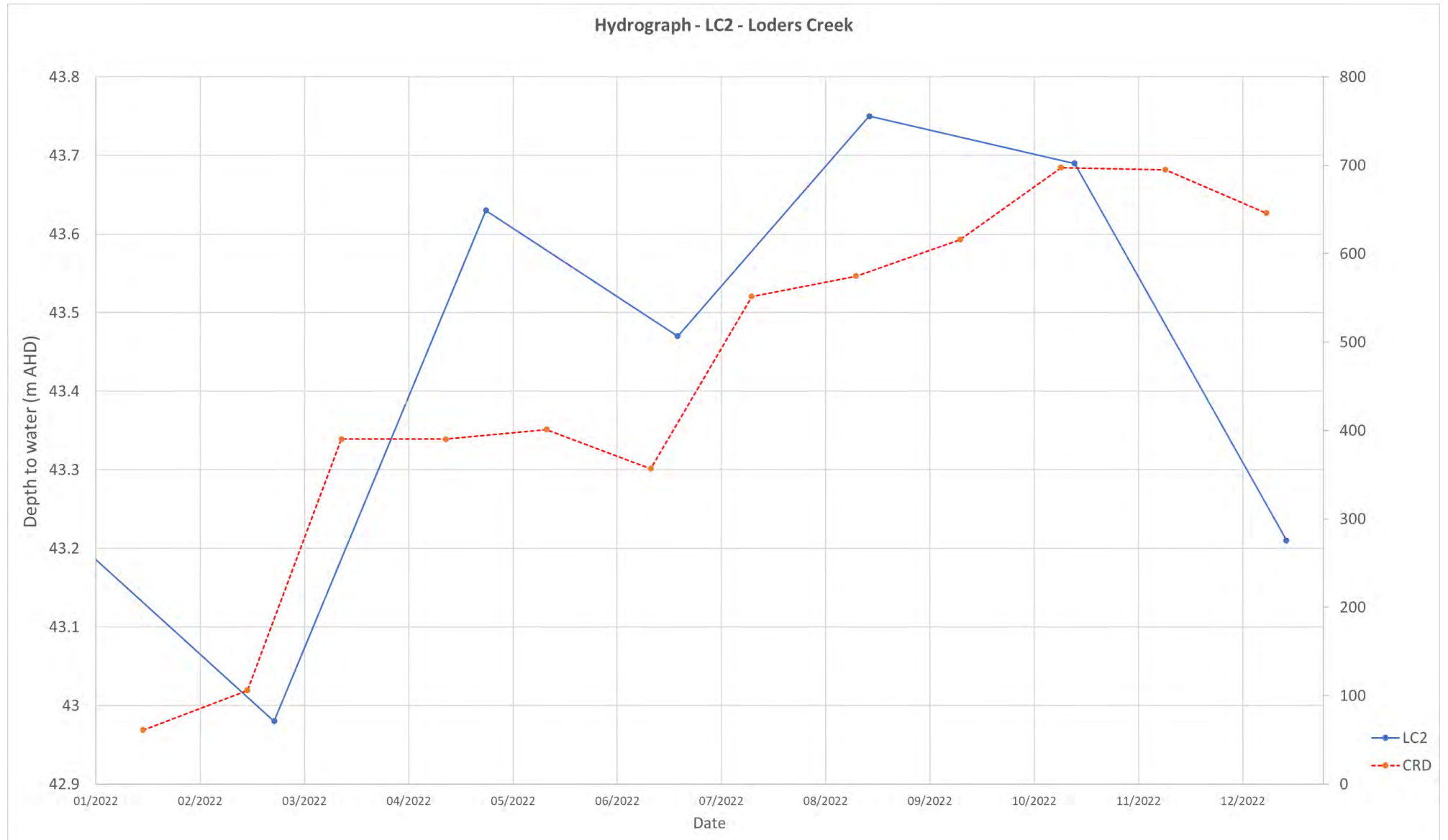
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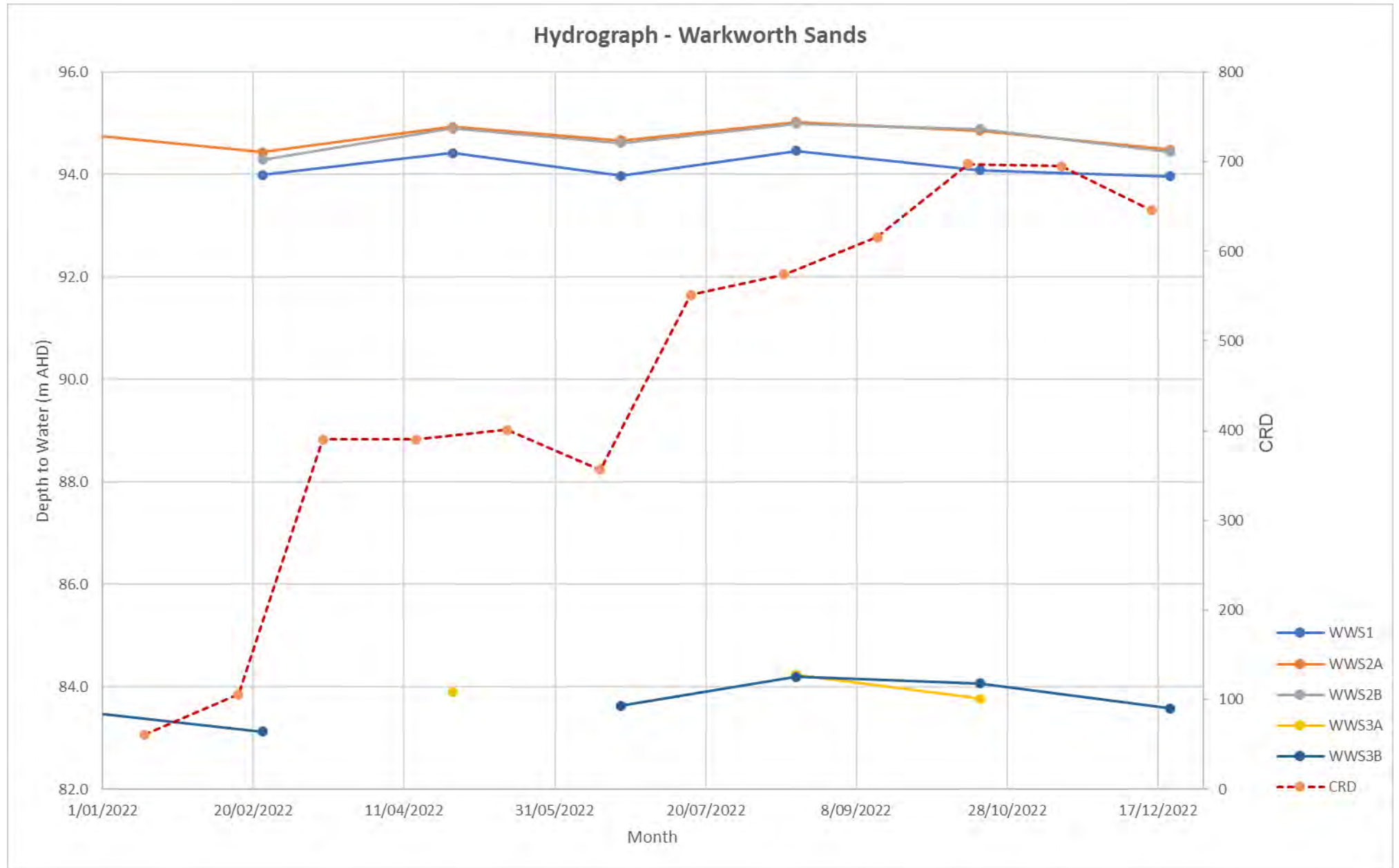
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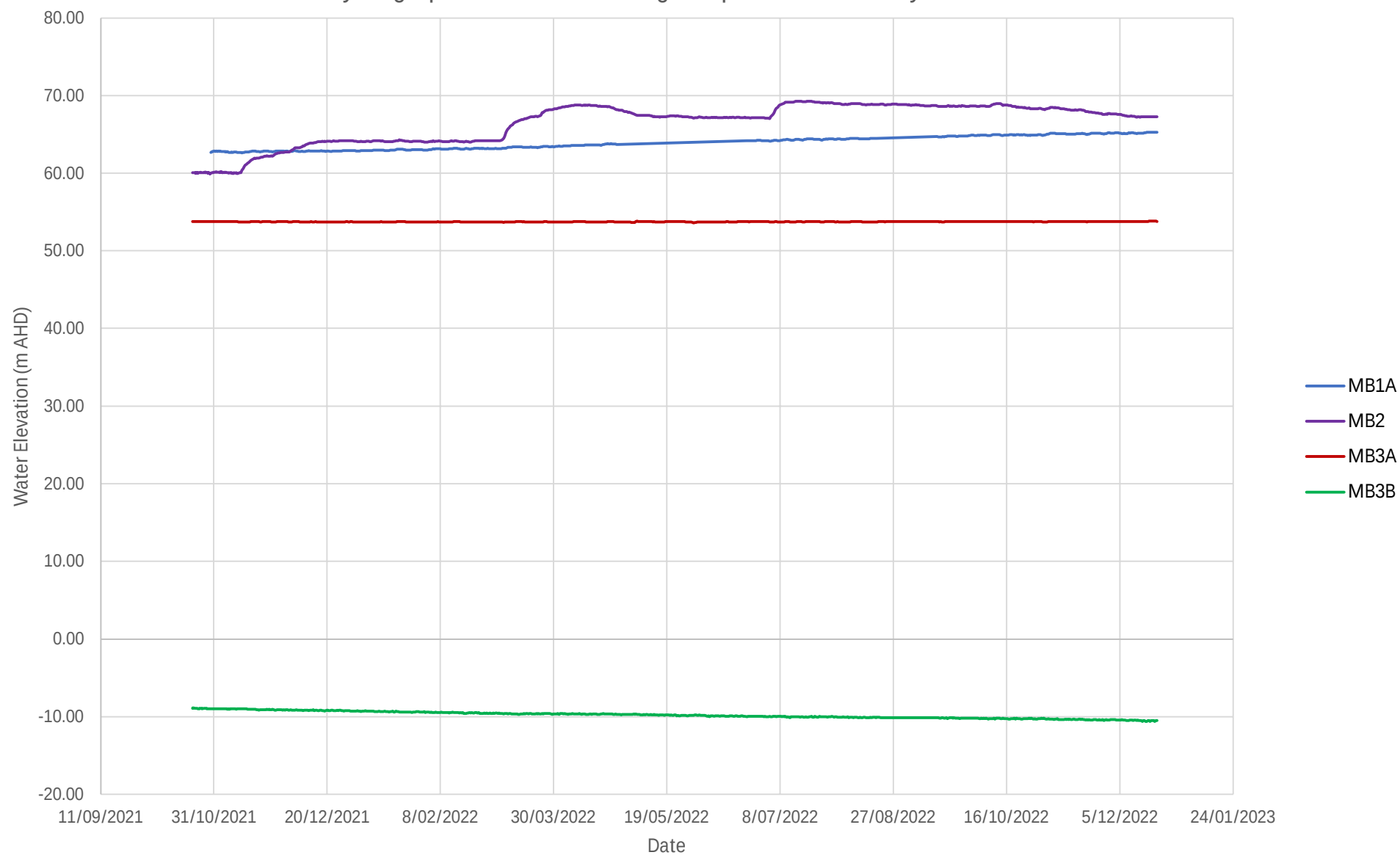
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Appendix A - Groundwater Hydrographs

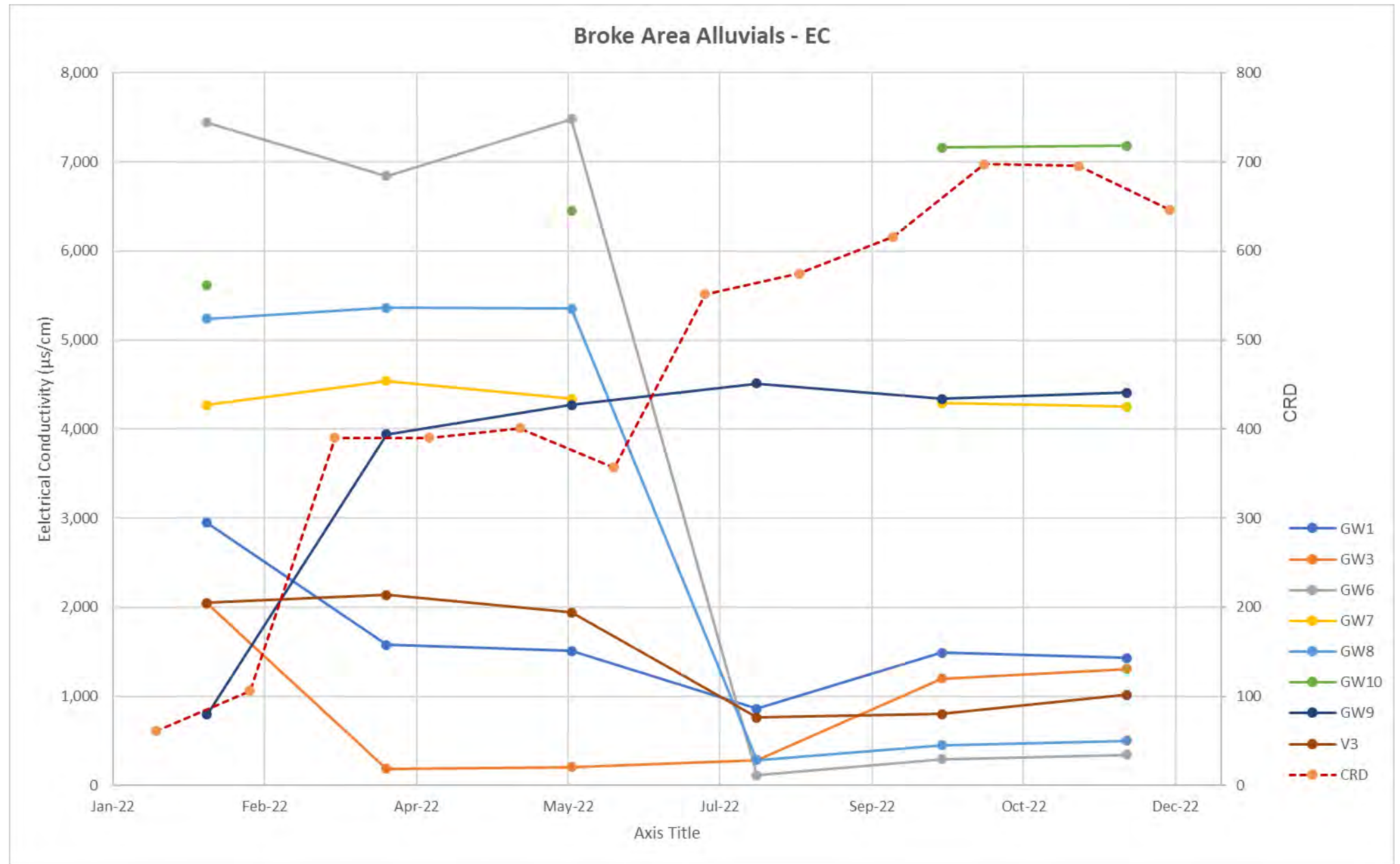


Hydrographs - Northern Tailings Emplacement Facility Piezometers

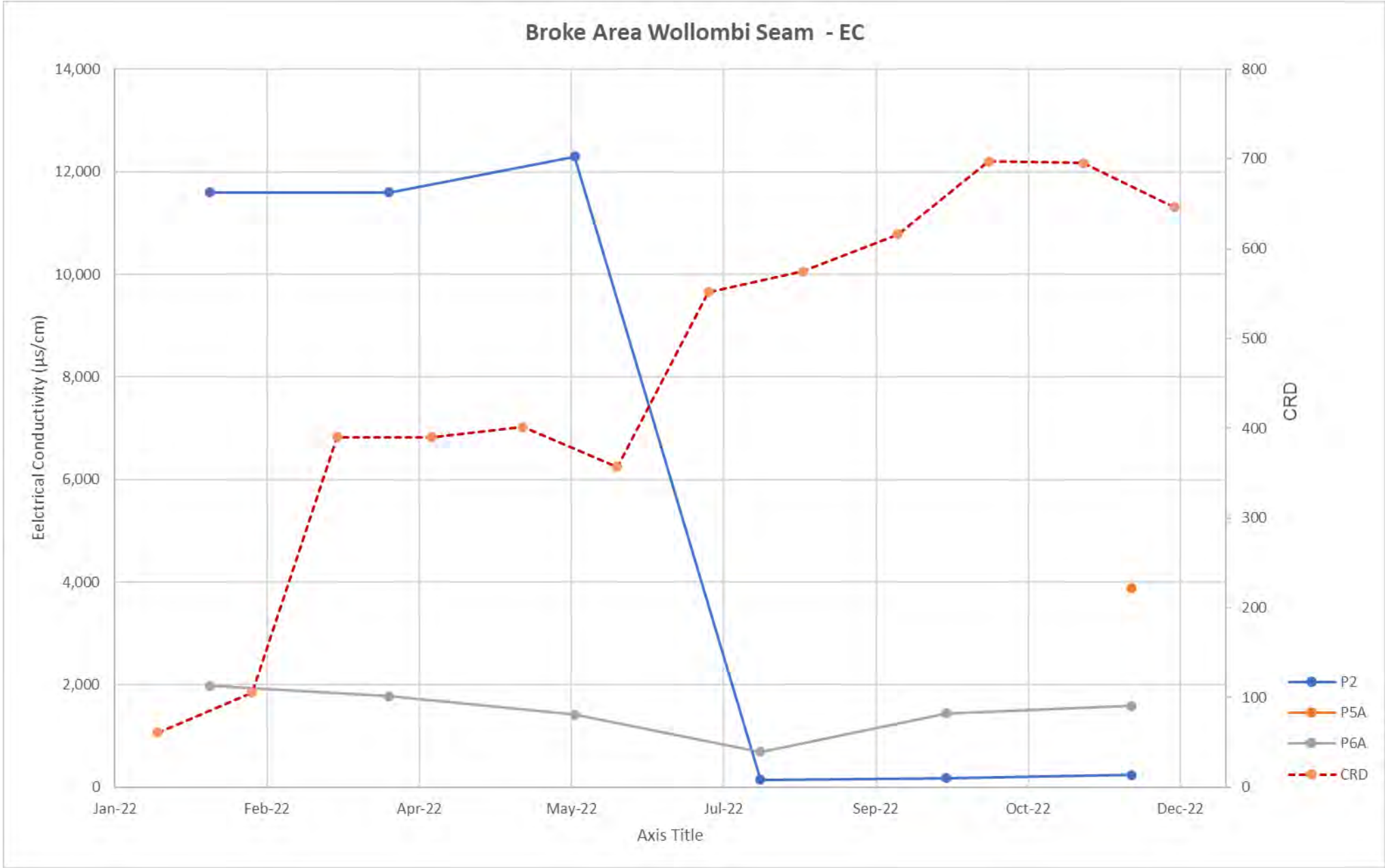


Appendix B. Groundwater and Surface water quality plots

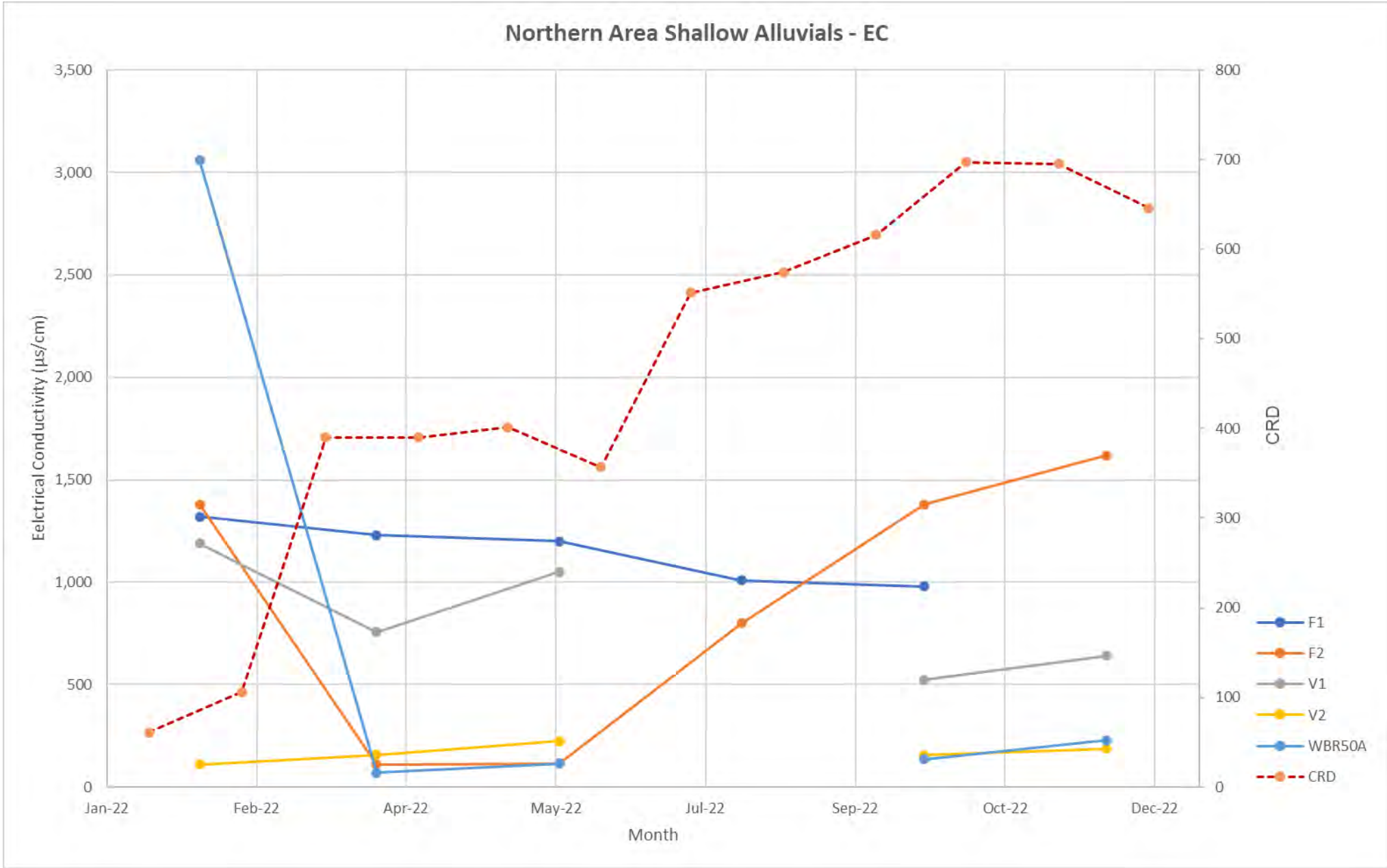
Appendix B - Groundwater Quality Figures



Appendix B - Groundwater Quality Figures



Appendix B - Groundwater Quality Figures



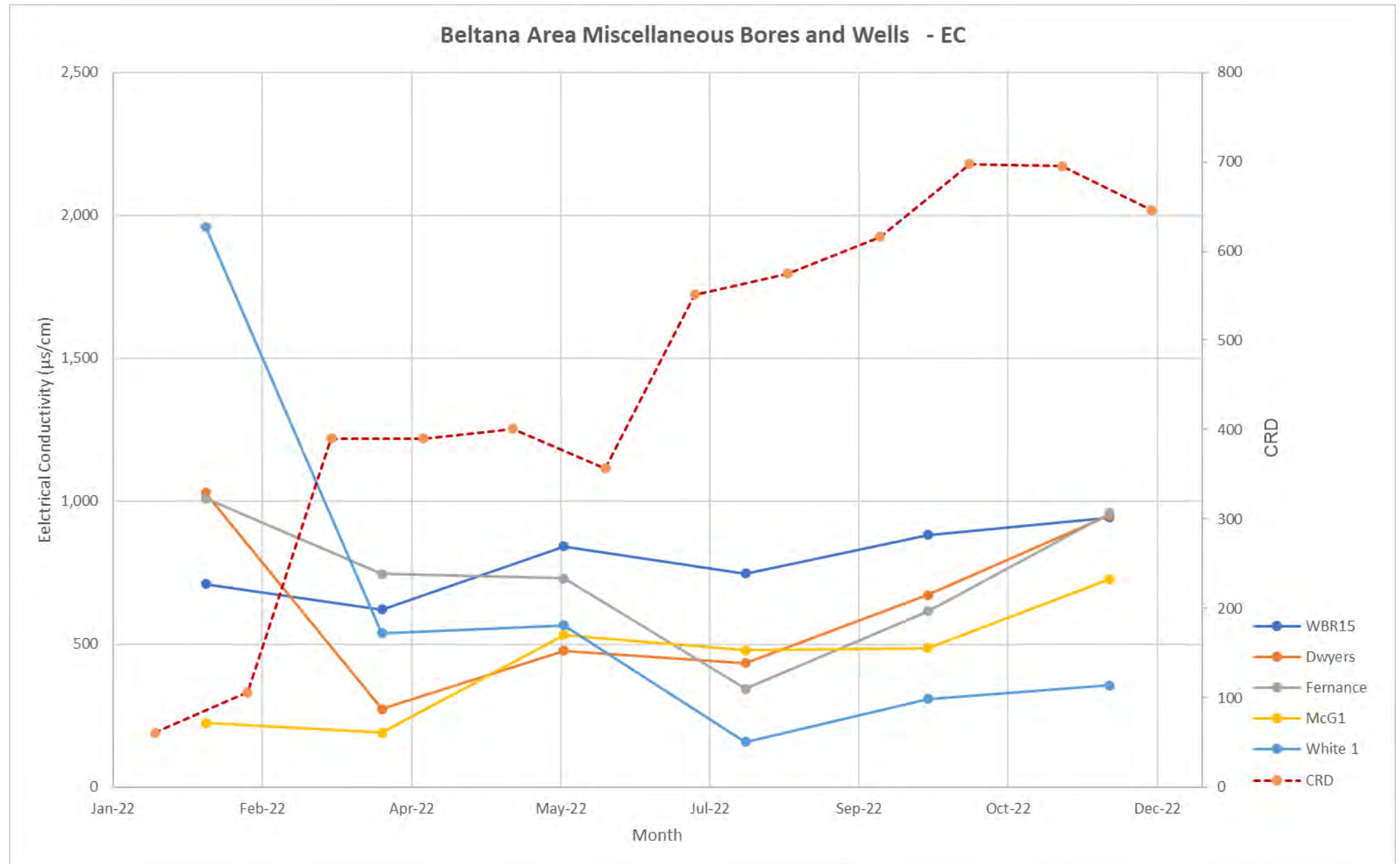
Appendix B - Groundwater Quality Figures



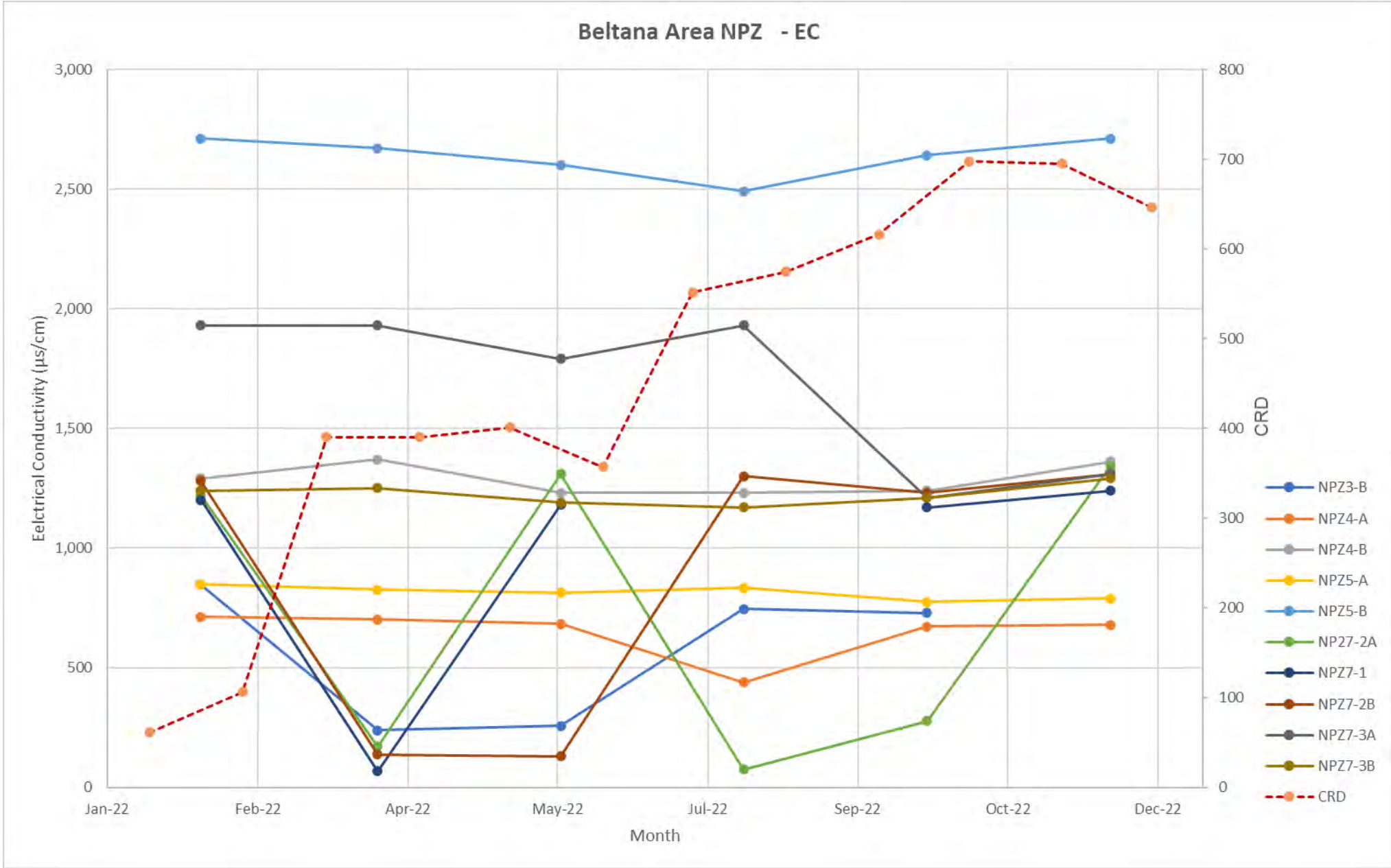
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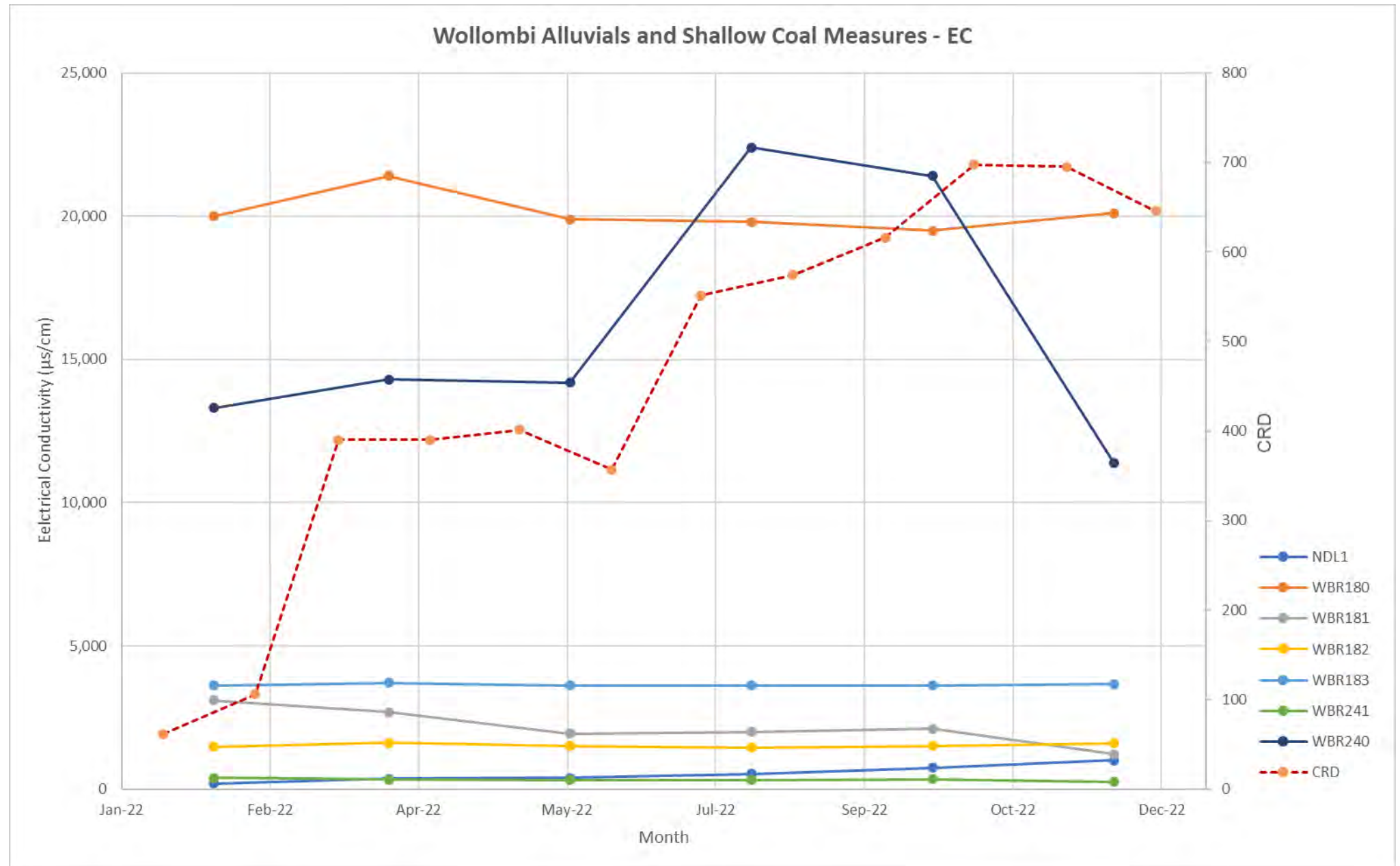
Appendix B - Groundwater Quality Figures



