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Kerosene Vale Ash Dam and Dry Ash Repository

Water Quality Assessment from April, 2016 to March, 2017 in relation to the Decommissioned Wallerawang Power Station

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Document prepared by:

Aurecon Australasia Pty Ltd
ABN 54 005 139 873
Level 2, 116 Military Road
Neutral Bay NSW 2089
PO Box 538
Neutral Bay NSW 2089
Australia

T +61 2 9465 5599
F +61 2 9465 5598
E sydney@aurecongroup.com
W aurecongroup.com

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Contents

Kerosene Vale Ash Dam and Dry Ash Repository 1

1. Introduction 2

1.1 Findings of Recent Reports 2

1.2 Background 3

1.3 KVAD Subsurface Drains 4

1.4 Scope 6

1.5 Aims and Objectives 7

1.6 Information provided by EnergyAustralia NSW 7

1.7 Data Quality 7

1.8 Structure of the Report 8

2. Surface and Groundwater Quality Monitoring 9

2.1 Monitoring Design for Differentiation of Water Quality Sources 9

2.2 Groundwater Monitoring 11

2.3 Surface Water Monitoring 12

2.3.1 Sampling in Upper Sawyers Swamp Creek 12

2.4 KVAR Surface Rainfall Runoff Management 13

2.5 Tracers for Ash and Coal Waste Leachates 13

2.6 Groundwater Levels 14

2.7 Climatic Conditions 14

2.8 Methods 14

2.9 Guidelines 15

2.9.1 Receiving Waters 19

2.9.2 Early Warning of Water Quality Changes 19

2.10 Control Charts 19

3. Review of Groundwater Quality 21

3.1 Groundwater Level Changes and Flow Directions 21

3.2 Groundwater Quality changes at Background Bores and SSCAD Seepage Bores 24

3.3 Groundwater Quality changes at KVAR/KVAD and Seepage Bores 25

3.3.1 Long-term changes at Groundwater Seepage Detection Bores 28

3.4 Long-term changes for Lidsdale Cut Water Quality 30

4. Review of Surface Water Quality 33

4.1 Springvale Coal Mine Water Discharge 33

4.2 Sawyers Swamp Creek Ash Dam effects on Surface Water Quality 33

4.3 KVAR/KVAD Groundwater Seepage Effects on Sawyers Swamp Creek 36
5. Discussion 38
6. Conclusions 39
7. Recommendations 40
8. References 41

Tables

Table 1: Pre-dry Ash Placement Water Quality Baseline 90th Percentile at Background and Receiving Water Sites and resulting Guidelines or Goals for KVAD/R Groundwater, Lidsdale Cut and Sawyers Swamp Creek

Table 2: Water Quality for SSCAD Seepage Detection Groundwater bores WGM1/D3 and D4 during Stage 2 to 2014/15 and the decommissioned KVAR period to 2016/17 compared to the Groundwater Background bore D2, Bore D4 90th Percentile Baseline and Groundwater Guidelines or Goals

Table 3: Average Water Quality changes for bore D5 compared to changes in KVAD Groundwater Quality from 2015/16 (in parentheses if significant) to 2016/17

Table 4: Long-term Groundwater Quality changes for KVAD groundwater seepage bores WGM1/D5 and D6 from Initial Stage 2 to current decommissioned period compared to background Bore D2, Bore D5 90th Percentile Baseline and Groundwater Guidelines or Goals

Table 5: Long-term Groundwater Quality changes for Lidsdale Cut Water Quality from Stage 1 and its Capping and Stage 2 to the current decommissioned period compared to the pre-placement conditions and the Groundwater Guidelines or Goals

Table 6: Water Quality in SSCAD for Pre-placement and Stage 2 Periods to 2014/15 and the V-notch Seepage Compared to Sawyers Swamp Creek Up- and Downstream of the V-notch and Surface Water Guidelines or Goals

Table 7: Water quality in Sawyers Swamp Creek at WX7 due to groundwater seepage from the KVAR/KVAD (see Table 3), SSCAD seepage (see Table 6) and Dump Creek mineralised background conditions compared to Sawyers Swamp Creek concentrations with and without Springvale coal mine discharges for the previous 2015/16 and the current periods compared to ANZECC (2000) Guidelines or Local Goals

Table 8: Estimated water quality increases in Sawyers Swamp Creek at WX7 due to groundwater seepage from the KVAR/KVAD without Springvale coal mine discharges for the previous 2014/15 and the current periods compared to recent Sawyers Swamp Creek concentrations and ANZECC (2000) Guidelines or Local Goals

Figures

Figure 1: Schematic of Kerosene Vale Dry Ash Placement Area Seepage Diversion works

Figure 2: Surface and Groundwater Monitoring Sites for Sawyers Swamp Creek Ash Dam and Kerosene Vale Dry Ash Placement Area

Figure 3: Location of original Kerosene Vale Ash Dam open-cut mine void used to store ash (hashed to right), Lidsdale Cut open-cut mine void filled with coal waste/chitter (hashed to left) and north of the Sawyers Swamp Creek: Centennial Coal surface coal emplacement on top of filled open-cut mine (hash to right, bordered by coal waste/chitter filled open-cut hashed to left) and plan of underground coal mine workings

Figure 4: Long-term Groundwater Elevation changes at background bores WGM1/D1 and D2 and SSCAD seepage detection bores D3 and D4 compared to receiving water bores D5 and D6 down-gradient of the KVAD/R ash placement area (vertical lines indicate beginning of dry ash placement (May, 2003) and pumping from Lidsdale Cut began June, 2012)

Figure 5: Kerosene Vale Ash Dam and Stage 1 and Stage 2 Dry Ash Repository Groundwater Level (RL m) Contours with Inferred Flow Directions (from sketch provided by Lend Lease Infrastructure to EnergyAustralia NSW)

Figure 6: Average concentrations of trace metals and aluminium at bore D5 for each reporting period since 2010/2012.

Figure 7: Average concentrations of trace metals and aluminium in the Lidsdale Cut Pond from the pre-KVAR placement period and each reporting period since 2003/2010

Figure 8: Long-term trends in conductivity, sulphate and trace metals in SSCAD Pond since cessation of wet ash placement and beginning dry ash placement at KVAR from 2003 to 2014 and KVAR decommissioning to 2017 with pumping from Lidsdale Cut since 2012.

Attachments

Attachment 1: Lithgow Rainfall Data from January, 2000 to March, 2017 (mm/month) from Bureau of Meteorology

Attachment 2: Wallerawang Power Station Ash Dam, Surface Water and Groundwater Quality Data from April, 2016 to March, 2017.

Attachment 3: Construction drawing of KVAD wall showing chitter used to construct the benches

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Summary

This annual assessment report for the 2016/17 reporting period has been prepared for the decommissioned and partly capped Kerosene Vale Ash Repository (KVAR) to address the requirements of the NSW Department of Planning and Environment's Consent Conditions (Condition 7.3 (c), (d) and (e) of Project Approval 07_0005) for monitoring to be undertaken to ascertain whether there have been any significant effects of the dry ash placement on the local surface or groundwater quality. Due to the complex, locally mineralised conditions, the assessment attempts to take these influences into account, including any residual effects of the Kerosene Vale Ash Dam (KVAD), Sawyers Swamp Creek Ash Dam (SSCAD) seepage and the effects of coal waste/chitter in the area.

The assessment found no significant effects on surface and groundwater quality due to the now decommissioned dry ash repository. This finding is consistent with that from previous annual assessment reports and the predictions of the Stage 2 Environmental Assessment on the basis of limited rainfall infiltration into the dry ash placement.

The assessment of effects of the residual wet ash in the Kerosene Vale Ash Dam, which is beneath the Kerosene Vale Ash Repository, found no significant effects of its groundwater seepage on the local surface or groundwater. This was most likely due to reduced seepage flows from the KVAD as a result of the local decrease in groundwater levels caused by installation of the subsurface drains in 2010. Most of the sulphate and trace metal concentrations appear to originate from pyrites in the pre-existing coal and coal waste/chitter with relatively low concentrations of leachates from the long-held ash.

The Lidsdale Cut pond showed a significant decrease in salinity, trace metals and aluminium during the current period from the peak in 2014/15. During 2016/17, the concentrations have further decreased but at a lower rate.

Due to the effects of the Springvale coal mine discharge, no significant effects on the surface water quality of Sawyers Swamp Creek were observable. Even under a scenario of only natural stream flows and no mine water, KVAR, KVAD and SSCAD seepages were estimated to be too small to have a significant effect on Sawyers Swamp Creek water quality.

Groundwater seepage from the SSCAD was also found to have no significant effects on the groundwater up-gradient of the Kerosene Vale Ash Repository. However, some seepage from the northern section of the SSCAD wall was evident, but the changes in salinity during the previous reporting period and the current 2016/17 period indicated that most of the salinity may be from the wider catchment rather than the ash dam.

1. Introduction

Wallerawang Power Station, including the Kerosene Vale Ash Repository (KVAR), ceased operation and subsequent ash production in March, 2014. Aurecon undertook the first and second surface and groundwater quality assessment report for the decommissioned KVAR (Aurecon, 2015 and 2016) and has been engaged to undertake the annual assessment report over the period April, 2016 to March, 2017, which includes changes in water quality over the time since decommissioning. Aurecon's scope also requires examination of long-term water quality changes from pre-dry ash placement to Stages 1 and 2 and during the decommissioned period to March, 2017.

The 2016/17 report is required for the NSW Department of Planning and Environment's Development Consent conditions for the Kerosene Vale Ash Repository and because the Wallerawang Power Station Environment Protection Licence (EPL) L766 of 20th December, 2016 has been retained by EnergyAustralia NSW.

To assess the effects, if any, of the dry ash KVAR placement during the current reporting period of 2016/17, it is necessary to also consider the effects of other sources of surface and groundwater on the receiving waters of Sawyers Swamp Creek. These include the residual effects of the previous wet slurry Kerosene Vale Ash Dam (KVAD), which is under the KVAR, seepage from Sawyers Swamp Creek Ash Dam (SSCAD), and to allow for other, non-ash related catchment inputs, including the local mineralised background conditions of pre-existing coal and coal waste/chitter.

The database from April, 2016 to March, 2017 has been included with that from previous years to examine changes since decommissioning and the current water quality and trace metal concentrations, including aluminium, in the KVAD groundwater, the KVAR groundwater bores, in Lidsdale Cut, as well as SSCAD seepage and Springvale mine water effects on Sawyers Swamp Creek.

The approach of assessing potential effects of the KVAR on surface and groundwater by taking into account the background conditions has been continued in the current reporting period report.

1.1 Findings of Recent Reports

The recent previous reports (Aurecon, 2014, 2015 and 2016) reviewed the available data and information which indicated that the KVAR dry ash placement during the decommissioning period had not significantly affected the local surface and groundwater quality. The review indicated that most of the leachates appearing in the groundwater and in Sawyers Swamp Creek are from the pre-existing coal waste/chitter in the mine void beneath the Repository, rather than from the ash placement in the KVAD, or from rainfall infiltration through the KVAR into the KVAD. The central basis for these findings was that rainfall infiltration into the dry ash placement is small, chitter/ coal leachates have higher concentrations of salts and trace metals than from the ash and that the wet ash leachates have been depleted over the long period of storage in the KVAD.

The earlier Aurecon (2014 and 2015) reports for the reporting periods 2013/14 and 2014/15 found that the Stage 1 and Stage 2 dry ash placements of the KVAR were not measurably affecting the groundwater quality, when assessed in the context of the local coal area mineral effects (Connell Wagner, 2008). In addition, although seepage due to limited rainfall infiltration through the KVAR dry ash may have combined with seepage from the KVAD, beneath the KVAR, and entered Sawyers

Swamp Creek, no significant effects on the creek receiving water quality has been indicated. These findings agreed with that of the KVAR Stage I and Stage II reports.

Recently, the dominant water quality and flow effects of the Springvale Mine water discharge[1] has made the effects, if any, of seepage from the KVAD/R and Lidsdale Cut (before seepage diversion in July, 2012), as well as from the Sawyers Swamp Creek Ash Dam (SSCAD), essentially undetectable. Hence, the flow of about 18 ML/day has caused the water quality in the creek to reflect that of the mine water.

1.2 Background

In 2002, Delta Electricity (now EnergyAustralia NSW) obtained approval for conversion of the wet slurry ash placement process at Wallerawang Power Station to dry ash. The dry placement is called the Kerosene Vale Ash Repository (KVAR). Stage 1 of the placement was completed and capped in February, 2009. Approval was obtained for further placement in the Stage 2 Area at the KVAR in November, 2008. The Stage 2 Area placement began in April, 2009 and was ongoing until cessation of operations in March, 2014.

As mentioned in previous reports, EnergyAustralia NSW advised Aurecon that all the Springvale Coal mine water discharge of about 18 ML/day has flowed into the creek since 1st July 2013. This change occurred because the mine water was no longer required to be sent directly to the power station for cooling water, so the emergency Springvale Coal mine water discharge point to upper Sawyers Swamp Creek (LDP20, see Figure 2) was removed from the Wallerawang Power Station licence on 2nd August, 2012 and became part of the Springvale Colliery licence. This discharge meant that ash related seepage effects from the KVAR, KVAD and SSCAD, if any, on the water quality in Sawyers Swamp Creek became essentially undetectable, due to the large volume of Springvale Mine Water within the system. It also meant that the creek monitoring site, WX7, has been compromised as the overall receiving water site for the ash placement area.

The year before the consistent mine water discharge began, the Lidsdale Cut discharge to Sawyers Swamp Creek was stopped in July, 2012 in response to an aluminium incident in the creek. The aluminium was thought to originate from the Lidsdale Cut pond water quality, and by implication a result of KVAD toe drain seepage from the wet ash placed in the KVAD, rather than from the surrounding coal mine waste areas. However, the 2015 and 2016 reports noted that the Lidsdale Cut open-cut mine void was back-filled with coal waste/chitter, as were other areas around Sawyers Swamp Creek (see Figure 3).

It was suggested that an aluminium deposit in Sawyers Swamp Creek after heavy rainfall in May, 2012, shortly after the February/March, 2012 flood, did not originate from the pond in Lidsdale Cut, but from coal waste/chitter groundwater leachate seepage into the creek and was unlikely to be related to the KVAR or KVAD. The reason for this view was that the aluminium concentration in the Lidsdale Cut pond did not increase until after the appearance of aluminium in the creek.

EnergyAustralia NSW advised Aurecon that the water in the Lidsdale Cut pond is regularly pumped to maintain a water level about 0.4 to 0.6m above the current void bottom and that the wetland plants (reeds) in the pond had perished (other than some clumps of submerged aquatic plants within the

[1] The Springvale Mine water discharge to Sawyers Swamp Creek was intermittent since 2009, increased in 2012 and has been continuous since 2013

deeper areas of Lidsdale Cut that still contain water). The reeds had treated the KVAD toe drain and Lidsdale Cut mine void coal waste/chitter groundwater inflows to the pond. Subsequently, the trace metal concentrations increased in the pond water since 2012 (Aurecon, 2016). This meant that the Lidsdale Cut pond had ceased to be part of the groundwater receiving waters for seepages from the KVAD/R area, and only bore D5 has been considered as the groundwater receiving water site since 2012.

1.3 KVAD Subsurface Drains

Following the placement of dry ash on top of the capped KVAD, groundwater from within the KVAD rose into the KVAR dry ash through cracks in the clay capping. As a result, a subsurface drainage system was installed in October, 2010, shown in Figure 1. The subsurface drains were installed at a RL of 913 to 910 m, below the level of the KVAD capping at approximately RL 918m, to prevent the KVAD groundwater from rising into the KVAR dry ash placement area. In addition, seepage from the KVAD has been collected and sent to the Lidsdale Cut pond via the existing KVAD toe drains.

Since 2014/15, it was noted that the groundwater levels in the KVAD had decreased, apparently by a general reduction in levels due to the combined effects of pumping water from Lidsdale Cut, together with the initial drawdown by installation of the subsurface drains. It was suggested that the increased concentrations of salts and trace metals in the KVAD groundwater, as well as at bore D5, in recent years was related to the groundwater level decreases and resulting chemical changes in the coal waste/chitter that forms the KVAD void and parts of the KVAD walls, as well as its presence in the wider area of Kerosene Vale.

Figure 1 also shows bores GW10 and GW11, which sample the groundwater in the KVAD, under the KVAR, on the western side. During 2011/12 the groundwater level at bore GW10 was drawn down by about 1.5m following installation of the subsurface drains (Aurecon, 2014) and EnergyAustralia NSW advised Aurecon that GW10 bore was dry in 2014/15. This was considered to be due to the additional effects of pumping down the water level in Lidsdale Cut, thereby increasing the hydraulic gradient from the KVAD.

Groundwater seepage flows are still occurring from the KVAD walls and groundwater levels and water quality are sampled at the northern wall by piezometers AP9 and AP17 (Figure 1). Most of the KVAD groundwater seepage is directed to Lidsdale Cut by the toe drain pipes.

In combination with the KVAD seepage diversion system, EnergyAustralia NSW also installed a new seepage collection and return system at the Sawyers Swamp Creek Ash Dam to minimise seepage from the ash dam into Sawyers Swamp Creek. The system commenced operating in May, 2010 returning seepage water from the ash dam seepage v-notch, the main seepage point (see Figure 1), to the SSCAD pond.

Figure 1: Schematic of Kerosene Vale Dry Ash Placement Area Seepage Diversion works

1.4 Scope

Aurecon has been requested by EnergyAustralia NSW to undertake the surface and groundwater quality report for 2016/17. Accordingly, the Kerosene Vale Ash Repository (KVAR) surface and groundwater database is required to be updated from April, 2016 to March, 2017. The groundwater monitoring results are to be reviewed to consider the likely effects on Sawyers Swamp Creek (SSC) due to groundwater seepage into the creek, under the dominant conditions of the Springvale Mine groundwater discharge.

This will involve taking into account possible effects of groundwater leachates from coal waste/chitter in the Kerosene Vale area, as well as KVAD leachates beneath the KVAR. In addition, the water quality effects of the SSCAD pond seepage and effects of the Springvale coal mine water discharges to Sawyers Swamp Creek are to be considered.

Clause 1.0 in the Scope requires water quality monitoring results to be assessed in conjunction with the baseline data and against the baseline condition as assessed in the Environmental Assessment with the ANZECC 2000 – Freshwater Aquatic Ecosystems guidelines (95% PL) to be used as a reference point.

However, previous Aurecon reports use locally derived guidelines for elements that are naturally elevated due to the coal waste/chitter mineralised nature of the area and use Freshwater Aquatic Ecosystems guidelines for mercury and selenium for the ANZECC (2000) required 99% PL. These were previously approved by Delta Electricity and are proposed to be used in the current reporting period report.

The water quality requirements of the EnergyAustralia NSW work scope are:

- Using the data provided, assess the changes, if any, in surface and groundwater quality due to the seepage collection and diversion systems at:
    - the Sawyers Swamp Creek Ash Dam (SSCAD) v-notch pump-back system;
    - sub-surface drains in the Kerosene Vale Ash Dam (KVAD) under the dry ash Kerosene Vale Ash Repository (KVAR);
    - diversion of the KVAD groundwater to Lidsdale Cut via the unblocked KVAD toe drains;
    - diversion of the Lidsdale Cut discharge from Sawyers Swamp Creek (SSC) to the Sawyers Swamp Creek Ash Dam (SSCAD)· The effects of the Stage 1 and Stage 2A dry ash placements on surface and groundwater receiving waters with the effects of the local coal mining and the Springvale Mine water discharge taken into account.

In addition, as previously approved by Delta Electricity, previous Aurecon reports showed that the OEMP requirement to use the groundwater beneath the KVAR as the receiving waters is not relevant to the site, so it is proposed to continue to use the receiving water sites set out in previous reports, other than the Lidsdale Cut pond, which has been pumped down to the level of the mine void groundwater inflows.

1.5 Aims and Objectives

One of the primary objectives of the design and operation of the KVAR is to have no adverse impact on the local ground or surface water quality. More specifically, this means that leachates from the dry ash placement should not increase concentrations of the various water quality characteristics in the receiving waters by more than the locally derived guidelines (based on the 90^{th} percentile of the background, pre-placement sites) or the ANZECC (2000) guidelines for protection of aquatic life, whichever is higher.

As noted in all the reports since 2008, the ANZECC (2000) guideline approach of assessing the likely impact of water quality and trace metals in the seepages from the KVAR and KVAD on the receiving surface and groundwater was continued to be used in this report for the decommissioned KVAR. This included local guidelines for some elements, due to the effects of mineralisation (coal bearing strata and coal wastes/chitter) in the ash placement area. The ANZECC (2000) guideline default trigger values and the locally derived guidelines are shown in Table 1, Section 2.7.

1.6 Information provided by EnergyAustralia NSW

In connection with the assignment, EnergyAustralia NSW has provided copies of:

- Surface and groundwater quality data from April 2016 to March, 2017, including water quality data collected in Sawyers Swamp Creek from upstream and downstream of the SSCAD spillway and v-notch and at the receiving water site, WX7
- Groundwater quality and levels in the SSCAD and KVAD seepage detection bores
- Groundwater quality and levels in the KVAD at bores A9, A17 and GW11 (GW10 is dry and no data is available)
- Water quality data from the SSCAD pond and v-notch seepage to define the pond water quality and seepage to SSC
- Water quality data from the Lidsdale Cut pond
- Background surface and groundwater data.

1.7 Data Quality

The data contained in this report was provided by EnergyAustralia NSW. The data was checked for outliers using the ANZECC (2000) protocol. In accordance with the protocol, outliers of three times the standard deviation from the mean were removed from the dataset, provided that no environmental changes had occurred that could account for such a significant change. Outliers have an asterisk next to the data in Attachment 2, thereby stopping the result from being used in statistical analyses by Excel.

As the database covers a long period of observations, it is likely that apparent changes in concentrations for trace metals such as silver, cadmium, chromium, copper and mercury may in fact be due to changes in the accuracy or detection limits of the analytical techniques used.

The OEMP requires the existing monitoring program to continue, with the addition of low detection limit analysis for trace metals (to ensure that the detection limit is lower than guideline values). All the metals tested, except for silver, met these criteria. As the laboratory has not been able to test at the required detection limit, and in the absence of any reason to suppose that silver might be an issue in this case, it is suggested that silver be removed from the sampling program.

Note that some of the data provided had concentrations recorded as less than the detection limit. If the detection limit was less than ANZECC (2000) guideline concentration, it was determined that there was no reason to alter the concentration, so the < sign was removed to allow the spreadsheet to use the data. If the detection limit was higher than the ANZECC (2000) guideline, the concentration was halved.

1.8 Structure of the Report

Section 2 describes the surface and groundwater monitoring program and the ANZECC (2000) and locally derived guideline trigger values. The assessment of the KVAR on surface and groundwater quality is shown in Section 3. The estimated effects of the KVAD are shown in Section 4 and the Sawyers Swamp Creek Ash Dam surface and groundwater effects are presented in Section 5.

2. Surface and Groundwater Quality Monitoring

This Section provides an overview of the groundwater quality and levels at the KVAR, KVAD and SSCAD and surface water quality monitoring in Sawyers Swamp Creek used for assessment of effects, if any, of ash leachates on the local surface and groundwater quality. The water quality sampling sites are shown in Figure 2[2].

Due to the inputs from the KVAD, which has the long-held wet ash placed in a coal mine void, containing coal waste and chitter in the bottom of the void and parts of the dam walls, as well as from the local mining activities in the area (Figure 3[3]), the assessment takes into account the background conditions and provides the locally derived and ANZECC (2000) guideline trigger values, which apply as assessment criteria to the receiving waters. The discharge of Springvale Mine water to Sawyers Swamp Creek has also been taken into account.

2.1 Monitoring Design for Differentiation of Water Quality Sources

As the KVAR is a dry ash placement with compaction of the ash to minimise rainfall infiltration, the effects on the surface and groundwater quality at the receiving water sites should be, and has been shown to be limited. Due to the KVAR being located in a mineralised area, the assessment of effects has been by examination of the residual effects after allowing for the effects of the mineralised inputs. These inputs are the pre-existing coal mining waste placements, local coal mine voids containing coal waste/chitter, and the KVAD imbedded in the coal waste void.

The water quality monitoring is undertaken to ascertain whether the local/ANZECC (2000) guidelines (as applicable) are met in the groundwater receiving water bores D5 and D6 and in Sawyers Swamp Creek at the final surface water receiving water site, WX7 (see Figure 2). The results of the monitoring are to enable contingency actions and investigations to be initiated in a timely manner if these limits are approached.

[2] Note that since the aerial photography, the south eastern area of KVAR known as Stage 2B has been excavated in preparation of ash placement, which did not proceed as a result of the decommissioning of Wallerawang.
[3] Note that the mine area plan shown in Figure 3 was provided without a legend so the areas have been described in the Figure name based on discussions with EnergyAustralia NSW.

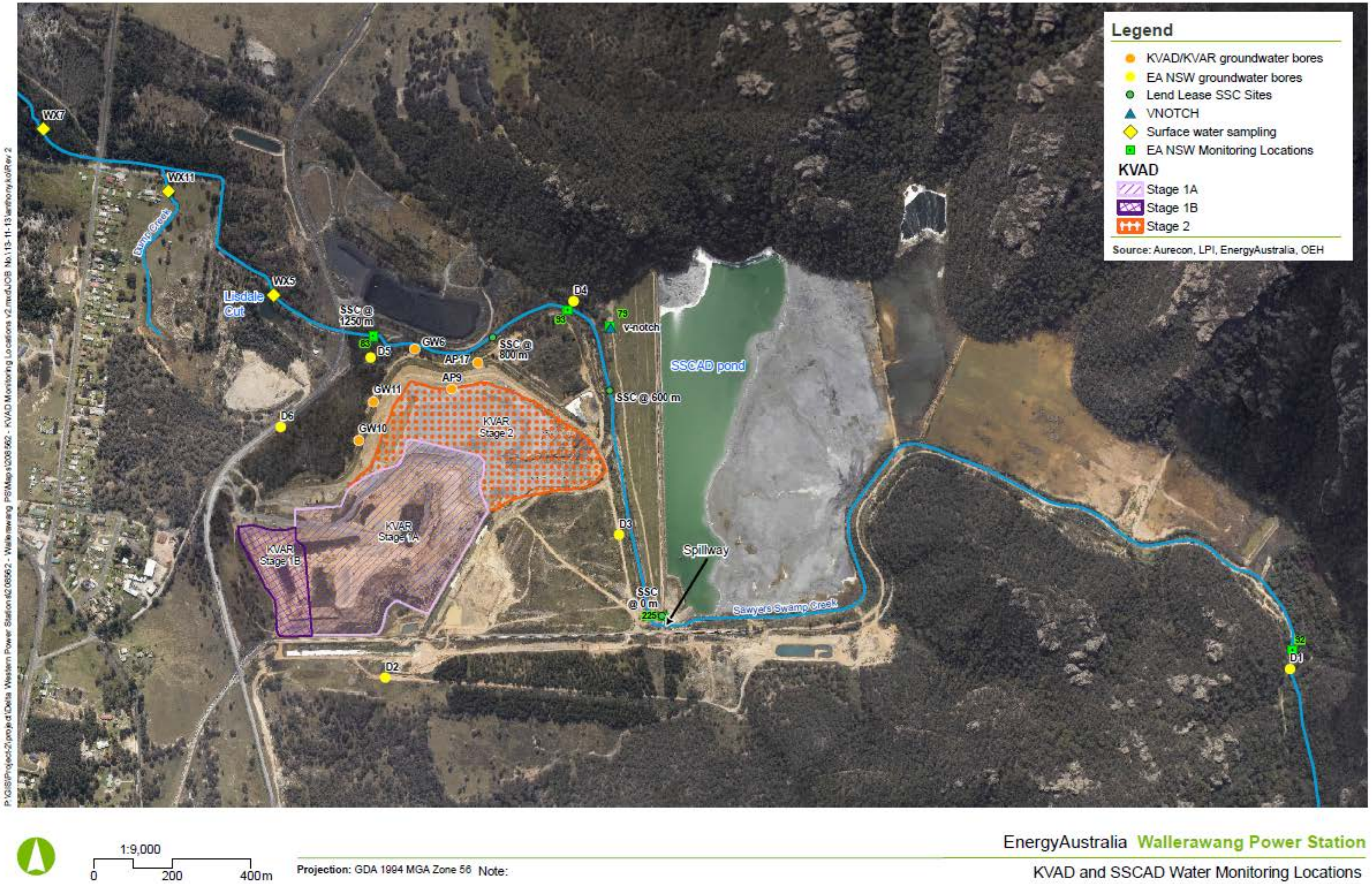

Figure 2: Surface and Groundwater Monitoring Sites for Sawyers Swamp Creek Ash Dam and Kerosene Vale Dry Ash Placement Area

Figure 3 shows coal mine voids containing coal waste/chitter. The void under the KVAD was filled with ash and then capped and the dry ash KVAR placed on top. The Lidsdale Cut open-cut mine void was filled with coal waste/chitter and only a small pond was left. The pond collects local coal waste/chitter groundwater and the following inputs via the KVAD toe drains: the KVAD groundwater seepage and KVAR rainfall infiltration, as well as KVAR surface runoff combined with KVAD groundwater seepage from the subsurface drains. From site inspections, it appears likely that coal waste/chitter was placed historically over much of the Kerosene Vale and Lidsdale cut areas.

