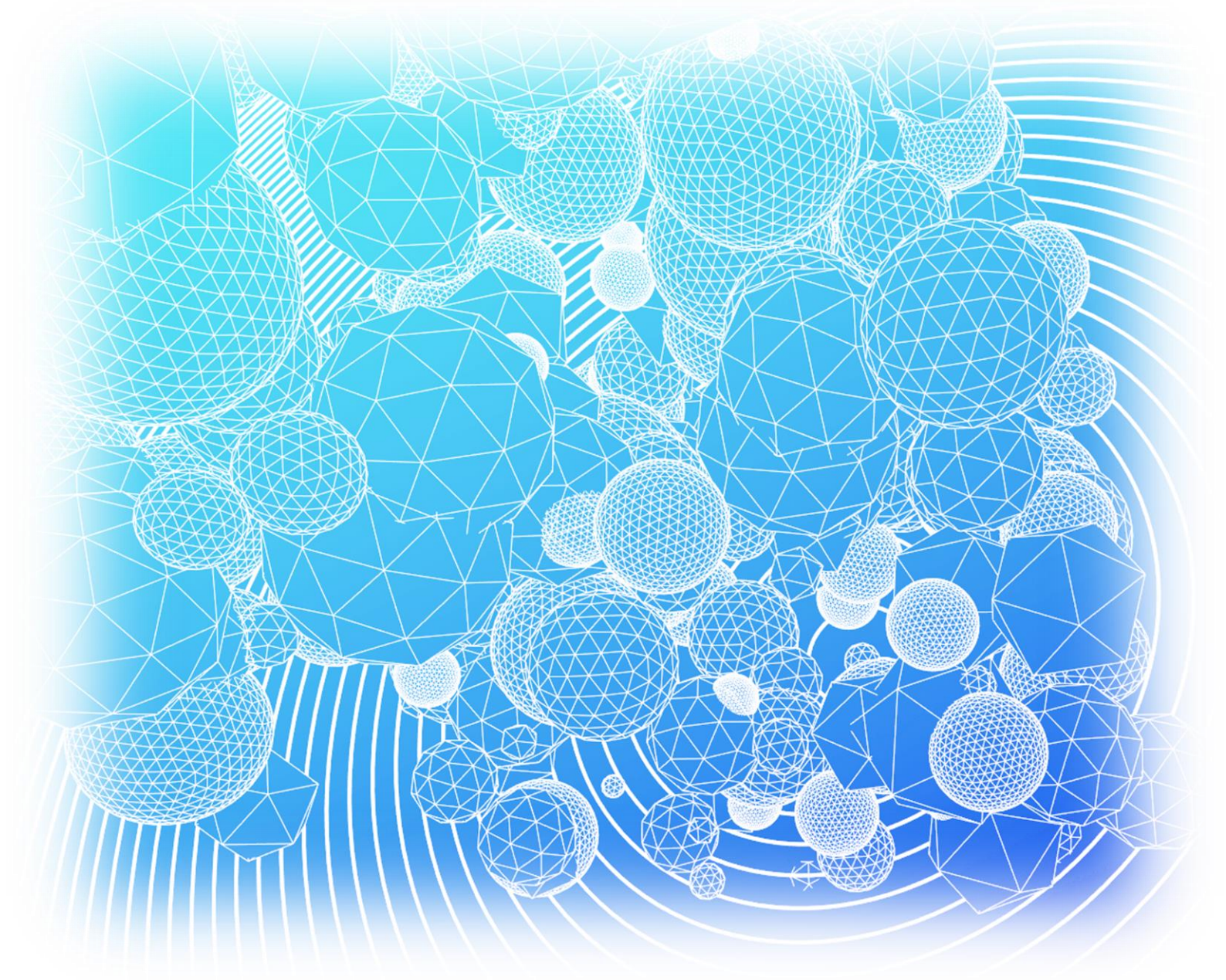

Human Health and Ecological Risk Assessment – Coal Ash

Prepared for: K&L Gates

26 February 2019

EnRiskS

Document History and Status

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Limitations

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It is prepared in accordance with the scope of work and for the purpose outlined in the **Section 1** of this report.

The methodology adopted and sources of information used are outlined in this report. Environmental Risk Sciences has made no independent verification of this information beyond the agreed scope of works and assumes no responsibility for any inaccuracies or omissions. No indications were found that information contained in the reports provided and listed in **Section 2** were false.

This report was prepared in January and February 2019 and is based on the information provided and reviewed at that time. Environmental Risk Sciences disclaims responsibility for any changes that may have occurred after this time.

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Glossary of Terms

ADI	Acceptable Daily Intake
ANZECC	Australia and New Zealand Environment and Conservation Council
AT	Averaging Time
BaP	Benzo(a)pyrene
BGL	Below Ground Level
BTEX	Benzene, toluene, ethylbenzene and total xylenes
BW	Body Weight
CF	Unit Conversion Factor
CoPC	Chemicals of Potential Concern
DECCW	Department of Environment, Climate Change and Water
ED	Exposure Duration
EF	Exposure Frequency
EPA	Environment Protection Authority
ET	Exposure Time
HHRA	Human Health Risk Assessment
HI	Hazard Index
HIL	Health Investigation Level
HQ	Hazard Quotient
HSL	Health Screening Level
LOR	Limit of Reporting
NEPM	National Environment Protection Measure
NHMRC	National Health and Medical Research Council
NSW	New South Wales
NSW DECC	New South Wales Department of Environment and Climate Change
PAH	Polycyclic aromatic hydrocarbon
RfC	Reference Concentration
RfD	Reference Dose
RME	Reasonable maximum exposure
SA	Surface area
TC	Tolerable Concentration
TDI	Tolerable Daily Intake
TEF	Toxicity equivalence factor
TEQ	Toxicity equivalent
TDS	Total Dissolved Solids
US EPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
WHO	World Health Organisation

Executive Summary

Environmental Risk Sciences Pty Ltd (enRiskS) has been engaged by K&L Gates on behalf of AGL Macquarie Pty Ltd (AGL Macquarie) to provide advice about the potential for human health or ecological risks from naturally occurring metals in coal ash supplied for a range of beneficial re-use purposes.

It is understood that, as a part of operations at Bayswater and Liddell Power Stations, some of the coal ash generated from the combustion of coal is supplied to a number of commercial operators who process the coal ash and sell it for beneficial re-use (directly or via third parties). It is understood that the coal ash supplied by AGL Macquarie is used:

- primarily in engineering applications, including for manufacturing concrete, in road base and pipe bedding. Some coal ash has also been used for mine void back fill and a small amount has also been used in plaster board building products; and
- some coal ash supplied may have been added by third parties to bagged horticultural applications including potting soil, turf management, landscape, gardens and green wall applications.

Sale of coal ash for beneficial re-use has occurred for some time and continued after AGL Macquarie acquired the power stations in September 2014. AGL Macquarie has temporarily suspended coal ash supplies on 16 January 2019 and is not currently supplying coal ash.

Supply of coal ash for beneficial reuse is regulated by the Coal Ash Order 2014 (Coal Ash Order) made under the Protection of the Environment Operations (Waste) Regulation 2014. The Coal Ash Order commenced on 24 November 2014.

Recently it has been identified that the metal levels reported in some analysis results of samples of coal ash from the power stations are above the levels specified in the Coal Ash Order. Hence this assessment has been undertaken to provide an assessment of risks to human health and the environment in relation to the levels of metals reported in the analysis reports based on the known beneficial re-use of the coal ash supplied by AGL Macquarie since the Coal Ash Order commenced.

The assessment has relied on information provided in relation to the nature of metals within the coal ash relevant to materials supplied between late 2014 and 16 January 2019.

In addition, ongoing sampling of coal ash is being conducted by AGL Macquarie post 16 January 2019. While this additional data does not specifically relate to coal ash supplied during the period November 2014 and 16 January 2019, the data relates to coal ash that is generated via a continuous process at the power stations and is expected to be representative on that basis. The additional coal ash data, collected post 16 January 2019 to 31 January 2019, has been used as supplementary information to inform the speciation of chromium and the leachability of metals from the coal ash.

It is understood that the accuracy of the analysis results obtained prior to January 2019 is being evaluated in light of indications that the levels of metals reported in the analysis reports are likely to be overstated. This assessment has not made any evaluation of the quality of the data provided. It

is understood that AGL Macquarie has engaged others to evaluate the data and advise on data quality. For the purpose of this assessment, regardless of data quality, all data has been considered.

While the maximum reported concentrations of some metals in coal ash sampled between November 2014 and 16 January 2019 (when sale was temporarily suspended) exceeds the criteria specified in the Coal Ash Order, the range of concentrations reported is similar to concentrations reported in coal ash in the US, as well as within natural/background soil present in urban and rural environments in Australia.

On the basis of the assessment undertaken, the following can be concluded:

- There are no human health risk issues of concern in relation exposures to workers or the general public as a result of the beneficial re-use of coal ash materials from Bayswater Power Station and Liddell Power Station.
- For workers involved in the storing and handling of coal ash materials from Bayswater Power Station and Liddell Power Station it is expected that workplace exposures will be appropriately managed as outlined in the relevant SDSs for the coal ash products.
- There are no concentrations of metals, pH or conductivity in coal ash materials beneficially reused from Bayswater Power Station and Liddell Power Station which are considered to be of concern to terrestrial ecology or aquatic ecosystems.

Section 1. Introduction

1.1 Background

Environmental Risk Sciences Pty Ltd (enRiskS) has been engaged by K&L Gates on behalf of AGL Macquarie Pty Ltd (AGL Macquarie) to provide advice about the potential for human health or ecological risks from naturally occurring metals in coal ash supplied for a range of beneficial re-use purposes.

It is understood that, as a part of operations at Bayswater and Liddell Power Stations, some of the coal ash generated from the combustion of coal is supplied to a number of commercial operators who process the coal ash and sell it for beneficial re-use (directly or via third parties). It is understood that the coal ash supplied by AGL Macquarie is used:

- primarily in engineering applications, including for manufacturing concrete, in road base and pipe bedding. Some coal ash has also been used for mine void back fill and a small amount has also been used in plaster board building products; and
- some coal ash supplied may have been added by third parties to bagged horticultural applications including potting soil, turf management, landscape, gardens and green wall applications.

Sale of coal ash for beneficial re-use has occurred for some time and continued after AGL Macquarie acquired the power stations in September 2014. AGL Macquarie has temporarily suspended coal ash supplies on 16 January 2019 and is not currently supplying coal ash.

Supply of coal ash for beneficial reuse is regulated by the Coal Ash Order 2014 (Coal Ash Order) made under the Protection of the Environment Operations (Waste) Regulation 2014. The Coal Ash Order commenced on 24 November 2014. A copy of the Coal Ash Order is included in **Appendix A**.

Recently it has been identified that the metal levels reported in some analysis results of samples of coal ash from the power stations are above the levels specified in the Coal Ash Order. Hence this assessment has been undertaken to provide an assessment of risks to human health and the environment in relation to the levels of metals reported in the analysis reports based on the known beneficial re-use of the coal ash supplied by AGL Macquarie since the Coal Ash Order commenced.

1.2 Objectives

The objectives of the human health and ecological risk assessment (HHERA) presented in this report are as follows:

- Review data available in relation to the presence of metals within coal ash as supplied by AGL Macquarie since the Coal Ash Order commenced;
- Undertake an assessment and provide advice in relation to potential risks to human health (workers and general public) associated with the handling and end-use of the coal ash materials; and
- Undertake an assessment and provide advice in relation to potential ecological risk issues related to the end-use of the coal ash materials.

The assessment undertaken has only considered the known end-uses of coal ash in relation to beneficial re-use. The assessment has relied on information provided in relation to the nature of metals within the coal ash relevant to materials supplied between late 2014 and 16 January 2019.

In addition, ongoing sampling of coal ash is being conducted by AGL Macquarie post 16 January 2019. While this additional data does not specifically relate to coal ash supplied during the period November 2014 and 16 January 2019, the data relates to coal ash that is generated via a continuous process at the power stations and is expected to be representative on that basis. The additional coal ash data, collected post 16 January 2019 to 31 January 2019, has been used as supplementary information to inform the speciation of chromium and the leachability of metals from the coal ash.

It is understood that the accuracy of the analysis results obtained prior to January 2019 is being evaluated in light of indications that the levels of metals reported in the analysis reports are likely to be overstated. This assessment has not made any evaluation of the quality of the data provided. It is understood that AGL Macquarie has engaged others to evaluate the data and advise on data quality. For the purpose of this assessment, regardless of data quality, all data has been considered.

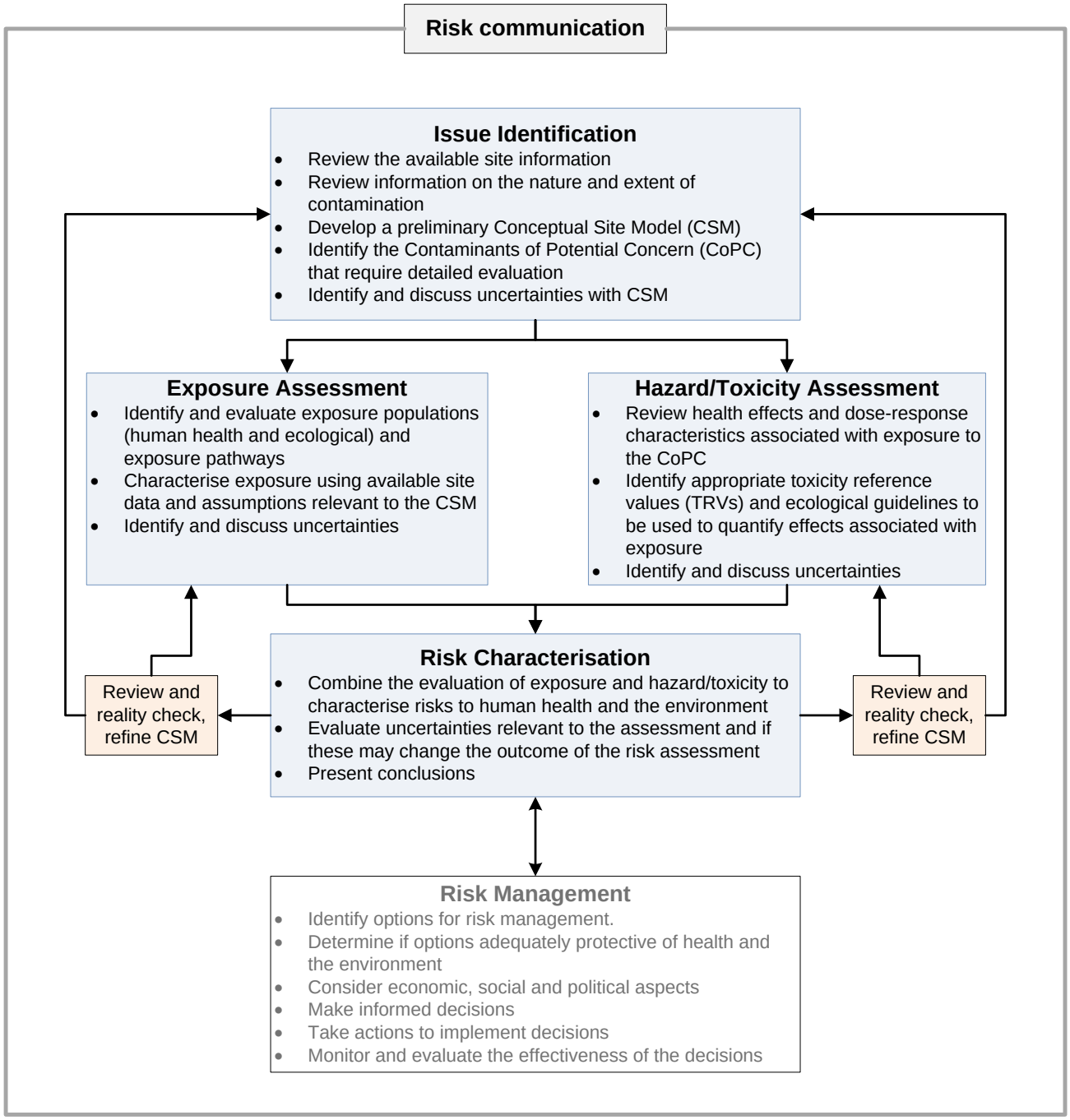
1.3 Methodology and Scope of Works

The approach taken for the quantitative assessment of human health and ecological risks is in accordance with guidelines/protocols endorsed by Australian regulators, including:

- Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards (enHealth 2012a)
- Australian Exposure Factor Guide (enHealth 2012b)
- ASC NEPM (1999) National Environmental Protection Measure – Assessment of Site Contamination including:
    - Schedule B1 Investigation Levels for Soil and Groundwater (NEPC 1999 amended 2013a)
    - Schedule B4 Guideline on Health Risk Assessment Methodology (NEPC 1999 amended 2013b)
    - Schedule B5 Guideline on Ecological Risk Assessment (NEPC 1999 amended 2013c)
    - Schedule B7 Guideline on Health-Based Investigation Levels (NEPC 1999 amended 2013d)
    - Toolbox Note – Key principles for the remediation and management of contaminated sites (NEPC 2013)
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018).

The above documents are supplemented by protocols and guidelines developed by international agencies such as the USEPA (USEPA 1989, 1991, 2002, 2004, 2009).

The overall approach to human health and ecological risk assessment recommended by the enHealth national risk assessment guidance document is outlined in the following (enHealth 2012a).



Modified from enHealth 2012a

Following this guidance, the assessment has been undertaken to include the following:

- A review of the available information relevant to characterising the nature of metals within coal ash (**Section 2**).
- Review of potential risks to human health associated with the presence of metals in coal ash, where coal ash materials may be handled and used for a range of products (**Section 3**).
- Review of potential risks to the environment relevant to the use of coal ash in a range of products (**Section 4**).
- Conclusions in relation to risks to human health and the environment (**Section 5**).

Section 2. Coal ash data

2.1 Characteristics of coal ash

The Bayswater and Liddell Power Stations combust black coal to generate electricity. Coal contains a range of naturally occurring chemicals, including some metals, from the geology in which the coal formed. Many of the naturally occurring chemicals in the coal are burned up within the coal fired power stations to generate energy and heat (i.e. the hydrocarbon-based compounds). The metals within the coal mostly remain within the ash that remains after burning is complete.

The coal ash from the power stations is classified as follows[1]:

- Fly ash – a fine, powdery material composed mostly of silica made from the burning of finely ground coal in a boiler. Fly ash is entrained in the combustion flue gas as it leaves the boiler furnace and is captured with a fabric filter collection plant, often referred to as a 'baghouse';
- Bottom ash – a coarse, angular ash particle that is too large and heavy to be entrained in the combustion flue gases and falls under gravity to the bottom of the coal furnace;
- Cenospheres – these are light weight hollow ceramic microspheres that typically form part of the fly ash and separate out on the surface when the fly ash is deposited in an ash dam.

Other by-products of the coal combustion process (not sold by AGL Macquarie) include boiler slag, fluidised bed combustion ash and scrubber residues.

AGL Macquarie has principally sold fly ash, bottom ash and cenospheres to third parties for a range of re-use options. Most of the coal ash supplied by AGL Macquarie in recent times comes from the Bayswater Power Station. However, some cenospheres are collected from the Liddell Power Station ash dam. Safety data sheets relevant to these products are included in **Appendix B**.

Metals detected in coal ash reflect the naturally occurring metals within the source coal materials used in the power stations. As these metals are naturally occurring, but likely to be variable depending on the source coal materials, the NSW EPA required that ash supplied for re-use be checked for metals to ensure that levels remain low as outlined in the Coal Ash Order. The limits specified in the order are stringent and are considered likely to have been based on expected concentrations in ash when the order was prepared.

2.2 Re-use of coal ash

The majority of coal ash generated from Bayswater and Liddell is deposited on site in authorised ash dams or used for rehabilitating mine voids located on site. A small proportion is sold for a range of beneficial re-uses.

[1] https://www.epa.gov/coalash/coal-ash-basics

The coal ash supplied by AGL Macquarie is known to have been used for specific uses. These uses can be considered in terms of encapsulated and unencapsulated re-use[2] as follows:

Encapsulated re-use

Encapsulated re-use involves binding the coal ash into specific products that include concrete and plasterboard building products. By binding coal ash within these solid products, this encapsulates the coal ash, preventing direct contact with the coal ash materials and limiting or preventing the potential for metals to leach from the encapsulated product.

These uses are also commonly referred to as engineering re-use. Within the Coal Ash Order, these uses are termed "cementitious mixes" which the Coal Ash Order defines as "either coal ash or blended coal ash which has been mixed with general purpose cement, lime and other activators for use in bound applications, where the materials must be chemically bound together".

For the purpose of this assessment the term encapsulated re-use has been adopted.

Unencapsulated re-use

This is where coal ash is re-used as a loose particulate and may be blended with other particulate materials. This includes the use of coal ash as pipe bedding material or road base (which are also considered to be engineering re-use) as well as products such as horticultural applications, including potting soil, turf management, landscape, gardens and green wall applications.

When blended in these products, which comprise loose particulates, there is the potential for exposure to occur via direct contact and inhalation. In addition, some metals that may be present in coal ash in these products may leach from the material and be available to plants or aquatic environments. It should be noted that metals are naturally occurring in the environment and are likely to also be present in soil and other materials used to blend with the coal ash. At present, the concentration of metals in the other materials used in these blends is not known. Hence this assessment only considers data relevant to coal ash.

Within the Coal Ash Order these uses are termed "non-cementitious mixes" which the Coal Ash Order defines as "either coal ash or blended coal ash that is not mixed with general purpose cement, lime and other activators or used in bound applications". For the purpose of this assessment the term unencapsulated re-use has been adopted.

2.3 Available data

Analytical data for coal ash materials sampled between November 2014 (when the Coal Ash Order commenced) and 16 January 2019 (when coal ash sales were temporarily suspended) has been provided for use in this assessment. A summary of the data provided is included in **Appendix C**.

It is understood that the accuracy of the analysis results obtained prior to January 2019 is being evaluated in light of indications that the levels of metals reported in the analysis reports are likely to

[2] The terminology encapsulated re-use and unencapsulated re-use has been adopted from the USEPA, and allows re-use to be categorised in terms of potential future exposure to the coal ash.

be overstated. This assessment has not made any evaluation of the quality of the data provided. It is understood that AGL Macquarie has engaged others to evaluate the data and advise on data quality. For the purpose of this assessment, regardless of data quality, all data has been considered.

Additional analytical data has also been provided for samples collected to 31 January 2019 (also included in **Appendix C**). Where this data has been used in this assessment, it has been referenced.

