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Lamberts North Water Conditioned Fly Ash Placement Water Quality Monitoring

Annual Update Report for 2015/16

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Attachment 4: Assessment Criteria – Local baseline and ANZECC (2000) Trigger values for Groundwater receiving waters and Neubecks Creek (Aurecon, 2011) in OEMP by CDM Smith (2013)

Summary

Aurecon has been engaged to assist EnergyAustralia NSW in their statutory reporting on the Lamberts North water conditioned ash placement area for the effects of the ash placement on water quality and trace metals in receiving surface and groundwater during 2015/16.

The key findings of the 2015/16 water quality data review were:

- The local and ANZECC (2000) guidelines in the receiving groundwater bore MPGM4/D9 have continued to be met, other than for salinity and sulphate, and a minor increase for boron.
- At the Neubecks Creek receiving water site, all the water quality and trace metal guidelines were met for the specifically derived local and ANZECC (2000) trigger values for the Lamberts North site.
- The sources of the nickel increase at bore MPGM4/D1 was investigated using the new groundwater bore, MPGM4/D20, installed at the Lamberts North dry ash placement embankment. The cause was indicated as due to groundwater inflows from the Western Main open-cut coal mine rubble drain, under the northern Mt Piper ash area, as a result of dry weather conditions and possible oxidation of coal pyrites in the mine void.

As no adverse water quality effects of the Lamberts North site could be identified, no ameliorative measures are indicated in the report.

The reports by GHD (2014) and Cardno (2015 and 2016) on the aquatic life in Neubecks Creek found that the macroinvertebrates were already in a poor condition due to the mineralised water quality characteristics of the local surface and groundwater. Statistical analyses showed no significant differences from the upstream background sites in Neubecks Creek with that near the downstream receiving water site at WX22. The lack of effects indicated that the aquatic life had adapted to the local mineralised conditions in the creek. Due to the complex interactions between the various sources of water quality inputs to the creek and the effect of variations in stream flow on the concentrations, as well as the abundance of aquatic life, Cardno (2016) considered it was unlikely that effects of the Lamberts North dry ash placement on aquatic life, if any, could be resolved from those due to the other inputs. Hence there was no evidence of effects of the Lamberts North water conditioned ash placement on the aquatic life.

1. Introduction

Aurecon has been engaged by EnergyAustralia NSW to undertake the Lamberts North annual surface and groundwater quality report for 2015/16 over the period September, 2015 to August, 2016. The 2015/16 report is required by the Conditions of Approval for Lamberts North ash repository.

The report is to include the background bores MPGM4/D10 and D11 so the potential effects of brine leachates from the brine conditioned ash area at Mt Piper are not assigned to the Lamberts North water conditioned dry ash placement. The review also includes the groundwater quality data in the new Lamberts North embankment at bore MPGM4/D20, which was installed in December, 2015. This bore was drilled to sample the groundwater near the level of the interface of the ash base and compacted mine spoil underneath (approximately RL917m)[1]. The results at D20 are compared to the background bores D4 and D5, as well as the pre-Mt Piper ash placement bores B904 and B901 (now covered with ash, see Figure 1), all of which sampled the underground mine workings, to allow for the mineralised conditions in the area.

Surface and groundwater monitoring for the Lamberts North placement began in October, 2012 and essentially follows the plan set out in the now modified Operational Environmental Management Plan[2] (OEMP, CDM Smith, 2013). The water quality sampling sites, including the receiving waters for groundwater at bores MPGM4/D8 and D9, as well as surface water in Neubecks Creek at WX22, are shown on an aerial photograph of the Mt Piper and Lamberts North areas in Figure 2.

The previous report for 2014/15 (Aurecon, 2016) found that the Local/ANZECC (2000) surface water trigger values for salinity, sulphate and trace metals[3] were met in Neubecks Creek. It was also found that the elevated concentrations of salinity and sulphate at the receiving groundwater bore MPGM4/D9 potentially originated from the Mt Piper brine co-placement area. Hence, other than those salinity related elements, and the locally enriched iron and manganese concentrations, bore D9 essentially met the groundwater trigger values.

Placement of water conditioned flyash in the Lamberts North site (coloured orange in Figure 1) has been undertaken in the re-contoured Huon Gully since September, 2013. The ash placement contours for the Mt Piper and Lamberts North sites in December, 2016[4] are shown in Figure 1.

[1] The 2015/16 sampling showed that the water level was lower than the interface level at about RL912m (Aurecon, 2016), indicating that the ash was not in contact with the groundwater.
[2] EnergyAustralia NSW advised Aurecon that in setting up the monitoring program, they took into consideration the practicalities of applying a consistent approach to each sampling site.
[3] The local trigger values for copper, nickel and zinc are based upon the 90th Percentile baseline concentrations in Neubecks Creek at WX22 using pre-placement data from October 2012 to August, 2013. The pre-placement data was set in 2012/13 so Lamberts North was not assigned potential earlier influences of the Mt Piper brine co-placement.
[4] Note that the study period is from September, 2015 to August, 2016.

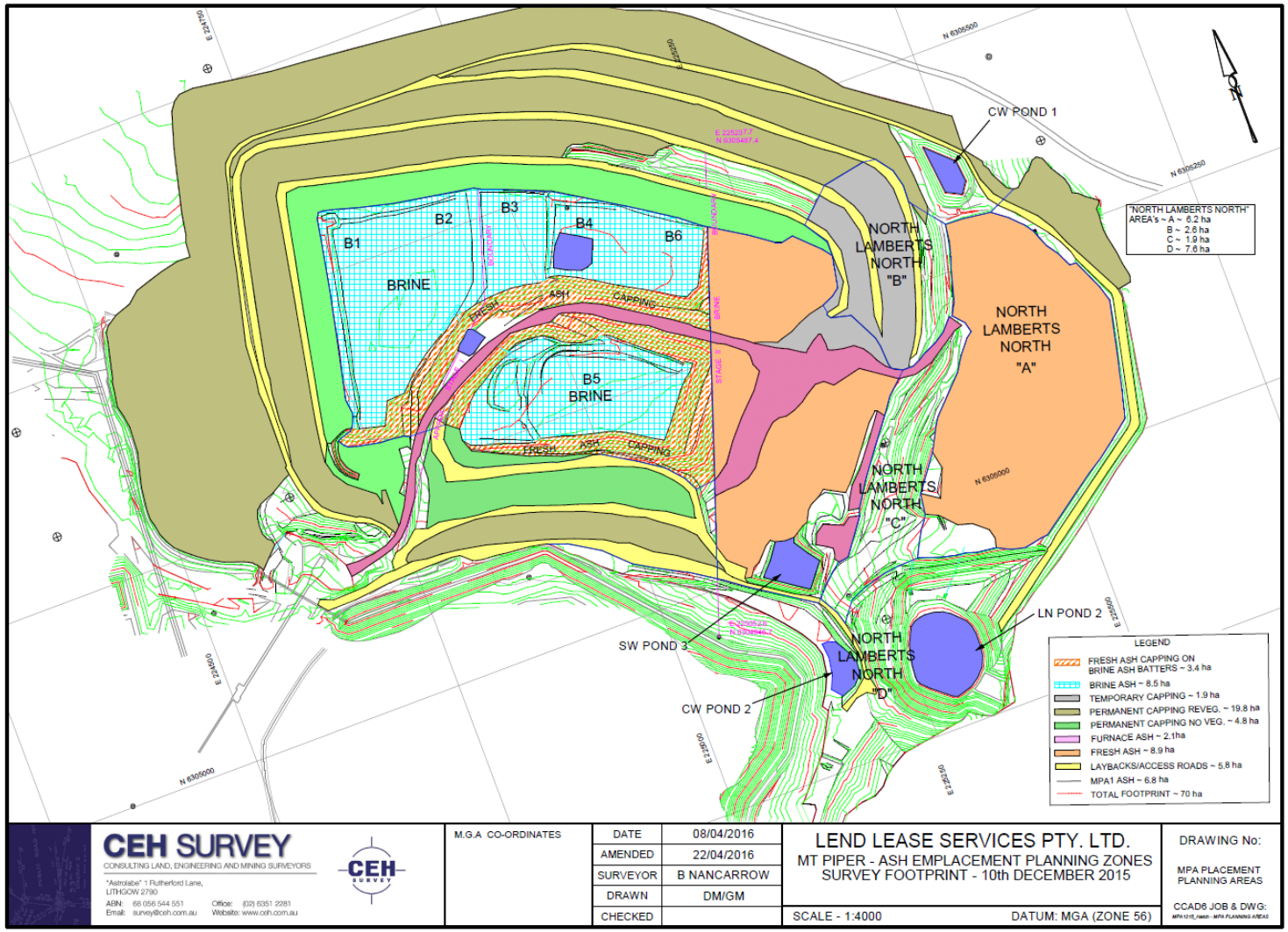

Figure 1: Mt Piper Power Station Brine Conditioned Ash and Lamberts North Placement Area contours in December, 2015.

1.1 Scope

Aurecon has been engaged by EnergyAustralia NSW to prepare the third annual review report on surface and groundwater quality for the Lamberts North dry ash placement. The scope includes preparation of a report for the 2015/16 Lamberts North Water Quality Annual Update, which involves the following:

- Results of all surface and groundwater water quality monitoring required under the Conditions of Approval, including the new bore MPGM4/D20 and data interpretations and written discussion
- Review whether the water quality in surface and groundwater meets the relevant water quality criteria. If the criteria is not met, and the cause can conclusively be attributed to the Lamberts North dry ash placement, EnergyAustralia NSW is to inform Aurecon of potential reasons for failure to meet the criteria, and the action taken to prevent recurrence of that type of failure, for inclusion in the annual update report.
- Collate and update the database at established bore sites as described in the Lamberts North Groundwater Management Plan
- Assess and report on the third year of monitoring of groundwater quality and depth of the water table at all monitoring sites[5].
- Collate and update the database for monitoring of dissolved oxygen, turbidity, sulphates, salinity, boron, manganese, iron, chloride, total phosphorus and total nitrogen at the existing water quality monitoring sites.
- Assess and report on third post-placement year of water quality monitoring at the Mt Piper surface water discharge point at the Holding Pond and in Neubecks Creek at NC1 and WX22
- Summarise the consultant report on the aquatic life in Neubecks Creek for:
    - sampling, data collection and baseline ecological health and assessment of the ecological health of the in-stream environment during the ash dam construction and the first year of ash placement;
    - at least one in-stream sampling at Neubecks Creek, prior to ash placement, and at least two (2) sampling periods following ash placement at Lamberts North;
    - management measures to address any adverse ecological impacts conclusively attributed to the Lamberts North dry ash placement.

To assist in the surface and groundwater assessment, the changes in water quality from pre- to post-ash placement have been graphed at all the sampling sites to aid in the assessment of potential effects of Lamberts North on surface and groundwater quality.

1.2 Outline of Report Structure

The report is structured to cover the issues in the EnergyAustralia NSW brief and includes:

- Description of the surface and groundwater quality monitoring program
- Description of the surface water rainfall runoff management and its importance to minimising infiltration into the Lamberts North site and into the local groundwater
- Assessment of effects, if any, of the dry ash placement on surface and groundwater quality, during the 2015/16 post-placement period. The assessment takes into account the Mt Piper and local coal mine groundwater inflows to Huon Gully, as well as the effects of conditioning the ash with cooling tower blowdown water
- Discussion on the findings including potential exceedances of the receiving water environmental goals and the potential necessity for mitigation measures

[5] It is understood that EnergyAustralia NSW samples at a frequency of once a month. Note: The CoA requires groundwater flows to be measured but EnergyAustralia NSW advised that they are unable to be estimated as the relevant soil permeability characteristics are unknown.

- Summary of the aquatic life monitoring in Neubecks Creek undertaken in December, 2015 by Cardno (2016)
- Presentation of conclusions and recommendations.

The sequence of surface and groundwater quality findings, assessment and inferences drawn has been followed throughout the report.

1.3 Aims and Objectives of Monitoring

The Lamberts North OEMP for the water conditioned dry ash placement sets out the surface and groundwater quality monitoring to be undertaken to provide feed-back for ash placement and surface rainfall runoff management. The aim of the monitoring is to ascertain whether or not leachates[6] from the water conditioned fly ash cause a significant increase in concentrations above the local/ANZECC (2000) guideline trigger values (environmental goals) in surface and/or groundwater receiving waters (see Table 1 in Section 2). The overall environmental aim is to have a neutral or beneficial effect of the ash placement, after consideration of the naturally mineralised conditions in the area, on water quality in receiving waters. In the event that the monitoring shows increases above the environmental goals at the groundwater bores MPGM4/D8 and D9 or in Neubecks Creek at WX22, the effects of the ash placement are expected to be reduced through implementation of mitigation measures.

A most important consideration in the OEMP is that ameliorative measures are only to be implemented if exceedances of the local/ANZECC (2000) trigger values are observed and are shown conclusively to be attributable to the operation of the Lamberts North ash placement. Such attribution is to be based upon a targeted investigation of the likely sources of the salts (represented by chloride, conductivity, total dissolved salts and sulphate) or trace metals that caused the environmental goals to be exceeded, as well as the process by which the Lamberts North placement could have introduced leachates into the local groundwater.

If the monitoring shows a significant pollution event down-gradient of the ash area, the OEMP suggests the submission of a report to the relevant Authorities that provides a description of the proposed ameliorative measures, including a timeframe for the management actions to be implemented. This could allow informed consideration of the findings of the targeted investigation of the likely sources and causes.

To be consistent with the Mt Piper Brine Conditioned Ash Water Management Plan, the Lamberts North OEMP has adopted the approach of having early warning of potential effects on groundwater and surface water. This is achieved by comparison of the measured post-placement median concentrations of parameters of interest with the relevant local (90th percentile) and ANZECC (2000) trigger values at the groundwater bores D8 and D9 and in Neubecks Creek at WX22. The intent of this approach is to allow the ash placement managers time to investigate the cause of any early warning trigger being exceeded and to implement mitigation measures if the cause is the water conditioned ash placement. It should be noted that the comparisons made in this report take any changes in water quality at the upstream sites in Neubecks Creek into account. This practice is also followed for the Mt Piper Brine placement surface and groundwater monitoring.

For the purposes of the OEMP, the final receiving waters are taken as being Neubecks Creek, just downstream of the ash placement area at WX22 (Figure 2, Section 2) and the ANZECC (2000)

[6] Leachates could be due to surface runoff from the Mt Piper ash placement directed into the Lamberts North ash area and, by direct rainfall infiltration through the ash into the underlying groundwater or by a rise in the groundwater table under the ash causing salts and trace metals to be leached from the ash.

guidelines and local guidelines for surface water apply to WX22. The ANZECC (2000) guidelines and local guidelines for the groundwater and surface water receiving waters are shown in Table 1 in Section 2.7, which also shows the 2012/2013 pre-placement baseline 90th percentile concentrations for Lamberts North.

1.4 Issues and Challenges

The groundwater monitoring plan (Section 6.4 of the OEMP) for Lamberts North does not include a background bore to enable the local coal mine or coal washery area groundwater inflows to Huon Gully to be taken into account. This means that any observed water quality changes at bore D1 or the receiving groundwater bores D8 and D9, relative to the local/ANZECC goals, cannot be fully understood. To address this matter, the Mt Piper background bores MPGM4/D4 and D5, as well as the pre-brine co-placement bores B901 and B904 (see Figure 2) have been examined for their influence on water quality at bores D1, D8 and D9. In addition, an additional groundwater bore, MPGM4/D23, was installed into the underground coal mine groundwater to the west of bore D10 in December, 2015. However, the bore had elevated concentrations of chloride and indicated that it contained some brine leachates (see Figure 8, Section 4.3), so it has not been used as a background for the Lamberts North site.

The internal ash placement bores MPGM4/D10 and D11 are included in the Lamberts North monitoring program to provide data on the groundwater quality flowing into Huon Gully from the Mt up-gradient coal mine groundwater and the Piper water and brine conditioned ash placements. These bores provide early warning of potential effects of Mt Piper on the seepage detection bore D1 and the receiving groundwater bore D9, which are located between the ash area property boundary and Neubecks Creek. The challenge in reviewing the Lamberts North placement in Huon Gully is to assess potential effects on receiving waters, recognising that the ash placement is in the path of both the D10 chloride plume as well as the underground coal mine groundwater flows from the rubble drain under the Mt Piper placement. Although the rubble drain groundwater has low chloride, it contains mine water related trace metals as well as being enriched with brine leachates.

Prior to June, 2016, the groundwater flows down Huon Gully also included rainfall runoff from the Mt Piper water conditioned ash area. EnergyAustralia NSW has advised that since June, 2016, surface runoff from the Mt Piper water conditioned ash area has been redirected from Huon Gully to into the final holding point within the Lamberts North ash placement area (See Figure 1). The runoff water collected in the holding pond is directed to the Lamberts North Ash Repository LN Pond 2 through a subsurface drain dug into the compacted mine spoil at the ash basement level, to the lined LN Pond 2, at the southern end of the Lamberts North repository.

1.5 Information provided by EnergyAustralia NSW

In connection with the assignment, EnergyAustralia NSW has provided copies of the following data and information[7] (the sampling sites referred to are shown in Figure 2):

- Ash Placement Area Contours in January, 2015 (Figure 1) showing the areas and elevation of the placed ash and surface water runoff ponds used for management[8], including:
    - an unlined pond to collect rainfall runoff (Temporary pond over furnace ash),
    - subsurface drain for directing runoff water to a lined pond (LN Pond 2)

[7] EnergyAustralia NSW provided data on total nitrogen, turbidity and dissolved oxygen concentrations at the three sites in Neubecks Creek, which are not related to this study, so the data has not been used.

[8] No water quality data was available for the temporary pond or the LN Pond 2

- Lamberts North groundwater bore water quality data for bores MPGM4/D1, D10, D11, D8, D9 and D19
- Water level data for the groundwater bores
- Mt Piper surface water quality monitoring data at the power station Licence Discharge Point LDP1 (v-notch below the Holding Pond) which is used as the up-stream background site, the aquatic life background site NC01 and at the Neubecks Creek receiving water site at WX22.
- Stream flow data for WX22 gauge 212055 in Neubecks Creek is available from Department of Primary Industries Office of Water (http://realtimedata.water.nsw.gov.au/water.stm).

1.6 Lamberts North Water Conditioned Ash Placement and Rainfall Runoff Management

An embankment made of compacted mine spoil was constructed at the northern end of Huon Gully to retain the ash placement as it is progressively placed up to the design height of RL980m and joined with the ash placement at Mt Piper (see CDM Smith, 2013). The current December, 2016 contours of the dry ash placement areas are shown in Figure 1 and the water conditioned ash already placed in Lamberts North is shown in orange.

During the reporting period September 2015 to August 2016, a total 133,342 tonne of fly ash was placed on the Lamberts North area. All of this ash was placed in April, May, June and July 2016. During the other months, the ash was placed at Mt Piper. The Lamberts North ash has now joined with the eastern end of the Mt Piper water conditioned ash area. Local surface water runoff is used for dust suppression by irrigation sprinklers.

1.6.1 Rainfall Runoff Management

EnergyAustralia NSW has advised that all benches in the Lamberts North area are graded west to direct the rainfall runoff to the unlined retention sump[9] on the western side of the Lamberts North area. The gradient also prevents runoff from flowing over the external boundary wall. The collected runoff is then directed to the lined LN Pond 2, at the southern end of Huon Gully, via a slotted pipe laid on the bottom of a sloped drainage line dug into mine spoil at the original floor level, and the drainage line then filled with furnace bottom ash.

External runoff collected from capped areas on the south side of the Mt Piper ash repository is directed to the small water collection pond called CW Pond 2 (Figure 1) at the location of Bore MPGM4/D23 which was installed in December, 2015 to sample the underground coal mine groundwater. The water collected in the LN Pond 2 is used for irrigation water. All other surface water runoff from external capped batters and laybacks at Mt Piper are directed to a north-eastern clean water pond (CW Pond 1). This water is also used for irrigation supply at the Lamberts North ash pad. All clean surface water is contained within the site boundary.

Furnace ash is a coarse material that is free draining, so the potential effects of seepage through the bottom of the retention sump at Lamberts North on the local groundwater and Neubecks Creek is examined in Section 4.1.

[9] CoA, C13 - Surface water run off collection ponds are to be lined.

2. Surface and Groundwater Monitoring

This Section provides an overview of the groundwater and surface water quality monitoring at the Lamberts North dry ash placement during the period 2012 to August, 2016. The monitoring design, management of the water conditioned ash placement and receiving water quality guidelines are set out in the Lamberts North Operational Environmental Management Plan (CDM Smith, 2013).

The groundwater monitoring program was established in October 2012 and involves monthly sampling at the bores shown in Figure 2, which includes both long-term Mt Piper monitoring bores D10 and D11, as well as the new bore, D20, recently installed in the Lamberts North embankment. The other bores involved in the monitoring are D1, D8, D9 and D19[10].

Bore D1 is north of Huon Gully and is used for detection of seepage from the north-eastern Mt Piper brine placement. However, it should be noted that bore D1 has been assumed by the OEMP to be the seepage detection bore for the Lamberts North placement. Similarly, the groundwater bores D9 and then D8 on the southern and northern sides of Neubecks Creek, respectively, are used as the Mt Piper receiving water bores and they are also assumed by the OEMP to be the receiving water bores for the Lamberts North placement. Given this monitoring design complexity, it has been attempted, in previous reports and in this report, to unravel the potential effects of the Lamberts North placement from that of the Mt Piper area.

Hence, bores D1, and D8 and D9, are used to provide a warning of leachates that may enter Neubecks Creek to enable management actions to be undertaken to minimise effects of both the Mt Piper brine and the Lamberts North water conditioned ash placements.

From previous reports, it has been shown that the chloride plume from D10 flows in the groundwater in Huon Gully, beneath the Lamberts North site, and reaches bore D1. From there, it flows via the coal seam under Neubecks Creek to bores D9 and then D8 on each side Neubecks Creek. Bore D19 is located to the east of the Lamberts North site and although it is outside the ash placement area, it samples washery waste/mine spoil in that area and provides information on groundwater flowing towards Neubecks Creek.

The long-term trends in surface and groundwater concentrations, since the Lamberts North sampling began in October, 2012, are examined for potential effects on the receiving groundwater bores, D8 and D9, as well as the surface water in Neubecks Creek. The post-placement water quality data is examined for indications of leachates from the Lamberts North water conditioned ash into the local groundwater.

[10] Bores D15 to D18, in the southern area of the Lamberts North site, are located around the previous Centennial Coal Mine open-cut area, which is now part of the Centennial coal washery, located in the south-east of the site. These bores are not used in this, or previous reports, because they sample groundwater in the basement rock rather than coal washery waste or mine spoil.

Figure 2. Lamberts North Ash Placement Area and Neubecks Creek Groundwater and Surface Water Quality Monitoring Sites

2.1 Surface Water

As well as routine monitoring of water quality in Neubecks Creek at WX22, the ash placement contractor, Lend Lease Infrastructure (LLI), has monitored the water quality of rainfall runoff from the Lamberts North ash placement area since the first year of operation of the ash placement. EnergyAustralia NSW has advised that the runoff water is collected in a sump and directed to the lined LN Pond 2 via a subsurface drainage line.

To provide a background benchmark to the WX22 receiving water site, the sampling sites LDP01, and the new NCO1, upstream on Neubecks Creek have been monitored monthly prior to ash placement and have continued to be monitored for comparison with results from WX22, downstream of Huon Gully (Figure 2).

The database provided for review includes monitoring of dissolved oxygen, turbidity, total phosphorus and total nitrogen at the three water quality monitoring sites in Neubecks Creek. It is understood that they are monitored in relation to the aquatic life monitoring and are not related to the groundwater effects on the creek, so they are not used in this report, but are collated in Attachment 1, as required by the work scope in Section 1.1.

2.2 Groundwater

Prior to construction and ash placement, groundwater monitoring started in October, 2012. It was conducted at monthly intervals to establish baseline results for the bores located inside and outside the Lamberts North area. Monthly monitoring has continued since ash placement began in September 2013. Additionally, groundwater down-gradient of Lamberts North is monitored at bores MPGM4/D1, D8 and D9 to detect groundwater seepage moving from the ash placement area toward Neubecks Creek.

The groundwater bore characteristics of water table depth, collar level and height of the PVC pipe were checked previously in 2011 and again in March, 2014 (see Attachment 3) in relation to the recent chloride increase at bore D10 and the associated groundwater level changes. These characteristics have been used to convert the groundwater level measurements, which are taken from the top of the pipe, to relative levels below the ground surface in AHDm.

The OEMP places emphasis on the need to understand water level changes taking place in the ash placement in Huon Gully and uses bore D1 as a surrogate. Each groundwater bore is monitored to allow identification of the direction of water movement and, in the case of the bores installed for Mt Piper, to measure the predicted groundwater level rise due to mounding under the large water conditioned ash placement area. Note that the layer of compacted mine spoil placed in Huon Gully was designed such that the expected increase in height of the water table in Huon Gully would not come into contact with the bottom of the Lamberts North ash placement. The water level monitoring data for the groundwater bores monitored for Lamberts North since October, 2012, including bore D1, are shown in spread-sheet format in Attachment 1.

2.3 Groundwater Modelling Verification

Verification of the groundwater model prediction of a groundwater level rise lower than the base of the ash placement was suggested to be undertaken in the OEMP if there was a significant increase in the groundwater level at D1. The OEMP suggested that, if there is any significant increase, flow

calculations should be undertaken and consideration given to re-running the CDM Smith (2012) groundwater model. The previous report found there has been no significant rise in the groundwater level at bore D1 and the groundwater levels in the bore installed in the Lamberts North embankment showed that it was about 7m lower than the base of the ash (see Section 3.1.1).

2.4 Methods

The surface and groundwater water quality characteristics monitored at each site are shown in Attachment 1. Sampling and analyses are undertaken as required on behalf of EnergyAustralia NSW by NALCO Analytical Resources[11], who measure conductivity, pH and dissolved oxygen in the field with a calibrated instrument and all other parameters in their NATA Accredited Laboratory. EnergyAustralia NSW has provided a copy of the NALCO laboratory data to Aurecon for the 2015/16 assessment.

EnergyAustralia NSW monitors the discharge flow at the Mt Piper Power Station to Neubecks Creek at a v-notch and the NALCO samplers note if the creek is flowing at the stream flow gauge 212055 near WX22 gauge in Neubecks Creek. The stream flow data is available from Department of Primary Industries Office of Water (DPI Water, formerly NOW) at http://realtimedata.water.nsw.gov.au/water.stm.

The OEMP requires the water quality and trace metal concentrations to be measured by the methods specified in DEC (2004). This method requires that all trace metal concentrations, except for iron and manganese, are measured on unfiltered samples. At collection, unfiltered trace metal samples are preserved with nitric acid and concentrations are measured on samples using the “acid extractable” method. This involves addition of hydrochloric acid and heating for 15 minutes on a steam bath, as set out in Standard Methods.

Since July, 2012, EnergyAustralia NSW has been determining the concentrations of aluminium, copper and zinc in filtered water collected at both the Mt Piper Licence Discharge Point LDP01 and at the Neubecks receiving water site, WX22. Similar filtered trace metal tests have been undertaken at the new upstream site NC01 since October, 2012. The trace metal tests were undertaken on filtered samples to give dissolved, rather than total “acid extractable” concentrations, because the ANZECC (2000) guideline trigger levels are based on ionic metals (eg Cu^{2+}), which are difficult to measure, and the dissolved concentrations would be closer to that of the ionic trigger values.

However, the Local/ANZECC (2000) trigger value environmental goals for surface water (see Table 1, Section 2.6) are based on unfiltered samples measured by the “acid extractable” method. As the dissolved concentration data is obtained by filtering the samples, it is not consistent with the environmental goals shown in Table 1, which are based on unfiltered samples, the filtered data has not been used in this report.

To allow comparison with the ANZECC (2000) guideline trigger levels, for those trace metals that do not have a locally derived trigger (such as arsenic), EnergyAustralia NSW began low detection limit (DL) testing for trace metals in April/July, 2006, so that all the metals, except silver, were measured at DLs lower than the ANZECC trigger levels. In this report, trace metal data shown as less than the DL are treated in the following way to be consistent with the previous reporting of trace metals at Mt Piper. When the concentration is less than the DL, and the DL is less than the trigger level shown in Table 1, the concentration has been assumed to be the same as the DL. In the event that the laboratory

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

reports the DL as higher than the ANZECC trigger level, the concentration of the metal is assumed to be half of the DL.

EnergyAustralia NSW has advised that silver has continued to be analysed at a higher DL than the guideline trigger value of 0.00005 mg/L because the matrix of elements present in the water samples prevents NALCO from measuring concentrations at the ANZECC (2000) guideline trigger value level (see Attachment 1). The silver data has continued to be tested at <0.001 mg/L, which is 20 times the ANZECC (2000) guidelines, so it has not been assessed in this report. As recommended in previous reports for the ash placement at Mt Piper, it is suggested that silver cease to be monitored as it provides no useful information.

Groundwater level measurements are undertaken at each bore using a dip meter, from the top of the bore pipe, before being bailed or pumped out. NALCO remove three bore volumes as suggested by the groundwater standard - 1998d, AS/NZS 5667.11:1998: Water quality – Sampling. Part 11: Guidance on Sampling of Ground Waters. After pumping, the water in the bore is allowed to recharge to a level suitable for sampling.

2.5 Guidelines

The locally derived and ANZECC (2000) guideline trigger values for the groundwater and surface water receiving waters are set out in the Mt Piper Brine Conditioned Ash Water Management Plan (Connell Wagner, 2008). The WMP freshwater trigger values for cadmium, chromium and copper were adjusted for the effects of changes in water hardness in Neubecks Creek (see Aurecon, 2011 and notes to Table 1). The OEMP adopted these trigger values as the Lamberts North ash placement environmental goals in (CDM Smith, 2013 and see them in Attachment 4 in this report). However, as the goals in the OEMP were for the Mt Piper surface and groundwater, some of the goals used in the OEMP have been adjusted by using the Lamberts North pre-ash placement baseline data to minimise the possibility of Mt Piper water and brine conditioned ash effects from being assigned to the Lamberts North placement. The effects, if any, of the Lamberts North placement on the receiving waters of Neubecks Creek, and the surrounding groundwater, have been assessed by comparison with these goals shown in Table 1.

