Final Report

Tailings dust environmental health assessment and monitoring study review

Cadia Valley Operations

Prepared for Newcrest Mining Limited Cadia Valley Operations - 2 July 2021

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Report title	Tailings dust environmental health assessment and monitoring study review - Cadia Valley Operations
Report number	CADIA191223F1a
Client reference	Cadia Tailings Dust Monitoring & Assessment Project Plan received by email 24 December 2019
Date issued	2 July 2021
Total number of pages	394 (including covers and blank pages)
Prepared for	Matt Armstrong Superintendent - Social Performance Newcrest Mining Cadia Valley Operations
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Acknowledgements

Many people at Cadia Valley Operations gave freely of their time and energy to contribute to this Study. Their input was marked by a desire to address the community impact of dust from Cadia Valley Operations. Their contributions are gratefully acknowledged.

Summary and key findings

Does tailings dust from Cadia Valley Operations pose a community health risk?

Based on the data and information available from the Cadia Tailings Dust Monitoring and Assessment Project (the Study), and the ambient dust levels measured by the Study, there is no current evidence to suggest that dust from the CVO tailings storage facilities or emissions from the mine ventilation system pose a health risk to the community.

Cadia Tailings Dust Monitoring and Assessment Project (the Study)

In March 2018, the Northern Tailings Storage Facility (NTSF) embankment slumped leading to the cessation of tailings deposition into the NTSF. As a consequence, the NTSF dried, resulting in increased dust emissions. To mitigate the dust emissions, application of dust suppression products to the surface of the NTSF commenced.

In November 2019, tailings deposition on the Southern Tailings Storage Facility (STSF) ceased and all tailings was directed to the Open Pit Tailings Storage Facility (PTSF). This was done to preserve STSF storage capacity and improve water recycling. Application of dust suppressant products was extended to the STSF.

Following the embankment slump there were a number of exceedances of the *Cadia East Project Approval Air Quality Short Term Criteria* (NSW Government 2019) and numerous community complaints about dust. The Cadia community expressed concerns about not fully understanding what is in the dust and what potential impacts the dust could have on community health and agricultural enterprises.

Cadia Valley Operations (CVO) undertook an environmental health assessment of the tailings dust to address the community's concerns. This was referred to as *Cadia Tailings Dust Monitoring and Assessment Project* (the Study).

Objectives of the Study

The objectives of the Study were to:

1. address community concerns about the potential health and livelihood impacts from tailings dust
2. deliver against commitments made to community stakeholders
3. work transparently and collaboratively with stakeholders to understand and manage impacts.

Scope of the Study

The Study incorporated a number of different components that were delivered by specialists in their respective fields. The Study work program encompassed:

1. undertaking geochemical and mineralogical analysis of tailings and tailings dust to enable an environmental health assessment of Cadia tailings dust
2. monitoring of ambient air concentrations of respirable crystalline silica (RCS) from vent (air outlet vents from the underground mine) emissions
3. assessment of the exposure risk to the community from RCS based on ambient air monitoring
4. testing and reporting on drinking water and water from farm dams used for livestock watering at local residences
5. development of a safety data sheet for Cadia's tailings, including a review of ore processing reagents, ameliorates (e.g., dust suppression products) and potential breakdown by-products of reagents and ameliorates (the safety data sheet is referred to herein as a *HSE Materials Hazard Assessment*).

Full details of the Study are documented in *Cadia Tailings Dust Environmental Health Assessment and Monitoring Project Plan for Community Consultation* (Newcrest Mining Limited 2019).

The role of Serinus Health Safety and Environment in the Study was review of the monitoring program; provision of advice about the monitoring program; review of data collected by the monitoring program; and review of the reports provided by specialists engaged for the Study.

Work undertaken for the Study

Earth Systems (Melbourne) undertook a characterisation of the chemical, geochemical and mineralogical fingerprint of the tailings. This was undertaken to assess the potential impact of dust from the tailings storage facilities on the local community. Refer to ***Appendix A*** for the full reports provided by Earth Systems.

Following identification of a chemical, geochemical and mineralogical fingerprint of the tailings, Earth Systems conducted an assessment of deposited dust. They undertook an examination of roof, farm dam and bore water sampled in May 2020 (refer to ***Appendix A***), taking into consideration information gathered during the dust identification and deposition assessment work. Additional water sampling and analysis was conducted by CVO in September/October 2020. In total, 48 water quality samples were collected during the two sampling periods (see Figure 1 for a map of sampling locations). The primary focus of the analysis was on metals as outlined in the Australian Drinking Water Guidelines (NHMRC, NRMMC 2011 updated March 2021). Refer to the health, safety and environmental (HSE) materials hazard assessment in ***Appendix B*** for the results of water analysis conducted by CVO.

Todoroski Air Sciences (Sydney) reviewed CVO's air quality monitoring plan and recommended amendments to assist with quantification of any potential dust emissions generated by the NTSF, STSF and mine vents. Refer to ***Appendix C*** for the full reports provided by Todoroski Air Sciences.

Based on the advice of Todoroski Air Sciences, CVO undertook monitoring for metals in PM_{10} (particulate matter less than 10 micrometres in aerodynamic diameter), $PM_{2.5}$ (particulate matter less than 2.5 micrometres in aerodynamic diameter), and RCS in $PM_{2.5}$. Refer to ***4.4 Airborne dust/PM10 metals*** on page 22 and Table D.1 in ***Appendix D*** for the results of the PM_{10} metals monitoring; and ***4.4 Airborne dust/Respirable crystalline silica*** on page 24 for the results of the $PM_{2.5}$ and RCS monitoring.

Callander & Johnson (Melbourne) conducted an evaluation of the organic chemicals used in the processing of minerals at CVO; and assessed the HSE hazards posed by the generated tailings material against internationally accepted protocols and classification schemes. Refer to ***Appendix B*** for the HSE Materials Hazard Assessment of the tailings and the results of the organic chemicals analysis.

Key findings of the Study

Tailings composition and health risk

1. Surface tailings samples contained a mixture of primary and secondary minerals, with secondary minerals and amorphous components being more concentrated in the PM_{10} fraction.
2. The major primary minerals present were plagioclase feldspar, illite/mica, quartz, chlorite/clinochore and potassium feldspar, making up over 80 wt% of the bulk tailings. Plagioclase feldspar, illite/mica, chlorite/clinochore and potassium feldspar are aluminosilicates which are found widely in the Earth's crust.
3. The secondary minerals were mostly hydrous calcium-sodium-magnesium sulphates (e.g., gypsum, blodite, glauberite) with lesser chlorides (halite) and iron sulphates (rhomboclase). Many of these secondary minerals are soluble to highly soluble in water and have low densities compared to primary tailings mineral phases.
4. Secondary minerals are the most likely tailings component to become airborne, due to their location at the surface of the tailings storage facility and comparatively low density. They are expected to be the first to be mobilised as dust and/or travel the furthest if they become airborne during windy conditions. After deposition, they are also

the most likely minerals to subsequently dissolve upon contact with water due to their high solubility. Consequently, these phases have the potential to effect down-wind water chemistry. For example, these minerals have the potential to give drinking water a salty and/or bitter taste.

5. Metal concentrations in the tailings material were found to be very low, except for aluminium as aluminosilicate and iron, as iron-sulphur compounds. No metal was found in concentrations which would cause short-term or long-term health effects according to the United Nations Globally Harmonised System of Classification and Labelling of Chemicals (GHS) (see Table 7).
6. Leaching data, which provides an analogue for the leaching of tailings during a rainfall event, indicated the presence of antimony, arsenic, chromium, copper, iron, lead, mercury, molybdenum, selenium and zinc. These are elements which are most likely to be mobilised from soluble tailings components during rainfall events. However, the results of water sampling indicated no significant effect on water quality (see Findings 19 and 21).
7. The pH of leachate water was 7.4 to 8.0, consistent with an excess of carbonate (non-acid forming), low acidity values, and elevated alkalinity values. A slightly negative Net Acid Production Potential calculated from the tailings mineralogy, supported the finding that the tailings material is non-acid forming.
8. Between 1.8 and 4.1 wt% of the tailings was in the PM_{10} size range (averaging 3.3 wt%).
9. The tailings contained significant concentrations of quartz (14 to 17 wt%). Quartz, when in the respirable size range, is usually the major component of RCS. In the PM_{10} component of the tailings, quartz was present at values ranging from 5.0 and 8.7 wt% (averaging 7.1 wt%). This equates to respirable quartz making up 0.23 wt% (on average) of the bulk tailings material. Consequently, the respirable fraction of quartz in the tailings was below levels that would classify the tailings as hazardous according to the United Nations GHS.
10. Amphibole group minerals were identified in two of the tailings samples (see ***Appendix E***). Certain amphibole minerals have the potential to occur in, what is referred to as, a fibrous habit (i.e., they are asbestiform minerals such as asbestos). Subsequent analysis of the tailings indicated that no asbestos or asbestiform materials were present (see Certificate of Analysis ES2016687 in ***Appendix F***).
11. Low levels of hydrocarbon compounds were found to be present in the tailings. There were eight unidentified hydrocarbon compounds reported with a total concentration of 33 ppm. These hydrocarbons were alkanes, which are low hazard hydrocarbons. None of the traditionally carcinogenic hydrocarbon compounds, such as polycyclic aromatic hydrocarbons or benzene, were present (see Certificate of Analysis EB2000591 in ***Appendix F***).
12. The tailings classified as non-hazardous in all categories of classification under the United Nations GHS and the European Commission 2008 Regulation (EC) No. 1272/2008 on classification, labelling and packaging of substances and mixtures (CLP) as it applies to metals and minerals (see Table 8).

Airborne dust and health risk

13. Measurements using dust deposition gauges (DDGs) indicated the presence of some metals in deposited dust. However, the levels were low, and they were not necessarily present in water-soluble form, so their presence does not automatically translate to water quality impacts. Indeed, as detailed in Findings 19 and 21, the results of water sampling indicated no significant effect on water quality.
14. Approximately 10 to 20 wt% of deposited dust reporting to DDGs was in a soluble form, consistent with a theory that highly soluble efflorescent (surface) materials from the tailings would be the most likely to be mobilised as dust in windy conditions and travel the furthest. This suggests, at least to some extent, that deposited dust is influenced by tailings dust. However, the results of water sampling indicated no significant effect on water quality (see Findings 19 and 21).
15. The monitoring of PM_{10} metals in ambient air conducted to date, indicated that airborne concentrations were within relevant ambient air quality guidelines (see Table 4).
16. The monitoring of $PM_{2.5}$ particulate matter in ambient air conducted to date, indicated that airborne concentrations were trending below the relevant ambient air quality guideline (see Table 5).

17. The monitoring of ambient air RCS to date, indicated that airborne concentrations were trending below the relevant ambient air quality guideline (see Table 5).
18. The current ambient air monitoring trends are indicative of results that will ultimately comply with the relevant air quality guidelines, but this will be confirmed at the end of a twelve-month monitoring program.

Water quality and health risk

19. All tank water samples met the Australian Drinking Water Guidelines for health-based criteria except for one. In one instance, cadmium slightly exceeded the guidelines. This was attributable to contamination from galvanised steel roofing or guttering (Taylor 2021, p. 23). Some samples exceeded the aesthetic criteria. See ***Appendix A*** and ***Appendix B***.
20. All roof water samples had very low sulphate and chloride concentrations which, based on mineralogy of the tailings (i.e., the tailings contain significant amounts of chloride and sulphate), strongly supports the proposition that there is no significant effect from CVO tailings dust on roof water. Consequently, metals in roof water appeared to be primarily influenced by local materials including galvanised steel roofing or guttering materials (sources of zinc and cadmium), rusting of steel roof materials (iron), copper piping (copper), lead flashing (lead) and dust from natural carbonate-bearing sources (e.g., manganese).
21. All water sources from the farm dams met the Australian livestock watering guidelines (see ***Appendix A*** and ***Appendix B***).

Dust suppressants and health risk

22. Dust suppressant chemicals used to coat the surface of the tailings dam were classified as non-hazardous under the United Nations GHS.

Recommendations

CVO proposes to continue the expanded air monitoring program implemented for the Study until a full data set has been collected. The following recommendations are provided to assist in achieving that aim:

1. Continue with the ambient air sampling program recommended by Todoroski Air Sciences until at least 12 months of data are collected for each of the locations.
2. Continue with the low-volume air sampling program at Bundarra and Woodville (locations potentially impacted by mine vent emissions) until 12 months of $PM_{2.5}$ and RCS data are collected.
3. Issue a further report following the completion of Recommendations 1 and 2.

1. Introduction

In March 2018, the Northern Tailings Storage Facility (NTSF) embankment slumped leading to the cessation of tailings deposition into the NTSF. As a consequence, the NTSF dried, resulting in increased dust emissions. To mitigate the dust emissions, application of dust suppression products to the surface of the NTSF commenced.

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The objectives of the Study were to:

1. address community concerns about the potential health and livelihood impacts from tailings dust
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2. Scope and approach

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Full details of the Study are documented in *Cadia Tailings Dust Environmental Health Assessment and Monitoring Project Plan for Community Consultation* (Newcrest Mining Limited 2019).

The role of Serinus Health Safety and Environment in the Study was review of the monitoring program; provision of advice about the monitoring program; review of data collected by the monitoring program; and review of the reports provided by specialists engaged for the Study. This involved visits to site on 30 June 2020 and 1 July 2020 to review the sampling methodology, including siting of air monitoring equipment. It also involved attendance at a meeting with interested members of the community on 1 July 2020. In addition to the site visits, formal communications with site and specialists engaged for the Study were conducted as follows:

- teleconference, 21 January 2020
- videoconference, 27 March 2020
- videoconference, 6 April 2020
- videoconference, 7 April 2020
- videoconference, 21 April 2020
- face to face meeting in Brisbane, 24 June 2020
- face to face meeting in Brisbane, 6 November 2020
- teleconference, 2 December 2020.

These were supplemented by numerous informal telephone and email communications.

This report provides an assessment of the testing and monitoring conducted within the scope of the Study.

The following information and data were examined:

- mineralogical, geochemical and chemical analysis of tailings materials conducted in February 2020
- organic chemical analysis of tailings material conducted in February 2020
- PM_{10} metals concentrations from monitoring commenced in April 2020
- water quality results from testing of tank, farm dam and bore water conducted in May 2020 and September/October 2020

- asbestos analysis of tailings materials conducted in May 2020
- $PM_{2.5}$ particulate matter and RCS concentrations from monitoring commenced in July 2020.

The following reports were examined:

- Earth Systems – Sampling and Analytical Protocols, Technical Memorandum (Waters and Taylor 2019) (refer to ***Appendix A***)
- Earth Systems – Preliminary assessment of surficial tailings and dust from Cadia Valley Operations, Technical Memorandum (Taylor 2020a) (refer to ***Appendix A***)
- Earth Systems – Relative elemental enrichments in tailings from the Cadia Valley Operations, Technical Memorandum (Taylor 2020b) (refer to ***Appendix A***)
- Earth Systems – Surficial processes in the tailings storage facility at the Cadia Valley Site, Technical Memorandum (Taylor 2020c) (refer to ***Appendix A***)
- Earth Systems – Dust Fingerprinting Study, Assessment of drinking and stock water chemistry from farms surrounding Cadia Valley Operations, New South Wales (Taylor 2021) (refer to ***Appendix A***)
- Callander & Johnson – HSE Materials Hazard Assessment (Johnson 2020) (refer to ***Appendix B***)
- Todoroski Air Sciences – Air quality monitoring plan Cadia Valley Operation - Tailings Storage Facility (Trahair and Henschke 2020) (refer to ***Appendix C***)
- Todoroski Air Sciences – Cadia Valley Operations – Ventilation shaft air dispersion modelling (Henschke 2020) (refer to ***Appendix C***)
- QUT Central Analytical Research Facility – Materials Characterisation Report X20005 (Spratt 2020a) (refer to ***Appendix E***)
- QUT Central Analytical Research Facility – Materials Characterisation Report X20005 [PM_{10}] (Spratt 2020b) (refer to ***Appendix E***)
- Various certificates of analysis from Australian Laboratory Services (ALS) (refer to ***Appendix F***)
- Various certificates of analysis from RCA Australia (refer to ***Appendix G***).

3. Concepts and terminology

3.1 When a result is below the limit of detection

No matter how sensitive the technique is for chemical analysis of samples, until methods are developed that can detect a single atom, every currently available method has a limit of detection (LOD). The LOD is the smallest amount of the substance being measured that can be detected by the method being used. Since measurements at concentrations around the LOD are subject to considerable variability, it is difficult to obtain the same result for the same sample multiple times when working at the LOD. Consequently, when developing methods of chemical analysis, statistical analysis is done on concentrations around the LOD to arrive at a limit of reporting (LOR). When there is a great deal of variability in the results of analysis around the LOD, the LOR will be a larger number than the LOD. The LOR is then effectively, the lowest quantity the method can measure with any certainty.

Laboratories conducting chemical analysis will not report a result of zero, because they cannot be certain that a sample does not contain the substance of interest. They can only definitively report that the substance could not be detected subject to the limitations imposed by the LOR. Consequently, results where the substance of interest is not detected are reported as being less than the LOR. For example, if the LOR for quartz is 5 µg, the laboratory will report the number <5 µg if no quartz is detected (i.e., less than 5 µg). Some of the results of monitoring and analysis dealt with in this report are below the relevant LOR. Consequently, they are reported as described in this paragraph.

3.2 Dust and particulate matter

Concepts

Dust in the air constitutes a component of airborne particulate matter. Airborne particulate matter is made up of a mixture of small particles and liquid droplets suspended in the air, originating from both natural and anthropogenic sources. The mixture is complex, comprising of components such as sulphates, nitrates, metals, organics and dust. Natural sources include bushfires, pollen, fungal spores, sea spray, crustal dust and volatile organic compounds. Anthropogenic sources include industrial activities, mining, combustion engines, power stations, domestic heating, transportation and agricultural activities (Hime, Cowie and Marks 2015, p. 22).

Particle size is a major determining factor in the potential health effects of airborne dust. Consequently, dust monitoring is conducted using methods that select for target particle size ranges.

Particulate matter in air pollution is generally characterised as follows:

- Total suspended particulates (TSP) refers to all particulate matter in the atmosphere (up to approximately 100 micrometres in aerodynamic diameter).
- PM_{10} is particulate matter less than 10 micrometres in aerodynamic diameter (the size range $PM_{10-2.5}$ is often referred to as the coarse fraction or coarse particulate matter)[1]. Note that PM_{10} includes $PM_{2.5}$.
- $PM_{2.5}$ is particulate matter less than 2.5 micrometres in aerodynamic diameter (often referred to as the fine fraction or fine particulate matter).
- $PM_{0.1}$ is particulate matter less than 0.1 micrometres in aerodynamic diameter (often referred to as the ultrafine fraction or ultrafine particulate matter).

TSP was the first indicator used to represent suspended particles in ambient air (ambient air is the air in the general outdoors atmosphere). In 1987, the US Environmental Protection Agency (USEPA) introduced PM_{10} as an indicator in the determination of health impacts from airborne particulate matter. This was because PM_{10} was responsible for most of the

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[1] Note that, contrary to the generally accepted terminology, the NSW *Protection of the Environment Operations (General) Regulation 2009* defines fine particulate as PM_{10} and coarse particulate as any airborne particulate matter larger than PM_{10}.

adverse human health effects of airborne particulate matter because these particles were small enough to reach the lower regions of the human respiratory tract. In those early days, PM_{10} was referred to as fine particulate matter or the fine fraction. Today, that term is largely reserved for $PM_{2.5}$, although in same applications fine particulate still means PM_{10}, for example, the NSW *Protection of the Environment Operations (General) Regulation 2009* and the IMA - Europe health hazard criteria (refer to page 25).

Particles in the size range $PM_{10-2.5}$ are produced by mechanical processes such as mining, wind erosion, re-suspension by transport activities, and agriculture. They include pollen, fungal spores, sea salt and crustal dust. In relative terms, these are large particles and only remain in the atmosphere for hours to a few days, depositing on surfaces close to the source (Hinds 1999, as cited in Hime et al. 2015, p. 25; and USEPA 2009, pp. 3-4).

$PM_{2.5}$ comprises of particles that are produced from emissions from smelters, refineries, steel mills and mining; the cohering together of ultrafine particles; reactions with water droplets in the atmosphere; and condensation of nitrates, sulphates and organic compounds (John et al. 1990, Seinfeld and Pandis 2006, as cited in Hime et al. 2015, p. 25). They include products from combustion processes and photochemical reactions of volatile organic compounds and oxides. These particles can remain suspended in the atmosphere for long periods of time (days to weeks) and can travel hundreds or thousands of kilometres (Hinds 1999, as cited in Hime et al. 2015, p. 25; and USEPA 2009, pp. 3-4).

$PM_{0.1}$ comprises particles produced by high temperature combustion processes or from nucleation of atmospheric gases. They are particles that are short-lived in the atmosphere (minutes to hours), so are not transported over any great distances (USEPA 2009, pp. 3-4).

Dust deposition

Dust deposition (also referred to as dustfall or dust fallout) is used to describe airborne particulate matter that settles out of the air under the influence of gravity. Because it is not particle size selective and generally contains particles in larger size ranges, dust deposition is not used as a measure of the health effects associated with airborne particulate matter. Rather, it is useful as a determinant of sources causing dust nuisance in surrounding areas.

Dust deposition is measured using a dust deposition gauge (DDG), which compromises of a large glass bottle fitted with a funnel of known surface area, mounted two metres above the ground. Dust *falls* out of the air into the funnel over a period of one month and is then collected for analysis. Dust deposition is measured in units of $g/m^2/month$.

Health impacts

Long-term and short-term exposures to ambient air particulate matter have been associated with detrimental health effects. Long-term exposure contributes to the initiation and progression of disease over months or years. These include conditions such as cardiovascular-related mortality, atherosclerosis, ischaemic heart disease, complications of diabetes, respiratory-related mortality, asthma symptoms, reduced lung function in children, reduced lung function in susceptible adults, and lung cancer, amongst others (Hime et al. 2015, pp. 40-41).

Short-term exposure affects susceptible members of the population because of existing chronic disease, compromised respiratory function in the developing lungs of children, or compromised physiological function in the elderly from the effects of ageing (Brook et al. 2020, as cited in Hime et al. 2015, p. 40).

The human respiratory system is designed to protect itself from particulate matter by preventing larger particles from reaching more sensitive parts of the system. However, smaller particles are able to reach the thoracic respiratory tract. The particles of most concern are the $PM_{2.5}$ particles. Morgan, Broome and Jalaludin (2013, p. 15) found that there was strong evidence for negative impacts on respiratory and cardiovascular systems from both short-term (24-hours) and long-term (annual) exposures to particulate air pollution.

Respirable crystalline silica

Silica is a widely abundant naturally occurring mineral that is a major constituent of most rocks and soils. Silica can occur in both crystalline and non-crystalline (amorphous) forms. Crystalline forms of silica, when ground into small particles, can lodge deep into the lungs and cause a range of respiratory illnesses including silicosis. These small particles of crystalline silica are referred to as respirable crystalline silica or RCS.

Quartz is the most common type of crystalline silica. The other major forms of crystalline silica are cristobalite and tridimite. Crystalline silica at CVO is primarily quartz, but occasionally contains a small proportion of cristobalite. The RCS concentrations detailed in this report are based on the analysis of both quartz and cristobalite in the dust sampled.

Several papers found in the literature have reported that freshly fractured quartz leads to increased cytotoxicity. It is theorised that cleavage of crystalline silica particles results in the formation of reactive radical species at the newly generated particle surfaces. This reactivity decays with time leading to *aged* crystalline silica being less cytotoxic. The process occurs slowly in air, but rapidly in water. However, the research conducted has been in the laboratory on rats, mice and dogs. There is no empirical field data to confirm the laboratory work. Humans appear to exhibit the adverse effects of silica exposure at lower levels than animals. Hence, results from animal trials may not be a good predictor of human effect levels (OEHHA 2005, pp. 22-24).

Regardless of the potential variability in toxicity of various forms of RCS, all forms are toxic (OEHHA 2005, p. 38).

Ambient air quality criteria

The key framework for ambient air quality in Australia is established by the *National Environment Protection (Ambient Air Quality) Measure* (NEPM). State jurisdictions enforce the key criteria (or standards) for ambient air quality set by the NEPM and are required to implement programs to measure air quality against the criteria. For air quality criteria not established by the NEPM, each state sets its own standards.

In terms of airborne dust, the NEPM only covers PM_{10}, $PM_{2.5}$ and lead. Since the measurement of other metals and RCS was also relevant to the Study, additional air quality criteria were required to benchmark the metals and RCS concentrations.

Averaging times play a role in the benchmarking. For example, under the NEPM PM_{10} and $PM_{2.5}$ both have 24-hour and annual average criteria, while lead only has an annual average criterion.

Since the NEPM only covers some of the substances relevant to the Study, and it takes a year to determine an annual average, alternative sources were sought for air quality criteria to benchmark against. This was to address substances not listed in the NEPM and to find, where possible, criteria with shorter averaging periods, so a performance assessment of dust control measures could be made in the shorter term. The order of priority given to the air quality criteria used as benchmarks for the Study is listed below. Where a criterion did not exist for the substance of interest or for the averaging time required, one was sought from the next source down in the priority list:

1. NSW Environmental Protection Authority (NSW EPA 2017)
2. Other Australian federal or state jurisdiction, e.g., Queensland Government (2019), Environmental Protection Authority Victoria (EPA Victoria 2008)
3. Ontario Ministry of Environment (MOE 2012).

Criteria set by the Ontario MOE were used on the recommendation of Todoroski Air Sciences, as *Ontario's Ambient Air Quality Criteria* (MOE 2012) is possibly the most comprehensive collection of ambient air quality criteria available.

Table 1 details the air quality criteria used for the Study.

Table 1: Ambient air quality criteria

Substance	Averaging period	Criteria	Source
PM_{10}	24-hour	50 µg/m^3	NSW EPA (NEPM)
	Annual	25 µg/m^3	NSW EPA (NEPM)
$PM_{2.5}$	24-hour	25 µg/m^3	NSW EPA (NEPM)
	Annual	8 µg/m^3	NSW EPA (NEPM)
Antimony (and compounds)	24-hour	25 µg/m^3	Ontario MOE
Arsenic (and compounds)	24-hour	0.3 µg/m^3	Ontario MOE
	Annual	0.003 µg/m^3	Qld Govt
Barium – total water soluble	24-hour	10 µg/m^3	Ontario MOE
Beryllium	24-hour	0.01 µg/m^3	Ontario MOE
Cadmium (and compounds)	24-hour	0.025 µg/m^3	Ontario MOE
	Annual	0.005 µg/m^3	Qld Govt
Chromium (III) compounds	24-hour	0.5 µg/m^3	Ontario MOE
Cobalt	24-hour	0.1 µg/m^3	Ontario MOE
Copper	24-hour	50 µg/m^3	Ontario MOE
Lead (and compounds)	24-hour	0.5 µg/m^3	Ontario MOE
	Annual	0.5 µg/m^3	NSW EPA (NEPM)
Manganese (and compounds)	24-hour	0.2 µg/m^3	Ontario MOE
	Annual	0.16 µg/m^3	Qld Govt
Mercury	24-hour	2 µg/m^3	Ontario MOE
Molybdenum	24-hour	120 µg/m^3	Ontario MOE
Nickel (and compounds)	24-hour	0.1 µg/m^3	Ontario MOE
	Annual	0.022 µg/m^3	Qld Govt
RCS (as $PM_{2.5}$)	Annual	3 µg/m^3	EPA Victoria
Selenium	24-hour	10 µg/m^3	Ontario MOE
Silver	24-hour	1 µg/m^3	Ontario MOE
Tin	24-hour	10 µg/m^3	Ontario MOE
Zinc	24-hour	120 µg/m^3	Ontario MOE

Mining and airborne particulate matter

According to Kan, Kellaghan and Roddis (2013, pp. 4-5), typical sources of particulate matter from mining include (in approximate order of volume produced):

- hauling on unsealed roads
- wind erosion on open areas
- material transfer of product and overburden
- bulldozers on product and overburden
- loading stockpiles
- trucks unloading product and overburden
- wind erosion and maintenance of stockpiles
- blasting
- topsoil handling
- drilling
- grading
- train loading.

Consequently, airborne particulate matter produced by mining is generally associated with the larger size fraction ($PM_{10-2.5}$), due to its generation via mechanical processes, as opposed to the smaller size fraction ($PM_{2.5}$ and smaller) generally associated with combustion and high temperature processes (Kan et al. 2013, p. 6 and USEPA 2019, pp. 2-6). That is not to say that there are no smaller size fraction particles in particulate matter generated by mining activities, just that most mining processes produce predominantly larger size fraction particles.

There have been studies undertaken in Australia in relation to coal mining and $PM_{2.5}$ (NSW EPA 2013), and the contribution of non-metallic mineral mining and quarrying to $PM_{2.5}$ is estimated to be small (NSW EPA 2016, p. 20); however, there appears to be little information about the contribution of metal mining activities.

Monitoring methods

There are a range of methods used to measure airborne particulate matter. In this report, reference is made to four methods used at CVO.

High-volume air sampling

This method uses a sampler with a high-volume air pump that draws approximately 1600 m^3 of air through a large rectangular filter paper over a 24-hour period. Particulate matter is collected on the filter paper for weighing and other analysis (e.g., metals). The samplers are run once every six days (rather than every seven days) to avoid coinciding with any regular weekly cycles that might be occurring at any nearby dust generating activities.

At CVO, high volume air samplers (HVAS) were used to collect PM_{10} for determining metal concentrations in ambient air for the Study.

Low-volume air sampling

This method uses a low-volume air pump that draws typically between 5 L/min and 16.7 L/min of air through a small circular filter paper. The sampler may be run for a day, several days or weeks at a time. Particulate matter is collected on the filter paper for weighing and other analysis (e.g., RCS).

At CVO, low volume air samplers (LVAS) were used to collect $PM_{2.5}$ for determination of particulate matter in the $PM_{2.5}$ size range and RCS concentrations in ambient air for the Study.

Tapered Element Oscillating Microbalances

A Tapered Element Oscillating Microbalance (TEOM) is an electronic air sampler that draws 16.7 L/min of air onto a filter paper mounted on a device that can measure the weight of particulate matter being deposited continuously in real time. The filter paper is changed infrequently and is generally not used for any other analysis.

At CVO, TEOMs are used to continuously monitor PM_{10} for determination of particulate matter concentrations in ambient air in real time as part the mine's Project Approval.

DustTraks

DustTrak is a proprietary name for a type of electronic air sampler that draws 3 L/min of air through a small chamber in which a laser light is present. Light is scattered off any particulate matter in the air stream and the electronics in the sampler convert the scattered light signals to a measurement of the amount of particulate matter present. Like the TEOMs, DustTraks can report the amount of particulate matter present continuously in real time.

Workplace exposure monitoring

Exposure to dust in workplace settings is conducted by fitting purpose-built workplace exposure samplers to potentially exposed workers and sampling in the breathing zone of the potentially exposed individual/s, for a period of time representative of a working shift. The air sampling conducted for this Study used sampling equipment and methodologies purpose-built for sampling dust in ambient air at fixed locations. Consequently, the results reported for the Study are not able to be compared to worker dust exposure standards.

3.3 Water quality

Australian Drinking Water Guidelines

Safe drinking water is essential to sustain life. Therefore, every effort needs to be taken to ensure that drinking water suppliers provide consumers with water that is safe to use.

The Australian Drinking Water Guidelines (NHRMC, NRMMC 2011 updated March 2021) are intended to provide a framework for good management of drinking water supplies that, if implemented, will assure safety at point of use. The guidelines have been developed after consideration of the best available scientific evidence. They are designed to provide an authoritative reference on what defines safe, good quality water, how it can be achieved, and how it can be assured. They are concerned both with safety from a health point of view and with aesthetic quality.

The Australian Drinking Water Guidelines are not mandatory standards; however, they provide a basis for determining the quality of water to be supplied to consumers in all parts of Australia. These determinations need to consider the diverse array of regional or local factors, and take into account economic, political and cultural issues, including customer expectations and willingness and ability to pay.

There are health-based guidelines and aesthetic guidelines (see Table 2). Health-based guidelines relate to the health risk to a water consumer. Aesthetic guidelines relate to the acceptability of water due to, for example, appearance, taste and odour.

Scope of the Australian Drinking Water Guidelines

Drinking water is defined as water intended primarily for human consumption, either directly, as supplied from the tap, or indirectly, in beverages, ice or foods prepared with water. Drinking water is also used for other domestic purposes such as bathing and showering.

With the exception of bottled or packaged water, the Australian Drinking Water Guidelines apply to any water intended for drinking irrespective of the source (municipal supplies, rainwater tanks, bores, etc.) or where it is consumed (the home, restaurants, camping areas, shops, etc.).

Purpose of the Australian Drinking Water Guidelines

The Australian Drinking Water Guidelines provide the authoritative Australian reference for use within Australia's administrative and legislative framework to ensure the accountability of drinking water suppliers (as managers) and of state and territory health authorities (as auditors of the safety of water supplies). The guidelines are not, however, mandatory legally enforceable standards.

With appropriate consultation with the community, the Australian Drinking Water Guidelines may be used directly as agreed levels of service, or they may form the basis for developing local levels of service. In the case of health-related water quality characteristics, there is less latitude for variation because the safety of drinking water is paramount. However, with regard to aesthetic characteristics, what is acceptable or unacceptable depends on public expectations and can therefore be determined by water authorities in consultation with consumers, taking into account the costs and benefits of further treatment of the water. The Australian Drinking Water Guidelines provide a starting point for that process. The guidelines may also be used by a standards body for defining quality processes suitable for third party accreditation of a quality management system.

The guideline values define water that, based on current knowledge, is safe to drink over a lifetime; that is, it constitutes no significant risk to health. For most of the water quality characteristics discussed, there is a grey area between what is clearly safe and what is clearly unsafe. Often the latter has not been reliably demonstrated and the guideline values always err on the side of safety. Therefore, for most characteristics, occasional excursions beyond the guideline value are not necessarily an immediate threat to health. The amount by which, and the duration for which, any health-related guideline value can be exceeded without raising concerns for public health depends on the particular circumstances. Exceeding a guideline value should be a signal to investigate the cause and, if appropriate, to take remedial action.

Livestock Drinking Water Guidelines

Water quality may have a significant impact on animal production, fertility and general health. Guidelines have been developed for livestock drinking water which include biological, chemical and radiological characteristics that may affect animal health (ANZECC/ARMCANZ 2000) (see Table 2). The guidelines are trigger values below which there should be minimal risk to animal health. If a trigger value is exceeded, investigation is warranted to determine the level of risk.

Guideline values

Drinking water quality guidelines are detailed in Table 2.

Table 2: Drinking water quality guidelines (NHMRC 2011; ANZECC/ARMCANZ 2000)

Parameter	Australian Drinking Water Guidelines (NHMRC 2011 updated March 2021)		Livestock Drinking Water Guidelines (ANZECC/ARMCANZ 2000)
	Health-based (mg/L)	Aesthetic (mg/L)	(mg/L)
Aluminium (Al) - acid-soluble	-	0.2	5
Ammonia (NH3)	-	0.5	-
Antimony (Sb)	0.003	-	-
Arsenic (As)	0.01	-	0.5; up to 5 see Table 4.3.2 (ANZECC/ARMCANZ 2000)
Cadmium (Cd)	0.002	-	0.01
Calcium (Ca)	-	-	1000
Chloride (Cl^-)	-	250	-

Parameter	Australian Drinking Water Guidelines (NHMRC 2011 updated March 2021) Health-based (mg/L)	Australian Drinking Water Guidelines (NHMRC 2011 updated March 2021) Aesthetic (mg/L)	Livestock Drinking Water Guidelines (ANZECC/ARMCANZ 2000) (mg/L)
Chlorine (Cl)	5	0.6	-
Chromium - total (Cr)	-	-	1
Chromium III (Cr^{3+})	-	-	-
Chromium VI (Cr^{6+})	0.05	-	-
Cobalt (Co)	-	-	1
Copper (Cu)	2	1	0.4 (sheep); 1 (cattle); 5 (pigs); 5 (poultry)
Electrical Conductivity (EC)	-	-	See Table 4.3.1 (ANZECC/ARMCANZ 2000)
Fluoride (F)	1.5	-	2
Iron (Fe)	-	0.3	-
Lead (Pb)	0.01	-	0.1
Magnesium (Mg)	-	-	ID
Manganese (Mn)	0.5	0.1	-
Molybdenum (Mo)	0.05	-	0.15
Nickel (Ni)	0.02	-	1
Nitrate (NO3)	50	-	400
Nitrite (NO2)	3	-	30
pH	-	6.5 - 8.5	-
Selenium (Se)	0.01	-	0.02
Silver (Ag)	0.1	-	-
Sodium (Na)	-	180	-
Sulphate (SO4)	-	250	1000
Turbidity (NTU)	-	5	-
Total Dissolved Solids (TDS)	-	600	2000 (poultry); 2500 (dairy cattle); 4000 (pigs, horses, beef cattle); 5000 (sheep) See Table 4.3.1 (ANZECC/ARMCANZ 2000)
Total Suspended Solids (TSS)	-	-	-
Zinc (Zn)	-	3	20

4.Results of monitoring and analysis

4.1 Tailings dust characterisation

Earth Systems was engaged by CVO to identify a chemical, geochemical and mineralogical fingerprint for the tailings. This was undertaken to assess the potential impact of dust from the tailings storage facilities on the local community (Waters and Taylor 2019; Taylor 2020a, 2020b, 2020c and 2021). Refer to ***Appendix A*** for the full reports provided by Earth Systems.

Earth Systems is a Melbourne-based environmental consultancy firm that provides a range of environmental and sustainability services throughout the world, including water management and geochemical characterisation.

Four samples of tailings material were collected from the NTSF, and four samples were collected from the STSF by CVO personnel. These eight bulk samples were sieved to obtain 16 subsamples made up of:

- the fraction with particle sizes ten micrometres or greater in diameter, and
- the fraction with particle sizes less than ten micrometres in diameter (PM_{10}).

Sampling was undertaken from the upper most layer of the tailings material (referred to by Earth Systems as *surficial* tailings material), and the PM_{10} samples were produced by sieving, to obtain material which is most likely to become airborne in windy conditions.

The tailings samples were subjected to the following analysis:

- Quantitative X-Ray diffraction analysis (XRD) conducted by QUT to determine the mineralogy of:
  - eight bulk surficial tailings samples (Spratt ,2020a)
  - eight PM_{10} surficial tailings samples (Spratt, 2020b)

  (Refer to ***Appendix E*** for the full reports from QUT).
- Trace element and partial major element chemistry conducted by ALS for the eight bulk surficial tailings samples (see Certificate of Analysis EB2000092 in ***Appendix F***).
- The net acid generation (NAG) suite for the eight bulk surface tailings samples (i.e., NAG pH, and NAG leachate chemistry) (see Certificate of Analysis EB2000092 in ***Appendix F***).
- Australian Standard Leachate Procedure (ASLP) data for the eight bulk surficial tailings samples. This procedure was intended to identify key mobile components in near neutral water – a proxy for leaching during rainfall events (see Certificate of Analysis EB2000092 in ***Appendix F***).
- Data from DDGs:
  - partial bulk chemistry (selected major and trace elements)
  - dust loads (i.e., the mass of dust per volume of air and unit of time)
  - proportions of soluble and insoluble components.

The analysis of the tailings samples indicated the following:

- Surface tailings samples contained a mixture of primary and secondary minerals, with secondary minerals and amorphous components being more concentrated in the PM_{10} fraction.
- Between 1.8 and 4.1 wt% of the tailings was in the PM_{10} size range (averaging 3.3 wt%).

- The dominant primary minerals were:
  - plagioclase feldspar (23 to 31 wt% [$(Na, Ca)(Si, Al)_4O_8$])
  - illite/mica (16 to 20 wt% [$(K, H_3O)(Al, Mg, Fe)_2(Si, Al)_4O_{10}[(OH)_2, (H_2O)]$])
  - quartz (14 to 17 wt% [SiO_2])
  - clinochlore (10 to 16 wt% [$Mg_5Al(AlSi_3O_{10})(OH)_8$])
  - potassium feldspar (8 to 13 wt% [$KAlSi_3O_8$])
  - calcite (3 to 4 wt% [$CaCO_3$])
  - minor (i.e., generally less than 2 wt%) concentrations of magnetite [Fe_3O_4], pyrite [FeS_2], dolomite [$MgCO_3{\cdot}CaCO_3$], and amphibole occurred in many samples.
- Secondary minerals were mostly hydrous calcium-sodium-magnesium sulphates (e.g., gypsum, blodite, glauberite) with lesser chlorides (halite) and iron sulphates (rhomboclase). Many of these secondary phases were soluble to highly soluble in water and had low densities compared to primary tailings mineral phases.
- Secondary minerals are produced from acid neutralisation reactions within the tailings. Fluids percolate upward through the tailings via capillary action, and secondary efflorescence minerals precipitate at the surface due to evaporation.
- Secondary phases are the most likely tailings component to become airborne, due to their location at the surface of the tailings storage facility and comparatively low density. They are expected to be the first to be mobilised as dust and/or travel the furthest if they become airborne during windy conditions. After deposition, they are also the most likely minerals to subsequently dissolve upon contact with water due to their high solubility. Consequently, these phases have the potential to effect down-wind water chemistry. For example, these minerals have the potential to give drinking water a salty and/or bitter taste.
- These surface minerals are expected to be the first to be mobilised as dust and/or travel the furthest if they become airborne during windy conditions. After deposition, they are also the most likely minerals to subsequently dissolve upon contact with water.
- A slightly negative Net Acid Production Potential was calculated from the XRD mineralogy, showing that the tailings material was non-acid forming.
- ASLP data, which provides an analogue for the leaching of tailings during a rainfall event, indicated the presence of antimony, arsenic, chromium, copper, iron, lead, mercury, molybdenum, selenium and zinc. These are elements which are most likely to be mobilised from soluble tailings components during rainfall events.
- The pH of leachate water was 7.4 to 8.0, consistent with an excess of carbonate (non-acid forming), low acidity values, and elevated alkalinity values.
- The bulk samples and the PM_{10} samples contained significant concentrations of quartz (14 to 17 wt% in the bulk samples and 5 to 8.2 wt% in the PM_{10} samples). Quartz, when in the respirable size range, is usually the major component of RCS.
- Amphibole group minerals were identified in two of the eight bulk tailings samples and in one of the eight PM_{10} tailings samples (this was the PM_{10} fraction of one of the two bulk samples containing amphibole). Certain amphibole minerals have the potential to occur in, what is referred to as, a fibrous habit (i.e., they are asbestiform minerals such as asbestos).

  The two bulk samples containing amphibole were submitted to ALS for asbestos analysis. No asbestos or asbestiform material was found (see Certificate of Analysis ES2016687 in ***Appendix F***).

4.2 Deposited dust

Following identification of a chemical, geochemical and mineralogical fingerprint for the tailings, Earth Systems conducted an assessment of deposited dust (Taylor 2020a and 2021). Refer to ***Appendix A*** for the full reports provided by Earth Systems.

Information from DDGs can be indicative of elements present in CVO tailings dust. However, since the dust deposited in the gauges may also derive from other sources, including non-mining sources, the presence of an element in deposited dust does not necessarily translate to impact on tank or farm water quality. This is dependent upon the mineral phase in which the element occurs and the solubility of that phase.

The DDGs indicated the presence of aluminium, copper, chromium, cobalt, iron, lead, manganese, molybdenum, nickel, zinc and occasionally arsenic, antinomy and selenium in deposited dust. However, the levels were low, and they were not necessarily present in water-soluble form, so their presence does not automatically translate to water quality impacts.

Earth Systems found that approximately 10 to 20 wt% of the dust reporting to the DDGs was in a soluble form. This is consistent with a theory that highly soluble efflorescent (surface) materials from the tailings would be the most likely to be mobilised as dust in windy conditions and travel the furthest. It suggests that, at least to some extent, deposited dust is influenced by tailings dust. Notwithstanding, the results of water testing did not indicate any measurable impact on water quality (see below).

4.3 Water quality

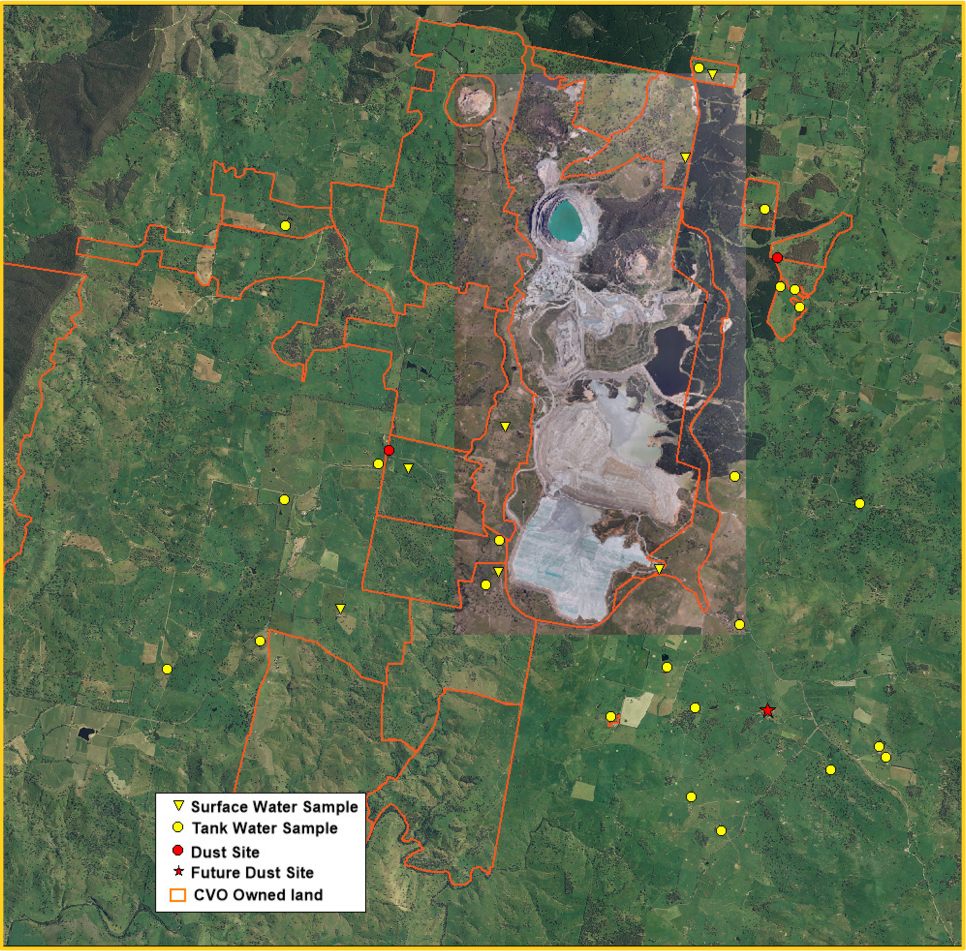

Figure 1: Sampling locations for water quality surveys and additional monitoring sites for $PM_{2.5}$ and RCS

Using information gathered in the dust identification and dust deposition assessment work, Earth Systems undertook an examination of roof, farm dam and bore water quality (Taylor 2021). Refer to ***Appendix A*** for the full reports provided by Earth Systems.

Due to the COVID 19 pandemic, a decision was taken to initially defer sampling of residents' properties, so the focus of Earth Systems' water quality work was on properties owned by CVO. This water sampling was conducted in May 2020. CVO later conducted sampling of residents' roof water in September/October 2020. The water quality results are included in the HSE Materials Hazard Assessment in ***Appendix B***.

In total, 48 water quality samples were collected from tanks, farm dams and bores (see Certificates of Analysis ES2016298, ES2034662, ES2034663, ES2034993 and ES2100772 in ***Appendix F***). Figure 1 shows the sampling locations. The primary focus was on metals as outlined in the Australian Drinking Water Guidelines.

Drinking water

Earth Systems found for roof water:

- Most samples met the Australian Drinking Water Guidelines (see Table 2), with the following exceptions:
  - pH in most roof water tanks measured 4.5 to 6.3 while the aesthetic guideline range is 6.5 to 8.5
  - total lead in one tank (CHST) measured 0.013 mg/L while the health-based guideline is 0.01 mg/L
  - total zinc in two tanks (SVWT and OCWT) measured 5 to 13 mg/L while the aesthetic guideline is 3 mg/L
  - total iron in one tank (BWWT) measured 0.42 mg/L while the aesthetic guideline is 0.2 mg/L.
- The samples were generally slightly acidic to near-neutral (pH 4.5 to 6.7) and well oxidised, with low salinity (less than 170 µS/cm), low suspended solids (less than 20 mg/L) and low metal and nutrient concentrations.
- The acidity and iron may relate to rusting of the roofing materials and/or organic acids (the lowest pH values and highest iron concentrations may be derived from the oldest or most corroded roofs).
- Despite elevated dissolved (and total) zinc concentrations, all the samples had very low sulphate and chloride concentrations, which strongly suggested no significant effect from CVO tailings dust on roof water. Zinc in the roof water is likely to be predominantly (or exclusively) derived from galvanised steel roofing, guttering or plumbing materials.
- There was significant variability in zinc concentrations in roof water samples. The reasons for this were unclear, but it was possible that older roofs, in poorer condition, were associated with higher zinc concentrations.
- This would be supported by the observed higher zinc concentrations in concrete tanks, and the possibility that concrete tanks (and their associated roof water collection systems) are older than plastic or Zincalume steel tanks.
- The marginally elevated lead concentration in one roof water collection tank (BWWT) could have been related to the use of lead flashing or impurities in plumbing or galvanising materials.
- Salinity and major ion concentrations in roof water were low, particularly compared to dam water, and were likely controlled by concrete dissolution, with lesser contributions from natural sources or agricultural additives.
- The mineral calcite may be derived from dust associated with the application of agricultural lime or dust derived from the weathering of local geological units (i.e., limestone). While dust derived from CVO tailings storage facilities is another potential source of calcite, this is considered less likely based on the above conclusion.
- Other metals that can be detected in some of the roof water include manganese, copper and cadmium, albeit at very low concentrations that fall within drinking water quality guidelines. The dissolved manganese is consistent with the presence of calcite (see above), whereas the copper and (minor) cadmium are probably derived from galvanised steel roofing or plumbing materials.
- Overall, roof water chemistry appears to be primarily influenced by local materials including galvanised steel roofing or guttering materials (sources of zinc and cadmium), rusting of steel roof materials (iron), copper piping

(copper), lead flashing (lead) and dust from natural carbonate-bearing sources (e.g., manganese). However, as some of these components – zinc, copper, manganese and (minor) cadmium – were also identified in the aqueous fingerprint of CVO tailings dust, further investigation would assist to confirm these assumptions and discount the influence of CVO tailings dust. Further analytical techniques to address this are currently being explored.

The water quality analysis undertaken on the September/October water samples by CVO indicated that all tank water samples, and one bore water sample, met the Australian Drinking Water Guidelines (see Table 2), with the following exceptions (the water quality results are included in the HSE Materials Hazard Assessment in ***Appendix B***):

- total dissolved solids in the bore sampled (EB_BT) measured 1020 mg/L while the aesthetic guideline is 600 mg/L
- total lead in one tank (SHARP_HT) measured 0.014 mg/L while the health-based guideline is 0.01 mg/L
- total cadmium in one tank (EB_HT1) measured 0.0025 mg/L while the health-based guideline is 0.002 mg/L. The zinc concentration in this sample was high (although not more than the aesthetic guideline) at 2.17 mg/L, suggesting zinc and cadmium contamination from galvanised steel roofing
- total zinc in one tank (STOCKTON_HT) measured 3.17 mg/L and in the bore water (EB_BT) measured 7.23 mg/L while the aesthetic guideline is 3 mg/L
- total iron in two tanks (SHARP_HT and SHARP_W) measured 2.02 to 4.77 mg/L while the aesthetic guideline is 0.2 mg/L.

As previously stated, roof water chemistry appears to be primarily influenced by local materials including galvanised steel roofing or guttering materials (sources of zinc and cadmium), rusting of steel roof materials (iron), copper piping (copper), lead flashing (lead) and dust from natural carbonate-bearing sources (e.g., manganese).

As detailed in ***Purpose of the Australian Drinking Water Guidelines*** on page 14, the guideline values define water that, based on current knowledge, is safe to drink over a lifetime; i.e., it constitutes no significant risk to health. For most of the water quality characteristics discussed, there is a grey area between what is clearly safe and what is clearly unsafe. Often the latter has not been reliably demonstrated and the guideline values always err on the side of safety. Therefore, for most characteristics, occasional excursions beyond the guideline value are not necessarily an immediate threat to health.

The amount by which, and the duration for which, any health-related guideline value can be exceeded without raising concerns for public health depends on the particular circumstances. Exceeding a guideline value should be a signal to investigate the cause and, if appropriate, to take remedial action.

Consequently, the two sources of marginally elevated lead levels were resampled and reanalysed. The subsequent samples indicated lead below the Australian Drinking Water Guidelines (see Certificate of Analysis ES2100772 in ***Appendix F***). The instance where cadmium slightly exceeded the guidelines was attributable to contamination from galvanised steel roofing or guttering.

Livestock water

Earth Systems found for farm dam and bore water:

- All dam water samples met ANZECC/ARMCANZ (2000) guidelines for livestock drinking water quality.
- Farm dam water was generally near-neutral (pH 5.1 to 7.7) and sometimes reduced, with low to moderate salinity (up to 533 µS/cm) and suspended solids (up to 41 mg/L) and low metal and nutrient concentrations.
- The chemistry of dam water samples is more complex than roof water samples. This is likely because dam water is exposed to soils containing a wide variety of minerals as well as potential soil amendments compared to the relatively simple roof water collection system.
- The observed higher concentrations of nitrogen and phosphorus-based nutrients in farm dam water, relative to roof water tanks, provides some evidence that soil amendments have been, or are being used, on farmland within the dam catchments.

- Salinity and major ion concentrations in dam water samples appear to be largely controlled by the carbonate mineral dolomite (and potentially calcite). Possible sources of dolomite include dust from the application of agricultural dolomite, dust from the weathering of the local rocks/soils, or dust derived from CVO tailings storage facilities.
- The dissolution of gypsum / bassanite / anhydrite is suggested by a correlation between dissolved sulphate and calcium concentrations in farm dam water. These minerals could be sourced from soil amendments or dust derived from CVO tailings.
- Potassium could potentially be associated with farm additives, whereas sodium and chloride may relate to the use of stock licks (sodium chloride) on farms and/or saline groundwater inflows to dams (sodium chloride). However, the fugitive dust from CVO tailings storage facilities cannot be discounted as a potential source of potassium and some sodium chloride (halite).
- While of no concern for livestock drinking water, metals that are present in some of the farm dam water include iron and very low concentrations of manganese, aluminium, molybdenum, copper, zinc, arsenic, cobalt and nickel.
- Overall, when comparing the farm dam water chemistry to the tailings ASLP data, the only metals in dam water that were consistent with the aqueous identification of CVO tailings dust were zinc, copper, manganese and molybdenum. However, micro-nutrient fertiliser sources cannot be excluded at this stage. Further investigation is required to clarify any influence of CVO tailings dust on the trace element signature of dam water. Analytical techniques to address this are being explored.
- All water samples from the farm dams met the Australian Livestock Drinking Water Guidelines.

4.4 Airborne dust

Monitoring network

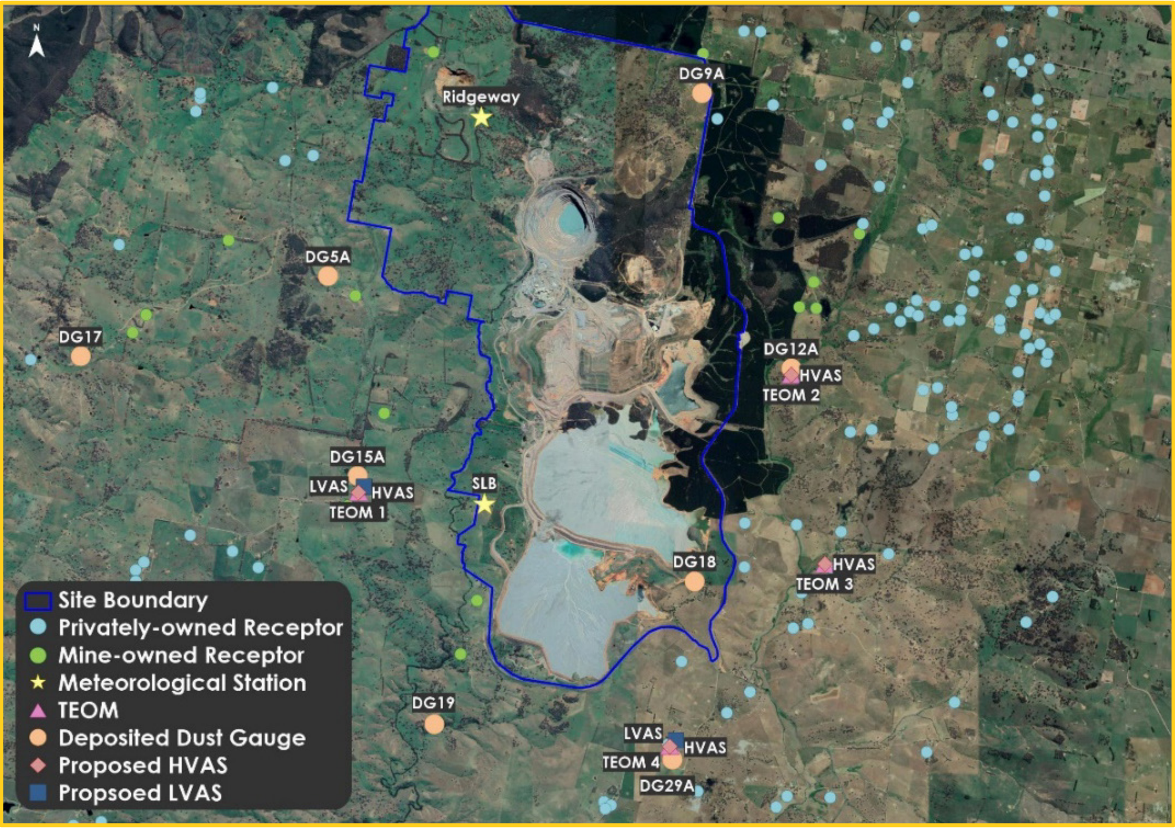

Figure 2: Air quality monitoring network recommended by Todoroski Air Sciences

Todoroski Air Sciences was engaged to review CVO's air quality monitoring plan and recommend amendments that might be necessary to assist with quantification of any potential dust emissions generated by the NTSF and STSF (Trahair and Henschke 2020). Refer to *Appendix C* for the full reports provided by Todoroski Air Sciences.

Todoroski Air Sciences is a Sydney based environmental consulting firm specialising in air quality assessment.

Todoroski recommended some amendments to the existing air quality monitoring program at CVO to meet the objectives of the Study. Figure 2 and Table 3 detail the location of the existing and recommended additional air sampling instruments. Refer to *4.2 Deposited dust* on page 18 for a discussion on deposited dust results.

Table 3: Ambient air quality monitoring network recommended by Todoroski Air Sciences

ID	Property name	Monitor type	Parameter monitored	Existing or new
TEOM 1	Flyers Creek Weir	TEOM	PM_{10}	Existing
HVAS 1	Flyers Creek Weir	HVAS	PM_{10}, metals	**New**
TEOM 2	Bundarra	TEOM	PM_{10}	Existing
HVAS 2	Bundarra	HVAS	PM_{10}, metals	**New**
LVAS 2	Bundarra	LVAS	RCS	**New**
TEOM 3	Triangle Flat	TEOM	PM_{10}	Existing
HVAS 3	Triangle Flat	HVAS	PM_{10}, metals	**New**
TEOM 4	Meribah	TEOM	PM_{10}	Existing
HVAS 4	Meribah	HVAS	PM_{10}, metals	**New**
LVAS 4	Meribah	LVAS	RCS	**New**
DG5A	Bundella	Deposited dust gauge	Deposited dust, metals	Existing
DG9A	Exploration	Deposited dust gauge	Deposited dust, metals	Existing
DG12A	Flyers Creek Weir	Deposited dust gauge	Deposited dust, metals	Existing
DG15A	Bundarra	Deposited dust gauge	Deposited dust, metals	Existing
DG17	Ashleigh Park	Deposited dust gauge	Deposited dust, metals	Existing
DG18	Wire Gully	Deposited dust gauge	Deposited dust, metals	Existing
DG19	Oakey Creek	Deposited dust gauge	Deposited dust, metals	Existing
DG29A	Meribah	Deposited dust gauge	Deposited dust, metals	Existing

PM_{10} metals

The results of HVAS PM_{10} particulate matter and metals monitoring (see Certificates of Analysis CA2003791, CA2003799, CA2004913, CA2004914, CA2006086, CA2006106, CA2007418, CA2100246 and CA2100247 in *Appendix F* and Table D.1 in

Appendix D) were reviewed against the ambient air quality criteria in Table 1. The sampling results available at the time of compilation of this report were for the period April 2020 to December 2020.

A summary of the results is shown in Table 4 which compares the maximum 24-hour and long-term average concentrations measured at any monitoring site for the period with 24-hour and annual ambient air quality criteria. None of the 24-hour criteria were exceeded and all were trending under the annual criteria. Indeed, apart from PM_{10} particulate matter, the closest any substance came to its relevant criteria was arsenic which reached 21% of the annual criterion, with the other substances at least an order of magnitude lower than their applicable criteria.

Table 4: Summary of HVAS PM_{10} particulate matter and metals results from April to December 2020

Substance	Maximum 24-hour measurement (µg/m^3)	24-hour criterion (µg/m^3)	Percent of 24-hr criterion (%)	Maximum average for sampling to date (µg/m^3)	Annual criterion (µg/m^3)	Percent of annual criterion (%)	Number of exceedances
PM_{10}	32.8	50	65.6	10.9	25	43.6	0
Iron	0.5	Not available			Not available		Not applicable
Aluminium	1.4	Not available			Not available		Not applicable
Antimony	0.00062	25	0.0025				0
Arsenic	0.00061	0.3	0.20	0.00062	0.003	21	0
Barium	0.033	10	0.33				0
Beryllium	<0.00069	0.01	<6.9				0
Cadmium	<0.00069	0.025	<2.8	<0.00062	0.005	<12	0
Chromium	0.0037	0.5	0.74				0
Cobalt	<0.00069	0.1	<0.69				0
Copper	0.053	50	0.11				0
Lead	0.0013	0.5	0.26	0.00093	0.5	0.19	0
Manganese	0.014	0.2	7	0.0037	0.16	2.3	0
Mercury	<0.00069	2	<0.035				0
Molybdenum	0.00061	120	0.00051				0
Nickel	0.0012	0.1	1.2	0.00073	0.022	3.3	0
Selenium	<0.00069	10	<0.0069				0
Silver	<0.00069	1	<0.069				0
Tin	<0.00069	10	<0.0069				0
Zinc	0.036	120	0.030				0
Total number of exceedances							**0**

$PM_{2.5}$

CVO acquired LVAS equipment, primarily to conduct monitoring for RCS. Since the RCS monitoring involved collection of $PM_{2.5}$ samples, $PM_{2.5}$ particulate matter concentrations were also able to be determined. However, the initial sampling for RCS (and, by inference, $PM_{2.5}$) was not carried out at the two community air monitoring sites recommended by Todoroski Air Sciences for sampling by LVAS (Trahair and Henschke 2020) (see Table 3). Of the community sites, only Bundarra was included. Another community site was selected for the measurement of RCS due to the potential influence of vent emissions on that location, based on plume dispersion modelling (discussed below in ***Respirable crystalline silica***). Figure 1 shows a map of the sampling locations. The results of $PM_{2.5}$ monitoring at these locations are detailed in Table 5. The relevant Certificates of Analysis are 15083-701, 15083-702 and 15083-703 and can be found in ***Appendix G***.

In future, it is proposed to conduct $PM_{2.5}$ monitoring using LVAS at the locations recommended by Todoroski. In addition, A DustTrak will be used to monitor $PM_{2.5}$ continuously, in real time, at Errowanbang (shown in Figure 1).

Respirable crystalline silica

Table 5: Results of LVAS sampling for $PM_{2.5}$ and RCS from July to December

Location	Date	Sample duration (hr)	$PM_{2.5}$ conc. (µg/m³)	Avg. $PM_{2.5}$ conc. (µg/m³)	$PM_{2.5}$ air quality criterion Annual (µg/m³)	RCS conc. (µg/m³)	Avg. RCS conc. (µg/m³)	RCS air quality criterion Annual (µg/m³)
Bundarra	16-Jul-2020 to 17-Jul-2020	24.0	2.50			<0.76		
Bundarra	28-Jul-2020 to 29-Jul-2020	24.0	0.55					
Bundarra	09-Aug-2020 to 10-Aug-2020	24.0	<0.14					
Bundarra	18-Aug-2020 to 31-Aug-2020	313.4	8.20			0.29		
Bundarra	31-Aug-2020 to 11-Sep-2020	262.1	8.87			0.41		
Bundarra	11-Sep-2020 to 23-Sep-2020	285.9	8.08			0.50		
Bundarra	23-Sep-2020 to 06-Oct-2020	312.2	5.32			0.23		
Bundarra	06-Oct-2020 to 03-Nov-2020	670.5	6.59			0.15		
Bundarra	03-Nov-2020 to 15-Dec-2020	1009.2	9.51	5.53	8	0.52	0.41	3
Woodville	16-Jul-2020 to 17-Jul-2020	24.0	<0.14					
Woodville	28-Jul-2020 to 29-Jul-2020	24.0	1.11					
Woodville	09-Aug-2020 to 10-Aug-2020	24.0	<0.14					
Woodville	18-Aug-2020 to 31-Aug-2020	311.1	6.05			0.12		
Woodville	31-Aug-2020 to 11-Sep-2020	264.1	3.71			0.16		
Woodville	18-Nov-2020 to 15-Dec-2020	645.1	7.54	3.12	8	0.68	0.32	3

Earth Systems reported that the tailings samples contained significant concentrations of quartz (14 to 17 wt% in the bulk tailings and 5.0 to 8.7 wt% in the PM_{10} component of the tailings) (Taylor 2020a). Quartz, when in the respirable size range, is usually the major component in RCS. While there were community concerns about RCS in the dust from CVO's mining operations, there appeared to be most concern about potential emissions of RCS from the mine ventilation system (vent emissions). Consequently, Todoroski Air Sciences was engaged to conduct plume dispersion modelling to determine the most likely location/s that emissions from the mine's ventilation stacks would impact the ground (Henschke 2020). Based on this modelling, an LVAS was located at Woodville (Figure 1 shows a map of the sampling locations), with a second sampler located at Bundarra as a reference sample.

Initially, sampling was only conducted for durations of 24 hours, but the sampling duration was subsequently increased to improve the LOD. Only a selection of the initial samples with higher weights of dust collected on the filter papers were submitted to RCA Australia for silica analysis (refer to ***Appendix G*** for RCA Australia's certificates of analysis). All the later, longer duration samples were submitted.

The results of the sampling are shown in Table 5. The relevant Certificates of Analysis are 250503, 250764 and 260401 and can be found in ***Appendix G***.

The results were trending under the annual ambient air quality criterion for $PM_{2.5}$ and RCS. Since the relevant criteria are annual averages, the sampling program will run for a year to confirm the initial indication of low annual average concentrations.

4.5 HSE Materials Hazard Assessment

Callander & Johnson Consultancy Services was engaged to undertake a HSE hazard assessment of the tailings material (Johnson 2020). Callander & Johnson is a Melbourne-based consulting firm that provides services in occupational health, development of safety data sheets, and product risk assessments.

HSE hazards posed by the tailings material were assessed by Callander & Johnson against internationally accepted protocols and classification schemes. Refer to ***Appendix B*** for a full copy of the HSE Materials Hazard Assessment.

Organic chemicals

The assessment included an examination of the potential for health and environmental impacts from organic chemicals used during mineral processing. It was found that CVO selected the processing reagents based on the use of the least hazardous chemicals, both from a worker health and safety perspective and consideration of the environmental impacts. The chemicals used are recycled in the process circuit and broken down during this processing.

Analysis of organic chemicals was undertaken on tailings samples by ALS. The analysis found low levels of hydrocarbon compounds were present. There were eight unidentified hydrocarbon compounds reported with a total concentration of 33 ppm. These hydrocarbons were alkanes, which are low hazard hydrocarbons. None of the traditionally carcinogenic hydrocarbon compounds, such as polycyclic aromatic hydrocarbons or benzene, were present in the tailings (see Certificate of Analysis EB2000591 in ***Appendix F***)

Dust suppressant chemicals used to coat the surface of the tailings dam were classified as non-hazardous under the United Nations Globally Harmonised System of Classification and Labelling of Chemicals (GHS).

Respirable crystalline silica

International silica classification criteria have been established by IMA - Europe to provide for the classification of products, substances and mixtures containing crystalline silica whether in the form of an identified impurity, additive or individual constituent.

For materials that contain crystalline silica, the United Nations GHS is applied. The GHS includes a classification category referred to as STOT-RE, meaning Specific Target Organ Toxicity - [following] Repeated Exposure. Long term, repeated exposure to RCS can cause silicosis, so RCS fits into this classification category. RCS can include quartz and/or cristobalite.

The IMA - Europe health hazard criteria based on the GHS for materials containing quartz or cristobalite in the fine fraction (PM_{10}) are:

- STOT-RE 1 – if the quartz or cristobalite concentration is equal to, or greater than 10%.
- STOT-RE 2 – if the quartz or cristobalite concentration is between 1 and 10%.
- If the quartz or cristobalite concentration is below 1%, the substance does not qualify for a hazard classification.

Analysis conducted by QUT and reported earlier (Spratt 2020b) (refer to ***Appendix E***) found that the concentration of quartz in the PM_{10} fraction of the tailings was in the range 5.0 to 8.7 wt%, averaging 7.1 wt%. The PM_{10} fraction of the tailings represented 3.25 wt% of the total material, hence the average RCS content of the total tailings material was 0.23 wt%. Based on this, the tailings material is classified as non-hazardous with respect to RCS.

Carcinogenicity

The International Agency for Research on Cancer (IARC) is an agency of the World Health Organization (WHO) and the leading international expert group that undertakes classification of carcinogens. The IARC classifications of carcinogens are listed in Table 6.

A Group 1 classification means the evidence strongly indicates the substance is a human carcinogen, while Group 2B means the substance is a possible human carcinogen because of limited evidence of carcinogenicity in humans.

Metals that are classified as having the potential to cause cancer are arsenic, cadmium, chromium VI, cobalt, lead and nickel. The criterion used to classify mixtures containing carcinogenic chemicals or metals, is one that contains a concentration of the chemical or metal greater than 0.1 wt% (1000 ppm).

The carcinogenic metals present in the tailings samples were all below 0.1 wt% (see Table 7). In fact, the concentrations were less than 0.001 wt%, except for chromium which was less than 0.01 wt%. Chromium in the environment exists in two forms, trivalent chromium and hexavalent chromium. Only hexavalent chromium, chromium VI (said as chromium six), is carcinogenic. Trivalent chromium, chromium III (said as chromium three), is an essential human dietary element. The form of the chromium present in the tailings material was not determined, only the total amount of chromium present. However, with total chromium (regardless of the form) recording a concentration less than 0.01 wt%, the threshold of 0.1 wt% was not reached. At these concentrations of arsenic, cadmium, chromium, cobalt, lead and nickel, the tailings are not classified as a carcinogenic material.

Aluminium and iron had concentrations greater than 1000 ppm and are shaded dark yellow in the table. These metal complexes, predominately aluminosilicates and iron - sulphur compounds which have low water solubility, are not classified as hazardous to health.

Table 6: IARC Classification of carcinogenicity

Group	Classification	No. of carcinogenic agents classified
1	Carcinogenic to humans	121 agents
2A	Probably carcinogenic to humans	89 agents
2B	Possibly carcinogenic to humans	315 agents
3	Not classifiable as to its carcinogenicity to humans	497 agents

Table 7: Metal concentrations in CVO tailings and carcinogenicity classification

Metal	IARC classification	Concentration range (ppm)	Average concentration (ppm)
Aluminium	Not Classified	10200 – 14500	**12600**
Arsenic	1	2.4 – 4.4	**3.5**
Barium	Not Classified	16.4 – 38.6	**25.2**
Cadmium	1	<0.1	**<0.1**
Chromium	1	21.4 – 39.4	**30.8**
Cobalt	2B	9.2 – 14	**11.4**
Copper	Not Classified	429 – 601	**498**
Iron	Not Classified	20700 – 28000	**24800**
Lead	2B	2.0 – 5.3	**3.7**
Lithium	Not Classified	2.4 – 16.0	**14.8**
Manganese	Not Classified	254 – 299	**287**
Molybdenum	Not Classified	7.9 – 36.1	**16.7**
Nickel	1	9.1 – 15.3	**12.8**
Strontium	Not Classified	90.4 – 219	**147**
Vanadium	Not Classified	54 – 83	**69.8**
Zinc	Not Classified	19.2 – 26.5	**23.9**

Metals toxicity

The United Nations GHS and the European Commission 2008 Regulation (EC) No. 1272/2008 on classification, labelling and packaging of substances and mixtures (CLP) as it applies to metals and minerals has been used to develop a process referred to as MeClas.

MeClas is a web-based tool used to generate toxicity hazard categories and corresponding classification and labelling information for inorganic metal-containing complex materials such as ores, concentrates, intermediates or alloys for which the manual application of the GHS/CLP rules is very complex (Verdonck et al. 2017). MeClas was designed specifically for classifying ore bodies, mineral concentrates and waste materials based on metals and mineralogy. It accounts for the toxicity of the metals, and the concentration and solubility of the metallic minerals.

Callander & Johnson reported that, using the MeClas assessment process and a comprehensive analysis of the tailings' mineralogy and metal content, the CVO tailings was classified as non-hazardous to the health and safety of people and the aquatic environment. A *not classified* determination indicates that these categories are not triggered for the United Nations GHS and European Union waste hazards properties listed in Table 8.

Table 8: Classification of CVO tailings against international guidelines

Health and environment legislation	GHS classification	EU waste hazard properties	Classification
Acute toxicity - oral	Not classified	Acute toxicity	Not classified
Acute toxicity - dermal	Not classified	Corrosive	Not classified
Acute toxicity - inhalation	Not classified	Irritant -skin irritation and eye damage	Not classified
Skin corrosion/irritation	Not classified	Sensitising	Not classified
Serious eye damage/eye irritation	Not classified	Mutagenic	Not classified
Respiratory/skin sensitisation	Not classified	Carcinogenic	Not classified
Germ cell mutagenicity	Not classified	Toxic to reproduction	Not classified
Carcinogenicity	Not classified	Specific target organ toxicity (STOT) - Aspiration	Not classified
Reproductive toxicity	Not classified	Ecotoxic	Not classified
Specific target organ toxicity (STOT) - single exposure	Not classified		
Specific target organ toxicity (STOT) - repeated exposure	Not classified		
Aspiration hazard	Not classified		
Hazardous to the aquatic environment - acute	Not classified		
Hazardous to the aquatic environment - chronic	Not classified		

Appendix A. Earth Systems reports

EARTH SYSTEMS
Environment · Water · Sustainability

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TECHNICAL MEMORANDUM

DATE	24/07/2019	**REF**	NCCADIA207502
TO	Jack Bowen	**REV**	Rev0
CC	Nicolas Bourgeot	**PROJECT**	Tailings Geochemical Fingerprinting
FROM	John Waters / Jeff Taylor		

SAMPLING AND ANALYTICAL PROTOCOLS

Jack / Nic,

As part of the project to identify distinctive chemical, geochemical and/or mineralogical fingerprints for the Cadia Valley Operation (CVO) tailings, Earth Systems has developed a materials sampling and analytical protocol. The protocol initially focuses on the tailings storage facilities and the dust deposition gauges. Additional protocols for baseline farm soil sampling and analysis are briefly outlined in this document, but they will be improved (before implementation) as initial data becomes available from the tailings and dust gauges.

TAILINGS SAMPLING PROTOCOLS

To establish the chemical/geochemical/mineralogical signature of the tailings dust, samples should be taken from both the North and South Tailings storage facility. The following sampling protocols will be observed:

- A total of 16 tailings samples should be taken for analysis.
    - 5 bulk tailings samples from the Northern Tailings Facility;
    - 5 bulk tailings samples from the Southern Tailings Facility;
    - Minimum of 3 efflorescence-rich samples from the surface of the Northern Tailings Facility,
    - Minimum of 3 efflorescence-rich samples from the surface of the Southern Tailings Facility (if available); and
    - Minimum of 2 windblown tailings adjacent to the North and South Tailings Facilities (if available).

- For the 5 bulk tailings samples to be taken from each of the TSF's (Northern and Southern):
    - Don't conduct sampling following rainfall, as this will impact on the soluble component of the dust. Ensure that it has not rained for at least 10 days before sampling.

  - Photograph sample sites before and after sampling.
  - Record GPS coordinates of site.
  - Collect 2 kg of sample scraped from within 2-5 millimetres of the surface using a trowel or similar suitable tool. This may require scraping a single bulk sample from several square meters of tailings surface area.
  - Samples should be collected in thick plastic sample bags and sealed to prevent contamination.
  - All samples are to be clearly labelled with sample identification number, location, time / date sampled.
  - Tailings samples should be representative of the surface area of the tailings (eg. average colour, texture) and be taken from areas as widely dispersed as possible. For the Northern Tailings Facility this should be from wide spaced sites across the whole surface area. For the Southern Tailings Facility sampling should be widely dispersed from areas safely reachable from the perimeter of the TSF.
  - Collect samples from unsaturated (and relatively dry) tailings ONLY.
  - Where possible collect samples from dry beached areas.
  - Record the colour of tailings being sampled, any changes in colour over the sampled area.
  - Estimate the sample grainsize.
  - Record the presence / absence of layering.
  - Estimate the moisture content.
  - Record any obvious odour emanating from the tailings within the sample site.
  - Record any other measurements take at the site.
  - Make sure all sampling equipment is washed clean after each sample is taken.

- For the 3 efflorescence-rich samples to be taken from each of the TSF's (Northern and Southern):
  - Don't sample following rainfall as efflorescences are likely to be soluble. Ensure that it has not rained for at least 10 days before sampling.
  - Locate a suitable accumulation of the 'white' efflorescence.
  - Photograph sample sites before and after sampling.
  - Record GPS coordinates of site.
  - Collect a minimum of 100g of efflorescence-rich sample scraped from the surface using a trowel or similar suitable tool. Make sure that none (or as little as possible) of the underlying tailings are collected with the sample.
  - Samples can be collected in a plastic sample vial and sealed to prevent contamination.
  - All samples are to be clearly labelled with sample identification number, location, time / date sampled.
  - Make sure all sampling equipment is washed clean after each sample is taken.

- For the windblown tailings samples:
  - Take at least one sample (where possible) from windblown tailings deposits adjacent to both the Northern and Southern Tailings Facilities.
  - Samples should be taken up to 100m away from the tailings dams from obvious windblown tailings deposits (if available).
  - Photograph sample sites before and after sampling.
  - Record GPS coordinates of site.

  - Collect a minimum of 2kg of windblown tailings scraped from the surface using a trowel or similar suitable tool. Make sure that none (or as little as possible) of the underlying soils / material / vegetation is collected with the sample.
  - Samples should be collected in thick plastic sample bags and sealed to prevent contamination.
  - All samples are to be clearly labelled with sample identification number, location, time / date sampled.
  - Make sure all sampling equipment is washed clean after each sample is taken.

TAILINGS ANALYTICAL PROTOCOLS

Sample Preparation

- All samples are to be initially oven dried (40°C) to permit the recovery of an initial XRD subsample (ie. avoid thermal decomposition of secondary efflorescences), then the remainder needs to be dried at 105°C for other analytical work (see below). Moisture content of the samples is not essential but would be helpful information.
- Analytical work listed below should proceed on a bulk tailings sample and possibly on a sieved <20 μm (fines) sample. The proposed final grainsize of the fines sample will be determined pending an examination of the grainsize of the dust found within the dust deposition gauges. CVO staff will be advised of the grainsize fraction once it has been determined.

Tailings Samples (in TSF or Wind Blown)

- A sub sample of the bulk sample tailings should be:
  - Sent for Quantitative (high precision) XRD analysis, with LOR of 0.01wt%, with feldspar compositions to be identified where possible.
  - Analysed for major and trace elements (see Table 1-1 for analytes).
  - Analysed for Rare Earth Elements (REE) (see Table 1-1 for analytes).
  - A distilled water leach (see Table 1-1 for analytes).
  - A NAG leachate produced and analysed (see Table 1-1 for analytes).
  - Tested for polyacrylamides (investigation of potential analytical procedures is underway).
- A sub sample of the sieved tailings fines should be:
  - Sent for Quantitative (high precision) XRD analysis, with LOR of 0.01wt%, with feldspar compositions to be identified where possible.
  - Analysed for major and trace elements (see Table 1-1 for analytes).
  - Analysed for Rare Earth Elements (REE) (see Table 1-1 for analytes).
  - A NAG leachate produced and analysed (see Table 1-1 for analytes).
  - Tested for polyacrylamides (investigation of potential analytical procedures is underway).

Tailings Efflorescence Samples

- The following procedures should be performed on the efflorescence samples collected:
  - Quantitative (high precision) XRD analysis, with LOR of 0.01wt%, with feldspar compositions to be identified where possible.
  - Analysed for major and trace elements (see Table 1-1 for analytes).
  - Analysed for Rare Earth Elements (REE) (see Table 1-1 for analytes).

  - A distilled water leach (see Table 1-1 for analytes).

NOTE: Remaining bulk and efflorescence samples as well as water samples from leach testwork are to be returned to CVO and stored for additional testwork (if required).

DUPLICATION OF DUST DEPOSITION GAUGES

Earth Systems will use the samples and data collected by the current series of dust deposition gauges, before it is subjected to its normal analytical process. In addition, to assist with obtaining sample quantities required to perform the testwork program, it is proposed that the current dust deposition gauges be duplicated.

Duplication of the dust deposition gauges will require the installation of a second dust deposition gauge at each of the current gauge sites. As the only purpose of this second gauge is to collect additional sample, it is proposed that these duplicate gauges be made larger as deposition rates from these second gauges are not required. Earth Systems proposes that the funnels for these duplicate gauges be larger (up to 0.5m diameter) and the collection/ sample bottles be larger (up to 5 litres). This will speed up the collection of dust samples and address analytical limitations based on sample size.

It is suggested that the funnels for the larger duplicate gauges be covered with nylon mesh (1-3 mm) squares to minimise larger organic objects (insects, leaf litter etc.) falling into the sample containers. This mesh could be stapled over the upper opening of the funnel.

DUST DEPOSITIONAL GAUGE SAMPLING PROTOCOLS

Dust deposition gauges should be checked monthly with all duplicate oversized gauges being subjected to the following sampling protocols to collect both the dust and the water within the sample containers. The chemistry of the water within the dust gauges could be very significant in identifying the provenance of the dust. For example, it is likely that secondary minerals at the surface of the tailings storage facilities (white efflorescences) are both very low density and highly soluble (eg. epsomite: $MgSO_4.7H_2O$). This means that this material may form a significant component of fugitive dust from the TSFs. The high solubility of such materials suggests that we may only identify its presence in soluble form within the water component of the dust deposition gauges.

Sampling protocols should include:

- Photograph the dust deposition gauges before changing the sample containers.
- All visible, non-dust related material covering the funnel mesh is to be cleaned off.
- Any visible dust still within the sample collection funnel washed into the sample container using a minimum amount of distilled / deionised water.
- Sample containers removed from each site will be capped / sealed. Any water present within the sample containers is to be left in the container and sealed in along with dust sample.
- Sample containers are to be labelled with the following information:
  - Sample location, number, date time of sample collection.
- All sample containers are to be replaced with a clean dry sample container.

DUST ANALYTICAL PROTOCOLS

The protocols for undertaking analytical work on the dust sampled from the dust gauges will be partly dependent on the analytical results from the tailings samples. These protocols are therefore subject to change / improvement, based on emerging analytical data from the tailings.

Dust Deposition Gauges

Water

A **filtered** and **unfiltered** sample of the water from within the sample container is to be analysed for:

- Major elements (see Table 1-1 for analytes).
- Trace elements (see Table 1-1 for analytes).
- Additional analytes (see Table 1-1 for analytes).
- Tested for polyacrylamides (investigation of potential analytical procedures is underway).
- The above parameters may vary depending on results from the tailings analytical work.

Dust

Once separated from the water, particulate material (dust) within the sample container is to be dried at 40°C.

The following analytical procedures are to be conducted on the 40°C dried dust samples:

- Approximately 0.5 grams (or the minimum required amount) be sent for Quantitative XRD analysis, with LOR of 0.01wt%, with feldspar compositions to be identified where possible.

Dry the remainder of the sample at 105°C, and analyse the material for:

    - Major element analysis (see Table 1-1 for analytes).
    - Trace element analysis (see Table 1-1 for analytes).
    - Additional analytes (see Table 1-1 for analytes).
    - ABA analysis (see Table 1-1).
    - NAG leachate (see Table 1-1 for analytes).
    - Tested for polyacrylamides (investigation of potential analytical procedures is underway).
    - Total sulfur and Total carbon - LECO (Table 1-1).
    - The above parameters may vary depending on results from the tailings analytical work.

TAPERED ELEMENT OSCILLATING MICROBALANCE (TEOM) ANALYSERS SAMPLING & ANALYTICAL PROTOCOL

Where possible the filters present in the TEOM's are to be collected and placed in sealer plastic bags for QXRD analysis prior to being sent for the current routine suite of destructive analyses. This should only be conducted if there is no impact on the primary purpose of the TEOM's. An initial test on one filter paper should be trialled to confirm its suitability for QXRD analysis. If the filter papers can be used for this purpose, then;

    - Photograph sample sites / filter paper.
    - Provide the GPS coordinates of site.
    - All samples are to be clearly labelled with sample identification number, location, time / date sampled.

BASELINE FARM SOIL SAMPLE PROTOCOLS

Should the dust deposition gauge testwork prove ambiguous or inconclusive, a baseline farm soil sampling and analytical program should be implemented.

A provisional soil sampling protocol is provided below. This protocol is subject to change based on the outcomes from the sampling and analytical protocols provided above. The finalised protocols will be made in conjunction with CVO staff.

Sampling Protocol

Soil samples are to be collected from up to 15 farm soil sites within 1 kilometre of the tailings storage facility. These sites should be selected based on the prevailing wind directions, as indicated by data from the Ridgeway / Southern Lease Boundary weather station, their proximity to the TSF and their distribution over different basement (soil) types (Silurian (post-mineralisation) and Ordovician (pre-mineralisation) lithologies). The coordinates of the proposed sample sites are to be determined but should be established jointly by CVO and Earth Systems staff.

Small excavations using a small backhoe (or equivalent), should be used to gain access to surface soils (potentially impacted by fugitive tailings dust) and soils immediately below the surface (background, pre TSF development). In addition, these shallow sample sites should allow sampling of materials with minimal organic matter (root material) and permit a close examination of soil characteristics.

All sampling equipment, including backhoe bucket and hand tools, need to be washed, removing all visible loose soil and sediment. This needs to be done both before sampling and between all sample sites. Avoid using hand tools with painted digging surfaces.

- Prior to any excavations with a backhoe, it is important to ensure that all sampling locations are;
    - Clear of utility lines and poles (subsurface as well as above surface).
    - Away from the impacts of roads.
    - Not in areas of recent activity or soil disturbance.
    - Not on or immediately adjacent to outcropping bedrock.
    - Away from areas trafficked by livestock.
    - Away from fence lines.
    - Not within poorly drained or saturated areas.
- Photograph the proposed sample site before excavation, including surrounding area.
- Using a small backhoe (or similar) recover a soil sample from 0-5 cm depth. Place removed or excavated soils on plastic sheets. Remove as much vegetative material as possible (roots / grass) to collect topsoil only. Collect approximately 4 kg of sample.
- Using clean sampling equipment, collect a second sample from a depth of 5-10 cm. Place removed or excavated soils on a plastic sheet. Remove as much vegetative material as possible (roots / grass) to collect soil only. Collect approximately 4 kg of sample.
- All samples should be collected in thick plastic sample bags and sealed to prevent contamination.
- It is important to use clean sampling equipment for each sample to prevent cross contamination.
- Document the sample site by noting:
    - GPS coordinates of site.
    - Colour of soil / sediment being sampled, any changes in colour with depth.
    - Grainsize.
    - Presence of layering and/or organic material.
    - Estimated moisture content (eg. dry, damp, moist).

  - Any obvious odour emanating from the soil / sediment within the test pit.
  - Whether there are any outcrops of basement bedrock nearby (within 10-20 metres).
  - Likely use of the area from where the sample is taken (eg. grazing livestock / sheep / cattle, crops, ..etc).
  - Whether there is a direct line of site to the TSF, if the site is elevated relative to the surrounding area, and whether there are wind breaks between the TSF and sampling site which could impact on the potential for fugitive dust to impact the site (eg. stands of mature trees, significant buildings).
  - The occurrence of visible accumulations of dust / wind-blown material close to the site.
  - Any other measurements taken at the site.
- Carefully and clearly label the sample bags with:
  - Sample number.
  - Location.
  - Time and date sampled.
  - Sample interval depth.
  - Preservation method used (if any).
- Once sampling is complete reinstate the sample site to as near to its original state by replacing soil / sediment removed from the test pit / trench and levelling the surface. Consider spreading typical pasture grass seeds over the affected areas. Photograph the reinstated site once work is complete.

SOIL ANALYTICAL PROTOCOLS

Analytical protocols for the soil samples will be determined based on the outcomes of the tailings analytical work. These protocols will be forwarded separately should they be required.

CONTACT DETAILS

If there are any questions regarding any of the sampling or analytical protocols, please contact either John Waters (0419 876 462) or Jeff Taylor (0402 158 682).

Table 1-1: Analytical procedures and parameters.

Analytical Procedure	Parameters	Method	Possible ALS Method Code	Notes
Dust Gauge and Tailings Sample Solids				
Mineralogy	All crystalline mineral phases present. Bulk Amorphous content.	High precision QXRD	TBA	LOR required 0.01 wt%
Major Elements	Al, Ca, Cl, Fe, K, Mg, Mn, Na, P, Ti, S, Si, LOI	XRF	ME-XRF21n	LOR required 0.01 wt%
Trace Elements	Al, As, Ag, Ba, Be, Bi, Cd, Cs, Ce, Cr, Co, Cu, Ga, Ge, Hf, In, La, Li, Mn, Mo, Ni, Nb, P, Pb, Rb, Sb, Sc, Se, Sn, Sr, Te, Ti, Tl, Th, W, U, V, Y, Zn, Zr Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb B F Hg	ICP-MS	EG020T REE Method? EG005T (B) EK040T (F) EG035T (Hg)	
Carbon / Sulfur	Total S / Total C Total Inorganic C	LECO Analyser by Furnace	ED042T, EP003TC EP003TIC	
NAG Leachate	pH, EC, Acidity (pH<6), Alkalinity(pH>6), Ca, Mg, K, Na, Cl, F, SO_4, Al, Fe, Mn, P, Sb, As, Ba, Be, Bi, B, Cd, Cs, Ce, Cr, Co, Cu, Ga, Ge, Hf, In, La, Pb, Li, Hg, Mn, Mo, Ni, Nb, Rb, Se, Ag, Sr, Te, Tl, Th, Sn, Ti, W, U, V, Y, Zn, Zr.	USEPA 6020	EA005 EA010 ED038 ED037NT-1 ED041G (SO4) ED045 EK040	

Analytical Procedure	**Parameters**	**Method**	**Possible ALS Method Code**	**Notes**
	Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb		EK067 EG035F (Hg) EG020F	
Acid-Base Accounting (ABA)	Chromium reducible sulfur suite ($\mathrm{pH_{KCl}}$,TAA,$\mathrm{S_{Cr}}$,ANC,$\mathrm{S_{KCl}}$,$\mathrm{S_{HCl}}$, $\mathrm{S_{NAS}}$)	Ahern et al (2004)	EA033 EA011	
Water Samples – Dust Gauge Water / ASLP Leach				
Physiochemical parameters	pH EC Acidity (pH<6), Alkalinity(pH>6)	APHA 2310 B	EA005 EA010 ED037 ED038	
Major Elements	Ca, K, Mg, Na	APHA 3120 Ca Mg K Na-B	NT-1	
Trace Elements	Al, As, Ag, B, Ba, Be, Bi, Cd, Cs, Ce, Cr, Co, Cu, Fe, Ga, Ge, Hf, Hg, In, La, Li, Mn, Mo, Ni, Nb, P, Pb, Rb, Sb, Sc, Se, Sn, Sr, Te, Ti, Tl, Th, W, U, V, Y, Zn, Zr Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb	USEPA 6020	EG020F	
Additional Analytes	SO_4 Cl F Total N NO_3 Total Kjeldahl Nitrogen (TKN)		ED041G ED045 EK040 NT-11	

Analytical Procedure	**Parameters**	**Method**	**Possible ALS Method Code**	**Notes**
	Total P			
Additional Analytical Protocols (To be confirmed)				
Bulk Cyanide Leach (BCL)	*Au, Ag, Co, Cu, Mn, Mo, Ni, Zn*	*Gold Cyanidation (Au, Ag, Cu)*		*30 g sample*
Polyacrylamides	*Organics(?)* *Cyclic hydrocarbons (?)*	*Currently being investigated*	*TBD*	
Stable Isotopic Analysis	*Sulfur isotopes* *Oxygen isotopes* *Carbon Isotopes*	*Stable Isotopes*	*S-ISTP01* *CO-ISTP01 (carbon and oxygen)*	
Petrographic Analysis	*Mineral identification*	*Grain mounts (reflected light microscopy)* *Grain mounts (transmitted light microscopy*	*TBD*	
SEM with EDS	Mineral Identification Grain shapes	Scanning electron microscopy	TBD	

Analytical procedures indicated in blue will be considered following tailings and dust gauge analytical work.