Appendix B - Groundwater Quality Figures

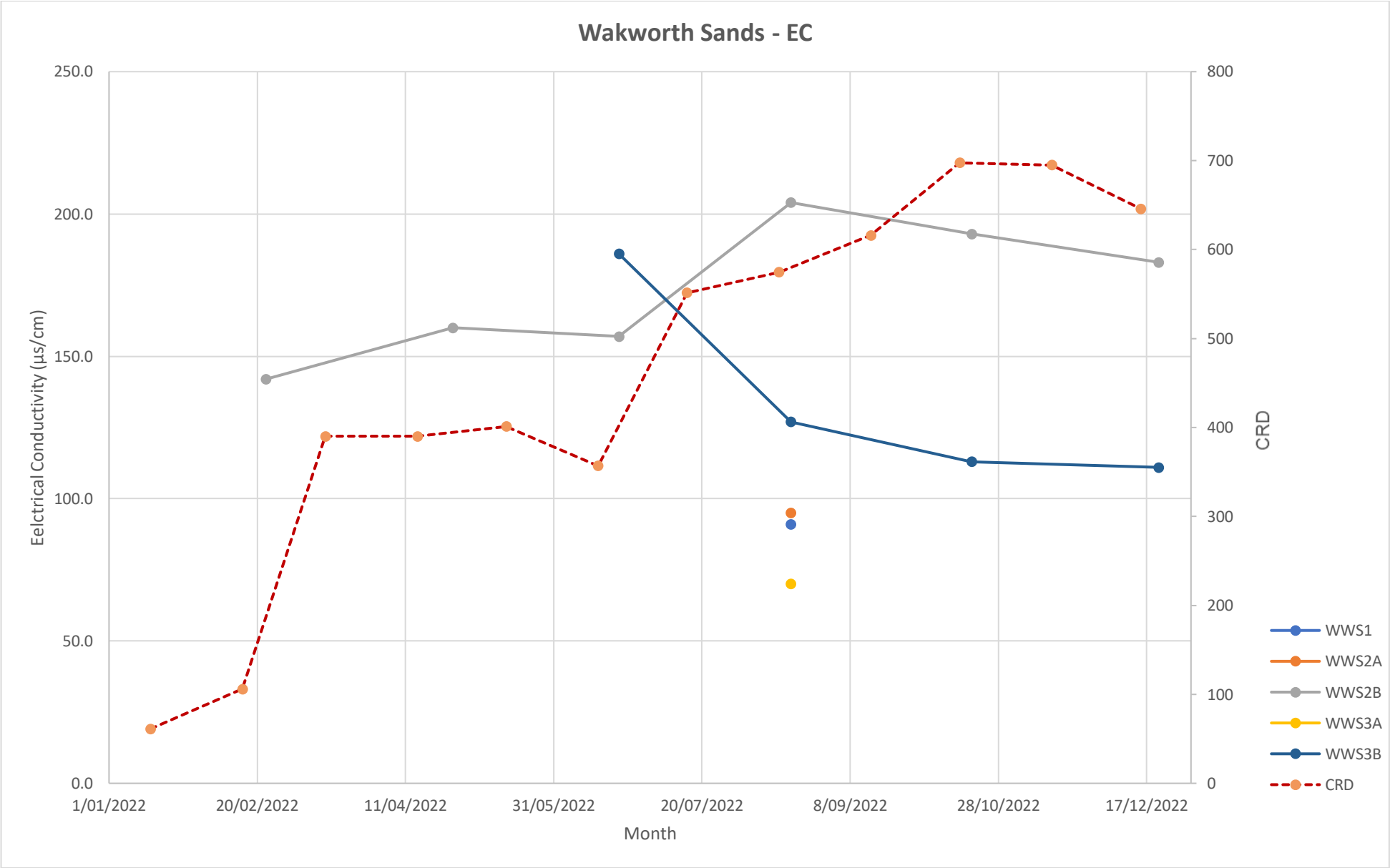


Appendix B - Groundwater Quality Figures

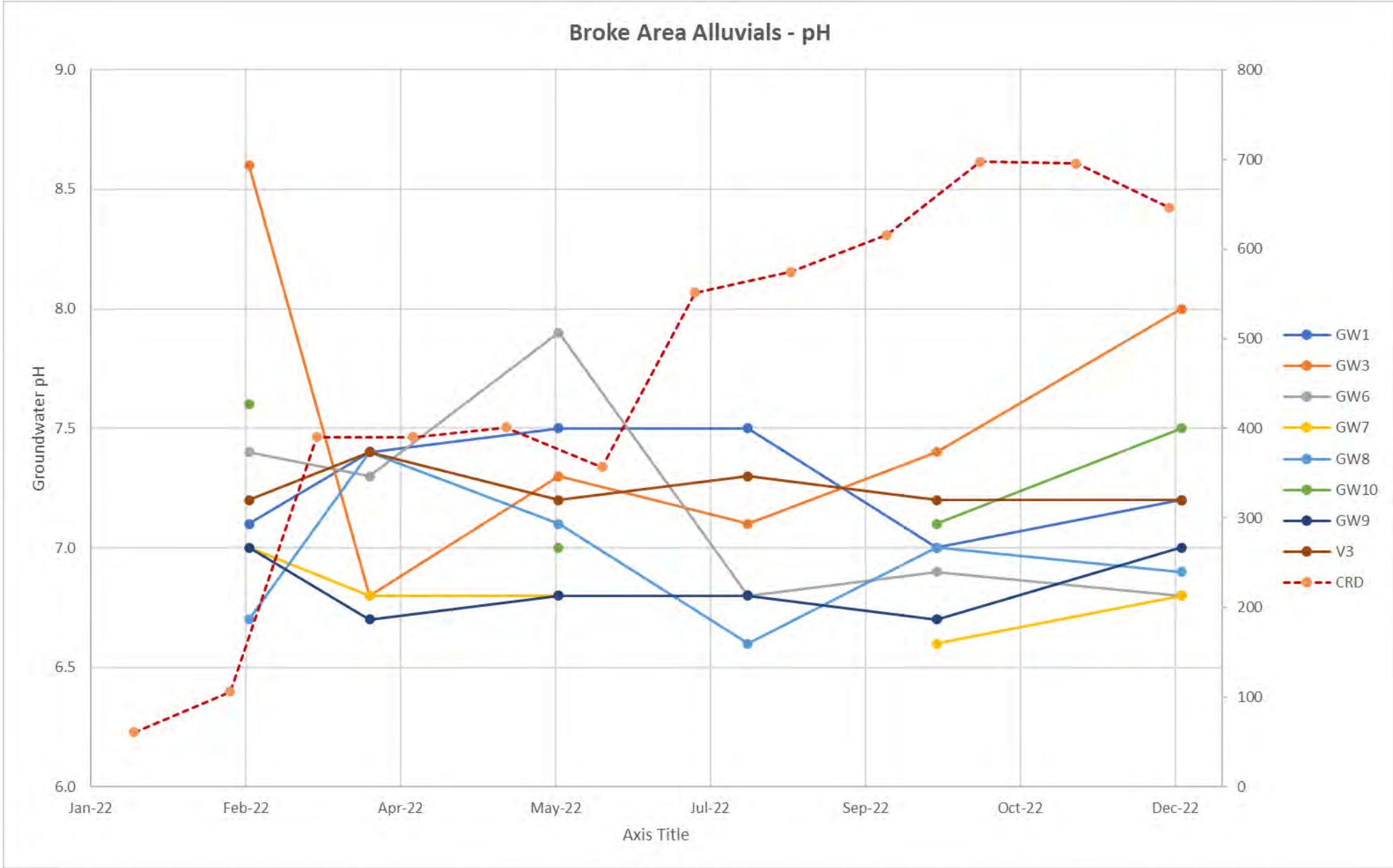


Appendix B - Groundwater Quality Figures

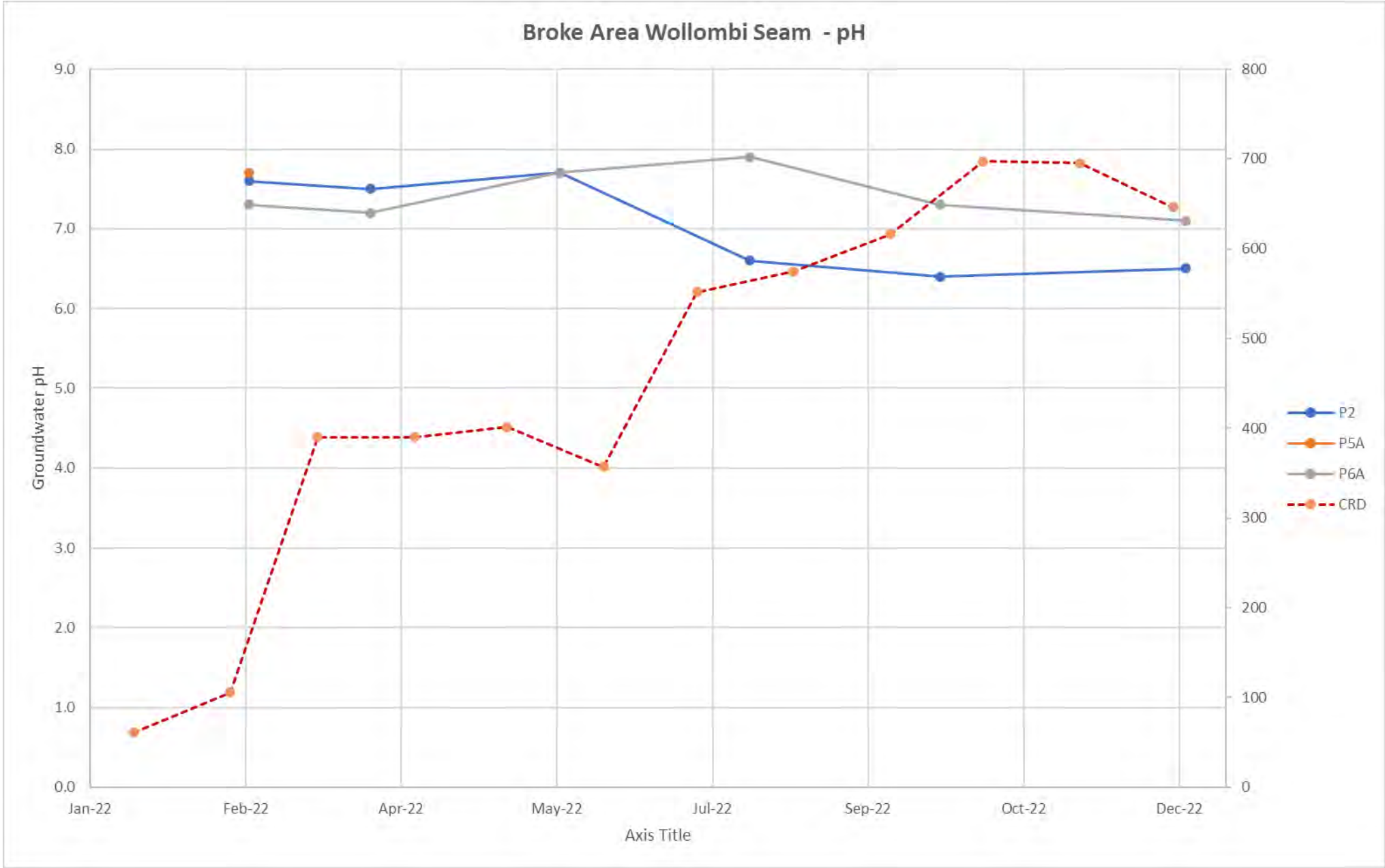




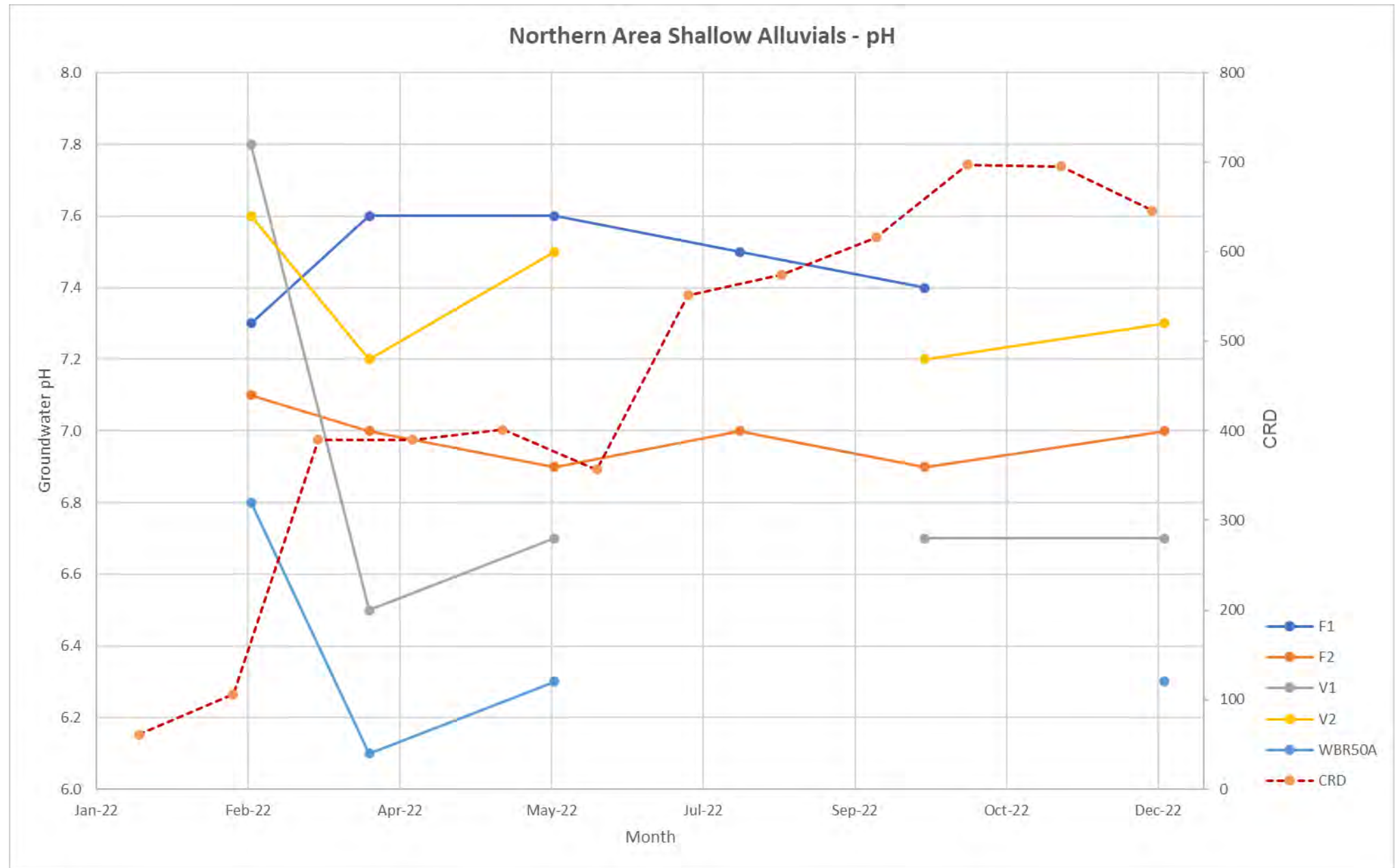
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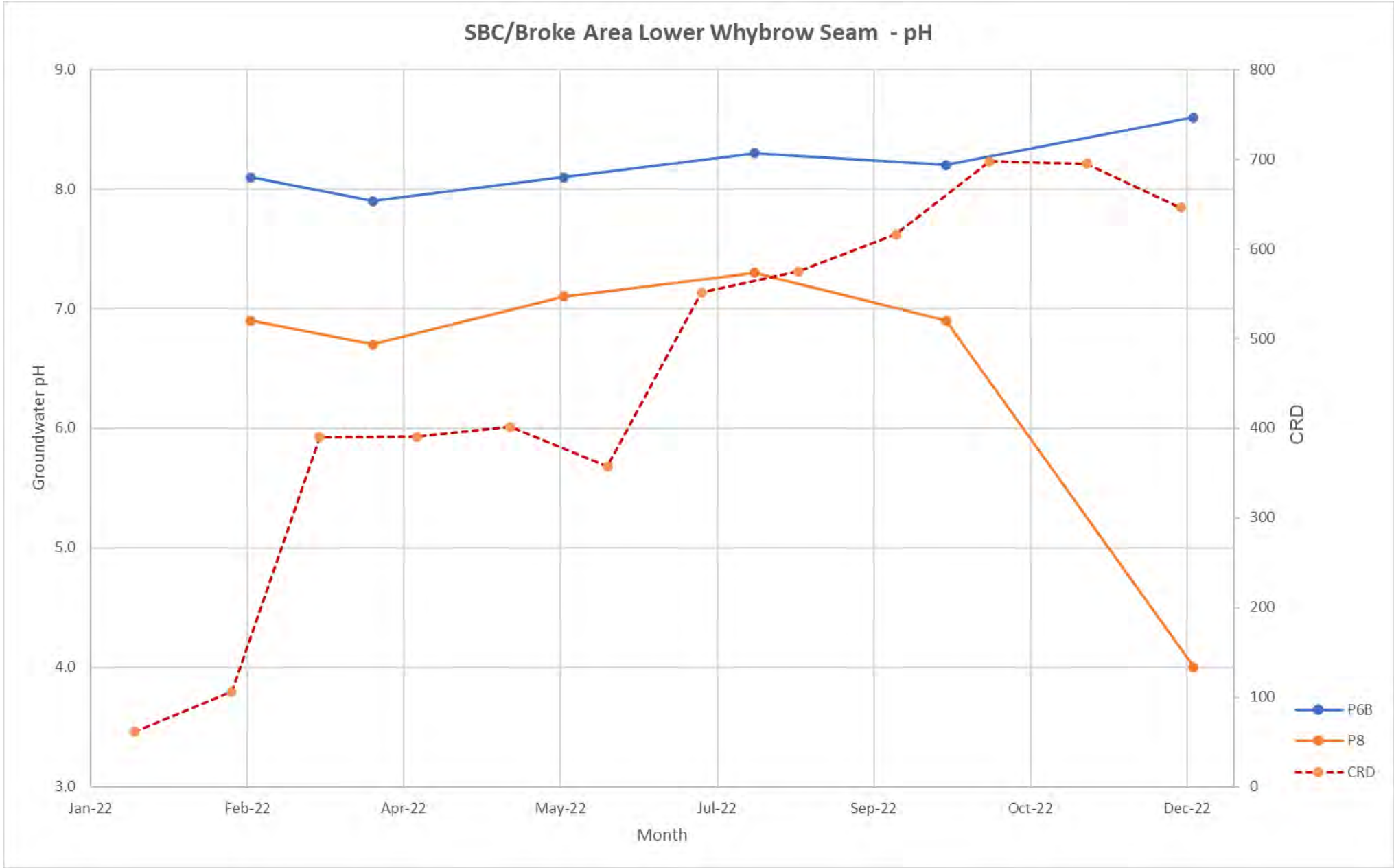
Appendix B - Groundwater Quality Figures



Appendix B - Groundwater Quality Figures



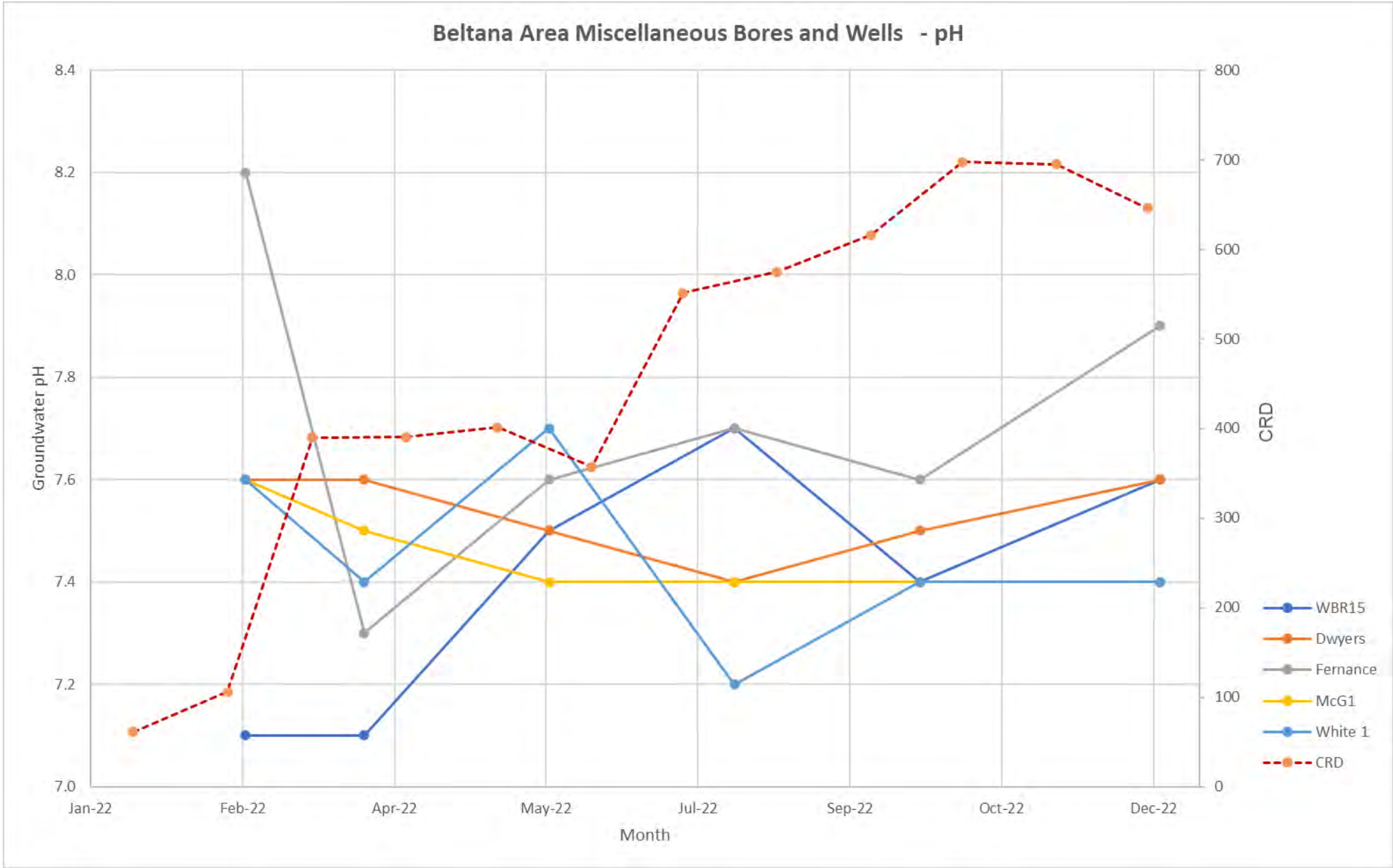
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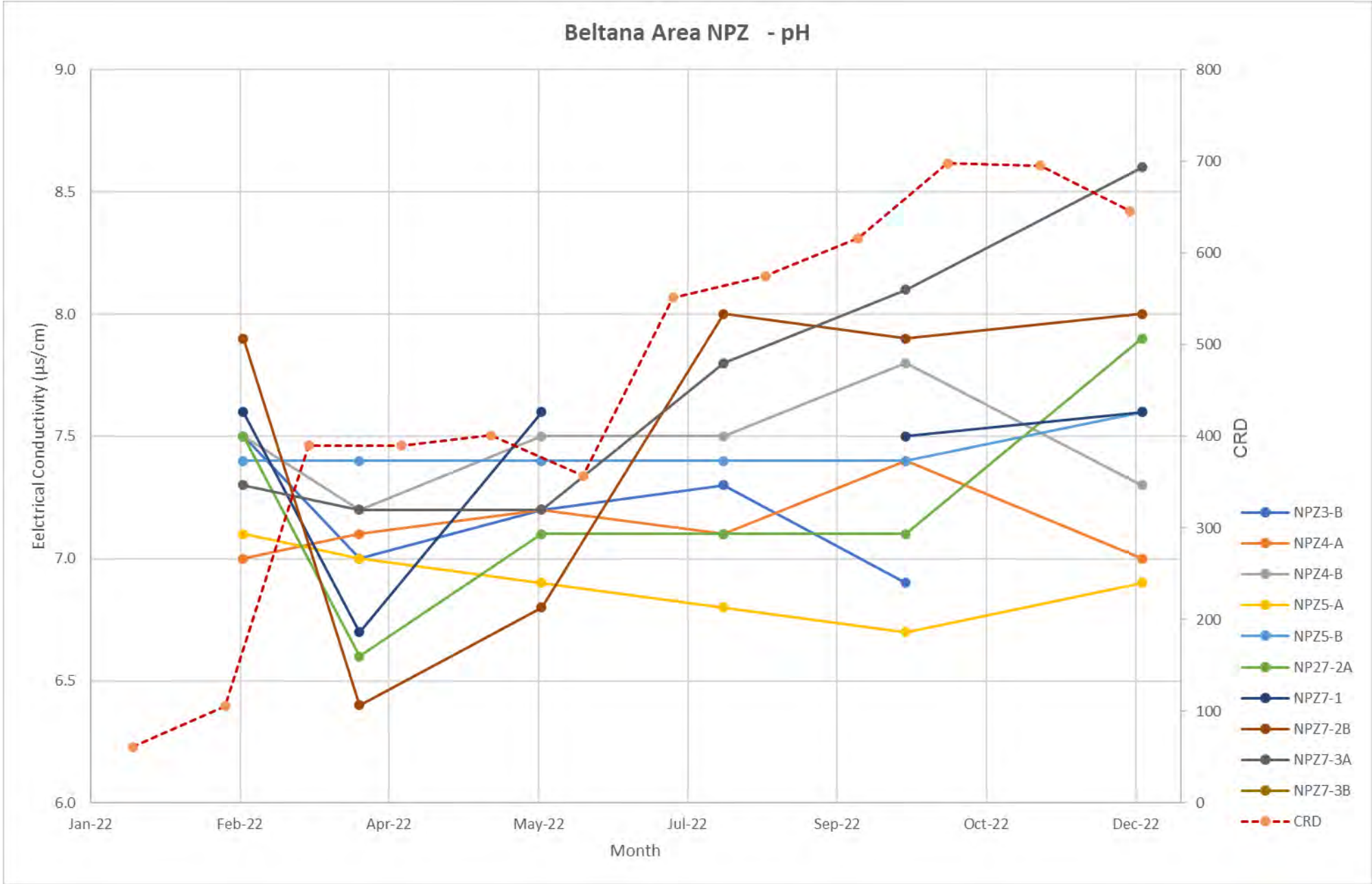
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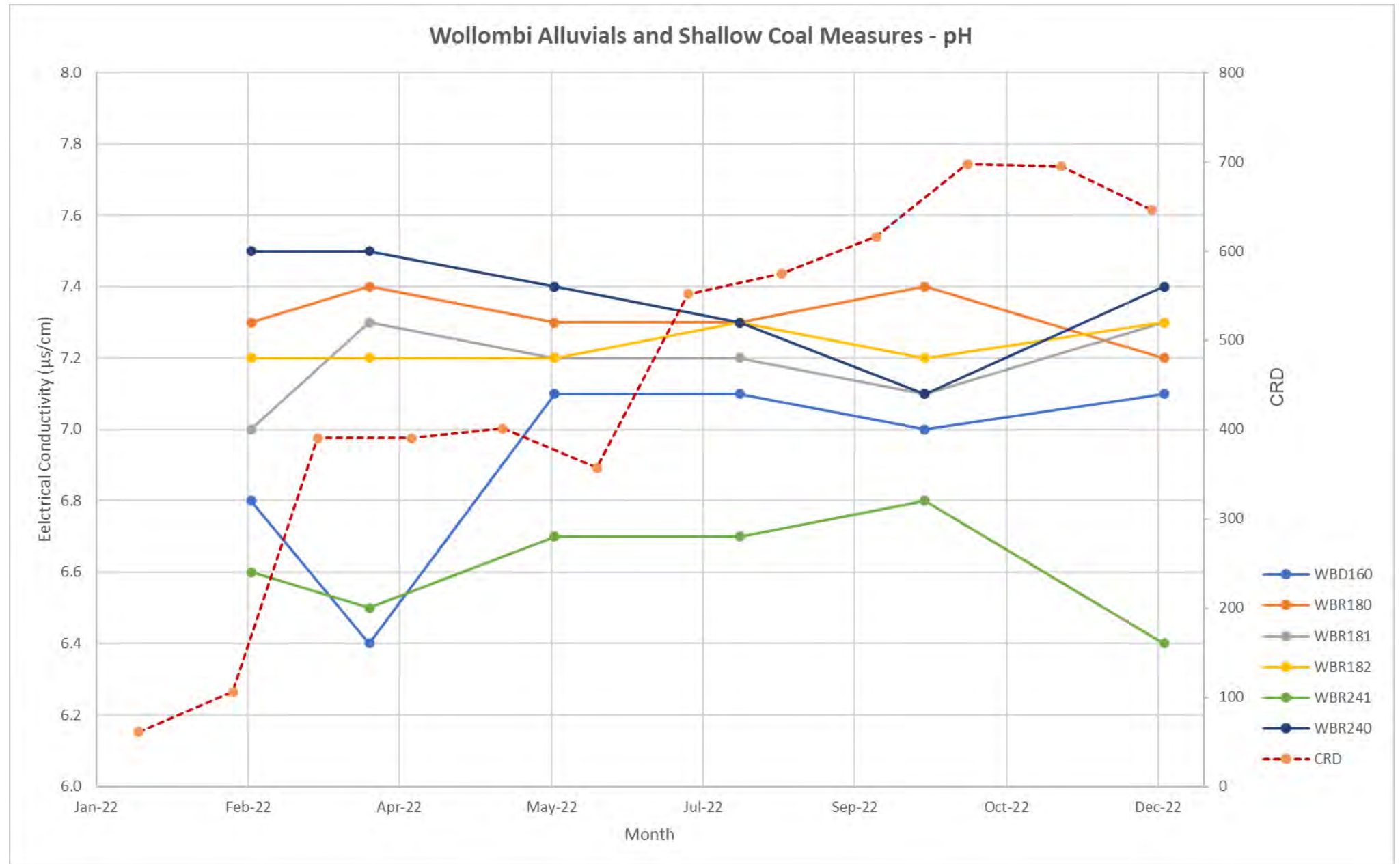
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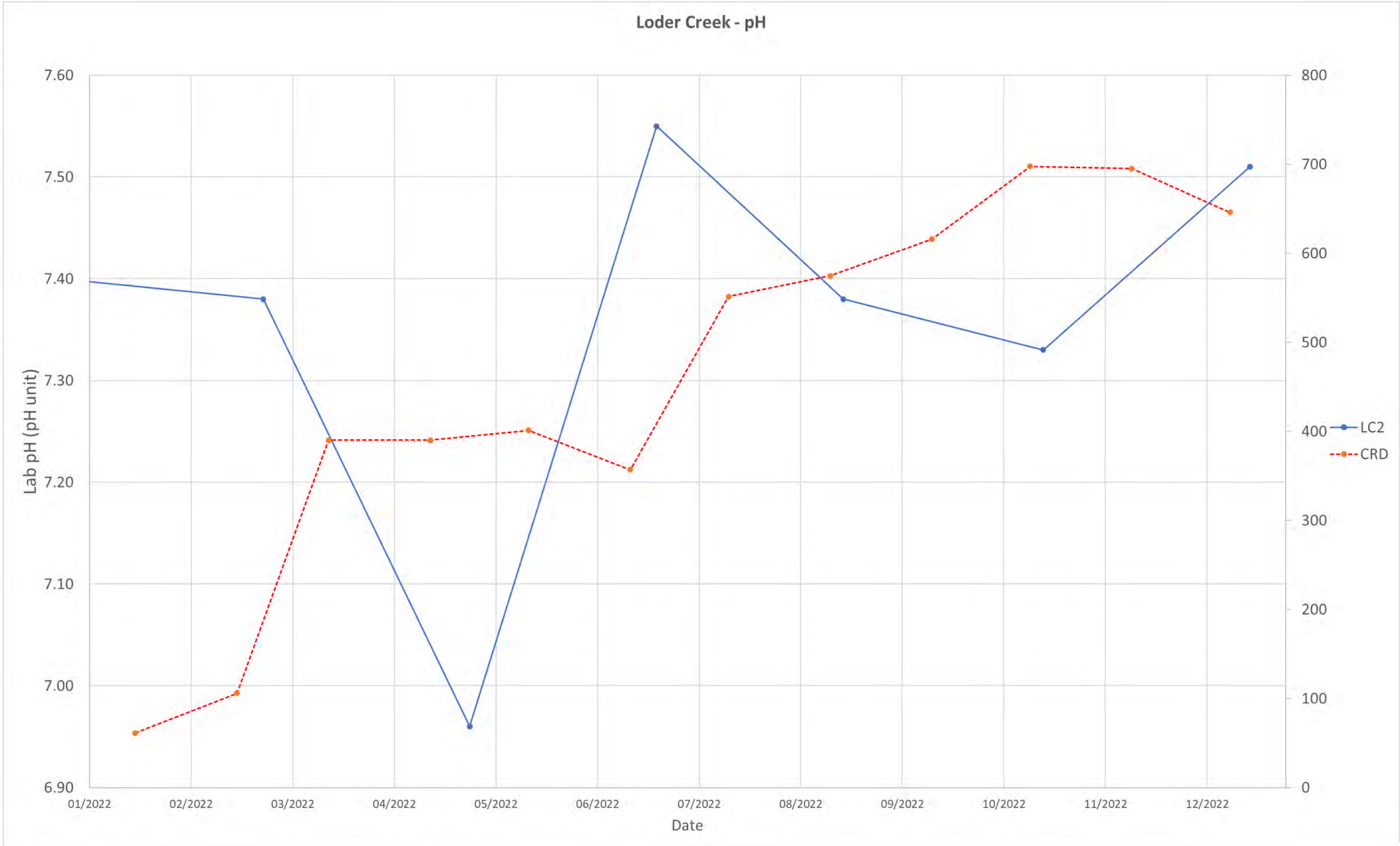
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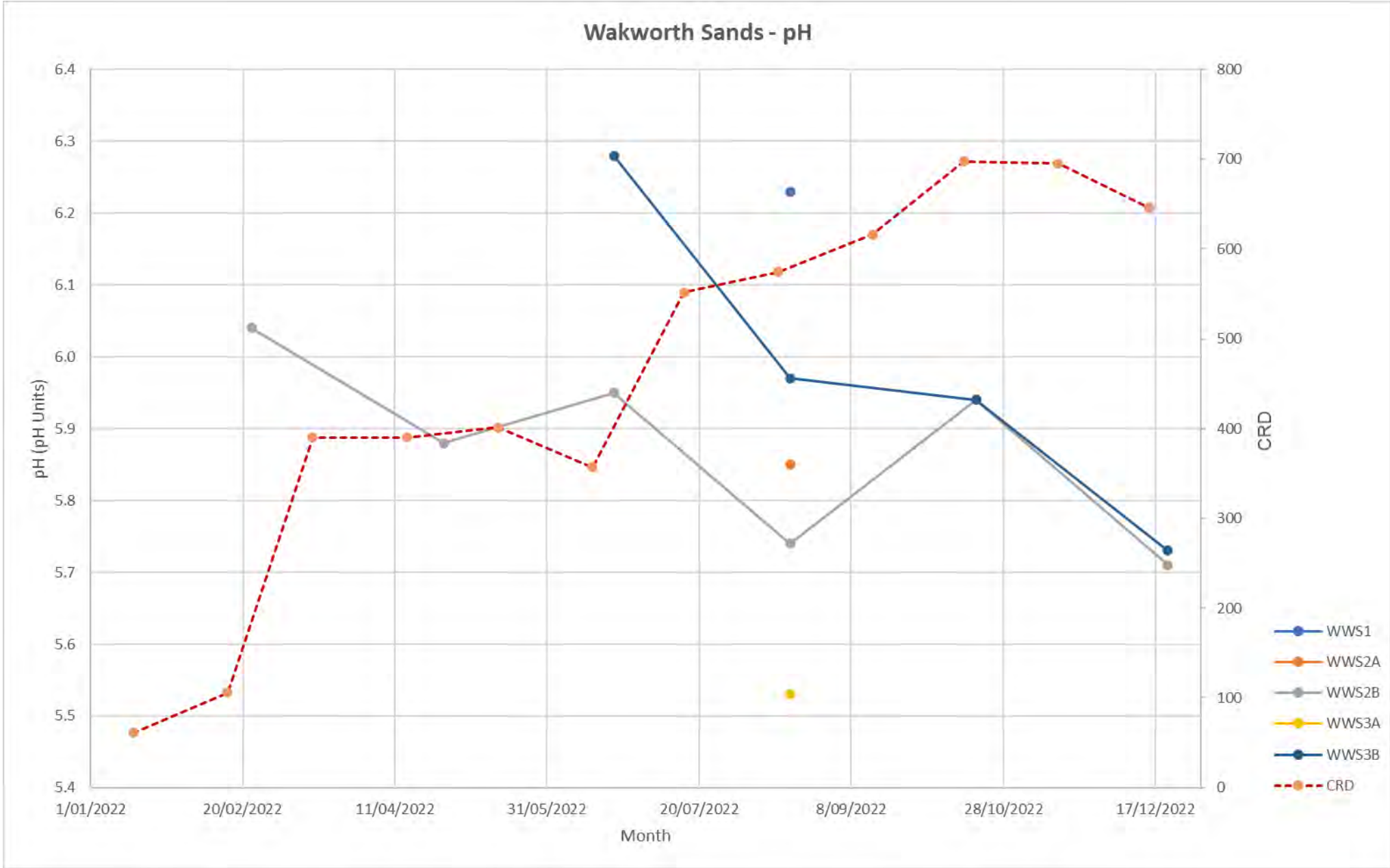
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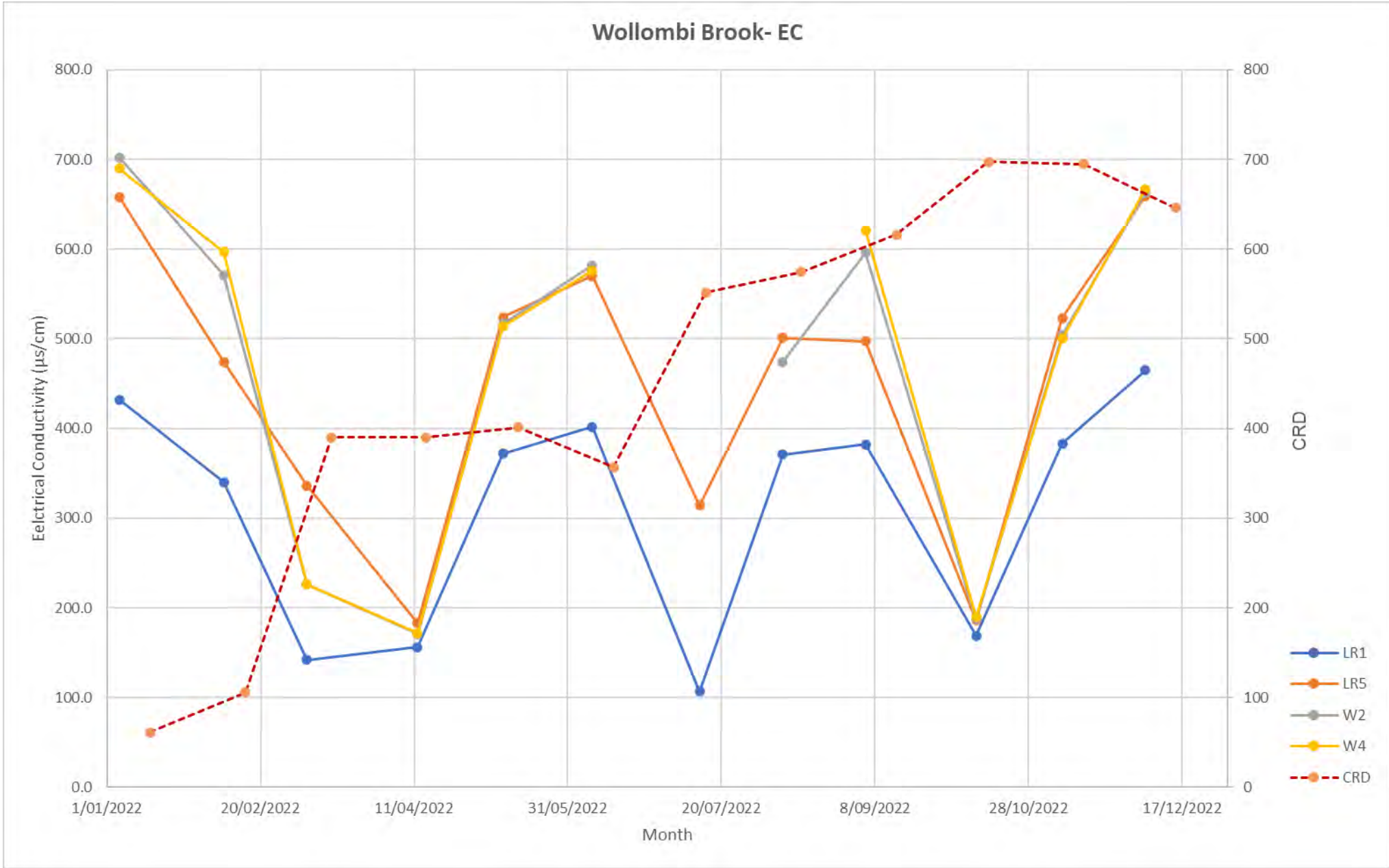
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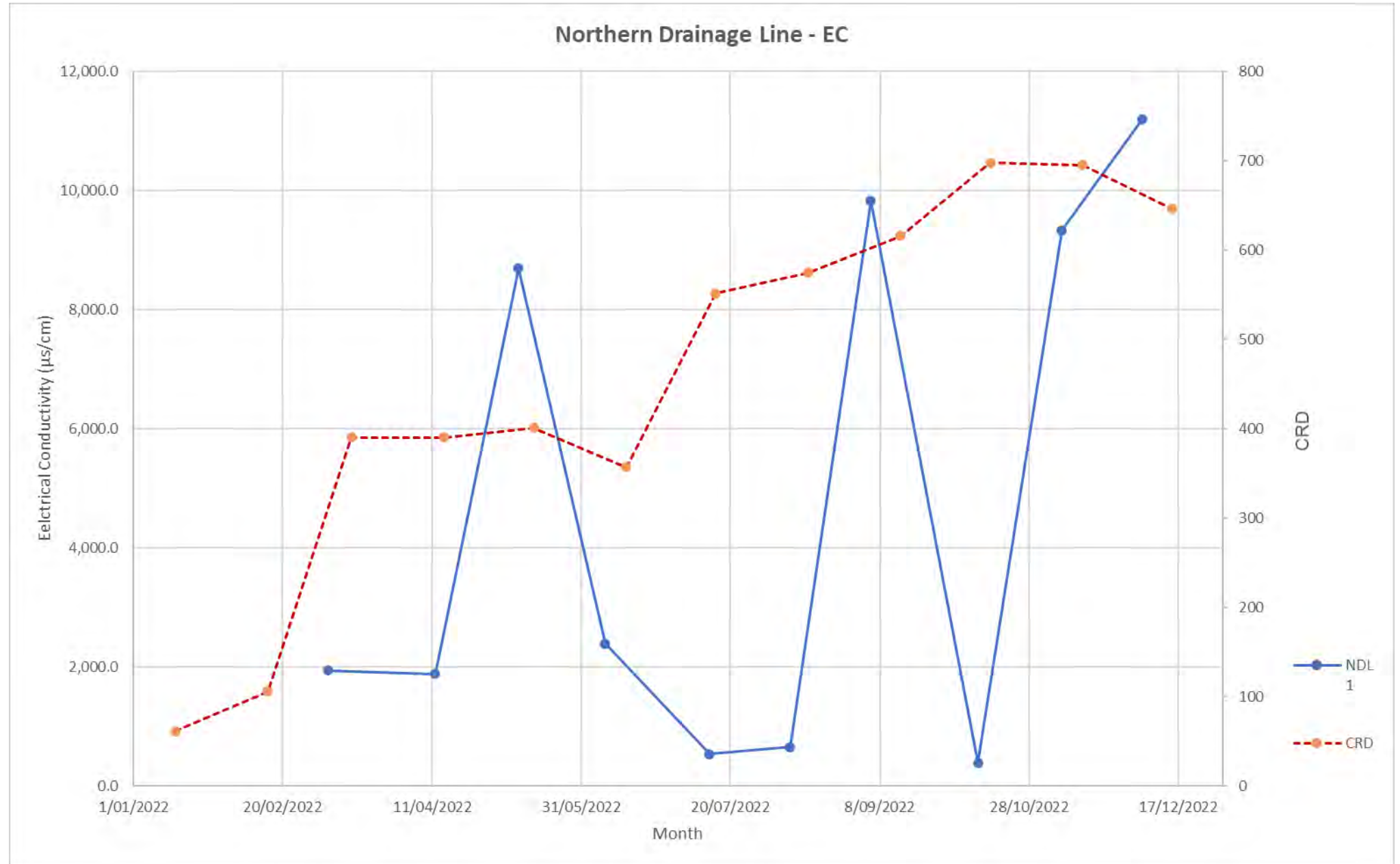
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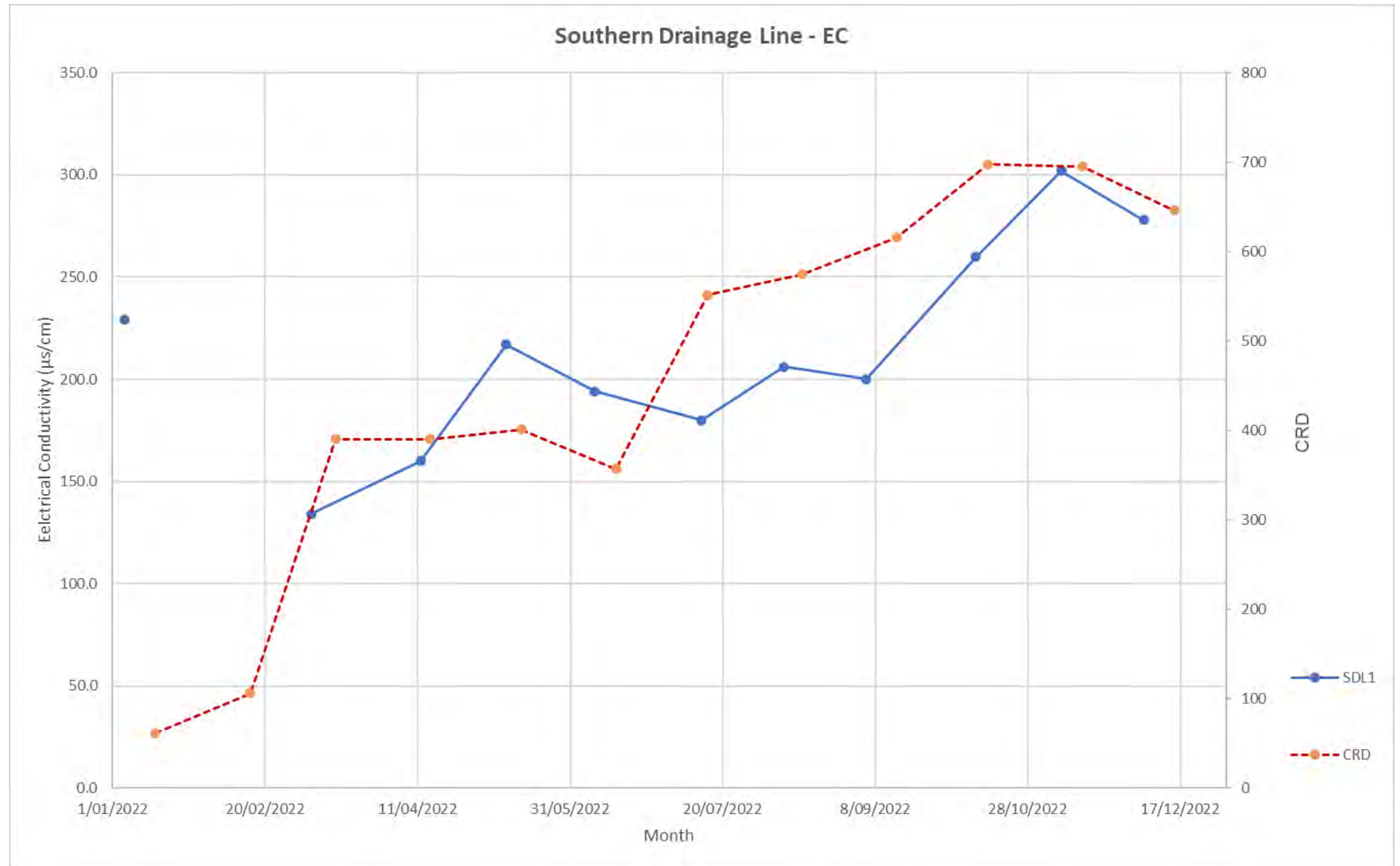
Appendix B – Surface Water Quality Figures