Data relevant to the level of metals reported in coal ash from the power stations sampled between November 2014 and 16 January 2019 are summarised in **Table 1**. This table presents the range of concentrations reported. For context, the concentrations reported in coal ash from this sampling period have been compared against each of the following:

- The maximum average concentration and absolute maximum concentrations specified in Table 1 of the Coal Ash Order
- Criteria for metals allowable within composts, soil conditioners and mulches, and potting mixes as per Australian Standards (AS 4454-2012 and AS 3743-2003) (relevant to some of the unencapsulated re-use purposes)
- Range of concentrations of metals reported in samples of coal ash (fly ash and bottom ash materials) from US power plants from 5 states and different coal sources (Bradley 2012)[3]
- Range of background concentrations of metals reported in rural and urban soil across Australia (Olszowy et al. 1995)

[3] AECOM 2012, Coal Ash Material Safety, A Health Risk-Based Evaluation of USGS Coal Ash Data from Five US Power Plants. Report prepared for the American Coal Ash Association, June 2012, https://www.acaa-usa.org/Portals/9/Files/PDFs/ACAA_CoalAshMaterialSafety_June2012.pdf

Table 1: Summary of coal ash data (November 2014 to 16 January 2019)

Metal	Concentrations reported in coal ash analytical results (mg/kg)		Coal Ash Order (mg/kg)		Compost as per AS 4454-2012** (mg/kg)	Range in coal ash from US power stations (min – max) (mg/kg)	Range in rural and urban soil in Australia (mg/kg)
	Average*	Range (min – max)	Maximum average	Absolute maximum			
Mercury	0.11	<0.1 - 2.9	0.5	1	1	0.01 – 1.15	<0.01 – 3.4
Cadmium	0.23	<0.1 - 0.5	0.5	1	1	0.1 – 3.3	<0.5 – 29
Lead	18	0.7 - 302	25	50	150	7.6 – 293	1 – 1465
Arsenic	4.1	<0.1 – 53.8	10	20	20	3.6 – 94	<0.3 – 76
Boron	28	5 - 280	75	60[1] 150[2]	100	--	--
Chromium (total)	72	<1 - 649	25	50	100	17 – 984	<5 – 400
Copper	31	<1 - 230	20	40	150	40 – 692	1 – 466
Molybdenum	5.8	0.6 – 41.1	10	20	--	2.1 – 90.5	--
Nickel	41	0.1 - 387	25	50	60	17 – 572	<0.05 – 180
Selenium	1.5	<0.1 – 5.4	10	20	5	0.12 – 22.5	--
Zinc	39	3.8 - 260	35	70	300	26.5 – 848	2 – 3820

* Arithmetic average of all samples from November 2014 – 16 January 2019 utilising the analytical limit of reporting (LOR) where not detected
** Unrestricted use upper limit for composts, soil conditioners and mulches. No upper limits for soil concentrations available for potting mixes.
1 criteria for soil amendment
2 criteria for engineering use

Review of **Table 1** indicates the following:

- The average metal concentration reported in the coal ash samples is below the maximum average concentration in the Coal Ash Order, with the exception of total chromium, nickel and zinc.
- The maximum concentrations of most metals reported in the coal ash samples exceed the absolute maximum criteria in the Coal Ash Order, with the exception of cadmium and selenium.
- The maximum concentrations of most metals reported in the coal ash samples exceed the unrestricted use upper limits for compost, soil conditioners and mulches as per AS 4454-2012, with the exception of lead, cadmium, selenium and zinc.
- The range of concentrations reported in the coal ash samples is consistent with the range of metals reported in coal ash sampled from US power stations.
- In addition, the range reported in the coal ash samples is also similar to the range reported in urban and rural soil in Australia (i.e. background soil concentrations)

It is noted that the criteria listed in **Table 1** from the Coal Ash Order and AS 4454-2012 are not risk-based criteria. Exceedance of these criteria does not mean that there are any risks to human health or the environment where coal ash is used for a range of re-use options. Further assessment of human health and ecological risks is presented in the following sections.

It is noted that the sampling and analysis of coal ash materials undertaken in January 2019 has reported lower concentrations of metals than the results reported in coal ash from the power stations sampled between November 2014 and 16 January 2019 presented in **Table 1**. In particular, the concentrations of total chromium, copper, nickel and zinc are significantly lower than presented in **Table 1** and meet the criteria within the Coal Ash Order.

Section 3. Further assessment of health risk issues

3.1 General

This section presents further assessment of potential risks to human health associated with the re-use of coal ash which includes trace amounts of various naturally occurring metals.

This section provides commentary on the ways in which people may be exposed to coal ash supplied from the power stations. Where there is the potential for exposure to coal ash materials, a screening level assessment has been presented to further evaluate whether these exposures have the potential to be elevated and require a more detailed assessment of health risk.

3.2 Potential for exposure

Where coal ash is supplied for a range of re-use purposes, workers handling the coal ash (as received) have the potential to be exposed to coal ash via the inhalation of dust and incidental ingestion and dermal contact.

It is noted that the focus of this assessment relates to workers who may beneficially reuse coal ash or products to which coal ash has been added and the general public who may be exposed to coal ash in products as sold for re-use. It is acknowledged that there are a number of other workers employed by businesses that collect coal ash materials from various locations within the Bayswater and Liddell power stations (such as at the ash dams and at offtakes from the Ravensworth Fly Ash Plant or Silos). These workers remove and handle coal ash materials from the power station sites for sale for a range of beneficial re-use options. Some additional discussion is provided in relation to workers from these businesses in **Section 3.3**. The focus, however, of the following discussion remains on workers using coal ash sold for beneficial re-use (i.e. not power station workers or contractors working at the power stations who carry out ash handling operations unrelated to the beneficial reuse of the coal ash off-site).

Where coal ash is processed for encapsulated re-use, the coal ash is bound within a solid material and there is no potential for the public to be exposed to the coal ash as a particulate (as there is no dust). The potential for any metals present in coal ash to be able to be incidentally ingested or dermally absorbed is also considered to be negligible as the encapsulated materials are solid.

Where coal ash is used for unencapsulated beneficial re-use purposes, there is the potential for the public to be exposed to coal ash present in these materials via direct contact (incidental ingestion and dermal contact) and inhalation (of dust generated). The potential for such exposure to occur depends on the nature of the re-use. Engineering re-use of coal ash (where the coal ash is unencapsulated and used for purposes such as road base or pipe bedding) presents minimal or negligible potential for exposure compared with other unencapsulated uses. **Table 2** presents a summary of the unencapsulated re-use scenarios and the potential for exposure to occur for the general public.

Table 2: Potential for exposure for workers and the general public using products sold for beneficial re-use – Unencapsulated re-use of coal ash

Re-use scenario	Exposure pathway			Comments
	Inhalation of dust	Incidental ingestion	Dermal contact	
Engineering re-use				
Pipe bedding materials	Negligible	X	X	While coal ash materials are used for these purposes there is the potential for small amounts to be released to air as dust. Workers may potentially be exposed to the dust as well as the general public, should they be present close to these areas. Workplace exposures would be required to be managed (refer to **Section 3.3**) and any dust inhalation exposures by the general public would be negligible as all dust releases would be minimised (a requirement of all workplaces) and any exposures would be of very short duration. Once the coal ash materials have been placed for these purposes, they are only present at depth (beneath pipes or beneath asphalt) where no one can come into contact with the materials unless maintenance works require excavations. Such exposures, however will infrequent and of short duration.
Road base	Negligible	X	X	
Other re-use				
Horticultural applications	✓	✓	✓	Where coal ash is blended with other particulate materials for horticultural applications that include potting soil, turf management, landscape, gardens and green wall applications, there is the potential for the general public (and persons undertaking gardening activities) to be exposed to coal ash in these materials via direct contact where incidental ingestion and dermal contact may occur, as well as some inhalation of fine particulates should they be released to air (during use via wind erosion).

3.3 Workplace exposure issues

Workplace exposure encompasses:

- workers involved in the collection and removal of coal ash from the power stations and the handling and of these materials during processing for beneficial re-use;
- workers involved in the further processing and handling of coal ash materials sold for beneficial re-use.

Workers involved in the removal of coal ash materials from the power stations, specifically the various ash dams and the Ravensworth Fly Ash Plant and Silos (A and B), may undertake works such as:

- the removal of coal ash using an excavator;
- the taking of coal ash directly from the plant or silos;
- the screening of coal ash into coarse and fine materials; and
- stockpiling and loading, using a front end loader or directly from ash hoppers, onto trucks where the material is covered.

These workers operate on the power station sites, and handle coal ash materials that comprise of fine particulates and silicates.

Under the NSW *Work Health and Safety Act 2011* and the *Work Health and Safety Regulation 2017* there are a number of requirements to safely manage exposures to dust from products like coal ash which contain silicates (and crystalline silica). SafeWork NSW has a number of guideline documents to assist in compliance with these aspects of the Act and Regulation. As a result, it is expected that worker exposures to dust when handling coal ash will be minimised. Minimising dust exposures to comply with the relevant guidelines will also minimise any exposure to metals contained within the coal ash, and other potential hazards, such as alkaline pH, that may also be present within the materials.

Where coal ash is supplied for re-use (regardless of the type of re-use), it is supplied with relevant Safety Data Sheets (SDSs). Refer to **Appendix B** for copies of the SDS's for fly ash and bottom ash materials. The SDS's outline the hazards associated with these materials, the personal protective equipment (PPE) that needs to be worn while handling the coal ash materials as supplied, and first-aid measures to be implemented should exposure (without the required PPE) occur. Safework Australia outlines guidelines to ensure safe workplaces, and all states have workplace (or occupational) health and safety acts and regulations that require the implementation of appropriate workplace health and safety measures/guidelines.

The key hazards identified in the SDSs relate to the presence of silicates (including crystalline silica), with fly ash containing the highest proportion of silicates. Adopting appropriate measures to minimise or prevent exposure to silicates while processing, storing and handling the coal ash products will also minimise or prevent exposure to metals that are present in the material. It is noted that the SDSs also require the use of gloves (PVC or rubber), coveralls and safety glasses, and to avoid contact with skin. These requirements will prevent any skin irritation that may occur if the materials are slightly alkaline.

On this basis, workplace exposures which occur during the collection and transport of coal ash from the power stations for beneficial reuse purposes are expected to be negligible, as they are required to be appropriately managed under relevant workplace safety guidelines.

It is noted that SafeWork Australia and SafeWork NSW have issued specific guidance on crystalline silica. This guidance includes requirements that need to be considered when handling materials known to contain crystalline silica, but also apply to workers undertaking activities on materials such as concrete and masonry where dust may be generated. Such requirements would minimise and prevent exposures to silicates as well as any metals present from the coal ash to workers who may grind, drill or sand encapsulated products such as concrete.

3.4 Consideration of exposures of the general public to unencapsulated coal ash re-use

The metals reported in coal ash are also present in background soil in Australia and the general public is exposed to the metals in background soil on a daily basis. To assist in determining the concentrations of metals that may be present in soil (and, in this case, coal ash materials) that have the potential to be of concern to the health of the community, health-based soil investigation levels or criteria (referred to as HILs) have been established. It is noted that HILs are screening criteria and are not dividing line between no risk and a risk. Exceedance of an HIL does not mean there is a risk to human health, rather it is a trigger to undertake a more detailed assessment and/or obtain further data to better understand and characterise exposure.

National guidelines for metals in soil are available from the National Environmental Protection (Assessment of Site Contamination) Measure (ASC NEPM) (NEPC 1999 amended 2013d). The guidelines in the ASC NEPM have been calculated using conservative generic exposure scenarios. These exposure scenarios assume people are regularly exposed to soil containing the guideline concentration of a metal.

The guidelines for land used for low density residential (referred to as HIL-A) indicate soil quality that is appropriate and acceptable for the backyard of a low-density residential house where people may garden or undertake recreational activities in their backyards and dust from the garden may be tracked inside the home. The exposure scenario for calculating these guidelines (HIL-A) involves assuming people are exposed to the contaminants in soil through:

- Incidental ingestion of 50 mg soil and dust per day for adults and 100 mg per day for children every day of the year (i.e. 365 days per year) for 29 years for adults and 6 years for children;
- Soil coming into contact with 1/3 of the skin surface area for adults and almost half of the skin surface area for children every day of the year for 29 years for adults and 6 years for children – the calculations assume the soil stays on the skin until the next shower;
- Consumption of fruit and vegetables grown in the backyard (10% of daily intake) every day of the year for 29 years for adults and 6 years for children; and
- Inhalation of dust occurs for 24 hours of the day, with 4 hours spent outside where outdoor dust is inhaled, and 20 hours is spent indoors where indoor dust is inhaled. This occurs every day of the year for 29 years for adults and 6 years for children.

These are conservative exposure scenarios and real life exposures are likely to be lower in many situations.

The guidelines/HILs established that are protective of exposures that occur in a low-density residential setting are more conservative (i.e. lower) than the HILs derived for medium to high density residential settings as well as public open space. Hence use of HIL-A provides a conservative screening criteria that is protective for all exposures to soil and soil materials where the general public may be exposed – whether such an exposure occurs every day or incidentally as a result of visiting an area where re-use materials are present.

There are other HILs available which relate to the less sensitive commercial/industrial land uses. The guidelines for land used for commercial/industrial purposes (referred to as HIL-D) indicate soil

quality that is appropriate and acceptable for a site used for offices, retail, light industrial or other industrial purposes where people may contact soil and dust during the work day, within a typical workplace setting. The exposure scenario for calculating these guidelines (HIL-D) involves assuming people are exposed to the contaminants in soil through:

- Incidental ingestion of 25 mg soil and dust per day for adults for 240 days per year for 30 years;
- Soil coming into contact with 1/5 of the skin surface area for adults for 240 days per year for 30 years – the calculations assume the soil stays on the skin until the next shower; and
- Inhalation of dust while at work where it is assumed 1 hour is spent outdoor inhaling outside dust and 8 hours is spent indoors inhaling indoor dust. Inhalation exposure is assumed to occur for 240 days per year for 30 years.

These are conservative exposure scenarios and real life exposures are likely to be lower in many situations.

It is noted that HIL-D are considered to be adequately protective of workers undertaking other activities, such as excavations for construction or maintenance of subsurface services, or the maintenance of gardens in public areas or within business premises.

Where soil guidelines are not available from the ASC NEPM, residential and industrial soil guidelines have been adopted from the USEPA. These are guidelines that have been developed using similar exposure assumptions and are considered sufficiently conservative for the purpose of screening.

A conservative screening assessment has been undertaken involving a comparison of the maximum measured concentrations reported in the coal ash sampled from the power stations from November 2014 to 16 January 2019 with HIL-A (low-density residential soil criteria) and HIL-D (commercial/industrial soil criteria) to determine if more detailed assessment is required (**Table 3**).

Table 3: Screening level assessment of coal ash – Human health

Metal	Maximum concentration reported in coal ash analytical results November 2014 to 16 January 2019 (mg/kg)	Health Investigation Level (low density residential) (HIL-A) (mg/kg)	Health Investigation Level (commercial/ industrial) (HIL-D) (mg/kg)
Mercury	2.9	40	730
Cadmium	0.5	20	900
Lead	302	300	1500
Arsenic	53.8	100	3000
Boron	280	4500	300000
Chromium (total)	649	100*	3600*
Copper	230	6000	240000
Molybdenum	41.1	390[U]	5800[U]
Nickel	387	400	6000
Selenium	5.4	200	10000
Zinc	260	7400	400000

* Criteria for chromium VI. There are no health-based guidelines for chromium III or total chromium. Use of chromium VI criteria for evaluating total chromium is conservative as it assumes 100% of chromium reported is chromium VI
U = USEPA Regional Screening Level for residential soil and industrial soil – no Australian guideline for molybdenum (USEPA 2018)

Review of **Table 3** indicates that:

- all concentrations of metals reported in coal ash from the power stations are below the HIL-D guidelines which apply to commercial and industrial land uses. Hence, all uses of coal ash in areas where workers may come into direct contact with either encapsulated or unencapsulated coal ash for beneficial reuse (unencapsulated coal ash uses include some engineering uses as well as horticultural uses), are not considered to be of concern in relation to human health.
- where unencapsulated coal ash is used in residential areas, such as for horticultural use, all concentrations reported in coal ash are below the HIL-A guidelines which apply to low density residential land uses, with the exception of total chromium, which exceeds the adopted guideline, and lead, which is equal to the guideline. The chromium and lead levels reported are further discussed below.

It is noted that the analytical results for the coal ash materials from the power stations also report pH in the range 4.7 to 11, with an average of 8.8. In general, the coal ash materials are slightly alkaline. In the interests of completeness, the pH related human health risk issues are furthered discussed below. The electrical conductivity of the coal ash materials is reported to be between 33 and 2200 µS/cm, with an average of 430 µS/cm. Electrical conductivity is a measure of the salinity of the material and this measure is not of relevant to the assessment of human health.

Further discussion on chromium

The maximum total chromium level detected in the coal ash samples exceeds the HIL-A guidelines which apply to low density residential land uses. This exceedance is relevant when considering potential exposure that may occur where unencapsulated coal ash is used in horticultural products that may be used in residential areas.

Direct comparison of the maximum reported concentration of total chromium in the coal ash samples with the adopted criteria (HIL-A) is highly conservative, for a number of reasons, as outlined below:

- *The species of chromium present in coal ash*

  The HIL-A criteria has been developed/derived for the most toxic form of chromium, namely chromium VI, and assumes that 100% of the chromium in the soil people are exposed to is chromium VI. Chromium in soil is typically present as chromium III. Chromium VI rarely occurs in nature, and rarely remains in soil, as it is readily reduced to chromium III (the most stable form) in the presence of iron and organic matter.

  Data available on coal ash materials sampled from November 2014 to 16 January 2019 did not include analysis to speciate total chromium to chromium III or chromium VI. However, further sampling undertaken in January 2019 (14 to 31 January 2019) included speciation of chromium III and chromium VI. This analysis has shown that for most samples, chromium VI was not detected as would be expected. There are a few samples where some chromium VI was detected, however, the concentration detected was low (maximum of 1 mg/kg) which is well below the HIL-A derived for chromium VI. These data support that chromium III is the dominant species reported in the total chromium results in the original analyses carried out on coal ash samples taken between 2014 and 16 January 2019. Chromium III is significantly less toxic than chromium VI. Given the low toxicity of chromium III, the NEPM did not develop a HIL for Chromium III, however, the USEPA (USEPA 2018) has developed a residential soil guideline of 120,000 mg/kg for chromium III. The maximum concentration reported in coal ash is many orders of magnitude below the USEPA residential soil guideline.

- *Proportion of coal ash in horticultural products*

  Coal ash is considered likely to make up only a small portion of the various horticultural products where the material is re-used, i.e. horticultural products such as potting mix will not be 100% coal ash.

  If it is assumed that the horticultural materials contain 10% coal ash, and 100% of the chromium present is chromium VI (which is unlikely), the mixed concentration of chromium in the material (assuming no chromium VI is present in the other materials used to blend with coal ash) would be diluted and would be reduced to 65 mg/kg, well below the HIL-A for chromium VI.

  Another scenario may be considered where the horticultural materials contain 20% coal ash, and up to 10% of the total chromium present is chromium VI (this may be a reasonable worst

case based on the available data), the total concentration of chromium VI in the product would be 13 mg/kg, again well below the HIL-A for chromium VI.

On this basis, there are no risk issues of concern in relation to chromium reported in coal ash materials.

Further discussion on lead

The maximum lead concentration reported in the coal ash samples of 302 mg/kg is equal to the HIL-A low density residential land use screening guideline of 300 mg/kg. The maximum concentration that is equal to the HIL-A has been reported once only, in a sample analysed by Symbio Laboratories. The second highest value for lead is reported to be 57 mg/kg, significantly lower than the HIL-A screening guideline level. A concentration that is equal to the HIL-A does not mean there are any health risk issues of concern. As discussed above for chromium, the proportion of coal ash in horticultural products will be much lower than 100% (more likely to be around 20%), which means that any coal ash that has a higher level of lead present will be diluted, reducing the actual concentration in the sold product.

On this basis, there are no risk issues of concern in relation to lead reported in coal ash materials.

Further discussion on pH

Where soil pH is higher than 7, it is generally considered to be alkaline. In relation to human health the issues of concern in relation to potentially alkaline materials relate to irritation effects from highly alkaline material on the skin or dust blowing into the eyes. The pH needs to be higher than 11 for it to be of concern in relation to irritation effects. Some individuals may find direct contact with materials with a pH greater than 8 to be mildly irritating. It is noted that domestic bleach products typically have a pH in the range of 8-11. The coal ash materials have an average pH of 8.8 and a maximum of 11. The pH of the coal ash materials as sold would be managed through the appropriate use of gloves, as is required on the SDSs for these products.

Within horticultural products, however, it is expected that the coal ash is blended with other materials so that it meets the specifications required for the product, which would include pH as pH is of importance to horticultural products. The Australian Standard for potting mixes (AS 3743-2003) requires the pH to be between 4.8 and 5.8 for acid mixes and 5.3 and 6.5 for other mixes. The AS for composts, soil conditioners and mulches (AS 4454-2012) requires a minimum pH of 5 and, where the pH >8, the product needs to be tested for alkalinity using a total carbonate method, which is then used to determine the application rate to increase pH by one unit in various soil types. As a result, the pH of the horticultural products sold is required to be measured and controlled to be appropriate for the product and application. Where this is undertaken, the pH of the coal ash materials which form a component of the final product is taken into account in the blending of these products and is no longer of relevance to the sold product.

On this basis, there are no risk issues of concern in relation to the pH of coal ash materials.

Overall

On the basis of the assessment undertaken, there are no human health risk issues of concern in relation exposures to workers or the general public as a result of the beneficial re-use of coal ash materials from Bayswater Power Station and Liddell Power Station.

Section 4. Further assessment of ecological risk issues

4.1 General

This section provides further discussion and evaluation of potential ecological risks relevant to the re-use of coal ash materials.

It is noted that encapsulated re-use binds the coal ash into these products preventing the migration of these metals to the environment, so no further consideration of these uses is required. Accordingly, the focus of this section relates to the unencapsulated re-uses. This is where coal ash remains as a particulate and is blended with other materials and used for some engineering re-uses (such as pipe bedding and road base) as well as horticultural applications.

For metals that are present within the coal ash to be able to impact on the terrestrial or aquatic environments, the metals need to be sufficiently mobile (i.e. soluble and/or leachable), to be able to be bioavailable to terrestrial plants and organisms or migrate to and affect aquatic ecosystems.

4.2 Review of terrestrial risk issues

Where coal ash is re-used for unencapsulated engineering uses, such as pipe bedding materials and road base, these uses do not result in the product being placed or used in an area where terrestrial environments are present (i.e. the products would be at the base of an excavation beneath pipes or beneath asphalt). Hence for these engineering re-use options there are no terrestrial ecological risk issues of concern.

For coal ash materials that are present as a component within horticultural products the issues of concern to terrestrial environments are considered to include pH and salinity, and the presence of metals. In particular, metals are of concern where these can leach into solution and then be taken up by plants or organisms.

pH and conductivity

As discussed in **Section 3.4**, the specific horticultural products are blended to achieve pH levels that meet the specifications relevant to the product being sold. As a result, the pH of the coal ash material will be addressed (i.e. modified) by the blending of these materials to meet the product specifications.