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TECHNICAL MEMORANDUM

DATE	17/03/2020	**REF**	NCCADIA207505_Memo_Rev0
TO	Dr Tim Wrigley – Newcrest Mining Ltd	**REV**	Rev0
FROM	Dr Jeff Taylor – Earth Systems	**PROJECT**	Dust Fingerprinting at the Cadia Mine

PRELIMINARY ASSESSMENT OF SURFICIAL TAILINGS AND DUST FROM CADIA VALLEY OPERATIONS

INTRODUCTION

Earth Systems was engaged by Newcrest Mining Limited (hereafter Newcrest) to identify a distinctive chemical, geochemical or mineralogical fingerprint to the site's tailings at their Cadia Valley Operations (CVO) in order to assess the potential for tailings dust to impact on local roof water quality at surrounding farm homesteads. In addition, it is understood that Newcrest staff are also interested in determining if there are any potential impacts posed by respirable components of fugitive dust.

This technical memorandum documents the key findings from an assessment of initial data collected on surficial tailings samples and dust deposition gauges (ie. mineralogy, bulk chemistry, and leachate [water] chemistry). Assessment of this data provides a better understanding of likely dust compositions and the specific components that are likely to be mobilised and solubilised, and therefore have the potential to impact on roof derived water supplies.

DATA PROVIDED

Eight (8) samples of surficial tailings material were collected by Newcrest staff from the Northern TSF (NTSF) and Southern TSF (STSF) at the Cadia mine (ie. four [4] samples from each TSF). From these bulk samples, eight (8) subsamples were produced by sieving to obtain a <10 μm "fines" fraction. Sampling from the upper most veneer of the TSF's and the production of a fines subsample aimed to obtain material which is most likely to become airborne. The tailings were analysed for:

- Trace element and partial major element chemistry for the eight (8) bulk surficial tailings samples.
- Quantitative X-Ray Diffraction (QXRD) data for:
    - eight (8) bulk surficial tailings samples.

  - eight (8) fine fraction (<10 μm) surficial tailings samples.
- The Net Acid Generation (NAG) suite for the eight (8) bulk surface tailings samples (ie. NAG pH, and NAG leachate chemistry).
- Australian Standard Leachate Procedure (ASLP) data for the eight (8) bulk surface tailings samples. This procedure involves dilution in de-ionised (DI) water (20:1, water to sample). The solution is tumbled for ~18 hours, stood for a minimum of 2 hours (for settling of any solids in suspension), and then an unfiltered sample of the solution is analysed. This procedure is intended to identify key mobile components in near neutral water (eg. a proxy for leaching during rainfall events).
- Data from the Dust Deposition Gauges (DDG's):
  - partial bulk chemistry (selected major and trace elements);
  - dust loads (ie., the mass of dust per volume of air and unit of time);
  - proportions of soluble and insoluble components.

INITIAL RESULTS

The initial chemical / geochemical data was assessed and pertinent results are summarised below. There is no systematic or statistically significant difference between the mineralogy or mineralogical abundances of the two sample localities (ie. the NTSF and STSF), hence these results are discussed collectively. However, there are significant differences between the bulk tailings sample and the fines (<10 μm) subsample, hence these results are discussed separately.

Tailings Compositions

The trace element geochemistry of the bulk tailings samples was used to calculate the samples enrichment relative to the average crustal abundance, known as the Geochemical Abundance Index (GIA). The GAI is calculated using the following formula:

$$\text{GAI} = \text{Log}_2\,(Mc\,/\,(1.5 \text{ x } Ac)).$$

Where *Mc* is the measured concentration of a given element, and Ac is the average [crustal] concentration of that element. The results of this calculation indicate that the tailings are enriched (ie. GAI >2) in selenium (Se), cobalt (Co), copper (Cu), molybdenum (Mo), fluoride (F), and chloride (Cl). It is noteworthy that element enrichments in solids do not necessarily correspond to element mobility in water.

Tailings Mineralogy

- For the eight (8) bulk tailings samples the dominant primary minerals include:
  - Plagioclase feldspar (23-31 wt.%; [$(Na, Ca)(Si, Al)_4O_8$]);
  - Illite/mica (16-20 wt.%; [$(K,H_3O)(Al, Mg, Fe)_2(Si, Al)_4O_{10}[(OH)_2, (H_2O)]$]);
  - Quartz (14-17 wt.%; [SiO_2]);
  - Clinochlore (10-16 wt.%; [$Mg_5Al(AlSi_3O_{10})(OH)_8$]);
  - Potassium feldspar (8-13 wt.%; [$KAlSi_3O_8$]);
  - Calcite (3-4 wt.%; [$CaCO_3$]); and

  - Minor (ie. generally <2 wt.%) concentrations of magnetite [Fe_3O_4], pyrite [FeS_2], dolomite [(Ca, Mg)$CaCO_3$], and amphibole occur in many samples.

- All samples contain a mixture of primary and secondary minerals. The secondary minerals are the result of pyrite oxidation (generation of acid), and subsequent neutralisation reactions within the TSF between the acid and carbonate minerals (ie. calcite and dolomite). Fluids that carry dissolved components from these neutralisation reactions percolate upwards through the tailings (via capillary action) and when they reach the surface these fluids undergo evaporative concentration causing surficial efflorescence precipitation. These minerals have likely formed in the last few months, not years.
- For these eight (8) bulk tailings samples the dominant secondary minerals include:
  - Gypsum (in all samples, 0.5-1.5 wt.%; [$CaSO_4\cdot 2H_2O$]); and
  - Halite (in 2/8 samples, 0.4-0.5 wt%; [NaCl]);
  - Blödite (in 1/8 samples, 12 wt.%; [$Na_2Mg(SO_4)_2\cdot 4H_2O$]);
  - Rhomboclase (in 1/8 samples, 0.8 wt.%; [$H_5Fe^{3+}O_2(SO_4)_2\cdot 2(H_2O)$]).
- Most samples contain a significant but variable amorphous content, ie., 1-13 wt.% in the bulk samples, and 6-51 wt.% in the fine fraction (<10 μm) subsamples. This amorphous content represents non-crystalline components that are not recorded by QXRD mineralogy but will be included in bulk chemical analyses. Without further calculations the composition of the amorphous content (as well as the potential impacts, if any) remains unknown.
- The eight (8) fine fraction (<10 μm) tailings subsamples contain the same primary mineralogy as the bulk samples, however, the former is relatively depleted in quartz and feldspars whilst enriched in all other minerals (particularly the amorphous component and secondary minerals).
- For the eight (8) fine fraction (<10 μm) tailings subsamples there is a higher abundance and more diversity in the secondary minerals present, with the dominant components including:
  - Anhydrite (in all samples, 1.4-3.2 wt.%; [$CaSO_4$]);
  - Halite (in 6/8 samples, 0.7-3.0 wt.%);
  - Glauberite (in 1/8 samples, 3.8 wt.%; [$Na_2Ca(SO_4)_2$]);
  - Bassanite (in 1/8 samples, 3.7 wt.%; [$CaSO_4\cdot 0.5H_2O$]); and
  - Gypsum (in 1/8 samples, 2.5 wt.%; [$CaSO_4\cdot 2H_2O$]).
- It is possible that the presence of anhydrite and bassanite in these samples is due to thermal decomposition of gypsum during sample preparation (eg. oven drying).
- The proportion of amorphous material in the <10 μm size fraction of each sample is between 2 and 4%.
- All samples have slightly negative Net Acid Production Potential (NAPP) values (calculated from QXRD mineralogy), indicating all of these samples are Non-Acid Forming (NAF).
- The major primary minerals in tailings samples (eg., quartz, feldspars) represent a lower risk of becoming airborne due to their relatively high densities (ie. >2.55 g/cm^3). In addition, these phases are also unlikely to produce significant changes water quality as the minerals are essentially insoluble.
- Many of the secondary minerals have relatively low densities (ie. <2.3 g/cm^3), which combined with their concentration and elevated location at the surface of the TSF makes them more likely to become airborne. This inference is supported by data collected from the DDG's, where ~10-20 wt.% of the dust captured is soluble.

- In addition, these secondary phases are soluble to highly soluble in water (eg, Halite = ~360 g/L at 25°C). Therefore, assuming these secondary minerals occur in significant concentrations down-wind (which has not yet been determined), they could impact on water chemistry / drinking water quality.
- No information exists on the trace element geochemistry of these secondary phases, which have the potential to accommodate a variety of metals (eg. copper, lead, zinc, nickel, arsenic, antimony).

Tailings Leachate (Water) Chemistry

Results of the ASLP (Australian Standard Leach Procedure - a 20:1 leach with DI water) are summarised below. These results provide a qualitative analogue for the leaching of tailings material during a rainfall event. The components released during the ASLP represent compounds likely to be mobilised by water and should be considered by future work.

- The pH of leachate water is 7.4-8.0, consistent with an excess of carbonate (NAF classification), low acidity values, and elevated alkalinity values.
- The presence of detectable soluble metals in near neutral leachate indicates that the surficial tailings represent an NMD (neutral metalliferous drainage) risk.
- The tailings leachate contains high to very high concentrations of sulfate (634-3820 mg/L), chloride (49-373 mg/L), calcium (107-414 mg/L), magnesium (7-365 mg/L) and sodium (145-1000 mg/L). Sulfate, sodium, calcium and magnesium all show a good correlation with electrical conductivity. Elevated sulfate and chloride concentrations means that the tailings leachate has very high salinity. These enrichments are consistent with the soluble secondary (Ca-Mg-Na bearing) sulfate-rich and chloride-bearing mineralogy identified by the QXRD analyses.
- Key soluble trace metals with concentrations above detection limits include antimony (Sb), arsenic (As), chromium (Cr), copper (Cu), fluoride (F), lead (Pb), molybdenum (Mo), mercury (Hg), selenium (Se) and zinc (Zn).

The NAG leachate testwork involves the rapid oxidation of sulfide minerals (through the addition of peroxide) and subsequent measurement of leachate produced. Whilst this leachate chemistry is unlikely to represent real-world water quality it is useful in highlighting potentially mobile elements in leachate from oxidised tailings. The NAG leachate contains the following metals with concentrations above their detection limits.

- Antimony (Sb), boron (B), cadmium (Cd), chromium (Cr), copper (Cu), gallium (Ga), lithium (Li), molybdenum (Mo), selenium (Se), vanadium (V), and zinc (Zn).
- It is noteworthy that the following elements are present above detection in both the ASLP and NAG leachate, suggesting they are very likely to become mobile upon interaction with water: aluminium (Al), antimony (Sb), chromium (Cr), copper (Cu), molybdenum (Mo), selenium (Se) and zinc (Zn).

Potential Risks Associated with Respirable Dust Components

- All samples analysed (ie. both the bulk sample and the <10 µm size fraction) contain significant concentrations of quartz (5-17 wt.%). Therefore, consideration should be given to quantifying the time weighted average concentrations of silica using existing DDG's.

- Amphibole group minerals were identified in 3 of the 16 tailings samples (both bulk and <10 µm size fraction). Certain amphibole minerals have the potential to occur in a fibrous habit (ie. asbestiform). It is currently unclear which specific amphibole minerals are present in the tailings samples, and therefore the potential risks cannot be assessed.

KEY CONCLUSIONS

- Surficial tailings samples contain a mixture of primary and secondary minerals, with secondary minerals and amorphous components being more concentrated in the <10 µm size fraction.
- Secondary minerals are the products of acid neutralisation reactions within the TSF. Whereby, fluids percolate upward through the TSF (via capillary action) and secondary efflorescence minerals precipitate at the surface due to evaporative concentration.
- These secondary minerals are predominantly hydrous Ca-Na-Mg sulfate minerals (eg. gypsum, blodite, glauberite) with lesser chlorides (halite) and Fe-sulfates (rhomboclase). Many of these secondary phases are soluble to highly soluble in water and have low densities compared to primary tailings mineral phases.
- The secondary phases are the most likely TSF component to become airborne, due to their location at the surface of the TSF and their comparatively low density. Moreover, these phases have the potential to effect down-wind water chemistry due to their high solubility. For example, at low concentrations these minerals may impart a salty and/or bitter taste on drinking water.
- The ASLP data provides an analogue for the leaching of tailings during a rainfall event. Although the concentrations are not indicative of actual water quality impacts, the elements present at concentrations above their detection limit (ie. Sb, As, Cr, Cu, F, Pb, Mo, Hg, Se, and Zn) represent elements which will likely be mobilised from soluble tailings components.
- The following remains unclear regarding the mobility and distribution of dust:
    - What is the distribution of airborne dust as a function of distance / direction from the TSF's?
    - How does the composition of this dust change as a function of distance / direction from the TSF (eg. changing mineralogy, or changing proportions of soluble to insoluble components)?

RECOMMENDATIONS

A number of recommendations have been developed based on the above results and conclusions, including:

- Develop a detailed sampling and analytical strategy for the routine collection of water and suspended solids from appropriately distributed dust collectors. This will help clarify the mass of dust landing on a certain area, and the properties of this dust (eg. composition, ratios of soluble to insoluble components) as a function of distance / direction from the TSF's. Dust collectors are a simple low-cost device consisting of a funnel attached to a container for collecting sample (dust, and potentially rainwater).
- Provide a single DDG filter to an XRD laboratory (prior to destructive analysis) to clarify if these filters can be used to provide direct constraints on the mineralogy of airborne dust.
- Collect water samples (and possibly suspended solids) from the drinking water tanks of local farms and analyse these samples for the full analytical water quality suite provided to Dr Tim Wrigley (on 03/03/2020 via email).

- Obtain major element analyses of the existing bulk tailings samples (see Earth Systems, 2019 for analytes). This will allow the calculation of the composition of the amorphous content of the studied samples, which may reach up to ~50 wt.%, and is concentrated in the fine (<10 µm) fraction (ie. a likely component of any airborne and potentially reactive dust).
- Include silica in the list of analytes for the DDG's filters. This will help with calculation of indicative average time weighted exposures to silica.
- Determine the type of amphibole minerals present to clarify the risk posed, if any, by fibrous minerals.

REFERENCES

Earth Systems, 2019. Sampling and analytical protocols – Technical Memorandum. 24th July, 2019.

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TECHNICAL MEMORANDUM

DATE	27 March 2020	**REF**	NCCADIA207507_Memo_Rev0
TO	Dr Tim Wrigley – Newcrest Mining Ltd	**REV**	0
FROM	Jeff Taylor – Earth Systems	**PROJECT**	Tailings Dust Fingerprinting at the Cadia Mine

RELATIVE ELEMENTAL ENRICHMENTS IN TAILINGS SAMPLES FROM THE CADIA VALLEY OPERATIONS

INTRODUCTION

Earth Systems was engaged by Newcrest Mining Limited to identify a distinctive chemical, geochemical or mineralogical fingerprint for tailings at Cadia Valley Operations (CVO), to assess the potential for tailings dust to impact on local receptors (e.g., roof water quality of surrounding farm homesteads). This technical memorandum documents the Geochemical Abundance Index (GAI) of tailings samples, as requested by Dr Tim Wrigley.

RESULTS

The major and trace element geochemistry of all tailings samples is reported in Table 1. These elemental concentrations have been colour coded according to their GAI values, which represent the samples relative enrichment compared to average global crustal abundances. The GAI was calculated using the following formula:

$$\mathrm{GAI} = \mathrm{Log}_2\,(Mx / (1.5 \times Cx))$$

Where Mx is the measured concentration of a given element in the sample, and Cx is the average global crustal abundance of that element. It is noted that the GAI value of an element does not directly relate to the potential impact of that element on a local receptor, because the GAI calculation does not consider the solubility of the mineral in which the element is bound.

Table 1: Major and Trace element geochemistry (ppm) of tailings samples from Cadia Valley Operations with colour coded GAI enrichment factors.

	STF1	STF2	STF3	STF4	NTSF1	NTSF2	NTSF3	NTSF4
Arsenic	2.6	2.4	3.1	3.7	3.6	4.1	4.4	3.7
Selenium	1	4	1	1	1	2	0.5	2
Silver	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Barium	22.8	16.4	20.9	22.6	38.6	29.6	26.6	23.9
Thallium	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Beryllium	0.3	0.2	0.3	0.4	0.3	0.3	0.3	0.2
Cadmium	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Bismuth	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.1
Cobalt	10.8	9.2	12.9	14	11.4	11.4	11.4	10
Chromium	32.9	21.4	39.4	37.6	30.4	33.7	26.7	24.5
Copper	444	429	457	607	490	458	610	488
Thorium	1.8	1.5	1.6	1.8	1.9	1.8	1.8	1.5
Manganese	294	254	287	299	283	325	283	274
Strontium	101	203	90.4	120	84.1	142	218	219
Molybdenum	7.9	36.1	10.3	9.2	9	15.9	11.6	33.5
Nickel	13.2	9.1	14.5	15.3	12.7	14.6	11.8	11.5
Lead	2.5	2	3.2	4	4.2	5.3	4	4.1
Antimony	0.2	0.2	0.2	0.1	0.1	0.2	0.2	0.2
Uranium	0.4	0.4	0.4	0.4	0.4	0.5	0.4	0.6
Zinc	24.7	19.2	23.4	26.4	22.9	26.5	25.9	21.8
Lithium	16	12.4	15.2	16	14.5	15.7	14.6	14.3
Vanadium	77	54	79	83	68	74	64	59
Tin	0.5	0.3	0.5	0.8	0.6	0.6	0.5	0.5
Fluoride	1250	1080	1280	1360	1130	1310	1260	1160
Aluminium	13700	10200	13700	14500	12700	13200	11900	10900
Boron	25	25	25	25	25	25	25	25
Iron	26100	20700	26900	28000	25200	26000	23800	21700
Chloride	1610	8720	3160	950	1070	4360	2460	4440
Calcium	2450	2270	1780	2170	830	2740	2500	2320
Magnesium	840	6150	920	140	680	2160	2140	7740
Sodium	4890	20700	4320	3640	2270	8540	9660	21300
Potassium	1220	5680	1350	620	750	2130	2270	5790

	Basis	Enrichment Factor				
Sample solids	Geochemical abundance index (GAI)	<3× (GAI: 0)	≥3× (GAI: 1)	≥6× (GAI: 2)	≥24× (GAI: 4)	≥96× (GAI: 6)

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TECHNICAL MEMORANDUM

DATE	12 May 2020	**REF**	NCCADIA207511
TO	Dr Tim Wrigley – Newcrest Mining Ltd	**REV**	0
FROM	Jeff Taylor – Earth Systems Ashton Soltys – Earth Systems	**PROJECT**	Tailings Dust Fingerprinting at the Cadia Mine

SURFICIAL PROCESSES IN THE TAILINGS STORAGE FACILITY AT THE CADIA VALLEY SITE

Tim,

Below is the requested text which explains the processes operating at the surface of the TSF at the Cadia Valley mine site. If required, the chemical formula for all listed minerals can be provided.

The key primary mineral constituents within surficial tailings deposits at the Cadia Valley Operations (CVO) are dominated by quartz, potassium feldspar, plagioclase feldspar, chlorite, potassium mica and calcite, with minor to trace quantities of magnetite, pyrite, amphibole, gypsum, dolomite, anatase and halite. Tailings samples collected on previous occasions (lower down in the tailings profile) also include minor to trace quantities of chalcopyrite, bornite, goethite, limonite, hematite, epidote, biotite, sphene, ilmenite, fluorite, apatite, kaolinite, ankerite, garnet, galena, sphalerite, molybdenite, barite and zircon.

Almost all of these phases are common rock-forming minerals that remain largely unreactive under most conditions at the Earth's surface. A small number of these minerals are less widespread and are specifically associated with the copper mineralisation at CVO. These include pyrite, chalcopyrite, bornite, galena, sphalerite and molybdenite. Pyrite, chalcopyrite and bornite are the main reactive mineral phases in the tailings, and only pyrite is currently detectable in the current surficial tailings material.

Pyrite is considered reactive as it can slowly decompose in the presence of atmospheric oxygen to generate sulfuric acid. The concentration of pyrite in current surficial tailings permits acid to form, but the abundance of neutralising minerals (calcite, ankerite, dolomite, feldspar) ensures that all of the acid is neutralised. Hence, the upper several centimetres of the tailings storage facilities will be undergoing slow and selective decomposition. During a rainfall event, the decomposition products largely dissolve, even in small volumes of water, generally producing near neutral, sulfate-rich saline porewater. Over the succeeding drier days, capillary action causes this water to rise to the tailings surface, evaporatively concentrate and subsequently crystallise into highly soluble, low density (secondary) salts / minerals as fields of crystalline efflorescences. These secondary salts include blodite, rhomboclase, gypsum, bassanite, *anhydrite, glauberite and probably some non-crystalline material. The rate of production of these salts is generally slow and is influenced by how far air can penetrate into the tailings deposits to form acid from pyrite oxidation. As low density, surficial salts, these phases are the most likely to be mobilised into the air during significant wind events, relative to the other rock forming minerals.*

Form a chemical perspective, these ultra-thin, temporary crystalline carpets across the surface of the tailings deposits are not inherently dangerous, but if they are mobilised as solids during windy periods, have the potential to contribute sulfate and chloride salinity to local water sources (ie. local waterways, farm dams, drinking water supplies from roofwater).

Some of these secondary salts also have the potential to incorporate trace quantities of heavy metals and metalloids such as copper, zinc, molybdenum, antimony, and arsenic into their crystal structure. The potential for wind mobilised salts to impact on the heavy metal / metalloid content of roofwater on farms surrounding the tailings storage facilities is believed to be very low but is being assessed via water quality monitoring.

Dust Fingerprinting Study

Assessment of drinking and stock water chemistry from farms surrounding Cadia Valley Operations, New South Wales

prepared for

Newcrest Mining Limited

by

Earth Systems

NCCADIA207513_Report_Rev3

4/5/2021

DOCUMENT INFORMATION

Project Title	Dust Fingerprinting Study
Document Title	Assessment of drinking and stock water chemistry from farms surrounding Cadia Valley Operations, New South Wales
Document Name	NCCADIA207513_Report_Rev3
Document Version	3
Version Date	4/5/2021
Prepared for	Newcrest Mining Limited
Project ID	NCCADIA2075

DOCUMENT REVISION HISTORY

Revision	Issue Date	Status	Approved by
0	28 July 2020	Draft	Jeff Taylor
1	24 November 2020	Draft	Jeff Taylor
2	1 December 2020	Final	Jeff Taylor
3	4 May 2021	Final	Jeff Taylor

DISTRIBUTION RECORD

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FIGURES

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ATTACHMENTS

Attachment A:	ALS laboratory reports.
Attachment B:	Water chemistry plots. Distribution of salinity, alkalinity, nutrients and dissolved metals between water from different tank types (concrete, plastic and zincalume steel), as well as between tank and dam water.
Attachment C:	Correlations between different elements / compounds in tank and dam water.
Attachment D:	Distribution of total metal concentrations and comparison with relevant water quality guidelines.

EXECUTIVE SUMMARY

Earth Systems was engaged by Newcrest Mining Limited to identify a distinctive chemical, geochemical or mineralogical fingerprint for tailings at Cadia Valley Operations (CVO), to enable assessment of the potential for tailings dust to impact on local receptors (eg. roof water quality of surrounding farm homesteads).

After review of available tailings characterisation data from CVO, a sampling and analytical program was developed by Earth Systems (2019) with a focus on tailings (surface efflorescence and depth samples) and materials collected in dust deposition gauges (DDG's) located on and around the CVO mine site. Additional protocols for baseline farm soil sampling and analysis were also briefly outlined, pending initial data from the tailings and dust gauges. The tailings and DDG analytical program included an extensive suite of mineralogical and geochemical parameters, as well as leachate chemical analyses to identify potential indicators associated with any water soluble components of the tailings. CVO personnel conducted sampling of the tailings and depositional dust material. Mineralogy, geochemistry (partial suite) and standard leach test data for the tailings samples, as well as selected depositional dust data (partial major and trace element suite; dust loads; proportions of soluble and insoluble components), were provided to Earth Systems for review. Key results of this preliminary work are documented in Earth Systems (2020a, b, c). In particular, the leach test data indicated that the most sensitive (distinctive) fingerprint of CVO tailings is likely to be associated with water-soluble components. This helped to focus subsequent investigation on potential receiving waters surrounding the mine site (such as roof water tanks and farm dams) rather than farm soils.

Accordingly, CVO personnel collected samples of roof water and dam water chemistry data from surrounding farms owned by Newcrest, to investigate whether any fingerprint of tailings dust was evident in regional water samples. The water chemistry data for these samples provided by CVO included field parameters (pH, electrical conductivity, redox potential and dissolved oxygen) and laboratory measurements of alkalinity, major ions, total and dissolved metal concentrations and nutrients (nitrogen speciation and phosphorus). In this report, roof water and dam water samples were assessed to determine the potential source of key chemical components and if a contribution from CVO tailings dust could be definitively ascribed or discounted. In addition, the water chemistry data were compared with relevant guidelines – (human) drinking water in the case of roof water samples and livestock drinking water for dam water samples.

When considering the potential influence of CVO tailings dust on roof water chemistry, it should be noted that:

- The catchment area of a roof is small compared to that of a farm dam catchment (ie. an entire paddock). Hence, a relatively small amount of water and dust can be collected by roof water tanks.
- It is likely that the tank water has a relatively high flow-through rate (ie. due to regular water consumption in farm dwellings and/or seasonal flushing).
- Tanks have very small surface areas and are generally enclosed, limiting the potential for evaporation and associated concentration of the dissolved components.
- Roof water chemistry has the potential to be influenced by galvanised steel roofing or guttering materials (potential source of iron, zinc, or copper), lead flashing (lead), plumbing materials and fittings (eg. copper pipes; brass taps/fittings) or the tank material (concrete, plastic, zincalume steel).

When considering the potential influence of CVO tailings dust on dam water chemistry, it should be noted that:

- The total catchment area of a farm dam is likely to be significantly greater than that of a roof water collection tank, and farm dams will be subject to evaporative concentration and the chance of dam overflow (ie. loss of dissolved components) is unlikely. Hence, farm dams may be more sensitive to potential soluble dust components derived from CVO tailings dams, in comparison with roof water.
- Farm dam water has the potential to be influenced by local soil composition, historical or recent chemical / nutrient additives to farmland within the catchment, or local/regional dust deposition

Hence, throughout this report the chemistry of roof water and farm dam water, and the potential influences on these, are discussed separately.

Roof water was found to be generally slightly acidic to near-neutral (pH 4.5-6.7) and well oxidised, with low salinity (less than 170 µS/cm), low suspended sediments (less than 20 mg/L) and low metal and nutrient concentrations. Most roof water samples met Australian (NHMRC, 2011) and international (WHO, 2017) drinking water guidelines, with the exception of:

- Total zinc in two tanks (12.8 mg/L in tank SVWT and 5.4 mg/L in tank OCWT) which exceeded the aesthetic guideline value of 3 mg/L.
- Total lead in one tank (CHST = 0.013 mg/L) which marginally exceeded the health-based guideline value of 0.01 mg/L.
- pH, which ranged from 4.5-6.3 in most roof water tanks, below the aesthetic guideline range of 6.5-8.5.
- Total iron in one tank (BWWT = 0.42 mg/L which exceeded the aesthetic guideline value of 0.2 mg/L.

Despite elevated dissolved (and total) zinc concentrations, all roof water samples had very low sulfate and chloride concentrations, which strongly supports no significant effect from CVO tailings dust on roof water.

The presence of zinc, acid and iron may relate to highly oxidised (rusted) galvanised (zinc-coated) steel roofing materials and/or organic acids. The lowest pH values and highest iron concentrations may be derived from the oldest / most corroded roofing materials. The marginally elevated lead concentration in one roof water collection tank (BWWT) could be related to impurities in plumbing or galvanising materials, or the use of lead flashing on the roof.

All dam water samples met ANZECC/ARMCANZ (2000) guidelines for livestock drinking water. Water samples from farm dams contained higher concentrations of dissolved metals such as aluminium, arsenic, cobalt, manganese, molybdenum, and iron, than roof water samples. Dissolved iron was up to 7.4 mg/L in farm dam water, but this is of no concern for livestock drinking water, nor does this reflect the CVO mineralisation. The presence of iron likely reflects the influence of natural iron oxide in local soils. As iron is a redox-sensitive element, it may dissolve in water under reducing conditions, which would not be unusual for a farm dam containing naturally decomposing organic matter (eg. animal faeces). The presence of manganese in farm dam water is consistent with the presence of dolomite / calcite (see above) in the local rocks/soils. Of the remaining metals listed above, molybdenum, copper and zinc are the only metals that are potentially indicative of the CVO mineralisation. However, these metals could also be derived from other sources, such as the use of micro-nutrient fertilisers on farms. While of no concern for livestock drinking water, further work is required before discounting fugitive tailings dust as a potential source of these metals in farm dam water.

The salinity was low in roof water and low to moderate in farm dam water samples. In both roof water and dam water, the salinity was dominated by bicarbonate alkalinity, likely caused by the dissolution of the carbonate mineral calcite in roof water collection tank samples, or calcite and dolomite in dam samples. Whilst some contribution from dust is highly likely, it is unclear if this dust is derived from the weathering of local carbonate-bearing geological units, the application of agricultural lime/dolomite to farm soils, or from CVO tailings dust that contains both calcite and dolomite.

1. INTRODUCTION

Newcrest Mining Limited's Cadia Valley Operations (CVO) comprises three mines in central-west New South Wales (ie. Cadia East underground, Ridgeway underground and Cadia Hill). These mines represent gold-copper porphyry intrusions, as well as associated alteration halos and skarns formed in the adjacent calcareous sediments. The mineralisation is late Ordovician (~440 Ma) in age and associated with shoshonitic dykes and stocks of the Cadia intrusive complex. The Cadia orebodies are overlain by thick post-mineralisation sediments of Silurian Age (see section 2.2.3 for details).

Earth Systems was engaged by Newcrest Mining Limited to identify a distinctive chemical, geochemical or mineralogical fingerprint for tailings at Cadia Valley Operations (CVO), to enable assessment of the potential for tailings dust to impact on local receptors (eg. roof water quality of surrounding farm homesteads).

Tailings from CVO were historically deposited into the Northern and Southern tailing storage facilities (ie. the NTSF and STSF, respectively). Surface materials (efflorescences) across CVO tailings dams are likely to comprise soluble, low density secondary minerals. These surface minerals are expected to be the first to be mobilised as dust and/or travel the furthest if they become airborne during windy conditions. After deposition, they are also the most likely minerals to subsequently dissolve upon contact with water.

After review of available tailings characterisation data from CVO, a sampling and analytical program was developed by Earth Systems (2019) with a focus on tailings (surface efflorescence and depth samples) and materials collected in dust deposition gauges (DDG's) located on and around the CVO mine site. Additional protocols for baseline farm soil sampling and analysis were also briefly outlined, pending initial data from the tailings and dust gauges. The tailings and DDG analytical program included an extensive suite of mineralogical and geochemical parameters, as well as leachate chemical analyses to identify potential indicators associated with any water-soluble components of the tailings.

CVO personnel conducted sampling of the tailings and depositional dust material and provided the following data to Earth Systems for review:

- Quantitative X-Ray Diffraction (QXRD) mineralogy data for the tailings samples.
- Geochemistry (partial suite) data for the tailings samples.
- Australian Standard Leach Procedure (ASLP) and Net Acid Generation (NAG) data on tailings leachate samples.
- Depositional dust data including selected major and trace elements, dust loads (mass of dust per volume of air and unit of time) and proportions of soluble and insoluble components.

An assessment of these data resulted in the identification of potential chemical indicators of the presence of CVO dust in water samples (Earth Systems, 2020a, b, c). Leach test data indicated that the most sensitive (distinctive) fingerprint of CVO tailings is likely to be associated with water-soluble components.

Subsequent investigations focussed on potential receiving waters surrounding the mine site (such as roof water tanks and farm dams) rather than farm soils. To assess whether a fingerprint of the CVO tailings dust could be detected in such waters, CVO staff provided water chemistry data for samples collected from local farm tanks (roof water) and paddock dams. This report provides an assessment of this water quality data and discusses the potential origins of specific elements / components.

2. BACKGROUND

2.1 A chemical fingerprint of CVO tailings

Mineralogy of the CVO tailings, ASLP and NAG leachate chemistry, as well as total metal concentrations of dust deposits in DDG's located on and around the CVO mine site were assessed by Earth Systems (2020a, b).

The results of this assessment are summarised below to provide an indication of the aqueous fingerprint of CVO tailings dust dissolved in near-neutral water (eg. rainwater), as context for the review of farm water chemistry data in this study (Section 5).

Mineralogy of CVO tailings

As described by Earth Systems (2020a), all tailings samples collected by Newcrest personnel contain a mixture of primary and secondary minerals. The secondary minerals are the result of pyrite oxidation (generation of acid), and subsequent neutralisation reactions within the TSF between the acid and carbonate minerals (ie. calcite and dolomite). Fluids that carry dissolved components from these neutralisation reactions percolate upwards through the tailings (via capillary action) and when they reach the surface these fluids undergo evaporative concentration causing surficial efflorescence precipitation. These minerals have likely formed in the last few months, not years.

The primary minerals identified in the bulk tailings samples included:

- Plagioclase feldspar (23-31 wt.%; [$(Na, Ca)(Si, Al)_4O_8$]);
- Illite/mica (16-20 wt.%; [$(K,H_3O)(Al, Mg, Fe)_2(Si, Al)_4O_{10}[(OH)_2, (H_2O)]$]);
- Quartz (14-17 wt.%; [SiO_2]);
- Clinochlore (10-16 wt.%; [$Mg_5Al(AlSi_3O_{10})(OH)_8$]);
- Potassium feldspar (8-13 wt.%; [$KAlSi_3O_8$]); and
- Calcite (3-4 wt.%; [$CaCO_3$]).

Minor (ie. generally, <2 wt.%) concentrations of magnetite [Fe_3O_4], pyrite [FeS_2], dolomite [$(Ca, Mg)CaCO_3$], and amphibole occurred in many samples.

The low-density secondary minerals located at the surface of the CVO TSF (ie. those most likely to become air-borne) included:

- Gypsum ($CaSO_4 \cdot 2H_2O$);
- Bassanite ($CaSO_4 \cdot 0.5H_2O$);
- Anhydrite ($CaSO_4$);
- Halite ($NaCl$);
- Blödite ($Na_2Mg(SO_4)_2 \cdot 4H_2O$);
- Rhomboclase ($H_5Fe^{3+}O_2(SO_4)_2 \cdot 2(H_2O)$); and
- Glauberite ($Na_2Ca(SO_4)_2$).

These secondary minerals are all moderately to highly water-soluble phases containing sulfate (SO_4) or chloride (Cl). Hence, if local water sources were to be influenced by CVO tailings dust, they would likely be initially characterised by elevated sulfate and/or chloride concentrations, potentially charge-balanced with sodium (Na), calcium (Ca) and magnesium (Mg). Trace metal substitution into many of the secondary mineral phases listed above is also possible, and hence they represent a potential influence on local water sources.

CVO tailings leachate chemistry data

The ASLP testwork provides an indication of which tailings components are able to dissolve in neutral water. This test work can therefore be considered a simplistic proxy for leaching of tailings materials by rainwater.

The tailings ASLP leachate contains elevated concentrations of sulfate (634-3820 mg/L), chloride (49-373 mg/L), calcium (107-414 mg/L), magnesium (7-365 mg/L) and sodium (145-1000 mg/L) (Earth Systems, 2020a). These major ions are consistent with the soluble secondary (Ca-Mg-Na bearing) sulfate-chloride mineralogy identified by the QXRD analyses (see above).

Soluble trace elements with concentrations above detection limits in the ASLP leachate included aluminium, antimony, arsenic, barium, boron, lithium, caesium, copper, cadmium, lead, molybdenum, mercury, selenium, manganese, strontium, rubidium and zinc.

Trace elements in dust deposition gauge (DDG) samples

The DDG data can provide an indication of elements that are present in CVO tailings dust, however depositional dust may also be derived from other parts of the mine site or non-mining related sources. Furthermore, the presence of an element in solid form within a depositional dust sample does not necessary mean that it has the potential to influence receiving water, as the solubility of an element in water is controlled by the mineral phase in which it occurs.

An important finding of this testwork was that around 10-20 wt.% of the dust captured in the DDG's is in a soluble form (Earth Systems, 2020a). This result is not inconsistent with the prediction that surface materials (efflorescences) from the CVO tailings would be the first to be mobilised as dust and/or travel the furthest if they become airborne during windy conditions, bearing in mind the highly water-soluble nature of these surface materials as identified from the mineralogy data. A lower percentage of soluble dust material would generally be expected if the DDG's were not influenced by CVO tailing dust to some degree.

Additional findings from the dust deposition data include:

- All depositional dust (solid) samples contained zinc, iron, copper, aluminium and manganese at concentrations above their respective detection limits.
- The DDG's that received the highest mass of dust per unit of time (ie. DGCP1 and DGVR1) had elevated concentrations of chromium, cobalt, lead, molybdenum, nickel and occasionally arsenic, antinomy and selenium.

However, as noted above, these elements are not necessarily present in water-soluble form.

Summary

Pyrite oxidation will continue to occur in the upper layer of tailings that is exposed to atmospheric oxygen, and this will result in ongoing secondary mineral efflorescence formation that is visible across the surface of CVO tailings dams in dry conditions. As the efflorescences are distributed above the uppermost layer of the tailings and have relatively low density, they are the most likely minerals to be mobilised as dust from CVO tailings dams during windy conditions. They are also the most likely minerals to dissolve in water.

Water in contact with CVO tailings dust is therefore likely to contain elevated sulfate and chloride concentrations, charge-balanced with calcium, magnesium and sodium. Based on a combined assessment of the mineralogy data, DDG data and the ASLP data (ie. soluble components in CVO tailings leachate), water influenced by CVO tailings dust may contain detectable concentrations of dissolved zinc, copper, lead, molybdenum, arsenic, antimony, selenium and possibly strontium.

Therefore, the most sensitive fingerprint for dust sourced from CVO tailings dams based on the work completed to date is expected to be some combination of the following components dissolved in water: sulfate, chloride, calcium, magnesium, sodium, dissolved zinc, copper, lead, molybdenum, arsenic, antimony, selenium and possibly strontium.

Further clarity on which elements are both present in CVO tailings dust, and soluble in near-neutral water, could be obtained by collecting the water that accumulates in the DDG's, or if these gauges are dry, perform leach tests on the material within the DDG collection container (see Earth Systems, 2020d).

2.2 Processes affecting farm water chemistry

The local area surrounding the CVO mine site consists predominantly of farmland used for livestock grazing (cattle and sheep). A number of farm dams exist to support this activity. In addition, several dwellings / sheds are located on this farmland. Rainwater runoff from the rooftops of these dwellings / sheds is often collected in farm tanks and used for drinking water and other domestic purposes. Water samples from selected tanks has been collected by CVO personnel for chemistry analysis. In order to accurately detect or rule out contributions from CVO dust to the farm dam and roof water chemistry, all potential sources of different elements must be considered. Some of the key processes and potential sources of chemical contribution are outlined below.

2.2.1 Roof water tanks

Samples from roof water tanks contain rainwater (ie. near neutral pH [~5.3], with sulfate and metal concentrations below conventional detection limits) that runs off the roof of sheds or houses, through guttering and piping, and into the tank. It is assumed here that the majority of roofing / guttering material is constructed of galvanised steel (ie. either steel coated with zinc or zincalume, an aluminium-zinc-magnesium alloy). Lead flashing, which is commonly used as a water-proofing material, may occasionally be present. The water tanks sampled in this study were constructed of three different material types: concrete, plastic, and aluminium-coated steel (assumed to be zincalume steel throughout this report). After residence in the tank, the water passes through steel, copper, polyvinylchloride (PVC) and/or HDPE piping before being consumed (and sampled). Roofing, guttering, waterproofing, piping, plumbing fittings and tank materials all have the potential to affect the water composition. Such effects may vary depending on material composition as well as age and condition.

When considering potential influence of any fugitive dust from CVO tailings dams on samples from roof water tanks, it should be noted that:

- The catchment area of a roof is small compared to that of a farm dam catchment (ie. an entire paddock). Hence, a relatively small amount of water and dust can be collected by roof water tanks.
- It is likely that the tank water has a relatively high flow-through rate (ie. due to regular water consumption in farm dwellings and/or seasonal flushing).
- Tanks have very small surface areas and are generally enclosed, limiting the potential for evaporation and associated concentration of the dissolved components.
- Roof water tanks therefore represent a simple hydrogeochemical system, relative to dam water (see below).
- Roof water chemistry has the potential to be influenced by galvanised steel roofing or guttering materials (potential source of iron, zinc or copper), lead flashing (lead), plumbing materials and fittings (eg. copper pipes; brass taps/fittings) or the tank material (concrete, plastic, zincalume steel).

2.2.2 Farm dams

The total catchment area of a farm dam is likely to be significantly greater than that of a roof water collection tank. In some respects, this may make farm dams a more sensitive tracer of potential soluble dust components derived from CVO tailings. In addition, in the area surrounding the CVO site, net evapotranspiration exceeds net rainfall (eg.1452 mm evapotranspiration *vs* 480 mm rainfall at Orange Airport in 2019 – Bureau of Meteorology). This means that farm dams will be subject to evaporative concentration and the chance of dam overflow (ie. loss of dissolved components) is unlikely.

On the other hand, the dam water may have dissolved various minerals from the soil as well as chemicals / minerals applied to crops and soils within the catchment. For example, the following compounds are commonly used in agriculture and may influence the chemistry of the farm dam water:

- Agricultural limestone [calcite] / dolomite for pH modification and as a source of calcium, magnesium, and trace quantities of manganese (which can substitute for calcium or magnesium in calcite / dolomite).
- Gypsum to assist in the breakup of clay rich soils.
- General fertilisers – phosphorus (eg. triple superphosphate), nitrogen (eg. urea, manure) or potassium-based compounds.
- Micronutrient fertilisers – eg. copper, manganese, nickel, zinc, cobalt, boron, selenium, and molybdenum.
- Stock licks – eg. sodium chloride.

Some of these common soil amendments are minerals that are also present in CVO tailings (eg. calcite, dolomite, and gypsum). Moreover, the high solubility metal-bearing fertilisers contain elements that could also be derived from CVO tailings (see above). This could make it difficult to unambiguously distinguish the contribution from CVO tailings from that of common soil / crop amendments using these elements alone, without knowledge of the specific crop amendments used on the farms studied. However, it is noted that components such as calcite / dolomite, gypsum and many of the general and micro-nutrient fertilisers are unlikely to pose a risk to stock water or soil quality.

When considering the potential influence of any fugitive dust from CVO tailings dams on farm dam water, it should be noted that:

- The total catchment area of a farm dam will be significantly greater than the dam water surface area (and much larger than the catchment of a roof water collection tank).
- Farm dam water will be subject to evaporation, leading to concentration of dissolved components (derived from the entire dam catchment area) in the dam water.
- Dam overflow or flushing (ie. loss of dissolved components) will be relatively uncommon, compared to roof water tank consumption / through-flow.
- Farm dam water will be regularly consumed but much of this water (and dissolved components) will be recycled back into same catchment.
- Hence, farm dams are expected to be more sensitive to potential soluble dust components derived from CVO tailings dams, in comparison with roof water.
- Farm dam water has the potential to be influenced by local soil composition, historical or recent chemical / nutrient additives to farmland within the catchment, or local/regional dust deposition.

2.2.3 Dust from natural sources

Consideration of the local geology and soils is important because the natural weathering of local materials has the potential to contribute to the dust loads received by local farms.

Local Rock Outcrops

The Geological Survey of New South Wales 1:100,000 Map sheet for the Molong area shows that the following geological unit's outcrop at the surface within a ~10 km radius of the CVO mine site:

- Qa - Quaternary alluvium: gravel, sand, silt, and clay;
- Tb – Tertiary basalts, alkali basalts, trachybasalts, trachyandesite;
- Tt – Tertiary trachyte, phonolite, nephelinite, syenite;
- Dtcc – Conglomerate: silt and sandstone – *Carlton Formation*;
- **Dtce** –Mudstone, sandstones, **calcareous gritstones** - *Edinboro Formation*;
- Dtcw – Conglomerate: silt, sandstone, shale – *Warree Creek Formation*;
- Dtbm – sandstone - *Macquarie Park Sandstone*;
- Sco –shale/siltstone - *Gospel Oak shale*;
- Oci – volcanoclastic sandstone/siltstone – *Millambri Formation*;
- **Ocm** – **calcareous / felspathic limestone**, mudstone, **limestone**– *Malongulli Formation*;
- **Obn** – **wackestone**, **limey mudstone**, shale - *Canomodine Limestone*; and
- Okf – basalts and basaltic andesites - *Fairbridge Volcanics*

Importantly, several of the geological formations in the local area (ie. Obn, Ocm, Dtce) are potential sources of dust containing carbonate minerals.

Local Soils

Local soil in the area were developed by either in situ weathering of bedrock, or unconsolidated, transported debris (Scott, 2003). Soils derived from aeolian transport can be readily distinguished from the local geology (volcanics) on the basis of grain size, mineralogy and geochemistry, for example (Scott, 2003):

- The aeolian component consists of quartz, feldspar, hematite, muscovite, kaolinite and anatase, whereas the underlying saprock (weathered bedrock) contains feldspar, amphibole, and ilmenite but no quartz.
- The aeolian material is richer in Si, K, Ti, Ce, Rb, Th, W, U, Y and Zr but poorer in Al, Fe, Mg, Ca, Na, Au, Ba, Cr, Ni, Sr, Sc, V and Zn than the underlying Blayney Volcanics.
- Ti/Zr ratios are much lower in the aeolian material (~13) than in the Blayney or Tertiary Volcanics (~70).

Hence, the local soils that have been transported from other regions could be equally if not more important than the natural / underlying geology of the area in terms of their contribution to dust loads on farmland.

3. SCOPE OF WORKS

This scope of works for this study was to:

- Use the aqueous fingerprint of CVO tailings dust derived from previous ASLP testwork, to assess the water chemistry of tank water (rainwater rooftop runoff) and dam water on farms that surround Cadia Valley Operations (CVO) and are owned by CVO.
- Compare water chemistry data for roof water and farm dams with relevant Australian and international guidelines for (human) drinking water and livestock drinking water.
- Discuss the potential sources of key elements / compounds in roof water and dam water samples.
- Provide a report with conclusions.

4. METHOD

Roof water samples were collected by CVO personnel from thirteen (13) drinking water tanks in total, including six (6) concrete tanks, five (5) plastic tanks and two (2) zincalume steel tanks. The water from each tank was sampled from different locations, including from the tank directly, from outdoor tap fittings or from indoor (eg. kitchen) tap fittings (see Table 5-1).

Water samples were also collected by CVO personnel from seven (7) farm dams, although the sampling details are not known.

The water samples were analysed by Australian Laboratory Services, an external laboratory, for the following water chemistry parameters:

- Electrical conductivity;
- Total dissolved solids;
- Total suspended solids;
- Alkalinity including total hardness as $CaCO_3$, hydroxide alkalinity as $CaCO_3$, carbonate alkalinity as $CaCO_3$, bicarbonate alkalinity as $CaCO_3$ and total alkalinity as $CaCO_3$.
- Sulfate as SO_4;
- Chloride;
- Dissolved major cations including calcium, magnesium, sodium and potassium;
- Dissolved and total metals including aluminium, antimony, arsenic, cadmium, chromium, cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, zinc and iron;
- Dissolved and total recoverable mercury;
- Nutrients including Nitrite as N, nitrate as N, total Kjeldahl nitrogen as N, total nitrogen as N and total phosphorus as P.

The data provided by CVO was collated, plotted and analysed to investigate the origin of key elements / compounds, and to enable comparison with relevant Australian and international water quality guidelines (ie. drinking water guidelines for roof water; livestock guidelines for farm dam water).

5. RESULTS AND DISCUSSION

The chemistry of roof water and dam water samples is summarised in Table 5-1 and Table 5-2, respectively. The relevant Australian and international water quality guidelines are provided in Table 5-3. Laboratory chemistry reports are provided in Attachment A.

Attachment B provides charts that show the distribution of salinity, alkalinity, nutrients, and dissolved metals as a function of different tank types (concrete, plastic and zincalume steel), as well as between roof water and dam water.

Attachment C provides a series of graphs that were used to investigate correlations between different elements / compounds in roof water and dam water that were produced to assist with interpreting the data and identifying or predicting the source of these elements / compounds.

Attachment D provides a series of graphs that show the distribution of total metal concentrations between water from different tank types (concrete, plastic and zincalume steel), as well as between roof water and dam water, including comparison with relevant water quality guidelines.

The pertinent results from the roof water and dam water chemistry analyses are outlined in Section 5.1 and Section 5.2, respectively. Elements that were below their detection limits in all samples (eg. dissolved and total mercury, silver and selenium) and not discussed in this report.

Table 5-1. Roof water chemistry grouped by tank type (concrete, plastic and zincalume steel). Values at or above Limits of Resolution (LOR) are shown in bold. Yellow shading indicates exceedance of Australian drinking water quality guidelines based on aesthetic (not health) risk. Red shading indicates exceedance of health-based guidelines (NHMRC, 2011; WHO, 2017).

Sample ID			**SVWT**	**OCWT**	**BWWT**	**W1ST**	**CHST**	**CHHT-2**	**EPHW**	**EPSW**	**W1HT**	**W3ST**	**CHHT-1**	**W2HT**	**W3HT**
Tank Material			Concrete	Concrete	Concrete	Concrete	Concrete	Concrete	Plastic	Plastic	Plastic	Plastic	Plastic	Zincalume steel	Zincalume steel
Tank Type			House	House	House	Shed	Cottage	Paddock	House	Shed	House	Shed	House	House	House
Outlet			Back door	Garage	Yard	Near tank	Tank	Tank	Kitchen	Tank	Kitchen	Tank	Tank	Back door	Tank
Field Parameters	**Unit**	**LOR**													
pH	pH	-	6.51	6.33	6.71	6.22	6.25	6.72	5.89	6.33	5.63	6.22	6.72	4.55	4.73
Electrical Conductivity	µS/cm	-	166.7	33.94	38.45	71.7	33.84	79.9	57.6	7.44	17.07	15.4	18.98	13.16	11.25
Oxidation-Reduction-Potential	mV	-	188	179	166	170	162	185	216	77	203	198	159	242	233
Laboratory Parameters															
Electrical Conductivity	µS/cm	1	**168**	**32**	**37**	**72**	**33**	**80**	**58**	**6**	**15**	**14**	**19**	**11**	**10**
Total Dissolved Solids	mg/L	10	**89**	**26**	**30**	**51**	**20**	**47**	**34**	<10	<10	10	<10	<10	<10
Suspended Solids	mg/L	5	<5	**5**	**6**	**7**	**18**	**6**	<5	**10**	**7**	**6**	<5	<5	<5
Alkalinity															
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1	**74**	**3**	**15**	**33**	**13**	**34**	**25**	<1	**5**	**3**	**4**	<1	<1
Dissolved Major Anions															
Sulfate as SO_4	mg/L	1	**4**	**3**	**1**	<1	<1	1	<1	<1	<1	<1	<1	<1	<1
Chloride	mg/L	1	**1**	<1	<1	**2**	<1	<1	**2**	<1	<1	<1	<1	<1	<1
Dissolved Major Cations															
Calcium	mg/L	1	**19**	<1	**6**	**8**	**4**	**11**	**4**	<1	**1**	**2**	<1	<1	<1
Magnesium	mg/L	1	<1	<1	<1	<1	<1	<1	**2**	<1	<1	<1	<1	<1	<1
Sodium	mg/L	1	**2**	<1	<1	**2**	<1	**1**	**3**	<1	<1	<1	<1	<1	<1
Potassium	mg/L	1	**2**	<1	<1	**2**	<1	**2**	<1	<1	<1	<1	**1**	<1	<1
Dissolved Metals															
Aluminium	mg/L	0.01	<0.01	<0.01	**0.04**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01
Antimony	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	mg/L	0.0001	<0.0001	**0.0002**	<0.0001	**0.001**	<0.0001	<0.0001	<0.0001	<0.0001	**0.0001**	<0.0001	<0.0001	<0.0001	**0.0001**
Chromium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**0.001**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	**0.023**	**0.043**	**0.002**	**0.002**	**0.001**	**0.001**	**0.02**	**0.004**	**0.187**	**0.008**	**0.009**	**0.045**	**0.008**
Lead	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**0.001**	<0.001	<0.001	<0.001	**0.002**	<0.001	<0.001

Sample ID			**SVWT**	**OCWT**	**BWWT**	**W1ST**	**CHST**	**CHHT-2**	**EPHW**	**EPSW**	**W1HT**	**W3ST**	**CHHT-1**	**W2HT**	**W3HT**
Tank Material			Concrete	Concrete	Concrete	Concrete	Concrete	Concrete	Plastic	Plastic	Plastic	Plastic	Plastic	Zincalume steel	Zincalume steel
Tank Type			House	House	House	Shed	Cottage	Paddock	House	Shed	House	Shed	House	House	House
Outlet			Back door	Garage	Yard	Near tank	Tank	Tank	Kitchen	Tank	Kitchen	Tank	Tank	Back door	Tank
Manganese	mg/L	0.001	**0.019**	**0.057**	**0.002**	**0.021**	**0.006**	**0.003**	<0.001	**0.023**	**0.005**	**0.014**	**0.021**	**0.047**	**0.031**
Molybdenum	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	mg/L	0.001	0.001	**0.002**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**0.002**	<0.001	**0.004**
Selenium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	mg/L	0.005	**12.5**	**5.25**	**0.128**	**1.48**	**1.17**	**0.548**	**0.031**	**0.13**	**0.807**	**0.242**	**1.07**	**0.049**	**0.092**
Iron	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Total Metals															
Aluminium	mg/L	0.01	**0.01**	**0.08**	**0.06**	**0.02**	**0.12**	**0.02**	**0.02**	**0.03**	**0.03**	**0.01**	**0.02**	**0.02**	**0.04**
Antimony	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	mg/L	0.0001	**0.0001**	**0.0002**	<0.0001	**0.0012**	<0.0001	<0.0001	<0.0001	<0.0001	**0.0002**	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001	<0.001	**0.006**	<0.001	<0.001	<0.001	<0.001	**0.003**	<0.001	<0.001	**0.001**	<0.001	**0.002**	**0.002**
Cobalt	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	**0.027**	**0.05**	**0.03**	**0.008**	**0.008**	**0.01**	**0.024**	**0.008**	**0.228**	**0.007**	**0.01**	**0.057**	**0.009**
Lead	mg/L	0.001	<0.001	**0.002**	**0.006**	**0.001**	**0.013**	**0.002**	<0.001	<0.001	<0.001	<0.001	**0.002**	<0.001	<0.001
Manganese	mg/L	0.001	**0.021**	**0.061**	**0.005**	**0.021**	**0.025**	**0.022**	**0.003**	**0.028**	**0.006**	**0.014**	**0.022**	**0.049**	**0.036**
Molybdenum	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	mg/L	0.001	**0.002**	**0.002**	<0.001	<0.001	<0.001	**0.001**	<0.001	<0.001	<0.001	<0.001	**0.001**	<0.001	**0.001**
Selenium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	mg/L	0.005	**12.8**	**5.36**	**0.244**	**1.69**	**1.7**	**1.14**	**0.039**	**0.148**	**0.873**	**0.256**	**1.14**	**0.053**	**0.084**
Iron	mg/L	0.05	<0.05	**0.12**	**0.42**	<0.05	**0.15**	<0.05	<0.05	**0.15**	<0.05	<0.05	<0.05	**0.09**	<0.05
Nutrients															
Nitrite as N	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrate as N	mg/L	0.01	**2.22**	**2.1**	**0.48**	**0.7**	**0.57**	**1.27**	**0.62**	**0.3**	**0.23**	**0.63**	**0.55**	**0.75**	**0.57**
Total Kjeldahl Nitrogen as N	mg/L	0.1	**0.4**	**0.3**	<0.1	<0.1	<0.1	**0.2**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	**0.5**
Total Phosphorus as P	mg/L	0.01	**0.03**	**0.05**	**0.02**	**0.01**	**0.07**	**0.09**	**0.03**	**0.01**	**0.02**	**0.02**	**0.07**	**0.02**	**0.03**

Table 5-2. Farm dam water chemistry. Values at or above Limits of Resolution (LOR) are shown in bold. All values are within trigger values for livestock drinking water (ANZECC/ARMCANZ, 2000).

Sample ID	Unit	LOR	EPSW	WGSW	WASW	OCSW	TASW	BDSW	EPB2
Field Parameters									
pH	pH	-	5.08	7.39	7.2	7.26	7.72	6.95	-
Electrical Conductivity	µS/cm	-	58.23	334.8	105	532.5	208.6	153.9	-
Oxidation-Reduction-Potential	mV	-	182	170	181	155	201	170	-
Laboratory Parameters									
Electrical Conductivity	µS/cm	1	**58**	**332**	**109**	**533**	**160**	**156**	**329**
Total Dissolved Solids	mg/L	10	**55**	**270**	**80**	**384**	**133**	**160**	**190**
Suspended Solids	mg/L	5	**22**	**41**	**33**	**18**	**27**	**12**	**6**
Alkalinity									
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1	**2**	**112**	**40**	**57**	**63**	**73**	**178**
Dissolved Major Anions									
Sulfate as SO_4	mg/L	1	**6**	**26**	<1	**176**	**24**	<1	**5**
Chloride	mg/L	1	**4**	**14**	**7**	**15**	**6**	**5**	**8**
Dissolved Major Cations									
Calcium	mg/L	1	**1**	**15**	**5**	**42**	**14**	**10**	**31**
Magnesium	mg/L	1	<1	**6**	**2**	**17**	**6**	**5**	**18**
Sodium	mg/L	1	**3**	**9**	**3**	**24**	**5**	**3**	**14**
Potassium	mg/L	1	**4**	**43**	**13**	**12**	**17**	**8**	**6**
Dissolved Metals									
Aluminium	mg/L	0.01	**0.15**	**0.49**	**0.07**	**0.03**	**0.26**	**0.23**	<0.01
Antimony	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	<0.001	**0.005**	<0.001	<0.001	**0.002**	<0.001	<0.001
Cadmium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001	**0.001**	**0.008**	**0.002**	<0.001	**0.004**	**0.002**	<0.001
Copper	mg/L	0.001	**0.002**	**0.008**	**0.004**	**0.01**	**0.007**	**0.006**	<0.001
Lead	mg/L	0.001	<0.001	**0.002**	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	**0.132**	**1.06**	**0.104**	**0.024**	**0.478**	**0.321**	**0.084**
Molybdenum	mg/L	0.001	<0.001	**0.002**	<0.001	**0.002**	**0.001**	<0.001	<0.001
Nickel	mg/L	0.001	<0.001	**0.005**	<0.001	**0.001**	**0.002**	**0.002**	<0.001
Selenium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	mg/L	0.005	<0.005	**0.012**	**0.011**	**0.078**	**0.008**	**0.011**	**0.007**
Iron	mg/L	0.05	**0.11**	**7.37**	**0.2**	**0.05**	**0.78**	**0.59**	**0.64**
Total Metals									
Aluminium	mg/L	0.01	**0.79**	**1.2**	**0.2**	**0.56**	**0.35**	**2.44**	-
Antimony	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Arsenic	mg/L	0.001	<0.001	**0.007**	<0.001	<0.001	**0.002**	**0.002**	-
Cadmium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Chromium	mg/L	0.001	<0.001	**0.002**	<0.001	**0.001**	<0.001	**0.002**	-
Cobalt	mg/L	0.001	**0.002**	**0.01**	**0.003**	<0.001	**0.005**	**0.004**	-
Copper	mg/L	0.001	**0.012**	**0.014**	**0.002**	**0.008**	**0.018**	**0.014**	-
Lead	mg/L	0.001	<0.001	**0.003**	<0.001	<0.001	<0.001	<0.001	-
Manganese	mg/L	0.001	**0.15**	**1.3**	**0.265**	**0.062**	**0.836**	**0.426**	-
Molybdenum	mg/L	0.001	<0.001	**0.003**	<0.001	**0.003**	**0.003**	<0.001	-
Nickel	mg/L	0.001	<0.001	**0.007**	<0.001	**0.002**	**0.003**	**0.002**	-
Selenium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Silver	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Zinc	mg/L	0.005	**0.008**	**0.031**	<0.005	**0.082**	**0.021**	**0.023**	-

Sample ID	Unit	LOR	EPSW	WGSW	WASW	OCSW	TASW	BDSW	EPB2
Iron	mg/L	0.05	**0.73**	**9.1**	**1.11**	**0.8**	**2.42**	**5.16**	-
Nutrients									
Nitrite as N	mg/L	0.01	<0.01	**0.08**	<0.01	**0.07**	**0.04**	**0.04**	<0.01
Nitrate as N	mg/L	0.01	**2.47**	**0.08**	**0.41**	**2.85**	**0.21**	**0.28**	<0.01
Total Kjeldahl Nitrogen as N	mg/L	0.1	**1.6**	**8.2**	**3.1**	**1.6**	**2.5**	**2.5**	<0.1
Total Phosphorus as P	mg/L	0.01	**0.06**	**1.22**	**0.22**	**0.15**	**0.35**	**0.19**	**0.08**

Table 5-3. Water quality guidelines (NHMRC, 2011; WHO, 2017; ANZECC/ARMCANZ, 2000).

Parameter	Australian Drinking Water Guidelines (NHMRC, 2011)		World Health Organization Drinking Water Guidelines (WHO, 2017)	Livestock water
	Health (mg/L)	Aesthetic (mg/L)	Health (mg/L)	mg/L
Aluminium (Al); acid-soluble	ID	0.2	**-**	**5**
Ammonia (NH_3)	ID	0.5	**-**	**-**
Antimony (Sb)	0.003	-	0.02	-
Arsenic (As)	0.01	-	0.01 ^{P}	0.5; up to 5 see Table 4.3.2 (ANZECC/ARMCANZ, 2000)
Cadmium (Cd)	0.002	-	0.003	0.01
Calcium (Ca)	-	-	-	1000
Chloride (Cl^-)	-	250	-	-
Chlorine (Cl)	5	0.6	5 ^{C}	-
Chromium - total (Cr)	-	-	0.05 ^{P}	1
Chromium III (Cr^{3+})	-	-	-	-
Chromium VI (Cr^{6+})	0.05	-	-	-
Cobalt (Co)	-	-	-	1
Copper (Cu)	2	1	2	0.4 (sheep); 1 (cattle); 5 (pigs); 5 (poultry)
Electrical Conductivity (EC)	-	-	-	See Table 4.3.1 (ANZECC/ARMCANZ, 2000)
Fluoride (F)	1.5	-	1.5	2
Iron (Fe)	ID	0.3	-	-
Lead (Pb)	0.01	-	0.01	0.1
Magnesium (Mg)	-	-	-	ID
Manganese (Mn)	0.5	0.1	0.4 ^{C}	-
Molybdenum (Mo)	0.05	-	0.07	0.15
Nickel (Ni)	0.02	-	0.02 ^{P}	1
Nitrate (NO_3)	50	-	50 (short term exposure)	400
Nitrite (NO_2)	3	-	3 (short term exposure); 0.2 ^{P} (long term exposure)	30
pH	ID	6.5 - 8.5	-	-
Selenium (Se)	0.01	-	0.01	0.02
Silver (Ag)	0.1	-	ID	-
Sodium (Na)	-	180		-
Sulfate (SO_4)	ID	250	-	1000
Turbidity (NTU)	ID	5	-	-
Total Dissolved Solids (TDS)	-	600	-	-
Total Suspended Solids (TSS)	-	-	-	-
Zinc (Zn)	ID	3	-	20

P = Provisional guideline value, as there is evidence of a hazard, but the available information on health effects is limited.

C = Concentrations of the substance at or below the health-based guideline value may affect the appearance, taste or odour of the water, leading to consumer complaints.

5.1 Roof water chemistry

5.1.1 Comparison with Guidelines

It is understood that roof water is used for drinking and other domestic uses by farmers. Therefore, the chemistry of the roof water samples was compared with Australian (NHMRC, 2011) and international (WHO, 2017) drinking water guidelines (see Table 5-3; Attachment D).

In general, the roof water chemistry was within the health-based and aesthetic-based drinking water guideline values including chloride, fluoride, sodium, sulfate, turbidity, ammonia, nitrate, nitrite, and a range of metals (eg. aluminium, antimony, arsenic, cadmium, chromium, copper, iron, lead, manganese, molybdenum, nickel, selenium, silver, zinc), with the following minor exceptions noted:

- The pH in most of the roof water tanks (9 out of 13 tanks) was in the range pH 4.5-6.3, below the aesthetic-based drinking water quality guideline range of 6.5-8.5 (NHMRC, 2011), as highlighted in yellow in Table 5-3. This is not surprising for roof water given that rainwater pH is typically around 5.3. The slightly lower pH in two of the roof water samples (ie. 4.55 and 4.73; Table 5-2) could be due to:
  - Organic acids (eg. tannins, humic and fluvic acids) derived from organic matter (eg. leaves);
  - The rusting (oxidation) of steel roofing materials (where the galvanisation has failed). This would occur when soluble iron (Fe^{2+}) is oxidised, hydrolysed and precipitates as $Fe(OH)_3$.
- Total lead in one of the roof water tanks (CHST; 0.013 mg/L Pb) marginally exceeded the Australian drinking water trigger value of 0.01 mg/L. This is most likely related to the interaction of roof water runoff with lead flashing that is a commonly used water-proofing material, or impurities in plumbing or galvanising materials.
- Total zinc in two of the concrete roof water tanks (SVWT and OCWT; 5-13 mg/L, mostly in dissolved form) exceeded the aesthetic-based drinking water quality guideline value of 3 mg/L (NHMRC, 2011). This is most likely related to the degradation of galvanised steel roofing materials (zincalume steel)[1].
- Total iron in one of the roof water tanks (BWWT; 0.42 mg/L Fe) exceeded the aesthetic (taste) drinking water guideline of 0.3 mg/L (NHMRC, 2011). This is most likely associated with rusting of steel roofing materials.

5.1.2 Detailed Review

A more detailed review of the data shown in Table 5-1 is provided below, with supporting graphs in Figure 1 to Figure 6:

- All roof water samples were slightly acidic to near-neural (pH = 4.55-6.71) with very low salinity (Electrical Conductivity [EC] = 6-168 µS/cm). Roof water from concrete tanks tended to have slightly higher pH and EC values relative to plastic or zincalume steel tanks (Table 5-1; Figure 1).
- The (very low) salinity of roof water was primarily associated with bicarbonate alkalinity (HCO_3^-), and there was a clear positive correlation between bicarbonate alkalinity and calcium ion concentrations (Attachment C). The salinity, alkalinity and calcium concentrations were higher for roof water in concrete tanks than plastic or zincalume steel tanks (Table 5-1; Figure 2). These data suggest that dissolution of concrete from the internal tank walls is occurring. Other potential sources of the bicarbonate alkalinity in roof water include depositional dust derived from the natural sources of the carbonate mineral calcite ($CaCO_3$) or agricultural limestone (see Section 2.2), however most non-concrete tanks do not display this signature.

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[1] Derivation of zinc from galvanised steel is consistent with reports such as NHMRC (2011), which states that zinc is most commonly elevated in "*galvanised iron rainwater tanks*".

- Based on the observed data for concrete tanks, the slightly higher salinity and alkalinity in roof water from one of the plastic tanks (EPHW) probably reflects interim storage in a concrete tank (or other interaction with concrete) prior to water entering EPHW, although this is speculative at present.
- All roof water had very low sulfate and chloride concentrations (ie. <5 mg/L, and commonly below detection limits [1 mg/L]; Table 5-1; Figure 3).
- The major cations in roof water were dominated by calcium, which again was slightly higher for roof water in concrete tanks (Table 5-1; Attachment B).
- The lack of a significant concentrations of either of the major anions – sulfate and chloride – strongly indicates that roof water chemistry is not influenced by CVO tailings dust. This is supported by the following key findings:
  - All of the soluble secondary minerals identified in the CVO tailings samples contain either sulfate or chloride (refer to Section 2.1).
  - Consistent with the mineralogy data, the tailings ASLP data (Section 2.1; Earth Systems, 2020a) are characterised by elevated sulfate (up to 3,820 mg/L) and chloride concentrations (up to 373 mg/L).
- The very low concentrations of nitrogen in roof water samples – comprising nitrate (0.3-2.2 mg/L) and lesser amounts of Total Kjeldahl Nitrogen (<0.1-0.5 mg/L) (Table 5-1; Attachment B) – are most likely derived from leaf litter, organic dust, bird faeces, dead insects or other dead animals (birds, possums), etc.
- Phosphorus concentrations were also very low (ie 0.01-0.09 mg/L; Table 5-1) and showed no systematic correlation with roof water collection tank type (Attachment B). Small quantities of phosphorus could be derived from dust affected by phosphorus-based fertilisers (eg. superphosphate) and/or the same sources that account for the nitrogen.
- A comparison of total versus dissolved metal concentration data indicates that:
  - Despite the detection of total (ie. particulate) iron and lead (at low concentrations) the dissolved form of these metals was largely below detection limits.
  - The relative proportions of dissolved versus particulate forms were higher for copper (7-89% of total copper was in dissolved form), manganese (0-96% in dissolved form) and zinc (52-98% in dissolved form) than for iron or lead.
  - Total lead, zinc and iron concentrations tended to be higher in roof water samples from concrete tanks.
- The only dissolved metals with detectable concentrations in all roof water samples, were zinc, copper and manganese (Table 5-1; Figure 4 and Figure 5). Of these, zinc and copper were notably higher in roof water than dam water, suggesting local influencing factors.
- The presence of zinc is most likely related to the degradation of galvanised steel roofing materials. Dissolved zinc concentrations were generally higher in roof water from concrete tanks (eg. 0.13-12.5 mg/L) relative to plastic or zincalume steel tanks (eg. 0.03-1.07 mg/L; Figure 4). This may be attributed to the fact that concrete tanks are generally older than plastic or zincalume steel tanks. Assuming that the roofing and guttering material that directs water to these tanks is also older, then the elevated zinc could be due breakdown of the galvanising layer of the roofing or guttering materials. The apparent correlation between dissolved zinc concentrations and the age / condition of roofing and guttering material would require field verification. Copper piping or brass fittings, which may contain zinc as an impurity, could represent another potential source of dissolved zinc in roof water.
- While dissolved copper concentrations were generally very low relative to drinking water standards (below 0.05 mg/L), one anomalous copper concentration (0.19 mg/L; plastic tank W1HT) was sampled from a kitchen tap. Plumbing materials (eg. copper pipes) are considered the most likely source of low level dissolved copper in roof water. Copper piping is most commonly associated with hot water plumbing systems (indicating that W1HT could have been sampled following the use of the hot water kitchen tap), but could potentially also be used for cold water systems on farm properties due to installation

convenience. Other potential but less likely sources of low-level copper include roofing or guttering materials (where copper occurs as impurities in zinc galvanising). Slightly elevated copper concentrations in roof water (eg. OCWT and W2HT) may correspond to greater lengths of copper piping, whereas lower concentrations (eg. BWWT, W1ST, and CHH2) may correspond to the use of PVC or polyethylene piping or shorter lengths of copper piping. Brass fittings could represent another potential source of dissolved copper in roof water. There was no clear correlation between dissolved copper and tank type (Figure 5).

- Consideration was given to the possibility of CVO tailings dust contributing to dissolved zinc and copper concentrations in the roof water tanks, however this would require the metal cations (Zn^{2+} and Cu^{2+}) to be charge-balanced with sulfate anions (SO_4^{2-}) in the roof water. Sulfate concentrations that would be expected in roof water, in the event that zinc, and copper were derived from (sulfate-bearing) CVO tailings dust, are much higher than measured sulfate concentrations, as shown in Figure 6. The measured sulfate concentrations in roof water (generally below 1 mg/L) are clearly insufficient to achieve a charge-balanced solution containing dissolved zinc concentrations up to 12.5 mg/L and dissolved copper concentrations up to 0.19 mg/L. Hence, this provides further evidence to support the interpretation above, indicating that roof water chemistry is very unlikely to be influenced by CVO tailings dust.
- Dissolved manganese concentrations showed no correlation with tank type and were generally lower in roof water samples compared with dam water samples (Attachment B). The source of manganese in roof water samples remains unclear but could potentially be associated with depositional dust derived from the natural sources of the carbonate mineral calcite ($CaCO_3$) or agricultural limestone, which typically contains trace quantities of manganese (where manganese substitutes for calcium).
- Some roof water also contained detectable, albeit very low, concentrations of dissolved nickel, aluminium, cadmium, and lead (Table 5-1). As with the metals discussed above, their presence is most likely attributable to local influencing factors, such as:
  - Interaction of roof water runoff with lead flashing that is commonly used as a water-proofing material.
  - Galvanised roofing materials or guttering materials, which may contain impurities such as cadmium, nickel, and lead, and therefore are a possible source of very low-level concentrations of these metals (as well as zinc).
  - Copper piping or brass fittings, which many contain impurities such as lead and nickel. Old lead-based solder, if present, could be another potential source of this metal.

  Indeed, these minor components are unlikely to be derived from CVO tailings dust based on the tailings leachate (ASLP) data (Section 2.1; Earth Systems, 2020a).
- Overall, roof water chemistry appears to be primarily influenced by local materials including galvanised steel roofing or guttering materials (source of zinc and cadmium), rusting of steel roof materials (source of iron), copper piping (copper), lead flashing (lead) and dust from natural carbonate-bearing sources (eg. manganese). However, as some of these components – zinc, copper, manganese and (minor) cadmium – were also identified in the aqueous fingerprint of CVO tailings dust, further investigation would assist to confirm these assumptions and discount the influence of CVO tailings dust.

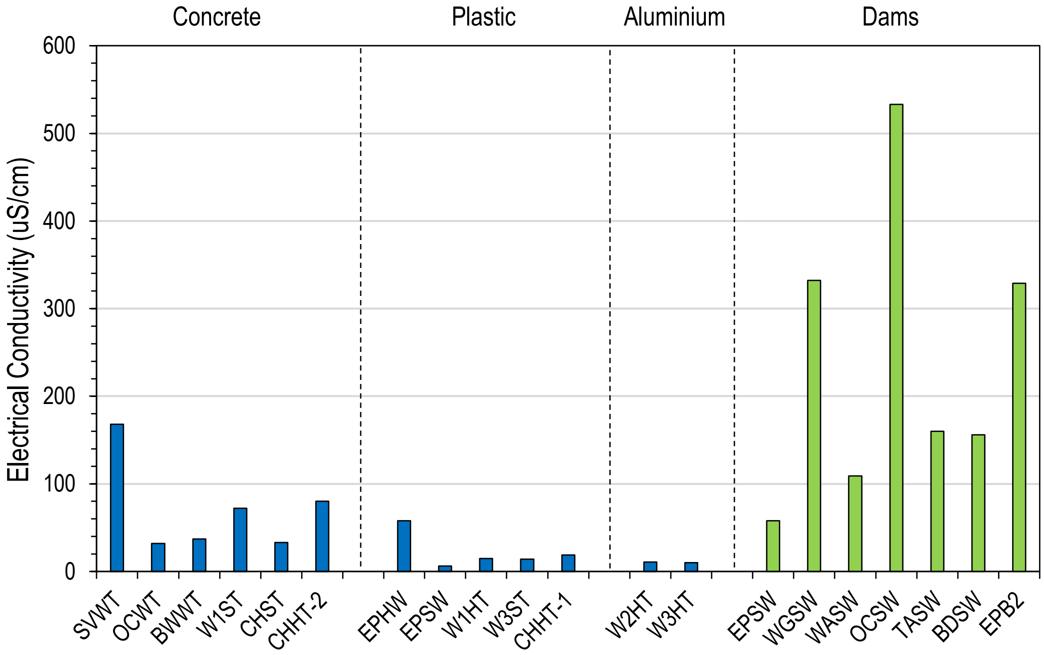

Figure 1. Electrical conductivity (μs/cm) of roof water (from concrete, plastic and zincalume steel tanks) and dam water samples.

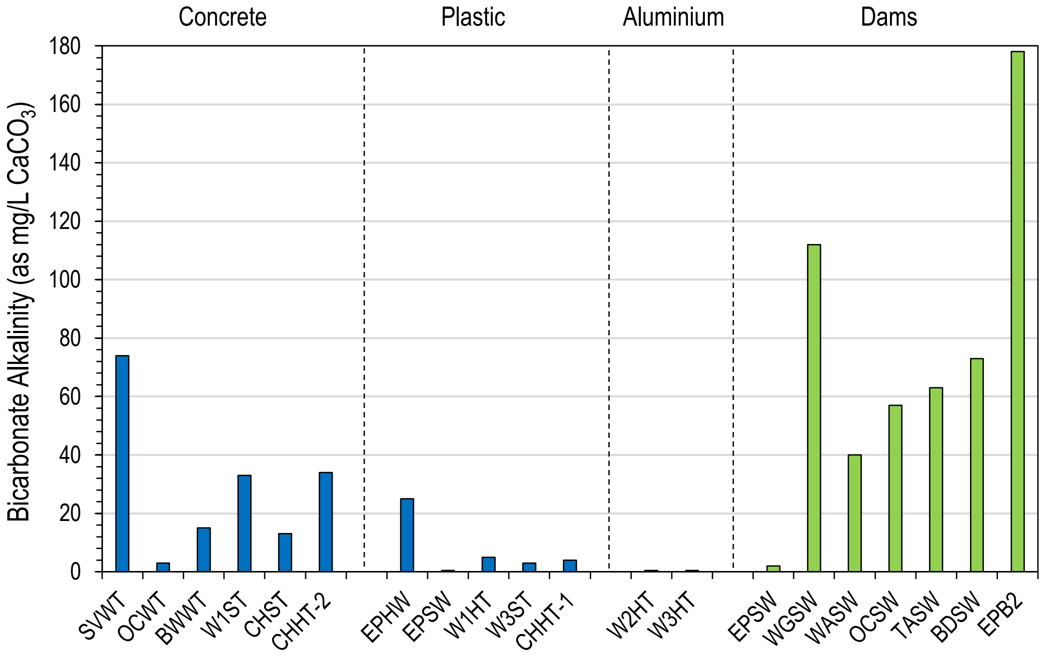

Figure 2. Bicarbonate alkalinity (as mg/L $CaCO_3$) of roof water (from concrete, plastic and zincalume steel tanks) and dam water samples.

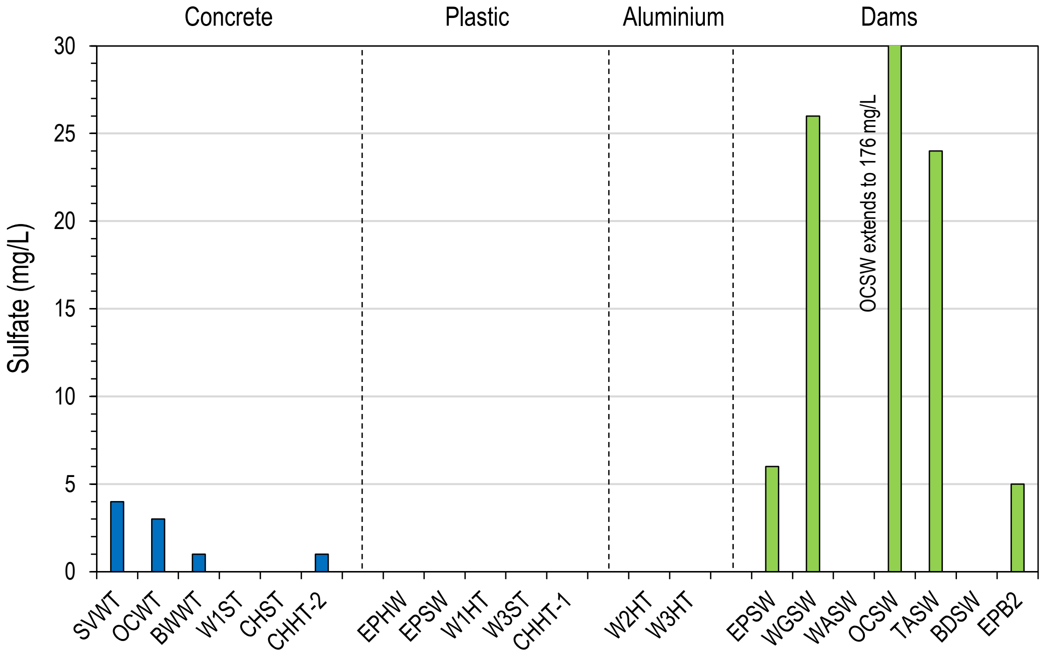

Figure 3 . Sulfate concentrations (mg/L) of roof water (from concrete, plastic and zincalume steel tanks) and dam water samples.

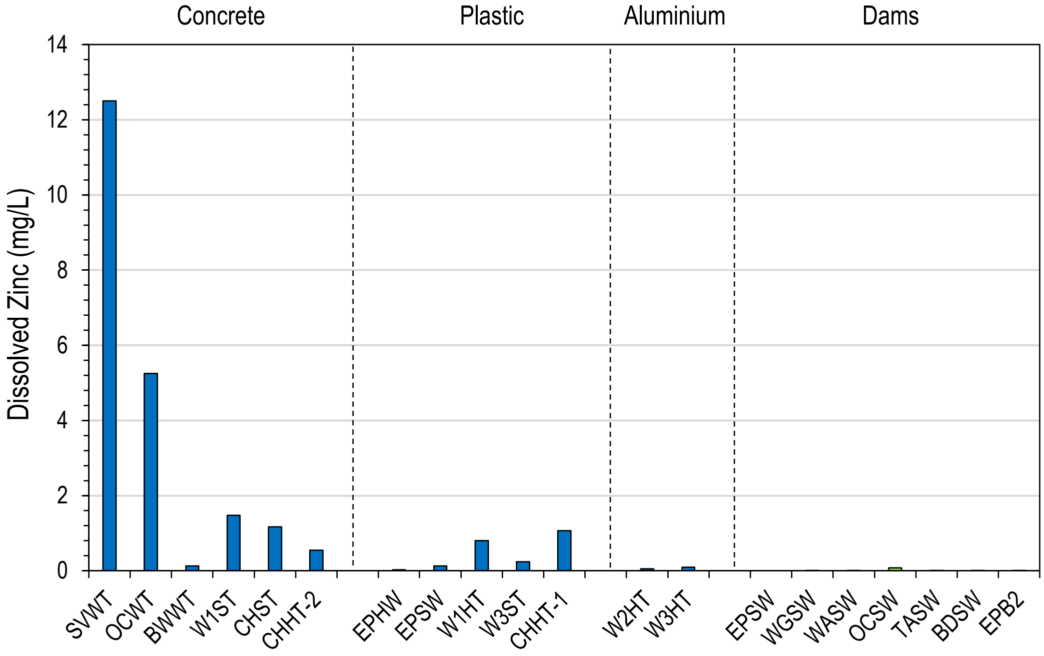

Figure 4. Dissolved zinc concentrations (mg/L) of roof water (from concrete, plastic and zincalume steel tanks) and dam water samples.

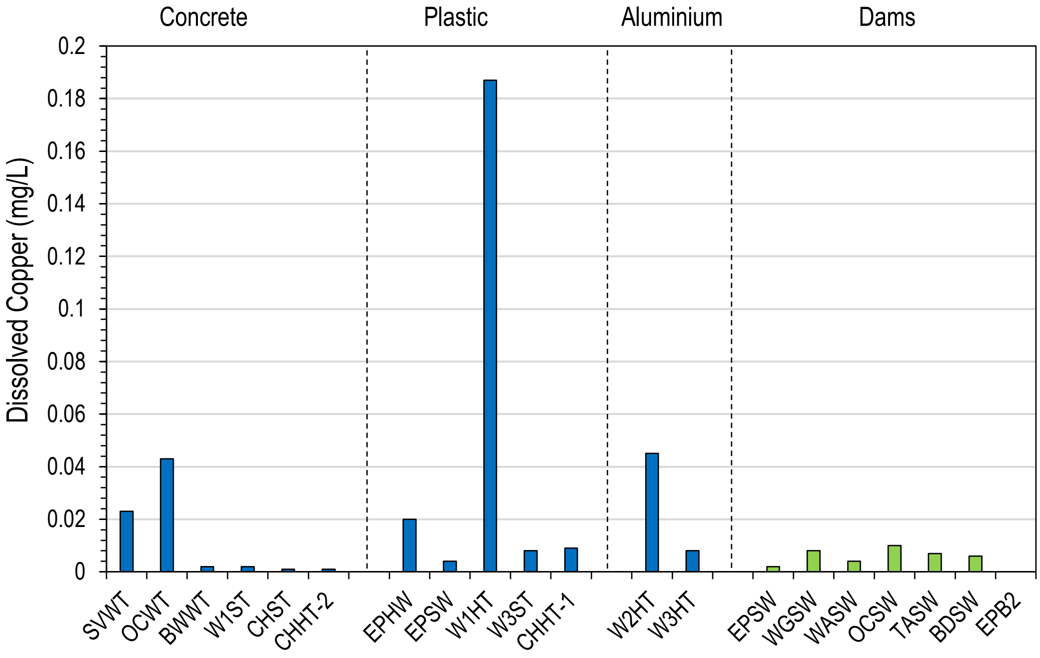

Figure 5. Dissolved copper concentrations (mg/L) of roof water (from concrete, plastic and zincalume steel tanks) and dam water samples.

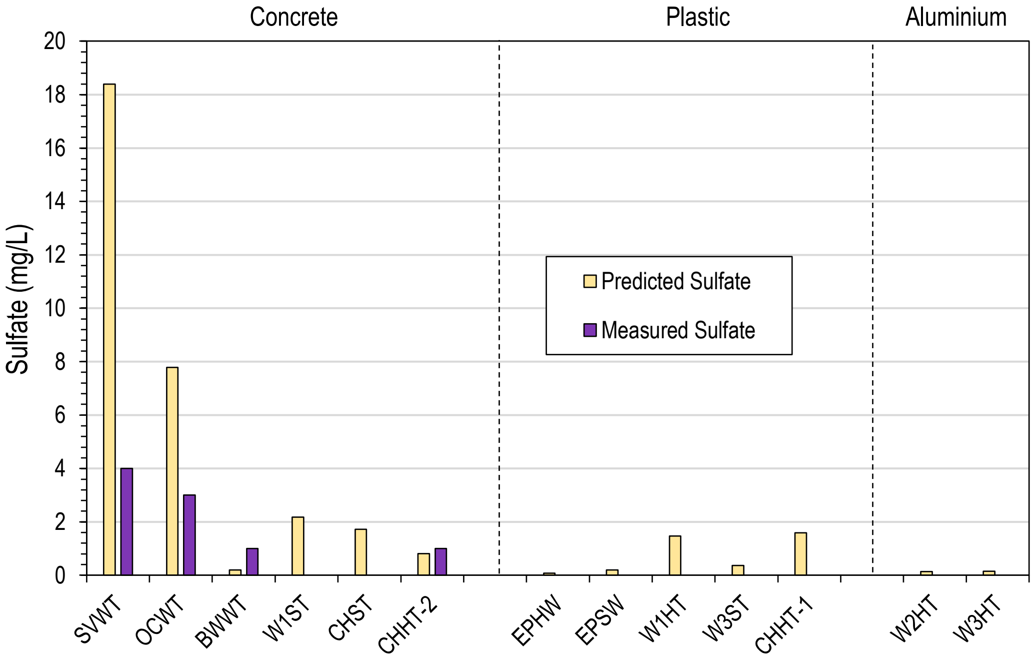

Figure 6. Sulfate concentrations that could be expected if all dissolved copper and zinc was derived from metal-sulfate minerals (ie. potentially CVO tailings) compared with the measured sulfate concentrations in roof water samples.

5.2 Farm dam water chemistry

5.2.1 Comparison with Guidelines

It is assumed that the farm dam water is used for livestock drinking water only, hence dam water chemistry data were compared with livestock guidelines outlined in ANZECC/ARMCANZ (2000).

The dam water chemistry was within these ANZECC/ARMCANZ (2000) livestock drinking water guideline values for all of the parameter suites tested, including guidelines for calcium, fluoride, nitrate, nitrite, sulfate and a range of metals (eg. aluminium, arsenic, cadmium, chromium, cobalt, copper, lead, molybdenum, nickel, selenium and zinc).

5.2.2 Detailed Review

For the purposes of investigating whether a CVO tailings dust fingerprint can be resolved in the dam water, a more detailed review of the data shown in Table 5-2 is provided below:

- Dam water was near neutral to slightly alkaline (pH = 5.08-7.72; Table 5-2) and generally had slightly higher pH values than roof water (eg. 4.55-6.71; Table 5-1).
- The salinity (EC) of dam water was low to moderate (58-533 µS/cm; Figure 1) and also generally higher than roof water. The dam water salinity was primarily associated with bicarbonate alkalinity (HCO_3^-), with minor contributions from chloride and sulfate in most samples.
- Dam water had low to moderate sulfate (<1 mg/L to 176 mg/L) and chloride (4 to 15 mg/L) concentrations that were generally higher than roof water samples (Figure 3; Attachment B).
- The major cations in dam water consisted of variable proportions of calcium, magnesium sodium and potassium, all of which were present at higher concentrations than in roof water samples (cf. Table 5-1 and Table 5-2; Attachment B).
- Correlations between bicarbonate alkalinity, calcium (Ca) and magnesium (Mg) suggest the dissolution of the dolomite ($CaMgCO_3$) and potentially calcite (Attachment C). If this is accurate, potential sources of dolomite / calcite could include:
  - Dust generated during the application of agricultural dolomite, limestone and/or weathering of local soils containing agricultural dolomite / calcite.
  - Dust derived from natural carbonate-bearing geological units, which are known to be widespread in the local area (see Section 2.2.3).
  - Dust derived from CVO tailings, as dolomite (as well as calcite) is present but in relatively low concentrations in the tailings (0.2-1.7 wt.%; Earth Systems, 2020a).
- Concentrations of sodium (Na; 3-24 mg/L) and potassium (K; 4-43 mg/L) were higher in dam water samples than roof water samples (<3 mg/L for both Na and K combined). Natural weathering of local soils / rocks could be sources of these cations in farm dams. However, potential contributions to sodium and chloride concentrations from halite (sodium chloride) derived from CVO tailings dust cannot be discounted, given the presence of halite in surficial tailings samples (ie. 0.4-3.0 wt.%) and the observed sodium and chloride concentrations in the tailings leachate (ASLP) data (Section 2.1; Earth Systems, 2020a).
- Whilst calcium could be partly derived from the dissolution of carbonate minerals (see above), calcium also shows a moderate-strong correlation with sulfate, suggesting the dissolution of gypsum / bassanite / anhydrite ($CaSO_4$ / $CaSO_4{\bullet}\frac{1}{2}H_2O$ / $CaSO_4{\bullet}H_2O$). Potential sources of these minerals include:
  - Farm soils – gypsum is a common amendment used to break up clay-rich soils.
  - CVO tailings – gypsum / anhydrite / bassanite were identified in QXRD analyses of tailings samples (ie. 0.5-3.7 wt.%; Earth Systems, 2020a).