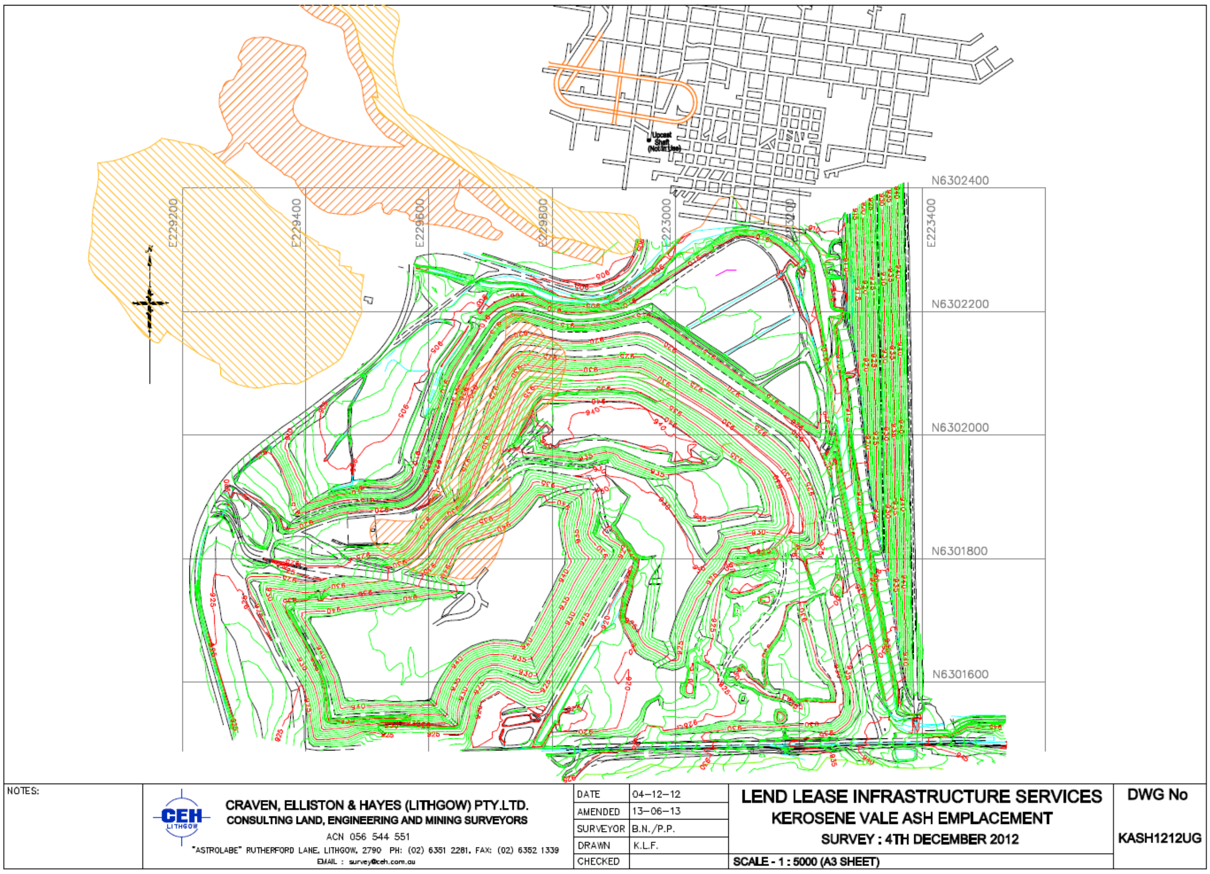

Figure 3. Location of original Kerosene Vale Ash Dam open-cut mine void used to store ash (hashed to right), Lidsdale Cut open-cut mine void filled with coal waste/chitter (hashed to left) and north of the Sawyers Swamp Creek: Centennial Coal surface coal emplacement on top of filled open-cut mine (hash to right, bordered by coal waste/chitter filled open-cut hashed to left) and plan of underground coal mine workings

2.2 Groundwater Monitoring

Piezometers were installed in the Stage 2 area of the KVAR to measure the amount of rainfall infiltration, accumulating above the KVAD clay capping. The previous report found that some rainfall infiltration was occurring but the piezometer bores are too small to sample for water quality and trace metals, so assessment of the potential effects on the local groundwater and surface water receiving waters were previously estimated (see Aurecon, 2015).

The background, up-gradient bores (WGM4/D1 and D2), are used as a benchmark for the effects of various local sources of groundwater flowing into the KVAD and into the Lidsdale Cut pond. The

SSCAD down-gradient bores (WGM4/D3 and D4) are located for detection of SSCAD seepage, which is up-gradient of the KVAR/KVAD. Figure 6 indicates that the groundwater at bore D4 mainly flows to Sawyers Swamp Creek. However, as the groundwater seepage is expected to be slower than that from the much higher hydraulic head in the SSCAD, the SSCAD seepage effects on the creek, if any, would be expected to override any groundwater effects.

Bores WGM4/D5 and D6 are the seepage detection bores for the KVAD, as well as potential for rainfall infiltration and surface runoff from the KVAR to enter and mix with the KVAD groundwater seepage. It is understood that surface runoff from the KVAR is contained on site and in unlined collection ponds (see Section 2.4), so the potential for effects of the KVAR are for limited amounts of surface water to seep into the KVAD beneath the KVAR. These down-gradient bores also sample the combined effects of the local coal mine up-gradient inputs as well as those from the SSCAD and the KVAD and the KVAR. Details of the monitoring design were set out in Aurecon (2012).

2.3 Surface Water Monitoring

The surface water monitoring sites comprise:

- Lidsdale Cut (WX5), which discharged to Sawyers Swamp Creek until July, 2012
- The final receiving water site, WX7, in Sawyers Swamp Creek, which is downstream of Lidsdale Cut and the local background site, WX11, in Dump Creek. WX7 is upstream of the junction of Sawyers Swamp Creek with the upper Coxs River (Figure 2).

Site WX5 samples the Lidsdale Cut pond which receives groundwater inflows from the local coal mine open-cut, surface runoff from the surrounding areas and the KVAD toe drains. EnergyAustralia NSW has advised Aurecon that sampling the water quality in the Lidsdale Cut pond from July, 2012 to September, 2013 was not undertaken due to drawdown of the void water level by the pumps that direct the water to the return canal/SSCAD. Sampling of the pond recommenced in October, 2013.

2.3.1 Sampling in Upper Sawyers Swamp Creek

Due to the discharge of mine water from the Springvale Coal Mine into Sawyers Swamp Creek, EnergyAustralia NSW began monitoring at the following five sites in the creek, which are shown as the green squares in Figure 2. The sites are:

- upstream of the SSCAD (site 92)
- at the SSCAD spillway (site 225) which is upstream of the SSCAD v-notch seepage
- where the SSCAD v-notch seepage previously entered the creek (EnergyAustralia NSW has advised that the seepage is now pumped back to the ash dam) – site 79
- downstream of the v-notch (site 93)
- downstream of KVAD (site 83).

These data, together with the routine, long-term Sawyers Swamp Creek data collected by EnergyAustralia NSW at the receiving water site, WX7, were used to identify any changes, above that found in previous reports in water quality in Sawyers Swamp Creek as a result of the many changes mentioned above.

The monitoring data are shown in spread-sheet format in Attachment 2, including the minimums, maximums, means and post-dry ash median as well as the estimated baseline (pre-placement 90th percentile) concentrations. The data for the current reporting period from April, 2016 to March, 2017 is included with its summary data. The 2016/17 data are also summarised in Tables in the body of the report.

2.4 KVAR Surface Rainfall Runoff Management

The decommissioned KVAR dry placement area had additional capping material placed during the reporting period. The SE corner of the Stage 2 area was excavated further to generate the cover material, which gave changes to the surface drainage in the area.

EnergyAustralia NSW has advised that extensive erosion of the dry ash surface on the eastern side of the Stage 2 area had occurred and the batter was repaired in 2017. Rainfall runoff flowed to the southern side of the KVAR and the various ponds and overflows collected the ash before the runoff entered the return canal.

Rainfall runoff from the northern part of KVAR is collected by a perimeter drain which directs the runoff to a Collection Pond in the north-east of the Stage 2 area (Figure 2). EnergyAustralia NSW has advised that groundwater seepage collected in the subsurface drains is also collected in this pond and the water is sent to the Lidsdale Cut pond via the pipeline. Consequently, no surface runoff water quality data has been available since January, 2013. It is also understood that some of the water in the Collection Pond is reused for dust suppression by spraying on the dry ash deposit.

The bores GW11 and AP9 and AP17, shown in Figure 2, sample the groundwater in the KVAD beneath the KVAR. The data from these bores was used to assess the potential effects of the KVAR and KVAD on groundwater quality at the receiving water bore MPGM4/D5.

2.5 Tracers for Ash and Coal Waste Leachates

As mentioned in previous reports, the main trace metals and elements of interest in the rainfall runoff and infiltration from the KVAR dry ash placement area are selenium, sulphate, boron, nickel and zinc. The elements used as ash leachate tracers, except selenium, are also present in the local mineralised coal geology of the area and are mainly due to the placement of coal mine waste and chitter in the catchment. Coal and coal mine waste/ chitter contains pyrites, which release sulphate and trace metals into the local groundwater and surface waters. Hence, selenium is used as a tracer of the direct effects of the KVAR, as well as the previous wet ash systems in the KVAD and SSCAD on the local surface and groundwater.

Long-term trends in surface and groundwater quality generally use conductivity/total dissolved salts (TDS) to trace salinity effects, which in the mineralised area, tends to follow that of sulphate. Sulphate and boron trends are used to show changes due to coal mining activities and selenium concentrations are used as an indicator of flyash management effects. Selenium concentrations are examined for trends if they consistently exceed the ANZECC (2000) guideline of 0.005 mg/L. Boron is used to monitor the effects of coal mining activities and can be used to represent potential effects of other trace metals.

The background conditions in Sawyers Swamp Creek, upstream of the SSCAD at site WX1 (also known as site 92, see Figure 2) shows that aluminium is naturally elevated in the area. The ANZECC (2000) guideline trigger value is 0.055 mg/L for slightly to moderately disturbed systems but averaged 0.37 mg/L prior to the continuous discharge from Springvale mine since August, 2012 and averaged 1.77

mg/L during 2016/17 (Attachment 2, Section 7), so it has not been used as a tracer for the dry ash placement.

However, as mentioned above, aluminium concentrations in Lidsdale Cut, the KVAD and in the local groundwater bores, as well as in groundwater at KVAR have been examined to determine the source of aluminium that may appear rarely in Sawyers Swamp Creek after heavy rainfall events. To provide an aluminium baseline concentration for these investigations, the Dump Creek 90th percentile concentration was used for surface water and the bore D6 90th percentile was used as the groundwater baseline concentration (see Table 1).

2.6 Groundwater Levels

The water levels in the groundwater bores inside the KVAD (AP9, AP17 and GW11, note that GW10 is dry), as well as at the receiving water bores D5 and D6 (between the KVAD and Lidsdale Cut) are monitored to allow identification of seepage from the KVAD/KVAR. Bores WGM1/D5 and D6 are situated down-gradient of the ash placement and up-gradient of the Lidsdale Cut to provide early detection of leachates from the KVAR placement area. Effects of the KVAR/KVAD seepage management on groundwater level changes at these bores are also monitored.

The bores up-gradient of the KVAD are used to define the concentration of dissolved elements and the direction of water movement in the areas from up-gradient of the ash placement areas to Lidsdale Cut. Their interaction with the groundwater under the dry ash placement and inside the KVAD are shown in Figure 5, Section 3.1.

2.7 Climatic Conditions

The average monthly rainfall at the Lithgow gauge over the period of KVAR ash placement from April, 2003 to March, 2017 was 64.9 mm and was below the long-term average of 72 mm/month. The average annual rainfall increased from 433 in 2006 to 969.5 mm/year in 2010 and was 920 mm/year from April, 2016 to March, 2017 (Attachment 1), which is 6.6% higher than the long-term average annual rainfall of 863 mm/year.

Since the Stage 2A placement began in April, 2010, there has been a series of wet summers due to above average rainfall events. The most recent occurred in February/March, 2012 with a total of 342 mm, February/March, 2013 (total of 297 mm), 299mm in December and January, 2015 and 270mm in both summer 2015/16 and summer 2016/17, while the 2014 summer was relatively dry (see Attachment 1).

2.8 Methods

Routine surface and groundwater water quality monitoring in the area is undertaken monthly on behalf of EnergyAustralia NSW by Nalco Analytical Resources who measure conductivity, pH and temperature in the field with a calibrated instrument.

In house methods[4] based upon Standard Methods (APHA, 1998) are used for the general water quality characteristics of alkalinity, sulphate, chloride, calcium, magnesium, sodium, potassium, total

[4] Nalco has NATA accreditation Number 1099 and is accredited for ISO/IEC 17025

dissolved solids (TDS) and Turbidity (NTU), which according to the ANZECC (2000) guidelines is similar to total suspended solids (TSS, also known as non-filterable residue, NFR).

The trace metals and elements monitored are the same for surface and groundwater: copper, cadmium, chromium, lead, zinc, iron, manganese, mercury, selenium, silver, arsenic, barium, boron and fluoride. Molybdenum, nickel and beryllium have been monitored since July, 2007 but beryllium was stopped in April, 2010 and aluminium has been monitored since July, 2010.

EnergyAustralia NSW has advised that the in-house methods are equivalent to those specified in DEC (2004), which also uses Standard Methods. (In this regard, it is relevant to note that the groundwater and Sawyers Swamp Creek monitoring is not required under Environment Protection Licence 766). Trace metal concentrations used were unfiltered, except for iron and manganese to correspond with the environmental goals set out in Table 1.

Groundwater bores are bailed and sampled after allowing time for the water level in the bore to re-establish. The depth to the water level from the top of the bore pipe is measured using a dip meter and the water surface elevation is calculated to AHD(m) after allowing for the pipe height.

Since April, 2006 the detection limits (DL) for routine monitoring of most trace metals tested were lower than the ANZECC (2000) guidelines (Table 1). Particular attention has been directed at the trace metals arsenic, cadmium, chromium, copper, mercury, nickel and lead, as well as the trace element selenium, which have been analysed with a low detection limit. However, due to sample matrix interference, silver has continued to be analysed above the ANZECC guideline trigger value of 0.00005mg/L since November, 2001 (see Attachment 2).

2.9 Guidelines

As used in previous reports since 2008, the principle of the ANZECC (1995) guidelines for protection of groundwater, where the potential future use of the water resource is considered, has been taken into account. In this regard, the Irrigation, Ecosystem and additional guidelines for protection of livestock or drinking water has been used, where appropriate, to provide a wider context of the ANZECC (2000) guidelines, to define acceptable ambient water quality at the KVAR Stage 2 receiving water sites.

The ANZECC Guidelines for Groundwater Protection in Australia (1995) and the NEPC (1999, update in May, 2013) require the background water quality in groundwater bores to be considered. As the NEPC (1999), and the updated 2013 version, did not define the meaning of “background” concentrations for groundwater, the baseline concentrations were continued to be defined as the 90th percentile of the pre-placement concentrations, or the ANZECC guideline default trigger values, whichever is higher. Use of the background 90th percentiles is taken from the ANZECC (2000) guideline procedure for condition 3, highly modified catchments, which generally occur in mineralised areas such as in the Kerosene Vale ash placement area.

Local guidelines are based on the ANZECC (2000) guideline approach of estimating local guidelines using the 90th percentile for naturally mineralised, highly disturbed groundwater. Hence, the background 90th percentiles that are higher than the default trigger values, are used as the local guidelines. The local and ANZECC guideline trigger values used are called the Environmental Goals and are shown in Table 1.

The groundwater background concentrations use the pre-placement data from the background bore, WGM1/D2, and elevated concentrations at the seepage detection bore WGM1/D5 and Lidsdale Cut (WX5) were also taken into account. The surface water background concentrations use the pre-placement data at Dump Creek, WX11, which is the local background for the mineralised area. The pre-KVAR data at WX7 was also taken into account. The 90th percentile baseline concentrations for all the water quality characteristics monitored are shown in bold in Table 1.

As discussed in Section 2.1, the surface water guideline goals apply to the receiving waters of Sawyers Swamp Creek at WX7 (Figure 1), only for the effects of the ash placement input concentrations (including the associated effects of coal waste/chitter leachates[5]), but not for the effects of the Springvale Coal Mine input.

The groundwater goals apply to the seepage detection bore WGM1/D5, but not Lidsdale Cut (WX5) since July, 2012 (see Section 4.5), and these are used for early warning of potential effects on the Sawyers Swamp Creek receiving waters. These goals are used for assessment of the decommissioned KVAR effects in this report.

In recent times, the level of groundwater in bore D5 has decreased due to lowering of the groundwater under the KVAR by the sub-surface drains and possibly the lowering of the water level in Lidsdale Cut. Hence, sample collection at D5 has been limited at times (see Section 4.4).

Aluminium local goals for surface and groundwater have been added to Table 1 due to the inadvertent assignment of the Lidsdale Cut pond discharge to the aluminium in Sawyers Swamp Creek in 2012. This has led to the need for local goals to account for the effects of coal waste and chitter effects on the creek. The recent Dump Creek 90th percentile concentration of 5.25 mg/L was used for the surface water local goal and the recent bore D6 90th percentile of 5.1 mg/L was used for the groundwater local goal (data for both from April, 2012 to March, 2015). The period used was taken since the Lidsdale Cut discharge to SSC was stopped to allow for potential effects of the water level decrease and demise of the wetland plants on the baseline conditions. Note that prior to 2012, the toe drain seepage collection was treated by the Lidsdale Cut pond wetland and discharged to the creek, allowing for assessment of effects of the KVAD seepage on Sawyers Swamp Creek.

A hydrological flow chart which explains how the various flows and discharges enter Sawyers Swamp Creek and the local groundwater is shown in Figure 6, Section 4.

[5] Coal waste/chitter leachates are covered by use of Dump Creek to set the 90th percentile baseline concentrations.

Table 1: Pre-dry Ash Placement Water Quality Baseline 90th Percentile at Background and Receiving Water Sites and resulting Guidelines or Goals for KVAD/R Groundwater, Lidsdale Cut and Sawyers Swamp Creek

	Groundwater				Surface Water		
Element (mg/L)	Background Groundwater (WGM1/D2)	KVAD & KVAR Groundwater (WGM1/D5)	Lidsdale Cut (WX5)		Dump Creek (WX11)	Sawyers Swamp Creek (WX7)	
	Pre-Placement (1988-2003) 90th Percentile	Pre-Placement (1988-2003) 90th Percentile	Pre-Placement (1992-2003) 90th Percentile	Groundwater Guidelines# or Goals	Pre-placement (1991-2003) 90th Percentile	Pre-placement (1991-2003) 90th Percentile	Surface Water Guidelines# or Goals
pH	5.4	4.5	6.9	6.5 – 8.0	8.0	7.6	6.5 – 8.0
Cond/ (µS/cm)	310	810	952	2600^	770	760	2200
TDS	258	550	650	2000++	772	584	1500^
SO4	61	328	359	1000	325	323	1000 ++
Cl	48	24	34	350	39	27	350 +
Al	-	-	2.43	5.1^^	0.125	0.274	5.25^^
As	<0.001	0.008	<0.001	0.024	<0.001	<0.001	0.024
Ag	<0.001*	<0.001*	<0.001*	0.00005	<0.001	<0.001*	0.00005
Ba	0.114	0.148	0.054	0.7	0.050	0.043	0.7 +++
Be	-	0.006	-	0.1	-	-	0.1
B	0.10	1.7	2.16	1.7	1.45	2.33	1.25
Cd	0.001	0.004	<0.001	0.001	<0.001	<0.001	0.0015
Cr	0.041	0.041	<0.006	0.004	<0.001	<0.001	0.005
Cu	0.010	0.058	<0.005	0.005	0.002	<0.007	0.005
F	0.28	0.65	1.99	1.5	1.1	1.1	1.5+++
Fe	1.7	14.7	0.7	1.7	2.38	0.507	0.3+++
Hg	<0.0007*	<0.0006	<0.0002*	0.00006	<0.0002*	<0.0002*	0.00006
Mn	0.44	2.5	2.12	1.9	1.94	0.829	1.9
Mo	-	-	-	0.01	-	-	0.01 +
Ni	0.031	0.137	-	0.137	-	-	0.05
Pb	0.010	0.021	0.004	0.01	<0.001	0.003	0.005
Se	<0.001	0.001	0.001	0.005	0.003	0.003	0.005
Zn	0.114	0.505	0.304	0.505	0.28	0.153	0.153

Notes:

* Detection limit used was higher than ANZECC guidelines; Concentrations highlighted in blue to indicate sampling sites with elements higher than the locally derived or ANZECC guidelines

^ Groundwater conductivity derived from TDS 90th percentile of 2000 mg/L TDS/0.77; Creek TDS derived from 0.68 x 2200 µS/cm, which is the ANZECC (2000) low land river conductivity for protection of aquatic life

ANZECC (2000) guidelines for protection of freshwaters, livestock or irrigation water.

Cadmium, Chromium, Copper, lead, nickel and zinc adjusted for effects of hardness: Ca, Mg in WGM1/D5 22.3, 29.0 mg/L: in Sawyers Swamp Creek 51.6, 38.0 mg/L, respectively

Note: Chromium guideline is 1 ug/L for CrVI and adjusted for hardness effect

Local guidelines using 90th percentile of pre-dry placement data in **bold** (Note: Fe guideline of 0.3 mg/L only marginally lower than

WX7 90th percentile so used ANZECC (2000) guideline

^^ Aluminium surface water local goal from Dump Creek 90th Percentile and groundwater local goal from bore D6 90th percentile (data for both

from April, 2012 to March, 2015). These sites used as background for period since Lidsdale Cut discharge to SSC stopped.

\+ Irrigation water moderately tolerant crops; irrigation. Note: Molybdenum drinking is 0.05 mg/L

++ Livestock

+++ drinking water

As set out in Connell Wagner (2008), the adoption of the surface water conductivity guideline of 2,200 µS/cm shown in Table 1 was based on the background Dump Creek site, WX11, and the Sawyers Swamp Creek receiving water site, WX7, both having 90th percentile conductivity of more than twice the ANZECC (2000) guideline default upland river trigger value of 350 µS/cm (upland rivers are defined as above 150m altitude).

The 90th percentile concentration at the Dump Creek site demonstrates that this was caused by local mineralisation effects, so use of the upland value was not considered appropriate. As a result, the higher ANZECC (2000) lowland (altitude below 150m) river conductivity trigger value of 2,200 µS/cm was used for protection of aquatic life in Sawyers Swamp Creek (Connell Wagner, 2008). Use of the guideline of 2,200 µS/cm corresponds with the livestock guideline of 1000 mg/L for sulphate, which in turn relates to the TDS guideline of 1500 mg/L.

This approach has proven to be appropriate because the background conductivity in Dump Creek, at WX11, increased to about 2100 uS/cm and the TDS reached 1500 mg/L in 2014, two years after the Lidsdale Cut discharge was stopped, apparently due to diffuse effects of historical coal mining activities in the area (Aurecon, 2015).

Although the background groundwater bore, D2, 90th percentile conductivity was lower than the upland river trigger value of 350 µS/cm, the pre-dry ash placement 90th percentiles at the KVAD groundwater bore D5, as well as the Lidsdale Cut conductivities, were higher than in the creeks. As groundwater seepage into Sawyers Swamp Creek would be slow, use of the creek trigger value was not considered appropriate for groundwater. Hence, the approach adopted was the ANZECC (1995) guidelines for protection of groundwater, where the potential future use of the water resource is taken into account. As shown in Table 1, the livestock drinking water guideline for salinity, of 2,000 mg/L TDS, was considered relevant to the assessment of groundwater in the area, should the groundwater be used for watering livestock in the future (Connell Wagner, 2008). The TDS was converted to the conductivity local trigger value of 2,600 µS/cm by dividing by the conversion factor 0.77, which was derived from the measured groundwater conductivity and TDS.

2.9.1 Receiving Waters

With the various toe and subsurface drain collection systems in place, bore WGM1/D5 represents the groundwater receiving water site for seepage from the KVAD/R that was not collected by the KVAD toe drains or the KVAR sub-surface drains that are directed to Lidsdale Cut via the KVAD toe drains. Consequently, the groundwater quality at bore D5, has continued to be used for early warning of potential effects of groundwater on the water quality at the Sawyers Swamp Creek receiving water site, WX7, if the Springvale mine water flow was to cease in the future.

However, due to the large changes that have taken place, the assessment of effect of the KVAR on surface and groundwater was previously undertaken by a direct method by estimating the rainfall infiltration through the dry ash and the effects of the resulting seepage on Sawyers Swamp Creek with no Springvale mine water flow (see Aurecon, 2015 and 2016). Those reports also assessed the effects of the KVAR leachates on the groundwater at bore D5.

In the current reporting period, the groundwater data at bore D5, as well as the Lidsdale Cut pond data, is reviewed to see if any significant changes have occurred that may affect conditions in Sawyers Swamp Creek due to groundwater seepage into the creek. The results are discussed in Section 4.

Although EnergyAustralia NSW has been undertaking routine monitoring of the water quality in the upper Sawyers Swamp Creek, where it flows through the coal measures upstream of the KVAR, significant changes in surface water quality are masked by the Springvale Mine water flow. Hence, changes in the Dump Creek water quality, at WX11, were examined to see if there may have been significant changes in the background conditions that potentially could have an effect on Sawyers Swamp Creek.

2.9.2 Early Warning of Water Quality Changes

An early warning of changes in water quality that may potentially approach the relevant local guidelines set out in Table 1 is required for the ash repository management to allow time for investigations of the causes of changes and controls to be implemented if necessary. The approach used is the ANZECC (2000) guideline procedure for developing triggers for investigations of the cause of changes, and possible management actions. This approach involves comparing the 50th percentile (median) in receiving waters with the 90th percentile of the background or pre-KVAR water quality at the receiving water sites. An early warning of changes is signalled when the post-placement 50th percentile exceeds the pre-placement 90th percentile water quality conditions. This approach is supplemented by the use of Control Charts to show concentration changes relative to local/ANZECC trigger values and the 90th percentile pre-KVAR conditions.

During this reporting period, these procedures are applied to each down-gradient groundwater bore, D5 and D6 to assess long-term changes that are approaching the local/ANZECC trigger values.

2.10 Control Charts

In previous reports, the long-term plots of the water quality data were used to allow the identification of trends against the baseline and environmental goals. The trends are tracked using Control Charts

(APHA Standard Methods, 1995 and ANZECC guidelines for Monitoring and Reporting, 2000) and the significance of any changes is determined by comparison with the criteria of pre-placement 90th percentiles, post-placement medians, ANZECC (2000) guidelines or local guidelines. Due to Springvale mine water discharge, the ANZECC guidelines cease to apply to the receiving waters of Sawyers Swamp Creek. The seepage detection bore D5, remains the groundwater receiving water site and the recent changes are shown in relevant tables in the report, as well as some of the changes by control charts.

The data are summarised in Tables in this report, or in spreadsheet format in Attachment 2, including the minimum, maximum and mean as well as the 90th percentile baseline, median post-placement, ANZECC guidelines and local guideline concentrations.

3. Review of Groundwater Quality

This Section reviews the groundwater quality during the reporting period 2016/17 at the KVAR/KVAD. The approach taken for the assessment is to review the groundwater quality at:

- Bores sampling the groundwater in the long-held wet ash in the KVAD (AP9, AP17, GW11) and the KVAD north and western seepage points
- Seepage detection bores MPGM4/D5 and D6
- The Lidsdale Cut pond.

The review of this data takes into account the water quality at the background bores MPGM4/D1 and D2, as well as effects of seepage from the SSCAD on its seepage detection bores D3 and D4, which are part of the background for the KVAR/KVAD.

As indicated in Sections 1 and 2, significant changes during this reporting period since the 2014/15 and 2015/16 reporting periods that could not be accounted for have been examined to see if they influence the previous report findings of no significant effects of the KVAR.

Review of the 2016/17 data begins with changes in the groundwater levels in the various bores as they determine the direction of groundwater flows in the area.

3.1 Groundwater Level Changes and Flow Directions

Figure 4 shows an overall long-term trend for groundwater elevation changes at the receiving water bores D5 and D6 down-gradient of the KVAD ash placement, compared to the background bores and those up-gradient of the KVAD. The highest groundwater levels up-gradient of the KVAR/KVAD are D1, D3, D2 and D4 in that order. The background bore, D2, level decreased since dry ash placement began and has become more variable since 2012.

Although the groundwater levels at the receiving water bore D5 are higher than at D6, the D5 levels have become more variable since installation of the sub-surface drains in 2010, and are often down to its lowest levels, which are essentially the same as the level in bore D6. By contrast, the bore D6 levels have remained relatively stable. The frequency of bore D5 being at is lowest levels has increased since pumping of water from the Lidsdale Cut began in 2012.