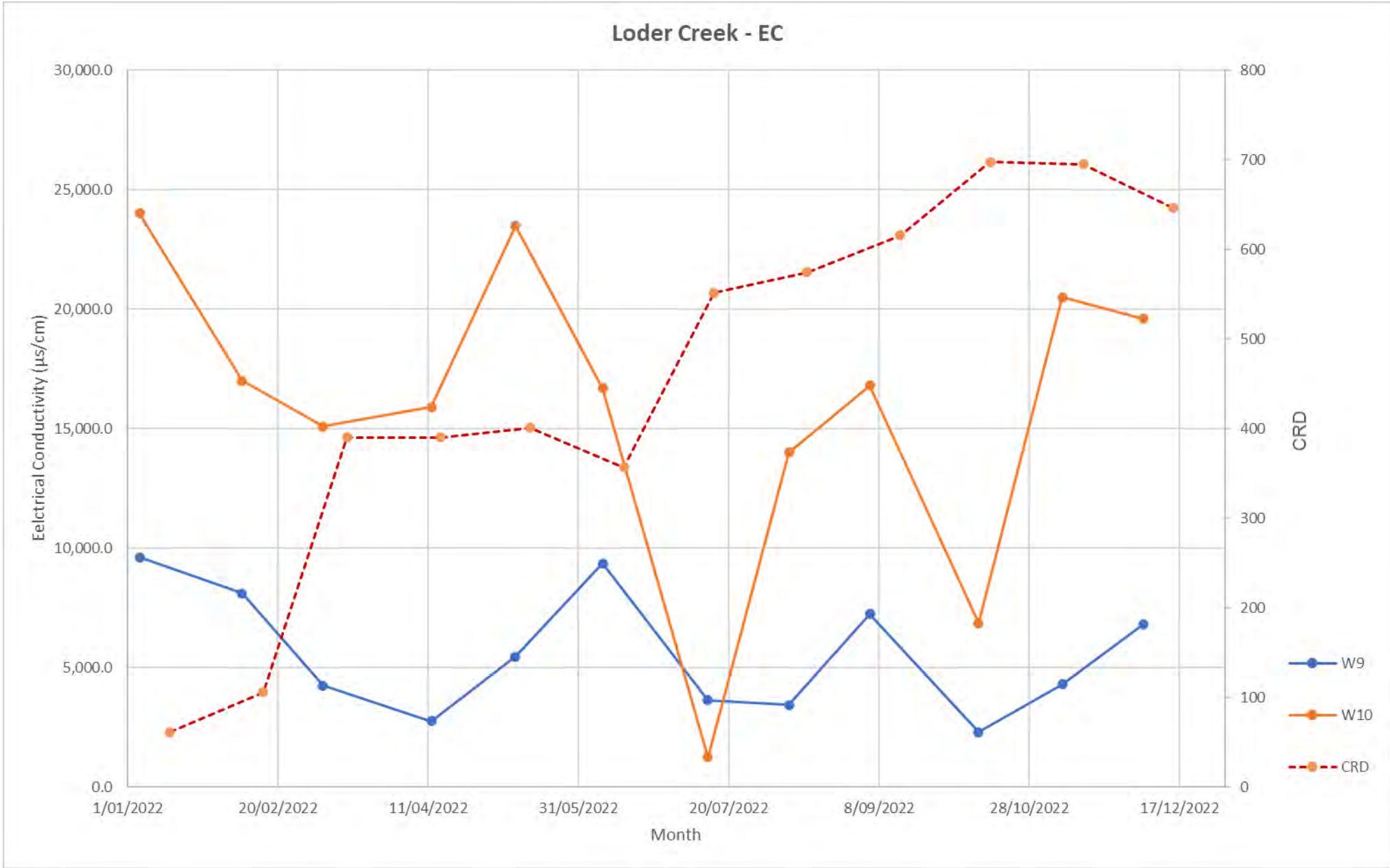
Appendix B – Surface Water Quality Figures



Appendix B – Surface Water Quality Figures



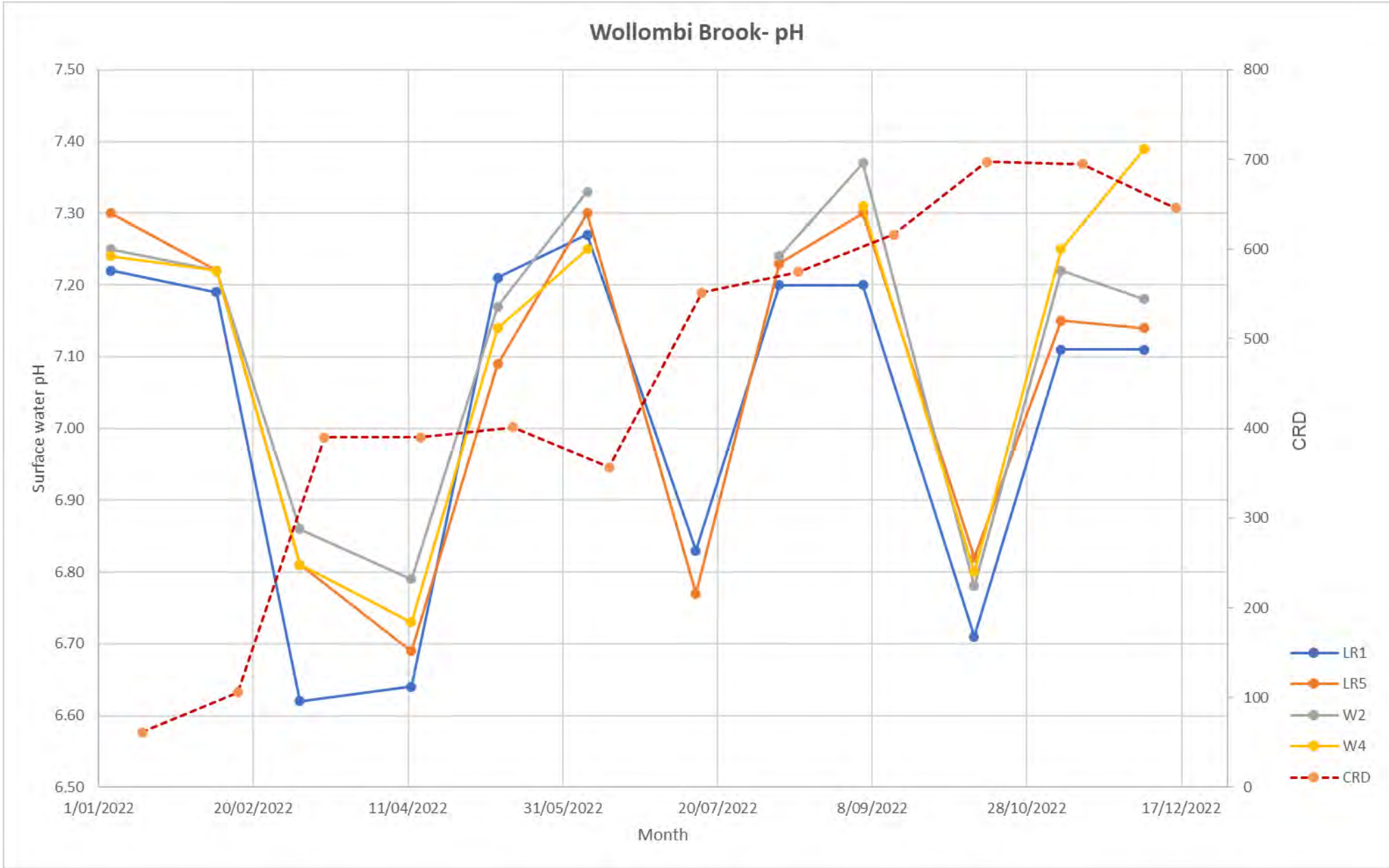
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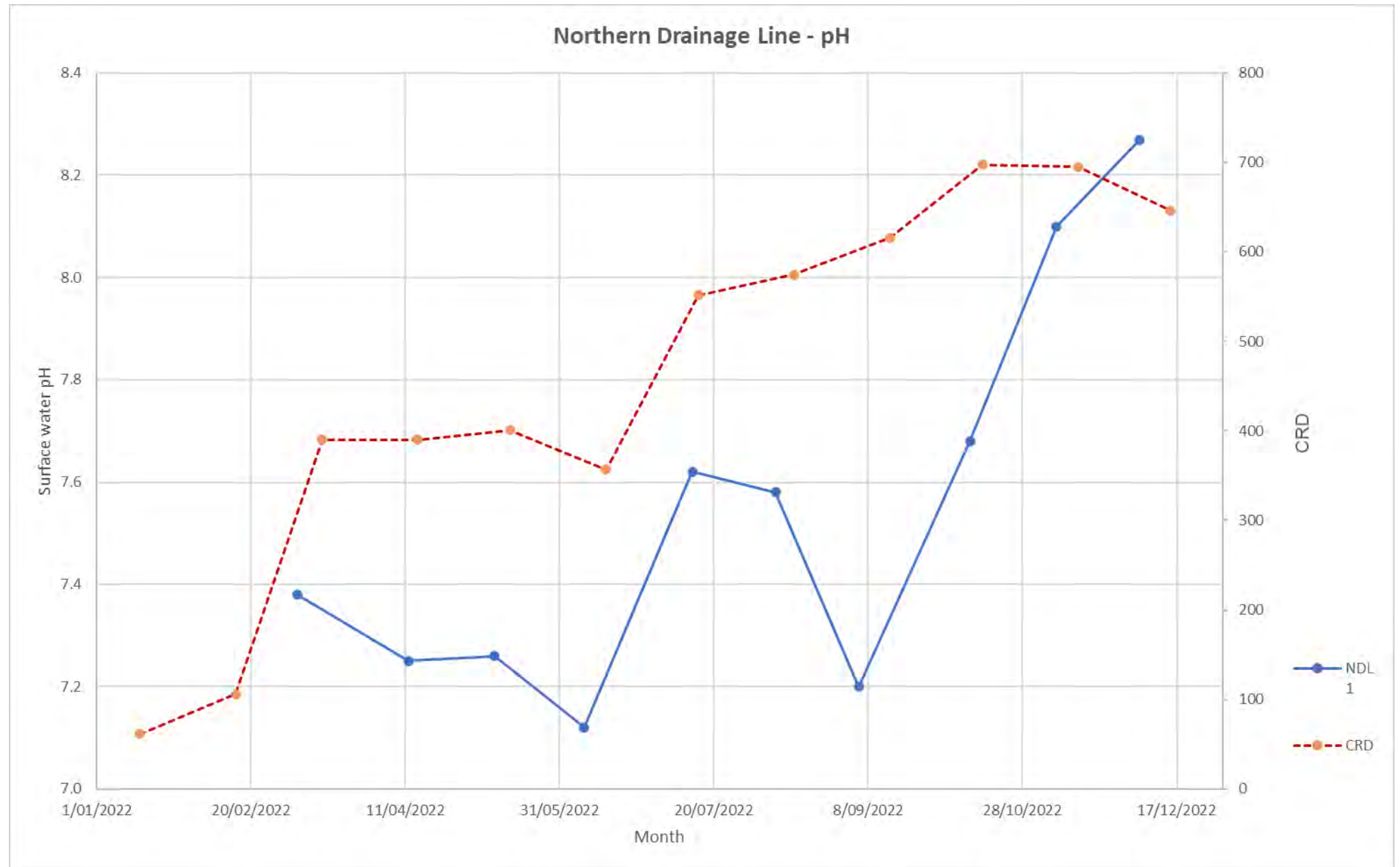
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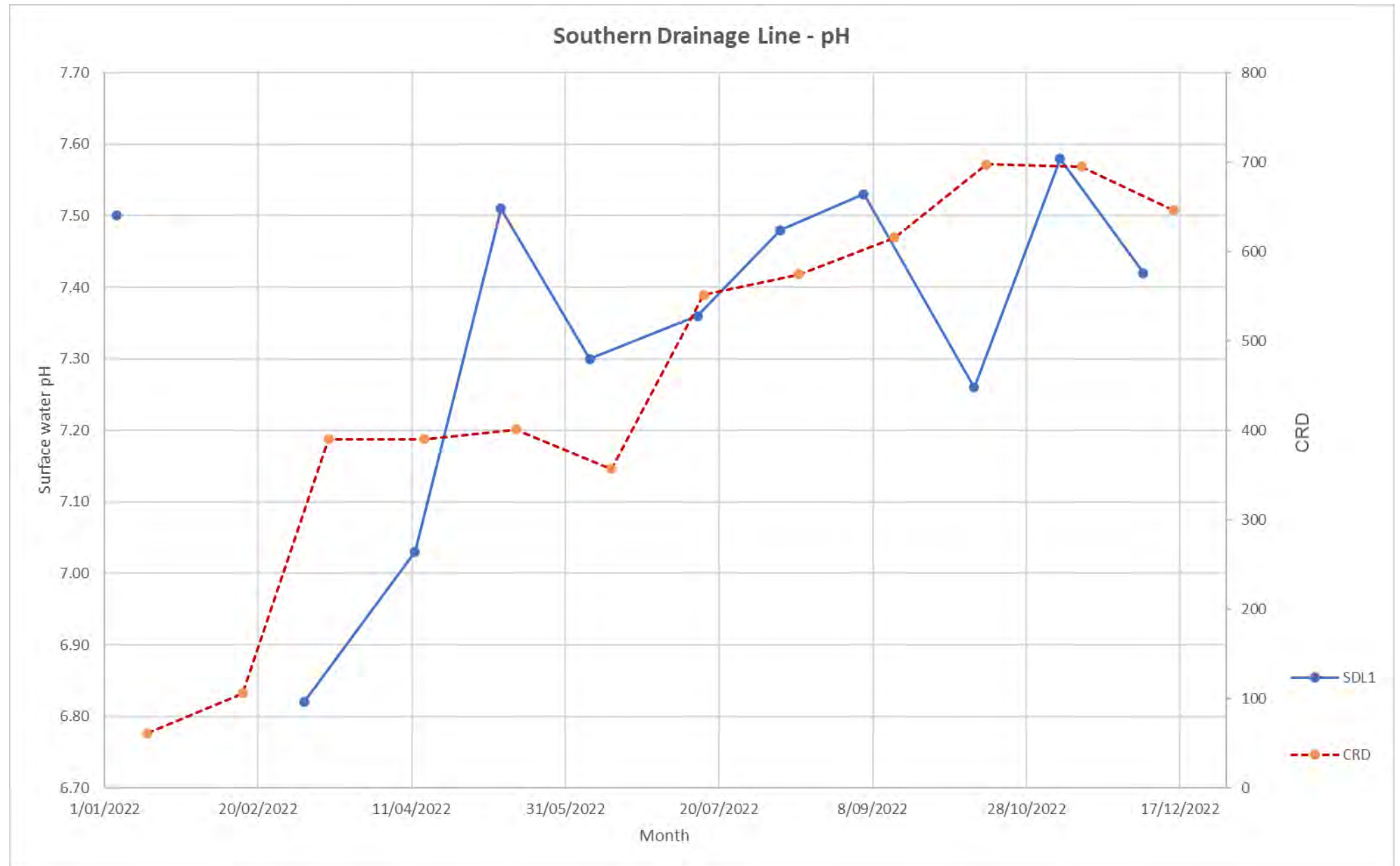
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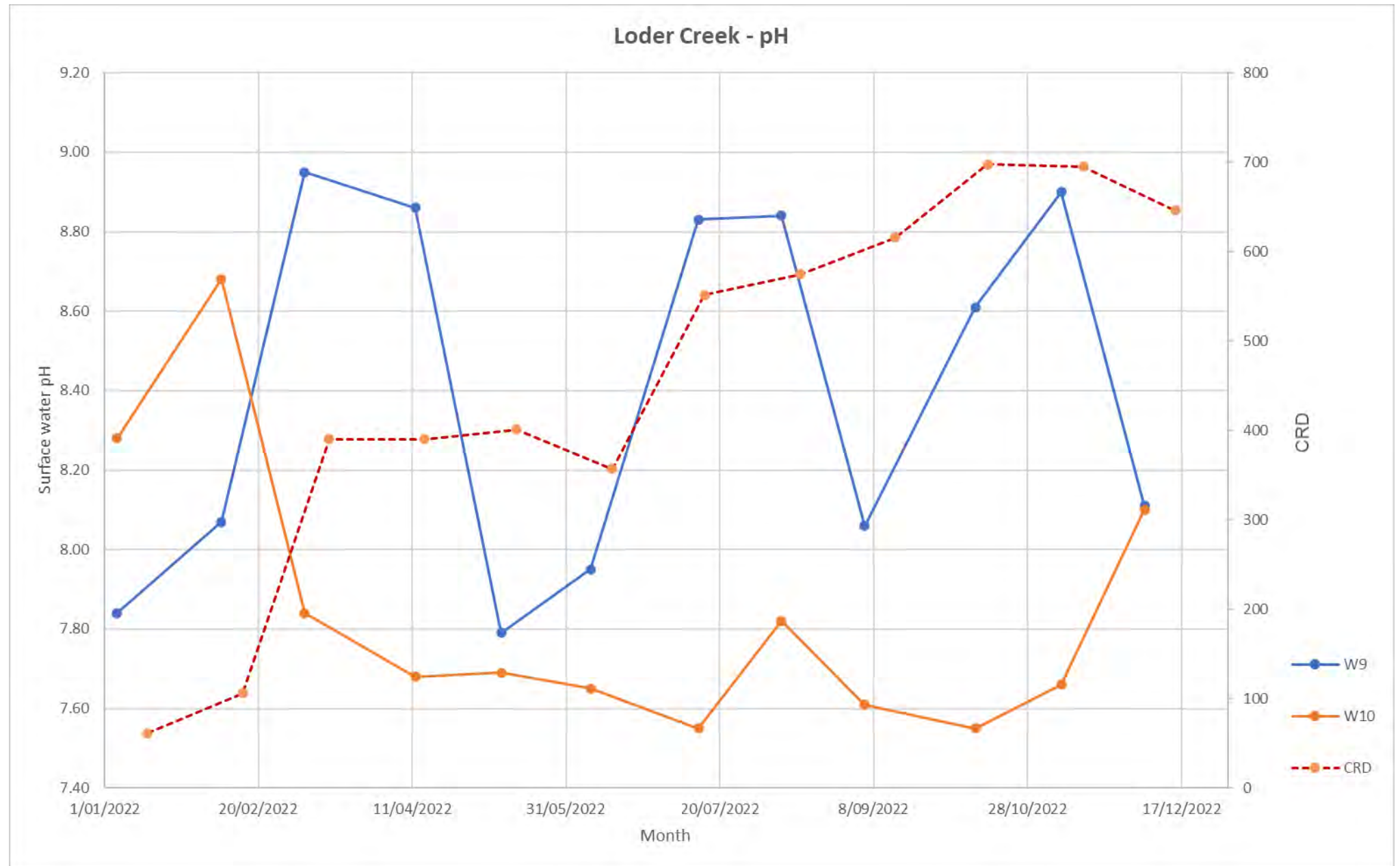
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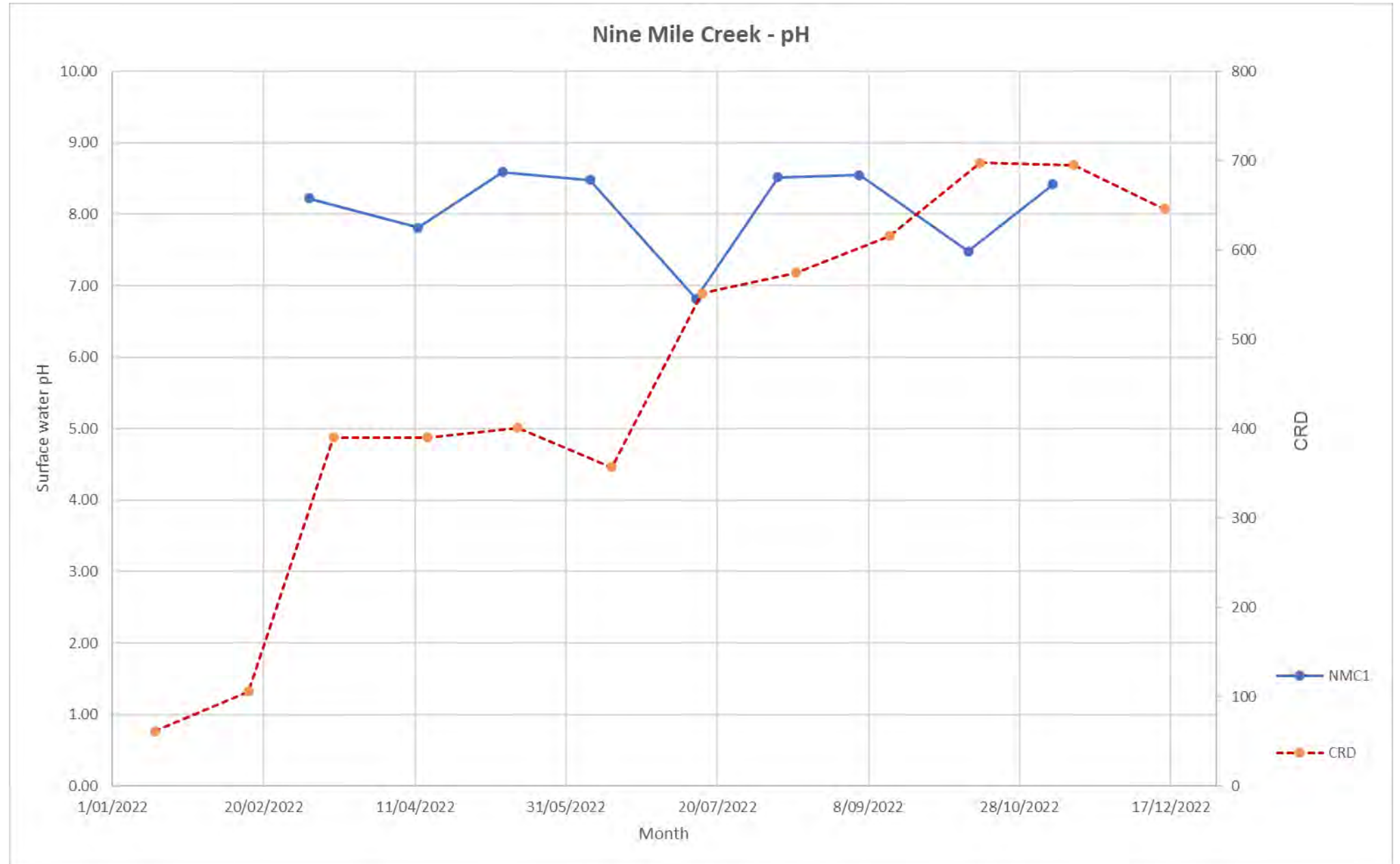
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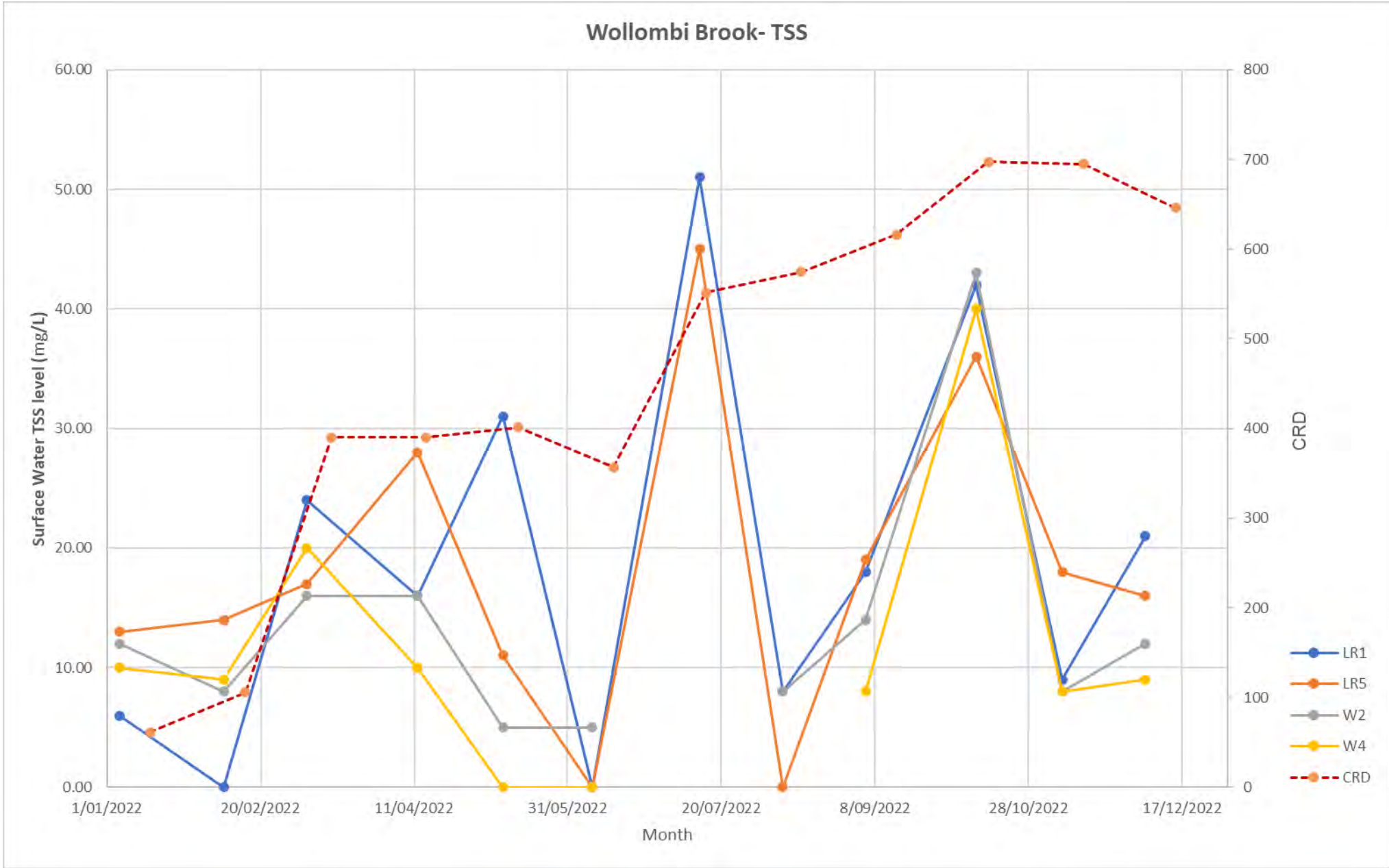
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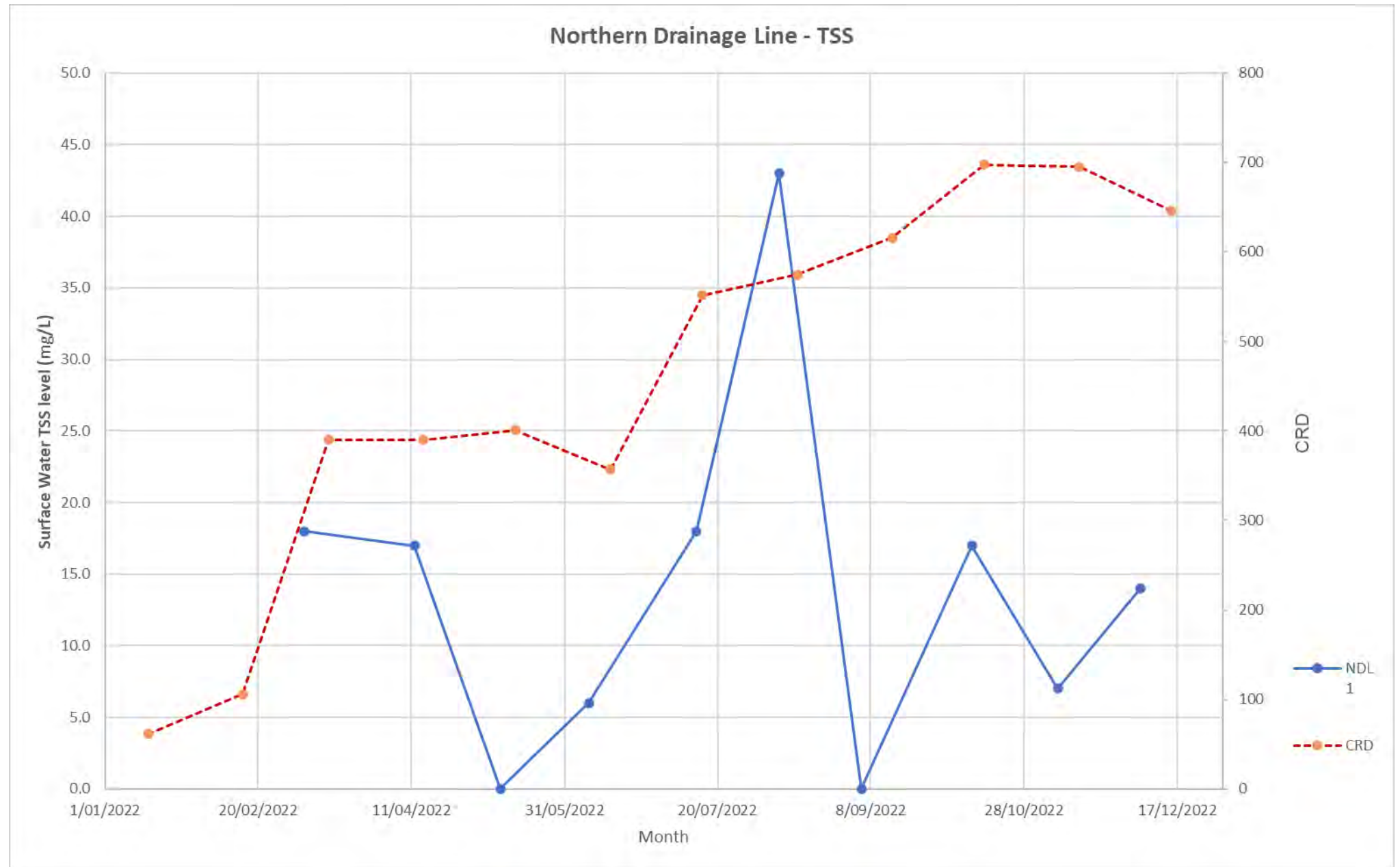
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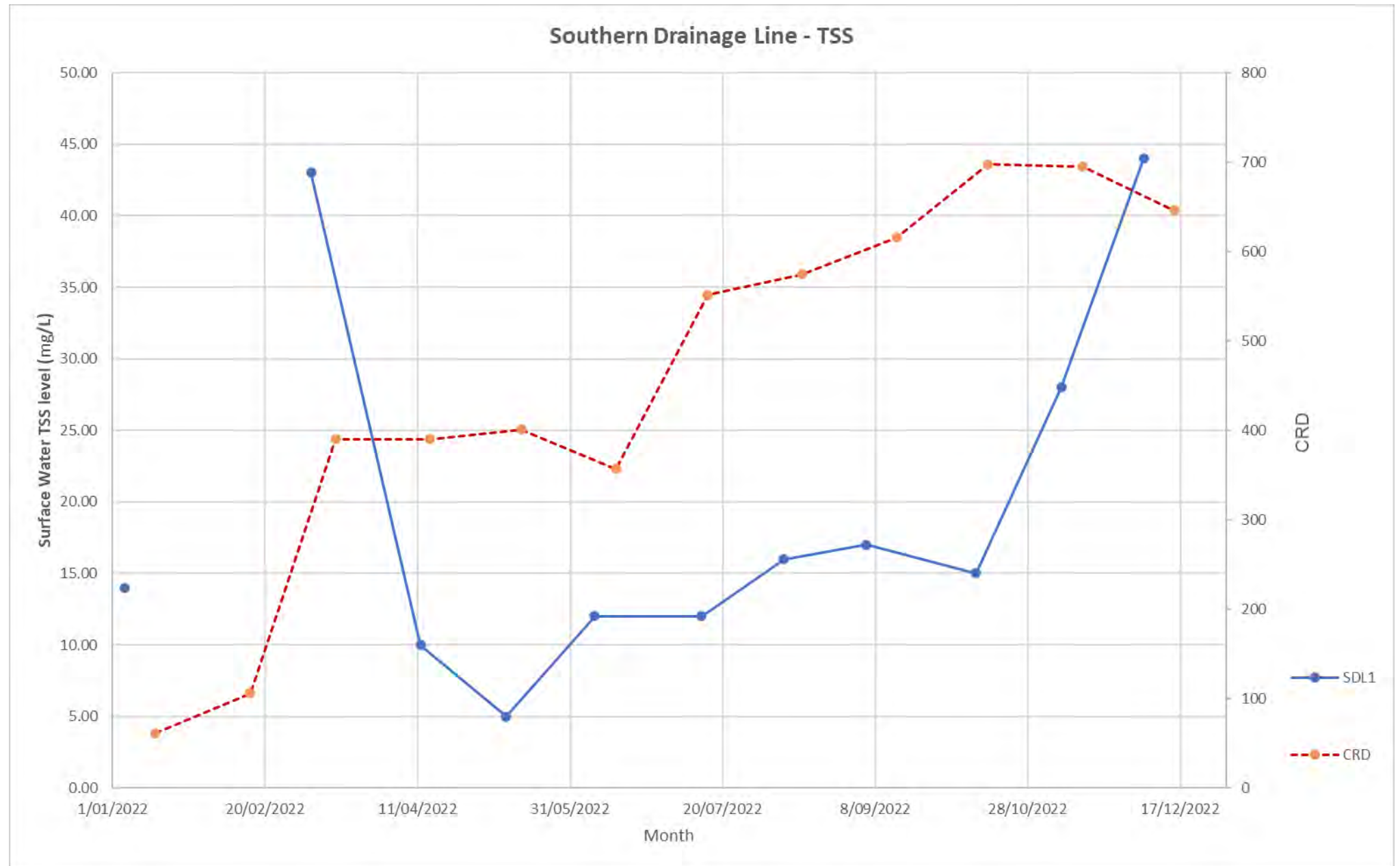
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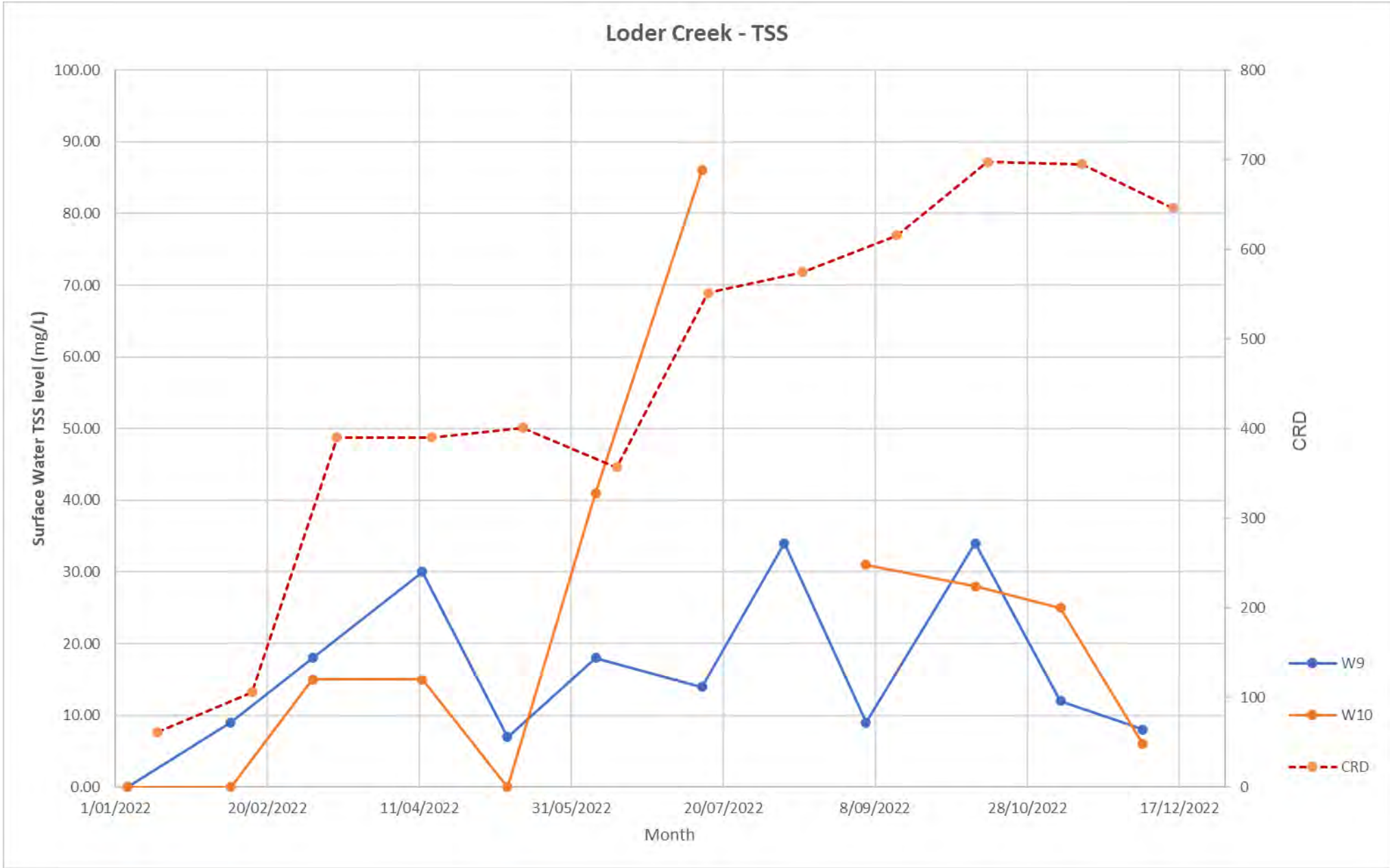
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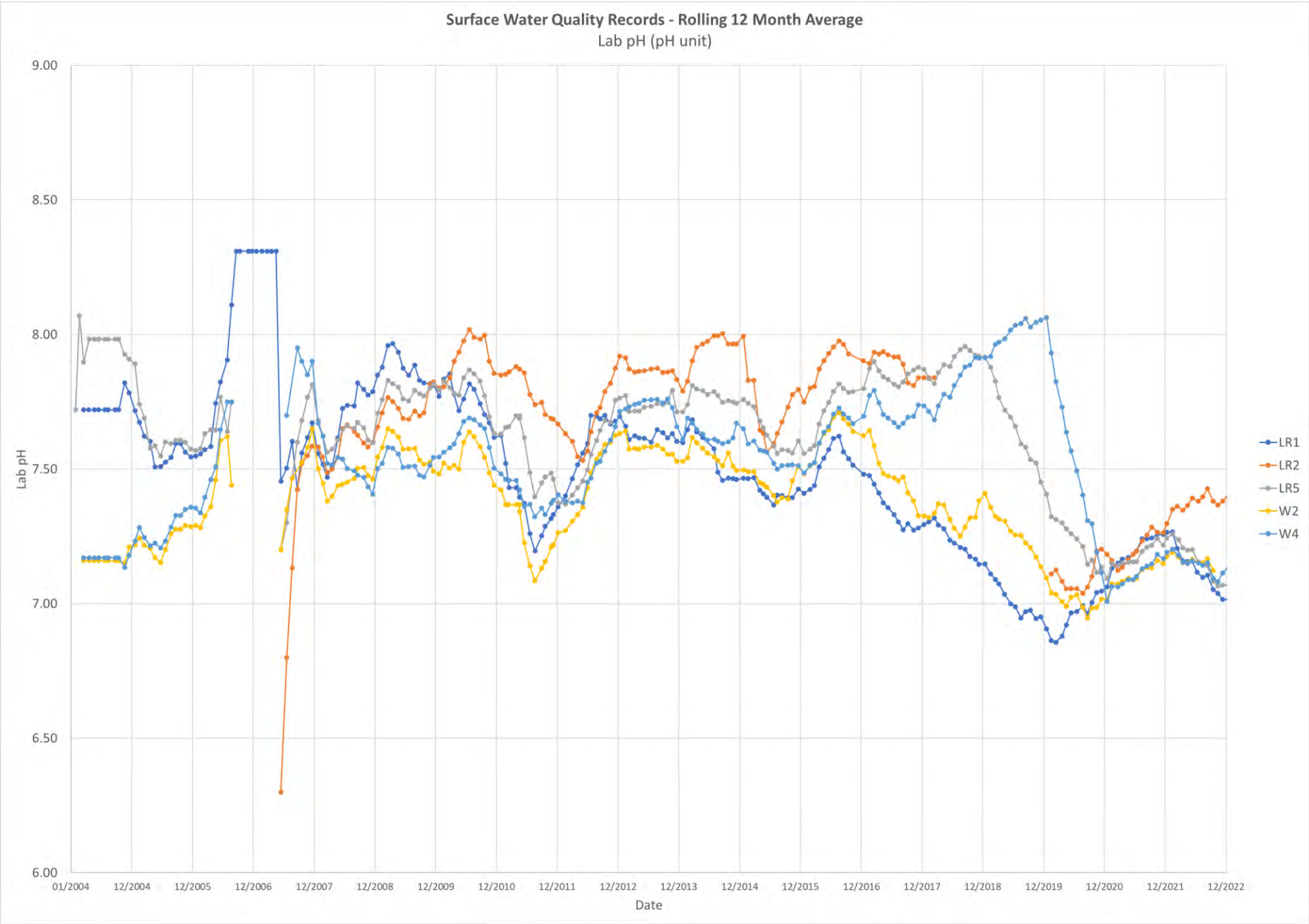
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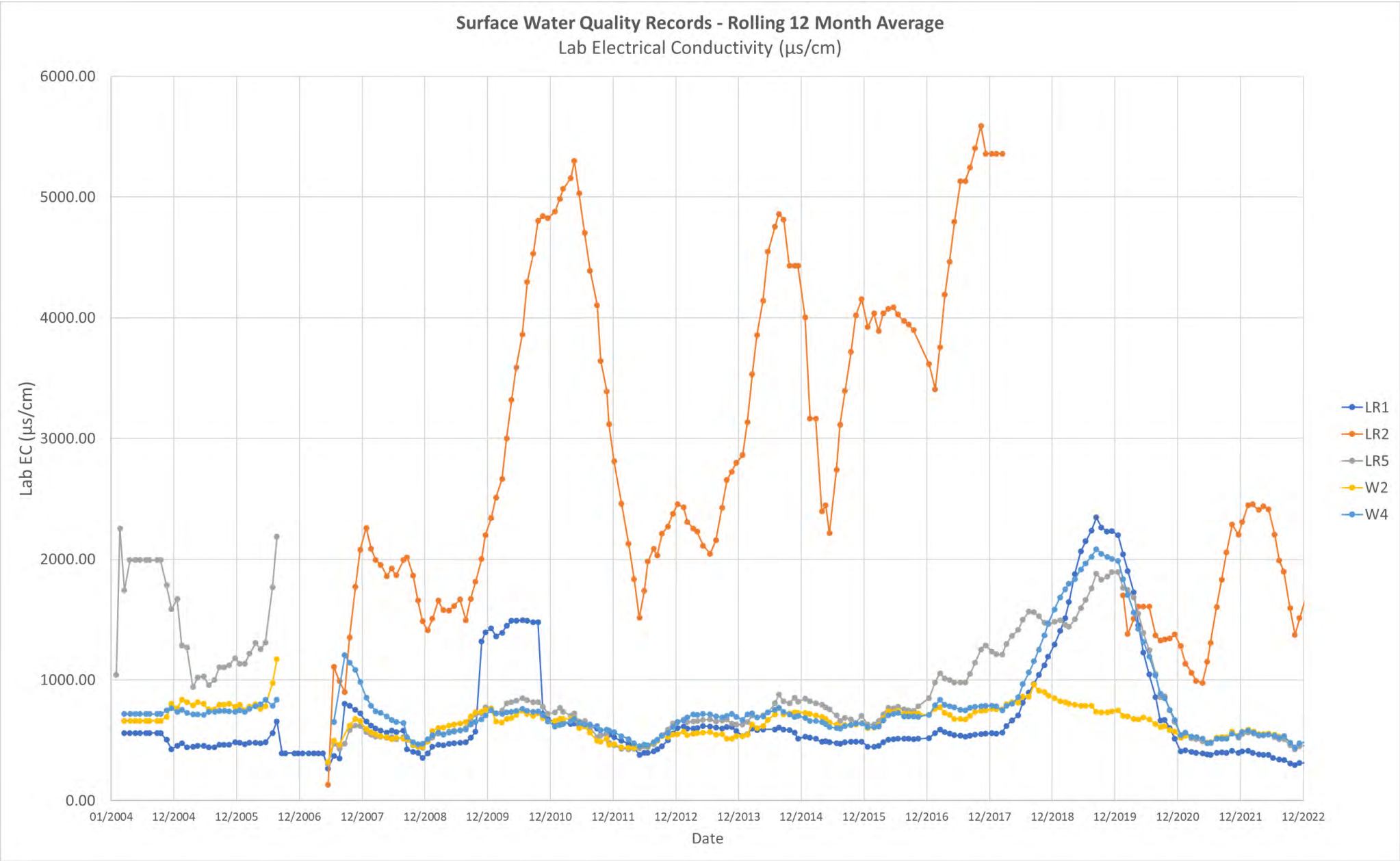
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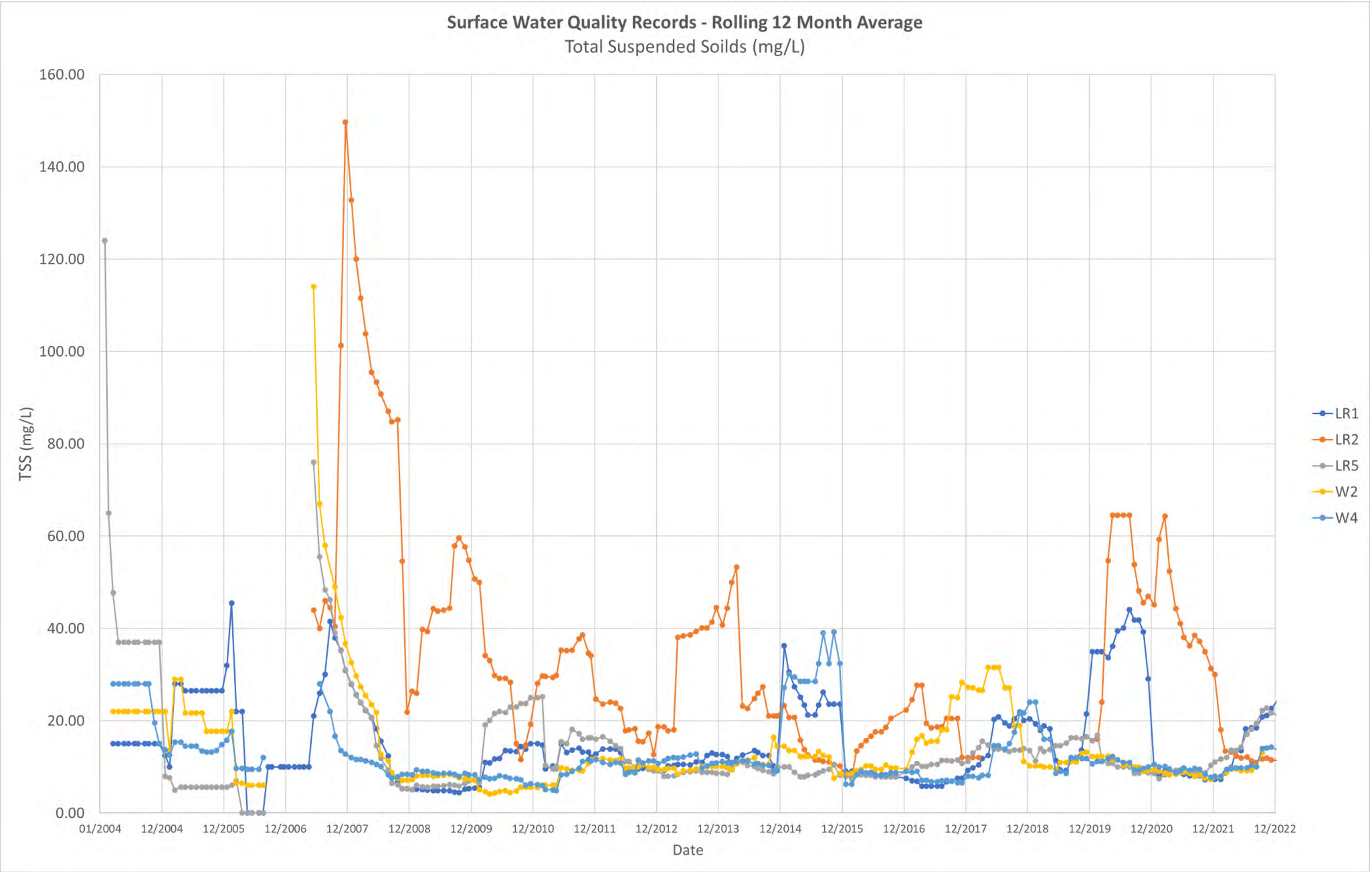
Appendix B – Surface Water Historical Trends