It is a similar situation for salinity (measured as electrical conductivity within the coal ash materials). The Australian Standards contain specifications for the salinity of potting mixes (as outlined in AS 3732-2003), and composts, mulches and soil conditioners (as outlined in AS 4454-2012). These specifications are required to be met for the horticultural products, and the salinity of the coal ash materials within these products needs to be considered (as does the salinity of all components that are mixed together to form the product) as part of ensuring the final products are compliant with the relevant requirements.

On the basis of the above, the pH and salinity of coal ash do not require any further consideration in relation to beneficial re-use and potential for ecological effects.

Metals

As coal ash is produced following the burning of coal at high temperatures, and coal ash is generally alkaline in nature, metals are expected to be well bound to the ash particles and not readily leachable.

Analysis of the coal ash samples collected from November 2014 to December 2018 did not include leachate testing. However, further sampling of coal ash materials from the power stations from 14 to 31 January 2019, has included leachate testing. **Appendix D** presents a summary of the leachate data available which are relevant to the leachable metals in the coal ash (i.e. both the reported concentrations of metals in the coal ash and the concentrations of metals in the leachate for each sample (i.e. leachable fraction)). The leachate testing undertaken is an ASLP leach test which is conducted at a pH more consistent with rainwater which is appropriate for this investigation. It should be noted that the ASLP leachate test involves vigorous shaking of the sample (which does not occur under natural environmental conditions) and so results in a conservative measure of potential leachability.

Table 4 presents a summary of the range of soil and leachate concentrations reported for metals in the coal ash samples taken from 14 to 31 January 2019. The table also provides the average calculated soil-water partition coefficient Kd (L/kg) from these data. Kd is the ratio of a sorbed (soil) concentration (mg/kg) to dissolved (water) concentration (mg/L). The higher the Kd value the more likely it will remain bound to soil or readily sorb to soil if the dissolved metal were transported. The lower the Kd the more likely the metal may move to soil water which allows distribution through the environment.

Table 4: Summary of leachate data for coal ash (data from 14 to 31 January 2019)

Metal	Coal ash concentration (range, mg/kg)	Coal ash leachate concentration (range mg/L)	Kd (average soil-water partition coefficient, L/kg)
Mercury	<0.01 – 0.13	<0.000005 – 0.008	8900
Cadmium	<0.1 – 0.2 (detected in 5 samples only)	<0.0001 - 0.0004 (detected in 4 samples only)	NA
Lead	0.2 – 9.7	<0.001 – 0.005	NA
Arsenic	0.8 – 12.1	0.004 – 0.83	110
Boron	1.8 - 55	0.07 – 1.35	40
Chromium (total)*	0.5 - 11	0.001 – 0.055	310
Copper	<0.005 – 8.1	<0.001 – 0.004	NA
Molybdenum	0.2 – 17.2	0.001 – 0.243	150
Nickel	0.4 – 14.3	<0.001 – 0.015	820
Selenium	1 - 18	<0.01 – 0.14	40
Zinc	0.6 – 44.1	0.006 – 0.082	570

* Speciation of total chromium indicates the dominant species was chromium III in fly ash, bottom ash or cenospheres samples. The data presented in this table relates to total chromium, which should be considered to be chromium III.
NA – leachable concentrations not detected in sufficient samples to be able to calculate a Kd. It is noted that lead was detected in leachate in only 2 samples, and copper was detected in leachate in only 1 sample

Review of the available leachate data (refer to **Appendix D** and **Table 4**) indicates the following:

- The concentration of metals reported in coal ash, particularly total chromium, copper, nickel and zinc, for data collected from 14 to 31 January 2019, is lower than reported in previous samples (refer to **Table 1**).

- Some metals, specifically cadmium, lead and copper, were not found to be leachable and these have accordingly not been further evaluated in relation to ecological risks.
- Metals such as mercury, nickel and zinc are considered to be poorly leachable, with high values of Kd.
- Metals such as boron, selenium, chromium and molybdenum are considered somewhat leachable, with lower values of Kd.

For all the metals tested, the calculated Kd is significantly higher than that published or estimated for these metals in soil. Median values for Kd were less than 5 for all metals considered in **Table 4** in other studies (Allison & Allison 2005). This supports the view that the metals present in coal ash are generally well bound and not particularly leachable.

To evaluate whether the metals reported in the coal ash have the potential to be of concern to plants and other terrestrial organisms, the maximum concentrations of the metals reported in coal ash have been compared with modified ecological investigation or screening levels (EILs/ESLs). EILs or ESLs are soil guidelines relevant to the protection of terrestrial ecosystems and are available in the NEPM (NEPC 1999 amended 2013a, 1999 amended 2013c) as well as other international publications (where not available from the NEPM). It is noted that EILs and ESLs are screening criteria that are used to determine where additional assessment and/or the collection of additional data is required to better understand risk.

The NEPM EIL values adopted in this assessment relate to residential or open space areas and are considered sufficiently conservative to address garden areas that include more sensitive plant species. Where guidelines have been adopted from international jurisdictions these are generally considered to be protective of all land uses (including areas where any sensitive species may be present).

These EILs relate to fresh or aged, bioavailable forms of metals in soil. This means they relate to metals that can easily move from soil to soil solution and be available for uptake. The development of EILs relates to metals in forms with typical Kd values of no more than 5 L/kg. The EILs have then been modified to account for the lower bioavailability of metals in coal ash by multiplying the criteria by the ratio of the Kd(coal ash = value in **Table 4**):Kd(soil = 5 L/kg). **Table 5** presents these modified EILs. These have been compared with a potential maximum concentration that may be present in horticultural products. This concentration is based on the maximum concentration reported in coal ash, and the assumption made that, at most, 20% of a blended horticultural product may be coal ash. The maximum concentrations reported in the coal ash have been used to provide a conservative assessment.

Table 5: Screening level assessment of coal ash – Terrestrial health

Metal	Maximum concentration reported in coal ash based on results November 2014 to 16 January 2019 (mg/kg)	Maximum concentration in blended horticultural product (20% coal ash) (mg/kg)	Ecological screening criteria (EIL for residential and open space) (mg/kg)	Adjusted EIL* (mg/kg)
Mercury	2.9	0.58	12[C]	21000
Arsenic	53.8	10.8	100[N]	2200
Boron	280	56	16.5[X]	130
Chromium (total)	649	130	190[N1]	11000
Molybdenum	41.1	8.2	270[R]	8100
Nickel	387	77	30[N2]	4900
Selenium	5.4	1	1[C]	8
Zinc	260	52	230[N3]	26000

* EIL adjusted to account for the lower leachability or bioavailability of metals in coal ash. The EIL has been modified by multiplying the criteria by the ratio of Kd(coal ash – from **Table 4**):Kd(soil = 5L/kg as a maximum)
N = NEPM (NEPC 1999 amended 2013c) EIL for urban residential and public open space areas
1 = lowest value adopted, for 1% clay content
2 = lowest value adopted, for 5% CEC
3 = lowest value adopted for pH = 7.5 (conservative for coal ash materials) and CEC = 5%
C = CCME soil quality guideline for the protection of environmental health
R = RIVM environmental risk limit (van Vlaardingen et al. 2005)
X = Soil guideline for boron based on the more recent review by Alberta Canada (Alberta Environment and Parks (AEP) 2016) which provides a guideline based on boron in soil solution of 3.3 mg/L. The value has been converted to a soil guideline based on the assumed Kd for boron in soil of 5 L/kg.

The maximum concentrations of metals that may be present within a blended horticultural product, where up to 20% of the product is coal ash, are all below the adjusted EIL. On this basis, there are no concentrations of metals reported in the coal ash samples that would be considered to be of concern to terrestrial ecology.

4.3 Review of aquatic risk issues

Where coal ash is re-used for unencapsulated engineering uses, such as pipe bedding materials and road base, these uses are not considered to be of key concern in relation to the potential for migration and impact to aquatic ecosystems.

Coal ash used for pipe bedding will be placed at depth beneath pipes, which are unlikely to be placed in a saturated zone (i.e. within an existing water table) or close to a waterway. To be able to impact on aquatic environments, rainwater would need to penetrate to a sufficient depth, the metals would need to be readily leachable and sufficient coal ash material would need to be present to result in high enough concentrations reaching groundwater (after attenuation) and being discharged to an aquatic environment (after further attenuation). This is highly unlikely to occur.

Where coal ash is used as road base, the presence of asphalt road materials is expected to prevent or minimise the entry of rainwater into these materials, preventing or minimising any migration of metals. Hence for these engineering re-use options there are no aquatic ecological risk issues of concern.

Where coal ash forms a component of horticultural products, for the metals present in the coal ash to be of concern to aquatic environments, the metals must be able to leach from the material and migrate to an aquatic environment at a concentration that is sufficiently elevated to be of concern.

As discussed in **Section 4.2**, the available leachate data indicates that metals in coal ash are not particularly leachable. There are some metals that have not been shown to leach (and have not been further assessed), with others considered to be either poorly leachable or only somewhat leachable.

To determine if there is the potential for metals present in coal ash to be of concern to aquatic environments, a screening level assessment has been undertaken (for metals found to be leachable in coal ash). The screening level assessment has considered the maximum measured leachate concentration (**Table 4**) as well as a maximum predicted leachate concentration (calculated using the maximum measured coal ash concentration reported in the samples taken between November 2014 and 16 January 2019 and the application of the metal-specific Kd (from **Table 4**)).

These leachate concentrations have then been compared with a leachate criteria. The leachate criteria have been developed on the basis of the following:

- Starting with the Australian Water Quality Guideline for fresh and marine water (adopting the lower value from these waters as it is unknown where the horticultural products may be used) based on a 95% species protection level
- Application of a dilution factor to account for the proportion of coal ash in the horticultural product (DF1), the dilution of soil leachate as it migrates from soil to groundwater (DF2), as well as dilution within groundwater (DF3) prior to discharge to an aquatic environment. The overall dilution factor DF = DF1 x DF2 x DF3 and comprises of the following:
    - DF1 = Proportion of coal ash in applied product – assumed to be a maximum of 20%, hence a factor of 5 has been adopted
    - DF2 = Soil leachate to groundwater = 20. This dilution factor can be calculated based on a range of factors relevant to infiltration rates and groundwater migration, however, for the re-use of soil adjacent to a sensitive environmental receptor, a conservative dilution factor of 20 calculated by the USEPA (USEPA 1996), has been adopted. The dilution factor of 20 is considered by the USEPA to be a conservative estimate of the dilution that occurs from soil into soil water, and then into groundwater immediately beneath contaminated soil in an affected area. The dilution factor of 20 does not include any consideration of any additional attenuation or dilution that occurs as the groundwater moves away from a site. This dilution attenuation factor is also sufficiently conservative to account for the dilution that would occur following rainfall on re-used materials and direct surface run-off to a waterway.
    - DF3 = 1 as it is assumed that the material may be used at locations directly adjacent to an aquatic environment and that no additional dilution occurs with groundwater migration or the discharge of groundwater into the aquatic environment. This is a conservative approach.

  The overall DF = 5 x 20 x 1 = 100

Table 6 presents the leachate data (measured (column 5) and maximum predicted (column 4 based on data in column 2 and 3) with comparison against the leachate criteria developed as outlined above. Relevant guidelines for aquatic systems are listed in column 6. Column 7 lists the guideline multiplied by the dilution factor of 100 (as discussed above).

Table 6: Screening level assessment of coal ash – Aquatic health

Metal	Maximum concentration reported in coal ash (November 2014 to 16 January 2019) (mg/kg)	Kd (soil-water partition coefficient, L/kg)	Estimated leachate concentration from maximum coal ash concentration (November 2014 to 16 January 2019) (mg/L)	Maximum leachate concentration measured in coal ash (14 to 31 January 2019) (mg/L)	Aquatic guideline (mg/L)	Leachate guideline* (mg/L)
Mercury	2.9	8900	0.0003	0.008	0.0006	0.06
Arsenic	53.8	110	0.5	0.83	0.024	2.4
Boron	280	40	7	1.35	0.37	37
Chromium (as III)	649	310	2	0.055	0.027	2.7
Molybdenum	41.1	150	0.3	0.243	0.034	3.4
Nickel	387	820	0.5	0.015	0.011	1.1
Selenium	5.4	40	0.1	0.14	0.011	1.1
Zinc	260	570	0.4	0.082	0.008	0.8

* Leachate guideline based on the aquatic guideline and application of a 100 fold dilution factor as discussed above

Review of **Table 6** indicates that the maximum leachate concentrations are all below the adopted leachate guidelines. This is the case for both:

- measured leachate concentrations which are based on leachate data reported between 14 and 31 January 2019; or
- predicted leachate concentrations which are based on the maximum concentrations in coal ash reported from November 2014 to 16 January 2019 and the Kd results determined from results from data collected between 14 and 31 January 2019.

On this basis, there are no risk issues of concern in relation to aquatic ecosystems where coal ash is re-used within various horticultural products.

Section 5. Conclusions

This report presents an assessment of potential risks to human health and the environment associated with the beneficial re-use of coal ash supplied from the Bayswater and Liddell Power Stations for a range of purposes, specifically:

- primarily in engineering applications, including for manufacturing concrete, in road base and pipe bedding. Some coal ash has also been used for mine void back fill and a small amount has also been used in plaster board building products; and
- some coal ash supplied may have been added by third parties to horticultural applications including potting soil, turf management, landscape, gardens and green wall applications.

While the maximum reported concentrations of some metals in coal ash sampled between November 2014 and 16 January 2019 (when sale was temporarily suspended) exceeds the criteria specified in the Coal Ash Order, the range of concentrations reported is similar to concentrations reported in coal ash in the US, as well as within natural/background soil present in urban and rural environments in Australia.

On the basis of the assessment undertaken, the following can be concluded:

- There are no human health risk issues of concern in relation exposures to workers or the general public as a result of the beneficial re-use of coal ash materials from Bayswater Power Station and Liddell Power Station.
- For workers involved in the storing and handling of coal ash materials from Bayswater Power Station and Liddell Power Station it is expected that workplace exposures will be appropriately managed as outlined in the relevant SDSs for the coal ash products.
- There are no concentrations of metals, pH or conductivity in coal ash materials beneficially reused from Bayswater Power Station and Liddell Power Station which are considered to be of concern to terrestrial ecology or aquatic ecosystems.

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Appendix A Coal Ash Order

Resource Recovery Order under Part 9, Clause 93 of the Protection of the Environment Operations (Waste) Regulation 2014

The coal ash order 2014

Introduction

This order, issued by the Environment Protection Authority (EPA) under clause 93 of the Protection of the Environment Operations (Waste) Regulation 2014 (Waste Regulation), imposes the requirements that must be met by suppliers of coal ash and blended coal ash to which 'the coal ash exemption 2014' applies. The requirements in this order apply in relation to the supply of coal ash and blended coal ash for application to land in line with the uses described in 'the coal ash exemption 2014'.

1. Waste to which this order applies

1.1. This order applies to coal ash and coal ash blended with other materials (blended coal ash). In this order, coal ash means coal combustion products (CCPs), fly ash or furnace bottom ash from burning Australian black coal. This does not include brine conditioned or treated ash.

2. Persons to whom this order applies

2.1. The requirements in this order apply, as relevant, to any person who supplies coal ash or blended coal ash that has been generated, processed or recovered by the person.

2.2. This order does not apply to the supply of coal ash or blended coal ash to a consumer for land application at a premises for which the consumer holds a licence under the POEO Act that authorises the carrying out of the scheduled activities on the premises under clause 39 'waste disposal (application to land)' or clause 40 'waste disposal (thermal treatment)' of Schedule 1 of the POEO Act.

3. Duration

3.1. This order commences on 24 November 2014 and is valid until revoked by the EPA by notice published in the Government Gazette.

4. Generator requirements

The EPA imposes the following requirements on any generator who supplies coal ash.

Sampling requirements

4.1. On or before supplying coal ash, the generator must:

4.1.1. Prepare a written sampling plan which includes a description of sample preparation and storage procedures for the coal ash.

4.1.2. Undertake sampling and testing of the coal ash as required under clauses 4.2 and 4.3 below. The sampling must be carried out in accordance with the written sampling plan and Australian Standard 1141.3.1-2012 Methods for sampling and testing aggregates – Sampling – Aggregates (or equivalent).

4.2. Where coal ash is generated for land application as a soil amendment for the growing of vegetation the generator must undertake the following sampling and analysis:

4.2.1. Where <1000 tonnes of coal ash is generated per year, the coal ash must be sampled by taking 3 composite samples per year. Each sample must be tested for analytes 5 and 12 in Table 1 according to test method 4.8.4 and 4.8.3.

4.2.2. Where >1000 tonnes of coal ash is generated per year, the coal ash must be sampled by taking 3 composite samples per year and an additional 1 composite sample for every 1000 tonnes or part thereof generated. Each sample must be tested for analytes 5 and 12 in Table 1 according to test method 4.8.4 and 4.8.3.

4.3. Where the coal ash is generated for use as an engineering material and is generated as part of a continuous process, the generator must undertake the following sampling:

4.3.1. Characterisation of the coal ash by collecting 20 composite samples of the waste and testing each sample for the chemicals and other attributes listed in Column 1 of Table 1. Each composite sample must be taken from a batch, truckload or stockpile that has not been previously sampled for the purposes of characterisation. Characterisation must be conducted for coal ash generated and processed during each 2-year period following the commencement of the continuous process; and

4.3.2. Routine sampling of the coal ash by collecting either 5 composite samples from every 10,000 tonnes (or part thereof) processed or 5 composite samples every 3 months (whichever is the lesser); and testing each sample for the chemicals and other attributes listed in Column 1 of Table 1 other than those listed as ‘not required’ in Column 3. Each composite sample must be taken from a batch, truckload or stockpile that has not been previously sampled for the purposes of routine sampling. However, if characterisation sampling occurs at the same frequency as routine sampling, any sample collected and tested for the purposes of characterisation under clause 4.3.1 may be treated as a sample collected and tested for the purposes of routine sampling under clause 4.3.2.

4.4. Where the coal ash is generated for use as an engineering material and is not generated as part of a continuous process, the generator must undertake one-off sampling of a batch, truckload or stockpile of the coal ash, by collecting and testing 10 composite samples from every 4,000 tonnes (or part thereof) generated and testing each sample for the chemicals and other attributes listed in Column 1 of Table 1.

Chemical and other material requirements

4.5. The generator must not supply coal ash to any person if, in relation to any of the chemical and other attributes of the coal ash:

4.5.1. The concentration or other value of that attribute of any sample collected and tested as part of the characterisation or the routine or one-off sampling of the coal ash exceeds the absolute maximum concentration or other value listed in Column 4 of Table 1, or

4.5.2. The average concentration or other value of that attribute from the characterisation or one-off sampling of the coal ash (based on the arithmetic mean) exceeds the maximum average concentration or other value listed in Column 2 of Table 1, or

4.5.3. The average concentration or other value of that attribute from the routine sampling of the coal ash (based on the arithmetic mean) exceeds the maximum average concentration or other value listed in Column 3 of Table 1.

4.6. The absolute maximum concentration or other value of that attribute in any coal ash supplied under this order must not exceed the absolute maximum concentration or other value listed in Column 4 of Table 1.

Table 1

Column 1	Column 2	Column 3	Column 4
Chemicals and other attributes	**Maximum average concentration for characterisation** (mg/kg 'dry weight' unless otherwise specified)	**Maximum average concentration for routine testing** (mg/kg 'dry weight' unless otherwise specified)	**Absolute maximum concentration** (mg/kg 'dry weight' unless otherwise specified)
1. Mercury	0.5	Not required	1
2. Cadmium	0.5	0.5	1
3. Lead	25	25	50
4. Arsenic	10	Not required	20
5. Boron	75	Not required	150 for engineering uses 60 for soil amendment
6. Chromium (total)	25	25	50
7. Copper	20	Not required	40
8. Molybdenum	10	Not required	20
9. Nickel	25	25	50
10. Selenium	10	10	20
11. Zinc	35	35	70
12. Electrical Conductivity[1]	NA	NA	NA for engineering uses 4dS/m for soil amendment
13. pH* in non-cementitious mixes[2]	7 to 12.5	7 to 12.5	6 to 13
14. pH in cementitious mixes	NA	NA	NA

[1]Note: while thresholds are not provided for electrical conductivity this must be tested and a record kept of the results.

[2]Note: The ranges given for pH are for the minimum and maximum acceptable pH values in the coal ash.

Test methods

4.7. The generator must ensure that any testing of samples required by this order is undertaken by analytical laboratories accredited by the National Association of Testing Authorities (NATA), or equivalent.

4.8. The generator must ensure that the chemicals and other attributes (listed in Column 1 of Table 1) in the coal ash it supplies are tested in accordance with the test methods specified below or other equivalent analytical methods. Where an equivalent analytical method is used the detection limit must be equal to or less than that nominated for the given method below.

4.8.1. Test method for measuring the mercury concentration:

4.8.1.1 Analysis using USEPA SW-846 Method 7471B Mercury in solid or semisolid waste (manual cold vapour technique), or an equivalent analytical method with a detection limit < 20% of the stated maximum average concentration in Table 1, Column 2 (i.e. < 0.1 mg/kg dry weight).

4.8.1.2 Report as mg/kg dry weight.

4.8.2. Test methods for measuring chemicals 2 - 11:

4.8.2.1 Sample preparation by digesting using USEPA SW-846 Method 3051A Microwave assisted acid digestion of sediments, sludges, soils, and oils.

4.8.2.2 Analysis using USEPA SW-846 Method 6010C Inductively coupled plasma - atomic emission spectrometry, or an equivalent analytical method with a detection limit < 10% of stated maximum average concentration in Table 1, Column 2 (i.e. 2.5 mg/kg dry weight for lead).

4.8.2.3 Report as mg/kg dry weight.

4.8.3. Test methods for measuring the electrical conductivity and pH:

4.8.3.1 Sample preparation by mixing 1 part coal ash with 5 parts distilled water.

4.8.3.2 Analysis using Method 103 (pH) and 104 (Electrical Conductivity) in Schedule B (3): Guideline on Laboratory Analysis of Potentially Contaminated Soils, National Environment Protection (Assessment of Site Contamination) Measure 1999 (or an equivalent analytical method).

4.8.3.3 Report electrical conductivity in deciSiemens per metre (dS/m).

4.8.4. Test method for measuring boron in coal ash for land application as a soil amendment:

4.8.4.1 Water soluble boron using a calcium chloride extractable method 12C1 or 12C2 in Rayment, G.E. and Lyons D.J. 2011 Soil Chemical Methods - Australasia, CSIRO Publishing (or an equivalent analytical method with a detection limit for water soluble boron <10% of the stated absolute maximum).

