Mt Piper Brine Conditioned Fly ash Co-Placement Environmental Monitoring Report

Annual Environmental Monitoring Report 2016/17

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Summary

Aurecon has been engaged to assist EnergyAustralia NSW in their statutory reporting on the Mt Piper Power Station brine co-placement area for the effects of the Stage I and Stage II brine conditioned ash co-placement on chloride, salinity and trace metals in receiving surface and groundwater during 2016/17.

The key findings of the 2016/17 water quality data review were:

- The Stage I and II brine co-placement system in the northern area of the site has effectively prevented brine leachates in the ash pores from entering the groundwater, so no significant effects were seen at the seepage detection bore MPGM4/D3.
- Although leachate from under the southern Mt Piper water and brine conditioned ash areas is entering the groundwater and is the potential cause of the high chloride in bore MPGM4/D10, increased coal mine ground water recharge during high rainfall events significantly lowered chloride concentrations entering the upper Huon Gully.
- The local and ANZECC (2000) guidelines for chloride and trace metals (including nickel) in the receiving groundwater bore MPGM4/D9 have continued to be met, other than for salinity and sulphate, as well as the coal mine groundwater related boron.
- At the Neubecks Creek receiving water site, WX22, the local and ANZECC (2000) guidelines were met for all the characteristics of salinity, chloride and trace metals.
- Increasing groundwater recharge through improving rainfall runoff controls may further reduce chloride concentrations and could be considered as part of further investigations to mitigate the chloride concentrations in the upper Huon Gully.

1. Introduction

Aurecon Australasia Pty Ltd (Aurecon) has been engaged by EnergyAustralia NSW to undertake the Environmental Monitoring Report for surface and groundwater quality at the Mt Piper Brine Conditioned Fly Ash Co-placement Facility. The report is the annual update report for water quality during the period July, 2016 to June, 2017 to be provided by EnergyAustralia NSW to the Department of Planning and Environment. The approved area for brine placement is shown in Figure 1.

The Mt Piper Power Station Brine Conditioned Flyash Co-placement Extension Water Management and Monitoring Plan (26th September, 2008), called the WMP, is shown in Attachment 6 to this report. The development consent conditions for the brine Area 1 and Area 2 are shown in Attachments 2 and 4 of the WMP. The conditions for extension of the brine and ash co-placement area of 23rd March, 2008 require that the cooling tower blowdown brine co-placement is undertaken generally in accordance with the Statement of Environmental Effects (SEE) dated June, 2007 by Connell Wagner (2007).

The main conditions in the SEE and the consent conditions are:

- The SEE was prepared on the basis that the ash placements in NSW are not classified as a “controlled waste facility” and therefore did not have to be licenced under the waste management legislation.
- Brine co-placement, with some of the ash at Mt Piper, was approved and the ash area status remained as not classified as a “controlled waste facility”. That status was on the basis that the SEE groundwater modelling predicted the effective immobilisation of brine in the ash such that the increase above background, due to the movement of brine to the groundwater, would meet the ANZECC guidelines in Neubecks Creek;
- Brine conditioning of the ash is to occur in about 7% of the annual flyash production with brine to give 15% moisture, which was estimated to be about 17% brine[1];
- Brine conditioned flyash is to be placed within the existing ash placement area and between RL946m and RL980m;
- Control of surface rainfall runoff from the water conditioned ash and collection and reuse of rainfall on the brine conditioned ash areas;
- Contingency plans for the mitigation of environmental impacts of runoff or leachates negatively impacting natural surface water or groundwater.

How the WMP applies to the surface and groundwater quality monitoring presented in this report is discussed in Section 1.3. The areas of the Stage I (Benches B1 & B2) and Stage II (B3, B5 and B6) brine conditioned ash placement are shown in Figure 1.

1.1 Recommendations from the 2015/16 report and responses thereto

The 2015/16 report recommendations included:

- Continue the routine monthly monitoring at all the groundwater bores, as well as at Neubecks Creek, to confirm they meet the requirements of the 2008 Water Management Plan.

[1] 17% brine conditioned ash was the maximum used for modelling of the potential effects of the brine conditioned ash on the local surface and groundwater quality by the UTS model of Merrick and Tammetta (1999) and Merrick (2007).

EnergyAustralia have advised that they have continued to monitor all groundwater bores and surface water sites during this reporting period.

- Delay the decision whether to re-run the UTS groundwater model after the investigation of the groundwater conditions beneath the Lamberts North ash placement are known.

  EnergyAustralia have advised that the decision to re-run the UTS groundwater model has been delayed. Investigations into the groundwater conditions beneath the Lamberts North ash placement are ongoing.

A3 scale: 1:7,500

0 100 200m

Job No:

Projection: MGA Zone 56

Figure 1: Mount Piper Power Station Ash and Brine Stage I and Stage II Co-placement Area Groundwater and Surface Water Quality Monitoring Sites showing Lamberts North Ash Placement Area and bore MPGM4/D19

1.2 Scope

The scope provided by EnergyAustralia NSW for the 2016/17 report is:

- The Mt Piper Brine Conditioned Fly Ash Co-placement Water Quality Assessment Report will be prepared in order to satisfy Conditions 44 (provide the Environmental Monitoring Report for surface and groundwater quality) and 45 of the Project Approval (DP&I, 2000). Condition 45 requires:
    - A summary and written discussion of all available results and analyses from Mt Piper's Water Monitoring Programs
    - A written discussion on the aims of the water management plan (Connell Wagner, 2008) and to what degree these aims have been attained in the context of the water quality results and analyses of the Water Monitoring Programs, as set out in Connell Wagner, 2008.
    - Recommendations regarding the actions taken, or intended to be taken, if any, to mitigate any adverse environmental impacts in accordance with the requirements set out in Connell Wagner, 2008 Water Management Plan.

- The report is to cover the operations between July of the previous year and June of the present year. The report is to be provided to EnergyAustralia NSW in time for them to provide comments on the draft and the final report to be submitted to the Department of Planning and Environment by 30th September, 2017.

- Review surface and groundwater water quality and trace metal data at Mt Piper Power Station brine co-placement area for the reporting period and report on potential effects on receiving surface water and groundwater.

- Assessment of the EnergyAustralia NSW groundwater data for the bore MPGM4/D19, at the Lamberts North ash placement area for possible interaction with the Neubecks Creek water quality.

- Review the monthly changes including long-term trends in surface and groundwater concentrations and potential effects of the recent chloride increases at bore D10 on the receiving groundwater and surface water in Neubecks Creek.

- Review surface and groundwater water quality and trace metal data obtained as part of investigations into the chloride increases at bore D10.

- The surface water and groundwater review is also to take into account the mineralised background effects of the local, abandoned, coal mine groundwater inflows.

Accordingly, the aim of this annual update report is to review the updated groundwater and surface water quality data for the effects of the Mt Piper groundwater on the receiving water bores MPGM/4D8 and D9, as well as in Neubecks Creek at the WX22 receiving water site. This involves the effects of the background coal mine groundwater flows from the western bores MPGM4/D4 and D5 (Figure 1) through the rubble drain (called "Inter-burden layer" in Figure 13) in the open-cut coal mine void, which underlies the Mt Piper ash, into Huon Gully (Merrick, 2007), as well as coal mine groundwater inflows from south of the ash placement area into Huon Gully.

1.3 Mt Piper Brine Conditioned Ash Water Management Plan

The surface and groundwater monitoring required to provide feed-back for management of the Mt Piper brine conditioned ash area is set out in the Mt Piper Brine Conditioned Ash Water Management Plan, for the Stage II extension (Connell Wagner, 2008a – see Attachment 6). The aim of the Water

Management Plan is to prevent local groundwater effects due to surface runoff from the brine placement areas. Hence, the overall aim of the monitoring is to ascertain whether or not leachates from the brine conditioned fly ash cause a significant increase in concentrations of the various water quality characteristics in the surface and groundwater receiving waters.

The Water Management Plan sets out various levels of warning of potential surface and groundwater effects of the brine placement areas. These are the ANZECC (2000) guideline trigger values, locally derived guideline concentrations and early warning of changes provided by the ANZECC (2000) guideline procedure, namely, in the event of the post-brine placement median exceeding the pre-placement 90th percentile, all of which apply to the receiving waters (see Section 2.7).

Bores MPGM4/D10 and D11 are located inside the ash placement area and are used for early warning of potential effects on the receiving waters, which are located outside the ash area property boundary. Note that the Local/ANZECC (2000) trigger values for groundwater do not apply to bores MPGM4/D10 or D11. To provide a further means of early warning, seepage detection bores are located just outside the brine areas at bores D1 and D3 (Figure 1).

The groundwater receiving waters are the groundwater sampled by bores D8 and D9, which are near Neubecks Creek. These early warning systems are intended to allow EnergyAustralia NSW time to both investigate the cause of the early warning triggers being exceeded and to implement mitigation measures if the cause is found to be the brine conditioned ash placement area.

The final receiving waters are taken as being Neubecks Creek, just downstream of the ash placement area at the receiving water site WX22 (Figure 1), where the ANZECC (2000) guidelines and local guidelines for surface water apply. The ANZECC (2000) guidelines and local guidelines for the groundwater and surface water receiving waters are from the Water Management Plan (Connell Wagner, 2008a) and are shown in Table 2 in Section 2.7.

1.4 Previous Reports

Previous reports on water quality have been prepared covering the following periods:
- First six months of the Stage I brine conditioned ash placement (PPI, 2001);
- The Stage I (Dumps I to II) placement to October, 2002 (Connell Wagner PPI, 2003);
- Stage I (Dumps II to Stage III) placement from November, 2002 to January, 2006 (Connell Wagner, 2007a);
- Mt Piper Power Station Brine Conditioned Flyash co-placement Water Management Plan Water Quality Monitoring Annual Update Report February, 2006 to January, 2007 (Connell Wagner, 2007b);
- Mt Piper Brine Conditioned Fly ash Co-Placement Water Quality Monitoring Annual Update Reports for:
    - February, 2007 to January, 2008 (Connell Wagner, 2008b)
    - February 2008 to January 2009 (Aurecon, 2009)
    - Calendar year 2009 (Aurecon, 2010)
    - Calendar year 2010 (Aurecon, 2011)
    - Calendar year 2011 (Aurecon, 2012)
    - Calendar year 2012 (Aurecon, 2013)
    - January, 2013 to May, 2014 (Aurecon, 2014)
    - June, 2014 to May, 2015 (Aurecon, 2016)
    - June, 2015 to June, 2016 (Aurecon, 2017).

This report is the thirteenth water quality monitoring report and follows the nine previous annual updates. The report assesses the monthly changes from July, 2016 to June, 2017 and reviews potential effects on the receiving groundwater bores and surface water in Neubecks Creek.

When the effects of the mineralised background effects of the local, abandoned, coal mine groundwater inflows were taken into account, these reports found no significant effects[2] of the brine placement areas on the water quality or trace metals at the receiving water site in Neubecks Creek. This suggests that rainfall recharge has mitigated the chloride, salinity and trace metal concentrations such that they continued to comply with the Local/ANZECC trigger values for the Neubecks Creek receiving water site, other than coal mine groundwater water related boron and nickel inputs.

The previous report for 2015/16 showed, by drilling through the southern brine placement area, that the brine conditioned ash was placed above the required RL 946m level. In addition, the 2015/16 report indicated, from the December, 2015 groundwater drilling, that the source of brine leachates is from beneath the Mt Piper water and brine conditioned ash placements and the upper Huon Gully groundwater has become enriched with salinity and chloride to be above that predicted by the UTS 1999 groundwater model. Since August 2013, the chloride concentrations at bore D10 became highly variable, with markedly reduced concentrations following high rainfall events. The 2014/15 report (Aurecon, 2015) noted that the underground coal mine water inflows from the southern coal mine areas were also recharging the local groundwater. This was followed by the 2015/16 report which noted that those rainfall recharge inflows, sampled at the new MPGM4/D23 bore, had diluted the chloride concentrations migrating from the southern brine area into Huon Gully. This mitigation of the chloride plume was in addition to that from the normal western underground coal mine inflows to Huon Gully via the rubble drain beneath the Lamberts North ash placement.

1.5 Information provided by EnergyAustralia NSW

In connection with the assignment, EnergyAustralia NSW has provided copies of the following data and information:

- Mt Piper bore data for bores MPGM4/D1, D3, D4, D5, D10 and D11
- Bores MPGM4/D8 and D9 as groundwater receiving waters and for early warning of potential effects of local groundwater seepage on Neubecks Creek;
- Bore MPGM4/D19, east of the ash placement area for indication of local coal waste/chitter effects on Neubecks Creek
- Bore MPGM4/D23 which samples the southern coal mine groundwater inflows to the area between the southern brine placement and bore D10 (see Figure 8)
- Mt Piper Power Station Licence discharge Point LDP1 (v-notch below the Holding Pond)
- WX22 (Neubecks Creek)
- Water level data for the groundwater bores
- The brine composition measurements in 2016/17
- Amount of brine used and times used to condition ash in 2016/17
- Ash Placement Area Contours in December, 2016.

EnergyAustralia NSW has also advised Aurecon that water conditioned dry ash began to be placed at the Lamberts North site in Huon Gully on 2nd September, 2013 and has now reached a height where the eastern edge of the Mt Piper water conditioned ash and the western edge of the Lamberts North ash have joined (see Figure 2).

[2] The concentrations were lower than the Locally derived or ANZECC trigger values, which apply to the receiving water sites and developed for the approved Connell Wagner (2008a) Water Management Plan (WMP).

1.6 Brine Conditioned Ash Placement and Brine Use

EnergyAustralia NSW has advised Aurecon that from July 2016 to June 2017, the brine conditioned ash was placed on the north side benches (B1 to B4, Figure 2) using a placement strategy to raise these benches to the general height of the B5 bench. Brine conditioned ash was placed every month except July and August, 2016. The total volume of brine used to condition ash during calendar year 2016 was 35.3 ML, and another 26.1 ML was used during 2017 to end June, so the estimated total for 2016/17 was about 31.8 ML/year (Table 1).

Table 1 - Volumes of Brine Used for Ash Conditioning (from Lend Lease Infrastructure, 2017)

Year ending	Volume (ML)	Cumulative Total (ML)	Ash use (approx. tonnes)
Dec-05	24.1	24.1	120,335
Dec-06	21.9	46.0	109,635
Dec-07	22.4	68.4	111,785
Dec-08	23.5	91.9	117,630
Dec-09	34.3	126.2	228,840
Dec-10	29.1	155.3	153,200
Dec-11	31.6	187.0	204,142
Dec-12	27.8	214.7	138,800
Dec-13	27.4	242.1	182,507
Dec- 14	21.2	263.3	134,764
Dec- 15	14.4	277.7	80,028
Dec 16	35.3	325.0	196,206
To June 17	26.1		66,789
Annual Average	26.1	-	148,156 (total 1,844,660)

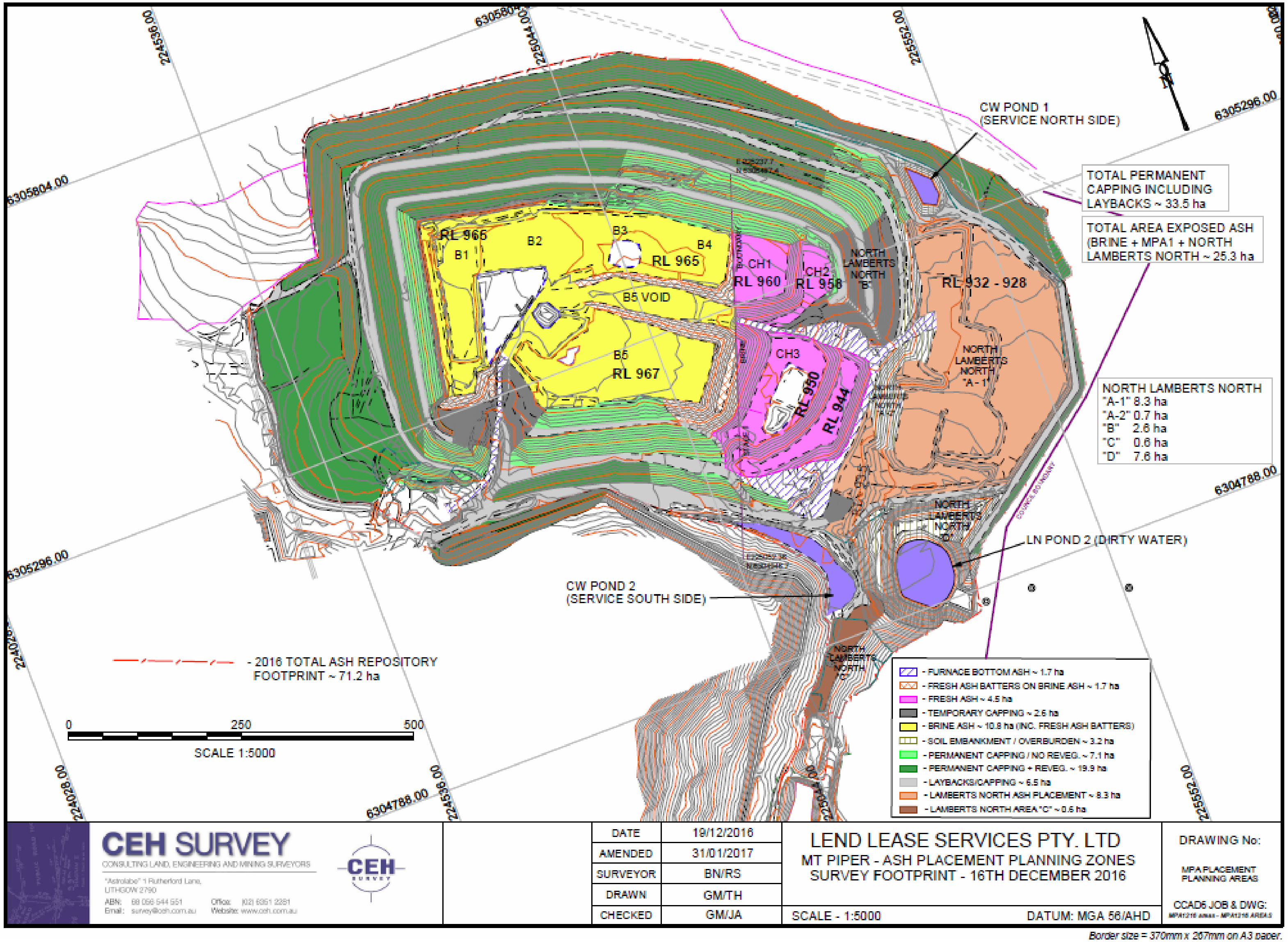

Figure 2: Mt Piper Power Station Stage I (Benches B1 & B2) and Stage II (currently B3, B4 and B5) Brine Conditioned Ash Placement Area Contours in December, 2016. Brine Rainfall Runoff Ponds, External Runoff Ponds (CW1 & CW2) with Lamberts North runoff pond (LN Pond 2) also shown.

The amount of ash used for brine conditioning is also shown in Table 1.

The current Mt Piper contours are shown in Figure 2 and the changes in brine conditioned ash and water conditioned ash areas and levels are shown in Attachment 7.

1.7 Rainfall Runoff Management

EnergyAustralia NSW has advised Aurecon of the current runoff management at the Mt Piper ash placement area. All surface water runoff from the ash footprint is managed within the boundary of the ash placement area. Rainfall runoff on the brine area is collected via retention and lined systems. Collected water on the brine area is reticulated through sprinklers.

All brine conditioned ash placement benches are constructed to retain rainfall runoff by grading of the ash. After rainfall events these retention areas are dewatered to lined ponds according to the operational management plan. If all the lined ponds are full, one management option is to release the surface water for collection in the Lamberts North west side retention area (the west side retention area). This is only done if field testing of soluble salts shows the values of electrical conductivity in the surface water is not greater than 1000 µS/cm (or not higher than blowdown tower water). The released water is directed to the Lamberts North collection area via pipes along the central haul road. Another management option is for the water in the fully lined ponds to be reticulated via sprinklers within the brine area, after the rainfall event is complete.

Since June, 2016, rainfall runoff from the Mt Piper water conditioned ash area has been captured at the Lamberts North west side retention area and all the free water collected drains to the lined LN Pond 2 via a furnace bottom ash drainage line previously installed at the original floor level of the North Lamberts North placement area. Retained runoff water in the LN Pond 2 is used as an irrigation supply for the Lamberts North ash area.

The external runoff collected from the north side Mt Piper capped areas flows to CW Pond 1. CW Pond 2 is located at the base of the hill south of the ash placement area and collects external runoff from the southern capped areas and water from the catchment north of the ash repository. Water levels of the CW1 and CW2 are managed by reticulation back to the power station through a pump back system.

Surface water runoff from the Mt Piper ash repository are limited to storm events, such as those with the intensity of 45 mm in 60 minutes such as occurred between 15-19th November 2016 or as 52.6 mm rainfall across the two days of 21-22nd March 2017. Both events caused ash washouts within the ash area and repairs were required.

1.8 Brine Composition

The brine salinity, chloride and trace metal composition, as well as the volumes of brine used for ash conditioning are reported each year because they are essential characteristics for detecting leachates, if any, from the brine benches. EnergyAustralia NSW has provided details of the average brine composition during 2014/15, 2015/16 and 2016/17 in Attachment 4.

2. Surface and Groundwater Monitoring

The groundwater monitoring design is based on sampling, before and after brine conditioned ash placement began in November, 2000 at bores up- and down-gradient of the brine area. Bores near the brine placement, inside the ash area, are used for early warning of leachates to enable management actions to be undertaken to minimise effects on the receiving water bores and Neubecks Creek. The receiving water bores D8 and D9, located north and south of Neubecks Creek, also have pre- and post-brine placement data. The surface water monitoring is designed in a similar manner with the LDP01/Holding Pond as the upstream site (the Holding Pond is built on Neubecks Creek) and WX22 is the downstream site, being downstream of the ash placement area and Huon Gully. The surface and groundwater sampling sites are shown in Figure 1.

With ongoing placement of water conditioned ash in and around Huon Gully since late 2013, the chloride concentrations at bore D19, located in mine spoil, just outside in the upper Lamberts North area (Figure 1), has been included for possible groundwater movement around the ash placement and potential effects on Neubecks Creek. The groundwater in the area flows to the low point in Huon Gully under the dry ash placement (see Figure 11 in Section 3.8) and it is anticipated that the groundwater is now flowing around the compacted mine spoil that the ash is placed on, as the low permeability of the compacted mine spoil is acting as a barrier to groundwater flow.

A new bore, D23, was installed in December, 2015 to detect the effects of coal mine groundwater inflows to the southern brine placement area. The previous report suggested that the low salinity mine water was diluting the chloride concentrations in the area, so the data for that bore has been included in this report (see Section 2.4).

2.1 Groundwater Levels

The water level in each groundwater bore is monitored to allow identification of the direction of water movement (flow regime) and to compare measured levels with the predicted groundwater level rise due to the large water conditioned ash placement area. The water level monitoring data for the Mt Piper groundwater bores, including bores D19 and D23, are shown in spread-sheet format in Attachment 1.

It is relevant to note that an inter-burden rubble drain was placed in the Western Main Coal Mine open-cut, prior to the water conditioned ash placement, such that the predicted increase in height of the water table was not expected to bring it into contact with the bottom of the ash placement. This drainage system is discussed further in Section 3.2 with a review of the groundwater level changes and flow directions around the Mt Piper and Lamberts North sites.

2.2 Climatic Conditions

The average annual rainfall over the period of brine conditioned ash placement from 2000 to June, 2017, as recorded at the Lithgow Bureau of Meteorology (BoM) gauge, has remained low at 761 mm/year (Attachment 2), which is 88.2% of the long-term annual rainfall of 863 mm/year. During the period July, 2016 to June, 2017, the monthly average rainfall of 68.0 mm/month, was slightly below the long-term average of 72 mm/month.

As the rainfall has been below average since 2012, the monthly rainfall deficit from January, 2012 to June, 2017 has been calculated by the cumulative deficit per month at the end of the previous month plus (72 - the current monthly rainfall). The deficit has been accumulated in this way by adding the deficit for each successive month from January, 2012 until June, 2017. A positive deficit, shown on the right hand scale of Figure 3, means a dominance of below average rainfall, while a negative deficit shows the effect of above average rainfall. That is, when the rainfall is above the long-term average rainfall (green line) the deficit will tend to be negative and when the rainfall is below the green line, the deficit will tend to be positive.

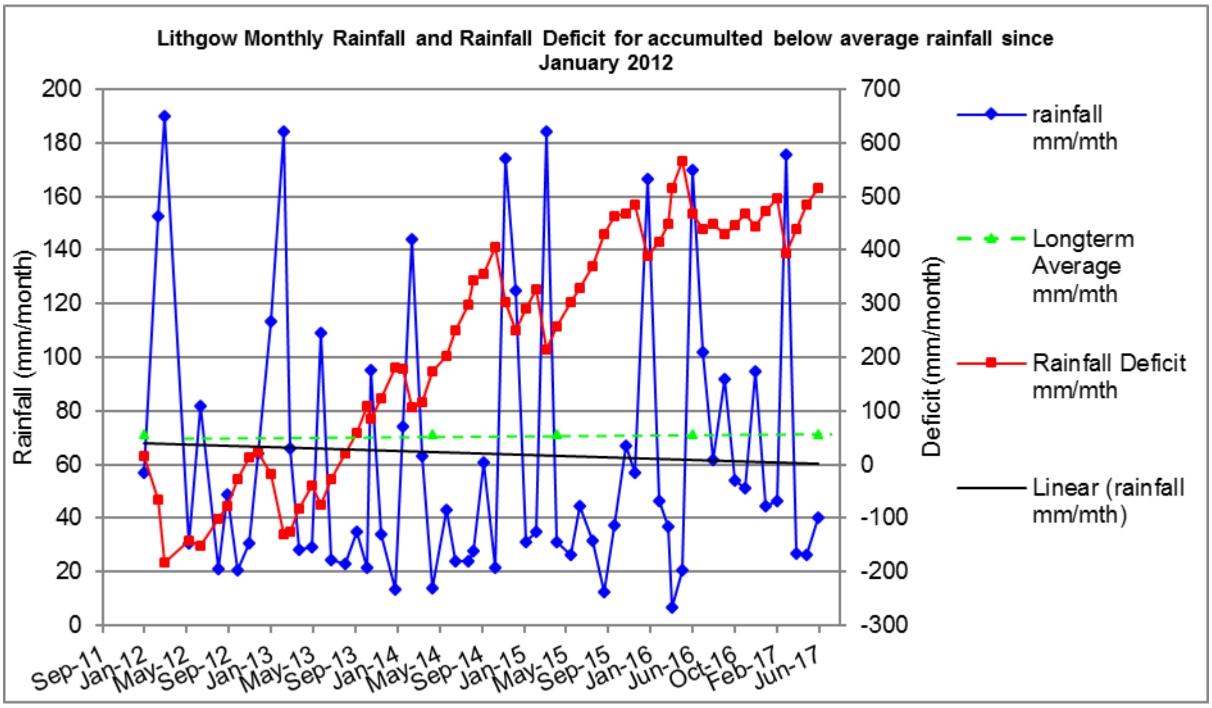

Figure 3. Lithgow Rainfall from January 2012 to June 2017 showing trend for decrease to below average rainfall and corresponding cumulative Rainfall Deficit

Figure 3 shows that the rainfall deficit has stabilised at about 450 mm/month. As undertaken in previous reports, the rainfall conditions have been investigated in relation to possible effects on the bore D10 chloride concentrations (see Figure 5 in Section 3.2).

2.3 Surface Water

As well as routine water quality monitoring in Neubecks Creek at sites LDP1 and WX22, the ash placement contractor, Lend Lease Infrastructure (LLI) monitors the water quality in the brine collection ponds, the B1 bench sump and in all collection and detention systems for the ash placement site, including the rainfall runoff collection ponds LN Pond 2, CW1 and the recently installed CW2 pond.

The monitoring is undertaken to confirm that leachates from the brine conditioned ash are not entering the water conditioned areas where surface runoff may enter the local groundwater.

2.4 Groundwater

No changes in the groundwater monitoring have been implemented since those outlined in the previous report, other than to include the new bore MPGM4/D23.

In December, 2015, bore MPGM4/D23 was installed to sample the coal mine groundwater but during 2016 it was enriched with chloride to about 300 mg/L, which is higher than the pre-ash placement D10 concentrations[3], so it was assumed that the bore could be a mixture of mine water and Mt Piper brine leachate flowing toward D10. However, in 2017 the chloride concentration had decreased to about 190 mg/L, which was similar to that measured in the mine water seepage into Huon Gully in March, 2014 (Aurecon, 2014), so the D23 data has been included in the groundwater report to provide an indication of the potential dilution of the D10 chloride by the local mine water.

Bores D8 and D9 have continued to be monitored as the receiving groundwater sites for the brine co-placement. The aim of these bores is to detect the potential effects of groundwater seepage moving from the ash placement area toward Neubecks Creek and effects at the receiving water site, WX22. The bores have been monitored monthly since October, 2013.

The ash placement area up-gradient bores, D4 and D5 were installed before ash placement began to provide a background groundwater benchmark. Bore D5 is located up-gradient of the north-western corner of the ash placement (Figure 1) and samples the deep groundwater in an abandoned underground coal mine. From the UTS groundwater model (Merrick and Tammetta, 1999 and Merrick, 2007), the rubble drain under the northern ash area allows the coal mine groundwater to flow directly to the lower groundwater levels in Huon Gully. Most of this groundwater flowing into Huon Gully was collected in the previous Huon Gully mine void (called the Groundwater Collection Basin), which has been replaced by compacted mine spoil.

The groundwater flows shown in Figure 8 indicate that this groundwater may enter Neubecks Creek during rainfall events, which is consistent with the UTS groundwater model, but mostly flows under the creek during dry weather, as shown in Figure 13. The other background bore, D4, up-gradient of the northern placement area is located near Neubecks Creek (Figure 1). This bore samples the shallow groundwater in an abandoned open-cut coal mine, which is also understood to seep into Neubecks Creek upstream of the ash area.

2.5 Groundwater Modelling Verification

The Water Management Plan requires salinity and trace metal groundwater modelling at Mt Piper to be undertaken if the monitoring results or other information may be reasonably interpreted as indicating that a significant effect of the brine conditioned fly ash placement on water quality has occurred in the groundwater at bores D8 and D9 and at the receiving waters of Neubecks Creek. A significant effect in the receiving waters is defined as chloride, salinity or trace metals exceeding the locally derived or ANZECC (2000) guideline trigger values set out in Table 2. As the previous report for 2015/16 (Aurecon, 2017) showed that the concentrations of salinity and trace metals at WX22 were lower than the trigger values, other than nickel, which appears to be mine water related (see Table 6, Section 3.9), a re-run of the model was not suggested at that time.

Subsequently, groundwater investigations at the Lamberts North dry ash placement area during 2015/16 found that some of the nickel in Neubecks Creek most likely came from the Western Main coal mine void, beneath the northern Mt Piper ash placement area, due to physio-chemical changes during dry weather, as well as the wider mineralised areas of the creek catchment (Aurecon, 2017b).

The need or otherwise for the Mt Piper model to be re-run, following the database update and consideration of the trends for the current reporting period, is discussed in Section 3.10.

[3] Bore D10 samples underground coal mine groundwater flowing into Huon Gully and averaged 40 mg/L chloride, prior to 2007 when brine conditioned ash placement began in the Stage II area.

2.6 Methods

Routine surface and groundwater quality monitoring has been undertaken monthly by Nalco Analytical Resources on behalf of EnergyAustralia NSW. Nalco measure conductivity, pH and temperature in the field with a calibrated instrument and all other parameters in a NATA Accredited Laboratory. EnergyAustralia NSW has provided a copy of the Nalco laboratory data to Aurecon for the 2016/17 assessment.

EnergyAustralia NSW has advised that in-house methods, based upon Standard Methods (see APHA, 1998), are used by Nalco for the general water quality characteristics of alkalinity, sulphate, chloride, calcium, magnesium, sodium, potassium and total dissolved solids (TDS, also known as total filterable residue, TFR). The trace metals and elements monitored are the same for surface and groundwater: copper, cadmium, chromium, lead, zinc, iron, manganese, mercury, selenium, silver, arsenic, barium, boron and fluoride. EnergyAustralia NSW has previously advised that the in-house methods are equivalent to those specified in DEC (2004), which also uses Standard Methods. (In this regard, it is relevant to note that the groundwater and Neubecks Creek monitoring is not required under the NSW EPA licence but the equivalent EPA approved methods are used for consistency).

Groundwater bores are bailed and sampled after allowing time for the water level in the bore to re-establish. The depth to the water level, from the top of the bore pipe is measured before bailing using a dip metre.

The trace metals in surface and groundwater samples were unfiltered, except for iron and manganese. However, since January, 2013, EnergyAustralia NSW (via Nalco) has also been determining the concentrations of aluminium, copper and zinc concentrations on filtered water collected at both the Mt Piper Licence Discharge Point LDP1 and at the Neubecks receiving water site, WX22.

Nevertheless, the Local/ANZECC (2000) trigger value environmental goals for surface water (see Table 2) are based on unfiltered samples measured by the “acid extractable” method. As the data obtained by filtering the samples is not consistent with the environmental goals shown in Table 2, which are based on unfiltered samples, the filtered data has not been used in this report or previous reports.

To allow comparison with the ANZECC guidelines, low detection limit (DL) testing for trace metals began in April/July, 2006. All the metals, except silver, were measured at DLs lower than the ANZECC guidelines. Due to the use of low detection limits, the concentration of elements shown as less than the DL has been (conservatively) assumed to be the same as the DL in this report. This assumption applies to the situation when the DL is lower than the ANZECC/Local trigger values. If the DL is greater than the trigger values, the concentration has been assumed to be half the DL.

EnergyAustralia NSW has also 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 trigger value level (see Section 3.10 and Attachment 1). The silver data has continued to be tested at <0.001 mg/L, which is 20 times the ANZECC (2000) guidelines. It should be noted that due to the very high DL for silver, it has not been halved because the resulting concentration cannot be assumed to be 0.0005 mg/L, which is an order of magnitude higher than the ANZECC guideline. Accordingly, and as recommended in previous reports, it is suggested that silver cease to be monitored, as it provides no useful information.

2.7 Guidelines

The Protection of the Environment Operations Act requires consideration of the ANZECC (2000) guidelines when assessing potential effects on water quality in receiving waters. The guideline trigger values apply to receiving waters of the groundwater seepage outside the ash placement area. These are taken as the two groundwater bores MPGM4/D8 and D9 (Figure 1) since July, 2013. Hence, the Local/ANZECC (2000) trigger values for groundwater shown in Table 2 apply to bores D8 and D9 in this report. Neubecks Creek, at WX22, remains the final receiving water site for the Mt Piper brine placement.

The ANZECC Guidelines for Groundwater Protection in Australia (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 as the 90^{th} percentile of the pre-stage I placement concentrations for naturally mineralised, highly disturbed groundwater (condition 3 waterbodies), or the ANZECC guideline default trigger values, whichever is higher. The pre-placement 90^{th} percentiles that are higher than the default trigger values, are the local guidelines shown in bold in Table 2. These include elements such as salinity, chloride and sulphate for the protection of freshwater aquatic life (via groundwater seepage into Neubecks Creek), livestock, irrigation water or drinking water. The ANZECC/ local guidelines are called the environmental goals. Table 2 shows that the guidelines for groundwater may be different from those used in Neubecks Creek, where the effects on aquatic life are considered.

Table 2. Baseline and Local/ANZECC (2000) Trigger Value Environmental Goals for the Groundwater Receiving Waters and Surface Water in Neubecks Creek

Element (mg/L)	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				
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				
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	0.5509	**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**	0.116	**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

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**) – 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.

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

2.7.1 Early Warning of Water Quality Changes

As described in previous reports, 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-brine placement 50th percentiles for the various elements exceed the pre-placement 90th percentiles.

The aim of any targeted investigations that arise is to determine if the changes are due to the brine conditioned ash placement or some other cause. If the increases are due to the placement, ash management plans are to be implemented to avoid concentrations approaching or consistently exceeding the relevant ANZECC or local guideline goals in the groundwater inside the brine placement area or at the seepage detection bores. This management strategy is used so that the goals are not exceeded at the surface and groundwater receiving water sites, after allowing for the mineralised background conditions.

2.8 Control Charts

Long-term changes at the receiving water sites are tracked by control charts. At the groundwater receiving water site, bores MPMG4/D8 and D9 long-term changes are indicated by comparison with the local background conditions at bores D4 and D5, the D9 pre-90th baseline, post 50th percentile and/or the groundwater trigger value environmental goals. Bore D5 is used as the baseline for chloride, salinity and trace metals at bores D10, D11, D1 and D9 because the underground mine water sampled is understood to flow into Huon Gully via the Mt Piper rubble drain and dilute the chloride, water quality and trace at these bores.

At WX22, long-term chloride changes are indicated by comparison with background conditions at the Mt Piper Power Station Licence Discharge Point, LDP1, on the upper Neubecks Creek, the concentrations at bores D8 and D9 and the environmental goals. The chloride at WX22 is compared to the D9 concentrations because previous reports have shown that the chloride entering Neubecks Creek originates from Huon Gully. In addition, the trace metal concentrations at WX22 are compared with those at D9, as well as to the background groundwater concentrations at bore D4 because it samples the shallow groundwater in an abandoned open-cut coal mine adjacent to Neubecks Creek. The D4 groundwater can flow directly into the creek after rainfall events.

The long-term changes are further put into context by use of the pre-Stage I brine placement 50th and 90th percentiles and the post-placement 50th and 90th percentiles. These are shown for each groundwater and surface water sampling site in the various water quality tables in the report as well as in Attachment 1. This allows pre- and post-placement “like for like” comparisons to be made, together with the pre- and post-placement averages, maximums and minimums, as well as the summary data in tables for the current reporting.

2.9 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 that no environmental changes have occurred that would account for such a significant change. No values were deleted from the 2016/17 dataset. As mentioned in Section 2.6, silver concentrations have not been used in this report because they cannot be compared to the ANZECC (2000) guidelines.

3. Brine Conditioned Ash Placement Effects on Surface and Groundwater Quality

This Section reviews the water quality data for the current reporting period for changes in the findings since 2015/16 of the Mt Piper brine co-disposal ash placement effects on the receiving waters. The local coal mine mineralized conditions and dilution of brine leachates by various sources of low salinity groundwater inflows to Huon Gully, after being recharged by rainfall events, are taken into account.

3.1 Review of the Surface and Groundwater Quality Data

As undertaken in previous reports, the long-term trends in water quality and trace metals have been examined in the following surface and groundwater:

- Background bores MPGM4/D4 and D5, which are up-gradient of the ash placement area (Figure 1)
- Post-brine conditioned ash placement concentrations for the two bores (MPGM4/D10 and D11) inside the ash placement area
- Seepage detection bores MPGM4/D1 and D3, located between the ash placement area and Neubecks Creek
- Groundwater receiving water bores D8 and D9
- Neubecks Creek receiving water site WX22.

As mentioned in the previous report, the highest chloride concentrations (the green section of the graph in Figure 4) occurred subsequent to the brine conditioned ash placement being expanded onto the NA5 bench since 2012 and its incorporation with the B5 bench in 2013/14. The previous report noted that the post-2012 concentrations had large variations due to dry weather with intermittent high rainfall events, indicating the effects of rainfall on recharge of the local groundwater flowing into Huon Gully. This is shown by the long-term changes in chloride at bore D10, which have been updated to June, 2017 in Figure 4.

