HUNTER VALLEY OPERATIONS

2020 Annual Environmental Review

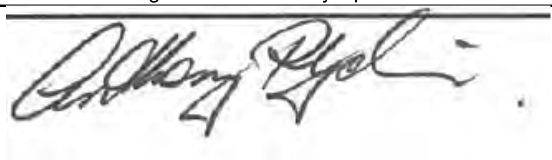
Name of Operations	Hunter Valley Operations
Name of Operator	HV Operations Pty Ltd
Development Consent /Project Approval	DA 450-10-2003 / PA 06_0261
Name of holder of development consent/project approval	HV Operations Pty Ltd
Mining Lease Number	Contained within Table 6 of this report
Name of Mining Lease Holder	Contained within Table 6 of this report
Water Licence Number	Contained within Table 8 of this report
Name of Water Licence Holder	Contained within Table 8 of this report
MOP/RMP Start Date	HVO North – 26 February 2019 HVO South – 25 July 2018
MOP/RMP End Date	HVO North – 30 July 2020 HVO South – 30 July 2023
Annual Review Start Date	01/01/2020
Annual Review End Date	31/12/2020

I, *Tony Galvin*, certify that this audit report is a true and accurate record of the compliance status of Hunter Valley Operations for the period 1st January 2020 to 31st December 2020 and that I am authorised to make this statement on behalf of Hunter Valley Operations.

Note.

a) The Annual Review is an 'environmental audit' for the purposes of section 122B(2) of the Environmental Planning and Assessment Act 1979. Section 122E provides that a person must not include false or misleading information (or provide information for inclusion in) an audit report produced to the Minister in connection with an environmental audit if the person knows the information is false or misleading in a material respect. The maximum penalty is, in the case of a corporation, $1 million and for an individual, $250,000.

b) The Crimes Act 1900 contains other offences relating to the false and misleading information: section 192G (Intention to defraud by false or misleading statement - maximum penalty 5 years imprisonment); sections 307A, 307B and 307C (False or misleading applications/information/documents – maximum penalty 2 years imprisonment or $22,000, or both).

Name of Authorised Reporting Officer	Tony Galvin
Title of Authorised Reporting Officer	General Manager – Hunter Valley Operations
Signature of Authorised Reporting Officer	
Date	31 March 2021

Executive Summary

This Annual Environmental Review (Annual Review) reports on the environmental performance of Hunter Valley Operations (HVO) during the 2020 calendar year and satisfies the requirements of HVO's Development Consents and Mining Leases. The structure of the 2020 Annual Review intends to align with the NSW Government Post-approval requirements for State significant mining developments – Annual Review GUIDELINE (October 2015).

Operations Summary
HVO extracted 16.83 million tonnes of run-of-mine (ROM) coal during 2020 against an approved ROM extraction rate of 42 million tonnes per annum (mtpa). The Coal Handling Preparation Plants (CHPPs) produced 11.98 million tonnes of saleable coal.

Noise
HVO received and responded to 1556 noise alarms and recorded over 51 hours of equipment downtime for the management of noise. There were no noise related non-compliances recorded against HVO's development consent limits.

To reduce noise output from mobile equipment HVO continued to retrofit sound attenuation packages to the existing haul truck fleet. A further 28 haul trucks were retrofitted in the reporting period resulting in 100% of the operational haul truck fleet now being sound attenuated. An ongoing sound power level testing schedule was developed and implemented. This will continue through 2021.

Blasting
A total of 186 blast events were initiated at HVO, 119 from HVO South and 67 from HVO North. HVO complied with all blasting related consent and licence criteria with the exception of one blast on 27 August 2020 in the HVO South area. This blast exceeded the air blast overpressure criteria at Knodlers Lane with a recorded air blast overpressure result of 127.16dB. This result was independently reviewed which deemed the exceedance to be a result of inadequate stemming in blast holes. The Department of Planning, Infrastructure and Environment (DPI&E) issued HVO with a Penalty Infringement Notice of $15,000. HVO implemented a number of improvement actions to prevent a reoccurrence:

HVO employs a blast fume management protocol to mitigate generation of post blast fume emissions. There were no Category 3, 4 or 5 fume events recorded in 2020.

Air Quality
A total of 97 exceedances of the short term (24 hr) PM10 criteria were recorded in 2020 over 31 days, 24 of these days were deemed to have been effected by extraordinary events. Air Quality was influenced by a combination of smoke from bushfires which significantly affected the Hunter Valley between January and February, and regional dust events. Despite these events, HVO continued to implement operational controls to manage dust emissions in accordance with its Air Quality Management Plan. Three other exceedances were measured outside of extraordinary events, including:

- Long Term (annual average) PM10 criteria at the Hunter Valley Gliding Club monitoring location
- Long Term (annual average) dust deposition rate at DL21, DL30 and Warkworth monitoring locations.
- Long Term (annual average) PM2.5 criteria at Maison Dieu and Kilburnie South monitoring locations.

Investigation by an external consultant found HVO not to be the primary contributor.

HVO responded to 1361 air quality alerts and recorded over 906 hours of operational downtime to manage dust in response to real time monitoring alerts and visual inspections.

Heritage
Under the provisions of both the HVO South and HVO North Aboriginal Cultural Heritage Management Plans (ACHMP), eight field based due diligence assessments where undertaken at various locations across HVO. A number of artefacts were identified at the remnant vegetation site on 14 July 2020. This area is now barricaded and was included as an agenda item at the CHWG meeting that convened on the 23 September 2020.

Two compliance inspections were conducted under the provision of the HVO South ACHMP and one inspection was conducted under the HVO North HMP. The inspections found that all sites have been managed in conformance with the ACHMP/HMP requirements. Additional sites were recorded and sites requiring maintenance and upgrades to site barricading and fencing were identified. Upgrade and maintenance work will be implemented in 2021.

The ‘dog leg fence’ that was the subject of a State Significance assessment in October 2019 will be the subject vegetation management prior to an archival recording of its features in 2021.

There were no incidents nor any unauthorised disturbance caused to cultural heritage sites at HVO during 2020.

Water
A total of 793mm of rainfall was recorded at HVO Corporate Meteorological Station in 2020 producing an estimated 9,351ML of runoff. A total of 3,413ML water was pumped from the Hunter River during 2020. HVO did not discharge water under the HRSTS.

HVO commenced work towards upgrade of its water management system, progressing to preliminary engineering for a number of projects. Priority projects include automated dam level monitoring, pipeline leak detection and upgrade to water containment at the train loading points.

Controls identified through the Pollution Reduction Programme to mitigate seepage from the North Void Tailings Facility Analysis continued with management of water levels on the surface and increased monitoring of groundwater. Groundwater monitoring results indicate that current management practices are effective in minimising seepage from the facility.

There were no water related non-compliances recorded in 2020.

Rehabilitation and Land Management
Rehabilitation at HVO is undertaken in accordance with commitments made in two Mining Operations Plans (MOPs) addressing Hunter Valley Operations North (includes Newdell CHPP and Hunter Valley Load Point) and Hunter Valley Operations South. During 2020 HVO prepared a new MOP which consolidates all operations and site rehabilitation in a single document. At the time of AER submission regulator assessment of the MOP is occurring and approval is pending.

A total of 94 ha of new rehabilitation was completed during 2020 and the total rehabilitation footprint is consistent with commitments for progressive rehabilitation establishment.

Restart of a scientific rehabilitation monitoring program occurred during 2020 following use of an abridged monitoring methodology over recent years. The rehabilitation areas monitored were assessed to be generally trending well. Initial TARP triggers relating to erosion and species composition have been activated and will inform response actions during the forward period.

Rehabilitation maintenance works aligned with previous Resources Regulator Section 240 Notice commitments continued to be implemented. Key activities included progression of 53.2 ha of historic Growth Medium Development phase rehabilitation to native covers, weed control within areas of concern, and preparation works for ongoing progression of areas to final vegetation covers.

Improvements to topsoil handling, storage and records keeping processes were implemented in response Resources Regulator’s 2019 audit of topsoil management practices.

As part of HVO’s Vertebrate Pest Action Plan a number of baiting programmes are carried out on a seasonal basis. These programmes are conducted at a level of frequency designed to disrupt pest species such as wild pigs, wild dogs, feral cats, foxes, hares and rabbits breeding/colonisation cycles. A variety of methodologies are employed including baiting, trapping and ground based shooting.

A total of 172 baits were taken by dogs and 23 by foxes. 18 feral pigs were trapped, 2 feral pigs were shot, 11 wild dogs and foxes were shot and 59 hares were shot.

Update of the *Rehabilitation and Restoration Strategy for Carrington Billabong* occurred during 2020. A remnant vegetation ecological risk assessment was undertaken and associated monitoring triggers defined. Monitoring indicated stable health of the River Red Gum population. Management activities included ecological monitoring, seed collection, and pest and weed controls.

Independent Environmental Audit

An Independent Environmental Audit (IEA) was undertaken in December 2019. This audit was undertaken against the conditions of both Project Approval PA06-0261 and DA 450-10-2003. The audit identified 28 non-compliances, one was identified as a moderate risk, 15 were administrative in nature and 12 findings were considered to be low risk. The audit report and HVO's response to the auditors' recommendations were submitted to DPI&E for their consideration on 24 February 2020.

Community

16 community complaints were received related to noise, blasting, air quality, lighting and property accessibility issues. Four CCC meetings were held to discuss operations, projects and mine activities. Community information sessions for near neighbours were held in November and December at Maison Dieu, Jerrys Plains and Long Point. HVO provided $47,000 to 15 local projects and initiatives and continues its partnership with Jerrys Plains Public School providing funding for their pre-school program.

Community consultation was undertaken to inform design for the HVO Continuation Project and to understand community concerns and interests in relation to the Project

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Appendices

Appendix A – Annual PM^{10} Exceedance Investigation

Appendix B – 2020 Annual Groundwater Report

Appendix C – HVO S240 Rehabilitation Maintenance Schedule

Appendix D – 2020 Heritage Compliance Inspection Audits

Appendix E - Assessment of MOP Completion Criteria

1 Statement of Compliance

Table 1 is a Statement of compliance against the relevant approvals. **Table 2** provides a brief summary of the non-compliances against development consents and a reference to where these are addressed within this Annual Review. **Table 3** shows the compliance status descriptions relating to **Table 2.**

Table 1 - Statement of Compliance

Were all conditions of the relevant approvals complied with?	
PA 06_02161 (HVO South)	No
DA 450-10-2003 (HVO North)	No

Table 2 - Non - Compliances

Relevant Approval	Condition Number	Condition Description	Compliance Status	Where addressed in Annual Review
PA06_0261	Schedule 3 Condition 23	Missed HVAS sample 09/01/2020	Non-Compliant (Administrative)	11.1.1
PA06_0261	Schedule 3 Condition 23	Missed HVAS sample 15/01/2020	Non-Compliant (Administrative)	11.1.2
PA06_0261	Schedule 3 Condition 23	Missed HVAS sample 21/01/2020	Non-Compliant (Administrative)	11.1.3
PA06_0261 & DA 450-10-2003	Schedule 3 Condition 23	Missed TEOM sample 23/01/2020	Non-Compliant (Administrative)	11.1.4
DA 450-10-2003	Schedule 3 Condition 23	Missed HVAS sample 28/04/2020	Non-Compliant (Administrative)	11.1.5
PA06_0261	Schedule 3 Condition 23	Missed TEOM sample 10/08/2020	Non-Compliant (Administrative)	11.1.6
PA06_0261	Schedule 3 Condition 23	Missed TEOM sample 27/08/2020	Non-Compliant (Administrative)	11.1.7
PA06_0261	Schedule 3 Condition 7	Overpressure exceedance 27/08/2020	Non-Compliant (low)	11.2.1
PA06_0261	Schedule 3 Condition 23	Missed HVAS sample 30/08/2020	Non-Compliant (Administrative)	11.1.8
PA06_0261 & DA 450-10-2003	Schedule 3 Condition 23	Missed TEOM sample 20/09/2020	Non-Compliant (Administrative)	11.1.9
PA06_0261	Schedule 3 Condition 23	Missed HVAS sample 23/09/2020	Non-Compliant (Administrative)	11.1.10
PA06_0261	Schedule 3 Condition 23	Missed HVAS sample 29/09/2020	Non-Compliant (Administrative)	11.1.10
PA06_0261	Schedule 3 Condition 23	Missed TEOM sample 02/12/2020	Non-Compliant (Administrative)	11.1.11
PA06_0261	Schedule 3 Condition 23	Missed HVAS sample 04/12/2020	Non-Compliant (Administrative)	11.1.12

Table 3 - Compliance Status Key for Table 2

Risk Level	Colour Code	Description
High	Non-compliant	Non-compliance with potential for significant environmental consequences, regardless of the likelihood of occurrence
Medium	Non-compliant	Non-compliance with: Potential for serious environmental consequences, but is unlikely to occur; or Potential for moderate environmental consequences, but is unlikely to occur
Low	Non-compliant	Non-compliance with: Potential for moderate environmental consequences, but is unlikely to occur; or Potential for low environmental consequences, but is unlikely to occur
Administrative Non-compliance	Non-compliant	Only to be applied where the non-compliance does not result in any risk of environmental harm (e.g. submitting a report to government later than required under approval conditions)

2 Introduction

2.1 Document Purpose

This Annual Review is written to satisfy the requirements of the Development Consents and conditions of mining leases held by Hunter Valley Operations (HVO) for events which occurred during the 2020 calendar year (the reporting period). The Annual Review has been written in accordance with the *Post-approval requirements for State significant mining developments – Annual Review Guideline (NSW Government, October 2015).*

This report is distributed to:

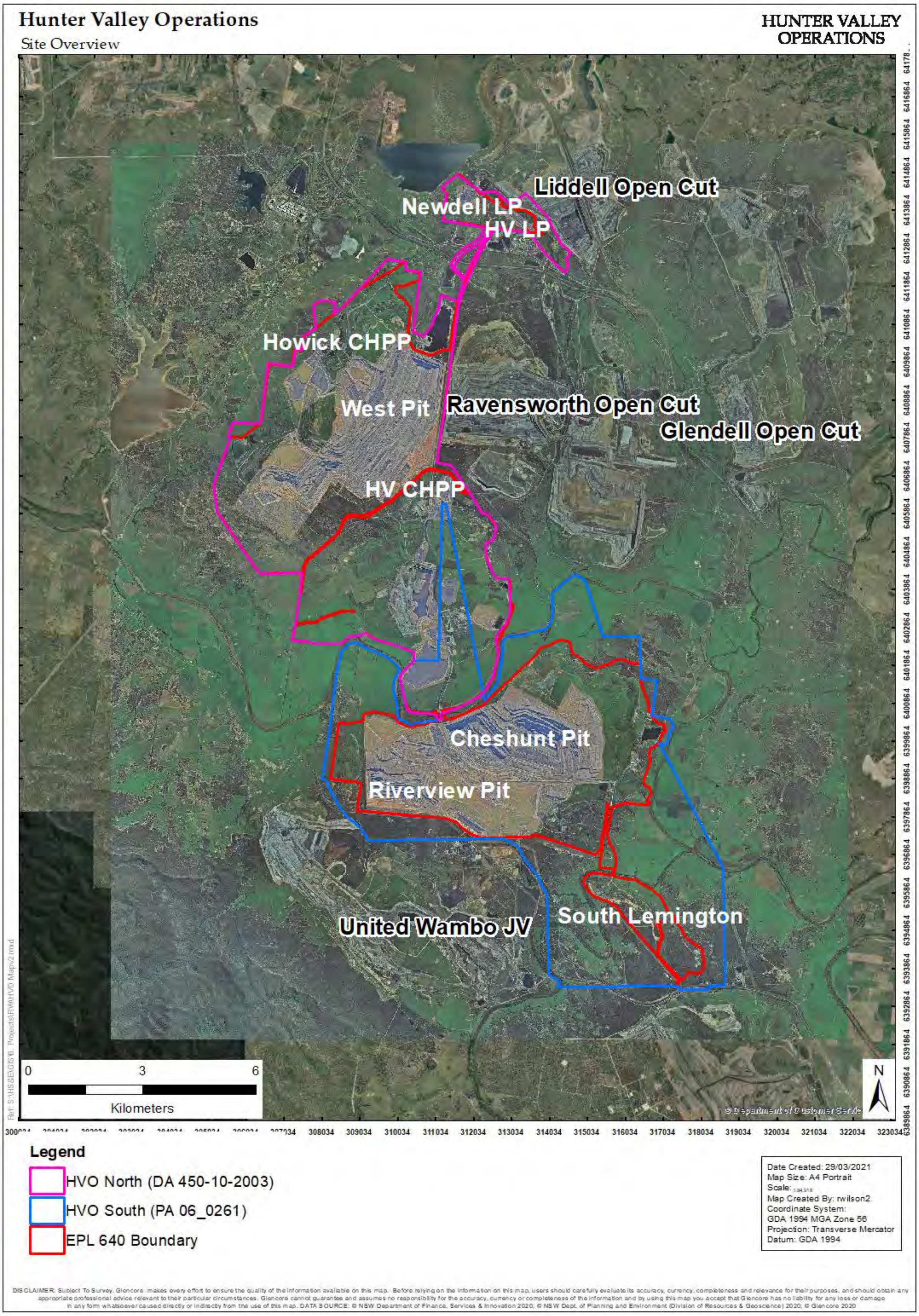
- NSW Department of Planning, Industry and Environment (DPI&E);
- NSW Resource Regulator (RR);
- NSW Environment Protection Authority (EPA);
- Natural Resource Access Regulator (NRAR);
- Singleton Council;
- Muswellbrook Shire Council; and
- HVO Community Consultative Committee (CCC).

2.2 Background

HVO is situated in the Upper Hunter Valley between Singleton and Muswellbrook, approximately 24 km northwest of Singleton, and approximately 100 km northwest of Newcastle. The Hunter River geographically divides HVO into HVO North (DA 450-10-2003) and HVO South (PA_06_0261); however they are integrated operationally with personnel, equipment and materials utilised as required. This improves operational efficiency, rationalisation of infrastructure and resource utilisation.

HVO is a jointly controlled operation through a Joint Venture (JV) between Glencore (49%) and Yancoal (51%).

The regional context and layout of the HVO pits and facilities are shown in **Figure 1** and



respectively.

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2.3 Mine Contacts

Key mine contacts are listed in **Table 4**.

Table 4 - Mine Contacts

Contact	Role	Phone	Email
Tony Galvin	General Manager	6570 0300	tony.galvin@hvo.com.au
Anthony Morris	Operations Manager		anthony.morris@hvo.com.au
Andrew Speechly	Environment & Community Manager		andrew.speechly@hvo.com.au

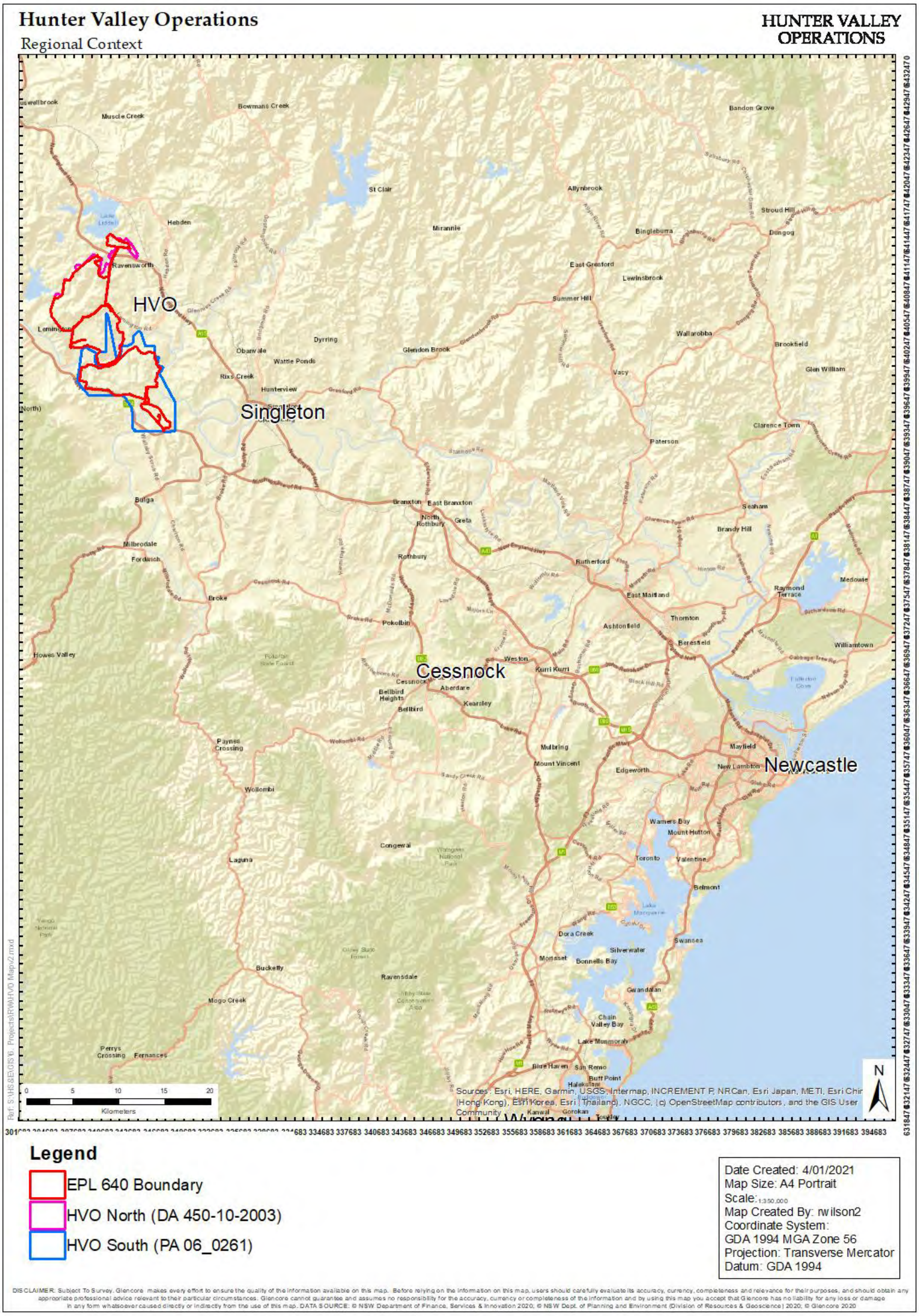

Figure 1 - Regional Context

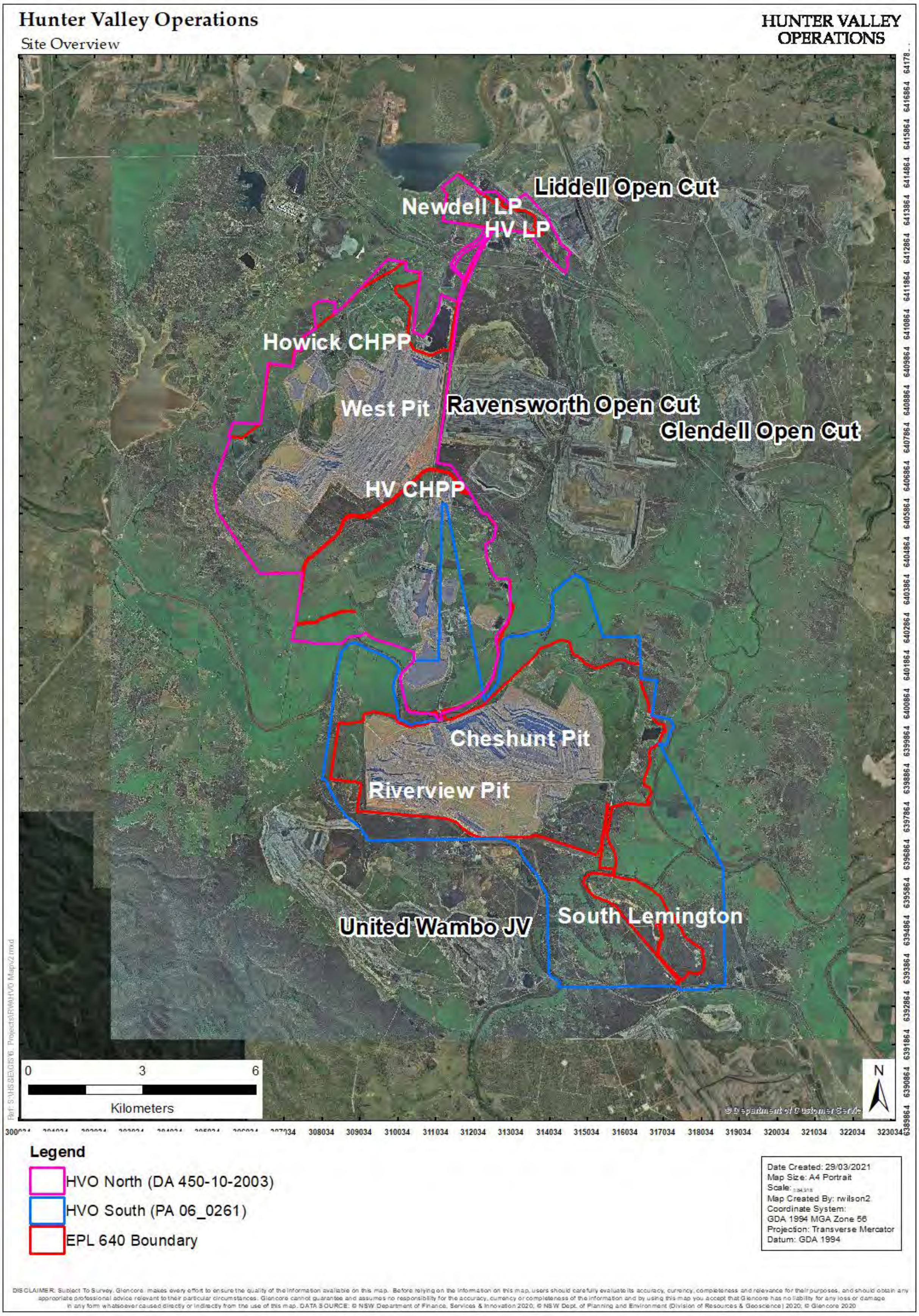

Figure 2 – Hunter Valley Operations Site Overview

3 Approvals

3.1 Approvals, Leases and Licences

3.1.1 Current Approvals

The status of HVO development consents, licenses and relevant approvals are listed in:

- **Table 5**: HVO Major Approvals
- **Table 6**: Summary of Mining Tenements
- **Table 7**: HVO Licences and Permits
- **Table 8**: Water Related Approvals
- **Table 9**: Water Access Licence

Table 5 - HVO Major Approvals

Approval Number	Description	Issue Date	Expiry Date
HVO North DA 450-10-2003 MOD 7	HVO West Pit Extension & Minor Modifications (2003); and associated modifications. MOD 7 approved July 2017. Covers West Pit (approved production limit of 12mtpa), Carrington Pit (approved production limit of 10mtpa), HVCHPP (approved processing limit of 20mtpa) and WCHPP (approved processing limit of 6mtpa).	28/07/2017	12/06/2025
HVO South PA 06_0261 MOD 5	Hunter Valley Operations – South Coal Project & associated modifications MOD 5 approved February 2018 The modification covered: - the progression of mining to the base of the Bayswater seam from Cheshunt Pit into Riverview Pit, and to the base of the Vaux seam in South Lemington Pit 2. - increased overburden emplacement height in some areas to 240m AHD and incorporation of micro-relief - extraction rate increase from 16Mpta to 20Mtpa of ROM coal at peak production and increased processing rate from 16Mpta to 20Mtpa of ROM coal across HVO coal preparation plants. The modification also involved changes to the Statement of Commitments.	28/02/2018	24/03/2030
EPBC 2016/7640	Hunter Valley Operations – State approved mining Hunter Valley NSW	10/10/2016	31/12/2030

Table 6 - Summary of Mining Tenements

Title	Mining Tenement	Titleholder	Purpose	Grant Date	Expiry Date	Status
AL 32	Assessment Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting	04/11/2020	03/11/2026	Granted
AL 33	Assessment Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting	04/11/2020	03/11/2026	Granted
AL 34	Assessment Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting	04/11/2020	03/11/2026	Granted
AUTH 72	Authorisation	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting	08/03/1977	24/03/2018	Renewal Pending
EL 5291	Exploration Licence	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting	28/04/1997	28/04/2023	Granted
EL 5292	Exploration Licence	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting	28/04/1997	27/04/2020	Renewal Pending
EL 5417	Exploration Licence	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting	23/12/1997	08/05/2018	Renewal Pending
EL 5418	Exploration Licence	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting	23/12/1997	08/05/2017	Renewal Pending
EL 5606	Exploration Licence	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting	11/08/1999	10/08/2019	Renewal Pending
EL 8175	Exploration Licence	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting	23/09/2013	23/09/2018	Renewal Pending
EL 8821	Exploration Licence	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting	13/02/2019	13/02/2025	Granted
(Part) CCL 708	Sub lease	Liddell Tenements Pty Ltd	Prospecting and Mining Coal	17/05/1990	29/12/2023	Granted
CCL 714	Consolidated Coal Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	23/05/1990	30/08/2030	Granted

CCL 755	Consolidated Coal Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	24/01/1990	05/03/2030	Granted
CL 327	Coal Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	06/03/1989	06/03/2031	Granted
CL 359	Coal Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	21/05/1990	21/05/2032	Granted
CL 360	Coal Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	29/05/1990	29/05/2032	Granted
CL 398	Coal Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	04/06/1992	04/06/2034	Granted
CL 584	Coal Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	01/01/1982	31/12/2023	Granted
CML 4	Consolidated Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	02/03/1993	03/06/2033	Granted
ML 1324	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	19/08/1993	19/08/2035	Granted
ML 1337	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	01/02/1994	01/02/2034	Granted
ML 1359	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	01/11/1994	31/10/2015	Renewal Pending
ML 1406	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	27/02/1997	10/02/2027	Granted
ML 1428	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	15/04/1998	14/04/2019	Renewal Pending
ML 1465	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	21/02/2000	21/02/2021	Granted
ML 1474	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	24/11/2000	23/11/2021	Granted

ML 1482	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	19/03/2001	14/04/2019	Renew al Pending
ML 1500	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	21/12/2001	20/12/2022	Granted
ML 1526	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	03/12/2002	02/12/2023	Granted
ML 1560	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	28/01/2005	27/01/2026	Granted
ML 1589	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	02/11/2006	01/11/2027	Granted
ML 1622	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	22/10/2010	10/03/2027	Granted
ML 1634	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	31/07/2009	31/07/2030	Granted
ML 1682	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	16/12/2012	15/12/2033	Granted
ML 1704	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Mining Purposes	05/12/2014	05/12/2035	Granted
ML 1705	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	17/12/2014	17/12/2035	Granted
ML 1706	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Mining Purposes	09/12/2014	0912/2035	Granted
ML 1707	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	09/12/2014	09/12/2035	Granted
ML 1710	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Prospecting and Mining Coal	22/12/2016	10/03/2027	Granted
ML 1732	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Mining Purposes	06/04/2016	06/04/2037	Granted

ML 1734	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Mining Purposes	06/04/2016	06/04/2037	Granted
ML 1748	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Mining Purposes	05/12/2016	04/12/2037	Granted
ML 1753	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Mining Purposes	19/04/2017	19/04/2038	Granted
ML 1810	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Mining Purposes	04/11/2020	04/11/2041	Granted
ML 1811	Mining Lease	Coal & Allied Pty Ltd and Anotero Pty Ltd	Mining Purposes	04/11/2020	04/11/2041	Granted
MLA 495	Mining Lease Application	Coal & Allied Pty Ltd and Anotero Pty Ltd	Mining Purposes	Mining Lease Application lodged 12th May 2015		Application Pending
MLA 496	Mining Lease Application	Coal & Allied Pty Ltd and Anotero Pty Ltd	Mining Purposes	Mining Lease Application lodged 12th May 2015		Application Pending
MLA 520	Mining Lease Application	Coal & Allied Pty Ltd and Anotero Pty Ltd	Mining Purposes	Mining Lease Application lodged 23rd December 2015		Application Pending
MLA 535	Mining Lease Application	Coal & Allied Pty Ltd and Anotero Pty Ltd	Mining Purposes	Mining Lease Application lodged 28th October 2016		Application Pending
MLA 542	Mining Lease Application	Coal & Allied Pty Ltd and Anotero Pty Ltd	Ancillary Mining Activities (Mining Purposes)	Mining Lease Application lodged 27th July 2017		Application Pending
MLA 543	Mining Lease Application	Coal & Allied Pty Ltd and Anotero Pty Ltd	Ancillary Mining Activities (Mining Purposes)	Mining Lease Application lodged 27th July 2017		Application Pending
MLA 562	Mining Lease Application	Coal & Allied Pty Ltd and Anotero Pty Ltd	Ancillary Mining Activities (Mining Purposes)	Mining Lease Application lodged 21st December 2018		Application Pending

Table 7 - HVO Licences and Permits

Type	Licence Number	Description	Authority	Expiry Date
Environment Protection Licence	EPL640	Environment Protection Licence	EPA	N/A
Dangerous Goods/ Explosives	RR12709	Licence to Store	Work Cover	06/07/2022
Radiation Licence	RML5085293	Radiation Management Licence	EPA	14/11/2021
Aboriginal Heritage Permit	C0001890	Care Agreement	OEH	03/06/2036
	C0002193	Aboriginal Heritage impact Permit	OEH	06/12/2026
Road Closure Permit	1543350	Road Occupancy Licences– Golden Highw ay	RMS	30/06/2021
	N/A	Road Closure Approval - Lemington Road	Singleton Council	30/06/2021

Table 8 - Water Related Approvals

Licence Number	Type of Licence	Purpose	Legislation	Description	Expiry Date
20BL030566	Bore	Well	Part 5 Water Act 1912	East Open Cut	Perpetuity
20BL141584	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO North – Carrington Work Licence	Perpetuity
20BL166637	Bore	Monitoring Bore	Part 5 Water Act 1912	No Current Bores	Perpetuity
20BL168820	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO North – Bores: CGW39, CGW45a, CGW46,CGW47, CGW47a, CGW48, CGW49, P50/38.5, ,CGW56, 4036C, 4035P, 4032P, 4034P, 4033P, 4053P, 4052P, 4051C, 4040P, 4038C, 4037P Destroyed:CGW7,CGW50, CGW57, CGW58, CGW59, CGW60, CGW61, CGW62, CGW63	Perpetuity
20BL169241	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO North – Bores: DM1, HF3, HF7 Destroyed: DM2	Perpetuity
20BL169641	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO North – Bores: CGW5, CGW51A, CGW52, CGW53, CGW54, CGW55A, CGW53A, CGW52A, CGW54A, CGW6, CFW55, CFW57, CFW57A, CFW59, and CFW55R. Destroyed: CGW1, CGW2, CGW3, CGW5, CGW8,CGW9, CGW10, CGW12, CGW13, CGW14, CGW30, CGW33, CGW34, CGW35, CGW36, CGW37, CGW38, CGW40, CGW41, CGW42, CGW43, CGW44, CFW56, CFW56A, CFW58	Perpetuity

20BL170496	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: BZ10 (CHPZ 2A), BZ11 (CHPZ 3A), BZ18 (CHPZ 10A), BZ20 (CHPZ 12A), BZ21 (CHPZ 13D) , BZ21A (CHPZ 13A), BZ20A (CHPZ 12D), BZ11A (CHPZ 3D) Destroyed: AP50/47.5, AQ52, AV50/56.5, AS50/62.5, AR55, Bunc 3, BZ25 (Bunc 12) , BZ23 (Bunc 14), BZ24 (Bunc 13),	Perpetuity
20BL170497	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: BZ15 (CHPZ 7A), BZ16 (CHPZ 8D), BZ17 (CHPZ 9A), BZ19 (CHPZ 11A), BZ16A (CHPZ 8A), Bunc 46D Destroyed: Bunc 39 (Shallow & Deep), Bunc 44D	Perpetuity
20BL170498	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: BZ12 (CHPZ 4A), BZ13 (CHPZ 5A), BZ14, BZ9 (CHPZ 1A), BC1, BC1a, BZ8-1, BZ8-2, BZ8-3, HG1, HG2, HG2a, HG3, S4, S6, BZ22 (CHPZ14D), BZ22A (CHPZ 14A), BZ5-1, BZ5-2 Destroyed: S2, S3, S9, S11	Perpetuity
20BL171423	Bore	Monitoring Bore	Part 5 Water Act 1912	E1.5	Perpetuity
20BL171424	Bore	Monitoring Bore	Part 5 Water Act 1912	Destroyed: GW9711	Perpetuity
20BL171425	Bore	Monitoring Bore	Part 5 Water Act 1912	Bores: GW9701, GW9710	Perpetuity
20BL171426	Bore	Monitoring Bore	Part 5 Water Act 1912	Bores: GW9702 Destroyed: D2(WH236)	Perpetuity
20BL171427	Bore	Monitoring Bore	Part 5 Water Act 1912	Bores: C335, C630 (BFS)	Perpetuity
20BL171428	Bore	Monitoring Bore	Part 5 Water Act 1912	D807	Perpetuity
20BL171429	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: B925 (BFS), C122 (BFS), C122 (WDH)	Perpetuity
20BL171430	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: C613 (BFS), C809 (GM/WDH)	Perpetuity
20BL171431	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: B631 (BFS), B631 (WDH)	Perpetuity
20BL171432	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: C130 (AFSH1), C130 (ALL), C130(BFS), C130 (WDH)	Perpetuity

20BL171433	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bore B334 (BFS)	Perpetuity
20BL171434	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: C317 (BFS), C317 (WDH)	Perpetuity
20BL171435	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: BZ3-1, BZ3-2, BZ3-3	Perpetuity
20BL171436	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: BZ4A(1), BZ4A(2), BZ4B	Perpetuity
20BL171437	Bore	Monitoring Bore	Part 5 Water Act 1912	Bores: WG1, WG2, WG3	Perpetuity
20BL171439	Bore	Monitoring Bore	Part 5 Water Act 1912	Bores: BRN, E012	Perpetuity
20BL171492	Bore	Monitoring Bore	Part 5 Water Act 1912	Bores: C1(WJ039), GW9704, North, GWAR981	Perpetuity
20BL171681	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: Bunc 45A, Bunc 45D	Perpetuity
20BL171725	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: B425 (WDH), BRS, C621 (BFS), C919 (ALL), D317 (BFS), D317(ALL), D317(WDH) Destroyed: D420, D425, D621, PB02	Perpetuity
20BL171726	Bore	Monitoring Bore	Part 5 Water Act 1912	Bores: SR002, SR003, SR004, SR005, SR006, SR007	Perpetuity
20BL171727	Bore	Monitoring Bore	Part 5 Water Act 1912	SR001	Perpetuity
20BL171728	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: BZ2B, BZ1-1, BZ1-2, BZ1-3, BZ2-1, BZ2-2	Perpetuity
20BL171762	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO South – Bores: C817, D010 (BFS), D214 (BFS), D406 (BFS) (AFS), D510 (BFS), PB01 (ALL), D510 (AFS), D010 (GM), D010 (WDH), D406 (BFS) (AFS), D612 (AFS), D612 (BFS)	Perpetuity
20BL171851	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO North/South – Bores: HV2, PZ1CH200, PZ2CH400, PZ3CH800, 4118P, 4119P	Perpetuity
20BL171852	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO North – PZ4CH1380	Perpetuity
20BL171853	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO North – DM3	Perpetuity
20BL171854	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO North – Bores: DM5, PZ6CH2450	Perpetuity
20BL171855	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO North – PZ5CH1800	Perpetuity

20BL171856	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO North – Bores: HV6, HV3, DM6, HV2 (2), 4113P, 4114P. 4116P, 4117P	Perpetuity
20BL171857	Bore	Monitoring Bore	Part 5 Water Act 1912	Bores: HV4, HV4 (2) (GA3), GA3,	Perpetuity
20BL171858	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO North – DM4	Perpetuity
20BL171895	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO West – NPZ4	Perpetuity
20BL171896	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO West – NPZ2	Perpetuity
20BL171897	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO West – Bores: NPZ5, NPZ1	Perpetuity
20BL171898	Bore	Monitoring Bore	Part 5 Water Act 1912	HVO West – NPZ3	Perpetuity
20BL173062	Bore	Monitoring Bore	Part 5 Water Act 1912	RC14	Perpetuity
20BL173065	Bore	Monitoring Bore	Part 5 Water Act 1912	HQ11	Perpetuity
20BL173063	Bore	Monitoring Bore	Part 5 Water Act 1912	RC07, RC08	Perpetuity
20BL173064	Bore	Monitoring Bore	Part 5 Water Act 1912	RC06	Perpetuity
20BL173069	Bore	Monitoring Bore	Part 5 Water Act 1912	RC11	Perpetuity
20CA201247	Works Approval	Pumping Plant	Water Management Act 2000	Associated with WAL965	Perpetuity
20CA212713	Works Approval	Pumping Plant	Water Management Act 2000	Associated with WAL36190	30/05/2025
20FW213280	Flood Work Approval	Levee	Water Management Act 2000	HVO North Carrington Levee 5	21/09/2021
20FW213281 Formerly 20CW802613	Flood Work Approval	Levee	Water Management Act 2000	HVO South – Barry Levee	21/09/2027
20FW213277 Formerly 20CW802603	Flood Work Approval	Block Dam	Water Management Act 2000	HVO South – Hobden Gully Levee	21/09/2027
20FW213278 Formerly 20CW802604	Flood Work Approval	Levee	Water Management Act 2000	HVO North – North Pit Levee 3	21/09/2021
20WA210991 (see WAL 18307) Formerly 20SL050903	Stream Diversion	Stream Diversion	Water Management Act 2000	HVO West – Parnells Creek Dam	09/01/2023
20WA211427 Formerly 20SL061290	Stream Diversion	Cutting (Diversion Drain)	Section 10 Water Act 1912	Pikes Gully Creek Stream Diversion	07/09/2023

20WA210985 (see WAL 18327) 20SL042746	Diversion Works	Industrial	Water Management Act 2000	HV Loading Point Pump Bayswater Creek	08/09/2022
20WA211428 20SL061594	Stream Diversion	Cutting (Diversion Drain)	Water Management Act 2000	HVO North – Carrington Stream Diversion	31/07/2022
20WA201238 (see WAL 962)	Diversion Works	Pumping Plant	Water Management Act 2000	HVCPP River Pump	16/03/2028
20WA201257 (see WAL 970)	Diversion Works	Pumping Plant	Water Management Act 2000	HVO South – LCPP River Pump	Perpetuity
20WA201338 (see WAL 1006)	Diversion Works	Pumping Plant	Water Management Act 2000	HVO South – LCPP River Pump	Perpetuity
20WA201501 (see WAL 1070)	Diversion Works	Pumping Plant	Water Management Act 2000	HVO South – LCPP River Pump	Perpetuity
20WA201685 (see WAL 13387)	Diversion Works	Pumping Plant	Water Management Act 2000	HVO West – "Lake Liddell" Licence	Perpetuity
20FW213274	Flood Work Approval	Levee	Water Management Act 2000	Riverview	26/10/2028

Table 9 – Surface Water Access Licences

Licence Number	Description	Water Source	Water Sharing Plan	Water Source – Management Zone	Approved Extraction (ML)	Extraction 2019/20 Water Year (ML)
WAL718[1]	Wambo United Operations	Hunter River	Hunter Regulated River WSP	Zone 2a (Hunter River From Glennies Creek Junction To Wollombi Brook Junction)	300 (HVO take allocation only)	0
WAL867	Comleroi, farming & irrigation	Hunter River	Hunter Regulated River WSP	Zone 2a (Hunter River From Glennies Creek Junction To Wollombi Brook Junction)	486	359.4[2]
WAL962	HVO North – HVCPP River Pump – Water Access Licence	Hunter River	Hunter Regulated River WSP	Zone 1b (Hunter River From Goulburn River Junction To Glennies Creek Junction)	3,165 (3,325 after transfer)	971.7

WAL969	HVO South – Former Riverview pump	Hunter River	Hunter Regulated River WSP	Zone 1b (Hunter River From Goulburn River Junction To Glennies Creek Junction)	39	0
WAL970	HVO South – LCPP River Pump – Water Access Licence	Hunter River	Hunter Regulated River WSP	Zone 2a (Hunter River From Glennies Creek Junction To Wollombi Brook Junction)	500 (1516.3 after transfer)	1191.3
WAL1006	HVO South – LCPP River Pump – Water Access Licence	Hunter River	Hunter Regulated River WSP	Zone 2a (Hunter River From Glennies Creek Junction To Wollombi Brook Junction)	500 (847 after transfer)	610.7
WAL1070	HVO South - LCPP River Pump – Water Access Licence	Hunter River	Hunter Regulated River WSP	Zone 2a (Hunter River From Glennies Creek Junction To Wollombi Brook Junction)	500	0
WAL13387	Macquarie Generation Hunter River Pump Station	Hunter River	Hunter Regulated River WSP	Zone 1b (Hunter River From Goulburn River Junction To Glennies Creek Junction)	20	0
WAL 13391	HVO North – Alluvial Rehabilitation Irrigation.	Hunter River	Hunter Regulated River WSP	Zone 1b (Hunter River From Goulburn River Junction To Glennies Creek Junction	420 (2,639 after transfers)	2,531
WAL18127	Carrington BB1	Hunter River Alluvium	Hunter Unregulated and Alluvial Water Sources WSP	Hunter Regulated River Alluvial Water Source – Upstream Glennies Creek management zone	383	0
WAL18158	Ollenberry	Hunter River Alluvium	Hunter Unregulated and Alluvial Water Sources WSP	Hunter Regulated River Alluvial Water Source – Upstream Glennies Creek management zone	65	0

WAL18307	HVO West – Parnells Creek Dam (Diversion Works Bywash)	Unregulated River	Hunter Unregulated and Alluvial Water Sources WSP	Jerrys Water Source; Jerrys Management Zone	500	0
WAL18327	HV Loading Point Pump Bayswater Creek (Diversion Works)	Unregulated River	Hunter Unregulated and Alluvial Water Sources WSP	Jerrys Water Source; Jerrys Management Zone	150	0
WAL23889	Greenleek	Wollombi Brook	Hunter Unregulated and Alluvial Water Sources WSP	Lower Wollombi Brook Water Source	144	0
WAL36190	HVO North, old farm bore	Hunter River Alluvium	Hunter Unregulated and Alluvial Water Sources WSP	Hunter Regulated River Alluvial Water Source – Jerrys Management Zone	120	0
TBA (20BL167860)	HVO North (Carrington Pit)	Permian Coal Seams	North Coast Fractured and Porous Rock Groundwater Sources WSP (commenced 1/7/16)	Permian Coal Seams	220	0
TBA (20BL170000)	HVO North – Pit Excavation	Permian Coal Seams	North Coast Fractured and Porous Rock Groundwater Sources WSP (commenced 1/7/16)	Permian Coal Seams	20	0

Notes:
[1] WAL718 held by Wambo United Operations. Reporting considers only extraction by HVO utilising WAL718 and associated works. Extraction by Wambo United Operations not detailed.
[2] Imports to HVO only. Does not include rural use by property licensee.

Table 10 - Ground Water Access Licences

Groundwater Licences						
Licence Number	**Description**	**Water Source**	**Water Sharing Plan (WSP)**	**Water Source – Management Zone**	**Approved Extraction (ML)**	**Extraction 2019/20 Water Year (ML)**
WAL39798	Lemington Underground (LUG) Bore	Permian Coal Seams	North Coast Fractured and Porous Rock Groundwater Sources WSP (commenced 1/7/16)	Permian Coal Seams	1,800	1315
WAL40462	HVO Pit Excavations / Alluvial Lands Bores (x4)	Permian Coal Seams	North Coast Fractured and Porous Rock Groundwater Sources WSP (commenced 1/7/16)	Permian Coal Seams	2,400	0
WAL40463	HVO Pit Excavations / Alluvial Lands Bores (x4)	Permian Coal Seams	North Coast Fractured and Porous Rock Groundwater Sources WSP (commenced 1/7/16)	Permian Coal Seams	180	0
WAL40466	HVO Pit Excavations / Alluvial Lands Bores (x4)	Permian Coal Seams	North Coast Fractured and Porous Rock Groundwater Sources WSP (commenced 1/7/16)	Permian Coal Seams	460	0
WAL41527	HVO North – Carrington Pit	Permian Coal Seams	North Coast Fractured and Porous Rock Groundwater Sources WSP (commenced 1/7/16) Previously Water Act 1912	Permian Coal Seams	700	353

3.1.2 Management Plans, Programs and Strategies

HVO is required by the development consent approvals to develop and submit a range of environmental management plans for approval prior to implementation. Approved management plans are made publically available on the HVO website (https://insite.hvo.com.au/).

Many updated plans were submitted to DPI&E in 2020. Some plans remain under review and will be submitted to DPI&E in 2021. The status of management plans is shown in **Table 10** and **Table 11**.

Table 10 - Management Plans and Mining Operations Plans (MOPs) Required for HVO North

Management Plan	Date Approved
Agricultural Lands Reinstatement Management Plan (addressed in MOP)*	26/02/2019
Fine Reject Management Strategy	07/12/2018
HVO Air Quality and Greenhouse Gas Management Plan	06/09/2019
HVO Blast Management Plan	30/04/2019
HVO Bushfire Management Plan	23/06/2015
HVO Environmental Management Strategy	08/01/2019
HVO Greenhouse and Energy Efficiency Plan (Addressed in HVO Air Quality and Greenhouse Gas Management Plan)	06/09/2019
HVO Noise Management Plan	19/02/2019
HVO North Heritage Management Plan	19/12/2019
HVO River Red Gum Rehabilitation & Restoration Strategy	24/03/2010
HVO Water Management Plan	16/10/2018
MOP - HVO North 2019-2021	26/02/2019
Rehabilitation Management Plan (addressed in MOP)	26/02/2019

*The Agricultural Lands Reinstatement Management Plan states that the agricultural reinstatement activities and monitoring results will be reported in the HVO Annual Environment Review (Annual Review). However work has not yet commenced hence no monitoring or reporting against the management plan specific to the Carrington West Wing project is provided in this report.

Table 11 - Management Plans and MOPs Required for HVO South

Management Plan	Date Approved
HVGC Amenity Management Plan	22/01/2013
HVO Air Quality and Greenhouse Gas Management Plan	06/09/2019
HVO Biodiversity Offset Strategy	23/10/2017
HVO Blast Management Plan	30/04/2019
HVO Bushfire Management Plan	23/06/2015
HVO Environmental Management Strategy	08/01/2019
HVO Integrated Biodiversity Management Plan	02/08/2018
HVO Noise Management Plan	19/02/2019
HVO River Red Gum Rehabilitation & Restoration Strategy	24/03/2010
HVO South Aboriginal Cultural Heritage Management Plan	19/12/2019
HVO Water Management Plan	16/10/2018
MOP - HVO South 2019-2021 Incorporates: - Landscape Management Plan - Rehabilitation and Biodiversity Management Plan - Mine Closure Plan - Final Voids Management Plan	26/02/2019
Rehabilitation and Biodiversity Management Plan (Offsets component)	26/06/2017 - Goulburn River Biodiversity Area Management Plan

4 Operations Summary

4.1 Mining

Areas to be mined are geologically modelled, a mine plan is formed and the relevant mining locations are surveyed prior to mining. The mining process is illustrated in **Figure 3**. There are no active underground workings at HVO.

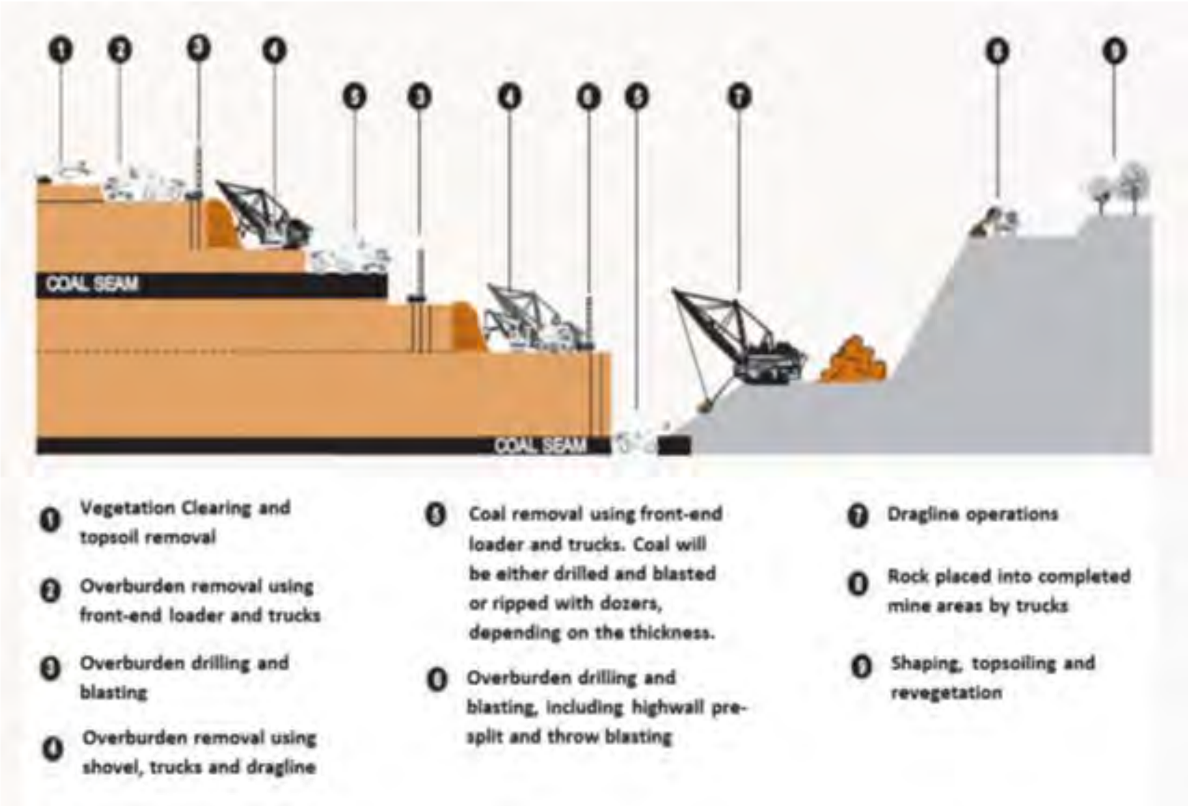

Figure 3 - Open Cut Mining Schematic

No material changes were made to the mining method during the reporting period. Mining progress deviated slightly from the schedule of the MOPs as a result of normal variations in productivity and utilisation.

The mining equipment fleet employed to carry out mining operations at HVO in 2019 and 2020 is detailed in **Table 12**, along with the fleet forecast for 2021.

Table 12 - HVO Equipment Used 2019-2020

Equipment Type	Number Used in 2019	Number Used in 2020	Forecast Numbers in 2021
Scrapers	2	2	2
Drills	8	8	8
Draglines	2	2	2
Shovels	3	3	2
Excavators	8	8	7
Trucks	81	82	72
Loaders	5	6	5

Equipment Type	Number Used in 2019	Number Used in 2020	Forecast Numbers in 2021
Service Trucks	5	5	5
Track Dozers	29	27	24
Rubber Tyre Dozers	5	5	4
Graders	11	11	8
Water Trucks	10	11	9
Floats	1	1	1
Cable Reeler	1	1	1
Cable Tractors	5	5	5
Total	**176**	**177**	**155**

4.1.1 Mineral Processing

Coal is transported to one of two CHPPs (Coal Handling and Preparation Plant) where it is crushed to size and processed to remove impurities. Processing produces saleable coal, along with coarse and fine reject materials. Coarse rejects are disposed of in-pit and fine rejects are placed in a tailings dam in accordance with the MOP. Each CHPP site has storage facilities for processed (saleable) and raw (unprocessed) coal. The capacity of each site is listed in **Table 13**.

No material changes or additions were made to process or facilities during the reporting period.

Table 13 - Stockpile Capacities

Location	Raw Stockpile (t)	Saleable Stockpile (t)
Hunter Valley CHPP	176,000	330,000
Howick CHPP	15,000	30,000
Newdell Load Point	0	400,000

Processed, or product coal is transported to one of the two loading points via conveyor belt or road, detailed in **Table 14**. The coal from HVCHPP is transported to the Hunter Valley Load Point (HVLP) by means of overland conveyor whereas coal from Howick CHPP is typically trucked to Newdell Load Point (NLP) but can receive coal from HVLP via overland conveyor if required. After the coal has reached either HVLP or the NLP it is transported to the Port of Newcastle by rail.

Table 14 - Methods of Coal Transportation

Transport Category	Quantity (Mt)
Coal transported from the site via trains	12.1
Amount of coal received from Hunter Valley Operations South of the Hunter River	10.7
Amount of coal hauled by road to the Hunter Valley Loading Point	Nil
Coal hauled by road to the Newdell Load Point	1.63
Amount of coal hauled by road from the Newdell Loading Point to the Ravensworth Coal Terminal	Nil
Amount of coal hauled by road from the Hunter Valley Loading Point to the Ravensworth Coal Terminal	Nil

Transport Category	Quantity (Mt)
Number of coal haulage truck movements generated by the development. (includes -coal hauled to stockpile, coal hauled to bins, coal hauled from stockpile to bins)	132,505 (truck movements)

4.1.2 Production Statistics

Project approvals allow for the extraction of up to 22 million ROM tonnes from HVO North and 20 million ROM tonnes from HVO South. A summary of production and waste at HVO during 2020 in comparison to previous years and approval limits is provided in **Table 15.**

Product coal includes low-ash, semi-soft and steaming coals.

Table 15 - Production Statistics and Correlating Project Approval Limits

	Approved Limit (PA 06_0261 and DA 450-10-2003)	Reporting Period 2019	Reporting Period 2020	Forecast for 2021
Prime Waste (Mbcm)	-	102.3	90.8	90.5
ROM Coal (Mtpa) (mined)	42	19.19	16.83	15.24
- HVO South	*20*	10.8	10.2	11.1
- West Pit	*12*	8.4	6.6	4.1
- Carrington Pit	*10*	0	0	0
Coarse Reject (Mt)	-	2.76	3.17	2.27
Fine Reject-Tailings (Mt)	-	1.7	1.63	1.44
Product (Mtpa)	-	13.59	11.98	11.35
ROM Coal Processed	26	18.05	16.83	15.06
- Hunter Valley CHPP	20	14.9	13.45	15.06
- Howick CHPP	6	3.13	2.40	0

4.1.3 Summary of Changes

Production and equipment numbers were reduced during 2020 compared to 2019 levels in response to changing market conditions.

Tailings emplacement continued in the Carrington mining void in 2020.

Mining in the Carrington West Wing location has not yet commenced. As of the time of reporting, mining in this area is not planned to commence during 2021.

4.2 Other Operations

There were no other notable operational changes.

4.3 HVO Continuation Project

The HVO Continuation Project comprises the continuation of the life of HVO North and HVO South, from the current approved mining completion dates of 2025 and 2030 respectively, to approximately 2050 at HVO North and 2045 at HVO South. The continuation of mining across the HVO Complex will optimise resource recovery from the existing operation, predominantly by mining through previously mined areas and to the extent of existing mining tenements, and extracting coal from deeper seams.

In December 2020, HVO submitted the Project Scoping Report and Request for Secretary's Environmental Assessment Requirements (SEARs) to DPIE. The SEARs will confirm the scope of environmental and social impact studies required to inform the Project Environmental Impact Statement (EIS).

Environmental studies for the HVO Continuation Project will be continued in 2021, with the aim to submit the EIS to DPI&E in 2021.

Community consultation associated with the HVO Continuation Project during 2020 is summarised in **Section 9.2.5**.

4.4 Forecast Operations for Next Reporting Period

Table 16 outlines the forecast operations for the next reporting period

Table 16 - Production Operations Forecast

Material	Unit	2020 (Forecast)	2020 (Actual)	2021 Forecast	2022 Forecast
Stripped Topsoil	Mbcm	520.0	162.1	212.9	229.9
Rock / Overburden	Mbcm	102.6	90.8	90.5	106.1
ROM Coal	Mt	18.61	15.85	15.24	17.52
Reject Material	Mt	4.51	3.87	3.89	2.92
Product	Mt	14.10	11.98	11.35	14.61

5 Actions Required From Previous Annual Review

2019 Annual Review

DPI&E responded to HVO on 3 July 2020 accepting the 2019 Annual Review. DPI&E did not require any changes to the 2019 Annual Review, however the following was noted:

Section 7.5 – Groundwater: exceedances of groundwater quality trigger values are reported across various monitoring locations to have occurred during the reporting period. The Department has reviewed Appendix A – 2019 Annual Groundwater Review and supports the recommendations made in Section 6.2 to better understand the current impact on groundwater quality within the monitoring network.

Actions from the 2019 groundwater review and HVO response are detailed in **Table 17**.

The RR did not provide any feedback in response to the 2019 Annual Review.

Table 17 – Actions recommended in 2019 Annual Groundwater Review and HVO response

Action recommended in 2019 Annual Groundwater Review	Action taken by HVO
Bore CGW46 is included in the current WMP, however, there are no trigger levels specified. It is recommended that trigger levels be added in the revised version of the WMP, and the purpose of bores be reviewed and outlined within the WMP.	The *HVO Water Management Plan (WMP)* was revised in 2020 and submitted to DPIE. The revised WMP contains trigger levels for CGW46 for EC and pH. The updated plan has not yet been approved by DPIE.
Bore BZ1-1 is included in the WMP as being within the alluvium; however, as identified in prior annual reviews the bore likely intersects interburden material. It is recommended that this bore be updated in the WMP as intersecting interburden.	The WMP was revised in 2020 and submitted to DPIE. The revised WMP lists the target seam / stratigraphy as interburden. The updated plan has not yet been approved by DPIE.
It is recommended that NPz2 and NPz3 be removed from the compliance monitoring network within the WMP, as the location and construction of the bores precludes them from providing an indication of potential impacts. However, these bores should continue to be monitored to assist with other assessments and post closure monitoring.	The WMP was revised in 2020 and submitted to DPIE. The revised WMP has removed these bores from the compliance monitoring network. The updated plan has not yet been approved by DPIE. Quarterly monitoring of these bores was continued in 2020.
Bores NPZ4 and NPZ5 should be removed from the WMP as they have been/ will be decommissioned with progression of mining at West Pit. Ongoing monitoring should be conducted at VWP's GW-103 to GW-105.	The WMP was revised in 2020 and submitted to DPIE. The revised WMP has removed these bores from the compliance monitoring network. The updated plan has not yet been approved by DPIE. Monitoring at VWPs was continued throughout the reporting period.
Sensor 1 within VWP GW-101a and sensor 3 within VWP GW-109 have failed. It is recommended that these sensors be removed from the WMP as monitoring can be continued by surrounding, close by bores.	These VWPs were repaired. Faults were due to battery issues.

Action recommended in 2019 Annual Groundwater Review	Action taken by HVO
VWP GW-110 is located close to the high wall of Carrington Pit final void and may be decommissioned. It is recommended that this be removed from the WMP and ongoing monitoring be conducted at spoil bores GW-107 and GW-108. Review of spoil water levels around the backfilled southern edge of Carrington Pit is also recommended.	The WMP was revised in 2020 and submitted to DPIE. The revised WMP has removed this bore from the compliance monitoring network. The updated plan has not yet been approved by DPIE. Sampling at GW-107 and GW-108 continued during the reporting period.
Review condition of CGW46 and 4051C, including checking the total depth of the bores and downhole camera survey to understand cause for uncharacteristic water trends that may relate to blockages in the bore or the condition of the bore.	CGW46 – bore was found uncapped which was rectified during the reporting period. 4051C - Blockage identified. Site will attempt to remove this blockage during the next reporting period.
Decommission bore CGW51a as available bore construction and water quality results indicates the bore was drilled through alluvium and into a shallow coal seam and does not provide representative groundwater results from one groundwater unit.	The WMP was revised in 2020 and submitted to DPIE. The revised WMP has removed this bore from the compliance monitoring network. The updated plan has not yet been approved by DPIE. HVO are required to continue monitoring this bore until the WMP is revised.
Check the total depth of bore 4051C.	Blockage identified. Site will attempt to remove this blockage during the next reporting period.
Groundwater levels in bores GW-100 and GW-101 indicate they are dry and water quality sampled is likely influenced by sediment in the base of the bore and not considered representative. It is recommended that the total depth of the bore be checked, and the monitoring program reviewed to ensure only representative groundwater samples are collected.	Small amount of sediment was identified at the bottom of each bore. Bores will be developed during the next reporting period to attempt to remove the sediment.
No information is available on the construction of D612(AFS), it is recommended that the total depth be measured to see if levels are near the base of the bore and water quality may reflect sediment within the bore.	Downhole camera survey was completed that identified sediment at the base of the bore. This information was provided to the groundwater consultant.
Assign one trigger level for EC for bore PB01(ALL) and C130(ALL) in WMP, based on historical data.	The WMP was revised in 2020 and submitted to DPIE. The revised WMP contains trigger levels for PB01(ALL) and C130(ALL) for EC and pH. The updated plan has not yet been approved by DPIE.
Ongoing water quality analysis for C130(ALL), as well as water quality analysis (i.e. major ions) and water level monitoring for LUG Bore and water stored within Lemington South Pit is recommended. This would also assist in verifying model predictions relating to abstraction from LUG Bore.	This additional monitoring is now being undertaken on site, with results provided to groundwater consultant.
Spoil bores 4116P and 4117P should be removed from the compliance network and ongoing monitoring be conducted at nearby bores MB14HVO01 and MB14HVO02.	The WMP was revised in 2020 and submitted to DPIE. The revised WMP has removed these bores from the compliance monitoring network. The updated plan has not yet been approved by DPIE.

Action recommended in 2019 Annual Groundwater Review	Action taken by HVO
Review condition of bore 4032P and local land use practices to understand cause for recent rise in water levels.	No local land processes identified that would contribute to rise in water levels. Downhole camera survey was completed that identified a blockage. Site will attempt to remove the blockage during the next reporting period.
Further works in relation to bores G1 to G3, including: - Based on findings from the downhole camera survey, conduct bore repairs for site monitoring bores and abandon adjacent bores; - Install dataloggers into bores G1 to G3 to collect more robust timeseries data; - Extend casing height for bore G3 and install a cap that enables pressure release.	- Repairs were not required based on the review aside from G3. - Site is investigating feasibility of installing dataloggers into bores G1 to G3. - Casing of G3 was extended during the reporting period.
Review the bore condition and construction to investigate the elevated groundwater levels at bore PZ2CH400.	Due to casing issue. Casing extended by 1 metre to rectify.
Review the condition and construction of bores HG2a, BC1a, BZ1-3, BZ2A(1), BZ3-3, BZ4A(2) and B425(WHD) in order to understand the cause for the variability in trends.	Downhole camera surveys were completed for these bores. HG2a – blockage identified. BC1a – Small amount of sediment identified at the bottom of the bore. BZ1-3 – blockage identified. BZ2A(1) – small amount of sediment identified at the bottom of the bore. BZ3-3 – blockage identified. BZ4A(2) – blockage identified. B425(WDH) – small amount of sediment identified at the bottom of the bore. These bores will be developed in the next reporting period to attempt to remove the sediment / blockage as relevant.
Review local land use activities around D807(BFS) to understand trends.	The area was reviewed and results provided to the groundwater consultant. No remarkable features were identified in the area.
Clear out/purge bore DM4 to remove sediment.	Bore was purged during the reporting period.
The abstraction rate from the LUG bore is higher than previously assessed. It is recommended that numerical modelling be undertaken to assess the impacts of the higher abstraction rate from the LUG bore on surrounding groundwater levels.	Included in 2020 groundwater review. See Appendix A.

6 Environmental Performance

6.1 Meteorological Data

The collection of meteorological (weather) data is carried out to assist in day to day operational decisions, planning, environmental management and to maintain a historic record. The meteorological stations record:

- wind speed,
- wind direction,
- temperature,
- humidity,
- solar radiation,
- rainfall.

HVO operates two real-time meteorological stations; the HVO Corporate Meteorological Station and the Cheshunt Meteorological Station. The locations of these monitors are shown in Error! Reference source not f ound.. Daily average data is publically available via the Monthly Environmental Monitoring Reports published on the HVO website.

Total annual rainfall for 2020 was 793mm (recorded at the HVO Corporate Meteorological Station) compared to 336.8mm in 2019. (**Figure 4**).

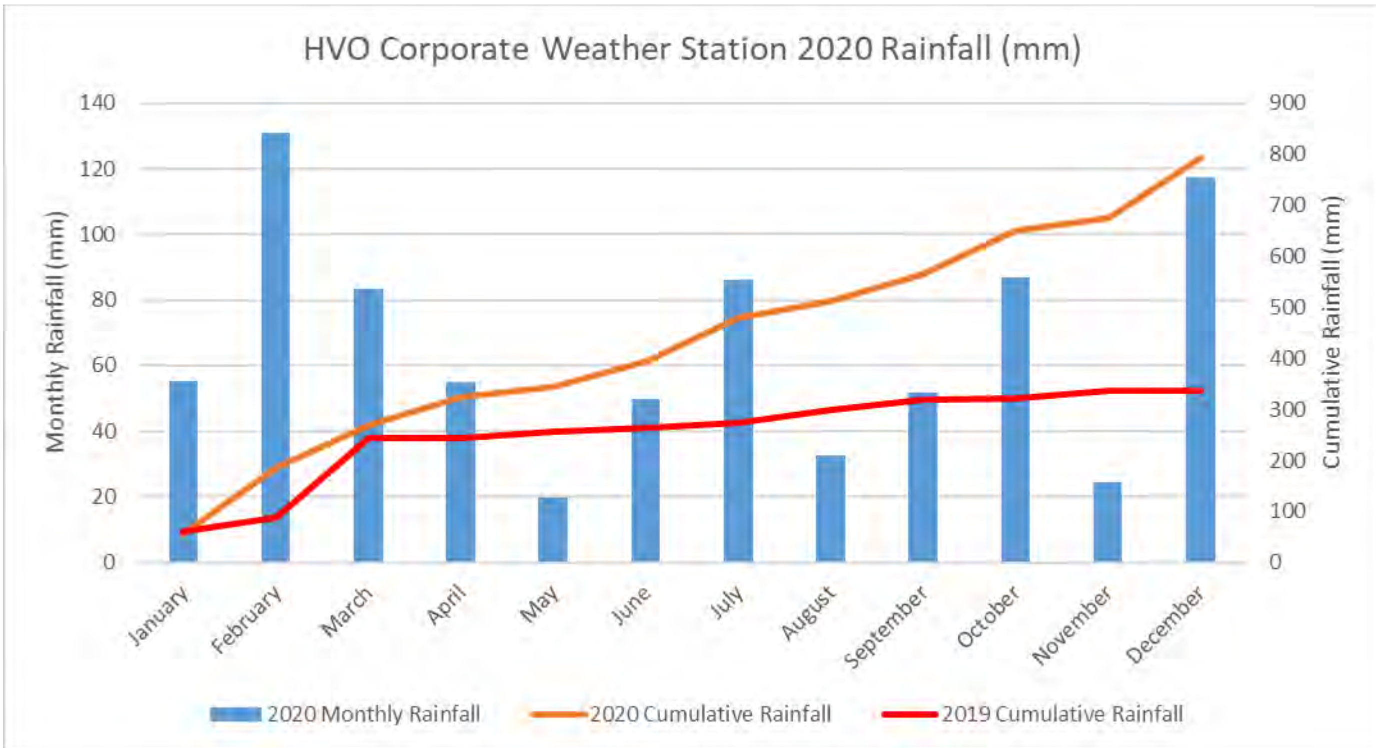

Figure 4 - HVO Corporate Meteorological Station 2019 vs 2020 Rainfall Data

6.2 Noise

6.2.1 Noise Management

Mining activities at HVO are managed to minimise adverse noise impacts and to maintain compliance with permissible noise limits at nearby private residences. A combination of proactive and reactive noise controls are employed to ensure effective management of noise. Noise controls are as detailed in the *HVO Noise Management Plan (NMP)*.

6.2.2 Sound Attenuation of Heavy Equipment

During 2020, 28 haul trucks were retrofitted with sound attenuation kits to achieve an in service sound power level of 123dB (A). This is in addition to 12 haul trucks that were retrofitted in 2019. All operational haul trucks at HVO how now been fitted with sound attenuation kits.

A routine sound power level testing schedule was implemented across site in 2020 and this will continue throughout 2021.

6.2.3 Real Time Noise Management

HVO operates a network of directional real-time noise monitors to measure and manage noise emissions and to minimise community impact.

The real-time system generates alarms when elevated noise is measured, triggering the implementation of reactive controls to reduce noise levels. HVO received and responded to 1556[1] noise alarms during 2020. The location of real-time noise monitoring locations as per the approved NMP are shown in **Figure 5.**

[1] Noise alarm triggers are based on internally set noise criteria. Alarms received include noise exceedances from non -mine sources.

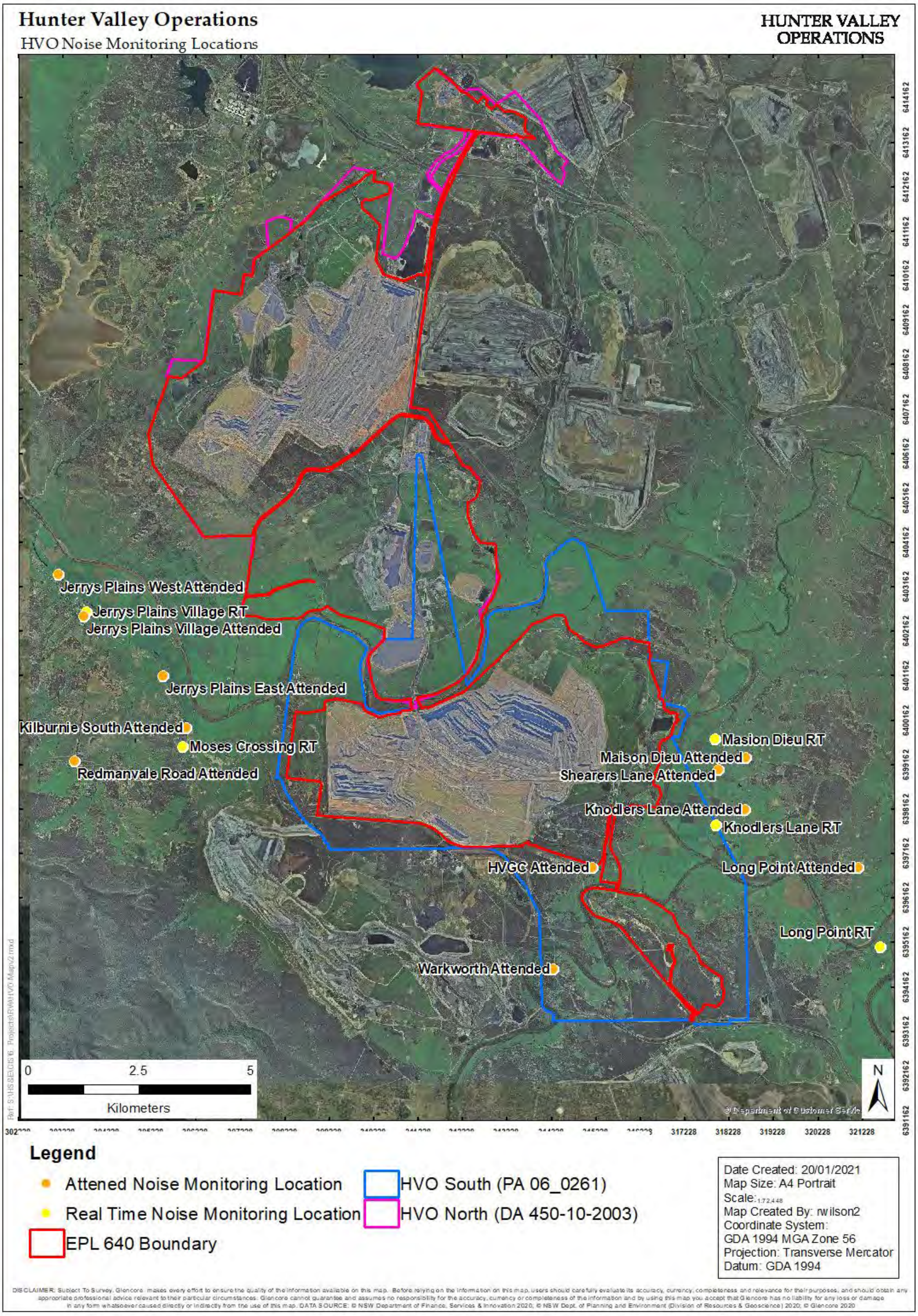

Figure 5 - HVO Attended and Real Time Noise Monitoring Locations

Attended monitoring during 2020 was compared to real time noise monitoring results where a comparison could be made (e.g HVO was audible) in order to validate real time noise monitoring systems. Results indicated that the real time monitoring system generally aligned with values recorded during attended noise measurements. Where they didn't align, the majority of real time measurements were higher than attended noise measurements.

Details of this assessment is provided in **Table 18.**

Table 18 - Comparison of Attended and Real Time Noise Monitoring 2020

Monitoring Location	Number of attended noise measurements where comparison could be made[1]		Real Time measurements that aligned[2] with attended measurements		Real Time measurements with positive variance > 3dB(A) of attended measurements		Real Time measurements with a negative variance > 3dB(A) of attended measurements	
	South	North	South	North	South	North	South	North
Maison Dieu[3]	5	-	2	-	3	-	-	-
Knodlers Lane	5	-	3	-	-	-	2	-
Long Point[3]	1	-	-	-	1	-	-	-
Kilburnie South[3]	3	2	1	1	1	1	1	0
Jerrys Plains Village[3]	-	4	-	1	-	1	N/A	2

Notes:

1. Includes measurements under all meteorological conditions

2. Aligned indicates measurements were within 3dB (A) of each other or measurement results <25dB indicated that source contribution was in audible or not measureable.

3. One or more data points not available for attended and / or real time monitoring events.

6.2.4 Operational Noise Performance

HVO engages a suitably qualified and experience acoustic consultant to undertake routine attended noise compliance monitoring at nearby private residences to assess compliance with the relevant Project Approval noise criteria, in accordance with the NMP. Monitoring is undertaken at a frequency of one night per month and an additional one night per quarter as required by the HVO North Approval. This monitoring is undertaken to evaluate and assess noise impacts under a range of meteorological conditions throughout the year.

A total of 110 measurements were recorded during 2020. Each measurement involves an assessment of HVO mine noise against the various $L_{Aeq,\ 15minute}$ and $L_{A1,1min}$ noise criteria in place under the HVO North and South Approvals. Full details for all noise assessments completed can be found in HVO Monthly Environmental Monitoring Reports published on the HVO website.

HVO was compliant with relevant noise criteria for all measurements recorded in 2020.

Comparison between the 2020 L_{Aeq} attended noise monitoring results (maximum HVO contribution levels measured under applicable meteorological conditions) and previous years are shown in **Table 19**.

Table 19 - Comparison of 2020 Noise monitoring results against previous years

Year	Number of Measurements	Number of measurements which exceeded allowable noise (under applicable meteorological conditions)	Number of non-compliances
2020	110	0	0

Year	Number of Measurements	Number of measurements which exceeded allowable noise (under applicable meteorological conditions)	Number of non-compliances
2019	101	1	0
2018	105	3	0
2017	100	1*	0
2016	109	2*	0

* The now superseded NSW Industrial Noise Policy (INP) allowed for the measured result to be less than or equal to 2 dB above the applicable noise limit without constituting a non-compliance. Note: Where the measured result is greater than 2dB above the applicable noise limit, the site has 75 minutes to reduce noise levels below applicable noise limits before constituting a non-compliance. As of late October 2017, the NSW INP was superseded by the Noise Policy for Industry (NPfI), with the requirements of this policy implemented in late 2017.

6.2.5 Comparison with Predictions

Comparisons against the predicted noise levels in the *HVO West Pit Extension and Minor Modifications Environmental Impact Statement (EIS) (2003)* have been made against the modelled scenario for Year 14 (indicative of activities carried out during 2020) of the development. (Table 5.2 of Part J – Hunter Valley Operations West Pit Extension and Minor Modifications Technical Reports Part 3) are shown in **Table 20**.

Table 20 - Comparison of 2020 monitoring against HVO North (Year 14, West Pit EIS, 2003) - Night Period

Location	Units	EIS Prediction (INP)	2020 (max. measured LAeq 15min under applicable met. conditions)
Knodlers Lane (5)	dB(A)	27	IA
Maison Dieu (6)	dB(A)	26	IA
Shearers Lane (5)	dB(A)	27	IA
Kilburnie South (4)	dB(A)	34	32
Jerrys Plains (13)	dB(A)	N/A	34
Jerrys Plains East (1)	dB(A)	38	33

Comparison of measured results against the modelled predictions for Year 14 in the HVO West Pit EIS (2003) demonstrates noise levels equal to or lower than predicted at all monitoring locations.

Comparisons against the predicted noise levels in the HVO Carrington West Wing EA (2010) have not been made in this years' Annual Review as this project has not commenced. Mining activity in the Carrington Pit area was limited to a short term mining campaign prior to the proposed deposition of tailings material.

Comparisons against the predicted noise levels in the HVO South Modification 5 Environmental Assessment have been made against Stage 1 modelling scenario (indicative of activities carried out during 2020), (Table 6.10 of Appendix E– Hunter Valley Operations South Modification 5 Approval Environmental Assessment Report Volume 2). The comparison (**Table 21**) indicates that during 2020, noise was lower than predicted levels for all receptors.

Table 21 - Comparison of 2020 monitoring against HVO South (Stage 1 HVO South Modification 5 EA- 2017)

Location	Units	EIS Prediction (INP)	2020 (max. measured $L_{Aeq\ 15min}$ under applicable met. conditions)
Knodlers Lane (120)	dB(A)	40	34
Maison Dieu (258)	dB(A)	40	30

Location	Units	EIS Prediction (INP)	2020 (max. measured $L_{Aeq\ 15min}$ under applicable met. conditions)
Shearers Lane (160)	dB(A)	41	34
Kilburnie South (307)	dB(A)	39	<20
Jerrys Plains (399)	dB(A)	34	IA
Jerrys Plains East (321)	dB(A)	35	IA

6.3 Blasting

6.3.1 Blasting Management

HVO operates a blast monitoring network to assess and evaluate blast vibration and overpressure impacts against the HVO North and HVO South Consent Criteria. There was 100% blast data capture for all blast monitors in 2020.

Monitors are located at or in close proximity to nearby privately owned residences as shown in Error! Reference source not found. (from the HVO Blast Management Plan). The monitors function as regulatory compliance monitors. These monitors are located at:

- Jerrys Plains Village
- Warkworth
- Maison Dieu
- Moses Crossing
- Knodlers Lane

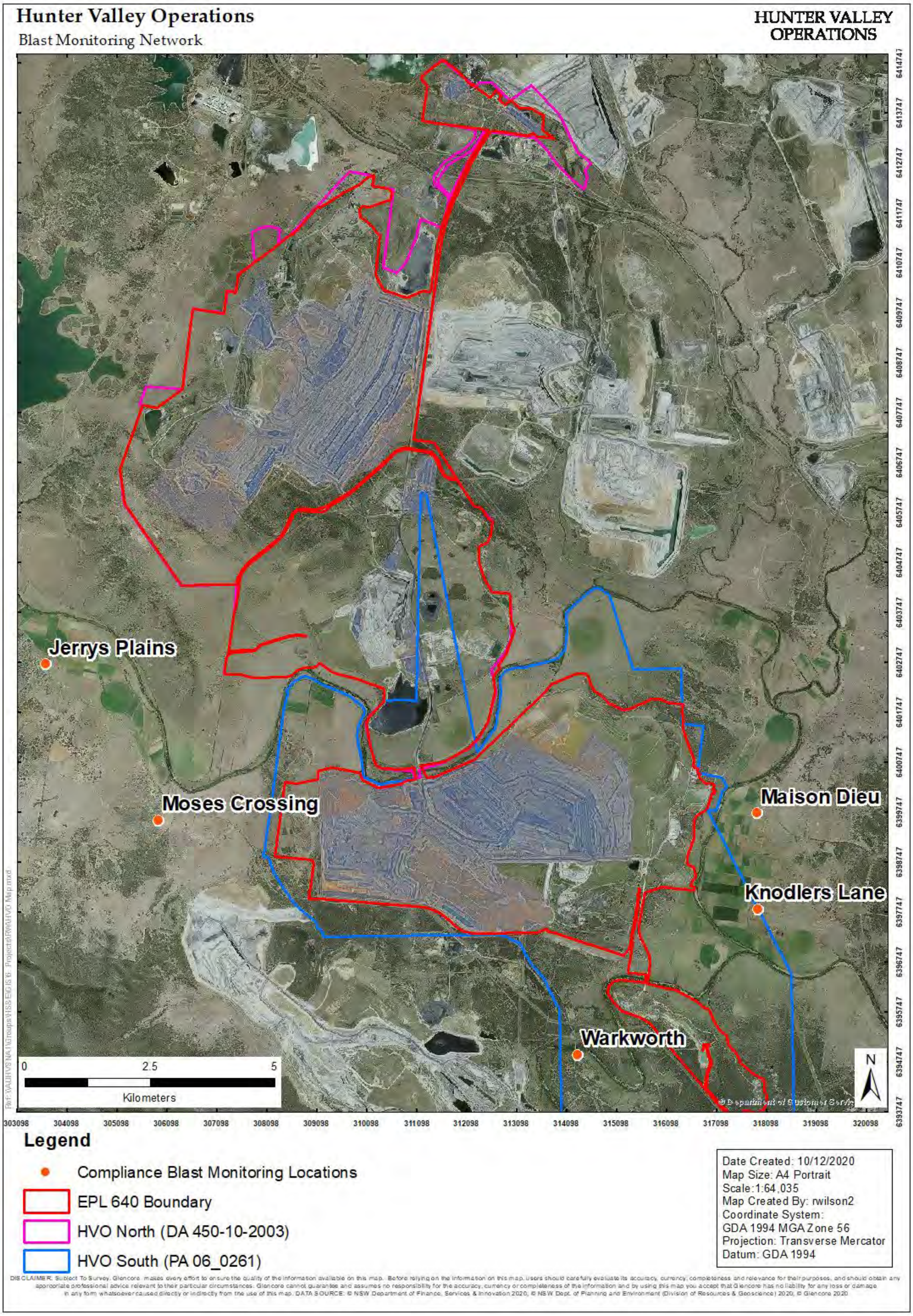

Figure 6 - HVO Blast Monitoring Network

6.3.2 Blasting Performance

186 blast events were initiated at HVO during the reporting period. 119 blasts were fired at HVO South, and 67 at HVO North. HVO complied with all blasting related consent and licence conditions with the exception of a blast on 27th August 2020 in the HVO South area which exceeded the air blast overpressure criteria at Knodlers Lane. Details on the incident are provided in the **Statement of Compliance.** Air blast overpressure and ground vibration results for all blasts fired during the reporting period are presented in Error! Reference source not found.Error! Reference source not found. to **Figure 11**

Four blasts recorded overpressure greater than 115 dB(L) during the reporting period. Comparison of total overpressure measurements above 115dB(L) against the requirement for 5% of total number of blasts being between 115dB(L) and 120dB(L) is shown in **Table 22**. HVO complied with this requirement during the reporting period.

Table 22 - HVO air blast overpressure allowable exceedance summary

Monitoring Location	HVO South Blasts		HVO West / North Blasts	
	Allowable Exceedance over 115 dB(L) of time over 12 months (%)	Percentage of blasts over 115dB(L)	Allowable Exceedance over 115 dB(L) of time over 12 months (%)	Percentage of blasts over 115dB(L)
Moses Crossing	5	0	5	0
Jerrys Plains	5	0	5	0
Warkworth	5	0.8	5	0
Maison Dieu	5	2.5	5	1.5
Knodlers Lane	5	0.8	5	

There were no exceedances of the 5 mm/s or 10 mm/s ground vibration criteria at any residence on privately-owned land.

Blasting occurred only between the hours of 7am and 6pm Monday to Saturday during the reporting period. No blasting was carried out on Sundays or Public Holidays. No more than 3 blasts were fired per day and the maximum number of blasts fired during any week was nine, less than the maximum weekly blasting frequencies as specified in project approvals.

No fume events were recorded leaving the site in accordance with protocols detailed in the HVO Blast Management Plan.

During the reporting period, HVO closed Lemington Road on 7 occasions for an average of 14 minutes, and the Golden Highway for an average of 13 minutes during the reporting period.

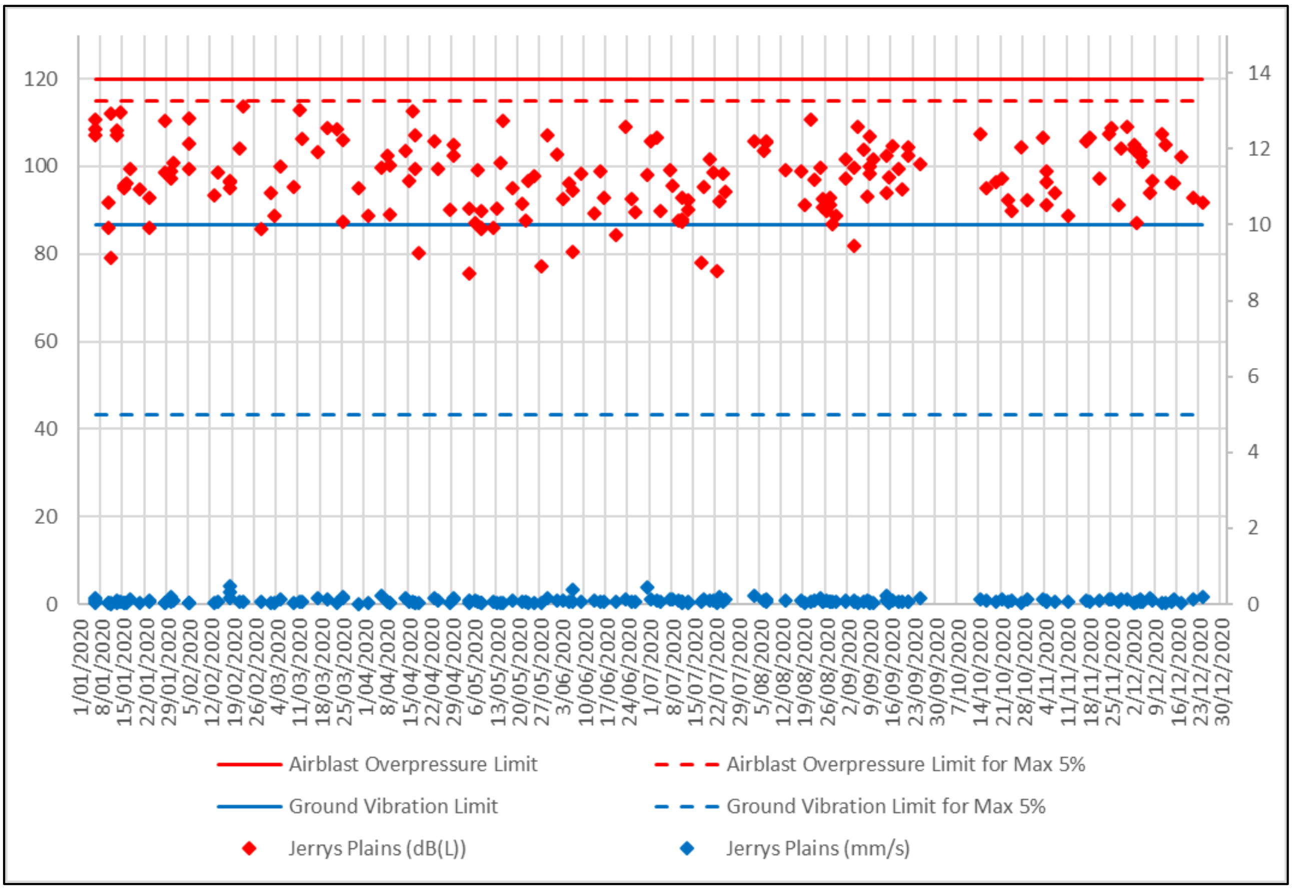

Figure 7 - Jerrys Plains Blast Monitoring Results 2020

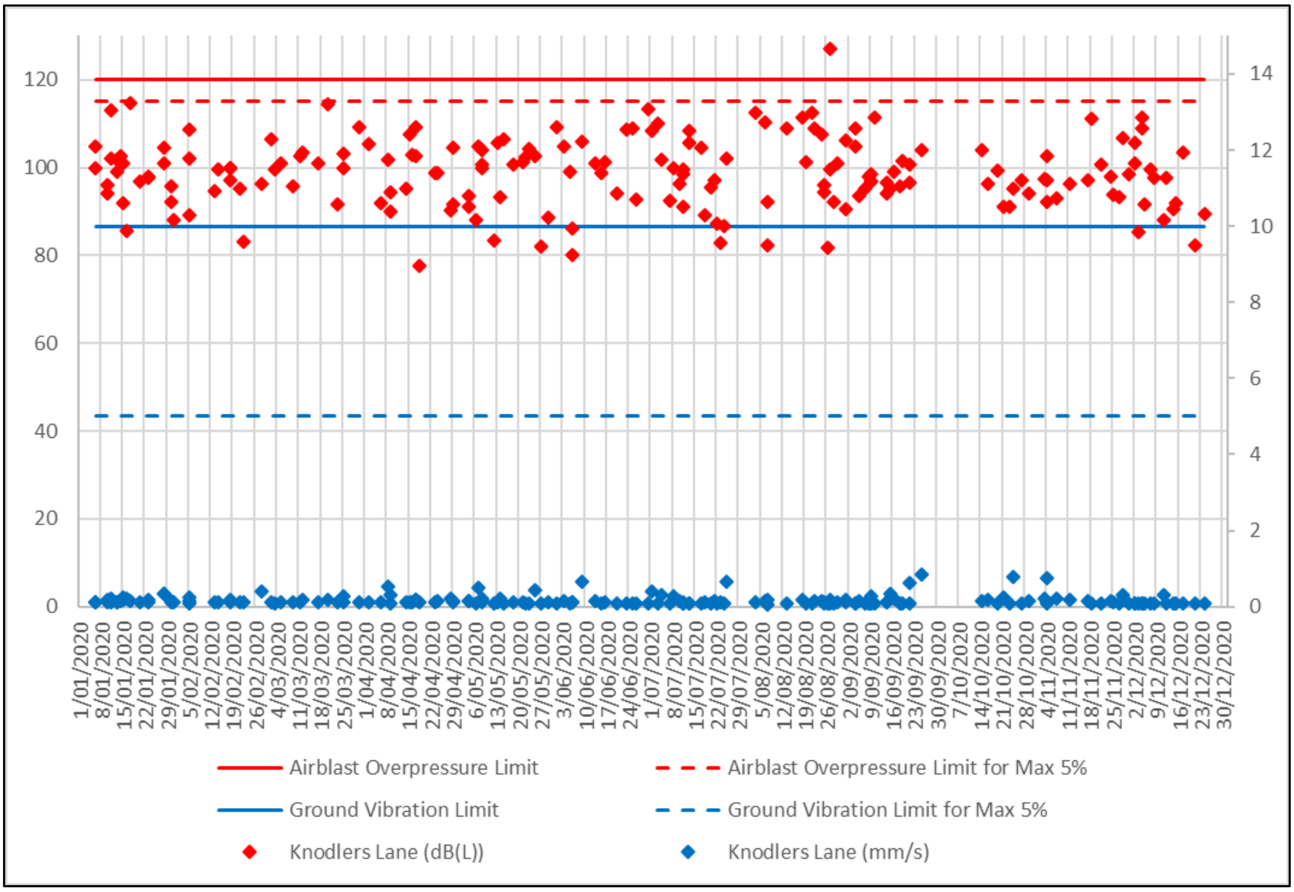

Figure 8 - Knodlers Lane Blast Monitoring Results 2020

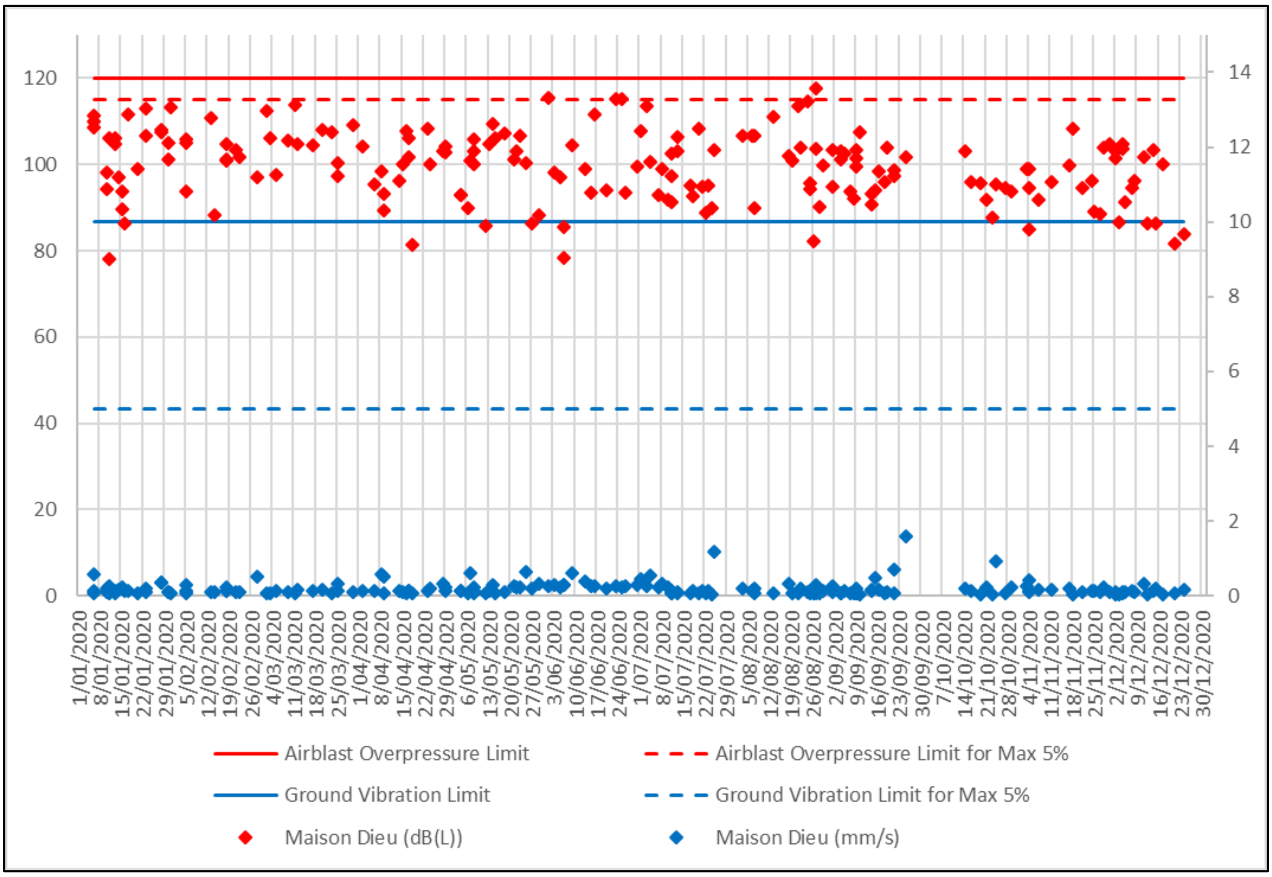

Figure 9 - Maison Dieu Blast Monitoring Results 2020

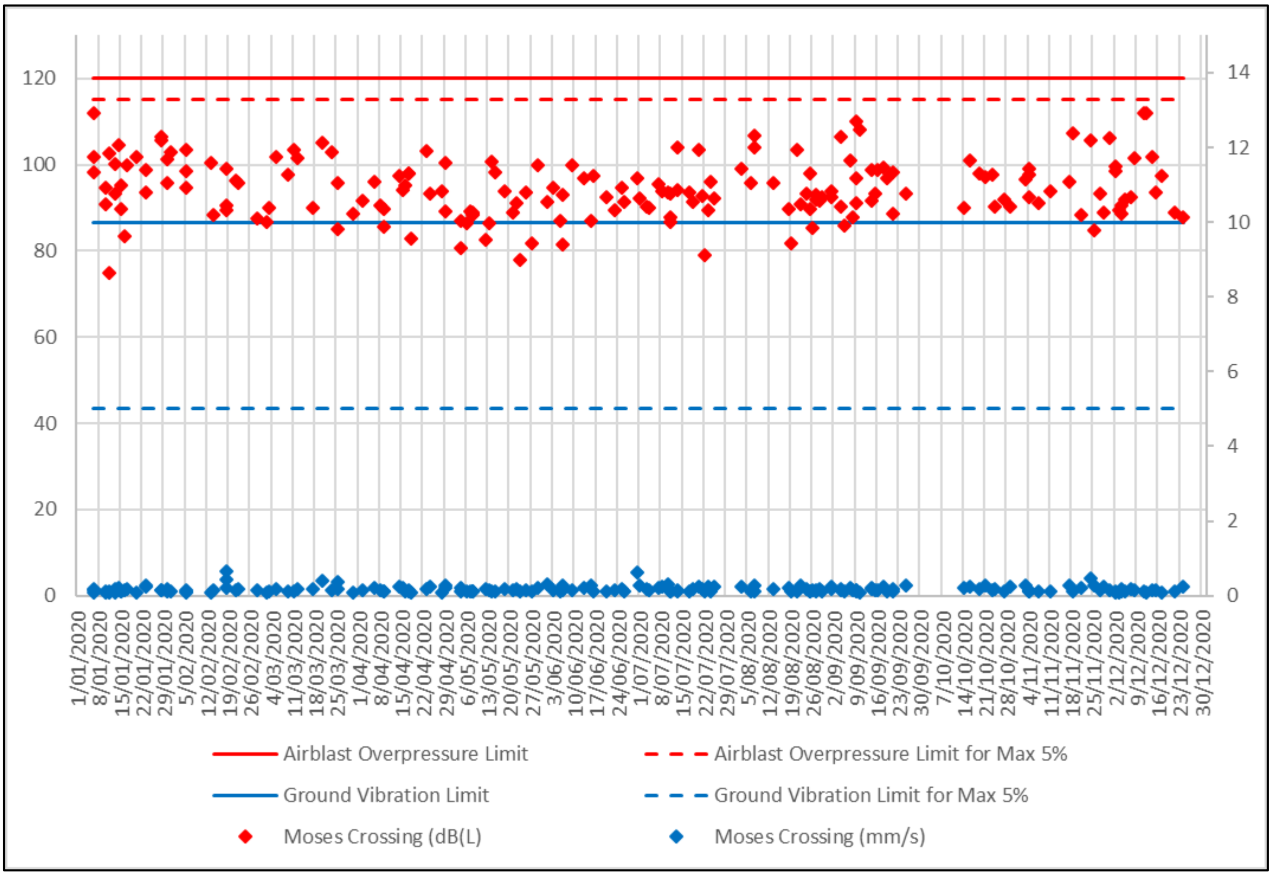

Figure 10 - Moses Crossing Blast Monitoring Results 2020

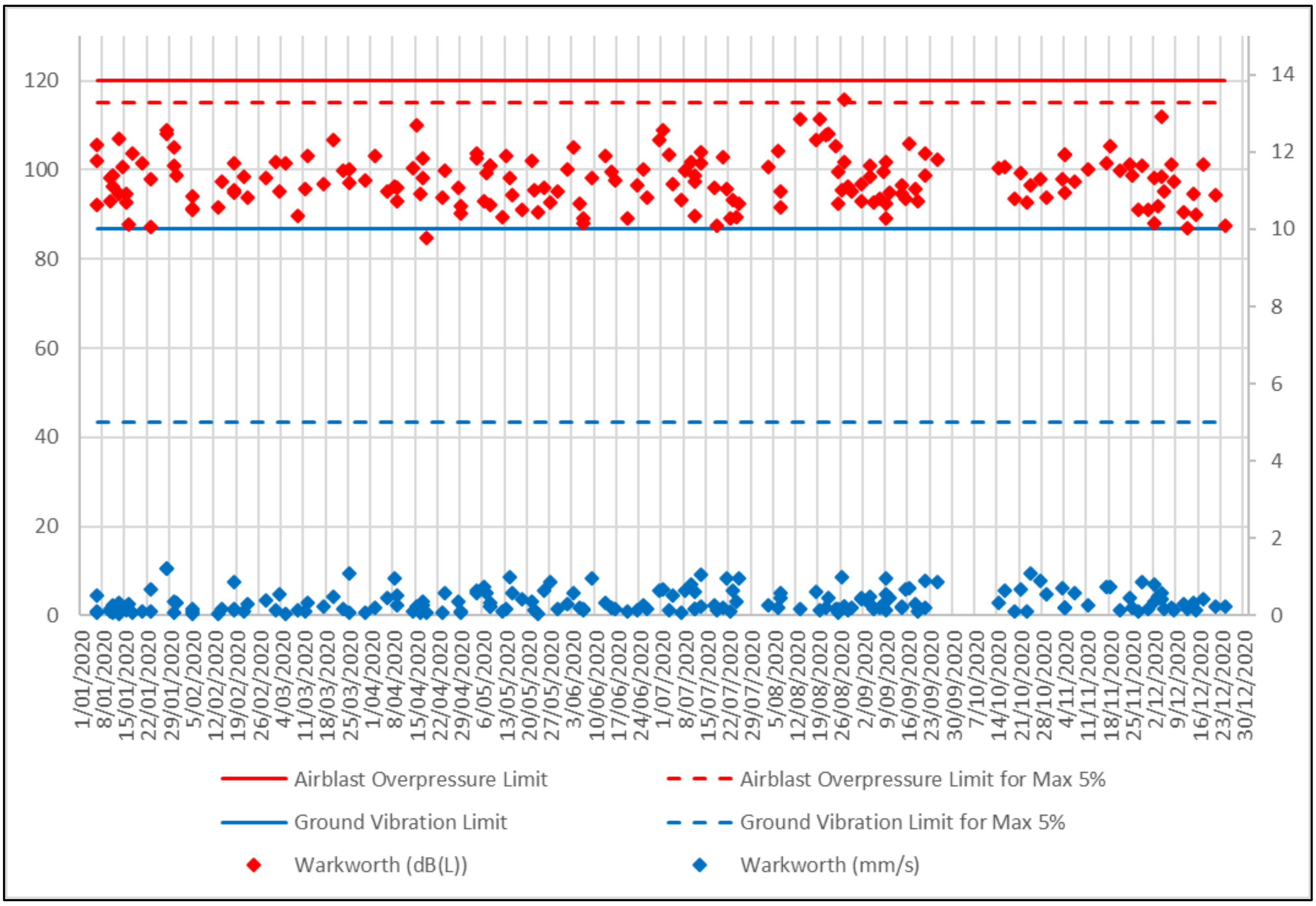

Figure 11 - Warkworth Blast Monitoring Results 2020

6.3.3 Blast Fume Management

Blasting operations at HVO are undertaken in accordance with the *HVO Post Blast Fume Generation Mitigation and Management Plan*. The plan outlines the practices to be utilised to reduce the risk of generation of post blast fume, and reduce potential offsite impact from any fume which may be produced. This includes specialised blasting design, appropriate product selection, on-bench water management, implementation of fume management zones and use of existing blasting permissions to identify likely path of any fume which may be produced.

All blasts are observed for fume and any fume produced is ranked according to the Australian Explosive Industry & Safety Group (AEISG) Scale.

Fume rankings for shots fired during 2020 and comparison to previous years is provided in **Table 23**. No blast fume ranked as category 3, 4 or 5 were observed at HVO during the reporting period.

Table 23 - Visible blast fume rankings according to the AEISG colour scale

AEISG Ranking	2017	2018	2019	2020
0	272	214	202	160
1	39	19	39	22
2	11	16	15	27
3	2	4	4	0
4	0	0	0	0
5	0	0	0	0

AEISG Ranking	2017	2018	2019	2020
Total*	324	253	260	209

* Where a number of individual blasts w ere fired as a blast event, fume w as assessed for each individual blast pattern rather than for the event as a w hole.

6.4 Air Quality

6.4.1 Air Quality Management

Air quality management initiatives are implemented at HVO to ensure that:

- Air quality impacts on surrounding residents are minimised;
- All statutory requirements are adhered to; and
- Local community and regulators are kept informed through prompt and effective response to issues and complaints.

Air quality control mechanisms employed at HVO are described in detail in the *Hunter Valley Operations Air Quality and Greenhouse Gas Management Plan (AQGHMP)*, publically available via the HVO website.

During 2020, a number of days were deemed to have been effected by extraordinary events caused predominantly by smoke associated with the 2019/2020 bushfires, dust storms or regional dust events. During this period 97 exceedances of the short term (24 hour) criteria were measured across the HVO monitoring network over 24 days in the calendar year. Each of these exceedances were reported to DPI&E and were noted to have been affected by an extraordinary event where relevant and therefore, as per the consent conditions, the criteria was not deemed to be applicable. The following dates during the reporting period are considered to be affected by an extraordinary event:

- January – 1 – 12, 15, 20, 21, 23-25
- February – 1, 2, 4 and 19
- August – 19
- November – 29

HVO continued to implement operational controls to manage dust emissions in accordance with the *AQGHMP*. HVO also continued implementation of additional dust management measures including the further training of Dispatch officers in response to alarms.

6.4.2 Air Quality Monitoring

Air quality monitoring at HVO is undertaken in accordance with the *HVO Air Quality Monitoring Program (AQMP).* An extensive network of monitoring equipment is utilised to assess performance against the relevant conditions of HVO's approvals. Air quality monitoring locations are shown in **Figure 12**.

The HC1 TEOM was moved during 2020 due to mine advance and was replaced with an ESampler located at HVO Corporate meteorological station until the relocation was completed. The TEOM will be relocated to an alternative location approved by the EPA in 2021. Air quality monitoring data is made publically available through the HVO Monthly Environmental Monitoring Report, available on the HVO website.

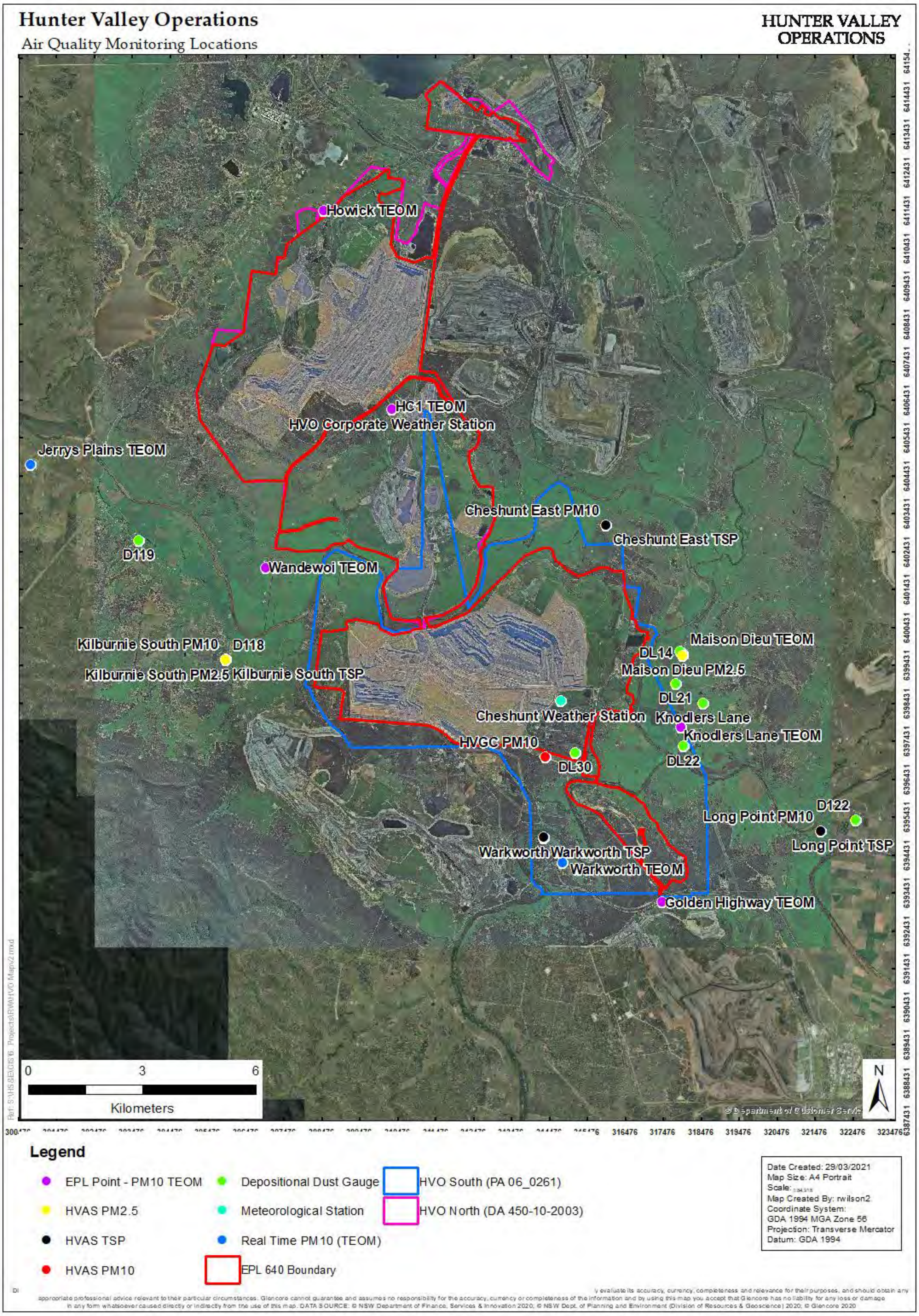

Figure 12 - Air Quality Monitoring Locations

6.4.3 Air Quality Performance

6.4.3.1 Real Time Air Quality Management

HVO’s real time air quality monitoring stations continuously log information and transmit data to a central database, generating alarms when particulate matter levels exceed internal trigger limits to guide the operational management of air quality on site.

A total of 1363 real time alarms for air quality and meteorological conditions were received and acknowledged during 2020, which is a decrease of 1164 alarms from those recorded during 2019. This decrease is likely due to the decrease in the number of ‘extraordinary event’ days as a result of bushfire smoke from October through to December 2019, and optimisation of air quality alarm trigger criteria.

In response, 906.2 hours of equipment downtime was recorded due to air quality management. A detailed breakdown of air quality related equipment stoppages (per month, per equipment type) presented in **Figure 13.** Note that these delays are instances where operations were completely stopped and does not include occasions where operations were changed/modified but not stopped (e.g. changed from exposed dump to in-pit dump).

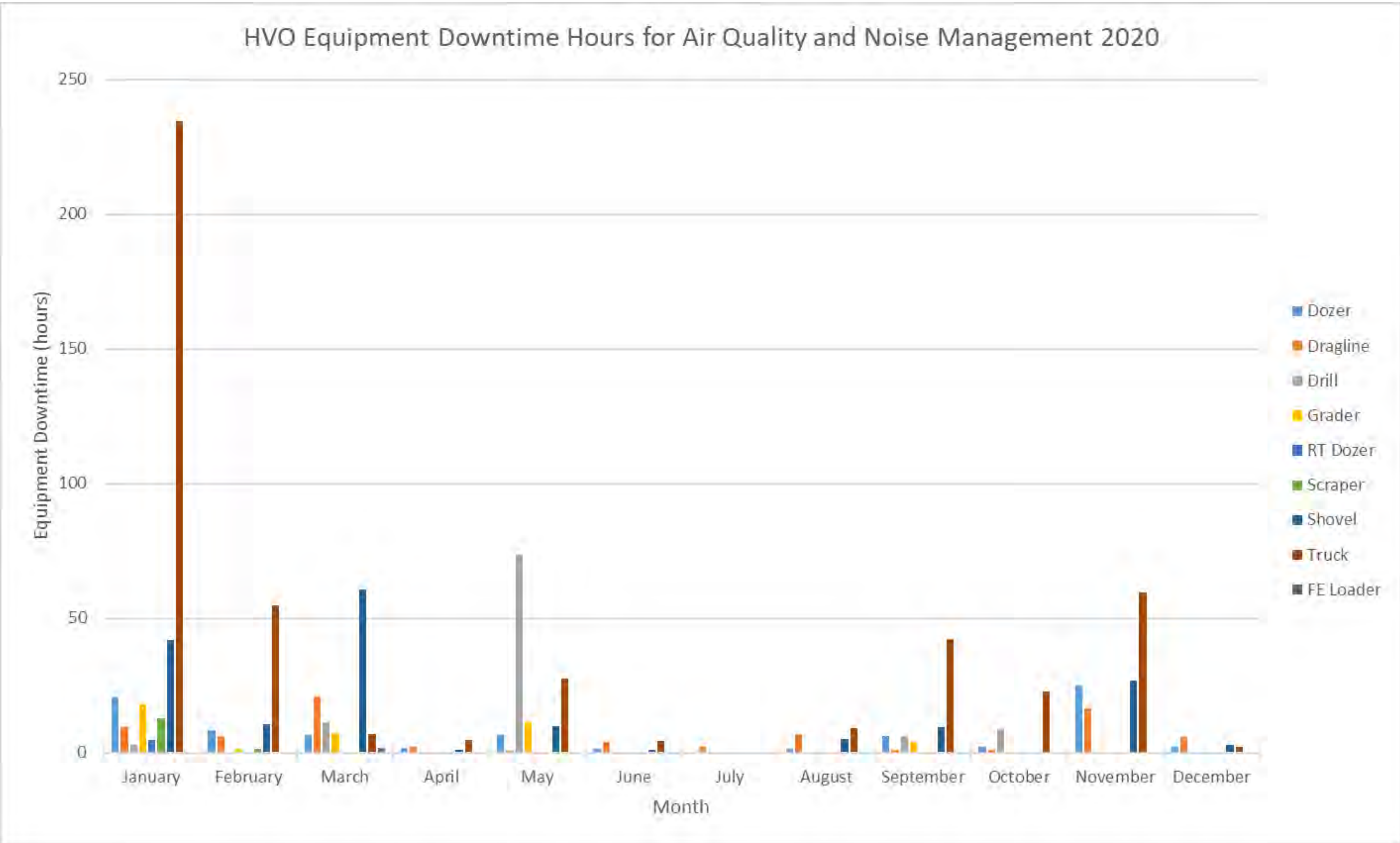

Figure 13 - Equipment Downtime Hours for Air Quality and Noise Management 2020

Data availability from HVO's real time air quality monitoring stations is presented in **Table 24**.

Table 24 - Real Time PM_{10} Air Quality Monitoring Data Availability 2020

Monitoring Location	2020 Data Availability
Warkworth	92%
Knodlers Lane	92%
Maison Dieu	93%
Howick	82%
HC1	95%
Wandewoi	91%
Golden Highway	90%
Jerrys Plains	93%

Note: Data availability calculated across 2020 is based on availability of a 24 hour average result.

6.4.3.2 Temporary Stabilisation

Aerial Seeding was undertaken in June 2020 by fixed wing aircraft to provide temporary cover to areas exposed to wind generated dust and erosion at HVO. Waste dumps and exposed areas were selected for seeding if they were not planned to be disturbed within six months. A total area of 405 ha was seeded which included waste dumps ahead of mining disturbance (**Figure 14).** All areas were seeded using an exotic pasture and legume mix suitable for autumn sowing. A starter fertiliser was mixed with the seed prior to loading to provide sufficient nutrients for plant growth.

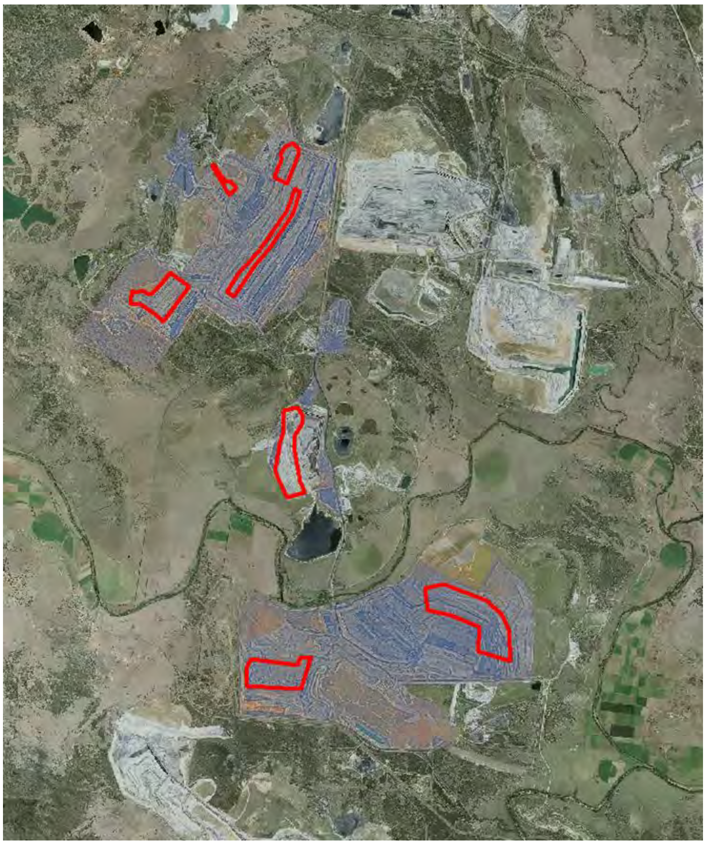

Figure 14 - Areas Aerial Seeded in 2020 – HVO North & South

6.4.3.3 Depositional Dust

Depositional dust is monitored at nine locations on privately-owned land in accordance with the *AQMP*. The annual average insoluble matter deposition rates in 2020 compared with the depositional dust impact assessment criterion and previous years' data are shown in **Figure 15.**

Depositional dust samples are collected monthly. Where field observations denote a sample as contaminated (typically with insects, bird droppings or vegetation), the results are excluded from annual average compliance assessment.

Three monitoring locations (DL21, DL30 and Warkworth) exceeded the annual average insoluble matter deposition rate criteria of 4 g/m^2/month (HVO North only) during 2020. All results were below the maximum insoluble solids incremental increase criteria of 2 g/m^2/month (**Figure 16**).

Meteorological conditions and the results of nearby monitors for the sampling period are also considered when determining level of HVO contribution to any elevated result.

The three exceedances were assessed to estimate maximum contribution from HVO North to the results. HVO North was not considered to be a significant contributor to these exceedances (**Table 25**).

Table 25 - Dust Deposition Annual Average Assessement

Date	Site	Measured Annual Average Dust Deposition (g/m^2/month)	Annual Average Dust Deposition Criteria (g/m^2/month)	HVO's contribution to Dust Deposition (g/m^2/month)	Discussion
2020	DL21	5.5	4	0.2	An external consultant was engaged to investigate the exceedance, which determined that the elevated result was not solely attributable to HVO North. HVO North was not considered to be a significant contributor to these exceedances and is therefore compliant.
	DL30	4.9	4	0.2	
	Warkworth	5.5	4	0.1	

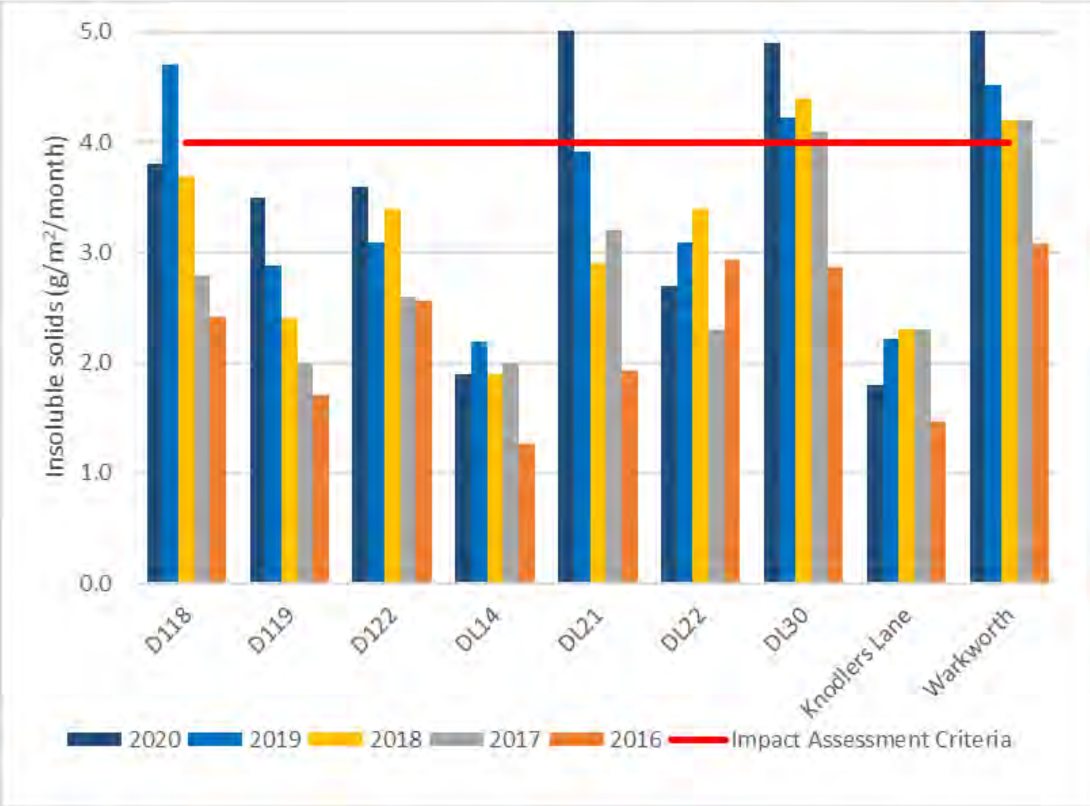

Figure 15 - Annual average insoluble matter deposition rates 2016-2020

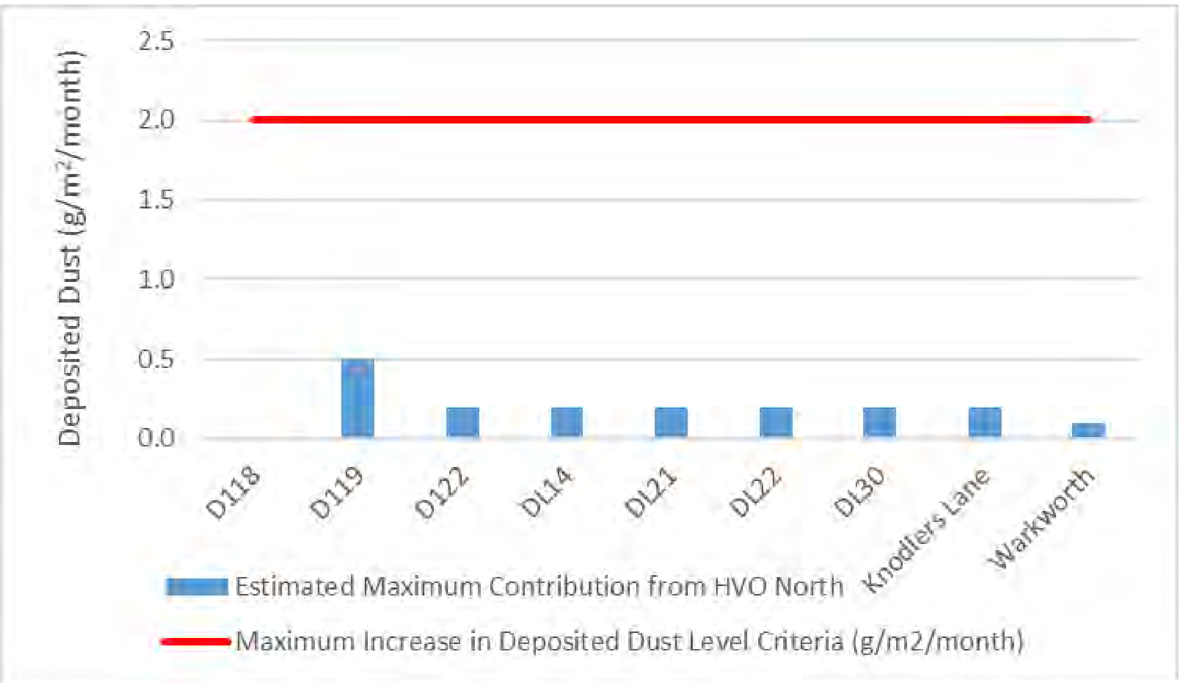

Figure 16 - Maximum allowable increase in deposited dust level 2020

6.4.3.4 Total Suspended Particulates (TSP)

TSP is monitored at six locations on privately owned land in accordance with the *AQMP*. An additional monitor at Cheshunt East is located on mine-owned land, however it is representative of privately owned property. This location was added to the monitoring program in the latest version approved in September 2019, hence this is the first annual assessment reported.

Annual average TSP concentrations recorded in 2020 compared with the long term impact assessment criterion and data from previous years are shown in **Figure 17.** Concentrations recorded in 2020 exclude days deemed to have been affected by extraordinary events (refer to **Section 6.4.1**). TSP results are considered to be generally consistent with those recorded in previous years.

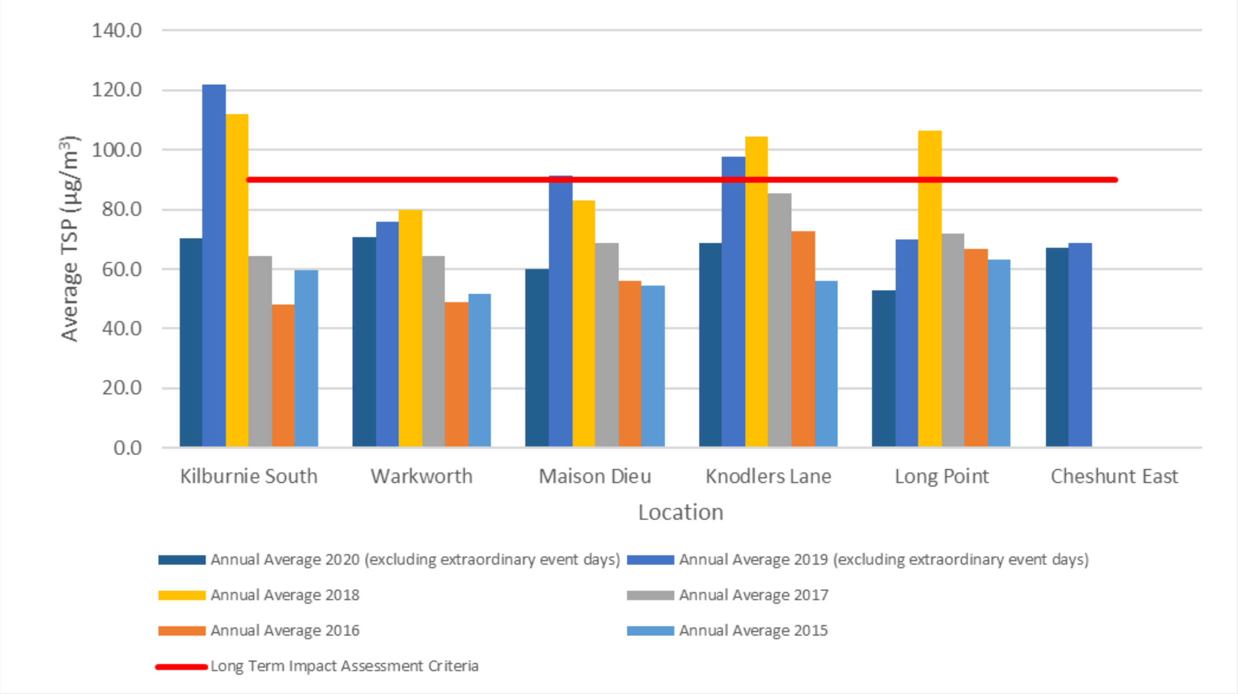

Figure 17 - Annual average TSP concentrations 2016 to 2020 (excludes extraordinary events)

All monitoring locations were below the impact assessment criteria during 2020.

8 out of 427 TSP measurements were not able to be collected on the scheduled sampling date (based on a sampling frequency of every six days) due to power failures and technical issues with the monitor these are reported in **Incidents and Non-Compliances**.

6.4.3.5 Particulate Matter <10µm (PM_{10})

Particulate Matter <10 µm³ (PM_{10}) is monitored using High Volume Air Samplers (HVAS) and Real Time Tapered Element Oscillating Microbalance (TEOM) monitors. Prior to the revised *AQGHMP* being approved in September 2019, HVAS monitors were utilised as the sole measure of PM_{10} compliance. Post September 2019, TEOM monitors replaced HVAS monitors at Maison Dieu, Knodlers Lane, Warkworth and Wandewoi as the measure of compliance. It should be noted that this significantly increased the number of samples being collected and assessed for compliance compared to previous years.

Cheshunt East is located on mine-owned land, however is representative of privately owned property. This location was added to the monitoring program in the latest version approved in September 2019, hence this is the first annual assessment reported.

Assessment of annual averages is presented against the full year results recorded against the current approved monitoring program and compliance protocol detailed in the *AQGHMP*.

6.4.3.6 Particulate Matter <10µm (PM_{10}) - Short Term (24 hour average) Impact Assessment Criteria

Short Term (24 hour average) PM_{10} concentrations were calculated for both HVAS and TEOM monitors and assessed against the relevant criteria as per the *AQGHMP*. For TEOM monitors, this was undertaken using hourly average data and for HVAS units this was calculated using the 24 hour average concentrations on each of the run days.

Short term (24 hour average) results recorded by HVO's compliance monitoring network during 2021 is presented in **Figure 18.**

The data presented includes total measured results including contribution from all particulate sources and extraordinary events. Each exceedance was investigated by an external consultant to determine the level of contribution from either HVO North, HVO South or where relevant both. Outcomes of these assessments is provided in **Appendix A** - **.**

There were a total of 97 exceedances recorded over 31 days during the reporting period. These 97 exceedances were based on 82 measurements as some monitors have separate criteria for North and South consents applied. All of these exceedances were found by the external consultant to not be attributable to HVO.

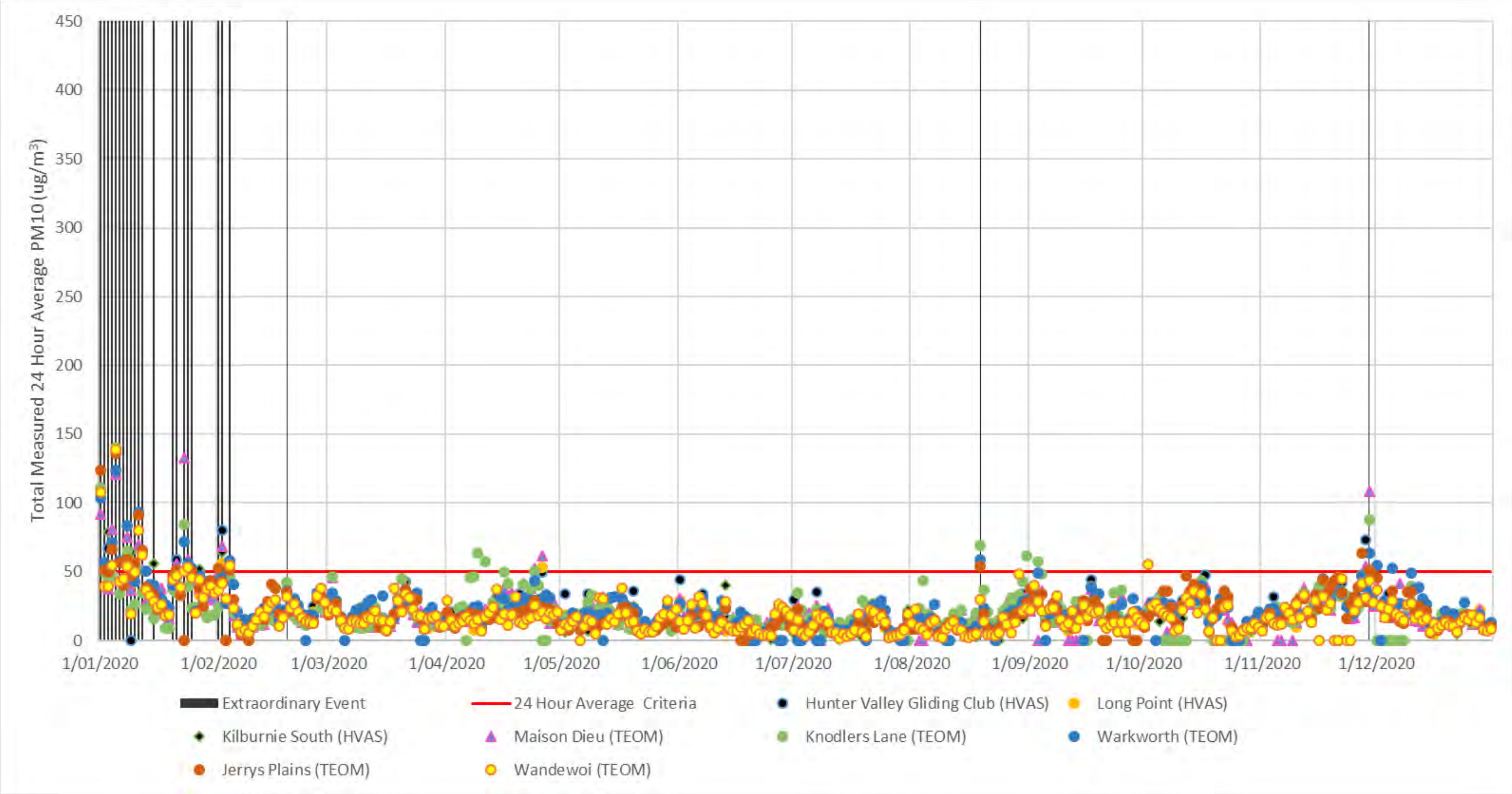

Figure 18 - 24 hour average total PM$_{10}$ results- 2020

6.4.3.7 Long term PM_{10} impact assessment criteria

Annual average PM_{10} concentrations were calculated for both HVAS and TEOM monitors and assessed against the relevant criteria as per the *AQGHMP*. This was undertaken for TEOM monitors using hourly average data, and was calculated for HVAS units using 24-hour average concentrations on each of the run days. Where results were deemed to have been effected by an extraordinary event these results have been excluded from the calculation of the annual average. A comparison of the long term PM_{10} impact assessment criterion and previous years' data are shown in **Figure 19.**

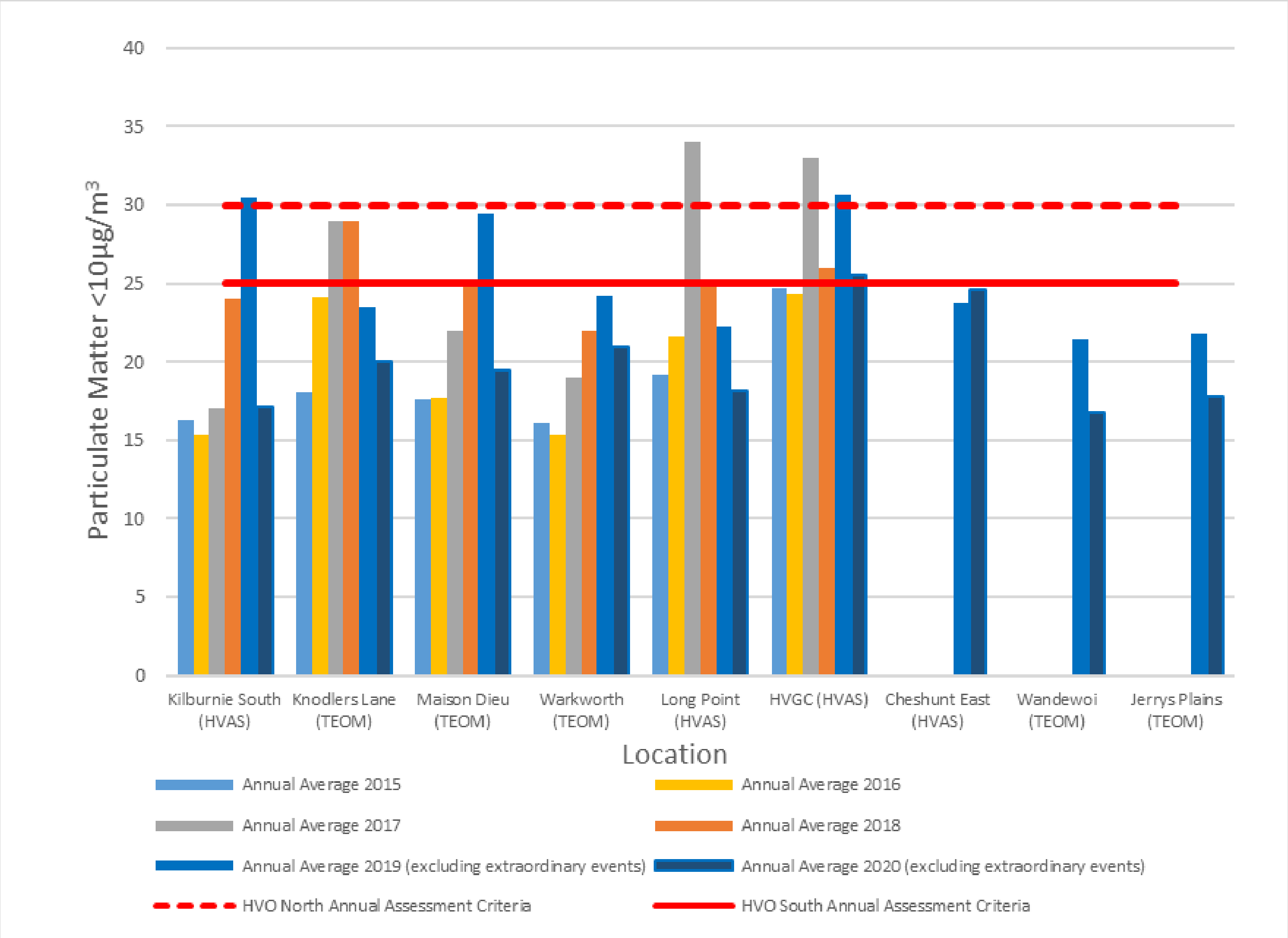

Figure 19 - Annual average HVAS PM 10 results 2015 to 2020

Annual average PM_{10} levels were elevated above impact assessment criteria at one of the eight monitoring locations during the reporting period. The result at the HV Glider Club was investigated by an external consultant to determine the level of contribution from HVO activities, in accordance with the *AQGHMP*. Results of the investigation is presented in **Table 26**.