4.8.4.2 Report as mg/kg dry weight.

Notification

4.9. On or before each transaction, the generator must provide the following to each person to whom the generator supplies the coal ash:

- a written statement of compliance certifying that all the requirements set out in this order have been met;
- a copy of the coal ash exemption, or a link to the EPA website where the coal ash exemption can be found; and
- a copy of the coal ash order, or a link to the EPA website where the coal ash order can be found.

Record keeping and reporting

4.10. The generator must keep a written record of the following for a period of six years:

- the sampling plan required to be prepared under clause 4.1.1;
- all characterisation, routine and/or one-off sampling results in relation to the coal ash supplied;
- the quantity of the coal ash supplied; and
- the name and address of each person to whom the generator supplied coal ash.

4.11. The generator must provide, on request, the most recent characterisation and sampling (whether routine or one-off or both) results for coal ash supplied to any processor or consumer of the coal ash.

4.12. The generator must notify the EPA within seven days of becoming aware that it has not complied with any requirement in clause 4.1 to 4.8.

5. Processor requirements

The EPA imposes the following requirements on any processor who supplies blended coal ash.

5.1. The processor may blend the coal ash with materials that are the subject of a Resource Recovery Exemption and Resource Recovery Order if that material complies with all of the chemical and other material requirements under its Resource Recovery Order, and is able to be applied to land under its Resource Recovery Exemption for the following purpose(s) described in clauses 5.2.1 to 5.2.3.

5.1.1. as a soil amendment for the growing of vegetation;

5.1.2. in cementitious mixes such as concrete; and

5.1.3. in non-cementitious mixes such as an engineered fill in earthworks or for roadmaking activities as follows:

(a) pipe bedding material,

(b) selected backfill adjacent to structures,

(c) road pavement, base and sub-base structures,

(d) composite filler in asphalt pavements,

(e) rigid and composite pavement structures,

(f) select layers which act as working platforms at the top of earthworks,

(g) fill for reinforced soil structures (including geo-grid applications).

5.2. Where the pH of the coal ash received is below 6 and it is intended to be supplied for use in non-cementitious mixes, the processor must undertake the following before supplying the coal ash to a consumer for use as in 5.1.3:

5.2.1. blend the coal ash at a rate of 20% or less with lime, natural quarried rock, coal washery rejects, recovered railway ballast, crushed concrete, blast furnace slag, steel furnace slag and/or electric arc furnace slag; and

5.2.2. sample the mix by taking the same number of samples as required to be taken under clause 4.3 or 4.4 and testing the pH of those samples. The test results for each composite sample must be validated as compliant with the requirements listed in row 13 of Table 1.

Notification

5.3. On or before each transaction, the processor must provide the following to each person to whom the processor supplies the blended coal ash:

- a written statement of compliance certifying that all the requirements set out in this order have been met;
- a copy of the coal ash exemption, or a link to the EPA website where the coal ash exemption can be found; and
- a copy of the coal ash order, or a link to the EPA website where the coal ash order can be found.

Record keeping and reporting

5.4. The processor must keep a written record of the following for a period of six years:

- the quantity of any coal ash received from the generator and the generator's name and address;
- the quantity of any blended coal ash supplied; and
- the name and address of each person to whom the processor supplied the blended coal ash.

5.5. The processor must provide, on request, the most recent characterisation and sampling (whether routine or one-off or both) results for coal ash that it received from the generator.

6. Definitions

In this order:

brine conditioned ash means coal ash that has been conditioned or treated with brine concentrator waste from process water treatment.

application or apply to land means applying to land by:

- spraying, spreading or depositing on the land; or
- ploughing, injecting or mixing into the land; or
- filling, raising, reclaiming or contouring the land.

blast furnace slag means material that meets the chemical and other material requirements for blast furnace slag which are required on or before supply of blast furnace slag under 'The blast furnace slag order 2014'

cementitious mixes means either coal ash or blended coal ash which has been mixed with general purpose cement, lime and other activators for use in bound applications, where the materials must be chemically bound together.

composite sample means a sample that combines five discrete sub-samples of equal size into a single sample for the purpose of analysis.

consumer means a person who applies, or intends to apply, coal ash or blended coal ash to land.

continuous process means a process that produces coal ash on an ongoing basis.

crushed concrete means waste concrete that has been processed into an engineered material, and meets the conditions of a resource recovery exemption.

electric arc furnace slag means material that meets the chemical and other material requirements for electric arc furnace slag which are required on or before supply of electric arc furnace slag under 'The electric arc furnace slag order 2014'

non-cementitious mixes means either coal ash or blended coal ash that is not mixed with general purpose cement, lime and other activators or used in bound applications.

non-processing supplier means a person who supplies, causes, or permits the supply of cementitious mixes to a consume and who does not undertake any processing of coal ash.

processor means a person who processes, mixes, blends, or otherwise incorporates coal ash into blended coal ash for supply to a consumer.

steel furnace slag means material that meets the chemical and other material requirements for steel furnace slag which are required on or before supply of steel furnace slag under 'The steel furnace slag order 2014'

transaction means:

- in the case of a one-off supply, the supply of a batch, truckload or stockpile of coal ash that is not repeated.
- in the case where the supplier has an arrangement with the recipient for more than one supply of coal ash the first supply of coal ash as required under the arrangement.

Manager Waste Strategy and Innovation

Environment Protection Authority

(by delegation)

Notes

The EPA may amend or revoke this order at any time. It is the responsibility of each of the generator and processor and to ensure it complies with all relevant requirements of the most current order. The current version of this order will be available on www.epa.nsw.gov.au

In gazetting or otherwise issuing this order, the EPA is not in any way endorsing the supply or use of this substance or guaranteeing that the substance will confer benefit.

The conditions set out in this order are designed to minimise the risk of potential harm to the environment, human health or agriculture, although neither this order nor the accompanying exemption guarantee that the environment, human health or agriculture will not be harmed.

Any person or entity which supplies coal ash should assess whether the material is fit for the purpose the material is proposed to be used for, and whether this use may cause harm. The supplier may need to seek expert engineering or technical advice.

Regardless of any exemption or order provided by the EPA, the person who causes or permits the application of the substance to land must ensure that the action is lawful and consistent with any other legislative requirements including, if applicable, any development consent(s) for managing operations on the site(s).

The supply of coal ash remains subject to other relevant environmental regulations in the POEO Act and Waste Regulation. For example, a person who pollutes land (s. 142A) or water (s. 120), or causes air pollution through the emission of odours (s. 126), or does not meet the special requirements for asbestos waste (Part 7 of the Waste Regulation), regardless of this order, is guilty of an offence and subject to prosecution.

This order does not alter the requirements of any other relevant legislation that must be met in supplying this material, including for example, the need to prepare a Safety Data Sheet. Failure to comply with the conditions of this order constitutes an offence under clause 93 of the Waste Regulation.

Appendix B SDSs for coal ash products as supplied

Macquarie Generation

Powering Our Community

SAFETY DATA SHEET

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

1.1 Product identifier

Product name **FLY ASH (MACQUARIE GENERATION)**

Synonym(s) COAL FIRED FLYASH • FLY ASH • FLY ASH - LIDDELL (FORMERLY) • FLY ASH BAYSWATER • FLY ASH LIDDELL • LIDDELL FLY ASH • MACQUARIE GENERATION FLY ASH

1.2 Uses and uses advised against

Use(s) CO-PRODUCT • INDUSTRIAL APPLICATIONS

1.3 Details of the supplier of the product

Supplier name **AGL MACQUARIE PTY LTD**

Address Private Bag No. 2, MUSWELLBROOK, NSW, 2333, AUSTRALIA

Telephone (02) 6542 0711

Website www.agl.com.au

1.4 Emergency telephone number(s)

Emergency (02) 6542 0711

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

CLASSIFIED AS HAZARDOUS ACCORDING TO AUSTRALIAN WHS REGULATIONS

GHS classification(s) Specific Target Organ Systemic Toxicity (Repeated Exposure): Category 2

2.2 Label elements

Signal word **WARNING**

Pictogram(s)

Hazard statement(s)

H373 May cause damage to organs through prolonged or repeated exposure.

Prevention statement(s)

P260 Do not breathe dust/fume/gas/mist/vapours/spray.

Response statement(s)

P314 Get medical advice/attention if you feel unwell.

Storage statement(s)

None allocated.

Disposal statement(s)

P501 Dispose of contents/container in accordance with relevant regulations.

2.3 Other hazards

No information provided.

3. COMPOSITION/ INFORMATION ON INGREDIENTS

3.1 Substances / Mixtures

Ingredient	CAS Number	EC Number	Content
SILICATE(S)	-	-	45 to 85%
QUARTZ (CRYSTALLINE SILICA)	14808-60-7	238-878-4	<10%
ALUMINIUM OXIDE(S)	-	-	10 to 20%
MULLITE (STABLE ALUMINIUM SILICATE)	-	-	<20%

4. FIRST AID MEASURES

4.1 Description of first aid measures

Eye If in eyes, hold eyelids apart and flush continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre, a doctor, or for at least 15 minutes.

Inhalation If inhaled, remove from contaminated area. Apply artificial respiration if not breathing.

Skin If skin or hair contact occurs, remove contaminated clothing and flush skin and hair with running water. Continue flushing with water until advised to stop by a Poisons Information Centre or a doctor.

Ingestion For advice, contact a Poison Information Centre on 13 11 26 (Australia Wide) or a doctor (at once).

First aid facilities Eye wash facilities and safety shower should be available.

4.2 Most important symptoms and effects, both acute and delayed

Chronic exposure to crystalline silica may result in lung fibrosis (silicosis). Principal symptoms of silicosis are coughing and breathlessness. Crystalline silica is classified as carcinogenic to humans (IARC Group 1).

4.3 Immediate medical attention and special treatment needed

Treat symptomatically.

5. FIRE FIGHTING MEASURES

5.1 Extinguishing media

Use an extinguishing agent suitable for the surrounding fire.

5.2 Special hazards arising from the substance or mixture

Non flammable. May evolve toxic gases if strongly heated.

5.3 Advice for firefighters

No fire or explosion hazard exists.

5.4 Hazchem code

None allocated.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

Wear Personal Protective Equipment (PPE) as detailed in section 8 of the SDS. Clear area of all unprotected personnel. Contact emergency services where appropriate.

6.2 Environmental precautions

Prevent product from entering drains and waterways.

6.3 Methods of cleaning up

Contain spillage, then collect and place in suitable containers for reuse or disposal. Avoid generating dust.

6.4 Reference to other sections

See Sections 8 and 13 for exposure controls and disposal.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling

Before use carefully read the product label. Use of safe work practices are recommended to avoid eye or skin contact and inhalation. Observe good personal hygiene, including washing hands before eating. Prohibit eating, drinking and smoking in contaminated areas.

7.2 Conditions for safe storage, including any incompatibilities

Store tightly sealed in a cool, dry, well ventilated area, removed from incompatible substances, heat or ignition sources and foodstuffs. Ensure containers are adequately labelled, protected from physical damage and sealed when not in use. Check regularly for leaks or spills.

7.3 Specific end use(s)

No information provided.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control parameters

Exposure standards

Ingredient	Reference	TWA		STEL	
		ppm	mg/m³	ppm	mg/m³
Quartz (respirable dust)	SWA (AUS)	--	0.1	--	--

Biological limits

No biological limit values have been entered for this product.

8.2 Exposure controls

Engineering controls Avoid inhalation. Use in well ventilated areas. Where an inhalation risk exists, mechanical extraction ventilation is recommended. Wet where possible. Maintain dust levels below the recommended exposure standard.

PPE

Eye / Face	Wear safety glasses and dust-proof goggles.
Hands	Wear PVC or rubber gloves.
Body	Wear coveralls.
Respiratory	Where an inhalation risk exists, wear a Class P2 (Particulate) respirator.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Appearance	FINE GREY POWDER
Odour	ODOURLESS
Flammability	NON FLAMMABLE
Flash point	NOT RELEVANT
Boiling point	NOT AVAILABLE
Melting point	> 1500°C
Evaporation rate	NOT AVAILABLE
pH	4 to 8
Vapour density	NOT AVAILABLE
Specific gravity	2 (Approximately)
Solubility (water)	SLIGHTLY SOLUBLE
Vapour pressure	NOT AVAILABLE
Upper explosion limit	NOT RELEVANT
Lower explosion limit	NOT RELEVANT
Partition coefficient	NOT AVAILABLE
Autoignition temperature	NOT AVAILABLE
Decomposition temperature	NOT AVAILABLE
Viscosity	NOT AVAILABLE

9.1 Information on basic physical and chemical properties

Explosive properties	NOT AVAILABLE
Oxidising properties	NOT AVAILABLE
Odour threshold	NOT AVAILABLE

10. STABILITY AND REACTIVITY

10.1 Reactivity

Carefully review all information provided in sections 10.2 to 10.6.

10.2 Chemical stability

Stable under recommended conditions of storage.

10.3 Possibility of hazardous reactions

Polymerization is not expected to occur.

10.4 Conditions to avoid

Avoid heat, sparks, open flames and other ignition sources.

10.5 Incompatible materials

Incompatible with acids (e.g. nitric acid) and alkalis (e.g. sodium hydroxide).

10.6 Hazardous decomposition products

Crystalline silica may form after the product is exposed to extended periods of high temperatures (> 900°C).

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity	**Information available for the product:** Based on available data, the classification criteria are not met.
Skin	Contact may result in irritation, redness, pain and rash.
Eye	Contact may result in irritation, lacrimation, pain and redness.
Sensitisation	Not classified as causing skin or respiratory sensitisation.
Mutagenicity	Insufficient data available to classify as a mutagen.
Carcinogenicity	Crystalline silica is classified as carcinogenic to humans (IARC Group 1). However, there is a body of evidence supporting the fact that increased cancer risk would be limited to people already suffering from silicosis.
Reproductive	Insufficient data available to classify as a reproductive toxin.
STOT – single exposure	Over exposure may result in irritation of the nose and throat, with coughing.
STOT – repeated exposure	Repeated exposure to respirable silica may result in pulmonary fibrosis (silicosis). Silicosis is a fibronodular lung disease caused by deposition in the lungs of fine respirable particles of crystalline silica. Principal symptoms of silicosis are coughing and breathlessness.
Aspiration	Not classified as causing aspiration.

12. ECOLOGICAL INFORMATION

12.1 Toxicity

No information provided.

12.2 Persistence and degradability

No information provided.

12.3 Bioaccumulative potential

No information provided.

12.4 Mobility in soil

No information provided.

12.5 Other adverse effects

No information provided.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Waste disposal Manufacturer recommends to keep the product moist with water to reduce the potential of dust generation and dispose of in an approved manner. Product may be suitable for recycling.

Legislation Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

NOT CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE, IMDG OR IATA

	LAND TRANSPORT (ADG)	SEA TRANSPORT (IMDG / IMO)	AIR TRANSPORT (IATA / ICAO)
14.1 UN Number	None Allocated	None Allocated	None Allocated
14.2 Proper Shipping Name	None Allocated	None Allocated	None Allocated
14.3 Transport Hazard Class	None Allocated	None Allocated	None Allocated
14.4 Packing Group	None Allocated	None Allocated	None Allocated

14.5 Environmental hazards No information provided

14.6 Special precautions for user

Hazchem code None Allocated

15. REGULATORY INFORMATION

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Poison schedule A poison schedule number has not been allocated to this product using the criteria in the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP).

Classifications Safework Australia criteria is based on the Globally Harmonised System (GHS) of Classification and Labelling of Chemicals.

The classifications and phrases listed below are based on the Approved Criteria for Classifying Hazardous Substances [NOHSC: 1008(2004)].

Hazard codes	Xn	Harmful
Risk phrases	R48/20	Harmful: danger of serious damage to health by prolonged exposure through inhalation.
Safety phrases	S22	Do not breathe dust.
	S36	Wear suitable protective clothing.

Inventory listing(s) **AUSTRALIA: AICS (Australian Inventory of Chemical Substances)**
All components are listed on AICS, or are exempt.

16. OTHER INFORMATION

Additional information RESPIRATORS: In general the use of respirators should be limited and engineering controls employed to avoid exposure. If respiratory equipment must be worn ensure correct respirator selection and training is undertaken. Remember that some respirators may be extremely uncomfortable when used for long periods. The use of air powered or air supplied respirators should be considered where prolonged or repeated use is necessary.

PERSONAL PROTECTIVE EQUIPMENT GUIDELINES:
The recommendation for protective equipment contained within this report is provided as a guide only. Factors such as method of application, working environment, quantity used, product concentration and the availability of engineering controls should be considered before final selection of personal protective equipment is made.

HEALTH EFFECTS FROM EXPOSURE:
It should be noted that the effects from exposure to this product will depend on several factors including: frequency and duration of use; quantity used; effectiveness of control measures; protective equipment used and method of application. Given that it is impractical to prepare a report which would encompass all possible scenarios, it is anticipated that users will assess the risks and apply control methods where appropriate.

Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
CAS #	Chemical Abstract Service number - used to uniquely identify chemical compounds
CNS	Central Nervous System
EC No.	EC No - European Community Number
EMS	Emergency Schedules (Emergency Procedures for Ships Carrying Dangerous Goods)
GHS	Globally Harmonized System
GTEPG	Group Text Emergency Procedure Guide
IARC	International Agency for Research on Cancer
LC50	Lethal Concentration, 50% / Median Lethal Concentration
LD50	Lethal Dose, 50% / Median Lethal Dose
mg/m^3	Milligrams per Cubic Metre
OEL	Occupational Exposure Limit
pH	relates to hydrogen ion concentration using a scale of 0 (high acidic) to 14 (highly alkaline).
ppm	Parts Per Million
STEL	Short-Term Exposure Limit
STOT-RE	Specific target organ toxicity (repeated exposure)
STOT-SE	Specific target organ toxicity (single exposure)
SUSMP	Standard for the Uniform Scheduling of Medicines and Poisons
SWA	Safe Work Australia
TLV	Threshold Limit Value
TWA	Time Weighted Average

Report status

This document has been compiled by RMT on behalf of the manufacturer, importer or supplier of the product and serves as their Safety Data Sheet ('SDS').

It is based on information concerning the product which has been provided to RMT by the manufacturer, importer or supplier or obtained from third party sources and is believed to represent the current state of knowledge as to the appropriate safety and handling precautions for the product at the time of issue. Further clarification regarding any aspect of the product should be obtained directly from the manufacturer, importer or supplier.

While RMT has taken all due care to include accurate and up-to-date information in this SDS, it does not provide any warranty as to accuracy or completeness. As far as lawfully possible, RMT accepts no liability for any loss, injury or damage (including consequential loss) which may be suffered or incurred by any person as a consequence of their reliance on the information contained in this SDS.

Prepared by

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[End of SDS]

SAFETY DATA SHEET

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

1.1 Product identifier

Product name **BOTTOM ASH (BAYSWATER)**

Synonyms BOTTOM ASH ● COAL FURNACE ASH

1.2 Uses and uses advised against

Uses ADDITIVE ● SOIL STABILISATION

1.3 Details of the supplier of the product

Supplier name **MACQUARIE GENERATION BAYSWATER POWER STATION**

Address Private Bag No. 2, Muswellbrook, NSW, 2333, AUSTRALIA

Telephone (02) 6542 0711

1.4 Emergency telephone numbers

Emergency (02) 6542 0711

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

CLASSIFIED AS HAZARDOUS ACCORDING TO SAFE WORK AUSTRALIA CRITERIA

GHS classifications Specific Target Organ Systemic Toxicity (Repeated Exposure): Category 2

2.2 GHS Label elements

Signal word **WARNING**

Pictograms

Hazard statements

H373 May cause damage to organs through prolonged or repeated exposure.

Prevention statements

P260 Do not breathe dust/fume/gas/mist/vapours/spray.

Response statements

P314 Get medical advice/attention if you feel unwell.

Storage statements

None allocated.

Disposal statements

P501 Dispose of contents/container in accordance with relevant regulations.

2.3 Other hazards

No information provided.

3. COMPOSITION/ INFORMATION ON INGREDIENTS

3.1 Substances / Mixtures

Ingredient	CAS Number	EC Number	Content
QUARTZ (CRYSTALLINE SILICA)	14808-60-7	238-878-4	1 to 5%

FURNACE ASH	-	-	>60%

Ingredient Notes Furnace ash is a glassy silica-aluminate material containing some unburnt carbon. The respirable fraction (< 10 um) in this material is approximately 2 %. Within this respirable fraction the crystalline silica quartz content is approximately 5 %.

4. FIRST AID MEASURES

4.1 Description of first aid measures

Eye If in eyes, hold eyelids apart and flush continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre, a doctor, or for at least 15 minutes.

Inhalation If inhaled, remove from contaminated area. Apply artificial respiration if not breathing.

Skin If skin or hair contact occurs, remove contaminated clothing and flush skin and hair with running water. Continue flushing with water until advised to stop by a Poisons Information Centre or a doctor.

Ingestion For advice, contact a Poisons Information Centre on 13 11 26 (Australia Wide) or a doctor (at once).

First aid facilities Eye wash facilities and safety shower should be available.

4.2 Most important symptoms and effects, both acute and delayed

Repeated exposure to crystalline silica may result in lung fibrosis (silicosis). Principal symptoms of silicosis are coughing and breathlessness. Crystalline silica is classified as carcinogenic to humans (IARC Group 1).

4.3 Immediate medical attention and special treatment needed

Treat symptomatically.

5. FIRE FIGHTING MEASURES

5.1 Extinguishing media

Use an extinguishing agent suitable for the surrounding fire.

5.2 Special hazards arising from the substance or mixture

Non flammable. May evolve toxic gases if strongly heated.

5.3 Advice for firefighters

No fire or explosion hazard exists.

5.4 Hazchem code

None allocated.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

Wear Personal Protective Equipment (PPE) as detailed in section 8 of the SDS. Clear area of all unprotected personnel. Contact emergency services where appropriate.

6.2 Environmental precautions

Prevent product from entering drains and waterways.

6.3 Methods of cleaning up

Contain spillage, then collect and place in suitable containers for reuse or disposal. Avoid generating dust.

6.4 Reference to other sections

See Sections 8 and 13 for exposure controls and disposal.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling

Before use carefully read the product label. Use of safe work practices are recommended to avoid eye or skin contact and inhalation. Observe good personal hygiene, including washing hands before eating. Prohibit eating, drinking and smoking in contaminated areas.

7.2 Conditions for safe storage, including any incompatibilities

Store tightly sealed in a cool, dry, well ventilated area, removed from incompatible substances, heat or ignition sources and foodstuffs. Ensure containers are adequately labelled, protected from physical damage and sealed when not in use. Check regularly for leaks or spills.

7.3 Specific end uses

No information provided.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control parameters

Exposure standards

Ingredient	Reference	TWA		STEL	
		ppm	mg/m³	ppm	mg/m³
Quartz (respirable dust)	SWA (AUS)	--	0.1	--	--

Biological limits

No biological limit values have been entered for this product.