- The total nitrogen and phosphorus concentrations were generally higher in dam water than roof water (Attachment B). Nitrogen speciation was variable between samples, but dam water generally contained a higher proportion of reduced nitrogen species (ie. Total Kjeldahl Nitrogen – <0.01-8.2 mg/L), with lower nitrate (<0.01-2.47 mg/L) compared to roof water. Some dam water also contained detectable but low level nitrite (up to 0.08 mg/L). These observations indicate that:
    - Higher concentrations of total nitrogen concentrations and reduced nitrogen species in dam water samples, relative to roof water samples, could be due to the use of nitrogen-based fertilisers (eg. urea) but is more likely related to stock manure in the dam surrounds and catchment.
    - Higher phosphorus concentrations in dam water, relative to roof water samples, are likely due to the application of fertilisers such as superphosphate. Other potential sources include stock manure. Whilst phosphorus bearing minerals are present in CVO tailings (ie. apatite), such minerals have only very limited solubility in near-neutral water and hence are highly unlikely to be significant sources.
- Hence, it appears likely that farm dam water chemistry has been influenced by the application of soil amendments, such as nitrogen- and phosphorus-based soil nutrients. This is not unexpected for farm land that is used for grazing (or other) purposes, and it raises the likelihood of other common soil amendments having an influence on farm dam water chemistry such as:
    - Potassium-based fertilisers, gypsum or limestone (potential contributors to EC, K, Cl, Ca, SO_4, HCO_3) as considered above); and
    - Micro-nutrients such as copper, manganese, nickel, zinc, cobalt, boron, selenium and molybdenum (see below).
- A review of total metal concentration data indicates that:
    - Overall, the concentrations of total metals in dam water were higher than in roof water, consistent with higher suspended solids.
    - The concentrations of total aluminium, iron and manganese were higher in dam water than roof water.
    - The concentrations of total lead were generally lower in dam water than roof water.
- Dissolved iron concentrations were low relative to guideline values, but above detection limits in all dams. Iron is a natural component of the local soils and the presence of dissolved iron is considered to be a function of the sometimes-reduced nature of the dam water. This is not considered unusual for a farm dam containing naturally decomposing organic matter (eg. animal faeces) as iron is a redox-sensitive element.
- Similarly, dissolved manganese concentrations were low relative to guideline values, but above detection limits in all dams. Dissolved manganese is usually derived from carbonate minerals such as dolomite / calcite. Potential sources therefore include agricultural dolomite / limestone or the weathering of local rocks. However, a possible contribution from CVO tailings dust cannot be discounted based on ASLP data (Section 2.1; Earth Systems, 2020a).
- Some dams also contained detectable, albeit very low, concentrations of dissolved zinc, aluminium, copper, cobalt, nickel, molybdenum, arsenic and lead (Table 5-2). A comparison of farm dam water and roof water indicates that :
    - Dissolved aluminium, arsenic, cobalt, manganese, molybdenum and iron were slightly higher in dam water than roof water (Attachment B).
    - In contrast, zinc, cadmium, and to a lesser extent copper, were slightly lower in dam water than roof water (eg. Figure 4; see also Attachment B).
    - Nickel and lead concentrations showed no systematic variations between roof water or dam water.
- Micro-nutrient fertilisers could be a potential source of dissolved metals such as copper, zinc and molybdenum, that were detected at low levels in the farm dam water. However, potential contributions from CVO tailings dust also cannot be discounted based on ASLP data (Section 2.1; Earth Systems, 2020a).

- Potential sources of other dissolved metals that were detectable at low levels in farm dam water are considered below:
  - Naturally occurring clay or feldspar minerals represent a likely source of dissolved aluminium. These minerals are widespread in soils globally and consistent with knowledge of the local soils (refer to Section 2.2). Hence, the presence of aluminium in farm dam water cannot be directly related to CVO tailings dust.
  - Cobalt may occur naturally in local soils and/or have been added as a micro-nutrient fertiliser. The presence of trace quantities of cobalt in the farm dam water cannot be unequivocally related to CVO tailings dust and was also not detected in the tailings ASLP data (Section 2.1; Earth Systems, 2020a).
  - Arsenic could potentially be derived from farm soils affected by historic arsenic-bearing pesticide use and/or timbers treated with chromated copper arsenate. The presence of trace quantities of arsenic in the farm dam water cannot be directly related to CVO tailings dust as it was largely undetected in the tailings ASLP data (Section 2.1; Earth Systems, 2020a).
  - Potential sources of dissolved lead and nickel in farm dam water remain uncertain, however they do not appear to be related to CVO tailings dust as they were largely undetected in the ASLP data (Section 2.1; Earth Systems, 2020a).
- Overall, when comparing the farm dam water chemistry to the tailings ASLP data (Section 2.1; Earth Systems, 2020a), the only metals in dam water that were consistent with the aqueous fingerprint of CVO tailings dust were zinc, copper, manganese and molybdenum. However, micro-nutrient fertiliser sources cannot be excluded at this stage. Further investigation is required to clarify any influence of CVO tailings dust on the trace element signature of dam water.

6. CONCLUSIONS

Context

- Surface salt efflorescences across CVO tailings dams are likely to comprise soluble, low density secondary minerals - such as gypsum, bassanite, anhydrite, halite, blodite, rhomboclase and glauberite – that are all sulfate- or chloride-bearing. These surface minerals are expected to be the first to be mobilised as dust and/or travel the furthest furthest if they become airborne during windy conditions. After deposition, they are also the most likely minerals to subsequently dissolve upon contact with water.
- Upon dissolution in water, the chemical signature of sulfate- and chloride-bearing minerals (that may be associated with any fugitive dust from CVO tailings dams) would likely be characterised by elevated sulfate and/or chloride, potentially coupled with elevated sodium, calcium and magnesium, as well as a range of mineralisation related trace elements.
- ASLP tests on the tailings surface materials indicate that soluble trace elements with concentrations above detection limits include aluminium, antimony, arsenic, barium, boron, lithium, chromium, copper, cadmium, lead, molybdenum, mercury, selenium, manganese, strontium, rubidium and zinc. Hence, these components may assist with fingerprinting of dust from the CVO tailings dams (if any) in waters downwind of the site.
- There is no significant evidence of metals such as beryllium, bismuth, cobalt, nickel, iron, silver, tellurium, thallium, thorium, tin, uranium, vanadium, zirconium or tungsten, in leachate from surface materials of CVO tailings dams, based on ASLP tests. Hence, if such components were found to be elevated in roof water or farm dam water, other potential sources unrelated to the mine would need to be considered.
- Several dwellings / sheds are located on farmland surrounding the CVO mine site. Rainwater runoff from the rooftops of these dwellings / sheds is often collected in tanks. Water samples were collected from 13 tanks for assessment in this study. When considering the potential influence of any fugitive dust from CVO tailings dams on samples from roof water tanks, it should be noted that:
  - The catchment area of a roof is small compared to that of a farm dam catchment (ie. an entire paddock). Hence, a relatively small amount of water and dust can be collected by roof water tanks.
  - It is likely that the tank water has a relatively high flow-through rate (ie. due to regular water consumption in farm dwellings and/or seasonal flushing).
  - Tanks have very small surface areas and are generally enclosed, limiting the potential for evaporation and associated concentration of the dissolved components.
  - Roof water chemistry has the potential to be influenced by galvanised steel roofing or guttering materials (potential source of iron, zinc or copper), lead flashing (lead), plumbing materials and fittings (eg. copper pipes; brass taps/fittings) or the tank material (concrete, plastic, zincalume steel).
- The local area surrounding the CVO mine site consists predominantly of farmland used for livestock grazing (cattle and sheep). A number of farm dams exist to support this activity. Water samples were collected from 7 of these dams for assessment in this study. When considering the potential influence of any fugitive dust from CVO tailings dams on farm dam water, it should be noted that:
  - The total catchment area of a farm dam is likely to be significantly greater than that of a roof water collection tank, and farm dams will be subject to evaporative concentration and the chance of dam overflow (ie. loss of dissolved components) is unlikely. Hence, farm dams may be more sensitive to potential soluble dust components derived from CVO tailings dams, in comparison with roof water.
  - Farm dam water has the potential to be influenced by local soil composition, historical or recent chemical / nutrient additives to farmland within the catchment, or local/regional dust deposition.

Roof water assessment

- Most roof water samples meet Australian (NHMRC, 2011) and international (WHO, 2017) drinking water guidelines, with the exception of pH in most roof water tanks (pH 4.5-6.3; aesthetic guideline range 6.5-8.5), total lead in one tank (CHST = 0.013 mg/L; health-based guideline 0.01 mg/L), total zinc in two tanks (5-13 mg/L; aesthetic guideline 3 mg/L) and total iron in one tank (BWWT = 0.42 mg/L; aesthetic guideline 0.2 mg/L).
- Roof water is generally slightly acidic to near-neutral (pH 4.5-6.7) and well oxidised, with low salinity (less than 170 µS/cm), low suspended sediments (less than 20 mg/L) and low metal and nutrient concentrations.
- The acidity and iron may relate to rusting of the roofing materials and/or organic acids (the lowest pH values and highest iron concentrations may be derived from the oldest / most corroded rooves).
- Despite elevated dissolved (and total) zinc concentrations, all roof water samples have very low sulfate and chloride concentrations (Table 5-1), which strongly suggests no significant effect from CVO tailings dust on roof water. Zinc in the roof water is likely to be predominantly (or exclusively) derived from galvanised steel roofing / guttering or plumbing materials.
- There is significant variability in zinc concentrations in roof water samples. The reason for this is unclear but it is possible that older rooves, in poorer condition, are associated with higher zinc concentrations. Indeed, this would be supported by the observed higher zinc concentrations in concrete tanks, and the possibility that concrete tanks (and their associated roof water collection systems) are older than plastic or zincalume steel tanks.
- The marginally elevated lead concentration in one roof water collection tank (BWWT) could be related to the use of lead flashing or impurities in plumbing or galvanising materials.
- Salinity and major ion concentrations in roof water are low, particularly compared to dam water, and are likely controlled by concrete dissolution, with lesser contributions from natural sources or agricultural additives.
- The mineral calcite may be derived from dust associated with the application of agricultural lime or dust derived from the weathering of local geological units (ie. limestone). While dust derived from CVO tailings dams is another potential source of calcite, this is considered less likely based on the above conclusion.
- Other metals that can be detected in some of the roof water include manganese, copper and cadmium, albeit at very low concentrations that fall within drinking water quality guidelines. The dissolved manganese is consistent with the presence of calcite (see above), whereas the copper and (minor) cadmium are probably derived from galvanised steel roofing or plumbing materials.
- Overall, roof water chemistry appears to be primarily influenced by local materials including galvanised steel roofing or guttering materials (source of zinc and cadmium), rusting of steel roof materials (iron), copper piping (copper), lead flashing (lead) and dust from natural carbonate-bearing sources (eg. manganese). However, as some of these components – zinc, copper, manganese and (minor) cadmium – were also identified in the aqueous fingerprint of CVO tailings dust, further investigation would assist to confirm these assumptions and discount the influence of CVO tailings dust.

Farm dam water assessment

- All dam water samples meet ANZECC/ARMCANZ (2000) guidelines for livestock drinking water.
- Farm dam water is generally near-neutral (pH 5.1-7.7) and sometimes reduced, with low to moderate salinity (up to 533 µS/cm) and suspended sediments (up to 41 mg/L) and low metal and nutrient concentrations.

- The chemistry of dam water samples is more complex than roof water samples. This is likely because dam water is exposed to soils containing a wide variety of minerals as well as potential soil amendments compared to the relatively simple roof water collection system.
- Indeed, the observed higher concentrations of nitrogen- and phosphorus-based nutrients in farm dam water, relative to roof water tanks, provides some evidence that soil amendments have been or are being used on farmland within the dam catchments.
- Salinity and major ion concentrations in dam water samples appear to be largely controlled by the carbonate mineral dolomite (and potentially calcite). Possible sources of dolomite include dust from the application of agricultural dolomite, dust from the weathering of the local rocks/soils, or dust derived from CVO tailings dams.
- The dissolution of gypsum / bassanite / anhydrite is suggested by a correlation between dissolved sulfate and calcium concentrations in farm dam water. These minerals could be sourced from soil amendments or dust derived from CVO tailings.
- Potassium could potentially be associated with farm additives, whereas sodium and chloride may relate to the use of stock licks (sodium chloride) on farms and/or saline groundwater inflows to dams (sodium chloride). However, the fugitive dust from CVO tailings dams cannot be discounted as a potential source of potassium and some sodium chloride (halite).
- While of no concern for livestock drinking water, metals that are present in some of the farm dam water include iron and very low concentrations of manganese, aluminium, molybdenum, copper, zinc, arsenic, cobalt and nickel.
- Overall, when comparing the farm dam water chemistry to the tailings ASLP data (Section 2.1; Earth Systems, 2020a), the only metals in dam water that were consistent with the aqueous fingerprint of CVO tailings dust were zinc, copper, manganese and molybdenum. However, micro-nutrient fertiliser sources cannot be excluded at this stage. Further investigation is required to clarify any influence of CVO tailings dust on the trace element signature of dam water.

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Attachment A

ALS Laboratory Reports

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order : **ES2016298**
Amendment : **1**
Client : **NEWCREST MINING LIMITED**
Contact : MR NICOLAS BOURGEOT
Address : 1460 CADIA ROAD
ORANGE NSW, AUSTRALIA 2800
Telephone : ----
Project : Cadia Water Monitoring
Order number : 4500922559
C-O-C number : ----
Sampler : Thomas Byron
Site : CADIA
Quote number : EN/107/17 B V5
No. of samples received : 20
No. of samples analysed : 20

Page : 1 of 14
Laboratory : Environmental Division Sydney
Contact : Customer Services ES
Address : 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone : +61-2-8784 8555
Date Samples Received : 13-May-2020 09:45
Date Analysis Commenced : 13-May-2020
Issue Date : 22-May-2020 21:42

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EG020: It is recognised that total concentration is less than dissolved for some metal analytes. However, the difference is within experimental variation of the methods.
- TDS by method EA-015 may bias high for various samples due to the presence of fine particulate matter, which may pass through the prescribed GF/C paper.
- Ionic Balance out of acceptable limits for various samples due to analytes not quantified in this report.
- Amendment (20/05/2020): This report has been amended and re-released to allow the reporting of additional analytical data.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

			Client sample ID	**SVWT20200507**	**OCWT20200507**	**EPHWT20200506**	**EPSWT20200506**	**BWWT20200506**
			Client sampling date / time	07-May-2020 00:00	07-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2016298-001**	**ES2016298-002**	**ES2016298-003**	**ES2016298-004**	**ES2016298-005**
				Result	Result	Result	Result	Result
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**168**	**32**	**58**	**6**	**37**
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**89**	**26**	**34**	<10	**30**
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	<5	**5**	<5	**10**	**6**
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	**47**	<1	**18**	<1	**15**
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**74**	**3**	**25**	<1	**15**
Total Alkalinity as CaCO3	----	1	mg/L	**74**	**3**	**25**	<1	**15**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**4**	**3**	<1	<1	**1**
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**1**	<1	**2**	<1	<1
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**19**	<1	**4**	<1	**6**
Magnesium	7439-95-4	1	mg/L	<1	<1	**2**	<1	<1
Sodium	7440-23-5	1	mg/L	**2**	<1	**3**	<1	<1
Potassium	7440-09-7	1	mg/L	**2**	<1	<1	<1	<1
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	**0.04**
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	**0.0002**	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	**0.001**	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	**0.023**	**0.043**	**0.020**	**0.004**	**0.002**
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	**0.001**	<0.001	<0.001
Manganese	7439-96-5	0.001	mg/L	**0.019**	**0.057**	<0.001	**0.023**	**0.002**
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	**0.001**	**0.002**	<0.001	<0.001	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**SVWT20200507**	**OCWT20200507**	**EPHWT20200506**	**EPSWT20200506**	**BWWT20200506**
			Client sampling date / time	07-May-2020 00:00	07-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2016298-001**	**ES2016298-002**	**ES2016298-003**	**ES2016298-004**	**ES2016298-005**
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	**12.5**	**5.25**	**0.031**	**0.130**	**0.128**
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.01**	**0.08**	**0.02**	**0.03**	**0.06**
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	**0.0001**	**0.0002**	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	**0.006**	**0.003**	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	**0.027**	**0.050**	**0.024**	**0.008**	**0.030**
Lead	7439-92-1	0.001	mg/L	<0.001	**0.002**	<0.001	<0.001	**0.006**
Manganese	7439-96-5	0.001	mg/L	**0.021**	**0.061**	**0.003**	**0.028**	**0.005**
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	**0.002**	**0.002**	<0.001	<0.001	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	**12.8**	**5.36**	**0.039**	**0.148**	**0.244**
Iron	7439-89-6	0.05	mg/L	<0.05	**0.12**	<0.05	**0.15**	**0.42**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**2.22**	**2.10**	**0.62**	**0.30**	**0.48**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**2.22**	**2.10**	**0.62**	**0.30**	**0.48**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.4**	**0.3**	<0.1	<0.1	<0.1
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ **Total Nitrogen as N**	----	0.1	mg/L	**2.6**	**2.4**	**0.6**	**0.3**	**0.5**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.03**	**0.05**	**0.03**	**0.01**	**0.02**
EN055: Ionic Balance								

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			Client sample ID	**SVWT20200507**	**OCWT20200507**	**EPHWT20200506**	**EPSWT20200506**	**BWWT20200506**
			Client sampling date / time	07-May-2020 00:00	07-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00
Compound	CAS Number	LOR	Unit	**ES2016298-001**	**ES2016298-002**	**ES2016298-003**	**ES2016298-004**	**ES2016298-005**
				Result	Result	Result	Result	Result
EN055: Ionic Balance - Continued								
ø **Total Anions**	----	0.01	meq/L	**1.59**	**0.12**	**0.56**	<0.01	**0.32**
ø **Total Cations**	----	0.01	meq/L	**1.82**	**0.15**	----	----	----
ø **Total Cations**	----	0.01	meq/L	----	----	**0.49**	<0.01	**0.30**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**W1HT20200506**	**W1ST20200506**	**W2HT20200506**	**W3HT20200506**	**W3ST20200506**
			Client sampling date / time	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2016298-006**	**ES2016298-007**	**ES2016298-008**	**ES2016298-009**	**ES2016298-010**
				Result	Result	Result	Result	Result
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**15**	**72**	**11**	**10**	**14**
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	<10	**51**	<10	<10	**10**
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	**7**	**7**	<5	<5	**6**
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	**2**	**20**	<1	<1	**5**
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**5**	**33**	<1	<1	**3**
Total Alkalinity as CaCO3	----	1	mg/L	**5**	**33**	<1	<1	**3**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	<1	<1	<1	<1
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	<1	**2**	<1	<1	<1
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**1**	**8**	<1	<1	**2**
Magnesium	7439-95-4	1	mg/L	<1	<1	<1	<1	<1
Sodium	7440-23-5	1	mg/L	<1	**2**	<1	<1	<1
Potassium	7440-09-7	1	mg/L	<1	**2**	<1	<1	<1
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	**0.0001**	**0.0010**	<0.0001	**0.0001**	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	**0.187**	**0.002**	**0.045**	**0.008**	**0.008**
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	7439-96-5	0.001	mg/L	**0.005**	**0.021**	**0.047**	**0.031**	**0.014**
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	**0.004**	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

			Client sample ID	**W1HT20200506**	**W1ST20200506**	**W2HT20200506**	**W3HT20200506**	**W3ST20200506**
			Client sampling date / time	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00
Compound	CAS Number	LOR	Unit	**ES2016298-006**	**ES2016298-007**	**ES2016298-008**	**ES2016298-009**	**ES2016298-010**
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	**0.807**	**1.48**	**0.049**	**0.092**	**0.242**
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.03**	**0.02**	**0.02**	**0.04**	**0.01**
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	**0.0002**	**0.0012**	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	**0.002**	**0.002**	**0.001**
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	**0.228**	**0.008**	**0.057**	**0.009**	**0.007**
Lead	7439-92-1	0.001	mg/L	<0.001	**0.001**	<0.001	<0.001	<0.001
Manganese	7439-96-5	0.001	mg/L	**0.006**	**0.021**	**0.049**	**0.036**	**0.014**
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	**0.001**	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	**0.873**	**1.69**	**0.053**	**0.084**	**0.256**
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	**0.09**	<0.05	<0.05
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.23**	**0.70**	**0.75**	**0.57**	**0.63**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.23**	**0.70**	**0.75**	**0.57**	**0.63**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	<0.1	<0.1	**0.5**	<0.1
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ **Total Nitrogen as N**	----	0.1	mg/L	**0.2**	**0.7**	**0.8**	**1.1**	**0.6**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.02**	**0.01**	**0.02**	**0.03**	**0.02**
EN055: Ionic Balance								

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			Client sample ID	**W1HT20200506**	**W1ST20200506**	**W2HT20200506**	**W3HT20200506**	**W3ST20200506**
			Client sampling date / time	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00
Compound	CAS Number	LOR	Unit	**ES2016298-006**	**ES2016298-007**	**ES2016298-008**	**ES2016298-009**	**ES2016298-010**
				Result	Result	Result	Result	Result
EN055: Ionic Balance - Continued								
ø **Total Anions**	----	0.01	meq/L	**0.10**	**0.72**	<0.01	<0.01	**0.06**
ø **Total Cations**	----	0.01	meq/L	**0.05**	**0.54**	<0.01	<0.01	**0.10**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)	*Client sample ID*			**CHHT20200506**	**CHST20200506**	**CHHT20200506**	**EPSW20200506**	**WGSW20200507**
	Client sampling date / time			06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	07-May-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2016298-011**	**ES2016298-012**	**ES2016298-013**	**ES2016298-014**	**ES2016298-015**
				Result	Result	Result	Result	Result
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**19**	**33**	**80**	**58**	**332**
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	<10	**20**	**47**	**55**	**270**
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	<5	**18**	**6**	**22**	**41**
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	<1	**10**	**27**	**2**	**53**
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**4**	**13**	**34**	**2**	**112**
Total Alkalinity as CaCO3	----	1	mg/L	**4**	**13**	**34**	**2**	**112**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	<1	**1**	**6**	**26**
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	<1	<1	<1	**4**	**14**
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	<1	**4**	**11**	**1**	**15**
Magnesium	7439-95-4	1	mg/L	<1	<1	<1	<1	**6**
Sodium	7440-23-5	1	mg/L	<1	<1	**1**	**3**	**9**
Potassium	7440-09-7	1	mg/L	**1**	<1	**2**	**4**	**43**
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.01**	<0.01	<0.01	**0.15**	**0.49**
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	**0.005**
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	**0.001**	**0.008**
Copper	7440-50-8	0.001	mg/L	**0.009**	**0.001**	**0.001**	**0.002**	**0.008**
Lead	7439-92-1	0.001	mg/L	**0.002**	<0.001	<0.001	<0.001	**0.002**
Manganese	7439-96-5	0.001	mg/L	**0.021**	**0.006**	**0.003**	**0.132**	**1.06**
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	**0.002**
Nickel	7440-02-0	0.001	mg/L	**0.002**	<0.001	<0.001	<0.001	**0.005**
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			Client sample ID	**CHHT20200506**	**CHST20200506**	**CHHT20200506**	**EPSW20200506**	**WGSW20200507**
			Client sampling date / time	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	07-May-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2016298-011**	**ES2016298-012**	**ES2016298-013**	**ES2016298-014**	**ES2016298-015**
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	**1.07**	**1.17**	**0.548**	<0.005	**0.012**
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	**0.11**	**7.37**
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.02**	**0.12**	<0.01	**0.79**	**1.20**
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	**0.007**
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	**0.002**
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	**0.002**	**0.010**
Copper	7440-50-8	0.001	mg/L	**0.010**	**0.008**	**0.007**	**0.012**	**0.014**
Lead	7439-92-1	0.001	mg/L	**0.002**	**0.013**	<0.001	<0.001	**0.003**
Manganese	7439-96-5	0.001	mg/L	**0.022**	**0.025**	**0.004**	**0.150**	**1.30**
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	**0.003**
Nickel	7440-02-0	0.001	mg/L	**0.001**	<0.001	<0.001	<0.001	**0.007**
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	**1.14**	**1.70**	**0.571**	**0.008**	**0.031**
Iron	7439-89-6	0.05	mg/L	<0.05	**0.15**	<0.05	**0.73**	**9.10**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	**0.08**
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.55**	**0.57**	**1.27**	**2.47**	**0.08**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.55**	**0.57**	**1.27**	**2.47**	**0.16**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	<0.1	**0.2**	**1.6**	**8.2**
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ **Total Nitrogen as N**	----	0.1	mg/L	**0.6**	**0.6**	**1.5**	**4.1**	**8.4**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.07**	**0.07**	**0.09**	**0.06**	**1.22**
EN055: Ionic Balance								

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			Client sample ID	**CHHT20200506**	**CHST20200506**	**CHHT20200506**	**EPSW20200506**	**WGSW20200507**
			Client sampling date / time	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	07-May-2020 00:00
Compound	CAS Number	LOR	Unit	**ES2016298-011**	**ES2016298-012**	**ES2016298-013**	**ES2016298-014**	**ES2016298-015**
				Result	Result	Result	Result	Result
EN055: Ionic Balance - Continued								
ø **Total Anions**	----	0.01	meq/L	**0.08**	**0.26**	**0.70**	**0.28**	**3.17**
ø **Total Cations**	----	0.01	meq/L	----	----	----	----	**3.13**
ø **Total Cations**	----	0.01	meq/L	**0.02**	**0.20**	**0.64**	**0.28**	----
ø **Ionic Balance**	----	0.01	%	----	----	----	----	**0.70**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**WASW20200507**	**OCSW20200507**	**TASW20200507**	**BDSW20200507**	**EPB20200506**
			Client sampling date / time	07-May-2020 00:00	07-May-2020 00:00	07-May-2020 00:00	07-May-2020 00:00	06-May-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2016298-016**	**ES2016298-017**	**ES2016298-018**	**ES2016298-019**	**ES2016298-020**
				Result	Result	Result	Result	Result
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**109**	**533**	**160**	**156**	**329**
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**80**	**384**	**133**	**160**	**190**
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	**33**	**18**	**27**	**12**	**6**
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	**21**	**175**	**60**	**46**	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**40**	**57**	**63**	**73**	**178**
Total Alkalinity as CaCO3	----	1	mg/L	**40**	**57**	**63**	**73**	**178**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	**176**	**24**	<1	**5**
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**7**	**15**	**6**	**5**	**8**
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**5**	**42**	**14**	**10**	**31**
Magnesium	7439-95-4	1	mg/L	**2**	**17**	**6**	**5**	**18**
Sodium	7440-23-5	1	mg/L	**3**	**24**	**5**	**3**	**14**
Potassium	7440-09-7	1	mg/L	**13**	**12**	**17**	**8**	**6**
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.07**	**0.03**	**0.26**	**0.23**	<0.01
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	**0.002**	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	**0.002**	<0.001	**0.004**	**0.002**	<0.001
Copper	7440-50-8	0.001	mg/L	**0.004**	**0.010**	**0.007**	**0.006**	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	7439-96-5	0.001	mg/L	**0.104**	**0.024**	**0.478**	**0.321**	**0.084**
Molybdenum	7439-98-7	0.001	mg/L	<0.001	**0.002**	**0.001**	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	<0.001	**0.001**	**0.002**	**0.002**	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER)**

			Client sample ID	**WASW20200507**	**OCSW20200507**	**TASW20200507**	**BDSW20200507**	**EPB20200506**
			Client sampling date / time	07-May-2020 00:00	07-May-2020 00:00	07-May-2020 00:00	07-May-2020 00:00	06-May-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2016298-016**	**ES2016298-017**	**ES2016298-018**	**ES2016298-019**	**ES2016298-020**
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	**0.011**	**0.078**	**0.008**	**0.011**	**0.007**
Iron	7439-89-6	0.05	mg/L	**0.20**	**0.05**	**0.78**	**0.59**	**0.64**
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.20**	**0.56**	**0.35**	**2.44**	----
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	**0.002**	**0.002**	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
Chromium	7440-47-3	0.001	mg/L	<0.001	**0.001**	<0.001	**0.002**	----
Cobalt	7440-48-4	0.001	mg/L	**0.003**	<0.001	**0.005**	**0.004**	----
Copper	7440-50-8	0.001	mg/L	**0.002**	**0.008**	**0.018**	**0.014**	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Manganese	7439-96-5	0.001	mg/L	**0.265**	**0.062**	**0.836**	**0.426**	----
Molybdenum	7439-98-7	0.001	mg/L	<0.001	**0.003**	**0.003**	<0.001	----
Nickel	7440-02-0	0.001	mg/L	<0.001	**0.002**	**0.003**	**0.002**	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Zinc	7440-66-6	0.005	mg/L	<0.005	**0.082**	**0.021**	**0.023**	----
Iron	7439-89-6	0.05	mg/L	**1.11**	**0.80**	**2.42**	**5.16**	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	----	----	----	----	<0.0001
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	**0.07**	**0.04**	**0.04**	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.41**	**2.85**	**0.21**	**0.28**	<0.01
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.41**	**2.92**	**0.25**	**0.32**	<0.01
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**3.1**	**1.6**	**2.5**	**2.5**	<0.1
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ **Total Nitrogen as N**	----	0.1	mg/L	**3.5**	**4.5**	**2.8**	**2.8**	<0.1
EK067G: Total Phosphorus as P by Discrete Analyser								

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			Client sample ID	**WASW20200507**	**OCSW20200507**	**TASW20200507**	**BDSW20200507**	**EPB20200506**
			Client sampling date / time	07-May-2020 00:00	07-May-2020 00:00	07-May-2020 00:00	07-May-2020 00:00	06-May-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2016298-016**	**ES2016298-017**	**ES2016298-018**	**ES2016298-019**	**ES2016298-020**
				Result	Result	Result	Result	Result
EK067G: Total Phosphorus as P by Discrete Analyser - Continued								
Total Phosphorus as P	----	0.01	mg/L	**0.22**	**0.15**	**0.35**	**0.19**	**0.08**
EN055: Ionic Balance								
ø **Total Anions**	----	0.01	meq/L	**1.00**	**5.23**	**1.93**	**1.60**	**3.89**
ø **Total Cations**	----	0.01	meq/L	**0.88**	**4.84**	**1.84**	**1.24**	**3.79**
ø **Ionic Balance**	----	0.01	%	----	**3.78**	----	----	**1.24**

Attachment B

Water chemistry plots

DISSOLVED MAJOR ANIONS

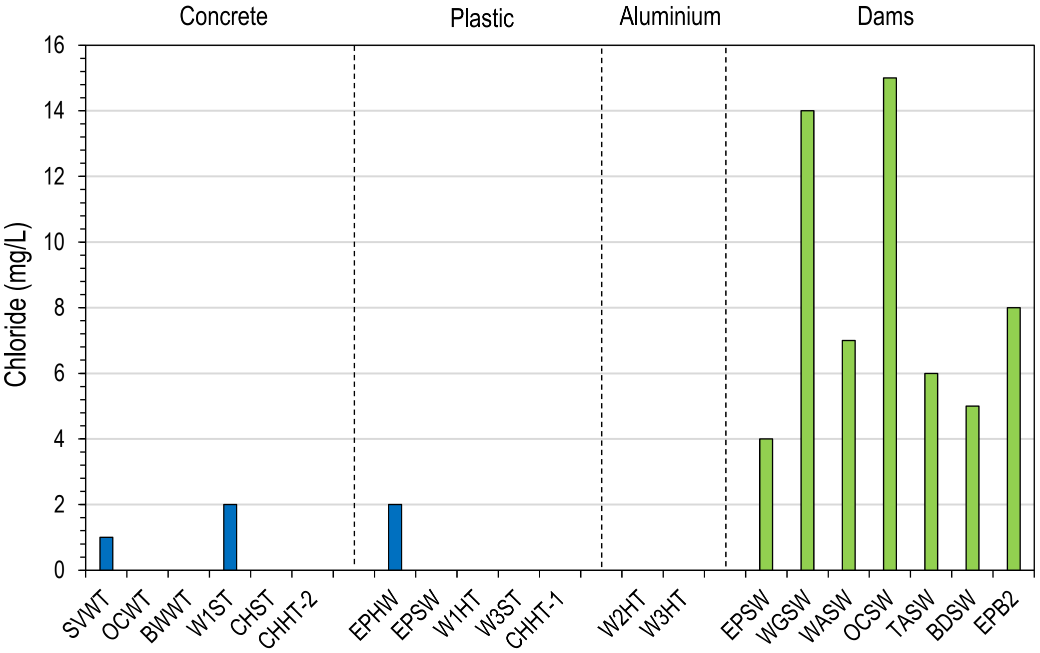

Figure B-7 Chloride concentrations (mg/L) in farm tank and dam water samples.

DISSOLVED MAJOR CATIONS

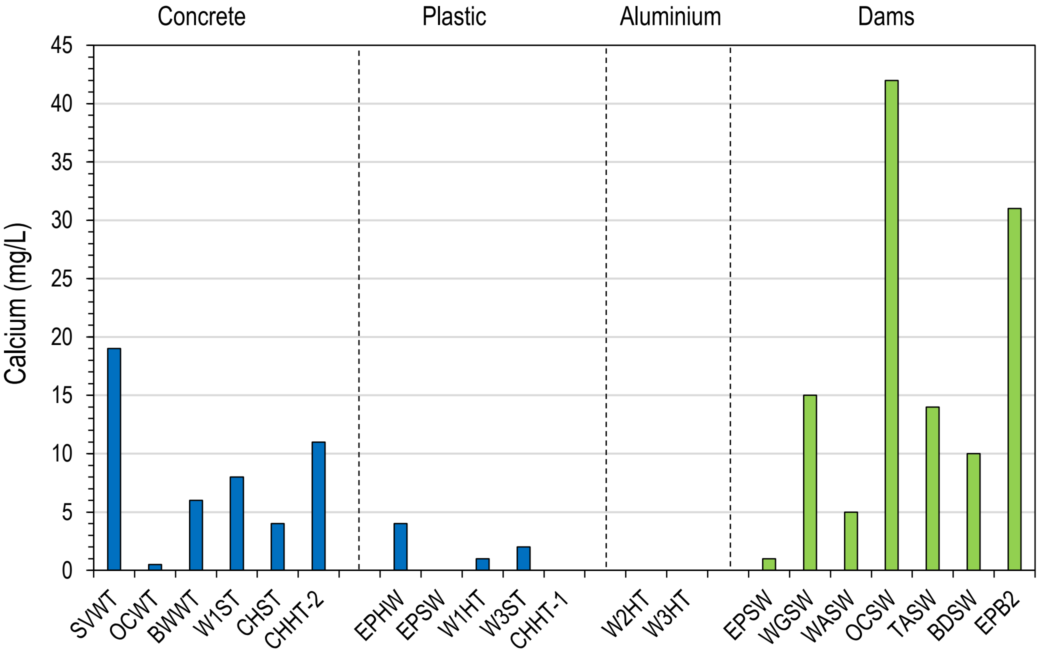

Figure B-8 Calcium concentrations (mg/L) in farm tank and dam water samples.

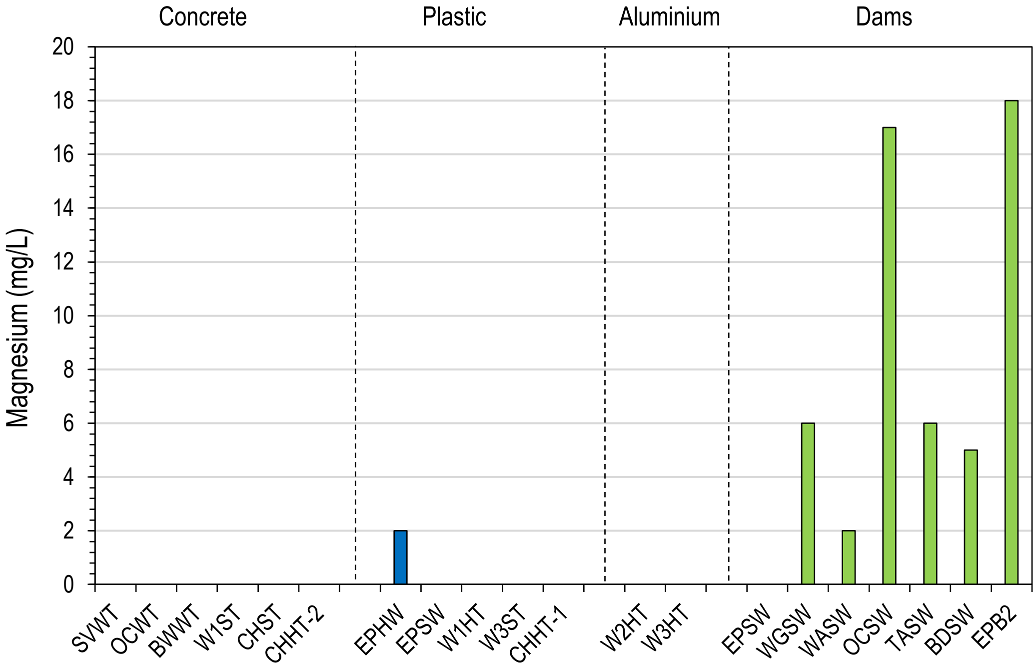

Figure B-9 Magnesium concentrations (mg/L) in farm tank and dam water samples.

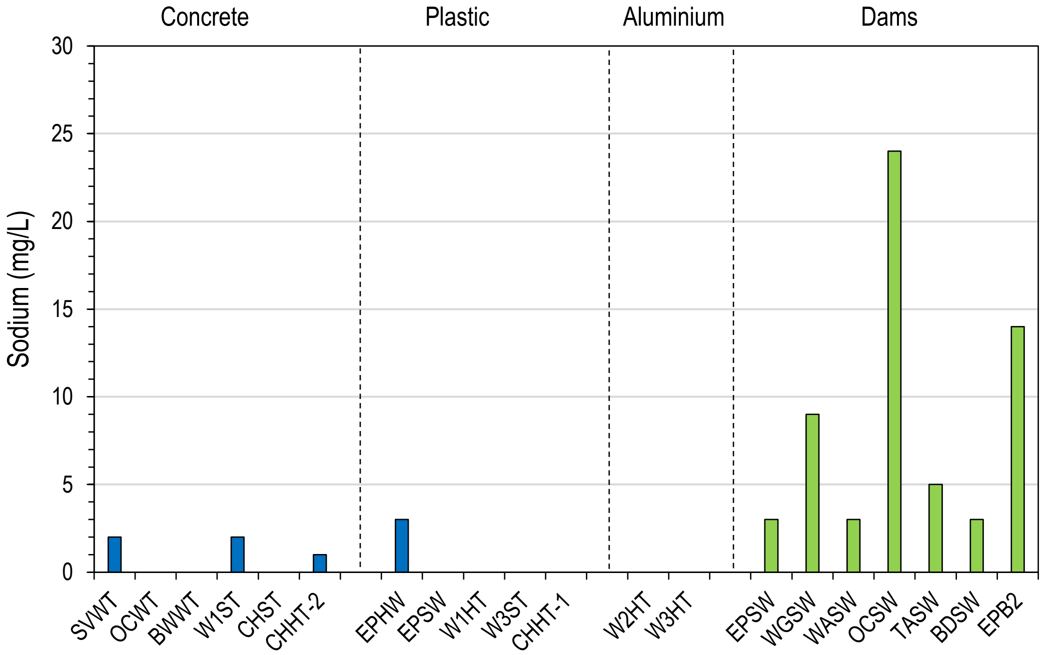

Figure B-10 Sodium concentrations (mg/L) in farm tank and dam water samples.

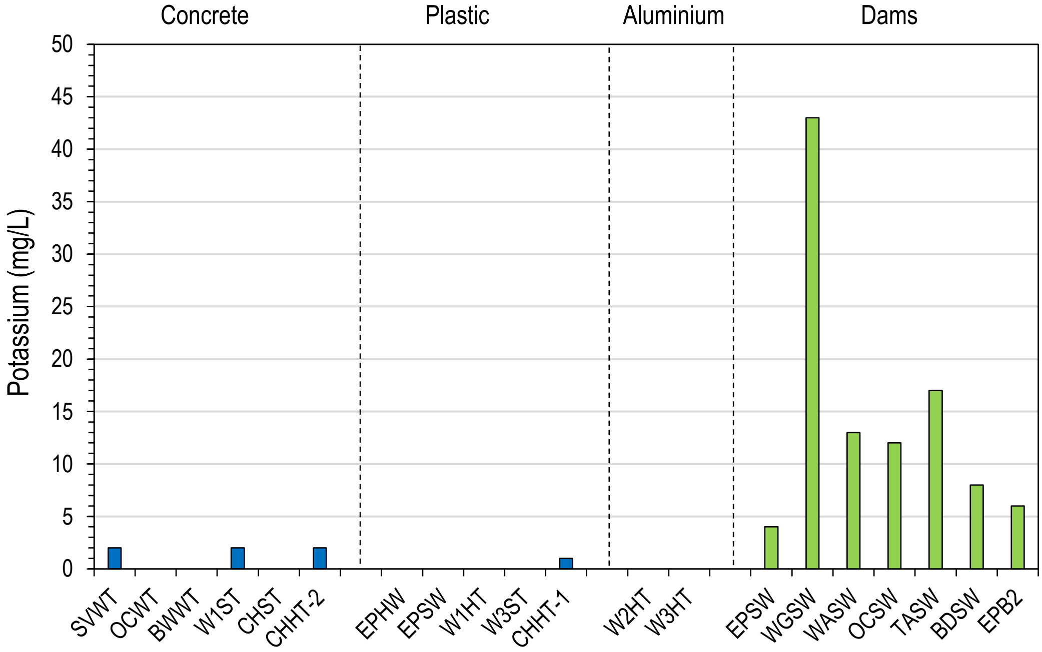

Figure B-11 Potassium concentrations (mg/L) in farm tank and dam water samples.

NUTRIENTS

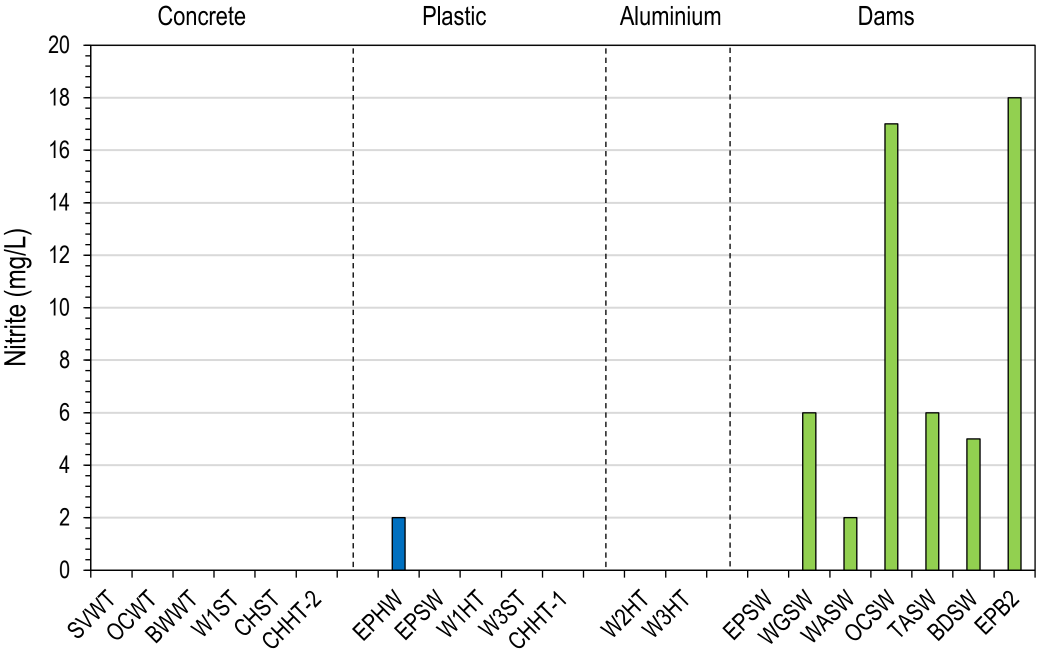

Figure B-12 Nitrite concentrations (mg/L) in farm tank and dam water samples.

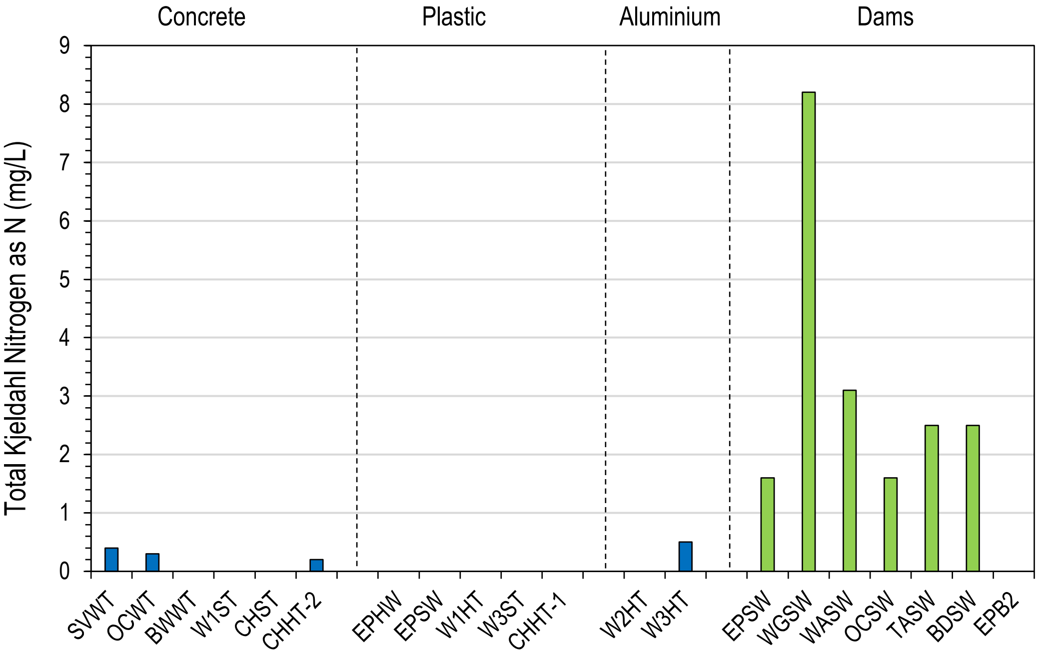

Figure B-13 Total Kjeldahl Nitrogen concentrations (mg/L) in farm tank and dam water samples.

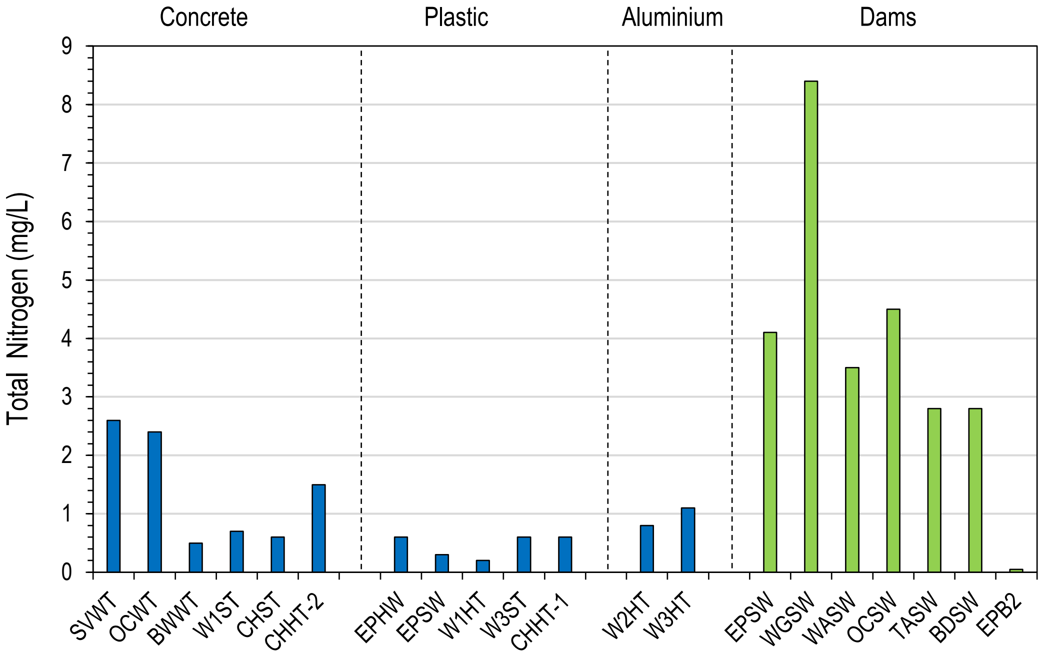

Figure B-14 Total nitrogen concentrations (mg/L) in farm tank and dam water samples.

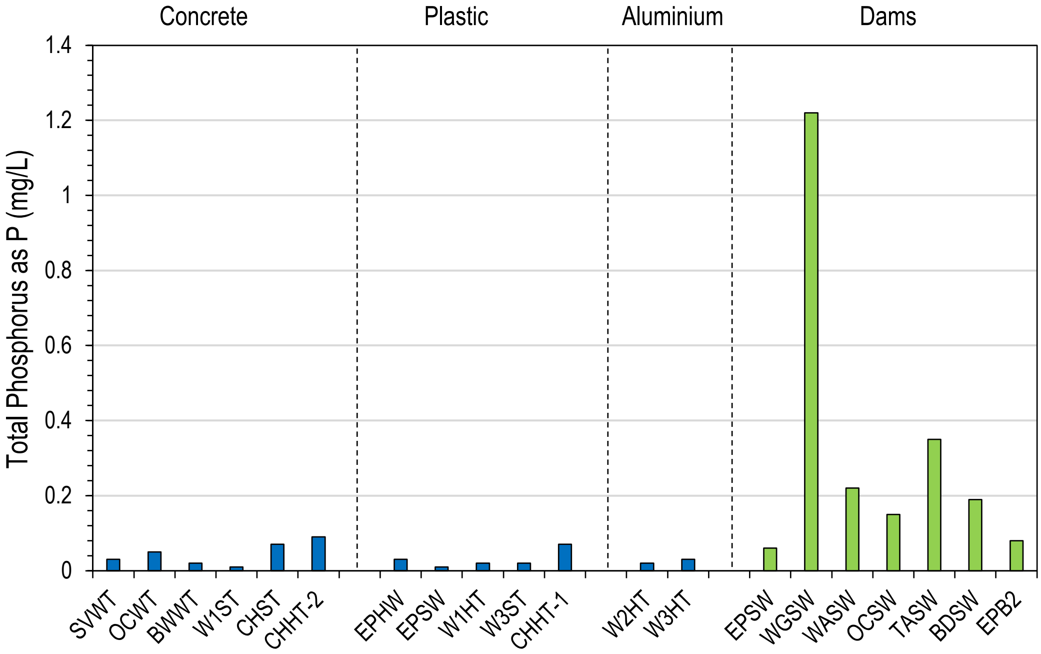

Figure B-15 Total phosphorus concentrations (mg/L) in farm tank and dam water samples.

DISSOLVED METAL(LOID)S

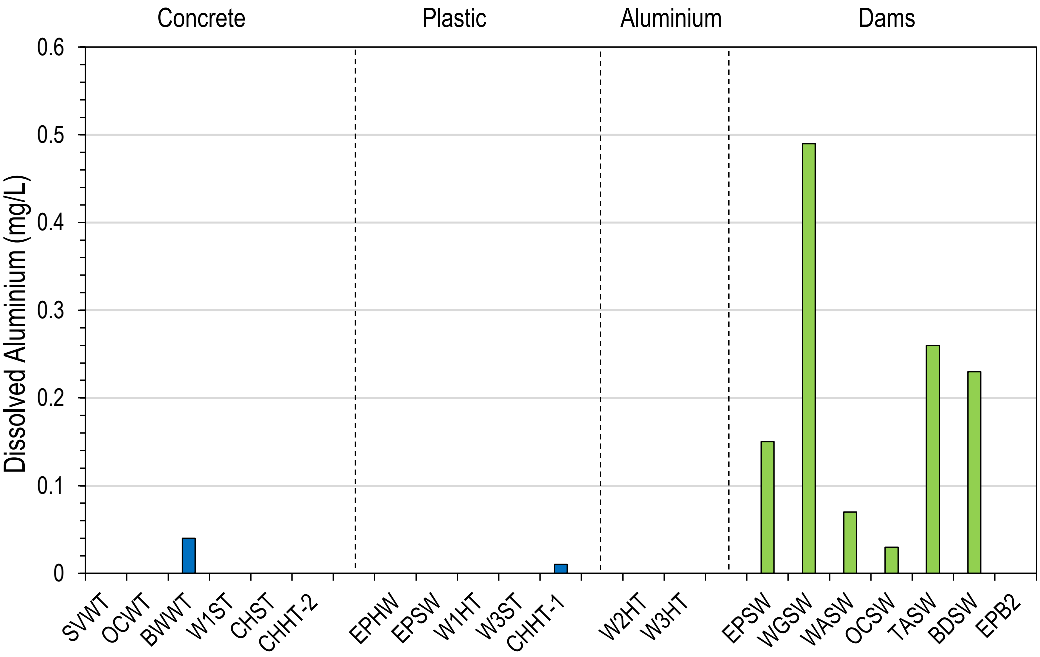

Figure B-16 Dissolved aluminium concentrations (mg/L) in farm tank and dam water samples.

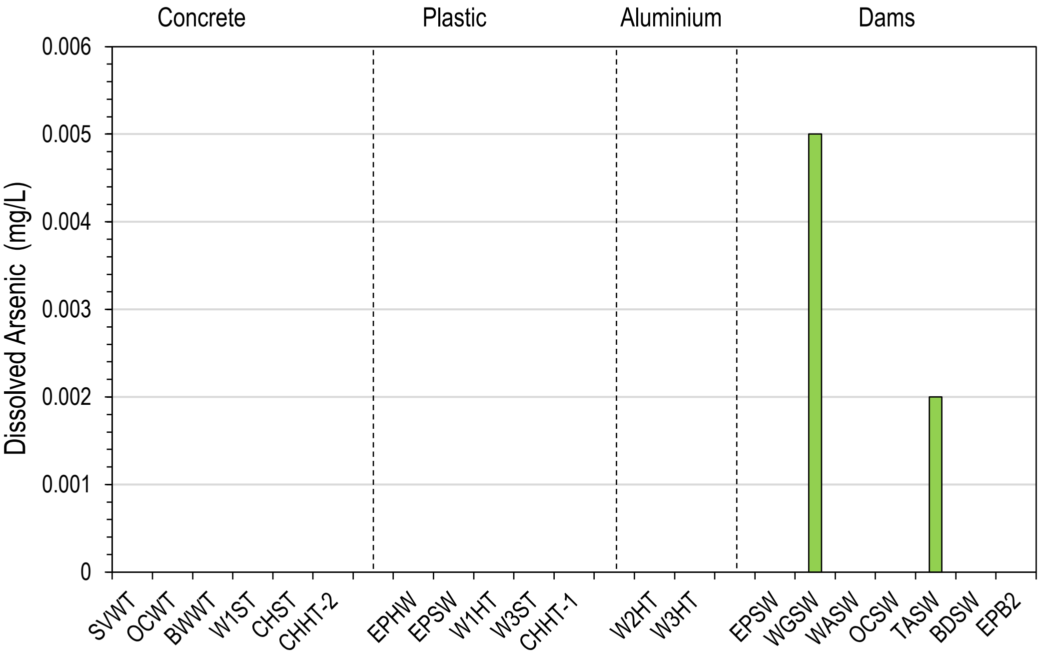

Figure B-17 Dissolved arsenic concentrations (mg/L) in farm tank and dam water samples.

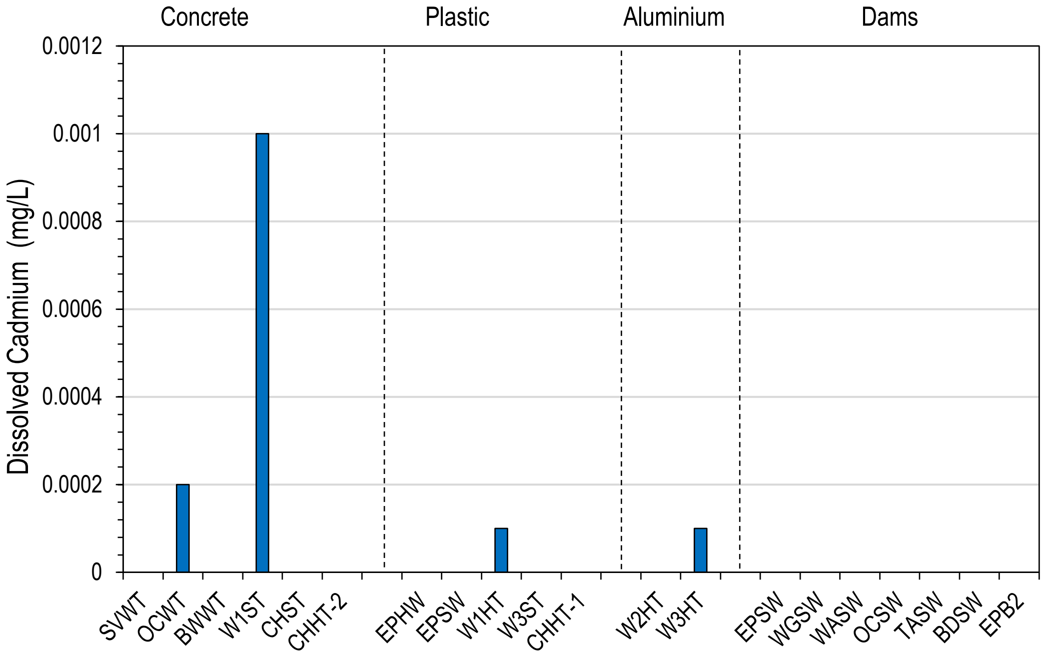

Figure B-18 Dissolved cadmium concentrations (mg/L) in farm tank and dam water samples.

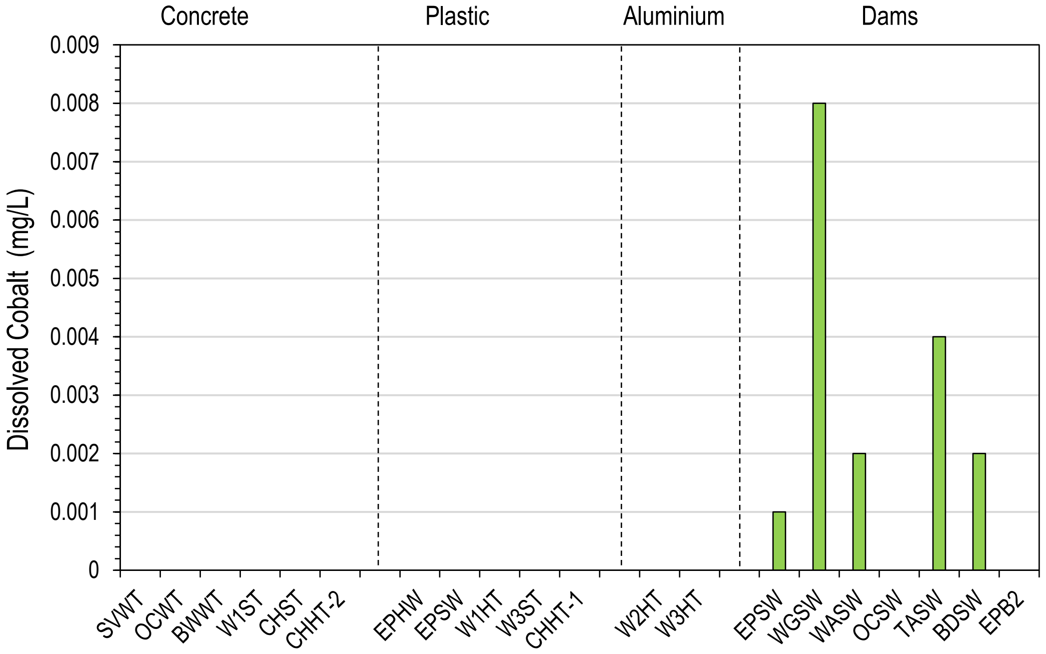

Figure B-19 Dissolved cobalt concentrations (mg/L) in farm tank and dam water samples.

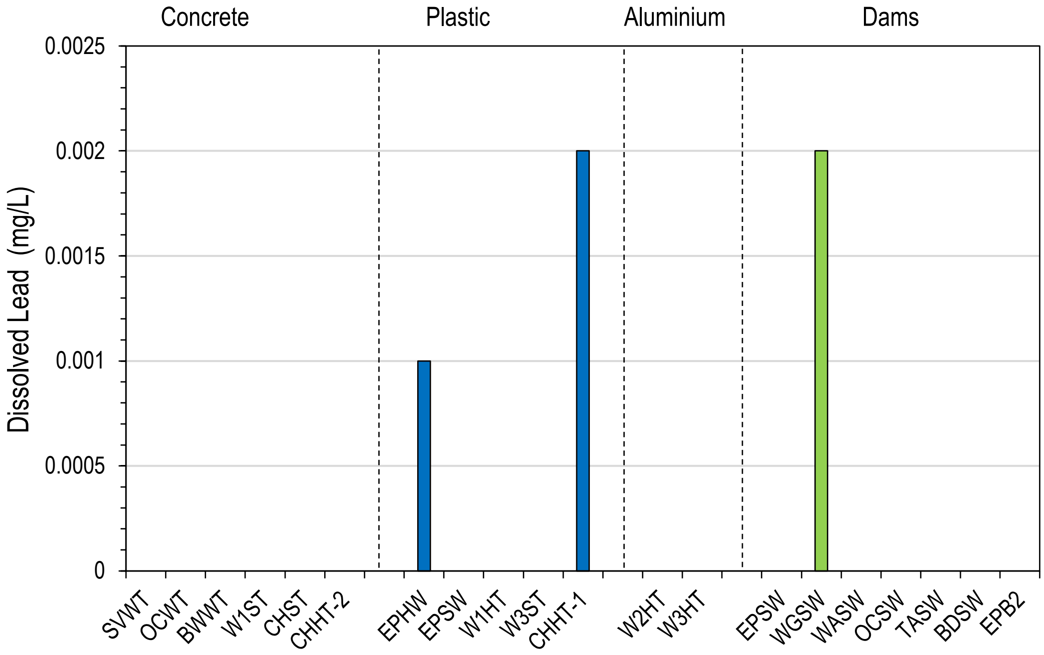

Figure B-20 Dissolved lead concentrations (mg/L) in farm tank and dam water samples.

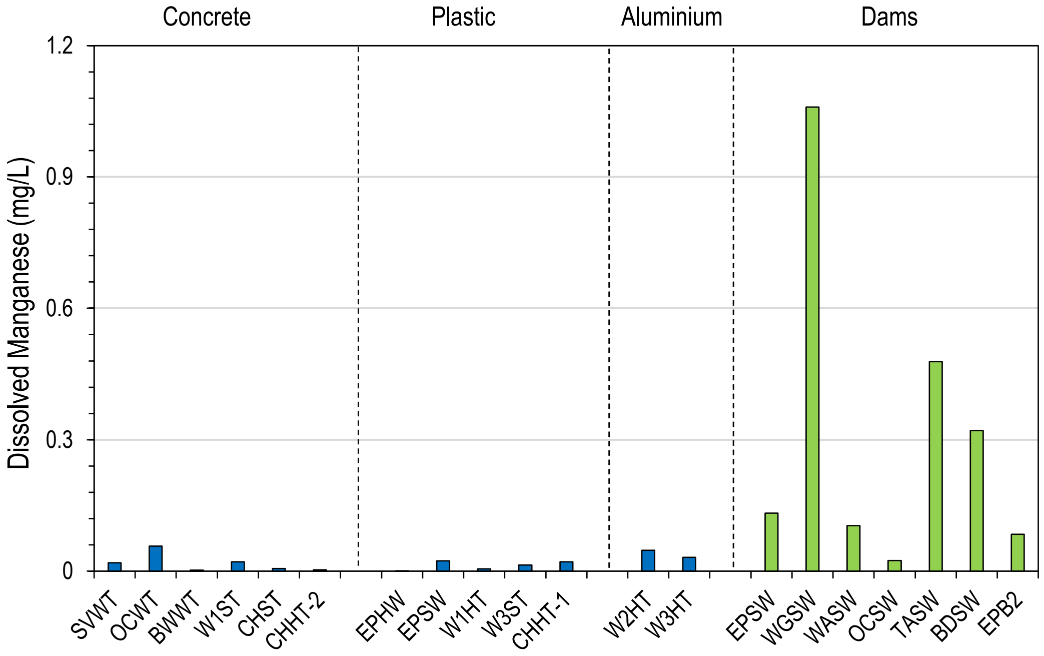

Figure B-21 Dissolved manganese concentrations (mg/L) in farm tank and dam water samples.

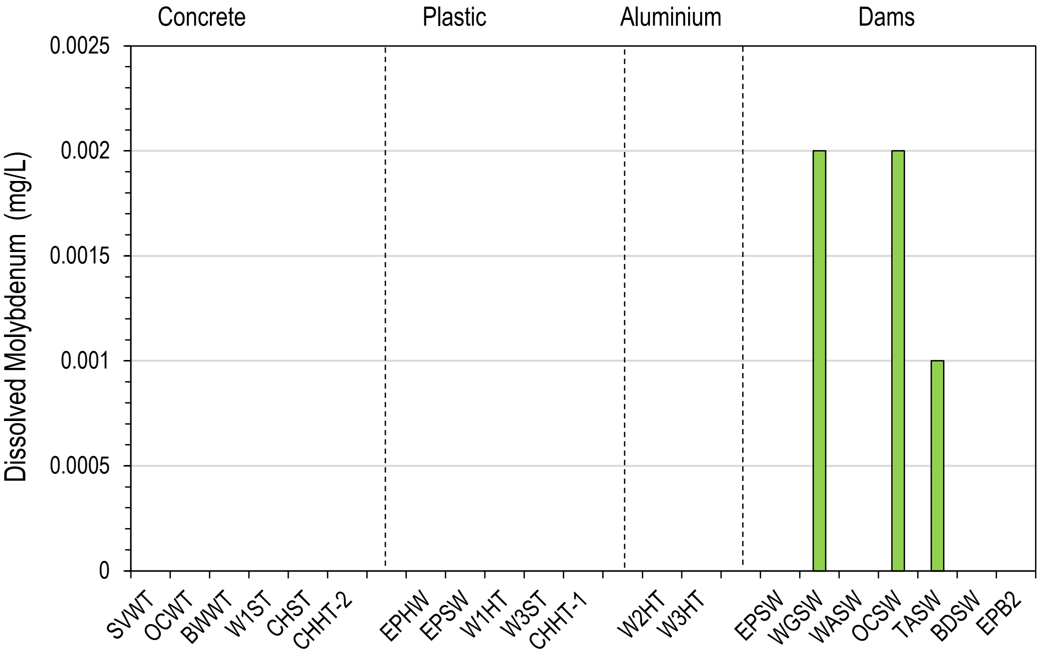

Figure B-22 Dissolved molybdenum concentrations (mg/L) in farm tank and dam water samples.

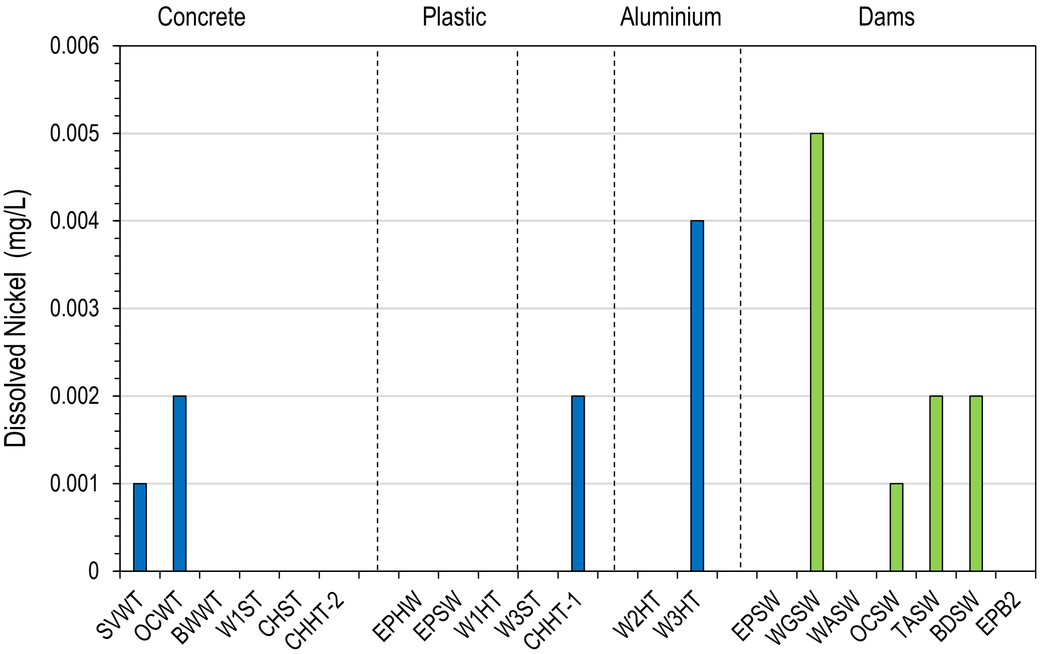

Figure B-23 Dissolved nickel concentrations (mg/L) in farm tank and dam water samples.

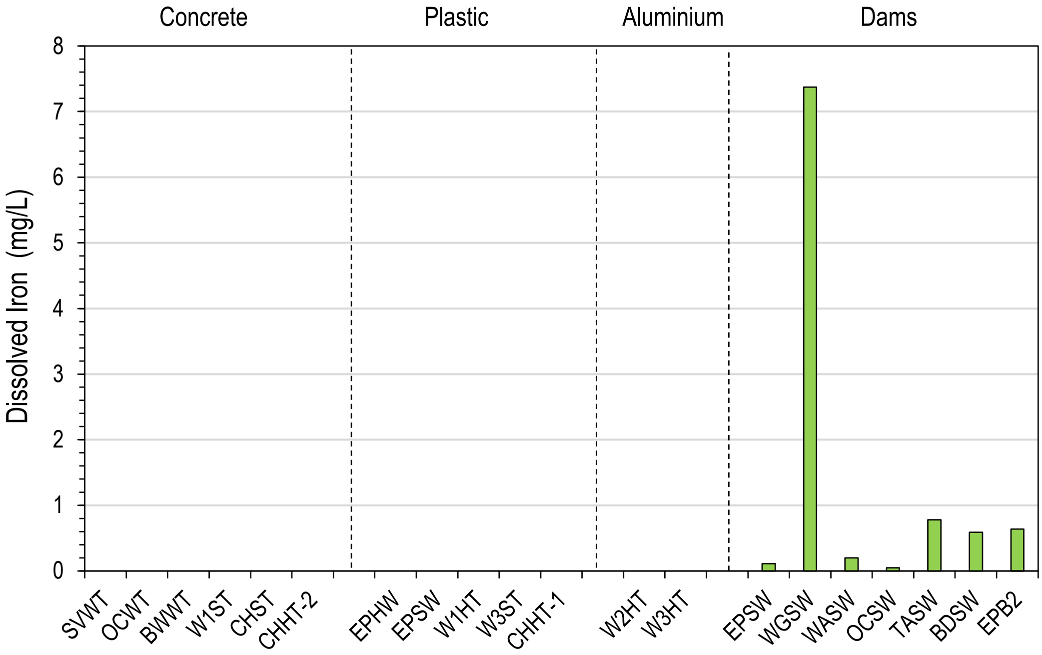

Figure B-24 Dissolved iron concentrations (mg/L) in farm tank and dam water samples.

Attachment C

Correlations between different elements / compounds in tank and dam water

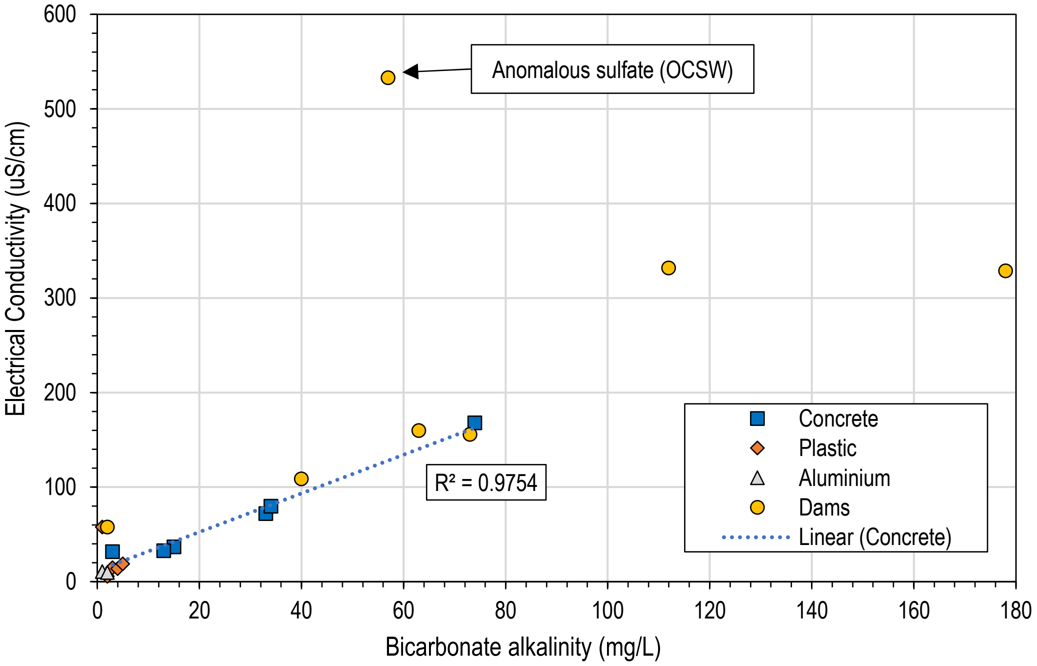

Figure C-25 Bicarbonate alkalinity (mg/L) vs electrical conductivity (µS/cm) of water samples from farm tanks (concrete, plastic, and aluminium) and dams.

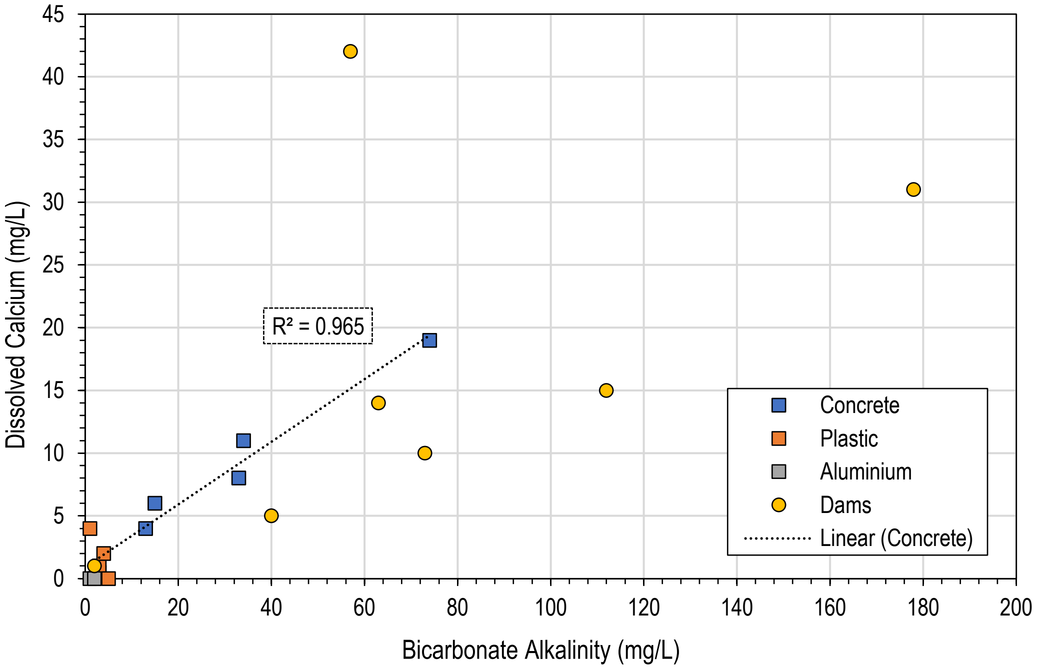

Figure C-26 Bicarbonate alkalinity (mg/L) vs dissolved calcium concentrations (mg/L) of water samples from farm tanks (concrete, plastic, and aluminium) and dams.

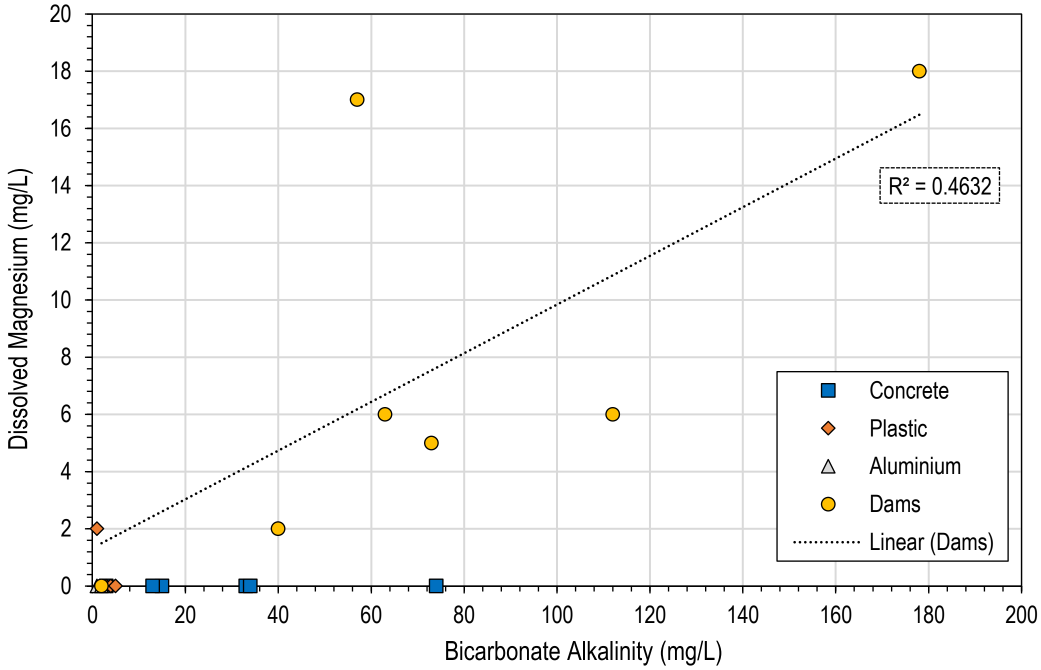

Figure C-27 Bicarbonate alkalinity (mg/L) vs dissolved magnesium concentrations (mg/L) of water samples from farm tanks (concrete, plastic, and aluminium) and dams.

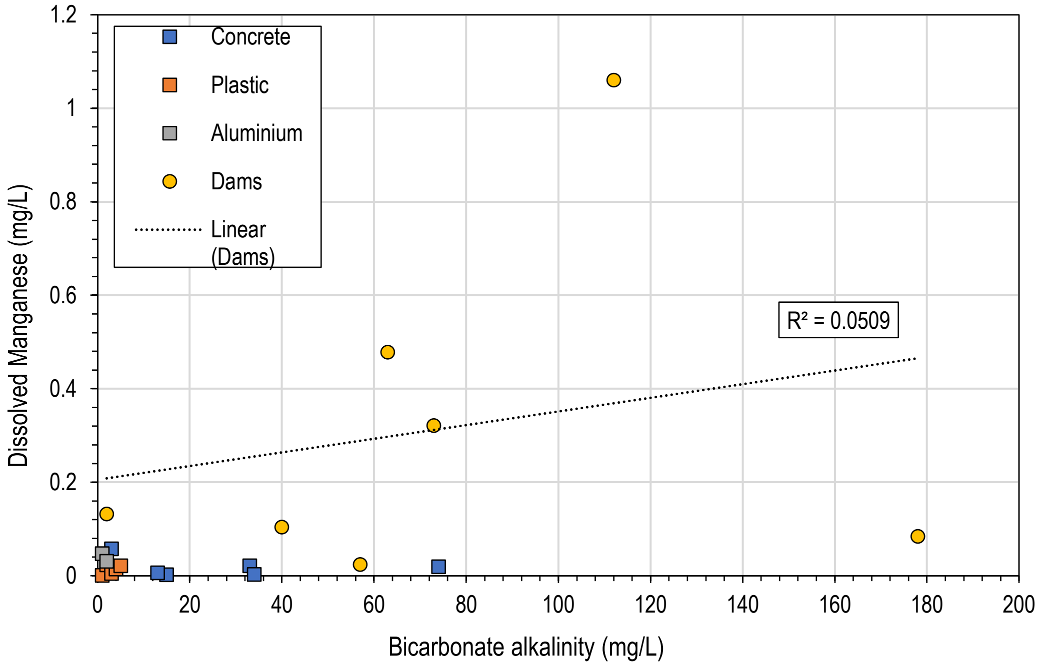

Figure C-28 Bicarbonate alkalinity (mg/L) vs dissolved manganese concentrations (mg/L) of water samples from farm tanks (concrete, plastic, and aluminium) and dams.

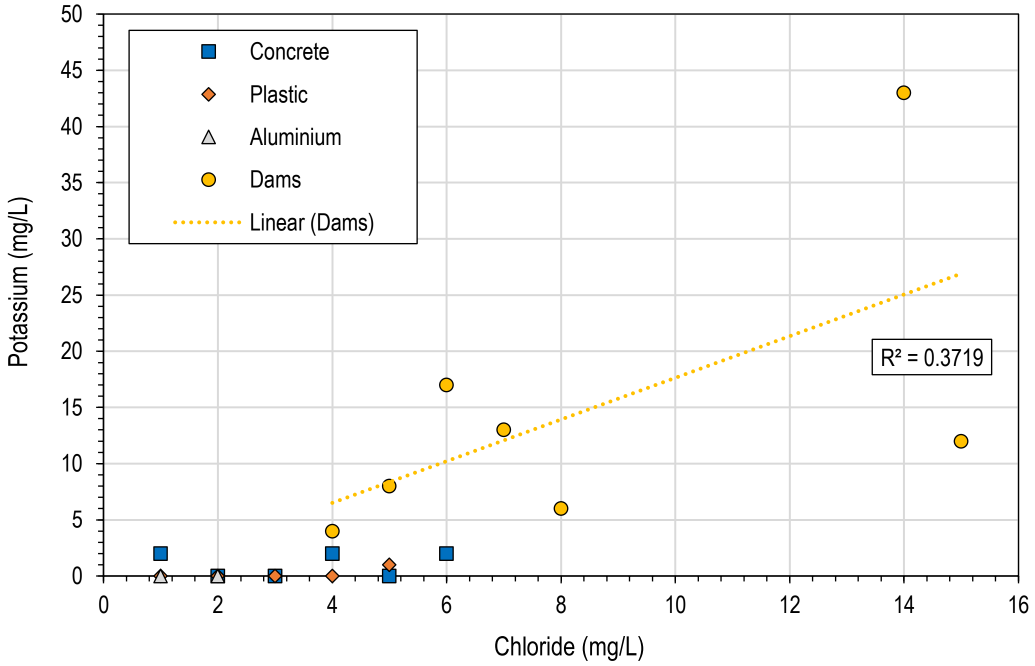

Figure C-29 Potassium (mg/L) vs chloride concentrations (mg/L) of water samples from farm tanks (concrete, plastic, and aluminium) and dams.

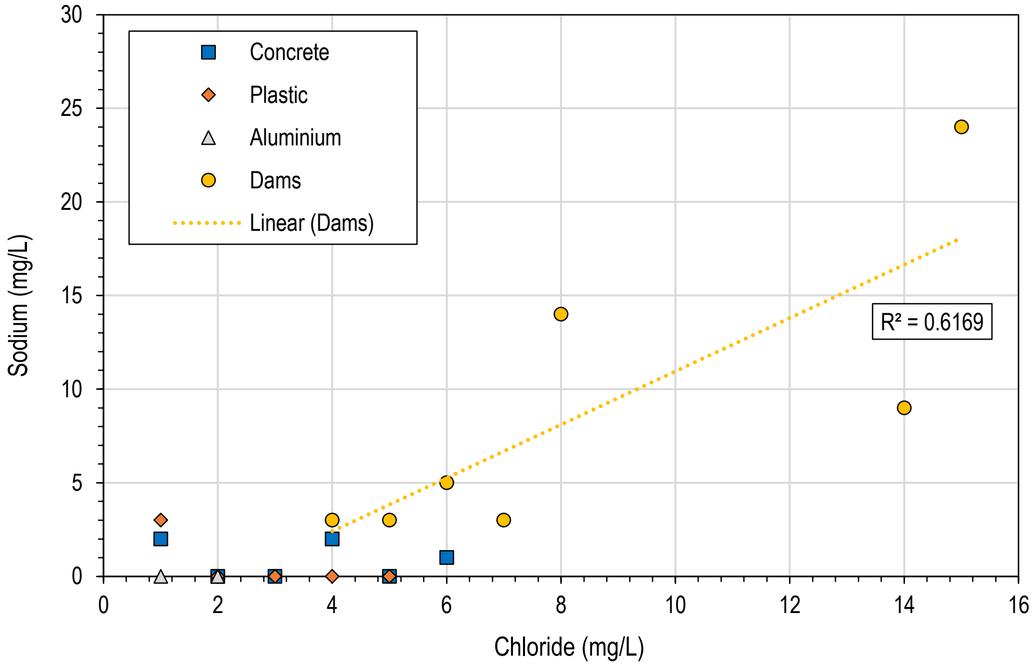

Figure C-30 Sodium (mg/L) vs chloride concentrations (mg/L) of water samples from farm tanks (concrete, plastic, and aluminium) and dams.

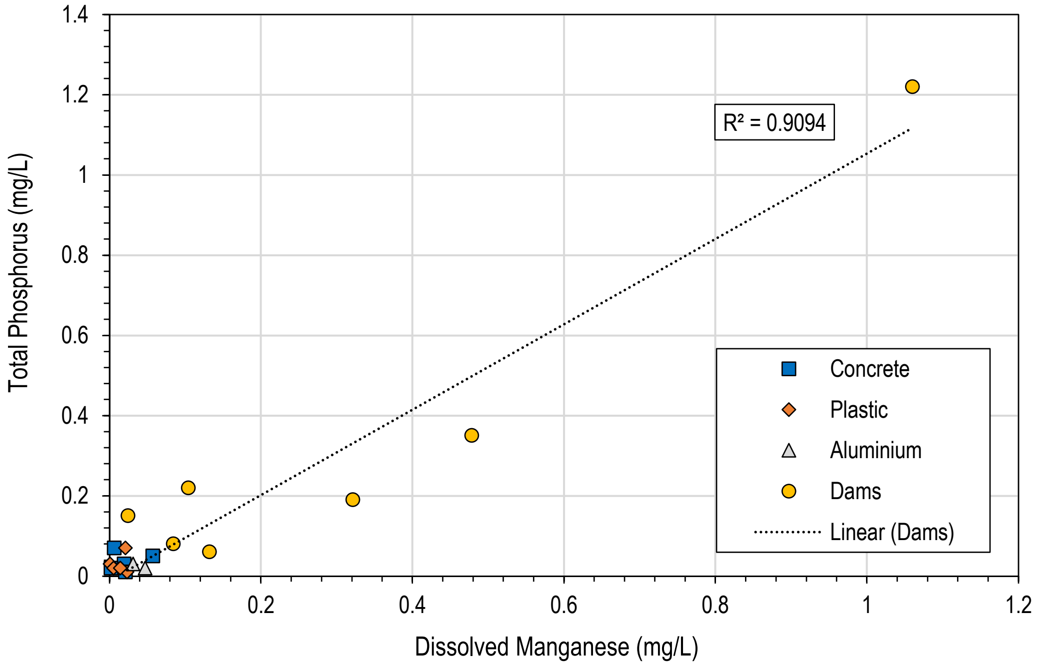

Figure C-31 Total phosphorous concentrations (mg/L) vs dissolved manganese concentrations (mg/L) of water samples from farm tanks (concrete, plastic, and aluminium) and dams.

Attachment D

Distribution of total metal concentrations and comparison with relevant water quality guidelines

TANK WATER SAMPLES

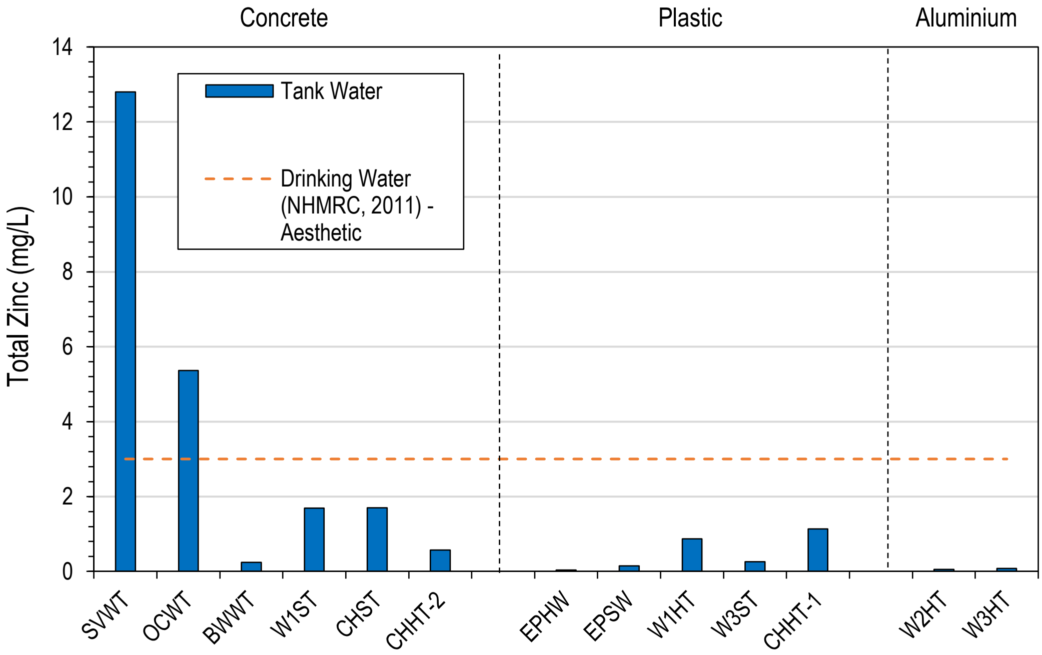

Figure D-32 Total zinc concentrations (mg/L) in tank water samples compared with Australian drinking water aesthetic (taste) guidelines.

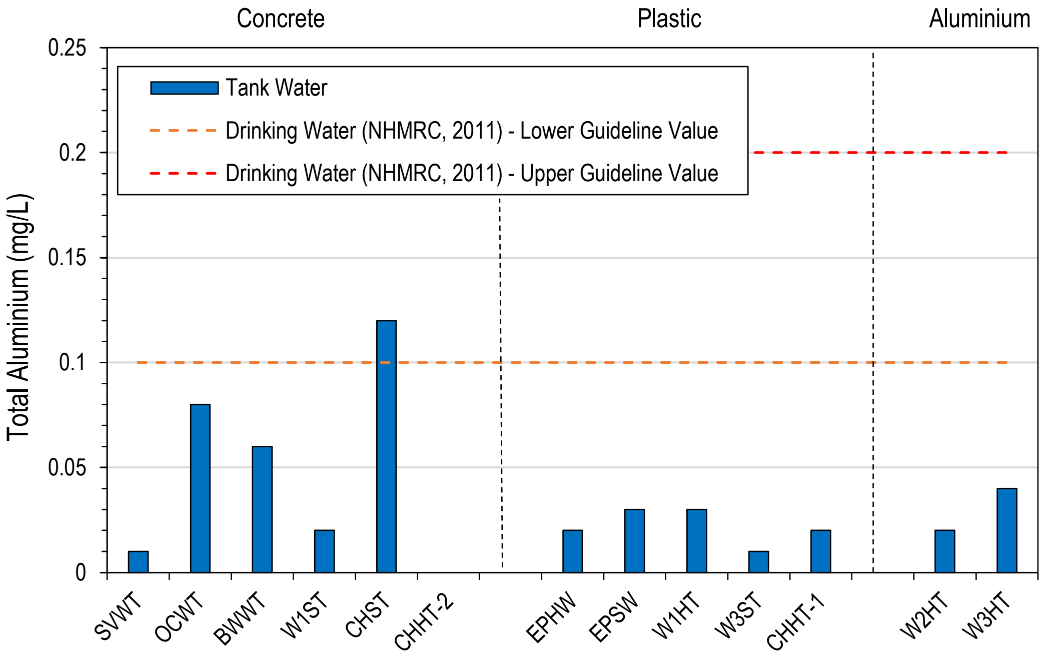

Figure D-33 Total aluminium concentrations (mg/L) in tank water samples compared with Australian drinking water guidelines, see text for details.