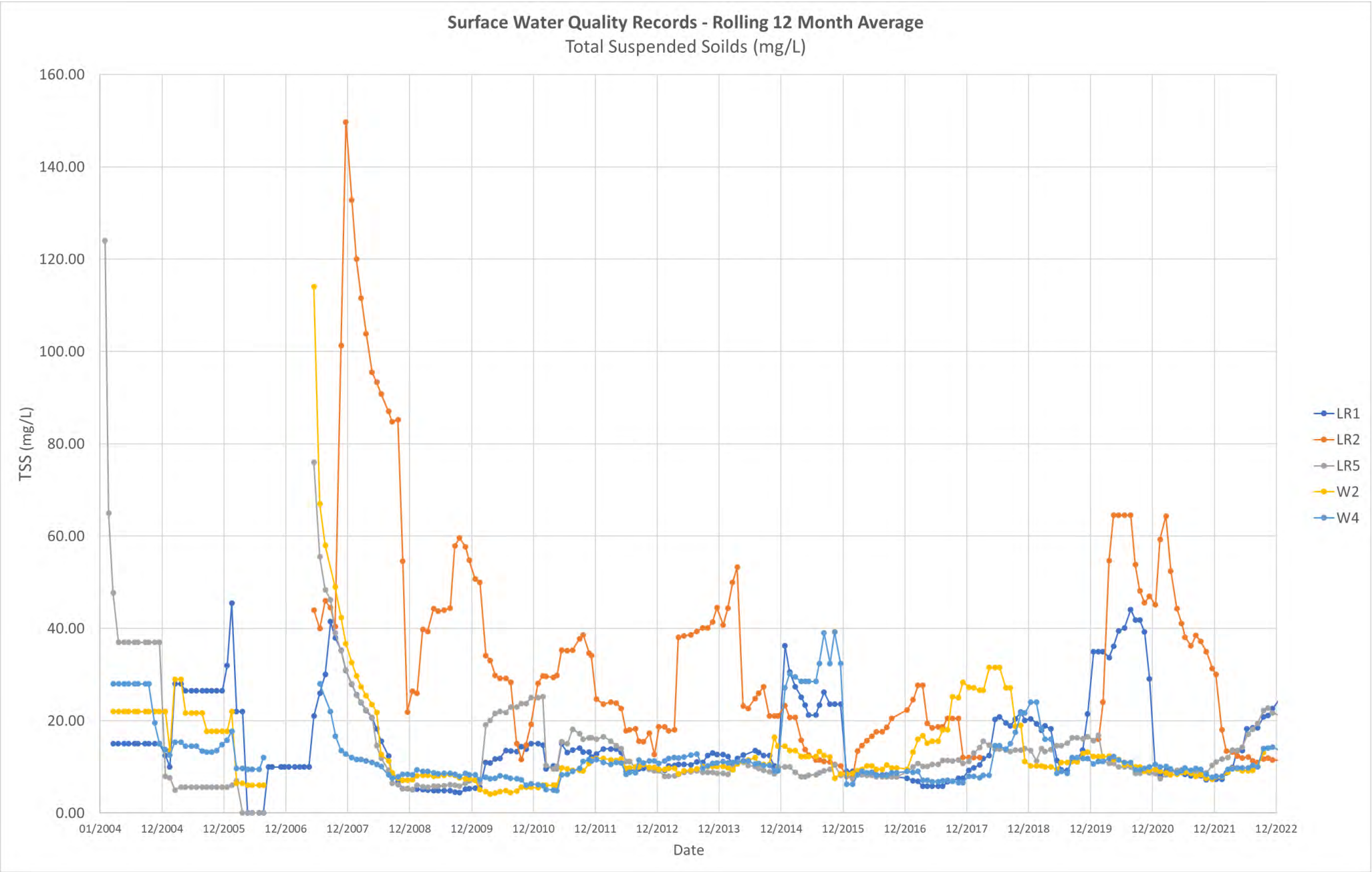
Appendix B – Surface Water Historical Trends

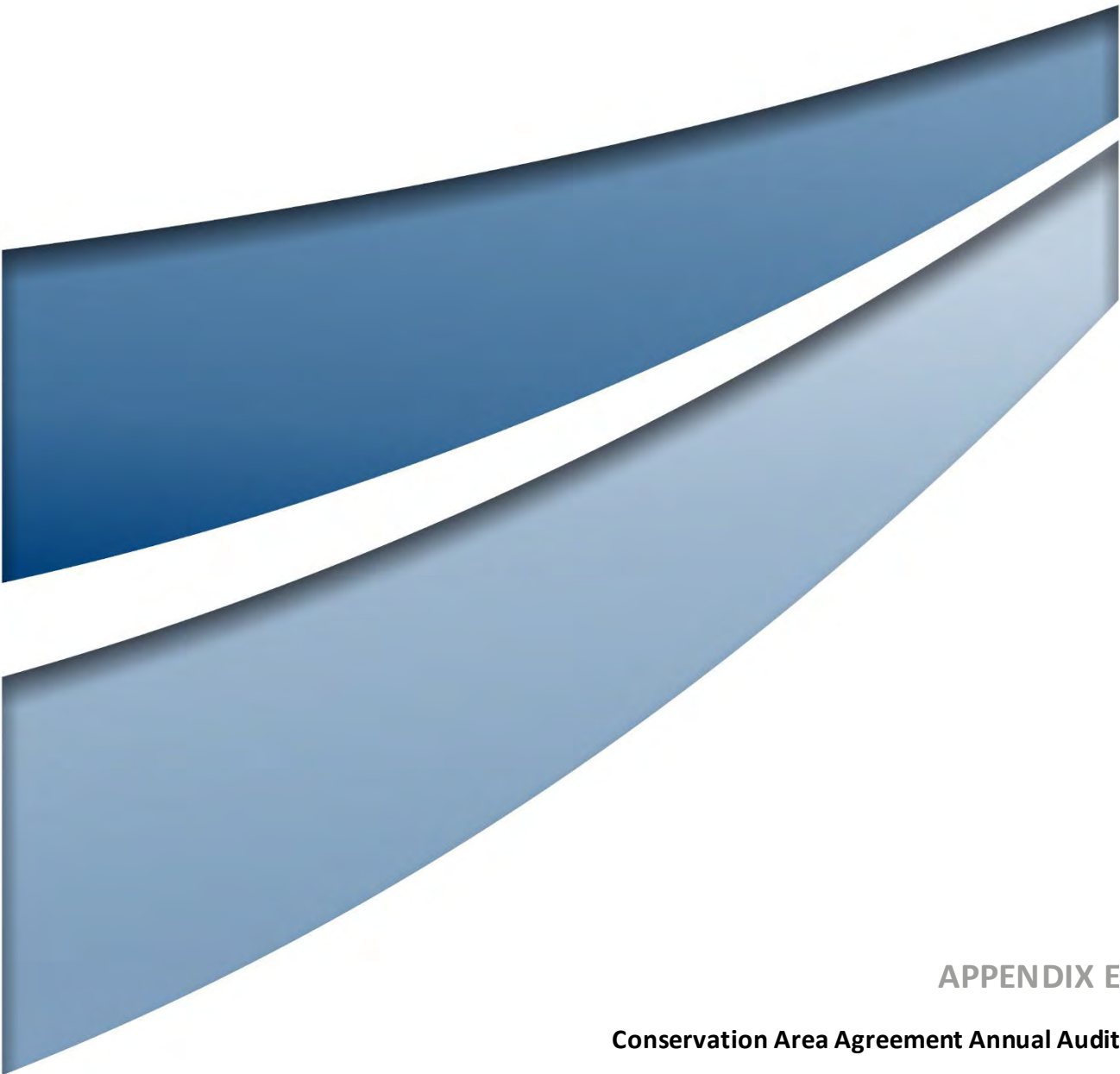


Appendix B – Surface Water Historical Trends



Appendix B – Surface Water Historical Trends





APPENDIX E

Conservation Area Agreement Annual Audit

Table E.1 Broke Road Conservation Area VCA0518 BCT 2022 Annual Audit

BOA	Aim/ Management Actions	Action completed satisfactorily	Recommendations	Recommendation Status	Actions for 2023
Management Actions					
Broke Road Conservation Area VCA0518	Site preparation and revegetation No planting to be undertaken in Broke Road Conservation Area. No provision for site preparation and revegetation required.	Yes	Ongoing revegetation works were in progress during the site inspection. Older plantings (2018) have been successful with significant growth of juvenile trees. Continue undertaking revegetation as per the Bulga Biodiversity Offset Revegetation Plan.	Ongoing	Continue undertaking revegetation as per the Bulga Biodiversity Offset Revegetation Plan.
	Supplementary planting The need for supplementary planting will be assessed based on the results of the monitoring program and will be addressed as required. Planting rates have however been developed to minimise the need for replanting and have considered the mortality rates as part of per hectare stem counts. Similarly, the need for thinning of trees will be assessed as part of annual ecological monitoring.	Yes	N/A	Ongoing	Assess the need for supplementary planting and continue to monitor regeneration.

BOA	Aim/ Management Actions	Action completed satisfactorily	Recommendations	Recommendation Status	Actions for 2023
	Primary Weed Control Cost of weed management within Broke Road Conservation Area is approximately \$2,000 per year for Years 1–10. Cost for annual management of identified weeds in target areas.	Partial	Ongoing weed control has been undertaken within the Broke Rd Conservation Area, however, weed infestation continues to impact native vegetation across the site. Continue to undertake weed control as per the recommendations in the Enright report. Particularly for Lantana which is widespread across the site and poses a risk to survival of plantings.	Ongoing	Continue to undertake weed control as per the recommendations in the annual inspection.
	Vertebrate Pest Control Annual feral fauna control program to be implemented at an estimated \$236/annum to be undertaken for ten years.	Yes	Pest control works and monitoring have been undertaken. Feral pests continue to pose a risk to the conservation area and require ongoing control and monitoring. Culling of kangaroos is not permitted within the conservation area.	Ongoing	Continue to monitor and implement management as required.
	Vertebrate Pest Control (rabbits) Provision for the annual rabbit management control event at a cost of \$118 per year.	Partial	Cannot determine from annual report or Enright report if rabbit control works were undertaken although signs of rabbit presence were noted in the Enright report. Please provide clearer information on annual pest control activities undertaken.	Ongoing	Monitoring program will start in 2023. Actions will be assessed.

BOA	Aim/ Management Actions	Action completed satisfactorily	Recommendations	Recommendation Status	Actions for 2023
	Erosion Control works on identified areas Cost to be determined if works required. Annual monitoring of erosion onsite is included within the annual reporting task.	Yes	No erosion noted in the conservation area.		
	Fire management ecological / hazard reduction burn No ecological burns to occur in offset between Years 1–10. Should burning be recommended following future revisions of the Bushfire Management Plan, guidelines specified in Annexure C Item 3 must be followed. Operate with NSW Rural Fire Service or fire management contractor to implement mosaic or partial area hazard reduction burn.	No	The diverse native grassland and woodland communities require introduction of an ecological fire regime to encourage regeneration as well as maintain open grasslands and woodland structure. It is understood that a burn strategy is to be developed in 2022 following an initial burn in the Wollombi Brook conservation area. Please provide the BCT with the burn strategy when completed and liaise with BCT if required during development of the strategy.	Ongoing The WBCA Cultural burn was not completed in 2022 due to unfavorable weather conditions.	A cultural burn will be assessed for implementation in 2024.
	Maintain vehicle access to Conservation Area for visitor management, fire management, weed and fencing management. No trails to be maintained in Broke Road Conservation Area. Provision for maintaining vehicle access not required.	Yes	Tracks accessible across most of the site, however, parts of the site inaccessible due to wet conditions. Continue monitoring for erosion and maintain tracks where required.	Completed	Tracks were maintained as required. Additional maintenance will be completed when identified.

BOA	Aim/ Management Actions	Action completed satisfactorily	Recommendations	Recommendation Status	Actions for 2023
	Maintain boundary fencing 592 m of boundary fence to be maintained annually in Years 1 and 2, and two subsequent rounds of maintenance for all fencing within the 10-year period (i.e. four rounds of maintenance in total). Based on 1/20th of new fencing rate (\$0.65/m) and calculated annually.	Partial	Fencing between VCA504 and VCA508 removed as previously requested by BCT. All (other) boundary fence works in the future is to replace barbed wire with plain wire wherever possible, particularly top and bottom wires.	Completed	Monitoring and maintenance will continue.
	Remove redundant internal fencing. No redundant internal fences requiring removal in offset.	N/A	N/A		
	Periodic maintenance/replacement of offset signage Provision of \$94 for periodic maintenance and replacement of signage at the Broke Road Conservation area during Years 1–10.	N/A	N/A		
	Initial waste removal No waste to be removed from Broke Road Conservation area. No provision for initial waste removal required.	N/A	N/A		

BOA	Aim/ Management Actions	Action completed satisfactorily	Recommendations	Recommendation Status	Actions for 2023
	Aboriginal Places and Aboriginal Objects The Owner must preserve and protect Aboriginal Places and Aboriginal Objects and other sites of cultural heritage significance on or in the Broke Road Conservation Area and in accordance with the relevant legislation. The Owner must ensure that these protective measures are undertaken in accordance with the management measures provided in the Bulga Coal Complex ACHMP or other approved ACHMP. This includes requirements to undertake an ongoing monitoring program. Annual inspection undertaken. Cost for an archaeologist to undertake a day inspection is approximately \$2,000 during Years 1–10.	No	Aboriginal site sign posted on the property; annual inspection is to occur as per CA and the ACHMP.	Ongoing	Continue to monitor Aboriginal heritage sites in accordance with the Aboriginal Cultural Heritage Management Plan.
	Annual Reporting Prepare annual reports according to specifications in Annexure D Monitoring Program. Ecological monitoring undertaken Years 1–10 annually at a cost of \$1,181 per year. Erosion control monitoring – cost for monitoring/inspection is assumed to be two inspections per year with each inspection to be two days (a total of four days). Each six-monthly inspection will therefore cost \$123 or \$246 per year.	Partial	Reports should be formatted to describe how the required management actions have been undertaken satisfactorily. The Enright reports valuable detailed information in the inspection report including future works requirement but should also provide more detail on what management actions have been undertaken each year.	Ongoing	Management actions to be reported in the Annual Review.

BOA	Aim/ Management Actions	Action completed satisfactorily	Recommendations	Recommendation Status	Actions for 2023
Monitoring, reporting and record keeping					
	Photo point monitoring – Annexure D – section (b) (i): 4 photos are required to be taken at each of the monitoring photo points. Photos must be taken from the exact location and bearing to allow subsequent comparison and assessment. Photo point locations are provided in Table 1 of Annexure D to the Conservation Agreement (below). Baseline photographs are provided in Annexure B to the Conservation Agreement;	Yes	N/A		
	Walk Through Assessment by Landholder – Annexure D – section (b) (ii): Walk through assessment to record opportunistic sightings within the Conservation Area including:	Yes	Continue undertaking weed and pest control as recommended above.	Ongoing	Actions to be implemented as per monitoring recommendations .
	i. fire impacts or impacts of fire management	Partial	As per recommendations above and in the monitoring report prepare a fire strategy and undertake ecological burns.	Ongoing The WBCA Cultural burn was not completed in 2022 due to unfavorable weather conditions.	A cultural burn will be assessed for implementation in 2024.

BOA	Aim/ Management Actions	Action completed satisfactorily	Recommendations	Recommendation Status	Actions for 2023
	ii. weeds (including compiling a list of exotic species and recording new weed infestations including location and extent).	Yes	Continue weed control as outlined above and in the Enright report.	Ongoing	Continue to undertake weed control as per the recommendations after the annual inspection.
	iii. pest animals (species and location must be recorded, including evidence of pest animals such as burrows, scats or disturbance).	Yes	Continue pest control works as outlined in the Enright report and continue monitoring.	Ongoing	Continue to monitor and implement management as required.
	iv. visitor impact and vehicle access (including evidence of any recent usage, and the presence of any new access tracks).	Yes	N/A		
	v. rubbish dumping	Yes	N/A		
	vi. natural regeneration of previously disturbed areas; and	Yes	N/A		
	vii. sightings of threatened species.	Yes	Please provide confirmation in future reports that threatened species sightings have been recorded in Bionet Atlas.	Ongoing	Monitoring program to be reported in the Annual Review.