8.2 Exposure controls

Engineering controls Avoid inhalation. Use in well ventilated areas. Where an inhalation risk exists, mechanical extraction ventilation is recommended. Wet where possible. Maintain dust levels below the recommended exposure standard. Material should be used in a damp condition to minimise dust generation. Use water for dust suppression in stockpile or work areas

PPE

Eye / Face	Wear dust-proof goggles.
Hands	Wear PVC or rubber gloves.
Body	Wear coveralls.
Respiratory	Where an inhalation risk exists, wear a Class P2 (Particulate) respirator.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Appearance	GREY/BLACK GRANULAR SOLID
Odour	SLIGHT ODOUR
Flammability	NON FLAMMABLE
Flash point	NOT RELEVANT
Boiling point	NOT AVAILABLE
Melting point	> 1500°C
Evaporation rate	NOT AVAILABLE
pH	NOT AVAILABLE
Vapour density	NOT AVAILABLE
Specific gravity	NOT AVAILABLE
Solubility (water)	INSOLUBLE
Vapour pressure	NOT AVAILABLE
Upper explosion limit	NOT RELEVANT
Lower explosion limit	NOT RELEVANT
Partition coefficient	NOT AVAILABLE
Autoignition temperature	NOT AVAILABLE
Decomposition temperature	NOT AVAILABLE
Viscosity	NOT AVAILABLE
Explosive properties	NOT AVAILABLE
Oxidising properties	NOT AVAILABLE
Odour threshold	NOT AVAILABLE

9.2 Other information

Density 0.7 - 1.1 tonne/m³ (Bulk)

10. STABILITY AND REACTIVITY

10.1 Reactivity

Carefully review all information provided in sections 10.2 to 10.6.

10.2 Chemical stability

Stable under recommended conditions of storage.

10.3 Possibility of hazardous reactions

Polymerization is not expected to occur.

10.4 Conditions to avoid

Avoid heat, sparks, open flames and other ignition sources.

10.5 Incompatible materials

Incompatible with acids (e.g. nitric acid) and alkalis (e.g. sodium hydroxide).

10.6 Hazardous decomposition products

Crystalline silica may form after the product is exposed to extended periods of high temperatures (> 900°C).

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity	Based on available data, the classification criteria are not met.
Skin	Contact may result in irritation, redness, pain and rash.
Eye	Contact may result in irritation, lacrimation, pain and redness.
Sensitisation	Not classified as causing skin or respiratory sensitisation.
Mutagenicity	Insufficient data available to classify as a mutagen.
Carcinogenicity	Crystalline silica is classified as carcinogenic to humans (IARC Group 1). However, there is a body of evidence supporting the fact that increased cancer risk would be limited to people already suffering from silicosis.
Reproductive	Insufficient data available to classify as a reproductive toxin.
STOT - single exposure	Over exposure may result in irritation of the nose and throat, with coughing.
STOT - repeated exposure	Repeated exposure to respirable silica may result in pulmonary fibrosis (silicosis). Silicosis is a fibronodular lung disease caused by deposition in the lungs of fine respirable particles of crystalline silica. Principal symptoms of silicosis are coughing and breathlessness.
Aspiration	Not classified as causing aspiration.

12. ECOLOGICAL INFORMATION

12.1 Toxicity

No information provided.

12.2 Persistence and degradability

No information provided.

12.3 Bioaccumulative potential

No information provided.

12.4 Mobility in soil

No information provided.

12.5 Other adverse effects

No information provided.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Waste disposal Ensure product is covered with moist soil to prevent dust generation and dispose of to approved Council landfill. Contact the manufacturer/supplier for additional information (if required).

Legislation Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

NOT CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE, IMDG OR IATA

	LAND TRANSPORT (ADG)	SEA TRANSPORT (IMDG / IMO)	AIR TRANSPORT (IATA / ICAO)
14.1 UN Number	None allocated.	None allocated.	None allocated.
14.2 Proper Shipping Name	None allocated.	None allocated.	None allocated.
14.3 Transport hazard class	None allocated.	None allocated.	None allocated.
14.4 Packing Group	None allocated.	None allocated.	None allocated.

14.5 Environmental hazards

No information provided.

14.6 Special precautions for user

Hazchem code None allocated.

15. REGULATORY INFORMATION

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Poison schedule A poison schedule number has not been allocated to this product using the criteria in the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP).

Classifications Safework Australia criteria is based on the Globally Harmonised System (GHS) of Classification and Labelling of Chemicals.

Inventory listings **AUSTRALIA: AICS (Australian Inventory of Chemical Substances)**
All components are listed on AICS, or are exempt.

16. OTHER INFORMATION

Additional information The respirable fraction (< 10 um) in this material is approximately 2 %. Within this respirable fraction the crystalline silica quartz content is approximately 5 %. With dust of this kind only particles that are capable of penetrating to this region of the lung are of concern in determining the health hazard. The information in this document is believed to be accurate. Please check the currency of this SDS by contacting the above telephone number. The provision of this information should not be construed as a recommendation to use this product in violation of any patent rights or in breach of any statute or regulation. Users are advised to make their own determination as to the suitability of this information in relation to their particular purposes and specific circumstances. Each user should read this SDS and consider the information in the context of how the product will be handled and used in the workplace and in conjunction with other substances or products. Since the information in the document may be applied under conditions beyond our control, no responsibility can be accepted by us for any loss or damage caused by any person acting or refraining from action as a result of this information.

PERSONAL PROTECTIVE EQUIPMENT GUIDELINES:
The recommendation for protective equipment contained within this report is provided as a guide only. Factors such as form of product, method of application, working environment, quantity used, product concentration and the availability of engineering controls should be considered before final selection of personal protective equipment is made.

HEALTH EFFECTS FROM EXPOSURE:
It should be noted that the effects from exposure to this product will depend on several factors including: form of product; frequency and duration of use; quantity used; effectiveness of control measures; protective equipment used and method of application. Given that it is impractical to prepare a report which would encompass all possible scenarios, it is anticipated that users will assess the risks and apply control methods where appropriate.

Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
CAS #	Chemical Abstract Service number - used to uniquely identify chemical compounds
CNS	Central Nervous System
EC No.	EC No - European Community Number
EMS	Emergency Schedules (Emergency Procedures for Ships Carrying Dangerous Goods)
GHS	Globally Harmonized System
GTEPG	Group Text Emergency Procedure Guide
IARC	International Agency for Research on Cancer
LC50	Lethal Concentration, 50% / Median Lethal Concentration
LD50	Lethal Dose, 50% / Median Lethal Dose
mg/m³	Milligrams per Cubic Metre
OEL	Occupational Exposure Limit
pH	relates to hydrogen ion concentration using a scale of 0 (high acidic) to 14 (highly alkaline).
ppm	Parts Per Million
STEL	Short-Term Exposure Limit
STOT-RE	Specific target organ toxicity (repeated exposure)
STOT-SE	Specific target organ toxicity (single exposure)
SUSMP	Standard for the Uniform Scheduling of Medicines and Poisons
SWA	Safe Work Australia
TLV	Threshold Limit Value
TWA	Time Weighted Average

Report status

This document has been compiled by RMT on behalf of the manufacturer, importer or supplier of the product and serves as their Safety Data Sheet ('SDS').

It is based on information concerning the product which has been provided to RMT by the manufacturer, importer or supplier or obtained from third party sources and is believed to represent the current state of knowledge as to the appropriate safety and handling precautions for the product at the time of issue. Further clarification regarding any aspect of the product should be obtained directly from the manufacturer, importer or supplier.

While RMT has taken all due care to include accurate and up-to-date information in this SDS, it does not provide any warranty as to accuracy or completeness. As far as lawfully possible, RMT accepts no liability for any loss, injury or damage (including consequential loss) which may be suffered or incurred by any person as a consequence of their reliance on the information contained in this SDS.

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[End of SDS]

Appendix C Coal ash data November 2014 to 31 January 2019

Coal ash data (mg/kg)

Sample ID	Sample Date	Sample Time	Lab	As	Cd	Cr	Cu	Pb	Mo	Ni	Se	Zn	B	Hg	Hexavalent Chromium	Trivalent Chromium	PH	Conductivity (µ/c	Methodology
LDFA28	28/11/2014		SGS	5.0	0.14	77	14	3.0	2.9	35.5	2.6	22	106	0.03			9.86		Coal & Coke Testing
LDFA29	19/12/2014		SGS	3.1	0.04	128	19	3.6	4.6	60.7	1.2	20	50	0.08			9.0		Coal & Coke Testing
LDFA30	30/01/2015		SGS	11.0	0.02	26	14	6.3	2.9	13	0.1	24	43	0.06			8.9		Coal & Coke Testing
LDFA31	6/02/2015		SGS	8.9	0.01	33	16	5.9	3.4	16	0.5	25	37	0.06			8.6		Coal & Coke Testing
LDFA32	29/03/2015		SGS	2.5	0.25	73	15	4.4	3.5	35	1.6	31	150	0.05			9.3		Coal & Coke Testing
LDFA33	30/04/2015		SGS	3.1	0.16	61	14	4.5	3.2	29	1.4	28	130	0.05			9.4		Coal & Coke Testing
LDFA34	30/05/2015		SGS	2.9	0.28	78	14	4.7	3.4	36	2.2	29	140	0.04			9.4		Coal & Coke Testing
LD FA	6/08/2017	14:00:00	SGS	4.2	0.31	60	38	38	10.0	54	2.0	52	29	0.12			9.2	385	Coal & Coke Testing
LD BA	6/08/2017	14:00:00	SGS	0.1	0.07	110	71	9.5	5.1	63	0.2	34	5	0.01			8.4	73	Coal & Coke Testing
BW FA	9/08/2017	12:40:00	SGS	1.7	0.45	82	110	57	11.0	66	2.8	130	12	0.08			8.0	335	Trace Elements by ICP
LID FA	14/09/2017	19:20:00	SGS	4.2	0.16	113	33	15.9	12.1	69	0.5	26	7	0.1			6.3	930	Trace Elements by ICP
LID BA	14/09/2017	19:30:00	SGS	0.2	0.14	56	37	9.0	4.2	35	0.2	20	5	0.0			8.1	170	Trace Elements by ICP
BW FA	15/09/2017		SGS	4.8	0.31	41	40	37.3	8.2	33	1.6	42	27	0.1			9.9	435	Trace Elements by ICP
BW BA	18/09/2017	6:00:00	SGS	0.9	0.13	88	73	10.9	7.0	66	0.5	35	9	0.0			8.8	560	Trace Elements by ICP
BW BA	24/10/2017	9:00:00	SGS	2.6	0.08	110	230	15.0	3.0	58	0.6	150	28	0.01			8.8	161	Trace Elements by ICP
BW FA	25/10/2017	10:00:00	SGS	4.2	0.13	17	20	26.0	3.5	15	2.0	48	40	0.09			10.0	493	Trace Elements by ICP
LID FA	29/10/2017	13:30:00	SGS	1.4	0.10	140	28	7.9	2.8	65	0.8	27	42	2.9			8.7	287	Trace Elements by ICP
LID BA	29/10/2017	14:35:00	SGS	11.0	0.20	19	23	30.0	4.4	26	1.3	59	25	0.01			4.7	246	Trace Elements by ICP
LID FA	23/11/2017	11:30:00	SGS	11.0	0.34	39	33	42.0	3.4	11	3.5	84	45	0.16			5.4	368	Trace Elements by ICP
LID BA	23/11/2017	11:30:00	SGS	0.9	0.09	34	47	7.5	1.3	16	0.5	43	47	0.01			7.7	144	Trace Elements by ICP
BW FA	28/11/2017		SGS	8.3	0.07	18	19	23.0	3.5	12	1.7	48	50	0.07			8.8	376	Trace Elements by ICP
BW BA	28/11/2017		SGS	1.6	0.08	96	39	11.0	5.2	38	1.4	42	46	0.01			7.9	295	Trace Elements by ICP
BW FA	21/12/2017	19:45:00	SGS	4.9	0.01	22	23	23.0	3.0	13	1.9	56	49	0.05			8.6	315	Trace Elements by ICP
BW BA	21/12/2017	9:30:00	SGS	2.0	0.01	150	35	21.0	4.9	50	1.3	57	24	0.01			7.8	300	Trace Elements by ICP
LID FA	23/12/2017	10:00:00	SGS	5.5	0.01	17	23	27.0	3.8	14	2.0	51	56	0.11			8.6	340	Trace Elements by ICP
LID BA	23/12/2017	10:00:00	SGS	1.1	0.06	87	26	6.3	2.3	44	0.4	25	46	0.01			7.7	245	Trace Elements by ICP
LID BA	25/01/2018	12:00:00	SGS	0.6	0.09	146	52	12.4	7.1	87	0.2	75	5	0.01			9.5	76	Trace Elements by ICP
LID FA	25/01/2018		SGS	4.4	0.27	44	35	35.6	7.2	40	1.6	71	15	0.18			8.4	320	Trace Elements by ICP
BW FA	29/01/2018	17:00:00	SGS	5.0	0.25	38	32	39.9	7.4	34	1.4	64	48	0.16			10.5	720	Trace Elements by ICP
LID FA	28/02/2018	11:15:00	SGS	9.6	0.32	50	44	39.0	7.6	50	2.2	114	36	0.21			10.2	640	Trace Elements by ICP
BW BA	28/02/2018		SGS	1.3	0.10	159	64	20.3	7.8	93	0.2	92	7	0.01			8.5	310	Trace Elements by ICP
LID BA	28/02/2018	11:00:00	SGS	0.3	0.10	339	112	10.7	10.8	172	0.2	75	6	0.01			9.9	125	Trace Elements by ICP
BW FA	28/02/2018	9:00:00	SGS	6.7	0.30	36	42	33.8	13.8	38	2.0	77	24	0.08			9.0	385	Trace Elements by ICP
LID FA	29/03/2018	15:00:00	SGS	0.1	0.28	41	35	37.7	5.7	30	1.6	43	15	0.16			8.9	440	Trace Elements by ICP
BW FA	29/03/2018	11:00:00	SGS	7.8	0.24	29	37	40.1	5.7	42	1.2	40	75	0.10			11.0	1120	Trace Elements by ICP
LID BA	29/03/2018	15:00:00	SGS	0.1	0.06	121	39	8.8	5.1	73	0.2	16	21	0.01			10.0	310	Trace Elements by ICP
LID FA	26/04/2018	7:30:00	SGS	6.8	0.20	37	40	36.1	5.6	31	1.2	44	21	0.07			10.8	770	Trace Elements by ICP
LID BA	26/04/2018	7:30:00	SGS	0.2	0.01	251	68	10.9	5.7	149	0.3	30	7	0.01			9.5	68	Trace Elements by ICP
BW FA	26/04/2018	9:00:00	SGS	3.6	0.20	41	45	40.9	6.0	26	1.9	51	14	0.06			8.9	305	Trace Elements by ICP
BW BA	26/04/2018	9:20:00	SGS	1.9	0.04	649	106	12.7	5.4	387	0.5	51	19	0.01			8.9	210	Trace Elements by ICP
LID FA	25/05/2018	13:51:00	SGS	1.2	0.19	59	31	25.3	6.1	41	0.6	35	9	0.11			9.5	290	Trace Elements by ICP
LID BA	25/05/2018	13:51:00	SGS	1.2	0.08	282	60	10.0	7.9	130	0.2	30	5	0.01			9.1	48	Trace Elements by ICP
BW FA	31/05/2018	13:15:00	SGS	4.7	0.24	61	34	32.3	7.7	63	0.8	44	11	0.06			10.0	390	Trace Elements by ICP
BW BA	31/05/2018	13:15:00	SGS	2.1	0.11	408	86	11.3	7.3	198	1.0	43	5	0.01			8.9	200	Trace Elements by ICP
BW BA	29/06/2018	13:30:00	SGS	1.1	0.10	148	71	11.2	14.4	85	0.2	52	28	0.01			7.8	300	Trace Elements by ICP
BW FA	29/06/2018	13:45:00	SGS	4.1	0.30	55	41	39.9	12.4	41	1.7	68	15	0.05			8.6	315	Trace Elements by ICP
LID FA	30/06/2018	10:00:00	SGS	3.7	0.32	63	59	39.0	14.0	41	1.5	76	17	0.11			8.6	340	Trace Elements by ICP
LID BA	30/06/2018	10:00:00	SGS	0.6	0.11	317	51	11.8	9.1	152	1.1	43	9	0.01			7.7	245	Trace Elements by ICP
BW FA	18/07/2018	13:20:00	SGS	3.5	0.21	38	46	35.0	7.0	29	1.8	260	30	0.05			8.5	320	Trace Elements by ICP
BW BA	18/07/2018	14:00:00	SGS	0.5	0.03	14	16	6.0	2.0	17	0.2	12	12	0.01			8.0	310	Trace Elements by ICP
LID FA	23/07/2018		SGS	8.2	0.31	35	52	40.0	8.0	24	3.3	120	41	0.16			11.0	660	Trace Elements by ICP
LID BA	23/07/2018		SGS	0.4	0.01	123	48	10.0	5.7	63	0.2	50	21	0.01			8.9	1340	Trace Elements by ICP
BW FA	27/08/2018	10:00:00	SGS	8.4	0.37	142	43	36.0	6.6	57	2.0	70	27	0.08			9.2	310	Trace Elements by ICP
BW BA	27/08/2018	14:45:00	SGS	1.4	0.13	144	33	8.8	4.4	81	0.4	32	10	0.01			7.2	250	Trace Elements by ICP
LID DUST	30/08/2018		SGS	6.3	0.37	65	36	38.7	8.2	47	2.3	65	41	0.22			9.2	1480	Trace Elements by ICP
LID ASH	30/08/2018		SGS	0.6	0.17	178	44	9.1	5.8	97	0.4	27	6	0.01			8.9	64	Trace Elements by ICP
LID DUST	29/09/2018		SGS	7.4	0.28	52	38	36.3	7.6	20	2.2	54	20	0.11			9.7	320	Trace Elements by ICP
LID ASH	29/09/2018		SGS	2.7	0.11	399	72	10.9	11.6	100	0.5	34	5	0.01			8.1	33	Trace Elements by ICP
BW FA	30/09/2018		SGS	7.5	0.29	43	36	40.8	6.4	19	0.6	52	20	0.05			9.8	295	Trace Elements by ICP
BW BA	30/09/2018		SGS	0.1	0.07	198	64	8.0	7.2	56	0.3	29	5	0.01			8.0	190	Trace Elements by ICP
BW BA	25/10/2018		SGS	0.7	0.20	190	42	8.7	35.0	98	0.7	24	23	0.01			8.8	440	Trace Elements by ICP
LID FA	27/10/2018		SGS	7.1	0.25	62	38	36.6	14.3	59	1.9	49	49	0.15			10.6	810	Trace Elements by ICP
LID BA	27/10/2018		SGS	0.2	0.20	121	27	12.8	14.5	71	0.9	50	26	0.01			9.7	460	Trace Elements by ICP
BW FA	29/10/2018	10:00:00	SGS	4.5	0.22	81	43	37.2	9.7	56	1.5	47	48	0.08			10.4	640	Trace Elements by ICP
LID FA	19/11/2018		SGS	8.2	0.22	69	42	39.0	12.9	55	1.6	61	58	0.20			10.5	780	Trace Elements by ICP
LID BA	19/11/2018		SGS	53.8	0.42	294	52	25.3	41.1	139	1.0	79	30	0.01			9.6	690	Trace Elements by ICP
BW BA	21/11/2018	10:00:00	SGS	0.2	0.11	609	102	9.5	12.6	284	1.1	53	26	0.01			9.4	350	Trace Elements by ICP
BW FA	21/11/2018	10:00:00	SGS	9.7	0.24	58	48	40.6	7.8	47	1.7	63	58	0.13			10.2	555	Trace Elements by ICP
BW FA	18/12/2018	10:00:00	SGS	3.8	0.26	40	43	48.0	6.6	37	1.7	72	34	0.00			9.3	280	Trace Elements by ICP
BW BA	18/12/2018		SGS	0.2	0.2	91	62	7.3	5.1	33	0.8	36	23	0.01			8.6	280	Trace Elements by ICP
LID FA	21/12/2018		SGS	2.7	0.22	43	38	39.3	6.6	30	1.4	57	31	0.11			9.4	270	Trace Elements by ICP
LID BA	21/12/2018		SGS	0.2	0.20	123	38	12.8	6.6	68	1.3	52	22	0.01			9.9	165	Trace Elements by ICP
BW BA	29/01/2018		SGS	1.6	0.11	371	118	13.1	10.8	204	0.5	88	7	0.01			8.6	830	Trace Elements by ICP
BW BA	29/03/2018		SGS	0.1	0.05	80	20	6.8	2.7	26	1.5	11	8	0.01			9.2	125	Trace Elements by ICP