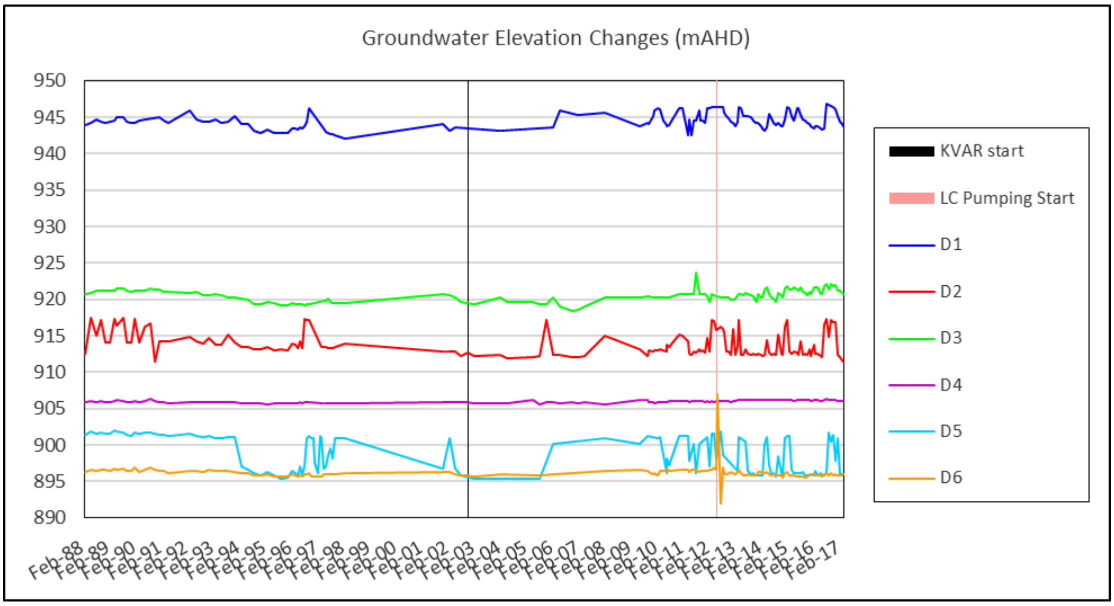

Figure 4. Long-term Groundwater Elevation changes at background bores WGM1/D1 and D2 and SSCAD seepage detection bores D3 and D4 compared to receiving water bores D5 and D6 down-gradient of the KVAD/R ash placement area (vertical lines indicate beginning of dry ash placement (May, 2003) and pumping from Lidsdale Cut began June, 2012)

The groundwater flow directions are used to help explain why groundwater quality changes occur in the groundwater under and around the KVAD/R, as well as potential effects of seepage into Sawyers Swamp Creek. Figure 5 shows the indicative KVAD seepage flow paths to the KVAD toe drains and toward the low point of the Lidsdale Cut. Seepage from the KVAD, under the KVAR that is intercepted by the toe drains, is also shown. Any KVAD seepage that is not collected by the subsurface drains or the toe drains is shown as flowing to the local groundwater.

Following installation of the subsurface drains in 2010 and pumping of the water from the Lidsdale Cut pond from June, 2012, the groundwater at bore GW10, in the south-west of the KVAD, has become dry (Aurecon, 2015). In addition to the subsurface drain effects, it appears that pumping of the groundwater out of the Lidsdale Cut pond is drawing down the surrounding groundwater levels, as seen in Figure 4 at Bore D5, which is near the open-cut area that forms the Lidsdale Cut. However, the background bores, D1 and D2 at higher elevations, show similar level fluctuations, suggesting an additional wider area effect on the groundwater levels (other than at the SSCAD seepage bores D3 and D4 and at D6).

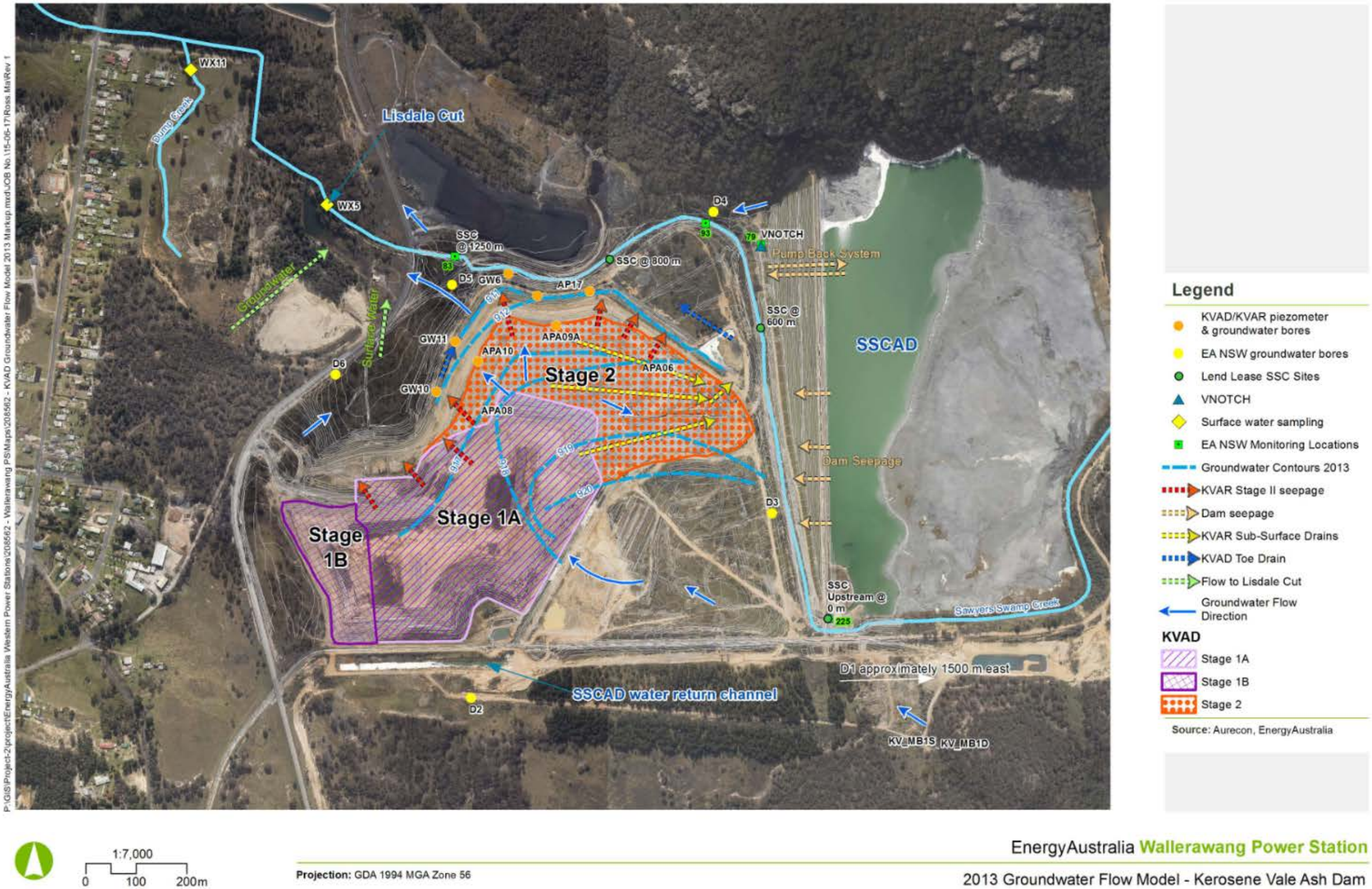

Figure 5: Kerosene Vale Ash Dam and Stage 1 and Stage 2 Dry Ash Repository Groundwater Level (RL m) Contours with Inferred Flow Directions (from sketch provided by Lend Lease Infrastructure to EnergyAustralia NSW)

3.2 Groundwater Quality changes at Background Bores and SSCAD Seepage Bores

To understand groundwater quality changes, if any, at the KVAR/KVAD and bore D5 and D6 that have occurred since the 2015 and 2016 reporting periods, it is necessary to examine changes at the background bores, D1 and D2, as well as at the SSCAD seepage detection bores D3 and D4.

The SSCAD dam wall seepage that does not enter Sawyers Swamp Creek, but flows under it, is shown as flowing to the local groundwater sampled by bore D3 in Figure 5. The D3 groundwater quality is also expected to reflect the inflows of background groundwater from the south-east of the dam wall.

Table 2 shows there were no significant changes at bore D3 during the current reporting period, except for an increase in nickel. All the water quality and trace metals, except for iron and nickel had concentrations lower than the ANZECC/Local groundwater trigger values, while pH was acidic at 5.2.

Bore D4 samples the groundwater seepage near the SSCAD north wall embankment and, other than the higher salinity compared to D3, had similar low concentrations, but iron and manganese were much higher. The boron concentration at D4 decreased to below its local guideline in 2016/17 and the pH was slightly acidic, but less so than at D3.

The groundwater inflows from the northern end of the dam wall are mostly from the v-notch seepage point. Flows not collected and pumped back to the ash dam from the seepage collection pond, or those that enter Sawyers Swamp Creek, are sampled by bore D4. The groundwater quality at D4 was originally thought to be from the ash dam, but since 2014 the salinity (TDS) in the ash dam pond has decreased to be lower than in D4 (Aurecon, 2015). This was confirmed in 2015/16, as well as in 2016/17, which shows the TDS is about 800 mg/L (Table 6). Hence, it appears likely that some groundwater from outside the wider area of the ash dam pond, possibly from under the nearby escarpment, is influencing the salinity at bore D4. Other than the historically high iron and manganese concentrations at D4[6], there were no trace metals showing significant increases in 2016/17 and all the other characteristics were lower than the ANZECC/Local groundwater trigger values.

From these observations, it is unlikely that the seepage from the SSCAD to the groundwater at the seepage detection bores up-gradient of the KVAD/KVAR areas are the source of the elevated concentrations of sulphate, boron, nickel and zinc at bore AP17 at the KVAD north wall, or sulphate, boron, cadmium, copper, nickel and zinc at the KVAD south-western seepage (site 94) or at bore D5 (Table 3 in Section 3.3).

[6] The elevated D4 Baseline 90th percentile concentrations for cadmium, chromium and copper have not been seen since 2004 and may reflect improvements in trace metal analytical techniques rather than a real change in concentrations.

Table 2: Water Quality for SSCAD Seepage Detection Groundwater bores WGM1/D3 and D4 during Stage 2 to 2014/15 and the decommissioned KVAR period to 2016/17 compared to the Groundwater Background bore D2, Bore D4 90^{th} Percentile Baseline and Groundwater Guidelines or Goals

Element (mg/L)	SSCAD Seepage Affected Bores								Back-ground (April, 2016 to March, 2017)	D4 Baseline (Pre-Stage I 90^{th} Percentile)	ANZECC Guideline Goals for Ground-water
	Stage 2 Post-placement (February, 2012 to March, 2013)		Stage 2 Post-placement (April, 2014 to March, 2015)		Decommissioned KVAR (April, 2015 to March, 2016)		Decommissioned KVAR (April, 2016 to March, 2017)				
	D3	D4	D3	D4	D3	D4	D3	D4	D2	D4	
pH	6.1	5.7	5.8	5.9	5.6	6.2	5.2	6.0	4.2	6.8	6.5-8.0
Cond (µS/cm)	540	1500	668	1658	637	1548	673	1662	444	728	2600
TDS	330	1200	403	1358	373	1186	412	1217	274	510	2000
SO4	68	770	153	849	155	757	175	781	147	201	1000
Cl	66	35	74	45	67	32	70	42	22	45	350
Al	0.44	0.06	0.12	0.05	0.2	0.03	0.23	0.036	0.23	-	5.1
As	0.005	0.002	0.001	0.002	0.002	0.002	0.0015	0.0014	<0.001	0.006	0.024
Cd	0.0002	0.0002	0.0002	<0.0002	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0033	0.001
Cr	<0.001	<0.001	0.001	<0.001	0.001	0.001	<0.0001	<0.0001	0.001	0.011	0.004
Cu	0.004	0.003	0.0019	0.0013	0.001	0.001*	0.0017	<0.001	0.001	0.010	0.005
Fe	4.2	39.0	2.37	47.7	4.1	51.7	4.05	43.6	0.76	86	1.7
Mn	0.80	16.5	0.73	15.8	0.6	14.3	0.67	12.27	0.44	6.5	1.9
B	0.02	1.55	0.04	1.75	<0.05	1.72	0.04	1.62	0.09	0.49	1.7
F	0.10	0.10	0.10	0.10	0.05	0.04	0.05	0.04	0.02	0.24	1.5
Mo	<0.010	<0.010	0.001	<0.001	<0.001	<0.001	0.001	0.001	<0.001		0.01
Ni	0.12	0.040	0.108	0.032	0.103	0.03	0.154	0.030	0.051	0.023	0.137
Pb	0.002	0.001	0.0015	0.001	0.002	0.001	0.001	0.001	0.001		0.005
Se	0.002	0.002	0.001	<0.002	<0.001	<0.001	0.0001	0.0001	<0.0001	0.002	0.005
Zn	0.070	0.065	0.140	0.049	0.075	0.038	0.116	0.039	0.061	0.060	0.505

3.3 Groundwater Quality changes at KVAR/KVAD and Seepage Bores

This Section assesses the effects of the KVAR/KVAD groundwater on the water quality at the receiving groundwater bore D5. This is undertaken by examining changes in the groundwater quality at the bores inside the KVAD and at its seepage points with the water quality at the receiving water bore D5 during 2015/16 and the current reporting period in Table 3. The KVAD groundwater receives the rainfall seepage through the dry ash KVAR placement on top of the KVAD, so the assessment of effects on D5 reflect the combined effects of the KVAR/KVAD on the local groundwater quality.

Although the Local/ANZECC trigger concentrations only apply to bore D5, the characteristics at all the sampling sites in Table 3 that had higher concentrations are highlighted in blue to indicate potential sources of salts and trace metals to the local groundwater.

The following description of water quality changes begins for the bores inside the KVAD and seepage from the KVAD walls. These are then compared to the water quality conditions at bore D5. The changes at bore D6 and at the Lidsdale Cut pond are examined in Tables 5 and 6.

As discussed in previous reports, the high salinity in the KVAD is mostly due to generation of sulphate by oxidation and dissolution of the coal waste/chitter pyrites. The resulting acidic conditions cause the release trace metals into the KVAD groundwater and seepage.

Table 3: Average Water Quality changes for bore D5 compared to changes in KVAD Groundwater Quality from 2015/16 (in parentheses if significant) to 2016/17

Element (mg/L)	Bore D5 ground-water Quality in 2016/17	KVAD Groundwater Quality 2016/17					
		AP09	GW11	AP17	KVAD Ground-water Seepage North Wall (Site 86)	KVAD Ground-water Seepage South-west Wall (Site 94)	Ground-water Guidelines or Goals*
pH	(4.0)3.8	(6.1) 5.9	(7.6)6.5	(3.9) 3.7	(3.0) 2.9	(3.4) 3.3	6.5-8.0
Cond (µS/cm)	(1020) 773	(2240) 2722	(318) 208	(4934) 5090	(4096) 4318	(3770) 3741	2600
TDS	(752) 556	(1720)2224	(266) 179	(4710) 4862	(3110) 3440	(3440) 3122	2000
SO4	(495) 341	(1159)1456	(45) 30.5	(3319) 3236	(2400) 2337	(2406) 2099	1000
Cl	(26.1) 19.0	(41.4) 29.8	(27.2) 14.3	(16.7) 16.0	(18.6) 19.1	(36.3) 39.0	350
Al	(18.9) 15.0	(0.25) 0.35	(9.2) 1.5	(62.1) 70.9	(5.58) 17.4	(93.8) 52.9	5.10**
As	(0.005) 0.003	0.072	(0.003) <0.001	(0.004) 0.046	0.004	(0.019) 0.007	0.024
B	(1.76) 1.23	2.3	(0.05) 0.06	(11.7) 12.61	(8.1) 9.0	(9.65) 8.61	1.7
Cd	(0.036) 0.0058	<0.0001	0.0001	(0.0007) 0.0015	0.0002	(0.025) 0.011	0.001
Cr	(0.0046) 0.0049	<0.001	(0.004) <0.001	0.001	0.001	(0.009) 0.005	0.004
Cu	(0.045) 0.022	0.0013	(0.015) 0.004	(0.017) 0.006	0.001	(0.022) 0.014	0.005
F	(0.67) 0.41	(0.61)0.43	0.065	(101.6) 85.3	(4.1) 17.8	(17.2) 14.8	1.5
Fe	(1.83) 1.20	(53.9) 93.1	(0.076) 0.53	(213) 196	(72.1) 52.2	(18.1) 28.1	1.7
Mn	(5.12) 3.58	(7.27) 8.65	0.006	(14.4) 12.65	16.1	(15.9) 21.0	1.9
Mo	0.002	(0.121) 0.106	<0.001	(0.029) 0.009	0.001	0.001	0.01
Ni	(0.354) 0.271	(0.303) 0.557	(0.01) 0.003	1.81	1.15	(1.46) 1.615	0.137
Pb	(0.072) 0.026	0.001	(0.025) 0.002	0.002	0.001	(0.004) 0.006	0.010
Se	0.002	0.0003	<0.001	(0.001) 0.053	0.002	(0.018) 0.007	0.005
Zn	(2.07) 0.883	(0.127)0.237	(0.102) 0.016	5.40	(1.56) 2.16	2.47	0.505

* From Table 1

** Dump Creek 90th Percentile and bore D6 90th percentile (data for both from April, 2012 to March, 2015). These sites used as background for period since Lidsdale Cut discharge to SSC stopped (see Sections 4.2 and 4.3 for explanation).

Bore AP09 samples the groundwater inside the KVAD near the north wall (Figure 2) and had an increase in salinity during 2016/17, such that sulphate has continued to exceed 1,000 mg/L since

2015/16 (Table 3). The salinity at D5 is much lower, indicating the north wall seepage is not a significant input to the groundwater sampled by D5.

The pH at AP09 decreased to 5.9 but was higher than in the groundwater at D5 and as a result, the concentrations of cadmium, chromium, copper, lead and zinc were much lower than at D5. Nickel, which had a similar concentration as D5 in 2015/16, increased at AP09 while it decreased at D5 during the current reporting period. In addition, iron, manganese and molybdenum were much higher than at D5. Due to its low solubility in flyash (Kapoor and Christian, 2016) and its slightly acidic pH, the aluminium concentration at AP09 was low at 0.25mg/L compared to the 15 mg/L at D5.

Bore AP17 samples the groundwater in the chitter bench under the KVAD north wall, has an acidic pH of 3.7 and continued to have a very high salinity and sulphate at about 10-fold higher than at bore D5. There was a moderate increase in salinity at this bore since 2015/16 and the sulphate concentration appears associated with its high concentrations of boron, fluoride, iron, nickel and zinc (chemical changes due to coal pyrite oxidation releases sulphate into the groundwater and the resulting acidic conditions release associated trace metals into solution). There were also significant increases since 2015/16 for arsenic, cadmium and selenium.

These groundwater metal concentrations reflect the local mineralised conditions in the area because the benches supporting the dam wall are constructed of coal waste/chitter taken from the Lidsdale cut mine void (see Attachment 3). Hence, the aluminium concentration of 70.9 mg/L (increased from 62 mg/L in 2015/16) is similar to that in the Lidsdale Cut (Table 5) but much lower than at Bore D5.

Groundwater seepage from the KVAD North Wall (Site 86) occurs at a higher level than the groundwater sampled by AP17 but is also highly acidic at pH 2.9. As for bore AP17, the salinity increased at the seepage site in the current reporting period, as did aluminium, boron, fluoride, iron and zinc. The high salinity and sulphate continued since 2014/15 with moderate increases since the previous year. Of the trace metals, significant increases were noted for the local mineralised elements of boron, fluoride and zinc, while manganese and nickel remained unchanged.

There were only two measurements at bore GW11, which were taken in July and September, 2016. The bore samples the KVAD groundwater on its western side and the low salinity, neutral pH and low concentrations of trace metals shows it to be sampling freshwater inside the KVAD that is not located near chitter benches used in other areas of the dam wall construction. The aluminium concentration decreased from 9.2 to 1.5 mg/L in the current reporting period, while the copper and nickel concentrations increased.

In contrast with the neutral pH, low salinity and trace metals at the western wall groundwater bore GW11, the KVAD groundwater seepage from the south-western wall (Site 94) is acidic, has high salinity and sulphate and high trace metal concentrations that are similar to that at the north wall groundwater (AP17) and seepage (Site 86). The Site 94 seepage is from the base of the dam wall and is understood to originate from the coal mine void under the wet ash placement. During 2016/17, there were moderate decreases at this site for salinity and sulphate, significant decrease for aluminium, arsenic, cadmium, chromium, copper and selenium, as well as moderate decreases for some of the other metals but increases for iron, manganese and nickel. All of the salinity characteristics and most of the trace metals had higher concentrations than at the receiving groundwater bore D5.

The lack of effects of the groundwater seepage from the long-held ash in the KVAD on trace metal concentrations at bore D5 is supported by the low selenium concentrations at D5. In addition, the lack of effects of the KVAD seepage on the salinity and sulphate at D5 is supported by the low salinity at

GW11, which samples the groundwater on the western side of the dam wall. Moreover, Table 3 shows that the salinity conditions at D5 have decreased since 2015/16, supporting the previous view that the groundwater level decrease inside the KVAD has limited the effects of seepage flows on the groundwater quality at bore D5 (Aurecon, 2015 and 2016).

Hence, the high salinity conditions, and the associated high trace metal concentrations, including aluminium, at the north wall and south-west walls is clearly related to the use of the coal mine void to store the ash, as well as chitter used in construction of the dam walls. Hence, the continuing low selenium and low salinity at D5 indicates no overall effects of the KVAR/KVAD groundwater on the water quality at D5. This view is in agreement with the estimated rainfall infiltration effects on the KVAD groundwater beneath the KVAR, as well as the consequential effects on Sawyers Swamp Creek, undertaken in 2014/15 and 2015/16 (Aurecon, 2015 and 2016).

3.3.1 Long-term changes at Groundwater Seepage Detection Bores

The long-term changes at bore D5 and Lidsdale Cut are shown in Tables 5 and 6 to assist with understanding the effects of the groundwater level changes shown in Figure 4 and pumping of water from Lidsdale Cut and associated changes in salinity, trace metals and aluminium concentrations.

To put the above assessments into the context of the long-term changes, Table 4 summarises the long-term groundwater quality changes at the KVAR/KVAD seepage detection groundwater bores, D5 and D6, during the Stage 2 dry ash placement to the decommissioned KVAR in 2016/17.

Table 4 shows the current average pH at Bore D5 is 3.8 and similar to that during previous periods. The salinity decreased from 752 mg/L in 2015/16 but is higher than at the beginning of the Stage 2 placement in 2012/13 and remained well below the guideline concentrations. All the trace metal concentrations decreased from 2015/16 to 2016/17, including aluminium and those that remained the same were already lower than the local guidelines.

Most of the trace metals at D5 remained above the Local/ANZECC trigger concentrations during the current reporting period, in contrast to the conditions at the beginning of the Stage 2 placement, when most of the metals had concentrations lower than the trigger concentrations. As discussed in previous reports, this change is considered to be due to the reduction in groundwater levels caused by installation of the subsurface drains in 2010, and possibly due to the reduction in water level in the Lidsdale Cut Pond since 2012.

The results for bore D6 are shown in Table 4. It shows that most of the trace metal concentrations, including aluminium but not for selenium, have increased since 2012/13. During the current reporting period, there have been small decreases for cadmium and zinc, but continued increases in iron and aluminium since the previous reporting period.

Table 4: Long-term Groundwater Quality changes for KVAD groundwater seepage bores WGM1/D5 and D6 from Initial Stage 2 to current decommissioned period compared to background Bore D2, Bore D5 90th Percentile Baseline and Groundwater Guidelines or Goals

Element (mg/L)	KVAD & KVAR Dry Ash Placement Monitoring Bores								Back-ground April 2013 to March 2015	D5 Baseline Pre-Stage I 90th Percentile	ANZECC Guideline Goals for Ground-water
	Stage 2 February, 2012 to March, 2013		Stage 2 April, 2014 to March, 2015		Decommissioned KVAR (April, 2015 to March, 2016)		Decommissioned KVAR (April, 2016 to March, 2017)				
	D5	D6	D5	D6	D5	D6	D5	D6	D2	D5	
pH	3.7	3.4	3.9	3.3	4.0	3.8	3.8	4.0	4.0	4.5	6.5-8.0
Cond (µS/cm)	580	1300	717	1475	1020	1328	773	1600	503	810	2600
TDS	430	885	533	1007	752	1010	556	1294	290	550	2000
SO4	240	530	330	658	495	678	341	807	159	328	1000
Cl	13	47	19.2	40	26.1	29.2	19	44.0	30	24	350
Al	7.5	1.85	16.7	3.55	18.9	4.5	15.0	5.51	0.27	-	5.1
As	0.001	0.002	0.007	0.005	0.005	0.003	0.003	0.001	0.001	0.008	0.024
B	0.80	0.63	1.06	0.85	1.76	0.76	1.23	0.88	0.1	1.7	1.7
Cd	0.001	0.0002	0.0334	0.002	0.036	0.002	0.0058	0.0014	0.0001	0.004	0.001
Cr	0.002	0.0015	0.005	0.002	0.0046	0.002	0.0049	0.002	0.0014	0.041	0.004
Cu	0.003	0.005	0.034	0.005	0.045	0.008	0.022	0.0107	0.0036	0.058	0.005
Fe	0.35	54.5	0.79	80.7	1.83	66.6	1.20	103.1	1.2	14.7	1.7
Mn	3.5	4.45	4.13	4.75	5.12	3.4	3.58	4.85	0.63	2.5	1.9
Mo	0.01	0.010	0.007	0.001	0.002	<0.001	0.002	<0.001	0.001	-	0.010
F	0.60	0.30	1.28	0.51	0.67	0.46	0.41	0.40	0.09	0.65	1.5
Ni	0.230	0.345	0.316	0.496	0.354	0.50	0.271	0.490	0.068	0.137	0.137
Pb	0.002	0.002	0.0625	0.012	0.072	0.015	0.026	0.010	0.002	0.021	0.010
Se	<0.002	0.002	0.003	0.001	0.002	<0.001	0.002	0.0002	0.001	0.002	0.005
Zn	0.560	0.920	1.62	1.30	2.07	1.30	0.883	1.220	0.094	0.505	0.505

Figure 6 shows the average concentrations for aluminium, cadmium, copper, lead and selenium at bore D5 during each reporting period since 2010/12. Other than selenium, which remained below its local goal, there were large increases during 2014/15 and 2015/16, followed by decreases in 2016/17. By comparison, the aluminium, copper, cadmium and lead concentrations in the KVAD western wall bore GW11 (Table 3) were all lower than at bore D5, while copper and lead in the south-western seepage (Site 94) were lower than at bore D5. This suggests another source of these metals at Bore D5, potentially from coal pyrites in the wider KVAD/Lidsdale Cut area.

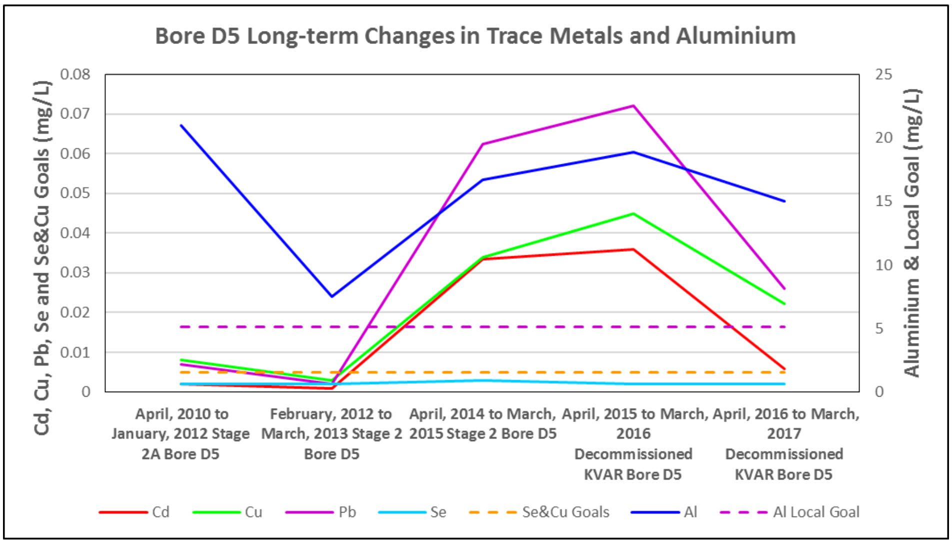

Figure 6: Average concentrations of trace metals and aluminium at bore D5 for each reporting period since 2010/2012.

3.4 Long-term changes for Lidsdale Cut Water Quality

The Lidsdale open-cut mine void pond receives most of the groundwater seepage from the KVAD via its toe drains/ pipeline from the Collection Pond. This includes rainfall infiltration through the KVAR dry ash placement into the KVAD groundwater. In addition, surface runoff from the KVAR is collected in pits that also collect groundwater KVAD seepage in the subsurface drains, and this combined surface and subsurface water is also sent to Lidsdale Cut via the toe drains/ pipeline from the Collection Pond.

EnergyAustralia NSW has confirmed that the Lidsdale Cut pond water level is pumped down to between 0.4 to 0.6m above the bottom of the pond. Previous reports have shown large increases in trace metal concentrations in the pond due to the effects of pumping down the water level, so the water quality changes in Lidsdale Cut since pumping began are examined in this Section.

Table 5 summarises the data from Stage 1 during May, 2003 to March, 2010 and the initial Stage 2 period to the current decommissioned period.

Table 5 shows that since 2012, the salinity and sulphate, and most of the trace metal concentrations, including aluminium, increased. The high sulphate concentrations suggests the source as pyrites in the coal waste/chitter that forms the Lidsdale open-cut mine void and surrounding areas. Trace metals that were held by the dense aquatic vegetation and subsequently released, due to the water level decrease, probably contributed to the initial increases.

Since the peak in 2014/15, the sulphate concentration has decreased to 2016/17, as has aluminium and nearly all the other trace metals except for manganese and selenium. Comparison of the selenium concentrations in Table 5 with that in Table 3 shows that the selenium is not from the KVAD because the pond concentration is higher than in the KVAD groundwater and seepage points.