Table 1. Pre-2000 brine co-placement 90th Percentile Baseline concentrations and Local/ANZECC (2000) Trigger Value Environmental Goals for the Groundwater Receiving Waters and Neubecks Creek with some Lamberts North elements adjusted for 90th Percentile Goals applying to bores MPGM4/D8 and D9 and WX22 during 2012/13 (bold and parentheses)

Element (mg/L)	Groundwater Collection Basin Pre-brine placement 90th Percentile	Groundwater ANZECC or Local Guidelines#	Neubecks Creek at WX22 Pre-brine placement 90th Percentile	Surface Water ANZECC or Local Guidelines#
General Water Quality				
pH		6.5 – 8.0	6.7-7.8	6.5 – 8.0
Cond/ (uS/cm)	1576	2600^	894	2200
TDS	1306	2000	580	1500^
Cl	31.5	350	22	350+
SO4	824	1000 (1170)!	332	1000++
Trace Metals				
As	0.001	0.024	<0.001	0.024
Ag	<0.001	0.00005	-	0.00005
Ba	0.037	0.7	0.029	0.7+++
Be	0.001	0.1	<0.001	0.1
B	0.244	0.37 (0.55)!	0.09	0.37
Cd	0.002	0.002	<0.001	0.00085
Cr	0.001	0.005	<0.001	0.002
Cu	0.001	0.005 (0.0075)!	<0.001	0.0035 (0.005)!
F	0.435	1.5	0.338	1.5+++
Fe	0.664	0.664 (15.9)!	0.281	0.3+++
Hg	<0.0001	0.00006	-	0.00006
Mn	5.704	5.704 (8.57)!	0.72	1.9
Mo	0.001	0.01	<0.001	0.01+
Ni	0.5509	0.5509	0.005	0.017 (0.051)!
Pb	0.001	0.005	<0.001	0.005
Se	0.002	0.005	<0.001	0.005
Zn	0.908	0.908	0.116	0.116

* high detection limits used when determining the baseline concentrations – see text

^ 2000 mg/L TDS/0.77 for groundwater; 0.68 x 2200 uS/cm low land river conductivity protection of aquatic life

ANZECC (2000) guidelines for protection of freshwaters, livestock, irrigation water or drinking water. Local guideline based upon 90th percentile pre-brine placement are shown in **bold** without parentheses – see text.

Cadmium, Chromium, Copper, lead, nickel and zinc adjusted for effects of hardness: Current Ca, Mg in GCB 147, 113 mg/L: in Neubecks Creek 19.7, 11.8 mg/L, respectively. Note: Surface water have changed from the Mt Piper WMP trigger values (Connell Wagner, 2008a) for Cd from 0.001 to 0.00085 mg/L; Cr from 0.001 to 0.002 mg/L and Cu from 0.0025 to 0.0035 mg/L due to changes in water hardness.

! Lamberts North trigger values adjusted from OEMP to allow for pre-placement baseline data October 2012 to August, 2013 at MPGM4/D9 for groundwater, which do not apply to Mt Piper bores D10 or D11, as well as at WX22 for surface water in parenthesis.

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

! Lamberts North from pre-placement 90th Percentile baseline for October 2012 to August, 2013 at MPGM4/D9 and Neubecks Creek at WX22 in parenthesis

The local/ANZECC trigger values shown in Table 1 are based on 90th percentiles pre-2000 data for the Mt Piper brine conditioned ash placement. As ash was not placed at Lamberts North until September, 2013, the 90th percentiles for bores D8 and D8 and Neubecks Creek at WX22 were checked for any increases in the pre-Lamberts North data that could have potentially been due to the Mt Piper area, as well as changes in the catchment background conditions since 2000, so they are not assigned to the Lamberts North placement. This was achieved by calculating the 90th percentile of the pre-placement data at bores D8 and D9 and at WX22[12] from October, 2012 to August, 2013. The resulting increases in the 90th percentile baselines, that are applicable to Lamberts North only, are shown in bold and parenthesis in Table 1[13].

The Protection of the Environment Operations Act requires consideration of the ANZECC (2000) guidelines when assessing potential effects on water quality in receiving waters. To achieve this, the OEMP uses the locally derived and ANZECC (2000) guideline trigger values developed for the Mt Piper Brine Conditioned Ash as the local environmental goals for the Lamberts North ash placement. The guideline trigger values apply to the receiving waters of the ash placement seepage, which are taken as being the two groundwater bores MPGM4/D8 and D9 and Neubecks Creek at WX22 (Figure 2). Hence, the Local/ANZECC (2000) trigger values shown in Table 1 for groundwater apply to bores D8 and D9 and the surface water guidelines apply to WX22, which is the final receiving water site for the Lamberts North ash placement.

The Local/ANZECC (2000) trigger values for trace metals used in Table 1 were developed for unfiltered samples, in both surface and groundwater, to establish the pre-placement baseline for Mt Piper ash placement. The baseline data were collected prior to November, 2000 and are consistent with the DEC (2004) requirement for measurements on unfiltered samples.

The ANZECC Guidelines for Groundwater Protection in Australia (ANZECC, 1995) and the NEPC (1999) require the background water quality in groundwater bores to be taken into account. As the NEPC (1999) did not define the meaning of “background” concentrations, the baseline concentrations were defined in previous reports for the Mt Piper ash placement as the 90th percentile of the pre-placement concentrations for naturally mineralised, highly disturbed groundwater (condition 3 waterbodies), or the ANZECC guideline default trigger values, whichever is higher.

The pre-placement 90th percentiles that are higher than the default trigger values, are the local guidelines, which are shown in bold in Table 1. The local guidelines for salinity, chloride and sulphate take into account the protection of freshwater aquatic life (via groundwater seepage into Neubecks Creek), livestock, and irrigation water or drinking water guidelines. Table 1 shows that the guidelines for groundwater may be different from those used in Neubecks Creek, where the effects on aquatic life are considered.

2.5.1 Early Warning of Water Quality Changes

As described in the OEMP, it is necessary to provide an early warning of water quality changes to allow time to undertake targeted investigations of the cause and to implement control measures before the environmental goals are exceeded at the receiving water sites. An early warning is triggered when the post- 50th percentiles for the various elements at the receiving water sites exceed their pre-

[12] Bores D8, D9 and WX22 are all in the path of groundwater seepage from the Mt Piper ash placement into Huon Gully, so the background measurements from October, 2012 to August, 2013 have been taken into account. Catchment inflows include the Mt Piper placement groundwater seepage to Huon Gully and local, up-stream, coal mine discharges to Neubecks Creek.
[13] The local, pre-placement Lamberts North 90th percentile baselines are not as reliable as those for Mt Piper because they are only based on eleven measurements at WX22 and four at D8 & D9, whereas the ANZECC (2000) guidelines require a minimum of 24 measurements to set local guidelines.

placement 90th percentiles. This is supported by sampling at bore MPGM4/D1, one of the Mt Piper groundwater seepage detection bores, which has been used to provide an early warning of potential future changes at the surface and groundwater receiving waters. The OEMP has nominated that bore to provide early warning of water quality and water level changes possibly taking place due to the Lamberts North ash placement.

The aim of any targeted investigations that arise is to determine if the changes are due to the water conditioned ash placement or some other cause. If the increases are due to the placement, mitigation measures could be implemented to avoid parameter concentrations approaching or consistently exceeding the relevant ANZECC and local guideline goals in the groundwater at either bore D8 or D9 or at the Neubecks Creek receiving water site, WX22.

2.6 Control Charts

Long-term changes at the receiving water sites are tracked by control charts. The long-term changes were taken from January/February, 2009 to August, 2013[14] to provide 24 measurements (as recommended by the ANZECC (2000) guidelines) prior to ash placement in September, 2013.

At the groundwater receiving water sites, the MPMG4/D8 and D9, long-term changes are indicated by comparison with the pre-90th baseline, post- 50th percentile and/or the groundwater trigger value environmental goals. The Lamberts North site does not have a suitable background bore to sample the local mine water inflows to Huon Gully for comparison with the water quality conditions at the Mt Piper seepage detection bore, D1, or bores D8 and D9. This means that changes at bore D1 and the receiving water sites may be difficult to interpret due to effects of mine water inflows, enriched with brine and water conditioned ash leachates, from under the Mt Piper ash placement.

At WX22, long-term changes are indicated by comparison with background conditions at the Mt Piper Power Station Licence Discharge Point, LDP01, on the upper Neubecks Creek, and the environmental goals. The new upstream site, NC01, in Neubecks Creek, just downstream of the Mt Piper Stage I brine conditioned ash placement and the Neubecks Creek north arm (Figure 2) are also compared with the changes at WX22.

2.7 Data Quality

The data contained in this report was provided by EnergyAustralia NSW and was checked for outliers using the ANZECC (2000) protocol. In accordance with the protocol, outliers of three times the standard deviation are removed from the dataset, provided no environmental changes have occurred that could account for such a significant change. No values were deleted from the 2015 to 2016 dataset.

Silver concentrations have not been used in this report because the high detection limits used mean they cannot be compared to the ANZECC (2000) guideline of 0.00005 mg/L. Hence, these measurements have not been used in this report and it is suggested that EnergyAustralia NSW have the tests undertaken at the appropriate detection limits.

[14] The January/February, 2009 to July, 2012 Mt Piper groundwater data is from Aurecon (2010, 2011 and 2012)

2.8 Climatic Conditions

The average annual rainfall over the pre- to post-water conditioned ash placement period from October, 2012 to August, 2016 was low at 785 mm/year (Attachment 2), which is 91.1% of the long-term annual rainfall of 862 mm/year. During this period, the monthly average rainfall of 67.5 mm/month, was below the long-term average of 72 mm/month, even though the rainfall in January, 2016 was 167 mm, and 170 and 102 mm in June and July, 2016, respectively.

Figure 3 shows that there was a trend from above average rainfall in 2012 to below average in 2015/16. This trend has been highlighted by calculation of the corresponding change in the cumulative monthly rainfall deficit, which is also shown in Figure 3. A rainfall deficit has accumulated because there has only been fourteen rainfall events higher than 72 mm/month in the last four and a half years.

The monthly rainfall deficit was calculated by subtracting the monthly rainfall each month from the long-term average rainfall of 72 mm/month. When the rainfall is lower than 72 mm/month, the difference is called the deficit. A positive deficit means a dominance of below average rainfall and a negative one indicates above average rainfall. The deficit (positive and negative) was accumulated each month until August 2016.

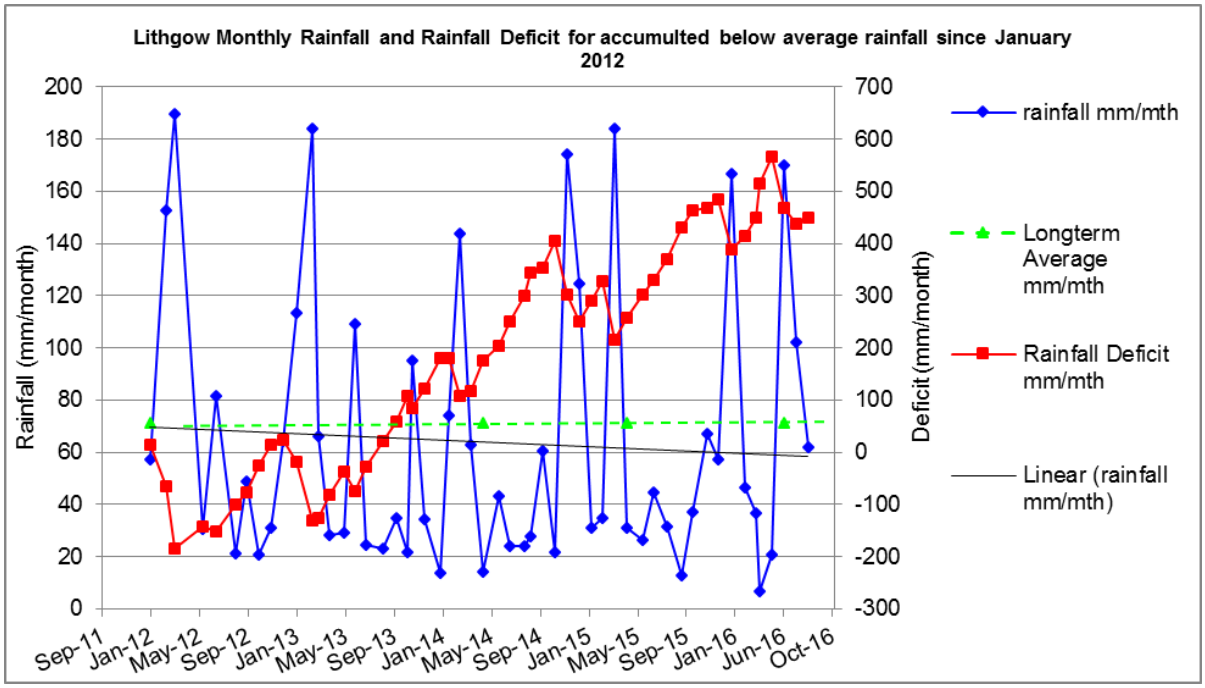

Figure 3. Lithgow Rainfall from January 2012 to August 2016 showing trend for decrease to below average rainfall and corresponding cumulative Rainfall Deficit

3. Review of Mt Piper background effects on Surface and Groundwater

This Section reviews the Lamberts North surface and groundwater quality and trace metal data for the third year of monitoring from pre-ash placement (October, 2012 to August, 2013) to the post-ash placement period (September, 2013 to August, 2016). The previous report in 2014/15 (Aurecon, 2016) estimated the rainfall infiltration through the dry ash placement, and by taking into account the salinity and trace metal inputs from Mt Piper, the results indicated no significant effects on the receiving surface or groundwater. However, a significant increase for the post-ash placement median for nickel to 0.027 mg/L was observed in Neubecks Creek compared to the pre-placement concentration of 0.0155 mg/L, so the possible causes are investigated in this report.

The Neubecks Creek aquatic life sampling by Cardno (2016) is reviewed in Section 4.6.

3.1 Mt Piper groundwater bores in coal mine open-cut and over underground mine workings

An important consideration for assessing the potential effects of the Lamberts North site is the locally mineralised conditions, which vary between the northern and southern areas of the Mt Piper ash placement. The underground and open-cut coal mine map (Attachment 3) shows that the western and northern edges of the ash were placed in the western Main open-cut mine void, which has a rubble drain at the bottom of the Western Main open-cut coal mine void. The open-cut area extends to the east under Huon Gully. The groundwater bores, B901 (now covered with ash, see Figure 2) and D11 sample the groundwater from the void area. The up-gradient, western underground coal mine groundwater flows into the rubble drain, under the Mt Piper ash area, into Huon Gully and dilutes the chloride in the D10 plume as it flows under the Lamberts North site towards bore D1 (Figure 2), but can add some mine water related trace metal concentrations to the groundwater.

The southern and middle areas of the Mt Piper ash placement are undelayed by an abandoned underground coal mine with coal barriers in place to minimise groundwater inflows into the open-cut areas. The groundwater bores, B904 (now covered with ash) and D10 sample the groundwater from the underground mine. Groundwater flows from the southern underground mine workings in a north-eastern direction and enters Huon Gully via the coal barrier near bore D10.

3.2 Groundwater Level Changes

To put the groundwater level changes since October, 2012 into context, and as bores D10 and D11 have been used to provide water quality and groundwater level data for flows from the Mt Piper site into Huon Gully, the long-term changes at these bores, as well as at D1, D8, D9, D19 and D20 are shown in Figure 4.

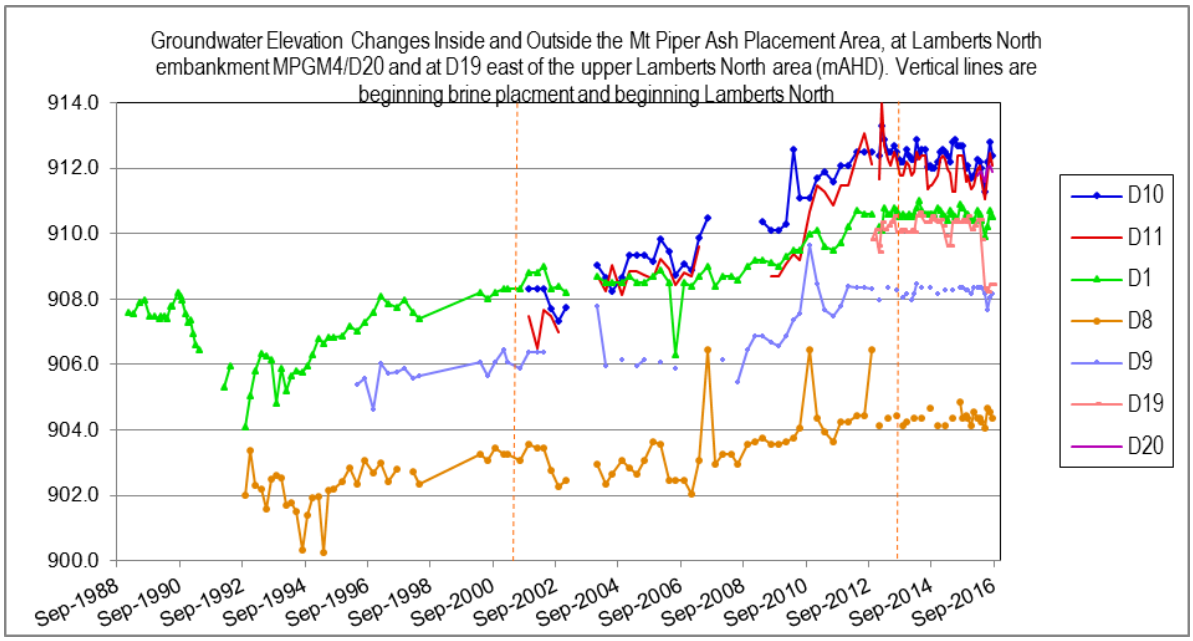

Figure 4. Groundwater Elevation changes at bores inside the Mt Piper ash placement area (MPGM4/D10 and D11 since 2001), at the Lamberts North embankment (MPGM4/D20 from February, 2016 - has similar depth as D11), Seepage Detection bore (D1 since 1989), at Groundwater Receiving Water Bores (D8 and D9 since 1992 and 1996), and just outside Lamberts North ash placement area at D19 since October, 2012

The overall trend for the groundwater levels in the area is to increase since ash was placed at the Mt Piper site in 2001[15], and the increases have ceased since the dry weather began in 2012 (see Figure 3). Figure 4 shows that bore D1 is about 2m higher than it was prior to beginning of ash placement at Mt Piper and is about 1.5m lower than at D20.

3.2.1 Groundwater levels below the Lamberts North Ash placement

Prior to commencement of ash placement, the groundwater level in Huon Gully was reduced to approximately RL901m by pumping, at which level the sediment bottom of the Groundwater Collection Basin (Huon Void) was exposed. The Huon Void was then filled with compacted mine spoil to RL917m, 4m above the highest estimated groundwater level as recommended by the CDM Smith (2012) model. The model indicated that groundwater levels across Lamberts North were at their maximum during wet weather patterns and suggested that groundwater levels were expected to remain at least 4m below the base of the dry ash placement. Therefore, effects of groundwater flows, or level rises, in Lamberts North on leaching salts and trace metals from the ash placement was not predicted to occur. Installation of the bore MPGM4/D20 in the northern embankment in December, 2015 showed that the groundwater level was about RL912m and 5m below the bottom of the ash placement (see Section 4.1).

The groundwater levels for the embankment bore D20 in Figure 4, are similar to that at bore D11, and about 5m below the bottom of the ash, which is at about RL917m. The bore D20 results show it samples the groundwater in the mine spoil under the ash, and its close relationship with the D11 levels indicates that the groundwater level under the ash is determined by the up-gradient flows from the Mt Piper area.

[15] The groundwater level in the Mt Piper ash placement area was predicted to rise by about 2m by groundwater modelling (PPI, 1999).

The previous report noted that the OEMP placed emphasis on the potential for water level increases in the Lamberts North ash placement area to leach salts and trace metals from the ash and suggested that bore D1 could be used to indicate if there has been a groundwater level increase inside the ash area due to it being placed in the local groundwater collection area of Huon Gully. However, the 2014/15 report found no groundwater level rise at D1, which was independent of the up-gradient bore levels, since ash placement began at Lamberts North in 2013.

Figure 4 confirms that finding and shows a continuing lack of groundwater level increase at D1, which is most likely due to the prevailing dry weather effects and that the groundwater levels are related to those at D11. This, together with the D20 level being well below that of the ash, indicates a limited input of salts and trace metals could be expected from the Lamberts North ash placement to the local groundwater.

3.2.2 Groundwater Flow Directions

The indicative groundwater flow directions into and under the Mt Piper brine/ash placement area and leaving the site toward Huon Gully and the Lamberts North ash area are discussed below to obtain an understanding of the sources of groundwater that could affect the local water quality.

As most of the groundwater bores inside the Mt Piper brine/ash placement area have been covered with ash, the groundwater flow directions have been conceptualised from an understanding of the local coal seam structure and hydrogeology. A rubble drain was installed in the western Main Coal mine void, under the Mt Piper ash, to enable the background groundwater to flow under the ash placement without coming in contact with the ash. This suggests that groundwater flows follow the dip in the mined coal seam strata, under the ash area, in a north-easterly direction from the ash placement up-gradient groundwater table areas to the now filled northern area of Huon Gully and to bores D1 and then to D9 and Neubecks Creek (Figure 5).

Figure 4 shows that since the beginning of 2016, groundwater levels at bore D19 decreased by about 2m to be similar to that at D9, but the reason is unknown. However, even with the level decrease, the chloride concentration has continued to increase and averaged 357 mg/L in 2015/16. The chloride increase indicates that the groundwater flows around the compacted mine spoil in Huon Gully may be affecting the eastern side of Huon Gully (Figure 5).

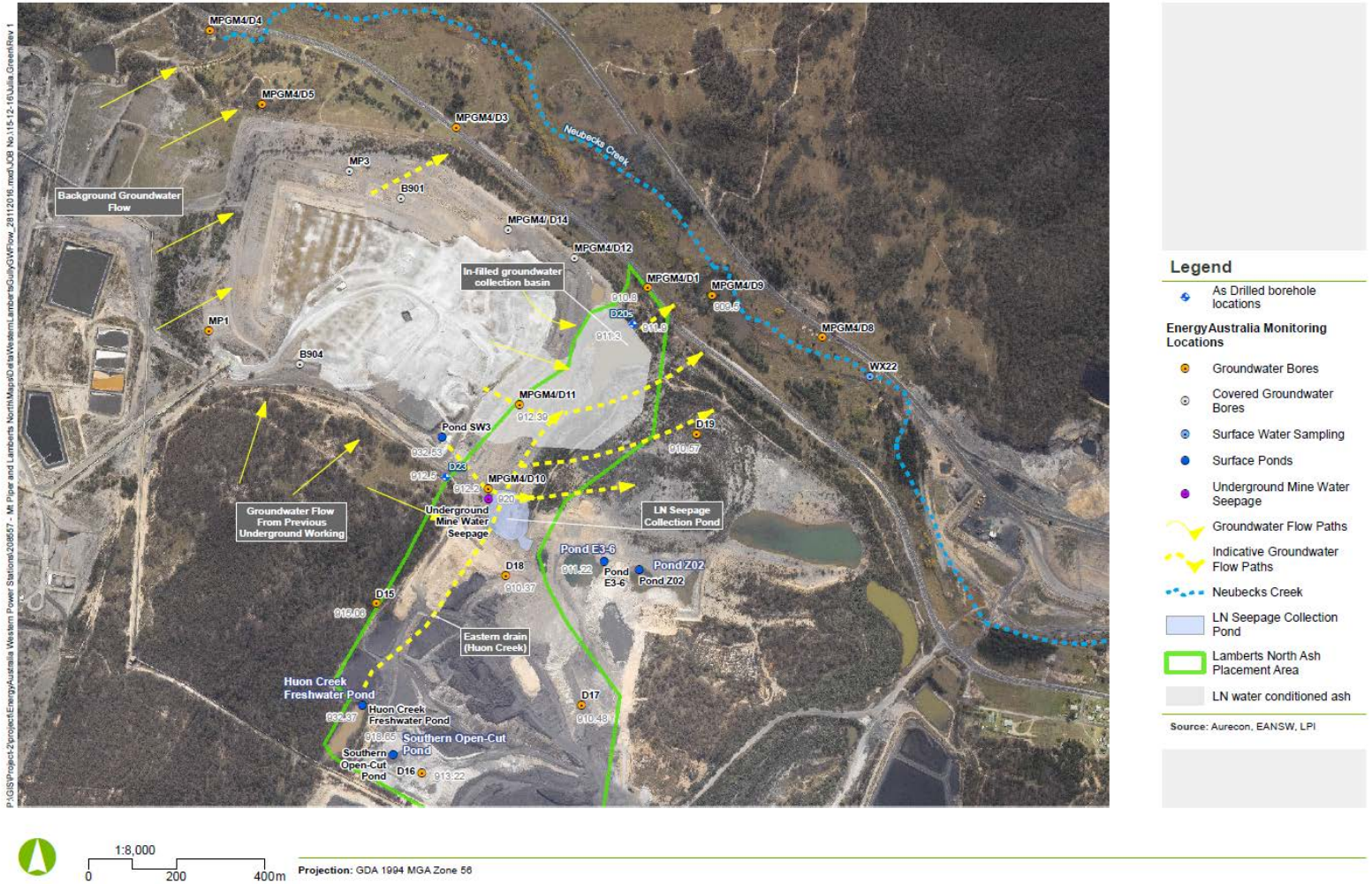

Figure 5. Schematic of Indicative Groundwater flow paths at the Mt Piper Brine Placement Area and beneath the Lamberts North ash placement via Huon Gully to bores MPGM4/D20, D1, D9 and Neubecks Creek

3.3 Groundwater seepage from the Mt Piper ash placement to Neubecks Creek

An important consideration for potential effects of the Lamberts North ash placement on the local groundwater, and its effects on the water quality in Neubecks Creek, is that the groundwater follows the dip in the mined coal seam strata toward the low point at bore D9 and then under Neubecks Creek, as shown in Figure 6.

The 2007 UTS groundwater model (Merrick, 2007) found that the Mt Piper ash placement area aquifer system is driven by underground coal mine groundwater flows. The mine groundwater flows naturally from the rubble drain, under the Mt Piper ash, to the northern end of Huon Gully beneath the Lamberts North ash area (sampled by bore D20) and then toward Neubecks Creek via bores D1 and D9.

Figure 6 shows that the groundwater flow from underground coal mines, from the west and south[16] of the Mt Piper ash placement area, is expected to follow the coal seams. As the coal seams had been removed from the Western Main open-cut void, an "interburden" layer (also called a rubble drain) was placed in the open-cut void to allow the mine water to flow under the ash without coming into contact with it. Any groundwater flowing towards Neubecks Creek from the Huon Gully Void, or more recently, under or around the Lamberts North placement in Huon Gully, is expected to flow under the creek via the coal seams, as shown in Figure 6.

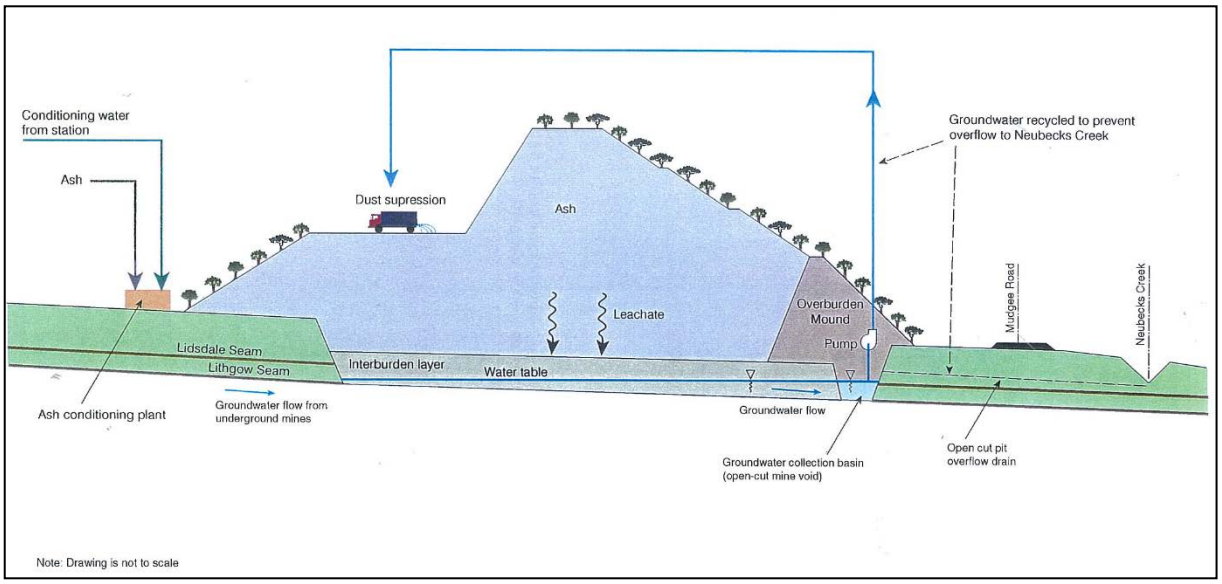

Figure 6. Schematic of Mt Piper ash placement management of surface and groundwater - from PPI (1999). (Note the Groundwater Collection Basin has been replaced by the Lamberts North ash placement on top of compacted mine spoil)

Some of the groundwater flowing down Huon Gully could potentially enter Neubecks Creek, upstream of the WX22 creek gauge 212055 after rainfall events that cause the water table to rise such that it is above the base of the creek. The UTS model predicted the salt load on the creek, from which the groundwater flow has been estimated at <0.1 ML/day, indicating that most of the mine groundwater flowing from under the Mt Piper ash placement, and down Huon Gully, actually flows under the creek.