Table 26 - Assessment of Annual Average PM_{10} - 2020

Monitoring Location	Measured PM_{10} Annual Average (µg/m³)	Annual Average PM_{10} Criteria (µg/m³)	Estimated contribution to annual average PM_{10} (µg/m³*)	Discussion
Hunter Valley Gliding Club (HVAS)	25.5	25	7.9 (HVO North) and 10.1 (HVO South)	An investigation was undertaken by an external consultant which concluded that the influence of other likely significant sources cannot be distinguished from HVO South's contribution. These would include the influence of HVO North, the operation of the Gliding Club itself and the significant earthworks conducted by adjacent mines in 2020 approximately 1.3km to the west of the monitor. Regardless, the cumulative impact of HVO, other sources and background concentrations results in a level only marginally above the criterion of 25 µg/m³.

* Excludes extraordinary events

6.4.3.8 Impact Assessment Criteria

$PM_{2.5}$ samples were collected at Maison Dieu and Kilburnie South during 2020 and these results are provided in **Table 27** and **Figure 20**.

17 results above criteria were recorded over 14 monitoring days during 2020. 7 of these results were found to be due to bushfires that were determined to be an extraordinary event by DPI&E. The remaining 10 results were determined through investigation by an external consultant to have not been significantly contributed to by HVO, and are therefore not deemed to be non-compliant against 24-hour impact assessment criteria.

Table 27 - Short Term Impact Assessment Criteria – $PM_{2.5}$ Results 2020

Date	Site	Measured 24 hour average $PM_{2.5}$ level (µg/m³)	HVO South 24 hour average $PM_{2.5}$ Incremental Criteria (µg/m³)	Estimated HVO South Incremental contribution to $PM_{2.5}$ level (µg/m³)	Discussion
03/01/2020	Maison Dieu	51	25	0	This day was deemed to have been effected by an extraordinary event caused by the influence of Bushfire Smoke.
03/01/2020	Kilburnie South	82	25	0	This day was deemed to have been effected by an extraordinary event caused by the influence of Bushfire Smoke.
09/01/2020	Kilburnie South	33	25	7.9	This day was deemed to have been effected by an extraordinary event caused by the influence of Bushfire Smoke.
15/01/2020	Kilburnie South	50	25	25	This day was deemed to have been effected by an extraordinary event caused by the influence of Bushfire Smoke.

Date	Site	Measured 24 hour average $PM_{2.5}$ level ($\mu g/m^3$)	HVO South 24 hour average $PM_{2.5}$ Incremental Criteria ($\mu g/m^3$)	Estimated HVO South Incremental contribution to $PM_{2.5}$ level ($\mu g/m^3$)	Discussion
21/01/2020	Maison Dieu	39	25	1	This day was deemed to have been effected by an extraordinary event caused by the influence of Bushfire Smoke.
21/01/2020	Kilburnie South	38	25	0	This day was deemed to have been effected by an extraordinary event caused by the influence of Bushfire Smoke.
27/01/2020	Maison Dieu	44	25	0	HVO assessed as providing no contribution by external consultant.
27/01/2020	Kilburnie South	43	25	0	HVO assessed as providing no contribution by external consultant
02/02/2020	Kilburnie South	82	25	0	This day was deemed to have been effected by an extraordinary event caused by the influence of Bushfire Smoke.
26/04/2020	Maison Dieu	56	25	12.2	HVO assessed to not be the significant contributor to the elevated result due to analysis by external consultant of average wind direction and upwind/downwind analysis.
17/09/2020	Maison Dieu	26	25	0.5	HVO assessed to not be the significant contributor to the elevated result due to analysis by external consultant of average wind direction and upwind/downwind analysis.
05/10/2020	Maison Dieu	29	25	2.4	HVO assessed to not be the significant contributor to the elevated result due to analysis by external consultant of average wind direction and upwind/downwind analysis.
11/10/2020	Maison Dieu	32	25	0.3	HVO assessed to not be the significant contributor to the elevated result due to analysis by external consultant of average wind direction and upwind/downwind analysis.
17/10/2020	Maison Dieu	37	25	1.4	HVO assessed to not be the significant contributor to the elevated result due to analysis by external consultant of average wind direction and upwind/downwind analysis.
16/11/2020	Maison Dieu	31	25	1.7	HVO assessed to not be the significant contributor to the elevated result due to analysis by external consultant of average wind direction and upwind/downwind analysis.
22/11/2020	Maison Dieu	26	25	0	HVO assessed as providing no contribution by external consultant
28/11/2020	Maison Dieu	59	25	0.4	HVO assessed to not be the significant contributor to the elevated result due to analysis by external consultant of average wind direction and upwind/downwind analysis.

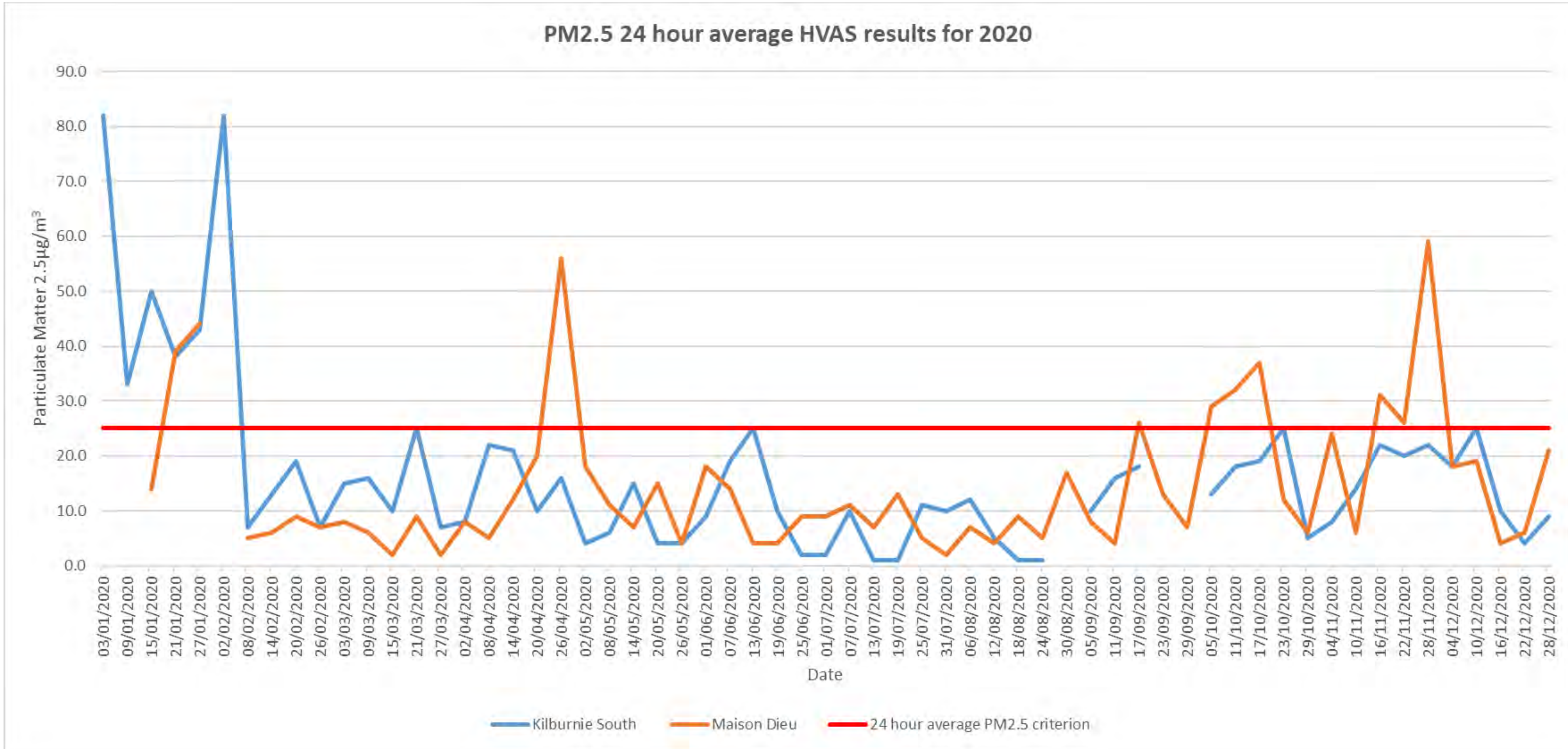

Figure 20 - 24 hour average PM2.5 Results 2020

6.4.3.9 Particulate Matter <2.5µm ($PM_{2.5}$) – Long Term (Annual average) Impact Assessment Criteria

Annual average $PM_{2.5}$ was elevated above the annual average criteria of 8 µg/m^3 at Maison Dieu and Kilburnie South for the reporting period, as presented in **Table 28**. 17 results above criteria were recorded over 14 monitoring days during 2020. 7 of these results were found to be due to bushfires that were determined to be an extraordinary event by DPI&E. The remaining 10 results were determined through investigation by an external consultant to have not been significantly contributed to by HVO. The external consultant concluded that the elevated $PM_{2.5}$ results may be due to monitoring method as the $PM_{2.5}$ / PM_{10} ratios for the Maison Dieu and Kilburnie South monitors are high for the locality, as shown in **Table 29**. The units are maintained and calibrated in accordance with relevant Australian Standards. Records of flow rates and run times for monitors for the year were reviewed and found to be accurate. HVO will review the methodology in 2021 to identify any potential causes and seek to rectify.

Table 28 - $PM_{2.5}$ Annual Average monitoring data 2020

Monitoring Location	HVO South Annual average $PM_{2.5}$ Criteria (µg/m^3)	Measured Annual average $PM_{2.5}$ level (µg/m^3)	Estimated contribution to annual average $PM_{2.5}$ level (µg/m^3)*
Maison Dieu	8	15.0	2.9
Kilburnie South	8	16.4	3.8

* Excludes extraordinary events

$PM_{2.5}$ levels measured at the Maison Dieu and Kilburnie South HVAS units were higher than UHAQMN annual average PM2.5 results in comparable locations, as shown in **Table 30**.

Table 29 - $PM_{2.5}$ / PM_{10} ratios in Upper Hunter

Year	$PM_{2.5}$ / PM_{10} ratios				
	Muswellbrook	Singleton	Camberwell	Maison Dieu	Kilburnie South
2015	0.46	0.39	0.33	*	*
2016	0.44	0.41	0.31	*	*
2017	0.43	0.39	0.27	*	*
2018	0.35	0.34	0.27	*	*
2019	0.35	0.36	0.26	*	*
2020	0.41	0.41	0.31	0.63	0.78

* Monitoring locations were not in place during this year

Table 30 – UHAQMN Annual Average PM 2.5 results for 2020

UHAQMN Monitor	Measured Annual Average 2020 $PM_{2.5}$ level (µg/m^3)
Muswellbrook	9.3
Singleton	8.4
Camberwell	7.5

6.4.4 Comparison against EA Predictions

Table 31 to **Table 32** show a comparison between 2020 air quality data and the Stage 2 predictions made in the HVO South Modification 5 EIS. Comparisons have been made against the predictions listed in the EA for the nearest private residence to each monitoring location.

Annual average PM_{10} measurements in 2020 were below predicted levels for all monitoring locations for both short term (24 hour average) and long term (annual average) criteria as shown in **Table 31** . Annual average TSP measurements in 2020 were either similar or below predicted levels for all monitoring locations for the long term (annual average) criteria as shown in **Table 32**. Depositional dust annual average results for D118, D119, DL21 and Warkworth were above the predicted levels.

*Table 31 - HVO South PM_{10} annual average results compared against cumulative predictions^*

Site (EA receptor)	Short Term (24hr) criteria		Long Term (annual average) criteria	
	Predicted maximum 24hr PM_{10} due to HVO South alone (µg/m³)	2020 maximum 24hr PM_{10} HVO contribution (µg/m³)*	Predicted PM_{10} annual averages (µg/m³)	2020 PM_{10} annual average (µg/m³)*
	Stage 2		Stage 2	
Maison Dieu (256)	36	12.6	21	19.5
Warkworth (90)	95	17.4	46	21.0
Kilburnie South (307)	31	29.6	27	17.1
Knodlers Lane (117)	59	38.8	28	20.0
Long Point (137)	36	28.8	20	18.2
Hunter Valley Gliding Club***	>50	39.0	>30	25.5

^ Cumulative predictions for Stage 2 of the HVO South Mod 5 Environmental Assessment.

* Excludes extraordinary events

*** The HVGC has entered into an Amenity Management Plan with Hunter Valley Operations.

*Table 32 - HVO South TSP annual average results compared against cumulative predictions^*

Site (EA receptor)	Long Term (annual average) TSP criteria	
	Stage 2 prediction (µg/m³)	2020 PM_{10} annual average (µg/m³)*
Maison Dieu (256)	60	60.0
Warkworth (90)	106	70.8
Kilburnie South (307)	76	70.3
Knodlers Lane (117)	75	68.6
Long Point (137)	61	52.9

^ Cumulative predictions for Stage 2 of the HVO South Mod 5 Environmental Assessment.

* Excludes extraordinary events.

*Table 33 - HVO South Depositional Dust annual average results compared against cumulative predictions^*

Site (representative receptor ID)	Units (Insoluble Solids)	Assessment Criteria	Stage 2 EA Predictions Annual Averages	2020 Actual Annual Average*
D118 (Kilburnie Sth) (307)	g/m²/month	4	2.9	3.8
D119 (Jerry's Plains) (421)			2.0	3.5
DL14 (Maison Dieu) (256)			2.0	1.9
DL21 (261)			2.2	5.5
DL22 (118)			2.9	2.7
Knodlers Lane (120)			2.4	1.8
Warkworth (90)			3.4	5.5

^ Cumulative predictions for Stage 2 of the HVO South Mod 5 Environmental Assessment.

* includes all sources

Table 34 and **Table 35** detail comparisons between 2020 air quality monitoring results and the modelled predictions from the 2010 HVO North Carrington West Wing Air Quality Impact Assessment. Predictions have been sourced from modelled scenarios of Year One of the Carrington West Wing development. It should be noted that while Approval has been granted for the commencement of that project, works have not yet commenced.

*Table 34 - HVO 2020 PM_{10} annual average results compared against cumulative predictions^*

Site (EA receptor)*	Long Term (annual average) criteria			
	Predicted PM_{10} annual average (µg/m³)	2020 PM_{10} annual average (µg/m³)**+	HVO Estimated Contribution to 2020 PM_{10} annual average (µg/m³)* (North)	HVO Estimated Contribution to 2020 PM_{10} annual average (µg/m³)* (South)
Maison Dieu (6)	19.1	19.5	3.0	0.7
Warkworth (39)	20.8	21.0	0.4	1.6
Kilburnie South (4)	19.7	17.1	1.0	2.3
Jerrys Plains (13)	16.6	17.8	0.5	1.8
Cheshunt East (7)	20.8	24.6	9.1	2.0

^ Cumulative predictions for Year One (CWW) of the HVO North Environmental Assessment.

*no modelled predictions for the Long Point area

** Excludes extraordinary events

+. Measured result includes both HVO North and South

*Table 35 - 2020 TSP Annual Average results compared against cumulative predictions^*

Site (EA receptor)*	Long Term (annual average) criteria	
	Predicted TSP annual average (µg/m^3)	2020 TSP annual average (µg/m^3)**
Maison Dieu (6)	44.7	60.0
Warkworth (39)	46.6	70.8
Kilburnie South (4)	45.2	70.3
Cheshunt East (7)	46.5	67.3

^ Cumulative predictions for Year One (CWW) of the HVO North Environmental Assessment.

*no modelled predictions for the Long Point area

**excludes all extraordinary events

Comparison of measured PM_{10} and TSP with modelled predictions demonstrates above average values for all monitoring locations for TSP and marginally higher PM_{10} at Maison Dieu, Warkworth, Jerrys Plains and Cheshunt East. Given that the TSP fraction settles out of suspension faster than PM_{10} (and thus much closer to the operation), it is not reasonable to suggest that nearby private residences are being impacted by mine-generated TSP to a greater degree than by PM_{10}, on the basis of measured data exceeding the predictions. Rather, the data suggests the assumptions in the model relating to extraneous dust sources are under predicting total TSP levels which are experienced at receptors. It is considered that above average results are also attributable to ongoing drought conditions that persisted through 2019 and reflects regional air quality trends.

6.5 Greenhouse Gas and Energy Management

During 2020, HVO continued to comply with Emissions Reporting (EERs) under the National Greenhouse and Energy Reporting (NGERs) Act 2007. As such HVO is required to report its annual greenhouse gas emissions, energy use and energy production. Results of greenhouse gas and energy information from corporations is publically available online at www.cleanenergyregulator.gov.au. A summary of greenhouse gas emissions for HVO compared to the previous reporting year are provided in **Table 36**.

Total emissions in 2019/2020 reporting year decreased from the previous reporting year. This is largely reflected by a reduction in fuel usage emissions.

Table 36 - Greenhouse Gas Emission summary

HVO Emissions	2018/2019 Reporting Year	2019/2020 Reporting Year
Fuel Usage (Kt CO^2e)	312.24	315.13
Fugitive Emissions (Kt CO^2e)	262.67	247.32
Industrial Processes (Kt CO^2e)	0.2[2]	0.02
Waste emissions by waste disposal (Kt CO^2e)	-	-
Electricity consumption (Scope 2) (Kt CO^2e)	112.66	111.92
Total (Kt CO^2e)	688	674

[2] Waste emissions by waste disposal (Kt CO^2e) for the 2018/19 reporting period should read 0.02.

6.6 Waste and Hazardous Materials

6.6.1 Recycling

HVO has continued to focus on training and reinforcing the principles of effective waste management across the site, including recycling.

21% of non-mineral waste material generated at HVO during the reporting period was disposed of in licensed offsite landfill facilities. 79% of waste was recycled during 2020. These results are consistent with 2019.

HVO will explore further opportunities to continue to improve recycling rates in 2020.

Details of waste and recyclables removed from demolition activities undertaken during the reporting period are included in **Section 6.6.7 and 8.12**.

6.6.2 Sewage Treatment/Disposal

The sewage treatment and disposal facilities at HVO consist of sewage treatment plants which treat, disinfect and re-use the treated effluent on-site where practicable. The remaining effluent from some septic systems that is unable to be treated on site is sent to approved facilities for disposal.

HVO currently operates 3 main grouped on-site sewage management facilities that are interconnected from multiple systems. These facilities are located at Howick, HVO North and HVO South.

6.6.3 Hydrocarbons

A total of 912 kL of waste oil was taken offsite to be refined into a base oil for reuse in new oil products during the reporting period. Other hydrocarbons recycled via a licenced waste hydrocarbon disposal company include approximately 31 tonnes of waste grease.

6.6.4 Contaminated Soil

HVO operates and maintains three bioremediation areas to manage hydrocarbon contaminated soil.

Contaminated soil is taken to one of the bioremediation areas and placed in cells based on the time of contamination. Contaminated soil is spread out in beds approximately 300 mm in height and turned in order to provide aeration for beneficial microbial activity.

Soil in the treatment area is sampled and tested as required until total hydrocarbon levels are below relevant guidelines. Soil meeting these criteria is then removed and disposed of in the spoil dump.

HVO completed a Preliminary Site Investigation and desktop review in 2020 for a future waste rock dump in a location of former equipment graveyard, bioremediation area, former landfill, former coal stockpiling area, and former substation. The investigation identified substances that are likely to be associated with the presence of coal fragments in the fill material, with the exception of two sites where contamination from anthropogenic sources is more likely. Overall the exceedances were generally related to ecological receptors and did not present an unacceptable level of risk to on-site human receptors. Given that the only identified linkage for ecological receptors is via direct contact with surface soil and the site is proposed to be used as a waste rock dump area for overburden (assuming at least 2m of overburden is placed), the site is considered suitable for proposed future use. Additional investigation will be undertaken at the two sites where anthropogenic sources of contamination were likely in 2021.

6.6.5 Acid Rock Drainage

There were no observed issues relating to Acid Rock Drainage during 2020. The acid rock drainage management process was reviewed during the reporting period and this will continue during 2021.

6.6.6 Waste/Hazardous Materials Non Compliances

There were no externally reportable incidents related to waste or hazard management during the reporting period.

6.6.7 Building Demolition

A total of 4.24 tonnes of mixed waste and 0.76 tonnes of asbestos were removed during demolition of rural buildings on HVO land and disposed of at appropriate facilities during the reporting period.

6.7 Heritage

6.7.1 Aboriginal Cultural Heritage Management and Community Consultation

Aboriginal cultural heritage is managed under the provisions of separate Aboriginal Cultural Heritage Management Plans (ACHMP) approved for the project approvals. At HVO North, where mining or associated development activities may impact Aboriginal cultural heritage sites, an Aboriginal Heritage Impact Permit (AHIP) must also be sought from Heritage New South Wales (formerly Office of Environment and Heritage) under Part 6 of the National Parks and Wildlife Act 1974 (NPW Act), on the basis of the management requirements established through the ACHMP process.

The HVO South ACHMP area was approved as a State Significant Development which excludes the requirement for obtaining AHIPs prior to implementing cultural heritage management measures authorised under the provisions of the ACHMP.

HVO consults jointly with the Upper Hunter Valley Aboriginal Cultural Heritage Working Group (CHWG) and the Plains Clan of the Wonnarua Peoples (PCWP). The CHWG is comprised of representatives from HVO and Registered Aboriginal Parties (RAPs) from Upper Hunter Valley aboriginal community groups, corporations and individuals. The CHWG met and discussed cultural heritage management matters associated with HVO on the 23 September 2020.

Separate to the ACHMP, the HVO JV was party to an Ancillary Agreement with the Plains Clan of the Wonnarua People (PCWP). This was an Ancillary Agreement to a Deed under Section 31(1)(b) of the *Native Title Act 1993 (Cth)* regarding the grant of Assessment Lease Application 59 and also an agreement for the grant of MLA 534. The agreement commenced on the 3rd May 2018 and is now terminated following the PCWP's withdrawal of its claims in relation to Assessment Lease Application 59 and Mining Lease Application 534.

Aboriginal cultural heritage at HVO is managed in consultation with the RAPs associated with the CHWG, in accordance with the ACHMPs, and development consent conditions, to protect, manage and mitigate cultural heritage at HVO. Management measures include:

- Ongoing consultation and involvement of the local Aboriginal community in all matters pertaining to Aboriginal cultural heritage management;
- Compliance with existing ACHMP's and Development Consent conditions;
- A cultural heritage Geographic Information System (GIS) and Cultural Heritage Zone Plan (CHZP) incorporating cultural heritage spatial and spatial data (site location, description, assessments, date recorded, associated reports, management provisions and various other details to assist with the management of sites);
- A Ground Disturbance Permit (GDP) system for the assessment and approval of ground disturbing activities to ensure these activities do not disturb cultural heritage places;
- Limit of Disturbance Boundary (LODB) procedures to demarcate approved disturbance areas and delineate areas not to be disturbed;
- Ongoing cultural heritage site inspections, monitoring and auditing along with regular compliance inspections of development works;
- Protective management measures such as fencing/barricading sites to avoid disturbance, protective buffer zones, cultural heritage off-set areas; and
- Communicating cultural heritage issues and site awareness to personnel via internal electronic and face to face processes.

In consultation with the CHWG and Office of Environment and Heritage (OEH), a Cultural Heritage Storage Facility (CHSF) was established at Hunter Valley Services. The CHSF is a storage shed, with an adjacent shipping container, fitted out to allow safe and secure storage of cultural materials, such as stone artefacts. It is a central repository for all materials collected during community collection and salvage activities on all lands related to HVO (including offset properties).

6.7.2 Aboriginal Archaeological and Cultural Heritage Investigations

A due diligence assessment and survey was conducted by Arrow Heritage Solutions on 12 February 2020 at a proposed groundwater drilling program site and access track south of the Golden Highway. This was followed by a second inspection on the 19th May 2020 when the proposed drill site and track was relocated. No artefacts were identified during the course of these surveys.

Due diligence assessments were conducted by Arrow Heritage Solutions on 23 & 26 June and 23 September 2020 at the Cheshunt rural property ahead of a soil sampling study. No ACH sites or objects were found during the archaeological inspection.

A field based due diligence assessment and survey was conducted by Arrow Heritage Solutions on 14 July 2020 at the Newdell Loading Facility and at an area of remnant native vegetation adjoining the Hunter River. A number of artefacts were identified at the remnant vegetation site. This site is now barricaded and was the subject of an assessment by RAPs during the HVO South Biannual Audit, and then included as an agenda item at the CHWG meeting convened on the 23rd September 2020.

A desktop due diligence assessment was conducted on 3 August 2020 as part of a GDP assessment for an existing track that adjoins a pipeline owned by a third party mine entity and in proximity to the HVO Newdell Loading Point. The assessment confirmed that the track was constructed on previously mined and rehabilitated land and that an update to the HVO CHZP should be made to rezone this area as Zone 5.

An on-ground due diligence assessment was conducted at the Howick Telstra telecommunications tower as part of a GDP assessment for the installation of an underground communication cable. No aboriginal artefacts were identified in the assessment area during the course of the survey.

A due diligence assessment was also conducted on 30 November 2020 at the Newdell Coal Loading facility as part of the assessments required for GDP 222 & 206 which covers the installation of a new electrical substation and mulching of vegetation adjoining the Newdell Rail Line. No Aboriginal objects or sites were identified within either assessment area during the survey. No mature native trees displaying evidence of cultural scarring were identified.

From the 7th December 2020 HVO has been conducting cultural heritage surveys as part of assessments for future mine development. These surveys are ongoing and will be outlined further in future Annual Reviews.

6.7.3 Heritage Audits and Incidents

Under the provisions of the HVO South ACHMP, two compliance inspections were conducted in 2020 and under the provisions of the HVO North HMP, a single compliance inspection was conducted during 2020. The purpose of the compliance inspections is to provide RAPs with:

- The opportunity to visit mine operations and mine areas to inspect operational compliance with ACHMP/HMP provisions and GDP procedures;
- To inspect and monitor the condition and management of sites; and
- To review the effectiveness and performance of the ACHMP/HMP provisions in the management of cultural heritage at the mine.

These compliance inspections were conducted by RAP representatives of the CHWG PCWP with the assistance of a qualified archaeologist and HVO personnel.

The biannual 2020 HVO South compliance inspection was conducted on 21 August 2020 by RAP representatives of the CHWG. A total of 66 aboriginal heritage sites were inspected focusing on areas East and West of Comleroi Road. In addition, an area of remnant vegetation adjacent to the Hunter River was inspected to enable RAPs to verify a potential artefact site that had been identified through the GDP process. The findings and recommendations of these inspections are documented in the Hunter Valley Operations South Aboriginal Heritage Management Plan August Compliance Audit Inspections report dated September 2020.

The annual 2020 HVO South and HVO North compliance inspection was conducted over several days between 4 and 6 of November 2020 by three RAP representatives of the CHWG and a suitably qualified and experienced archaeologist. During the HVO South portion of the compliance inspection, a total of 37 aboriginal heritage sites were inspected in the HVO Southern Area accessed via Long Point Road. During the HVO North portion of the compliance inspection, a total of 17 heritage sites were assessed including the key sites in proximity to the Newdell Coal Loader, HVO North conveyor, Howick, Mitchell Pit, Carrington Pit and CM CD1. The findings and recommendations of these inspections are documented in the Hunter Valley Operations Aboriginal Heritage Management Plans November 2020 Compliance Audit Inspections report.

The inspections found that all sites have been managed in conformance with the ACHMP/HMP requirements. 2 Additional sites were recorded and sites requiring maintenance and upgrades to site barricading and fencing were identified, with upgrade and maintenance work to be implemented in 2020. In addition, at least 9 sites had locational and site extent information updated or confirmed.

During the reporting period there were 75 GDPs assessed for cultural heritage management considerations at HVO.

There were no incidents nor any unauthorised disturbance caused to cultural heritage sites at HVO during 2020.

6.7.4 Historic Heritage – Management and Community Consultation

Consultation was conducted at the Hunter Valley Operations Community Consultative Committee (CCC) Meetings held on 19 February, 20 May, 9 September and 18 November 2020 as outlined in **Section 9.2.3**.

At the meeting held on 19 February, CCC members inquired about the management of European heritage sites at HVO. This resulted in the following action. "HVO to provide detail of properties that are registered as Historical Properties and the Maintenance Plans in place for these".

At the CCC meeting on 20 May, the HVO Environment and Community team provided a summary of the management measures in place to protect and maintain heritage properties. Following this presentation the Committee identified the following actions;

1. HVO to add Historical Properties and their associated Management/Maintenance Plans as a standing Agenda Item for future CCC Meetings, and
2. HVO to collate an inventory of European Heritage artefacts that are stored within heritage buildings.

The HVO Environment and Community Team advised the committee members at the CCC meeting held on 9 September that HVO have engaged an archaeologist, Arrow Heritage Solutions, to update the 2012 Historic Heritage Register which includes a summary of Management and Maintenance Plans, along with a variety of actions for various sites and buildings. The Register is in final draft and currently under review at the time of writing of this report. In addition, Arrow Heritage Solutions were tasked to prepare an inventory which also forms part of the Historic Heritage Register. This inventory describes and includes photographs of items that have been identified. A listing of items at Archerfield homestead was provided to the committee as an example.

The finalised HVO Historic Heritage Register was circulated to the CCC members prior to the meeting held 18 November with members confirming receipt of the Register and their ongoing interest.

HVO has one State listed property and 3 LEP listed building complexes within its property portfolio. These are all subject to scheduled grounds maintenance and termite inspections.

The State listed Chain of Ponds Inn has a termite interception system that is maintained on a monthly basis.

The Archerfield outbuildings were the subject of roof repairs to the hayshed in 2020, with further maintenance work planned for the stables in 2021.

The ‘dog leg fence’ that was the subject of a State Significance assessment in October 2019 will require vegetation management prior to an archival recording of its features in 2021.

7 Water Management

HVO manages surface and ground water according to three main objectives:

- Fresh water usage is minimised;
- Impacts on the environment and HVO neighbours are minimised; and
- Interference to mining production is minimal.

This is achieved by:

- Minimising freshwater use from the Hunter River when other lower quality sources are available;
- Preferentially using mine water for coal preparation and dust suppression;
- Emphasis on control of water quality and quantity at the source;
- Segregating waters of different quality where practical;
- Recycling on-site water;
- Ongoing maintenance and review of the system; and
- Disposing of water to the environment in accordance with statutes and regulations.

Plans showing the layout of all water management structures and key pipelines are shown in **Figure 21** to **Figure 23**. The *HVO WMP* contains further detail on management practices and is available on HVO website.

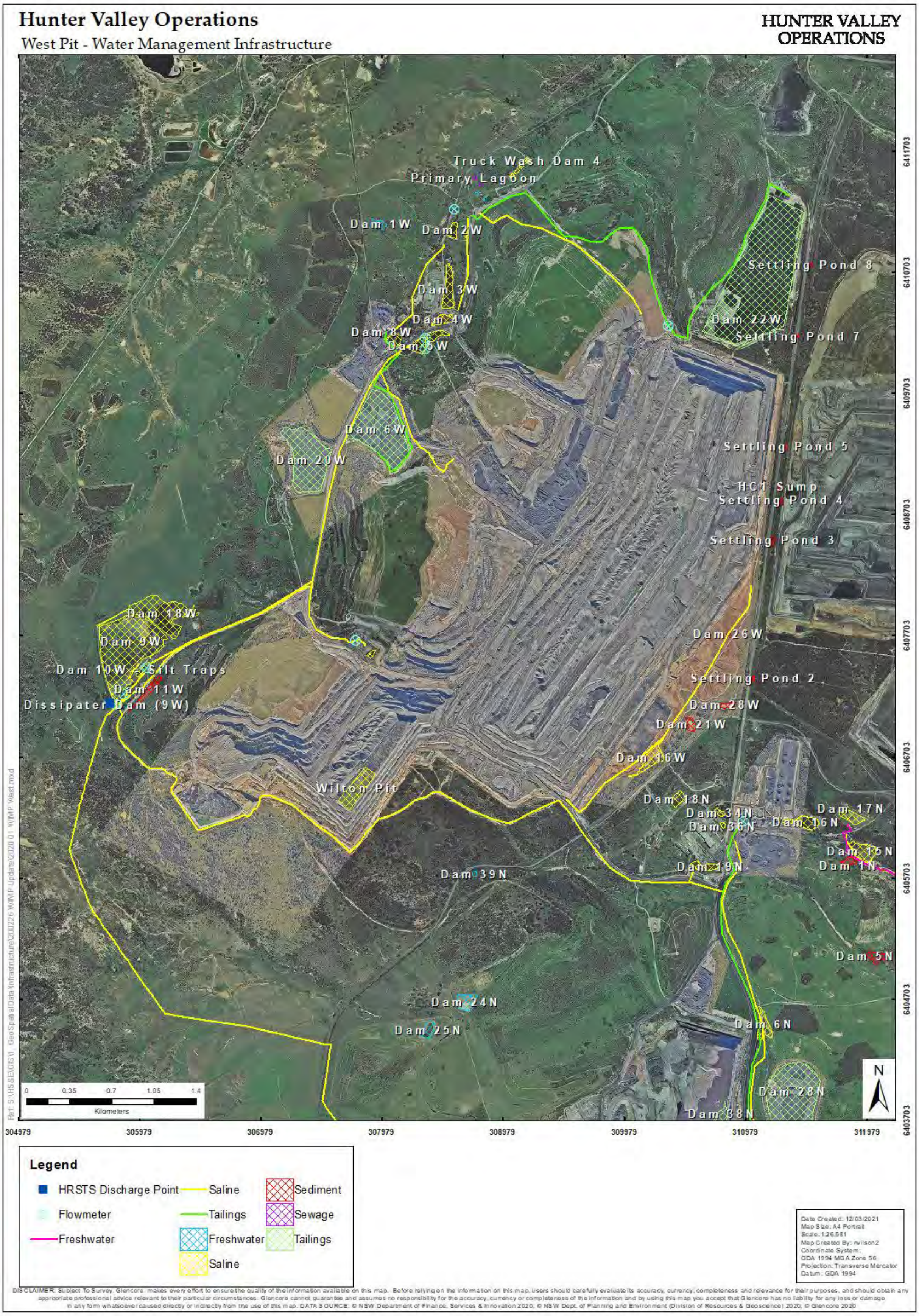

Figure 21 - West Pit water management infrastructure

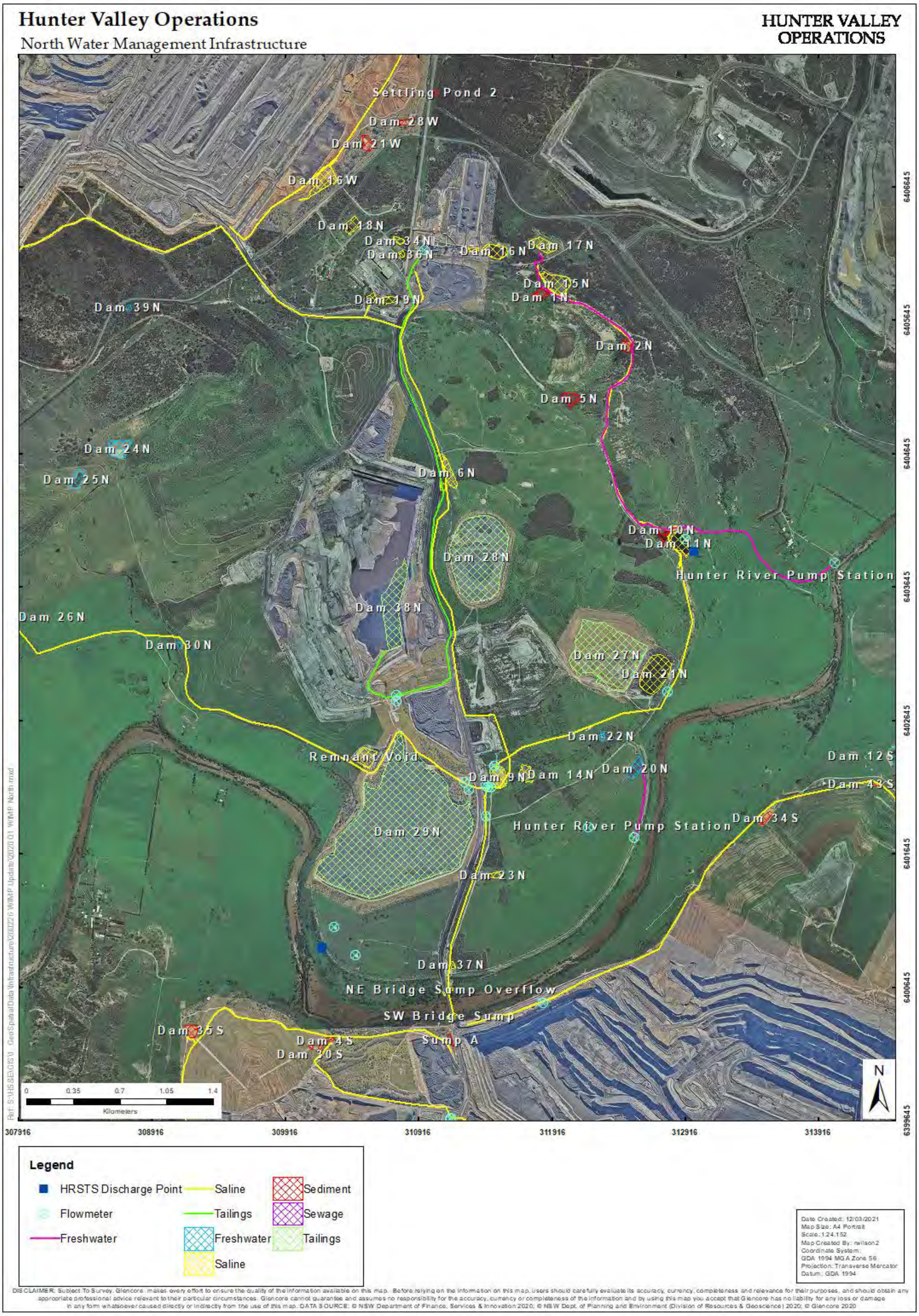

Figure 22 - North Pit water management infrastructure

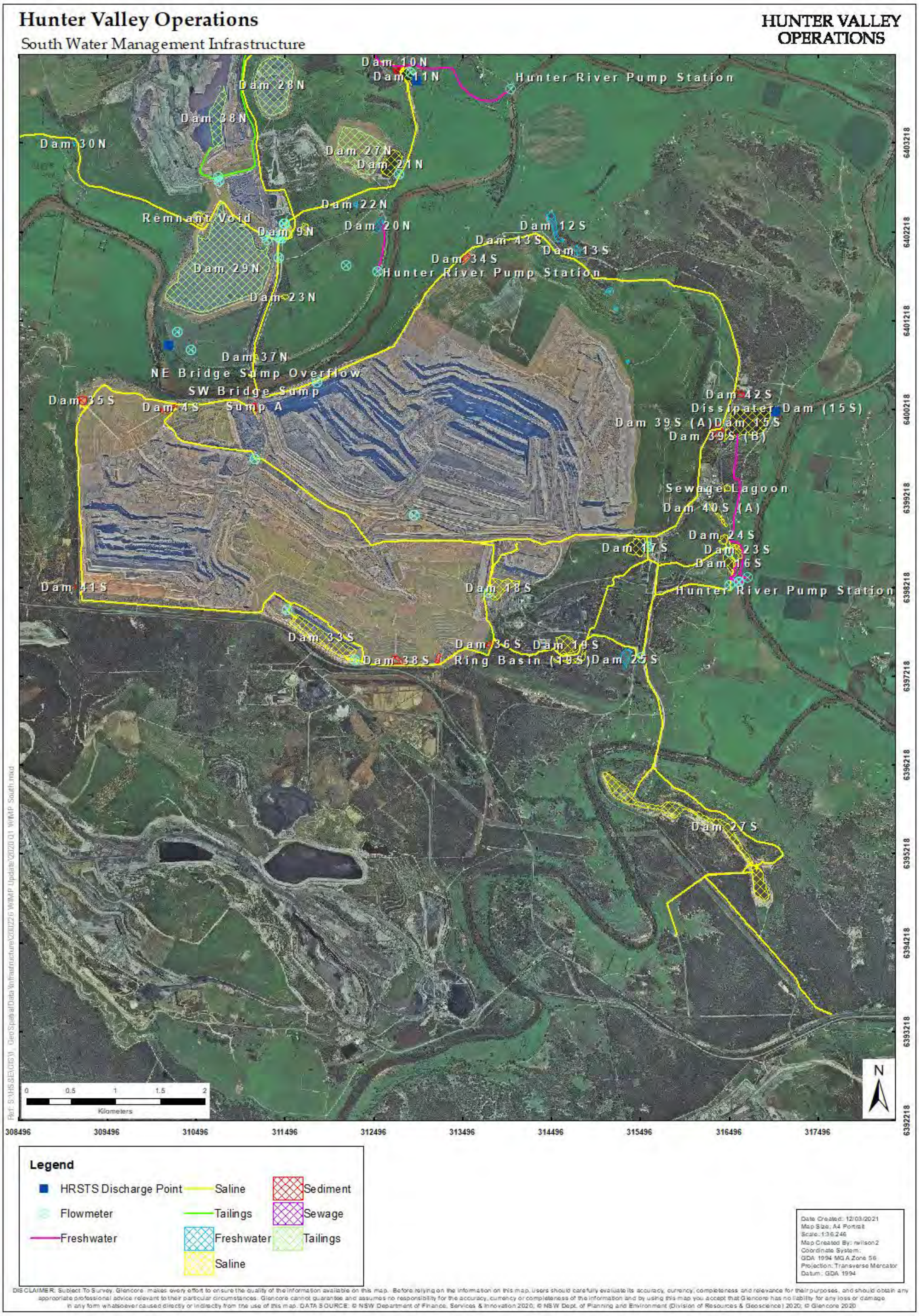

Figure 23 - South Pit water management infrastructure

7.1 Water Balance

The 2020 static water balance for HVO is presented in **Table 37**.

Table 37 - 2020 HVO Water Balance

Water Stream	Volume (ML)
Inputs	
Fresh Water (potable)	36.9 (1%)
Fresh Water (Hunter River extraction)	3413 (20%)
Groundwater	3281 (19%)
Rainfall Runoff	9351 (54%)
Recycled to CHPP from Tails & Storage (not included in total)	4191
Imported (Liddell/Ravensworth (via Cumnock))	0 (0%)
Water from ROM Coal	1096 (6%)
Total Inputs	**17,178**
Outputs	
Dust Suppression	2360 (26%)
Evaporation - Mine Water & Tailings Dams	2148 (24%)
Entrained in Process Waste	2257 (25%)
Discharged (HRSTS)	0 (0%)
Vehicle Wash-down	310 (3%)
Miscellaneous Industrial Use	350 (4%)
Water in Coarse Reject	559 (6%)
Water in Product Coal	1088 (12%)
Total Outputs	**9,072**
Change in Pit Storage	**2,533 (increase)**

7.1.1 Water Inputs

A total of 793 mm of rainfall was recorded at HVO Corporate Meteorological Station in 2020 producing an estimated 9,351 ML of runoff. Water falling on undisturbed clean water catchments is diverted off site into natural systems where practicable.

Groundwater inflows to the pits are calculated via numerical groundwater modelling methods. These are given in **Table 37**.

Groundwater inflows were estimated to have contributed 3281 ML to the site during 2020. 3413 ML of fresh water was pumped from the Hunter River during the reporting period.

7.1.2 Water Outputs

The main outputs were water use for dust suppression (2,360 ML), evaporation from dams (2,148 ML), water entrained in process waste (2,257 ML) and water in product coal (1,088 ML).

HVO participates in the Hunter River Salinity Trading Scheme (HRSTS) allowing discharge from licensed discharge points during declared discharge events associated with increased flow in the Hunter River. HVO maintains three licensed discharge monitoring locations:

- Dam 11N, located at HVO North, which discharges to Farrell's Creek
- Lake James, located at HVO South, which discharges to the Hunter River; and
- Parnell's Dam, located at HVO West, which discharges to Parnell's Creek.

Hunter Valley Operations did not discharge under the Hunter River Salinity Trading Scheme and Environment Protection Licence 640 during 2020.

7.2 Surface Water

Surface water monitoring activities continued in 2020 in accordance with the *HVO WMP* and *HVO Surface Water Monitoring Program (SWMP)*. HVO maintains a network of surface water monitoring sites located on mine site dams, discharge points and surrounding natural watercourses (**Figure 24**). Water quality monitoring is undertaken to verify the effectiveness of the water management system onsite, and to identify the emergence of potentially adverse effects on surrounding watercourses. A number of mine water dams are monitored routinely to verify the quality of mine water. This water is used in coal processing, dust suppression, and other day to day activities around the mine.

Surface water monitoring data is reviewed on a quarterly basis. The review involves a comparison of measured pH, Electrical Conductivity (EC) and Total Suspended Solids (TSS) results against internal trigger values which have been derived from the historical data set. The response to measured excursions outside the trigger limits is detailed in the *HVO WMP*.

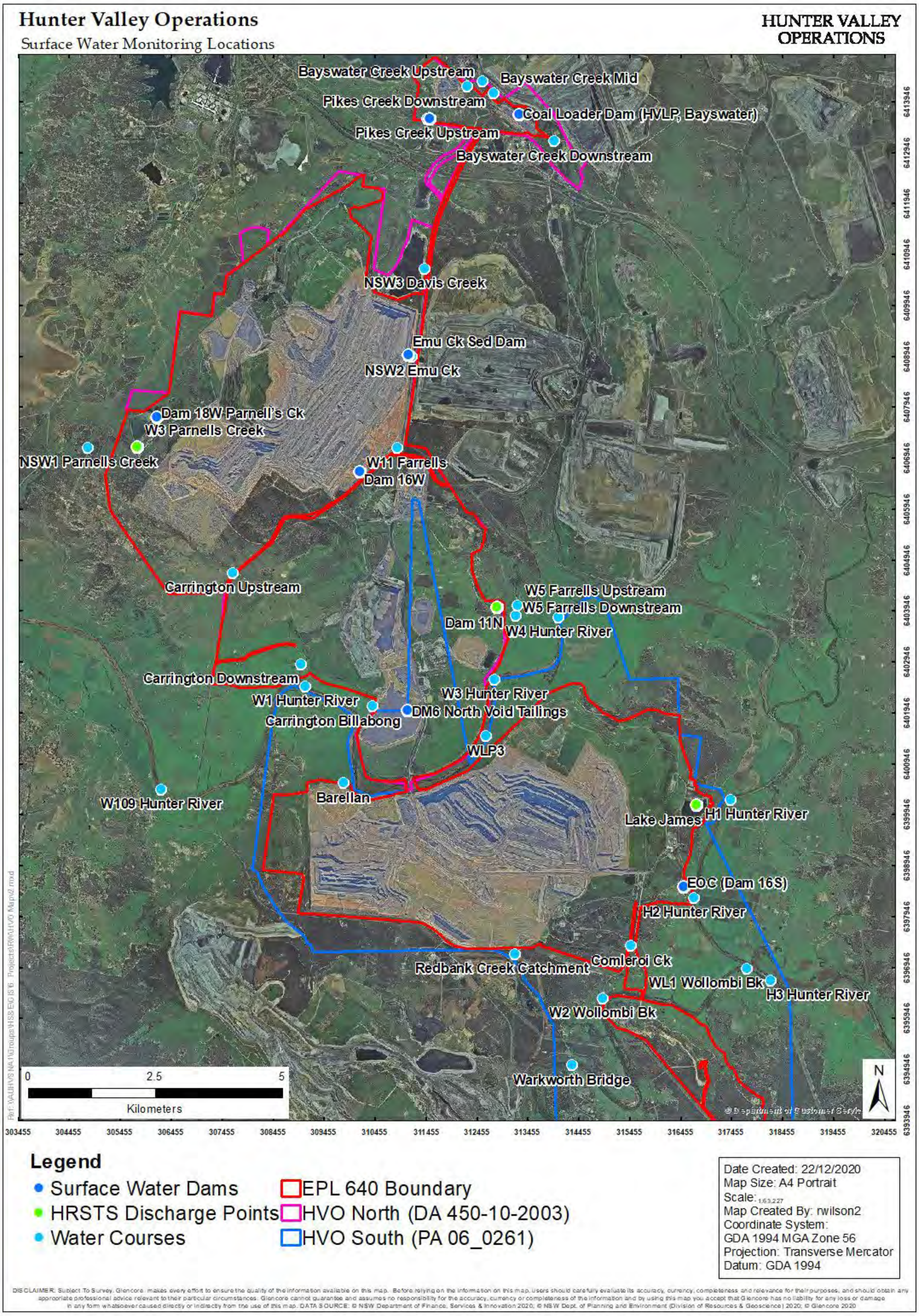

Figure 24 - Surface Monitoring Locations

7.2.1 Surface Water Monitoring

Routine surface water monitoring was undertaken in 2020 in accordance with the *HVO SWMP*. All laboratory analysis of surface water was carried out in accordance with approved methods by a NATA accredited laboratory.

Water quality is evaluated through the parameters of pH, EC and TSS. Pertinent surface water sites are also sampled for comprehensive analysis annually. Long term water quality trends for the Hunter River, Wollombi Brook, other surrounding tributaries and site dams are also presented in this section. The sampling frequency for ephemeral water sites was modified in 2016, from quarterly to a rain-event trigger system, in an effort to ensure samples taken were more representative of typical water quality for those streams - up to eight sampling events per annum can now be taken under the revised sampling protocol.

All required sampling and analysis was undertaken, except as detailed in **Table 38**. Australia and New Zealand Environment and Conservation Council (ANZECC) criteria are shown in the figures for comparative purposes.

Table 38 - HVO Water Monitoring Data Recovery for 2020 (by exception)

Location	Data Recovery (%)	Comments
Barellan	0%	Site recorded as dry during all 2020 monitoring events.
Bayswater Creek Downstream	80%	Site recorded as too shallow to sample during February monitoring event
Carrington Billabong	0%	Site recorded as dry during all 2020 monitoring events.
Carrington Downstream	80%	Site recorded as dry during February monitoring event.
Carrington Upstream	40%	Site recorded as dry during February, October and December monitoring events.
Dam 16N	91%	Site recorded as unsafe access during March monitoring event
Dam 16W	83%	Site recorded as unsafe access during January and August monitoring events
Dam 4W	83%	Site recorded as unsafe access during January and February monitoring events
Dam 6W	75%	Site recorded as insufficient water for sampling during January, September and October monitoring events
DM6 North Void Tailings	33%	Site recorded as insufficient water for sampling during January, March, May, June, July, October, November and December monitoring events
H2 – Hunter River	91%	Site recorded as unsafe access during February monitoring event
H3 – Hunter River	66%	Site recorded as unsafe access during March and April monitoring events
NSW1 (Parnell's Ck)	0%	Site recorded as unsafe access during February, July, October and December monitoring events
NSW3 Davis Ck	0%	Site recorded as unsafe access during February, July, October and December monitoring events

Location	Data Recovery (%)	Comments
Pikes Creek Downstream	50%	Site recorded as insufficient water for sampling during February monitoring event and dry during December monitoring event
Pikes Creek Upstream	25%	Site recorded as dry during February, October and December monitoring events
Redbank Creek Catchment	75%	Site recorded as dry during February monitoring event.
W3 – Hunter River	83%	Site recorded as unsafe access during March monitoring event
W4 – Hunter River	83%	Site recorded as no access during April monitoring event
W5 (Farrell's Creek Downstream)	50%	Site recorded as dry during October and December monitoring events.
W5 (Farrell's Creek Upstream)	50%	Site recorded as dry during October and December monitoring events.
WL1	91%	Site recorded as unsafe access during March monitoring event
WLP10	91%	Site recorded as unsafe access during April monitoring event
WLP3	91%	Site recorded as unsafe access during March monitoring event

7.2.1.1 Hunter River

The Hunter River was sampled on 60 occasions from eight monitoring locations during 2020. Long term trends for pH, EC and TSS are shown in **Figure 25** to **Figure 27**.
EC was seasonally variable and controlled by flow volumes through the catchment. The elevated TSS levels recorded at multiple locations throughout 2020 are likely due the higher than average rainfall received for the year.

Trigger exceedance results are detailed in **Table 39**.

Table 39 - Hunter River Internal Trigger Tracking Results

Location	Date	Trigger Limit	Action Taken In Response
W1 – Hunter River	25/02/2020	pH	First trigger exceedance, Watching Brief*
W1 – Hunter River	25/02/2020	TSS	First trigger exceedance, Watching Brief*
W109 - Hunter River	30/03/2020	pH	First trigger exceedance, Watching Brief*
W109 - Hunter River	30/03/2020	TSS	First trigger exceedance, Watching Brief*
W1 - Hunter River	30/03/2020	pH	Second trigger exceedance, Watching Brief*
W1 - Hunter River	30/03/2020	TSS	Second trigger exceedance, Watching Brief*
W4 - Hunter River	30/03/2020	pH	First trigger exceedance, Watching Brief*
W4 - Hunter River	30/03/2020	TSS	First trigger exceedance, Watching Brief*
H1 - Hunter River	30/03/2020	pH	First trigger exceedance, Watching Brief*
H1 - Hunter River	30/03/2020	TSS	First trigger exceedance, Watching Brief*
H2 - Hunter River	30/03/2020	pH	First trigger exceedance, Watching Brief*
H2 - Hunter River	30/03/2020	TSS	First trigger exceedance, Watching Brief*
W3 - Hunter River	22/04/2020	TSS	First trigger exceedance, Watching Brief*
W109 – Hunter River	22/04/2020	TSS	Second trigger exceedance, Watching Brief*
W1 – Hunter River	22/04/2020	TSS	Third trigger exceedance. Elevated TSS results are consistent with water quality expected in the Hunter River following rainfall on 2, 3 and 4 of April. Monitoring indicates water quality consistent with upstream results. No evidence to suggest elevated TSS is associated with mining influence
H1 – Hunter River	22/04/2020	TSS	Second trigger exceedance, Watching Brief*
H2 – Hunter River	22/04/2020	TSS	Second trigger exceedance, Watching Brief*

Location	Date	Trigger Limit	Action Taken In Response
W109 – Hunter River	20/5/2020	TSS	Third trigger exceedance. Monitoring indicates water quality consistent with downstream results. No evidence to suggest elevated TSS is associated with mining influence
W1 – Hunter River	20/5/2020	TSS	Fourth trigger exceedance. Monitoring indicates water quality consistent with downstream results. No evidence to suggest elevated TSS is associated with mining influence
W4 – Hunter River	20/5/2020	TSS	Second trigger exceedance, Watching Brief*
W3 – Hunter River	20/5/2020	TSS	Second trigger exceedance, Watching Brief*
H1 – Hunter River	20/5/2020	TSS	Third trigger exceedance. Monitoring indicates water quality consistent with upstream results. No evidence to suggest elevated TSS is associated with mining influence
H2 – Hunter River	20/5/2020	TSS	Third trigger exceedance. Monitoring indicates water quality consistent with upstream results. No evidence to suggest elevated TSS is associated with mining influence
H3 – Hunter River	20/5/2020	TSS	First trigger exceedance, Watching Brief*
H1 - Hunter River	17/06/2020	TSS	Fourth trigger exceedance. Elevated TSS results are consistent with water quality expected in the Hunter River following rainfall on 14 of June. Monitoring indicates water quality consistent with upstream results. No evidence to suggest elevated TSS is associated with mining influence.
W4 - Hunter River	17/06/2020	TSS	Third trigger exceedance. Elevated TSS results are consistent with water quality expected in the Hunter River following rainfall on 14 of June. Monitoring indicates water quality consistent with upstream results. No evidence to suggest elevated TSS is associated with mining influence.
W109 - Hunter River	17/06/2020	TSS	Fourth trigger exceedance. Elevated TSS results are consistent with water quality expected in the Hunter River following rainfall on 14 of June. Monitoring indicates water quality consistent with downstream results. No evidence to suggest elevated TSS is associated with mining influence
H3 - Hunter River	17/06/2020	TSS	Second trigger exceedance, Watching Brief*
H2 - Hunter River	17/06/2020	TSS	Fourth trigger exceedance. Elevated TSS results are consistent with water quality expected in the Hunter River following rainfall on 14 of June. Monitoring indicates water quality consistent with upstream results. No evidence to suggest elevated TSS is associated with mining influence
W1 – Hunter River	11/08/2020	TSS	Fifth trigger exceedance. Elevated TSS results are consistent with water quality expected in the Hunter River following rainfall on 9 and 10 of August. Monitoring indicates water quality consistent with downstream results. No evidence to suggest elevated TSS is associated with mining influence.
H2 – Hunter River	11/08/2020	pH	Second trigger exceedance, Watching Brief*

Location	Date	Trigger Limit	Action Taken In Response
H2 – Hunter River	11/08/2020	TSS	Fifth trigger exceedance. Elevated TSS results are consistent with water quality expected in the Hunter River following rainfall on 9 and 10 of August. Monitoring indicates water quality consistent with upstream results. No evidence to suggest elevated TSS is associated with mining influence
H1 Hunter River	24/09/2020	TSS	Fifth trigger exceedance. Elevated TSS results are consistent with water quality expected in the Hunter River following rainfall on 20 and 21 of September. Monitoring indicates water quality consistent with upstream results. No evidence to suggest elevated TSS is associated with mining influence
W4 Hunter River	24/09/2020	TSS	Fourth trigger exceedance. Elevated TSS results are consistent with water quality expected in the Hunter River following rainfall on 20 and 21 of September. Monitoring indicates water quality consistent with upstream results. No evidence to suggest elevated TSS is associated with mining influence
W1 Hunter River	24/09/2020	TSS	Sixth trigger exceedance. Elevated TSS results are consistent with water quality expected in the Hunter River following rainfall on 20 and 21 of September. Monitoring indicates water quality consistent with downstream results. No evidence to suggest elevated TSS is associated with mining influence.
W109 - Hunter River	24/09/2020	TSS	Fourth trigger exceedance. Elevated TSS results are consistent with water quality expected in the Hunter River following rainfall on 20 and 21 of September. Monitoring indicates water quality consistent with downstream results. No evidence to suggest elevated TSS is associated with mining influence.
H2 – Hunter River	21/10/2020	TSS	Sixth trigger exceedance. Elevated TSS results are consistent with water quality expected in the Hunter River following rainfall on 18 and 19 of October. Monitoring indicates water quality inconsistent with downstream and upstream results suggesting influence from a localised source such as adjacent farming. No evidence to suggest elevated TSS is associated with mining influence.
W1 - Hunter River	11/11/2020	TSS	Seventh trigger exceedance. Elevated TSS results are consistent with water quality expected in the Hunter River following rainfall on 5 of November. Monitoring results show an improvement in water quality downstream suggesting influence from a localised source such as adjacent farm land. No evidence to suggest elevated TSS is associated with mining influence
H2 - Hunter River	18/11/2020	pH	Third trigger exceedance, Investigation commenced
H2 - Hunter River	18/11/2020	TSS	Sixth trigger exceedance. Elevated TSS results are consistent with water quality expected in the Hunter River following rainfall on 13 and 16 of November. No evidence to suggest elevated TSS is associated with mining influence
H1 - Hunter River	9/12/2020	TSS	Seventh trigger exceedance. Elevated TSS results are consistent with water quality expected in the Hunter River following rainfall on 5 and 6 December. Monitoring indicates water quality consistent with upstream results. No evidence to suggest elevated TSS is associated with mining influence

Location	Date	Trigger Limit	Action Taken In Response
W4 - Hunter River	9/12/2020	TSS	Fifth trigger exceedance. Elevated TSS results are consistent with water quality expected in the Hunter River following rainfall on 5 and 6 December. Monitoring indicates water quality consistent with upstream results. No evidence to suggest elevated TSS is associated with mining influence
W1 - Hunter River	9/12/2020	TSS	Eighth trigger exceedance. Elevated TSS results are consistent with water quality expected in the Hunter River following rainfall on 5 and 6 December. Monitoring indicates water quality consistent with downstream results. No evidence to suggest elevated TSS is associated with mining influence
W109 - Hunter River	9/12/2020	TSS	Fifth trigger exceedance. Elevated TSS results are consistent with water quality expected in the Hunter River following rainfall on 5 and 6 December. Monitoring indicates water quality consistent with downstream results. No evidence to suggest elevated TSS is associated with mining influence
H3 - Hunter River	9/12/2020	EC	First trigger exceedance, Watching Brief*

* = Watching brief established pending outcomes of subsequent monitoring events. No specific actions required.

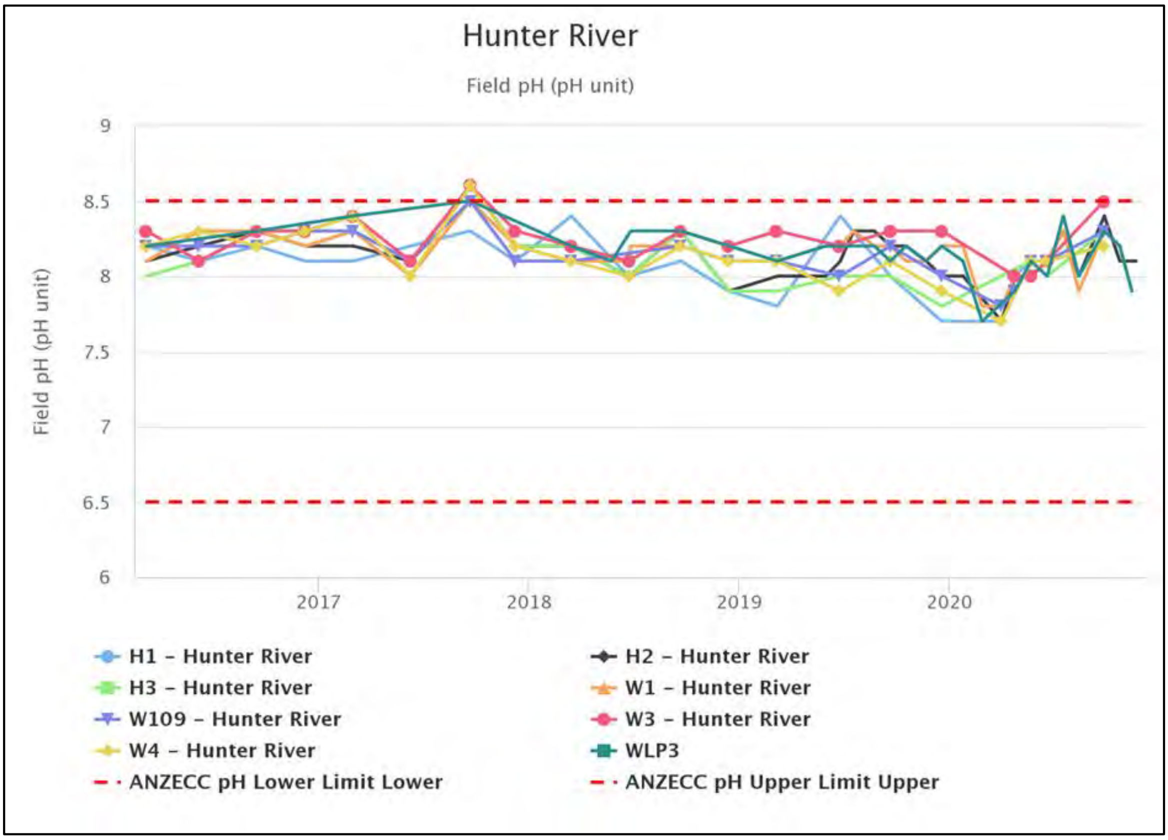

Figure 25 - Hunter River pH Trends 2016 - 2020

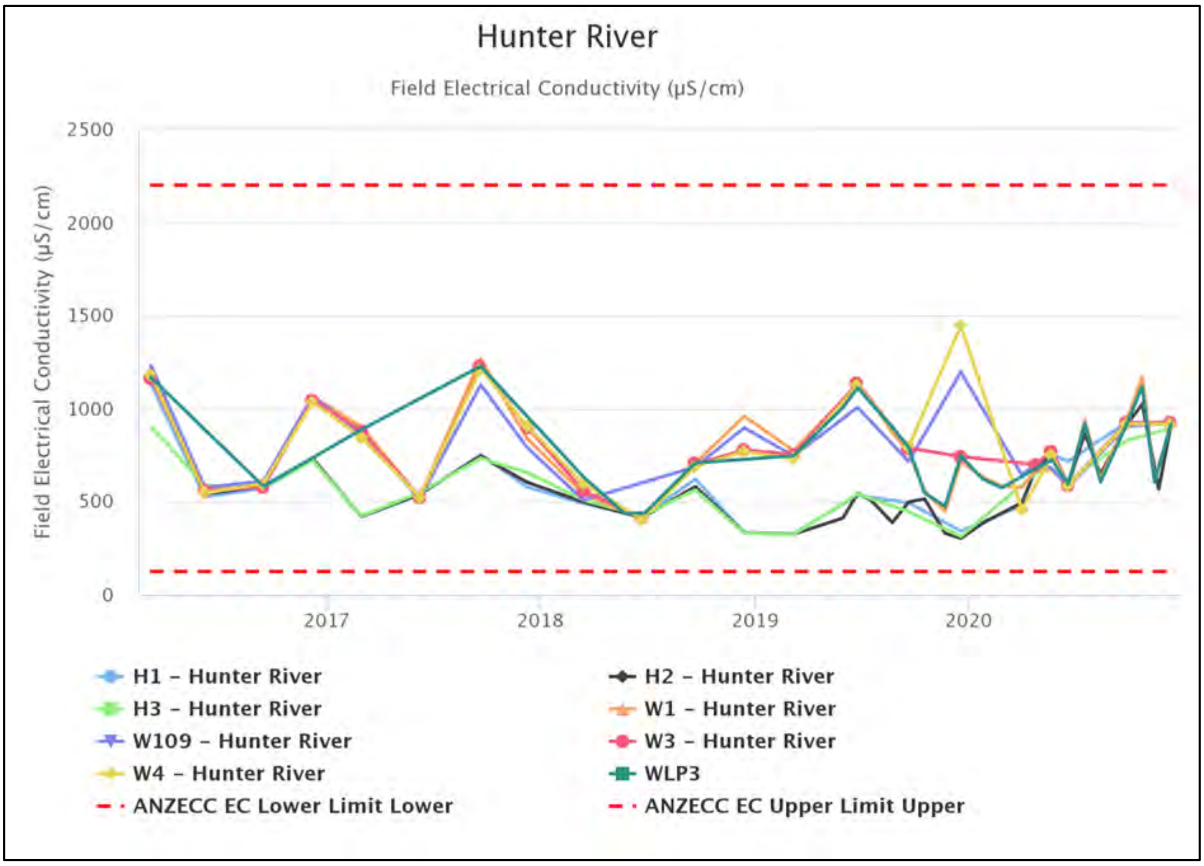

Figure 26 - Hunter River EC Trends 2016- 2020

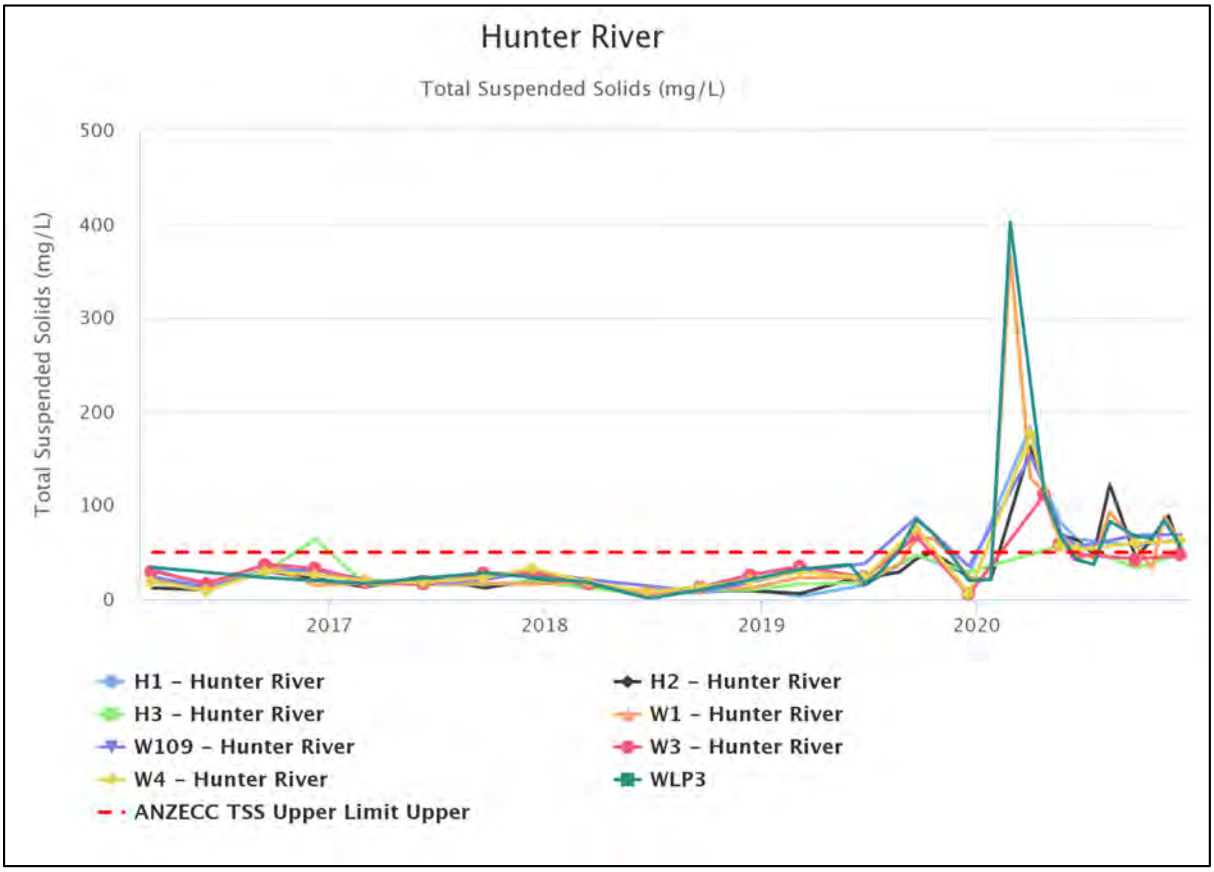

Figure 27 - Hunter River TSS Trends 2016 - 2020

7.2.1.2 Wollombi Brook

Wollombi Brook was sampled on 23 occasions from three monitoring locations during 2020. Long term trends for pH, EC and TSS from Wollombi Brook are shown in **Figure 28** to **Figure 30**.
Results were generally consistent with historical trends and acceptable ranges. EC & pH was variable with a sharp decline in reading recorded following the large rainfall event in February

Trigger exceedance investigation results are detailed in **Table 40**.

Table 40 - Wollombi Brook Internal Trigger Exceedance Results

Location	Date	Trigger Limit	Action Taken In Response
WL1	23/01/2020	TSS	First trigger exceedance, Watching Brief*
WL1	25/02/2020	pH	First trigger exceedance, Watching Brief*
WL1	25/02/2020	TSS	Second trigger exceedance, Watching Brief*
Warkworth Bridge	30/03/2020	pH	First trigger exceedance, Watching Brief*
W2 - Wollombi Brook	30/03/2020	pH	First trigger exceedance, Watching Brief*
WL1	22/04/2020	pH	Second trigger exceedance, Watching Brief*
WL1	20/05/2020	TSS	Third trigger exceedance. Monitoring indicates water quality was higher than upstream results. No evidence to suggest elevated TSS is associated with mining influence. TSS results may be isolated to a localised source. TSS levels dropped below the upper limit for the remainder of the year
WL1	17/06/2020	TSS	Fourth trigger exceedance. Elevated TSS results are consistent with water quality expected in the Hunter River following rainfall on 14 of June. . Monitoring indicates water quality consistent with upstream results. No evidence to suggest elevated TSS is associated with mining influence
WL1	11/08/2020	pH	Third trigger exceedance, Investigation commenced

* = Watching brief established pending outcomes of subsequent monitoring events. No specific actions required.

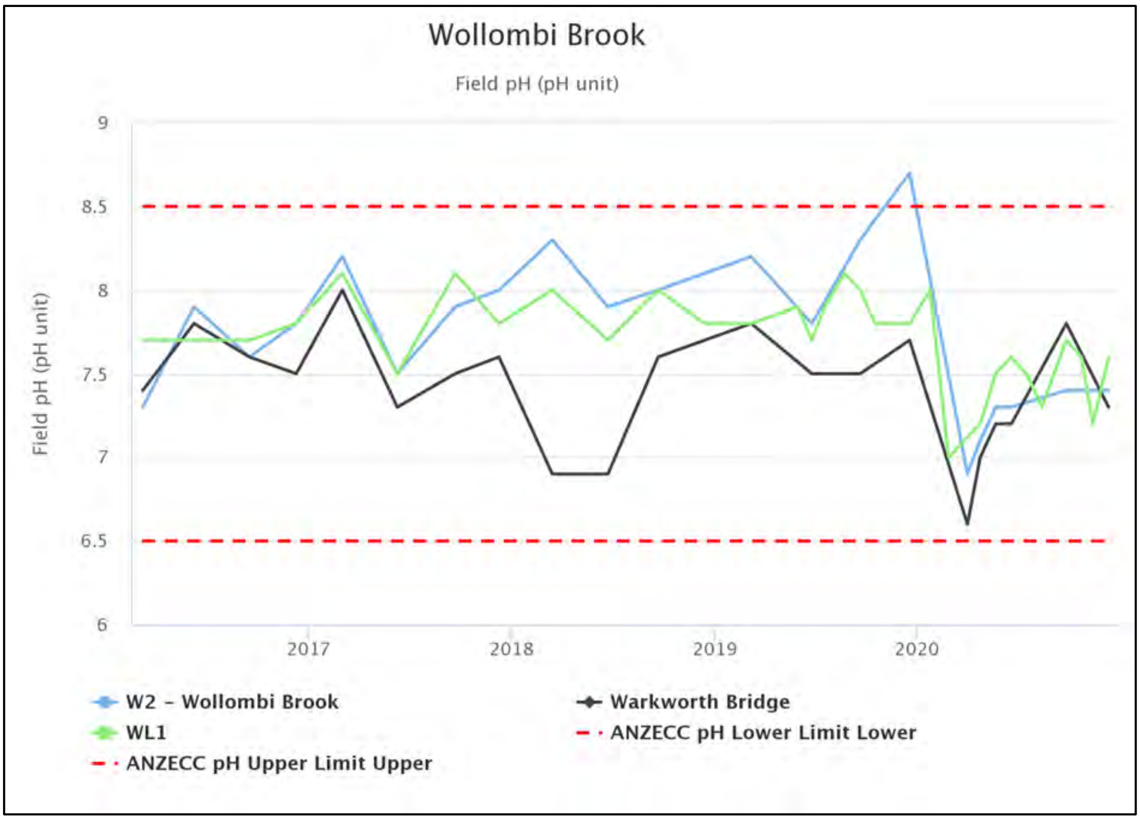

Figure 28 - Wollombi Brook pH Trends 2016 – 2020

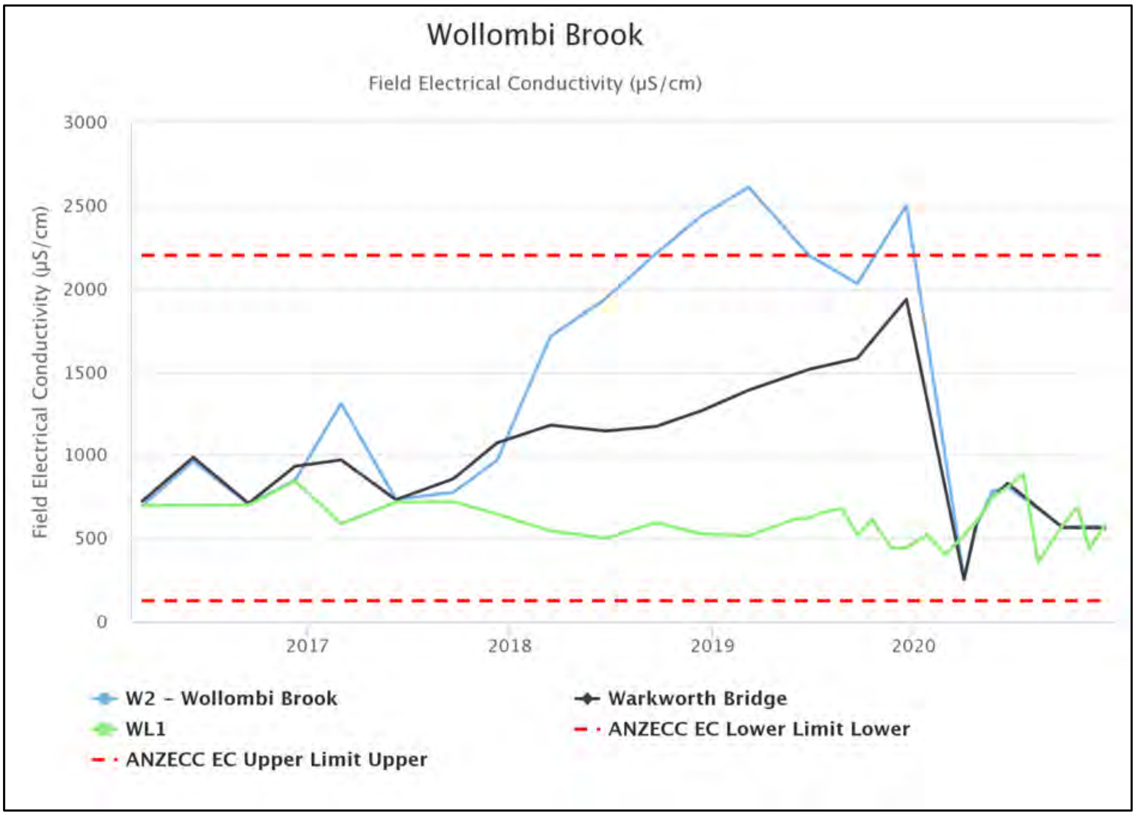

Figure 29 - Wollombi Brook EC Trends 2016 – 2020

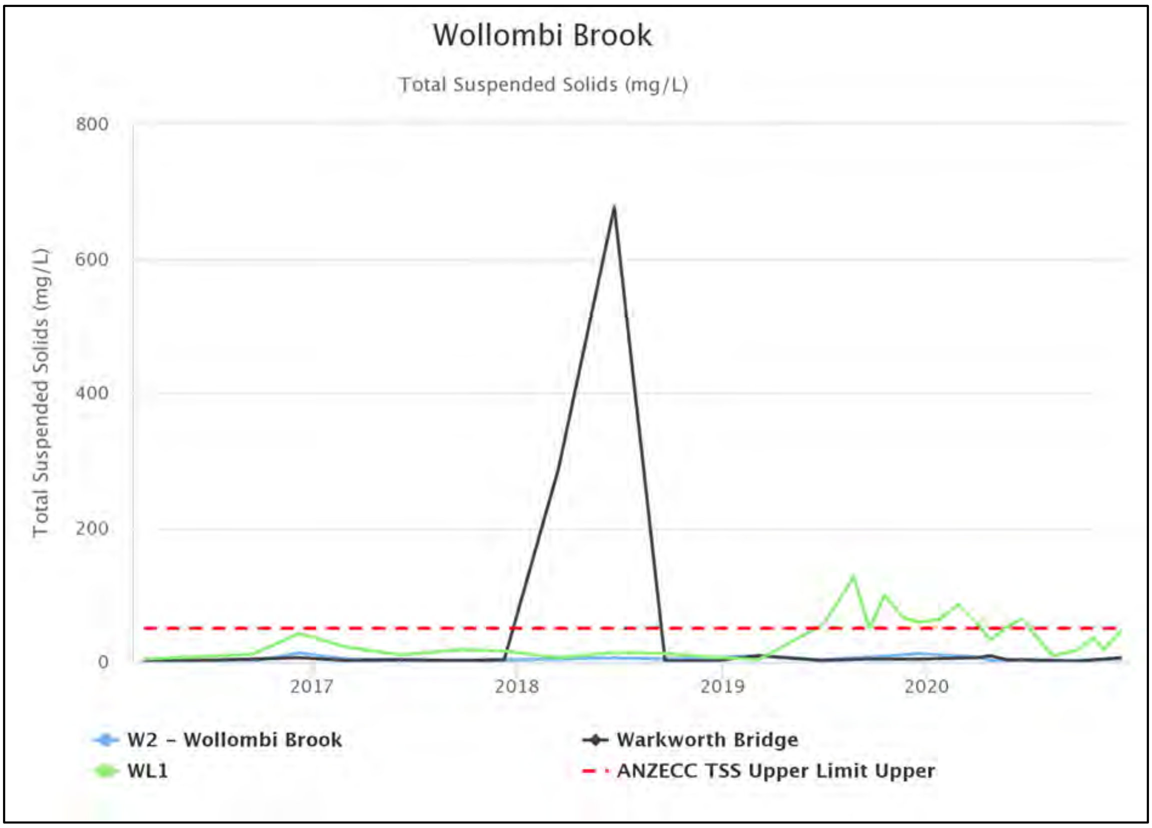

Figure 30 - Wollombi Brook TSS Trends 2016 - 2020

7.2.1.3 Other Surrounding Tributaries

Rain event-based monitoring of natural tributaries surrounding HVO continued during 2020.

In accordance with the *HVO WMP*, three rain event sampling rounds were triggered during 2020. These occurred following rainfall greater 30mm in a 24 hour period on the days of 7 February, 9 and 10 February, 27 July and 26 October. Monitoring during these rain event's occurred on the following water courses:

- Comleroi Creek;
- Emu Creek;
- Farrells Creek;
- Pikes Creek;
- Redbank Creek;
- Davis Creek;
- Bayswater Creek; and
- Parnells Creek

Long term trends for pH, EC and TSS are shown **Figure 31** to **Figure 33**. On occasion, some sampling sites recorded results outside of the internal trigger levels however, results for water quality remained generally within historical trends and acceptable ranges. The surface water monitoring programme will be reviewed in 2021. The ephemeral nature of these monitoring locations is the primary reason for the considerable variation in physical water quality. Trigger tracking results are detailed in **Table 41**.

Table 41 - Other Tributaries Internal Trigger Exceedance Results

Location	Date	Trigger Limit	Action Taken In Response
Bayswater Creek Upstream HVLP	7/02/2020	TSS	First trigger exceedance, Watching Brief*
Bayswater Creek Mid	7/02/2020	pH	First trigger exceedance, Watching Brief*
NSW 2 (Emu Creek)	7/02/2020	TSS	First trigger exceedance, Watching Brief*
Bayswater Creek Mid	10/02/2020	pH	Second trigger exceedance, Watching Brief*
NSW 2 (Emu Creek)	9/02/2020	TSS	Second trigger exceedance, Watching Brief*
W11 (Farrells Ck)	9/02/2020	pH	First trigger exceedance, Watching Brief*
W5 (Farrells Ck Upstream)	9/02/2020	TSS	First trigger exceedance, Watching Brief*
W5 (Farrells Ck Downstream)	9/02/2020	TSS	First trigger exceedance, Watching Brief*
NSW2 (Emu CK)	27/07/2020	TSS	Third trigger exceedance, Investigation commenced. Rain event sampling after 33mm rain. The ephemeral nature of this monitoring location is the primary reason for considerable variation in physical water quality.
W11 (Farrells Ck)	27/07/2020	TSS	First trigger exceedance, Watching Brief*
Pikes Creek Upstream	27/07/2020	TSS	First trigger exceedance, Watching Brief*
Pikes Creek Downstream	27/07/2020	TSS	First trigger exceedance, Watching Brief*
Bayswater Creek Downstream	27/07/2020	TSS	First trigger exceedance, Watching Brief*
W5 (Farrells Ck Upstream)	27/07/2020	TSS	Second trigger exceedance, Watching Brief*
W5 (Farrells Ck Downstream)	27/07/2020	TSS	Second trigger exceedance, Watching Brief*
W11 (Farrells Ck)	26/10/2020	pH	Second trigger exceedance, Watching Brief*
NSW2 Emu Ck	26/10/2020	TSS	Fourth trigger exceedance. Rain event sampling after 47mm of rain in a 48hr period. The ephemeral nature of this monitoring location is the primary reason for considerable variation in physical water quality.
Pikes Creek Downstream	26/10/2020	TSS	Second trigger exceedance, Watching Brief*
Bayswater Creek Mid	26/10/2020	pH	Third trigger exceedance, Investigation commenced

Location	Date	Trigger Limit	Action Taken In Response
Bayswater Creek Downstream	26/10/2020	TSS	Second trigger exceedance, Watching Brief*
W11 (Farrells Ck)	22/12/2020	pH	Third trigger exceedance, Investigation commenced.
NSW2 Emu Ck	22/12/2020	TSS	Fifth trigger exceedance. Rain event sampling after 30mm of rain in a 48hr period. The ephemeral nature of this monitoring location is the primary reason for considerable variation in physical water quality.
Redbank Creek Catchment	22/12/2020	TSS	First trigger exceedance, Watching Brief*

* = Watching brief established pending outcomes of subsequent monitoring events. No specific actions required.

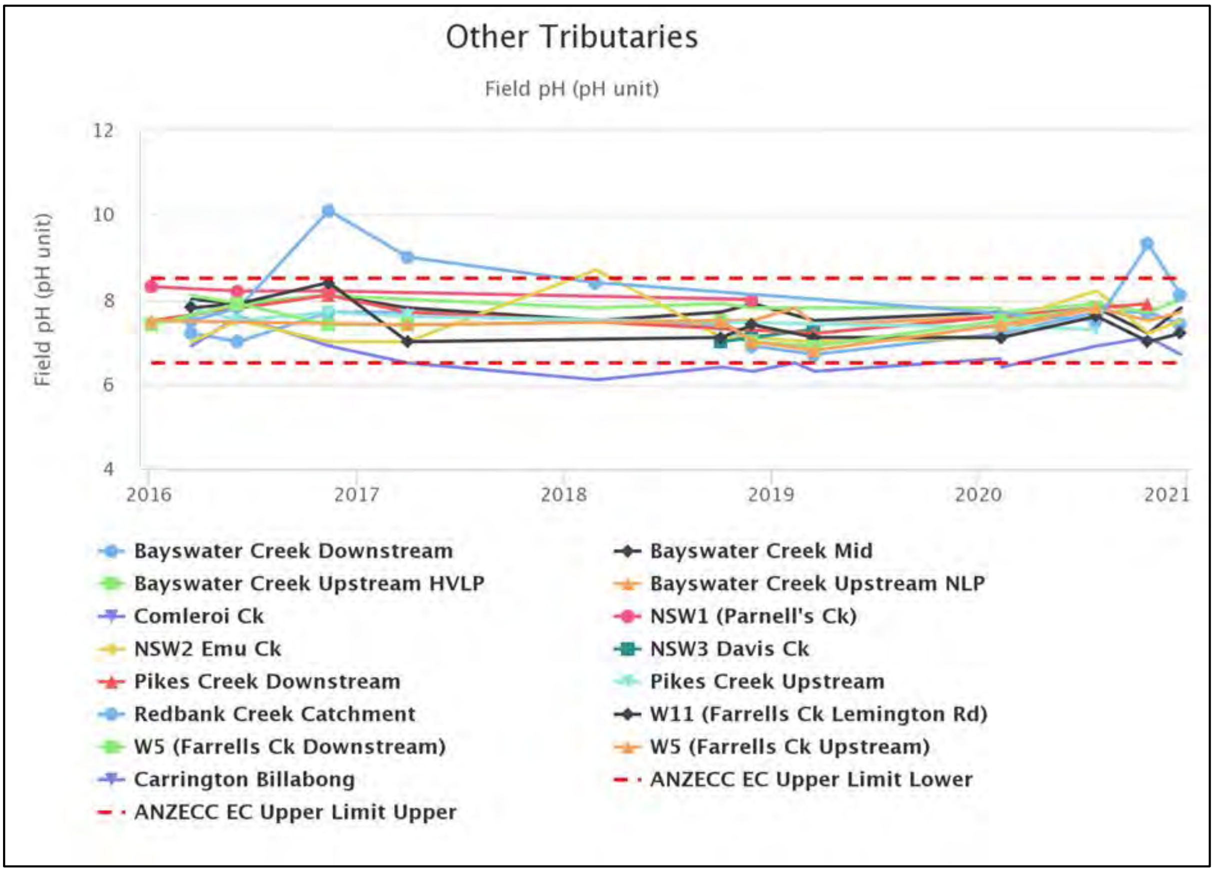

Figure 31 - Other Tributaries pH Trends 2016 – 2020

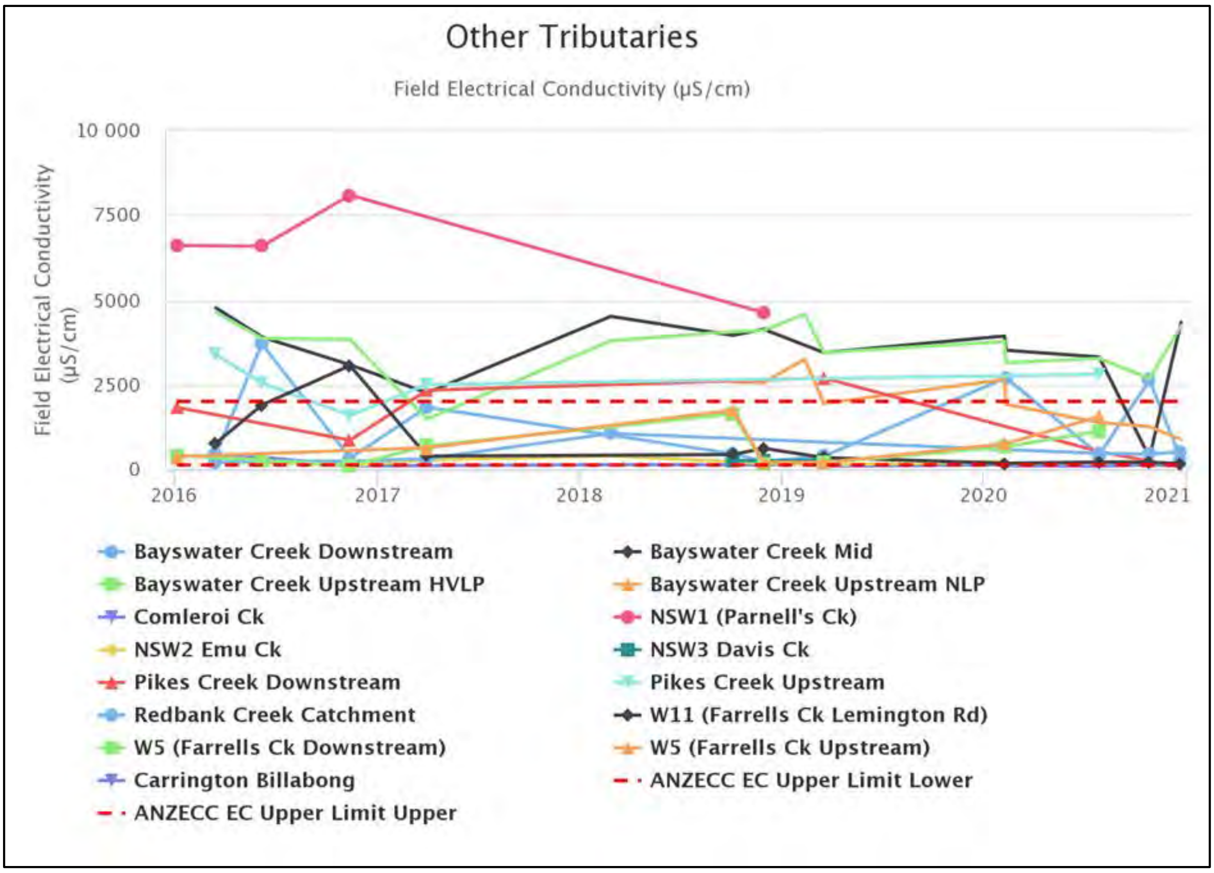

Figure 32 - Other Tributaries EC Trends 2016 – 2020

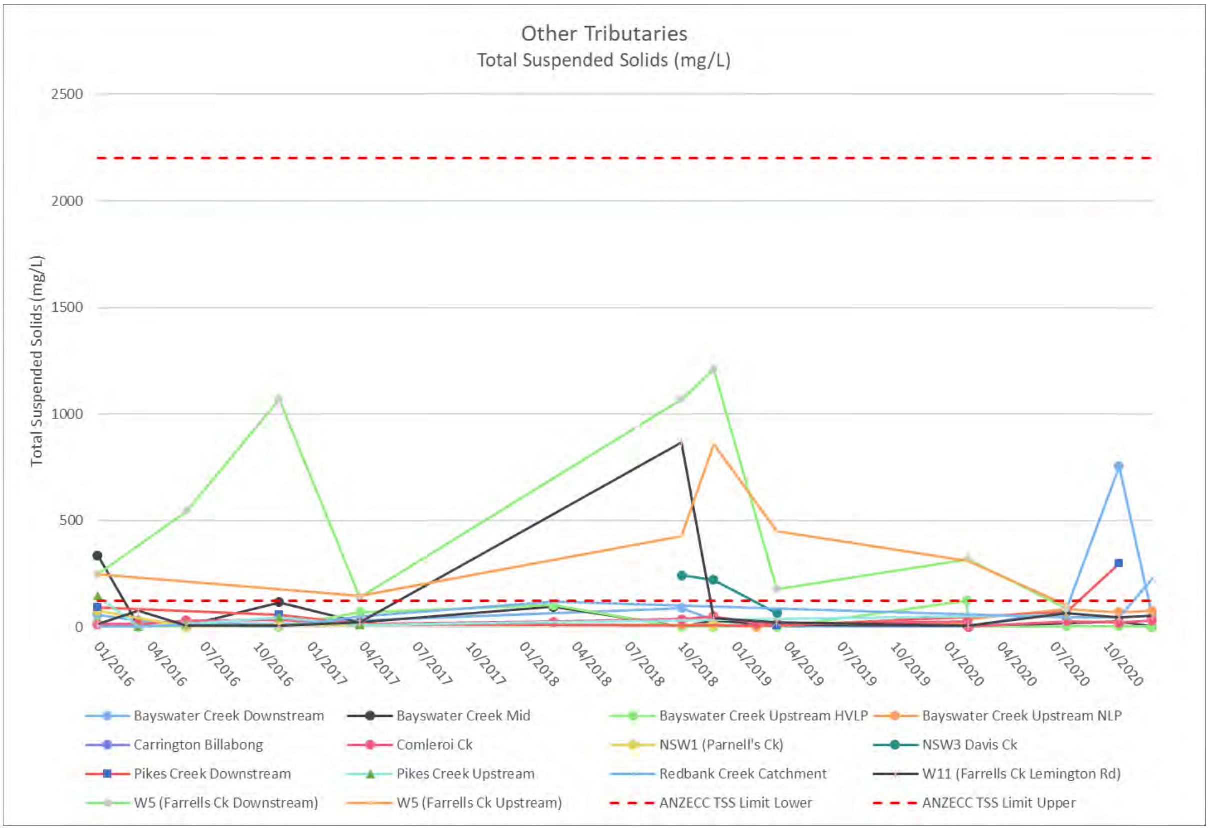

Figure 33 - Other Tributaries TSS Trends 2016 – 2020

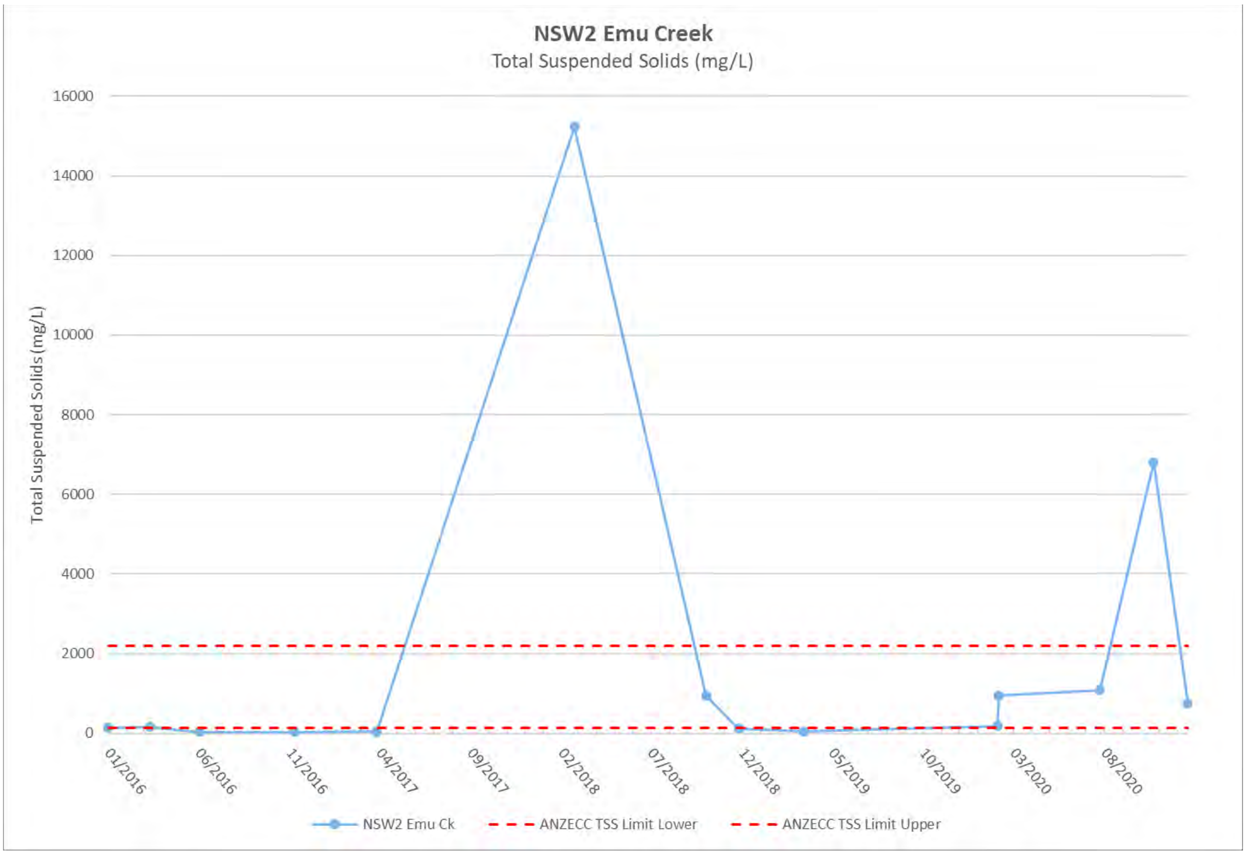

Figure 34 - NSW2 Emu Creek TSS Trends 2016 - 2020

7.2.1.4 HVO Site Dams

During 2020 110 samples were collected across 10 onsite dams. Long term trends for pH, EC and TSS are shown in **Figure 35** to **Figure 37**. EC results show a lowering overall during the reporting period, as a result of wetter than average weather conditions.

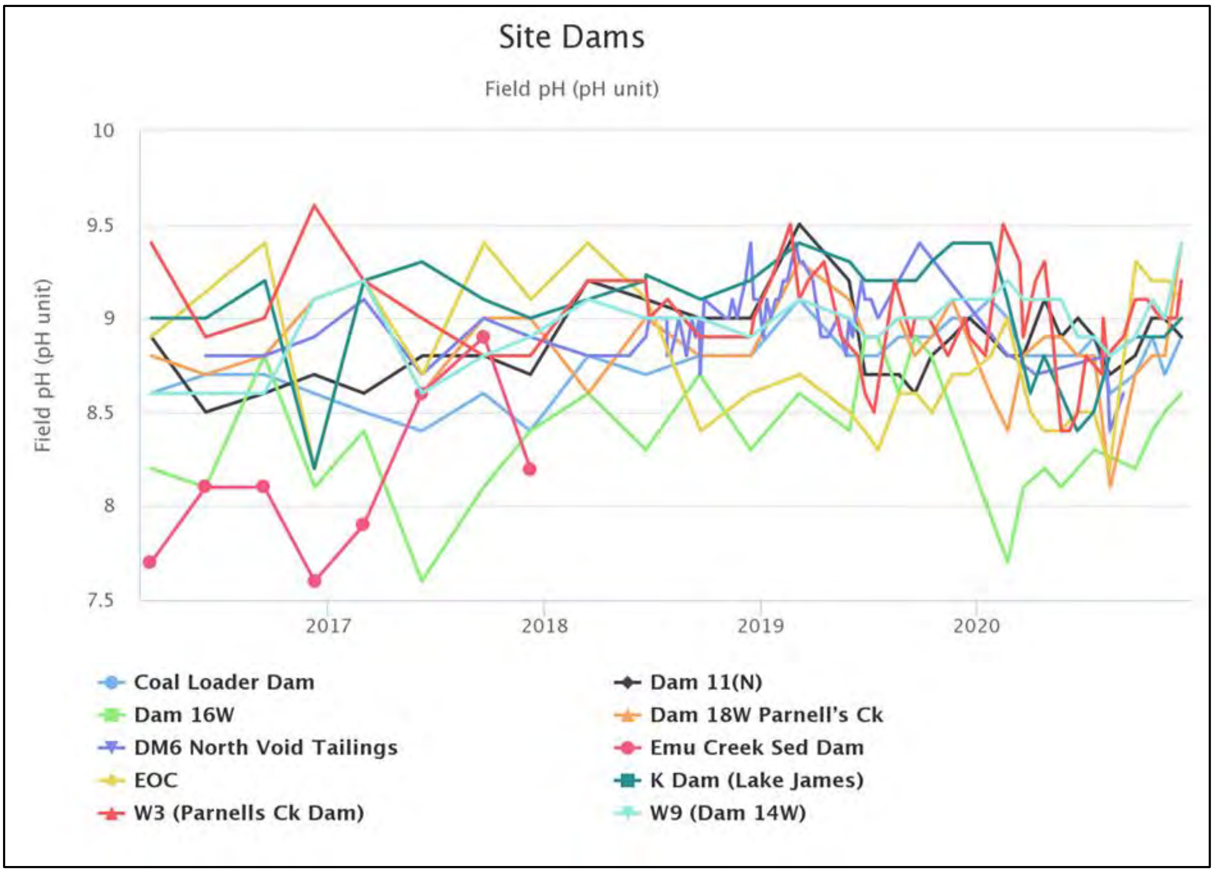

Figure 35 - HVO Site Dams pH Trends 2016 – 2020

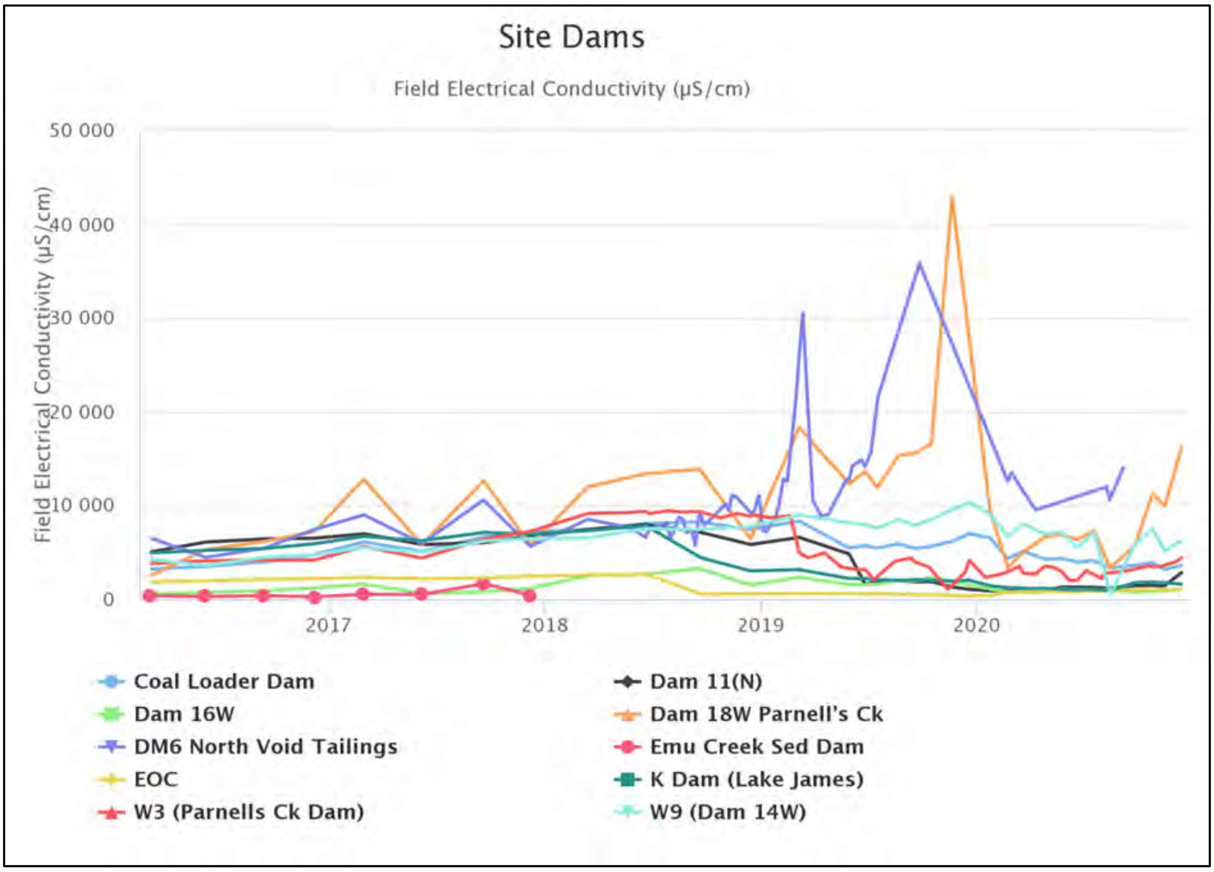

Figure 36 - HVO Site Dams EC Trends 2016 – 2020

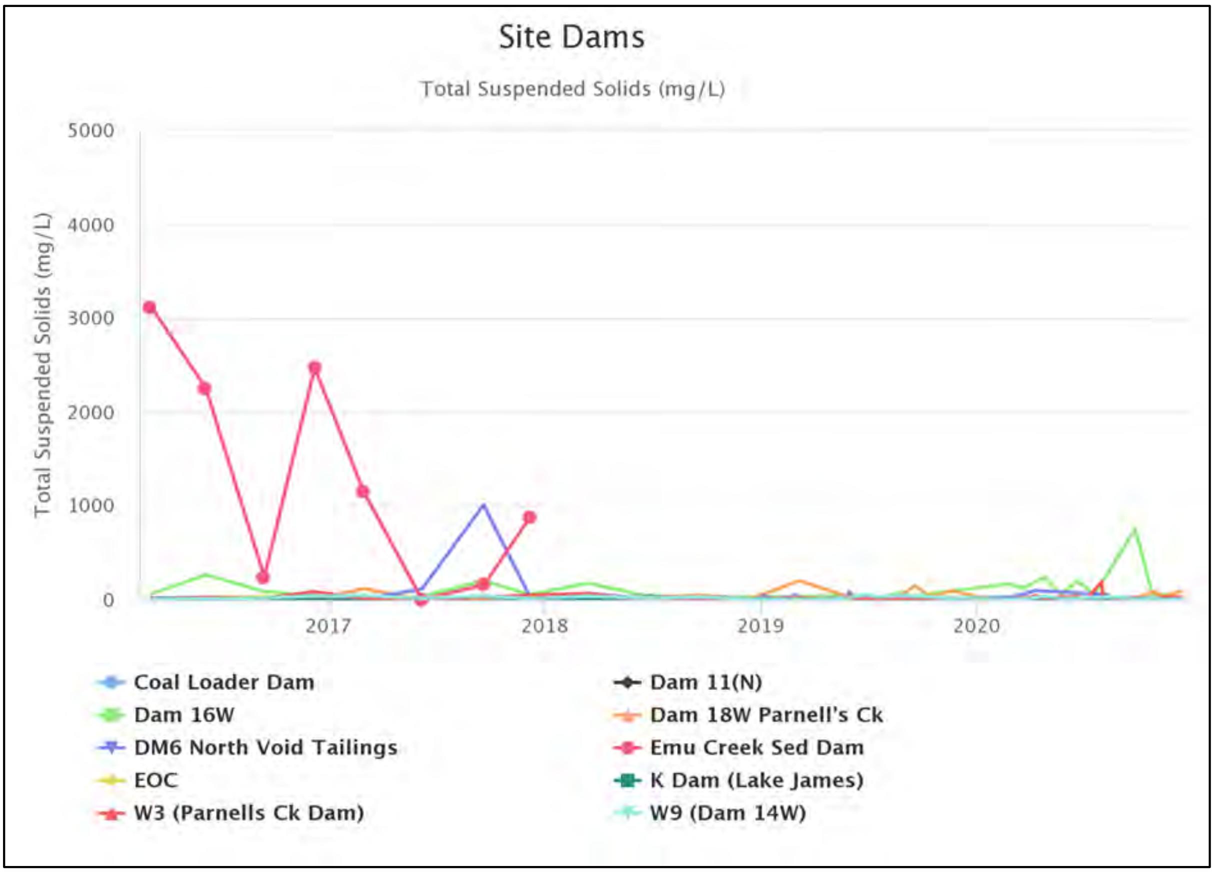

Figure 37 - HVO Site Dams TSS Trends 2016 – 2020

7.3 Comparison with EIS Predictions

7.3.1 South Pit EIS Predictions

The South Pit EIS estimated an 'instantaneous' water quality for EC of 5,700 µS/cm as an upper limit. Instantaneous water quality is a simple estimate obtained by dividing the total salt available by the maximum amount of possible void water. Electrical Conductivity measurements at Lake James averaged 1,333 µS/cm during 2020, lower than what was predicted in the EIS. The water quality during this period was influenced by freshwater inputs from the Hunter River.

The South Pit EIS estimated average runoff water quality from undisturbed catchments to be 400 mg/L for TSS and 615 µS/cm for EC. Comleroi Creek, South of Cheshunt Pit was sampled five times during rain events in 2020 resulting in an average TSS of 22 mg/L and EC of 110 µS/cm, demonstrating that runoff water from undisturbed catchments in the HVO South area is of better quality than that which was predicted in the EIS.

7.3.2 Carrington Pit EIS Predictions

The long term mine water quality for Carrington is discussed in the Carrington Mine Environmental Impact Statement (ERM 1999). The EIS estimated an 'instantaneous' water quality for EC of 7,050 µS/cm.

Water in the Carrington pit area is a mixture of surface runoff from overburden emplacements, haul roads, tailings decant, rehabilitation and Hunter River abstraction. Water is directed to Dam 9N and into Dam 11N. The average EC and TSS in Dam 11N during 2020 was 1,315 µS/cm and 1.8 mg/L respectively, this is lower than normal and influenced by increased rainfall runoff and inputs from the Hunter River.

The Carrington EIS states that runoff from undisturbed catchments within the Carrington Pit will be directed around the mine via contour banks or surface drains to discharge where possible into natural creeks. The salinity of the runoff water was predicted to be approximately 615 µS/cm. Runoff from rehabilitated lands was initially predicted to have higher TSS, with levels approaching pre-mining conditions after several years. Carrington Billabong (where such water quality is currently measured in this catchment) was reported as dry during the rain event monitoring rounds in 2020 with no samples collected. The catchment area has changed significantly since the EIS predictions were made with a levee now in place between rehabilitated mine areas and Carrington Billabong.

7.3.3 West Pit EIS Predictions

The West Pit EIS included the data in **Table 42** as representative of water quality in the local catchment area. Emu Creek (NSW2) was sampled five times during 2020. The pH was reported to be 7.7 pH units during the review period, which is within the EIS predictions and the Electrical conductivity was 196 µS/cm, indicating fresher than predicted EC results. The pH and EC at Farrells Creek (combined upstream and downstream monitoring sites) averaged 7.5 and 1,021 µS/cm respectively during the review period; these results were within the EIS predictions. Davis creek (where such water quality would be measured for this comparison) was reported as dry during the rain event monitoring rounds in 2020 with no samples collected. Parnell's Dam (W3) measured an average EC of 2,969 µS/cm in 2020, within the prediction.

Table 42 - Representative Water Quality for West Pit

Watercourse	pH (pH Units)	EC (µS/cm)
Davis Creek	7.7 to 8.4	767 to +8,000
Emu Creek	7.5 to 8.8	365 to +1,000
Farrells Creek	7.0 to 9.2	195 to +12,000
Mine Water (Parnell's Dam)	-	2,400 to 6,300

7.4 Performance relating to HRSTS Discharges

HVO submitted a discharge report for the 2019/20 financial year in accordance with EPL 640. No water was discharged off site during 2020 via the HRSTS.

7.5 Groundwater

7.5.1 Groundwater Management

Groundwater monitoring activities were undertaken in 2020 in accordance with the *HVO WMP* and Groundwater Monitoring Programme. The monitoring results are used to establish and monitor trends in physical and geochemical parameters of surrounding groundwater potentially influenced by mining.

The groundwater monitoring programme at HVO measures the quality of groundwater against background data, EIS predictions and historical trends. Ground water quality is evaluated through the parameters of pH, EC, and Standing Water Level (SWL) (measured as elevation in metres with respect to the Australian Height Datum, mAHD). On a periodic basis (nominally once per annum) a comprehensive suite of analytes are measured, including major anions, cations and metals. Prior to sampling for comprehensive analysis, bore purging is undertaken to ensure a representative sample is collected.

Groundwater monitoring data is reviewed on a quarterly basis. The review involves a comparison of measured pH and EC results against internal trigger values which have been derived from the historical data set. Trigger limits are calculated as the 95th percentile maximum value (EC and pH) and the 5th percentile minimum value (pH only) from data collected since 2011. Trigger levels have been set on the basis of geographical proximity and target stratigraphy. Bores that record as dry and bores of unknown seam have not been included in calculation of the trigger limits. The response to measured data outside the trigger limits is detailed in the HVO Water Management Plan. Where investigations and subsequent actions have been undertaken following review of monitoring data, these are detailed in this section. Monitoring locations are shown in **Figure 38**.

The Annual Groundwater Impacts Review and the Triennial Groundwater Model Review conducted during 2020 is provided in Appendix A.

7.5.2 Groundwater Performance

Sampling of groundwater was carried out in accordance with the HVO Groundwater Monitoring Programme. Where laboratory analysis was undertaken, this was performed by a NATA accredited laboratory. Sites with a data capture rate of less than 100 per cent are outlined in **Table 43.**

Table 43 - HVO Groundwater Monitoring Data Recovery for 2020 (by exception)

Location	Type	Data Recovery (%)	Comments
4036C	SWL, WQ	0%	Dry during 2020 monitoring events.
B425(WDH)	WQ	0%	Insufficient water to sample
BZ3-3	WQ	75%	Insufficient water during August monitoring event
BZ4A(2)	WQ	75%	Insufficient water during March monitoring event
C122(BFS)	WQ	0%	Insufficient water during 2020 monitoring events
C919(ALL)	WQ	0%	Bore dry
	SWL	40 %	Bore dry
CGW45	SWL, WQ	0%	Bore unable to be sampled during 2020 sampling event due to obstruction
CGW47a	WQ	25%	Bore dry
CHPZ8A	WQ	75%	Insufficient water to sample
D612(AFS)	WQ	50%	Insufficient water during November monitoring event
DM3	SWL, WQ	75%	Bore unsafe to access during March monitoring event
DM7	SWL, WQ	0%	Dry during 2020 monitoring events.
GW100	WQ	75%	Insufficient water during January monitoring event
GW101	SWL	25%	Bore dry Q1, Q2 and Q4
	WQ	0%	Insufficient water to sample
GW107	WQ	0%	Insufficient water during 2020 monitoring events
GW108	WQ	0%	Insufficient water during 2020 monitoring events
GW-114	WQ	50%	Insufficient water to sample
	SWL	75%	Unsafe access Q1
GW-121	WQ	0%	Insufficient water to sample
	SWL	50%	Bore dry
GW-128	WQ	25%	Insufficient water to sample
NPZ5	SWL, WQ	0%	Bore unable to be sampled during 2020 sampling events due to unsafe access
SR007	SWL, WQ	50%	No access in June and August sampling due to access issues

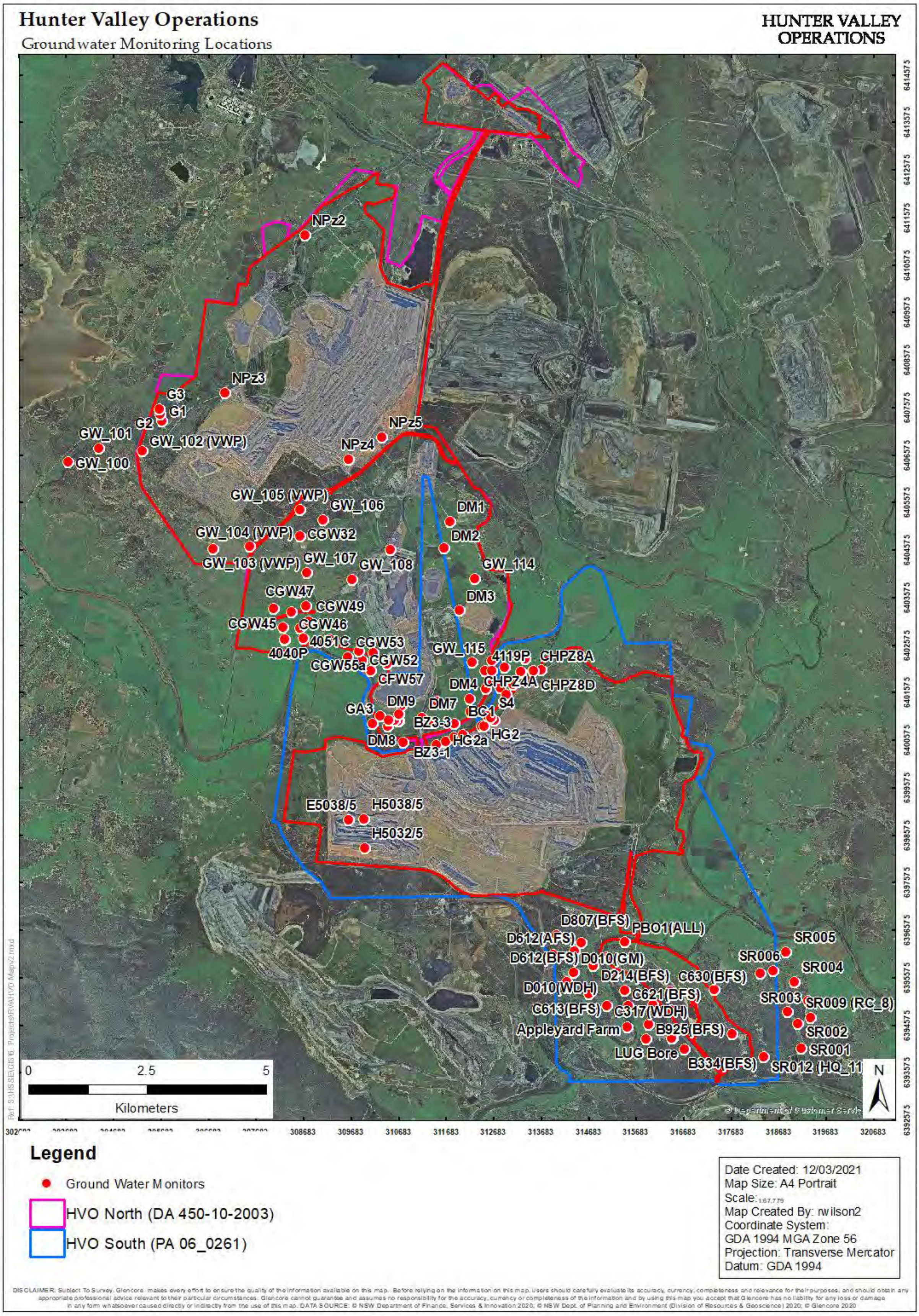

Figure 38 - Groundwater Monitoring Network at HVO – 2020

7.5.3 Groundwater Monitoring Summary

The following section presents groundwater monitoring data in relation to the geographic locations and target stratigraphy for groundwater monitoring bores.

Each location is discussed and a summary of monitoring data presented. Where monitoring results required further investigation following the recording of three consecutive measurements outside the internal statistical limits, these results are summarised in tables for each location.

7.5.3.1 Carrington Broonie

Carrington groundwater was sampled on 8 occasions during 2020 from two monitoring locations. The EC, pH and SWL trends for 2016 to 2020 for Carrington Broonie Seam groundwater bores are shown in **Figure 39** to **Figure 41** respectively. Data was generally consistent with historical ranges with some minor variation noted with pH results.

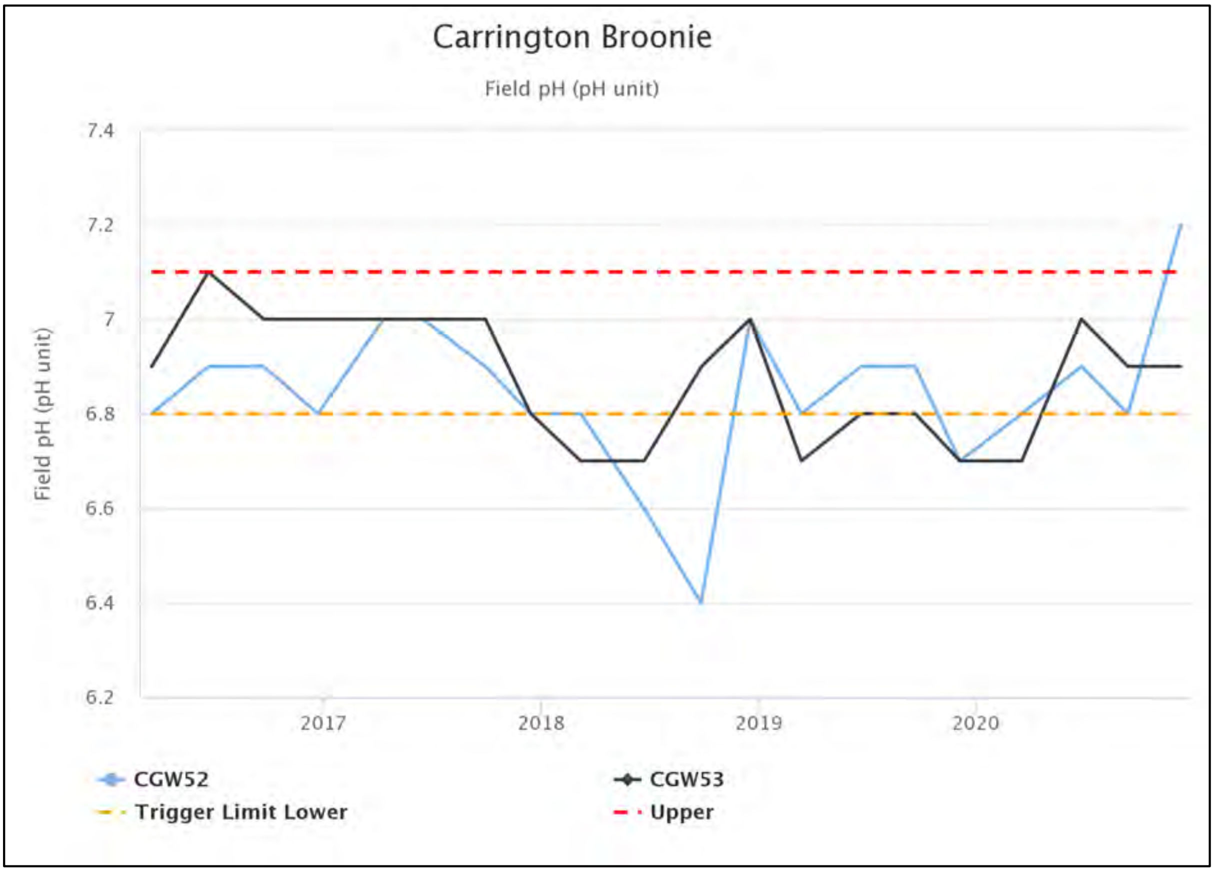

Figure 39 - Carrington Broonie Groundwater pH Trends 2016 – 2020

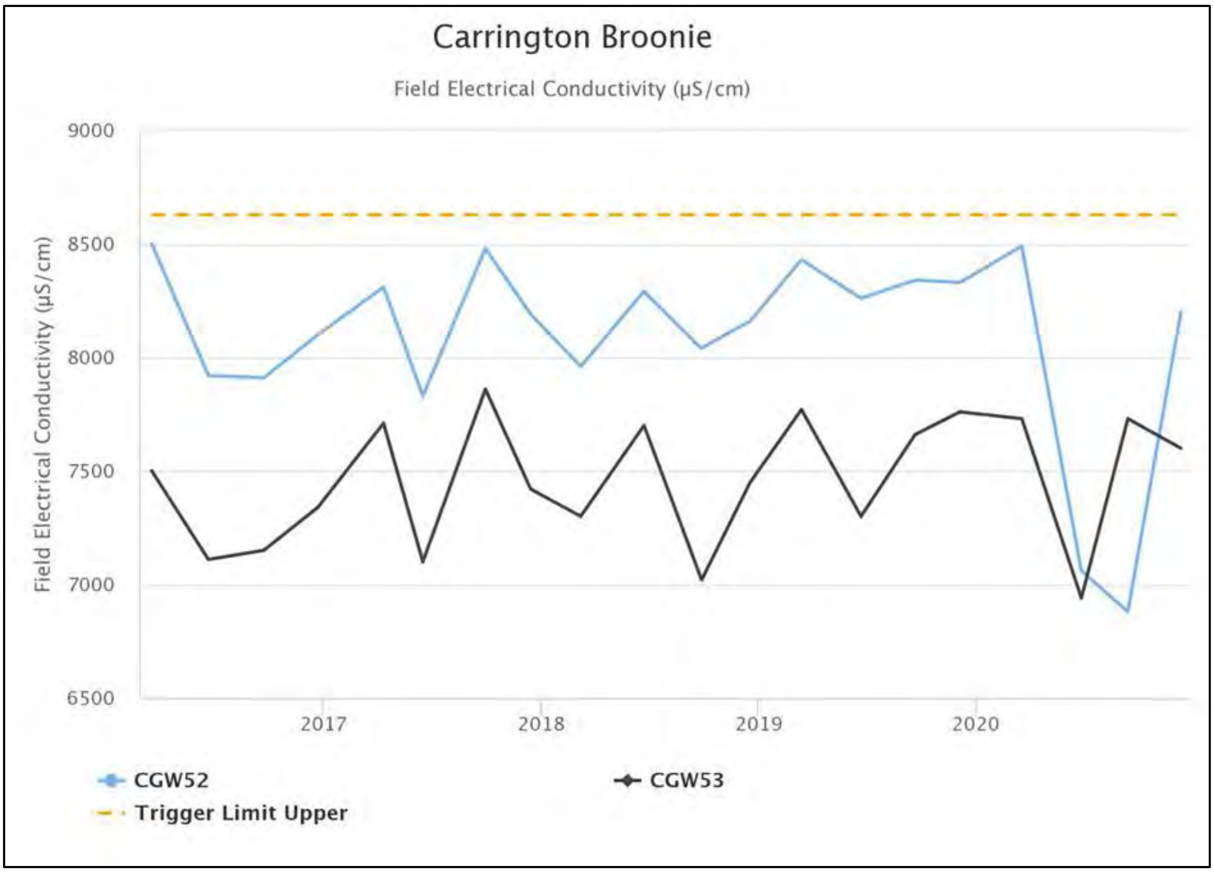

Figure 40 - Carrington Broonie Groundwater EC Trends 2016 – 2020

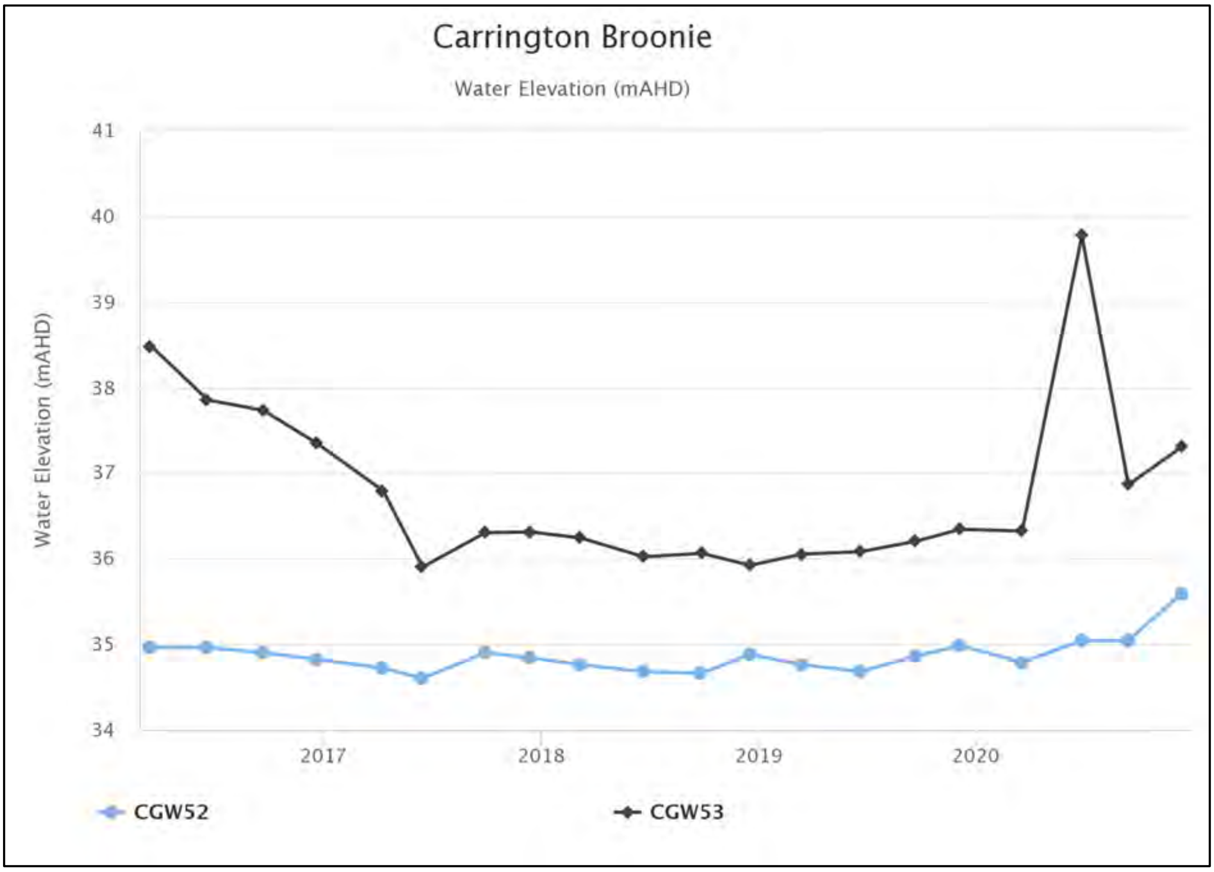

Figure 41 - Carrington Broonie Groundwater SWL Trends 2016 – 2020

7.5.3.2 Carrington Alluvium

Groundwater monitoring in the Carrington Alluvium area was undertaken at five sites during 2020, with 46 samples collected during the reporting period. The EC, pH and SWL trends for 2016 to 2020 for Carrington Alluvium groundwater bores are shown in **Figure 42** to **Figure 44**. Trigger exceedance results are listed in **Table 44**.

During 2020, HVO continued to work with the EPA to address potential impacts of seepage from the North Void Tailings Storage Facility (TSF). This included ceasing deposition of tailings to the TSF and decanting of surface water to allow the tailings to dry and consolidate. Monitoring of the area continues at an increased frequency including data collection from continuous groundwater loggers measuring water level and quality. EC and pH have stabilised and standing water level has declined, this is an indication that current controls are being effective. HVO will continue to work with the EPA during 2021 as part of a Pollution Reduction Programme (PRP) to address the seepage.

Table 44 - HVO Carrington Alluvium Groundwater 2020 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken In Response
CFW55R	2/01/2020	EC	First breach - watching brief established
CFW55R	12/02/2020	EC	Second breach - watching brief established
CFW55R	13/03/2020	EC	Third breach – investigation commenced.
CFW55R	7/4/2020	EC	Investigation ongoing
CFW55R	6/05/2020	EC	Investigation ongoing
CFW55R	4/06/2020	EC	Investigation ongoing
CFW55R	2/07/2020	EC	Investigation ongoing
CFW55R	5/08/2020	EC	Investigation ongoing
CFW55R	2/09/2020	EC	Investigation ongoing
CFW55R	15/10/2020	EC	Investigation ongoing
CFW55R	4/11/2020	EC	Investigation ongoing
CFW55R	04/12/2020	EC	Investigation ongoing

* = Watching brief established pending outcomes of subsequent monitoring events. No specific actions required.