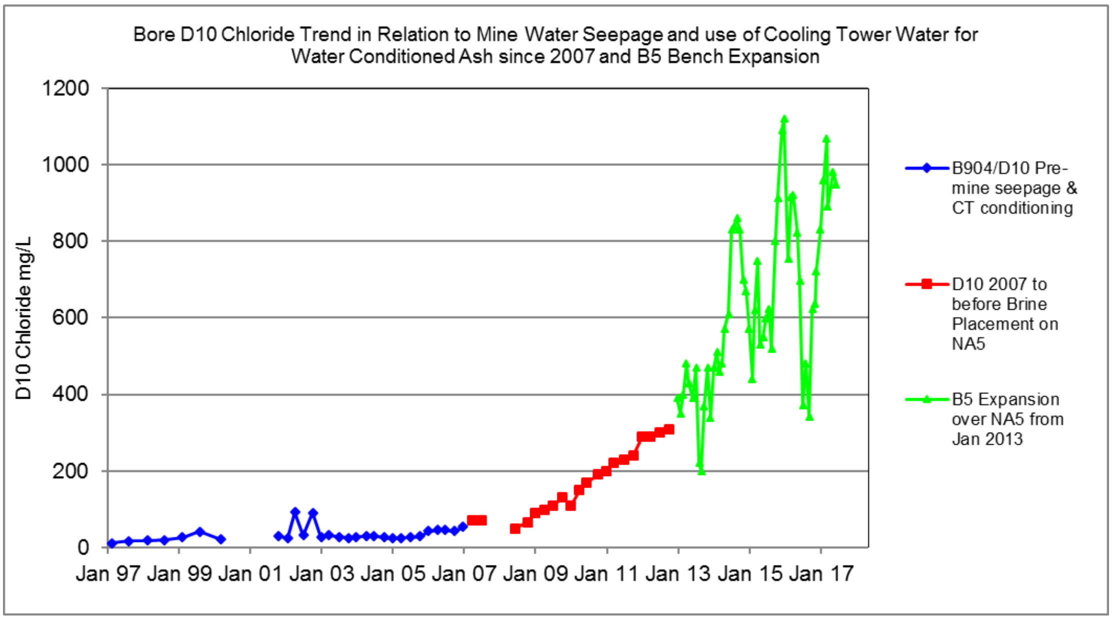

Figure 4. Mt Piper Brine Placement Area Groundwater Bore MPGM4/D10 trend for periods 1997 to October, 2006 (blue), April, 2007 to October 2012 (red) and January 2013 to June 2017 (green)

Figure 4 shows the D10 chloride changes over the following periods:

- 1997 to October, 2006 - B904/D10 Pre-changes in coal mine water seepage into Huon Gully via the ash placement rubble drain and pre-use of cooling tower blowdown water to replace the use of Coxs River water for water conditioned ash (blue line)
- April, 2007 to October 2012 – increased coal mine water seepage from 2007 to before Brine Placement on NA5 began in 2012. Rapid and consistent rate of chloride increase period was thought to be due to increasing groundwater levels of mine water seepage (as indicated by the moderate concentrations of chloride) and use of blowdown water (red line)
- January 2013 to June 2017 - B5 Expansion in 2013/14 to place brine conditioned ash on the NA5 bench and ongoing placement with water conditioned batters (green line). The large variability during this period suggests western and southern underground coal mine groundwater recharge.

The period from 2013 to 2017 shows increasing variability of the chloride concentrations at D10 with the largest decrease from July to September, 2016 to a minimum of 342 mg/L following the period of heavy rainfall in June and July, 2016 of 170mm and 102mm, respectively. The chloride concentration was the lowest since December, 2013 but increased again with a long period of below average rainfall until another high rainfall event in March, 2017 (see Figure 3).

The cause of the D10 chloride decrease is investigated in Section 3.3 and was explored here by comparing the chloride decrease during 2016/17 with the rainfall deficit, as shown in Figure 5.

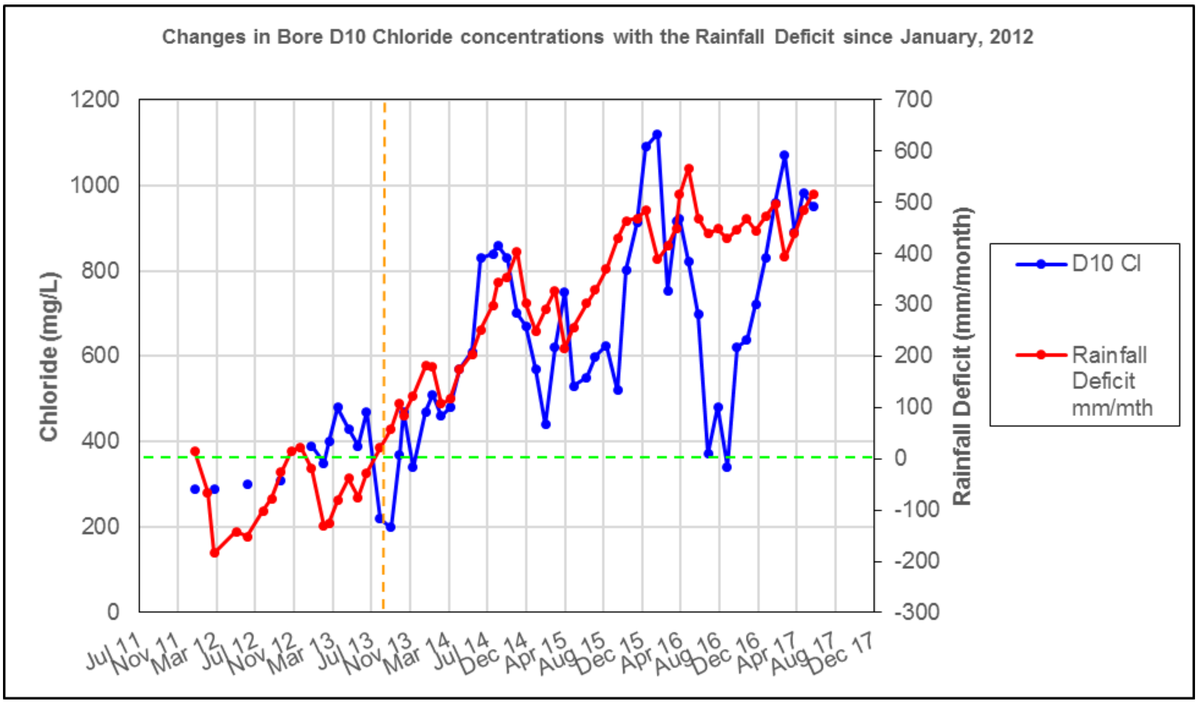

Figure 5. Bore D10 Chloride concentration changes with the cumulative Rainfall Deficit from January, 2012 to period of brine conditioned ash placement from January, 2013 (vertical line) to June, 2017 on the B5 and NA5 Benches

Figure 5 shows that the large decrease in chloride was due to the June and July rainfall event and appears to be caused by coal mine groundwater recharge. This was followed by a period of dry weather from January to June, 2017 and the D10 chloride concentration increased back to be similar to the rainfall deficit.

Prior to 2016/17, the chloride increase at bore D10 with rainfall deficit could be interpreted as a decrease in rainfall recharge to groundwater flowing from the southern coal mine area due to dry weather. This leads to the view that there is less dilution of brine leachates with the low salinity underground coal mine groundwater, giving the trend for increase in chloride with the rainfall deficit.

The large reduction in chloride at D10 for a long period, up to December, after the June and July, 2016 rainfall events, indicates ongoing and larger groundwater recharge, up-gradient of D10, than during previous periods. Possible causes of the increased recharge are investigated in the next section after consideration of groundwater level changes at the monitoring bores.

3.2 Groundwater Level Changes

Figure 6 shows an overall long-term trend for increase in the height of the water table as the water conditioned ash placement has approached to within 50m of Huon Gully, which is the eastern boundary of the Mt Piper water conditioned ash placement area. The increases have been about one metre higher than the 2m predicted by the groundwater model, including at the background bore, D5, due to the mounding effect of the wide area of the water conditioned ash placement at Mt Piper. The level increases at bores D10 and D11 have been the highest, with increases of about 4m to May, 2015 and have been decreasing as the prolonged dry weather takes effect.

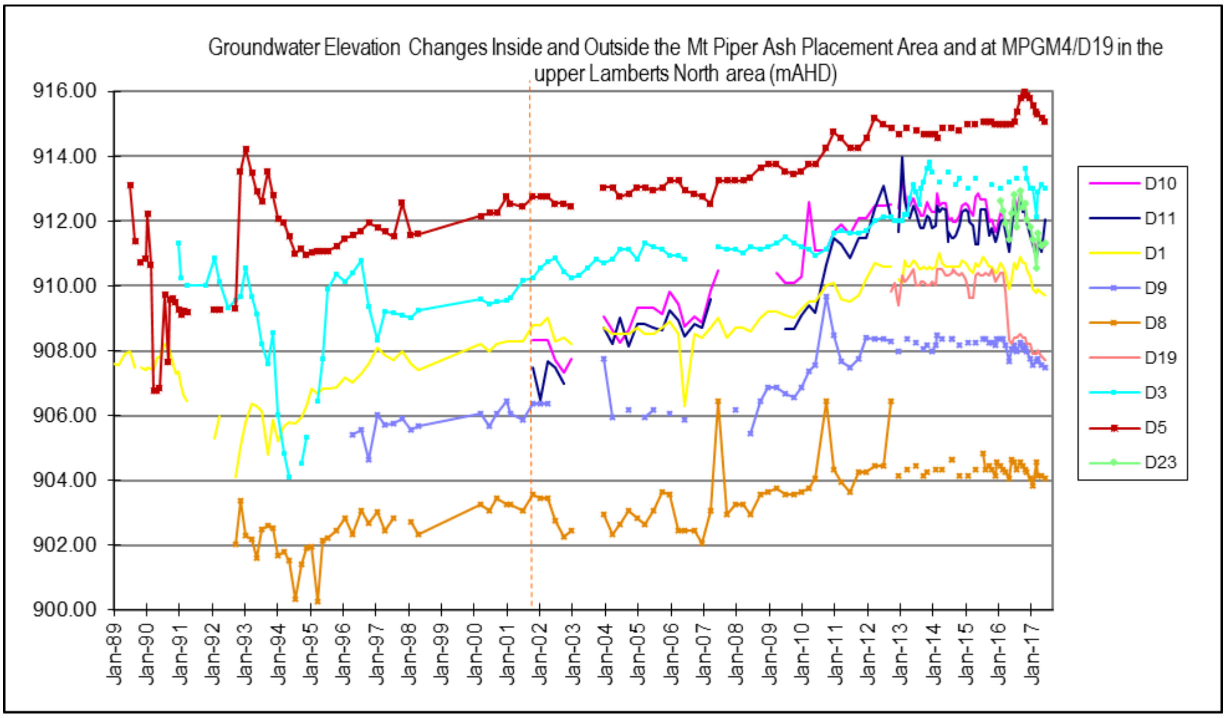

Figure 6. Groundwater Elevation changes at bores inside (MPGM4/D10 and D11 since 2001) and outside the ash placement area (D1, D3 and D5 since 1989), at Groundwater Receiving Water Bores (D8 and D9 since 1992 and 1996), upper Lamberts North D19 since October, 2012 and underground coal mine levels at D23 since February, 2016

Figure 6 also includes the more recent groundwater levels for bores D19 and D23. Bore D19, adjacent to the Lamberts North placement, was initially about 2m higher than at D9, which is located near Neubecks Creek, but decreased sharply from March to May, 2016 and then followed the levels at D9.

The underground coal mine groundwater levels at D23 closely follows the D10 levels, but as D23 is up-gradient of D10, it appears that the mine water governs the levels at D10 for most of the time.

3.3 Possible causes of increased groundwater recharge at Bore D10

The relationships between the groundwater levels at D10 and D23, which has a current chloride concentration of about 190 to 300 mg/L, with influence of rainfall and the corresponding changes in chloride at D10 are investigated in Figure 7.

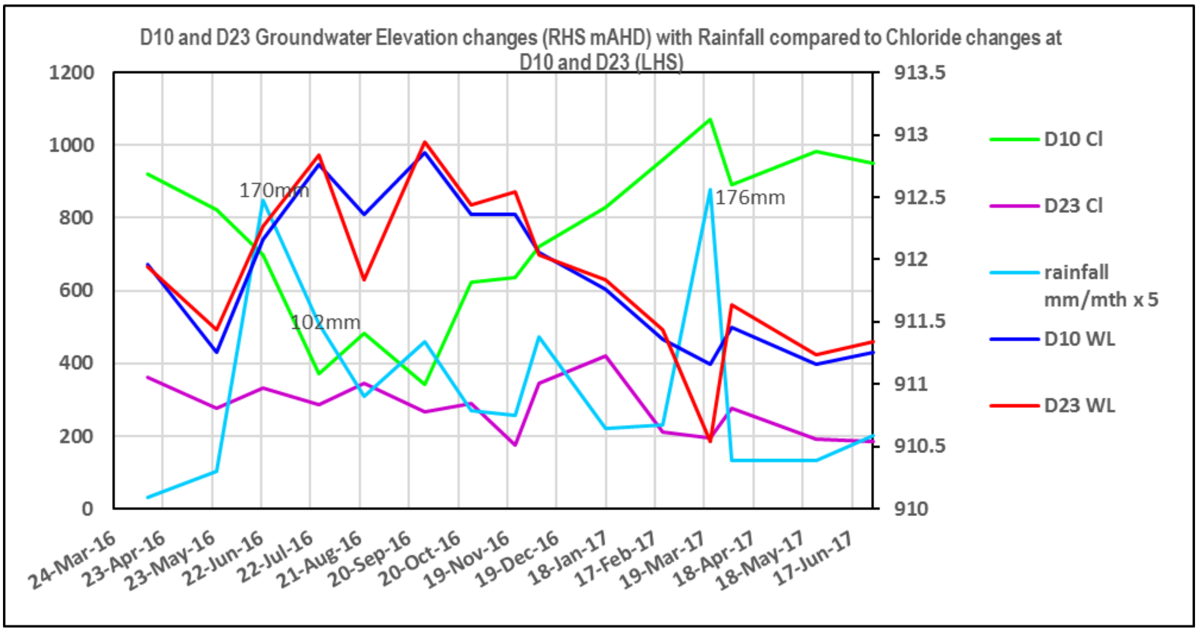

Figure 7. Groundwater Elevation changes and chloride at bore D23 with effects on levels and chloride at D10 following high rainfall in June and July, 2016.

The groundwater levels increased in parallel at both bores D10 and D23 with the 170mm rainfall in June, 2016 and they continued to rise in parallel following the 102 mm in July, 2016. Consequently, the chloride decreased at D10 from about 800 mg/L in May to about 400 mg/L in July and remained at about that concentration until September.

The D10 reduction in chloride is attributed to rainfall recharge of the local, abandoned underground coal mine groundwater south of the ash area at D23, and its relatively low chloride of about 300 mg/L. The recent increase in underground coal mine rainfall recharge, which is evident in the increased chloride reduction at D10 in Figure 5, appears to come from the coal washery ponds south of the ash placement area (see Figure 8). The recent expansion of coal washery ponds, south of the coal conveyor, may have increased the amount of recharge to the local groundwater.

Another potential source of recharge up-gradient of D10 is the runoff collection pond CW2, which was installed in 2013/14. The pond collects external runoff from the B5 brine bench capped areas, as well as being located at the base of a hill south of the B5 brine bench, so it may also collect runoff from the hill.

Extension of the graph to cover the 176mm of rainfall in March, 2017 event shows a subsequent increase in the groundwater level at D23 with a smaller level increase at D10. These increases gave a moderate reduction in the D10 chloride concentration. Examination of the rainfall pattern showed it had low rainfall scattered over the month, rather than a concentrated event, hence the moderate chloride reduction compared to that in June and July, 2016.

3.4 Groundwater Flow Directions

Figure 8 shows the indicative groundwater flow directions around the ash placement area, as well as in and around Huon Gully and the Lamberts North placement. Bore D23, that samples the underground mine groundwater to the west of bore D10, diluted the southern areas of brine leachates to a minimum of 342 mg/L in September, 2016 during rainfall recharge after the June and July, 2016 rainfall event. The indicative, low chloride plume at the upper Huon Gully area is shown superimposed over the flow directions. The plume flows down Huon Gully to the north-east, which is the direction of dip of the coal seam.

The flow direction and chloride concentrations indicate that the chloride plume is moving around the compacted mine spoil placed in Huon Gully towards bore D19. The 2m decrease in groundwater level at D19 (Figure 6) may have been caused by the use of water from the ponds to the east of D19 for washery water (see Figure 8). This drawdown may also be causing the Huon Gully chloride plume to migrate toward D19.

It was noted that bore D11 is not in the flow path of the southern bore D23 recharge flows, because D11 remained with elevated chloride concentrations at the time of dilution of D10 by the underground mine water.

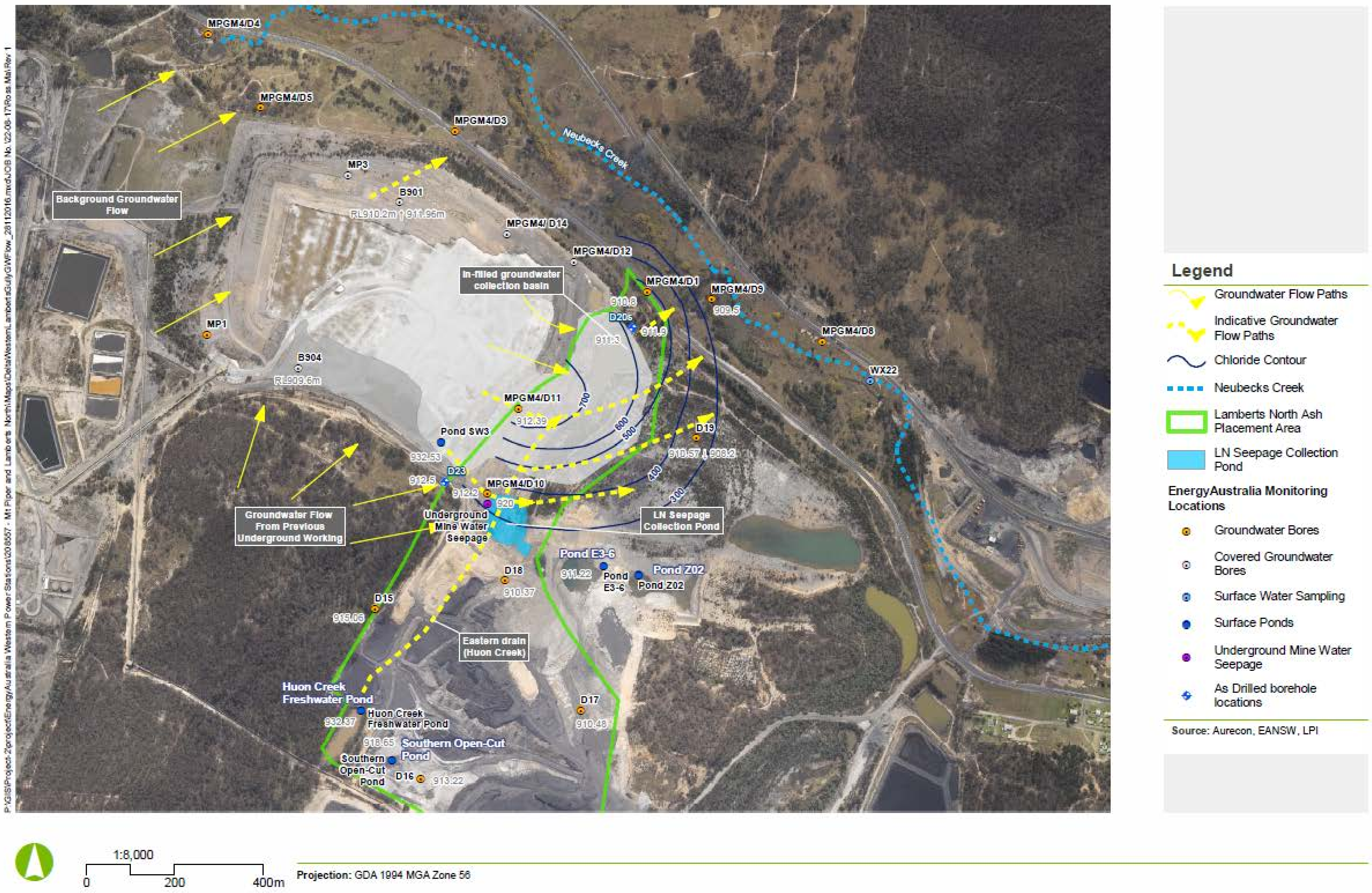

Figure 8. Schematic of Mt Piper Brine Co-Placement Area and Lamberts North Indicative Groundwater flow paths (yellow arrows) and indicative September, 2016 wet weather chloride distribution (blue lines) from underground coal mine and down Huon Gully beneath and around Lamberts North to bore MPGM4/D9 and Neubecks Creek

3.5 Groundwater Quality inside the Mt Piper Brine Co-Placement Area

The changes in water quality at bores D10 and D11 are shown in Table 3, 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 inter-burden rubble drain - see Figures 1 and 8). Table 3 also includes background bore D5, which samples the western underground coal mine groundwater up-gradient of the ash area and the new D23, which samples the southern underground coal mine groundwater. The current status for July, 2016 to June, 2017 is also shown. In addition, the D10 and D11 concentrations are compared to the brine leachate concentrations expected from brine conditioned ash (PPI, 1999) and accompanied by the brine composition shown in Attachment 4.

Long-term changes are indicated by comparison of the pre-placement 50th and 90th percentiles at the B904 background bore with the Post-50th and 90th percentile values at bore D10. The Groundwater Guidelines or Goals, which apply to the receiving waters for bores D8 and D9, are shown for comparison.

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
- Green is for characteristics showing such large increases that the post-placement 90th percentile is higher than the pre-placement 90th percentile background. As such increases could occur at any time during the post-placement period, the times are indicated by footnotes to the table.

Table 3 shows that during 2016/17 the D10 chloride concentration decreased from 794 mg/L in 2015/16 to 738 mg/L during the current reporting period, while the chloride at D11 increased from 686 mg/L to 880 mg/L. As discussed in Section 3.3, the decrease at bore D10 was mostly due to a period of groundwater recharge from the southern underground coal mine areas, and possibly a lesser recharge from the CW2 pond, with heavy rainfall.

Although brine leachates are occurring, most of the trace metals (not including the locally abundant iron and manganese) had low concentrations at bores D10 and D11. The concentrations of boron, cadmium, nickel and zinc were elevated, as they were at the south-western mine void background bore B904 before brine placement began. These elevated trace metals at D10 and D11 are from the B904 groundwater as it flows in the rubble drain to Huon Gully. Table 3 also shows that the background bore D5 has lower concentrations of these trace metals.

Other than boron and chromium, the diluting flows from D23 have low trace metals, and the boron is lower than the background mine void concentrations at B904, so the southern D23 underground groundwater is not significantly contributing to the elevated mine void concentrations at D10 (see Table 3).

Table 3: Water Quality for Mt Piper Brine Internal Monitoring Bores D10 and D11 during the Current 2016/17 Period compared to the D5 Background, underground coal mine D23, D10 Baseline at Mine Void Bore B904, Pre- and Post- Trends, Brine Conditioned Ash Leachates and the ANZECC Groundwater Guidelines or Local Goals

Element (mg/L)	Mt Piper Brine Co-Placement Area Internal Monitoring Bores*					D5 Back-ground July, 2016 to June, 2017	D23 under-ground mine July, 2016 to June, 2017	Brine Leachate (PPI, 1999)	ANZECC Guideline Goals for Ground-water#
	Current Stage I & II July, 2016 to June, 2017		D10 Baseline (Pre-Stage I 90th Percentile)	D10 Trend (Pre-Stage I 50th Percentile)	D10 Trend Post-(2000 to June, 2017) 90th Percentile				
	D10	D11	B904*	B904*	D10	D5**	D23		
pH	5.6	6.2	7.4	5.1	6.4	6.0	5.7	7.6	6.5-8.0
Cond (µS/cm)	8481	8980	1747	1128	9397!	1284	4112	10900	2600
TDS	7106	7615	1980	1500	8300!	989	3068	8400	2000^
SO4	4137	4568	1320	1100	4585!	596	1881	3750	1000++
Cl	738	880	32.6	20	875!	23.4	267	1410	350+
As	<0.001	0.008	0.008	0.005	0.002	<0.001	0.001	0.050	0.024
B	3.28	2.95	2.26	1.4	4.4 !	0.11	1.06	6.1	0.37
Cd	0.006	<0.0001	0.01	0.004	0.0078	<0.0001	0.0004	0.003	0.001
Cr	<0.001	<0.001	-	-	0.005	<0.001	0.007	0.037	0.004
Cu	<0.001	<0.001	0.01	0.005	0.008	<0.001	0.002	0.078	0.005
Fe***	8.34	71.1	28	0.83	14.56	54.5	15.01	0.007	0.664
Mn***	7.2	17.1	15.36	6.4	9.88	8.4	3.4	0.44	5.704
Mo	<0.001	<0.001	-	-	<0.010	<0.001	<0.001	0.84	0.01+
F	0.5	0.27	9.1	6.8	1.97	0.1	0.22	6.0	1.5+++
Ni	0.906	0.901	1.14	0.96	1.100	0.055	0.352	0.2	0.5509
Pb	0.004	<0.001	0.005	0.005	0.014!	<0.001	0.0023	<0.0002	0.005
Se	0.003	<0.001	0.005	0.005	0.008 !	<0.001	0.003	0.18	0.005
Zn	1.13	0.127	4.18	2.8	1.57	0.024	0.388	0.039	0.908

*Bore B904 samples underground coal mine goaf areas up-gradient of bore D10, which also samples the underground groundwater flowing from coal mine goaf areas. Bore D11 samples groundwater in the open-cut mine area to the north of D10.

** D5 sampling the up-gradient background groundwater that flows into the western Main open-cut mine void rubble drain under the northern Mt Piper ash.

! Boron since April, 2010; Chloride, Cond. SO_4 and TDS since Nov 2016; Pb Oct 08 to April 09; Se Jan-April 2012, Cu since April, 2011

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**

+ 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; Green: post-placement 90th > pre-placement 90th percentile.

3.6 Bore D10 Chloride Down-gradient Groundwater Effects

The elevated groundwater concentrations at bore D10, and particularly D11, are approaching that of brine conditioned ash leachates (see Table 3 and Figure 9), which, according to the UTS groundwater modelling (Merrick, 1999), is unlikely to be due to the brine conditioned ash placement. It appears that as water conditioned ash was placed higher, the groundwater level increased (see Figure 6), indicating the groundwater reached a brine source beneath the B5 bench water conditioned ash (Aurecon, 2017a).

Figure 9 shows that the overall rate of chloride increase at bore D10 has begun to slow during 2016/17 due to the effects of rainfall recharge and is now oscillating around 700 mg/L due to the opposing effects of the recharge and dry weather. The concentration was reduced by about half due to the June and July, 2016 rainfall event and lasted from July to September, 2016, after which it increased again during dry weather.

The chloride at bore D1 was also lowered by the rainfall recharge diluted plume as it migrated down Huon Gully and the high rainfall of 175 mm in March, 2017 caused the chloride to decrease to 252 mg/L in June, 2017, its lowest for three years. As a result of these groundwater recharge events, the chloride at the receiving water bore, D9, continued to decrease to 114 mg/L in June, 2017, its lowest concentration for four years.

Based on these observations, it is suggested that increasing groundwater recharge could reduce chloride levels and should be considered as an option in further mitigating chloride concentrations in Huon Gully.

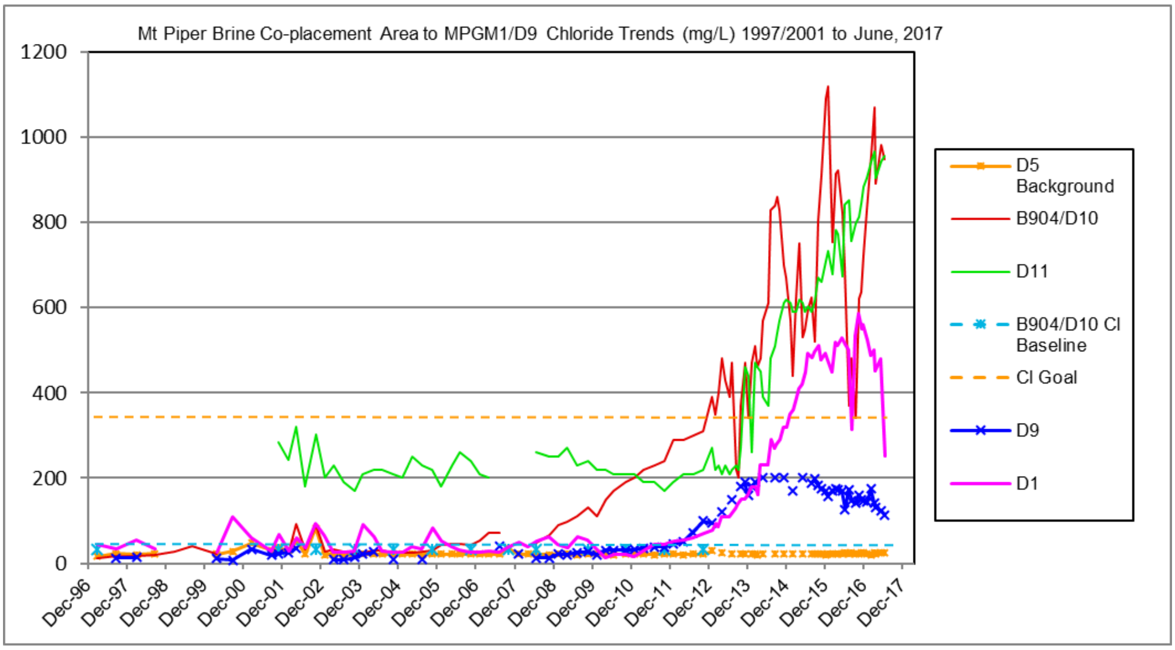

Figure 9. Mt Piper Brine Placement Area Chloride Trends at groundwater bores (MPGM4/D10 and D11), Seepage Detection Bore D1 and Receiving Water Bore D9 from 1997 to June, 2017 compared to the Background Bore D5, B904/D10 baseline and Environmental Goal of 350 mg/L for bore D9.

Although the chloride concentration at D11 continued to increase during 2016/17, its influence on concentrations at D9 appears limited, most likely due to dilution of its flow down Huon Gully by the low salinity western mine water inflows through the northern mine void rubble drain. In addition, it appears likely that the chloride concentrations observed in borehole D9 are diluted by effect of recharge of the local groundwater via vertical seepage through alluvial deposits / stream bed sediments of Neubecks Creek into the underlying coal seam aquifer beneath the creek (see Figure 13). Hence, it is suggested that this mitigating effect of the Huon Gully plume be investigated.

Examination of the initial groundwater sampling at the Lamberts North ash placement for the previous reporting period 2015/16 (Aurecon, 2017b) indicates that the low salinity, western underground coal mine groundwater, and possibly together with rainfall runoff collected in the Lamberts North west side retention area, recharges the groundwater flows under the Lamberts North site. Table 3 in Aurecon, 2017b shows that the D20 chloride concentration (109 mg/L) was about 4-fold lower than at bore D1 (483 mg/L), which is immediately down-gradient of the groundwater sampled by D20 beneath the ash placement.

Figure 9 also shows that bore D11 is not in the flow path of the southern mine water bore D23 recharge flows, and may actually add salts to the seepage detection bore D1, which rebounded to a slightly higher chloride shortly after the June/July mine water recharge event.

3.7 Seepage Detection Bores

As noted above, the large chloride decreases at bore D1 due to rainfall recharge of the local groundwater is clearly seen in Figure 10. Hence, following from the above suggestion to consider rainfall recharge of the local groundwater, the role of rainfall runoff from Lamberts North dry ash on improvement of the groundwater quality flowing underneath the ash area, from the upper areas of Huon Gully, should also be considered.

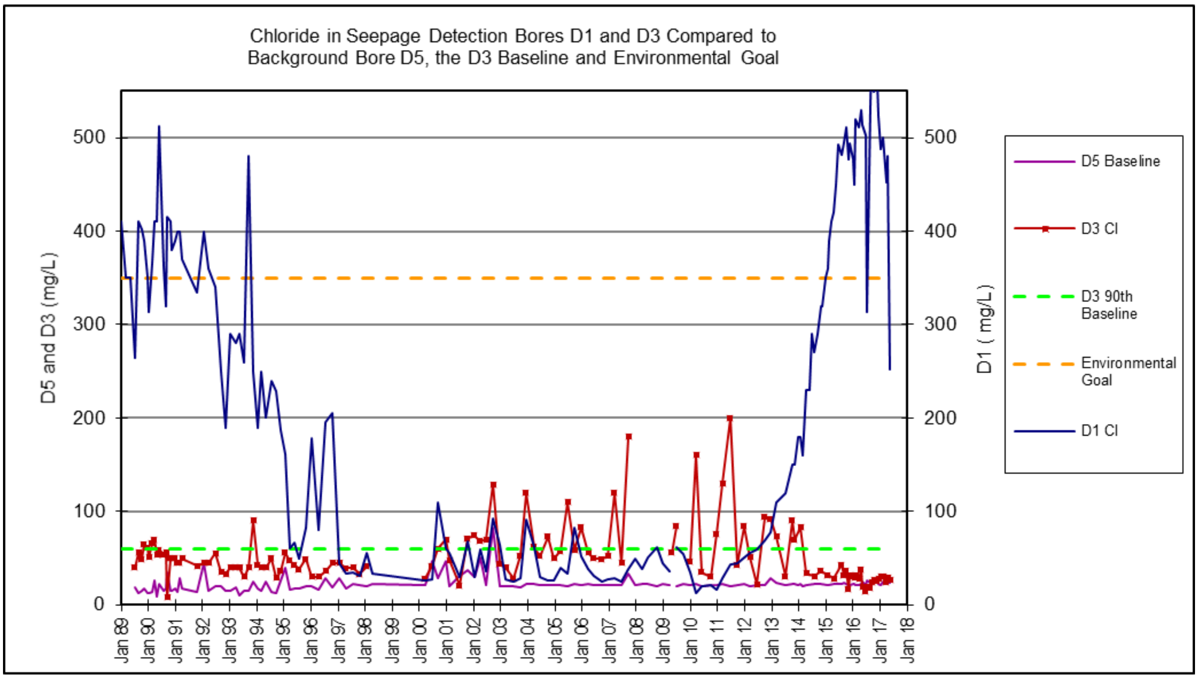

Figure 10. Chloride Trends in Seepage Detection Bores D1 and D3 Compared to Chloride in Background Bore D5 and the D3 Chloride Baseline and Environmental Goal

As discussed in previous reports, Figure 10 shows that the chloride concentration at bore D3 has been lower than the pre-brine placement baseline of 60 mg/L since February, 2014, indicating the effectiveness of management of the brine conditioned ash and retention of brine leachates in the ash pores. As brine placement on the northern B6 Bench has been ongoing and is expected to continue, the water quality at bore D3 should continue to be monitored. The detailed water quality changes at bores D1 and D3 are shown in Table 4.

Table 4: Water Quality for Mt Piper Seepage Detection Bores D1 and D3 during Stage I and II and the Current 2016/17 Period Compared to the Bore MPGM4/D5 Background, Baseline and Pre- and Post-50th and 90th Percentile Trends and the Groundwater Guidelines or Goals

Element (mg/L)	Mt Piper Brine Co-Placement Seepage Detection Monitoring Bores							D5 Back-ground July, 2016 to June, 2017	ANZECC Guideline Goals for Ground-water#
	Post-Stage I & II 2000 to June, 2017		Current Stage I & II June, 2016 to June, 2017		D1 Baseline (Pre-Stage I 90th Percentile)	D1 Trend (Pre-Stage I 50th Percentile)	D1 Trend Post-(2000 to June, 2017) 90th Percentile		
	D1	D3	D1	D3	D1	D1	D1	D5	
pH	6.2	6.4	5.9	5.9	7.4	6.7	6.5	6.0	6.5-8.0
Cond (µS/cm)	2620	868	4944	732	2609	2050	4898 !	1284	2600
TDS	2327	563	4002	474	1615	1330	4140 !	989	2000^
SO4	1322	234	2143	256	466	377	2143 !	596	1000++
Cl	202	56	478	25	410	272	502 !	23.4	350+
As	0.01	0.002	0.011	0.003	0.002	0.001	0.014 !	<0.001	0.024
B	1.41	0.035	2.08	0.087	0.015	0.005	2.24	0.11	0.37
Cd	0.0002	0.0003	<0.0001	<0.0001	0.001	0.001	<0.001	<0.0001	0.001
Cr	0.002	0.002	<0.001	0.002	0.001	0.001	0.005	<0.001	0.004
Cu	0.004	0.003	<0.001	0.004	0.011	0.001	0.005	<0.001	0.005
Fe***	20.6	5.13	37.2	5.83	7.72	0.19	45	54.5	0.664
Mn***	10.3	0.655	15.4	0.59	2.64	0.2	16.7	8.4	5.704
Mo	0.003	0.004	<0.001	<0.001	0.001	0.001	<0.01	<0.001	0.01+
F	0.113	0.101	0.102	0.049	0.656	0.23	0.2	0.1	1.5+++
Ni	0.657	0.013	1.025	0.011	0.182	0.059	1.1	0.055	0.5509
Pb	0.004	0.004	<0.001	0.007	0.006	0.001	0.005	<0.001	0.005
Se	0.002	<0.001	<0.001	<0.001	0.002	0.001	0.003 !	<0.001	0.005
Zn	0.069	0.021	0.125	0.015	0.063	0.001	0.133 !	0.024	0.908

! Cond., TDS & SO_4 various events since 2004; Cl various events since Oct 2002 & since Oct 2015; Mn various events since 2001, As consistently since 2012, Se 2003 to 2006, Zn various times since Oct, 2013;
*** 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**
+ 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; Green: post-placement 90th > pre-placement 90th percentile

Table 4 shows that at bore D1, the average salinity, sulphate and chloride concentrations are beginning to decrease in response to the increased groundwater recharge in the up-gradient areas.

Other than the locally enriched iron and manganese, bore D1 had elevated concentrations of boron and nickel, and when the local mineralised conditions are taken into account, all the other metals were at acceptable levels. The elevated concentration of nickel at bore D1 was previously investigated using the Lamberts North data for 2015/16 (Aurecon, 2017b) and was found to be mostly from the Western Main open-cut coal mine void.

The mine void groundwater quality, at the northern ash area background bore B901[4], shown in Attachment 1, part 4. The data shows the nickel concentration increased as the groundwater level increased, with increased height of the water conditioned ash placement, to average about 0.92 mg/L at bore B901 from 1997 to 2000 (see Table 5), while that in brine leachates is low at about 0.2 mg/L (Table 3). Note that the nickel concentration at D9 had increased so that the post-median exceeded the pre-placement 90th percentile baseline since 2012 (see Table 5).

The elevated boron concentration at bore D1 was previously assumed to be mostly from brine conditioned ash leachates, but the migration of nickel from the mine void to D1 prompted an investigation of the role of the bore B901 mine void concentrations to the boron concentrations at D1. The B901 boron concentration also increased as the groundwater level increased to average 3.18 mg/L from 1997 to September, 2000, and reached 12 mg/L before the brine conditioned ash began to be placed in November, 2000. The parallel increase of boron with that of nickel at B901 indicates that most of the boron at D1 originates from the mine void.

The June and July, 2016 rainfall event caused the concentration of lead to increase to 0.007 mg/L at bore D3. The cause was investigated and was not from the brine conditioned ash because the leachates contain no detectable lead concentrations (Table 3). Attachment 1, part 3 shows that the background conditions sampled by bores D4 and D5 to the west of the ash placement are in previous copper, lead and zinc open-cut mining areas and the groundwater has elevated concentrations of lead with the baseline 90th percentile of 0.02 mg/L at D5 and 0.20 mg/L at D4. It appears that the prolonged rainfall event mobilised some trace metals from these areas into the northern rubble drain and were detected in flows to the north-east by bore D3, which is located to the north of the brine placement area (Figure 1).

3.8 Groundwater Receiving Water Bores

Effects of the brine placement on water quality and trace metals at the receiving water bores D8 and D9 are discussed in this section. Figure 11 extends the long-term trends in chloride at bores D1 and D9, shown in Figures 9 and 10, to include that of the receiving water bore D8, which is on the northern side of Neubecks Creek (see Figure 7). The chloride increase at D19, noted in previous reports, is included in Figure 11 in relation to potential effects on the water quality at D9 and Neubecks Creek.

[4] The B901 Western Main coal mine void groundwater quality is summarised in Table 5 in relation to potential effects on the receiving groundwater bore D9 in Section 3.8.