Sample ID	Sample Date	Sample Time	Lab	As	Cd	Cr	Cu	Pb	Mo	Ni	Se	Zn	B	Hg	Hexavalent Chromium	Trivalent Chromium	PH	Conductivity (µ/c	Methodology
BW FLY ASH 1	14/01/2019	07:00:00	ALS	4.4	0.1	4.3	2.5	2.8	4.8	1.3	2.0	10.5	21.1	0.1	0.5	6.0	10.4	413	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW FLY ASH 2	14/01/2019	07:30:00	ALS	4.4	0.1	4.2	2.4	2.6	4.6	2.0	2.0	8.7	22.5	0.1	0.5	6.0	10.5	445	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW FLY ASH 3	14/01/2019	08:00:00	ALS	5.1	0.1	3.8	2.4	2.8	4.0	2.0	2.0	8.6	22.6	0.1	0.5	6.0	10.5	418	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW FLY ASH 4	14/01/2019	08:30:00	ALS	5.0	0.1	4.4	2.8	2.6	4.5	1.9	3.0	11.1	23.9	0.1	0.5	6.0	10.5	420	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW FLY ASH 5	14/01/2019	09:00:00	ALS	4.4	0.1	3.9	2.7	2.5	4.3	1.5	2.0	10.4	22.6	0.1	0.5	6.0	10.7	469	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW FLY ASH 6	14/01/2019	09:30:00	ALS	5.1	0.1	4.5	2.4	3.0	3.9	2.0	2.0	12.0	24.6	0.1	0.5	6.0	10.7	467	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW FLY ASH 7	14/01/2019	10:00:00	ALS	5.5	0.1	5.5	3.6	4.5	4.0	3.5	2.0	15.9	25.0	0.1	0.5	6.0	10.6	475	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW FLY ASH 8	14/01/2019	10:30:00	ALS	5.2	0.1	4.9	3.4	3.9	4.0	3.1	2.0	14.8	24.7	0.1	0.6	5.0	10.7	498	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW FLY ASH 9	14/01/2019	11:00:00	ALS	4.5	0.1	4.2	2.0	1.9	4.8	1.6	2.0	7.8	26.7	0.1	0.5	5.0	10.7	495	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW FLY ASH 10	14/01/2019	11:30:00	ALS	4.9	0.1	3.9	2.1	1.6	4.2	1.7	3.0	7.7	28.6	0.1	0.5	6.0	10.8	518	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW FLY ASH 11	15/01/2019	06:30:00	ALS	4.1	0.1	3.3	2	2.2	3.8	1.3	2	7	9.1	0.1	0.5	4	9.2	309	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW FLY ASH 12	15/01/2019	07:00:00	ALS	4.4	0.1	3.7	2.2	2.3	3.6	1.7	2	6.8	9.3	0.1	0.5	4	9.2	314	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW FLY ASH 13	15/01/2019	07:30:00	ALS	4.3	0.1	3.8	3.1	4.6	4.9	2.5	3	11.9	7.8	0.1	0.5	4	9.2	291	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW FLY ASH 14	15/01/2019	08:00:00	ALS	4.7	0.1	2.7	1.8	2.2	4	1.6	2	6.4	9.5	0.1	0.5	4	9.3	313	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW FLY ASH 15	15/01/2019	08:30:00	ALS	4.4	0.1	3.9	2.4	3.4	3.8	2.4	3	9	9.5	0.1	0.5	4	9.1	328	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW FLY ASH 16	15/01/2019	09:00:00	ALS	4.6	0.1	2.4	1.6	1.2	4.3	0.8	2	4.2	8.8	0.1	0.5	4	9.2	308	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW FLY ASH 17	15/01/2019	09:30:00	ALS	4.7	0.1	2.6	2.1	1.6	4.1	1.1	3	5.5	9.2	0.1	0.5	4	9.1	304	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW FLY ASH 18	15/01/2019	10:00:00	ALS	4.3	0.1	3.6	2.8	3.3	4.8	2.5	2	9.5	8.5	0.1	0.5	4	9	294	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW FLY ASH 19	15/01/2019	10:30:00	ALS	4.2	0.1	3.2	2	2.2	4.1	1.2	2	7.6	8.9	0.1	0.5	4	9.1	312	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW FLY ASH 20	15/01/2019	11:00:00	ALS	4.1	0.1	2.5	1.6	1.1	3.9	1.1	2	3.8	9	0.1	0.5	4	9.4	294	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW Bottom Ash 02	18/01/2019	13:20:00	ALS	0.9	0.1	0.7	3.3	0.9	0.4	0.8	1	1.8	3.5	0.01	0.5	2	9.1	202	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW Fly Ash	19/01/2019	09:00:00	ALS	3.4	0.1	4.8	2.6	2.5	4.7	1.6	2	42.1	29	0.05	0.5	5	5.3	287	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW Bottom Ash	19/01/2019	09:30:00	ALS	3.2	0.1	1.4	8.1	2.4	1.6	1	1	6.4	5.7	0.01	0.5	2	8.8	302	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
Vendor 1	20/01/2019	10:30:00	ALS	12.1	0.2	11	7.8	9.7	8.3	4.9	5	28.5	34	0.03	0.7	9	7.4	433	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
LD Cenospheres	20/01/2019	10:15:00	ALS	1.8	0.1	1.6	1.5	0.6	0.2	0.5	1	44.1	23.2	0.01	0.5	2	9.1	144	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW Fly Ash	20/01/2019	08:40:00	ALS	3.5	0.1	4.6	2.8	2.3	4.4	1.4	2	7.3	11.4	0.05	0.5	4	4.8	276	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW Bottom Ash	20/01/2019	09:15:00	ALS	2.3	0.1	0.6	5.1	0.1	0.9	2.3	1	3.1	4	0.01	0.5	2	8.8	312	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW Fly Ash	21/01/2019	00:00:00	ALS	4.7	0.1	4.8	2.7	2.3	4.6	1.6	2	7.7	18.7	0.06	0.5	0.5	10.3	9	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW Bottom Ash	21/01/2019	00:00:00	ALS	3.4	0.1	1.5	6.1	0.5	1.7	1.1	1	3.6	5	0.01	0.5	2	8.9	265	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW Fly Ash	22/01/2019	10:00:00	ALS	5.3	0.1	6	3.1	2.3	5.6	2.1	2	8.6	26.6	0.07	0.5	6	10.5	400	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS

Sample ID	Sample Date	Sample Time	Lab	As	Cd	Cr	Cu	Pb	Mo	Ni	Se	Zn	B	Hg	Hexavalent Chromium	Trivalent Chromium	PH	Conductivity (µ/c	Methodology
BW Bottom Ash	22/01/2019	10:00:00	ALS	1.7	0.1	0.8	4.4	0.3	1	0.6	1	2.5	3.3	0.01	0.5	2	9.0	247	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW Fly Ash	23/01/2019	N/A	SGS	5	0.3	5.1	2.9	3	4	2.3	3	9	18	0.08	0.5	5.1	9.5	300	Heavy Metals by acid microwave digestion
BW Bottom Ash	23/01/2019	N/A	SGS	5	0.3	1.6	4	1	3	1.9	4	5	5	0.05	0.5	1.6	8.6	380	Heavy Metals by acid microwave digestion
BW Fly Ash	23/01/2019	N/A	SGS	0.09	0.001	0.007	0.009	0.02	0.14	0.014	0.14	0.03	0.62	0.0001	0.004	0.007	(1:20- 8.1) (TCLP after 18hs- 5)	N/A	Zero Headspace Toxicity Characteristic Leaching Procedure (TCLP)
BW Bottom Ash	23/01/2019	N/A	SGS	0.05	0.001	0.005	0.029	0.02	0.01	0.006	0.07	0.05	0.14	0.0001	0.004	0.005	(1:20- 7) (TCLP after 18hs- 5)	N/A	Zero Headspace Toxicity Characteristic Leaching Procedure (TCLP)
BW Fly Ash	23/01/2019	11:40:00	ALS	3.8	0.1	4.5	2.4	1.5	4	1.7	1	6.2	16.7	0.06	0.5	4	9.7	284	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW Bottom Ash	23/01/2019	11:50:00	ALS	2	0.1	4.9	3.5	0.4	17.2	1.3	1	1.6	3.8	0.01	0.5	5	8.7	313	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW Fly Ash	24/01/2019	N/A	SGS	4	0.3	7.2	5.1	2	5	3.6	4	14	11	0.06	0.9	6.3	9.5	350	Heavy Metals by acid microwave digestion
BW Bottom Ash	24/01/2019	N/A	SGS	8	0.3	0.6	2.2	1	2	0.5	11	14	9	0.05	0.5	0.6	7.8		Heavy Metals by acid microwave digestion
BW Fly Ash	24/01/2019	N/A	SGS	0.13	0.003	0.014	0.021	0.02	0.14	0.009	0.05	0.03	0.77	0.0001	0.005	0.009	(1:20- 9.5) (TCLP after 18hs- 5)	N/A	Zero Headspace Toxicity Characteristic Leaching Procedure (TCLP)
BW Bottom Ash	24/01/2019	N/A	SGS	0.02	0.001	0.005	0.01	0.02	0.01	0.006	0.05	0.01	0.05	0.0001	0.004		(1:20- 8.8) (TCLP after 18hs- 5)	N/A	Zero Headspace Toxicity Characteristic Leaching Procedure (TCLP)
BW Fly Ash	24/01/2019	00:00:00	ALS	5.8	0.1	5	2.6	1.5	3.9	1.3	2	6.2	22.6	0.06	0.5	5	9.6	366	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW Bottom Ash	24/01/2019	00:00:00	ALS	1	0.1	0.8	1.4	0.1	0.8	0.6	1	1.9	1.8	0.01	0.5	2	9.1	284	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW Fly Ash	25/01/2019	N/A	SGS	6	0.3	5.1	2.1	1	2	1.7	4	6	6	0.05	0.9	4.2	9.0	280	Heavy Metals by acid microwave digestion
BW Bottom Ash	25/01/2019	N/A	SGS	7	0.3	0.6	3.1	1	1	0.5	18	3	5	0.05	0.5	0.6	10.5	440	Heavy Metals by acid microwave digestion
BW Fly Ash	25/01/2019	N/A	SGS	0.07	0.001	0.012	0.007	0.02	0.08	0.009	0.05	0.02	0.53	0.0001	0.004	0.012	(1:20- 9) (TCLP after 18hs- 5)	N/A	Zero Headspace Toxicity Characteristic Leaching Procedure (TCLP)
BW Bottom Ash	25/01/2019	N/A	SGS	0.02	0.001	0.005	0.015	0.02	0.01	0.007	0.05	0.04	0.07	0.0001	0.004	0.005	(1:20- 9.9) (TCLP after 18hs- 5)	N/A	Zero Headspace Toxicity Characteristic Leaching Procedure (TCLP)
BW Fly Ash	25/01/2019	12:15	ALS	2.6	0.1	3.3	1.3	0.7	2.6	0.8	1	2.4	14.2	0.06	0.5	3	10.5	355	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW Bottom Ash	25/01/2019	11:45	ALS	3.2	0.1	4.5	1.5	1.1	3.4	1.2	2	3.5	18.9	0.07	0.5	4	9.1	289	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW Fly Ash	26/01/2019	N/A	SGS	5	0.3	3.3	2.2	1	2	1.6	11	8	7	0.05	1	2.3	10.2	260	Heavy Metals by acid microwave digestion
BW Bottom Ash	26/01/2019	N/A	SGS	1	0.3	0.5	2.9	1	4	1	16	4	5	0.05	0.5	0.5	8.9	310	Heavy Metals by acid microwave digestion
BW Fly Ash	26/01/2019	N/A	SGS	5	0.3	3.3	2.2	1	2	0.005	0.076	0.01	0.22	0.0001	0.004	0.005	(1:20- 9.8) (TCLP after 18hs- 5)	N/A	Zero Headspace Toxicity Characteristic Leaching Procedure (TCLP)
BW Bottom Ash	26/01/2019	N/A	SGS	0.02	0.001	0.005	0.011	0.02	0.01	0.014	0.05	0.05	0.05	0.0001	0.004	0.005	(1:20- 9.1) (TCLP after 18hs- 5)	N/A	Zero Headspace Toxicity Characteristic Leaching Procedure (TCLP)
BW Fly Ash	26/01/2019	7:35	ALS	2	0.1	2.1	1.2	0.7	1.7	0.6	1	2.8	11	0.05	0.5	2	10.1	240	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW Bottom Ash	26/01/2019	7:30	ALS	1.4	0.1	0.5	2.4	0.3	0.6	0.6	1	14.3	3.4	0.01	0.5	2	9.1	265	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
Vendor 02/1	27/01/2019	0:00:00	ALS	7.4	0.1	7.2	2.6	2.4	5.2	1.8	2	6.6	43.4	0.09	0.5	7	10.7	619	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
Vendor 02/2	27/01/2019	0:00:00	ALS	7.3	0.1	7.4	2.8	2.7	5.3	2	2	8	43.4	0.07	0.5	7	10.7	601	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
Vendor 02/3	27/01/2019	0:00:00	ALS	7.5	0.1	7.6	3.2	3.3	5.4	2.3	2	8.6	43.1	0.08	0.5	8	10.5	342	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
Vendor 02/4	27/01/2019	0:00:00	ALS	6.3	0.1	5.2	2.2	1.5	5	1.2	2	6.3	28.8	0.06	0.5	5	N/A	N/A	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
Vendor 02/5	27/01/2019	0:00:00	ALS	7.8	0.1	7	2.2	1.6	5.7	1.3	2	5.3	46	0.07	0.5	7	10.6	378	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
Vendor 02/6	27/01/2019	0:00:00	ALS	6	0.1	5.2	2.2	1.7	4.9	1.2	2	5.8	29.9	0.08	0.5	5	10.3	432	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
Vendor 02/7	27/01/2019	0:00:00	ALS	6	0.1	4.1	1.6	0.7	5	0.7	2	3.6	28.4	0.05	0.5	4	N/A	N/A	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
Vendor 02/8	27/01/2019	0:00:00	ALS	11.9	0.1	11	5.4	4.8	9.5	3.5	5	15.8	55	0.13	0.5	11	10.3	426	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
Vendor 02/9	27/01/2019	0:00:00	ALS	6.2	0.1	4.8	2	1.2	5.1	1.1	2	5.2	30.2	0.06	0.5	5	10.2	292	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS

Sample ID	Sample Date	Sample Time	Lab	As	Cd	Cr	Cu	Pb	Mo	Ni	Se	Zn	B	Hg	Hexavalent Chromium	Trivalent Chromium	PH	Conductivity (µ/c	Methodology
Vendor 02/10	27/01/2019	0:00:00	ALS	6.4	0.1	4.8	2	1.1	5.2	1.1	2	7.8	30.6	0.05	0.5	5	10.3	422	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
Vendor 02/11	27/01/2019	0:00:00	ALS	6.4	0.1	4.9	2	1.2	5.2	1	2	4.7	30.5	0.06	0.5	5	10.2	266	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
Vendor 02/12	27/01/2019	0:00:00	ALS	6	0.1	4.8	2	1.3	5	1.1	2	4.9	28.9	0.06	0.5	5	N/A	N/A	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
Vendor 03/1	27/01/2019	15:01	ALS	5.6	0.1	7	2.8	2.2	4.5	2.2	2	7.7	29.7	0.06	0.5	7	10.6	486	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
Vendor 03/2	27/01/2019	15:02	ALS	5.6	0.1	5.4	2.2	1	4.3	1.2	2	5.1	35.4	0.1	0.5	5	10.8	609	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
Vendor 03/3	27/01/2019	15:03	ALS	6.1	0.1	6.5	2.4	2	4.7	1.7	2	6.2	38.8	0.07	0.5	6	10.8	603	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
Vendor 03/4	27/01/2019	15:04	ALS	7	0.1	4.8	2.3	1.7	4.5	1.2	2	8.1	29.7	0.1	0.5	5	10.3	372	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
Vendor 03/5	27/01/2019	15:05	ALS	5.2	0.1	3.6	1.6	0.9	4.6	0.8	2	4	17	0.07	0.5	4	8.6	278	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
Vendor 03/6	27/01/2019	15:06	ALS	4.4	0.1	3.7	2.2	1.8	4.3	1.2	2	6	17	0.06	0.5	4	8.9	292	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
Vendor 03/7	27/01/2019	15:07	ALS	4.5	0.1	3	1.7	0.9	4.1	0.8	2	4.1	17.9	0.07	0.5	3	9.5	314	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
Vendor 03/8	27/01/2019	15:31	ALS	5.9	0.1	6.2	2.4	1.4	4.6	1.5	2	5.4	34.6	0.07	0.5	6	10.7	518	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
Vendor 03/9	27/01/2019	15:32	ALS	6.6	0.1	5.8	2.6	2.2	4.6	1.6	2	7.6	34.4	0.12	0.5	6	10.6	481	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
Vendor 03/10	27/01/2019	15:33	ALS	4.9	0.1	3.3	1.6	0.9	4.6	0.7	2	3.7	16.9	0.06	0.5	3	8.8	276	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
Vendor 03/11	27/01/2019	15:34	ALS	4.9	0.1	3.3	1.8	1	4.4	0.9	2	4.2	20.3	0.08	0.5	3	9.7	318	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
Vendor 04/1	27/01/2019	16:01	ALS	6.4	0.1	6.6	2	1.2	5.2	1.3	2	8.7	32	0.05	0.5	6	10.5	473	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
Vendor 04/2	27/01/2019	16:02	ALS	6.8	0.1	6.5	2.7	1.4	5	1.5	2	5.4	42.7	0.07	0.5	6	10.8	626	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
Vendor 04/3	27/01/2019	16:03	ALS	7.8	0.1	7	2.7	2.1	5.4	1.6	2	6.3	45.6	0.07	0.5	7	10.7	590	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
Vendor 04/4	27/01/2019	16:04	ALS	8.4	0.1	6	3.3	3.1	5.4	1.8	2	10.1	31.9	0.09	0.5	6	10.1	372	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
Vendor 04/5	27/01/2019	16:05	ALS	6	0.1	4.8	2.2	1.6	5.2	1.3	2	6	18.7	0.05	0.5	5	9.4	328	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
Vendor 04/6	27/01/2019	16:06	ALS	5.1	0.1	4.6	2.6	2.2	5.1	1.6	2	7	20.9	0.06	0.5	5	9	306	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
Vendor 04/7	27/01/2019	16:07	ALS	5.5	0.1	3.8	2.3	1.6	4.8	1.2	2	6.3	20.7	0.1	0.5	4	9.3	341	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW Fly Ash	27/01/2019	N/A	SGS	9	0.3	6.2	3.2	5	5	3.4	5	11	30	0.06	0.8	0.5	9.5	290	Heavy Metals by acid microwave digestion
BW Bottom Ash	27/01/2019	N/A	SGS	9	0.3	0.7	1.6	1	1	0.5	3	4	5	0.05	0.5	0.7	9.1	300	Heavy Metals by acid microwave digestion
BW Fly Ash	27/01/2019	N/A	SGS	0.11	0.002	0.01	0.012	0.02	0.13	0.06	0.097	0.06	0.42	0.0001	0.004	0.01	(1:20- 9.3) (TCLP after 18hs- 5)	N/A	Zero Headspace Toxicity Characteristic Leaching Procedure (TCLP)
BW Bottom Ash	27/01/2019	N/A	SGS	0.03	0.001	0.005	0.006	0.02	0.01	0.005	0.05	0.02	0.09	0.0001	0.004	0.005	(1:20- 8.8) (TCLP after 18hs- 5)	N/A	Zero Headspace Toxicity Characteristic Leaching Procedure (TCLP)
BW Fly Ash	27/01/2019	0:00	ALS	4.1	0.1	3.8	1.5	0.9	4.1	1	2	3.9	17.2	0.07	0.5	4	9.9	309	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW Bottom Ash	27/01/2019	0:00	ALS	0.8	0.1	0.5	1.1	0.1	0.7	0.4	1	0.9	3.3	0.01	0.5	2	9.2	109	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW Fly Ash	28/01/2019	N/A	SGS	10	0.3	5.9	3.3	1	5	2.1	10	14	28	0.08	0.6	5.3	10.4	390	Heavy Metals by acid microwave digestion
BW Bottom Ash	28/01/2019	N/A	SGS	9	0.3	0.7	1.6	1	1	0.5	3	4	5	0.05	0.5	0.7	9.1	300	Heavy Metals by acid microwave digestion
BW Fly Ash	28/01/2019	N/A	SGS	0.12	0.001	0.011	0.014	0.02	0.13	0.009	0.08	0.04	0.95	0.0001	0.004	0.011	(1:20- 9.9) (TCLP after 18hs- 5)	N/A	Zero Headspace Toxicity Characteristic Leaching Procedure (TCLP)
BW Bottom Ash	28/01/2019	N/A	SGS	0.02	0.001	0.005	0.005	0.02	0.01	0.005	0.05	0.01	0.05	0.0001	0.004	0.005	(1:20- 9) (TCLP after 18hs- 5)	N/A	Zero Headspace Toxicity Characteristic Leaching Procedure (TCLP)
BW Fly Ash	28/01/2019	0:00	ALS	5.3	0.1	5.2	2.4	2.4	4.4	1.7	2	8	26.5	0.08	0.6	4	10.6	427	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS

Sample ID	Sample Date	Sample Time	Lab	As	Cd	Cr	Cu	Pb	Mo	Ni	Se	Zn	B	Hg	Hexavalent Chromium	Trivalent Chromium	PH	Conductivity (µ/c	Methodology
BW Bottom Ash	28/01/2019	0:00	ALS	0.8	0.1	0.5	0.7	0.1	0.6	0.4	1	0.6	4	0.01	0.5	2	9.2	280	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW Fly Ash	29/01/2019	N/A	SGS	5	0.3	6.5	3.4	5	4	2.4	3	11	21	0.08	0.5	0.5	10.6	460	Heavy Metals by acid microwave digestion
BW Bottom Ash	29/01/2019	N/A	SGS	1	0.3	0.8	1.3	2	1	2	3	4	5	0.05	0.6	0.2	8.9	340	Heavy Metals by acid microwave digestion
BW Fly Ash	29/01/2019	N/A	SGS	0.13	0.001	0.011	0.016	0.02	0.15	0.015	0.14	0.05	1.1	0.0001	0.004	0.005	(1:20- 9.7) (TCLP after 18hs- 5.1)	N/A	Zero Headspace Toxicity Characteristic Leaching Procedure (TCLP)
BW Bottom Ash	29/01/2019	N/A	SGS	0.02	0.001	0.005	0.005	0.02	0.01	0.007	0.05	0.03	0.15	0.0001	0.004	0.006	(1:20- 8.4) (TCLP after 18hs- 5)	N/A	Zero Headspace Toxicity Characteristic Leaching Procedure (TCLP)
BW Fly Ash	29/01/2019	10:45	ALS	5	0.1	3.9	1.6	0.7	4.3	0.8	2	3.4	26.3	0.06	0.5	4	10.5	463	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW Bottom Ash	29/01/2019	11:10	ALS	1.1	0.1	0.8	1	0.1	0.9	0.6	1	1.3	4.3	0.01	0.5	2	9.0	226	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW Fly Ash	30/01/2019	13:00	ALS	3.2	0.1	3.8	2.5	1.7	3.8	1	2	5.9	10.3	0.04	0.5	4	10	267	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW Bottom Ash	30/01/2019	13:10	ALS	2.8	0.1	4.7	4.2	2.4	2.8	1.8	1	2.9	4.8	0.01	0.5	5	9	220	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW CENOSPHERES	31/01/2019	12:55	ALS	3.9	0.1	2.4	1.2	0.5	0.2	1.1	2	2	1.8	0.01	0.5	2	9.4	82	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW Fly Ash	31/01/2019	13:10	ALS	5.4	0.1	5.9	3.1	2.7	4.3	2.1	2	9.3	27.7	0.05	0.5	6	10.5	361	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS
BW Bottom Ash	31/01/2019	13:20	ALS	1.9	0.1	1.2	1.8	0.3	1.6	1.4	1	2.6	7.7	0.01	0.5	2	9	216	Total Metals by nitric acid microwave digestion, pH 1:5 (Soils), Conductivity (1:5), Total Recoverable Mercury by FIMS

0.001 Not reported above the analytical limit of reporting (LOR) - the LOR is listed

Loop organics analysis data (mg/kg)