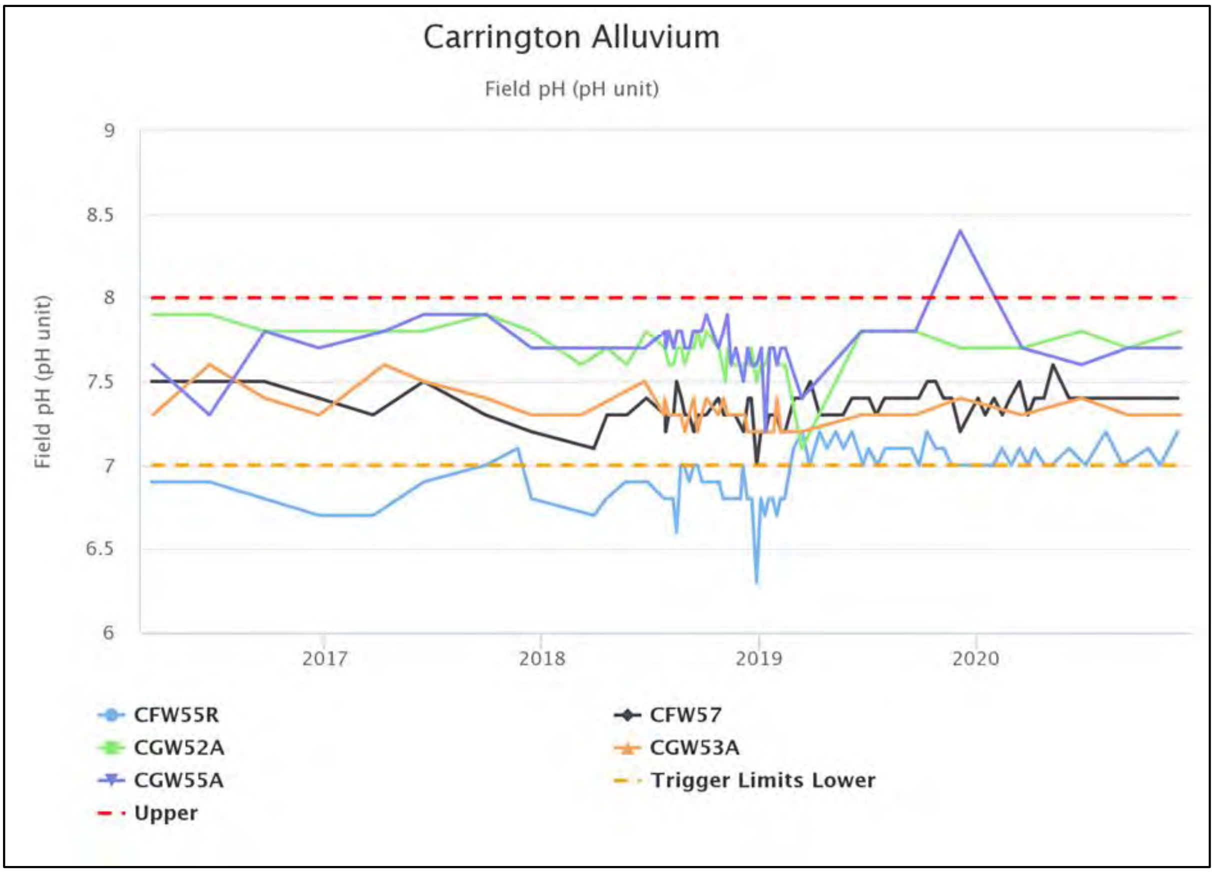

Figure 42 - Carrington Alluvium Groundwater pH Trends 2016 – 2020

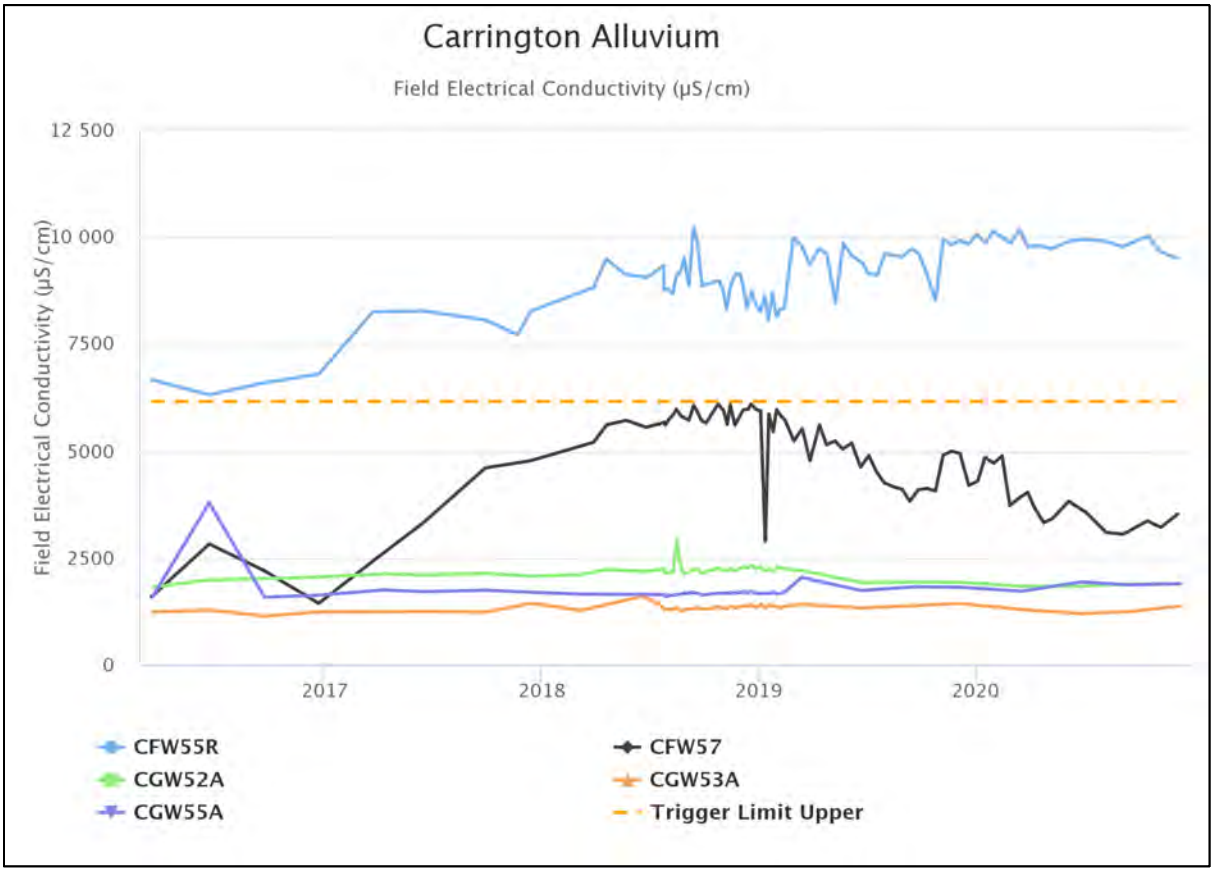

Figure 43 - Carrington Alluvium Groundwater EC Trends 2016 – 2020

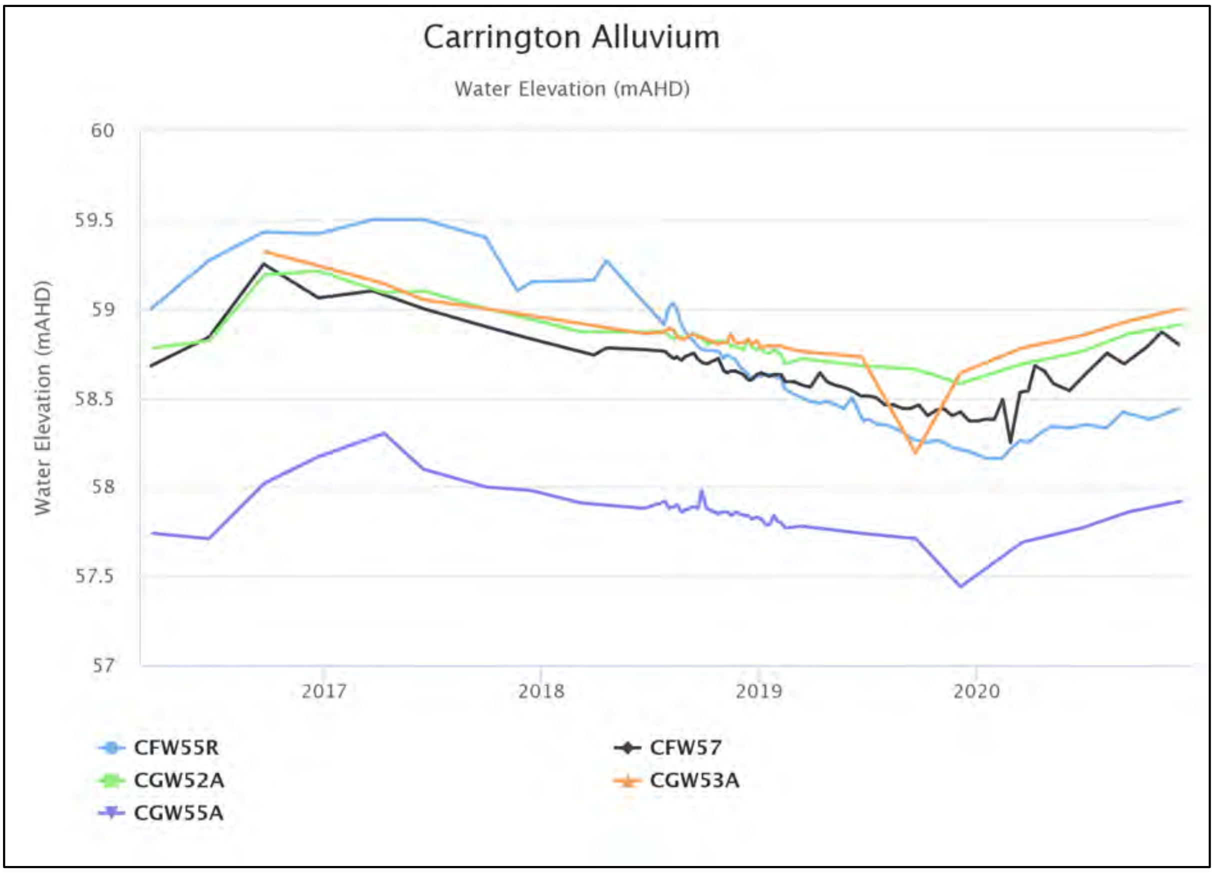

Figure 44 - Carrington Alluvium Groundwater SWL Trends 2016 – 2020

7.5.3.3 Carrington Interburden

Groundwater monitoring in the Carrington Interburden was undertaken at two sites during 2020, with 8 samples collected for field analysis during the reporting period.

The EC, pH and SWL trends for 2016 to 2020 for groundwater bores in the Carrington Interburden are shown in **Figure 45** to **Figure 47** respectively. Results were generally consistent with historical trends.

Bore 4036C was dry and therefore samples were unable to be collected during 2020. Sampling frequency for CGW51A had been increased during early 2019 in response to an ongoing groundwater investigation

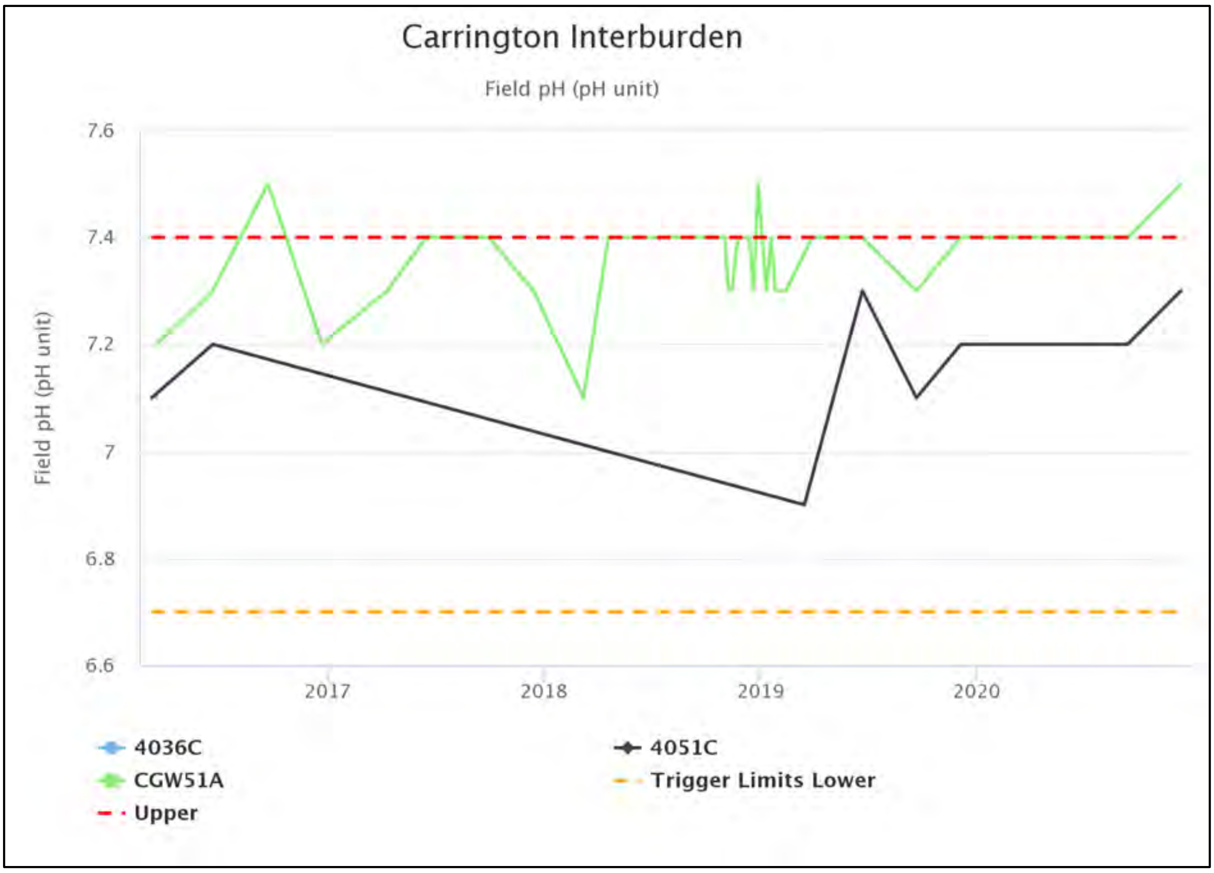

Figure 45 - Carrington Interburden Groundwater pH Trends 2016 – 2020

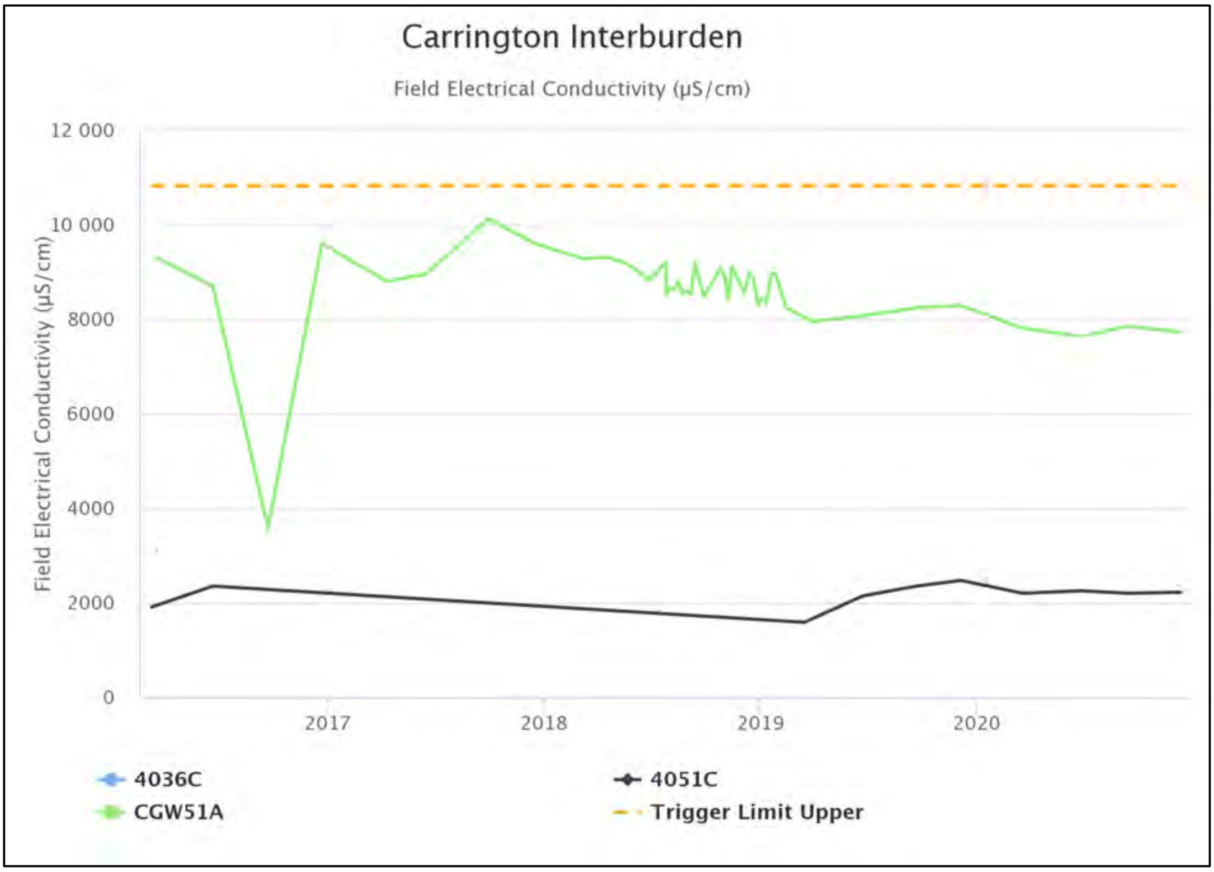

Figure 46 - Carrington Interburden Groundwater EC Trends 2016 – 2020

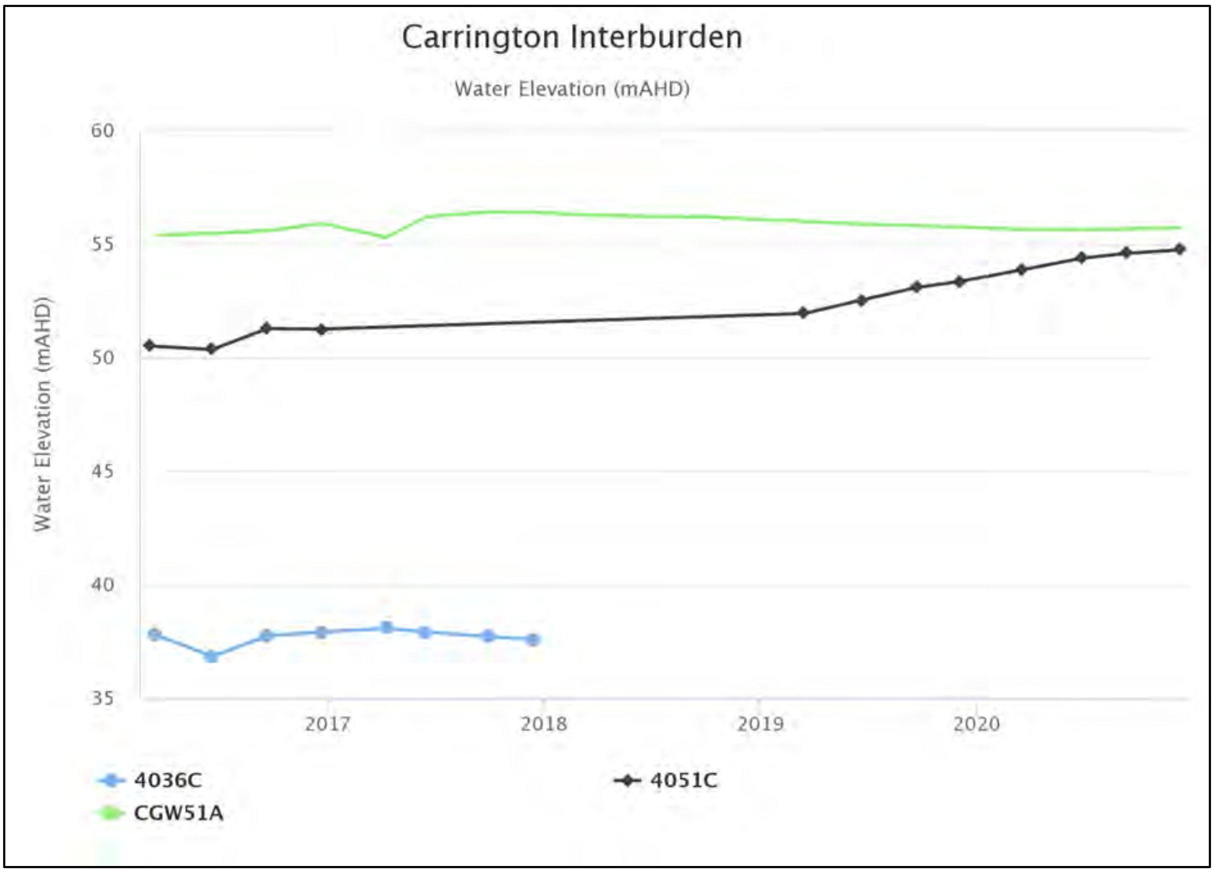

Figure 47 - Carrington Interburden Groundwater SWL Trends 2016 – 2020

7.5.3.4 Carrington West Wing Alluvium

Groundwater monitoring in the Carrington West Wing Alluvium was undertaken at five sites in 2020 with 20 samples collected for field analysis during the reporting period. Results are shown in **Figure 48** to **Figure 50**. Results during 2020 were generally consistent with historical trends.

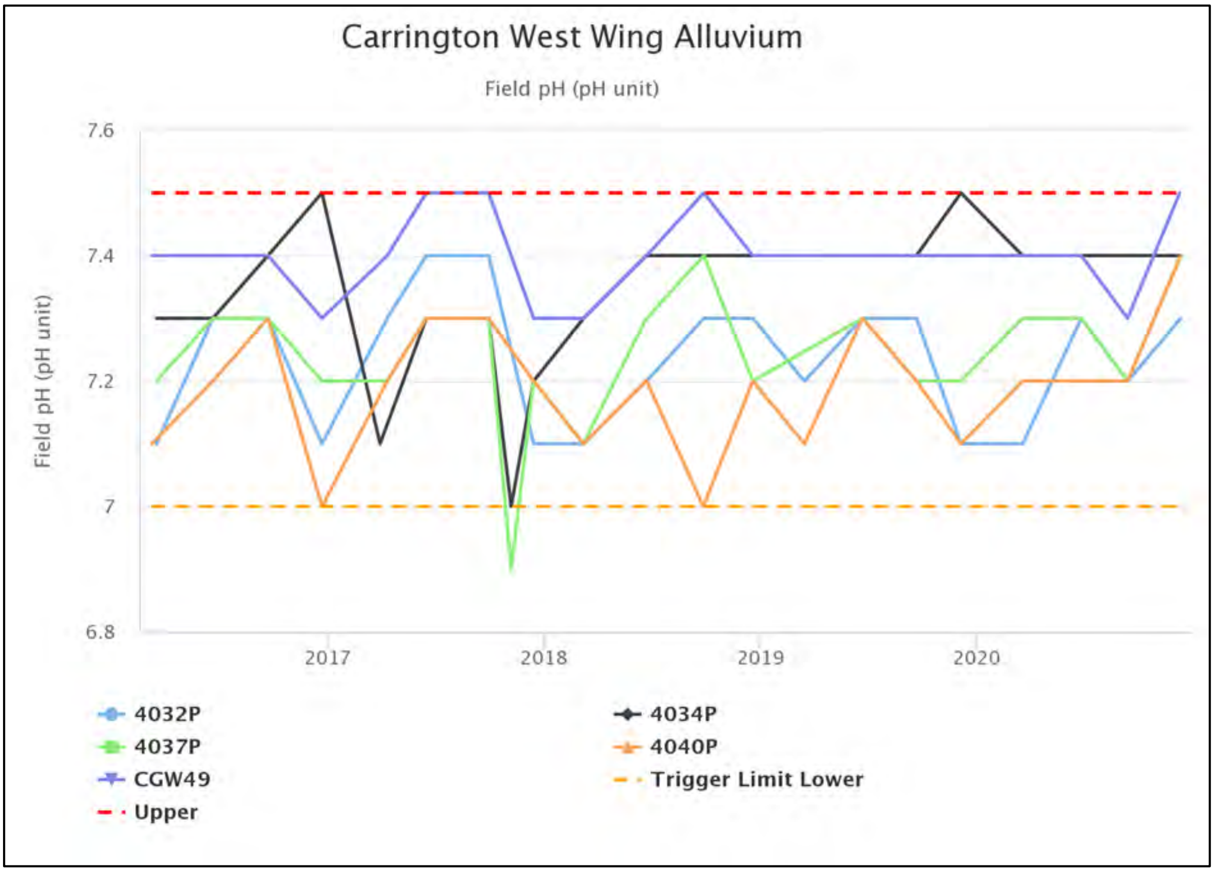

Figure 48 - Carrington West Wing Alluvium Groundwater pH Trends 2016 – 2020

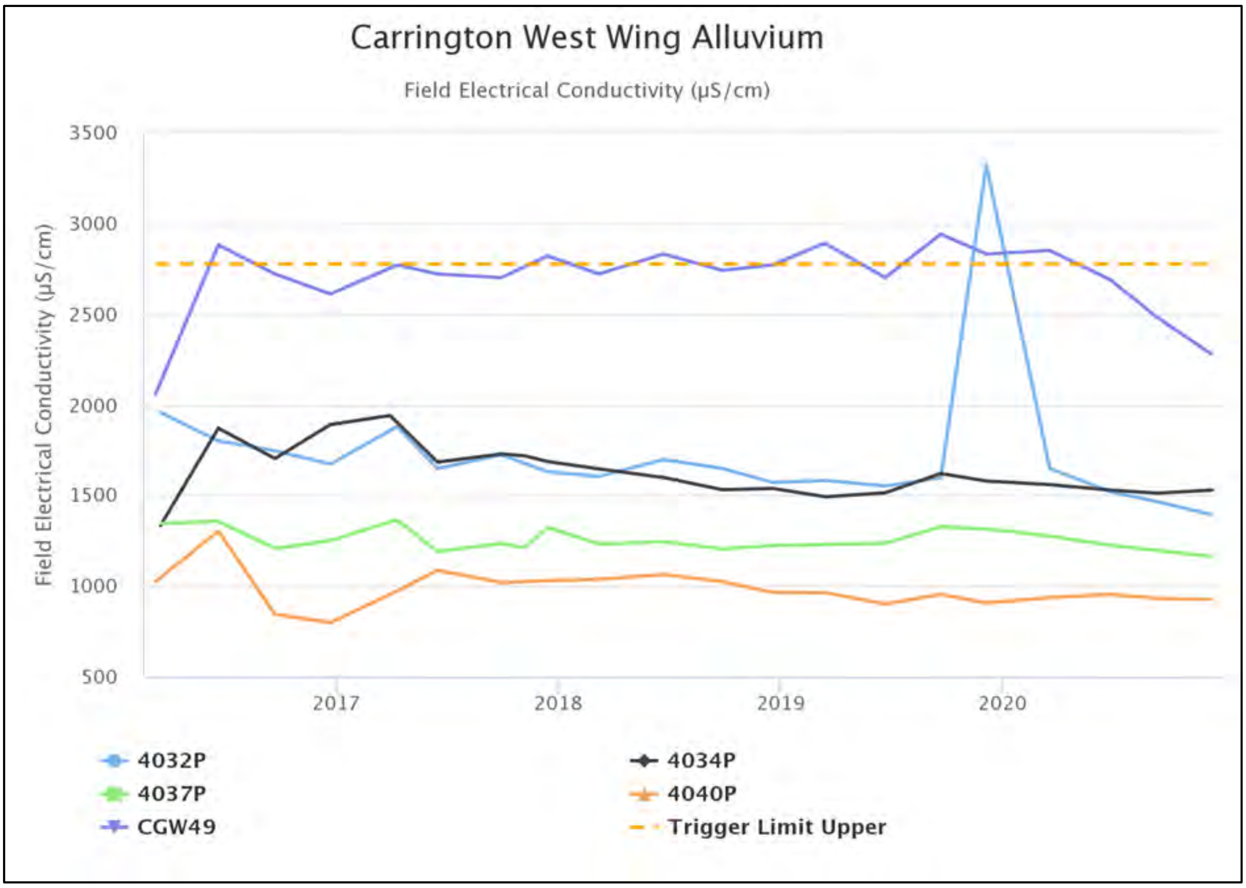

Figure 49 - Carrington West Wing Alluvium Groundwater EC Trends 2016 – 2020

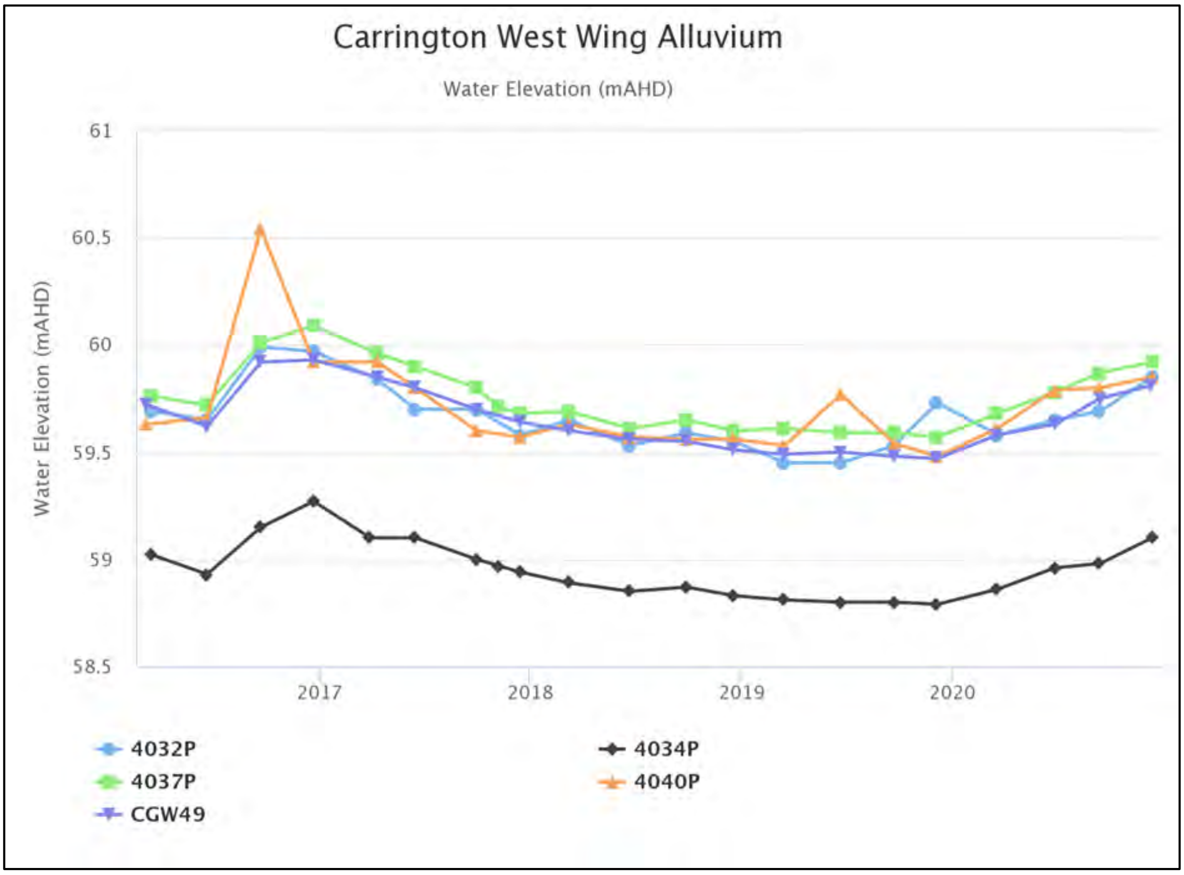

Figure 50 - Carrington West Wing Alluvium Groundwater SWL Trends 2016 – 2020

7.5.3.5 Carrington West Wing Flood Plain

Groundwater monitoring in the Carrington West Wing Flood Plain was undertaken at four sites in 2020 with 14 samples collected for field analysis during the reporting period. Results are shown in **Figure 51** to **Figure 53**. Groundwater levels in 2020 were consistent with 2019 levels in all bores.

Trigger tracking results are listed in **Table 45**.

Table 45 - HVO Carrington West Wing Flood Plain Groundwater 2020 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken In Response
GW-106	10/09/2020	pH	First exceedance. Watching brief established*

* = Watching brief established pending outcomes of subsequent monitoring events. No specific actions required.

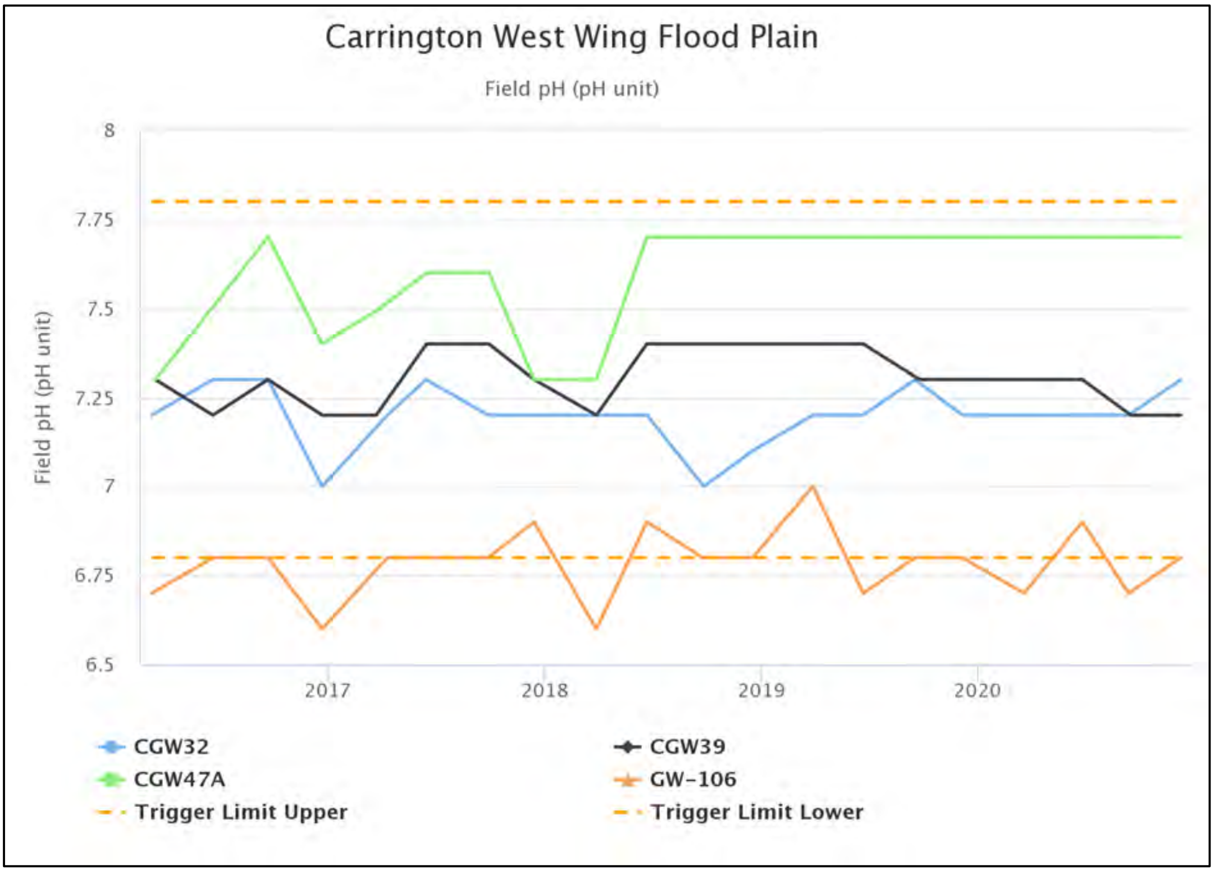

Figure 51 - Carrington West Wing Flood Plain Groundwater pH Trends 2016 – 2020

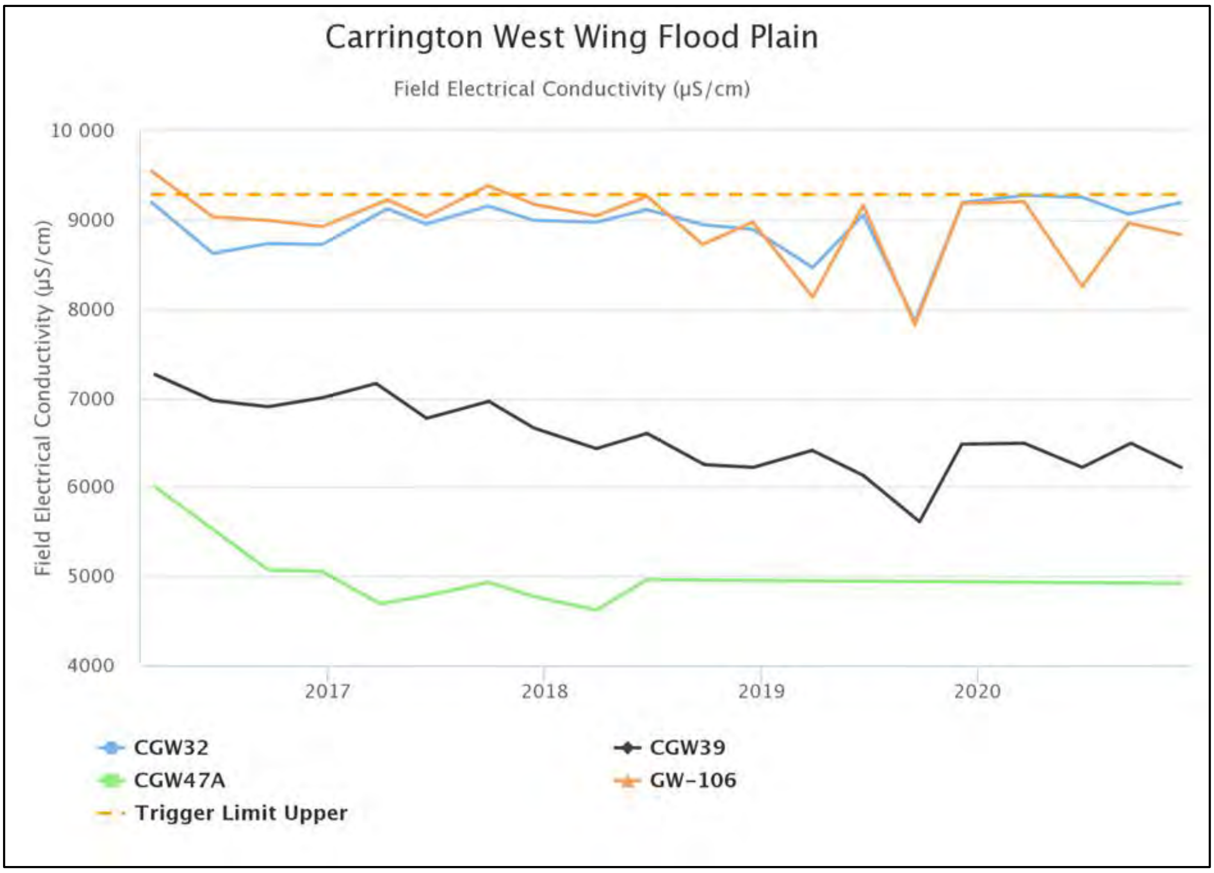

Figure 52 - Carrington West Wing Flood Plain Groundwater EC Trends 2016 – 2020

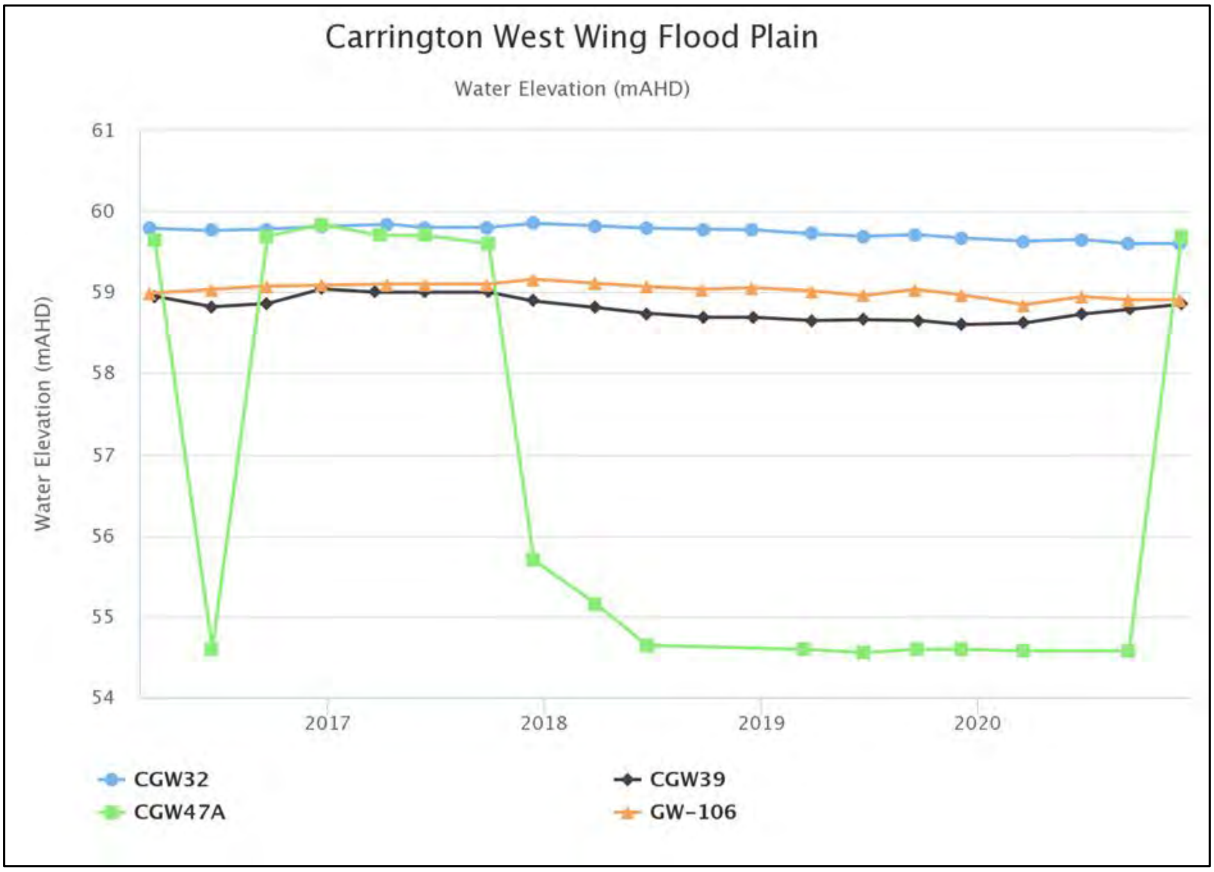

Figure 53 - Carrington West Wing Flood Plain Groundwater SWL Trends 2016 – 2020

7.5.3.6 Cheshunt/North Pit Alluvium

Groundwater monitoring in the Cheshunt / North Pit area was undertaken at 17 sites during 2020, with 63 samples collected during routine monitoring. Electrical Conductivity, pH and SWL trends for 2016 to 2020 are shown in **Figure 54** to **Figure 56**. Trigger tracking results are listed in **Table 46**.

Table 46 - HVO Cheshunt/North Pit Alluvium Groundwater 2020 Monitoring Internal Trigger Exceedances

Location	Date	Trigger Limit	Action Taken In Response
Hobdens Well	27/05/2020	pH -	First exceedance - Watching brief established*
Hobdens Well	19/08/2020	pH	Second breach, maintain watching brief*

** Watching Brief established pending outcomes of subsequent monitoring events. No specific actions required.*

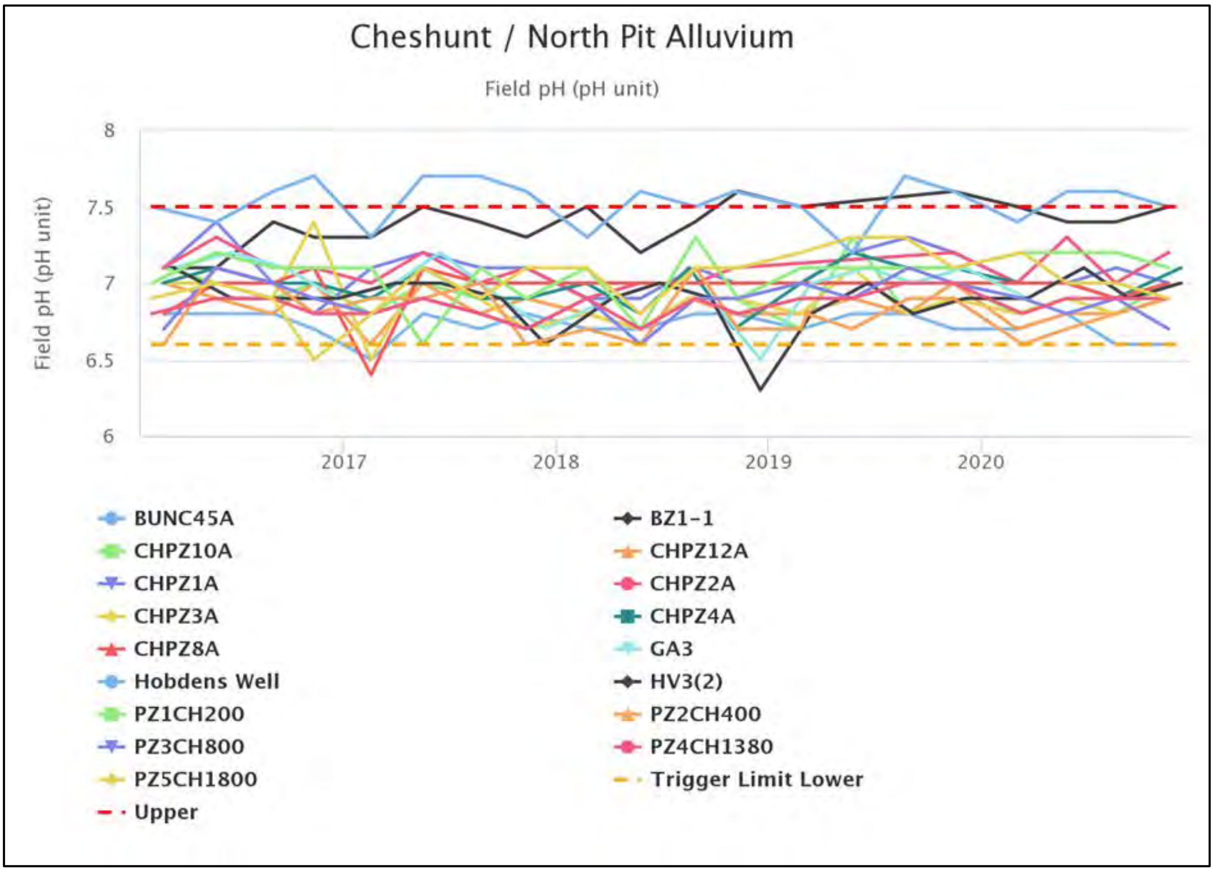

Figure 54 - Cheshunt/North Pit Alluvium Groundwater pH Trends 2016 – 2020

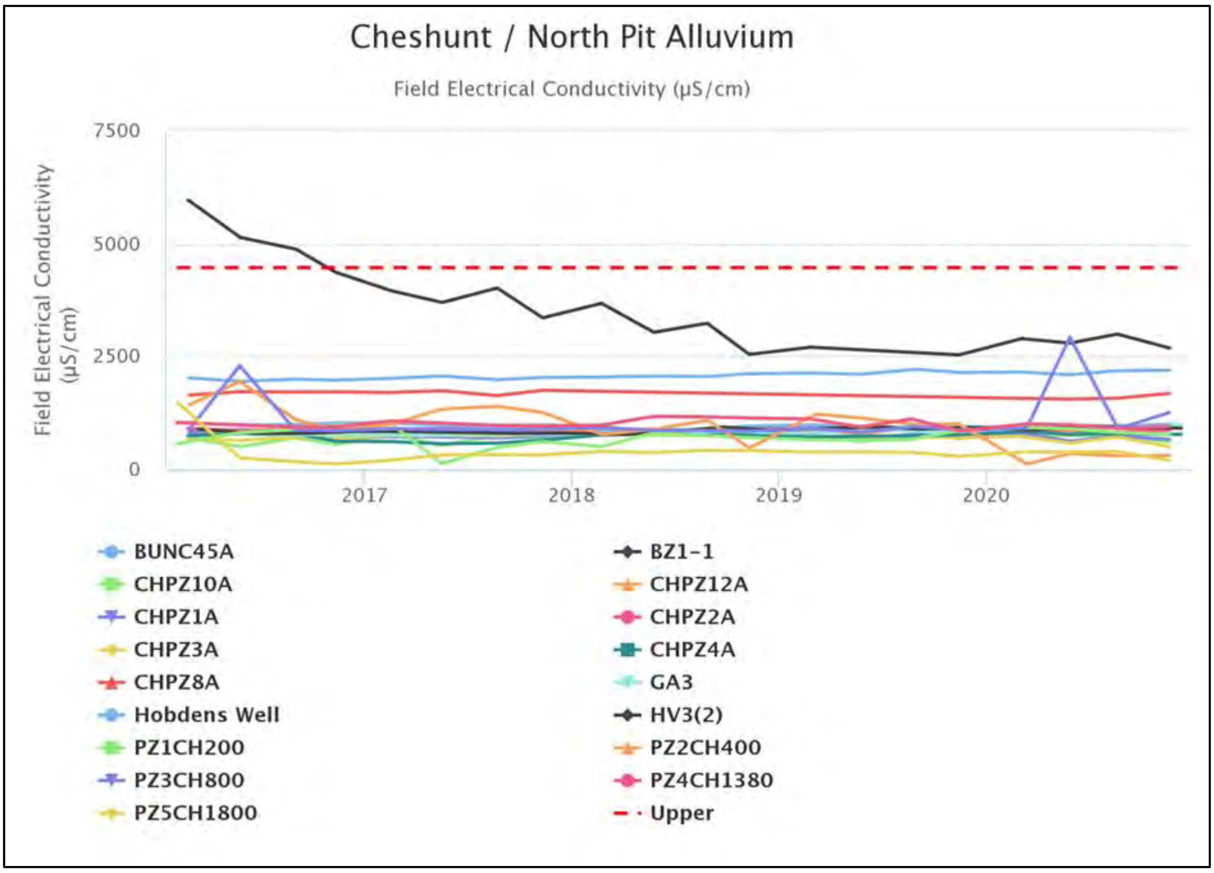

Figure 55 - Cheshunt/North Pit Alluvium Groundwater EC Trends 2016 – 2020

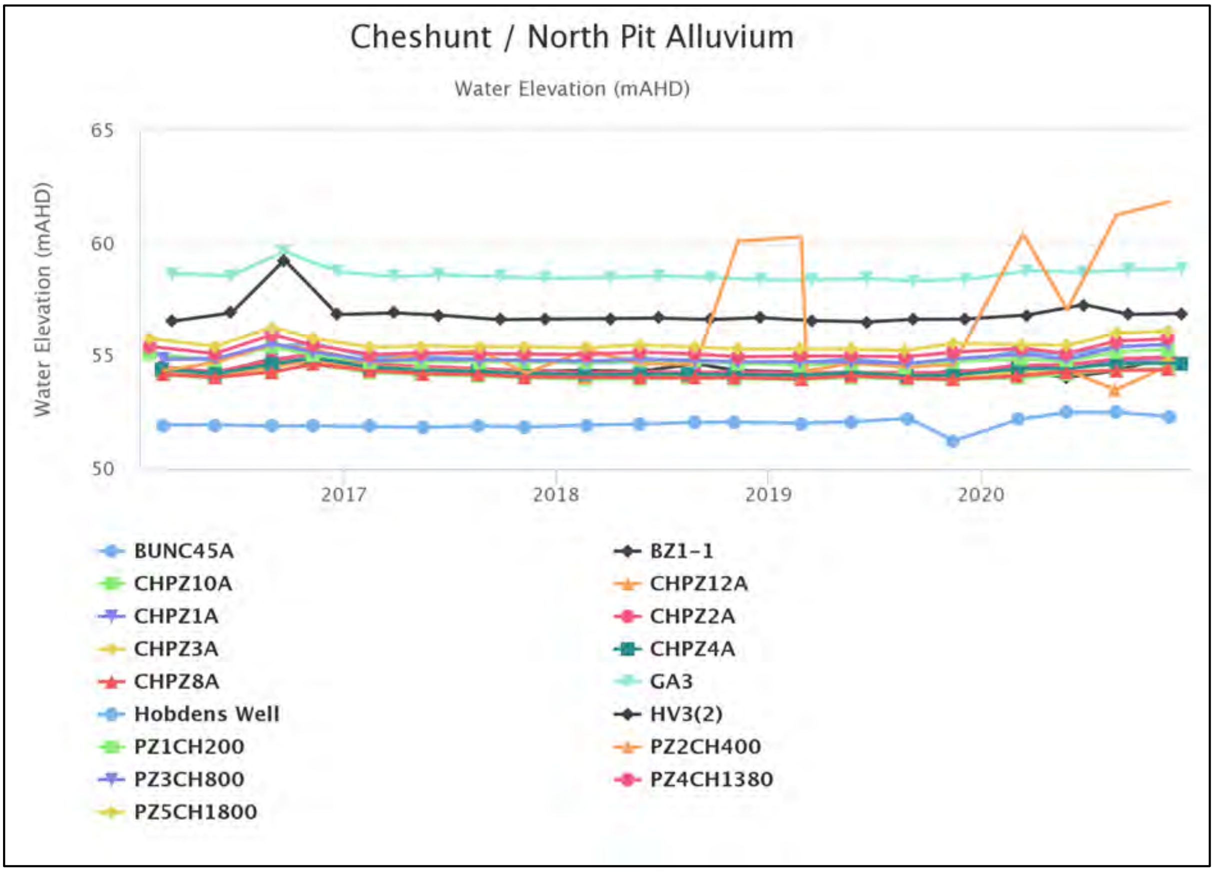

Figure 56 - Cheshunt/North Pit Alluvium Groundwater SWL Trends 2016 – 2020

7.5.3.7 Cheshunt Interburden

Groundwater monitoring in the Cheshunt Interburden area was undertaken at three sites during 2020, with 12 samples collected during the reporting period. The EC, pH and SWL trends for 2016 to 2020 are shown in **Figure 57** to **Figure 59**. Trigger tracking results are listed in **Table 47**.

Table 47 - Cheshunt Interburden Groundwater 2020 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken In Response
BZ3-1	3/03/2020	pH	First exceedance - Watching brief established*
BZ3-1	27/05/2020	pH	Second exceedance - Watching brief established*
BZ3-1	19/08/2020	pH	Third exceedance. Investigation commenced. Bore BZ3-1 intersects the Interburden, and recorded a trigger exceedance with the trigger level of 7.7 exceeded in 4 consecutive readings, Q4 2019 and Q1, Q2 and Q3 2020. This trigger exceedance is attributable to mining affect. As, the trigger exceedance is part of a medium term increasing pH trend since 2013 associated with a draw down in water level trend over the same period, This affect is associated with mining induced depressurisation pH peaked at 8.1 in Q4 2019 and followed a decreasing trend during 2020, with the Q4 reading returning to 7.0, concordant with increased rainfall and stabilised water level BZ3-1 in 2020
BZ8-2	27/05/2020	pH	First exceedance - Watching brief established*

* Watching Brief established pending outcomes of subsequent monitoring events. No specific actions required.

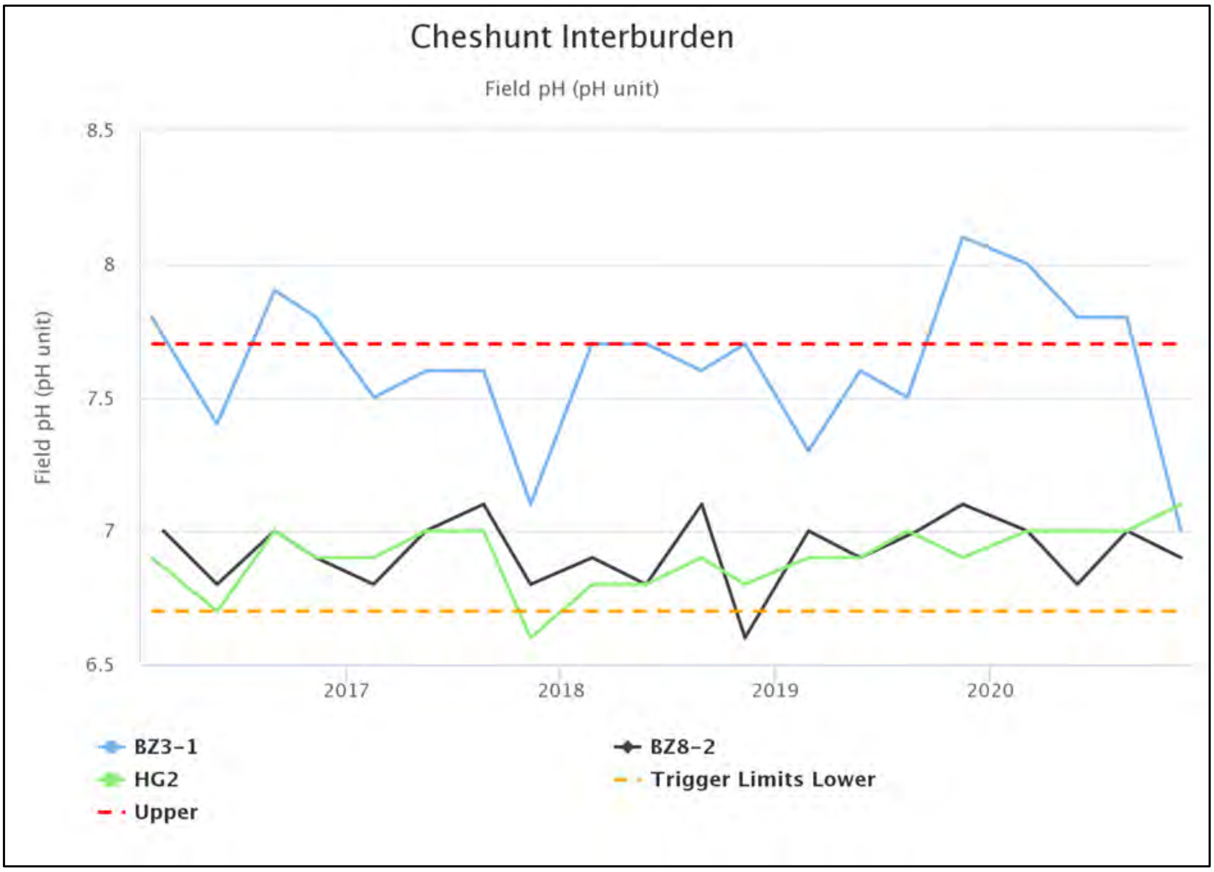

Figure 57 - Cheshunt Interburden Groundwater pH Trends 2016 – 2020

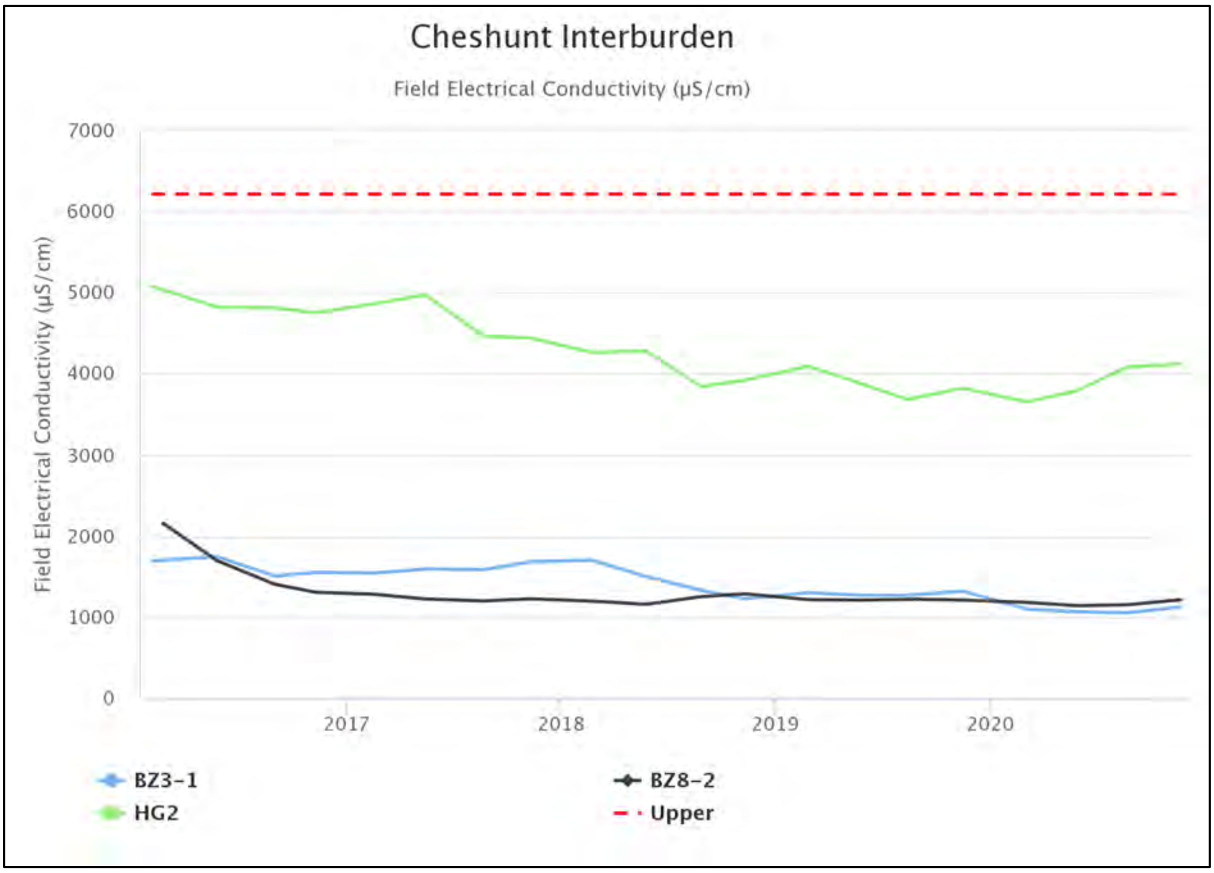

Figure 58 - Cheshunt Interburden Groundwater EC Trends 2016 – 2020

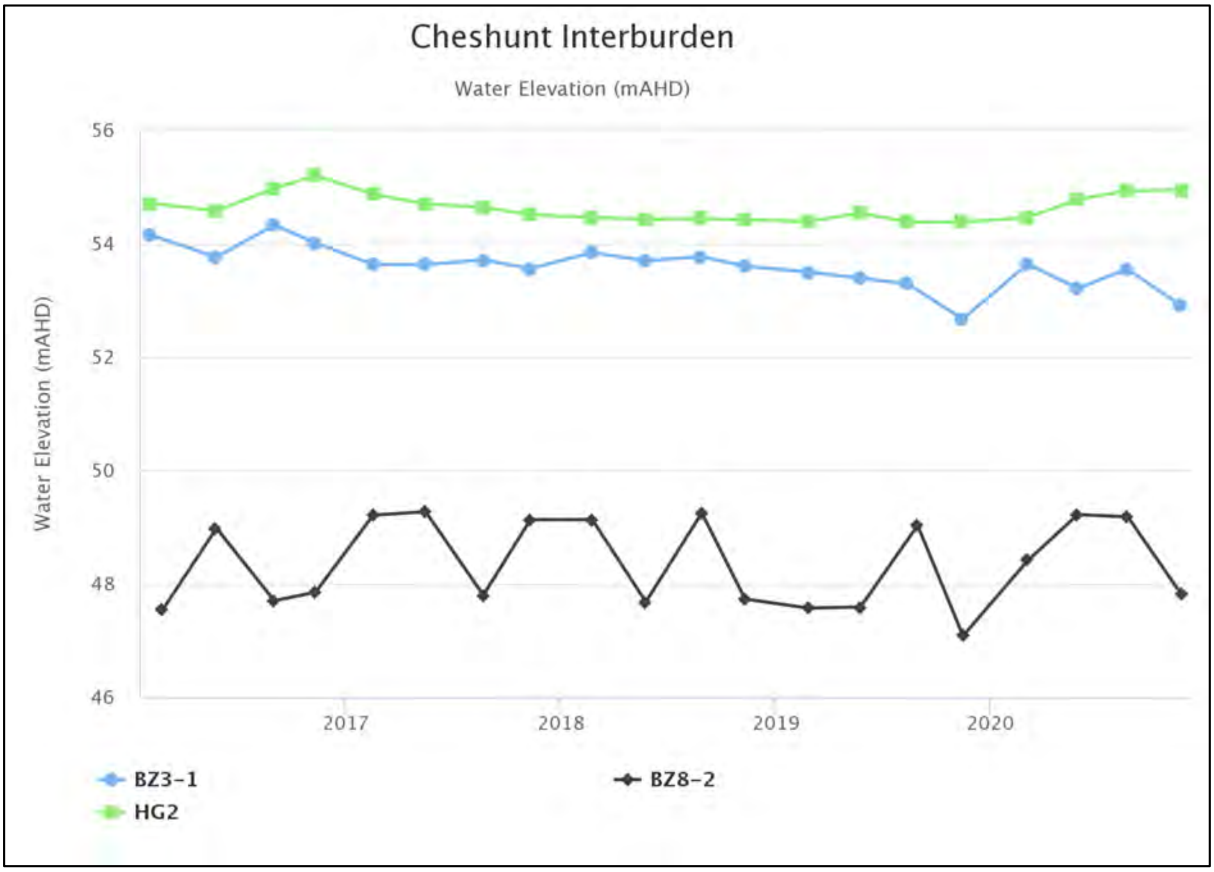

Figure 59 - Cheshunt Interburden Groundwater SWL Trends 2016 – 2020

7.5.3.8 Cheshunt Mt Arthur

Groundwater monitoring in the Cheshunt Mt Arthur area was undertaken at nine sites during 2020. A total of 34 samples were collected during the reporting period. The pH, EC and SWL trends for 2016 to 2020 are shown in **Figure 60** to **Figure 62**. Monitoring results were generally consistent with historical trends. Trigger tracking results are listed in **Table 48**.

Table 48 - Cheshunt Mt Arthur Groundwater 2020 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken In Response
BZ2A(1)	3/03/2020	pH	First exceedance - Watching brief established*
BZ3-3	3/03/2020	pH	First exceedance - Watching brief*
BZ2A(1)	27/05/2020	pH	Second exceedance - Watching brief*
BZ3-3	27/05/2020	pH	Second exceedance - Watching brief*
BZ4A(2)	27/05/2020	pH	First exceedance - Watching brief established*
HG2A	27/05/2020	EC	First exceedance - Watching brief established*
CHPZ3D	18/08/2020	pH	First exceedance - Watching brief established*
BZ2A(1)	19/08/2020	pH	Third exceedance. Investigation commenced. Bores BZ2A(1), BZ3-3, BZ4a and CHPZ12D intersect the Mt Arthur Seam and are positioned between Cheshunt Pit and the Hunter River. The trigger values range for the bores is 6.5 to 7.6, while the full value range within the historical data for the bores is 6.0 to 8.2. The 2020 readings for the three bores are considered consistent with historical recorded concentrations, with no adverse impacts identified
BZ4A(2)	19/08/2020	pH	Second exceedance - Watching brief*
BZ3-3	19/11/2020	pH	Third exceedance. Investigation commenced. Bores BZ2A(1), BZ3-3, BZ4a and CHPZ12D intersect the Mt Arthur Seam and are positioned between Cheshunt Pit and the Hunter River. The trigger values range for the bores is 6.5 to 7.6, while the full value range within the historical data for the bores is 6.0 to 8.2. The 2020 readings for the three bores are considered consistent with historical recorded concentrations, with no adverse impacts identified
BZ2A(1)	19/11/2020	pH	Fourth exceedance. Investigation commenced. Bores BZ2A(1), BZ3-3, BZ4a and CHPZ12D intersect the Mt Arthur Seam and are positioned between Cheshunt Pit and the Hunter River. The trigger values range for the bores is 6.5 to 7.6, while the full value range within the historical data for the bores is 6.0 to 8.2. The 2020 readings for the three bores are considered consistent with historical recorded concentrations, with no adverse impacts identified
BZ4A(2)	19/11/2020	pH	Third exceedance. Investigation commenced. Bore BZ4a(2) intersects the Mt Arthur Seam, and recorded a trigger exceedance in 2020 with pH recording the lower pH trigger level of 6.5 throughout 2020, with the lowest reading of 6.2 recorded in Q3. The pH results recorded are consistent with results recorded in this bore since previously impacted by depressurisation in 2011

* Watching Brief established pending outcomes of subsequent monitoring events. No specific actions required.

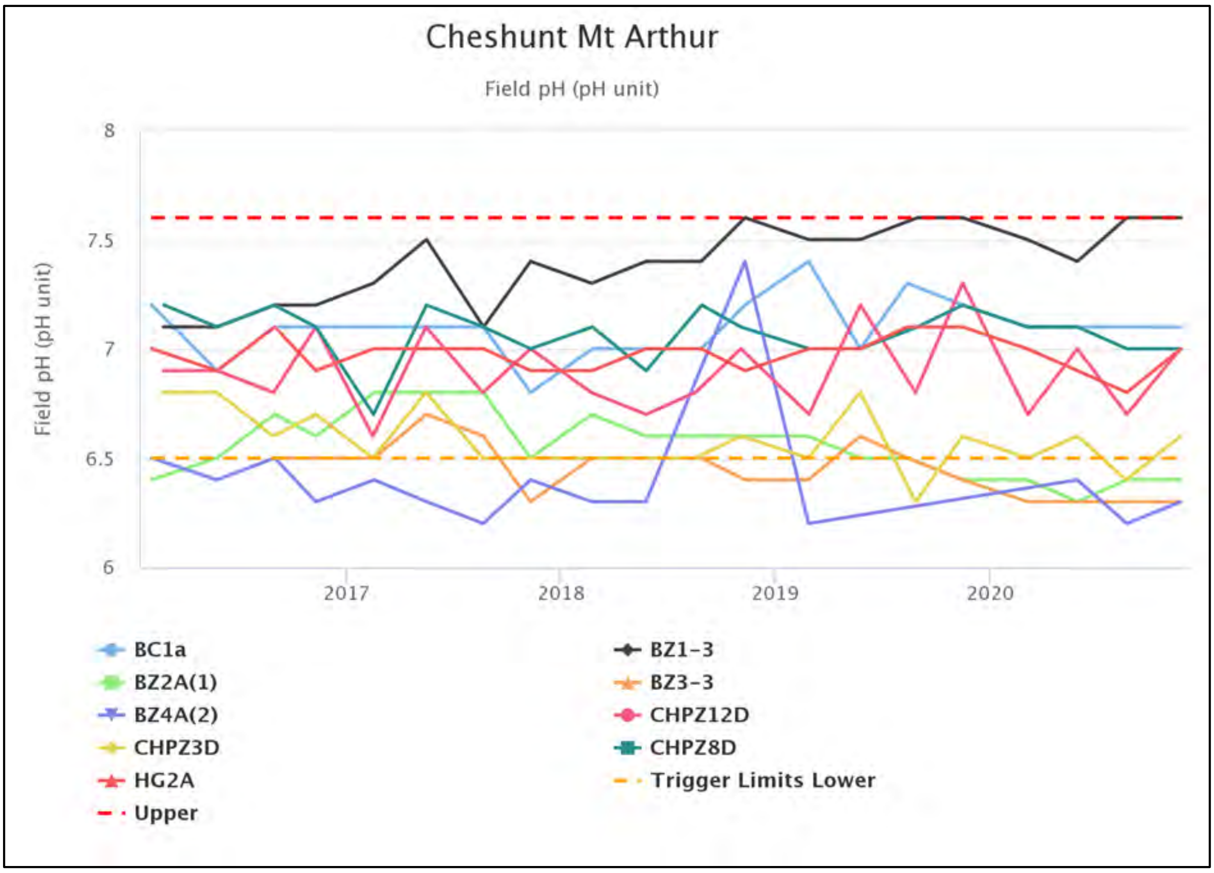

Figure 60 - Cheshunt Mt Arthur Groundwater pH Trends 2016 – 2020

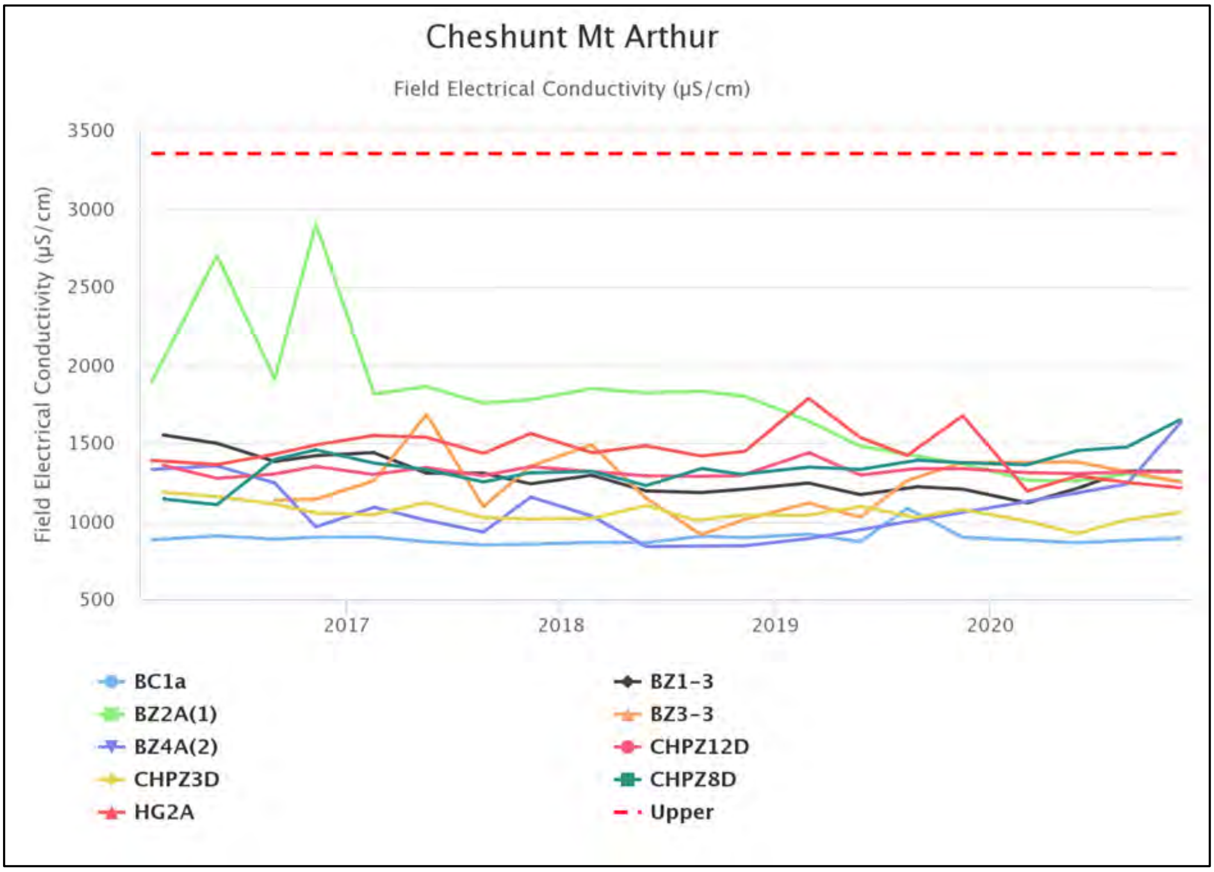

Figure 61 - Cheshunt Mt Arthur Groundwater EC Trends 2016 – 2020

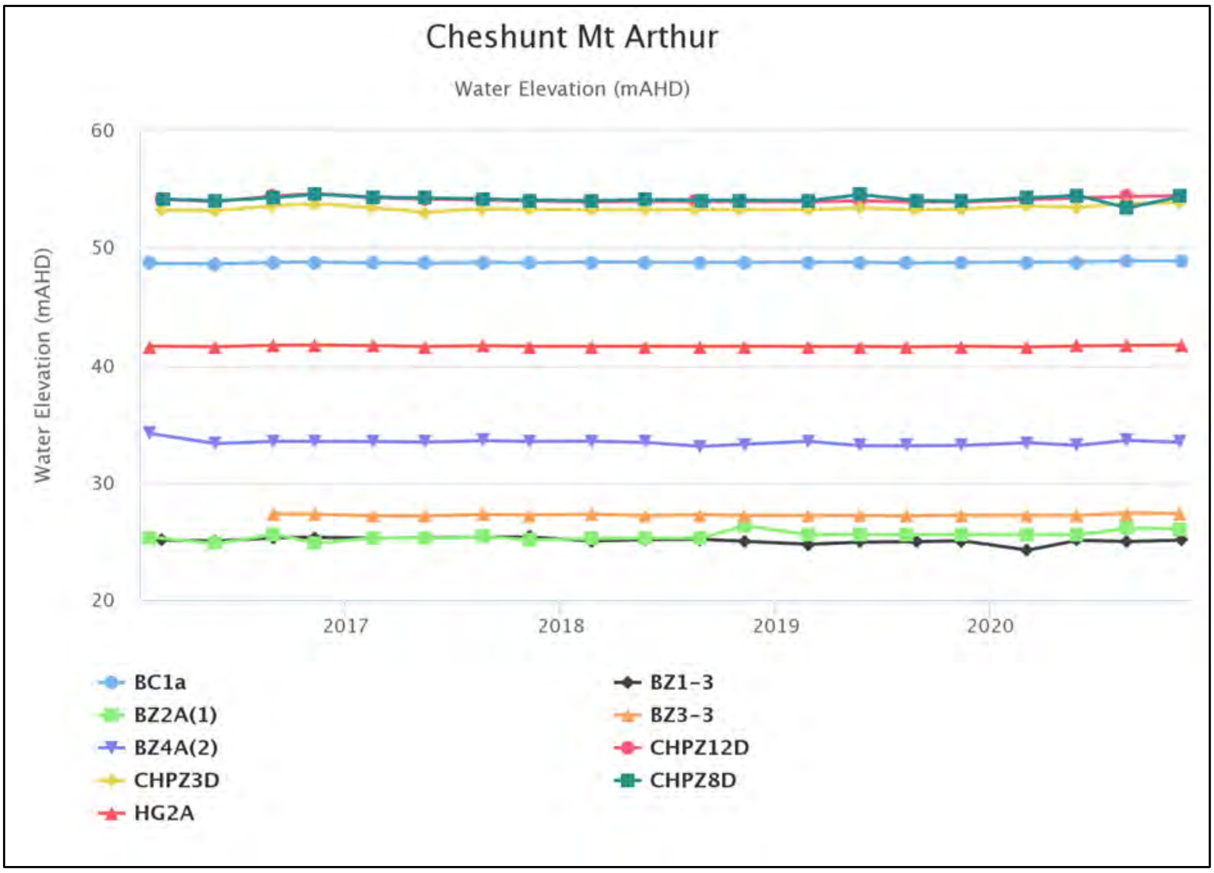

Figure 62 - Cheshunt Mt Arthur Groundwater SWL Trends 2016 – 2020

7.5.3.9 Cheshunt Piercefield

Groundwater monitoring in the Cheshunt Piercefield area was undertaken from one site during 2020; a total of four samples were collected. The pH, EC and SWL trends for 2016 to 2020 are shown in **Figure 63** to **Figure 65**.

Water quality results were generally consistent with historical trends. There were no trigger exceedances recorded in 2020.

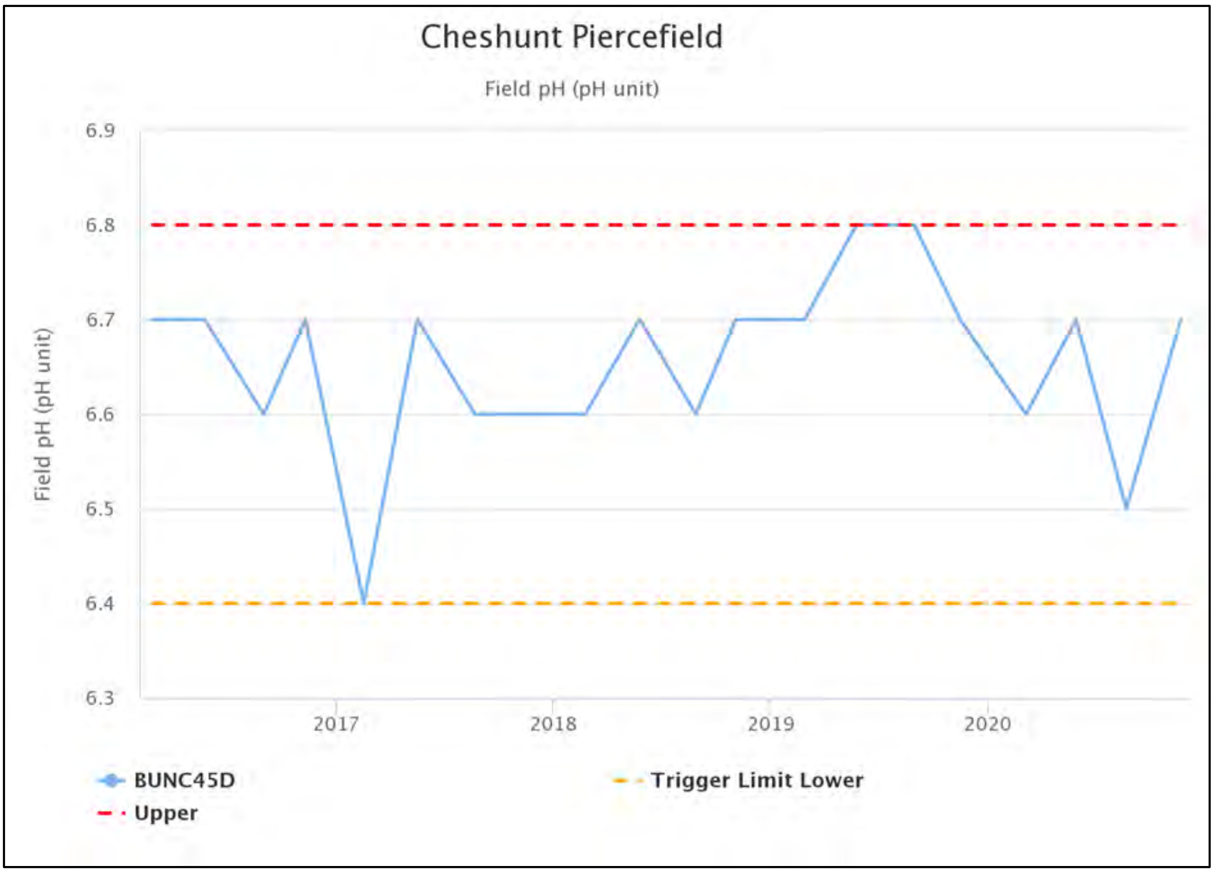

Figure 63 - Cheshunt Piercefield Groundwater pH Trends 2016 – 2020

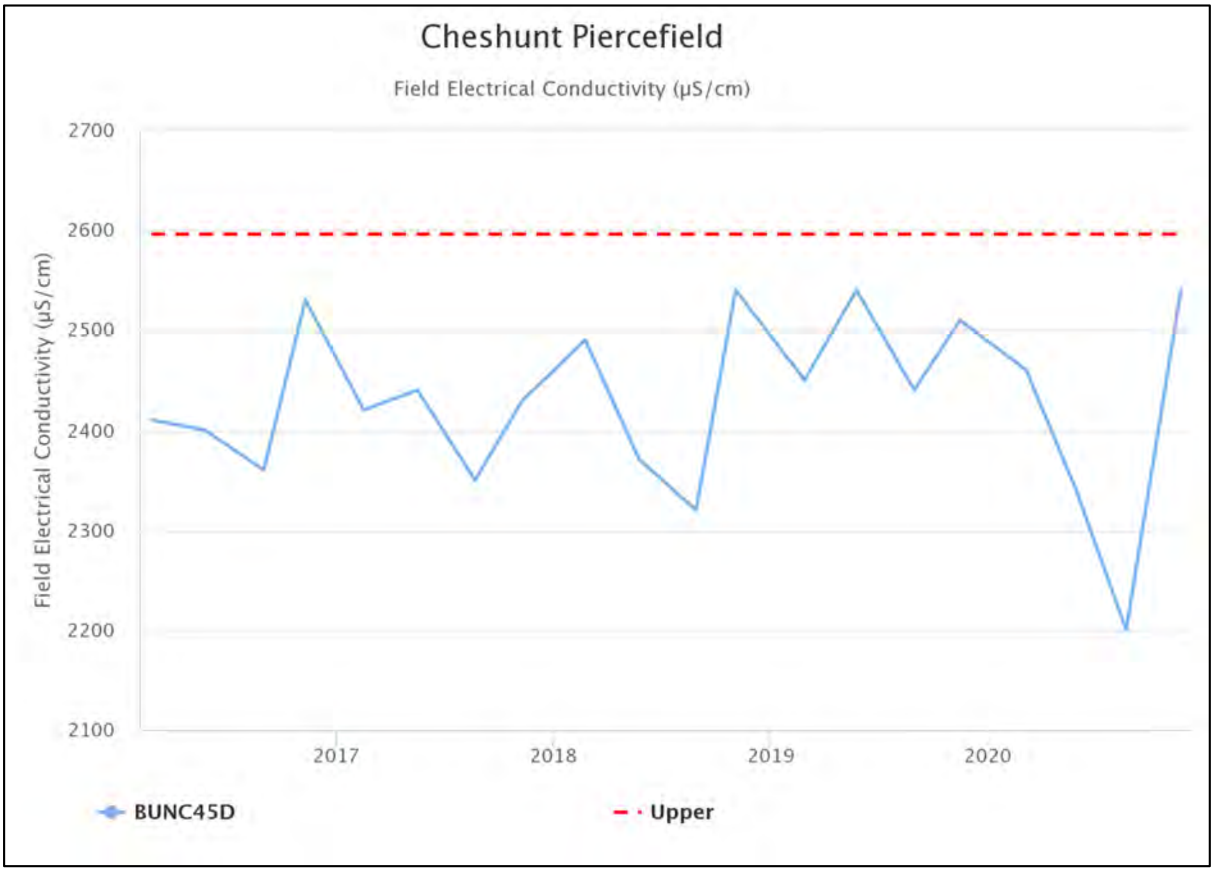

Figure 64 - Cheshunt Piercefield Groundwater EC Trends 2016 – 2020

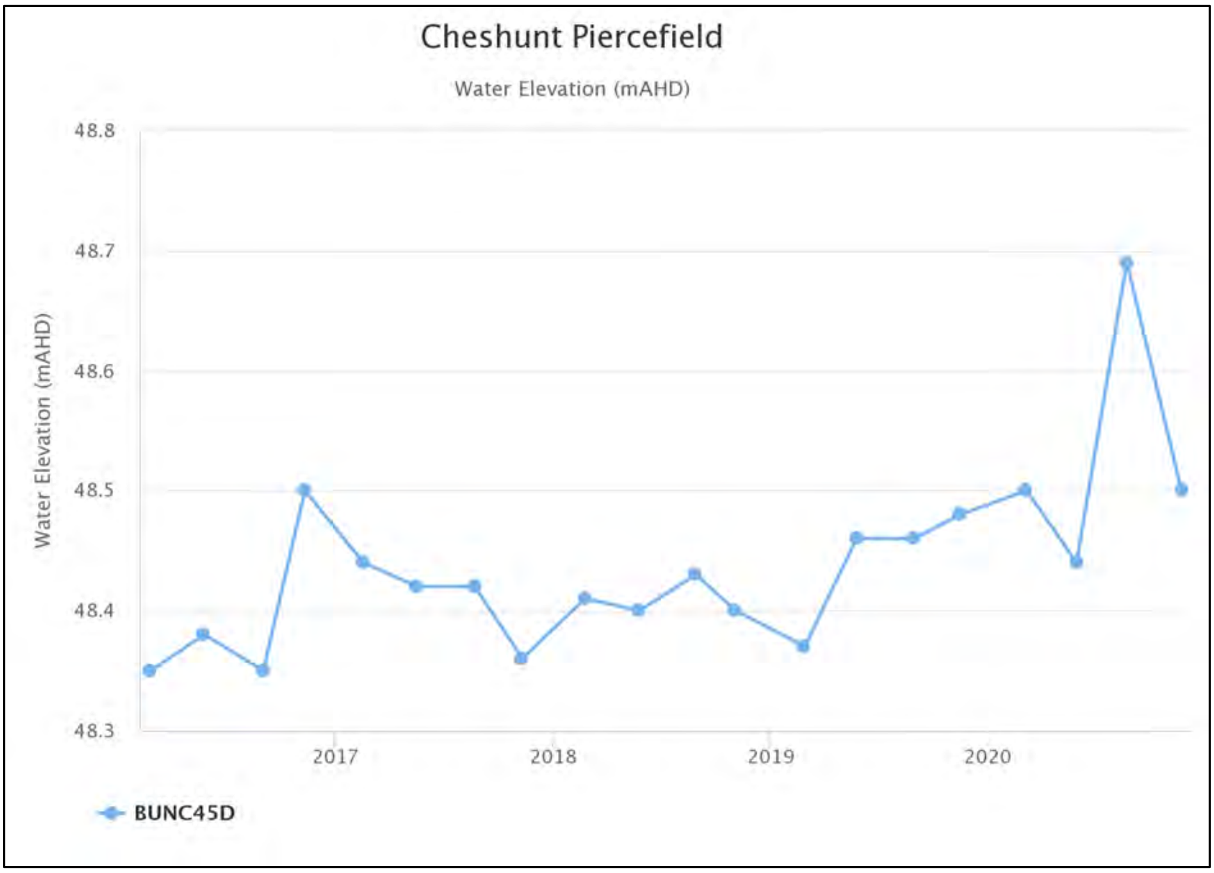

Figure 65 - Cheshunt Piercefield Groundwater SWL Trends 2016 – 2020

7.5.3.10 Lemington South Alluvium

Groundwater monitoring in the Lemington South Alluvium area was undertaken at three sites during 2020. A total of 8 samples were collected during the reporting period with water level measured on a monthly basis. Bore C919 (ALL) had insufficient water for sampling during 2020.

The pH, EC and SWL trends for 2016 to 2020 are shown in **Figure 66** to **Figure 68**. Trigger limits are listed in **Table 49**.

Table 49 - Lemington South Alluvium Groundwater 2020 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken In Response
Appleyard Farm	28/02/2020	pH	First exceedance - Watching brief established*
PB01(ALL)	28/02/2020	EC	First exceedance - Watching brief established*
Appleyard Farm	6/05/2020	pH	Second exceedance - Watching brief established*
PB01(ALL)	7/08/2020	EC	Second exceedance - Watching brief established*
Appleyard Farm	7/08/2020	pH	Third exceedance. Investigation commenced. The Appleyard Farm bore recorded pH below 5th percentile of recorded values trigger level of 6.6 through all four Quarters of 2020. The recorded decrease in pH can be associated with increased rainfall/brook flow recharge occurring in 2020 due to the close level of connectivity with Wollobi Brook, as the decrease in pH is correlated with increasing CRD and return to flowing conditions in Wollombi Brook. Flow in Wollombi Brook in rainfall dependant. pH in Wollombi Brook is not measured;

Location	Date	Trigger Limit	Action Taken In Response
			however "normally, pure rainwater has a pH of 5.3" EPA SA, 2004.
Appleyard Farm	17/11/2020	pH	Fourth exceedance. The Appleyard Farm bore recorded pH below 5th percentile of recorded values trigger level of 6.6 through all four Quarters of 2020. The recorded decrease in pH can be associated with increased rainfall/brook flow recharge occurring in 2020 due to the close level of connectivity with Wollobi Brook, as the decrease in pH is correlated with increasing CRD and return to flowing conditions in Wollombi Brook. Flow in Wollombi Brook in rainfall dependant. pH in Wollombi Brook is not measured; however "normally, pure rainwater has a pH of 5.3" EPA SA, 2004.

* Watching Brief established pending outcomes of subsequent monitoring events. No specific actions required.

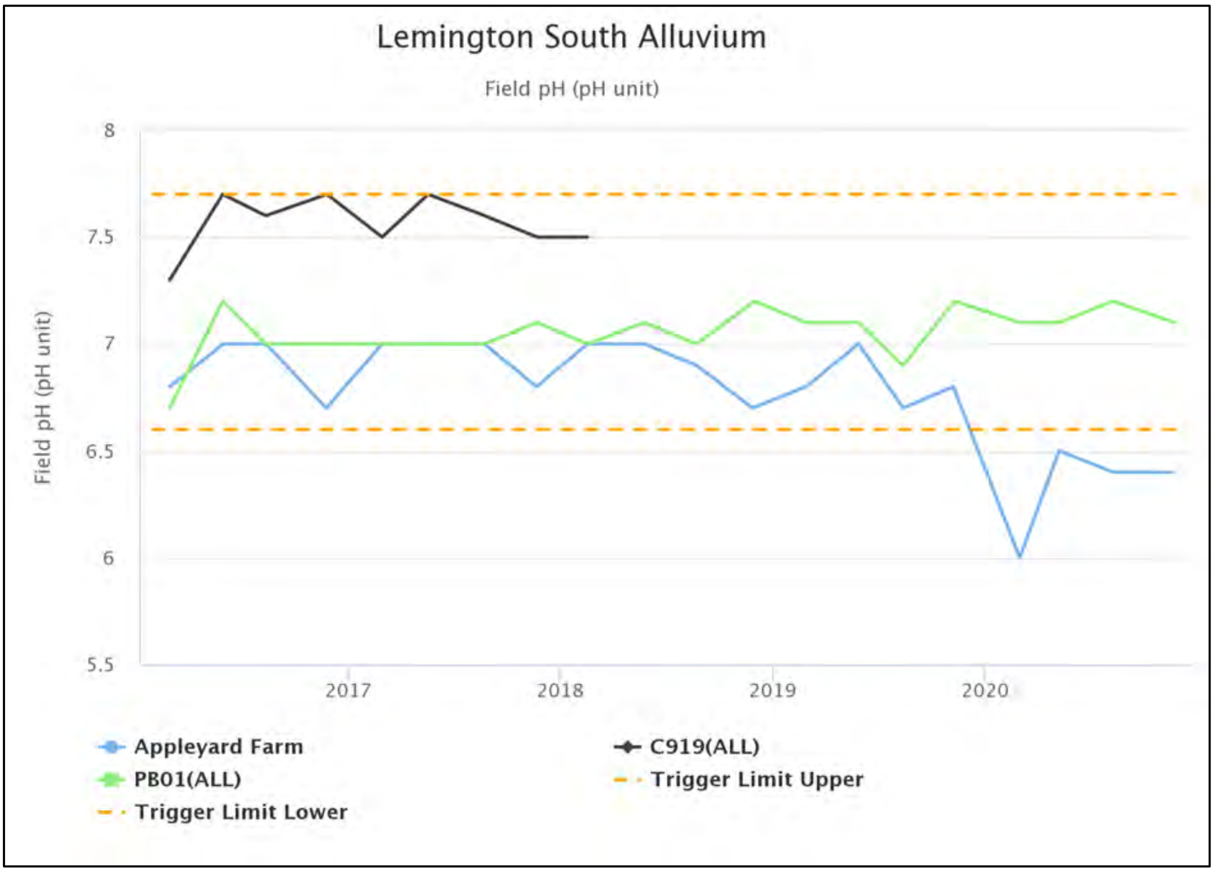

Figure 66 - Lemington South Alluvium Groundwater pH Trends 2016 – 2020

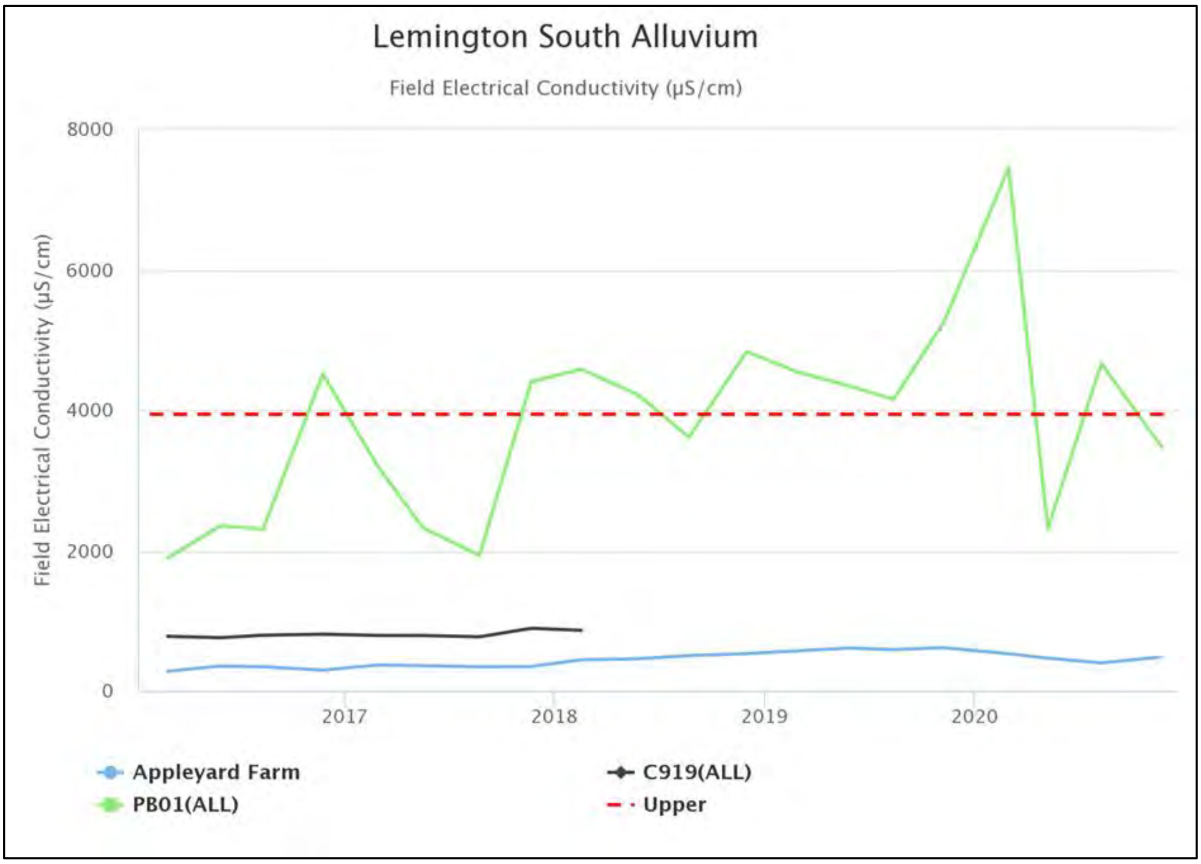

Figure 67 - Lemington South Alluvium Groundwater EC Trends 2016 – 2020

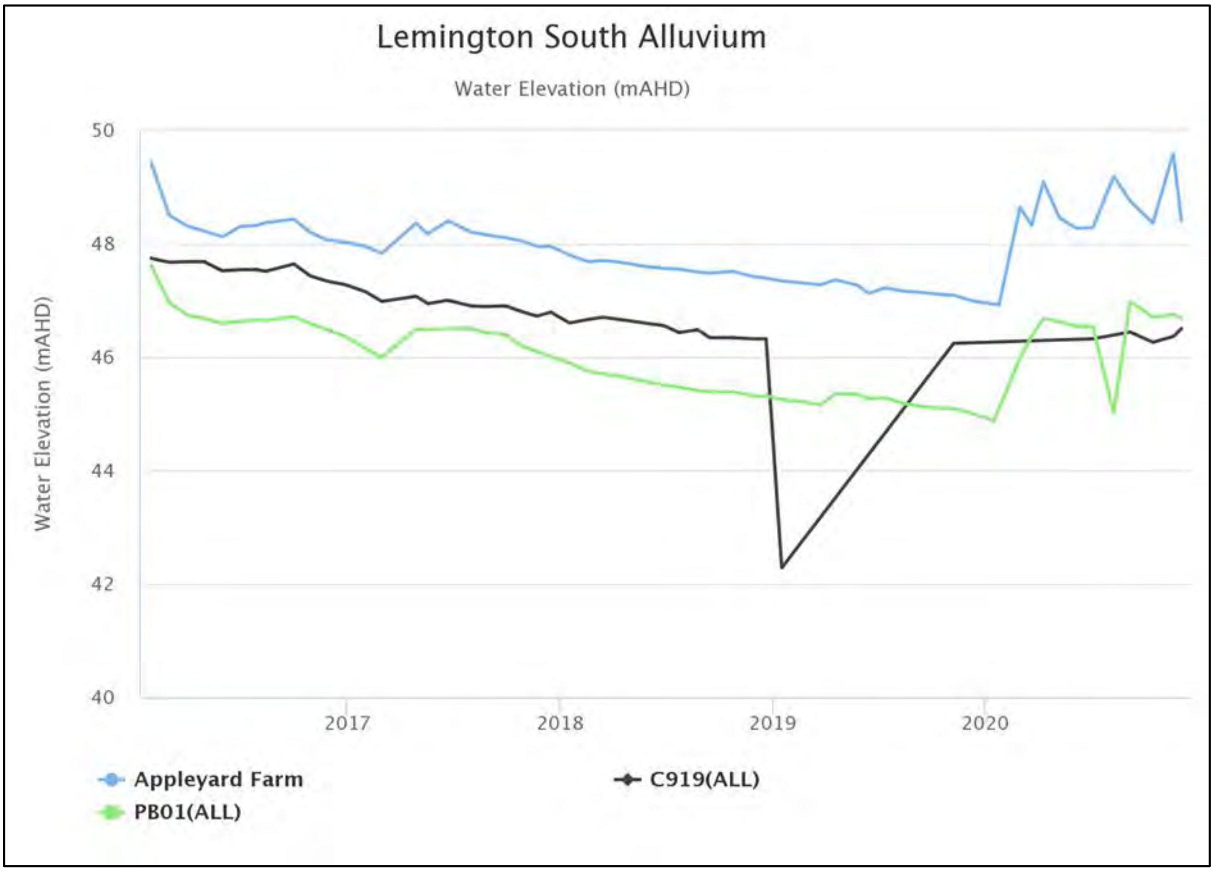

Figure 68 - Lemington South Alluvium Groundwater SWL Trends 2016 – 2020

7.5.3.11 Lemington South Arrowfield

Groundwater monitoring in the Lemington South Arrowfield area was undertaken at four sites during 2020. A total of 7 samples were collected during the reporting period. The pH, EC and SWL trends for 2016 to 2020 are shown in **Figure 69** to **Figure 71**. Results were generally consistent with historical trends with the exception of an exceedance of internal EC trigger for D612(AFS) as listed in **Table 50**.

Table 50 - Lemington South Arrowfield Groundwater 2020 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken In Response
D612(AFS)	6/5/2020	EC	First exceedance. Watching brief*.

* Watching Brief established pending outcomes of subsequent monitoring events. No specific actions required.

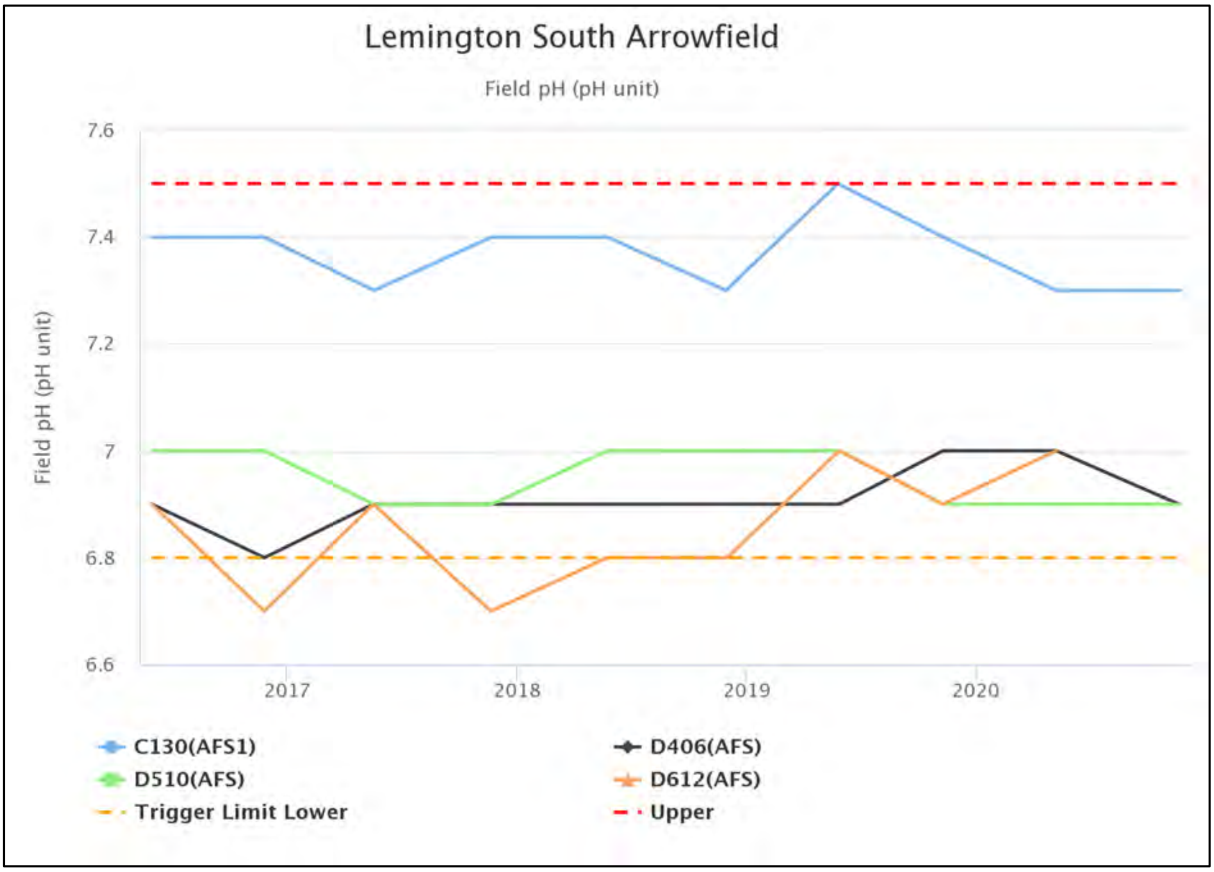

Figure 69 - Lemington South Arrowfield Groundwater pH Trends 2016 – 2020

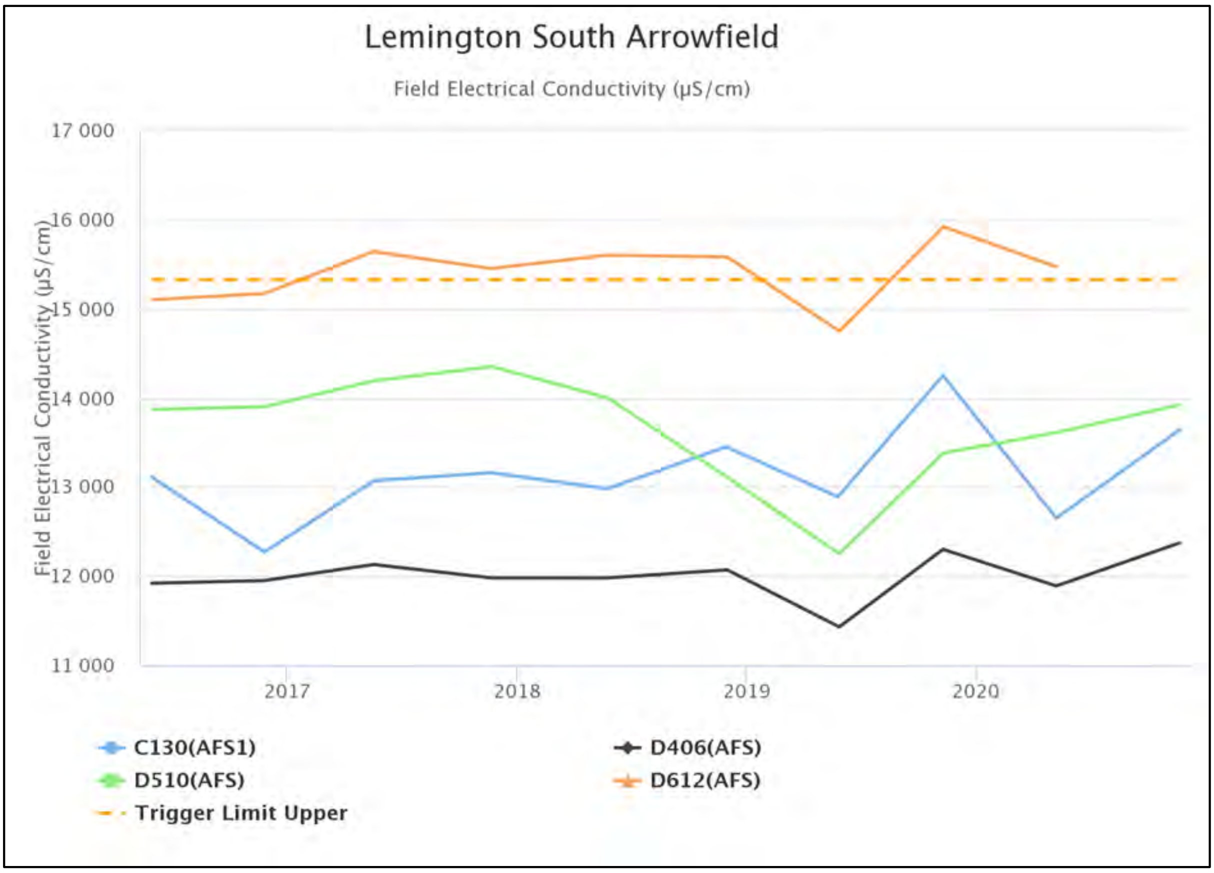

Figure 70 - Lemington South Arrowfield Groundwater EC Trends 2016 – 2020

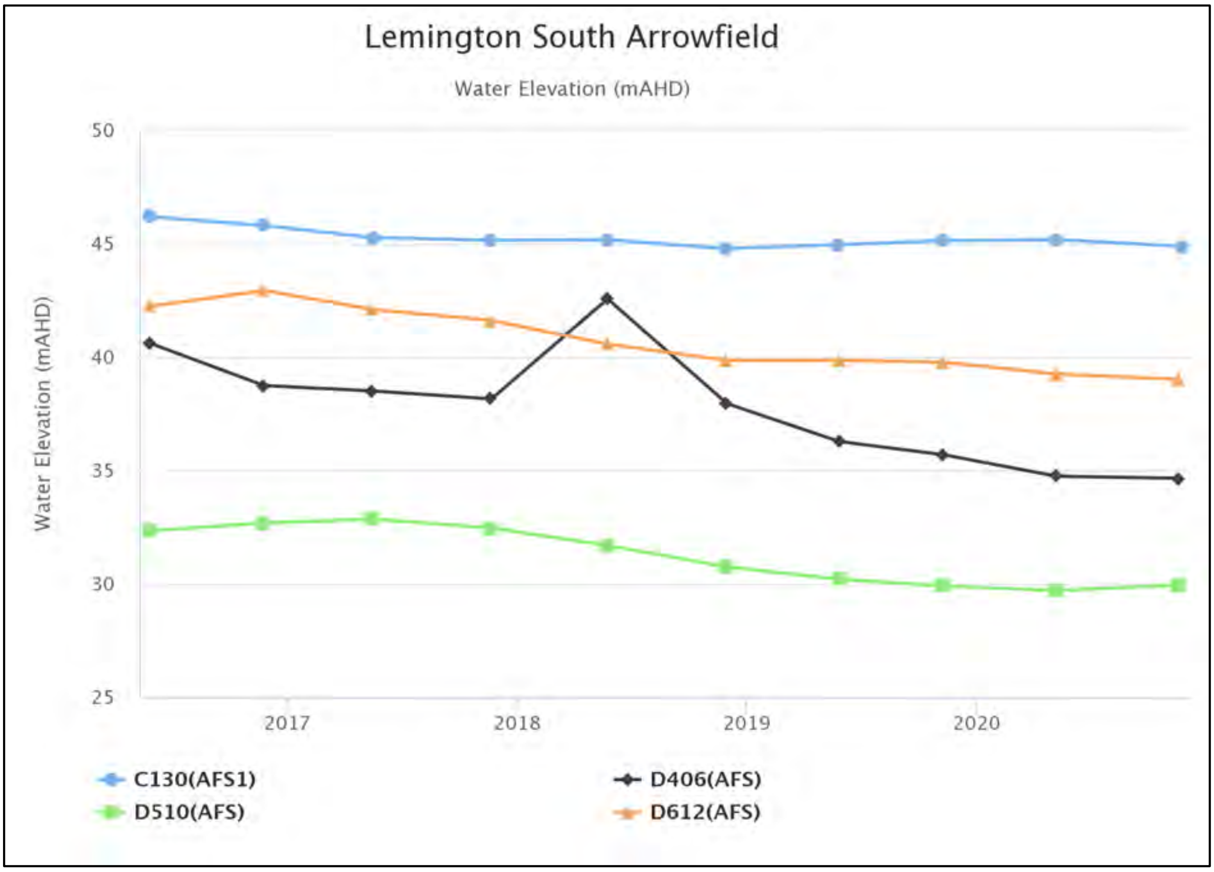

Figure 71 - Lemington South Arrowfield Groundwater SWL Trends 2016 – 2020

7.5.3.12 Lemington South Bowfield

Groundwater monitoring in the Lemington South Bowfield area was undertaken at 16 sites during 2020. A total of 30 samples were collected during the reporting period. The pH, EC and SWL trends for 2016 to 2020 are shown in **Figure 72** to **Figure 74**. Results were generally considered to be consistent with historical trends with the exception of B631(BFS) and C630(BFS) which exceeded internal triggers as listed in **Table 51**. Note that C122 (BFS) has been excluded from the graphs as there was insufficient water for sampling during the reporting period.

Table 51 - Lemington South Bowfield Groundwater 2020 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken In Response
B631(BFS)	6/05/2020	pH	First exceedance Watching brief*
B631(BFS)	6/05/2020	EC	First exceedance Watching brief*
C630(BFS)	6/05/2020	pH	First exceedance Watching brief*
C630(BFS)	19/11/2020	pH	Second exceedance Watching brief*
B631(BFS)	19/11/2020	EC	Second exceedance Watching brief*

* Watching Brief established pending outcomes of subsequent monitoring events. No specific actions required.

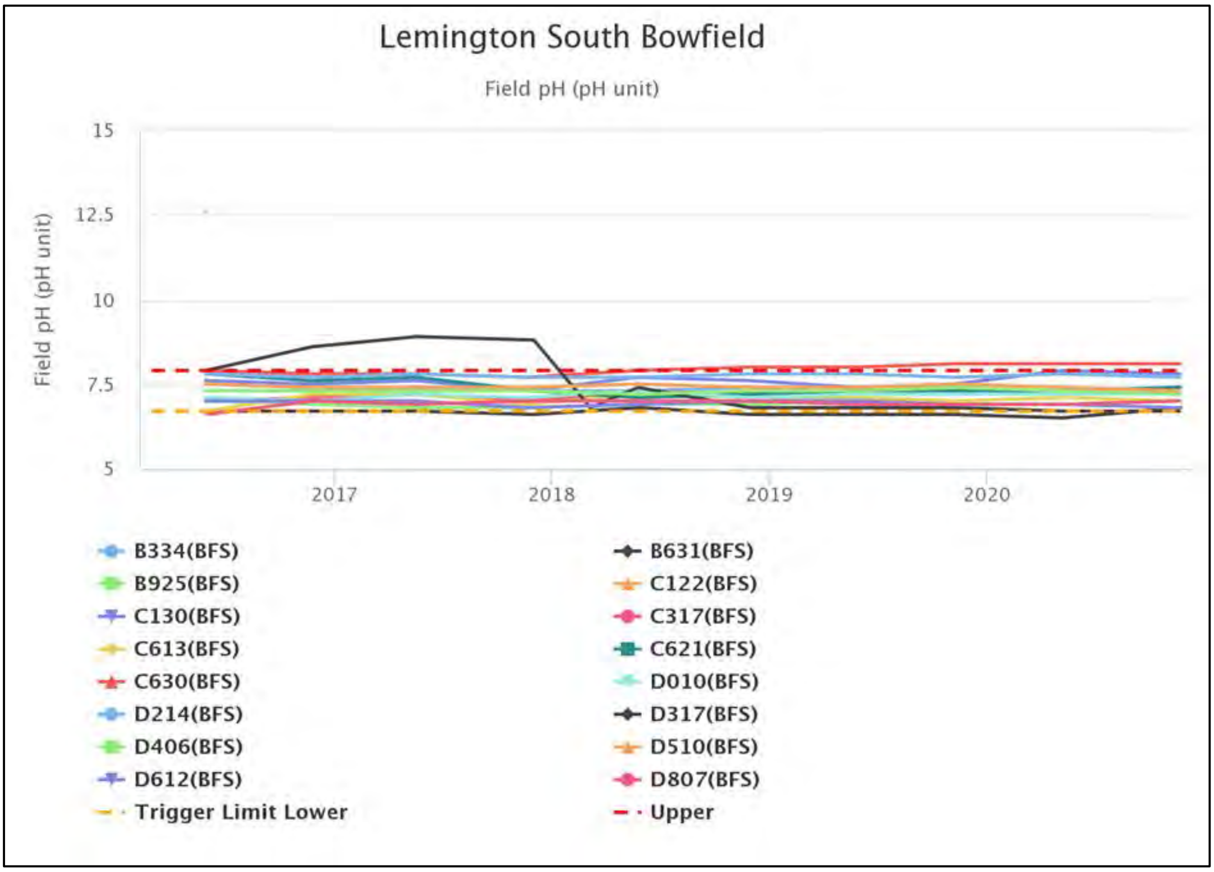

Figure 72 - Lemington South Bowfield Groundwater pH Trends 2016 – 2020

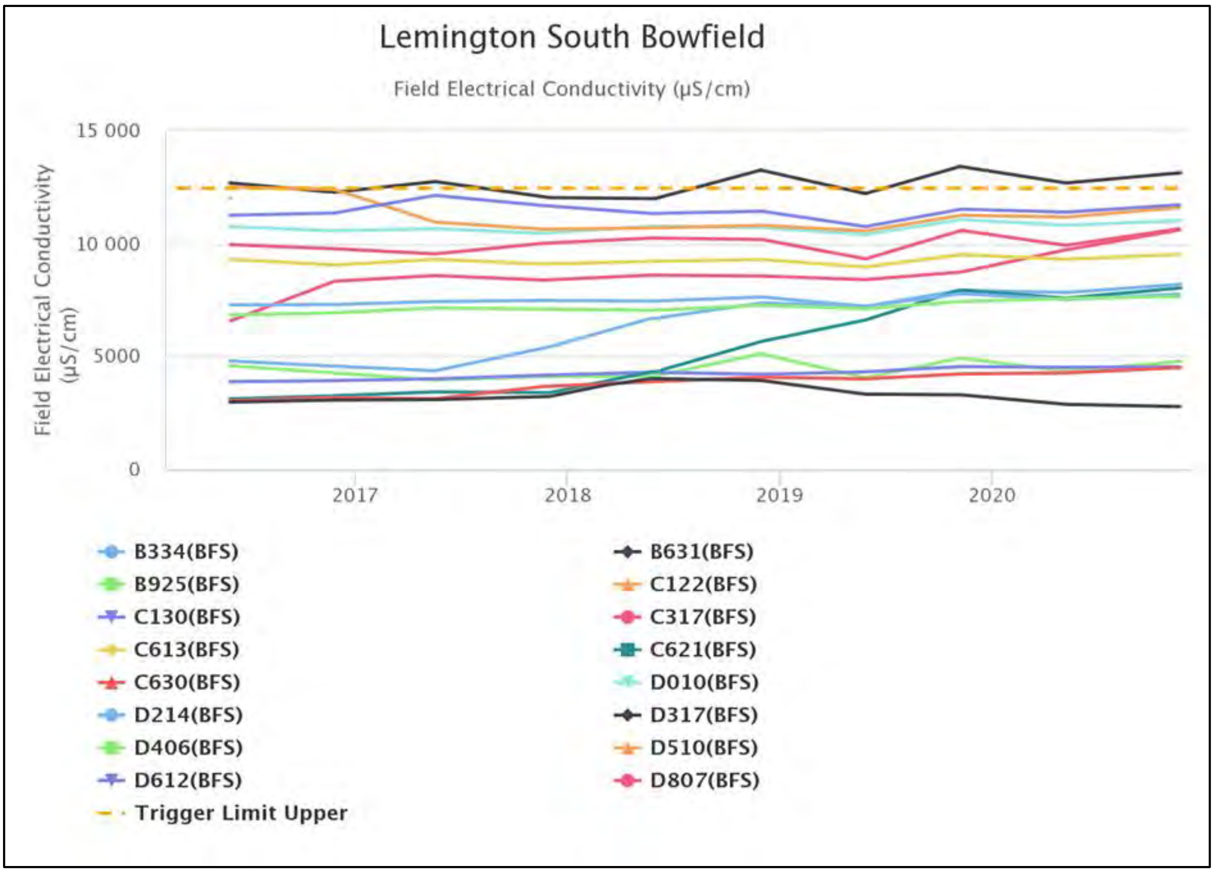

Figure 73 - Lemington South Bowfield Groundwater EC Trends 2016 – 2020

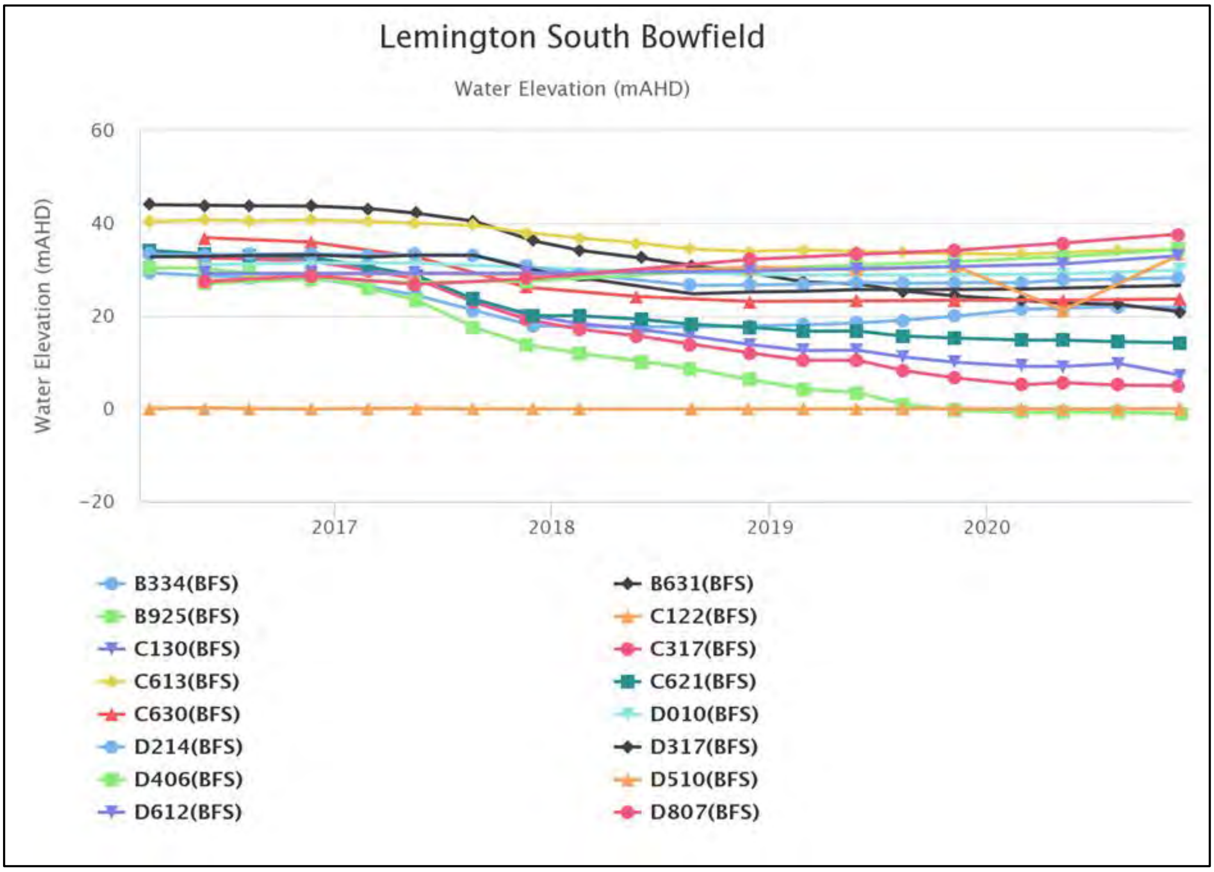

Figure 74 - Lemington South Bowfield Groundwater SWL Trends 2016 – 2020

7.5.3.13 Lemington South Interburden

Groundwater monitoring in the Lemington South Interburden area was undertaken at one site during 2020; a total of 12 samples were collected. The pH, EC and SWL trends for 2016 to 2020 are shown in **Figure 75** to **Figure 77**. EC has generally been trending upwards during since 2016. The groundwater level has been gradually declining since 2016. Internal triggers are listed in **Table 52.**

Table 52 - Lemington South Interburden Groundwater 2020 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken In Response
C130(ALL)	27/02/2020	EC	First exceedance. Watching brief
C130(ALL)	6/05/2020	EC	Second exceedance. Watching brief
C130(ALL)	7/08/2020	EC	Third exceedance. Investigation commenced. Bore C130(ALL) is located between Lemington South pit and the LUG Bore and intersects shallow weathered overburden to 17 m depth. Historical readings since 2000 show regular fluctuations of between 19,500 µS/cm and 24,200 µS/cm for EC. The rise in EC corresponds with a general decline in groundwater levels.

* Watching Brief established pending outcomes of subsequent monitoring events. No specific actions required.

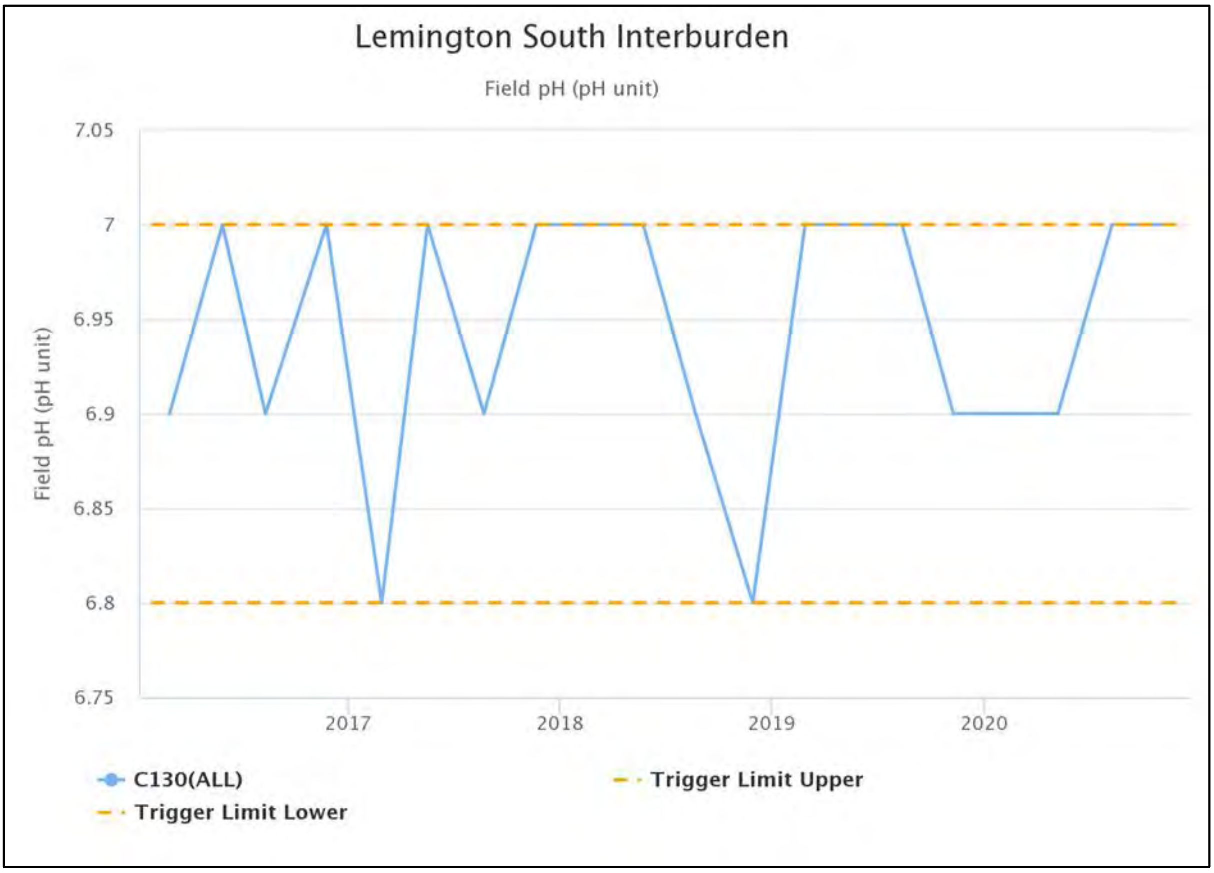

Figure 75 - Lemington South Interburden Groundwater pH Trends 2016 – 2020

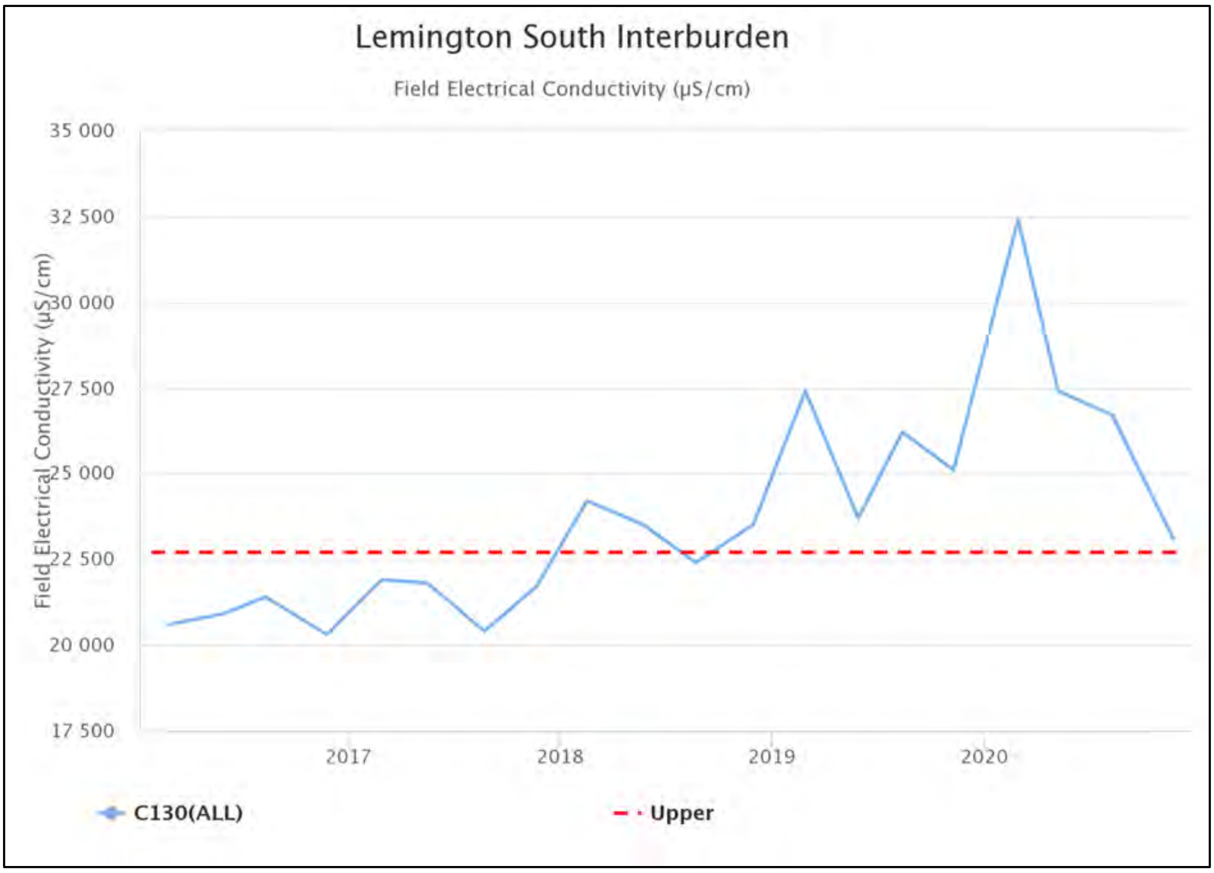

Figure 76 - Lemington South Interburden Groundwater EC Trends 2016 – 2020

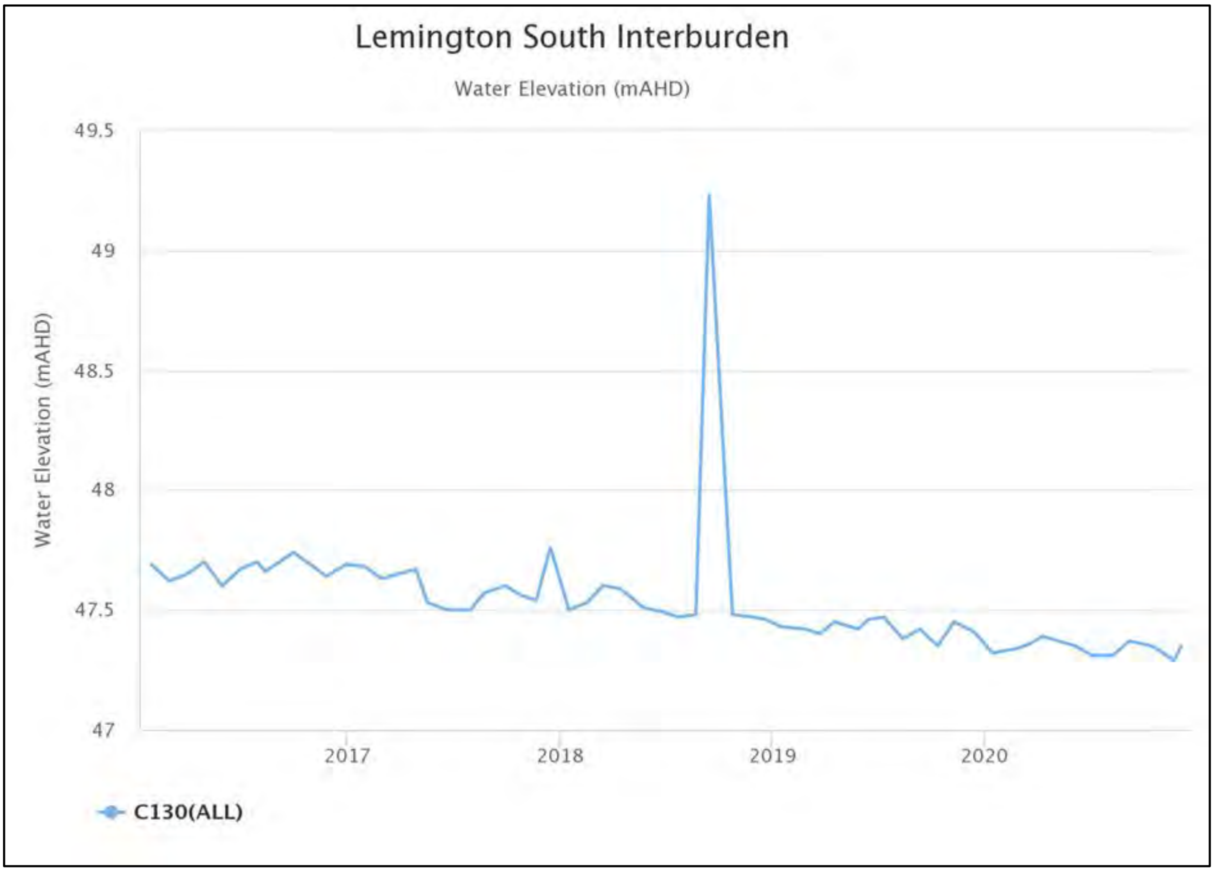

Figure 77 - Lemington South Interburden Groundwater SWL Trends 2016 – 2020

7.5.3.14 Lemington South Woodlands Hill

Groundwater monitoring in the Lemington South Interburden area was undertaken at seven sites during 2020; a total of 12 samples were collected. The pH, EC and SWL trends for 2016 to 2020 are shown in **Figure 78** to **Figure 80**. Internal triggers are listed in **Table 53.**

Table 53 - Lemington South Woodlands Hill Groundwater 2020 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken In Response
C130(WDH)	6/05/2020	EC	First exceedance. Watching brief.*
C317(WDH)	17/11/2020	pH	First exceedance. Watching brief.*
C130(WDH)	19/11/2020	EC	Second exceedance. Watching brief.*

* Watching Brief established pending outcomes of subsequent monitoring events. No specific actions required.