[16] The southern underground mine groundwater had limited access to the open-cut by a coal barrier that was left in place.

Following for this background review, the review of the Lamberts North ash placement groundwater and surface water effects are undertaken in Section 4.

3.4 Lamberts North background groundwater quality

To prevent the effects of the Mt Piper inflows to Huon Gully from being assigned to the Lamberts North ash placement operations, the water quality at the groundwater bores D10 and D11, inside the Mt Piper placement area, are used to provide the concentrations of salts and trace metals entering Huon Gully from Mt Piper. Accordingly, the post-ash placement water quality data for the period September, 2015 to August, 2016 for bores D10 and D11 are summarised in Table 2.

Table 2 shows the changes in groundwater quality changes at bores D10 and D11, compared to their pre-Stage I 90th percentile baseline at bore B904 (which previously sampled the up-gradient southern underground coal mine groundwater flowing into the rubble drain). The current status for September, 2015 to August, 2016 is also shown. To put these changes into context they are compared to the background bore D5, which samples the underground coal mine groundwater up-gradient of the ash area, as well as the B904 bore that was installed in the southern water conditioned ash area prior to brine conditioned ash placement.

Significant changes in water quality are highlighted in Table 3 by the following colour codes:

- Blue is for concentrations higher than the ANZECC or local guidelines, during and before the brine co-placement began in December, 2000
- Yellow shows the concentration increases for characteristics triggering investigations of the causes because the post-median is greater than the 90th percentile baseline.

Table 2 shows that during 2015/16 the D10 and D11 bores had chloride, salinity and sulphate concentrations higher than the ANZECC or local guidelines. Compared to the pre-brine placement concentrations at bore B904, they had elevated concentrations of boron while lead was elevated at D10 and iron at D11. Bore D11 also increased in arsenic concentrations such that it exceeded the pre-placement 90th percentile baseline. The background bore, D5, remained at low concentrations for all the elements, except for the locally abundant iron and manganese and the locally acidic groundwater conditions.

Table 2: Lamberts North background groundwater quality using Mt Piper Brine conditioned ash Bores D10 and D11 compared to the southern ash area pre-brine placement bore B904, D4 and D5 Background bores, Brine Conditioned Ash Leachates and ANZECC Groundwater Guidelines or Local Goals

Element (mg/L)	Mt Piper Brine Co-Placement Area Internal Monitoring Bores^					D5 Back-ground Jan., 2001 to June, 2016	D4 Back-ground Jan., 2001 to June, 2016	Brine Conditioned ash Leachate (PPI, 1999)	ANZECC Guideline Goals for Ground-water#
	Post-Stage I & II 2000 to August, 2016		Current Stage I & II Sept, 2015 to August, 2016		D10 Baseline (Pre-Stage I 90th Percentile)				
	D10	D11	D10	D11	B904*	D5^^	D4^^		
pH	5.7	6.3	5.6	6.2	7.4	5.9	3.0	7.6	6.5-8.0
Cond (µS/cm)	7019	5898	8663	7724	1747	1129	884	10900	2600
TDS	6071	5450	6688	6603	1980	909	808	8400	2000^
SO4	3541	2990	4093	3778	1320	579	698	3750	1000++
Cl	647	574	784	729	32.6	24	16	1410	350+
As	0.001	0.010	0.001	0.010	0.008	0.002	0.050	0.050	0.024
B	3.47	2.64	3.75	2.86	2.26	0.19	0.038	6.1	0.37(0.55)!
Cd	0.0059	0.0001	0.0063	0.0001	0.01	0.0003	0.0009	0.003	0.001
Cr	0.001	0.002	<0.001	0.0013	-	0.004	0.006	0.037	0.004
Cu	0.003	0.002	0.0022	0.0011	0.01	0.002	0.017	0.078	0.005(0.0075)!
Fe**	10.9	56.6	9.35	67.5	28	44.8	86.6	0.007	0.664 (15.9)!
Mn**	8.5	14.7	8.4	15.4	15.36	8.9	0.80	0.44	5.704(8.57)!
Mo	0.001	0.001	<0.001	0.001	-	0.004	0.005	0.84	0.01+
F	0.97	0.18	0.56	0.19	9.1	0.19	0.22	6.0	1.5+++
Ni	0.91	0.48	0.948	0.688	1.14	0.067	0.022	0.2	0.5509
Pb	0.006	0.001	0.004	<0.001	0.005	0.003	0.037	<0.0002	0.005
Se	0.005	0.001	0.004	<0.001	0.005	0.001	0.002	0.180	0.005
Zn	1.33	0.071	1.26	0.095	4.18	0.069	0.236	0.039	0.908

*Bore B904 samples coal mine goaf areas up-gradient of the ash placement void rubble drain, data from 1997 to end of bore monitoring in 2000

^Bore D10 samples groundwater flowing from underground coal mine goaf areas and D11 samples open-cut mine area.

^^ Bore D4 samples shallow groundwater in a previous open-cut copper, lead and zinc & then coal mine; bore D5 samples groundwater in the abandoned underground coal mine up-gradient of the Mt Piper ash site.

^^Jan., 2001 to Oct, 2012

Notes:

**filtered samples for iron and manganese

ANZECC (2000) guidelines for protection of freshwaters, livestock or irrigation water apply to groundwater receiving water bores D8 & D9. Cadmium, Chromium, Copper, lead, nickel and zinc adjusted for effects of hardness: Ca, Mg in GCB 147, 113 mg/L:

Local guidelines using 90th percentile of pre-placement data in **bold**.

! Lamberts North from pre-placement baseline data October 2012 to August, 2013 at MPGM4/D9 in parenthesis, which do not apply to Mt Piper bores D10 or D11

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

Highlights: Blue: > ANZECC/local guidelines, Yellow: post-median > 90th baseline.

The trends in chloride concentrations at bores D10 and D11 are shown in Figure 7, which shows that the D10 chloride concentration went over 350 mg/L in early 2013 and D11 in late 2013. The high rainfall event in June and July, 2016 (see Figure 3) caused the chloride to decrease to about 400 mg/L but the chloride at bore D11 remained at about 800 mg/L.

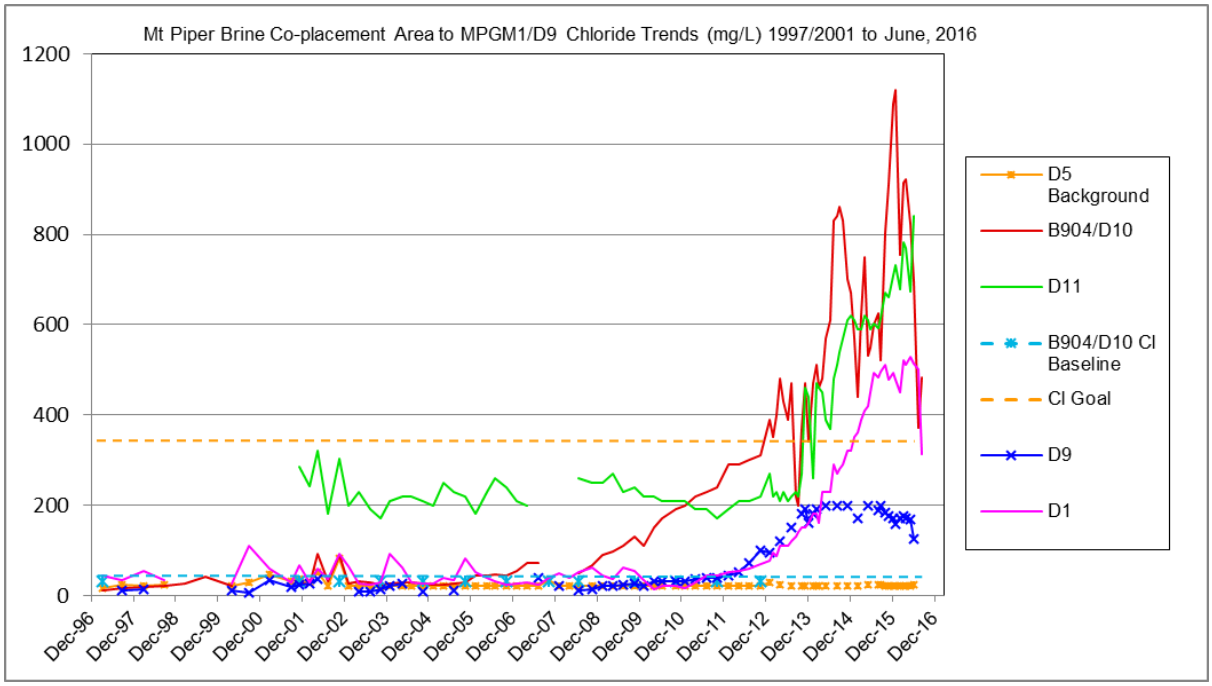

Figure 7. Mt Piper Brine Placement Area Chloride Trends at groundwater bores (MPGM4/D10 and D11), compared to the Background Bore D5, B904/D10 baseline and Environmental Goal of 350 mg/L which apples to the receiving groundwater outside the ash placement area.

These differing responses of D10 and D11 to the recent heavy rainfall indicate differing influences of the diluting inflows of low chloride in underground coal mine groundwater that flows to those bores from the western and southern areas outside the ash placement. This is most likely explained by bore D10 samples the groundwater flowing from southern underground coal mine goaf areas to Huon Gully, while D11 samples groundwater from the west into the open-cut mine rubble drain.

The chloride concentrations at bores D10 and D11 provide a tracer for potential trace metal migrations down Huon Gully for the Lamberts North surface and groundwater review in the next Section.

4. Lamberts North water conditioned ash effects on Surface and Groundwater Quality

As required by the OEMP by CDM Smith (2013), the review undertaken here is for the Lamberts North background groundwater bores D10 and D11 (see the previous Section), the common Mt Piper and Lamberts North seepage detection bore, MPGM4/D1, the receiving water bores D8 and D9 and Neubecks Creek, as well as the Lamberts North groundwater bore D20. The Neubecks Creek final receiving water site, WX22 is compared with its upstream background sites. The data base for these sites has been updated to August, 2016 and changes over time from the pre- to post-placement periods of ash placement at Lamberts North are commented on.

As noted in Table 1, Section 2.6, the local goals for boron, copper, iron and manganese have been increased (shown in parenthesis and bold), but they only apply to the Lamberts North placement (these higher goals do not apply to D10 or D11, which use the existing Mt Piper goals). These Lamberts North only goals were developed using the pre-placement groundwater baseline data from October 2012 to August, 2013 at bore MPGM4/D9. This was necessary to ensure that any increases at the down-gradient bores due to groundwater inflows to Huon Gully from under the Mt Piper area (measured at bores D10 and D11) were not assigned to the Lamberts North site.

Although the previous report for 2014/15 (Aurecon, 2016) found that the Local/ANZECC (2000) surface water trigger values for salinity, sulphate and trace metals were met in Neubecks Creek, a significant increase for nickel to 0.027 mg/L was observed in Neubecks Creek compared to the pre-placement concentration of 0.0155 mg/L, so the possible causes are investigated in this report. This was undertaken by examination of the surface water runoff water quality data at the Lamberts North site (Section 4.1) and that was compared to the groundwater quality in bore D20 (Section 4.2).

The 2014/15 report also noted increases for nickel at bore D1, to be higher than at D10, along with increases for boron, zinc and iron. It was suggested that the increases may be due to the changed conditions in the mine groundwater flowing in the rubble drain, on the bottom of the Western Main open-cut coal mine void, under the Mt Piper ash placement, due to the lower rainfall recharge conditions. Hence, the source of the nickel at bore D1 is investigated after review of the current groundwater conditions at bores D20 and D1 in the Section 4.3. The data for the receiving water bores D8 and D9 is reviewed in Section 4.4.

4.1 Lamberts North rainfall runoff water quality and diversion line water quality to LN Pond 2

Surface water runoff water quality data for the Lamberts North area during 2016 is shown in Attachment 1, part 6 and it includes water quality in the underground drainage line that diverts the runoff to the lined pond LN Pond 2. Part 6 also shows runoff water quality data from 2012 to 2016.

The runoff water has a chloride concentration of about 70 mg/L, which is similar to that in bore D20 but the sulphate in the runoff of about 1000 mg/L is about half that in the groundwater (see Table 3). Trace metal concentrations in the runoff water were similar to that expected from the ash leachates conditioned with cooling tower blowdown water for boron at about 4 mg/L, cadmium 0.021 mg/L and lead at 0.002 mg/L, but lower for arsenic, copper, iron and selenium (Table 3), while higher concentrations were measured in the runoff for nickel (0.135 mg/L) and zinc (0.335 mg/L).

A sample of the water in the drainage line taken in November, 2016 showed concentrations of trace metals higher than in the bore D20 groundwater. The boron concentration in the drainage line, at 31.6 mg/L is about 25 times higher than in the groundwater at D20 (see Table 3), indicating that the drainage concentrations are not a significant contribution to the local groundwater trace metal concentrations sampled at bore D20. The possible reasons for these high concentrations and likely effects on the receiving groundwater quality are discussed in the next Section.

4.2 Current groundwater quality at bores MPGM4/D1 and D20

Table 3 shows the current groundwater quality for bore D20 at Lamberts North, compared to that at the seepage detection bore D1. Their water quality is compared with the Groundwater Guidelines or Goals, which apply to the receiving waters. The summary data in Table 3 for parameters with higher concentrations than the ANZECC or local guidelines, during and before the ash placement began in September, 2013, are highlighted in blue. Parameters triggering investigations of the causes (post-median greater than baseline) are highlighted in yellow.

The data for these bores are also compared to the following characteristics for the following reasons:

- As D20 samples the groundwater in the compacted mine spoil, beneath the level of the bottom of the ash, its data is compared to mine spoil leachates, as well as with water conditioned ash leachates (taken from PPI, 1999). The water conditioned ash leachates were adjusted for effects of conditioning with cooling tower blowdown water (from Table 2 in Aurecon,2016)
- As bore D1 has elevated concentrations of nickel, the bores are compared to the groundwater quality in the northern Mt Piper background bore, B901. That bore was installed in the northern ash area to sample the pre-brine co-placement groundwater under the water conditioned ash during 1997 to September, 2000.

Table 3: Average Water Quality for Lamberts North embankment bore MPGM4/D20 and the Mt Piper Seepage Detection Bore D1 during 2015/16 compared to northern ash area pre-Brine Placement bore B901, mine spoil and water conditioned ash Leachates, as well as the Groundwater Guidelines or Goals

Element (mg/L)	LN embankment groundwater	Mine Spoil Leachate (PPI, 1999)	Mt Piper & LN Seepage Detection			Mt Piper ash area background	Cooling tower Blowdown Water Conditioned^ ash Leachate (PPI, 1999)	ANZECC Guideline Goals for Ground-water # !
	Current Lamberts North Sept, 2015 to August, 2016		Pre-Lamberts North Oct, 2012 to August, 2013	Post-ash placement Sept, 2013 to August, 2016	Current Lamberts North Sept, 2015 to August, 2016	B901 Northern Ash area pre-brine placement 1997 - 2000		
	D20		D1	D1	D1	B901		
pH	6.3	7.6	6.2	6.1	5.9	6.6	5.1	6.5-8.0
Cond (µS/cm)	3546	1212	2300	3646	4096	1361	902	2600
TDS	3299	800	2189	2189	3470	1638	736	2000
SO4	2039	349	1289	1964	2264	948	424	1000
Cl	109	103	101	354	483	30	3.8	350
As	0.026	0.001	0.013	0.012	0.012	0.005	0.013	0.024
B	1.18	1.475	1.8	2.16	2.36	0.18	3.8	0.37(0.55)!
Cd	0.0112	0.002	0.0002	0.0002	0.0001	0.010	0.022	0.002
Cr	0.039	0.001	0.001	0.001	<0.001	0.001	0.003	0.005
Cu	0.048	0.002	0.011	0.001	<0.001	0.017	0.167	0.005(0.0075)!
Fe*	1.25	0.097	18.0	31.8	40.1	6.08	<0.1	0.664(15.9)!
Mn*	14.4	1.64	10.0	15.4	16.6	5.66	0.15	5.704(8.57)!
Mo	0.003	0.003	0.007	<0.001	0.001	0.001	2.2	0.01
F	1.0	0.49	0.10	0.11	0.10	4.45	7.77	1.5
Ni	0.469	0.050	0.53	0.93	1.066	0.92	0.035	0.5509
Pb	0.042	0.0002	0.001	<0.001	0.001	0.003	0.003	0.005
Se	0.002	0.0115	0.002	<0.001	0.002	0.005	0.116	0.005
Zn	0.406	0.366	0.047	0.13	0.135	0.52	0.117	0.908

^Water conditioned ash leachates from PPI (1999) adjusted for effects of conditioning with cooling tower blowdown water from Table 2 in Aurecon (2016)

* filtered samples for iron and manganese

ANZECC (2000) guidelines for protection of freshwaters, livestock or irrigation water apply to groundwater receiving water bores D8 & D9. Cadmium, Chromium, Copper, lead, nickel and zinc adjusted for effects of hardness: Local guidelines using 90th percentile of pre-placement data in **bold.**

! Lamberts North from pre-placement baseline data October 2012 to August, 2013 at MPGM4/D9 in parenthesis, which do not apply to Mt Piper bores D10 or D11

Highlights: Blue: > ANZECC/local guidelines, Yellow: post-median > 90th baseline.

Review of the distribution of salinity and trace metals between bores D20 and D1 and the ash background bore B901 in Table 3 shows the following water quality characteristics. The influence of the D10 and D11 groundwater (in Table 2) on the characteristics at bores D20 and D1 are also indicated by the following:

- The salinity and chloride decreases from that at D10 and D11 (Table 2) to low concentrations at D20 and D1 as the D10 groundwater plume flows down Huon Gully, under the Lamberts North ash, on its way to Neubecks Creek. The decreases were due to dilution by low salinity and chloride background concentrations in underground coal mine groundwater inflows from the southern and western areas under the Mt Piper placement (as shown by bores D5, B904 and B901 groundwater).
- As the salinity and chloride decrease, a corresponding decrease in trace metal concentrations from those at D10 are expected. Increases above that trend could indicate an input from another source. The trace metals at D20 that followed the decreasing salinity and chloride trend, as well as those that showed an increase in concentrations are:
    - D20 decreased trace metals: boron, iron, nickel, selenium, zinc
    - D20 increased trace metals: arsenic, cadmium, chromium, copper, manganese, molybdenum, fluoride, lead.

  The possible sources of these increases at D20 were examined by comparison with the concentrations in the estimated cooling tower blowdown water conditioned ash leachates, as well as the measured leachates for mine spoil in Table 3. Due to the slow rate of rainfall infiltration through the compacted ash (Aurecon, 2016), the increase in concentrations of trace metals in bore D20 due to ash leachates is expected to be small. This can be seen by the elevated concentration of selenium in ash leachates at 0.116 mg/L compared to the much lower concentration at D20 of 0.002 mg/L (Table 3). Large decreases from leachates to D20 concentrations can also be seen in Table 3 for fluoride and molybdenum, and to a lesser extent for boron.

  The increased concentrations at D20 for arsenic, chromium, manganese and lead, to be higher than at D10, and higher than for water conditioned ash and in mine spoil leachate concentrations, indicates another source of trace metals beneath the Lamberts North ash. In this regard, hydrogen sulphide was noticed in the groundwater seeping from the base of the Lamberts North embankment while the D20 bore was being installed, indicating a lack of dissolved oxygen at the bottom of Huon Gully. It appears as if the physio-chemical conditions in the mine spoil have changed and released trace metals into the local groundwater. It is suggested that this process needs to be investigated.

  The potential release of trace metals from pyrites in the mine spoil is consistent with the observation of elevated trace metals in the water from the Lamberts North drainage line, which is in mine spoil below the original ash floor level (section 4.1).

  To confirm this view, it is suggested that the dissolved oxygen concentration in bore D20 be measured, after bailing with groundwater flowing into the bore, and compared to the concentrations the other bores D1, D9, D10, D11 and D19. Dissolved oxygen in the Lamberts North drainage line is also suggested to be measured.

- As bore D1 is down-gradient of D20, the trace metal concentrations at D1 were expected to decrease in line with the decrease in salinity and chloride. However, the chloride concentration at D1 increased from 109 mg/L at D20 to 483 mg/L (Table 3), indicating that the chloride plume is flowing at the bottom of Huon Gully, well under the Lamberts North ash placement and below the D20 bore sampling depth. As a result, all the trace metals at D1 were lower than at D20, except boron, iron, manganese and nickel.

To investigate the reason for these increases, a comparison of D1 with bore D10 showed the trace metals that decreased, as well as those that showed an increase in concentrations, relative to the chloride changes from D10 to D1, are:

- D1 decreased trace metals: boron, cadmium, copper, fluoride, lead, selenium, zinc
- D1 increased trace metals: arsenic, iron, manganese, nickel.

The increases in arsenic, iron, manganese and nickel at bore D1 are higher than could be explained due to water conditioned ash leachates or from mine spoil, so another source is indicated. A possible source, and cause, is changed conditions in the northern section of the rubble drain due to lower groundwater inflows caused by the prolonged dry weather. Pyrites in coal waste on the bottom of the mine void may have been oxidised and released trace metals into the rubble drain groundwater. In particular, the increase in nickel may be related to the increase in manganese (see Larsen and Postma, 1997). Figure 5 indicates that the groundwater from the coal mine void rubble drain at Mt Piper may flow towards bore D1 by joining the D10 plume as it leaves Huon Gully.

The nickel increase at D1 is the main element of interest as nickel triggered a significant increase in Neubecks Creek in the previous report, so the cause is investigated in the next Section.

4.3 Distribution of Nickel between groundwater sampling sites

The distribution of nickel and chloride concentrations between groundwater bores in the Mt Piper/Lamberts North area was graphed to see if there is a relationship between the two characteristics. A relationship between nickel and chloride was expected to exist because, as the chloride groundwater plume moves down Huon Gully, the chloride concentrations decrease from bore D10 to D11, D1 and to D9, while the nickel concentrations decreased in agreement from D10, D11 to D9, but increased at D1 (see Table 4 in Aurecon, 2015). The higher nickel concentration at D1, than at D10, was confirmed in the above Tables 2 and 3 for 2015/16.

The possible cause of the D1 increase was investigated using the updated 2015/16 data, including the bore D20 data at Lamberts North collected in 2016. Figure 8 shows the differences in nickel concentrations between all the sampling sites in the Mt Piper/Lamberts North area by using nickel/chloride signatures. In order to explain the changes over time and differences between sites, it was necessary to graph all the sites, including the southern underground coal mine seepage to Huon Gully. The bore locations are shown in Figure 5.

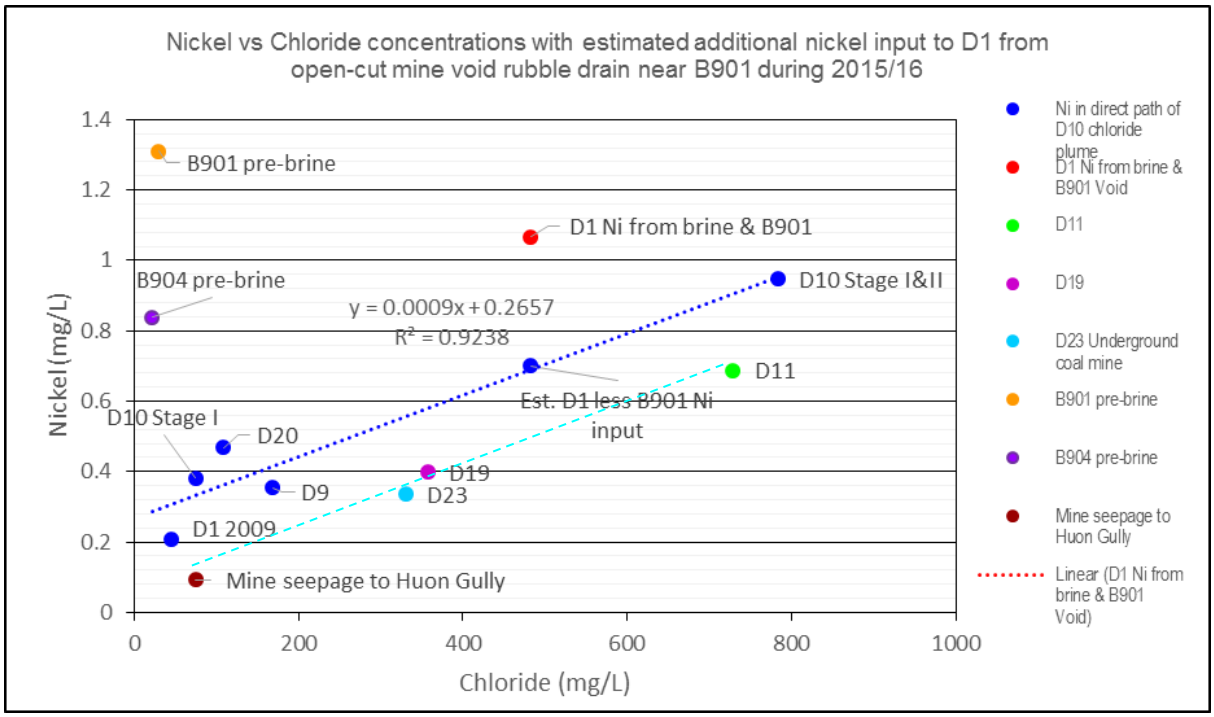

Figure 8. Signature plot of Nickel concentration compared to Chloride for each background and Lamberts North groundwater bore.

The bores used in Figure 8, including the Ni/Cl signature for the ash area background bores, B901 and B904, as well as D1 and D10 at specific times, are:

- B904 background pre-brine placement (1997 to March, 2000) in southern Mt Piper ash area sampling the underground coal mine goaf area to the west of bore D10
- Underground coal mine goaf seepage to Huon Gully (see Figure 5 – just to west of LN Pond 2)
- D10 during Stage I in October, 2009 when the post-brine conditioned ash 50th percentile chloride concentration first exceeded the pre-placement 90th percentile of 32.6 mg/L for chloride
- D10 during 2015/16, covering Stage I and II effects
- D20 (2016)
- D1 in October, 2009 for comparison with D10 at the same date
- D1 during 2015/16 showing the Ni concentration from the brine area with potential B901 input
- B901 northern Mt Piper ash area background pre-brine placement (1998 to October, 2000) sampling the northern area rubble drain in the Western Main coal mine void
- D9 during 2015/16
- D11 which is north of D10
- D19 (east of Lamberts North) and
- D23 underground coal mine west of D10.

Note that the underground coal mine seepage to Huon Gully was used to indicate the effects of the southern underground coal mine groundwater on the Mt Piper/Lamberts North groundwater because the recently installed bore D23 was found to contain elevated chloride concentrations.

Figure 8 shows that bores D11, D19 and D23 are at the margins of the D10 chloride plume and their nickel concentrations are lower than those for D10, as it varied over time, but are parallel to them. Their

relationship with the Ni/Cl signature with the underground coal mine seepage to Huon Gully (dashed line in Figure 8) indicates that the groundwater in these bores is being diluted by the low chloride and nickel concentrations in the underground coal mine inflows from the south of the Mt Piper ash area (see Figure 5).

The lower in nickel concentration of 0.381 mg/L at D10, during the early Stage I period, compared to the much higher concentration of 0.839 mg/L at the B904 background pre-brine bore, is also likely to be due to the underground mine groundwater inflows with a Ni/Cl signature of 0.092 mg/L nickel and 75 mg/L chloride (see Figure 8).

The D10 nickel concentration increased to 0.948 mg/L during the current Stage I&II brine placement as the chloride concentration increased to an average of 784 mg/L in 2015/16, but the nickel concentration has remained below the B904 pre-brine placement 90th percentile background of 1.14 mg/L (Table 2).

The nickel concentration at bore D1 of 1.066 mg/L was higher than at bore D10 with a much lower chloride concentration of 483 mg/L. This indicates an additional source of nickel above that originating from D10. A regression of the bores showing nickel concentrations associated with chloride concentrations was significant and was used to estimate the expected nickel concentration at D1, relative to the diluted chloride and nickel from D10. By this method, the estimated nickel concentration at D1 of about 0.70 mg/L is expected to represent that from D10.

Figure 8 shows that the B901 northern Mt Piper ash area background bore had a nickel concentration, at 1.31 mg/L, higher than at D10 and D1, so it is a likely source of the higher than expected nickel at D1. On this basis, it is likely that the D1 nickel concentration was increased by dry weather effects on physio-chemical conditions in the rubble drain. The estimated nickel concentration at D1, without input from the northern rubble drain is shown as “D1 less B901 Ni input” in Figure 8.

4.4 Current groundwater quality at the receiving water bores

Table 4 shows the pre-dry ash placement, long-term post-placement and current groundwater quality for the receiving groundwater bores D8 and D9 at Lamberts North, compared to the local coal waste/chitter area groundwater bore D19.

Bore D9 is the closest to the seepage detection bore D1 and the salinity and sulphate concentrations have increased to be higher than the pre-placement concentrations such that they now exceed the ANZECC Groundwater Guidelines or Local Goals. The chloride at this bore has also increased, and now the post-50th percentile exceeds the pre-placement 90th percentile, giving a warning that the D10 chloride plume has reached D9.

The salinity, sulphate and chloride increases at D8, on the northern side of Neubecks Creek, were small and were well under the post-50th percentile > pre-placement 90th percentile warning level. Other than commonly low pH in the area, all the elements at D8 met the ANZECC Guidelines or Local Goals.

Groundwater at the mine spoil/coal waste bore D19 had salinity, sulphate and chloride concentrations higher than at D9 and similar to that at bore D1. They all exceeded the 50th > 90th warning level in 2014 and the chloride at that bore has increased from an average of 186 mg/L, during the pre-placement period, to the current concentration of 357 mg/L. The flow path shown in Figure 5 indicates that the bore D10 plume may be flowing around the compacted mine spoil in Huon Gully and causing the increase at D19.