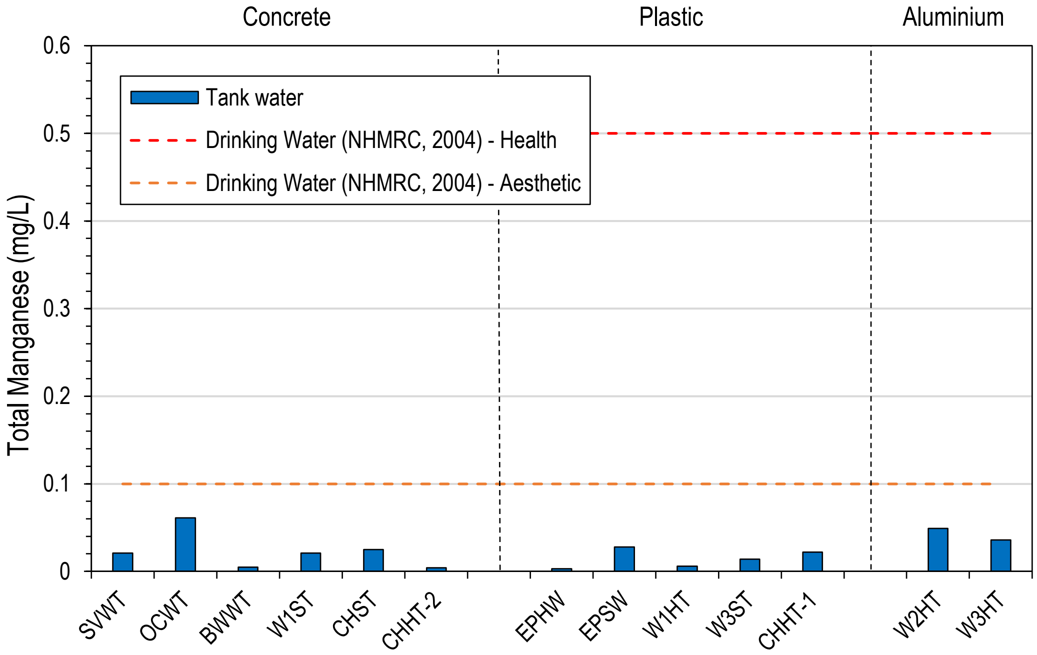

Figure D-34 Total manganese concentrations (mg/L) in tank water samples compared with Australian drinking water aesthetic (taste) and health guidelines.

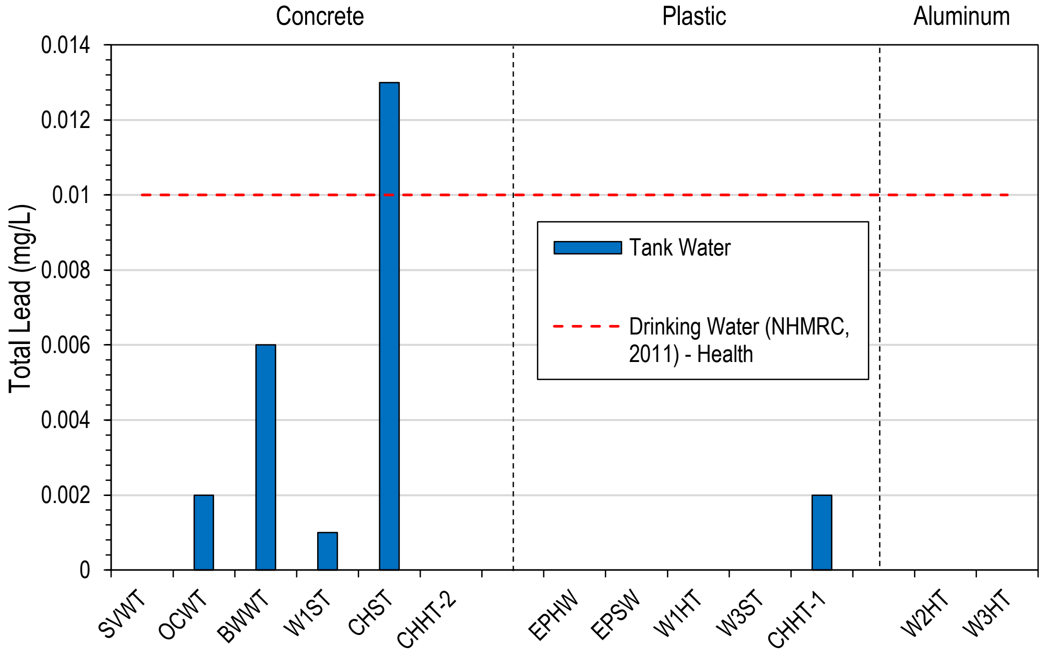

Figure D-35 Total lead concentrations (mg/L) in tank water samples compared with Australian drinking water health guidelines. Note the exceedance in sample CHST.

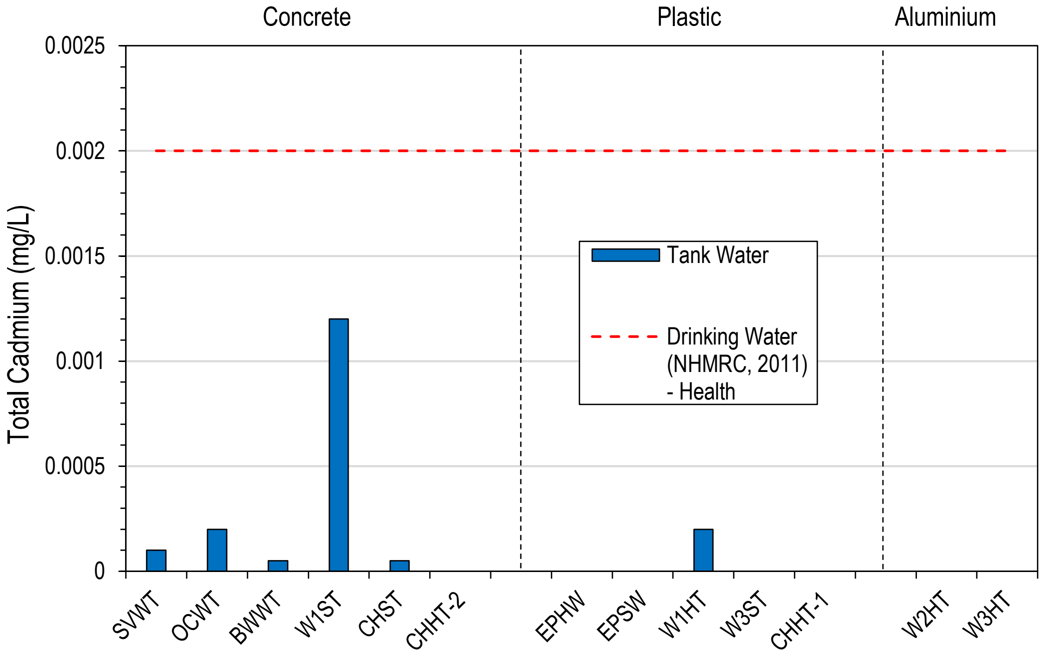

Figure D-36 Total cadmium concentrations (mg/L) in tank water samples compared with Australian drinking water health guidelines.

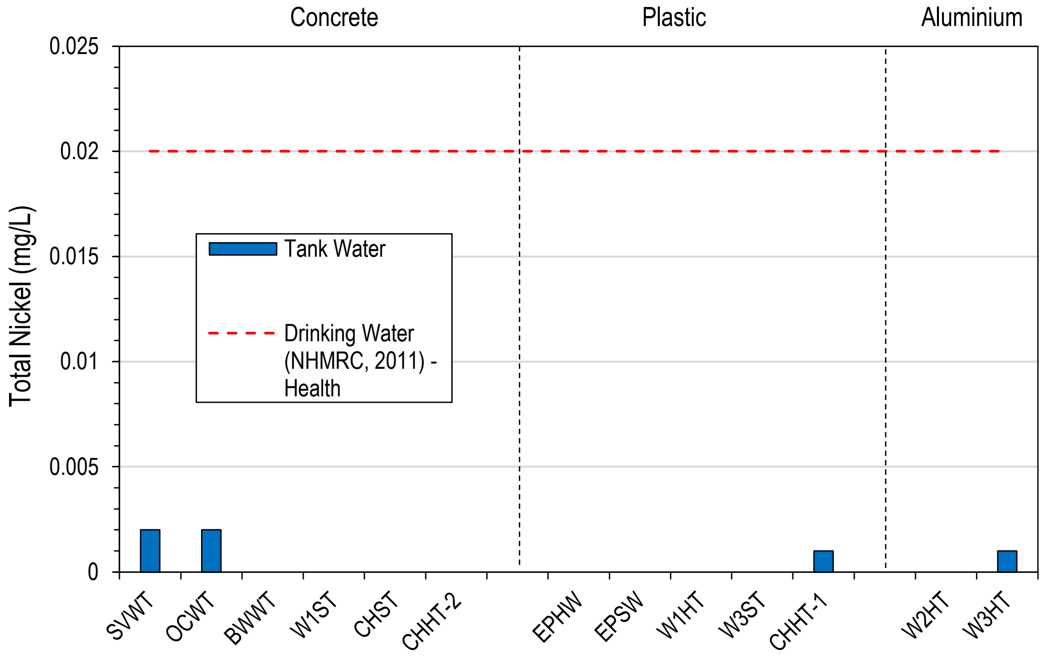

Figure D-37 Total nickel concentrations (mg/L) in tank water samples compared with Australian drinking water health guidelines.

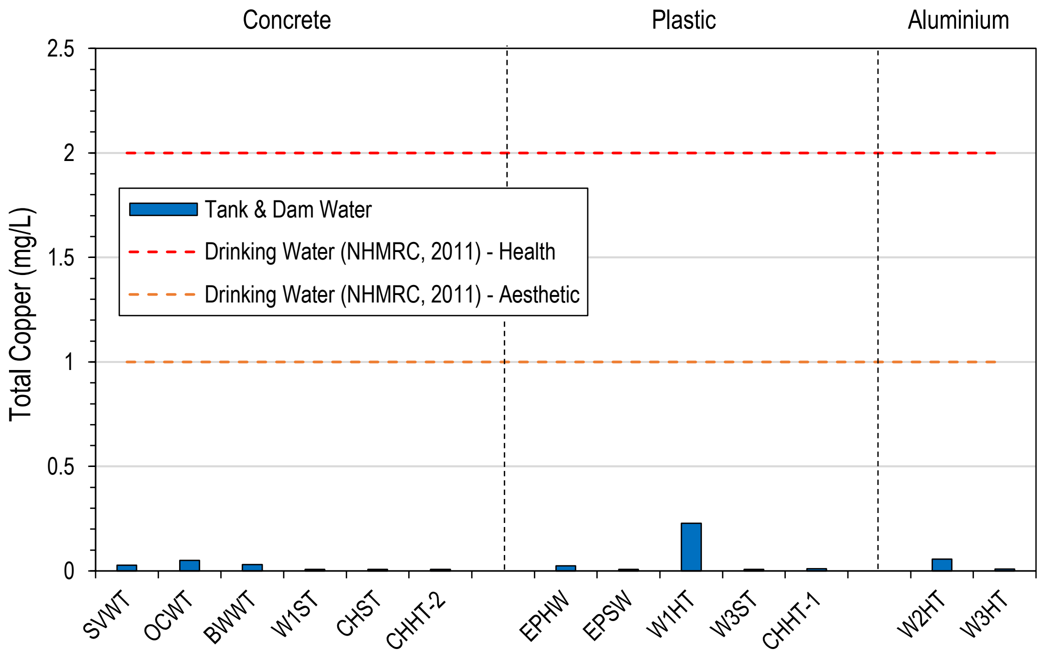

Figure D-38 Total copper concentrations (mg/L) in tank water samples compared with Australian drinking water aesthetic (taste) and health guidelines.

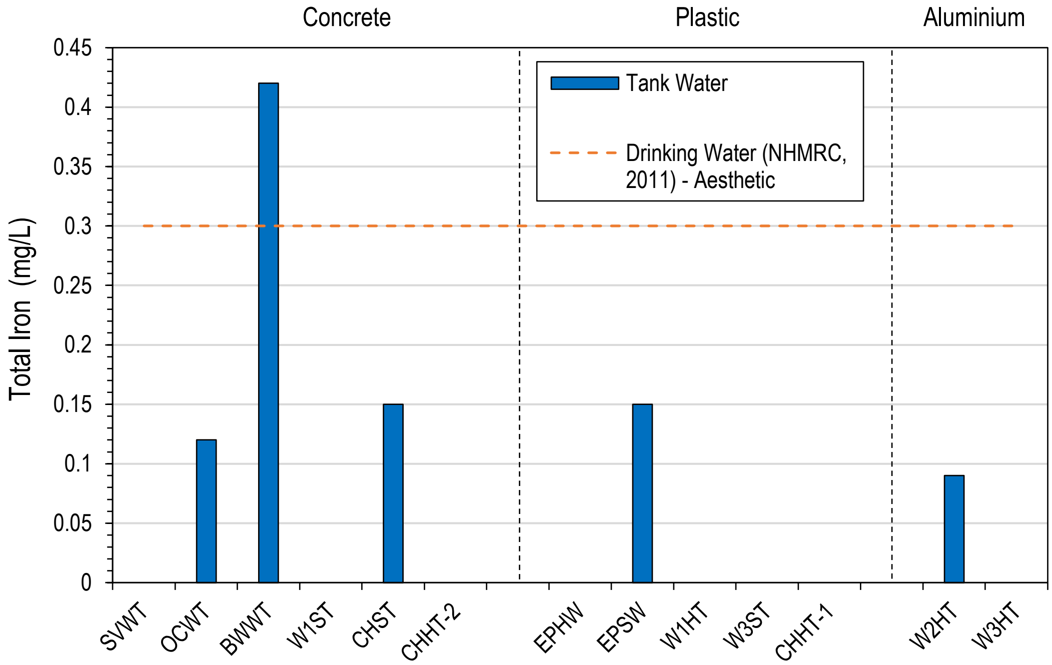

Figure D-39 Total iron concentrations (mg/L) in tank water samples compared with Australian drinking water aesthetic (taste) guidelines.

DAM WATER SAMPLES

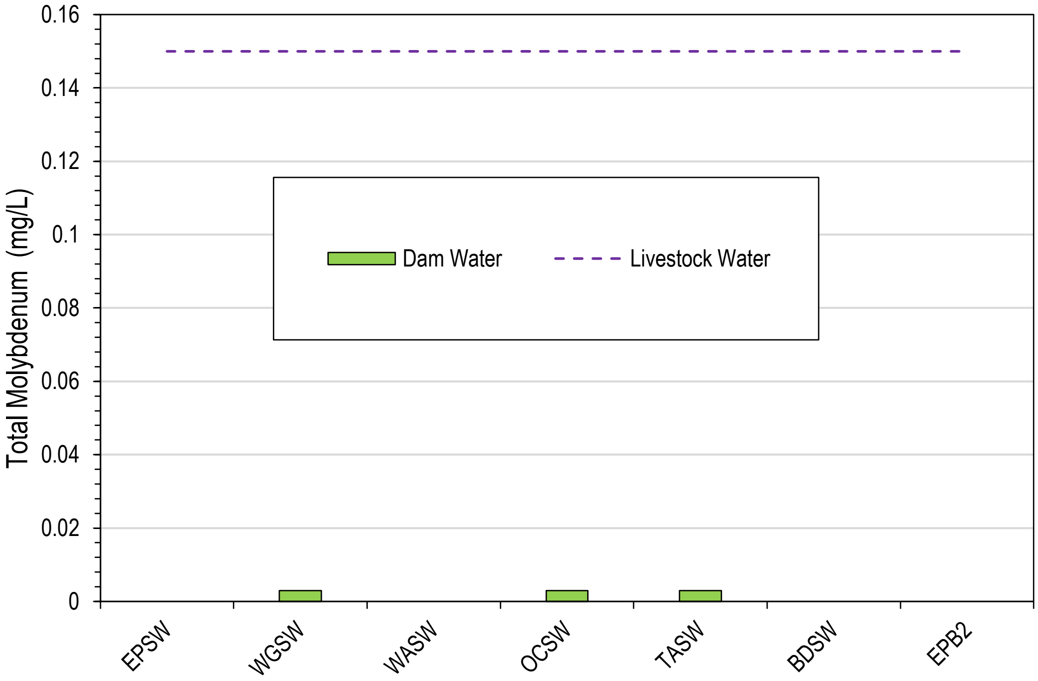

Figure D-40 Total molybdenum concentrations (mg/L) in dam water samples compared with Australian livestock water, and irrigation and general use trigger values.

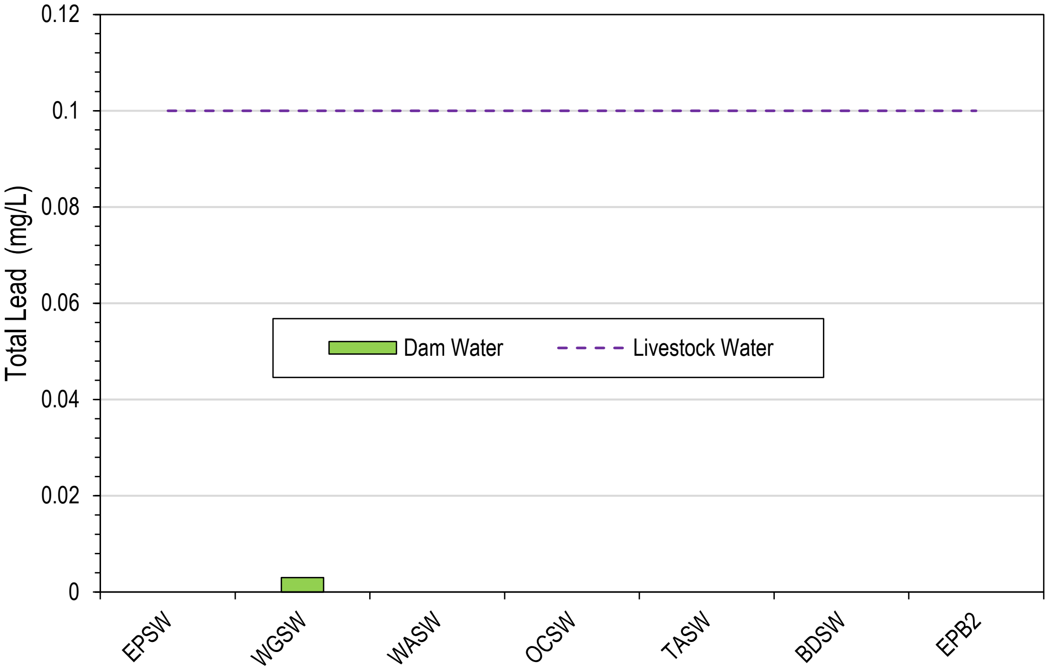

Figure D-41 Total lead concentrations (mg/L) in dam water samples compared with Australian livestock water trigger values (ANZECC, 2000).

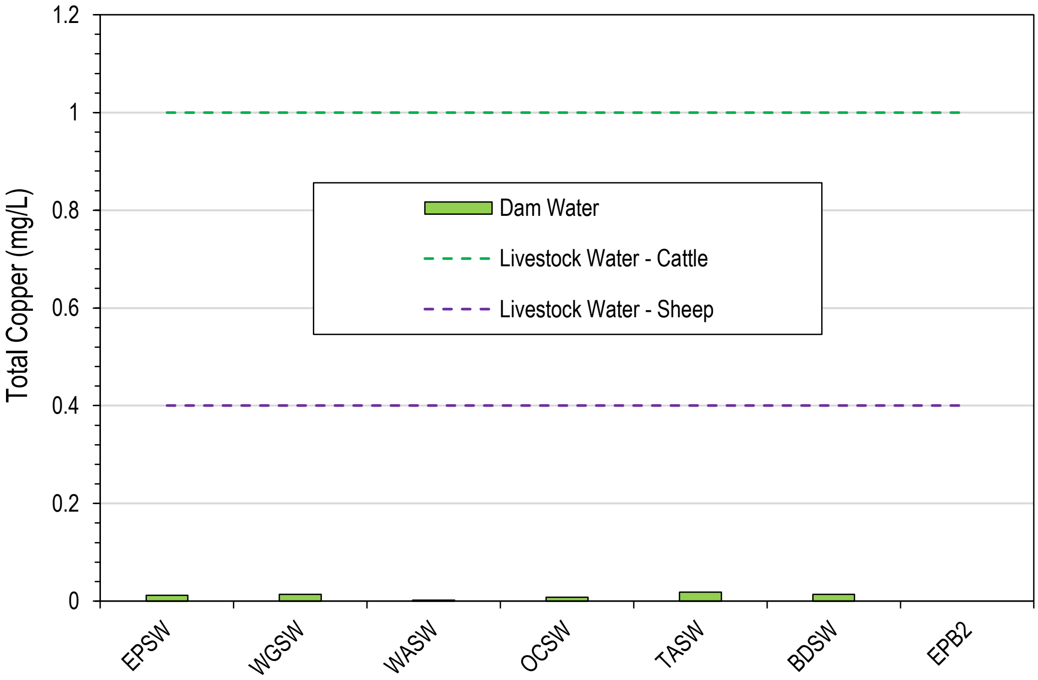

Figure D-42 Total copper concentrations (mg/L) in dam water samples compared with Australian livestock (cattle and sheep) as well as long term irrigation and general use water trigger values.

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Appendix B. HSE Materials Hazard Assessment

Cadia Valley Operations Tailings

HSE Materials Hazard Assessment

Prepared by
Dr Sharann Johnson, PhD, COH, FAIOH
Callander & Johnson Consultancy Services Pty Ltd

May 2020 (updated June 2021 with water quality results)

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1. Introduction

This document was prepared for Cadia Valley Operations (CVO) to inform the Cadia Valley community about the health issues associated with wind-blown dust from the CVO tailings storage facilities.

This document focusses on the mineralogy, metal composition and chemicals present in surface tailings to assist in the understanding of potential impacts on the health of nearby communities.

This document, and a number of associated documents, assessed the health risk within the community by understanding the composition of the source dust from the tailings, the amount and nature of dust received within the community and the mechanisms of community exposure, e.g., via tank drinking water or inhalation of the respirable fraction of the dust.

2. Summary of Hazard Classification

A total of eight samples of the tailings material were collected from the two tailings storage facilities (the Northern Tailings Storage Facility, NTSF, and the Southern Tailings Storage Facility, STSF), with two of the samples being crustal material. The mineralogy, metals and percentage of the material in the respirable size fraction, referred to as PM10 (i.e., particulate matter less than 10 micrometres in aerodynamic diameter) were all assessed.

The United Nations Globally Harmonised System of Classification and Labelling of Chemicals (GHS) was used to determine the health, safety and environmental (HSE) hazards associated with these components of the tailings. The protocols and guidelines of the GHS ensure a consistent approach to identifying hazardous materials, covered by legislation such as International Maritime Organization and road and rail transport codes for dangerous goods.

The findings of the assessment were:

- The metals concentrations in the tailings material were found to be very low, except for aluminum as aluminosilicate and iron, as iron-sulphur compounds. No metal was found in concentrations which would cause long-term or short-term health effects according to the GHS. Ongoing community air quality monitoring for metals will determine whether ambient air values are below community exposure guidelines.
- The PM10 component was within a range between 1.8 and 4.1 wt% of the tailings material, averaging 3.3 wt%. Ongoing community air quality monitoring for PM10 will determine whether ambient air values are below community exposure guidelines.
- In addition, ongoing community air quality monitoring for PM2.5 will further determine whether ambient air values are below community exposure guidelines.
- The respirable crystalline silica (RCS) component in the total tailings material was 0.23 wt%. In the PM10 component, silica was present at values ranging between 5.0 and 8.7 wt%, averaging 7.1 wt%. Ongoing community air quality monitoring for silica will determine whether ambient air values are below community exposure guidelines.
- The tailings material was not classified as hazardous to the health and safety of the aquatic environment using the GHS convention.

3. Tailings at Cadia Valley Operations

At CVO, the ore is mined underground and passes through a series of crushing and grinding units. The crushed ore is combined with water and organic chemicals to help frothing and separation in the flotation process. Cyanide is NOT used at CVO. The flotation process physically separates the copper and gold from the remainder of the processed ore which then goes to the tailings dam. The minerals are not chemically changed during the flotation process.

In summary, tailings are the materials that remain after the minerals (gold and copper) have been processed and removed for further downstream processing.

4. Methodology

Sources: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

Figure 1: Sampling sites for tailings at both Southern and Northern Tailings Storage Facilities at Cadia Valley Operations

Figure 2: Surface of tailings storage facility

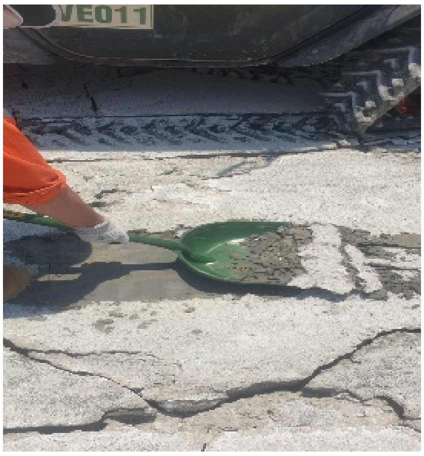

Figure 3: Collection of tailings material for analysis

Tailings samples were collected from both tailings storage facilities in December 2019. Eight samples were collected, four samples from each storage facility (see Figure 1).

One crustal sample (20 mm) and three deeper samples (150 mm) were collected from each storage facility (see Figure 2 and Figure 3).

Tailings samples were analysed by X-ray diffraction (XRD) to identify the types of minerals present. This was completed for all samples and the PM10 size fractions by the Queensland University of Technology (QUT) Central Analytical Research Facility (Spratt 2020a and 2020b).

Elemental metal analysis and metal residue leachate analysis were completed by Australian Laboratory Services (ALS), Brisbane (ALS Certificate of Analysis EB2000092).

The results of the mineralogy and metal/elemental analyses have been used as the basis for the HSE hazard assessment in this document.

5. Hazard Assessment of Tailings Using the Globally Harmonised System (GHS)

The United Nations GHS convention specifies a number of testing protocols and the criteria requirements to classify the HSE hazards of chemicals and complex mixtures. It is a global system developed to ensure consistency in hazard classifications of materials, allow comparisons in the selection of chemicals / products, a basis for informed risks assessment and implementation of controls to ensure safe handling by users, including the transportation of dangerous goods. The various GHS HSE categories HSE have been listed in Appendix 1.

Refer to https://unece.org/about-ghs for further information on the GHS.

6. Mineral Composition of the Tailings

The mineral composition of the tailings is reported in Table 1. The two crustal samples, NTSF4 and STSF2, have been shaded in the table.

Table 1: QUT XRD Results on Tailings with % Composition of Minerals

	1	2	3	4	5	6	7	8	
Sample Number	**NTSF1**	**NTSF2**	**NTSF3**	**NTSF4**	**STSF1**	**STSF2**	**STSF3**	**STSF4**	**Average**
Mineral	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	**wt%**
Quartz	16.3	14.0	15.2	14.0	16.7	17.0	16.2	15.1	**15.6**
Anatase?[1]				0.4					
Magnetite	0.7	0.5	0.2	0.4	1.1	0.5	1.0	0.6	**0.6**
Pyrite	0.6	0.5	0.6	0.5	0.4	0.5	0.6	0.6	**0.5**
Calcite	3.7	3.2	3.4	3.3	3.4	3.4	3.8	3.8	**3.5**
Dolomite		0.3		1.7		0.5	0.2		**0.3**
Blodite				11.9					
Rhomboclase				0.9					
Gypsum	0.5	1.3	1.5	0.7	0.7	0.9	0.6	0.7	**0.9**
Amphibole					1.4		2.1		**0.4**
Plagioclase (An0-50)	30.1	26.0	29.3	23.9	30.9	29.3	31.4	29.0	**28.7**
Potassium feldspar	12.8	11.5	11.9	8.0	11.3	9.2	11.4	11.2	**10.9**
Laumontite				1.3					
Halite		0.5		0.4		0.8			**0.2**
Chlorite/Clinochlore	10.5	10.1	11.3	9.5	12.6	10.6	15.7	14.7	**11.9**
Illite/Mica (TOTAL)	19.8	19.8	19.5	15.6	18.9	18.7	16.3	18.7	**18.4**
Amorphous (non-crystalline)	5	12.5	7	7.6	2.7	8.6	0.9	5.7	**6.3**
Total									**98.3**

The major crystalline minerals present were plagioclase feldspar (av. 28.7 wt%), illite/mica (av. 18.4 wt%), quartz (av. 15.6 wt%), chlorite/clinochore (av. 11.9 wt%) and potassium feldspar (av. 10.9 wt%) making up over 80 wt% of each sample. The amorphous component, made of non-crystalline materials such as clays, varied between 0.9 wt% and 12.5 wt% of the tailings.

The major minerals reported, plagioclase feldspar, illite/mica, chlorite/clinochore and potassium feldspar, are aluminosilicates which are found widely in the Earth's crust. A short summary about their properties and uses has been included in Appendix 2. These minerals are not classified as hazardous according to GHS protocols.

The mineral quartz, and in particular crystalline silica (a component of quartz), may be hazardous when people are repeatedly exposed to airborne respirable crystalline silica (RCS) at concentrations which exceed the legislated occupational exposure standard published by Safe Work Australia, http://hcis.safeworkaustralia.gov.au/ExposureStandards. This is discussed in more detail in Section 8.

Amphibole minerals were reported in two samples, STSF1 and STSF3. Further analysis of these samples determined that there were no asbestos or asbestiform minerals present (ALS Certificate of Analysis ES2016687).

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[1] QUT reported a weak peak in the X-ray diffraction pattern which they tentatively identified as Anatase.

7. Mineralogical Composition of the PM10 Fraction of the Tailings

The eight tailings samples were separated into a two size fractions – PM10 and larger than PM10. PM10 particles have the potential to travel deep into the lungs effecting health. The PM10 fraction of the tailings samples was in the range of 1.8 to 4.1 wt%, averaging 3.25 wt% (see Table 2).

The two crustal samples, NTSF4 and STSF2, have been shaded in the following tables.

Table 2: QUT Results for the Percentage of PM10 in the Tailings

	1	2	3	4	5	6	7	8	
Sample Number	**NTSF1**	**NTSF2**	**NTSF3**	**NTSF4**	**STSF1**	**STSF2**	**STSF3**	**STSF4**	**Average**
PM10 wt%	3.989	2.773	2.330	1.843	4.003	3.091	3.902	4.105	**3.2545**

The mineralogy of the PM10 fraction as measured by XRD analysis, is reported in Table 3 with a summary of the major components reported in Table 4.

The major components of the PM10 fraction were plagioclase feldspar, illite/mica, chlorite/ clinochore and potassium feldspar, which are major crustal compounds found in soils. These materials can be referred to as aluminosilicates, all containing different forms of aluminium, silica, oxygen with various metals. These minerals are not classified as hazardous.

There were no asbestiform minerals present in this size fraction.

Table 3: QUT XRD Mineral Analysis of the PM10 Fraction of the Tailings

	1	2	3	4	5	6	7	8	
Sample Number	**NTSF1**	**NTSF2**	**NTSF3**	**NTSF4**	**STSF1**	**STSF2**	**STSF3**	**STSF4**	**Average**
Mineral	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	**wt%**
Quartz	6.6	6.5	7.5	5.0	7.4	7.9	8.2	7.7	**7.1**
Hematite	0.8				1.1		1.2	1.1	**0.5**
Magnetite									
Pyrite									
Calcite	2.6	1.0	1.0	0.8	1.8	0.3	1.9	1.9	**1.4**
Anhydrite	1.6	3.2	2.4	2.3	2.2	2.1	1.5	1.4	**2.1**
Glauberite				3.8					
Bassanite						3.7			
Gypsum						2.5			
Amphibole							1.8		
Plagioclase (An0-50)	22.5	19.6	21.1	11.7	25.6	19.7	28.7	23.6	**21.6**
Potassium feldspar	10.1	9.4	8.7	4.2	11.9	6.5	12.7	10.7	**9.3**
Laumontite							0.7		
Halite		3.0	0.7	1.8	0.7	2.4			**1.1**
Chlorite/Clinochlore	9.6	6.8	8.6	6.5	9.9	7.6	10.6	12.4	**9.0**
Illite/Mica (TOTAL)	25	23.5	23.5	12.7	25.6	16.4	26.7	23.7	**22.1**
Amorphous (non-crystalline)	21.2	26.9	26.6	51.2	13.9	31.1	6.1	17.5	**24.3**
Total									**96.4**

Table 4: Major Minerals Present in the PM10 Fraction of the Tailings

Mineral	Type of Compound Present	Range wt%	Average wt%
Quartz	Crystalline Silicon Dioxide	5.0 – 8.2	**7.1**
Hematite	Iron Oxide	0.8 – 1.2	**0.5**
Calcite	Calcium Carbonate	0.3 – 2.6	**1.4**
Anhydrite	Anhydrous Calcium Sulphate	1.4 – 3.2	**2.1**
Plagioclase	Sodium and Calcium Aluminosilicates	11.7 – 28.7	**21.6**
K-Feldspar	Potassium Aluminosilicates	4.2 – 12.7	**9.3**
Halite	Sodium Chloride (Rock salt)	0.7 – 3.0	**1.1**
Chlorite	Iron-Magnesium hydrous aluminosilicates	6.5 – 12.4	**9.0**
Illite / Mica	Iron-Magnesium hydrous aluminosilicates	12.7 – 26.7	**22.1**
Amorphous	Not crystalline	6.1 – 51.2	**24.3**

Metal Sulphide Mineralogy in the Tailings

In Table 1 and Table 3, the key primary mineral constituents within surface tailings deposits were dominated by quartz, potassium feldspar, plagioclase feldspar, chlorite, potassium mica and calcite, with minor to trace quantities of magnetite, pyrite, amphibole, gypsum, dolomite, anatase and halite. Almost all of these phases are common rock-forming minerals that remain largely unreactive under most conditions at the Earth's surface.

A small number of these minerals were less widespread and were specifically associated with the copper mineralisation at CVO. These included the metal sulphur minerals, pyrite, chalcopyrite, bornite, galena, sphalerite and molybdenite, present at very low levels. Pyrite, chalcopyrite and bornite were the main reactive mineral phases in the tailings, and only pyrite was currently detectable in the surface tailings material. Pyrite is considered reactive as it can slowly decompose in the presence of atmospheric oxygen to generate sulfuric acid. The concentration of pyrite in surface tailings permits acid to form, but the abundance of neutralising minerals containing calcium, potassium and magnesium (calcite, ankerite, dolomite, and feldspar) ensures that all of the acid is neutralised. Hence, the upper several centimetres of the tailings storage facilities can undergo slow and selective decomposition.

During a rainfall event, the decomposition products largely dissolve, even in small volumes of water, generally producing near neutral, sulphate-rich saline porewater. Over the following drier days, capillary action can cause the water to rise to the tailings surface, and with evaporation of the water causes concentration and subsequently, crystallisation into highly soluble, low density (secondary) salts / minerals as fields of crystal migration to the surface of the tailings.

These secondary salts include blodite, rhomboclase, gypsum, bassanite, anhydrite, glauberite and probably some non-crystalline material. Information about the chemistry as well as concentrations have been included in Table 5. The levels found were generally low and not present in all samples.

The rate of production of these salts is generally slow and influenced by how far air can penetrate into the tailings deposits to form acid from pyrite oxidation. As low-density surface salts, these phases will be mobilised into the air during significant wind events, relative to the other rock forming minerals.

Table 5: Minor Secondary Salt Minerals Present in the Tailings Minerals Analysis

Mineral	Type of Compound Present	Chemical Formula	Range wt%
Blodite	Sodium Magnesium Sulphate	$Na_2Mg(SO_4).4H_2O$	ND – 11.9
Rhomboclase	Sulphated Iron Oxide	$H_5FeO_2(SO_4)_2.2H_2O$	ND – 0.9
Gypsum	Calcium Sulphate	$CaSO4.2H_2O$	0.5 – 1.5
Bassanite	Calcium Sulphate	$CaSO4.H_2O$	ND – 0.13*
Anhydrite	Calcium Sulphate	$CaSO_4$	0.06 – 0.11*
Glauberite	Sodium, Calcium Sulphate	$Na_2Ca(SO_4)_2$	ND – 0.13*

ND – not detected.
* Calculated from PM10 to complete tailings sample.

From a chemical perspective, these ultra-thin, temporary crystalline carpets across the surface of the tailings deposits are not inherently hazardous. When mobilised as solids during windy periods, they have the potential to contribute sulphate and chloride salinity to local water sources such as local waterways, farm dams and drinking water supplies from roof water.

The metal analyses of the tailing samples have been reported in Table 6, and a number of metals such as copper, zinc, molybdenum, antimony and arsenic were found at trace levels. These may combine with the sulphate and chloride compounds discussed above. Hence, these may be a potential source of low-level contribution of metals to local water sources. To confirm this, a targeted survey of water quality from local water supply tanks and from farm dams was undertaken. The results of the water quality sampling are detailed in Appendix 3.

All metal concentrations levels were below Australian Drinking Water Guidelines[2] and ANZECC livestock drinking water quality guidelines[3] except two values for lead and one value for cadmium marginally higher than the drinking water guidelines. The two locations where the lead values slightly exceeded the guidelines were resampled. Lead was below the drinking water guidelines for the second set of samples. Where cadmium slightly exceeded the drinking water guidelines, this was attributable to contamination from galvanised steel roofing or guttering.

8. Respirable Crystalline Silica (RCS)

For many years, it has been known that prolonged inhalation of RCS dust may cause a specific type of lung damage called silicosis. Although silicosis has been recognised for centuries, its links to lung cancer have become more well understood over the past two decades.

IARC, the International Agency for Research on Cancer, an agency of the World Health Organization (https://www.iarc.fr/), is the premier international expert group which undertakes classification of carcinogens. In 1987, IARC evaluated RCS as a probable human carcinogen for the first time,

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[2] *Australian Drinking Water Guidelines Paper 6 National Water Quality Management Strategy*, version 3.6, updated March 2021, National Health and Medical Research Council, National Resource Management Ministerial Council, Commonwealth of Australia, Canberra.

[3] *Australian and New Zealand guidelines for fresh and marine water quality. Volume 1: The guidelines*, Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, October 2000, Canberra.

and in 1997 concluded on the basis of literature review that inhaled RCS from occupational sources is carcinogenic to humans. In 2012, IARC confirmed its conclusions as: '*Crystalline silica in the form of quartz or cristobalite dust is carcinogenic to humans*'.

The industry group, IMA - Europe (https://safesilica.eu/) report that, despite the ubiquitous presence of crystalline silica in the environment, specific health effects of RCS only appear at the workplace not in the general environment. It is widely believed that the risk of developing silicosis from environmental exposure is extremely low. However, despite this widely held view and IMA - Europe's assertion, there have been reported instances in the literature of non-occupational cases of silicosis.[4] Notwithstanding, given the further discussion on RCS below; it is highly unlikely that this is a risk posed by CVO.

The fine fraction of crystalline silica is the relevant fraction which, if made airborne, can potentially reach the deep lung, as defined by EN 481[5]. These are particles less than 10 micrometres in particle size (PM10).

IMA - Europe has established international silica classification criteria to allow manufacturers to classify products, substances and mixtures containing quartz in relation to the hazards of RCS whether in the form of an identified impurity, additive or individual constituent.

Materials with less than 1 % *fine* (PM10) are determined as not requiring a health hazard classification.

The GHS classification system has a category STOT - RE, which refers to *Specific Target Organ Toxicity - Repeated Exposure*. This relates to the health effects of RCS exposure on lung tissue.

The IMA - Europe health hazard criteria are listed below:

- STOT - RE 1, if the quartz (fine fraction) or cristobalite (fine fraction) concentration is equal to, or greater than 10%
- STOT - RE 2, if the quartz (fine fraction) or cristobalite (fine fraction) concentration is between 1 and 10%
- If the quartz (fine fraction) or cristobalite (fine fraction) in mixtures and substances is below 1%, no classification is required.

The concentration of quartz, also referred to as crystalline silica, in the PM10 fraction of the tailings was in the range 5.0 to 8.7 wt%, averaging 7.1 wt%. Using 7.1 wt% of RCS in a fraction that was 3.25 wt% of the total tailings material, the RCS content of the tailings would represent 0.23 wt%, of the total tailings sample – (3.25 X 7.1)/100.

Based upon this review, the tailings material is not classified as a health hazard with respect to RCS.

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[4] See Bridge I (2009) Crystalline silica: A review of the dose response relationship and environmental risk, *Air Quality and Climate Change* **43(1)**, pp 17-23.

[5] European Standard EN 481 (1993) *Workplace Atmospheres - Size Fraction Definitions for Measurement of Airborne Particles*.

9. Metals Present in the Tailings

Metal concentrations found in the tailings material are reported in Table 6 (the two crustal samples, NTSF4 and STSF2, have been shaded orange in the table). Thirty metals were analysed using the ICP-MS chemical analysis technique, as well as ICP-AES for aluminium, boron and iron content.

Table 6: Metals Analysis of the Tailings

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	
Sample No.	**STF1**	**STF2**	**STF3**	**STF4**	**NTSF1**	**NTSF2**	**NTSF3**	**NTSF4**	**Average**
Metal	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Aluminium	13700	10200	13700	14500	12700	13200	11900	10900	**12600**
Arsenic	2.6	2.4	3.1	3.7	3.6	4.1	4.4	3.7	**3.5**
Antimony	0.2	0.2	0.2	0.1	0.1	0.2	0.2	0.2	**0.2**
Barium	22.8	16.4	20.9	22.6	38.6	29.6	26.6	23.9	**25.2**
Beryllium	0.3	0.2	0.3	0.4	0.3	0.3	0.3	0.2	**0.3**
Bismuth	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.1	**0.2**
Boron	<50	<50	<50	<50	<50	<50	<50	<50	**<50**
Cadmium	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	**<0.1**
Calcium	2450	2270	1780	2170	830	2740	2500	2320	**2132**
Chromium	32.9	21.4	39.4	37.6	30.4	33.7	26.7	24.5	**30.8**
Cobalt	10.8	9.2	12.9	14	11.4	11.4	11.4	10	**11.4**
Copper	444	429	457	607	490	458	610	488	**498**
Iron	26100	20700	26900	28000	25200	26000	23800	21700	**24800**
Lead	2.5	2	3.2	4	4.2	5.3	4	4.1	**3.7**
Lithium	16	12.4	15.2	16	14.5	15.7	14.6	14.3	**14.8**
Magnesium	840	6150	920	140	680	2160	2140	7740	**2596**
Manganese	294	254	287	299	283	325	283	274	**287**
Molybdenum	7.9	36.1	10.3	9.2	9	15.9	11.6	33.5	**16.7**
Nickel	13.2	9.1	14.5	15.3	12.7	14.6	11.8	11.5	**12.8**
Potassium	1220	5680	1350	620	750	2130	2270	5790	**2476**
Sodium	4890	20700	4320	3640	2270	8540	9660	21300	**9415**
Selenium	1	4	1	1	1	2	<1	2	**1.5**
Silver	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	**0.2**
Strontium	101	203	90.4	120	84.1	142	218	219	**147**
Thallium	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	**<0.1**
Thorium	1.8	1.5	1.6	1.8	1.9	1.8	1.8	1.5	**1.7**
Tin	0.5	0.3	0.5	0.8	0.6	0.6	0.5	0.5	**0.5**
Uranium	0.4	0.4	0.4	0.4	0.4	0.5	0.4	0.6	**0.4**
Vanadium	77	54	79	83	68	74	64	59	**70**
Zinc	24.7	19.2	23.4	26.4	22.9	26.5	25.9	21.8	**24**

The health and environmental effects of the metals found were determined by understanding the toxicity and concentration of the metal complexes present in addition to the solubility of the metal compounds.

Metals which were present at greater than 0.1% (1000 ppm) have been shaded in blue and include: aluminium, calcium, iron, magnesium, potassium and sodium. These metals have a low order of toxicity and are widely found in soil.

Metals considered potentially hazardous from a health consideration are listed in Table 8 in Section 10.

10. Human Health Effects Classification of the Tailings Based on Metals

Table 7: IARC Classification of Carcinogens

Classification	Meaning	Number of Agents Classified
Group 1	Carcinogenic to humans	121 agents
Group 2A	Probably carcinogenic to humans	89 agents
Group 2B	Possibly carcinogenic to humans	315 agents
Group 3	Not classifiable as to its carcinogenicity to humans	497 agents

Table 8: Metal Concentrations in the Tailings and Carcinogenicity Classification

Metal	IARC Classification	Concentration	Range in CVO Tailings	Average
Aluminium	Not Classified	ppm	10200 – 14500	**12600**
Arsenic	Group 1	ppm	2.4 – 4.4	**3.5**
Barium	Not Classified	ppm	16.4 – 38.6	**25.2**
Cadmium	Group 1	ppm	<0.1	**<0.1**
Chromium	Group 1	ppm	21.4 – 39.4	**30.8**
Cobalt	Group 2B	ppm	9.2 – 14	**11.4**
Copper	Not Classified	ppm	429 – 601	**497.9**
Iron	Not Classified	ppm	20700 – 28000	**24800**
Lead	Group 2B	ppm	2.0 – 5.3	**3.7**
Lithium	Not Classified	ppm	2.4 – 16.0	**14.8**
Manganese	Not Classified	ppm	254 – 299	**287.4**
Molybdenum	Not Classified	ppm	7.9 – 36.1	**16.7**
Nickel	Group 1	ppm	9.1 – 15.3	**12.8**
Strontium	Not Classified	ppm	90.4 – 219	**147.2**
Vanadium	Not Classified	ppm	54 – 83	**69.8**
Zinc	Not Classified	ppm	19.2 – 26.5	**23.9**

Blue shading indicates metals present at a concentration greater than 0.1% (1000 ppm).

The classification of carcinogens undertaken by IARC is listed in Table 7.

A Group 1 classification means the evidence strongly indicates the agent is a human carcinogen and Group 2B means the agent is a possible human carcinogen because of limited evidence of carcinogenicity in humans.

Metals classified as having the potential to cause cancer are arsenic (As), cadmium, (Cd) chromium VI (Cr VI), cobalt (Co), lead (Pb) and nickel (Ni). The criterion used to classify mixtures containing carcinogenic chemicals or metals, is a concentration of the chemical or metal greater than 0.1% (1000 ppm).

The metals (As, Cd, Cr VI, Co, Pb and Ni) associated with cancer that were present in the tailings samples were all below 0.1%. The concentrations were less than 0.001%, except chromium (assuming the worst-case chromium VI), which was less than 0.01%. At these concentrations, arsenic, cadmium, chromium, cobalt, lead and nickel would not result in the tailings being classified as a carcinogenic material.

Aluminium and iron were metals with concentrations greater than 1000 ppm and are shaded blue in Table 8. These metal complexes, predominately aluminosilicates and iron - sulphur compounds which have low water solubility, are not classified as hazardous to health.

Table 9: MeClas Results for the Tailings

Health & Environment Legislation	GHS Classification		EU Waste Hazard Properties	Classification
Acute toxicity - oral	Not classified		Acute toxicity	Not classified
Acute toxicity – dermal	Not classified		Corrosive	Not classified
Acute toxicity - inhalation	Not classified		Irritant -skin irritation and eye damage	Not classified
Skin corrosion/irritation	Not classified		Sensitizing	Not classified
Serious eye damage/eye irritation	Not classified		Mutagenic	Not classified
Respiratory/skin sensitization	Not classified		Carcinogenic	Not classified
Germ cell mutagenicity	Not classified		Toxic to reproduction	Not classified
Carcinogenicity	Not classified		Specific target organ toxicity (STOT)/ Aspiration	Not classified
Reproductive toxicity	Not classified		Ecotoxic	Not classified
Specific target organ toxicity (STOT) – single exposure	Not classified			
Specific target organ toxicity (STOT) – repeated exposure	Not classified			
Aspiration hazard	Not classified			
Hazardous to the aquatic environment - ACUTE	Not classified			
Hazardous to the aquatic environment - CHRONIC	Not classified			

The United Nations GHS has established protocols and guidelines for assessing HSE hazards of materials. The GHS and the European Commission 2008 Regulation (EC) No. 1272/2008 on classification, labelling and packaging of substances and mixtures (CLP) as it applies to metals and minerals has been used to develop a process called MeClas (http://www.meclas.eu/), specifically designed for classifying ore bodies, mineral concentrates and waste materials based on metals and mineralogy. It takes into account the toxicity of the metals, and the concentration and solubility of the metallic minerals. The MeClas test results for the tailings material based on the metal composition are listed in Appendix 4. The specific MeClas results are listed in Table 9.

The tailings material, using the MeClas assessment process, was found to be classified as non-hazardous to the health and safety of people and environmental aquatic toxicity categories. A *not classified* determination, indicates that these guidelines are not triggered for the listed United Nations GHS and European Union Waste Hazards Properties in Table 9.

11. Hydrocarbon Compounds Found in the Tailings

The hierarchy of control of risks by eliminating hazardous chemicals is part of the process in selecting any new materials coming onto the Cadia site to protect workers, the community and the environment.

The organic chemicals and the small amount of diesel used in the flotation process are selected to be the least hazardous, both from a worker health and safety perspective and environmental impact consideration. These chemicals are recycled in the process circuit and broken down during this processing.

The organic chemistry analyses undertaken on the tailings samples found low level hydrocarbon compounds were present. There were eight unidentified hydrocarbon compounds reported adding to 33 ppm in total. These hydrocarbons were reported as alkanes, which are considered to be low hazard hydrocarbons. None of the traditionally carcinogenic hydrocarbon compounds were identified as being present, such as polycyclic aromatic hydrocarbons or benzene.

12. Dust Suppressant Chemicals Used to Coat the Surface of the Tailings Storage Facilities

During 2019, a project was undertaken to top coat the surface of the tailings storage facilities with dust suppressant agents to reduce dust generation. According to the GHS, these products (listed below) are non-hazardous. The products used were:

- Erizon - FibreLoc, Wood Mulch Fibre
- Erizon - Ecobond
- Erizon - Product 4000077.

The information extracted from the product information sheets and safety data sheets is listed in Table 10.

Table 10: Summary of Dust Suppressant Product Information and Safety Data Sheets (SDS)

	Product Name	Supplier	Description	Composition	Information	Classification	SDS
1	Product 4000077	Erizon	Dust suppression	Blue/Green emulsion, water soluble polymer surfactant blend	pH 4 to 6 / Opaque white/grey liquid Toxicity to Fish: LC50>96 mg/L Oral Toxicity LD50 (Rat): >5000 mg/kg Acute Bacterial Toxicity: EC0>100 mg/L	Not Classified by GHS / Poison Schedule 5	Yes
2	FibreLoc, Wood Mulch Fibre	Erizon		100% wood fibre Interlocking organic wood fibres incorporated by stronghold environmentally sustainable binders. Phyto-Sanitised to eliminate potential weed seeds and pathogens Natural Green Marker Dye added.	,	Not Classified by GHS	General Product Information Sheet
3	Ecobond	Erizon	Ecobond Hydromulch Binder	100% naturally occurring polymers, nontoxic biopolymers. Binds wood mulch and seeds to the surface.		Not Classified by GHS	General Product Information Sheet

Glossary of Terms and Abbreviations

aerodynamic diameter	the diameter of a hypothetical sphere of density 1 g/cm^3 having the same terminal settling velocity in calm air as the particle in question, regardless of its geometric size, shape and true density.
aesthetic guideline	a value, which is the concentration or measure of a water quality characteristic that is associated with acceptability of water to the consumer; for example, appearance, taste and odour
ALS	Australian Laboratory Services
ambient air	the air in the general outdoors atmosphere
Australian Drinking Water Guidelines	NHMRC, NRMMC (2011) *Australian Drinking Water Guidelines Paper 6 National Water Quality Management Strategy*, version 3.6, updated March 2021, National Health and Medical Research Council, National Resource Management Ministerial Council, Commonwealth of Australia, Canberra.
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
CLP	Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006.
CVO	Cadia Valley Operations
EC	European Commission
EU	European Union
g/cm^3	grams per cubic centimetre
GHS	Globally Harmonised System of Classification and Labelling of Chemicals
health-based guideline	a value, which is the concentration or measure of a water quality characteristic that, based on present knowledge, does not result in any significant risk to the health of the consumer over a lifetime of consumption
HSE	health, safety and environment
IARC	International Agency for Research on Cancer
IMA - Europe	Industrial Minerals Association – Europe
livestock drinking water guidelines	*Australian and New Zealand guidelines for fresh and marine water quality. Volume 1: The guidelines*, ANZECC and ARMCANZ, October 2000, Canberra.
MeClas	A web-based tool used to generate toxicity hazard categories and corresponding classification and labelling information of inorganic metal-containing complex materials such as ores, concentrates, intermediates or alloys using the GHS/CLP rules.
mg/kg	milligrams per kilogram (same as ppm for solids)
mg/L	milligrams per litre (same as ppm for liquids)
micrometre	one thousandth of a metre
micron	see micrometre
NHMRC	National Health and Medical Research Council

NRMMC	National Resource Management Ministerial Council
NTSF	Northern Tailings Storage Facility
PM10	particulate matter less than 10 micrometres in aerodynamic diameter
PM2.5	particulate matter less than 2.5 micrometres in aerodynamic diameter
ppm	parts per million (by volume for liquids – mg/L – and by weight for solids – mg/kg)
QUT	Queensland University of Technology
RCS	respirable crystalline silica
SDS	safety data sheet
STOT-RE	Specific Target Organ Toxicity - Repeated Exposure
STSF	Southern Tailings Storage Facility
wt%	weight percent – the weight of the thing being measured present in every 100 grams of total material
XRD	X-ray diffraction analysis

References

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Spratt, H (2020a) *Materials Characterisation Report X20005*, 10 February 2020, QUT Central Analytical Research Facility, Brisbane.

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Appendix 1. GHS Safety, Health and Environmental Hazard Classification Categories

Physical	Explosives
	Flammable gases/aerosols/liquid/solids
	Oxidizing gases/liquids/solids
	Gases under pressure
	Self-reactive substances and mixtures
	Pyrophoric liquid/solid
	Self-heating substances and mixtures
	Substances and mixtures which on contact with water emit flammable gases
	Organic peroxides
	Corrosive to metal
Human Health	Acute toxicity (via the oral, dermal, inhalation route)
	Skin corrosion/irritation
	Serious eye damage/eye irritation
	Respiratory/skin sensitization
	Germ cell mutagenicity
	Carcinogenicity
	Reproductive toxicity
	Specific target organ toxicity (STOT) – single exposure (SE)
	Specific target organ toxicity (STOT) – repeated exposure (RE)
	Aspiration hazard
Environmental	Hazardous to the aquatic environment
	Hazardous to the ozone layer

Appendix 2. Information about Major Minerals Identified in the Tailings

Feldspar

Feldspar is by far the most abundant group of minerals in the Earth's crust, forming about 60% of terrestrial rocks.

The term feldspar encompasses a whole range of materials. Most of the products we use on a daily basis are made with feldspar: glass for drinking, glass for protection, glass wool for insulation, the floor tiles and shower basin in our bathroom, the tableware from which we eat. Feldspar minerals are essential components in igneous, metamorphic and sedimentary rocks, to such an extent that the classification of a number of rocks is based on feldspar content.

Based on their chemical composition, feldspars can be subdivided into two mineral groups – plagioclase feldspars and potassium feldspars. Plagioclase feldspars are a continuous mineral series in which calcium and sodium substitute for one another in the same crystal structure. Because they share a similar crystal structure, all the plagioclase varieties exhibit very similar properties and in the field are often only identified as *plagioclase*. Plagioclase minerals are typically white or gray, hard blocky crystal masses that exhibit cleavage in two directions that are nearly at right angles. They are particularly common in igneous and metamorphic rocks, where they often form the bulk of the rock's volume.

The mineralogical composition of most feldspars can be expressed in terms of the ternary system orthoclase ($KAlSi_3O_8$), albite ($NaAlSi_3O_8$) and anorthite ($CaAl_2Si_2O_8$). Chemically, the feldspars are silicates of aluminium, containing sodium, potassium, iron, calcium, or barium or combinations of these elements.

Plagioclase

Plagioclase is the name of a group of **feldspar minerals** that form a solid solution series ranging from pure albite, $Na(AlSi_3O_8)$, to pure anorthite, $Ca(Al_2Si_2O_8)$. Plagioclase minerals are important constituents of some building stone and **crushed stone** such as **granite** and **trap rock**. These rocks are also cut and polished for use as countertops, stair treads, wall panels, building facing, monuments, and many other types of decorative and architectural stone.

Many decorative igneous and metamorphic building stones are composed primarily of plagioclase minerals. The plagioclase component of these stones is hard enough, and resistant enough, to maintain a polish and the varied distribution of plagioclase and other minerals creates the patterns prized in these stones. By volume, however, the most significant use of plagioclase is that it comprises much of the sand and gravel used as aggregate in concrete and asphalt. Large volumes of plagioclase are also mined and processed to create a wide variety of ceramics, ranging from pottery to industrial uses. Ground into powder, plagioclases are also used in the manufacture of paints, rubber, glass, plastics, and are even used as a mild cleaning abrasive.

Mica

Mica is a mineral name given to a group of minerals that are physically and chemically similar. They are all silicate minerals, known as sheet silicates, because they form in distinct layers. Micas are fairly light and relatively soft, and the sheets and flakes of mica are flexible. Mica is heat-resistant and does not conduct electricity. There are 37 different mica minerals which differentiate from each other, primarily, by atom substitutions or vacancies in the crystal lattice.

The principal use of ground mica is in gypsum wallboard joint compound, where it acts as a filler and extender, provides a smoother consistency, improves workability, and prevents cracking. In the paint industry, ground mica is used as a pigment extender which also facilitates suspension due to its light weight and platy morphology. The ground mica also reduces checking and chalking, prevents shrinkage and shearing of the paint film, provides increased resistance to water penetration and weathering, and brightens the tone of coloured pigments. Ground mica also is used in the well-drilling industry as an additive to drilling *muds*.

The plastic industry uses ground mica as an extender and filler and also as a reinforcing agent. The rubber industry uses ground mica as an inert filler and as a mould lubricant in the manufacture of moulded rubber products, including tires.

Sheet mica is used principally in the electronic and electrical industries. The major uses of sheet and block mica are as electrical insulators in electronic equipment, thermal insulation, gauge ‘glass’, windows in stove and kerosene heaters, dielectrics in capacitors, decorative panels in lamps and windows, insulation in electric motors and generator armatures, field coil insulation, and magnet and commutator core insulation.

Illite also includes glauconite (a green clay sand) and are the commonest clay minerals; formed by the decomposition of some micas and feldspars; predominant in marine clays and shales.

Appendix 3. Water Quality Results

Table 11: Drinking water quality guidelines (NHMRC 2011; ANZECC/ARMCANZ 2000)

Parameter	Australian drinking water guidelines (NHMRC 2011 updated March 2021)		Livestock drinking water guidelines (ANZECC/ARMCANZ 2000)
	Health-based (mg/L)	Aesthetic (mg/L)	(mg/L)
Aluminium (Al); acid-soluble	-	0.2	5
Ammonia (NH3)	-	0.5	-
Antimony (Sb)	0.003	-	-
Arsenic (As)	0.01	-	0.5; up to 5 see Table 4.3.2 (ANZECC/ARMCANZ 2000)
Cadmium (Cd)	0.002	-	0.01
Calcium (Ca)	-	-	1000
Chloride (Cl^-)	-	250	-
Chlorine (Cl)	5	0.6	-
Chromium - total (Cr)	-	-	1
Chromium III (Cr^{3+})	-	-	-
Chromium VI (Cr^{6+})	0.05	-	-
Cobalt (Co)	-	-	1
Copper (Cu)	2	1	0.4 (sheep); 1 (cattle); 5 (pigs); 5 (poultry)
Electrical Conductivity (EC)	-	-	See Table 4.3.1 (ANZECC/ARMCANZ 2000)
Fluoride (F)	1.5	-	2
Iron (Fe)	-	0.3	-
Lead (Pb)	0.01	-	0.1
Magnesium (Mg)	-	-	ID
Manganese (Mn)	0.5	0.1	-
Molybdenum (Mo)	0.05	-	0.15
Nickel (Ni)	0.02	-	1
Nitrate (NO3)	50	-	400
Nitrite (NO2)	3	-	30
pH	-	6.5 - 8.5	-
Selenium (Se)	0.01	-	0.02
Silver (Ag)	0.1	-	-
Sodium (Na)	-	180	-
Sulphate (SO4)	-	250	1000
Turbidity (NTU)	-	5	-
Total Dissolved Solids (TDS)	-	600	2000 (poultry); 2500 (dairy cattle); 4000 (pigs, horses, beef cattle); 5000 (sheep) See Table 4.3.1 (ANZECC/ARMCANZ 2000)
Total Suspended Solids (TSS)	-	-	-
Zinc (Zn)	-	3	20

Table 12: Drinking water quality for individual residences for May 2020

		Sample ID	**SVWT 20200507**	**OCWT 20200507**	**EPHWT 20200506**	**EPSWT 20200506**	**BWWT 20200506**	**W1HT 20200506**	**W1ST 20200506**	**W2HT 20200506**	**W3HT 20200506**	**W3ST 20200506**	**CHHT-1 20200506**	**CHST 20200506**	**CHHT-2 20200506**
		Tank material	Concrete	Concrete	Plastic	Plastic	Concrete	Plastic	Concrete	Zincalume steel	Zincalume steel	Plastic	Plastic	Concrete	Concrete
		Tank type	House	House	House	Shed	House	House	Shed	House	House	Shed	House	Cottage	Paddock
		Sampled from	Back door tap	Garage tap	Kitchen tap	Tank tap	Yard tap	Kitchen tap	Poly outlet near tank	Back door tap	Tank tap	Tank tap	Tank tap	Tank tap	Tank tap
Parameter	***Unit***	***LOR***													
Conductivity, dissolved and suspended solids															
Electrical Conductivity	µS/cm	1	168	32	58	6	37	15	72	11	10	14	19	33	80
Total Dissolved Solids	mg/L	10	89	26	34	<10	30	<10	51	<10	<10	10	<10	20	47
Suspended Solids	mg/L	5	<5	5	<5	10	6	7	7	<5	<5	6	<5	18	6
Alkalinity															
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1	74	3	25	<1	15	5	33	<1	<1	3	4	13	34
Dissolved major anions															
Sulphate as SO_4	mg/L	1	4	3	<1	<1	1	<1	<1	<1	<1	<1	<1	<1	1
Chloride	mg/L	1	1	<1	2	<1	<1	<1	2	<1	<1	<1	<1	<1	<1
Dissolved major cations															
Calcium	mg/L	1	19	<1	4	<1	6	1	8	<1	<1	2	<1	4	11
Magnesium	mg/L	1	<1	<1	2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Sodium	mg/L	1	2	<1	3	<1	<1	<1	2	<1	<1	<1	<1	<1	1
Potassium	mg/L	1	2	<1	<1	<1	<1	<1	2	<1	<1	<1	1	<1	2
Total metals															
Aluminium	mg/L	0.01	0.01	0.08	0.02	0.03	0.06	0.03	0.02	0.02	0.04	0.01	0.02	0.12	<0.01
Antimony	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	mg/L	0.0001	0.0001	0.0002	<0.0001	<0.0001	<0.0001	0.0002	0.0012	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001	<0.001	0.006	0.003	<0.001	<0.001	<0.001	<0.001	0.002	0.002	0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Sample ID			**SVWT 20200507**	**OCWT 20200507**	**EPHWT 20200506**	**EPSWT 20200506**	**BWWT 20200506**	**W1HT 20200506**	**W1ST 20200506**	**W2HT 20200506**	**W3HT 20200506**	**W3ST 20200506**	**CHHT-1 20200506**	**CHST 20200506**	**CHHT-2 20200506**
Tank material			Concrete	Concrete	Plastic	Plastic	Concrete	Plastic	Concrete	Zincalume steel	Zincalume steel	Plastic	Plastic	Concrete	Concrete
Tank type			House	House	House	Shed	House	House	Shed	House	House	Shed	House	Cottage	Paddock
Sampled from			Back door tap	Garage tap	Kitchen tap	Tank tap	Yard tap	Kitchen tap	Poly outlet near tank	Back door tap	Tank tap	Tank tap	Tank tap	Tank tap	Tank tap
Parameter	***Unit***	***LOR***													
Copper	mg/L	0.001	0.027	0.05	0.024	0.008	0.03	0.228	0.008	0.057	0.009	0.007	0.01	0.008	0.007
Lead	mg/L	0.001	<0.001	0.002	<0.001	<0.001	0.006	<0.001	0.001	<0.001	<0.001	<0.001	0.002	0.013	<0.001
Manganese	mg/L	0.001	0.021	0.061	0.003	0.028	0.005	0.006	0.021	0.049	0.036	0.014	0.022	0.025	0.004
Molybdenum	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	mg/L	0.001	0.002	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.001	<0.001	<0.001
Selenium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	mg/L	0.005	12.8	5.36	0.039	0.148	0.244	0.873	1.69	0.053	0.084	0.256	1.14	1.7	0.571
Iron	mg/L	0.05	<0.05	0.12	<0.05	0.15	0.42	<0.05	<0.05	0.09	<0.05	<0.05	<0.05	0.15	<0.05
Nutrients															
Nitrite as N	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrate as N	mg/L	0.01	2.22	2.1	0.62	0.3	0.48	0.23	0.7	0.75	0.57	0.63	0.55	0.57	1.27
Total Kjeldahl Nitrogen as N	mg/L	0.1	0.4	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.5	<0.1	<0.1	<0.1	0.2
Total Phosphorus as P	mg/L	0.01	0.03	0.05	0.03	0.01	0.02	0.02	0.01	0.02	0.03	0.02	0.07	0.07	0.09

Yellow shading indicates exceedance of Australian drinking water guidelines based on aesthetic (not health) risk. Orange shading indicates exceedance of health-based guidelines (NHMRC, 2011 updated March 2021).

Table 13: Farm dam and bore water quality for May 2020.

		Sample ID	**EPSW 20200506**	**WGSW 20200507**	**WASW 20200507**	**OCSW 20200507**	**TASW 20200507**	**BDSW 20200507**	**EPB 20200506**
		Source	Dam	Dam	Dam	Dam	Dam	Dam	Bore
Parameter	***Unit***	***LOR***							
Conductivity, dissolved and suspended solids									
Electrical Conductivity	µS/cm	1	58	332	109	533	160	156	329
Total Dissolved Solids	mg/L	10	55	270	80	384	133	160	190
Suspended Solids	mg/L	5	22	41	33	18	27	12	6
Alkalinity									
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1	2	112	40	57	63	73	178
Dissolved major anions									
Sulphate as SO_4	mg/L	1	6	26	<1	176	24	<1	5
Chloride	mg/L	1	4	14	7	15	6	5	8
Dissolved major cations									
Calcium	mg/L	1	1	15	5	42	14	10	31
Magnesium	mg/L	1	<1	6	2	17	6	5	18
Sodium	mg/L	1	3	9	3	24	5	3	14
Potassium	mg/L	1	4	43	13	12	17	8	6
Total metals									
Aluminium	mg/L	0.01	0.79	1.2	0.2	0.56	0.35	2.44	----
Antimony	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	----
Arsenic	mg/L	0.001	<0.001	0.007	<0.001	<0.001	0.002	0.002	----
Cadmium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	----
Chromium	mg/L	0.001	<0.001	0.002	<0.001	0.001	<0.001	0.002	----
Cobalt	mg/L	0.001	0.002	0.01	0.003	<0.001	0.005	0.004	----
Copper	mg/L	0.001	0.012	0.014	0.002	0.008	0.018	0.014	----
Lead	mg/L	0.001	<0.001	0.003	<0.001	<0.001	<0.001	<0.001	----
Manganese	mg/L	0.001	0.15	1.3	0.265	0.062	0.836	0.426	----
Molybdenum	mg/L	0.001	<0.001	0.003	<0.001	0.003	0.003	<0.001	----
Nickel	mg/L	0.001	<0.001	0.007	<0.001	0.002	0.003	0.002	----
Selenium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	----
Silver	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	----

		Sample ID	**EPSW 20200506**	**WGSW 20200507**	**WASW 20200507**	**OCSW 20200507**	**TASW 20200507**	**BDSW 20200507**	**EPB 20200506**
		Source	Dam	Dam	Dam	Dam	Dam	Dam	Bore
Parameter	***Unit***	***LOR***							
Zinc	mg/L	0.005	0.008	0.031	<0.005	0.082	0.021	0.023	----
Iron	mg/L	0.05	0.73	9.1	1.11	0.8	2.42	5.16	----
Nutrients									
Nitrite as N	mg/L	0.01	<0.01	0.08	<0.01	0.07	0.04	0.04	<0.01
Nitrate as N	mg/L	0.01	2.47	0.08	0.41	2.85	0.21	0.28	<0.01
Total Kjeldahl Nitrogen as N	mg/L	0.1	1.6	8.2	3.1	1.6	2.5	2.5	<0.1
Total Phosphorus as P	mg/L	0.01	0.06	1.22	0.22	0.15	0.35	0.19	0.08

All values are within trigger values for livestock drinking water (ANZECC/ARMCANZ, 2000).

Table 14: Drinking water quality for individual residences for Sep/Oct 2020

Sample ID			**SOUTHLOG_ HT_20200929**	**STOCKTON_HT_ 20200929**	**STOCKTON _UG_20200929**	**SHARP_HT_ 20200929**	**SHARP_W_ 20200929**	**WEEMALLA_HT _20200929**	**GG_ST_ 20200929**	**ARGLE_HT_ 20200929**	**EB_HT1_ 20200929**	**EB_BT_ 20200929**
Tank material			Plastic	Plastic	Concrete	Metal	Well	Concrete	Concrete	Concrete	Plastic	
Tank type			House	House	Underground	House	Well	Above ground	Shed	Underground	House	Bore
Sampled from			Pump tap	Tank	Manhole	Tank	Garden tap	Manhole	Manhole	Manhole	Pump tap	Garden tap
Parameter	***Unit***	***LOR***										
Conductivity, dissolved and suspended solids												
Electrical Conductivity	µS/cm	1	44	18	20	14	870	30	35	31	15	1680
Total Dissolved Solids	mg/L	10	26	10	12	<10	551	35	28	23	14	1020
Suspended Solids	mg/L	5	<5	<5	<5	<5	20	<5	<5	<5	<5	<5
Alkalinity												
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1	21	7	16	9	299	16	16	13	6	570
Major dissolved anions												
Sulphate as SO_4	mg/L	1	<1	<1	<1	<1	158	<1	<1	<1	<1	160
Chloride	mg/L	1	<1	<1	<1	<1	74	<1	<1	<1	<1	174
Major dissolved cations												
Calcium	mg/L	1	6	<1	1	<1	72	4	4	4	<1	135
Magnesium	mg/L	1	<1	<1	<1	<1	61	<1	<1	<1	<1	78
Sodium	mg/L	1	1	1	<1	<1	31	<1	<1	<1	<1	105
Potassium	mg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Total metals												
Aluminium	mg/L	0.01	0.01	0.03	<0.01	0.08	<0.01	0.02	<0.01	0.02	0.03	<0.01
Antimony	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002
Cadmium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	0.0004	<0.0001	<0.0001	0.0002	<0.0001	0.0025	<0.0001
Chromium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	0.004	0.071	0.002	0.237	0.033	<0.001	0.001	0.002	0.005	0.004
Lead	mg/L	0.001	0.002	0.003	<0.001	0.014	<0.001	<0.001	0.001	<0.001	0.003	<0.001
Manganese	mg/L	0.001	0.004	0.004	0.006	0.007	0.445	0.006	0.003	0.008	0.006	0.039
Molybdenum	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001

Sample ID			**SOUTHLOG_HT_20200929**	**STOCKTON_HT_20200929**	**STOCKTON_UG_20200929**	**SHARP_HT_20200929**	**SHARP_W_20200929**	**WEEMALLA_HT_20200929**	**GG_ST_20200929**	**ARGLE_HT_20200929**	**EB_HT1_20200929**	**EB_BT_20200929**
Tank material			Plastic	Plastic	Concrete	Metal	Well	Concrete	Concrete	Concrete	Plastic	
Tank type			House	House	Underground	House	Well	Above ground	Shed	Underground	House	Bore
Sampled from			Pump tap	Tank	Manhole	Tank	Garden tap	Manhole	Manhole	Manhole	Pump tap	Garden tap
Parameter	***Unit***	***LOR***										
Selenium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	mg/L	0.005	1.46	3.17	1.77	0.819	0.737	0.123	1.78	0.441	2.17	7.23
Iron	mg/L	0.05	<0.05	<0.05	<0.05	2.02	4.77	<0.05	<0.05	<0.05	<0.05	<0.05
Nutrients												
Nitrite as N	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01	0.01
Nitrate as N	mg/L	0.01	0.46	0.33	0.47	0.65	0.47	0.48	0.8	1.39	0.31	7.45
Total Kjeldahl Nitrogen as N	mg/L	0.1	<0.1	<0.1	0.1	0.2	<0.1	<0.1	0.3	0.2	0.2	0.5
Total Phosphorus as P	mg/L	0.01	0.01	<0.01	<0.01	0.08	<0.01	<0.01	<0.01	0.02	0.02	0.02

Yellow shading indicates exceedance of Australian drinking water guidelines based on aesthetic (not health) risk. Orange shading indicates exceedance of health-based guidelines (NHMRC, 2011 updated March 2021).

Table 15: Drinking water quality for individual residences for Sep/Oct 2020

Sample ID			**RV_HT_ 20201001**	**RV_KT_ 20201001**	**RV_KTHOT_ 20201001**	**MERIBAH_HT_ 20201001**	**NW_HT_ 20201001**	**NW_TAP_ 20201001**	**WALLABY_T1_ 20201002**	**WALLABY_T2_ 20201002**	**TP_HT_ 20201002**	**TP_ST_ 20201002**
Tank material			Concrete			Metal	Metal	Metal	Concrete	Plastic	Metal	Concrete
Tank location			Towards shed			House	House	House	Garage	Garage	House	Shed
Sampled from			House tap	Kitchen cold tap	Kitchen hot tap	Pump tap	Manhole	House tap	Manhole	Pump tap	Tank tap	Manhole
Parameter	***Unit***	***LOR***										
Conductivity, dissolved and suspended solids												
Electrical Conductivity	µS/cm	1	24	30	26	62	25	26	20	14	12	28
Total Dissolved Solids	mg/L	10	15	17	20	36	19	14	12	11	<10	16
Suspended Solids	mg/L	5	<5	<5	<5	<5	<5	<5	<5	<5	37	<5
Alkalinity												
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1	9	11	10	29	14	11	8	2	<1	11
Major dissolved anions												
Sulphate as SO_4	mg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chloride	mg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Major dissolved cations												
Calcium	mg/L	1	3	4	3	11	3	3	2	2	<1	3
Magnesium	mg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Sodium	mg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Potassium	mg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Total metals												
Aluminium	mg/L	0.01	<0.01	0.02	<0.01	0.06	0.01	0.01	0.03	0.02	0.12	0.01
Antimony	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	mg/L	0.0001	0.0001	<0.0001	0.0001	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0005
Chromium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	<0.001
Cobalt	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	0.002	1.13	0.128	0.013	<0.001	0.01	0.002	0.009	0.016	0.002
Lead	mg/L	0.001	<0.001	<0.001	<0.001	0.003	<0.001	<0.001	<0.001	0.001	0.006	<0.001
Manganese	mg/L	0.001	0.003	0.001	0.003	0.013	0.008	0.007	0.012	0.005	0.014	0.003
Molybdenum	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Sample ID			**RV_HT_ 20201001**	**RV_KT_ 20201001**	**RV_KTHOT_ 20201001**	**MERIBAH_HT_ 20201001**	**NW_HT_ 20201001**	**NW_TAP_ 20201001**	**WALLABY_T1_ 20201002**	**WALLABY_T2_ 20201002**	**TP_HT_ 20201002**	**TP_ST_ 20201002**
Tank material			Concrete			Metal	Metal	Metal	Concrete	Plastic	Metal	Concrete
Tank location			Towards shed			House	House	House	Garage	Garage	House	Shed
Sampled from			House tap	Kitchen cold tap	Kitchen hot tap	Pump tap	Manhole	House tap	Manhole	Pump tap	Tank tap	Manhole
Parameter	***Unit***	***LOR***										
Selenium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	mg/L	0.005	0.663	0.106	0.685	0.223	0.135	0.128	0.208	0.224	0.069	1.43
Iron	mg/L	0.05	<0.05	0.11	<0.05	0.08	0.09	0.1	0.05	<0.05	0.13	<0.05
Nutrients												
Nitrite as N	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrate as N	mg/L	0.01	0.49	0.21	0.43	0.36	0.23	0.23	0.25	0.25	0.15	0.41
Total Kjeldahl Nitrogen as N	mg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	0.3	0.3
Total Phosphorus as P	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.01	0.12

Yellow shading indicates exceedance of Australian drinking water guidelines based on aesthetic (not health) risk. Orange shading indicates exceedance of health-based guidelines (NHMRC, 2011 updated March 2021).

Table 16: Drinking water quality for individual residences for Sep/Oct 2020

Sample ID			BRAEBURN_HT_20200930	CARRAMAR_HT1_20200930	CARRAMAR_HT2_20200930	CHESNEY_HT_20200930	MIAWARRA_HT_20201001	MIAWARRA_T2_20201001	MIAWARRA_T3_20201001	MIAWARRA_ST_20201001
Tank material				Plastic	Plastic	Concrete	Concrete	Concrete	Concrete	Plastic
Tank location				House	Shearing shed	Underground	House	On hill - left	On hill - right	Shed
Sampled from			Kitchen tap	Hose from tank	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole
Parameter	***Unit***	***LOR***								
Conductivity, dissolved and suspended solids										
Electrical Conductivity	µS/cm	1	63	11	10	26	34	49	34	12
Total Dissolved Solids	mg/L	10	48	<10	<10	13	22	29	22	<10
Suspended Solids	mg/L	5	<5	8	<5	<5	<5	<5	<5	<5
Alkalinity										
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1	31	2	2	10	15	22	15	<1
Major dissolved anions										
Sulphate as SO_4	mg/L	1	2	1	<1	<1	<1	<1	<1	<1
Chloride	mg/L	1	<1	<1	<1	<1	<1	<1	<1	<1
Major dissolved cations										
Calcium	mg/L	1	10	<1	<1	3	4	6	3	<1
Magnesium	mg/L	1	<1	<1	<1	<1	<1	<1	<1	<1
Sodium	mg/L	1	<1	<1	<1	<1	<1	1	<1	<1
Potassium	mg/L	1	<1	<1	<1	<1	<1	1	<1	<1
Total metals										
Aluminium	mg/L	0.01	0.01	0.02	<0.01	<0.01	0.01	0.02	<0.01	0.04
Antimony	mg/L	0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	mg/L	0.0001	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001	<0.001	0.004	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	0.014	0.007	<0.001	0.001	0.003	0.001	0.001	0.004
Lead	mg/L	0.001	0.003	<0.001	0.002	<0.001	0.004	<0.001	0.002	<0.001
Manganese	mg/L	0.001	0.004	0.016	0.003	0.01	0.003	0.003	0.004	0.011
Molybdenum	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

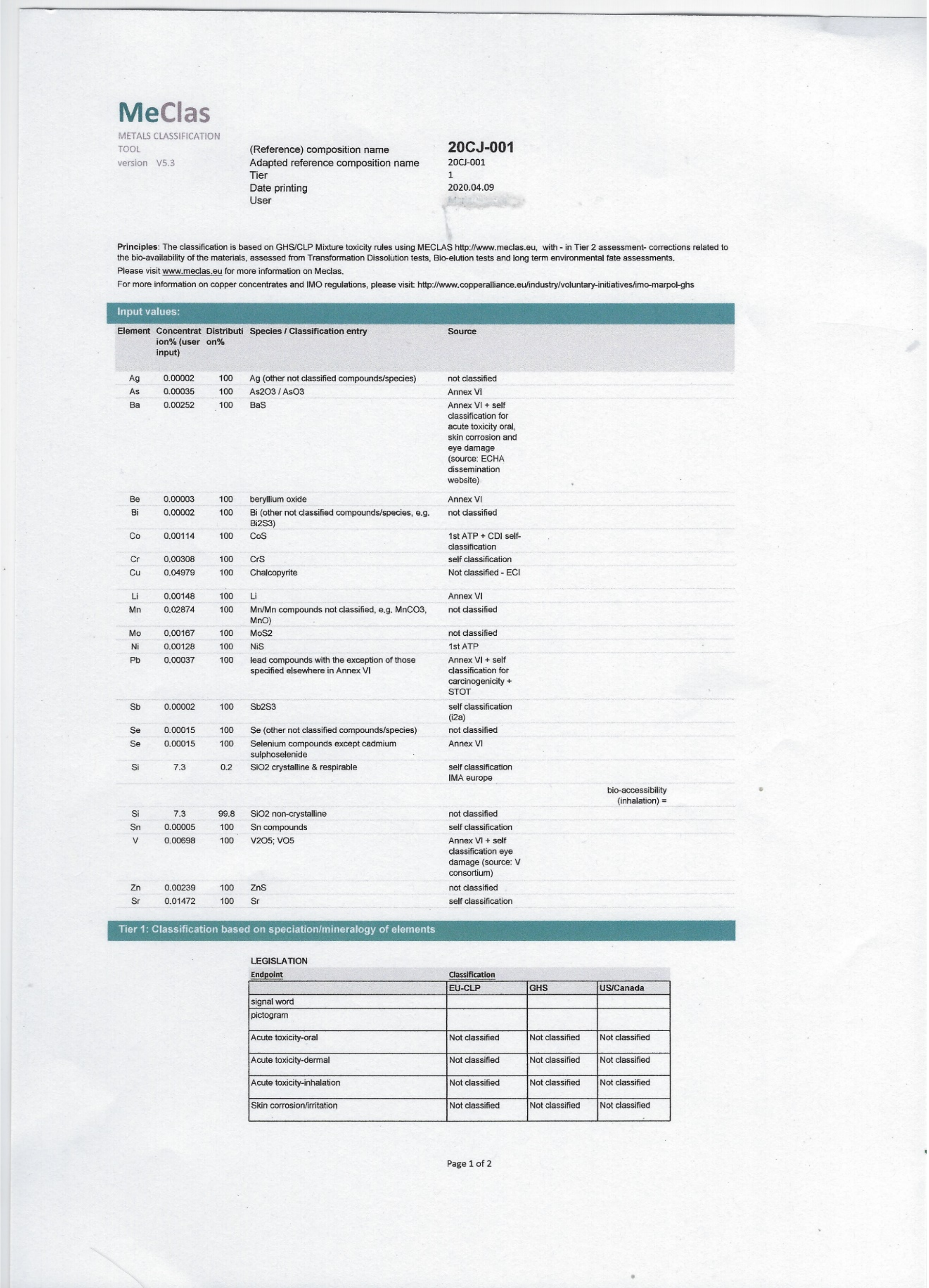
		Sample ID	**BRAEBURN_HT_20200930**	**CARRAMAR_HT1_20200930**	**CARRAMAR_HT2_20200930**	**CHESNEY_HT_20200930**	**MIAWARRA_HT_20201001**	**MIAWARRA_T2_20201001**	**MIAWARRA_T3_20201001**	**MIAWARRA_ST_20201001**
		Tank material		Plastic	Plastic	Concrete	Concrete	Concrete	Concrete	Plastic
		Tank location		House	Shearing shed	Underground	House	On hill - left	On hill - right	Shed
		Sampled from	Kitchen tap	Hose from tank	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole
Parameter	***Unit***	***LOR***								
Selenium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	mg/L	0.005	1.03	0.553	2.01	2.3	0.316	1.32	2.57	0.177
Iron	mg/L	0.05	0.13	0.11	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nutrients										
Nitrite as N	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrate as N	mg/L	0.01	0.21	0.47	0.43	0.31	0.59	0.58	0.39	0.41
Total Kjeldahl Nitrogen as N	mg/L	0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1
Total Phosphorus as P	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.04	<0.01	<0.01

Yellow shading indicates exceedance of Australian drinking water guidelines based on aesthetic (not health) risk. Orange shading indicates exceedance of health-based guidelines (NHMRC, 2011 updated March 2021).

Table 17: Drinking water quality for individual residences for repeat samples (Dec 2020 and Jan 2021)

		Sample ID	**SHARP_W _20210108**	**SHARP_HT _20210108**	**CHHT _20201223**	**CHPT _20201223**	**CHCT _20201223**
		Tank material	Well	Metal	Plastic	Concrete	Concrete
		Tank location	Well	House	House	Paddock	Cottage
		Sampled from	Garden tap	Tank	Tank tap	Tank tap	Tank tap
Parameter	***Unit***	***LOR***					
Total metals							
Aluminium	mg/L	0.01	<0.01	<0.01	0.01	<0.01	<0.01
Antimony	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	mg/L	0.0001	<0.0001	0.0002	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	0.008	0.039	0.018	<0.001	<0.001
Lead	mg/L	0.001	<0.001	0.001	0.005	<0.001	<0.001
Manganese	mg/L	0.001	0.016	0.009	0.043	0.004	0.023
Molybdenum	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	mg/L	0.001	<0.001	<0.001	0.087	<0.001	<0.001
Selenium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	mg/L	0.005	0.043	0.441	1.51	0.465	1.46
Iron	mg/L	0.05	0.11	0.06	0.05	<0.05	<0.05

Appendix 4. MeClas Classification of the Tailings Based on Metal Composition



MeClas
METALS CLASSIFICATION
TOOL
version V5.3

(Reference) composition name **20CJ-001**
Adapted reference composition name 20CJ-001
Tier 1
Date printing 2020.04.09
User [redacted]

Principles: The classification is based on GHS/CLP Mixture toxicity rules using MECLAS http://www.meclas.eu, with - in Tier 2 assessment- corrections related to the bio-availability of the materials, assessed from Transformation Dissolution tests, Bio-elution tests and long term environmental fate assessments.

Please visit www.meclas.eu for more information on Meclas.

For more information on copper concentrates and IMO regulations, please visit: http://www.copperalliance.eu/industry/voluntary-initiatives/imo-marpol-ghs

Input values:

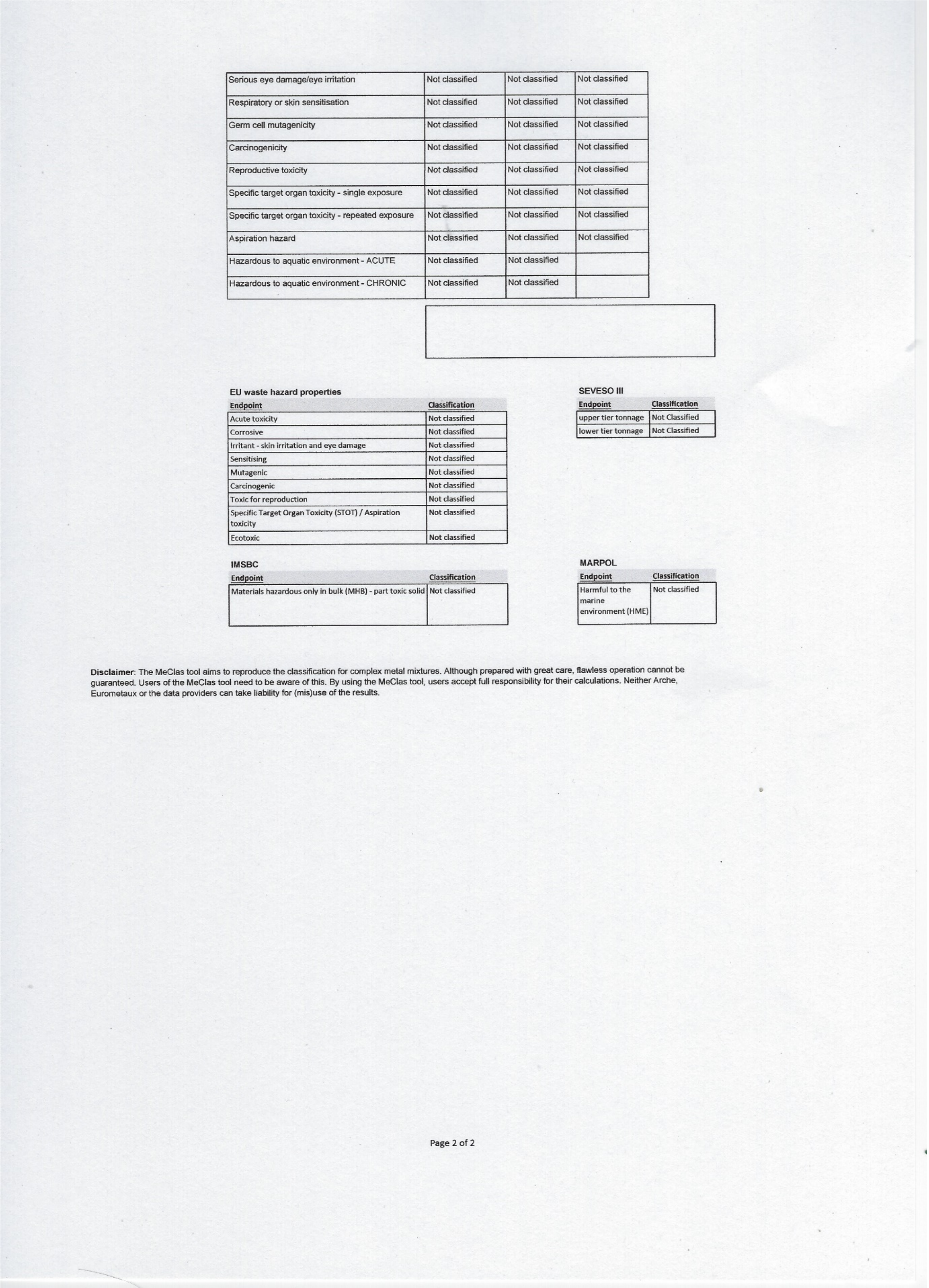
Element	Concentration% (user input)	Distribution%	Species / Classification entry	Source	
Ag	0.00002	100	Ag (other not classified compounds/species)	not classified	
As	0.00035	100	As2O3 / AsO3	Annex VI	
Ba	0.00252	100	BaS	Annex VI + self classification for acute toxicity oral, skin corrosion and eye damage (source: ECHA dissemination website)	
Be	0.00003	100	beryllium oxide	Annex VI	
Bi	0.00002	100	Bi (other not classified compounds/species, e.g. Bi2S3)	not classified	
Co	0.00114	100	CoS	1st ATP + CDI self-classification	
Cr	0.00308	100	CrS	self classification	
Cu	0.04979	100	Chalcopyrite	Not classified - ECI	
Li	0.00148	100	Li	Annex VI	
Mn	0.02874	100	Mn/Mn compounds not classified, e.g. MnCO3, MnO)	not classified	
Mo	0.00167	100	MoS2	not classified	
Ni	0.00128	100	NiS	1st ATP	
Pb	0.00037	100	lead compounds with the exception of those specified elsewhere in Annex VI	Annex VI + self classification for carcinogenicity + STOT	
Sb	0.00002	100	Sb2S3	self classification (i2a)	
Se	0.00015	100	Se (other not classified compounds/species)	not classified	
Se	0.00015	100	Selenium compounds except cadmium sulphoselenide	Annex VI	
Si	7.3	0.2	SiO2 crystalline & respirable	self classification IMA europe	
					bio-accessibility (inhalation) =
Si	7.3	99.8	SiO2 non-crystalline	not classified	
Sn	0.00005	100	Sn compounds	self classification	
V	0.00698	100	V2O5; VO5	Annex VI + self classification eye damage (source: V consortium)	
Zn	0.00239	100	ZnS	not classified	
Sr	0.01472	100	Sr	self classification	

Tier 1: Classification based on speciation/mineralogy of elements

LEGISLATION

Endpoint	Classification		
	EU-CLP	GHS	US/Canada
signal word			
pictogram			
Acute toxicity-oral	Not classified	Not classified	Not classified
Acute toxicity-dermal	Not classified	Not classified	Not classified
Acute toxicity-inhalation	Not classified	Not classified	Not classified
Skin corrosion/irritation	Not classified	Not classified	Not classified

Page 1 of 2



Serious eye damage/eye irritation	Not classified	Not classified	Not classified
Respiratory or skin sensitisation	Not classified	Not classified	Not classified
Germ cell mutagenicity	Not classified	Not classified	Not classified
Carcinogenicity	Not classified	Not classified	Not classified
Reproductive toxicity	Not classified	Not classified	Not classified
Specific target organ toxicity - single exposure	Not classified	Not classified	Not classified
Specific target organ toxicity - repeated exposure	Not classified	Not classified	Not classified
Aspiration hazard	Not classified	Not classified	Not classified
Hazardous to aquatic environment - ACUTE	Not classified	Not classified	
Hazardous to aquatic environment - CHRONIC	Not classified	Not classified	

EU waste hazard properties

Endpoint	Classification
Acute toxicity	Not classified
Corrosive	Not classified
Irritant - skin irritation and eye damage	Not classified
Sensitising	Not classified
Mutagenic	Not classified
Carcinogenic	Not classified
Toxic for reproduction	Not classified
Specific Target Organ Toxicity (STOT) / Aspiration toxicity	Not classified
Ecotoxic	Not classified

SEVESO III

Endpoint	Classification
upper tier tonnage	Not Classified
lower tier tonnage	Not Classified

IMSBC

Endpoint	Classification
Materials hazardous only in bulk (MHB) - part toxic solid	Not classified

MARPOL

Endpoint	Classification
Harmful to the marine environment (HME)	Not classified

Disclaimer: The MeClas tool aims to reproduce the classification for complex metal mixtures. Although prepared with great care, flawless operation cannot be guaranteed. Users of the MeClas tool need to be aware of this. By using the MeClas tool, users accept full responsibility for their calculations. Neither Arche, Eurometaux or the data providers can take liability for (mis)use of the results.