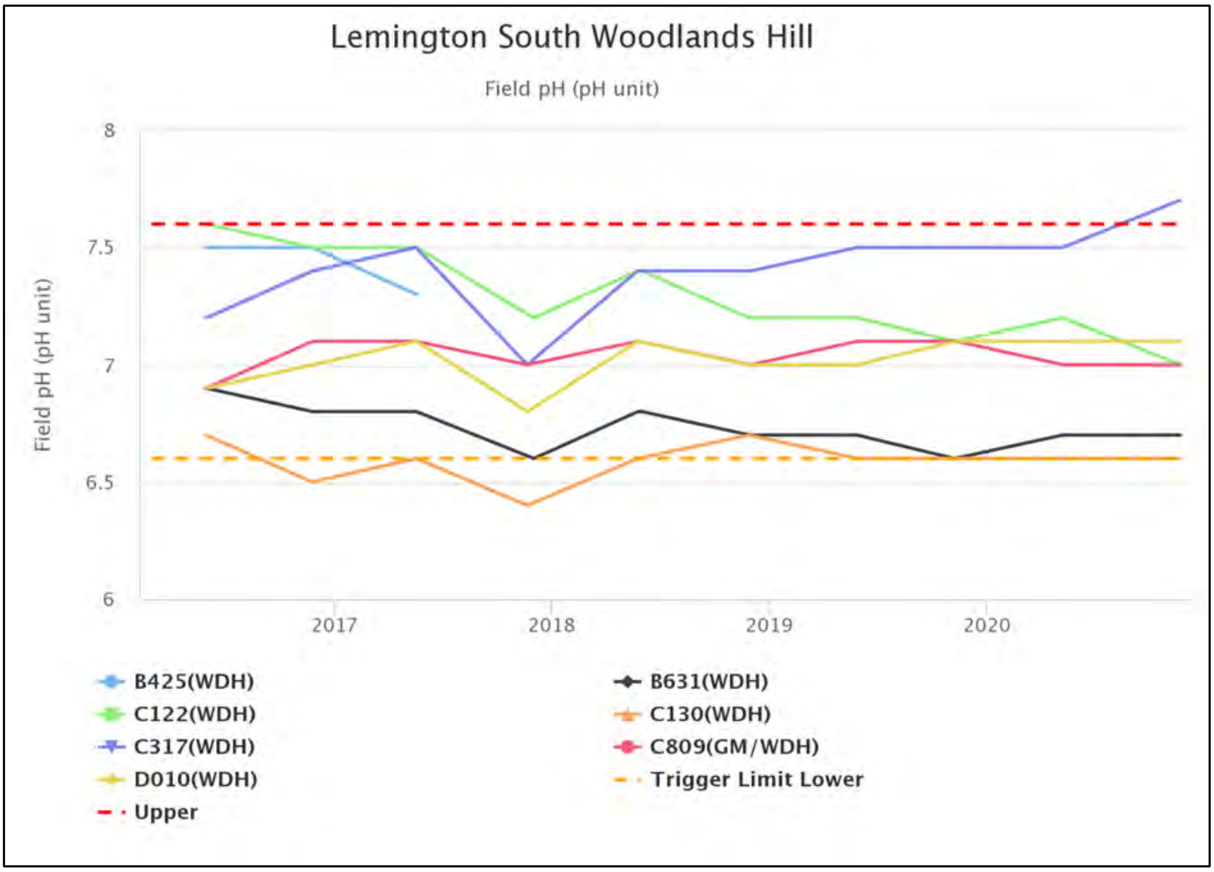

Figure 78 - Lemington South Woodlands Hill Groundwater pH Trends 2016 – 2020

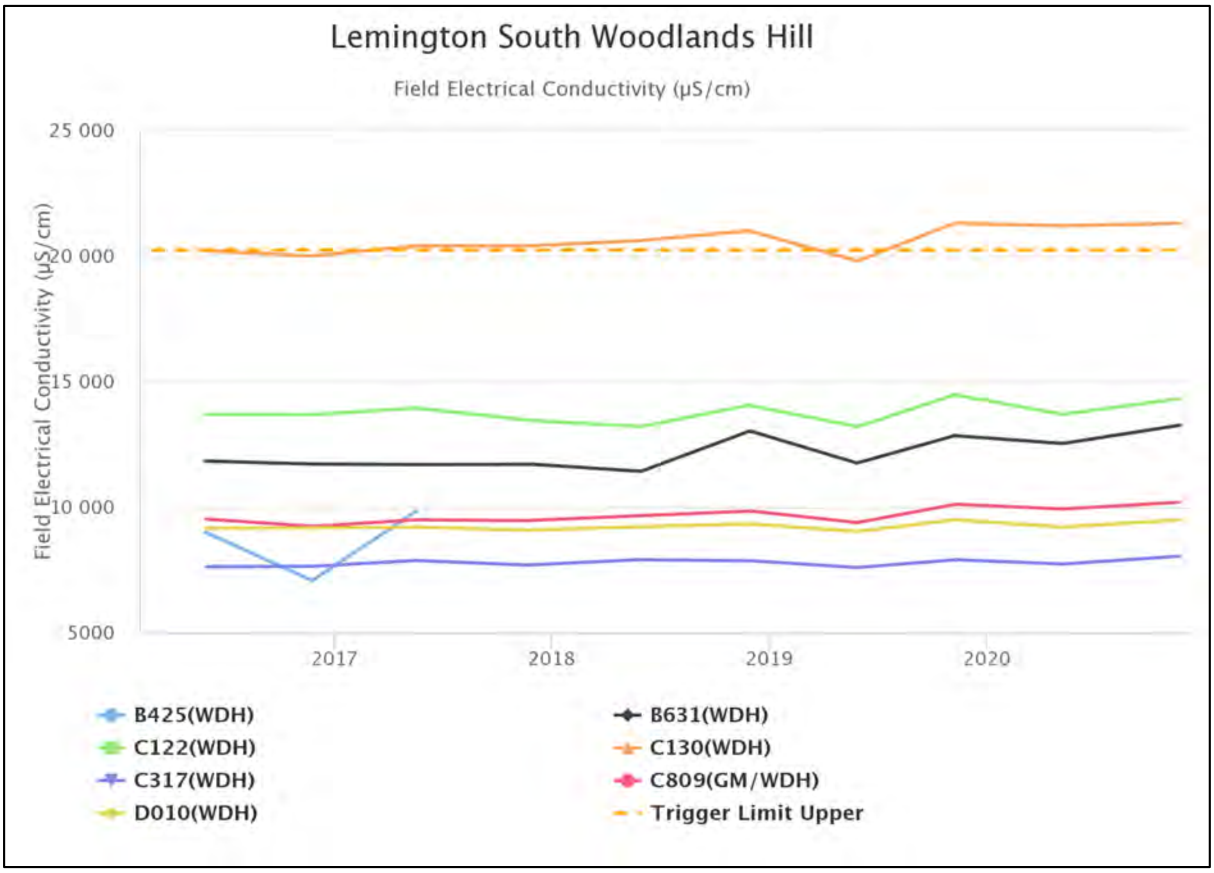

Figure 79 - Lemington South Woodlands Hill Groundwater EC Trends 2016 – 2020

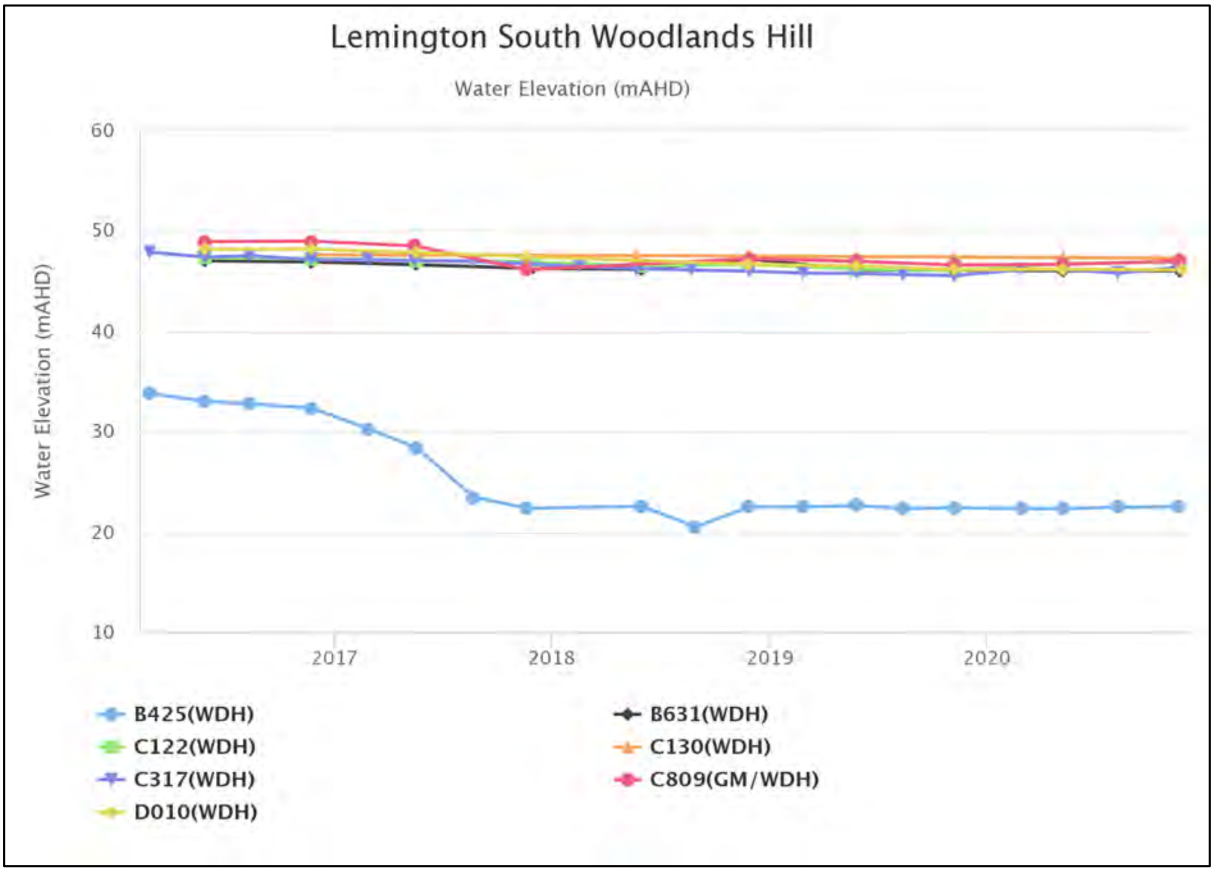

Figure 80 - Lemington South Woodlands Hill Groundwater SWL Trends 2016 – 2020

7.5.3.15 Lemington South Glen Munro

Groundwater monitoring in the Lemington South Glen Munro seam was undertaken at one site during 2020; two samples were collected. The pH, EC and SWL trends for 2016 to 2020 are shown in **Figure 81** to **Figure 83.** Internal triggers are listed in **Table 54**. The groundwater level continued to fall during 2020.

Table 54 - Lemington South Glen Munro Groundwater 2020 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken In Response
D010(GM)	20/11/2020	EC	First exceedance. Watching brief.*

* Watching Brief established pending outcomes of subsequent monitoring events. No specific actions required.

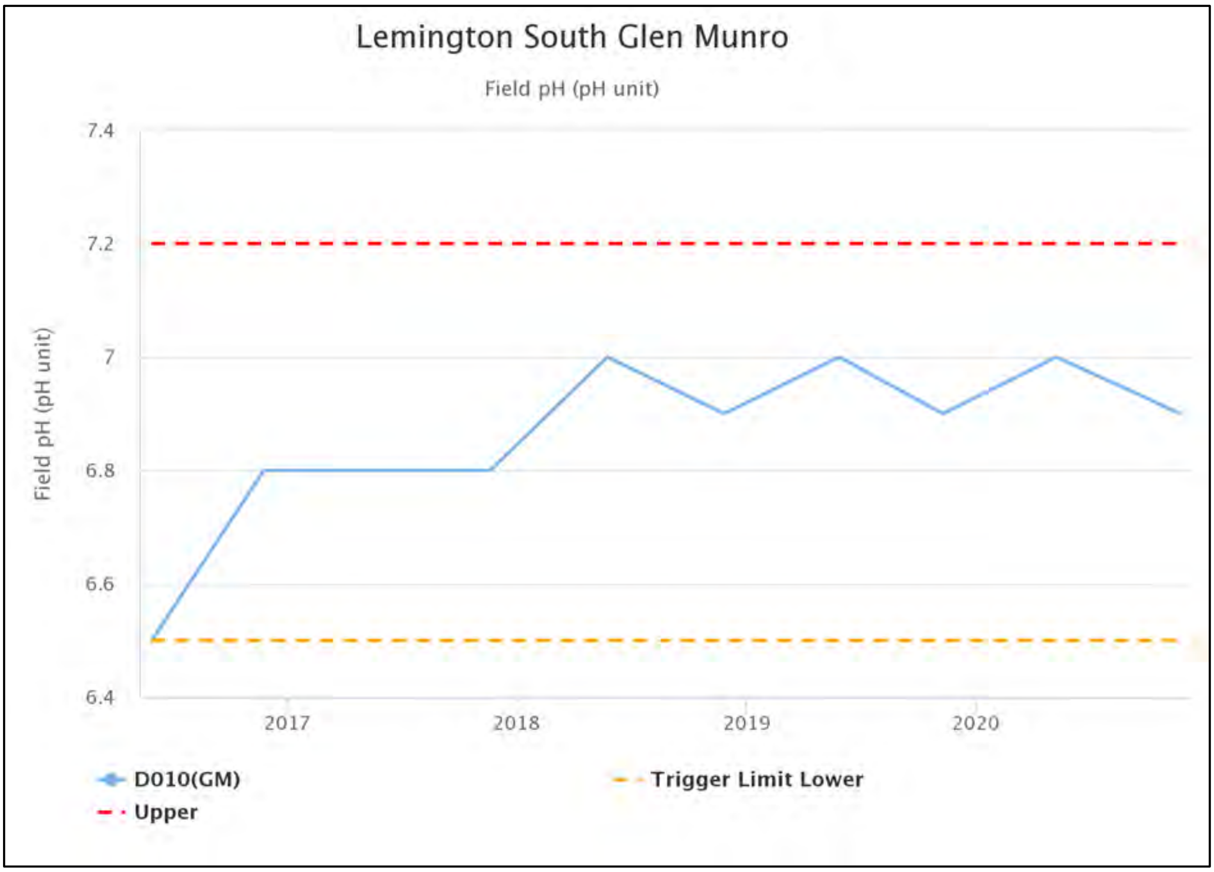

Figure 81 - Lemington South Glen Munro Groundwater pH Trends 2016 – 2020

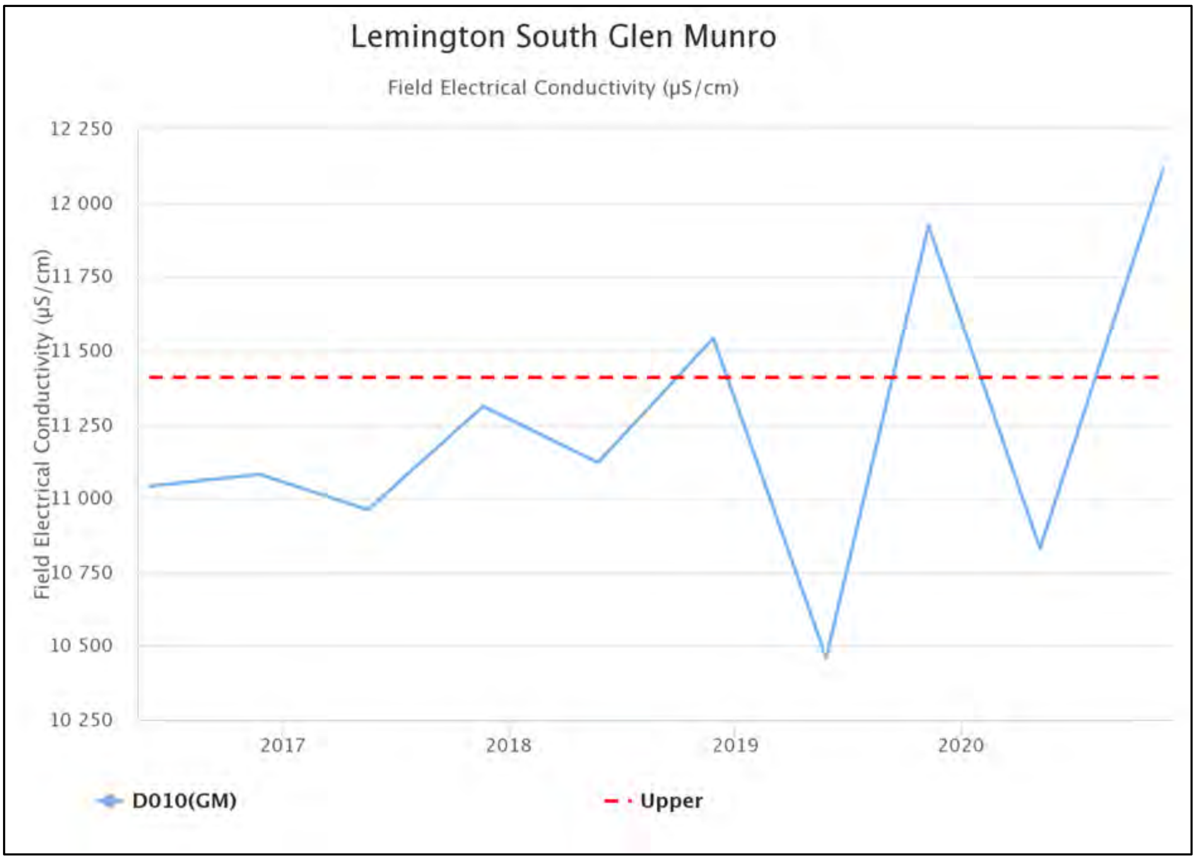

Figure 82 - Lemington South Glen Munro Groundwater EC Trends 2016 – 2020

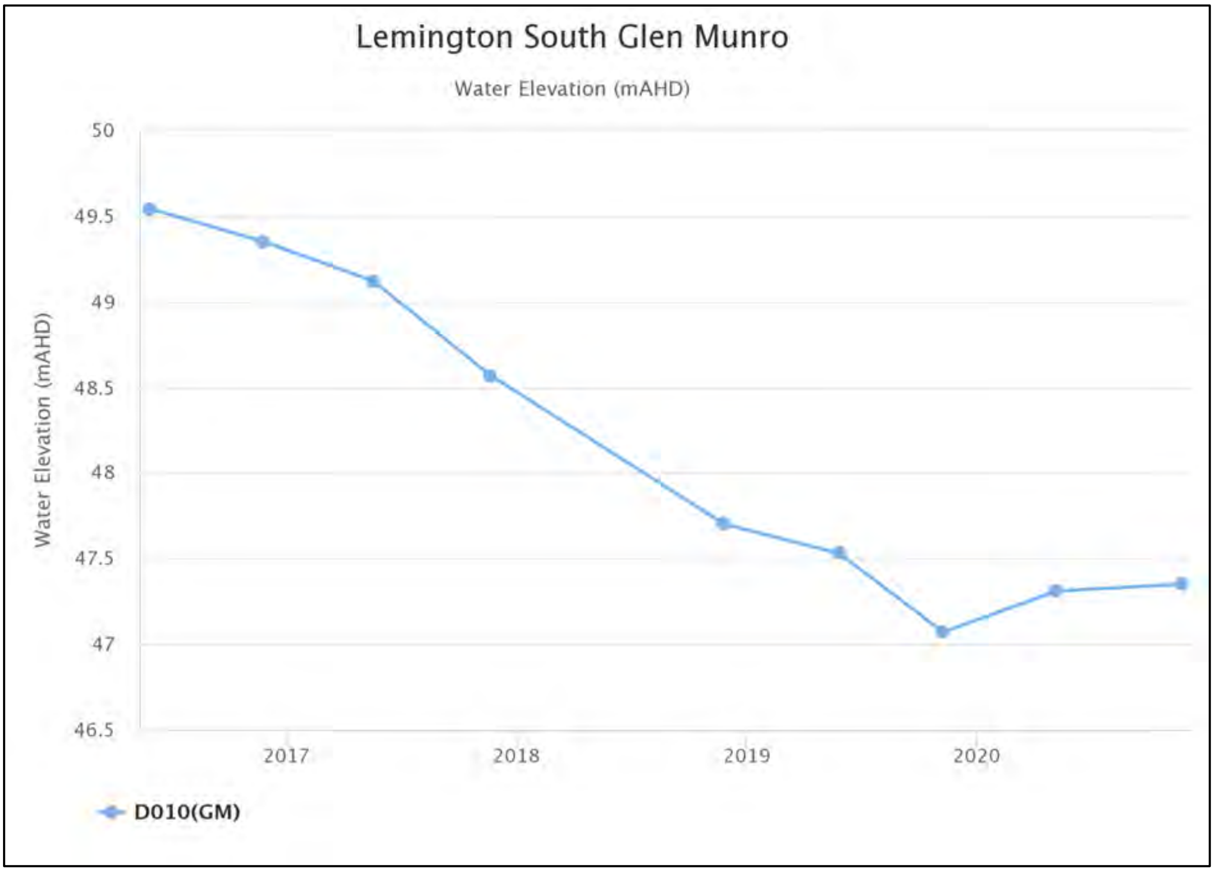

Figure 83 - Lemington South Glen Munro Groundwater SWL Trends 2016 – 2020

7.5.3.16 North Pit Spoil

Groundwater monitoring in the North Pit Spoil area was undertaken at 13 sites during 2020. A total of 45 samples were collected during the reporting period. The pH, EC and SWL trends for 2016 to 2020 are shown in **Figure 84** to **Figure 86**. Water quality and levels were generally stable and consistent with historical trends with the exception of exceedances of internal triggers as listed in **Table 55**. Bore DM7 was dry for the entire reporting period.

Table 55 - North Pit Spoil Groundwater 2020 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken In Response
4116P	25/06/2020	EC	First exceedance. Watching Brief*
4116P	11/09/2020	EC	Second exceedance. Watching Brief*
DM1	14/09/2020	pH	First exceedance. Watching Brief*
DM3	18/09/2020	pH	First exceedance. Watching Brief*
4116P	9/12/2020	EC	Third exceedance. Investigation commenced. Bore 4116P is located at the southern end of North Pit and recorded an increasing trend in EC during 2020. Historical readings show regular fluctuations of betw een 10,890 µS/cm and 13,560 µS/cm for EC. The 2020 readings are slightly above the range of historical readings. Review of w ater quality and w ater level data for nearby bores indicates this trend is unique to bore 4116P. Groundw ater level trends indicate the bore is almost dry and there is potential that historical readings may not have been based on representative groundw ater samples. Numerous blockages have been recorded in 4116P since 2015. On review of the bore construction details it appears the groundw ater level is below the screened interval and w ater quality samples are not representative of the groundw ater in this area.

* Watching Brief established pending outcomes of subsequent monitoring events. No specific actions required.

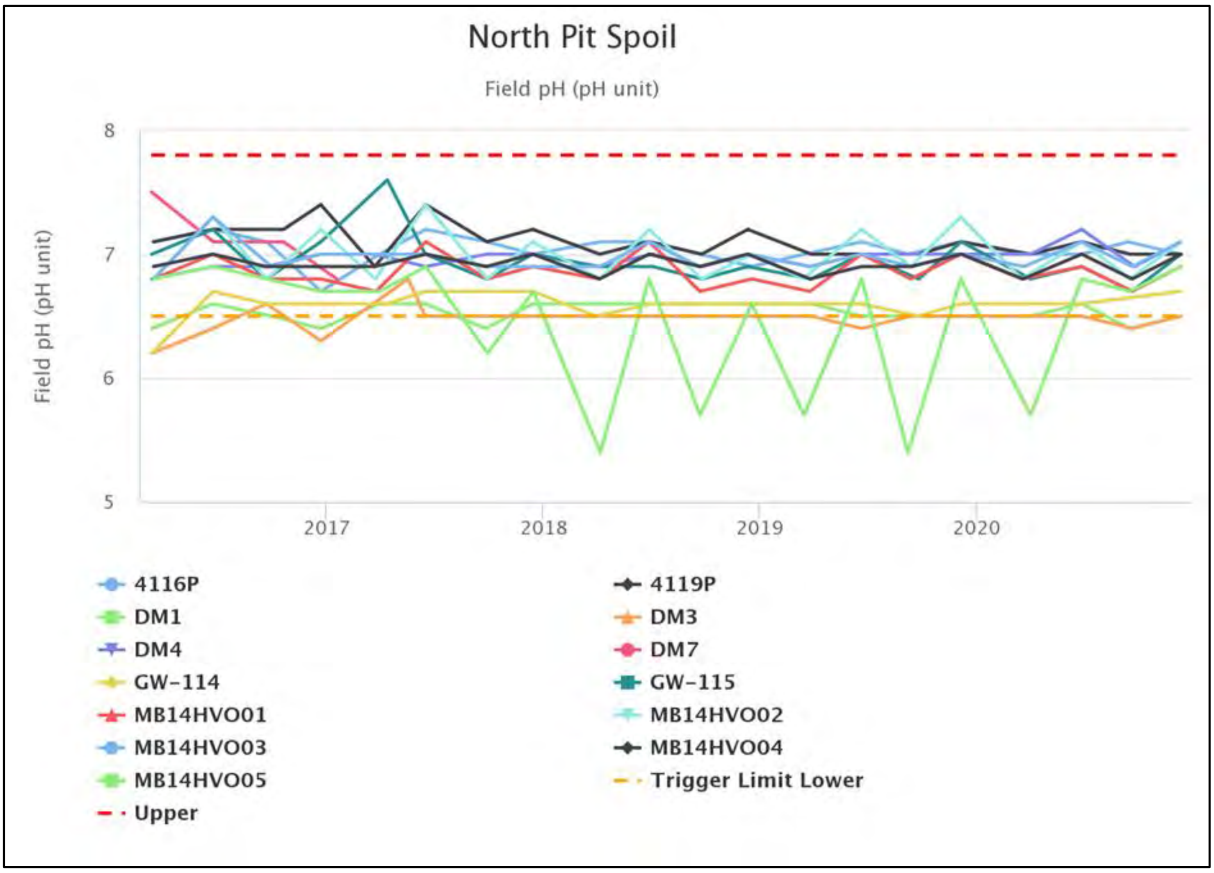

Figure 84 - North Pit Spoil Groundwater pH Trends 2016 – 2020

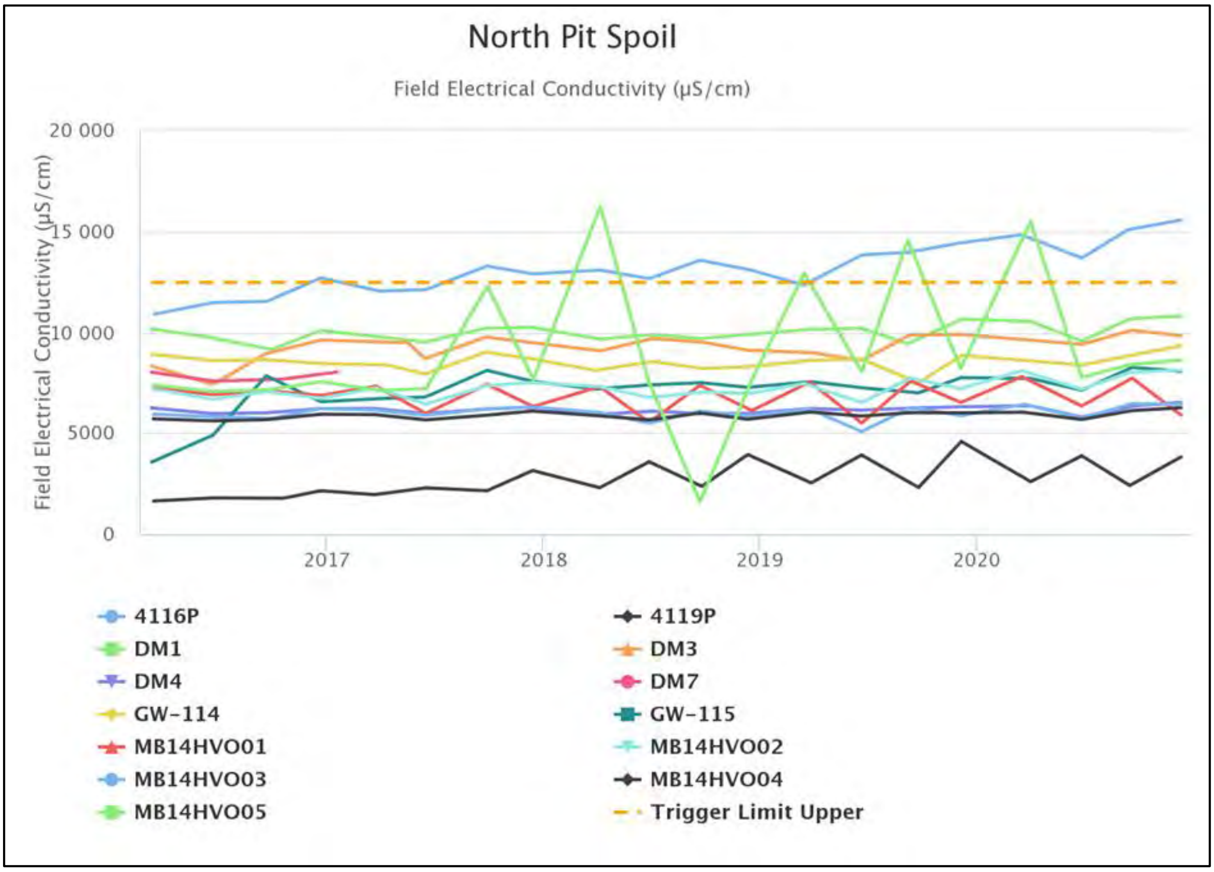

Figure 85 - North Pit Spoil Groundwater EC Trends 2016 – 2020

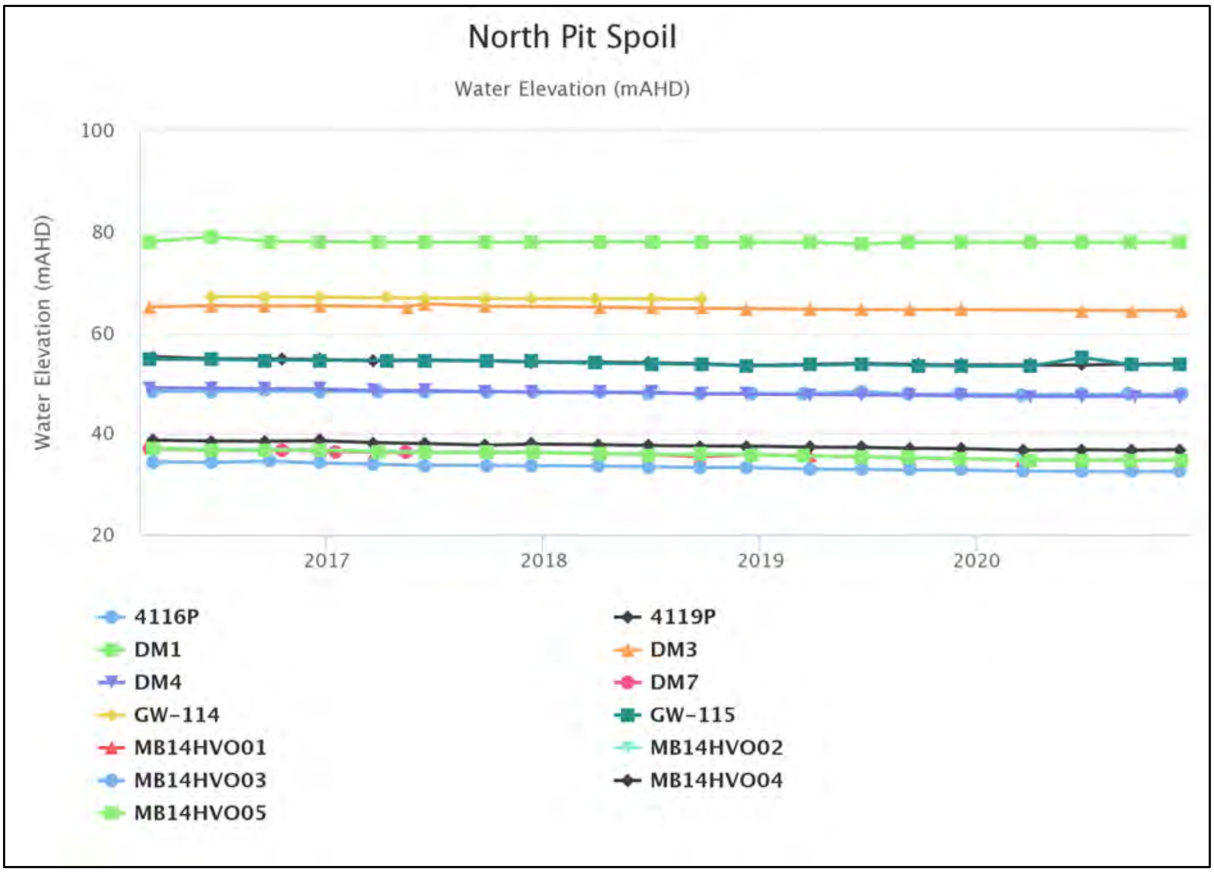

Figure 86 - North Pit Spoil Groundwater SWL Trends 2016 – 2020

7.5.3.17 West Pit Alluvium

Groundwater monitoring in the West Pit Alluvium area was undertaken at 5 sites during 2020. A total of 38 samples were collected during the reporting period. Bores G1, G2 and G3 continued to be monitored on a monthly basis during the reporting period. Monitoring frequency of these bores will be reviewed in the next reporting period. Monitoring in bores GW-100 and GW-101 was undertaken quarterly in accordance with the HVO Groundwater Monitoring Programme. GW-101 had insufficient water for sampling in March and June and was dry during the September and December monitoring rounds.

The pH, EC and SWL trends for 2016 to 2020 are shown in **Figure 87** to **Figure 89**. Results were consistent with historical trends. Exceedances are shown in **Table 56**.

Table 56 - North Pit Spoil Groundwater 2020 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken In Response
G1	5/06/2020	EC	First exceedance. Watching Brief*

* Watching Brief established pending outcomes of subsequent monitoring events. No specific actions required.

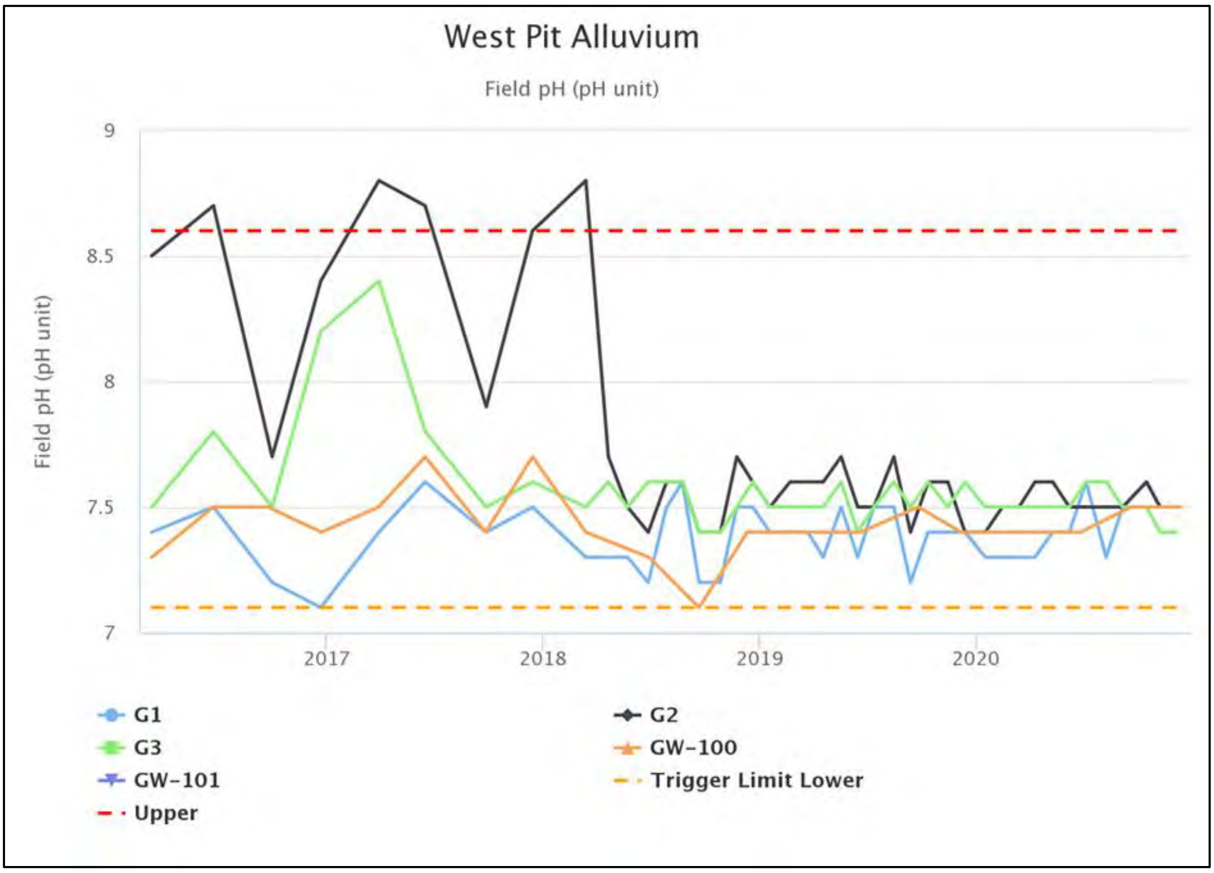

Figure 87 - West Pit Alluvium Groundwater pH Trends 2016 – 2020

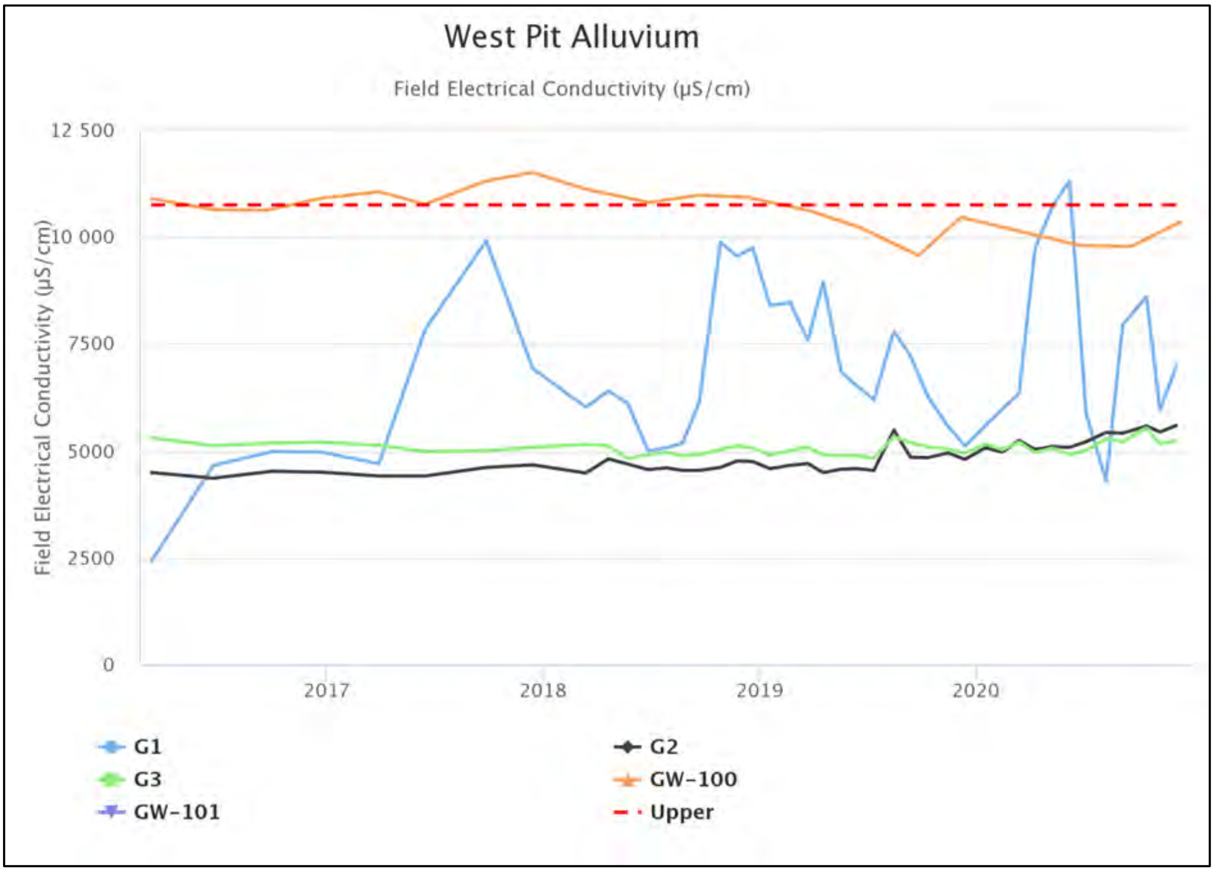

Figure 88 - West Pit Alluvium Groundwater EC Trends 2016 – 2020

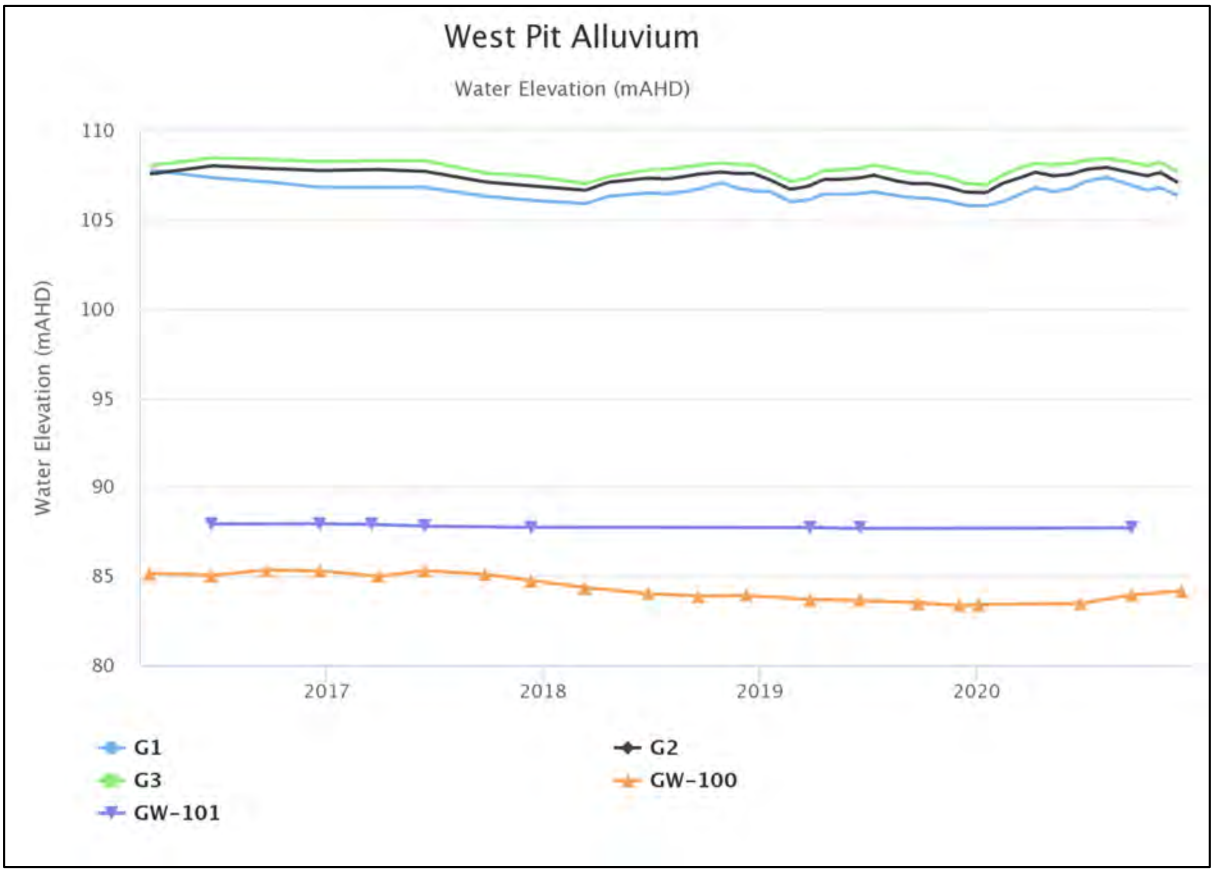

Figure 89 - West Pit Alluvium Groundwater SWL Trends 2016 – 2020

7.5.3.18 West Pit Sandstone/Siltstone

Groundwater monitoring in the West Pit Sandstone/ Siltstone area was undertaken at three sites during 2020. A total of 8 samples were collected during the reporting period. The pH, EC and SWL trends for 2016 to 2020 are shown in **Figure 90** to **Figure 92**. Results were generally consistent with historical trends with the exception of internal trigger exceedances listed in **Table 57**.

Table 57 - West Pit Sandstone/Siltstone Groundwater 2020 Monitoring Internal Trigger Tracking

Location	Date	Trigger Limit	Action Taken In Response
NPZ2	31/03/2020	EC	First exceedance. Watching Brief*
NPZ2	24/06/2020	EC	Second exceedance. Watching Brief*
NPZ2	17/09/2020	EC	Third exceedance. Investigation commenced. Bore NPz2 is located approximately 4.5 km north-east of Plashett Reservoir and 1 km north-west of the West Pit mine area. The bore intersects interburden material (siltstone/sandstone) of the deeper Permian coal measures; with a screened interval between 57-60 m bgl. Historical EC readings for NPz2 since 2008 show regular fluctuations of between 12,590 µS/cm and 19,400 µS/cm. The 2020 readings are consistent with historical concentrations. Based on available information, the cause for the changes in EC at NPz2 do not appear to correlate to mine activities conducted at West Pit; EC at NPz2 was elevated during the period 2008-2012 which indicates that higher EC levels have

Location	Date	Trigger Limit	Action Taken In Response
			been recorded at this location in the data record available.
NPZ2	10/12/2020	EC	Fourth exceedance. Investigation commenced. Bore NPz2 is located approximately 4.5 km north-east of Plashett Reservoir and 1 km north-west of the West Pit mine area. The bore intersects interburden material (siltstone/sandstone) of the deeper Permian coal measures; with a screened interval between 57-60 m bgl. Historical EC readings for NPz2 since 2008 show regular fluctuations of between 12,590 µS/cm and 19,400 µS/cm. The 2020 readings are consistent with historical concentrations. Based on available information, the cause for the changes in EC at NPz2 do not appear to correlate to mine activities conducted at West Pit; EC at NPz2 was elevated during the period 2008-2012 which indicates that higher EC levels have been recorded at this location in the data record available.

* Watching Brief established pending outcomes of subsequent monitoring events. No specific actions required.

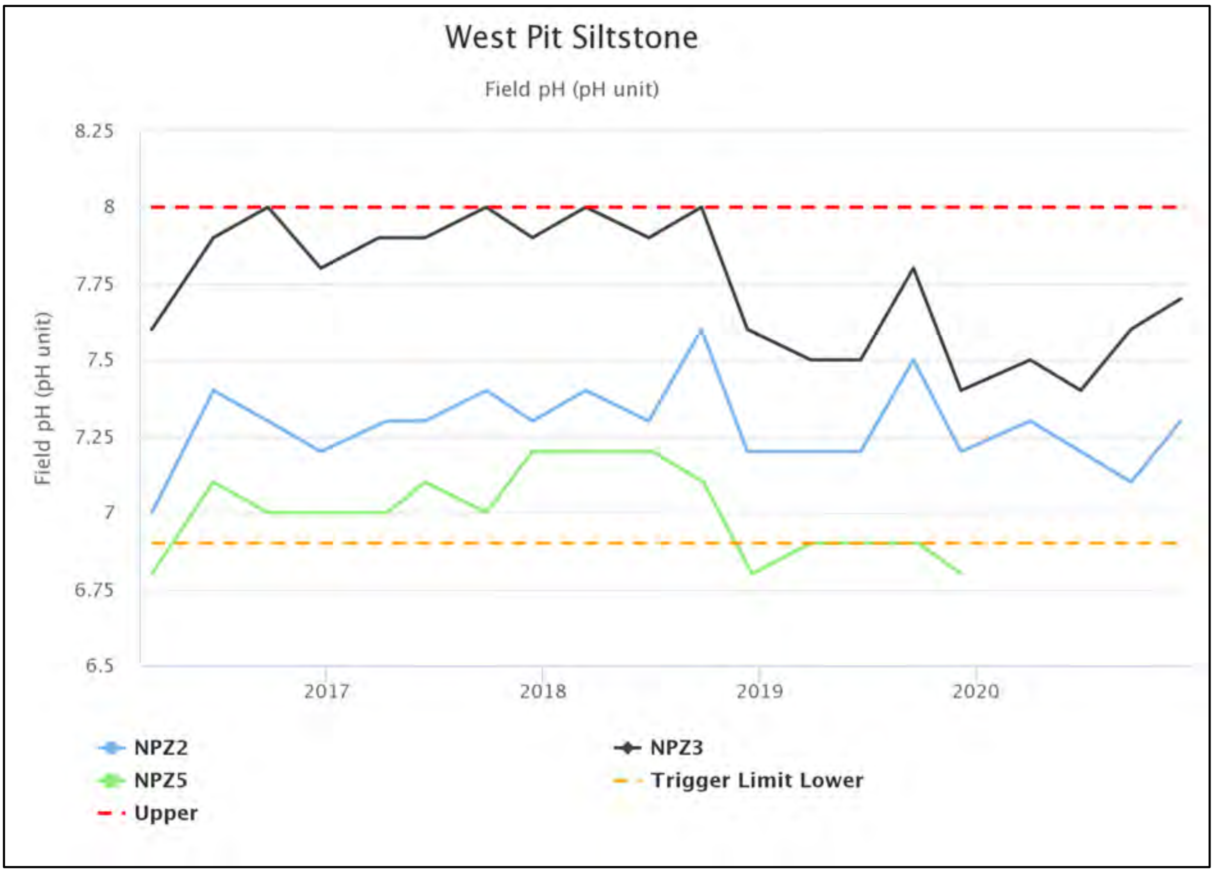

Figure 90 - West Pit Sandstone/Siltstone Groundwater pH Trends 2016 – 2020

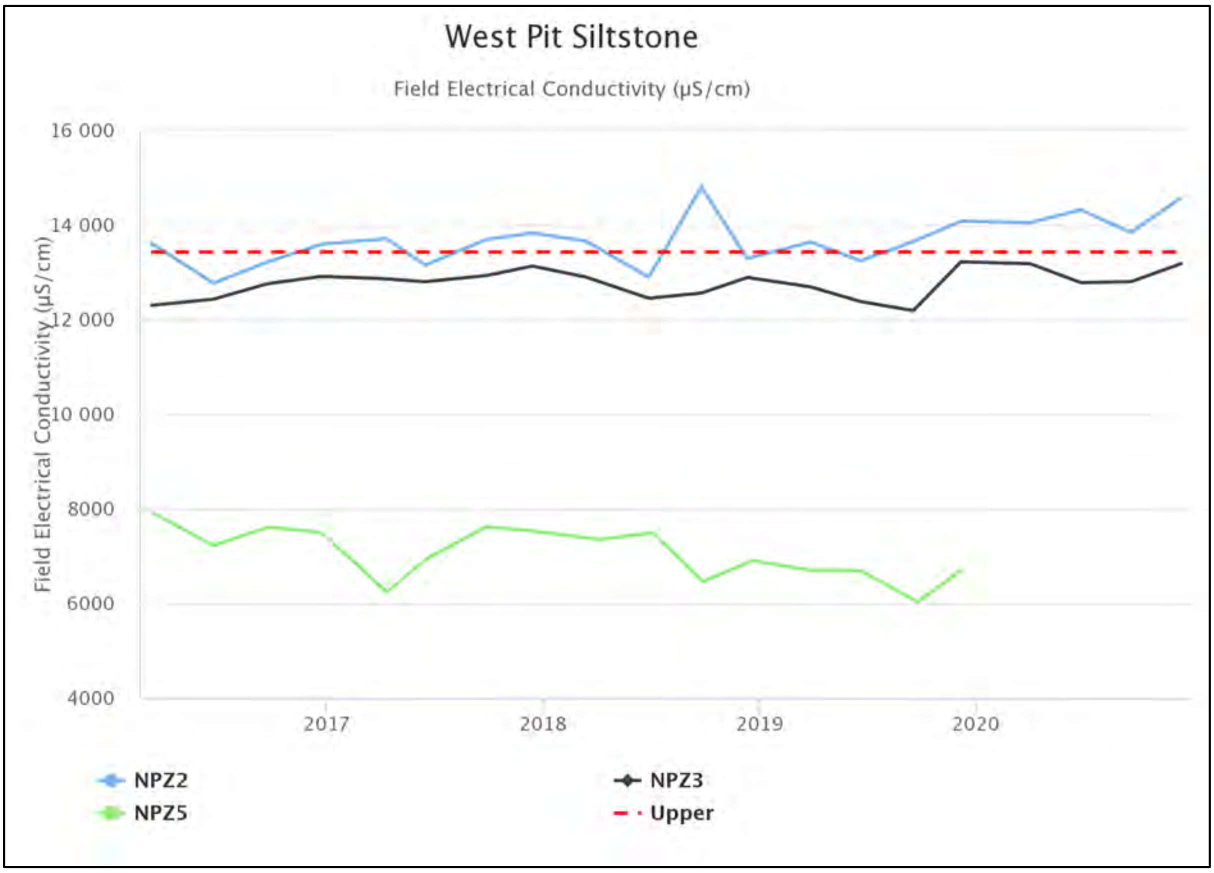

Figure 91 - West Pit Sandstone/Siltstone Groundwater EC Trends 2016 – 2020

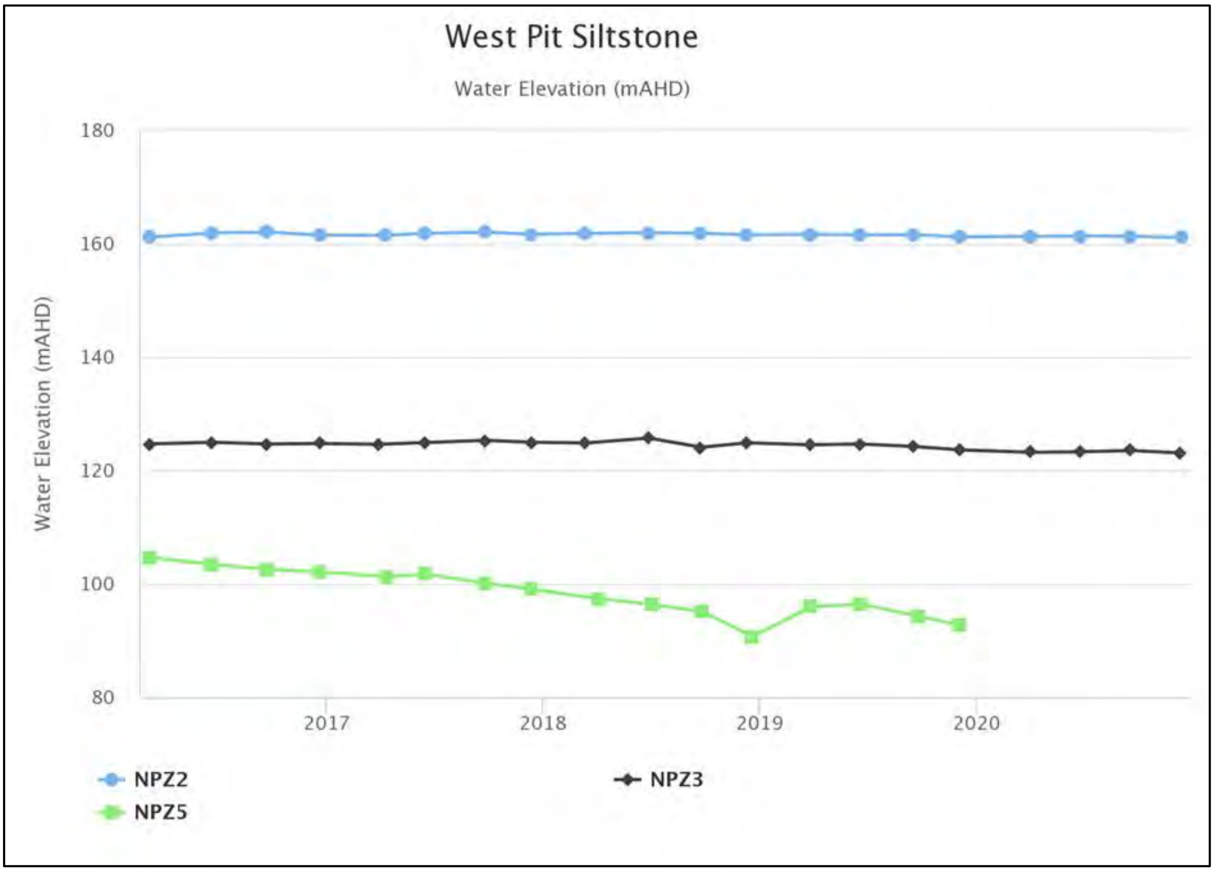

Figure 92 - West Pit Sandstone/Siltstone Groundwater SWL Trends 2016 – 2020

7.5.3.19 Carrington West Wing Bayswater

Groundwater monitoring in the Carrington West Wing Bayswater area was undertaken at one site during 2020. A total of 4 samples were collected during the reporting period. The pH, EC and SWL trends for 2016 to 2020 are shown in **Figure 93** to **Figure 95.** There were no trigger exceedances recorded during the reporting period

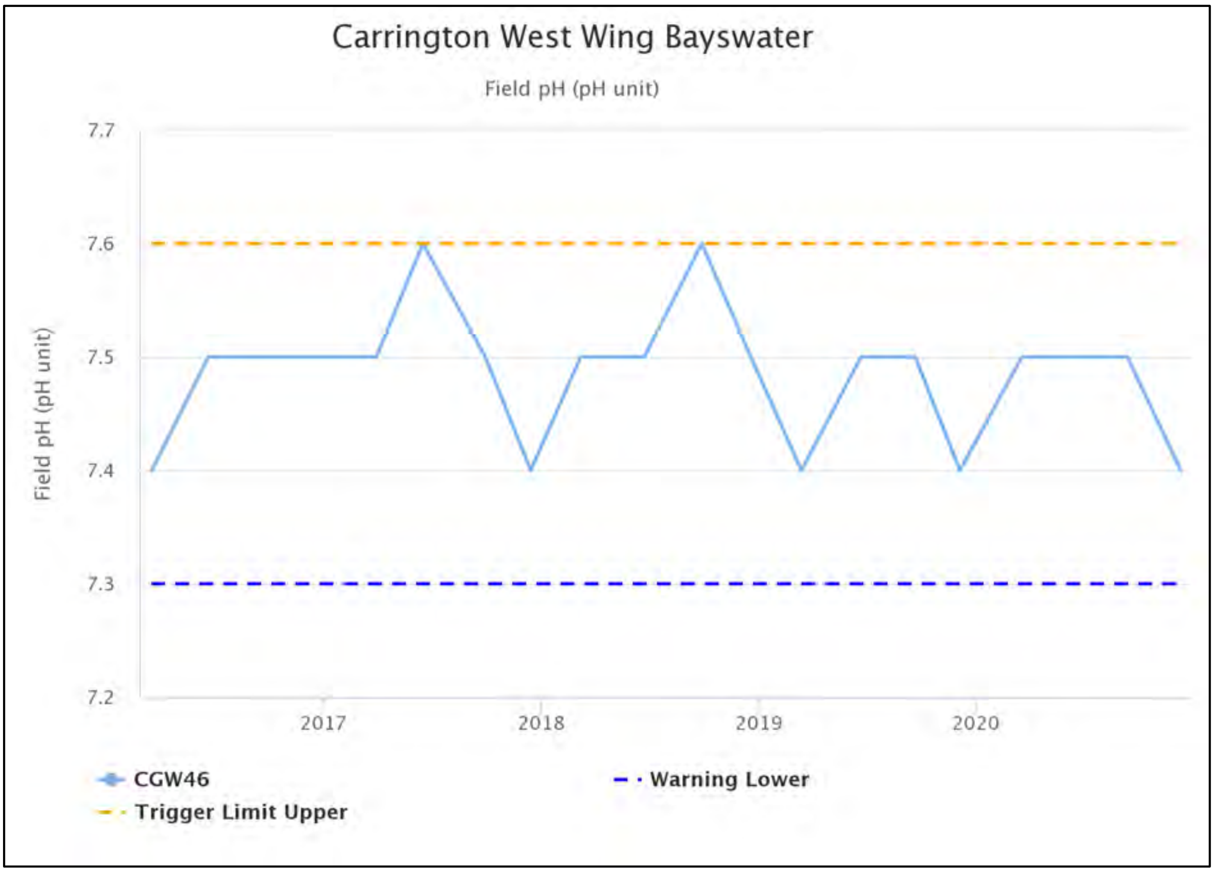

Figure 93 – Carrington West Wing Bayswater Groundwater pH Trends 2016 to 2020

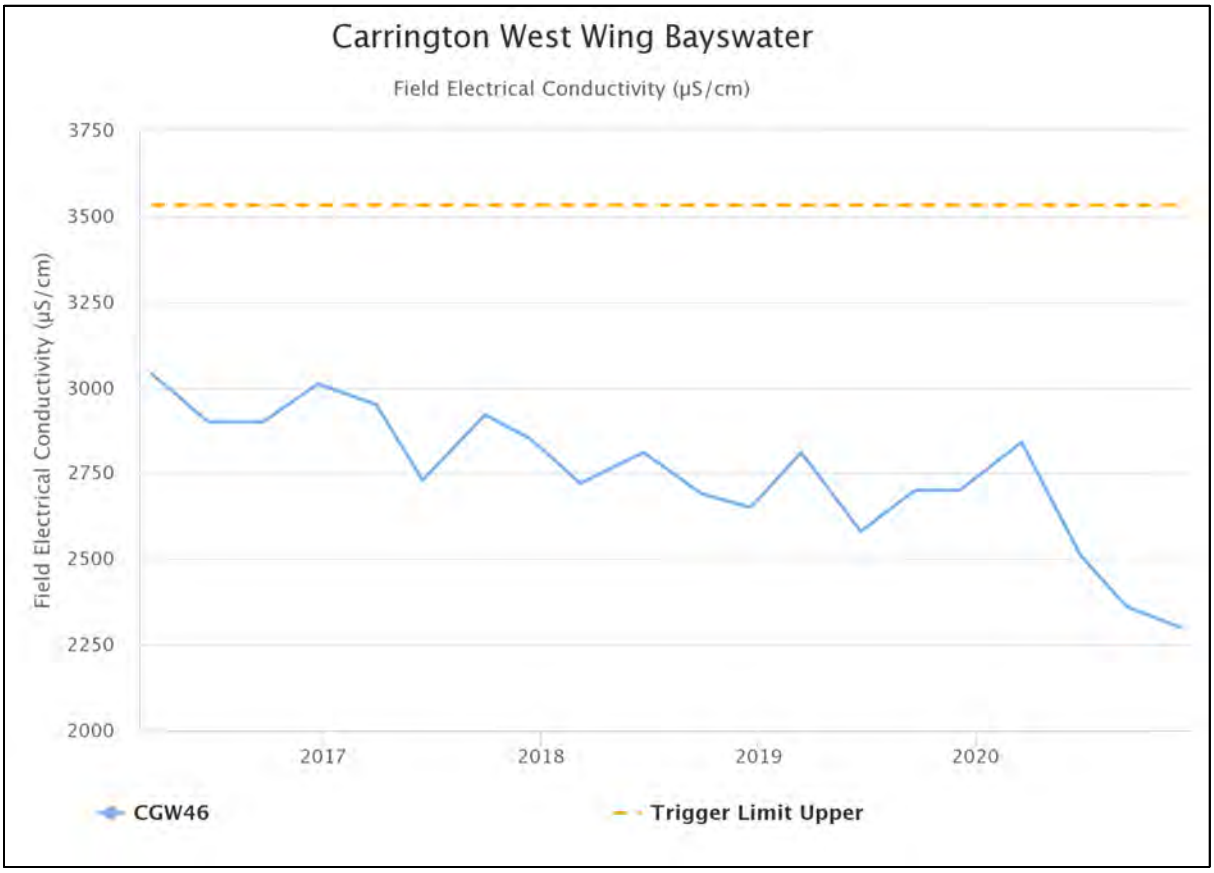

Figure 94 – Carrington West Wing Bayswater Groundwater EC Trends 2016 to 2020

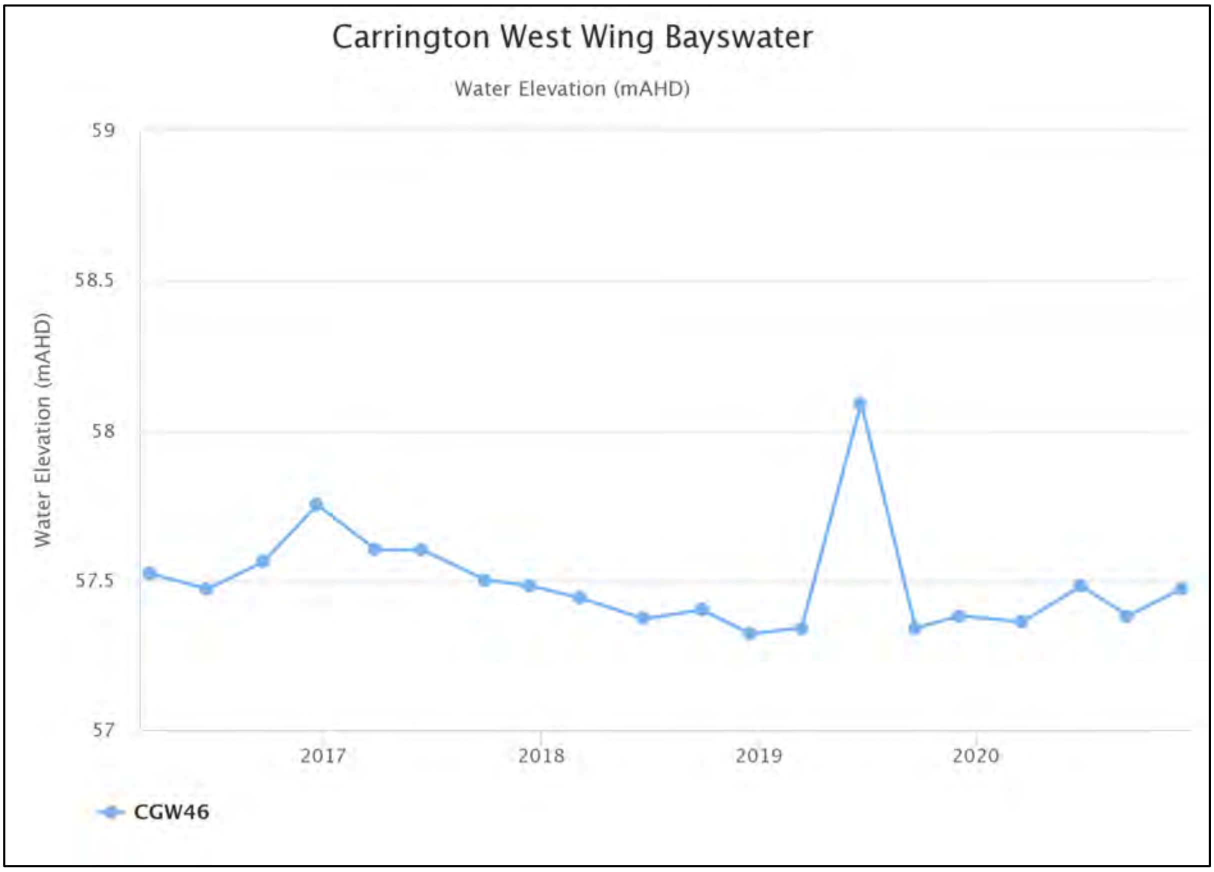

Figure 95 – Carrington West Wing Bayswater Groundwater SWL Trends 2016 to 2020

7.6 Compensatory Water Supply

Circumstances which may trigger a requirement to provide a compensatory water supply were not identified during the reporting period. HVO did not provide compensatory water supply or alternate compensation in lieu of compensatory water supply under any new or existing agreements during 2020.

8 Rehabilitation and Land Management

8.1 Summary of Rehabilitation

Rehabilitation at HVO is undertaken in accordance with commitments made in the various Mining Operations Plans (MOPs) covering the site: Hunter Valley Operations North MOP (includes Newdell CHPP and Hunter Valley Load Point) and Hunter Valley Operations South MOP.

A summary of the key rehabilitation performance indicators is shown in **Table 58**.

Table 58 - Key Rehabilitation Performance Indicators

Mine Area Type	Previous Reporting Period (Actual) Year 2019 (ha)	This Reporting Period (Actual) Year 2020 (ha)	Next Reporting Period (Forecast) Year 2021 (ha)
A. Total mine footprint[3]	6567.8	6665.0	6834.8
B. Total Active Disturbance[4]	3639.1	3753.8	4010.2
C. Land being prepared for rehabilitation[5]	529.7*	418.2	331.7
D. Land under active rehabilitation[6]	2392.5	2492.9	2470.5
E. Completed rehabilitation[7]	0	0	0

[3] **Total mine footprint** includes all areas within a mining lease that either have at some point in time or continue to pose a rehabilitation liability due to mining and associated activities. As such it is the sum of total active disturbance, decommissioning, landform establishment, growth medium development, ecosystem establishment, ecosystem development and relinquished lands (as defined in DRE MOP/RMP Guidelines). Please note that subsidence remediation areas are excluded

[4] **Total active disturbance** includes all areas ultimately requiring rehabilitation such as: on-lease exploration areas, stripped areas ahead of mining, infrastructure areas, water management infrastructure, sewage treatment facilities, topsoil stockpiles areas, access tracks and haul road, active mining areas, waste emplacements (active/unshaped/in or out-of-pit), and tailings dams (active/unshaped/uncapped).

[5] **Land being prepared for rehabilitation** – includes the sum of mine disturbed land that is under the following rehabilitation phases – decommissioning, landform establishment and growth medium development (as defined in DRE MOP/RMP Guidelines).

[6] **Land under active rehabilitation** – includes areas under rehabilitation and being managed to achieve relinquishment – includes the following rehabilitation phases as described in the DRE MOP/RMP Guidelines – "ecosystem and land use sustainability" (revegetation assessed as showing signs of trending towards relinquishment OR infrastructure development).

[7] **Completed rehabilitation** – requires formal sign off by DRE that the area has successfully met the rehabilitation land use objectives and completion criteria.

8.2 Rehabilitation Overview

A summary of rehabilitation completed in 2019 is shown in **Table 59.**

Table 59 - Summary of new rehabilitation completed in 2020

Rehabilitation Site Name	Seed Mix	Area (ha)	Summary
Glider 155	HVO Woodland	3.8	Interim landform sown with native seed
West North 190 batter	HVO Woodland	8.8	Final landform sown with final cover
West North 230	HVO Pasture Light Woodland	4.3	Final landform sown with final cover
West Centre 230	HVO Woodland	2.8	Final landform sown with final cover
West South 230 batter	HVO Woodland	3.7	Final landform sown with final cover
West South 230	HVO Pasture Light Woodland	6.0	Final landform sown with final cover
Riverview West	HVO Woodland	53.1	Interim landform sown with native seed
Cheshunt 165	HVO Woodland	3.9	Final landform sown with final cover
Cheshunt Barrys	HVO Woodland	7.6	Final landform sown with final cover
Cheshunt Barrys (East)	HVO Woodland	16.9	Final landform sown with final cover (GMD progression)
Cheshunt Barrys (West)	HVO Woodland	28.6	Final landform sown with final cover (GMD progression)
Cheshunt Barrys (temp)	Native grasses (Howick mix)	7.7	Interim landform sown with native seed (GMD progression)
Total Rehabilitation		**147.2**	

8.3 Rehabilitation Performance

A total of 147.2 ha of rehabilitation was undertaken during 2020 comprising 94.0 ha of new rehabilitation and 53.2 ha progressing historic growth medium development areas. Details of the rehabilitation areas including areas completed during 2020, the extent of mining, surface contours and rehabilitation vegetation types are provided in **Figure 96**.

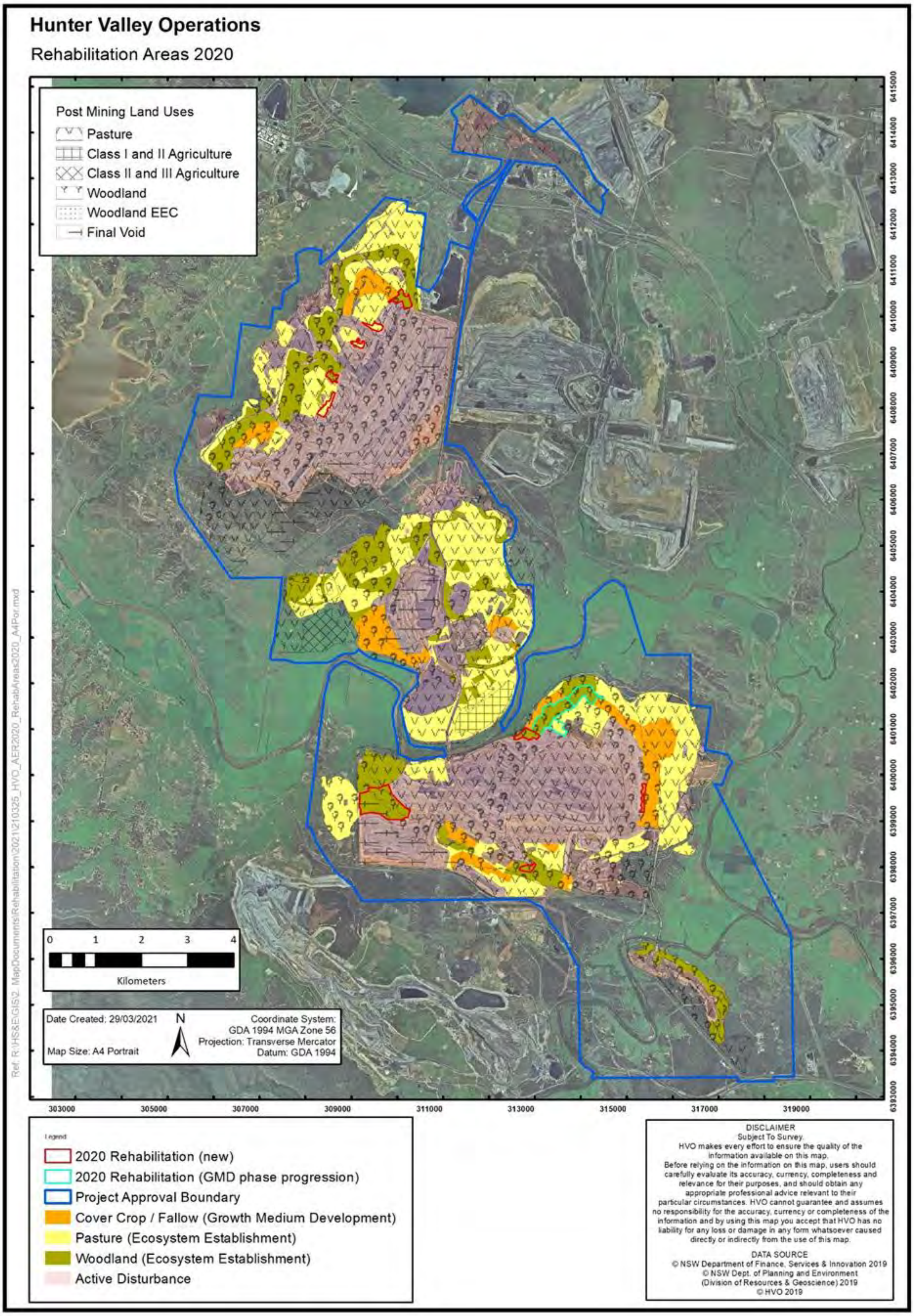

Figure 96 - HVO Rehabilitation Areas as at 2020

Table 60 details the amount of rehabilitation and disturbance completed during the reporting period compared with proposed area in the respective MOP's.

Table 60 - Summary of rehabilitation and disturbance completed in 2020

MOP	2020 Totals (ha)		Cumulative Totals During Current MOP Period (ha)*	
	Actual	Proposed MOP	Actual	Proposed MOP
Rehabilitation				
HVO North	25.5	42.2	46.9	63.6
HVO South	68.5	59.8	236.4	211.6
HVO Total	**94.0**	**102.0**	**283.3**	**275.2**
Rehabilitation Disturbance				
HVO North	6.7	0	23.32	16.6
HVO South	62.5	62.5	167.6	239.1
HVO Total	**69.1**	**62.5**	**190.8**	**255.7**
New Disturbance				
HVO North	39.4	34.8	84.0	79.4
HVO South	9.4	2.3	35.3	43.8
HVO Total	**48.8**	**37.1**	**119.3**	**123.2**
Net Rehabilitation (Rehabilitation minus Rehabilitation Disturbance)				
HVO North	18.8	42.2	23.7	47.1
HVO South	6.0	-2.7	68.8	-27.5
HVO Total	**24.9**	**39.5**	**92.5**	**19.6**

Comparison with HVO North MOP 2019 to 2021 (approved 26 February 2019) and HVO South MOP Amendment A 2018 to 2022 (approved 26 February 2018);

Following commencement of the MOP for HVO South in July 2018 the rehabilitation to end of 2020 exceeded the MOP projection for the reporting period by 8.7 hectares and the projection since MOP commencement by 27.8 hectares. As rehabilitation disturbance projected during the initial period of the MOP has been delayed net rehabilitation since MOP commencement is 96.3 hectares in advance of predictions. This gap will continue to narrow over coming years as planned rehabilitation disturbance occurs (at end of 2019 reporting period net rehabilitation was 195.1 hectares in advance of MOP predictions).

The area of rehabilitation sown in HVO North during 2020 was 25.5 hectares which was 16.7 hectares below the MOP commitment. Cumulative rehabilitation across the MOP period was similarly 16.7 hectares below the MOP projection. Rehabilitation disturbance during the reporting period was 6.7 hectares exceeding the nil projection for the period in the MOP. In terms of net rehabilitation HVO North is therefore 23.4 hectares in arrears of the MOP projection with net rehabilitation of 23.7 hectares completed compared with MOP projection of 47.1 hectares. This deficit has occurred due to changes in the mine plan in response to significant market impacts arising as a result of the COVID-19 pandemic. Plan changes included reductions in waste movement in the West Pit which resulted in delayed landform completion and associated release for progressive rehabilitation.

During 2019 HVO reclassified areas of existing rehabilitation at both HVO North and HVO South from under active rehabilitation to within the Growth Medium Development phase. This was because these areas are under cover-crop vegetation management regimes and remain to be sown to final vegetation covers. Reclassification corrects an historic reporting practice which does not align with contemporary guidelines. These areas are substantively advanced along the establishment continuum however are unable to be reported as active rehabilitation. Exclusion of these areas from reporting tallies would significantly under-represent progress against rehabilitation commitments. Given this, and for completeness, these reclassified areas are included in progression assessments. During the reporting period 45.2 hectares of these areas located on final landform were sown to final cover in addition to a further 7.7 hectares upon interim landform which was sown to native vegetation. Seeding of historic Growth Medium Development areas to final covers remains ongoing and the quantum of areas will reduce with time.

A comparison of rehabilitation progression against predictions in the HVO West Pit Extension and Minor Modifications Environmental Impact Statement (EIS) (October 2003) and subsequent modifications to the HVO North approval (DA 450-10-2003) indicates that rehabilitation progression is generally consistent with EIS predictions. Planning approval modifications that changed the rate of rehabilitation progression at HVO North include: Carrington East Extension (Modification 2 - 2006); Carrington Out-of-Pit TSF (modification 4 - 2014); and Carrington In-Pit TSF (Modification 6 - 2014). When the modifications listed above are taken into account the EIS projection for rehabilitation area at the end of 2018 was 1766.9 hectares. The EIS projection for average annual rehabilitation between 2018 (Year 14) and 2024 (Year 20) is 26.2 hectares hence projected rehabilitation at the end of 2020 was 1819.3 hectares. Land under active rehabilitation at HVO North at the end of 2020 totalled 1647.7 hectares. A further 182.3 hectares are classified as within growth medium development phase representing a total rehabilitation management footprint at end of 2020 of 1830.0 hectares which is consistent with EIS projections.

As at the end of 2020, rehabilitation progress for HVO South is consistent with the predictions in the HVO South Coal Project Environmental Assessment Report (January 2008), although with similar considerations to HVO North with respect to current rehabilitation phase classifications. EIS rehabilitation progression at the end of 2019 (Stage 1) shows 1048 ha of rehabilitation completed. The EA projection for average annual rehabilitation between 2019 (Stage 1) and 2022 (Stage 2) is 22 hectares hence projected rehabilitation at the end of 2020 was 1070 hectares. Land under active rehabilitation at the end of 2020 was 845.2 hectares in association with 213.1 hectares in growth medium development phase. Total rehabilitation management footprint at end 2020 is therefore 1058.3 hectares. The slight lag in rehabilitation progression is associated with re-disturbance during the reporting period of 14.7 hectares of temporary rehabilitation located upon interim landform for the construction of topsoil stockpiles. HVO South can therefore be seen to be generally consistent with progressive rehabilitation projections for the current stage of mine development.

8.4 Rehabilitation Programme Variations

The 2020 variations to the rehabilitation programme are summarised in **Table 61**.

Table 61 - Variations to the Rehabilitation Programme in 2020

MOP	Has rehabilitation work proceeded generally in accordance with the conditions of an accepted Mining Operations Plan?	Comment
HVO South	No	HVO South rehabilitation completed during period 2018 to 2020: Actual = 236.4 ha vs MOP target 211.6 ha. Rehabilitation establishment has progressed slightly in advance of the MOP with establishment of rehabilitation in advance of MOP sequence on interim landform at Riverview North and on final landform at Cheshunt (Barrys) northern embankment. HVO South net rehabilitation (net rehabilitation = rehabilitation minus – rehabilitation disturbance) completed during period 2018 to 2020: Actual = +68.8 ha vs MOP target = -27.5 ha. HVO South net rehabilitation progress 96.3 ha ahead of MOP projection for period 2018 to 2020. HVO South net rehabilitation progress advanced due to HVO delaying re-disturbing rehabilitation areas on interim landforms at Cheshunt and Riverview.
HVO North	No	HVO North rehabilitation completed during period 2019 to 2020: Actual = 46.9 ha vs MOP target 63.6 ha. HVO North net rehabilitation (net rehabilitation = rehabilitation minus – rehabilitation disturbance) completed during period 2019 to 2020: Actual = 23.7 ha vs MOP target = 47.1 ha. HVO North net rehabilitation progress 23.4 ha less than MOP projection for period 2019 to 2020. HVO North net rehabilitation deficit due to HVO reduced waste movement in West Pit and associated delayed construction of final landforms across the West Pit dump systems; re-disturbance of temporary rehabilitation areas for in-pit ROM stockpiles; and re-disturbance of final rehabilitation area for topsoil stockpile.
HVO North & HVO South (GMD Progression areas)		Following receipt of Section 240 notice issued 18/7/19 from Resources Regulator HVO reviewed rehabilitation phase classification of all rehabilitation areas such that: • Rehabilitation areas sown to final cover are classified as Ecosystem Establishment phase, • Rehabilitation areas awaiting sowing to final cover are classified as Growth Medium Development (GMD) phase; Classification of historic rehabilitation areas awaiting sowing to final cover is not considered in the MOPs. At end of 2020 residual areas currently classified as GMD are: HVO North = 182.3 ha HVO South = 213.1 ha

8.5 Rehabilitation Trials

No rehabilitation trials were conducted during 2020.

8.6 Key Issues that may affect Rehabilitation

The key issues that may affect rehabilitation are:

- **Vegetation Establishment** impacts due to competition from problematic weed species, uncontrolled or inappropriate vehicle or livestock impacts, or resulting in low resilience to bushfire impact; and atypical species diversities, structural densities, growth rates, productivity and recruitment levels when compared with analogue sites;
- **Growth Medium Suitability** issues due to soil nutrient and chemical properties impacting vegetation establishment; or establishment of inadequate soil depth during the Growth Medium Establishment phase;
- **Landform Stability** including the stability of water management structures, internal and external batter slopes and final void batters, and settlement and ponding on final landform surfaces of tailings storage facilities;
- **Spontaneous Combustion** occurring from placement of high risk materials on or near the final surface, or from exposed coal seams; and
- **Fauna Recolonisation** impacts due to competition and predation by vertebrate pest species.

A Trigger Action Response Plan (TARP) is included in the MOPs and identifies the proposed contingency strategies in the event of variations or impacts to rehabilitation outcomes. Weed management continues to be a key issue to manage in order to meet rehabilitation objectives. Management activities to improve rehabilitation performance are described below.

Vegetation Establishment

Over the decade to 2019 HVO utilised cover crops for initial stabilisation of rehabilitation areas and as a tool to combat heavy weed seed loads in site topsoils. Delays in progressing these areas to final cover led to a backlog of areas requiring ongoing maintenance within the Growth Medium Development phase of rehabilitation. A key current focus of rehabilitation maintenance activities is sowing of these areas to final vegetation covers to allow progression to the Ecosystem Establishment phase. Stand-alone initial cover cropping is no longer utilised except in specific and targeted circumstances. HVO prioritises prompt seeding and establishment of final vegetation covers with inclusion of cover crop components to assist with initial stabilisation.

Weed competition

Historic weed infestation of former rehabilitation grazing areas and associated weed establishment upon many historic topsoil stockpiles has resulted in a significant weed seed burden in many establishing rehabilitation areas. HVOs response to TARP triggers for weed competition (in association with native stem density i.e. vegetation establishment) are a key element of the current rehabilitation maintenance focus. HVO maintains a strong focus upon managing weed competition during the initial post-sowing establishment window, in addition to prioritised interventions based on routine inspection and monitoring triggers. Despite this, it is anticipated that weed issues will remain a threat to rehabilitation establishment over the forward period and that associated TARP triggers will continue to present while the historic weed seed burden is progressively reduced.

Topsoil Management

Topsoil management processes have been identified as an area for improvement at HVO. During 2018 and in association with the s240 rehabilitation improvement program HVO commenced revision of site topsoil management procedures including characterisation based source separation and discrete stockpiling, topsoil stockpile inspection and maintenance protocols, and topsoil tracking and reconciliation processes. Development of an integrated Topsoil Management Plan to support improvements in site practice and rehabilitation outcomes was undertaken during 2020 and was finalised in early 2021. HVO will continue to embed improvements in topsoil management practices across the forward period to further mitigate weed impacts on site soil resources.

Review of rehabilitation processes

In association with changes in ownership and site management in 2018 HVO adopted the Glencore Coal Assets Australia (GCAA) rehabilitation process framework. Key additional process elements have been integrated to site include:

- Development of a comprehensive Annual Rehabilitation and Closure Plan which provides an integrated overview of all rehabilitation and closure related works to be undertaken during the forward period;
- Implementation of an Annual Walkover Inspection of all rehabilitation areas to identify landform stability and vegetation establishment issues, maintenance planning, and budgeting;
- Annual review and inspection of site conformance with annual plans and GCAA rehabilitation processes; and
- Use of GCAA rehabilitation monitoring procedures and associated generic completion criteria and TARP frameworks as base templates prior to the addition of site specific elements; and
- Adoption of GCAA spatial data management protocols for rehabilitation tracking and records management.

Native Vegetation Rehabilitation

Over the recent decade HVO has focussed on re-establishing a diverse native understorey within native vegetation rehabilitation. Experience has shown that weed competition, which includes exotic grasses in the context of native vegetation establishment, is the main limiting factor to the successful establishment of a native understorey. The problematic weed seed load is arising from both historically disturbed areas that are being stripped ahead of mining and from the cover species on site topsoil stockpiles.

HVO continues to refine the approach to minimise the impact of weeds in rehabilitation, including:

- Prioritising the use of topsoils from good quality native vegetation areas on rehabilitation that is being returned to native vegetation;
- Managing new and old topsoil stockpiles progressively to remove exotic grass/weed cover and establish native vegetation covers;
- Chemical application techniques to target exotic grasses and weeds in establishing rehabilitation areas that have already been sown with native seed mixes. This includes weed wiping of exotic grasses, post-sowing pre-emergent spraying of areas with high risk weed seed loads; and targeted spot spraying across key development windows;
- Development of a native seed production area to supply local provenance native grasses for use in rehabilitation and topsoil stockpile maintenance.

HVO has committed to a detailed work plan in response to TARP triggers arising from rehabilitation monitoring and subsequent engagement with Resources Regulator during 2018 and 2019. The plan is particularly focussed upon native vegetation establishment on historic cover crop areas (Growth Medium Development progression seeding), and protection of these and existing areas from weed threats while vegetation establishes. The work plan annotated with work completed during 2020 is presented in **Appendix E**.

8.7 Rehabilitation Monitoring

During 2020 HVO adopted the revised GCAA rehabilitation monitoring program to monitor rehabilitation areas and trajectory towards meeting the rehabilitation objectives and performance and closure criteria. The monitoring framework comprises Initial Establishment Monitoring (IEM) and Long Term Monitoring depending upon the age of the rehabilitation area.

Initial establishment monitoring is a rapid style assessment of young (≤3 years old) rehabilitated areas, principally to determine germination success and landform stability, and describes differing methods for HVO's key final land uses of grazing and non-specific woodland.

Long term rehabilitation monitoring utilises the Biodiversity Assessment Methodology to compare rehabilitation areas with analogue site results. The objective of the long term monitoring program (areas ≥4 years old) is to evaluate progress of rehabilitation towards fulfilling completion criteria and, ultimately, the targeted post-mining land use. Like methods apply for LTM of both rehabilitation and reference monitoring sites.

Monitoring during the reporting period represented restart of an ecological monitoring program at HVO following utilisation of an abridged monitoring procedure over 2018 and 2019. The abridged program was utilised to inform targeted rehabilitation maintenance interventions in association with development of a detailed maintenance plan to address the requirements of Resources Regulator Section 240 Notices received during 2018 and 2019.

During the 2020 event, thirty five sites were monitored across 10 discrete rehabilitation blocks. Monitoring comprised:

- 3 blocks of Initial Establishment Monitoring for Grazing Pastures;
- 2 blocks of Long Term Monitoring for Grazing Pastures;
- 3 blocks of Initial Establishment Monitoring for Rehabilitation; and
- 2 Long Term Monitoring blocks Non-specific Native Vegetation.

As the new monitoring method is not derived from the completion criteria detailed in the existing MOPs (15/01/2019) there is a degree of misalignment between these respective elements. At the time of commissioning the monitoring works HVO anticipated that an updated MOP with completion criteria reflecting the GCAA methodology would be in effect. The event scope included each type of monitoring to facilitate understanding of each type of monitoring and inform opportunities for improvement at subsequent events. Reference sites were not monitored as part of the programme as suitable sites remain to be identified. Reference sites are expected to be finalised during 2021 ahead of the next monitoring event during Spring 2021.

Despite the absence of reference site data and fully aligned completion criteria the monitoring indicated that overall the sites inspected were performing well and that a number of sites were meeting a range of the more generic completion criteria targets. Monitoring also indicated that a number of TARP trigger conditions have been activated and a number of follow on actions will be required. An overview of TARP triggers is shown in **Table 62** and presented in **Figure 97** and an assessment of the monitoring results against the current MOP criteria is provided in **Appendix E**.

Table 62 - Summary of 2020 rehabilitation monitoring inspections

		TARP Element																				
Type of Monitoring	Monitoring Location	Erosion Control			Pasture Cover			Pasture Weeds			Pasture Species Composition			Woodland Cover			Woodland Weeds			Woodland Species Composition		
		Green	Amber	Red	Green	Amber	Red	Green	Amber	Red	Green	Amber	Red	Green	Amber	Red	Green	Amber	Red	Green	Amber	Red
IEM Pasture	HVOWES20150101		x						x				x									
	HVOWES20150102								x				x									
	HVOWES20150103								x				x									
	HVOWES20150104								x				x									
	HVOWES20190201		x						x													
	HVOWIL20190101		x			x																
	HVOWIL20190102		x			x																
	HVOWIL20190103		x			x																
LTM Pasture	HVOWES20150201								x				x									
	HVOWES20150202								x				x									
	HVOWES20150203								x				x									
	HVOWES20150204								x				x									
	HVOWES20160301								x				x									
	HVOWES20160302								x				x									
	HVOWES20160303								x				x									
IEM Woodland	HVOCHE20150301		x															x				
	HVOCHE20150302		x																		x	
	HVOCHE20150303		x																x		x	
	HVOCHE20180101		x															x				
	HVORIV20180201																	x			x	
	HVORIV20180202																				x	
	HVORIV20180203																					
	HVORIV20180204		x																x			
	HVORIV20180301		x															x				
	HVORIV20180302																	x				
	HVORIV20180303		x															x				
	HVOWES20150301																		x			
	HVOWES20150302																		x			
	HVOWES20150303																		x			
LTM Woodland	HVORIV14150101		x																x			
	HVORIV14150102		x																x			x

	HVORIV14150103		x															x				
	HVORIV14150104		x															x				x
	HVOWES20160201																	x				
	HVOWES20160202		x															x				

	Summary Assessment of MOP completion criteria	**Summary Assessment of TARP Triggers**
IEM Pasture Sites	Erosion and sediment control targets have been met at all sites. The 'weed presence' target is met at all HVOWIL201901 sites, but not met at the HVOWES201501 sites, or the HVOWES20190201 site. The 'total groundcover' target is met at the HVOWES201501 sites and the HVOWES20190201 site, but not at the HVOWIL201901 sites. The correlation between 'weed presence' and 'total groundcover' suggests that weeds are contributing largely to the total groundcover score. 'Species abundance' data collected by the GCAA (2020) method does not correlate well to the MOP completion criteria and was unable to be assessed against completion criteria.	The amber trigger for 'erosion' is activated for all HVOWIL201901 sites as well as the following HVOWES sites: HVOWES20150101, HVOWES20190201. The TARP response requires that a site inspection is undertaken by a suitably trained person at these sites to investigate opportunities to install water management infrastructure or other controls to address erosion, followed by remediation. The amber or red trigger for 'pasture cover' is activated for all HVOWIL201901 sites, meaning the following TARP responses are required: Review procedures where required to increase vegetation cover; or An inspection of the site will be undertaken by a suitably trained person. Investigate use of appropriate management options to remediate. Remediate as appropriate. The amber trigger for 'pasture weeds' is activated for HVOWES201501 sites and the HVOWES20190201 site, meaning the following TARP response is required: "Review monitoring report to identify the nature of the weeds present and recommendations from monitoring report. Undertake weed control to remove noxious and problematic weeds if required." The red trigger is activated for 'pasture species composition' at all IEM Pasture sites that trigger IEM meaning that the following TARP response is required: an inspection is to be undertaken by a suitably trained person to investigate remedial options to achieve the required species composition at all IEM Pasture sites. The remaining sites have not elapsed the initial two year period prior to IEM.

	Summary Assessment of MOP completion criteria	Summary Assessment of TARP Triggers
LTM Pasture Sites	Erosion and sediment control targets have been met at all sites. The 'weed presence' target has not been met for any of the LTM Pasture sites. The 'total groundcover' target is met at all LTM Pasture sites. 'Species abundance' data collected by the GCAA (2020) method does not correlate well to the MOP completion criteria and was unable to be assessed against completion criteria.	All sites were green for 'erosion' and 'pasture cover', meaning no response is required (apart from ongoing monitoring). The amber trigger for 'pasture weeds' is activated for all LTM Pasture sites, meaning that the following TARP response is required: "Review monitoring report to identify the nature of the weeds present and recommendations from monitoring report. Undertake weed control to remove noxious and problematic weeds if required." The red trigger is activated for 'pasture species composition' at all LTM Pasture sites meaning that the following TARP response is required: an inspection is to be undertaken by a suitably trained person to investigate remedial options to achieve the required species composition at all IEM Pasture sites.
IEM Non-specific Woodland Vegetation Sites	Erosion and sediment control targets have been met at all sites. 'Weed', 'Groundcover', 'Understorey', 'Tree Diversity' and 'Reproductive Structure' collected by the GCAA (2020) method do not correlate well to the MOP completion criteria and were unable to be assessed against completion criteria.	The amber trigger for 'erosion' is activated for HVOCHE20180101, HVORIV20180204, HVORIV20180301, HVORIV20180303, as well as for all HVOCHE201503 sites. The TARP response requires that a site inspection is undertaken by a suitably trained person at these sites to investigate opportunities to install water management infrastructure or other controls to address erosion, followed by remediation. 'Woodland cover' is green at all IEM Non-specific Native Vegetation sites, meaning no response is required (apart from ongoing monitoring). The amber trigger for 'woodland species composition' is activated for the following sites: HVOCHE20150302, HVOCHE20150303, HVORIV20180201, HVORIV20180202. This means that the following TARP response is required: an inspection of the site is to be undertaken by a suitably trained person to investigate remedial options to achieve the required species composition.
LTM Non-specific Woodland Vegetation Sites	Erosion and sediment control targets have been met at all sites.	The amber trigger for 'erosion' is activated for HVOWES20160202, as well as for all HVORIV141501 sites. The TARP response requires that a site inspection is undertaken by a suitably trained person at these sites to investigate opportunities to install water management

	Summary Assessment of MOP completion criteria	**Summary Assessment of TARP Triggers**
	The targets for ‘reproductive structures’ are met at HVORIV14150103, HVORIV14150104 as well as the HVOWES201602 sites, but not met at two sites (HVORIV14150101 and HVORIV14150102). ‘Weed’, ‘Groundcover’, ‘Understorey’ and ‘Tree Diversity’ collected by the GCAA (2020) method do not correlate well to the MOP completion criteria and were unable to be assessed.	infrastructure or other controls to address erosion, followed by remediation. ‘Woodland cover’ is green at all LTM Non-specific Native Vegetation sites; accordingly, no TARP response is required (apart from ongoing monitoring). The amber trigger for ‘woodland species composition’ is activated for the following sites: HVORIV14150102 and HVORIV14150104. The TARP response requires an inspection of the site to be undertaken by a suitably trained person that will investigate remedial options to achieve the required species composition.

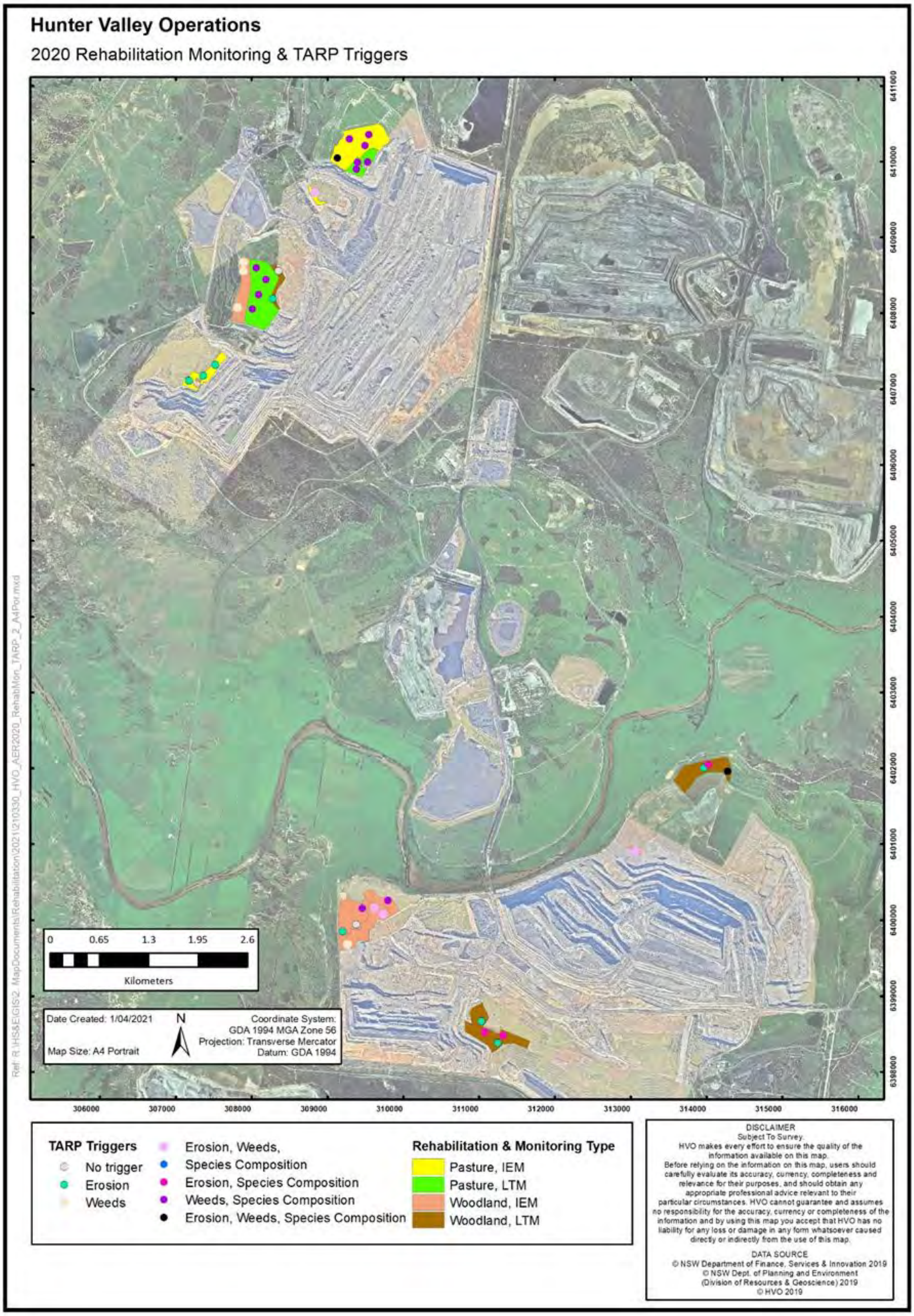

Figure 97 - Overview of 2020 rehabilitation monitoring inspections and associate TARP triggers

(Note: pasture and woodland cover have been exclude due to limited triggers relative to other elements)

8.8 Overview of Rehabilitation Trajectory

The limited scope of rehabilitation monitoring and absence of reference sites makes clear assessment of the current rehabilitation trajectory somewhat difficult. Despite this, sites assessed during the 2020 monitoring event can be seen to be meeting a range of completion criteria targets against which assessment is possible.

The primary risk to successful rehabilitation establishment and progression remains weed competition. This is supported by the elevated number of monitoring sites which have activated weed presence TARP triggers. The strong commitment to timely implementation of rehabilitation maintenance actions which has been occurring since a range of initial TARP triggers in 2018 should provide confidence of ongoing timely action to understand and address these emerging issues. Corrective actions to address the triggers will be integrated to the existing rehabilitation maintenance program.

TARP triggers for species composition amongst long term monitoring sites are also of some concern however given the likelihood that the establishment of woodland species has been delayed due to relatively dry climatic conditions prior to 2019 it is possible that greater species richness will develop naturally in association with the activation and emergence of further stems with time. As only 5 of the 20 total woodland sites have triggered in this regard and only 1 of 6 amongst the long term monitoring plots suggests woodland sites are not currently at risk.

The relatively high incidence of composition triggers amongst both initial and long term monitoring sites may suggest trajectory issues however it is possible that the species composition trigger in the long term pasture monitoring blocks is over-representing TARP trigger conditions in these blocks. This is due to a narrow definition of pasture species arising from Pasture varieties used in NSW 2012-13 (DPI, 2012) which does not consider the native species represented by the Pasture Light Woodland seed mix used in these areas. The stable nature and relative absence of vegetative cover issues supports the likelihood that composition will trend favourably with time provided weed threats are effectively managed. Refinement of the monitoring methodology and more explicit definition of pasture species for future monitoring events based on the species sown will provide confidence when future monitoring results are assessed.

Although a number of sites have activated erosion triggers all erosion scores were relatively low. Exclusion of sites not located on slopes leaves 7 of 35 sites with a low level trigger and appropriate to be addressed by site specific actions and not a risk to landform stability.

Reproduction via flowering and fruiting is occurring at most woodland sites and canopy cover at woodland sites was found to be generally good.

Broadly then, and provided the identified TARP triggers are appropriately addressed, the rehabilitation sample associated with this monitoring event can be seen to be trajecting in a generally favourable manner to support achieving rehabilitation completion in the long term. As further targeted maintenance interventions are undertaken in association with the ongoing maintenance plan this success trajectory may be expected to be more obviously demonstrated across the rehabilitation sites.

Development of aligned SMART completion and TARP criteria and an associated refined methodology for future monitoring events will allow increased confidence in assessing rehabilitation trajectory at future events. It is expected that this will be progressed prior to the next monitoring event in Spring 2021.

8.9 Rehabilitation Maintenance

Management of rehabilitated areas is undertaken proactively to assist in initial establishment and when issues are identified through monitoring, auditing or inspections.

An overview of key rehabilitation maintenance activities is shown in **Figure 98** and detailed below.

Section 240 Maintenance Program

During 2019 HVO developed and committed to a rehabilitation maintenance and improvement program in response to concerns from Resources Regulator about progressive rehabilitation performance across the site. This plan integrates and prioritises rehabilitation maintenance activities across the site to progress areas of rehabilitation initially sown to cover crop, manage weed competition, and encourage vegetation establishment. An overview of Plan and work undertaken during 2020 is presented in Appendix C, in addition to being detailed further below.

Broadacre maintenance

Broadacre weed treatment within rehabilitation areas is undertaken using agricultural methods comprising boom sprays, wick wipers, slasher/mulchers, aerators and seeding implements. In existing rehabilitation areas boom spraying is primarily used to manage cover crop and fallow areas prior to sowing to final native seed mixes. Pre-emergent application of herbicide is used when appropriate necessary to control emerging weeds in the period between sowing and germination of the desired species. Wick wiping targets rapidly growing exotic grasses and other erect growing weeds in the period following native germination but while desirable species remain below the wiper target zone. Slashing and mulching is used to remove rank pasture grasses and stimulate fresh growth as herbicide target and to truncate seed cycles. Aeration is used to prepare ground for seeding and to undertake rill repairs. During 2020 areas totalling 216 ha were boom sprayed, 158 ha was slashed or mulched, 84ha was aerated prior to seeding or in undertaking surface stability repairs.

Native seed mixes are sown as part of the maintenance program where areas have been sown to an initial cover crop or where areas previously sown to native have not established successfully. During 2020 53.2 ha of historic Growth Medium Development phase rehabilitation was progressed to final native cover and 13.1 ha of additional maintenance seeding was undertaken in augmentation works and seeding of topsoil stockpiles.

Ground based interventions

Hand spraying and manual removal of weeds is undertaken in rehabilitation areas with early stage and establishing native vegetation that would be likely to be damaged or destroyed should broadacre methods be used. During 2020 129 ha of rehabilitation areas at various stages of establishment were treated by ground crews in this manner.

Grazing of Rehabilitation Areas

Grazing of rehabilitation areas is utilised to encourage and maintain pasture diversity, encourage nutrient cycling, and assist in fuel load management. A licence agreement is in place for grazing 666 ha of HVO North rehabilitation area, with temporary fuel load licences across a further 394 ha of rehabilitated land around HVO North and 210 ha around HVO South. Opportunities to integrate grazing to assist rehabilitation progression continue to be assessed and initial projects to install fencing and stock watering at Cheshunt rehab are planned to commence during 2021.

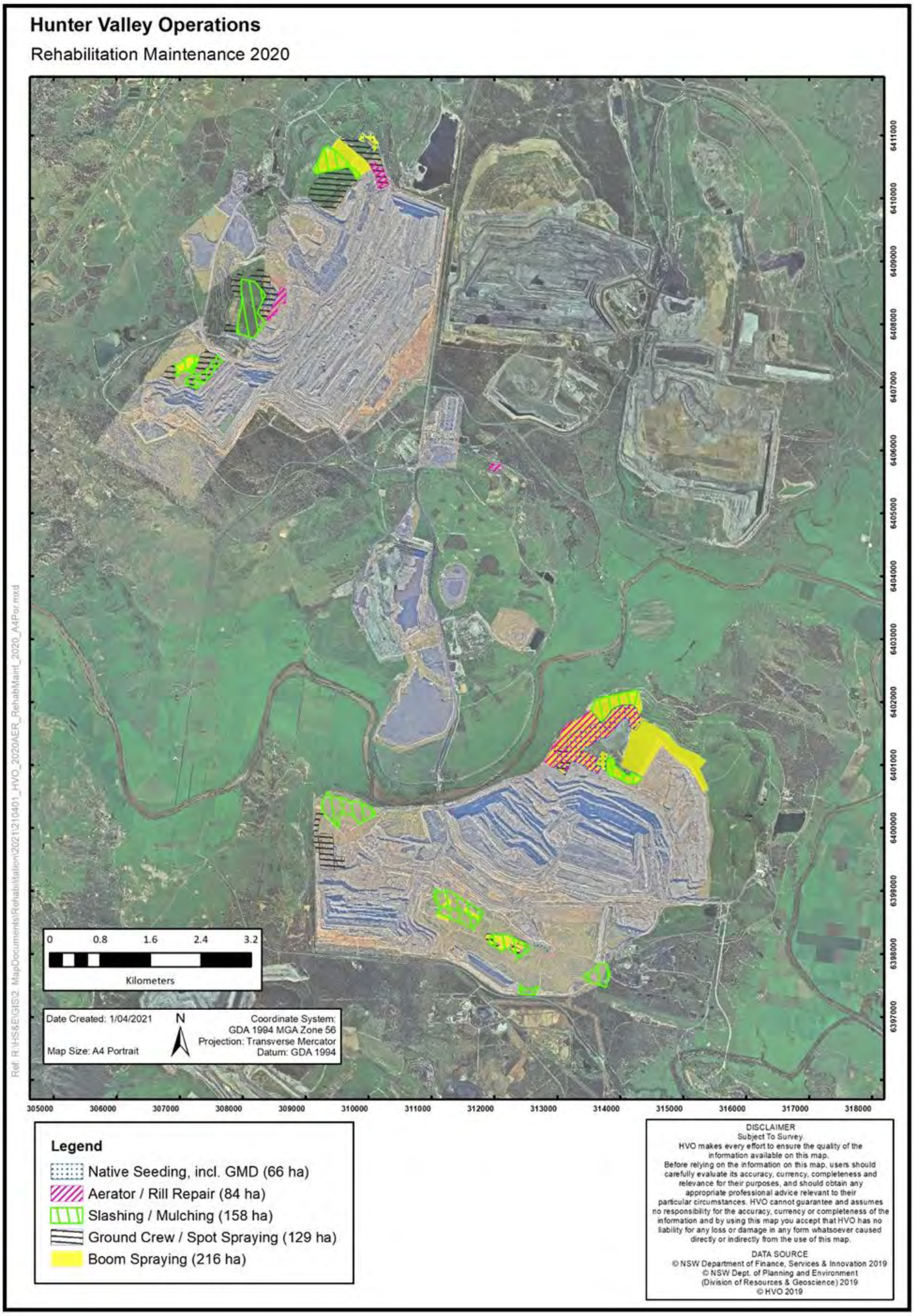

Figure 98 - Rehabilitation Maintenance – post-rehabilitation weed control

8.10 Vertebrate Pest Management

A number of baiting programs are carried out on a seasonal basis as part of the HVO Vertebrate Pest Action Plan. These programs are conducted at a level of frequency designed to disrupt pest species breeding/colonisation cycles and employ a variety of methodologies including baiting, trapping and ground based shooting

Wild Dog and Fox Baiting Programmes

Three 1080 ground baiting programs targeting wild dogs and foxes were implemented across operational and biodiversity areas. These were undertaken during summer, winter and spring. Each program consisted of approximately 60 bait sites utilising meat baits and ejector baits. Baits were checked over a three week period and replaced each week when taken.

Pig Trapping

One synchronised 1080 pig trapping program was conducted by HVO in conjunction with the Singleton Local Land Services (branch) and adjoining corporate landholders in July 2020. The program consisted of 8 trap stations equipped with ‘Hog eye cameras’. The trap station at the Archerfield properties accounted for 18 pigs across the ten day program. Pig sightings and numbers are declining and this is attributed partly to the numbers of pigs successfully controlled in previous programs and the benefits of synchronising control activities with neighbours.

Ground Based Shooting

HVO has two shooters attending the site on a regular basis opportunistically controlling feral pest species. Feral species controlled include pigs, wild dogs, foxes, hares/ rabbits and cats.

Table 63 summarises the results from the programmes carried out at HVO during 2020 with wild dog and fox baiting locations and results for the programs illustrated in **Figure 101, Figure 102** and **Figure 103**.

Table 63 - Summary of Vertebrate Pest Management 2020

Season	1080 Baiting				Trapping		Shooting			
	Total Lethal Baits Laid	Takes by Wild Dog	Takes by Fox	Takes by Feral Pig	Wild Dog	Feral Pig	Feral Pig	Wild Dog/ Fox	Feral Cat	Hares & Rabbits
Summer	140	72	4	0	0	0	0	0	0	0
Autumn-Winter	118	44	15	0	0	18	2	9	0	47
Spring	120	56	4	0	0	0	0	5	0	12
Total	**378**	**172**	**23**	**0**	**0**	**18**	**2**	**11**	**0**	**59**

Table 64 provides a comparison of results from the last 16 baiting programmes undertaken at HVO. In 2020, as for previous programs undertaken at HVO, the vast majority of baits showed evidence of being consumed by wild dogs at 89% with foxes taking 6%, and 5% of baits being consumed by non-target species.

Results reported indicate the majority of takes by dogs or foxes, and photographic evidence taken in previous programs indicate a high populations of wild dogs in the area. The number of takes by dogs in spring has increased (56 takes currently compared to 44 in the last program); and by foxes has decreased (four in the current program compared to fifteen in the last). The changes may reflect an increase in dog population and a subsequent decrease in fox population from competition for territory and / or prey. Seasonal changes may also be affecting foraging patterns.

It is, however, becoming increasingly apparent as motion sensor camera photographic data is processed, that non-target species including Australian ravens and lace monitor lizards are digging up and extracting meat baits.

Table 64 - Comparison of results between baiting programmes at HVO

Baiting Program	No. of Baiting Sites	Baiting Opportunities	Baits taken by Dogs	Dog (%)	Baits taken by Foxes	Fox (%)	Baits taken by non-target species	Other (%)	Total No. of Baits Taken	No. Sites where baits taken at least once	Represented as Percentage (%)	No. sites with baits taken on all occasions	No. sites with no baits taken	No. baits Disturbed Not Taken	No. baits taken alternatively by Dog or Fox	Baiting Efficiency %	Baiting efficiency excluding 'other'
1506 HVO	40	120	55	98%	0	0%	1	2%	56	31	76%	5	9	1	0	47%	46%
1510 HVO	60	180	71	89%	8	10%	1	1%	80	43	72%	10	17	4	5	44%	44%
1602 HVO	60	120	49	92%	3	6%	1	2%	53	42	70%	13	18	0	2	44%	43%
1606 HVO	60	180	94	96%	4	4%	0	0	98	54	90%	10	6	6	4	54%	54%
1609 HVO	60	180	83	94%	5	6%	0	0%	88	49	82%	11	11	12	3	49%	49%
1702 HVO	59	117	58	84%	10	14.5%	1	1.5%	69	49	87%	20	11	7	5	59%	58%
1705 HVO	60	120	70	95%	4	5%	0	0%	74	51	85%	23	9	3	0	62%	62%
1709 HVO	60	120	67	96%	3	4%	0	0	70	48	80%	22	12	5	2	58%	58%
1803 HVO	60	120	69	90%	6	8%	2	2%	77	49	82%	31	11	7	0	64%	63%
1806 HVO	60	120	77	94%	5	6%	0	0%	82	50	83%	32	10	8	4	68%	68%
1809 HVO	61	122	73	87%	10	12%	1	1%	84	50	82%	34	11	2	6	69%	68%
1905 HVO	64	124	61	85%	10	14%	1	1%	72	50	78%	22	17	8	8	64%	63%
1910 HVO	60	120	66	93%	4	6%	1	1%	71	48	80%	23	12	9	2	59%	58%
2002 HVO	60	140	72	94%	4	5%	1	1%	77	48	80%	2	12	9	2	55%	54%
2005 HVO	60	118	44	71%	15	24%	3	5%	62	41	68%	21	19	12	6	53%	50%

2010 HVO	60	120	56	89%	4	6%	3	5%	63	43	72%	20	17	7	2	53%	50%
												Average Baiting Efficiency				56%	56%

Figure 99 - A Lace Monitor captured on motion sensor camera at bait site 25

When assessing bait sites in the field, it is often difficult to determine if wild dogs, ravens or goannas have taken the meat baits as dogs and goannas have been photographed sniffing and investigating bait sites (**Figure 99** and **Figure 100**) within days of each other.

Figure 100 - Wild Dog at Bait Site 25

The increase in bait takes by non target animals is disconcerting and may be attributed to the Spring Baiting Program being carried out later in the season than usual (October – November). Contractors have recommended that the program be carried out ideally in early September, before the lace monitors reach peak feeding in their breeding season.

Dates for Wild dog baiting programs are synchronised with programs run by the Local land Services and neighbouring mining/corporate entities. Moving the timing back for these programs will be a discussion item at future regional vertebrate pest management meetings.

Vertebrate pest management programmes will continue to be carried out during 2021 to limit feral pest impacts on landholdings and surrounding neighbours.

Figure 101 - HVO Vertebrate Pest Management Bait Locations – Summer 2020

Figure 102 - HVO North Vertebrate Pest Management Bait Locations – Autumn 2020

Figure 103 - HVO Vertebrate Pest Management Bait Locations – Spring 2020

8.11 Supplementary Weed Treatment

HVO has areas of biodiversity habitat that has regrown with the reduction of agriculture and grazing pressures. In addition to the rural buffer lands, these vegetated areas also include riparian habitats along the Hunter River and Wollombi Brook and vegetated areas adjacent to rehabilitation and mining areas. These stands are increasingly being managed to reduce weed invasion, feral animal disturbance and overgrazing by vertebrate pests.

Weed surveys that incorporate these vegetated areas are undertaken annually. The increased rainfall during 2020 resulted in a proliferation of weeds occurring across these areas – a response typical across the wider Hunter Valley. While these 'remnant' vegetation areas will receive greater attention during 2021, within the 2020 reporting period, several areas were managed to reduce the weed load. The management activities included slashing and targeted spraying of the key species.

The weeds targeted during the 2020 weed management programme were based on the results of the 2019 weed survey and observations that occurred throughout the 2020 growing season

The dominant weed species that were targeted during 2020 included:

- African boxthorn *(Lycium ferocissimum)*
- African olive *(Olea europea)*
- Balloon vine *(Cardiospermum grandiflorum)*
- Bathurst burr *(Xanthium spinosum)*
- Galenia *(Galenia pubescens)*
- Grasses *(Various spp)*
- Green cestrum *(Cestrum parqui)*
- Mallow *(Malva parviflora)*
- Mustard weed *(Sisymbrium officinale)*
- Narrow leaf cotton bush *(Gomphocarpus fructicosis)*
- Opuntia (Pear) species *(Tiger, Prickly and Creeping pear)*
- Saligna / Golden wreath wattle *(Acacia saligna)*
- Various thistles: Scotch thistle (*Onopordum acanthium*), saffron thistle *(Carthamus lanatus)* and variegated thistle (*Silybum marianum)*

8.12 Renovations

8.12.1 Derelict Rural Buildings

HVO completed the demolition of two derelict rural buildings located within its rural property portfolio. Works included the decommissioning of septic systems, asbestos removal, the salvage/ recycling of building materials (where feasible) and restoration of vegetation cover. Works were undertaken in compliance with relevant Australian Standards and Legislation.

8.13 Topsoil Management

Topsoil is managed according to the HVO Ground Disturbance Permit system and land management procedures. **Table 65** outlines the topsoil used and stockpiled during 2020. There were 94.0 ha of rehabilitation completed during 2020, using soil resources from ahead of mining pre-strip and rehabilitation disturbance activities.

Table 65 - Soil Management

Soil Used This Period (m^3)	Soil Prestripped This Period (m^3)	Soil Stockpiled to Date (m^3)	Soil Stockpiled Last Report (m^3)
109,691	95,226	2,204,427	1,879,745

*includes estimated 16,589m^3 underlying new topsoil stockpiles.

2019 Topsoil Audit

On 5 June 2019 Resources Regulator undertook an audit to assess operational performance of HVO South in relation to the management of topsoil and the implementation of management systems and controls to provide for the sustainable management of the mine's topsoil resources.

The audit identified one non-conformance and made five observations. Remaining actions arising from the audit were completed during 2020 or addressed within the HVO Topsoil Management Plan which was drafted during the reporting period and finalised in early 2021.

Full details of the audit are contained in *Compliance Audit Report, Hunter Valley Operations South – Topsoil Management* (COC19/704213) available on the Resources Regulator and HVO Insite website.

8.14 Tailings Management

HVO operates in accordance with a Fine Rejects Management Strategy developed in accordance with the planning approval for HVO North (Clause 28A of DA 450-10-2003 Mod 4). The strategy outlines tailings management for the time horizon spanned by the current approvals. A revised strategy will be submitted in 2021 to reflect deposition tailings in Carrington Pit and implementation of the North Void TSF seepage management activities.

Key Tailings Management Activities in 2020, included:

- Capping of the Southeast TSF remained ongoing.
- Review & adjustment of Secondary Flocculent dosage into Carrington In Pit TSF, to improve beaching;
- Temporary cessation of deposition into Dam 6W TSF, allowing time for consolidation prior to final top up deposition;
- Ongoing implementation of the North Void TSF Management Plan to manage and mitigate any potential impacts from an identified seepage pathway. Provision of quarterly and annual analysis reports to EPA;
- Design of the first capping stages of Bob's Dump completed; ready for implementation in 2021;

Table 68 below outlines the current state of Tailings Storage Facilities across HVO that are still active or pending decommissioning.

Table 66 - HVO Tailings Storage Facilities

Facility	Status	Decant System
North Void	Inactive	Decant pumps in place, regular pumping.
Dam 6W	Active (not currently depositing)	Decant pumps in place, regular pumping.
Cumnock Void	Active (HVO not currently depositing)	Decant pump in place, regular pumping when deposition occurring.
Bob’s Dump	Inactive; preparation for decommission	Solar pump in place, pumping as required.
Southeast TSF	Inactive - capping commenced	Solar pump in place, pumping as required.
Central TSF	Inactive	No pumps required due to drying after rainfall (small catchment reporting to TSF).

8.15 River Red Gum Restoration and Rehabilitation

8.15.1 River Red Gum Overview

As part of a development consent (DA 450-10-2003) to extend mining at the Carrington Pit, Hunter Valley Operations (HVO) were required to prepare and implement a comprehensive Rehabilitation and Restoration Strategy for Carrington Billabong and its *Eucalyptus camaldulensis* (River Red Gum) population. River Red Gums have become increasingly rare in the Hunter Valley, and the entire population occurring within the Hunter catchment is now listed as an Endangered Population under the NSW Biodiversity Conservation Act 2016.

There are a number of River Red Gum sites across HVO South and North. The locations are shown in **Figure 104**. The stands are managed in accordance with the HVO River Red Gum Restoration and Rehabilitation Strategy (Strategy) (HVO 2020).

The Strategy has an established monitoring programme of the river red gum subpopulations and vegetation communities in Carrington Billabong and priority sites on the Hunter River and Wollombi Brook in HVO North and South. The Strategy was updated during 2020 to incorporate the results of the 10 year monitoring programme.

The sites have been categorised into a high level of management at the Carrington Billabong, intermediate level at the priority sites and low level at the low priority sites. Each has varying levels of monitoring and maintenance requirements as outlined in the Strategy.

The objectives of the monitoring program at Carrington Billabong are to:

- determine if there is any improvement or deterioration in RRG within Carrington Billabong
- determine if there is any improvement or deterioration of the natural habitat at Carrington Billabong
- provide management recommendations to achieve further improvements in the ecological management of the site to assist in the recovery of RRG and their habitat.
- remove any potential influence that mining activities at HVO may have on the population, the monitoring results are compared to a reference site to the north of HVO that is not within a mining area.

Management activities undertaken within the HVO River Red Gum areas include ecological monitoring, which included floristic survey, seedling survey and a remnant ecological heath assessment.

In addition, an ecological risk assessment, rabbit warren and weed species inspections, weed control and vertebrate pest management were undertaken in 2020. These activities are discussed further in the following sections.

8.15.2 RRG Monitoring Activities

Rainfall and recruitment

Above average rainfall in 2020, following years of below average rainfall, have resulted in a landscape-scale change to environmental conditions. The regeneration and recruitment among stands of River Red Gums increases following flood events. Despite the increased rainfall in 2020, it was not sufficient to flood the Carrington Billabong or the Reference Site. Isolated inundation of depressions and low-lying areas was, however, evident at the Reference Site.

The 2020 monitoring period recorded an increase in species diversity, vegetative cover and canopy health. These progression of categories was similar in previous years, and trends and changes observed at Carrington Billabong were largely consistent with the observations recorded at the Reference Site.

Floristic survey

The survey compared plots established within the Carrington Billabong with plots within the reference site. Within the Billabong, 28 (42%) native species and 39 (58%) exotic species were identified. Within the reference site, 19 (34%) native species and 37 (66%) exotic species were recorded. A comparison of the data recorded during the 2020 monitoring period to previous monitoring events that have occurred since 2007, noted a general increase in species diversity, both native and exotic, over time.

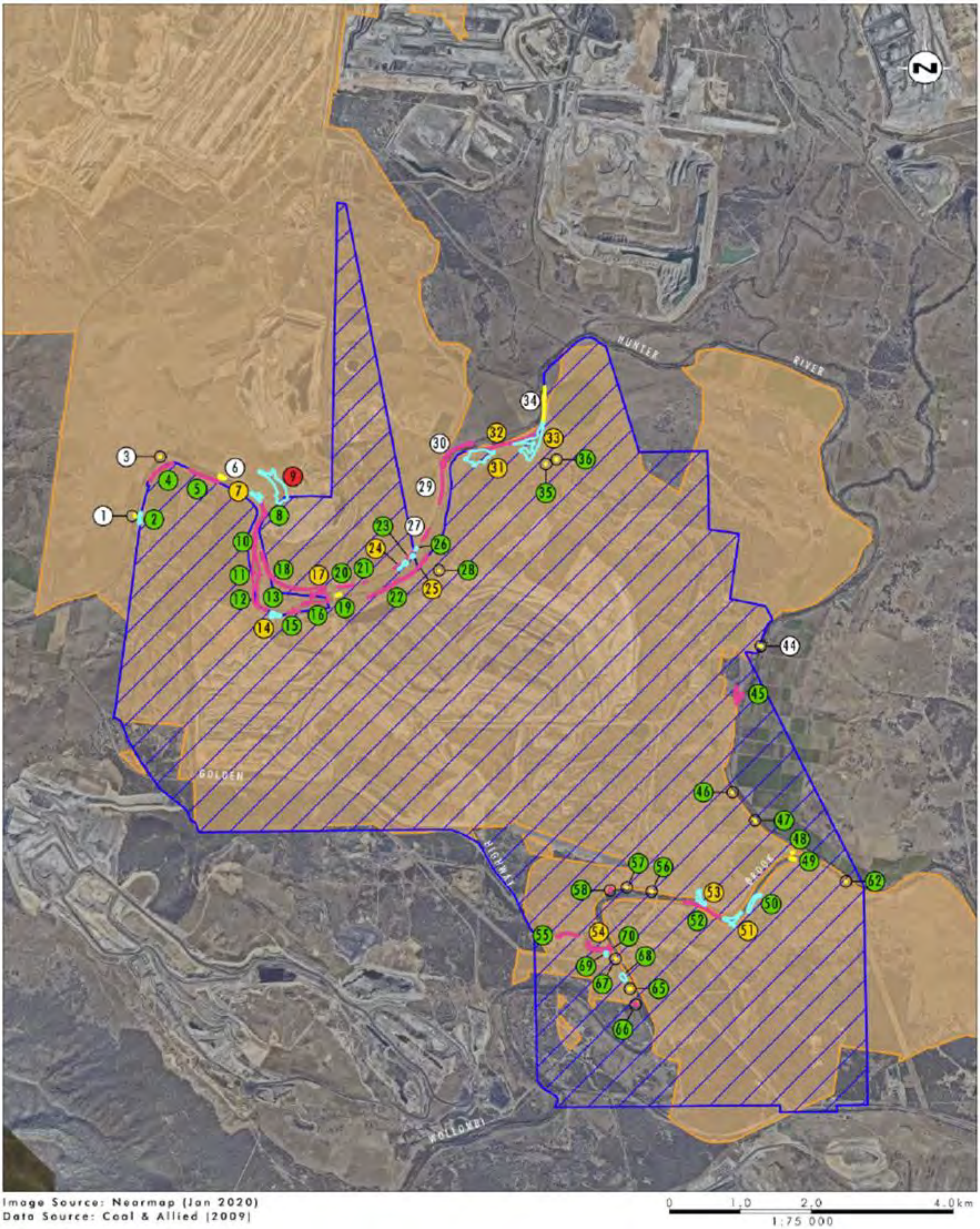

Figure 104 - Eucalyptus camaldulensis stands being managed at HVO.

Health monitoring

The health of 63 RRG were recorded during monitoring at Carrington Billabong out of the 140 trees that were originally tagged in 2007 during baseline survey. Generally trees were in similar or improved condition compared to baseline data, although with the decline in the number of tags remaining on trees, drawing broad, meaningful comparisons between the data collected in 2020 to previous years is difficult. Rather, changes to individual trees has been colour coded in **Table 69**. Comparing the 2020 data for canopy condition against that recorded in 2017, the average canopy health score increased from 2.4 in 2017 to 3.8 in 2020. Remnant Ecological Health Assessments (REHA) were conducted at sites at Carrington Billabong, the Reference Site and Priority Sites. Additional sites were sampled at Carrington Billabong and the Reference Site where floristic and seedling assessments were conducted.

The sum of scores from the REHA for 2020 and previous years are provided in **Table 68**. Sites with higher scores are in better condition with the maximum potential score being 39. The assessment determined that the summed scores were similar or higher to previous years.

Table 67 - Observations that relate to the monitoring objectives.

Goals	Objectives	2020 Observations
To reduce the impacts of threatening processes on the stands	To supress or eradicate the *in situ* environmental factors that are acting to reduce the viability of the remnant population	Weeds continue to dominate the species assemblage at Carrington Billabong, and priority sites. While the data mirrors trends at the Reference Site, the previous 10 years of data suggests that active management and restoration is required to "supress and eradicate" this threat. Flooding is required for germination of RRG. Carrington Billabong appears to continue to be subject to isolated/patchy areas of inundation that has resulted in small germination events.
	To improve the conditions within this population such that it can withstand reasonable periods of stress, predation and shortage of water supply	Average tree health and canopy condition data showed an improvement since 2017.
To aid the establishment of the appropriate conditions to promote the health of the River Red Gum populations	To identify the likely *ex situ* factors that are contributing to the reduction in viability of this population and the health of the billabong and act, where possible, to control those factors or to take account of those factors in management approaches if they are not able to be directly controlled	The ERA outlines the groundwater exceedance issues around Carrington Billabong and, ecological monitoring and triggers. Refer to Error! Reference source not found..

Goals	Objectives	2020 Observations
	To ensure that the results of ongoing monitoring are appropriately used to modify the management regime in response to new or unexpected information	This report is provided to HVO to inform ongoing management decisions.
Increase the understanding of the water requirements of the River Red Gums	Develop an understanding of water requirements through the timely monitoring of responses of River Red Gums to flood and storm events	Groundwater monitoring is undertaken at Carrington Billabong. Flood modelling and commence to flow models will identify the flood levels required to inundate Carrington Billabong.
To enhance the River Red Gum population to enable it to persist as a viable functioning population	To assist this population to continue to self-propagate to ensure ample replacement of senescing trees with juvenile recruits.	Weeds continue to dominate the RRG community. It is likely that active management is required to assist the community to become a self sustaining population. However it is likely that, given the predominance of weeds in the area, that flooding, wind and other vectors affect ongoing weed management efforts.
	To support the establishment of a self-sustaining, functional and viable ecosystem that resembles what is likely to have been present in Carrington Billabong prior to European settlement	Species diversity is similar between Carrington Billabong and the Reference Site. Recruitment is evident at both Carrington Billabong and the Reference Site but no (likely) recent recruitment was noted. Remnant Ecological Health Assessments were similar at Carrington Billabong and the Reference Site, but Priority Sites were approximately 10-20%.
	To support the establishment of a self-sustaining, functional and viable ecosystem	
To increase biodiversity including residence habitat, foraging habitat and native flora and fauna species	To increase habitat for the identified and potential native flora and fauna species	The area of habitat has not increased for flora and fauna.
To determine if there is any improvement or deterioration in	Data shows a slight improvement in RRG condition. Average canopy health increased from 2.4 in 2017 to 3.8 in 2020	

Goals	Objectives	2020 Observations
RRG within Carrington Billabong		
To determine if there is any improvement or deterioration of the natural habitat at Carrington Billabong	Data shows a slight improvement in the condition of remnant vegetation at Carrington Billabong and Priority Sites	
To provide management recommendations to achieve further improvements in the ecological management of the site to assist in the recovery of RRG and their habitat	• Weed management • Flood and/or flow modelling of Carrington Billabong to understand flood levels that initiate commence to flow into the billabong Record the boundary and duration of inundation events within Carrington Billabong to identify potential areas for recruitment events/actions.	

Table 68 - A comparison of the remnant ecological health assessment scores between monitoring events.

Site	Remnant Ecological Health Assessment Score					
	2007	2008	2010	2012	2017	2020
CB1	21	25	27	24	28	30
CB2						28
CB3						31
CB4						30
CB5						27
HR1	25	21	25	26	26	27
HR2	32	32	28	25	25	25
HR8	23	23	2	25	24	28
HR11	26	28	25	25	26	26
HR13	24	26	26	24	24	26
WB1	28	28	27	29	26	29
CA1	29	27		31	31	31
CA2	26	25		26	28	30

Site	Remnant Ecological Health Assessment Score					
	2007	2008	2010	2012	2017	2020
CA3						30
CA4						30
CA5						30

Note: CB = Carrington billabong, HR = Hunter River sites, WB = Wollombi Brook sites,
CA = Camyr Allen (reference site)

Table 69 - Remnant Ecological Health Assessments comparison of 2017 and 2020

Tree Tag No.	Age Class	DBH (cm)	Canopy Density Estimate	Canopy Health	Flowering and/or fruiting evident (Y/N)	Hollows	Epicormic growth	Mistleto e	Insect/funga l attack
H61	Mature	48	10-20	Stressed	Y	2-5	Nil-low	0-5	Nil-low
H62	Mature	65	20-30	Slightly stressed	Y	0	Nil-low	0-5	Nil-low
H63	Mature	98	30-40	Healthy	Y	2-5	Nil-low	0-5	Nil-low
H64	Mature	95	30-40	Slightly stressed	Y	2-5	Nil-low	0-5	Nil-low
H66	Mature	36	30-40	Healthy	Y	0	Nil-low	0-5	Nil-low
H67	Mature	36	30-40	Healthy	Y	0	Nil-low	0-5	Nil-low
H69	Mature	85	10-20	Healthy	Y	2-5	Moderate	0-5	Nil-low
H70	Mature	95	30-40	Slightly stressed	Y	6-10	Moderate	0-5	Nil-low
H71	Mature	89	30-40	Healthy	Y	0	Nil-low	0-5	Nil-low
H72	Mature	63	20-30	Healthy	Y	2-5	Nil-low	0-5	Nil-low
H73	Old Growth	121	30-40	Slightly stressed	Y	10+	Nil-low	0-5	Moderate
H74	Old Growth	135	10-20	Slightly stressed	Y	10+	Nil-low	0-5	Nil-low
H75	Mature	71	20-30	Stressed	Y	2-5	Moderate	0-5	Nil-low
H76	Old Growth	82	20-30	Slightly stressed	Y	2-5	Nil-low	0-5	Nil-low
H77	Old Growth	87	20-30	Stressed	N	6-10	Nil-low	0-5	Nil-low
H78	Old Growth	180	20-30	Slightly stressed	Y	10+	Nil-low	0-5	Nil-low
H79	Mature	111	30-40	Healthy	Y	6-10	Nil-low	0-5	Moderate
H80	Old Growth	106	20-30	Slightly stressed	Y	6-10	Nil-low	0-5	Nil-low
H81	Mature	93	20-30	Healthy	Y	2-5	Nil-low	0-5	Nil-low

Tree Tag No.	Age Class	DBH (cm)	Canopy Density Estimate	Canopy Health	Flowering and/or fruiting evident (Y/N)	Hollows	Epicormic growth	Mistletoe	Insect/fungal attack
H82	N/A	114	0	Dead	-	2-5	-	-	Nil-low
H83	N/A	58	0	Dead	-	0	-	-	Nil-low
H84	Old Growth	125	20-30	Slightly stressed	Y	10+	Nil-low	0-5	Nil-low
H86	Mature	97	40-50	Healthy	Y	2-5	Nil-low	0-5	Nil-low
H87	Old Growth	186	30-40	Slightly stressed	Y	10+	Nil-low	0-5	Nil-low
H88	Old Growth	123	30-40	Healthy	Y	6-10	Nil-low	0-5	Nil-low
H89	Old Growth	124	30-40	Slightly stressed	N	0	Nil-low	0-5	Nil-low
H90	Old Growth	123	20-30	Healthy	Y	10+	Nil-low	0-5	Nil-low
H91	Mature	117	20-30	Healthy	Y	10+	Nil-low	0-5	Nil-low
H92	Mature	92	40-50	Healthy	Y	1	Nil-low	0-5	Nil-low
H93	Mature	121	20-30	Slightly stressed	N	2-5	Nil-low	0-5	Nil-low
H94	Mature	84	20-30	Healthy	Y	2-5	Nil-low	0-5	Nil-low
H95	Old Growth	148	10-20	Stressed	N	6-10	Nil-low	0-5	Nil-low
1	N/A	102	0	Dead	N	10+	Nil-low	0-5	N/A
2	Old Growth	144	0-10	Slightly stressed	Y	10+	Nil-low	0-5	Nil-low
3	Old Growth	107	40-50	Stressed	Y	10+	Nil-low		Nil-low
4	Old Growth	75	20-30	Healthy	Y	10+	Nil-low	0-5	Nil-low
5	Old Growth	151	30-40	Healthy	Y	6-10	Nil-low	6-10	Nil-low
6	Old Growth	183	20-30	Healthy	Y	2-5	Nil-low	0-5	Nil-low
8	Mature	76	30-40	Healthy	Y	2-5	Nil-low	0-5	Nil-low
9	Old Growth	83	0-10	Stressed	Y	10+	Moderate	0-5	Nil-low
13	Old Growth	87	30-40	Slightly stressed	N	6-10	Nil-low	0-5	Moderate

Tree Tag No.	Age Class	DBH (cm)	Canopy Density Estimate	Canopy Health	Flowering and/or fruiting evident (Y/N)	Hollows	Epicormic growth	Mistleto e	Insect/funga l attack
Not labelled 14?	N/A	74	0	Dead	-	2-5	-	-	Severe
Not labelled 18? (near H70)	Mature	62	20-30	Healthy	Y	2-5	Nil-low	0-5	Nil-low
19	Mature	102	30-40	Healthy	Y	6-10	Nil-low	0-5	Nil-low
21	Mature	96	10-20	Slightly stressed	Y	2-5	Nil-low	0-5	Nil-low
25	Mature	53	30-40	Stressed	Y	2-5	Nil-low	0-5	Nil-low
26	Mature	60	20-30	Slightly stressed	Y	2-5	Nil-low	0-5	Nil-low
27	Mature	84	20-30	Slightly stressed	Y	2-5	Moderate	0-5	Nil-low
30	Mature	53	0-10	Near dead	N	0	Nil-low	0-5	Severe
31	N/A	20	0	Dead	-	1	-	-	Moderate
32	Mature	84	30-40	Slightly stressed	Y	1	Nil-low	0-5	Nil-low
52	Mature	72	30-40	Stressed	Y	0	Nil-low	0-5	Nil-low
60	Mature	127	20-30	Slightly stressed	Y	10+	Nil-low	0-5	Moderate
66	N/A	126	-	Dead	-	6-10	-	-	Nil-low
68	Old Growth	92	30-40	Slightly stressed	N	2-5	Nil-low	0-5	Nil-low
71	Old Growth	108	20-30	Healthy	Y	6-10	Nil-low	0-5	Nil-low
75	Old Growth	129	10-20	Stressed	Y	6-10	Nil-low	0-5	Nil-low
Not labelled 92?	Old Growth	215	10-20	Stressed	Y	10+	Moderate	0-5	Nil-low
95	Old Growth	182	30-40	Healthy	Y	6-10	Nil-low	0-5	Nil-low
99	Mature	89	10-20	Stressed	Y	6-10	Nil-low	0-5	Moderate

Tree Tag No.	Age Class	DBH (cm)	Canopy Density Estimate	Canopy Health	Flowering and/or fruiting evident (Y/N)	Hollows	Epicormic growth	Mistleto e	Insect/funga l attack
101	N/A	165	0	Dead	-	10+	-	-	Nil-low
105	Old Growth	179	40-50	Healthy	Y	10+	Nil-low	0-5	Nil-low
141	Mature	25	40-50	Healthy	Y	0	Nil-low	0-5	Nil-low

Note: The change in key condition scores from 2017 data is shaded to indicate a decrease in condition (red), stable condition (blue) and improved condition (green)

8.15.3 Ecological Risk Assessment

As noted in the Groundwater section, HVO has a monitoring programme in place to monitor changes in groundwater quality due to seepage from the North Void TSF. Carrington Billabong is located adjacent to the North Void TSF.