Table 5: Long-term Groundwater Quality changes for Lidsdale Cut Water Quality from Stage 1 and its Capping and Stage 2 to the current decommissioned period compared to the pre-placement conditions and the Groundwater Guidelines or Goals

Element (mg/L)	Lidsdale Cut (WX5)							
	Pre-Placement (1992-2003) 90th Percentile	Initial Stage 2 (April, 2009-March, 2010)	Stage 2A (April, 2010-January, 2012) *	Stage 2 * April, 2013 to March, 2014	Stage 2 April, 2014 to March, 2015	Decommissioned KVAR (April, 2015 to March, 2016)	Decommissioned KVAR (April, 2016 to March, 2017)	Ground-water Guidelines or Goals
pH	6.9	3.4	4.8	3.4	3.5	3.4	3.4	6.5 – 8.0
Cond/ (µS/cm)	952	1965	1011	3917	4146	2549	2435	2600^
TDS	650	1500	740	4083	4633	2089	2094	2000
SO4	359	970	460	2900	3148	1529	1311	1000
Cl	34	19	21	28.7	33	21.1	19.5	350
Al	2.43	-	9.7	155	198	61.1	49.9	5.1
As	<0.001	0.002	0.002	0.020	0.030	0.013	0.009	0.024
B	2.16	5.20	2.4	13.3	14.8	6.6	5.57	1.7
Cd	<0.001	0.0008	0.0013	0.047	0.059	0.0156	0.011	0.001
Cr	<0.006	0.0013	0.001	0.020	0.0337	0.006	0.005	0.004
Cu	<0.005	0.003	0.004	0.031	0.068	0.016	0.011	0.005
F	1.99	6.70	2.60	28.7	30.0	13.2	10.23	1.5
Fe	0.7	3.05	0.04	-	-	8.27	6.52	1.7
Mn	2.12	6.30	4.10	2.5	2.53	8.48	9.62	1.9
Mo	-	0.010	<0.010	0.001	0.004	0.001	0.001	0.010
Ni	-	0.540	0.280	1.08	1.129	0.752	0.748	0.137
Pb	0.004	0.003	0.002	0.015	0.006	0.013	0.006	0.01
Se	0.001	0.001	0.002	0.058	0.072	0.022	0.0558	0.005
Zn	0.304	1.20	0.520	2.84	2.815	1.62	1.427	0.505

* EnergyAustralia NSW was unable to monitor the water quality in the Lidsdale Cut void from July, 2012 to March, 2013 due to drawdown of the void water level by the pumps.

Figure 7 shows the changes over time from pre-Stage 2 to 2012 and to the current reporting period for aluminium, cadmium, copper, lead and selenium. The large increases from below the local goals[7] since pumping began in 2012 are shown for concentrations of selenium, cadmium, copper and aluminium from 2012 to their peak in 2014/15 and the large reductions during 2015/16 and further reductions in 2016/17.

[7] Note that the local goals, which apply to WX7 in Sawyers Swamp Creek, rather than the Lidsdale Cut pond, are shown in Figure 7 for comparative purposes only.

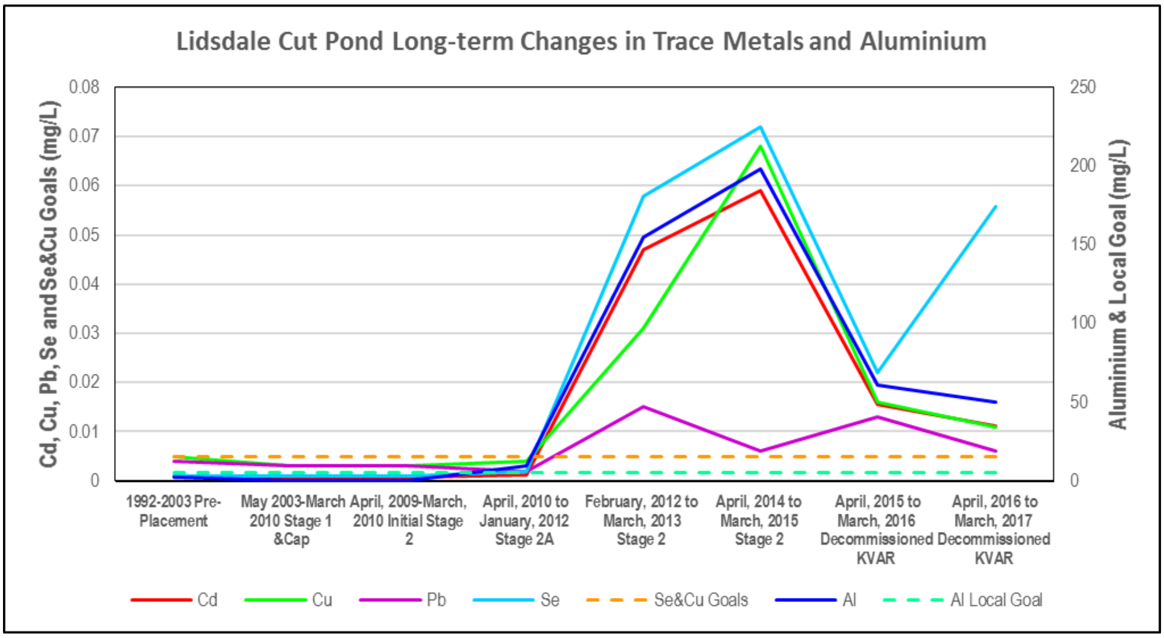

Figure 7: Average concentrations of trace metals and aluminium in the Lidsdale Cut Pond from the pre-KVAR placement period and each reporting period since 2003/2010

Before updating the potential effects of seepage from the KVAR/KVAD on Sawyers Swamp Creek, a review of the effects of the SSCAD on the water quality on the creek is undertaken in the next Section.

4. Review of Surface Water Quality

This Section reviews the changes in water quality at the receiving water site, WX7, in Sawyers Swamp Creek which has become dominated by the effects of the Springvale coal mine water discharge into the creek since it became continuous in 2013. Other than the coal mine discharge, other potential sources of effects on the water quality at WX7 are the Sawyers Swamp Creek Ash Dam (SSCAD) pond seepage from under the wall, as well as the effects of seepage from the KVAR/KVAD further downstream.

Previous reports have shown that, prior to the Springvale coal mine water discharge into the creek since it became continuous in 2013, the SSCAD seepage was causing a moderate increase in salinity but there was no significant effect on trace metals. Although the mine water discharge now dominates the water quality in the creek, EnergyAustralia NSW has continued to monitor the water quality in the SSCAD pond and at the main v-notch seepage point so significant changes can be related to the pre-mine water flow conditions. In addition, a seepage return water system was installed in May, 2010, so most of the v-notch seepage has been prevented from entering the creek since then. In addition, water discharged from the Lidsdale Cut pond to the creek was stopped and the water has been pumped into the return canal since June, 2012.

The effects of seepage from the KVAR/KVAD on Sawyers Swamp Creek were assessed as not significant in the 2014/15 and 2015/16 reports and those potential effects are updated in Section 4.3.

4.1 Springvale Coal Mine Water Discharge

Table 6 shows that the Springvale coal mine water discharge is characterised by high alkalinity at 626 mg/L, has low salinity, sulphate concentrations and low trace metals, except for elevated concentrations of arsenic, copper and molybdenum. Table 6 also shows that the Sawyers Swamp Creek water quality, at the sampling sites upstream and downstream of the SSCAD v-notch seepage, reflects these elevated characteristics of the mine water.

4.2 Sawyers Swamp Creek Ash Dam effects on Surface Water Quality

Table 6 shows the long-term changes in water quality in the SSCAD pond and the current v-notch seepage, compared to the differences in the creek water quality from upstream to downstream of the v-notch seepage in 2015/16[8].

The effects of the SSCAD seepage on the water quality in Sawyers Swamp Creek is assessed by comparison of the sampling sites upstream and downstream of the v-notch seepage. The upstream site (Site 225, Figure 1) is located in the creek just downstream of the ash dam spillway. Catchment runoff from upstream of the ash dam enters the creek, via a pipe, that discharges over the spillway and joins the creek flow just upstream of the sampling location. The mine water discharge enters the creek upstream of the dam spillway at Site 158 (after treatment to settle suspended solids, see Figure 2) and mixes with the catchment runoff. Hence, the water quality differences from upstream to downstream

[8] Note that elements in the pond and the seepage with higher concentrations than the local guidelines are highlighted in blue to indicate potential sources of salts and trace metals, the guidelines actually apply to the receiving water site at WX7 (without the effect of the Springvale Mine discharge) and not the pond or the v-notch seepage.

(site 93) covers the length of the entire dam wall. In this way, any seepage from the dam wall that enters the creek along its length could be addressed.

Table 6 shows no significant increases in salinity, sulphate or trace metals at Site 93 downstream of the SSCAD seepage to the creek.

Table 6: Water Quality in SSCAD for Pre-placement and Stage 2 Periods to 2014/15 and the V-notch Seepage Compared to Sawyers Swamp Creek Up- and Downstream of the V-notch and Surface Water Guidelines or Goals

Element (mg/L)	Pre-Placement (1996-2003)	Stage 2 February ,2012 to March, 2013	Stage 2 during April, 2013-March 2015	Decommissioned KVAR (April, 2015 to March, 2016)	Decommissioned KVAR (April, 2016 to March, 2017)	V-Notch Seepage Site 79 2016/17	SSC Up-stream V-Notch Seepage Site 225 April, 2016 to March, 2017	SSC Down-stream V-Notch Seepage Site 93 April, 2016 to March, 2017	Springvale Mine water discharge (site 158)	ANZECC (2000) Guidelines & Goals for SSC
	SSCAD	SSCAD	SSCAD	SSCAD	SSCAD	SSCAD v-notch	SSC	SSC	Springvale Mine Water	
pH	5.4	4.8	6.1	4.8	5.1	6.9	8.1	8.5	8.0	6.5-8.0
Cond (µS/cm)	1219	1457	1496	1169	1162	1293	1189	1184	1186	2200
TDS	858	1066	1083	820	802	990	676	660	925*	1500
SO4	553	674	710	563	544	522	38.2	25.8	28.9	1000
Cl	18	20	19	13.9	14	32.9	7.1	5.6	5.5	350
Alk	18	25	28	3.6	0.63	133	592	611	626	-
Al	-	4.5	2.16	7.77	5.50	3.6	0.29	0.29	0.31	5.25
As	0.016	0.002	0.002	0.002	0.002	0.002	0.026	0.026	0.0272	0.024
Cd	0.012	0.0042	0.0038	0.0046	0.0042	0.0016	0.0001	<0.0001	<0.0001	0.0015
Cr	0.005	0.0028	0.001	0.001	0.001	0.001	0.001	<0.001	-	0.005
Cu	0.007	0.0203	0.0055	0.011	0.0103	0.014	0.001	<0.001	0.0086	0.005
Fe	0.17	0.08	0.10	0.13	0.06	0.102	0.013	0.024	0.30	0.3
Mn	1.2	1.17	1.23	1.64	1.77	4.87	0.019	0.002	0.0126	1.9
B	4.7	1.82	2.07	2.15	2.27	0.92	0.098	0.144	0.087	1.25
F	9.3	2.21	2.19	2.73	2.44	1.358	1.00	1.18	1.24	1.5
Mo	0.152	0.013	0.024	0.004	0.014	0.005	0.040	0.042	0.041	0.01
Ni	0.129	0.071	0.076	0.108	0.119	0.105	0.004	0.003	0.003	0.05
Pb	0.002	0.003	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.005
Se	0.151	0.009	0.004	0.003	0.003	<0.001	<0.001	<0.001	0.0002	0.005
Zn	0.426	0.263	0.196	0.360	0.356	0.156	0.008	0.010	0.001	0.153

*Springvale TDS estimated from TDS=0.78xconductivity

The only significant changes in the SSCAD pond from 2015/16 to the current reporting period were for a decrease in aluminium and a rebound in the molybdenum concentration from a low level in 2015/16 to similar levels present in 2012/13.

As mentioned in previous reports, trace metals are removed from the SSCAD pond water as it passes through the dam wall soils and exits into the creek at the v-notch. During 2016/17, significant decreases were observed for aluminium, cadmium, boron, fluoride, molybdenum and zinc in the v-notch concentrations relative to that in the pond. It is assumed that a similar removal process occurred for the whole length of the dam wall. The only metal that showed an increase as the water passed from the SSCAD pond through the dam wall as seepage was manganese, which had been observed previously.

The V-notch trace metal concentrations (even if they were not pumped back into SSCAD) are not expected to increase the concentrations in the creek above their guideline levels, even without the Springvale mine water flows. The two previous reports estimated that the v-notch seepage flow was about 0.069 ML/day compared to the estimated Sawyers Swamp Creek flow of about 4.5 ML/day at WX7, giving a 60-fold dilution. This amount of dilution was also expected to be sufficiently high enough to allow for the unknowns of seepage along the whole length of the dam wall (Aurecon, 2015 and 2016).

The SSCAD long-term changes are shown in Figure 8, since the wet ash placement to conversion to dry ash at the KVAR in 2003, for conductivity and sulphate, as well as the trace metals boron, manganese, nickel and zinc.

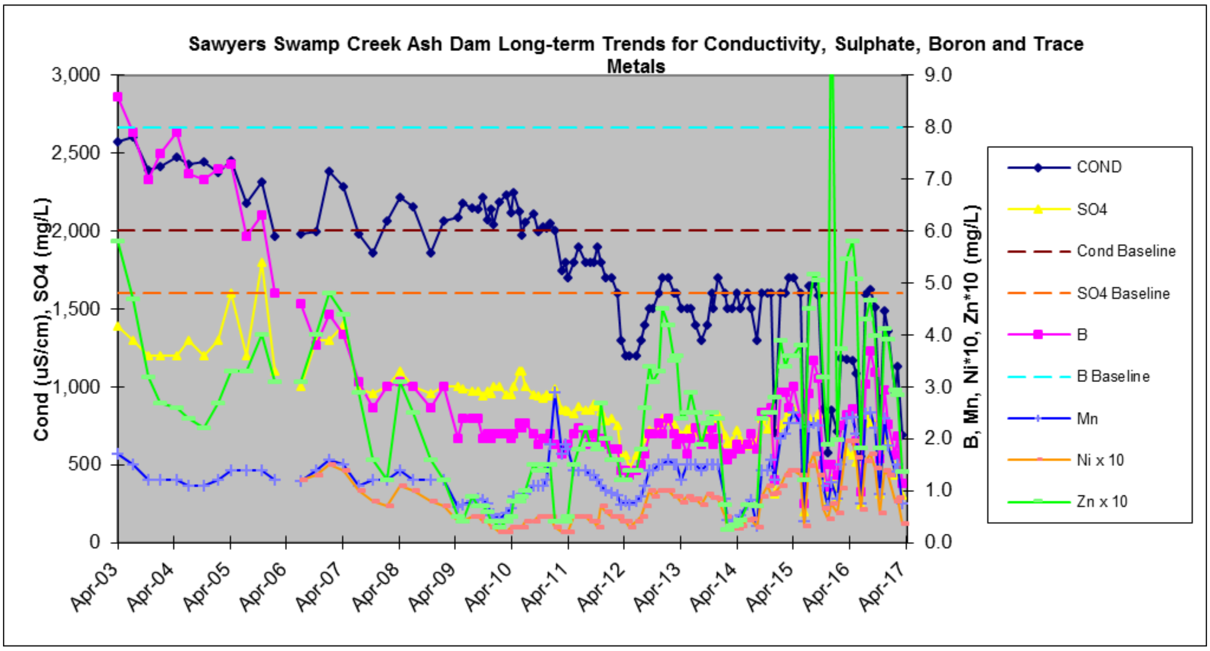

Figure 8: Long-term trends in conductivity, sulphate and trace metals in SSCAD Pond since cessation of wet ash placement and beginning dry ash placement at KVAR from 2003 to 2014 and KVAR decommissioning to 2017 with pumping from Lidsdale Cut since 2012.

Figure 8 shows significant improvements in conductivity, sulphate and boron concentrations since 2003. There has been a trend for increase since 2010 for nickel and manganese concentrations, while zinc increased significantly during 2015/16 and was considered to be related to release from the pond sediments under low oxygen conditions (Aurecon, 2016).

The conductivity has become highly variable in recent years and the boron tends to follow that variability, as does nickel and zinc. This may reflect the effects of rainfall runoff on concentrations in the reduced size of the pond at the dam wall.

As the Sawyers Swamp Creek Ash Dam is unlikely to have had a significant effect on water quality or trace metals, the effects of KVAR/KVAD groundwater seepage on the creek further downstream are examined in the next Section.

4.3 KVAR/KVAD Groundwater Seepage Effects on Sawyers Swamp Creek

Table 7 shows that the water quality and trace metals in Sawyers Swamp Creek at WX7 are dominated by the effects of the Springvale mine water.

Table 7: Water quality in Sawyers Swamp Creek at WX7 due to groundwater seepage from the KVAR/KVAD (see Table 3), SSCAD seepage (see Table 6) and Dump Creek mineralised background conditions compared to Sawyers Swamp Creek concentrations with and without Springvale coal mine discharges for the previous 2015/16 and the current periods compared to ANZECC (2000) Guidelines or Local Goals

	Sawyers Swamp Creek (WX7)							Dump Creek (WX11)	
Element (mg/L)	Pre-placement (1991-2003) 90th Percentile	Stage 2A (April, 2010-January, 2012) Median	Ongoing Stage 2 (February, 2012-March, 2013)	Stage 2 during April, 2013-March 2015	Decommissioned KVAR (April, 2015 to March, 2016)	Decommissioned KVAR (April, 2016 to March, 2017)	WX7 Pre-Springvale Mine Water Discharge#	Decommissioned Period (April, 2016 to March, 2017)	Surface Water Guide-lines or Goals
pH	7.6	7.3	7.5	8.7	8.8	8.7	6.3	3.4	6.5 – 8.0
Cond (µS/cm)	760	1100	828	1129	1154	1167	1070	1419	2200
TDS	584	690	553	696	659	661	774	927	1500
SO4	323	300	156	36	38	27	496	596	1000
Cl	27	16	11	5.3	5.9	5.5	26.5	22.2	350
Alkalinity	20	162*	257*	557	590	604	20	0.54	-
Al		10.5	23.8	0.20	0.42	0.42	0.274	3.29	5.25
As	<0.001	0.004	0.007	0.022	0.023	0.025	0.015	0.001	0.024
B	2.33	1.4	0.634	0.091	0.143	0.17	2.26	2.28	1.25
Cd	<0.001	0.0007	0.0011	0.0001	0.0001	0.0001	0.0006	0.0005	0.0015
Cr	<0.001	0.0025	0.0128	0.0013	0.001	0.001	0.0003	0.0011	0.005
Cu	<0.007	0.003	0.0099	0.0021	0.001	0.001	0.0004	0.0048	0.005
F	1.1	1.7	1.7	1.10	1.17	1.10	0.89	1.48	1.5
Fe	0.507	0.02	0.26	-	0.025	0.03	0.065	7.35	0.3
Mn	0.829	1.7	0.72	-	0.017	0.01	1.12	4.47	1.9
Mo	-	0.02	0.014	0.043	0.045	0.040	0.005	<0.001	0.01
Ni	-	0.16	0.059	0.006	0.005	0.004	0.142	0.362	0.05
Pb	0.003	0.002	0.003	0.0011	0.001	0.001	0.004	0.0048	0.005
Se	0.003	<0.002	<0.001	0.001	<0.001	<0.001	0.002	<0.001	0.005
Zn	0.153	0.45	0.035	0.025	0.012	0.009	0.144	1.008	0.153

*averages used to allow for effects of periods of mine water pipeline leakage or the recent discharge #Averages for KVAR Stage I period May, 2003 to July, 2007 from Connell Wagner (2008) before Springvale discharge into Sawyers Swamp Creek from 17th February, 2009

To assess the effects, if any, of the dry ash KVAR placement during the current reporting period on the receiving waters at WX7, the other potential sources of water quality and trace metal inputs to the creek have been examined.

These include the residual effects of the previous wet slurry Kerosene Vale Ash Dam (KVAD), as well as the KVAR rainfall infiltration, which have been examined in Table 3. Seepage from Sawyers Swamp Creek Ash Dam (SSCAD) are shown in Table 6. To allow for the local mineralised background conditions, the water quality and trace metal inputs from Dump Creek (WX11), are shown in Table 7.

The SSCAD v-notch seepage indicates that the only trace metals that may affect concentrations at WX7 are copper, manganese and nickel (Table 6). However, the copper and manganese concentrations at WX7, prior to the mine water discharge, were not elevated and the nickel concentration in Dump Creek, which enters Sawyers Swamp Creek upstream of WX7 has elevated nickel concentrations, as well as manganese.

As mentioned above, the combined KVAD/KVAR groundwater and seepages have limited effects on the local groundwater quality, as measured at the receiving water bore D5. Although some trace metal concentrations have increased over time at D5 (see Table 4) the groundwater seepage is diluted by the Sawyers Swamp Creek stream flows. Hence, the current effects, if any, of groundwater inflows to Sawyers Swamp Creek are assumed to be represented by the groundwater quality at bore D5 (see Table 3 and the long-term changes at D5 in Table 4).

The current potential effects of the KVAR/KVAD groundwater seepage on Sawyers Swamp Creek are indicated by the bore D5 seepage, relative to that of inflows from the background catchment of Dump Creek, which enters Sawyers Swamp Creek just upstream of WX7. Table 7 shows the WX7 water quality and trace metal concentrations without any Springvale mine water discharge prior to February, 2009. At that time, only boron and nickel concentrations exceeded the local guidelines at WX7. The current concentrations at D5 for boron (1.23 mg/L) are lower than in Dump Creek (2.28 mg/L), as are the nickel concentrations (D5 is 0.142 mg/L compared to 0.362 mg/L at Dump Creek).

Table 4 also shows that the D5 aluminium concentrations have been elevated since monitoring began, but the aluminium concentration at WX7 was not elevated during the period of natural stream flows prior to February, 2009 (Table 7). This shows a significant level of dilution of the groundwater seepage in Sawyers Swamp Creek, so effects of the KVAR/KVAD groundwater seepage on the creek are unlikely.

5. Discussion

This current review of the KVAR related surface and groundwater quality attempts to take into account the complex, locally mineralised conditions in which the KVAR is placed. The assessment of the effects of the decommissioned and partly capped KVAR has found similar results to those in 2014/15 and 2015/16, namely:

- Although the concentration of sulphate and of some coal pyrite related trace metals increased in the seepage from the KVAD wall during 2016/17, no significant effects of rainfall infiltration through the KVAR into the KVAD and then on the groundwater quality at bore D5 were apparent.
- The KVAR rainfall infiltration seepage rate is small, and it has to pass through the clay capping under the KVAR to enter the KVAD. The low selenium concentration in the receiving water bore D5 and the lower sulphate concentrations suggest that the KVAD/KVAR had essentially no effects on the local groundwater.
- Seepage effects of the local groundwater at D5 on the water quality and trace metals in Sawyers Swamp Creek at the receiving water site are unlikely due to dilution of the seepage by the natural stream flows (and Springvale mine water discharge).

Significant decreases in salinity and trace metal concentrations occurred in the Lidsdale Cut pond during 2016/17 compared to the elevated concentrations during the previous period and, other than selenium, the decreases continued during the current reporting period.

The current trace metal concentrations in the SSCAD v-notch seepage show that only a few are elevated after adsorption onto soils in the dam wall. Due to the slow rate of seepage into Sawyers Swamp Creek (especially as flows from the v-notch seepage are captured and returned to the ash dam pond), all the water quality, trace metals and aluminium concentrations are expected to be lower than the Local/ANZECC (2000) guideline concentrations in the creek, even without the diluting effects of the current Springvale mine water discharge.

Due to the reduced average salinity and relatively low concentrations of most of the trace metals in SSCAD, as well as adsorption of the trace metals as they pass through the dam wall soils, no significant effects have been seen at the seepage detection bore D3. In addition, although there has been a steady increase in salinity at bore D4, no effects on trace metals have been seen.

6. Conclusions

The overall conclusions of this assessment for the 2016/17 study is that:

- The KVAR is not having a significant effect on the local surface and groundwater quality.
- Leachates from the long-held ash in the KVAD have been largely depleted given the current conditions (as indicated by the very low selenium concentrations in the bore D5 groundwater).
- The slow rate of movement of groundwater from the KVAD appears to be the reason for no significant effects on the receiving water groundwater at bore D5.
- The trace metal and aluminium decrease in the Lidsdale Cut pond is possibly due to the previous accumulation by the wetland plants and soils, which is no longer being released to the same extent. The rate of selenium depletion appears to be slower than for the other elements.
- The SSCAD seepage is not having a significant effect on the local groundwater up-gradient of the KVAD. Seepage at the northern part of the dam wall has increased salinity above the MPGM4/D4 background levels, indicating that the increases are due to another source.

7. Recommendations

Based on the findings of this study, including the effects of pumping from Lidsdale Cut and the domination of the water quality in Sawyers Swamp Creek by the discharge of water from the Springvale Mine, the following recommendations are made:

- Continue monthly water quality monitoring at the EnergyAustralia NSW routine surface water and groundwater monitoring sites until the relevant Authorities advise on the decommissioning conditions for the site
- EnergyAustralia NSW continue to monitor the water quality in the Lidsdale Cut pond to see if the current decrease in concentrations continues.

8. References

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Attachment 1

Lithgow Rainfall Data

Lithgow Rainfall Data from January, 2000 to March, 2017 (mm/month) from Bureau of Meteorology

Year(s)	January	February	March	April	May	June	July	August	September	October	November	December	Annual
2000	57	22.2	271.4	50.6	53.4	32.2	37.4	51.2	43	75	119.2	59	871.6
2001	105.4	90.6	89.6	84.4	28.8	9	63.2	30.8	46.4	58.8	80	26.6	713.6
2002	87.8	187	69.4	40.2	67.6	22.6	16.8	17	21.2	3	22	47.2	601.8
2003	3.6	135	41.8	38.4	54	43.2	20.6	0	18.6	82.4	121	68.8	627.4
2004	35	98.2	22.4	10.4	35.2	16.2	30.2	50.8	34.8	118.4	113.8	88.6	654
2005	102.8	104.6	55.8	28.6	14.2	117.2	59.2	24.6	87.6	116.5	159.4	48.4	918.9
2006	146.6	32.6	6.4	6.8	6.8	6.8	54.2	5.8	59.2	3.2	32.2	72.7	433.3
2007	92.6	141.4	72.1	44.6	56.6	223	24.9	65.4	9	37.8	134.7	67	969.1
2008	102	84.6	47.6	59.8	11	60.9	37.1	43.6	88.2	66.2	83.3	113.2	797.5
2009	25.2	165.8	28	74.5	80.9	44.5	35.9	48.8	63	69	23.6	81.5	740.7
2010	76.4	119.2	85.1	35.8	54.4	40.9	73.5	73.5	52.4	70.9	122.8	164.6	969.5
2011	114	57.2	77.2	41.2	51.2	72.4	24.6	58.7	78.4	46.2	168	96	885.1
2012	57.1	152.6	189.8	44.4	30.6	81.8	49.8	21.2	48.6	20.8	30.9	64.1	791.7
2013	64.1	113.2	184.2	66.2	28.1	29	24.4	23.2	36.8	21.8	95.2	34.2	720.4
2014	13.6	74	143.8	63	14	43.2	24.2	24.2	27.9	60.7	21.8	174.3	684.7
2015	124.8	31	35	184	31	26	44.6	31.6	12.6	37.2	67.2	57.2	682.2
2016	166.6	46.6	36.8	6.6	20.6	170	102	61.8	92	54.2	51.4	94.8	903.4
2017	44.6	46.6	175.6										

Attachment 2

Wallerawang Power Station Ash Dam Surface Water and Groundwater Quality data from April, 2016 to March, 2017

Attachment contains:

- Pre-Dry Ash Placement Summary statistics before April, 2003 and;
- Sawyers Swamp Creek Summary statistics for April, 2016 to March, 2017 decommissioned period.

NOTE: Post-Dry Ash Placement Stage 1 and Stage 2 Raw Data and Summary statistics are in previous reports to March, 2016.