Disclaimer

This report is specifically intended for the use of the Newcrest Mining Limited, CVO. The advice and recommendations contained in this report are based on advice and information obtained during the consultancy at CVO. Callander and Johnson Consultancy Services believe that the information herein is accurate and reliable as well as provided in good faith.

May 2020

Appendix C. Todoroski Air Sciences reports

TODOROSKI
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Web: www.airsciences.com.au
ACN: 151 202 765 | ABN: 74 955 076 914

26 May 2020

Tim Wrigley
Environmental Specialist – Cadia Valley Operations
Newcrest Mining
Via email: Tim.Wrigley@newcrest.com.au

RE: Cadia Valley Operations – Ventilation shaft air dispersion modelling

Dear Tim,

Todoroski Air Sciences has completed air dispersion modelling of the ventilation shafts at Cadia Valley Operations. The aim of the air dispersion modelling is to identify potential areas of off-site impact to locate ambient air quality monitors.

The CALPUFF air dispersion model was used in conjunction with meteorological data for the 2018 calendar period. The ventilation shaft modelling parameters are outlined in **Table 1**. Additional assumptions applied include an exit temperature of 25 degrees Celsius and a dust concentration of 4.715mg/m^3 to estimate the mass emission rate from each ventilation shaft.

Table 1: Summary of ventilation shaft parameters

Ventilation shaft ID	Height (m)	Diameter (m)	Exit velocity (m/s)
VR3-0	5.6	4.5	18.86
VR5-0	5.6	5	20.37
VR7-0	5.6	6	15.91
VR8-0	5.6	6	15.91

The modelling predictions are presented as isopleth diagrams in **Figure 1** to **Figure 3** showing the maximum 1-hour, 24-hour and annual average concentrations. The modelling indicates that the greatest off-site impacts occur to the east-northeast and northeast of the ventilation sources.

Please feel free to contact us if you would like to clarify any aspect of this letter.

Yours faithfully,
Todoroski Air Sciences

Philip Henschke

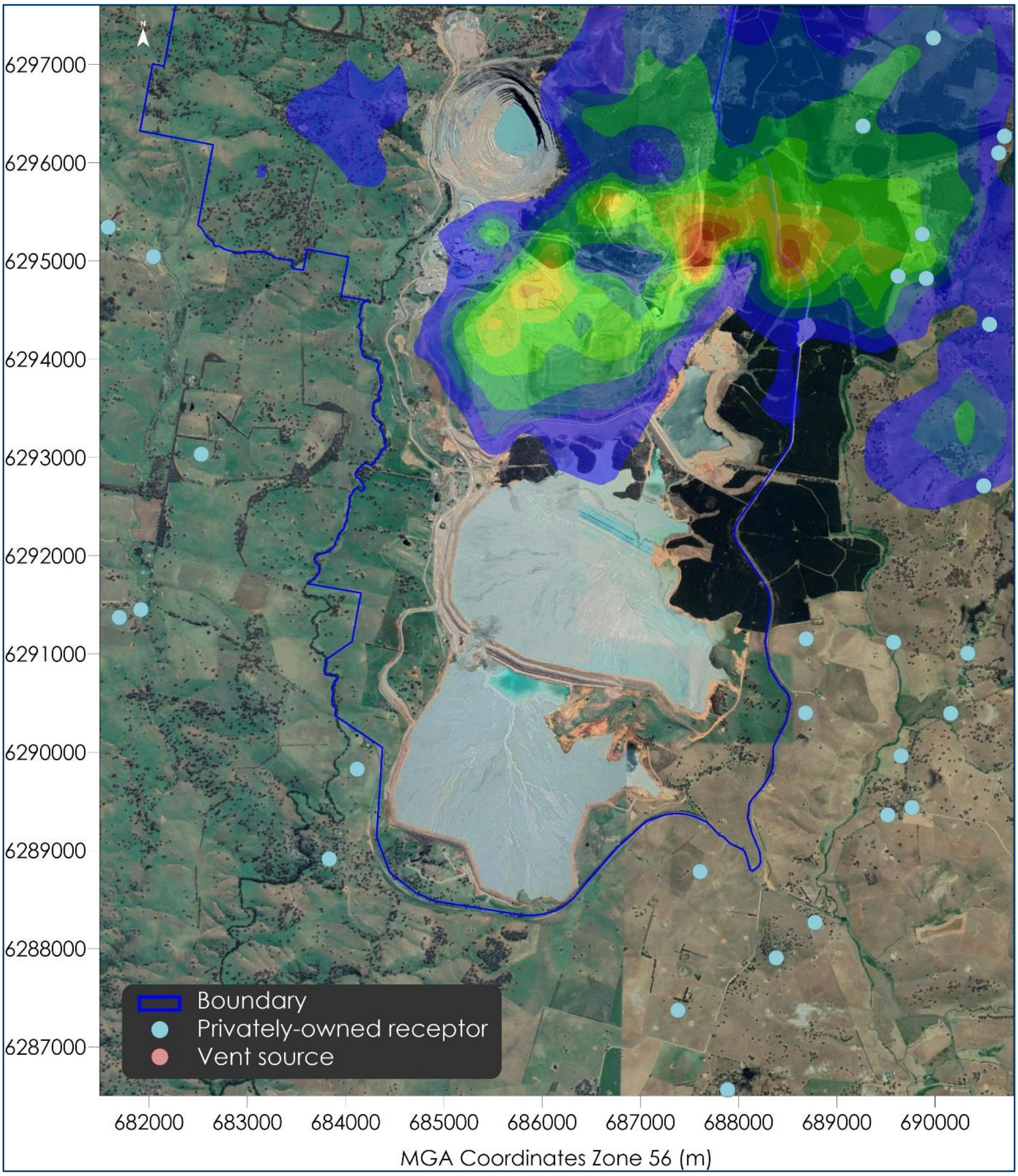

Figure 1: Predicted maximum 1-hour average levels

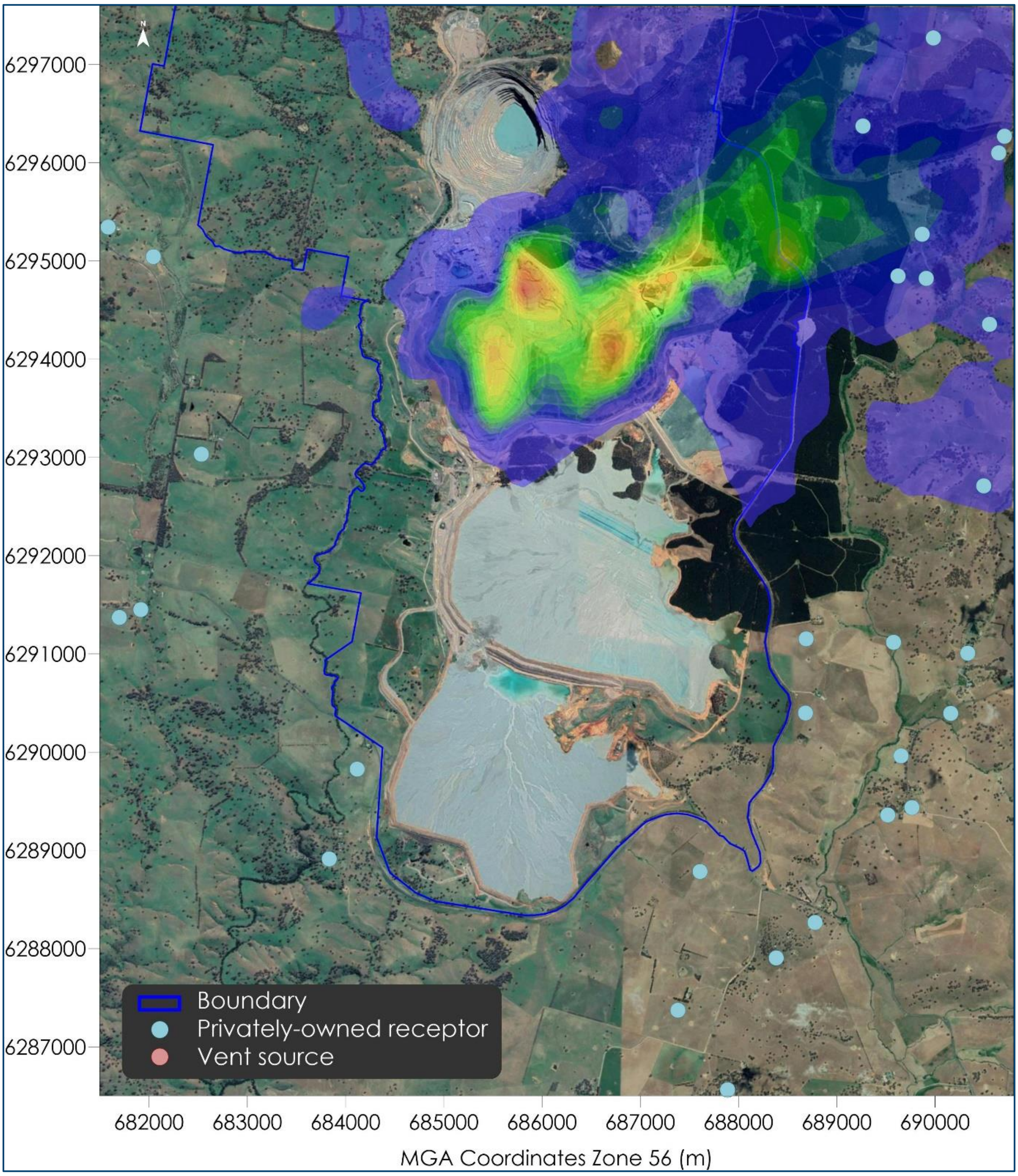

Figure 2: Predicted maximum 24-hour average levels

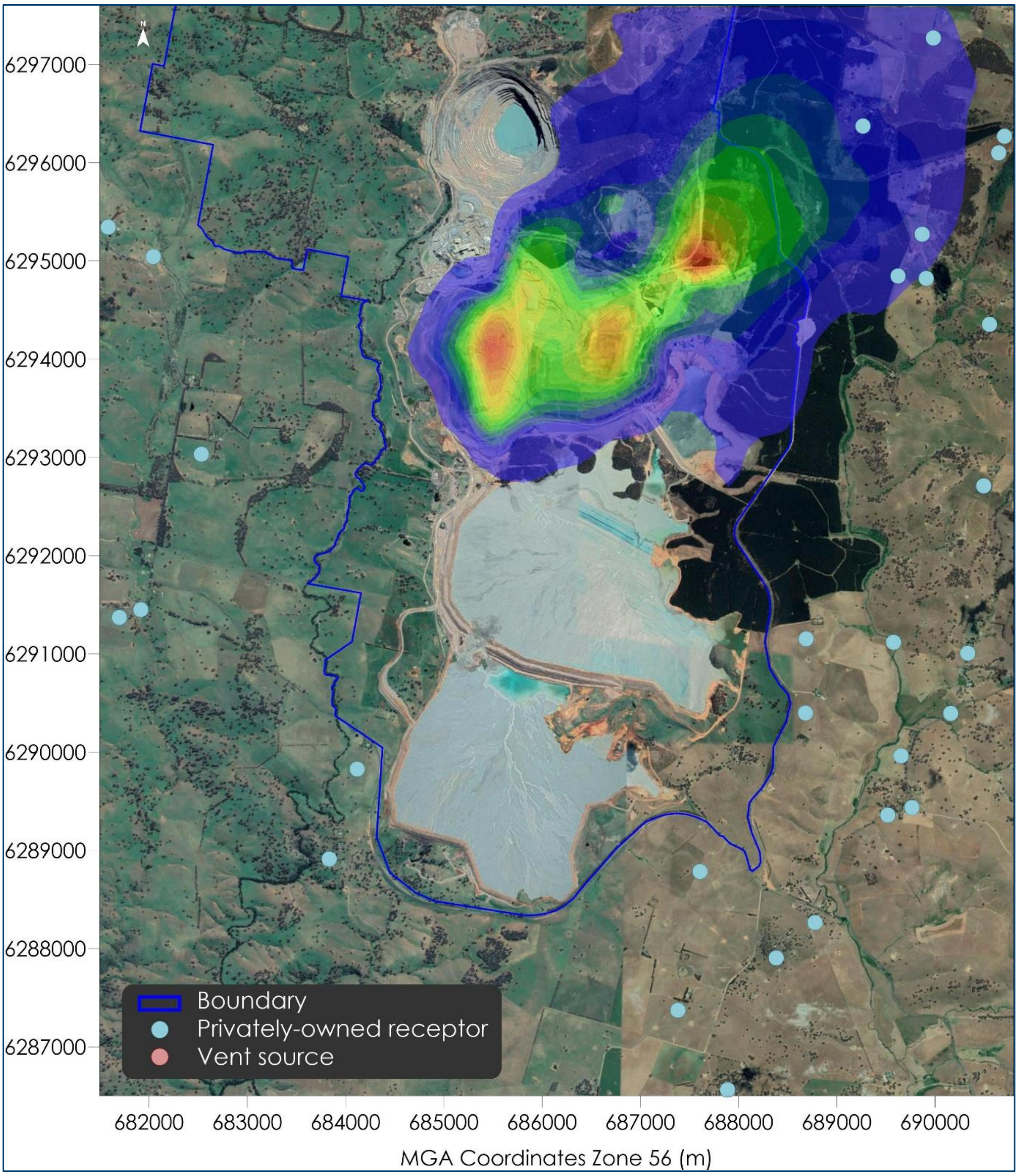

Figure 3: Predicted annual average levels

AIR QUALITY MONITORING PLAN

CADIA VALLEY OPERATION -

TAILINGS STORAGE FACILITY

Newcrest Mining Limited

9 June 2020

Job Number 19111036

Prepared by
Todoroski Air Sciences Pty Ltd
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Air Quality Monitoring Plan

Cadia Valley Operations –Tailings Storage Facility

DOCUMENT CONTROL

Report Version	Date	Prepared by	Reviewed by
DRAFT - 001	03/03/2020	K Trahair & P Henschke	
FINAL - 001	09/06/2020	P Henschke	

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

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1 INTRODUCTION

Todoroski Air Sciences has prepared this air quality monitoring plan on behalf of Newcrest Mining Limited (hereafter referred to as the Proponent). It outlines a monitoring plan to measure potential air emissions arising from the Tailings Storage Facility (TSF) located at Cadia Valley Operations (hereafter referred to as the Project).

In February 2018, a section of the Northern TSF wall slumped making the tailing storage facility unusable. Due to the inactivity the tailing storage facility has dried out and it is now susceptible to dust lift off during periods of elevated winds.

This air quality monitoring plan aims to assist with the quantification of dust emissions generated from the TSF.

2 LOCAL SETTING

Cadia Valley Operations is a gold and copper mining operation which involves both open pit and underground mining methods. The site is located approximately 22 kilometres (km) to the southwest of Orange and approximately 25km west-northwest of Blayney.

Figure 2-1 presents the Cadia Valley Operations indicating the location of the TSF, nearest mine-owned and privately owned residences.

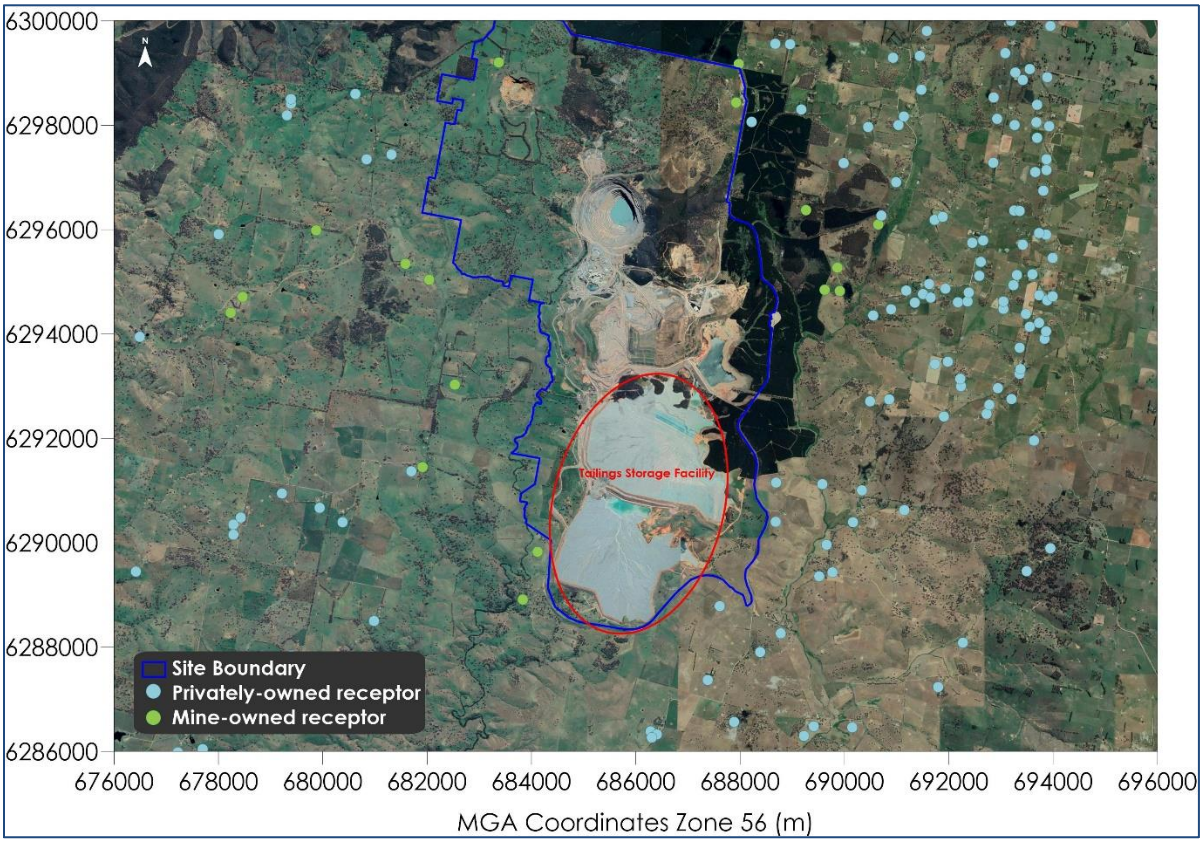


Figure 2-1: TSF location and nearest receptors

3 EXISTING ENVIRONMENT

This section reviews the available meteorological monitoring data and ambient air quality monitoring data sourced from the Cadia Valley Operations monitoring network. **Figure 3-1** shows the approximate location of each of the monitoring stations reviewed.

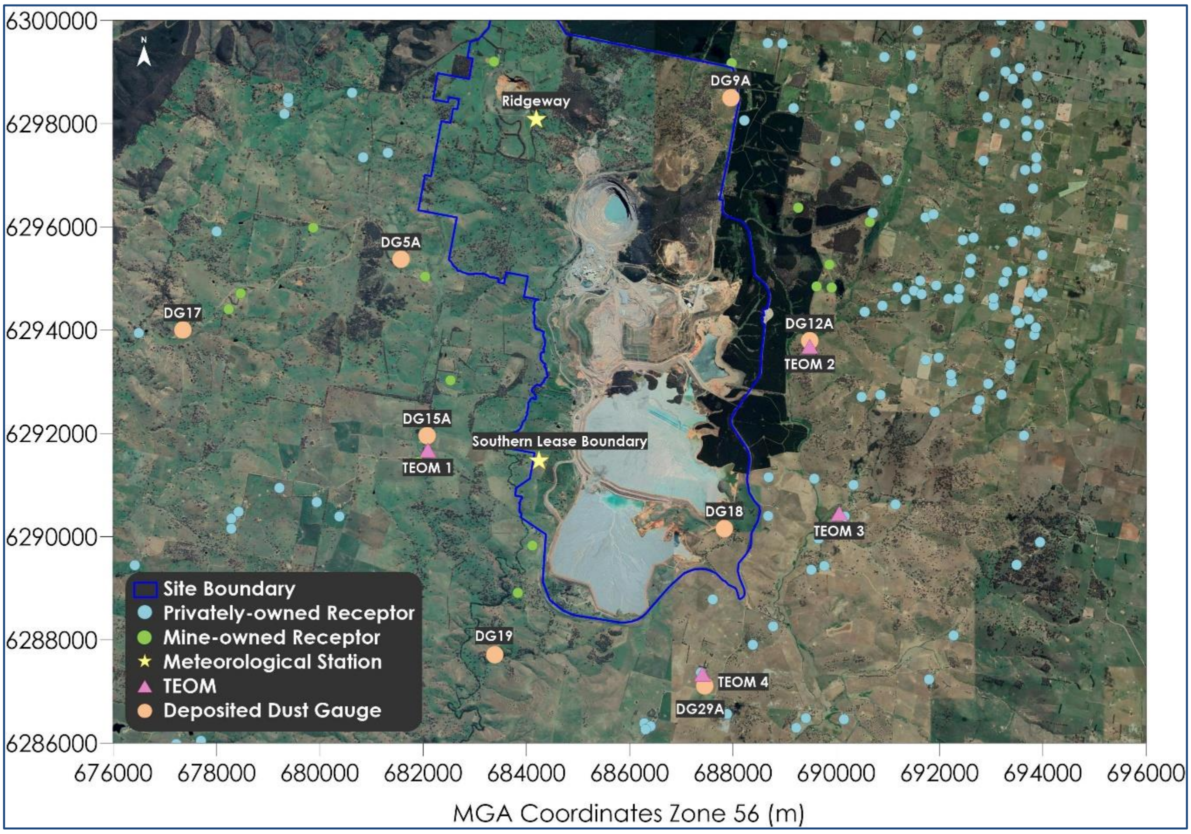


Figure 3-1: Existing air quality monitoring network

3.1 Local meteorological conditions

Cadia Valley Operations operate two on-site meteorological stations, Ridgeway and Southern Lease Boundary (SLB). The location of the meteorological stations is shown in **Figure 3-1**.

Figure 3-2 and **Figure 3-3** presents annual and seasonal windroses for the Ridgeway and SLB meteorological stations for the 2018 period, respectively. Analysis of the windroses show that on an annual basis the dominant wind at both stations is from the north, with both stations showing the predominant wind flows typically along a southwest to northeast axis.

At the Ridgeway station, the summer winds are predominately from the north and north-northeast. The autumn and spring wind distribution is similar to the annual distribution with winds from the north, southwest and northeast quadrant. During winter, winds are primarily from the north and west-southwest.

Wind from the north is a feature in all seasons at the SLB station. During summer winds from the northeast are most predominant. Similar to the Ridgeway station, the autumn and spring wind distribution is similar to the annual distribution. In winter winds occur from the north and northwest quadrants.

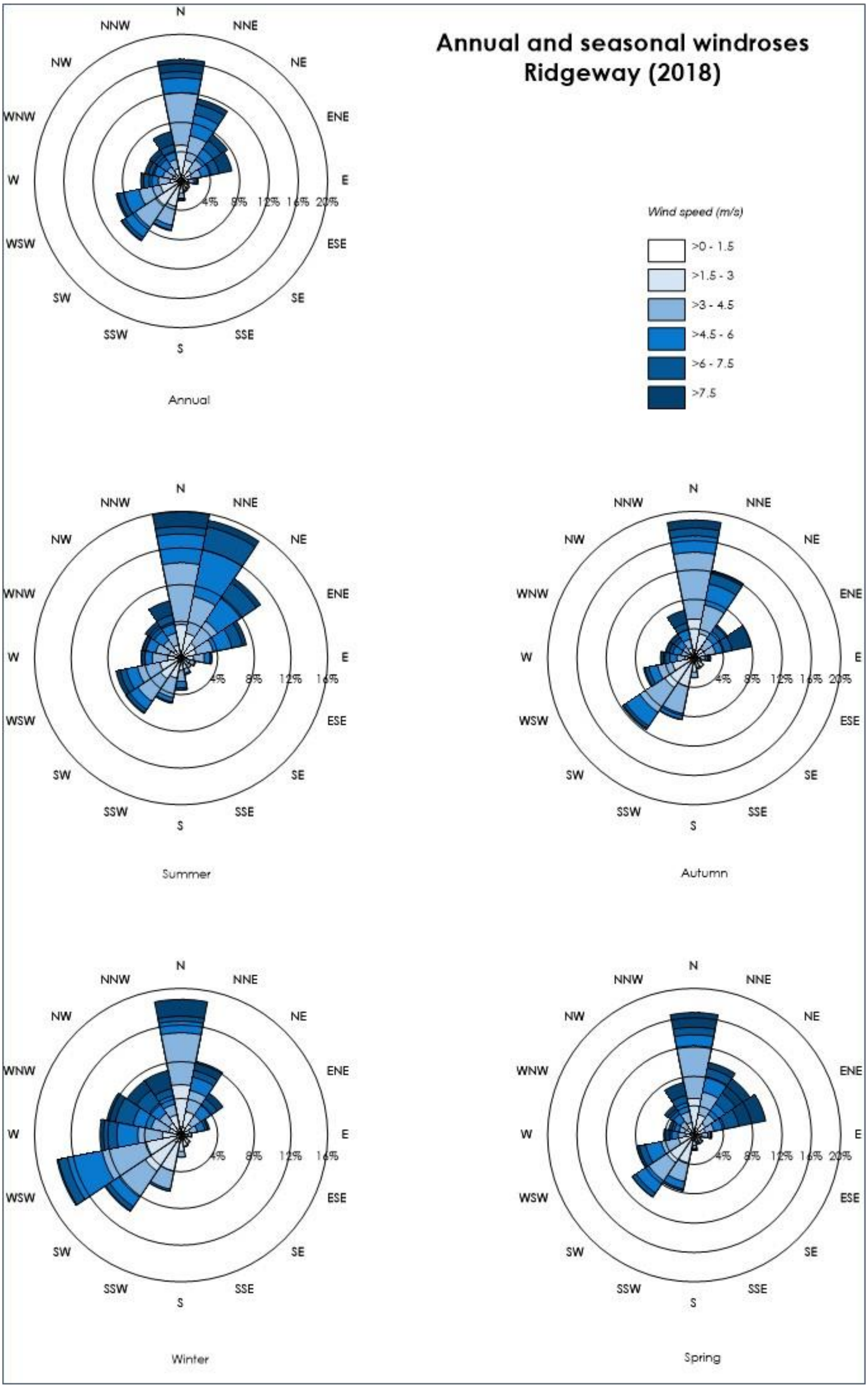


Figure 3-2: Ridgeway annual and seasonal windroses (2018)

Figure 3-3: Southern Lease Boundary annual and seasonal windroses (2018)

3.2 Local air quality monitoring

Cadia Valley Operations operate a range of ambient air quality monitors that assist with the ongoing environmental management of the operations.

Table 3-1 lists the monitoring stations reviewed in this section. The air quality monitors include Tapered Element Oscillating Microbalances (TEOMs) and dust deposition gauges. **Figure 3-1** shows the approximate location of each of the monitoring stations reviewed.

Table 3-1: Existing ambient air quality monitors

ID	Property name	Monitor type	Parameter monitored
TEOM 1	Flyers Creek Weir	TEOM	PM_{10}
TEOM 2	Bundarra	TEOM	PM_{10}
TEOM 3	Triangle Flat	TEOM	PM_{10}
TEOM 4	Meribah	TEOM	PM_{10}
DG5A	Bundella	Deposited dust gauge	Deposited dust, metals
DG9A	Exploration	Deposited dust gauge	Deposited dust, metals
DG12A	Flyers Creek Weir	Deposited dust gauge	Deposited dust, metals
DG15A	Bundarra	Deposited dust gauge	Deposited dust, metals
DG17	Ashleigh Park	Deposited dust gauge	Deposited dust, metals
DG18	Wire Gully	Deposited dust gauge	Deposited dust, metals
DG19	Oakey Creek	Deposited dust gauge	Deposited dust, metals
DG29A	Meribah	Deposited dust gauge	Deposited dust, metals

Recorded 24-hour average PM_{10} concentrations are presented graphically in **Figure 3-4**. The figure shows that the monitors typically record similar levels which suggest they are predominantly influenced by regional events. At other times, potential localised sources (such as mining activity) may have contributed to periods of elevated PM_{10} levels at individual monitors.

We note that dust levels appear to increase during 2018 and 2019 periods. During this time, NSW experienced drought conditions which would have contributed to the regional dust levels.

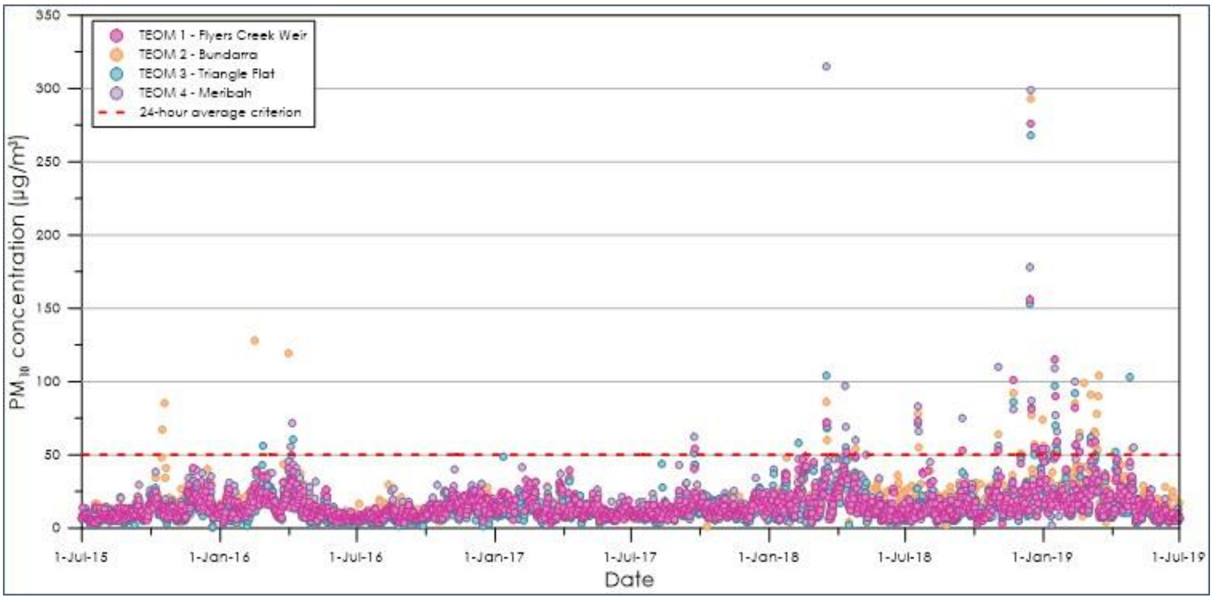


Figure 3-4: TEOM 24-hour average PM_{10} monitoring data ($\mu g/m^3$)

Figure 3-5 presents the monthly deposited dust levels recorded between July 2018 and June 2019. The graph indicates the dust deposition gauges typically recorded similar levels and suggests the monitors are subject to similar levels of monthly dust fallout.

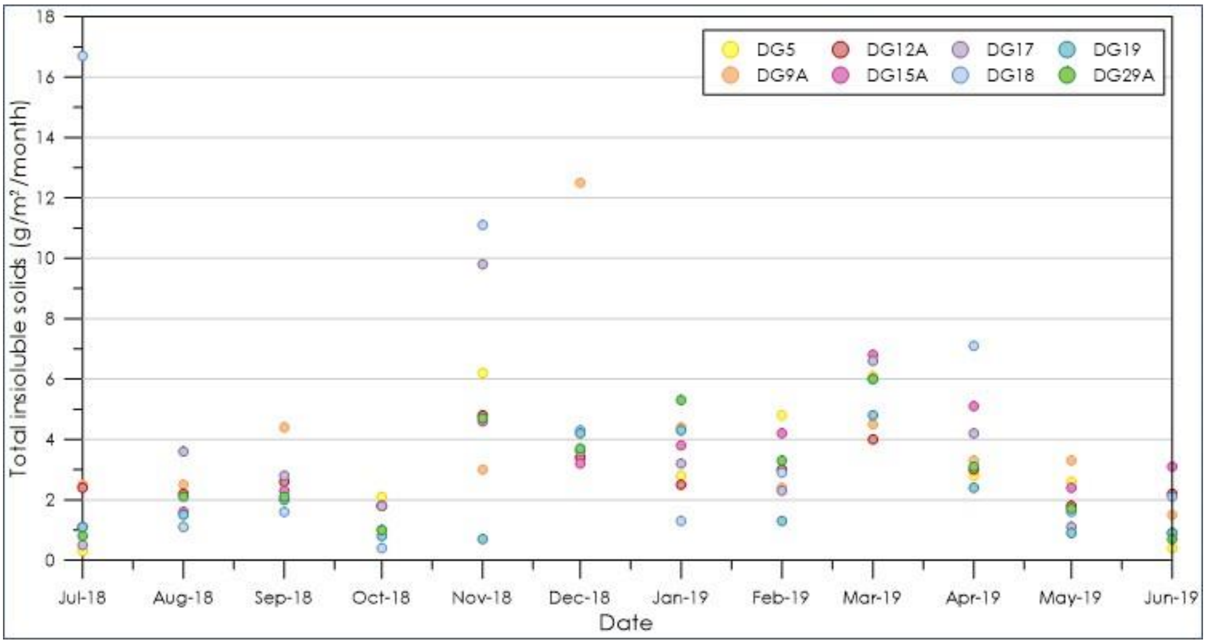


Figure 3-5: Deposited dust as insoluble solids monitoring data (g/m²/month)

Figure 3-6 presents the available copper levels measured in the monthly deposited dust levels. Data are available for December 2015, early 2017 and from mid-2018. The recorded copper levels in early 2017 are noticeable higher than the other periods reviewed. The results from mid-2018 do not show any clear trend in copper levels.

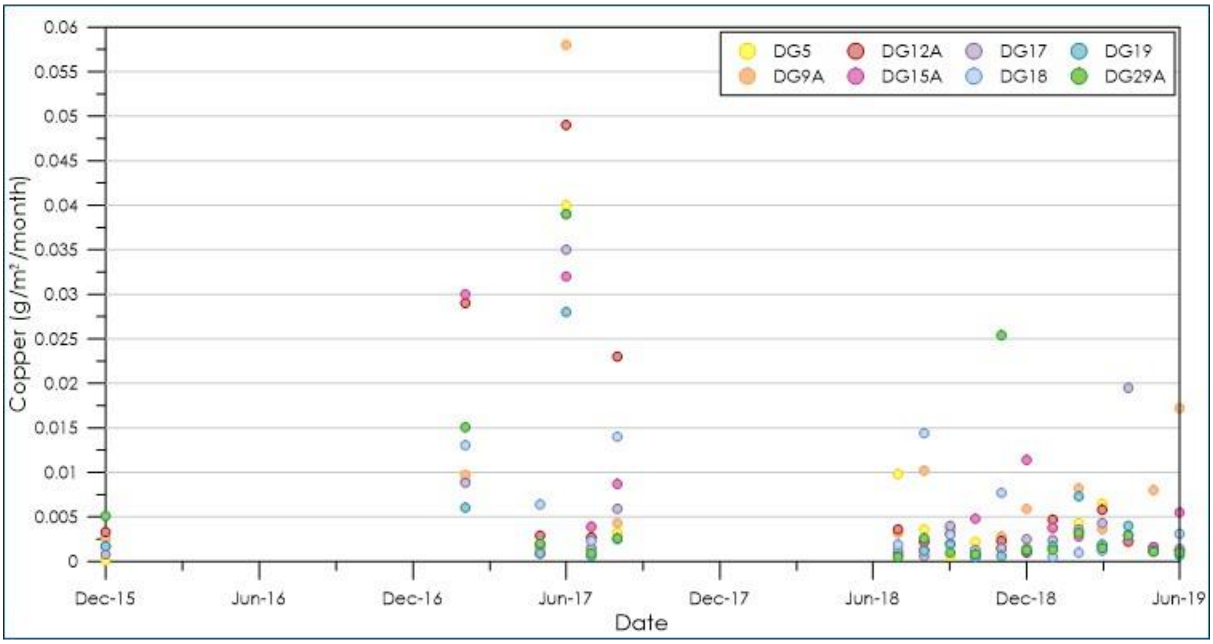


Figure 3-6: Copper levels in deposited dust monitoring data (g/m²/month)

4 RECOMMENDED AIR QUALITY MONITORING FOR THE TSF

The purpose of the air quality monitoring for the TSF is the measure the contribution of air emissions arising from the TSF and identify the constituents of the air emissions. The air quality monitoring would also be used to verify the environmental performance of any management measures adopted.

4.1 Monitoring methods and sampling instruments

Monitoring methods are to be undertaken per the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales* (**NSW DEC, 2007**) where applicable.

4.1.1 TEOM

The TEOM monitors are used to continuously measure concentrations of PM_{10}, as per the Australian Standard AS 3580.9.8: *Methods for sampling and analysis of ambient air – Determination of suspended particulate matter –* PM_{10} *continuous direct mass method using a tapered element oscillating microbalance analyser*.

4.1.2 Deposited dust gauges

Deposited dust is assessed as insoluble solids as defined by Standards Australia AS/NZS 3580.10.1: *Methods for sampling and analysis of ambient air – Determination of particulate matter – Deposited matter – Gravimetric Method*. Gravimetric analysis of the material collected in the dust gauge is conducted by a NATA accredited analytical laboratory to determine the total insoluble matter in g/m^2/month.

The samples are subsequently analysed for the determination of total base metal concentrations present in the insoluble matter.

4.1.3 HVAS

A HVAS is used to measure PM_{10} concentrations in the ambient air. HVAS monitoring is conducted approximately every 6 days for a 24-hour monitoring period in accordance with Australian Standard 3580.9.6: *Methods for sampling and analysis of ambient air – Determination of suspended particulate matter –* PM_{10} *high volume sampler with size selective inlet – gravimetric method*.

The samples are subsequently analysed for the determination of total base metal concentrations present in the captured particulate. The following analytes are recommended for the HVAS sample:

- Antimony
- Arsenic
- Barium
- Beryllium
- Boron
- Chromium
- Cobalt
- Copper
- Iron
- Lead
- Lithium
- Manganese
- Molybdenum
- Nickel
- Tin
- Selenium
- Silver
- Strontium
- Uranium
- Vanadium
- Zinc

4.1.4 Low Volume Air Sampler

A Low Volume Air Sampler (LVAS) is used to measure PM_4 and $PM_{2.5}$ concentrations in the ambient air. LVAS monitoring is conducted in accordance with Australian Standard 3580.9.9: *Methods for sampling and analysis of ambient air – Determination of suspended particulate matter –* $PM_{2.5}$ *low volume sampler with size selective inlet – gravimetric method*.

The LVAS samples are subsequently analysed for the determination of silica concentrations present in the captured particulate.

4.2 Monitoring locations

The recommended air quality monitoring locations for the TSF would be supplemented by the existing air quality monitoring network for Cadia Valley Operations.

In addition to the existing monitoring network, it is recommended to co-locate HVAS monitors at the existing TEOM monitoring stations. The HVAS monitors would be used to measure total base metal concentrations in the ambient air. The installation of the HVAS monitors in these locations will enable the upwind/ downwind assessment of contributions from the TSF. Co-locating these monitors with the TEOM will provide an indication of the hourly dust trends and can also be used to identify the potential origin of the measured base metals in the HVAS.

Two LVAS are recommended to be co-located with TEOM 2 and TEOM 4. These monitors will measure silica dust in the ambient air and will enable upwind/ downwind assessment of contributions from the TSF.

Metals analysed from the deposited dust gauges are recommended to be ongoing and will be used for analysis of any trends.

Table 4-1 outlines the recommended ambient air quality monitoring network. **Figure 4-1** shows the approximate location of each of the monitoring stations.

Table 4-1: Recommended ambient air quality monitoring network

ID	Property name	Monitor type	Parameter monitored
TEOM 1	Flyers Creek Weir	TEOM	PM_{10}
HVAS 1	Flyers Creek Weir	HVAS	PM_{10}, metals
TEOM 2	Bundarra	TEOM	PM_{10}
HVAS 2	Bundarra	HVAS	PM_{10}, metals
LVAS 2	Bundarra	LVAS	Silica
TEOM 3	Triangle Flat	TEOM	PM_{10}
HVAS 3	Triangle Flat	HVAS	PM_{10}, metals
TEOM 4	Meribah	TEOM	PM_{10}
HVAS 4	Meribah	HVAS	PM_{10}, metals
LVAS 4	Meribah	LVAS	Silica
DG5A	Bundella	Deposited dust gauge	Deposited dust, metals
DG9A	Exploration	Deposited dust gauge	Deposited dust, metals
DG12A	Flyers Creek Weir	Deposited dust gauge	Deposited dust, metals
DG15A	Bundarra	Deposited dust gauge	Deposited dust, metals
DG17	Ashleigh Park	Deposited dust gauge	Deposited dust, metals
DG18	Wire Gully	Deposited dust gauge	Deposited dust, metals
DG19	Oakey Creek	Deposited dust gauge	Deposited dust, metals

ID	Property name	Monitor type	Parameter monitored
DG29A	Meribah	Deposited dust gauge	Deposited dust, metals

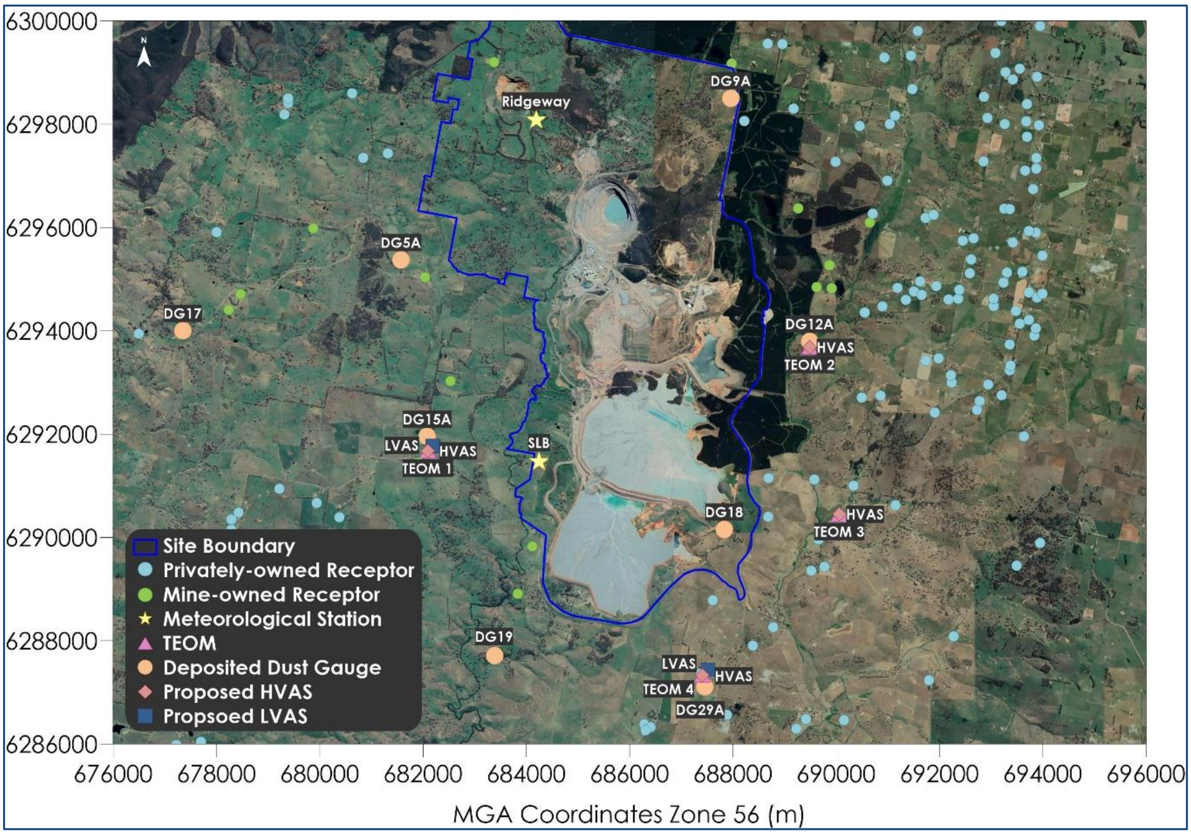


Figure 4-1: Recommended air quality monitoring network

4.3 Benchmarking of monitoring data

Table 4-2 presents the air quality criteria recommended to be used to benchmark the measured ambient air quality levels.

The NSW EPA document *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW EPA, 2017**) provides applicable criteria for ambient 24-hour average PM$_{10}$ and PM$_{2.5}$ concentrations and annual average TSP, PM$_{10}$, PM$_{2.5}$ and deposited dust levels.

We note that the recommended air quality monitoring does not include measurement of TSP. In this situation, levels of TSP can be estimated from the measured PM$_{10}$ concentrations assuming the relationship of the annual average TSP criteria of 90µg/m^3 corresponds to an annual average PM$_{10}$ criteria of 25µg/m^3.

The air quality criteria for metals are obtained from the Ontario Ministry of the Environment (MOE) document *Ontario's Ambient Air Quality Criteria* (**MOE, 2012**). The Approved Methods (**NSW EPA, 2017**) also has criteria for metals, however these are assessed on a 1-hour averaging period. When sampling ambient air quality, it is necessary to sample for a long enough period to capture a suitable amount of material for analysis. This can be achieved by sampling for a 24-hour period and be benchmarked against 24-hour average criteria, sampling for a 1-hour period will not provide enough sample for analysis.

Table 4-2: Ambient air quality criteria

Substance	Averaging period	Limit	Source
TSP	Annual	90µg/m^3	NSW EPA
PM$_{10}$	24-hour	50µg/m^3	NSW EPA
	Annual	25µg/m^3	NSW EPA
PM$_{2.5}$	24-hour	25µg/m^3	NSW EPA
	Annual	8µg/m^3	NSW EPA
Deposited dust	Annual	4g/m^2/month	NSW EPA
Antimony and compounds	24-hour	25 µg/m^3	MOE
Arsenic and compounds	24-hour	0.3 µg/m^3	MOE
Barium – total water soluble	24-hour	10 µg/m^3	MOE
Beryllium	24-hour	0.01 µg/m^3	MOE
Boron	24-hour	120 µg/m^3	MOE
Chromium (III) compounds	24-hour	0.5 µg/m^3	MOE
Chromium VI compounds	24-hour	0.00035 µg/m^3	MOE
Cobalt	24-hour	0.1 µg/m^3	MOE
Copper	24-hour	50 µg/m^3	MOE
Iron (metallic)	24-hour	4 µg/m^3	MOE
Lead (and compounds)	24-hour	0.5 µg/m^3	MOE
Lithium (other than hydrides)	24-hour	20 µg/m^3	MOE
Manganese and compounds	24-hour	0.2 µg/m^3	MOE
Molybdenum	24-hour	120 µg/m^3	MOE
Nickel (and compounds) in PM$_{10}$	24-hour	0.1 µg/m^3	MOE
Tin	24-hour	10 µg/m^3	MOE
Selenium	24-hour	10 µg/m^3	MOE
Silica – respirable (<10 µg diameter)	24-hour	5 µg/m^3	MOE
Silver	24-hour	1 µg/m^3	MOE
Strontium	24-hour	120 µg/m^3	MOE
Uranium	24-hour	0.15 (U in PM$_{10}$)	MOE
Vanadium	24-hour	2 µg/m^3	MOE
Zinc	24-hour	120 µg/m^3	MOE

4.4 Reporting of monitoring data

Reporting of ambient air quality monitoring data should be conducted at least monthly and include the following:

- A description of all activities occurring at the TSF during the month;
- An analysis of any air quality related complaints recorded during the month;
- A review of the measured levels against relevant benchmark levels for the period;
- Identification of any trends in the ambient monitoring data; and,
- A description of management measures applied during the period and an estimation recorded of the performance of the measures.

4.5 Period for monitoring

Monitoring is recommended for a minimum period of approximately three months and would be reviewed following this period.

4.6 Review of monitoring plan

It is recommended that the air quality monitoring for the TSF is reviewed and updated on a regular basis to ensure the performance of the plan and incorporate any improvements identified.

5 REFERENCES

MOE (2012)

“Ontario’s Ambient Air Quality Criteria”, Standards Development Branch Ontario Ministry of the Environment (MOE), April 2012.

NSW DEC (2007)

“Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales”, NSW Department of Environment and Conservation [DEC], January 2007.

NSW EPA (2017)

“Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales”, January 2017.

Appendix D. Results of PM$_{10}$ metals monitoring

Table D.1: Results of PM$_{10}$ metals monitoring

Location	Date	PM$_{10}$ (µg/m^3)	Iron (µg/m^3)	Aluminium (µg/m^3)	Antimony (µg/m^3)	Arsenic (µg/m^3)	Barium (µg/m^3)	Beryllium (µg/m^3)	Cadmium (µg/m^3)	Chromium (µg/m^3)	Cobalt (µg/m^3)	Copper (µg/m^3)	Lead (µg/m^3)	Manganese (µg/m^3)	Mercury (µg/m^3)	Molybdenum (µg/m^3)	Nickel (µg/m^3)	Selenium (µg/m^3)	Silver (µg/m^3)	Tin (µg/m^3)	Zinc (µg/m^3)
Bundarra	23-Apr-2020	14.2	0.26	0.74	<0.0006	<0.0006	0.0066	<0.0006	<0.0006	0.003	<0.0006	0.014	0.0006	0.006	<0.0006	<0.0006	0.0006	<0.0006	<0.0006	<0.0006	0.0096
Bundarra	29-Apr-2020	6	0.12	0.64	<0.00061	<0.00061	0.0055	<0.00061	<0.00061	0.0025	<0.00061	0.0049	0.00061	0.0055	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.0098
Bundarra	05-May-2020	9	0.2	0.63	<0.00061	<0.00061	0.0055	<0.00061	<0.00061	0.0024	<0.00061	0.023	0.00061	0.0037	<0.00061	<0.00061	0.00061	<0.00061	<0.00061	<0.00061	0.0079
Bundarra	17-May-2020	7.6	0.22	0.74	<0.00061	<0.00061	0.0067	<0.00061	<0.00061	0.0031	<0.00061	0.018	0.00061	0.0037	<0.00061	<0.00061	0.00061	<0.00061	<0.00061	<0.00061	0.0086
Bundarra	23-May-2020	3.8	0.076	1.2	<0.00061	<0.00061	0.012	<0.00061	<0.00061	0.003	<0.00061	0.0043	0.0012	0.0018	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.011
Bundarra	29-May-2020	19.8	0.42	1.4	<0.00061	<0.00061	0.011	<0.00061	<0.00061	0.0037	<0.00061	0.047	0.0012	0.0067	<0.00061	0.00061	0.00061	<0.00061	<0.00061	<0.00061	0.01
Bundarra	04-Jun-2020	24.8	0.37	1.3	<0.00061	<0.00061	0.011	<0.00061	<0.00061	0.003	<0.00061	0.045	0.0012	0.0067	<0.00061	0.00061	0.00061	<0.00061	<0.00061	<0.00061	0.012
Bundarra	10-Jun-2020	9.7	0.17	1.1	<0.00061	<0.00061	0.011	<0.00061	<0.00061	0.0031	<0.00061	0.017	0.0012	0.0037	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.0098
Bundarra	16-Jun-2020	7.1	0.048	0.8	<0.00061	<0.00061	0.0073	<0.00061	<0.00061	0.0018	<0.00061	0.003	0.00061	0.0012	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.0049
Bundarra	22-Jun-2020	3	0.062	0.95	<0.00061	<0.00061	0.0098	<0.00061	<0.00061	0.0031	<0.00061	0.0025	0.00061	0.0025	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.017
Bundarra	28-Jun-2020	20	0.3	0.88	<0.00061	<0.00061	0.0073	<0.00061	<0.00061	0.0018	<0.00061	0.038	0.0012	0.0049	<0.00061	0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.0067
Bundarra	04-Jul-2020	4.9	0.036	0.61	<0.00061	<0.00061	0.0061	<0.00061	<0.00061	0.0012	<0.00061	0.003	<0.00061	0.0012	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.0043
Bundarra	10-Jul-2020	15.7	0.21	0.85	<0.00061	<0.00061	0.0074	<0.00061	<0.00061	0.0018	<0.00061	0.023	0.00061	0.0037	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.0067
Bundarra	16-Jul-2020	8.4	0.14	0.66	<0.00061	<0.00061	0.0067	<0.00061	<0.00061	0.0018	<0.00061	0.013	0.00061	0.0025	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.0061
Bundarra	22-Jul-2020	15.5	0.34	0.75	<0.00061	<0.00061	0.0074	<0.00061	<0.00061	0.0025	<0.00061	0.029	0.00061	0.0049	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.0061
Bundarra	28-Jul-2020	2	0.075	0.94	<0.00061	<0.00061	0.0098	<0.00061	<0.00061	0.0037	<0.00061	0.0037	0.0012	0.0018	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.0098
Bundarra	03-Aug-2020	12.9	0.43	1	<0.00061	<0.00061	0.0098	<0.00061	<0.00061	0.0037	<0.00061	0.034	0.0012	0.0055	<0.00061	<0.00061	0.00061	<0.00061	<0.00061	<0.00061	0.0098
Bundarra	09-Aug-2020	2.9	0.063	1	<0.00061	<0.00061	0.022	<0.00061	<0.00061	0.0031	<0.00061	0.0037	0.00061	0.0012	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.013
Bundarra	27-Aug-2020	18.8	0.5	0.85	<0.00061	<0.00061	0.016	<0.00061	<0.00061	0.0025	<0.00061	0.053	0.0012	0.0061	<0.00061	0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.012
Bundarra	02-Sep-2020	17.1	0.15	0.78	<0.00061	<0.00061	0.013	<0.00061	<0.00061	0.0024	<0.00061	0.0049	0.00061	0.0037	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.0092
Bundarra	14-Sep-2020	13.1	0.21	0.8	<0.00061	<0.00061	0.0061	<0.00061	<0.00061	0.0018	<0.00061	0.019	<0.00061	0.0037	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.008
Bundarra	20-Sep-2020	7	0.086	0.72	<0.00061	<0.00061	0.0055	<0.00061	<0.00061	0.0018	<0.00061	0.0061	<0.00061	0.0018	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.0067
Bundarra	08-Oct-2020	7.7	0.077	0.81	<0.00061	<0.00061	0.0061	<0.00061	<0.00061	0.0018	<0.00061	0.0049	<0.00061	0.0025	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.0067

Location	Date	PM$_{10}$ (µg/m^3)	Iron (µg/m^3)	Aluminium (µg/m^3)	Antimony (µg/m^3)	Arsenic (µg/m^3)	Barium (µg/m^3)	Beryllium (µg/m^3)	Cadmium (µg/m^3)	Chromium (µg/m^3)	Cobalt (µg/m^3)	Copper (µg/m^3)	Lead (µg/m^3)	Manganese (µg/m^3)	Mercury (µg/m^3)	Molybdenum (µg/m^3)	Nickel (µg/m^3)	Selenium (µg/m^3)	Silver (µg/m^3)	Tin (µg/m^3)	Zinc (µg/m^3)
Flyer Creek	22-Jun-2020	7	0.16	0.97	<0.00058	<0.00058	0.0099	<0.00058	<0.00058	0.0029	<0.00058	0.012	0.0012	0.0035	<0.00058	<0.00058	0.0012	<0.00058	<0.00058	<0.00058	0.02
Flyer Creek	28-Jun-2020	6.9	0.043	0.6	<0.0006	<0.0006	0.006	<0.0006	<0.0006	0.0012	<0.0006	0.003	0.0012	0.0012	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	0.011
Flyer Creek	04-Jul-2020	6.7	0.076	0.8	<0.0006	<0.0006	0.0077	<0.0006	<0.0006	0.0018	<0.0006	0.0054	0.0006	0.0018	<0.0006	<0.0006	0.0006	<0.0006	<0.0006	<0.0006	0.011
Flyer Creek	10-Jul-2020	8	0.06	0.79	<0.0006	<0.0006	0.0071	<0.0006	<0.0006	0.0018	<0.0006	0.003	0.0012	0.0018	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	0.0083
Flyer Creek	16-Jul-2020	3.6	0.076	1.1	<0.0006	<0.0006	0.011	<0.0006	<0.0006	0.003	<0.0006	0.003	0.0012	0.0024	<0.0006	<0.0006	0.0006	<0.0006	<0.0006	<0.0006	0.015
Flyer Creek	22-Jul-2020	10.4	0.15	0.8	<0.00059	<0.00059	0.0083	<0.00059	<0.00059	0.0024	<0.00059	0.0065	0.00059	0.003	<0.00059	<0.00059	<0.00059	<0.00059	<0.00059	<0.00059	0.0083
Flyer Creek	28-Jul-2020	4.4	0.11	1.1	<0.0006	<0.0006	0.011	<0.0006	<0.0006	0.0036	<0.0006	0.0071	0.0012	0.0024	<0.0006	<0.0006	0.0006	<0.0006	<0.0006	<0.0006	0.015
Flyer Creek	03-Aug-2020	9.1	0.16	0.8	<0.0006	<0.0006	0.0083	<0.0006	<0.0006	0.0024	<0.0006	0.0077	0.0006	0.003	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	0.0083
Flyer Creek	09-Aug-2020	5.8	0.12	0.83	<0.0006	<0.0006	0.0072	<0.0006	<0.0006	0.0024	<0.0006	0.0084	0.0006	0.0018	<0.0006	<0.0006	0.0012	<0.0006	<0.0006	<0.0006	0.01
Meribah	17-May-2020	9.2	0.23	0.76	<0.00061	0.00061	0.008	<0.00061	<0.00061	0.0031	<0.00061	0.0055	0.00061	0.0049	<0.00061	<0.00061	0.00061	<0.00061	<0.00061	<0.00061	0.015
Meribah	23-May-2020	6.6	0.053	1.2	<0.00061	<0.00061	0.011	<0.00061	<0.00061	0.003	<0.00061	0.0024	0.0012	0.0018	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.013
Meribah	29-May-2020	9.2	0.13	1.2	<0.00061	<0.00061	0.011	<0.00061	<0.00061	0.0031	<0.00061	0.0031	0.0012	0.0037	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.013
Meribah	04-Jun-2020	8.7	0.058	1.1	<0.00061	<0.00061	0.0098	<0.00061	<0.00061	0.0025	<0.00061	0.0031	0.0012	0.0025	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.014
Meribah	10-Jun-2020	4.9	0.066	0.98	<0.00061	<0.00061	0.0092	<0.00061	<0.00061	0.0025	<0.00061	0.0025	0.00061	0.0018	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.012
Meribah	16-Jun-2020	12	0.074	0.89	<0.00061	<0.00061	0.0074	<0.00061	<0.00061	0.0018	<0.00061	0.0061	0.0012	0.0018	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.013
Meribah	22-Jun-2020	7	0.042	0.91	<0.00061	<0.00061	0.008	<0.00061	<0.00061	0.0018	<0.00061	0.0025	<0.00061	0.0012	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.0092
Meribah	28-Jun-2020	7.8	0.048	0.69	<0.00061	<0.00061	0.0067	<0.00061	<0.00061	0.0012	<0.00061	0.0031	0.00061	0.0012	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.01
Meribah	04-Jul-2020	6.5	0.035	0.74	<0.00061	<0.00061	0.0067	<0.00061	<0.00061	0.0012	<0.00061	0.0025	<0.00061	0.0012	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.036
Meribah	10-Jul-2020	11.9	0.1	0.84	<0.00069	<0.00069	0.0083	<0.00069	<0.00069	0.0021	<0.00069	0.0028	0.00069	0.0028	<0.00069	<0.00069	<0.00069	<0.00069	<0.00069	<0.00069	0.013
Meribah	16-Jul-2020	5.6	0.052	0.74	<0.00061	<0.00061	0.0079	<0.00061	<0.00061	0.0018	<0.00061	0.0037	0.00061	0.0012	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.013
Meribah	22-Jul-2020	6.5	0.13	0.91	<0.00061	<0.00061	0.01	<0.00061	<0.00061	0.0037	<0.00061	0.0049	0.0012	0.003	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.01
Meribah	28-Jul-2020	2	0.064	0.9	0.00061	<0.00061	0.0092	<0.00061	<0.00061	0.0031	<0.00061	0.0037	0.0012	0.0018	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.017
Meribah	03-Aug-2020	12.9	0.27	0.7	<0.00062	<0.00062	0.0074	<0.00062	<0.00062	0.0025	<0.00062	0.012	0.00062	0.0043	<0.00062	<0.00062	<0.00062	<0.00062	<0.00062	<0.00062	0.0056
Meribah	15-Aug-2020	6	0.074	0.9	<0.00061	<0.00061	0.02	<0.00061	<0.00061	0.0025	<0.00061	0.0031	0.00061	0.0012	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.012
Meribah	21-Aug-2020	9.8	0.066	0.76	<0.00066	<0.00066	0.0079	<0.00066	<0.00066	0.002	<0.00066	0.0046	0.00066	0.002	<0.00066	<0.00066	<0.00066	<0.00066	<0.00066	<0.00066	0.0072

Location	Date	PM_{10} (µg/m^{3})	Iron (µg/m^{3})	Aluminium (µg/m^{3})	Antimony (µg/m^{3})	Arsenic (µg/m^{3})	Barium (µg/m^{3})	Beryllium (µg/m^{3})	Cadmium (µg/m^{3})	Chromium (µg/m^{3})	Cobalt (µg/m^{3})	Copper (µg/m^{3})	Lead (µg/m^{3})	Manganese (µg/m^{3})	Mercury (µg/m^{3})	Molybdenum (µg/m^{3})	Nickel (µg/m^{3})	Selenium (µg/m^{3})	Silver (µg/m^{3})	Tin (µg/m^{3})	Zinc (µg/m^{3})
Meribah	27-Aug-2020	7.8	0.17	0.77	<0.00061	<0.00061	0.018	<0.00061	<0.00061	0.0025	<0.00061	0.0074	0.0012	0.0031	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.012
Meribah	14-Sep-2020	13.1	0.19	0.81	<0.00061	<0.00061	0.0067	<0.00061	<0.00061	0.0018	<0.00061	0.0098	<0.00061	0.0049	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.012
Meribah	20-Sep-2020	7.2	0.096	0.72	<0.00061	<0.00061	0.0055	<0.00061	<0.00061	0.0018	<0.00061	0.0055	<0.00061	0.0025	<0.00061	<0.00061	0.00061	<0.00061	<0.00061	<0.00061	0.0067
Meribah	26-Sep-2020	5.2	0.048	0.71	<0.00061	<0.00061	0.0061	<0.00061	<0.00061	0.0018	<0.00061	0.0037	<0.00061	0.0012	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.0055
Meribah	02-Oct-2020	11.7	0.11	1	<0.00061	<0.00061	0.018	<0.00061	<0.00061	0.0024	<0.00061	0.0043	<0.00061	0.0031	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.014
Meribah	08-Oct-2020	7.1	0.075	0.84	<0.00061	<0.00061	0.016	<0.00061	<0.00061	0.0024	<0.00061	0.0037	0.00061	0.0024	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.011
Meribah	26-Oct-2020	9.1	0.043	0.5	0.00062	<0.00062	0.0099	<0.00062	<0.00062	0.0019	<0.00062	0.0037	<0.00062	0.0019	<0.00062	<0.00062	<0.00062	<0.00062	<0.00062	<0.00062	0.018
Meribah	01-Nov-2020	10.4	0.058	0.48	<0.00061	<0.00061	0.0098	<0.00061	<0.00061	0.0018	<0.00061	0.0037	<0.00061	0.0018	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.0098
Meribah	19-Nov-2020	26.5	0.38	0.76	<0.00061	<0.00061	0.029	<0.00061	<0.00061	0.0024	<0.00061	0.0049	0.00061	0.0085	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.022
Meribah	25-Nov-2020	15.9	0.15	0.71	<0.00061	<0.00061	0.026	<0.00061	<0.00061	0.0025	<0.00061	0.0061	0.00061	0.0037	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.021
Meribah	01-Dec-2020	32.8	0.49	0.86	<0.00062	<0.00062	0.027	<0.00062	<0.00062	0.0025	<0.00062	0.0068	0.0012	0.014	<0.00062	<0.00062	0.00062	<0.00062	<0.00062	<0.00062	0.022
Meribah	07-Dec-2020	14.4	0.18	0.65	<0.00062	<0.00062	0.023	<0.00062	<0.00062	0.0025	<0.00062	0.0031	<0.00062	0.0056	<0.00062	<0.00062	<0.00062	<0.00062	<0.00062	<0.00062	0.019
Meribah	13-Dec-2020	12.5	0.14	0.58	<0.00061	<0.00061	0.0098	<0.00061	<0.00061	0.0018	<0.00061	0.0037	<0.00061	0.0037	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.0086
Meribah	19-Dec-2020	10.2	0.1	0.62	<0.00062	<0.00062	0.0099	<0.00062	<0.00062	0.0019	<0.00062	0.0037	<0.00062	0.0037	<0.00062	<0.00062	<0.00062	<0.00062	<0.00062	<0.00062	0.012
Meribah	25-Dec-2020	12.5	0.11	0.58	<0.00061	<0.00061	0.0098	<0.00061	<0.00061	0.0018	<0.00061	0.0049	<0.00061	0.0031	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.0092
Meribah	31-Dec-2020	10.9	0.12	0.71	<0.00061	<0.00061	0.011	<0.00061	<0.00061	0.0025	<0.00061	0.0067	0.00061	0.0037	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.012
Meribah	06-Jan-2021	10.1	0.14	0.6	<0.00062	<0.00062	0.0099	<0.00062	<0.00062	0.0019	<0.00062	0.0074	<0.00062	0.0031	<0.00062	<0.00062	<0.00062	<0.00062	<0.00062	<0.00062	0.011
Triangle Flat	17-May-2020	3.5	0.058	0.63	<0.00061	<0.00061	0.0061	<0.00061	<0.00061	0.0024	<0.00061	0.0036	0.0012	0.0018	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.011
Triangle Flat	23-May-2020	2.9	0.05	0.99	<0.00061	<0.00061	0.008	<0.00061	<0.00061	0.0031	<0.00061	0.0031	0.0012	0.0018	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.014
Triangle Flat	29-May-2020	4.6	0.065	1.1	<0.00061	<0.00061	0.0086	<0.00061	<0.00061	0.0031	<0.00061	0.0031	0.0012	0.0025	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.015
Triangle Flat	04-Jun-2020	8	0.06	0.99	<0.00061	<0.00061	0.0085	<0.00061	<0.00061	0.003	<0.00061	0.0043	0.00061	0.0024	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.013
Triangle Flat	10-Jun-2020	3.8	0.052	1	<0.00061	<0.00061	0.0092	<0.00061	<0.00061	0.0031	<0.00061	0.0031	0.00061	0.0018	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.015
Triangle Flat	16-Jun-2020	8.4	0.071	0.75	<0.00061	<0.00061	0.0061	<0.00061	<0.00061	0.0018	<0.00061	0.0073	0.00061	0.0018	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.012
Triangle Flat	22-Jun-2020	4.4	0.051	0.62	<0.00061	<0.00061	0.0055	<0.00061	<0.00061	0.0012	<0.00061	0.0061	<0.00061	0.0012	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.0085
Triangle Flat	28-Jun-2020	8.4	0.052	0.77	<0.00061	<0.00061	0.0067	<0.00061	<0.00061	0.0018	<0.00061	0.0031	0.00061	0.0012	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.011

Location	Date	PM$_{10}$ (µg/m^3)	Iron (µg/m^3)	Aluminium (µg/m^3)	Antimony (µg/m^3)	Arsenic (µg/m^3)	Barium (µg/m^3)	Beryllium (µg/m^3)	Cadmium (µg/m^3)	Chromium (µg/m^3)	Cobalt (µg/m^3)	Copper (µg/m^3)	Lead (µg/m^3)	Manganese (µg/m^3)	Mercury (µg/m^3)	Molybdenum (µg/m^3)	Nickel (µg/m^3)	Selenium (µg/m^3)	Silver (µg/m^3)	Tin (µg/m^3)	Zinc (µg/m^3)
Triangle Flat	04-Jul-2020	4	0.035	0.58	<0.00061	<0.00061	0.0049	<0.00061	<0.00061	0.0012	<0.00061	0.0025	<0.00061	0.0012	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.0092
Triangle Flat	10-Jul-2020	8.3	0.056	0.71	<0.00061	<0.00061	0.0061	<0.00061	<0.00061	0.0018	<0.00061	0.0025	0.00061	0.0018	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.0098
Triangle Flat	16-Jul-2020	5.1	0.04	0.67	<0.00061	<0.00061	0.0061	<0.00061	<0.00061	0.0018	<0.00061	0.0031	<0.00061	0.0012	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.0092
Triangle Flat	22-Jul-2020	8.8	0.087	0.69	<0.00061	<0.00061	0.008	<0.00061	<0.00061	0.0025	<0.00061	0.0043	0.00061	0.0025	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.0061
Triangle Flat	28-Jul-2020	6.2	0.064	0.72	<0.00061	<0.00061	0.008	<0.00061	<0.00061	0.0025	<0.00061	0.0043	<0.00061	0.0018	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.0061
Triangle Flat	03-Aug-2020	11.2	0.23	0.72	<0.00061	<0.00061	0.0067	<0.00061	<0.00061	0.0018	<0.00061	0.014	0.00061	0.0037	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.0061
Triangle Flat	09-Aug-2020	3.6	0.04	0.49	<0.00061	<0.00061	0.0061	<0.00061	<0.00061	0.0018	<0.00061	0.0037	<0.00061	0.0012	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.0049
Triangle Flat	27-Aug-2020	6.1	0.16	0.81	<0.00062	<0.00062	0.019	<0.00062	<0.00062	0.0025	<0.00062	0.0086	0.0012	0.0031	<0.00062	<0.00062	<0.00062	<0.00062	<0.00062	<0.00062	0.012
Triangle Flat	02-Sep-2020	0.7	0.2	0.97	<0.00061	<0.00061	0.0086	<0.00061	<0.00061	0.0031	<0.00061	0.0037	0.0012	0.0067	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.008
Triangle Flat	14-Sep-2020	9.5	0.13	0.79	<0.00061	<0.00061	0.0074	<0.00061	<0.00061	0.0018	<0.00061	0.0068	<0.00061	0.0031	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.0055
Triangle Flat	20-Sep-2020	7.5	0.11	0.77	<0.00061	<0.00061	0.0061	<0.00061	<0.00061	0.0018	<0.00061	0.0074	<0.00061	0.0025	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.0055
Triangle Flat	26-Sep-2020	5	0.048	0.91	<0.00066	<0.00066	0.0072	<0.00066	<0.00066	0.002	<0.00066	0.0033	<0.00066	0.0013	<0.00066	<0.00066	<0.00066	<0.00066	<0.00066	<0.00066	0.0066
Triangle Flat	02-Oct-2020	8.6	0.072	0.92	<0.00061	<0.00061	0.018	<0.00061	<0.00061	0.0025	<0.00061	0.0031	<0.00061	0.0018	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.012
Triangle Flat	08-Oct-2020	8.3	0.09	0.85	<0.00061	<0.00061	0.015	<0.00061	<0.00061	0.0018	<0.00061	0.0049	0.00061	0.0025	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.0098
Triangle Flat	26-Oct-2020	7.5	0.046	0.48	<0.00062	<0.00062	0.01	<0.00062	<0.00062	0.0019	<0.00062	0.0037	<0.00062	0.0019	<0.00062	<0.00062	<0.00062	<0.00062	<0.00062	<0.00062	0.011
Triangle Flat	01-Nov-2020	10	0.068	0.57	<0.00061	<0.00061	0.012	<0.00061	<0.00061	0.0018	<0.00061	0.0037	<0.00061	0.0024	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.01
Triangle Flat	07-Nov-2020	13.6	0.087	0.61	<0.00061	<0.00061	0.012	<0.00061	<0.00061	0.0024	<0.00061	0.0043	<0.00061	0.0024	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.014
Triangle Flat	13-Nov-2020	13.8	0.13	0.53	<0.00059	<0.00059	0.01	<0.00059	<0.00059	0.0018	<0.00059	0.0071	<0.00059	0.0041	<0.00059	<0.00059	<0.00059	<0.00059	<0.00059	<0.00059	0.0095
Triangle Flat	19-Nov-2020	26.4	0.29	0.81	<0.00063	<0.00063	0.033	<0.00063	<0.00063	0.0025	<0.00063	0.0057	0.0013	0.011	<0.00063	<0.00063	<0.00063	<0.00063	<0.00063	<0.00063	0.025
Triangle Flat	25-Nov-2020	13.2	0.15	0.75	<0.00061	<0.00061	0.031	<0.00061	<0.00061	0.0025	<0.00061	0.0092	0.00061	0.0037	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.024
Triangle Flat	01-Dec-2020	26.4	0.25	0.77	<0.00061	<0.00061	0.029	<0.00061	<0.00061	0.0025	<0.00061	0.0043	0.00061	0.008	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.023
Triangle Flat	07-Dec-2020	13.2	0.16	0.73	<0.00061	<0.00061	0.03	<0.00061	<0.00061	0.0024	<0.00061	0.0061	0.00061	0.0049	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.023
Triangle Flat	13-Dec-2020	8.5	0.088	0.62	<0.00062	<0.00062	0.013	<0.00062	<0.00062	0.0025	<0.00062	0.0037	<0.00062	0.0037	<0.00062	<0.00062	<0.00062	<0.00062	<0.00062	<0.00062	0.01
Triangle Flat	19-Dec-2020	7.9	0.11	0.7	<0.00062	<0.00062	0.013	<0.00062	<0.00062	0.0025	<0.00062	0.0037	<0.00062	0.0049	<0.00062	<0.00062	<0.00062	<0.00062	<0.00062	<0.00062	0.01
Triangle Flat	25-Dec-2020	11.2	0.1	0.72	<0.00062	<0.00062	0.03	<0.00062	<0.00062	0.0025	<0.00062	0.0049	0.00062	0.0037	<0.00062	<0.00062	<0.00062	<0.00062	<0.00062	<0.00062	0.023

Location	Date	PM$_{10}$ (µg/m^3)	Iron (µg/m^3)	Aluminium (µg/m^3)	Antimony (µg/m^3)	Arsenic (µg/m^3)	Barium (µg/m^3)	Beryllium (µg/m^3)	Cadmium (µg/m^3)	Chromium (µg/m^3)	Cobalt (µg/m^3)	Copper (µg/m^3)	Lead (µg/m^3)	Manganese (µg/m^3)	Mercury (µg/m^3)	Molybdenum (µg/m^3)	Nickel (µg/m^3)	Selenium (µg/m^3)	Silver (µg/m^3)	Tin (µg/m^3)	Zinc (µg/m^3)
Triangle Flat	31-Dec-2020	6	0.071	0.69	<0.00061	<0.00061	0.012	<0.00061	<0.00061	0.0024	<0.00061	0.0049	<0.00061	0.0024	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.0098
Triangle Flat	06-Jan-2021	7.2	0.12	0.66	<0.00061	<0.00061	0.011	<0.00061	<0.00061	0.0024	<0.00061	0.0079	<0.00061	0.003	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	<0.00061	0.012

Notes:

Results that were invalid are not included in this table (e.g., due to excess or insufficient sampling time or volume, or laboratory errors).

Results below the limit of reporting are in black font.

Results above the limit of reporting are in coloured font.

Appendix E. QUT reports



QUT Central Analytical Research Facility
Materials Characterisation Report

CLIENT	Kathryn Stewart & Tim Wrigley Newcrest
REPORT DATE	2020-02-10
PREPARED BY	Henry Spratt
ANALYSIS REQUESTED	Sizing (sieve), Quantitative XRD, Clay Analysis
OUR REFERENCE	X20005
YOUR REFERENCE	PO4500983185 – Cadia Enviro/Dust *8x Tailings Samples*
QUT CONTACTS	Mr Ashley Locke, X-ray Analysis Coordinator Ph: 0400128230 | email: a.locke@qut.edu.au Dr Henry Spratt, Senior X-ray Technologist (Geoscience) Ph: 07 3138 9526 | email: henry.spratt@qut.edu.au **X-ray and Particles Laboratory enquiries: xandp@qut.edu.au**

RESULTS

Sizing

The table below summarises the particle sizing (via sieve) of the 8 powder samples.

Sample	+300 µm (wt%)	-300/+0 µm (wt%)
NTSF1	41.3	58.7
NTSF2	47.0	53.0
NTSF3	55.2	44.8
NTSF4	59.5	40.5
STSF1	39.2	60.8
STSF2	21.3	78.7
STSF3	40.5	59.5
STSF4	37.4	62.6

Phase Identification / Quantification

The powder X-ray diffraction patterns show the presence of crystalline phases. Graphics of the collected diffraction patterns along with the phases identified are included at the end of this report. The estimated normalised abundance of the corundum internal standard in the samples is higher than 20 wt%. This means there is an unaccounted for component in the samples (i.e., the samples contain non-diffracting and/or unidentified material). This component is frequently referred to as amorphous.

Trace pyrite could be successfully modelled in all samples. The presence of magnetite was confirmed by passing a strong magnet over the samples and noting particle movement. Chlorite/clinochlore and illite/micas (specifically illite, muscovite and phengite) were the only clay phases detected in all samples. Cordierite or an amphibole member were detected in samples 5 and 7; amphibole was modelled in the absence of other information. A sharp but weak peak at 50.57 °2θ in sample 8 could be due to trace FeS phases such as pyrrhotite or troilite, but the data does not support the modelling of these phases. A weak but sharp peak at 30.1 °2θ is tentatively modelled as anatase in sample 4: this peak is only observed in this particular sample. Sample 4 is also the most different sample out of the 8 submitted as it was the only sample which was found to contain laumontite, rhomboclase and blodite. There is an unidentified peak at 10.56 °2θ in sample 6 which could be a different mica phase that is not in our reference database.

Table of phase abundances (nominal wt%, absolute)

X20005 8x Tailings Samples	1 NTSF1	2 NTSF2	3 NTSF3	4 NTSF4
Quartz	16.3	14.0	15.2	14.0
Anatase?				0.4
Magnetite	0.7	0.5	0.2	0.4
Pyrite	0.6	0.5	0.6	0.5
Calcite	3.7	3.2	3.4	3.3
Dolomite		0.3		1.7
Blodite				11.9
Rhomboclase				0.9
Gypsum	0.5	1.3	1.5	0.7
Plagioclase (An0-50)	30.1	26.0	29.3	23.9
K-Feldsdpar	12.8	11.5	11.9	8.0
Laumontite				1.3
Halite		0.5		0.4
Chlorite/clinochlore	10.5	10.1	11.3	9.5
Illite/mica (TOTAL)	19.8	19.8	19.5	15.6
Amorphous	5.0	12.5	7.0	7.6

X20005 8x Tailings Samples	5 STSF1	6 STSF2	7 STSF3	8 STSF4
Quartz	16.7	17.0	16.2	15.1
Magnetite	1.1	0.5	1.0	0.6
Pyrite	0.4	0.5	0.6	0.6
Calcite	3.4	3.4	3.8	3.8
Dolomite		0.5	0.2	
Gypsum	0.7	0.9	0.6	0.7
Amphibole	1.4		2.1	
Plagioclase (An0-50)	30.9	29.3	31.4	29.0
K-Feldsdpar	11.3	9.2	11.4	11.2
Halite		0.8		
Chlorite/clinochlore	12.6	10.6	15.7	14.7
Illite/mica (TOTAL)	18.9	18.7	16.3	18.7
Amorphous	2.7	8.6	0.9	5.7

Table of fine fraction (clay phases) identifications (qualitative, nominal)

8x Tailings Samples	NTSF1	NTSF2	NTSF3	NTSF4
Chlorite	major	major	major	major
Illite/mica	major	major	major	major

X20005	5	6	7	8
8x Tailings Samples	STSF1	STSF2	STSF3	STSF4
Quartz	major	major	major	major
Magnetite	major	major	major	major

Abundant – nominally > 40 wt%

Major – nominally > 10 wt% but < 40 wt%

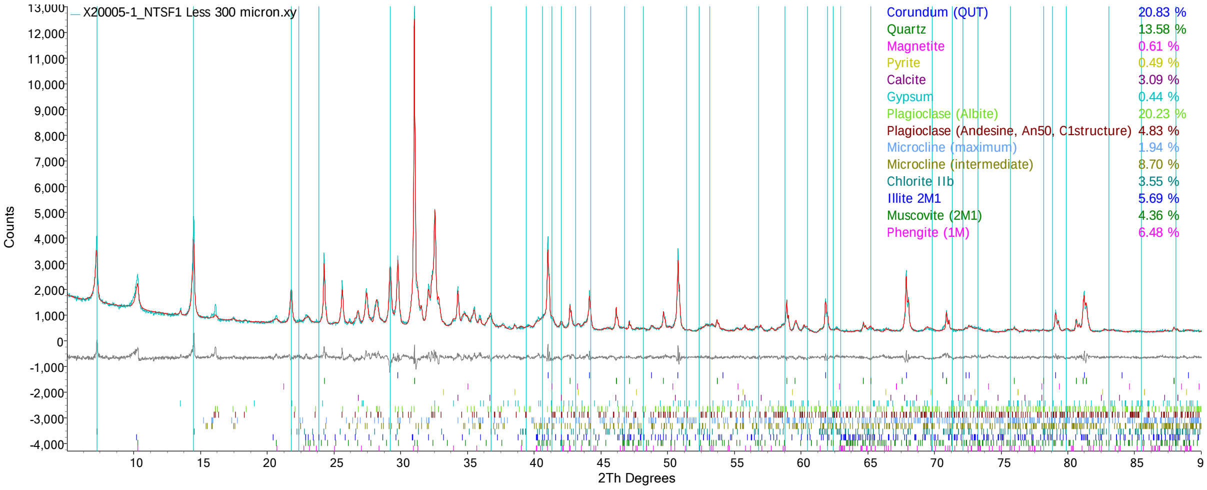
Minor – nominally > 1 wt% but < 10 wt%

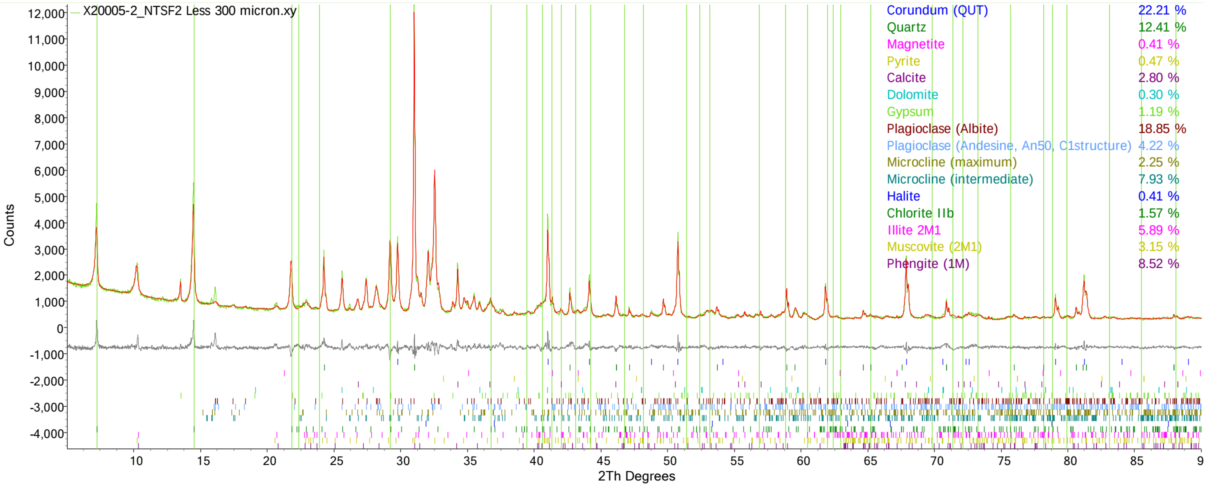
Trace – nominally < 1 wt%

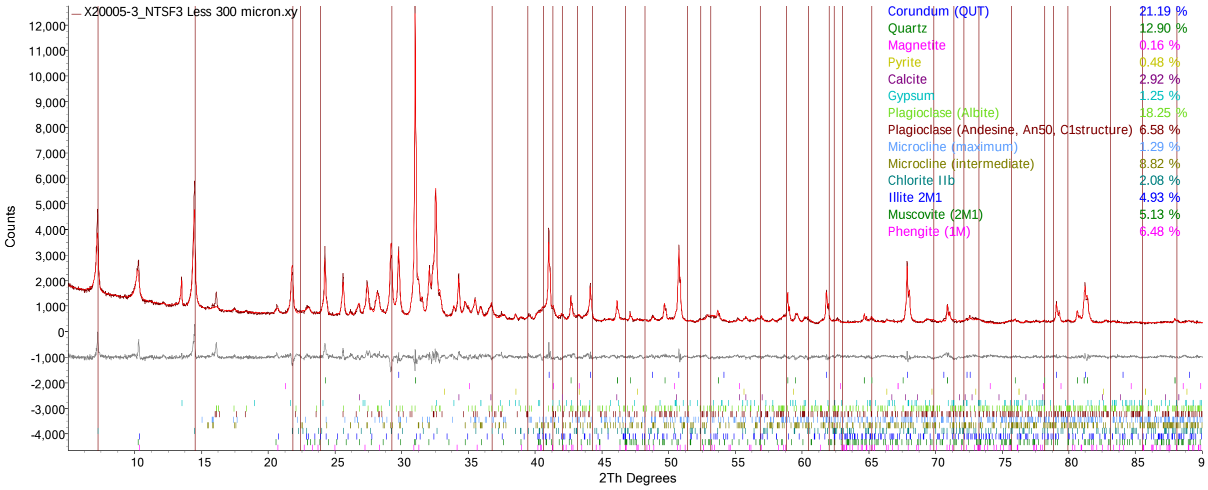
APPENDIX 1 – X-RAY DIFFRACTION DATA AND GRAPHICS

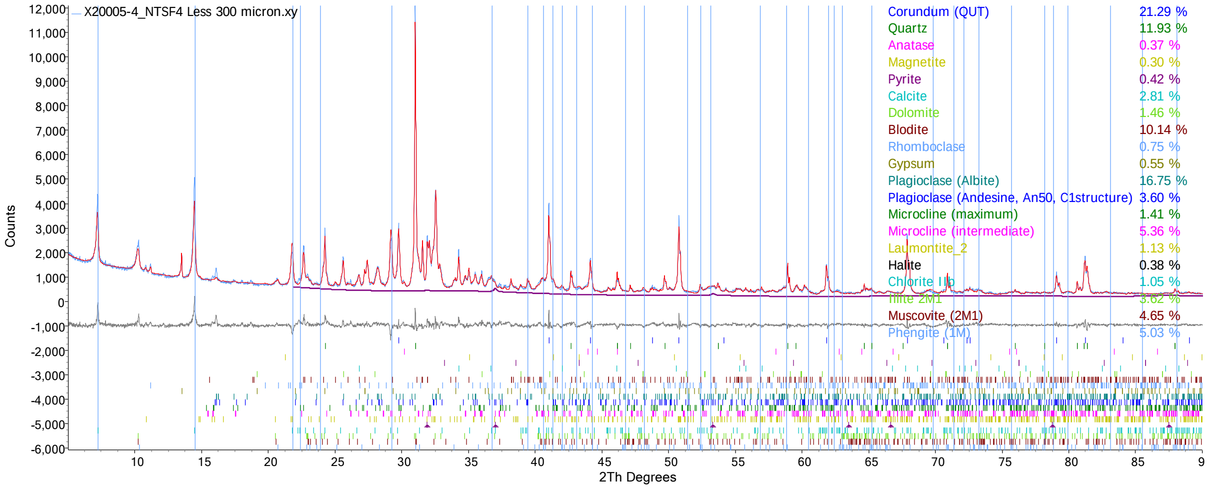
Powder X-ray Diffraction Patterns

In the graphics below the red line is the Rietveld refinement model, the coloured line is the collected data, and the grey line is the difference. The abundances on the graphics are before taking into account the known addition of corundum standard. Please use the tabulated abundances (wt% in original sample) which require no further manipulation. Vertical lines are the expected peak positions of an in-house model for ripidolite.