BOA	Aim/ Management Actions	Action completed satisfactorily	Recommendations	Recommendation Status	Actions for 2023
	Annual reporting – Annexure D – section (c): After each Monitoring Event, the Owner must produce a monitoring report on the Conservation Area by 30 December of each year, beginning in 2018 (Monitoring Report). The Monitoring Report must include:	Yes	Reports should be formatted to describe how the required management actions have been undertaken satisfactorily. The Enright reports valuable detailed information in the inspection report including future works requirement but should also provide more detail on what management actions have been undertaken each year. Enright inspection and annual works reports should be submitted in future with monitoring report.	Ongoing	Monitoring program to be reported in the Annual Review.
	i. a description of all completed management actions undertaken in the previous 12-month period;	Partial	See comments above	Ongoing	Management actions to be reported in the Annual Review.
	ii. completed monitoring data sheets (including photographs) using the template provided in Table 2 and Table 3 of Annexure D to the Conservation Agreement (below);	Yes	N/A		
	iii. a discussion of the changes recorded at monitoring points and quadrats;	Yes	N/A		
	iv. a discussion of the condition of Conservation values;	Yes	N/A		
	v. a discussion of effectiveness of any management actions implemented; and	Yes	N/A		

BOA	Aim/ Management Actions	Action completed satisfactorily	Recommendations	Recommendation Status	Actions for 2023
	vi. recommendations and proposed management actions to be performed in following year(s).	Yes	Yes		
	The Monitoring Report must be submitted to OEH within 21 days of it being received by the Owner. (d) The Owner must retain receipts from third party contractors engaged by the Owner to undertake management actions listed in items 1 and 2 of Annexure C to the Conservation Agreement and provide to OEH copies of those receipts upon request by OEH. (e) The Monitoring Event and the Monitoring Report comprise the monitoring program (Monitoring Program). The Owner must complete the Monitoring Program to the satisfaction of OEH, for a minimum period of 10 years from the date of the Conservation Agreement.				
Summary and Further action required					
	- Continue revegetation works. - Control of weed infestations, particularly Lantana. - Ongoing feral species monitoring and control. Kangaroos are not to be culled within the conservation area. - Preparation and implementation of an ecological burn regime.				

BOA	Aim/ Management Actions	Action completed satisfactorily	Recommendations	Recommendation Status	Actions for 2023
	- Monitoring and reporting of Aboriginal site as required under CA and ACHMP. - Align format of future monitoring reports more closely with CA targets and management actions.				

Table E.2 Broke Road (BCM) Conservation Area (VCA0504) BCT 2022 Annual Audit

BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Recommendation Status	Actions for 2023
Management Actions					
Broke Road BCM Conservation Area VCA0504	Site preparation and revegetation Tube stock planting will be undertaken during Years 2–6 at a density of 1,000 stems per hectare. There are 104,000 tubes to be planted at approximately \$7.10 per tube which includes propagation and planting of tube stock. All planting is to occur during Years 2–6.	Yes	Ongoing revegetation works were in progress during the site inspection. Continue undertaking revegetation as per the Bulga Biodiversity Offset Revegetation Plan. It was previously requested by BCT that ripping for revegetation site preparation not be undertaken. While ripping has still been used for site preparation, the width of the ripping machinery has been substantially reduced to minimise the impacts to soil stability.	Ongoing	Continue undertaking revegetation as per the Bulga Biodiversity Offset Revegetation Plan.

BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Recommendation Status	Actions for 2023
	Supplementary planting The need for supplementary planting will be assessed based on the results of the monitoring program and will be addressed as required. Planting rates have however been developed to minimise the need for replanting and have considered the mortality rates as part of per hectare stem counts. Similarly, the need for thinning of trees will be assessed as part of annual ecological monitoring.	Yes	N/A		
	Primary Weed Control Cost of weed management within Broke Road Conservation Area DNG and Disturbed Land is approximately \$20,000 per year for Years 1–10. Cost for annual management of identified weeds in target areas.	Partial	Ongoing weed control has been undertaken within the Broke Rd Conservation Area, however, weed infestation continues to impact native vegetation across the site. Continue to undertake weed control as per the recommendations in the Enright report. Particularly for Lantana which is widespread across the site and poses a risk to survival of plantings.	Ongoing	Continue to undertake weed control as per the recommendations in the annual inspection.
	Vertebrate Pest Control Annual feral fauna control program to be implemented at an estimated \$4,763/annum to be undertaken for ten years.	Yes	Pest control works and monitoring have been undertaken. Feral pests continue to pose a risk to the conservation area and require ongoing control and monitoring. Culling of kangaroos is not permitted within the conservation area.	Ongoing	Continue to monitor and implement management as required.

BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Recommendation Status	Actions for 2023
	Vertebrate Pest Control (rabbits) Provision for the annual rabbit management control event at a cost of \$2,381 per year.	Partial	Cannot determine from annual report or Enright report if rabbit control works were undertaken although signs of rabbit presence were noted in the Enright report. Please provide clearer information on annual pest control activities undertaken.	Ongoing	Rabbit monitoring program will start in 2023. Actions will be assessed.
	Erosion Control works on identified areas Cost to be determined if works required. Annual monitoring of erosion onsite is included within the annual reporting task.	Partial	Track erosion was noted in the Enright report and observed during the site inspection. Monitoring report (page 17) identifies erosional slumping which resulted in fallen <i>Allocasuarina luehmannii</i> individuals. It is understood that erosion controls are prioritised for the Condran conservation area which is more severe. It is recommended that erosion remediation also be undertaken within the Broke Road conservation area at the soonest opportunity to prevent further impacts to native vegetation.	Ongoing 2022 Annual Monitoring program reported stable conditions and natural revegetation in the eroded area.	. Continue to monitor in 2023.

BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Recommendation Status	Actions for 2023
	Fire management ecological / hazard reduction burn Ecological burns of established vegetation may be undertaken approximately every seven years (assessed annually), with site estimated cost at \$7,000 per event. Must be carried out in accordance with the Bushfire Management Plan. Allocation has been provided for one burn between Years 1–10. Should burning be recommended following future revisions of the Bushfire Management Plan, guidelines specified in Annexure C Item 3 must be followed. Operate with NSW Rural Fire Service or fire management contractor to implement mosaic or partial area hazard reduction burn.	No	The diverse native grassland and woodland communities require introduction of an ecological fire regime to encourage regeneration as well as maintain open grasslands and woodland structure. It is understood that a burn strategy is to be developed in 2022 following an initial burn in the Wollombi Brook conservation area. Please provide the BCT with the burn strategy when completed and liaise with BCT if required during development of the strategy.	Ongoing The WBCA Cultural burn was not completed in 2022 due to unfavorable weather conditions.	A cultural burn will be assessed for implementation in 2024.
	Maintain vehicle access to Conservation Area for visitor management, fire management, weed and fencing management. Cost of maintaining fire trails and access tracks. Estimated total length of tracks is approximately 12 km, with estimate assuming repairs every three years at a rate of \$1000/km. Maintenance is therefore estimated to be required to occur three times between Years 1–10.	Yes	Tracks accessible across most of the site, however, parts of the site inaccessible due to wet conditions. Continue monitoring for erosion and maintain tracks where required.	Completed	Tracks were maintained as required. Additional maintenance will be completed when identified.

BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Recommendation Status	Actions for 2023
	Maintain boundary fencing 9,843 m of fencing to be maintained annually in Years 1 and 2, and two subsequent rounds of maintenance for all fencing within the 10 year period (i.e. four rounds of maintenance in total). Based on 1/20 th of new fencing rate (\$0.65/m) and calculated annually.	Partial	Fencing between VCA504 and VCA508 removed as previously requested by BCT. All (other) boundary fence works in the future is to replace barbed wire with plain wire wherever possible, particularly top and bottom wires.	Completed	Monitoring and maintenance will continue.
	Remove redundant internal fencing. Removal of fencing has been calculated assuming cost at a rate of two people doing 10-hour days for 15 days at \$60/hr per person (\$18,000) Not required until third year following completion of initial monitoring period.	N/A	N/A		
	Periodic maintenance/replacement of offset signage Provision of \$1,905 for periodic maintenance and replacement of offset signage at the Broke Road (BCM) Conservation Area during Years 1–10.	N/A	N/A		
	Initial waste removal All initial waste removed. No provision for initial waste removal required.	No	Enright report identifies rubbish that requires removal from the CA. BCT requested this rubbish be removed during the previous audit. If any items may be of historic value, contact BCT to discuss.	Ongoing	Continue to remove identified waste.

BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Recommendation Status	Actions for 2023
	Aboriginal Places and Aboriginal Objects The Owner must preserve and protect Aboriginal Places and Aboriginal Objects and other sites of cultural heritage significance on or in the Conservation Area and in accordance with the relevant legislation. The Owner must ensure that these protective measures are undertaken in accordance with the management measures provided in the Bulga Coal Complex ACHMP or other approved ACHMP. This includes requirements to undertake an ongoing monitoring program. Annual inspection undertaken. Cost for an archaeologist to undertake a day inspection is approximately \$2,000 during Years 1–10.	No	Aboriginal site sign posted on the property; annual inspection is to occur as per CA and the ACHMP.	Ongoing	Continue to monitor Aboriginal heritage sites in accordance with the Aboriginal Cultural Heritage Management Plan.
	Annual Reporting Prepare annual reports according to specifications in Annexure D Monitoring Program. Ecological monitoring undertaken Years 1–10 annually at a cost of \$23,193 per year.	Partial	Reports should be formatted to describe how the required management actions have been undertaken satisfactorily. The Enright reports include valuable detailed information in the inspection report including future works requirement but should also provide more detail on what management actions have been undertaken each year. Enright inspection and annual works reports should be submitted in future with monitoring report.	Ongoing	Management actions and monitoring program to be reported in the 2023 Annual Review.

BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Recommendation Status	Actions for 2023
Monitoring, reporting and record keeping					
	Photo Point Monitoring 4 photos are required to be taken at each of the monitoring photo points. Photos must be taken from the exact location and bearing to allow subsequent comparison and assessment. Photo point locations are provided in Table 1 of Annexure D to the Conservation Agreement (below). Baseline photographs are provided in Annexure B to the Conservation Agreement;	Yes	N/A		
	Biometric Plot Monitoring Quadrat data must be collected at each of the floristic quadrat monitoring sites. Quadrat locations are provided in Table 1 of Annexure D to the Conservation Agreement (below). Results must be compared to baseline and benchmark quadrat data which is provided in Tables 1 and 2 of Annexure D to the Conservation Agreement below.	Yes	N/A		
	i. fire impacts or impacts of fire management	Partial	As per recommendations above and in the monitoring report prepare a fire strategy and undertake ecological burns.	Ongoing The WBCA Cultural burn was not completed in 2022 due to unfavorable weather conditions.	A cultural burn will be assessed for implementation in 2024.

BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Recommendation Status	Actions for 2023
	ii. weeds (including compiling a list of exotic species and recording new weed infestations including location and extent).	Yes	Continue weed control as outlined above and in the Enright report.	Ongoing	Continue weed control as recommendations in the annual inspection.
	iii. pest animals (species and location must be recorded, including evidence of pest animals such as burrows, scats or disturbance).	Yes	Continue pest control works as outlined in the Enright report and continue monitoring.	Ongoing	Continue to monitor and implement pest animal management and report actions in the Annual Review.
	iv. visitor impact and vehicle access (including evidence of any recent usage, and the presence of any new access tracks).	Yes	N/A		
	v. rubbish dumping	Yes	N/A		
	vi. natural regeneration of previously disturbed areas; and	Yes	N/A		

BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Recommendation Status	Actions for 2023
	vii. sightings of threatened species.	Yes	Please provide confirmation in future reports that threatened species sightings have been recorded in Bionet Atlas.	Ongoing	Monitoring program to be reported in the Annual Review.
	Annual Reporting Annexure D – section (c): After each Monitoring Event, the Owner must produce a monitoring report on the Conservation Area by 30 December of each year, beginning in 2018 (Monitoring Report). The Monitoring Report must include:	Yes	Reports should be formatted to describe how the required management actions have been undertaken satisfactorily. The Enright reports valuable detailed information in the inspection report including future works requirement but should also provide more detail on what management actions have been undertaken each year. Enright inspection and annual works reports should be submitted in future with monitoring report.	Ongoing	Monitoring program to be reported in the Annual Review.
	i. a description of all completed management actions undertaken in the previous 12-month period;	Partial	See comments above	Ongoing	Management actions and monitoring program to be reported in the 2023 Annual Review.
	ii. completed monitoring data sheets (including photographs) using the template provided in Table 2 and Table 3 of Annexure D to the Conservation Agreement (below);	Yes	N/A		

BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Recommendation Status	Actions for 2023
	iii. a discussion of the changes recorded at monitoring points and quadrats;	Yes	N/A		
	iv. a discussion of the condition of Conservation values;	Yes	N/A		
	iii. a discussion of effectiveness of any management actions implemented; and	Yes	N/A		
	iii. recommendations and proposed management actions to be performed in following year(s).	Yes	Yes		
	The Monitoring Report must be submitted to OEH within 21 days of it being received by the Owner. (d) The Owner must retain receipts from third party contractors engaged by the Owner to undertake management actions listed in items 1 and 2 of Annexure C to the Conservation Agreement and provide to OEH copies of those receipts upon request by OEH. (e) The Monitoring Event and the Monitoring Report comprise the monitoring program (Monitoring Program). The Owner must complete the Monitoring Program to the satisfaction of OEH, for a minimum period of 10 years from the date of the Conservation Agreement.	Partial	Please ensure these requirements are followed.	Ongoing	Monitoring report will be submitted as per requirement.

BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Recommendation Status	Actions for 2023
Summary and Further actions required					
	• Continue revegetation works. • Control of weed infestations, particularly Lantana. • Ongoing feral species monitoring and control. Kangaroos are not to be culled within the conservation area. • Erosion remediation should be undertaken within the Broke Road conservation area at the soonest opportunity to prevent further impacts to native vegetation. • Removal of existing rubbish within the conservation area. • Preparation and implementation of an ecological burn regime. • Monitoring and reporting of Aboriginal site as required under CA and ACHMP. • Align format of future monitoring reports more closely with CA targets and management actions.				

Table E.3 Condran Conservation Area (VCA0502) BCT Annual Audit

BOA	Aim/ Management Actions	Action completed satisfactorily	Recommendations	Status Incomplete/ complete	Actions for 2023
Management Actions					
Condran Conservation Area VCA0502	Site preparation and revegetation Planting of tube stock will be undertaken during Years 2–6 at a density of 1,000 stems per hectare. There are 5,490 tubes to be planted at approximately \$7.10 per tube which includes propagation and planting of tube stock. All planting is to occur during Years 2–6. Thinning of supplementary planting is assumed to be required every three years to allow for non-pioneer species to colonise, it is noted that the need for thinning will be reviewed as part of the annual ecological monitoring with any thinning required to be undertaken in accordance with the requirements of the CA. Thinning has been estimated at \$15,000 per event and has been assumed as being required three times between Years 1–10.	No	Natural regeneration is occurring, and previous plantings doing well. Despite this, open areas, including Coolatai infestation areas (once sufficiently treated) should be targeted with further revegetation in accordance with the Agreement.	Ongoing	Continue undertaking revegetation as per the Bulga Biodiversity Offset Revegetation Plan. Management of Coolatai infestation areas to continue during 2023.
	Supplementary planting The need for supplementary planting will be assessed based on the results of the monitoring program and will be addressed accordingly.	N/A	N/A		

BOA	Aim/ Management Actions	Action completed satisfactorily	Recommendations	Status Incomplete/ complete	Actions for 2023
	Primary Weed Control Weed Management across the site (50 ha) including Derived Native Grasslands Assisted Natural Regeneration Areas. Estimated at \$10,000 per year for first two years, \$6,000 per year for years 3 to 10. Allowance includes labour and herbicide. Estimates are based on site costs.	Yes	Further weed control is required as per ENRIGHT report.	Ongoing	Continue to undertake weed control as per the recommendations in the annual inspection.
	Vertebrate Pest Control Conducted annually and if indicated necessary by results of inspections or monitoring. Includes baiting, trapping, warren ripping, and open range shooting by qualified pest management contractors. Costs estimated at \$2000/yr.	Yes	Continue to monitor pest animals and control as required focusing on high biodiversity threats such as foxes and cats.	Ongoing	Continue to monitor and implement management as required.
	Vertebrate Pest Control (rabbits) Provision for the annual rabbit management control event at a cost of \$2,500 per year.	Partial	Cannot determine from annual report or Enright report if rabbit control works were undertaken although signs of rabbit presence were noted in the Enright report. Please provide clearer information on annual pest control activities undertaken. Treatment of rabbits should be undertaken as recommended.	Ongoing	Rabbit monitoring program will start in 2023. Actions will be assessed.

BOA	Aim/ Management Actions	Action completed satisfactorily	Recommendations	Status Incomplete/ complete	Actions for 2023
	Erosion Control works on identified areas Cost to be determined if works required. Annual monitoring of erosion onsite is included within the annual reporting task.		The Enright report outlines a number of gully and creek crossings that require maintenance. It is recommended that track maintenance is undertaken in these areas as recommended by the Enright report.	Completed. Track maintenance and erosion control activities were implemented in 2022	Tracks and erosion monitoring will continue in 2023.
	Fire management ecological / hazard reduction burn Ecological burns of established vegetation may be undertaken approximately every seven years (assessed annually), with site estimated cost at \$5,000 per event. Must be carried out in accordance with the Bushfire Management Plan. Allocation has been provided for one burn between Years 1–10. Should burning be recommended following future revisions of the Bushfire Management Plan, guidelines specified in Annexure C Item 3 must be followed. Operate with NSW Rural Fire Service or fire management contractor to implement mosaic or partial area hazard reduction burn.	No	Introduction of an ecological fire regime to encourage regeneration as well as maintain open grasslands and woodland structure is required. Lessons learned from undertaking the planned Wollombi Brook burn should be used to help inform the future burn plan for the Condran offset site.	Ongoing The WBCA Cultural burn was not completed in 2022 as unfavorable conditions.	A cultural burn will be assessed for implementation in 2024.

BOA	Aim/ Management Actions	Action completed satisfactorily	Recommendations	Status Incomplete/ complete	Actions for 2023
	Maintain vehicle access to Conservation Area for visitor management, fire management, weed and fencing management. Trail length to be maintained estimated at 3.6 km. Maintenance estimate is for \$1000/km every three years. Maintenance is therefore estimated to be required to occur three times between Years 1–10.	Nil	Undertake track maintenance at gully and creek crossings as per ENRIGHT report. Continue monitoring erosion for and maintain tracks where required.	Completed	Tracks were maintained as required. Additional maintenance will be completed when identified.
	Maintain boundary fencing Standard repair works to existing fencing of estimated length of 3.5 km. Any repairs to fences undertaken in the first year. Four rounds of maintenance for all fencing have been allowed for within the 10-year period. Based on 1/20th of new fencing rate (\$0.65/m). A new fence is not expected to be required at house paddock within Years 1–10.	Yes	Maintain fences as required. New fences to be wildlife friendly.	Completed	Monitoring and maintenance will continue.
	Aboriginal Places and Aboriginal Objects The Owner must preserve and protect Aboriginal Places and Aboriginal Objects and other sites of cultural heritage significance on or in the Conservation Area and in accordance with the relevant legislation and any Aboriginal Cultural Heritage Management Plan that may apply.	N/A	N/A		

BOA	Aim/ Management Actions	Action completed satisfactorily	Recommendations	Status Incomplete/ complete	Actions for 2023
	Annual Reporting Prepare annual reports according to specifications in Annexure D Monitoring Program. Ecological monitoring undertaken Years 1–10 annually at a cost of \$20,000 per year. Erosion control monitoring – cost for monitoring/inspection is assumed to be two inspections per year with each inspection to be two days (a total of 4 days). An environmental consultant charged at \$160 / hr for an 8 hour/day has been assumed. Each six-monthly inspection will therefore cost \$2,560.	Yes	Reports should be formatted to describe how the required management actions have been undertaken satisfactorily. The Enright report includes valuable detailed information including future works requirements but should also provide more detail on what management actions have been undertaken each year. Enright inspection and annual works reports should be submitted in future with monitoring report.	Ongoing	Management actions to be reported in the Annual Review.
Monitoring, reporting and record keeping					
	Photo point monitoring – Annexure D – section (b) (i): Four photos are required to be taken at each of the four monitoring photo points. Photos must be taken from the exact location and bearing to allow subsequent comparison and assessment. Photo point locations are provided in Table 1 of Annexure D to the Conservation Agreement (below). Baseline photographs are provided in Annexure B to the Conservation Agreement; Note: There are 8 photo points and 8 biometric plots.	Yes	No further comments		

BOA	Aim/ Management Actions	Action completed satisfactorily	Recommendations	Status Incomplete/ complete	Actions for 2023
	Biometric Plot Monitoring – Annexure D, section (b) (ii): Quadrat data must be collected at each of the four floristic quadrat monitoring sites. Quadrat locations are provided in Table 1 of Annexure D to the Conservation Agreement (below). Results must be compared to baseline and benchmark quadrat data which is provided in Tables 1 and 2 of Annexure D to the Conservation Agreement below. Note: There are 8 photo points and 8 biometric plots.	Yes	No further comments		
	Walk Through Assessment by Landholder – Annexure D – section (b) (iii): Walk through assessment to record opportunistic sightings within the Conservation Area including:	Yes	No further comment		
	i. fire impacts or impacts of fire management	Yes	As per recommendations above and in the monitoring report prepare a fire strategy and undertake ecological burns.	Ongoing	A cultural burn will be assessed for implementation in 2024.
	ii. weeds (including compiling a list of exotic species and recording new weed infestations including location and extent).	Yes	Continue weed control as outlined above and in the Enright report.	Ongoing	Continue weed control as outlined above and in the Enright report.
	iii. pest animals (species and location must be recorded, including evidence of pest animals such as burrows, scats or disturbance).	Yes	Recommend replacement of field cameras and continued monitoring and pest control works as outlined in the Enright report.	Ongoing	Continue pest control works as outlined in the Enright report and continue monitoring.

BOA	Aim/ Management Actions	Action completed satisfactorily	Recommendations	Status Incomplete/ complete	Actions for 2023
	iv. visitor impact and vehicle access (including evidence of any recent usage, and the presence of any new access tracks).	Nil	No further comment		
	v. rubbish dumping	Nil	No further comment		
	vi. natural regeneration of previously disturbed areas; and	Yes	No further comment		
	vii. sightings of threatened species.	Yes	Please provide confirmation in future reports that threatened species sightings have been recorded in Bionet Atlas.	Ongoing	Monitoring program to be reported in the 2023 Annual Review.
	Annual reporting – Annexure D – section (c): After each Monitoring Event, the Owner must produce a monitoring report on the Conservation Area by 30 December of each year, beginning in 2018 (Monitoring Report). The Monitoring Report must include:	Yes	Reports should be formatted to describe how the required management actions have been undertaken satisfactorily. The Enright reports include valuable detailed information including future works requirements but should also provide more detail on what management actions have been undertaken each year. Enright inspection and annual works reports should be submitted in future with monitoring report.	Ongoing	Monitoring program to be reported in the 2023 Annual Review.

BOA	Aim/ Management Actions	Action completed satisfactorily	Recommendations	Status Incomplete/ complete	Actions for 2023
	i. a description of all completed management actions undertaken in the previous 12-month period;	Yes	See comments above	<u>Ongoing</u>	Management actions and monitoring program to be reported in the Annual Review.
	ii. completed monitoring data sheets (including photographs) using the template provided in Table 2 and Table 3 of Annexure D to the Conservation Agreement (below);	Yes	No further comments		
	iii. a discussion of the changes recorded at monitoring points and quadrats;	Yes	No further comments		
	iv. a discussion of the condition of Conservation values;	Yes	No further comments		
	v. a discussion of effectiveness of any management actions implemented; and	Yes	No further comments		
	vi. recommendations and proposed management actions to be performed in following year(s).	Yes	No further comments		

BOA	Aim/ Management Actions	Action completed satisfactorily	Recommendations	Status Incomplete/ complete	Actions for 2023
	The Monitoring Report must be submitted to OEH within 21 days of it being received by the Owner. (d) The Owner must retain receipts from third party contractors engaged by the Owner to undertake management actions listed in items 1 and 2 of Annexure C to the Conservation Agreement and provide to OEH copies of those receipts upon request by OEH. (e) The Monitoring Event and the Monitoring Report comprise the monitoring program (Monitoring Program). The Owner must complete the Monitoring Program to the satisfaction of OEH, for a minimum period of 10 years from the date of the Conservation Agreement.	Yes		Ongoing	Monitoring report will be submitted as per requirement
Summary and Further action required					
	• Ongoing weed control efforts, targeting areas of active regeneration and interface between intact native vegetation and encroaching invasive species including Coolatai infestation. • Undertake track maintenance at gully and creek crossings as per ENRIGHT report. • Ongoing feral species monitoring and control with integration of local efforts. • Some minor fence maintenance required, including replacement of bunting for exclusion areas relating to threatened Diurus tricolour. Replacement / repair of existing boundary fencing to be wildlife friendly (plain wire).				

BOA	Aim/ Management Actions	Action completed satisfactorily	Recommendations	Status Incomplete/ complete	Actions for 2023
	• Introduction of an ecological fire regime to encourage regeneration as well as maintain open grasslands and woodland structure. Lessons learned from undertaking the planned Wollombi Brook burn should be used to help inform the future burn plan for the Condran offset site. • Removal of rubbish, including the leaking drum highlighted in the Enright report. • • Align format of future monitoring reports more closely with CA targets and management actions.				

Table E.4 Reedy Valley Conservation Area (VCA0503) Annual Audit Compliance

BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Status Incomplete/ complete	Actions for 2023
Management Actions					
Reedy Valley Conservation Area VCA0503	Site preparation and revegetation As per Reedy Valley BOMP, annual seed collection to be undertaken by two experienced people, approximately 5 days per year, assuming 10-hour days at rate of \$60/hr per person. Planting of tube stock will be undertaken during Years 2–6 at a density of 1,000 stems per hectare.	Not able to be assessed onsite	Works to continue onsite in line with the Agreement and Revegetation Plan (DRAFT – 2022). Note – please send Final version of the Revegetation Plan when ready.	Ongoing	Continue undertaking revegetation as per the Bulga Biodiversity Offset Revegetation Plan. Biodiversity Offset Revegetation Plan to be submitted.

BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Status Incomplete/ complete	Actions for 2023
	There are 85,700 tubes to be planted at approximately \$7.10 per tube which includes propagation and planting of tube stock. All planting is to occur during Years 2–6.				
	Supplementary planting The need for supplementary planting will be assessed based on the results of the monitoring program however there has been no allocation in Years 1–10. The need for thinning will be considered as part of annual ecological monitoring however thinning is not expected to be required during Years 1–10.	N/A	Requirement for supplementary planting to be assessed in future revegetation plans.	Ongoing	Continue undertaking revegetation as per the Bulga Biodiversity Offset Revegetation Plan.
	Primary Weed Control Cost of weed management within areas of natural regeneration and established woodland. Costs are estimated at \$9,000 / year for regeneration areas and \$6,000 / year for woodland areas. Annual weed control costs are estimated at \$15,000.	Not able to be assessed onsite	Works to continue onsite in line with the Agreement.	Ongoing	Continue to undertake weed control as per the recommendations in the annual inspection.
	Vertebrate Pest Control Annual feral fauna control program to be implemented at an estimated \$5,000/annum to be undertaken for ten years.	Not able to be assessed onsite	Works to continue onsite in line with the Agreement.	Ongoing	Continue to monitor and implement management –as required.

BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Status Incomplete/ complete	Actions for 2023
	Fire management ecological / hazard reduction burn Ecological burns of established vegetation may be undertaken approximately every seven years (assessed annually), with site estimated cost at \$5,000 per event. Must be carried out in accordance with the Bushfire Management Plan. Allocation has been provided for one burn between Years 1–10. Should burning be recommended following future revisions of the Bushfire Management Plan, guidelines specified in Annexure C Item 3 must be followed. Operate with NSW Rural Fire Service or fire management contractor to implement mosaic or partial area hazard reduction burn.	N/A	The Conservation Agreement calls for a burn at least once every 7 years if required. However, 6.2 of the Annual Monitoring Report notes that fire be introduced for grassy woodland areas at a frequency of 2–3 years, to suppress weed growth and encourage strong native grass/forb regrowth. This approach is also supported by the Bushfire Inspection Report (2021). The BCT supports more frequent burn implementation with appropriate planning and monitoring in place to support this increased burn frequency. We note that the Burn Plan for Wollombi Brook CA area has been prepared by Tasman Willis of Emergent Ecology. Lessons learned from this initial burn are to be carried into planning for a burn on Reedy Valley site.	Ongoing The WBCA Cultural burn was not completed in 2022 as unfavorable conditions.	A cultural burn will be assessed for implementation in 2024.
	Maintain vehicle access to Conservation Area for visitor management, fire management, weed and fencing management. Provision for fire trail and access track maintenance. Length of tracks for maintenance approximately 20 km, with Bulga estimate assuming repairs every 3 years at a rate of \$1000/km for each event.	No	Undertake planned track maintenance, creek crossing repairs and track improvements, as guided by the ENRIGHT Track Inspection Report (Feb 2022), and / or as required to allow for ongoing / long term access to all areas of the offset areas on the site.	Completed Tracks were maintained in March and December 2022, after flooding seasons.	Additional maintenance will be completed when identified. Monitoring and maintenance will continue.

BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Status Incomplete/ complete	Actions for 2023
	Maintenance is therefore estimated to be required to occur three times between Years 1–10.				
	Maintain boundary fencing Establishment of 16,500 m of new fencing at a rate of approximately \$13/m. Cost for four rounds of maintenance for all fencing (including new fencing) within the 10-year period. Based on 1/20th of new fencing rate (\$0.65/m). Total fencing length within Reedy Valley which is 28,500 m. (including fence to be constructed).	Not able to be assessed onsite	Ensure boundary fencing excludes stock as per the Agreement.	Ongoing	3.5 km of new fence will be installed along the northern section of the BOA.
	Annual Reporting Prepare annual reports according to specifications in Annexure D Monitoring Program.	No – supplementary information provided	Please ensure the annual report is provided in 2022.	Completed	Monitoring and maintenance will continue.
Monitoring, reporting and record keeping					
	Photo Point Monitoring 4 photos are required to be taken at each of the photo monitoring points. Photos must be taken from the exact location and bearing to allow subsequent comparison and assessment. Photo point locations are provided in Table 1 of Annexure D to the Conservation Agreement (below). Baseline photographs are provided in Annexure B to the Conservation Agreement;	No. Delays in track reconstruction and access meant monitoring report not provided.	Please ensure this is included in 2022 report.	No. Wet weather conditions and creek floodings prevented safe access to complete the Monitoring Program.	2023 Monitoring Program to be completed according to schedule.

BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Status Incomplete/ complete	Actions for 2023
	Note: There are 12 photo points and 12 biometric plots.				
	Biometric Plot Monitoring Quadrat data must be collected at each of the floristic quadrat monitoring sites. Quadrat locations are provided in Table 1 of Annexure D to the Conservation Agreement (below). Results must be compared to baseline and benchmark quadrat data which is provided in Tables 1 and 2 of Annexure D to the Conservation Agreement below. Note: There are 12 photo points and 12 biometric plots.	No. Delays in track reconstruction and access meant monitoring report not provided.	Please ensure this is included in 2022 report.	No. Wet weather conditions and creek floodings prevented safe access to complete the Monitoring Program.	2023 Monitoring Program to be completed according to schedule.
	Walk Through Assessment by Landholder – Annexure D – section (b)(iii): Walk through assessment to record opportunistic sightings within the Conservation Area including:	Yes	No further comments		
	i. fire impacts or impacts of fire management	Yes	Bulga preparing a burn plan for all of its Offset sites, with an initial “trial” burn to take place in Wollombi Brook site in late 2022.	Ongoing	A cultural burn will be assessed for implementation in 2024.

BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Status Incomplete/ complete	Actions for 2023
	ii. weeds (including compiling a list of exotic species and recording new weed infestations including location and extent).	No. Delays in track reconstruction and access meant monitoring report not provided.	Where required provide weed mapping for new infestations in future reports.	Ongoing. Weed management was completed as conditions permitted; focusing mainly in St John's worth and prickly pear.	Continue to undertake weed control as per the recommendations after the annual inspection.
	iii. pest animals (species and location must be recorded, including evidence of pest animals such as burrows, scats or disturbance).	No. Delays in track reconstruction and access meant monitoring report not provided.	Please ensure this is included in 2022 report.	Ongoing. 2022 Pig trapping and baiting program was completed.	Continue to monitor and implement management as required.
	iv. visitor impact and vehicle access (including evidence of any recent usage, and the presence of any new access tracks).	Nil			
	v. rubbish dumping	Nil	N/A		
	vi. natural regeneration of previously disturbed areas; and	Yes	N/A		
	vii. sightings of threatened species.	Yes	Please provide confirmation in future reports that threatened species sightings have been recorded in Bionet Atlas.	Ongoing	Monitoring program to be reported in the Annual Review.

BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Status Incomplete/ complete	Actions for 2023
	Annual Reporting Annexure D – section (c): After each Monitoring Event, the Owner must produce a monitoring report on the Conservation Area by 30 December of each year, beginning in 2018 (Monitoring Report). The Monitoring Report must include:	No. Delays in track reconstruction and access meant monitoring report not provided.	Please ensure this is included in 2022 report.	No 2022 Monitoring Program was not completed as wet weather conditions and creek floodings prevented safe access to the BOA.	Monitoring program to be reported in the Annual Review.
	i. a description of all completed management actions undertaken in the previous 12-month period;	Partial	Please ensure this is included in 2022 report.	Ongoing	Management actions and monitoring program to be reported in the 2023 Annual Review.
	ii. completed monitoring data sheets (including photographs) using the template provided in Table 2 and Table 3 of Annexure D to the Conservation Agreement (below);	No	Please ensure this is included in 2022 report.	No 2022 Monitoring Program was not completed as wet weather conditions and creek floodings prevented safe access to the BOA	Monitoring data sheets to be included in the Annual Monitoring Report

BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Status Incomplete/ complete	Actions for 2023
	iii. a discussion of the changes recorded at monitoring points and quadrats;	No	Please ensure this is included in 2022 report.	No 2022 Monitoring Program was not completed as wet weather conditions and creek floodings prevented safe access to the BOA.	Changes recorded at Monitoring points to be included in the Annual Monitoring Report
	iv. a discussion of the condition of Conservation values;	No	Please ensure this is included in 2022 report.	No 2022 Monitoring Program was not completed as wet weather conditions and creek floodings prevented safe access to the BOA.	Discussion of conservation values to be included in the Annual Monitoring Report
	iii. a discussion of effectiveness of any management actions implemented; and	No	Please ensure this is included in 2022 report.	Partial 2022 Monitoring Program was not completed as wet weather conditions and creek floodings prevented safe access to the BOA.	Discussion of management actions to be included in the Annual Review.
	iii. recommendations and proposed management actions to be performed in following year(s).	No	Please ensure this is included in 2022 report.	Completed	To be included in the Annual Review

BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Status Incomplete/ complete	Actions for 2023
	The Monitoring Report must be submitted to OEH within 21 days of it being received by the Owner. (d) The Owner must retain receipts from third party contractors engaged by the Owner to undertake management actions listed in items 1 and 2 of Annexure C to the Conservation Agreement and provide to OEH copies of those receipts upon request by OEH. (e) The Monitoring Event and the Monitoring Report comprise the monitoring program (Monitoring Program). The Owner must complete the Monitoring Program to the satisfaction of OEH, for a minimum period of 10 years from the date of the Conservation Agreement.	No	Report not received	No 2022 Monitoring Program was not completed as wet weather conditions and creek floodings prevented safe access to the BOA.	
Summary and Further actions required					
	Undertake the planned track maintenance works as soon as weather allows. Track works are to occur as identified in the Enright Track Inspection Report (Feb 2022), the Bushfire inspection report (7.11.2021) and as per the Conservation Agreement, or as required to allow for long term access to all areas of the offset areas on the site. This is now considered an urgent priority for the site.				

BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Status Incomplete/ complete	Actions for 2023
	- A greater focus on resourcing/ prioritising this site is required to ensure that required land management actions on the site do not slip behind the timeframes for the required management actions identified in the CA. Forward planning and a flexible approach to resourcing is likely to be required for this site. - The Conservation Agreement calls for a burn at least once every 7 years if required. However, Section 6.2 of the 2020 Annual Monitoring Report recommends that that fire be introduced for grassy woodland areas at a frequency of 2–3 years, to suppress weed growth and encourage strong native grass/forb regrowth. This approach is also supported by the Bushfire Inspection Report (2021) to suppress fuel loads. - The BCT supports more frequent burn implementation with appropriate planning and monitoring in place to support this increased burn frequency. Lessons learned from undertaking the planned Wollombi Brook burn should be used to help inform the future burn plan for the Reedy Valley site.				

BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Status Incomplete/ complete	Actions for 2023
	• Thank you for sending across the Bulga draft Revegetation plan. This report provides greater clarity on revegetation progress and future requirements across all Bulga CA offsets. Please ensure that you provide us with a copy of the final plan when finalised with the 2022 Monitoring Plan. • Please ensure that the 2022 monitoring report is provided, and that the format of the monitoring report aligns with required management actions in the CA.				

