Dendrobium Mine

Monthly report on water quality sampling for the NSW Dams Safety Committee: **February 2016**

FOR

South32 (Illawarra Coal)

BY

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TABLE OF CONTENTS

LIST OF TABLES

FIGURES

SUMMARY

The Dendrobium Mine is located approximately 65 km southwest of Sydney, New South Wales (NSW), in the Southern Coalfields, and operated by South32 (Illawarra Coal). Longwall mining has occurred at the mine since 2005. South32 is currently mining the Wongawilli Seam in Area 3B, located to the east of Lake Avon, between the Native Dog Creek arm of the Lake and Wongawilli Creek.

NSW Dams Safety Committee (DSC) conditions of approval for Dendrobium Mine require that South32 undertakes routine collection and analysis of water samples from underground workings, monitoring boreholes, surface waters and adjacent flooded mining workings in accordance with the *Avon and Cordeaux Reservoirs DSC Notification Area Management Plan*. This report presents the results for samples collected in January 2016 in the context of previous water quality monitoring at the site. A summary of findings related to the most recent round of sampling is provided below:

DSC Condition	Water source	Sampling points	Results
Entering workings	Goaf	DWS190 (Area 2)	Median EC and Na/Cl ratio for 1 sample of goaf water collected from mining Area 2 in January 2016 falls within the 5^{th} to 95^{th} percentile range for samples in the previous 2 years (Table 4.1). No additional Tritium analyses were obtained in this reporting period. Tritium levels in the 8 most recent samples collected from Mine Area 2 (July and October 2015) are the highest since 2008 with a mean of 0.50 TU (n = 8), and exceed the 95th percentile value for Area 2 goaf waters over the last 2 years (P95 = 0.40 TU).; Figure 4.4
		DWS162B (Area 3B)	Median EC and Na/Cl ratio for 1 goaf water sample collected from mining Area 3B in January 2016 falls within the 5^{th} to 95^{th} percentile range for the previous 2 years (Table 4.1). No adverse or anomalous trends are noted in time-series (Figure 4.2)
	Roof seepage	Not sampled this period	
	Water supply	DWS28A	Median EC and Na/Cl ratio for 1 water supply sample collected from Nebo Mains in January 2016 falls within the 5th to 95th percentile range for the previous 2 years (Table 4.1). No adverse or anomalous trends are noted in time-series (Figure 4.7).
Adjacent workings		Not sampled this period	
Groundwater in overlying strata		Not sampled this period	
Surface water	Lake Cordeaux	Not sampled this period	
	Lake Avon	Not sampled this period	

No new algae analyses are reported for the January 2016 period. Analysis of Algae in water samples collected previously from the Mine Areas 2 and 3A indicates an assemblage of species that are distinct from those in surface water reservoirs. There is a statistically significant difference between nitrogen isotopic compositions of organic particular matter from the goaf samples and in the surface water samples. This is interpreted to indicate that algae in the mine waters are unlikely to have interacted with surface water within the timescales over which adaptation of algal metabolism typically occurs (up to about 1 week).

1 INTRODUCTION

The Dendrobium Mine is located approximately 65 km southwest of Sydney, New South Wales (NSW), in the Southern Coalfields (Figure 1.1). Longwall mining has occurred at the mine since 2005. South32 is currently mining the Wongawilli Seam in Area 3B; workings include development of roadways and longwall extraction. Extraction of Longwalls 9, 10 and 11 in Area 3B has been completed, with Longwall 11 finishing on the 26th of January 2016. Area 3B is located to the east of Lake Avon, between the Native Dog Creek arm of the Lake and Wongawilli Creek and is partially located within the NSW Dams Safety Committee (DSC) Notification Area for Avon Reservoir (DSC Notification Area) (Figure 1.2).

Dendrobium has previously extracted Longwalls 1 and 2 in Area 1 (April 2005 to March 2007), Longwalls 3 to 5 in Area 2 (March 2007 to December 2009), and Longwalls 6 to 8 in Area 3A (February 2010 to December 2012). Areas 1, 2 and 3A are partially located within the DSC Notification Area for Cordeaux Reservoir (Figure 1.2).

As was the case for Areas 1, 2 and 3A, none of the current or proposed Area 3B mine workings underlie any dam wall and no longwall extraction is undertaken below stored waters of Avon or Cordeaux Reservoirs. Longwalls 9 and 10 are outside the Avon DSC Notification Areas and Longwall 11 extends just inside the Area (Figure 1.2). Longwalls 12 to 18 are set back from the Avon Reservoir Full Storage level (FSL) by between 215 m and 300 m. The development headings known as Nebo Mains between Areas 1 and 2 and North West Mains between Areas 2 and 3A pass directly below the stored waters of the Cordeaux Reservoir.

To comply with relevant DSC conditions of approval for Dendrobium Mine, as detailed in the *Avon and Cordeaux Reservoirs DSC Notification Area Management Plan*, South32 undertakes routine collection and analysis of water samples from underground workings, inter-seam boreholes, monitoring boreholes, surface waters and adjacent flooded mining workings. Samples are collected and analysed following the protocols outlined in the *DSC-Dendrobium Water Management Procedure (DENP0048)*.