Table 4: Average Water Quality for Mt Piper and Lamberts North receiving water bores during Pre- placement (October, 2012 to August, 2013), Post-placement (September, 2013 to August, 2015) and current 2015/16 Periods compared to background coal mine spoil/coal waste conditions at Bore MPGM4/D19 and ANZECC Groundwater Guidelines or Local Goals (including Lamberts North Pre-placement 90th Percentile Goals)

Element (mg/L)	Mt Piper & LN Groundwater Receiving Waters						Mine Spoil/ Coal Waste at D19 Sept, 2015 to August, 2016	ANZECC Guideline Goals for Ground-water # !
	Pre-Lamberts North Oct, 2012 to August, 2013	Post-ash placement Sept, 2013 to August, 2016	Current Lamberts North Sept, 2015 to August, 2016	Pre-Lamberts North Oct, 2012 to August, 2013	Post-ash placement Sept, 2013 to August, 2016	Current Lamberts North Sept, 2015 to August, 2016		
	D8	D8	D8	D9	D9	D9	D19	
pH	5.9	5.6	5.4	6.1	6.0	5.9	6.2	6.5-8.0
Cond (µS/cm)	525	660	627	2000	2687	2758	4600	2600
TDS	393	501	460	1675	2274	2151	3407	2000
SO4	216	284	268	1048	1352	1298	2250	1000
Cl	18.3	32	31	116	177	169	357	350
As	0.001	0.001	<0.001	0.002	0.002	0.002	0.003	0.024
B	0.063	0.058	0.052	0.47	0.55	0.56	1.56	0.37(0.55)
Cd	0.0003	0.0001	0.0001	0.0002	0.0001	0.0001	0.0002	0.002
Cr	0.001	0.001	0.001	0.001	0.001	<0.001	0.025	0.005
Cu	0.005	0.002	0.001	0.005	0.003	0.0018	0.0026	0.005(0.0075)
Fe*	0.17	0.82	0.62	8.26	14.55	14.55	5.22	0.664(15.9)
Mn*	1.34	1.55	1.16	7.73	9.22	8.50	3.81	5.704(8.57)
Mo	<0.01	0.001	<0.001	<0.01	0.001	<0.001	<0.001	0.01
F	0.10	0.06	0.02	0.13	0.11	0.07	0.10	1.5
Ni	0.098	0.084	0.078	0.273	0.352	0.353	0.399	0.5509
Pb	0.002	0.001	<0.001	0.003	0.002	0.001	0.001	0.005
Se	0.002	0.001	<0.001	0.002	0.001	<0.001	<0.001	0.005
Zn	0.083	0.096	0.096	0.120	0.118	0.126	0.348	0.908

Notes: *filtered samples for iron and manganese

ANZECC (2000) guidelines for protection of freshwaters, livestock or irrigation water apply to groundwater receiving water bores D8 & D9.

Cadmium, Chromium, Copper, lead, nickel and zinc adjusted for effects of hardness:

Local guidelines using 90th percentile of pre-placement data in **bold**

! Lamberts North from pre-placement baseline data October 2012 to August, 2013 at MPGM4/D9 in **parenthesis**, which do not apply to bores D10 or D11

Highlights: Blue: > ANZECC/local guidelines, Yellow: post-median > 90th pre-placement baseline.

The trace metal concentrations at bore D9 met the ANZECC Groundwater Guidelines or Local Goals, other than for boron, while iron, manganese and nickel increases triggered the 50th > 90th warning level. The boron at D9 of 0.56 mg/L (compared to the guideline of 0.37 mg/L) most likely originated from the underground coal mine inflows to bore D10 (B904 pre-placement 90th percentile 2.26 mg/L, Table 2) with some additional input likely from brine leachates (D10 currently 3.75 mg/L, Table 2). The elevated concentration at D1 of 2.36 mg/L (Table 3), together with potentially some input from the mine spoil/coal waste area (D19 boron of 1.56 mg/L) could explain the small increase at D9. The

elevated boron at D20, of 1.18 mg/L, which has a lower concentration than at D1, is not considered to be the cause of the boron concentration at D9.

The iron and manganese increases at D9 most likely originated from the recent increase at bore D1 (Table 3), which probably reflect changes in the physio-chemical conditions in the rubble drain. These increases are also consistent with the increase in nickel concentrations at bore D1.

4.5 Neubecks Creek Surface Water Quality

The dry ash placement at Lamberts North is not expected to be a significant source of salinity or trace metals to Neubecks Creek (Aurecon, 2016), and the changes in chloride at bores D1 and D9 shown in Figure 9, which are used as an indication of the likely increaes in water quality and trace metal concentrations in Neubecks Creek due to groundwater inflows.

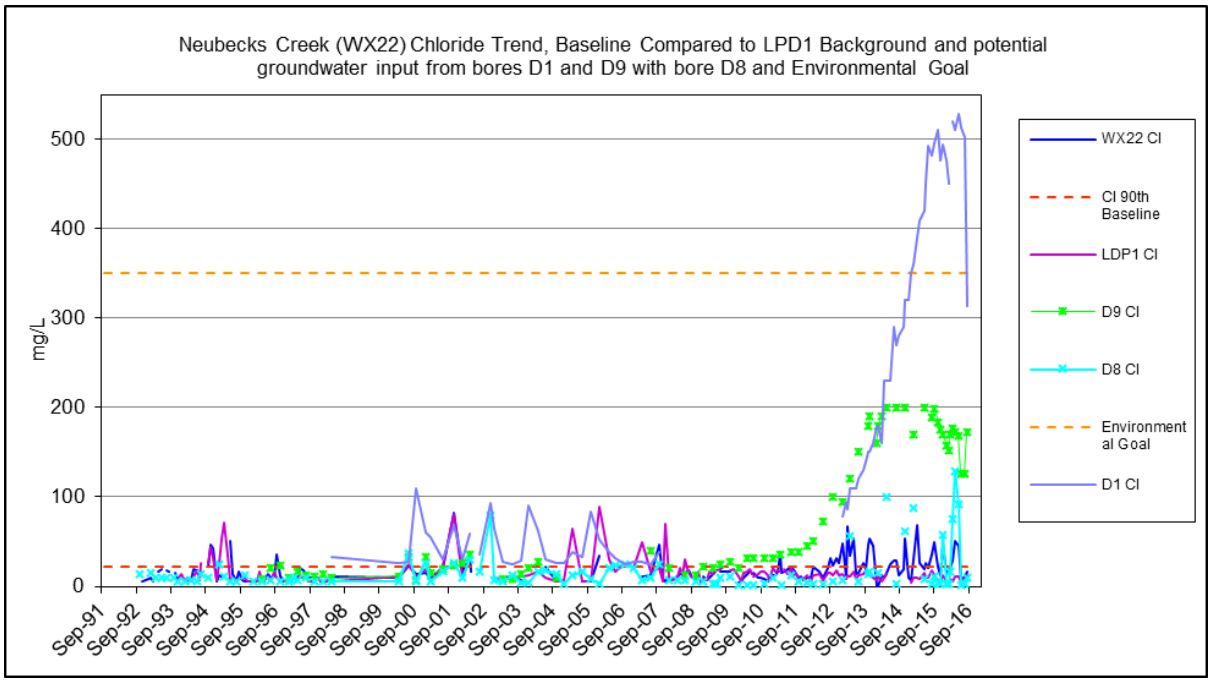

Figure 9. Chloride Trends in Neubecks Creek (WX22) Compared to its 90th percentile baseline, LDP1 background concentrations and groundwater receiving water bores MPGM4/D8 and D9, potential input from bore D1 and Environmental Chloride Goal

Figure 9 shows the sharp decrease in chloride at D1, due to the recent heavy rainfall events (Figure 3), which corresponds with the decrease in chloride at bore D10 (Figure 7) and confirms the connection between the chloride plume in Huon Gully with bores D1 and D9. However, Figure 9 shows that the chloride increase at D9 was lower than expected compared, with that at D1, and is consistent with low chloride, local coal mine groundwater inflows of the D9 area. The much lower chloride concentrations in Neubecks Creek appear to reflect the view that most of the flows of groundwater pass under the creek (Figure 6). In addition, any groundwater that does seep into the creek are diluted by the stream flows as they vary with rainfall runoff.

Table 5 summarises the water quality and trace metal characteristics in Neubecks Creek. There were no exceedances of the Local or ANZECC (2000) guideline trigger values at the WX22 receiving water site. The nickel concentration remained essentially unchanged since 2014/15 but met the locally derived surface water guideline for the Lamberts North site.

The upstream site, NC01, had an increase in iron concentration which may be related local changes in up-gradient coal mine groundwater inflows to Neubecks Creek, which became evident at bores D1 and D9. Only copper had an elevated concentration at the background site LDP01, which had decreased since the Lamberts North pre-placement period.

Table 5: Average Surface Water Quality for Neubecks Creek at Mt Piper Holding Pond Background Licence Discharge LDP01, Lamberts North NC01 Background and the Receiving Water Site WX22 Compared to ANZECC Surface Water Guidelines or Local Goals (including Lamberts North Pre-placement 90th Percentiles)

Element (mg/L)	Neubecks Creek Surface Water Monitoring								Surface Water Guidelines or Goals#
	Mt Piper Holding Pond Background		Lamberts North Ash Placement Background			Surface Water Receiving Water Site			
	Pre-LDP01 Background Oct, 2012 – Aug 2013**	Current LDP01 Sept, 2015 –Aug 2016**	Pre-NC01 Background Oct, 2012 –Aug 2013**	Post-NC01 Sept, 2013 – Aug 2016**	Current NC01 Sept, 2015 –Aug 2016**	Pre-WX22 Background Oct, 2012 – Aug 2013**	Post-WX22 Sept, 2013 – Aug 2016**	Current WX22 Sept, 2015 –Aug 2016**	
pH	7.5	7.8	7.1	7.1	6.8	7.3	7.2	7.1	6.5 – 8.0
Cond/ (uS/cm)	440	364	310	365	323	620	661	571	2200
TDS	290	286	170	230	214	390	486	486	1500^
SO4	120	106	73	83	63	210	234	169	1000 ++
Cl	12	8.9	10	9.8	8.0	26	31.6	26.5	350 +
As	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	0.024
B	0.05	0.050	0.05	0.043	0.041	0.16	0.10	0.08	0.37
Cd	<0.0002	<0.0001	<0.0002	<0.0001	0.0001	<0.0002	<0.0001	<0.0001	0.00085
Cr	<0.001	0.0014	<0.001	0.001	0.001	<0.001	<0.001	<0.001	0.002
Cu**	0.016	0.010	0.002	0.0023	0.0023	0.002	0.0013	0.0013	0.0035 (0.005)!
Fe*	0.060	0.030	0.06	0.3	0.37	0.04	0.14	0.23	0.3+++
Mn*	0.034	0.06	0.19	0.39	0.36	0.55	0.58	0.55	1.9
Mo	<0.01	0.003	0.01	0.001	0.001	<0.01	<0.001	<0.001	0.01+
F	0.2	0.129	0.16	0.14	0.15	0.1	0.14	0.13	1.5+++
Ni	0.09	0.007	0.004	0.004	0.003	0.023	0.025	0.021	0.017 (0.051)!
Pb	0.002	0.004	<0.001	<0.001	0.002	<0.001	0.001	0.001	0.005
Se	<0.002	0.0017	<0.002	<0.001	<0.001	<0.002	0.001	<0.001	0.005
Zn**	0.045	0.041	0.026	0.017	0.010	0.026	0.024	0.014	0.116

* filtered samples for iron and manganese

** See Attachment 1 for aluminium, copper and zinc tested on filtered samples

^ River salinity from 0.68 x 2200 uS/cm low land river conductivity 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 Neubecks Creek 19.7, 11.8 mg/L, respectively. Local guidelines using 90th percentile of pre-placement data in **bold**

! Lamberts North pre-placement 90th percentile from October 2012 to August 2013 data at WX22 and NC01 in parenthesis (does not apply to LDP01)

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

Highlights: Blue: > ANZECC/local guidelines, Yellow: post-median > 90th pre-placement baseline.

From the above water quality observations, the monitoring of aquatic life in Neubecks Creek, for potential effects of the dry ash placement is summarised in the next Section and discussed in the context of the above water quality monitoring results. The likely effects of the Lamberts North ash placement on aquatic life are then discussed in Section 5.

4.6 Aquatic Life Monitoring in Neubecks Creek

The OEMP requires that at least one pre-placement and two post-placement aquatic life surveys be undertaken in Neubecks Creek for assessment of the potential effects of the Lamberts North water conditioned ash placement[17]. Cardno (2016) undertook the second post-placement sampling in December, 2015 and found that none of the statistical tests for the spring 2015 data indicated any change through time at NCR1 (upstream of the Lamberts North site and adjacent to Mt Piper) and NCR2 (near the receiving water site WX22) that could conclusively be attributed to an impact of the Lamberts North dry ash placement. There was no indication of effects of the elevated trace metal concentrations in the creek on aquatic ecology. Hence, no specific mitigation, impact minimisation or ameliorate actions were recommended.

A similar finding was found by the first post-placement study (Cardno, 2014), so it is recommended that EnergyAustraliaNSW consider ceasing aquatic life monitoring because the conditions of the OEMP have been met and no effects have been found.

Further monitoring is unlikely to find any different result for the following reasons presented in Cardno (2016):

- The water quality and trace metals in Neubecks Creek are elevated due to the local mineralised conditions, but they meet the local and ANZECC (2000) guideline concentrations when these conditions are taken into account[18].
- Survey indicated that aquatic habitat, biota and macroinvertebrate assemblages in Neubecks Creek is generally depauperate due to the poor water quality and historic and current coal mining activities, power generation and historic land clearing in the local area.
- Despite these findings, pollution sensitive taxa are present, and the creek supports aquatic ecology of some value and maintains a variety of ecosystem processes.
- Sampling and assessment of effects on aquatic life will always be confounded because the sampling sites within Neubecks Creek are different. Sites NCR1 and NCR3 have different conditions of the riparian vegetation, creek banks and streambed than that of the receiving water site NCR2 near WX22. These differences could be expected to influence the number and type of macroinvertebrate taxa (and other aquatic biota) found in the samples in the upstream control sites and at NCR2.
- The Coxs River sampling site (CR0) was shown by Cardno (2014) as not having a similar environment as in Neubecks Creek, and hence was not a valid site for comparison. This was confirmed by the spring 2015 sampling.

[17] The CoA states this two post-placement requirement but also states that an ecological monitoring program be developed. The ecological monitoring program was developed and it states that monitoring will continue for up to 5 years from the beginning of operation, that is, to 2018.

[18] Cardno (2016) inappropriately compared the trace metal concentrations to the default ANZECC (2000) trigger values, which are based on concentrations of bioavailable dissolved ionic concentrations (eg.,Ni^{2+}) rather than with the approved locally derived trigger values based on total (unfiltered) trace metal concentrations.

5. Discussion

The investigation of potential effects of the Lamberts North dry ash placement on the local surface and groundwater undertaken during the 2015/16 reporting period, together with the additional groundwater data collected at bore MPGM4/D20 in the Lamberts North embankment, has provided a better understanding of the groundwater processes in the area. From these investigations, it has been indicated that the northern Mt Piper area coal mine void/rubble drain is contributing iron and nickel to bores D1 and D9 downgradient of Huon Gully. These inputs are in addition to those coming from the southern area underground coal mine groundwater, which flows beneath the southern Mt Piper ash placement area.

The investigations have also indicated that these southern mine inflows are likely to be enhanced by brine leachates and most of the salts, chloride and trace metals in the leachates are diluted as they flow down Huon Gully by lower concentrations in mine water inflows from the western areas. Although the concentrations decrease, the boron concentration at the receiving groundwater bore, D9, slightly exceeded the local guideline in 2015/16. Significant increases were observed at D9 for iron, manganese and nickel, but they remained below the local groundwater guidelines. The increases appear to be due to the northern coal mine void/rubble drain with changed physio-chemical conditions caused by the prolonged dry weather.

Although there were significant increases in trace metals in the mine spoil beneath the Lamberts North site, they were unlikely to be due to the ash placement, but appeared to be due to lack of dissolved oxygen in the groundwater. However, the elevated trace metals did not significantly affect the trace metals at the down-gradient bores D1 or D9.

Consequent to the various enrichments and dilution processes occurring in the local groundwater, and the groundwater flows from Huon Gully mostly passing under the Neubecks Creek, there were no exceedances of the Local/ANZECC (2000) trigger values at the receiving water site in Neubecks Creek.

Accordingly, as no adverse effects of the Lamberts North site have been identified, no ameliorative measures were indicated.

6. Conclusions

The 2015/16 assessment of effects of the Lamberts North water conditioned dry ash placement on the receiving surface water and groundwater has led to the following conclusions:

- Mine spoil under the Lamberts North water conditioned ash placement is releasing trace metals into the groundwater. Although the cause is unknown, it is suggested to be due to release from pyrites in the mine spoil
- The effects of the Lamberts North water conditioned ash leachates on groundwater are indicated as small due to limited rainfall infiltration through the compacted ash
- The cause of the elevated nickel concentration at bore MPGM4/D1 was indicated as due to groundwater inflows from the Western Main open-cut coal mine rubble drain, under the northern Mt Piper ash area, as a result of dry weather conditions and possible oxidation of coal pyrites in the mine void
- ANZECC (2000) and locally derived guideline trigger values for groundwater, other than salinity, sulphate and boron, continued to be met at bore MPGM4/D9
- The salinity and sulphate at D9 most likely came from the Mt Piper brine co-placement area. The slight increase in boron appeared to originate from a combination of southern underground coal mine groundwater enhanced with brine leachates
- No exceedances of the local and ANZECC guidelines at D8, other than the commonly low pH for in the area
- Chloride, salinity and trace metals continued to comply with the local/ANZECC trigger values for the Neubecks Creek receiving water site.

The acceptable levels of water quality and trace metals at WX22 are consistent with the aquatic life study, which found no significant differences in macroinvertebrates at the upstream and downstream sampling sites in Neubecks Creek.

7. Recommendations

From the review of water quality data collected during 2015/16, the following recommendations are made for the water conditioned ash placement at the Lamberts North ash storage area:

It is recommended that the source of the elevated trace metal concentrations in bore MPGM4/D20, which samples the groundwater in mine spoil beneath the Lamberts North ash placement be investigated. This is recommended to be undertaken:

- After a further 12 months of groundwater data has been collected at D20
- By measuring the concentration of dissolved oxygen in bore D20, after bailing with groundwater flowing into the bore, and sample the concentrations in bores D1, D9, D10, D11 and D19, as well as inside the Lamberts North drainage line for comparison
- Assessing the effects of potential additional rainfall infiltration through the ash placement due to rainfall runoff seepage through the bottom of the unlined pond in the ash area.

Additional recommendations are:

- Continue the routine monthly monitoring at all the groundwater bores, as well as at Neubecks Creek, to confirm they meet the requirements of the Operational Environmental Water Management Plan.

8. References

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Attachment 1

Surface and Groundwater Data for October, 2012 to August, 2015

1. a) Water Quality Data and Summary for Neubecks Creek WX22 and

   b) Mt Piper Power station Licence Discharge Point LDP01 with

   c) Neubecks Creek background site for Lamberts North NC01

2. Water Quality Data and Summary for Mt Piper Groundwater Receiving Water Bores and MPGM4/D8 and MPGM 4/D9

3. Water Quality Data and Summary for Mt Piper Groundwater Seepage Detection Bore MPGM4/D1

4. Water Quality Data and Summary for Mt Piper Ash Placement Area Groundwater Bores MPGM4/D10 and MPGM4/D11

5. Water Quality Data and Summary for Lamberts North Groundwater Bores MPGM4/D15, MPGM4/D16, MPGM4/D17, MPGM4/D18 and MPGM4/D19

6. Lamberts North Water Conditioned Ash Runoff Pond Water Quality October, 2012 to July, 2014 for Ponds LN1 and LN2 and mine water seepage (no data for 2015). LN runoff sump 1 and drainage line in 2016.

1. Water Quality Data and Summary for Neubecks Creek WX22 and Lamberts North Power station Licence Discharge Point

1a. Water Quality Data and Summary for Neubecks Creek WX22

Pre-Water conditioned ash Placement - Background Summary Data in Neubecks Creek at WX22 October, 2012 - August, 2013 (mg/L)																						
	Ag	Al	Al-f	ALK	As	B	Ba	Be	Ca:	Cd	Cl:	Co	COND uS/cm	Cr	Cr-6	Cu	Cu-f	F	Fe	Hg	K:	Li
Average	<0.001	0.11	0.01	68.0	0.001	0.18	0.034		50	0.0002	32		703	0.001		0.003	0.001	0.18	0.07	<0.00005	7	
Maximum	<0.001	0.61	0.01	86.0	0.001	0.47	0.062		83	0.0002	67		1300	0.002		0.009	0.003	0.70	0.32	<0.00005	11	
Minimum	<0.001	0.02	<0.01	51.0	<0.001	0.06	0.016		26	<0.00002	9		330	<0.001		<0.001	<0.001	<0.01	0.02	<0.00005	4	
90th Percentile	<0.001	0.21	0.01	85.0	0.001	0.28	0.058		81	0.0002	54		1100	0.001		0.005	0.002	0.38	0.07	<0.00005	9	
Pre-50th Percentile Trend	<0.001	0.06	0.01	61.0	0.001	0.16	0.032		48	0.0002	26		620	0.001		0.002	0.001	0.10	0.04	<0.00005	6	
ANZECC 2000	0.00005	0.055	0.055		0.024	0.370	0.700			0.00085	350		2200	0.002		0.0035 **(0.005)**		1.5	0.3	0.00006		

Continued…Pre-Water conditioned ash Placement - Background Summary Data in Neubecks Creek at WX22 October, 2012 - August, 2013 (mg/L)																						
	Mg:	Mn	Mo	Na:	NFR	Ni	NO2	NO3	Total Nitrogen	Pb	pH	Total Phosphorus	Se	SO4:	TDS	TFR	Turbidity	V	Zn	Zn-f	DO	Temp
Average	35	0.83	0.007	48		0.023	<1	<0.5	0.41	0.001	7.2	0.01	0.002	253	455		6.22		0.040	0.012	10.8	
Maximum	63	3.30	0.010	110		0.060	<1	<0.5	0.70	0.003	7.6	0.02	0.002	570	880		31.00		0.190	0.040	15.3	
Minimum	15	0.14	<0.001	22		0.006	<1	<0.5	0.35	<0.001	6.8	<0.001	<0.002	86	210		1.50		0.005	0.005	8.2	
90th Percentile	62	1.50	0.010	76		0.051	<1	<0.5	0.50	0.002	7.5	0.01	0.002	450	800		9.10		0.040	0.022	14.2	
Pre-50th Percentile Trend	31	0.55	0.010	40		0.0155	<1	<0.5	0.35	0.001	7.3	0.01	0.002	210	390		3.60		0.026	0.007	10.1	
ANZECC 2000		1.900	0.010		10.0	0.017 **(0.051)**		0.015	0.250 **(0.55)**	0.005	6.5-8.0	0.020 **(0.030)**	0.005	1000	1500	10.0 **(19.0)**	10.0		0.116			

Neubecks Creek WX22 Water conditioned ash Placement Water Quality Data September 2015 to August 2016																						
Sample Date	Ag	Al	Al-f	ALK	As	B	Ba	Be	Ca:	Cd	Cl:	Co	COND uS/cm	Cr	Cr-6	Cu	Cu-f	F	Fe	Hg	K:	Li
16-Sep-15	0.0005	0.02	0.005	56	0.001	0.16	0.029		64.8	0.0001	49.9		928	0.001		0.0005	0.001	0.025	0.146	0.00002	7.61	
22-Oct-15	0.0005	0.35	0.01	67	0.001	0.1	0.017		33.3	0.0001	22.5		529	0.001		0.002	0.001	0.177	0.081	0.00002	8.24	
19-Nov-15	0.0005	0.07	0.005	75	0.001	0.09	0.011		27.6	0.0001	12.9		412	0.001		0.001	0.001	0.092	0.185	0.00002	4.42	
10-Dec-15	0.0005	0.07	0.02	92	0.001	0.16	0.027		71.4	0.0001	47.1		979	0.001		0.001	0.001	0.114	0.285	0.00002	5.73	
21-Jan-16	0.0005	0.19	0.01	74	0.001	0.07	0.013		27.4	0.0001	14.8		408	0.001		0.001	0.001	0.171	0.209	0.00002	4.13	
11-Feb-16	0.0005	0.09	0.005	88	0.001	0.07	0.013		29.9	0.0001	18.1		461	0.001		0.002	0.001	0.173	0.248	0.00002	4.01	
24-Feb-16	0.0005	0.08	0.01	97	0.001	0.06	0.016		36.6	0.0001	21.1		542	0.001		0.001	0.001	0.145	0.426	0.00002	4.64	
23-Mar-16	0.0005	0.03	0.005	103	0.001	0.1	0.018		42.3	0.0001	28.7		576	0.001		0.001	0.001	0.182	0.285	0.00002	6.7	
14-Apr-16	0.0005	0.09	0.02	121	0.001	0.1	0.024		57.8	0.0001	50.9		918	0.001		0.001	0.001	0.163	0.437	0.00002	7.1	
25-May-16	0.0005	0.03	0.005	96	0.001	0.09	0.022		44.8	0.0001	45.6		727	0.001		0.001	0.001	0.123	0.386	0.00002	6.71	
22-Jun-16	0.0005	1.49	0.15	54	0.001	0.025	0.016		13.8	0.0001	6.55		189	0.001		0.003	0.001	0.103	0.136	0.00002	3.9	
27-Jul-16	0.0005	0.46	0.07	61	0.001	0.05	0.016		21.2	0.0001	10.3		291	0.001		0.002	0.001	0.078	0.075	0.00002	4.4	
24-Aug-16	0.0005	0.15	0.01	67	0.001	0.025	0.024		33.3	0.0001	15.9		463	0.001		0.001	0.001	0.073	0.051	0.00002	5.33	

Continued…Neubecks Creek WX22 Water conditioned ash Placement Water Quality Data September 2015 to August 2016																							
Sample Date	Mg:	Mn	Mo	Na:	NFR	Ni	NO2	NO3	Total Nitrogen	Pb	pH	Total Phosphorus	Se	SO4:	TDS	TFR	Turbidity	V	Zn	Zn-f	DO	Temp	Rainfall
16-Sep-15	43.2	0.274	0.001	58.2		0.022		0.01	0.1	0.001	7.06		0.0001	352	608		2	0.005	0.011	0.009	12.6	16.5	20.8
22-Oct-15	19.3	0.144	0.001	39.8		0.01		0.01	0.4	0.001	7.33		0.0003	160	372		22.4	0.005	0.012	0.0025	6.8	14.4	30.9
19-Nov-15	15.8	0.293	0.001	28.5		0.013		0.02	0.2	0.001	7.27		0.0001	97.1	266		2.8	0.005	0.006	0.006	9.4	14.3	64.1
10-Dec-15	48.9	0.967	0.001	75.4		0.053		0.01	0.05	0.001	6.93		0.0001	363	694		7.1	0.005	0.034	0.034	7.5	17.5	113.2
21-Jan-16	18	0.424	0.001	27.2		0.018		0.01	0.1	0.001	6.98		0.0001	98.8	270		5.1	0.005	0.011	0.009	5.8	17.9	184.2
11-Feb-16	19.1	0.547	0.001	30.5		0.018		0.01	0.2	0.001	7.05		0.0001	108	247		3.3	0.005	0.01	0.009	4.8	17.3	66.2
24-Feb-16	24.9	1.12	0.001	35.4		0.03		0.01	0.1	0.001	7.03		0.0002	116	318		6.1	0.005	0.022	0.019	6.9	15.8	28.1
23-Mar-16	25.4	1.04	0.001	37.8		0.019		0.01	0.2	0.001	7.13		0.0001	155	418		2.2	0.005	0.007	0.006	16	12.6	29
14-Apr-16	40	1.34	0.001	59.4		0.047		0.01	0.05	0.001	6.88		0.0001	292	422		7.4	0.005	0.03	0.024	8.66	11.57	109
25-May-16	30.4	0.749	0.001	50		0.028		0.01	0.05	0.001	7.35		0.0001	200	398		3.3	0.005	0.016	0.015	10.2	4.6	24.4
22-Jun-16	7.08	0.055	0.001	14.3		0.006		0.01	0.4	0.002	7.15		0.0006	42.8	224		138	0.005	0.013	0.0025	11.7	7.85	
27-Jul-16	11.6	0.057	0.001	16.7		0.005		0.03	0.9	0.004	6.54		0.0003	69.3	202		48.3	0.005	0.009	0.0025	13.4	6.1	35

24-Aug-16	20.2	0.079	0.001	22.1		0.005		0.02	0.05	0.001	7.63		0.0001	137	262		6.4	0.005	0.005	0.0025	13.3	6.4	21.8

Neubecks Creek WX22 Post- water conditioned ash Placement summary September 2015 - August 2016 (mg/L)																						
	Ag	Al	Al-f	ALK	As	B	Ba	Be	Ca:	Cd	Cl:	Co	COND uS/cm	Cr	Cr-6	Cu	Cu-f	F	Fe	Hg	K:	Li
Average	0.0005	0.24	0.025	80.846	0.001	0.08	0.019		39	0.0001	26.5		571	0.0010		0.0013	0.001	0.125	0.23	0.00002	5.6	
Maximum	0.0005	1.49	0.150	121.000	0.001	0.16	0.029		71	0.0001	50.9		979	0.0010		0.0030	0.001	0.182	0.437	0.00002	8.2	
Minimum	0.0005	0.02	0.005	54.000	0.001	0.025	0.011		14	0.0001	6.6		189	0.0010		0.0005	0.001	0.025	0.051	0.00002	3.9	
90th Percentile	0.0005	0.09	0.010	75.000	0.001	0.09	0.017		33	0.0001	21.1		529	0.0010		0.0010	0.001	0.123	0.209	0.00002	5.3	
Pre-50th Percentile Trend	0.0005	0.44	0.060	101.800	0.001	0.15	0.026		63	0.0001	49.3		926	0.001		0.002	0.001	0.18	0.42	0.00002	7.5	
ANZECC 2000	0.0005	0.24	0.025	80.846	0.001	0.08	0.019		39	0.0001	26.5		571	0.0010		0.0013	0.001	0.125	0.23	0.00002	5.6	