As part of Condition 8, U1 of EPL 640, HVO has implemented a monitoring program that includes an Ecological Risk Assessment (ERA) (Umwelt 2020) that assesses the impact to the RRG community. The annual monitoring required to detect a notable decline in ecological condition of RRG at the Carrington Billabong. Should ecological monitoring identify any of the following factors, additional investigations will be implemented to determine the cause:

- An increase in tree dieback of 10% or greater compared to the previous year;
- Adult tree death of 10% compared to the previous year;
- Remnant ecological health scores decline of 10% compared to the previous year;
- Unforeseen event that indicates a relatively rapid decline in ecological health or function that can't be linked to catchment wide causes (such as drought).

The results of the 2020 monitoring relative to these ERA trigger values is presented in **Table 70**.

Table 70 - Factors to be considered to detect a notable decline in ecological condition of the RRG community in accordance with the ERA (Umwelt 2020.).

Trigger	Monitoring outcome - 2020
An increase in tree dieback of 10% or greater compared to the previous year	Data for 63 tagged RRG trees was collected. Canopy cover scores were compared to 2017 data for the same 63 RRG trees. On average there was an increase in canopy cover from 2017 to 2020.
Adult tree death of 10% compared to the previous year	Of the 63 remaining tagged RRG trees monitored, one died between 2017 and 2020. This is approximately 1.6% of the trees monitored.
Remnant ecological health scores decline of 10% compared to the previous year	Remnant ecological health scores were stable or increased from 2017 to 2020.
Unforeseen event that indicates a relatively rapid decline in ecological health or function that can't be linked to catchment wide causes (such as drought)	A rapid decline has not been observed in the ecological health or function of the RRG population

8.15.4 Management Actions

Weed Management

Weed management occurred throughout HVO in 2020 within the Carrington Billabong, alluvial land River Red Gum populations and the population occurring near the Cheshunt Pit. This included targeted spraying of various species and broad slashing of Farmers Friends (*Bidens pilosa*) and various thistle species that dominated the understorey following the extensive rainfall received early in 2020.

The dense population of African olives that occur along the Hunter River was given additional attention during 2020 and have been largely removed from the area identified in Error! Reference source not found.. These were eradicated by cut and paint methods with the fallen biomass retained as bird and animal habitat. Additional works to remove African Olive from adjacent areas will occur during 2021, and the areas managed during 2020 will be re-examined at a later date to remove any recruiting seedlings before they mature and set seed.

The weed eradication works from within the areas managed by HVO for River Red Gums are shown in **Figure 105**.

Regeneration

To facilitate access to and monitoring of the Camyr Allen River Red Gum reference site, HVO has agreed to plant additional plants at a designated site specified by the landholder. In addition, to assist to protect the existing stand at Carrington Billabong from future storm and wind damage, HVO will plant and maintain an additional 200 *E.camaldulensis* tubestock within the Hunter River floodplain adjoining the billabong to broaden the population.

To ensure genetic integrity of each population, seeds from each location was collected during 2020 for propagation and planting back within the location from which it came. Planting of these propagated plants will occur during autumn 2021.

Rabbit Warren and Weed Inspection

To comply with the management actions outlined in the Strategy relating to the control of feral animals within the lower priority sites, a rabbit warren and weed assessment was undertaken across the priority and low priority River Red Gum sites at HVO. The results determined that only six of the 59 sites attended contained burrows and these will be managed during the 2021 vertebrate pest control activities.

Importantly, the assessment provided valuable information regarding the required management actions relating to weed and grass management at the lower priority sites. Weed and grass management at these sites will also be implemented during 2021 to facilitate improved habitat for the regeneration of the River Red Gum populations.

Vertebrate Pest Control

As part of HVO's Vertebrate Pest Action Plan, programmes are carried out on a seasonal basis and include sites where the River Red Gum populations are found. These programmes are conducted at a level of frequency designed to disrupt pest species breeding/colonisation cycles and employ a variety of methodologies including baiting, trapping and ground based shooting. Further detail on vertebrate pest control undertaken in 2020 is included in **Section 8.10.**

Figure 105 - Weed control undertaken in River Red Gum Areas 2020.

8.15.5 River Red Gum Condition Summary

Overall, the comparison of the monitoring data between 2020 and previous events have indicated that, while fluctuations in the data will occur between years, the general trend is for the categories to remain consistent or improve over the monitoring period. The works that HVO is undertaking in managing the River Red Gum populations have shown that mining is not having a detrimental impact on these vegetation communities.

The control of feral pests and weeds within areas managed for the River Red Gums at HVO will continue and efforts to enlarge and protect the stands of River Red Gums both at HVO and within the reference site have commenced during 2020.

8.16 Biodiversity Offsets

8.16.1 Goulburn River Biodiversity Area Overview

In accordance with condition 29 of HVO's Project Approval, PA 06_0261, Hunter Valley Operations are accountable for managing a 140ha offset at the Goulburn River Biodiversity Area (BA).

HVO manage a number of other offsets including the Wandewoi, Condon View, Crescent Head and Mitchelhill biodiversity areas, however, these are managed under EPBC approval 2016/7640, are subject to compliance reporting under that approval and are not subject to further discussion in this document.

The Goulburn River BA is located near the town of Merriwa and, when considered in combination with the adjoining offset for the Warkworth Mine, forms an area of protected vegetation extending from the Goulburn River National Park (**Figure 107**). The Goulburn River BA is managed according to the Goulburn River Management Plan that is available on the HVO public website (https://insite.hvo.com.au).

Given that the Goulburn River offsets for the Warkworth Mine and HVO are adjacent to each other and both parties have a common managing partner in Yancoal, HVO and the Warkworth Mine have a commercial agreement for the HVO BA to be managed by the Warkworth Mine on its behalf. The benefit of this agreement is a reduction in duplication related to the management and monitoring activities that are undertaken by consultants and contractors. As such, while the figures presented below may include information relating to the Warkworth Mine, the text will focus on the data and activities originating from the HVO BA.

8.16.2 Weather Records

Overall, the rainfall recorded at the closest weather station to the Goulburn River BA significantly exceeded the average total rainfall in 2020 **(Figure 106).** In this period, the Merriwa (Roscommon gauge) received 916.4 mm, which is well above the mean average rainfall for the area (588.6 mm). Exceedances of the mean rainfall were typical of records occurring across the Hunter Valley during 2020.

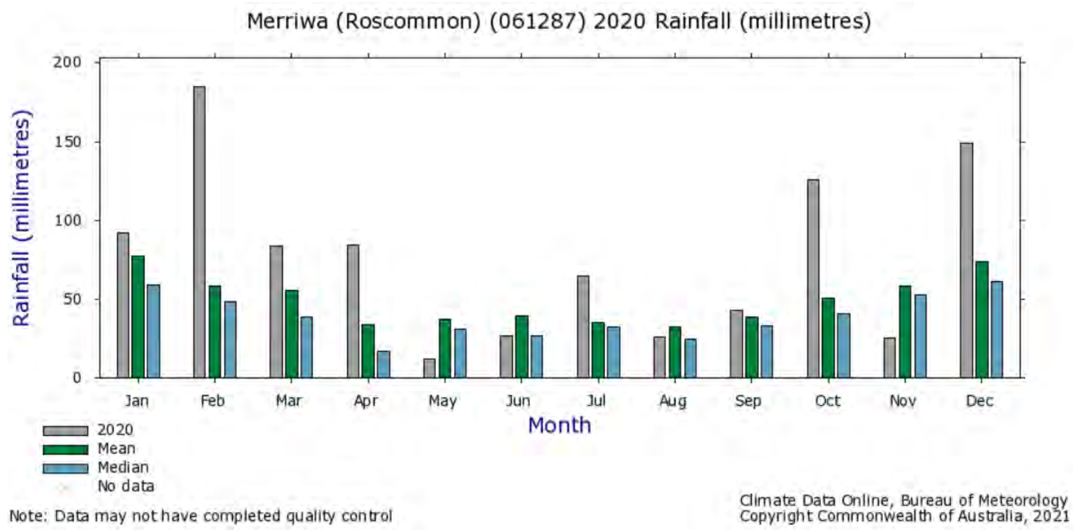

Figure 106 - Rainfall records recorded at the Merriwa (Roscommon) gauge - 2020.

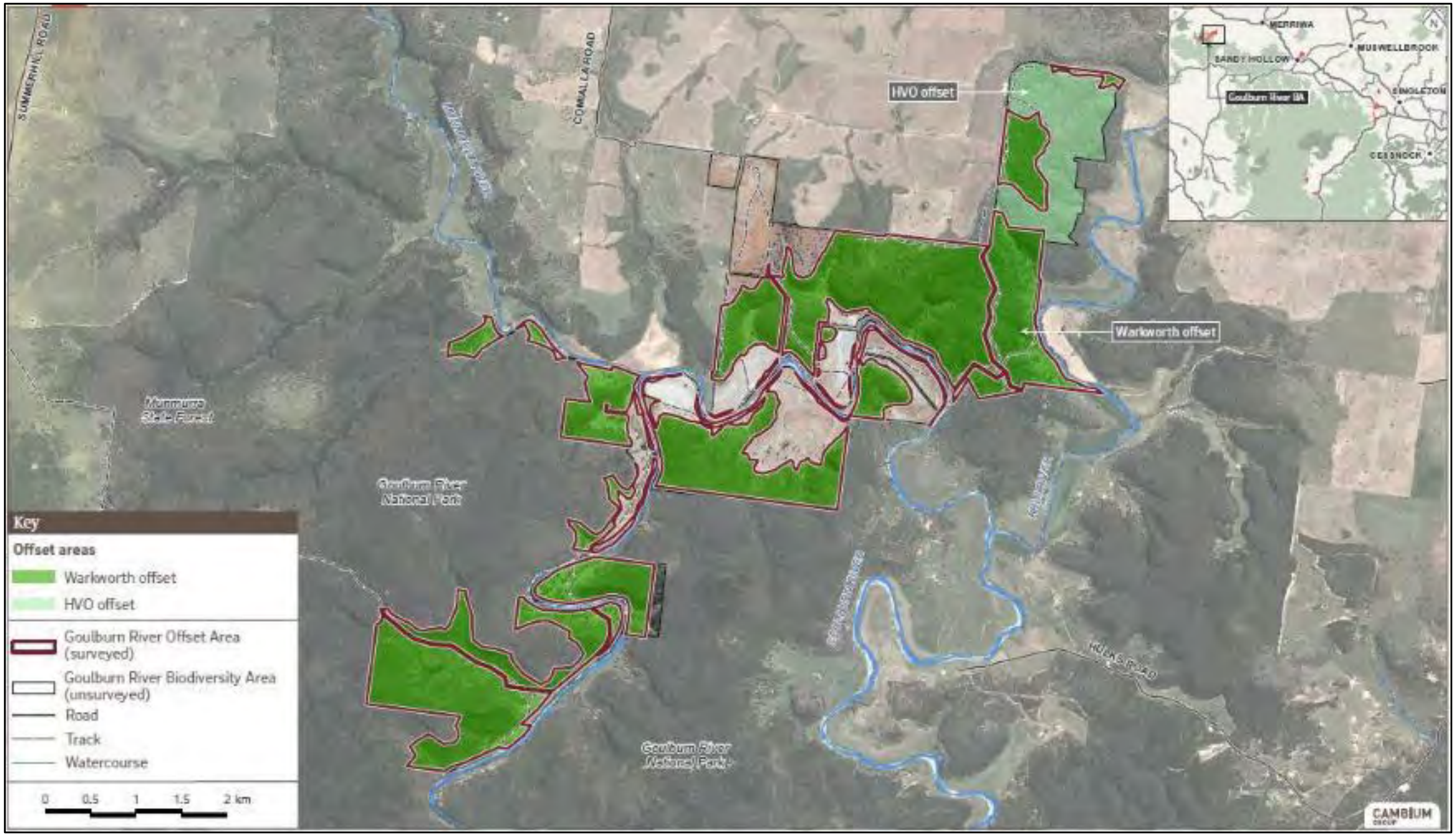

Figure 107 - HVO's Goulburn River Offset and adjoining Warkworth Mine offset

8.16.3 Biodiversity Area Management Activities

Various management activities were undertaken at the Goulburn River BA throughout 2020 in accordance with the approved management plan. These activities included weed control, vertebrate pest control and monitoring activities. A summary of the key actions in the BA throughout 2020 is outlined in **Table 71** below and discussed further in the text.

As can be seen from the weather records, the area received a significant rainfall event across several months throughout the year. For this reason, the depth of the Goulburn River was high which prevented access to the HVO portion of the BA for much of the year. An alternative non-river access to the HVO offset has been mapped and is being considered to enable future access during high rainfall events and when the river crossing is unable to be used.

Table 71 - Biodiversity Area Management Activities 2020

Activity	Description
Weed Control	All tracks maintained to reduce encroaching vegetation and improve access.
Bird Assemblage Monitoring	Bird assemblage monitoring occurred at three monitoring sites between June and September 2020.
Infrastructure Management and Improvement	Property inspections were undertaken at the Goulburn River Biodiversity Area in 2020. This included the Rapid Condition Assessment.
Strategic Grazing	Strategic grazing activities did not take place during the 2020 reporting period.
Vertebrate Pest Management	The 1080 ground baiting programmes were undertaken in autumn and spring at Goulburn River BA targeting wild dogs and foxes. Baits were checked over a three week period and replaced each week when taken. Aerial shoot conducted by NPWS controlled 14 feral pigs at the Goulburn River BA in October. The Professional Wild Dog Controller Program has trapped and euthanised more than 360 problem wild dogs in the three years it has been running. This is a four-year program with the primary goal to reduce the impacts of wild dog predation on livestock production, the social wellbeing of livestock producers, and native fauna, through professional and targeted control of problem dogs in the Upper Hunter district. A total of 19 wild dogs have been controlled on the Goulburn River BA (both HVO and MTW portions) since July 2017.

8.16.3.1 Bird Assemblage Monitoring

The project aimed to determine the usage of the Hunter Valley Operations (HVO) Goulburn River BA by two priority species: the critically endangered regent honeyeater *Athochaera phrygia* and swift parrot *Lathamus discolour*. The project also aimed to assess bird usage of the BAs in general, with a particular focus on other threatened woodland birds, and to establish a baseline bird monitoring program for the property.

Three monitoring sites established on the Goulburn River BA managed by HVO. Each monitoring site was visited three times between June and September 2020, to cover the period when swift parrots and regent honeyeaters are most likely to be present on site. An overall bird species list for the Goulburn River BA was also compiled.

No swift parrots or regent honeyeaters were detected occupying the HVO Goulburn River BA during the surveys. A single, unbanded male regent honeyeater was identified on the Goulburn River, approximately five kilometres from the HVO Goulburn River BA during National Regent Honeyeater Monitoring Program surveys on 13th August 2020. Subsequent searches confirmed the bird did not stick around on the property. Given a general lack of eucalypt and below-average needle-leaf mistletoe *Amyema cambagei* blossom there this spring, it is most likely that this bird was passing through the area at the time it was detected.

Four threatened species were detected occupying the property. Overall bird activity was likely affected by lagged effects of drought, namely a lack of eucalypt blossom. A total of four threatened bird species were detected occupying the HVO Goulburn River BA: Speckled warbler *Pyrrholaemus sagittatus*, varied sittella *Daphoenositta chrysoptera*, and brown treecreeper Climacteris picumnus, were detected during standardised surveys **(Figure 108),** whilst little lorikeet *Glossopsitta pusilla* were detected on the property but not during standardised surveys.

A total of 43 bird species were recorded during standardised surveys across the HVO Goulburn River BA. The site species list, including all bird species detected on the property (regardless of whether they were detected during a standardised survey) comprised 53 species. Analysis of the data determined that three visits during each survey period is sufficient to sample the majority of bird species occupying the monitoring locations within the property. Mean bird abundance ranged from 16 to 32, with the highest abundance and species richness occurring at HVOGR3 **(Table 72).**

Table 72 - Summary of mean bird abundance and species richness measures by monitoring site and by bird group at the HVO Goulburn River BA in 2020.

	Abundance					Species richness				
Site	Total	Woodland	Resident	Threatened	Songbird	Total	Woodland	Resident	Threatened	Songbird
HVOGR1	16.3	14.7	11	0	13	9.7	8.7	7.3	0	8.3
HVOGR2	21.7	20.7	17	0.7	19	14.7	14.3	12.7	0.7	12.3
HVOGR3	32.3	32	24	1.3	31	17.3	17	13.7	2	16.3

The recommendations from the survey are to include an additional survey point, undertake pest management for pigs, especially around the dam at HVOGR1, continue the noisy miner cull and undertake habitat restoration on the MTW portion of the BA.

Wild dog and pig pest management will continue in 2021 and will include the suggested location. MTW is anticipated to continue the noisy miner cull in 2021, and during 2020, planting occurred on the flats at the Goulburn River BA to increase the suitability of habitat for the Regent Honeyeater. MTW planted 12,000 tube stock into the cleared areas of Yellow Box – Grey Box – Red Gum Grassy Woodland and riparian woodland areas.

Figure 108 - Spatial location of the three bird monitoring sites at Goulburn River BA.

8.16.3.2 Property Inspections and Rapid Condition Assessment

Due to the restricted access associated with the high water levels, the property inspections were only able to be undertaken in August. During this inspection, the fences were found to be intact and in good condition, no stray stock was observed on the property and no illegal activities or access were found to have occurred. Some minor track maintenance is required due to high rainfall events creating a boggy area **(Figure 109)** but generally, the tracks are in a suitable condition.

Untreated Prickly pear (*Opuntia spp*) was found to occur in limited areas, as was scattered populations of Crumb and Fireweed (*Senecio madagascariensis*).

Pig activity was sighted throughout the offset, including wallows near the dam (**Figure 110),** mud rub marks on trees and recent tracks. As mentioned previously, pig management will continue in 2021 and target the locations where pig activity has been found to occur.

Figure 109 - Boggy area identified on a track within the HVO portion of the Goulburn River BA.

Figure 110 - Pig activity observed within the HVO portion of the Goulburn River BA.

The rapid condition assessments have been undertaken on the HVO Goulburn River BA each year since 2013. In that time, the results have been consistent with the only change being to the abundance of native ground flora that has fluctuated with the change in climatic conditions.

9 Community

9.1 Complaints

HVO provides a 24 hour Community Complaints Hotline (via freecall number 1800 888 733) for community members to comment on concerns relating to its operations. All complaint details are recorded in a database in accordance with Condition M4.2 of Environmental Protection Licence 640 and made available on HVO's website (https://insite.hvo.com.au).

A total of 16 complaints were received by HVO during 2020 (**Figure 111**). This represents an increase of 7 community complaints from the previous year (**Figure 112**). Complaints were received in relation to noise, blasting, air quality, lighting and property accessibility issues. Details of complaints received in 2020 are included in **Table 73**. The trend in complaint increases relates to three key activities being access to the Travelling Stock Route, horn noise and lighting plants. Corrective actions were implemented for each of these aspects as detailed in the table.

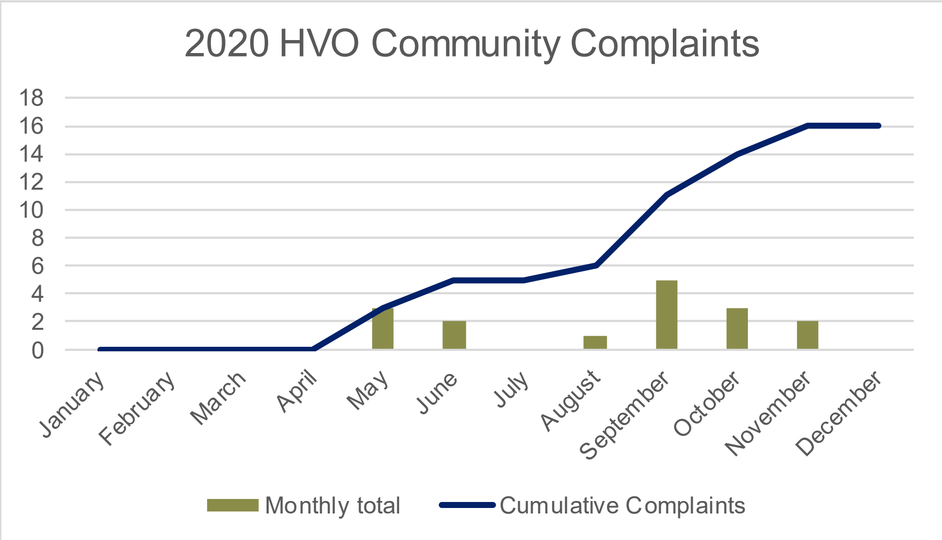

Figure 111 - Summary of Community Complaints in 2020

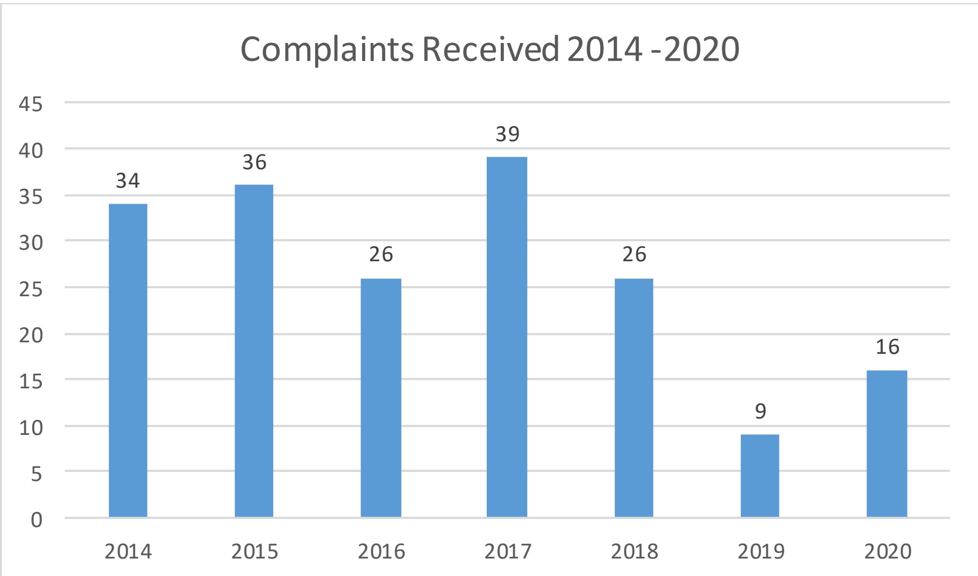

Figure 112 - Community Complaints 2014 – 2020

Table 73 - Details of Complaints Received in 2020

Date	Time	Type	Description	Follow Up Action
19/05/2020	8:28 PM	Noise	Complaint was received via community complaints hotline. Complainant noted they could hear horns from a digger, as well as dozer tracks and trucks running.	The senior mine supervisor reviewed operations and the OCE undertook a field inspection. Shovel 317 was shutdown and dozer tracking was minimised. The complainant was called back as outlined in the complaint and was informed of the operational changes.
19/05/2020	9:02 PM	Noise	Complaint was received via community complaints hotline. Complainant noted they could hear horns from a digger, as well as rocks dropping.	The senior mine supervisor contacted the complainant to discuss the complaint. Operations were reviewed and horn use was minimised. In addition, trucks dumping at RL 150 were changed to noise attenuated trucks. The complainant was again called back and mentioned that they were happy with the modifications made and that noise levels had dropped.
30/5/2020	9.35 PM	Noise	Complaint was received via community complaints hotline. Complainant noted they could hear horns that sounded like they were coming from the Denman side of Lemington Rd (similar to previous complaint).	The complainant was called back and advised that the complaint would be investigated. The senior mine supervisor contacted the West Pit OCE to conduct a field inspection. Operations were reviewed and operations were occurring below natural surface line. Truck and horn noise were audible but unlikely to be travelling to Jerrys Plains. No operational changes were required.
1/6/2020	8:28 AM	Noise	Complaint was received via direct phone call to Environment and Community Officer (ECO). Complainant noted they could hear the sound of a pump in the Lake James area from Friday (29/05) to Monday (1/06) and that is disrupted sleep.	The ECO attend both Lake James and Maison Dieu to conduct noise measurements. The pump was audible as well as external noise sources (tractor and wind). The pump was sound attenuated with the addition of sound curtains and will not operate during night shift. The complainant was appreciative of the actions taken.
12/6/2020	9:41 PM	Noise	Complaint was received via community complaints hotline. Complainant noted they could hear horn noises.	The complainant was called back and advised that the complaint would be investigated. Shovel 341 horn noise was identified to be the key source of noise. Operations were reviewed and the OCE developed a plan to limit horn noise including lowering air pressure in the horn, reducing

Date	Time	Type	Description	Follow Up Action
				the time the horn was held for and utilising dispatch to coordinate truck movements.
7/8/2020	2:29 PM	Blasting	Complaint was received via direct phone call to Environment and Community Officer (ECO). Complainant reported that the blast shook the house and windows at 2:29pm.	Blast vibration and overpressure results were reviewed and were below compliance limits. The complainant was called back to outline the results of the investigation. Complaint was received via community complaints hotline. The Environment and Community Officer (ECO) called the complainant back to discuss the complaint. The complainant reported that a large static light was coming from the truck stop on the HVO side of the Golden highway and was shining directly into the bedroom. The ECO and the Environment and Community Coordinator (ECCO) undertook a field inspection from near the complainants location to determine the source of light. Operations were reviewed with the OCE and found a lighting plant that was used to illuminate the work area of a dozer on a high dump to be the light source. It was communicated to the OCE and crews that lighting plants must be pointed away from nearby residents.
1/9/2020	10:02 AM	Lighting	The complainant reported that a large static light was coming from the truck stop on the HVO side of the Golden Highway and was shining directly into the bedroom.	The ECO and the Environment and Community Coordinator (ECCO) undertook a field inspection from near the complainants location to determine the source of light. Operations were reviewed with the OCE and found a lighting plant that was used to illuminate the work area of a dozer on a high dump to be the light source. It was communicated to the OCE and crews that lighting plants must be pointed away from nearby residents.
13/9/2020	8:34 AM	Lighting	The complainant reported that a large static light was coming from the truck stop on the HVO side of the Golden Highway and was shining directly into the bedroom, similar to a previous complaint.	The ECO called the complainant to confirm that it was a lighting plant from the Riverview pit and that an OCE would contact the complainant on night shift to confirm the lighting plant was no longer visible. The OCE conducted an inspection and moved the lighting plant away from neighbouring residents.

Date	Time	Type	Description	Follow Up Action
				The complainant was called back and confirmed that the light could no longer be seen.
15/9/2020	11:58 PM	Lighting	Complaint was received via direct phone call to OCE. The complainant noted a light shining into the bedroom.	The Environment and Community Officer (ECO) called the complainant back the next day and explained why the voicemail was missed and advised that future complaints should be reported via the HVO community complaints hotline, ensuring they can be dealt with. The Environment and Community Manager (ECM) reviewed camera footage from the Riverview pit with all lighting plants facing away from neighbouring residents.
22/9/2020	10:12 AM	Property Access	Complaint was received via a direct phone call to Environment and Community Officer (ECO). The complainant left a voice message and sent a follow up text to confirm they were unable to access the Travelling Stock Route (TSR) from the Golden Highway as their lock had been removed from the sequence.	The ECO returned the call and the complainant outlined that they were extremely frustrated as this has happened previously. The ECO committed to restoring access immediately. The ECO restored the locks to the correct sequence and sent a confirmation text and photograph to the complainant. The complainant replied to the message confirming they were happy with the actions and appreciated the assistance.
25/9/2020	9:25 AM	Blasting	Complaint was received via a text message to the Environment and Community Officer (ECO) stating that the blast "just about shakes the house off the piers and frightened the dogs".	Blast vibration and overpressure results were reviewed and were below compliance limits. The complainant was called back to outline the results of the investigation and confirm that HVO had fired a blast in the Cheshunt Pit at 9:23am. The complainant stated that the vibration shook the house and the blasts can be felt more and more.
4/10/2020	4:17 PM	Property Access	HVO security checked the gate to the Travelling Stock Route (TSR) at 4am noting that the HVO lock had been cut and a single chain applied. Thinking it was an illegal entry they cut the lock and entered the TSR.	The Environment and Community Manager (ECM) was notified and then contacted a near by resident who confirmed they cut the lock as they had been locked out. The complainant advised that they had enough of being repeatedly locked out and if HVO wanted access they would have to walk in. A combination lock was purchased to replace the complainants cut lock and the complainant was advised of the lock code as well as the outcome.

Date	Time	Type	Description	Follow Up Action
13/10/2020	6:48 PM	Dust	Complaint was received via community complaints hotline. The complainant was not complaining about the dust having a direct impact on them but had observed dust from their property and considered to be excessive.	The OCE on shift confirmed the source of the dust and stopped trucks running to this area. The Environment and Community Manager (ECM) spoke to the complainant and confirmed they were happy with the outcome of the complaint. They complainant mentioned that they didn't like to complain but wanted to provide feedback.
21/10/2020	10:04 AM	Lighting	Complaint was received via community complaints hotline. The complainant was calling about a lighting plant from the Riverview operation shining directly into the property that disturbed their sleep. The complainant mentioned that the location of the light was in the same area as previous complaints.	The Environment and Community Officer (ECO) called the complainant back to ascertain further information about the complaint. A field verification was conducted by the ECO and OCE and confirmed that the lighting plant had been set up to illuminate dozer work. The lighting plant was put out of service and confirmed to not be operated by the Mine Manager.

9.2 Review of Community Engagement

9.2.1 Communication

Two near neighbour newsletters were sent to HVO's near neighbours during 2020 providing an overview of:

- COVID19 management measures;
- Operational updates;
- Environmental activities such as aerial seeding activities, feral pest management program;
- Community initiatives such as near neighbour amenity resource program and community grants; and
- Communication tools – HVO website, environmental monitoring public reporting website and the blast notification SMS alert system.

9.2.2 Consultation and Engagement Activities

Due to COVID19 restrictions, consultation and engagement activities were limited to the below:

- Support of Jerrys Plains Primary School pre-school program; and
- Community information sessions for near neighbour's were held in November and December at Maison Dieu, Jerrys Plains and Long Point. These sessions were aimed at providing community members with an opportunity to speak with HVO representatives about current operations and as well as the proposed HVO Continuation Project. The sessions were attended by residents from Maison Dieu, Jerrys Plains and Long Point as well as members from HVO's Senior Leadership Team.

HVO continued to encourage the community to contact the company in a way that suits the individual community members.

9.2.3 Community Consultative Committee

The HVO CCC meetings were held in February, May, September and November 2020. The HVO CCC meet to discuss operations, projects and mine activities. The Committee is comprised of HVO representatives, community members and other key external stakeholders, including Council. The HVO CCC minutes are available on the HVO website (https://insite.hvo.com.au/document-library/ccc). The community is invited to visit the website(s) to learn more about the HVO CCC.

In 2020 CCC members included:

- Dr Colin Gellatly (Independent chairperson)
- Cr Hollee Jenkins
- Dr Neville Hodkinson
- Mrs Janelle Wenham
- Mr David Love
- Mr Brian Atfield
- Mrs Di Gee
- Mr Todd Mills
- Mr Michael Wellard
- Mrs Jeanie Hayes
- Mrs Sarah Purser (minute taker)
- HVO General Manager – Tony Galvin
- HVO Production Manager – Bruce Gould

- HVO Environment & Community Manager – Andrew Speechly
- HVO Environment & Community Officer – Merri Bartlett

9.2.4 Community Grants

HVO supports applications for local donations and sponsorships that have a clear community benefit. In 2020, HVO provided $47,000 to 15 local projects and initiatives, including:

1. Westpac Rescue Helicopter Service - 2020 Hunter Valley Mining Charity Rugby League Day (sponsorship donation to be disbursed when Festival is held pending COVID19 restrictions)
2. St Catherine's Catholic College - Safe Livestock Handling
3. Singleton High School - Flying High with Drones
4. Singleton Council - Sponsorship Cycling NSW
5. Singleton Chamber of Commerce - Hunter Coal Festival (sponsorship donation to be disbursed when Festival is held pending COVID19 restrictions)
6. Branxton Lions - Lions Road Safety signs in Branxton
7. Denman Little Athletics - Shelving for Sports Shed
8. Singleton Girl Guides - Building Floor Repair and Maintenance
9. Singleton Heights Pre-School Inc - Smartscreen Education Technology
10. Singleton PCYC - Singleton PCYC Open Day
11. Hunter Valley Campdraft Club Inc - Hunter Valley Campdraft Club Arena
12. Westpac Rescue Helicopter Service - Volunteer Support Groups Contactless Payment Devices
13. Aberdeen Senior and Little Athletics Centre Inc - Technology Update
14. Singleton Fire Brigade Social Club – Singleton Lolly Run
15. Singleton Beef Land Management Association – Weeds Field Day

HVO also continued its partnership with Jerrys Plains Public School providing funding for their pre-school program.

9.2.5 HVO Continuation Project

Community consultation was undertaken in 2020 to inform design for the HVO Continuation Project and to understand community concerns and interests in relation to the Project. Key community consultation activities included:

- Presentation and discussion of the Project at HVO CCC and CHWG meetings;
- Establishment of a dedicated Project website;
- Distribution of a newsletter and community survey, informing near neighbours and seeking feedback on the Project;
- Series of one-on-one teleconferences with interested nearby residents to discuss key concerns;
- Presentation of Project information at HVO community information sessions at Maison Dieu, Jerrys Plains and Long Point;
- Inclusion of a media article in the Hunter River Times; and
- Presentation and discussion of proposed Aboriginal archaeological and cultural heritage assessment methodology with the Aboriginal community.

Consultation activities for the Project will continue throughout 2021.

10 Independent Audit

An Independent Environmental Audit (IEA) was undertaken in December 2019. This audit was undertaken against the conditions of both Project Approval PA06-0261 (as modified) and DA 450-10-2003 (as modified). The audit also assessed compliance with other licences and approvals including:

- HVO North - EPL 640 and associated Water Access Licences; and
- HVO South – EPL 640 and relevant mining/coal leases including ML1634, ML1465, ML1734, ML1753, ML1682, CL398 and CCL714.

Environmental consultant's Hansen Bailey were engaged and endorsed by DPI&E as suitably qualified, independent experts to undertake the audit. The timeframe for the audit was from 1 November 2016 to 1 December 2019. The site inspection component of the audit was undertaken over four days between 2 and 5 December 2019.

The audit report and HVO's response to the auditors' recommendations were submitted to the DPI&E on 24 February 2020.

The audit identified 28 non-compliances, one was identified as a moderate risk, 15 were administrative in nature and 12 findings were considered to be low risk. These findings along with the auditor's recommendation and HVO's response to recommendation are summarised in **Table 74**. Where non-compliances have been identified as relevant to activities that occurred during 2019, these have been identified in the Statement of Compliance in **Table 1**. The next Independent Environmental Audit is due in 2022.

Table 74 - Independent Environmental Audit Findings and Recommendations – 2020

Reference	Audit Finding	Risk Rating	Auditors Recommendation	HVO Response	Timing
HVO South – PA 06_0261 Non-Compliance Recommendations					
Sch 2 Cond 2a	Some non-compliances were identified with the conditions of this approval	Administrative	Work with DPI&E to comply with conditions in Section 5 **Error! Reference source not found.** of the IEA Report where practical.	Actions to address non compliances are committed to via HVO's response to recommendations.	N/A
Sch 2 Cond 15	Sch 3 Cond 60 no evidence of correspondence with Singleton Council or NSW RFS in relation to consultation on the Bush Fire Management Plan has been provided.	Administrative	Ensure consultation with Singleton Council and RFS over the Bushfire Management Plan as per Schedule 3 Condition 30.	Council and RFS have been consulted on the revised version since the audit and this will be included in the plan once finalised.	Completed
Sch 3 Cond 7	Measured overpressure levels exceeded the 120dbL criterion at two locations (Moses Crossing, Jerrys Plains) on 17 January 2018.	Low	Bridges Acoustic recommends to avoid possible overpressure reflection from the control building and resultant uncertainty regarding overpressure levels, the second Maison Dieu monitor should be considered the primary monitor in this area.	HVO has since received confirmation from DPI&E that its relocation approved. HVO is currently seeking approval from the EPA for the relocation as part of the five yearly licence review and will permanently relocate the monitor once approval is received.	Completed
Sch 3 Cond 10	One blast on Easter Saturday 2017 (which was officially considered a public holiday in 2017).	Administrative	No recommendation provided	N/A	N/A
Sch 3 Cond 19	The measurement on 29/07/17 at the Gliding Club was determined to be non-compliant at 58 µg/m^3 (with HVO contribution being 85% against the maximum contribution limit of 75% in accordance with the approved AQMP at the time). Incident was reported to the HVGC and DPI&E.	Low	Dust deposition gauges at DL30 and Warkworth; and PM_{10} monitors at Knodlers Lane and Long Point be reconsidered as to their appropriateness as representative of private receivers (occur outside EA predictions of exceedance of criteria) as they are exceeding annual average results during the IEA period (however stated not due to HVO activities and not reported consistent with approved *AQMP*). As Knodlers Lane and Long Point monitoring sites occur within exceedance predictions for PM_{10} in the MOD5 assessment, it is likely that they will exceed on a continuous basis. HVO advises that DG will remain as internal management sites, not compliance as per Table 5 of the *AQMP*.	The current approved *AQMP* identifies which DDG are utilised as a measure of compliance, HVO considers this issue to now be addressed in the current *AQMP*.	Completed

Reference	Audit Finding	Risk Rating	Auditors Recommendation	HVO Response	Timing
			Internal procedures and relevant training be updated for change to *AQMP* which changes reportable circumstances for PM_{10} 24 hr consistent with the updated *AQMP* Section 9. HVO advises this is proposed.		
Sch 3 Cond 28	No confirmation that CLWD (now DoI Water) received the 2017 Annual Review.	Administrative	No recommendation provided	N/A	N/A
Sch 3 Cond 30 31	No evidence to confirm all River Red Gum sites (as shown in Appendix 8) have addressed management practices listed in the River Red Gum Strategy (2010).	Low	River Red Gum Strategy: • Add confirmation in the Annual Review over what areas of the Goulburn River Biodiversity areas have been addressed (in order to confirm HVO's 140 ha is compliant). • Recommend any revision to the Strategy include consultation with DoI Water and OEH. Recommend holistic review of actions in light of future mining in the immediate area and likely impacts, flooding potential, climate, groundwater and surface water monitoring, and ecological monitoring to determine a realistic way forward in relation to the management of the area which has been inconclusive to date. DPIE should be consulted in relation to findings and way forward to ensure satisfaction secured.	Dot point one – HVO will address this in future Annual Reviews Dot Point two and three – The strategy is currently under review and HVO will include evidence of relevant consultation in next revision.	2020 Annual Review Completed
Sch 3 Cond 40	One compliance inspection per year has been completed rather than two as required within the approved ACHMP (2009) for 2018 and 2017.	Administrative	No recommendation provided	N/A	N/A
Sch 3 Cond 48	Overburden emplacement area (OEA) in the Glider Pit was approximately 10 m above the Obstacle Limitation Surface without obtaining prior approval from the HVGC. This was reported and OEA reshaped to remediate issue.	Low	No recommendation provided	N/A	N/A

Reference	Audit Finding	Risk Rating	Auditors Recommendation	HVO Response	Timing
Sch 3 Cond 53	Northstar advises that whilst a number of the actions undertaken by HVO may have some impact on the annualised GHG emission budget, these have not been presented in context of assessing all reasonable and feasible options.	Low	Northstar recommends that the *AQMP* Section 7 is updated to identify opportunities for emission reductions (in the reasonable and feasible areas of electricity use, diesel and other fuels, and Land Management. The Annual Review should include a summary of greenhouse gas emissions against commitments in *AQMP*.	The current *AQMP* discuss' Greenhouse Gas Management and as such no further modification to the *AQMP* is considered necessary HVO will recommence reporting in the Annual Review greenhouse gas emission summary information against the *AQMP*.	2020 Annual Review
Sch 3 Cond 60	No evidence available of consultation with Singleton Council or the RFS.	Administrative	Obtain correspondence from Council and Rural Fire Service confirming consultation and add to appendix at next review of the Bushfire Management Plan.	Council and RFS have been consulted on the revised version since the audit and this will be included in the plan once finalised.	Completed
Sch 4 Cond 2	Notification of relevant landholders regarding the blasting exceedance - measured overpressure levels exceeded the 120 dBL criterion at two locations (Moses Crossing, Jerrys Plains) on 17 January 2018 (refer to Sch 3 Cond 7) was sent on 27/11/19, however was outside the required 2-week notification timeframe.	Administrative	Update process to notify affected landholders for exceedances of air and blasting.	HVO has developed a post incident (exceedance) checklist which is to ensure that landowners and/or tenants are notified as required.	Completed
Sch 5 Cond 1a	Management plans do not contain all required sections. Refer to Sch 5 Cond 1a for further detail.	Administrative	At the next required revision to relevant management plans (none urgent) ensure all items within Sch 5 Cond 1a are addressed.	HVO does not consider this to be non-compliant in accordance with the footnote of the condition that the Secretary may waive some of the requirements required by the condition if they are unnecessary or unwarranted for particular management plans. HVO considers the Secretary's approval of the plans is Approval of these Waivers. Nonetheless, HVO will review this for adequacy in the next revision of each relevant management plan.	N/A
Sch 5 Cond 4a	No evidence available to confirm reviews of strategies, plans and programs conducted on each	Administrative	No recommendation provided	N/A	N/A

Reference	Audit Finding	Risk Rating	Auditors Recommendation	HVO Response	Timing
	occasion listed in this condition. How ever, all plans have been updated in the audit period except for the follow ing: • HVO South Aboriginal Cultural Heritage Management Plan (May 2009); • Amenity Management Plan-Hunter Valley Gliding Club (October 2012); and River Red Gum Rehabilitation and Restoration Strategy (March 2010).				
App4 A.4	Bridges Acoustics notes the NMP and noise monitoring reports do not assess and correct for (or do not report) tonal noise as required by the NSW Industrial Noise Policy and later Noise Policy for Industry.	Low	Tonal noise should be included in the noise monitoring reports and the NMP on its next revision.	HVO's noise monitoring consultant's monitoring reports indicate that intermittent or tonal features are not typically present in mining operational noise and the assessment is not undertaken on this basis. How ever, HVO w ill request this inclusion to noise monitoring reports developed by the noise monitoring consultant.	Completed
SOC Ref 11	No evidence exists that collection and storage of River Red Gum seed from existing stands is occurring.	Low	Collect seed from River Red Gum area or justify w hy not possible/required in revised BMP.	Seed collection w ill occur during 2020 if available.	Completed
HVO North - DA 450-10-2003 Non-Compliance Recommendations					
Sch 2 Cond 2a	Some non-compliances w ere identified w ith the conditions of this approval.	Administrative	Work w ith DPIE to comply w ith non-compliances in Section 5 of the IEA Report, w here practical.	Actions to address non compliances are committed to via HVO's response to recommendations.	N/A
Sch 2 Cond 15	Sch 3 Cond 61 no evidence of correspondence w ith Singleton Council or NSW RFS in relation to consultation on the Bushfire Management Plan w as available.	Administrative	Ensure consultation w ith relevant regulators occurs for all management plans, or justify w hy not required in plan (e.g. administrative changes).	Noted	N/A

Reference	Audit Finding	Risk Rating	Auditors Recommendation	HVO Response	Timing
Sch 3 Cond 4	As per PA 06_0261 Sch 3 Cond 53.	Low	As per PA 06_0261 Sch 3 Cond 53.	The current AQMP discuss' Greenhouse Gas Management and as such no further modification to the AQMP is considered necessary HVO will recommence reporting in the Annual Review greenhouse gas emission summary information against the AQMP.	2020 Annual Review
Sch 3 Cond 7	Exceedance of noise level criteria listed in Table 9. Refer to Appendix E DA 450-10-2003 Sch 3 Cond 7.	Administrative	No recommendation provided	N/A	N/A
Sch 3 Cond 20	The following incidents relating to pollution of waters include: • Discharge from leaking pipework on Parnell's Dam to Parnell's Creek on 4 November 2016; and Discharge from the Hunter Valley Load Point Sump to Bayswater Creek on 30 March 2017.	Medium	No recommendation provided	N/A	N/A
Sch 5 Cond 4	No evidence available to confirm reviews of strategies, plans and programs conducted on each occasion listed in this condition. However, all plans have been updated in the audit period. Action has since been added to CMO with reminders.	Administrative	No recommendation provided	N/A	N/A
App4 A.4	The NMP and noise monitoring reports do not assess and correct for (or do not report) tonal noise as required by the NSW Industrial Noise Policy and later Noise Policy for Industry.	Low	Tonal noise should be included in the noise monitoring reports and the NMP on its next revision.	HVO's noise monitoring consultant's monitoring reports indicate that intermittent or tonal features are not typically present in mining operational noise and the assessment is not undertaken on this basis. However, HVO will request this inclusion to noise	Completed

Reference	Audit Finding	Risk Rating	Auditors Recommendation	HVO Response	Timing
				monitoring reports developed by the noise monitoring consultant.	
SOC Ref 22	Annual visual assessments have not been completed. HVO has since purchased all properties that would have been considered to have been visually impacted by HVO North (particularly the Wandewoi Property on Lemington Road).	Administrative	A written justification should be provided to DPIE for approval that annual visual assessments are no longer required.	As per previous IEA, HVO's response to the recommendations was to review current relevance of completing the assessments in respect to recent property purchases to determine if private receptors would still be impacted visually by HVO north since the 2010 SOC. HVO has since purchased all properties that would have been considered to have been visually impacted by HVO north particularly the Wandewoi Property on Lemington Road. Annual visual assessments are therefore no longer considered relevant. Agree with recommendation to have confirmation from DPIE that these are no longer required.	Completed
EPL 640					
L1.1	The following incidents occurred relating to the pollution of waters: • Turbid water entered Farrells Creek from sediment dam overtop on 4-5/10/18 (See response to DA 450-10-2003 Sch 5 Cond 2); • Turbid water entered Farrells Creek from a rehabilitation area on the 18/3/19 (See response to DA 450-10-2003 Sch 5 Cond 2)	Low	No recommendation provided	N/A	N/A

Reference	Audit Finding	Risk Rating	Auditors Recommendation	HVO Response	Timing
	• Turbid water entered Farrells Creek from two sediment dams on 30/3/19 (See response to DA 450-10-2003 Sch 5 Cond 2); and Discharge of mine water to Bayswater Creek 11/5/18 (See response to (PA 06_0261 Sch 3 Cond 20).				
L4.1	One blast on Easter Saturday 2017 (which was officially considered a public holiday in 2017) as per PA 06_0261 Sch 3 Cond 10	Administrative	No recommendation provided	N/A	N/A
L4.3	Two blasting exceedances on one occasion in 2018 at point 9 &18: Measured overpressure levels exceeded the 120 dBL criterion at two locations (Moses Crossing, Jerrys Plains) on 17 January 2018. (See response to PA 06_0261 Sch 3 Cond 7)	Low	Refer to PA 06_0261 Sch 3 Cond 7.	HVO has since received confirmation from DPIE that its relocation approved. HVO is currently seeking approval from the EPA for the relocation as part of the five yearly licence review and will permanently relocate the monitor once approval is received.	TBA – pending EPA response.
O2.1	Minor discharge of saline water to Parnells Creek due to pinhole leak on 4/11/16. See response to DA 450-10-2003 Sch 3 Cond 20.	Low	No recommendation provided	N/A	N/A

11 Incidents and Non-Compliances

There was one incident and 12 administrative non compliances recorded at HVO. These relate to blasting and air quality monitoring respectively.

11.1 Air Quality

During 2020 there were twelve non-compliances related to air quality. These non-compliances are summarised below.

11.1.1 Missed HVAS Sample – 9 January 2020

On 10 January 2020, HVO was notified that the PM10 High Volume Air Sampler HVAS at the Hunter Valley Glider Club site had failed to run for the full 24 hour period on 9 January, with the HVAS recording 20 hours.

HVO's environmental contractor checked the timer settings which were confirmed to be correct and also rechecked the previous counter readings to confirm that there had been no calculation errors on the total run times. In addition, no faults were found with the machine during post-run checks.

The cause of the HVAS failure has been investigated with the cause likely to be a localised power outage.

11.1.2 Missed HVAS Sample – 15 January 2020

On 16 January 2020, HVO was notified that the TSP High Volume Air Sampler HVAS and the PM10 HVAS at the Warkworth site both had failed to run for the full 24 hour period on 15 January, with both unit's recording 18.6 hours.

The cause of the HVAS failure has been investigated with the cause likely to be a localised power outage given that both units failed to record for the full 24 hour period.

11.1.3 Missed HVAS Sample – 21 January 2020

On 23 January 2020, HVO was notified that the TSP High Volume Air Sampler HVAS and the PM10 HVAS at the Warkworth site both had failed to run for the full 24 hour period on 21 January, with both unit's recording 18.6 hours.

The cause of the HVAS failure has been investigated with the cause likely to be a localised power outage given that both units failed to record for the full 24 hour period.

Both the TSP and PM10 HVAS's were investigated by HVO's environmental contractor on 28 January and no faults were found with either unit. It was noted that both units ran successfully and for the full 24 hours on the run date of 27 January.

11.1.4 Missed TEOM Sample – 23 January 2020

The daily environmental monitoring data validation checks on the 24th January confirmed that only 25.5% and 62.1% of data was captured at the Jerrys Plains and Wandewoi TEOM's respectively.

It had been noted the previous day that the Jerrys Plains and Wandewoi dust monitors were showing offline due to a power outage in the area which was confirmed by the Ausgrid website showing a map of power outage locations.

11.1.5 Missed HVAS Sample – 28 April 2020

On 28 April 2020, notification was received from HVO's environmental monitoring contractor that the TSP High Volume Air Sampler (HVAS) at the Cheshunt East site had failed to run for the full 24 hour period on 26 April. A reason for the run failure was unable to be determined. The adjacent PM10 HVAS ran without issue over the same time period indicating power supply was not the cause and the contractor confirmed that the timer settings, clock and run schedules were checked and found to be normal.

The monitor had a partial run failure on 3 March (a valid sample was able to be collected) and was repaired and put back to service. The last bimonthly calibration was undertaken on 1st April 2020. The unit was test-run on the 27 April and operated without issue.

11.1.6 Missed TEOM Sample – 10 August 2020

On 10 and 11 August 2020, the Warkworth monitor failed to obtain the minimum of 75% of valid data required for a daily 24 hour average result, as a result of an Ausgrid power outage. The 10th of August recorded 57.6% data capture whilst the 11th of August recorded 31.3% data capture. All other HVO compliance air quality monitors recorded PM10 levels of less than 20µg/m3 on the day, which is less than the 24 hour criteria of 50 µg/m3.

Additionally at the time of the data miscapture, HVO mistakenly identified the Warkworth monitor as an EPL requirement, not a requirement of the AQMP. Subsequently, HVO failed to report the incident to the DPI&E as soon as practicable. This oversight was later identified when the Warkworth monitor had a subsequent power outage on 27 August 2020 and an incident report was being prepared.

HVO has since updated its Air Quality Exceedance Identification and Investigation Procedure to correctly identify which monitors require immediate notification to DPI&E.

11.1.7 Missed TEOM Sample – 27 August 2020

On 27 August 2020, the Warkworth monitor failed to obtain a valid sample between 8:50am and 4:20pm, resulting in a sample capture percentage of 67.4% for the day. The Warkworth TEOM monitoring unit is owned and managed by the DPI&E as part of the NSW Upper Hunter Air Quality Monitoring Network (UHAQMN). When contacted about the missing data, representatives from DPI&E confirmed that there had been an unplanned Ausgrid power outage for that period, resulting in no data capture.

All other HVO compliance air quality monitors recorded PM10 levels of less than 30µg/m3 on the day, which is less than the 24 hour criteria of 50 µg/m3.

11.1.8 Missed HVAS Sample – 30 August 2020

On 31 August 2020, notification was received from HVO's environmental monitoring contractor that the PM2.5 HVAS at the Kilburnie South site had failed to run for the majority (except for 5 minutes) of the 24 hour period on the run day of 30 August.

The contractor noted on arrival to the site that the HVAS was displaying a blocked filter error and after running the HVAS in manual mode there was a motor error on the display. The monitor is calibrated bi-monthly and the latest calibration was undertaken on 4 August 2020.

11.1.9 Missed TEOM Sample – 20 September 2020

On 20 September 2020, the Jerrys Plains monitor failed to obtain a valid sample after 12:50am, resulting in a sample capture percentage of 3.5% for the day. On 21 September 2020 the monitor began recording valid samples after 12:10pm, resulting in a data capture of 42.4% for the day.

The Jerrys Plains TEOM monitoring unit is owned and managed by DPI&E as part of the NSW UHAQMN. When contacted about the missing data, representatives from DPI&E confirmed that there had been an issue with the data logger for that period, resulting in data loss.

All other HVO compliance air quality monitors recorded PM10 levels of less than 20µg/m3 on both days, which is less than the 24 hour criteria of 50 µg/m3.

11.1.10 Missed HVAS Sample – 23 & 29 September 2020

On 25 September 2020, notification was received from HVO's environmental monitoring contractor that the PM2.5 HVAS at the Kilburnie South site had failed to run on the run day of 23 September. When the monitoring contractor attended the site there appeared to be no issue with the HVAS and it had been programmed correctly. It is believed the machine suffered an issue with its internal power supply. This HVAS was a hire unit which had been installed following a failure of the original Kilburnie South PM2.5 HVAS on 30 August.

As a result the HVAS was removed from service and replaced with a second hire unit and programmed to run on 29 September. Upon attending site on 30 September, the monitoring contractor again found that the HVAS failed to run on 30 September. This time the HVAS did not turn on or function properly when the monitoring contractor attempted to run the HVAS to confirm the run time. Therefore it appears this second hire HVAS has had a similar internal power failure.

It should be noted that there are two other HVAS units (a TSP and PM10) that are used at the same location and utilising the same power source as the PM2.5 HVAS. They also run on the same run days and have not experienced and run failures. Despite this, an electrician investigated the possibility of power supply issues on Monday 28 September 2020 and found no issues with the power supply.

11.1.11 Missed TEOM Sample – 2 December 2020

On 2 December 2020, the Warkworth and Knodlers Lane monitors failed to obtain a valid sample, resulting in a sample capture percentage of 38.9% and 45.8% for the day respectively.

This was a result of an electrical storm on the evening of 1 December 2020 that resulted in a localised power outage. The unit was inspected by the environmental contractor who reset the power and restored full functionality at 1:10pm 02 December 2020.

11.1.12 Missed HVAS Sample – 4 December 2020

An inspection of the Kilburnie South PM10 and TSP by an electrical contractor on 7 December noted that the residual current device (RCD) for the units was tripped. These were reset and it was reported that subsequently both units were running without issue. On 8 December 2020, notification was received from HVO's environmental monitoring contractor that the PM10 and TSP HVAS units at the Kilburnie South site had failed to run for the majority (except for nine hours) of the 24 hour period on the run day of 4 December 2020.

In addition, the Warkworth TSP unit only ran for 2 minutes only on 4 December. The environmental monitoring contractor noted on arrival to the site of the Warkworth TSP unit that there was no programming issue or tripped RCD and that the HVAS was running without issue.

The monitors are calibrated bi-monthly and the latest calibration was undertaken on 1 October 2020. It is believed that a power surge on the evening of 3 December 2020 was responsible for the run failures at the Kilburnie South (PM10 and TSP).

11.2 Blasting

During 2020 there was one incident related to blasting summarised below.

11.2.1 Air Blast Overpressure Exceedance - 27 August 2020

At 9:12am on 27 August 2020 HVO fired shot P205BAC01A in Cheshunt Pit 2 at HVO South. The Knodlers Lane blast monitor recorded an air blast overpressure result of 127.16dB. Meteorological conditions were assessed in accordance with the sites internal blasting permissions procedure. The shot was fired early due to elevated winds that were forecast for later in the day. The investigation revealed that the primary cause of elevated blasting overpressure can be attributed to cratering of blast holes and wavefront reinforcement. Isolated cratering events were observed within the blast, suggesting a lack of containment in three separate areas of the blast.

The cratering events are likely to have been caused by inadequate stemming with evidence of one hole being stemmed using drill cuttings. In this case, stem height was reached during loading of the hole and the bulk emulsion was likely to gas further. To prevent the hole becoming overloaded drill cuttings were used to stem the hole. The use of drill cuttings does not provide adequate containment compared with aggregate stemming.

In response to the incident and these findings, HVO implemented the following improvement actions to prevent a reoccurrence:

- Applying HVO's disciplinary process with the Shotfirer who failed to follow the HVO Shotfiring Activities Procedure, in regards to managing an overloaded hole.

- Requirement to use Blastlogic (or similar) software to assess wavefront reinforcement impacts prior to each blast.
- Review and update drill and blast QA/QC processes and record keeping procedures.

HVO received a $15,000 Penalty Infringement Notice from DPI&E.

12 Activities to be completed in 2021

12.1 Noise

Noise management improvements identified for implementation in 2021 include:

- Sound Power Level testing of various heavy mining equipment; and
- Continuation of sound attenuation on other heavy mining equipment.

12.2 Air Quality

Air quality management improvements identified for implementation in 2021 include:

- Aerial seeding of overburden that is temporarily unavailable for rehabilitation where available; and
- Trialling an agricultural irrigator on the ROM coal stockpile.

12.3 Historic Heritage

Improvements to historic heritage identified for implementation in 2021 include:

- Scar tree and hearth verification work;
- Vegetation management and asset protection zone around dog leg fence;
- Archerfield homestead stables stabilisation works; and
- Continued consultation with the neighbouring Liddell Coal Operations on any future mining plans that may interact with the Chain of Ponds Inn complex to ensure appropriate protective management measures are implemented where required.

12.4 Water

Improvements to mine water management in 2021 include:

- Implementing automated dam level monitoring and pipeline leak detection on mine water pipelines;
- Completing detailed engineering for water containment upgrades at the train load out facilities;
- Augmenting sediment dam capacity ahead of mining in West Pit;
- Continue preliminary engineering and scoping of water projects beyond 2022;
- Assessing feasibility of barrier wall installation between the North Void TSF and Carrington Alluvium;
- Ongoing upgrade of internal water transfer pipelines, pumping infrastructure, and system controls and monitoring.

12.5 Rehabilitation

During the next reporting period key focus areas for HVO will be:

- Completion of annual rehab target of 53.4ha;
- Continuation of Section 240 rehabilitation maintenance plan including continued progression of historic cover crop / weed management areas to final cover;
- Further development of rehabilitation completion criteria and refine TARP and monitoring programs to align with completion criteria;
- Commence remediation of degraded rehabilitation at the former Eastern TSF at HVO North; and
- Further develop opportunities for grazing access to suitable rehabilitation areas.

12.6 Tailing Storage Facility Capping

- Capping activities on Southeast TSF will continue during 2021 to progress rehabilitation of the remaining surface;
- Continuation of management activities for the North Void TSF, focusing on dewatering and capping strategy development;
- Optimisation of pipe-head flocculation systems at Carrington In-Pit TSF;
- Review the Life of Mine Fine Rejects Management Strategy;
- Review & Update of all tailings dam Operational and Maintenance Manuals; and
- Capping activities on Bob's Dump TSF to begin.

12.7 Stakeholder Engagement

The following stakeholder engagement activities are planned for 2021:

- Hosting four CCC meetings;
- Implementing two rounds of the HVO Community Fund;
- Developing and distributing two community newsletters;
- Conducting two Community Information sessions (at Jerrys Plains, Maison Dieu and Long Point); and
- Hosting a UHMD School Site Tour

All stakeholder engagement activities will be subject to COVID-19 restrictions.

12.8 Timeline for Implementation of Improvement Projects

A proposed timeline for the improvement projects mentioned in Section 12 is shown below in **Figure 113.**

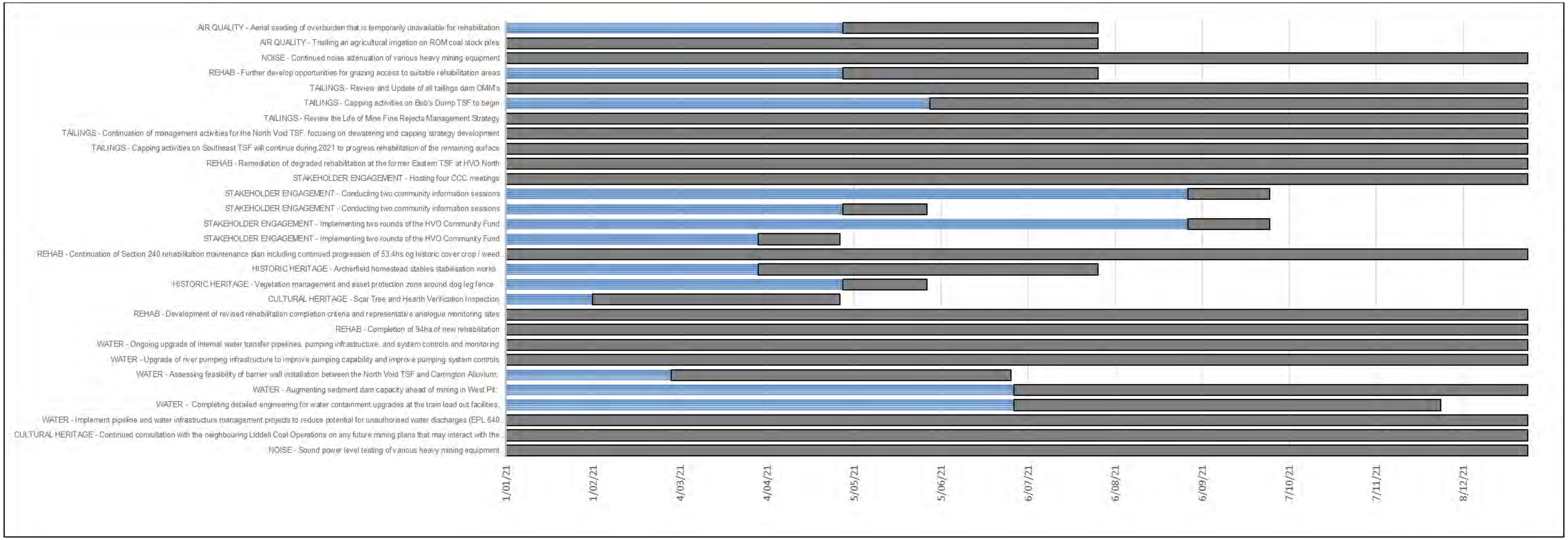

Figure 113 - Proposed Timeline for Implementation of 2021 Improvement Project

Appendix A - Annual PM10 Exceedance Investigations

Date	Monitoring Location	24hr result (µg/m³)	Estimated max. contribution from HVO (µg/m³)	Estimated max. Concentration (%)	Discussion
01/01/2020	Jerrys Plains TEOM	112.6	8.0 – HVO North	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
01/01/2020	Jerrys Plains TEOM	112.6	32.0 – HVO South	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
01/01/2020	Knodlers Lane TEOM	105.8	N/A	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
01/01/2020	Maison Dieu TEOM	86.7	N/A	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
01/01/2020	Warkworth TEOM	102.6	N/A	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
01/01/2020	Wandewoi TEOM	95.2	16.2 – HVO South	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
02/01/2020	Jerrys Plains TEOM	50.8	0.6 – HVO North	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
02/01/2020	Jerrys Plains TEOM	50.8	6.3 – HVO South	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
02/01/2020	Maison Dieu TEOM	51.7	N/A	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
02/01/2020	Warkworth TEOM	53.8	N/A	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
02/01/2020	Knodlers Lane TEOM	50.6	N/A	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
03/01/2020	Gliding Club HVAS	67.0	22.2 – HVO South	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
03/01/2020	Kilburnie South HVAS	79.0	34.2 – HVO South	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
03/01/2020	Warkworth TEOM	58.3	N/A	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.

Date	Monitoring Location	24hr result (µg/m^3)	Estimated max. contribution from HVO (µg/m^3)	Estimated max. Concentration (%)	Discussion
03/01/2020	Jerrys Plains TEOM	51.9	3.9 – HVO North	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
03/01/2020	Jerrys Plains TEOM	51.9	N/A	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
04/01/2020	Jerrys Plains TEOM	68.0	3.0 – HVO North	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
04/01/2020	Jerrys Plains TEOM	68.0	N/A	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
04/01/2020	Maison Dieu TEOM	86.9	N/A	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
04/01/2020	Warkworth TEOM	71.9	11.2 – HVO South	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
04/01/2020	Wandewoi TEOM	84.0	N/A	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
04/01/2020	Knodlers Lane TEOM	87.3	N/A	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
05/01/2020	Jerrys Plains TEOM	134.4	6.2 – HVO North	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
05/01/2020	Jerrys Plains TEOM	134.4	29.4 – HVO South	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
05/01/2020	Knodlers Lane TEOM	103.4	N/A	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
05/01/2020	Maison Dieu TEOM	116.3	15.0 – HVO South	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
05/01/2020	Warkworth TEOM	120.6	N/A	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
05/01/2020	Wandewoi TEOM	108.4	33.7 – HVO South	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
06/01/2020	Jerrys Plains TEOM	55.7	N/A	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.

Date	Monitoring Location	24hr result (µg/m³)	Estimated max. contribution from HVO (µg/m³)	Estimated max. Concentration (%)	Discussion
06/01/2020	Jerrys Plains TEOM	55.7	17.2 – HVO South	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
06/012020	Warkworth TEOM	54.5	N/A	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
08/01/2020	Jerrys Plains TEOM	66.3	4.6 – HVO North	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
08/01/2020	Jerrys Plains TEOM	66.3	12.1 – HVO South	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
08/01/2020	Knodlers Lane TEOM	61.5	0.4 – HVO South	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
08/01/2020	Maison Dieu TEOM	76.3	N/A	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
08/01/2020	Warkworth TEOM	81.6	5.1 – HVO South	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
09/01/2020	Warkworth TEOM	51.5	N/A	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
09/01/2020	Kilburnie South HVAS	64.0	24.8 – HVO South	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
10/01/2020	Jerrys Plains TEOM	69.4	N/A	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
10/01/2020	Jerrys Plains TEOM	69.4	3.3 – HVO South	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
10/01/2020	Maison Dieu TEOM	51.4	N/A	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
11/01/2020	Warkworth TEOM	91.0	N/A	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
11/01/2020	Jerrys Plains TEOM	85.8	4.8 – HVO North	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
11/01/2020	Jerrys Plains TEOM	85.8	14.5 – HVO South	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.

Date	Monitoring Location	24hr result (µg/m³)	Estimated max. contribution from HVO (µg/m³)	Estimated max. Concentration (%)	Discussion
11/01/2020	Maison Dieu TEOM	69.1	0.2 – HVO South	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
11/01/2020	Warkworth TEOM	91.0	N/A	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
11/01/2020	Wandewoi TEOM	75.7	6.9 – HVO South	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
12/01/2020	Jerrys Plains TEOM	66.5	14.1 – HVO South	22	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
12/01/2020	Maison Dieu TEOM	51.3	N/A	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
12/01/2020	Warkworth TEOM	73.6	N/A	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
12/01/2020	Wandewoi TEOM	61.0	11.9 – HVO South	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
15/01/2020	Kilburnie South HVAS	56	25 – HVO South	45	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
20/01/2020	Jerrys Plains TEOM	54.7	N/A	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
21/01/2020	Maison Dieu TEOM	54.2	0.6 – HVO South	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
21/01/2020	Cheshunt East HVAS	61.0	11.0 – HVO North	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
21/01/2020	Long Point HVAS	51.0	1.0 – HVO South	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
21/01/2020	Gliding Club HVAS	59.0	9.0 – HVO South	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
23/01/2020	Knodlers Lane TEOM	80.1	15.3 – HVO south	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
23/01/2020	Maison Dieu TEOM	128.7	0.9 – HVO South	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.

Date	Monitoring Location	24hr result (µg/m³)	Estimated max. contribution from HVO (µg/m³)	Estimated max. Concentration (%)	Discussion
23/01/2020	Warkworth TEOM	69.7	19.7 – HVO South	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
24/01/2020	Jerrys Plains TEOM	53.6	2.8 – HVO North	1.9	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
24/01/2020	Jerrys Plains TEOM	53.6	1 – HVO South	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
24/01/2020	Maison Dieu TEOM	62.5	0.4 – HVO South	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
24/01/2020	Warkworth TEOM	62.2	1.3 – HVO South	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
24/01/2020	Wandewoi TEOM	58.2	2.7 – HVO South	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
27/01/2020	Kilburnie South HVAS	52.0	0 – HVO South	N/A	An investigation determined HVO South maximum potential contribution to be in the order of 0ug/m3 based on prevailing wind conditions.
01/02/2020	Jerrys Plains TEOM	56.9	N/A	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
01/02/2020	Jerrys Plains TEOM	56.9	N/A	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
01/02/2020	Maison Dieu TEOM	51.8	N/A	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
02/02/2020	Maison Dieu TEOM	66.0	1.0 – HVO South	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
02/02/2020	Cheshunt East HVAS	91	N/A	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
02/02/2020	Gliding Club HVAS	80.00	16.0 – HVO South	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
02/02/2020	Kilburnie South HVAS	64.0	N/A	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
02/02/2020	Long Point HVAS	56.0	N/A	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.

Date	Monitoring Location	24hr result (µg/m^3)	Estimated max. contribution from HVO (µg/m^3)	Estimated max. Concentration (%)	Discussion
04/02/2020	Jerrys Plains TEOM	51.5	3.5 – HVO North	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
04/02/2020	Jerrys Plains TEOM	51.5	7.9 – HVO South	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
04/02/2020	Warkworth TEOM	56.3	N/A	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
04/02/2020	Wandewoi TEOM	51.4	9.8 – HVO South	N/A	External consultant engaged to determine source of exceedance. This day was deemed to be affected by an 'extraordinary' event by DPI&E.
9/04/2020	Knodlers Lane TEOM	63.4	0.0 – HVO South	0	An investigation determined HVO South maximum potential contribution to be in the order of 0.0 µg/m^3 (0%) based on prevailing wind conditions. Primary cause deemed to be a localised source.
11/04/2020	Knodlers Lane TEOM	57.1	38.1 – HVO South	67	An investigation determined HVO South maximum potential contribution to be in the order of 38.1 µg/m^3 (67%) based on prevailing wind conditions. Strong winds were seen across site.
24/04/2020	Maison Dieu TEOM	52.3	0.8 – HVO South	2	An investigation determined HVO South maximum potential contribution to be in the order of 0.8 µg/m^3 (2%) based on prevailing wind conditions.
26/04/2020	Cheshunt East HVAS	72	45.2 – HVO North	63	An investigation determined HVO North maximum potential contribution to be in the order of 45.2 µg/m^3 (63%) based on prevailing wind conditions.
26/04/2020	Long Point HVAS	53	<28.8 – HVO South	<54	An investigation determined HVO South maximum potential contribution to be in the order of 28.8 µg/m^3 (<54%) based on prevailing wind conditions.
26/04/2020	Maison Dieu TEOM	67	12.2 – HVO South	18	An investigation determined HVO South maximum potential contribution to be in the order of 12.2 µg/m^3 (18%) based on prevailing wind conditions.
19/08/2020	Jerrys Plains TEOM	53.9	0.0 – HVO North	0	An investigation determined HVO North maximum potential contribution to be in the order of 0.0 µg/m^3 (0%) based on prevailing wind conditions. Note that this day is deemed to be affected by an 'extraordinary' event.
19/08/2020	Jerrys Plains TEOM	53.9	0.0 – HVO South	0	An investigation determined HVO South maximum potential contribution to be in the order of 0.0 µg/m^3 (0%) based on prevailing wind conditions. Note that this day is deemed to be affected by an 'extraordinary' event.
19/08/2020	Knodlers Lane TEOM	69.2	23.1 – HVO South	33.4	An investigation determined HVO South maximum potential contribution to be in the order of 23.1 µg/m^3 (33.4%) based on prevailing wind conditions. Note that this day is deemed to be affected by an 'extraordinary' event.

Date	Monitoring Location	24hr result (µg/m^3)	Estimated max. contribution from HVO (µg/m^3)	Estimated max. Concentration (%)	Discussion
19/08/2020	Maison Dieu TEOM	57.3	7.5 – HVO South	13	An investigation determined HVO South maximum potential contribution to be in the order of 7.5 µg/m^3 (13%) based on prevailing wind conditions. Note that this day is deemed to be affected by an 'extraordinary' event.
19/08/2020	Warkworth TEOM	59.1	0.3 – HVO South	0.5	An investigation determined HVO South maximum potential contribution to be in the order of 0.3 µg/m^3 (0.5%) based on prevailing wind conditions. Note that this day is deemed to be affected by an 'extraordinary' event.
03/09/2020	Knodlers Lane TEOM	57.2	19.7 – HVO South	34.4	An investigation determined HVO South maximum potential contribution to be in the order of 19.7 µg/m^3 (34.4%) based on prevailing wind conditions.
02/10/2020	Wandewoi TEOM	55.5	<0.1 – HVO North	<0.1%	An investigation determined HVO North maximum potential contribution to be in the order of <0.1 µg/m^3 (<0.1%) based on prevailing wind conditions.
02/10/2020	Wandewoi TEOM	55.5	8.0 – HVO South	14.3	An investigation determined HVO South maximum potential contribution to be in the order of 8.0 µg/m^3 (14.3%) based on prevailing wind conditions.
27/11/2020	Jerrys Plains TEOM	63.5	10.7 – HVO North	16.8	An investigation determined HVO North maximum potential contribution to be in the order of 10.7 µg/m^3 (16.8%) based on prevailing wind conditions.
27/11/2020	Jerrys Plains TEOM	63.5	14.8 – HVO South	23.3	An investigation determined HVO South maximum potential contribution to be in the order of 14.8 µg/m^3 (23.3%) based on prevailing wind conditions.
28/11/2020	Cheshunt East HVAS	75	40.3 – HVO North	53.8	An investigation determined HVO North maximum potential contribution to be in the order of 40.3 µg/m^3 (53.8%) based on prevailing wind conditions.
28/11/2020	Gliding Club HVAS	73	39 – HVO South	53.5	An investigation determined HVO South maximum potential contribution to be in the order of 39 µg/m^3 (53.5%) based on prevailing wind conditions.
28/11/2020	Maison Dieu TEOM	53.9	0.4 – HVO South	0.8	An investigation determined HVO South maximum potential contribution to be in the order of 0.4 µg/m^3 (0.8%) based on prevailing wind conditions.
29/11/2020	Warkworth TEOM	63.5	5.2 HVO South	8.2	An investigation determined HVO South maximum potential contribution to be in the order of 5.2 µg/m^3 (8.2%) based on prevailing wind conditions. Note that this day is deemed to be affected by an 'extraordinary' event.

Date	Monitoring Location	24hr result (µg/m³)	Estimated max. contribution from HVO (µg/m³)	Estimated max. Concentration (%)	Discussion
29/11/2020	Jerrys Plains TEOM	51.4	0.1 – HVO North	0.2	An investigation determined HVO North maximum potential contribution to be in the order of 0.1 µg/m³ (0.2%) based on prevailing wind conditions. Note that this day is deemed to be affected by an 'extraordinary' event.
29/11/2020	Jerrys Plains TEOM	51.4	0.1 – HVO South	0.2	An investigation determined HVO South maximum potential contribution to be in the order of 0.1 µg/m³ (0.2%) based on prevailing wind conditions. Note that this day is deemed to be affected by an 'extraordinary' event.
29/11/2020	Knodlers Lane TEOM	88.1	26.7 – HVO South	30.3	An investigation determined HVO South maximum potential contribution to be in the order of 26.7 µg/m³ (30.3%) based on prevailing wind conditions. Note that this day is deemed to be affected by an 'extraordinary' event.
29/11/2020	Maison Dieu TEOM	108.3	10.6 – HVO South	9.8	An investigation determined HVO South maximum potential contribution to be in the order of 10.6 µg/m³ (9.8%) based on prevailing wind conditions. Note that this day is deemed to be affected by an 'extraordinary' event.
01/12/2020	Warkworth TEOM	54.9	0.7 – HVO South	1.2	An investigation determined HVO South maximum potential contribution to be in the order of 0.7 µg/m³ (1.2%) based on prevailing wind conditions.

Appendix B - Annual Groundwater Review

HUNTER VALLEY OPERATIONS

2020 Annual Groundwater Review

Prepared for:

HV Operations Pty Ltd
1011 Lemington Road,
Lemington NSW 2330

SLR Ref: 620.12182.60001-R18
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SLR

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with HV Operations Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised	Comment
620.12182.60001-R18-v1.0	1 March 2021	Joel Vernon	Angus McFarlane	Graham Hawkes	
620.12182.60001-R18-v2.0	30 March 2021	Joel Vernon	Angus McFarlane	Graham Hawkes	Incorporating HVO review

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APPENDICES

1 Introduction

1.1 Overview

The Hunter Valley Operations (HVO) mining complex is located approximately 24 km north-west of Singleton, NSW. As part of compliance with mine approval conditions, routine groundwater monitoring is conducted across HVO, and the data reviewed and analysed on an annual basis. The annual groundwater review is required to meet the following Development Consent and Water Access Licenses' Conditions:

- HVO North in accordance with Condition 27 of Development Consent (DA 450 10 2003) and individual bore license conditions (20BL173587-89 and 20BL173847).
- HVO South in accordance with Condition 28 of the Project Approval (PA 06 0261 24) and licence conditions for Lemington Underground (LUG) Bore (20BL173392).
- Individual bore license conditions (20BL173587-89, 20BL173847 and 20BL173392).

This report presents the annual groundwater review for HVO, developed in accordance with the approval conditions and requirements outlined within the Water Management Plan (WMP).

1.2 Scope

The scope of work for this review included analysis of monitoring data and reporting. This report presents:

- Site background:
  - Legislative requirements and conditions relevant to groundwater;
  - Mine activities over reporting period;
  - Hydrogeological regime; and
  - Groundwater monitoring network and programme.
- Data review:
  - Review and illustration (i.e. hydrographs) of groundwater level trends;
  - Review and illustration (i.e. hydrographs) of groundwater quality trends;
  - Comparison of water level and quality trends to relevant trigger levels and natural trends (i.e. surface water levels and rainfall); and
  - Assess compliance with mine approval conditions and present a checklist summarising findings.
- Discussion of groundwater impacts and compliance over the reporting period and provision of recommendations (where required).

2 HVO Complex

The following section provides a description of the HVO Complex of relevance to this annual groundwater review. The general site layout is presented in Figure 2-1.

2.1 Mine operations

Table 2-1 presents a summary of mine areas across HVO, approved mining timeframes and activities conducted throughout 2020. Overall, mining was active at West Pit, Cheshunt Pit, and Riverview Pit during 2020.

Table 2-1 Summary of HVO Activities

Mine Area	Seam Mined To	Approved Life of Mining	2020 Activities
West Pit	Bayswater to Hebden seams	1949 to 2025	Mining active
North Pit	Vaux Seam	1979 to 2003	Inactive – fully rehabilitated
Alluvial Lands	Vaux Seam	1993 to 2003	Inactive – fully rehabilitated
Carrington Pit	Bayswater Seam	2000 to 2021	Inactive – commenced receiving tailings in January 2020
Carrington West Wing	Bayswater Seam	Not commenced	Not commenced
Cheshunt Pit	Vaux & Bayswater seams	2002 to 2030	Mining active – down to the Bayswater Seam
Riverview Pit	Vaux & Bayswater seams	1997 to 2030	Mining active – down to the Vaux Seam
Glider Pit	Vaux Seam	2016 – 2017	Inactive – fully rehabilitated
Lemington South Pit 1	Bowfield Seam Warkworth Seam	1998 to 2006 2020 to 2030	Inactive – rehabilitated with final void/pit lake present. Used for water storage from LUG Bore abstraction

As of the 28th February 2018 the Planning Assessment Commission granted consent for the HVO South Modification 5. These approved operations are reflected in Table 2-1, which includes mining of the Riverview Pit down to the Bayswater seam.

A range of tailings storage facilities (TSF) are present across HVO, as summarised in Table 2-2. The TSF's are managed in accordance with the site Fine Rejects Management Strategy, which includes decant requirements to enable better consolidation of the material.

Table 2-2 Summary of approved tailings storage facilitates at HVO

Mine Area	Location	Status
Dam 6W	West Pit	Active over 2020
Bob's Dump (20W)	West Pit	Inactive over 2020
North Void (DM6)	North Pit	Ceased receiving tailings in January 2019, planning for decommissioning and rehabilitation has commenced
Southeast TSF (27N)	North Pit	Inactive – capping commenced 2016
Central TSF (28N)	North Pit	Inactive over 2020
Carrington Out of Pit Fine Reject Emplacement (COOP FRE)	Carrington area – out of pit emplacement.	Approved, not constructed
Carrington In Pit Fine Reject Emplacement (FRE)	Carrington area – in pit emplacement	Void area over 2018, receiving tailings since January 2020

Over 2020 only two areas were actively used for tailings storage, Dam 6W at West Pit and Carrington In Pit Fine Reject Emplacement. North Void ceased receiving tailings in January 2019, planning for decommissioning and rehabilitation has commenced.

Groundwater was also abstracted from the Lemington Underground Bore (LUG) during 2020. LUG Bore is a production bore constructed into the historical Lemington Underground beneath HVO that mined the Mt Arthur Seam of the Whittingham Coal Measures, with this mine having been inactive since 1999. Abstraction from LUG Bore is managed by Yancoal for the Mt Thorley Warkworth (MTW) operations.

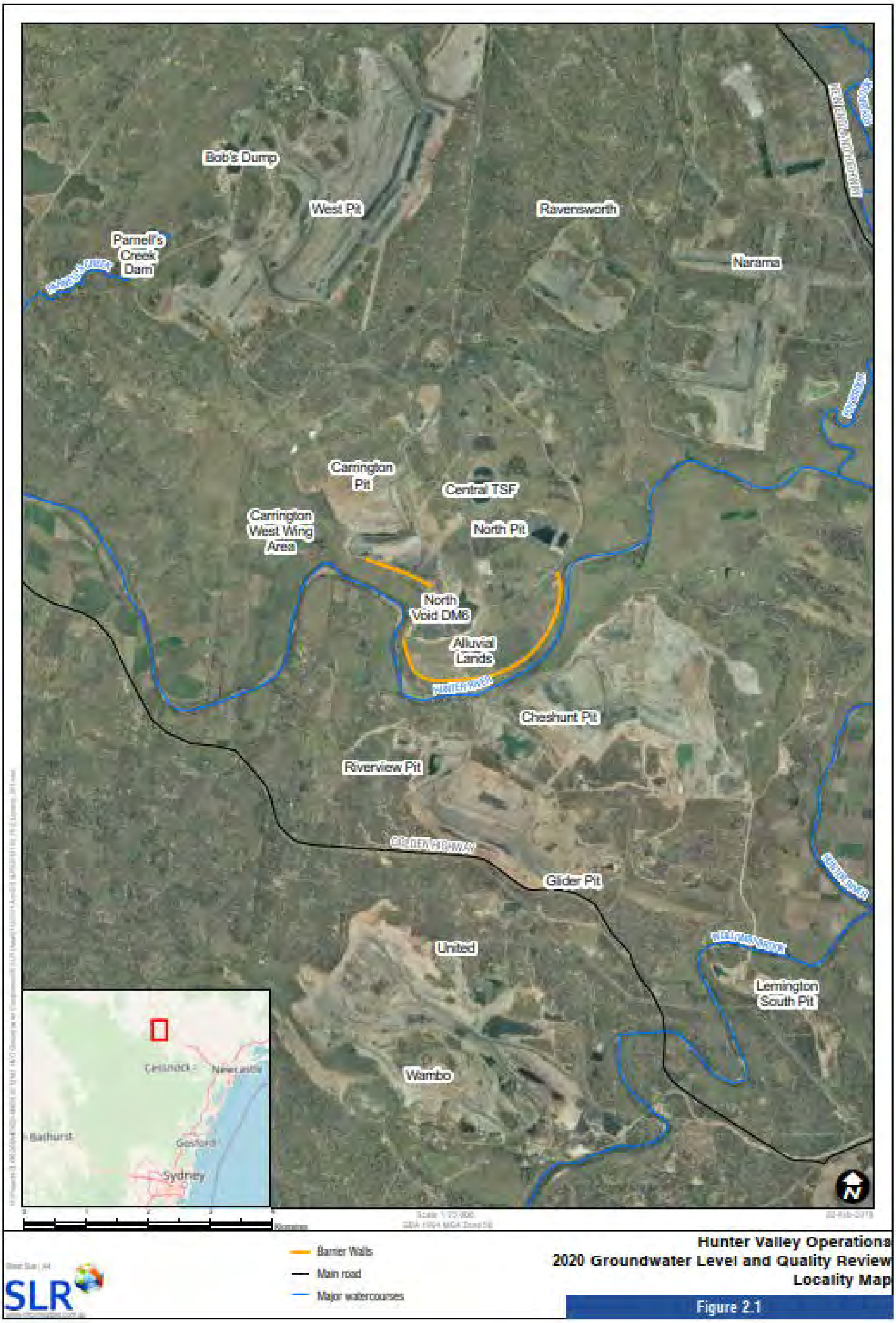

Figure 2-1 Locality Map

2.2 Groundwater Impacts

Groundwater impacts associated with the approved operations at HVO have been progressively assessed for each mining area, including:

- Alluvial Lands Project Groundwater Assessment (MMA 1992);
- Carrington Pit Groundwater Assessment (MER 1998);
- West Pit Extension Groundwater Assessment (MER 2003);
- Carrington Pit Extended Groundwater Assessment (MER 2005);
- Carrington West Wing Groundwater Assessment (MER 2010);
- HVO South Groundwater Assessment (ERM 2008);
- HVO North Modification 4 Groundwater Assessment – Carrington Out of Pit Fine Reject Emplacement (AGE 2013b);
- HVO North Modification 6 Groundwater Assessment – Carrington In Pit Fine Reject Emplacement (AGE 2016); and
- HVO South Modification 5 Groundwater Assessment (AGE 2017).

The most recent groundwater assessment that captures operations across HVO North and HVO South was the HVO South Modification 5, which was granted consent by the Planning Assessment Commission on 28th February 2018. The groundwater assessment for Modification 5 was completed by AGE (2017) and included development of a numerical groundwater model to represent groundwater response to approved mine activities and the proposed modification.

AGE (2017) reported on predicted impacts associated with approved operations over 2020 (model Year 5). The approved operations included mining at Cheshunt Pit, Riverview Pit, Glider Pit and West Pit, as well as surrounding non-HVO mining operations (i.e. Ravensworth, Mt Thorley Warkworth etc) and abstraction from the LUG Bore. The groundwater model also included approved mining at Carrington West Wing until 2021; however, no mining has occurred at Carrington West Wing to date.

The model was calibrated to the end of 2015 and groundwater conditions and groundwater response to approved mining to the end of 2015, as reported by AGE (2017), indicated:

- Groundwater within the hard rock units (i.e. Whittingham Coal Measures) is directly intercepted by approved operations at HVO;
- Groundwater within the confined to semi-confined Permian coal measures became depressurised around the area of active mining. Groundwater drawdown responses were observed around 2 km to 6 km from active mine areas within the Permian coal measures;
- There is no direct interception of groundwater within alluvium for active mine operations at HVO. However, historically the South Lemington Pit 1 footprint did directly intercept alluvium and barrier walls were established at Alluvial Lands and Carrington Pit to separate mine areas from alluvium; and
- With depressurisation of the coal measures, the model predicted a reduction in upward seepage to the alluvium that was referred to as ‘indirect take’.

- These findings largely aligned with historical groundwater assessments conducted for the approved operations across HVO. Groundwater licenses have been obtained for the approved operations, as discussed in Section 2.3. Management and monitoring requirements of potential groundwater related impacts from approved operations are captured within the development consent conditions. Schedule 3, Condition 27 of Development Consent (DA 450 10 2003) for HVO North, last updated January 2017 for Modification 6 and again in July 2017 (no changes to groundwater conditions in July); and
- Schedule 3, Condition 28 of the Project Approval (PA 06 0261 24) for HVO South, last updated October 2012.

These conditions are addressed within the site Water Management Plan (WMP). Further discussion on the monitoring and management requirements is included within Section 2.4.

2.3 Groundwater Licensing

Under the Water Act 1912 and Water Management Act 2000, adequate water licences are required for approval of the mine developments. Groundwater licenses held for HVO are outlined in Table 2-3.

Table 2-3 HVO Groundwater Licenses

License Number	Description	WSP	Water Source - Management Zone	Approved Extraction (ML)
WAL 40462	HVO Pit Excavations – Alluvial Lands Bores	North Coast Fractured and Porous Rock	Permian Coal Seams	2,400
WAL 40463				180
WAL 40466				460
WAL41527	HVO North – Carrington Pit			700
WAL41533	HVO North Pit Excavation			20
WAL39798	Lemington Underground (LUG) Bore			1,800
WAL18127	Carrington BB1	Hunter Unregulated and Alluvial Water Sources	Hunter Regulated River Alluvial Water Source – Upstream Glennies Creek Management zone	383
WAL18158	Ollenberry			65
WAL18307	HVO West – Parnells Creek Dam (Diversion Works Bywash)		Jerrys Management Zone Jerrys Management Zone	500
WAL18327	HV Loading Point Pump Bayswater Creek (Diversion Works)			150
WAL36190	HVO North, old farm bore			120
WAL23889	Greenleek		Lower Wollombi Brook Water Source	144

License Number	Description	WSP	Water Source - Management Zone	Approved Extraction (ML)
WAL962 (20AL201237)	Surface water access – West Pit area	Hunter Regulated River Water Source	Hunter River (Zone 1b) between Goulburn River junction and Glennies Creek junction.	3,165
WAL970, WAL1006 & WAL1070 (20AL201256, 20AL201337 & 20AL201500)	Surface water access – HVO North and HVO South areas		Hunter River (Zone 2a) between Glennies Creek junction and Wollombi Brook junction.	1,500 (500 each)

2.4 Groundwater Conditions

In accordance with the development consent approval conditions, HVO are required to prepare and implement a Water Management Plan (WMP) to the satisfaction of the Secretary. Table 2-4 presents a summary of the relevant groundwater conditions from the development consent and WMP. The table identifies where the conditions relating to routine groundwater monitoring for 2020 have been addressed.

Table 2-4 Groundwater Conditions within WMP

Approval Condition	Condition	Where Addressed
Sch. 3, Cond. 27(c) (PA 06_0261)	A groundwater monitoring programme that includes:	
	• Additional baseline data of groundwater levels yield and quality in the region, and privately-owned groundwater bores, which could be affected by the project;	See WMP No private bores predicted to be impacted for current approved operations and no monitoring of private bores.
	• Groundwater impact assessment criteria, including trigger levels for investigating any potentially adverse groundwater impacts of the project; and	See Section 4.3 for criteria Section 5 comparison to triggers
	• A programme to monitor: o Groundwater inflows to the open cut mining operations; and	See WMP
	o Impacts of the project on the region's aquifers, any groundwater bores, and surrounding watercourses, and in particular, the Hunter River and Wollombi Brook and adjacent alluvium; and	See Section 5
Sch. 3, Cond. 27(c)	A Groundwater Management Plan, which includes:	

Approval Condition	Condition	Where Addressed
(DA450-10-2003)	• Detailed baseline data on groundwater levels, yield and quality in the region, and privately- owned groundwater bores, that could be affected by the development;	See WMP
	• Groundwater assessment criteria, including trigger levels for investigating any potentially adverse groundwater impacts;	See Section 4.3 for criteria and Section 5 for comparison to triggers
	• A programme to monitor:	
	o Groundwater inflows to the open cut mining operations;	See WMP
	o the impacts of the development on: ▪ The alluvial aquifers, including additional groundwater monitoring bores as required by NOW;	See Section 5.2.1
	▪ The effectiveness of the low permeability barrier;	See Section 5.2.3
	o Base flows to the Hunter River;	Groundwater trends reviewed in Section 5.2
	o Any groundwater bores on privately-owned land that could be affected by the development;	No private bores predicted to be impacted for current approved operations and no monitoring of private bores.
	o Groundwater dependent ecosystems, including the River Red Gum Floodplain Woodland EEC located in the Hunter River alluvium;	See WMP
	o The seepage/leachate from water storages, backfilled voids and the final void;	See Section 5.2.3 – including discussion on groundwater trends within North Pit spoil.
	o The development, including an independent review of the model, every three years and comparison of monitoring results with modelled predictions; and	See Section 5.5
	o A plan to respond to any exceedances of the groundwater assessment criteria.	See Section 6.2
Sch. 3, Cond. 27(c) (DA450-10-2003)	• A programme to validate and recalibrate (if necessary) the groundwater model for the development, including an independent review of the model every 3 years, and comparison of monitoring results with modelled predictions;	See Section 5.5
HVO South Statement of Commitments	In addition to the mitigation measures undertaken at HVO for groundwater management, the following controls specific to the proposal will be implemented:	See Surface Water Review

Approval Condition	Condition	Where Addressed
	• Groundwater Flow To and From Rivers: o development of protocols for monitoring and reporting of NOW stream gauge results to clearly record any reductions in flows that are attributed to mining. This will include monitoring Hunter River flows immediately up gradient and down gradient of the site. In addition, consideration will be given to tying in specific CNA water level recordings with current NOW gauging locations;	
	o monitoring of groundwater elevations within alluvium between the Hunter River and the Cheshunt Pit; and	See Section 5.2.1.3
	o measured groundwater elevations and river flow will be assessed against predictions to determine whether application of additional management measures is required; and	See Section 5.5
	o offset seepage to pits in accordance with regulatory requirements.	See WMP

Additional conditions are in place for the approved Carrington West Wing; however, mining has not commenced here and there are no current plans to commence these operations in the near future.

Groundwater monitoring is conducted in accordance with the Groundwater Monitoring Programme outlined within Appendix A of the WMP. The programme outlines groundwater monitoring frequency, parameters to be tested and groundwater triggers for electrical conductivity (EC) and pH. The WMP was updated in October 2018, including updates to the monitoring network and trigger levels. This annual review is based upon the monitoring and reporting requirements documented within the October 2018 version of the WMP. Further discussion on the groundwater monitoring programme and triggers is included in Section 4.

3 Hydrogeological Setting

This section presents a brief summary of the hydrogeological setting for HVO. This includes discussion on climate, terrain, drainage, geology and groundwater bearing units.

3.1 Climate, Terrain and Drainage

3.1.1 Climate

The climate of the HVO region can be classed as temperate and is characterised by hot summers and mild dry winters. Rainfall data is available from the Scientific Information for Landowners (SILO) database of historical climate records for Australia (DSITI, 2015). This service interpolates rainfall and evaporation records from available stations for an area within 100 km of the search coordinates, which was Latitude -32.50/Longitude 151.00. Climatic data was obtained between 01/01/1900 to 01/01/2021. Table 3-1 provides the average monthly rainfall data, as well as the 2020 monthly data from SILO. Annual rainfall for 2020 exceeds the annual average rainfall by 234.4 mm.

A cumulative deviation from mean (CDM) rainfall plot is provided as Figure 3-1 to illustrate long term climate trends in the HVO area. The CRD graphically shows trends in recorded rainfall compared to long-term averages and provides a historical record of relatively wet and dry periods. A rising trend in slope in the CRD graph indicates periods of above average rainfall, whilst a declining slope indicates periods when rainfall is below average. A level slope indicates average rainfall conditions. As shown in Figure 3-1 below, the region has generally experienced below average annual rainfall from 2016 to 2019 and 2020 rainfall was above average.

Table 3-1 Long Term Average and 2020 Climate Data

Rainfall (mm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Average Historical	73.0	71.7	60.6	46.4	38.8	46.0	39.6	34.5	38.5	50.5	59.9	67.8	627.3
2020 Rainfall	55.4	130.8	83.4	54.8	19.8	49.8	86	32.6	51.6	87	24.4	117.4	793
Deficit/surplus	-4.0	72.2	39.4	-0.3	-18.6	-12.8	32.2	2.6	-0.6	51.5	-24.4	97.2	234.4

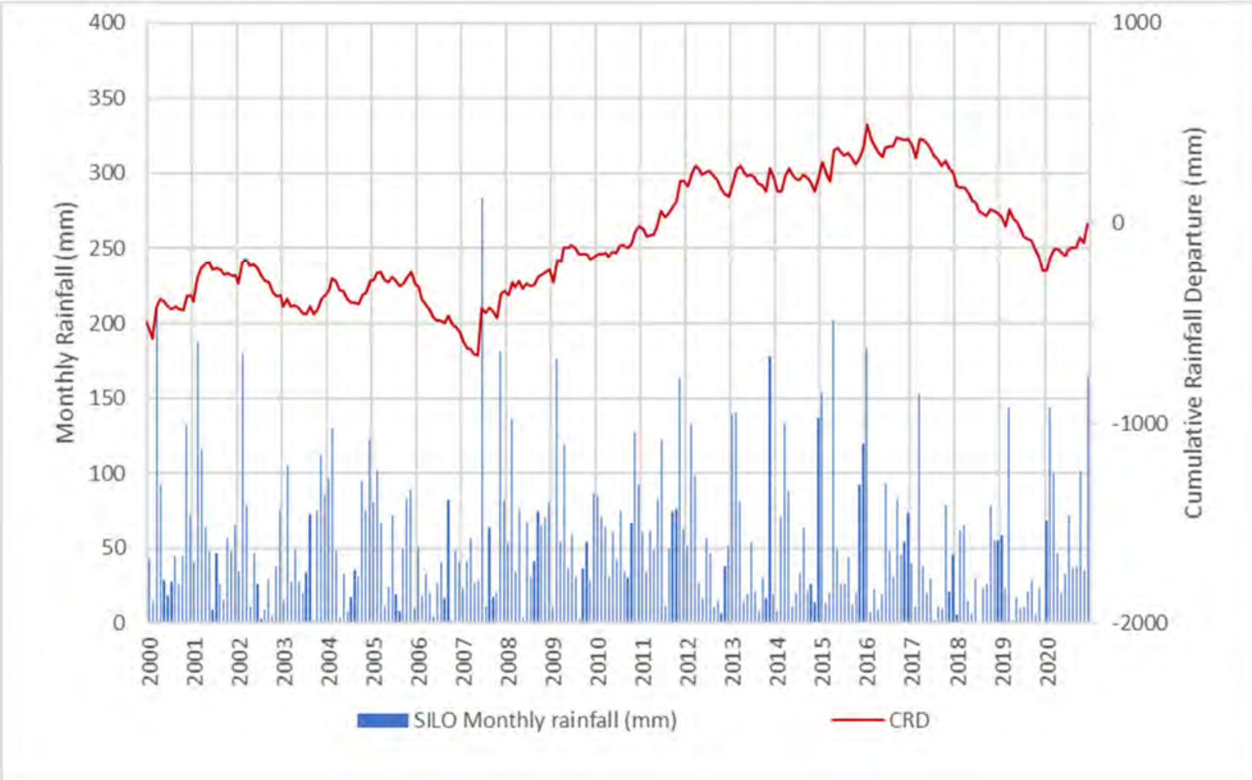

Figure 3-1 Cumulative Rainfall Departure and Monthly Rainfall

3.1.2 Terrain and Drainage

The HVO site terrain and surface drainage are dominated by the easterly flowing Hunter River, which dissects the complex in a general east-west direction. Ground elevations range between 60 m Australian Height Datum (mAHD) along the Hunter River alluvial plains to 180 mAHD in the northern parts of HVO North and in the western parts of HVO South. Minor ephemeral drainage features are also present around HVO North (i.e. Parnells Creek, Farrells Creek and Bayswater Creek) and HVO South (Wollombi Brook), draining into the Hunter River.

Real time stream flow data is monitored along the Hunter River and Wollombi Brook at DPI water gauging stations via the Hunter Integrated Telemetry System (HITS). Time series river water elevations (mean level above zero gauge elevation) is presented in Figure 3-2 for three HITS stations (Hunter River @ Liddell, Hunter River @ U/S Foy Brook and Wollombi Brook @ Warkworth) as well as four locations monitored monthly at HVO along the Hunter River (WL03, WL05, WL10 and WL14).

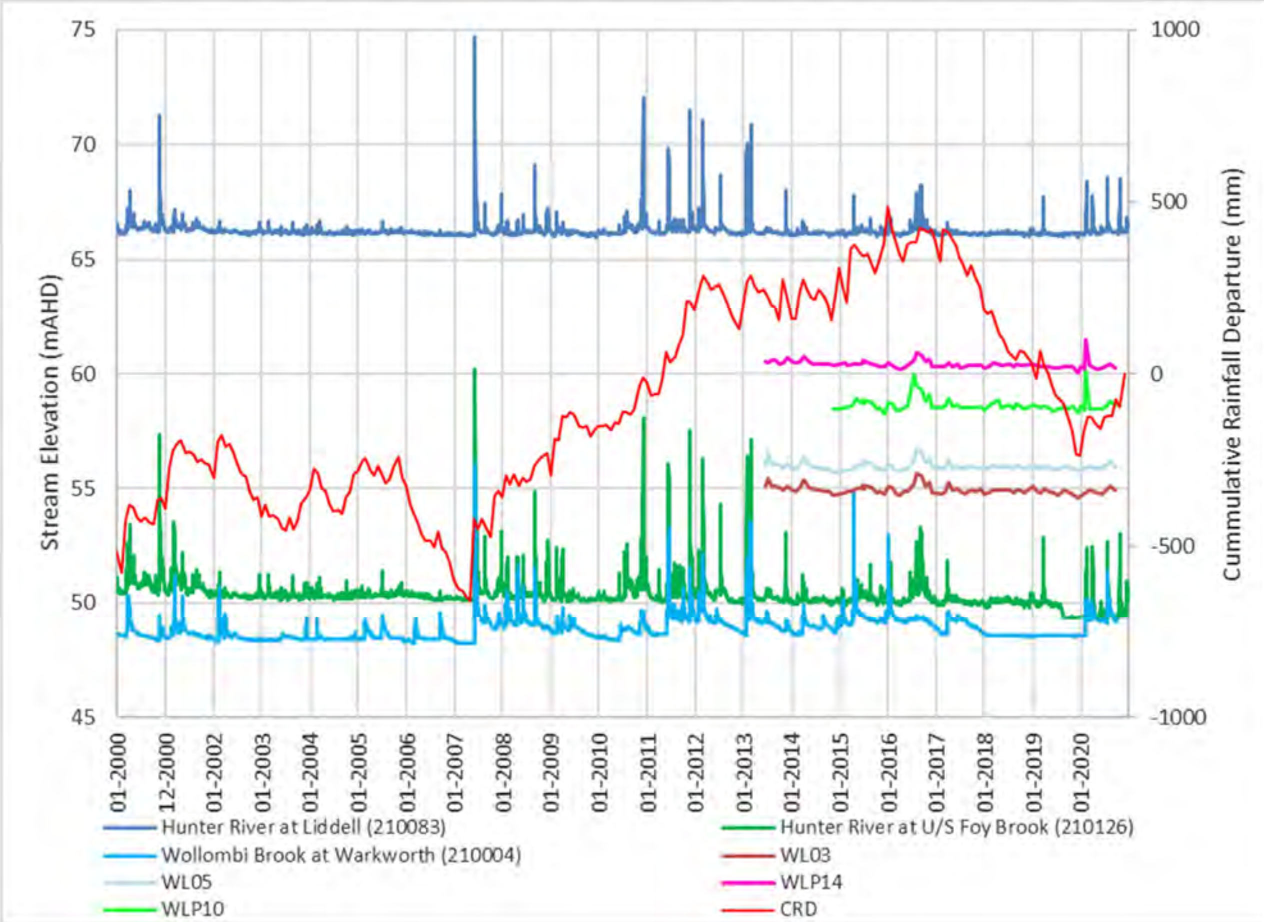

Figure 3-2 Surface Water Levels

As shown in Figure 3-2, over 2020 stream elevations within the Hunter River ranged from 68.5 mAHD upstream at Liddell, down to 49.4 mAHD at Foy Brook. Review of stream discharge for the Hunter River at Foybrook (210126) indicates discharge rates peaked during the monitoring period with the highest flow of 14,653 ML/day (30/7/2020) recorded. For the remainder of the year stream discharge fluctuated between low flow below 200 ML/day and peaks over 100ML/day averaging 864ML/day. Over 2020, stream elevations within Wollombi Brook fluctuated ranging between 48.2 mAHD and 51.4 mAHD, review of stream discharge shows the Wollombi Brook did not flow from 2017 until 10/02/2020 and remained flowing for the remainder of 2020.

3.2 Geology

HVO lies within the Hunter Coalfields, which are dominated by the Permian aged Whittingham Coal Measures of the Sydney Basin. The Whittingham Coal Measures are made up of the Jerrys Plains Sub-group and Van Sub-group. These units comprise economic coal seams along with overburden and interburden consisting of sandstone, siltstone, tuffaceous mudstone and conglomerate. The Whittingham Coal Measures are truncated to the east by the Hunter-Mooki Thrust Fault and occur at HVO as stratified (layered) sequences that dip at a shallow angle (2° to 5°) to the south-west. The coal seams subcrop to the north and east of HVO.

At HVO North the Whittingham Coal Measures are incised by a paleochannel of the Hunter River (Figure 3-3). The properties and extent of the paleochannel were assessed and mapped by MER (2008). The paleochannel comprises a heterogeneous distribution of silts, sands and gravels.

Along the Hunter River and Wollombi Brook thin Quaternary alluvial deposits unconformably overlie the Permian strata. The alluvial deposits comprise surficial fine-grained sediments (i.e. silts and clays). Along major watercourses (i.e. Hunter River and Wollombi Brook) the surficial sediments overly basal sands and gravels that are between 7 m to 20 m thick. Table 3-2 presents a summary of site geology and Figure 3-3 presents a map of the geology of the HVO site and surrounds.

Table 3-2 HVO Generalized Stratigraphy

<table>
<tr><th>Age</th><th colspan="2">Stratigraphic Unit</th><th>Description</th></tr>
<tr><td rowspan="4">Cainozoic</td><td rowspan="2">Quaternary sediments - alluvium (Qa)</td><td>Surficial alluvium (Qhb)</td><td>Shallow sequences of clay, silty sand and sand.</td></tr>
<tr><td>Productive basal sands/gravel (Qha)</td><td>Basal sands and gravels along major watercourses (i.e. Hunter River).</td></tr>
<tr><td colspan="2">Silicified weathering profile (Czas)</td><td>Silcrete</td></tr>
<tr><td colspan="2">Alluvial terraces (Cza)</td><td>Silt, sand and gravel</td></tr>
<tr><td>Jurassic</td><td colspan="2">Volcanics (Jv)</td><td>Flows, sills and dykes</td></tr>
<tr><td rowspan="3">Permian</td><td rowspan="3">Whittingham Coal Measures</td><td>Jerrys Plains Sub-group (Pswj)</td><td>Coal bearing sequences interbedded with sandstone and siltstone.
Coal seams (youngest to oldest) include Whybrow Seam, Redbank Creek Seam, Wambo Seam, Whynot Seam, Blakefield Seam, Glen Munro Seam, Woodlands Hill Seam, Arrowfield Seam, Bowfield Seam, Warkworth Seam, Mt Arthur Seam, Piercefield Seam, Vaux Seam, Broonie Seam and Bayswater Seam.</td></tr>
<tr><td>Archerfield Sandstone</td><td>Lithic sandstone marker bed.</td></tr>
<tr><td>Vane Sub-group (Pswv)</td><td>Coal bearing sequences interbedded with sandstone and siltstone.
Coal seams (youngest to oldest) include Lemington Seam, Pikes Gully Seam, Arties Seam, Liddell Seam, Barrett Seam and Hebden Seam.</td></tr>
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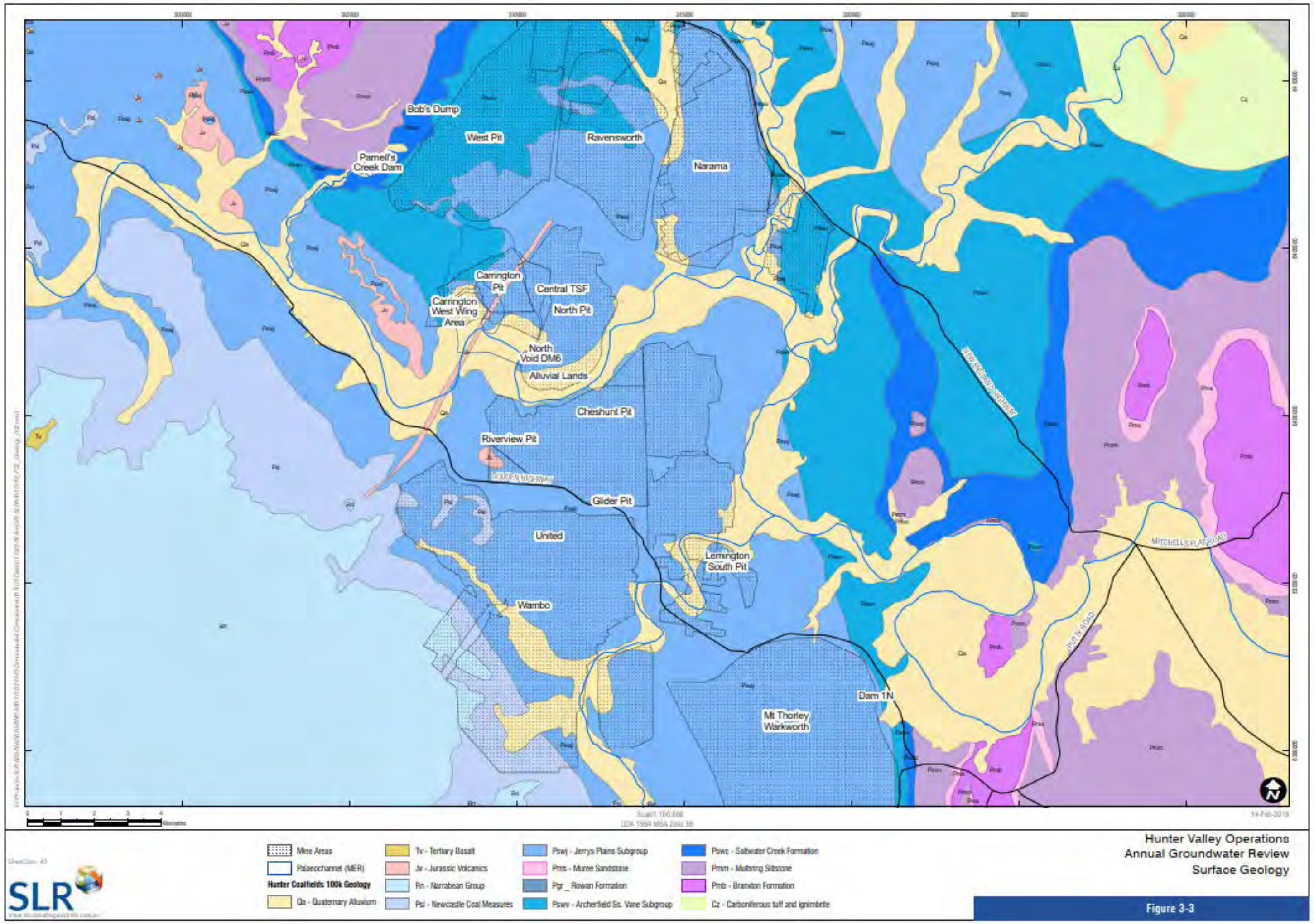


Figure 3-3 Surface Geology

3.2.1 Hydrostratigraphic Units

The principal hydrostratigraphic units at HVO and its immediate surrounds are the productive alluvium associated with the Hunter River and Wollombi Brook, and the Permian coal seams of the Whittingham Coal Measures. Description of the hydrostratigraphic units was derived from historical groundwater assessment reports, discussed in Section 2.2.

3.2.2 Alluvium

The Quaternary alluvium is an unconfined groundwater system that is recharged by rainfall infiltration, streamflow and upward leakage from the underlying stratigraphy, particularly in undisturbed areas (i.e. away from active mining). The potentiometric surface and flow direction within the alluvium is a subdued reflection of topography. Groundwater within the Hunter River alluvium flows in an easterly direction, while water within the Wollombi Brook alluvium flows in a north to north-easterly direction towards the Hunter River.

Regionally, the Hunter River and Wollombi Brook are predominantly gaining water from the surrounding alluvium, as well as from rainfall and regulated flow (i.e. dam releases). However, there are also areas where the rivers recharge the underlying alluvium. These losing conditions can occur around areas of active mining, where the hydraulic gradient is increased due to depressurisation of the underlying coal measures. Losing conditions also occur within the more topographically elevated tributaries of the main water courses, where the water table is deeper and not connected directly to the streams.

While “less productive” groundwater within the surficial alluvium does not meet the ANZECC (2000) water quality guidelines for stock water supply, the “highly productive” alluvium (basal sands and gravels) is considered suitable for stock water supply from a water quality perspective. However, most agricultural producers (crop and cattle) utilise surface water resources (Hunter River and Wollombi Brook) in preference to alluvial groundwater.

The alluvial aquifer of the Hunter River supports Carrington Billabong, an ephemeral freshwater wetland located south of Carrington Pit that is considered a Groundwater Dependant Ecosystem (GDE). Alluvial groundwater levels around Carrington Billabong have remained relatively stable during active mining at Carrington Pit. This is due to installation of a barrier wall through the unconsolidated alluvial sediments, which separates the Billabong from Carrington Pit. The stable alluvial groundwater levels in this area are also taken to indicate limited hydraulic connection between the nearby paleochannel alluvium and the underlying depressurised coal measures.

3.2.3 Permian Coal Measures

The Whittingham Coal Measures outcrop across the north to east of HVO. The coal measures form unconfined groundwater systems at outcrop, becoming semi-confined to confined as they dip towards the south-west.

Recharge occurs from direct rainfall to the ground surface, infiltrating into the formations through the thin soil cover and weathered profile. The coal measures also occur at subcrop in localised zones beneath alluvium associated with the Hunter River and Wollombi Brook, where the unit is recharged by downward seepage where gradients promote this flow.

The coal seams are typically moderately to slightly permeable, whilst the hydraulic conductivity of the interburden material is generally less than coal seams but is more variable, depending on the predominance of fractures in the rock mass. The hydraulic conductivity of the coal seams generally decreases with depth due to the closure of the cleats with increasing stratigraphic pressure.

The direction of groundwater flow for the Whittingham Coal Measures is influenced by the local geomorphology and structural geology, as well as the long history of mining within the region which has significantly altered groundwater flow paths within the Permian units. Groundwater flow in the Permian aquifers on a regional scale follows the regional topography, flowing in a north-easterly direction. However, on a local scale groundwater levels show drawdown impacts associated with the extensive active mining areas. Groundwater discharge from the Whittingham Coal Measures currently occurs as discharge to active mining and abstraction bores, as well as upward seepage to the Quaternary alluvium where hydraulic gradients promote this flow.

There is no significant usage of groundwater from the Permian coal measures, likely due to the poor quality that generally exceeds ANZECC (2000) water quality guidelines for stock supply, and presence of perennial surface water flows (Hunter River and Wollombi Brook) and the more productive alluvial aquifer.

4 Groundwater Monitoring

4.1 Groundwater Monitoring Program

Groundwater monitoring is conducted at HVO in accordance with the HVO WMP, specifically the Groundwater Management Plan and Groundwater Monitoring Programme. The monitoring results are used to establish and monitor trends in physical and geochemical parameters of surrounding groundwater potentially influenced by mining.

The monitoring programme at HVO measures the Standing Water Level (SWL) in monitoring bores, reported as elevation (mAHD). The data is compared against background data, EIS predictions and historical trends as a means of assessing any HVO related impacts to the quantity of groundwater in the various aquifers.

The monitoring programme at HVO also assesses the quality of groundwater against background data and historical trends. Groundwater quality is evaluated through the parameters of pH and electrical conductivity (EC). On a periodic basis (nominally once per annum) a comprehensive suite of analytes is measured, including major anions, cations and metals. Prior to sampling for comprehensive analysis, bore purging is undertaken to ensure a representative sample is collected.

Groundwater quality monitoring data is reviewed on a quarterly basis. The review involves a comparison of measured pH and EC results against internal trigger values which have been derived from the historical data set. Trigger limits are calculated as the 95th percentile maximum value (EC and pH) and the 5th percentile minimum value (pH only) from data collected since 2011. Trigger levels have been set based on geographical proximity and target stratigraphy.

The groundwater monitoring network at HVO has evolved over time and includes 127 groundwater monitoring points that require routine monitoring in accordance with the 2018 WMP, as well as other historical monitoring locations. The bores are installed into a number of geologic units. As outlined within the WMP, bores are grouped into one of eight Locations, as summarised below:

- West Pit (HVO North)
- North Pit (HVO North – historical mine area fully rehabilitated)
- Carrington (HVO North – historical mine area)
- Carrington West Wing - CWW (HVO North – approved mine area but not yet commenced)
- Cheshunt/North Pit (HVO North and HVO South - bores located between North Pit and Cheshunt Pit)
- Cheshunt (HVO South – south of Hunter River)
- Lemington South – Lemington (HVO South – near Wollombi Brook)
- Southern (HVO South – unmined area east of Lemington South Pit 1)

The details of each of the HVO monitoring bores as well as each bores respective monitoring programme are provided in Appendix A and the location of the bores are presented in Figure 4-1 to Figure 4-3.

The 103 compliance bores have trigger levels set for water quality (EC and pH) and five for water quality and water levels (CFW55R, CFW57, CGW52a, CGW53a and CGW55a). It is noted there are 104 bores listed in the trigger table of the WMP, but no triggers are assigned for one bore (CGW46). It is recommended that triggers be assigned during the next revision of the WMP. An additional ten bores were installed in 2018 to monitor the area to the south of the Carrington Pit/North Void. These bores (GW-120 to GW-129) are yet to be included in the WMP, however, they have been routinely monitored since installation.

As outlined in Appendix A, full laboratory water quality analysis is required to be conducted for 65 bores, either 6-monthly (27 bores) or annually (38 bores). There are also two different laboratory analytical suites used, as follows:

Comprehensive analysis 1

- TDS;
- Major Ions (Ca, Cl, K, Na, SO_4 (or S), CO_3);
- Total Alkalinity, Bicarbonate Alkalinity, Carbonate Alkalinity, Hydroxide Alkalinity; and
- Metals (Al, As, B, Cd, Cu, Hg, Mg, Ni, Pb, Se, and Zn).

Comprehensive analysis 2

- TDS;
- Major ions (Ca, Cl, K, Na, SO_4 (or S), CO_3);
- SiO_2;
- Total Alkalinity, Bicarbonate Alkalinity, Carbonate Alkalinity, Hydroxide Alkalinity;
- Metals (Al, As, B, Be, Cd, Co, Cu, F, Fe, Hg, Mg, Mn, Pb, Rb, Sb, Se, Sr, Zn); and
- Nutrients (Ni, NH_3, NO_2, NO_3 and P).

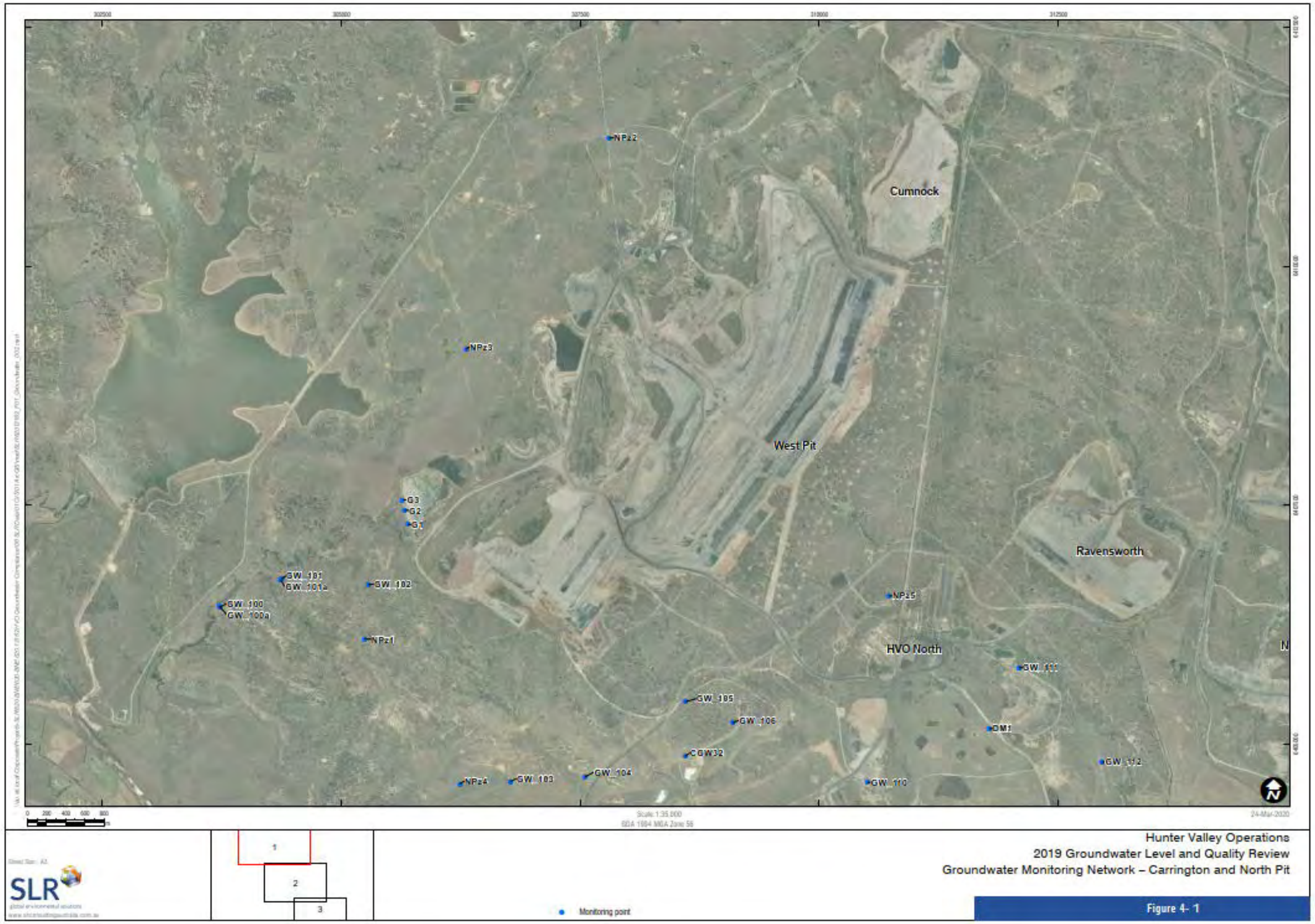


Figure 4-1 Groundwater Monitoring Network – West Pit

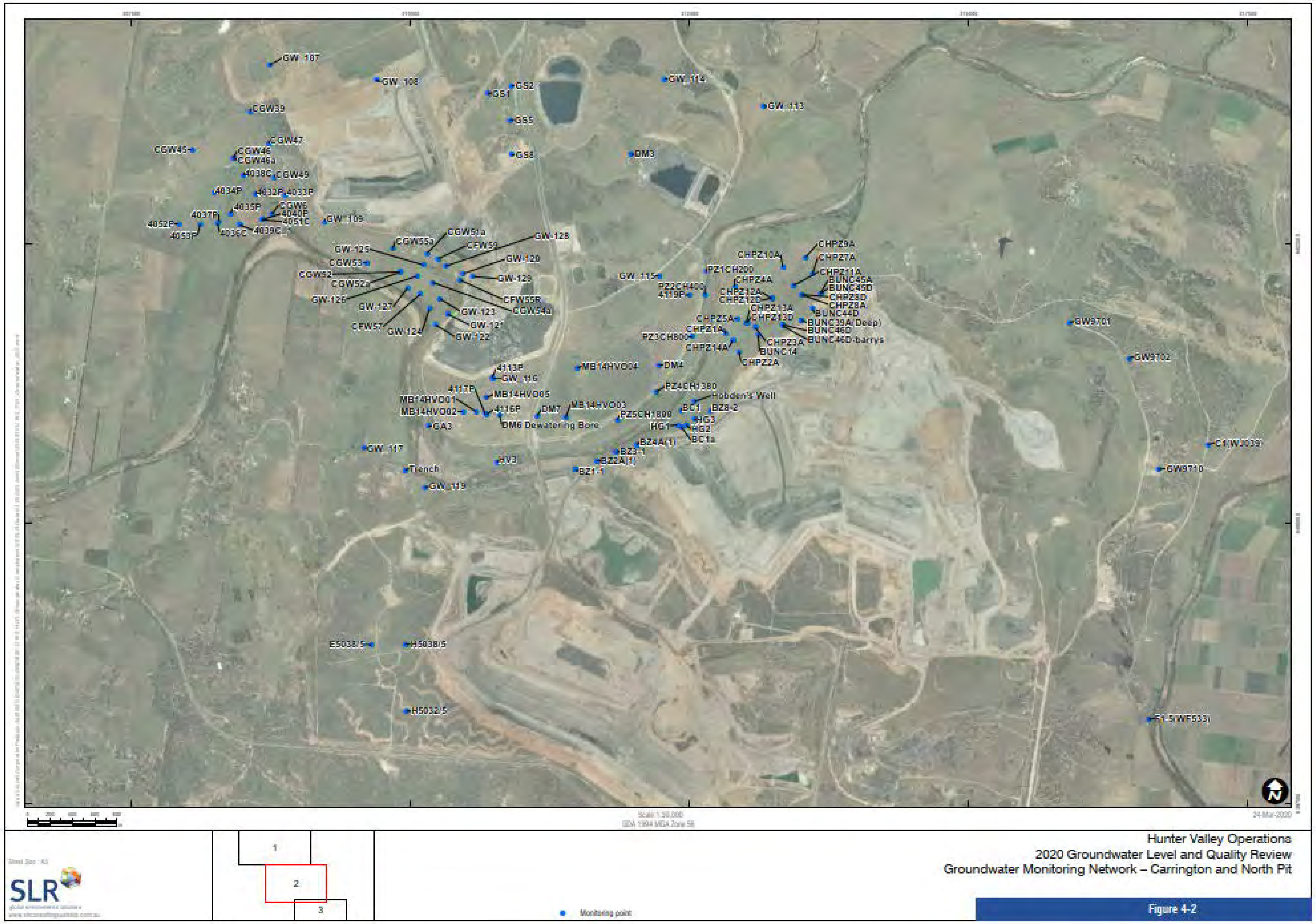


Figure 4-2 Groundwater Monitoring Network – Carrington and North Pit

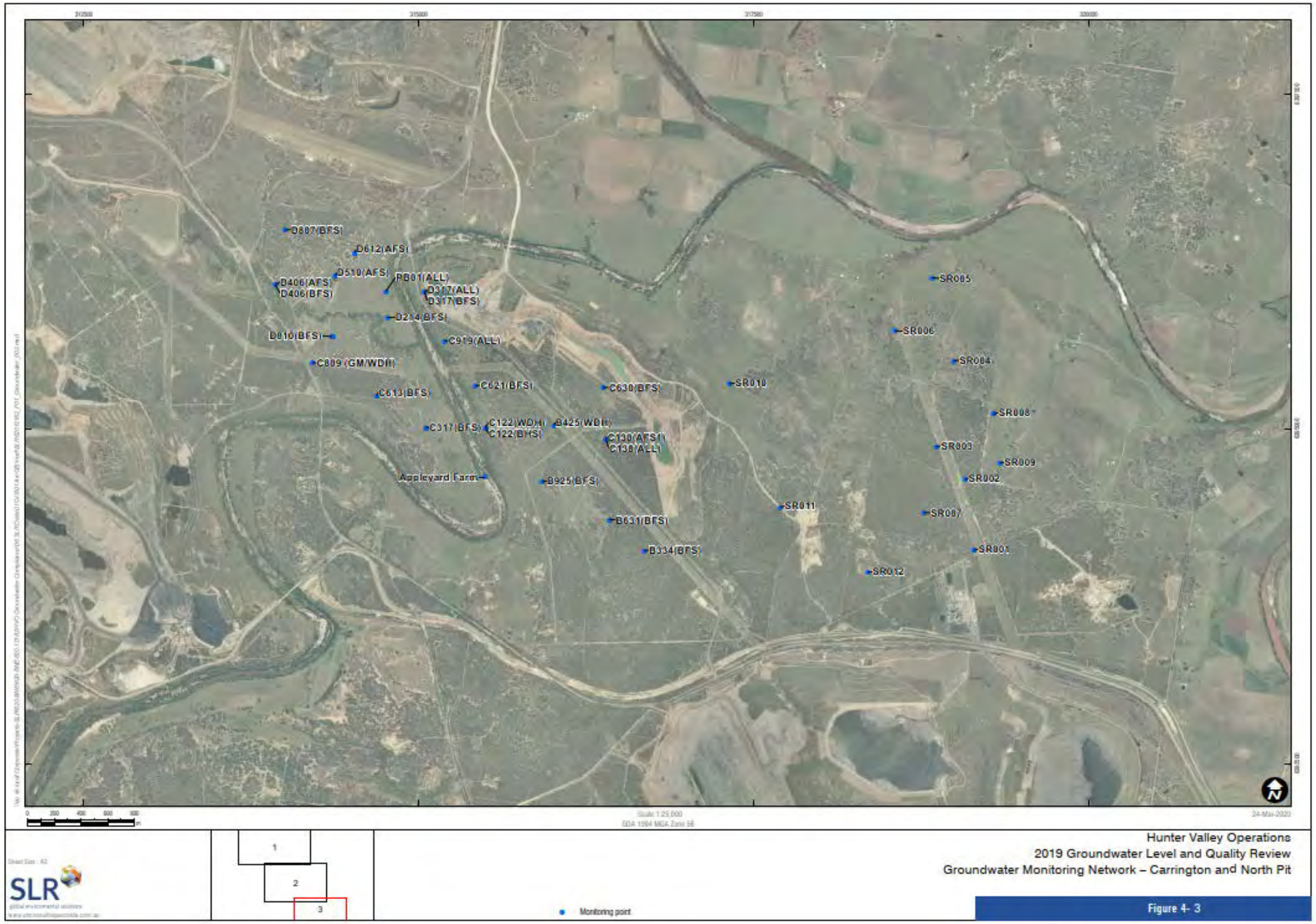


Figure 4-3 Groundwater Monitoring Network – Cheshunt, Riverview and Lemington

4.2 Groundwater Monitoring Methodology

HVO engages external contractors AECOM to carry out sampling and analysis. SLR understands that annual sampling is undertaken in accordance with relevant Australian Standards and other regulatory guidelines with representative groundwater quality samples collected. Samples are analysed by laboratories that are National Association of Testing Authorities (NATA) accredited or equivalent for the parameters being analysed.

It was previously identified by SLR (2018) that monthly to quarterly sampling methodology undertaken by the external contractors was not providing representative samples. This resulted in trigger exceedances. This sampling methodology was reviewed by HVO and improvements in sampling technique made to ensure representative samples are collected.

4.3 Groundwater Triggers

The WMP includes groundwater assessment criteria, including trigger levels for investigating any potentially adverse groundwater impacts. These criteria are summarised in Table 4-1.

Table 4-1 Groundwater Impact Assessment Criteria

Criteria	Description
1	The groundwater level does not decline more than 2 m at any privately owned bores and wells identified in the HVO complex EA’s (with the exception of a single bore on land owned by the Ravensworth mine (10011459) which is predicted to decline by a maximum of 2.7 m.)
2	Water quality does not lower the beneficial use category of the groundwater source beyond 40 m from the mining pit. This will be identified using groundwater triggers (EC) for individual monitoring bores specified in the Groundwater Monitoring Programme.
3	The alluvial groundwater source within 40 m of the recognised GDE communities does not experience more than a 10% reduction in piezometric levels predicted in the EA’s for HVO North and HVO South (allowing for typical climatic variation).

For Criteria 1, assessment of groundwater level trends over 2020 is discussed in Section 5.2. There are no private bores identified within the WMP and no routine monitoring of private landholder bores. However, to ensure no additional impacts are observed than were predicted for current approved operations (including potential for impacts on landholder bores), verification of the model predictions is undertaken in accordance with Condition 27(c) of the Development Consent conditions. Discussion on the model verification is included in Section 5.5.Criteria 2 relates to the trigger levels established for electrical conductivity (EC) based on the 95th percentile of baseline data, and the trigger levels for pH based on the 5th and 95th percentiles, as presented in the WMP and summarized Table 4-2. Groundwater quality readings from the site monitoring bores have been compared to the relevant trigger levels in Section 5.3.

For Criteria 3, it is assumed that direct pumping from surface water is assessed as part of the surface water annual review. Predicted ‘indirect’ take of water from alluvium and subsequent reductions in baseflow contributions are discussed in Section 5.4. These predictions are derived from the existing regional-scale numerical groundwater model developed by AGE (2017) as part of the HVO South Modification 5.

Table 4-2 Groundwater Quality Triggers by Location

Location	Target Seam/ Stratigraphy	EC (95th) µS/cm	pH (5th)	pH (95th)
Carrington	Alluvium	6,154	7.0	8.0
Carrington	Interburden	10,824	6.7	7.4
Carrington	Broonie	8,628	6.8	7.1
Carrington West Wing	Alluvium	2,775	7.0	7.5
Carrington West Wing	LBL	3,531	7.3	7.6
Cheshunt	Mt Arthur	3,350	6.5	7.6
Cheshunt	Interburden	6,213	6.9	7.7
Cheshunt	Piercefield	2,596	6.4	6.8
Cheshunt / North Pit	Alluvium	4,462	6.6	7.5
Lemington South	Bowfield	12,440	6.7	7.9
Lemington South	Woodlands Hill	20,240	6.6	7.6
Lemington South	Arrowfield	15,324	6.8	7.5
Lemington South	Alluvium	22,700 3,938	6.8 6.6	7.0 7.7
Lemington South	Glen Munro	1,894	6.5	7.2
Lemington South	Interburden	11,408	6.7	7.1
North Pit	Spoil	12,460	6.5	7.8
West Pit	Sandstone / Siltstone	13,428	6.9	8.0

The WMP also includes individual groundwater trigger levels for five bores in the Carrington alluvium. Each individual trigger level and corresponding groundwater level are shown in Table 4-3.

Table 4-3 Carrington Alluvium SWL Trigger Levels

Bore	SWL Trigger (mAHD) (5th Percentile)	SWL Trigger (mAHD) (95th Percentile)
CFW55R	57.06	59.41
CFW57	58.24	59.24
CGW52a	58.23	60.52
CGW53a	58.33	59.19
CGW55a	57.49	58.43

Triggers have also been proposed as part of the North Void (NV TSF) assessment and are detailed in Table 4-4.

Table 4-4 Proposed Groundwater Triggers – NV TSF Seepage

Parameter	Trigger Level Recorded in Bores	Frequency	Response
pH	<6.8 (acidic) or >8.0 (alkaline)	Monitor monthly until pH is recorded between 6.8 and 8.0 for two consecutive readings at bores, then quarterly for a period of 2 years, after which time reassess monitoring frequency.	Three consecutive readings outside of the trigger criteria, and an investigation into the cause of the trend by a suitably qualified person will also be undertaken and captured within existing monitoring program reporting requirements. In addition, ecological monitoring should be undertaken in accordance with monitoring program, which includes six monthly survey.
Sulphate	CFW55R: 2,000 mg/L GW_123: 1,400 mg/L CGW54a, GW_124 and CFW57: 680 mg/L GW_125, GW_126 and GW_127: 230 mg/L	Monitor monthly intervals until sulphate level has dropped to less than the trigger value for two consecutive readings at bores, then quarterly for a period of 2 years, after which time reassess monitoring frequency.	
Sulphate/ Chloride Ratio	0.8 meq (GW_123 and CFW55R) 0.5 meq (CGW54a, GW_124 and CFW57) 0.24 meq (GW_125, GW_126 and GW_127)	Monitor monthly intervals until the sulphate/chloride ratio has dropped to less than 0.5 for three consecutive readings, then quarterly for a period of 2 years, after which time reassess monitoring frequency.	
Water Level	> 0.5 m over 12 months (rising trend)	Monitor monthly until water level records stable to declining levels for more than three consecutive readings at bores, then quarterly for a period of 2 years, after which time reassess monitoring frequency.	An observed rise in groundwater levels at Trigger Bores by more than 0.5 m over a 12-month period and in conjunction with water quality changes, not related to above average rainfall/Hunter River flow. Undertake an investigation into the cause of the trend by a suitably qualified person.

4.4 Trigger Investigations

A range of investigations were conducted at HVO over 2019 to address recommendations for bores with trigger threshold exceedances; these investigations have previously been reported in SLR 2020 so are not reproduced here.

5 Monitoring Results

5.1 Data Recovery

As per the WMP, groundwater level monitoring and sampling was carried out at 127 monitoring bores. An additional 15 monitoring bores not specified in the WMP were also sampled and measured as part of the site monitoring programme. Sites with a data capture rate of less than 100 per cent are outlined in Table 5-1.

Table 5-1 Groundwater Monitoring Data Recovery – Compliance Bores

Location	Type	Data Recovery	Comments
4036C	SWL, WQ	0%	Bore dry
B425(WDH)	WQ	0%	Insufficient water to sample
BZ3-3	WQ	75%	Insufficient water to sample in Q2
BZ4A(2)	WQ	75%	Insufficient water to sample in Q4
C122(BFS)	WQ	0%	Insufficient water to sample
C919(ALL)	WQ	0%	Bore dry/Insufficient water to sample
	SWL	40%	Bore dry
CGW45	SWL, WQ	0%	Blocked
CGW47a	WQ	0%	Bore dry
CHPZ8A	WQ	75%	Insufficient water to sample
D612(AFS)	WQ	50%	Insufficient water to sample in Q4
DM3	SWL, WQ	75%	Unsafe access – Q1
DM7	SWL, WQ	0%	Bore dry
GW100	WQ	75%	Insufficient water to sample in Q1
GW-101	SWL	25%	Bore dry Q1, Q2 and Q4
	WQ	0%	Insufficient water to sample
GW-107	WQ	0%	Insufficient water to sample
GW-108	WQ	0%	Insufficient water to sample
GW-114	WQ	50%	Insufficient water to sample
	SWL	75%	Unsafe access Q1
GW-121	WQ	0%	Insufficient water to sample
	SWL	50%	Bore dry
GW-128	WQ	25%	Insufficient water to sample
NPz5	SWL, WQ	0%	No Access - unsafe due to mining proximity
SR007	SWL, WQ	50%	No Access

5.2 Water Levels

A summary of the water level results is provided for each of the main water bearing units (alluvium, Permian coal measures and spoil) below. Routine water level readings for 2020 are presented in Appendix B.

5.2.1 Alluvium

Two bores were recorded as dry part way through the year (C919 (ALL) in Q2, Q3 and Q4; GW-101 in Q1, Q2 and Q4).