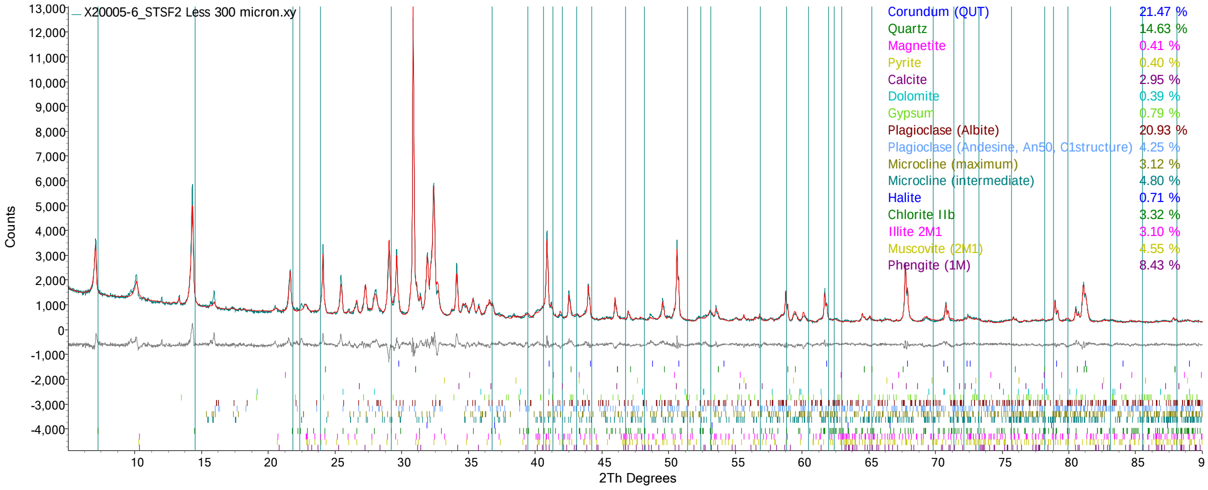


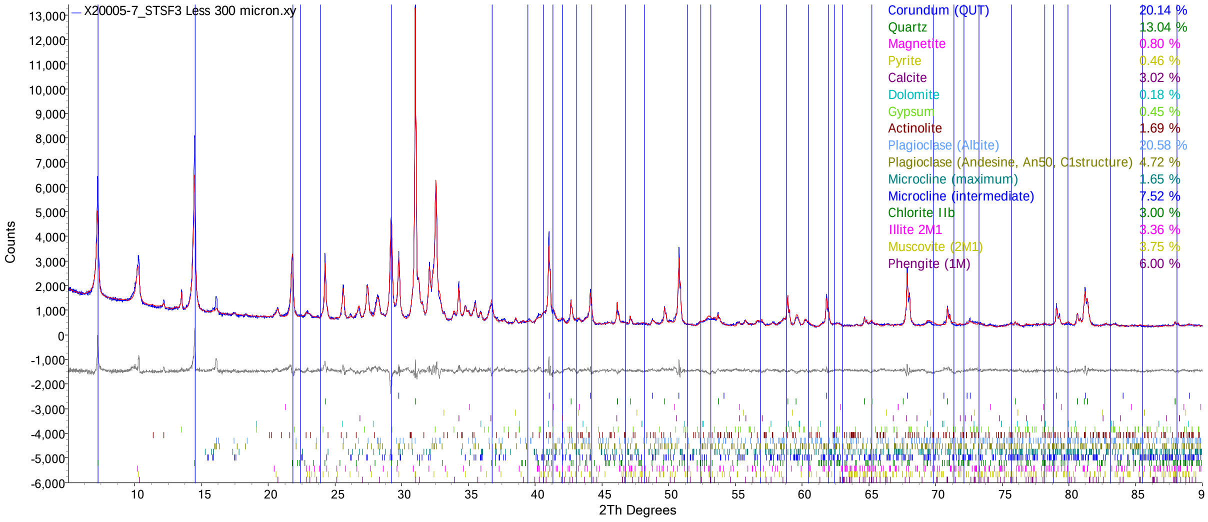


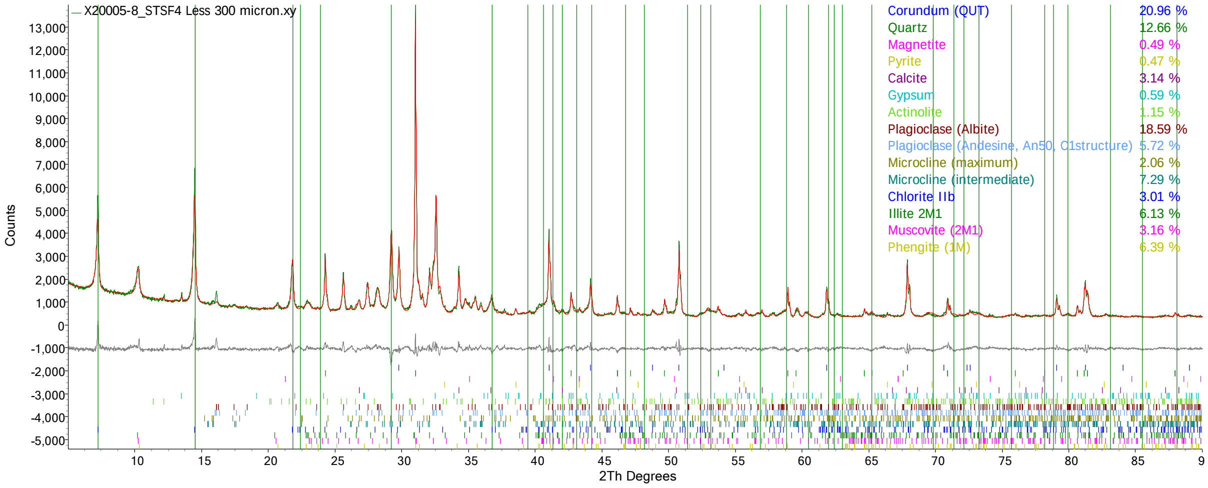

X20005-3_NTSF3 Less 300 micron.xy
Counts
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
-1,000
-2,000
-3,000
-4,000
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
9
2Th Degrees
Corundum (QUT) 21.19 %
Quartz 12.90 %
Magnetite 0.16 %
Pyrite 0.48 %
Calcite 2.92 %
Gypsum 1.25 %
Plagioclase (Albite) 18.25 %
Plagioclase (Andesine, An50, C1structure) 6.58 %
Microcline (maximum) 1.29 %
Microcline (intermediate) 8.82 %
Chlorite IIb 2.08 %
Illite 2M1 4.93 %
Muscovite (2M1) 5.13 %
Phengite (1M) 6.48 %


X20005-4_NTSF4 Less 300 micron.xy
Counts
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
-1,000
-2,000
-3,000
-4,000
-5,000
-6,000
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
9
2Th Degrees
Corundum (QUT) 21.29 %
Quartz 11.93 %
Anatase 0.37 %
Magnetite 0.30 %
Pyrite 0.42 %
Calcite 2.81 %
Dolomite 1.46 %
Blodite 10.14 %
Rhomboclase 0.75 %
Gypsum 0.55 %
Plagioclase (Albite) 16.75 %
Plagioclase (Andesine, An50, C1structure) 3.60 %
Microcline (maximum) 1.41 %
Microcline (intermediate) 5.36 %
Laumontite_2 1.13 %
Halite 0.38 %
Chlorite IIb 1.05 %
Illite 2M1 3.62 %
Muscovite (2M1) 4.65 %
Phengite (1M) 5.03 %

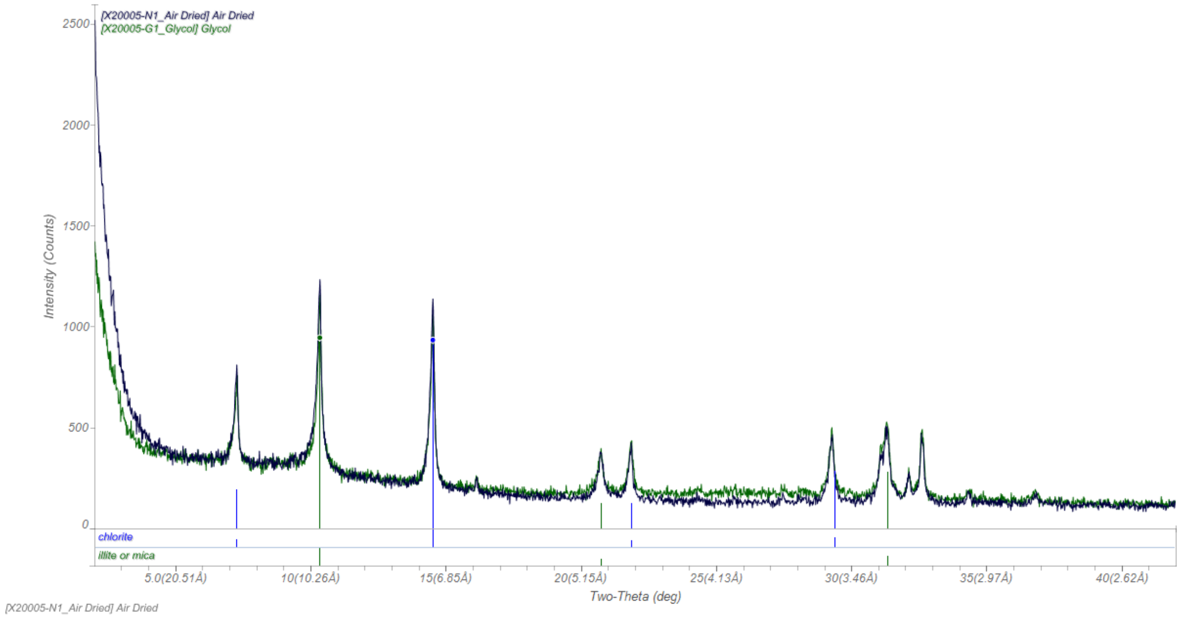

X20005-5_STSF1 Less 300 micron.xy
Counts
13,000
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
-1,000
-2,000
-3,000
-4,000
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
9
2Th Degrees
Corundum (QUT) 20.44 %
Quartz 13.63 %
Magnetite 0.88 %
Pyrite 0.33 %
Calcite 2.79 %
Gypsum 0.59 %
Actinolite 1.13 %
Plagioclase (Albite) 19.51 %
Plagioclase (Andesine, An50, C1structure) 5.74 %
Microcline (maximum) 1.73 %
Microcline (intermediate) 7.52 %
Chlorite IIb 3.23 %
Illite 2M1 5.40 %
Muscovite (2M1) 3.20 %
Phengite (1M) 6.83 %

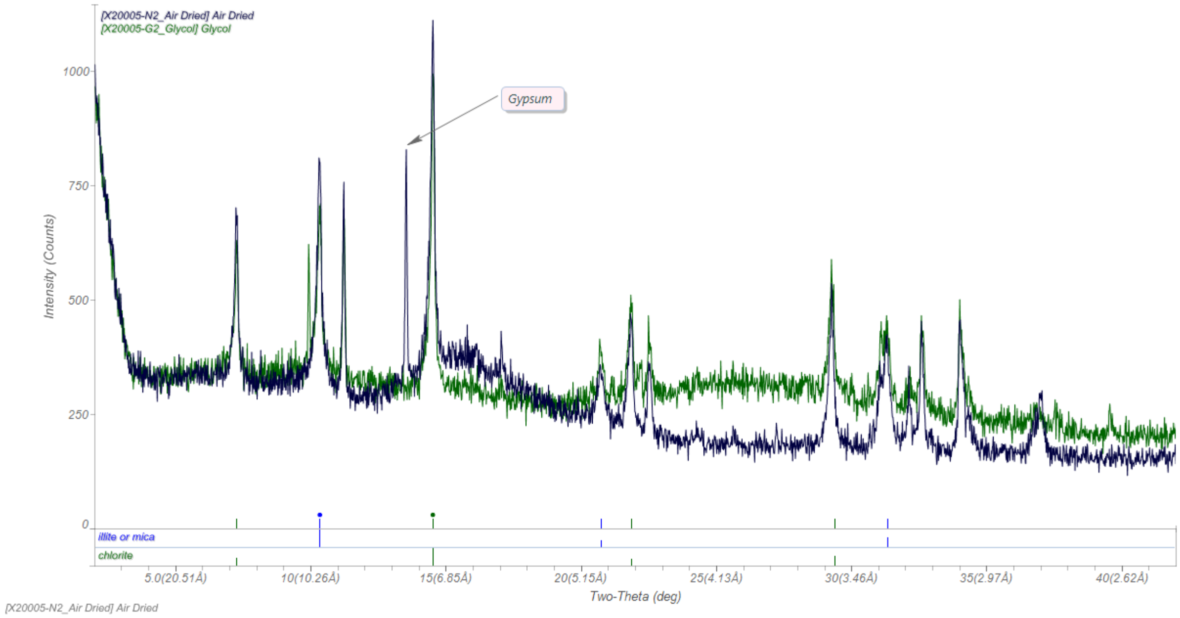

X20005-6_STSF2 Less 300 micron.xy
Counts
13,000
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
-1,000
-2,000
-3,000
-4,000
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
9
2Th Degrees
Corundum (QUT) 21.47 %
Quartz 14.63 %
Magnetite 0.41 %
Pyrite 0.40 %
Calcite 2.95 %
Dolomite 0.39 %
Gypsum 0.79 %
Plagioclase (Albite) 20.93 %
Plagioclase (Andesine, An50, C1structure) 4.25 %
Microcline (maximum) 3.12 %
Microcline (intermediate) 4.80 %
Halite 0.71 %
Chlorite IIb 3.32 %
Illite 2M1 3.10 %
Muscovite (2M1) 4.55 %
Phengite (1M) 8.43 %

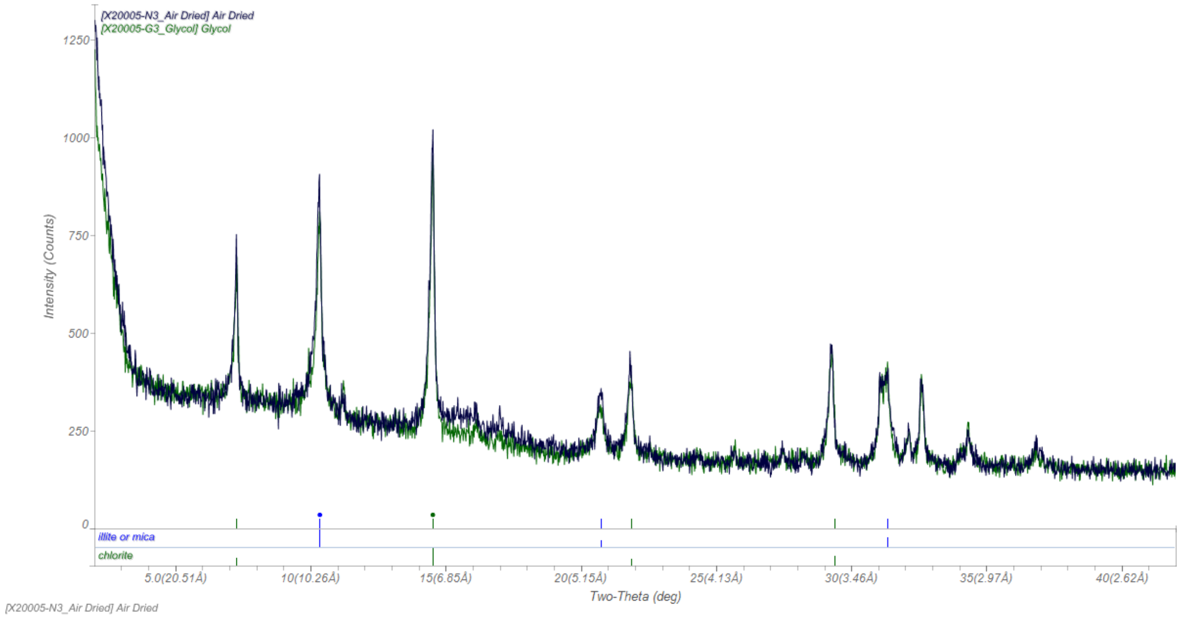

X20005-7_STSF3 Less 300 micron.xy
Counts
13,000
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
-1,000
-2,000
-3,000
-4,000
-5,000
-6,000
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
9
2Th Degrees
Corundum (QUT) 20.14 %
Quartz 13.04 %
Magnetite 0.80 %
Pyrite 0.46 %
Calcite 3.02 %
Dolomite 0.18 %
Gypsum 0.45 %
Actinolite 1.69 %
Plagioclase (Albite) 20.58 %
Plagioclase (Andesine, An50, C1structure) 4.72 %
Microcline (maximum) 1.65 %
Microcline (intermediate) 7.52 %
Chlorite IIb 3.00 %
Illite 2M1 3.36 %
Muscovite (2M1) 3.75 %
Phengite (1M) 6.00 %

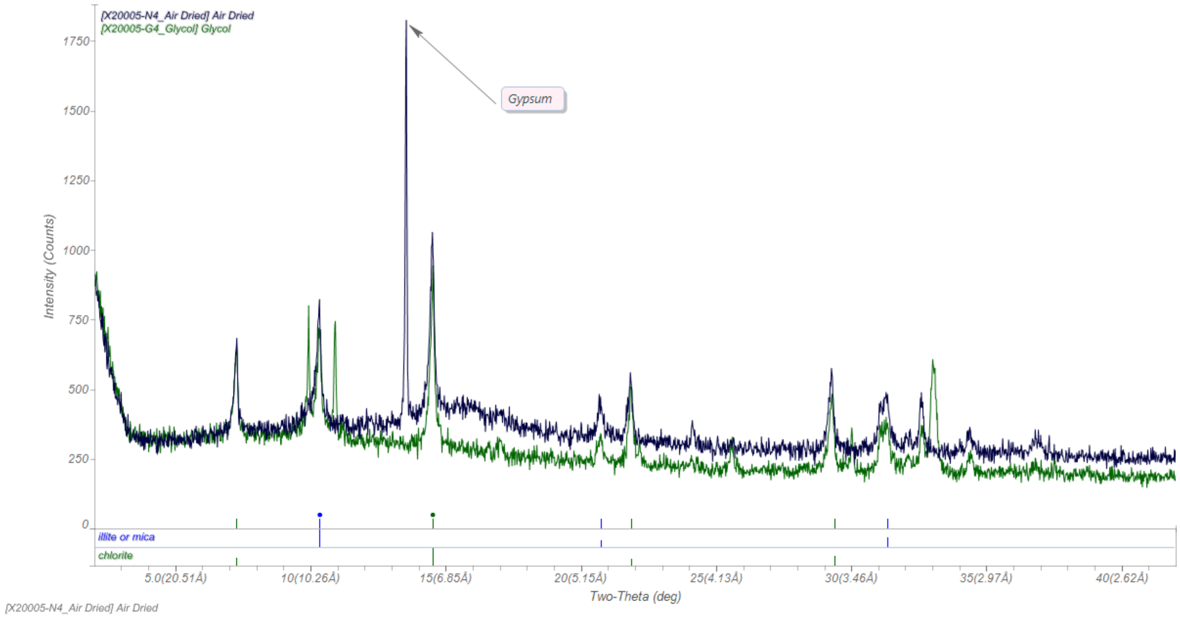

X20005-8_STSF4 Less 300 micron.xy
Counts
13,000
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
-1,000
-2,000
-3,000
-4,000
-5,000
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
9
2Th Degrees
Corundum (QUT) 20.96 %
Quartz 12.66 %
Magnetite 0.49 %
Pyrite 0.47 %
Calcite 3.14 %
Gypsum 0.59 %
Actinolite 1.15 %
Plagioclase (Albite) 18.59 %
Plagioclase (Andesine, An50, C1structure) 5.72 %
Microcline (maximum) 2.06 %
Microcline (intermediate) 7.29 %
Chlorite IIb 3.01 %
Illite 2M1 6.13 %
Muscovite (2M1) 3.16 %
Phengite (1M) 6.39 %

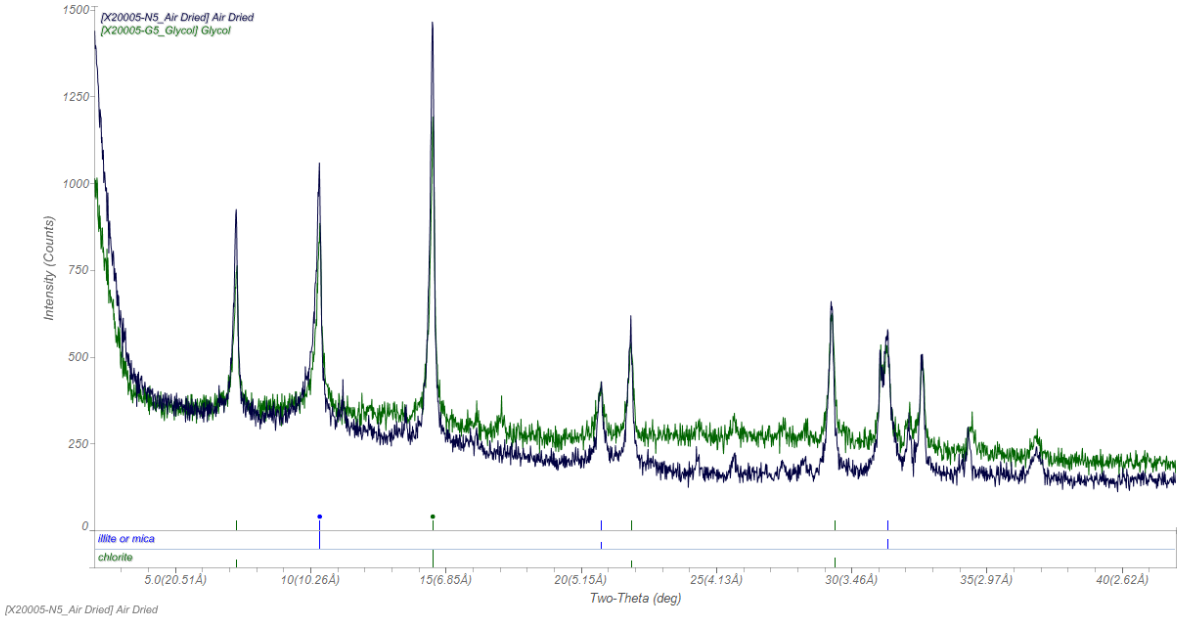
Fine Fraction (Clay) X-ray Diffraction Patterns

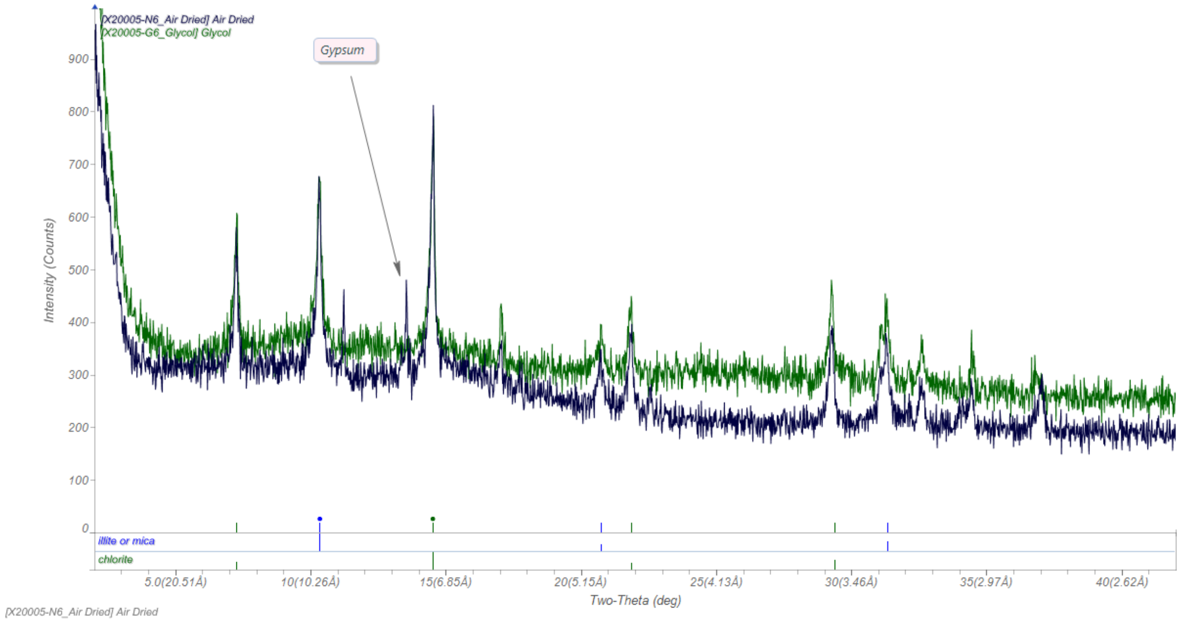


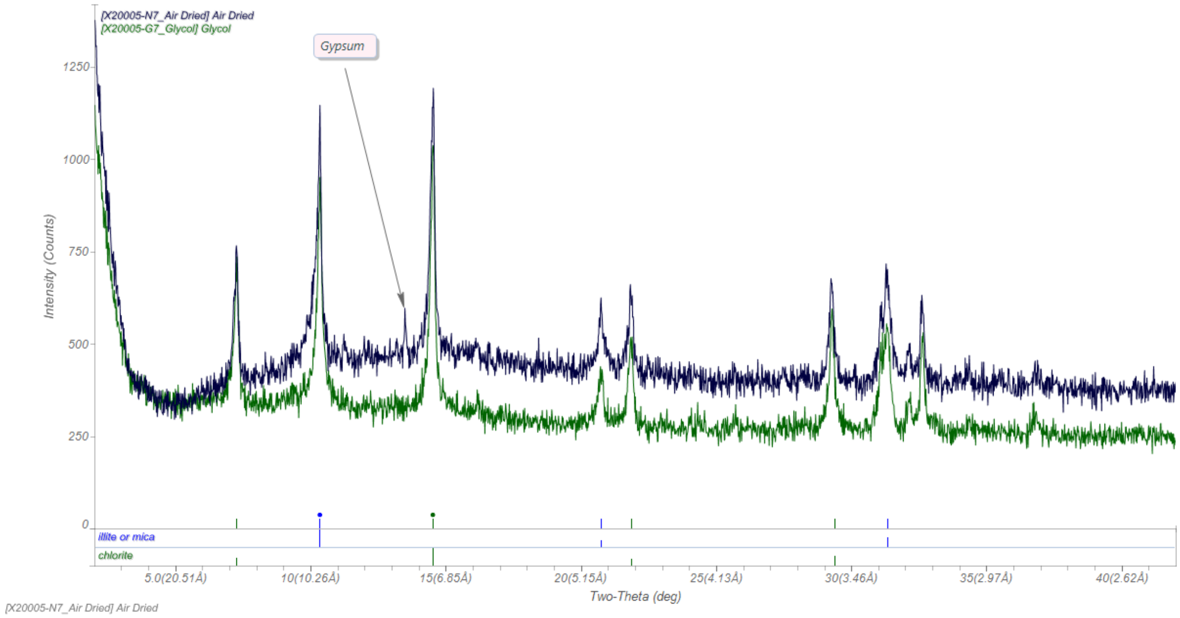


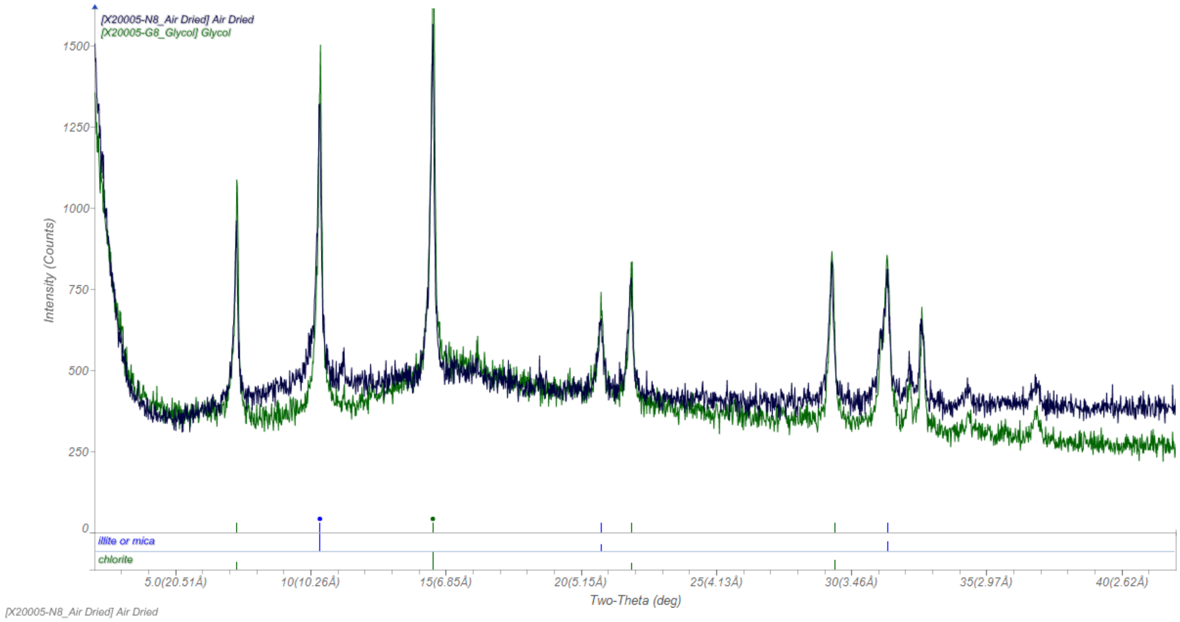

[X20005-N3_Air Dried] Air Dried
[X20005-G3_Glycol] Glycol
Intensity (Counts)
1250
1000
750
500
250
0
illite or mica
chlorite
5.0(20.51Å)
10(10.26Å)
15(6.85Å)
20(5.15Å)
25(4.13Å)
30(3.46Å)
35(2.97Å)
40(2.62Å)
Two-Theta (deg)
[X20005-N3_Air Dried] Air Dried


[X20005-N4_Air Dried] Air Dried
[X20005-G4_Glycol] Glycol
Gypsum
Intensity (Counts)
1750
1500
1250
1000
750
500
250
0
illite or mica
chlorite
5.0(20.51Å)
10(10.26Å)
15(6.85Å)
20(5.15Å)
25(4.13Å)
30(3.46Å)
35(2.97Å)
40(2.62Å)
Two-Theta (deg)
[X20005-N4_Air Dried] Air Dried


[X20005-N5_Air Dried] Air Dried
[X20005-G5_Glycol] Glycol
1500
1250
1000
750
500
250
0
Intensity (Counts)
illite or mica
chlorite
5.0(20.51Å)
10(10.26Å)
15(6.85Å)
20(5.15Å)
25(4.13Å)
30(3.46Å)
35(2.97Å)
40(2.62Å)
Two-Theta (deg)
[X20005-N5_Air Dried] Air Dried


[X20005-N6_Air Dried] Air Dried
[X20005-G6_Glycol] Glycol
Gypsum
900
800
700
600
500
400
300
200
100
0
Intensity (Counts)
illite or mica
chlorite
5.0(20.51Å)
10(10.26Å)
15(6.85Å)
20(5.15Å)
25(4.13Å)
30(3.46Å)
35(2.97Å)
40(2.62Å)
Two-Theta (deg)
[X20005-N6_Air Dried] Air Dried


[X20005-N7_Air Dried] Air Dried
[X20005-G7_Glycol] Glycol
Gypsum
Intensity (Counts)
1250
1000
750
500
250
0
illite or mica
chlorite
5.0(20.51Å)
10(10.26Å)
15(6.85Å)
20(5.15Å)
25(4.13Å)
30(3.46Å)
35(2.97Å)
40(2.62Å)
Two-Theta (deg)
[X20005-N7_Air Dried] Air Dried


[X20005-N8_Air Dried] Air Dried
[X20005-G8_Glycol] Glycol
Intensity (Counts)
1500
1250
1000
750
500
250
0
illite or mica
chlorite
5.0(20.51Å)
10(10.26Å)
15(6.85Å)
20(5.15Å)
25(4.13Å)
30(3.46Å)
35(2.97Å)
40(2.62Å)
Two-Theta (deg)
[X20005-N8_Air Dried] Air Dried

APPENDIX 2 – ANALYTICAL TECHNIQUES

Sample preparation

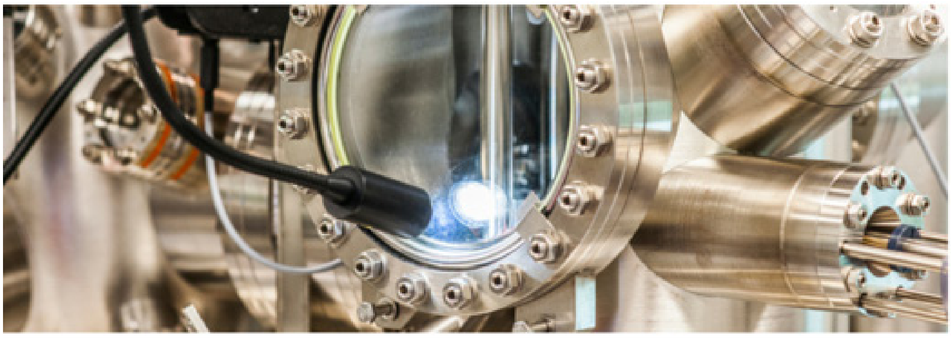
The as-received samples were sieved to < 300 µm. Sub-samples were accurately weighed from the < 300 µm fraction, and specimens prepared for X-ray diffraction analysis by the addition of a corundum (Al_2O_3) internal standard at 20 wt%. The specimens were micronised in a McCrone mill using zirconia beads and ethanol, then dried in an oven overnight at 40 °C. The resultant homogenous powders were back-pressed into sample holders.

A small portion of the crushed samples were dispersed in water. After sonication (5 min) and settling for 5 min, the fine fraction (nominally < 5 µm in suspension) was transferred via pipette to a low background plate and allowed to settle and dry (these samples have the label N in this report). This preparation is used to concentrate the fine (clay dominant) fraction and aids identification of the clays present. This means ratios of the clays and other phases present in this extract may vary from the bulk sample: the fine fraction result is qualitative. The air dried slides were further treated in an ethylene glycol atmosphere (60 °C) for several hours, then immediately re-examined. The ethylene glycol treated samples have the label G in this report.

Sample analysis

Step scanned X-ray diffraction patterns were collected for an hour per sample using a PANalytical X’Pert Pro powder diffractometer and cobalt Kα radiation operating in Bragg-Brentano geometry. The collected data was analysed using JADE (V2010, Materials Data Inc.), EVA (V5, Bruker) and X’Pert Highscore Plus (V4, PANalytical) with various reference databases (PDF4+, AMCSD, COD) for phase identification. Rietveld refinement was performed using TOPAS (V6, Bruker). The known addition of corundum facilitates reporting of absolute phase abundances for the modelled phases. The sum of the absolute abundances is subtracted from 100 wt% to obtain a residual (called non-diffracting/unidentified, also known as “amorphous”). The residual represents the unexplained portion of the pattern: it may be non-diffracting content but will also contain unidentified phases and the error from poorly modelled phases. It is the least accurate measure as its error is the sum of the errors of the modelled phases. The estimated uncertainties in the reported phase abundances are 20 wt% relative or better for every modelled phase. Due to propagation of errors the uncertainty in the amorphous (non-diffracting/unidentified) content is higher at approximately 30 wt% relative. The detection limit and limit of quantification using our method is approximately 1 wt% or less depending on the phase in question and sample matrix.

Powder X-ray diffraction is bulk phase analysis, it is not bulk chemical analysis. Phase abundances may be mis-estimated if an incorrect chemical formula is assigned to a phase. Therefore, the closest matches in the reference phase identification databases were used in the Rietveld refinement model, but other members of the identified mineral groups may be present.



QUT Central Analytical Research Facility
Materials Characterisation Report

CLIENT	Kathryn Stewart / Tim Wrigley Newcrest
REPORT DATE	2020-02-21
PREPARED BY	Henry Spratt (
ANALYSIS REQUESTED	Stokes' law size separation (< 10 µm) Quantitative XRD on yield from Stokes' law size fraction
OUR REFERENCE	X20005
YOUR REFERENCE	PO4500983185; 8x Tailings Samples
QUT CONTACTS	Mr Ashley Locke, X-ray Analysis Coordinator Ph: 0400128230 | email: a.locke@qut.edu.au Dr Henry Spratt, Senior X-ray Technologist (Geoscience) Ph: 07 3138 9526 | email: henry.spratt@qut.edu.au

X-ray and Particles Laboratory enquiries: xandp@qut.edu.au

RESULTS

All results below refer to the yield from Stokes' law size separation.

Stokes' Law Size Separation

The percentage of the submitted samples that is < 10 µm (spherical equivalent) is given in the table below.

Table of < 10 micron yields

X20005 8 Tailings Samples	1 < 10 micron	2 < 10 micron	3 < 10 micron	4 < 10 micron
Mass used (g)	5.4679	5.4843	5.5534	5.2084
Mass < 10 micron (g)	0.2181	0.1521	0.1294	0.096
Yield < 10 micron (%)	3.989	2.773	2.330	1.843

X20005 8 Tailings Samples	5 < 10 micron	6 < 10 micron	7 < 10 micron	8 < 10 micron
Mass used (g)	5.4679	5.4843	5.5534	5.2084
Mass < 10 micron (g)	0.2189	0.1695	0.2167	0.2138
Yield < 10 micron (%)	4.003	3.091	3.902	4.105

XRD Phase Identification / Quantification

The powder X-ray diffraction patterns show the presence of crystalline phases. Graphics of the collected diffraction patterns along with the phases identified are included in Appendix 1.

Table of phase abundances (nominal wt%, absolute)

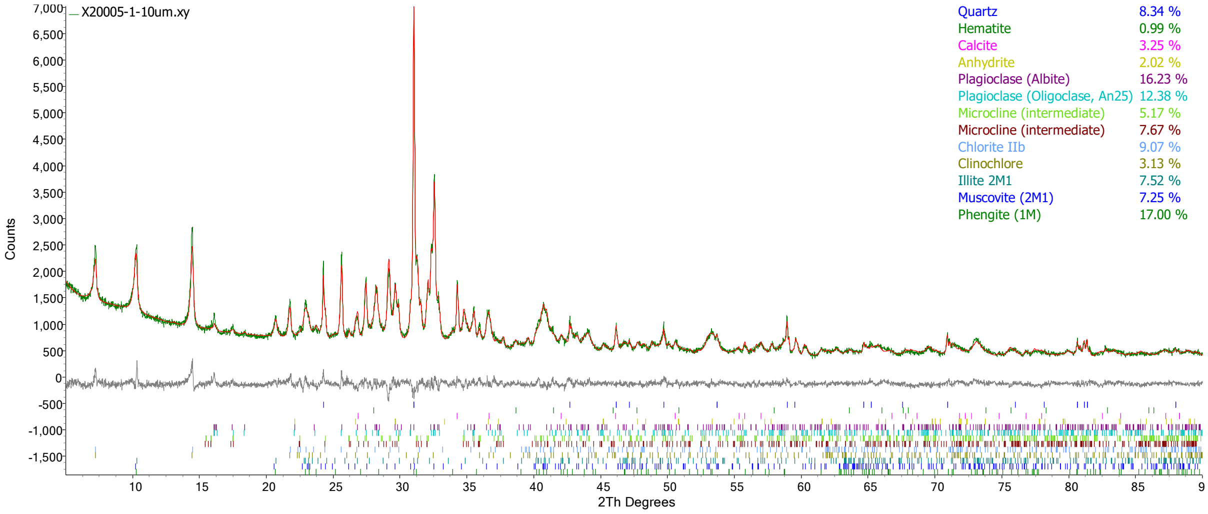
X20005 8 Tailings Samples	1 < 10 micron NTSF1	2 < 10 micron NTSF2	3 < 10 micron NTSF3	4 < 10 micron NTSF4
Quartz	6.6	6.5	7.5	5.0
Hematite	0.8			
Calcite	2.6	1.0	1.0	0.8
Anhydrite	1.6	3.2	2.4	2.3
Glauberite				3.8
Plagioclase (An0-25)	22.5	19.6	21.1	11.7
K-Feldspar	10.1	9.4	8.7	4.2
Halite		3.0	0.7	1.8
Chlorite/clinochlore	9.6	6.8	8.6	6.5
Illite/mica	25.0	23.5	23.5	12.7
Amorphous	21.2	26.9	26.6	51.2

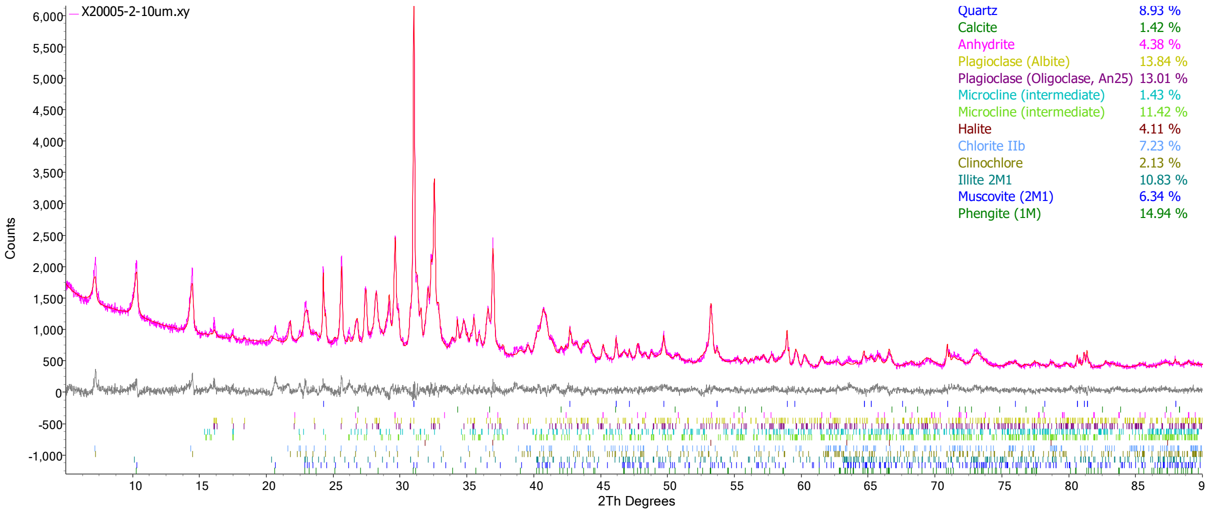
X20005 8 Tailings Samples	5 < 10 micron STSF1	6 < 10 micron STSF2	7 < 10 micron STSF3	8 < 10 micron STSF4
Quartz	7.4	7.9	8.2	7.7
Hematite	1.1		1.2	1.1
Calcite	1.8	0.3	1.9	1.9
Anhydrite	2.2	2.1	1.5	1.4
Bassanite		3.7		
Gypsum		2.5		
Amphibole			1.8	
Plagioclase (An0-25)	25.6	19.7	28.7	23.6
K-Feldspar	11.9	6.5	12.7	10.7
Halite	0.7	2.4	0.7	
Chlorite/clinochlore	9.9	7.6	10.6	12.4
Illite/mica	25.6	16.4	26.7	23.7
Amorphous	13.9	31.1	6.1	17.5

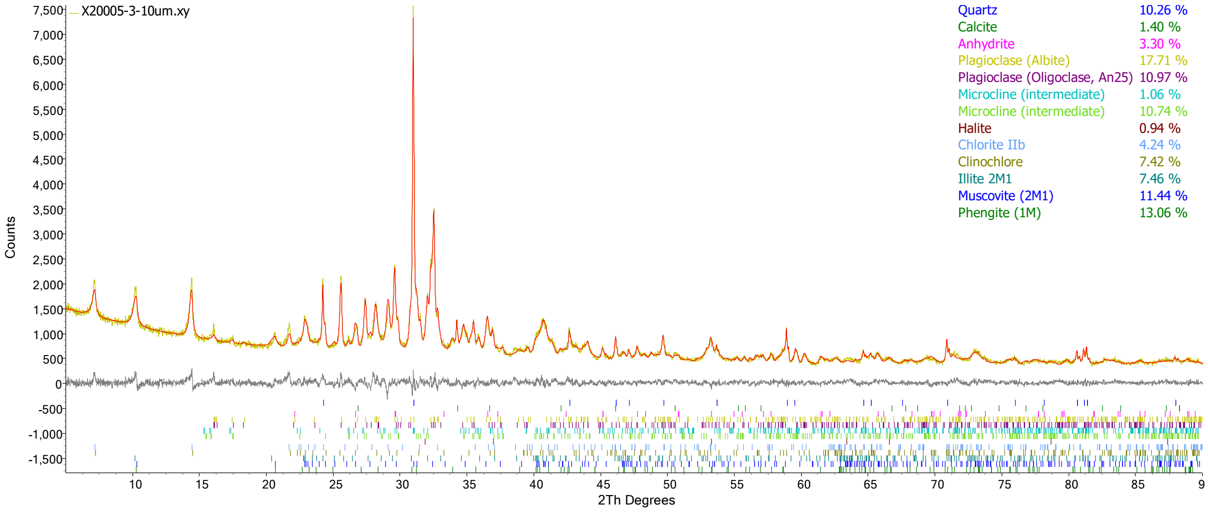
APPENDIX 1 – X-RAY DIFFRACTION DATA AND GRAPHICS

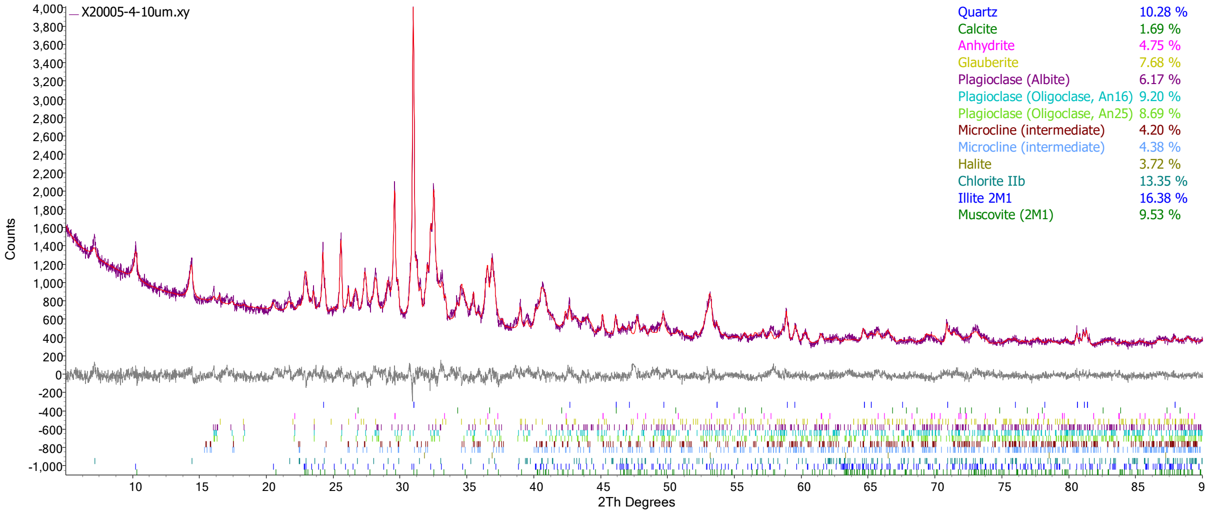
Powder X-ray Diffraction Patterns

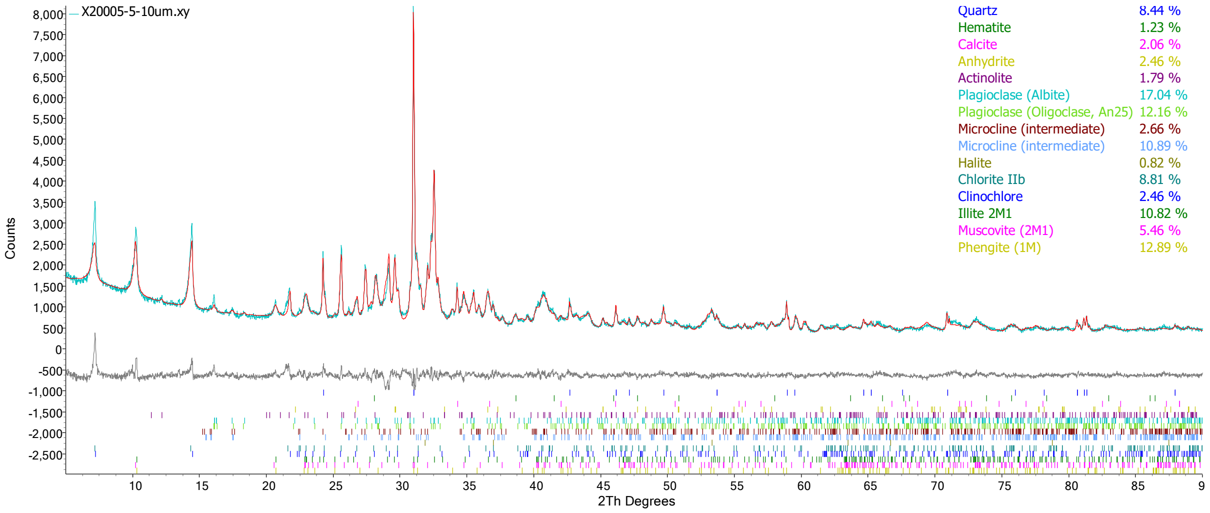
In the graphics below the coloured line is the collected data, the red line is the Rietveld refinement model, and the grey line is the difference. Note that the phase abundances on the graphics are before taking into account the external standard. Please use the tabulated abundances which require no further manipulation.

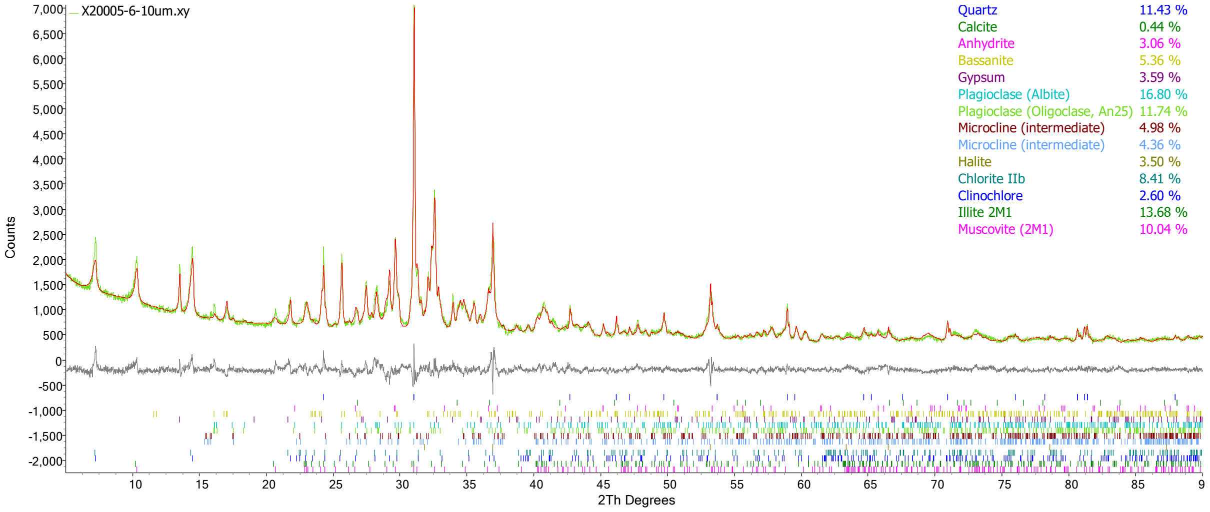


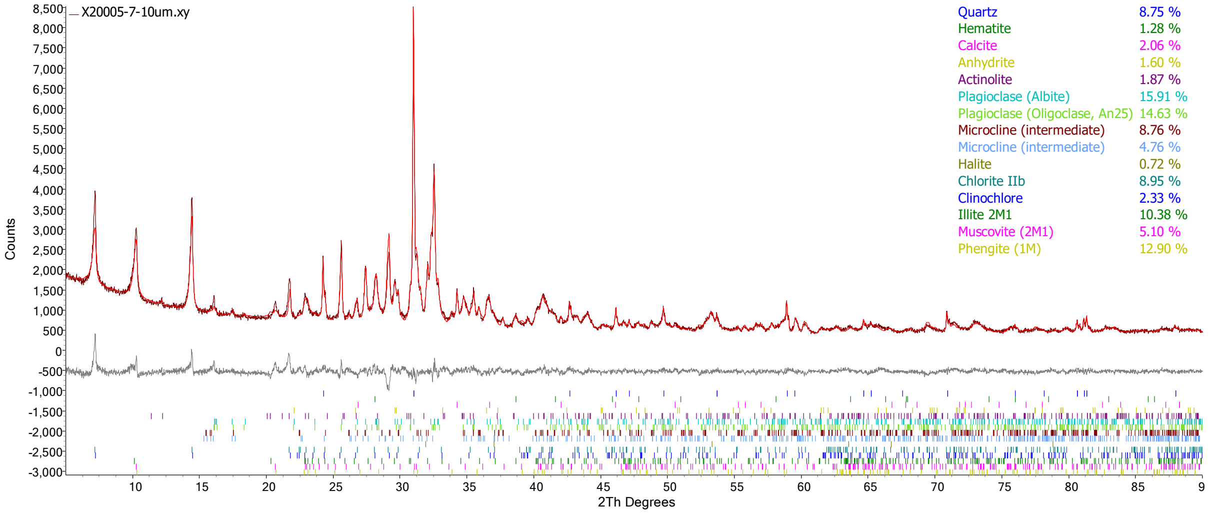

X20005-2-10um.xy
Counts
6,000
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
-500
-1,000
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
9
2Th Degrees
Quartz 8.93 %
Calcite 1.42 %
Anhydrite 4.38 %
Plagioclase (Albite) 13.84 %
Plagioclase (Oligoclase, An25) 13.01 %
Microcline (intermediate) 1.43 %
Microcline (intermediate) 11.42 %
Halite 4.11 %
Chlorite IIb 7.23 %
Clinochlore 2.13 %
Illite 2M1 10.83 %
Muscovite (2M1) 6.34 %
Phengite (1M) 14.94 %

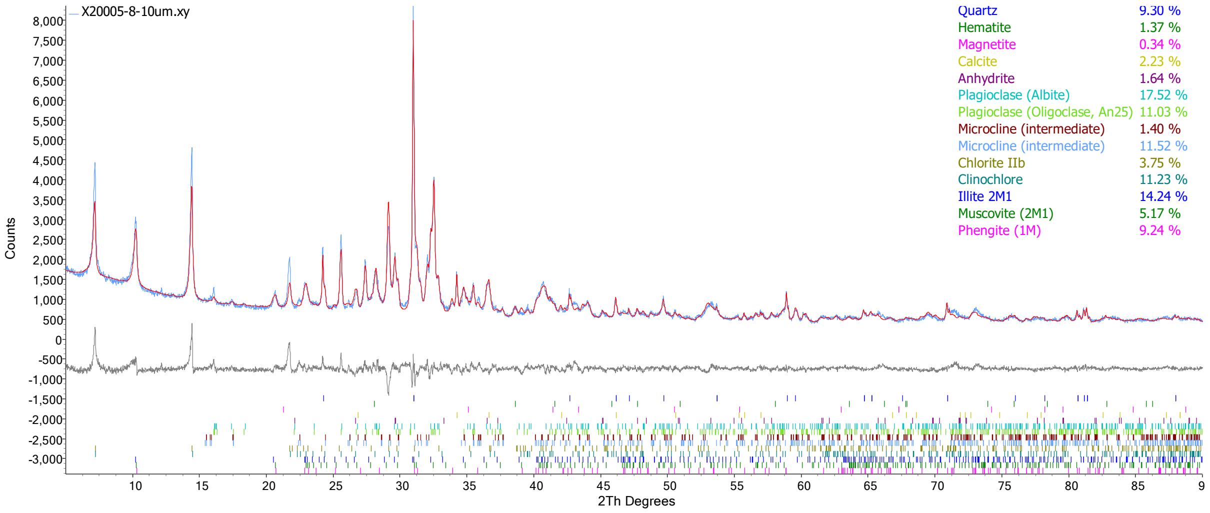

X20005-3-10um.xy
Counts
7,500
7,000
6,500
6,000
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
-500
-1,000
-1,500
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
9
2Th Degrees
Quartz 10.26 %
Calcite 1.40 %
Anhydrite 3.30 %
Plagioclase (Albite) 17.71 %
Plagioclase (Oligoclase, An25) 10.97 %
Microcline (intermediate) 1.06 %
Microcline (intermediate) 10.74 %
Halite 0.94 %
Chlorite IIb 4.24 %
Clinochlore 7.42 %
Illite 2M1 7.46 %
Muscovite (2M1) 11.44 %
Phengite (1M) 13.06 %


X20005-4-10um.xy
Counts
4,000
3,800
3,600
3,400
3,200
3,000
2,800
2,600
2,400
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
-200
-400
-600
-800
-1,000
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
9
2Th Degrees
Quartz 10.28 %
Calcite 1.69 %
Anhydrite 4.75 %
Glauberite 7.68 %
Plagioclase (Albite) 6.17 %
Plagioclase (Oligoclase, An16) 9.20 %
Plagioclase (Oligoclase, An25) 8.69 %
Microcline (intermediate) 4.20 %
Microcline (intermediate) 4.38 %
Halite 3.72 %
Chlorite IIb 13.35 %
Illite 2M1 16.38 %
Muscovite (2M1) 9.53 %


X20005-5-10um.xy
Counts
2Th Degrees
Quartz 8.44 %
Hematite 1.23 %
Calcite 2.06 %
Anhydrite 2.46 %
Actinolite 1.79 %
Plagioclase (Albite) 17.04 %
Plagioclase (Oligoclase, An25) 12.16 %
Microcline (intermediate) 2.66 %
Microcline (intermediate) 10.89 %
Halite 0.82 %
Chlorite IIb 8.81 %
Clinochlore 2.46 %
Illite 2M1 10.82 %
Muscovite (2M1) 5.46 %
Phengite (1M) 12.89 %


X20005-6-10um.xy
Counts
2Th Degrees
Quartz 11.43 %
Calcite 0.44 %
Anhydrite 3.06 %
Bassanite 5.36 %
Gypsum 3.59 %
Plagioclase (Albite) 16.80 %
Plagioclase (Oligoclase, An25) 11.74 %
Microcline (intermediate) 4.98 %
Microcline (intermediate) 4.36 %
Halite 3.50 %
Chlorite IIb 8.41 %
Clinochlore 2.60 %
Illite 2M1 13.68 %
Muscovite (2M1) 10.04 %


X20005-7-10um.xy
Counts
2Th Degrees
Quartz 8.75 %
Hematite 1.28 %
Calcite 2.06 %
Anhydrite 1.60 %
Actinolite 1.87 %
Plagioclase (Albite) 15.91 %
Plagioclase (Oligoclase, An25) 14.63 %
Microcline (intermediate) 8.76 %
Microcline (intermediate) 4.76 %
Halite 0.72 %
Chlorite IIb 8.95 %
Clinochlore 2.33 %
Illite 2M1 10.38 %
Muscovite (2M1) 5.10 %
Phengite (1M) 12.90 %



APPENDIX 2 – ANALYTICAL TECHNIQUES

Stokes' Law Size Separation

Samples were accurately weighed into a plastic beaker and dispersed in ethanol via sonication (5 min) and vigorous swirling with 90 mg of Calgon as dispersing agent. The sample dispersed in ethanol was then transferred into a cylindrical vessel and enough ethanol added to bring the total volume to 500 mL. The suspension was allowed to settle for a certain amount of time which leaves the < 10 µm *spherical equivalent* particles in the first 5 cm of suspension. This technique uses Stokes' law which shows that the time taken for a particle to settle a specific distance is a function of its size:

$$t = 305.9\eta H / \left[\left(d_p - d_f \right) D^2 \right]$$

Where:

- η is the viscosity of the fluid in centipoise
- H is the travel distance in cm
- $d_{p/f}$ are the particle and fluid density (g/cm^3)
- D is the desired *spherical equivalent* particle diameter in µm

The density of quartz (2.65 g/cm^3) was used to calculate the settling time required. The < 10 µm aliquot was transferred out of the container via siphoning off the meniscus then dried in an oven overnight at 40 °C. The < x µm aliquot was then accurately weighed.

XRD Sample Preparation

The size separated < 10 µm by Stokes' law aliquot were front-pressed into sample holders following drying. An XRD pattern was acquired from pure corundum using the same scan conditions as the samples to facilitate quantification using the external standard method.

XRD Sample Analysis

Step scanned X-ray diffraction patterns were collected for an hour per sample using a PANalytical X'Pert Pro powder diffractometer and cobalt Kα radiation operating in Bragg-Brentano geometry. The collected data was analysed using JADE (V2010, Materials Data Inc.) and X'Pert Highscore Plus (V4, PANalytical) with various reference databases (PDF4+, AMCSD, COD) for phase identification. Rietveld refinement was performed using TOPAS (V5, Bruker) or Siroquant (Sietronics, V3) for quantitative phase analysis. Siroquant is typically used for those samples which contain significant clay in the bulk powder patterns. An absorption contrast correction (Brindley) was made on the basis that the average size of the particles in the specimens is approximately 5 µm. The more absorbing phases will be under estimated if their actual average particle size is greater than 5 µm. The estimated uncertainties in the reported phase abundances are 20 wt% relative or better for every modelled phase. Due to propagation of errors the uncertainty in the amorphous (non-diffracting/unidentified) content is higher at approximately 30 wt% relative. The detection limit and limit of quantification using our method is approximately 1 wt% or less depending on the phase in question and sample matrix.

Powder X-ray diffraction is bulk phase analysis, it is not bulk chemical analysis. Phase abundances may be mis-estimated if an incorrect chemical formula is assigned to a phase. Therefore, the closest matches in the reference phase identification databases were used in the Rietveld refinement model, but other members of the identified mineral groups may be present.

Appendix F. ALS certificates of analysis

CERTIFICATE OF ANALYSIS

Work Order : **EB2000092**
Client : **NEWCREST MINING LIMITED**
Contact : TIM WRIGLEY
Address : LEVEL 32 400 GEORGE STREET
BRISBANE QLD, AUSTRALIA 4000
Telephone : ----
Project : Tailings
Order number : 4500922559
C-O-C number : ----
Sampler : TIM WRIGLEY
Site : ----
Quote number : BN/346/19
No. of samples received : 16
No. of samples analysed : 16

Page : 1 of 18
Laboratory : Environmental Division Brisbane
Contact : John Pickering
Address : 2 Byth Street Stafford QLD Australia 4053
Telephone : +61 7 3552 8634
Date Samples Received : 31-Dec-2019 09:20
Date Analysis Commenced : 06-Jan-2020
Issue Date : 14-Jan-2020 17:34

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Alison Graham	Supervisor - Inorganic	Newcastle - Inorganics, Mayfield West, NSW
Dave Gitsham	Metals Instrument Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Santusha Pandra	Senior Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Ionic Balances out of acceptable limits for some samples due to analytes not quantified in this report.
- EG035W (Water Leachable Mercury): Positive mercury results have been confirmed by re-extraction and re-analysis.
- ED093S (Cations - soluble by ICP-AES): Sample NTSF1 (EB12000092-003) shows poor duplicate results due to sample heterogeneity. Confirmed by visual inspection.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: **ASLP LEACHATE** (Matrix: **WATER**)			Client sample ID	**STF1**	**STF2**	**STF3**	**STF4**	**NTSF1**
			Client sampling date / time	30-Dec-2019 09:30	30-Dec-2019 09:30	30-Dec-2019 09:30	30-Dec-2019 09:30	30-Dec-2019 09:30
Compound	CAS Number	LOR	Unit	**EB2000092-001**	**EB2000092-002**	**EB2000092-003**	**EB2000092-004**	**EB2000092-005**
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**7.93**	**7.90**	**7.44**	**7.52**	**7.60**
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**2140**	**7480**	**2220**	**1620**	**1590**
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**13**	**24**	**21**	**27**	**26**
Total Alkalinity as CaCO3	----	1	mg/L	**13**	**24**	**21**	**27**	**26**
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	**2**	**5**	**2**	**1**	**2**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**826**	**3820**	**789**	**641**	**634**
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**71**	**373**	**151**	**49**	**51**
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**145**	**319**	**164**	**136**	**107**
Magnesium	7439-95-4	1	mg/L	**38**	**279**	**46**	**7**	**48**
Sodium	7440-23-5	1	mg/L	**239**	**1000**	**227**	**188**	**145**
Potassium	7440-09-7	1	mg/L	**64**	**278**	**78**	**34**	**47**
EG020W: Water Leachable Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.03**	<0.01	**0.03**	**0.04**	**0.02**
Germanium	7440-56-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Antimony	7440-36-0	0.001	mg/L	**0.001**	**0.004**	<0.001	<0.001	**0.008**
Niobium	7440-03-1	0.001	mg/L	**0.002**	**0.002**	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	**0.001**	**0.002**	<0.001	<0.001	<0.001
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	7440-39-3	0.001	mg/L	**0.047**	**0.065**	**0.051**	**0.045**	**0.061**
Bismuth	7440-69-9	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	**0.0006**	<0.0001	<0.0001	<0.0001
Cerium	7440-45-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Caesium	7440-46-2	0.001	mg/L	**0.002**	**0.004**	**0.002**	<0.001	<0.001
Chromium	7440-47-3	0.001	mg/L	<0.001	**0.001**	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	**0.004**	**0.012**	**0.003**	**0.004**	**0.001**

Analytical Results

Sub-Matrix: **ASLP LEACHATE** (Matrix: **WATER**)			Client sample ID	STF1	STF2	STF3	STF4	NTSF1
			Client sampling date / time	30-Dec-2019 09:30	30-Dec-2019 09:30	30-Dec-2019 09:30	30-Dec-2019 09:30	30-Dec-2019 09:30
Compound	CAS Number	LOR	Unit	EB2000092-001	EB2000092-002	EB2000092-003	EB2000092-004	EB2000092-005
				Result	Result	Result	Result	Result
EG020W: Water Leachable Metals by ICP-MS - Continued								
Dysprosium	7429-91-6	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Erbium	7440-52-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Europium	7440-53-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Gadolinium	7440-54-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Gallium	7440-55-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Hafnium	7440-58-6	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Holmium	7440-60-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Indium	7440-74-6	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Lanthanum	7439-91-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Lead	7439-92-1	0.001	mg/L	0.002	<0.001	<0.001	<0.001	<0.001
Lithium	7439-93-2	0.001	mg/L	0.008	0.026	0.009	0.005	0.010
Manganese	7439-96-5	0.001	mg/L	0.010	0.007	0.020	0.020	0.017
Molybdenum	7439-98-7	0.001	mg/L	0.185	1.70	0.284	0.209	0.200
Neodymium	7440-00-8	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Praseodymium	7440-10-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Rubidium	7440-17-7	0.001	mg/L	0.056	0.218	0.065	0.027	0.038
Samarium	7440-19-9	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	7782-49-2	0.01	mg/L	0.02	0.17	0.01	<0.01	<0.01
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	7440-24-6	0.001	mg/L	3.49	9.29	2.57	2.48	2.47
Tellurium	22541-49-7	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Terbium	7440-27-9	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium	7440-28-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Thulium	7440-30-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Titanium	7440-32-6	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Ytterbium	7440-64-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Yttrium	7440-65-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	0.021	0.034	0.035	0.036	0.024
Zirconium	7440-67-7	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Boron	7440-42-8	0.05	mg/L	0.13	0.23	0.12	0.11	0.14

Analytical Results

Sub-Matrix: **ASLP LEACHATE**
(Matrix: **WATER**)

			Client sample ID	**STF1**	**STF2**	**STF3**	**STF4**	**NTSF1**
			Client sampling date / time	30-Dec-2019 09:30	30-Dec-2019 09:30	30-Dec-2019 09:30	30-Dec-2019 09:30	30-Dec-2019 09:30
Compound	CAS Number	LOR	Unit	**EB2000092-001**	**EB2000092-002**	**EB2000092-003**	**EB2000092-004**	**EB2000092-005**
				Result	Result	Result	Result	Result
EG020W: Water Leachable Metals by ICP-MS - Continued								
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Tungsten	7440-33-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
EG035W: Water Leachable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	**0.0002**	**0.0004**	<0.0001	<0.0001
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**1.2**	**4.5**	**1.5**	**1.6**	**1.2**
EN055: Ionic Balance								
ø **Total Anions**	----	0.01	meq/L	**19.5**	**90.5**	**21.1**	**15.3**	**15.2**
ø **Total Cations**	----	0.01	meq/L	**22.4**	**89.5**	**23.8**	**16.4**	**16.8**
ø **Ionic Balance**	----	0.01	%	**7.01**	**0.58**	**6.08**	**3.60**	**5.13**

Analytical Results

Sub-Matrix: **ASLP LEACHATE**
(Matrix: **WATER**)

			Client sample ID	**NTSF2**	**NTSF3**	**NTSF4**	**----**	**----**
			Client sampling date / time	30-Dec-2019 09:30	30-Dec-2019 09:30	30-Dec-2019 09:30	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2000092-006**	**EB2000092-007**	**EB2000092-008**	**--------**	**--------**
				Result	Result	Result	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**7.80**	**7.81**	**7.98**	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**3820**	**3890**	**7390**	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**43**	**25**	**22**	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**43**	**25**	**22**	----	----
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	**4**	**8**	**5**	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**1340**	**1720**	**3380**	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**326**	**121**	**297**	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**196**	**223**	**414**	----	----
Magnesium	7439-95-4	1	mg/L	**108**	**110**	**365**	----	----
Sodium	7440-23-5	1	mg/L	**477**	**499**	**952**	----	----
Potassium	7440-09-7	1	mg/L	**122**	**123**	**238**	----	----
EG020W: Water Leachable Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	**0.02**	**0.01**	----	----
Germanium	7440-56-4	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Antimony	7440-36-0	0.001	mg/L	**0.069**	**0.005**	<0.001	----	----
Niobium	7440-03-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	**0.001**	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Barium	7440-39-3	0.001	mg/L	**0.049**	**0.041**	**0.042**	----	----
Bismuth	7440-69-9	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Cadmium	7440-43-9	0.0001	mg/L	**0.0002**	**0.0001**	**0.0005**	----	----
Cerium	7440-45-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Caesium	7440-46-2	0.001	mg/L	**0.002**	**0.003**	**0.006**	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Copper	7440-50-8	0.001	mg/L	**0.005**	**0.007**	**0.013**	----	----

Analytical Results

Sub-Matrix: **ASLP LEACHATE** (Matrix: **WATER**)			*Client sample ID*	**NTSF2**	**NTSF3**	**NTSF4**	**----**	**----**
			Client sampling date / time	30-Dec-2019 09:30	30-Dec-2019 09:30	30-Dec-2019 09:30	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2000092-006**	**EB2000092-007**	**EB2000092-008**	**--------**	**--------**
				Result	Result	Result	----	----
EG020W: Water Leachable Metals by ICP-MS - Continued								
Dysprosium	7429-91-6	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Erbium	7440-52-0	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Europium	7440-53-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Gadolinium	7440-54-2	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Gallium	7440-55-3	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Hafnium	7440-58-6	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Holmium	7440-60-0	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Indium	7440-74-6	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Lanthanum	7439-91-0	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Lithium	7439-93-2	0.001	mg/L	**0.017**	**0.021**	**0.053**	----	----
Manganese	7439-96-5	0.001	mg/L	**0.007**	**0.006**	**0.011**	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.509**	**0.301**	**1.38**	----	----
Neodymium	7440-00-8	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Praseodymium	7440-10-0	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Rubidium	7440-17-7	0.001	mg/L	**0.089**	**0.076**	**0.182**	----	----
Samarium	7440-19-9	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Selenium	7782-49-2	0.01	mg/L	**0.02**	<0.01	**0.06**	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Strontium	7440-24-6	0.001	mg/L	**4.51**	**6.53**	**9.81**	----	----
Tellurium	22541-49-7	0.005	mg/L	<0.005	<0.005	<0.005	----	----
Terbium	7440-27-9	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Thallium	7440-28-0	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Thulium	7440-30-4	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Titanium	7440-32-6	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Ytterbium	7440-64-4	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Yttrium	7440-65-5	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Zinc	7440-66-6	0.005	mg/L	**0.035**	**0.031**	<0.005	----	----
Zirconium	7440-67-7	0.005	mg/L	<0.005	<0.005	<0.005	----	----
Boron	7440-42-8	0.05	mg/L	**0.13**	**0.15**	**0.20**	----	----

Analytical Results

Sub-Matrix: **ASLP LEACHATE** (Matrix: **WATER**)			Client sample ID	**NTSF2**	**NTSF3**	**NTSF4**	**----**	**----**
			Client sampling date / time	30-Dec-2019 09:30	30-Dec-2019 09:30	30-Dec-2019 09:30	----	----
Compound	CAS Number	LOR	Unit	**EB2000092-006**	**EB2000092-007**	**EB2000092-008**	**--------**	**--------**
				Result	Result	Result	----	----
EG020W: Water Leachable Metals by ICP-MS - Continued								
Iron	7439-89-6	0.05	mg/L	**0.10**	<0.05	<0.05	----	----
Tungsten	7440-33-7	0.001	mg/L	<0.001	**0.005**	**0.001**	----	----
EG035W: Water Leachable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**1.6**	**1.9**	**4.5**	----	----
EN055: Ionic Balance								
ø **Total Anions**	----	0.01	meq/L	**38.0**	**39.7**	**79.2**	----	----
ø **Total Cations**	----	0.01	meq/L	**42.5**	**45.0**	**98.2**	----	----
ø **Ionic Balance**	----	0.01	%	**5.69**	**6.26**	**10.7**	----	----

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

			Client sample ID	**STF1**	**STF2**	**STF3**	**STF4**	**NTSF1**
			Client sampling date / time	30-Dec-2019 09:30	30-Dec-2019 09:30	30-Dec-2019 09:30	30-Dec-2019 09:30	30-Dec-2019 09:30
Compound	*CAS Number*	*LOR*	*Unit*	**EB2000092-001**	**EB2000092-002**	**EB2000092-003**	**EB2000092-004**	**EB2000092-005**
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**12.0**	**1.9**	**12.7**	**18.7**	**19.0**
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**19000**	**71400**	**14800**	**13000**	**8920**
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	**1610**	**8720**	**3160**	**950**	**1070**
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	**2450**	**2270**	**1780**	**2170**	**830**
Magnesium	7439-95-4	10	mg/kg	**840**	**6150**	**920**	**140**	**680**
Sodium	7440-23-5	10	mg/kg	**4890**	**20700**	**4320**	**3640**	**2270**
Potassium	7440-09-7	10	mg/kg	**1220**	**5680**	**1350**	**620**	**750**
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	**13700**	**10200**	**13700**	**14500**	**12700**
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Iron	7439-89-6	50	mg/kg	**26100**	**20700**	**26900**	**28000**	**25200**
EG020T: Total Metals by ICP-MS								
Arsenic	7440-38-2	0.1	mg/kg	**2.6**	**2.4**	**3.1**	**3.7**	**3.6**
Selenium	7782-49-2	1	mg/kg	**1**	**4**	**1**	**1**	**1**
Silver	7440-22-4	0.1	mg/kg	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**
Barium	7440-39-3	0.1	mg/kg	**22.8**	**16.4**	**20.9**	**22.6**	**38.6**
Thallium	7440-28-0	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Beryllium	7440-41-7	0.1	mg/kg	**0.3**	**0.2**	**0.3**	**0.4**	**0.3**
Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bismuth	7440-69-9	0.1	mg/kg	**0.1**	**0.2**	**0.2**	**0.2**	**0.2**
Cobalt	7440-48-4	0.1	mg/kg	**10.8**	**9.2**	**12.9**	**14.0**	**11.4**
Chromium	7440-47-3	0.1	mg/kg	**32.9**	**21.4**	**39.4**	**37.6**	**30.4**
Copper	7440-50-8	0.1	mg/kg	**444**	**429**	**457**	**607**	**490**
Thorium	7440-29-1	0.1	mg/kg	**1.8**	**1.5**	**1.6**	**1.8**	**1.9**
Manganese	7439-96-5	0.1	mg/kg	**294**	**254**	**287**	**299**	**283**
Strontium	7440-24-6	0.1	mg/kg	**101**	**203**	**90.4**	**120**	**84.1**
Molybdenum	7439-98-7	0.1	mg/kg	**7.9**	**36.1**	**10.3**	**9.2**	**9.0**
Nickel	7440-02-0	0.1	mg/kg	**13.2**	**9.1**	**14.5**	**15.3**	**12.7**
Lead	7439-92-1	0.1	mg/kg	**2.5**	**2.0**	**3.2**	**4.0**	**4.2**
Antimony	7440-36-0	0.1	mg/kg	**0.2**	**0.2**	**0.2**	**0.1**	**0.1**
Uranium	7440-61-1	0.1	mg/kg	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

			Client sample ID	**STF1**	**STF2**	**STF3**	**STF4**	**NTSF1**
			Client sampling date / time	30-Dec-2019 09:30	30-Dec-2019 09:30	30-Dec-2019 09:30	30-Dec-2019 09:30	30-Dec-2019 09:30
Compound	*CAS Number*	*LOR*	*Unit*	**EB2000092-001**	**EB2000092-002**	**EB2000092-003**	**EB2000092-004**	**EB2000092-005**
				Result	Result	Result	Result	Result
EG020T: Total Metals by ICP-MS - Continued								
Zinc	7440-66-6	0.5	mg/kg	**24.7**	**19.2**	**23.4**	**26.4**	**22.9**
Lithium	7439-93-2	0.1	mg/kg	**16.0**	**12.4**	**15.2**	**16.0**	**14.5**
Vanadium	7440-62-2	1	mg/kg	**77**	**54**	**79**	**83**	**68**
Tin	7440-31-5	0.1	mg/kg	**0.5**	**0.3**	**0.5**	**0.8**	**0.6**
EK040T: Fluoride Total								
Fluoride	16984-48-8	40	mg/kg	**1250**	**1080**	**1280**	**1360**	**1130**
EN60: ASLP Leaching Procedure								
Extraction Fluid pH	----	0.1	pH Unit	**6.0**	**6.0**	**6.0**	**6.0**	**6.0**
Final pH	----	0.1	pH Unit	**8.4**	**8.6**	**8.5**	**8.4**	**8.6**

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL**)			*Client sample ID*	**NTSF2**	**NTSF3**	**NTSF4**	**----**	**----**
			Client sampling date / time	30-Dec-2019 09:30	30-Dec-2019 09:30	30-Dec-2019 09:30	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2000092-006**	**EB2000092-007**	**EB2000092-008**	**--------**	**--------**
				Result	Result	Result	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**12.0**	**10.4**	**8.5**	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**29500**	**33800**	**85300**	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	**4360**	**2460**	**4440**	----	----
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	**2740**	**2500**	**2320**	----	----
Magnesium	7439-95-4	10	mg/kg	**2160**	**2140**	**7740**	----	----
Sodium	7440-23-5	10	mg/kg	**8540**	**9660**	**21300**	----	----
Potassium	7440-09-7	10	mg/kg	**2130**	**2270**	**5790**	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	**13200**	**11900**	**10900**	----	----
Boron	7440-42-8	50	mg/kg	<50	<50	<50	----	----
Iron	7439-89-6	50	mg/kg	**26000**	**23800**	**21700**	----	----
EG020T: Total Metals by ICP-MS								
Arsenic	7440-38-2	0.1	mg/kg	**4.1**	**4.4**	**3.7**	----	----
Selenium	7782-49-2	1	mg/kg	**2**	<1	**2**	----	----
Silver	7440-22-4	0.1	mg/kg	**0.2**	**0.2**	**0.2**	----	----
Barium	7440-39-3	0.1	mg/kg	**29.6**	**26.6**	**23.9**	----	----
Thallium	7440-28-0	0.1	mg/kg	<0.1	<0.1	<0.1	----	----
Beryllium	7440-41-7	0.1	mg/kg	**0.3**	**0.3**	**0.2**	----	----
Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	<0.1	----	----
Bismuth	7440-69-9	0.1	mg/kg	**0.2**	**0.2**	**0.1**	----	----
Cobalt	7440-48-4	0.1	mg/kg	**11.4**	**11.4**	**10.0**	----	----
Chromium	7440-47-3	0.1	mg/kg	**33.7**	**26.7**	**24.5**	----	----
Copper	7440-50-8	0.1	mg/kg	**458**	**610**	**488**	----	----
Thorium	7440-29-1	0.1	mg/kg	**1.8**	**1.8**	**1.5**	----	----
Manganese	7439-96-5	0.1	mg/kg	**325**	**283**	**274**	----	----
Strontium	7440-24-6	0.1	mg/kg	**142**	**218**	**219**	----	----
Molybdenum	7439-98-7	0.1	mg/kg	**15.9**	**11.6**	**33.5**	----	----
Nickel	7440-02-0	0.1	mg/kg	**14.6**	**11.8**	**11.5**	----	----
Lead	7439-92-1	0.1	mg/kg	**5.3**	**4.0**	**4.1**	----	----
Antimony	7440-36-0	0.1	mg/kg	**0.2**	**0.2**	**0.2**	----	----
Uranium	7440-61-1	0.1	mg/kg	**0.5**	**0.4**	**0.6**	----	----

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL**)			*Client sample ID*	**NTSF2**	**NTSF3**	**NTSF4**	**----**	**----**
			Client sampling date / time	30-Dec-2019 09:30	30-Dec-2019 09:30	30-Dec-2019 09:30	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2000092-006**	**EB2000092-007**	**EB2000092-008**	**--------**	**--------**
				Result	Result	Result	----	----
EG020T: Total Metals by ICP-MS - Continued								
Zinc	7440-66-6	0.5	mg/kg	**26.5**	**25.9**	**21.8**	----	----
Lithium	7439-93-2	0.1	mg/kg	**15.7**	**14.6**	**14.3**	----	----
Vanadium	7440-62-2	1	mg/kg	**74**	**64**	**59**	----	----
Tin	7440-31-5	0.1	mg/kg	**0.6**	**0.5**	**0.5**	----	----
EK040T: Fluoride Total								
Fluoride	16984-48-8	40	mg/kg	**1310**	**1260**	**1160**	----	----
EN60: ASLP Leaching Procedure								
Extraction Fluid pH	----	0.1	pH Unit	**6.0**	**6.0**	**6.0**	----	----
Final pH	----	0.1	pH Unit	**8.6**	**8.7**	**8.7**	----	----

Analytical Results

Sub-Matrix: **WATER LEACHATE** (Matrix: **WATER**)			*Client sample ID*	**STF1** **NAG LEACHATE**	**STF2** **NAG LEACHATE**	**STF3** **NAG LEACHATE**	**STF4** **NAG LEACHATE**	**NTSF1** **NAG LEACHATE**
			Client sampling date / time	30-Dec-2019 09:30	30-Dec-2019 09:30	30-Dec-2019 09:30	30-Dec-2019 09:30	30-Dec-2019 09:30
Compound	*CAS Number*	*LOR*	*Unit*	**EB2000092-009**	**EB2000092-010**	**EB2000092-011**	**EB2000092-012**	**EB2000092-013**
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**10.9**	**8.67**	**10.8**	**10.9**	**10.9**
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**890**	**1940**	**842**	**736**	**734**
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	**53**	<1	**40**	**52**	**50**
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	**73**	**7**	**67**	**62**	**61**
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	<1	**20**	<1	<1	<1
Total Alkalinity as CaCO3	----	1	mg/L	**126**	**27**	**107**	**114**	**110**
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	<1	<1	<1	<1	<1
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**235**	**679**	**184**	**151**	**157**
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**16**	**119**	**30**	**9**	**11**
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**98**	**162**	**92**	**80**	**86**
Magnesium	7439-95-4	1	mg/L	<1	**2**	<1	<1	<1
Sodium	7440-23-5	1	mg/L	**76**	**234**	**68**	**57**	**51**
Potassium	7440-09-7	1	mg/L	**20**	**62**	**25**	**14**	**17**
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**1.46**	<0.01	**1.44**	**2.21**	**1.25**
Dysprosium	7429-91-6	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Bismuth	7440-69-9	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Erbium	7440-52-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	7440-42-8	0.05	mg/L	**0.45**	**1.03**	**0.47**	**0.36**	**0.62**
Europium	7440-53-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	7440-24-6	0.001	mg/L	**0.707**	**1.77**	**0.498**	**0.444**	**0.588**
Barium	7440-39-3	0.001	mg/L	**0.249**	**0.220**	**0.023**	**0.024**	**0.025**
Gadolinium	7440-54-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Titanium	7440-32-6	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Gallium	7440-55-3	0.001	mg/L	**0.001**	<0.001	**0.001**	**0.002**	<0.001

Analytical Results

Sub-Matrix: **WATER LEACHATE**
(Matrix: **WATER**)

			Client sample ID	**STF1 NAG LEACHATE**	**STF2 NAG LEACHATE**	**STF3 NAG LEACHATE**	**STF4 NAG LEACHATE**	**NTSF1 NAG LEACHATE**
			Client sampling date / time	30-Dec-2019 09:30	30-Dec-2019 09:30	30-Dec-2019 09:30	30-Dec-2019 09:30	30-Dec-2019 09:30
Compound	CAS Number	LOR	Unit	**EB2000092-009**	**EB2000092-010**	**EB2000092-011**	**EB2000092-012**	**EB2000092-013**
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Cadmium	7440-43-9	0.0001	mg/L	**0.0001**	**0.0004**	<0.0001	<0.0001	<0.0001
Hafnium	7440-58-6	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Tellurium	22541-49-7	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Holmium	7440-60-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Caesium	7440-46-2	0.001	mg/L	<0.001	**0.002**	<0.001	<0.001	<0.001
Chromium	7440-47-3	0.001	mg/L	**0.041**	**0.062**	**0.075**	**0.074**	**0.074**
Indium	7440-74-6	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	**0.002**	**0.004**	**0.002**
Lanthanum	7439-91-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Rubidium	7440-17-7	0.001	mg/L	**0.025**	**0.059**	**0.033**	**0.026**	**0.023**
Lithium	7439-93-2	0.001	mg/L	<0.001	**0.008**	<0.001	<0.001	<0.001
Lutetium	7439-94-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cerium	7440-45-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	7439-96-5	0.001	mg/L	<0.001	**0.003**	<0.001	**0.002**	<0.001
Neodymium	7440-00-8	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Molybdenum	7439-98-7	0.001	mg/L	**0.073**	**0.339**	**0.099**	**0.110**	**0.093**
Praseodymium	7440-10-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	<0.001	**0.003**	<0.001	<0.001	<0.001
Samarium	7440-19-9	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Terbium	7440-27-9	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Antimony	7440-36-0	0.001	mg/L	<0.001	**0.001**	<0.001	**0.001**	<0.001
Thulium	7440-30-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	**0.04**	<0.01	<0.01	<0.01
Ytterbium	7440-64-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Yttrium	7440-65-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium	7440-28-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zirconium	7440-67-7	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Vanadium	7440-62-2	0.01	mg/L	**0.05**	<0.01	**0.05**	**0.04**	**0.03**
Zinc	7440-66-6	0.005	mg/L	**0.064**	**0.099**	<0.005	<0.005	<0.005

Analytical Results

Sub-Matrix: **WATER LEACHATE** (Matrix: **WATER**)			Client sample ID	**STF1 NAG LEACHATE**	**STF2 NAG LEACHATE**	**STF3 NAG LEACHATE**	**STF4 NAG LEACHATE**	**NTSF1 NAG LEACHATE**
			Client sampling date / time	30-Dec-2019 09:30	30-Dec-2019 09:30	30-Dec-2019 09:30	30-Dec-2019 09:30	30-Dec-2019 09:30
Compound	*CAS Number*	*LOR*	*Unit*	**EB2000092-009**	**EB2000092-010**	**EB2000092-011**	**EB2000092-012**	**EB2000092-013**
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.5**	**1.0**	**0.5**	**0.5**	**0.4**
EN055: Ionic Balance								
ø **Total Anions**	----	0.01	meq/L	**7.86**	**18.0**	**6.82**	**5.68**	**5.78**
ø **Total Cations**	----	0.01	meq/L	**8.71**	**20.0**	**8.19**	**6.83**	**6.94**
ø **Ionic Balance**	----	0.01	%	**5.10**	**5.20**	**9.15**	**9.23**	**9.18**

Analytical Results

Sub-Matrix: **WATER LEACHATE** (Matrix: **WATER**)			*Client sample ID*	**NTSF2** **NAG LEACHATE**	**NTSF3** **NAG LEACHATE**	**NTSF4** **NAG LEACHATE**	**----**	**----**
			Client sampling date / time	30-Dec-2019 09:30	30-Dec-2019 09:30	30-Dec-2019 09:30	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2000092-014**	**EB2000092-015**	**EB2000092-016**	**--------**	**--------**
				Result	Result	Result	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**10.3**	**10.4**	**8.12**	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**1140**	**1140**	**1980**	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	**19**	**25**	<1	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	**59**	**57**	<1	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	<1	<1	**26**	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**78**	**83**	**26**	----	----
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	<1	<1	**3**	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**376**	**411**	**800**	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**52**	**26**	**52**	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**116**	**119**	**185**	----	----
Magnesium	7439-95-4	1	mg/L	<1	<1	**24**	----	----
Sodium	7440-23-5	1	mg/L	**109**	**115**	**200**	----	----
Potassium	7440-09-7	1	mg/L	**30**	**30**	**54**	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.43**	**0.53**	<0.01	----	----
Dysprosium	7429-91-6	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Bismuth	7440-69-9	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Erbium	7440-52-0	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Boron	7440-42-8	0.05	mg/L	**0.83**	**0.97**	**0.67**	----	----
Europium	7440-53-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Strontium	7440-24-6	0.001	mg/L	**1.03**	**1.28**	**2.05**	----	----
Barium	7440-39-3	0.001	mg/L	**0.040**	**0.036**	**0.088**	----	----
Gadolinium	7440-54-2	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Titanium	7440-32-6	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Gallium	7440-55-3	0.001	mg/L	<0.001	<0.001	<0.001	----	----

Analytical Results

Sub-Matrix: **WATER LEACHATE**
(Matrix: **WATER**)

			Client sample ID	**NTSF2** **NAG LEACHATE**	**NTSF3** **NAG LEACHATE**	**NTSF4** **NAG LEACHATE**	**----**	**----**
			Client sampling date / time	30-Dec-2019 09:30	30-Dec-2019 09:30	30-Dec-2019 09:30	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2000092-014**	**EB2000092-015**	**EB2000092-016**	**--------**	**--------**
				Result	Result	Result	----	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----
Hafnium	7440-58-6	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Tellurium	22541-49-7	0.005	mg/L	<0.005	<0.005	<0.005	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Holmium	7440-60-0	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Caesium	7440-46-2	0.001	mg/L	<0.001	<0.001	**0.001**	----	----
Chromium	7440-47-3	0.001	mg/L	**0.054**	**0.054**	**0.034**	----	----
Indium	7440-74-6	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	**0.001**	<0.001	----	----
Lanthanum	7439-91-0	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Rubidium	7440-17-7	0.001	mg/L	**0.034**	**0.034**	**0.051**	----	----
Lithium	7439-93-2	0.001	mg/L	**0.002**	**0.002**	**0.019**	----	----
Lutetium	7439-94-3	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Cerium	7440-45-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Neodymium	7440-00-8	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.143**	**0.125**	**0.276**	----	----
Praseodymium	7440-10-0	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Samarium	7440-19-9	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Terbium	7440-27-9	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Antimony	7440-36-0	0.001	mg/L	**0.001**	**0.001**	**0.001**	----	----
Thulium	7440-30-4	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	**0.02**	----	----
Ytterbium	7440-64-4	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Yttrium	7440-65-5	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Thallium	7440-28-0	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Zirconium	7440-67-7	0.005	mg/L	<0.005	<0.005	<0.005	----	----
Vanadium	7440-62-2	0.01	mg/L	**0.03**	**0.03**	<0.01	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	----	----

Analytical Results

Sub-Matrix: **WATER LEACHATE** (Matrix: **WATER**)			*Client sample ID*	**NTSF2 NAG LEACHATE**	**NTSF3 NAG LEACHATE**	**NTSF4 NAG LEACHATE**	**----**	**----**
			Client sampling date / time	30-Dec-2019 09:30	30-Dec-2019 09:30	30-Dec-2019 09:30	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2000092-014**	**EB2000092-015**	**EB2000092-016**	**--------**	**--------**
				Result	Result	Result	----	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	**----**	**----**
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.5**	**0.5**	**0.7**	**----**	**----**
EN055: Ionic Balance								
ø **Total Anions**	----	0.01	meq/L	**10.8**	**10.9**	**18.6**	**----**	**----**
ø **Total Cations**	----	0.01	meq/L	**11.3**	**11.7**	**21.3**	**----**	**----**
ø **Ionic Balance**	----	0.01	%	**2.00**	**3.35**	**6.62**	**----**	**----**

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB2000591**	Page	: 1 of 10
Client	: **NEWCREST MINING LIMITED**	Laboratory	: Environmental Division Brisbane
Contact	: TIM WRIGLEY	Contact	: John Pickering
Address	: LEVEL 32 400 GEORGE STREET BRISBANE QLD, AUSTRALIA 4000	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61 7 3552 8634
Project	: TSF CADIA	Date Samples Received	: 10-Jan-2020 13:15
Order number	: 4500922559	Date Analysis Commenced	: 13-Jan-2020
C-O-C number	: ----	Issue Date	: 17-Jan-2020 14:55
Sampler	: TIM WRIGLEY		
Site	: CADIA		
Quote number	: EN/222		
No. of samples received	: 2		
No. of samples analysed	: 2		

NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Diana Mesa	2IC Organic Chemist	Brisbane Organics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EP075: 'Sum of PAH' is the sum of the USEPA 16 priority PAHs
- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero, for 'TEQ 1/2LOR' are treated as half the reported LOR, and for 'TEQ LOR' are treated as being equal to the reported LOR. Note: TEQ 1/2LOR and TEQ LOR will calculate as 0.6mg/Kg and 1.2mg/Kg respectively for samples with non-detects for all of the eight TEQ PAHs.