Table E.5 Wollombi Brook Offset Area (VCA0501) Annual Audit Report

BOA	Aim/ Management Actions	Action completed satisfactorily	Recommendations	Status Incomplete/ complete	Actions for 2023
Management Actions					
Wollombi Brook Offset Area VCA0501	Site preparation and revegetation Density reduction of Bull oak regeneration to promote growth of native species. Will require four years of management to naturally suppress Bull oak regeneration over 2.98 ha of affected area. Costs for completion of this item are an estimated site cost at \$1,063 a day with Year 1 works taking five days with subsequent years requiring a single day to maintain the density. Planting of tube stock will be undertaken during Years 2–6 at a density of 1,000 stems per hectare. There are 15,000 tubes to be planted at approximately \$7.10 per tube which includes propagation and planting of tube stock. All planting is to occur during Years 2–6.	Yes	Recent site preparation works and revegetation undertaken in the northern part of Wollombi Brook Conservation Area. Continue to monitor new plantings and improve chances of survival through weed control.	Ongoing	Continue undertaking revegetation as per the Bulga Biodiversity Offset Revegetation Plan
	Supplementary planting The need for supplementary planting will be assessed based on the results of the monitoring program however there has been no allocation in Years 1–10.	N/A	Revegetation occurring, supplementary planting in native woodland/forest not required at this stage.	Ongoing	Assess the need for supplementary planting and continue to monitor regeneration.
	Primary Weed Control Cost of weed management within 13.8 hectares of Wollombi Brook Conservation Area is approximately \$7,972 per year for Years 1 and 2. Costs approximately \$5,314 per year for Years 3–10.	Yes		Ongoing	Continue to undertake weed control as per the recommendations in the Annual Inspection.

BOA	Aim/ Management Actions	Action completed satisfactorily	Recommendations	Status Incomplete/ complete	Actions for 2023
	Vertebrate Pest Control Implementation of feral fauna control program at unit cost of \$1,062/per year to be undertaken annually for Years 1–10.	Yes	Continue to engage contractors for vertebrate pest control works as well as in conjunction with Local Land Services.	Ongoing	Continue to monitor and implement management as required.
	Vertebrate Pest Control (rabbits) Provision for an annual rabbit management control event at a cost of \$1,328 per year.	Partial	Several rabbit warrens and signs of rabbit inhabitation noted in Enright report. Continue to engage shooters to undertake rabbit control. Fumigate active rabbit warrens along Wollombi Brook.	Ongoing	Rabbit monitoring program will start in 2023. Actions will be assessed.
	Erosion Control works on identified areas There are no known erosion works required to be undertaken. Annual monitoring of erosion onsite is included within the annual reporting task.	Partial	Enright report notes that track maintenance is required on access tracks and notes erosion along the Wollombi Brook. Considering intensive weed control has been undertaken along Wollombi Brook, in addition to presence of rabbit warrens, the bank is at risk of severe erosion. Continue to monitor and implement remediation works if required.	Ongoing	Continue to monitor and implement controls as required.

BOA	Aim/ Management Actions	Action completed satisfactorily	Recommendations	Status Incomplete/ complete	Actions for 2023
	Fire management ecological / hazard reduction burn Ecological burns of established vegetation may be undertaken approximately every seven years (assessed annually), with site estimated cost at \$7,500 per burn event. Must be carried out in accordance with the Bushfire Management Plan. Allocation has been provided for one burn between Years 1–10. Should burning be recommended following future revisions of the Bushfire Management Plan, guidelines specified in Annexure C Item 3 must be followed. Operate with NSW Rural Fire Service or fire management contractor to implement mosaic or partial area hazard reduction burn.	No	It is understood that an ecological burn is planned for the Wollombi Brook offset sites for this year with detailed burn plans to be prepared for the remainder of the site and other offset sites following the burn. Draft burn plan has been provided to the BCT. Please provide the burn strategy to the BCT once it has been completed.	No Wet weather conditions triggered the cancellation of the Cultural Burn planned in 2022.	A cultural burn will be assessed for implementation in 2023.
	Maintain vehicle access to Conservation Area for visitor management, fire management, weed and fencing management. Cost of maintaining fire trails and tracks. Estimated total length is approximately 4.6 km, with site estimate assuming repairs every three years at estimated cost of \$1000/km. Maintenance is therefore estimated to be required to occur three times between Years 1–10.	Yes	Tracks were generally in good condition; however, parts of the site were inaccessible due to boggy tracks following heavy rainfall.	Ongoing	Tracks were maintained as required. Additional maintenance will be completed when identified.
	Maintain boundary fencing 5,325 m of boundary fence to be maintained annually for Year 1–2 and two further rounds of maintenance allowed for within the 10-year period (i.e. 4 rounds of maintenance in Years 1–10). Based on 1/20th of new fencing rate (\$0.65/m).	Partial	Enright report identifies damaged fencing along the western boundary notes and other areas require maintenance. Undertake maintenance and replace with plain wire fencing.	Completed	Monitoring and maintenance will continue as required.

BOA	Aim/ Management Actions	Action completed satisfactorily	Recommendations	Status Incomplete/ complete	Actions for 2023
	Remove redundant internal fencing. Redundant internal fencing to be removed after Year 2, with site estimated costs assuming two people working 10 hours for eight days at \$60 / person /hr.	N/A	Internal fencing has been noted and requires removal	Ongoing	Removal of internal fencing will be endeavor in 2023
	Aboriginal Places and Aboriginal Objects The Owner must preserve and protect Aboriginal Places and Aboriginal Objects and other sites of cultural heritage significance on or in the Conservation Area and in accordance with the relevant legislation. The Owner must ensure that these protective measures are undertaken in accordance with the management measures provided in the Wollombi Brook Conservation Area Plan of Management or other approved ACHMP. Provision of \$476,150 has been included for the establishment of a Glencore Artefacts and Training Facility within the Wollombi Brook Conservation Area. Cost includes construction of the facility teaching area including rainwater tank, toilets and associated sewerage system, barbeques, furniture fittings and fencing. Maintenance costs for the facility are estimated at approximately \$10,000 per year. This includes lawn maintenance, septic and water tank management, waste removal etc.	Partial	No information has been provided in the annual report with regards to Archaeological monitoring. It was noted that the Minimbah Teaching Place has been recently constructed adjacent to the conservation area for the conservation of Aboriginal artefacts within the conservation area and Bulga Coal operational areas.	Ongoing Progress regarding the Minimbah Teaching Place development is included in Section 6.8	Continue to monitor Aboriginal heritage sites in accordance with the Aboriginal Cultural Heritage Management Plan.

BOA	Aim/ Management Actions	Action completed satisfactorily	Recommendations	Status Incomplete/ complete	Actions for 2023
	Annual Reporting Prepare annual reports according to specifications in Annexure D Monitoring Program. Ecological monitoring undertaken Years 1–10 annually at a cost of \$10,628 per year. Erosion control monitoring – cost for monitoring/inspection is assumed to be two inspections per year with each inspection to be two days (a total of four days). An environmental consultant charged at \$160 / hr for an eight-hour day has been assumed. Each six-monthly inspection will therefore cost \$1,384 or \$2,768 per year.	Partial	Reports should be formatted to describe how the required management actions have been undertaken satisfactorily. The Enright reports valuable detailed information in the inspection report including future works requirement but should also provide more detail on what management actions have been undertaken each year. Enright inspection and annual works reports should be submitted in future with monitoring report.	Ongoing	Management actions to be reported in the Annual Review. Annual Inspection report to be submitted as per requirement.
Monitoring, reporting and record keeping					
	Photo point monitoring – Annexure D – section (b) (i): 4 photos are required to be taken at each of the monitoring photo points. Photos must be taken from the exact location and bearing to allow subsequent comparison and assessment. Photo point locations are provided in Table 1 of Annexure D to the Conservation Agreement (below). Baseline photographs are provided in Annexure B to the Conservation Agreement;	Yes	N/A		

BOA	Aim/ Management Actions	Action completed satisfactorily	Recommendations	Status Incomplete/ complete	Actions for 2023
	Biometric Plot Monitoring – Annexure D, section (b) (ii): Quadrat data must be collected at each of the floristic quadrat monitoring sites. Quadrat locations are provided in Table 1 of Annexure D to the Conservation Agreement (below). Results must be compared to baseline and benchmark quadrat data which is provided in Tables 1 and 2 of Annexure D to the Conservation Agreement below	Yes	No significant findings resulting from monitoring plot results. Vegetation conditions generally below benchmark, however, noted that the vegetation will take considerable time to reach benchmark. Overall increase in diversity and cover since 2017. Revegetation areas contain increases in native stems, likely resulting from recruitment of adjacent vegetation.	Ongoing	Continue to report results in the Annual Review and Monitoring Report
	Walk Through Assessment by Landholder – Annexure D – section (b) (ii): Walk through assessment to record opportunistic sightings within the Conservation Area including:	Yes	N/A		
	i. fire impacts or impacts of fire management	Yes	Undertake planned low intensity prescribed burn in partnership with Firesticks Alliance. Develop burn plan for wider Wollombi Brook Conservation Area as well as all other Bulga Offset Conservation Areas and provide to the BCT.	No Wet weather conditions triggered the cancellation of the Cultural Burn planned in 2022.	A cultural burn will be assessed for implementation in 2023.

BOA	Aim/ Management Actions	Action completed satisfactorily	Recommendations	Status Incomplete/ complete	Actions for 2023
	ii. weeds (including compiling a list of exotic species and recording new weed infestations including location and extent).	Yes	Detailed information on weed infestations provided in Enright report and maps. Recommend these maps also identify where weed control works have been provided by contractors.	Ongoing	Continue to undertake weed control as per the recommendations after the annual inspection.
	iii. pest animals (species and location must be recorded, including evidence of pest animals such as burrows, scats or disturbance).	Yes	Continue control and monitoring of pest animals.	Ongoing	Continue to monitor and implement management as required.
	iv. visitor impact and vehicle access (including evidence of any recent usage, and the presence of any new access tracks).	Yes	N/A		
	v. rubbish dumping	Yes	Rubbish identified in Enright report should be removed from the Conservation Area.	Partial	Waste to be removed
	vi. natural regeneration of previously disturbed areas; and	Yes	The Conservation Area is showing signs of natural regeneration within revegetation areas and forested areas. Areas subjected to the ecological thinning trial have shown increase regeneration in the last 2 years since the end of drought conditions.	Yes Regeneration assessment completed in 2022. Results included in the Annual Review	Continue to monitor and assess changes in identified areas with natural regeneration.

BOA	Aim/ Management Actions	Action completed satisfactorily	Recommendations	Status Incomplete/ complete	Actions for 2023
	vii. sightings of threatened species.	Yes	Five threatened fauna species recorded in 2021 (two birds, three microbats). No threatened flora recorded in 2021 (nor previously). Two rare Hunter endemic flora species <i>Grevillea montana</i> and <i>Diuris</i> sp. <i>Aff.dendrobioides</i> were recorded. Please provide confirmation in future reports that threatened species sightings have been recorded in Bionet Atlas.	Ongoing	Monitoring program to be reported in the Annual Review.
	Annual reporting – Annexure D – section I: After each Monitoring Event, the Owner must produce a monitoring report on the Conservation Area by 30 December of each year, beginning in 2018 (Monitoring Report). The Monitoring Report must include:	Yes			
	i. a description of all completed management actions undertaken in the previous 12-month period;	Partial	Greater detail should be provided in the monitoring report or Enright report on the management works undertaken in each management year. The details outlined in this audit report should be used as a template to describe how required management actions have or have not been met.	Ongoing	Monitoring program to be reported in the Annual Review.

BOA	Aim/ Management Actions	Action completed satisfactorily	Recommendations	Status Incomplete/ complete	Actions for 2023
	ii. completed monitoring data sheets (including photographs) using the template provided in Table 2 and Table 3 of Annexure D to the Conservation Agreement (below);	Yes	N/A		
	iii. a discussion of the changes recorded at monitoring points and quadrats;	Yes	The monitoring reports provide substantial detail and analysis on ecological changes occurring at monitoring points and within the site.		
	iv. a discussion of the condition of Conservation values;	Yes	N/A		
	v. a discussion of effectiveness of any management actions implemented; and	Yes	In future reports please refer more directly to the requirements of the agreement, whether management actions have been undertaken and if they have been successful	Ongoing	Discussion of management actions to be included in the Annual Review.
	vi. recommendations and proposed management actions to be performed in following year(s).	Yes	Recommendations for future management provided in the annual report.	Completed	To be included in the Annual Review

BOA	Aim/ Management Actions	Action completed satisfactorily	Recommendations	Status Incomplete/ complete	Actions for 2023
	The Monitoring Report must be submitted to OEH within 21 days of it being received by the Owner. (d) The Owner must retain receipts from third party contractors engaged by the Owner to undertake management actions listed in items 1 and 2 of Annexure C to the Conservation Agreement and provide to OEH copies of those receipts upon request by OEH(e) The Monitoring Event and the Monitoring Report comprise the monitoring program (Monitoring Program). The Owner must complete the Monitoring Program to the satisfaction of OEH, for a minimum period of 10 years from the date of the Conservation Agreement.	Yes		Ongoing	Monitoring program to and submitted be completed as scheduled.
Summary and Further action required					
	- Continue undertaking revegetation as per the Bulga Biodiversity Offset Revegetation Plan and water as appropriate. - Ongoing weed control as per the Enright recommendations and targeting regenerating areas and interface with good condition vegetation. - Pest Control as per Enright report (rabbits noted on site). - Undertake fence maintenance, damaged fences noted in Enright report. Ensure fencing is wildlife friendly (top and bottom strands consisting of plain wire).				

BOA	Aim/ Management Actions	Action completed satisfactorily	Recommendations	Status Incomplete/ complete	Actions for 2023
	• Monitor for erosion along Wollombi Brook, undertake remediation works if required. • Ensure construction of ACH site is correctly located as per CA. • Remove rubbish identified in the Enright report. • Undertake ecological burn, as detailed in the burn plan. Prepare fire strategy for the entire CA. • Align format of future annual reports to provide more detail information on management actions required/undertaken and how they align with CA.				

Table E.6 Wollombi Brook (BCM) Offset Area (VCA0500) Annual Audit Compliance

BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Status Incomplete/ complete	Actions for 2023
Management Actions					
Wollombi Brook BCM Conservation Area VCA0500	Site preparation and revegetation Density reduction of bull oak regeneration to promote growth of native species. Will require four years of management to naturally suppress bull oak regeneration over 2.62 ha of affected area. Costs for completion of this item are an estimated site cost at \$937 a day with Year 1 works taking five days with subsequent years requiring a single day to maintain the density. Planting tube stock will be undertaken during Years 2–6 at a density of 1,000 stems per hectare. There are 4,500 tubes to be planted at approximately \$7.10 per tube which includes propagation and planting of tube stock. All planting to occur during Years 2–6.	Yes	Recent site preparation works and revegetation undertaken in the northern part of Wollombi Brook Conservation Area. Continue to monitor new plantings and improve chances of survival through weed control.	Ongoing	Continue undertaking revegetation as per the Bulga Biodiversity Offset Revegetation Plan.
	Supplementary planting The need for supplementary planting will be assessed based on the results of the monitoring program however there has been no allocation in Years 1–10.	N/A	Revegetation occurring. Supplementary planting in native woodland/forest not required at this stage.	Ongoing	Assess the need for supplementary planting and continue to monitor regeneration.

BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Status Incomplete/ complete	Actions for 2023
	Primary Weed Control Cost of weed management within 12.2 hectares in Wollombi Brook (BCM) Conservation Area is approximately \$7,028 per year for Years 1 and 2. Costs approximately \$4,685 per year for Years 3–10.	Yes	Evidence of recent weed control works was noted in the Wollombi Brook Conservation Area, particularly in the riparian area with recent treatment of <i>Cardiospermum grandiflorum</i> (Balloon Vine) and <i>Cestrum parqui</i> (Green Cestrum). Continue treatment of weeds within the riparian area, as well as smaller weed infestations in the wider conservation area such as <i>Opuntia</i> spp., <i>Lantana camara</i> (Lantana), <i>Eragrostis curvula</i> (African Love Grass) and <i>Sida rhombifolia</i> (Paddys Lucerne) which were observed in the property.	Ongoing	Continue to undertake weed control as per the recommendations in the Annual Inspection.
	Vertebrate Pest Control Implementation of feral fauna control program at unit cost of \$937 per year to be undertaken annually for Years 1–10.	Yes	Continue to engage contractors for vertebrate pest control works as well as in conjunction with Local Land Services.	Ongoing	Continue to monitor and implement management as required.
	Vertebrate Pest Control (rabbits) Provision for an annual rabbit management control event at a cost of \$1,171 per year.	Partial	Several rabbit warrens and signs of rabbit inhabitation noted in Enright report. Continue to engage shooters to undertake rabbit control. Fumigate active rabbit warrens along Wollombi Brook.	Ongoing	Rabbit monitoring program will start in 2023. Actions will be assessed.

BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Status Incomplete/ complete	Actions for 2023
	Erosion Control works on identified areas Cost to be determined if works required. Annual monitoring of erosion onsite is included within the annual reporting tasks.	Partial	Enright report notes that track maintenance is required on access tracks and notes erosion along the Wollombi Brook. Considering intensive weed control has been undertaken along Wollombi Brook, in addition to presence of rabbit warrens, the bank is at risk of severe erosion. Continue to monitor and implement remediation works if required.	<u>Ongoing</u>	<u>Continue to monitor and implement controls as required.</u>
	Fire management ecological / hazard reduction burn Ecological burns of established vegetation may be undertaken approximately every seven years (assessed annually), with site estimated cost at \$7,500 per burn event. Must be carried out in accordance with the Bushfire Management Plan. Allocation has been provided for one burn between Years 1–10. Should burning be recommended following future revisions of the Bushfire Management Plan, guidelines specified in Annexure C Item 3 must be followed. Operate with NSW Rural Fire Service or fire management contractor to implement mosaic or partial area hazard reduction burn.	No	It is understood that an ecological burn is planned for the Wollombi Brook offset sites for this year with detailed burn plans to be prepared for the remainder of the site and other offset sites following the burn. Draft burn plan has been provided to the BCT. Please provide the burn strategy to the BCT once it has been completed.	No Wet weather conditions triggered the cancellation of the Cultural Burn planned in 2022.	A cultural burn will be assessed for implementation in 2023.

BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Status Incomplete/ complete	Actions for 2023
	Maintain vehicle access to Conservation Area for visitor management, fire management, weed and fencing management. Cost of maintaining fire trails and access tracks. Estimated total length is approximately 400 km, with site estimate assuming repairs every three years at estimated cost of \$1000/km. Maintenance is therefore estimated to be required to occur three times between Years 1–10.	Yes	Tracks were generally in good condition, however, parts of the site were inaccessible due to boggy tracks following heavy rainfall.	Ongoing Tracks were maintained as required.	Additional maintenance will be completed when identified.
	Maintain boundary fencing 3,648 m of boundary fence to be maintained annually for Year 1–2 and two further rounds of maintenance allowed for within the 10-year period (i.e. four rounds of maintenance in Years 1–10). Based on 1/20th of new fencing rate (\$0.65/m).	Partial	Enright report identifies damaged fencing along the western boundary and notes other areas require maintenance. Undertake maintenance and replace with plain wire fencing.	Completed	Monitoring and maintenance will continue as required.
	Remove redundant internal fencing. Redundant internal fencing to be removed after Year 2, with site estimated costs assuming two people working 10 hours for seven days at \$60 / person /hr.	N/A	Internal fencing has been noted and requires removal.	Ongoing	Removal of internal fencing will be endeavor in 2023

BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Status Incomplete/ complete	Actions for 2023
	Aboriginal Places and Aboriginal Objects The Owner must preserve and protect Aboriginal Places and Aboriginal Objects and other sites of cultural heritage significance on or in the Wollombi Brook (BCM) Conservation Area and in accordance with the relevant legislation. The Owner must ensure that these protective measures are undertaken in accordance with the management measures provided in the Wollombi Brook Plan of Management, Bulga Coal Complex ACHMP or other approved ACHMP. This includes requirements to undertake an ongoing monitoring program, with the Conservation Area to be subject to a monitoring inspection at least once every calendar year. Annual inspection undertaken. Cost for an archaeologist to undertake a day inspection is approximately \$2,000 during Years 1–10.	Partial	No information has been provided in the annual report with regards to Archaeological monitoring. It was noted that the Minimbah Teaching Place has been recently constructed adjacent to the conservation area for the conservation of Aboriginal artefacts within the conservation area and Bulga Coal operational areas.	Ongoing Progress regarding the Minimbah Teaching Place development is included in Section 6.8.	Continue to monitor Aboriginal heritage sites in accordance with the Aboriginal Cultural Heritage Management Plan.

BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Status Incomplete/ complete	Actions for 2023
	Annual Reporting Prepare annual reports according to specifications in Annexure D Monitoring Program. Ecological monitoring undertaken Years 1–10 annually at a cost of \$9,371 per year. Erosion control monitoring – cost for monitoring/inspection is assumed to be two inspections per year with each inspection to be two days (a total of four days). Each six-monthly inspection will therefore cost \$1,220 or \$2,441 per year.	Partial	Reports should be formatted to describe how the required management actions have been undertaken satisfactorily. The Enright reports valuable detailed information in the inspection report including future works requirements but should also provide more detail on what management actions have been undertaken each year. Enright inspection and annual works reports should be submitted in future with monitoring report.	Ongoing	Management actions to be reported in the Annual Review. Annual Inspection report to be submitted.
Monitoring, reporting and record keeping					
	Photo Point Monitoring 4 photos are required to be taken at each of the monitoring photo points. Photos must be taken from the exact location and bearing to allow subsequent comparison and assessment. Photo point locations are provided in Table 1 of Annexure D to the Conservation Agreement (below). Baseline photographs are provided in Annexure B to the Conservation Agreement;	Yes	N/A		

BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Status Incomplete/ complete	Actions for 2023
	Biometric Plot Monitoring Quadrat data must be collected at each of the floristic quadrat monitoring sites. Quadrat locations are provided in Table 1 of Annexure D to the Conservation Agreement (below). Results must be compared to baseline and benchmark quadrat data which is provided in Tables 1 and 2 of Annexure D to the Conservation Agreement below.	Yes	No significant findings resulting from monitoring plot results. Vegetation conditions generally below benchmark, however, noted that the vegetation will take considerable time to reach benchmark. Overall increase in diversity and cover since 2017. Revegetation areas contain increases in native stems, likely resulting from recruitment of adjacent vegetation.	Ongoing	Continue to report results in the Annual Review and Monitoring Report.
	Walk Through Assessment by Landholder – Annexure D – section (b) (iii): Walk through assessment to record opportunistic sightings within the Conservation area including:	Yes	N/A		
	i. fire impacts or impacts of fire management	Yes	Undertake planned low intensity prescribed burn in partnership with Firesticks Alliance. Develop burn plan for wider Wollombi Brook Conservation Area as well as all other Bulga Offset Conservation Areas and provide to the BCT.	No Wet weather conditions triggered the cancellation of the Cultural Burn planned in 2022.	A cultural burn will be assessed for implementation in 2023.

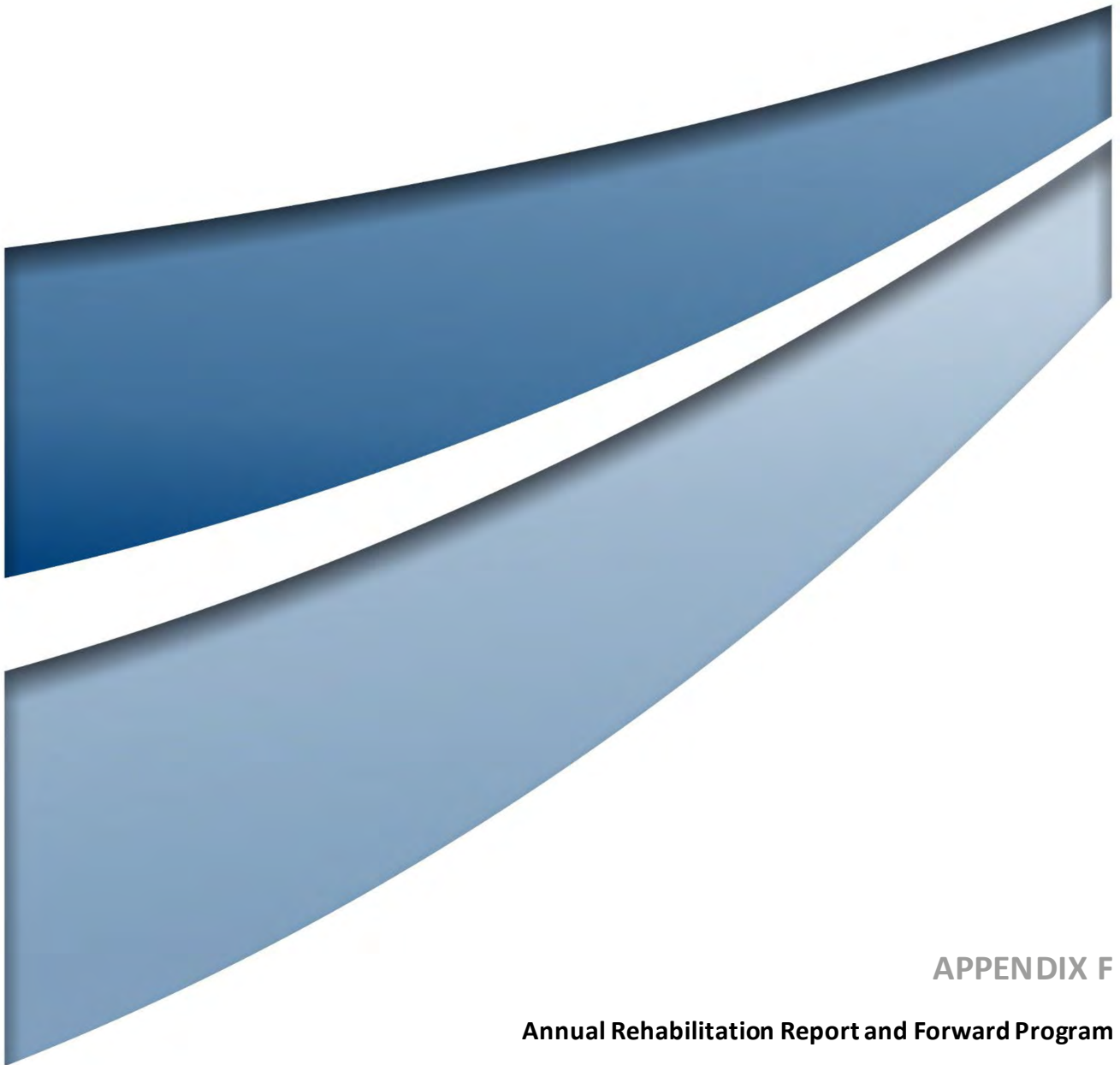
BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Status Incomplete/ complete	Actions for 2023
	ii. weeds (including compiling a list of exotic species and recording new weed infestations including location and extent).	Yes	Detailed information on weed infestations provided in Enright report and maps. It is recommended these maps also identify where weed control works have been provided by contractors.	Ongoing	Continue to undertake weed control as per the recommendations after the annual inspection.
	iii. pest animals (species and location must be recorded, including evidence of pest animals such as burrows, scats or disturbance).	Yes	Continue control and monitoring of pest animals.	Ongoing	Continue to monitor and implement management as required.
	iv. visitor impact and vehicle access (including evidence of any recent usage, and the presence of any new access tracks).	Yes	N/A		
	v. rubbish dumping	Yes	Rubbish identified in Enright report should be removed from the Conservation Area.	Partial	Waste to be removed.
	vi. natural regeneration of previously disturbed areas; and	Yes	The Conservation Area is showing signs of natural regeneration within revegetation areas and forested areas. Areas subjected to the ecological thinning trial have shown increase regeneration in the last 2 years since the end of drought conditions.	Yes Regeneration assessment completed in 2022. Results included in the Annual Review	Continue to monitor and assess changes in identified areas with natural regeneration.

BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Status Incomplete/ complete	Actions for 2023
	vii. sightings of threatened species.	Yes	Five threatened fauna species recorded in 2021 (two birds, three microbats). No threatened flora recorded in 2021 (nor previously). Two rare Hunter endemic flora species <i>Grevillea montana</i> and <i>Diuris sp. aff.dendrobioides</i> were recorded. Please provide confirmation in future reports that threatened species sightings have been recorded in Bionet Atlas.	Ongoing	Monitoring program to be reported in the Annual Review.
	Annual Reporting Annexure D – section (c): After each Monitoring Event, the Owner must produce a monitoring report on the Conservation Area by 30 December of each year, beginning in 2018 (Monitoring Report). The Monitoring Report must include:	Yes			
	i. a description of all completed management actions undertaken in the previous 12-month period;	Partial	Greater detail should be provided in the monitoring report or Enright report on the management works undertaken in each management year. The details outlined in this audit report should be used as a template to describe how required management actions have or have not been met.	Ongoing	Monitoring program to be reported in the Annual Review.

BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Status Incomplete/ complete	Actions for 2023
	ii. completed monitoring data sheets (including photographs) using the template provided in Table 2 and Table 3 of Annexure D to the Conservation Agreement (below);	Yes	N/A		
	iii. a discussion of the changes recorded at monitoring points and quadrats;	Yes	The monitoring reports provide substantial detail and analysis on ecological changes occurring at monitoring points and within the site.	Ongoing	Monitoring program to be reported in the Annual Review and Annual monitoring program to be submitted.
	iv. a discussion of the condition of Conservation values;	Yes	N/A	Ongoing	Monitoring program to be reported in the Annual Review and Annual monitoring program to be submitted.
	iii. a discussion of effectiveness of any management actions implemented; and	Yes	In future reports please refer more directly to the requirements of the agreement, whether management actions have been undertaken and if they have been successful	Ongoing	Monitoring program to be reported in the Annual Review and Annual monitoring program to be submitted.
	iii. recommendations and proposed management actions to be performed in following year(s).	Yes	Recommendations for future management provided in the annual report.	Ongoing	Recommendation to be reported and discussed in the Annual Review

BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Status Incomplete/ complete	Actions for 2023
	The Monitoring Report must be submitted to OEH within 21 days of it being received by the Owner. (d) The Owner must retain receipts from third party contractors engaged by the Owner to undertake management actions listed in items 1 and 2 of Annexure C to the Conservation Agreement and provide to OEH copies of those receipts upon request by OEH. (e) The Monitoring Event and the Monitoring Report comprise the monitoring program (Monitoring Program). The Owner must complete the Monitoring Program to the satisfaction of OEH, for a minimum period of 10 years from the date of the Conservation Agreement.	Yes			
Summary and Further actions required					
	- Continue undertaking revegetation as per the Bulga Biodiversity Offset Revegetation Plan and water as appropriate. - Ongoing weed control as per the Enright recommendations and targeting regenerating areas and interface with good condition vegetation. - Pest Control as per Enright report (rabbits noted on site). - Undertake fence maintenance (damaged fences noted in Enright report). Ensure fencing is wildlife friendly (top and bottom strands consisting of plain wire).				

BOA	Aim/ Management Actions	Action completed satisfactorily Yes/No/Partial	Recommendations	Status Incomplete/ complete	Actions for 2023
	• Monitor for erosion along Wollombi Brook and undertake remediation works if required. • Ensure construction of ACH site correctly located as per CA. • Remove rubbish identified in the Enright report. • Undertake ecological burn, as detailed in the burn plan. Prepare fire strategy for the entire CA. • Align format of future annual reports to provide more detailed information on management actions required/undertaken and how they align with CA.				



APPENDIX F

Annual Rehabilitation Report and Forward Program

Annual Rehabilitation Report

1.1 Applicant details

[Select applicant details from drop-down options]

Mine Details

2.1 Project description

Provide a description of the mining project. The description must be consistent with the development consent for the mine [1000 characters only]

Bulga Coal is located approximately 12 kilometres (km) southwest of Singleton, and 2 km from the townships of Broke and Bulga in the Upper Hunter Valley of New South Wales (NSW). Bulga Coal comprises two coal mining operations, being Bulga Open Cut and Bulga Underground Operations. The CHPP and rail loading facility are located in the eastern side of the site. In May 2018, Bulga Underground Operations ceased mining and the mine was sealed in July 2018.

Bulga Coal is managed by Bulga Coal Management Pty Ltd on behalf of the Bulga Joint Venture. Bulga Coal Management Pty Ltd is owned by Oakbridge Pty Ltd, which is the majority shareholder (87.5%) of the Bulga Joint Venture. Glencore is the majority shareholder of Oakbridge Pty Ltd.

Estimated life of mine (in years) [type number]

16 years.

SSD-4960 Modification 3 (Mod 3) was approved by the DPE on 16 July 2020, allowing an extension of the life of mine until 31 December 2039.

2.2 Current development consents, leases and licences

[Check mining authorisations are correct – if not, complete the form Register mine/multiple please]

Any other approvals, licences, or authorities issued by government agencies that are relevant to the progress of mining operation and rehabilitation activities [type names of other authorisations – no noted character limit]

If there have been changes to the status of these approvals during the annual reporting period, the lease holder must include a summary of the scope and/or purpose of the new applications or modifications to existing approvals. [1500 characters]

Development Consent/s and Commonwealth Approvals

- DA 41-03-99 (Surrendered 31 August 2022)
- DA 376-8-2003
- SSD-4960
- EPBC 2002/773
- EPBC 2012/6637
- EPBC 2018/8300

Mining Tenements

- ML 1494
- ML 1547
- ML 1674
- ML 1717
- ML 1788
- Sublease within CL 219
- CL 224
- EL 5277
- EL 5461
- EL 8315
- AUTH 447
- AUTH 450

Bulga Coal Licences

Environmental Protection Licence

- EPL 563

Water Licences

- WAL41687
- WAL41546
- WAL41543
- WAL41544
- WAL41545
- WAL36221
- 20BL166867
- 20BL167776
- 20BL167777
- 20BL169204
- 20BL169246
- 20BL172659
- 20BL172660
- 20BL173014
- 20BL173617
- 20BL173618
- 20BL173619
- 20BL173620
- 20BL173621
- 20BL173640
- 20BL173657
- 20BL173708

Radiation/Dangerous Goods Licences

- Radiation Management Licence 5061333
- NDG018992
- XSTR100095

Changes to the Status of Approvals during the Reporting Period

SSD-4960 superseded DA 41-03-99 at the granting of the Bulga Optimisation Project approval. On 20 May 2022 Bulga Coal provided DPE with a notice of surrender for DA 41-03-99 and DPE accepted the surrender on 31 August 2022.

In December 2021 Bulga Coal submitted administrative modifications for SSD-4960 (Mod 4) and DA 376-8-2003 (Mod 8). The modifications were approved 24 February 2022 and include amendments to the following conditions:

- Schedule 5 Condition 4 of SSD-4960 and Schedule 6 Condition 4 of DA 376-8-2003 to change the Bulga Coal Annual Review reporting period to a calendar year; and
- Schedule 3 Condition 23 and Appendix 7 Condition 1 of SSD-4960, and Schedule 4 Condition 33 and Appendix 4 Condition 1 of DA 376-8-2003 to include the use of the sigma theta method for determining the meteorological stability category as per the *Noise Policy for Industry (EPA, 2017)*.

2.3 Land ownership and land use

Provide details of any changes to land ownership and land use related to the land, that has occurred during the annual reporting period. [250 characters only]

No changes to land ownership and land use within the 2022 reporting period.

Complaints

3.1 Complaints received

This section must list any complaints received during the reporting period in relation to rehabilitation and provide details of the response(s) to these complaints.

Were any complaints received during the reporting period in relation to rehabilitation?

[select Yes/No]

Attach any relevant documentation. Please compress your files into one file (i.e. zip folder) if you have multiple files to attach. [Attach files]

There were no complaints in relation to rehabilitation during the 2022 reporting period at Bulga Coal.

Stakeholders

4.1 Stakeholder consultation

This section must summarise, in a table, stakeholder consultation about rehabilitation undertaken during the annual reporting period.

Add rows to in-built table. For each row, include:

- **Date – 18 May 2022**

- **Relevant stakeholder (e.g. the NSW Resources Regulator, landholders, community)**

Community Consultative Committee

- **Consultation activities and forms of consultation [500 characters]**

A Community Consultative Committee (CCC) operates in accordance with SSD-4960 and DA 376-8-2003. The CCC is operated jointly by BUO and BOC and provides a forum for open discussion between Bulga Coal representatives, the community, Singleton Council (Council) and other stakeholders on issues directly relating to the mine's operations and environmental performance.

- **Matters subject to consultation [500 characters]**

Bulga Coal provided an overview of the 2021 rehabilitation targets and actuals, as well as an overview of the rehabilitation and disturbance progress for 2022 YTD. A general discussion was held around rehabilitation progression and implementation of the rehabilitation reforms.

- **Actions taken by the lease holder in response to matters raised by any stakeholder in relation to rehabilitation [500 characters]**

Request from community member to clarify whether a document exists which shows the proposed post mining landforms across the Hunter Valley, this was actioned and reviewed at the subsequent CCC meeting in November 2022.

Attach any relevant documentation. Please compress your files into one file (i.e. zip folder) if you have multiple files to attach. [Attach files]

Attach the May CCC meeting minutes.