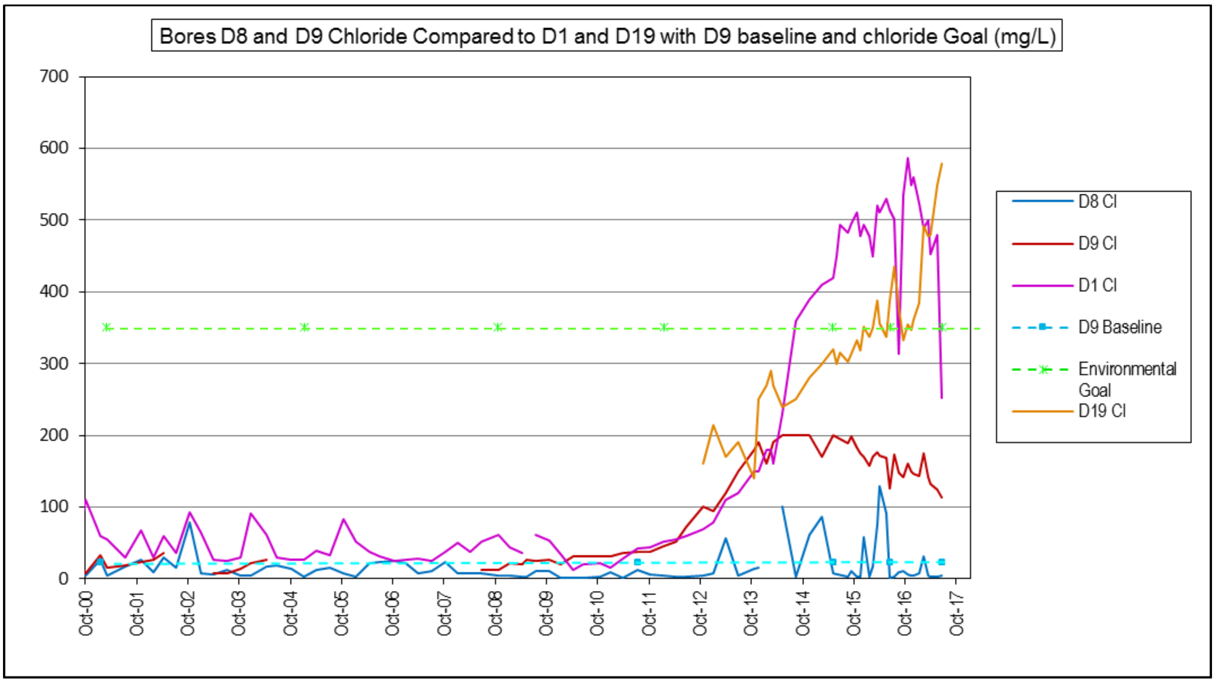

Figure 11. Chloride Trends at Groundwater Receiving Water Bores MPGM4/D8 and D9 Compared to Bore D1, D9 Baseline and local Environmental Goal (Note: graph begins at October, 2000, one month before brine placement began, to show recent D19 changes with rainfall recharge)

Figure 11 shows that, although the D1 chloride has exceeded its pre-brine conditioned ash placement concentration it was reduced to below the local guideline of 350 mg/L during rainfall events.

The graph also shows that chloride at D9 has remained lower than the local guideline and is trending down towards its pre-brine placement concentration. The large decrease in chloride from D1 to D9 may indicate that the creek water flows into the groundwater as it passes via the coal seam under the creek bed.

At bore D8, chloride remained below its pre-brine placement baseline of 14 mg/L, confirming the understanding that the groundwater plume flows under Neubecks Creek via the coal seam (see Figure 13). The spike at D8 in February, 2017 occurred when there was no flow in Neubecks Creek. Hence, although there have been earlier spikes, the chloride, sulphate and salinity concentrations were all lower than their pre-brine placement baselines and all the trace metal concentrations were lower than the ANZECC/Local trigger values during 2016/17 (see Table 5).

The chloride increase at D19, due to the D10 plume being drawn to the west by the D19 groundwater level drawdown, was interrupted by effects of the June and July, 2016 heavy rainfall events which caused the concentration to decrease for five months from August to December, 2016. The D19 decrease occurred one month after that at D10 (see Figure 9), and lasted longer, before increasing again during dry weather.

The detailed water quality changes at bores D8 and D9, together with the local coal mine background conditions at bores B901 and D19, are shown in Table 5.

Table 5 shows that for bore D9, although the conductivity, salinity and sulphate are higher than the local groundwater goals, the chloride concentration remained lower while the acid pH, iron and manganese concentrations are a common occurrence in the coal mine background conditions. Other than boron, all the current trace metal concentrations (not including the common iron and manganese) were lower than the ANZECC/Local groundwater trigger values.

The boron concentrations at bore D9 of 0.65 mg/L (Table 5) appears to have been diluted from 2.08 mg/L at bore D1 (Table 4) by a source of low boron groundwater near bore D9. As the Neubecks Creek water was found to have entered the groundwater at D8, it is likely that the creek water is recharging the groundwater sampled by bore D9 as well. This most likely occurs because the groundwater is expected to flow under the creek bed for most of the time and D9 is only about 4m from the creek. Hence, it appears that as the Huon Gully plume flows to the north-west towards D9, the water quality is diluted by recharging Neubecks Creek water.

Due to these mediating effects, no significant effect of the Huon Gully plume on Neubecks Creek are expected. This is discussed in Section 3.9 in relation to the water quality in Neubecks Creek.

As the groundwater level has decreased at bore D19 to be similar to that at D9, it appears unlikely that the D19 chloride, sulphate, salinity and trace metals (Table 5) could significantly influence the concentrations at D9 because of the much lower groundwater flows. It also appears that the influence of D19 on the concentrations in Neubecks Creek at WX22 would be reduced. This is investigated in the next Section.

Table 5: Water Quality for Mt Piper Receiving Water Bores MPGM4/D8 and D9 for Stage I and II Brine Conditioned Ash Placement Compared to Background Mine Void Bore B901 and Coal Waste/Chitter Bore MPGM4/D19, Bore D9 Pre-Brine Placement Baseline and Pre- and Post-50th and 90th Percentile Trends and the Groundwater Guidelines or Goals

Element (mg/L)	Mt Piper Brine Co-Placement Groundwater Receiving Water Monitoring Bores							B901 Western Main Void Back-ground 1997 to Sept 2000	Lamberts North July, 2016 to June, 2017	ANZECC Guideline Goals for Ground-water#
	Post-Stage I & II 2000 to June, 2017		Current Stage I & II July, 2016 to June, 2017		D9 Baseline (Pre-Stage I 90th Percentile)	D9 Trend (Pre-Stage I 50th Percentile)	D9 Trend Post-(2000 to June, 2017) 90th Percentile			
	D8	D9	D8	D9	D9	D9	D9	B901	D19	
pH	5.8	6.2	5.4	5.8	6.8	6.0	6.6	6.6	5.9	6.5-8.0
Cond (µS/cm)	409	1750	299	2774	607	375	2909 !	1623	5499	2600
TDS	301	1419	226	2168	451	220	2400 !	1638	4163	2000^
SO4	163	844	116	1428	139	86	1440 !	948	2633	1000++
Cl	17	98	7.6	146	23	12	188 !	30	431	350+
As	0.001	0.011	<0.001	<0.001	0.0146	0.0065	0.028 !	0.005	0.009	0.024
B	0.035	0.338	0.05	0.65	0.022	0.008	0.668 !	3.16	2.21	0.37
Cd	0.0002	0.0003	<0.0001	<0.0001	<0.001	0.001	0.001	0.0103	0.0001	0.001
Cr	0.001	0.002	<0.001	<0.001	0.0105	0.0045	0.006	-	0.030	0.004
Cu	0.002	0.012	0.001	<0.001	0.0628	0.0135	0.025	0.017	0.011	0.005
Fe*	0.30	7.7	0.13	11.6	1.667	1.025	23.1	6.08	23.7	0.664
Mn*	0.75	6.2	0.25	10.1	1.004	0.79	10.9 !	5.66	11.7	5.704
Mo	0.005	0.002	<0.001	<0.001	0.002	0.001	<0.05	-	0.002	0.01+
F	0.07	0.10	0.017	0.09	0.297	0.14	0.20	4.45	0.112	1.5+++
Ni	0.064	0.264	0.044	0.334	0.178	0.115	0.370 !	0.92	0.912	0.5509
Pb	0.003	0.018	0.002	<0.001	0.158	0.042	0.049	0.002	0.021	0.005
Se	0.0011	<0.001	<0.001	<0.001	0.002	0.001	0.002	0.005	<0.001	0.005
Zn	0.080	0.811	0.052	0.126	1.24	0.175	1.49 !	3.88	0.374	0.908

! Cond., Cl, TDS, SO_4, Arsenic and Mn as well as Zn various events to Oct, 2008; Cond., TDS, SO_4, consistently since January, 2009 and Cl since April, 2010; Mn consistently since January, 2009; Boron various events since April, 2002 and consistent since January, 2010; Nickel consistently since April, 2012

* filtered samples for iron and manganese

\# 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 GCB 147, 113 mg/L.

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

\+ 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; Green: post-placement 90th > pre-placement 90th percentile

3.8.1 Chloride and Nickel Concentration Trends at Bore D19

It was noted above that elevated nickel concentrations in Huon Gully and at bore D1 are most likely due to inputs from the Western Main open-cut mine void. The water conditioned ash was placed in the void prior to brine conditioned ash placed on top, above RL946m. This view is because bores B904 (south-west mine void) and B901 (north-west mine void) groundwater are both elevated with nickel concentrations (B904 nickel re-brine baseline concentration 1.14 mg/L and B901 was 1.49 mg/L). This suggests that nickel could be used as a tracer for the mine void flows under the ash into Huon Gully because brine conditioned ash leachates contain only a small concentration of nickel (Table 3).

In this regard, it was noted that the current nickel concentration at D19 of 0.912 mg/L (Table 5) is similar to that at D1 (1.025 mg/L, Table 4) while most of the other metals at D1 were much lower than at D19, so the changes in nickel concentrations at D1, D9 and D19 are examined in Figure 12, relative to the changes in chloride concentrations at D19.

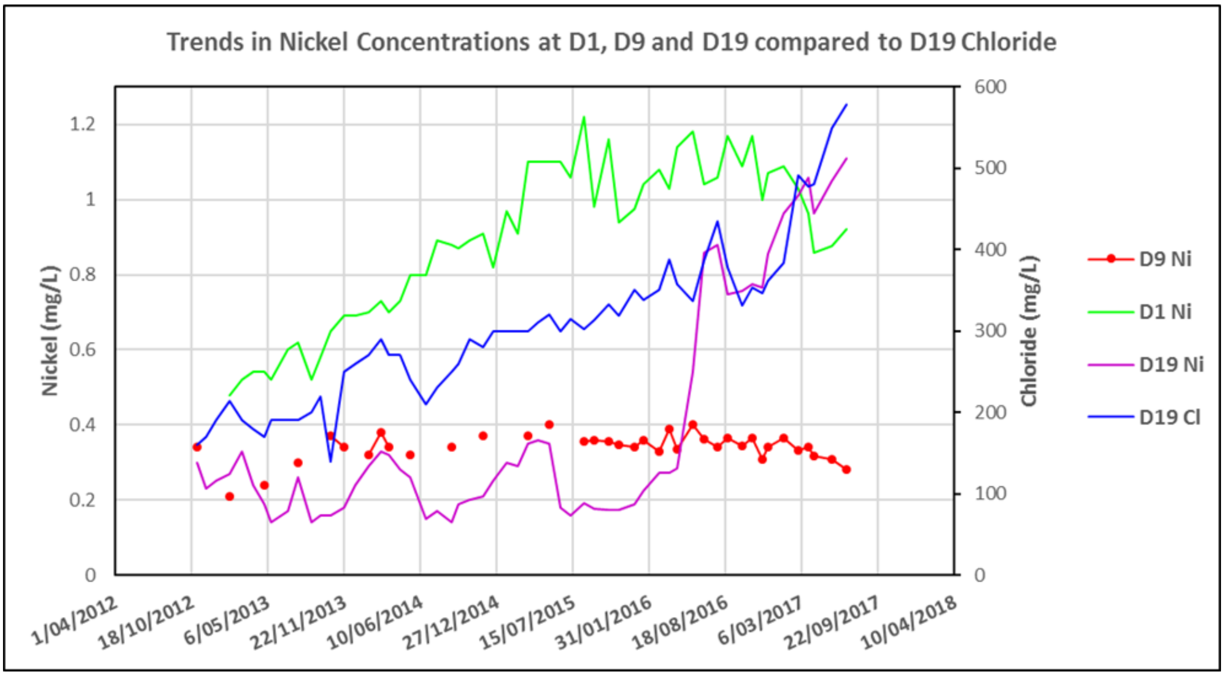

Figure 12. Recent Nickel Trends at Bores MPGM4/D1, D9 and D19 Compared to Bore D19 Chloride trends

Prior to May, 2016, the nickel concentration at D19 varied from 0.15 to 0.35 mg/L, while that at the receiving groundwater bore, D9, was slightly higher, indicating the influence of the higher nickel concentration at bore D1. However, D9 only had a minor response to the large increase at D1 to about 1.1 mg/L in 2015. In addition, the nickel concentration at D19 only tended to follow its chloride concentration up to May, 2014 and then showed no response to the increasing chloride trend until the groundwater level drawdown in May, 2016 (see Figure 6).

From May, 2016, there was a large decrease in groundwater level at D19 by 2m from April to May, 2016 to a level only slightly higher than that at D9 (Figure 6)[5]. The reduced groundwater level at D19 of RL908.2m became about 1.8m lower than the B904 mine void baseline level of RL910.0

[5] The groundwater level drawdown at D19 may be related to possible use of groundwater surfacing in ponds to the east of D19 for washery water.

(Attachment 1, part 4). The chloride contours in Figure 8 show that the mine void groundwater at the southern B904 could flow towards D19.

Consequently, the mine void nickel concentration at D19 increased sharply after May, 2016 to average 0.916 mg/L (Table 5) to be similar to that at D10 of 0.906 mg/L (Table 3, with the D10 nickel originating from the coal mine void bore B904) and followed the D19 chloride concentration flowing from bore D10 (Section 3.8). Furthermore, the rate of chloride increase at D19 increased after May, 2016, indicating that, prior to that date, the slower rate of chloride increase was due to the Huon Gully groundwater flow moving around the compacted mine spoil and after May, the chloride plume was being actively drawn towards the east of Huon Gully by the groundwater level drawdown.

Figure 12 shows that after the May, 2016 drawdown, the D19 nickel increase had no effect on the concentration at D9, possibly due to the much lower difference in groundwater levels between the two bores. This is consistent with the lack of increase of other trace metals, such as copper, chromium and lead, at D9 during 2016/17, compared to the higher concentrations at D19 (Table 5), and the continued decrease in chloride concentrations at D9, shown in Figure 10.

3.9 Neubecks Creek

As discussed in previous reports, 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 under and through the inter-burden rubble drain, under the ash, to the void at the end of Huon Gully at a rate of about 2 ML/day and from there toward Neubecks Creek. Brine leachates were predicted to enter the mine groundwater flows and to be diluted by them, so no significant effects on the water quality at the creek receiving water site were expected due to the leachates.

From previous investigations, it is understood the path of groundwater seepage from under the Mt Piper ash placement to Neubecks Creek is via Huon Gully. The Mt Piper groundwater flow directions (Figure 8) were conceptualised from an understanding of the local coal seam structure and hydrogeology. This suggests that groundwater flows follow the dip in the mined coal seam strata, under the ash area, in a north-easterly direction. The main groundwater inflows are from the west, indicated by the background bore, D5, and the south (bore D23) toward the low point at bore D20, located in the northern Lamberts North embankment at the end of Huon Gully. The flows continue down to bore D1, and then to the lowest level at the receiving bore D9, which is near Neubecks Creek.

Figure 13 shows a schematic of the groundwater flow from underground coal mines, up-gradient of the Mt Piper ash placement area, which 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. Groundwater flowing towards Neubecks Creek from Huon Gully is expected to flow under the creek via the coal seams.

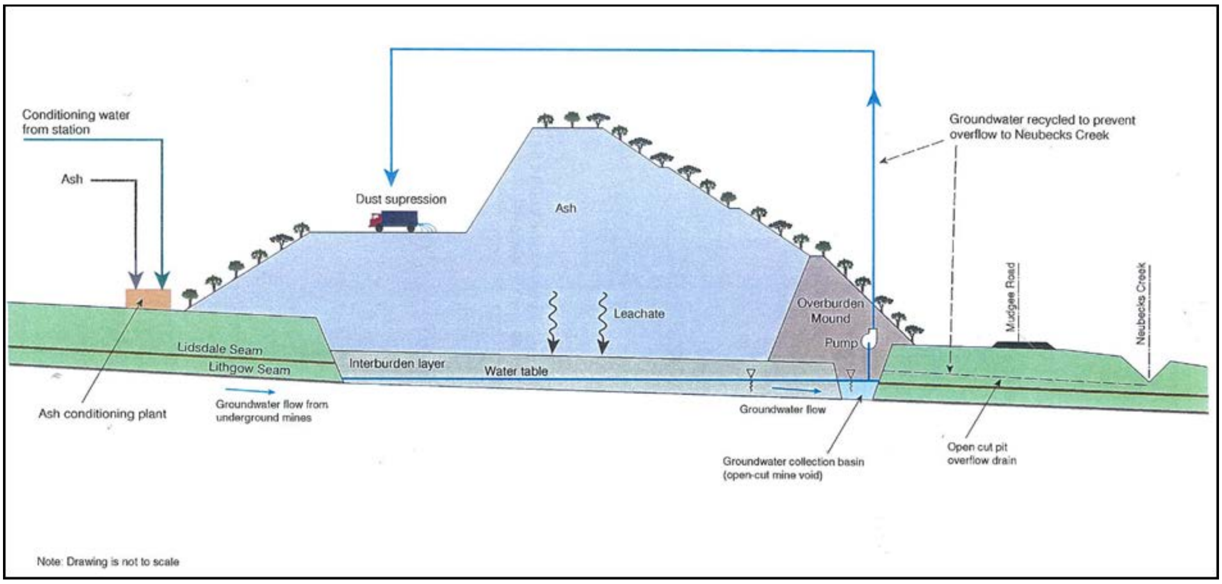

Figure 13. Schematic of Mt Piper Ash Placement Management of Surface and Groundwater - from PPI (1999)

Some of the groundwater flowing down Huon Gully could potentially enter Neubecks Creek, upstream of the WX22 (see Figure 1), 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 into the creek has been estimated at <0.1 ML/day, indicating that most of the 2 ML/day of mine groundwater flowing from under the ash placement, and down Huon Gully, actually flows under the creek by following the dip in the coal seam.

Figure 14 shows that, although the chloride in bore D9 had reached 200mg/L in 2014, the concentration has steadily decreased, apparently due to increased mine water inflows to Huon Gully. Consequently, the chloride concentrations in Neubecks Creek, at the WX22 receiving water site, remained below its pre-placement baseline of 22 mg/L during 2016/17, other than in February, 2017 when there was no flow in the creek.

The Neubecks Creek background location at LDP1 (upstream of the brine placement area) has had chloride concentrations below the pre-placement baseline of 26 mg/L since 2008. Bore D8 chloride concentrations on the northern side of the creek were lower than the pre-placement baseline of 14 mg/L during 2016/17, other than when Neubecks Creek had no flow.

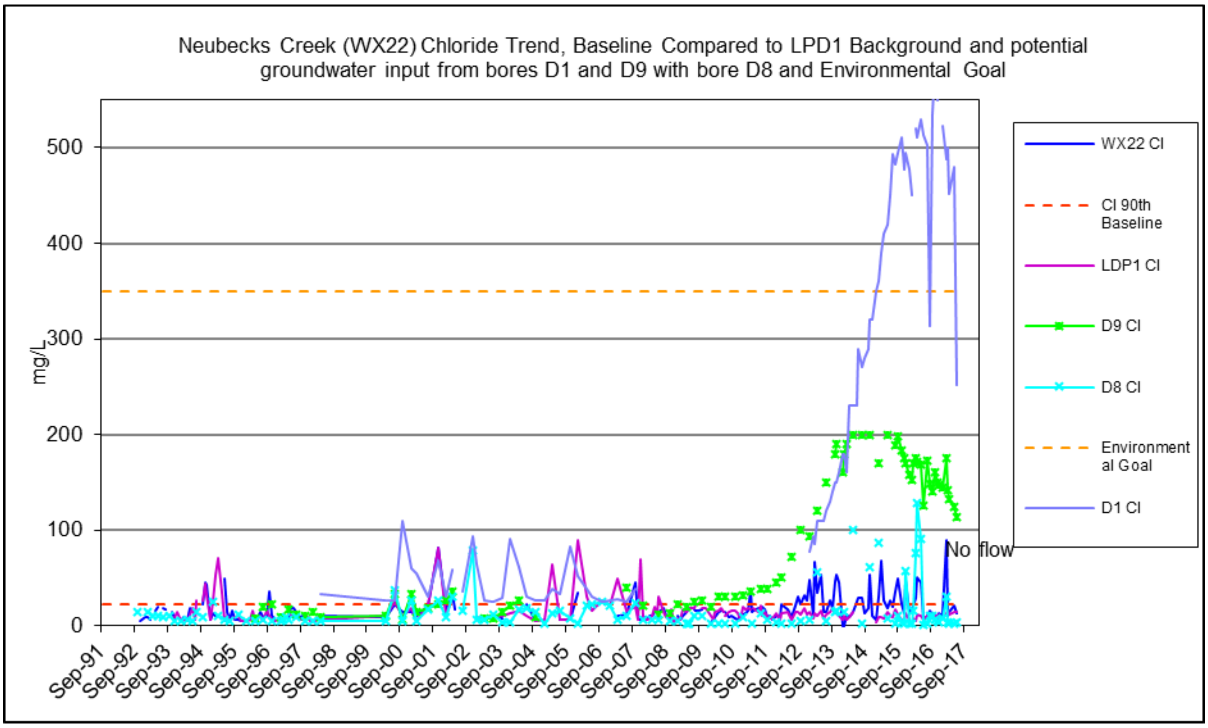

Figure 14. Chloride Trends in Neubecks Creek (WX22) Compared to its 90th percentile baseline, LDP1 background concentrations and groundwater receiving water bores MPGM4/D8 and D9 concentrations as well as the Environmental Chloride Goal

Table 6 shows the changes in the water quality and trace metals in Neubecks Creek from the pre-brine placement to the post-placement (since 2001) and the current Stage II placement in 2016/17. These changes have been compared to those from the upstream site (LPD1) to the downstream site at WX22. In addition, the WX22 concentrations have been compared to the bore D9 concentrations because it receives groundwater inflows from Huon Gully and may influence the final concentrations at WX22 when it seeps into the creek after rainfall events (Merrick, 2007).

Although the sulphate and salinity concentrations were elevated at bore D9, the concentrations at WX22 were well below the Local/ANZECC (2000) trigger values (Table 6), showing no significant effects of the groundwater on the creek salinity. Likewise, the chloride concentration at WX22 was an order of magnitude lower than at D9 and all the trace metals, including nickel, had lower concentrations than the surface water local goals.

In addition, the post-brine placement 90th percentile trends from 2001 (shown in green in Table 6) had lower salinity, sulphate, chloride and trace metal concentrations than the local goals, other than the local coal mine related nickel concentrations.

Table 6: Water Quality for Neubecks Creek during Stage I and II and the current period compared to Pre-Brine Placement Baseline, Background at LDP1 and Pre- and Post-50th and 90th Percentile Trends as well as bore MPGM4/D9 background groundwater and the Surface Water Guidelines or Goals

Element (mg/L)	Neubecks Creek at WX22					LDP1 Background Current Stage I & II July 2016 to June, 2017	D9 Groundwater July, 2016 to June, 2017	Surface Water Guidelines or Goals#
	Baseline (Pre-Stage I 90th Percentile) 1993-2000	Post- Stage I & II Jan. 2001 to June, 2017	Current Stage I & II July 2016 to June, 2017	Trend (Pre-Stage I 50th Percentile)	Trend (Post-Stage I & II 90th Percentile) Jan. 2001 to June, 2017			
pH	7.8	7.3	7.3	7.5	7.7	7.9	5.8	6.5 – 8.0
Cond/ (uS/cm)	894	486	442	396	935	435	2774	2200
TDS	580	322	279	226	614	297	2168	1500^
SO4	332	151	109	104	354	115	1428	1000 ++
Cl	22	20	18.7	10	46 !	11.5	146	350 +
As	0.001	0.001	<0.001	0.001	0.002	0.001	<0.001	0.024
B	0.090	0.09	0.05	0.026	0.17 !	0.057	0.65	0.37
Cd	0.001	0.0002	<0.0001	<0.001	0.0002	<0.0001	<0.0001	0.00085
Cr	0.001	0.001	<0.001	0.001	0.002	0.001	<0.001	0.002
Cu	0.001	0.002	0.001	0.001	0.002 !	0.005	<0.001	0.0035
Fe*	0.281	0.12	0.11	0.11	0.29	0.03	11.6	0.3+++
Mn*	0.720	0.52	0.32	0.212	0.99 !	0.11	10.1	1.9
Mo	0.001	0.005	<0.001	0.001	<0.01	0.002	<0.001	0.01+
F	0.338	0.19	0.12	0.2	0.30	0.13	0.09	1.5+++
Ni	0.005	0.019	0.014	0.001	0.043 !	0.007	0.334	0.017
Pb	0.001	0.001	0.001	0.001	0.001	0.002	<0.001	0.005
Se	0.001	<0.001	<0.001	0.001	0.002	<0.001	<0.001	0.005
Zn**	0.116	0.029	0.008	0.021	0.040	0.028	0.126	0.116

Notes: * filtered samples for iron and manganese

^ 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**

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

! Cl Sept2012,Mar, Aug, Oct2013 to Feb2014; B Aug2012, Oct2013 to Mar2014; Cu Aug 2010 to Feb 2011,Mar, 2013;Mn various events since 2003 with latest in Feb2014; Ni July & Oct 2007, Feb2013 to present; Cd LOR of <0.001 mg/L in 2001/02

3.10 Model Verification

The UTS Mt Piper groundwater model was suggested to be updated in the previous report if the additional groundwater bores installed to sample the southern underground coal mine (bore D23) and the groundwater under the Lamberts North ash (embankment bore D20) showed that the flow path of groundwater was from the upper areas toward bore D9 via Huon Gully. The chloride distribution following heavy rainfall events in June and July, 2016 (Figure 8), which recharged the groundwater entering Huon Gully, confirms this view.

Examination of the D20 chloride data in (Aurecon, 2017b) showed it was eight times lower than at D10 (102 mg/L compared to 822 mg/L) before the rainfall events. However in August, 2016, after the rainfall recharge, bore D20 remained at roughly stable, low concentrations, despite the chloride at D10 decreasing by approximately 60%. Nevertheless, the chloride reduction at D10 was followed by a reduction at D9, near Neubecks Creek, in September, which had a further reduction after the February, 2017 rainfall event. Accordingly, it is suggested that updating the model, or otherwise, should wait for the results of the 2017 Lamberts North annual update report to see how the D20 groundwater levels, rainfall and chloride concentrations responded to rainfall recharge from the underground mine water in the area.

The understanding of how bores D20, D1 and D9 respond to underground mine water recharge effects, up-gradient of Huon Gully, is expected to aid investigations into the role of rainfall recharge and its mitigation of the chloride plume in Huon Gully.

In addition to these observations, it is considered possible that the compacted mine spoil in Huon Gully has resulted in partially dammed conditions for groundwater flow from the Mt Piper rubble drain as it flows into Huon Gully (Merrick, 2007). These changed conditions may be affecting the groundwater flow regime, particularly with respect to flow paths and volumes, beneath the Lamberts North ash placement site. Hence, it is suggested that the UTS Mt Piper Model to be updated following results of the Lamberts North annual update for 2016/17.

4. Discussion

The 2016/17 annual update report has found ongoing evidence that the northern brine conditioned ash benches (B1 to B4) are not having a significant effect on the groundwater at the northern seepage detection bore MPGM4/D3. The previous report for 2015/16 (Aurecon, 2017a) showed that the brine leachates from the southern Stage II B5 brine conditioned ash area were from a source beneath the Mt Piper water conditioned and brine conditioned ash placements. This leachate is entering the groundwater and is the potential cause of the high chloride in bore D10.

In addition, drilling through the B5 brine bench confirmed that the brine conditioned ash was placed above the required water conditioned ash level of RL946m, so, other than limited effects of rainfall infiltration through the bench, the increased chloride in the upper reaches of Huon Gully are unlikely to be due to the brine conditioned ash placement.

The previous report, and current results have found that chloride concentrations decrease in the groundwater plume from under the southern ash area as groundwater flows down Huon Gully, resulting in lower concentrations at each of the down-gradient bores D20, D1 and D9. The decreases were most likely due to the effects of low chloride inflows from the north-western underground coal mine groundwater. However, a much larger mitigation of the chloride plume in the upper reaches of Huon Gully has since become evident during a high rainfall event in 2016. The parallel increases in groundwater levels at bores D23 and D10 indicates that the mitigation of groundwater chloride concentrations was most likely due to increased groundwater inflows through the southern underground coal mine with increased groundwater recharge.

Additionally, the recently installed rainfall runoff collection pond, CW2, appears to contribute to the rainfall recharge of the upper Huon Gully area. Figures 1 and 2 show the pond is located near a trench at the base of the hill south of the ash area, which may also contribute some rainfall runoff into the local groundwater. Hence, it is suggested that an investigation be undertaken to determine how to enhance rainfall recharge of the local groundwater to mitigate the chloride plume in Huon Gully, particularly during dry weather. These investigations could also include, subject to suitable water quality, the use of rainfall runoff from the Lamberts North dry ash and the collection and storage of runoff from the Mt Piper ash area.

The previous and current groundwater recharge effects are most likely the reason why there have been no significant effects of the southern salinity and chloride source beneath the Mt Piper water and brine conditioned ash placements on the water quality or trace metals at the receiving water site in Neubecks Creek. This suggests that an enhanced rainfall recharge system be investigated to see if it could mitigate the salinity and boron concentrations at the receiving groundwater bore MPGM4/D9, regardless of the source, to comply with the Local/ANZECC trigger values.

5. Conclusions

The 2016/17 assessment of effects of the Mt Piper Stage I and Stage II brine co-placements on the receiving surface water and groundwater has led to the following conclusions:

- No significant effects of the northern brine area placement on the local groundwater at D3.
- ANZECC (2000) and locally derived guideline trigger values for groundwater, other than salinity and sulphate, with a minor elevation in mine water related boron, continued to be met at bore MPGM4/D9
- No exceedances of the local and ANZECC guidelines at D8
- Chloride, salinity and trace metals complied with the local/ANZECC trigger values for the Neubecks Creek receiving water site WX22.

6. Recommendations

From the assessment of water quality data collected in 2016/17, it became apparent that rainfall recharge of the underground coal mine groundwater could mitigate the chloride concentrations in the upper Huon Gully, so it is recommended that the potential for enhancing groundwater recharge in the area by rainfall runoff be investigated.

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 2008 Water Management Plan
- The rainfall recharge investigation to consider use of the UTS groundwater model to confirm the potential benefits of mitigation of chloride concentrations in Huon Gully
- Assess effects of the 2016, and early 2017, rainfall recharge of the southern underground coal mine groundwater on the groundwater quality beneath the Lamberts North ash placement during 2016/17.

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Attachment 1

Surface and Groundwater Data for July, 2016 to June, 2017

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

   b) Mt Piper Power Station Licence Discharge Point LDP1

2. Water Quality Data and Summary for Groundwater Seepage Detection Bores MPGM4/D1 and 4/D3

3. Water Quality Data and Summary for Background Groundwater Bores MPGM4/D4 and 4/D5

4. Water Quality Data and Summary for Ash Placement Area Groundwater Bores B901 (north-west ash area background), B904 (south-west ash area background for Bore D10), bores MPGM4/D10 and MPGM4/D11

5. Mt Piper Water Conditioned Ash Runoff Pond Water Quality (no runoff collection pond in the area – see Figure 2, so previous data from 2001 to February, 2014 is shown)

6. Water Quality Data and Summary for Groundwater Receiving Water Bores MPGM4/D8 and 4/D9

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

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

Neubecks Creek WX22 Pre-Brine/ash Placement - Background Data 1993 - 2000 (mg/L)																				
	Ag	**Al**	**ALK**	**As**	**B**	**Ba**	**Be**	**Ca**	**Cd**	**Cl**	**Co**	**COND µS/cm**	**Cr**	**Cu**	**F**	**Fe**	**Hg**	**K**	**Li**	**Mg**
Average		0.148	58	0.001	0.035	0.025	0.001	33	0.001	15	0.001	470	0.001	0.001	0.19	0.164		5.9	0.032	21
Maximum		1.110	124	0.002	0.130	0.030	0.001	108	0.001	114	0.001	1180	0.001	0.001	0.600	0.446		10.9	0.039	75
Minimum		0.005	11	0.001	0.005	0.02	0.001	13	0.001	5	0.001	190	0.001	0.001	0.001	0.1		5.0	0.02	7
90th Percentile		0.320	90	<0.001	0.090	0.029	0.001	49	<0.001	22	<0.001	894	<0.001	<0.001	0.338	0.281		7.0	0.038	34
Pre-50th Percentile Trend		0.057	60	0.001	0.026	0.025	0.001	27	0.001	10	0.001	396	0.001	0.001	0.200	0.110		5.0	0.036	17
ANZECC 2000	0.00005	-	-	0.024	0.370	0.700	0.100	175	0.00085	350	-	2200	0.002	0.0035	1.500	0.300	0.00006	-	-	-

Continued……………….Neubecks Creek WX22 Pre-Brine/ash Placement - Background Data 1993 - 2000 (mg/L)																			
	Mn	**Mo**	**Na**	**NFR**	**Ni**	**NO2+NO3**	**ORTH P**	**Pb**	**pH**	**Sb**	**Se**	**SiO2**	**SO4**	**Temp**	**TFR**	**TN**	**TOTP**	**V**	**Zn**
Average	0.289	0.001	15	8.6	0.003	0.068	0.007	0.001	7.4		0.001	10.1	147	14.4	305	2.81	0.070	0.001	0.039
Maximum	1.030	0.001	55	94	0.006	0.960	0.051	0.002	8.1		0.002	183.0	565	18.1	1020	8.00	2.120	0.001	0.308
Minimum	0.033	0.001	5	1	0.001	0.001	0.001	0.001	5.3		0.001	0.1	19	11.5	18	0.001	0.001	0.001	0.001
90th Percentile	0.720	<0.001	28	17	0.005	0.153	0.017	0.001	7.8		<0.001	11.6	332	17	580	3.141	0.130	0.001	0.116
Pre-50th Percentile Trend	0.212	0.001	14	2	0.001	0.029	0.003	0.001	7.5		0.001	5.0	104	14	226	3.001	0.021	0.001	0.021
ANZECC 2000	1.900	0.010	230	10.0	0.017	-	-	0.005	6.5-8.0	-	0.005	-	1000	-	1500	-	-	-	0.116

Neubecks Creek WX22 Post- Brine/ash Placement Data July 2016 to June, 2017																				
Date	**Ag**	**Al**	**ALK**	**As**	**B**	**Ba**	**Be**	**Ca**	**Cd**	**Cl**	**Co**	**COND µS/cm**	**Cr**	**Cu**	**F**	**Fe**	**Hg**	**K**	**Li**	**Mg**
27/07/2016	0.0005	0.46	61	0.0005	0.05	0.016		21.2	0.0001	10.3		291	0.001	0.002	0.078	0.075	0.00002	4.4		11.6
24/08/2016	0.0005	0.15	67	0.0005	0.025	0.024		33.3	0.0001	15.9		463	0.001	0.001	0.073	0.051	0.00002	5.33		20.2
28/09/2016	0.0005	0.28	54	0.0005	0.06	0.018		19.3	0.0001	11.7		290	0.001	0.001	0.07	0.079	0.00002	4.05		12
26/10/2016	0.0005	0.12	71	0.0005	0.025	0.017		24.7	0.0001	12.4		336	0.001	0.001	0.093	0.065	0.00002	3.98		15
23/11/2016	0.0005	0.11	82	0.0005	0.025	0.014		22.8	0.0001	8		283	0.001	0.001	0.121	0.13	0.00002	3.17		13.1
7/12/2016	0.0005	0.06	106	0.0005	0.025	0.014		31.3	0.0001	12.5		394	0.001	0.001	0.131	0.199	0.00002	3.1		19.1
11/01/2017	0.0005	0.08	120	0.0005	0.025	0.014		28.5	0.0001	10.7		390	0.001	0.001	0.185	0.084	0.00002	3.04		17.7
18/01/2017	0.0005	0.13	137	0.0005	0.025	0.016		33.7	0.0001	12.5		464	0.001	0.001	0.196	0.2	0.00002	3.14		22.4
22/02/2017	0.0005	0.04	119	0.0005	0.15	0.024		86	0.0001	89.8		1380	0.001	0.001	0.206	0.047	0.00002	7.72		71.8
22/03/2017	0.0005	1.83	50	0.002	0.08	0.026		18	0.0001	10.6		261	0.002	0.005	0.102	0.152	0.00002	5.34		9.47
5/04/2017	0.0005	0.29	87	0.0005	0.08	0.018		23.3	0.0001	14.5		348	0.001	0.001	0.164	0.079	0.00002	5.24		13.8
24/05/2017	0.0005	0.1	72	0.0005	0.025	0.018		27.7	0.0001	21.1		393	0.001	0.002	0.125	0.087	0.00002	6.81		15.6
28/06/2017	0.0005	0.03	36	0.0005	0.06	0.02		26.1	0.0001	13.1		454	0.001	0.001	0.063	0.153	0.00002	4.35		16.1

Continued……………Neubecks Creek WX22 Post- Brine/ash Placement Data July 2016 to June, 2017																			
Date	Mn	Mo	Na	NFR	Ni	NO2+NO3	ORTHP	Pb	pH	Sb	Se	SiO2	SO4	Temp	TFR	TN	TOTP	V	Zn
27/07/2016	0.057	0.001	16.7		0.005	0.03		0.004	6.54		0.0003		69.3	6.1	202	0.9		0.005	0.009
24/08/2016	0.079	0.001	22.1		0.005	0.02		0.001	7.63		0.0001		137	6.4	262	0.05		0.005	0.005
28/09/2016	0.047	0.001	14		0.005	0.01		0.001	7.27		0.0001		67.6	8.7	191	0.1		0.005	0.003
26/10/2016	0.079	0.001	16.2		0.005	0.04		0.001	7.39		0.0001		78.1	10.5	172	0.3		0.005	0.003
23/11/2016	0.203	0.001	15.1		0.007	0.06		0.001	7.33		0.0001		42.7	18.1	175	0.4		0.005	0.003
7/12/2016	0.441	0.001	21.3		0.015	0.04		0.001	7.51		0.0001		67.3	18.4	267	0.3		0.005	0.003
11/01/2017	0.522	0.001	23.8		0.009	0.005		0.001	7.5		0.0002		60.5	26.3	240	0.3		0.005	0.003
18/01/2017	0.745	0.001	29.1		0.024	0.005		0.001	7.28		0.0001		80.8	22.6	333	0.3		0.005	0.011
22/02/2017	0.878	0.001	105		0.068	0.03		0.001	7.58		0.0001		551	19.5	932	0.4		0.005	0.035
22/03/2017	0.14	0.001	13.4		0.01	0.04		0.004	7.15		0.0004		57.9	19	216	0.6		0.005	0.024
5/04/2017	0.398	0.001	22.8		0.01	0.005		0.001	7.21		0.0003		62.3	13.7	302	0.3		0.005	0.003
24/05/2017	0.298	0.001	27.8		0.008	0.03		0.001	7.35		0.0001		85	9.3	210	0.4		0.005	0.003
28/06/2017	0.259	0.001	27.8		0.009	0.04		0.001	7.1		0.0001		56.2	7.7	126	0.1		0.005	0.007

Neubecks Creek WX22 Post- Brine/ash Placement Summary July 2016 to June, 2017																				
	Ag	**Al**	**ALK**	**As**	**B**	**Ba**	**Be**	**Ca**	**Cd**	**Cl**	**Co**	**COND µS/cm**	**Cr**	**Cu**	**F**	**Fe**	**Hg**	**K**	**Li**	**Mg**
Ave	0.001	0.28	82	0.001	0.050	0.018		30	0.0001	18.7		442	0.001	0.001	0.12	0.11	0.00002	4.6		20
Max	0.001	1.83	137	0.002	0.150	0.026		86	0.0001	89.8		1380	0.002	0.005	0.21	0.20	0.00002	7.7		72
Min	0.001	0.03	36	0.001	0.025	0.014		18	0.0001	8.0		261	0.001	0.001	0.06	0.05	0.00002	3.0		9
50th Percentile	0.001	0.12	72	0.001	0.025	0.018		26	0.0001	12.5		390	0.001	0.001	0.12	0.08	0.00002	4.4		16
Post-90th Percentile Trend	0.001	0.43	120	0.001	0.080	0.024		34	0.0001	20.1		464	0.001	0.002	0.19	0.19	0.00002	6.5		22

Continued……………Neubecks Creek WX22 Post- Brine/ash Placement Summary July 2016 to June, 2017																			
	Mn	**Mo**	**Na**	**NFR**	**Ni**	**NO2+NO3**	**ORTHP**	**Pb**	**pH**	**Sb**	**Se**	**SiO2**	**SO4**	**Temp**	**TFR**	**TN**	**TOTP**	**V**	**Zn**
Ave	0.32	0.001	27		0.014			0.001	7.3		0.0002		109		279	0.34		0.005	0.008
Max	0.88	0.001	105		0.068			0.004	7.6		0.0004		551		932	0.90		0.005	0.035
Min	0.05	0.001	13		0.005			0.001	6.5		0.0001		43		126	0.05		0.005	0.003
50th Percentile	0.26	0.001	22		0.009			0.001	7.3		0.0001		68		216	0.30		0.005	0.003
Post-90th Percentile Trend	0.70	0.001	29		0.022			0.003	7.6		0.0003		127		327	0.56		0.005	0.021