This monthly report presents the results and data analysis for samples collected in January 2016.

1.1 DSC WATER MONITORING REQUIREMENTS

The DSC requirement for underground water sampling and analysis is provided in Annexure D1, Section III, Condition 3.1:

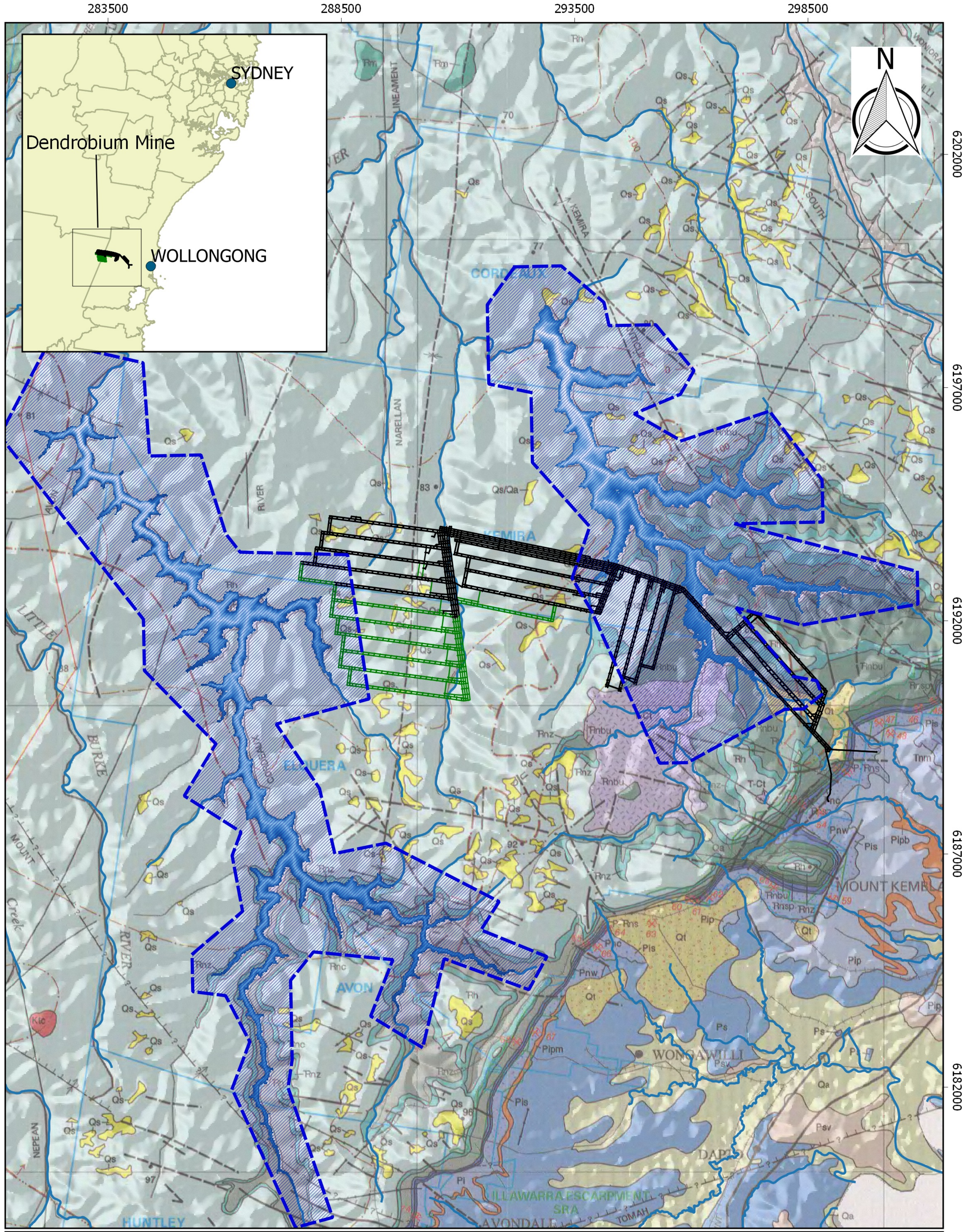
"The company shall undertake a program of sampling and assessment of the properties of water entering the workings, water in adjacent workings, water near any mine portal, groundwater in overlying strata and surface water overlying the workings, in accordance with a plan endorsed by the DSC".

The *DSC – Dendrobium Water Management Procedure (DENP0048)* details the routine periodic sampling of water sources with fingerprinting analysis against known reference sources and reported monthly to the DSC. The characteristics of underground waters are compared to reference surface water samples (Cordeaux Reservoir, Sandy Creek, Kembla Creek and the Upper Cordeaux No.2 Reservoir), rainwater and groundwater in overburden strata (Scarborough, Hawkesbury and Bulgo sandstones). Fingerprinting of discrete water sources using hydrogeochemistry, isotopes, and algae allows for identification and quantification of any surface water or groundwater water reporting to underground workings.

This report addresses the DSC water monitoring reporting requirements, as detailed in Table 1.1.