The following data and Summary Statistics are shown for:

1. Water Quality Data and Summary for Sawyers Swamp Creek WX7 and Background at Dump Creek WX11
2. Water Quality Data and Summary for Lidsdale Cut WX5
3. Water Quality Data and Summary for Sawyers Swamp Creek at WX1, upstream of SSCAD. EANSW site 92
4. Water Quality Data and Summary for SSCAD Groundwater Seepage Detection Bores WGM1/D3 and 1/D4
5. Water Quality Data and Summary for Background Groundwater Bore WGM1/D2
6. Water Quality Data and Summary for KVAD and KVAR Stage I and II Dry Ash Placements Seepage Detection Groundwater Bores WGM1/D5 and 1/D6
7. Water Quality Data and Summary for SSCAD (includes data from April, 2010 to January, 2012)
8. Water Quality Data and Summary for Sawyers Swamp Creek Monitoring from SSCAD Spillway to near WGM4/D5

Sawyers Swamp Creek EANSW & LLI WQ monitoring data, including:

- Sawyer Swamp Creek at WX1, upstream SSCAD. EANSW Site 92
- Sawyers Swamp creek upstream @0 m where SSCAD diversion and Springvale Mine Water from enters SSC at spillway
- Sawyers Swamp Creek Ash Dam Seepage from V-notch (water collected and recycling back into dam)
- Sawyers Swamp Creek at @850m - upstream seepage from KVAD wall and Below SSCAD v-notch Seepage Point. EANSW Site 93
- Sawyers Swamp Creek at 1250 m near GW Bore D5. EANSW Site 83

- KVAD/R Seepage water Northern wall collection pit near GW6 Groundwater from the KVAD on the north side drains
- KVAD southwestern seepage at Site 94
- KVAD groundwater Bores GW11, AP09 and AP17

1. Water Quality Data and Summary for Sawyers Swamp Creek WX7 and Background at Dump Creek WX11

a) *SAWYERS SWAMP CEEK AT WOLGAN ROAD BRIDGE WX7 (mg/L)*

Sawyers Swamp Creek WX7 Pre-Dry Ash Placement Summary 1991-April, 2003 (mg/L)																	
	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe	Hg	K	Mg
Average	0.001	0.274	22	0.001	0.919	0.037		20	0.001	19	44042	0.001	0.004	0.612	0.291	0.0001	12	15
Maximum	<0.01	0.647	84	<0.05	2.900	0.045		57	<0.002	82	147800	<0.01	0.009	3.100	0.927	0.0002	36	39
Minimum	0.001	0.105	5	0.001	0.205	0.030		4	0.001	6	3000	0.001	0.001	0.110	0.050	0.0001	1	4
90th Percentile	0.001	0.4927	33	0.001	2.331	0.043		38	0.001	27	76000	0.001	0.007	1.1	0.507	0.0002	27	22

*Outliers

Continued…………Sawyers Swamp Creek WX7 Pre-Dry Ash Placement Summary 1991-April, 2003 (mg/L)															
	Mn	**Mo**	**NO2+NO3**	**Na**	**NFR**	**Ni**	**Ortho P**	**Pb**	**pH**	**Se**	**SiO2**	**SO4**	**TDS**	**TOT P**	**Zn**
Average	0.635		0.061	40	21		0.006	0.002	7.0	0.002	12.2	160	308	0.017	0.099
Maximum	1.510		0.199	120	326		0.031	<0.01	9.3	<0.006	75.0	540	800	0.093	0.342
Minimum	0.153		0.009	11	2		0.001	0.001	6.1	0.001	0.1	38	20	0.001	0.004
90th Percentile	0.829		0.1158	86	23		0.013	0.003	7.6	0.003	22.4	323	584	0.047	0.153

*Outliers

Sawyers Swamp Creek WX7 Decommissioned Ash Placement Data (mg/l) April, 2016 to March, 2017 (mg/L)																																
Date	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	NO2+NO3	Na	NFR	Ni	Pb	pH	Se	SO4	TDS	TKN	TN	Zn
28-Apr-16	0.0005	0.83	630	0.04	0.23	0.036		4.9	0.00005	4.87	1200	0.0005	0.001	1.10	0.02400	0.00002	13.3	3.56	0.008	0.043	0.54	265		0.006	0.001	8.5	0.0003	33.4	652		0.9	0.018
18-May-16	0.0005	0.36	641	0.025	0.14	0.028		4.4	0.00005	5.42	1200	0.0005	0.0005	1.61	0.00900	0.00002	11.7	3.28	0.008	0.042	0.41	288		0.003	0.0005	8.7	0.0001	40.9	640		0.7	0.008
16-Jun-16	0.0005	0.28	602	0.031	0.44	0.029		4.36	0.00005	4.74	1200	0.0005	0.002	1.36	0.02700	0.00002	13	3.17	0.017	0.04	0.43	257		0.006	0.0005	8.6	0.0001	27.5	665		0.8	0.01
22-Jul-16	0.0005	0.57	539	0.03	0.1	0.031		4.82	0.00005	5.73	1100	0.0005	0.001	1.05	0.05000	0.00002	9.48	3.29	0.002	0.038	0.59	259		0.004	0.0005	8.8	0.0003	35.4	605		0.9	0.012
18-Aug-16	0.0005	0.39	566	0.021	0.12	0.028		4.01	0.00005	5	1100	0.0005	0.0005	0.93	0.01700	0.00002	10.8	2.97	0.01	0.042	0.55	241		0.003	0.0005	8.8	0.0001	23.8	682		1	0.008
22-Sep-16	0.0005	0.52	584	0.023	0.23	0.034		5.15	0.00005	6.12	1100	0.0005	0.0005	0.88	0.05400	0.00002	10.5	3.62	0.022	0.037	0.44	231		0.004	0.0005	8.8	0.0002	28.1	594		0.7	0.012
20-Oct-16	0.0005	0.27	646	0.022	0.15	0.03		4.45	0.00005	5.57	1100	0.0005	0.002	0.97	0.02000	0.00002	11.5	3.34	0.011	0.041	0.56	312		0.003	0.0005	8.7	0.0003	22.7	652		1	0.0025
17-Nov-16	0.0005	0.15	570	0.019	0.32	0.025		4.69	0.00005	5.76	1200	0.0005	0.0005	0.91	0.03100	0.00002	12.4	3.45	0.009	0.04	0.38	282		0.003	0.0005	8.8	0.0001	32.3	730		0.7	0.0025
15-Dec-16	0.0005	0.09	589	0.021	0.09	0.029		4.47	0.00005	5.64	1200	0.0005	0.0005	1.23	0.02200	0.00002	11.3	3.46	0.006	0.042	0.29	327		0.002	0.0005	8.7	0.0001	18.8	690		0.7	0.0025
25-Jan-17	0.0005	0.27	662	0.024	0.09	0.027		4.39	0.00005	5.57	1200	0.0005	0.0005	0.94	0.01900	0.00002	11.8	3.26	0.006	0.043	0.32	307		0.004	0.0005	8.7	0.0001	18.9	638		0.8	0.0025
16-Feb-17	0.0005	0.32	620	0.024	0.11	0.031		5.06	0.00005	5.45	1200	0.0005	0.0005	1.19	0.02800	0.00002	12.8	3.33	0.013	0.041	0.28	287		0.003	0.0005	8.7	0.0002	21.5	606		0.7	0.01
15-Mar-17	0.0005	0.95	597	0.022	0.07	0.036		9.94	0.00005	5.55	1200	0.0005	0.004	1.03	0.02000	0.00002	12.5	3.68	0.007	0.034	0.47	309		0.004	0.009	8.7	0.0003	25.7	780		1.0	0.021

Sawyers Swamp Creek WX7 Decommissioned Ash Placement Data (mg/l) April, 2016 to March, 2017 (mg/L)																																
	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	NO2+ NO3	Na	NFR	Ni	Pb	pH	Se	SO4	TDS	TKN	TN	Zn
Average	0.0005	0.42	604	0.025	0.17	0.030		5.1	0.0001	5.5	1167	0.001	0.001	1.10	0.03	0.00002	11.8	3.4	0.01	0.040	0.44	280		0.004	0.001	8.7	0.0002	27	661		0.83	0.009
Maximum	0.0005	0.95	662	0.040	0.44	0.036		9.9	0.0001	6.1	1200	0.001	0.004	1.61	0.05	0.00002	13.3	3.7	0.02	0.043	0.59	327		0.006	0.009	8.8	0.0003	41	780		1.00	0.021
Minimum	0.0005	0.09	539	0.019	0.07	0.025		4.0	0.0001	4.7	1100	0.001	0.001	0.88	0.01	0.00002	9.5	3.0	0.00	0.034	0.28	231		0.002	0.001	8.5	0.0001	19	594		0.70	0.003
50th Percentile	0.0005	0.34	600	0.024	0.13	0.030		4.6	0.0001	5.6	1200	0.001	0.001	1.04	0.02	0.00002	11.8	3.3	0.01	0.041	0.44	284		0.004	0.001	8.7	0.0002	27	652		0.80	0.009

b) Water Quality Data and Summary for Background at Dump Creek WX11

Dump Creek WX11 Pre-Dry Ash Placement Background Summary 1991-April, 2003 (mg/L)

	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	NFR	Ni	Pb	pH	Se	SO4	TDS	Zn
Average	0.001	0.13	7	0.001	0.64	0.03		32	0.001	23	56732	0.001	0.002	0.539	1.36	0.0002	23	24	0.63		76	5		0.001	6.6	0.002	209	559	0.09
Maximum	0.001	0.38	16	0.001	3.30	0.05		71	0.001	83	137113	0.001	0.002	1.200	11.00	0.0002	36	42	2.20		156	12		0.001	8.0	0.003	593	984	0.32
Minimum	0.001	0.04	0	0.001	0.04	0.02		18	0.001	8	32000	0.001	0.001	0.200	0.03	0.0002	14	14	0.09		39	2		0.001	3.6	0.001	88	362	0.00
90th Percentile	0.001	0.30	15	0.001	1.45	0.05		58	0.001	39	77000	0.001	0.002	1.100	2.38	0.0002	31	35	1.94		110	8		0.001	8.0	0.003	325	772	0.28

Dump Creek WX11 Decommissioned Ash Placement Data April, 2016 to March, 2017 (mg/L)

Date	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	NFR	Ni	Pb	pH	Se	SO4	TDS	Zn
28-Apr-16	0.0005	5.06	0.5	0.001	3.77	0.019		80.6	0.0006	23.1	2010	0.0005	0.004	2.87	10.3	0.00002	36.8	77	7.39	0.0005	115		0.58	0.005	2.95	0.0005	896	1440	1.53
18-May-16	0.0005	5.07	0.5	0.0005	2.82	0.02		80.9	0.0005	23.5	1910	0.0005	0.008	3.43	7.9	0.00033	32	74.1	6.02	0.0005	112		0.527	0.007	3.05	0.0007	825	1400	1.52
16-Jun-16	0.0005	3.83	0.5	0.0005	2.88	0.019		74.6	0.0007	20.4	1760	0.0005	0.005	1.65	9.45	0.00023	35.5	67.6	6.17	0.0005	108		0.534	0.005	3.18	0.0005	823	1090	1.43
22-Jul-16	0.0005	1.77	0.5	0.0005	1.06	0.017		38.5	0.0004	18.1	821	0.0005	0.005	0.665	1.02	0.00002	13.7	28.7	2.38	0.0005	51.4		0.197	0.002	3.91	0.001	360	537	0.542
18-Aug-16	0.0005	4.14	0.5	0.001	2.52	0.019		53.9	0.0005	26	1507	0.001	0.007	1.54	6.28	0.00002	23.1	49.9	4.89	0.0005	84.8		0.405	0.007	3.48	0.0006	598	876	1.21
22-Sep-16	0.0005	1	1	0.0005	0.62	0.015		20	0.0002	17.2	467	0.0005	0.002	0.353	0.593	0.00002	7.62	15.8	1.37	0.0005	34.1		0.091	0.001	5.44	0.0001	186	312	0.282
20-Oct-16	0.0005	2.41	0.5	0.0005	1.92	0.019		49.4	0.0005	27.9	1276	0.0005	0.003	1.14	4	0.00002	21.6	44.1	3.74	0.0005	79.2		0.299	0.004	3.25	0.0003	445	764	0.866
17-Nov-16	0.0005	2.14	0.5	0.0005	2.1	0.022		41.9	0.0004	20.8	1220	0.0005	0.002	1.24	7.91	0.00002	21.7	40.1	4.04	0.0005	70.7		0.279	0.003	3.31	0.0002	505	672	0.819
15-Dec-16	0.0005	4.58	0.5	0.001	2.36	0.04		61.7	0.0005	23.6	1564	0.002	0.005	1.56	11.3	0.00002	28.4	58.6	4.21	0.0005	103		0.358	0.009	3.23	0.0004	656	1060	1.02
25-Jan-17	0.0005	3.24	0.5	0.001	2.55	0.027		56.2	0.0004	23.3	1509	0.0005	0.006	1.41	13.4	0.00002	30.2	54.3	4.64	0.0005	93.5		0.345	0.005	3.23	0.0003	635	1220	0.875
16-Feb-17	0.0005	3.91	0.5	0.0005	2.99	0.034		71.1	0.0005	24.4	1788	0.0005	0.006	1.34	11.8	0.00002	38.5	65.4	5.34	0.0005	115		0.442	0.007	3.14	0.0004	745	982	1.24
15-Mar-17	0.0005	2.36	0.5	0.0005	1.78	0.016		47.7	0.0004	18	1200	0.0005	0.004	0.531	4.25	0.00002	25	39.9	3.5	0.0005	63.2		0.283	0.003	3.13	0.0002	478	772	0.766

Dump Creek WX11 Decommissioned Ash Placement Data April, 2016 to March, 2017 (mg/L)

	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	NFR	Ni	Pb	pH	Se	SO4	TDS	Zn
Average	0.0005	3.29	0.54	0.001	2.28	0.022		56.4	0.0005	22.2	1419	0.001	0.005	1.48	7.35	0.00006	26.2	51.3	4.47	0.001	85.8		0.362	0.005	3.4	0.0004	596	927	1.008
Maximum	0.0005	5.07	1.00	0.001	3.77	0.040		80.9	0.0007	27.9	2010	0.002	0.008	3.43	13.40	0.00033	38.5	77.0	7.39	0.001	115.0		0.580	0.009	5.4	0.0010	896	1440	1.530
Minimum	0.0005	1.00	0.50	0.001	0.62	0.015		20.0	0.0002	17.2	467	0.001	0.002	0.35	0.59	0.00002	7.6	15.8	1.37	0.001	34.1		0.091	0.001	3.0	0.0001	186	312	0.282
50th Percentile	0.0005	3.54	0.50	0.001	2.44	0.019		55.1	0.0005	23.2	1508	0.001	0.005	1.38	7.91	0.00002	26.7	52.1	4.43	0.001	89.2		0.352	0.005	3.2	0.0004	617	929	0.948

2. Water Quality Data and Summary for Lidsdale Cut WX5

Lidsdale Cut WX5 Pre-Dry Ash Placement Summary 1992-April, 2003 (mg/L)																													
	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	NFR	Ni	Pb	pH	Se	SO4	TDS	Zn
Average	0.001	2.43	14	0.001	1.70	0.042		28	0.001	26	74991	0.003	0.003	1.50	0.51	0.0002	39	17	1.41		62	7		0.003	4.7	0.001	266	518	0.219
Maximum	0.001	3.17	50	0.001	2.17	0.060		32	0.001	78	113402	0.010	0.005	2.20	1.00	0.0002	53	21	2.34		84	15		0.004	6.9	0.001	400	671	0.397
Minimum	0.001	0.70	1	0.001	0.54	0.030		24	0.001	15	37800	0.001	0.002	0.98	0.07	0.0002	16	8	0.21		31	3		0.002	3.2	0.001	92	400	0.072
90th Percentile	0.001	3.08	38	0.001	2.16	0.054		31	0.001	34	95200	0.006	0.005	1.99	0.70	0.0002	51	20	2.12		77	13		0.004	6.9	0.001	359	650	0.304

Lidsdale Cut WX5 Post-Dry Ash Placement Data April, 2016 to March, 2017 (mg/l)																													
Date	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	NFR	Ni	Pb	pH	Se	SO4	TDS	Zn
28-Apr-16																													
18-May-16																													
16-Jun-16	0.0005	53	0.5	0.012	7.08	0.015		161	0.0111	17.6	2750	0.006	0.018	9.87	9.99	0.00002	112	66.8	10.9	0.0005	160		0.955	0.007	3.09	0.09	1460	2240	1.7
21-Jul-16	0.0005	19.8	0.5	0.004	2.88	0.024		89.9	0.004	14.1	1414	0.002	0.005	5.85	5.11	0.00002	44.1	34.2	5.1	0.0005	84.7		0.414	0.004	4.02	0.03	633	996	0.809
17-Aug-16																													
22-Sep-16	0.0005	32.9	0.5	0.006	3.91	0.024		87.4	0.0074	15.1	1604	0.003	0.008	6.35	4.48	0.00002	57.8	37.2	5.79	0.0005	94.2		0.461	0.004	3.73	0.05	823	1260	0.944
19-Oct-16																													
16-Nov-16	0.0005	48.9	0.5	0.005	5.75	0.023		137	0.01	20.4	2455	0.003	0.01	10.3	5.48	0.00002	85.8	56.8	11	0.0005	142		0.699	0.008	3.3	0.04	1310	2220	1.47
19-Dec-16	0.0005	54	0.5	0.008	4.81	0.02		174	0.0119	23.5	2838	0.005	0.012	10.4	6.46	0.00002	104	72.8	10.4	0.0005	186		0.84	0.009	3.14	0.005	1620	2380	1.57
25-Jan-17																													
16-Feb-17																							1.12	0.006	2.99	0.12	2020	3470	2.07
15-Mar-17	0.0005	90.9	0.5	0.018	9	0.026		220	0.0221	26	3550	0.01	0.015	18.6	7.59	0.00002	160	88.1	14.5	0.002	222		0.955	0.007	3.09	0.09	1460	2240	1.7

Lidsdale Cut WX5 Post-Dry Ash Placement Data April, 2016 to March, 2017 (mg/l)																													
	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	Mn	Ni	Pb	pH	Se	SO4	TDS	Zn
Average	0.0005	49.9	0.5	0.0133	6.58	0.032		144.9	0.0111	19.5	2435	0.005	0.011	10.23	6.52	0.00002	94.0	59.3	9.62	0.001	148.2		0.748	0.006	3.4	0.0558	1311	2094	1.427
Maximum	0.0005	90.9	0.5	0.0230	10.10	0.077		220.0	0.0221	26.0	3550	0.010	0.018	18.60	9.99	0.00002	160.0	88.1	14.50	0.002	222.0		1.120	0.009	4.0	0.1200	2020	3470	2.070
Minimum	0.0005	19.8	0.5	0.0070	3.41	0.016		87.4	0.0040	14.1	1414	0.002	0.005	5.85	4.48	0.00002	44.1	34.2	5.10	0.001	84.7		0.414	0.004	3.0	0.0050	633	996	0.809
50th Percentile	0.0005	50.95	0.5	0.0110	6.05	0.028		149.0	0.0106	19.0	2603	0.004	0.011	10.09	5.97	0.00002	94.9	61.8	10.65	0.001	151.0		0.770	0.007	3.2	0.0450	1385	2230	1.520

3. Water Quality Data and Summary for Sawyers Swamp Creek at WX1, upstream of SSCAD. EANSW site 92

Sawyers Swamp Creek Upstream of SSCAD WX1 Post-Dry Ash Placement Data (mg/l) February, 2012 to April, 2003																													
Date	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	NFR	Ni	Pb	pH	Se	SO4	TDS	Zn
10-Mar-92		0			0.042					8.0	3000				0.435				0.068										0.040

Sawyers Swamp Creek Upstream of SSCAD WX1 Post-Dry Ash Placement Data April, 2016 to March, 2017 (mg/l)																																	
SAMPLE	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	NFR	Ni	NO2+NO3	Pb	pH	Se	SO4	TDS	TKN	TN	TP	Zn
28-Apr-16																																	
18-May-16																																	
16-Jun-16																																	
21-Jul-16	0.0005	0.65	13	0.0005	0.025	0.018		5.84	0.00005	12.9	124	0.0005	0.001	0.013	0.601	0.00002	3.76	1.86	0.05	0.0005	11.4		0.0005	1.1	0.0005	6.14	0.0001	17.8	94		1.9		0.006
17-Aug-16	0.0005	2.4	13	0.0005	0.025	0.023		1.36	0.00005	9.38	137	0.002	0.003	0.2	0.731	0.00002	1.59	0.751	0.043	0.0005	18.1		0.003	0.03	0.003	5.99	0.0001	31.1	113		0.5		0.016
21-Sep-16	0.0005	1.97	16	0.0005	0.06	0.018		1.46	0.00005	9.96	113	0.001	0.003	0.025	0.584	0.00002	1.67	0.692	0.036	0.0005	18.3		0.002	0.09	0.002	6.45	0.0001	19.4	128		0.7		0.014
19-Oct-16	0.0005	1.55	23	0.0005	0.06	0.012		1.28	0.00005	11.3	127	0.0005	0.003	0.039	0.515	0.00002	1.58	0.52	0.053	0.0005	24.1		0.002	0.01	0.001	6.18	0.0001	16.5	156		0.4		0.008
16-Nov-16	0.0005	2.07	24	0.0005	0.025	0.018		1.45	0.00005	10.5	129	0.001	0.003	0.021	0.99	0.00002	1.71	0.64	0.114	0.0005	21.1		0.002	0.01	0.002	6.14	0.0001	17.2	152		0.5		0.012
14-Dec-16	0.0005	1.57	34	0.0005	0.025	0.017		1.58	0.00005	11.6	142	0.001	0.003	0.026	1.56	0.00002	1.8	0.532	0.102	0.0005	27.4		0.002	0.03	0.002	6.41	0.0002	17.8	130		0.7		0.009
25-Jan-17	0.0005	2.17	30	0.0005	0.025	0.022		1.4	0.00005	10.4	141	0.001	0.004	0.023	1.22	0.00002	2.29	0.721	0.109	0.0005	27.5		0.002	0.05	0.002	6.14	0.0002	17.9	125		0.8		0.011
16-Feb-17																																	
15-Mar-17																																	

WX1 (mg/L) SAWYERS SWAMP CREEK FRESH WATER UPSTREAM OF SCAD April, 2016 to March, 2017 (mg/l)																																	
	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	NFR	Ni	NO2+NO3	Pb	pH	Se	SO4	TDS	TKN	TN	TP	Zn
Average	0.0005	1.8	21.9	0.001	0.035	0.018		2.1	0.0001	10.9	130	0.001	0.003	0.05	0.89	0.00002	2.1	0.817	0.07	0.001	21.1		0.002		0.002	6.2	0.0001	19.7	128.3		0.8		0.011
Maximum	0.0005	2.4	34	0.001	0.060	0.023		5.8	0.0001	12.9	142	0.002	0.004	0.20	1.56	0.00002	3.8	1.860	0.11	0.001	27.5		0.003		0.003	6.5	0.0002	31.1	156.0		1.9		0.016
Minimum	0.0005	0.65	13	0.001	0.025	0.012		1.3	0.0001	9.4	113	0.001	0.001	0.01	0.52	0.00002	1.6	0.520	0.04	0.001	11.4		0.001		0.001	6.0	0.0001	16.5	94.0		0.4		0.006
50th Percentile	0.0005	1.97	23	0.001	0.025	0.018		1.5	0.0001	10.5	129	0.001	0.003	0.03	0.73	0.00002	1.7	0.692	0.05	0.001	21.1		0.002		0.002	6.1	0.0001	17.8	128.0		0.7		0.011

4. Water Quality Data and Summary for SSCAD Groundwater Seepage Detection Bores WGM1/D3 and 1/D4

a) *Water Quality Data and Summary for WGM1/D3*

WGM1/D3 Pre-Dry Ash Placement Summary 1988- April, 2003 (mg/L)

	Ag	ALK	Al	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	WL1	WL AHD	Zn
Average	0.001	115		0.010	0.05	0.292		18.7	0.001	64	62308	0.009	0.005	0.19	4.9	0.0004	8	20.0	0.592		69	0.080	0.008	6.0	0.001	94	349	10.0	920.2	0.061
Maximum	0.001	229		0.043	0.22	5.700		31.0	0.001	140	77320	0.026	0.040	0.73	21.0	0.0009	38	28.0	1.930		109	0.092	0.074	6.9	0.003	144	660	11.1	921.5	0.200
Minimum	0.001	8		0.001	0.005	0.080		6.3	0.001	25	34200	0.001	0.001	0.040	0.5	0.0001	1	2.0	0.080		31	0.071	0.001	4.6	0.001	20	125	8.7	919.1	0.010
90th Percentile	0.001	154		0.027	0.19	0.150		24.0	0.001	77	72000	0.020	0.010	0.33	9.4	0.0007	9	25.0	0.710		85	0.089	0.014	6.4	0.002	116	470	10.9	921.3	0.110

WGM1/D3 Post-Dry Ash Placement Data (mg/L) April, 2016 to March 2017

Date	Ag	ALK	Al	As	B	Ba	Be	Ca	Cd	Cl	Co	COND	Cr	Cu	F	Fe	Hg	K	Li	Mg	Mn	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	WL1	WL AHD	Zn
29-Apr-16	0.0005	47	0.11	0.002	0.025	0.086		17	0.00005	72.8		634	0.001	0.001	0.053	4.08	0.00002	7.23		18.5	0.515	0.0005	61.3	0.06	0.002	5.29	0.0001	135	392	9.4	920.80	0.037
19-May-16	0.0005	56	0.27	0.002	0.025	0.09		16.9	0.00005	74.8		627	0.001	0.004	0.109	4.86	0.00017	6.49		18.7	0.521	0.0005	57.7	0.059	0.001	5.44	0.0001	145	304	9.4	920.80	0.045
17-Jun-16	0.0005	24	0.37	0.002	0.07	0.071		12.6	0.00005	54.5		612	0.001	0.003	0.05	1.52	0.00002	7.3		17.8	0.596	0.0005	64.6	0.197	0.001	4.88	0.0001	181	374	8.4	921.80	0.14
22-Jul-16	0.0005	24	0.36	0.0005	0.07	0.083		19	0.00005	49.3		627	0.001	0.001	0.01	4.49	0.00002	6.29		21.4	0.695	0.0005	58.1	0.158	0.003	5.14	0.0001	201	364	8.1	922.10	0.113
18-Aug-16	0.0005	25	0.11	0.0005	0.025	0.097		20.6	0.0001	48.7		677	0.001	0.001	0.075	3.44	0.00002	7.21		22.1	0.707	0.0005	60.9	0.116	0.0005	4.54	0.0001	217	401	8.8	921.40	0.084
22-Sep-16	0.0005	9	0.28	0.001	0.1	0.077		17	0.00005	93.4		752	0.001	0.002	0.025	1.42	0.00002	6.74		26	0.932	0.0005	78.5	0.339	0.002	4.97	0.0001	197	417	8.1	922.10	0.287
20-Oct-16	0.0005	15	0.18	0.001	0.025	0.077		19.9	0.00005	79.5		744	0.001	0.002	0.025	4.25	0.00002	7.49		27.7	0.855	0.0005	64.1	0.266	0.0005	5.03	0.0001	168	528	8.4	921.80	0.2
17-Nov-16	0.0005	15	0.46	0.002	0.05	0.056		12.9	0.00005	70.4		686	0.001	0.002	0.025	2.73	0.00002	6.89		21.4	0.832	0.0005	68.9	0.234	0.0005	5.06	0.0001	198	356	8.3	921.90	0.204
15-Dec-16	0.0005	41	0.25	0.003	0.025	0.082		19.5	0.00005	80		704	0.001	0.001	0.124	7.12	0.00002	7.68		23.6	0.57	0.0005	74.6	0.12	0.0005	5.42	0.0001	178	462	9	921.20	0.082
27-Jan-17	0.0005	38	0.15	0.001	0.025	0.068		16.8	0.00005	69.4		662	0.001	0.001	0.025	3.04	0.00002	7.73		22.5	0.645	0.0005	71.4	0.153	0.001	5.32	0.0001	158	465	9	921.20	0.114
16-Feb-17	0.0005	60	0.11	0.001	0.025	0.088		20.3	0.00005	74.9		680	0.001	0.001	0.068	5.47	0.00002	8.05		22.2	0.59	0.0005	64.6	0.081	0.0005	5.51	0.0001	165	431	9.3	920.90	0.044
16-Mar-17	0.0005	55	0.11	0.002	0.025	0.086		21.1	0.00005	77.6		670	0.001	0.001	0.07	6.15	0.00002	8.21		23.1	0.551	0.0005	68.9	0.07	0.0005	5.45	0.0001	159	448	9.5	920.70	0.04

WGM1/D3 Post-Dry Ash Placement Data (mg/L) April, 2016 to March 2017

	Ag	ALK	Al	As	B	Ba	Be	Ca	Cd	Cl	Co	COND	Cr	Cu	F	Fe	Hg	K	Li	Mg	Mn	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	WL1	WL AHD	Zn
Average	0.0005	34	0.23	0.0015	0.04	0.080		18	0.0001	70		673	0.0010	0.0017	0.05	4.05	0.00003	7		22	0.67	0.001	66	0.154	0.001	5.2	0.0001	175	412	8.8	921.4	0.116
Maximum	0.0005	60	0.46	0.0030	0.10	0.097		21	0.0001	93		752	0.0010	0.0040	0.12	7.12	0.00017	8		28	0.93	0.001	79	0.339	0.003	5.5	0.0001	217	528	9.5	922.1	0.287
Minimum	0.0005	9	0.11	0.0005	0.03	0.056		13	0.0001	49		612	0.0010	0.0010	0.01	1.42	0.00002	6		18	0.52	0.001	58	0.059	0.001	4.5	0.0001	135	304	8.1	920.7	0.037
50th Percentile	0.0005	32	0.22	0.0015	0.03	0.083		18	0.0001	74		674	0.0010	0.0010	0.05	4.17	0.00002	7		22	0.62	0.001	65	0.137	0.001	5.2	0.0001	173	409	8.9	921.3	0.099

b)   Water Quality Data and Summary for WGM1/D4

WGM1/D4 Pre-Dry Ash Placement Summary 1988- April, 2003 (mg/L)																												
	Ag	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	WL1	WL AHD	Zn
Average	0.001	96	0.003	0.27	0.372		30.0	0.002	30	58408	0.005	0.012	0.15	54.6	0.0009	6	18.9	4.588		29	0.018	0.006	6.3	0.009	118	327	1.3	905.8	0.041
Maximum	0.001	282	0.012	0.61	6.700		58.0	0.004	86	98969	0.019	0.100	0.72	120.0	0.0033	46	47.0	12.000		82	0.024	0.022	7.3	0.100	350	768	1.5	906.3	0.100
Minimum	0.001	20.60	0.001	0.07	0.050		16.0	0.001	6.00	16100	0.001	0.001	0.001	0.1	0.0002	0	1.8	0.094		4	0.011	0.001	5.2	0.001	11	96	0.8	905.3	0.004
90th Percentile	0.001	168	0.006	0.49	0.330		43.8	0.003	45	72780	0.012	0.036	0.24	86.0	0.0020	7	26.8	6.500		42	0.023	0.011	6.8	0.002	201	510	1.4	906.0	0.060