Most other alluvial bores were stable or recorded a slight increase in groundwater levels over 2020, which corresponds with an increasing trend in the CRD (above average rainfall). Where saturated, groundwater within the alluvium occurred between 0.1 m (bore G3) and 22.6 m (bore GW-106) below ground level (bgl) over 2020. Discussion of water level trends is included for each of the mine locations from Section 5.2.1.1 to Section 5.2.1.4.

5.2.1.1 West Pit

Time series groundwater levels for the five alluvial/regolith bores north and north-west of West Pit are presented in Figure 5-1. Over 2020, groundwater elevations within the three bores (G1, G2 and G3) on the south-western side of Parnell's Creek Dam (18W) ranged between 105.7 mAHD and 108.4 mAHD (2.43 m and 0.1 m depth). Groundwater levels within the 3 bores over 2020, as in 2018 and 2019, remained within a 3 m range and displayed a seasonality likely connected to water storage level in the Parnell's Creek Dam.

Bores GW-100 and GW-101 are located along Parnell's Creek, downslope of the dam (18W). Comparison between groundwater levels and screened depths indicates the bores are likely dry and readings may relate to water within the sump at the base of the bore. Review of the bore construction log indicates GW-100 extends to 6 m in depth and has a well screen from 4 m to 6 m bgl within gravels (colluvial deposit). Bore GW-101 extends to 12 m in depth and has a well screen from 9 m to 12 m bgl depth within clay. Groundwater levels within bore GW-100 show a general increase over 2020. This increase in groundwater levels appears to correspond with a general increasing trend in CRD in 2020 and trends are likely related to rainfall recharge. Bore GW-101 has recorded groundwater levels over 12.8 m bgl and noted as dry or having insufficient water to sample since 2013. This may relate to the construction of the bore screen across low permeability clay.

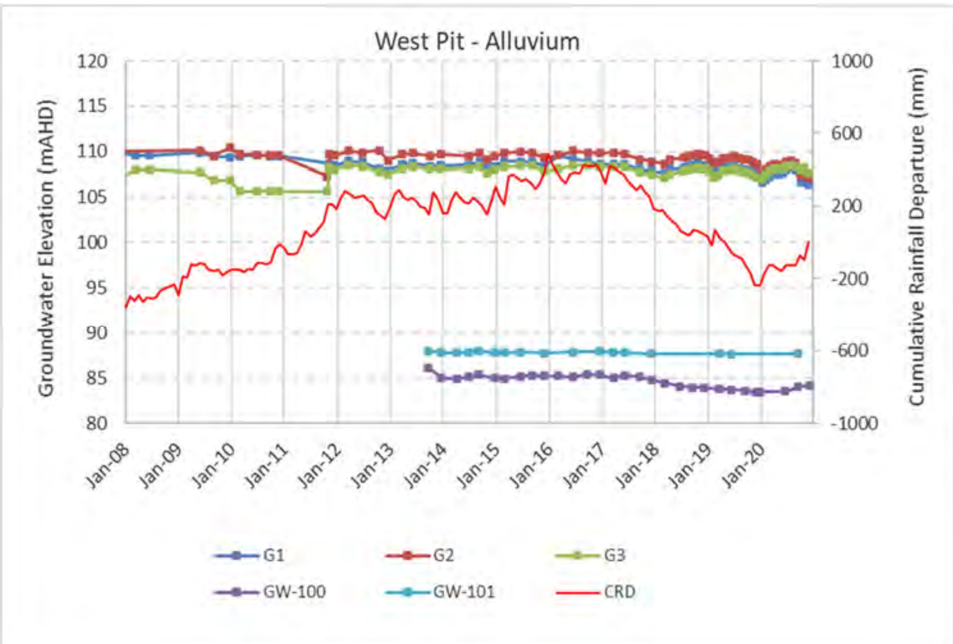


Figure 5-1 Hydrograph of Alluvial Bores – West Pit

5.2.1.2 Carrington West Wing and Carrington

Time series groundwater levels for bores within the alluvium on the western limb of the paleochannel near Carrington and Carrington West Wing are shown in Figure 5-2. Over 2020, groundwater elevations within the four bores (4032P, 4034P, 4037P and 4040P) in this area ranged between 58.86 mAHD and 59.92 mAHD (9.31 m and 12.29 m depth). Groundwater levels increased in the four bores by 0.24 m up to 0.27 m over 2020, which correlates with climate and stream flow trends.

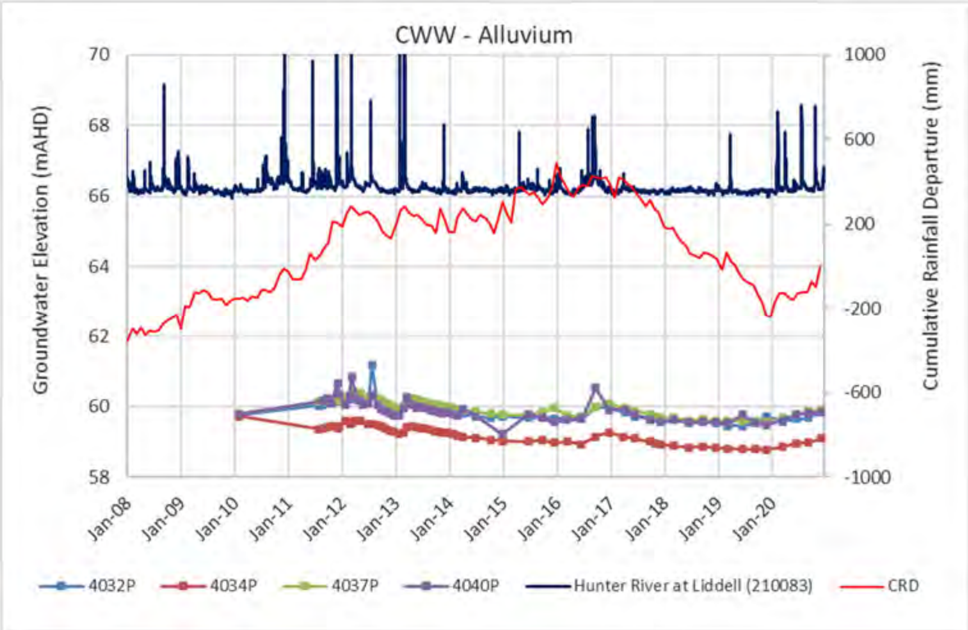


Figure 5-2 Hydrograph of Alluvial Bores – Carrington (Western Limb)

Time series groundwater levels for bores within the floodplain alluvium on the northern end of the paleochannel (CGW32 and GW-106) and the two bores on the western limb of the paleochannel (CGW39 and CGW47a) near Carrington and Carrington West Wing are shown in Figure 5-3. Over 2020, groundwater elevations within the four bores in this area ranged between 54.57 mAHD and 59.68 mAHD (11.15 m and 23.41 m bgl). Bore CGW47a was recorded as dry throughout the first three quarters of 2020 and became saturated in December 2020 with above average rainfall. CGW39 water levels increased by 0.23 m over 2020. Water levels in bores CGW32 and GW-106 remained stable over 2020.

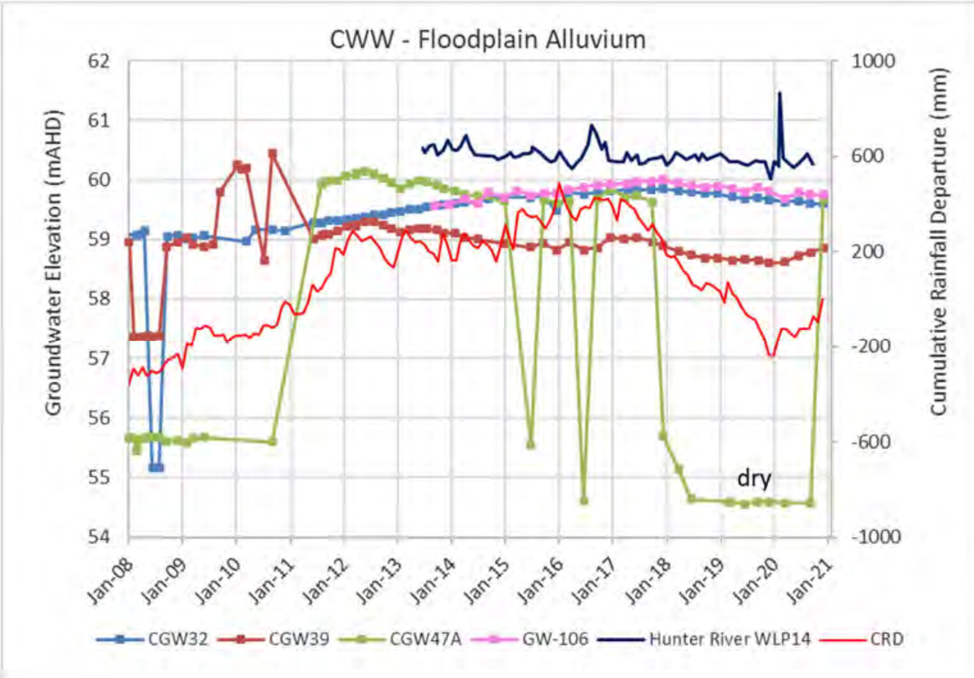


Figure 5-3 Hydrograph of Floodplain Alluvial Bores – Carrington (Western Limb)

Time series groundwater levels for bores within the alluvium on the five bores on the eastern limb of the paleochannel near Carrington and Carrington West Wing are shown followed an increasing trend throughout 2020. Groundwater levels ranged between 57.44 mAHD (13.60 m depth – CGW55a) and 58.63 mAHD (11.65 m depth – CFW55R).

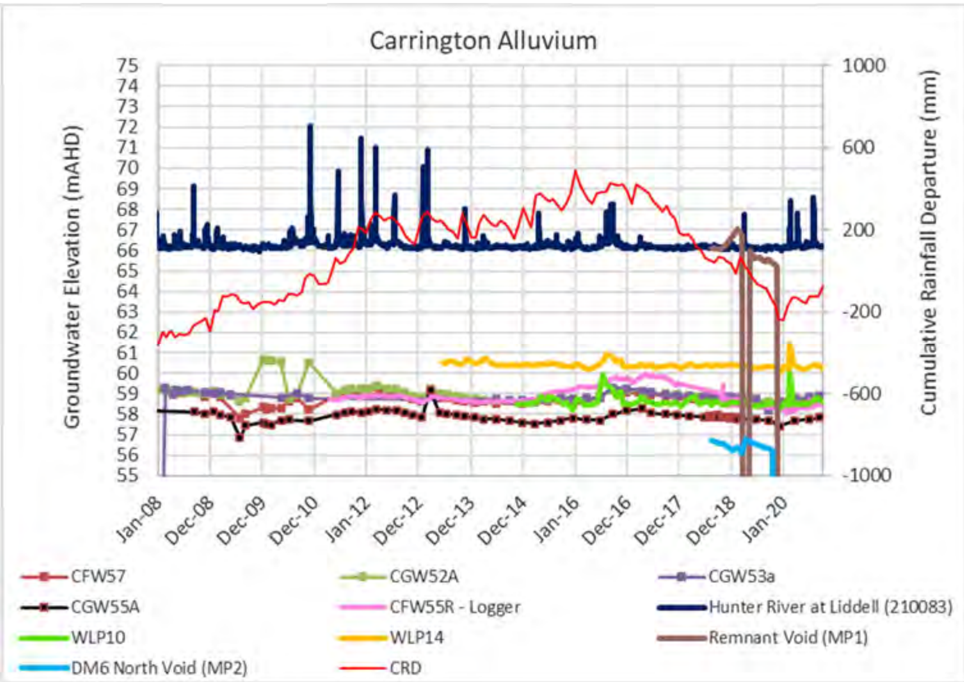


Figure 5-4 Hydrograph of Alluvial Bores – Carrington

Hydrographs for each of the five alluvial bores at Carrington, CFW55R, CFW57, CGW52a, CGW53a and CGW55a, and Hunter River elevations are compared to CRD in Figure 5-5 to Figure 5-9. The graphs show that all five bores followed an increasing trend throughout 2020 consistent with CRD and Hunter River level trends and remained within the trigger level settings during 2020.

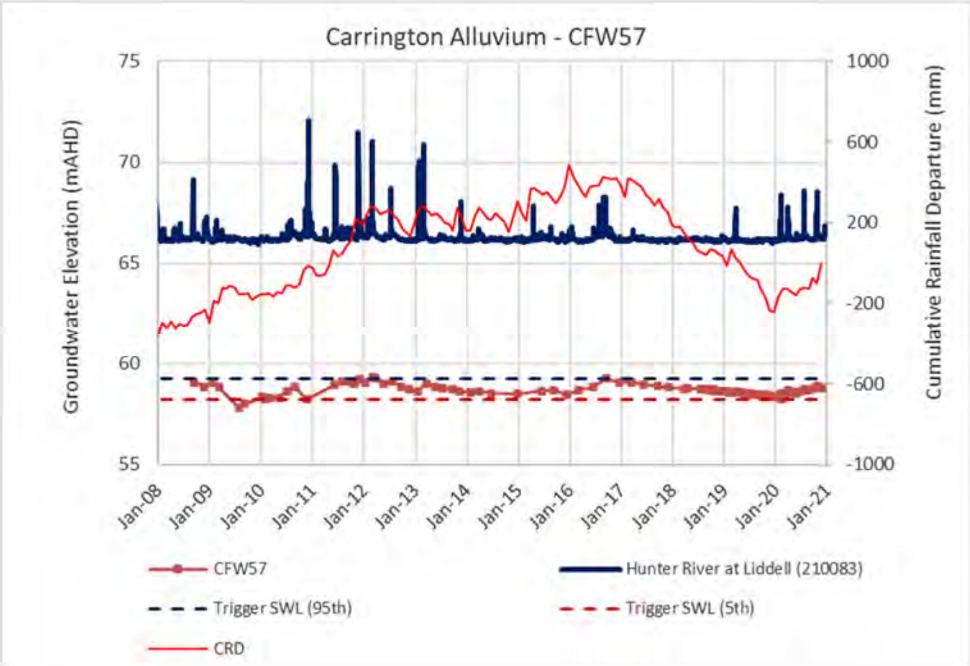


Figure 5-5 Hydrograph of Alluvial Bores – Carrington – CGW57

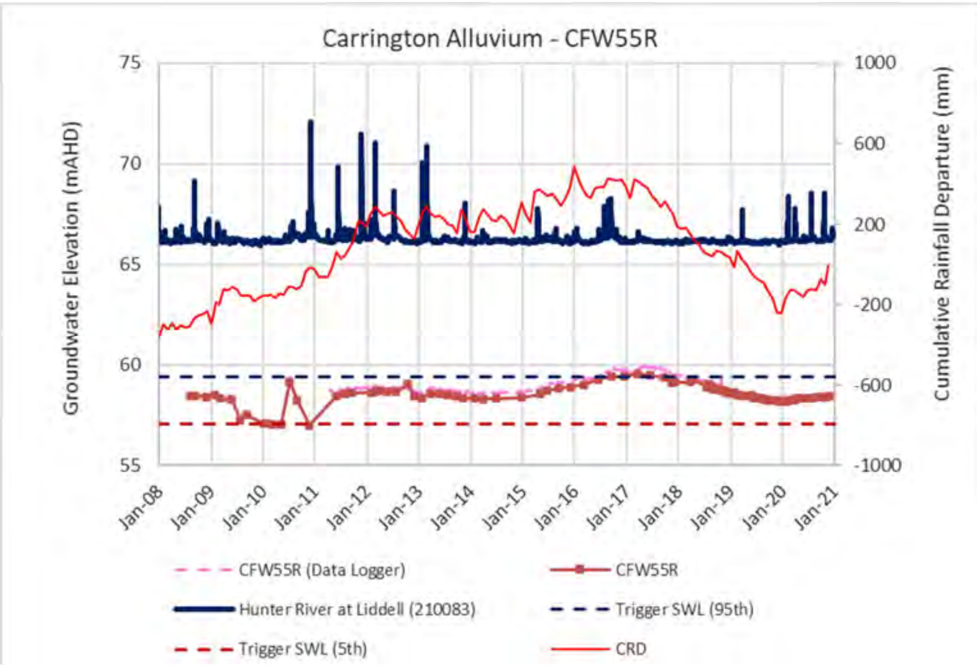


Figure 5-6 Hydrograph of Alluvial Bores – Carrington – CGW55R

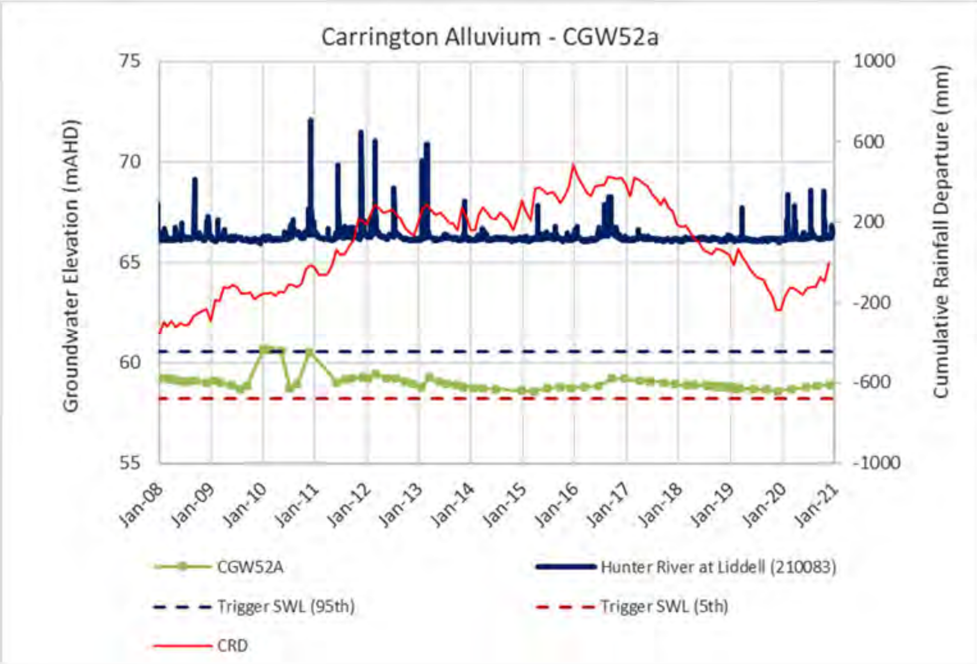


Figure 5-7 Hydrograph of Alluvial Bores – Carrington – CGW52a

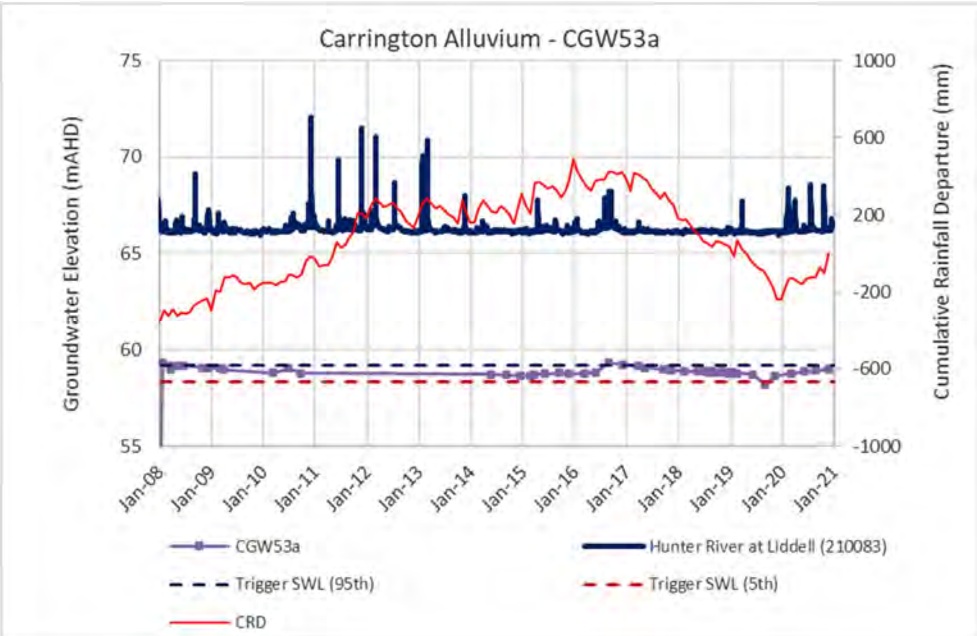


Figure 5-8 Hydrograph of Alluvial Bores – Carrington – CGW53a

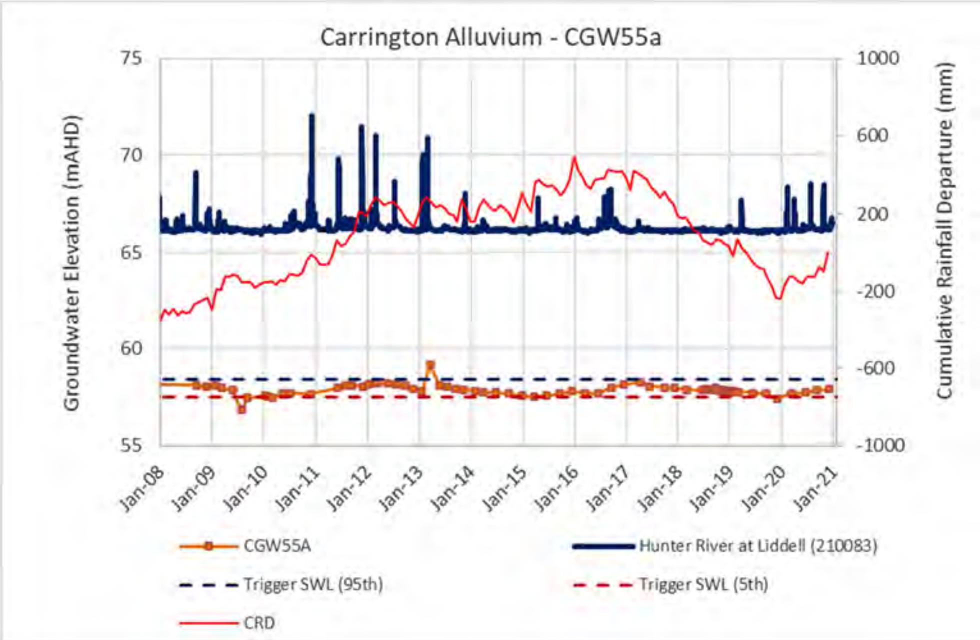


Figure 5-9 Hydrograph of Alluvial Bores – Carrington – CGW55a

Ten additional groundwater monitoring bores (GW-120 to GW-129) were installed in 2018 to the west of the North Void TSF; eight bores within the alluvium, one within spoil and one with the Permian coal measures. The bores were installed to delineate the extent of impacts and monitor response to management practices. Time series groundwater levels for the newly installed bores within the alluvium along the western edge of the North Void and south of Carrington Pit are shown in Figure 5-10. Monitoring began in the eight bores in October 2018. During 2020, groundwater elevations within the eight alluvium bores in this area ranged between 57.2 mAHD and 59.6 mAHD (9.2 m and 15.8 m depth). Bore GW-121 became saturated in November 2020, for the first time since 2018. Bore-GW124 displayed the greatest water level response to peaks in Hunter River levels during 2020, indicating the greatest connectivity to river recharge, other bores displayed a more muted response. Groundwater levels followed a small but distinct increasing trend within the bores throughout 2020. The purpose of the monitoring is to detect that there is no additional seepage into the alluvium at this location. The observed increase in groundwater levels over 2020 corresponds with a general trend of above average rainfall and associated increase in alluvial groundwater levels and therefore is not indicative of seepage.

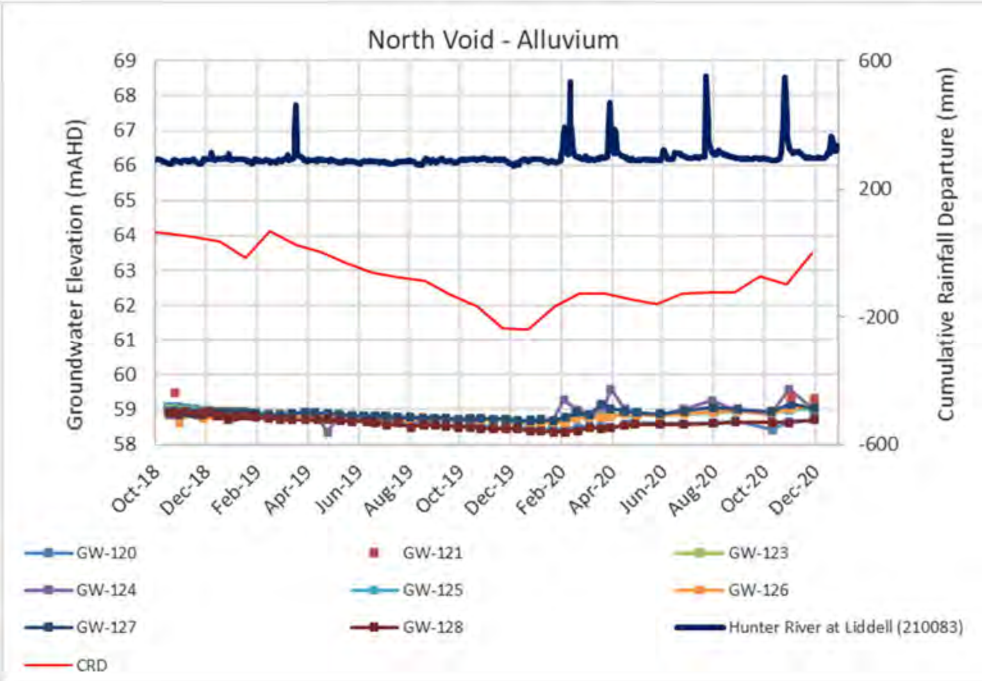


Figure 5-10 Hydrograph of Alluvial Bores – Carrington/North Void

5.2.1.3 Cheshunt Pit/North Pit

Time series groundwater levels for bores within the alluvium north and south of the Hunter River, between North Pit and Cheshunt Pit are shown in Figure 5-11. Groundwater levels ranged between 52.2 mAHD and 61.8 mAHD. With the exception of PZ2CH400, groundwater levels were generally stable and increased slightly by up to 0.5 m within the Cheshunt Pit/North Pit alluvial bores during 2020.

Groundwater level elevations indicate groundwater flow in the Hunter River alluvium follows stream flow, with higher elevations to the west at PZ3CH800 and lowest elevations at bores PZ2CH400 and PZ1CH200.

Throughout 2020, groundwater levels in PZ2CH400 were highly variable, but remained within the historic range, ranging from 5.48 m (57.05 mAHD) in Q2 to 0.7 m (61.83 mAHD) in Q4. Groundwater elevation variation does respond to rainfall and remained higher than upstream bore PZ3CH800. Bore PZ2CH400 is located immediately east of the North Pit barrier wall and around 180 m east of spoil bore 4119P. Bore 4119P recorded spoil water elevations between 53.56 mAHD and 53.85 mAHD over 2020, lower than alluvial levels at bore PZ2CH400. It was recommended that the bore construction and condition be reviewed in the 2018 Annual Review, casing of bore PZ2CH400 has now been raised by 1 m.

Bore BZ1-1 is not plotted, as although it is included in the WMP as being within the alluvium, prior annual reviews (AGE, 2013a) identified the bore likely intersects interburden material. It is recommended that this bore be updated in the WMP as intersecting interburden.

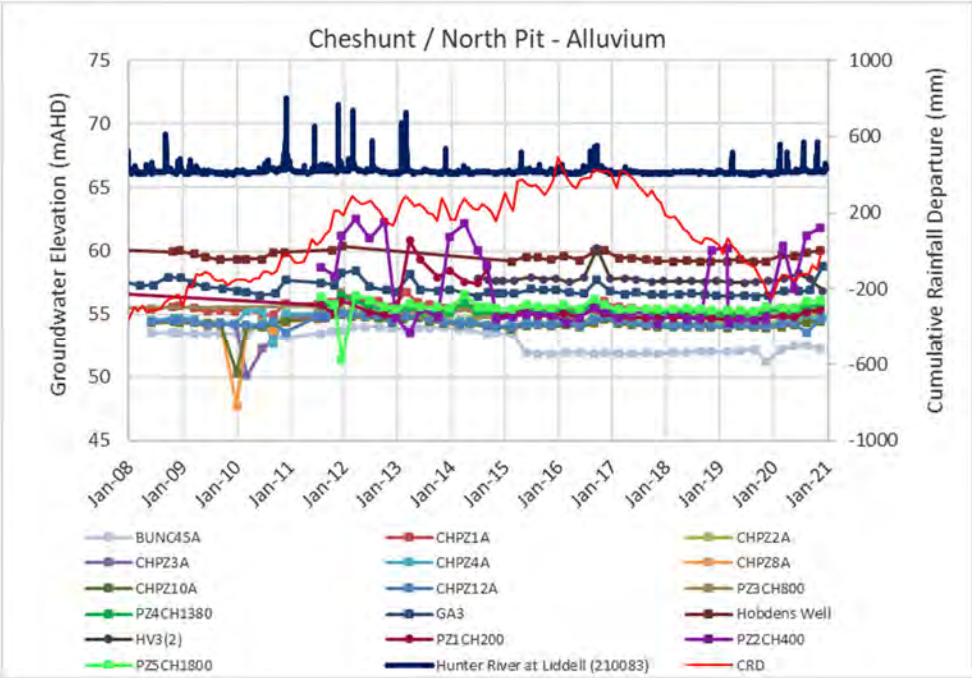


Figure 5-11 Hydrograph of Alluvial Bores – Cheshunt/North Pit

5.2.1.4 Lemington South

Time series groundwater levels for four bores within the alluvium at Lemington South, along the Wollombi Brook, are shown in Figure 5-12. As shown in Figure 5-12, groundwater levels increased throughout 2020.

During 2020 groundwater elevations within the alluvial bores Appleyard Farm and PB01(ALL) ranged between 36.4 mAHD and 4546.9 mAHD. Throughout 2020, groundwater levels in Appleyard Farm and PB01(ALL) displayed correlation with the Wollombi Brook stream gauge.

Appleyard Farm bore is located over 1.2 km upstream of Lemington South Pit and within 50 m of Wollombi Brook. The stream gauge Wollombi Brook at Warkworth is located approximately 350 m upstream of the bore. The groundwater level trends show a close correlation with increased stream flow levels and discharge for Wollombi Brook, with discharge recorded in January 2020 for the first time since 2017. Bore PB01(ALL) is located approximately 150 m from Wollombi Brook and also shows a response to stream flow throughout 2020. Bore C919(ALL) was recorded as dry through the first half of 2020. Bore D317(ALL) is located adjacent to the Lemington South Pit, approximately 190 m from Wollombi Brook, and remained dry or water level near the bottom of the bore throughout 2020.

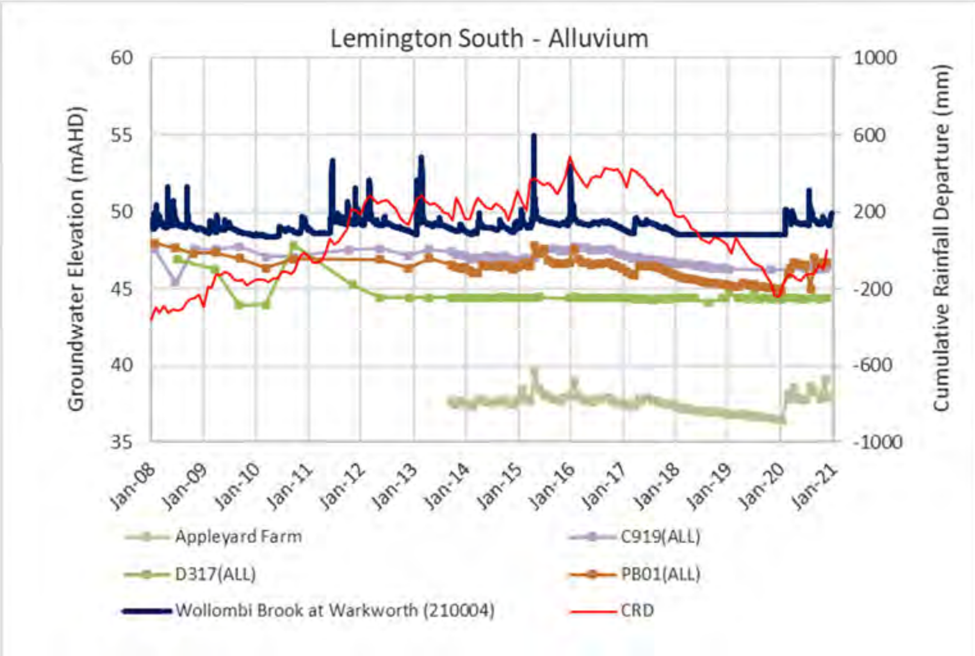


Figure 5-12 Hydrograph of Alluvial Bores – Lemington South

5.2.2 Permian Coal Measures

During 2020, two bores in the Permian coal measures were recorded as dry (4036C and C122(BFS)), and one bore was reported as blocked (CGW45). There are eight vibrating wire piezometers (VWPs) that monitor the coal seam and interburden sequences of the Permian coal measures in the Carrington mine area (GW-100a, GW-101a, GW-102, GW-103, GW-104, GW-105, GW-109 and GW-110).

Discussion in water level trends within the Permian coal measures is included for each of the mine locations from Section 5.2.2.1 to Section 5.2.2.4.

5.2.2.1 West Pit

Two of the four bores targeting the Permian coal measures at West Pit were monitored throughout 2020, bores NPZ2 and NPZ3. Bore NPZ4 was decommissioned after December 2016, and NZP5 was too close to mining for safe access during 2020.

Groundwater elevations for the bores at West Pit are presented in Figure 5-13. Throughout 2020, groundwater levels were generally stable with a slight declining trend, bore NPZ2 declined by 0.2 m over 2020, while bore NPZ3 groundwater levels declined 0.1 m. These two bores are located upslope, on the northwest side of West Pit. The cause for the groundwater trends at NPZ2 and NPZ3 is unclear and would require further information regarding historical land use activities in the region. However, based on available information, the cause for the changes in groundwater levels do not appear to correlate to mine activities conducted at West Pit. As part of a network review it was recommended that NPZ2 and NPZ3 be removed from the compliance network within the WMP, as the location and construction of the bores precludes them from providing an indication of potential impacts. However, it is recommended these bores remain in the monitoring program to assist with future assessments and assessment of post closure groundwater conditions.

With the removal of bores NPZ4 and NPZ5, ongoing monitoring of groundwater trends in the coal measures can be captured at VWP GW-103 to GW-105.

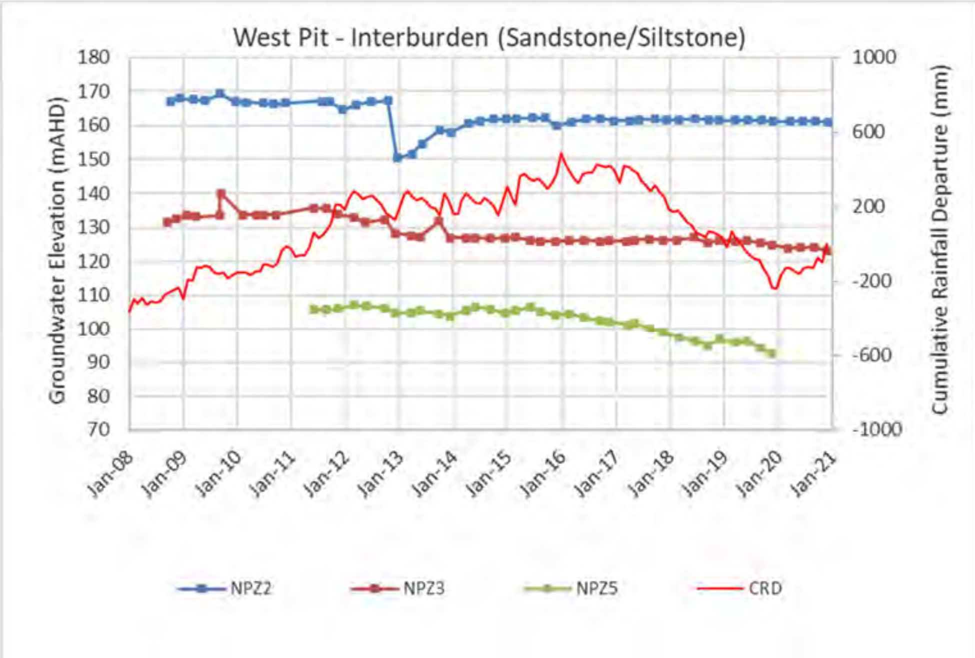


Figure 5-13 Hydrograph of Permian Coal Measures Bores – West Pit Bores

Eight vibrating wire piezometers (VWPs) were installed in the West Pit area (GW-100a, GW-101a, GW-102, GW-103, GW-104, GW-105, GW-109, and GW-110) in 2012 that intersect the Permian coal measures. Bores GW-103, GW-104 and GW-105 are located to the south of West Pit. Bore GW-109 is located to the west of Carrington Pit, and bore GW-110 is located north of Carrington Pit. Groundwater level trends for the VWPs are presented in Figure 5-14. Review of the data identified that some sensors have previously failed. VWP's that were active during 2020 were GW-100a, GW-101, GW-102, GW-104, GW-105 and GW-109.

VWP GW-100a (Barrett Seam and interburden), VWP GW101a (interburden) and VWP GW-102 (interburden) are located to the west of West Pit. GW-100a and GW-101a recorded relatively stable levels, while GW-102 has continued to increase over 2020.

VWP GW-103, VWP GW-104, VWP GW-105 and GW-110 are located south of West Pit. All VWP sensors in GW-103 appear to have failed on the 20th of January 2020. Groundwater levels at GW-104 VWP1 (Lower Pikes Gully Seam) and VWP2 (interburden material) continued to decline due to depressurisation from coal mining at West Pit, while groundwater levels at VWP3 (in sandstone above the Barrett Seam) were stable. Groundwater levels at GW-105 VWP1 and VWP2 were stable over 2020. GW-105 VWP3 appears to have failed on the 17th of February 2020. VWP GW-110 sensors were unstable and is being removed from the monitoring network.

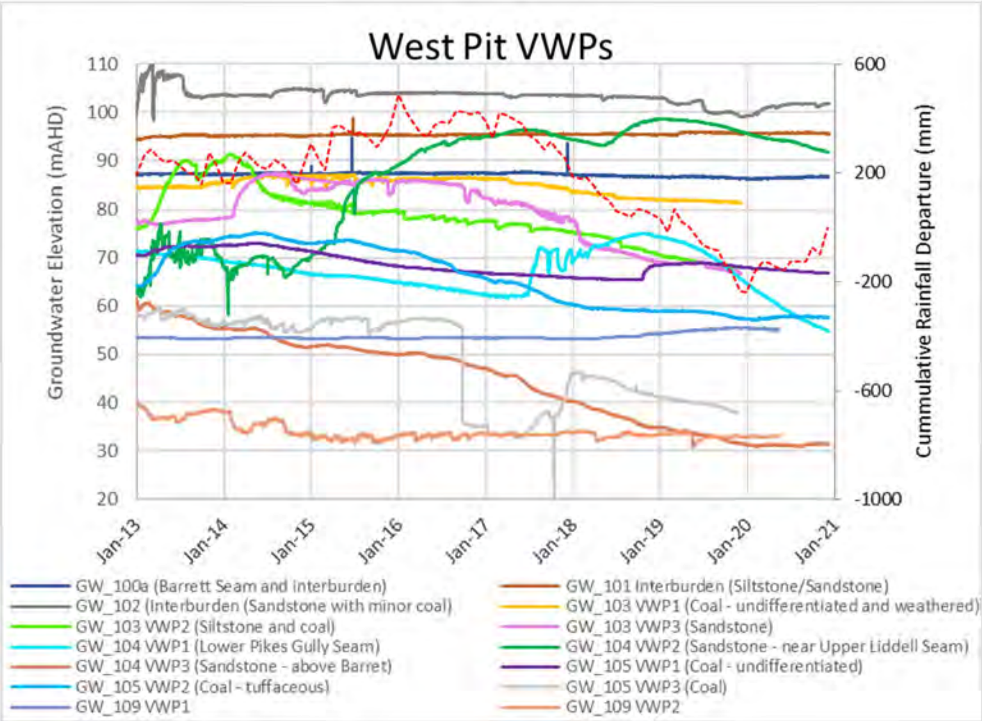


Figure 5-14 Hydrograph of Permian Coal Measures Bores – West Pit VWPs

5.2.2.2 Carrington and Carrington West Wing

The WMP includes seven monitoring bores with screens that intersect the Permian coal measures at Carrington and Carrington West Wing. This includes two bores within the Bayswater Seam (CGW45 and CGW46), two within the Broonie Seam (CGW52, CGW53) and three within the interburden material (4036C, 4051C and CGW51a). One of the bores (CGW45) were reported as blocked during 2020, and one was recorded as dry (4036C). Time series groundwater elevations for the seven bores are presented in Figure 5-15.

Bore CGW46 intersects the shallow Bayswater Seam (approximately 13 m deep) underlying alluvium on the western limb of the paleochannel. During 2020, groundwater within the bore followed a slight declining trend, recorded at depths of between 12.8 m and 12.9 m. Groundwater levels within the bore are close to the base of the bore and have remained relatively stable since 2012, which may indicate the bore is dry. Further review of the condition of the bore is recommended. Bore CGW53 recorded fluctuations in groundwater levels throughout the year with an overall small rise in groundwater levels. Bores CGW52 and CGW53 both intersect the Broonie Seam and recorded a slight rise in water levels over 2020 following trends from 2019, which appears to relate to recovery in groundwater conditions with cessation of mining at Carrington Pit.

Review of available bore details indicates bore CGW51a is actually screened within alluvium comprising fine to medium grained gravel and sand immediately overlying coal. As a result, groundwater within the bore is representative of alluvial groundwater and groundwater within the weathered coal measures. During 2020 groundwater levels within the bore were stable. Due to the construction of the bore, it is recommended that it be decommissioned to minimise potential mixing and groundwater levels within the backfilled Carrington Pit be monitored to ensure the void continues to act as a groundwater sink. It is recommended that a new bore be installed within the spoil material to replace CGW51a.

Bore 4051C is located in the western limb of the paleochannel, screened within interburden. Groundwater levels in bore 4051C increased by 0.9 m over 2020.

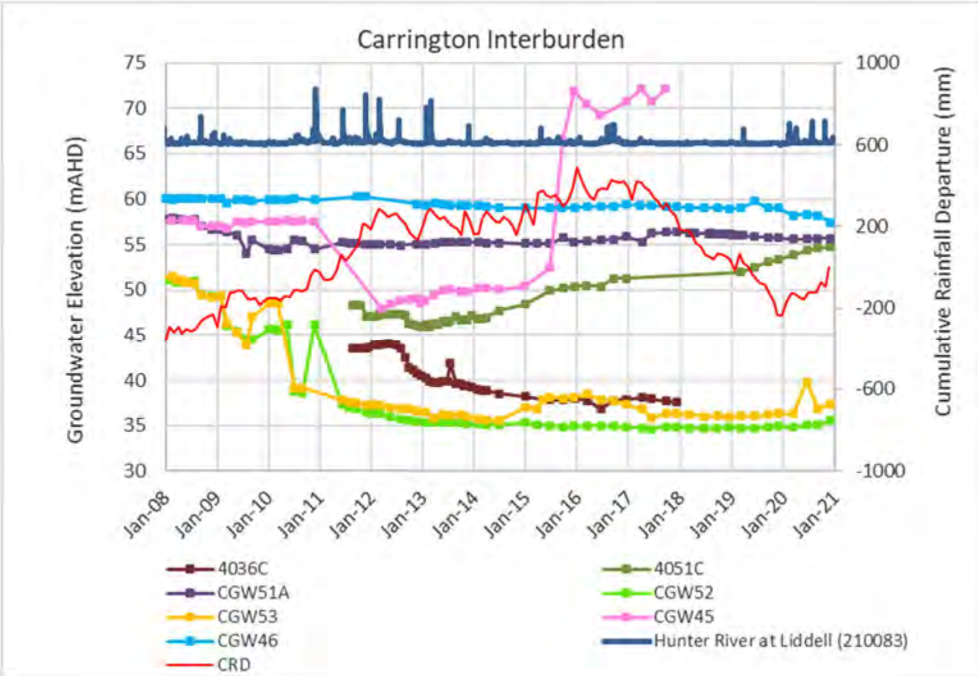


Figure 5-15 Hydrograph of Permian Coal Measures Bores – Carrington

5.2.2.3 Cheshunt Pit

The WMP includes 13 monitoring bores with screen that intersects the Permian coal measures at Cheshunt Pit. This includes nine bores within the Mt Arthur Seam (BC1a, BZ1-3, BZ2A(1), BZ3-3, BZ4A(2), CHPZ3D, CHPZ8D, CHPZ12D, HG2a), one within the Piercefield Seam (BUNC45D) and three within the interburden material (BZ3-1, BZ8-2 and HG2).

Time series groundwater elevations for the bores are presented in Figure 5-16 to Figure 5-18. Sustained groundwater level drawdown in response to the approved mining is visible within two of the bores intersecting the Mt Arthur seam (BZ1-3 and BZ4A(2)). Bores BZ2A(1), BZ3-3, which also intersect the Mt Arthur seam, had stable groundwater level trends over 2020. Bore BC1a also intersects the Mt Arthur Seam and showed drawdown from 2011 to 2014 (48.78 mAHD), followed by a gradual recovery in groundwater levels (49.08 mAHD) in 2017. Over 2020, groundwater levels in BC1a remained fairly stable. The adjacent Mt Arthur Seam bore HG2a shows relatively stable groundwater elevations of around 41 mAHD since 2012.

Groundwater levels in bores within the Mt Arthur and Piercefield Seams (CHPZ3D, CHPZ8D, CHPZ12D, and BUNC45D), on the north to north-east side of Cheshunt Pit near Barry's Pit, have remained relatively stable since 2011.

Groundwater levels in bores within the Mt Arthur Seam, north to north-west side of Cheshunt Pit remain drawn down since 2015 at bores BC1a, BZ1-3, BZ2A(1), BZ3-3, BZ4A(2), and HG2A. This is due to depressurisation from approved active mining on the western side of Cheshunt Pit.

Bore (BZ8-2) within interburden on the north side of Cheshunt Pit was variable and recorded a minor increase of 0.6 m over 2020 while a second bore within the interburden recorded a rise in groundwater levels at HG2 (0.5m) in 2020. This rise may relate to increased rainfall or delayed response to recharge to the backfilled spoil near the bore. It is recommended that the condition of the bore be checked.

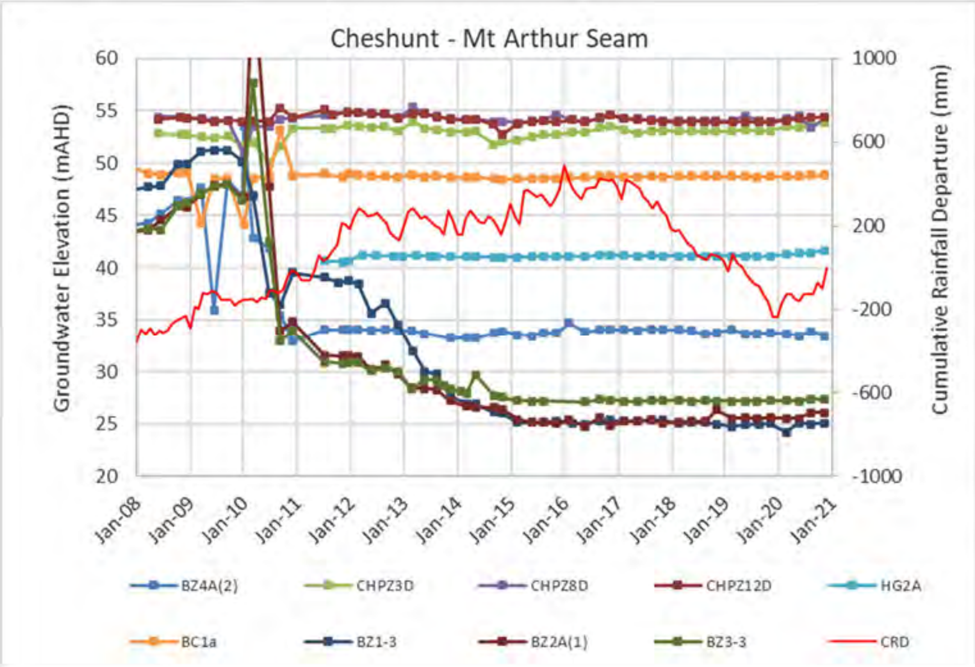


Figure 5-16 Hydrograph of Permian Coal Measures – Cheshunt Mt Arthur Seam

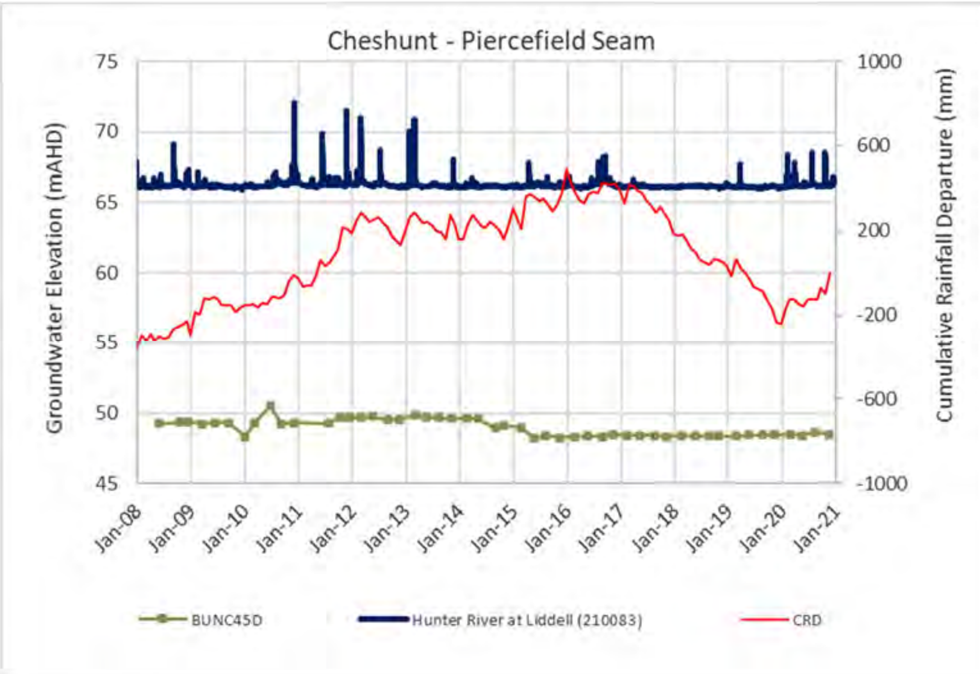


Figure 5-17 Hydrograph of Permian Coal Measures – Cheshunt Piercefield Seam

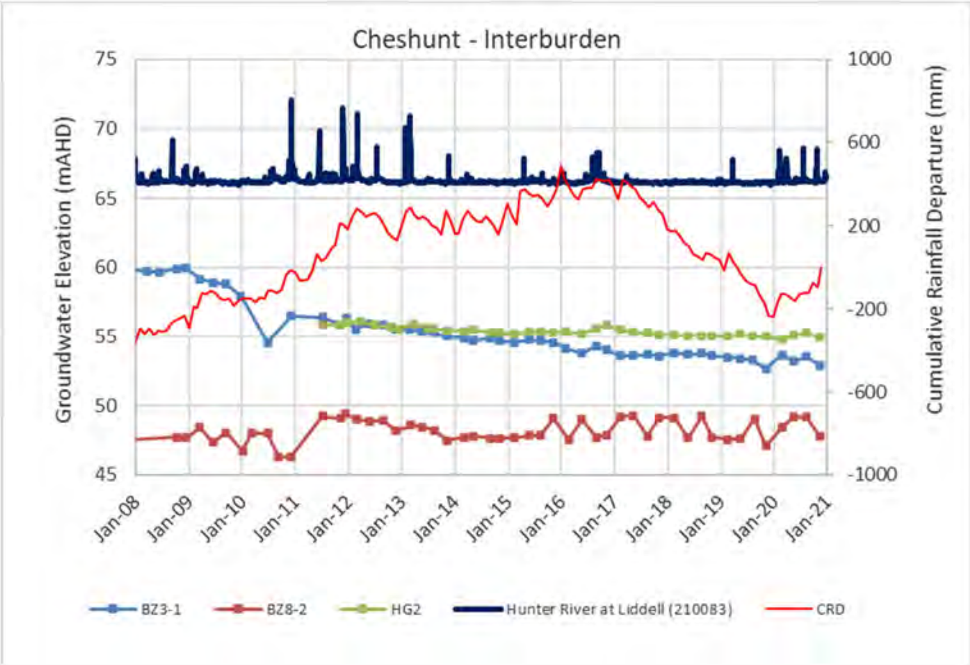


Figure 5-18 Hydrograph of Permian Coal Measures – Cheshunt Interburden

5.2.2.4 Lemington South

The WMP includes 29 monitoring bores with screen that intersects the Permian coal measures at Lemington South. This includes:

- Four bores within the Arrowfield Seam - C130(AFS1), D406(AFS), D510(AFS) and D612(AFS);
- One bore within the shallow interburden material (siltstone/sandstone) - C130(ALL);
- Eight bores within the Glen Munro Seam and/or Woodlands Hill Seam - B425(WDH), B631(WDH), C122(WDH), C130(WDH), C317(WDH), C809(GM/WDH), D010(WDH) and D010(GM); and
- 16 bores within the Bowfield Seam - B334(BFS), B631(BFS), B925(BFS), C122(BFS), C130(BFS), C317(BFS), C613(BFS), C621(BFS), C630(BFS), D010(BFS), D214(BFS), D317(BFS), D406(BFS), D510(BFS), D612(BFS) and D807(BFS).

Time series data for bores targeting the Arrowfield Seam are presented in Figure 5-19. As shown in Figure 5-19, Bore D406(AFS) 2020 declined, likely due to approved mining operations, and groundwater levels in bores C130(AFS1and D612(AFS) remained stable over 2020. Bore D510(AFS) experienced a decline in water levels in mid-2017 but levels have been stable since mid-2019. Lemington pit lake water levels have been recorded during 2020.

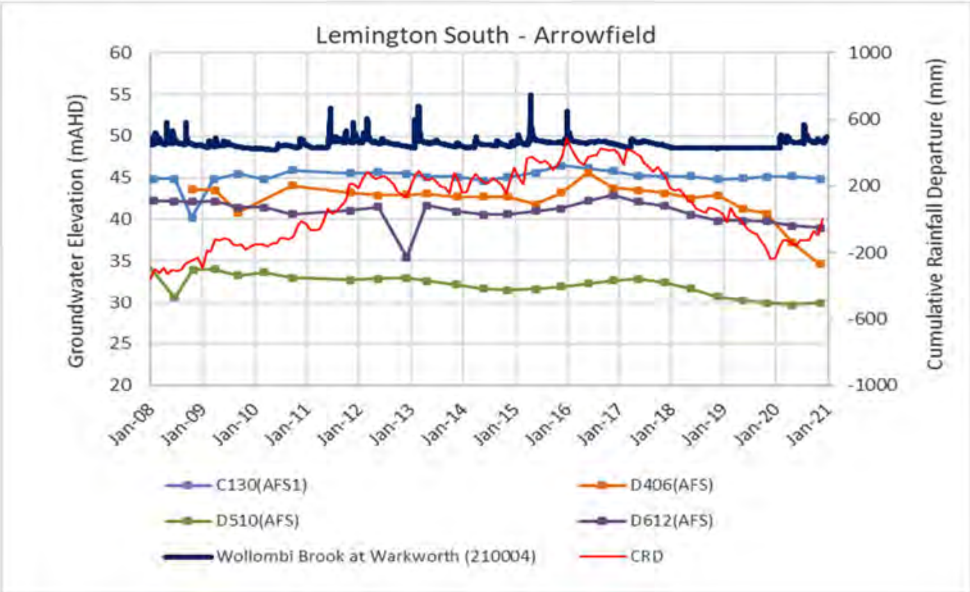


Figure 5-19 Hydrograph of Arrowfield Seam – Lemington South

Time series data for bores targeting the shallow interburden, Woodlands Hill Seam and Glen Munro Seam are presented in Figure 5-20. As shown in Figure 5-20 groundwater elevations for all bores except B425(WDH) ranged between 45.5 mAHD and 47.4 mAHD. Over 2020, the groundwater levels were stable. Bore B425(WDH) was previously drawn down and remained dry throughout 2020. These elevations and trends correspond more closely with trends observed for the Bowfield Seam bores.

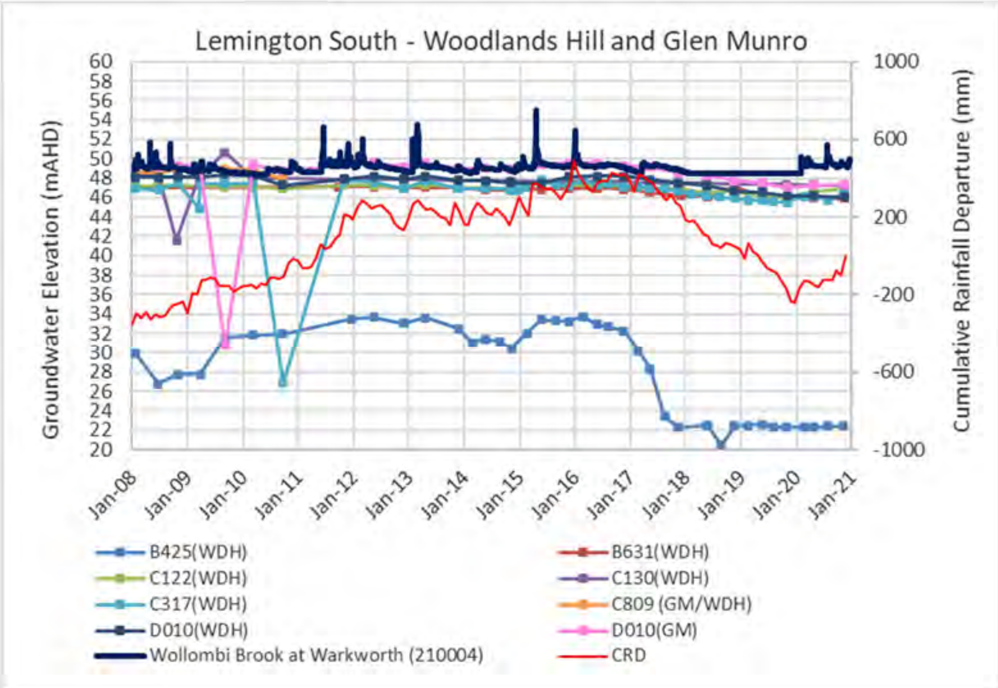


Figure 5-20 Hydrograph of Woodlands Hill Seam and Glen Munro Seam – Lemington South

Time series data for bores targeting the Bowfield Seam are presented in Figure 5-21. As shown in Figure 5-21, groundwater elevations ranged between 6.58 mAHD and 34.22 mAHD (24.66 m and 55.66 m depth). The May 2020 reading in D510(BFS) recorded a decline in water level however this reading is considered anomalous since the following measurement continued to follow the recovery trend. Interpolated groundwater elevation contours for the Bowfield Seam are presented in Figure 5-22, based on December 2020 readings of groundwater levels in bores C630(BFS), D317(BFS), D214(BFS), D010(BFS) and C613(BFS), displays that during 2020 groundwater level change varied between 2 m drawdown and 2 m recovery.

The observed drawdown is consistent with predicted drawdown in the coal measures with abstraction from LUG Bore, as modelled by SLR (2020b). SLR (2020b) utilised the existing numerical groundwater model developed for HVO Modification 5 to predict the change in groundwater levels and sustainable yield from LUG Bore. The model predicted groundwater level drawdown within the Mt Arthur Seam in response to abstraction from the historical Lemington Underground workings by LUG Bore. The abstraction was predicted to induce depressurisation in the coal measures correlating to the observed decline in groundwater levels for bores intersecting the coal measures near Lemington Underground.

Alluvial bore Appleyard Farm is the closest alluvial bore to the LUG Bore. As discussed in Section 5.2.1.4, groundwater trends within the bore reflect rainfall and stream flow trends. The bore shows no clear impacts related to groundwater abstraction from the historical underground mine beyond climate and streamflow changes. Validation of model predictions has been undertaken in 2020 (SLR, 2020).

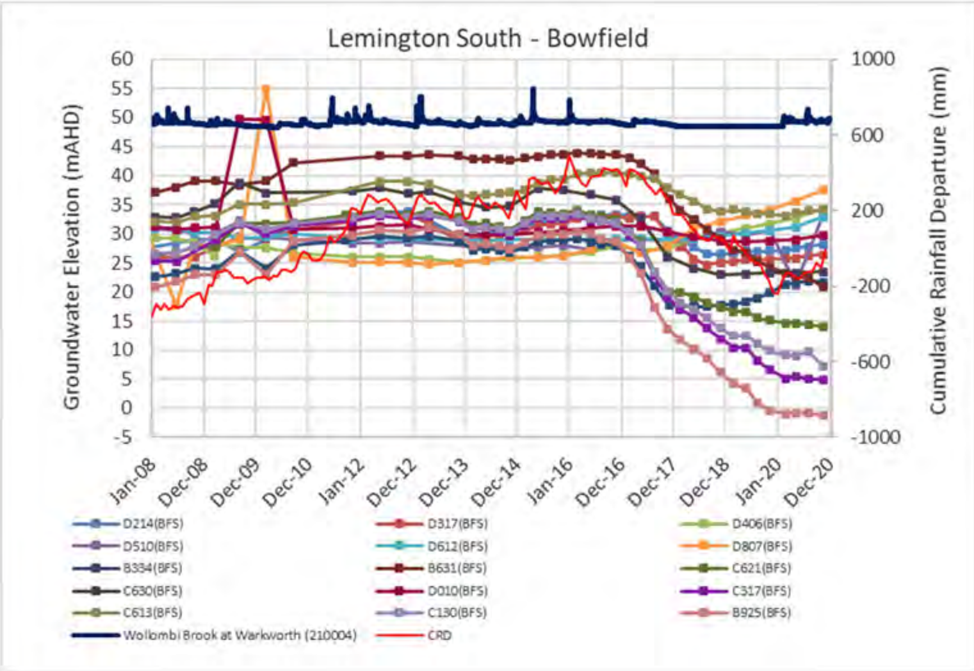
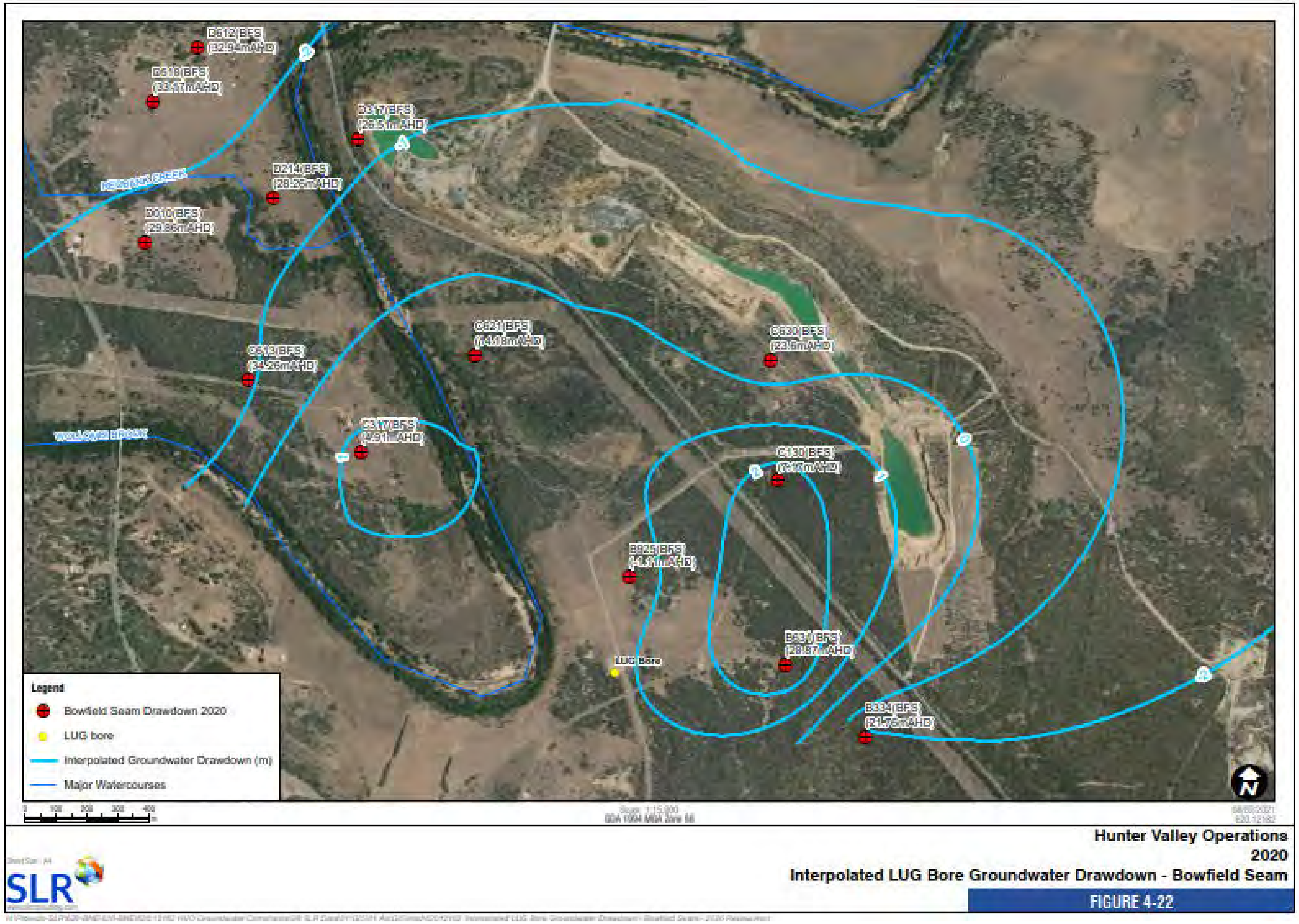


Figure 5-21 Hydrograph of Bowfield Seam – Lemington South

Figure 5-22 Interpolated LUG Bore Groundwater Drawdown – Bowfield Seam



5.2.3 Spoil

The WMP includes 15 monitoring bores that intersect spoil material within North Pit. Bore DM7 which is located within North Pit, was recorded as dry throughout 2020. A comparison was made in bores GW-114, 4116P, GW-107 and GW-108, which intersect the spoil, between groundwater levels and screened depths and indicates that the bores are likely dry and readings may relate to water within the sump at the base of the bore.

5.2.3.1 North Pit

Time series groundwater levels for the spoil are presented in Figure 5-23. During 2020, groundwater elevations within the bores ranged between 32.4 mAHD and 77.8 mAHD (9.8 m and 36.9 m depth). Groundwater within the spoil flows from northern-most bore DM1 (77.86 mAHD) in a southerly direction towards the southern-most bore MB14HVO03 (32.74 mAHD). Over the course of 2020, groundwater levels remained stable. Bores MB14HV0: 03, 04 and 05 displayed that the declining water level trends seen in previous years stalled in 2020 with increased rainfall.

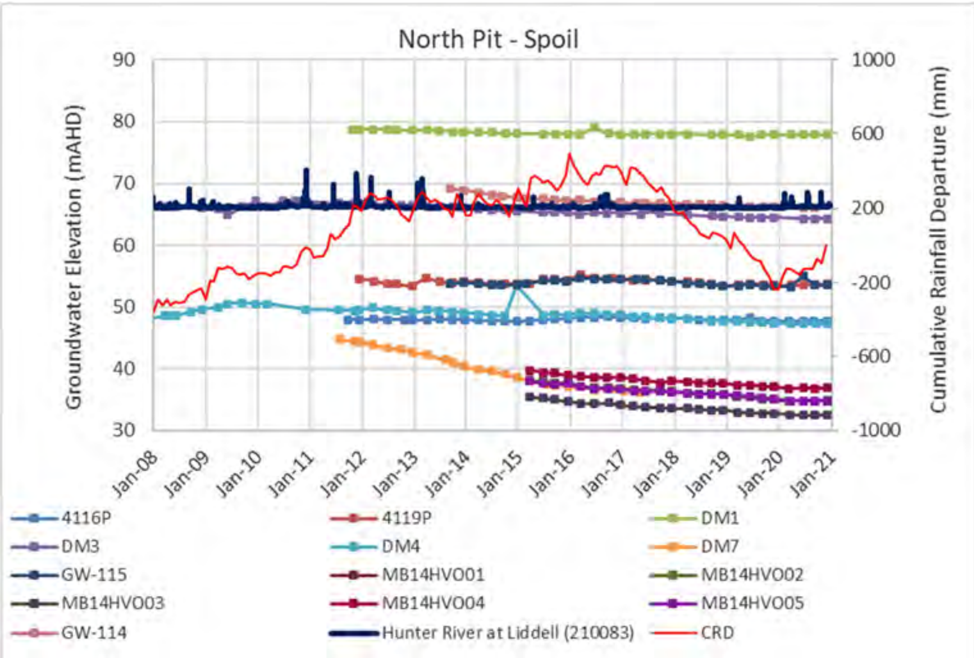


Figure 5-23 Hydrograph of Spoil Bores – North Pit

5.2.3.2 Carrington

Time series groundwater levels for the spoil are presented in Figure 5-24. During 2020, groundwater elevations within the bores ranged between 23.5 mAHD and 58.2 mAHD (13.8 m and 60.9 m depth). Groundwater within the spoil flows from northern-most bore DM1 (77.86 mAHD) in a southerly direction towards southern-most bore MB14HVO03 (32.74 mAHD). Over the course of 2020, groundwater levels declined by 0.4 m in bore GW-129, while bores GW-107 and GW-108 remained essentially dry throughout 2020. It is likely the reduction in groundwater levels in these bores is a result of decanting of water from the North Pit/North Void and influence of the Carrington Pit final void.

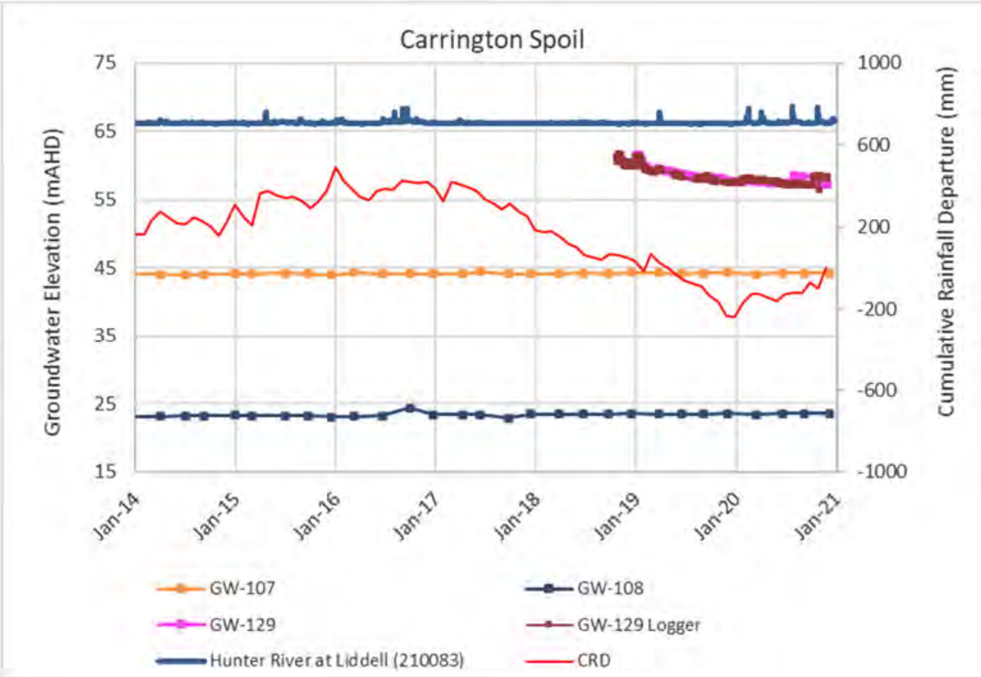


Figure 5-24 Hydrograph of Spoil Bores – Carrington

5.3 Water Quality

A summary of the water quality results is provided for each of the main water bearing units (alluvium, Permian coal measures and spoil) below. Routine EC and pH readings and historical trends are presented in Appendix C and Appendix D, respectively.

5.3.1 Alluvium

Routine monitoring of EC and pH was conducted for all alluvial monitoring bores over 2020 on a quarterly basis. Bores unable to be sampled are outlined in Table 5-1.

Alluvial groundwater quality over 2020 ranges between locations, as discussed below:

- West Pit: EC ranges between 4,300 µS/cm and 11,310 µS/cm and pH ranges between 7.3 and 7.6;
- Carrington and Carrington West Wing area: EC ranges between 1,193 µS/cm and 10,180 µS/cm and pH ranges between 7.0 and 7.8;
- Between Cheshunt Pit and North Pit: EC ranges between 114 µS/cm and 2,920 µS/cm and pH ranges between 6.6 and 7.6; and
- Lemington South Pit: EC ranges between 395 µS/cm and 7,450 µS/cm and pH ranges between 6.0 and 7.2.

Discussion in water quality trends and triggers is included for each of the mine locations from Section 5.3.1.1 to Section 5.3.1.4.

Full water quality analysis was conducted for the site alluvial bores in accordance with the WMP. Exceptions to this include bores C919(ALL), CGW47a, CHPZ8A, GW-121 and GW-101, as outlined in Table 5-1, which had insufficient water available to sample. Full water quality data is presented in Appendix E and summarised below:

- Total aluminium: variable readings from below laboratory limit of reporting up to 26.1 mg/L (BZ1-1) over 2020;
- Total arsenic: concentrations generally below the limit of reporting or less than 0.02 mg/L;
- Total cadmium: concentrations generally below the limit of reporting or less than 0.0001 mg/L; and
- Total zinc: concentrations generally below the limit of reporting or less than 0.2 mg/L. With a maximum of 0.37 mg/L (4037P).

As discussed in Section 5.2.1, groundwater level readings for bores GW-100 and GW-101 indicates they are dry and water quality sampled is likely influenced by sediment in the base of the bore and not considered representative. It is recommended that the total depth of the bore be checked, and the monitoring programme reviewed to ensure only representative groundwater samples are collected. Bore 4037P zinc increase was consistent with increasing water levels in this bore.

5.3.1.1 West Pit

Throughout the 2020 monitoring period, there were no trigger exceedances for pH at the West Pit alluvium the following bores exceeded their trigger values for EC:

- Bore G1 recorded EC of 11,310 µS/cm in June Q2 2020, above the trigger level of 10,751µS/cm in

5.3.1.2 Carrington and Carrington West Wing

Throughout the 2020 monitoring period, groundwater samples collected from the following bores exceeded their trigger values for EC and pH at the Carrington and Carrington West Wing bores:

- Bore CGW49 recorded EC above 2,775 µS/cm in Q1; Bore CFW55R recorded EC above 6154 µS/cm throughout 2020.
- Bore GW-106 recorded pH below 6.8 throughout.

Bore CGW49 intersects alluvium within the western limb of the paleochannel. Historical readings show that bore CGW49 has recorded an average EC of 4,692 µS/cm and ranging between 2,060 µS/cm and 8,180 µS/cm. Review of EC readings at CGW49 shows levels fluctuated slightly over 2020 but remained consistent with historical concentrations. The results show no adverse impacts due to mining and highlight that the established trigger levels do not reflect historical trends.

Bore GW-106 intersects a remnant patch of paleochannel alluvium between West Pit and Carrington Pit. Since monitoring commenced at the bore in September 2013, bore GW-106 has recorded an average pH of 6.8 with a range between 6.6 and 6.9, below the trigger level for the period of record. Review of pH readings are within historical concentrations. The results show no adverse impacts due to mining.

During 2020, EC readings for CFW55R fluctuated and were recorded above the trigger level of 6,154 µS/cm, but remained below historical reading of 10,840 µS/cm (2008) as shown in Figure 5-25. Figure 5-25 shows that bores within the paleochannel alluvium (CFW57, CFW55R and CGW54A) were historically saline but became less saline with progression of mining at Carrington Pit. This is due to direct interception of groundwater within the paleochannel, as well as depressurisation of the coal measures reducing natural upward seepage from the coal measures where they are incised by the paleochannel. Sulphate was also identified as a key analyte to track the extent and movement of impacted water.

The plot shows increase indicative of impacts from 2015. During 2020, sulphate concentrations declined at bores CFW55R CGW54a and CFW57. The sulphate to chloride molar ratio helps to identify the presence of sulphate oxidation. Figure 5-26 shows a general reduction in the SO_4/Cl ratio for bore CFW57 while the ratio remained stable for bores CGW54A and CFW55R. In line with increased rainfall recharge in 2020.

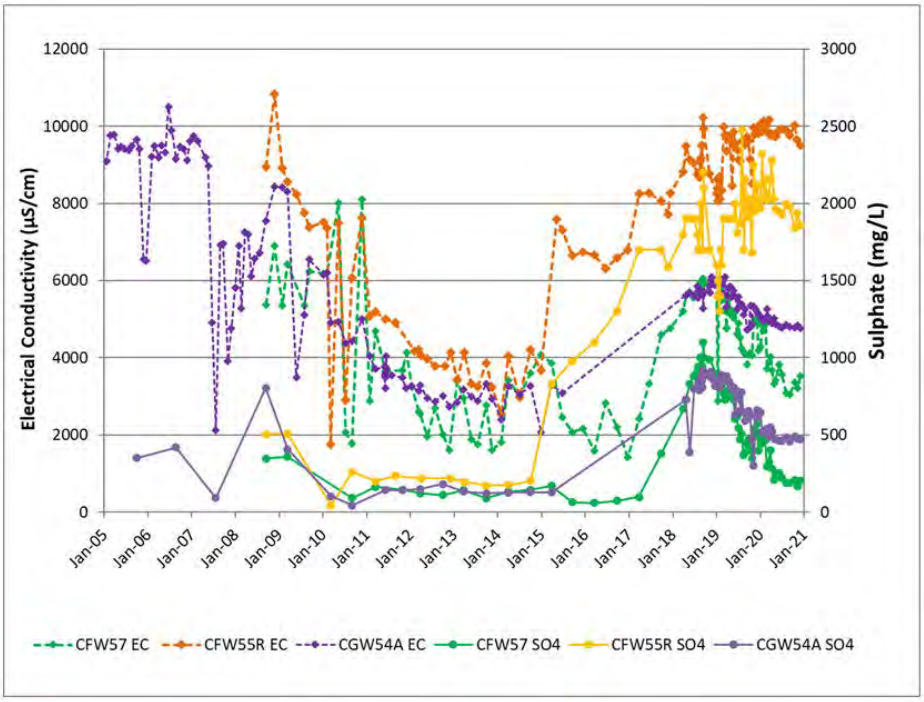


Figure 5-25 EC vs Sulphate

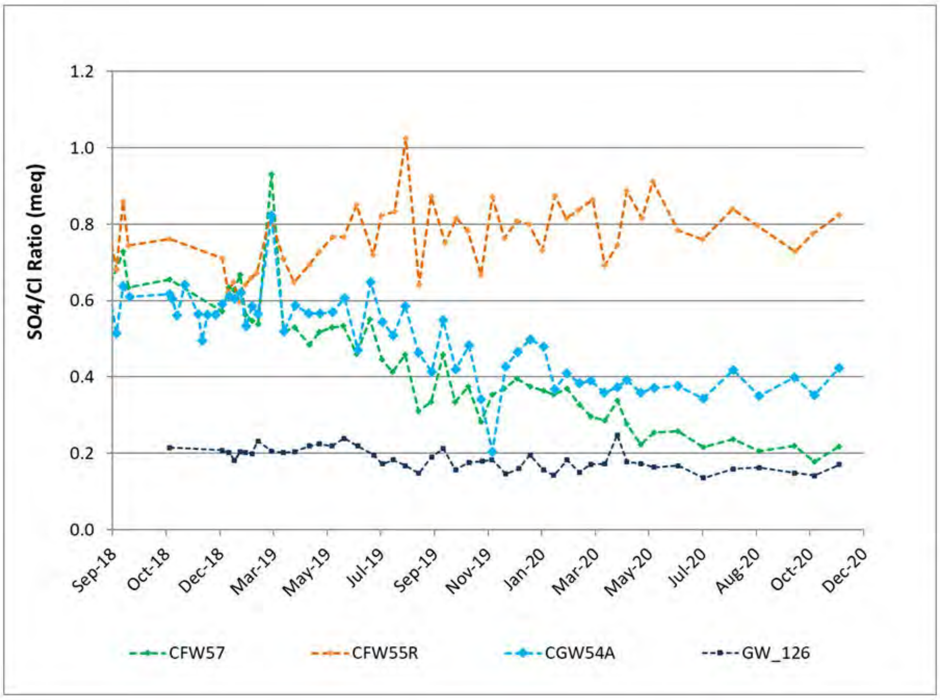


Figure 5-26 Sulphate/Chloride Ratio

5.3.1.3 Cheshunt Pit

During 2020, bore CHPZ8A was essentially dry as groundwater levels were close to bore depth. There was insufficient water column to sample.

Over the 2020 monitoring period, the following triggers were exceeded at the Cheshunt Pit bores:

- No bores exceeded triggers for EC;
- Hobden's Well recorded pH of 7.6, over the trigger level of 7.5, in Q2 and Q3,

Hobden's Well recorded trigger level breaches of 7.6 in Q2 and Q3 are within the historical reading range at this bore of 7.2 to 7.8. pH of 7.5 has regularly been exceeded at this bore since the start of monitoring in 2008 and is not indicative of any change in this bore with no adverse impacts identified. It is recommended that in the next revision of the groundwater management plan an individual trigger level for Hobden's Well is adopted rather than the group pH trigger level for all Cheshunt Pit Alluvium bores currently applied.

5.3.1.4 Lemington South

Over the 2020 monitoring period, the following triggers for EC and pH were exceeded at the Lemington South bores:

- Bore PB01(ALL) recorded EC above 3,938 µS/cm in Q1 and Q3 2020;
- Appleyard Farm bore recorded pH below 6.5 through 2020.

Since monitoring commenced at the bore in January 2000, PB01(ALL) has recorded an average EC of 2,758 µS/cm with a range between 840 µS/cm and 7,450 µS/cm. PB01(ALL) records large fluctuations in EC, however, there is a trend of rising EC over time up to 7,450 µS/cm in 2020 and showing increased variability in 2020. This displays that the EC did not decline in response to flows occurring in the Wollombi Brook.

Bore PB01(ALL) is located on the northern banks of the Wollombi Brook, in an area with no active mining or land clearance. It is also understood that sampling methodology was revised over 2019, therefore the change in results may relate to increased purging of the bore and collection of more representative samples. Equally this may represent a flushing of salts out of the catchment following rainfall and this trend should be continually monitored. No adverse impacts due to mining have been identified. It is recommended that the duplicate trigger level for the Lemington South alluvium be removed from the WMP, and one trigger level be applied based on representative data.

Appleyard Farm bore is located within 50m of Wollombi Brook, Figure 5-12 demonstrates that water level in Appleyard Farm bore is controlled by water level in Wollombi Brook and recharge to this bore is dominated by Wollombi Brook flow. The Appleyard Farm bore recorded pH below 5th percentile of recorded values trigger level of 6.6 through all four Quarters of 2020. The recorded decrease in pH can be associated with increased rainfall/brook flow recharge occurring in 2020 due to the close level of connectivity with Wollombi Brook, as the decrease in pH is correlated with increasing CRD and return to flowing conditions in Wollombi Brook. Flow in Wollombi Brook in rainfall dependant. pH in Wollombi Brook is not measured; however, "normally, pure rainwater has a pH of 5.3" EPA SA, 2004.

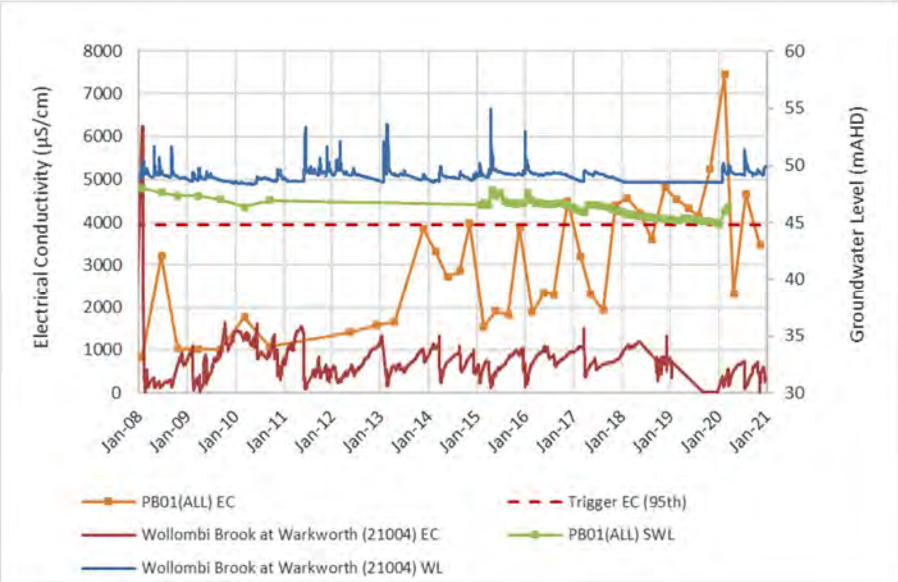


Figure 5-27 Water Level and EC Trends for PB01(ALL) and Wollombi Brook

5.3.2 Permian Coal Measures

Routine monitoring of EC and pH was conducted for all monitoring bores intersecting the Permian coal measures on a quarterly or six-monthly basis over 2020. Exceptions to this were bores 4036C, B425(WDH), C122(BFS), CGW45, Bz3-3, BZ4A(2), D612(AFS), and NPz5, as outlined in Table 5-1.

During 2020, groundwater quality within the Permian coal measures varied within and between locations, as discussed below:

- West Pit: EC ranges between 12,780 µS/cm and 14,570 µS/cm and pH ranges between 7.1 and 7.7;
- Carrington and Carrington West Wing area: EC ranges between 2,200 µS/cm and 7,810 µS/cm and pH ranges between 7.2 and 7.5;
- Between Cheshunt Pit and North Pit: EC ranges between 890 µS/cm and 4,120 µS/cm and pH ranges between 6.2. and 8; and
- Lemington South Pit: EC ranges between 2,770 µS/cm and 21,300µS/cm and pH ranges between 6.5 and 8.1.

Discussion in water quality trends and triggers is included for each of the mine locations from Section 5.3.2.1 to Section 5.3.2.4.

In accordance with the WMP full water quality analysis was conducted for the bores targeting the Permian coal measures. Analysis was also conducted for bores not specified within the WMP. Full water quality data is presented in Appendix E and summarised below:

- Total aluminium: variable readings from below laboratory limit of reporting to 3.6 mg/L (CHPZ8D) over 2020;
- Total arsenic: concentrations generally below the limit of reporting or less than 0.06 mg/L;
- Total cadmium: concentrations generally below the limit of reporting;
- Total lead: concentrations below the limit of reporting or less than 0.01 mg/L;

- Total selenium: concentrations below the limit of reporting or less than 0.02 mg/L; and
- Total zinc: concentrations generally below the limit of reporting or less than 0.35 mg/L.

5.3.2.1 West Pit

Over the 2020 monitoring period, the following triggers were exceeded for the West Pit bores:

- Bore NPz2 recorded EC over the trigger level of 13,428 µS/cm throughout 2020;

Bore NPZ2 is located approximately 4.5 km north-east of Plashett Reservoir and 1 km north-west of the West Pit mine area. The bore intersects interburden material (siltstone/sandstone) of the deeper Permian coal measures; with a screened interval between 57-60 m bgl. Historical EC readings for NPZ2 since 2008 show regular fluctuations of between 12,590 µS/cm and 19,400 µS/cm at the site, data plot displayed in Appendix D. The 2020 readings are consistent with historical concentrations. Based on available information, the cause for the changes in EC at NPZ2 do not appear to correlate to mine activities conducted at West Pit; EC at NPZ2 was elevated during the period 2008-2012 which indicates that higher EC levels have been recorded at this location in the data record available. As discussed in Section 5.2.2, it has been recommended that NPZ2 be removed from the compliance network as the bore location and construction does not provide information on potential impacts related to site activities. However, this bore should continue to be monitored to assist with other assessments and post closure monitoring.

5.3.2.2 Carrington and Carrington West Wing

Over the 2020 monitoring period, the following triggers were exceeded for the Carrington and Carrington West Wing bores:

- No bores exceeded triggers for EC;
- Bore CGW46 and CGW51a both recorded a pH over the trigger level of 7.5 in 2020.

The CGW46 and CGW51a 2020 pH readings ranging from 7.2 to 7.5 are considered consistent with historical concentrations, with no adverse impacts identified.

5.3.2.3 Cheshunt Pit

Over the 2020 monitoring period, the following triggers were exceeded at the Cheshunt Pit bores:

- No bores exceeded triggers for EC;
- Bore BZ2A(1), Bz3-3, BZ4a(2), CHPZ12D recorded a pH under the trigger level of 6.5 during 2020. Bore BZ3-1 exceeded the upper pH trigger of 7.7 in Q1, Q2 and Q3.

Bores BZ2A(1), BZ3-3 and CHPZ12D intersect the Mt Arthur Seam and are positioned between Cheshunt Pit and the Hunter River. The trigger values range for the bores is 6.5 to 7.6, while the full value range within the historical data for the bores is 6.0 to 8.2. The 2020 readings for the three bores are considered consistent with historical recorded concentrations, with no adverse impacts identified.

Bore BZ4a(2) intersects the Mt Arthur Seam, and recorded a trigger exceedance in 2020 with PH recorded the lower pH trigger level of 6.5 throughout 2020, with the lowest reading of 6.2 recorded in Q3. The pH results recorded are consistent with results recorded in this bore since previously impacted by depressurisation in 2011, as discussed in Section 5.2.2.3.

Bore BZ3-1 intersects the Interburden and recorded a trigger exceedance with the trigger level of 7.7 exceeded in 4 consecutive readings, Q4 2019 and Q1, Q2 and Q3 2020. This trigger exceedance is attributable to mining affect. As, the trigger exceedance is part of a medium term increasing pH trend since 2013 associated with a drawdown in water level trend over the same period, shown in Figure 5-18. This affect is associated with mining induced depressurisation as discussed in Section 5.2.2.3. pH peaked at 8.1 in Q4 2019 and followed a decreasing trend during 2020, with the Q4 reading returning to 7.0, concordant with increased rainfall and stabilised water level BZ3-1 in 2020.

5.3.2.4 Lemington South

During the 2020 monitoring period, the following triggers were exceeded at the Lemington South bores:

- Bore B631(BFS) recorded an EC above the trigger level of 13,400 µS/cm in Q2 and a pH below 6.7 in Q2, Q3 and Q4;
- Bore C130(ALL) recorded an EC above the trigger level of 11,408 µS/cm; throughout 2020:
- Bore C130(WDH) recorded an EC above the trigger level of 20,240 µS/cm in Q2 and Q4;
- Bore D612(AFS) recorded an EC above the trigger level of 15,324 µS/cm in Q2.
- Bore C317(WDH) recorded a pH, 7.7, above the trigger level of 7.6 in Q4.

Bore B631(BFS) is located approximately 560 m south-west of Lemington South pit and around 660 m east of the LUG Bore. The bore intersects the Bowfield Seam (BFS). Historical readings for bore B631(BFS) since 2000 show regular fluctuations of EC between 9,250 µS/cm and 15,780 µS/cm and pH variations between of 5.7 and 7.3. The 2020 readings are therefore considered consistent with historical concentrations. However, it is noted that the slight decline in pH for B631(BFS) may correspond with the decline in groundwater levels within the Bowfield Seam.

Bore C130(ALL) is located between Lemington South pit and the LUG Bore and intersects shallow weathered overburden to 17 m depth. Historical readings since 2000 show regular fluctuations of between 19,500 µS/cm and 24,200 µS/cm for EC and 6.4 to 7.9 for pH. The 2020 readings for pH are considered consistent with historical concentrations; however, three of the 2020 EC readings are above historical concentrations. The rise in EC corresponds with a general decline in groundwater levels. Review of water quality data also indicates a slight rise in sulphate concentrations over time with the rise in EC Figure 5-28. However, a low SO_4/Cl molar ratio of 0.07 meq was calculated, indicating the trend is likely not a result of sulphide oxidation. The groundwater type for C130(ALL) is Na-Mg-Cl and this has remained the stable over the last four years of water quality sampling. It is unclear as to the cause for the EC exceedances.

It is recommended that the water level of Lemington South Pit be monitored to understand the influence of in-pit water storage on the local groundwater regime. It is also noted that the trigger level for the Lemington South interburden was 22,780 µS/cm prior to a change in 2018 to 11,408 µS/cm. It is recommended that the trigger level for the interburden, and therefore C130(ALL), be reviewed.

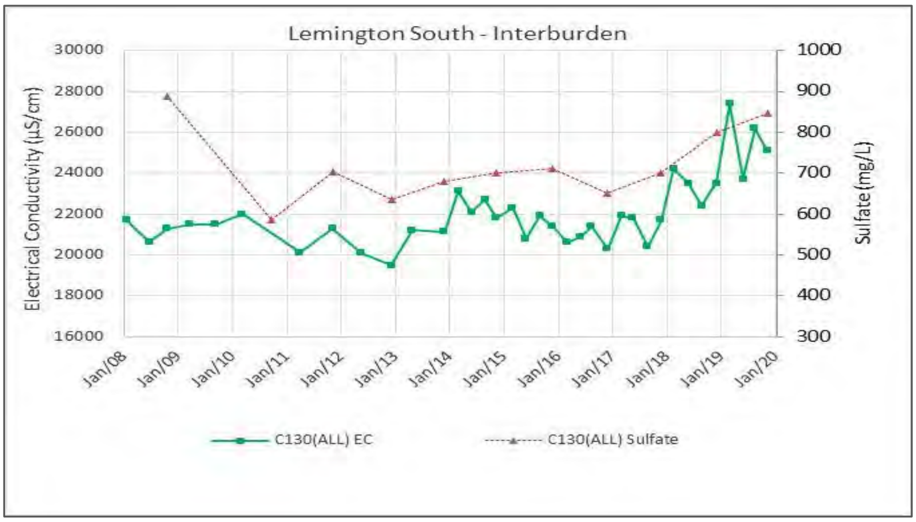


Figure 5-28 C130(ALL) EC vs Sulphate

Bore C130(WDH) is located between Lemington South Pit and LUG Bore and intersects the Woodlands Hill Seam (WDH). Historical readings since 2000 show regular fluctuations, of EC between 18,210 µS/cm and 21,000 µS/cm, and pH of 6.4 to 7.5 for pH. The 2020 readings for pH are therefore considered consistent with historical concentrations. The 2020 reading for EC of 21,300 µS/cm recorded in Q4 is slightly above historical concentrations.

Bore D612(AFS) is located between Lemington South Pit and LUG Bore and intersects the Arrowfield Seam (AFS). Historical readings show regular fluctuations of between 11,000 µS/cm and 15,890 µS/cm for EC and 6.7 to 7.6 for pH. The EC readings in 2020 slightly above historical concentrations. The rise in EC appears to correlate with a decline in groundwater levels, to over 22 m below surface (corresponding to a decline of 1.5 m) there was insufficient water to sample in Q4 2020. No information is available on the construction of D612(AFS), it is recommended that the total depth be measured to see if levels are near the base of the bore and water quality may reflect sediment within the bore.

Bore D010(GM) is located between Lemington South Pit and LUG Bore and intersects the Glen Munro Seam (GM). Historical readings show regular fluctuations of between 9,050 µS/cm and 12,310 µS/cm for EC and 6.5 to 8.1 for pH. The 2020 readings are therefore considered consistent with historical concentrations.

At Lemington there is a continued general trend of rising EC within the bores intersecting the Permian coal measures. The rise in EC for some bores is within the range of historical readings, but a trend is visible. There are no known changes in local land use in the area that could result in introduction of more saline groundwater. The trend of rising EC appears to correlate to the decline in groundwater levels around the LUG Bore that is used to abstract water stored within the Lemington Underground. EC is a measure of the ability of water to conduct an electrical current and relates to the concentration of dissolved ions in the water, which can comprise dissolved salts, alkalis, chlorides, sulphides and carbonate compounds. The change in EC around the LUG Bore likely relates to changes in local recharge processes and geochemistry in response to abstraction. There are no private groundwater users near Lemington that could be impacted by the change in water quality.

5.3.3 Spoil

Routine monitoring of EC and pH was conducted for the spoil monitoring bores over 2020 on a quarterly basis. Exceptions to this were bores DM7, GW-107 and GW-108 which were recorded as dry throughout the year, and DM3 which was not accessible. Over 2020, water within the spoil material at North Pit recorded an EC of between 2,400 µS/cm and 15,550 µS/cm, and a pH of between 5.7 and 7.2. Exceedances for EC were recorded for bores 4116P and MB14HVO05. Exceedances for pH were recorded for bores DM1 and DM3, recorded a pH, of 6.4, below the lower trigger of 6.5.

Bore 4116P is located at the southern end of North Pit and recorded an increasing trend in EC during 2020. Historical readings show regular fluctuations of between 10,890 µS/cm and 13,560 µS/cm for EC. The 2020 readings are slightly above the range of historical readings. Review of water quality and water level data for nearby bores indicates this trend is unique to bore 4116P. Groundwater level trends indicate the bore is almost dry and there is potential that historical readings may not have been based on representative groundwater samples. Numerous blockages have been recorded in 4116P since 2015. On review of the bore construction details it appears the groundwater level is below the screened interval and water quality samples are not representative of the groundwater in this area. Monitoring was recommended for adjacent bore 4117P that intersects the spoil at the base of Alluvial Lands Pit in the network review (SLR, 2020). However, bore 4117P has also become blocked, or possibly collapsed. It is also noted that nearby bore 4113P also collapsed in 2018. This coincides with a general reduction in water levels in the spoil over time and settling of the waste rock material. Ongoing monitoring of the spoil can be maintained at the more recently installed bores MB14HVO01 and MB14HVO02.

Measured EC from within bore MB14HVO05 has been highly variable from June 2017 to June 2020 and exceeded the trigger level of 12,460 µS/cm in 2020 Q1 during the second half of 2020 the EC appears to have stabilised, pH was recorded below the trigger level of 6.5 with reading of 5.7. Bore MB14VHO05 has been monitored since March 2015. EC and pH concentrations have fluctuated significantly over this short period of time. The timing of fluctuations appears to correspond with results for MB14HVO01 and MB14HVO02; however, the magnitude of the fluctuations is unique to MB14VHO05. This may relate to localised geochemical processes within the spoil material.

In accordance with the WMP, full water quality analysis was conducted for the site bores targeting the spoil material, with the exception of dry bores GW-107, GW-108 and DM7. Additional analysis was also conducted for bores not specified within the WMP. Full water quality data is presented in Appendix E and summarised below:

- Total aluminium: variable readings from below laboratory limit of reporting to 39.4 mg/L (MB14HVO05) over 2020;
- Total arsenic: concentrations generally below the limit of reporting or less than 0.22 mg/L;
- Total cadmium: concentrations generally below the limit of reporting or less than 0.02 mg/L;
- Total lead: concentrations below the limit of reporting or less than 0.06 mg/L;
- Total selenium: concentrations below the limit of reporting or less than 0.002 mg/L; and
- Total zinc: concentrations generally below the limit of reporting or less than 01.3 mg/L, with the exception of MB14HVO05 that recorded zinc concentration of 14.8 mg/L (Q1) 2020.

5.4 Groundwater Take

Interception of groundwater occurs at site due to a range of activities, including direct interception of groundwater with mining activities and abstraction from water supply bores, and indirect interception via induced inter-formation flows due to depressurisation of the Permian coal measures. Each activity is discussed below, and the estimated groundwater take for the various water sources summarised in Section 5.4.3.

5.4.1 Groundwater Inflows to Mine Operations

A numerical groundwater model was developed for the HVO South Modification 5. The model was calibrated up to December 2015 and replicates mine progression on a quarterly basis to the year 2039. Year 5 model results (predictive model) represent predicted groundwater conditions and take for the 2020 reporting period for inclusion in this report. The AGE (2015) report does not report predicted take for West Pit and includes inflows for Carrington West Wing that did not commence operations in 2020. To account for this, the predicted inflows to West Pit for model Year 5 were extracted from the model and added to the total take from the North Coast Fractured and Porous Rock water source. In addition, the volume of water taken as part of the modelled Carrington West Wing was subtracted from the total take.

5.4.2 Bore Abstraction

Lemington Underground (LUG) bore is an abstraction bore constructed into the abandoned LUG mine void underlying HVO. The bore is licensed to take up to 1,800 ML of water from the North Coast Fractured and Porous Rock aquifer (20BL173392) per water year. The bore is equipped with a flow meter, where total monthly abstraction is documented. Based on the flow volumes recorded, from July 2019 to June 2020 (water year) 1,475 ML of water was abstracted from the LUG bore, which is within the licensed allocation of 1,800 ML/year. From July 2020 to December 2020 80 ML of water was abstracted.

As the bore intersects LUG that mined the Permian coal measures, groundwater levels within bores intersecting the coal measures around the bore have been reviewed to identify the extent of groundwater drawdown. As discussed in Section 5.2.2.4, groundwater levels within the Bowfield Seam of the Permian coal measures around Lemington South have declined by up to 3 m (B631(BFS)) during 2020 to a distance of 1.8 km from LUG Bore. However, groundwater levels in most bores within the shallower coal measures surrounding LUG Bore recovered during 2020. In addition, no clear impacts related to groundwater abstraction from the historical underground mine were observed for nearby alluvial bore Appleyard Farm.

5.4.3 Summary of Groundwater Take For 2020

The predicted take of groundwater from the various groundwater sources associated with HVO is presented in Table 5-2.

Table 5-2 Predicted Groundwater Take for 2020

	Hunter Regulated (ML)	Hunter Unregulated (ML)	North Coast Fractured and Porous Rock (ML)
HVO Mine Operations†	205	353	821
LUG Bore Abstraction	-	-	1,475
Total	205	353	2,296

Note: † HVO Mine Operation predictions from HVO South Modification 5 include Carrington West Wing that has not commenced, and excludes West Pit

* take over water year (July 2019 to end of June 2020)

As shown in Table 5-2, over the 2020 reporting year the total take under the Hunter Regulated water source was estimated at 205 ML, total take from Hunter Unregulated water source was estimated at 353 ML and around 2,296 ML from the North Coast Fractured and Porous Rock water source. These volumes are within the licensed take for each groundwater source.

5.5 Verification of Model Predictions

In accordance with Schedule 4 Condition 27 (c) under DA 450-10-2003 (HVO North) and Schedule 3 Condition 27 (c) under PA 06_0261 (HVO South), the WMP includes requirements to validate and recalibrate (if necessary) the groundwater model for the development. This includes an independent review of the model every 3 years, and comparison of monitoring results with modelled predictions. The latest numerical groundwater model that replicates all approved operations across HVO (north and south) was developed by AGE Consultants as part of HVO South Modification 5 (2017).

The three yearly independent review of the HVO South Modification 5 numerical groundwater model to verify model predictions was undertaken by SLR at the start of 2020 (SLR, 2020 (2)) and is therefore not required to be done this year. The hydrogeological description, conceptualisation and model design of AGE's 2016 groundwater model were revisited and reviewed. As a part of the review process, the modelled recharge, stream stage heights and mine progression were compared against the actual data for January 2016 to December 2020.

6 Conclusions and Recommendations

6.1 Conclusions

This annual groundwater review covers data collected over 2020 and was completed in compliance with:

- Condition 27 of Development Consent DA 450 10 2003 for HVO North;
- Condition 28 of the Project Approval PA 06 0261 24 for HVO South; and
- Individual bore license conditions (20BL173587-89, 20BL173847 and 20BL173392).

During 2020, operations across HVO included active mining at West Pit, Cheshunt Pit, and Riverview Pit. Two tailings facilities were used over the year (Dam 6W and North Void DM6) and groundwater was abstracted from LUG Bore.

Review of climate data indicates the region generally experienced above average rainfall over 2020 (861.7 mm). Similar trends are reflected in stream levels for the Hunter River and Wollombi Brook from the HITS stations and site monitoring locations (WL03, WL05, WL10 and WL14).

The groundwater bore network at HVO is extensive, with 137 bores that were installed progressively over the life of the operations, with 104 of these bores within the WMP. Annual sampling is undertaken in accordance with relevant Australian Standards. It was previously identified by SLR (2018) that monthly to quarterly sampling methodology undertaken by the external contractors was not providing representative samples. This resulted in trigger exceedances. This sampling methodology was reviewed by HVO and improvements in sampling technique were made to ensure representative samples are collected over 2020.

Review of groundwater level trends indicates that where saturated, water within the alluvium were generally slightly increasing with some stable over 2020, generally in line with climate and stream flow trends indicating the primary driver has been climatic. Groundwater levels within the Permian coal measures remained relatively stable to slightly declining over 2020.

Over 2020, monitoring of the groundwater bore network was largely conducted in accordance with the Groundwater Monitoring Programme outlined within the WMP. However, water level and water quality readings were not taken in all required bores due to a range of factors such as dry or blocked bore conditions and access restrictions.

Review of water quality results and comparison to trigger levels for EC and pH identified several trigger exceedances over 2020. It was identified that several bores exceeded triggers for EC and pH; however, readings were generally in line with historical trends for these bores.

Quantification of groundwater take was undertaken based on reported volumes estimated for approved operations as part of Modification 5 (AGE 2017) and metered abstraction volumes from LUG Bore. Based on this, over the 2020 reporting year the total take under the Hunter Regulated water source was estimated at 205 ML, total take from Hunter Unregulated water source was estimated at 353 ML and around 2,296 ML from the North Coast Fractured and Porous Rock water source. These volumes are within the licensed take for each groundwater source.

6.2 Recommendations

Based on review of the available data for 2020, the following recommendations, in addition to those made in the quarterly reports, have been made. The recommendations have been grouped into compliance and operational bores and prioritised with bores listed first that have trigger exceedances, summarised in Sections 6.2.1, 6.2.2 and 6.2.3 below.

6.2.1 Compliance Bores

CFW55R - it is recommended that the local water quality results be considered during the spring ecological monitoring, and findings compared to inform if additional action is required.

Hobden's Well- It is recommended that in the next revision of the groundwater management plan an individual trigger level for pH Hobden's Well is adopted.

GW-124, GW-125, CFW57 and CFW55R - to help understand the cause for the total metals readings it is recommended that the bores be checked to see if sediment is present in the base of the bores.

BZ8-2 and HG2 - during routine monitoring include water quality analysis for major ions and dissolved metals. Check the condition of BZ8-2.

GW-124 - reinstall datalogger for bore.

B925(BFS) - verify the depth of the base of screen and total depth.

B334(BFS) - it is recommended that the bore is inspected to determine the groundwater source leading to increasing groundwater levels.

VWP GW-110 - requires the sensor calibration data to enable analysis of the recorded data.

VWP GW-109 - install replacement battery to enable data to be continued to be recorded.

DC130 – update EC trigger level

D010GM – update EC trigger level.

GW100 – GW101 check the depth of the bores for water quality sampling

BZ1-1 - update the WMP as intersecting interburden instead of alluvium.

6.2.2 Operational Bores

CGW45 - remediate bore or remove from the monitoring network.

BZ3-1 - check the condition of bore to ensure the data being collected is correct.

4051C - inspect the condition of bore to see if there is a blockage causing groundwater levels to rise.

PZ2CH400 - check the condition of bore.

B425(WDH) - verify the depth of the base of screen and total depth.

CGW47a - review the construction and condition of the bore to determine if it is suitable for ongoing monitoring of recovery within the Carrington Pit or should be removed from the network.

NPZ2 - recommend removal from the compliance monitoring network.

CGW51a – recommend decommissioning to minimise potential mixing and groundwater levels within the backfilled Carrington Pit. Replace with a new bore screened within the spoil material.

PB01 (All) - The duplicate trigger level for the Lemington South alluvium be removed from the WMP, and one trigger level be applied based on representative data.

6.2.3 General

During the collection of field monitoring data, it should be confirmed by samplers if bores are dry by comparing screen depth and water level. Review the groundwater quality monitoring program to ensure only representative groundwater samples are collected.

Check access options for surface water monitoring points (i.e. WLP14 and WLP10), or the option to install a datalogger to measure timeseries levels to ensure peak river levels are recorded.

7 References

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APPENDIX A

Groundwater Monitoring Programme

ID	Location	Easting	Northing	Ground Level (mAHD)	Screened Interval (m bgl)	Geology	Groundwater Monitoring Programme				
							Water Level	EC	pH	Full WQ	Alk/Acidity
4032P	CWW	308609	6402945	69.35	7.4-13.4	Paleochannel alluvium	Q	Q	Q	6M	
4034P	CWW	308239	6402959	71.15	5.6-14.6	Paleochannel alluvium	Q	Q	Q	6M	
4036C	Carrington	308272	6402688	70.7	33.1-34.1	Interburden (Siltstone/Sandstone)	Q	Q	Q		
4037P	CWW	308277	6402702	70.74	8.3-14.3	Paleochannel alluvium	Q	Q	Q	6M	
4040P	CWW	308675	6402724	69.16	5.9-11.9	Paleochannel alluvium	Q	Q	Q		
4051C	Carrington	308664	6402721	68.92	31.8-32.8	Interburden (Siltstone/Sandstone)	Q	Q	Q		
4116P	North Pit	310681	6400978	70.17	20.9-23.5	Spoil	Q	Q	Q	6M	
4119P	North Pit	312501	6402048	63.51	14.9-17.5	Spoil	Q	Q	Q	6M	
Appleyard Farm	Lemington	315491	6394639	43.4	7-10	Alluvium	M	Q	Q	A	
B334(BFS)	Lemington	316684	6394088	73.37	58.5-64.5	Bowfield Seam	Q	6M	6M		
B425(WDH)	Lemington	316010	6395024	57.88	31.5-35.5	Woodlands Hill Seam	Q	6M	6M	A	
B631(BFS)	Lemington	316425	6394319	72.11	78-84	Bowfield Seam	Q	6M	6M		
B631(WDH)	Lemington	316424	6394319	71.98	29.8-32.3	Woodlands Hill Seam	6M	6M	6M		
B925(BFS)	Lemington	315921	6394604	62.45	81-87	Bowfield Seam	Q	6M	6M	A	
BC1a	Cheshunt	312421	6400872	66.08	21.98	Mt Arthur Seam	Q	Q	Q		
BUNC45A	Cheshunt/ North Pit	313667	6402055	72.9	17.3-20.3	Regolith	Q	Q	Q	6M	
BUNC45D	Cheshunt Pit	313677	6402060	73.36	25.9-28.9	Mt Arthur Seam	Q	Q	Q	6M	
BZ1-1	Cheshunt/ North Pit	311472	6400483	71.39	21-24	Interburden	Q	Q	Q	6M	
BZ1-3	Cheshunt	311472	6400483	71.39	53-56	Mt Arthur Seam	Q	Q	Q	6M	
BZ2A(1)	Cheshunt	311671	6400561	71.17	49.1-52.1	Mt Arthur Seam	Q	Q	Q		
BZ3-1	Cheshunt	311840	6400640	69.97	TD 26.5	Interburden	Q	Q	Q		
BZ3-3	Cheshunt	311840	6400640	69.97	41.5-44.5	Mt Arthur Seam	Q	Q	Q		
BZ4A(2)	Cheshunt	312029	6400705	74.4	38-41	Mt Arthur Seam	Q	Q	Q		
BZ8-2	Cheshunt	312685	6401010	67.8	18-21	Interburden	Q	Q	Q	6M	
C122(WDH)	Lemington	315501	6395007	58.44	19.6-22.6	Woodlands Hill Seam	6M	6M	6M		
C122(BFS)	Lemington	315501	6395007	58.2	-	Bowfield Seam	Q	Q	Q		
C130(AFS1)	Lemington	316400	6394916	63.17	42-44	Arrowfield Seam	6M	6M	6M	A	
C130(ALL)	Lemington	316400	6394916	63.04	15-17	Interburden	Q	Q	Q	A	
C130(BFS)	Lemington	316400	6394916	62.98	55.5-64.5	Bowfield Seam	6M	6M	6M		

ID	Location	Easting	Northing	Ground Level (mAHD)	Screened Interval (m bgl)	Geology	Groundwater Monitoring Programme				
							Water Level	EC	pH	Full WQ	Alk/Acidity
C130(WDH)	Lemington	316400	6394916	63.14	19-21.5	Woodlands Hill Seam	6M	6M	6M		
C317(BFS)	Lemington	315054	6395007	60.38	70-76.5	Bowfield Seam	Q	6M	6M		
C317(WDH)	Lemington	315054	6395007	60.12	31-33.5	Woodlands Hill Seam	Q	6M	6M		
C613(BFS)	Lemington	314688	6395243	63.64	77-85	Bowfield Seam	Q	6M	6M		
C621(BFS)	Lemington	315421	6395321	58.37	47-56	Bowfield Seam	Q	6M	6M		
C630(BFS)	Lemington	316378	6395306	68.81	40.3-48.3	Bowfield Seam	6M	6M	6M		
C809 (GM/WDH)	Lemington	314207	6395493	59.13	28-38	Woodlands Hill Seam	6M	6M	6M		
C919(ALL)	Lemington	315192	6395655	57.94	7.5-13.5	Alluvium	M	Q	Q	A	
CFW55R	Carrington	310439	6402180	69.78	9.4-16.4	Paleochannel alluvium	Q	Q	Q	6M	
CFW57	Carrington	310084	6402053	70.05	8.4-15.4	Paleochannel alluvium	Q	Q	Q	6M	
CGW32	CWW	308598	6404872	78.48	14-23	Paleochannel alluvium	Q	Q	Q		
CGW39	CWW	308566	6403694	70.31	5-14	Alluvium	Q	Q	Q	6M	
CGW45	CWW	308042	6403349	71.83	28.6	Bayswater Seam	Q	Q	Q		
CGW46	CWW	308413	6403276	71.95	13.6	Bayswater Seam	Q	Q	Q	6M	
CGW47a	CWW	308731	6403405	70.39	16.47	Broonie Seam	Q	Q	Q	6M	
CGW49	CWW	308778	6403098	69.05	13.3	Bayswater Seam	Q	Q	Q		
CGW51a	Carrington	310149	6402419	70.04	13 - 16	Interburden (Siltstone/Sandstone)	Q	Q	Q		
CGW52	Carrington	309906	6402255	70.7	39.6-42.6	Broonie Seam	Q	Q	Q		
CGW52a	Carrington	309902	6402249	70.61	15 - 18	Alluvium	Q	Q	Q		
CGW53	Carrington	309606	6402333	69.87	38.5-41.5	Broonie Seam	Q	Q	Q		
CGW53a	Carrington	309606	6402333	69.83	11.7 – 14.7	Alluvium	Q	Q	Q		
CGW55a	Carrington	309840	6402457	70.56	12.8 – 15.8	Alluvium	Q	Q	Q		
CHPZ10A	Cheshunt/ North Pit	313334	6402297	62.57	9.5-12.6	Alluvium	Q	Q	Q	6M	
CHPZ12A	Cheshunt/ North Pit	313238	6402013	63.13	9.5-11.5	Alluvium	Q	Q	Q	6M	
CHPZ12D	Cheshunt	313236	6402020	63.26	12-15	Mt Arthur Seam	Q	Q	Q	6M	
CHPZ1A	Cheshunt/ North Pit	312820	6401697	65.9	15-18.7	Alluvium	Q	Q	Q	6M[2]	
CHPZ2A	Cheshunt/ North Pit	312941	6401539	65.14	13.7-16.9	Alluvium	Q	Q	Q	6M	
CHPZ3A	Cheshunt/ North Pit	313086	6401756	63.18	14.5-11.5	Alluvium	Q	Q	Q	6M	

ID	Location	Easting	Northing	Ground Level (mAHD)	Screened Interval (m bgl)	Geology	Groundwater Monitoring Programme				
							Water Level	EC	pH	Full WQ	Alk/Acidity
CHPZ3D	Cheshunt	313094	6401756	62.96	20.5-23.6	Mt Arthur Seam	Q	Q	Q	6M	
CHPZ4A	Cheshunt/ North Pit	312904	6402123	65.45	10.9-14.2	Alluvium	Q	Q	Q	6M	
CHPZ8A	Cheshunt/ North Pit	313503	6402051	60.05	4-6	Alluvium	Q	Q	Q	6M	
CHPZ8D	Cheshunt	313508	6402047	59.89	6-9.5	Mt Arthur Seam	Q	Q	Q	6M	
D010(BFS)	Lemington	314355	6395687	55.94	60-66.5	Bowfield Seam	6M	6M	6M		
D010(GM)	Lemington	314355	6395687	55.95	12.5-17	Glen Munro Seam	6M	6M	6M	A	
D010(WDH)	Lemington	314355	6395687	56	19.5-22.5	Woodlands Hill Seam	6M	6M	6M		
D214(BFS)	Lemington	314768	6395831	56.67	43-52.5	Bowfield Seam	Q	6*M	6*M		
D317(BFS)	Lemington	315043	6396019	59.64	39-44.2	Bowfield Seam	Q	6M	6M		
D406(AFS)	Lemington	313931	6396074	57.41	24-27.5	Arrowfield Seam	6M	6M	6M		
D406(BFS)	Lemington	313931	6396074	57.36	51-57	Bowfield Seam	6M	6M	6M		
D510(AFS)	Lemington	314380	6396141	54.99	25.5-30.5	Arrowfield Seam	6M	6M	6M		
D510(BFS)	Lemington	314380	6396141	54.98	34-38	Bowfield Seam	6M	6M	6M		
D612(AFS)	Lemington	314524	6396314	62.16	24.01	Arrowfield Seam	6M	6M	6M		
D612(BFS)	Lemington	314524	6396314	62.1	29.15	Bowfield Seam	6M	6M	6M		
D807(BFS)	Lemington	314002	6396484	59.94	36-41	Bowfield Seam	6M	6M	6M		
DM1	North Pit	311778	6405164	102.73	29.15	Spoil (Base)	Q	Q	Q	A	Q
DM3	North Pit	311971	6403310	94.14	41.5	Spoil (Base)	Q	Q	Q	A	Q
DM4	North Pit	312222	6401418	64.85	55-	Spoil (Base)	Q	Q	Q	A	Q
DM7	North Pit	311136	6400961	69.26	32-	Spoil	Q	Q	Q	A	Q
G1	West Pit	305694	6407301	110	<10	Alluvium	Q	Q	Q	A	
G2	West Pit	305660	6407451	110.6	3.04	Alluvium	Q	Q	Q	A	
G3	West Pit	305636	6407556	108.6	<10	Alluvium	Q	Q	Q	A	
GA3	Cheshunt/ North Pit	310159	6400876	67.02	12	Coal	Q	Q	Q		
GW-100	West Pit	303729	6406436	89.6	4.4-5	Alluvium	Q	Q	Q	A	
GW_100a (VWP)	Carrington	303722	6406445	89.4	51	Barrett Seam and Interburden	Q*				
GW-101	West Pit	304374	6406728	100.5	9-12	Alluvium	Q	Q	Q	A	
GW-101a (VWP)	Carrington	304362	6406721	100.5	51	Interburden (Siltstone/Sandstone)	Q*				
GW-102 (VWP)	Carrington	305280	6406668	114.6	60.5	Interburden (Sandstone with minor coal)	Q*				

ID	Location	Easting	Northing	Ground Level (mAHD)	Screened Interval (m bgl)	Geology	Groundwater Monitoring Programme				
							Water Level	EC	pH	Full WQ	Alk/Acidity
GW-103 (VWP)	Carrington	306769	6404610	103.2	25.5 64.5 119.5	Coal - undifferentiated and weathered Siltstone and coal Sandstone - mg, fresh	Q*				
GW-104 (VWP)	Carrington	307549	6404657	86.7	59 107 135	Lower Pikes Gully Seam Sandstone IB (near Upper Liddell Seam) Sandstone (above Barret)	Q*				
GW-105 (VWP)	Carrington	308597	6405442	93.1	33 103.5 154	Coal - undifferentiated Coal - tuffaceous Coal	Q*				
GW-106	CWW	309092	6405224	82.3	24-27	Paleochannel alluvium	Q	Q	Q	A	
GW-107	Carrington	308738	6404103	73.5	24.2-27.2	Carrington Spoil	Q	Q	Q	A	
GW-108	Carrington	309695	6403971	84.4	52.5-58.5	Carrington Spoil	Q	Q	Q	A	
GW-109 (VWP)	Carrington	309232	6402706	85.2	31.5 65 89.5	Coal - slightly weathered Coal - tuffaceous Bayswater Seam	Q*				
GW-110 (VWP)	Carrington	310503	6404598	124.6	38 63 93	Sandstone - fresh Sandstone Bayswater Seam	Q*				
GW-114	North Pit	312272	6403981	98.2	27-30	Spoil	Q	Q	Q	A	
GW-115	North Pit	312227	6402216	68.3	22.2-28.2	Spoil	Q	Q	Q	A	
GW-120	Carrington	310463	6402239	69.97	12-15	Alluvium	TBC	TBC	TBC	TBC	
GW-121	Carrington	310332	6401877	68	5-8	Alluvium	TBC	TBC	TBC	TBC	
GW-122	Carrington	310225	6401781	69.06	12-15	Interburden	TBC	TBC	TBC	TBC	
GW-123	Carrington	310259	6402014	68.99	9.9-12.9	Alluvium	TBC	TBC	TBC	TBC	
GW-124	Carrington	310170	6401924	68.9	11.7-14.7	Alluvium	TBC	TBC	TBC	TBC	
GW-125	Carrington	310118	6402315	68.46	10.4-13.4	Alluvium	TBC	TBC	TBC	TBC	
GW-126	Carrington	310055	6402214	70.29	11.8-14.8	Alluvium	TBC	TBC	TBC	TBC	
GW-127	Carrington	309973	6402109	68.92	11.1-14.1	Alluvium	TBC	TBC	TBC	TBC	

ID	Location	Easting	Northing	Ground Level (mAHD)	Screened Interval (m bgl)	Geology	Groundwater Monitoring Programme				
							Water Level	EC	pH	Full WQ	Alk/Acidity
GW-128	Carrington	310314	6402307	69.77	8.7 - 11.7	Alluvium	TBC	TBC	TBC	TBC	
GW-129	Carrington	310553	6402211	72.3	12.3 - 21.3	Spoil	TBC	TBC	TBC	TBC	
HG2	Cheshunt	312469	6400886	67.4	11-17	Interburden	Q	Q	Q		
HG2a	Cheshunt	312469	6400886	66.82	25.8-27.8	Mt Arthur Seam	Q	Q	Q		
Hobdens Well	Cheshunt/ North Pit	312540	6401093	71	13.9	Alluvium	Q	Q	Q	A	
HV3(2)	Cheshunt/ North Pit	310776	6400546	68.06	-	Hunter River Alluvium	Q	Q	Q		
LUG Bore	Lemington	315874	6394295		-		M	Q	Q	A	
NPz2	West Pit	307800	6411340	190.475	57-60	Sandstone/Siltstone	Q	Q	Q	A	
NPz3	West Pit	306305	6409131	148.4	93.3-96.6	Siltstone	Q	Q	Q	A	
NPz5	West Pit	310730	6406550	113.76	40-43	Sandstone/Siltstone	Q	Q	Q	A	
PBO1(ALL)	Lemington	314754	6396026	54.37	9.5-12.5	Alluvium	M	Q	Q	A	
PZ1CH200	Cheshunt/ North Pit	312646	6402256	62.06	>8.9-11.1	Alluvium	Q	Q	Q		
PZ2CH400	Cheshunt/ North Pit	312635	6402051	62.53	>9.9-11.2	Hunter River Alluvium	Q	Q	Q	6M[2]	
PZ3CH800	Cheshunt/ North Pit	312522	6401674	64.16	10.47	Hunter River Alluvium	Q	Q	Q	6M[2]	
PZ4CH1380	Cheshunt/ North Pit	312196	6401176	64.93	14.58	Hunter River Alluvium	Q	Q	Q		
PZ5CH1800	Cheshunt/ North Pit	311852	6400928	66.1	15	Hunter River Alluvium	Q	Q	Q		
SR001	Southern	319146	6394094	58.44	60	Coal	6M	6M	6M		
SR002	Southern	319079	6394620	56.99	38-41	Bayswater Seam	6M	6M	6M		
SR003	Southern	318863	6394864	61.33	64.44	Bayswater Seam	6M	6M	6M		
SR004	Southern	318994	6395506	78.15	40.64	Bayswater Seam	6M	6M	6M		
SR005	Southern	318831	6396128	65.36	27.08	Bayswater Seam	6M	6M	6M		
SR006	Southern	318555	6395732	83.31	92.25	Bayswater Seam	6M	6M	6M		
SR007 (RC_11)	Southern	318772	6394373	60.9	31.5-37.5	Overburden and Vaux Seam coal	6M	6M	6M	A	
SR008 (RC_7)	Southern	319290	6395111	56.8	24.4-30.4	Siltstone/sandstone below Lemington Seam	6M	6M	6M	A	
SR009 (RC_8)	Southern	319338	6394746	56.1	30.4-36.4	Lemington Seam	6M	6M	6M	A	
SR010 (RC_6)	Southern	317319	6395338	57.5	24.6-30.6	Conglomerate and Warkworth Seam	6M	6M	6M	A	

ID	Location	Easting	Northing	Ground Level (mAHD)	Screened Interval (m bgl)	Geology	Groundwater Monitoring Programme				
							Water Level	EC	pH	Full WQ	Alk/Acidity
SR011 (RC_14)	Southern	317699	6394412	88.2	41.4-47.4	Mt Arthur Seam and underburden	6M	6M	6M	A	
SR012(HQ_11)	Southern	316354	6393926	76.2	23.4-29.4	Overburden - conglomerate and sandstone	6M	6M	6M	A	
MB14HVO01	North Pit	310587	6401003	71.3	90	Spoil	Q	Q	Q	A	
MB14HVO02	North Pit	310469	6401001	70.9	90	Spoil	Q	Q	Q	A	
MB14HVO03	North Pit	311387	6400950	67.1	80	Spoil	Q	Q	Q	A	
MB14HVO04	North Pit	311491	6401392	67.1	55	Spoil	Q	Q	Q	A	
MB14HVO05	North Pit	310675	6401127	71.7	85	Spoil	Q	Q	Q	A	

Notes:

(VWP) indicates that the hole is fitted with a grouted vibrating wire piezometer.
Q* - Data downloaded quarterly
RE – Rain Event sampling (≥30mm rainfall in 24hrs, max 2 sampling events per quarter),
M – Monthly,
Q – Quarterly,
6M – Six Monthly
A – Annual
[2] Comprehensive analysis 2

APPENDIX B

Groundwater Level Readings 2020

Alluvium

ID	Location	Easting	Northing	Ground Level (mAHD)	Screened Interval (m bgl)	WMP Geology	SWL (mAHD)			
							Q1	Q2	Q3	Q4
4032P	CWW	308609	6402945	69.35	7.4-13.4	Carrington West Wing_Alluvium	59.58	59.65	59.69	59.85
4034P	CWW	308239	6402959	71.15	5.6-14.6	Carrington West Wing_Alluvium	58.86	58.96	58.98	59.1
4037P	CWW	308277	6402702	70.74	8.3-14.3	Carrington West Wing_Alluvium	59.68	59.78	59.87	59.92
4040P	CWW	308675	6402724	69.16	5.9-11.9	Carrington West Wing Alluvium	59.61	59.79	59.8	59.85
Appleyard Farm	Lemington	315491	6394639	43.4	7-10	Lemington South_Alluvium	36.42	37.95	37.78	37.9
BUNC45A	Cheshunt/ North Pit	313667	6402055	72.9	17.3-20.3	Cheshunt / North Pit_Alluvium	52.18	52.49	52.5	52.31
BZ1-1	Cheshunt/ North Pit	311472	6400483	71.39	21-24	Cheshunt / North Pit_Alluvium	54.3	54.05	54.34	54.98
C919(ALL)	Lemington	315192	6395655	57.94	?	Lemington South_Alluvium	#N/A	#N/A	46.32	46.5
CFW55R	Carrington	310439	6402180	69.78	9.4-16.4	Carrington_Alluvium	58.18	58.34	58.35	0
CFW57	Carrington	310084	6402053	70.05	8.4-15.4	Carrington_Alluvium	58.37	58.65	58.64	58.8
CGW32	CWW	308598	6404872	78.48	?	Carrington West Wing_Flood Plain	59.63	59.65	59.6	59.6
CGW39	CWW	308566	6403694	70.31	5-14	Carrington West Wing_Flood Plain	58.62	58.73	58.79	58.85
CGW47a	CWW	308731	6403405	70.39	?	Carrington West Wing_Flood Plain	54.57	#N/A	54.57	59.68
CGW49	CWW	308778	6403098	69.05	?	Carrington West Wing_Alluvium	59.58	59.63	59.75	59.81
CGW52a	Carrington	309902	6402249	70.61	?	Carrington_Alluvium	58.69	58.76	58.86	58.91
CGW53a	Carrington	309606	6402333	69.83	?	Carrington_Alluvium	58.78	58.85	58.93	59
CGW55a	Carrington	309840	6402457	70.56	?	Carrington_Alluvium	57.69	57.77	57.86	57.92
CHPZ10A	Cheshunt/ North Pit	313334	6402297	62.57	9.5-12.6	Cheshunt / North Pit_Alluvium	54.02	54.2	54.37	54.43
CHPZ12A	Cheshunt/ North Pit	313238	6402013	63.13	9.5-11.5	Cheshunt / North Pit_Alluvium	54.22	54.35	53.5	54.57
CHPZ1A	Cheshunt/ North Pit	312820	6401697	65.9	15-18.7	Cheshunt / North Pit_Alluvium	55.5	55.53	55.73	54.82
CHPZ2A	Cheshunt/ North Pit	312941	6401539	65.14	13.7-16.9	Cheshunt / North Pit_Alluvium	54.58	54.61	54.86	54.95
CHPZ3A	Cheshunt/ North Pit	313086	6401756	63.18	14.5-11.5	Cheshunt / North Pit_Alluvium	54.27	54.49	54.61	54.73
CHPZ4A	Cheshunt/ North Pit	312904	6402123	65.45	10.9-14.2	Cheshunt / North Pit_Alluvium	54.43	54.44	54.66	54.67
CHPZ8A	Cheshunt/ North Pit	313503	6402051	60.05	4-6	Cheshunt / North Pit_Alluvium	54.11	54.3	54.35	54.39
G1	West Pit	305694	6407301	110	?	West Pit_Alluvium	107.57	108.58	108.95	106.36
G2	West Pit	305660	6407451	110.6	?	West Pit_Alluvium	108.54	109.69	109.85	107.11
ID	Location	Easting	Northing			WMP Geology	SWL (mAHD)			

				Ground Level (mAHD)	Screened Interval (mbgl)		Q1	Q2	Q3	Q4
G3	West Pit	305636	6407556	108.6	?	West Pit_Alluvium	107.03	108.23	108.42	107.69
GA3	Cheshunt/ North Pit	310159	6400876	67.02	?	Cheshunt / North Pit_Alluvium	56.87	56.8	56.92	58.83
GW-100	West Pit	303729	6406436	89.6	4.4-5	West Pit_Alluvium	83.46	83.52	84	84.16
GW-101	West Pit	304374	6406728	100.5	9-12	West Pit_Alluvium	#N/A	#N/A	87.66	0
GW-106	CWW	309092	6405224	82.3	24-27	Carrington West Wing_Alluvium	59.69	59.79	59.75	59.75
GW-120	North Void	310463	6402239	69.97	12-15	North Void_Alluvium	58.46	58.57	58.59	58.71
GW-121	North Void	310332	6401877	68	5-8	North Void_Alluvium	#N/A	#N/A	#N/A	59.32
GW-123	North Void	310259	6402014	68.99	10-12.9	North Void_Alluvium	58.66	58.82	58.89	58.99
GW-124	North Void	310170	6401924	68.9	11.7-14.7	North Void_Alluvium	58.67	59	59.01	58.96
GW-125	North Void	310118	6402315	68.46	10.4-13.4	North Void_Alluvium	58.7	58.87	58.88	59.05
GW-126	North Void	310055	6402214	70.29	11.8-14.8	North Void_Alluvium	58.63	58.82	58.87	59.12
GW-127	North Void	309973	6402109	68.92	11.1-14.1	North Void_Alluvium	58.67	58.9	58.95	59.04
GW-128	North Void	310314	6402307	69.77	8.7-11.7	North Void_Alluvium	58.39	58.47	58.57	58.7
Hobdens Well	Cheshunt/ North Pit	312540	6401093	71	?	Cheshunt / North Pit_Alluvium	59.69	59.57	59.9	55.52
HV3(2)	Cheshunt/ North Pit	310776	6400546	68.06	?-16.7	Cheshunt / North Pit_Alluvium	57.78	58.24	57.8	56.88
PB01(ALL)	Lemington	314754	6396026	54.37	9.5-12.5	Lemington South_Alluvium	44.87	46.62	46.54	46.68
PZ1CH200	Cheshunt/ North Pit	312646	6402256	62.06	>8.9-11.1	Cheshunt / North Pit_Alluvium	54.86	54.76	55.18	55.28
PZ2CH400	Cheshunt/ North Pit	312635	6402051	62.53	>9.9-11.2	Cheshunt / North Pit Alluvium	60.41	57.05	61.25	61.83
PZ3CH800	Cheshunt/ North Pit	312522	6401674	64.16	?	Cheshunt / North Pit_Alluvium	55.08	54.84	55.4	55.51
PZ4CH1380	Cheshunt/ North Pit	312196	6401176	64.93	?	Cheshunt / North Pit Alluvium	55.33	55.11	55.66	55.75
PZ5CH1800	Cheshunt/ North Pit	311852	6400928	66.1	?	Cheshunt / North Pit_Alluvium	55.51	55.46	56.01	56.09

Permian Coal Measures

ID	Location	Easting	Northing	Ground Level (mAHD)	Screened Interval (mbgl)	WMP Geology	SWL (mAHD)			
							Q1	Q2	Q3	Q4
4036C	Carrington	308272	6402688	70.7	33.1-34.1	Carrington_Interburden	Bore Dry	Bore Dry	Bore Dry	Bore Dry
4051C	Carrington	308664	6402721	68.92	31.8-32.8	Carrington_Interburden	53.87	54.37	54.59	54.74
B334(BFS)	Lemington	316684	6394088	73.37	58.5-?	Lemington South_Bowfield	21.36	21.65	21.97	21.76
B425(WDH)	Lemington	316010	6395024	57.88	?	Lemington South_Woodlands Hill	22.29	22.29	22.42	22.44
B631(BFS)	Lemington	316425	6394319	72.11	78-?	Lemington South_Bowfield	23.31	22.72	22.44	20.87
B631(WDH)	Lemington	316424	6394319	71.98	?	Lemington South_Woodlands Hill	#N/A	46	#N/A	45.98
B925(BFS)	Lemington	315921	6394604	62.45	81-?	Lemington South_Bowfield	-0.92	-0.79	-0.86	-1.11
BC1a	Cheshunt	312421	6400872	66.08	?	Cheshunt_Mt Arthur	48.78	48.78	#N/A	48.87
BUNC45D	Cheshunt Pit	313677	6402060	73.36	25.9-28.9	Cheshunt_Piercefield	48.5	48.44	48.69	48.5
BZ1-3	Cheshunt	311472	6400483	71.39	?	Cheshunt_Mt Arthur	24.24	25.08	24.97	25.09
BZ2A(1)	Cheshunt	311671	6400561	71.17	?	Cheshunt_Mt Arthur	25.55	25.55	26.09	26.06
BZ3-1	Cheshunt	311840	6400640	69.97	?	Cheshunt_Interburden	53.64	53.21	53.55	52.9
BZ3-3	Cheshunt	311840	6400640	69.97	?	Cheshunt_Mt Arthur	27.21	27.19	27.39	27.36
BZ4A(2)	Cheshunt	312029	6400705	74.4	?	Cheshunt_Mt Arthur	33.92	33.69	34.12	33.42
BZ8-2	Cheshunt	312685	6401010	67.8	?	Cheshunt_Interburden	48.42	49.23	49.19	47.81
C122(WDH)	Lemington	315501	6395007	58.44	?	Lemington South_Woodlands Hill	#N/A	46.7	#N/A	46.87
C122(BFS)	Lemington	315501	6395007	58.2	?	Lemington South_Bowfield	Bore Dry	Bore Dry	Bore Dry	Bore Dry
C130(AFS1)	Lemington	316400	6394916	63.17	42-44	Lemington South_Arrowfield	#N/A	45.18	#N/A	44.88
C130(ALL)	Lemington	316400	6394916	63.04	15-17	Lemington South_Interburden	47.32	47.37	47.31	47.35
C130(BFS)	Lemington	316400	6394916	62.98	55.5-64.5	Lemington South_Bowfield	9.1	9.07	9.7	7.17
C130(WDH)	Lemington	316400	6394916	63.14	19-21.5	Lemington South_Woodlands Hill	#N/A	47.29	#N/A	47.26
C317(BFS)	Lemington	315054	6395007	60.38	?	Lemington South_Bowfield	5.13	5.57	5.04	4.91
C317(WDH)	Lemington	315054	6395007	60.12	?	Lemington South_Woodlands Hill	46.13	46.11	45.77	46.34
C613(BFS)	Lemington	314688	6395243	63.64	?	Lemington South_Bowfield	33.19	33.66	34.06	34.26
C621(BFS)	Lemington	315421	6395321	58.37	?	Lemington South_Bowfield	14.76	14.74	14.4	14.18
C630(BFS)	Lemington	316378	6395306	68.81	?	Lemington South_Bowfield	#N/A	23.35	#N/A	23.6
C809 (GM/WDH)	Lemington	314207	6395493	59.13	28-38	Lemington South_Woodlands Hill	#N/A	#N/A	#N/A	#N/A
CGW45	CWW	308042	6403349	71.83	?	Carrington West Wing_LBL	Blocked	Blocked	Blocked	Blocked
CGW46	CWW	308413	6403276	71.95	?	Carrington West Wing_Bayswater	59.03	59.15	59.05	57.47
CGW51a	Carrington	310149	6402419	70.04	?	Carrington_Interburden	55.64	55.63	55.66	55.71