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

Mt Piper Power Station Licence Discharge Point LDP1 Summary of Pre-brine Placement Background Data 1993 - 2000 (mg/L)																				
	Ag	**Al**	**ALK**	**As**	**B**	**Ba**	**Be**	**Ca**	**Cd**	**Cl**	**Co**	**COND µS/cm**	**Cr**	**Cu**	**F**	**Fe**	**Hg**	**K**	**Li**	**Mg**
Average			69	0.001	0.071	0.028	0.001	31	0.001	13	0.001	370	0.001	0.011	0.252	0.162		7	0.013	19
Maximum			215	0.003	0.571	0.033	0.001	89	0.001	71	0.001	990	0.001	0.039	1.000	0.890		22	0.019	83
Minimum			29	0.001	0.005	0.020	0.001	5	0.001	5	0.001	102	0.001	0.001	0.001	0.100		5	0.010	7
90th Percentile			92	0.001	0.173	0.032	0.001	47	0.001	26	0.001	552	0.001	0.016	0.386	0.218		11	0.017	30
Pre-50th Percentile Trend			63	0.001	0.037	0.030	0.001	29	0.001	9	0.001	365	0.001	0.010	0.230	0.11		5	0.010	17

Continued……………………Mt Piper Power Station Licence Discharge Point LDP1 Summary of Pre-brine Placement Background Data 1993 - 2000 (mg/L)																		
	Mn	**Mo**	**Na**	**NFR**	**Ni**	**NO2+NO3**	**ORTHP**	**Pb**	**pH**	**Sb**	**Se**	**SiO2**	**SO4**	**Temp**	**TFR**	**TKN**	**TOTP**	**V**	**Zn**
Average	0.102	0.003	16	28	0.007	0.186	0.014	0.002	7.5		0.001	2.8	103	16.0	299		0.037	0.001	0.020
Maximum	0.229	0.004	67	224	0.008	0.535	0.216	0.005	8.4		0.001	7.9	356	18.6	1092		0.242	0.001	0.136
Minimum	0.036	0.001	5	1	0.005	0.006	0.001	0.001	6.2		0.001	0.0	8	12.3	78		0.001	0.001	0.001
90th Percentile	0.162	0.004	33	82	0.008	0.447	0.020	0.003	7.9		0.001	4.7	159	17.8	464		0.090	0.001	0.037
Pre-50th Percentile Trend	0.089	0.003	12	14	0.008	0.144	0.006	0.001	7.5		0.001	2.6	95	16.1	250		0.023	0.001	0.013

Mt Piper Power Station Licence Discharge Point LDP1 Post-brine Placement Data July 2016 to June, 2017 (mg/L)																				
Date	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	Co	COND uS/cm	Cr	Cu	F	Fe-filtered	Hg	K	Li	Mg
22-Jul-16	0.0005	3.46	58	0.001	0.025	0.04	0.0005	22.9	0.0001	9.85		470	0.002	0.007	0.054	0.064	0.00002	5.02		13.3
18-Aug-16	0.0005	0.18	88	0.0005	0.025	0.028	0.0005	34.6	0.0001	12.8		540	0.0005	0.002	0.097	0.012	0.00002	6.32		28.1
22-Sep-16	0.0005	2.25	52	0.001	0.025	0.029	0.0005	18.5	0.0001	7.9		250	0.002	0.007	0.087	0.08	0.00002	4.36		10.8
20-Oct-16	0.0005	0.45	87	0.0005	0.05	0.023	0.0005	32.3	0.0001	13		460	0.0005	0.004	0.108	0.017	0.00002	5.64		24.5
17-Nov-16	0.0005	2.8	59	0.001	0.09	0.031	0.0005	19.1	0.0001	6.57		230	0.002	0.01	0.09	0.049	0.00002	4.94		11.9
14-Dec-16	0.0005	0.28	97	0.0005	0.025	0.027	0.0005	34.8	0.0001	11.3		580	0.0005	0.004	0.114	0.024	0.00002	5.87		25.9
25-Jan-17	0.0005	0.58	82	0.001	0.025	0.028	0.0005	26.7	0.0001	8.08		340	0.0005	0.006	0.232	0.056	0.00002	5.26		15.5
15-Feb-17	0.0005	0.24	112	0.0005	0.14	0.023	0.0005	32.9	0.0001	12.7		464	0.0005	0.005	0.202	0.022	0.00002	6.3		20.6
15-Mar-17	0.0005	0.3	100	0.0005	0.07	0.03	0.0005	36.5	0.0001	16.3		540	0.0005	0.005	0.144	0.018	0.00002	6.96		21.3
27-Apr-17	0.0005	0.47	80	0.0005	0.16	0.034	0.0005	32.8	0.0001	11.3		451	0.0005	0.005	0.127	0.007	0.00002	5.48		21.2
17-May-17	0.0005	0.25	97	0.0005	0.025	0.028	0.0005	31.3	0.0001	14.1		460	0.0005	0.004	0.173	0.014	0.00002	6.5		19.7
21-Jun-17	0.0005	0.25	88	0.0005	0.025	0.025	0.0005	32.8	0.0001	14		430	0.0005	0.005	0.115	0.022	0.00002	6.13		18.4

Continued…………Mt Piper Power Station Licence Discharge Point LDP1 Post-brine Placement Data July 2016 to June, 2017 (mg/L)																	
Date	Mn-filtered	Mo	Na	Ni	NO2+NO3	ORTHP	Pb	pH	Sb	Se	SiO2	SO4	Temp	TFR	TOTP	V	Zn
22-Jul-16	0.078	0.001	13.2	0.01	0.16		0.007	8		0.0011		150		296		0.005	0.054
18-Aug-16	0.175	0.001	23.6	0.011	0.09		0.004	8		0.0004		190		371		0.005	0.017
22-Sep-16	0.064	0.001	11.9	0.01	0.13		0.004	7.7		0.0008		71		229		0.005	0.048
20-Oct-16	0.084	5E-04	18.3	0.007	0.04		0.004	8		0.0006		130		280		0.005	0.017
17-Nov-16	0.035	0.001	15	0.008	0.11		0.005	7.7		0.0009		63		276		0.005	0.052
14-Dec-16	0.047	0.002	24.6	0.004	0.09		0.004	7.9		0.0003		130		290		0.005	0.01
25-Jan-17	0.094	0.003	20.4	0.006	0.18		0.004	8.7		0.0006		90		248		0.005	0.041
15-Feb-17	0.06	0.004	26	0.004	0.06		0.004	7.91		0.0006		97.4		312		0.005	0.013
15-Mar-17	0.071	0.003	31.3	0.005	0.18		0.004	7.7		0.0006		140		374		0.005	0.015
27-Apr-17	0.41	0.003	33.9	0.007	0.18		0.004	7.72		0.0006		103		298		0.005	0.027
17-May-17	0.082	0.004	32.3	0.003	0.17		0.004	7.9		0.0005		110		338		0.005	0.022
21-Jun-17	0.068	0.003	29.9	0.004	0.15		0.004	7.9		0.0003		110		252		0.005	0.021

Mt Piper Power Station Licence Discharge Point LDP1 Post-brine Placement Summary July 2016 to June, 2017 (mg/L)																			
	Ag	**Al**	**ALK**	**As**	**B**	**Ba**	**Be**	**Ca**	**Cd**	**Cl**	**Co**	**COND uS/cm**	**Cr**	**Cu**	**F**	**Fe-filtered**	**Hg^**	**K**	**Li**	**Mg**
Ave	0.0005	0.96	83	0.001	0.057	0.029	0.001	30	0.0001	11.5		435	0.001	0.005	0.13	0.03	0.00002	5.7		19
Max	0.0005	3.46	112	0.001	0.160	0.040	0.001	37	0.0001	16.3		580	0.002	0.010	0.23	0.08	0.00002	7.0		28
Min	0.0005	0.18	52	0.001	0.025	0.023	0.001	19	0.0001	6.6		230	0.001	0.002	0.05	0.01	0.00002	4.4		11
50th Percentile	0.0005	0.38	88	0.001	0.025	0.028	0.001	33	0.0001	12.0		460	0.001	0.005	0.11	0.02	0.00002	5.8		20
Post-90th Percentile Trend	0.0005	2.75	100	0.001	0.135	0.034	0.001	35	0.0001	14.1		540	0.002	0.007	0.20	0.06	0.00002	6.5		26

Continued……Mt Piper Power Station Licence Discharge Point LDP1 Post-brine Placement Summary July 2016 to June, 2017 (mg/L)																
	Mn-filtered	Mo	Na	Ni	NO2+NO3	ORTHP	Pb	pH	Sb	Se	SiO2	SO4	Temp	TFR	TOTP	V	Zn
Ave	0.11	0.002	23	0.007	0.13		0.002	7.9		0.0006		115		297		0.005	0.028
Max	0.41	0.004	34	0.011	0.18		0.007	8.7		0.0011		190		374		0.005	0.054
Min	0.04	0.001	12	0.003	0.04		0.001	7.7		0.0003		63		229		0.005	0.010
50th Percentile	0.07	0.003	24	0.007	0.14		0.001	7.9		0.0006		110		293		0.005	0.022
Post-90th Percentile Trend	0.17	0.004	32	0.010	0.18		0.005	8.0		0.0009		149		368		0.005	0.052

2. Water Quality Data and Summary for Groundwater Seepage Detection Bores MPGM4/D1 and 4/D3

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

MPGM4/D1 Pre-Brine/Ash Placement Background Summary 1993-2000 (mg/L)																			
	Ag	**ALK**	**As**	**B**	**Ba**	**Be**	**Ca**	**Cd**	**Cl**	**Co**	**COND µS/cm**	**Cr**	**Cu**	**F**	**Fe**	**Hg**	**K**	**Li**	**Mg**
Average	0.001	223	0.001	0.018	0.046	0.001	69	0.001	257	0.024	1975	0.002	0.011	0.292	1.939	0.00011	6	0.023	91
Maximum	0.005	405	0.008	0.582	0.500	0.001	135	0.006	512	0.056	3410	0.008	0.02	0.71	15	0.00030	15.3	0.08	225
Minimum	0.001	90	0.001	0.005	0.001	0.001	5	0.001	26	0.001	1170	0.001	0.005	0.001	0.1	0.00010	5	0.005	5
Baseline 90th Percentile	0.001	397	0.002	0.015	0.14	0.001	98	0.001	410	0.048	2609	0.001	0.011	0.656	7.72	0.00010	9	0.059	131
Pre-50th Percentile Trend	0.001	311	0.001	0.005	0.001	0.001	66	0.001	272	0.019	2050	0.001	0.010	0.230	0.19	0.00010	5	0.005	86

Continued……………MPGM4/D1Pre-Brine/Ash Placement Background Summary 1993-2000 (mg/L)																
	Mn	**Mo**	**Na**	**Ni**	**Pb**	**pH**	**Sb**	**Se**	**SO4**	**Temp**	**TFR**	**V**	**WL1**	**WL2**	**WLAHD**	**Zn**
Average	0.840	0.001	199	0.087	0.002	6.4		0.001	372	15.4	1018	0.001	6.02	6.00	906.70	0.029
Maximum	4.51	0.001	390	0.219	0.007	7.5		0.002	610	17.4	1560	0.001	7.80	7.80	908.08	0.116
Minimum	0.001	0.001	14	0.010	0.001	5.7		0.001	180	13.0	795	0.001	4.80	4.50	904.81	0.001
Baseline90th Percentile	2.64	0.001	290	0.182	0.006	7.4		0.002	466	17.2	1615	0.001	7.30	7.30	907.92	0.063
Pre-50th Percentile Trend	0.20	0.001	230	0.059	0.230	6.7		0.001	377	15.9	1330	0.001	5.71	5.71	907.29	0.001

MPGM4/D1 Post-Brine/Ash Placement Data July 2016 to June, 2017 (mg/L)																				
Date	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	Co	COND µS/cm	Cr	Cu	F	Fe	Hg	K	Li	Mg
27-Jul-16	0.0005	0.42	110	0.011	2.01	0.032		377	0.00005	502		4685	0.0005	0.0005	0.1	41.1	0.00002	38.9		269
24-Aug-16	0.0005	0.18	145	0.009	2.48	0.036		409	0.00005	314		5123	0.0005	0.0005	0.1	45.9	0.00007	39.9		291
28-Sep-16	0.0005	0.63	97	0.009	2.19	0.043		417	0.00005	535		5091	0.001	0.0005	0.1	36.6	0.00002	40.6		289
26-Oct-16	0.0005	0.38	148	0.012	2.24	0.034		419	0.00005	586		5332	0.0005	0.0005	0.1	34.3	0.00002	33.9		286
23-Nov-16	0.0005	0.13	124	0.01	1.84	0.032		433	0.00005	549		5177	0.0005	0.0005	0.1	37.2	0.00002	42.6		301
07-Dec-16	0.0005	0.18	130	0.008	2.28	0.032		409	0.00005	560		5183	0.0005	0.0005	0.25	38	0.00002	37.1		296
18-Jan-17	0.0005	0.37	135	0.01	2.12	0.034		404	0.00005	523		5016	0.0005	0.0005	0.066	42.6	0.00002	36.3		290
22-Feb-17	0.0005	0.14	136	0.01	2.09	0.033		385	0.00005	488		4900	0.0005	0.0005	0.084	41.9	0.00002	41		279
22-Mar-17	0.0005	0.04	137	0.008	2.18	0.029		355	0.00005	500		4790	0.0005	0.0005	0.078	20.2	0.00002	32.6		255
05-Apr-17	0.0005	0.27	150	0.01	1.76	0.032		345	0.00005	452		4610	0.002	0.0005	0.051	27.9	0.00002	39.3		252
24-May-17	0.0005	0.76	151	0.01	1.83	0.029		361	0.00005	480		4680	0.0005	0.0005	0.1	42.4	0.00002	38		257
28-Jun-17	0.0005	0.005	143	0.022	1.91	0.033		361	0.00005	252		4740	0.0005	0.0005	0.1	38.6	0.00002	40.8		263

Continued……………MPGM4/D1 Post-Brine/Ash Placement Data July 2016 to June, 2017 (mg/L)																
Date	Mn	Mo	Na	Ni	Pb	pH	Sb	Se	SO4	Temp	TFR	V	WL1	WL2	WLAHD	Zn
27-Jul-16	15.2	0.0005	333	1.06	0.0005	5.53		0.0001	2130		3770	0.005	1.9		910.7	0.138
24-Aug-16	15.6	0.0005	376	1.17	0.0005	6.3		0.0001	2540		4400	0.005	2.1		910.5	0.152
28-Sep-16	16.8	0.0005	385	1.09	0.0005	5.87		0.0002	2530		4050	0.005	1.7		910.9	0.139
26-Oct-16	17.5	0.0005	464	1.17	0.0005	5.87		0.0001	2480		4040	0.005	1.9		910.7	0.145
23-Nov-16	15.8	0.0005	419	1	0.0005	5.91		0.0001	2210		4140	0.005	1.9		910.7	0.123
07-Dec-16	16.7	0.0005	451	1.07	0.0005	5.88		0.0001	2380		4140	0.005	2.1		910.5	0.129
18-Jan-17	16	0.0005	468	1.09	0.0005	5.9		0.0001	2230		4550	0.005	2.3		910.3	0.133
22-Feb-17	14.1	0.0005	428	1.03	0.0005	5.86		0.0001	2100		4350	0.005	2.7		909.9	0.124
22-Mar-17	14.8	0.0005	408	0.962	0.0005	5.84		0.0001	2000		3480	0.005	2.8		909.8	0.109
05-Apr-17	13.4	0.0005	406	0.858	0.0005	5.86		0.0002	1900		3870	0.005	2.7		909.9	0.108
24-May-17	13.8	0.0005	392	0.877	0.0005	5.86		0.0001	2120		3450	0.005	2.8		909.8	0.101
28-Jun-17	14.8	0.0005	408	0.922	0.0005	5.89		0.0001	1100		3780	0.005	2.9		909.7	0.103

MPGM4/D1 Post-Brine/Ash Placement Summary July 2016 to June, 2017 (mg/L)																				
	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	Co	COND µS/cm	Cr	Cu	F	Fe	Hg	K	Li	Mg
Ave	0.0005	0.29	134	0.011	2.08	0.033		390	0.0001	478		4944	0.001	0.001	0.102	37.2	0.00002	38.4		277
Max	0.0005	0.76	151	0.022	2.48	0.043		433	0.0001	586		5332	0.002	0.001	0.250	45.9	0.00007	42.6		301
Min	0.0005	0.01	97	0.008	1.76	0.029		345	0.0001	252		4610	0.001	0.001	0.051	20.2	0.00002	32.6		252
50th Percentile	0.0005	0.23	137	0.010	2.11	0.033		395	0.0001	501		4958	0.001	0.001	0.100	38.3	0.00002	39.1		283
Post-90th Percentile Trend	0.0005	0.61	150	0.012	2.28	0.036	0.005	419	0.0001	559		5182	0.001	0.001	0.100	42.6	0.00002	41.0		296

Continued………………..MPGM4/D1 Post-Brine/Ash Placement Summary July 2016 to June, 2017 (mg/L)																
	Mn	Mo	Na	Ni	Pb	pH	Sb	Se	SO4	Temp	TFR	V	WL1	WL2	WLAHD	Zn
Ave	15.4	0.001	412	1.025	0.001	5.9		0.0001	2143		4002	0.005	2.3		910.3	0.125
Max	17.5	0.001	468	1.170	0.001	6.3		0.0002	2540		4550	0.005	2.9		910.9	0.152
Min	13.4	0.001	333	0.858	0.001	5.5		0.0001	1100		3450	0.005	1.7		909.7	0.101
50th Percentile	15.4	0.001	408	1.045	0.001	5.9		0.0001	2170		4045	0.005	2.2		910.4	0.127
Post-90th Percentile Trend	16.8	0.001	463	1.162	0.001	5.9		0.0002	2525		4395	0.005	2.8	4.8	910.7	0.144

3b. Water Quality Data and Summary for Groundwater Seepage Detection Bore MPGM4/D3

MPGM4/D3 Pre-Brine/Ash Placement Background Summary 1993-2000 (mg/L)																			
	Ag	**ALK**	**As**	**B**	**Ba**	**Be**	**Ca**	**Cd**	**Cl**	**Co**	**COND µS/cm**	**Cr**	**Cu**	**F**	**Fe**	**Hg**	**K**	**Li**	**Mg**
Average	0.001	161	0.001	0.066	0.184	0.001	50	0.001	45	0.003	734	0.003	0.011	0.147	6.9	0.00014	6.9	0.008	30
Maximum	0.001	345	0.0012	2	4.8	0.001	85	0.003	90	0.011	1084	0.035	0.05	0.62	20.0	0.00050	9.8	0.02	47
Minimum	0.001	44	0.001	0.005	0.001	0.001	11	0.001	7.9	0.001	307	0.001	0.001	0.001	0.10	0.00010	5.0	0.005	12
Baseline 90th Percentile	0.001	221	0.001	0.0242	0.11	0.001	70	0.001	60	0.008	870	0.0035	0.010	0.408	14.17	0.00030	8.3	0.014	40
Pre-50th Percentile Trend	0.001	190	0.001	0.0050	0.05	0.001	55	0.001	45	0.001	808	0.0010	0.010	0.110	7.10	0.00010	7.2	0.005	33

Continued…………MPGM4/D3 Pre-Brine/Ash Placement Background Summary 1993-2000 (mg/L)																
	Mn	**Mo**	**Na**	**Ni**	**Pb**	**pH**	**Sb**	**Se**	**SO4**	**Temp**	**TFR**	**V**	**WL1**	**WL2**	**WLAHD**	**Zn**
Average	0.643	0.001	47	0.008	0.006	6.4		0.001	150	15.0	459	0.001	10.8	10.9	909.1	0.020
Maximum	1.8	0.001	68	0.02	0.093	7.4		0.005	350	16.5	975	0.001	16.0	16.0	911.3	0.516
Minimum	0.02	0.001	24	0.001	0.001	3.0		0.001	67	12.7	225	0.001	8.8	8.8	904.1	0.001
Baseline90th Percentile	1.067	0.001	66	0.0164	0.010	6.9	0.001	0.001	190	16.3	588	0.001	13.7	13.7	910.7	0.05
Pre-50th Percentile Trend	0.640	0.001	50	0.006	0.001	6.4	0.001	0.001	155	16.3	480	0.001	10.5	10.5	909.7	0.001

MPGM4/D3 Post-Brine/Ash Placement Data July 2016 to June, 2017 (mg/L)																				
Date	**Ag**	**Al**	**ALK**	**As**	**B**	**Ba**	**Be**	**Ca**	**Cd**	**Cl**	**Co**	**COND µS/cm**	**Cr**	**Cu**	**F**	**Fe**	**Hg**	**K**	**Li**	**Mg**
28-Jul-16	0.0005	0.08	26	0.0005	0.08	0.039		13.1	0.00005	14		233	0.003	0.0005	0.013	0.05	0.00002	2.03		8.58
25-Aug-16	0.0005	0.51	30	0.006	0.06	0.052		18.5	0.00005	18.9		307	0.003	0.003	0.013	0.07	0.00006	2.66		11.3
29-Sep-16	0.0005	1.08	32	0.012	0.18	0.109		19.9	0.00005	18.1		331	0.003	0.011	0.014	0.025	0.00002	2.76		12.7
27-Oct-16	0.0005	1.72	61	0.012	0.13	0.096		49.7	0.00005	24.4		614	0.007	0.016	0.025	0.68	0.00005	8.9		38.8
24-Nov-16	0.0005	0.15	81	0.002	0.08	0.036		76.4	0.00005	26.3		892	0.001	0.002	0.025	6.85	0.00002	8.51		43.4
8-Dec-16	0.0005	0.19	88	0.0005	0.14	0.028		85.3	0.00005	25.7		953	0.001	0.0005	0.05	10.2	0.00002	9.22		48.5
19-Jan-17	0.0005	0.14	102	0.001	0.07	0.026		78.3	0.00005	28.1		926	0.0005	0.0005	0.087	8.93	0.00002	8.99		47.4
22-Feb-17	0.0005	0.1	108	0.0005	0.06	0.023		77.8	0.00005	31		910	0.0005	0.0005	0.066	7.78	0.00002	9.47		45.7
23-Mar-17	0.0005	0.07	108	0.0005	0.025	0.025		72.6	0.00005	29.8		910	0.001	0.0005	0.101	1.12	0.00002	8.46		43.2
6-Apr-17	0.0005	0.08	112	0.0005	0.07	0.021		75.9	0.00005	24.7		930	0.0005	0.0005	0.062	11.4	0.00002	10.6		45.8
25-May-17	0.0005	0.1	108	0.0005	0.12	0.024		80.2	0.00005	29.4		890	0.0005	0.0005	0.075	9.81	0.00002	10.4		43.6
29-Jun-17	0.0005	0.11	116	0.0005	0.025	0.024		75	0.00005	27.2		890	0.0005	0.01	0.056	13	0.00002	9.74		43

Continued…………….MPGM4/D3Post-Brine/Ash Placement Data July 2016 to June, 2017 (mg/L)																
Date	**Mn**	**Mo**	**Na**	**Ni**	**Pb**	**pH**	**Sb**	**Se**	**SO4**	**Temp**	**TFR**	**V**	**WL1**	**WL2**	**WLAHD**	**Zn**
28-Jul-16	0.026	0.0005	16.4	0.005	0.0005	5.55		0.0001	61		155	0.005	6.3		913.7	0.008
25-Aug-16	0.057	0.0005	18.2	0.009	0.01	5.77		0.0004	86		170	0.005	6.1		913.9	0.018
29-Sep-16	0.054	0.001	21	0.024	0.024	5.8		0.0021	98.2		182	0.005	6.1		913.9	0.039
27-Oct-16	0.476	0.0005	46.5	0.029	0.042	5.88		0.0012	210		368	0.005	6.2		913.8	0.064
24-Nov-16	0.768	0.0005	37.1	0.009	0.002	6.01		0.0001	340		623	0.005	6.4		913.6	0.008
8-Dec-16	0.998	0.0005	40	0.028	0.001	6		0.0001	369		498	0.005	6.6		913.4	0.017
19-Jan-17	0.755	0.0005	37.8	0.005	0.002	6.07		0.0001	322		670	0.005	6.9		913.1	0.006
22-Feb-17	0.714	0.0005	38.2	0.004	0.0005	5.98		0.0001	348		637	0.005	7.2		912.8	0.0025
23-Mar-17	0.791	0.0005	34.4	0.003	0.0005	5.97		0.0001	306		660	0.005	7.4		912.6	0.0025
6-Apr-17	0.827	0.0005	35.9	0.005	0.0005	6.02		0.0001	318		594	0.005	7.4		912.6	0.0025
25-May-17	0.749	0.0005	36.7	0.003	0.0005	6.01		0.0001	307		538	0.005	7.5		912.5	0.0025
29-Jun-17	0.816	0.0005	35.2	0.002	0.0005	6		0.0001	308		595	0.005	7.6		912.4	0.013

MPGM4/D3 Post-Brine/Ash Placement Summary July 2016 to June, 2017 (mg/L)																				
	Ag	**Al**	**ALK**	**As**	**B**	**Ba**	**Be**	**Ca**	**Cd**	**Cl**	**Co**	**COND µS/cm**	**Cr**	**Cu**	**F**	**Fe**	**Hg**	**K**	**Li**	**Mg**
Ave	0.0005	0.36	81	0.003	0.087	0.042		60	0.0001	25		732	0.002	0.004	0.049	5.83	0.00003	7.6		36.0
Max	0.0005	1.72	116	0.012	0.180	0.109		85	0.0001	31		953	0.007	0.016	0.101	13.00	0.00006	10.6		48.5
Min	0.0005	0.07	26	0.001	0.025	0.021		13	0.0001	14		233	0.001	0.001	0.013	0.03	0.00002	2.0		8.6
50th Percentile	0.0005	0.13	95	0.001	0.075	0.027		75	0.0001	26		891	0.001	0.001	0.053	7.32	0.00002	8.9		43.3
Post-90th Percentile Trend	0.0005	1.02	112	0.011	0.139	0.092	0.001	80	0.0001	30		930	0.003	0.011	0.086	11.28	0.00005	10.3		47.2

Continued…….MPGM4/D3 Post-Brine/Ash Placement Summary July 2016 to June, 2017 (mg/L)																
	Mn	**Mo**	**Na**	**Ni**	**Pb**	**pH**	**Sb**	**Se**	**SO4**	**Temp**	**TFR**	**V**	**WL1**	**WL2**	**WLAHD**	**Zn**
Ave	0.59	0.001	33.1	0.011	0.007	5.9		0.0004	256		474	0.005	6.8		913.2	0.015
Max	1.00	0.001	46.5	0.029	0.042	6.1		0.002	369		670	0.005	7.6		913.9	0.064
Min	0.03	0.001	16.4	0.002	0.001	5.6		0.000	61		155	0.005	6.1		912.4	0.003
50th Percentile	0.75	0.001	36.3	0.005	0.001	6.0		0.000	308		566	0.005	6.8		913.3	0.008
Post-90th Percentile Trend	0.83	0.001	39.8	0.028	0.023	6.0		0.001	347		658	0.005	7.5	1.9	913.9	0.037

3. Water Quality Data and Summary for Background Groundwater Bores MPGM4/D4 and D5

3a. Water Quality Data and Summary for Background Groundwater Bore MPGM4/D4

MPGM4/D4 Pre-Brine/Ash Placement Background Summary 1989-2000 (mg/L)																			
	Ag	**ALK**	**As**	**B**	**Ba**	**Be**	**Ca**	**Cd**	**Cl**	**Co**	**COND µS/cm**	**Cr**	**Cu**	**F**	**Fe**	**Hg**	**K**	**Li**	**Mg**
Average	<0.001	6	0.029	0.042	0.039	0.013	37	0.002	12	0.018	1887	0.016	0.196	0.135	227	0.00011	7	0.029	19
Maximum	<0.001	29	0.139	0.9	1	0.08	110	0.008	37	0.036	8200	0.090	1.400	0.440	935	0.00040	12	0.099	50
Minimum	<0.001	5	0.001	0.005	0.001	0.001	5.4	0.001	5	0.007	460	0.001	0.01	0.001	0.1	0.0001	5	0.005	5
Baseline 90th Percentile	0.0052	5	0.077	0.030	0.035	0.0289	62.1	0.004	18.9	0.0304	2988	0.0425	0.412	0.316	505	0.0001	9	0.0787	32
Pre-50th Percentile Trend	0.0010	5	0.012	0.005	0.001	0.0025	36.5	0.001	10.0	0.0160	1705	0.0085	0.100	0.120	218	0.0001	6	0.0050	18

MPGM4/D4 Pre-Brine/Ash Placement Background Summary 1989-2000 (mg/L)																
	Mn	**Mo**	**Na**	**Ni**	**Pb**	**pH**	**Sb**	**Se**	**SO4**	**Temp**	**TFR**	**V**	**WL1**	**WL2**	**WLAHD**	**Zn**
Average	1.2	0.001	15	0.046	0.098	2.8	0.001	0.001	942	15.9	1483	0.046	2.7	2.7	917.0	0.500
Maximum	3.3	0.001	105	0.086	0.337	6.1	0.001	0.005	2646	18.5	5070	0.100	3.9	3.9	918.7	2.800
Minimum	0.22	0.001	5	0.019	0.001	1.7	0.001	0.001	120	13.5	142	0.01	1.0	1.0	915.8	0.001
Baseline 90th Percentile	2.10	0.001	23	0.074	0.200	3.3	0.001	0.001	1854	18.1	2965	0.084	3.4	3.4	918.5	1.070
Pre-50th Percentile Trend	1.10	0.001	13	0.041	0.086	2.8	0.001	0.001	815	15.7	984	0.042	2.9	3.0	916.7	0.310

MPGM4/D4 Post-Brine/Ash Placement Background Data July 2016 to June, 2017 (mg/L)																				
Date	**Ag**	**Al**	**ALK**	**As**	**B**	**Ba**	**Be**	**Ca**	**Cd**	**Cl**	**Co**	**COND µS/cm**	**Cr**	**Cu**	**F**	**Fe**	**Hg**	**K**	**Li**	**Mg**
13-Jul-16	0.0005	24.2	0.5	0.066	0.025	0.012		10.8	0.001	6.24		1100	0.004	0.003	0.346	181	0.00002	5.76		6.34
10-Aug-16	0.0005	25.8	0.5	0.066	0.025	0.011		11.6	0.0012	7		1114	0.004	0.003	0.123	165	0.00002	6.43		6.94
15-Sep-16	0.0005	27	0.5	0.065	0.025	0.011		11.8	0.0012	6.88		1123	0.004	0.002	0.266	170	0.00002	6.6		7.36
12-Oct-16	0.0005	28.2	0.5	0.069	0.025	0.013		12.4	0.0012	6.49		1115	0.004	0.003	0.132	175	0.00002	7.09		6.88
9-Nov-16	0.0005	26.8	0.5	0.061	0.025	0.011		11.5	0.0012	7.68		1115	0.004	0.003	0.289	155	0.00002	6.43		6.88
21-Dec-16	0.0005	25.6	0.5	0.057	0.025	0.011		11.9	0.0012	8.86		1091	0.004	0.004	0.139	125	0.00002	6.5		7.26
12-Jan-17	0.0005	25.1	0.5	0.055	0.025	0.011		12.6	0.0012	8.03		1074	0.004	0.002	0.22	131	0.00002	7.42		7.7
9-Feb-17	0.0005	22.7	0.5	0.061	0.025	0.012		12.4	0.001	8.23		1047	0.003	0.0005	0.122	139	0.00002	7.69		7.09
8-Mar-17	0.0005	22.4	0.5	0.06	0.025	0.011		12.1	0.0011	9.21		1040	0.004	0.002	0.15	120	0.00002	7.66		7.41
20-Apr-17	0.0005	21.7	0.5	0.058	0.025	0.012		12.6	0.001	8.53		1030	0.003	0.0005	0.157	126	0.00002	8.08		7.65
10-May-17	0.0005	18.4	0.5	0.056	0.025	0.012		13.2	0.0008	10.2		1000	0.004	0.002	0.128	114	0.00002	8.24		7.91
15-Jun-17	0.0005	23.6	0.5	0.061	0.025	0.011		12	0.001	6.88		1080	0.003	0.002	0.149	142	0.00002	7.37		7.26

Continued……….MPGM4/D4 Post-Brine/Ash Placement Background Data July 2016 to June, 2017 (mg/L)																
Date	**Mn**	**Mo**	**Na**	**Ni**	**Pb**	**pH**	**Sb**	**Se**	**SO4**	**Temp**	**TFR**	**V**	**WL1**	**WL2**	**WLAHD**	**Zn**
13-Jul-16	0.766	0.0005	19.8	0.026	0.026	3.19		0.0002	526		701	0.02	1.1		918.5	0.274
10-Aug-16	0.836	0.0005	20.8	0.028	0.042	3.12		0.0002	585		810	0.02	1.2		918.4	0.305
15-Sep-16	0.8	0.0005	22.8	0.027	0.027	3.41		0.0002	541		1060	0.02	1.1		918.5	0.309
12-Oct-16	0.81	0.0005	22.1	0.028	0.027	3.31		0.0016	555		732	0.02	1.2		918.4	0.316
9-Nov-16	0.783	0.0005	19.7	0.026	0.025	3.3		0.0003	474		1020	0.02	1.2		918.4	0.296
21-Dec-16	0.708	0.0005	21.4	0.025	0.024	3.29		0.0002	476		1140	0.02	1.2		918.4	0.267
12-Jan-17	0.74	0.0005	21.2	0.025	0.024	3.26		0.0002	519		1080	0.02	1.4		918.2	0.275
9-Feb-17	0.745	0.0005	21.4	0.026	0.023	3.31		0.0002	431		914	0.02	1.7		917.9	0.266
8-Mar-17	0.714	0.0005	18.4	0.024	0.023	3.25		0.0001	459		1020	0.01	1.7		917.9	0.251
20-Apr-17	0.716	0.0005	19	0.021	0.022	3.29		0.0002	423		1030	0.01	1.5		918.1	0.257
10-May-17	0.75	0.0005	22.9	0.021	0.026	3.31		0.0002	454		934	0.01	1.6		918.0	0.223
15-Jun-17	0.765	0.0005	18.6	0.027	0.021	3.23		0.0002	515		959	0.02	1.7		917.9	0.275

MPGM4/D4 Post-Brine/Ash Placement Background Summary July 2016 to June, 2017 (mg/L)																				
	Ag	**Al**	**ALK**	**As**	**B**	**Ba**	**Be**	**Ca**	**Cd**	**Cl**	**Co**	**COND µS/cm**	**Cr**	**Cu**	**F**	**Fe**	**Hg**	**K**	**Li**	**Mg**
Ave	0.0005	24.29	0.50	0.06	0.03	0.01		12.1	0.0011	7.9		1077	0.004	0.002	0.19	143.43	0.00002	7.1		7.2
Max	0.0005	28.2	0.5	0.069	0.025	0.013		13.2	0.0012	10.2		1240	0.004	0.004	0.346	181	0.00002	8.2		7.9
Min	0.0005	18.4	0.5	0.055	0.025	0.011		10.8	0.0008	6.2		856	0.003	0.001	0.122	79.8	0.00002	5.8		6.3
50th Percentile	0.0005	24.65	0.5	0.061	0.025	0.011		12.1	0.0012	7.9		1080	0.004	0.002	0.1495	142.00	0.00002	7.2		7.3
Post-90th Percentile Trend	0.0005	26.98	0.5	0.066	0.025	0.012	0.00156	12.6	0.0012	9.2		2284	0.004	0.003	0.2867	362.00	0.00002	8.0		7.7

Continued……………….MPGM4/D4 Post-Brine/Ash Placement Background Summary July 2016 to June, 2017 (mg/L)																
	Mn	Mo	Na	Ni	Pb	pH	Sb	Se	SO4	Temp	TFR	V	WL1	WL2	WLAHD	Zn
Ave	0.76	0.001	20.7	0.025	0.026	3.3		0.0003	519		956	0.018	1.4		918.3	0.276
Max	0.836	0.001	22.9	0.028	0.042	3.4		0.0016	686		1190	0.020	1.7		918.5	0.316
Min	0.708	0.001	18.4	0.021	0.021	3.1		0.0001	361		479	0.010	1.1		917.9	0.223
50th Percentile	0.7575	0.001	21.0	0.026	0.025	3.3		0.0002	525		1020	0.020	1.3		918.3	0.275
Post-90th Percentile Trend	0.809	0.001	22.7	0.028	0.027	3.3		0.0003	1707		2567	0.020	1.7	33.9	918.5	0.309

4b. Water Quality Data and Summary for Background Groundwater Bore MPGM4/D5

MPGM4/D5 Pre-Brine/Ash Placement Background Summary 1993-2000 (mg/L)																		
	Ag	**ALK**	**As**	**B**	**Ba**	**Be**	**Ca**	**Cd**	**Cl**	**Co**	**COND µS/cm**	**Cr**	**Cu**	**F**	**Fe**	**Hg**	**K**	**Li**	**Mg**
Average	<0.001	38	0.001	0.020	0.066	0.001	51	0.001	20	0.030	678	0.002	0.012	0.129	15	<0.0001	6.8	0.044	33
Maximum	<0.001	130	0.002	0.26	1.9	0.001	83	0.002	47	0.036	1690	0.026	0.14	0.51	70	0.0003	35.4	0.14	64
Minimum	<0.001	5	0.001	0.005	0.001	0.001	25.8	0.001	9	0.023	376	0.001	0.001	0.001	0.1	0.0001	5.0	0.005	7.9
Baseline 90th Percentile	0.001	68	0.001	0.0257	0.061	0.001	74	0.001	28	0.034	986	0.001	0.010	0.318	42.0	0.0001	8.0	0.116	52
Pre-50th Percentile Trend	0.001	35	0.001	0.0050	0.001	0.001	50	0.001	18	0.031	624	0.001	0.010	0.125	8.8	0.0001	6.0	0.005	29

Continued…………MPGM4/D5 Pre-Brine/Ash Placement Background Summary 1993-2000 (mg/L)																
	Mn	**Mo**	**Na**	**Ni**	**Pb**	**pH**	**Sb**	**Se**	**SO4**	**Temp**	**TFR**	**V**	**WL1**	**WL2**	**WLAHD**	**Zn**
Average	4	0.001	19	0.068	0.018	5.8		0.001	262	15.1	471	0.001	14.8	14.8	910.8	0.124
Maximum	10.5	0.001	55	0.086	0.28	6.7		0.01	605	16.5	1020	0.001	18.99	18.99	914.23	0.39
Minimum	0.3	0.001	5	0.056	0.001	3.0		0.001	110	13.7	255	0.001	11.52	11.52	906.76	0.001
Baseline 90th Percentile	5.8	0.001	25	0.082	0.020	6.4		0.001	418	16.3	734	0.001	16.5	16.6	913.0	0.240
Pre-50th Percentile Trend	3.3	0.001	18	0.068	0.006	6.0		0.001	240	15.3	410	0.001	14.5	14.5	911.3	0.120

MPGM4/D5 Post-Brine/Ash Placement Data July 2016 to June, 2017 (mg/L)																				
Date	**Ag**	**Al**	**ALK**	**As**	**B**	**Ba**	**Be**	**Ca**	**Cd**	**Cl**	**Co**	**COND µS/cm**	**Cr**	**Cu**	**F**	**Fe**	**Hg**	**K**	**Li**	**Mg**
13-Jul-16	0.0005	0.05	99	0.002	0.11	0.018		84.8	0.0001	21.2		1275	0.0005	0.0005	0.082	76.2	0.00002	7.68		61.2
10-Aug-16	0.0005	0.07	123	0.002	0.11	0.02		94.3	0.0001	26		1275	0.0005	0.0005	0.104	67.9	0.00002	8.28		67.4
14-Sep-16	0.0005	0.06	96	0.002	0.11	0.017		93.6	0.0001	23.5		1284	0.0005	0.0005	0.025	69.7	0.00002	8.71		74.3
12-Oct-16	0.0005	0.04	116	0.002	0.12	0.018		100	0.0001	22.3		1292	0.0005	0.0005	0.05	45.1	0.00002	9.99		70.5
9-Nov-16	0.0005	0.07	111	0.002	0.12	0.017		92.5	0.0001	25		1294	0.0005	0.0005	0.177	63	0.00002	8.93		68.3
21-Dec-16	0.0005	0.08	95	0.002	0.12	0.017		94.8	0.0001	24.6		1302	0.0005	0.0005	0.226	55.1	0.00002	8.89		70.8
12-Jan-17	0.0005	0.10	58	0.002	0.11	0.018		98.5	0.0001	22.4		1290	0.0005	0.0005	0.126	57.7	0.00002	9.48		73
9-Feb-17	0.0005	0.04	62	0.0005	0.11	0.018		96.9	0.0001	20.9		1279	0.0005	0.0005	0.05	24.7	0.00002	10.1		67.2
9-Mar-17	0.0005	0.07	101	0.001	0.1	0.017		96.9	0.0001	24.4		1290	0.0005	0.0005	0.116	56.9	0.00002	9.66		71.6
20-Apr-17	0.0005	0.04	68	0.0005	0.11	0.018		95.7	0.0001	23.3		1260	0.0005	0.0005	0.119	28.4	0.00002	9.98		71
10-May-17	0.0005	0.07	85	0.0005	0.1	0.017		95.9	0.0001	23.9		1270	0.0005	0.0005	0.077	51.7	0.00002	10.1		70.5
15-Jun-17	0.0005	0.06	81	0.001	0.11	0.017		95	0.0001	23.6		1300	0.0005	0.0005	0.101	57	0.00002	8.99		71.7

Continued………………….. MPGM4/D5 Post-Brine/Ash Placement Data July 2016 to June, 2017 (mg/L)																
Date	**Mn**	**Mo**	**Na**	**Ni**	**Pb**	**pH**	**Sb**	**Se**	**SO4**	**Temp**	**TFR**	**V**	**WL1**	**WL2**	**WLAHD**	**Zn**
13-Jul-16	8.75	0.0005	25.5	0.053	0.0005	6.07		0.0003	634		1000	0.005	10.7		915.1	0.026
10-Aug-16	9.09	0.0005	27.2	0.06	0.0005	5.89		0.0003	611		945	0.005	10.4		915.4	0.023
14-Sep-16	8.76	0.0005	28.9	0.057	0.0005	5.96		0.0002	562		961	0.005	10		915.8	0.023
12-Oct-16	9.29	0.0005	30.3	0.057	0.0005	5.95		0.0014	625		850	0.005	9.7		916.1	0.022
9-Nov-16	8.78	0.0005	26.6	0.061	0.0005	5.97		0.0003	662		1140	0.005	9.8		916.0	0.02
21-Dec-16	8.14	0.0005	29.1	0.055	0.0005	5.97		0.0002	624		1100	0.005	9.9		915.9	0.022
12-Jan-17	8.3	0.0005	28.8	0.058	0.0005	6.06		0.0002	616		1050	0.005	10		915.8	0.03
9-Feb-17	8.04	0.0005	29.1	0.054	0.0005	5.92		0.0001	533		1020	0.005	10.2		915.6	0.02
9-Mar-17	8.19	0.0005	24.9	0.054	0.0005	5.93		0.0001	601		968	0.005	10.4		915.4	0.026
20-Apr-17	7.72	0.0005	24.6	0.047	0.0005	5.91		0.0001	554		882	0.005	10.5		915.3	0.019
10-May-17	7.82	0.0005	29.9	0.048	0.0005	5.93		0.0002	613		958	0.005	10.6		915.2	0.026
15-Jun-17	8.16	0.0005	25.5	0.055	0.0005	5.87		0.0003	516		990	0.005	10.7		915.1	0.03

MPGM4/D5 Post-Brine/Ash Placement Summary July 2016 to June, 2017 (mg/L)																				
Date	Ag	Al	ALK	As	B	Ba	Be	Ca	Cd	Cl	Co	COND µS/cm	Cr	Cu	F	Fe	Hg	K	Li	Mg
Ave	0.0005	0.06	91	0.001	0.11	0.018		95	0.0001	23.4		1284	0.001	0.001	0.10	54.5	0.00002	9.2		69.8
Max	0.0005	0.10	123	0.002	0.12	0.020		100	0.0001	26.0		1302	0.001	0.001	0.23	76.2	0.00002	10.1		74.3
Min	0.0005	0.04	58	0.001	0.10	0.017		85	0.0001	20.9		1260	0.001	0.001	0.03	24.7	0.00002	7.7		61.2
50th Percentile	0.0005	0.07	96	0.002	0.11	0.018		95	0.0001	23.6		1287	0.001	0.001	0.10	57.0	0.00002	9.2		70.7
Post-90th Percentile Trend	0.0005	0.079	116	0.002	0.12	0.018	0.001	98	0.0001	25.0		1299	0.001	0.001	0.1719	69.5	0.00002	10.1		72.9

Continued……………MPGM4/D5 Post-Brine/Ash Placement Summary July 2016 to June, 2017 (mg/L)																
	Mn	Mo	Na	Ni	Pb	pH	Sb	Se	SO4	Temp	TFR	V	WL1	WL2	WLAHD	Zn
Ave	8.4	0.001	27.5	0.055	0.001	6.0		0.0003	596		989	0.005	10.2		915.5	0.024
Max	9.3	0.001	30.3	0.061	0.001	6.1		0.0014	662		1140	0.005	10.7		916.1	0.030
Min	7.7	0.001	24.6	0.047	0.001	5.9		0.0001	516		850	0.005	9.7		915.1	0.019
50th Percentile	8.2	0.001	28.0	0.055	0.001	5.9		0.0002	612		979	0.005	10.3		915.5	0.023
Post-90th Percentile Trend	9.1	0.001	29.8	0.060	0.001	6.1		0.0003	633		1095	0.005	10.7	60.0	916.0	0.030

4. Water Quality Data and Summary for Ash Placement Area Groundwater Bores B901 (north-west ash area background) B904 (south-west ash area background for Bore D10), bores MPGM4/D10 and MPGM4/D11.