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL**)			*Client sample ID*	**NTSF 4**	**STSF 2**	**----**	**----**	**----**
			Client sampling date / time	10-Jan-2020 00:00	10-Jan-2020 00:00	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2000591-001**	**EB2000591-002**	**--------**	**--------**	**--------**
				Result	Result	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**9.3**	<1.0	----	----	----
EP074A: Monocyclic Aromatic Hydrocarbons								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	----	----	----
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	----	----	----
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	----	----	----
Styrene	100-42-5	0.5	mg/kg	<0.5	<0.5	----	----	----
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	----	----	----
Isopropylbenzene	98-82-8	0.5	mg/kg	<0.5	<0.5	----	----	----
n-Propylbenzene	103-65-1	0.5	mg/kg	<0.5	<0.5	----	----	----
1.3.5-Trimethylbenzene	108-67-8	0.5	mg/kg	<0.5	<0.5	----	----	----
sec-Butylbenzene	135-98-8	0.5	mg/kg	<0.5	<0.5	----	----	----
1.2.4-Trimethylbenzene	95-63-6	0.5	mg/kg	<0.5	<0.5	----	----	----
tert-Butylbenzene	98-06-6	0.5	mg/kg	<0.5	<0.5	----	----	----
p-Isopropyltoluene	99-87-6	0.5	mg/kg	<0.5	<0.5	----	----	----
n-Butylbenzene	104-51-8	0.5	mg/kg	<0.5	<0.5	----	----	----
EP074B: Oxygenated Compounds								
Vinyl Acetate	108-05-4	5	mg/kg	<5	<5	----	----	----
2-Butanone (MEK)	78-93-3	5	mg/kg	<5	<5	----	----	----
4-Methyl-2-pentanone (MIBK)	108-10-1	5	mg/kg	<5	<5	----	----	----
2-Hexanone (MBK)	591-78-6	5	mg/kg	<5	<5	----	----	----
EP074C: Sulfonated Compounds								
Carbon disulfide	75-15-0	0.5	mg/kg	<0.5	<0.5	----	----	----
EP074D: Fumigants								
2.2-Dichloropropane	594-20-7	0.5	mg/kg	<0.5	<0.5	----	----	----
1.2-Dichloropropane	78-87-5	0.5	mg/kg	<0.5	<0.5	----	----	----
cis-1.3-Dichloropropylene	10061-01-5	0.5	mg/kg	<0.5	<0.5	----	----	----
trans-1.3-Dichloropropylene	10061-02-6	0.5	mg/kg	<0.5	<0.5	----	----	----
1.2-Dibromoethane (EDB)	106-93-4	0.5	mg/kg	<0.5	<0.5	----	----	----
EP074E: Halogenated Aliphatic Compounds								
Dichlorodifluoromethane	75-71-8	5	mg/kg	<5	<5	----	----	----
Chloromethane	74-87-3	5	mg/kg	<5	<5	----	----	----
Vinyl chloride	75-01-4	5	mg/kg	<5	<5	----	----	----
Bromomethane	74-83-9	5	mg/kg	<5	<5	----	----	----

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL**)			*Client sample ID*	**NTSF 4**	**STSF 2**	**----**	**----**	**----**
			Client sampling date / time	10-Jan-2020 00:00	10-Jan-2020 00:00	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2000591-001**	**EB2000591-002**	**--------**	**--------**	**--------**
				Result	Result	----	----	----
EP074E: Halogenated Aliphatic Compounds - Continued								
Chloroethane	75-00-3	5	mg/kg	<5	<5	----	----	----
Trichlorofluoromethane	75-69-4	5	mg/kg	<5	<5	----	----	----
1.1-Dichloroethene	75-35-4	0.5	mg/kg	<0.5	<0.5	----	----	----
Iodomethane	74-88-4	0.5	mg/kg	<0.5	<0.5	----	----	----
trans-1.2-Dichloroethene	156-60-5	0.5	mg/kg	<0.5	<0.5	----	----	----
1.1-Dichloroethane	75-34-3	0.5	mg/kg	<0.5	<0.5	----	----	----
cis-1.2-Dichloroethene	156-59-2	0.5	mg/kg	<0.5	<0.5	----	----	----
1.1.1-Trichloroethane	71-55-6	0.5	mg/kg	<0.5	<0.5	----	----	----
1.1-Dichloropropylene	563-58-6	0.5	mg/kg	<0.5	<0.5	----	----	----
Carbon Tetrachloride	56-23-5	0.5	mg/kg	<0.5	<0.5	----	----	----
1.2-Dichloroethane	107-06-2	0.5	mg/kg	<0.5	<0.5	----	----	----
Trichloroethene	79-01-6	0.5	mg/kg	<0.5	<0.5	----	----	----
Dibromomethane	74-95-3	0.5	mg/kg	<0.5	<0.5	----	----	----
1.1.2-Trichloroethane	79-00-5	0.5	mg/kg	<0.5	<0.5	----	----	----
1.3-Dichloropropane	142-28-9	0.5	mg/kg	<0.5	<0.5	----	----	----
Tetrachloroethene	127-18-4	0.5	mg/kg	<0.5	<0.5	----	----	----
1.1.1.2-Tetrachloroethane	630-20-6	0.5	mg/kg	<0.5	<0.5	----	----	----
trans-1.4-Dichloro-2-butene	110-57-6	0.5	mg/kg	<0.5	<0.5	----	----	----
cis-1.4-Dichloro-2-butene	1476-11-5	0.5	mg/kg	<0.5	<0.5	----	----	----
1.1.2.2-Tetrachloroethane	79-34-5	0.5	mg/kg	<0.5	<0.5	----	----	----
1.2.3-Trichloropropane	96-18-4	0.5	mg/kg	<0.5	<0.5	----	----	----
Pentachloroethane	76-01-7	0.5	mg/kg	<0.5	<0.5	----	----	----
1.2-Dibromo-3-chloropropane	96-12-8	0.5	mg/kg	<0.5	<0.5	----	----	----
EP074F: Halogenated Aromatic Compounds								
Chlorobenzene	108-90-7	0.5	mg/kg	<0.5	<0.5	----	----	----
Bromobenzene	108-86-1	0.5	mg/kg	<0.5	<0.5	----	----	----
2-Chlorotoluene	95-49-8	0.5	mg/kg	<0.5	<0.5	----	----	----
4-Chlorotoluene	106-43-4	0.5	mg/kg	<0.5	<0.5	----	----	----
1.2.3-Trichlorobenzene	87-61-6	0.5	mg/kg	<0.5	<0.5	----	----	----
EP074G: Trihalomethanes								
Chloroform	67-66-3	0.5	mg/kg	<0.5	<0.5	----	----	----
Bromodichloromethane	75-27-4	0.5	mg/kg	<0.5	<0.5	----	----	----
Dibromochloromethane	124-48-1	0.5	mg/kg	<0.5	<0.5	----	----	----
Bromoform	75-25-2	0.5	mg/kg	<0.5	<0.5	----	----	----

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

			Client sample ID	**NTSF 4**	**STSF 2**	**----**	**----**	**----**
			Client sampling date / time	10-Jan-2020 00:00	10-Jan-2020 00:00	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2000591-001**	**EB2000591-002**	**--------**	**--------**	**--------**
				Result	Result	----	----	----
EP075A: Phenolic Compounds								
Phenol	108-95-2	0.5	mg/kg	<0.5	<0.5	----	----	----
2-Chlorophenol	95-57-8	0.5	mg/kg	<0.5	<0.5	----	----	----
2-Methylphenol	95-48-7	0.5	mg/kg	<0.5	<0.5	----	----	----
3- & 4-Methylphenol	1319-77-3	0.5	mg/kg	<0.5	<0.5	----	----	----
2-Nitrophenol	88-75-5	0.5	mg/kg	<0.5	<0.5	----	----	----
2.4-Dimethylphenol	105-67-9	0.5	mg/kg	<0.5	<0.5	----	----	----
2.4-Dichlorophenol	120-83-2	0.5	mg/kg	<0.5	<0.5	----	----	----
2.6-Dichlorophenol	87-65-0	0.5	mg/kg	<0.5	<0.5	----	----	----
4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg	<0.5	<0.5	----	----	----
2.4.6-Trichlorophenol	88-06-2	0.5	mg/kg	<0.5	<0.5	----	----	----
2.4.5-Trichlorophenol	95-95-4	0.5	mg/kg	<0.5	<0.5	----	----	----
Pentachlorophenol	87-86-5	1	mg/kg	<1	<1	----	----	----
EP075B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	----	----	----
2-Methylnaphthalene	91-57-6	0.5	mg/kg	<0.5	<0.5	----	----	----
2-Chloronaphthalene	91-58-7	0.5	mg/kg	<0.5	<0.5	----	----	----
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	----	----	----
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	----	----	----
Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	----	----	----
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	----	----	----
Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	----	----	----
Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	----	----	----
Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	----	----	----
N-2-Fluorenyl Acetamide	53-96-3	0.5	mg/kg	<0.5	<0.5	----	----	----
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	----	----	----
Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	----	----	----
Benzo(b+j) & Benzo(k)fluoranthene	205-99-2 207-08-9	1	mg/kg	<1	<1	----	----	----
7.12-Dimethylbenz(a)anthracene	57-97-6	0.5	mg/kg	<0.5	<0.5	----	----	----
Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	----	----	----
3-Methylcholanthrene	56-49-5	0.5	mg/kg	<0.5	<0.5	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	----	----	----
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	----	----	----
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	----	----	----
^ **Sum of PAHs**	----	0.5	mg/kg	<0.5	<0.5	----	----	----

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL**)			*Client sample ID*	**NTSF 4**	**STSF 2**	**----**	**----**	**----**
			Client sampling date / time	10-Jan-2020 00:00	10-Jan-2020 00:00	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2000591-001**	**EB2000591-002**	**--------**	**--------**	**--------**
				Result	Result	----	----	----
EP075B: Polynuclear Aromatic Hydrocarbons - Continued								
^ **Benzo(a)pyrene TEQ (zero)**	----	0.5	mg/kg	<0.5	<0.5	----	----	----
^ **Benzo(a)pyrene TEQ (half LOR)**	----	0.5	mg/kg	**0.6**	**0.6**	----	----	----
^ **Benzo(a)pyrene TEQ (LOR)**	----	0.5	mg/kg	**1.2**	**1.2**	----	----	----
EP075C: Phthalate Esters								
Dimethyl phthalate	131-11-3	0.5	mg/kg	<0.5	<0.5	----	----	----
Diethyl phthalate	84-66-2	0.5	mg/kg	<0.5	<0.5	----	----	----
Di-n-butyl phthalate	84-74-2	0.5	mg/kg	<0.5	<0.5	----	----	----
Butyl benzyl phthalate	85-68-7	0.5	mg/kg	<0.5	<0.5	----	----	----
bis(2-ethylhexyl) phthalate	117-81-7	5.0	mg/kg	<5.0	<5.0	----	----	----
Di-n-octylphthalate	117-84-0	0.5	mg/kg	<0.5	<0.5	----	----	----
EP075D: Nitrosamines								
N-Nitrosomethylethylamine	10595-95-6	0.5	mg/kg	<0.5	<0.5	----	----	----
N-Nitrosodiethylamine	55-18-5	0.5	mg/kg	<0.5	<0.5	----	----	----
N-Nitrosopyrrolidine	930-55-2	1.0	mg/kg	<1.0	<1.0	----	----	----
N-Nitrosomorpholine	59-89-2	0.5	mg/kg	<0.5	<0.5	----	----	----
N-Nitrosodi-n-propylamine	621-64-7	0.5	mg/kg	<0.5	<0.5	----	----	----
N-Nitrosopiperidine	100-75-4	0.5	mg/kg	<0.5	<0.5	----	----	----
N-Nitrosodibutylamine	924-16-3	0.5	mg/kg	<0.5	<0.5	----	----	----
N-Nitrosodiphenyl & Diphenylamine	86-30-6 122-39-4	1.0	mg/kg	<1.0	<1.0	----	----	----
Methapyrilene	91-80-5	0.5	mg/kg	<0.5	<0.5	----	----	----
EP075E: Nitroaromatics and Ketones								
2-Picoline	109-06-8	0.5	mg/kg	<0.5	<0.5	----	----	----
Acetophenone	98-86-2	0.5	mg/kg	<0.5	<0.5	----	----	----
Nitrobenzene	98-95-3	0.5	mg/kg	<0.5	<0.5	----	----	----
Isophorone	78-59-1	0.5	mg/kg	<0.5	<0.5	----	----	----
2.6-Dinitrotoluene	606-20-2	1.0	mg/kg	<1.0	<1.0	----	----	----
2.4-Dinitrotoluene	121-14-2	1.0	mg/kg	<1.0	<1.0	----	----	----
1-Naphthylamine	134-32-7	0.5	mg/kg	<0.5	<0.5	----	----	----
4-Nitroquinoline-N-oxide	56-57-5	0.5	mg/kg	<0.5	<0.5	----	----	----
5-Nitro-o-toluidine	99-55-8	0.5	mg/kg	<0.5	<0.5	----	----	----
Azobenzene	103-33-3	1	mg/kg	<1	<1	----	----	----
1.3.5-Trinitrobenzene	99-35-4	0.5	mg/kg	<0.5	<0.5	----	----	----
Phenacetin	62-44-2	0.5	mg/kg	<0.5	<0.5	----	----	----

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL**)			*Client sample ID*	**NTSF 4**	**STSF 2**	**----**	**----**	**----**
			Client sampling date / time	10-Jan-2020 00:00	10-Jan-2020 00:00	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2000591-001**	**EB2000591-002**	**--------**	**--------**	**--------**
				Result	Result	----	----	----
EP075E: Nitroaromatics and Ketones - Continued								
4-Aminobiphenyl	92-67-1	0.5	mg/kg	<0.5	<0.5	----	----	----
Pentachloronitrobenzene	82-68-8	0.5	mg/kg	<0.5	<0.5	----	----	----
Pronamide	23950-58-5	0.5	mg/kg	<0.5	<0.5	----	----	----
Dimethylaminoazobenzene	60-11-7	0.5	mg/kg	<0.5	<0.5	----	----	----
Chlorobenzilate	510-15-6	0.5	mg/kg	<0.5	<0.5	----	----	----
EP075F: Haloethers								
Bis(2-chloroethyl) ether	111-44-4	0.5	mg/kg	<0.5	<0.5	----	----	----
Bis(2-chloroethoxy) methane	111-91-1	0.5	mg/kg	<0.5	<0.5	----	----	----
4-Chlorophenyl phenyl ether	7005-72-3	0.5	mg/kg	<0.5	<0.5	----	----	----
4-Bromophenyl phenyl ether	101-55-3	0.5	mg/kg	<0.5	<0.5	----	----	----
EP075G: Chlorinated Hydrocarbons								
1.3-Dichlorobenzene	541-73-1	0.5	mg/kg	<0.5	<0.5	----	----	----
1.4-Dichlorobenzene	106-46-7	0.5	mg/kg	<0.5	<0.5	----	----	----
1.2-Dichlorobenzene	95-50-1	0.5	mg/kg	<0.5	<0.5	----	----	----
Hexachloroethane	67-72-1	0.5	mg/kg	<0.5	<0.5	----	----	----
1.2.4-Trichlorobenzene	120-82-1	0.5	mg/kg	<0.5	<0.5	----	----	----
Hexachloropropylene	1888-71-7	0.5	mg/kg	<0.5	<0.5	----	----	----
Hexachlorobutadiene	87-68-3	0.5	mg/kg	<0.5	<0.5	----	----	----
Hexachlorocyclopentadiene	77-47-4	2.5	mg/kg	<2.5	<2.5	----	----	----
Pentachlorobenzene	608-93-5	0.5	mg/kg	<0.5	<0.5	----	----	----
Hexachlorobenzene (HCB)	118-74-1	1.0	mg/kg	<1.0	<1.0	----	----	----
EP075H: Anilines and Benzidines								
Aniline	62-53-3	0.5	mg/kg	<0.5	<0.5	----	----	----
4-Chloroaniline	106-47-8	0.5	mg/kg	<0.5	<0.5	----	----	----
2-Nitroaniline	88-74-4	1.0	mg/kg	<1.0	<1.0	----	----	----
3-Nitroaniline	99-09-2	1.0	mg/kg	<1.0	<1.0	----	----	----
Dibenzofuran	132-64-9	0.5	mg/kg	<0.5	<0.5	----	----	----
4-Nitroaniline	100-01-6	0.5	mg/kg	<0.5	<0.5	----	----	----
Carbazole	86-74-8	0.5	mg/kg	<0.5	<0.5	----	----	----
3.3`-Dichlorobenzidine	91-94-1	0.5	mg/kg	<0.5	<0.5	----	----	----
EP075I: Organochlorine Pesticides								
alpha-BHC	319-84-6	0.5	mg/kg	<0.5	<0.5	----	----	----
beta-BHC	319-85-7	0.5	mg/kg	<0.5	<0.5	----	----	----
gamma-BHC	58-89-9	0.5	mg/kg	<0.5	<0.5	----	----	----

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL**)			Client sample ID	**NTSF 4**	**STSF 2**	----	----	----
			Client sampling date / time	10-Jan-2020 00:00	10-Jan-2020 00:00	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2000591-001**	**EB2000591-002**	--------	--------	--------
				Result	Result	----	----	----
EP075I: Organochlorine Pesticides - Continued								
delta-BHC	319-86-8	0.5	mg/kg	<0.5	<0.5	----	----	----
Heptachlor	76-44-8	0.5	mg/kg	<0.5	<0.5	----	----	----
Aldrin	309-00-2	0.5	mg/kg	<0.5	<0.5	----	----	----
Heptachlor epoxide	1024-57-3	0.5	mg/kg	<0.5	<0.5	----	----	----
alpha-Endosulfan	959-98-8	0.5	mg/kg	<0.5	<0.5	----	----	----
4.4`-DDE	72-55-9	0.5	mg/kg	<0.5	<0.5	----	----	----
Dieldrin	60-57-1	0.5	mg/kg	<0.5	<0.5	----	----	----
Endrin	72-20-8	0.5	mg/kg	<0.5	<0.5	----	----	----
beta-Endosulfan	33213-65-9	0.5	mg/kg	<0.5	<0.5	----	----	----
4.4`-DDD	72-54-8	0.5	mg/kg	<0.5	<0.5	----	----	----
Endosulfan sulfate	1031-07-8	0.5	mg/kg	<0.5	<0.5	----	----	----
4.4`-DDT	50-29-3	1.0	mg/kg	<1.0	<1.0	----	----	----
EP075J: Organophosphorus Pesticides								
Dichlorvos	62-73-7	0.5	mg/kg	<0.5	<0.5	----	----	----
Dimethoate	60-51-5	0.5	mg/kg	<0.5	<0.5	----	----	----
Diazinon	333-41-5	0.5	mg/kg	<0.5	<0.5	----	----	----
Chlorpyrifos-methyl	5598-13-0	0.5	mg/kg	<0.5	<0.5	----	----	----
Malathion	121-75-5	0.5	mg/kg	<0.5	<0.5	----	----	----
Fenthion	55-38-9	0.5	mg/kg	<0.5	<0.5	----	----	----
Chlorpyrifos	2921-88-2	0.5	mg/kg	<0.5	<0.5	----	----	----
Pirimphos-ethyl	23505-41-1	0.5	mg/kg	<0.5	<0.5	----	----	----
Chlorfenvinphos	470-90-6	0.5	mg/kg	<0.5	<0.5	----	----	----
Prothiofos	34643-46-4	0.5	mg/kg	<0.5	<0.5	----	----	----
Ethion	563-12-2	0.5	mg/kg	<0.5	<0.5	----	----	----
EP074S: VOC Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.5	%	**110**	**110**	----	----	----
Toluene-D8	2037-26-5	0.5	%	**99.1**	**109**	----	----	----
4-Bromofluorobenzene	460-00-4	0.5	%	**111**	**127**	----	----	----
EP075S: Acid Extractable Surrogates								
2-Fluorophenol	367-12-4	0.5	%	**109**	**108**	----	----	----
Phenol-d6	13127-88-3	0.5	%	**101**	**103**	----	----	----
2-Chlorophenol-D4	93951-73-6	0.5	%	**106**	**104**	----	----	----
2.4.6-Tribromophenol	118-79-6	0.5	%	**69.5**	**61.4**	----	----	----
EP075T: Base/Neutral Extractable Surrogates								

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL)**			*Client sample ID*	**NTSF 4**	**STSF 2**	**----**	**----**	**----**
			Client sampling date / time	10-Jan-2020 00:00	10-Jan-2020 00:00	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2000591-001**	**EB2000591-002**	**--------**	**--------**	**--------**
				Result	Result	----	----	----
EP075T: Base/Neutral Extractable Surrogates - Continued								
Nitrobenzene-D5	4165-60-0	0.5	%	**102**	**100**	----	----	----
1.2-Dichlorobenzene-D4	2199-69-1	0.5	%	**89.0**	**88.4**	----	----	----
2-Fluorobiphenyl	321-60-8	0.5	%	**98.4**	**98.0**	----	----	----
Anthracene-d10	1719-06-8	0.5	%	**93.3**	**97.0**	----	----	----
4-Terphenyl-d14	1718-51-0	0.5	%	**94.4**	**89.4**	----	----	----

Surrogate Control Limits

Sub-Matrix: **SOIL**

Compound	*CAS Number*	*Recovery Limits (%)*	
		Low	***High***
EP074S: VOC Surrogates			
1.2-Dichloroethane-D4	17060-07-0	53	134
Toluene-D8	2037-26-5	60	131
4-Bromofluorobenzene	460-00-4	59	127
EP075S: Acid Extractable Surrogates			
2-Fluorophenol	367-12-4	10	150
Phenol-d6	13127-88-3	19	134
2-Chlorophenol-D4	93951-73-6	21	127
2.4.6-Tribromophenol	118-79-6	17	143
EP075T: Base/Neutral Extractable Surrogates			
Nitrobenzene-D5	4165-60-0	10	147
1.2-Dichlorobenzene-D4	2199-69-1	10	154
2-Fluorobiphenyl	321-60-8	10	128
Anthracene-d10	1719-06-8	10	137
4-Terphenyl-d14	1718-51-0	10	157

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order : **ES2016687**
Client : **NEWCREST MINING LIMITED**
Contact : MR NICOLAS BOURGEOT
Address : 1460 CADIA ROAD
ORANGE NSW, AUSTRALIA 2800
Telephone : ----
Project : Cadia Water Monitoring
Order number : 4500922559
C-O-C number : ----
Sampler : THOMAS BYRON
Site : CADIA
Quote number : EN/107/17 B V5
No. of samples received : 2
No. of samples analysed : 2

Page : 1 of 3
Laboratory : Environmental Division Sydney
Contact : Customer Services ES
Address : 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone : +61-2-8784 8555
Date Samples Received : 15-May-2020 08:33
Date Analysis Commenced : 20-May-2020
Issue Date : 22-May-2020 14:58

ilac-MRA NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Descriptive Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Alexander Ristoski	Laboratory Technican	Newcastle - Asbestos, Mayfield West, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EA200N: Asbestos weights and percentages are not covered under the Scope of NATA Accreditation.
  Weights of Asbestos are based on extracted bulk asbestos, fibre bundles, and/or ACM and do not include respirable fibres (if present)
  The Asbestos (Fines and Fibrous) weight is calculated from the extracted Fibrous Asbestos and Asbestos Fines as an equivalent weight of 100% Asbestos
  Percentages for Asbestos content in ACM are based on the 2013 NEPM default values.
  All calculations of percentage Asbestos under this method are approximate and should be used as a guide only.
- EA200 'Am' Amosite (brown asbestos)
- EA200 'Cr' Crocidolite (blue asbestos)
- EA200 'Trace' - Asbestos fibres ("Free Fibres") detected by trace analysis per AS4964. The result can be interpreted that the sample contains detectable 'respirable' asbestos fibres
- EA200: Asbestos Identification Samples were analysed by Polarised Light Microscopy including dispersion staining.
- EA200 Legend
- EA200 'Ch' Chrysotile (white asbestos)
- EA200: 'UMF' Unknown Mineral Fibres. "-" indicates fibres detected may or may not be asbestos fibres. Confirmation by alternative techniques is recommended.
- EA200N: ALS laboratory procedures and methods used for the identification and quantitation of asbestos are consistent with AS4964-2004 and the requirements of the 2013 NEPM for Assessment of Site Contamination
- EA200: For samples larger than 30g, the <2mm fraction may be sub-sampled prior to trace analysis as outlined in ISO23909:2008(E) Sect 6.3.2-2
- EA200: 'Yes' - Asbestos detected by polarised light microscopy including dispersion staining.
- EA200: 'No*' - No asbestos found, at the reporting limit of 0.1g/kg, by polarised light microscopy including dispersion staining. Asbestos material was detected and positively identified at concentrations estimated to be below 0.1g/kg.
- EA200: 'No' - No asbestos found at the reporting limit 0.1g/kg, by polarised light microscopy including dispersion staining.

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL**)			*Client sample ID*	**STSF1_Soil_20200512**	**STSF3_Soil_20200512**	**----**	**----**	**----**
			Client sampling date / time	16-Jan-2020 00:00	16-Jan-2020 00:00	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES2016687-001**	**ES2016687-002**	**--------**	**--------**	**--------**
				Result	Result	----	----	----
EA200: AS 4964 - 2004 Identification of Asbestos in Soils								
Asbestos Detected	1332-21-4	0.1	g/kg	**No**	**No**	**----**	**----**	**----**
Asbestos Type	1332-21-4	-	--	**-**	**-**	**----**	**----**	**----**
Asbestos (Trace)	1332-21-4	5	Fibres	**No**	**No**	**----**	**----**	**----**
Sample weight (dry)	----	0.01	g	**1250**	**1130**	**----**	**----**	**----**
Synthetic Mineral Fibre	----	0.1	g/kg	**No**	**No**	**----**	**----**	**----**
Organic Fibre	----	0.1	g/kg	**No**	**No**	**----**	**----**	**----**
APPROVED IDENTIFIER:	----	-	--	**A. RISTOSKI**	**A. RISTOSKI**	**----**	**----**	**----**
EA200N: Asbestos Quantification (non-NATA)								
ø **Asbestos (Fines and Fibrous <7mm)**	1332-21-4	0.0004	g	<0.0004	<0.0004	**----**	**----**	**----**
ø **Asbestos (Fines and Fibrous FA+AF)**	----	0.001	% (w/w)	<0.001	<0.001	**----**	**----**	**----**
ø **Weight Used for % Calculation**	----	0.0001	kg	**1.25**	**1.13**	**----**	**----**	**----**
ø **Fibrous Asbestos >7mm**	----	0.0004	g	<0.0004	<0.0004	**----**	**----**	**----**

Analytical Results

Descriptive Results

Sub-Matrix: **SOIL**

Method: Compound	*Client sample ID - Client sampling date / time*	*Analytical Results*
EA200: AS 4964 - 2004 Identification of Asbestos in Soils		
EA200: Description	STSF1_Soil_20200512 - 16-Jan-2020 00:00	Mid brown soil.
EA200: Description	STSF3_Soil_20200512 - 16-Jan-2020 00:00	Mid brown soil.

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order : **ES2016298**
Amendment : **1**
Client : **NEWCREST MINING LIMITED**
Contact : MR NICOLAS BOURGEOT
Address : 1460 CADIA ROAD
ORANGE NSW, AUSTRALIA 2800
Telephone : ----
Project : Cadia Water Monitoring
Order number : 4500922559
C-O-C number : ----
Sampler : Thomas Byron
Site : CADIA
Quote number : EN/107/17 B V5
No. of samples received : 20
No. of samples analysed : 20

Page : 1 of 14
Laboratory : Environmental Division Sydney
Contact : Customer Services ES
Address : 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone : +61-2-8784 8555
Date Samples Received : 13-May-2020 09:45
Date Analysis Commenced : 13-May-2020
Issue Date : 22-May-2020 21:42

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Accreditation No. 825
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Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW

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Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EG020: It is recognised that total concentration is less than dissolved for some metal analytes. However, the difference is within experimental variation of the methods.
- TDS by method EA-015 may bias high for various samples due to the presence of fine particulate matter, which may pass through the prescribed GF/C paper.
- Ionic Balance out of acceptable limits for various samples due to analytes not quantified in this report.
- Amendment (20/05/2020): This report has been amended and re-released to allow the reporting of additional analytical data.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)	*Client sample ID*			**SVWT20200507**	**OCWT20200507**	**EPHWT20200506**	**EPSWT20200506**	**BWWT20200506**
	Client sampling date / time			07-May-2020 00:00	07-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2016298-001**	**ES2016298-002**	**ES2016298-003**	**ES2016298-004**	**ES2016298-005**
				Result	Result	Result	Result	Result
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**168**	**32**	**58**	**6**	**37**
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**89**	**26**	**34**	<10	**30**
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	<5	**5**	<5	**10**	**6**
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	**47**	<1	**18**	<1	**15**
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**74**	**3**	**25**	<1	**15**
Total Alkalinity as CaCO3	----	1	mg/L	**74**	**3**	**25**	<1	**15**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**4**	**3**	<1	<1	**1**
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**1**	<1	**2**	<1	<1
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**19**	<1	**4**	<1	**6**
Magnesium	7439-95-4	1	mg/L	<1	<1	**2**	<1	<1
Sodium	7440-23-5	1	mg/L	**2**	<1	**3**	<1	<1
Potassium	7440-09-7	1	mg/L	**2**	<1	<1	<1	<1
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	**0.04**
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	**0.0002**	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	**0.001**	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	**0.023**	**0.043**	**0.020**	**0.004**	**0.002**
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	**0.001**	<0.001	<0.001
Manganese	7439-96-5	0.001	mg/L	**0.019**	**0.057**	<0.001	**0.023**	**0.002**
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	**0.001**	**0.002**	<0.001	<0.001	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**SVWT20200507**	**OCWT20200507**	**EPHWT20200506**	**EPSWT20200506**	**BWWT20200506**
			Client sampling date / time	07-May-2020 00:00	07-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2016298-001**	**ES2016298-002**	**ES2016298-003**	**ES2016298-004**	**ES2016298-005**
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	**12.5**	**5.25**	**0.031**	**0.130**	**0.128**
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.01**	**0.08**	**0.02**	**0.03**	**0.06**
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	**0.0001**	**0.0002**	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	**0.006**	**0.003**	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	**0.027**	**0.050**	**0.024**	**0.008**	**0.030**
Lead	7439-92-1	0.001	mg/L	<0.001	**0.002**	<0.001	<0.001	**0.006**
Manganese	7439-96-5	0.001	mg/L	**0.021**	**0.061**	**0.003**	**0.028**	**0.005**
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	**0.002**	**0.002**	<0.001	<0.001	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	**12.8**	**5.36**	**0.039**	**0.148**	**0.244**
Iron	7439-89-6	0.05	mg/L	<0.05	**0.12**	<0.05	**0.15**	**0.42**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**2.22**	**2.10**	**0.62**	**0.30**	**0.48**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**2.22**	**2.10**	**0.62**	**0.30**	**0.48**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.4**	**0.3**	<0.1	<0.1	<0.1
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ **Total Nitrogen as N**	----	0.1	mg/L	**2.6**	**2.4**	**0.6**	**0.3**	**0.5**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.03**	**0.05**	**0.03**	**0.01**	**0.02**
EN055: Ionic Balance								

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			Client sample ID	**SVWT20200507**	**OCWT20200507**	**EPHWT20200506**	**EPSWT20200506**	**BWWT20200506**
			Client sampling date / time	07-May-2020 00:00	07-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00
Compound	CAS Number	LOR	Unit	**ES2016298-001**	**ES2016298-002**	**ES2016298-003**	**ES2016298-004**	**ES2016298-005**
				Result	Result	Result	Result	Result
EN055: Ionic Balance - Continued								
ø **Total Anions**	----	0.01	meq/L	**1.59**	**0.12**	**0.56**	<0.01	**0.32**
ø **Total Cations**	----	0.01	meq/L	**1.82**	**0.15**	----	----	----
ø **Total Cations**	----	0.01	meq/L	----	----	**0.49**	<0.01	**0.30**

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

			Client sample ID	**W1HT20200506**	**W1ST20200506**	**W2HT20200506**	**W3HT20200506**	**W3ST20200506**
			Client sampling date / time	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2016298-006**	**ES2016298-007**	**ES2016298-008**	**ES2016298-009**	**ES2016298-010**
				Result	Result	Result	Result	Result
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**15**	**72**	**11**	**10**	**14**
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	<10	**51**	<10	<10	**10**
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	**7**	**7**	<5	<5	**6**
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	**2**	**20**	<1	<1	**5**
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**5**	**33**	<1	<1	**3**
Total Alkalinity as CaCO3	----	1	mg/L	**5**	**33**	<1	<1	**3**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	<1	<1	<1	<1
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	<1	**2**	<1	<1	<1
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**1**	**8**	<1	<1	**2**
Magnesium	7439-95-4	1	mg/L	<1	<1	<1	<1	<1
Sodium	7440-23-5	1	mg/L	<1	**2**	<1	<1	<1
Potassium	7440-09-7	1	mg/L	<1	**2**	<1	<1	<1
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	**0.0001**	**0.0010**	<0.0001	**0.0001**	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	**0.187**	**0.002**	**0.045**	**0.008**	**0.008**
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	7439-96-5	0.001	mg/L	**0.005**	**0.021**	**0.047**	**0.031**	**0.014**
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	**0.004**	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**W1HT20200506**	**W1ST20200506**	**W2HT20200506**	**W3HT20200506**	**W3ST20200506**
			Client sampling date / time	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2016298-006**	**ES2016298-007**	**ES2016298-008**	**ES2016298-009**	**ES2016298-010**
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	**0.807**	**1.48**	**0.049**	**0.092**	**0.242**
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.03**	**0.02**	**0.02**	**0.04**	**0.01**
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	**0.0002**	**0.0012**	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	**0.002**	**0.002**	**0.001**
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	**0.228**	**0.008**	**0.057**	**0.009**	**0.007**
Lead	7439-92-1	0.001	mg/L	<0.001	**0.001**	<0.001	<0.001	<0.001
Manganese	7439-96-5	0.001	mg/L	**0.006**	**0.021**	**0.049**	**0.036**	**0.014**
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	**0.001**	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	**0.873**	**1.69**	**0.053**	**0.084**	**0.256**
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	**0.09**	<0.05	<0.05
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.23**	**0.70**	**0.75**	**0.57**	**0.63**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.23**	**0.70**	**0.75**	**0.57**	**0.63**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	<0.1	<0.1	**0.5**	<0.1
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ **Total Nitrogen as N**	----	0.1	mg/L	**0.2**	**0.7**	**0.8**	**1.1**	**0.6**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.02**	**0.01**	**0.02**	**0.03**	**0.02**
EN055: Ionic Balance								

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**W1HT20200506**	**W1ST20200506**	**W2HT20200506**	**W3HT20200506**	**W3ST20200506**
			Client sampling date / time	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2016298-006**	**ES2016298-007**	**ES2016298-008**	**ES2016298-009**	**ES2016298-010**
				Result	Result	Result	Result	Result
EN055: Ionic Balance - Continued								
ø **Total Anions**	----	0.01	meq/L	**0.10**	**0.72**	<0.01	<0.01	**0.06**
ø **Total Cations**	----	0.01	meq/L	**0.05**	**0.54**	<0.01	<0.01	**0.10**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**CHHT20200506**	**CHST20200506**	**CHHT20200506**	**EPSW20200506**	**WGSW20200507**
			Client sampling date / time	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	07-May-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2016298-011**	**ES2016298-012**	**ES2016298-013**	**ES2016298-014**	**ES2016298-015**
				Result	Result	Result	Result	Result
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**19**	**33**	**80**	**58**	**332**
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	<10	**20**	**47**	**55**	**270**
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	<5	**18**	**6**	**22**	**41**
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	<1	**10**	**27**	**2**	**53**
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**4**	**13**	**34**	**2**	**112**
Total Alkalinity as CaCO3	----	1	mg/L	**4**	**13**	**34**	**2**	**112**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	<1	**1**	**6**	**26**
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	<1	<1	<1	**4**	**14**
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	<1	**4**	**11**	**1**	**15**
Magnesium	7439-95-4	1	mg/L	<1	<1	<1	<1	**6**
Sodium	7440-23-5	1	mg/L	<1	<1	**1**	**3**	**9**
Potassium	7440-09-7	1	mg/L	**1**	<1	**2**	**4**	**43**
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.01**	<0.01	<0.01	**0.15**	**0.49**
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	**0.005**
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	**0.001**	**0.008**
Copper	7440-50-8	0.001	mg/L	**0.009**	**0.001**	**0.001**	**0.002**	**0.008**
Lead	7439-92-1	0.001	mg/L	**0.002**	<0.001	<0.001	<0.001	**0.002**
Manganese	7439-96-5	0.001	mg/L	**0.021**	**0.006**	**0.003**	**0.132**	**1.06**
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	**0.002**
Nickel	7440-02-0	0.001	mg/L	**0.002**	<0.001	<0.001	<0.001	**0.005**
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	CHHT20200506	CHST20200506	CHHT20200506	EPSW20200506	WGSW20200507
			Client sampling date / time	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	07-May-2020 00:00
Compound	CAS Number	LOR	Unit	ES2016298-011	ES2016298-012	ES2016298-013	ES2016298-014	ES2016298-015
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	**1.07**	**1.17**	**0.548**	<0.005	**0.012**
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	**0.11**	**7.37**
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.02**	**0.12**	<0.01	**0.79**	**1.20**
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	**0.007**
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	**0.002**
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	**0.002**	**0.010**
Copper	7440-50-8	0.001	mg/L	**0.010**	**0.008**	**0.007**	**0.012**	**0.014**
Lead	7439-92-1	0.001	mg/L	**0.002**	**0.013**	<0.001	<0.001	**0.003**
Manganese	7439-96-5	0.001	mg/L	**0.022**	**0.025**	**0.004**	**0.150**	**1.30**
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	**0.003**
Nickel	7440-02-0	0.001	mg/L	**0.001**	<0.001	<0.001	<0.001	**0.007**
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	**1.14**	**1.70**	**0.571**	**0.008**	**0.031**
Iron	7439-89-6	0.05	mg/L	<0.05	**0.15**	<0.05	**0.73**	**9.10**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	**0.08**
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.55**	**0.57**	**1.27**	**2.47**	**0.08**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.55**	**0.57**	**1.27**	**2.47**	**0.16**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	<0.1	**0.2**	**1.6**	**8.2**
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	**0.6**	**0.6**	**1.5**	**4.1**	**8.4**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.07**	**0.07**	**0.09**	**0.06**	**1.22**
EN055: Ionic Balance								

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER)**

			Client sample ID	**CHHT20200506**	**CHST20200506**	**CHHT20200506**	**EPSW20200506**	**WGSW20200507**
			Client sampling date / time	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	07-May-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2016298-011**	**ES2016298-012**	**ES2016298-013**	**ES2016298-014**	**ES2016298-015**
				Result	Result	Result	Result	Result
EN055: Ionic Balance - Continued								
ø **Total Anions**	----	0.01	meq/L	**0.08**	**0.26**	**0.70**	**0.28**	**3.17**
ø **Total Cations**	----	0.01	meq/L	----	----	----	----	**3.13**
ø **Total Cations**	----	0.01	meq/L	**0.02**	**0.20**	**0.64**	**0.28**	----
ø **Ionic Balance**	----	0.01	%	----	----	----	----	**0.70**

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

			Client sample ID	**WASW20200507**	**OCSW20200507**	**TASW20200507**	**BDSW20200507**	**EPB20200506**
			Client sampling date / time	07-May-2020 00:00	07-May-2020 00:00	07-May-2020 00:00	07-May-2020 00:00	06-May-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2016298-016**	**ES2016298-017**	**ES2016298-018**	**ES2016298-019**	**ES2016298-020**
				Result	Result	Result	Result	Result
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**109**	**533**	**160**	**156**	**329**
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**80**	**384**	**133**	**160**	**190**
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	**33**	**18**	**27**	**12**	**6**
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	**21**	**175**	**60**	**46**	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**40**	**57**	**63**	**73**	**178**
Total Alkalinity as CaCO3	----	1	mg/L	**40**	**57**	**63**	**73**	**178**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	**176**	**24**	<1	**5**
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**7**	**15**	**6**	**5**	**8**
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**5**	**42**	**14**	**10**	**31**
Magnesium	7439-95-4	1	mg/L	**2**	**17**	**6**	**5**	**18**
Sodium	7440-23-5	1	mg/L	**3**	**24**	**5**	**3**	**14**
Potassium	7440-09-7	1	mg/L	**13**	**12**	**17**	**8**	**6**
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.07**	**0.03**	**0.26**	**0.23**	<0.01
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	**0.002**	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	**0.002**	<0.001	**0.004**	**0.002**	<0.001
Copper	7440-50-8	0.001	mg/L	**0.004**	**0.010**	**0.007**	**0.006**	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	7439-96-5	0.001	mg/L	**0.104**	**0.024**	**0.478**	**0.321**	**0.084**
Molybdenum	7439-98-7	0.001	mg/L	<0.001	**0.002**	**0.001**	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	<0.001	**0.001**	**0.002**	**0.002**	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	WASW20200507	OCSW20200507	TASW20200507	BDSW20200507	EPB20200506
			Client sampling date / time	07-May-2020 00:00	07-May-2020 00:00	07-May-2020 00:00	07-May-2020 00:00	06-May-2020 00:00
				ES2016298-016	**ES2016298-017**	**ES2016298-018**	**ES2016298-019**	**ES2016298-020**
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	**0.011**	**0.078**	**0.008**	**0.011**	**0.007**
Iron	7439-89-6	0.05	mg/L	**0.20**	**0.05**	**0.78**	**0.59**	**0.64**
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.20**	**0.56**	**0.35**	**2.44**	----
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	**0.002**	**0.002**	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
Chromium	7440-47-3	0.001	mg/L	<0.001	**0.001**	<0.001	**0.002**	----
Cobalt	7440-48-4	0.001	mg/L	**0.003**	<0.001	**0.005**	**0.004**	----
Copper	7440-50-8	0.001	mg/L	**0.002**	**0.008**	**0.018**	**0.014**	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Manganese	7439-96-5	0.001	mg/L	**0.265**	**0.062**	**0.836**	**0.426**	----
Molybdenum	7439-98-7	0.001	mg/L	<0.001	**0.003**	**0.003**	<0.001	----
Nickel	7440-02-0	0.001	mg/L	<0.001	**0.002**	**0.003**	**0.002**	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Zinc	7440-66-6	0.005	mg/L	<0.005	**0.082**	**0.021**	**0.023**	----
Iron	7439-89-6	0.05	mg/L	**1.11**	**0.80**	**2.42**	**5.16**	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	----	----	----	----	<0.0001
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	**0.07**	**0.04**	**0.04**	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.41**	**2.85**	**0.21**	**0.28**	<0.01
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.41**	**2.92**	**0.25**	**0.32**	<0.01
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**3.1**	**1.6**	**2.5**	**2.5**	<0.1
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ **Total Nitrogen as N**	----	0.1	mg/L	**3.5**	**4.5**	**2.8**	**2.8**	<0.1
EK067G: Total Phosphorus as P by Discrete Analyser								

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			Client sample ID	**WASW20200507**	**OCSW20200507**	**TASW20200507**	**BDSW20200507**	**EPB20200506**
			Client sampling date / time	07-May-2020 00:00	07-May-2020 00:00	07-May-2020 00:00	07-May-2020 00:00	06-May-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2016298-016**	**ES2016298-017**	**ES2016298-018**	**ES2016298-019**	**ES2016298-020**
				Result	Result	Result	Result	Result
EK067G: Total Phosphorus as P by Discrete Analyser - Continued								
Total Phosphorus as P	----	0.01	mg/L	**0.22**	**0.15**	**0.35**	**0.19**	**0.08**
EN055: Ionic Balance								
ø **Total Anions**	----	0.01	meq/L	**1.00**	**5.23**	**1.93**	**1.60**	**3.89**
ø **Total Cations**	----	0.01	meq/L	**0.88**	**4.84**	**1.84**	**1.24**	**3.79**
ø **Ionic Balance**	----	0.01	%	**----**	**3.78**	**----**	**----**	**1.24**

CERTIFICATE OF ANALYSIS

Work Order	: **ES2034662**	Page	: 1 of 11
Amendment	: **1**		
Client	: **NEWCREST MINING LIMITED**	Laboratory	: Environmental Division Sydney
Contact	: MR NICOLAS BOURGEOT	Contact	: Customer Services ES
Address	: 1460 CADIA ROAD ORANGE NSW, AUSTRALIA 2800	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61-2-8784 8555
Project	: Cadia Water Monitoring	Date Samples Received	: 02-Oct-2020 09:20
Order number	: 45000922559	Date Analysis Commenced	: 02-Oct-2020
C-O-C number	: ----	Issue Date	: 19-Oct-2020 19:50
Sampler	: Martin Englert		
Site	: CADIA		
Quote number	: EN/107/17 B V5		
No. of samples received	: 13		
No. of samples analysed	: 13		

NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EG020: It has been confirmed by re-digestion and re-analysis that total Copper and Manganese concentration is less than dissolved for sample ES2034662-#013. For all other samples and analytes where dissolved is greater than total, the difference is within experimental variation of the methods.
- EG020: It has been confirmed by re-digestion and re-analysis that total Copper concentration is less than dissolved for sample ES2034662-#009.
- EG020: It has been confirmed by re-digestion and re-analysis that total Zinc concentration is less than dissolved for sample ES2034662-#005.
- TDS by method EA-015 may bias high for various samples due to the presence of fine particulate matter, which may pass through the prescribed GF/C paper.
- Amendment (14/10/20): This report has been amended and re-released to allow the reporting of additional analytical data.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**SOUTHLOG_HT_20200929**	**STOCKTON_HT_20200929**	**STOCKTON_UG_20200929**	**SHARP_HT_20200929**	**SHARP_W_20200929**
			Client sampling date / time	29-Sep-2020 00:00	29-Sep-2020 00:00	29-Sep-2020 00:00	29-Sep-2020 00:00	29-Sep-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2034662-001**	**ES2034662-002**	**ES2034662-003**	**ES2034662-004**	**ES2034662-005**
				Result	Result	Result	Result	Result
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**44**	**18**	**20**	**14**	**870**
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**26**	**10**	**12**	<10	**551**
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	<5	<5	<5	<5	**20**
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**21**	**7**	**16**	**9**	**299**
Total Alkalinity as CaCO3	----	1	mg/L	**21**	**7**	**17**	**9**	**299**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	<1	<1	<1	**158**
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	<1	<1	<1	<1	**74**
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**6**	<1	**1**	<1	**72**
Magnesium	7439-95-4	1	mg/L	<1	<1	<1	<1	**61**
Sodium	7440-23-5	1	mg/L	**1**	**1**	<1	<1	**31**
Potassium	7440-09-7	1	mg/L	<1	<1	<1	<1	<1
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	**0.0002**	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	**0.002**	**0.032**	<0.001	**0.030**	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	7439-96-5	0.001	mg/L	**0.001**	**0.004**	**0.006**	**0.006**	**0.408**
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	**0.001**
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	**1.42**	**2.86**	**1.62**	**0.540**	**2.43**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**SOUTHLOG_HT_20200929**	**STOCKTON_HT_20200929**	**STOCKTON_UG_20200929**	**SHARP_HT_20200929**	**SHARP_W_20200929**
			Client sampling date / time	29-Sep-2020 00:00	29-Sep-2020 00:00	29-Sep-2020 00:00	29-Sep-2020 00:00	29-Sep-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2034662-001**	**ES2034662-002**	**ES2034662-003**	**ES2034662-004**	**ES2034662-005**
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	**0.53**
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.01**	**0.03**	<0.01	**0.08**	<0.01
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	**0.0004**	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	**0.004**	**0.071**	**0.002**	**0.237**	**0.033**
Lead	7439-92-1	0.001	mg/L	**0.002**	**0.003**	<0.001	**0.014**	<0.001
Manganese	7439-96-5	0.001	mg/L	**0.004**	**0.004**	**0.006**	**0.007**	**0.445**
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	**1.46**	**3.17**	**1.77**	**0.819**	**0.737**
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	**2.02**	**4.77**
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.46**	**0.33**	**0.47**	**0.65**	**0.47**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.46**	**0.33**	**0.47**	**0.65**	**0.47**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	<0.1	**0.1**	**0.2**	<0.1
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ **Total Nitrogen as N**	----	0.1	mg/L	**0.5**	**0.3**	**0.6**	**0.8**	**0.5**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.01**	<0.01	<0.01	**0.08**	<0.01

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			Client sample ID	**SOUTHLOG_HT_20200929**	**STOCKTON_HT_20200929**	**STOCKTON_UG_20200929**	**SHARP_HT_20200929**	**SHARP_W_20200929**
			Client sampling date / time	29-Sep-2020 00:00	29-Sep-2020 00:00	29-Sep-2020 00:00	29-Sep-2020 00:00	29-Sep-2020 00:00
Compound	CAS Number	LOR	Unit	**ES2034662-001**	**ES2034662-002**	**ES2034662-003**	**ES2034662-004**	**ES2034662-005**
				Result	Result	Result	Result	Result
EN055: Ionic Balance								
ø **Total Anions**	----	0.01	meq/L	**0.42**	**0.14**	**0.34**	**0.18**	**11.4**
ø **Total Cations**	----	0.01	meq/L	**----**	**----**	**0.13**	**----**	**----**
ø **Total Cations**	----	0.01	meq/L	**0.34**	**0.04**	**----**	<0.01	**9.96**
ø **Ionic Balance**	----	0.01	%	**----**	**----**	**----**	**----**	**6.52**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**WEEMALLA_HT_20200929**	**GG_ST_20200929**	**ARGLE_HT_20200929**	**EB_HT1_20200929**	**EB_BT_20200929**
			Client sampling date / time	29-Sep-2020 00:00	29-Sep-2020 00:00	29-Sep-2020 00:00	29-Sep-2020 00:00	29-Sep-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2034662-006**	**ES2034662-007**	**ES2034662-008**	**ES2034662-009**	**ES2034662-010**
				Result	Result	Result	Result	Result
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**30**	**35**	**31**	**15**	**1680**
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**35**	**28**	**23**	**14**	**1020**
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	<5	<5	<5	<5	<5
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**16**	**16**	**13**	**6**	**570**
Total Alkalinity as CaCO3	----	1	mg/L	**16**	**16**	**13**	**6**	**570**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	<1	<1	<1	**160**
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	<1	<1	<1	<1	**174**
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**4**	**4**	**4**	<1	**135**
Magnesium	7439-95-4	1	mg/L	<1	<1	<1	<1	**78**
Sodium	7440-23-5	1	mg/L	<1	<1	<1	<1	**105**
Potassium	7440-09-7	1	mg/L	<1	<1	<1	<1	<1
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	**0.001**
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	**0.0002**	<0.0001	**0.0022**	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	**0.012**	**0.001**
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	7439-96-5	0.001	mg/L	**0.002**	<0.001	**0.001**	**0.004**	**0.044**
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	**0.110**	**1.60**	**0.406**	**2.01**	**7.26**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**WEEMALLA_HT_20200929**	**GG_ST_20200929**	**ARGLE_HT_20200929**	**EB_HT1_20200929**	**EB_BT_20200929**
			Client sampling date / time	29-Sep-2020 00:00	29-Sep-2020 00:00	29-Sep-2020 00:00	29-Sep-2020 00:00	29-Sep-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2034662-006**	**ES2034662-007**	**ES2034662-008**	**ES2034662-009**	**ES2034662-010**
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.02**	<0.01	**0.02**	**0.03**	<0.01
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	**0.002**
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	**0.0002**	<0.0001	**0.0025**	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	<0.001	**0.001**	**0.002**	**0.005**	**0.004**
Lead	7439-92-1	0.001	mg/L	<0.001	**0.001**	<0.001	**0.003**	<0.001
Manganese	7439-96-5	0.001	mg/L	**0.006**	**0.003**	**0.008**	**0.006**	**0.039**
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	**0.001**	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	**0.123**	**1.78**	**0.441**	**2.17**	**7.23**
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	**0.01**	**0.01**	**0.01**
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.48**	**0.80**	**1.39**	**0.31**	**7.45**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.48**	**0.80**	**1.40**	**0.32**	**7.46**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	**0.3**	**0.2**	**0.2**	**0.5**
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ **Total Nitrogen as N**	----	0.1	mg/L	**0.5**	**1.1**	**1.6**	**0.5**	**8.0**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.01	<0.01	**0.02**	**0.02**	**0.02**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			Client sample ID	**WEEMALLA_HT_20200929**	**GG_ST_20200929**	**ARGLE_HT_20200929**	**EB_HT1_20200929**	**EB_BT_20200929**
			Client sampling date / time	29-Sep-2020 00:00	29-Sep-2020 00:00	29-Sep-2020 00:00	29-Sep-2020 00:00	29-Sep-2020 00:00
Compound	CAS Number	LOR	Unit	**ES2034662-006**	**ES2034662-007**	**ES2034662-008**	**ES2034662-009**	**ES2034662-010**
				Result	Result	Result	Result	Result
EN055: Ionic Balance								
ø **Total Anions**	----	0.01	meq/L	**0.32**	**0.32**	**0.26**	**0.12**	**19.6**
ø **Total Cations**	----	0.01	meq/L	**0.20**	**0.20**	**0.20**	<0.01	**17.7**
ø **Ionic Balance**	----	0.01	%	**----**	**----**	**----**	**----**	**5.10**

Analytical Results

Sub-Matrix: **WATER** (*Matrix*: **WATER**)	*Client sample ID*			**BRAEBURN_HT_20200930**	**CARRAMAR_HT1_20200930**	**CARRAMAR_HT2_20200930**	----	----
	Client sampling date / time			30-Sep-2020 00:00	30-Sep-2020 00:00	30-Sep-2020 00:00	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES2034662-012**	**ES2034662-013**	**ES2034662-014**	--------	--------
				Result	Result	Result	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**63**	**11**	**10**	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**48**	<10	<10	----	----
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	<5	**8**	<5	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**31**	**2**	**2**	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**31**	**2**	**2**	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**2**	**1**	<1	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	<1	<1	<1	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**10**	<1	<1	----	----
Magnesium	7439-95-4	1	mg/L	<1	<1	<1	----	----
Sodium	7440-23-5	1	mg/L	<1	<1	<1	----	----
Potassium	7440-09-7	1	mg/L	<1	<1	<1	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	**0.002**	<0.001	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Copper	7440-50-8	0.001	mg/L	**0.006**	**0.037**	<0.001	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	**0.002**	<0.001	----	----
Manganese	7439-96-5	0.001	mg/L	**0.005**	**0.021**	<0.001	----	----
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Zinc	7440-66-6	0.005	mg/L	**0.410**	**0.464**	**1.78**	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**BRAEBURN_HT_20200930**	**CARRAMAR_HT1_20200930**	**CARRAMAR_HT2_20200930**	**----**	**----**
			Client sampling date / time	30-Sep-2020 00:00	30-Sep-2020 00:00	30-Sep-2020 00:00	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES2034662-012**	**ES2034662-013**	**ES2034662-014**	**--------**	**--------**
				Result	Result	Result	----	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	----	----
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.01**	**0.02**	<0.01	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Cadmium	7440-43-9	0.0001	mg/L	**0.0002**	<0.0001	<0.0001	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	**0.004**	<0.001	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Copper	7440-50-8	0.001	mg/L	**0.014**	**0.007**	<0.001	----	----
Lead	7439-92-1	0.001	mg/L	**0.003**	<0.001	**0.002**	----	----
Manganese	7439-96-5	0.001	mg/L	**0.004**	**0.016**	**0.003**	----	----
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Zinc	7440-66-6	0.005	mg/L	**1.03**	**0.553**	**2.01**	----	----
Iron	7439-89-6	0.05	mg/L	**0.13**	**0.11**	<0.05	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.21**	**0.47**	**0.43**	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.21**	**0.47**	**0.43**	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	<0.1	<0.1	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ **Total Nitrogen as N**	----	0.1	mg/L	**0.2**	**0.5**	**0.4**	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.01	<0.01	<0.01	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			Client sample ID	**BRAEBURN_HT_20200930**	**CARRAMAR_HT1_20200930**	**CARRAMAR_HT2_20200930**	**----**	**----**
			Client sampling date / time	30-Sep-2020 00:00	30-Sep-2020 00:00	30-Sep-2020 00:00	----	----
Compound	CAS Number	LOR	Unit	**ES2034662-012**	**ES2034662-013**	**ES2034662-014**	**--------**	**--------**
				Result	Result	Result	----	----
EN055: Ionic Balance								
ø **Total Anions**	----	0.01	meq/L	**0.66**	**0.06**	**0.04**	**----**	**----**
ø **Total Cations**	----	0.01	meq/L	**0.50**	<0.01	<0.01	**----**	**----**

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order : **ES2034663**
Amendment : **1**
Client : **NEWCREST MINING LIMITED**
Contact : MR NICOLAS BOURGEOT
Address : 1460 CADIA ROAD
ORANGE NSW, AUSTRALIA 2800
Telephone : ----
Project : Cadia Water Monitoring
Order number : 45000922559
C-O-C number : ----
Sampler : Martin Englert
Site : CADIA
Quote number : EN/107/17 B V5
No. of samples received : 1
No. of samples analysed : 1

Page : 1 of 5
Laboratory : Environmental Division Sydney
Contact : Customer Services ES
Address : 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone : +61-2-8784 8555
Date Samples Received : 02-Oct-2020 09:20
Date Analysis Commenced : 02-Oct-2020
Issue Date : 16-Oct-2020 13:02

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Amendment (14/10/20): This report has been amended and re-released to allow the reporting of additional analytical data.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**CHESNEY_HT_20200930**	----	----	----	----
			Client sampling date / time	30-Sep-2020 00:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES2034663-001**	--------	--------	--------	--------
				Result	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**26**	----	----	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**13**	----	----	----	----
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	<5	----	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**10**	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**10**	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	----	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	<1	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**3**	----	----	----	----
Magnesium	7439-95-4	1	mg/L	<1	----	----	----	----
Sodium	7440-23-5	1	mg/L	<1	----	----	----	----
Potassium	7440-09-7	1	mg/L	<1	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	----	----	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	----	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Manganese	7439-96-5	0.001	mg/L	**0.009**	----	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	<0.001	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	----	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	----	----	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	**2.27**	----	----	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**CHESNEY_HT_20200930**	----	----	----	----
			Client sampling date / time	30-Sep-2020 00:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES2034663-001**	--------	--------	--------	--------
				Result	----	----	----	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Iron	7439-89-6	0.05	mg/L	<0.05	----	----	----	----
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	----	----	----	----
Antimony	7440-36-0	0.001	mg/L	**0.001**	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	----	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	**0.001**	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Manganese	7439-96-5	0.001	mg/L	**0.010**	----	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	<0.001	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	----	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	----	----	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	**2.30**	----	----	----	----
Iron	7439-89-6	0.05	mg/L	<0.05	----	----	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.31**	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.31**	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.1**	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ **Total Nitrogen as N**	----	0.1	mg/L	**0.4**	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.01	----	----	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			Client sample ID	**CHESNEY_HT_20200930**	**----**	**----**	**----**	**----**
			Client sampling date / time	30-Sep-2020 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	**ES2034663-001**	**--------**	**--------**	**--------**	**--------**
				Result	----	----	----	----
EN055: Ionic Balance								
ø **Total Anions**	----	0.01	meq/L	**0.20**	**----**	**----**	**----**	**----**
ø **Total Cations**	----	0.01	meq/L	**0.15**	**----**	**----**	**----**	**----**

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order : **ES2034993**
Client : **NEWCREST MINING LIMITED**
Contact : MR NICOLAS BOURGEOT
Address : 1460 CADIA ROAD
ORANGE NSW, AUSTRALIA 2800
Telephone : ----
Project : Cadia Water Monitoring
Order number : 4501043447
C-O-C number : ----
Sampler : Martin Engler
Site : CADIA
Quote number : EN/107/17 B V5
No. of samples received : 14
No. of samples analysed : 14

Page : 1 of 8
Laboratory : Environmental Division Sydney
Contact : Customer Services ES
Address : 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone : +61-2-8784 8555
Date Samples Received : 07-Oct-2020 09:00
Date Analysis Commenced : 07-Oct-2020
Issue Date : 13-Oct-2020 14:21

ilac-MRA NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	MIAWARRA_HT_20201001	MIAWARRA_T2_20201001	MIAWARRA_T3_20201001	MIAWARRA_ST_20201001	RV_HT_20201001
			Client sampling date / time	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00
				ES2034993-001	**ES2034993-002**	**ES2034993-003**	**ES2034993-004**	**ES2034993-005**
				Result	Result	Result	Result	Result
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**34**	**49**	**34**	**12**	**24**
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**22**	**29**	**22**	<10	**15**
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	<5	<5	<5	<5	<5
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**15**	**22**	**15**	<1	**9**
Total Alkalinity as CaCO3	----	1	mg/L	**15**	**22**	**15**	<1	**9**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	<1	<1	<1	<1
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	<1	<1	<1	<1	<1
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**4**	**6**	**3**	<1	**3**
Magnesium	7439-95-4	1	mg/L	<1	<1	<1	<1	<1
Sodium	7440-23-5	1	mg/L	<1	**1**	<1	<1	<1
Potassium	7440-09-7	1	mg/L	<1	**1**	<1	<1	<1
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.01**	**0.02**	<0.01	**0.04**	<0.01
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	**0.0001**
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	**0.003**	**0.001**	**0.001**	**0.004**	**0.002**
Lead	7439-92-1	0.001	mg/L	**0.004**	<0.001	**0.002**	<0.001	<0.001
Manganese	7439-96-5	0.001	mg/L	**0.003**	**0.003**	**0.004**	**0.011**	**0.003**
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	**0.316**	**1.32**	**2.57**	**0.177**	**0.663**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**MIAWARRA_HT_20201001**	**MIAWARRA_T2_20201001**	**MIAWARRA_T3_20201001**	**MIAWARRA_ST_20201001**	**RV_HT_20201001**
			Client sampling date / time	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2034993-001**	**ES2034993-002**	**ES2034993-003**	**ES2034993-004**	**ES2034993-005**
				Result	Result	Result	Result	Result
EG020T: Total Metals by ICP-MS - Continued								
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.59**	**0.58**	**0.39**	**0.41**	**0.49**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.59**	**0.58**	**0.39**	**0.41**	**0.49**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ **Total Nitrogen as N**	----	0.1	mg/L	**0.6**	**0.6**	**0.4**	**0.4**	**0.5**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.01	**0.04**	<0.01	<0.01	<0.01
EN055: Ionic Balance								
ø **Total Anions**	----	0.01	meq/L	**0.30**	**0.44**	**0.30**	<0.01	**0.18**
ø **Total Cations**	----	0.01	meq/L	**0.20**	**0.37**	**0.15**	<0.01	**0.15**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**RV_KT_20201001**	**RV_KTHOT_20201001**	**MERIBAH_HT_20201001**	**NW_HT_20201001**	**NW_TAP_20201001**
			Client sampling date / time	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2034993-006**	**ES2034993-007**	**ES2034993-008**	**ES2034993-009**	**ES2034993-010**
				Result	Result	Result	Result	Result
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**30**	**26**	**62**	**25**	**26**
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**17**	**20**	**36**	**19**	**14**
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	<5	<5	<5	<5	<5
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**11**	**10**	**29**	**14**	**11**
Total Alkalinity as CaCO3	----	1	mg/L	**11**	**10**	**29**	**14**	**11**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	<1	<1	<1	<1
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	<1	<1	<1	<1	<1
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**4**	**3**	**11**	**3**	**3**
Magnesium	7439-95-4	1	mg/L	<1	<1	<1	<1	<1
Sodium	7440-23-5	1	mg/L	<1	<1	<1	<1	<1
Potassium	7440-09-7	1	mg/L	<1	<1	<1	<1	<1
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.02**	<0.01	**0.06**	**0.01**	**0.01**
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	**0.0001**	**0.0002**	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	**1.13**	**0.128**	**0.013**	<0.001	**0.010**
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	**0.003**	<0.001	<0.001
Manganese	7439-96-5	0.001	mg/L	**0.001**	**0.003**	**0.013**	**0.008**	**0.007**
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	**0.106**	**0.685**	**0.223**	**0.135**	**0.128**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**RV_KT_20201001**	**RV_KTHOT_20201001**	**MERIBAH_HT_20201001**	**NW_HT_20201001**	**NW_TAP_20201001**
			Client sampling date / time	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00	01-Oct-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES2034993-006**	**ES2034993-007**	**ES2034993-008**	**ES2034993-009**	**ES2034993-010**
				Result	Result	Result	Result	Result
EG020T: Total Metals by ICP-MS - Continued								
Iron	7439-89-6	0.05	mg/L	**0.11**	<0.05	**0.08**	**0.09**	**0.10**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.21**	**0.43**	**0.36**	**0.23**	**0.23**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.21**	**0.43**	**0.36**	**0.23**	**0.23**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ **Total Nitrogen as N**	----	0.1	mg/L	**0.2**	**0.4**	**0.4**	**0.2**	**0.2**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EN055: Ionic Balance								
ø **Total Anions**	----	0.01	meq/L	**0.22**	**0.20**	**0.58**	**0.28**	**0.22**
ø **Total Cations**	----	0.01	meq/L	**0.20**	**0.15**	**0.55**	**0.15**	**0.15**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**WALLABY_T1_20201002**	**WALLABY_T2_20201002**	**TP_HT_20201002**	**TP_ST_20201002**	**----**
			Client sampling date / time	01-Oct-2020 00:00	02-Oct-2020 00:00	02-Oct-2020 00:00	02-Oct-2020 00:00	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES2034993-011**	**ES2034993-012**	**ES2034993-013**	**ES2034993-014**	**--------**
				Result	Result	Result	Result	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**20**	**14**	**12**	**28**	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**12**	**11**	<10	**16**	----
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	<5	<5	**37**	<5	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**8**	**2**	<1	**11**	----
Total Alkalinity as CaCO3	----	1	mg/L	**8**	**2**	<1	**11**	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	<1	<1	<1	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	<1	<1	<1	<1	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**2**	**2**	<1	**3**	----
Magnesium	7439-95-4	1	mg/L	<1	<1	<1	<1	----
Sodium	7440-23-5	1	mg/L	<1	<1	<1	<1	----
Potassium	7440-09-7	1	mg/L	<1	<1	<1	<1	----
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.03**	**0.02**	**0.12**	**0.01**	----
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	**0.0005**	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	**0.003**	<0.001	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Copper	7440-50-8	0.001	mg/L	**0.002**	**0.009**	**0.016**	**0.002**	----
Lead	7439-92-1	0.001	mg/L	<0.001	**0.001**	**0.006**	<0.001	----
Manganese	7439-96-5	0.001	mg/L	**0.012**	**0.005**	**0.014**	**0.003**	----
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Zinc	7440-66-6	0.005	mg/L	**0.208**	**0.224**	**0.069**	**1.43**	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**WALLABY_T1_20201002**	**WALLABY_T2_20201002**	**TP_HT_20201002**	**TP_ST_20201002**	**----**
			Client sampling date / time	01-Oct-2020 00:00	02-Oct-2020 00:00	02-Oct-2020 00:00	02-Oct-2020 00:00	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES2034993-011**	**ES2034993-012**	**ES2034993-013**	**ES2034993-014**	**--------**
				Result	Result	Result	Result	----
EG020T: Total Metals by ICP-MS - Continued								
Iron	7439-89-6	0.05	mg/L	**0.05**	<0.05	**0.13**	<0.05	**----**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	**----**
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	**----**
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.25**	**0.25**	**0.15**	**0.41**	**----**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.25**	**0.25**	**0.15**	**0.41**	**----**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.2**	<0.1	**0.3**	**0.3**	**----**
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ **Total Nitrogen as N**	----	0.1	mg/L	**0.4**	**0.2**	**0.4**	**0.7**	**----**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.01**	<0.01	**0.01**	**0.12**	**----**
EN055: Ionic Balance								
ø **Total Anions**	----	0.01	meq/L	**0.16**	**0.04**	<0.01	**0.22**	**----**
ø **Total Cations**	----	0.01	meq/L	**0.10**	**0.10**	<0.01	**0.15**	**----**

CERTIFICATE OF ANALYSIS

Work Order : **ES2100772**
Client : **NEWCREST MINING LIMITED**
Contact : MR NICOLAS BOURGEOT
Address : 1460 CADIA ROAD
ORANGE NSW, AUSTRALIA 2800
Telephone : ----
Project : Cadia Water Monitoring
Order number : 4501043447
C-O-C number : ----
Sampler : Liam Brindle
Site : CADIA
Quote number : EN/107/17 B V5
No. of samples received : 30
No. of samples analysed : 30

Page : 1 of 18
Laboratory : Environmental Division Sydney
Contact : Customer Services ES
Address : 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone : +61-2-8784 8555
Date Samples Received : 12-Jan-2021 09:00
Date Analysis Commenced : 12-Jan-2021
Issue Date : 18-Jan-2021 18:58

ilac-MRA
NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This certificate included results from other sampling which were not relevant to the Study. The pages containing these results have been removed.

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Ashesh Patel	Senior Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
Dian Dao	Senior Chemist - Inorganics	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW
Sunitha Kannampilli	Phycologist	Sydney Phycology, Smithfield, NSW
Wisam Marassa	Inorganics Coordinator	Sydney Inorganics, Smithfield, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EP080: Where reported, Total Xylenes is the sum of the reported concentrations of m&p-Xylene and o-Xylene at or above the LOR.
- TDS by method EA-015 may bias high for various samples due to the presence of fine particulate matter, which may pass through the prescribed GF/C paper.
- MW024: Under microscopic observation, debris present in sample #08
- KEY: PTP=Potential Toxin Producers
  ; ND=Not Detected; NS=Not Specified
  ; cf. = comparable form
- Results apply to sample(s) as submitted.
- Samples were preserved with Lugols Iodine solution.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: **SURFACE WATER**
(Matrix: **WATER**)

			Sample ID	**CAWS62_WS_20210108**	**CAWS59_WS_20210108**	**CAWS61_WS_20210108**	**QAQC_FD_20210108**	**SHARP_W_20210108**
			Sampling date / time	08-Jan-2021 14:15	08-Jan-2021 14:30	08-Jan-2021 15:15	08-Jan-2021 15:15	08-Jan-2021 14:15
Compound	*CAS Number*	*LOR*	*Unit*	**ES2100772-021**	**ES2100772-022**	**ES2100772-023**	**ES2100772-024**	**ES2100772-025**
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	----
Iron	7439-89-6	0.05	mg/L	**0.06**	<0.05	**0.08**	**0.08**	----
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	----	----	----	----	<0.01
Antimony	7440-36-0	0.001	mg/L	----	----	----	----	<0.001
Arsenic	7440-38-2	0.001	mg/L	----	----	----	----	<0.001
Cadmium	7440-43-9	0.0001	mg/L	----	----	----	----	<0.0001
Chromium	7440-47-3	0.001	mg/L	----	----	----	----	<0.001
Cobalt	7440-48-4	0.001	mg/L	----	----	----	----	<0.001
Copper	7440-50-8	0.001	mg/L	----	----	----	----	**0.008**
Lead	7439-92-1	0.001	mg/L	----	----	----	----	<0.001
Manganese	7439-96-5	0.001	mg/L	----	----	----	----	**0.016**
Molybdenum	7439-98-7	0.001	mg/L	----	----	----	----	<0.001
Nickel	7440-02-0	0.001	mg/L	----	----	----	----	<0.001
Selenium	7782-49-2	0.01	mg/L	----	----	----	----	<0.01
Silver	7440-22-4	0.001	mg/L	----	----	----	----	<0.001
Zinc	7440-66-6	0.005	mg/L	----	----	----	----	**0.043**
Iron	7439-89-6	0.05	mg/L	----	----	----	----	**0.11**
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.02**	<0.01	**0.07**	**0.09**	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.02**	<0.01	**0.07**	**0.09**	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.3**	**0.6**	**0.3**	**0.3**	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ **Total Nitrogen as N**	----	0.1	mg/L	**0.3**	**0.6**	**0.4**	**0.4**	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.01**	**0.26**	<0.01	<0.01	----
EN055: Ionic Balance								

Analytical Results

Sub-Matrix: **SURFACE WATER** (Matrix: **WATER**)			Sample ID	**CAWS62_WS_20210108**	**CAWS59_WS_20210108**	**CAWS61_WS_20210108**	**QAQC_FD_20210108**	**SHARP_W_20210108**
			Sampling date / time	08-Jan-2021 14:15	08-Jan-2021 14:30	08-Jan-2021 15:15	08-Jan-2021 15:15	08-Jan-2021 14:15
Compound	CAS Number	LOR	Unit	**ES2100772-021**	**ES2100772-022**	**ES2100772-023**	**ES2100772-024**	**ES2100772-025**
				Result	Result	Result	Result	Result
EN055: Ionic Balance - Continued								
ø **Total Anions**	----	0.01	meq/L	**7.63**	**21.3**	**6.34**	**6.30**	----
ø **Total Cations**	----	0.01	meq/L	**7.00**	**19.5**	**5.89**	**5.89**	----
ø **Ionic Balance**	----	0.01	%	**4.34**	**4.59**	**3.67**	**3.36**	----

Analytical Results

Sub-Matrix: **SURFACE WATER** (Matrix: **WATER**)			*Sample ID*	**SHARP_HT_20210108**	**CHHT_20201223**	**CHPT_20201223**	**CHCT_20201223**	**----**
			Sampling date / time	08-Jan-2021 14:15	23-Dec-2020 10:30	23-Dec-2020 10:30	23-Dec-2020 10:30	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES2100772-026**	**ES2100772-027**	**ES2100772-028**	**ES2100772-029**	**--------**
				Result	Result	Result	Result	----
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	**0.01**	<0.01	<0.01	----
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Cadmium	7440-43-9	0.0001	mg/L	**0.0002**	<0.0001	<0.0001	<0.0001	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Copper	7440-50-8	0.001	mg/L	**0.039**	**0.018**	<0.001	<0.001	----
Lead	7439-92-1	0.001	mg/L	**0.001**	**0.005**	<0.001	<0.001	----
Manganese	7439-96-5	0.001	mg/L	**0.009**	**0.043**	**0.004**	**0.023**	----
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Nickel	7440-02-0	0.001	mg/L	<0.001	**0.087**	<0.001	<0.001	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Zinc	7440-66-6	0.005	mg/L	**0.441**	**1.51**	**0.465**	**1.46**	----
Iron	7439-89-6	0.05	mg/L	**0.06**	**0.05**	<0.05	<0.05	----

Surrogate Control Limits

Sub-Matrix: **GROUNDWATER**

		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

CERTIFICATE OF ANALYSIS

Work Order : **CA2003791**
Client : **Newcrest Mining**
Contact : Group Email
Address : 1460 Cadia Road
Orange NSW 2800
Telephone : ----
Project : CVO Hi-Vol Sampling and Analysis
Order number :
C-O-C number : ----
Sampler : ----
Site : CADIA
Quote number : ----
No. of samples received : 7
No. of samples analysed : 7

Page : 1 of 4
Laboratory : ALS Water Resources Group
Contact : Client Services
Address : 16B Lithgow Street Fyshwick ACT Australia 2609
Telephone : +61 2 6202 5404
Date Samples Received : 28-May-2020 12:03
Date Analysis Commenced : 10-Jun-2020
Issue Date : 10-Jun-2020 15:08

Accreditation No. 992
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Clare Kennedy	Analyst	Inorganics, Fyshwick, ACT

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- **For samples collected by ALS WRG, sampling was carried out in accordance with Procedure EN67**
- Metals conducted on seperate workorder: CA2003799

Analytical Results

Sub-Matrix: **SOLID** (Matrix: **SOLID**)			*Client sample ID*	**010230** **Bundarra**	**010229** **Bundarra**	**010228** **Bundarra**	**010227** **Bundarra**	**010219** **Bundarra**
			Client sampling date / time	23-Apr-2020 00:00	29-Apr-2020 00:00	05-May-2020 00:00	11-May-2020 00:00	17-May-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**CA2003791-001**	**CA2003791-002**	**CA2003791-003**	**CA2003791-004**	**CA2003791-005**
				Result	Result	Result	Result	Result
EA143CA: Total Suspended Particulates								
ø **Paper Number**	----	1	-	**0230**	**0229**	**0228**	**0227**	**0219**
ø **Sampling Period**	----	1.00	hours	**24.6**	**24.1**	**24.2**	**10.0**	**24.1**
ø **Volume**	----	1.00	m^3	**1670**	**1630**	**1640**	**679**	**1630**
ø **PM10**	----	1.0	$\mu g/m^3$	**14.2**	**6.0**	**9.0**	**11.8**	**7.6**

Analytical Results

Sub-Matrix: **SOLID**
(Matrix: **SOLID)**

			Client sample ID	**010226** **Meribah**	**010225** **Triangle Flat**	**----**	**----**	**----**
			Client sampling date / time	17-May-2020 00:00	17-May-2020 00:00	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**CA2003791-006**	**CA2003791-007**	**--------**	**--------**	**--------**
				Result	Result	----	----	----
EA143CA: Total Suspended Particulates								
ø **Paper Number**	----	1	-	**0226**	**0225**	**----**	**----**	**----**
ø **Sampling Period**	----	1.00	hours	**24.2**	**24.2**	**----**	**----**	**----**
ø **Volume**	----	1.00	m³	**1630**	**1650**	**----**	**----**	**----**
ø **PM10**	----	1.0	µg/m³	**9.2**	**3.5**	**----**	**----**	**----**

CERTIFICATE OF ANALYSIS

Work Order : **CA2003799**
Amendment : **1**
Client : **Newcrest Mining**
Contact : Mr Nicolas Bourgeot
Address : 1460 Cadia Road
Orange NSW 2800
Telephone : ----
Project : CVO Hi-Vol Sampling and Analysis
Order number : ----
C-O-C number : ----
Sampler : ----
Site : CADIA
Quote number : ----
No. of samples received : 7
No. of samples analysed : 7

Page : 1 of 4
Laboratory : ALS Water Resources Group
Contact : Client Services
Address : 16B Lithgow Street Fyshwick ACT Australia 2609
Telephone : +61 2 6202 5404
Date Samples Received : 04-Jun-2020 13:08
Date Analysis Commenced : 16-Jun-2020
Issue Date : 04-May-2021 14:43

Accreditation No. 992
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Titus Vimalasiri	Metals Teamleader	Inorganics, Fyshwick, ACT

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key :
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- **For samples collected by ALS WRG, sampling was carried out in accordance with Procedure EN67**
- Amended Workorder - CA2003799: Incorrect sampled dates on all samples. Refer to CA2003791. JN 04/05/21

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Sample ID*	**010230** **Bundarra**	**010229** **Bundarra**	**010228** **Bundarra**	**010227** **Bundarra**	**010219** **Bundarra**
			Sampling date / time	23-Apr-2020 00:00	29-Apr-2020 00:00	05-May-2020 00:00	11-May-2020 00:00	17-May-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**CA2003799-001**	**CA2003799-002**	**CA2003799-003**	**CA2003799-004**	**CA2003799-005**
				Result	Result	Result	Result	Result
EG005CA: Total Metals by ICP-OES								
ø **Iron**	7439-89-6	1	µg/filter	**426**	**189**	**324**	**292**	**352**
EG020CA: Total Metals by ICP-MS								
ø **Aluminium**	7429-90-5	1	µg/filter	**1230**	**1040**	**1040**	**1150**	**1210**
ø **Antimony**	7440-36-0	1	µg/filter	<1	<1	<1	<1	<1
ø **Arsenic**	7440-38-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Barium**	7440-39-3	1	µg/filter	**11**	**9**	**9**	**10**	**11**
ø **Beryllium**	7440-41-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Cadmium**	7440-43-9	1	µg/filter	<1	<1	<1	<1	<1
ø **Chromium**	7440-47-3	1	µg/filter	**5**	**4**	**4**	**5**	**5**
ø **Cobalt**	7440-48-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Copper**	7440-50-8	1	µg/filter	**23**	**8**	**37**	**28**	**30**
ø **Lead**	7439-92-1	1	µg/filter	**1**	**1**	**1**	**1**	**1**
ø **Manganese**	7439-96-5	1	µg/filter	**10**	**9**	**6**	**5**	**6**
ø **Molybdenum**	7439-98-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Nickel**	7440-02-0	1	µg/filter	**1**	<1	**1**	<1	**1**
ø **Selenium**	7782-49-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Silver**	7440-22-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Tin**	7440-31-5	1	µg/filter	<1	<1	<1	<1	<1
ø **Mercury**	7439-97-6	1	µg/filter	<1	<1	<1	<1	<1
ø **Zinc**	7440-66-6	1	µg/filter	**16**	**16**	**13**	**14**	**14**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Sample ID*	**010226** **Meribah**	**010225** **Triangle Flat**	**----**	**----**	**----**
			Sampling date / time	17-May-2020 00:00	17-May-2020 00:00	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**CA2003799-006**	**CA2003799-007**	**--------**	**--------**	**--------**
				Result	Result	----	----	----
EG005CA: Total Metals by ICP-OES								
ø **Iron**	7439-89-6	1	µg/filter	**370**	**95**	----	----	----
EG020CA: Total Metals by ICP-MS								
ø **Aluminium**	7429-90-5	1	µg/filter	**1240**	**1040**	----	----	----
ø **Antimony**	7440-36-0	1	µg/filter	<1	<1	----	----	----
ø **Arsenic**	7440-38-2	1	µg/filter	**1**	<1	----	----	----
ø **Barium**	7440-39-3	1	µg/filter	**13**	**10**	----	----	----
ø **Beryllium**	7440-41-7	1	µg/filter	<1	<1	----	----	----
ø **Cadmium**	7440-43-9	1	µg/filter	<1	<1	----	----	----
ø **Chromium**	7440-47-3	1	µg/filter	**5**	**4**	----	----	----
ø **Cobalt**	7440-48-4	1	µg/filter	<1	<1	----	----	----
ø **Copper**	7440-50-8	1	µg/filter	**9**	**6**	----	----	----
ø **Lead**	7439-92-1	1	µg/filter	**1**	**2**	----	----	----
ø **Manganese**	7439-96-5	1	µg/filter	**8**	**3**	----	----	----
ø **Molybdenum**	7439-98-7	1	µg/filter	<1	<1	----	----	----
ø **Nickel**	7440-02-0	1	µg/filter	**1**	<1	----	----	----
ø **Selenium**	7782-49-2	1	µg/filter	<1	<1	----	----	----
ø **Silver**	7440-22-4	1	µg/filter	<1	<1	----	----	----
ø **Tin**	7440-31-5	1	µg/filter	<1	<1	----	----	----
ø **Mercury**	7439-97-6	1	µg/filter	<1	<1	----	----	----
ø **Zinc**	7440-66-6	1	µg/filter	**24**	**18**	----	----	----

CERTIFICATE OF ANALYSIS

Work Order	: **CA2004913**	Page	: 1 of 9
Client	: **Newcrest Mining**	Laboratory	: ALS Water Resources Group
Contact	: Zac Zhang	Contact	: Client Services
Address	: 1460 Cadia Road Orange NSW 2800	Address	: 16B Lithgow Street Fyshwick ACT Australia 2609
Telephone	: ----	Telephone	: +61 2 6202 5404
Project	: CVO Hi-Vol Sampling and Analysis	Date Samples Received	: 24-Jul-2020 16:00
Order number	: ----	Date Analysis Commenced	: 30-Jul-2020
C-O-C number	: ----	Issue Date	: 30-Jul-2020 14:39
Sampler	: Zac Zhang		
Site	: CADIA		
Quote number	: ----		
No. of samples received	: 35		
No. of samples analysed	: 35		

Accreditation No. 992
Accredited for compliance with
ISO/IEC 17025 - Testing

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- Analytical Results

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Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Clare Kennedy	Analyst	Inorganics, Fyshwick, ACT

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

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LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- **For samples collected by ALS WRG, sampling was carried out in accordance with Procedure EN67**

Analytical Results

Sub-Matrix: **SOLID**
(Matrix: **SOLID)**

			Client sample ID	**010253 Flyer Creek**	**003981 Flyer Creek**	**003995 Flyer Creek**	**003971 Flyer Creek**	**010256 Flyer Creek**
			Client sampling date / time	22-Jun-2020 00:00	28-Jun-2020 00:00	04-Jul-2020 00:00	10-Jul-2020 00:00	16-Jul-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**CA2004913-001**	**CA2004913-002**	**CA2004913-003**	**CA2004913-004**	**CA2004913-005**
				Result	Result	Result	Result	Result
EA143CA: Total Suspended Particulates								
ø **Paper Number**	----	1	-	**0253**	**3981**	**3995**	**3971**	**0256**
ø **Initial Weight**	----	0.00001	g	**3.53**	**3.54**	**3.54**	**3.54**	**3.52**
ø **Final Weight**	----	0.00001	g	**3.54**	**3.55**	**3.55**	**3.55**	**3.53**
ø **Sampling Period**	----	1.00	hours	**24.5**	**24.1**	**24.1**	**24.1**	**24.1**
ø **Volume**	----	1.00	m³	**1710**	**1680**	**1680**	**1680**	**1660**
ø **PM10**	----	1.0	µg/m³	**7.0**	**6.9**	**6.7**	**8.0**	**3.6**

Analytical Results

Sub-Matrix: **SOLID** (Matrix: **SOLID**)			*Client sample ID*	**010224** **Bundarra**	**010222** **Bundarra**	**010216** **Bundarra**	**010214** **Bundarra**	**03978** **Bundarra**
			Client sampling date / time	23-May-2020 00:00	29-May-2020 00:00	04-Jun-2020 00:00	10-Jun-2020 00:00	16-Jun-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**CA2004913-006**	**CA2004913-007**	**CA2004913-008**	**CA2004913-009**	**CA2004913-010**
				Result	Result	Result	Result	Result
EA143CA: Total Suspended Particulates								
ø **Paper Number**	----	1	-	**0224**	**0222**	**0216**	**0214**	**3978**
ø **Initial Weight**	----	0.00001	g	**3.48**	**3.48**	**3.48**	**3.48**	**3.54**
ø **Final Weight**	----	0.00001	g	**3.48**	**3.51**	**3.52**	**3.49**	**3.55**
ø **Sampling Period**	----	1.00	hours	**24.2**	**24.1**	**24.2**	**24.0**	**24.2**
ø **Volume**	----	1.00	m³	**1640**	**1630**	**1640**	**1630**	**1640**
ø **PM10**	----	1.0	µg/m³	**3.8**	**19.8**	**24.8**	**9.7**	**7.1**

Analytical Results

Sub-Matrix: **SOLID** (Matrix: **SOLID)**			*Client sample ID*	**010257** **Bundarra**	**03980** **Bundarra**	**03973** **Bundarra**	**03993** **Bundarra**	**03970** **Bundarra**
			Client sampling date / time	22-Jun-2020 00:00	28-Jun-2020 00:00	04-Jul-2020 00:00	10-Jul-2020 00:00	16-Jul-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**CA2004913-011**	**CA2004913-012**	**CA2004913-013**	**CA2004913-014**	**CA2004913-015**
				Result	Result	Result	Result	Result
EA143CA: Total Suspended Particulates								
ø **Paper Number**	----	1	-	**0257**	**3980**	**3973**	**3993**	**3970**
ø **Initial Weight**	----	0.00001	g	**3.53**	**3.54**	**3.54**	**3.54**	**3.54**
ø **Final Weight**	----	0.00001	g	**3.53**	**3.57**	**3.55**	**3.56**	**3.55**
ø **Sampling Period**	----	1.00	hours	**24.1**	**24.1**	**24.1**	**24.1**	**24.1**
ø **Volume**	----	1.00	m^3	**1630**	**1640**	**1640**	**1630**	**1630**
ø **PM10**	----	1.0	µg/m^3	**3.0**	**20.0**	**4.9**	**15.7**	**8.4**

Analytical Results

Sub-Matrix: **SOLID**
(Matrix: **SOLID)**

			Client sample ID	**010218 Meribah**	**010220 Meribah**	**010217 Meribah**	**010213 Meribah**	**03977 Meribah**
			Client sampling date / time	23-May-2020 00:00	29-May-2020 00:00	04-Jun-2020 00:00	10-Jun-2020 00:00	16-Jun-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**CA2004913-016**	**CA2004913-017**	**CA2004913-018**	**CA2004913-019**	**CA2004913-020**
				Result	Result	Result	Result	Result
EA143CA: Total Suspended Particulates								
ø **Paper Number**	----	1	-	**0218**	**0220**	**0217**	**0213**	**3977**
ø **Initial Weight**	----	0.00001	g	**3.49**	**3.47**	**3.48**	**3.47**	**3.53**
ø **Final Weight**	----	0.00001	g	**3.50**	**3.48**	**3.49**	**3.48**	**3.55**
ø **Sampling Period**	----	1.00	hours	**24.2**	**24.1**	**24.1**	**24.1**	**24.2**
ø **Volume**	----	1.00	m^3	**1640**	**1630**	**1630**	**1630**	**1630**
ø **PM10**	----	1.0	$\mu g/m^3$	**6.6**	**9.2**	**8.7**	**4.9**	**12.0**

Analytical Results

Sub-Matrix: **SOLID**
(Matrix: **SOLID**)

			Client sample ID	**03976 Meribah**	**03975 Meribah**	**03974 Meribah**	**03972 Meribah**	**03992 Meribah**
			Client sampling date / time	22-Jun-2020 00:00	28-Jun-2020 00:00	04-Jul-2020 00:00	10-Jul-2020 00:00	16-Jul-2020 00:00
Compound	CAS Number	LOR	Unit	**CA2004913-021**	**CA2004913-022**	**CA2004913-023**	**CA2004913-024**	**CA2004913-025**
				Result	Result	Result	Result	Result
EA143CA: Total Suspended Particulates								
ø **Paper Number**	----	1	-	**3976**	**3975**	**3974**	**3972**	**3992**
ø **Initial Weight**	----	0.00001	g	**3.54**	**3.54**	**3.54**	**3.54**	**3.54**
ø **Final Weight**	----	0.00001	g	**3.55**	**3.55**	**3.55**	**3.55**	**3.54**
ø **Sampling Period**	----	1.00	hours	**24.1**	**24.0**	**24.1**	**24.1**	**24.1**
ø **Volume**	----	1.00	m³	**1630**	**1630**	**1630**	**1450**	**1640**
ø **PM10**	----	1.0	µg/m³	**7.0**	**7.8**	**6.5**	**11.9**	**5.6**

Analytical Results

Sub-Matrix: **SOLID** (Matrix: **SOLID**)			*Client sample ID*	**010223** **Triangle Flat**	**010221** **Triangle Flat**	**010215** **Triangle Flat**	**010212** **Triangle Flat**	**03979** **Triangle Flat**
			Client sampling date / time	23-May-2020 00:00	29-May-2020 00:00	04-Jun-2020 00:00	10-Jun-2020 00:00	16-Jun-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**CA2004913-026**	**CA2004913-027**	**CA2004913-028**	**CA2004913-029**	**CA2004913-030**
				Result	Result	Result	Result	Result
EA143CA: Total Suspended Particulates								
ø **Paper Number**	----	1	-	**0223**	**0221**	**0215**	**0212**	**3979**
ø **Initial Weight**	----	0.00001	g	**3.48**	**3.48**	**3.48**	**3.48**	**3.54**
ø **Final Weight**	----	0.00001	g	**3.49**	**3.48**	**3.49**	**3.49**	**3.55**
ø **Sampling Period**	----	1.00	hours	**24.2**	**24.1**	**24.1**	**24.0**	**24.2**
ø **Volume**	----	1.00	m^3	**1630**	**1630**	**1640**	**1630**	**1640**
ø **PM10**	----	1.0	µg/m^3	**2.9**	**4.6**	**8.0**	**3.8**	**8.4**

Analytical Results

Sub-Matrix: **SOLID** **(**Matrix: **SOLID)**			*Client sample ID*	**03982 Triangle Flat**	**03994 Triangle Flat**	**03985 Triangle Flat**	**03991 Triangle Flat**	**03990 Triangle Flat**
			Client sampling date / time	22-Jun-2020 00:00	28-Jun-2020 00:00	04-Jul-2020 00:00	10-Jul-2020 00:00	16-Jul-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**CA2004913-031**	**CA2004913-032**	**CA2004913-033**	**CA2004913-034**	**CA2004913-035**
				Result	Result	Result	Result	Result
EA143CA: Total Suspended Particulates								
ø **Paper Number**	----	1	-	**3982**	**3994**	**3985**	**3991**	**3990**
ø **Initial Weight**	----	0.00001	g	**3.54**	**3.54**	**3.53**	**3.54**	**3.54**
ø **Final Weight**	----	0.00001	g	**3.55**	**3.55**	**3.54**	**3.56**	**3.54**
ø **Sampling Period**	----	1.00	hours	**24.1**	**24.1**	**24.1**	**24.1**	**24.1**
ø **Volume**	----	1.00	m^3	**1640**	**1630**	**1630**	**1630**	**1630**
ø **PM10**	----	1.0	µg/m^3	**4.4**	**8.4**	**4.0**	**8.3**	**5.1**