BW

Bottom Ash **Sampled: 17/04/2018**

Sample #	Arsenic	Boron	Cadmium	Chromium	Copper	lead	Mercury	Molybdenum	Nickel	Selenium	Zinc	Conductivity	pH
1	4.4	13	0.5	6.9	5.4	1.7	0.2	0.69	7.5	1.3	9.8	110	6
2	11	41	0.5	6.9	5.4	1.7	0.2	1.5	0.13	2.2	20	760	5.9
3	11	41	0.5	8.9	7.2	2.2	0.2	0.82	11	1.4	13	330	6.3
4	2.3	11	0.5	4.7	4	1	0.2	0.7	6.1	0.69	6.7	300	6.3
5	3.2	14	0.5	6.7	5.7	1.4	0.2	0.84	8.3	0.95	9.9	200	6.6
6	4	23	0.5	6.4	5.1	1.6	0.2	1.5	6.4	1.2	10	1000	6.7
7	3.8	14	0.5	6.1	5.3	1.5	0.2	0.63	7.2	0.95	9	200	7
8	1.7	23	0.5	4.8	4.9	0.7	0.2	2	7.4		6.3	2000	6.8
9	2.6	18	0.5	6.6	5.6	0.71	0.2	1.1	12	0.95	9.6	480	7
10	2.4	15	0.5	3.5	3.3	1.2	0.2	0.66	3.9	0.65	5.9	490	6.9
11	5.5	21	0.5	6.8	5.1	1.9	0.2	1.2	6.1	5.4	9.4	430	7.1
12	2.5	22	0.5	4.3	3.3	1.1	0.2	1.7	4.1	1.4	5.8	1100	7.1
13	3.1	20	0.5	5.5	4.2	1.4	0.2	1.7	5	1.2	7	2200	6.9
14	2.8	10	0.5	4.6	3.7	1.2	0.2	0.68	4.5	1.1	6.5	100	7.7
15	2.4	9.4	0.5	3.6	3.2	1.1	0.2	0.57	3.7	0.98	5.6	150	7.6
16	2.4	16	0.5	5.4	5.3	0.7	0.2	1.2	9.7	5	5.9	690	7.2
17	2.5	11	0.5	4.1	3.6	1.1	0.2	0.63	4.5	1	6	300	7.5
18	2.5	13	0.5	3.7	3.5	1.1	0.2	0.79	3.8	1.6	8	600	7.4
19	3.6	9.8	0.5	5	4.4	1.6	0.2	0.57	5.2	1.6	8	52	8.1
20	2.3	9.8	0.5	3.5	3.1	0.97	0.2	0.64	3.5	1.8	5.1	230	7.8

Symbio Laboratories data (mg/kg)

Sample tested between				31/05/2016 - 7/06/16	31/05/2016 - 7/06/16	31/05/2016 - 7/06/16	31/05/2016 - 7/06/16	31/05/2016 - 7/06/16	31/05/2016 - 7/06/16
Reference	**Units**	**PQL**	**Method**	**453025-A**	**453025-A**	**453025-A**	**453025-A**	**453025-A**	**453025-A**
Description				**Soil - 3860**	**Soil - 3860**	**Soil - 3860**	**Soil - 3860**	**Soil - 3860**	**Soil - 3860**
Sample				**BAYSFLY1**	**BAYSBOT1**	**LDDLFLY1**	**LDDLBOT1**	**LDDLCEN01**	**BAYSGYP01**
Sample				**1**	**2**	**3**	**4**	**5**	**6**
Cerium (Ce)*	mg/kg	0.05	IND042	6.8	1.5	5.3	8.4	1.4	0.06
Uranium (U)*	mg/kg	0.05	IND042	1	<0.05	0.37	0.26	0.1	1.5
Antimony (Sb)	mg/kg	0.01	ESM02	0.06	0.03	0.03	0.01	0.02	0.99
Silver (Ag)	mg/kg	0.01	ESM02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Tin (Sn)	mg/kg	0.025	ESM02	0.58	0.044	0.25	0.13	0.055	<0.025
Aluminium (Al)	mg/kg	0.5	IND041	4280	763	2180	1870	537	61.6
Arsenic (As)	mg/kg	1	IND041	3.5	1	1	1	1.7	1
Barium (Ba)	mg/kg	0.5	IND041	68	21	267	73	13	19
Boron (B)	mg/kg	5	IND041	9.9	5	5	5	5	280
Cadmium (Cd)	mg/kg	0.5	IND041	0.5	0.5	0.5	0.5	0.5	0.5
Chromium (Cr)	mg/kg	1	IND041	6.4	1	1	1	1	1
Copper (Cu)	mg/kg	1	IND041	3.1	1	1.5	2.4	1	28.8
Iron (Fe)	mg/kg	2	IND041	9010	10100	13400	31800	759	105
Lead (Pb)	mg/kg	1	IND041	5	1	1.8	302	1	1
Manganese (Mn)	mg/kg	1	IND041	252	223	258	807	18.2	5.6
Molybdenum (Mo)	mg/kg	0.5	IND041	4	0.7	1.4	1.1	0.6	20.1
Nickel (Ni)	mg/kg	0.5	IND041	3.4	2.3	3.4	4.3	1	14.7
Selenium (Se)	mg/kg	1	IND041	1	1	1	1	1	1
Silicon (Acid Soluble)	mg/kg	5	IND041	157	126	335	259	283	484
Sodium (Na)	mg/kg	50	IND041	62	130	330	180	320	78000
Sulphur (S)	mg/kg	20	IND041	180	226	272	487	259	154000
Zinc (Zn)	mg/kg	5	IND041	16	5	8.6	23.6	5	5
Vanadium (V)	mg/kg	0.5	IND041	10.3	1.7	5.5	3.1	4.4	<0.5
Lithium (Li)*	mg/kg	2	IND041	<2	<2	<2	<2	<2	17
Calcium (Ca)	mg/kg	10	IND041	600	730	2600	1800	950	100000
Magnesium (Mg)	mg/kg	5	IND041	563	391	999	1420	268	22400
Strontium (Sr)	mg/kg	0.5	IND041	10.8	4.8	32	17	11	1070
Potassium (K)	mg/kg	20	IND041	240	52	150	210	110	1230

Coal ash data - BW Flyash Nalco (mg/kg)

Sample ID	Sample Date	As	B	Cd	Cr	Cu	Pb	Hg	Mo	Ni	Se	Zn
BW-Fly Ash (October Samples)	4/11/2014	6.4	32.8	0.27	24	41	39	0.06	5	23	2.4	73
BW-Fly Ash - December	14/01/2015	0.2	6	0.26	20	43	42	0.05	5	25.0	0.2	69
BW-Fly Ash - February Sample	14/04/2015	7.6	32	0.29	33	44	43	0.04	5	25	2.3	85
BW-Fly Ash - March Sample	14/04/2015	4.5	29	0.26	24	44	42	0.02	5	23	2.2	65
BW-Fly Ash - April 2015	20/05/2015	2.7	30	0.19	24	29	35	0.05	5	26	1.7	63
BW-Fly Ash - May 2015	26/05/2015	4	32.7	0.25	33	42	35	0.06	5	30	2	70
BW-Fly Ash - June 2015	30/06/2015	5	38.2	0.26	34	50	35	0.06	10	39	2.3	73

Appendix D Leachate data for coal ash

Samples	Chromium					
	Ash (mg/kg)			Leachate (mg/L)		
	Total Cr	Cr 6	Cr 3	Total Cr	Cr 6	Cr 3
14-Jan-19						
Fly ash 1	4.3	<0.5	4	0.016		
Fly ash 2	4.2	<0.5	4	0.016		
Fly ash 3	3.8	<0.5	4	0.016		
Fly ash 4	4.4	<0.5	4	0.014		
Fly ash 5	3.9	<0.5	4	0.019		
Fly ash 6	4.5	<0.5	4	0.019		
Fly ash 7	5.5	<0.5	6	0.019		
Fly ash 8	4.9	0.6	4	0.02		
Fly ash 9	4.2	<0.5	4	0.019		
Fly ash 10	3.9	<0.5	4	0.02		
15-Jan-19						
Fly ash11	3.3	<0.5	3	0.009		
Fly ash 12	3.7	<0.5	4	0.01		
Fly ash 13	3.8	<0.5	4	0.008		
Fly ash 14	2.7	<0.5	3	0.01		
Fly ash 15	3.9	<0.5	4	0.01		
Fly ash 16	2.4	<0.5	2	0.009		
Fly ash 17	2.6	<0.5	3	0.01		
Fly ash 18	3.6	<0.5	4	0.008		
Fly ash 19	3.2	<0.5	3	0.009		
Fly ash 20	2.5	<0.5	2	0.008		
Bottom ash 1	0.5	<0.5	<2	<0.001	<0.01	<0.01
18-Jan-19						
Bottom ash 2	0.7	<0.5	<2	<0.001	<0.001	<0.001
19-Jan-19						
Fly ash 1	4.8	<0.5	5	<0.001	<0.001	<0.001
Bottom ash 1	1.4	<0.5	<2	<0.001	<0.001	<0.001
20-Jan-19						
Cenospheres	1.6	<0.5	<2	0.001	<0.001	0.001
Fly ash 1	4.6	<0.5	4	<0.001	<0.001	<0.001
Bottom ash 1	0.6	<0.5	<2	<0.001	<0.001	<0.001
Vendor 1	11	0.7	9	0.028	0.02	0.006
21-Jan-19						
Fly ash 1	4.8			0.013		
Bottom ash 1	1.5			<0.001		
22-Jan-19						
Fly ash	6	<0.5	6	0.022	0.018	0.004
Bottom ash	0.8	<0.5	<0.5	<0.001	<0.001	<0.001

Samples	Chromium					
	Ash (mg/kg)			Leachate (mg/L)		
	Total Cr	Cr 6	Cr 3	Total Cr	Cr 6	Cr 3
23-Jan-19						
Fly ash	4.5	<0.5	4	0.009	0.007	0.002
Bottom ash	4.9	<0.5	5	<0.001	<0.001	<0.001
Fly ash (SGS)	5.1	<0.5	5.1	0.007	<0.004	0.007
Bottom ash (SGS)	1.6	<0.5	1.6	<0.005	<0.004	<0.005
24-Jan-19						
Fly ash	5	<0.5	5	0.013	0.013	<0.001
Bottom ash	0.8	<0.5	<2	<0.001	<0.001	<0.001
Fly ash (SGS)	7.2	0.9	6.3	0.014	0.005	0.009
Bottom ash (SGS)	0.6	<0.5	0.6	<0.005	<0.004	<0.005
25-Jan-19						
Fly ash	3.3	<0.5	3	0.011	0.011	<0.001
Bottom ash	4.5	<0.5	4	<0.001	<0.001	<0.001
Fly ash (SGS)	5.1	0.9	4.2	0.012	<0.004	0.012
Bottom ash (SGS)	0.6	<0.5	0.6	<0.005	<0.004	<0.005
26-Jan-19						
Fly ash	2.1	<0.5	2	0.003	<0.001	0.002
Bottom ash	0.5	<0.5	<2	<0.001	<0.001	<0.001
Fly ash (SGS)	3.3	1	2.3	<0.005	<0.004	<0.005
Bottom ash (SGS)	0.5	<0.5	0.5	<0.005	<0.004	<0.005
27-Jan-19						
Fly ash	3.8	<0.5	4	0.008	0.005	0.003
Bottom ash	0.5	<0.5	<2	<0.001	<0.001	<0.001
Fly ash (SGS)	6.2	0.8	5.4	0.01	<0.004	0.01
Bottom ash (SGS)	0.7	<0.5	0.7	<0.005	<0.004	<0.005
Vendor 03/1	7	<0.5	7	0.037	0.035	0.001
Vendor 03/2	5.4	<0.5	5	0.043	0.042	<0.001
Vendor 03/3	6.5	<0.5	6	0.048	0.047	<0.001
Vendor 03/4	4.8	<0.5	5	0.027	0.025	<0.001
Vendor 03/5	3.6	<0.5	4	0.014	0.013	<0.001
Vendor 03/6	3.7	<0.5	4	0.015	0.013	0.001
Vendor 03/7	3	<0.5	3	0.017	0.015	0.001
Vendor 03/8	6.2	<0.5	6	0.042	0.039	0.001
Vendor 03/9	5.8	<0.5	6	0.038	0.036	<0.001
Vendor 03/10	3.3	<0.5	3	0.014	0.013	0.001
Vendor 03/11	3.3	<0.5	3	0.017	0.016	0.001
Vendor 04/1	6.6	<0.5	6	0.044	0.042	<0.001
Vendor 04/2	6.5	<0.5	6	0.054	0.05	0.001
Vendor 04/3	7	<0.5	7	0.055	0.052	0.001

Samples	Chromium					
	Ash (mg/kg)			Leachate (mg/L)		
	Total Cr	Cr 6	Cr 3	Total Cr	Cr 6	Cr 3
Vendor 04/4	6	<0.5	6	0.026	0.024	0.001
Vendor 04/5	4.8	<0.5	5	0.014	0.013	0.001
Vendor 04/6	4.6	<0.5	5	0.016	0.015	0.001
Vendor 04/7	3.8	<0.5	4	0.017	0.016	<0.001
Vendor 02/1	7.2	<0.5	7	0.054	0.049	0.003
Vendor 02/2	7.4	<0.5	7	0.053	0.05	<0.001
Vendor 02/3	7.6	<0.5	8	0.053	0.05	<0.001
Vendor 02/4	5.2	<0.5	5	0.027	0.024	0.001
Vendor 02/5	7	<0.5	7	0.054	0.051	<0.001
Vendor 02/6	5.2	<0.5	5	0.027	0.026	<0.001
Vendor 02/7	4.1	<0.5	4	0.026	0.025	<0.001
Vendor 02/8	11	<0.5	11	0.026	0.025	<0.001
Vendor 02/9	4.8	<0.5	5	0.027	0.026	<0.001
Vendor 02/10	4.8	<0.5	5	0.027	0.026	<0.001
Vendor 02/11	4.9	<0.5	5	0.026	0.025	<0.001
Vendor 02/12	4.8	<0.5	5	0.027	0.025	<0.001
28-Jan-19						
Fly ash	5.2	0.6	4	0.016	0.016	<0.001
Bottom ash	0.5	<0.5	<2	<0.001	<0.001	<0.001
Fly ash (SGS)	5.9	0.6	5.3	0.011	<0.004	0.011
Bottom ash (SGS)	0.7	<0.5	0.7	<0.005	<0.004	<0.005
29-Jan-19						
Fly ash	3.9	<0.5	4	0.021	0.019	0.001
Bottom ash	0.8	<0.5	<2	<0.001	<0.001	<0.001
Fly ash (SGS)	6.5	<0.5	<0.5	0.011	<0.004	<0.005
Bottom ash (SGS)	0.8	0.6	0.2	<0.005	<0.004	<0.005
30-Jan-19						
Fly ash	3.8	<0.5	4	0.002	0.002	<0.001
Bottom ash	4.7	<0.5	5	<0.001	<0.001	<0.001
31-Jan-19						
Fly ash	5.9	<0.5	6	0.021	0.019	0.001
Bottom ash	1.2	<0.5	<2	<0.001	<0.001	<0.001
Cenospheres	2.4	<0.5	2	0.007	<0.001	0.006

Samples	Arsenic	
	Concentration in Ash (mg/kg)	Leachate Concentration (mg/L)
14-Jan-19		
Fly ash 1	4.4	0.057
Fly ash 2	4.4	0.06
Fly ash 3	5.1	0.058
Fly ash 4	5	0.072
Fly ash 5	4.4	0.055
Fly ash 6	5.1	0.056
Fly ash 7	5.5	0.054
Fly ash 8	5.2	0.064
Fly ash 9	4.5	0.074
Fly ash 10	4.9	0.074
15-Jan-19		
Fly ash11	4.1	0.072
Fly ash 12	4.4	0.075
Fly ash 13	4.3	0.072
Fly ash 14	4.7	0.083
Fly ash 15	4.4	0.078
Fly ash 16	4.6	0.077
Fly ash 17	4.7	0.067
Fly ash 18	4.3	0.077
Fly ash 19	4.2	0.081
Fly ash 20	4.1	0.075
Bottom ash 1	1.3	0.005
18-Jan-19		
Bottom ash 2	0.9	0.005
19-Jan-19		
Fly ash 1	3.4	0.011
Bottom ash 1	3.2	0.014
20-Jan-19		
Cenospheres	1.8	0.016
Fly ash 1	3.5	0.005
Bottom ash 1	2.3	0.013
Vendor 1	12.1	0.081
21-Jan-19		
Fly ash 1	4.7	0.077
Bottom ash 1	3.4	0.011
22-Jan-19		
Fly ash	5.3	0.085

Samples	Arsenic	
	Concentration in Ash (mg/kg)	Leachate Concentration (mg/L)
Bottom ash	1.7	0.011
23-Jan-19		
Fly ash	3.8	0.078
Bottom ash	2	0.01
Fly ash (SGS)	5	0.09
Bottom ash (SGS)	5	0.05
24-Jan-19		
Fly ash	5.8	0.085
Bottom ash	1	0.007
Fly ash (SGS)	4	0.13
Bottom ash (SGS)	8	<0.02
25-Jan-19		
Fly ash	2.6	0.045
Bottom ash	3.2	0.009
Fly ash (SGS)	6	0.07
Bottom ash (SGS)	7	0.02
26-Jan-19		
Fly ash	2	0.046
Bottom ash	1.4	0.009
Fly ash (SGS)	5	0.05
Bottom ash (SGS)	<1	<0.02
27-Jan-19		
Fly ash	4.1	0.068
Bottom ash	0.8	0.006
Fly ash (SGS)	9	0.11
Bottom ash (SGS)	9	0.03
Vendor 03/1	5.6	0.059
Vendor 03/2	5.6	0.044
Vendor 03/3	6.1	0.053
Vendor 03/4	7	0.085
Vendor 03/5	5.2	0.064
Vendor 03/6	4.4	0.065
Vendor 03/7	4.5	0.075
Vendor 03/8	5.9	0.05
Vendor 03/9	6.6	0.069
Vendor 03/10	4.9	0.068
Vendor 03/11	4.9	0.08
Vendor 04/1	6.4	0.068

Samples	Arsenic	
	Concentration in Ash (mg/kg)	Leachate Concentration (mg/L)
Vendor 04/2	6.8	0.045
Vendor 04/3	7.8	0.062
Vendor 04/4	8.4	0.095
Vendor 04/5	6	0.086
Vendor 04/6	5.1	0.066
Vendor 04/7	5.5	0.086
Vendor 02/1	7.4	0.078
Vendor 02/2	7.3	0.079
Vendor 02/3	7.5	0.081
Vendor 02/4	6.3	0.099
Vendor 02/5	7.8	0.078
Vendor 02/6	6	0.099
Vendor 02/7	6	0.096
Vendor 02/8	11.9	0.1
Vendor 02/9	6.2	0.099
Vendor 02/10	6.4	0.097
Vendor 02/11	6.4	0.1
Vendor 02/12	6	0.1
28-Jan-19		
Fly ash	3.3	0.83
Bottom ash	0.8	0.004
Fly ash (SGS)	10	0.12
Bottom ash (SGS)	9	<0.02
29-Jan-19		
Fly ash	5	0.083
Bottom ash	1.1	0.009
Fly ash (SGS)	5	0.13
Bottom ash (SGS)	<1	<0.02
30-Jan-19		
Fly ash	3.2	0.035
Bottom ash	2.8	0.01
31-Jan-19		
Fly ash	5.4	0.088
Bottom ash	1.9	0.017
Cenospheres	3.9	0.028

Samples	Molybdenum	
	Concentration in Ash (mg/kg)	Leachate Concentration (mg/L)
14-Jan-19		
Fly ash 1	4.8	0.12
Fly ash 2	4.6	0.125
Fly ash 3	4	0.118
Fly ash 4	4.5	0.142
Fly ash 5	4.3	0.129
Fly ash 6	3.9	0.125
Fly ash 7	4	0.129
Fly ash 8	4	0.145
Fly ash 9	4.8	0.149
Fly ash 10	4.2	0.153
15-Jan-19		
Fly ash11	3.8	0.154
Fly ash 12	3.6	0.164
Fly ash 13	4.9	0.157
Fly ash 14	4	0.168
Fly ash 15	3.8	0.167
Fly ash 16	4.3	0.165
Fly ash 17	4.1	0.152
Fly ash 18	4.8	0.166
Fly ash 19	4.1	0.001
Fly ash 20	3.9	0.001
Bottom ash 1	0.4	0.008
18-Jan-19		
Bottom ash 2	0.4	0.006
19-Jan-19		
Fly ash 1	4.7	0.181
Bottom ash 1	1.6	0.013
20-Jan-19		
Cenospheres	0.2	0.004
Fly ash 1	4.4	0.141
Bottom ash 1	0.9	0.01
Vendor 1	8.3	0.243
21-Jan-19		
Fly ash 1	4.6	0.156
Bottom ash 1	1.7	0.011
22-Jan-19		
Fly ash	5.6	0.175
Bottom ash	1	0.012

Samples	Molybdenum	
	Concentration in Ash (mg/kg)	Leachate Concentration (mg/L)
23-Jan-19		
Fly ash	4	0.14
Bottom ash	17.2	0.012
Fly ash (SGS)	4	0.14
Bottom ash (SGS)	3	<0.01
24-Jan-19		
Fly ash	3.9	0.138
Bottom ash	0.8	0.01
Fly ash (SGS)	5	0.14
Bottom ash (SGS)	2	<0.01
25-Jan-19		
Fly ash	2.6	0.095
Bottom ash	3.4	0.012
Fly ash (SGS)	2	0.08
Bottom ash (SGS)	1	<0.01
26-Jan-19		
Fly ash	1.7	0.069
Bottom ash	0.6	0.01
Fly ash (SGS)	2	0.06
Bottom ash (SGS)	4	<0.01
27-Jan-19		
Fly ash	4.1	0.138
Bottom ash	0.7	0.009
Fly ash (SGS)	5	0.13
Bottom ash (SGS)	1	<0.01
Vendor 03/1	4.5	0.136
Vendor 03/2	4.3	0.127
Vendor 03/3	4.7	0.15
Vendor 03/4	4.5	0.142
Vendor 03/5	4.6	0.153
Vendor 03/6	4.3	0.156
Vendor 03/7	4.1	0.16
Vendor 03/8	4.6	0.133
Vendor 03/9	4.6	0.147
Vendor 03/10	4.6	0.161
Vendor 03/11	4.4	0.154
Vendor 04/1	5.2	0.164
Vendor 04/2	5	0.142
Vendor 04/3	5.4	0.163

Samples	Molybdenum	
	Concentration in Ash (mg/kg)	Leachate Concentration (mg/L)
Vendor 04/4	5.4	0.165
Vendor 04/5	5.2	0.187
Vendor 04/6	5.1	0.175
Vendor 04/7	4.8	0.17
Vendor 02/1	5.2	0.17
Vendor 02/2	5.3	0.169
Vendor 02/3	5.4	0.17
Vendor 02/4	5	0.179
Vendor 02/5	5.7	0.17
Vendor 02/6	4.9	0.18
Vendor 02/7	5	0.178
Vendor 02/8	9.5	0.181
Vendor 02/9	5.1	0.181
Vendor 02/10	5.2	0.181
Vendor 02/11	5.2	0.182
Vendor 02/12	5	0.18
28-Jan-19		
Fly ash	4.4	0.148
Bottom ash	0.6	0.01
Fly ash (SGS)	5	0.13
Bottom ash (SGS)	1	<0.01
29-Jan-19		
Fly ash	4.3	0.162
Bottom ash	0.9	0.009
Fly ash (SGS)	4	0.15
Bottom ash (SGS)	<1	<0.01
30-Jan-19		
Fly ash	3.8	0.144
Bottom ash	2.8	0.007
31-Jan-19		
Fly ash	4.3	0.161
Bottom ash	1.6	0.011
Cenospheres	0.2	0.003