- **Date – 2 November 2022**

- **Relevant stakeholder (e.g. the NSW Resources Regulator, landholders, community)**

Community Consultative Committee

- **Consultation activities and forms of consultation [500 characters]**

The CCC is operated jointly by BUO and BOC and provides a forum for open discussion between Bulga Coal representatives, the community, Singleton Council (Council) and other stakeholders on issues directly relating to the mine's operations and environmental performance. Bulga Coal conducted a Community Consultative Committee Meeting in November 2022.

- **Matters subject to consultation [500 characters]**

Bulga Coal provided an overview of the annual rehabilitation and disturbance targets and actuals for 2022 YTD.

Discussion around the Rehabilitation Reform and the Rehabilitation Management Plan that includes 5 yearly stage plans. As well as the Annual Rehabilitation Report and Forward Work Program that indicates current rehabilitation and disturbance for the next 3 years.

Actions taken by the lease holder in response to matters raised by any stakeholder in relation to rehabilitation [500 characters]

Query from community member regarding internal slopes of Northern Tailings Storage Facility (NTSF) which can be seen from Bulga. Site is currently assessing whether any temporary rehabilitation can be undertaken to minimise visibility of internal slopes and will provide an update at the next CCC meeting schedule in May 2023.

Attach any relevant documentation. Please compress your files into one file (i.e. zip folder) if you have multiple files to attach. [Attach files]

Attach the November CCC meeting minutes.

Surface disturbance activities

5.1 Surface disturbance and rehabilitation activities

Describe the surface disturbance and rehabilitation activities that were conducted, and, an analysis of the progress against the schedule presented in the previous annual rehabilitation report and forward program, as well as any relevant development consent. [1500 characters]

Exploration

A total of two (2) exploration holes were drilled during 2022:

- EBR108 and EBR109 were drilled to define the true seam dip at the inflection point of the Mt Thorley Monocline throughout the mine plan.

Land Preparation

During 2022, approximately 5,403 m³ of topsoil was stripped and 2 habitat trees were salvaged by Bulga Coal. 1.83 ha of disturbance was undertaken to allow mining, overburden dumping and construction activities (roads, drains, dams) to commence. There was also 10.75 ha of existing rehabilitation cleared to facilitate infrastructure construction and the southerly extension of mining operations.

Rehabilitation Summary

Rehabilitation activities have been completed in accordance with the approved Bulga Open Cut and Bulga Underground Operations MOPs, Forward Work Program and Bulga Coal Rehabilitation Management Plan. Rehabilitation activities undertaken in 2022 included:

- Shaping of overburden dumps;
- Removal of decommissioned infrastructure;
- Installation of geomorphic drainage structures;
- Deep ripping;
- Rock raking;
- Installation of habitat features;
- Application of ameliorants;
- Re-ripping of prepared surface; and
- Seeding with target ecological communities.

Rehabilitation in 2022 was as per the MOP predictions, whilst disturbance was less than planned, this is due to delays in commencing construction of Dam S53.

Describe any rehabilitation planning activities that were conducted, including any specialist studies. Examples: contamination, heritage, landform design and demolition. [1500 characters]

Rehabilitation Planning Activities

Bulga Coal undertook rehabilitation planning activities as part of the sites annual Life of Mine and Budget mine planning processes. Prior to June 2022, Bulga Coal reviewed and updated the Life of Mine (LOM) plan for the subsequent year. The LOM Plan includes all clearing, rehabilitation, and mine closure requirements to meet the site's rehabilitation objectives. A Budget Mine Plan for the subsequent 5 years is then developed and includes clearing, rehabilitation, and mine closure activities for the budget period. The 2023 Forward Program was then developed based on the budget mine plan.

Bulga Coal conducted a Rehabilitation Risk Assessment and an Annual Mine Closure risk assessment in 2022 to review rehabilitation and mine closure risks and ensure appropriate measures are in place to control or mitigate risks.

Provide an overview of any subsidence repair and/or remediation works undertaken. [1500 characters]

Subsidence inspections are undertaken on an annual basis or after high rainfall events. Repairs are undertaken on an as needs basis. No subsidence repairs were required during 2022. Where identified, repairs to surface subsidence cracking for previously mined areas continued to be undertaken during the reporting period.

Provide an overview of rehabilitation management and maintenance activities. Examples: reseeding, weed and feral animal control and erosion control works. [1500 characters]

Rehabilitation Management and Maintenance Activities

Weed and Pests

Several weed species are present throughout most historical rehabilitation areas and significant resources are dedicated to their removal. The methods employed at Bulga Open Cut during 2022 include:

- Appropriate topsoil management, including scraping of topsoil stockpiles prior to spreading and weed control in areas prior to stripping;
- Seeding with quick establishing cover crops and acacia species to out-compete weed species;
- Ongoing weed spraying and removal; and
- Seeding with a Eucalypt and Acacia heavy native woodland seed mix to shade-out introduced weed species such as Rhodes grass (*Chloris gayana*) and Galenia (*Galenia pubescens*).

1080 baits were placed in rehabilitation areas where wild dogs had previously been identified.

Weed and pest management, inclusive of rehabilitation was undertaken throughout 2022 at Bulga Underground Operations.

Erosion and Water Quality

In 2022, Bulga continued to implement the annual landform stability and drainage inspection across all rehabilitation areas and associated drainage structures. The inspection noted a marked improvement in landform stability from previous inspections with a reduced number of erosion and maintenance issues identified. Spatial data from the 2021 and 2022 inspections was used to develop a maintenance program which was carried out throughout 2022. Maintenance works undertaken included repairing rock drainage lines, desilting contour banks, repairing rill and gully erosion and tunnelling.

Detail any rehabilitation actions taken as required by any letters, notices or directions issued by government agencies, including the NSW Resources Regulator. [1500 characters]

N/A

Detail any rehabilitation areas that have achieved the final land use (as set out in clause 6 of Schedule 8A to the Mining Regulation 2016, in the reporting period. That is, rehabilitation areas where the NSW Resources Regulator has determined in writing that the relevant rehabilitation obligations have been fulfilled following submission of the relevant application by the lease holder. [1500 characters]

N/A

5.1.1.1 Key production milestones

[Year 1 FWP is carried over automatically from the previous year's Forward Program. Complete "This report" column.]

Table 1 Key production milestones

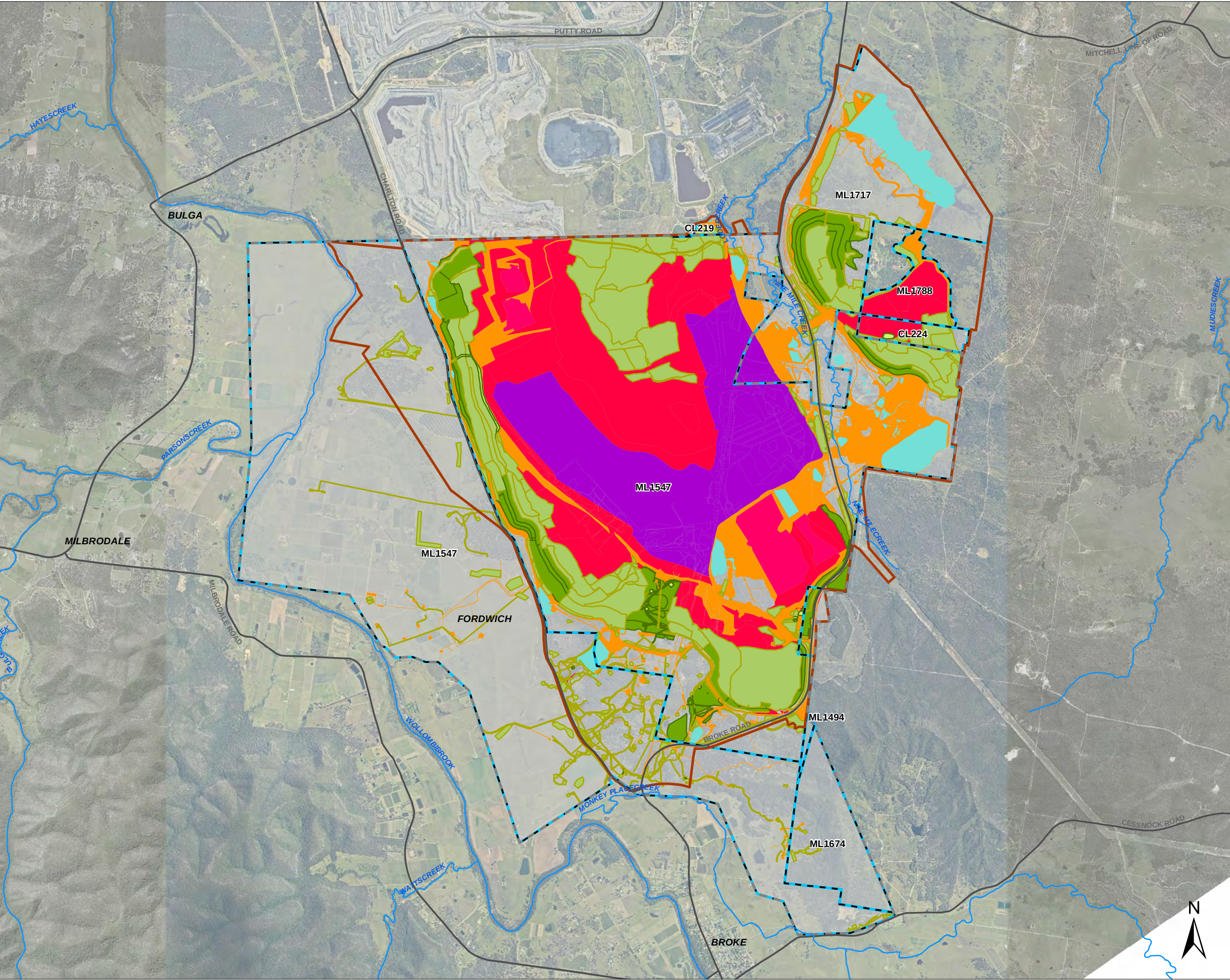
Material	Unit	Year 1 – FWP0001058	This report
Stripped topsoil (if applicable)	m ³	9,376	5,403
Rock/overburden	m ³	53,850,680	56,282,130
Ore	Mt	0	0
Reject material	Mt	3.16	3.96
Product	Mt	6.77	6.35

Plan 1

6.1 Plan 1 – status of mining and rehabilitation at completion of annual reporting period

Mine rehabilitation portal spatial data themes [*symbols will be ticks when data submitted in Mine Rehabilitation Portal*]

Submission of Plan 1 electronic copy (PDF) [*Attach Plan 1A and 1B PDF*]



BULGA COAL COMPLEX
REHABILITATION MANAGEMENT

BULGA COAL

GLENCORE

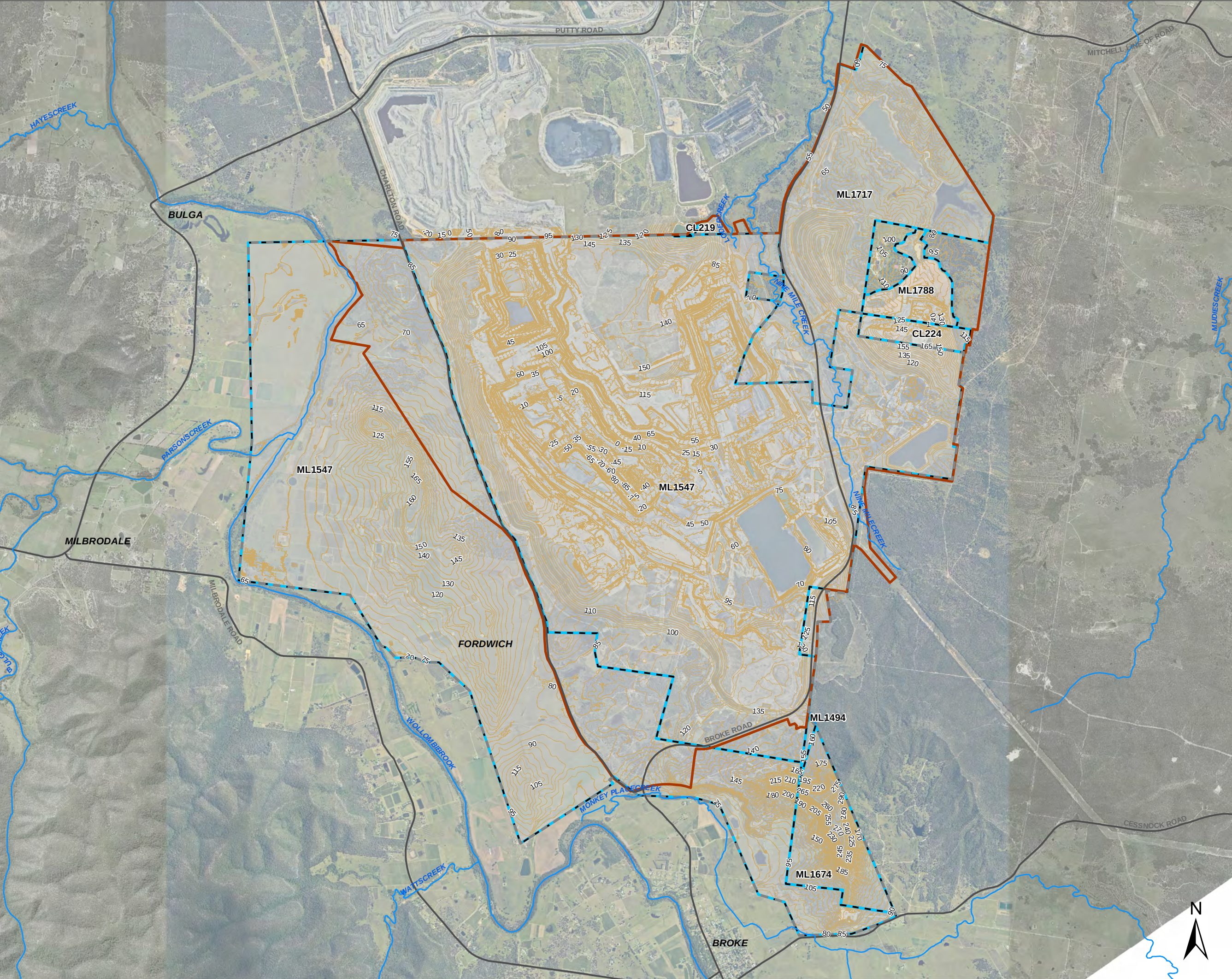
FIGURE 8 - REHABILITATION AND
DISTURBANCE AT END OF 2022
(PLAN 1A)

LEGEND

- Project Approval Boundary
- Bulga Underground Project Area
- Coal - Current Titles
- Major road
- Major Waterway
- Mining Domain Type**
 - Infrastructure Area
 - Other
 - Overburden Emplacement Area
 - Tailings Storage Facility
 - Underground Mining Area (SMP)
 - Active Mining Area (Open cut void)
 - Water Management Area
- Rehabilitation Phase**
 - Decommissioning
 - Growth Media Development
 - Ecosystem and Land Use Establishment
 - Ecosystem and Land Use Development

Coordinate System:	GDA2020 MGA Zone 56
Scale:	1:48,529 at A3
Data Theme Submission ID No.	NUMBER
Date:	23/03/2023
Drawn by:	NW

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BULGA COAL COMPLEX
REHABILITATION MANAGEMENT

BULGA COAL

GLENCORE

FIGURE 9 - LANDFORM
CONTOURS AT END OF 2022
(PLAN 1B)

- LEGEND**
- Project Approval Boundary
 - Bulga Underground Project Area
 - Coal - Current Titles
 - Current Landform Contours
 - Major Waterway
 - Major road

Coordinate System:	GDA2020 MGA Zone 56
Scale:	1:48,531 at A3
Data Theme	NUMBER
Submission ID No.	
Date:	23/03/2023
Drawn by:	NW

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Disturbance and Rehabilitation

7.1 Current disturbance and rehabilitation progression

[values automatically generated from data submitted to Mine Rehabilitation Portal]

Table 2 Current disturbance and rehabilitation progression

	Year 1 FWP0001058	This report
A Total Disturbance footprint – surface disturbance	3,265.1	3,481.9
B Total active disturbance (ha)	2,171.27	2,358.1
C Rehabilitation – Land Preparation (ha)	16.2	15.8
D Ecosystem and Land Use Establishment (ha)	868.46	857.2
E Ecosystem and Land Use Development (ha)	0	250.8
F Rehabilitation Completion (ha)	0	0

7.2 Rehabilitation key performance indicators (KPIs)

[values automatically generated from data submitted to Mine Rehabilitation Portal]

Table 3 Rehabilitation key performance indicators (KPIs)

	Year 1 FWP0001058	This report
G Total New Active Disturbance Area During Reporting Period (ha)	21.73	1.83
H Area of Land Proposed for Active Rehabilitation During Reporting Period (ha)	36.8	36.8
J Annual Rehabilitation to Disturbance Ratio	1.69	20.11
I Established Rehabilitation		
K % Rehabilitation Land to Total Mine Footprint		32.3%

7.3 Progressive achievement of established rehabilitation

[values automatically generated from data submitted to Mine Rehabilitation Portal]

Table 4 Progressive achievement of established rehabilitation

	This Report
L Established Rehabilitation for Agricultural Final Land Uses (%)	
M Established Rehabilitation for Native Ecosystem Land Uses (%)	
N Established Rehabilitation for other/non-vegetated final land uses (%)	

7.4 Variation to the rehabilitation schedule

Rehabilitation key performance indicators reported in the annual rehabilitation report and forward program are not consistent with the life of mine rehabilitation schedule in the rehabilitation management plan, or the rehabilitation schedule for Year 1 in the most recent forward program, this section must:

Identify the components of the most recent forward program that were not achieved. [1500 characters]

Rehabilitation in 2022 was as per the MOP predictions, whilst disturbance was less than planned due to delays in commencing construction of Dam S53.

Identify the key factors that have delayed the progressive rehabilitation schedule and the timing for any corrective actions. [1500 characters]

N/A

Outline actions that will be included in the forward program and carried out to minimise disturbance and undertake progressive rehabilitation as far as reasonably practical. [1500 characters]

N/A

Rehabilitation Monitoring

8.1 Rehabilitation monitoring

Provide a summary of the rehabilitation monitoring carried out in the annual reporting period, at established rehabilitation areas and at analogue sites, in accordance with the monitoring program detailed in the rehabilitation management plan.

This summary must include monitoring activities, such as inspections undertaken following the completion of key rehabilitation steps and phases of rehabilitation, in accordance with the rehabilitation quality assurance process in the rehabilitation management plan.

Rehabilitation monitoring summary [3000 characters]

In 2022 monitoring methods incorporated and addressed the requirements specified in BC's Rehabilitation Management Plan (RMP) and Biodiversity Management Plan (BMP), as well as Glencore procedure 'GCAA 11.16 - Completion Criteria and Rehabilitation Monitoring'. This included a combination of plot-based monitoring in accordance with the NSW Biodiversity Assessment Method (BAM) and walkover inspections of rehabilitation areas to detect potential issues occurring at the broader scale. For rehabilitation areas, the monitoring approach was implemented according to two distinct time periods:

- Initial establishment monitoring (IEM) – rapid monitoring of rehabilitation aged 1 to 3 years, mainly focussing on native species germination success, landform stability (i.e. erosion issues) and early identification of problematic weeds.
- Long-term monitoring (LTM) – detailed scientific monitoring of older rehabilitation (>3 years) to evaluate and track progress toward defined rehabilitation objectives and completion criteria.

In 2022, a total of 19 rehabilitation blocks and 52 transects/plots were assessed across the Viking Dump, Noise and Visual Bund (NVB) and Eastern Emplacement Area (EEA), including eleven blocks monitored for IEM, seven blocks monitored for LTM and one block of temporary rehabilitation. All rehabilitation blocks assessed (except temporary rehabilitation) were being returned to a native woodland land use and covered a cumulative area of approximately 461.2 hectares.

Analogue Site Baseline Monitoring

Reference monitoring plots are established in remnant native vegetation, these sites set the benchmark for assessment of rehabilitation performance.

Long-term monitoring (LTM) was conducted at three reference sites in May 2022 located within each of the following vegetation communities:

- Central Hunter Grey Box – Ironbark Woodland Endangered Ecological Community (EEC);
- Central Hunter Ironbark – Spotted Gum – Grey Box Forest EEC; and
- Swamp Oak Forest (two sites).

Annual Rehabilitation Walk Over Inspections

The annual rehabilitation walkover inspection provides management recommendations to assist the rehabilitation in moving towards the criteria. During 2022, the assessment consisted of a walkover inspection of each IEM and LTM block, ensuring optimum geographical coverage within the timeframes allocated for the assessment.

Temporary Rehabilitation Monitoring

In 2022 one block of rehabilitation was monitored as temporary rehabilitation, these areas are inspected solely to demonstrate adequate stability and vegetative cover.

Further details regarding the Bulga Coal Complex Rehabilitation monitoring in 2022 can be found in the Bulga Coal 2022 Annual Review.

8.2 Status of performance against rehabilitation objectives and rehabilitation completion criteria

Provide details about the monitoring program that has been implemented to evaluate how rehabilitation is progressing against the approved, or if not yet approved, the proposed rehabilitation objectives, rehabilitation completion criteria and final landform and rehabilitation plan. [1500 characters]

The objective of the long-term monitoring program (areas >3 years old) is to evaluate progress of rehabilitation towards fulfilling completion criteria, additional statutory requirements that may apply to the operation and ultimately the targeted post-mining land use.

A total of seven LTM blocks were assessed, in which a total of 24 plots were monitored.

Additionally, LTM monitoring was conducted at three reference sites in May 2022 located within each of the following vegetation communities:

- Central Hunter Grey Box – Ironbark Woodland Endangered Ecological Community (EEC);
- Central Hunter Ironbark – Spotted Gum – Grey Box Forest EEC; and
- Swamp Oak Forest (two sites).

The initial establishment monitoring (IEM) is a rapid style assessment of young (≤ 3 years old) rehabilitated areas, principally to determine germination success, presence of weeds and landform stability. In 2022 A total of eleven IEM blocks were assessed.

Are all rehabilitation areas in the Landform Establishment phase or higher represented in the monitoring program to assess performance against the approved, or if not yet approved, the proposed rehabilitation objectives, rehabilitation completion criteria and final landform and rehabilitation plan? [Select Yes/No]

Yes, a total of 19 rehabilitation blocks and 52 transects/plots were assessed across the Viking Dump, Noise and Visual Bund (NVB) and Eastern Emplacement Area (EEA), including seven blocks monitored for LTM.

Include an appraisal of whether rehabilitation is moving towards achieving the approved, or if not yet approved, the proposed rehabilitation objectives, rehabilitation completion criteria and final landform and rehabilitation plan. [1500 characters]

Based on the 2022 LTM block field assessments (walkover observations and plot-based monitoring results), an assessment of the current rehabilitation condition against the completion criteria was provided within the 2022 Rehabilitation Monitoring Report. A summary of compliance findings is provided below:

Five of the seven LTM blocks returned a BAM compositional attribute score within the defined completion criteria. With localised exceptions, vegetation structure and function attribute scores were however below targets which mainly reflected the still relatively young ecological age of the rehabilitation. Positively, between 32.1–70.4% (average ~42.8%) of native tree and shrub species were recorded as bearing reproductive structures at the time of monitoring, indicating an overall good potential for the established communities to be self-sustainable.

Cover of high threat weeds was non-compliant for four out of seven of the LTM blocks, while the remaining three sites were compliant.

The presence of litter cover against benchmark was trending towards benchmarks for all seven LTM blocks.

Evidence of invertebrates and artificial habitat features established at adequate densities were compliant for all seven LTM blocks.

Based on the above findings, overall, the rehabilitation is trending towards achieving the approved completion criteria, proposed rehabilitation objectives and final landform and rehabilitation plan.

Please select the best description of the appraisal: [select one choice]

- Rehabilitation is moving towards achieving the final land use as soon as reasonably practicable
- There are performance issues preventing rehabilitation moving towards achieving the final land use as soon as reasonably practicable

Include summaries of the findings of the rehabilitation monitoring program, including specialist reports (e.g. ecology, water quality, agronomy). [1500 characters]

Temporary Rehabilitation

The one block of temporary rehabilitation assessed in 2022 showed no major erosion issues and variable but overall satisfactory vegetative cover.

IEM Blocks

- IEM blocks were identified as requiring erosion repair works.
- Ground cover protection (live + litter) and native species assemblages were overall satisfactory.
- Priority weed cover levels exceeded allowable levels in all IEM blocks across the NVB/Viking Dump rehabilitation and were locally very severe. Moderate to high densities of young Lantana seedlings were establishing across most locations across the Eastern Emplacement Area blocks.

LTM Blocks

- All LTM blocks showed excellent soil and slope stability.
- Established native species assemblages were generally satisfactory.
- Five of the seven LTM blocks returned a BAM compositional attribute score within the defined completion criteria.
- Weed cover levels were satisfactory across all EEA rehabilitation LTM blocks. In contrast, all blocks on the Viking Dump / NVB displayed problematic weed levels.

Reference Sites

Reference site results from 2022 showed no further deterioration in overall vegetation quality and integrity compared to previous years.

A more detailed summary of the rehabilitation monitoring program results are provided within Section 8.6 of the Annual Review and Section 9 of the Bulga Coal Complex Rehabilitation and Ecological Monitoring Report 2022.

Include any performance issues and their causes including identification of any knowledge gaps that must be addressed to rectify identified performance issues. If none identified, type "Nil". [1500 characters]

Rehabilitation IEM Blocks

As a function of the rainfall received in the past two years including several heavy rainfall events, some erosion issues have materialised across the IEM blocks where vegetation is in early stages of establishment (particularly in Year 1 blocks). Seven of the eleven IEM blocks were identified as requiring erosion repair works, ranging from localised tunnel inlets in contour banks to gullying of moderate to high severity (i.e. 30cm-<1m in depth).

Due to weed cover levels, the ground layer across the NVB/Viking Dump will need to be improved towards a native-dominated composition, however this undertaking is unlikely to be practical at least until significant tree growth has been achieved.

Significant and ongoing management inputs will also be required to control the young Lantana seedlings identified across the EEA.

Rehabilitation LTM Blocks

All blocks on the Viking Dump / NVB displayed problematic weed levels, and the ground layer was often severely infested with high-threat grasses. Although inevitable to meet rehabilitation objectives, the management of these grasses will be difficult and likely require significant management inputs and long-timeframes.

Localised reductions in tree stem densities will likely be required in the future to encourage the development of adequate vegetation structure, however, has not been recommended for immediate implementation on the precept that high tree densities should, in the short term, facilitate the management of high-threat grasses populations.

8.3 Outcomes of rehabilitation research and trials

Summarise the results and outcomes of any research projects and rehabilitation trials (where relevant) and identify whether research projects and rehabilitation trials are complete, ongoing, or will lead to any follow up trials or research programs.

List of active rehabilitation research and trials

[this looks like it would carry over data from previous Forward Program]

If required, add rows to in-built table. For each row, include:

- **Project/trial name**

Tree Thinning Trial

- **Objective of trial/project [200 characters]**

Higher than desired densities of Eucalypt species were found to be leading to suppression of understorey CHGBI EEC species. The tree thinning trial aims to reduce suppression of understorey species.

- **Methodology [500 characters]**

A team of experienced land management and environmental restoration contractors conducted the tree thinning using the cut and paint method. Areas subject to thinning works will be monitored in subsequent years to assess EEC development.

The 2022 rehabilitation monitoring program assessed areas that had been previously thinned for success and identified areas for future tree thinning. Further thinning will likely be required in the future in areas of excessive stem densities (>1,000 stems/ha).

- **Expected date of completion [select date]**

- **N/A**

- **Status [select from: complete/ongoing/superseded/cancelled/not started]**

Ongoing

- **On track [select Yes/No]**

List of inactive rehabilitation research and trials

[Automatically populates from previous Forward Program – no option to add additional]

Finalise

9.1 Finalise and submit application

[Complete declaration]

[Submit]

1.0 Forward Program

The numbers used here relate to which tab they are found on in the RR Portal Forward Program Form.

Remember to save your drafts.

Note that **all fields allow a maximum of 1500 characters**, other than:

- 2.1 Project description – 1000 characters
- 3.4 Underground subsidence remediation – 1000 characters
- 3.5 Research trials – trial objectives, 200 characters; trial methodology, 500 characters

1.1 Applicant details

[Select applicant details from drop-down options]

2.0 Surface Disturbance Activities

2.1 Project description

Provide a description of the mining project. The description must be consistent with the development consent for the mine (1000 characters only)

Bulga Coal is located approximately 12 km southwest of Singleton, and approximately 2 km from the townships of Broke and Bulga, in the Upper Hunter Valley of New South Wales. Development Consent SSD-4960 allows for extraction of up to 12.2 million tonnes of ROM coal from open cut mining operations per calendar year, up until 31 December 2039. BOC incorporates the Coal Handling and Preparation Plant (CHPP). The CHPP and the rail loading facility are located in the north-east corner of Bulga Coal and service both BUO and BOC. The BUO ceased mining and sealed the Blakefield South Mine in May 2018.

2.2 Description of surface disturbance activities

2.2.1 Exploration activities

Identify and describe exploration activities that are proposed or likely to be proposed to be carried out in areas within the mining leases in the next three years

Bulga Coal will continue to undertake exploration drilling within the mining lease area to obtain further information regarding resources to be mined as well as geological and geotechnical information relevant to future mining activities. No additional surface disturbance will be undertaken for the purpose of exploration.

2.2.2 Construction activities

Identify and describe any construction activities scheduled in the next three years

- Commissioning of the Nine Mile Creek water management system upgrades and Dam C3A in accordance with the *Bulga Coal Water Management Plan*.
- Drilling ten (10) exploration holes designed to further define the true seam dip at the inflection point of the Mt Thorley Monocline throughout the Main Pit mine plan.
- Installation of Piercefield Seam pre-drainage gas wells and pipelines which will be reticulated to the gas fired power station and associated flares.
- Construction of mine dewatering pump station, associated pipelines and power supply.
- Construction and commissioning Dam S53 and associated pump station, pipelines and drainage.
- Construction of colour bond fencing adjacent to Broke Road.
- Sealing of the East Pit car parking area.
- Relocation of a high voltage substation.

- Modification and upgrades to offices and bath house at the East Pit Offices.
- Construction of a light vehicle workshop at the East Pit Offices.
- Construction of a light vehicle wash bay facility.
- Construction of a bulk fuel facility and decommissioning of the light vehicle bulk fuel facility.
- Relocation of temporary shelter structures (Igloo's) at Mine Infrastructure Area (MIA).
- Construction of a four bay maintenance workshop at the MIA.
- Decommissioning of Dam MW2 and Dam S7.

2.2.3 Mining schedule

Describe the method of mining development and sequencing and general mine features

Open cut mining in the Main Pit, Southern Extension and East Pit at a rate up to 12.2 Mtpa ROM coal via truck and shovel mining. BOC will extend the open cut mining areas to the south. Existing rehabilitated areas across the east and main pit dumps will be re-disturbed to allow for additional overburden emplacement as approved under the Bulga Optimisation Project SSD-4960 MOD 3.

- Year 1 – 18.8 ha of new disturbance will occur for the progression of mining into the BOP MOD 3 additional disturbance area and construction of infrastructure. 66.5 ha of previously rehabilitated areas will be re-disturbed to allow overburden emplacement across the east and main pit dumps as per the Bulga Optimisation Project SSD-4960 MOD 3.
- Year 2 – 4.5 ha of new disturbance will occur for the progression of mining into the BOP MOD 3 additional disturbance area. 85.4 ha of previously rehabilitated areas will be re-disturbed to allow overburden emplacement across the east and main pit dumps as per the Bulga Optimisation Project SSD-4960 MOD 3.
- Year 3 – 5.9 ha of new disturbance will occur for the progression of mining into the BOP MOD 3 additional disturbance area. 59.9 ha of previous rehabilitation will be re-disturbed to allow overburden emplacement across the east and main pit dumps as per the Bulga Optimisation Project SSD-4960 MOD 3.

Describe the areas identified for emplacements, the sequencing of emplacements, construction and management

Overburden will be emplaced in either out-of-pit emplacement areas (Noise and Visual Bund, and Eastern Emplacement Areas) or in-pit, filling previously mined areas. Overburden emplacement will focus on reaching final dump height at the Eastern Emplacement area to enable progressive rehabilitation works each year as shown in the Forward Work Program.

Identify processing infrastructure activities and the location of tailings facilities and schedule for emplacement

Tailings generated through coal processing will be pumped from the Bulga CHPP (located to the east of Broke Road) to the Northern TSF (NTSF). Tailings material currently stored in the existing Deep Pit and Bayswater Pit TSFs will be pumped to the NTSF via the Tailings Relocation System. Coarse rejects and paste thickened tailings will be co disposed with overburden.

Describe waste disposal and materials handling operations over the next three years. This should include a discussion of disposal of putrescible waste, hydrocarbons, and management of contaminated soils

Waste is removed by a licensed contractor and where appropriate, the waste is recycled. Wastes removed from site include batteries, light vehicle tyres, scrap metal, domestic waste, fuel and oil filters, solvent, radiator coolant, wooden pallets, oily rags, and oily water from oil water separator systems. Bulga manages hydrocarbon contaminated spoil onsite by treating it at the onsite bioremediation facility.

2.2.4 Key production milestones

Provide an outline of the key production milestones that underpin the proposed rehabilitation schedule
[insert table and quantities in form submission – also found in Section 2.1.2, Table 9, ARRF Form & Way]

Material	Unit	Year 1	Year 2	Year 3
Stripped topsoil	m ³	28,200	6,750	8,850
Rock/overburden	m ³	60,328,965	61,540,130	60,028,639
Ore	Mt	-	-	-
Reject material	Mt	2.89	3.53	3.74
Product	Mt	7.12	6.65	6.84

3.0 Rehabilitation Forecast

3.1 Rehabilitation planning schedule

Provide a schedule, with defined milestones, outlining the rehabilitation planning activities (where applicable) that will be carried out over the next three years, to address potential knowledge gaps and to ensure that rehabilitation is undertaken as soon as reasonably practicable.

Rehabilitation planning is included in the site's annual Life of Mine and Budget Mine Planning processes. Each year, prior to June, Bulga Coal conducts a Life of Mine Plan risk assessment and then develops a new Life of Mine plan for the subsequent year. This life of Mine Plan includes all clearing, rehabilitation, and mine closure requirements to meet the site's rehabilitation objectives. A Budget Mine Plan for the subsequent 5 years is then developed and includes clearing, rehabilitation, and mine closure activities for the budget period. The Forward Program (this document and associated figures) is then developed based on the Budget Mine Plan.

An annual Mine Closure risk assessment is conducted to review rehabilitation and mine closure risks and ensure appropriate controls and or mitigation measures are implemented.

Provide an overview of relevant stakeholder consultation that will be carried out over the next three years.

Bulga Coal have a Stakeholder Engagement Strategy (SES) which facilitates the planning and implementation of Bulga Coal's community and stakeholder engagement conducted throughout the lifecycle of the operations, including site closure. The SES will be revised based on engagement outcomes with Bulga Coal's community and stakeholders around rehabilitation and closure including the social dimensions of site closure. Over the next three years Bulga Coal will engage various stakeholders to further refine the final land use, final landform and rehabilitation completion criteria for the site.

Provide an overview of rehabilitation studies, risk assessments and/or design work associated with finalising the rehabilitation methodologies relating to establishment of the final landform, surface water management, final void management, and tailings dam decommissioning that will be carried out over the next three years.

Over the next three years Bulga Coal will complete the following activities to finalise its rehabilitation methodologies.

- Revise the Conceptual Mine Closure Plan to incorporate potential management in perpetuity associated with the declared dams.
- Assess the long-term stability of final landforms constructed across the site (both currently constructed and proposed), Bulga will consider using a Landform Evolution Model (LEM) or similar to determine the scope (if any) of management/maintenance requirements that may be needed to address potential erosion issues.

3.2 Rehabilitation maintenance and corrective actions

Include a detailed description of the rehabilitation maintenance and corrective action measures that will be carried out to address all rehabilitation performance issues and/or knowledge gaps identified in the latest annual rehabilitation report.

Based on outcomes of the annual monitoring and inspection program, a maintenance program is developed annually for implementation. At present maintenance activities include:

- Ongoing repairs to erosion across the established landform particularly following periods of high rainfall;
- Maintenance repairs and desilting of erosion and sediment controls e.g. drop structures, geomorphic drainage lines, contour banks and sediment dams;
- Ongoing weed and pest control; and
- Re-seeding or infill planting where monitoring identifies vegetation is not trending towards the targeted vegetation community.

3.3 Rehabilitation schedule

Outline the key activities required to implement the mining and rehabilitation schedule for the next three years. The information in this section must be consistent with the spatial depiction of progressive rehabilitation shown on Plan 2. Note: This section must describe how the mining and rehabilitation schedule has been developed to minimise disturbance and progressively rehabilitate as soon as reasonably practicable.