ID	Location	Easting	Northing	Ground Level (mAHD)	Screened Interval (mbgl)	WMP Geology	SWL (mAHD)			
							Q1	Q2	Q3	Q4
CGW52	Carrington	309906	6402255	70.7	?	Carrington_Broonie	34.79	35.04	35.04	35.59
CGW53	Carrington	309606	6402333	69.87	?	Carrington_Broonie	36.32	39.77	36.86	37.3
CHPZ12D	Cheshunt	313236	6402020	63.26	12-15	Cheshunt_Mt Arthur	54.1	54.23	54.36	54.43
CHPZ3D	Cheshunt	313094	6401756	62.96	20.5-23.6	Cheshunt_Mt Arthur	53.37	53.25	53.57	53.84
CHPZ8D	Cheshunt	313508	6402047	59.89	6-9.5	Cheshunt_Mt Arthur	54.25	54.45	53.39	54.37
D010(BFS)	Lemington	314355	6395687	55.94	60-66.5	Lemington South_Bowfield	#N/A	29.04	#N/A	29.86
D010(GM)	Lemington	314355	6395687	55.95	12.5-17	Lemington South_Glen Munro	#N/A	47.31	#N/A	47.35
D010(WDH)	Lemington	314355	6395687	56	19.5-22.5	Lemington South_Woodlands Hill	#N/A	46.22	#N/A	46.07
D214(BFS)	Lemington	314768	6395831	56.67	43-52.5	Lemington South_Bowfield	27.14	27.69	27.87	28.26
D317(BFS)	Lemington	315043	6396019	59.64	39-44.2	Lemington South_Bowfield	25.76	25.95	26.25	26.51
D406(AFS)	Lemington	313931	6396074	57.41	?	Lemington South_Arrowfield	#N/A	39.74	#N/A	34.65
D406(BFS)	Lemington	313931	6396074	57.36	?	Lemington South_Bowfield	#N/A	32.79	#N/A	34.29
D510(AFS)	Lemington	314380	6396141	54.99	25.5-30.5	Lemington South_Arrowfield	#N/A	29.7	#N/A	29.94
D510(BFS)	Lemington	314380	6396141	54.98	34-38	Lemington South_Bowfield	#N/A	21.21	#N/A	33.17
D612(AFS)	Lemington	314524	6396314	62.16	?	Lemington South_Arrowfield	#N/A	39.25	#N/A	39.01
D612(BFS)	Lemington	314524	6396314	62.1	?	Lemington South_Bowfield	#N/A	31.18	#N/A	32.94
D807(BFS)	Lemington	314002	6396484	59.94	36-41	Lemington South_Bowfield	#N/A	35.69	#N/A	37.59
GW-122	North Void	310225	6401781	69.06	12-15	North Void_Permian	58.18	58.58	58.7	58.65
HG2	Cheshunt	312469	6400886	67.4	11-17	Cheshunt_Interburden	55.09	55.41	55.56	54.95
HG2a	Cheshunt	312469	6400886	66.82	25.8-27.8	Cheshunt_Mt Arthur	41.07	41.15	41.2	41.7
NPz2	West Pit	307800	6411340	190.475	57-60	West Pit_Sandstone/Siltstone	161.265	161.345	161.305	161.07
NPz3	West Pit	306305	6409131	148.4	?	West Pit_Sandstone/Siltstone	124.49	124.58	124.8	123.07
NPz5	West Pit	310730	6406550	113.76	40-43	West Pit_Sandstone/Siltstone	#N/A	#N/A	#N/A	#N/A
SR001	Southern	319146	6394094	58.44	?	Southern_Coal	#N/A	47.14	#N/A	47.32
SR002	Southern	319079	6394620	56.99	38-41	Southern_Bayswater Seam	#N/A	42.58	#N/A	42.42
SR003	Southern	318863	6394864	61.33	?	Southern_Bayswater Seam	#N/A	43.07	#N/A	42.89
SR004	Southern	318994	6395506	78.15	?	Southern_Bayswater Seam	#N/A	42.96	#N/A	42.92
SR005	Southern	318831	6396128	65.36	?	Southern_Bayswater Seam	#N/A	43.13	#N/A	43.23
SR006	Southern	318555	6395732	83.31	?	Southern_Bayswater Seam	#N/A	43.18	#N/A	43.15
SR007	Southern	318772	6394373	60.9	31.5-37.5	Southern_Overburden and Vaux Seam coal	25.82	#N/A	#N/A	47.11
SR008	Southern	319290	6395111	56.8	24.4-30.4	Southern_Siltstone/sandstone below Lemington Seam	47	47.03	47.03	46.63
ID	Location	Easting	Northing			WMP Geology	SWL (mAHD)			

				Ground Level (mAHD)	Screened Interval (mbgl)		Q1	Q2	Q3	Q4
SR009	Southern	319338	6394746	56.1	30.4-36.4	Southern_Lemington Seam	48.85	49.01	48.97	46.68
SR010	Southern	317319	6395338	57.5	24.6-30.6	Southern_Conglomerate and Warkworth Seam	46.84	46.87	46.85	48.24
SR011	Southern	317699	6394412	88.2	41.4-47.4	Southern_Mt Arthur Seam and underburden	53.25	53.15	53.1	52.15
SR012	Southern	316354	6393926	76.2	23.4-29.4	Southern_Overburden - conglomerate and sandstone	48.77	48.62	49.23	48.72

Spoil

ID	Location	Easting	Northing	Ground Level (mAHD)	Screened Interval (mbgl)	WMP Geology	SWL (mAHD)			
							Q1	Q2	Q3	Q4
4116P	North Pit	310681	6400978	70.17	20.9-23.5	North Pit_Spoil	47.69	47.77	47.76	47.79
4119P	North Pit	312501	6402048	63.51	14.9-17.5	North Pit_Spoil	53.54	53.54	53.71	53.74
DM1	North Pit	311778	6405164	102.73	?	North Pit_Spoil	77.81	77.86	77.81	77.83
DM3	North Pit	311971	6403310	94.14	50-?	North Pit_Spoil	#N/A	64.38	64.31	64.34
DM4	North Pit	312222	6401418	64.85	55-?	North Pit_Spoil	47.32	47.32	47.36	47.29
DM7	North Pit	311136	6400961	69.26	32-?	North Pit_Spoil	Bore Dry	Bore Dry	Bore Dry	Bore Dry
GW-107	Carrington	308738	6404103	73.5	24.2-27.2	Carrington_Spoil	44.07	44.29	44.3	44.28
GW-108	Carrington	309695	6403971	84.4	52.5-58.5	Carrington_Spoil	23.41	23.57	23.56	23.6
GW-114	North Pit	312272	6403981	98.2	27-30	North Pit_Spoil	#N/A	66.17	66.18	0
GW-115	North Pit	312227	6402216	68.3	22.2-28.2	North Pit_Spoil	53.32	55.02	53.56	53.58
GW-129	Carrington	310553	6402211	72.3	12.3-21.3	Carrington_Spoil	57.67	57.41	57.45	57.23
MB14HVO01	North Pit	310587	6401003	71.3	?	North Pit_Spoil	34.73	34.74	34.71	34.77
MB14HVO02	North Pit	310469	6401001	70.9	?	North Pit_Spoil	34.74	34.75	34.7	34.8
MB14HVO03	North Pit	311387	6400950	67.1	?	North Pit_Spoil	32.51	32.44	32.4	32.5
MB14HVO04	North Pit	311491	6401392	67.1	?	North Pit_Spoil	36.74	36.84	36.74	36.83
MB14HVO05	North Pit	310675	6401127	71.7	?	North Pit_Spoil	34.79	34.79	34.78	34.78

APPENDIX C

Groundwater Quality Data 2020

Alluvium

ID	Location	Q1		Q2		Q3		Q4		EC Trigger	pH Trigger (5th Percentile)	pH Trigger (95th Percentile)
		EC	pH	EC	pH	EC	pH	EC	pH			
4032P	CWW	1649	7.1	1520	7.3	1465	7.2	1393	7.3	2775	7	7.5
4034P	CWW	1559	7.4	1529	7.4	1512	7.4	1559	7.4	2775	7	7.5
4037P	CWW	1276	7.3	1225	7.3	1196	7.2	1276	7.4	2775	7	7.5
4040P	CWW	936	7.2	954	7.2	932	7.2	954	7.4	2775	7	7.5
Appleyard Farm	Lemington	526	6	464	6.5	395	6.4	526	6.5	22700 3938	6.8 6.6	7.0 7.7
BUNC45A	Cheshunt/ North Pit	2150	6.7	2090	6.8	2180	6.6	2190	6.8	4462	6.6	7.5
BZ1-1	Cheshunt/ North Pit	2890	7.5	2790	7.4	2990	7.4	2990	7.5	4462	6.6	7.5
C919(ALL)	Lemington	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	22700 3938	6.8 6.6	7.0 7.7
CFW55R	Carrington	10180	7.1	9900	7.1	9940	7.2	10020	7.2	6154	7	8
CFW57	Carrington	4880	7.5	3820	7.6	3560	7.4	4880	7.6	6154	7	8
CGW32	CWW	9270	7.2	9250	7.2	9060	7.2	9270	7.3	9280	6.8	7.8
CGW39	CWW	6490	7.3	6220	7.3	6490	7.2	6490	7.3	9280	6.8	7.8
CGW47a	CWW	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	4920	7.7	9280	6.8	7.8
CGW49	CWW	2850	7.4	2690	7.4	2480	7.3	2280	7.5	2775	7	7.5
CGW52a	Carrington	1829	7.7	1837	7.8	1879	7.7	1894	7.8	6154	7	8
CGW53a	Carrington	1288	7.3	1193	7.4	1237	7.3	1369	7.4	6154	7	8
CGW55a	Carrington	1717	7.7	1934	7.6	1865	7.7	1934	7.7	6154	7	8
CHPZ10A	Cheshunt/ North Pit	749	6.8	746	6.9	740	6.8	749	7	4462	6.6	7.5
CHPZ12A	Cheshunt/ North Pit	928	6.7	754	6.8	966	6.8	966	6.9	4462	6.6	7.5
CHPZ1A	Cheshunt/ North Pit	792	7	621	7	734	7.1	792	7.1	4462	6.6	7.5
CHPZ2A	Cheshunt/ North Pit	881	7	865	7.3	819	7	881	7.3	4462	6.6	7.5
CHPZ3A	Cheshunt/ North Pit	726	6.8	578	6.9	715	6.8	726	6.9	4462	6.6	7.5
CHPZ4A	Cheshunt/ North Pit	836	7	772	7	790	6.9	836	7.1	4462	6.6	7.5
CHPZ8A	Cheshunt/ North Pit	Bore Dry	Bore Dry	1550	7	1572	6.9	1675	7	4462	6.6	7.5

ID	Location	Q1		Q2		Q3		Q4		EC Trigger	pH Trigger (5th Percentile)	pH Trigger (95th Percentile)
		EC	pH	EC	pH	EC	pH	EC	pH			
G1	West Pit	6340	7.3	11310	7.4	7960	7.6	11310	7.6	10751	7.1	8.6
G2	West Pit	5240	7.5	5100	7.6	5430	7.5	5590	7.6	10751	7.1	8.6
G3	West Pit	5200	7.5	5060	7.5	5280	7.6	5540	7.6	10751	7.1	8.6
GA3	Cheshunt/ North Pit	902	6.9	924	7.1	920	6.9	984	7.1	4462	6.6	7.5
GW-100	West Pit	0	0	9800	7.4	9780	7.5	10360	7.5	10751	7.1	8.6
GW-101	West Pit	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	10751	7.1	8.6
GW-106	CWW	9200	6.7	8250	6.9	8960	6.7	9200	6.9	9280	6.8	7.8
GW-120	North Void	9900	7.2	9690	7.1	10200	7.2	10350	7.2	-	-	-
GW-121	North Void	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	-	-	-
GW-123	North Void	7200	7.3	6540	7.3	6190	7.4	7200	7.4	-	-	-
GW-124	North Void	5740	7.5	5020	7.5	4850	7.6	5740	7.6	-	-	-
GW-125	North Void	4600	7.7	4610	7.6	4330	7.6	4610	7.7	-	-	-
GW-126	North Void	2460	7.7	2540	7.7	2390	7.7	2540	7.8	-	-	-
GW-127	North Void	2630	7.4	2480	7.4	2420	7.3	2630	7.4	-	-	-
GW-128	North Void	7220	7.4	0	0	0	0	7220	7.4	-	-	-
Hobdens Well	Cheshunt/ North Pit	921	7.4	965	7.6	959	7.6	991	7.6	4462	6.6	7.5
HV3(2)	Cheshunt/ North Pit	866	6.9	952	7.1	918	6.9	952	7.1	4462	6.6	7.5
PB01(ALL)	Lemington	7450	7.1	2310	7.1	4660	7.2	3470	7.2	22700 3938	6.8 6.6	7.0 7.7
PZ1CH200	Cheshunt/ North Pit	923	7.2	894	7.2	812	7.2	923	7.2	4462	6.6	7.5
PZ2CH400	Cheshunt/ North Pit	114	6.6	345	6.7	296	6.8	345	6.9	4462	6.6	7.5
PZ3CH800	Cheshunt/ North Pit	908	6.9	2920	6.8	897	6.9	2920	6.9	4462	6.6	7.5
PZ4CH1380	Cheshunt/ North Pit	1002	6.8	982	6.9	908	6.9	1002	6.9	4462	6.6	7.5
PZ5CH1800	Cheshunt/ North Pit	383	7.2	377	7	390	7	390	7.2	4462	6.6	7.5

Permian Coal Measures

ID	Location	Q1		Q2		Q3		Q4		EC Trigger	pH Trigger (5th Percentile)	pH Trigger (95th Percentile)
		EC	pH	EC	pH	EC	pH	EC	pH			
4036C	Carrington	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	10824	6.7	7.4
4051C	Carrington	2200	7.2	2250	7.2	2200	7.2	2250	7.3	10824	6.7	7.4
B334(BFS)	Lemington	-	-	7820	7.3	-	-	8180	7.4	12440	6.7	7.9
B425(WDH)	Lemington	-	-	Bore Dry	Bore Dry	-	-	Bore Dry	Bore Dry	20240	6.6	7.6
B631(BFS)	Lemington	-	-	12670	6.5	-	-	13120	6.8	12440	6.7	7.9
B631(WDH)	Lemington	-	-	12530	6.7	-	-	13260	6.7	20240	6.6	7.6
B925(BFS)	Lemington	-	-	4330	6.9	-	-	4780	7	12440	6.7	7.9
BC1a	Cheshunt	877	7.1	861	7.1	877	7.1	890	7.1	3350	6.5	7.6
BUNC45D	Cheshunt	2460	6.6	2340	6.7	2200	6.5	2540	6.7	2596	6.4	6.8
BZ1-3	Cheshunt	1116	7.5	1209	7.4	1320	7.6	1320	7.6	3350	6.5	7.6
BZ2A(1)	Cheshunt	1261	6.4	1256	6.3	1302	6.4	1302	6.4	3350	6.5	7.6
BZ3-1	Cheshunt	1093	8	1062	7.8	1050	7.8	1121	7	6213	6.9	7.7
BZ3-3	Cheshunt	1376	6.3	1378	6.3	0	0	1378	6.3	3350	6.5	7.6
BZ4A(2)	Cheshunt	0	0	1180	6.4	1237	6.2	1632	6.4	3350	6.5	7.6
BZ8-2	Cheshunt	1178	7	1138	6.8	1149	7	1211	7	6213	6.9	7.7
C122(WDH)	Lemington	-	-	13690	7.2	-	-	14320	7.2	20240	6.6	7.6
C122(BFS)	Lemington	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	12440	6.7	7.9
C130(AFS1)	Lemington	-	-	12650	7.3	-	-	13650	7.3	15324	6.8	7.5
C130(ALL)	Lemington	32400	6.9	27400	6.9	26700	7	32400	7	11408	6.7	7.1
C130(BFS)	Lemington	-	-	4510	7.9	-	-	4530	7.9	12440	6.7	7.9
C130(WDH)	Lemington	-	-	21200	6.6	-	-	21300	6.6	20240	6.6	7.6
C317(BFS)	Lemington	-	-	9710	7.3	-	-	10590	7.3	12440	6.7	7.9
C317(WDH)	Lemington	-	-	7730	7.5	-	-	8040	7.7	20240	6.6	7.6
C613(BFS)	Lemington	-	-	9290	7.1	-	-	9510	7.1	12440	6.7	7.9
C621(BFS)	Lemington	-	-	7570	7.3	-	-	8020	7.4	12440	6.7	7.9
C630(BFS)	Lemington	-	-	4260	8.1	-	-	4500	8.1	12440	6.7	7.9
C809 (GM/WDH)	Lemington	-	-	9920	7.00	-	-	10190	7	20240	6.6	7.6

Permian Coal Measures

ID	Location	Q1		Q2		Q3		Q4		EC Trigger	pH Trigger (5th Percentile)	pH Trigger (95th Percentile)
		EC	pH	EC	pH	EC	pH	EC	pH			
CGW45	CWW	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked	3531	7.3	7.6
CGW46	CWW	2840	7.5	2510	7.5	2360	7.5	2840	7.5	Trigger Removed	Trigger Removed	Trigger Removed
CGW51a	Carrington	7810	7.4	7640	7.4	7850	7.4	7850	7.5	10824	6.7	7.4
CGW52	Carrington	8490	6.8	7060	6.9	6880	6.8	8490	7.2	8628	6.8	7.1
CGW53	Carrington	7730	6.7	6940	7	7730	6.9	7730	7	8628	6.8	7.1
CHPZ12D	Cheshunt	1309	6.7	1304	7	1314	6.7	1315	7	3350	6.5	7.6
CHPZ3D	Cheshunt	998	6.5	920	6.6	1007	6.4	1055	6.6	3350	6.5	7.6
CHPZ8D	Cheshunt	1360	7.1	1451	7.1	1473	7	1648	7.1	3350	6.5	7.6
D010(BFS)	Lemington	-	-	10800	7.2	-	-	11000	7.2	12440	6.7	7.9
D010(GM)	Lemington	-	-	10830	7	-	-	12110	7	1894	6.5	7.2
D010(WDH)	Lemington	-	-	9200	7.1	-	-	9490	7.1	20240	6.6	7.6
D214(BFS)	Lemington	-	-	7510	7.8	-	-	7750	7.8	12440	6.7	7.9
D317(BFS)	Lemington	-	-	2870	6.7	-	-	2870	6.7	12440	6.7	7.9
D406(AFS)	Lemington	-	-	11890	7	-	-	12370	7	15324	6.8	7.5
D406(BFS)	Lemington	-	-	7550	7.3	-	-	7650	7.3	12440	6.7	7.9
D510(AFS)	Lemington	-	-	13610	6.9	-	-	13920	6.9	15324	6.8	7.5
D510(BFS)	Lemington	-	-	11160	7.4	-	-	11580	7.4	12440	6.7	7.9
D612(AFS)	Lemington	-	-	15470	7	-	-	15470	7	15324	6.8	7.5
D612(BFS)	Lemington	-	-	11380	6.9	-	-	11700	6.9	12440	6.7	7.9
D807(BFS)	Lemington	-	-	9910	6.9	-	-	10640	7	12440	6.7	7.9
GW-122	North Void	5610	7.3	4600	7.3	4610	7.3	5610	7.4	-	-	-
HG2	Cheshunt	3650	7	3790	7.0	4080	7	4120	7.1	6213	6.9	7.7
HG2a	Cheshunt	1192	7	1289	6.9	1247	6.8	1289	7	3350	6.5	7.6
LUG Bore	Lemington	8700	7.1	8220	7	7530	7.6	8700	7.6	-	-	-
NPz2	West Pit	14050	7.3	14320	7.2	13840	7.1	14570	7.3	13428	6.9	8
NPz3	West Pit	13180	7.5	12780	7.4	12800	7.6	13180	7.7	13428	6.9	8
NPz5	West Pit	#N/A	#N/A	0	0	0	0	0	0	13428	6.9	8
SR001	Southern	-	-	16760	6.7	-	-	17780	6.7	-	-	-
SR002	Southern	-	-	15270	6.8	-	-	15500	6.8	-	-	-
SR003	Southern	-	-	10000	7	-	-	10230	7	-	-	-

ID	Location	Q1		Q2		Q3		Q4		EC Trigger	pH Trigger (5th Percentile)	pH Trigger (95th Percentile)
		EC	pH	EC	pH	EC	pH	EC	pH			
SR004	Southern	-	-	13320	6.8	-	-	13420	6.8	-	-	-
SR005	Southern	-	-	3330	6.5	-	-	3400	6.5	-	-	-
SR006	Southern	-	-	11560	7	-	-	11580	7	-	-	-
SR007	Southern	5980	6.6	0	0	0	0	5980	6.6	-	-	-
SR008	Southern	5920	7.3	12730	6.8	785	7.3	12780	7.3	-	-	-
SR009	Southern	4550	7.6	5970	7.3	4910	7.3	6090	7.6	-	-	-
SR010	Southern	2640	7.6	5820	7	2110	7.3	5820	7.6	-	-	-
SR011	Southern	15300	6.6	16800	6.5	14080	6.6	16800	6.6	-	-	-
SR012	Southern	13570	6.7	14250	6.8	14120	6.7	14630	6.9	-	-	-

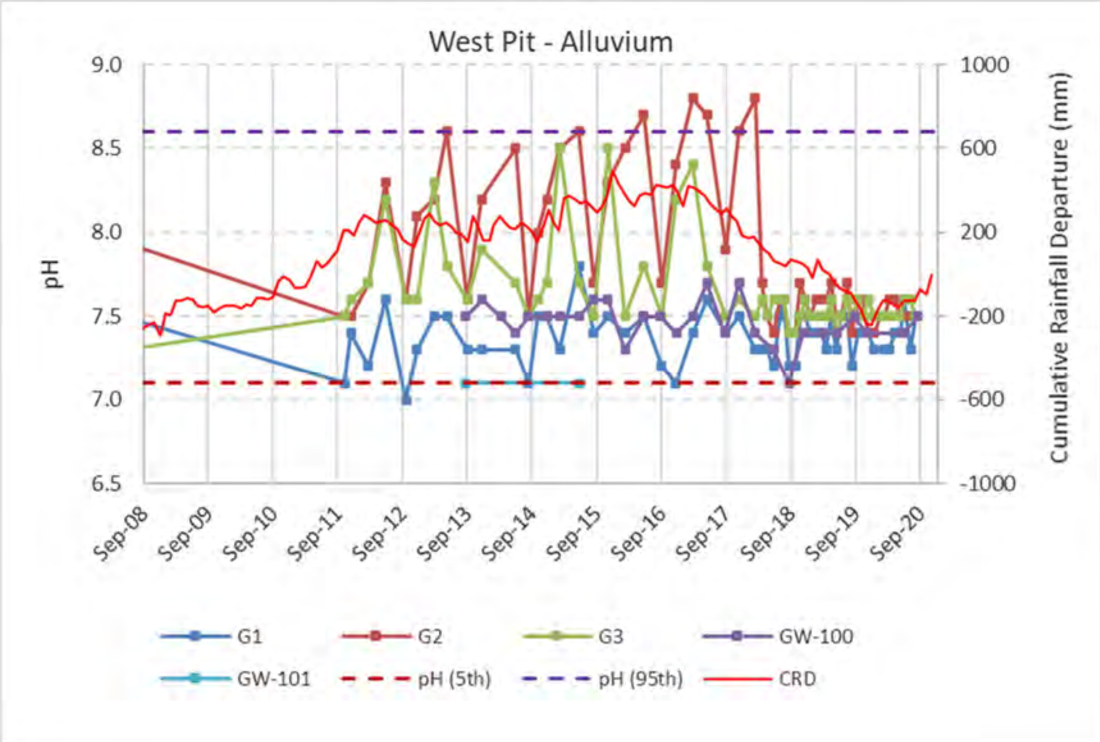
Spoil

ID	Location	Q1		Q2		Q3		Q4		EC Trigger	pH Trigger (5th Percentile)	pH Trigger (95th Percentile)
		EC	pH	EC	pH	EC	pH	EC	pH			
4116P	North Pit	14820	7	13670	7	15070	7.1	15550	7.1	12460	6.5	7.8
4119P	North Pit	2590	7	3870	7.1	2400	7	3870	7.1	12460	6.5	7.8
DM1	North Pit	10530	6.5	9550	6.6	10660	6.4	10790	6.6	12460	6.5	7.8
DM3	North Pit	0	0	9390	6.5	10090	6.4	10090	6.5	12460	6.5	7.8
DM4	North Pit	6350	7	5790	7.2	6340	6.9	6510	7.2	12460	6.5	7.8
DM7	North Pit	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	12460	6.5	7.8
GW-107	Carrington	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	-	-	-
GW-108	Carrington	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	Bore Dry	-	-	-
GW-114	North Pit	0	0	8370	6.6	0	0	9320	6.7	12460	6.5	7.8
GW-115	North Pit	7700	6.8	7120	6.9	8250	6.7	8250	7	12460	6.5	7.8
GW-129	Carrington	8940	7.2	8790	7.1	9170	7.1	9270	7.2	-	-	-
MB14HVO01	North Pit	7790	6.8	6340	6.9	7720	6.7	7790	6.9	12460	6.5	7.8
MB14HVO02	North Pit	8080	6.8	7170	7.1	8000	6.8	8110	7.1	12460	6.5	7.8
MB14HVO03	North Pit	6420	6.9	5740	7.1	6450	6.9	6450	7.1	12460	6.5	7.8
MB14HVO04	North Pit	6030	6.8	5670	7	6110	6.8	6250	7	12460	6.5	7.8
MB14HVO05	North Pit	15470	5.7	7760	6.8	8380	6.7	15470	6.9	12460	6.5	7.8

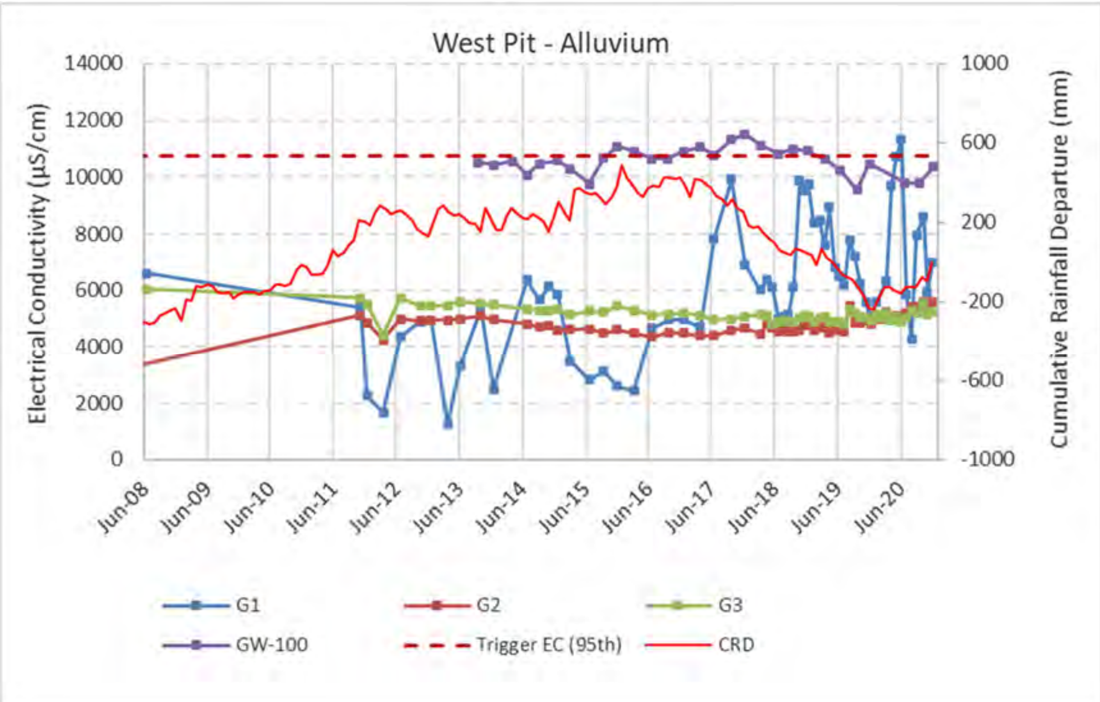
APPENDIX D

Groundwater Quality Graphs – By Location and Geology

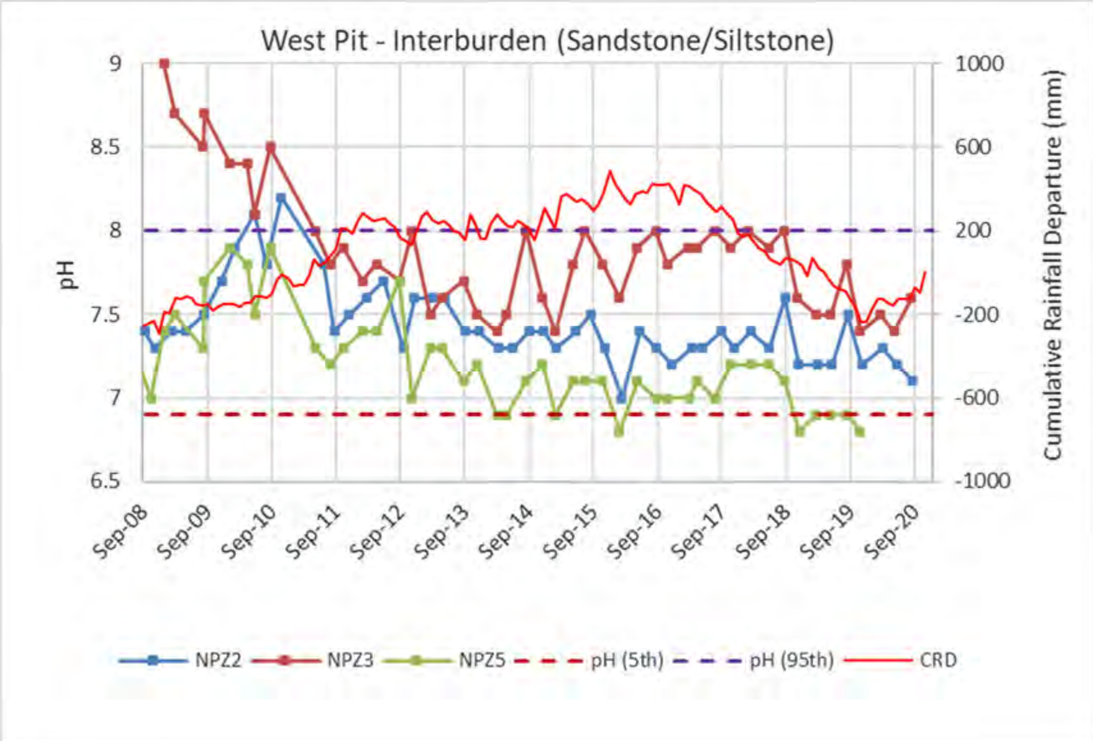
West Pit – Alluvium: pH



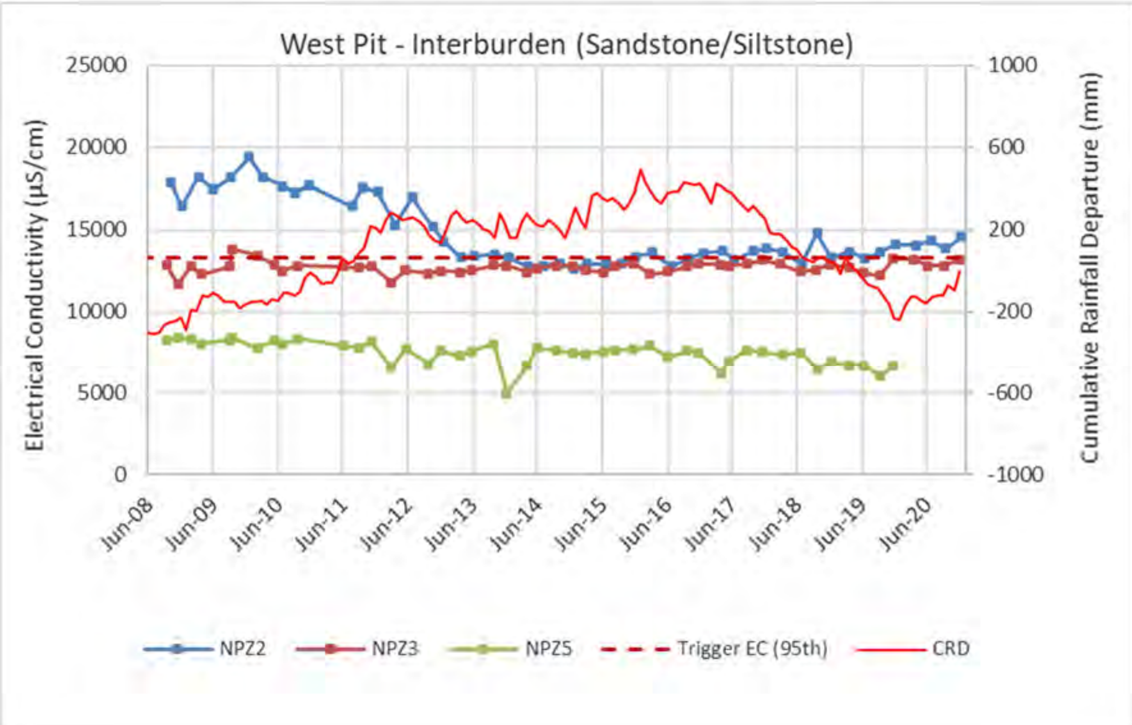
West Pit – Alluvium: EC



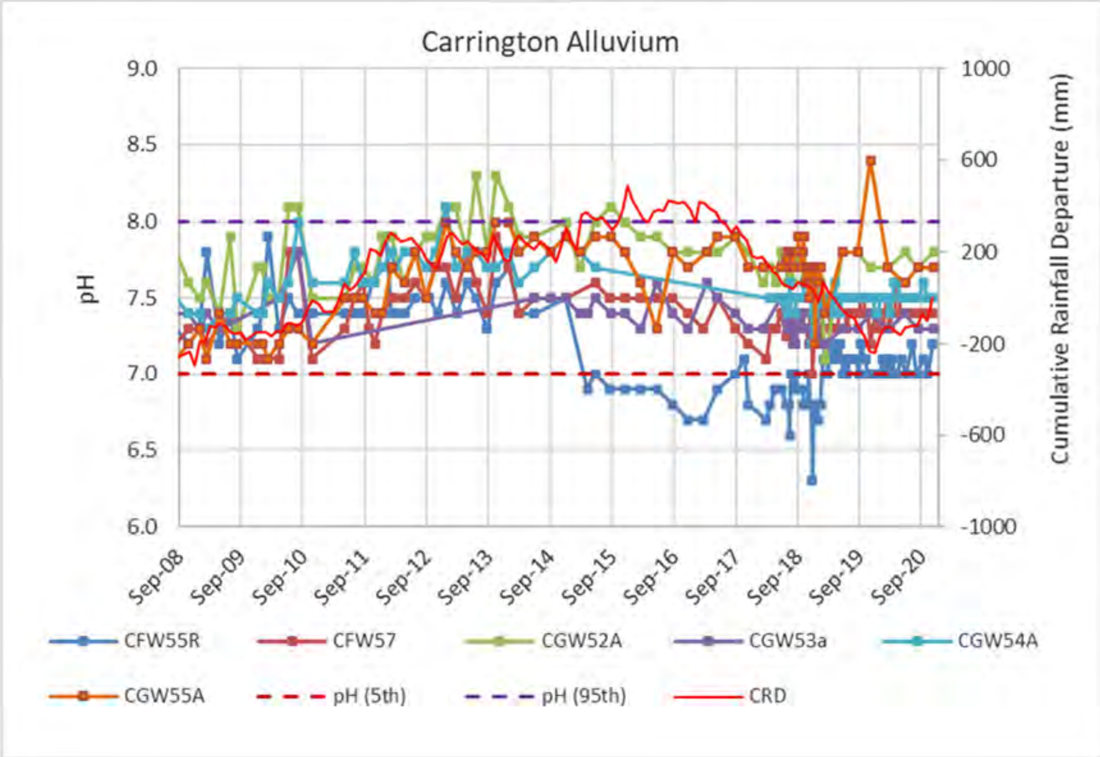
West Pit - Sandstone/Siltstone (Interburden): pH



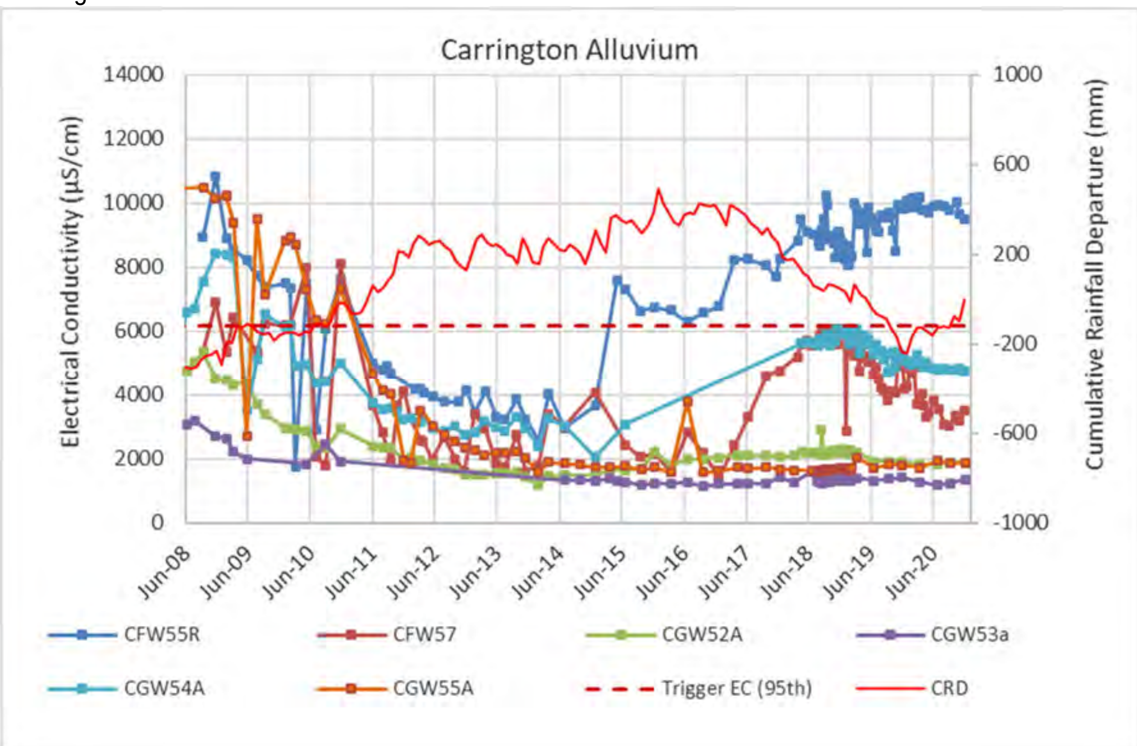
West Pit - Sandstone/Siltstone (Interburden): EC



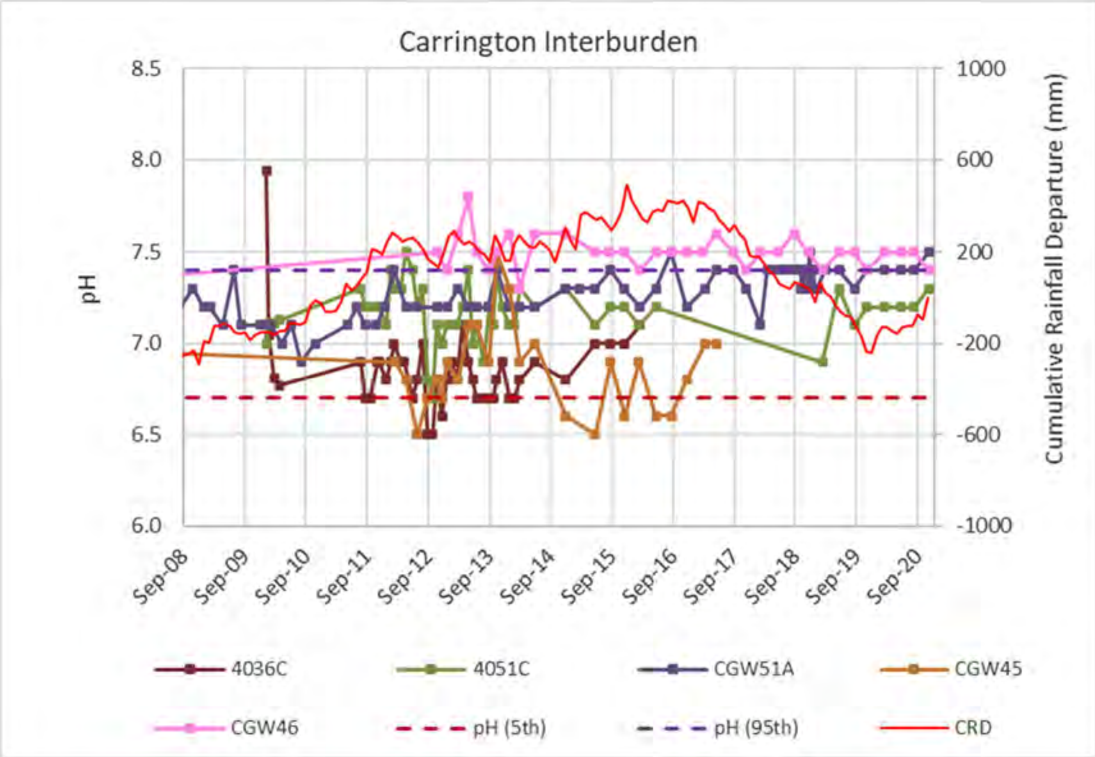
Carrington Pit – Alluvium: pH



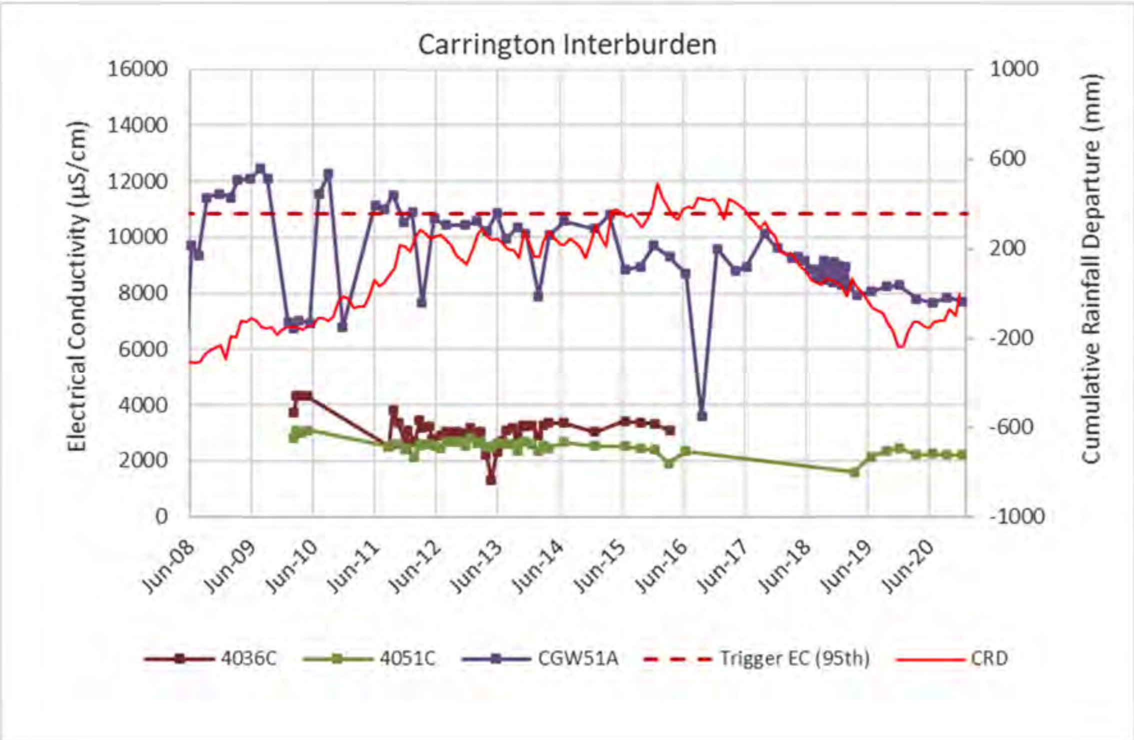
Carrington Pit – Alluvium: EC



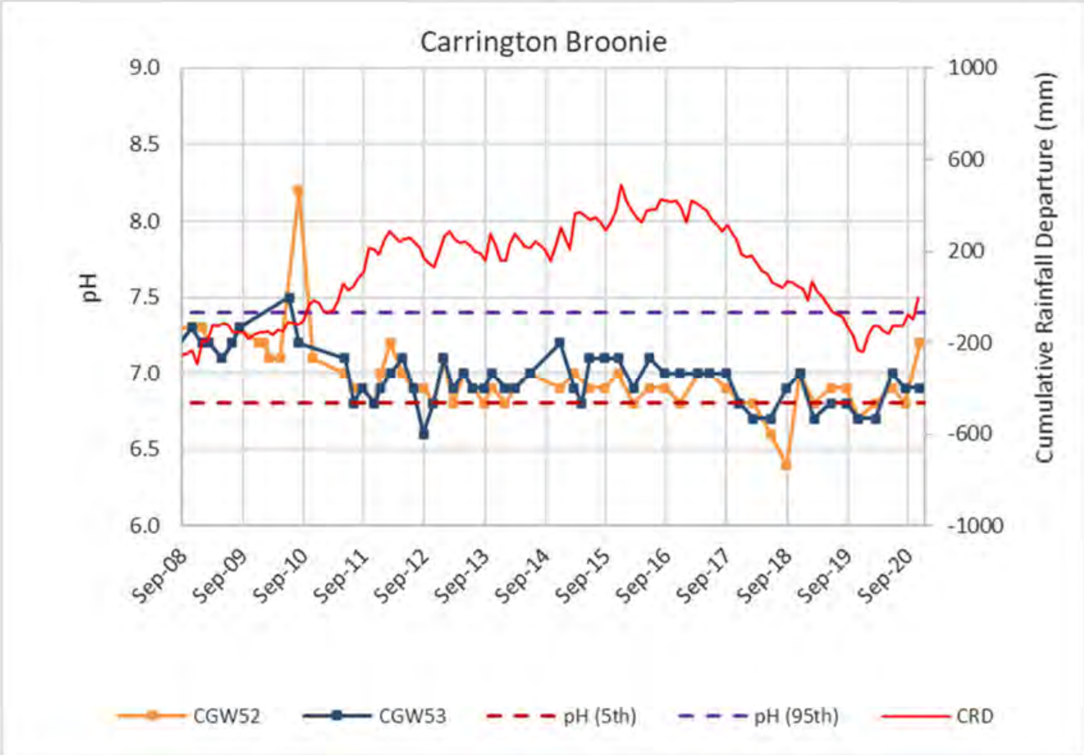
Carrington Pit – Interburden: pH



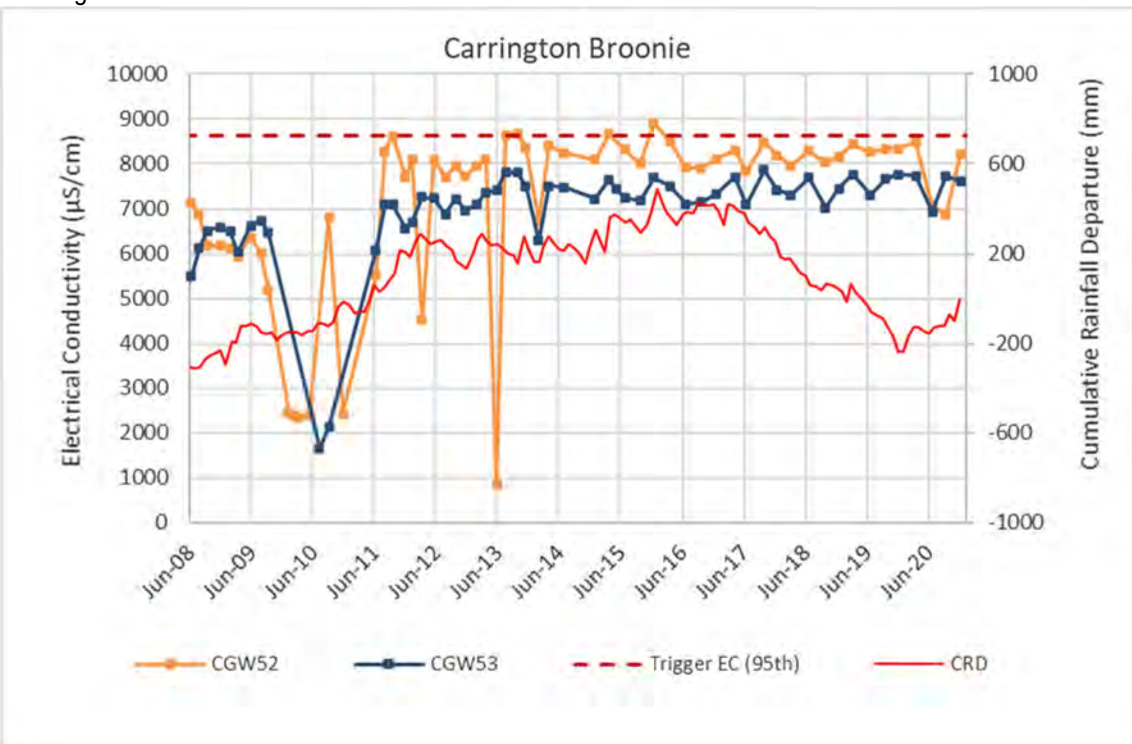
Carrington Pit – Interburden: EC



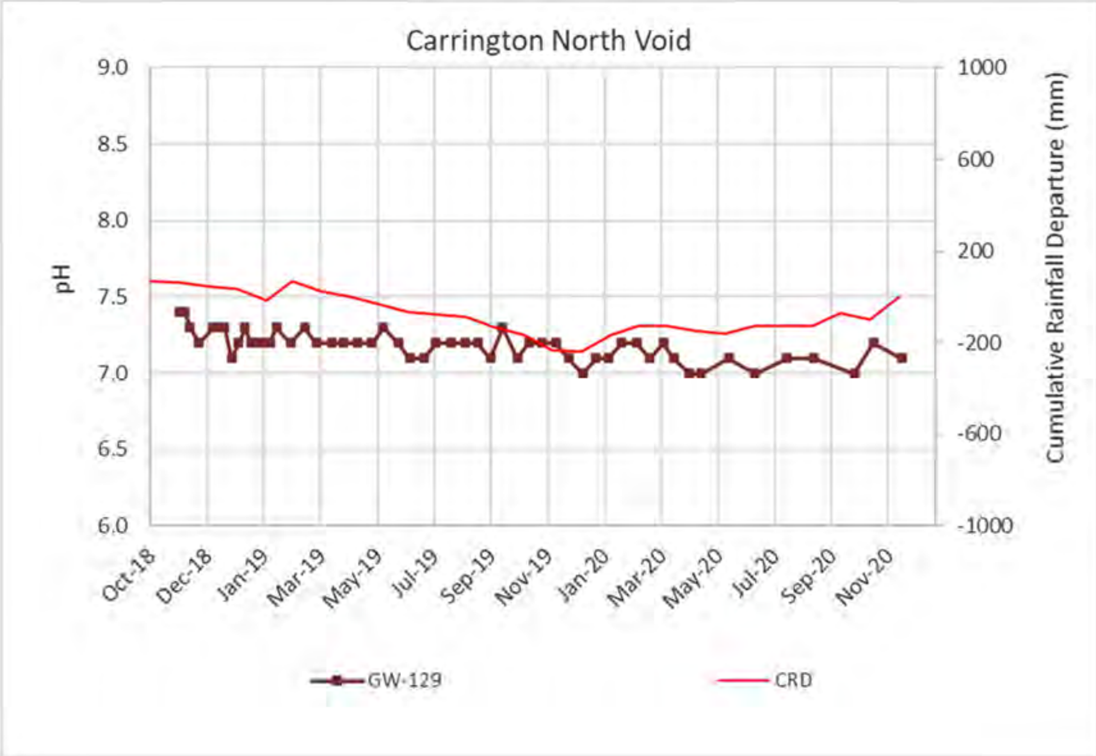
Carrington Pit – Broonie Seam: pH



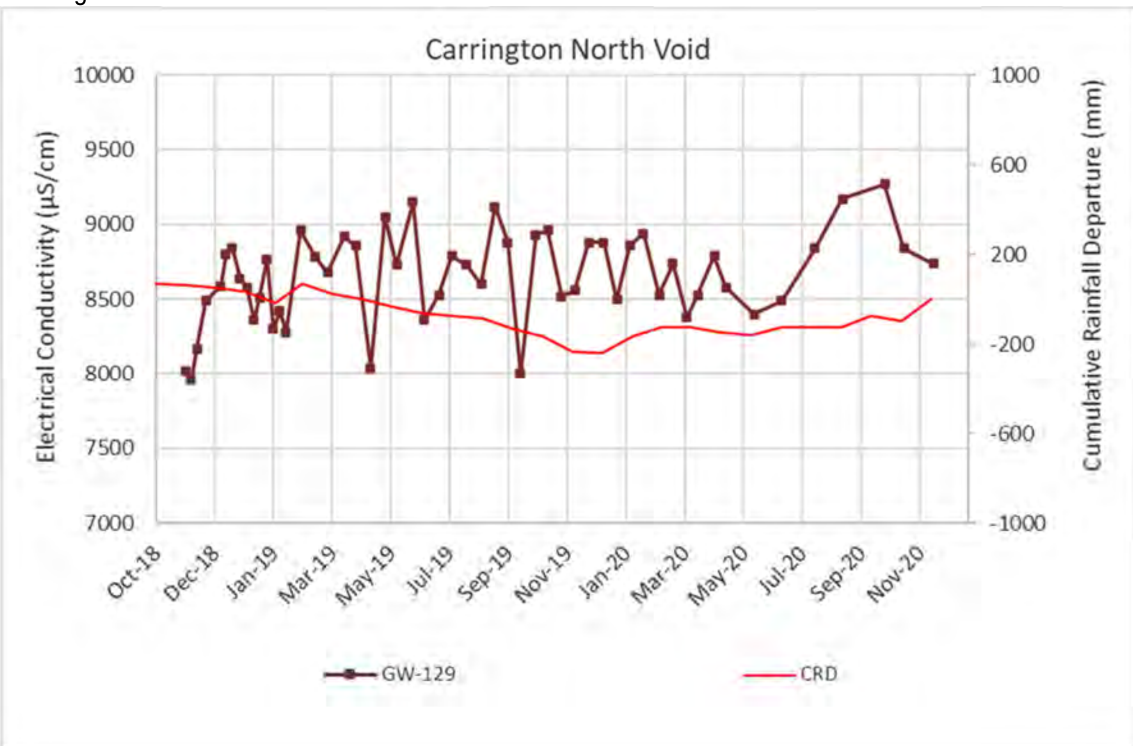
Carrington Pit – Broonie Seam: EC



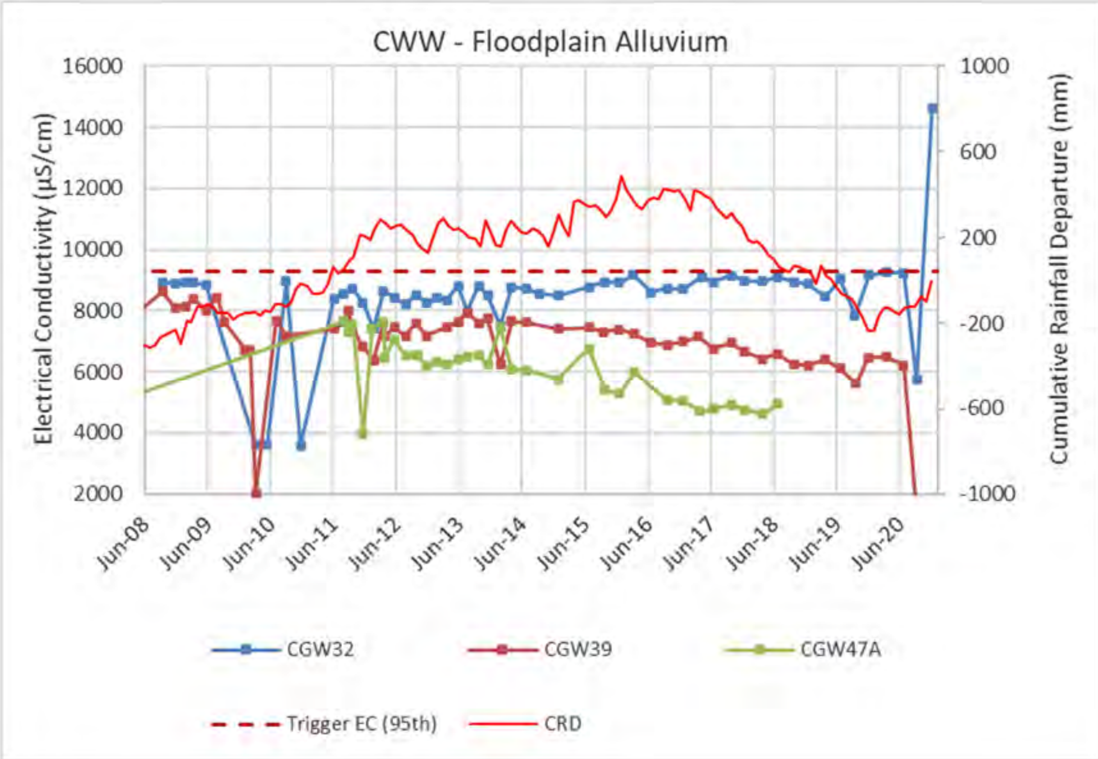
Carrington Pit – North Void: pH



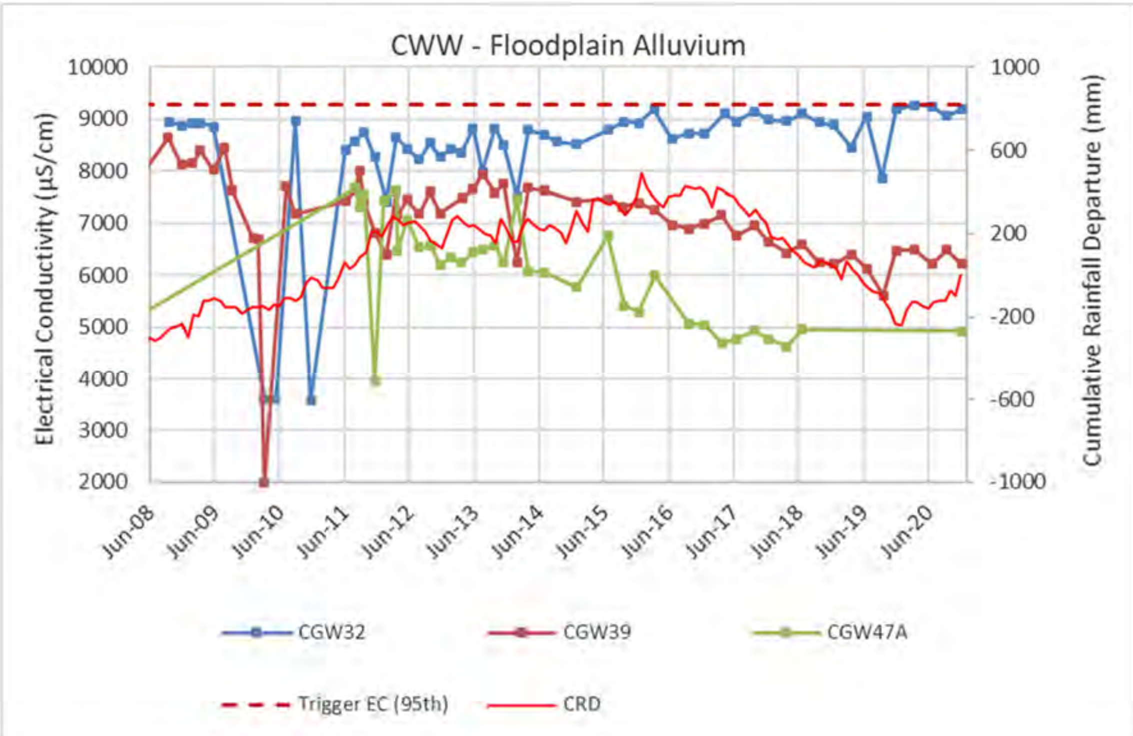
Carrington Pit – North Void: EC



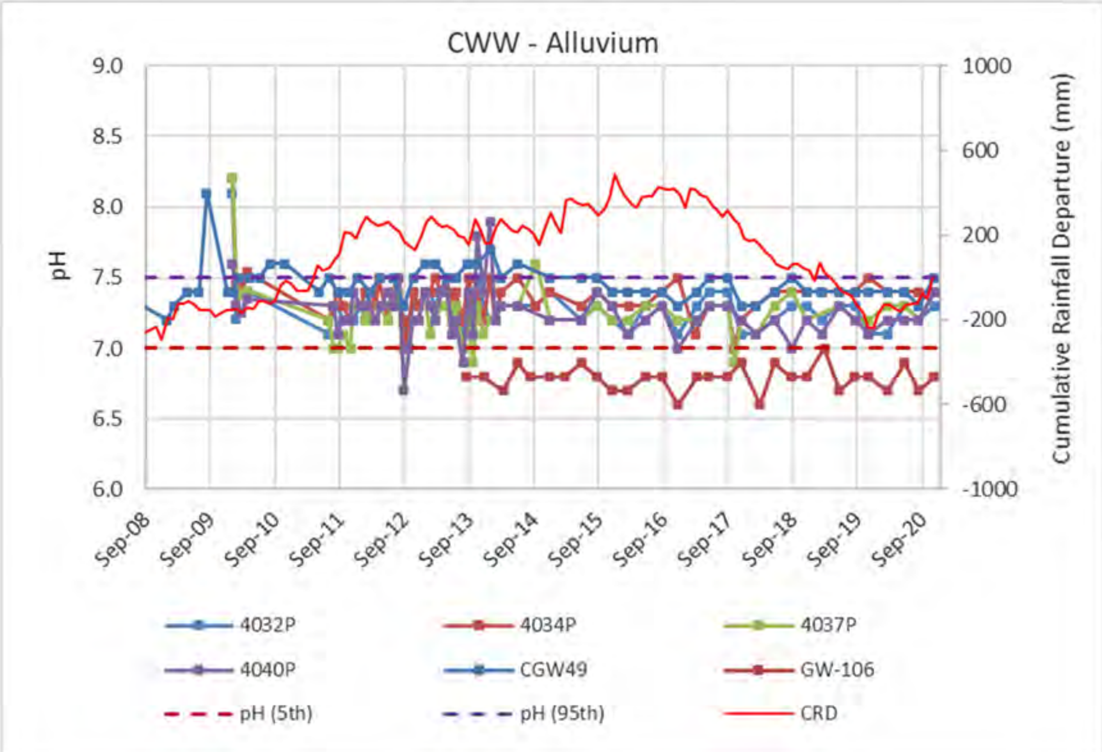
CWW Area - Flood Plain Alluvium: pH



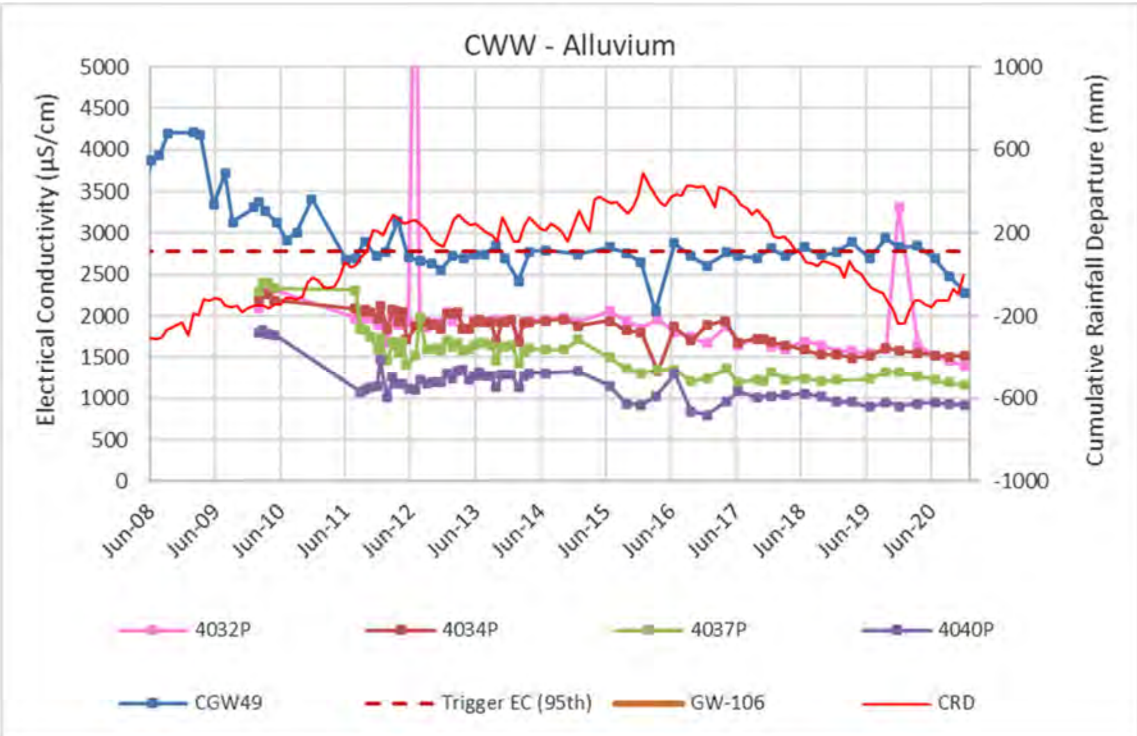
CWW Area - Flood Plain Alluvium: EC



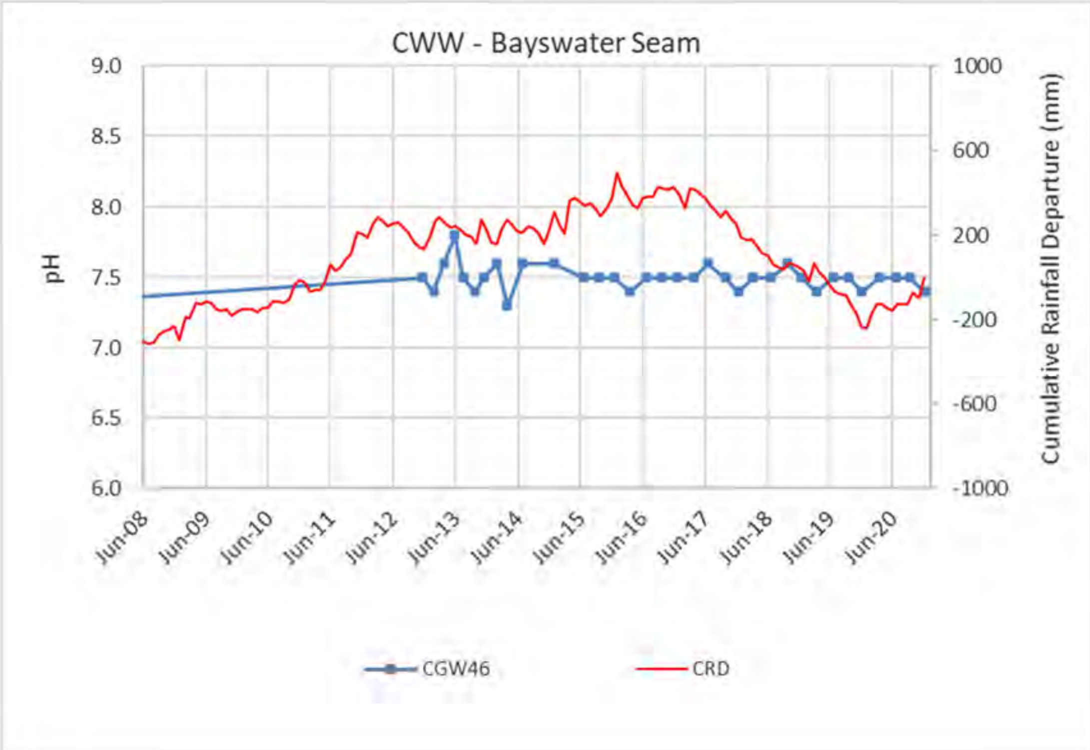
CWW Area – Alluvium: pH



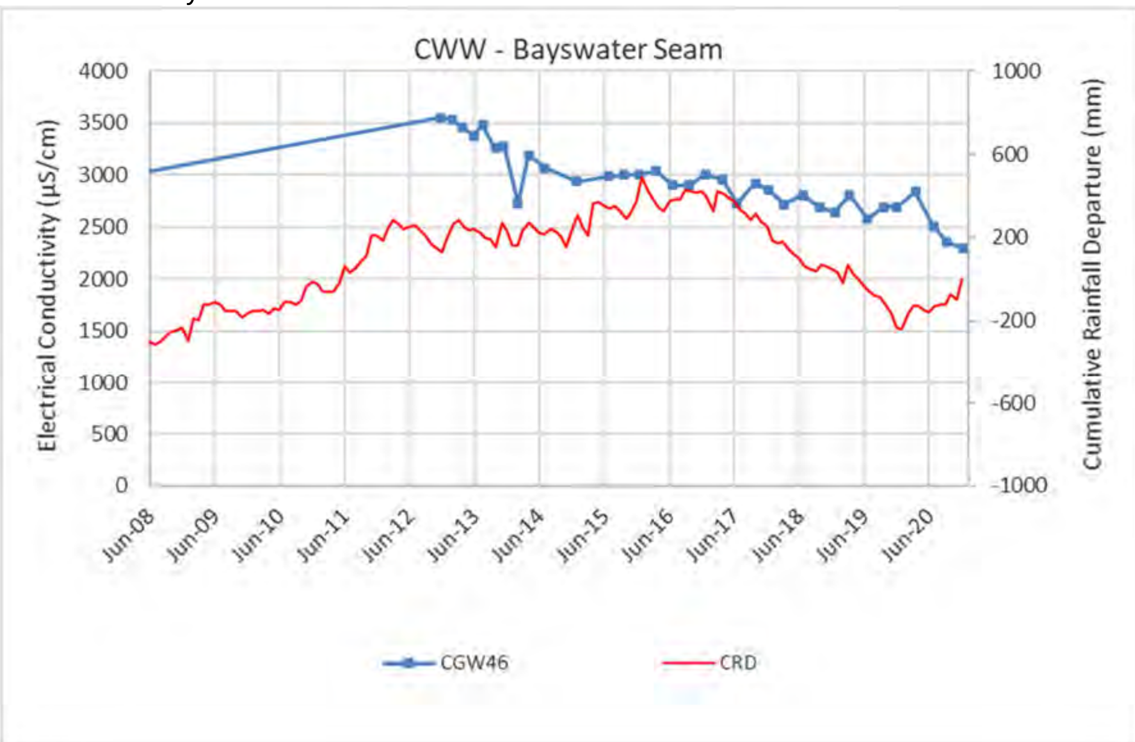
CWW Area – Alluvium: EC



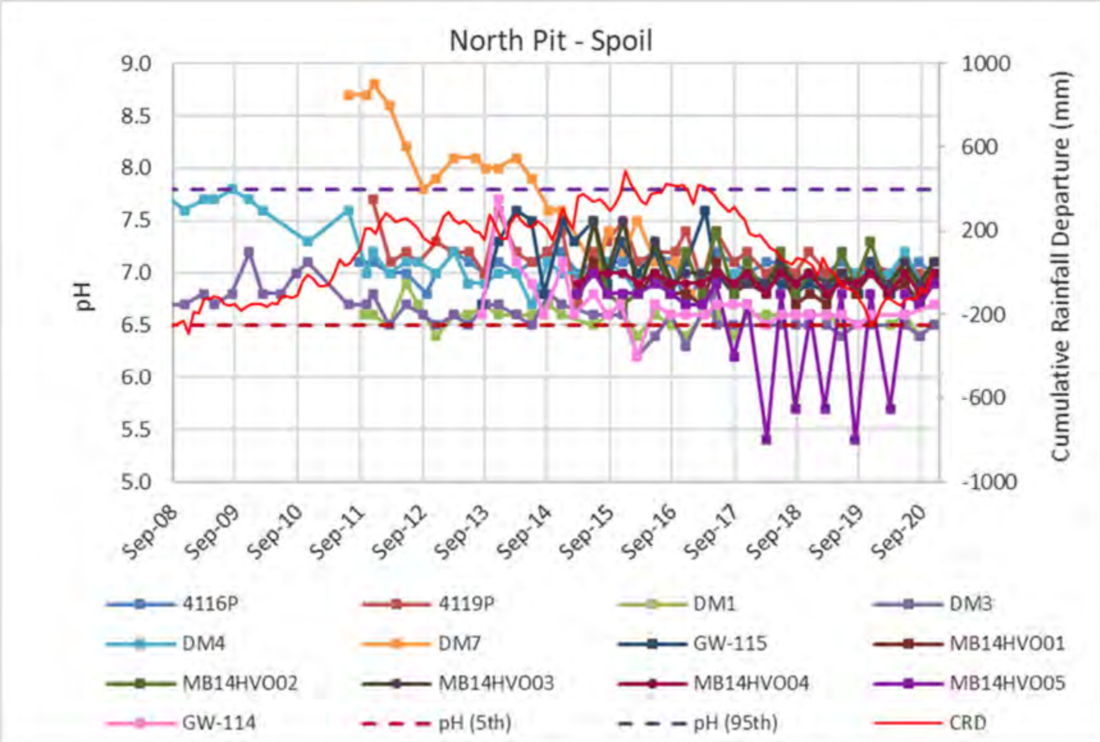
CWW Area - Bayswater Seam: pH



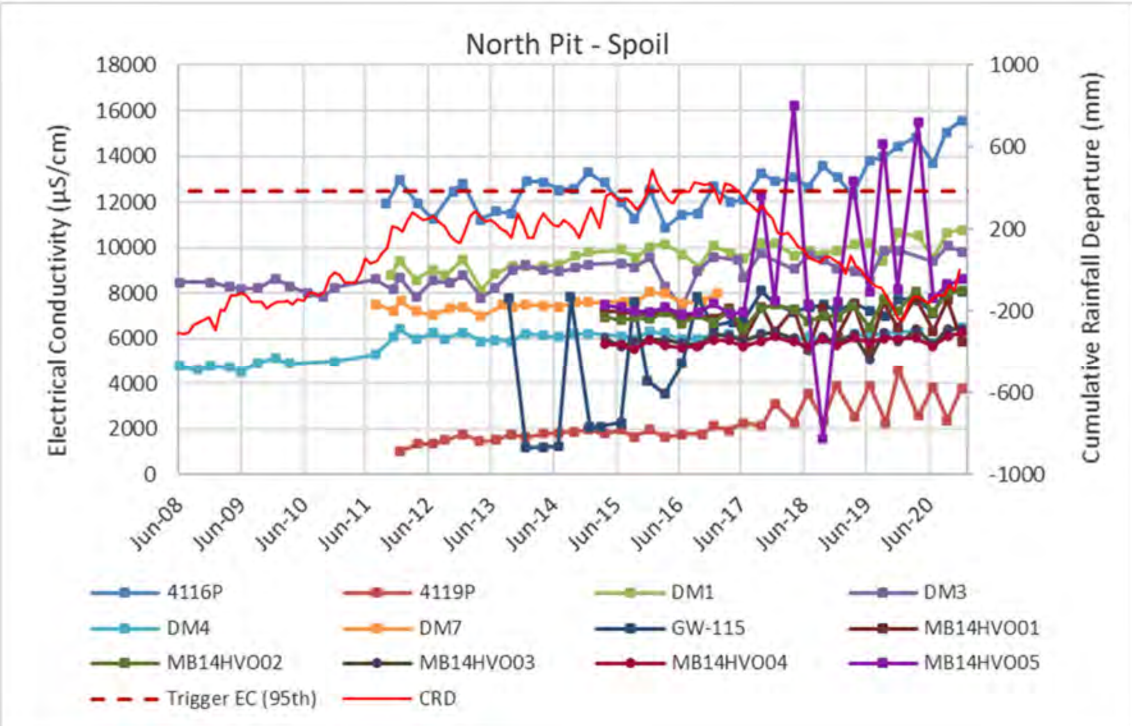
CWW Area - Bayswater Seam: EC



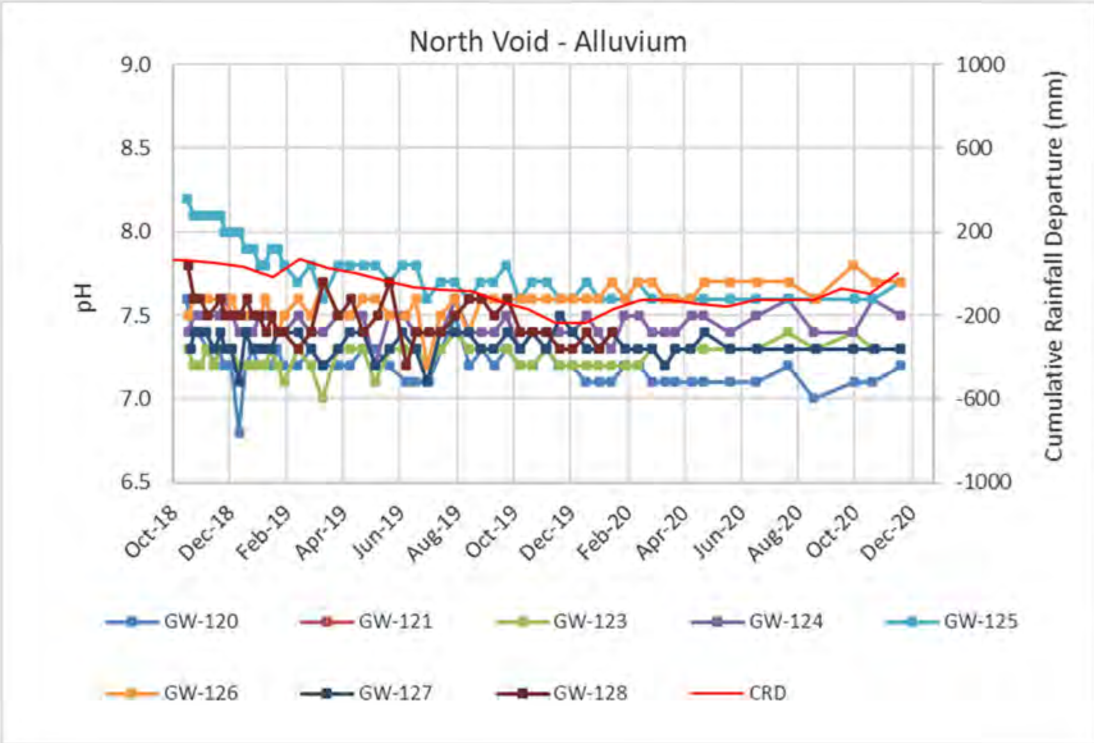
North Pit – Spoil: pH



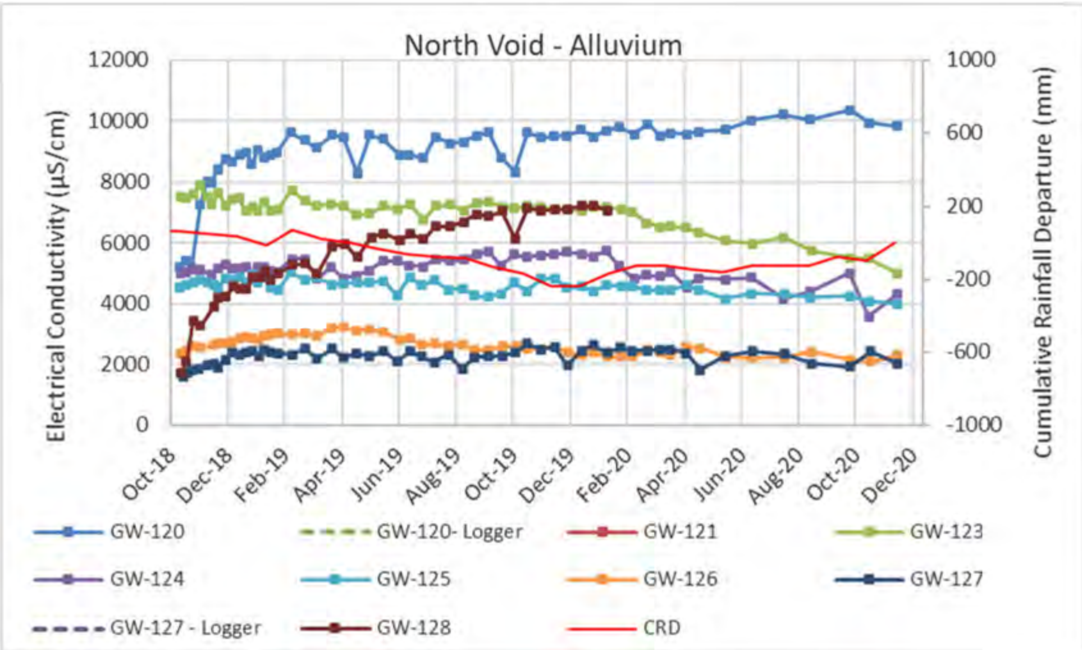
North Pit – Spoil: EC



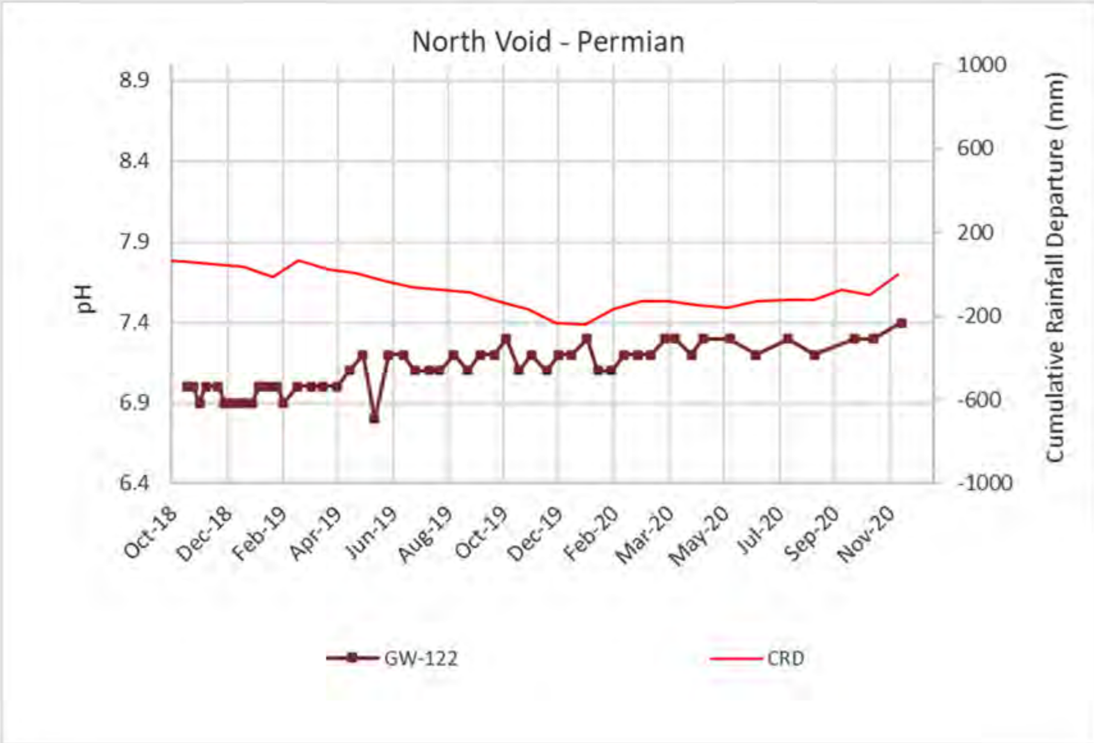
North Void – Alluvium: pH



North Void – Alluvium: EC

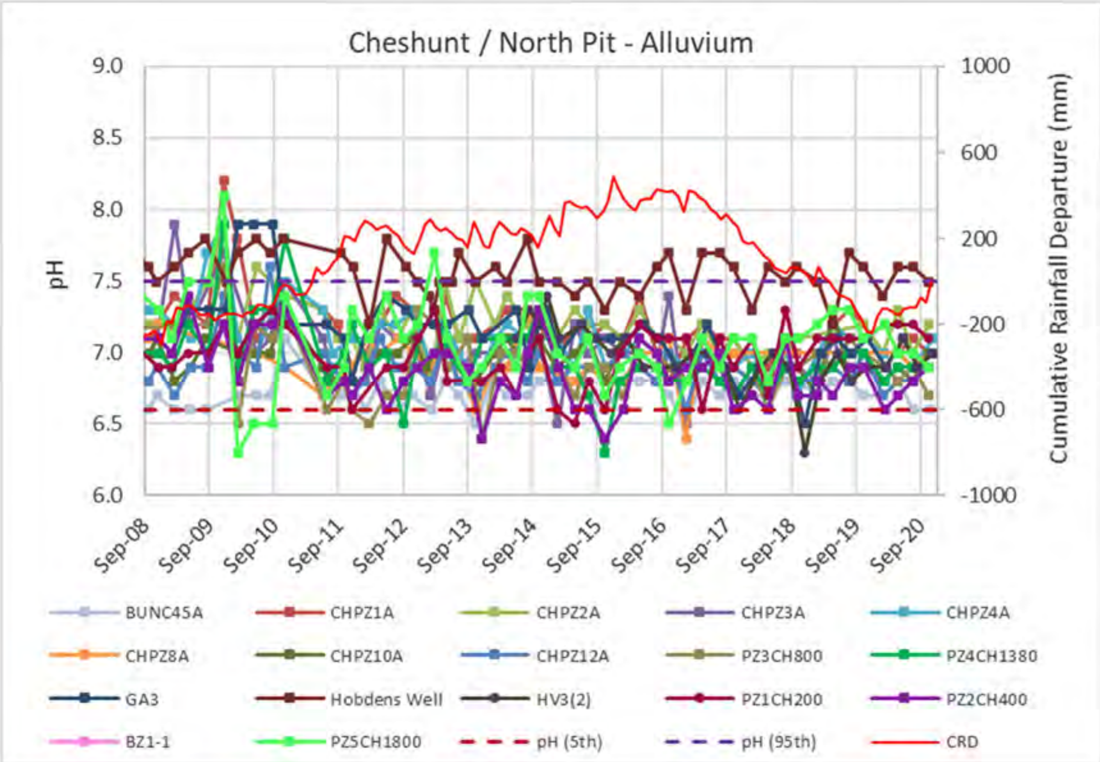


North Void – Permian: pH

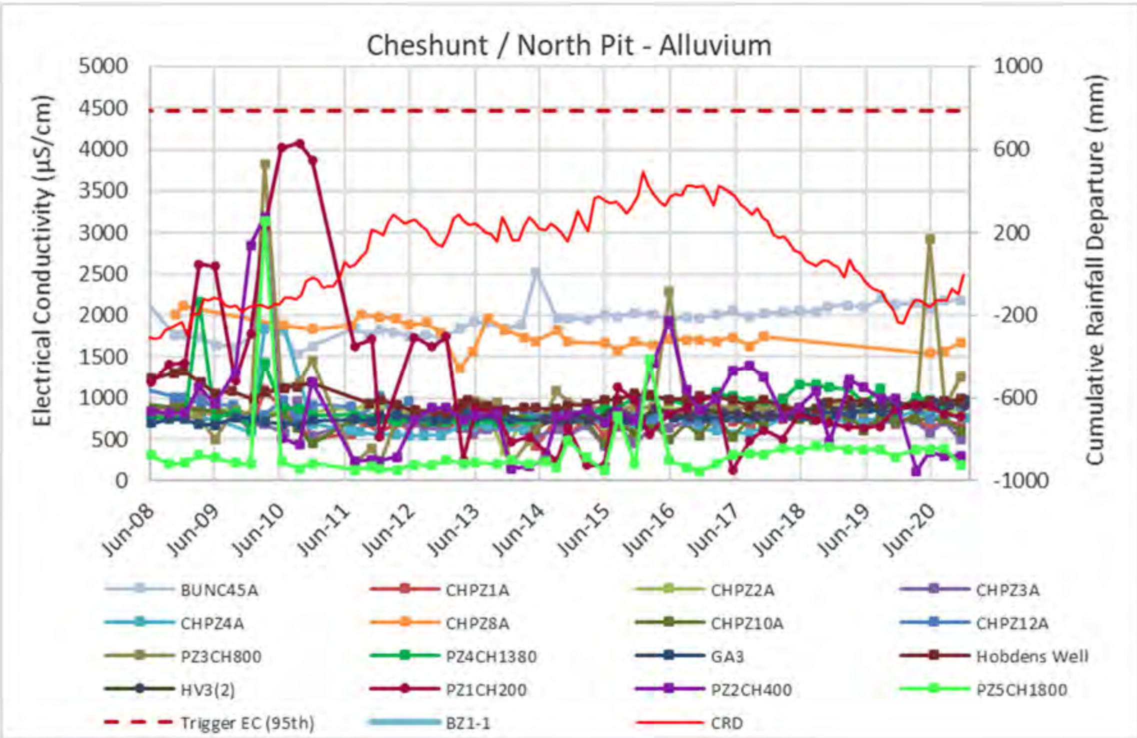


North Void – Permian: EC

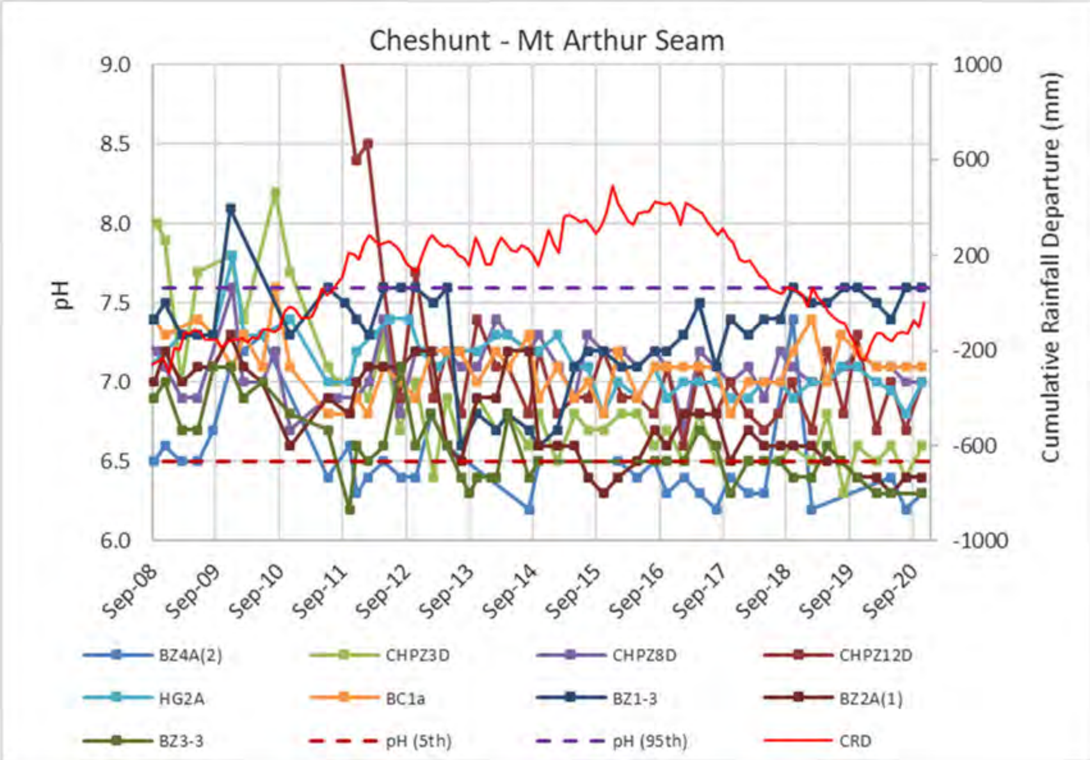
Cheshunt Pit/ North Pit – Alluvium: pH



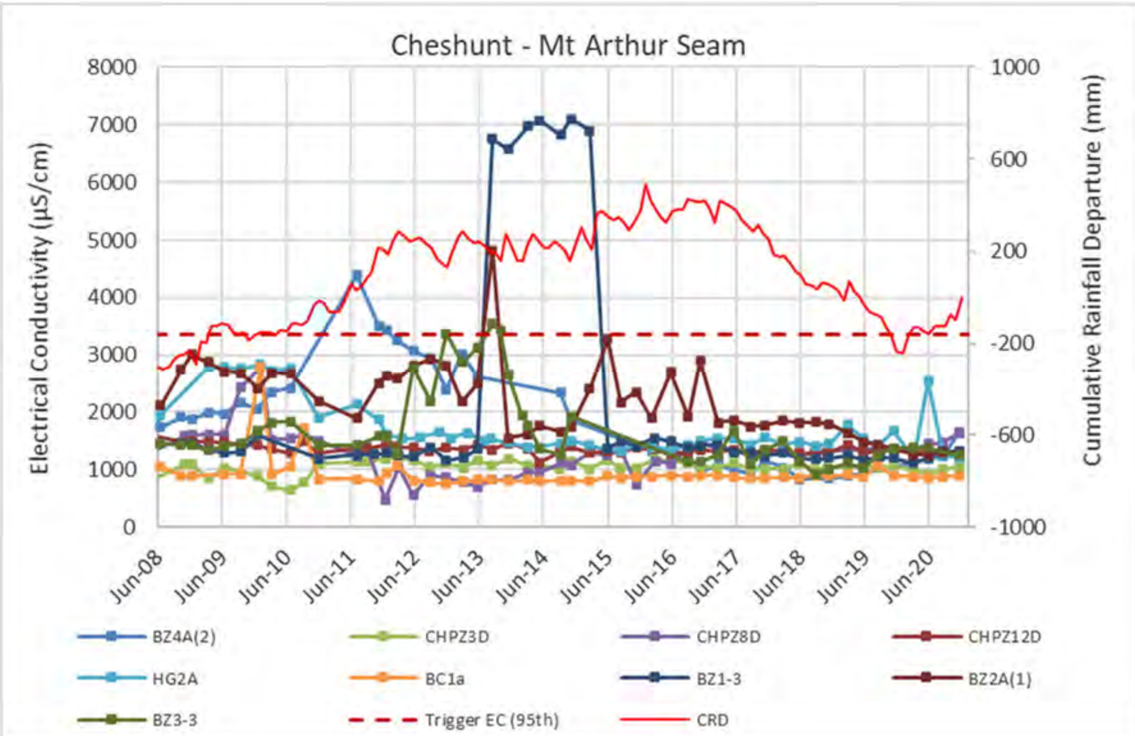
Cheshunt Pit/ North Pit – Alluvium: EC



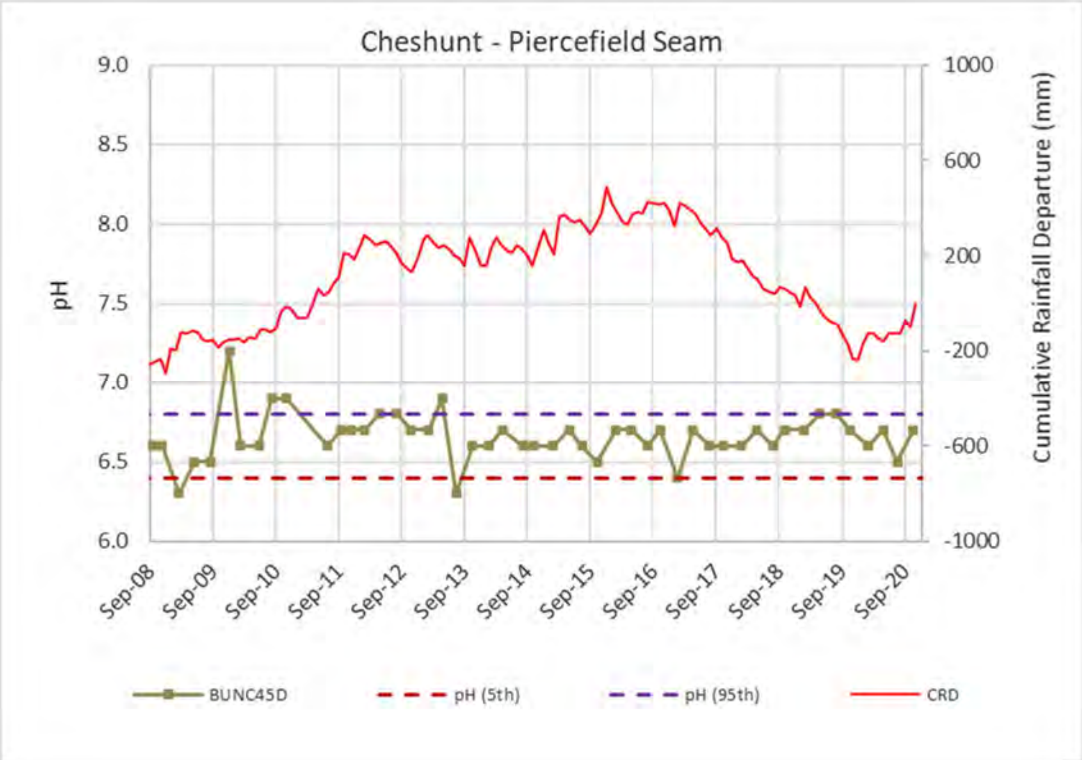
Cheshunt Pit - Mt Arthur Seam: pH



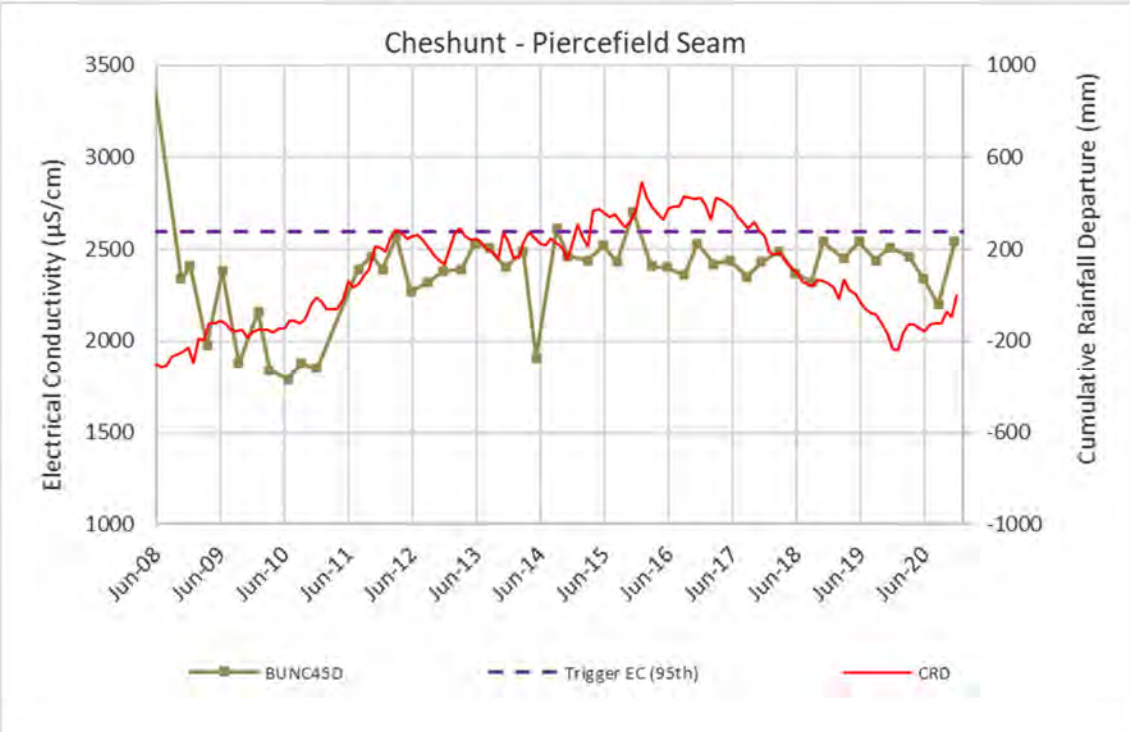
Cheshunt Pit - Mt Arthur Seam: EC



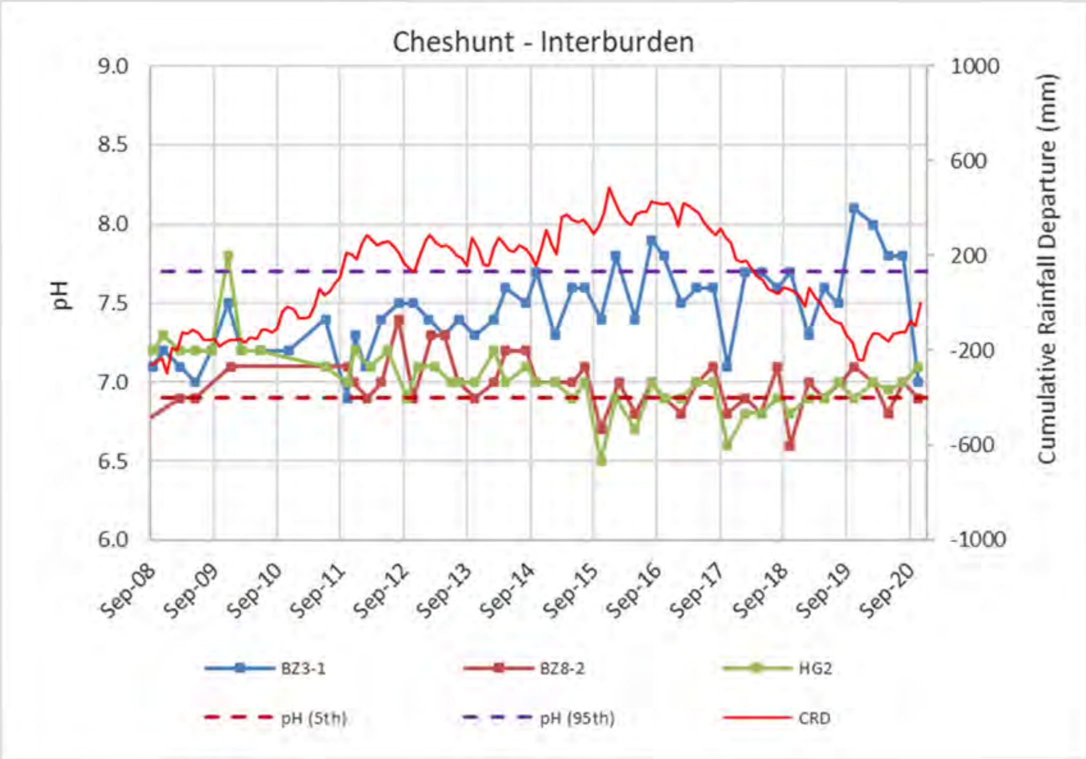
Cheshunt Pit – Piercefield: pH



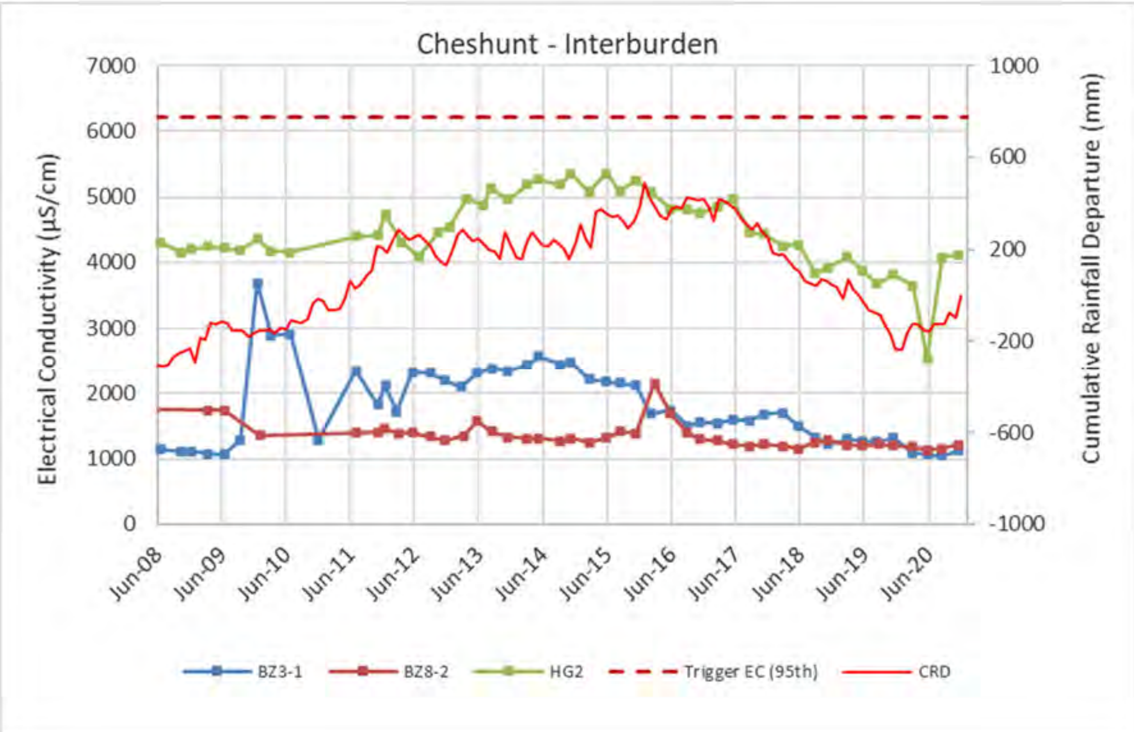
Cheshunt Pit – Piercefield: EC



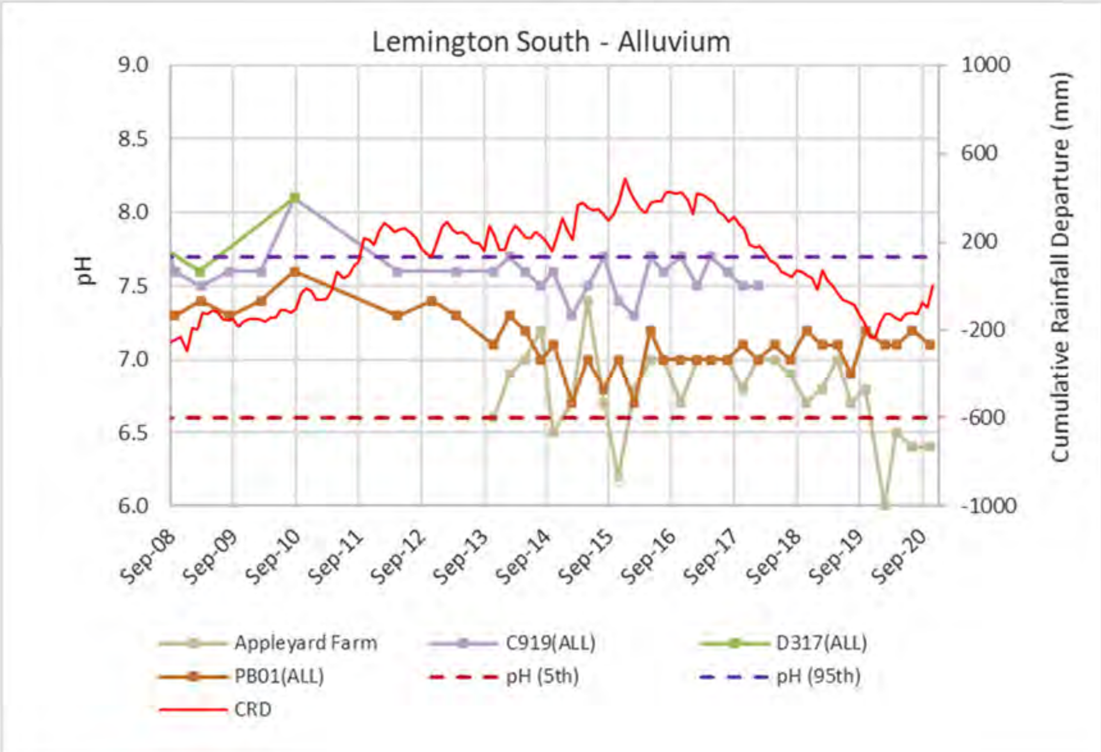
Cheshunt Pit – Interburden: pH



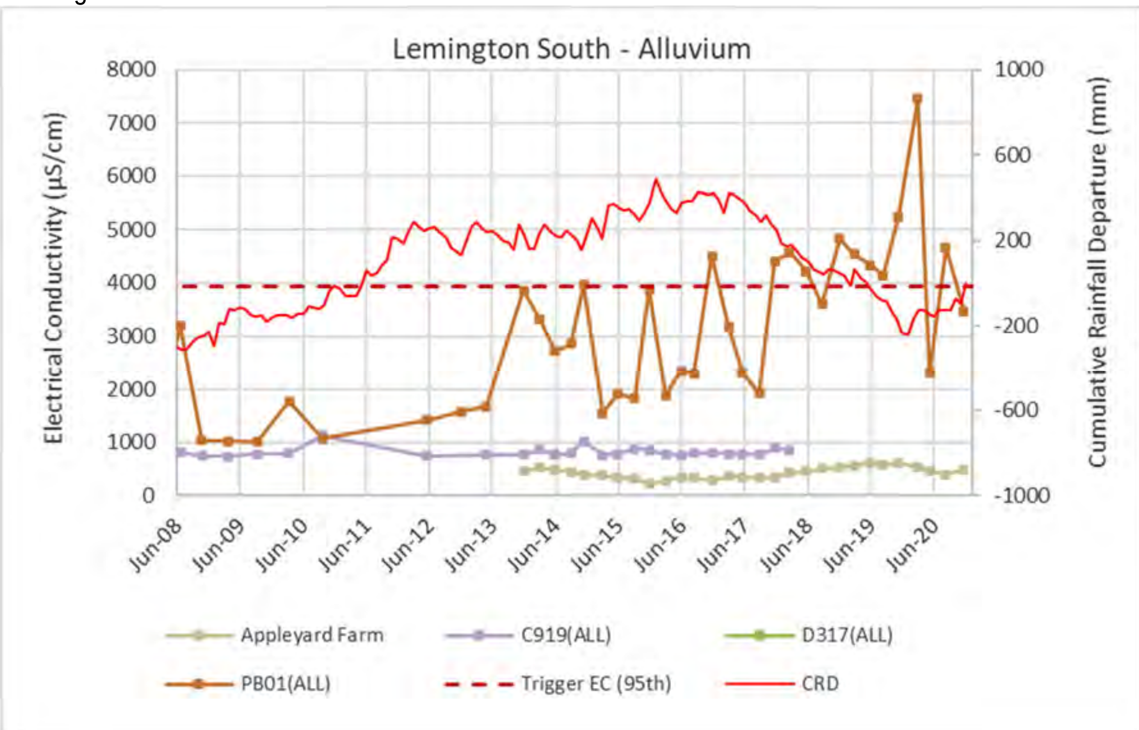
Cheshunt Pit – Interburden: EC



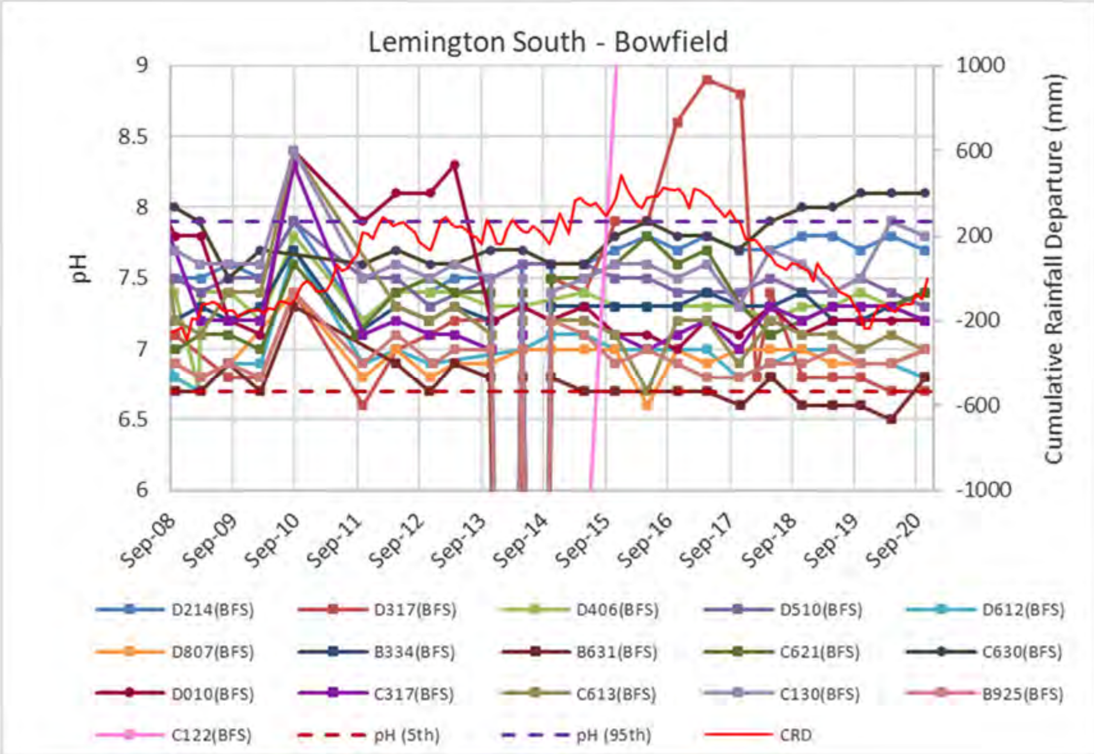
Lemington South Pit – Alluvium: pH



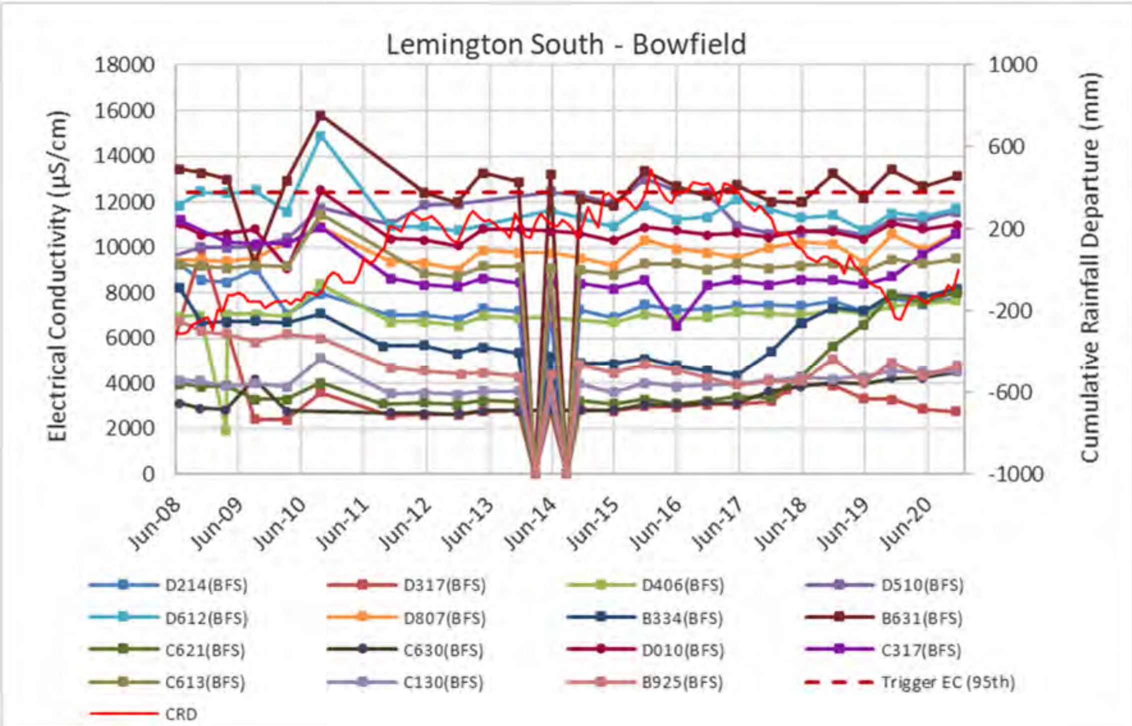
Lemington South Pit – Alluvium: EC



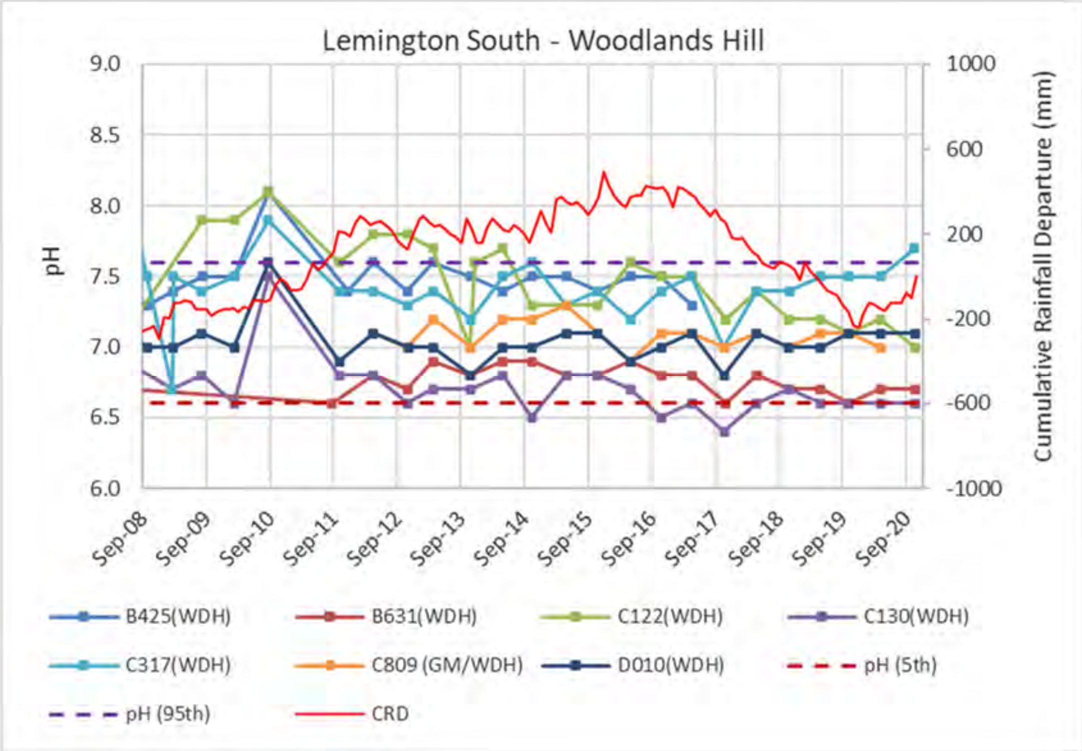
Lemington South Pit – Bowfield Seam: pH



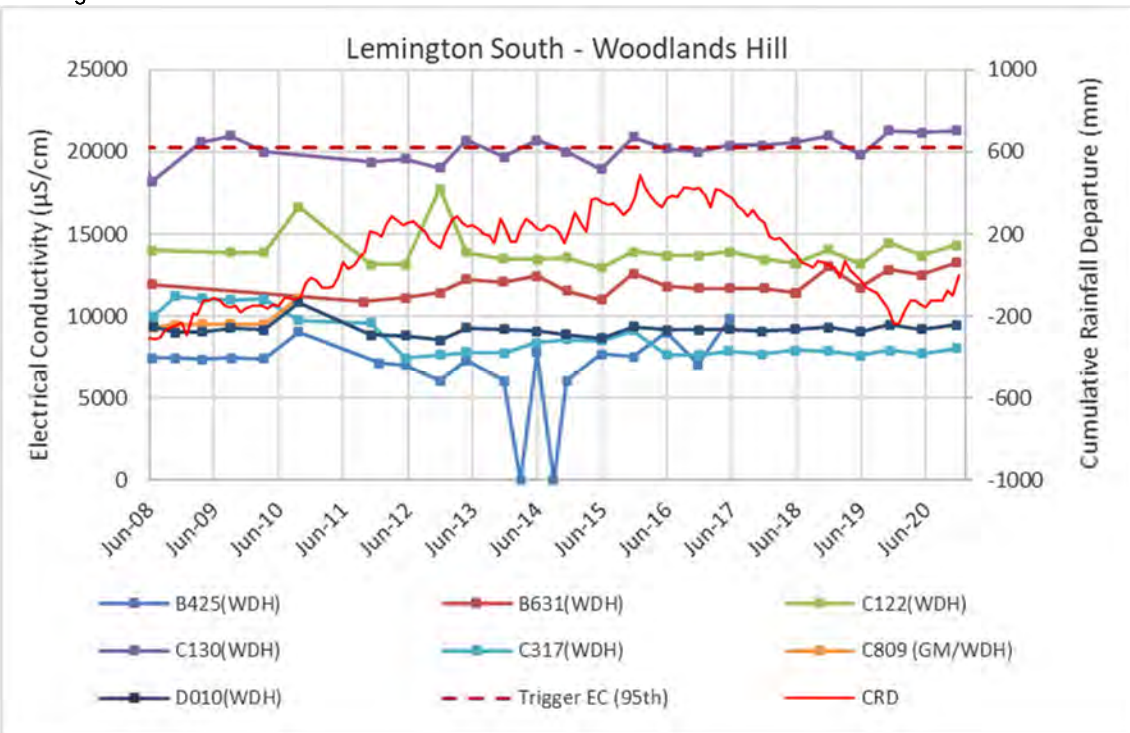
Lemington South Pit – Bowfield Seam: EC



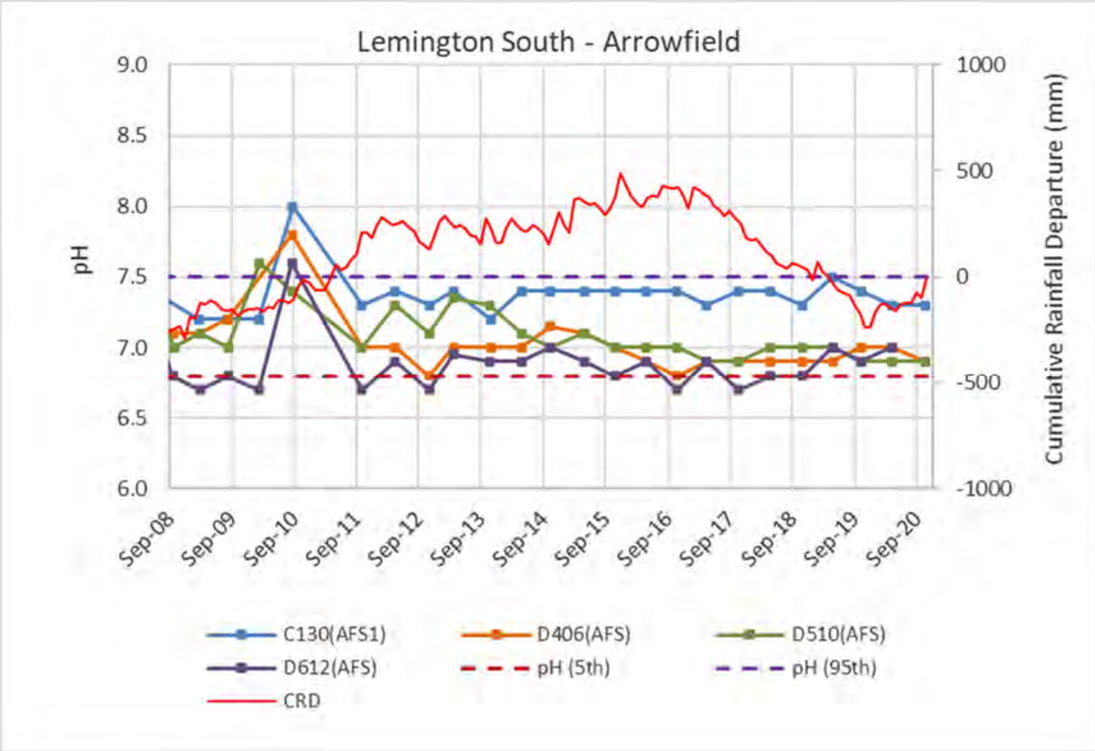
Lemington South Pit - Woodlands Hill Seam: pH



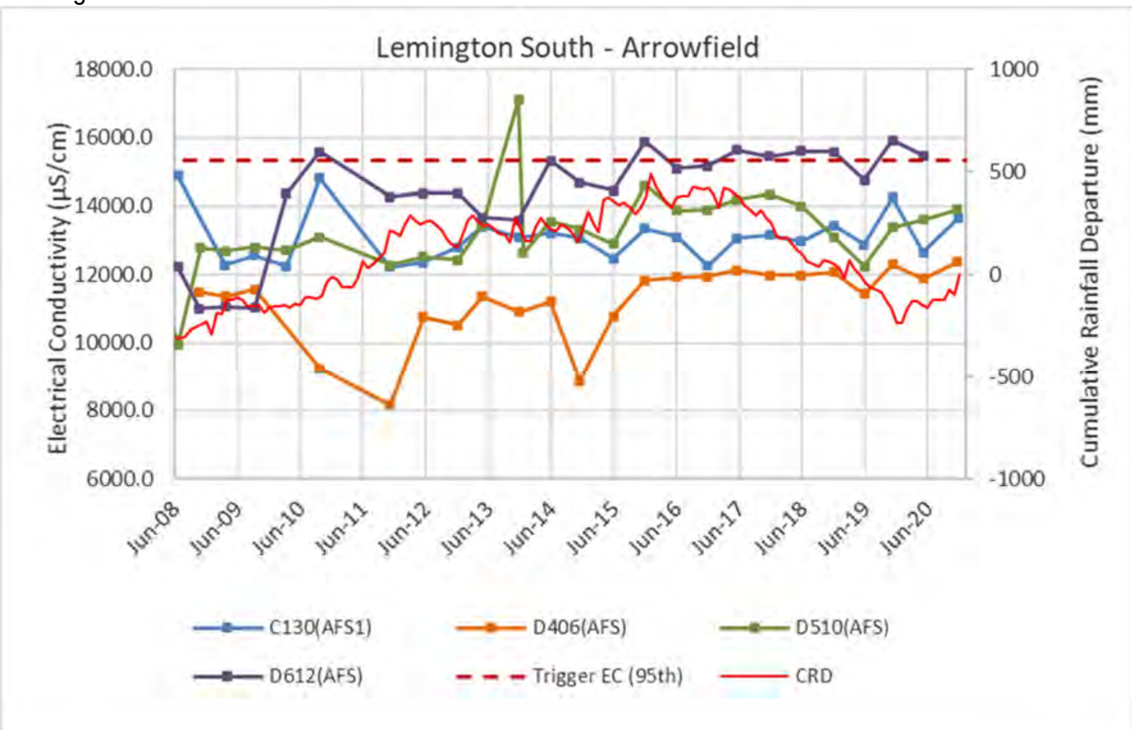
Lemington South Pit - Woodlands Hill Seam: EC



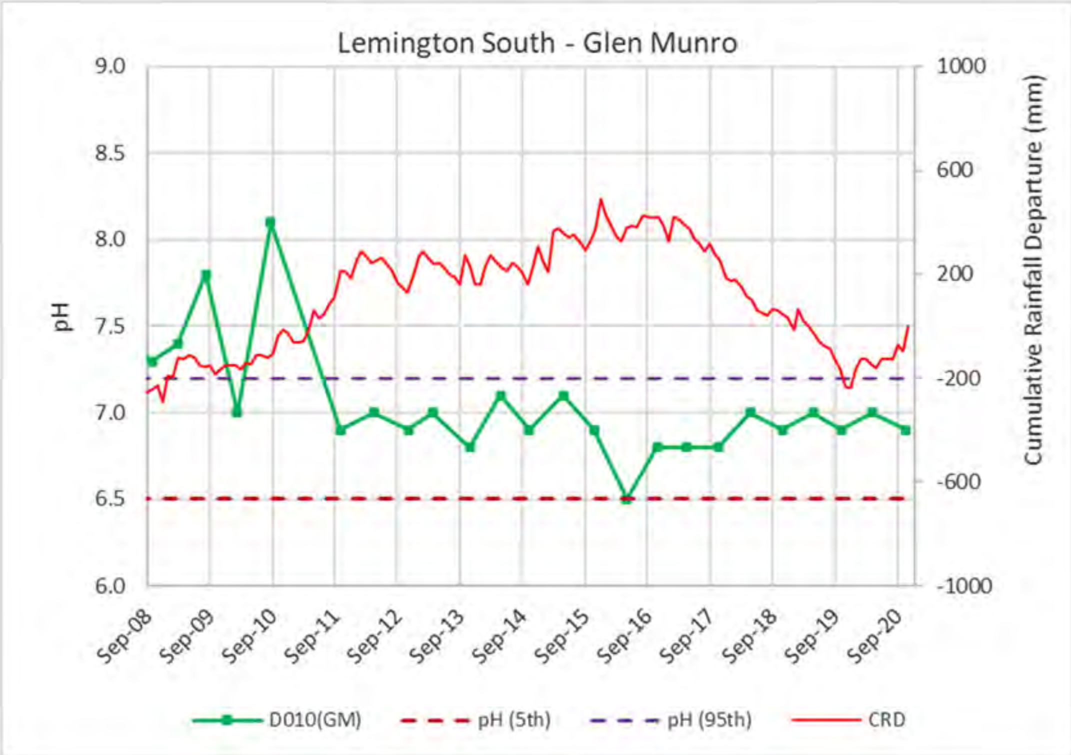
Lemington South Pit – Arrowfield Seam: pH



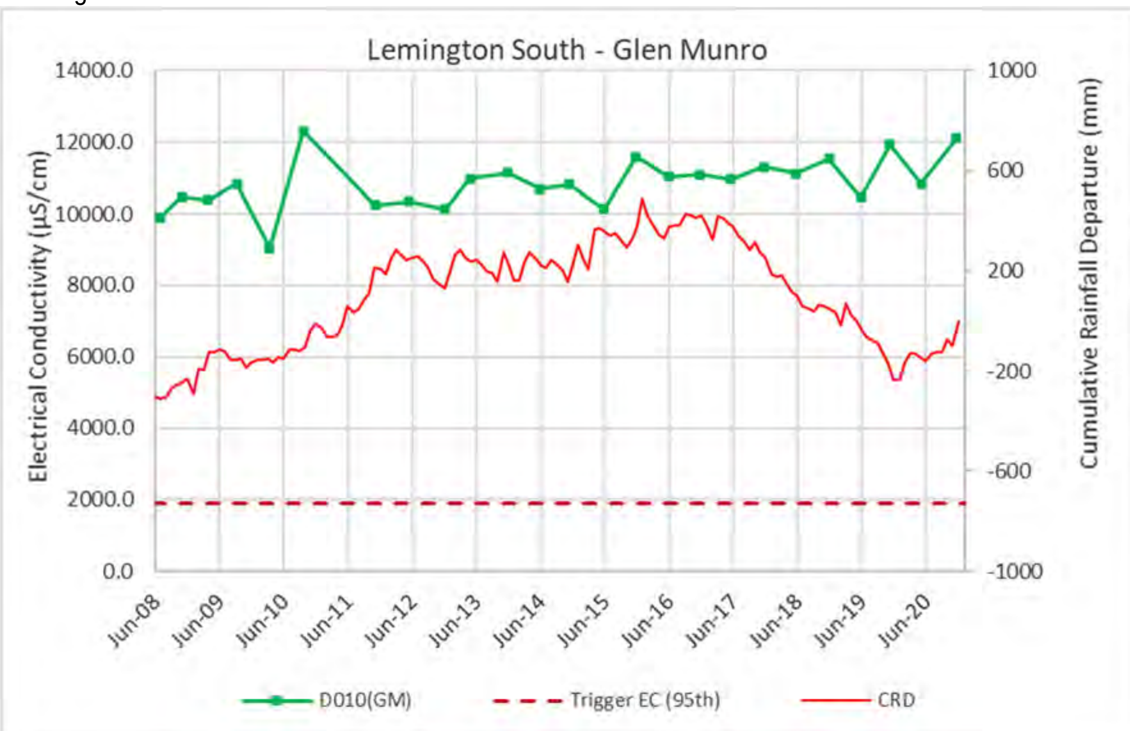
Lemington South Pit – Arrowfield Seam: EC



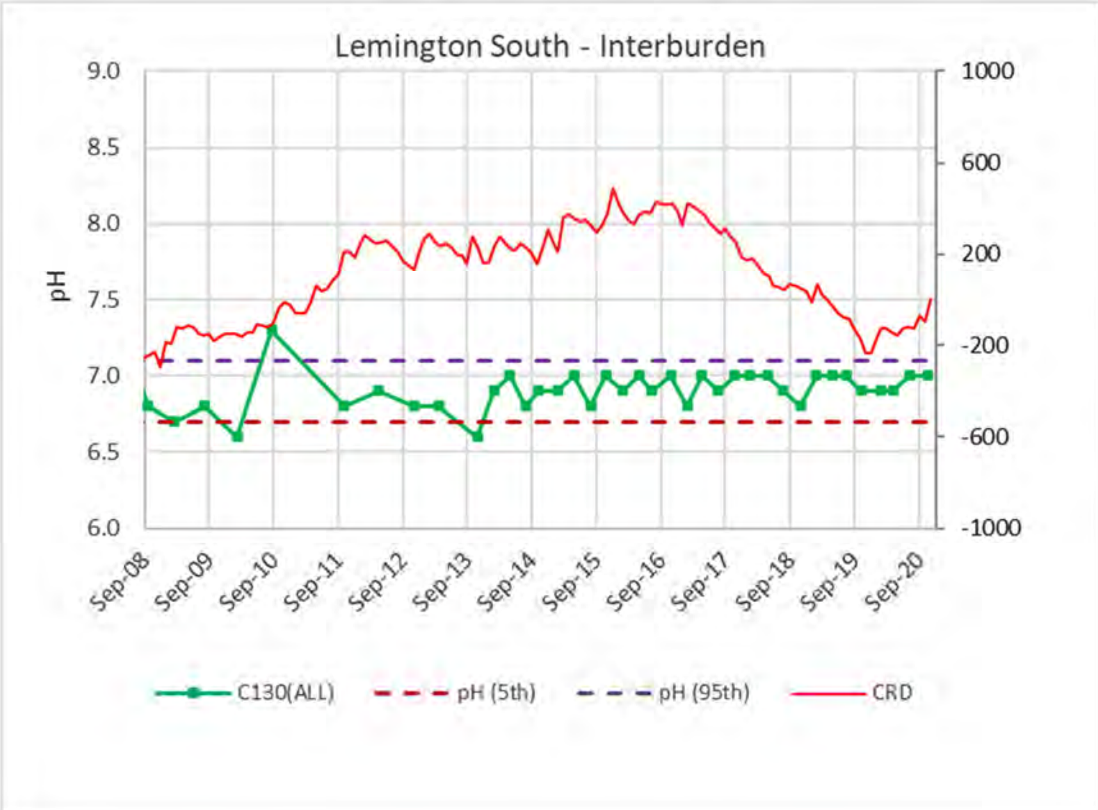
Lemington South Pit - Glen Munro Seam: pH



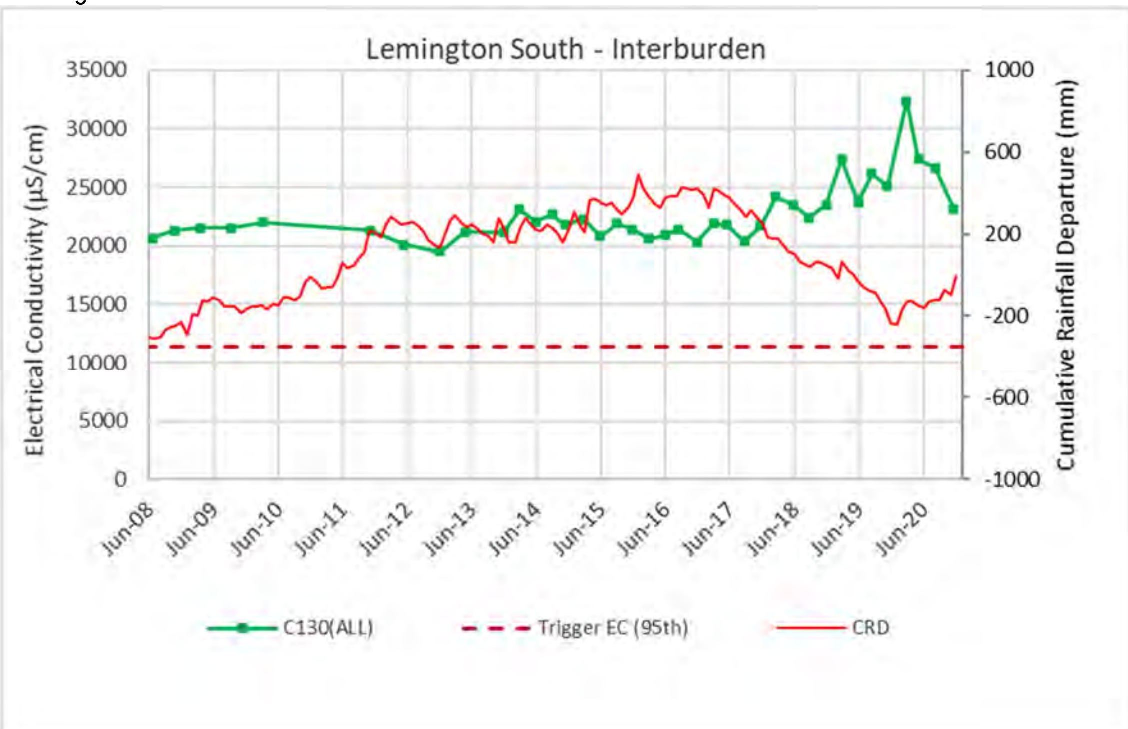
Lemington South Pit - Glen Munro Seam: EC