Note: Pre- and Post-placement data for bores B901 (covered with ash after August, 2001), 4/D12 (covered after July, 2006), B904 (covered after March, 2000), D13 (covered after April, 2005) and 4/D14 (covered after January, 2003) are shown in Connell Wagner (2008).

4a. Water Quality Data and Summary for Ash Placement Area Groundwater Bore B901

Bore B901 Pre-Brine/ash Placement - Background Summary 1997- September 2000 (mg/L)

	Al	Ag	ALK	As	B	Ba	Be	Ca:	Cd	Cl:	Co	COND uS/cm	Cr	Cr-6	Cu	F	Fe	Hg	K:	Li	Mg:
Average	2.30		224	0.005	3.18	0.021		216	0.0103	30	0.355	1623			0.017	4.45	6.08		36		112
Maximum	17.00		440	0.010	12.00	0.05		390	0.054	65	1.000	3430			0.055	17.00	34.00		140		180
Minimum	0.01		22	0.003	0.05	0.01		130	0.001	15	0.005	1030			0.001	0.20	0.05		11		3
90th Percentile	5.8		342	0.007	7.45	0.0292		320	0.023	47	0.706	2274			0.039	12.1	14.54		64		159
Pre-50th Percentile Trend	0.05		230	0.005	1.05	0.018		190	0.003	27	0.190	1388			0.008	1.8	1.95		21		115

Continued…………Bore B901 Pre-Brine/ash Placement - Background Summary 1997- September 2000 (mg/L)

	Mn	Mo	Na:	NFR	Ni	NO3	Pb	pH	Se	SO4:	Temp	TDS	V	WL1	WL2	WLAHD	Zn
Average	5.66		46	364	0.92	4.45	0.002	6.6	0.005	948		1638		2.3		910.2	3.883
Maximum	14.00		66	570	2.40	17.00	0.005	7.6	0.005	1600		2500		2.5		912.0	12.000
Minimum	2.90		37	120	0.23	0.20	0.001	6.1	0.005	580		1100		2.1		909.1	0.140
90th Percentile	9.03		57	563	1.49	12.1	0.005	7.2	0.005	1320		2290		2.4		911.4	8.780
Pre-50th Percentile Trend	4.5		43	420	0.825	1.8	0.001	6.5	0.005	855		1550		2.3		909.8	2.800

Note: B901 data updated to August, 2001 with maximum TDS corrected from 5400 to 2700 mg/L using relationships with SO4 and COND uS/cm.

4b. Water Quality Data and Summary for Ash Placement Area Groundwater Bores B904+ MPGM4/D10

Pre-Brine/ash Placement - Background Summary in Bore B904 1997 - 2000 (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**	**Mg:**
Average		7.33	114	0.005	1.48	0.100		182	0.005	22	0.388	1118			0.005	5.3	10.59	0.0001	27		86
Maximum		20.00	430	0.010	2.50	0.280		240	0.018	41	0.670	1839			0.011	10.0	34.00	<0.0005	37		130
Minimum		0.01	3	0.001	0.08	0.004		55	0.001	12	0.027	449			0.001	0.5	0.10	0.0001	14		6
Baseline 90th Percentile		13.76	364	0.008	2.26	0.172		228	0.010	32.6	0.568	1748			0.010		28.00	0.0001	34		130
Pre-50th Percentile for Trend		6.2	17	0.005	1.40	0.091		200	0.004	20.0	0.370	1128			0.005	6.8	0.83	0.0001	28		110

Continued…………………Pre-Brine/ash Placement - Background Summary in Bore B904 1997 - 2000 (mg/L)																		
	Mn	**Mo**	**Na:**	**NFR**	**Ni**	**NO2**	**NO3**	**Pb**	**pH**	**Se**	**SO4:**	**Temp**	**TFR**	**V**	**WL1**	**WL2**	**WLAHD**	**Zn**
Average	9.2		33	165	0.839	0.29	1.30	0.004	5.7	0.005	892		1384				909.57	2.620
Maximum	24.0		40	320	1.200	1.00	5.80	0.005	8.2	0.005	1500		2100				910.31	4.900
Minimum	5.2		18	68	0.056	0.04	0.04	0.001	4.1	0.003	42		270				908.79	0.140
Baseline 90th Percentile	15.4		38	314	1.140	0.88	4.18	0.005	7.4	0.005	1320		1980				910.0	4.180
Pre-50th Percentile for Trend	6.4		36	110	0.960	0.04	0.04	0.005	5.1	0.005	1100		1500				909.7	2.800

MPGM4/D10 Post-Brine/ash Placement – Data from July 2016 to June, 2017 (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**	**Mg:**
28-Jul-16	0.0005	0.34	59	0.001	1.42	0.014		194	0.0026	371		4867	0.0005		0.0005	0.435	14.7	0.00002	106		172
24-Aug-16	0.0005	0.15	71	0.001	2.48	0.019		261	0.0043	482		6603	0.0005		0.0005	0.546	16	0.00002	116		244
30-Sep-16	0.0005	0.1	87	0.001	1.68	0.016		179	0.0028	342		4820	0.002		0.001	0.1	13.4	0.00002	92.5		161
28-Oct-16	0.0005	0.1	87	0.001	2.81	0.018		299	0.0052	622		7286	0.0005		0.0005	0.25	12.7	0.00002	125		258
24-Nov-16	0.0005	0.07	89	0.001	2.6	0.017		262	0.005	638		7620	0.0005		0.0005	0.567	9.65	0.00002	141		288
8-Dec-16	0.0005	0.08	89	0.001	3.52	0.017		290	0.0059	722		8258	0.0005		0.0005	0.325	11	0.00002	142		316
18-Jan-17	0.0005	0.1	98	0.001	3.94	0.016		314	0.0066	830		9242	0.0005		0.0005	0.785	7.6	0.00002	172		358
22-Feb-17	0.0005	0.11	104	0.001	4.53	0.019		346	0.0085	959		10630	0.0005		0.002	0.578	4.96	0.00002	209		424
23-Mar-17	0.0005	0.1	96	0.001	5.02	0.016		352	0.0081	1070		11130	0.0005		0.0005	0.444	1.67	0.00002	206		428
5-Apr-17	0.0005	0.09	104	0.001	3.38	0.015		307	0.0069	890		10360	0.0005		0.0005	0.684	4.1	0.00002	218		396
26-May-17	0.0005	0.09	90	0.001	4.11	0.016		349	0.008	982		10880	0.0005		0.002	0.62	1.75	0.00002	208		423
30-Jun-17	0.0005	0.09	92	0.001	3.86	0.017		306	0.0077	949		10080	0.0005		0.0005	0.687	2.55	0.00002	209		384

Continued…………………MPGM4/D10 Post-Brine/ash Placement - Data from July 2016 to June, 2017 (mg/L)																		
Date	**Mn**	**Mo**	**Na:**	**NFR**	**Ni**	**NO2**	**NO3**	**Pb**	**pH**	**Se**	**SO4:**	**Temp**	**TFR**	**V**	**WL1**	**WL2**	**WLAHD**	**Zn**
28-Jul-16	4.18	0.0005	639		0.591			0.002	5.57	0.0011	2260		3660	0.005	13.3		912.8	1
24-Aug-16	6.35	0.0005	907		0.846			0.004	5.83	0.0017	2770		4450	0.005	13.7		912.4	1.36
30-Sep-16	4.35	0.0005	627		0.574			0.002	5.65	0.0012	2160		3920	0.005	13.2		912.9	0.957
28-Oct-16	6.61	0.0005	1190		0.914			0.004	5.59	0.0022	3480		6060	0.005	13.7		912.4	1.31
24-Nov-16	6.34	0.0005	1150		0.797			0.004	5.69	0.0023	3630		6530	0.005	13.7		912.4	1.05
8-Dec-16	7.41	0.0005	1320		0.985			0.004	5.65	0.0029	4000		7190	0.005	14		912.1	1.22
18-Jan-17	7.98	0.0005	1570		0.976			0.004	5.62	0.0033	4530		8150	0.005	14.3		911.8	1.15
22-Feb-17	8.72	0.0005	1760		1.14			0.006	5.56	0.0036	5040		9140	0.005	14.7		911.4	1.25
23-Mar-17	9.55	0.002	2110		1.12			0.004	5.64	0.0038	5760		9190	0.005	14.9		911.2	1.2
5-Apr-17	8.49	0.001	1500		0.941			0.006	5.58	0.0035	4810		8890	0.005	14.6		911.5	1.02
26-May-17	8.64	0.0005	1800		1.04			0.005	5.51	0.0043	5340		9630	0.005	14.9		911.2	1.09
30-Jun-17	8.37	0.0005	1710		0.948			0.004	5.55	0.0037	5860		8460	0.005	14.8		911.3	1.00

MPGM4/D10 Post- Brine/ash Placement Summary July 2016 to June, 2017 (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**	**Mg**
Ave	0.0005	0.118	89	0.001	3.28	0.017		288	0.0060	738		8481	0.001		0.001	0.50	8.34	0.00002	162		321
Max	0.0005	0.340	104	0.001	5.02	0.019		352	0.0085	1070		11130	0.002		0.002	0.79	16.00	0.00002	218		428
Min	0.0005	0.070	59	0.001	1.42	0.014		179	0.0026	342		4820	0.001		0.001	0.10	1.67	0.00002	92.5		161
50th Percentile	0.0005	0.100	89.5	0.001	3.45	0.017		303	0.0063	776		8750	0.001		0.001	0.56	8.63	0.00002	157		337
90th Percentile	0.0005	0.146	103	0.001	4.49	0.019		349	0.0081	980		10855	0.001		0.002	0.69	14.57	0.00002	209		424

Continued……………………MPGM4/D10 Post- Brine/ash Placement Summary July 2016 to June, 2017 (mg/L)																		
	Mn-filtered	**Mo**	**Na**	**NFR**	**Ni**	**NO2**	**NO3**	**Pb**	**pH**	**Se**	**SO4**	**Temp**	**TFR**	**V**	**WL1**	**WL2**	**WLAHD**	**Zn**
Ave	7.2	0.001	1357		0.906			0.004	5.6	0.0028	4137		7106	0.005	14.2		911.9	1.134
Max	9.6	0.002	2110		1.140			0.006	5.8	0.0043	5860		9630	0.005	14.9		912.9	1.360
Min	4.2	0.001	627		0.574			0.002	5.5	0.0011	2160		3660	0.005	13.2		911.2	0.957
50th Percentile	7.7	0.001	1410		0.945			0.004	5.6	0.0031	4265		7670	0.005	14.2		911.9	1.120
90th Percentile	8.7	0.001	1796		1.112			0.006	5.7	0.0038	5718		9185	0.005	14.9		912.7	1.304

4c. Water Quality Data and Summary for Ash Placement Area Groundwater Bore MPGM4/D11

MPGM4/D11 Post-Brine/ash Placement - Data from July 2016 to June, 2017 (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**	**Mg**
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		389
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		365
29-Sep-16	0.0005	0.02	96	0.008	2.96	0.022		574	0.0001	798		8604	0.003		0.001	0.25	61.4	0.00002	98.2		355
27-Oct-16	0.0005	0.06	163	0.008	2.97	0.037		567	0.0001	814		8488	0.002		0.001	0.25	69.8	0.00002	80.1		346
24-Nov-16	0.0005	0.005	105	0.008	2.49	0.019		610	0.0001	845		8700	0.001		0.001	0.25	75.1	0.00002	99.5		382
7-Dec-16	0.0005	0.02	119	0.006	3.32	0.024		594	0.0001	884		8920	0.001		0.001	0.5	78.4	0.00002	88.2		384
19-Jan-17	0.0005	0.01	124	0.008	3.09	0.022		618	0.0001	903		9180	0.001		0.001	0.25	67.5	0.00002	86.4		400
23-Feb-17	0.0005	0.005	110	0.008	2.92	0.02		602	0.0001	943		9150	0.001		0.001	0.107	62.9	0.00002	107		398
22-Mar-17	0.0005	0.005	119	0.006	3.16	0.019		578	0.0001	965		9470	0.001		0.001	0.286	39.7	0.00002	94.5		396
5-Apr-17	0.0005	0.005	127	0.008	2.33	0.018		554	0.0001	903		9320	0.001		0.001	0.5	64.1	0.00002	101		402
25-May-17	0.0005	0.005	132	0.006	3.26	0.015		617	0.0001	942		9640	0.001		0.001	0.25	81.6	0.00002	126		423
29-Jun-17	0.0005	0.01	135	0.012	2.79	0.018		605	0.0001	956		9260	0.001		0.001	0.1	93.5	0.00002	116		406

Continued…………………… MPGM4/D11 Post-Brine/ash Placement - Data from July 2016 to June, 2017 (mg/L)															
Date	**Mn-filtered**	**Mo**	**Na**	**Ni**	**Pb**	**pH**	**Se**	**SO4**	**Temp**	**TFR**	**V**	**WL1**	**WL2**	**WLAHD (m)**	**Zn**
9-Jul-15	17.2	0.0005	1090	0.904	0.0005	5.85	0.0002	4480		6570	0.005	24.9		912.5	0.146
13-Aug-15	15.6	0.0005	1010	0.822	0.0005	6.35	0.0001	3880		6080	0.005	25.3		912.1	0.126
10-Sep-15	17.7	0.0005	1000	0.846	0.0005	6.18	0.0003	4270		7220	0.005	24.6		912.8	0.118
15-Oct-15	17.5	0.0005	1170	0.866	0.0005	6.17	0.0001	4180		7650	0.005	25.1		912.3	0.11
11-Nov-15	16.3	0.0005	1080	0.819	0.0005	6.19	0.0001	4370		7930	0.005	25.1		912.3	0.104
23-Dec-15	16.3	0.0005	1180	0.895	0.0005	6.25	0.0002	4560		7250	0.005	25.4		912.0	0.12
13-Jan-16	19.3	0.0005	1310	0.962	0.0005	6.29	0.0002	4580		8440	0.005	25.8		911.6	0.117
25-Feb-16	15.7	0.0005	1250	0.937	0.0005	6.14	0.0003	4710		8760	0.005	26.1		911.3	0.137
23-Mar-16	18.6	0.0005	1430	1.01	0.0005	6.06	0.0002	4910		8850	0.005	26.5		910.9	0.137
13-Apr-16	16.4	0.0005	1070	0.862	0.0005	6.11	0.0003	4620		6460	0.005	26		911.4	0.118
26-May-16	17	0.0005	1330	0.966	0.0005	6.1	0.0003	4820		8990	0.005	26.3		911.1	0.145
23-Jun-16	17.8	0.0005	1280	0.928	0.0005	6.15	0.0002	5430		7180	0.005	25.3		912.1	0.149

*water level measurement not consistent with new concrete footings and pipe height RLs

MPGM4/D11 Post-Brine/ash Placement Summary from July 2016 to June, 2017 (mg/L)																				
	Ag	**Al**	**ALK**	**As**	**B**	**Ba**	**Be**	**Ca**	**Cd**	**Cl**	**Co**	**COND µS/cm**	**Cr**	**Cr-6**	**Cu**	**F**	**Fe-filtered**	**Hg**	**K**	**Li**	**Mg**
Ave	0.0005	0.032	121	0.008	2.95	0.022		589	0.0001	880		8980	0.001		0.001	0.27	71.13	0.00002	102		387
Max	0.0005	0.140	163	0.012	3.32	0.037		618	0.0001	965		9640	0.003		0.001	0.50	93.50	0.00002	126		423
Min	0.0005	0.005	73	0.006	2.33	0.015		554	0.0001	755		8392	0.001		0.001	0.10	39.70	0.00002	80.1		346
50th Percentile	0.0005	0.010	121.5	0.008	2.97	0.020		588	0.0001	894		9035	0.001		0.001	0.25	72.45	0.00002	100		393
Post-90th Percentile Trend	0.0005	0.096	152	0.010	3.27	0.027		616	0.0001	955		9455	0.002		0.001	0.48	81.54	0.00002	121		406

Continued……………………MPGM4/D11 Post-Brine/ash Placement Summary from July 2016 to June, 2017 (mg/L)															
Date	**Mn-filtered**	**Mo**	**Na**	**Ni**	**Pb**	**pH**	**Se**	**SO4**	**Temp**	**TFR**	**V**	**WL1**	**WL2**	**WLAHD (m)**	**Zn**
Ave	17.1	0.001	1183	0.901	0.001	6.2	0.0002	4568		7615	0.005	25.5		911.8	0.127
Max	19.3	0.001	1430	1.010	0.001	6.4	0.0003	5430		8990	0.005	26.5		912.8	0.149
Min	15.6	0.001	1000	0.819	0.001	5.9	0.0001	3880		6080	0.005	24.6		910.9	0.104
50th Percentile	17.1	0.001	1175	0.900	0.001	6.2	0.0002	4570		7450	0.005	25.4		912.0	0.123
Post-90th Percentile Trend	18.5	0.001	1328	0.966	0.001	6.3	0.0003	4901		8841	0.005	26.3		912.5	0.146

5. Mt Piper Water Conditioned Ash Runoff Pond Water Quality February, 2001 to March, 2010 and SW3 only in 2011 - 2014																							
Mt Piper Ash Dam Runoff Pond (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**	**Mg**
5-Feb-01		0.64	144	<0.001			0.94	0.03		104.0	<0.005	20		139000			<0.005		<0.03	0.0001	20.5		120.0
13/03/2001	0.001		32	0.001			0.8	0.001	0.001	59.2	0.001	67	0.012	106300	0.001		0.041	0.43	0.1	0.0002	43.7	0.211	32.5
19/07/2001	0.001	0.077	60	0.007			0.061	1.83	0.001	99	0.001	31	0.003	78700	0.001		0.001	0.14	0.12	0.0002	53	0.467	21
9/11/2001	0.001		13	0.002			0.73	0.062	0.001	66	0.001	13	0.002	76000	0.001		0.002	1	0.1	0.0002	23	0.195	22
6/02/2002			5	0.002			0.12	0.084		16	0.001	22		19500		<0.01	0.005	0.4	0.1		7		6
30/05/2002	<0.005	0.75	<1	0.002			0.26	0.036		57	0.0005	15	<0.005	25900	<0.05		<0.005	<0.01	0.36	0.00005	8.8		21
29/08/2002	<0.005	0.2	39	<0.002			0.64	0.063		51	0.0005	27	<0.005	79200	<0.05		<0.005	0.6	0.11	0.00005	13		24
3/03/2003	<0.005	0.73	32	*<0.02			0.51	*<0.05		35	*<0.005	76	*<0.05	93300	<0.05		*<0.05	0.6	0.45	0.00005	13		24
27/02/2006	<0.01	0.59	50	0.002			0.48	0.053		51	<0.002	31	0.013				0.017	0.4	0.77**	0.0001	18		33
22/08/2006	<0.01	1.4	<10	<0.002			0.62	0.04			<0.002	46	0.006	1410	<0.01		0.006	0.5	0.39	0.0001	26		45
26/02/2007		0.21	30	<0.01*			0.63	0.06			<0.002	88	0.006	1758	<0.05		<0.005	1.2	0.07	0.0001	35		49
30/08/2007	<0.01	0.03	50	0.006			0.22	0.045		64	<0.002	36	<0.005	886		<0.005	<0.010	1	0.05	0.0001	12		28
18/03/2008		0.51	60	0.002			0.48	0.062		93	<0.002	67	<0.005	1428	<0.05		<0.005	1	0.13	0.0001	24		33
22/10/2008	<0.01	0.2	20	0.002			0.90	0.300		140	0.002	190	0.0050	2955	<0.01		<0.01	1.00	0.03	0.0001	57		71
19/03/2009	<0.01	0.6	70	0.004			1.80	0.090		150	<0.002	61	0.0050	1592	<0.01		<0.005	2.10	0.01	0.0001	29		38
23/3/2010	0.010	6	80	0.018			1.00	0.150		170	0.002	190	0.0100	4359	0.01		0.290	4.00	1.50	0.00005	86		80
SW3																							
Feb to May 2011												65		1402									
27/12/2012		58	<25	0.036			0.24	0.36		86	0.0008	20		625	<0.001		0.046	0.6	<0.01		16		14
27/07/2013														510									
21/02/2014		9.8	34				0.07	0.150		28	<0.0002	12	0.0100	340			0.042	<1	0.09	<0.0005	10		12

Note: since August, 2006 conductivity reported as uS/cm

5. Mt Piper Water Conditioned Ash Runoff Pond Water Quality February, 2001 to March, 2010 and SW3 only in 2011 - 2014

Mt Piper Ash Dam Runoff Pond (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	Mg
Ave	0.003	5.00	49	0.007			0.578	0.242	0.001	83	0.001	59	0.006	1312	0.003	<0.0075	0.051	0.998	0.25	0.00008	29	0.291	39
Min	0.001	0.03	5	0.001			0.061	0.001	0.001	16	<0.0005	13	0.002	195	0.001	<0.005	0.001	0.140	0.01	0.00005	7	0.195	6
Max	<0.01	58.00	144	0.036			1.800	1.830	0.001	170	<0.005	190	0.013	4359	0.010	<0.01	0.290	4.000	1.50	0.00010	86	0.467	120
50th Percentile	0.001	0.60	45	0.002			0.510	0.062	0.001	66	0.001	41	0.005	1045	0.001	<0.0075	0.012	0.600	0.11	0.00010	23	0.211	33

Note: Results for May and August 2002 and March 2003 come from SWPond2

Note: No Mt Piper rainfall runoff water quality data for the water conditioned ash area has been recorded since February 2014.

6. Water Quality Data and Summary for Proposed Groundwater Receiving Water Bores MPGM4/D8 and 4/D9

6a. MPGM4/D8

MPGM4/D8 Pre-Brine/Ash Placement Background Summary 1992-2000 (mg/L)

	Ag	ALK	Al	As	B	Ba	Be	Ca	Cd	Cl	Co	COND µS/cm	Cr	Cu	F	Fe	Hg	K	Li	Mg
Average	0.0010	26		0.0010	0.007	0.015	0.001	54	0.0010	9	0.011	566	0.0022	0.0104	0.075	1.566	0.00010	5	0.004	32
Maximum	0.0010	85		0.0024	0.023	0.036	0.001	440	0.0010	37	0.054	1020	0.0170	0.0300	0.490	7.550	0.00010	10	0.008	70
Minimum	0.0010	6		0.0010	0.005	0.001	0.001	16	0.0010	5	0.001	288	0.0010	0.0010	0.001	0.100	0.00010	5	0.001	14
Baseline 90th Percentile	0.0010	33		0.0010	0.009	0.032	0.001	74	0.0010	14	0.030	929	0.0020	0.0100	0.253	4.100	0.00010	6	0.006	57
Pre-50th Percentile Trend	0.0010	24		0.0010	0.005	0.021	0.001	31	0.0010	7	0.001	435	0.0010	0.0100	0.001	0.520	0.00010	5	0.005	25

Continued…………MPGM4/D8 Pre-Brine/Ash Placement Background Summary 1992-2000 (mg/L)

	Mn	Mo	Na	Ni	Pb	pH	Sb	Se	SO4	Temp	TDS	V	WL1	WL2	WLAHD	Zn
Average	1.132	0.001	16	0.07	0.004	5.5	0.001	0.001	239	14.8	395	0.001	3.49	4.17	902.3	0.086
Maximum	3.300	0.001	42	0.23	0.027	6.3	0.001	0.001	470	17.1	730	0.001	4.12	6.20	903.4	0.241
Minimum	0.024	0.001	5	0.02	0.001	4.8	0.001	0.001	86	12.0	145	0.001	3.00	3.00	900.2	0.001
Baseline 90th Percentile	2.600	0.001	29	0.16	0.010	6.0	0.001	0.001	428	16.8	635	0.001	3.96	4.94	903.1	0.160
Pre-50th Percentile Trend	0.640	0.001	14	0.04	0.001	5.4	0.001	0.001	165	15.0	340	0.001	3.40	4.16	902.3	0.070

MPGM4/D8 Post-Brine/ash Placement - Data from July 2016 to June, 2017 (mg/L)																				
Date	Ag	ALK	Al	As	B	Ba	Be	Ca	Cd	Cl	Co	COND µS/cm	Cr	Cu	F	Fe-filtered	Hg	K	Li	Mg
28/07/2016	0.0005	8	0.56	0.0005	0.025	0.026		14.2	0.0001	2.15		200	0.0001	0.0001	0.005	0.094	0.00002	1.67		9.65
25/08/2016	0.0005	9	1.03	0.0005	0.025	0.042		22.5	0.0001	9.81		331	0.0001	0.001	0.01	0.203	0.00002	2.57		15.1
29/09/2016	0.0005	8	0.35	0.0005	0.07	0.032		15.5	0.0001	11.1		230	0.0001	0.002	0.013	0.071	0.00002	1.48		11.1
27/10/2016	0.0005	8	0.19	0.0005	0.05	0.032		21	0.0001	5.87		302	0.0001	0.0001	0.019	0.062	0.00002	1.93		15.8
24/11/2016	0.0005	7	0.12	0.0005	0.025	0.034		21.7	0.0001	5.05		295	0.0001	0.0001	0.011	0.03	0.00002	1.8		16.1
8/12/2016	0.0005	8	0.07	0.0005	0.1	0.035		21.8	0.0001	4.31		304	0.0001	0.0001	0.025	0.023	0.00002	1.81		17.1
19/01/2017	0.0005	8	0.12	0.0005	0.025	0.04		23.7	0.0001	8.33		366	0.0001	0.0001	0.018	0.099	0.00002	2.34		19.6
23/02/2017	0.0005	12	0.18	0.0005	0.14	0.058		47.1	0.0001	30.8		700	0.0001	0.0001	0.021	0.529	0.00002	4.51		37
23/03/2017	0.0005	12	0.62	0.0005	0.025	0.032		13.2	0.0001	4.2		156	0.0001	0.003	0.026	0.215	0.00002	2.45		5.85
6/04/2017	0.0005	6	0.53	0.0005	0.025	0.032		14.4	0.0001	2.8		221	0.0001	0.001	0.02	0.108	0.00002	2.49		11.1
25/05/2017	0.0005	5	0.55	0.0005	0.025	0.028		16	0.0001	2.35		217	0.0001	0.002	0.017	0.068	0.00002	2.21		11.1
30/06/2017	0.0005	7	0.58	0.003	0.025	0.031		17.2	0.0001	4.05		261	0.0001	0.001	0.015	0.076	0.00002	2.11		13.4

Continued…………………… MPGM4/D8 Post-Brine/ash Placement - Data from July 2016 to June, 2017 (mg/L)																
Date	**Mn-filtered**	**Mo**	**Na**	**Ni**	**Pb**	**pH**	**Sb**	**Se**	**SO4**	**Temp**	**TFR**	**V**	**WL1**	**WL2**	**WLAHD (m)**	**Zn**
28/07/2016	0.036	0.0005	4.32	0.019	0.0005	5.21		0.0001	74.7		138	0.005	1.9		904.5	0.031
25/08/2016	0.291	0.0005	13	0.034	0.001	5.23		0.0001	128		244	0.005	2.1		904.3	0.05
29/09/2016	0.052	0.0005	4.96	0.029	0.0005	5.58		0.0001	89.1		182	0.005	1.9		904.5	0.039
27/10/2016	0.184	0.0005	9.96	0.036	0.0005	5.44		0.0001	118		182	0.005	2		904.4	0.045
24/11/2016	0.154	0.0005	7.73	0.04	0.0005	5.25		0.0001	118		206	0.005	2.1		904.3	0.048
8/12/2016	0.526	0.0005	7.83	0.076	0.0005	5.31		0.0001	125		188	0.005	2.2		904.2	0.053
19/01/2017	0.3	0.0005	12.4	0.066	0.0005	5.34		0.0001	139		332	0.005	2.4		904.0	0.076
23/02/2017	1.21	0.0005	38.9	0.114	0.0005	5.37		0.0001	283		568	0.005	2.6		903.8	0.117
23/03/2017	0.016	0.0005	3.75	0.018	0.003	5.74		0.0002	46.3		117	0.005	1.9		904.5	0.031
6/04/2017	0.02	0.0005	5.69	0.028	0.0005	5.26		0.0001	84.3		186	0.005	2.3		904.1	0.036
25/05/2017	0.024	0.0005	5.62	0.027	0.0005	5.31		0.0001	85.3		169	0.005	2.3		904.1	0.043
30/06/2017	0.139	0.0005	8.39	0.039	0.0005	5.26		0.0001	104		197	0.005	2.4		904.0	0.059

MPGM4/D8 Post-Brine/ash Placement Summary from July 2016 to June, 2017 (mg/L)																			
	Ag	ALK	Al	As	B	Ba	Be	Ca	Cd	Cl	Co	COND µS/cm	Cr	Cu	F	Fe-filtered	Hg	K	Li	Mg
Ave	0.0005	8.2	0.41	0.001	0.05	0.035		20.7	0.0001	7.6		299	0.000	0.001	0.017	0.13	0.00002	2.3		15.2
max	0.0005	12.0	1.03	0.003	0.14	0.058		47.1	0.0001	30.8		700	0.000	0.003	0.026	0.53	0.00002	4.5		37.0
Min	0.0005	5.0	0.07	0.001	0.03	0.026		13.2	0.0001	2.2		156	0.000	0.000	0.005	0.02	0.00002	1.5		5.9
50th Percentile	0.0005	8.0	0.44	0.001	0.025	0.032		19.1	0.0001	4.7		278	0.000	0.001	0.018	0.09	0.00002	2.2		14.3
Post-90th Percentile Trend	0.0005	11.7	0.62	0.001	0.10	0.042	#REF!	23.6	0.0001	11.0		363	0.000	0.002	0.025	0.21	0.00002	2.6		19.4

Continued…………………….MPGM4/D8 Post-Brine/ash Placement Summary from July 2016 to June, 2017 (mg/L)																
Date	Mn-filtered	Mo	Na	Ni	Pb	pH	Sb	Se	SO4	Temp	TFR	V	WL1	WL2	WLAHD (m)	Zn
Ave	0.25	0.001	10.2	0.044	0.001	5.4		0.0001	116		226	0.005	2.2		904.3	0.052
max	1.21	0.001	38.9	0.114	0.003	5.7		0.0002	283		568	0.005	2.6		904.5	0.117
Min	0.02	0.001	3.8	0.018	0.001	5.2		0.0001	46		117	0.005	1.9		903.8	0.031
50th Percentile	0.15	0.001	7.8	0.035	0.001	5.3		0.0001	111		187	0.005	2.2		904.3	0.047
Post-90th Percentile Trend	0.50	0.001	12.9	0.075	0.001	5.6		0.0001	138		323	0.005	2.4		904.5	0.074

6b. MPGM4/D9

MPGM4/D9 Pre-Brine/Ash Placement Background Summary 1996-2000 (mg/L)																				
	Ag	**ALK**	**Al**	**As**	**B**	**Ba**	**Be**	**Ca**	**Cd**	**Cl**	**Co**	**COND µS/cm**	**Cr**	**Cu**	**F**	**Fe**	**Hg**	**K**	**Li**	**Mg**
Average		77		0.0073	0.011	0.093	0.003	23	0.0010	15	0.035	430	0.0053	0.0334	0.160	1.078		5	0.009	19
Maximum		125		0.0180	0.024	0.190	0.006	40	0.0010	33	0.062	640	0.0120	0.1280	0.450	2.000		5	0.014	35
Minimum		32		0.0020	0.005	0.030	0.001	14	0.0010	7	0.026	340	0.0010	0.0100	0.001	0.240		5	0.005	10
Baseline 90th Percentile		111		0.0146	0.022	0.160	0.005	29	0.0010	23	0.048	607	0.0105	0.0628	0.297	1.667		5	0.013	23
Pre-50th Percentile Trend		71.5		0.0065	0.008	0.086	0.003	21	0.0010	12	0.031	375	0.0045	0.0135	0.140	1.025		5	0.008	19

Continued…………MPGM4/D9 Pre-Brine/Ash Placement Background Summary 1996-2000 (mg/L)														
	Mn	**Mo**	**Na**	**Ni**	**Pb**	**pH**	**Se**	**SO4**	**Temp**	**TFR**	**V**	**WL1**	**WL2**	**WLAHD**	**Zn**
Average	0.828	0.001	24	0.127	0.067	6.1	0.001	104	16.2	248	0.014	3.8	4.0	907.7	0.501
Maximum	1.600	0.002	38	0.220	0.230	6.8	0.003	254	20.0	500	0.027	4.1	5.0	909.7	1.720
Minimum	0.460	0.001	13	0.079	0.002	5.3	0.001	59	11.5	80	0.001	3.6	3.6	905.6	0.140
Baseline 90th Percentile	1.004	0.002	34	0.178	0.158	6.8	0.002	139	19.2	451	0.026	4.0	4.3	909.7	1.238
Pre-50th Percentile Trend	5.000	0.050	54	0.168	0.086	6.7	0.002	510	19.0	880	0.022	3.7	3.8	907.8	5.910

MPGM4/D9 Post-Brine/ash Placement - Data from July 2016 to June, 2017 (mg/L)																				
Date	Ag	ALK	Al	As	B	Ba	Be	Ca	Cd	Cl	Co	COND µS/cm	Cr	Cu	F	Fe-filtered	Hg	K	Li	Mg
28/07/2016	0.0005	77	0.23	0.0001	0.49	0.026		183	0.0001	173		2583	0.0001	0.001	0.05	4.06	0.00002	17.4		154
25/08/2016	0.0005	81	0.82	0.0001	0.56	0.036		185	0.0001	148		2661	0.0001	0.002	0.05	11.8	0.00002	16.4		157
28/09/2016	0.0005	101	0.005	0.002	0.5	0.029		181	0.0001	141		2728	0.0001	0.001	0.05	21.6	0.00002	15.4		156
27/10/2016	0.0005	87	0.07	0.0001	0.52	0.03		224	0.0001	160		2794	0.0001	0.001	0.05	6.25	0.00007	14.9		167
24/11/2016	0.0005	91	0.03	0.0001	0.44	0.034		208	0.0001	150		2722	0.0001	0.001	0.1	15.1	0.00013	16.9		174
8/12/2016	0.0005	103	0.08	0.002	0.6	0.038		224	0.0002	147		2904	0.0001	0.001	0.25	21.3	0.00007	16.5		194
19/01/2017	0.0005	117	0.02	0.0001	0.76	0.035		220	0.0001	144		2963	0.0001	0.001	0.214	18	0.00002	17.6		208
23/02/2017	0.0005	112	0.09	0.0001	0.78	0.035		214	0.0001	175		2910	0.0001	0.001	0.1	19.3	0.00002	19.2		204
22/03/2017	0.0005	115	0.11	0.0001	0.84	0.037		197	0.0001	142		2910	0.0001	0.001	0.072	5.68	0.00012	16.4		193
6/04/2017	0.0005	128	0.05	0.0001	0.75	0.039		202	0.0001	132		2910	0.0001	0.003	0.026	14.3	0.00002	19.5		201
25/05/2017	0.0005	101	0.05	0.0001	0.84	0.036		216	0.0001	124		2780	0.0001	0.001	0.05	1.39	0.00002	19.4		201
30/06/2017	0.0005	82	0.1	0.001	0.68	0.032		164	0.0001	114		2420	0.0001	0.001	0.05	0.43	0.00002	15.7		166