ALS Water

CERTIFICATE OF ANALYSIS

Work Order	: **CA2004914**
Client	: **Newcrest Mining**
Contact	: Zac Zhang
Address	: 1460 Cadia Road Orange NSW 2800
Telephone	: ----
Project	: CVO Hi-Vol Sampling and Analysis
Order number	: ----
C-O-C number	: ----
Sampler	: Zac Zhang
Site	: CADIA
Quote number	: ----
No. of samples received	: 35
No. of samples analysed	: 35

Page	: 1 of 9
Laboratory	: ALS Water Resources Group
Contact	: Client Services
Address	: 16B Lithgow Street Fyshwick ACT Australia 2609
Telephone	: +61 2 6202 5404
Date Samples Received	: 24-Jul-2020 16:00
Date Analysis Commenced	: 30-Jul-2020
Issue Date	: 05-Aug-2020 17:02

Accreditation No. 992
Accredited for compliance with
ISO/IEC 17025 - Testing

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Signatories

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Signatories	*Position*	*Accreditation Category*
Titus Vimalasiri	Metals Teamleader	Inorganics, Fyshwick, ACT

General Comments

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LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- **For samples collected by ALS WRG, sampling was carried out in accordance with Procedure EN67**

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

			Client sample ID	**010253** **Flyer Creek**	**003981** **Flyer Creek**	**003995** **Flyer Creek**	**003971** **Flyer Creek**	**010256** **Flyer Creek**
			Client sampling date / time	22-Jun-2020 00:00	28-Jun-2020 00:00	04-Jul-2020 00:00	10-Jul-2020 00:00	16-Jul-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**CA2004914-001**	**CA2004914-002**	**CA2004914-003**	**CA2004914-004**	**CA2004914-005**
				Result	Result	Result	Result	Result
EG005CA: Total Metals by ICP-OES								
ø **Iron**	7439-89-6	1	µg/filter	**276**	**73**	**127**	**100**	**126**
EG020CA: Total Metals by ICP-MS								
ø **Aluminium**	7429-90-5	1	µg/filter	**1660**	**1000**	**1350**	**1330**	**1840**
ø **Antimony**	7440-36-0	1	µg/filter	<1	<1	<1	<1	<1
ø **Arsenic**	7440-38-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Barium**	7440-39-3	1	µg/filter	**17**	**10**	**13**	**12**	**18**
ø **Beryllium**	7440-41-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Cadmium**	7440-43-9	1	µg/filter	<1	<1	<1	<1	<1
ø **Chromium**	7440-47-3	1	µg/filter	**5**	**2**	**3**	**3**	**5**
ø **Cobalt**	7440-48-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Copper**	7440-50-8	1	µg/filter	**20**	**5**	**9**	**5**	**5**
ø **Lead**	7439-92-1	1	µg/filter	**2**	**2**	**1**	**2**	**2**
ø **Manganese**	7439-96-5	1	µg/filter	**6**	**2**	**3**	**3**	**4**
ø **Molybdenum**	7439-98-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Nickel**	7440-02-0	1	µg/filter	**2**	<1	**1**	<1	**1**
ø **Selenium**	7782-49-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Silver**	7440-22-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Tin**	7440-31-5	1	µg/filter	<1	<1	<1	<1	<1
ø **Mercury**	7439-97-6	1	µg/filter	<1	<1	<1	<1	<1
ø **Zinc**	7440-66-6	1	µg/filter	**35**	**18**	**18**	**14**	**25**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**010224** **Bundarra**	**010222** **Bundarra**	**010216** **Bundarra**	**010214** **Bundarra**	**03978** **Bundarra**
			Client sampling date / time	23-May-2020 00:00	29-May-2020 00:00	04-Jun-2020 00:00	10-Jun-2020 00:00	16-Jun-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**CA2004914-006**	**CA2004914-007**	**CA2004914-008**	**CA2004914-009**	**CA2004914-010**
				Result	Result	Result	Result	Result
EG005CA: Total Metals by ICP-OES								
ø **Iron**	7439-89-6	1	µg/filter	**124**	**686**	**613**	**280**	**79**
EG020CA: Total Metals by ICP-MS								
ø **Aluminium**	7429-90-5	1	µg/filter	**2010**	**2240**	**2140**	**1850**	**1310**
ø **Antimony**	7440-36-0	1	µg/filter	<1	<1	<1	<1	<1
ø **Arsenic**	7440-38-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Barium**	7440-39-3	1	µg/filter	**19**	**18**	**18**	**18**	**12**
ø **Beryllium**	7440-41-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Cadmium**	7440-43-9	1	µg/filter	<1	<1	<1	<1	<1
ø **Chromium**	7440-47-3	1	µg/filter	**5**	**6**	**5**	**5**	**3**
ø **Cobalt**	7440-48-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Copper**	7440-50-8	1	µg/filter	**7**	**76**	**73**	**28**	**5**
ø **Lead**	7439-92-1	1	µg/filter	**2**	**2**	**2**	**2**	**1**
ø **Manganese**	7439-96-5	1	µg/filter	**3**	**11**	**11**	**6**	**2**
ø **Molybdenum**	7439-98-7	1	µg/filter	<1	**1**	**1**	<1	<1
ø **Nickel**	7440-02-0	1	µg/filter	<1	**1**	**1**	<1	<1
ø **Selenium**	7782-49-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Silver**	7440-22-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Tin**	7440-31-5	1	µg/filter	<1	<1	<1	<1	<1
ø **Mercury**	7439-97-6	1	µg/filter	<1	<1	<1	<1	<1
ø **Zinc**	7440-66-6	1	µg/filter	**18**	**17**	**19**	**16**	**8**

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

Client sample ID				**010257** **Bundarra**	**03980** **Bundarra**	**03973** **Bundarra**	**03993** **Bundarra**	**03970** **Bundarra**
Client sampling date / time				22-Jun-2020 00:00	28-Jun-2020 00:00	04-Jul-2020 00:00	10-Jul-2020 00:00	16-Jul-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**CA2004914-011**	**CA2004914-012**	**CA2004914-013**	**CA2004914-014**	**CA2004914-015**
				Result	Result	Result	Result	Result
EG005CA: Total Metals by ICP-OES								
ø **Iron**	7439-89-6	1	µg/filter	**101**	**491**	**59**	**349**	**227**
EG020CA: Total Metals by ICP-MS								
ø **Aluminium**	7429-90-5	1	µg/filter	**1550**	**1440**	**1000**	**1380**	**1080**
ø **Antimony**	7440-36-0	1	µg/filter	<1	<1	<1	<1	<1
ø **Arsenic**	7440-38-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Barium**	7440-39-3	1	µg/filter	**16**	**12**	**10**	**12**	**11**
ø **Beryllium**	7440-41-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Cadmium**	7440-43-9	1	µg/filter	<1	<1	<1	<1	<1
ø **Chromium**	7440-47-3	1	µg/filter	**5**	**3**	**2**	**3**	**3**
ø **Cobalt**	7440-48-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Copper**	7440-50-8	1	µg/filter	**4**	**62**	**5**	**37**	**22**
ø **Lead**	7439-92-1	1	µg/filter	**1**	**2**	<1	**1**	**1**
ø **Manganese**	7439-96-5	1	µg/filter	**4**	**8**	**2**	**6**	**4**
ø **Molybdenum**	7439-98-7	1	µg/filter	<1	**1**	<1	<1	<1
ø **Nickel**	7440-02-0	1	µg/filter	<1	<1	<1	<1	<1
ø **Selenium**	7782-49-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Silver**	7440-22-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Tin**	7440-31-5	1	µg/filter	<1	<1	<1	<1	<1
ø **Mercury**	7439-97-6	1	µg/filter	<1	<1	<1	<1	<1
ø **Zinc**	7440-66-6	1	µg/filter	**27**	**11**	**7**	**11**	**10**

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

			Client sample ID	**010218** **Meribah**	**010220** **Meribah**	**010217** **Meribah**	**010213** **Meribah**	**03977** **Meribah**
			Client sampling date / time	23-May-2020 00:00	29-May-2020 00:00	04-Jun-2020 00:00	10-Jun-2020 00:00	16-Jun-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**CA2004914-016**	**CA2004914-017**	**CA2004914-018**	**CA2004914-019**	**CA2004914-020**
				Result	Result	Result	Result	Result
EG005CA: Total Metals by ICP-OES								
ø **Iron**	7439-89-6	1	µg/filter	**87**	**220**	**95**	**107**	**121**
EG020CA: Total Metals by ICP-MS								
ø **Aluminium**	7429-90-5	1	µg/filter	**1920**	**1900**	**1730**	**1590**	**1450**
ø **Antimony**	7440-36-0	1	µg/filter	<1	<1	<1	<1	<1
ø **Arsenic**	7440-38-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Barium**	7440-39-3	1	µg/filter	**18**	**18**	**16**	**15**	**12**
ø **Beryllium**	7440-41-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Cadmium**	7440-43-9	1	µg/filter	<1	<1	<1	<1	<1
ø **Chromium**	7440-47-3	1	µg/filter	**5**	**5**	**4**	**4**	**3**
ø **Cobalt**	7440-48-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Copper**	7440-50-8	1	µg/filter	**4**	**5**	**5**	**4**	**10**
ø **Lead**	7439-92-1	1	µg/filter	**2**	**2**	**2**	**1**	**2**
ø **Manganese**	7439-96-5	1	µg/filter	**3**	**6**	**4**	**3**	**3**
ø **Molybdenum**	7439-98-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Nickel**	7440-02-0	1	µg/filter	<1	<1	<1	<1	<1
ø **Selenium**	7782-49-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Silver**	7440-22-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Tin**	7440-31-5	1	µg/filter	<1	<1	<1	<1	<1
ø **Mercury**	7439-97-6	1	µg/filter	<1	<1	<1	<1	<1
ø **Zinc**	7440-66-6	1	µg/filter	**21**	**21**	**23**	**20**	**22**

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

			Client sample ID	**03976** **Meribah**	**03975** **Meribah**	**03974** **Meribah**	**03972** **Meribah**	**03992** **Meribah**
			Client sampling date / time	22-Jun-2020 00:00	28-Jun-2020 00:00	04-Jul-2020 00:00	10-Jul-2020 00:00	16-Jul-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**CA2004914-021**	**CA2004914-022**	**CA2004914-023**	**CA2004914-024**	**CA2004914-025**
				Result	Result	Result	Result	Result
EG005CA: Total Metals by ICP-OES								
ø **Iron**	7439-89-6	1	µg/filter	**68**	**79**	**57**	**151**	**85**
EG020CA: Total Metals by ICP-MS								
ø **Aluminium**	7429-90-5	1	µg/filter	**1480**	**1130**	**1210**	**1220**	**1220**
ø **Antimony**	7440-36-0	1	µg/filter	<1	<1	<1	<1	<1
ø **Arsenic**	7440-38-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Barium**	7440-39-3	1	µg/filter	**13**	**11**	**11**	**12**	**13**
ø **Beryllium**	7440-41-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Cadmium**	7440-43-9	1	µg/filter	<1	<1	<1	<1	<1
ø **Chromium**	7440-47-3	1	µg/filter	**3**	**2**	**2**	**3**	**3**
ø **Cobalt**	7440-48-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Copper**	7440-50-8	1	µg/filter	**4**	**5**	**4**	**4**	**6**
ø **Lead**	7439-92-1	1	µg/filter	<1	**1**	<1	**1**	**1**
ø **Manganese**	7439-96-5	1	µg/filter	**2**	**2**	**2**	**4**	**2**
ø **Molybdenum**	7439-98-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Nickel**	7440-02-0	1	µg/filter	<1	<1	<1	<1	<1
ø **Selenium**	7782-49-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Silver**	7440-22-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Tin**	7440-31-5	1	µg/filter	<1	<1	<1	<1	<1
ø **Mercury**	7439-97-6	1	µg/filter	<1	<1	<1	<1	<1
ø **Zinc**	7440-66-6	1	µg/filter	**15**	**17**	**58**	**19**	**21**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER)**			*Client sample ID*	**010223** **Triangle Flat**	**010221** **Triangle Flat**	**010215** **Triangle Flat**	**010212** **Triangle Flat**	**03979** **Triangle Flat**
			Client sampling date / time	23-May-2020 00:00	29-May-2020 00:00	04-Jun-2020 00:00	10-Jun-2020 00:00	16-Jun-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**CA2004914-026**	**CA2004914-027**	**CA2004914-028**	**CA2004914-029**	**CA2004914-030**
				Result	Result	Result	Result	Result
EG005CA: Total Metals by ICP-OES								
ø **Iron**	7439-89-6	1	µg/filter	**82**	**106**	**98**	**85**	**116**
EG020CA: Total Metals by ICP-MS								
ø **Aluminium**	7429-90-5	1	µg/filter	**1620**	**1740**	**1620**	**1680**	**1230**
ø **Antimony**	7440-36-0	1	µg/filter	<1	<1	<1	<1	<1
ø **Arsenic**	7440-38-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Barium**	7440-39-3	1	µg/filter	**13**	**14**	**14**	**15**	**10**
ø **Beryllium**	7440-41-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Cadmium**	7440-43-9	1	µg/filter	<1	<1	<1	<1	<1
ø **Chromium**	7440-47-3	1	µg/filter	**5**	**5**	**5**	**5**	**3**
ø **Cobalt**	7440-48-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Copper**	7440-50-8	1	µg/filter	**5**	**5**	**7**	**5**	**12**
ø **Lead**	7439-92-1	1	µg/filter	**2**	**2**	**1**	**1**	**1**
ø **Manganese**	7439-96-5	1	µg/filter	**3**	**4**	**4**	**3**	**3**
ø **Molybdenum**	7439-98-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Nickel**	7440-02-0	1	µg/filter	<1	<1	<1	<1	<1
ø **Selenium**	7782-49-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Silver**	7440-22-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Tin**	7440-31-5	1	µg/filter	<1	<1	<1	<1	<1
ø **Mercury**	7439-97-6	1	µg/filter	<1	<1	<1	<1	<1
ø **Zinc**	7440-66-6	1	µg/filter	**23**	**24**	**22**	**24**	**20**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**03982** **Triangle Flat**	**03994** **Triangle Flat**	**03985** **Triangle Flat**	**03991** **Triangle Flat**	**03990** **Triangle Flat**
			Client sampling date / time	22-Jun-2020 00:00	28-Jun-2020 00:00	04-Jul-2020 00:00	10-Jul-2020 00:00	16-Jul-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**CA2004914-031**	**CA2004914-032**	**CA2004914-033**	**CA2004914-034**	**CA2004914-035**
				Result	Result	Result	Result	Result
EG005CA: Total Metals by ICP-OES								
ø **Iron**	7439-89-6	1	µg/filter	**84**	**84**	**57**	**92**	**66**
EG020CA: Total Metals by ICP-MS								
ø **Aluminium**	7429-90-5	1	µg/filter	**1020**	**1250**	**946**	**1160**	**1090**
ø **Antimony**	7440-36-0	1	µg/filter	<1	<1	<1	<1	<1
ø **Arsenic**	7440-38-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Barium**	7440-39-3	1	µg/filter	**9**	**11**	**8**	**10**	**10**
ø **Beryllium**	7440-41-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Cadmium**	7440-43-9	1	µg/filter	<1	<1	<1	<1	<1
ø **Chromium**	7440-47-3	1	µg/filter	**2**	**3**	**2**	**3**	**3**
ø **Cobalt**	7440-48-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Copper**	7440-50-8	1	µg/filter	**10**	**5**	**4**	**4**	**5**
ø **Lead**	7439-92-1	1	µg/filter	<1	**1**	<1	**1**	<1
ø **Manganese**	7439-96-5	1	µg/filter	**2**	**2**	**2**	**3**	**2**
ø **Molybdenum**	7439-98-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Nickel**	7440-02-0	1	µg/filter	<1	<1	<1	<1	<1
ø **Selenium**	7782-49-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Silver**	7440-22-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Tin**	7440-31-5	1	µg/filter	<1	<1	<1	<1	<1
ø **Mercury**	7439-97-6	1	µg/filter	<1	<1	<1	<1	<1
ø **Zinc**	7440-66-6	1	µg/filter	**14**	**18**	**15**	**16**	**15**

ALS Water

CERTIFICATE OF ANALYSIS

Work Order : **CA2006086**
Amendment : **1**
Client : **Newcrest Mining**
Contact : Zac Zhang
Address : 1460 Cadia Road
Orange NSW 2800
Telephone : ----
Project : CVO Hi-Vol Sampling and Analysis
Order number : 4501057533
C-O-C number : ----
Sampler : John Ford, Martin Englert, Zac Zhang
Site : CADIA
Quote number : ----
No. of samples received : 25
No. of samples analysed : 25

Page : 1 of 7
Laboratory : ALS Water Resources Group
Contact : Client Services
Address : 16B Lithgow Street Fyshwick ACT Australia 2609
Telephone : +61 2 6202 5404
Date Samples Received : 09-Sep-2020 15:35
Date Analysis Commenced : 18-Sep-2020
Issue Date : 27-Nov-2020 11:45

ilac-MRA NATA
Accreditation No. 992
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Geetha Ramasundara	Chemistry Teamleader	Inorganics, Fyshwick, ACT

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- **For samples collected by ALS WRG, sampling was carried out in accordance with Procedure EN67**
- **General Amend: Client requested results reported to 5 decimal places**

Analytical Results

Sub-Matrix: **SOLID**
(Matrix: **SOLID**)

			Sample ID	**003983** **Flyer Creek**	**010208** **Flyer Creek**	**003984** **Flyer Creek**	**003903** **Flyer Creek**	**003969** **Bundarra**
			Sampling date / time	22-Jul-2020 00:00	28-Jul-2020 00:00	03-Aug-2020 00:00	09-Aug-2020 00:00	22-Jul-2020 00:00
Compound	CAS Number	LOR	Unit	**CA2006086-001**	**CA2006086-002**	**CA2006086-003**	**CA2006086-004**	**CA2006086-005**
				Result	Result	Result	Result	Result
EA143CA: Total Suspended Particulates								
ø **Paper Number**	----	1	-	**3983**	**0208**	**3984**	**3903**	**3969**
ø **Initial Weight**	----	0.00001	g	**3.54962**	**3.47747**	**3.54735**	**3.52520**	**3.54769**
ø **Final Weight**	----	0.00001	g	**3.56717**	**3.48486**	**3.56261**	**3.53491**	**3.57295**
ø **Sampling Period**	----	1.00	hours	**24.1**	**24.1**	**24.1**	**24.1**	**24.1**
ø **Volume**	----	1.00	m³	**1690**	**1680**	**1680**	**1660**	**1630**
ø **PM10**	----	1.0	µg/m³	**10.4**	**4.4**	**9.1**	**5.8**	**15.5**

Analytical Results

Sub-Matrix: **SOLID** (Matrix: **SOLID**)			*Sample ID*	**010209** **Bundarra**	**010211** **Bundarra**	**003901** **Bundarra**	**001900** **Bundarra**	**001896** **Bundarra**
			Sampling date / time	28-Jul-2020 00:00	03-Aug-2020 00:00	09-Aug-2020 00:00	15-Aug-2020 00:00	21-Aug-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**CA2006086-006**	**CA2006086-007**	**CA2006086-008**	**CA2006086-009**	**CA2006086-010**
				Result	Result	Result	Result	Result
EA143CA: Total Suspended Particulates								
ø **Paper Number**	----	1	-	**0209**	**0211**	**3901**	**1900**	**1896**
ø **Initial Weight**	----	0.00001	g	**3.48317**	**3.48580**	**3.52742**	**3.62863**	**3.63631**
ø **Final Weight**	----	0.00001	g	**3.48643**	**3.50684**	**3.53216**	**3.62863**	**3.64378**
ø **Sampling Period**	----	1	hours	----	----	----	**0.083**	----
ø **Sampling Period**	----	1.00	hours	**24.1**	**24.0**	**24.1**	----	**22.5**
ø **Volume**	----	1.00	m^3	**1630**	**1630**	**1630**	**5.65**	**1520**
ø **PM10**	----	1.0	µg/m^3	**2.0**	**12.9**	**2.9**	<1.0	**4.9**

Analytical Results

Sub-Matrix: **SOLID**
(Matrix: **SOLID)**

			Sample ID	**001893** **Bundarra**	**010255** **Meribah**	**010210** **Meribah**	**003967** **Meribah**	**001888** **Meribah**
			Sampling date / time	27-Aug-2020 00:00	22-Jul-2020 00:00	28-Jul-2020 00:00	03-Aug-2020 00:00	09-Aug-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**CA2006086-011**	**CA2006086-012**	**CA2006086-013**	**CA2006086-014**	**CA2006086-015**
				Result	Result	Result	Result	Result
EA143CA: Total Suspended Particulates								
ø **Paper Number**	----	1	-	**1893**	**0255**	**0210**	**3967**	**1888**
ø **Initial Weight**	----	0.00001	g	**3.62853**	**3.52681**	**3.47690**	**3.54047**	**3.59452**
ø **Final Weight**	----	0.00001	g	**3.65917**	**3.53753**	**3.48009**	**3.56142**	**3.72676**
ø **Sampling Period**	----	1.00	hours	**24.1**	**24.1**	**24.1**	**24.0**	**24.1**
ø **Volume**	----	1.00	m³	**1630**	**1640**	**1630**	**1620**	**1630**
ø **PM10**	----	1.0	µg/m³	**18.8**	**6.5**	**2.0**	**12.9**	**81.0**

Analytical Results

Sub-Matrix: **SOLID** (Matrix: **SOLID**)			*Sample ID*	**001898** **Meribah**	**001895** **Meribah**	**001892** **Meribah**	**003966** **Triangle Flat**	**003988** **Triangle Flat**
			Sampling date / time	15-Aug-2020 00:00	21-Aug-2020 00:00	27-Aug-2020 00:00	22-Jul-2020 00:00	28-Jul-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**CA2006086-016**	**CA2006086-017**	**CA2006086-018**	**CA2006086-019**	**CA2006086-020**
				Result	Result	Result	Result	Result
EA143CA: Total Suspended Particulates								
ø **Paper Number**	----	1	-	**1898**	**1895**	**1892**	**3966**	**3988**
ø **Initial Weight**	----	0.00001	g	**3.62152**	**3.57584**	**3.63872**	**3.53846**	**3.54011**
ø **Final Weight**	----	0.00001	g	**3.63132**	**3.59071**	**3.65139**	**3.55275**	**3.55017**
ø **Sampling Period**	----	1.00	hours	**24.1**	**22.5**	**24.1**	**24.1**	**24.1**
ø **Volume**	----	1.00	m^3	**1630**	**1520**	**1630**	**1630**	**1630**
ø **PM10**	----	1.0	µg/m^3	**6.0**	**9.8**	**7.8**	**8.8**	**6.2**

Analytical Results

Sub-Matrix: **SOLID**
(Matrix: **SOLID)**

			Sample ID	**003968 Triangle Flat**	**003904 Triangle Flat**	**001899 Triangle Flat**	**001894 Triangle Flat**	**001891 Triangle Flat**
			Sampling date / time	03-Aug-2020 00:00	09-Aug-2020 00:00	15-Aug-2020 00:00	21-Aug-2020 00:00	27-Aug-2020 00:00
Compound	CAS Number	LOR	Unit	**CA2006086-021**	**CA2006086-022**	**CA2006086-023**	**CA2006086-024**	**CA2006086-025**
				Result	Result	Result	Result	Result
EA143CA: Total Suspended Particulates								
ø **Paper Number**	----	1	-	**3968**	**3904**	**1899**	**1894**	**1891**
ø **Initial Weight**	----	0.00001	g	**3.54042**	**3.53000**	**3.64000**	**3.62508**	**3.64245**
ø **Final Weight**	----	0.00001	g	**3.55876**	**3.53585**	**3.64659**	**3.63279**	**3.65233**
ø **Sampling Period**	----	1.00	hours	**24.0**	**24.1**	**24.0**	**22.6**	**24.1**
ø **Volume**	----	1.00	m^3	**1630**	**1640**	**1620**	**1520**	**1620**
ø **PM10**	----	1.0	µg/m^3	**11.2**	**3.6**	**4.0**	**5.0**	**6.1**

CERTIFICATE OF ANALYSIS

Work Order : **CA2006106**
Client : **Newcrest Mining**
Contact : Mr Nicolas Bourgeot
Address : 1460 Cadia Road
Orange NSW 2800
Telephone : ----
Project : CVO Hi-Vol Sampling and Analysis
Order number : 4501057533
C-O-C number : ----
Sampler : Martin Englert, Zac Zhang
Site : CADIA
Quote number : ----
No. of samples received : 25
No. of samples analysed : 25

Page : 1 of 7
Laboratory : ALS Water Resources Group
Contact : Client Services
Address : 16B Lithgow Street Fyshwick ACT Australia 2609
Telephone : +61 2 6202 5404
Date Samples Received : 09-Sep-2020 15:35
Date Analysis Commenced : 21-Sep-2020
Issue Date : 28-Sep-2020 15:37

Accreditation No. 992
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Titus Vimalasiri	Metals Teamleader	Inorganics, Fyshwick, ACT

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

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Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- **For samples collected by ALS WRG, sampling was carried out in accordance with Procedure EN67**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**003983** **Flyer Creek**	**010208** **Flyer Creek**	**003984** **Flyer Creek**	**003903** **Flyer Creek**	**003969** **Bundarra**
			Client sampling date / time	22-Jul-2020 00:00	28-Jul-2020 00:00	03-Aug-2020 00:00	09-Aug-2020 00:00	22-Jul-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**CA2006106-001**	**CA2006106-002**	**CA2006106-003**	**CA2006106-004**	**CA2006106-005**
				Result	Result	Result	Result	Result
EG005CA: Total Metals by ICP-OES								
ø **Iron**	7439-89-6	1	µg/filter	**260**	**190**	**262**	**198**	**554**
EG020CA: Total Metals by ICP-MS								
ø **Aluminium**	7429-90-5	1	µg/filter	**1360**	**1790**	**1350**	**1380**	**1220**
ø **Antimony**	7440-36-0	1	µg/filter	<1	<1	<1	<1	<1
ø **Arsenic**	7440-38-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Barium**	7440-39-3	1	µg/filter	**14**	**18**	**14**	**12**	**12**
ø **Beryllium**	7440-41-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Cadmium**	7440-43-9	1	µg/filter	<1	<1	<1	<1	<1
ø **Chromium**	7440-47-3	1	µg/filter	**4**	**6**	**4**	**4**	**4**
ø **Cobalt**	7440-48-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Copper**	7440-50-8	1	µg/filter	**11**	**12**	**13**	**14**	**48**
ø **Lead**	7439-92-1	1	µg/filter	**1**	**2**	**1**	**1**	**1**
ø **Manganese**	7439-96-5	1	µg/filter	**5**	**4**	**5**	**3**	**8**
ø **Molybdenum**	7439-98-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Nickel**	7440-02-0	1	µg/filter	<1	**1**	<1	**2**	<1
ø **Selenium**	7782-49-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Silver**	7440-22-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Tin**	7440-31-5	1	µg/filter	<1	<1	<1	<1	<1
ø **Mercury**	7439-97-6	1	µg/filter	<1	<1	<1	<1	<1
ø **Zinc**	7440-66-6	1	µg/filter	**14**	**26**	**14**	**17**	**10**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**010209 Bundarra**	**010211 Bundarra**	**003901 Bundarra**	**001900 Bundarra**	**001896 Bundarra**
			Client sampling date / time	28-Jul-2020 00:00	03-Aug-2020 00:00	09-Aug-2020 00:00	15-Aug-2020 00:00	21-Aug-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**CA2006106-006**	**CA2006106-007**	**CA2006106-008**	**CA2006106-009**	**CA2006106-010**
				Result	Result	Result	Result	Result
EG005CA: Total Metals by ICP-OES								
ø **Iron**	7439-89-6	1	µg/filter	**122**	**700**	**102**	**103**	**104**
EG020CA: Total Metals by ICP-MS								
ø **Aluminium**	7429-90-5	1	µg/filter	**1540**	**1710**	**1640**	**1630**	**1210**
ø **Antimony**	7440-36-0	1	µg/filter	<1	<1	<1	<1	<1
ø **Arsenic**	7440-38-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Barium**	7440-39-3	1	µg/filter	**16**	**16**	**36**	**36**	**29**
ø **Beryllium**	7440-41-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Cadmium**	7440-43-9	1	µg/filter	<1	<1	<1	<1	<1
ø **Chromium**	7440-47-3	1	µg/filter	**6**	**6**	**5**	**4**	**4**
ø **Cobalt**	7440-48-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Copper**	7440-50-8	1	µg/filter	**6**	**56**	**6**	**6**	**5**
ø **Lead**	7439-92-1	1	µg/filter	**2**	**2**	**1**	**1**	**1**
ø **Manganese**	7439-96-5	1	µg/filter	**3**	**9**	**2**	**2**	**2**
ø **Molybdenum**	7439-98-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Nickel**	7440-02-0	1	µg/filter	<1	**1**	<1	<1	<1
ø **Selenium**	7782-49-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Silver**	7440-22-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Tin**	7440-31-5	1	µg/filter	<1	<1	<1	<1	<1
ø **Mercury**	7439-97-6	1	µg/filter	<1	<1	<1	<1	<1
ø **Zinc**	7440-66-6	1	µg/filter	**16**	**16**	**21**	**20**	**17**

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

			Client sample ID	**001893 Bundarra**	**010255 Meribah**	**010210 Meribah**	**003967 Meribah**	**001888 Meribah**
			Client sampling date / time	27-Aug-2020 00:00	22-Jul-2020 00:00	28-Jul-2020 00:00	03-Aug-2020 00:00	09-Aug-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**CA2006106-011**	**CA2006106-012**	**CA2006106-013**	**CA2006106-014**	**CA2006106-015**
				Result	Result	Result	Result	Result
EG005CA: Total Metals by ICP-OES								
ø **Iron**	7439-89-6	1	µg/filter	**807**	**216**	**105**	**432**	**96**
EG020CA: Total Metals by ICP-MS								
ø **Aluminium**	7429-90-5	1	µg/filter	**1390**	**1500**	**1470**	**1130**	**1350**
ø **Antimony**	7440-36-0	1	µg/filter	<1	<1	**1**	<1	**1**
ø **Arsenic**	7440-38-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Barium**	7440-39-3	1	µg/filter	**26**	**17**	**15**	**12**	**30**
ø **Beryllium**	7440-41-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Cadmium**	7440-43-9	1	µg/filter	<1	<1	<1	<1	<1
ø **Chromium**	7440-47-3	1	µg/filter	**4**	**6**	**5**	**4**	**4**
ø **Cobalt**	7440-48-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Copper**	7440-50-8	1	µg/filter	**86**	**8**	**6**	**20**	**6**
ø **Lead**	7439-92-1	1	µg/filter	**2**	**2**	**2**	**1**	**1**
ø **Manganese**	7439-96-5	1	µg/filter	**10**	**5**	**3**	**7**	**2**
ø **Molybdenum**	7439-98-7	1	µg/filter	**1**	<1	<1	<1	<1
ø **Nickel**	7440-02-0	1	µg/filter	<1	<1	<1	<1	<1
ø **Selenium**	7782-49-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Silver**	7440-22-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Tin**	7440-31-5	1	µg/filter	<1	<1	<1	<1	<1
ø **Mercury**	7439-97-6	1	µg/filter	<1	<1	<1	<1	<1
ø **Zinc**	7440-66-6	1	µg/filter	**19**	**17**	**27**	**9**	**31**

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

			Client sample ID	**001898 Meribah**	**001895 Meribah**	**001892 Meribah**	**003966 Triangle Flat**	**003988 Triangle Flat**
			Client sampling date / time	15-Aug-2020 00:00	21-Aug-2020 00:00	27-Aug-2020 00:00	22-Jul-2020 00:00	28-Jul-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**CA2006106-016**	**CA2006106-017**	**CA2006106-018**	**CA2006106-019**	**CA2006106-020**
				Result	Result	Result	Result	Result
EG005CA: Total Metals by ICP-OES								
ø **Iron**	7439-89-6	1	µg/filter	**121**	**101**	**272**	**141**	**104**
EG020CA: Total Metals by ICP-MS								
ø **Aluminium**	7429-90-5	1	µg/filter	**1470**	**1150**	**1250**	**1130**	**1170**
ø **Antimony**	7440-36-0	1	µg/filter	<1	<1	<1	<1	<1
ø **Arsenic**	7440-38-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Barium**	7440-39-3	1	µg/filter	**33**	**12**	**30**	**13**	**13**
ø **Beryllium**	7440-41-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Cadmium**	7440-43-9	1	µg/filter	<1	<1	<1	<1	<1
ø **Chromium**	7440-47-3	1	µg/filter	**4**	**3**	**4**	**4**	**4**
ø **Cobalt**	7440-48-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Copper**	7440-50-8	1	µg/filter	**5**	**7**	**12**	**7**	**7**
ø **Lead**	7439-92-1	1	µg/filter	**1**	**1**	**2**	**1**	<1
ø **Manganese**	7439-96-5	1	µg/filter	**2**	**3**	**5**	**4**	**3**
ø **Molybdenum**	7439-98-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Nickel**	7440-02-0	1	µg/filter	<1	<1	<1	<1	<1
ø **Selenium**	7782-49-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Silver**	7440-22-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Tin**	7440-31-5	1	µg/filter	<1	<1	<1	<1	<1
ø **Mercury**	7439-97-6	1	µg/filter	<1	<1	<1	<1	<1
ø **Zinc**	7440-66-6	1	µg/filter	**20**	**11**	**19**	**10**	**10**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**003968** **Triangle Flat**	**003904** **Triangle Flat**	**001899** **Triangle Flat**	**001894** **Triangle Flat**	**001891** **Triangle Flat**
			Client sampling date / time	03-Aug-2020 00:00	09-Aug-2020 00:00	15-Aug-2020 00:00	21-Aug-2020 00:00	27-Aug-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**CA2006106-021**	**CA2006106-022**	**CA2006106-023**	**CA2006106-024**	**CA2006106-025**
				Result	Result	Result	Result	Result
EG005CA: Total Metals by ICP-OES								
ø **Iron**	7439-89-6	1	µg/filter	**375**	**65**	**85**	**108**	**259**
EG020CA: Total Metals by ICP-MS								
ø **Aluminium**	7429-90-5	1	µg/filter	**1170**	**796**	**1270**	**1190**	**1310**
ø **Antimony**	7440-36-0	1	µg/filter	<1	<1	<1	<1	<1
ø **Arsenic**	7440-38-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Barium**	7440-39-3	1	µg/filter	**11**	**10**	**29**	**30**	**31**
ø **Beryllium**	7440-41-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Cadmium**	7440-43-9	1	µg/filter	<1	<1	<1	<1	<1
ø **Chromium**	7440-47-3	1	µg/filter	**3**	**3**	**4**	**4**	**4**
ø **Cobalt**	7440-48-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Copper**	7440-50-8	1	µg/filter	**23**	**6**	**5**	**6**	**14**
ø **Lead**	7439-92-1	1	µg/filter	**1**	<1	**1**	**1**	**2**
ø **Manganese**	7439-96-5	1	µg/filter	**6**	**2**	**2**	**2**	**5**
ø **Molybdenum**	7439-98-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Nickel**	7440-02-0	1	µg/filter	<1	<1	<1	<1	<1
ø **Selenium**	7782-49-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Silver**	7440-22-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Tin**	7440-31-5	1	µg/filter	<1	<1	<1	<1	<1
ø **Mercury**	7439-97-6	1	µg/filter	<1	<1	<1	<1	<1
ø **Zinc**	7440-66-6	1	µg/filter	**10**	**8**	**16**	**17**	**19**

CERTIFICATE OF ANALYSIS

Work Order : **CA2007418**
Client : **Newcrest Mining**
Contact : Mr Nicolas Bourgeot
Address : 1460 Cadia Road
Orange NSW 2800
Telephone : ----
Project : CVO Hi-Vol Sampling and Analysis
Order number : 4501057533
C-O-C number : ----
Sampler : ----
Site : CADIA
Quote number : ----
No. of samples received : 21
No. of samples analysed : 21

Page : 1 of 7
Laboratory : ALS Water Resources Group
Contact : Client Services
Address : 16B Lithgow Street Fyshwick ACT Australia 2609
Telephone : +61 2 6202 5404
Date Samples Received : 02-Nov-2020 09:00
Date Analysis Commenced : 09-Nov-2020
Issue Date : 19-Nov-2020 14:03

Accreditation No. 992
Accredited for compliance with
ISO/IEC 17025 - Testing

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Signatories	*Position*	*Accreditation Category*
Titus Vimalasiri	Metals Teamleader	Inorganics, Fyshwick, ACT

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^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- **For samples collected by ALS WRG, sampling was carried out in accordance with Procedure EN67**
- Split TAT - Prelim report sent 18/11/20. Due to a delay on metal analysis, the final report will be send on or before 20/11/20. Apologies for any inconvenience

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

			Client sample ID	**001890 Bundarra**	**003914 Bundarra**	**003916 Bundarra**	**003921 Bundarra**	**003915 Meribah**
			Client sampling date / time	02-Sep-2020 00:00	14-Sep-2020 00:00	20-Sep-2020 00:00	08-Oct-2020 00:00	14-Sep-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**CA2007418-001**	**CA2007418-002**	**CA2007418-003**	**CA2007418-004**	**CA2007418-005**
				Result	Result	Result	Result	Result
EG005CA: Total Metals by ICP-OES								
ø **Iron**	7439-89-6	1	µg/filter	**241**	**344**	**141**	**126**	**314**
EG020CA: Total Metals by ICP-MS								
ø **Aluminium**	7429-90-5	1	µg/filter	**1270**	**1300**	**1180**	**1320**	**1320**
ø **Antimony**	7440-36-0	1	µg/filter	<1	<1	<1	<1	<1
ø **Arsenic**	7440-38-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Barium**	7440-39-3	1	µg/filter	**22**	**10**	**9**	**10**	**11**
ø **Beryllium**	7440-41-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Cadmium**	7440-43-9	1	µg/filter	<1	<1	<1	<1	<1
ø **Chromium**	7440-47-3	1	µg/filter	**4**	**3**	**3**	**3**	**3**
ø **Cobalt**	7440-48-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Copper**	7440-50-8	1	µg/filter	**8**	**31**	**10**	**8**	**16**
ø **Lead**	7439-92-1	1	µg/filter	**1**	<1	<1	<1	<1
ø **Manganese**	7439-96-5	1	µg/filter	**6**	**6**	**3**	**4**	**8**
ø **Molybdenum**	7439-98-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Nickel**	7440-02-0	1	µg/filter	<1	<1	<1	<1	<1
ø **Selenium**	7782-49-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Silver**	7440-22-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Tin**	7440-31-5	1	µg/filter	<1	<1	<1	<1	<1
ø **Mercury**	7439-97-6	1	µg/filter	<1	<1	<1	<1	<1
ø **Zinc**	7440-66-6	1	µg/filter	**15**	**13**	**11**	**11**	**20**

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

			Client sample ID	**003918** **Meribah**	**003919** **Meribah**	**001883** **Meribah**	**001885** **Meribah**	**003905** **Meribah**
			Client sampling date / time	20-Sep-2020 00:00	26-Sep-2020 00:00	02-Oct-2020 00:00	08-Oct-2020 00:00	14-Oct-2020 00:00
Compound	CAS Number	LOR	Unit	**CA2007418-006**	**CA2007418-007**	**CA2007418-008**	**CA2007418-009**	**CA2007418-010**
				Result	Result	Result	Result	Result
EG005CA: Total Metals by ICP-OES								
ø **Iron**	7439-89-6	1	µg/filter	**156**	**78**	**185**	**123**	**1330**
EG020CA: Total Metals by ICP-MS								
ø **Aluminium**	7429-90-5	1	µg/filter	**1180**	**1160**	**1630**	**1370**	**1340**
ø **Antimony**	7440-36-0	1	µg/filter	<1	<1	<1	<1	<1
ø **Arsenic**	7440-38-2	1	µg/filter	<1	<1	<1	<1	**2**
ø **Barium**	7440-39-3	1	µg/filter	**9**	**10**	**30**	**26**	**16**
ø **Beryllium**	7440-41-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Cadmium**	7440-43-9	1	µg/filter	<1	<1	<1	<1	<1
ø **Chromium**	7440-47-3	1	µg/filter	**3**	**3**	**4**	**4**	**4**
ø **Cobalt**	7440-48-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Copper**	7440-50-8	1	µg/filter	**9**	**6**	**7**	**6**	**9**
ø **Lead**	7439-92-1	1	µg/filter	<1	<1	<1	**1**	**4**
ø **Manganese**	7439-96-5	1	µg/filter	**4**	**2**	**5**	**4**	**28**
ø **Molybdenum**	7439-98-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Nickel**	7440-02-0	1	µg/filter	**1**	<1	<1	<1	**1**
ø **Selenium**	7782-49-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Silver**	7440-22-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Tin**	7440-31-5	1	µg/filter	<1	<1	<1	<1	<1
ø **Mercury**	7439-97-6	1	µg/filter	<1	<1	<1	<1	<1
ø **Zinc**	7440-66-6	1	µg/filter	**11**	**9**	**23**	**18**	**17**

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	001899 Triangle Flat	010254 Triangle Flat	039113 Triangle Flat	003917 Triangle Flat	003920 Triangle Flat
			Client sampling date / time	15-Aug-2020 00:00	02-Sep-2020 00:00	08-Sep-2020 00:00	14-Sep-2020 00:00	20-Sep-2020 00:00
Compound	CAS Number	LOR	Unit	CA2007418-011	CA2007418-012	CA2007418-013	CA2007418-014	CA2007418-015
				Result	Result	Result	Result	Result
EG005CA: Total Metals by ICP-OES								
ø Iron	7439-89-6	1	µg/filter	934	329	532	209	179
EG020CA: Total Metals by ICP-MS								
ø Aluminium	7429-90-5	1	µg/filter	1390	1580	1420	1290	1260
ø Antimony	7440-36-0	1	µg/filter	<1	<1	<1	<1	<1
ø Arsenic	7440-38-2	1	µg/filter	1	<1	<1	<1	<1
ø Barium	7440-39-3	1	µg/filter	29	14	10	12	10
ø Beryllium	7440-41-7	1	µg/filter	<1	<1	<1	<1	<1
ø Cadmium	7440-43-9	1	µg/filter	<1	<1	<1	<1	<1
ø Chromium	7440-47-3	1	µg/filter	4	5	3	3	3
ø Cobalt	7440-48-4	1	µg/filter	<1	<1	<1	<1	<1
ø Copper	7440-50-8	1	µg/filter	18	6	53	11	12
ø Lead	7439-92-1	1	µg/filter	2	2	2	<1	<1
ø Manganese	7439-96-5	1	µg/filter	22	11	10	5	4
ø Molybdenum	7439-98-7	1	µg/filter	<1	<1	<1	<1	<1
ø Nickel	7440-02-0	1	µg/filter	<1	<1	<1	<1	<1
ø Selenium	7782-49-2	1	µg/filter	<1	<1	<1	<1	<1
ø Silver	7440-22-4	1	µg/filter	<1	<1	<1	<1	<1
ø Tin	7440-31-5	1	µg/filter	<1	<1	<1	<1	<1
ø Mercury	7439-97-6	1	µg/filter	<1	<1	<1	<1	<1
ø Zinc	7440-66-6	1	µg/filter	18	13	28	9	9

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

			Client sample ID	**003922 Triangle Flat**	**001884 Triangle Flat**	**001880 Triangle Flat**	**003910 Triangle Flat**	**003911 Meribah**
			Client sampling date / time	26-Sep-2020 00:00	02-Oct-2020 00:00	08-Oct-2020 00:00	22-Oct-2020 00:00	11-Sep-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**CA2007418-016**	**CA2007418-017**	**CA2007418-018**	**CA2007418-019**	**CA2007418-020**
				Result	Result	Result	Result	Result
EG005CA: Total Metals by ICP-OES								
ø **Iron**	7439-89-6	1	µg/filter	**73**	**117**	**146**	**348**	**175**
EG020CA: Total Metals by ICP-MS								
ø **Aluminium**	7429-90-5	1	µg/filter	**1390**	**1500**	**1380**	**1260**	**1010**
ø **Antimony**	7440-36-0	1	µg/filter	<1	<1	<1	<1	<1
ø **Arsenic**	7440-38-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Barium**	7440-39-3	1	µg/filter	**11**	**29**	**25**	**12**	**8**
ø **Beryllium**	7440-41-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Cadmium**	7440-43-9	1	µg/filter	<1	<1	<1	<1	<1
ø **Chromium**	7440-47-3	1	µg/filter	**3**	**4**	**3**	**3**	**2**
ø **Cobalt**	7440-48-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Copper**	7440-50-8	1	µg/filter	**5**	**5**	**8**	**9**	**9**
ø **Lead**	7439-92-1	1	µg/filter	<1	<1	**1**	**4**	**1**
ø **Manganese**	7439-96-5	1	µg/filter	**2**	**3**	**4**	**10**	**5**
ø **Molybdenum**	7439-98-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Nickel**	7440-02-0	1	µg/filter	<1	<1	<1	<1	<1
ø **Selenium**	7782-49-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Silver**	7440-22-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Tin**	7440-31-5	1	µg/filter	<1	<1	<1	<1	<1
ø **Mercury**	7439-97-6	1	µg/filter	<1	<1	<1	<1	<1
ø **Zinc**	7440-66-6	1	µg/filter	**10**	**19**	**16**	**16**	**16**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**003912** **Triangle Flat**	**----**	**----**	**----**	**----**
			Client sampling date / time	11-Sep-2020 00:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**CA2007418-021**	**--------**	**--------**	**--------**	**--------**
				Result	----	----	----	----
EG005CA: Total Metals by ICP-OES								
ø **Iron**	7439-89-6	1	µg/filter	**528**	----	----	----	----
EG020CA: Total Metals by ICP-MS								
ø **Aluminium**	7429-90-5	1	µg/filter	**1440**	----	----	----	----
ø **Antimony**	7440-36-0	1	µg/filter	<1	----	----	----	----
ø **Arsenic**	7440-38-2	1	µg/filter	**1**	----	----	----	----
ø **Barium**	7440-39-3	1	µg/filter	**13**	----	----	----	----
ø **Beryllium**	7440-41-7	1	µg/filter	<1	----	----	----	----
ø **Cadmium**	7440-43-9	1	µg/filter	<1	----	----	----	----
ø **Chromium**	7440-47-3	1	µg/filter	**3**	----	----	----	----
ø **Cobalt**	7440-48-4	1	µg/filter	<1	----	----	----	----
ø **Copper**	7440-50-8	1	µg/filter	**9**	----	----	----	----
ø **Lead**	7439-92-1	1	µg/filter	**1**	----	----	----	----
ø **Manganese**	7439-96-5	1	µg/filter	**12**	----	----	----	----
ø **Molybdenum**	7439-98-7	1	µg/filter	<1	----	----	----	----
ø **Nickel**	7440-02-0	1	µg/filter	<1	----	----	----	----
ø **Selenium**	7782-49-2	1	µg/filter	<1	----	----	----	----
ø **Silver**	7440-22-4	1	µg/filter	<1	----	----	----	----
ø **Tin**	7440-31-5	1	µg/filter	<1	----	----	----	----
ø **Mercury**	7439-97-6	1	µg/filter	<1	----	----	----	----
ø **Zinc**	7440-66-6	1	µg/filter	**19**	----	----	----	----

CERTIFICATE OF ANALYSIS

Work Order : **CA2100246**
Client : **Newcrest Mining**
Contact : Kendra Campbell
Address : 1460 Cadia Road
Orange NSW 2800
Telephone : ----
Project : CVO Hi-Vol Sampling and Analysis
Order number : ----
C-O-C number : ----
Sampler : Kendra Campbell, Martin Englert
Site : CADIA
Quote number : ----
No. of samples received : 26
No. of samples analysed : 26

Page : 1 of 8
Laboratory : ALS Water Resources Group
Contact : Client Services
Address : 16B Lithgow Street Fyshwick ACT Australia 2609
Telephone : +61 2 6202 5404
Date Samples Received : 12-Jan-2021 16:45
Date Analysis Commenced : 15-Jan-2021
Issue Date : 18-Jan-2021 12:26

Accreditation No. 992
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Clare Kennedy	Analyst	Inorganics, Fyshwick, ACT

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- **For samples collected by ALS WRG, sampling was carried out in accordance with Procedure EN67**

Analytical Results

Sub-Matrix: **SOLID**
(Matrix: **SOLID)**

			Sample ID	**003906 Triangle Flat**	**003986 Triangle Flat**	**003987 Triangle Flat**	**003909 Triangle Flat**	**001814 Triangle Flat**
			Sampling date / time	26-Oct-2020 00:00	01-Nov-2020 00:00	07-Nov-2020 00:00	13-Nov-2020 00:00	19-Nov-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**CA2100246-001**	**CA2100246-002**	**CA2100246-003**	**CA2100246-004**	**CA2100246-005**
				Result	Result	Result	Result	Result
EA143CA: Total Suspended Particulates								
ø **Paper Number**	----	1	-	**3906**	**3986**	**3987**	**3909**	**1814**
ø **Initial Weight**	----	0.00001	g	**3.53**	**3.54**	**3.53**	**3.54**	**3.61**
ø **Final Weight**	----	0.00001	g	**3.54**	**3.55**	**3.56**	**3.56**	**3.65**
ø **Sampling Period**	----	1.00	hours	**24.1**	**24.1**	**24.1**	**24.8**	**23.4**
ø **Volume**	----	1.00	m^3	**1620**	**1640**	**1640**	**1690**	**1580**
ø **PM10**	----	1.0	µg/m^3	**7.5**	**10.0**	**13.6**	**13.8**	**26.4**

Analytical Results

Sub-Matrix: **SOLID** (Matrix: **SOLID**)			Sample ID	**001806** **Triangle Flat**	**001808** **Triangle Flat**	**001809** **Triangle Flat**	**003871** **Triangle Flat**	**003872** **Triangle Flat**
			Sampling date / time	25-Nov-2020 00:00	01-Dec-2020 00:00	07-Dec-2020 00:00	13-Dec-2020 00:00	19-Dec-2020 00:00
Compound	CAS Number	LOR	Unit	**CA2100246-006**	**CA2100246-007**	**CA2100246-008**	**CA2100246-009**	**CA2100246-010**
				Result	Result	Result	Result	Result
EA143CA: Total Suspended Particulates								
ø **Paper Number**	----	1	-	**1806**	**1808**	**1809**	**3871**	**3872**
ø **Initial Weight**	----	0.00001	g	**3.62**	**3.63**	**3.63**	**3.56**	**3.56**
ø **Final Weight**	----	0.00001	g	**3.64**	**3.67**	**3.65**	**3.58**	**3.57**
ø **Sampling Period**	----	1.00	hours	**24.1**	**24.1**	**24.2**	**24.0**	**24.0**
ø **Volume**	----	1.00	m^3	**1630**	**1630**	**1640**	**1620**	**1620**
ø **PM10**	----	1.0	µg/m^3	**13.2**	**26.4**	**13.2**	**8.5**	**7.9**

Analytical Results

Sub-Matrix: **SOLID** (Matrix: **SOLID**)			Sample ID	**001812** **Triangle Flat**	**003873** **Triangle Flat**	**003874** **Triangle Flat**	**003989** **Meribah**	**003907** **Meribah**
			Sampling date / time	25-Dec-2020 00:00	31-Dec-2020 00:00	06-Jan-2021 00:00	22-Oct-2020 00:00	01-Nov-2020 00:00
Compound	CAS Number	LOR	Unit	**CA2100246-011**	**CA2100246-012**	**CA2100246-013**	**CA2100246-014**	**CA2100246-015**
				Result	Result	Result	Result	Result
EA143CA: Total Suspended Particulates								
ø **Paper Number**	----	1	-	**1812**	**3873**	**3874**	**3989**	**3907**
ø **Initial Weight**	----	0.00001	g	**3.61**	**3.56**	**3.56**	**3.54**	**3.53**
ø **Final Weight**	----	0.00001	g	**3.63**	**3.57**	**3.57**	**3.55**	**3.55**
ø **Sampling Period**	----	1.00	hours	**24.0**	**24.1**	**24.1**	**24.1**	**24.0**
ø **Volume**	----	1.00	m^3	**1620**	**1640**	**1640**	**1620**	**1630**
ø **PM10**	----	1.0	µg/m^3	**11.2**	**6.0**	**7.2**	**9.1**	**10.4**

Analytical Results

Sub-Matrix: **SOLID** (Matrix: **SOLID**)			*Sample ID*	**003908** **Meribah**	**001805** **Meribah**	**001813** **Meribah**	**001807** **Meribah**	**001810** **Meribah**
			Sampling date / time	07-Nov-2020 00:00	13-Nov-2020 00:00	19-Nov-2020 00:00	25-Nov-2020 00:00	01-Dec-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**CA2100246-016**	**CA2100246-017**	**CA2100246-018**	**CA2100246-019**	**CA2100246-020**
				Result	Result	Result	Result	Result
EA143CA: Total Suspended Particulates								
ø **Paper Number**	----	1	-	**3908**	**1805**	**1813**	**1807**	**1810**
ø **Initial Weight**	----	0.00001	g	**3.54**	**3.62**	**3.62**	**3.63**	**3.61**
ø **Final Weight**	----	0.00001	g	**3.57**	**3.65**	**3.66**	**3.65**	**3.67**
ø **Sampling Period**	----	1.00	hours	**30.6**	**17.7**	**24.1**	**24.1**	**24.0**
ø **Volume**	----	1.00	m^3	**2060**	**1200**	**1640**	**1630**	**1610**
ø **PM10**	----	1.0	$\mu g/m^3$	**12.8**	**21.4**	**26.5**	**15.9**	**32.8**

Analytical Results

Sub-Matrix: **SOLID**
(Matrix: **SOLID)**

			Sample ID	**001811** **Meribah**	**003900** **Meribah**	**003899** **Meribah**	**003898** **Meribah**	**003897** **Meribah**
			Sampling date / time	07-Dec-2020 00:00	13-Dec-2020 00:00	19-Dec-2020 00:00	25-Dec-2020 00:00	31-Dec-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**CA2100246-021**	**CA2100246-022**	**CA2100246-023**	**CA2100246-024**	**CA2100246-025**
				Result	Result	Result	Result	Result
EA143CA: Total Suspended Particulates								
ø **Paper Number**	----	1	-	**1811**	**3900**	**3899**	**3898**	**3897**
ø **Initial Weight**	----	0.00001	g	**3.62**	**3.60**	**3.59**	**3.59**	**3.56**
ø **Final Weight**	----	0.00001	g	**3.64**	**3.62**	**3.61**	**3.61**	**3.58**
ø **Sampling Period**	----	1.00	hours	**24.1**	**24.1**	**24.1**	**24.0**	**24.1**
ø **Volume**	----	1.00	m^3	**1620**	**1630**	**1620**	**1630**	**1630**
ø **PM10**	----	1.0	$\mu g/m^3$	**14.4**	**12.5**	**10.2**	**12.5**	**10.9**

Analytical Results

Sub-Matrix: **SOLID** (Matrix: **SOLID**)			*Sample ID*	**003893** **Meribah**	**----**	**----**	**----**	**----**
			Sampling date / time	06-Jan-2021 00:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**CA2100246-026**	**--------**	**--------**	**--------**	**--------**
				Result	----	----	----	----
EA143CA: Total Suspended Particulates								
ø **Paper Number**	----	1	-	**3893**	**----**	**----**	**----**	**----**
ø **Initial Weight**	----	0.00001	g	**3.56**	**----**	**----**	**----**	**----**
ø **Final Weight**	----	0.00001	g	**3.58**	**----**	**----**	**----**	**----**
ø **Sampling Period**	----	1.00	hours	**24.1**	**----**	**----**	**----**	**----**
ø **Volume**	----	1.00	m^3	**1620**	**----**	**----**	**----**	**----**
ø **PM10**	----	1.0	µg/m^3	**10.1**	**----**	**----**	**----**	**----**

ALS Water

CERTIFICATE OF ANALYSIS

Work Order : **CA2100247**
Client : **Newcrest Mining**
Contact : Kendra Campbell
Address : 1460 Cadia Road
Orange NSW 2800
Telephone : ----
Project : CVO Hi-Vol Sampling and Analysis
Order number : 4501057533
C-O-C number : ----
Sampler : Kendra Campbell, Martin Englert
Site : CADIA
Quote number : ----
No. of samples received : 26
No. of samples analysed : 26

Page : 1 of 8
Laboratory : ALS Water Resources Group
Contact : Client Services
Address : 16B Lithgow Street Fyshwick ACT Australia 2609
Telephone : +61 2 6202 5404
Date Samples Received : 12-Jan-2021 16:45
Date Analysis Commenced : 18-Jan-2021
Issue Date : 22-Jan-2021 17:33

ilac-MRA NATA
Accreditation No. 992
Accredited for compliance with
ISO/IEC 17025 - Testing

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- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Titus Vimalasiri	Metals Teamleader	Inorganics, Fyshwick, ACT

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- **For samples collected by ALS WRG, sampling was carried out in accordance with Procedure EN67**

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

			Sample ID	**003906** **Triangle Flat**	**003986** **Triangle Flat**	**003987** **Triangle Flat**	**003909** **Triangle Flat**	**001814** **Triangle Flat**
			Sampling date / time	26-Oct-2020 00:00	01-Nov-2020 00:00	07-Nov-2020 00:00	13-Nov-2020 00:00	19-Nov-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**CA2100247-001**	**CA2100247-002**	**CA2100247-003**	**CA2100247-004**	**CA2100247-005**
				Result	Result	Result	Result	Result
EG005CA: Total Metals by ICP-OES								
ø **Iron**	7439-89-6	1	µg/filter	**74**	**111**	**142**	**218**	**460**
EG020CA: Total Metals by ICP-MS								
ø **Aluminium**	7429-90-5	1	µg/filter	**780**	**931**	**996**	**890**	**1280**
ø **Antimony**	7440-36-0	1	µg/filter	<1	<1	<1	<1	<1
ø **Arsenic**	7440-38-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Barium**	7440-39-3	1	µg/filter	**17**	**19**	**20**	**17**	**52**
ø **Beryllium**	7440-41-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Cadmium**	7440-43-9	1	µg/filter	<1	<1	<1	<1	<1
ø **Chromium**	7440-47-3	1	µg/filter	**3**	**3**	**4**	**3**	**4**
ø **Cobalt**	7440-48-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Copper**	7440-50-8	1	µg/filter	**6**	**6**	**7**	**12**	**9**
ø **Lead**	7439-92-1	1	µg/filter	<1	<1	<1	<1	**2**
ø **Manganese**	7439-96-5	1	µg/filter	**3**	**4**	**4**	**7**	**18**
ø **Molybdenum**	7439-98-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Nickel**	7440-02-0	1	µg/filter	<1	<1	<1	<1	<1
ø **Selenium**	7782-49-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Silver**	7440-22-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Tin**	7440-31-5	1	µg/filter	<1	<1	<1	<1	<1
ø **Mercury**	7439-97-6	1	µg/filter	<1	<1	<1	<1	<1
ø **Zinc**	7440-66-6	1	µg/filter	**18**	**17**	**23**	**16**	**39**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Sample ID*	**001806** **Triangle Flat**	**001808** **Triangle Flat**	**001809** **Triangle Flat**	**003871** **Triangle Flat**	**003872** **Triangle Flat**
			Sampling date / time	25-Nov-2020 00:00	01-Dec-2020 00:00	07-Dec-2020 00:00	13-Dec-2020 00:00	19-Dec-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**CA2100247-006**	**CA2100247-007**	**CA2100247-008**	**CA2100247-009**	**CA2100247-010**
				Result	Result	Result	Result	Result
EG005CA: Total Metals by ICP-OES								
ø **Iron**	7439-89-6	1	µg/filter	**243**	**407**	**260**	**142**	**178**
EG020CA: Total Metals by ICP-MS								
ø **Aluminium**	7429-90-5	1	µg/filter	**1220**	**1260**	**1200**	**1010**	**1140**
ø **Antimony**	7440-36-0	1	µg/filter	<1	<1	<1	<1	<1
ø **Arsenic**	7440-38-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Barium**	7440-39-3	1	µg/filter	**50**	**48**	**50**	**21**	**21**
ø **Beryllium**	7440-41-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Cadmium**	7440-43-9	1	µg/filter	<1	<1	<1	<1	<1
ø **Chromium**	7440-47-3	1	µg/filter	**4**	**4**	**4**	**4**	**4**
ø **Cobalt**	7440-48-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Copper**	7440-50-8	1	µg/filter	**15**	**7**	**10**	**6**	**6**
ø **Lead**	7439-92-1	1	µg/filter	**1**	**1**	**1**	<1	<1
ø **Manganese**	7439-96-5	1	µg/filter	**6**	**13**	**8**	**6**	**8**
ø **Molybdenum**	7439-98-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Nickel**	7440-02-0	1	µg/filter	<1	<1	<1	<1	<1
ø **Selenium**	7782-49-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Silver**	7440-22-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Tin**	7440-31-5	1	µg/filter	<1	<1	<1	<1	<1
ø **Mercury**	7439-97-6	1	µg/filter	<1	<1	<1	<1	<1
ø **Zinc**	7440-66-6	1	µg/filter	**39**	**37**	**38**	**17**	**17**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Sample ID*	**001812** **Triangle Flat**	**003873** **Triangle Flat**	**003874** **Triangle Flat**	**003989** **Meribah**	**003907** **Meribah**
			Sampling date / time	25-Dec-2020 00:00	31-Dec-2020 00:00	06-Jan-2021 00:00	26-Oct-2020 00:00	01-Nov-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**CA2100247-011**	**CA2100247-012**	**CA2100247-013**	**CA2100247-014**	**CA2100247-015**
				Result	Result	Result	Result	Result
EG005CA: Total Metals by ICP-OES								
ø **Iron**	7439-89-6	1	µg/filter	**167**	**117**	**200**	**69**	**94**
EG020CA: Total Metals by ICP-MS								
ø **Aluminium**	7429-90-5	1	µg/filter	**1170**	**1130**	**1080**	**803**	**788**
ø **Antimony**	7440-36-0	1	µg/filter	<1	<1	<1	**1**	<1
ø **Arsenic**	7440-38-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Barium**	7440-39-3	1	µg/filter	**48**	**19**	**18**	**16**	**16**
ø **Beryllium**	7440-41-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Cadmium**	7440-43-9	1	µg/filter	<1	<1	<1	<1	<1
ø **Chromium**	7440-47-3	1	µg/filter	**4**	**4**	**4**	**3**	**3**
ø **Cobalt**	7440-48-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Copper**	7440-50-8	1	µg/filter	**8**	**8**	**13**	**6**	**6**
ø **Lead**	7439-92-1	1	µg/filter	**1**	<1	<1	<1	<1
ø **Manganese**	7439-96-5	1	µg/filter	**6**	**4**	**5**	**3**	**3**
ø **Molybdenum**	7439-98-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Nickel**	7440-02-0	1	µg/filter	<1	<1	<1	<1	<1
ø **Selenium**	7782-49-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Silver**	7440-22-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Tin**	7440-31-5	1	µg/filter	<1	<1	<1	<1	<1
ø **Mercury**	7439-97-6	1	µg/filter	<1	<1	<1	<1	<1
ø **Zinc**	7440-66-6	1	µg/filter	**37**	**16**	**19**	**29**	**16**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Sample ID*	**003908** **Meribah**	**001805** **Meribah**	**001813** **Meribah**	**001807** **Meribah**	**001810** **Meribah**
			Sampling date / time	07-Nov-2020 00:00	13-Nov-2020 00:00	19-Nov-2020 00:00	25-Nov-2020 00:00	01-Dec-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**CA2100247-016**	**CA2100247-017**	**CA2100247-018**	**CA2100247-019**	**CA2100247-020**
				Result	Result	Result	Result	Result
EG005CA: Total Metals by ICP-OES								
ø **Iron**	7439-89-6	1	µg/filter	**216**	**293**	**624**	**244**	**789**
EG020CA: Total Metals by ICP-MS								
ø **Aluminium**	7429-90-5	1	µg/filter	**825**	**1180**	**1240**	**1160**	**1390**
ø **Antimony**	7440-36-0	1	µg/filter	<1	<1	<1	<1	<1
ø **Arsenic**	7440-38-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Barium**	7440-39-3	1	µg/filter	**17**	**46**	**47**	**42**	**43**
ø **Beryllium**	7440-41-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Cadmium**	7440-43-9	1	µg/filter	<1	<1	<1	<1	<1
ø **Chromium**	7440-47-3	1	µg/filter	**3**	**4**	**4**	**4**	**4**
ø **Cobalt**	7440-48-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Copper**	7440-50-8	1	µg/filter	**10**	**13**	**8**	**10**	**11**
ø **Lead**	7439-92-1	1	µg/filter	<1	**1**	**1**	**1**	**2**
ø **Manganese**	7439-96-5	1	µg/filter	**5**	**9**	**14**	**6**	**22**
ø **Molybdenum**	7439-98-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Nickel**	7440-02-0	1	µg/filter	<1	<1	<1	<1	**1**
ø **Selenium**	7782-49-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Silver**	7440-22-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Tin**	7440-31-5	1	µg/filter	<1	<1	<1	<1	<1
ø **Mercury**	7439-97-6	1	µg/filter	<1	<1	<1	<1	<1
ø **Zinc**	7440-66-6	1	µg/filter	**17**	**35**	**36**	**35**	**35**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Sample ID*	**001811** **Meribah**	**003900** **Meribah**	**003899** **Meribah**	**003898** **Meribah**	**003897** **Meribah**
			Sampling date / time	07-Dec-2020 00:00	13-Dec-2020 00:00	19-Dec-2020 00:00	25-Dec-2020 00:00	31-Dec-2020 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**CA2100247-021**	**CA2100247-022**	**CA2100247-023**	**CA2100247-024**	**CA2100247-025**
				Result	Result	Result	Result	Result
EG005CA: Total Metals by ICP-OES								
ø **Iron**	7439-89-6	1	µg/filter	**288**	**227**	**165**	**185**	**193**
EG020CA: Total Metals by ICP-MS								
ø **Aluminium**	7429-90-5	1	µg/filter	**1060**	**940**	**998**	**950**	**1160**
ø **Antimony**	7440-36-0	1	µg/filter	<1	<1	<1	<1	<1
ø **Arsenic**	7440-38-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Barium**	7440-39-3	1	µg/filter	**38**	**16**	**16**	**16**	**18**
ø **Beryllium**	7440-41-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Cadmium**	7440-43-9	1	µg/filter	<1	<1	<1	<1	<1
ø **Chromium**	7440-47-3	1	µg/filter	**4**	**3**	**3**	**3**	**4**
ø **Cobalt**	7440-48-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Copper**	7440-50-8	1	µg/filter	**5**	**6**	**6**	**8**	**11**
ø **Lead**	7439-92-1	1	µg/filter	<1	<1	<1	<1	**1**
ø **Manganese**	7439-96-5	1	µg/filter	**9**	**6**	**6**	**5**	**6**
ø **Molybdenum**	7439-98-7	1	µg/filter	<1	<1	<1	<1	<1
ø **Nickel**	7440-02-0	1	µg/filter	<1	<1	<1	<1	<1
ø **Selenium**	7782-49-2	1	µg/filter	<1	<1	<1	<1	<1
ø **Silver**	7440-22-4	1	µg/filter	<1	<1	<1	<1	<1
ø **Tin**	7440-31-5	1	µg/filter	<1	<1	<1	<1	<1
ø **Mercury**	7439-97-6	1	µg/filter	<1	<1	<1	<1	<1
ø **Zinc**	7440-66-6	1	µg/filter	**31**	**14**	**19**	**15**	**19**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Sample ID*	**003893** **Meribah**	**----**	**----**	**----**	**----**
			Sampling date / time	13-Oct-2020 00:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**CA2100247-026**	**--------**	**--------**	**--------**	**--------**
				Result	----	----	----	----
EG005CA: Total Metals by ICP-OES								
ø **Iron**	7439-89-6	1	µg/filter	**222**	----	----	----	----
EG020CA: Total Metals by ICP-MS								
ø **Aluminium**	7429-90-5	1	µg/filter	**973**	----	----	----	----
ø **Antimony**	7440-36-0	1	µg/filter	<1	----	----	----	----
ø **Arsenic**	7440-38-2	1	µg/filter	<1	----	----	----	----
ø **Barium**	7440-39-3	1	µg/filter	**16**	----	----	----	----
ø **Beryllium**	7440-41-7	1	µg/filter	<1	----	----	----	----
ø **Cadmium**	7440-43-9	1	µg/filter	<1	----	----	----	----
ø **Chromium**	7440-47-3	1	µg/filter	**3**	----	----	----	----
ø **Cobalt**	7440-48-4	1	µg/filter	<1	----	----	----	----
ø **Copper**	7440-50-8	1	µg/filter	**12**	----	----	----	----
ø **Lead**	7439-92-1	1	µg/filter	<1	----	----	----	----
ø **Manganese**	7439-96-5	1	µg/filter	**5**	----	----	----	----
ø **Molybdenum**	7439-98-7	1	µg/filter	<1	----	----	----	----
ø **Nickel**	7440-02-0	1	µg/filter	<1	----	----	----	----
ø **Selenium**	7782-49-2	1	µg/filter	<1	----	----	----	----
ø **Silver**	7440-22-4	1	µg/filter	<1	----	----	----	----
ø **Tin**	7440-31-5	1	µg/filter	<1	----	----	----	----
ø **Mercury**	7439-97-6	1	µg/filter	<1	----	----	----	----
ø **Zinc**	7440-66-6	1	µg/filter	**18**	----	----	----	----

Appendix G. RCA Australia certificates of analysis

Robert Carr & Associates Pty Ltd Trading as RCA Laboratories – Environmental
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ABN 53 063 515 711 Ph 02 4902 9200 – Fax 02 4902 9299
Email: administrator@rca.com.au Web www.rca.com.au

NATA Accredited Laboratory 9811
Corporate Site Number 18077
Accredited for compliance with ISO/IEC 17025-Testing

28/08/2020

Newcrest – Cadia Hill Gold Mine
C/- Post Office
South Orange NSW 2800

Attention : Tim Wigley

CERTIFICATE OF ANALYSIS – GRAVIMETRIC ANALYSIS OF DUST ON FILTERS

Report	15083-701/0		
Client order number		Site location	Woodville, The Pines Bundarra
Type of samples	Membrane filters	Date received	26/08/2020

ANALYSIS METHOD

Gravimetric analysis is undertaken in accordance with the Australian Standard AS/NZS 3650.9.9-2017 Determination of suspended particulate matter –PM10 low volume sampler gravimetric method, as per RCA Laboratories Method ENV-LAB120 All sampling and site work has been undertaken by the Client Analytical procedures and results reported in this report have been conducted by RCA Laboratories' staff.

RESULTS

Laboratory Sample No.	Date Sampled	Filter No.	Pre –Weight (mg)	Post-Weight (mg)	Airborne Concentration (mg / filter)
082015083001	16/07/2020 - 17/07/2020	PVC 07-20-01	14.887	14.887	0.000
082015083002	16/07/2020 – 17/07/2020	PVC 07-20-08	14.730	14.748	0.018
082015083003	16/07/2020 – 17/07/2020	PVC 07-20-05	16.423	16.427	0.004
082015083004	28/07/2020 – 29/07/2020	PVC 07-20-04	14.841	14.849	0.008
082015083005	28/07/2020 – 29/07/2020	PVC 07-20-12	14.829	14.850	0.021
082015083006	28/07/2020 – 29/07/2020	PVC 07-20-06	15.545	15.549	0.004
082015083007	9/08/2020 – 10/08/2020	PVC 07-20-10	15.269	15.269	0.000
082015083008	9/08/2020 – 10/08/2020	PVC 07-20-03	15.623	15.623	0.000
082015083009	9/08/2020 – 10/08/2020	PVC 07-20-02	15.520	15.452	0.032
082015083010	Blank	BLK 1	15.499	15.499	0.000
082015083011	Blank	BLK 2	15.104	15.103	0.001

Lab blanks withing ±20µg

Please contact the undersigned if you have any queries.

Yours sincerely

Laura Schofield
Environmental Laboratory Manager
Robert Carr & Associates Pty Ltd Trading as
RCA Laboratories – Environmental

Dr Neena Tewari
Senior Environmental Microbiologist
Robert Carr & Associates Pty Ltd Trading as
RCA Laboratories – Environmental

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NATA Accredited Laboratory 9811
Corporate Site Number 18077
Accredited for compliance with ISO/IEC 17025-Testing

22/09/2020

Newcrest – Cadia Hill Gold Mine
C/- Post Office
South Orange NSW 2800

Attention : Tim Wigley

CERTIFICATE OF ANALYSIS – GRAVIMETRIC ANALYSIS OF DUST ON FILTERS

Report	15083-702/0
Client order number	
Site location	Woodville, The Pines Bundarra
Type of samples	Membrane filters
Date received	9/09/2020

ANALYSIS METHOD

Gravimetric analysis is undertaken in accordance with the Australian Standard AS/NZS 3650.9.9-2017 Determination of suspended particulate matter –PM10 low volume sampler gravimetric method, as per RCA Laboratories Method ENV-LAB120 All sampling and site work has been undertaken by the Client Analytical procedures and results reported in this report have been conducted by RCA Laboratories' staff.

RESULTS

Laboratory Sample No.	Date Sampled	Filter No.	Pre –Weight (mg)	Post-Weight (mg)	Airborne Concentration (mg / filter)
092015083001	18/08/2020 – 31/08/2020	PVC 07-20-15	15.811	16.600	0.789
092015083002	18/08/2020 – 31/08/2020	PVC 07-20-11	15.838	17.381	1.543
0982015083003	18/08/2020 – 31/08/2020	PVC 07-20-07	16.139	16.716	0.577

Please contact the undersigned if you have any queries.

Yours sincerely

Laura Schofield
Environmental Laboratory Manager
Robert Carr & Associates Pty Ltd Trading as
RCA Laboratories – Environmental

Dr Neena Tewari
Senior Environmental Microbiologist
Robert Carr & Associates Pty Ltd Trading as
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Corporate Site Number 18077
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21/01/2021

Newcrest – Cadia Hill Gold Mine
C/- Post Office
South Orange NSW 2800

Attention : Tim Wigley

CERTIFICATE OF ANALYSIS – GRAVIMETRIC ANALYSIS OF DUST ON FILTERS

Report	15083-703/0		
Client order number		Site location	Woodville, The Pines Bundarra
Type of samples	Membrane filters	Date received	17/12/2020

ANALYSIS METHOD

Gravimetric analysis is undertaken in accordance with the Australian Standard AS/NZS 3650.9.9-2017 Determination of suspended particulate matter –PM10 low volume sampler gravimetric method, as per RCA Laboratories Method ENV-LAB120 All sampling and site work has been undertaken by the Client Analytical procedures and results reported in this report have been conducted by RCA Laboratories' staff.

RESULTS

Laboratory Sample No.	Date Sampled	Filter No.	Pre –Weight (mg)	Post-Weight (mg)	Airborne Concentration (mg / filter)
122015083001	31/08/2020 13:29 – 11/09/2020 13:35	PVC 07-20-14	15.478	15.733	0.255
122015083002	31/08/2020 14:09 – 11/09/2020 12:17	PVC 07-20-13	16.103	16.815	0.712
122015083003	3/08/2020 15:21 – 14/09/2020 13:17	PVC 07-20-09	16.634	17.587	0.953
122015083004	11/09/2020 12:20 – 23/09/2020 10:17	PVC 07-20-25	15.225	15.933	0.708
122015083005	11/09/2020 13:35 – 23/09/2020 12:10	PVC 07-20-16	14.961	15.043	0.082
122015083006	14/09/2020 103:21 – 23/09/2020 11:26	PVC 07-20-19	15.345	16.162	0.817
122015083007	23/09/2020 10:19 – 6/10/2020 10:30	PVC 07-20-27	15.394	15.903	0.509
122015083008	23/09/2020 11:29 – 6/10/2020 11:43	PVC 07-20-29	15.086	16.018	0.932
122015083009	6/10/2020 10:33 – 3/11/2020 9:04	PVC 07-20-26	15.777	17.184	1.407
122015083010	6/10/2020 11:47 – 3/11/2020 10:09	PVC 07-20-17	15.809	17.535	1.726

Laboratory Sample No.	Date Sampled	Filter No.	Pre –Weight (mg)	Post-Weight (mg)	Airborne Concentration (mg / filter)
122015083011	3/11/2020 9:07 – 15/12/2020 10:19	PVC 07-20-30	15.592	18.710	3.118
122015083012	3/11/2020 10:12 – 15/12/2020 10:43	PVC 07-20-18	15.772	20.783	5.011
122015083013	15/11/2020 13:57 – 15/12/2020 11:01	PVC 10-20-11	15.021	16.569	1.548

Note PVC 07-20-16 Comments logger off no power

Please contact the undersigned if you have any queries.

Yours sincerely

Laura Schofield
Environmental Laboratory Manager
Robert Carr & Associates Pty Ltd Trading as
RCA Laboratories – Environmental

Dr Neena Tewari
Senior Environmental Microbiologist
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CERTIFICATE OF ANALYSIS 250503

Client Details

Client	RCA Australia
Attention	Laura Schofield
Address	PO Box 175, Carrington, NSW, 2294

Sample Details

Your Reference	**15053**
Number of Samples	4 Filter
Date samples received	04/09/2020
Date completed instructions received	04/09/2020

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	11/09/2020
Date of Issue	24/09/2020
Reissue Details	This report replaces R01 created on 24/09/2020 due to: result entry error

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Results Approved By
Nick Sarlamis, Inorganics Supervisor

Authorised By

Nancy Zhang, Laboratory Manager

Quartz in dust					
Our Reference		250503-1	250503-2	250503-3	250503-4
Your Reference	UNITS	PVC 07-20-08	PVC 07-20-12	PVC 07-20-2	Blank included
Type of sample		Filter	Filter	Filter	Filter
Date Sampled		16/7/20	28/7/20	9/8/20	-
Date prepared	-	17/09/2020	17/09/2020	17/09/2020	17/09/2020
Date analysed	-	17/09/2020	17/09/2020	17/09/2020	17/09/2020
a-Quartz on Filter	µg	<5	10	<5	<5
Cristobalite on Filter	µg	<10	<10	<10	<10

Method ID	Methodology Summary
DUST-004	Respirable Quartz (and/or Cristabolite) determined after ashing, redeposition and FTIR determination. The Quartz exposure standard is 50µg/m3, therefore where sampling follows MDHS 101 guidelines and at least 500L of air is sampled, this is equivalent to a dust weight of 25µg/filter. The estimated measurement uncertainty for the laboratory analysis of Quartz is 40% at 25µg at 95% confidence limit (i.e. statistically the true value lies between 15-35µg / filter (30 –70 µg/m3) at 95% confidence). The estimated measurement uncertainty was determined during method validation.

Client Reference: 15053

QUALITY CONTROL: Quartz in dust					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			10/09/2020	[NT]	[NT]	[NT]	[NT]	10/09/2020	[NT]
Date analysed	-			10/09/2020	[NT]	[NT]	[NT]	[NT]	10/09/2020	[NT]
a-Quartz on Filter	µg	5	DUST-004	<5	[NT]	[NT]	[NT]	[NT]	103	[NT]
Cristobalite on Filter	µg	10	DUST-004	<10	[NT]	[NT]	[NT]	[NT]	99	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Report Comments

MPL report no. 250284

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CERTIFICATE OF ANALYSIS 250764

Client Details

Client	RCA Australia
Attention	Laura Schofield
Address	PO Box 175, CARRINGTON, NSW, 2294

Sample Details

Your Reference	**15083 - Orange**
Number of Samples	3 Filters
Date samples received	25/09/2020
Date completed instructions received	25/09/2020
Sampler Name	Not applicable for this job

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	05/10/2020
Date of Issue	06/10/2020

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Results Approved By
Michael Kubiak, Laboratory Manager

Authorised By

Michael Kubiak, Laboratory Manager

Client Reference: 15083 - Orange

Quartz in Dust					
Our Reference			250764-1	250764-2	250764-3
Your Reference	UNITS	PQL	PVC-07-20-15	PVC-07-20-07	PVC-07-20-11
a-Quartz on Filter	µg	5	25	10	34
Cristobalite on Filter	µg	10	<20	<20	<20

Method ID	Methodology Summary
DUST-004	Airborne samples analysed according to AS 2985 for Respirable Dust or AS 3640 for Inhalable Dust . Sample results based on volume data supplied by client. Samples tested as received, *accreditation does not cover sampling.
DUST-004	Respirable Quartz determined after ashing, redeposition and FTIR determination. The Quartz exposure standard is 50µg/m3, therefore where sampling follows MDHS 101 guidelines and at least 500L of air is sampled, this is equivalent to a dust weight of 25µg/filter. The estimated measurement uncertainty for the laboratory analysis of Quartz is 40% at 25µg at 95% confidence limit (i.e. statistically the true value lies between 15-35µg / filter (30 –70µg/m3) at 95% confidence). The estimated measurement uncertainty was determined during method validation.

Client Reference: 15083 - Orange

QUALITY CONTROL: Quartz in Dust					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
a-Quartz on Filter	µg	5	DUST-004	<5	[NT]	[NT]	[NT]	[NT]	101	[NT]
Cristobalite on Filter	µg	10	DUST-004	<10	[NT]	[NT]	[NT]	[NT]	115	[NT]

Result Definitions

DOL	Samples rejected due to particulate overload
RPF	Sample rejected due to pump failure
RFD	Sample rejected due to filter damage
RUD	Sample rejected due to uneven deposition
PQL	Practical quantitation limit

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Report Comments

Crystoballite pql raised due to spectrum interferences.

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CERTIFICATE OF ANALYSIS 260401

Client Details

Client	RCA Australia
Attention	Laura Schofield
Address	PO Box 175, Carrington, NSW, 2294

Sample Details

Your Reference	**15083, Orange**
Number of Samples	13 Filter
Date samples received	28/01/2021
Date completed instructions received	28/01/2021

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	04/02/2021
Date of Issue	04/02/2021

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Results Approved By
Diego Bigolin, Team Leader, Inorganics

Authorised By

Nancy Zhang, Laboratory Manager

NATA
ACCREDITED FOR
TECHNICAL
COMPETENCE

Client Reference: 15083, Orange

Quartz in dust						
Our Reference		260401-1	260401-2	260401-3	260401-4	260401-5
Your Reference	UNITS	PVC 07-20-14	PVC 07-20-13	PVC 07-20-09	PVC 07-20-25	PVC 07-20-16
Type of sample		Filter	Filter	Filter	Filter	Filter
Date Sampled		31/08/2020	31/08/2020	31/08/2020	11/09/2020	11/09/2020
Date prepared	-	01/02/2021	01/02/2021	01/02/2021	01/02/2021	01/02/2021
Date analysed	-	02/02/2021	02/02/2021	02/02/2021	02/02/2021	02/02/2021
a-Quartz on Filter	µg	10	30	30	40	<5
Cristobalite on Filter	µg	<10	<10	<10	<10	<10

Quartz in dust						
Our Reference		260401-6	260401-7	260401-8	260401-9	260401-10
Your Reference	UNITS	PVC 07-20-19	PVC 07-20-27	PVC 07-20-29	PVC 07-20-26	PVC 07-20-17
Type of sample		Filter	Filter	Filter	Filter	Filter
Date Sampled		14/09/2020	23/09/2020	23/09/2020	6/10/2020	6/10/2020
Date prepared	-	01/02/2021	01/02/2021	01/02/2021	01/02/2021	01/02/2021
Date analysed	-	02/02/2021	02/02/2021	02/02/2021	02/02/2021	02/02/2021
a-Quartz on Filter	µg	40	20	40	30	80
Cristobalite on Filter	µg	<10	<10	<10	<10	<10

Quartz in dust				
Our Reference		260401-11	260401-12	260401-13
Your Reference	UNITS	PVC 07-20-30	PVC 07-20-18	PVC 10-20-11
Type of sample		Filter	Filter	Filter
Date Sampled		3/11/2020	3/11/2020	15/11/2020
Date prepared	-	01/02/2021	01/02/2021	01/02/2021
Date analysed	-	02/02/2021	02/02/2021	02/02/2021
a-Quartz on Filter	µg	160	280	130
Cristobalite on Filter	µg	<10	<10	<10

Method ID	Methodology Summary
DUST-004	Respirable Quartz (and/or Cristabolite) determined after ashing, redeposition and FTIR determination. The Quartz exposure standard is 50µg/m3, therefore where sampling follows MDHS 101 guidelines and at least 500L of air is sampled, this is equivalent to a dust weight of 25µg/filter. The estimated measurement uncertainty for the laboratory analysis of Quartz is 40% at 25µg at 95% confidence limit (i.e. statistically the true value lies between 15-35µg / filter (30 –70 µg/m3) at 95% confidence). The estimated measurement uncertainty was determined during method validation.

QUALITY CONTROL: Quartz in dust					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			01/02/2021	[NT]	[NT]	[NT]	[NT]	01/02/2021	[NT]
Date analysed	-			02/02/2021	[NT]	[NT]	[NT]	[NT]	02/02/2021	[NT]
a-Quartz on Filter	µg	5	DUST-004	<5	[NT]	[NT]	[NT]	[NT]	103	[NT]
Cristobalite on Filter	µg	10	DUST-004	<10	[NT]	[NT]	[NT]	[NT]	110	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
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Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

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The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

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For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Glossary of terms and abbreviations

aerodynamic diameter	the diameter of a hypothetical sphere of density 1 g/cm^3 having the same terminal settling velocity in calm air as the particle in question, regardless of its geometric size, shape and true density
aesthetic guideline	a value, which is the concentration or measure of a water quality characteristic that is associated with acceptability of water to the consumer; for example, appearance, taste and odour
ALS	Australian Laboratory Services
ambient air	the air in the general outdoors atmosphere
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ASLP	Australian Standard Leachate Procedure
Australian Drinking Water Guidelines	NHMRC, NRMMC (2011) *Australian Drinking Water Guidelines Paper 6 National Water Quality Management Strategy*, version 3.6, updated March 2021, National Health and Medical Research Council, National Resource Management Ministerial Council, Commonwealth of Australia, Canberra.
CLP	Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006.
coarse particulate matter	see $PM_{10-2.5}$
crustal dust	dust generated from materials derived from the earth’s crust
CVO	Cadia Valley Operations
DDG	dust deposition gauge
deposited dust	airborne particulate matter that settles out of the air under the influence of gravity
dust deposition	the process of airborne particulate matter settling out of the air under the influence of gravity
EC	European Commission
EPA Victoria	Environmental Protection Authority Victoria
EU	European Union
fine particulate matter	see $PM_{2.5}$, but may also sometimes mean PM_{10}
GHS	Globally Harmonised System of Classification and Labelling of Chemicals
health-based guideline	a value, which is the concentration or measure of a water quality characteristic that, based on present knowledge, does not result in any significant risk to the health of the consumer over a lifetime of consumption
HSE	health, safety and environment
HVAS	high volume air sampler or sampling
IARC	International Agency for Research on Cancer
IMA - Europe	Industrial Minerals Association – Europe
Livestock Drinking Water Guidelines	*Australian and New Zealand guidelines for fresh and marine water quality. Volume 1: The guidelines*, ANZECC and ARMCANZ, October 2000, Canberra.

LOD	limit of detection
LOR	limit of reporting
LVAS	low volume air sampler or sampling
MeClas	A web-based tool used to generate toxicity hazard categories and corresponding classification and labelling information of inorganic metal-containing complex materials such as ores, concentrates, intermediates or alloys using the GHS/CLP rules.
MOE	Ontario Ministry of Environment
NAG	net acid generation
NEPM	National Environment Protection (Ambient Air Quality) Measure
NHMRC	National Health and Medical Research Council
NRMMC	National Resource Management Ministerial Council
NSW EPA	New South Wales Environment Protection Authority
NTSF	Northern Tailings Storage Facility
Ontario MOE	Ontario Ministry of Environment
p.	page
$PM_{0.1}$	particulate matter less than 0.1 micrometres in aerodynamic diameter (often referred to as the ultrafine fraction or ultrafine particulate matter)
PM_{10}	particulate matter less than 10 micrometres in aerodynamic diameter
$PM_{10-2.5}$	particulate matter between 2.5 and 10 micrometres in aerodynamic diameter (often referred to as the coarse fraction or coarse particulate matter)
$PM_{2.5}$	particulate matter less than 2.5 micrometres in aerodynamic diameter (often referred to as the fine fraction or fine particulate matter)
pp.	pages
PTSF	Open Pit Tailings Storage Facility
QUT	Queensland University of Technology
RCS	respirable crystalline silica
STOT-RE	Specific Target Organ Toxicity - Repeated Exposure
STSF	Southern Tailings Storage Facility
Study	Cadia Tailings Dust Monitoring and Assessment Project
TEOM	Tapered Element Oscillating Microbalance
TSP	total suspended particulate
ultrafine particulate matter	see $PM_{0.1}$
USEPA	United States Environmental Protection Agency
WHO	World Health Organization
XRD	X-ray diffraction analysis

Units of measure

g/cm^3	grams per cubic centimetre
g/m^2/month	grams per square metre per month
L/min	litres per minute
m^3	cubic metre
mg/kg	milligrams per kilogram (same as ppm for solids)
mg/L	milligrams per litre (same as ppm for liquids)
micrometre	one thousandth of a metre
micron	see micrometre
pH	A figure expressing the acidity or alkalinity of a solution on a logarithmic scale on which 7 is neutral, lower values are more acid and higher values more alkaline. pH can range from 0 to 14.
ppm	parts per million (by volume for liquids – mg/L – and by weight for solids – mg/kg)
wt%	weight percent – the weight of the thing being measured present in every 100 grams of total material
µg	microgram
$µg/m^3$	micrograms per cubic metre
µS/cm	microsiemens per centimetre

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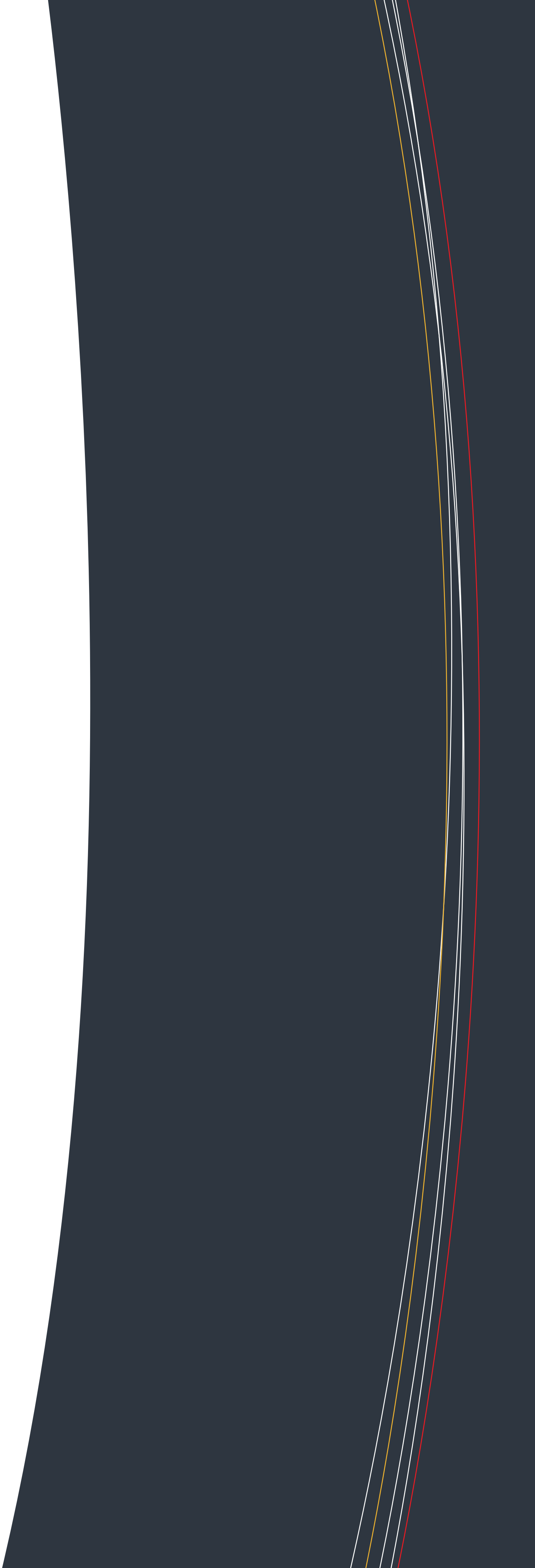
Controlled document name: Long Report Template **Version:** 1.4 **Issue date:** 20/03/2020



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