Lemington South Pit – Interburden: pH



Lemington South Pit – Interburden: EC



APPENDIX E

Full Water Quality Data 2020

Station	Date	Geology	Groundwater Analysis Event	pH Field	EC Field (uS/cm (25TRef))	TDS - Total (mg/l)	Depth to Stand Pipe (m)	SWL (mAHD)	Al - Total (mg/l)	Alk - Total (mg/l)	As - Total (mg/l)	B (mg/l)	Bicarbonate Alkalinity as CaCO3	Ca - Total (mg/l)	Carbonate Alkalinity as CaCO3	Cd - Total (mg/l)	Cl (mg/l)	Co - Total (mg/l)	Cu - Total (mg/l)	F (mg/l)	Fe - Filtered (mg/L)	Hg - Total (mg/l)	Hydroxide Alk (mg/l)	K - Total (mg/l)	Mg - Total (mg/l)	Mn - Total (mg/l)	Na - Total (mg/l)	Ni - Total (mg/l)	Pb - Total (mg/l)	Se (mg/l)	SO4 - Total (mg/l)	Zn - Total (mg/l)
4032P	17-03-2020	Carrington West Wing Alluvium	6M	7.1	1649	931	10.71	59.58	2.45	595	0	0.06	595	61	<1	<0.0001	203		0.01			<0.0001	<1	2	69		198	0	<0.001	<0.01	62	0.06
4032P	24-06-2020	Carrington West Wing Alluvium	6M	7.3	1,520		10.64	59.65																								
4032P	10-09-2020	Carrington West Wing Alluvium	6M	7.2	1465	827	10.6	59.69	17.8	532	0	0.07	532	53	<1	0	201		0.08			<0.0001	<1	2	54		164	0.05	0.01	<0.01	53	0.36
4032P	09-12-2020	Carrington West Wing Alluvium	6M	7.3	1,393		10.44	59.85																								
4034P	17-03-2020	North Pit_Spoil	6M	7.4	1559	836	12.6	58.86	1.31	494	0.01	0.07	494	52	<1	<0.0001	234		0.02			<0.0001	<1	2	72		173	0.01	<0.001	<0.01	50	0.06
4034P	24-06-2020	North Pit_Spoil	6M	7.4	1,529		12.5	58.96																								
4034P	10-09-2020	North Pit_Spoil	6M	7.4	1512	831	12.48	58.98	10.2	438	0.02	0.11	438	50	<1	<0.0001	267		0.15			<0.0001	<1	3	66		158	0.04	0.01	0.02	60	0.27
4034P	09-12-2020	North Pit_Spoil	6M	7.4	1529		12.36	59.1																								
4036C	17-03-2020	Carrington West Wing Interburden	#N/A																													
4036C	24-06-2020	Carrington West Wing Interburden	#N/A																													
4036C	10-09-2020	Carrington West Wing Interburden	#N/A																													
4036C	09-12-2020	Carrington West Wing Interburden	#N/A																													
4037P	17-03-2020	Carrington West Wing Alluvium	6M	7.3	1,276	694	12.09	59.68	7.6	408	0.01	<0.05	408	63	<1	<0.0001	196		0.59			<0.0001	<1	2.0	58		129	0.04	0.01	<0.01	36	0.37
4037P	24-06-2020	Carrington West Wing Alluvium	6M	7.3	1225		11.99	59.78																								
4037P	10-09-2020	Carrington West Wing Alluvium	6M	7.2	1,196	656	11.9	59.87	1.97	386	0	<0.05	386	56	<1	<0.0001	200		0.08			<0.0001	<1	2.0	51		119	0.01	0	<0.01	36	0.07
4037P	09-12-2020	Carrington West Wing Alluvium	6M	7.4	1163		11.85	59.92																								
4040P	17-03-2020	Carrington West Wing Alluvium	#N/A	7.20	936		10.52	59.61																								
4040P	24-06-2020	Carrington West Wing Alluvium	#N/A	7.2	954		10.34	59.79																								
4040P	10-09-2020	Carrington West Wing Alluvium	#N/A	7.2	932		10.33	59.8																								
4040P	09-12-2020	Carrington West Wing Alluvium	#N/A	7.4	926		10.28	59.85																								
4051C	17-03-2020	Carrington_Interburden	#N/A	7.2	2200		16.03	53.87																								
4051C	24-06-2020	Carrington_Interburden	#N/A	7.2	2,250		15.53	54.37																								
4051C	10-09-2020	Carrington_Interburden	#N/A	7.2	2,200		15.31	54.59																								
4051C	09-12-2020	Carrington_Interburden	#N/A	7.3	2220		15.16	54.74																								
4113P	31-03-2020	#N/A	#N/A																													
4113P	25-06-2020	#N/A	#N/A																													
4113P	11-09-2020	#N/A	#N/A																													
4113P	09-12-2020	#N/A	#N/A																													
4116P	16-03-2020	North Pit_Spoil	6M	7.0	14820	9790	23.79	47.69	6.57	871	0.01	0.17	871	179	<1	0	4310		0.02			<0.0001	<1	32	596		2130	0.07	0.01	<0.01	706	0.3
4116P	25-06-2020	North Pit_Spoil	6M	7	13,670		23.71	47.77																								
4116P	11-09-2020	North Pit_Spoil	6M	7.1	15070	10500	23.72	47.76	19.7	776	0.01	0.15	776	169	<1	0	4700		0.03			<0.0001	<1	32	603		2220	0.200	0.04	<0.01	744	1.3
4116P	09-12-2020	North Pit_Spoil	6M	7.00	15,550		23.69	47.79																								
4117P	16-03-2020	#N/A	#N/A				36.85	34.58																								
4117P	25-06-2020	#N/A	#N/A				27.91	43.52																								
4117P	11-09-2020	#N/A	#N/A																													
4117P	09-12-2020	#N/A	#N/A				27.91	43.52																								
4119P	31-03-2020	North Pit_Spoil	6M	7	2,590	1520	11.2	53.55	0.06	629	0.08	0.11	629	83	<1	<0.0001	362		<0.001			<0.0001	<1	21.0	65		356	0.01	<0.001	<0.01	394	0.02
4119P	25-06-2020	North Pit_Spoil	6M	7.10	3,870		11.2	53.55																								
4119P	14-09-2020	North Pit_Spoil	6M	7.00	2,400	1340	11.03	53.72	0.45	567	0.08	0.09	567	81	<1	<0.0001	311		0			<0.0001	<1	15.0	62		337	0.01	<0.001	<0.01	299	0.05
4119P	09-12-2020	North Pit_Spoil	6M	7.00	3,810		11.01	53.74																								
Appleyard Farm	23-01-2020	Lemington South Alluvium	A				7.78	46.92																								
Appleyard Farm	28-02-2020	Lemington South Alluvium	A	6	526		6.06	48.64																								
Appleyard Farm	19-03-2020	Lemington South Alluvium	A				6.38	48.32																								
Appleyard Farm	08-04-2020	Lemington South Alluvium	A				5.61	49.09																								
Appleyard Farm	06-05-2020	Lemington South Alluvium	A	6.5	464		6.25	48.45																								
Appleyard Farm	04-06-2020	Lemington South Alluvium	A				6.43	48.27																								
Appleyard Farm	02-07-2020	Lemington South Alluvium	A				6.42	48.28																								
Appleyard Farm	07-08-2020	Lemington South Alluvium	A	6.4	395		5.51	49.19																								
Appleyard Farm	04-09-2020	Lemington South Alluvium	A				5.95	48.75																								
Appleyard Farm	13-10-2020	Lemington South Alluvium	A				6.34	48.36																								
Appleyard Farm	17-11-2020	Lemington South Alluvium	A	6.40	479	293	5.11	49.59	<0.01	70	<0.001	<0.05	70	14	<1	<0.0001	90		0			<0.0001	<1	4.0	12		45	<0.001	<0.001	<0.01	24	<0.005
Appleyard Farm	01-12-2020	Lemington South Alluvium	A				6.3	48.40																								
B334(BFS)	27-02-2020	Lemington South Bowfield	#N/A				52.31	21.36																								

Station	Date	Geology	Comprehensive Anlysis Event	pH Field	EC Field (uS/cm (25TRef))	TDS - Total (mg/l)	Depth to Stand Pipe (m)	SWL (mAHD)	Al - Total (mg/l)	Alk - Total (mg/l)	As - Total (mg/l)	B (mg/l)	Bicarbonate Alkalinity as CaCO3	Ca - Total (mg/l)	Carbonate Alkalinity as CaCO3	Cd - Total (mg/l)	Cl- (mg/l)	Co - Total (mg/l)	Cu - Total (mg/l)	F (mg/l)	Fe - Filtered (mg/L)	Hg - Total (mg/l)	Hydroxide Alk (mg/l)	K - Total (mg/l)	Mg - Total (mg/l)	Mn - Total (mg/l)	Na - Total (mg/l)	Ni - Total (mg/l)	Pb - Total (mg/l)	Se (mg/l)	SO4 - Total (mg/l)	Zn - Total (mg/l)
B334(BFS)	06-05-2020	Lemington South Bowfield	#N/A	7.30	7,820		52.02	21.65																								
B334(BFS)	07-08-2020	Lemington South Bowfield	#N/A				51.7	21.97																								
B334(BFS)	19-11-2020	Lemington South Bowfield	#N/A	7.40	8,180		51.91	21.76																								
B425(WDH)	27-02-2020	Lemington South_Woodlands Hill	A				35.9	22.29																								
B425(WDH)	06-05-2020	Lemington South_Woodlands Hill	A				35.9	22.29																								
B425(WDH)	07-08-2020	Lemington South_Woodlands Hill	A				35.77	22.42																								
B425(WDH)	17-11-2020	Lemington South_Woodlands Hill	A				35.75	22.44																								
B631(BFS)	27-02-2020	Lemington South_Bowfield	#N/A				49.13	23.31																								
B631(BFS)	06-05-2020	Lemington South_Bowfield	#N/A	6.5	12670		49.72	22.72																								
B631(BFS)	07-08-2020	Lemington South_Bowfield	#N/A				50	22.44																								
B631(BFS)	19-11-2020	Lemington South_Bowfield	#N/A	6.8	13120		51.57	20.87																								
B631(WDH)	06-05-2020	#N/A	#N/A	6.7	12,530		26.25	46.00																								
B631(WDH)	19-11-2020	#N/A	#N/A	6.7	13260		26.27	45.98																								
B925(BFS)	27-02-2020	Lemington South Bowfield	A				63.74	-0.92																								
B925(BFS)	06-05-2020	Lemington South Bowfield	A	6.9	4330		63.61	-0.79																								
B925(BFS)	07-08-2020	Lemington South Bowfield	A				63.68	-0.86																								
B925(BFS)	20-11-2020	Lemington South Bowfield	A	7.0	4780	3010	63.93	-1.11	0.84	1170	<0.001	0.12	1170	18	<1	0	915		0.02			<0.0001	<1	10	14		1130	0.000	0	<0.01	<1	0.07
BC1	07-02-2020	#N/A	#N/A																													
BC1	14-02-2020	#N/A	#N/A																													
BC1	03-03-2020	#N/A	#N/A																													
BC1	27-05-2020	#N/A	#N/A																													
BC1	27-07-2020	#N/A	#N/A																													
BC1	19-08-2020	#N/A	#N/A																													
BC1	26-10-2020	#N/A	#N/A																													
BC1	19-11-2020	#N/A	#N/A					dry																								
BC1	22-12-2020	#N/A	#N/A																													
BC1a	03-03-2020	Cheshunt Mt Arthur	#N/A	7.1	877		17.58	48.78																								
BC1a	27-05-2020	Cheshunt Mt Arthur	#N/A	7.1	861		17.58	48.78																								
BC1a	27-07-2020	Cheshunt Mt Arthur	#N/A																													
BC1a	19-08-2020	Cheshunt Mt Arthur	#N/A	7.1	877		17.48	48.88																								
BC1a	19-11-2020	Cheshunt Mt Arthur	#N/A	7.10	890		17.49	48.67																								
BUNC45A	04-03-2020	Cheshunt Regolith	6M	6.7	2150	1240	21.02	52.18	2.26	480	<0.001	0.1	480	51	<1	<0.0001	470		0.01			<0.0001	<1	6	40		367	0	0	<0.01	74	0.04
BUNC45A	27-05-2020	Cheshunt Regolith	6M	6.8	2090		20.71	52.49																								
BUNC45A	19-08-2020	Cheshunt Regolith	6M	6.6	2,180	1260	20.7	52.5	3.34	615	0	0.07	615	62	<1	<0.0001	411		0.01			<0.0001	<1	6.0	45		379	0.01	0	<0.01	6	0.06
BUNC45A	19-11-2020	Cheshunt Regolith	6M	6.6	2190		20.89	52.31																								
BUNC45D	04-03-2020	Cheshunt Mt Arthur	6M	6.6	2,460	1400	25.22	48.50	0.23	789	<0.001	0.13	789	65	<1	<0.0001	441		<0.001			<0.0001	<1	10.0	57		416	0	<0.001	<0.01	<1	0.01
BUNC45D	27-05-2020	Cheshunt Mt Arthur	6M	6.7	2,340		25.28	48.44																								
BUNC45D	19-08-2020	Cheshunt Mt Arthur	6M	6.5	2,200	1360	25.03	48.69	0.43	801	0	0.1	801	76	<1	<0.0001	397		<0.001			<0.0001	<1	10.0	59		409	0.01	<0.001	<0.01	<1	0
BUNC45D	19-11-2020	Cheshunt Mt Arthur	6M	6.7	2540		25.22	48.5																								
BZ1-1	03-03-2020	Cheshunt Interburden	6M	7.5	2890	1780	17.49	54.3	22.3	601	0.02	0.09	601	16	<1	0	627		0.09			<0.0001	<1	9	43		566	0.06	0.08	<0.01	101	0.29
BZ1-1	27-05-2020	Cheshunt Interburden	6M	7.4	2,790		17.74	54.05																								
BZ1-1	19-08-2020	Cheshunt Interburden	6M	7.4	2990	1950	17.45	54.34	26.1	678	0.02	0.08	678	21	<1	0	585		0.09			<0.0001	<1	10	51		599	0.04	0.09	<0.01	105	0.29
BZ1-1	19-11-2020	Cheshunt Interburden	6M	7.5	2,680		16.81	54.98																								
BZ1-2	07-02-2020	Cheshunt Alluvium	#N/A																													
BZ1-2	14-02-2020	Cheshunt Alluvium	#N/A																													
BZ1-2	03-03-2020	Cheshunt Alluvium	#N/A																													
BZ1-2	27-05-2020	Cheshunt Alluvium	#N/A																													
BZ1-2	19-08-2020	Cheshunt Alluvium	#N/A																													
BZ1-2	26-10-2020	Cheshunt Alluvium	#N/A																													
BZ1-2	19-11-2020	Cheshunt Alluvium	#N/A					dry																								
BZ1-2	22-12-2020	Cheshunt Alluvium	#N/A																													
BZ1-3	03-03-2020	Cheshunt Mt Arthur	6M	7.5	1116	670	47.55	24.24	3.48	369	0	0.07	369	11	<1	0	151		0.01			<0.0001	<1	9	20		217	0.02	0	<0.01	32	0.06
BZ1-3	27-05-2020	Cheshunt Mt Arthur	6M	7.4	1,209		46.71	25.08																								
BZ1-3	19-08-2020	Cheshunt Mt Arthur	6M	7.6	1320	674	46.82	24.97	2.8	398	<0.001	0.06	398	13	<1	<0.0001	153		0.01			<0.0001	<1	9	24		234	0.01	0	<0.01	34	0.05
BZ1-3	19-11-2020	Cheshunt Mt Arthur	6M	7.6	1317		46.7	25.09																								
BZ2A(1)	03-03-2020	Cheshunt_Mt Arthur	#N/A	6.4	1,261		46.17	25.55																								

Station	Date	Geology	Comprehensive Analysis Event	pH Field	EC Field (uS/cm 25TRef)	TDS - Total (mg/l)	Depth to Stand Pipe (m)	SWL (mAHD)	Al - Total (mg/l)	Alk - Total (mg/l)	As - Total (mg/l)	B (mg/l)	Bicarbonate Alkalinity as CaCO3	Ca - Total (mg/l)	Carbonate Alkalinity as CaCO3	Cd - Total (mg/l)	Cl- (mg/l)	Co - Total (mg/l)	Cu - Total (mg/l)	F (mg/l)	Fe - Filtered (mg/L)	Hg - Total (mg/l)	Hydroxide Alk (mg/l)	K - Total (mg/l)	Mg - Total (mg/l)	Mn - Total (mg/l)	Na - Total (mg/l)	Ni - Total (mg/l)	Pb - Total (mg/l)	Se (mg/l)	SO4 - Total (mg/l)	Zn - Total (mg/l)
BZ2A(1)	27-05-2020	Cheshunt_Mt Arthur	#N/A	6.3	1256		46.17	25.55																								
BZ2A(1)	19-08-2020	Cheshunt_Mt Arthur	#N/A	6.4	1,302		45.63	26.09																								
BZ2A(1)	19-11-2020	Cheshunt_Mt Arthur	#N/A	6.4	1,254		45.66	26.06																								
BZ3-1	03-03-2020	Cheshunt_Interburden	#N/A	8	1,093		16.65	53.64																								
BZ3-1	27-05-2020	Cheshunt_Interburden	#N/A	7.8	1062		17.08	53.21																								
BZ3-1	19-08-2020	Cheshunt_Interburden	#N/A	7.8	1,050		16.74	53.55																								
BZ3-1	19-11-2020	Cheshunt_Interburden	#N/A	7	1,121		17.39	52.90																								
BZ3-3	03-03-2020	Cheshunt_Mt Arthur	#N/A	6.3	1376		43.12	27.21																								
BZ3-3	27-05-2020	Cheshunt_Mt Arthur	#N/A	6.3	1,378		43.14	27.19																								
BZ3-3	19-08-2020	Cheshunt_Mt Arthur	#N/A				42.94	27.39																								
BZ3-3	19-11-2020	Cheshunt_Mt Arthur	#N/A	6.3	1248		42.97	27.36																								
BZ4A(2)	03-03-2020	Cheshunt Mt Arthur	#N/A				41.1	33.4																								
BZ4A(2)	27-05-2020	Cheshunt Mt Arthur	#N/A	6.4	1180		41.31	33.16																								
BZ4A(2)	19-08-2020	Cheshunt Mt Arthur	#N/A	6.2	1237		40.88	33.59																								
BZ4A(2)	19-11-2020	Cheshunt Mt Arthur	#N/A	6.3	1,632		41.05	33.42																								
BZ8-2	03-03-2020	Cheshunt Interburden	6M	7.0	1178	646	19.38	48.41	1.38	321	0.02	0.05	321	31	<1	<0.0001	206		0			<0.0001	<1	5	53		152	0	0	<0.01	38	0.03
BZ8-2	27-05-2020	Cheshunt Interburden	6M	6.8	1,138		18.57	49.22																								
BZ8-2	20-08-2020	Cheshunt Interburden	6M	7	1149	608	18.61	49.18	1.42	340	0.04	<0.05	340	32	<1	<0.0001	183		0			<0.0001	<1	5	51		150	0	0	<0.01	39	0.02
BZ8-2	19-11-2020	Cheshunt Interburden	6M	6.9	1,211		19.98	47.81																								
C122(BFS)	27-02-2020	Lemington South_Bowfield	#N/A				58.82	-0.08																								
C122(BFS)	06-05-2020	Lemington South_Bowfield	#N/A				58.84	-0.10																								
C122(BFS)	07-08-2020	Lemington South_Bowfield	#N/A				58.82	-0.08																								
C122(BFS)	19-11-2020	Lemington South_Bowfield	#N/A				58.77	-0.03																								
C122(WDH)	06-05-2020	#N/A	#N/A	7.2	13,690		12.03	46.70																								
C122(WDH)	19-11-2020	#N/A	#N/A	7.0	14320		11.86	46.87																								
C130(AFS1)	06-05-2020	#N/A	A	7.3	12,650		18.38	45.18																								
C130(AFS1)	20-11-2020	#N/A	A	7.3	13650	8500	18.68	44.88	0.13	742	0	0.15	742	149	<1	<0.0001	4140		0.01			<0.0001	<1	26	138		2460	0.02	<0.001	<0.01	6	0.03
C130(ALL)	14-01-2020	Lemington South Overburden	A				16.1	47.32																								
C130(ALL)	27-02-2020	Lemington South Overburden	A	6.9	32400		16.08	47.34																								
C130(ALL)	19-03-2020	Lemington South Overburden	A				16.06	47.36																								
C130(ALL)	08-04-2020	Lemington South Overburden	A				16.03	47.39																								
C130(ALL)	06-05-2020	Lemington South Overburden	A	6.9	27,400		16.05	47.37																								
C130(ALL)	04-06-2020	Lemington South Overburden	A				16.07	47.35																								
C130(ALL)	02-07-2020	Lemington South Overburden	A				16.11	47.31																								
C130(ALL)	07-08-2020	Lemington South Overburden	A	7	26700		16.11	47.31																								
C130(ALL)	04-09-2020	Lemington South Overburden	A				16.05	47.37																								
C130(ALL)	13-10-2020	Lemington South Overburden	A				16.07	47.35																								
C130(ALL)	20-11-2020	Lemington South Overburden	A	7	23,100	19900	16.13	47.29	0.68	1020	<0.001	<0.05	1020	258	<1	0	7360		0.01			<0.0001	<1	34.0	665		3860	0	0.01	<0.01	601	0.03
C130(ALL)	03-12-2020	Lemington South Overburden	A				16.07	47.35																								
C130(BFS)	27-02-2020	Lemington South Bowfield	#N/A				54.22	9.10																								
C130(BFS)	06-05-2020	Lemington South Bowfield	#N/A	7.9	4510		54.25	9.07																								
C130(BFS)	07-08-2020	Lemington South Bowfield	#N/A				53.62	9.70																								
C130(BFS)	18-11-2020	Lemington South Bowfield	#N/A	7.8	4,530		56.15	7.17																								
C130(WDH)	06-05-2020	#N/A	#N/A	6.6	21200		16.23	47.29																								
C130(WDH)	19-11-2020	#N/A	#N/A	6.6	21,300		16.26	47.26																								
C317(BFS)	28-02-2020	Lemington South Bowfield	#N/A				55.61	5.13																								
C317(BFS)	06-05-2020	Lemington South Bowfield	#N/A	7.3	9710		55.17	5.57																								
C317(BFS)	07-08-2020	Lemington South Bowfield	#N/A				55.7	5.04																								
C317(BFS)	17-11-2020	Lemington South Bowfield	#N/A	7.2	10590		55.83	4.91																								
C317(WDH)	28-02-2020	Lemington South Woodlands Hill	#N/A				14.2	46.13																								
C317(WDH)	06-05-2020	Lemington South Woodlands Hill	#N/A	7.5	7,730		14.22	46.11																								
C317(WDH)	07-08-2020	Lemington South Woodlands Hill	#N/A				14.56	45.77																								
C317(WDH)	17-11-2020	Lemington South Woodlands Hill	#N/A	7.7	6,040		13.99	46.34																								

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Appendix C - Rehabilitation Maintenance Schedule

HVO s240 Rehab Maintenance Schedule 2019-2020 - [2020 AER Update]

LEGEND KEY

Legend - December 2020 updates	
Updates at December 2020 shown in red	
Delivery against plan	
✓	Work performed

Legend - s240 submission planned work	
	Primary task timing
	Secondary timing (contingency / follow-up as needed)

Legend - Rehab Trajectory (after CPS monitoring 2018/19)	
	Tracking towards success but needs work
	Stable but need work to improve
	Failing
	Failed
	Not monitored

Legend - s240 Issue	
Veg, Weeds	2018 TARP Monitoring event & event trigger(s)
19Q2	2019 Additional sites monitoring event
GMD Rollback	Failed block - phase reversion to Growth Med. Dev.

Notes to s240 submission

Work to occur across the periods shown, however may not occur in all periods shown.
Relative priorities balance addressing at-risk areas with maintaining areas demonstrating favourable trajectories.
2020 work plans are indicative only. Final 2020 plans to be informed by observations and trajectory at 2019 monitoring events, and will be detailed in annual reporting.
Changes to work plans may occur due to weather events and climatic influences. Where work components are not undertaken details will be provided in annual reporting.
Maintenance in Riverview reflects that majority of blocks are temporary rehabilitation of interim landform and will be progressively re-disturbed with mine advance.

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HVO s240 Rehab Maintenance Schedule 2019-2020 - West Pit [2020 AER Update]												
Location	Maintenance	Relative	2019				2020				s240
		Priority	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Issue
HVOWES201601 [West North 190, 6.2ha]		1									
Priorities	Re-monitoring, Soil investigation		✓								
1. additional monitoring	Soil amelioration (if req)						not required				Veg,
2. weed control	Weed control / spray out				✓	✓			✓	✓	Weeds
3. understanding growth medium	Seeding										
AER UPDATE:	Weed controls and initial seeding preparations implemented. Ongoing work will occur over the forward period.										
HVOWES201701 [West North 190, 6.6ha]		1									
Priorities	Weed control			✓	✓	✓			✓		
1. weed control	Scope contour repair						✓				19Q2
2. monitor trajectory	Contour repair						✓				
AER UPDATE:	Contour repairs completed. Weed controls and initial seeding preparations implemented. Ongoing work will occur over the forward period. Native emergence and establishment from existing seed is progressing.										
HVOWES201401 [West Centre 230, 8ha]		2									
Priorities	Weed control					✓					
1. weed control	Soil investigation					✓					19Q2
2. understanding growth medium	Soil amelioration (if req)						not required				
	Selective seeding (if req)										
AER UPDATE:	No work undertaken during 2020.										
HVOWES201502 [West South 230 Flat, 29.2ha]		2									
Priorities	Weed control								✓	✓	
1. weed control	Selective seeding (if req)										19Q2
AER UPDATE:	Weed controls and initial seeding preparations implemented. Ongoing work will occur over the forward period. Block monitored during 2020 monitoring event.										
HVOWES201605 [West South 230 - Nth Slope, 14.2ha]		2									
Priorities	Routine inspection (watching brief)				✓			✓			
1. weed control	Weed control							✓			19Q2
2. monitor trajectory (natives sown 2018)											
AER UPDATE:	Weed controls implemented. Follow up to occur over the forward period.										
HVOWES201702 [West Wilton 210 - Nth Amphitheatre, 3.6ha]		2									
Priorities	Weed control		✓					✓			
1. weed control	Soil investigation		✓								19Q2
2. understanding growth medium / degraded area issues	Develop intervention plan										
3. intervention plan development for degraded portion	Plan execution										
AER UPDATE:	Initial weed passes undertaken. Amelioration not required. Detailed intervention plan not required. Native emergence is ongoing. Ongoing work will occur over the forward period.										
HVOWES201704 [West South 230 Flat, 13ha]		2									
Priorities	Weed control								✓		
1. weed control	Soil investigation					✓					19Q2
2. understanding growth medium	Develop intervention plan							✓			
3. intervention plan development	Plan execution								✓	✓	
AER UPDATE:	Portions of block emerging naturally. Interventions implemented during 2020 to control weeds and prepare ground for augmentation sowing. Follow up to occur over the forward period.										
HVOWES201501 [West North 230 Flat, 26.2ha]		3									
Priorities	Routine inspection (watching brief)				✓	✓		✓			
1. weed control	Weed control								✓		19Q2
2. monitor trajectory	Re-monitor (if req)										
										✓	
AER UPDATE:	Weed controls implemented. Follow up to occur over the forward period. Block monitored during 2020 monitoring event.										
HVOWES201603 [West North 230 Flat, 6.7ha]		3									
Priorities	Soil investigation		✓								
1. weed control	Weed control				✓			✓			19Q2
	Selective seeding (if req)										
AER UPDATE:	Weed controls implemented. Follow up to occur over the forward period. Block monitored during 2020 monitoring event.										
HVOWES201604 [Wilton 210, 3.7ha]		3									
Priorities	Weed control			✓				✓			
1. weed control	Selective seeding (if req)										Weeds
2. understanding growth medium											
3. increase diversity											
AER UPDATE:	Maintenance weed controls implemented. Follow up to occur over the forward period.										
HVOWES201301 [West Wilton, 3.7ha]		4									
Priorities	Weed control			✓				✓			
1. weed control	Selective seeding (if req)										19Q2
AER UPDATE:	Maintenance weed controls implemented. Follow up to occur over the forward period.										
HVOWES201703 [West South 230 - Nth Slope, 13.1ha]		4									
Priorities	Weed control										
1. Weed control	Selective seeding (if req)										19Q2
AER UPDATE:	No work undertaken during 2020.										

HVO s240 Rehab Maintenance Schedule 2019-2020 - West Pit [2020 AER Update]											
Location	**Maintenance**	**Relative Priority**	**2019**				**2020**				**s240 Issue**
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
HVOWES201101 [WS190 above Dam 6W, 2.2ha]		**5**									
Priorities 1. weed control 2. manage for re-disturbance	Weed control										19Q2
	Selective seeding (if req)										
AER UPDATE:	No work undertaken during 2020.										

HVO s240 Rehab Maintenance Schedule 2019-2020 - West Pit [2020 AER Update]												
Location	**Maintenance**	**Relative Priority**	**2019**				**2020**				**s240 Issue**
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
HVOWES201602 [West South 230 Flat, 4ha]		**5**									
Priorities	Weed control								✓		19Q2
1. weed control	Selective seeding (if req)										
AER UPDATE:	Maintenance weed controls implemented. Follow up to occur over the forward period. Block monitored during 2020 monitoring event.										

Notes:
Work to occur across the periods shown, however may not occur in all periods shown.
Relative priorities balance addressing at-risk areas with maintaining areas demonstrating favourable trajectories.
2020 work plans are indicative only. Final 2020 plans to be informed by observations and trajectory at 2019 monitoring events, and will be detailed in annual reporting.
Changes to work plans may occur due to weather events and climatic influences. Where work components are not undertaken details will be provided in annual reporting.

Legend - Rehab Trajectory (after CPS monitoring 2018/19)
- Tracking towards success but needs work
- Stable but need work to improve
- Failing
- Failed
- Not monitored

Legend - planned work
- Primary task timing
- Secondary timing (contingency / follow-up as needed)

Legend - updates
✓ done

Legend - s240 Issue (2018/2019 s240 Notices)
- Veg, Weeds — 2018 TARP Monitoring event & event trigger(s)
- 19Q2 — 2019 Additional sites monitoring event
- GMD Rollback — Failed block - phase reversion to Growth Med. Dev.

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HVO s240 Rehab Maintenance Schedule 2019-2020 - Riverview Pit [2020 AER Update]											
Location	Maintenance	Relative	2019				2020				s240
		Priority	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Issue
HVORIV201403 [Riverview 145/155, 4.8ha]		1									
Priorities	Soil investigation		✓								
1. weed control	Soil amelioration (if req)										Veg, Weeds
2. soil amelioration	Weed control										
3. manage for re-disturbance	Selective seeding (if req)										
AER UPDATE:	No work in 2020 due to mining interactions. Area reduced by approximately 1/3 with mine advance.										
HVORIV201404 [Riverview 150, 8.4ha]		1									
Priorities	Soil investigation		✓								
1. weed control	Weed control / spray out										Veg
2. soil amelioration	Soil amelioration										
3. manage for re-disturbance	Seeding										
AER UPDATE:	No work in 2020 due to mining interactions. Area reduced by approximately 2/3 with mine advance and topsoil stockpile establishment.										
HVORIV201405 [Riverview 150, 14.3ha]		1									
Priorities	Soil investigation		✓								
1. weed control	Weed control / spray out				✓						Veg / GMD Rollback
2. manage for re-disturbance	Soil amelioration										
	Seeding							reclassified as disturbed			
AER UPDATE:	Topsoil stockpiles established across entire block. Block reclassified as disturbed.										
Riverview North Hayshed block [7.2ha]		1									
Priorities	Weed control							✓			-
1. weed control											
2. monitor trajectory (sown over to native 19Q2, not yet monitored)											
AER UPDATE:	Block slashed to remove exotic grass competition.										
HVORIV201703 [Riverview Glider 110 South Batter, 5.4ha]		2									
Priorities	Weed control		✓								19Q2
1. weed control											
2. monitor trajectory (natives sown 2018)											
AER UPDATE:	No work in 2020.										
HVORIV201802 [RivNorth West Batter, 18.8ha]		2									
Priorities	Weed control			✓				✓	✓		19Q2
1. weed control											
2. monitor trajectory											
AER UPDATE:	Post establishment weed control undertaken (ground crew). Initial Establishment Monitoring undertaken. Block bounds reconfigured for monitoring.										
HVORIV201803 [RivNorth North Batter, 16.3ha]		2									
Priorities	Weed control		✓					✓			19Q2
1. weed control											
2. monitor trajectory											
AER UPDATE:	Post establishment weed control undertaken (slashing). Initial Establishment Monitoring undertaken. Block bounds reconfigured for monitoring.										
HVORIV201401 [Riverview 145, 5.8ha]		3									
Priorities	Weed control										Weeds
1. weed control	Selective seeding (if req)										
2. manage for re-disturbance											
AER UPDATE:	No maintenance work in 2020. Merged with HVORIV1402 and HVORIV1503 as Long Term Monitoring block.										
HVORIV201402 [Riverview 145, 10ha]		3									
Priorities	Weed control										Weeds
1. weed control	Selective seeding (if req)										
2. manage for re-disturbance											
AER UPDATE:	No maintenance work in 2020. Merged with HVORIV1401 and HVORIV1503 as Long Term Monitoring block.										
HVORIV201501 [Riverview 150, 2.4ha]		3									
Priorities	Weed control										Weeds
1. weed control	Selective seeding (if req)										
2. manage for re-disturbance											
AER UPDATE:	No work in 2020.										
HVORIV201503 [Riverview 145, 6.2ha]		3									
Priorities	Weed control										Weeds
1. weed control	Selective seeding (if req)										
2. manage for re-disturbance											
AER UPDATE:	No maintenance work in 2020. Merged with HVORIV1401 and HVORIV1402 as Long Term Monitoring block.										
HVORIV201601A [Riverview Western Amphitheatre, 3ha]		3									
Priorities	Weed control			✓							19Q2
1. weed control											
2. monitor trajectory											
3. manage for re-disturbance											
AER UPDATE:	No work during 2020.										
HVORIV201701 [Riverview Glider 125 Flat, 10ha]		3									
Priorities	Weed control		✓								19Q2
1. weed control											
2. monitor trajectory (natives sown 2018)											
AER UPDATE:	No work during 2020.										
HVORIV201702 [Riverview Glider 110 North Batter, 4.4ha]		3									
Priorities	Weed control		✓								19Q2
1. weed control											
2. monitor trajectory (natives sown 2018)											
AER UPDATE:	No work during 2020.										
HVORIV201801 [Riverview 150, 2.2ha]		3									
Priorities	Weed control		✓								19Q2
1. weed control											
2. monitor trajectory											

HVO s240 Rehab Maintenance Schedule 2019-2020 - Riverview Pit [2020 AER Update]											
Location	**Maintenance**	**Relative Priority**	**2019**				**2020**				**s240 Issue**
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
AER UPDATE:	No work during 2020.										
HVORIV201406 [Riverview East Amphitheatre & adjacent 155, 5.1ha]		**4**									
Priorities	Weed control			✓							19Q2
1. weed control	Soil investigation					✓					
2. monitor trajectory	Selective seeding (if req)										
3. manage for re-disturbance											
AER UPDATE:	No work during 2020.										

HVO s240 Rehab Maintenance Schedule 2019-2020 - Riverview Pit [2020 AER Update]												
Location	Maintenance	Relative Priority	2019				2020				s240 Issue
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
HVORIV201407 [Riverview 125, 7.8ha]		**4**									
Priorities 1. weed control 2. manage for re-disturbance	Weed control										19Q2
AER UPDATE:	No work in 2020 due to mining interactions. Area reduced by approximately 2/3 with mine advance.										

Notes:

Work to occur across the periods shown, however may not occur in all periods shown.

Relative priorities balance addressing at-risk areas with maintaining areas demonstrating favourable trajectories.

2020 work plans are indicative only. Final 2020 plans to be informed by observations and trajectory at 2019 monitoring events, and will be detailed in annual reporting.

Changes to work plans may occur due to weather events and climatic influences. Where work components are not undertaken details will be provided in annual reporting.

Maintenance in Riverview reflects that majority of blocks are temporary rehabilitation of interim landform and will be progressively re-disturbed with mine advance.

Legend - Rehab Trajectory (after CPS monitoring 2018/19)

(blue)	Tracking towards success but needs work
(yellow)	Stable but need work to improve
(orange)	Failing
(red)	Failed
(pink)	Not monitored

Legend - planned work

(dark grey)	Primary task timing
(light grey)	Secondary timing (contingency / follow-up as needed)

Legend - updates

✓ done

Legend - s240 Issue (2018/2019 s240 Notices)

Veg, Weeds	2018 TARP Monitoring event & event trigger(s)
19Q2	2019 Additional sites monitoring event
GMD Rollback	Failed block - phase reversion to Growth Med. Dev.

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HVO s240 Rehab Maintenance Schedule 2019-2020 - Carrington, Cheshunt & Lemington Pits [2020 AER Update]

Location	Maintenance	Relative Priority	2019 Q1	2019 Q2	2019 Q3	2019 Q4	2020 Q1	2020 Q2	2020 Q3	2020 Q4	s240 Issue
HVOCHE201501A [Barrys Lower East Slope, 19.6ha]		1									
Priorities	Weed control							✓			-
1. weed control											
2. monitor trajectory (sown to native 19Q2, not yet monitored)											
AER UPDATE:	Rank grasses slashed. Rill repair aeration completed. Block renamed for 2020 monitoring as HVOCHE201503 nnd Initial Establishment Monitoring undertaken.										
HVOCHE201501B / HVOCHE201601A [Barrys Upper East Slope, 16.1ha]		1									
Priorities	Weed control / spray out		✓				✓				GMD Rollback
1. halt exotic establishment & competition	Re-establish cover crop			✓							
2. re-establish cover crop	Investigate soil issues		✓			✓					
3. understand growth medium	Develop re-establishment plan							✓			
AER UPDATE:	Amelioration not required. Weed control, rill repair and ground preparations undertaken. Re-sown to final native cover 20Q2 in association with portion of adjacent GMD block. Block bounds reconfigured for future monitoring and block renamed HVOCHE201504.										
HVOCHE201801 [Barrys Slope, 4.9ha; east portion of 2018 block]		1									
Priorities	Weed control			✓	✓	✓					19Q2
1. weed control	Routine inspection						✓	✓			
2. monitor trajectory	Re-sow native cover							✓			
AER UPDATE:	Weed control, rill repair and ground preparations undertaken. Re-sown to final native cover 20Q2 in association with adjacent GMD blocks.										
HVOCHE201801 [Barrys Slope, 1ha; west portion of 2018 block]		2									
Priorities	Weed control			✓				✓			19Q2
1. weed control											
AER UPDATE:	Maintenance spraying completed.										
HVOCHE201201 [Cheshunt Rim, 20.8ha]		4									
Priorities	Investigate soil issues		✓								Veg / GMD Rollback
1. understanding growth medium	Develop re-establishment plan										
2. addressing growth medium constraints	Plan execution										
3. plan development											
AER UPDATE:	Re-classified as GMD phase and no longer considered 'Under active rehabilitation'. No work undertaken during 2020. To be included in Cheshunt East Embankment grazing area following construction of fencing and water points.										
HVOCHE201702 [Fmr Drill Parkup, 2.2ha]		4									
Priorities	Weed control										19Q2
1. weed control	Selective seeding (if req)										
2. increase ground cover /surface stability											
AER UPDATE:	No work undertaken during 2020.										
HVOCHE201802 [Barrys 230 Flat, 19.5ha]		4									
Priorities	Weed control		✓				✓				19Q2
1. weed control											
2. manage for potential re-use of surface layer (temp spoil/compost rehab)											
AER UPDATE:	Maintenance spraying completed. To be redisturbed 2021.										
HVOLEM201501 [Lemington South, 13.4ha]		4									
Priorities	Weed control										19Q2
1. weed control	Soil investigation					✓					
2. understanding growth medium	Soil amelioration (if req)										
	Selective seeding (if req)										
AER UPDATE:	No work undertaken during 2020. Inspection indicates favourable trajectory emerging.										
HVOLEM201601 [Lemington South, 5ha]		4									
Priorities	Weed control										Weeds
1. weed control	Soil investigation					✓					
	Soil amelioration (if req)										
	Selective seeding (if req)										
AER UPDATE:	No work undertaken during 2020. Inspection indicates favourable trajectory emerging.										
HVOCAR200901 [Carrington, 14.2ha]		5									
Priorities	Stem thinning										19Q2
1. open canopy	Weed control										
2. weed control	Selective seeding										
3. drainage review	Drainage review										
AER UPDATE:	No work undertaken during 2020.										
HVOCAR200902 [Carrington, 7.7ha]		5									
Priorities	Stem thinning										Weeds
1. open canopy	Weed control										
2. weed control	Selective seeding										
3. increase diversity											
AER UPDATE:	No work undertaken during 2020.										

Notes:
Work to occur across the periods shown, however may not occur in all periods shown.
Relative priorities balance addressing at-risk areas with maintaining areas demonstrating favourable trajectories.
2020 work plans are indicative only. Final 2020 plans to be informed by observations and trajectory at 2019 monitoring events, and will be detailed in annual reporting.
Changes to work plans may occur due to weather events and climatic influences. Where work components are not undertaken details will be provided in annual reporting.
Maintenance of HVOCHE201802 reflects that the block is temporary rehab of an interim landform and will be subsequently re-disturbed by overburden emplacement.

Legend - Rehab Trajectory (after CPS monitoring 2018/19)

Blue	Tracking towards success but needs work
Yellow	Stable but need work to improve
Orange	Failing
Red	Failed
Pink	Not monitored

Legend - planned work

Dark grey	Primary task timing
Light grey	Secondary timing (contingency / follow-up as needed)

Legend - updates

✓ done

Legend - s240 Issue (2018/2019 s240 Notices)

Veg, Weeds	2018 TARP Monitoring event & event trigger(s)
19Q2	2019 Additional sites monitoring event
GMD Rollback	Failed block - phase reversion to Growth Med. Dev.

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HVO s240 Rehab Maintenance Schedule - Growth Medium Development Progression [2020 AER Update]								
Location	**Maintenance**	**Relative Priority**	**2019**	**2020**	**2021**	**2022**	**2023+**	**s240 Issue**
West North 230 2014 Flat [14.1ha]		**1**						
Priorities	Slashing, spraying		✓	✓				
1. weed control - break seed cycle, prevent exotic re-establishment	Drainage improvement							GMD
2. establish pioneer native species	Seeding							Phase
3. weed control - manage competition								
AER UPDATE:	Ground preparation maintenance undertaken.							
	Progression to final cover now to occur during 2021.							
West North 230 East Batter [18.3ha]		**1**						
Priorities	Sink hole repairs							
1. repair sinkholes	Slashing, spraying			✓				GMD
2. weed control - break seed cycle, prevent exotic re-establishment	Develop intervention plan			✓				Phase
3. improve growth medium	Plan execution							
AER UPDATE:	Lmitied intial ground preparation maintenance undertaken in association with neighbouring block. .							
	Progression now to occur during 2021.							
Riverview Glider RL80 [7.6ha]		**1**						
Priorities	Enlarge sediment dam for increased catchment							
1. enlarge sediment dam	Slashing / spraying		✓	✓				GMD
2. weed control - break seed cycle, prevent exotic re-establishment	Pre-sowing herbicide application (if needed)							Phase
3. establish pioneer native species	Sow final vegetation							
AER UPDATE:	Initial slashing completed.							
	Poriton of area planned for topsoil stockpiling.							
Cheshunt Barrys Amphitheatre [5.9ha]		**1**						
Priorities	Pre-sowing herbicide application / spot-spray			✓				
1. establish pioneer native species (slope stability)	Sow native pioneers (grasses)							GMD
2. weed control	Increase native diversity / sow final vegetation							Phase
3. progression to final vegetation								
AER UPDATE:	Maintenance weed controls undertaken during 2020.							
	Anticipated seeding in 2021 in ssociation with adjacent GMD areas along base of landform.							
Cheshunt Barrys Upper West Slope [17ha]		**1**						
Priorities	Re-establish / maintain cover crop		✓					
1. weed control / sowing preparation	Pre-sowing herbicide application / spot-spray		✓	✓				GMD
2. sow to final cover	Sow final vegetation			✓				Phase
3. weed control / monitor trajectory								
AER UPDATE:	Maintenance weed controls and ground preparations completed.							
	Sown to final native cover.							
West Wilton 210 2014 Flat [9.6ha]		**2**						
Priorities	Slashing, spot spraying		✓	✓				
1. weed control - exotic grasses	Sow native pioneers							GMD
2. augment existing native grasses / establish pioneer native species	Increase native diversity							Phase
AER UPDATE:	Maintenance weed controls and ground preparations undertaken during 2020.							
	Anticipated seeding in early 2021.							
Cheshunt Barrys Lower West Slope (east) [chute to amphitheatre, 12.1ha]		**2**						
Priorities	Weed control		✓	✓				
1. weed control	Soil investigation			✓				GMD
2. understanding growth medium	Soil amelioration (if required)							Phase
3. intervention plan development	Sow final vegetation							
AER UPDATE:	Maintenance weed controls and ground prep / rill repairs undertaken during 2020.							
	Planned sowing of final cover during 2021.							
Cheshunt Barrys Lower West Slope (west) [west of amphitheatre, 5.7ha]		**2**						
Priorities	Pre-sowing herbicide application / spot-spray		✓	✓				
1. weed control / sowing preparation	Sow final vegetation			partial				GMD
2. sow to final cover								Phase
3. weed control / monitor trajectory								
AER UPDATE:	Initial weed control and ground prep / rill repairs completed.							
	Initial portion sown in association with adjacent Barrys blocks (5.3ha of 23.7ha).							
	Planned completion during 2021.							
Cheshunt Rim [north, central & south; 87.6ha]		**2**						
Priorities	Develop intervention plan			✓				
1. intervention plan development (livestock grazing based)	Install grazing infrastructure							GMD
2. grazing introduction	Plan execution							Phase
3. sequenced progression to final vegetation								
AER UPDATE:	To be grazed as interim management regime and to assist in progressing to final cover.							
	Fencing and watering points to be installed during 2021.							
	Sequenced progression to final woodland cover over subsequent years.							
Cheshunt Barrys RL155 2018 Topsoil [7.8ha]		**2**						
Priorities	Re-establish cover crop		✓					
1. weed control - prevent establishment	Residual herbicide application			✓				GMD
2. establish pioneer native species	Sow native pioneers (grasses)			✓				Phase
3. manage for re-disturbance (over-dumping)	Sow native pioneers (trees & shrubs)							
AER UPDATE:	Sown to interim native grass cover.							
	To be redisturbed in 2021 and 2022. Limited furher work anticipated.							
Cheshunt Barrys RL155 2013 Topsoil [27.9ha]		**2**						
Priorities	Residual herbicide application			✓				
1. weed control	Slashing / ongoing spraying							GMD
2. manage for re-disturbance (over-dumping)	Sow native pioneers (grasses)							Phase
AER UPDATE:	Initial works completed.							
	To be redisturbed in 2021 and 2021. Further work on opportune basis based on topsoil placement plan.							
Cheshunt Polo Green [52.4ha]		**3**						
Priorities	Develop intervention plan							
1. intervention plan development (livestock grazing based)	Install grazing infrastructure							GMD
2. grazing introduction	Plan execution							Phase
3. sequenced progression to final vegetation								
AER UPDATE:	To be fenced and grazed in association with wider Cheshunt Rim during 2021.							
	Identified as potential topsoil stocpile location.							
West North 230 North Batter [22.8ha]		**3**						
Priorities	Monitor landform & drainage stability		✓	✓				

HVO s240 Rehab Maintenance Schedule - Growth Medium Development Progression [2020 AER Update]								
Location	**Maintenance**	**Relative Priority**	**2019**	**2020**	**2021**	**2022**	**2023+**	**s240 Issue**
1. monitor landform stability	Develop intervention plan							GMD
2. intervention plan development	Plan execution							Phase
AER UPDATE:	Limited work during 2020 (MOP). Planned for progression to final cover during late 2021.							

HVO s240 Rehab Maintenance Schedule - Growth Medium Development Progression [2020 AER Update]

Location	Maintenance	Relative Priority	2019	2020	2021	2022	2023+	s240 Issue
West Wilton 210 2013 North Batter [13ha]		3						
Priorities	Monitor landform & drainage stability			✓				
1. monitor landform stability	Develop intervention plan							GMD Phase
2. intervention plan development	Plan execution							
AER UPDATE:	Limited work during 2020 (MOP). Planned for progression to final covers during 2022 and 2023.							
Carrington Western OEA [88.6ha]		3						
Priorities	Develop intervention plan			✓				
1. intervention plan development (livestock grazing based)	Install grazing infrastructure							GMD Phase
2. grazing introduction	Plan execution							
3. sequenced progression to final vegetation								
AER UPDATE:	To be grazed as interim management regime and to assist in progressing to final cover. Fencing and watering points to be installed during 2021. Sequenced progression to final woodland cover over subsequent years.							
South East TSF [23.6ha]		3						
Priorities	Hold on ground works proposed during capping							
1. recommence capping (in process)	Review medium term landform and drainage plans							GMD Phase
2. review rehab strategy following cap establishment								
AER UPDATE:	Capping works recommenced and initial capping layer completed. Construction of subsequent layers to remain ongoing. Further work on hold until future mine interactions understood.							
Riverview Void [Western Amphitheatre, Void Slope; 34.2]		3						
Priorities	Pre-sowing herbicide application (if needed)							
1. weed control / sowing preparation	Ground preparation							GMD Phase
2. establish pioneer native species	Aerial seed (drone / light aircraft)							
3. manage for re-disturbance								
AER UPDATE:	No work occurred during 2020. Likely to be redisturbed over forward term. Further work on hold until mine interactions understood.							
Riverview 125 Pasture / CHE2 AOM [12.9ha]		3						
Priorities	Slashing / spraying		✓					
1. weed control								GMD Phase
2. manage for re-disturbance (mine advance)								
AER UPDATE:	No rehabilitation work occurred during 2020 however bthe lock was substantively redisturbed for mine advance. No further work proposed.							
Riverview 145 Pasture / CHE1 AOM [30.2ha]		3						
Priorities	Slashing / spraying		✓					
1. weed control								GMD Phase
2. manage for re-disturbance (mine advance)								
AER UPDATE:	Weed control and ground preparation works were undertaken ahead of disturbance activities. Similar work is planned to occur in association with mine advance.							

Notes:
Work anticipated to occur across the periods shown, however may not occur in all periods shown.
Changes to work plans may occur due to weather events, climatic influences, and operational interactions. Where work components are not undertaken details will be provided in annual reporting.

Legend		Legend - planned work	
(yellow)	Area in Growth Medium Development phase	(dark grey)	Primary task timing
		(light grey)	Secondary timing (contingency / follow-up as needed)

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HVO s240 Rehab Maintenance Schedule - Other Maintenance [2020 AER Update]								
Location	**Planning & Maintenance**	**Relative Priority**	**2019**	**2020**	**2021**	**2022**	**2023+**	**s240 Issue**
North Rehab / Former East TSF / Dam 5N catchment		1						
Context / background	Routine inspection of initial stabilisation works		✓	✓				
* Integrated drainage is degarded. Turbid water has flowed off site.	Expert development of detailed intervention plan		✓	✓				Other Maint.
* Vegetation development appears constrained in places.	Plan implementation							
AER UPDATE:	Remediation Plan development including works to support a High Risk Activity Notice application remain in process.							
West South drainage chute		2						
Context / background	Confirm reporting catchment and design adequacy							
* initial migration of rock in drainage chute	Repair / upgrade drainage chute							Other Maint.
* timely repair may prevent major failure								
AER UPDATE:	No work undertaken during 2029.							
Cheshunt Rim drainage		2						
Context / background	Detailed drainage design for future layout							
* Catchment modifying with development of upper level dumps.	Construct / upgrade / repair drainage incl. chute							Other Maint.
* Existing central chute failed.								
* Clarification of future needs required prior to repair / replacement.								
AER UPDATE:	No work undertaken during 2029.							
West South historic rehab		2						
Context / background	Review area drainage			Y				
* Integrated drainage throughout catchment is degraded.	Develop detailed, sequenced improvement plan(s)							Other Maint.
* Complex cycling occurring (e.g. fruiting fungi) in association with presence of undesirable species. Targeted corrective actions required.								
AER UPDATE:	No work undertaken during 2029.							
Historic rehabilitation areas (generally)		4						
Context / background	Conduct verification inspections			✓				
* Walkover identified minor issues in various historic catchments	Identify issues of elevated rehab progression risk			✓				Other Maint.
* Risk ranking / prioritisation required to support decision making & resource allocation	Develop maintenance task scopes and priorities			✓				
AER UPDATE:	Inspections completed. Initial scoopes and costing estimates completed.							

Notes:
Initial tasks identified from GCAA Annual Rehab Walkover. Other sources may include: Monthly Inspections, discussions and informal reports.
Work anticipated to occur across the periods shown, however may not occur in all periods shown.
Changes to work plans may occur due to weather events, climatic influences, and operational interactions. Where work components are not undertaken details will be provided in annual reporting.
Outcomes of plan development tasks to be reported at annual reporting and be reflected in subsequent annual work plans.

Legend		Legend - planned work		Legend - updates	
	Other / general rehab maintenance		Primary task timing	✓	Done
			Secondary timing (contingency / follow-up as needed)		

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Appendix D - Aboriginal Heritage Management Plan Compliance Audit Inspections

Hunter Valley Operations Aboriginal Heritage Management Plans November 2020 Compliance Audit Inspections

Report prepared for

Hunter Valley Operations

November 2020

Joel Deacon

ARROW HERITAGE SOLUTIONS

Introduction

The Hunter Valley Operations Joint Venture (HVOJV) manages the Hunter Valley Operations (HVO) mining complex and associated Biodiversity Areas located in the Hunter Valley. The HVOJV provides management services that include accountability for Aboriginal cultural heritage (ACH) and community consultation.

The development of HVO's mining operations has occurred through a process of expansion and acquisition, and as a result there are two separate development approvals that apply to the operation - HVO North (DA_450-10-2003) and HVO South (PA_06_0261). The mining & processing activities at HVO are geographically divided by the Hunter River, with movement of coal, overburden, equipment, materials and personnel between two operational areas.

Each consent contains a condition requiring the development of an Aboriginal Heritage Management Plan (AHMP). Such plans have been developed (in consultation with the Aboriginal community through the HVO Cultural Heritage Working Group [CHWG]) and approved for each operational area. Within each of these plans provision is made to conduct annual AHMP compliance inspections (biannual for HVO South) with members of the Aboriginal community throughout the life of operations. The purpose of the compliance inspections is to afford the Aboriginal stakeholders and the HVOJV:

- the opportunity to visit mine operations and mine areas to inspect the operational compliance with AHMP provisions and Ground Disturbance Permit procedures;
- to inspect and monitor the condition and management of various ACH sites; and
- to review the effectiveness and performance of AHMP provisions in the management of cultural heritage at the mine.

Due to the number of cultural heritage sites within the AHMP areas & the time foreseen to inspect all sites, it is not feasible to inspect every ACH site during the same field trip. Therefore, a regular, rolling program of compliance inspections has been implemented that will visit all sites periodically each & every year. A record will be kept of each compliance inspection against each cultural heritage site, so that it can be ensured that each site is inspected regularly.

Proposed Activity and Project Brief

The compliance inspections involved the following elements:

- An AHMP compliance inspection report pro-forma was completed for each ACH site or area visited;
- Photographs of the inspected ACH sites were also taken;
- The pro-forma noted the outcomes of the inspections including evidence of compliance and non-compliance with AHMP provisions, recommendations on modifications and improvements to management provisions and/or recommendations on corrective actions;
- Specific site condition monitoring inspection of CM-CD1, as per Schedule 15 of the HVO North HMP.

Timing & Personnel

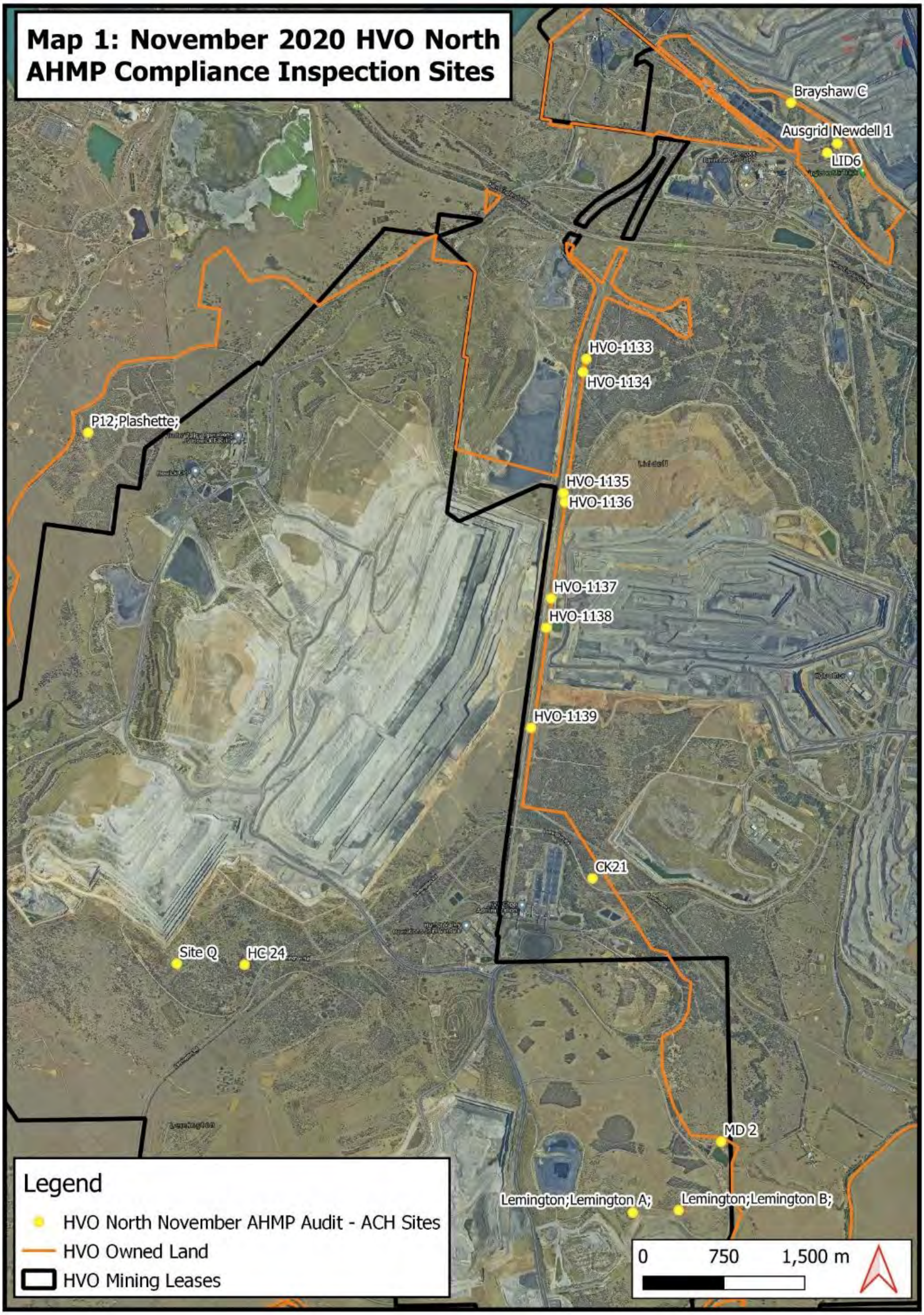
The HVO November 2019 AHMP compliance inspection program was conducted between 4-6 November 2020. The personnel involved in these inspections were:

- Joel Deacon (Arrow Heritage Solutions Principal Archaeologist)
- Peter Bowman (HVO Environment and Community Officer)
- Rhonda Ward (CHWG Representative – Ungooroo Community and Cultural Services)
- George Sampson (CHWG Representative – Cacatua Cultural Services)
- Aden Perry (CHWG Representative – Upper Hunter Wonnarua Council)

Arrow Heritage Solutions were engaged as independent heritage consultants to conduct the AHMP compliance inspections, and Joel Deacon acted as technical advisor and author of this report. HVO's Environment & Community Officer Peter Bowman arranged the compliance inspection programs and escorted the field team.

HVO North AHMP Compliance Inspection

A total of 17 ACH sites were inspected across various areas at HVO North, including in the vicinity of the Newdell Loading Facility, the HVO North conveyor, Howick, Mitchell Pit north-east and the Carrington Pit east area (see Map 1). Although not active mining zones, these areas were selected for inspection for a variety of reasons. Some of the sites are located adjacent to mining pits or active infrastructure areas, while others were visited to obtain further information regarding their extent, contents and condition as the information contained in the HVO sites database was lacking in some regard.


Map 1: November 2020 HVO North AHMP Compliance Inspection Sites
Brayshaw C
Ausgrid Newdell 1
LID6
HVO-1133
HVO-1134
P12;Plashette;
HVO-1135
HVO-1136
HVO-1137
HVO-1138
HVO-1139
CK21
Site Q
HC 24
MD 2
Lemington;Lemington A;
Lemington;Lemington B;
Legend
HVO North November AHMP Audit - ACH Sites
HVO Owned Land
HVO Mining Leases
0
750
1,500 m

Results

Table 1 details the results of the HVO North compliance inspection and summarises the information recorded on the individual pro-forma inspection sheets. Using a mobile mapper pre-loaded with the GIS co-ordinates for each Aboriginal heritage site, the field team travelled to each locale and attempted to re-identify each site. Sometimes this was not possible due to poor ground surface visibility (GSV), a result which in itself was not overly significant as long as it was determined that the vicinity had not been inadvertently disturbed. Another factor affecting site re-identification was the age of the original recording and the lack of data recorded. The presence and condition of barricading or fencing was noted, as well as the presence and nature of various potential site disturbing factors (e.g erosion, animal, human). General observations of each site were made if necessary, and, based on information provided for all of the above factors, management recommendations were discussed and agreed by the field team for each site.

Site Name	Date Inspected	Site re-identified?	Site intact?	Site fenced/ barricaded?	Fencing/ barricading intact?	Natural erosion	Livestock damage	Human disturbance	Animal disturbance	Pests & weeds	General observations	Management recommendations
37-2-0528 Site Q	6/11/20	No	Yes	No	-	Yes	No	No	No	No	-	nil
37-2-0559 P12; Plashette	6/11/20	Yes	Yes	No	-	Yes	No	Yes – dam	No	No	Co-ordinates slightly out.	Update co-ordinates on HVO database.
37-2-0800 HC 24	6/11/20	Yes	Yes	No	-	Yes	No	No	No	No	Co-ordinates slightly out.	Update co-ordinates on HVO database.
37-2-1951 CK21	6/11/20	No	Yes	No	-	No	No	No	No	No	Zero ground surface visibility	nil
37-2-5061 HVO-1133	5/11/20	No	Yes	Yes	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure	Site locations were only observed from a distance – no obvious disturbance.	Find access to other side of conveyor for inspection next audit.
37-2-5062 HVO-1134	5/11/20	No	Yes	Yes	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure	Site locations were only observed from a distance – no obvious disturbance.	Find access to other side of conveyor for inspection next audit.
37-2-5063 HVO-1136	5/11/20	No	Yes	Yes	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure	Site locations were only observed from a distance – no obvious disturbance.	Find access to other side of conveyor for inspection next audit.
37-2-5064 HVO-1138	5/11/20	No	Yes	Yes	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure	Site locations were only observed from a distance – no obvious disturbance.	Find access to other side of conveyor for inspection next audit.
37-2-5065 HVO-1139	5/11/20	No	Yes	Yes	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure	Site locations were only observed from a distance – no obvious disturbance.	Find access to other side of conveyor for inspection next audit.
37-2-5315 HVO-1135	5/11/20	No	Yes	Yes	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure	Site locations were only observed from a distance – no obvious disturbance.	Find access to other side of conveyor for inspection next audit.
37-2-5316 HVO-1137	5/11/20	No	Yes	Yes	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure	Site locations were only observed from a distance – no obvious disturbance.	Find access to other side of conveyor for inspection next audit.
37-3-0034 Lemington B	6/11/20	No	No	No	-	Site confirmed to be in mined out area and destroyed, as was suspected.					-	Amend site record to ‘destroyed’

37-3-0035 Lemington A	6/11/20	No	No	No	-	Site confirmed to be in mined out area and destroyed, as was suspected.					-	Amend site record to 'destroyed'
37-3-0286 MD 2	6/11/20	Yes	Yes	Yes	Yes	No	No	Yes - ditches	No	No	Artefacts found inside barricading and outside.	Update site extent and amend barricading to include.
37-3-0449 LID6	6/11/20	Yes	Yes	Yes	No	Yes	No	Yes – covers old track	No	Prickly pear	Artefacts found inside barricading and outside.	Update site extent and amend barricading to include.
37-3-0459 Brayshaw C	6/11/20	No	Yes	No	-	No	No	No	No	Prickly pear	No ground surface visibility	Nil
37-3-1210 Ausgrid Newdell 1	6/11/20	No	Yes	No	-	No	No	Yes – mowed Ausgrid compound	No	No	Possibly outside of HVO lands	Obtain site card

Table 1: Results of the November 2020 HVO North Aboriginal Sites Compliance Inspection

Aboriginal Site Management Recommendations

Management recommendations were provided for many of the Aboriginal heritage sites visited. The nature of these recommendations are described below.

Update site extent and amend barricading

Sites: MD 2; LID6

MD 2 and LID6 have been barricaded in the past and are located in areas that are subject to moderate levels of mining activity or grazing. It was noted during the current inspection that artefactual material extended beyond the extent of the current barricading. The newly identified site extents should be updated on the HVO ACH GIS system and these areas included within the barricaded area.

Area where artefacts were noted on opposite side of creek to currently barricaded 'LID6' site.

It should be noted that the new and upgraded barricading specification being trialled and installed at several ACH sites across HVO was received positively by the RAPs in attendance and should be considered as a favourable option when upgraded site protection is warranted.

Request and assess further site information

Sites: Ausgrid Newdell 1

This site was unable to be re-identified during the audit inspection, and prior to any further attempts at re-identification it would be beneficial to obtain the Aboriginal Heritage Management Information System (AHIMS) site card. The site was recorded by a third party and minimal information is held by HVO regarding its nature or size. Examination of the AHIMS site card would assist in determining whether the site was located on HVO-owned land.

Update HVO Aboriginal sites databases

Sites: P12 Plashette; HC-24

During the current inspection it was found that the actual location of these sites was slightly away from their recorded co-ordinates, which was not surprising considering the age of the assessments when they were originally recorded. The newly re-recorded site locations and extents should be updated within the "HVO_sites_current" and "HVO_site_extents" GIS databases to maintain their accuracy.

Access during next AHMP audit inspection

Sites: HVO-1133 through 1139

These sites are located on the eastern side of the HVO North conveyor where access is not readily available. During the current inspection these sites were only able to be observed from vantage-points on the western side of the conveyor. Although no disturbance was apparent, it will be necessary to make closer observations during the next planned AHMP audit to confirm this. A powerline does traverse through most of the area where the sites are located, and so this might provide adequate access once appropriate permissions are obtained.

Amend databases to change site status

Sites: Lemington A, Lemington B

Both these sites have been misplotted in AHIMS and noted as being still valid. During the current inspection, the more accurate site locations held by HVO were investigated to ascertain whether or not the sites remain in situ. Although unable to be visited specifically, it was clear that the locations where HVO have plotted these sites are in heavily disturbed and rehabilitated landforms. A process of reconciliation between the HVO and AHIMS ACH site databases is underway, and the information gained from this inspection will be used to move the AHIMS points to the HVO locations, and mark both sites as destroyed on both databases.

CM-CD1

The HVO North HMP (Schedule 15) contains a specific Plan of Management for Aboriginal site CM-CD1 (AHIMS ID 37-2-1877) that includes a description of measures that would be implemented to protect, monitor and manage potential impacts on the site by HVO North's mining operations and associated activities. As shown in Map 2, CM-CD1 includes an area c.450m long and up to 25m in width and is located immediately to the west of HVO Carrington Pit and c.900m north of the Hunter River.

As part of the brief for the HVO North AHMP compliance inspection audit, the consultant was also required to audit the current condition of CM-CD1 with reference to the management measures outlined in Schedule 15 of the HVO AHMP. It should be positively noted that the elements of the management regime identified in previous compliance audits continue to ne robustly applied. The maintenance of these management processes will be the ongoing focus of compliance audits at CM-CD1:

1. A disturbance exclusion buffer area will be maintained around Aboriginal cultural heritage site 37-2-1877 (CM-CD1) of not less than 20m from the boundary of the recorded extent of the CM-CD1 site and incorporating the Older Stratum.
   During the November 2020 inspection of CM-CD1 no ground disturbance was noted within the disturbance exclusion buffer area (as depicted in Map 2 and the co-ordinates in 2. below). This is evident through comparison of photographs from the current and the previous two audit inspections.

2. The CM-CD1 disturbance exclusion buffer area will be aligned within the following coordinates (MGA 94):
   i. North-East corner at E308805 and N6403833
   ii. North-West corner at E308696 and N6403791
   iii. South-West corner at E308861 and N6403341
   iv. South-East corner at E308996 and N6403355
   See Point 1.

3. The CM-CD1 disturbance exclusion buffer area is to be zoned as a Zone 1 Restricted Access Area within the HVO North Cultural Heritage Zoning Scheme (CHZS). All development disturbance activities are to be excluded from within the buffer area.
   The CM-CD1 exclusion area is zoned as Zone 1 in the HVO North CHZS.


Map 2 Aboriginal heritage site CM-CD1 showing protective buffers
HVO_CMCD1Extent
HVO_CMCD1Buffer20m_2013
HVO_CMCD1BufferDisturbanceExclusion
CMCD1_FENCING
former alignment
new fenceline
50 0 50 100 150 200 m

4. The CM-CD1 disturbance exclusion buffer area will be delineated with stock-proof fencing and appropriate signage denoting that the area is a Restricted Access Area and no ground disturbance is authorised within the buffer area except where such ground disturbance is authorised under the provisions of this Plan of Management. Ground disturbance, such as for archaeological investigations, may require a consent under relevant legislation.
   The entirety of CM-CD1, including a substantial buffer, has been delineated with stock-proof fencing and adequate Cultural Heritage Site signage is visible on the fence.

5. Access within the CM-CD1 disturbance exclusion buffer area will be limited to authorised personnel and visitors only either on foot (e.g. for monitoring inspections) or in light vehicles (e.g. for pest, weed and fire management) for the purposes of implementing the management provisions approved under this Plan of Management.
   No evidence was noted to suggest the contrary has occurred.

6. An annual site condition monitoring inspection will be conducted by HVO personnel with representatives of the CHWG and the results of the inspection reported as an element of the HVO North DA 450-10-2003 Annual Environmental Management Report. The results of the inspection will also be reported to Aboriginal community stakeholders through the CHWG and/or other relevant Aboriginal community consultation forum.
   This report documents the 2020 annual site condition monitoring inspection.

7. A series of condition and disturbance monitoring photo points will be established within the CM-CD1 disturbance exclusion buffer area and condition monitoring images taken during the course of the annual monitoring inspection.
   Five photographic monitoring points have been established from where disturbance monitoring photographs of CM-CD1 are taken. These points are located in the north-west, north-east, south-west and south-east of the site, as well as the centre. These photographs and their locational information are contained in Appendix A of this report.

8. HVO will determine the nature and risks of potential impacts of blasting activities upon site CM-CD1 as an element of the HVO North blast management plan. Consistent with the results of the risk assessment process used to inform the development of the HVO North blast management plan, HVO will implement appropriate management measures to protect site CM-CD1 from any adverse impact that may be caused by blasting in a manner consistent with the provisions of this Plan of Management. In accordance with Schedule 4 of Condition 40 of the Approval, regular visual monitoring will be undertaken to confirm that impacts have not been caused by blasting vibration or from flyrock impacts.

   No evidence of any blasting-related disturbance or flyrock impacts were noted during the site inspection. Indeed, blasting activity in the Carrington Pit ceased on the 17th October 2018 and mining and blasting activity was been focused on the eastern side of the Carrington Pit in the years leading up to the cessation of blasting.

9. As mining, and related blasting activities, approach the CM-CD1 disturbance exclusion buffer area, regular visual monitoring to confirm that impacts have not been caused by blasting vibration will be conducted by HVO personnel. Damage to CM-CD1 caused by flyrock is considered a very low risk, however, if it is evident, through regular monitoring, that this risk profile may increase in the future, protective management measures will be considered.

   See above Point 8.

10. A variety of land management activities will be required to maintain the cultural and environmental values of the CM-CD1 disturbance exclusion buffer area. Land management activities approved under this HMP are as follows.

    i. Hand or light vehicle spraying of weeds.
    ii. Brush cutting by hand to control weeds and vegetation.
    iii. Prescribed burning and fire protection management.
    iv. Maintenance of fencing including replacement of posts as required.

    No evidence was noted of any adverse impacts to CM-CD1 by any of the land management practices listed above, with no evidence of site disturbance arising from the erection of the new fencing.

    However, it was noted that weed and vegetation growth throughout the CM-CD1 disturbance exclusion buffer area was very high. Also, feral pig

activity was noted within the fenced area, but outside the disturbance exclusion zone buffer. Potential management measures were discussed with the field team and are presented as recommendations below.

Evidence of pig digging and weed growth within fenced area but outside of CM-CD1 disturbance exclusion buffer zone.

Recommendations

CM-CD1 is being managed well, with no evident impacts to the site's cultural heritage values. All recommended actions from previous compliance inspections have been implemented. The following recommendations relate to land management activities that could be implemented to maintain the environmental values of the site:

- **Using a hand-held brush-cutter and proceeding on foot, the 20m CM-CD1 buffer area (as depicted within Map 2) should be subject to weed and vegetation growth slashing;**
- **The remainder of the CM-CD1 fenced area should be subject to machine slashing to reduce weed and vegetation growth; and**
- **The CM-CD1 area should be targeted during the next round of HVO's vermin control program in order to reduce feral pig disturbance as much as possible.**

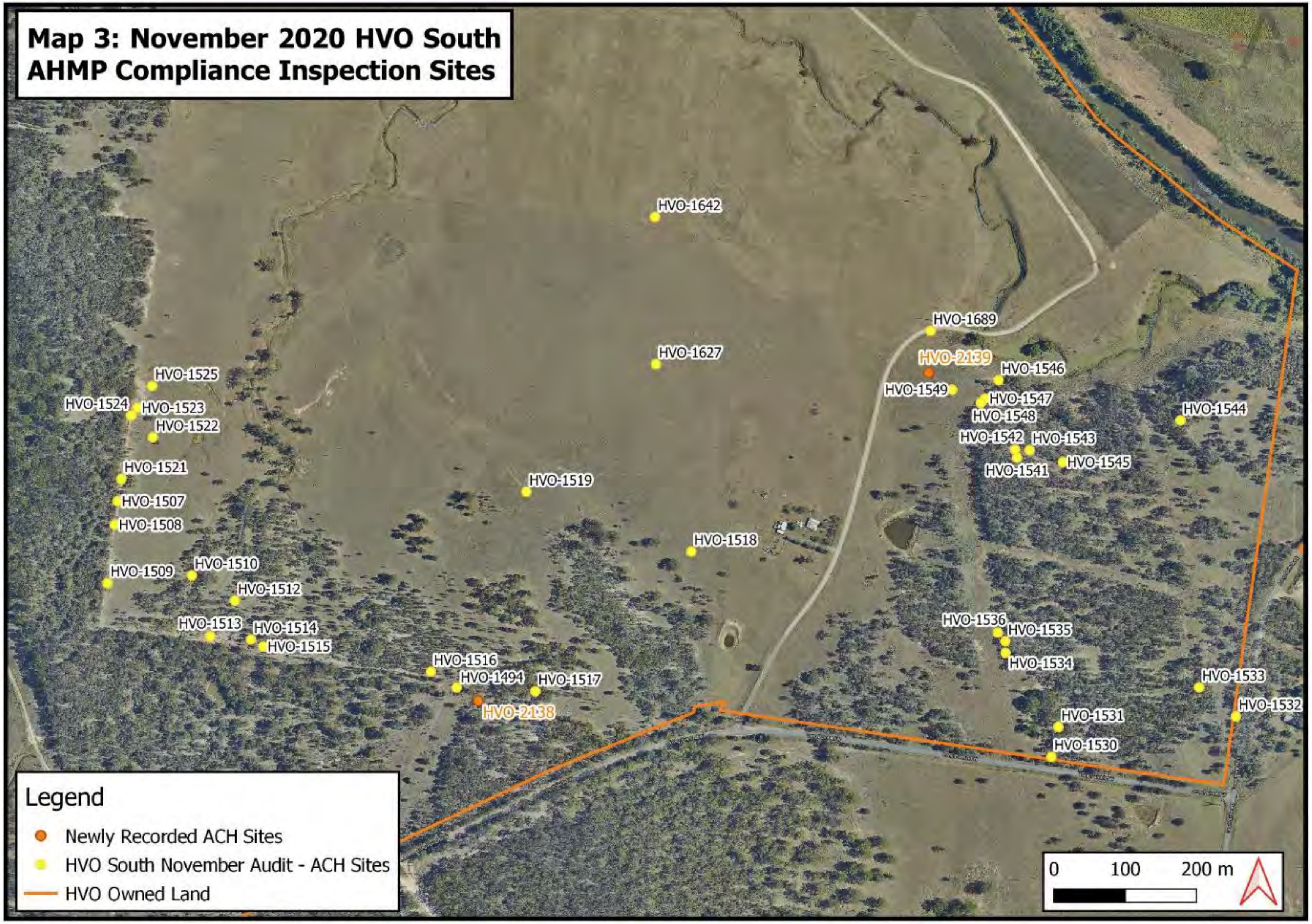
HVO South AHMP Compliance Inspection

A total of 37 Aboriginal heritage sites were inspected in the HVO Southern area via Long Point Road at HVO South (see Map 3). Although not an active mining zone, this area was selected for inspection as it is frequently accessed by third party users for activities associated with powerline maintenance and grazing.

Results

Table 2 summarises the results of the HVO South compliance inspection and summarises the information recorded on the individual pro-forma inspection sheets. Using a mobile mapper pre-loaded with the GIS co-ordinates for each Aboriginal heritage site, the field team travelled to each location and attempted to re-identify each site. Sometimes this was not possible due to poor ground surface visibility (GSV), a result which in itself was not overly significant as long as it was determined that the vicinity had not been inadvertently disturbed. The presence and condition of barricading or fencing was noted, as well as the presence and nature of various potential site disturbing factors (e.g erosion, animal, human). General observations of each site were made if necessary, and, based on information provided for all of the above factors, management recommendations were discussed and agreed by the field team for each site.

Two previously unrecorded ACH sites were also located and added into the HVO ACH sites database


Map 3: November 2020 HVO South AHMP Compliance Inspection Sites
HVO-1642
HVO-1689
HVO-2139
HVO-1546
HVO-1549
HVO-1547
HVO-1548
HVO-1542
HVO-1543
HVO-1541
HVO-1545
HVO-1544
HVO-1627
HVO-1525
HVO-1524
HVO-1523
HVO-1522
HVO-1521
HVO-1507
HVO-1508
HVO-1519
HVO-1518
HVO-1509
HVO-1510
HVO-1512
HVO-1513
HVO-1514
HVO-1515
HVO-1516
HVO-1494
HVO-1517
HVO-2138
HVO-1536
HVO-1535
HVO-1534
HVO-1533
HVO-1532
HVO-1531
HVO-1530
Legend
Newly Recorded ACH Sites
HVO South November Audit - ACH Sites
HVO Owned Land
0
100
200 m

Site Name	Date Inspected	Site re-identified	Site intact?	Site fenced/ barricaded?	Fencing/ barricading intact?	Natural erosion	Livestock damage	Human disturbance	Animal disturbance	Pests & weeds	General observations	Management recommendations
HVO-1494	4/11/2020	No	Yes	No	-	No	No	No	No	No	-	Nil
HVO-1507	4/11/2020	Yes	Yes	No	-	No	No	No	No	No	-	Nil
HVO-1508	4/11/2020	No	Yes	No	-	No	No	No	No	No	-	Nil
HVO-1509	4/11/2020	No	Yes	No	-	No	No	No	No	No	-	Nil
HVO-1510	4/11/2020	Yes	Yes	No	-	No	No	No	No	No	-	Nil
HVO-1512	4/11/2020	Yes	Yes	No	-	No	No	No	No	No	-	Nil
HVO-1513	4/11/2020	Yes	Yes	No	-	No	No	No	No	No	Site noted as more extensive	Amend HVO sites database to refine extent
HVO-1514	4/11/2020	Yes	Yes	No	-	No	No	No	No	No	-	Nil
HVO-1515	4/11/2020	Yes	Yes	No	-	No	No	No	No	No	Site noted as more extensive	Amend HVO sites database to refine extent
HVO-1516	4/11/2020	Yes	Yes	No	-	No	No	No	No	No	-	Nil
HVO-1517	4/11/2020	No	Yes	No	-	No	No	Very old track	No	No	-	Nil
HVO-1518	4/11/2020	No	Yes	No	-	No	No	No	No	No	Very thick ground cover	Nil
HVO-1519	4/11/2020	Yes	Yes	No	-	No	No	No	No	No	-	Nil
HVO-1521	4/11/2020	Yes	Yes	No	-	No	No	No	No	No	-	Nil
HVO-1522	4/11/2020	Yes	Yes	No	-	No	No	No	No	No	-	Nil
HVO-1523	4/11/2020	Yes	Yes	No	-	No	No	No	No	No	-	Nil
HVO-1524	4/11/2020	Yes	Yes	No	-	No	No	No	No	No	Site noted as more extensive	Amend HVO sites database to refine extent
HVO-1525	4/11/2020	Yes	Yes	No	-	No	No	No	No	No	-	Nil
HVO-1530	4/11/2020	Yes	Yes	No	-	No	No	No	No	No	-	Nil
HVO-1531	4/11/2020	Yes	Yes	No	-	No	No	No	No	No	-	Nil
HVO-1532	4/11/2020	Yes	Yes	No	-	No	No	Roadside rubbish	No	No	-	Nil
HVO-1533	4/11/2020	Yes	Yes	No	-	Within creek line	No	No	No	No	-	Nil

HVO-1534	4/11/2020	Yes	Yes	No	-	No	No	On edge of powerline easement	No	No	-	Barricade site or re-route track
HVO-1535	4/11/2020	Yes	Yes	No	-	No	No	In powerline easement	No	No	-	Barricade site or re-route track
HVO-1536	4/11/2020	Yes	Yes	No	-	No	No	In powerline easement	No	No	-	Barricade site or re-route track
HVO-1541	4/11/2020	Yes	Yes	No	-	Yes	No	Very old track	No	No	-	Nil
HVO-1542	4/11/2020	Yes	Yes	No	-	No	No	No	No	No	-	Nil
HVO-1543	4/11/2020	Yes	Yes	No	-	No	No	No	No	Cactus	-	Nil
HVO-1544	4/11/2020	Yes	Yes	No	-	No	No	No	No	Yes	-	Nil
HVO-1545	4/11/2020	Yes	Yes	No	-	No	No	No	No	Cactus	-	Nil
HVO-1546	4/11/2020	Yes	Yes	No	-	Steep slope	No	No	No	No	Site noted as more extensive	Amend HVO sites database to refine extent
HVO-1547	4/11/2020	Yes	Yes	No	-	Slight	No	No	No	No	Site noted as more extensive	Amend HVO sites database to refine extent
HVO-1548	4/11/2020	Yes	Yes	No	-	No	No	No	No	No	Site noted as more extensive	Amend HVO sites database to refine extent
HVO-1549	4/11/2020	Yes	Yes	No	-	No	No	On old track	No	Yes	Site noted as more extensive	Amend HVO sites database to refine extent, and barricade site or re-route track
HVO-1627	4/11/2020	No	Yes	No	-	No	No	No	No	Thick thistle	-	Nil
HVO-1642	4/11/2020	No	Yes	No	-	No	No	No	No	Thick thistle	-	Nil
HVO-1689	4/11/2020	No	Yes	No	-	No	No	No	No	No	Thick ground cover	Nil

Table 2: Results of the November 2020 HVO South Aboriginal Sites Compliance Inspection

Newly Recorded Aboriginal Sites

During the course of the current audit, two additional previously unrecorded ACH sites were located by the field team (shown in Map 3), which will be registered on AHIMS.

HVO-2138

319716E 6394495N (GDA94z56)

A single flake of mudstone located in an exposure caused by animal burrowing. The find is located 35m from HVO-1494 in a wooded paddock north of Long Point Rd.

HVO-2139

320348E 6394955N (GDA94z56)

This site consists of dozens of flakes of mudstone and silcrete located mainly upon the existing power-line track that runs through the site. The site extends c.60 x 30m and may extend further, however visibility precluded the identification of artefacts outside the recorded boundary. Several artefact sites are located to the west of HVO-2139, on an elevated ridge above Sandy Hollow Creek.

Mudstone flake at HVO-2138

Track along which HVO-2139 is located

Aboriginal Site Management Recommendations

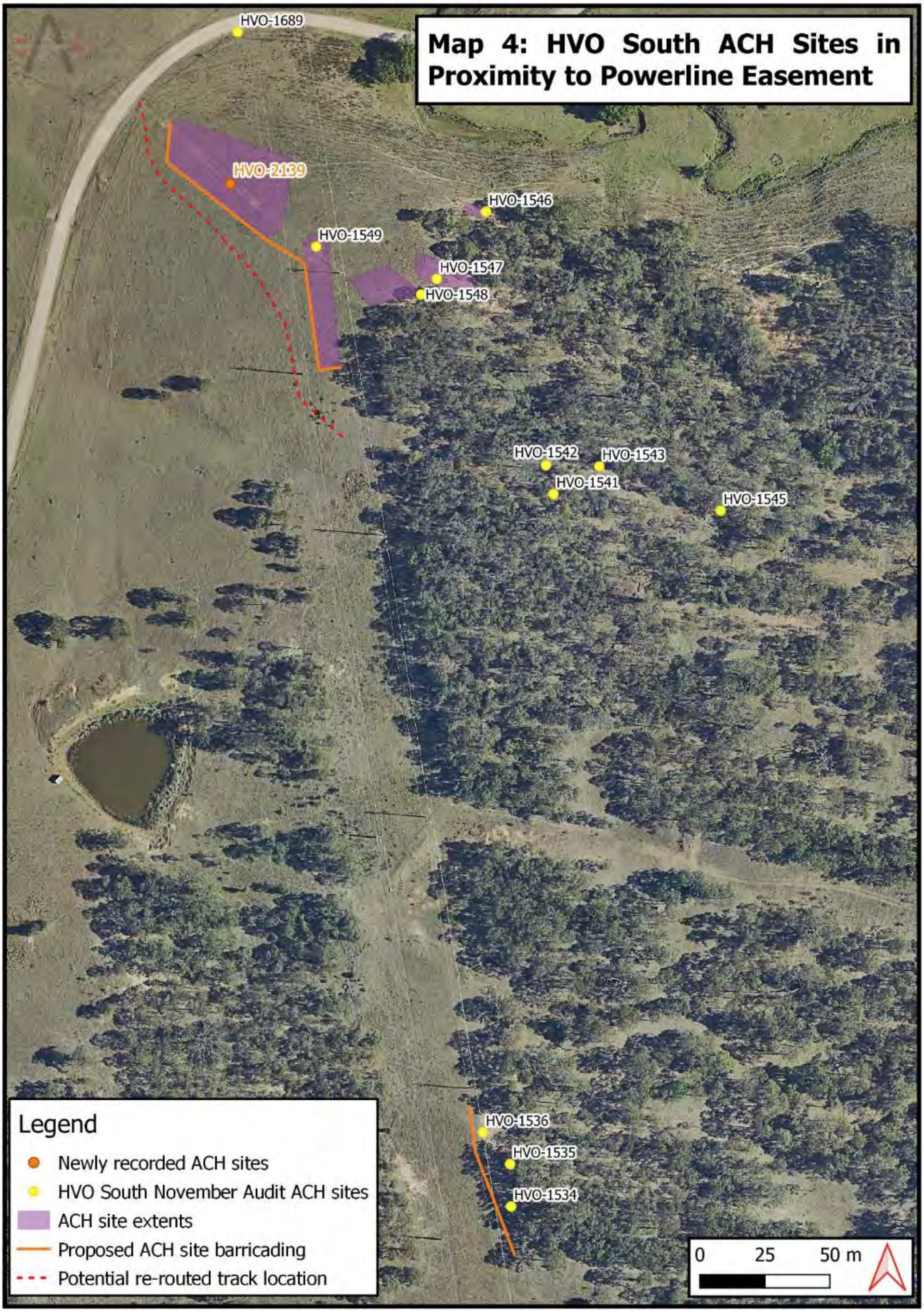
Management recommendations were provided for some of the ACH sites visited, however, as the majority of sites were located on intact landforms with very low risk of future disturbance, the field team were satisfied with the current passive management regime. The nature of those recommendations that were forthcoming are described below.

Fencing of sites/re-routing of track along powerline easement

Sites: HVO-1534-6, HVO-1549, HVO-2139

These sites are located either on or within close proximity to an existing track used to access along the power-line easement. It is recommended that these sites be barricaded to protect them from inadvertent vehicle disturbance, which, in the northern section, would also result in the existing track being re-routed away from the site extent (see Map 4). Consultation with Transgrid/Ausgrid is recommended to devise the best strategy for managing this shared area.

View north through HVO-1534 within power-line easement


Map 4: HVO South ACH Sites in Proximity to Powerline Easement
HVO-1689
HVO-2139
HVO-1546
HVO-1549
HVO-1547
HVO-1548
HVO-1542
HVO-1543
HVO-1541
HVO-1545
HVO-1536
HVO-1535
HVO-1534
Legend
Newly recorded ACH sites
HVO South November Audit ACH sites
ACH site extents
Proposed ACH site barricading
Potential re-routed track location
0 25 50 m

Update HVO Aboriginal sites databases

Sites: HVO-1513, 1515, 1546-9

During the current inspection, the extent of these sites was found to be larger than originally recorded, probably due to different visibility levels at the time of recording. To ensure that the full extent of these sites can be avoided by any future ground disturbing activities, the new boundary information should be updated within the “HVO_site_extents” GIS databases to keep it current.

Recommendations from the November 2020 AHMP Audit

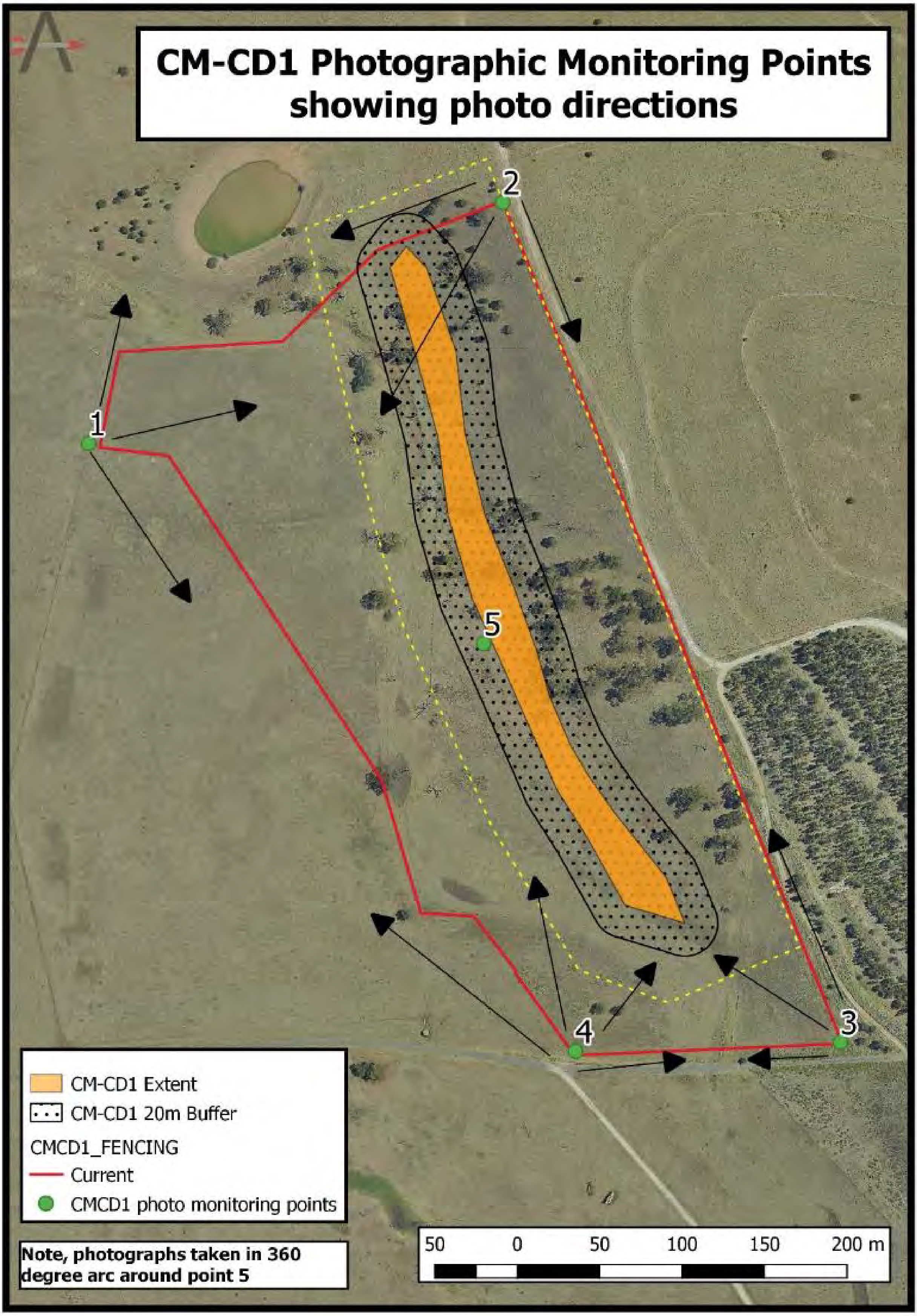
The following ACH management recommendations are provided as a result of the November 2020 AHMPs Compliance Audit.

1. **Pending increased nearby activity, update barricading at MD2 and LID6.**
2. **Request and assess further AHIMS information for ACH site Ausgrid Newdell 1.**
3. **Update HVO Aboriginal sites and site extents databases with additional information for ACH sites MD2; LID6; P12 Plashette; HC-24; Lemington A; Lemington B; HVO-1513; HVO-1515; HVO-1546; HVO-1547; HVO-1548; and HVO-1549.**
4. **Barricading around ACH sites HVO-1534; HVO-1535; HVO-1536; HVO-1549; and HVO-2139 in the vicinity of the power-line access track, and develop new access route to avoid potential impacts to ACH sites. Consultation with Transgrid/Ausgrid is recommended to devise the best strategy for managing this shared area.**
5. **Access and inspect ACH sites HVO-1133 through 1139 along the HVO North conveyor during the next audit.**
6. **Implement vegetation management controls at CM-CD1, including:**
    i. **Use a hand-held brush-cutter to slash weeds and growth within the 20m CM-CD1 buffer area;**
    ii. **The remainder of the CM-CD1 fenced area should be subject to machine slashing to reduce weed and vegetation growth.**
7. **Target CM-CD1 during the next round of HVO’s vermin control program in order to reduce feral pig disturbance as much as possible.**
8. **Register new ACH sites HVO-2138 and HVO-2139 on the AHIMS database.**

APPENDIX A – CM-CD1 PHOTO MONITORING RESULTS

Photo Point #	Location at CM-CD1	Easting	Northing
1	North-west	308614	6403653
2	North-east	308814	6403807
3	South-east	309022	6403297
4	South-west	308860	6403290
5	Centre	308809	6403513

Co-ordinates (GDA94, z56) for CM-CD1 photo monitoring points



Location of CM-CD1 photo monitoring points

CM-CD1 Monitoring Point 1 Panorama – December 2018

CM-CD1 Monitoring Point 1 Panorama – October 2019

CM-CD1 Monitoring Point 1 Panorama – November 2020

CM-CD1 Monitoring Point 2 Panorama – December 2018

CM-CD1 Monitoring Point 2 Panorama – October 2019

CM-CD1 Monitoring Point 2 Panorama – November 2020

CM-CD1 Monitoring Point 3 Panorama – December 2018

CM-CD1 Monitoring Point 3 Panorama – October 2019

CM-CD1 Monitoring Point 3 Panorama – November 2020

CM-CD1 Monitoring Point 4 Panorama – December 2018

CM-CD1 Monitoring Point 4 Panorama – October 2019

CM-CD1 Monitoring Point 4 Panorama – November 2020

CM-CD1 Monitoring Point 5 Panorama – December 2018: (L-R: north through east through south)

CM-CD1 Monitoring Point 5 Panorama – December 2018 (L-R: south through west through north)

CM-CD1 Monitoring Point 5 Panorama – October 2019

CM-CD1 Monitoring Point 5 Panorama – November 2020

Hunter Valley Operations South Aboriginal Heritage Management Plan August 2020 Compliance Audit Inspections

Report prepared for

Hunter Valley Operations

September 2020

Joel Deacon

ARROW HERITAGE SOLUTIONS

200909_HVO_2023_South_AHMP_Compliance_Audit_Report

Introduction

The Hunter Valley Operations Joint Venture (HVOJV) manages the Hunter Valley Operations (HVO) mining complex and associated Biodiversity Areas located in the Hunter Valley. The HVOJV provides management services that include accountability for Aboriginal cultural heritage management & community consultation.

The development of HVO mining operations has occurred through a process of expansion and acquisition and as a result there are two separate development approvals that apply to the operation. The mining & processing activities at HVO are geographically divided by the Hunter River, with movements of coal, overburden, equipment, materials and personnel between two operational areas - HVO North (DA_450-10-2003) and HVO South (PA_06_0261).

Each consent contains a condition requiring the development of an Aboriginal Heritage Management Plan (AHMP). Such plans have been developed (in consultation with the Aboriginal community through the HVO Cultural Heritage Working Group [CHWG]) and approved for each operational area. Within the HVO South plan, provision is made to conduct biannual AHMP compliance inspections with members of the Aboriginal community throughout the life of operations. The purpose of the compliance inspections is to afford the Aboriginal stakeholders and the HVOJV:

- the opportunity to visit mine operations and mine areas to inspect the operational compliance with AHMP provisions and Ground Disturbance Permit (GDP) procedures;
- to inspect and monitor the condition and management of various sites; and
- to review the effectiveness and performance of AHMP provisions in the management of cultural heritage at the mine.

Due to the number of Aboriginal cultural heritage (ACH) sites within the HVO South AHMP area & the time foreseen to inspect all sites, it is not feasible to inspect every site during the same field trip. Therefore, a regular, rolling program of compliance inspections has been implemented that will visit all sites at each location periodically each & every year. A record will be kept of each compliance inspection against each ACH site, so that it can be ensured that each site is inspected regularly.

Proposed Activity and Project Brief

The compliance inspection involved the following elements:

- An AHMP compliance inspection report pro-forma will be completed for the nominated inspection areas and ACH sites visited;
- Photographs of the inspected ACH sites will also be taken; and
- The pro-forma will note the outcomes of the inspections including evidence of compliance and non-compliance with AHMP provisions, recommendations on modifications and improvements to management provisions, recommendations on corrective actions, and other comments associated with AHMP provisions;

Timing & Personnel

The August 2020 HVO South AHMP compliance inspection program was conducted on 21 August 2020. The personnel involved in these inspections were:

Name	Organisation
Joel Deacon	Arrow Heritage Solutions
Peter Bowman	HVO Environment and Community Officer
Andrew Horton	Upper Hunter Wonnarua Council
David Horton	Upper Hunter Wonnarua Council

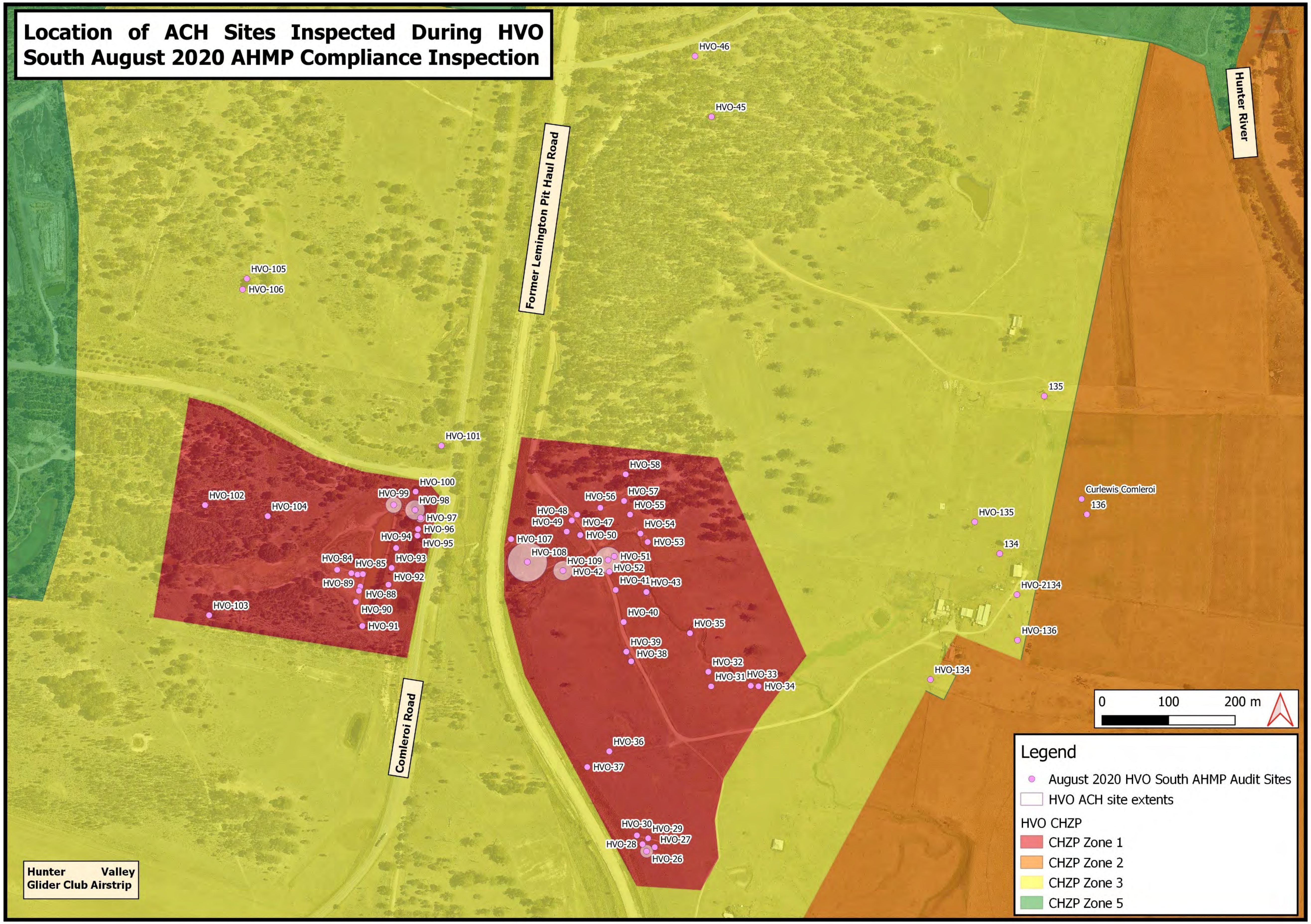
Arrow Heritage Solutions were engaged as independent heritage consultants to conduct the AHMP compliance inspection, and Joel Deacon acted as technical advisor and author of this report. HVO's Environment & Community Officer Peter Bowman arranged the compliance inspection program and escorted the field team.

Results

The August 2020 HVO South AHMP compliance inspection focused on two elements, the first being the inspection of a number of ACH sites to assess their management against the provisions of the HVO South AHMP. The second element involved the inspection of an area the subject of an internal Ground Disturbance Permit (GDP) where suspected artefacts had been identified by HVO personnel and barricaded for their protection.

During the ACH sites inspection a total of 66 Aboriginal heritage sites were included for the audit. These sites were located on either side of Comleroi Road and north of the Hunter Valley Glider Club airstrip (see Map 1). Although not within an active mining area, these sites were selected for inspection as they are located in areas that are actively farmed and/or are sites explicitly requiring protection under the terms of the HVO South development consent (PA_06_0261). Many of these sites have already been identified by HVO as requiring permanent fencing to aid in their protection. A number of such fences have been recently erected and this inspection afforded the CHWG representatives the opportunity to observe and assess their efficacy in protecting the ACH sites within.

The table below summarises the results of the HVO South compliance inspection and summarises the information recorded on the individual pro-forma inspection sheets. Using a mobile mapper pre-loaded with the GIS co-ordinates for each ACH site, the field team travelled to each location and attempted to re-identify each site. Sometimes this was not possible due to poor ground surface visibility (GSV), a result which in itself was not overly significant as long as it was determined that the vicinity had not been inadvertently disturbed. The presence and condition of barricading or fencing was noted, as well as the presence and nature of various potential site disturbing factors (e.g erosion, animal, human). General observations of each site were made if necessary, and, based on information provided for all of the above factors, management recommendations were discussed and agreed by the field team for each site.



Location of ACH Sites Inspected During HVO South August 2020 AHMP Compliance Inspection
Former Lemington Pit Haul Road
Comleroi Road
Hunter River
Hunter Valley Glider Club Airstrip
HVO-46
HVO-45
HVO-105
HVO-106
HVO-101
HVO-102
HVO-104
HVO-103
HVO-99
HVO-100
HVO-98
HVO-97
HVO-96
HVO-95
HVO-94
HVO-93
HVO-92
HVO-84
HVO-85
HVO-89
HVO-88
HVO-90
HVO-91
HVO-58
HVO-56
HVO-57
HVO-55
HVO-48
HVO-49
HVO-47
HVO-50
HVO-54
HVO-53
HVO-107
HVO-108
HVO-109
HVO-42
HVO-51
HVO-52
HVO-41
HVO-43
HVO-40
HVO-35
HVO-39
HVO-38
HVO-32
HVO-31
HVO-33
HVO-34
HVO-36
HVO-37
HVO-30
HVO-29
HVO-27
HVO-28
HVO-26
135
Curlewis Comleroi
136
HVO-135
134
HVO-2134
HVO-136
HVO-134
0
100
200 m
Legend
August 2020 HVO South AHMP Audit Sites
HVO ACH site extents
HVO CHZP
CHZP Zone 1
CHZP Zone 2
CHZP Zone 3
CHZP Zone 5

Site Name	AHIMS ID	Site re-identified	Site intact?	Site fenced/ barricaded?	Fencing/ barricading intact?	Natural erosion	Livestock damage	Human disturbance	Animal disturbance	Pests & weeds	General observations	Management recommendations
Curlewis Comleroi	37-6-0253	No	-	No	No	No	No	Long-term cultivated paddock	No	No	Very old recording	Request and assess further site information
HVO-26	37-6-3225	No	-	Yes	Yes	No	No	No	No	No	Fencing visibly inspected and discussed	Nil
HVO-27	37-6-3226	No	-	Yes	Yes	No	No	No	No	No	Fencing visibly inspected and discussed	Nil
HVO-28	37-6-3227	No	-	Yes	Yes	No	No	No	No	No	Fencing visibly inspected and discussed	Nil
HVO-29	37-6-3228	No	-	Yes	Yes	No	No	No	No	No	Fencing visibly inspected and discussed	Nil
HVO-30	37-6-3229	No	-	Yes	Yes	No	No	No	No	No	Fencing visibly inspected and discussed	Nil
HVO-31	37-6-3230	No	-	Yes	Yes	No	No	No	No	No	Fencing visibly inspected and discussed	Consider use of sediment fencing on downslope boundary of sites if risk or eroding into waterways
HVO-32	37-6-3231	No	-	Yes	Yes	No	No	No	No	No	Fencing visibly inspected and discussed	Nil
HVO-33	37-6-3232	No	-	Yes	Yes	No	No	No	No	No	Fencing visibly inspected and discussed	Consider use of sediment fencing on downslope boundary of sites if risk or eroding into waterways
HVO-34	37-6-3233	No	-	Yes	Yes	No	No	No	No	No	Fencing visibly inspected and discussed	Consider use of sediment fencing on downslope boundary of sites if risk or eroding into waterways
HVO-35	37-6-3234	No	-	Yes	Yes	No	No	No	No	No	Fencing visibly inspected and discussed	Consider use of sediment fencing on downslope boundary of sites if risk or eroding into waterways
HVO-36	37-6-3235	No	-	Yes	Yes	No	No	No	No	No	Fencing visibly inspected and discussed	Nil
HVO-37	37-6-3236	No	-	Yes	Yes	No	No	No	No	No	Fencing visibly inspected and discussed	Nil
HVO-38	37-6-3237	No	-	Yes	Yes	No	No	No	No	No	Fencing visibly inspected and discussed	Nil
HVO-39	37-6-3238	No	-	Yes	Yes	No	No	No	No	No	Fencing visibly inspected and discussed	Nil
HVO-40	37-6-3239	No	-	Yes	Yes	No	No	No	No	No	Fencing visibly inspected and discussed	Nil
HVO-41	37-6-3240	No	-	Yes	Yes	No	No	No	No	No	Fencing visibly inspected and discussed	Nil
HVO-42	37-6-3241	No	-	Yes	Yes	No	No	No	No	No	Fencing visibly inspected and discussed	Consider use of sediment fencing on downslope boundary of sites if risk or eroding into waterways
HVO-43	37-6-3242	No	-	Yes	Yes	No	No	No	No	No	Fencing visibly inspected and discussed	Consider use of sediment fencing on downslope boundary of sites if risk or eroding into waterways
HVO-45	37-6-3244	Yes	Yes	No	No	No	No	No	No	No		Install hard fencing
HVO-46	37-6-3245	Yes	Yes	Yes	No	No	No	On edge of track	No	No		Install hard fencing

Site Name	AHIMS ID	Site re-identified	Site intact?	Site fenced/ barricaded?	Fencing/ barricading intact?	Natural erosion	Livestock damage	Human disturbance	Animal disturbance	Pests & weeds	General observations	Management recommendations
HVO-47	37-6-3246	No	-	Yes	Yes	No	No	No	No	No	Fencing visibly inspected and discussed	Nil
HVO-48	37-6-3247	No	-	Yes	Yes	No	No	No	No	No	Fencing visibly inspected and discussed	Nil
HVO-49	37-6-3248	No	-	Yes	Yes	No	No	No	No	No	Fencing visibly inspected and discussed	Nil
HVO-50	37-6-3249	No	-	Yes	Yes	No	No	No	No	No	Fencing visibly inspected and discussed	Nil
HVO-51	37-6-3250	No	-	Yes	Yes	No	No	No	No	No	Fencing visibly inspected and discussed	Consider use of sediment fencing on downslope boundary of sites if risk or eroding into waterways
HVO-52	37-6-3251	No	-	Yes	Yes	No	No	No	No	No	Fencing visibly inspected and discussed	Consider use of sediment fencing on downslope boundary of sites if risk or eroding into waterways
HVO-53	37-6-3252	No	-	Yes	Yes	No	No	No	No	No	Fencing visibly inspected and discussed	Consider use of sediment fencing on downslope boundary of sites if risk or eroding into waterways
HVO-54	37-6-3253	No	-	Yes	Yes	No	No	No	No	No	Fencing visibly inspected and discussed	Consider use of sediment fencing on downslope boundary of sites if risk or eroding into waterways
HVO-55	37-6-3254	No	-	Yes	Yes	No	No	No	No	No	Fencing visibly inspected and discussed	Nil
HVO-56	37-6-3255	No	-	Yes	Yes	No	No	No	No	No	Fencing visibly inspected and discussed	Nil
HVO-57	37-6-3256	No	-	Yes	Yes	No	No	No	No	No	Fencing visibly inspected and discussed	Nil
HVO-58	37-6-3257	No	-	Yes	Yes	No	No	No	No	No	Fencing visibly inspected and discussed	Nil
HVO-84	37-6-3281	No	Yes	Yes	No	No	No	No	No	No	Sites not individually inspected but discussed in fencing plan	Install hard fencing
HVO-85	37-6-3282	No	Yes	Yes	No	No	No	No	No	No	Sites not individually inspected but discussed in fencing plan	Install hard fencing
HVO-86	37-6-3283	No	Yes	Yes	No	No	No	No	No	No	Sites not individually inspected but discussed in fencing plan	Install hard fencing
HVO-87	37-6-3279	No	Yes	Yes	No	No	No	No	No	No	Sites not individually inspected but discussed in fencing plan	Install hard fencing
HVO-88	37-6-3284	No	Yes	Yes	No	No	No	No	No	No	Sites not individually inspected but discussed in fencing plan	Install hard fencing
HVO-89	37-6-3285	No	Yes	Yes	No	No	No	No	No	No	Sites not individually inspected but discussed in fencing plan	Install hard fencing
HVO-90	37-6-3286	No	Yes	Yes	No	No	No	No	No	No	Sites not individually inspected but discussed in fencing plan	Install hard fencing
HVO-91	37-6-3287	No	Yes	Yes	No	No	No	No	No	No	Sites not individually inspected but discussed in fencing plan	Install hard fencing
HVO-92	37-6-3288	No	Yes	Yes	No	No	No	No	No	No	Sites not individually inspected but discussed in fencing plan	Install hard fencing
HVO-93	37-6-3289	No	Yes	Yes	No	No	No	No	No	No	Sites not individually inspected but discussed in fencing plan	Install hard fencing

Site Name	AHIMS ID	Site re-identified	Site intact?	Site fenced/ barricaded?	Fencing/ barricading intact?	Natural erosion	Livestock damage	Human disturbance	Animal disturbance	Pests & weeds	General observations	Management recommendations
HVO-94	37-6-3290	No	Yes	Yes	No	No	No	No	No	No	Sites not individually inspected but discussed in fencing plan	Install hard fencing
HVO-95	37-6-3291	No	Yes	Yes	No	No	No	No	No	No	Sites not individually inspected but discussed in fencing plan	Install hard fencing
HVO-96	37-6-3292	Yes	Yes	Yes	No	No	No	No	No	No	Several sites barricaded together	Install hard fencing
HVO-97	37-6-3293	Yes	Yes	Yes	No	No	No	No	No	No	Several sites barricaded together	Install hard fencing
HVO-98	37-6-3294	Yes	Yes	Yes	No	No	No	No	No	No	Several sites barricaded together	Install hard fencing
HVO-99	37-6-3295	Yes	Yes	Yes	No	No	No	No	No	No	Several sites barricaded together	Install hard fencing
HVO-100	37-6-3296	Yes	Yes	Yes	No	No	No	No	No	No	Several sites barricaded together	Install hard fencing
HVO-101	37-6-3297	No	Yes	Yes	Yes	No	No	No	No	No		Install hard fencing
HVO-102	37-6-3298	No	Yes	Yes	No	No	No	No	No	No	Sites not individually inspected but discussed in fencing plan	Install hard fencing
HVO-103	37-6-3299	No	Yes	Yes	No	No	No	No	No	No	Sites not individually inspected but discussed in fencing plan	Install hard fencing
HVO-104	37-6-3300	No	Yes	Yes	No	No	No	No	No	No	Sites not individually inspected but discussed in fencing plan	Install hard fencing
HVO-105	37-6-3301	Yes	Yes	Yes	No	No	No	No	No	No		Install hard fencing
HVO-106	37-6-3302	Yes	Yes	Yes	No	No	No	No	No	No		Install hard fencing
HVO-107	37-6-3303	No	-	Yes	Yes	No	No	No	No	No	Fencing visibly inspected and discussed	Consider use of sediment fencing on downslope boundary of sites if risk or eroding into waterways
HVO-108	37-6-3304	No	-	Yes	Yes	No	No	No	No	No	Fencing visibly inspected and discussed	Consider use of sediment fencing on downslope boundary of sites if risk or eroding into waterways
HVO-109	37-6-3305	No	-	Yes	Yes	No	No	No	No	No	Fencing visibly inspected and discussed	Consider use of sediment fencing on downslope boundary of sites if risk or eroding into waterways
HVO-134	37-6-1765	No	No	No	-	No	Cattle	In paddock gateway	No	No	At risk of damage	Salvage site
HVO-135	37-6-1766	No	Yes	Yes	No	No	Cattle	Within active farm area	No	No	At risk of damage	Salvage site
HVO-136	37-6-1767	No	Yes	Yes	No	No	No	No	No	Covered in weeds		Install hard fencing
134	37-6-1765	No	-	No	-	No	No	No	No	No	Erroneous duplicate recording of HVO-134	Remove entry from HVO and AHIMS databases
135	37-6-1766	No	-	No	-	No	No	No	No	No	Erroneous duplicate recording of HVO-135	Remove entry from HVO and AHIMS databases
136	37-6-1767	No	-	No	-	No	No	No	No	No	Erroneous duplicate recording of HVO-136	Remove entry from HVO and AHIMS databases
HVO-2134	37-6-3878	Yes	Yes	No	-	No	Cattle	Within active farm area	No	No	Recently recorded site	Install hard fencing

Aboriginal Site Management Recommendations

Management recommendations were provided for many of the ACH sites visited, the nature of which are described below.

Install hard fencing

Sites: HVO-45, 46, 84-106, 136, 2134

There are a number of sites that were inspected where hard fencing is recommended for their demarcation and protection. Many of these sites have been barricaded in the past and are located in areas that are regularly grazed. It should be noted that the new and upgraded ACH site fencing specification being trialled and installed at several ACH sites across HVO, including within the current inspection area, was received positively by the RAPs in attendance and is considered the favoured option when site protection is warranted.

Where it is feasible and practical, ACH sites could be contained within the same fence and consideration should be given to erosion/sediment run-off as outlined below.

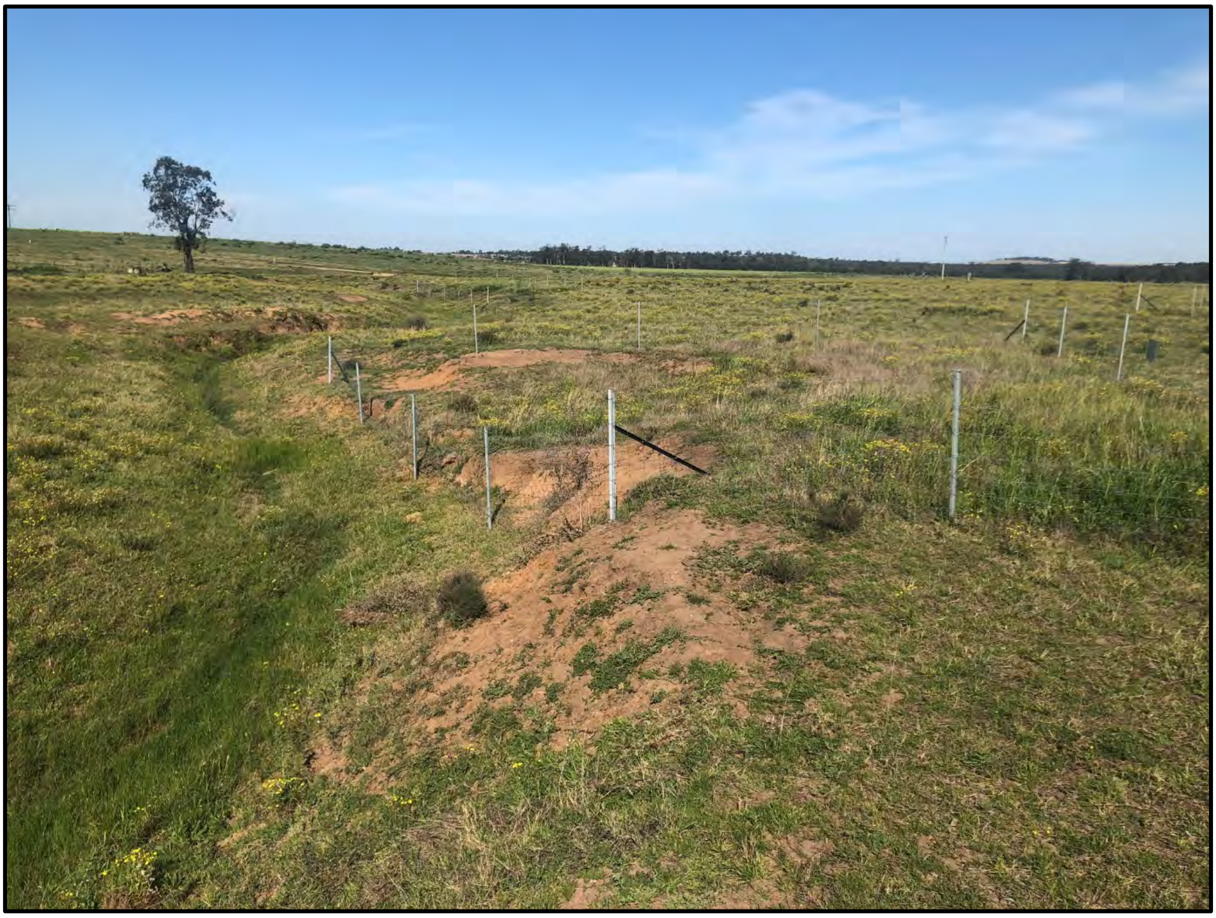
An example of dilapidated barricading at ACH sites HVO-105 and 106

Example of new ACH site fencing technique

Consider use of sediment fencing

Sites: HVO-31, 33-35, 42, 43, 51-54, 107-109

These sites (as well as all other sites in the vicinity) have been recently hard fenced, much to the satisfaction of the CHWG representatives present. The future use of this fencing method, in preference to barricading, was thoroughly endorsed, with the suggestion put forward that sediment fencing be installed along the downslope edge of those sites located close to water-courses. This would help prevent the erosion of and wash of artefacts out of the fenced areas and into these water-courses. This recommendation was understood and well received by the HVO Environment and Community Officer present and will be included in future fencing scopes where required.



Example of ACH site where sediment fencing would be useful to the preservation of the site

Request and assess further site information

Sites: Curlewis Comleroi

This site was not re-identified during the audit inspection, and prior to any further attempts at re-identification it would be beneficial to obtain and assess any site information held within AHIMS. The site was recorded in 1982 using topographic maps. An assessment of the latest available AHIMS data as well as the relevant report for the site may assist.

Suggest salvage next program

Sites: HVO-134, 135

Both these sites are located within an active farming area, in close proximity to high traffic areas where fencing would not be a practical option. HVO-134 consists of a single mudstone flaked piece in a heavily grassed area within a gateway. HVO-135 consists of five flaked pieces of mudstone and a flaked piece of quartz within a 50m diameter area. This area is in a high impact area where cattle regularly gather. Due to the risk of further disturbance to these sites it was recommended by the CHWG representatives that they be salvaged An AHIP is not required to implement this measure, as the salvage of these sites, with Aboriginal community participation, is authorised under the HVO South AHMP.

Location of HVO-135 (between picket in foreground and vehicles)

Remove from HVO and AHIMS Aboriginal sites database

Sites: 134, 135, 136

Three sites have been erroneously entered and misplotted on the AHIMS and HVO ACH sites databases. These three sites ('134', '135' and '136') are duplicates of HVO-134, HVO-135 and HVO-136 that have been geographically plotted and registered on AHIMS using the AGD 66 datum rather than the GDA 94 datum. The HVO-134/135/136 entries on the HVO database have been plotted correctly. Sites '134, '135' and '136' need to be deleted from the AHIMS and HVO databases, and sites HVO-134/135/136 registered on AHIMS as a true reflection of the site locations. The field team visited the locations of '134, '135' and '136' and no artefacts were identified at these points.

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For all other ACH sites visited during the audit inspection no further recommendations were forthcoming.

Hunter River Remnant Vegetation Area

Aside from providing CHWG representatives with an opportunity to visit mining operations and monitor the condition of ACH sites, the intention of the compliance inspections is also to afford the opportunity to inspect the operational compliance with AHMP provisions and GDP procedures. To this end, an inspection was made of an area of remnant vegetation within which soil testing and exploration drilling has been earmarked through the GDP process.

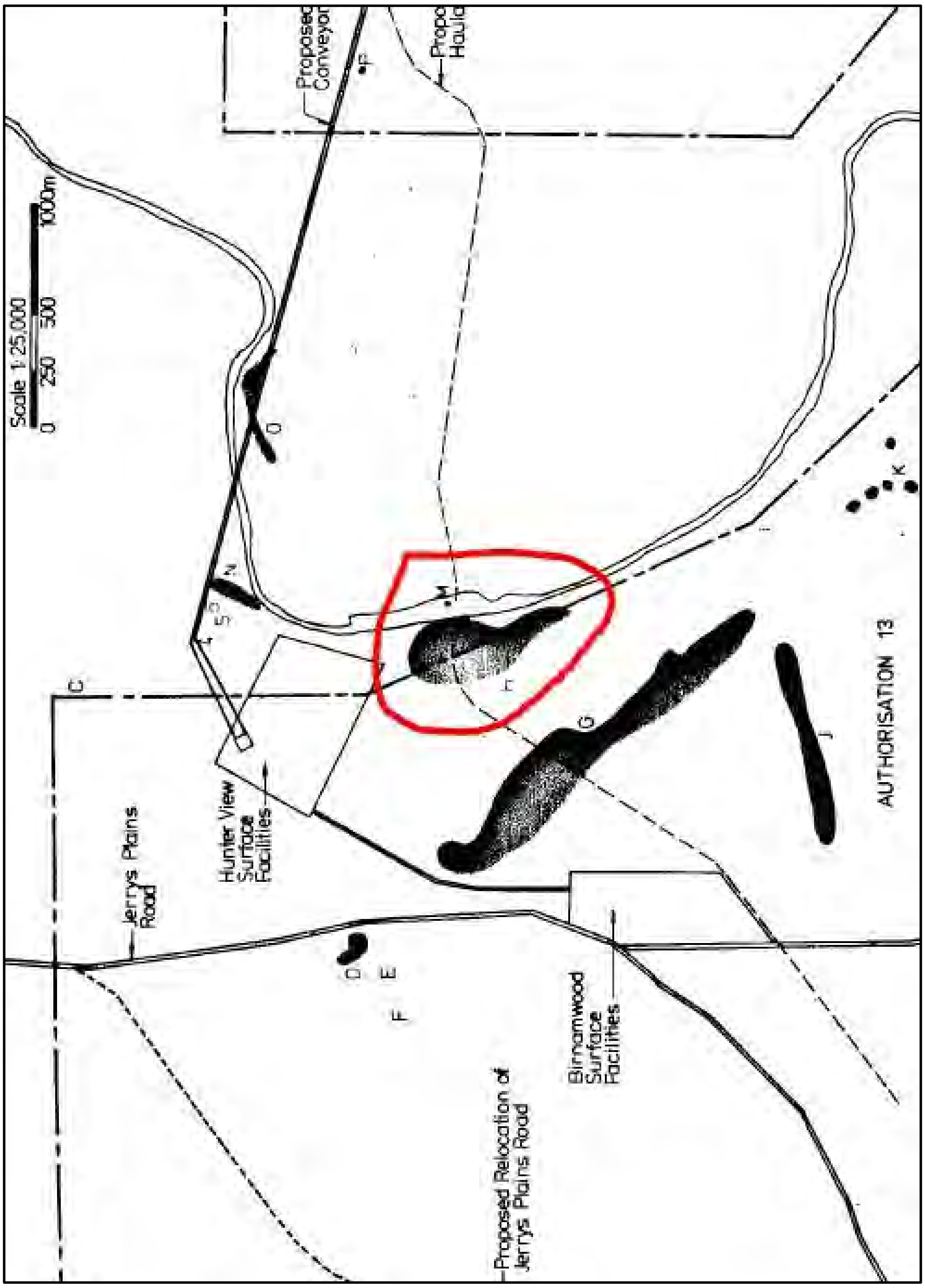
This area, measuring c.150m x 100m is located south of the Hunter River and to the immediate west of the main haul road connecting HVO North and South. Although located within Zone 5 (all ACH management requirements completed) of the HVO Cultural Heritage Zoning System, Environment and Community personnel had located possible Aboriginal stone artefacts in the area during their preliminary inspections. In accordance with Provision 34 (Discovery of New Finds) of the HVO AHMP, HVO requested an inspection of the area to confirm whether or not further ACH management was required in this area. A preliminary inspection of the area was made by the consultant where it was confirmed that Aboriginal stone artefacts were indeed present. A more comprehensive assessment was then conducted with the CHWG representatives during the current audit inspection to accurately map the extent of the ACH site and document the nature of the finds.

History of ACH Site Recordings and Salvage in the Area

Prior to detailing the results of the audit inspection, a summary of the history of ACH assessments and salvage programs in the area is worthwhile as context to the present situation.

A review of the HVO ACH sites database records the location of a site – AHIMS ID 37-5-0047 “Malabar Site H” - 70m north-west of the inspection area. This site was recorded in September 1981 (prior to accurate GPS technology) as extending over an estimated area of approximately 900m x 400m, with the report map (see figure below) indicating the site extended across both sides of the then proposed haul road. The site is noted as being relatively dense in parts.

Two consents to destroy (#798 in 1985 and SZ315 in 2001) authorised under Section 90 of the *National Parks and Wildlife Act* have been issued in the past over the area containing ACH site 37-5-0047, with this site specifically named as one approved to be disturbed. It is unclear whether 37-5-0047 was actually salvaged, either in part or in full, but if it was, it is not uncommon for some artefacts to remain in situ at the completion of a salvage exercise.



Original 1981 archaeological survey map showing the location of ACH site 37-5-0047 "H" (circled in red) with the now current haul road (dashed line) intersecting it.

In October 2014, a scatter of artefacts ("HVO-1707"; AHIMS ID 37-5-0690) was recorded in a location that would have been on the western edge of the original recording for 37-5-0047, which perhaps confirms this state of affairs (see map below, including results of current inspection). Specific Condition 4 of the later consent to destroy, SZ315, states that should any 'relics' remain in existence at the site two years from the date of issue then the consent shall be deemed to be void and further damage to the 'relics' would not be allowed without further regulatory consent.

Although the current HVO South Development Consent and AHMP provide such consent, there is also a requirement under Provision 34 that no further ground disturbance occur in the area prior to a formal assessment and recording involving members of the HVO CHWG.

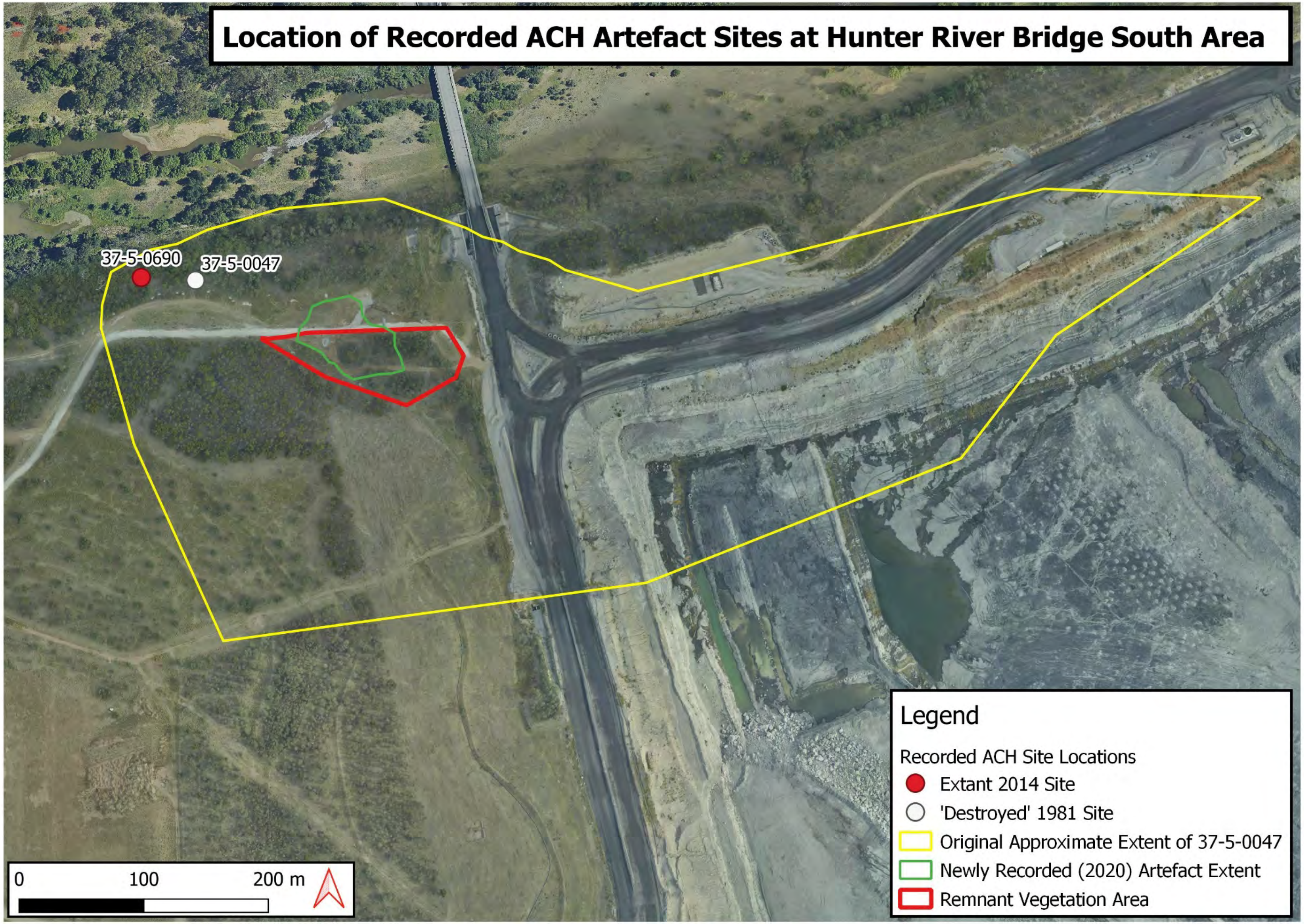
Results of Audit Inspection

The audit inspection confirmed that, despite some considerable disturbance due to vehicle tracks and rehabilitation activities, Aboriginal stone artefacts remained in situ in rather large numbers. Between 100-200 artefacts were flagged in the area, mainly on the southern side of a vehicle track that runs through the area but small numbers of artefacts were recorded on the northern side where ground surface visibility was poorer. Mudstone flakes predominated, with silcrete flakes also common and several mudstone cores. Most artefacts were noted on old disused tracks, with no artefacts noted on the main track.

Pink flags showing artefact density throughout area (see also cover photo).

Example of mudstone flake from area.

As the remnant site is located in an area surrounded by mining related disturbance, and considering that previous consents to salvage the site have been issued, it is recommended that the site be salvaged according to the provisions of the HVO South AHMP, a course of action with which the CHWG representatives present concurred. The vicinity is earmarked for several ground disturbing activities and is used for vehicular access and powerline maintenance. Due to the high level of ground cover over some portions of the site, it is recommended that the site salvage be conducted either outside of the growing season or the ground cover be sprayed with herbicide prior to salvage to maximise artefact recovery.


Location of Recorded ACH Artefact Sites at Hunter River Bridge South Area
37-5-0690
37-5-0047
Legend
Recorded ACH Site Locations
Extant 2014 Site
'Destroyed' 1981 Site
Original Approximate Extent of 37-5-0047
Newly Recorded (2020) Artefact Extent
Remnant Vegetation Area
0
100
200 m

Recommendations from August 2020 HVO South AHMP Compliance Audit Inspection

The following ACH management recommendations were agreed during the August 2020 HVO South AHMP Compliance Audit, and should be presented to the CHWG for consideration.

1. **Install hard fencing at ACH sites HVO-45, 46, 84-106, 136, 2134;**
2. **Consider the use of sediment fencing at ACH sites HVO-31, 33-35, 42, 43, 51-54, 107-109, and any sites to be fenced in the future that are liable to erosion and wash into nearby waterways;**
3. **Request further information from AHIMS to assist in determining the accurate location, nature and extent of ACH site 'Curlewis Comleroi';**
4. **ACH sites HVO-134, 135 should be considered for salvage to prevent further inadvertent damage; and**
5. **Salvage the remnant artefacts in the vicinity of the Hunter River haul road bridge associated with AHIMS site 37-5-0047. Ground cover in the area should be denuded prior to salvage to aid in artefact recovery.**

Appendix E - Assessment of MOP Completion Criteria

Completion Criteria Assessment for IEM Pasture Sites

Site Code	Weed Presence1	Erosion and Sediment Control	Total Groundcover2	Species Abundance
HVOWES20150101	Not met	Met	Met	NA
HVOWES20150102	Not met	Met	Met	NA
HVOWES20150103	Not met	Met	Met	NA
HVOWES20150104	Not met	Met	Met	NA
HVOWES20190201	Not met	Met	Met	NA
HVOWIL20190101	Met	Met	Not met	NA
HVOWIL20190102	Met	Met	Not met	NA
HVOWIL20190103	Met	Met	Not met	NA

Notes: (1) Not properly assessed, weeds are not clearly defined, (2) Not properly assessed without analogues

Completion Criteria Assessment for LTM Pasture Sites

Site Code	Weed Presence1	Erosion and Sediment Control	Total Groundcover2	Species Abundance
HVOWES20150201	Not met	Met	Met	NA
HVOWES20150202	Not met	Met	Met	NA
HVOWES20150203	Not met	Met	Met	NA
HVOWES20150204	Not met	Met	Met	NA
HVOWES20160301	Not met	Met	Met	NA
HVOWES20160302	Not met	Met	Met	NA
HVOWES20160303	Not met	Met	Met	NA

Notes: (1) Not properly assessed, weeds are not clearly defined, (2) Not properly assessed without analogues

Completion Criteria Assessment for IEM Non-specific Native Vegetation Sites

Site Code	Weed	Erosion	Ground Cover	Understorey	Tree Diversity	Reproduction
HVOCHE20150301	NA	Met	NA	NA	NA	NA
HVOCHE20150302	NA	Met	NA	NA	NA	NA
HVOCHE20150303	NA	Met	NA	NA	NA	NA
HVOCHE20180101	NA	Met	NA	NA	NA	NA
HVORIV20180201	NA	Met	NA	NA	NA	NA
HVORIV20180202	NA	Met	NA	NA	NA	NA
HVORIV20180203	NA	Met	NA	NA	NA	NA
HVORIV20180204	NA	Met	NA	NA	NA	NA
HVORIV20180301	NA	Met	NA	NA	NA	NA
HVORIV20180302	NA	Met	NA	NA	NA	NA
HVORIV20180303	NA	Met	NA	NA	NA	NA
HVOWES20180301	NA	Met	NA	NA	NA	NA
HVOWES20180302	NA	Met	NA	NA	NA	NA
HVOWES20180303	NA	Met	NA	NA	NA	NA

Completion Criteria Assessment for LTM Non-specific Native Vegetation Sites

Site Code	Weed	Erosion	Ground Cover	Understorey	Tree Diversity	Reproduction
HVORIV14150101	NA	Met	NA	NA	NA	Not met
HVORIV14150102	NA	Met	NA	NA	NA	Not met
HVORIV14150103	NA	Met	NA	NA	NA	Met
HVORIV14150104	NA	Met	NA	NA	NA	Met
HVOWES20160201	NA	Met	NA	NA	NA	Met
HVOWES20160202	NA	Met	NA	NA	NA	Met