Continued…………………….. MPGM4/D9 Post-Brine/ash Placement - Data from July 2016 to June, 2017 (mg/L)															
Date	Mn-filtered	Mo	Na	Ni	Pb	pH	Se	SO4	Temp	TFR	V	WL1	WL2	WLAHD (m)	Zn
28/07/2016	8.68	0.0005	172	0.342	0.001	5.41	0.0001	1390		1910	0.005	1.5		908.2	0.139
25/08/2016	9.11	0.001	166	0.366	0.001	5.41	0.0001	1280		2030	0.005	1.7		908.0	0.191
28/09/2016	9.34	0.001	161	0.343	0.001	5.89	0.0001	1400		2070	0.005	1.4		908.3	0.137
27/10/2016	9.46	0.001	205	0.366	0.001	5.91	0.0001	1400		2280	0.005	1.6		908.1	0.12
24/11/2016	8.75	0.001	186	0.309	0.001	5.94	0.0001	1290		2040	0.005	1.5		908.2	0.084
8/12/2016	10.4	0.001	199	0.341	0.001	5.93	0.0001	1450		2110	0.005	1.7		908.0	0.14
19/01/2017	11	0.001	210	0.364	0.001	5.96	0.0001	1450		2820	0.005	1.9		907.8	0.146
23/02/2017	10.2	0.001	194	0.333	0.001	5.94	0.0001	1360		2630	0.005	2.1		907.6	0.145
22/03/2017	10.9	0.001	182	0.341	0.001	5.85	0.0001	1650		2160	0.005	2		907.7	0.128
6/04/2017	11.2	0.001	182	0.317	0.001	5.83	0.0001	1440		1920	0.005	1.9		907.8	0.129
25/05/2017	11.8	0.001	172	0.307	0.001	5.85	0.0001	1790		2160	0.005	2.1		907.6	0.078
30/06/2017	10.2	0.001	142	0.28	0.001	5.86	0.0001	1230		1880	0.005	2.2		907.5	0.072

MPGM4/D9 Post-Brine/ash Placement Summary from July 2016 to June, 2017 (mg/L)																				
	Ag	**ALK**	**Al**	**As**	**B**	**Ba**	**Be**	**Ca**	**Cd**	**Cl**	**Co**	**COND µS/cm**	**Cr**	**Cu**	**F**	**Fe-filtered**	**Hg**	**K**	**Li**	**Mg**
Ave	0.0005	100	0.14	0.000	0.65	0.034		202	0.0001	146		2774	0.000	0.001	0.089	11.6	0.00005	17.1		181
max	0.0005	128	0.82	0.002	0.84	0.039		224	0.0002	175		2963	0.000	0.003	0.250	21.6	0.00013	19.5		208
Min	0.0005	77	0.01	0.000	0.44	0.026		164	0.0001	114		2420	0.000	0.001	0.026	0.4	0.00002	14.9		154
50th Percentile	0.0005	101	0.08	0.000	0.64	0.035		205	0.0001	146		2787	0.000	0.001	0.050	13.1	0.00002	16.7		184
Post-90th Percentile Trend	0.0005	117	0.22	0.002	0.83	0.038	#REF!	224	0.0001	172		2910	0.000	0.002	0.203	21.1	0.00012	19.4		204

Continued……………………MPGM4/D9 Post-Brine/ash Placement Summary from July 2016 to June, 2017 (mg/L)															
Date	**Mn-filtered**	**Mo**	**Na**	**Ni**	**Pb**	**pH**	**Se**	**SO4**	**Temp**	**TFR**	**V**	**WL1**	**WL2**	**WLAHD (m)**	**Zn**
Ave	10.1	0.001	181	0.334	0.001	5.8	0.0001	1428		2168	0.005	1.8		907.9	0.126
max	11.8	0.001	210	0.366	0.001	6.0	0.0001	1790		2820	0.005	2.2		908.3	0.191
Min	8.7	0.001	142	0.280	0.001	5.4	0.0001	1230		1880	0.005	1.4		907.5	0.072
50th Percentile	10.2	0.001	182	0.341	0.001	5.9	0.0001	1400		2090	0.005	1.8		907.9	0.133
Post-90th Percentile Trend	11.2	0.001	204	0.366	0.001	5.9	0.0001	1630		2595	0.005	2.1		908.2	0.146

Attachment 2

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

Year(s)	January	February	March	April	May	June	July	August	September	October	November	December	Annual
2000	57	22.2	271.4	50.6	53	32.2	37.4	51.2	43	75	119.2	59	871.6
2001	105.4	90.6	89.6	84.4	29	9	63.2	30.8	46.4	58.8	80	26.6	713.6
2002	87.8	187	69.4	40.2	68	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	16.2	30.2	50.8	34.8	118	113.8	88.6	654
2005	102.8	105	55.8	28.6	14	117	59.2	24.6	87.6	117	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	72.1	44.6	57	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	166	28	74.5	81	44.5	35.9	48.8	63	69	23.6	81.5	740.7
2010	76.4	119	85.1	35.8	54	40.9	73.5	73.5	52.4	70.9	122.8	164.6	969.5
2011	114	57.2	77.2	41.2	51.2	72.4	24.6	58.7	78.4	46.2	168	96	885.1
2012	57.1	152.6	189.8	44.4	30.6	81.8	49.8	21.2	48.6	20.8	30.9	64.1	791.7
2013	64.1	113.2	184.2	66.2	28.1	29	24.4	23.2	36.8	21.8	95.2	34.2	720.4
2014	13.6	74	143.8	63	14	43.2	24.2	24.2	27.9	60.7	21.8	174.3	684.7
2015	124.8	31	35	184	31	26	44.6	31.6	12.6	37.2	67.2	57.2	682.2
2016	166.6	46.6	36.8	6.6	20.6	170	102	61.8	92	54.2	51.4	94.8	903.4
2017	44.6	46.6	175.6	26.8	26.4	40.2							
												Average	726.6

Attachment 3

Mt Piper Power Station Groundwater Bore Collar and Pipe Height Survey results for:

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

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

a) 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.

b) 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	MGA North	AHD Height
	224266.86	6306197.29	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

Attachment 4

Mt Piper Power Station Average Brine Composition 2014/15, 2015/16 and 2016/17

Composition of Brine used for Ash Conditioning

Date Sampled		2014-2015	2015-2016	2016-2017
Ag	mg/L		0.010	
Al	mg/L		0.5	0.7
As	mg/L		0.3	
B	mg/L		31.4	29.3
Ba	mg/L		0.5	0.3
Be	mg/L			0.1
Bromide	mg/L			72.9
Ca	mg/L		587.3	537.5
Cd	mg/L		0.0	0.1
Chloride	mg/L	8331.3	7681.1	6635.8
Co	mg/L		0.5	0.1
Conductivity (uS/cm)		83487.5	76977.8	73400.0
Cr	mg/L		0.5	0.1
Cu	mg/L		17.9	7.0
Fe	mg/L		0.5	0.3
Fe	mg/L Unfiltered			0.7
Fluoride	mg/L			77.8
Hg	mg/L		0.0	
K	mg/L		2673.3	2425.0
Mg	mg/L		2840.0	2765.0
Mn	mg/L		5.7	5.8
Mo	mg/L			2.3
Na	mg/L		27633.3	29350.0
Ni	mg/L		6.3	2.4
Nitrate	mg/L		8.6	118.5
Nitrite	mg/L		7.2	7.4
Nitrogen N	mg/L			181.0
Pb	mg/L		0.0	0.1
pH		8.0	8.3	8.3
Phenolphthalein Alkalinity (CaCO3)	mg/L		17.9	8.2
Sb	mg/L		0.1	0.1
Se	mg/L		0.2	
SiO2	mg/L		97.8	106.5
Sr	mg/L			5.8
Sulphate	mg/L	70337.5	61066.7	53800.0
TDS (mg/L)	[gravimetric]	108937.5	99266.7	97966.7
Ti	mg/L			0.1
Total Alkalinity (CaCO3)	mg/L		804.1	708.8
Total P	mg/l			1.4
TSS	mg/L	119.3	71.1	44.8
Va	mg/L			0.1
Zn	mg/L		1.7	0.8

Attachment 5

EPA Letter regarding Chloride increases at Mt Piper Groundwater Bore MPGM4/D10 dated 18th December, 2013

NSW EPA

Our reference: EF13/4130: DOC13/94863
Contact: Mr Allan Adams 6332 7610

The General Manager
EnergyAustralia NSW Pty Ltd
Private Mail Bag 1
PORTLAND NSW 2847

Attention: Chan Sinnadurai

18 December 2013

Dear Mr Welfare

I refer to the Mt Piper Brine Conditioned Fly Ash Co-Placement Water Quality Monitoring and Effect of Lamberts Gully, Annual Update Report 2012 (AUR), prepared by Aurecon 2013, ref 208557. The Environment Protection Authority (EPA) has undertaken a desktop review of the 2012 AUR, and the reports for the periods 2009, 2010, and 2011.

The 2012 AUR presents data on Chloride concentrations (Table 5b, p.68, Aurecon 2013) at groundwater bore MPGM4/D10 that have increased over the reporting period (20/01/12 – 19/10/12) from 290 mg/L to 310 mg/L. After reviewing the 2009, 2010, and 2011 data it is evident that Chloride concentrations at bore D10 have been increasing since approximately December 2009 (Figure 5, p. 21, Aurecon 2013).

The 2012 AUR states that "in previous reports, the increase at bore D10, since 2009, was suggested to be related to rainfall runoff from the exposed brine conditioned ash batters at the B5 Brine Bench, which are on top of the water conditioned ash". In addition, the 2012 AUR states that groundwater sample at the D10 bore were expected to be modified by inflows from previous underground mine workings (goaf), up-gradient of D10.

The AUR 2011 highlights in the summary that, "the Mt Piper groundwater model predicted that it would take about 12 years (from the commencement of brine conditioned ash placement in 2000) for the brine leachates to reach the groundwater under the ash, which as yet has not occurred". The summary also states that in light of the expansion of the ash placement area and the water quality at bore D10 that the model be updated and re-run with revised and hydrological conditions.

In addition to the above matters, EPA officer Matthew Corradin attended a meeting with Delta Electricity employees Mr Bryan Beudeker (Manager Environment) and Ms Julia Harvey (Corporate Relations Manager), and consultants from CDM Smith, Mr Simon Witney (Principle Environmental Planner) and Ms Michelle Cooke (Senior Environmental Scientist) to discuss the Mt Piper Ash Placement Project on two separate occasions (17/07/2013, 30/08/2013). The outcome of these meetings, as identified through modelling of groundwater data, that the cause of elevated Chloride levels in groundwater was due to old coal reject ponds, and that elevated Sulphate was due to old mine workings.

The 2012 AUR states that the increased Chloride and salinity at bore D10 affected concentrations in the groundwater Collection Basin (GCB), at the new groundwater receiving water bore MPGM4/D9 with a minor effect on Neubecks Creek at site WX22. The EPA is particularly concerned that as the Chloride concentrations have continued to increase at bore D10 over several years a minor effect was reported at Neubecks Creek (WX22) in the 2012 annual update report. In the event that Chloride concentrations at bore D10 continue to rise, either due to brine leachates or historic mining activities this may result in further impacts at Neubecks Creek.

The EPA review of each AUR (2009–2012) concludes that there is uncertainty over the cause of the increasing concentrations of Chloride at bore D10. .

As part of the EPA investigation to determine whether the increasing concentrations of Chloride at bore D10 is due to seepage of brine leachates to groundwater or historic mining acitivities, the EPA is seeking a response to the following:

(1) What is the progress of the proposed covering of the southern brine batters with water conditioned ash;

(2) What is the progress of the monitoring recommended in the 2012 AUR to confirm the potential reduction in salinity and Chloride following the covering of the southern brine batters with water conditions ash.

(3) As per the findings of the Mt Piper groundwater model predictions that it would take 12 years from the commencement of brine conditioned ash placement in 2000 for the brine leachates to reach the groundwater under the ash; what long–term strategy is in place to manage the brine leachate once it reaches the groundwater under the ash (as predicted by the Mt Piper groundwater model)?

Further, the EPA requests copies of the following:

(4) Water quality data for Neubecks Creek (WX22) for the period January 2013–September 2013.

(5) Water quality data for the Groundwater Collection Basin for the period January 2013–September 2013.

(6) Water quality data for Groundwater Seepage Detection Bores MPGM4/D1 and 4/D3 for the period January 2013–September 2013.

(7) Water quality data for Ash Placement Area Groundwater Bores B901+MPGM4/D12, B904+MPGM4/D10, and MPGM4/D11, D13 and D14 for the period January 2013–September 2013.

(8) Copies of any reports/data produced by consulting firm CDM Smith on the potential cause of increased concentrations of Chloride, Sulphate or any other elements likely to impact groundwater or surface water due to historical mining activities or brine leachates at Mt Piper Ash Placement Area or surrounds.

Should you have any enquiries regarding this matter please contact Allan Adams at the Central West (Bathurst) Office of the EPA by telephoning (02) 6332 7610.

Yours sincerely

DARRYL CLIFT
Head Central West Unit
<u>Environment Protection Authority</u>

Attachment 6

Mt Piper Power Station Brine Conditioned Flyash Co-placement Extension Water Management and Monitoring Plan, 26 September, 2008.

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Mt Piper Power Station Brine Conditioned Flyash Co-placement Extension Water Management and Monitoring Plan

Delta Electricity Western

26 September 2008
Reference 7053 01 EC
Revision 3

Connell Wagner

Document Control

Connell Wagner

Document ID: O:\7053\MOUNT PIPER WQ 2440\MTPIPER + BRINE\WATER MGT PLAN\MT PIPER BRINE-ASH EXPANSION WMP C DE & GM AND DOP COMM.DOC

Rev No	Date	Revision Details	Typist	Author	Verifier	Approver
0	20/03/08	Draft	BRH	BRH	GM	LK
1	15/04/08	Final Draft	BRH	BRH	GM	LK
2	5/05/08	Final Report with DE comments	BRH	BRH	GM	LK
3	26/09/08	Revised Final Report with DoP comments	BRH	BRH	GM	CV

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Contents

Figures

Attachments

Summary

A Statement of Environmental Effects (SEE) was prepared for extension of the Mount Piper Power Station brine co-placement project area (Connell Wagner, 2007a) due to space limitations in the currently approved area and to allow for increased brine production resulting from the approved upgrade of the power station from 1,320 MW to 1,500 MW (Connell Wagner, 2005). In accordance with the requirements of the Development Consent, the Water Management Plan (WMP) for the existing brine co-placement area has been updated to include the expanded area. The updated WMP includes:

- a water monitoring program for surface and groundwater monitoring at the ash disposal site and receiving waters;
- the requirements for an annual environmental monitoring report;
- strategies for reduction of brine production, and
- requirements for an update of the groundwater modelling, based upon the monitoring data.

The updated WMP contains a water cycle management plan that describes how surface runoff will be managed to prevent contamination of groundwater and surface water from the brine conditioned ash placement area. A contingency plan is also described in the event that monitoring suggests surface or groundwater contamination may be occurring.

1. Introduction

Mount Piper Power Station obtained development approval from the Department of Urban Affairs and Planning (DUAP) on 3rd April, 2000 for the co-placement of brine conditioned flyash in the existing ash placement area. The existing brine/ash placement, as described in the PPI (1999) Statement of Environmental Effects (SEE), allows brine produced in the treatment of the cooling tower blowdown and other waste waters, to be disposed on site with acceptable environmental effects.

A Water Management Plan (WMP) was prepared, as required under Clause 43 of Schedule 2 attached to the original brine conditioned ash co-placement consent (see Attachment 2). This plan, and storage of brine conditioned ash within the ash placement area, has been in operation since November, 2000.

In 2006, the Department of Planning approved an application to upgrade the nominal capacity of the power station from 1,320 MW to 1,500 MW on 3rd June, 2006 (Attachment 3). This was described in a SEE for the project (Connell Wagner PPI, 2005).

Due to space limitations in the currently approved area and to provide for increased brine production due to the upgrade, Delta Electricity proposes to extend the existing brine and ash co-placement area at Mount Piper Power Station. The environmental effects of the proposal were examined in a SEE (Connell Wagner, 2007a) which was submitted in support of an application to modify the ash disposal area. The modification was approved by the Department of Planning on 23rd March 2008 (Attachment 4). The area involved is shown in Figure 1.

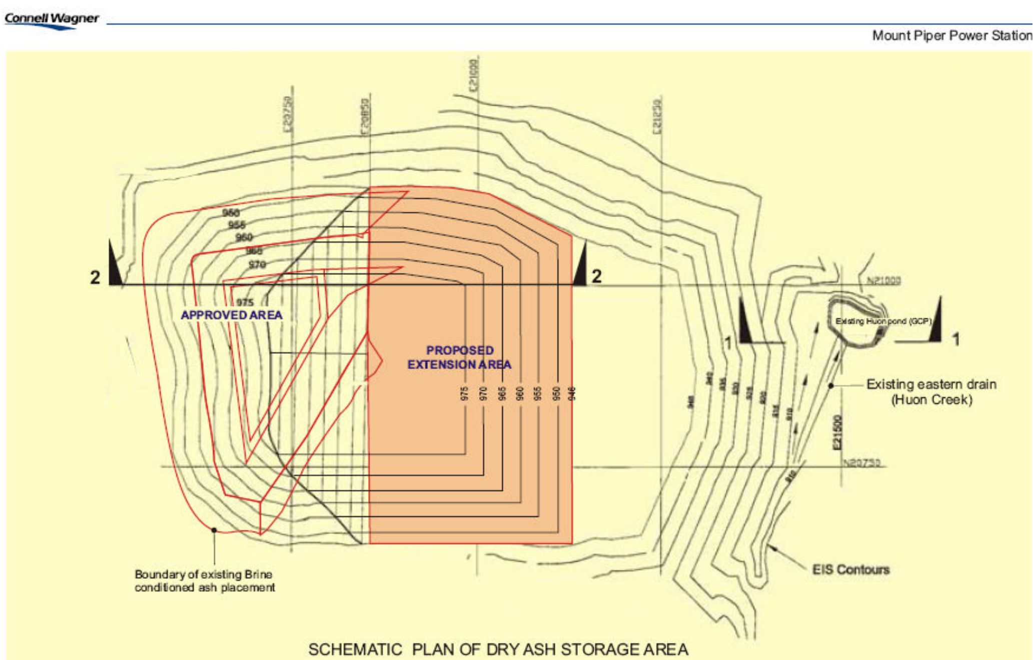

Figure 1. Existing and Approved Extension to the Brine Conditioned Ash Placement Area

The extension shown in Figure 1 will provide adequate volume for placement of brine conditioned ash for the remaining life of the ash placement facility. The existing and proposed extension areas are also overlayed on Figure 5 to show the relation between the monitoring points and the two areas.

The development consent for the extension required that the existing Water Management and Monitoring Plan (WMP) be updated and approved by the Director-General prior to undertaking extension of the brine conditioned ash placement area. The update must include details of:

- the increased catchment area;
- extension of drains, and
- the additional detention pond and/or storage areas.

This WMP addresses the water cycle management on the site, including strategies for reduction of brine production. It also includes a water monitoring program for surface and groundwater monitoring at the ash disposal site and receiving waters. The requirement for an annual environmental monitoring report is also included in the WMP.

Should the water quality monitoring indicate significant effects of the brine placement, groundwater modelling would be undertaken and the report is required to be an update of the modelling presented in the Connell Wagner (2007) SEE. The model is required to be calibrated using the water quality monitoring data.

The WMP for the extended brine placement area was updated by modifying the original Water Management and Monitoring Plan (PPI 2000), as required by the 2007 SEE and the 2008 approval conditions. The aim of the WMP is to minimise the effect of the placement of brine conditioned ash on local natural waters. It outlines the existing water quality, describes surface water and groundwater management strategies and documents the surface water and groundwater monitoring programs. Contingency plans in the event of runoff or leachate having an effect upon natural surface water or groundwater quality are also presented.

It is expected that the WMP will be integrated with the Repository Site Management Plan for the brine conditioned ash area (BBS, 2007). The site is administered by Bilfinger Berger Services Pty Ltd (BBS) for the power station. The Mount Piper Environment Section will be responsible for monitoring and will request Bilfinger Berger Services to implement the contingency plan, if required.

2. Current Water Cycle Management and Water Quality

2.1 Water Cycle Management

The Mount Piper Power Station and ash storage area are located within the catchment of Neubecks Creek, a tributary of the Coxs River, which is a Sub-catchment of the Warragamba Catchment. Water cycle management practices in the Mount Piper Power Station ash placement area direct surface runoff from the external batters away from the deposited ash into drains and clean water collection ponds (Figure 2). External runoff is also directed to the Eastern Drain (called Huon Creek), which flows into settling ponds or the local Huon Mine void called the Groundwater Collection Basin (GCB).

Surface water management of runoff from within the existing brine conditioned ash and proposed extension placement areas are outlined in Figure 2. The normal water conditioned ash runoff is directed to dirty water storage ponds, runoff from the brine area to the brine dirty water ponds and clean water diversion to a detention pond. Details of the existing brine runoff system and proposed brine dam are also shown in Figure 2. Collected water will only be used for dust suppression within the ash and brine placement area.

2.2 Surface Water Quality

Surface water in the nearby Neubecks Creek is characterised by elevated concentrations of sulphate, iron and manganese. This reflects the nature of the local geology, which includes out-cropping coal seams, some of which have been mined in this area (Connell Wagner, 2007b). Attachment 1 provides a summary of the existing surface and groundwater quality in and near the ash disposal area.

Water quality in Neubecks Creek is relatively poor and variable due to catchment inputs and stream flows. The median stream flow is only about 3.7 ML/day.

2.3 Groundwater Quality

Groundwater management is an essential part of the water cycle management for the ash disposal area. Groundwater flows travel from west of the ash disposal area to the Eastern Drain, which enters the Huon mine void. Limited flow occurs between the mine void and Neubecks Creek (Merrick, 2007).

The local groundwater is elevated in salts, mainly sulphate, and iron and manganese as well as some trace elements such as lead and zinc. The trace elements such as zinc and lead are due to local mineralisations originating from an old copper, lead and zinc open-cut mine to the north-west of the ash disposal site. The groundwater has low pH due to the presence of iron pyrites. Oxidation of the iron pyrites, by groundwater passing through the area, results in very high concentrations of iron and sulphate.

Poor water quality is also present in underground mine goaf areas to the south of the site. This has affected the water quality in the Groundwater Collection Basin in recent years (Connell Wagner, 2007b). The goaf areas are the underground mine areas where coal pillars between former mine headings have been partially mined and the roof allowed to collapse. The water quality is characterised by elevated concentrations of boron and sulphate as well as iron, manganese, nickel and zinc.

The groundwater concentrations of trace metals are much lower at background bores located away from the old mine area. Due to the localised nature of the various ore bodies and coal mines in the area, the groundwater water quality is highly variable between sampling bores. The relevant background bores are used to represent background conditions for comparison with the ash placement area down-gradient bores (see Attachment 1).

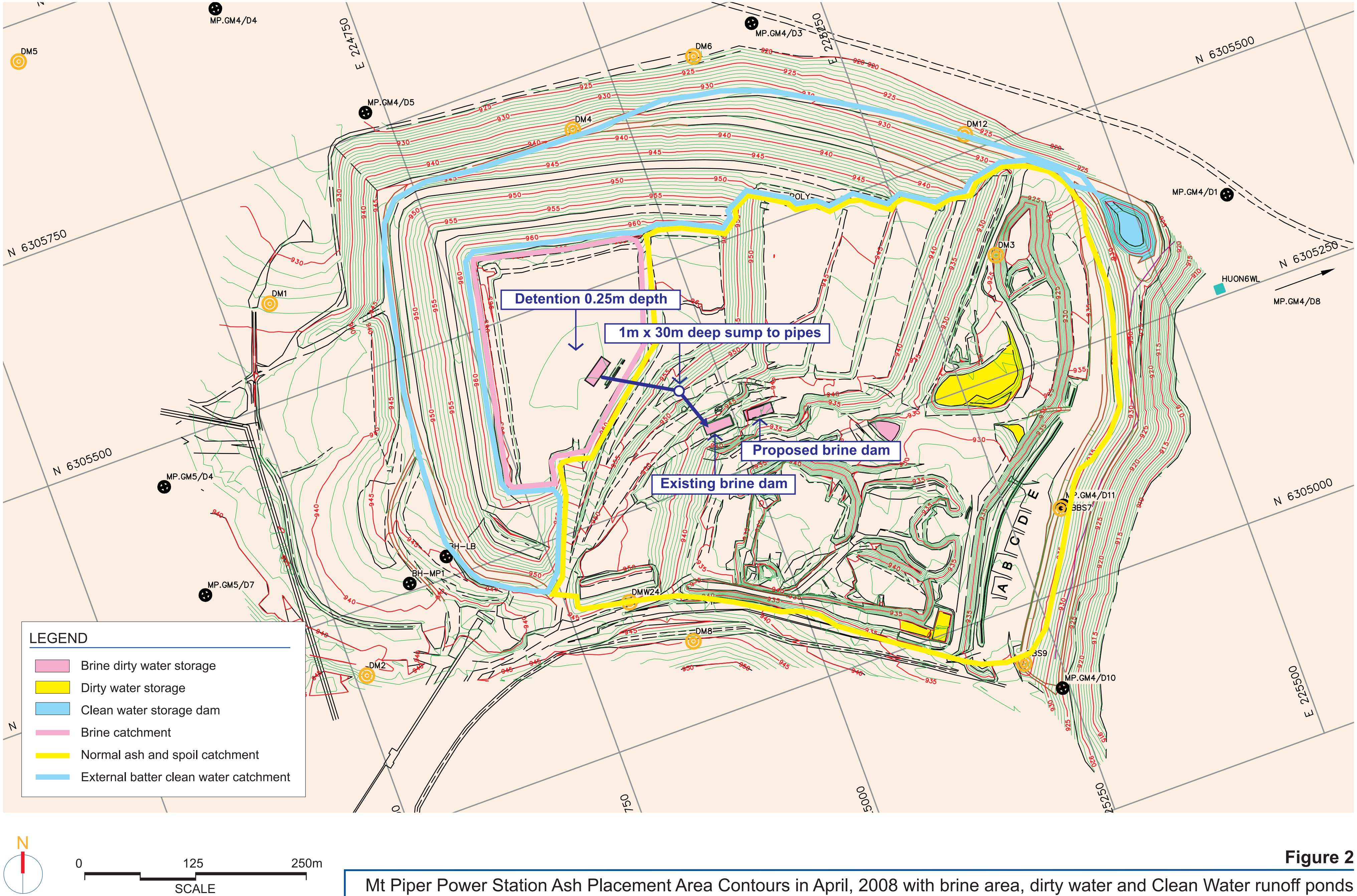

Figure 2

Mt Piper Power Station Ash Placement Area Contours in April, 2008 with brine area, dirty water and Clean Water runoff ponds and Proposed Extension Area Brine Dam

3. Planned Extended Area Water Cycle Management

Management of surface runoff for the existing brine conditioned ash placement is described in the following section. A similar arrangement will be used for the extended area.

3.1 Existing Surface Runoff

The brine-conditioned flyash placement area is managed to control surface runoff to minimise contamination of the local groundwater and surface water. As can be seen in Figure 3, the brine conditioned flyash is placed in layers and the external batters are capped with one metre of normal flyash to prevent leaching of the brine by runoff into surface waters outside the placement area.

At the completion of a placement stage, the normal flyash capping is covered with spoil and revegetated, in accordance with the Bilfinger Berger Services Repository Site Management Plan (BBS, 2007). In this way, the brine conditioned ash deposit is segregated from the surrounding environment by an envelope of water conditioned ash and spoil capping, as originally approved for the ash placement proposal. The location of the ash disposal area is such that the risk of surface runoff entering natural water courses is minimal.

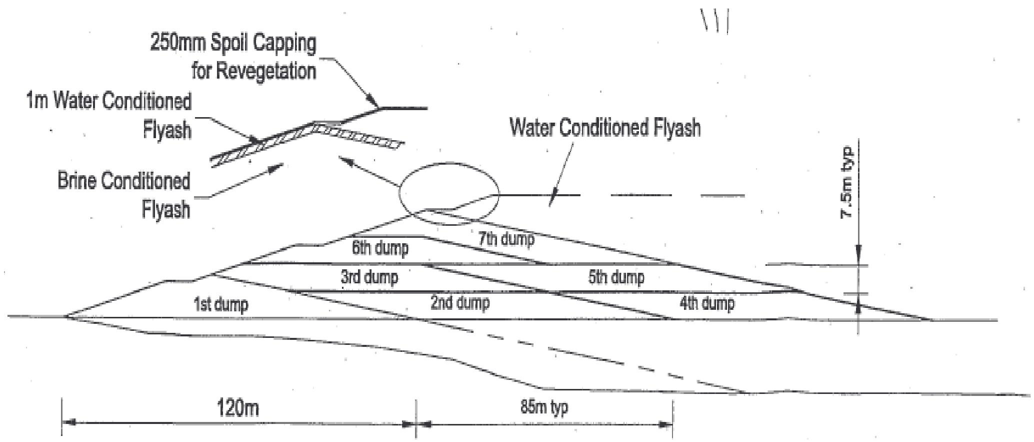

Figure 3. Schematic of Water Conditioned Ash External Batter Placement for Containment of Brine Conditioned Ash Placement (from PPI, 1999)

The annual “Long term average rainfall” measured at Lithgow is 870mm (Forster 1999). The brine/ash pilot field test showed that the majority of the rainfall is evaporated from the ash surface, resulting in an average of only 5% of the annual rainfall appearing as surface runoff.

Surface runoff from within the existing brine conditioned ash placement area is as shown in Figure 4. A surface slope of 2% directs the rainfall runoff to a wide detention pond in the centre of the deposit, which has a maximum depth of 0.25m. Water collected in this pond is directed to a 30m long, 1m deep sump which then directs water to the lined 300m^3 Brine Dam. Inspections of the system are undertaken daily to ensure its integrity during the placement period. A variety of other components are checked during these inspections as detailed in the BBS Ash Placement Area Daily Inspection Sheet (Attachment 5).

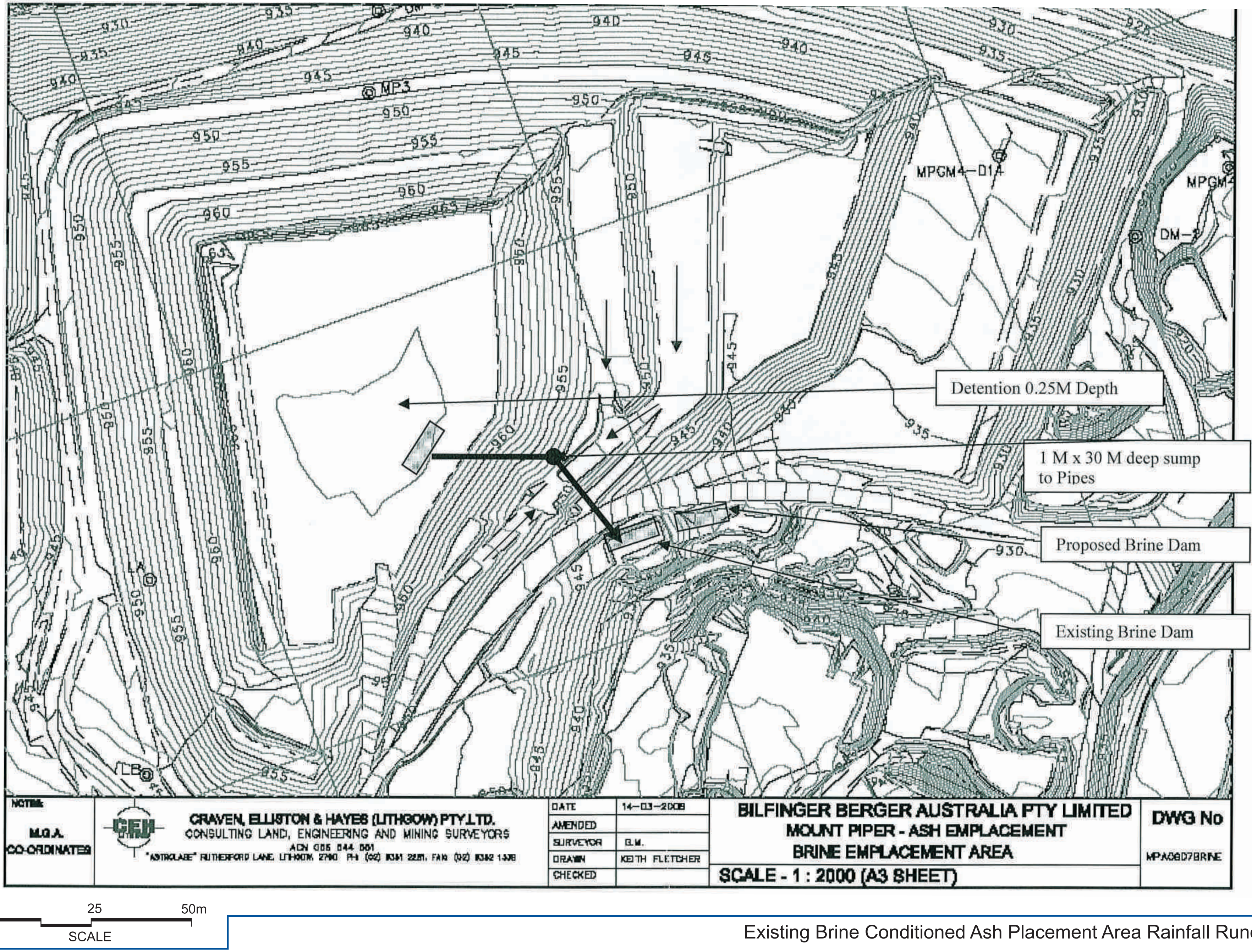

Figure 4

Existing Brine Conditioned Ash Placement Area Rainfall Runoff System

The lined Brine Dam was sized at 300m^3 to collect 1 in 10 year storm events from individual ash placement stage areas. This was estimated based upon the 90th percentile of 100 years of monthly rainfall data and taking 5% of surface runoff from the area of the placement. Storm intensity runoff calculation showed that the original pond size was conservative so the larger size was used.

Water collected in the dam is reused for dust suppression by spraying onto the ash/brine area. In this way the size of the pond can be kept to a minimum. The dam will be kept empty as far as possible to reduce the possibility of an overflow. In the unlikely event that the dam was to overflow, the water would drain to the dirty water storage dams where it could be pumped back to the brine placement area. The contingency plans in Section 5 would then be adopted with regards to increased monitoring frequency for the detection of seepage, and the treatment of any confirmed contaminated water in the Groundwater Collection Basin.

3.2 Extended Area Surface Runoff

The design of the extended brine conditioned ash placement area drainage system, to manage external and internal runoff, will be similar to that used for the existing area. The existing detention pond will be extended into the expanded area as required, maintaining a similar configuration to that shown in Figure 4. The 30m long, 1m deep sump for collection of runoff will be moved as required. Water from the sump will be directed to the existing lined Brine Dam as well as an additional Brine Dam in the extended area. As the configuration for extended area will be similar to that for the existing placement, the size of the second Brine Dam will also be 300m^3, as depicted in Figure 4.

The design of the drainage system will be suited to the extended placement area and the planned design is expected to be similar to that shown in Figure 4.

3.3 Surface Runoff at Completion of Brine Placement

Once placement of brine conditioned ash ceases, the area will be covered with normal ash and the Brine Dam will be decommissioned. All areas will be rehabilitated and free draining. Runoff from the rehabilitated areas will be diverted to the main site drainage system for clean runoff (Figure 2).

3.4 Groundwater

Protection of natural groundwater is an essential part of the water cycle management. Measures outlined in this management plan seek to minimise the impact that the ash disposal area could have on local groundwater and in turn surface water.

The location of the ash disposal area was chosen to minimise the formation of leachates and its infiltration into the local groundwater. Groundwater modelling carried out for the original 1989 ash disposal EIS (ECNSW, 1989) indicated that a sub-surface drain, constructed of mine spoil, to prevent the deposited ash from coming in contact with the groundwater in the mine void would achieve this aim. The brine conditioned flyash proposal has the brine conditioned ash deposit placed on top of the ash deposit, some 37m above the water table.

Brine-conditioned flyash will not come into contact with the local groundwater table. The water table is predicted to rise by about 2m as a result of ash placement. The local groundwater should therefore be some 35 m below the brine conditioned ash disposal area (Merrick and Tammetta, 1999 and Merrick, 2007).

As the compacted flyash has a low porosity, only very small amounts of leachate are predicted to be formed as a result of rainfall infiltration into the brine conditioned ash deposit. The brine in ash field trial (Forster, 1999) found that the rainfall infiltration was only about 5 mm per year, equivalent to less than 1% of the annual average rainfall. Recent contaminant transport modelling (MERRICK, 2007) has indicated that the leachate produced from the extended brine conditioned ash area is not expected to have a significant effect on water quality in the Eastern Drain, the Groundwater Collection Basin or Neubecks Creek.

4. Water Monitoring Program

Water quality monitoring provides important feedback for water cycle management in the ash disposal area. The monitoring program has been designed to supply sufficient information to give an accurate picture of the state of the water cycle management so that decisions can be made as to whether changes in local water quality are due to the placement of brine conditioned ash or other activities within the area. The aim is to identify water quality changes at an early stage so the causes can be investigated. In the event that changes are expected to be due to the brine co-placement, decisions can be made regarding corrective actions.

The original April, 2000 Development Approval conditions No. 40 and 41 (Attachment 2) and the recent approval to modify the development (Attachment 4) requires the Department of Planning to consult with the DECC, Department of Water and Energy (DWE), Sydney Catchment Authority (SCA) and Lithgow Council regarding proposed changes to the existing groundwater and surface water monitoring program, before approval of an updated Water Quality Management Plan (WQMP) can be granted.

4.1 Water Quality Guidelines

The local guidelines used are the pre-placement 90th percentile or the ANZECC (2000) guidelines for protection of freshwater (see Connell Wagner, 2007b and Attachment 1). It should be noted that modelling indicates that significant increases of salts and trace metals are not expected in the long-term, so changes in concentrations due to the brine conditioned ash placement are unlikely.

4.2 Groundwater

The groundwater monitoring bores, shown in Figure 5, have been used to monitor effects of the existing brine conditioned placement area. Due to the placement of water conditioned ash, the pre-brine conditioned ash bores MP3, B901 and B904 have been capped before being covered by ash. The background bore MP1 has been dry since brine conditioned ash placement began but is uncapped because it is monitored each quarter for water content. The more recent bores MPGM4/D12, D13 and D14 have also been capped before being covered by ash and recently bores D10 and D11 have been capped and covered with mine spoil. Therefore, changes in water quality in the seepage detection bores and the Groundwater Collection Basin will continue to be used to monitor the effects of brine conditioned ash placement in the ash placement area. In addition, vibrating wire piezometers (which only monitor water level) have been placed around the location of the covered bore D14 (see Figure 5) to provide early warning of increasing groundwater elevation and therefore possible brine leachates from the extended brine placement area. Where a significant increase in groundwater elevation is detected by a vibrating wire piezometer, a bore will be drilled through the ash. Free water in the bore will be analysed for water quality and ash core samples collected and analysed for moisture and salts in leachate tests. However, due to the water conditioned ash placement, there is no possibility of installing more groundwater monitoring bores inside the ash placement area.

It is proposed that, as well as installing additional vibrating wire piezometers in the expanded brine placement area (see Section 4.2.2), the water quality in the Groundwater Collection Basin and the existing monitoring bores outside the ash placement area, shown in Figure 5, will be used to monitor the extended brine conditioned placement area. The vibrating wire piezometers, Groundwater Collection Basin and remaining bores are sufficient for monitoring purposes.

If, for some reason, expansion of the existing groundwater and surface water monitoring programs becomes necessary, it will be undertaken with consultation and in accordance with reasonable requirements of DOP, in consultation with DECC, DWE, SCA and Lithgow Council. To avoid any confusion, it should be noted that Attachment 2 refers to the DLWC and that DWE replaces any reference to the former DLWC.

Extensive groundwater monitoring has been ongoing on at least a quarterly basis around the ash disposal site since 1985 to characterise the water quality and hydraulic characteristics of the area. The locations of the bores were selected according to the ANZECC (1995) principles of up-gradient and down-gradient bores. The bores were placed inside and adjacent to the ash disposal area for early warning of leachates originating from the ash/brine deposit. In addition , bores have been established further away to allow detection of groundwater movements toward the Groundwater Collection Basin and Neubecks Creek and to monitor background conditions. The location of the bores are shown in Figure 5.

The existing groundwater monitoring program will be continued under the WMP with sampling undertaken every three months at all of the groundwater monitoring boreholes . The parameters monitored in the bores are: water depth before bailing (to Australian Height Datum, AHD), conductivity (calibrated YSI meter), pH, sulphate, chloride and trace elements listed in Attachment 1 that are relevant to the ANZECC (2000) guidelines. As discussed in attachment 1, groundwater bore MPGM4/D5 (Figure 5) is used as the background bore due to its consistent results.

Bores are bailed 24 hours before sampling and if the bore has high recharge it is bailed a minimum of three times the bore volume.

All water quality analyses are undertaken in accordance with DECC approved methods (EPA 2004). Detection limits are set so that accurate measurements can be obtained at a level relevant to specific guidelines. In some cases, this may be as low as 1/10th the guideline concentration.

The results from the sampling, including core samples as required, will be presented in the annual Environmental Monitoring Report (EMR), as set out in the following section describing Data Management and Assessment.