WGM1/D4 Post-Dry Ash Placement Data April, 2016 to March 2017 (mg/l)																															
Date	Ag	ALK	Al	As	B	Ba	Be	Ca	Cd	Cl	Co	COND	Cr	Cu	F	Fe	Hg	K	Li	Mg	Mn	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	WL1	WL AHD	Zn
28-Apr-16	0.0005	25	0.005	0.002	2.26	0.017		93.6	0.0001	29.6		1590	0.001	0.001	0.018	35.9	0.00002	11.8		65.1	14.8	0.0005	127	0.038	0.0005	6.11	0.0001	717	1230	1.1	906.02	0.041
18-May-16	0.0005	90	0.07	0.002	1.77	0.017		84.4	0.0001	30.4		1580	0.001	0.001	0.042	51.5	0.00002	9.21		57.7	13.4	0.0005	117	0.032	0.0005	6.21	0.0001	755	976	1.1	906.02	0.034
16-Jun-16	0.0005	65	0.02	0.001	1.59	0.017		99.2	0.0001	40.9		1730	0.001	0.001	0.1	37.3	0.00002	10.8		62.4	13.5	0.0005	138	0.029	0.0005	5.86	0.0001	851	1280	1.0	906.12	0.035
21-Jul-16	0.0005	53	0.11	0.001	1.14	0.03		144	0.0001	90.7		2070	0.001	0.001	0.05	33.2	0.00002	8.4		69.2	10.3	0.0005	205	0.026	0.0005	5.54	0.0001	1050	1390	0.8	906.32	0.04
17-Aug-16	0.0005	72	0.04	0.001	1.43	0.02		102	0.0001	49.6		1711	0.001	0.001	0.05	50.8	0.00002	8.57		57.6	10.9	0.0005	131	0.033	0.0005	5.98	0.0001	807	1340	1.0	906.12	0.047
22-Sep-16																																
20-Oct-16	0.0005	87	0.04	0.001	1.39	0.02		110	0.0001	43.4		1670	0.001	0.001	0.05	50.5	0.00002	8.94		61.4	10	0.0005	139	0.027	0.0005	6.16	0.0001	730	1180	1.0	906.12	0.036
16-Nov-16	0.0005	54	0.04	0.002	1.49	0.017		90	0.0001	35.4		1579	0.001	0.001	0.025	59	0.00002	9.17		54.4	12.8	0.0005	116	0.029	0.0005	6.07	0.0001	698	1150	1.0	906.12	0.044
14-Dec-16	0.0005	80	0.01	0.002	1.66	0.018		92.6	0.0001	28.9		1560	0.001	0.001	0.05	48.8	0.00002	9.67		61.7	12.4	0.0005	132	0.031	0.0005	6.15	0.0001	746	1280	1.1	906.02	0.04
25-Jan-17	0.0005	34	0.005	0.0005	1.66	0.016		88.3	0.0001	26.9		1569	0.001	0.001	0.025	19.2	0.00002	10.3		58.7	13.2	0.0005	125	0.031	0.0005	6.18	0.0001	699	1150	1.1	906.02	0.034
15-Feb-17	0.0005	58	0.02	0.001	1.73	0.017		88.8	0.0001	28.6		1565	0.001	0.001	0.025	56.8	0.00002	11.2		58.1	13	0.0005	125	0.03	0.0005	6.2	0.0001	731	1040	1.1	906.02	0.038
15-Mar-17	0.0005	61	0.04	0.002	1.69	0.018		94.8	0.0001	55.3		1660	0.001	0.001	0.039	37	0.00002	12.2		63	10.7	0.0005	162	0.029	0.0005	6.05	0.0001	811	1370	1.1	906.02	0.035

WGM1/D4 Post-Dry Ash Placement Data April, 2016 to March 2017 (mg/l)																															
	Ag	ALK	Al	As	B	Ba	Be	Ca	Cd	Cl	Co	COND	Cr	Cu	F	Fe	Hg	K	Li	Mg	Mn	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	WL1	WL AHD	Zn
Average	0.0005	61.73	0.036	0.0014	1.62	0.019		99	0.0001	42		1662	0.0010	0.0010	0.04	43.64	0.00002	10		61	12.27	0.001	138	0.030	0.001	6.0	0.0001	781	1217	1.0	906.1	0.039
Maximum	0.0005	90.00	0.110	0.0020	2.26	0.030		144	0.0001	91		2070	0.0010	0.0010	0.10	59.00	0.00002	12		69	14.80	0.001	205	0.038	0.001	6.2	0.0001	1050	1390	1.1	906.3	0.047
Minimum	0.0005	25.00	0.005	0.0005	1.14	0.016		84	0.0001	27		1560	0.0010	0.0010	0.02	19.20	0.00002	8		54	10.00	0.001	116	0.026	0.001	5.5	0.0001	698	976	0.8	906.0	0.034
50th Percentile	0.0005	61.00	0.040	0.0010	1.66	0.017		94	0.0001	35		1590	0.0010	0.0010	0.04	48.80	0.00002	10		61	12.80	0.001	131	0.030	0.001	6.1	0.0001	746	1230	1.1	906.0	0.038

5. Water Quality Data and Summary for Background Groundwater Bore WGM1/D1 and WGM1/D2

WGM1/D1 Pre-Dry Ash Placement Background Summary 1988- April, 2003 (mg/L)

	Ag	ALK	As	B	Ba	Be	Ca	Cd	Cl	Co	COND	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	WL1	WL AHD	Zn
Average	0.001	16	0.002	0.05	0.156		2.4	0.001	48		210	0.016	0.016	0.19	2.3	0.0002	3	2.5	0.37		27		0.010	5.3	0.002	4	143	4.0	944.0	0.078
Maximum	0.001	32	0.006	0.35	2.000		19.0	0.003	92		394	0.045	0.170	0.66	15.7	0.0006	10	15.0	1.00		65		0.035	6.8	0.003	31	302	6.1	946.3	0.230
Minimum	0.001	1.50	0.001	0.01	0.030		0.0	0.001	15		99	0.001	0.001	0.001	0.0	0.0001	0	0.0	0.05		8		0.001	4.2	0.001	0	50	1.9	942.1	0.012
90th Percentile	0.001	24	0.004	0.10	0.090		5.1	0.002	78		305	0.041	0.035	0.41	5.6	0.0004	6	5.0	0.66		44		0.018	5.9	0.002	9	215	5.3	945.0	0.122

WGM1/D1 Post-Dry Ash Placement Data April, 2016 to March 2017 (mg/L)

SAMPLE	Ag	ALK	Al	As	B	Ba	Be	Ca	Cd	Cl	Co	COND	Cr	Cu	F	Fe	Hg	K	Li	Mg	Mn	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	WL1	WL AHD	Zn
29-Apr-16	0.0005	9	2.5	0.0005	0.025	0.046		1.24	0.00005	25.9		134	0.002	0.008	0.011	1.29	0.00002	2.78		1.73	0.095	0.0005	19	0.004	0.004	4.92	0.0001	5.87	142	4.6	943.52	0.083
19-May-16	0.0005	8	9.91	0.002	0.025	0.093		1.1	0.0001	29.4		139	0.007	0.021	0.01	1.56	0.00017	3.2		1.92	0.09	0.0005	18.5	0.007	0.016	4.94	0.0005	6.16	77	4.8	943.32	0.115
17-Jun-16	0.0005	8	3.74	0.0005	0.025	0.049		1.16	0.00005	19.8		108	0.003	0.01	0.01	0.226	0.00002	3.21		1.39	0.062	0.0005	15.4	0.004	0.006	4.83	0.0001	6.45	160	4.7	943.42	0.095
22-Jul-16	0.0005	6	0.55	0.0005	0.025	0.06		2.02	0.00005	13.1		127	0.0005	0.002	0.005	0.05	0.00002	3.52		3.89	0.009	0.0005	11.2	0.0005	0.0005	5.14	0.0001	13.4	79	1.3	946.82	0.037
17-Aug-16																																
22-Sep-16	0.0005	7	0.22	0.0005	0.025	0.075		1.51	0.00005	15.4		131	0.0005	0.002	0.005	0.069	0.00002	3.34		4.97	0.012	0.0005	11.1	0.002	0.0005	5.34	0.0001	12	88	1.6	946.52	0.028
20-Oct-16	0.0005	7	0.1	0.0005	0.05	0.07		1.17	0.00005	15.1		127	0.0005	0.001	0.005	0.031	0.00002	3.21		4.66	0.014	0.0005	11.4	0.0005	0.0005	5.05	0.0001	11.2	99	1.7	946.42	0.019
17-Nov-16	0.0005	6	0.45	0.0005	0.05	0.042		0.545	0.00005	10.7		102	0.0005	0.0005	0.005	0.055	0.00002	2.5		2.68	0.009	0.0005	10.7	0.0005	0.0005	5.06	0.0001	18.1	53	2	946.12	0.012
15-Dec-16	0.0005	7	0.4	0.0005	0.025	0.045		0.638	0.00005	11.2		105	0.0005	0.001	0.01	0.109	0.00002	2.66		3.05	0.017	0.0005	12.3	0.0005	0.0005	5.16	0.0001	17.3	85	3	945.12	0.02
27-Jan-17	0.0005	9	0.18	0.0005	0.025	0.026		1.85	0.00005	4.45		62	0.0005	0.009	0.031	0.157	0.00002	3.71		1.53	0.059	0.0005	5.13	0.002	0.0005	5.21	0.0001	7.11	94	3.7	944.42	0.08
16-Feb-17	0.0005	12	0.34	0.0005	0.025	0.036		1.23	0.00005	16		111	0.0005	0.002	0.021	0.2	0.00002	2.91		2.26	0.063	0.0005	13	0.001	0.0005	5.39	0.0001	9.41	92	4	944.12	0.05
16-Mar-17	0.0005	14	0.33	0.0005	0.05	0.036		1.6	0.00005	19.2		128	0.0005	0.004	0.02	0.67	0.00002	3.23		2.64	0.097	0.0005	16.8	0.002	0.0005	5.35	0.0001	11.4	120	4.3	943.82	0.048

WGM1/D1 Post-Dry Ash Placement Data April, 2016 to March 2017 (mg/L)

	Ag	ALK	Al	As	B	Ba	Be	Ca	Cd	Cl	Co	COND	Cr	Cu	F	Fe	Hg	K	Li	Mg	Mn	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	WL1	WL AHD	Zn
Average	0.0005	8.5	1.7	0.0006	0.03	0.053		1	0.0001	16		116	0.0015	0.0055	0.01	0.40	0.00003	3		3	0.05	0.001	13	0.002	0.003	5.1	0.000	11	99	3.2	944.9	0.053
Maximum	0.0005	14.0	9.9	0.0020	0.05	0.093		2	0.0001	29		139	0.0070	0.0210	0.03	1.56	0.00017	4		5	0.10	0.001	19	0.007	0.016	5.4	0.001	18	160	4.8	946.8	0.115
Minimum	0.0005	6.0	0.1	0.0005	0.03	0.026		1	0.0001	4		62	0.0005	0.0005	0.01	0.03	0.00002	3		1	0.01	0.001	5	0.001	0.001	4.8	0.000	6	53	1.3	943.3	0.012
50th Percentile	0.0005	8.0	0.4	0.0005	0.03	0.046		1	0.0001	15		127	0.0005	0.0020	0.01	0.16	0.00002	3		3	0.06	0.001	12	0.002	0.001	5.1	0.000	11	92	3.7	944.4	0.048

WGM1/D2 Pre-Dry Ash Placement Background Summary 1988- April, 2003 (mg/L)																														
	Ag	**ALK**	**As**	**B**	**Ba**	**Be**	**Ca**	**Cd**	**Cl**	**Co**	**COND**	**Cr**	**Cu**	**F**	**Fe**	**Hg**	**K**	**Mg**	**Mn**	**Mo**	**Na**	**Ni**	**Pb**	**pH**	**Se**	**SO4**	**TDS**	**WL1**	**WL AHD**	**Zn**
Average	0.007	14	0.001	0.05	0.173		1.6	0.001	36	0.017	25534	0.013	0.007	0.17	1.1	0.0003	2	5.2	0.301		32	0.027	0.008	4.6	0.001	45	160	5.9	914.3	0.067
Maximum	0.020	138	0.002	0.30	3.000		13.0	0.001	104	0.021	44536	0.048	0.080	0.75	13.0	0.0009	5	16.0	0.800		66	0.032	0.074	5.6	0.001	102	345	8.7	917.6	0.180
Minimum	0.001	0.00	0.001	0.005	0.010		0.0	0.001	9.00	0.014	9720	0.001	0.001	0.001	0.03	0.0001	0	0.0	0.035		11	0.023	0.001	2.9	0.001	6	10	2.7	911.5	0.012
90th Percentile	0.016	24	0.001	0.10	0.114		5.0	0.001	48	0.020	31000	0.041	0.010	0.28	1.7	0.0007	4	9.0	0.442		42	0.031	0.010	5.4	0.001	61	258	7.3	917.2	0.114

WGM1/D2 Post-Dry Ash Placement Data April, 2016 to March 2017																																
Date	Ag	ALK	Al	As	B	Ba	Be	Ca	Cd	Cl	Co	COND	Cr	Cu	F	Fe	Hg	K	Li	Mg	Mn	Mo	Na	Ni	Pb	pH	Se	D2 SO4	TDS	WL1	WL AHD	Zn
29-Apr-16	0.0005	0.5	0.26	0.001	0.2	0.027		2.53	0.0001	36		632	0.001	0.002	0.014	3.12	0.00002	3.55		17.8	0.72	0.0005	58.4	0.079	0.002	3.42	0.0001	184	363	8	912.2	0.094
19-May-16	0.0005	0.5	0.28	0.001	0.2	0.029		2.45	0.0002	38.3		643	0.001	0.001	0.023	5.12	0.00002	2.89		17.4	0.762	0.0005	57.2	0.078	0.002	3.44	0.0001	196	319	8.1	912.1	0.096
17-Jun-16	0.0005	0.5	0.31	0.001	0.025	0.039		0.789	0.0001	11.8		354	0.001	0.001	0.025	0.006	0.00002	3.63		12.2	0.283	0.0005	36.3	0.039	0.0005	4.42	0.0001	125	235	3.6	916.6	0.053
22-Jul-16	0.0005	2	0.28	0.001	0.025	0.029		1.19	0.0001	13.6		351	0.001	0.001	0.01	0.004	0.00002	3.07		14.4	0.312	0.0005	35.3	0.038	0.001	4.57	0.0002	128	210	2.9	917.3	0.046
18-Aug-16	0.0005	1	0.24	0.001	0.025	0.031		0.906	0.00005	13		356	0.001	0.001	0.014	0.007	0.00002	3.11		13.1	0.318	0.0005	36.7	0.039	0.0005	4.16	0.0001	129	202	5.3	914.9	0.043
22-Sep-16	0.0005	3	0.16	0.001	0.025	0.033		0.975	0.00005	14.2		354	0.001	0.001	0.01	0.001	0.00002	3.19		14.2	0.294	0.0005	36.7	0.037	0.0005	4.82	0.0001	128	214	3	917.2	0.043
20-Oct-16	0.0005	2	0.18	0.001	0.025	0.029		0.978	0.0001	16.3		360	0.001	0.001	0.023	0.006	0.00002	3.19		14.4	0.312	0.0005	36.7	0.036	0.0005	4.67	0.0001	120	262	3.4	916.8	0.045
17-Nov-16	0.0005	0.5	0.2	0.001	0.025	0.028		0.824	0.00005	16		359	0.001	0.001	0.012	0.006	0.00002	3.44		13.5	0.342	0.0005	36.4	0.036	0.0005	4.69	0.0001	124	155	3.3	916.9	0.052
15-Dec-16	0.0005	0.5	0.21	0.001	0.025	0.028		0.89	0.0001	19.7		381	0.001	0.001	0.016	0.008	0.00002	3.39		15	0.358	0.0005	44.2	0.039	0.0005	4.5	0.0001	134	324	7.8	912.4	0.042
27-Jan-17	0.0005	0.5	0.18	0.001	0.21	0.03		1.82	0.00005	24.5		469	0.001	0.001	0.025	0.297	0.00002	3.69		17.7	0.501	0.0005	52.4	0.057	0.001	4.21	0.0001	153	336	8.2	912	0.07
16-Feb-17	0.0005	0.5	0.2	0.001	0.11	0.032		2	0.00005	29.3		511	0.001	0.001	0.023	0.125	0.00002	3.82		18.2	0.553	0.0005	51	0.066	0.0005	4	0.0001	161	317	8.6	911.6	0.076
16-Mar-17	0.0005	0.5	0.21	0.001	0.16	0.028		2.24	0.0001	33.1		560	0.001	0.001	0.02	0.379	0.00002	3.76		19.2	0.55	0.0005	58.8	0.069	0.002	3.61	0.0001	182	352	8.8	911.4	0.076

WGM1/D2 Post-Dry Ash Placement Data April, 2016 to March 2017																																
	Ag	ALK	Al	As	B	Ba	Be	Ca	Cd	Cl	Co	COND	Cr	Cu	F	Fe	Hg	K	Li	Mg	Mn	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	WL1	WL AHD	Zn
Average	0.0005	1.00	0.23	0.0010	0.09	0.030		1	0.0001	22		444	0.0010	0.0011	0.02	0.76	0.00002	3		16	0.44	0.001	45	0.051	0.001	4.2	0.0001	147	274	5.9	914.3	0.061
Maximum	0.0005	3.00	0.31	0.0010	0.21	0.039		3	0.0002	38		643	0.0010	0.0020	0.03	5.12	0.00002	4		19	0.76	0.001	59	0.079	0.002	4.8	0.0002	196	363	8.8	917.3	0.096
Minimum	0.0005	0.50	0.16	0.0010	0.03	0.027		1	0.0001	12		351	0.0010	0.0010	0.01	0.00	0.00002	3		12	0.28	0.001	35	0.036	0.001	3.4	0.0001	120	155	2.9	911.4	0.042
50th Percentile	0.0005	0.50	0.21	0.0010	0.03	0.029		1	0.0001	18		371	0.0010	0.0010	0.02	0.01	0.00002	3		15	0.35	0.001	40	0.039	0.001	4.3	0.0001	132	290	6.6	913.7	0.053

6. Water Quality Data and Summary for KVAD/R Dry Ash Placement Area Seepage Detection Groundwater Bores WGM1/D5 and 1/D6

a) Groundwater Bore WGM1/D5

WGM1/D5 Pre-Dry Ash Placement Background Summary 1988-April, 2003 (mg/L)

	Ag	ALK	As	B	Ba	Be	Ca	Cd	Cl	Co	COND	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	WL1	WL AHD	Zn
Average	0.001	18	0.004	1.29	0.166	0.006	12.4	0.002	20	0.061	701	0.017	0.019	0.41	6.9	0.0003	16	20.3	1.630		61	0.125	0.010	3.8	0.001	259	470	4.8	899.6	0.338
Maximum	0.001	90	0.013	2.00	1.700	0.006	23.0	0.005	90	0.075	1050	0.055	0.080	1.02	17.0	0.0007	23	34.0	3.970		127	0.140	0.050	5.4	0.002	380	1913	8.8	902.0	2.630
Minimum	0.001	1	0.001	0.08	0.010	0.006	5.2	0.001	8	0.047	283	0.003	0.001	0.10	0.1	0.0002	7	8.0	0.520		7	0.110	0.002	2.8	0.001	92	48	2.3	895.4	0.032
90th Percentile	0.001	51	0.008	1.70	0.148	0.006	19.7	0.004	24	0.072	810	0.041	0.058	0.65	14.7	0.0006	19	26.0	2.500		70	0.137	0.021	4.5	0.002	328	550	8.3	901.7	0.505

WGM1/D5 Post-Dry Ash Placement Date April, 2016 to March 2017

Date	Ag	ALK	Al	As	B	Ba	Be	Ca	Cd	Cl	Co	COND	Cr	Cu	F	Fe	Hg	K	Li	Mg	Mn	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	WL AHD	WL1	Zn
29-Apr-16	0.0005	0.5	19.2	0.004	1.86	0.041		36.1	0.0175	26.1		1052	0.004	0.035	0.573	1.57	0.00008	21.8		40.4	5.42	0.002	58.1	0.372	0.046	3.91	0.0019	474	888	895.79	8.4	1.58
19-May-16	0.0005	0.5	27.7	0.006	2.16	0.068		36.5	0.0227	28		1051	0.01	0.054	0.698	0.654	0.00002	19.7		42.3	5.08	0.004	59	0.45	0.072	3.54	0.0024	492	717	895.89	8.3	2.06
17-Jun-16	0.0005	0.5	9.08	0.005	0.57	0.074		14.6	0.0103	10.2		477	0.007	0.042	0.025	0.305	0.00034	14.2		13.3	1.57	0.003	32.3	0.139	0.04	3.65	0.0024	192	317	896.09	8.1	0.932
22-Jul-16	0.0005	0.5	4.62	0.0005	0.32	0.034		15.9	0.0008	3.54		326	0.0005	0.002	0.198	0.057	0.00002	4.81		9.23	1.45	0.0005	8.03	0.135	0.002	3.72	0.0005	131	225	901.69	2.5	0.354
18-Aug-16	0.0005	0.5	8.04	0.0005	0.86	0.033		20.8	0.0013	11.5		601	0.0005	0.003	0.47	0.534	0.00002	9.58		18.9	3.04	0.0005	22.9	0.241	0.004	2.85	0.0003	242	464	900.49	3.7	0.628
22-Sep-16	0.0005	0.5	5.25	0.0005	0.48	0.028		13.3	0.0008	5.43		346	0.0005	0.007	0.191	0.187	0.00002	5.33		10.2	1.56	0.0005	11.4	0.122	0.002	4.01	0.0003	132	237	901.39	2.8	0.345
20-Oct-16	0.0005	0.5	13.7	0.0005	1.7	0.034		29.1	0.0017	21.7		866	0.0005	0.006	0.522	1.69	0.00002	13.5		32.4	4.4	0.0005	39.4	0.32	0.006	3.67	0.0004	349	641	897.89	6.3	0.878
17-Nov-16	0.0005	0.5	8.34	0.0005	0.94	0.027		21.2	0.0013	10		637	0.0005	0.002	0.244	0.146	0.00002	11.9		22.3	3.41	0.0005	26.9	0.259	0.002	3.73	0.0003	276	370	900.89	3.3	0.708
15-Dec-16	0.0005	0.5	33.8	0.008	2.04	0.12		45	0.0048	34.2		1289	0.014	0.049	0.623	3.1	0.0001	22.2		52	5.03	0.006	101	0.409	0.059	4.05	0.0052	645	1020	895.99	8.2	1.14
27-Jan-17	0.0005	0.5	14.9	0.004	1.45	0.055		35.4	0.0039	32.2		1052	0.005	0.015	0.369	3.24	0.00007	21.6		37.3	4.39	0.002	81.1	0.295	0.019	4.55	0.0013	462	828	895.99	8.2	0.758
16-Feb-17	0.0005	0.5	19.8	0.003	1.52	0.045		36.5	0.0033	25.3		969	0.005	0.021	0.826	1.57	0.00005	19.1		38.7	5	0.001	53.5	0.326	0.022	4.19	0.0022	446	492	895.99	8.2	0.795
16-Mar-17	0.0005	0.5	15.8	0.006	0.82	0.082		20.9	0.0015	18		606	0.011	0.031	0.217	1.34	0.00012	16		22	2.63	0.005	35.6	0.186	0.04	3.98	0.0028	252	476	896.49	7.7	0.412

WGM1/D5 Post-Dry Ash Placement Date April, 2016 to March 2017

	Ag	ALK	Al	As	B	Ba	Be	Ca	Cd	Cl	Co	COND	Cr	Cu	F	Fe	Hg	K	Li	Mg	Mn	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	WL1	WL AHD	Zn
Average	0.0005	1	15.02	0.0032	1.23	0.053		27	0.0058	19		773	0.0049	0.0223	0.41	1.20	0.00007	15		28	3.58	0.002	44	0.271	0.026	3.8	0.002	341	556	897.9	6.3	0.883
Maximum	0.0005	1	33.80	0.0080	2.16	0.120		45	0.0227	34		1289	0.0140	0.0540	0.83	3.24	0.00034	22		52	5.42	0.006	101	0.450	0.072	4.6	0.005	645	1020	901.7	8.4	2.060
Minimum	0.0005	1	4.62	0.0005	0.32	0.027		13	0.0008	4		326	0.0005	0.0020	0.03	0.06	0.00002	5		9	1.45	0.001	8	0.122	0.002	2.9	0.000	131	225	895.8	2.5	0.345
50th Percentile	0.0005	1	14.30	0.0035	1.20	0.043		25	0.0025	20		752	0.0045	0.0180	0.42	1.00	0.00004	15		27	3.90	0.002	38	0.277	0.021	3.8	0.002	313	484	896.3	7.9	0.777

b) Groundwater Bore WGM1/D6

WGM1/D6 Pre-Dry Ash Placement Background Summary 1988-April, 2003 (mg/L)

	Ag	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	WL1	WL AHD	Zn
Average	0.001	27	0.003	0.78	0.184		22.3	0.002	53	94830	0.011	0.016	0.14	93.3	0.0004	7	25.4	4.005		45	0.117	0.007	4.5	0.016	340	603	10.8	896.2	0.107
Maximum	0.001	390	0.015	1.10	1.900		33.0	0.009	160	143000	0.032	0.260	0.65	174.2	0.0009	48	34.0	5.400		90	0.210	0.023	5.8	0.100	536	902	11.4	896.9	0.566
Minimum	0.001	0	0.001	0.27	0.021		14.0	0.001	23	60100	0.001	0.001	0.001	0.1	0.0001	4	17.0	1.390		26	0.023	0.001	1.4	0.001	190	320	10.1	895.6	0.004
90th Percentile	0.001	39	0.005	0.98	0.210		27.0	0.003	65	110000	0.020	0.021	0.28	123.0	0.0007	9	30.0	4.810		55	0.191	0.013	5.5	0.043	381	736	11.2	896.6	0.232

WGM1/D6 Post-Dry Ash Placement Data April, 2016 to March 2017

Date	Ag	ALK	Al	As	B	Ba	Be	Ca	Cd	Cl	Co	COND	Cr	Cu	F	Fe	Hg	K	Li	Mg	Mn	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	WL1	WL AHD	Zn
29-Apr-16	0.0005	0.5	4.14	0.002	1.19	0.017		41.2	0.0018	40.8		1740	0.003	0.01	0.371	166	0.00002	9.87		83	7.93	0.0005	110	0.481	0.01	4.21	0.0002	907	1590	11.2	895.75	1.17
19-May-16	0.0005	0.5	7.14	0.0005	1.22	0.02		45.4	0.0049	50.3		2030	0.002	0.04	0.548	167	0.00002	8.63		91.5	8.12	0.0005	116	0.552	0.034	3.82	0.0005	1170	1700	11.3	895.65	1.67
17-Jun-16	0.0005	0.5	6.38	0.002	0.9	0.018		33	0.002	38.2		1770	0.003	0.029	0.311	119	0.00002	9.6		80.2	5.78	0.0005	126	0.59	0.016	3.73	0.0004	962	1460	11	895.95	1.58
22-Jul-16	0.0005	0.5	8.3	0.0005	0.48	0.023		14	0.0013	64.6		1419	0.001	0.004	0.521	26.4	0.00002	6.16		68.2	1.46	0.0005	137	0.482	0.008	3.6	0.0003	650	894	10.8	896.15	1.21
18-Aug-16	0.0005	0.5	6.05	0.001	0.7	0.021		19.2	0.0012	47.2		1532	0.001	0.011	0.542	71.8	0.00002	7.35		70.9	3.2	0.0005	119	0.57	0.007	3.59	0.0002	711	1160	11.1	895.85	1.48
22-Sep-16	0.0005	0.5	6.84	0.0005	0.39	0.018		6.42	0.0007	35.4		1105	0.0005	0.002	0.438	3.63	0.00002	5.47		55.5	0.438	0.0005	105	0.39	0.006	3.89	0.0001	474	726	10.8	896.15	0.872
20-Oct-16	0.0005	0.5	5.14	0.001	0.75	0.019		20.1	0.0006	43.8		1440	0.002	0.004	0.544	64.1	0.00002	7.48		73.6	2.86	0.0005	121	0.502	0.005	4.07	0.0002	621	1110	11.1	895.85	1.24
17-Nov-16	0.0005	0.5	4.14	0.002	0.73	0.016		20.5	0.0004	34.1		1370	0.002	0.002	0.291	77.7	0.00002	7.29		61.3	3.64	0.0005	101	0.425	0.006	4.15	0.0001	634	1070	11	895.95	1.11
15-Dec-16	0.0005	0.5	5.07	0.002	0.95	0.02		32.9	0.0009	39.8		1585	0.003	0.005	0.357	106	0.00002	8.21		78.7	4.61	0.0005	117	0.498	0.008	4.2	0.0003	812	1330	11.1	895.85	1.2
27-Jan-17	0.0005	0.5	5.17	0.001	0.88	0.019		30.3	0.002	36.2		1572	0.002	0.014	0.297	89.2	0.00002	8.45		75.3	5.17	0.0005	113	0.492	0.013	4.05	0.0002	756	1380	11.1	895.85	1.24
16-Feb-17	0.0005	0.5	4.12	0.001	1.18	0.018		43.1	0.0008	43.8		1802	0.003	0.004	0.308	189	0.00002	9.81		80	7.62	0.0005	111	0.469	0.007	4.31	0.0002	956	1540	11.1	895.85	0.932
16-Mar-17	0.0005	0.5	3.63	0.001	1.15	0.016		46.8	0.0006	48.6		1830	0.002	0.003	0.223	157	0.00002	10.3		85.4	7.42	0.0005	116	0.429	0.005	4.24	0.0001	1030	1570	11	895.95	0.931