Overburden will be emplaced in either out-of-pit emplacement areas (Noise and Visual Bund, and Eastern Emplacement Areas) or in-pit, filling previously mined areas. The sequence of mining and development of emplacement areas has been designed to allow early and progressive final rehabilitation. All areas available for final rehabilitation will be shaped and rehabilitated according to the final land use plan. Temporary rehabilitation (aerial seeding with stabilisation species) will be undertaken on areas of inactive overburden emplacement which has not yet reached the final landform height.

- Year 1- 38.5ha of native woodland rehabilitation will be established across a natural landform at the Eastern Emplacement Area and Main Pit Emplacement Area.
- Year 2 – 31 ha of native woodland rehabilitation will be established at the Eastern Emplacement Area.
- Year 3 – 93.4 of native woodland rehabilitation across the Noise and Visual Bund, and the Eastern Emplacement Area.

3.4 Subsidence remediation for underground operations

Provide an overview of the nature and scope of any subsidence monitoring and expected remediation works proposed to be conducted over the next three years (1000 characters only)

There is currently no active underground mining occurring across Bulga Complex mining titles and no current SMP in place. Whilst no ongoing subsidence associated with historic underground mining is predicted, subsidence monitoring is conducted annually and post high rainfall events. Any areas of subsidence will be remediated as per section 6.3 of the RMP. At present there are no areas of active subsidence requiring remediation and therefore this has been excluded from the forward program.

3.5 Rehabilitation research and trials

Provide a detailed description of the rehabilitation research and trials that will be carried out in the three-year forecast period (where applicable). This must include the rehabilitation research and trials identified in the rehabilitation management plan and/or any other rehabilitation research or trials proposed to address knowledge gaps identified in annual rehabilitation reports.

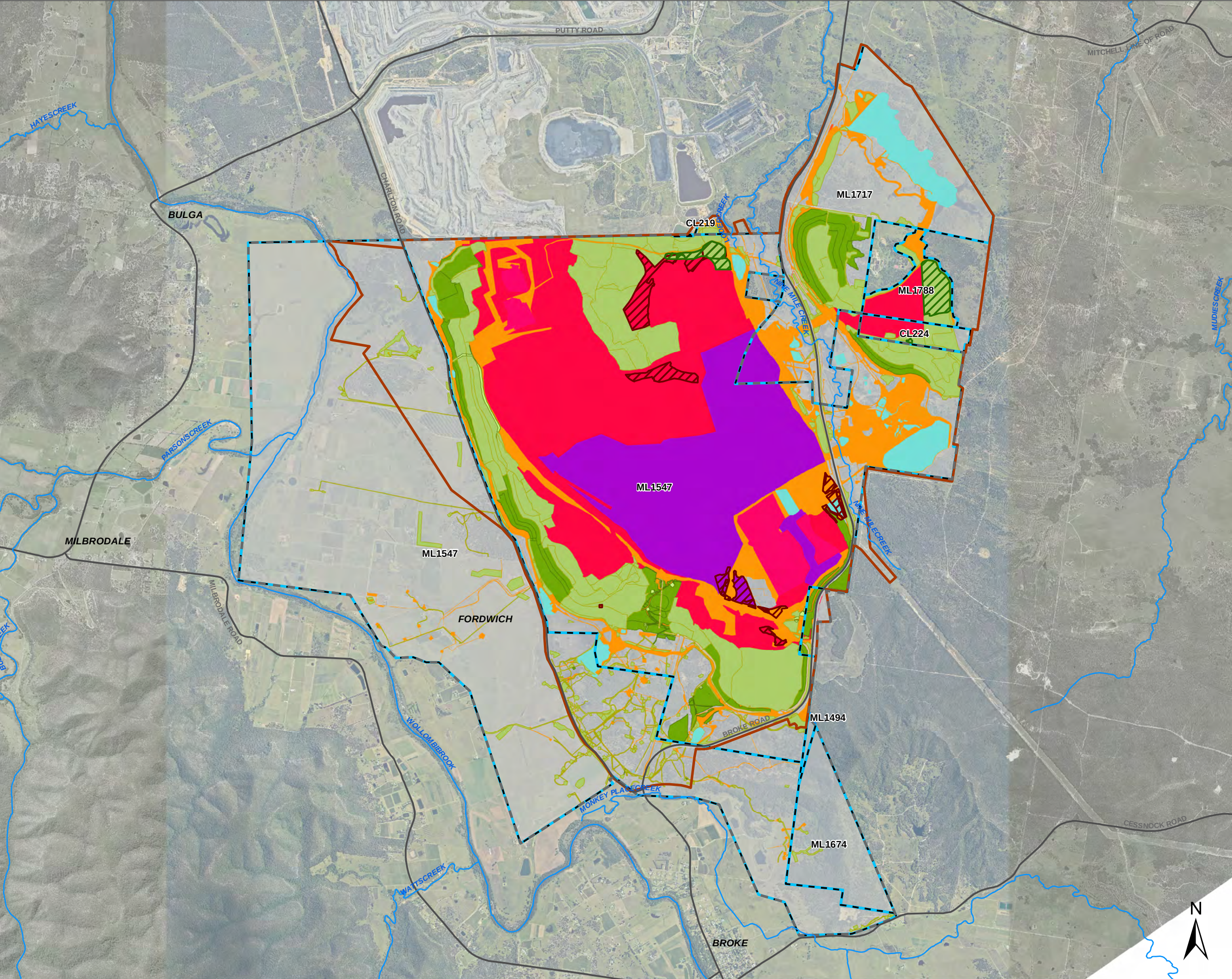
[Complete table in form submission for active and inactive research and trials. For each trial (row added) – trial objective allows 200 characters; trial methodology allows 500 characters]

RRT Number	Project/Trial Name	Objective of Trial/Project	Methodology	Expected Date of Completion	Status
RRT0001042	Canopy Tree Thinning Trial	To assess whether tree thinning at early stages of rehabilitation establishment is effective in reducing stem densities without increasing weed growth	A team of experienced land management and environmental restoration contractors conducted the tree thinning using the cut and paint method. Areas subject to thinning work will be monitored in subsequent years to assess EEC development. The 2022 rehabilitation monitoring program assessed areas that had been previously thinned for success and identified areas for future tree thinning. Further thinning will likely be required in the future in areas of excessive stem densities (>1,000 stems/ha).	31 Dec 2023	Ongoing

4.0 Plan 2

4.1 Submission of plan 2 spatial data

[upload Plan 2A, 2B, 2C PDFs]



BULGA COAL COMPLEX
REHABILITATION MANAGEMENT

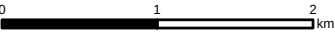
BULGA
COAL

GLENCORE

MINING AND REHABILITATION
YEAR 1 - 2023
(PLAN 2A)

LEGEND

- Project Approval Boundary
- Bulga Underground Project Area
- Coal - Current Titles
- Major road
- Major Waterway
- Mining Domain Type**
 - Infrastructure Area
 - Overburden Emplacement Area
 - Tailings Storage Facility
 - Active Mining Area (Open cut void)
 - Water Management Area
- Rehabilitation Phase**
 - Decommissioning
 - Growth Media Development
 - Ecosystem and Land Use Establishment
 - Ecosystem and Land Use Development
- Forecast Area - Year 1 (2023)**
 - Ecosystem and Land Use Establishment
 - Forecast Disturbance



Coordinate System: GDA2020 MGA Zone 56

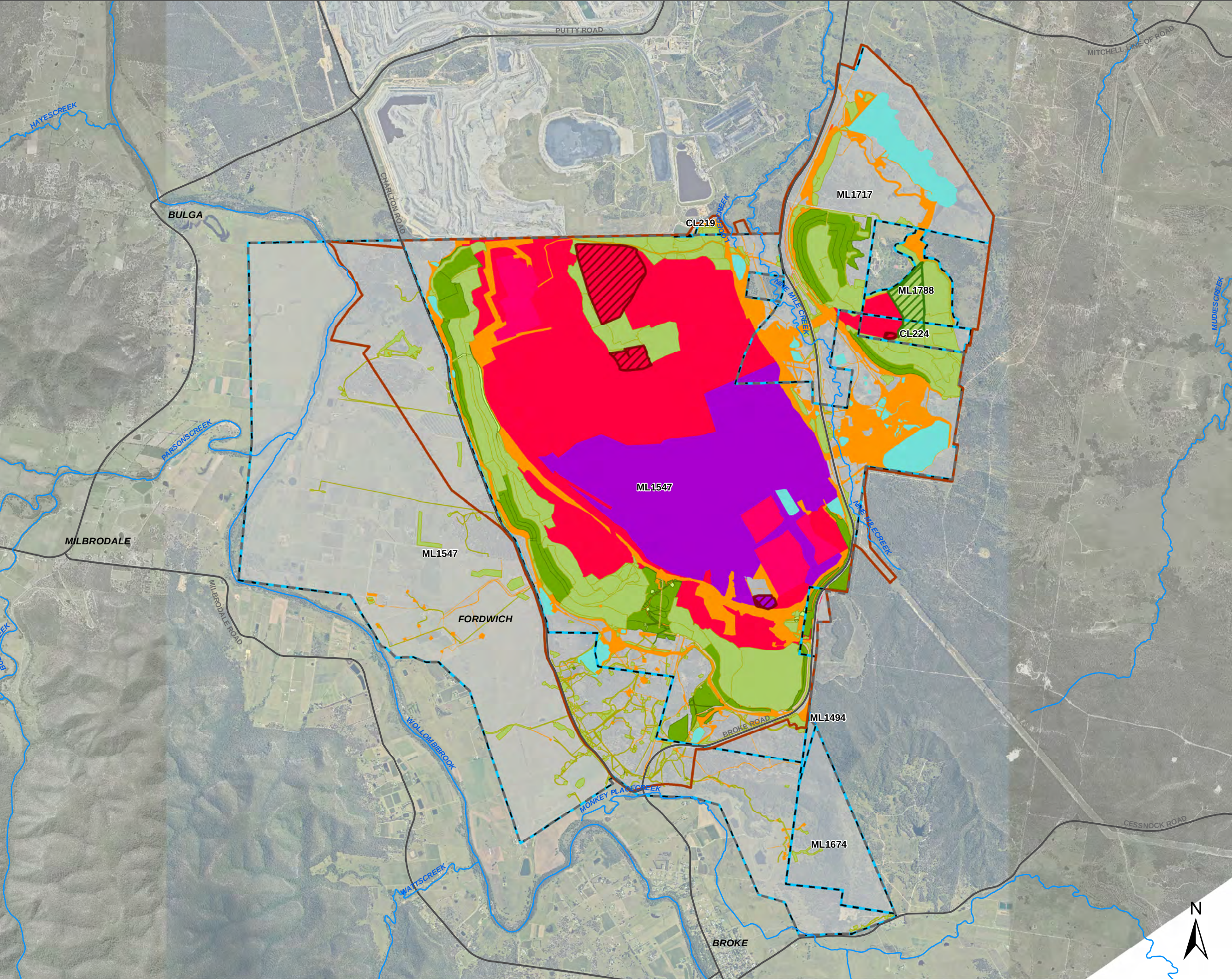
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Data Theme
Submission ID No. 2764

Date: 23/03/2023

Drawn by: NW

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BULGA COAL COMPLEX
REHABILITATION MANAGEMENT

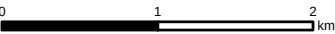
BULGA
COAL

GLENCORE

MINING AND REHABILITATION
YEAR 2 - 2024
(PLAN 2B)

LEGEND

- Project Approval Boundary
- Bulga Underground Project Area
- Coal - Current Titles
- Major road
- Major Waterway
- Mining Domain Type**
 - Infrastructure Area
 - Overburden Emplacement Area
 - Tailings Storage Facility
 - Active Mining Area (Open cut void)
 - Water Management Area
- Rehabilitation Phase**
 - Decommissioning
 - Growth Media Development
 - Ecosystem and Land Use Establishment
 - Ecosystem and Land Use Development
- Forecast Area - Year 2 (2024)**
 - Forecast Disturbance
 - Ecosystem and Land Use Establishment



Coordinate System: GDA2020 MGA Zone 56

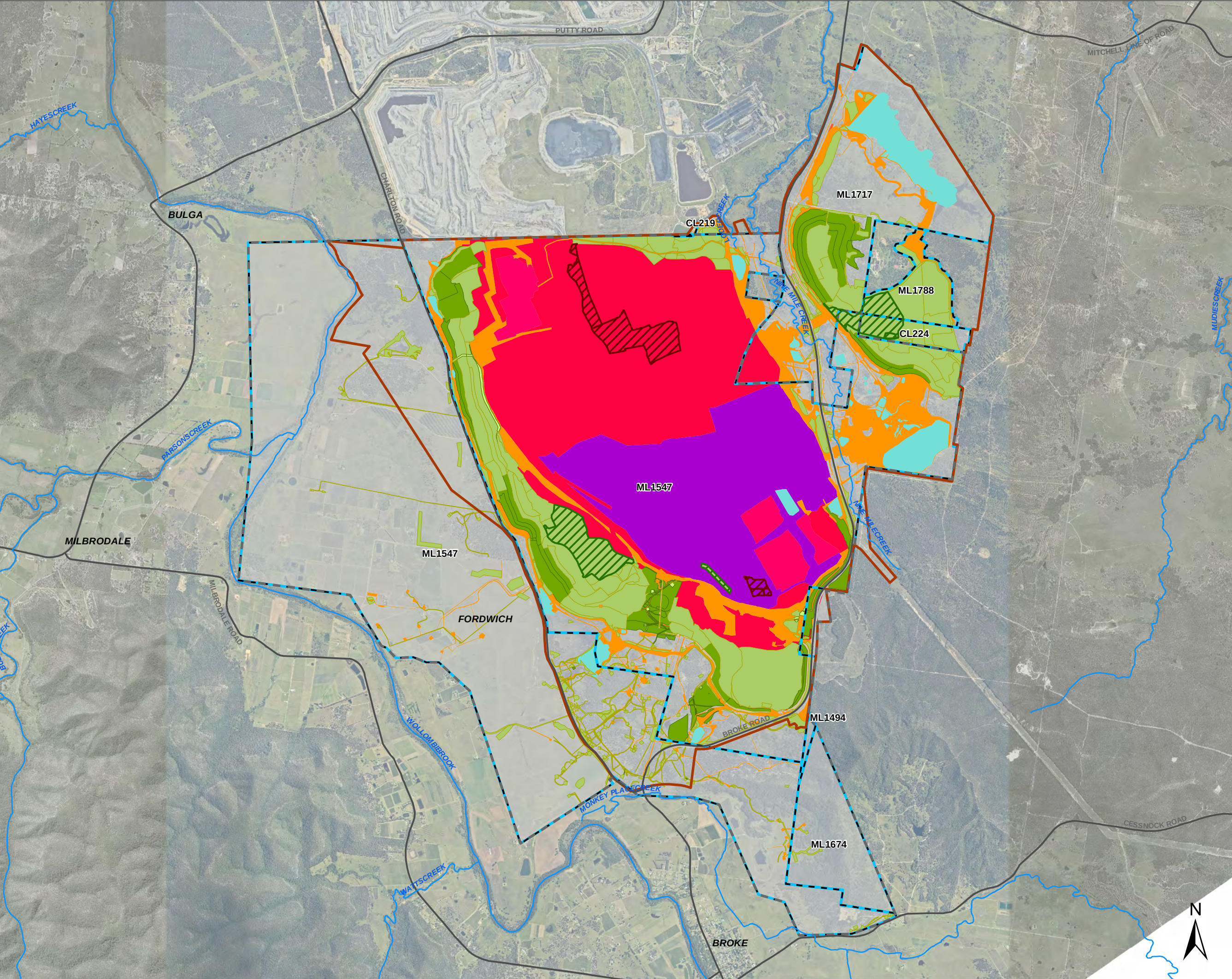
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Data Theme
Submission ID No. 2764

Date: 23/03/2023

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BULGA COAL COMPLEX
REHABILITATION MANAGEMENT

BULGA COAL

GLENCORE

MINING AND REHABILITATION
YEAR 3 - 2025
(PLAN 2C)

- LEGEND**
- Project Approval Boundary
 - Bulga Underground Project Area
 - Coal - Current Titles
 - Major road
 - Major Waterway
 - Mining Domain Type**
 - Infrastructure Area
 - Overburden Emplacement Area
 - Tailings Storage Facility
 - Active Mining Area (Open cut void)
 - Water Management Area
 - Rehabilitation Phase**
 - Decommissioning
 - Growth Media Development
 - Ecosystem and Land Use Establishment
 - Ecosystem and Land Use Development
 - Forecast Area - Year 3 (2025)**
 - Forecast Disturbance
 - Ecosystem and Land Use Establishment

0 1 2 km

Coordinate System: GDA2020 MGA Zone 56

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Data Theme Submission ID No. 2764

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5.0 Mining and Rehabilitation

[Cumulative disturbance and rehab progression, and KPI tables should automatically populate once Plan 2s are submitted to Mining Rehabilitation Portal]

Table 1 Three yearly forecast cumulative disturbance and rehabilitation progression

	Forecast	Unit	Year 1	Year 2	Year 3
A	Total disturbance footprint	Ha	3,500.7	3,505.2	3,511.1
B	Total active disturbance	Ha	2404.9	2,463.8	2,436.2
C	Land prepared for rehabilitation	Ha	0	0	0
D	Ecosystem and land use establishment	Ha	1095.8	1041.4	1074.9

Table 2 Rehabilitation key performance indicators

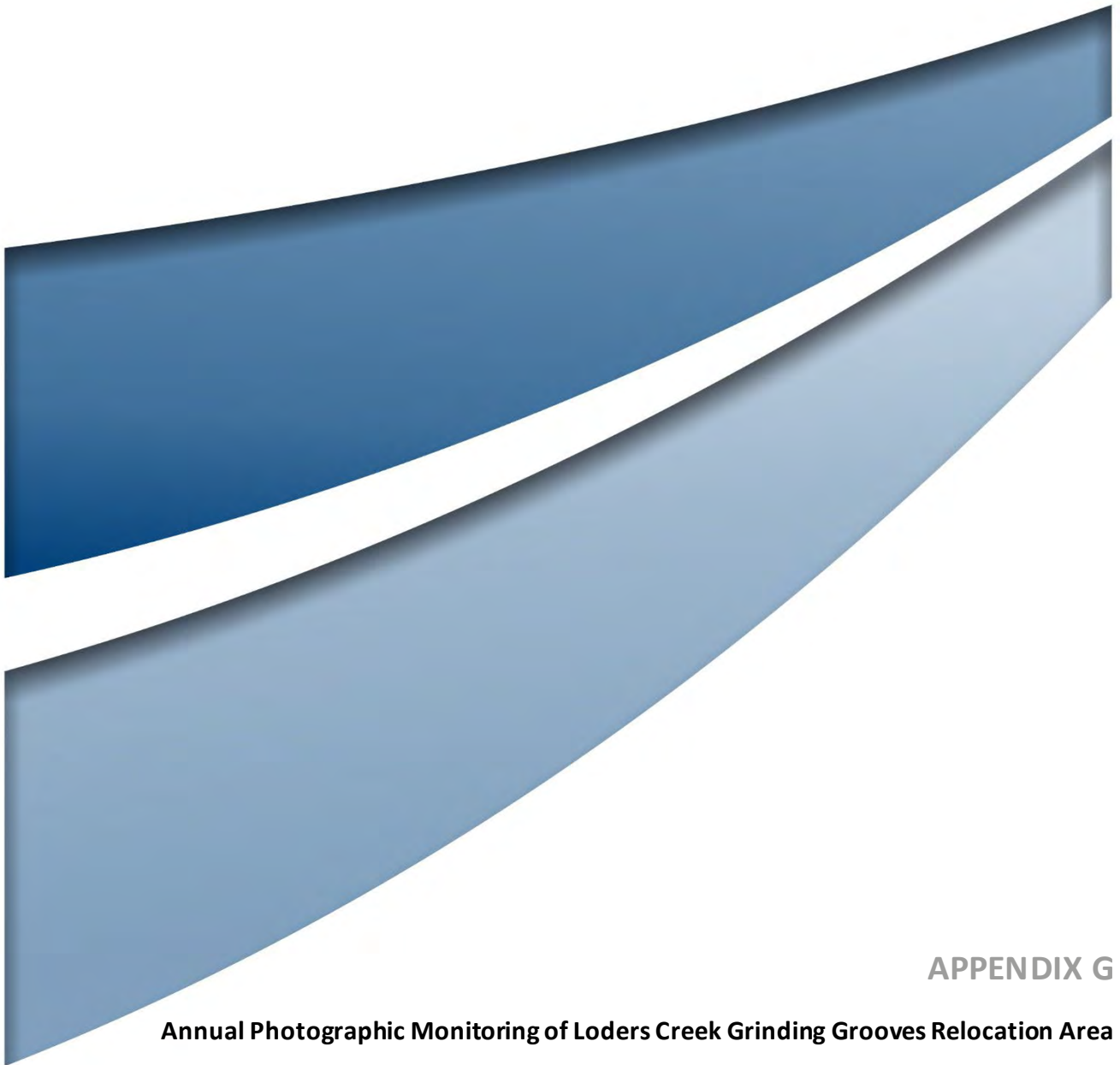
	Forecast	Unit	Year 1	Year 2	Year 3
O	Total new active disturbance area	Ha	85.3	89.9	65.8
P	Area proposed for active rehabilitation	Ha	38.5	31.0	93.4
Q	Annual rehabilitation to disturbance ratio		0.45	0.34	1.42

6.0 Rehabilitation Cost Estimate

[the RCE portal function is still under construction – our understanding is that until it is active (estimated late 2022) your RCE spreadsheet still needs to be emailed to nswresourcesregulator@service-now.com]

7.0 Finalise

[make declaration and save as draft or submit]



APPENDIX G

Annual Photographic Monitoring of Loders Creek Grinding Grooves Relocation Area

2 PHOTOGRAPHIC MONITORING OF LODERS CREEK GRINDING GROOVES RELOCATION AREA (LCGGRA)

As per Section 9.4.1 of the 2018 Bulga Coal *Aboriginal Cultural Heritage Management Plan* (ACHMP; BULCX-2103827161-4225), the BCC undertakes a quarterly monitoring program of all known Aboriginal sites at the BCC. The BCC also undertakes to conduct annual photographic monitoring at the LCGGRA in accordance with the *Loders Creek Grinding Grooves Conservation Area Management Plan* (Section 5) so that the condition of the slabs containing grinding grooves, as well as the general area, can be regularly monitored.

Photographic monitoring of the LCGGRA has occurred in September 2015, February 2017, February 2018, April 2019, April 2020, March 2021, and March 2021. This has enabled the grinding grooves to be monitored during the past six and a half years.

The 2017 monitoring program established four fixed photo points to enable an accurate on-going photographic record of the LCGGRA to be assembled. These photo points have been marked with wooden pegs hammered to just above ground level and the tops painted white and were used again in 2022.

The following protocol is followed for the photographic recordings at LCGGRA:

- All photographs are to be taken at:
 - Standing height (camera height is approximately 1.5 m)
 - 28 mm focal length
 - 200 ISO.
- Photographs should be taken in raw image format (digital negative)
- A one metre staff should be placed 10 m from the camera so that consistent scale in the photos can be ascertained
- Photo Point 1: Located on the upper terrace to the northeast of the grooves. Two photographs should be taken: one at 240°; and the other at 260°
- Photo Point 2: Located on the upper terrace to the southeast of the grooves. Two photographs should be taken: one at 300°; and the other at 320°
- Photo Point 3: Located on the lower terrace to the north of the grooves. One photograph should be taken at 220°
- Photo Point 4: Located on the lower terrace to the south of the grooves. One photograph should be taken at 35°
- Details of all five slab groups (A–E) should also be taken. Each photo should have a scale and a north arrow included.

Figure 2-1 shows two aerial (drone) views of the site and the location of the four photographic points and are shown on **Figure 2-2**. **Figure 2-3** provides an example of the 2017, 2020 and 2022 photographs taken from the four photographic monitoring points.

Figure 2-4 to **Figure 2-9** provide details of the slabs containing grooves to assess whether there has been any change in their condition between 2015 and 2022. Notes on any observable changes are provided in this figure.

Figure 2-1. Overhead views of the LCGGRA.

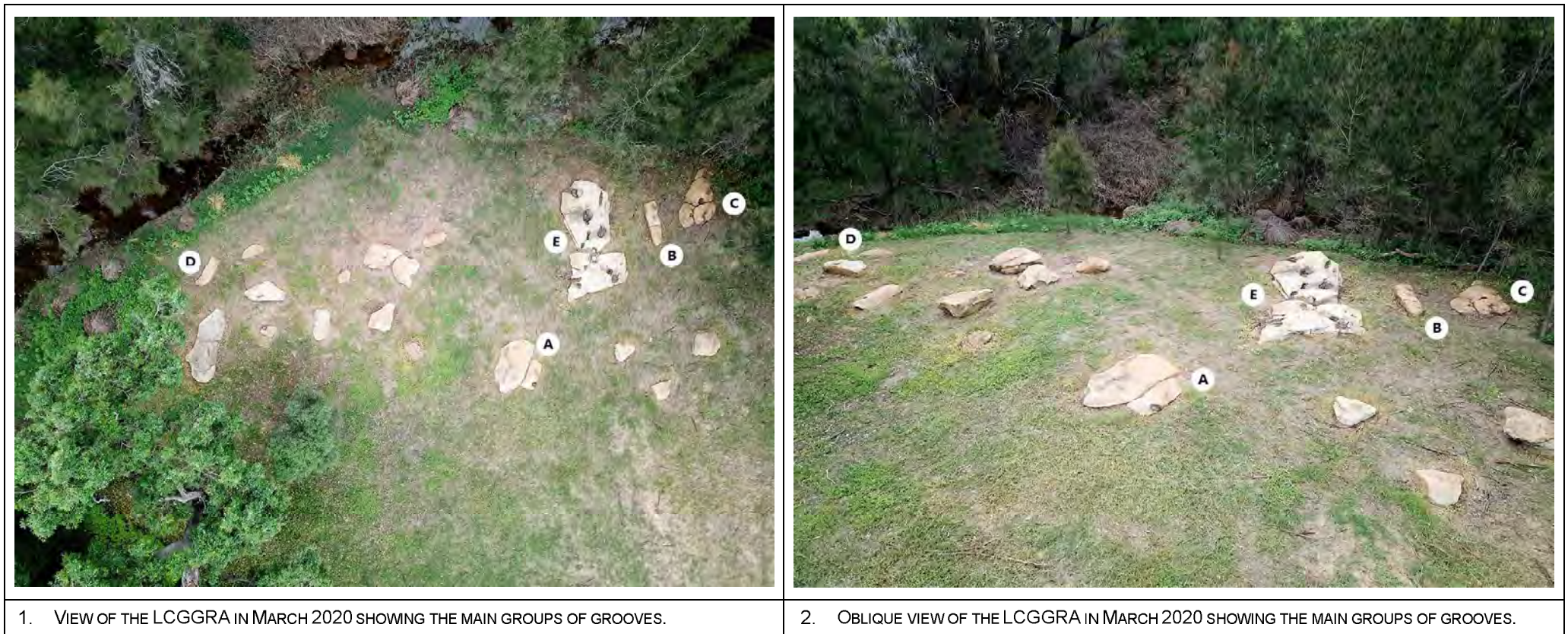


Figure 2-2. Plan of the LCGGRA showing the approximate location of the fixed photographic points.

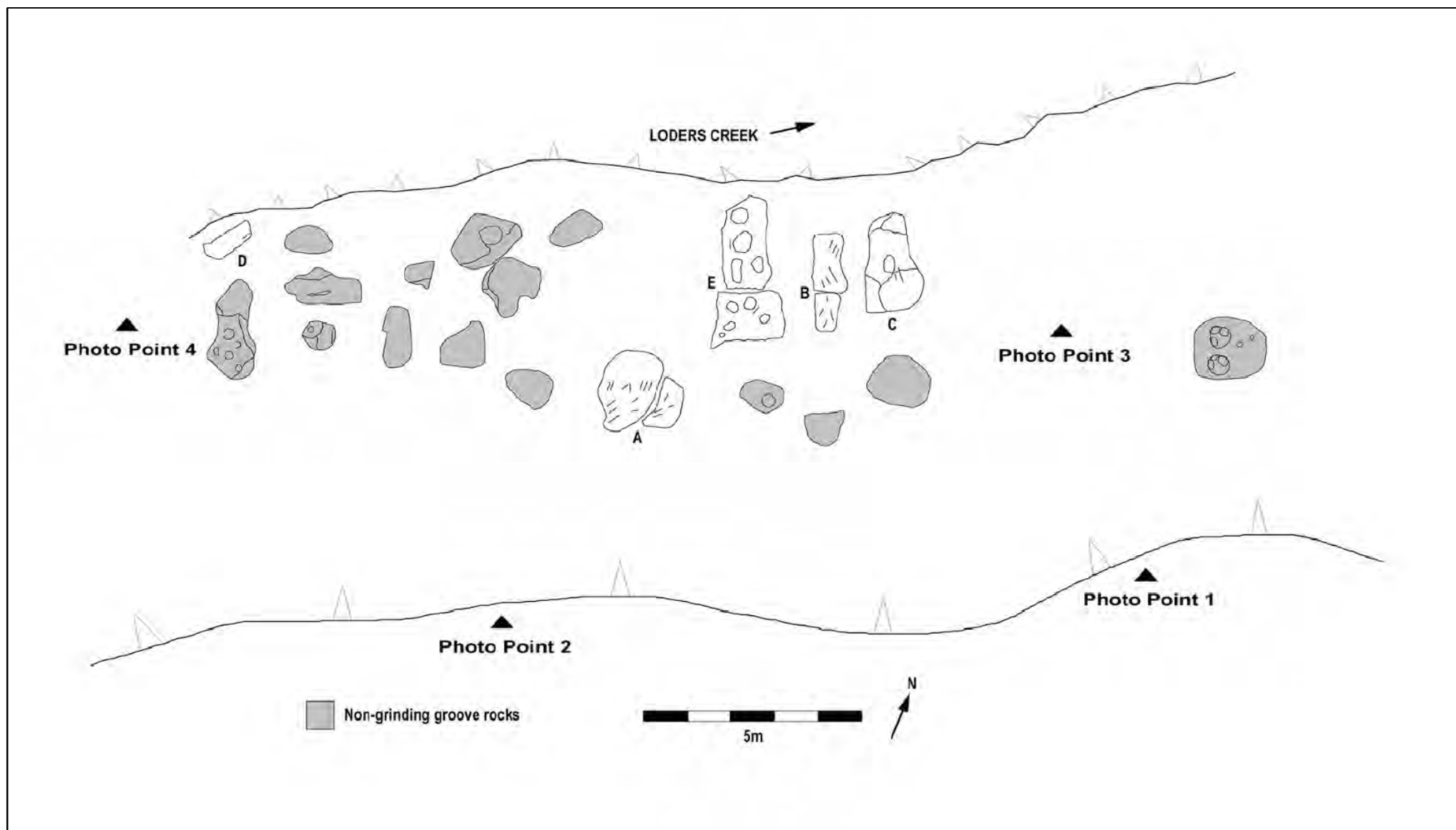


Figure 2-3. 2017–2022 photographic records of the LCGGRA taken from the four photographic points.

		
2017 VIEW FROM PHOTO POINT 1: 240°	2020 VIEW FROM PHOTO POINT 1: 240°	2022 VIEW FROM PHOTO POINT 1: 240°
		
2017 VIEW FROM PHOTO POINT 2: 320°	2020 VIEW FROM PHOTO POINT 2: 320°	2022 VIEW FROM PHOTO POINT 2: 320°



2017 VIEW FROM PHOTO POINT 3: 220°



2020 VIEW FROM PHOTO POINT 3: 220°



2022 VIEW FROM PHOTO POINT 3: 220°



2017 VIEW FROM PHOTO POINT 4: 35°

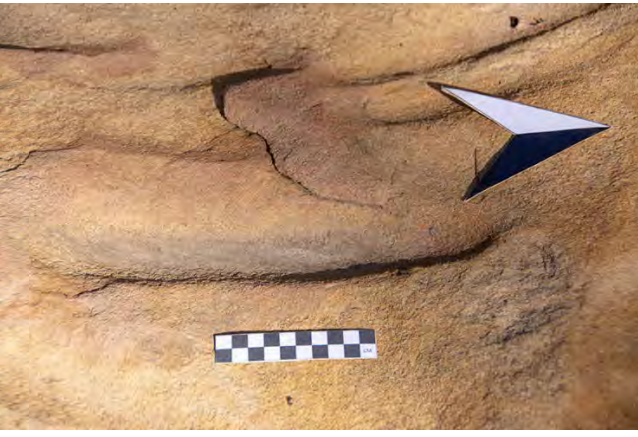


2020 VIEW FROM PHOTO POINT 4: 35°



2022 VIEW FROM PHOTO POINT 4: 35°

Figure 2-4. Comparison between the 2015–2022 condition of Group A at the LCGGRA.

		
GROUP A. SEPTEMBER 2015	GROUP A. FEBRUARY 2018	GROUP A. MARCH 2022

		GROUP A CONSISTS OF THE GREATEST NUMBER OF GROOVES THAT ARE DIVIDED ACROSS TWO SEPARATE SLABS, AS THEY WERE WHEN <i>IN SITU</i>. THE SLABS ARE STABLE APART FROM ONE AREA WHERE A LAYER OF SANDSTONE IS EXFOLIATING. AFTER SIX AND A HALF YEARS OF OBSERVATION (SEE ABOVE) THIS PORTION OF THE SLAB APPEARS NOT TO BE DETACHING FURTHER BUT IS BECOMING MORE WEATHERED. GENERALLY, THE GROOVES ARE SLOWLY BECOMING LESS DISTINCT ALTHOUGH THIS REMAINS A MARGINAL CHANGE AT THIS STAGE. IN 2022 THE ROCK SLABS WERE WET THAT ACCOUNTS FOR THE COLOUR CHANGE SEEN IN THE PHOTOGRAPHS.
GROUP A APRIL 2019	GROUP A MARCH 2022	

Figure 2-5. Areas of concern with the condition of Group A.

1. AN AREA ON THE EDGE OF THE LARGEST GROUP A SLAB WAS NOTED TO BE DETERIORATING IN 2020 WITH INCREASED CRACKING AND EXFOLIATION. PHOTO: 2020.



2. PHOTO OF THE CRACKED AREA IN 2022. THERE HAS BEEN NO DISCERNIBLE CHANGE FROM THE CONDITION OF THE SLAB SINCE 2020.

Figure 2-6. Comparison between the 2015–2022 condition of Group B at the LCGGRA.



Figure 2-7. Comparison between the 2015–2022 condition of Group C at the LCGGRA.

		
GROUP C. SEPTEMBER 2015	GROUP C. APRIL 2019	GROUP C. MARCH 2022

		GROUP C CONSISTS OF SEVERAL SLABS THAT HAD BROKEN APART PRIOR TO THE REMOVAL OF THE GROOVES. THE SLABS ARE STABLE APART FROM THE PRE-EXISTING CRACKS BETWEEN THE SLABS. THERE HAS BEEN NO DISCERNIBLE INCREASE IN THE WIDTH OF THE CRACKS IN THE SIX AND A HALF YEARS SEPARATING THE PHOTOGRAPHIC MONITORING EVENTS. THE GROOVE SEEN CLEARLY IN THE 2015 PHOTOGRAPH STILL REMAINS DISTINCT IN 2022.
GROUP B APRIL 2019	GROUP C MARCH 2022	

Figure 2-8. Comparison between the 2015–2022 condition of Group D at the LCGGRA.

		
GROUP D. SEPTEMBER 2015	GROUP D. APRIL 2019	GROUP D. MARCH 2022

		GROUP D CONSISTS OF A SINGLE GROOVE CONTAINED WITHIN A SINGLE SLAB. THE SLAB IS STABLE WITH NO SIGN OF EXFOLIATION OR CRACKING. THERE HAS BEEN DISCERNIBLE WEATHERING OF THE AREA SURROUNDING THE GROOVE IN THE SIX AND A HALF YEARS SEPARATING THE PHOTOGRAPHIC MONITORING EVENTS AND THE SINGLE GROOVE IS BECOMING LESS OBVIOUS.
GROUP D APRIL 2019	GROUP D MARCH 2022	

Figure 2-9. Comparison between the 2015–2022 condition of Group E at the LCGGRA.

		
GROUP E. SEPTEMBER 2015	GROUP E. APRIL 2019	GROUP E. MARCH 2022
 	 	GROUP E CONSISTS OF A NUMBER OF SLABS THAT HAD TO BE CUT AND SPLIT FROM THE ROCK SHELVING WHEN THE GROOVES WERE BEING REMOVED. THERE HAS BEEN NO DISCERNIBLE WEATHERING OF THE AREAS SURROUNDING THE GROOVES IN THE SIX AND A HALF YEARS SEPARATING THE PHOTOGRAPHIC MONITORING EVENTS. IN 2019 SOME EXFOLIATION OF SMALL PORTIONS OF ROCK FROM THE EDGE OF THE SLAB WAS NOTICED. THESE PORTIONS WERE AWAY FROM THE GRINDING GROOVES AND DO NOT APPEAR HAVE WORSENERD IN THE INTERVENING YEARS.  VIEW OF THE SECOND GROOVE AT GROUP E IN 2022.
GROUP E APRIL 2019	GROUP E MARCH 2022	