Neubecks Creek WX22 Post- water conditioned ash Placement summary September 2015 - August 2016 (mg/L)																						
	Mg:	Mn	Mo	Na:	NFR	Ni	NO2	NO3	Total Nitrogen	Pb	pH	Total Phosphorus	Se	SO4:	TDS		Turbidity	V	Zn	Zn-f	DO	Temp
Average	25	0.55	0.001	38		0.021		0.013	0.215	0.001	7.1		0.0002	169	362		19.6	0.005	0.014	0.011	9.8	
Maximum	49	1.34	0.001	75		0.053		0.030	0.900	0.004	7.6		0.0006	363	694		138.0	0.005	0.034	0.034	16.0	
Minimum	7	0.06	0.001	14		0.005		0.010	0.050	0.001	6.5		0.0001	43	202		2.0	0.005	0.005	0.003	4.8	
90th Percentile	20	0.42	0.001	35		0.018		0.010	0.100	0.001	7.1		0.0001	137	318		6.1	0.005	0.011	0.009	9.4	
Pre-50th Percentile Trend	43	1.10	0.001	59		0.044		0.020	0.400	0.002	7.3		0.0003	340	571		43.1	0.005	0.028	0.023	13.4	

1b. Water Quality Data and Summary for Mt Piper Power station Licence Discharge Point

Pre-Water conditoned ash Placement - Background summary Data at Mt Piper Power Station Licence Discharge Point LMP01 October, 2012 - August, 2013 (mg/L)																					
Sample Date	Ag	Al	Al-f	ALK	As	B	Ba	Be	Ca:	Cd	Cl:	Co	COND uS/cm	Cr	Cr-6	Cu	Cu-f	F	Fe	Hg	K:	Li
Ave	<0.001	0.43	0.03	80	0.001	0.05	0.030	<0.001	34	0.0002	13		464	0.001		0.016	0.005	0.2	0.06	<0.00005	6	
Max	<0.001	1.10	0.10	91	0.001	0.07	0.041	<0.001	43	0.0003	18		570	0.002		0.07	0.012	0.4	0.34	<0.00005	8	
Min	<0.001	0.13	0.01	52	0.001	0.03	0.022	<0.001	24	<0.00002	8		370	<0.001		0.005	0.001	0.1	<0.01	<0.00005	5	
90th Baseline	<0.001	0.72	0.05	91	0.001	0.06	0.035	<0.001	39	0.0003	16		560	0.001		0.029	0.008	0.3	0.10	<0.00005	7	
Pre-50th Percentile Trend	<0.001	0.4	0.01	81	0.001	0.05	0.029	<0.001	33	0.0002	12		440	0.001		0.008	0.003	0.2	0.02	<0.00005	6.6	
ANZECC 2000	0.00005	0.055	0.055		0.024	0.370	0.700			0.00085	350		2200	0.002		0.0035 **(0.005)**		1.5	0.3	0.00006		

Continued…… Background summary data – Mt Piper Power Station Licence Discharge Point LDP01 October, 2012 – August, 2013 (mg/L)																			
	Mg:	Mn	Mo	Na:	NFR	Ni	NO2	NO3	Total Nitrogen	Pb	pH	Total Phosphorus	Se	SO4:	Temp	TDS	Turbidity	V	Zn
Average	21	0.070	0.007	29		0.009				0.002	7.6	0.028	0.002	128		292	35.9		0.045455
Maximum	31	0.190	0.010	35		0.010				0.008	7.9	0.080	0.002	180		400	100.0		0.070
Minimum	12	0.002	0.002	23		0.006				0.001	7.3	0.010	0.002	90		210	7.3		0.030
90th Percentile	30	0.165	0.01	34		0.010				0.0045	7.9	0.050	0.002	172		380	75.0		0.060
Pre-50th Percentile Trend	21	0.034	0.01	30		0.010				0.0015	7.5	0.020	0.002	120		290	28.0		0.040
ANZECC 2000		1.900	0.010		10.0	0.017 **(0.051)**		0.015	0.250 **(0.55)**	0.005	6.5-8.0	0.020 **(0.030)**	0.005	1000	1500	10.0 **(19.0)**	10.0		0.116

Mt Piper Power Station Licence Discharge Point LDP01 Water conditioned ash Placement Water Quality Data September, 2015 to August, 2016 (mg/L)																					
Date	**Ag**	**Al**	**Al-f**	**ALK**	**As**	**B**	**Ba**	**Be**	**Ca:**	**Cd**	**Cl:**	**Co**	**COND uS/cm**	**Cr**	**Cr-6**	**Cu**	**Cu-f**	**F**	**Fe**	**Hg**	K:	Li
16/09/2015	0.0005	0.46	0.005	72	0.001	0.07	0.025	0.001	31.2	0.0001	11.7		440	0.001	0.001	0.011	0.005	0.025	0.023	0.00002	6.43	
22/10/2015	0.0005	2.39	0.03	57	0.002	0.025	0.034	0.001	22.8	0.0001	7.01		300	0.002	0.002	0.021	0.005	0.091	0.056	0.00002	6.87	
19/11/2015	0.0005	1.38	0.02	54	0.001	0.08	0.029	0.001	19.8	0.0001	4.88		260	0.001	0.001	0.01	0.003	0.088	0.043	0.00002	4.88	
9/12/2015	0.0005	0.46	0.02	87	0.001	0.12	0.034	0.001	32.4	0.0001	12.8		460	0.001	0.001	0.014	0.006	0.237	0.018	0.00002	7.24	
21/01/2016	0.0005	2.35	0.01	64	0.001	0.025	0.04	0.001	17.3	0.0001	5.94		288	0.002	0.002	0.012	0.002	0.16	0.025	0.00002	5.31	
11/02/2016	0.0005	0.78	0.01	82	0.001	0.06	0.029	0.001	27.9	0.0001	8.29		310	0.001	0.001	0.011	0.002	0.167	0.022	0.00002	5.16	
16/03/2016	0.0005	3.09	0.15	60	0.002	0.025	0.036	0.001	19.7	0.0001	5.36		250	0.002	0.002	0.008	0.002	0.005	0.027	0.00002	5.52	
28/04/2016	0.0005	0.14	0.01	108	0.001	0.05	0.028	0.001	29.9	0.0001	11.5		440	0.001	0.001	0.004	0.003	0.15	0.014	0.00002	6.06	
18/05/2016	0.0005	2.04	0.02	81	0.001	0.025	0.028	0.001	24.6	0.0001	10.3		370	0.001	0.001	0.01	0.004	0.4	0.021	0.00002	4.98	
16/06/2016	0.0005	3.76	0.04	51	0.002	0.025	0.043	0.001	15.7	0.0002	6.04		240	0.002	0.002	0.012	0.003	0.079	0.047	0.00009	6.03	
22/07/2016	0.0005	3.46	0.04	58	0.001	0.025	0.04	0.001	22.9	0.0001	9.85		470	0.002	0.002	0.007	0.002	0.054	0.064	0.00002	5.02	
18/08/2016	0.0005	0.18	0.005	88	0.001	0.025	0.028	0.001	34.6	0.0001	12.8		540	0.001	0.001	0.002	0.001	0.097	0.012	0.00002	6.32	

Continued……Mt Piper Power Station Licence Discharge Point LDP1 Water Conditioned Ash Placement Water Quality Data September, 2015 to August, 2016 (mg/L)																					
Date	Mg:	Mn	Mo	Na:	NFR	Ni	NO2	NO3	Total Nitrogen	Pb	pH	Total Phosphorus	Se	SO4:	Temp	TDS	Turbidity	V	Zn	Zn-f	DO
16/09/2015	18.1	0.025	0.005	34.2		0.004	0.005	0.16	0.4	0.001	7.9		0.0011	140		286	22.2	0.005	0.025	0.01	10.8
22/10/2015	8.47	0.044	0.002	26.2		0.01	0.005	0.23	1.6	0.006	8		0.0019	86		248	269	0.005	0.067	0.006	5.6
19/11/2015	7.58	0.035	0.002	18.8		0.006	0.005	0.28	0.9	0.003	7.52		0.0019	56.6		251	149	0.005	0.041	0.0025	7.7	
9/12/2015	14.4	0.06	0.004	43.8		0.007	0.005	0.12	0.4	0.001	7.8		0.0009	160		328	45	0.005	0.031	0.006	6.4	
21/01/2016	9.16	0.095	0.002	18.7		0.007	0.005	0.12	1	0.009	7.68		0.0026	61.7		360	271	0.005	0.057	0.0025	5.3	
11/02/2016	15.1	0.041	0.003	20.6		0.005	0.005	0.12	0.4	0.002	7.9		0.0017	87		248	65.5	0.005	0.029	0.0025	4.6	
16/03/2016	9.36	0.034	0.002	23		0.007	0.005	0.23	1	0.005	7.6		0.0029	78		274	251	0.005	0.052	0.005	7.5	
28/04/2016	16.3	0.076	0.006	30.3		0.004	0.005	0.17	0.6	0.001	7.9		0.001	100		243	10.5	0.005	0.013	0.0025	8.4	
18/05/2016	12.3	0.044	0.003	27.5		0.003	0.005	0.22	0.5	0.001	7.9		0.0024	94		274	43.4	0.005	0.023	0.006	9.7	
16/06/2016	7.97	0.014	0.004	19.2		0.009	0.005	0.13	3.1	0.01	7.8		0.0026	67		252	654	0.005	0.078	0.01	9.9	
22/07/2016	13.3	0.078	0.001	13.2		0.01	0.005	0.16	1.4	0.007	8		0.0011	150		296	366	0.005	0.054	0.013	10.5	
18/08/2016	28.1	0.175	0.001	23.6		0.011	0.005	0.09	0.2	0.001	8		0.0004	190		371	19.9	0.005	0.017	0.012	11.8	

Mt Piper Power Station Licence Discharge Point LDP01 Post-water conditioned ash Placement Summary September, 2015 to August, 2016 (mg/L)

	Ag	Al	Al-f	ALK	As	B	Ba	Ag	Ca:	Cd	Cl:	Co	COND uS/cm	Cr	Cr-6	Cu	Cu-f	F	Fe	Hg	K:	Li
Average	0.0005	1.71	0.030	71.833	0.001	0.05	0.033	0.001	25	0.0001	8.9		364	0.0014	0.0014	0.0102	0.003	0.129	0.03	0.00003	5.8	
Maximum	0.0005	3.76	0.150	108.000	0.002	0.12	0.043	0.001	35	0.0002	12.8		540	0.0020	0.0020	0.0210	0.006	0.4	0.064	0.00009	7.2	
Minimum	0.0005	0.14	0.005	51.000	0.001	0.025	0.025	0.001	16	0.0001	4.9		240	0.0010	0.0010	0.0020	0.001	0.005	0.012	0.00002	4.9	
50th Percentile	0.0005	1.71	0.020	68.000	0.001	0.025	0.032	0.001	24	0.0001	9.1		340	0.0010	0.0010	0.0105	0.003	0.094	0.024	0.00002	5.8	
Post-90th Percentile Trend	0.0005	3.42	0.040	87.900	0.002	0.08	0.040	0.001	32	0.0001	12.7		469	0.002	0.002	0.014	0.005	0.23	0.06	0.00002	6.8	

Continued……Mt Piper Power Station Licence Discharge Point LDP01 Post-water conditioned ash Placement Summary September, 2015 to August, 2016 (mg/L)

	Mg:	Mn	Mo	Na:	NFR	Ni	NO2	NO3	Total Nitrogen	Pb	pH	Total Phosphorus	Se	SO4:	Temp	TDS	Turbidity	V	Zn	Zn-f	DO	TSS
Average	13	0.06	0.003	25		0.007	0.005	0.169	0.958	0.004	7.8		0.0017	106		286	180.5	0.005	0.041	0.007	8.183	81.3
Maximum	28	0.18	0.006	44		0.011	0.005	0.280	3.100	0.010	8.0		0.0029	190		371	654.0	0.005	0.078	0.013	11.800	220.0
Minimum	8	0.01	0.001	13		0.003	0.005	0.090	0.200	0.001	7.5		0.0004	57		243	10.5	0.005	0.013	0.003	4.600	6.0
50th Percentile	13	0.04	0.003	23		0.007	0.005	0.160	0.750	0.003	7.9		0.0018	91		274	107.3	0.005	0.036	0.006	8.050	36.5
Post-90th Percentile Trend	18	0.09	0.005	34		0.010	0.005	0.230	1.580	0.009	8.0		0.0026	159		357	356.5	0.005	0.066	0.012	10.770	198.6

1C. *Water Quality Data and Summary for Neubecks Creek at upstream site NC01*

Neubecks Creek NC01 Pre-water conditioned ash Placement - Background summary Data October, 2012 – August, 2013 (mg/L)																						
	Ag	Al	Al-f	ALK	As	B	Ba	Be	Ca:	Cd	Cl:	Co	COND uS/cm	Cr	Cr-6	Cu	Cu-f	F	Fe	Hg	K:	Li
Average	<0.001	0.33	0.03	71	0.001	0.04	0.032	<0.001	23	0.0002	10		310	0.001		0.002	0.002	0.16	0.18	<0.00005	4.2	
Maximum	<0.001	0.73	0.08	94	0.001	0.05	0.042	<0.001	40	0.0002	15		540	0.002		0.005	0.003	0.30	0.55	<0.00005	6.3	
Minimum	<0.001	0.06	0.01	34	0.001	0.02	0.024	<0.001	4	<0.00002	5		85	0.000		0.001	0.001	0.10	0.02	<0.00005	2.0	
90th Percentile	<0.001	0.49	0.07	87	0.001	0.05	0.042	<0.001	35	0.0002	13		470	0.001		0.004	0.002	0.21	0.38	<0.00005	6.0	
Pre-50th Percentile Trend	<0.001	0.37	0.02	70	0.001	0.05	0.029	<0.001	24	0.0002	10		310	0.001		0.002	0.002	0.15	0.06	<0.00005	4.0	
ANZECC 2000		0.055			0.024	0.37	0.700			0.00085	350		2200	0.002		0.0035 (0.005)		1.50	0.30	0.0006		

Continued……..Neubecks Creek NC01 Pre- water conditioned ash Placement - Background summary Data October, 2012 – August, 2013 (mg/L)																					
	Mg:	Mn	Mo	Na:	NFR	Ni	NO2	NO3	Total Nitrogen	Pb	pH	Total Phosphorus	Se	SO4:	Temp	TDS	Turbidity	V	Zn	Zn-f	Ammonia Nitrogen	DO
Average	14	0.23	0.007	19		0.004	<1	<0.5	0.46	0.001	7.1	0.02	0.002	72		184	15.7		0.022	0.006	<0.1	8.0
Maximum	27	1.00	0.020	27		0.005	<1	<0.5	0.70	0.002	7.4	0.03	0.002	156		280	40.0		0.039	0.012	<0.1	14.3
Minimum	3	0.01	0.005	8		0.003	<1	<0.5	0.35	<0.001	6.5	0.00	<0.002	4		61	5.7		0.005	0.005	<0.1	1.7
90th Percentile	24	0.31	0.010	26		0.005	<1	<0.5	0.55	0.002	7.4	0.03	0.002	130		280	19.0		0.031	0.007	<0.01	11.7
Pre-50th Percentile Trend	14	0.19	0.005	22		0.005	<1	<0.5	0.45	0.001	7.1	0.02	0.002	73		170	17.0		0.026	0.005	<0.01	7.5
ANZECC 2000		1.9	0.010		10.0	0.017 (0.051)			0.250 (0.55)	0.005	6.5-8.0	0.020 (0.030)	0.005	1000		1500			0.116		0.013	

Neubecks Creek Upstream NC01 Water conditioned ash Placement Water Quality Data September, 2015 – August, 2016 (mg/L)																						
Date	Ag	Al	Al-f	ALK	As	B	Ba	Be	Ca:	Cd	Cl:	Co	COND uS/cm	Cr	Cr-6	Cu	Cu-f	F	Fe	Hg	K:	Li
16-Sep-15	0.0005	0.33	0.005	68	0.001	0.06	0.029	0.0005	26.2	0.0001	12.4		399	0.001		0.001	0.0005	0.107	0.116	0.00002	5.56	
22-Oct-15	0.0005	0.6	0.02	81	0.001	0.06	0.029	0.0005	26.7	0.0001	9.23		365	0.001		0.004	0.001	0.216	0.101	0.00002	6.4	
19-Nov-15	0.0005	0.41	0.05	70	0.001	0.06	0.029	0.0005	20.4	0.0001	5.1		264	0.001		0.002	0.0005	0.174	0.262	0.00002	4.23	
10-Dec-15	0.0005	0.1	0.01	103	0.001	0.08	0.036	0.0005	28.6	0.0001	6.66		376	0.001		0.001	0.0005	0.166	0.296	0.00002	4.67	
21-Jan-16	0.0005	0.65	0.12	70	0.001	0.025	0.027	0.0005	15.4	0.0001	4.49		205	0.001		0.001	0.0005	0.189	0.605	0.00002	3.67	
10-Feb-16	0.0005	0.25	0.02	96	0.001	0.025	0.034	0.0005	23.8	0.0001	5.27		291	0.001		0.002	0.0005	0.209	0.757	0.00002	4.13	
16-Mar-16	0.0005	0.38	0.05	100	0.001	0.025	0.037	0.0005	23.4	0.0001	6.56		300	0.001		0.001	0.0005	0.145	0.483	0.00002	4.52	
28-Apr-16	0.0005	0.09	0.005	125	0.001	0.025	0.037	0.0005	29.4	0.0001	10.1		396	0.001		0.002	0.0005	0.145	0.944	0.00002	5.74	
18-May-16	0.0005	0.2	0.005	107	0.001	0.025	0.032	0.0005	24.9	0.0001	11.6		379	0.001		0.001	0.0005	0.184	0.459	0.00002	4.33	
16-Jun-16	0.0005	1.36	0.04	69	0.001	0.025	0.024	0.001	16.6	0.0001	6.12		241	0.001		0.005	0.0005	0.081	0.109	0.00004	4.56	
22-Jul-16	0.0005	3.67	0.15	38	0.001	0.06	0.035	0.0005	13.8	0.0001	6.28		182	0.002		0.006	0.002	0.039	0.139	0.00002	4.05	
17-Aug-16	0.0005	0.23	0.05	76	0.001	0.025	0.032	0.0005	30.3	0.0001	11.8		472	0.001		0.001	0.0005	0.083	0.11	0.00002	5.2	

Continued……. Neubecks Creek Upstream NC01 Water conditioned ash Placement Water Quality Data October, 2012 – August, 2015 (mg/L)																						
Date	Mg:	Mn	Mo	Na:	NFR	Ni	NO2	NO3	Total Nitrogen	Pb	pH	Total Phosphorus	Se	SO4:	Temp	TDS	Turbidity	V	Zn	Zn-f	Ammonia Nitrogen	DO
16-Sep-15	0.001	0.0005	0.107	0.116	0.00002	5.56		0.001	0.0005	0.107	0.116	0.00002	5.56		0.001	0.0005	0.107	0.116	0.00002	5.56		0.001
22-Oct-15	0.004	0.001	0.216	0.101	0.00002	6.4		0.004	0.001	0.216	0.101	0.00002	6.4		0.004	0.001	0.216	0.101	0.00002	6.4		0.004
19-Nov-15	0.002	0.0005	0.174	0.262	0.00002	4.23		0.002	0.0005	0.174	0.262	0.00002	4.23		0.002	0.0005	0.174	0.262	0.00002	4.23		0.002
10-Dec-15	0.001	0.0005	0.166	0.296	0.00002	4.67		0.001	0.0005	0.166	0.296	0.00002	4.67		0.001	0.0005	0.166	0.296	0.00002	4.67		0.001
21-Jan-16	0.001	0.0005	0.189	0.605	0.00002	3.67		0.001	0.0005	0.189	0.605	0.00002	3.67		0.001	0.0005	0.189	0.605	0.00002	3.67		0.001
10-Feb-16	0.002	0.0005	0.209	0.757	0.00002	4.13		0.002	0.0005	0.209	0.757	0.00002	4.13		0.002	0.0005	0.209	0.757	0.00002	4.13		0.002
16-Mar-16	0.001	0.0005	0.145	0.483	0.00002	4.52		0.001	0.0005	0.145	0.483	0.00002	4.52		0.001	0.0005	0.145	0.483	0.00002	4.52		0.001
28-Apr-16	0.002	0.0005	0.145	0.944	0.00002	5.74		0.002	0.0005	0.145	0.944	0.00002	5.74		0.002	0.0005	0.145	0.944	0.00002	5.74		0.002
18-May-16	0.001	0.0005	0.184	0.459	0.00002	4.33		0.001	0.0005	0.184	0.459	0.00002	4.33		0.001	0.0005	0.184	0.459	0.00002	4.33		0.001
16-Jun-16	0.005	0.0005	0.081	0.109	0.00004	4.56		0.005	0.0005	0.081	0.109	0.00004	4.56		0.005	0.0005	0.081	0.109	0.00004	4.56		0.005
22-Jul-16	0.006	0.002	0.039	0.139	0.00002	4.05		0.006	0.002	0.039	0.139	0.00002	4.05		0.006	0.002	0.039	0.139	0.00002	4.05		0.006
17-Aug-16	0.001	0.0005	0.083	0.11	0.00002	5.2		0.001	0.0005	0.083	0.11	0.00002	5.2		0.001	0.0005	0.083	0.11	0.00002	5.2		0.001

Neubecks Creek NC01 Post-water conditioned ash Placement Summary Data September, 2015 – August, 2016 (mg/L)																						
	Ag	Al	Al-f	Ca:	As	B	Ba	Be	Ca:	Cd	Cl:	Co	COND uS/cm	Cr	Cr-6	Cu	Cu-f	F	Fe	Hg	K:	Li
Average	0.0005	0.69	0.044	83.583	0.001	0.041	0.032	0.001	23	0.0001	8.0		323	0.0011		0.0023	0.001	0.145	0.37	0.00002	4.8	
Maximum	0.0005	3.67	0.150	125.000	0.001	0.080	0.037	0.001	30	0.0001	12.4		472	0.0020		0.0060	0.002	0.216	0.944	0.00004	6.4	
Minimum	0.0005	0.09	0.005	38.000	0.001	0.025	0.024	0.001	14	0.0001	4.5		182	0.0010		0.0010	0.0005	0.039	0.101	0.00002	3.7	
90th Percentile	0.0005	0.355	0.030	78.500	0.001	0.025	0.032	0.001	24	0.0001	6.6		333	0.0010		0.0015	0.0005	0.1555	0.279	0.00002	4.5	
Pre-50th Percentile Trend	0.0005	1.29	0.113	106.600	0.001	0.06	0.037	0.001	29	0.0001	11.8		399	0.001		0.005	0.001	0.21	0.74	0.00002	5.7	

Continued……. Neubecks Creek NC01 Post-water conditioned ash Placement Summary Data September, 2015 – August, 2016 (mg/L)																						
	Mg:	Mn	Mo	Na:	NFR	Ni	NO2	NO3	Total Nitrogen	Pb	pH	Total Phosphorus	Se	SO4:	Temp	TDS	Turbidity	V	Zn	Zn-f	Ammonia Nitrogen	DO
Average	12	0.36	0.001	22		0.003		0.034	0.408	0.002	6.8		0.0004	63		214	54.0	0.010	0.010	0.004		6.2
Maximum	22	0.75	0.001	34		0.004		0.100	1.200	0.006	7.8		0.0009	133		292	302.0	0.070	0.031	0.010		11.4
Minimum	6	0.03	0.001	9		0.002		0.005	0.200	0.001	5.6		0.0002	24		139	8.9	0.005	0.003	0.003		2.5
90th Percentile	11	0.32	0.001	20		0.003		0.025	0.300	0.001	6.9		0.0004	54		223	21.3	0.005	0.008	0.003		5.2
Pre-50th Percentile Trend	15	0.70	0.001	32		0.004		0.069	0.590	0.002	7.1		0.0008	107		276	133.6	0.005	0.022	0.009		10.3

MPGM4/D8 Pre-water conditioned ash Placement - Background summary Data October, 2012 – August, 2013 (mg/L)																			
	Ag	Al	ALK	As	B	Ba	Be	Ca:	Cd	Cl:	Co	COND uS/cm	Cr	Cr-6	Cu	F	Fe	Hg	K:	Li
Average	<0.001	0.46		0.001	0.063	0.048		78	0.0003	18.3		525	0.001		0.005	0.10	0.17	<0.00005	8.0	
Maximum	<0.001	0.72		0.001	0.180	0.080		180	0.0004	56.0		1200	0.001		0.010	0.10	0.47	<0.00005	20.0	
Minimum	<0.001	0.03		<0.001	0.010	0.032		21	<0.0002	5.0		290	<0.001		0.003	<0.10	<0.01	<0.00005	2.0	
90th Percentile	<0.001	0.71		0.001	0.138	0.068		153	0.0004	41.3		933	0.001		0.009	0.10	0.38	<0.00005	16.1	
Pre-50th Percentile Trend	<0.001	0.55		0.001	0.030	0.040		56	0.0002	6.0		305	0.001		0.003	0.10	0.02	<0.00005	5.0	
ANZECC 2000	<0.001	0.39		0.001	0.025	0.03		37	0.0002	16		480	0.002		0.001	0.2	0.01	<0.00005	3	

Continued……. MPGM4/D8 - Background Summary October, 2012 – August, 2013 (mg/L)																		
	Mn	Mo	Na:	NFR	Ni	NO2	NO3	Pb	pH	Se	SO4:	Temp	TFR	V	WL1	WL2	WLAHD	Zn
Average	1.34	0.01	23.3		0.098			0.002	5.9	0.002	216		393		2.1		904.3	0.083
Maximum	4.90	0.01	59.0		0.270			0.003	6.3	0.002	514		940		2.3		904.4	0.160
Minimum	0.06	<0.001	6.0		0.040			<0.001	5.6	<0.002	110		200		2.0		904.1	0.050
90th Percentile	3.50	0.01	47.3		0.201			0.003	6.21	0.002	396		727		2.3		904.4	0.130
Pre-50th Percentile Trend	0.20	0.01	14		0.041			0.002	5.85	0.002	120		215		2.1		904.3	0.060
ANZECC 2000	5.704(8.57)	0.010	230	10.0	0.5509	-	-	0.005	6.5-8.0	0.005	1000(1170)	-	2000	-	-	-	-	0.908

MPGM4/D8 Water conditioned ash Placement Water Quality Data September, 2015 – August, 2016 (mg/L)																			
Date:	Ag	Al	ALK	As	B	Ba	Be	Ca:	Cd	Cl:	Co	COND uS/cm	Cr	Cr -6	Cu	F	Fe	Hg	K:	Li
24-Sep-15	0.0005	0.14	9	0.001	0.025	0.038		29.4	0.00005	10.6		385	0.001		0.001	0.025	0.028	0.00002	2.3	
30-Oct-15	0.0005	0.49	8	0.001	0.025	0.036		17.1	0.00005	3.55		241	0.001		0.001	0.005	0.106	0.00002	1.81	
26-Nov-15	0.0005	0.14	10	0.001	0.025	0.038		17.5	0.00005	2.98		244	0.001		0.001	0.012	0.038	0.00002	1.72	
17-Dec-15	0.0005	0.05	11	0.001	0.06	0.087		67.4	0.00005	57.9		1066	0.001		0.001	0.005	0.572	0.00002	4.9	
29-Jan-16	0.0005	0.23	9	0.001	0.025	0.037		15.9	0.00005	2.5		224	0.001		0.001	0.017	0.06	0.00002	1.77	
18-Feb-16	0.0005	0.22	10	0.001	0.025	0.034		16	0.00005	2.2		219	0.001		0.001	0.005	0.053	0.00002	1.56	
25-Feb-16	0.0005	0.24	10	0.001	0.025	0.052		29.2	0.00005	16.3		463	0.001		0.001	0.018	0.088	0.00002	2.83	
24-Mar-16	0.0005	0.09	17	0.001	0.12	0.126		92.3	0.0002	75.9		1282	0.001		0.001	0.03	0.798	0.00002	7.75	
14-Apr-16	0.0005	0.05	32	0.001	0.15	0.074		138	0.00005	129		2010	0.001		0.001	0.033	4.19	0.00002	10.4	
26-May-16	0.0005	0.22	29	0.001	0.12	0.048		86.5	0.00005	91.4		1328	0.001		0.001	0.05	1.68	0.00002	7.9	
23-Jun-16	0.0005	0.6	14	0.001	0.025	0.026		14	0.00005	1.46		159	0.001		0.002	0.025	0.167	0.00002	1.82	
28-Jul-16	0.0005	0.56	8	0.001	0.025	0.026		14.2	0.00005	2.15		200	0.001		0.001	0.005	0.094	0.00002	1.67	
25-Aug-16	0.0005	1.03	9	0.001	0.025	0.042		22.5	0.00005	9.81		331	0.001		0.001	0.01	0.203	0.00002	2.57	

Continued……. MPGM4/D8 Water conditioned ash Placement Water Quality Data September, 2015 – August, 2016 (mg/L)