WGM1/D6 Post-Dry Ash Placement Data April, 2016 to March 2017

	Ag	ALK	Al	As	B	Ba	Be	Ca	Cd	Cl	Co	COND	Cr	Cu	F	Fe	Hg	K	Li	Mg	Mn	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	WL1	WL AHD	Zn
Average	0.0005	0.50	5.51	0.0012	0.88	0.019		29	0.0014	44		1600	0.0020	0.0107	0.40	103.07	0.00002	8		75	4.85	0.001	116	0.490	0.010	4.0	0.0002	807	1294	11.1	895.9	1.220
Maximum	0.0005	0.50	8.30	0.0020	1.22	0.023		47	0.0049	65		2030	0.0030	0.0400	0.55	189.00	0.00002	10		92	8.12	0.001	137	0.590	0.034	4.3	0.0005	1170	1700	11.3	896.2	1.670
Minimum	0.0005	0.50	3.63	0.0005	0.39	0.016		6	0.0004	34		1105	0.0005	0.0020	0.22	3.63	0.00002	5		56	0.44	0.001	101	0.390	0.005	3.6	0.0001	474	726	10.8	895.7	0.872
50th Percentile	0.0005	0.50	5.16	0.0010	0.89	0.019		32	0.0011	42		1579	0.0020	0.0045	0.36	97.60	0.00002	8		77	4.89	0.001	116	0.487	0.008	4.1	0.0002	784	1355	11.1	895.9	1.205

7. Water Quality Data and Summary for SSCAD

SSCAD Pre-Dry Ash Placement Background Summary 1996-April, 2003 (mg/L)

	Ag	ALK	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	CrIV	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	Zn
Average	0.001	18	0.016	4.7	0.128	0.009	56	0.012	18	121893	0.005		0.007	9.3	0.17	0.0002	53	11	1.2	0.152	137	0.129	0.002	5.4	0.151	553	858	0.426
Maximum	0.001	53	0.039	8.6	0.152	0.009	140	0.020	74	257800	0.018		0.035	14.0	0.45	0.0002	110	18	1.7	0.190	380	0.150	0.005	6.5	0.379	1390	2170	0.650
Minimum	0.001	5	0.003	2.7	0.110	0.008	33	0.006	8	86000	0.001		0.001	7.2	0.03	0.0001	35	7	0.8	0.113	46	0.108	0.001	4.7	0.029	351	215	0.100
90th Percentile	0.001	28.4	0.034	8.0	0.142	0.009	107	0.020	28	200360	0.013		0.016	11.4	0.29	0.0002	88	15	1.7	0.182	287	0.146	0.005	6.0	0.298	1029	1604	0.580

SSCAD Post-Dry Ash Placement April, 2016 to March 2017

Date	Ag	ALK	Al	As	B	Ba	Be	Ca	Cd	Cl	Co	COND	Cr	CrIV	Cu	F	Fe	Hg	K	Li	Mg	Mn	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	Zn
28-Apr-16	0.0005	0.5	10.1	0.003	2.58	0.038		71.1	0.0059	12.6		1173	0.001		0.049	4.4	0.046	0.00002	38.9		17.5	2.41	0.0005	94.6	0.196	0.002	4.58	0.0041	562	820	0.582
18-May-16	0.0005	0.5	7.76	0.001	1.97	0.04		70.4	0.0053	11.7		1088	0.001		0.022	4.59	0.041	0.00002	34.4		16.4	2.09	0.0005	88.6	0.164	0.0005	4.79	0.0044	513	704	0.509
16-Jun-16	0.0005	0.5	2.04	0.001	0.97	0.03		34.3	0.0022	9.86		556	0.001		0.006	0.817	0.027	0.00002	21.4		6.6	0.757	0.0005	46.2	0.064	0.0005	5.16	0.0017	241	359	0.183
22-Jul-16	0.0005	0.5	8.83	0.003	3.06	0.032		93.8	0.0061	19.3		1598	0.001		0.007	3.77	0.098	0.00002	47.1		20.1	2.48	0.026	188	0.157	0.0005	4.78	0.0044	827	964	0.43
17-Aug-16	0.0005	0.5	8.87	0.002	3.68	0.031		76.2	0.0061	17.1		1623	0.001		0.008	3.34	0.08	0.00002	49.8		18.9	2.5	0.029	164	0.172	0.0005	5.04	0.0038	765	1180	0.466
22-Sep-16	0.0005	0.5	8.42	0.003	3.27	0.03		74.4	0.0054	18.7		1512	0.001		0.006	3.71	0.063	0.00002	49.4		18.8	2.22	0.026	161	0.143	0.0005	4.91	0.0038	760	1100	0.399
19-Oct-16	0.0005	0.5	1.97	0.0005	1.62	0.018		37.7	0.0024	10.1		765	0.001		0.003	1.14	0.056	0.00002	25.6		8.13	0.937	0.012	75.8	0.056	0.0005	5.24	0.0015	309	499	0.183
16-Nov-16	0.0005	0.5	8.85	0.002	2.94	0.028		69.4	0.005	17.7		1488	0.001		0.008	3.27	0.199	0.00006	44.6		18.4	2.4	0.024	153	0.139	0.0005	4.5	0.0036	676	1140	0.413
14-Dec-16	0.0005	0.5	6.06	0.003	2.27	0.03		72.3	0.0045	15.7		1360	0.001		0.009	1.96	0.056	0.00002	42		18	1.86	0.011	159	0.129	0.0005	4.78	0.0042	638	961	0.393
25-Jan-17	0.0005	0.5	1.61	0.0005	1.69	0.027		52.5	0.003	10.6		961	0.001		0.003	0.975	0.021	0.00002	33.1		11.4	1.37	0.01	97.8	0.079	0.0005	5.03	0.0021	430	774	0.293
15-Feb-17	0.0005	0.5	1.19	0.0005	2.04	0.032		66.5	0.003	13.3		1130	0.001		0.001	0.96	0.019	0.00002	40.5		13.4	1.51	0.016	115	0.086	0.0005	5.38	0.0023	506	672	0.285
15-Mar-17	0.0005	2	0.27	0.0005	1.13	0.021		43.4	0.0013	8.43		690	0.001		0.002	0.375	0.004	0.00002	24.1		7.54	0.756	0.016	64.8	0.037	0.0005	6.59	0.0014	304	452	0.136

SSCAD Post-Stage 2 Dry Ash Placement April, 2016 to March, 2017 (mg/l)

	Ag	ALK	Al	As	B	Ba	Be	Ca	Cd	Cl	Co	COND	Cr		Cu	F	Fe	Hg	K	Li	Mg	Mn	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	Zn
Average	0.0005	0.63	5.50	0.0017	2.27	0.030		64	0.0042	14		1162	0.0010		0.0103	2.44	0.06	0.0000	38		14.60	1.77	0.014	117	0.119	0.001	5.1	0.003	544	802	0.356
Maximum	0.0005	2.00	10.10	0.0030	3.68	0.040		94	0.0061	19		1623	0.0010		0.0490	4.59	0.20	0.0001	50		20.10	2.50	0.029	188	0.196	0.002	6.6	0.004	827	1180	0.582
Minimum	0.0005	0.50	0.27	0.0005	0.97	0.018		34	0.0013	8		556	0.0010		0.0010	0.38	0.00	0.0000	21		6.60	0.76	0.001	46	0.037	0.001	4.5	0.001	241	359	0.136
50th Percentile	0.0005	0.50	6.91	0.0015	2.16	0.030		70	0.0048	13		1152	0.0010		0.0065	2.62	0.05	0.0000	40		16.95	1.98	0.014	106	0.134	0.001	5.0	0.004	538	797	0.396

8.

Water Quality Data and Summary for Sawyers Swamp Creek Monitoring from SSCAD Spillway to near WGM4/D5

Sawyers Crk upstream 0m Site 225 where SSCAD diversion and Springvale Mine Water from April, 2016 to March, 2017 enters SSC at spillway

Date	Ag	Al	Alk	As	B	Ba	Be	Ca	Cd	Cl	Cond	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	DO	Pb	pH	NO3	se	So4	TDS	TKN	TN	Turbidity (NTU)	Zn
28/04/2016	0.0005	0.17	480	0.024	0.14	0.031		28.7	0.0001	25.7	1367	0.001	0.001	0.8	0.019	0.00002	15.4	19.2	0.079	0.034	237	0.017	7.8	0.0005	8.29	0.44	0.0002	201	758		0.6	4.2	0.013
18/05/2016	0.0005	0.4	619	0.034	0.16	0.027		4.08	0.0001	5.26	1167	0.001	0.001	1.38	0.007	0.00002	10.6	2.99	0.009	0.039	262	0.003	7.7	0.0005	8.07	0.27	0.0001	31.8	606		0.8	2.6	0.008
16/06/2016	0.0005	0.14	612	0.032	0.13	0.029		4.37	0.0001	4.89	1165	0.001	0.001	1.12	0.013	0.00002	13.2	3.08	0.01	0.04	264	0.003	7.7	0.0005	7.93	0.28	0.0001	25.6	741		0.8	3.7	0.009
21/07/2016	0.0005	0.34	576	0.031	0.07	0.028		4.31	0.0001	5.31	1124	0.001	0.001	0.869	0.017	0.00002	9.63	2.96	0.006	0.039	274	0.003	9	0.0005	8.13	0.4	0.0001	25.2	683		0.7	5.3	0.007
17/08/2016	0.0005	0.38	560	0.022	0.08	0.031		3.85	0.0001	5.19	1138	0.001	0.001	0.903	0.007	0.00002	10.6	2.89	0.01	0.043	222	0.002	8.5	0.0005	8.01	0.46	0.0001	23.4	649		1.2	2.8	0.01
21/09/2016	0.0005	0.4	547	0.024	0.09	0.029		3.99	0.0001	5.51	1120	0.001	0.001	0.844	0.005	0.00002	10.2	2.96	0.011	0.038	232	0.003	8.6	0.0005	8.24	0.4	0.0001	21.7	648		0.7	3.3	0.006
19/10/2016	0.0005	0.37	677	0.02	0.09	0.03		4.22	0.0001	5.68	1177	0.001	0.001	0.801	0.007	0.00002	12.6	3.04	0.013	0.043	287	0.002	8.6	0.0005	8.24	0.43	0.0003	20.1	596		0.9	1.9	0.005
16/11/2016	0.0005	0.16	563	0.028	0.1	0.025		4.16	0.0001	5.68	1198	0.001	0.001	0.588	0.03	0.00002	11.5	2.99	0.02	0.04	269	0.003	8.5	0.0005	8.19	0.22	0.0001	26.8	678		0.7	3.8	0.01
14/12/2016	0.0005	0.28	612	0.025	0.06	0.029		4.36	0.0001	5.35	1207	0.001	0.001	1.36	0.015	0.00002	11.5	3.32	0.027	0.044	326	0.004	8.3	0.0005	8.22	0.09	0.0001	17.4	696		0.8	1.6	0.005
25/01/2017	0.0005	0.25	611	0.024	0.07	0.029		4.29	0.0001	5.55	1208	0.001	0.001	1.03	0.009	0.00002	12.1	3.21	0.016	0.043	319	0.003	8.2	0.0005	8.06	0.12	0.0002	18.1	739		0.7	2.1	0.005
15/02/2017	0.0005	0.31	644	0.024	0.11	0.03		4.29	0.0001	5.87	1204	0.001	0.001	1.13	0.016	0.00002	13	3.14	0.019	0.041	288	0.003	8.2	0.0005	8.1	0.08	0.0002	21	612		0.7	4.1	0.005
15/03/2017	0.0005	0.26	599	0.022	0.07	0.027		4.64	0.0001	5.49	1190	0.001	0.001	1.19	0.01	0.00002	13.2	3.41	0.012	0.039	319	0.003	8.2	0.0005	8.22	0.24	0.0003	26.1	707		0.6	2.5	0.007

Sawyers Crk upstream 0m Site 225 where SSCAD diversion and Springvale Mine Water from April, 2016 to March, 2017 enters SSC at spillway

	Ag	Al	Alk	As	B	Ba	Be	Ca	Cd	Cl	Cond	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	DO	Pb	pH	NO3	se	So4	TDS	TKN	TN	Turbidity (NTU)	Zn
Average	0.0005	0.29	592	0.026	0.098	0.029		6.3	0.0001	7.1	1189	0.001	0.001	1.001	0.013	0.00002	12.0	4.43	0.019	0.040	275	0.004	8.3	0.001	8.1	0.29	0.0002	38.2	676		0.8	3.2	0.008
Maximum	0.0005	0.40	677	0.034	0.16	0.031		28.7	0.0001	25.7	1367	0.001	0.001	1.380	0.03	0.00002	15.4	19.20	0.079	0.044	326	0.017	9.0	0.001	8.3	0.46	0.0003	201.0	758		1.2	5.3	0.013
Minimum	0.0005	0.14	480	0.02	0.06	0.025		3.9	0.0001	4.9	1120	0.001	0.001	0.588	0.005	0.00002	9.6	2.89	0.006	0.034	222	0.002	7.7	0.001	7.9	0.08	0.0001	17.4	596		0.6	1.6	0.005
50th Percentile	0.0005	0.30	605	0.024	0.09	0.029		4.3	0.0001	5.5	1184	0.001	0.001	0.967	0.012	0.00002	11.8	3.06	0.013	0.040	271.5	0.003	8.3	0.001	8.2	0.28	0.0001	24.3	681		0.7	3.1	0.007

Sawyers Creek Ash Dam Seepage from V-notch Site 79 (water collected and recycling back into dam) from April, 2016 to March, 2017																																
Date	ag	Al	Alk	As	B	Ba	Be	Ca	Cd	Cl	Cond	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	DO	Pb	pH	NO3	se	So4	TDS	TKN	TN	Turbidity (NTU)	Zn
28/04/2016	0.0005	18.3	0.5	0.002	2.42	0.026		247	0.0091	41.4	2890	0.002	0.014	3.74	0.056	0.00002	42.6	96.7	22.5	0.001	232	0.517	7.3	0.001	8.33	0.46	0.0003	41.8	627		0.9	3.8	0.013
18/05/2016	0.0005	0.18		0.009	0.66	0.009		51.8	0.00005	19.5	1560	0.001	0.112	2.81	0.006	0.00002	20.9	22	0.398	0.023	283	0.014	7.5	0.001	8.41	0.34	0.0001	28.6	598		0.7	4.9	0.011
16/06/2016	0.0005	2.42	43	0.002	0.27	0.033		27	0.00005	23.2	468	0.001	0.003	0.386	0.18	0.00002	6.4	13.4	0.001	0.001	43.6	0.005	7.4	0.001	8.29	0.37	0.0001	27.6	664		0.8	4.4	0.007
21/07/2016	0.0005	2.86	31	0.0005	0.2	0.034		16	0.00005	22.4	281	0.002	0.004	0.118	0.412	0.00002	4.54	7.83	0.02	0.001	23.3	0.011	8.6	0.001	8.51	0.51	0.0002	33.6	601		0.7	7	0.007
17/08/2016	0.0005	0.21	82	0.0005	0.52	0.035		43.2	0.00005	55.1	837	0.001	0.0005	0.584	0.02	0.00002	7.58	21.2	0.287	0.001	79.1	0.006	8.6	0.001	8.58	0.52	0.0002	25.5	699		0.8	3.8	0.006
21/09/2016	0.0005	1.43	40	0.0005	0.24	0.033		24.6	0.00005	23.3	409	0.001	0.002	0.429	0.176	0.00002	4.96	11	0.423	0.001	34	0.014											
19/10/2016	0.0005	13.5	0.5	0.001	2.38	0.035		227	0.0065	52.2	2634	0.002	0.014	2.62	0.152	0.00002	34.6	97.1	20.6	0.001	247	0.463	8.5	0.001	8.69	0.51	0.0003	20.4	624		1	1.8	0.006
16/11/2016	0.0005	1.05	38	0.0005	0.95	0.028		43.7	0.00005	28	733	0.001	0.002	0.936	0.078	0.00002	9.78	18.2	1.44	0.001	53.4	0.02	8.3	0.001	8.62	0.28	0.0002	27.1	674		0.7	5.5	0.011
14/12/2016	0.0005	0.3	134	0.0005	0.92	0.037		68	0.00005	58.9	1188	0.001	0.002	1.03	0.048	0.00002	14.9	31.1	0.722	0.002	139	0.009	7.9	0.001	8.67	0.2	0.0001	18.1	694		0.7	1.8	0.005
25/01/2017	0.0005	0.96		0.004	0.27	0.034		23.2	0.00005	7.82	969	0.001	0.0005	1.12	0.076	0.00002	11.6	11.4	1.3	0.015	199	0.005	8	0.001	8.66	0.21	0.0002	18.4	680		0.8	2.2	0.005
15/02/2017	0.0005	1.72		0.0005	1.3	0.032		146	0.0024	29.4	2107	0.001	0.004	1.73	0.012	0.00002	29.6	61.2	8.76	0.008	272	0.167	8.1	0.001	8.57	0.17	0.0001	17.7	609		0.8	2.9	0.011
15/03/2017	0.0005	0.86	84	0.001	0.91	0.059		93.6	0.0003	33	1440	0.001	0.006	0.796	0.011	0.00002	19.4	46.5	2.04	0.002	159	0.034	8.3	0.001	8.64	0.3	0.0003	25	788		0.7	8.5	0.029

Sawyers Creek Ash Dam Seepage from V-notch Site 79 (water collected and recycling back into dam) from April, 2016 to March, 2017																																
	Ag	Al	Alk	As	B	Ba	Be	Ca	Cd	Cl	Cond	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	DO	Pb	pH	NO3	se	So4	TDS	TKN	TN	Turbidity (NTU)	Zn
Average	0.0005	3.6	50.3	0.026	0.144	0.030		4.5	0.0001	5.6	1184	0.001	0.002	1.18	0.024	0.00002	11.8	3.29	0.02	0.042	277	0.003	8.0	0.001	8.5	0.35	0.0002	25.8	660		0.8	4.2	0.010
Maximum	0.0005	18.3	134	0.033	0.52	0.034		6.2	0.0001	6.5	1214	0.001	0.008	1.96	0.048	0.00002	13.4	4.16	0.08	0.048	322	0.005	8.6	0.001	8.7	0.52	0.0003	41.8	788		1.0	8.5	0.029
Minimum	0.0005	0.18	0.5	0.02	0.06	0.027		3.8	0.0001	2.8	1125	0.001	0.001	0.77	0.012	0.00002	9.5	2.85	0.01	0.039	221	0.003	7.3	0.001	8.3	0.17	0.0001	17.7	598		0.7	1.8	0.005
50th Percentile	0.0005	1.24	40	0.025	0.1	0.03		4.4	0.0001	5.8	1190	0.001	0.001	1.06	0.022	0.00002	12.2	3.24	0.01	0.041	271	0.003	8.1	0.001	8.6	0.34	0.0002	25.5	664		0.8	3.8	0.007

Sawyer Creek @850m Site 93 - upstream seepage from KVAD wall and Below v-notch Seepage Point. Detailed data from April, 2015 to March, 2016 is at Site 93																																
Date	Ag	Al	Alk	As	B	Ba	Be	Ca	Cd	Cl	Cond	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	DO	Pb	pH	NO3	se	So4	TDS	TKN	TN	Turbidity (NTU)	Zn
28/04/2016	0.0005	0.19	631	0.031	0.08	0.031		4.89	0.00005	5.27	1186	0.0005	0.0005	1.25	0.015	0.00002	12.8	3.54	0.014	0.044	255	0.003	7.7	0.0005	8.37	0.49	0.0002	36.4	706		0.9	4	0.008
18/05/2016	0.0005	0.49	625	0.024	0.33	0.03		4.37	0.00005	5.42	1173	0.0005	0.001	1.77	0.01	0.00002	11.4	4.26	0.005	0.042	253	0.011	7.8	0.0005	8.47	0.36	0.0001	50.8	808		0.8	5.5	0.02
16/06/2016	0.0005	0.3	632	0.032	0.1	0.031		4.47	0.00005	5.57	1151	0.0005	0.002	1.48	0.018	0.00002	13.6	3.2	0.011	0.042	262	0.003	7.9	0.0005	8.3	0.38	0.0001	28	757		0.8	4.4	0.008
21/07/2016	0.0005	0.39	552	0.027	0.11	0.028		5.01	0.00005	5.64	1098	0.0005	0.0005	1.05	0.251	0.00002	9.24	3.11	0.019	0.038	263	0.002	8.9	0.0005	8.7	0.56	0.0003	31.3	648		0.8	7.8	0.01
17/08/2016	0.0005	0.34	554	0.02	0.23	0.03		4.38	0.00005	5.35	1131	0.0005	0.0005	0.814	0.011	0.00002	11.6	3.22	0.005	0.043	243	0.004	9.4	0.0005	8.04	0.54	0.0001	24.6	759		0.7	5.7	0.008
22/09/2016	0.0005	0.48	631	0.027	0.39	0.035		4.7	0.00005	5.73	1130	0.0005	0.0005	1.17	0.016	0.00002	11	3.36	0.022	0.041	249	0.004	9.1	0.0005	8.73	0.46	0.0002	28.2	594		0.9	10.2	0.009
20/10/2016	0.0005	0.32	651	0.019	0.12	0.028		4.51	0.00005	6.22	1180	0.0005	0.0005	1.3	0.019	0.00002	12	3.24	0.011	0.041	327	0.002	9.4	0.0005	8.68	0.5	0.0003	30.8	758		0.9	3.5	0.0025
16/11/2016	0.0005	0.19	551	0.023	0.53	0.026		4.89	0.0002	5.66	1199	0.0005	0.0005	1.03	0.042	0.00002	13.2	3.51	0.025	0.038	297	0.004	9.1	0.0005	8.63	0.31	0.0001	33.9	768		0.7	2.6	0.008
14/12/2016	0.0005	0.15	589	0.022	0.27	0.028		4.5	0.00005	5.24	1209	0.0005	0.0005	1.41	0.018	0.00002	11.3	3.4	0.009	0.044	325	0.006	8.3	0.0005	8.61	0.23	0.0001	22.9	615		0.7	1.7	0.0025
25/01/2017	0.0005	0.26	659	0.023	0.13	0.029		4.28	0.00005	5.49	1208	0.0005	0.0005	1.01	0.017	0.00002	11.9	3.24	0.008	0.043	312	0.004	8	0.0005	8.67	0.28	0.0001	19.1	710		0.7	3.8	0.008
15/02/2017	0.0005	0.25	607	0.024	0.07	0.031		4.26	0.00005	5.6	1207	0.0005	0.0005	1.3	0.022	0.00002	12.5	3.18	0.007	0.042	282	0.003	8.2	0.0005	8.06	0.22	0.0002	24.7	598		0.7	2.9	0.008
15/03/2017	0.0005	0.19	584	0.021	0.09	0.026		4.62	0.00005	5.64	1190	0.0005	0.0005	1.22	0.02	0.00002	12.9	3.49	0.015	0.039	313	0.002	8.3	0.0005	8.64	0.36	0.0003	25.3	672		0.7	4.2	0.006

Sawyer Creek @850m site 93 - upstream seepage from KVAD wall and Below v-notch Seepage Point. Detailed data from April, 2015 to March, 2016 is at Site 93																															
	Ag	Al	Alk	As	B	Ba	Be	Ca	Cd	Cl	Cond	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	DO	Pb	pH	se	So4	TDS	TKN	TN	Turbidity (NTU)	Zn
Average	0.0005	0.3	605.5	0.024	0.204	0.029		4.6	0.0001	5.6	1172	0.0005	0.001	1.234	0.038	0.00002	12.0	3.4	0.013	0.041	282	0.004	8.5	0.0005	8.5	0.39	0.0002	29.7	699		0.78	4.7
Maximum	0.0005	0.5	659.0	0.032	0.53	0.035		5.0	0.0002	6.2	1209	0.0005	0.002	1.77	0.251	0.00002	13.6	4.3	0.025	0.044	327	0.011	9.4	0.0005	8.7	0.56	0.0003	50.8	808		0.90	10.2
Minimum	0.0005	0.2	551.0	0.019	0.07	0.026		4.3	0.0001	5.2	1098	0.0005	0.0005	0.814	0.01	0.00002	9.2	3.1	0.005	0.038	243	0.002	7.7	0.0005	8.0	0.22	0.0001	19.1	594		0.70	1.7
50th Percentile	0.0005	0.3	616.0	0.0235	0.125	0.0295		4.5	0.0001	5.6	1183	0.0005	0.0005	1.235	0.018	0.00002	12.0	3.3	0.011	0.042	272.5	0.0035	8.3	0.0005	8.6	0.37	0.0002	28.1	708		0.75	4.1

Sawyers Creek at @1250m near GWD5 (site 83) data from April, 2015 to March, 2016 is at Site 83																																		
Date	Ag	Al	Alk	As	B	Ba	Be	Ca	Cd	Cl	Cond	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	DO	Pb	pH	NO3	se	So4	TDS	TKN	TN	Turbidity (NTU)	Zn
28/04/2016	0.0005	0.19	631	0.031	0.08	0.031		4.89	0.00005	5.27	1186	0.0005	0.0005	1.25	0.015	0.00002	12.8	3.54	0.014	0.044	255	0.003	7.7	0.0005	8.37	0.49	0.0002	36.4	706		0.9	4	0.008
18/05/2016	0.0005	0.49	625	0.024	0.33	0.03		4.37	0.00005	5.42	1173	0.0005	0.001	1.77	0.01	0.00002	11.4	4.26	0.005	0.042	253	0.011	7.8	0.0005	8.47	0.36	0.0001	50.8	808		0.8	5.5	0.02
16/06/2016	0.0005	0.3	632	0.032	0.1	0.031		4.47	0.00005	5.57	1151	0.0005	0.002	1.48	0.018	0.00002	13.6	3.2	0.011	0.042	262	0.003	7.9	0.0005	8.3	0.38	0.0001	28	757		0.8	4.4	0.008
21/07/2016	0.0005	0.39	552	0.027	0.11	0.028		5.01	0.00005	5.64	1098	0.0005	0.0005	1.05	0.251	0.00002	9.24	3.11	0.019	0.038	263	0.002	8.9	0.0005	8.7	0.56	0.0003	31.3	648		0.8	7.8	0.01
17/08/2016	0.0005	0.34	554	0.02	0.23	0.03		4.38	0.00005	5.35	1131	0.0005	0.0005	0.814	0.011	0.00002	11.6	3.22	0.005	0.043	243	0.004	9.4	0.0005	8.04	0.54	0.0001	24.6	759		0.7	5.7	0.008
22/09/2016	0.0005	0.48	631	0.027	0.39	0.035		4.7	0.00005	5.73	1130	0.0005	0.0005	1.17	0.016	0.00002	11	3.36	0.022	0.041	249	0.004	9.1	0.0005	8.73	0.46	0.0002	28.2	594		0.9	10.2	0.009
20/10/2016	0.0005	0.32	651	0.019	0.12	0.028		4.51	0.00005	6.22	1180	0.0005	0.0005	1.3	0.019	0.00002	12	3.24	0.011	0.041	327	0.002	9.4	0.0005	8.68	0.5	0.0003	30.8	758		0.9	3.5	0.0025
16/11/2016	0.0005	0.19	551	0.023	0.53	0.026		4.89	0.0002	5.66	1199	0.0005	0.0005	1.03	0.042	0.00002	13.2	3.51	0.025	0.038	297	0.004	9.1	0.0005	8.63	0.31	0.0001	33.9	768		0.7	2.6	0.008
14/12/2016	0.0005	0.15	589	0.022	0.27	0.028		4.5	0.00005	5.24	1209	0.0005	0.0005	1.41	0.018	0.00002	11.3	3.4	0.009	0.044	325	0.006	8.3	0.0005	8.61	0.23	0.0001	22.9	615		0.7	1.7	0.0025
25/01/2017	0.0005	0.26	659	0.023	0.13	0.029		4.28	0.00005	5.49	1208	0.0005	0.0005	1.01	0.017	0.00002	11.9	3.24	0.008	0.043	312	0.004	8	0.0005	8.67	0.28	0.0001	19.1	710		0.7	3.8	0.008
15/02/2017	0.0005	0.25	607	0.024	0.07	0.031		4.26	0.00005	5.6	1207	0.0005	0.0005	1.3	0.022	0.00002	12.5	3.18	0.007	0.042	282	0.003	8.2	0.0005	8.06	0.22	0.0002	24.7	598		0.7	2.9	0.008
15/03/2017	0.0005	0.19	584	0.021	0.09	0.026		4.62	0.00005	5.64	1190	0.0005	0.0005	1.22	0.02	0.00002	12.9	3.49	0.015	0.039	313	0.002	8.3	0.0005	8.64	0.36	0.0003	25.3	672		0.7	4.2	0.006

Sawyers Creek at @1250m near GWD5 (site 83) data from April, 2015 to March, 2016 is at Site 83																																	
	Ag	Al	Alk	As	B	Ba	Be	Ca	Cd	Cl	Cond	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	DO	Pb	pH	NO3	se	So4	TDS	TKN	TN	Turbidity (NTU)	Zn
Average	0.0005	0.3	605.5	0.024	0.204	0.029		4.6	0.0001	5.6	1172	0.0005	0.001	1.234	0.038	0.00002	12.0	3.4	0.013	0.041	281.75	0.004	8.5	0.0005	8.5	0.39	0.0002	29.7	699		0.78	4.7	0.008
Maximum	0.0005	0.5	659.0	0.032	0.53	0.035		5.0	0.0002	6.2	1209	0.0005	0.002	1.77	0.251	0.00002	13.6	4.3	0.025	0.044	327	0.011	9.4	0.0005	8.7	0.56	0.0003	50.8	808		0.90	10.2	0.02
Minimum	0.0005	0.2	551.0	0.019	0.07	0.026		4.3	0.0001	5.2	1098	0.0005	0.0005	0.814	0.01	0.00002	9.2	3.1	0.005	0.038	243	0.002	7.7	0.0005	8.0	0.22	0.0001	19.1	594		0.70	1.7	0.0025
50th Percentile	0.0005	0.3	616.0	0.0235	0.125	0.0295		4.5	0.0001	5.6	1183	0.0005	0.0005	1.235	0.018	0.00002	12.0	3.3	0.011	0.042	272.5	0.0035	8.3	0.0005	8.6	0.37	0.0002	28.1	708		0.75	4.1	0.008

Site 86 Seepage water Northern wall collection pit near GW6 Groundwater from the KVAD on the northside drains from April, 2015 to March, 2016. All water reports to the pipe out to the Lisdale Cut.