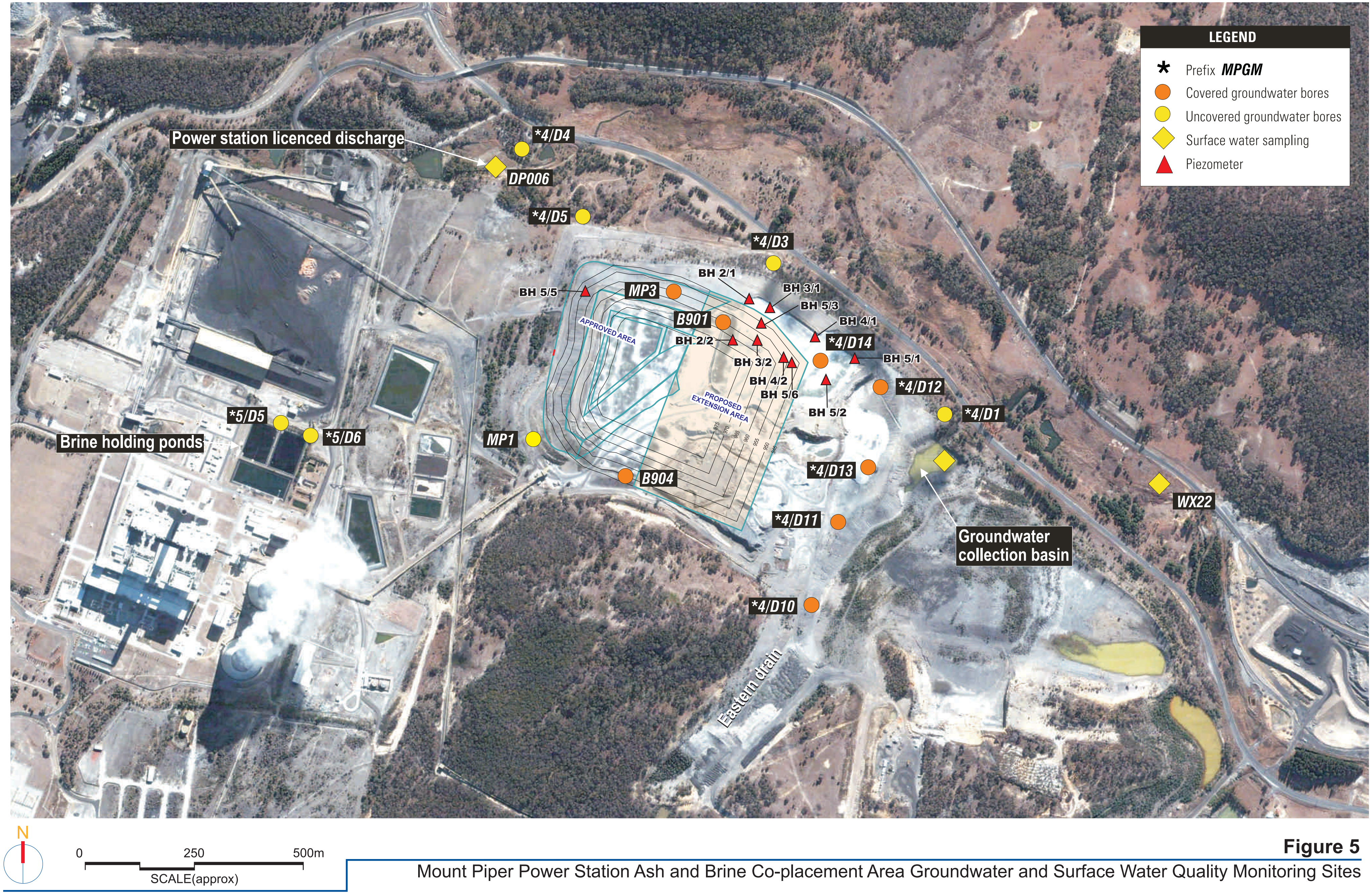

Figure 5

Mount Piper Power Station Ash and Brine Co-placement Area Groundwater and Surface Water Quality Monitoring Sites

4.2.1 Data Management and Assessment

As the data is received from the laboratory it is compared with the existing data base for outliers and exceedence of guideline concentrations. A trace element outlier is defined using the ANZECC (2000) procedure, which is if a data point is equal to, or greater than, three times the standard deviation of the database away from the database mean. If this occurs, the laboratory is requested to repeat the test. If the outlier is above the guideline concentration, an investigation is undertaken to determine if the result is real or due to sample contamination. Such data is not deleted from the database until an investigation of the likely causes of the outlier can recommend that it be deleted.

The water quality data is graphed over time to show trends at the background and receiving water groundwater and surface water monitoring sites. Chloride is used as a tracer for brine leachates because the local area is highly mineralised and it is difficult to distinguish the origin of other trace elements,. The chloride concentration provides an early warning of leaching from the brine conditioned ash deposit. Chloride is also unlikely to undergo chemical alteration in the groundwater.

If concentrations increase above background and approach the relevant local guidelines and it can be reasonably expected to due the brine placement area, when the local mineralisations and background conditions are taken into account, the contingency plan, described in the following sections will be implemented.

4.2.2 Seepage Monitoring

In addition to groundwater bores, vibrating wire piezometers (VWP) have been installed within the ash disposal area to detect rainfall infiltration and seepage, if any, from the brine conditioned flyash deposit. The first VWP will be installed in the extended area after placement of the first layer is completed. The VWP will be sunk to a suitable depth to indicate whether there is seepage from the brine conditioned flyash placement. If the VWP's indicate that seepage is occurring, the sampling frequency of the outside bores will be increased, as required, to provide feedback for management of the brine conditioned flyash placement area. The VWPs will be monitored regularly and leachates analysed for the presence of salts, such as conductivity measurements.

4.2.3 Groundwater Model Verification

The DA conditions (Attachment 4) require that the next Groundwater Modelling Report is to be an update the groundwater modelling presented in the Mount Piper Power Station Extension of Brine Conditioned Ash Placement Area - Statement of Environmental Effects (dated June 2007). The report is also required to use the results and analyses from the water quality monitoring to calibrate the groundwater contaminant transport model.

The contaminant transport modelling undertaken for extension of the existing brine conditioned ash placement area SEE was calibrated using the current water level and water quality database. In order to calibrate the model for the extended area, it will be re-run once sufficient data has been collected after brine conditioned flyash placement has started in the extended area.

The time required to collect sufficient data to do this is uncertain. Modelling suggests it is in the order of 40 years, which is after the life of ash placement. However, calibration could be undertaken once the leachate plume (as indicated by chloride concentrations) reaches the sub-surface drain, below the placed ash, on the bottom of the mine void, or when some significant change in water quality has occurred that may indicate leachates originating from the brine conditioned ash area have reached the groundwater.

4.3 Surface Water

Surface water quality monitoring involves the water quality at the Mt Piper Power Station licensed discharge point (LDP006), in Neubecks Creek at the stream gauging station, site WX22 and the GCB.

The sampling sites are shown in Figure 5. Stream flows are recorded at WX22 by DWE and provided to Mt Piper Power Station when requested. The WX22 site in Neubecks Creek is located downstream of the ash and brine co-placement areas for monitoring of water quality changes relative to the upstream site at LDP006.

Surface water quality monitoring is currently undertaken on a three monthly basis, except at WX22 which has been monthly since October, 2007, and consistent with the requirements of the original April, 2000 Development Consent. This sampling frequency will be maintained at the surface water quality monitoring sites. Characteristics measured and methods used, such as conductivity (calibrated YSI meter), will be consistent with those used for the groundwater bores (see Section 4.2 and Attachment 1). Data management and assessment will continue to be the same as for groundwater data management.

5. Contingency Plans

In the unlikely event that the brine runoff collection dam was to overflow, the water would drain to the dirty water storage dams where it could be pumped back to the brine placement area. The following contingency plans would then be adopted.

In the event that monitoring indicates the contaminant concentrations in the Groundwater Collection Basin void or Neubecks Creek have increased, and are approaching the relevant locally derived ANZECC guideline concentrations, the monitoring results will be examined to determine if:

- the increase can reasonably be expected to be due the brine placement area, when the local mineralisations and background conditions are taken into account, and
- there has been a significant and consistent exceedence of the relevant locally derived ANZECC guideline concentration for any of the water quality characteristics.

Should the review of the data suggest the increase is potentially caused by the brine/ash deposit, the following actions/risk assessments will be undertaken:

- The Groundwater Collection Basin , Neubecks Creek and all the groundwater bores will be re-sampled, as soon as the increase is evident, to determine if the increase is real and to determine the cause. The frequency of sampling will be increased to monthly until the matter is resolved;
- The runoff Brine Dam liner will be re-checked for leaks. Any leaks that are detected will be repaired;
- The integrity of the surface runoff collection systems in the brine conditioned ash placement area, which are regularly checked, will be inspected to ensure runoff has not bypassed the detention pond, sump and dam and repaired, if necessary, as part of site maintenance activities;
- The rate of seepage of leachates from the co-placement area will be regularly monitoring by the vibrating wire piezometers installed in each stage of the brine conditioned ash placement area. The piezometers would be expected to detect seepage well before it reached the mine spoil below;
- If the water quality in the Groundwater Collection Basin is shown to have the potential to affect the water quality in Neubecks Creek, it will be pumped out and sprayed on the ash placement area. Leachates in the vibrating wire piezometers will be checked to determine if this is the cause of changes to the water quality in the Groundwater Collection Basin;
- A groundwater investigation, including modelling, will be undertaken to determine if the cause of the water quality change in the Groundwater Collection Basin is due to brine leachate from the ash/brine deposit;
- The placement of brine conditioned flyash will be temporarily suspended pending the outcome of the above investigations. The brine storage ponds have the capacity to store 40ML of brine. Therefore there is ample time to undertake an investigation (predicted annual brine production is 8 to 16 ML).
- Should the source of contaminant concentrations be identified as the brine/ash deposits, an investigation will be carried out to determine how to overcome the problem;
- The relevant stakeholders (SCA, DWE, Lithgow City Council and DECC) will be notified and involved in discussions on actions needed to rectify the situation. The Department of Planning will be provided with evidence of this consultation process and details of any increase in contaminants and the remediation measures undertaken;
- Once an acceptable solution is devised and approved, co-placement would then recommence, following approval by the relevant Authorities.

Approval for the discharge of brine via the Wollongong sewage treatment plant was previously granted by DUAP, as a contingency to the on site brine/ash placement. Ocean disposal involves trucking the brine to the sewage plant where it is mixed with sewage to give a dilution of about 300 to 1, giving a total dilution of 20,000 times once the sewage and brine are diluted in the ‘mixing zone’ of the ocean outfall.

In the unlikely event that the above situation was to occur when there was inadequate capacity in brine storage ponds, additional temporary storage could be arranged on site or surplus brine could be transported to Wollongong for ocean disposal.

Should leaks be detected from the brine storage ponds, through regular monitoring of the adjacent bores (shown in Figure 5) or as a result of special investigations, the storage of the brine could be transferred to another pond at the Power Station while the defective liner is repaired. Construction of a temporary storage area could also be considered if the adjacent ponds were not suitable for storage.

6. Brine Management Strategies

As far as is practicable, Mount Piper Power station is operated so that the production, handling and storage of the brine is minimised and its management is carried out in a responsible manner.

Several strategies for minimising brine production at Mt Piper Power Station have been investigated. The most effective method is to use a greater proportion of the Fish River water supply allocation and to reduce the use of the more saline Coxs River supply. This has limited brine production, even when the power station was operated at near full capacity. The current prolonged drought has limited access to the Fish River water supply and increased the salinity of the Coxs River supply, so the volume of brine production has increased in recent years. The extended area of brine conditioned ash placement has taken this effect into account for future co-placement requirements.

Other brine reduction strategies being used include recycling of plant wastewater and using cooling tower water to condition ash. The option to discharge brine via at the Wollongong sewage treatment is available as a contingency plan in the event that on site disposal of brine conditioned flyash is interrupted or suspended.

The handling of brine at the site is carried out to prevent any release into the surrounding environment. Brine conditioning of the flyash occurs within the paved power station area, away from the ash disposal area, to prevent any brine or brine contaminated material entering natural waterways. The fly ash conditioning plant area is protected by drainage systems that collects and pumps drainage water to settling basins from where the water is recycled for appropriate uses. The brine conditioned flyash is transported to the designated disposal area by conveyor.

The pump to transport the brine to the ash conditioning plant is located adjacent to the brine holding ponds, and any drainage from the pump area is directed back to the brine ponds. The pipeline is fully welded HDPE and ABS pipe, located above ground to ensure that the possibility of an undetected leak is minimised.

The site layout ensures that any spill of brine is intercepted at the earliest point. The drainage system is backed up by the Mt Piper Final Holding Pond, so that in the unlikely event of leaked brine, it can be collected and pumped back to the water treatment plant.

The brine storage ponds are double lined to minimise the risk of leaks and local groundwater contamination. Groundwater bores have been installed adjacent to the ponds and are monitored quarterly to provide early warning of leaks in the outer liner. The groundwater is monitored for pH, chloride, sulphate, conductivity and total dissolved solids. In addition, trace metals are sampled quarterly to confirm the local guidelines are not exceeded.

During storage of the brine in the holding ponds, some solids settle as the settled material cannot be slurried with the brine for mixing with the fly ash. The material is periodically excavated as required and transported to the ash storage area in sealed trucks, where it is deposited in the brine conditioned ash placement area. The brine sludge is spread in thin layers and covered by a layer of brine conditioned fly ash in the manner described in the “Mount Piper Power Station Brine Conditioned Flyash Co-placement - Statement of Environmental Effects” (PPI 1999). These solids will continue to be spread in a thin layer in the designated brine conditioned flyash disposal area as necessary.

7. References

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Attachment 1

Table 1. Existing Surface and Groundwater Quality in and Near the Ash Disposal Area

Element	Ash Disposal Area		Background **	Neubecks Creek ***	ANZECC (2000) Guidelines #	
(mg/L)	B901 and MPGM4/D12	GCB	MPGM4/D5	WX22	Groundwater	Freshwater
Al	14.05	-	-	-		0.055
Ag	0.001	0.00067	0.001	<0.001	0.00005	0.00005
ALK	68	132	42	54		
As	0.008	0.001	0.001	0.001	0.024	0.024
B	1.84	0.790	0.151	0.049	0.37	0.370
Ba	0.022	0.025	0.022	0.026	0.7	0.7+++
Be	0.002	0.001	0.001	0.001	0.100	0.100
Cd	0.016	0.001	0.001	0.001	0.002	0.001
Cl	28	38	27	19	350	350+
COND (uS/cm)	1370	1499	1117	316	2600^	2200
Cr	0.001	0.001	0.003	0.001	0.005	0.001
Cu	0.011	0.001	0.002	0.001	0.005	0.0025
F	2.37	0.095	0.175	0.246	1.5	1.5+++
Fe-filtered	13.12	0.163	56.3	0.089	**0.664**	0.3+++
Hg	0.000113	0.000120	<0.00012	0.00017	0.00006	0.00006
Mn-filtered	7.47	4.29	8.41	0.575	**5.704**	1.900
Mo	0.002	0.003	0.003	0.003	0.01	0.01+
NFR	99	-	-			10.0
Ni	1.483	0.356	0.083	0.013	**0.5509**	0.017
Pb	0.003	0.001	0.004	0.001	0.005	0.005
pH	6.2	7.3	6.0	7.1	6.5-8.0	6.5-8.0
Se	0.002	0.001	0.001	0.001	0.005	0.005
SO4	753	762	586	90	1000	1000++
TDS	1232	1216	910	220	2000	1500^
Zn	1.050	0.077	0.085	0.061	**0.908**	**0.116**

* average of bores B901and MPGM4/D12 in ash placement area
** bore MPGM4/D5 upgradient of ash disposal area and between ash disposal area and Neubecks Creek
^ 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 (**shown in bold**) – 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: Chromium is for CrVI only and not adjusted for hardness
\+ Irrigation water moderately tolerant crops; irrigation. Note: Molybdenum drinking is 0.05 mg/L
++ Livestock
+++ Drinking water

Attachment 2

Modification of the Mt Piper Power Station Development Consent to allow Brine Conditioned Ash Placement in the Ash Placement Area, 3rd April, 2000

NOTICE OF AMENDMENT OF A DEVELOPMENT CONSENT GRANTED UNDER SECTION 101 OF THE UNAMENDED ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979 PURSUANT TO SECTION 96(2) OF THE AMENDED ACT.

I, the Minister for Urban Affairs and Planning, pursuant to Section 96(2) of the amended Environmental Planning and Assessment Act 1979, modify the development consent referred to in Schedule 1 in the manner set out in Schedule 2 (S90/01696).

Andrew Refshauge MP
Deputy Premier
Minister for Urban Affairs and Planning
Minister for Aboriginal Affairs
Minister for Housing

Sydney, 3 April 2000

ABBREVIATIONS AND INTERPRETATION

The Director-General	Director-General of the Department of Urban Affairs and Planning
The Council	Lithgow City Council
The Applicant	Delta Electricity
DLWC	Department of Land and Water Conservation
EPA	New South Wales Environment Protection Authority
SCA	Sydney Catchment Authority
The Site	Mount Piper Power Station
Relevant Authority	EPA, DLWC or SCA

SCHEDULE 1

Development consent granted by the Minister for Planning and Environment on 1 April 1982, in respect of a development application made by the Applicant, the Electricity Commission of New South Wales, to the Greater Lithgow City Council for construction and operation of a power station known as the Mount Piper Power Station, as modified on 18 March 1991 and 21 June 1996 and 18 January 1999.

SCHEDULE 2

Delete Condition 34 of the development consent.

Renumber Condition 38 as Condition 49.

Insert the following Conditions 38 to 48, inclusive.

38) The Applicant shall carry out modifications to the development generally in accordance with the Statement of Environmental Effects (SEE) dated August 1999, prepared by Environmental Services, Pacific Power International for Delta Electricity, and as modified by the following conditions. Any alteration, variation or extension of the development shall require the further consent of the Minister for Urban Affairs and Planning.

39) The Applicant shall, prior to the first placement of brine-conditioned flyash, apply to the EPA for a modification to the EPA licence for the Site. The licence modification shall address conditions for the continued on-site storage of brine, the placement of brine-conditioned flyash, and any reasonable requirements of the EPA.

WATER MONITORING PROGRAMS

40) The Applicant shall, at least one month prior to the first placement of brine-conditioned flyash, consult with the EPA, DLWC and SCA to establish the requirements for Water Monitoring Programs for groundwater and surface water. The Water Monitoring Programs shall:

(i) be based on the monitoring programs presented in the Statement of Environmental Effects for this modification;
(ii) include water quality testing at a minimum frequency of every three months;
(iii) be at the expense of the Applicant.

41) The Applicant shall expand the groundwater and surface water monitoring programs, including, if so required, the establishment of additional groundwater monitoring bores and surface water sampling points, in accordance with any reasonable requirements of the EPA, DLWC or SCA.

42) The Applicant shall, prior to the construction or operation of any monitoring bore on or in the vicinity of the development, consult with DLWC regarding the licensing of any bore on or in the vicinity of the development, under the provisions of the *Water Act 1912*.

WATER MANAGEMENT PLAN

43) At least one month prior to the placement of brine-conditioned flyash, or within such further period as the Director-General may agree, the Applicant shall prepare and submit for the approval of the EPA, the Sydney Catchment Authority, DLWC, Council, and the Director-General, a Water Management Plan (WMP) which shall include, but not be limited to:

a) Details of the monitoring programs for surface water and groundwater required under conditions 40 and 41.
b) Details of measures to be employed to control surface water run-off from the site.

c) Contingency plans for the mitigation of environmental impacts should run-off or leachate from the site be found to be negatively impacting on natural surface water or groundwater.
d) Brine management objectives and strategies, with specific reference to measures aimed at reducing the volume of brine produced at the Mount Piper Power Station.

ENVIRONMENTAL MONITORING REPORT

44) The Applicant shall provide to the Director-General, EPA, DLWC SCA and Council, an Environmental Monitoring Report (EMR) on a yearly basis, with the first EMR to be submitted no later than six months after the first placement of brine-conditioned flyash on-site. The Applicant shall agree to Council making the Environmental Monitoring Reports available on request for public inspection.

45) The Environmental Monitoring Report shall include, but not be limited to:

(a) a summary and discussion of all available results and analyses from Water Monitoring Programs;
(b) a discussion of the aims of the Water Management Plan and to what degree these aims have been attained in the context of results and analyses of the Water Monitoring Programs;
(c) actions taken, or intended to be taken, if any, to mitigate any adverse environmental impacts; and to meet the reasonable requirements of the Director-General, EPA, DLWC, Sydney Catchment Authority or Council.

GROUNDWATER MODELLING

46) The Director-General, EPA, DLWC, SCA or Council may, based on the results and analyses presented in the Environmental Monitoring Report, or any other information that may be reasonably interpreted as indicating significant impacts on the groundwater quality in the vicinity of the Site as a result of the placement of brine-conditioned flyash, request the preparation of a Groundwater Modelling Report.

47) The Groundwater Modelling Report shall be an update of the groundwater modelling presented in the Statement of Environmental Effects for this modification and will employ the results and analyses of the Water Monitoring Programs to calibrate the groundwater contaminant transport model. The Groundwater Modelling Report shall be prepared by a qualified person approved by the Director-General or relevant Authority.

48) The Applicant shall comply with any reasonable requirement of the Director-General, DLWC, EPA, SCA or Council with regard to the content or scope of the Groundwater Modelling Report, or actions to be taken in response to the results of the report.

Attachment 3

Modification of the Development Consent to Increase the Capacity of Mt Piper Power Station
3rd June, 2006

Modification Approval

Section 96(2) of the *Environmental Planning and Assessment Act 1979*

I, the Minister for Planning, pursuant to section 96(2) of the *Environmental Planning and Assessment Act 1979*, modify the development consent referred to in Schedule 1 in the manner set out in Schedule 2.

Frank Sartor MP
Minister for Planning

Sydney 3 June 2006 File No: S90/01696

SCHEDULE 1

Development consent:	granted by the Minister for Planning and Environment on 1 April 1982.
In respect of:	Lot 1 DP 325532, Lot 1 DP 400022, Lot 15 DP 626299, Part Lot 191 DP 629212, Lot 2 DP 702619, Lots 362 and 366 DP 740604, Part Lot 10 and Lots 18, 59, 260 and 261 DP 751636, Part Lot 1 DP 803655, Lots 1-7 and Part Lot 13 DP 804929, Lot 1 DP 813288, Lot 1 DP 816420, Lots 40, 41 and 46-52 DP 827626, Lot 1 DP 829065, Lot 21 DP 832446 and Lot 1 DP 920999.
For the following:	The construction and operation of a power station known as the Mount Piper Power Station
Modification Application:	Modification of the development consent to increase the capacity of the power station in two phases: • initially operating the power station at a capacity factor of up to 90%, to generate up to a nominal capacity of 1400 megawatts; and • undertaking equipment upgrade works or replacements to provide a nominal capacity of 1500 megawatts when operating at a capacity factor of up to 90%.

SCHEDULE 2

The development consent is modified by:

1) **inserting the following immediately after existing condition 49:**

Expansion and Upgrade of the Power Station

50. The Applicant is permitted to upgrade and expand the development in two stages:
   a) stage 1 being the operation of the development at a capacity factor of up to 90%, to generate up to a nominal capacity of 1400 megawatts; and
   b) stage 2 being the implementation of equipment upgrade works or replacements to provide a nominal capacity of 1500 megawatts when operating at a capacity factor of up to 90%.

51. Expansion and upgrade of the development, as defined under condition 50 of this consent shall be undertaken generally in accordance with *Statement of Environmental Effects: Mount Piper Power Station Units 1 and 2 Upgrade*, prepared by Connell Wagner PPI and dated December 2005.

Air Quality Impacts

52. The Applicant shall design, construct, commission, operate and maintain the expanded and upgraded development to ensure that the concentration of each pollutant listed in Table 1 does not exceed the maximum allowable discharge concentration for that pollutant when measured at discharge monitoring point 11 and 12 (as defined under the Environment Protection Licence (No. 766) for the site). For the purpose of monitoring and determining compliance with this condition, "dioxins and furans" shall be polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF), presented as 2,3,7,8-tetrachloro-dibenzo-p-dioxin (TCDD) equivalent and calculated in accordance with the procedures included in Part 4, clause 29 of the *Protection of the Environment Operations (Clean Air) Regulation 2002.*

Table 1 – Maximum Allowable Discharge Concentration Limits (Air)

Pollutant	Maximum Allowable Discharge Concentration Limit	Reference Conditions
Nitrogen dioxide (NO_x) or nitric oxide (NO) or both	1500 mgm^{-3}	dry, 273K, 101.3 kPa, 7% O_2
Sulfuric acid mist (H_2SO_4) or sulfur trioxide (SO_3), or both, as (SO_3)	100 mgm^{-3}	dry, 273K, 101.3 kPa, 7% O_2
Solid particles	50 mgm^{-3}	dry, 273K, 101.3 kPa, 7% O_2
Total fluoride	50 mgm^{-3}	dry, 273K, 101.3 kPa, 7% O_2
Chlorine	200 mgm^{-3}	dry, 273K, 101.3 kPa, 7% O_2
Hydrogen chloride	100 mgm^{-3}	dry, 273K, 101.3 kPa, 7% O_2
Total of Sb, As, Cd, Pb, Hg, Be, Cr, Co, Mn, Ni, Se, Sn and V	1 mgm^{-3}	dry, 273K, 101.3 kPa, 7% O_2
Cadmium	0.2 mgm^{-3}	dry, 273K, 101.3 kPa, 7% O_2
Mercury	0.2 mgm^{-3}	dry, 273K, 101.3 kPa, 7% O_2
Dioxins and furans	0.1 ngm^{-3}	I-TEQ, dry, 273K, 101.3 kPa, 11% O_2
Total volatile organic compounds	40 mgm^{-3} (as VOC) or 125 mgm^{-3} (as CO)	dry, 273K, 101.3 kPa, 7% O_2

53. The Applicant shall determine the pollutant concentrations and emission parameters specified in Table 2 below, at discharge monitoring points 11 and 12 (as defined under the Environment Protection Licence (No. 766) for the site), and employing the sampling

and analysis method specified. Monitoring shall be undertaken at the frequency specified in the Table.

Table 2 –Pollutant and Parameter Monitoring (Air)

Pollutant/ Parameter	Units of Measure	Frequency	Method
Nitrogen oxides	gm^{-3}	continuously	CEM-2
Sulfur dioxide	mgm^{-3}		CEM-2
Solid particles	mgm^{-3}	quarterly during the first 12 months following commissioning of Stage 1 and Stage 2, then annually or as otherwise specified by Environment Protection Licence conditions thereafter	TM-15
Sulfuric acid mist and sulfur trioxide (as SO_3)	mgm^{-3}		TM-3
Chlorine	mgm^{-3}		TM-7 & TM-8
Total fluoride	mgm^{-3}		TM-9
Hydrogen chloride	mgm^{-3}		TM-7 & TM-8
Total of Sb, As, Cd, Pb, Hg, Be, Cr, Co, Mn, Ni, Se, Sn and V	mgm^{-3}		TM-12, TM-13 & TM-14
Cadmium	mgm^{-3}		
Mercury	mgm^{-3}		TM-12, TM-13 & TM-14
Copper	mgm^{-3}		TM-12, TM-13 & TM-14
Dioxins and furans	ngm^{-3}		TM-18
Carbon dioxide	%		TM-24
Oxygen	%		CEM-3
Dry gas density	kgm^{-3}		TM-23
Moisture content	%		TM-22
Molecular weight of stack gases	$gmol^{-1}$		TM-23
Temperature	^{o}C		TM-2
Velocity	ms^{-1}		TM-2
Volumetric flowrate	m^3s^{-1}		TM-2

54. Notwithstanding conditions 52 and 53, nothing in this consent relieves the Applicant from the requirement to comply with the Environment Protection Licence for the site issued under the *Protection of the Environment Operations Act 1997.* In the event that the Environment Protection Licence for the site is modified from time to time to be inconsistent with or more stringent than the requirements of this consent, the requirements of the Licence shall prevail over this consent to the extent of any such inconsistency.

Air Quality Performance Verification

55. Within 90 days of commissioning Stage 2 of the expanded and upgraded development, or as may be directed by the Director-General, and during a period in which the upgraded and expanded development is operating under design loads and normal operating conditions, the Applicant shall undertake a program to confirm the air emission performance of the development and update air quality modelling. The program shall include, but not necessarily be limited to:
    a) point source emission sampling and analysis subject to the requirements listed under condition 54;
    b) an update of the air quality impact assessment presented in *Statement of Environmental Effects: Mount Piper Power Station Units 1 and 2 Upgrade*, prepared by Connell Wagner PPI and dated December 2005, using actual air emission data collected under a). The assessment shall be undertaken strictly in accordance with the methods outlined in *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in New South Wales* (DEC, 2005) and to meet the requirements of the DEC with respect to updating the air quality impact assessment;

c) a comparison of the results of the air quality impact assessment required under b) above, and the predicted air quality impacts detailed in *Statement of Environmental Effects: Mount Piper Power Station Units 1 and 2 Upgrade*, prepared by Connell Wagner PPI and dated December 2005; and

d) a comparison of the results of the air quality impact assessment required under b) above, and the impact assessment criteria detailed in *Approved Methods and Guidance for the Sampling and Analysis of Air Pollutants in New South Wales* (EPA, 2005).

A report providing the results of the program shall be submitted to the Director-General and the DEC with 28 days of completion of the testing required under a).

Construction Environmental Management

56. Prior to the commencement of construction of each Stage of the expanded and upgraded development, the Applicant shall prepare and implement a Construction Environmental Management Protocol to outline environmental management practices and procedures to be followed during the construction of the development. The Protocol(s) shall be prepared in accordance with *Guideline for the Preparation of Environmental Management Plans* (DIPNR 2004) and shall focus on the management of erosion and sedimentation, dust, heavy vehicle movements and noise during the construction works.

Attachment 4

Modification of the Development Consent for Extension of the Existing Brine and Ash Co-placement Area, April, 2008

NSW GOVERNMENT
Department of Planning

Contact: Swati Sharma
Phone: (02) 9228 6221
Fax: (02) 9228 6355
Email: swati.sharma@planning.nsw.gov.au

Our ref: S90/01696

Mr Stephen Saladine
Delta Electricity
350 Boulder Road
PORTLAND NSW 2847

Dear Mr Saladine

Expansion of the Existing Brine and Ash Co-placement Area, Mount Piper Power Station, Lithgow (MOD-77-9-2007-i)

On 23 March 2008, the Executive Director, Major Project Assessments Division of the Department, approved the Modification Application for the expansion of the existing brine and ash co-placement area of the Mount Piper Power Station. I have attached a copy of the Executive Director's approval for your information. The Executive Director's approval can also be viewed on the Department's website under "Notices of Determination" in the "Major Project Assessments" section.

If you are dissatisfied with this decision, section 96(6) of the *Environmental Planning and Assessment Act 1979*, gives you a right to appeal to the Land and Environment Court.

If you have any enquiries about the proposal, please contact Swati Sharma on 9228 6221 or via email at swati.sharma@planning.nsw.gov.au.

Yours sincerely

28/03/08

Scott Jeffries
Director
Major Infrastructure Assessments

Bridge St Office 23-33 Bridge St Sydney NSW 2000 GPO Box 39 Sydney NSW 2001
Telephone (02) 9228 6111 Facsimile (02) 9228 6191 DX 10181 Sydney Stock Exchange
Website www.planning.nsw.gov.au

Modification Approval

Section 96(2) of the *Environmental Planning and Assessment Act 1979*

I, the Executive Director, Major Project Assessments Division of the Department of Planning, in accordance with the Instrument of Delegation issued by the Minister for Planning, on 19 December 2007, pursuant to section 96(2) of the *Environmental Planning and Assessment Act 1979*, modify the development consent referred to in Schedule 1 in the manner set out in Schedule 2.

Chris Wilson
Executive Director
Major Project Assessments
As delegate for the Minister for Planning

Sydney 23 MARCH 2008 File No: S90/01696

SCHEDULE 1

Development consent:	granted by the Minister for Planning and Environment on 1 April 1982.
In respect of:	Lot 1 DP 325532, Lot 1 DP 400022, Lot 15 DP 626299, Part Lot 191 DP 629212, Lot 2 DP 702619, Lots 362 and 366 DP 740604, Part Lot 10 and Lots 18, 59, 260 and 261 DP 751636, Part Lot 1 DP 803655, Lots 1-7 and Part Lot 13 DP 804929, Lot 1 DP 813288, Lot 1 DP 816420, Lots 40, 41 and 46-52 DP 827626, Lot 1 DP 829065, Lot 21 DP 832446 and Lot 1 DP 920999.
For the following:	The construction and operation of a power station known as Mount Piper Power Station
Modification Application:	Modification of the development consent to extend the brine and ash co-placement area.

SCHEDULE 2

The development consent is modified by:

1) Inserting the following conditions immediately after Condition 38

Extension of the Existing Brine and Ash Co-placement Area

38 A Notwithstanding the provisions of Condition No. 38, the brine and ash co-placement area may be extended and shall be undertaken generally in accordance with the *Statement of Environmental Effects: Mount Piper Power Station Extension of Brine Conditioned Ash Placement Area*, prepared by Connell Wagner Pty Ltd and dated June 2007. This includes:

I. The extended area must lie within the existing ash placement area;
II. Co-placement activities in the proposed extended area must use existing facilities and methods;
III. The placement of brine conditioned ash may only occur between the levels of RL 946 metres (the end-point of the water conditioned ash layer) and RL 980 metres.

38 B The groundwater and surface water monitoring programs required by Condition No. 40 and 41 apply to the extension of the brine and ash co-placement area, permitted by Condition 38 A.

38 C The Applicant must update the Water Management Plan (WMP) required by Condition No. 43, and obtain the approval of the Director-General for the update, prior to undertaking any works permitted by Condition No. 38 A. In determining whether to grant approval, the Director-General must consult with the Department of Environment and Climate Change, the Sydney Catchment Authority, the Department of Water and Energy, and Council.

38 D The spray irrigation system of the ash disposal area must be automated to operate when conditions indicate the potential for dust movement to occur, with a manual override function, in order to reduce the likelihood of non-compliant dust emissions from the ash placement area. The implementation of the automated system must occur no later than 30 June 2008 or as otherwise agreed by the Director-General.

2) Replace Condition 47 with the following:

47 The Groundwater Modelling Report shall be an update of the groundwater modelling presented in the *Mount Piper Power Station Extension of Brine Conditioned Ash Placement Area - Statement of Environmental Effects* (dated June 2007). The report must also employ the results and analyses of the Water Monitoring Programs to calibrate the groundwater contaminant transport model. The Groundwater Modelling Report shall be prepared by a qualified person approved by the Director-General or relevant Authority.