Date:	Mg:	Mn	Mo	Na:	NFR	Ni	NO2	NO3	Pb	pH	Se	SO4:	Temp	TFR	V	WL1	WL2	WLAHD	Zn
24-Sep-15	22.4	0.327	0.001	15.4		0.049			0.001	5.37	0.0001	159		224	0.005	2.1		904.3	0.064
30-Oct-15	11.9	0.066	0.001	5.07		0.029			0.001	5.32	0.0001	98.4		151	0.005	2		904.4	0.037
26-Nov-15	12.5	0.062	0.001	5.08		0.032			0.001	5.28	0.0001	96.4		180	0.005	2.1		904.3	0.035
17-Dec-15	51.7	2.45	0.001	54.4		0.15			0.001	5.22	0.0001	473		858	0.005	2.3		904.1	0.192
29-Jan-16	12.1	0.055	0.001	5.21		0.029			0.001	5.23	0.0001	85.7		213	0.005	1.9		904.5	0.034
18-Feb-16	11.7	0.067	0.001	4.38		0.031			0.001	5.28	0.0001	79.3		182	0.005	2		904.4	0.037
25-Feb-16	23	0.607	0.001	21.9		0.061			0.001	5.43	0.0001	181		322	0.005	2.1		904.3	0.084
24-Mar-16	69	2.48	0.001	83.8		0.152			0.001	5.5	0.0001	562		957	0.005	2.1		904.3	0.177
14-Apr-16	106	4.71	0.001	127		0.243			0.001	5.47	0.0001	923		1470	0.005	2.2		904.2	0.274
26-May-16	65.6	3.9	0.001	85.6		0.168			0.001	5.39	0.0001	570		892	0.005	2.4		904.0	0.203
23-Jun-16	7.52	0.018	0.001	3.24		0.017			0.001	5.97	0.0001	57.8		147	0.005	1.8		904.6	0.025
28-Jul-16	9.65	0.036	0.001	4.32		0.019			0.001	5.21	0.0001	74.7		138	0.005	1.9		904.5	0.031
25-Aug-16	15.1	0.291	0.001	13		0.034			0.001	5.23	0.0001	128		244	0.005	2.1		904.3	0.05

MPGM4/D8 – Post-water conditioned ash Summary September, 2015 – August, 2016 (mg/L)

	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	Co	COND uS/cm	Cr	Cr-6	Cu	F	Fe-filtered	Hg	K	Li
Ave	0.0005	0.31	14	0.001	0.052	0.051		43	0.0001	31		627	0.001		0.0011	0.02	0.62	0.00002	3.8	
Max	0.0005	1.03	32	0.001	0.150	0.126		138	0.0002	129		2010	0.001		0.0020	0.05	4.19	0.00002	10.4	
Min	0.0005	0.05	8	0.001	0.025	0.026		14	0.0001	1		159	0.001		0.0010	0.005	0.028	0.00002	1.6	
50th Investigation Trigger	0.0005	0.22	10	0.001	0.025	0.038		23	0.0001	10		331	0.001		0.0010	0.017	0.106	0.00002	2.3	
Post-90th for Trend	0.0005	0.59	27	0.001	0.12	0.084		91	0.0001	88		1319	0.001		0.001	0.03	1.50	0.00002	7.9	

Continued……. MPGM4/D8 – Post-water conditioned ash Summary September, 2015 – August, 2016 (mg/L)

	Mg	Mn-filtered	Mo	Na	NFR	Ni	NO2	NO3	Pb	pH	Se	SO4	Temp	TFR	V	WL1	WL2	WLAHD	Zn
Ave	32.2	1.16	0.001	33		0.078			0.001	5.4	0.0001	268		460	0.005	2.1		904.4	0.096
Max	106.0	4.71	0.001	127		0.243			0.001	6.0	0.0001	923		1470	0.005	2.4		904.6	0.274
Min	7.5	0.02	0.001	3		0.017			0.001	5.2	0.0001	58		138	0.005	1.8		904.0	0.025
50th Investigation Trigger	15.1	0.29	0.001	13		0.034			0.001	5.3	0.0001	128		224	0.005	2.1		904.3	0.050
Post-90th for Trend	68.3	3.62	0.001	85		0.165			0.001	5.5	0.0001	568		944	0.005	2.3		904.5	0.201

MPGM4/D9 – Pre-water conditioned ash Background Summary October, 2012 – August, 2013 (mg/L)

	Ag	Al	ALK	As	B	Ba	Be	Ca:	Cd	Cl:	Co	COND uS/cm	Cr	Cr-6	Cu	F	Fe	Hg	K:	Li
Ave	<0.001	0.06	45	0.002	0.47	0.055		178	0.0002	116		2000	0.001		0.005	0.13	8.26	<0.00005	13.5	
Max	<0.001	0.08	52	0.003	0.56	0.060		210	0.0002	150		2200	0.001		0.009	0.20	18.00	<0.00005	15.0	
Min	<0.001	0.03	40	0.002	0.36	0.044		150	0.0002	94		1700	<0.001		<0.001	<0.10	0.02	<0.00005	13.0	
90th Baseline	<0.001	0.075	50	0.003	0.55	0.059		204	0.0002	141		2170	0.001		0.0075	0.18	15.90	<0.00005	14.4	
Pre-50th for Trend	<0.001	0.055	44	0.002	0.49	0.058		175	0.0002	110		2050	0.001		0.0035	0.10	7.50	<0.00005	13.0	
ANZECC 2000	0.00005	0.055		0.024	0.37	0.700			0.002	350		2600	0.005		0.005 (0.0075)	1.50	0.664(15.9)	0.00006		

Continued… .MPGM4/D9 – Pre-water conditioned ash Background Summary October, 2012 – August, 2013 (mg/L)

	Mg:	Mn	Mo	Na:	NFR	Ni	NO2	NO3	Pb	pH	Se	SO4:	Temp	TFR	V	WL1	WL2	WLAHD	Zn
Ave	133	7.73	0.01	135		0.273			0.003	6.1	0.002	1048		1675		1.5		908.1	0.120
Max	170	8.90	0.01	180		0.340			0.004	6.3	0.002	1200		1800		1.7		908.3	0.220
Min	110	6.60	<0.001	100		0.210			0.001	5.8	<0.002	940		1500		1.4		908.0	0.070

90th Baseline	158	8.57	0.01	168		0.328			0.004	6.3	0.002	1170		1800		1.6		908.2	0.184
Pre-50th for Trend	125	7.70	0.01	130		0.270			0.003	6.2	0.002	1025		1700		1.5		908.2	0.096
ANZECC 2000		5.704(8.57)	0.010		10.0	0.5509			0.005	6.5-8.0	0.005	1000(1170)		2000					0.908

Continued….MPGM4/D9 Water conditioned ash Placement Water Quality Data September, 2015 – August, 2016 (mg/L)

Date	Mg:	Mn	Mo	Na:	NFR	Ni	NO2	NO3	Pb	pH	Se	SO4:	Temp	TFR	V	WL1	WL2	WLAHD	Zn
9/09/2015	183	9.27	0.001	246		0.36			0.001	6.05	0.0001	1200		2340	0.005	1.3		908.4	0.108
15/10/2015	151	9.41	0.001	201		0.355			0.001	5.98	0.0001	1440		1930	0.005	1.4		908.3	0.128
11/11/2015	169	8.92	0.001	220		0.348			0.001	6	0.0001	1330		2350	0.005	1.4		908.3	0.109
23/12/2015	150	9.77	0.001	187		0.34			0.001	6.06	0.0001	1380		2100	0.005	1.5		908.2	0.166
14/01/2016	160	8.61	0.001	216		0.36			0.001	5.98	0.0001	1220		2080	0.005	1.3		908.4	0.112
25/02/2016	161	8.49	0.001	195		0.313			0.001	5.99	0.0001	1200		2060	0.005	1.3		908.4	0.107
23/03/2016	170	8.84	0.001	205		0.328			0.001	5.98	0.0001	1290		2390	0.005	1.3		908.4	0.117
14/04/2016	168	8.07	0.001	212		0.389			0.001	5.93	0.0001	1290		2300	0.005	1.3		908.4	0.157
25/05/2016	158	0.026	0.001	204		0.334			0.001	5.8	0.0001	1300		2210	0.005	1.5		908.2	0.093
23/06/2016	164	10.1	0.001	188		0.4			0.001	5.7	0.0001	1410		2140	0.005	2		907.7	0.157
27/07/2016	170	11.8	0.001	184		0.363			0.001	5.98	0.0001	1130		2000	0.005	1.6		908.1	0.114
24/08/2016	154	8.68	0.001	172		0.342			0.001	5.41	0.0001	1390		1910	0.005	1.5		908.2	0.139

MPGM4/D9 Water conditioned ash Placement Water Quality Data September, 2015 – August, 2016 (mg/L)

Date:	Ag	Al	ALK	As	B	Ba	Be	Ca:	Cd	Cl:	Co	COND uS/cm	Cr	Cr-6	Cu	F	Fe	Hg	K:	Li
9/09/2015	0.0005	0.02	106	0.002	0.65	0.033		223	0.0001	198		2963	0.001		0.001	0.05	24.3	0.00002	17.8	
15/10/2015	0.0005	0.13	78	0.002	0.55	0.032		187	0.0001	183		2759	0.001		0.001	0.1	16	0.00002	15.5	
11/11/2015	0.0005	0.03	99	0.001	0.48	0.03		213	0.0001	175		2769	0.001		0.001	0.05	22.7	0.00002	18.5	
23/12/2015	0.0005	0.05	101	0.002	0.54	0.031		182	0.0001	170		2797	0.001		0.001	0.005	26.5	0.00002	14.7	
14/01/2016	0.0005	0.01	82	0.002	0.54	0.028		190	0.0001	158		2630	0.001		0.001	0.055	24.7	0.00002	15.3	
25/02/2016	0.0005	0.01	111	0.001	0.56	0.028		194	0.0001	152		2651	0.001		0.001	0.045	23.1	0.00002	14.6	
23/03/2016	0.0005	0.02	105	0.002	0.67	0.032		219	0.0001	170		2792	0.001		0.001	0.072	4.53	0.00002	17.6	
14/04/2016	0.0005	0.05	95	0.002	0.7	0.04		208	0.0001	176		2802	0.001		0.001	0.078	3.86	0.00013	18.5	
25/05/2016	0.0005	0.005	85	0.001	0.5	0.027		200	0.0001	172		2870	0.001		0.011	0.064	0.08	0.00002	17.6	
23/06/2016	0.0005	0.42	97	0.001	0.56	0.033		196	0.0001	169		2790	0.001		0.001	0.05	22.5	0.00072	17.8	
27/07/2016	0.0005	0.12	79	0.001	0.42	0.033		204	0.0001	126		2690	0.001		0.001	0.25	2.22	0.00002	17.2	
24/08/2016	0.0005	0.23	77	0.001	0.49	0.026		183	0.0001	173		2583	0.001		0.001	0.05	4.06	0.00002	17.4	

MPGM4/D9 – Post-water conditioned ash Summary September, 2015 – August, 2016 (mg/L

	Ag	Al	ALK	As	B	Ba	Be	Ca:	Cd	Cl:	Co	COND uS/cm	Cr	Cr-6	Cu	F	Fe	Hg	K:	Li
Ave	0.0005	0.09	93	0.002	0.56	0.031		200	0.0001	169		2758	0.001		0.0018	0.07	14.55	0.00009	16.9	
Max	0.0005	0.42	111	0.002	0.7	0.040		223	0.0001	198		2963	0.001		0.0110	0.25	26.5	0.00072	18.5	
Min	0.0005	0.01	77	0.001	0.42	0.026		182	0.0001	126		2583	0.001		0.0010	0.005	0.08	0.00002	14.6	
Post-90th for Trend	0.0005	0.04	96	0.0015	0.545	0.032		198	0.0001	171		2780	0.001		0.0010	0.0525	19.25	0.00002	17.5	
50th Trigger	0.0005	0.22	106	0.002	0.67	0.033		218	0.0001	182		2863	0.001		0.001	0.10	24.66	0.00012	18.4	

Continued……. MPGM4/D9 – Post-water conditioned ash Summary September, 2015– August, 2016 (mg/L)

Date	Mg	Mn-filtered	Mo	Na	NFR	Ni	NO2	NO3	Pb	pH	Se	SO4:	Temp	TFR	V	WL1	WL2	WLAHD	Zn

Ave	163.2	8.50	0.001	203		0.353			0.001	5.9	0.0001	1298		2151	0.005	1.5		908.2	0.126
Max	183.0	11.80	0.001	246		0.400			0.001	6.1	0.0001	1440		2390	0.005	2.0		908.4	0.166
Min	150.0	0.03	0.001	172		0.313			0.001	5.4	0.0001	1130		1910	0.005	1.3		907.7	0.093
Post-90th for Trend	162.5	8.88	0.001	203		0.352			0.001	6.0	0.0001	1295		2120	0.005	1.4		908.3	0.116
50th Trigger	170.0	10.07	0.001	220		0.386			0.001	6.0	0.0001	1408		2349	0.005	1.6		908.4	0.157

3. Water Quality Data and Summary for Groundwater Seepage Detection Bore MPGM4/D1

MPGM4/D1 – Pre-water conditioned ash Summary October, 2012 – August, 2013 (mg/L)																			
	Ag	Al	ALK	As	B	Ba	Be	Ca:	Cd	Cl:	Co	COND uS/cm	Cr	Cr-6	Cu	F	Fe	Hg	K:	Li
Ave	<0.001	0.07	108	0.013	1.8	0.038		254	0.0002	101		2300	0.001		0.011	0.10	18.0	<0.00005	18	
Max	<0.001	0.36	130	0.017	2.1	0.045		290	0.0002	130		2400	0.002		0.073	0.1	37	<0.00005	19	
Min	<0.001	0.01	92	0.011	1.6	0.032		220	<0.0002	69		2100	0.001		0.001	0.1	5.3	<0.00005	16	
90th Baseline	<0.001	0.157	130	0.0162	1.94	0.0434		282	0.0002	122		2400	0.0013		0.0254	0.1	33	<0.00005	19	
Pre-50th Trend	<0.001	0.03	100	0.012	1.80	0.038		260	0.0002	110		2400	0.001		0.0025	0.1	17.0	<0.00005	18	
ANZECC 2000	0.00005	0.055		0.024	0.37(0.55)	0.700			0.002	350		2600	0.005		0.005 (0.0075)	1.50	0.664(15.9)	0.00006		

Continued..... MPGM4/D1 – Pre-water conditioned ash Summary October, 2012 – August, 2013 (mg/L)																		
	Mg:	Mn	Mo	Na:	NFR	Ni	NO2	NO3	Pb	pH	Se	SO4:	Temp	TFR	V	WL1	WL2	WLAHD	Zn
Ave	177	10	0.007	126		0.53			0.001	6.2	0.002	1289		2189		2.1		910.5	0.047
Max	200	12	0.010	150		0.62			0.004	6.3	0.002	1400		2500		2.5		910.8	0.065
Min	150	8.5	<0.001	100		0.43			0.001	6.1	<0.002	1100		1900		1.8		910.1	0.030
90th Baseline	200	11.2	0.01	142		0.604			0.0022	6.3	0.002	1400		2420		2.4		910.8	0.061
Pre-50th Trend	180	10.0	0.010	130		0.52			0.001	6.1	0.002	1300		2200		2.0		910.6	0.048
ANZECC		5.704(8.57)	0.010		10.0	0.5509			0.005	6.5 -8.0	0.005	1000(1170)		2000					0.908

MPGM4/D1 Water conditioned ash Placement Water Quality Data September, 2015 – August, 2016 (mg/L)																			
Date	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	Co	COND µS/cm	Cr	Cr-6	Cu	F	Fe-filtered	Hg	K	Li
9/09/2015	0.0005	0.03	110	0.014	2.26	0.036		393	0.0001	495		4775	0.001		0.001	0.1	44.9	0.00002	40	
15/10/2015	0.0005	0.05	109	0.012	2.53	0.036		424	0.0001	511		4783	0.001		0.001	0.1	27.5	0.00002	40.5	
11/11/2015	0.0005	0.09	138	0.013	1.82	0.034		436	0.0001	477		4671	0.001		0.001	0.1	43.4	0.00002	43	
23/12/2015	0.0005	0.24	153	0.012	2.67	0.036		410	0.0001	494		4935	0.001		0.001	0.075	48.3	0.00002	41.2	
14/01/2016	0.0005	0.4	128	0.012	2.4	0.034		469	0.0001	477		4641	0.001		0.001	0.03	46.5	0.00002	44.5	
25/02/2016	0.0005	0.16	150	0.013	3.06	0.033		435	0.0001	450		4713	0.001		0.001	0.044	46.3	0.00002	39.2	
23/03/2016	0.0005	0.24	114	0.012	2.25	0.042		456	0.0001	520		4877	0.001		0.001	0.068	8.25	0.00002	44.1	
14/04/2016	0.0005	0.1	121	0.011	2.16	0.034		398	0.0001	511		5000	0.008		0.002	0.072	22.4	0.00002	40.3	
25/05/2016	0.0005	0.18	152	0.013	2.55	0.034		418	0.0001	529		491	0.001		0.001	0.289	50.6	0.00002	40.3	
23/06/2016	0.0005	0.24	190	0.014	2.12	0.034		406	0.0001	514		458	0.001		0.001	0.159	56.3	0.00002	40.4	
27/07/2016	0.0005	0.42	110	0.011	2.01	0.032		377	0.0001	502		4685	0.001		0.001	0.1	41.1	0.00002	38.9	
24/08/2016	0.0005	0.18	145	0.009	2.48	0.036		409	0.0001	314		5123	0.001		0.001	0.1	45.9	0.00007	39.9	

Continued….MPGM4/D1 Water conditioned ash Placement Water Quality Data October, 2012 – August, 2015 (mg/L)																			
Date	Mg	Mn-filtered	Mo	Na	NFR	Ni	NO2	NO3	Pb	pH	Se	SO4	Temp	TFR	V	WL1	WL2	WLAHD	Zn
9/09/2015	278	16.3	0.001	318		0.981			0.001	5.95	0.0001	2370		4080	0.005	1.8		910.8	0.139
15/10/2015	288	16.6	0.0005	315		1.16			0.001	5.93	0.0003	2380		4140	0.005	2		910.6	0.13
11/11/2015	308	16.3	0.001	322		0.939			0.001	5.93	0.0001	2170		4360	0.005	2		910.6	0.111
23/12/2015	290	17	0.001	341		0.976			0.001	5.86	0.0001	2260		4370	0.005	2.2		910.4	0.134
14/01/2016	329	17.3	0.001	386		1.04			0.001	5.86	0.0001	2220		4270	0.005	2.2		910.4	0.124
25/02/2016	299	16.5	0.001	342		1.08			0.001	5.97	0.0001	1950		4180	0.005	1.9		910.7	0.136
23/03/2016	312	15	0.001	376		1.03			0.001	5.91	0.0001	2220		3280	0.005	2		910.6	0.134
14/04/2016	286	14.1	0.001	354		1.14			0.001	5.85	0.0001	2250		4390	0.005	2.2		910.4	0.146
25/05/2016	294	18.8	0.001	359		1.18			0.001	5.9	0.0001	2350		3050	0.005	2.7		909.9	0.146

23/06/2016	290	20.2	0.001	359		1.04			0.001	6.04	0.0001	2330		4110	0.005	2.4		910.2	0.128
27/07/2016	269	15.2	0.001	333		1.06			0.001	5.53	0.0001	2130		3770	0.005	1.9		910.7	0.138
24/08/2016	291	15.6	0.001	376		1.17			0.001	6.3	0.0001	2540		4400	0.005	2.1		910.5	0.152

MPGM4/D1 – Post-water conditioned ash Summary September, 2015 – August, 2016 (mg/L)

Date	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	Co	COND mS/m	Cr	Cr-6	Cu	F	Fe-filtered	Hg	K	Li
Ave	0.0005	0.19	135	0.012	2.36	0.035		419	0.0001	483		4096	0.0016		0.0011	0.10	40.12	0.00002	41.0	
Max	0.0005	0.42	190	0.014	3.06	0.042		469	0.0001	529		5123	0.0080		0.0020	0.289	56.3	0.00007	44.5	
Min	0.0005	0.03	109	0.009	1.82	0.032		377	0.0001	314		458	0.0010		0.0010	0.03	8.25	0.00002	38.9	
50th Investigation Trigger	0.0005	0.18	133	0.012	2.33	0.034		414	0.0001	499		4744	0.0010		0.0010	0.1	45.4	0.00002	40.4	
Post-90th for Trend	0.0005	0.38	153	0.014	2.66	0.036		454	0.0001	519		4994	0.001		0.001	0.15	50.37	0.00002	44.0	

Continued..... MPGM4/D1 – Post-water conditioned ash Summary September, 2015 – August, 2016 (mg/L)

Date	Mg	Mn-filtered	Mo	Na	NFR	Ni	NO2	NO3	Pb	pH	Se	SO4	Temp	TFR	V	WL1	WL2	WLAHD	Zn
Ave	294.5	16.6	0.001	348		1.066			0.001	5.9	0.0001	2264		4033	0.005	2.1		910.5	0.135
Max	329.0	20.2	0.001	386		1.180			0.001	6.3	0.0003	2540		4400	0.005	2.7		910.8	0.152
Min	269.0	14.1	0.001	315		0.939			0.001	5.5	0.0001	1950		3050	0.005	1.8		909.9	0.111
50th Investigation Trigger	290.5	16.4	0.001	348		1.050			0.001	5.9	0.0001	2255		4160	0.005	2.1		910.6	0.135
Post-90th for Trend	311.6	18.7	0.001	376		1.169			0.001	6.0	0.0001	2379		4388	0.005	2.4		910.7	0.146

4. Water Quality Data and Summary for Ash Placement Area Groundwater Bores MPGM4/D10 and MPGM4/D11

MPGM4/D10 – Pre-water conditioned ash Summary October, 2012 – August, 2013 (mg/L)

Date	Ag	Al	ALK	As	B	Ba	Be	Ca:	Cd	Cl:	Co	COND uS/cm	Cr	Cr-6	Cu	F	Fe	Hg	K:	Li
Ave	<0.001	1.06	32	0.001	3.46	0.024		308	0.005	382		4533	0.001		0.012	1.7	3.71	<0.00005	88	
Max	<0.001	1.90	44	0.001	5.10	0.035		380	0.008	480		5500	0.002		0.028	2.5	11.00	<0.00005	110	
Min	<0.001	0.63	13	<0.001	1.90	0.018		230	0.004	220		3100	0.001		0.001	1.4	0.38	<0.00005	54	
90th Baseline	<0.001	1.34	40	0.001	4.86	0.031		348	0.007	472		5180	0.002		0.026	2.0	7.64	<0.00005	102	
Pre-50th for Trend	<0.001	1.00	34	0.001	3.50	0.023		320	0.005	390		4600	0.001		0.005	1.6	2.50	<0.00005	92	
ANZECC 2000	0.00005	0.055		0.024	0.37 (0.55)	0.700			0.002	350		2600	0.005		0.005 (0.0075)	1.50	0.664 (15.9)	0.00006		

Continued……. MPGM4/D10 – Pre-water conditioned ash Summary October, 2012 – August, 2013 (mg/L)

Date	Mg:	Mn	Mo	Na:	NFR	Ni	NO2	NO3	Pb	pH	Se	SO4:	Temp	TFR	V	WL1	WL2	WLAHD	Zn
Ave	208	7.3	0.007	623		0.69			0.007	5.6	0.007	2456		4267		13.5		912.6	1.333
Max	270	8.9	0.01	780		0.82			0.015	5.9	0.010	2900		5100		13.8		913.3	1.700
Min	140	4.5	0.001	390		0.46			0.003	5.4	0.004	1800		2700		12.8		912.3	1.000
90th Baseline	254	8.9	0.01	756		0.80			0.009	5.7	0.010	2820		5100		13.7		913.0	1.700
Pre-50th for Trend	210	7.7	0.01	620		0.69			0.005	5.6	0.007	2600		4500		13.6		912.5	1.200
ANZECC		5.704(8.57)	0.010		10.0	0.5509			0.005	6.5 -8.0	0.005	1000(1170)		2000					0.908

MPGM4/D10 Water conditioned ash Placement Water Quality Data September, 2015 – August, 2016 (mg/L)

Date:	Ag	Al	ALK	As	B	Ba	Be	Ca:	Cd	Cl:	Co	COND uS/cm	Cr	Cr-6	Cu	F	Fe	Hg	K:	Li
9-Sep-15	0.0005	0.15	59	0.001	2.17	0.02		250	0.0038	520		6186	0.001		0.002	0.1	7.81	0.00002	122	
15-Oct-15	0.0005	0.21	61	0.001	4.17	0.018		378	0.0065	802		8441	0.001		0.001	1.03	6.85	0.00002	154	
11-Nov-15	0.0005	0.19	71	0.001	3.09	0.016		417	0.0055	912		9430	0.001		0.001	0.25	10.3	0.00002	178	
23-Dec-15	0.0005	0.24	79	0.001	6.18	0.017		428	0.0083	1090		11190	0.001		0.001	0.762	6.96	0.00002	217	
14-Jan-16	0.0005	0.24	73	0.001	6.01	0.018		414	0.0088	1120		10980	0.001		0.001	1.12	6.66	0.00002	216	
25-Feb-16	0.0005	0.19	83	0.002	3.28	0.018		327	0.0065	754		8753	0.001		0.001	0.434	9.55	0.00002	162	
23-Mar-16	0.0005	0.17	80	0.001	3.79	0.019		433	0.007	915		9363	0.001		0.001	0.672	4.34	0.00002	230	
14-Apr-16	0.0005	0.17	80	0.001	3.97	0.015		336	0.0083	921		9800	0.001		0.019	0.615	8.54	0.00002	195	
25-May-16	0.0005	0.23	83	0.001	5.24	0.017		382	0.0087	822		10370	0.001		0.001	0.25	5.53	0.00002	212	
23-Jun-16	0.0005	0.14	106	0.001	3.18	0.014		292	0.0054	697		7972	0.001		0.001	0.5	15	0.00002	161	
27-Jul-16	0.0005	0.34	59	0.001	1.42	0.014		194	0.0026	371		4867	0.001		0.001	0.435	14.7	0.00002	106	
24-Aug-16	0.0005	0.15	71	0.001	2.48	0.019		261	0.0043	482		6603	0.001		0.001	0.546	16	0.00002	116	

Continued….MPGM4/D10 Water conditioned ash Placement Water Quality Data September, 2015 – August, 2016 (mg/L)

Date:	Mg:	Mn	Mo	Na:	NFR	Ni	NO2	NO3	Pb	pH	Se	SO4:	Temp	TFR	V	WL1	WL2	WLAHD	Zn
9-Sep-15	207	5.36	0.001	817		0.597			0.002	5.61	0.0075	3120		4180	0.005	13.4		912.7	1.01
15-Oct-15	351	8.93	0.001	1220		1.06			0.004	5.54	0.0046	4290		6510	0.005	14.1		912.0	1.33
11-Nov-15	442	10.2	0.001	1440		0.937			0.005	5.54	0.0036	4690		7350	0.005	14		912.1	1.08
23-Dec-15	474	10.2	0.002	1700		1.1			0.004	5.52	0.0047	5360		9090	0.005	14.4		911.7	1.41
14-Jan-16	471	11.5	0.001	1720		1.26			0.007	5.52	0.0052	5510		8700	0.005	14.3		911.8	1.45
25-Feb-16	358	8.74	0.001	1430		0.907			0.005	5.74	0.0026	3630		7040	0.005	13.8		912.3	1.25
23-Mar-16	486	8.03	0.001	1800		0.919			0.002	5.67	0.003	4640		7580	0.005	13.9		912.2	1.26
14-Apr-16	407	7.7	0.001	1510		1.08			0.007	5.55	0.0036	4750		8330	0.005	14.1		912.0	1.44
25-May-16	442	11.1	0.001	1700		1.21			0.006	5.34	0.0053	4300		8870	0.005	14.8		911.3	1.41
23-Jun-16	323	9.03	0.001	1250		0.867			0.004	5.7	0.0026	3790		4490	0.005	13.9		912.2	1.13
27-Jul-16	172	4.18	0.001	639		0.591			0.002	5.57	0.0011	2260		3660	0.005	13.3		912.8	1.00
24-Aug-16	244	6.35	0.001	907		0.846			0.004	5.83	0.0017	2770		4450	0.005	13.7		912.4	1.36

MPGM4/D10 – Post-water conditioned ash Summary September, 2015 – August, 2016 (mg/L)

Date	Ag	Al	ALK	As	B	Ba	Be	Ca:	Cd	Cl:	Co	COND uS/cm	Cr	Cr-6	Cu	F	Fe	Hg	K:	Li
Ave	0.0005	0.20	75	0.001	3.75	0.017		343	0.0063	784		8663	0.0010		0.0026	0.56	9.35	0.00002	172	
Max	0.0005	0.34	106	0.002	6.18	0.020		433	0.0088	1120		11190	0.0010		0.0190	1.12	16	0.00002	230	
Min	0.0005	0.14	59	0.001	1.42	0.014		194	0.0026	371		4867	0.0010		0.0010	0.1	4.34	0.00002	106	

50th Investigation Trigger	0.0005	0.19	76	0.001	3.535	0.018		357	0.0065	812		9058	0.0010		0.0010	0.523	8.175	0.00002	170	
Post-90th for Trend	0.0005	0.24	83	0.001	5.93	0.019		427	0.0087	1073		10919	0.001		0.002	1.00	14.97	0.00002	217	

Continued……. MPGM4/D10 – Post-water conditioned ash Summary September, 2015 – August, 2016 (mg/L)

Date	Mg:	Mn	Mo	Na:	NFR	Ni	NO2	NO3	Pb	pH	Se	SO4:	Temp	TFR	V	WL1	WL2	WLAHD	Zn
Ave	365	8.4	0.001	1344		0.948			0.004	5.6	0.0038	4093		6688	0.005	14.0		912.1	1.261
Max	486	11.5	0.002	1800		1.260			0.007	5.8	0.0075	5510		9090	0.005	14.8		912.8	1.450
Min	172	4.2	0.001	639		0.591			0.002	5.3	0.0011	2260		3660	0.005	13.3		911.3	1.000
50th Investigation Trigger	383	8.8	0.001	1435		0.928			0.004	5.6	0.0036	4295		7195	0.005	14.0		912.1	1.295
Post-90th for Trend	474	11.0	0.001	1718		1.199			0.007	5.7	0.0053	5299		8853	0.005	14.4		912.7	1.437