Samples	Nickel	
	Concentration in Ash (mg/kg)	Leachate Concentration (mg/L)
14-Jan-19		
Fly ash 1	1.3	<0.001
Fly ash 2	2	<0.001
Fly ash 3	2	<0.001
Fly ash 4	1.9	<0.001
Fly ash 5	1.5	0.003
Fly ash 6	2	<0.001
Fly ash 7	3.5	<0.001
Fly ash 8	3.1	<0.001
Fly ash 9	1.6	<0.001
Fly ash 10	1.7	<0.001
15-Jan-19		
Fly ash11	1.3	<0.001
Fly ash 12	1.7	<0.001
Fly ash 13	2.5	<0.001
Fly ash 14	1.6	<0.001
Fly ash 15	2.4	0.001
Fly ash 16	0.8	<0.001
Fly ash 17	1.1	<0.001
Fly ash 18	2.5	<0.001
Fly ash 19	1.2	0.001
Fly ash 20	1.1	0.001
Bottom ash 1	0.4	0.001
18-Jan-19		
Bottom ash 2	0.8	0.001
19-Jan-19		
Fly ash 1	1.6	0.006
Bottom ash 1	1	<0.001
20-Jan-19		
Cenospheres	0.5	<0.001
Fly ash 1	1.4	0.008
Bottom ash 1	2.3	<0.001
Vendor 1	4.9	0.001
21-Jan-19		
Fly ash 1	1.6	<0.001
Bottom ash 1	1.1	<0.001
22-Jan-19		
Fly ash	2.1	<0.001
Bottom ash	0.6	<0.001

Samples	Nickel	
	Concentration in Ash (mg/kg)	Leachate Concentration (mg/L)
23-Jan-19		
Fly ash	1.7	<0.001
Bottom ash	1.3	<0.001
Fly ash (SGS)	2.3	0.014
Bottom ash (SGS)	1.9	0.006
24-Jan-19		
Fly ash	1.3	<0.001
Bottom ash	0.6	<0.001
Fly ash (SGS)	3.6	0.009
Bottom ash (SGS)	<0.5	0.006
25-Jan-19		
Fly ash	0.8	<0.001
Bottom ash	1.2	0.001
Fly ash (SGS)	1.7	0.009
Bottom ash (SGS)	<0.5	0.007
26-Jan-19		
Fly ash	0.6	<0.001
Bottom ash	0.6	<0.001
Fly ash (SGS)	1.6	<0.005
Bottom ash (SGS)	1	0.014
27-Jan-19		
Fly ash	1	<0.001
Bottom ash	0.4	<0.001
Fly ash (SGS)	3.4	0.011
Bottom ash (SGS)	<0.5	<0.005
Vendor 03/1	2.2	<0.001
Vendor 03/2	1.2	<0.001
Vendor 03/3	1.7	<0.001
Vendor 03/4	1.2	<0.001
Vendor 03/5	0.8	<0.001
Vendor 03/6	1.2	<0.001
Vendor 03/7	0.8	<0.001
Vendor 03/8	1.5	<0.001
Vendor 03/9	1.6	<0.001
Vendor 03/10	0.7	<0.001
Vendor 03/11	0.9	<0.001
Vendor 04/1	14.3	<0.001
Vendor 04/2	1.5	<0.001
Vendor 04/3	1.6	<0.001

Samples	Nickel	
	Concentration in Ash (mg/kg)	Leachate Concentration (mg/L)
Vendor 04/4	1.8	<0.001
Vendor 04/5	1.3	<0.001
Vendor 04/6	1.6	<0.001
Vendor 04/7	1.2	<0.001
Vendor 02/1	1.8	<0.001
Vendor 02/2	2	<0.001
Vendor 02/3	2.3	<0.001
Vendor 02/4	1.2	<0.001
Vendor 02/5	1.3	<0.001
Vendor 02/6	1.2	<0.001
Vendor 02/7	0.7	<0.001
Vendor 02/8	3.5	<0.001
Vendor 02/9	1.1	<0.001
Vendor 02/10	1.1	<0.001
Vendor 02/11	1	<0.001
Vendor 02/12	1.1	<0.001
28-Jan-19		
Fly ash	1.7	<0.001
Bottom ash	0.4	<0.001
Fly ash (SGS)	2.1	0.009
Bottom ash (SGS)	<0.5	<0.005
29-Jan-19		
Fly ash	0.8	<0.001
Bottom ash	0.6	<0.001
Fly ash (SGS)	2.4	0.015
Bottom ash (SGS)	2	0.007
30-Jan-19		
Fly ash	1	<0.001
Bottom ash	1.8	0.001
31-Jan-19		
Fly ash	2.1	<0.001
Bottom ash	1.4	<0.001
Cenospheres	1.1	0.003

Samples	Selenium	
	Concentration in Ash (mg/kg)	Leachate Concentration (mg/L)
14-Jan-19		
Fly ash 1	2	0.05
Fly ash 2	2	0.05
Fly ash 3	2	0.05
Fly ash 4	3	0.06
Fly ash 5	2	0.05
Fly ash 6	2	0.06
Fly ash 7	2	0.05
Fly ash 8	2	0.06
Fly ash 9	2	0.06
Fly ash 10	3	0.06
15-Jan-19		
Fly ash11	2	0.06
Fly ash 12	2	0.07
Fly ash 13	3	0.07
Fly ash 14	2	0.07
Fly ash 15	3	0.07
Fly ash 16	2	0.07
Fly ash 17	3	0.07
Fly ash 18	2	0.07
Fly ash 19	2	0.14
Fly ash 20	2	0.07
Bottom ash 1	<1	<0.01
18-Jan-19		
Bottom ash 2	<1	<0.01
19-Jan-19		
Fly ash 1	2	0.04
Bottom ash 1	1	0.01
20-Jan-19		
Cenospheres	<1	<0.01
Fly ash 1	2	0.03
Bottom ash 1	1	<0.01
Vendor 1	5	0.04
21-Jan-19		
Fly ash 1	2	0.06
Bottom ash 1	1	<0.01
22-Jan-19		
Fly ash	2	0.07
Bottom ash	<1	<0.01

Samples	Selenium	
	Concentration in Ash (mg/kg)	Leachate Concentration (mg/L)
23-Jan-19		
Fly ash	1	0.05
Bottom ash	<1	<0.01
Fly ash (SGS)	<3	0.14
Bottom ash (SGS)	4	0.07
24-Jan-19		
Fly ash	2	0.05
Bottom ash	<1	<0.01
Fly ash (SGS)	4	<0.05
Bottom ash (SGS)	11	<0.05
25-Jan-19		
Fly ash	1	0.04
Bottom ash	2	<0.01
Fly ash (SGS)	4	<0.05
Bottom ash (SGS)	18	<0.05
26-Jan-19		
Fly ash	1	0.04
Bottom ash	<1	<0.01
Fly ash (SGS)	11	0.076
Bottom ash (SGS)	16	<0.05
27-Jan-19		
Fly ash	2	0.05
Bottom ash	<1	<0.01
Fly ash (SGS)	5	0.097
Bottom ash (SGS)	<3	<0.05
Vendor 03/1	2	0.06
Vendor 03/2	2	0.06
Vendor 03/3	2	0.06
Vendor 03/4	2	0.06
Vendor 03/5	2	0.05
Vendor 03/6	2	0.05
Vendor 03/7	2	0.05
Vendor 03/8	2	0.05
Vendor 03/9	2	0.06
Vendor 03/10	2	0.05
Vendor 03/11	2	0.06
Vendor 04/1	2	0.06
Vendor 04/2	2	0.06
Vendor 04/3	2	0.06

Samples	Selenium	
	Concentration in Ash (mg/kg)	Leachate Concentration (mg/L)
Vendor 04/4	2	0.06
Vendor 04/5	2	0.06
Vendor 04/6	2	0.05
Vendor 04/7	2	0.06
Vendor 02/1	2	0.07
Vendor 02/2	2	0.07
Vendor 02/3	2	0.07
Vendor 02/4	2	0.07
Vendor 02/5	2	0.07
Vendor 02/6	2	0.07
Vendor 02/7	2	0.07
Vendor 02/8	5	0.07
Vendor 02/9	2	0.07
Vendor 02/10	2	0.07
Vendor 02/11	2	0.07
Vendor 02/12	2	0.07
28-Jan-19		
Fly ash	2	0.06
Bottom ash	<1	<0.01
Fly ash (SGS)	10	0.08
Bottom ash (SGS)	<3	<0.05
29-Jan-19		
Fly ash	2	0.07
Bottom ash	<1	<0.01
Fly ash (SGS)	<3	0.14
Bottom ash (SGS)	<3	<0.05
30-Jan-19		
Fly ash	2	0.05
Bottom ash	1	<0.01
31-Jan-19		
Fly ash	2	0.07
Bottom ash	<1	<0.01
Cenospheres	2	0.02

Samples	Zinc	
	Concentration in Ash (mg/kg)	Leachate Concentration (mg/L)
14-Jan-19		
Fly ash 1	10.5	0.01
Fly ash 2	8.7	0.011
Fly ash 3	8.6	0.01
Fly ash 4	11.1	0.01
Fly ash 5	10.4	0.02
Fly ash 6	12	0.006
Fly ash 7	15.9	0.006
Fly ash 8	14.8	0.016
Fly ash 9	7.8	0.013
Fly ash 10	7.7	0.015
15-Jan-19		
Fly ash11	7	0.01
Fly ash 12	6.8	0.016
Fly ash 13	11.9	0.013
Fly ash 14	6.4	0.014
Fly ash 15	9	0.015
Fly ash 16	4.2	0.02
Fly ash 17	5.5	0.021
Fly ash 18	9.5	0.012
Fly ash 19	7.6	0.015
Fly ash 20	3.8	0.006
Bottom ash 1	3.1	0.016
18-Jan-19		
Bottom ash 2	1.8	0.023
19-Jan-19		
Fly ash 1	42.1	0.066
Bottom ash 1	6.4	0.017
20-Jan-19		
Cenospheres	44.1	0.015
Fly ash 1	7.3	0.082
Bottom ash 1	3.1	0.01
Vendor 1	28.5	0.02
21-Jan-19		
Fly ash 1	7.7	0.015
Bottom ash 1	3.6	0.015
22-Jan-19		
Fly ash	8.6	0.015
Bottom ash	2.5	0.015

Samples	Zinc	
	Concentration in Ash (mg/kg)	Leachate Concentration (mg/L)
23-Jan-19		
Fly ash	6.2	0.011
Bottom ash	1.6	0.013
Fly ash (SGS)	9	0.03
Bottom ash (SGS)	5	0.05
24-Jan-19		
Fly ash	6.2	0.006
Bottom ash	1.9	<0.005
Fly ash (SGS)	14	0.03
Bottom ash (SGS)	14	0.01
25-Jan-19		
Fly ash	2.4	<0.005
Bottom ash	3.5	0.011
Fly ash (SGS)	6	0.02
Bottom ash (SGS)	3	0.04
26-Jan-19		
Fly ash	2.8	0.01
Bottom ash	14.3	<0.005
Fly ash (SGS)	8	0.01
Bottom ash (SGS)	4	0.05
27-Jan-19		
Fly ash	3.9	0.006
Bottom ash	0.9	<0.005
Fly ash (SGS)	11	0.06
Bottom ash (SGS)	4	0.02
Vendor 03/1	7.7	0.007
Vendor 03/2	5.1	0.009
Vendor 03/3	6.2	0.007
Vendor 03/4	8.1	<0.005
Vendor 03/5	4	0.028
Vendor 03/6	6	0.02
Vendor 03/7	4.1	0.028
Vendor 03/8	5.4	0.006
Vendor 03/9	7.6	0.013
Vendor 03/10	3.7	0.01
Vendor 03/11	4.2	0.012
Vendor 04/1	8.7	0.013
Vendor 04/2	5.4	0.018
Vendor 04/3	6.3	0.008

Samples	Zinc	
	Concentration in Ash (mg/kg)	Leachate Concentration (mg/L)
Vendor 04/4	10.1	0.014
Vendor 04/5	6	0.012
Vendor 04/6	7	0.011
Vendor 04/7	6.3	0.012
Vendor 02/1	6.6	0.022
Vendor 02/2	8	0.013
Vendor 02/3	8.6	0.022
Vendor 02/4	6.3	0.014
Vendor 02/5	5.3	0.02
Vendor 02/6	5.8	0.01
Vendor 02/7	3.6	0.01
Vendor 02/8	15.8	0.011
Vendor 02/9	5.2	0.014
Vendor 02/10	7.8	0.011
Vendor 02/11	4.7	0.008
Vendor 02/12	4.9	0.01
28-Jan-19		
Fly ash	8	<0.005
Bottom ash	0.6	<0.005
Fly ash (SGS)	14	0.04
Bottom ash (SGS)	4	0.01
29-Jan-19		
Fly ash	3.4	0.009
Bottom ash	1.3	0.006
Fly ash (SGS)	11	0.05
Bottom ash (SGS)	4	0.03
30-Jan-19		
Fly ash	5.9	0.021
Bottom ash	2.9	0.01
31-Jan-19		
Fly ash	9.3	0.016
Bottom ash	2.6	<0.005
Cenospheres	2	0.05

Samples	Boron	
	Concentration in Ash (mg/kg)	Leachate Concentration (mg/L)
14-Jan-19		
Fly ash 1	21.1	0.56
Fly ash 2	22.5	0.59
Fly ash 3	22.6	0.61
Fly ash 4	23.9	0.6
Fly ash 5	22.6	0.64
Fly ash 6	24.6	0.64
Fly ash 7	25	0.63
Fly ash 8	24.7	0.65
Fly ash 9	26.7	0.63
Fly ash 10	28.6	0.68
15-Jan-19		
Fly ash11	12.9	0.39
Fly ash 12	15.4	0.44
Fly ash 13	12.7	0.4
Fly ash 14	19.6	0.43
Fly ash 15	17.3	0.39
Fly ash 16	16.9	0.4
Fly ash 17	14.7	0.4
Fly ash 18	17	0.39
Fly ash 19	13.7	0.43
Fly ash 20	10.6	0.39
Bottom ash 1	5.2	0.12
18-Jan-19		
Bottom ash 2	3.5	0.09
19-Jan-19		
Fly ash 1	29	0.4
Bottom ash 1	5.7	0.14
20-Jan-19		
Cenospheres	23.2	0.07
Fly ash 1	11.4	0.33
Bottom ash 1	4	0.12
Vendor 1	34	0.93
21-Jan-19		
Fly ash 1	18.7	0.58
Bottom ash 1	5	0.11
22-Jan-19		
Fly ash	26.6	0.74
Bottom ash	3.3	0.12

Samples	Boron	
	Concentration in Ash (mg/kg)	Leachate Concentration (mg/L)
23-Jan-19		
Fly ash	16.7	0.49
Bottom ash	3.8	0.12
Fly ash (SGS)	18	0.62
Bottom ash (SGS)	<5	0.14
24-Jan-19		
Fly ash	22.6	0.57
Bottom ash	1.8	0.09
Fly ash (SGS)	11	0.77
Bottom ash (SGS)	9	<0.05
25-Jan-19		
Fly ash	14.2	0.41
Bottom ash	18.9	0.1
Fly ash (SGS)	6	0.53
Bottom ash (SGS)	<5	0.07
26-Jan-19		
Fly ash	11	0.3
Bottom ash	3.4	0.08
Fly ash (SGS)	7	0.22
Bottom ash (SGS)	<5	<0.05
27-Jan-19		
Fly ash	17.2	0.49
Bottom ash	3.3	0.11
Fly ash (SGS)	30	0.42
Bottom ash (SGS)	<5	0.09
Vendor 03/1	29.7	0.84
Vendor 03/2	35.4	1.01
Vendor 03/3	38.8	1.17
Vendor 03/4	29.7	0.89
Vendor 03/5	17	0.61
Vendor 03/6	17	0.61
Vendor 03/7	17.9	0.63
Vendor 03/8	34.6	0.95
Vendor 03/9	34.4	1.05
Vendor 03/10	16.9	0.62
Vendor 03/11	20.3	0.65
Vendor 04/1	32	0.92
Vendor 04/2	42.7	1.19
Vendor 04/3	45.6	1.35

Samples	Boron	
	Concentration in Ash (mg/kg)	Leachate Concentration (mg/L)
Vendor 04/4	31.9	0.91
Vendor 04/5	18.7	0.62
Vendor 04/6	20.9	0.68
Vendor 04/7	20.7	0.7
Vendor 02/1	43.4	1.29
Vendor 02/2	43.4	1.31
Vendor 02/3	43.1	1.28
Vendor 02/4	28.8	0.84
Vendor 02/5	46	1.31
Vendor 02/6	29.9	0.92
Vendor 02/7	28.4	0.88
Vendor 02/8	55	0.83
Vendor 02/9	30.2	0.86
Vendor 02/10	30.6	0.88
Vendor 02/11	30.5	0.88
Vendor 02/12	28.9	0.87
28-Jan-19		
Fly ash	26.5	0.66
Bottom ash	4	0.1
Fly ash (SGS)	28	0.95
Bottom ash (SGS)	<5	<0.05
29-Jan-19		
Fly ash	26.3	0.76
Bottom ash	4.3	0.14
Fly ash (SGS)	21	1.1
Bottom ash (SGS)	<5	0.15
30-Jan-19		
Fly ash	10.3	0.31
Bottom ash	4.8	0.09
31-Jan-19		
Fly ash	27.7	0.76
Bottom ash	7.7	0.13
Cenospheres	1.8	0.1

Samples	Mercury	
	Concentration in Ash (mg/kg)	Leachate Concentration (mg/L)
14-Jan-19		
Fly ash 1	0.07	<0.000005
Fly ash 2	0.08	<0.000005
Fly ash 3	0.08	<0.000005
Fly ash 4	0.08	<0.000005
Fly ash 5	0.07	<0.000005
Fly ash 6	0.08	<0.000005
Fly ash 7	0.08	<0.000005
Fly ash 8	0.07	<0.000005
Fly ash 9	0.07	<0.000005
Fly ash 10	0.07	<0.000005
15-Jan-19		
Fly ash11	0.09	<0.000005
Fly ash 12	0.08	<0.000005
Fly ash 13	0.08	0.000006
Fly ash 14	0.08	<0.000005
Fly ash 15	0.08	<0.000005
Fly ash 16	0.08	<0.000005
Fly ash 17	0.08	0.000007
Fly ash 18	0.08	0.000006
Fly ash 19	0.08	0.000016
Fly ash 20	0.07	<0.000005
Bottom ash 1	<0.01	<0.000005
18-Jan-19		
Bottom ash 2	<0.01	0.0000019
19-Jan-19		
Fly ash 1	0.05	<0.000005
Bottom ash 1	<0.01	0.000006
20-Jan-19		
Cenospheres	<0.01	<0.000005
Fly ash 1	0.05	<0.000005
Bottom ash 1	<0.01	<0.000005
Vendor 1	0.03	0.000024
21-Jan-19		
Fly ash 1	0.06	<0.000005
Bottom ash 1	<0.01	<0.000005
22-Jan-19		
Fly ash	0.07	<0.000005
Bottom ash	<0.01	<0.000005

Samples	Mercury	
	Concentration in Ash (mg/kg)	Leachate Concentration (mg/L)
23-Jan-19		
Fly ash	0.06	<0.000005
Bottom ash	<0.01	<0.000005
Fly ash (SGS)	0.08	<0.0001
Bottom ash (SGS)	<0.05	<0.0001
24-Jan-19		
Fly ash	0.06	0.006
Bottom ash	<0.01	0.008
Fly ash (SGS)	0.06	<0.0001
Bottom ash (SGS)	<0.05	<0.0001
25-Jan-19		
Fly ash	0.06	<0.000005
Bottom ash	0.07	<0.000005
Fly ash (SGS)	<0.05	<0.0001
Bottom ash (SGS)	<0.05	<0.0001
26-Jan-19		
Fly ash	0.05	<0.000005
Bottom ash	<0.01	<0.000005
Fly ash (SGS)	<0.05	<0.0001
Bottom ash (SGS)	<0.05	<0.0001
27-Jan-19		
Fly ash	0.07	<0.000005
Bottom ash	<0.01	<0.000005
Fly ash (SGS)	0.06	<0.0001
Bottom ash (SGS)	<0.05	<0.0001
Vendor 03/1	0.06	<0.000005
Vendor 03/2	0.1	<0.000005
Vendor 03/3	0.07	<0.000005
Vendor 03/4	0.1	<0.000005
Vendor 03/5	0.07	<0.000005
Vendor 03/6	0.06	0.000011
Vendor 03/7	0.07	<0.000005
Vendor 03/8	0.07	<0.000005
Vendor 03/9	0.12	<0.000005
Vendor 03/10	0.06	0.000009
Vendor 03/11	0.08	0.000007
Vendor 04/1	0.05	<0.000005
Vendor 04/2	0.07	<0.000005
Vendor 04/3	0.07	<0.000005

Samples	Mercury	
	Concentration in Ash (mg/kg)	Leachate Concentration (mg/L)
Vendor 04/4	0.09	<0.000005
Vendor 04/5	0.05	<0.000005
Vendor 04/6	0.06	0.000014
Vendor 04/7	0.1	0.000008
Vendor 02/1	0.09	<0.000005
Vendor 02/2	0.07	0.000006
Vendor 02/3	0.08	<0.000005
Vendor 02/4	0.06	<0.000005
Vendor 02/5	0.07	<0.000005
Vendor 02/6	0.08	<0.000005
Vendor 02/7	0.05	<0.000005
Vendor 02/8	0.13	<0.000005
Vendor 02/9	0.06	<0.000005
Vendor 02/10	0.05	<0.000005
Vendor 02/11	0.06	<0.000005
Vendor 02/12	0.06	<0.000005
28-Jan-19		
Fly ash	0.08	<0.000005
Bottom ash	<0.01	<0.000005
Fly ash (SGS)	0.08	<0.0001
Bottom ash (SGS)	<0.05	<0.0001
29-Jan-19		
Fly ash	0.06	<0.000005
Bottom ash	<0.01	<0.000005
Fly ash (SGS)	0.08	<0.0001
Bottom ash (SGS)	<0.05	<0.0001
30-Jan-19		
Fly ash	0.04	0.000016
Bottom ash	<0.01	<0.000005
31-Jan-19		
Fly ash	0.005	<0.000005
Bottom ash	<0.01	0.000006
Cenospheres	<0.01	0.000007