Attachment 5:
Bilfinger Berger Services Ash Placement Area - Daily Inspection Record Sheet

ASH PLACEMENT AREA - DAILY INSPECTION RECORD SHEET

Site : MT PIPER

Date:

Inspected by:

Wind Speed, Direction and Temperature						
Wind speed	Nil	Light	Moderate	Strong	Reading	Comment
Windspeed meter reading (km/hr)						
Temperature reading (deg celcius)						
Wind direction						

Irrigation Rates						
Weather Conditions	>25° >20km/hr	15-24° <20km/hr	15° <20km/hr	Pump start time	Pump stop time	Total Irrigation Hrs
Sprinkler hours/day	10	8	6			

Rainfall (mm)			
On the Pad (mm)			
At the crib hut (mm)		Ref APA log	
On the western batter (mm)			

Water Usage (Pumps and meters)					
Pump	*Service area*	*Hours*		*Volume (L)*	*Comment*
Return Water Pump Blue	NA pads				
Return Water Pump Yellow	Brine area				
HP Pump	Bottom ash & haul roads				
HP Pump at silo	To calculate APA use				
Water at the bins	Fly ash moisture content				
Water cart fill point	Gravity				
Water cart fill point	Pump				

Piezometer Readings			
BH2/1:		BH2/2:	
BH3/1:		BH3/2:	
BH4/1:		BH4/2:	
BH5/1:		BH5/2:	

Environmental conditions		
	OK (y/n)	Comment
Bottom ash tipping area		
Emergency pad		
Working pad		
Perimeter drains in place & functioning		
Internal haul road drains		

Brine dam (s)		
Surface water drainage on pads		
Water seepage through bund wall (external perimeter)		
Presence of fugitive dust		
If dust present: how much?		
Which areas dusting up?		
Sprinkler operation		
Number of water carts operating		
Actions - Notes - General		

Attachment 7

Contour maps of the Mt Piper Power Station brine conditioned ash placement areas each year from 2008 to 2016

Figure A7.1 2008 Mt Piper ash placement area contours

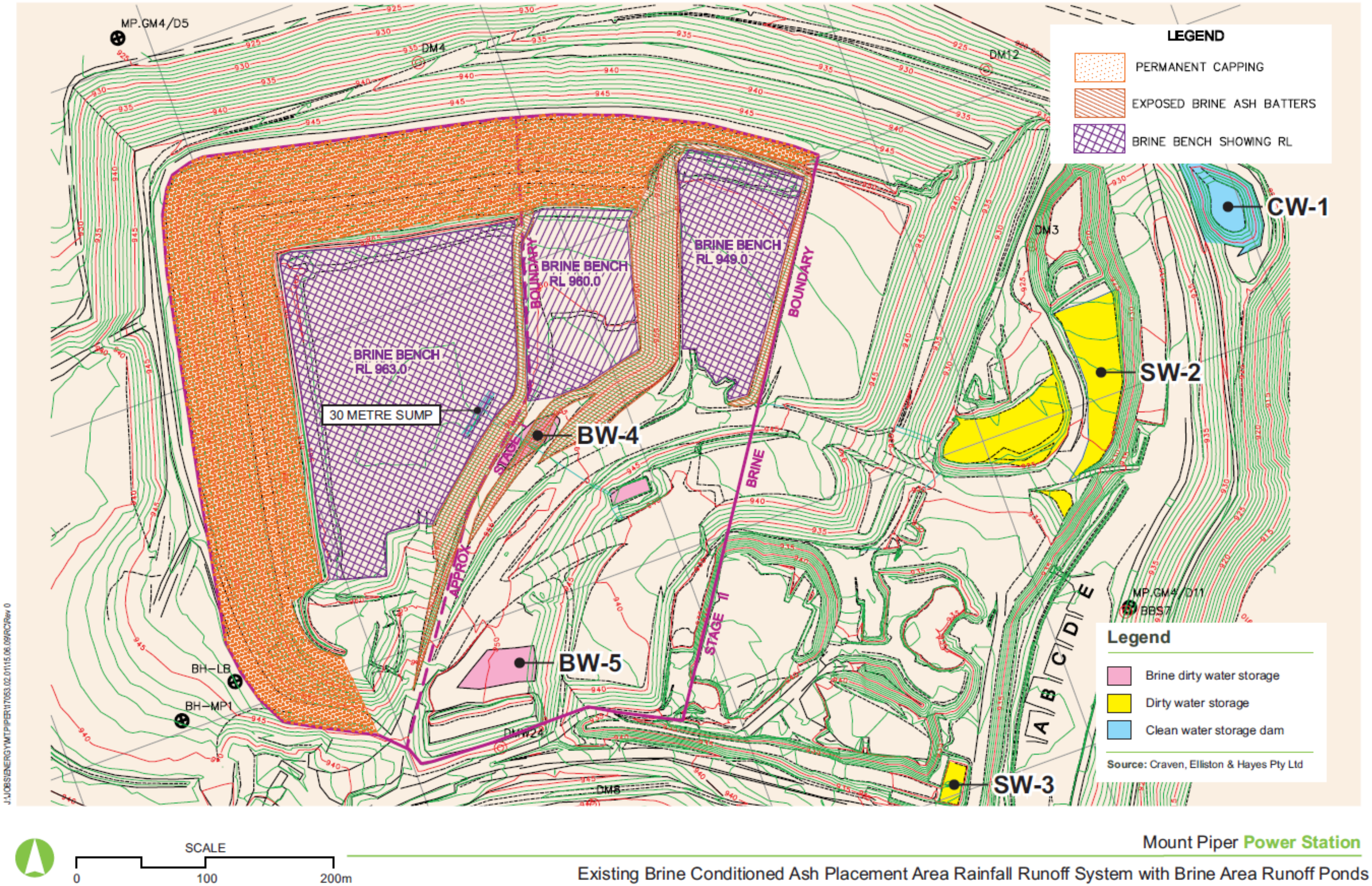
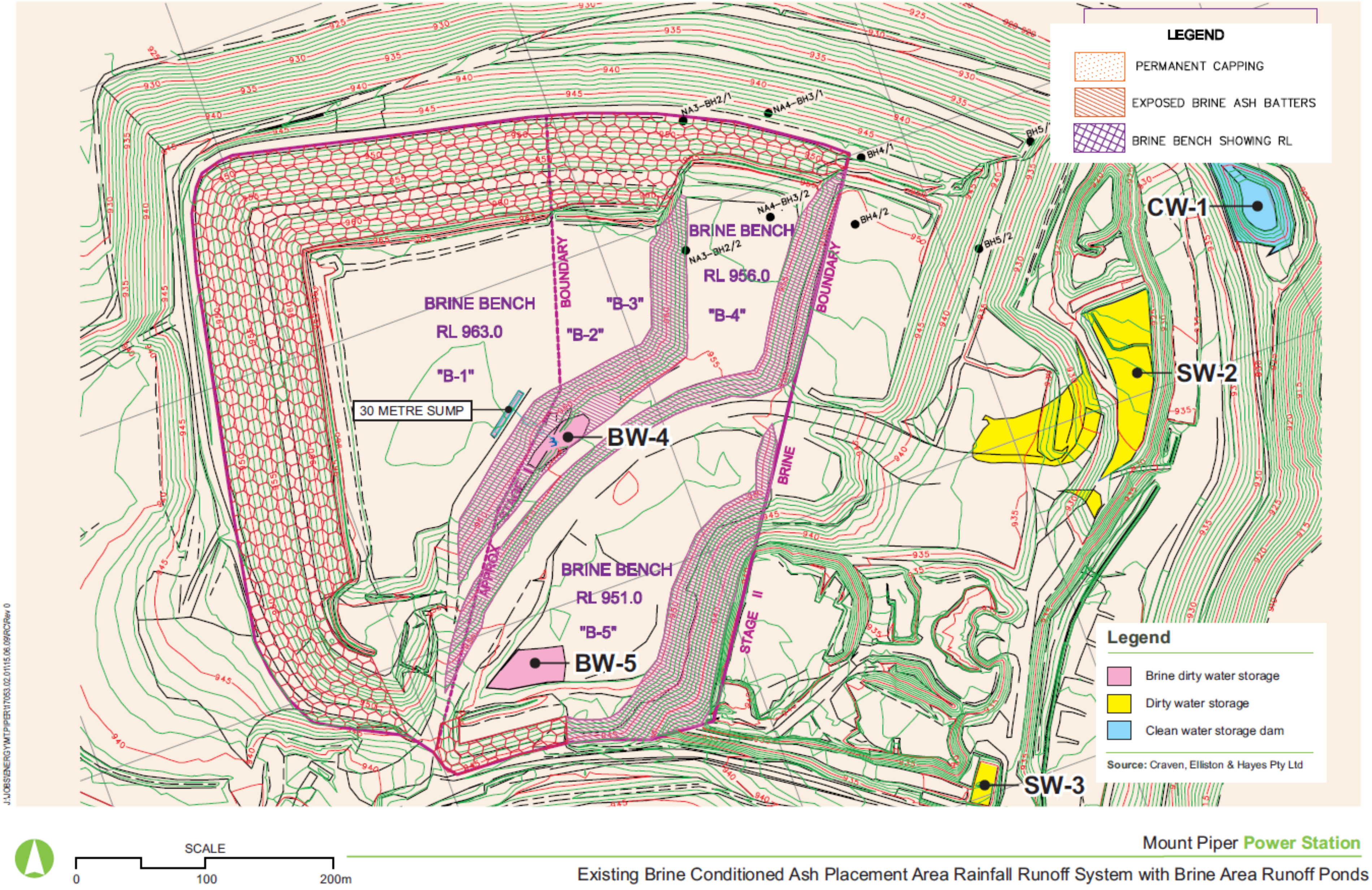


Figure A7.2 2009 Mt Piper ash placement area contours

aurecon



Mount Piper Power Station

Existing Brine Conditioned Ash Placement Area Rainfall Runoff System with Brine Area Runoff Ponds

Figure A7.3 2010 Mt Piper ash placement area contours

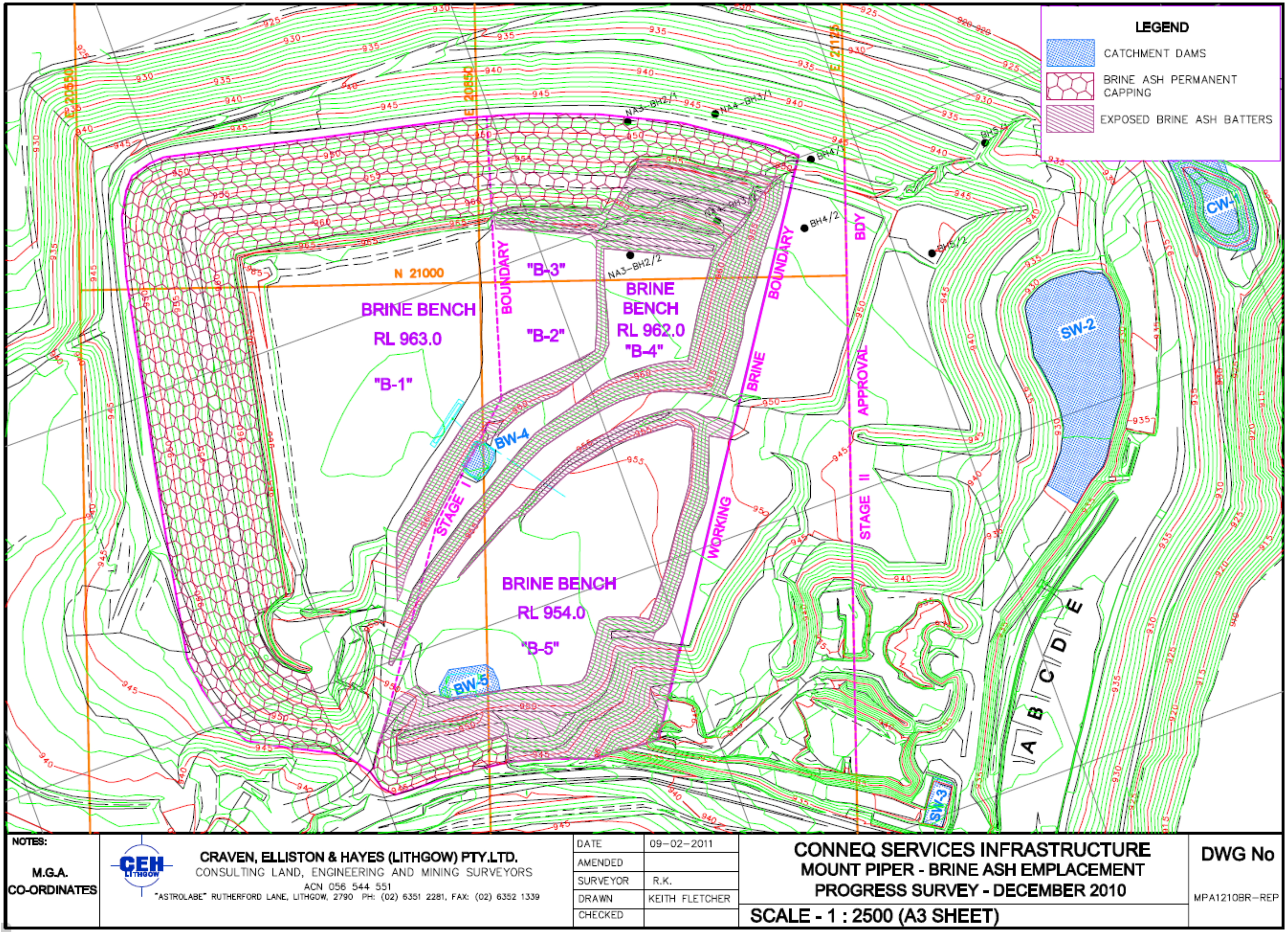


Figure A7.4 2011 Mt Piper ash placement area contours

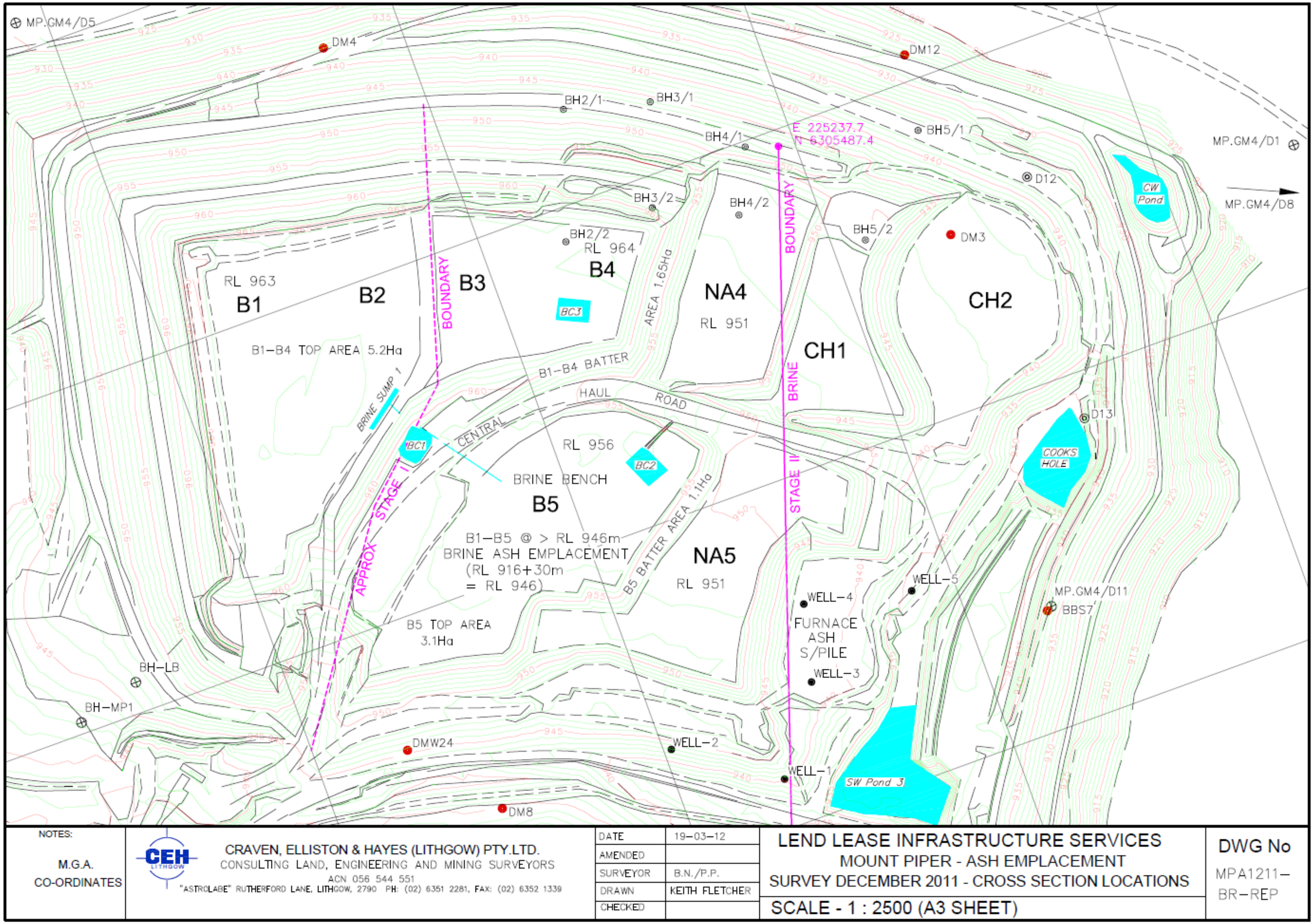


Figure A7.5 2012 Mt Piper ash placement area contours

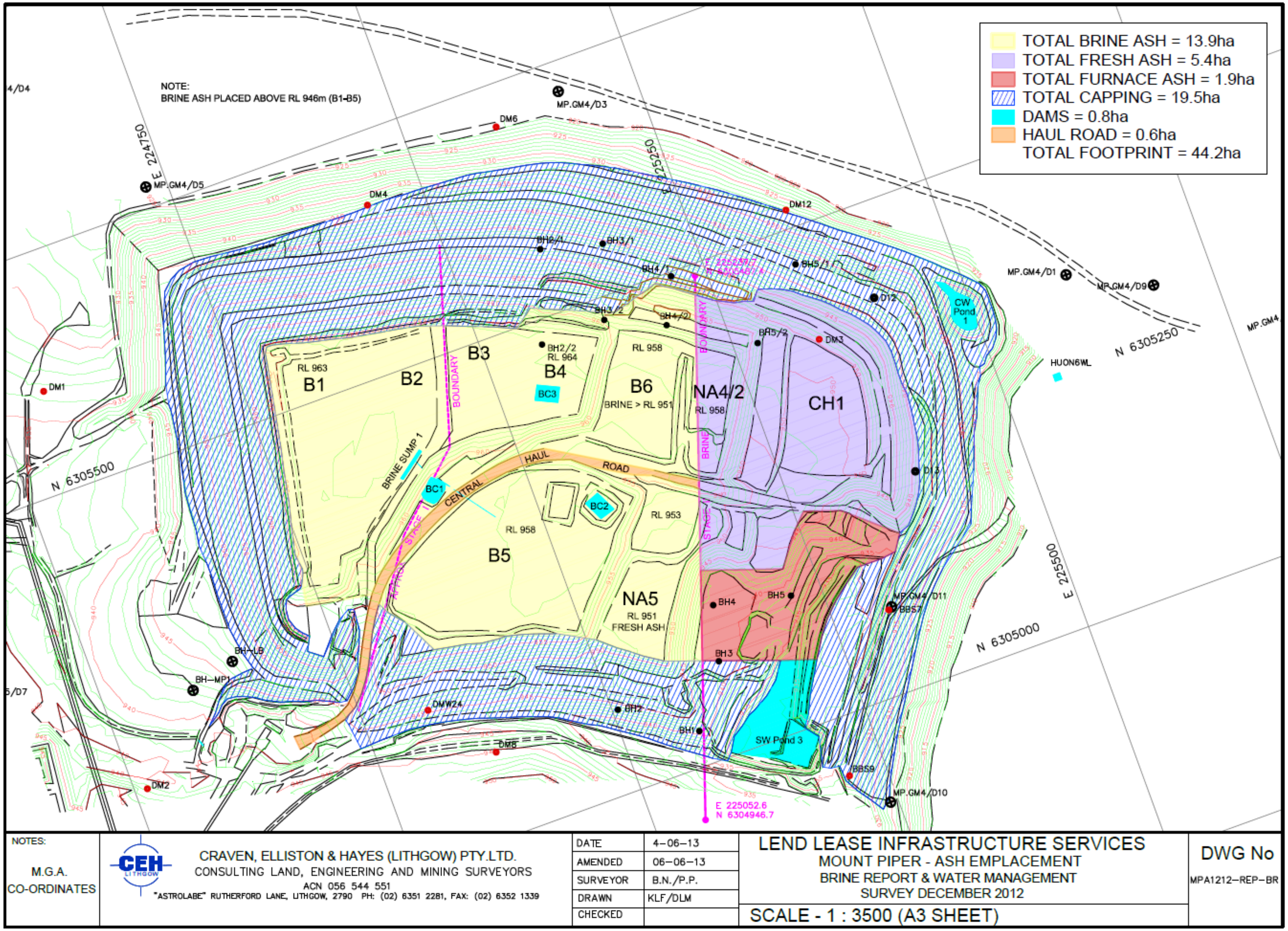


Figure A7.6 2013 Mt Piper ash placement area contours

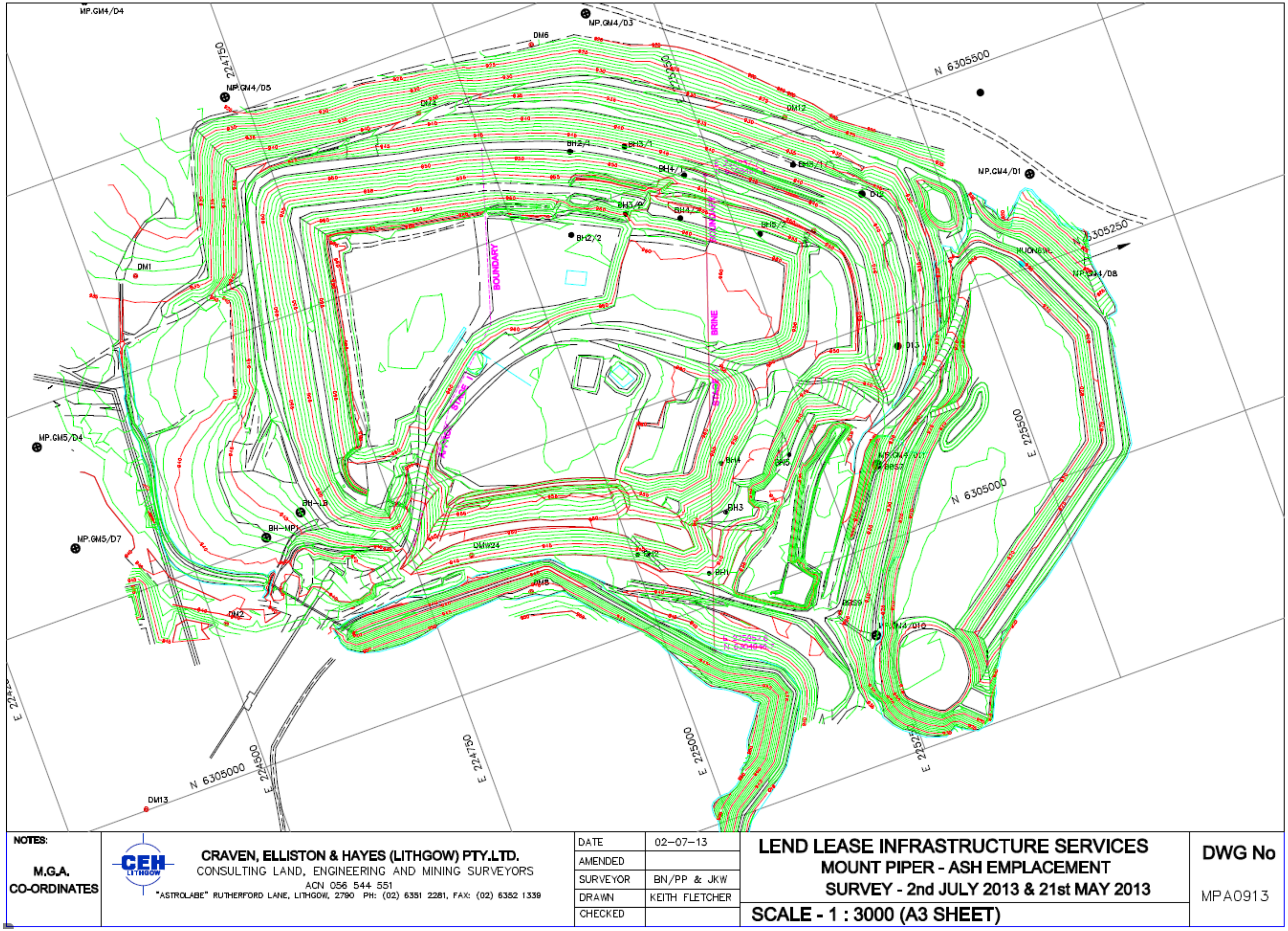
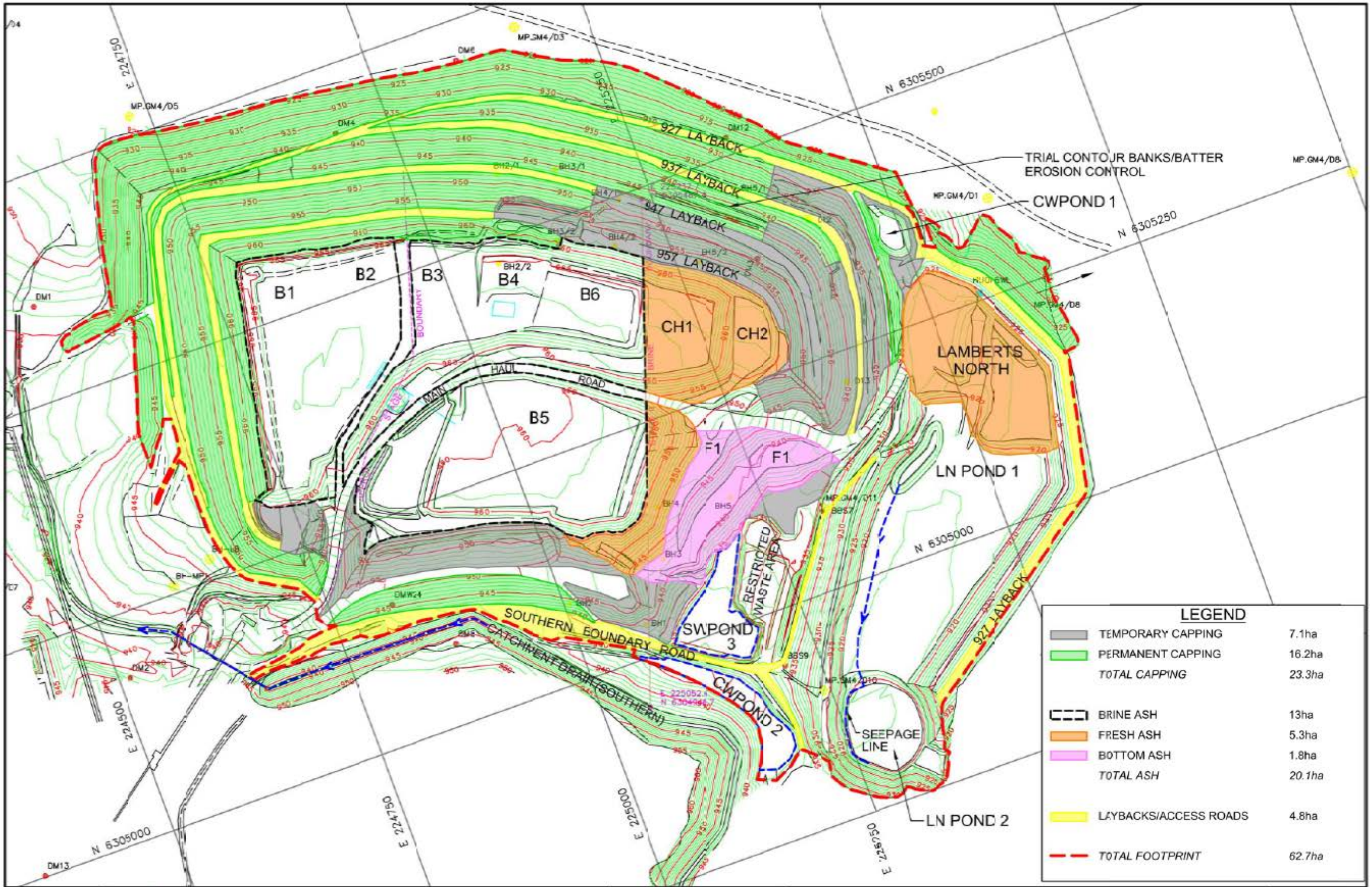
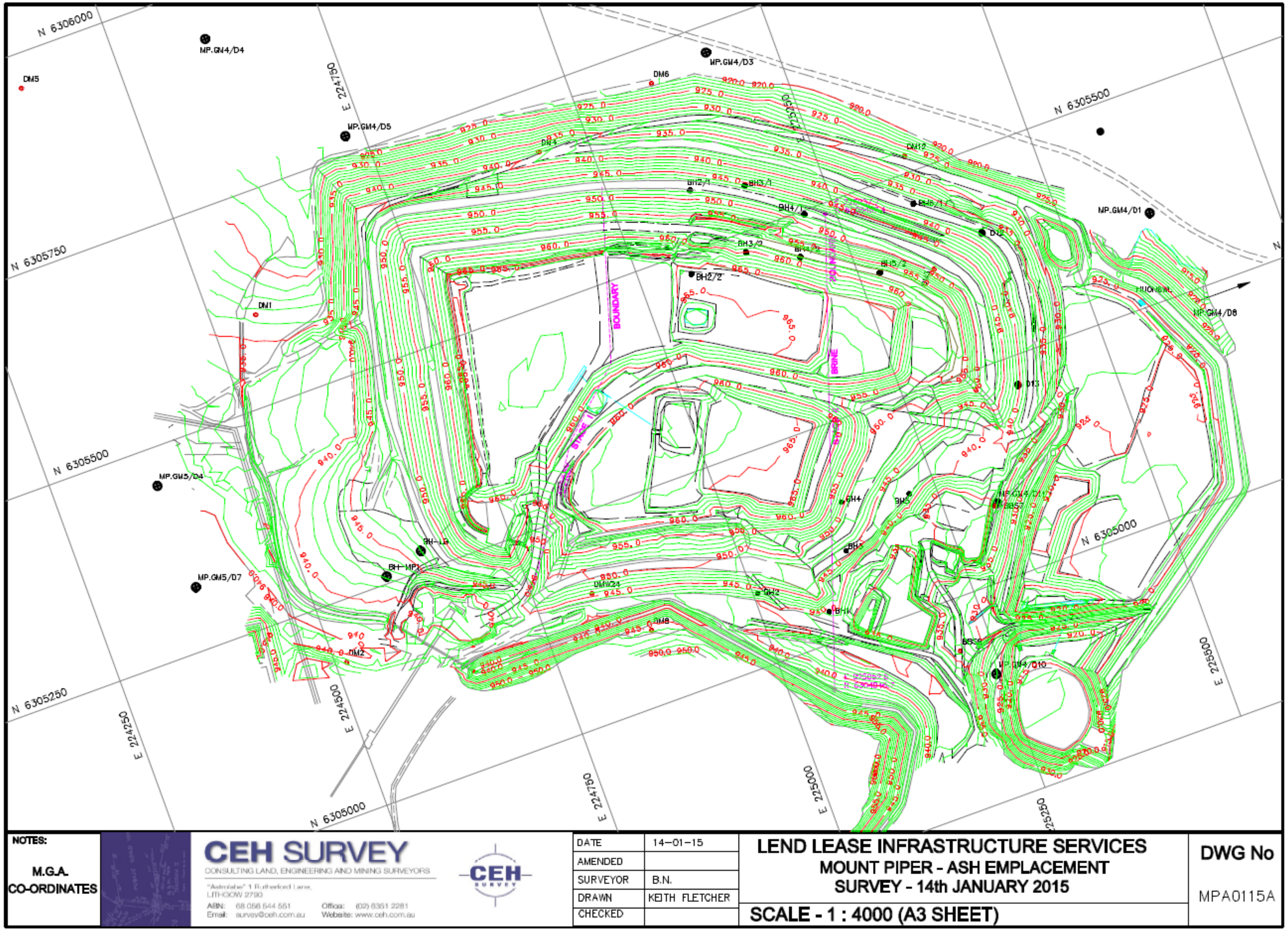


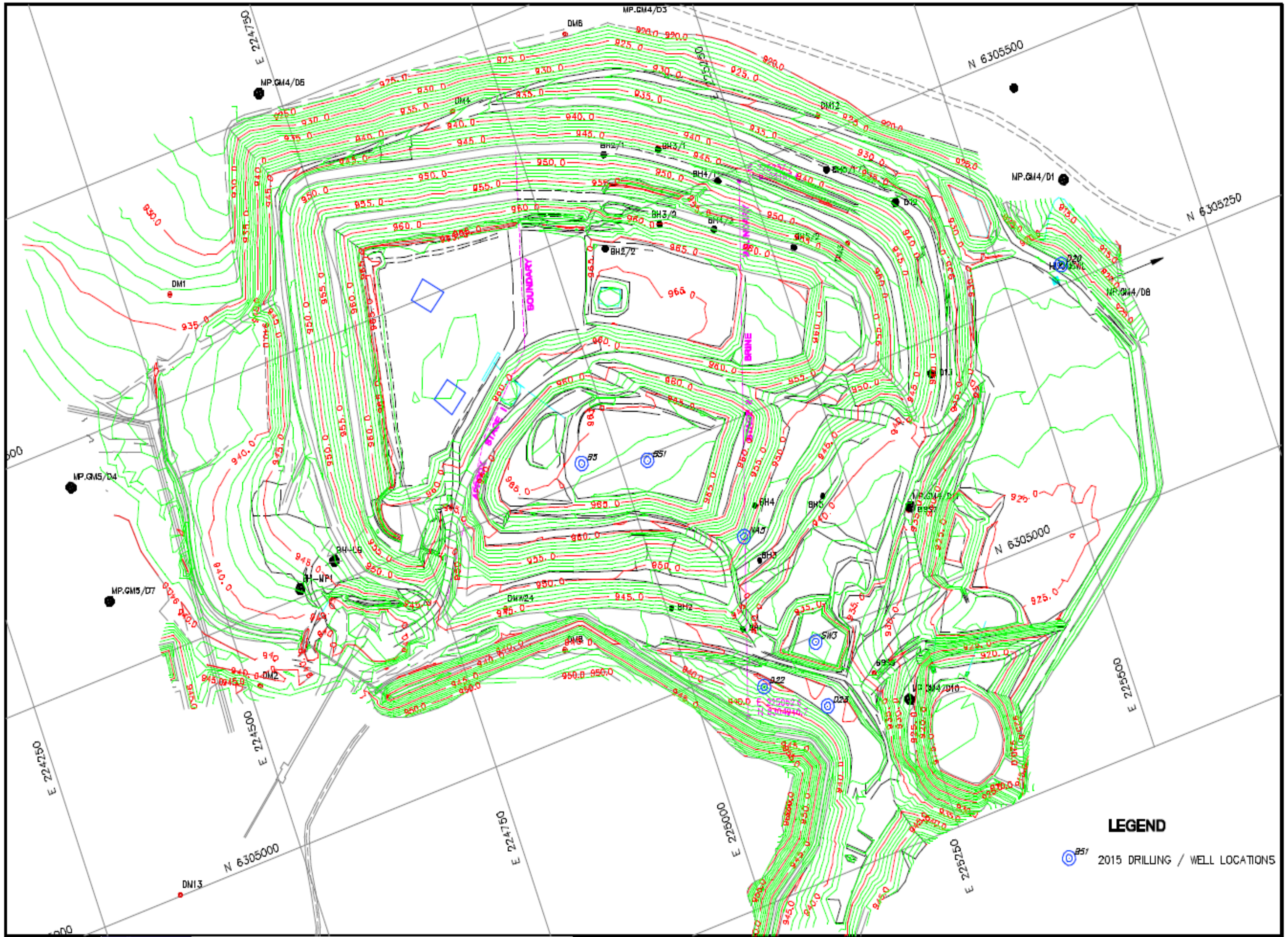
Figure A7.7 2014 Mt Piper ash placement area contours



NOTES:					
M.G.A CO-ORDINATES	CRAVEN, ELLISTON & HAYES (LITHGOW) PTY.LTD. CONSULTING LAND, ENGINEERING AND MINING SURVEYORS ACN 056 544 551 "ASTROLABE" RUTHERFORD LANE, LITHGOW, 2790 PH: (02) 6351 2281 FAX: (02) 6352 1339	DATE	24-03-14	LEND LEASE INFRASTRUCTURE SERVICES MOUNT PIPER - ASH EMPLACEMENT UPDATED SURVEY -17th MARCH 2014	DWG No
		AMENDED			
		SURVEYOR	BH/PP		MPA0314
		DRAWN	KLF/DM		
		CHECKED		SCALE - 1 : 4000 (A3 SHEET)	

Figure A7.8 January, 2015 Mt Piper ash placement area contours





NOTES:

M.G.A. CO-ORDINATES

CEH SURVEY

CONSULTING LAND, ENGINEERING AND MINING SURVEYORS

DATE	18-12-15
AMENDED	
SURVEYOR	B.N.
DRAWN	KEITH FLETCHER
CHECKED	

LEND LEASE SERVICES PTY LTD

MOUNT PIPER - ASH EMPLACEMENT

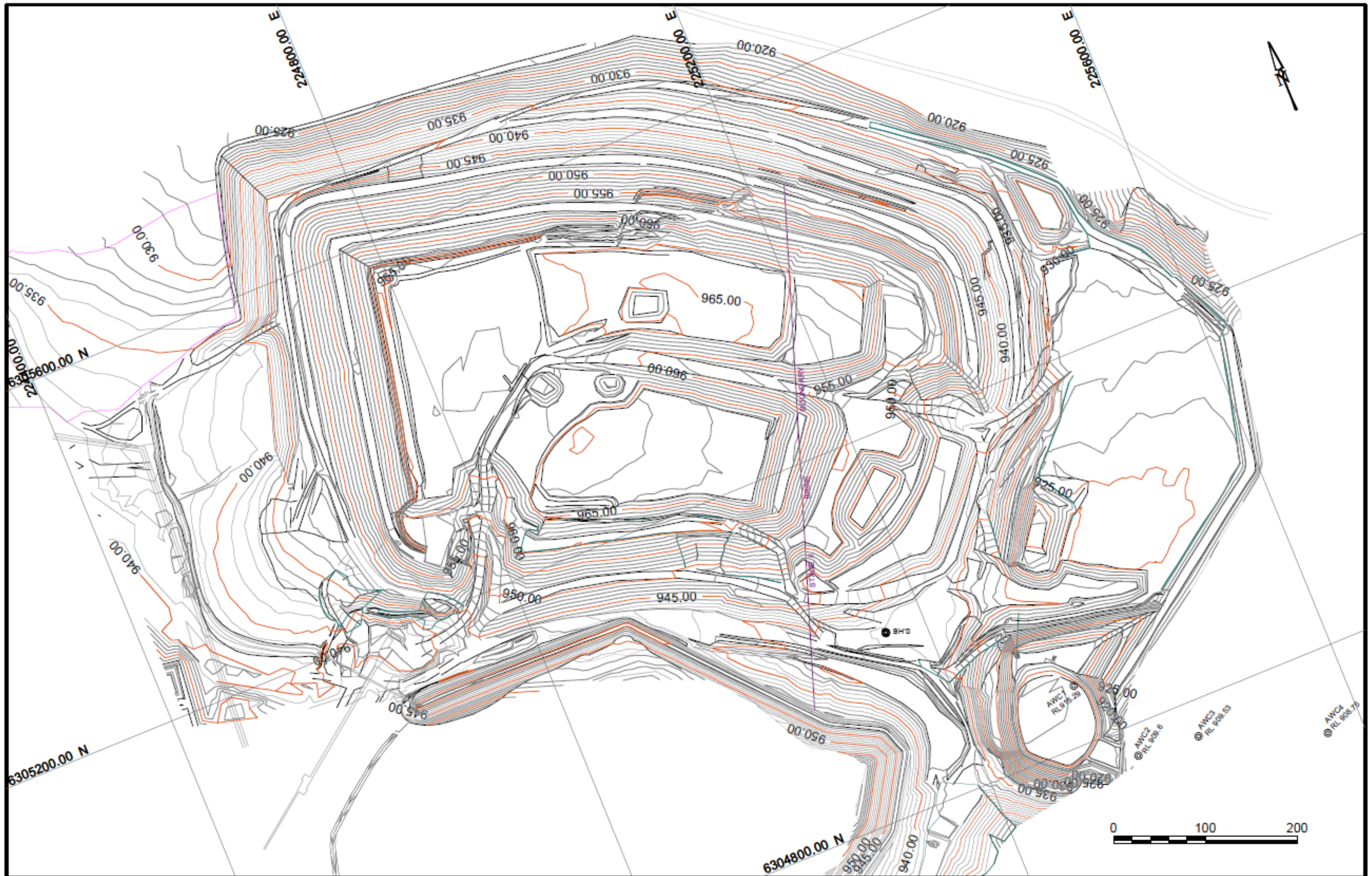
SURVEY : 10th DECEMBER 2015

2015 DRILLING / WELL LOCATIONS

SCALE - 1 : 4000 (A3 SHEET)

DWG No

MPA1215 –BH



NOTES:

CEH SURVEY
CONSULTING LAND, ENGINEERING AND MINING SURVEYORS

"Astrolabe" 1 Rutherford Lane,
LITHGOW 2790
ABN: 68 056 544 551 Office: (02) 6351 2281
Email: survey@ceh.com.au Website: www.ceh.com.au

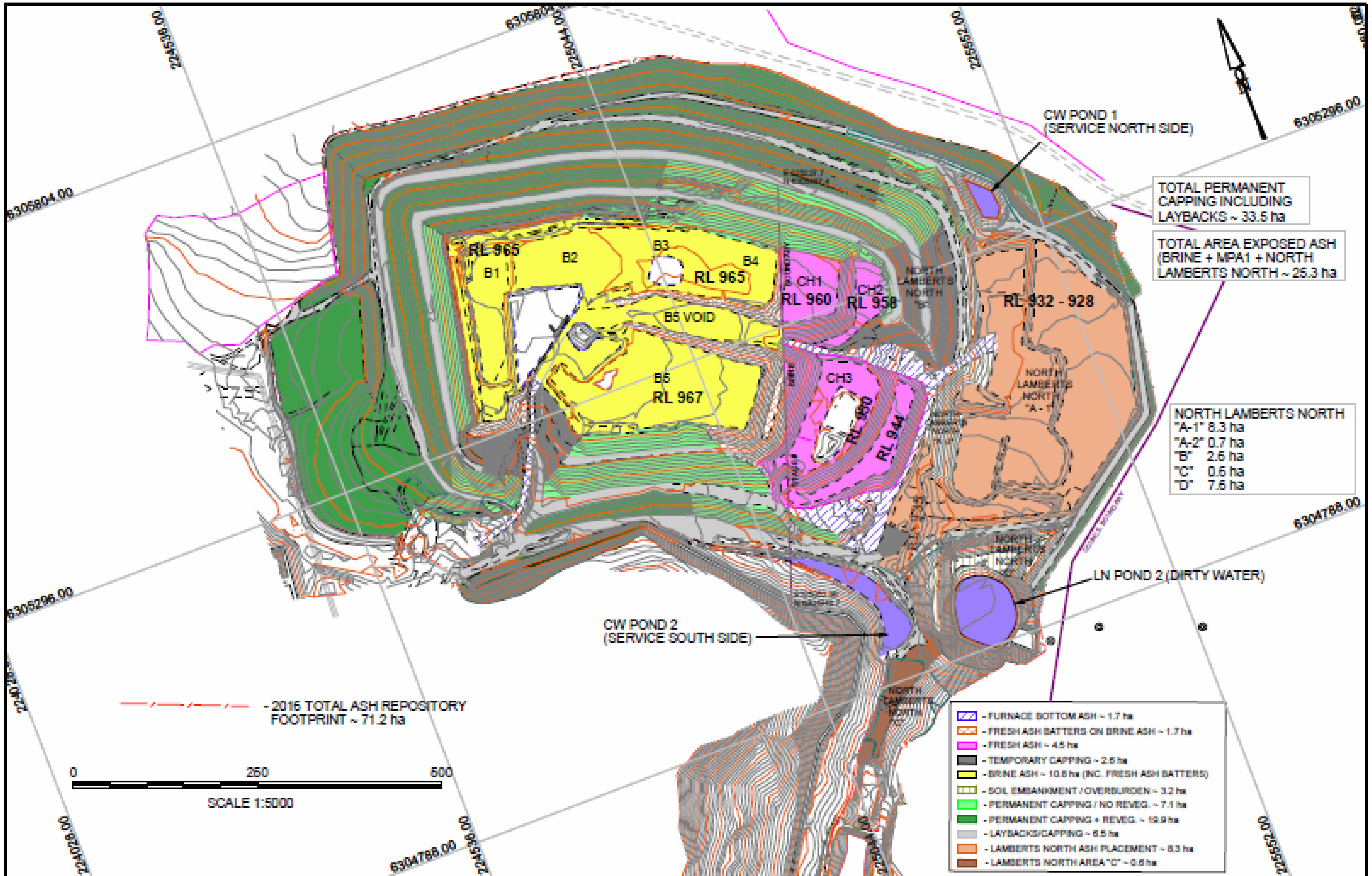
DATE	02/06/2016
AMENDED	09/06/2016
SURVEYOR	BN/RS
DRAWN	G MUIR
CHECKED	

LEND LEASE SERVICES PTY. LTD.
MOUNT PIPER - ASH EMPLACEMENT
SURVEY : 2nd JUNE 2016

SCALE - 1:4000 (A3 SHEET) DATUM: MGA (ZONE 56)

DRAWING No:
MPA0616

CCAD6 JOB & DWG:
MPA0616 - MPA0616



CEH SURVEY
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ABN: 66 066 544 581 Office: (02) 6351 2261
Email: survey@ceh.com.au Website: www.ceh.com.au

DATE	19/12/2016
AMENDED	31/01/2017
SURVEYOR	BN/RS
DRAWN	GM/TH
CHECKED	GM/JA

LEND LEASE SERVICES PTY. LTD
MT PIPER - ASH PLACEMENT PLANNING ZONES
SURVEY FOOTPRINT - 16TH DECEMBER 2016

SCALE - 1:5000 DATUM: MGA 56/AHD

DRAWING No:
MPA PLACEMENT PLANNING AREAS

CCADS JOB & DWG:

Border size = 370mm x 267mm on A3 paper.

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