MPGM4/D11 – Pre-water conditioned ash Summary October, 2012 – August, 2013 (mg/L)																			
Date	Ag	Al	ALK	As	B	Ba	Be	Ca:	Cd	Cl:	Co	COND uS/cm	Cr	Cr-6	Cu	F	Fe	Hg	K:	Li
Ave	<0.001	0.11	737	0.003	1.02	0.833		207	0.0002	227		2278	0.003		0.005	0.53	0.07	<0.00005	54	
Max	<0.001	0.29	900	0.008	2.30	1.400		340	0.0002	270		3200	0.005		0.015	0.80	0.28	<0.00005	61	
Min	<0.001	0.01	200	0.001	0.66	0.350		170	<0.0002	210		1800	0.001		0.001	0.20	0.01	<0.00005	45	
90th Baseline	<0.001	0.21	892	0.007	1.74	1.080		292	0.0002	238		2880	0.004		0.011	0.73	0.16	<0.00005	59	
Pre-50th for Trend	<0.001	0.07	840	0.001	0.78	0.850		180	0.0002	220		2100	0.003		0.004	0.50	0.03	<0.00005	55	
ANZECC 2000	0.00005	0.055		0.024	0.37 (0.55)	0.700			0.002	350		2600	0.005		0.005 (0.0075)	1.50	0.664 (15.9)	0.00006		

Continued..... MPGM4/D11 – Pre-water conditioned ash Summary October, 2012 – August, 2013 (mg/L)																			
Date	Mg:	Mn	Mo	Na:	NFR	Ni	NO2	NO3	Pb	pH	Se	SO4:	Temp	TFR	V	WL1	WL2	WLAHD	Zn
Ave	94	2.2	0.008	221		0.055			0.005	7.1	0.002	345		1433		25.1		912.4	0.045
Max	170	11.0	0.010	290		0.140			0.024	7.6	0.002	1700		2100		25.8		914.0	0.080
Min	76	0.2	<0.001	200		0.030			0.001	6.4	0.002	10		1200		23.5		911.7	0.014
90th Baseline	138	7.6	0.010	242		0.100			0.011	7.3	0.002	1036		1620		25.64		912.9	0.080
Pre-50th for Trend	77	0.4	0.010	210		0.039			0.002	7.2	0.002	110		1400		25.2		912.3	0.040
ANZECC		5.704(8.57)	0.010		10.0	0.5509			0.005	6.5 -8.0	0.005	1000(1170)		2000					0.908

MPGM4/D11 Water conditioned ash Placement Water Quality Data September, 2015 – August, 2016 (mg/L)																			
Date	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	Co	COND µS/cm	Cr	Cr-6	Cu	F	Fe-filtered	Hg	K	Li
10-Sep-15	0.0005	0.005	144	0.013	2.49	0.032		454	0.0001	616		6509	0.001		0.001	0.1	84.6	0.00002	73.4	
15-Oct-15	0.0005	0.005	122	0.005	2.55	0.024		526	0.0001	670		6750	0.001		0.001	0.25	32.7	0.00002	80.4	
11-Nov-15	0.0005	0.005	151	0.011	2.06	0.019		554	0.0001	660		7035	0.001		0.001	0.25	97.3	0.00002	90.4	
23-Dec-15	0.0005	0.005	183	0.014	3.7	0.025		533	0.0001	710		7624	0.001		0.001	0.058	100	0.00002	89.8	
13-Jan-16	0.0005	0.005	135	0.013	3.28	0.022		548	0.0001	732		7419	0.001		0.001	0.039	96.3	0.00002	95.9	
25-Feb-16	0.0005	0.005	173	0.008	2.62	0.022		564	0.0001	678		7618	0.001		0.001	0.073	43.1	0.00002	83.6	
23-Mar-16	0.0005	0.02	119	0.005	2.92	0.023		604	0.0001	783		7935	0.001		0.001	0.177	13.6	0.00002	99.8	
13-Apr-16	0.0005	0.005	140	0.006	2.77	0.019		556	0.0001	771		8150	0.001		0.002	0.066	1.31	0.00002	111	
26-May-16	0.0005	0.16	175	0.011	2.83	0.027		557	0.0001	674		8170	0.004		0.001	0.25	65	0.00002	96.8	
23-Jun-16	0.0005	0.08	226	0.012	3.03	0.025		589	0.0001	842		8442	0.001		0.001	0.5	116	0.00002	120	
27-Jul-16	0.0005	0.14	73	0.01	2.8	0.02		581	0.0001	851		8641	0.001		0.001	0.25	78.5	0.00002	121	
25-Aug-16	0.0005	0.1	154	0.01	3.27	0.027		566	0.0001	755		8392	0.001		0.001	0.25	81	0.00002	106	

Continued….MPGM4/D11 Water conditioned ash Placement Water Quality Data September, 2015 – August, 2016 (mg/L)																			
Date	Mg	Mn-filtered	Mo	Na	NFR	Ni	NO2	NO3	Pb	pH	Se	SO4	Temp	TFR	V	WL1	WL2	WLAHD	Zn
10-Sep-15	264	13.9	0.002	650		0.463			0.001	6.34	0.0001	3260		5620	0.005	25		912.4	0.076
15-Oct-15	300	15.2	0.001	742		0.586			0.001	6.37	0.0003	3490		5730	0.005	25.8		911.6	0.048
11-Nov-15	335	14.9	0.001	796		0.488			0.001	6.26	0.0002	3540		6390	0.005	25.6		911.8	0.059
23-Dec-15	324	16.5	0.002	845		0.625			0.001	6.2	0.0001	3650		6950	0.005	26		911.4	0.082
13-Jan-16	335	17.4	0.001	895		0.661			0.001	6.21	0.0001	3820		7050	0.005	25.9		911.5	0.085
25-Feb-16	346	17.1	0.001	1020		0.632			0.001	6.34	0.0001	3340		7160	0.005	25.4		912.0	0.091
23-Mar-16	366	15.4	0.001	1000		0.658			0.001	6.33	0.0001	4010		9450	0.005	25.3		912.1	0.075
13-Apr-16	361	3.2	0.002	982		0.746			0.001	6.28	0.0001	4000		7150	0.005	25.7		911.7	0.098
26-May-16	358	16.9	0.001	1020		0.806			0.001	5.89	0.0004	3500		6160	0.005	26.3		911.1	0.12
23-Jun-16	394	21.8	0.001	1100		0.866			0.001	6.3	0.0001	4370		4930	0.005	25.6		911.8	0.138
27-Jul-16	389	17.2	0.001	1090		0.904			0.001	5.85	0.0002	4480		6570	0.005	24.9		912.5	0.146
25-Aug-16	365	15.6	0.001	1010		0.822			0.001	6.35	0.0001	3880		6080	0.005	25.3		912.1	0.126

MPGM4/D11 – Post-water conditioned ash Summary September, 2015 – August, 2016 (mg/L)																			
Date	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	Co	COND uS/cm	Cr	Cr-6	Cu	F	Fe-filtered	Hg	K	Li
Ave	0.0005	0.04	150	0.010	2.86	0.024		553	0.0001	729		7724	0.0013		0.0011	0.19	67.45	0.00002	97	
Ave	0.0005	0.16	226	0.014	3.7	0.032		604	0.0001	851		8641	0.0040		0.0020	0.5	116	0.00002	121	
Max	0.0005	0.005	73	0.005	2.06	0.019		454	0.0001	616		6509	0.0010		0.0010	0.039	1.31	0.00002	73	
Min	0.0005	0.005	148	0.0105	2.815	0.024		557	0.0001	721		7780	0.0010		0.0010	0.2135	79.75	0.00002	96	
50th Investigation Trigger	0.0005	0.14	182	0.013	3.28	0.027		588	0.0001	836		8437	0.001		0.001	0.25	99.73	0.00002	119	
Post-90th for Trend	0.0005	0.04	150	0.010	2.86	0.024		553	0.0001	729		7724	0.0013		0.0011	0.19	67.45	0.00002	97	

Continued..... MPGM4/D11 – Post-water conditioned ash Summary September, 2015 – August, 2016 (mg/L)																		
Date	Mg	Mn-filtered	Mo	Na	NFR	Ni	NO2	NO3	Pb	pH	Se	SO4	Temp	TFR	V	WL1	WL2	WLAHD	Zn
Ave	345	15.4	0.001	929		0.688			0.001	6.2	0.0002	3778		6603	0.005	25.6		911.8	0.095
Max	394	21.8	0.002	1100		0.904			0.001	6.4	0.0004	4480		9450	0.005	26.3		912.5	0.146
Min	264	3.2	0.001	650		0.463			0.001	5.9	0.0001	3260		4930	0.005	24.9		911.1	0.048
50th Investigation Trigger	352	16.1	0.001	991		0.660			0.001	6.3	0.0001	3735		6480	0.005	25.6		911.8	0.088
Post-90th for Trend	387	17.4	0.002	1083		0.862			0.001	6.3	0.0003	4334		7159	0.005	26.0		912.3	0.137

5. **Lamberts North Groundwater Bores MPGM4/D19 and D20**

MPGM4/D19 – Pre-water conditioned ash Summary October, 2012 – August, 2013 (mg/L)																				
	Ag	Al	ALK	As	B	Ba	Be	Ca:	Cd	Cl:	Co	COND uS/cm	Cr	Cr-6	Cu	F	Fe	Hg	K:	Li
Ave	<0.001	0.55	25.0	0.001	1.35	0.021		226	0.0006	186		2836	0.003		0.009	0.06	0.07	<0.00005	31	
Max	<0.001	2.70	25.0	0.002	1.60	0.030		250	0.0009	214		3000	0.004		0.017	0.10	0.63	<0.00005	35	
Min	<0.001	0.06	<25	<0.001	1.20	0.016		210	0.0003	160		2600	0.002		0.002	0.05	0.01	<0.00005	27	
90th Baseline	<0.001	0.74	25.0	0.002	1.50	0.027		250	0.0007	200		2900	0.004		0.015	0.06	0.03	<0.00005	34	
Pre-50th for Trend	<0.001	0.31	25.0	0.001	1.30	0.020		230	0.0006	190		2800	0.002		0.009	0.05	0.01	<0.00005	30	
ANZECC	0.00005	0.055		0.024	0.37 (0.55)	0.700			0.002	350		2600	0.005		0.005 (0.0075)	1.50	0.664 (15.9)	0.00006		

Continued..... MPGM4/D19 – Pre-water conditioned ash Summary October, 2012 – August, 2013 (mg/L)																		
	Mg:	Mn	Mo	Na:	NFR	Ni	NO2	NO3	Pb	pH	Se	SO4:	Temp	TFR	V	WL1	WL2	WLAHD	Zn
Ave	159	0.54	0.004	306		0.23			0.005	6.1	0.002	1513		2445		7.6		910.0	0.58
Max	170	1.30	0.005	340		0.33			0.012	6.3	0.002	1600		2800		8.2		910.5	0.94
Min	140	0.11	0.0005	260		0.14			0.003	5.7	<0.002	1400		2100		7.1		909.4	0.35
90th Baseline	170	0.9	0.005	320		0.3			0.008	6.3	0.002	1600		2700		8.0		910.3	0.733
Pre-50th for Trend	159	0.54	0.004	306		0.23			0.005	6.1	0.002	1513		2445		7.6		910.0	0.58
ANZECC 2000		5.704(8.57)	0.010		10.0	0.5509			0.005	6.5 -8.0	0.005	1000(1170)		2000					0.908

MPGM4/D19 Water conditioned ash data September, 2015 – August, 2016 (mg/L)																				
Date:	Ag	Al	ALK	As	B	Ba	Be	Ca:	Cd	Cl:	Co	COND uS/cm	Cr	Cr-6	Cu	F	Fe	Hg	K:	Li
9/09/2015	0.0005	0.22	33	0.001	1.41	0.013		246	0.0001	313		4166	0.048		0.002	0.05	0.056	0.00002	46.8	
15/10/2015	0.0005	0.16	28	0.001	1.28	0.01		255	0.0001	333		4302	0.049		0.002	0.1	0.042	0.00002	51	
11/11/2015	0.0005	0.05	28	0.001	1.25	0.011		271	0.0002	319		4327	0.004		0.0005	0.1	0.053	0.00002	55.8	
23/12/2015	0.0005	0.26	32	0.001	1.76	0.012		253	0.0002	351		4688	0.013		0.002	0.059	0.065	0.00002	54.6	
14/01/2016	0.0005	0.09	30	0.001	1.6	0.013		256	0.0002	338		4500	0.014		0.001	0.055	0.074	0.00002	51.5	
25/02/2016	0.0005	0.43	32	0.001	1.66	0.024		286	0.0003	350		4522	0.037		0.002	0.082	0.058	0.00002	56.1	
23/03/2016	0.0005	0.17	30	0.001	1.57	0.016		278	0.0003	388		4611	0.027		0.003	0.096	0.123	0.00002	57.7	
14/04/2016	0.0005	0.11	28	0.001	1.46	0.014		255	0.0003	357		4660	0.019		0.002	0.076	0.122	0.00002	56.4	
25/05/2016	0.0005	0.8	51	0.002	1.56	0.022		246	0.0005	337		4340	0.021		0.004	0.1	1.49	0.00002	47.4	
23/06/2016	0.0005	1.48	122	0.009	1.29	0.038		310	0.0001	387		4881	0.028		0.007	0.25	19.6	0.00002	45.6	
27/07/2016	0.0005	0.81	106	0.007	1.69	0.026		297	0.0001	435		5372	0.032		0.003	0.1	21.6	0.00002	56.3	
24/08/2016	0.0005	0.43	128	0.006	2.14	0.022		238	0.0001	378		4828	0.008		0.003	0.1	19.4	0.00002	47.2	

Continued..... MPGM4/D19 Water conditioned ash data September, 2015 – August, 2016 (mg/L)																			
Date:	Mg:	Mn	Mo	Na:	NFR	Ni	NO2	NO3	Pb	pH	Se	SO4:	Temp	TFR	V	WL1	WL2	WLAHD	Zn
9/09/2015	171	0.143	0.001	467		0.176			0.001	6.24		2140		2250	0.005	7.2		910.4	0.319
15/10/2015	183	0.073	0.002	487		0.174			0.001	6.3	0.0004	2150		3720	0.005	7.3		910.3	0.193
11/11/2015	199	0.149	0.001	497		0.175			0.001	6.22	0.0003	2160		3630	0.005	7.1		910.5	0.252
23/12/2015	192	0.125	0.001	526		0.19			0.001	6.1	0.0002	2240		3740	0.005	7.5		910.1	0.321
14/01/2016	190	0.155	0.001	532		0.223			0.001	6.12	0.0002	2190		3380	0.005	7.4		910.2	0.312
25/02/2016	206	0.266	0.001	557		0.271			0.002	6.28	0.0004	2130		3700	0.005	7.2		910.4	0.391
23/03/2016	202	0.372	0.001	577		0.273			0.001	6.1	0.0003	2430		3660	0.005	7.2		910.4	0.374
14/04/2016	194	0.418	0.001	552		0.285			0.001	6.66	0.0003	2190		3280	0.005	7.8		909.8	0.393
25/05/2016	189	6.13	0.001	482		0.54			0.005	5.88	0.0003	2180		3520	0.005	9.3		908.3	0.485
23/06/2016	255	15.7	0.001	521		0.858			0.023	6.19	0.0005	2440		3870	0.005	9.4		908.2	0.447
27/07/2016	247	12.2	0.001	663		0.88			0.014	5.76	0.0004	2510		3220	0.005	9.2		908.4	0.374
24/08/2016	195	9.96	0.001	586		0.748			0.01	6.17	0.0004	2240		2910	0.005	9.2		908.4	0.316

MPGM4/D19 – Post-water conditioned ash Summary September, 2015 – August, 2016 (mg/L)																				
	Ag	Al	ALK	As	B	Ba	Be	Ca:	Cd	Cl:	Co	COND uS/cm	Cr	Cr-6	Cu	F	Fe	Hg	K:	Li
Ave	0.0005	0.42	54.0	0.003	1.56	0.018		266	0.0002	357		4600	0.025		0.0026	0.10	5.22	0.00002	52.2	
Max	0.0005	1.48	128.0	0.009	2.14	0.038		310	0.0005	435		5372	0.049		0.0070	0.25	21.6	0.00002	57.7	
Min	0.0005	0.05	28.0	0.001	1.25	0.010		238	0.0001	313		4166	0.004		0.0005	0.05	0.042	0.00002	45.6	
90th Baseline	0.0005	0.24	32.0	0.001	1.565	0.015		256	0.0002	351		4567	0.024		0.0020	0.098	0.098	0.00002	53.1	
Pre-50th for Trend	0.0005	0.81	120.4	0.007	1.75	0.026		296	0.0003	388		4876	0.047		0.004	0.10	19.58	0.00002	56.4	
ANZECC	0.0005	0.42	54.0	0.003	1.56	0.018		266	0.0002	357		4600	0.025		0.0026	0.10	5.22	0.00002	52.2	

Continued……. MPGM4/D19 – Post-water conditioned ash Summary September, 2015 – August, 2016 (mg/L)																		
	Mg:	Mn	Mo	Na:	NFR	Ni	NO2	NO3	Pb	pH	Se	SO4:	Temp	TFR	V	WL1	WL2	WLAHD	Zn
Ave	201.9	3.81	0.001	537		0.399			0.005	6.2	0.0003	2250		3407	0.005	8.0		909.6	0.348
Max	255.0	15.70	0.002	663		0.880			0.023	6.7	0.0005	2510		3870	0.005	9.4		910.5	0.485
Min	171.0	0.07	0.001	467		0.174			0.001	5.8	0.0002	2130		2250	0.005	7.1		908.2	0.193
90th Baseline	194.5	0.32	0.001	529		0.272			0.001	6.2	0.0003	2190		3575	0.005	7.5		910.2	0.348
Pre-50th for Trend	242.9	11.98	0.001	585		0.847			0.014	6.3	0.0004	2439		3738	0.005	9.3		910.4	0.442
ANZECC 2000	201.9	3.81	0.001	537		0.399			0.005	6.2	0.0003	2250		3407	0.005	8.0		909.6	0.348

MPGM4/D20 Water conditioned ash data September, 2015 – August, 2016 (mg/L)

Date:	Ag	Al	ALK	As	B	Ba	Be	Ca:	Cd	Cl:	Co	COND uS/cm	Cr	Cr-6	Cu	F	Fe	Hg	K:	Li
24/02/2016		18.3	526	0.037	0.64	0.45		307	0.0278	91.4		3505	0.046		0.069	0.929	0.39	0.00016	29	
23/03/2016	<0.001	12.7	482	0.028	1.56	0.309		301	0.0142	108		3628	0.033		0.050	1.41	0.16	0.00016	31.4	
13/04/2016	<0.001	14	424	0.028	1.38	0.305		283	0.009	96		3620	0.041		0.046	1.35	2.5	0.00011	28.7	
25/05/2016	<0.001	22.8	446	0.048	0.8	0.521		281	0.0124	100		3570	0.065		0.096	<0.200	<0.05	0.0002	28	
29/06/2016	<0.001	6.67	314	0.018	2.19	0.231		240	0.0064	133		3384	0.028		0.028	1.46	2.4	0.00007	29.8	
27/07/2016	<0.001	3.35	428	0.008	1.06	0.089		277	0.0041	132		3532	0.026		0.02	0.613	1.29	0.00005	27.6	
24/08/2016	<0.001	5.34	392	0.013	0.63	0.149		309	0.0045	102		3583	0.037		0.026	0.247	0.78	0.00008	23.8	

Continued..... MPGM4/D20 Water conditioned ash data September, 2015 – August, 2016 (mg/L)

Date:	Mg:	Mn	Mo	Na:	NFR	Ni	NO2	NO3	Pb	pH	Se	SO4:	Temp	TFR	V	WL1	WL2	WLAHD	Zn
24/02/2016	398	10.3	0.004	116		0.346			0.064	6.5	0.0032	1980		3360	0.04	17.3		911.79	0.346
23/03/2016	386	11	0.003	146		0.372			0.044	6.45	0.0025	2200		3490	0.03	17.2		911.89	0.364
13/04/2016	368	12.4	0.003	137		0.475			0.042	6.62	0.0018	1940		3390	0.04	17.2		911.89	0.431
25/05/2016	369	13.6	0.004	128		0.524			0.084	6.13	0.003	1990		3680	0.06	17.5		911.59	0.586
29/06/2016	304	23.1	0.002	159		0.646			0.023	5.97	0.0012	2140		3120	0.02	17.1		911.99	0.552
27/07/2016	351	16.4	0.003	142		0.513			0.014	5.82	0.001	1990		3010	<0.01	17		912.09	0.286
24/08/2016	375	14.3	0.003	125		0.409			0.02	6.48	0.001	2030		3040	0.02	17.2		911.89	0.278

MPGM4/D20 – Post-water conditioned ash Summary September, 2015 – August, 2016 (mg/L)

	Ag	Al	ALK	As	B	Ba	Be	Ca:	Cd	Cl:	Co	COND uS/cm	Cr	Cr-6	Cu	F	Fe	Hg	K:	Li
Ave	<0.001	11.88	430	0.026	1.180	0.293		285	0.0112	109		3546	0.039		0.048	1.00	1.25	0.00012	28	
Max	<0.001	22.80	526	0.048	2.190	0.521		309	0.0278	133		3628	0.065		0.096	1.46	2.50	0.00020	31	
Min	<0.001	3.35	314	0.008	0.630	0.089		240	0.0041	91		3384	0.026		0.020	0.25	0.16	0.00005	24	
90th Baseline	<0.001	12.70	428	0.028	1.060	0.305		283	0.0090	102		3570	0.037		0.046	1.14	1.04	0.00011	29	
Pre-50th for Trend	<0.001	20.10	500	0.041	1.812	0.478		308	0.0196	132		3623	0.054		0.080	1.44	2.45	0.00018	30	
ANZECC	<0.001	11.88	430	0.026	1.180	0.293		285	0.0112	109		3546	0.039		0.048	1.00	1.25	0.00012	28	

Continued..... MPGM4/D20 – Post-water conditioned ash Summary September, 2015 – August, 2016 (mg/L)

	Mg:	Mn	Mo	Na:	NFR	Ni	NO2	NO3	Pb	pH	Se	SO4:	Temp	TFR	V	WL1	WL2	WLAHD	Zn
Ave	364	14.4	0.003	136		0.469			0.042	6.3	0.002	2039		3299	0.04	17.2		911.9	0.406
Max	398	23.1	0.004	159		0.646			0.084	6.6	0.003	2200		3680	0.06	17.5		912.1	0.586
Min	304	10.3	0.002	116		0.346			0.014	5.8	0.001	1940		3010	0.02	17.0		911.6	0.278
90th Baseline	369	13.6	0.003	137		0.475			0.042	6.5	0.002	1990		3360	0.04	17.2		911.9	0.364
Pre-50th for Trend	391	19.1	0.004	151		0.573			0.072	6.5	0.003	2164		3566	0.05	17.4		912.0	0.566
ANZECC 2000	364	14.4	0.003	136		0.469			0.042	6.3	0.002	2039		3299	0.04	17.2		911.9	0.406

6. Lamberts North Water Conditioned Ash Runoff Pond LN Pond 1 and LN Pond 2 Water Quality 2012 to 2014 (no data for 2015 or LN retention sump in 2016)

Lamberts North Pond 1							
Date	pH	Conductivity (uS/cm)	TDS (mg/L)	Temperature °C	TSS	Chloride	Sulphate
2/09/2013	7.6	330	300		12	9	100
3/11/2013	7.2	600	360		860	15	240
5/02/2014	7.4	1800	1500		800	54	900
10/04/2014	8	1000	680		14	30	140
30/04/2014	7.9	1300	880		4	37	480
18/07/2014	8.2	2000	1600		7	92	920
30/07/2014	7.4	2400	2100		4	82	1000
Average	7.7	1347	1060		243	46	540
Lamberts North Pond 2							
Date	pH	Conductivity (uS/cm)	TDS (mg/L)	Temperature °C	TSS	Chloride	Sulphate
2/09/2013	7	2800	2300		2	130	140
3/11/2013	8.4	2000	1700		16	110	1100
5/02/2014	8.1	2700	2300		2	130	1300
10/04/2014	7.7	810	560		43	29	310
30/04/2014	8.1	1300	900		26	45	460
18/07/2014	8.1	2000	1500		36	88	890
Average	7.9	1935	1543		21	89	700

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LLS INDUSTRIAL C/- MT PIPER POWER
BOULDER ROAD
PORTLAND NSW 2847 AUSTRALIA
Sold To: 0150139749 **Ship To**: 0150139749
Representative: Clive Stacey

Sample Number	AW044094
Date Sampled	18-Jul-2014
Date Received	24-Jul-2014
Date Completed	7-Aug-2014
Date Authorised	7-Aug-2014

Analytical Report

This sample was analysed as received, the results being as follows:

Sampling point: LN GW Collection 1

Water

Cations Metals	Test Method	Filtered	Total
Chromium Hexavalent (Cr)	External		<0.01 mg/L
Aluminium (Al)	*CA14106		0.1 mg/L
Antimony (Sb)	External		<0.001 mg/L
Arsenic (As)	External		0.001 mg/L
Barium (Ba)	*CA14106		0.04 mg/L
Boron (B)	*CA14106		1 mg/L
Cadmium (Cd)	*CA14106		<0.01 mg/L
Calcium (Ca)	*CA14106		120 mg/L
Chromium (Cr)	*CA14106		<0.01 mg/L
Cobalt (Co)	*CA14106		0.01 mg/L
Copper (Cu)	*CA14106		<0.01 mg/L
Iron (Fe)	*CA14106	<0.01 mg/L	0.14 mg/L
Lead (Pb)	*CA14106		<0.01 mg/L
Magnesium (Mg)	*CA14106		79 mg/L
Manganese (Mn)	*CA14106		0.25 mg/L
Mercury (Hg)	External		<0.00005 mg/L
Nickel (Ni)	*CA14106		0.07 mg/L
Potassium (K)	*CA14106		35 mg/L
Selenium (Se)	External		0.008 mg/L
Silver (Ag)	External		<0.001 mg/L
Sodium (Na)	*CA14106		240 mg/L
Zinc (Zn)	*CA14106		0.08 mg/L

Anions Test Method: *CA15000	Filtered
Fluoride (F)	1 mg/L
Chloride (Cl)	92 mg/L
Bromide (Br)	<1 mg/L
Sulfate (SO4)	920 mg/L
Nitrate (N)	1.9 mg/L
Nitrite (N)	<0.3 mg/L

Analytical Report

This sample was analysed as received, the results being as follows:

Sampling point: LN GW Collection 1

Alkalinity **Test Method: *CA12121**	**Total**
Total Alkalinity (CaCO3)	100 mg/L
Phenolphthalein Alkalinity (CaCO3)	<25 mg/L
Bicarbonate (CaCO3)	100 mg/L

Physical	**Test Method**	**Total**
Conductivity at 25°C	*CA12121	2000 µS/cm
pH @ 25°C	*CA12121	8.2 pH Units
Total Suspended Solids @ 105°C	*CA12119	7 mg/L
Total Dissolved Solids @ 180°C	*CA12120	1600 mg/L

External Analysis Performed By: Australian Laboratory Services. NATA Accreditation no. 825. Report Number: ES1417084. Report Date: 7-Aug-2014
Chromium, Hexavalent (Cr)

External Analysis Performed By: National Measurement Institute. NATA Accreditation no. 198. Report Number: RN1031365. Report Date: 4-Aug-2014
Total ICP

Customer Analytical Services
Gate 5 / 3 Anderson Street Botany NSW 2019
Phone: (612) 9392 3708 Fax: (612) 9392 3722 Email: customeranalyticalservices@nalco.com

Final - Report Number: 1211489
LLS INDUSTRIAL C/- MT PIPER POWER
BOULDER ROAD
PORTLAND NSW 2847 AUSTRALIA
Sold To: 0150139749 **Ship To**: 0150139749
Representative: Clive Stacey

Sample Number	AW044095
Date Sampled	18-Jul-2014
Date Received	24-Jul-2014
Date Completed	7-Aug-2014
Date Authorised	7-Aug-2014

Analytical Report

This sample was analysed as received, the results being as follows:

Sampling point: LN Pond 2 Big Pond

Water

Cations - Metals	Test Method	Filtered	Total
Chromium Hexavalent (Cr)	External		<0.01 mg/L
Aluminium (Al)	*CA14106		0.2 mg/L
Antimony (Sb)	External		<0.001 mg/L
Arsenic (As)	External		0.001 mg/L
Barium (Ba)	*CA14106		0.04 mg/L
Boron (B)	*CA14106		1 mg/L
Cadmium (Cd)	*CA14106		<0.01 mg/L
Calcium (Ca)	*CA14106		120 mg/L
Chromium (Cr)	*CA14106		<0.01 mg/L
Cobalt (Co)	*CA14106		<0.01 mg/L
Copper (Cu)	*CA14106		<0.01 mg/L
Iron (Fe)	*CA14106	<0.01 mg/L	0.32 mg/L
Lead (Pb)	*CA14106		<0.01 mg/L
Magnesium (Mg)	*CA14106		74 mg/L
Manganese (Mn)	*CA14106		0.08 mg/L
Mercury (Hg)	External		<0.00005 mg/L
Nickel (Ni)	*CA14106		0.04 mg/L
Potassium (K)	*CA14106		35 mg/L
Selenium (Se)	External		0.006 mg/L
Silver (Ag)	External		<0.001 mg/L
Sodium (Na)	*CA14106		240 mg/L
Zinc (Zn)	*CA14106		0.03 mg/L

Anions Test Method: *CA15000	Filtered
Fluoride (F)	1 mg/L
Chloride (Cl)	88 mg/L
Bromide (Br)	<1 mg/L
Sulfate (SO4)	890 mg/L
Nitrate (N)	2.0 mg/L
Nitrite (N)	<0.3 mg/L

Analytical Report

This sample was analysed as received, the results being as follows:

Sampling point: LN Pond 2 Big Pond

Alkalinity **Test Method: *CA12121**	**Total**
Total Alkalinity (CaCO3)	100 mg/L
Phenolphthalein Alkalinity (CaCO3)	<25 mg/L
Bicarbonate (CaCO3)	100 mg/L

Physical	**Test Method**	**Total**
Conductivity at 25°C	*CA12121	2000 µS/cm
pH @ 25°C	*CA12121	8.1 pH Units
Total Suspended Solids @ 105°C	*CA12119	36 mg/L
Total Dissolved Solids @ 180°C	*CA12120	1500 mg/L