Date	ag	Al	Alk	As	B	Ba	Be	Ca	Cd	Cl	Cond	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	DO	Pb	pH	NO3	se	So4	TDS	TKN	TN	Turbidity (NTU)	Zn
28/04/2016	0.0005	15.1	0.5	0.003	8.38	0.0005		355	0.0002	22	4680	0.0005	0.0005	17	43.7	0.00002	169	114	17.8	0.001	313	1.23	4.5	0.0005	2.83	0.02	0.0023	2480	4120		5.9	0.9	2.28
18/05/2016	0.0005	15.1	0.5	0.004	8.28	0.0005		334	0.0002	20.8	4670	0.001	0.002	15.2	45.3	0.00002	157	107	16.6	0.001	303	1.28	6.2	0.0005	2.72	0.02	0.0031	2510	3935.897		5	0.6	2.61
16/06/2016	0.0005	15.6	0.5	0.006	9.65	0.0005		340	0.0002	18.7	4530	0.002	0.002	13.5	50.4	0.00002	158	108	17.3	0.0005	295	1.29	6.3	0.0005	2.88	0.03	0.0026	2680	3620		4.4	0.9	2.42
21/07/2016	0.0005	8.09	0.5	0.002	4.35	0.004		186	0.0003	10.7	2735	0.001	0.001	4.33	17.2	0.00002	70.4	48.4	8.27	0.0005	146	0.572	6.8	0.001	3.32	0.04	0.0013	1110	1710		2.1	7	1.01
17/08/2016	0.0005	13.4	0.5	0.003	9.38	0.0005		273	0.00005	5	4197	0.0005	0.001	4.36	59	0.00002	131	87.1	16.4	0.0005	240	1.17	7.9	0.0005	3.19	0.02	0.0018	2000	3350		3.6	1.1	2.19
21/09/2016	0.0005	13.6	0.5	0.003	8.36	0.001		254	0.0002	18.4	3919	0.0005	0.0005	9.22	44.9	0.00002	133	81.8	14.1	0.0005	232	1.02	10.7	0.0005	2.85	0.03	0.0018	2080	3160		2.8	2.3	1.94
19/10/2016	0.0005	18.1	0.5	0.004	10.6	0.0005		331	0.0002	23.1	4395	0.0005	0.002	17.7	66.1	0.00002	164	104	16.4	0.0005	300	1.16	9.9	0.0005	2.77	0.02	0.0018	2020	3170		3.5	1.6	2.4
16/11/2016	0.0005	17.9	0.5	0.004	9.04	0.005		282	0.0008	19.6	4201	0.002	0.002	13.6	38.8	0.00002	130	86.8	14.4	0.0005	261	1.11	13.6	0.001	2.89	0.03	0.0021	2180	2960		2.7	10.9	2.17
14/12/2016	0.0005	20.4	0.5	0.006	7.26	0.003		379	0.0002	24.1	4903	0.001	0.0005	25.7	78.4	0.00002	184	115	15.2	0.002	368	1.36	6.3	0.0005	2.89	0.01	0.0041	2820	4420		4.4	2.1	2.51
25/01/2017	0.0005	24.7	0.5	0.006	12.1	0.0005		386	0.0001	23	4962	0.002	0.0005	31.3	82.1	0.00002	205	114	17.4	0.0005	367	1.35	5.1	0.0005	2.95	0.05	0.0024	2790	4510		5.2	2.1	2.26
15/02/2017	0.0005	27.6	0.5	0.006	13.3	0.001		402	0.0001	22.6	5130	0.002	0.0005	34.1	78.9	0.00002	199	117	17.7	0.0005	360	1.38	5.1	0.0005	2.87	0.025	0.0022	2840	3320		6	2.5	2.61
15/03/2017	0.0005	19.4	0.5	0.005	6.99	0.003		293	0.0002	21.7	3490	0.002	0.002	27.2	21.6	0.00002	135	73.5	10.5	0.0005	233	0.821	6.6	0.004	2.88	0.07	0.0018	2530	3000		3.9	9.6	1.54

Site 86 Seepage water Northern wall collection pit near GW6 Groundwater from the KVAD on the north side drains from April, 2015 to March, 2016. All water reports to the asbestos pipe out to the Lidsdale Cut (site 86)

	Ag	Al	Alk	As	B	Ba	Be	Ca	Cd	Cl	Cond	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	DO	Pb	pH	NO3	se	So4	TDS	TKN	TN	Turbidity (NTU)	Zn
Average	0.0005	17.4	0.5	0.004	9.0	0.002		318	0.0002	19.1	4318	0.001	0.001	17.8	52.2	0.00002	152.95	96.4	15.1725	0.001	285	1.15	7.4	0.001	2.9	0.03	0.002	2337	3440		4.13	3.5	2.162
Maximum	0.0005	27.6	0.5	0.006	13.3	0.005		402	0.0008	24.1	5130	0.002	0.002	34.1	82.1	0.00002	205	117	17.8	0.002	368	1.38	13.6	0.004	3.3	0.07	0.0041	2840	4510		6.00	10.9	2.61
Minimum	0.0005	8.1	0.5	0.002	4.4	0.0005		186	0.00005	5.0	2735	0.0005	0.0005	4.33	17.2	0.00002	70.4	48.4	8.27	0.0005	146	0.57	4.5	0.0005	2.7	0.01	0.0013	1110	1710		2.10	0.6	1.01
50th Percentile	0.0005	16.8	0.5	0.004	8.7	0.00075		332.5	0.0002	21.3	4463	0.001	0.001	16.1	47.85	0.00002	157.5	105.5	16.4	0.0005	297.5	1.20	6.45	0.0005	2.9	0.03	0.00215	2495	3335		4.15	2.1	2.27

Seepage Water Southwest wall at end of seepage line before entering Lidsdale Cut at Site 94

Site 94 Seepage water south-west wall groundwater seepage from the KVAD on from April, 2015 to March, 2016. All water reports to the pipe out to the Lisdale Cut.																																	
Date	ag	Al	Alk	As	B	Ba	Be	Ca	Cd	Cl	Cond	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	DO	Pb	pH	NO3	Se	So4	TDS	TKN	TN	Turbidity (NTU)	Zn
28/04/2016	0.0005	36.2	0.5	0.002	10.4	0.007		286	0.0034	47.8	4410	0.001	0.006	19.2	45.6	0.00046	205	162	25.3	0.002	309	2.28	8.6	0.007	3.12	0.24	0.003	2510	3940		4.9	2	3.11
18/05/2016	0.0005	36.2	0.5	0.004	10	0.008		260	0.0045	42.8	4380	0.001	0.009	20	45	0.00002	176	146	22.9	0.001	272	2.31	9.4	0.008	2.94	0.31	0.0044	2510	2940		4.7	1.5	3.46
16/06/2016	0.0005	35.3	0.5	0.006	8.4	0.014		250	0.0073	40.1	3740	0.002	0.014	15.8	30	0.00002	138	124	20.9	0.001	256	1.67	9.7	0.005	3.21	0.36	0.0043	1500	3420		3.3	8.3	2.46
21/07/2016	0.0005	16.8	0.5	0.002	4.4	0.023		160	0.0029	28.6	2178	0.001	0.006	3.64	16.2	0.00002	65	66.7	11.4	0.001	156	0.792	10.7	0.004	3.98	0.2	0.0018	1130	1760		1.7	58.1	1.18
17/08/2016	0.0005	25.7	0.5	0.003	7.04	0.019		204	0.0052	39.8	3411	0.001	0.01	5.49	30.4	0.00002	102	101	24.6	0.001	206	1.45	10.9	0.006	3.61	0.3	0.0022	1940	2120		2.5	37.4	2.16
22/09/2016	0.0005	16.8	0.5	0.003	4.26	0.028		134	0.0032	36.5	2262	0.001	0.006	4.51	17.6	0.00002	63.4	67.8	11.4	0.001	146	0.848	11.4	0.004	3.74	0.21	0.0018	1200	1520		1.6	74.1	1.28
19/10/2016	0.0005	88	0.5	0.015	12.2	0.014		277	0.0223	43.1	4136	0.008	0.027	13.7	27	0.00002	181	129	23.9	0.001	283	1.82	10.2	0.006	3.23	0.15	0.0121	2450	3430		3.4	22.2	3.08
17/11/2016	0.0005	200	0.5	0.026	14.1	0.02		250	0.0582	30.1	4417	0.026	0.054	22.4	13.7	0.00002	181	84.4	16.3	0.001	246	1.34	9.9	0.006	3.58	0.22	0.0314	3050	4810		2.8	52.4	3.08
14/12/2016	0.0005	34	0.5	0.004	7.49	0.007		280	0.0033	40	4372	0.001	0.005	22.9	37.2	0.00002	188	146	22.6	0.002	318	2.27	8.6	0.007	3.07	0.24	0.0054	2550	4010		4.8	2.3	3.01
25/01/2017	0.0005	81	0.5	0.009	10.8	0.032		285	0.0104	36.5	4113	0.008	0.006	20.4	26.4	0.00002	163	125	24.6	0.001	294	1.67	8.9	0.006	3.31	0.2	0.0104	2450	4070		3.7	155	2.56
15/02/2017	0.0005	27.2	0.5	0.003	6.95	0.016		268	0.006	45.1	3771	0.001	0.011	13.6	25.1	0.00002	133	132	29.6	0.001	273	1.52	8.7	0.007	3.22	0.2	0.0028	1920	2020		2.6	4.3	2.19
15/03/2017	0.0005	37.5	0.5	0.006	7.25	0.018		266	0.0092	37.4	3700	0.003	0.015	16.1	23.2	0.00002	138	123	18.7	0.001	268	1.41	8.8	0.005	3.08	0.23	0.0052	1980	3420		2.6	2.3	2.11

Site 94 Seepage water south-west wall groundwater seepage from the KVAD on from April, 2015 to March, 2016. All water reports to the pipe out to the Lisdale Cut. All water reports to the Lidsdale Cut (site 86)																																	
	Ag	Al	Alk	As	B	Ba	Be	Ca	Cd	Cl	Cond	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	DO	Pb	pH	NO3	Se	So4	TDS	TKN	TN	Turbidity (NTU)	Zn
Average	0.0005	52.9	0.5	0.007	8.61	0.017		243	0.011	39.0	3741	0.005	0.014	14.8	28.1	0.00006	144	117	21.0	0.001	252	1.615	9.65	0.006	3.3	0.24	0.007	2099	3122		3.2	35.0	2.47
Maximum	0.0005	200	0.5	0.026	14.10	0.032		286	0.0582	47.8	4417	0.026	0.054	22.9	45.6	0.00046	205	162	29.6	0.002	318	2.31	11.4	0.008	4.0	0.36	0.0314	3050	4810		4.9	155	3.46
Minimum	0.0005	16.8	0.5	0.002	4.26	0.007		134	0.0029	28.6	2178	0.001	0.005	3.64	13.7	0.00002	63	66.7	11.4	0.001	146	0.792	8.6	0.004	2.9	0.15	0.0018	1130	1520		1.6	1.5	1.18
50th Percentile	0.0005	35.75	0.5	0.004	7.95	0.017		263	0.0056	39.9	3942	0.001	0.009	15.95	26.7	0.00002	150	124	22.75	0.001	270	1.595	9.55	0.006	3.2	0.225	0.00435	2215	3420		3.05	15.3	2.51

KVAD groundwater Bores GW11, AP09 and AP17

KVAD groundwater bore GW11 April, 2016 to March 2017

Date	Ag	ALK	Al	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	WL AHD	WL1	Zn
28/04/2016																													dry	
18/05/2016																													dry	
17/06/2016																													2.7	
22/07/2016	0.0005	1.32	44	0.001	0.025	0.02		16	0.0001	13.7	183	0.001	0.002	0.047	0.467	0.00002	1.04	2.87	0.001	0.001	16.3	0.002	0.001	6.21	0.0004	25.1	168		0.9	0.007
18/08/2016																													2.8	
22/09/2016	0.0005	1.61	58	0.001	0.09	0.027		19.1	0.0001	14.9	232	0.001	0.006	0.082	0.59	0.00002	1.04	3.7	0.01	0.001	21.1	0.003	0.002	6.71	0.0003	35.8	190		2	0.025
20/10/2016																													3.1	
16/11/2016																													3.4	
14/12/2016																													dry	
25/01/2017																													dry	
15/02/2017																													dry	
15/03/2017																													dry	

KVAD groundwater bore GW11 April, 2016 to March 2017

	Ag	ALK	Al	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	WLAHD	WL1	Zn
Average	0.0005	1.5	51.0	0.001	0.06	0.024		17.6	0.0001	14.3	207.5	0.001	0.004	0.065	0.53	0.00002	1.04	3.29	0.0055	0.001	18.7	0.0025	0.002	6.5	0.0004	30.5	179		2.5	0.016
Maximum	0.0005	1.6	58.0	0.001	0.09	0.027		19.1	0.0001	14.9	232.0	0.001	0.006	0.082	0.59	0.00002	1.04	3.70	0.01	0.001	21.1	0.003	0.002	6.7	0.0004	35.8	190		3.4	0.025
Minimum	0.0005	1.3	44.0	0.001	0.03	0.020		16.0	0.0001	13.7	183.0	0.001	0.002	0.047	0.47	0.00002	1.04	2.87	0.001	0.001	16.3	0.002	0.001	6.2	0.0003	25.1	168		0.9	0.007
50th Percentile	0.0005	1.5	51.0	0.001	0.06	0.024		17.6	0.0001	14.3	207.5	0.001	0.004	0.065	0.53	0.00002	1.04	3.29	0.0055	0.001	18.7	0.0025	0.002	6.5	0.0004	30.5	179		2.8	0.016

KVAD groundwater bore AP09 April, 2016 to March 2017

Date	Ag	ALK	Al	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	WL AHD	WL1	Zn
28/04/2016	0.0005	0.24	20	0.066	2.27	0.017		132	0.0001	36.8	2380	0.001	0.001	0.374	71.9	0.00002	118	64.7	8.17	0.094	150	0.322	0.001	6.01	0.0002	1180	2030		3	0.119
18/05/2016	0.0005	0.27	63	0.067	1.89	0.018		140	0.0001	37.8	2380	0.001	0.004	0.414	66.8	0.00002	132	67.1	7.01	0.101	165	0.314	0.001	6.09	0.0002	1180	1950		3	0.132
17/06/2016	0.0005	0.28	47	0.068	2.16	0.017		141	0.0001	30.2	2470	0.001	0.001	0.25	71.3	0.00002	124	64.6	8.07	0.108	154	0.35	0.001	5.86	0.0002	1230	1990		2.9	0.14
22/07/2016	0.0005	0.33	65	0.067	1.99	0.016		205	0.0001	35.7	2608	0.001	0.001	0.331	36.8	0.00002	121	66.4	3.72	0.114	174	0.398	0.001	6.17	0.0002	1300	1660		2.7	0.157
18/08/2016	0.0005	0.36	44	0.08	2.45	0.015		154	0.0001	27.6	2662	0.001	0.001	0.1	105	0.00002	123	65.6	9.27	0.117	154	0.442	0.001	5.81	0.0002	1390	2050		3	0.191
22/09/2016	0.0005	0.6	31	0.134	2.63	0.021		194	0.0001	30.3	2759	0.001	0.001	0.263	111	0.00002	152	78	9.54	0.145	187	0.538	0.001	5.98	0.0004	1560	2310		2.9	0.243
20/10/2016	0.0005	0.36	46	0.077	2.23	0.015		190	0.0001	30.7	2800	0.001	0.001	0.361	110	0.00002	154	73.5	9.17	0.114	193	0.526	0.001	5.93	0.0003	1460	2520		3	0.209
16/11/2016	0.0005	0.37	40	0.064	2.31	0.015		174	0.0001	27.1	2867	0.001	0.001	0.198	111	0.00002	139	68.5	10.1	0.108	174	0.639	0.001	5.89	0.0003	1500	2570		3	0.278
14/12/2016	0.0005	0.38	54	0.067	2.08	0.016		182	0.0001	25	2833	0.001	0.001	0.208	101	0.00002	145	70.3	9.31	0.1	189	0.622	0.001	5.87	0.0006	1540	2540		3	0.276
25/01/2017	0.0005	0.37	0.5	0.05	2.53	0.013		196	0.0001	23.4	3009	0.001	0.001	0.932	99.4	0.00002	168	74.4	10.7	0.087	196	0.828	0.001	5.92	0.0004	1650	2660		3.1	0.362
15/02/2017	0.0005	0.34	44	0.063	2.37	0.015		181	0.0001	24.5	2868	0.001	0.001	0.888	121	0.00002	150	66.6	9.15	0.086	177	0.758	0.001	5.92	0.0004	1600	1880		3.2	0.316
15/03/2017	0.0005	0.34	46	0.057	2.43	0.013		202	0.0001	28.4	3030	0.001	0.001	0.835	112	0.00002	171	75	9.6	0.1	197	0.95	0.001	5.82	0.0003	1880	2530		3.1	0.416

KVAD groundwater bore AP09 April, 2016 to March 2017

	Ag	ALK	Al	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	WLAHD	WL1	Zn
Average	0.0005	0.35	41.7	0.072	2.3	0.016		174	0.0001	29.8	2722	0.001	0.0013	0.43	93.1	0.00002	141	69.6	8.65	0.106	176	0.557	0.001	5.9	0.0003	1456	2224		3.0	0.237
Maximum	0.0005	0.60	65.0	0.134	2.6	0.021		205	0.0001	37.8	3030	0.001	0.004	0.93	121	0.00002	171	78	10.70	0.145	197	0.95	0.001	6.2	0.0006	1880	2660		3.2	0.416
Minimum	0.0005	0.24	0.5	0.05	1.9	0.013		132	0.0001	23.4	2380	0.001	0.001	0.10	36.8	0.00002	118	64.6	3.72	0.086	150	0.314	0.001	5.8	0.0002	1180	1660		2.7	0.119
50th Percentile	0.0005	0.35	45.0	0.067	2.3	0.0155		182	0.0001	29.3	2780	0.001	0.001	0.35	103	0.00002	142	67.8	9.22	0.1045	175.5	0.532	0.001	5.9	0.0003	1480	2180		3	0.226

KVAD groundwater bore AP17 April, 2016 to March 2017

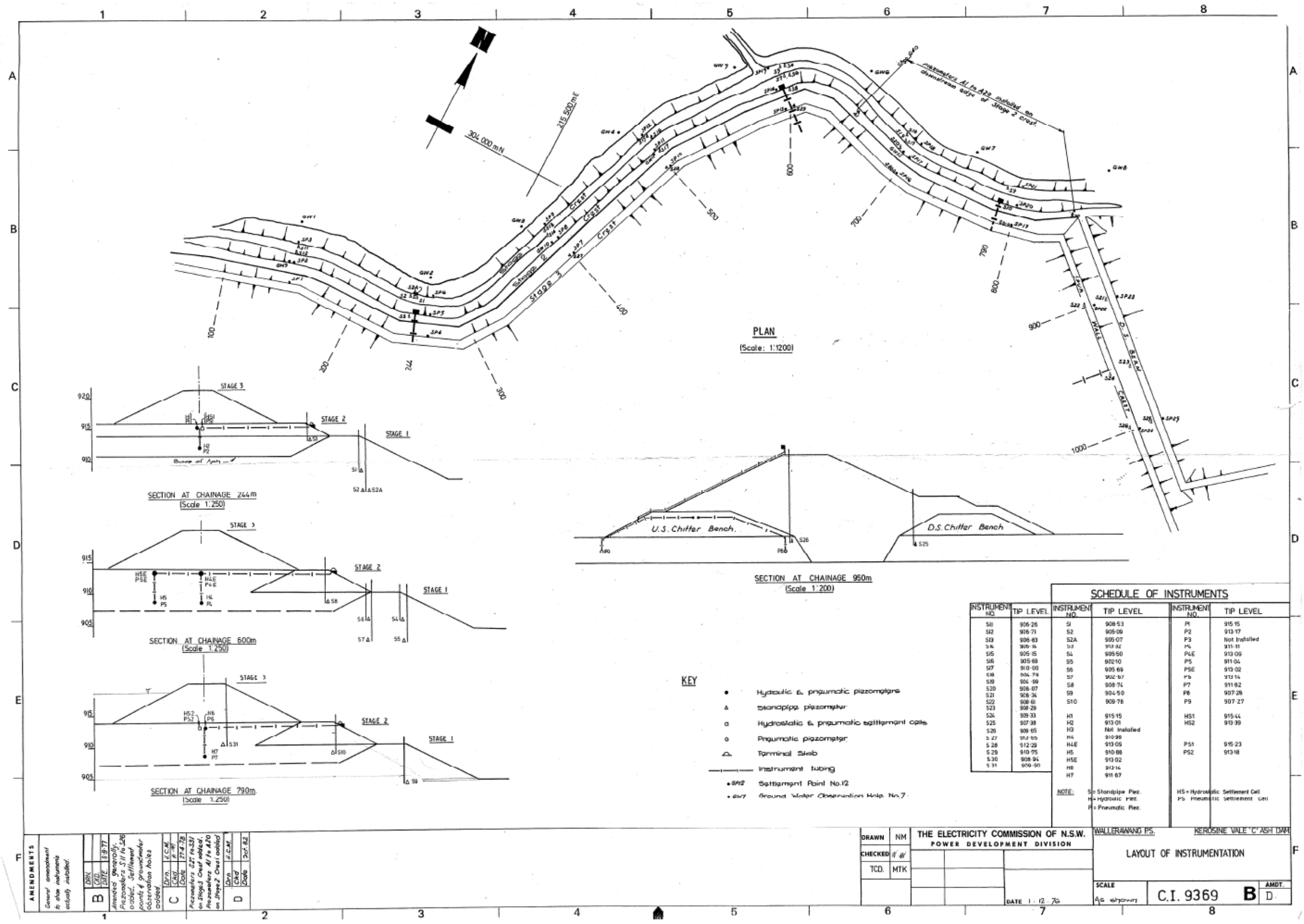
Date	Ag	ALK	Al	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	WL AHD	WL1	Zn
29/04/2016	0.0005	66.5	0.5	0.007	13	0.014		403	0.0011	18.8	5090	0.001	0.01	110	246	0.00017	274	94.6	15.4	0.014	346	1.97	0.002	4.11	0.0045	3160	5340		2.4	5.46
19/05/2016	0.0005	66.4	0.5	0.012	10.8	0.012		510	0.0012	18.4	5050	0.001	0.004	111	223	0.00032	351	118	13.2	0.036	436	1.81	0.001	4.69	0.0154	3280	4680		2.4	5.42
17/06/2016	0.0005	69.4	0.5	0.028	12.7	0.014		405	0.0013	12.7	5040	0.001	0.014	76.8	207	0.00011	278	93.6	14.2	0.012	344	1.83	0.003	3.48	0.0219	2890	4580		2.4	5.41
22/07/2016	0.0005	71.6	0.5	0.033	12	0.008		484	0.0014	9.68	5034	0.001	0.004	50.1	13.4	0.00002	292	87.7	0.987	0.011	354	1.83	0.001	3.45	0.0378	2980	3910		2.3	5.44
18/08/2016	0.0005	75.5	0.5	0.042	13.7	0.008		450	0.0015	5	5102	0.001	0.007	55.3	209	0.00002	343	105	13.9	0.008	381	1.95	0.002	2.74	0.0459	2790	4780		2.4	5.73
22/09/2016	0.0005	76.4	0.5	0.063	14.8	0.005		417	0.0017	17.9	5150	0.001	0.008	93.6	186	0.00009	331	95.9	14.3	0.004	365	1.86	0.004	3.33	0.0603	3260	5120		2.4	5.88
20/10/2016	0.0005	75.4	0.5	0.076	13.3	0.011		429	0.0014	20.2	5158	0.001	0.003	95	233	0.00007	343	94.4	13.2	0.004	384	1.78	0.001	4	0.0688	3180	5030		2.4	5.29
17/11/2016	0.0005	67.3	0.5	0.043	12.8	0.008		399	0.0014	18.6	5181	0.001	0.004	91.3	226	0.00002	309	89.2	14.4	0.007	358	1.78	0.001	3.86	0.0699	3220	5260		2.4	5.71
15/12/2016	0.0005	66.1	0.5	0.066	9.04	0.012		413	0.0017	16	5052	0.001	0.005	72.2	220	0.00002	299	92.9	12	0.006	387	1.73	0.002	3.86	0.105	3260	5290		2.5	4.74
27/01/2017	0.0005	71	0.5	0.044	13.1	0.011		398	0.0016	17.7	5086	0.001	0.003	92.7	183	0.00002	323	90.3	14.2	0.001	375	1.79	0.002	3.82	0.0723	3100	5360		2.5	5.25
16/02/2017	0.0005	73.2	0.5	0.065	13.3	0.013		389	0.0016	16.4	5051	0.001	0.002	92.4	232	0.00002	304	88.9	13.4	0.001	350	1.72	0.001	3.89	0.0732	3190	3570		2.6	5.32
16/03/2017	0.0005	71.7	0.5	0.072	12.8	0.013		406	0.0018	20.3	5080	0.001	0.006	83.4	179	0.00002	335	92.8	12.6	0.004	364	1.67	0.002	3.64	0.0631	3320	5420		2.5	5.12

KVAD groundwater bore AP17 April, 2016 to March 2017

	Ag	ALK	Al	As	B	Ba	Be	Ca	Cd	Cl	COND	Cr	Cu	F	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	Pb	pH	Se	SO4	TDS	WL1	WL AHD	Zn
Average	0.0005	70.9	0.5	0.046	12.61	0.011		425	0.0015	16.0	5090	0.001	0.006	85.3	196	0.00008	315	95.3	12.65	0.009	370	1.81	0.002	3.7	0.053	3136	4862	2.4		5.40
Maximum	0.0005	76.4	0.5	0.076	14.80	0.014		510	0.0018	20.3	5181	0.001	0.014	111.0	246	0.00032	351	118	15.40	0.036	436	1.97	0.004	4.7	0.105	3320	5420	2.6		5.88
Minimum	0.0005	66.1	0.5	0.007	9.04	0.005		389	0.0011	5	5034	0.001	0.002	50.1	13.4	0.00002	274	87.7	0.99	0.001	344	1.67	0.001	2.7	0.0045	2790	3570	2.3		4.74
50th Percentile	0.0005	71.3	0.5	0.0435	12.90	0.0115		410	0.00145	17.8	5083	0.001	0.0045	91.9	215	0.00002	316	93.25	13.65	0.0065	364.5	1.8	0.002	3.8	0.0617	3185	5075	2.4		5.42

Attachment 3

Construction drawing of KVAD wall showing chitter used to construct the benches



SCHEDULE OF INSTRUMENTS

INSTRUMENT NO.	TIP LEVEL	INSTRUMENT NO.	TIP LEVEL	INSTRUMENT NO.	TIP LEVEL
S11	906·26	S1	908·53	P1	915·15
S12	906·71	S2	905·09	P2	913·17
S13	906·83	S2A	905·07	P3	Not Installed
S14	906·14	S3	913·32	P4	911·11
S15	905·15	S4	905·50	P4E	913·09
S16	905·69	S5	902·10	P5	911·04
S17	910·00	S6	905·69	P5E	913·02
S18	904·78	S7	902·67	P6	913·14
S19	904·99	S8	908·74	P7	911·82
S20	906·07	S9	904·50	P8	907·28
S21	906·34	S10	909·78	P9	907·27
S22	908·61				
S23	908·29				
S24	909·33	H1	915·15	HS1	915·44
S25	907·38	H2	913·01	HS2	913·39
S26	909·65	H3	Not Installed		
S27	913·65	H4	910·96		
S28	912·29	H4E	913·09	PS1	915·23
S29	910·75	H5	910·88	PS2	913·18
S30	908·94	H5E	913·02		
S31	909·90	H6	913·14		
		H7	911·67		

NOTE: S = Standpipe Piez.
H = Hydraulic Piez.
P = Pneumatic Piez.
HS = Hydrostatic Settlement Cell
PS Pneumatic Settlement Cell

Aurecon Australasia Pty Ltd
ABN 54 005 139 873
Level 2, 116 Military Road
Neutral Bay NSW 2089
PO Box 538
Neutral Bay NSW 2089
Australia
T +61 2 9465 5599
F +61 2 9465 5598
E sydney@aurecongroup.com
W aurecongroup.com