External Analysis Performed By: Australian Laboratory Services. NATA Accreditation no. 825. Report Number: ES1417084. Report Date: 7-Aug-2014
Chromium, Hexavalent (Cr)

External Analysis Performed By: National Measurement Institute. NATA Accreditation no. 198. Report Number: RN1031365. Report Date: 4-Aug-2014
Total ICP

Customer Analytical Services
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Final - Report Number: 1211489

LLS INDUSTRIAL C/- MT PIPER POWER
BOULDER ROAD
PORTLAND NSW 2847 AUSTRALIA
Sold To: 0150139749 **Ship To:** 0150139749
Representative: Clive Stacey

Sample Number	AW044096
Date Sampled	18-Jul-2014
Date Received	24-Jul-2014
Date Completed	7-Aug-2014
Date Authorised	7-Aug-2014

Analytical Report

This sample was analysed as received, the results being as follows:

Sampling point: LN Pond 2 Seepage Inflow

Water

Cations - Metals	Test Method	Filtered	Total
Chromium Hexavalent (Cr)	External		<0.01 mg/L
Aluminium (Al)	*CA14106		<0.1 mg/L
Antimony (Sb)	External		<0.001 mg/L
Arsenic (As)	External		0.002 mg/L
Barium (Ba)	*CA14106		0.01 mg/L
Boron (B)	*CA14106		2 mg/L
Cadmium (Cd)	*CA14106		<0.01 mg/L
Calcium (Ca)	*CA14106		130 mg/L
Chromium (Cr)	*CA14106		<0.01 mg/L
Cobalt (Co)	*CA14106		<0.01 mg/L
Copper (Cu)	*CA14106		<0.01 mg/L
Iron (Fe)	*CA14106	<0.01 mg/L	0.04 mg/L
Lead (Pb)	*CA14106		<0.01 mg/L
Magnesium (Mg)	*CA14106		75 mg/L
Manganese (Mn)	*CA14106		0.57 mg/L
Mercury (Hg)	External		<0.00005 mg/L
Nickel (Ni)	*CA14106		0.13 mg/L
Potassium (K)	*CA14106		47 mg/L
Selenium (Se)	External		0.010 mg/L
Silver (Ag)	External		<0.001 mg/L
Sodium (Na)	*CA14106		310 mg/L
Zinc (Zn)	*CA14106		0.13 mg/L

Anions Test Method: *CA15000	Filtered
Fluoride (F)	2 mg/L
Chloride (Cl)	110 mg/L
Bromide (Br)	<1 mg/L
Sulfate (SO4)	1100 mg/L
Nitrate (N)	2.8 mg/L
Nitrite (N)	<0.3 mg/L

Analytical Report

This sample was analysed as received, the results being as follows:

Sampling point: LN Pond 2 Seepage Inflow

Alkalinity	**Test Method: *CA12121**	**Total**
Total Alkalinity (CaCO3)		120 mg/L
Phenolphthalein Alkalinity (CaCO3)		<25 mg/L
Bicarbonate (CaCO3)		120 mg/L

Physical	**Test Method**	**Total**
Conductivity at 25°C	*CA12121	2400 µS/cm
pH @ 25°C	*CA12121	7.8 pH Units
Total Suspended Solids @ 105°C	*CA12119	5 mg/L
Total Dissolved Solids @ 180°C	*CA12120	1800 mg/L

External Analysis Performed By: Australian Laboratory Services. NATA Accreditation no. 825. Report Number: ES1417084. Report Date: 7-Aug-2014
Chromium, Hexavalent (Cr)

External Analysis Performed By: National Measurement Institute. NATA Accreditation no. 198. Report Number: RN1031365. Report Date: 4-Aug-2014
Total ICP

Customer Analytical Services
Gate 5 / 3 Anderson Street Botany NSW 2019
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Final - Report Number: 1242035
LLS INDUSTRIAL C/- MT PIPER POWER
BOULDER ROAD
PORTLAND NSW 2847 AUSTRALIA
Sold To: 0150139749 **Ship To:** 0150139749
Representative: Clive Stacey

Sample Number	AW045000
Date Sampled	30-Jul-2014
Date Received	22-Aug-2014
Date Completed	15-Sep-2014
Date Authorised	18-Sep-2014

Analytical Report

This sample was analysed as received, the results being as follows:

Sampling point: MPiper - Ramberts Nth Seepage Collection Drain

Water

Cations - Metals	Test Method	Filtered	Total
Mercury (Hg)	*CA14500		<0.00005 mg/L
Aluminium (Al)	*CA14106		<0.1 mg/L
Barium (Ba)	*CA14106		0.03 mg/L
Beryllium (Be)	*CA14106		<0.01 mg/L
Boron (B)	*CA14106		<1 mg/L
Cadmium (Cd)	*CA14106		<0.01 mg/L
Calcium (Ca)	*CA14106		200 mg/L
Chromium (Cr)	*CA14106		<0.01 mg/L
Cobalt (Co)	*CA14106		<0.01 mg/L
Copper (Cu)	*CA14106		<0.01 mg/L
Iron (Fe)	*CA14106	<0.01 mg/L	0.06 mg/L
Lead (Pb)	*CA14106		<0.1 mg/L
Magnesium (Mg)	*CA14106		230 mg/L
Manganese (Mn)	*CA14106		0.06 mg/L
Molybdenum (Mo)	*CA14106		<0.1 mg/L
Nickel (Ni)	*CA14106		<0.01 mg/L
Potassium (K)	*CA14106		18 mg/L
Sodium (Na)	*CA14106		140 mg/L
Strontium (Sr)	*CA14106		0.65 mg/L
Titanium (Ti)	*CA14106		<0.01 mg/L
Vanadium (V)	*CA14106		<0.01 mg/L
Zinc (Zn)	*CA14106		<0.01 mg/L
Antimony (Sb)	*CA14503		0.001 mg/L
Arsenic (As)	*CA14503		<0.001 mg/L
Cadmium (Cd)	*CA14503		<0.0002 mg/L
Lead (Pb)	*CA14503		<0.001 mg/L
Selenium (Se)	*CA14503		0.009 mg/L
Silver (Ag)	*CA14503		<0.001 mg/L

Analytical Report

This sample was analysed as received, the results being as follows:

Sampling point: MPiper - Ramberts Nth Seepage Collection Drain

Anions	**Test Method: *CA15000**	**Filtered**
Chloride (Cl)		82 mg/L
Sulfate (SO4)		1000 mg/L

Alkalinity	**Test Method: *CA12121 (CA11113)**	**Total**
Total Alkalinity (CaCO3)		500 mg/L
Phenolphthalein Alkalinity (CaCO3)		<25 mg/L
Bicarbonate (CaCO3)		500 mg/L

Physical	**Test Method**	**Total**
Conductivity at 25°C	*CA12121 (CA11116)	2400 µS/cm
pH @ 25°C	*CA12121 (A-4.4)	7.4 pH Units
Total Suspended Solids @ 105°C	*CA12119	4 mg/L
Total Dissolved Solids @ 180°C	*CA12120	2100 mg/L

Regulatory Comments

CA14106 according to APHA 3030 E, F & 3120 B

Titanium by CA14106 - NATA Accreditation does not cover the performance of this service.

CA12120 according to APHA 2540 C

Customer Analytical Services
Ecolab Nalco Unit 12, 2 Eden Park Drive Macquarie Park NSW 2113
Phone: (612)8870 8433 Email: customeranalyticalservices@nalco.com

NALCO Water
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Final - **Report Number:** 1907639
LEND LEASE C/-MOUNT PIPER POWER
BOULDER ROAD
PORTLAND NSW 2847 AUSTRALIA
Sold To: 0500092084 **Ship To**: 0500092084
Representative: CLIVE STACEY

Sample Number	AW060819
Date Sampled	16-Nov-2016
Date Received	23-Nov-2016
Date Completed	2-Dec-2016
Date Authorised	5-Dec-2016

Summary Report

This sample was analysed as received, the results being as follows:

Sampling point: MP LN DRAINAGE

Testing Laboratory: ALS Environmental

Water

Cations - Metals	Test Method	Filtered	Total
Aluminium (Al)	EG005T		612 mg/L
Antimony (Sb)	EG005T		<0.01 mg/L
Barium (Ba)	EG005T		<0.1 mg/L
Beryllium (Be)	EG005T		0.37 mg/L
Boron (B)	EG005T		31.6 mg/L
Cadmium (Cd)	EG005T		0.153 mg/L
Calcium (Ca)	ED093T		435 mg/L
Chromium (Cr)	EG005T		0.17 mg/L
Cobalt (Co)	EG005T		0.50 mg/L
Copper (Cu)	EG005T		0.50 mg/L
Iron (Fe)	EG005F	<0.05 mg/L	
Iron (Fe)	EG005T		11.4 mg/L
Lead (Pb)	EG005T		0.02 mg/L
Magnesium (Mg)	ED093T		100 mg/L
Manganese (Mn)	EG005T		14.9 mg/L
Molybdenum (Mo)	EG005T		0.03 mg/L
Nickel (Ni)	EG005T		1.37 mg/L
Potassium (K)	ED093T		375 mg/L
Silica (SiO2)	ED040T		85.4 mg/L
Sodium (Na)	ED093T		394 mg/L
Strontium (Sr)	EG005T		14.8 mg/L
Titanium (Ti)	EG005T		<0.01 mg/L
Vanadium (V)	EG005T		0.02 mg/L
Zinc (Zn)	EG005T		4.58 mg/L

Authorised by Mohammad Sjam
Chemist

Customer Analytical Services
Ecolab Nalco Unit 12, 2 Eden Park Drive Macquarie Park NSW 2113
Phone: (612)8870 8433 Email: customeranalyticalservices@nalco.com

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Final - Report Number: 1907639
LEND LEASE C/-MOUNT PIPER POWER
BOULDER ROAD
PORTLAND NSW 2847 AUSTRALIA
Sold To: 0500092084 **Ship To**: 0500092084
Representative: CLIVE STACEY

Sample Number	AW060819
Date Sampled	16-Nov-2016
Date Received	23-Nov-2016
Date Completed	2-Dec-2016
Date Authorised	5-Dec-2016

Summary Report

This sample was analysed as received, the results being as follows:

Sampling point: MP LN DRAINAGE

Testing Laboratory: ALS Environmental

Anions **Test Method: ED009-X**	**Filtered**
Chloride (Cl)	96.7 mg/L
Sulfate (SO4)	1840 mg/L

Alkalinity **Test Method: ED037-P**	**Total**
Total Alkalinity (CaCO3)	76 mg/L
Phenolphthalein Alkalinity (CaCO3)	<1 mg/L

Physical	**Test Method**	**Total**
Conductivity at 25°C	EA010-P	3680 µS/cm
pH @ 25°C	EA005-P	7.04 pH Units
Total Suspended Solids @ 105°C	EA025H	24 mg/L
Total Dissolved Solids @ 180°C	EA015H	2940 mg/L

Testing services provided by: ALS Environmental. NATA accreditation number 825. Refer attached document for ALS Environmental NATA accredited report.

Authorised by Mohammad Sjam
Chemist

LN runoff collection sump 1

Sample ID		MP LN SUMP 1 stability wall	MP LN SUMP 1 stability wall
Date Sampled		25/01/2016	12/02/2016
Laboratory Report		aw056035	aw056336
Date Tested			
pH		7.58	7.54
Conductivity (uS/cm)		2280	2700
TDS (mg/L)	[gravimetric]	1480	1890
Temperature °C			
TSS	mg/L	85	22
Chloride	mg/L	69.1	78
Sulphate	mg/L	953	1090
Total Alkalinity (CaCO3) mg/L		102	172
Phenophthalein Alkalinity mg/L		1	1
BiCarbonate mg/L		102	172
Nitrate	mg/L	0.56	0.76
Nitrite	mg/L	0.01	0.01
Hg	mg/L	0.00004	0.00004
Al	mg/L	4.24	3.07
Ba	mg/L	0.1	0.1
B	mg/L	3.7	4.6
Ca	mg/L	185	194
Cr	mg/L	0.01	0.01
Co	mg/L	0.02	0.01
Cu	mg/L	0.01	0.01
Fe	mg/L	0.05	0.05
Fe	mg/L Unfiltered)		
Mg	mg/L	51	64
Mn	mg/L	0.54	0.74
Ni	mg/L	0.13	0.14
K	mg/L	58	72
SiO2	mg/L		
Na	mg/L	276	292
Zn	mg/L	0.34	0.33
Sb	mg/L	0.016	0.021
As	mg/L	0.005	0.005
Cd	mg/L	0.022	0.0209
Pb	mg/L	0.003	0.001
Se	mg/L	0.04	0.07
Ag	mg/L	0.001	0.001

Attachment 2

Lithgow Rainfall Data from January, 2000 to August, 2016 (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					

Attachment 3

a) Map of Coal Mine workings in the Mt Piper Ash Placement Area

b) Mt Piper Power Station and Lamberts North Groundwater Bore Collar and Pipe Height Survey results for:

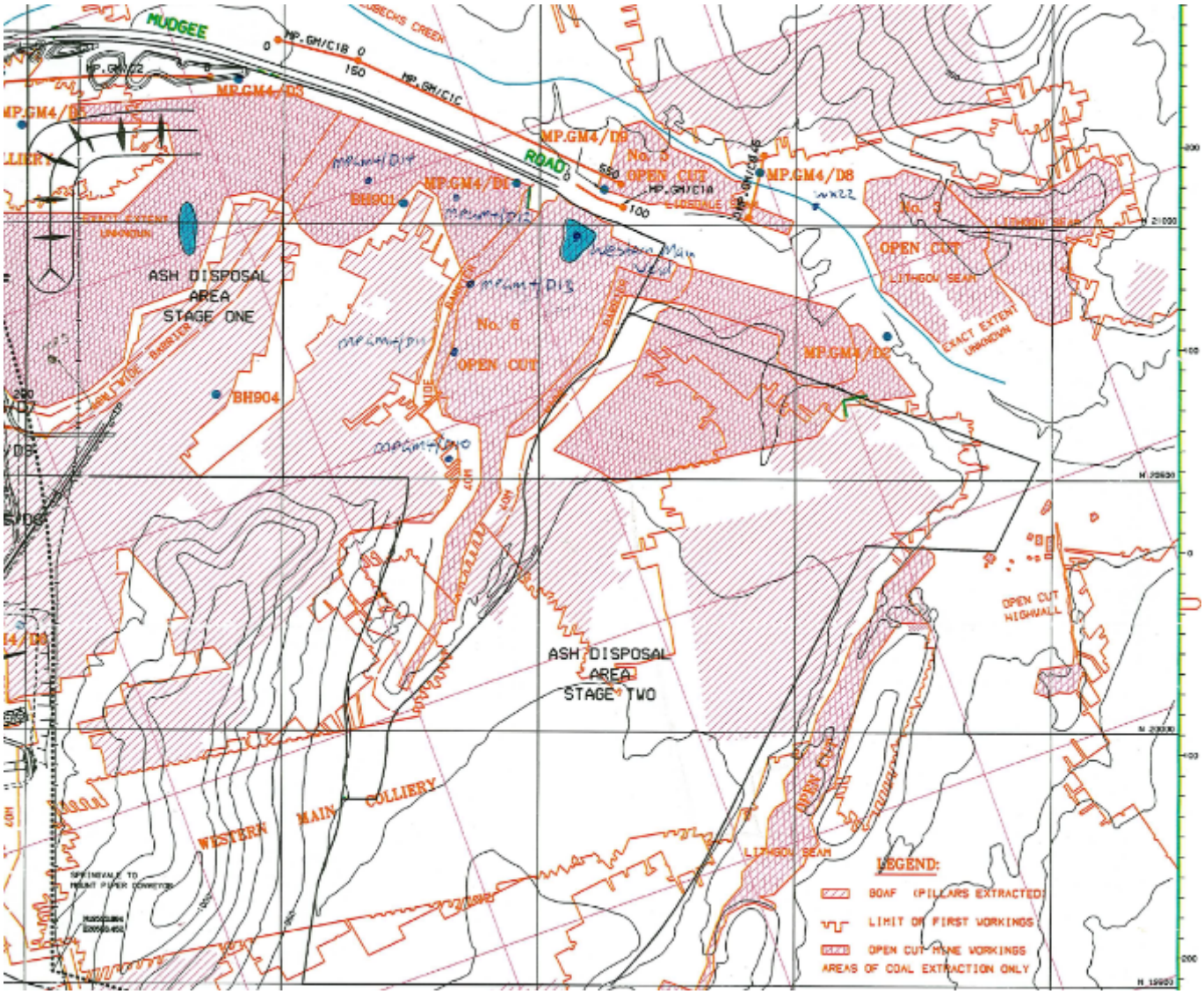
i) December, 2011 with Bores MPGM4/D9 and D19 Levels in 2012

i) Groundwater Level Survey 20th March, 2014 including water level of SW3 Pond and underground coal mine water seepage point into Huon Gully

c) Bore logs for MPGM4/D20 (Lamberts North embankment) and MPGM4/D1

a) Map of Coal Mine workings in the Mt Piper Ash Placement Area

(Bores B901 and MPGM4/D11 sample western Main open-cut groundwater; B904 and MPGM4/D10 sample underground goaf coal mine groundwater)



i) Groundwater Bore Survey results December, 2011					
Bore Name	**Easting**	**Northing**	**Ground level RLm**	**Top of pipe RLm**	**Pipe Height m**
MPGM4/D1	225603.983	6305355.123	911.973	912.603	0.63
MPGM4/D3	225168.952	6305718.268	919.834	920.014	0.18
MPGM4/D4	224609.58	6305939.21	919.38	919.64	0.26
MPGM4/D5	224727.822	6305772.088	925.347	925.787	0.44
MPGM4/D8	226000.54	6305241.889	905.899	906.449	0.55
MPGM4/D9*	225686.68	6305313.55	909.566	909.664	0.098
MPGM4/D11	225312.635	6305090.199	937.344	937.48	0.15
MPGM4/D10	225241.559	6304897.926	925.932	926.087	0.14
MPGM4/D19**			916.947	917.607	0.66

January 2012

**from CDM Smith (2012) and Delta Electricity May 2013.

ii) Groundwater Level Survey 20th March, 2014

MT PIPER POWER STATION WATER MONITORING

Survey Date 20/03/14

Notes			
Vertical Datum is 'Australian Hieght Datum' (AHD)			
Horizontal Datum is Map Grid Australia (MGA)			
Origin for Survey PM 69965	MGA East 224266.86	MGA North 6306197.29	AHD Height 934.946

D 10	MGA EAST	MGA NORTH	AHD HEIGHT
GROUND	225241.71	6304897.87	925.95
TOP OF CONDUIT	225241.69	6304897.87	926.06

	MGA EAST	MGA NORTH	AHD HEIGHT	Comments
MINE WATER SEEPAGE POINT INTO HUON GULLY	225242.29	6304874.82	923.16	Ground wet but little seepage
	225248.59	6304873.18	920.02	Seepage flowing
POND WATER LEVEL	225279.48	6304894.09	915.34	

D 11	MGA EAST	MGA NORTH	AHD HEIGHT
GROUND	225312.69	6305090.30	937.30
TOP OF CONDUIT	225312.67	6305090.30	937.37

D 15	MGA EAST	MGA NORTH	AHD HEIGHT
GROUND	225027.57	6304669.51	940.18
TOP OF CONDUIT	225027.46	6304669.58	940.83

D 16	MGA EAST	MGA NORTH	AHD HEIGHT
GROUND	225090.33	6304252.03	921.11
TOP OF CONDUIT	225090.35	6304251.90	921.82

D 17	MGA EAST	MGA NORTH	AHD HEIGHT
GROUND	225454.95	6304437.14	935.69
TOP OF CONDUIT	225454.86	6304437.13	936.50

D 18	MGA EAST	MGA NORTH	AHD HEIGHT
GROUND	225278.06	6304710.02	932.18
TOP OF CONDUIT	225278.00	6304709.93	932.79

POND SW3	MGA EAST	MGA NORTH	AHD HEIGHT
WATER LEVEL	225142.93	6304987.14	932.53

c) Bore logs for MPGM4/D20 and MPGM4/D1

Borehole No: D20

Engineering Log - Borehole

SHEET 1 OF 3

Client	Energy Australia	Project No.	245409
Project	Mount Piper D10 Chloride Investigation	Logged By	JK
Location	Mount Piper Power Station	Checked By	ML

Started Drilling	8.12.15	Northing	6305271.00	Slope	90°	Equipment	Sonic Rig
Completed Drilling	8.12.15	Easting	225571.00	Bearing	---	Ground Level	928.42 AHD

DRILLING				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION			
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)	Well Details
		928	0			FILL: Silty CLAY: low to medium plasticity, dark grey, brown, with fine to medium grained angular gravel	<PL	St			FILL 0 - 0.5 concrete seal with steel monument	
		927	1									
		926	2									
		925	3									
		924	4									
		923	5									
		922	6									
		921	7									
		920	8									
		919	9									
			10									

Remarks:

Well Legend:

Cement Seal | Slough Backfill: 1 pipe group, 1 pipe | Bentonite Seal | Blank PVC Pipe with Sand Backfill | Slotted PVC Pipe with Sand Backfill | Slough at Bottom of Hole

AURECON SYD LIB 05.GLB Log WW BOREHOLE & WELL LOG MOUNT PIPER LOGS.GPJ <<DrawingFile>> 20/04/2016 14:38 8.30.002 Developed by Datgel

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Engineering Log - Borehole

Client	Energy Australia	Project No.	245409
Project	Mount Piper D10 Chloride Investigation	Logged By	JK
Location	Mount Piper Power Station	Checked By	ML

Started Drilling	8.12.15	Northing	6305271.00	Slope	90°	Equipment	Sonic Rig
Completed Drilling	8.12.15	Easting	225571.00	Bearing	---	Ground Level	928.42 AHD

DRILLING				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION			
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)	Well Details
		918	11			FILL: Silty CLAY: low to medium plasticity, dark grey, brown, with fine to medium grained angular gravel *(continued)*					FILL	
		917	12			FILL: Silty CLAY: medium plasticity, dark grey, with siltstone and shale fragments						
		916	13									
		915	14				<PL					
		914	15					St				
		913	16									
	02/02/16	912	17									
		911	18									
		910	19				>>PL					
		909	20									

Remarks:

Well Legend:

Cement Seal | Slough Backfill: 1 pipe group, 1 pipe | Bentonite Seal | Blank PVC Pipe with Sand Backfill | Slotted PVC Pipe with Sand Backfill | Slough at Bottom of Hole

Borehole No: D20

Engineering Log - Borehole

Client	Energy Australia	Project No.	245409
Project	Mount Piper D10 Chloride Investigation	Logged By	JK
Location	Mount Piper Power Station	Checked By	ML

Started Drilling	8.12.15	Northing	6305271.00	Slope	90°	Equipment	Sonic Rig
Completed Drilling	8.12.15	Easting	225571.00	Bearing	---	Ground Level	928.42 AHD

DRILLING				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION			
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)	Well Details
		908	21			FILL: Silty CLAY: medium plasticity, dark grey, with siltstone and shale fragments *(continued)* COAL: Dark grey, low strength, slightly weathered					BEDROCK 20 - 21 Bentonite Plug	
		907	22			Borehole D20 Terminated at 21.00 m					Borehole terminated at target depth	
		906	23									
		905	24									
		904	25									
		903	26									
		902	27									
		901	28									
		900	29									
		899	30									

Remarks:

Well Legend:

Cement Seal | Slough Backfill: 1 pipe group, 1 pipe | Bentonite Seal | Blank PVC Pipe with Sand Backfill | Slotted PVC Pipe with Sand Backfill | Slough at Bottom of Hole

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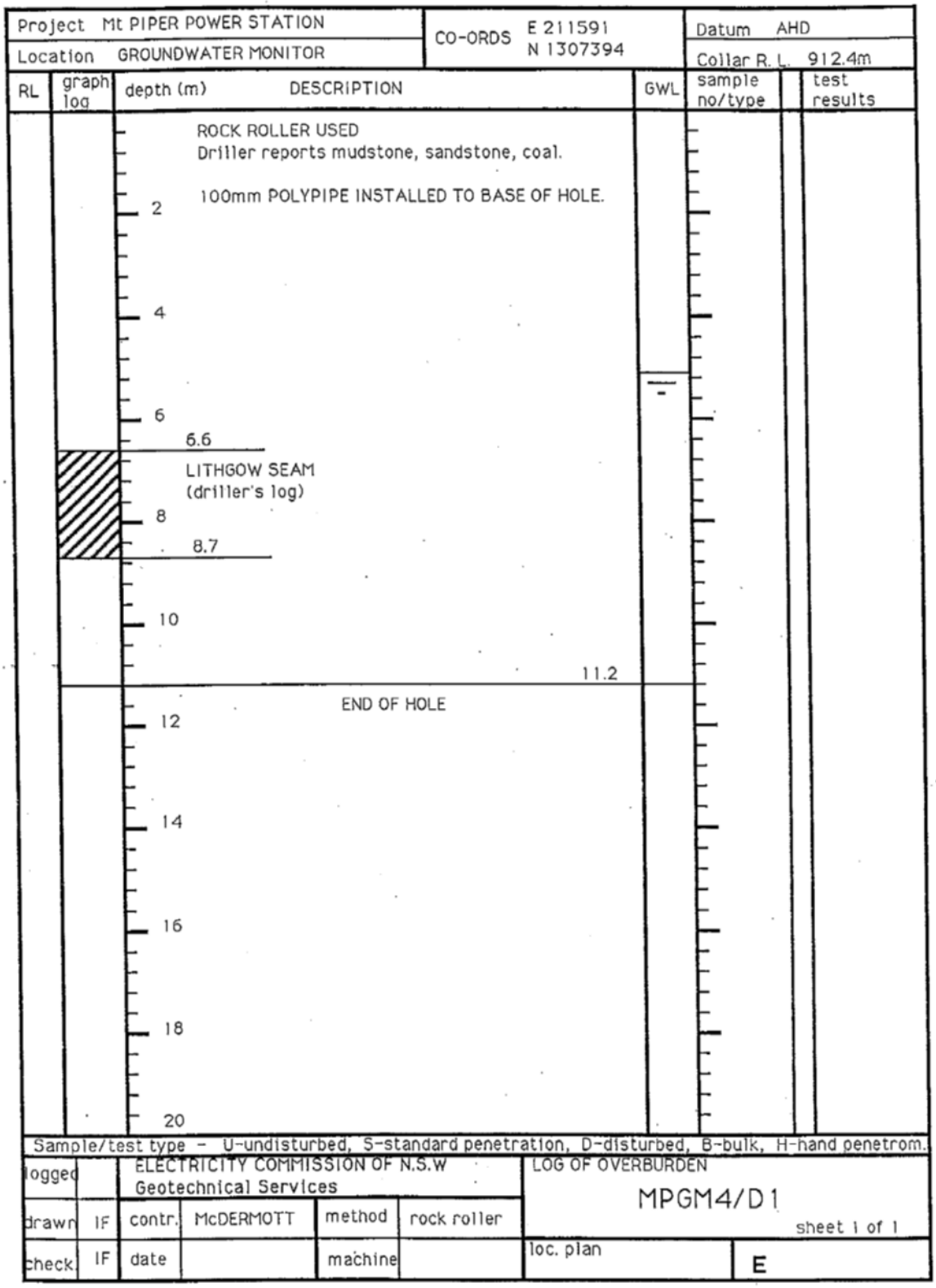
Bore Log MPGM4/D1



Attachment 4

Assessment Criteria – Local baseline and ANZECC (2000) Trigger values for Groundwater receiving waters and Neubecks Creek (Aurecon, 2011) in OEMP by CDM Smith (2013)

Assessment Criteria – Local baseline and ANZECC (2000) Trigger values for Groundwater receiving waters and Neubecks Creek (Aurecon, 2011) in OEMP by CDM Smith (2013)

Table 7-3: Assessment Criteria – Local baseline and ANZECC (2000) Trigger values for Groundwater receiving waters and Neubecks Creek (Aurecon, 2011)

Element	Groundwater Collection Basin Pre-placement 90th Percentile	Groundwater ANZECC or Local Guidelines #	Neubecks Creek at WX22 Pre-placement 90th Percentile	Surface Water ANZECC or Local Guidelines #
General Water Quality (mg/L)				
pH		6.5 – 8.0	6.7-7.8	6.5 – 8.0
Cond/ (uS/cm)	1576	2600^	894	2200
TDS	1306	2000	580	1500^
Cl	31.5	350	22	350+
SO4	824	1000	332	1000 ++
Trace Metals (mg/L)				
As	0.001	0.024	<0.001	0.024
Ag	<0.001	0.00005	-	0.00005
Ba	0.037	0.7	0.029	0.7+++
Be	0.001	0.1	<0.001	0.1
B	0.244	0.37	0.09	0.37
Cd	0.002	0.002	<0.001	0.00085
Cr	0.001	0.005	<0.001	0.002
Cu	0.001	0.005	<0.001	0.0035
F	0.435	1.5	0.338	1.5+++
Fe	0.664	0.664	0.281	0.3+++
Hg	<0.0001	0.00006	-	0.00006
Mn	5.704	5.704	0.72	1.9
Mo	0.001	0.01	<0.001	0.01+
Ni	0.356	**0.5509**	0.005	0.017
Pb	0.001	0.005	<0.001	0.005
Se	0.002	0.005	<0.001	0.005
Zn	0.908	**0.908**	0.061	**0.116**

Notes: * High detection limits used when determining the baseline concentrations. ^ 2000 mg/L TDS/0.77 for groundwater; 0.68 x 2200 uS/cm low land river conductivity protection of aquatic life. # ANZECC (2000) guidelines for protection of freshwaters, livestock, irrigation water or drinking water. Local guideline based upon 90th percentile pre-brine placement (**shown in bold**). Cadmium, Chromium, Copper, lead, nickel and zinc adjusted for effects of hardness: Current Ca, Mg in GCB 147, 113 mg/L: in Neubecks Creek 19.7, 11.8 mg/L, respectively. + Irrigation water moderately tolerant crops; irrigation. Note: Molybdenum drinking is 0.05 mg/L ++ Livestock +++ drinking water.

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