Table 1.1. Report structure

Chapter	Title
Chapter 2	Provides details of sample locations (underground workings, inter-seam boreholes, monitoring boreholes, surface waters and adjacent flooded mining workings, rain), and water quality analyses
Chapter 3	Previous geochemical investigations - Hydrogeochemical, algal and isotopic fingerprinting of discrete water sources from previous studies/mined areas
Chapter 4	Water chemistry results: presents water chemistry, algae and tritium results from the current monitoring period
Chapter 5	Recommendations for future monitoring rounds based on the latest results.



- Mined Longwalls
- Proposed Longwalls
- Watercourse
- DSC Notification Areas
- Reservoirs

Southern Coalfield 100K Geological Sheet MGAz56

South 32 (Illawarra Coal)
Dendrobium Water Quality Report

Location Map for Dendrobium Mine

GDA 1994 MGA Zone 56
Scale: 1:104,145 @A4

DrawingNo: 1
Rev: 1
Created By: Adam Skorulis
Date: 10/12/2015
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Figure 1.1

2 WATER MONITORING

The *DSC-Dendrobium Water Management Procedure (DENP0048)* details the water sampling and analysis requirements at Dendrobium Mine. The procedure applies to all underground waters that are sampled and analysed for the purposes of identifying their type, and likely origin or sources. It includes sampling protocols, analytical suites, post-sampling treatment, quality assurance/quality control protocols and reporting requirements.

2.1 WATER SOURCES

A number of potential sources exist that may contribute to water in underground workings at the Dendrobium Mine:

- Roof / wall seepage: Water assumed to have seeped into the mine from the coal seam or from immediately surrounding formations (roof seepages and in seam boreholes).
- Stored water pumped from Nebo Colliery old workings used for general (non-hydraulic) uses within Dendrobium Mine.
- Town water pumped from Dendrobium Pit Top for use in hydraulic oil makeup for the longwall chocks. The original source of town water is known to be Lake Avon (Avon Dam Reservoir).
- Stored water from Kemira Colliery old workings adjacent to Dendrobium Mine that can flow through the surrounding strata including coal seams, geological structures and boreholes.
- Stored water from Mt Kembla Colliery old workings lying partly above Dendrobium mine workings that can flow through the surrounding strata including coal seams, geological structures and boreholes.
- Groundwater in overlying strata (Scarborough, Hawkesbury and Bulgo sandstones)
- Surface water including lakes, creeks and dams that may flow over and partly through strata or faults and fissures that might extend from the Dendrobium workings to the surface.

Samples from some sites are a mixture of water derived from more than one source.

2.2 MONITORING NETWORK

Groundwater and surface water monitoring locations are shown in Figure 2.1. Current and historical underground water sampling locations are shown in Figure 2.2 and details are provided in Appendix A. The current monitoring network is listed in Table 2.1.

Table 2.1. Water quality monitoring sites 2016

DSC Condition	Water source	Sampling points 2016 to date	Description	Sites sampled this period	No. of samples
Entering workings	Goaf	DWS190	Area 2 goaf (LWs 3, 4 & 5)	DWS190	1
	Goaf	DWS162B	Area 3B goaf (LWs 9, 10 &11)	DWS162B	1
	Roof seepage		Area 3B roof seepage		1
	Water supply		Town water supply Dendrobium Pit Top and underground hydraulic oil makeup water		
Adjacent workings	Nebo	DWS28A	Stored water pumped from Nebo Colliery for non-hydraulic uses within Dendrobium Mine	DWS28A	1
	Kemira		Recycled water		
Groundwater in overlying strata	Hawkesbury Sandstone		Strata water		
	Bulgo Sandstone		Strata water		
	Scarborough Sandstone		Area 2 Scarborough Sandstone borehole		
Surface water	Lake Cordeaux		Lake Cordeaux Sandy Creek Arm (NE of Area 3A)		
	Lake Avon		Area 3B Lake Avon (Native Dog Creek Arm)		
	Year to date:	**3**	**Total this period:**		**3**

2.3 ANALYTICAL SUITE

The full analytical suite for the Dendrobium monitoring is listed in the *DSC-Dendrobium Water Management Procedure (DENP0048)* and is summarised in Table 2.2.

Table 2.2. Analytical suite

Suite	Analytes
Physiocchemical parameters	Electrical conductivity and pH
Anions	Bromide, chloride, fluoride, iodide, sulphate, silicon
Cations	Calcium, magnesium, sodium, potassium
Dissolved metals	Al, As, B, Ba, Br, Cs, Cu, Fe, I, Li, Mn, Ni, Pb, Se, Sr, Zn
Nitrogen Nutrients	Total Kjeldahl Nitrogen (TKN), Ammonia Nitrogen (NH_3-N), Nitrate/Nitrite, Nitrogen (NOx –N)
DOC	Dissolved organic carbon
Algae	Algal identification and algal count, Seston δ^{15}N, Seston δ^{13}C, Seston Δ^{13}C, Seston C/N mole ratio
Isotopes	Tritium (^{3}H), δ^{13}DIC

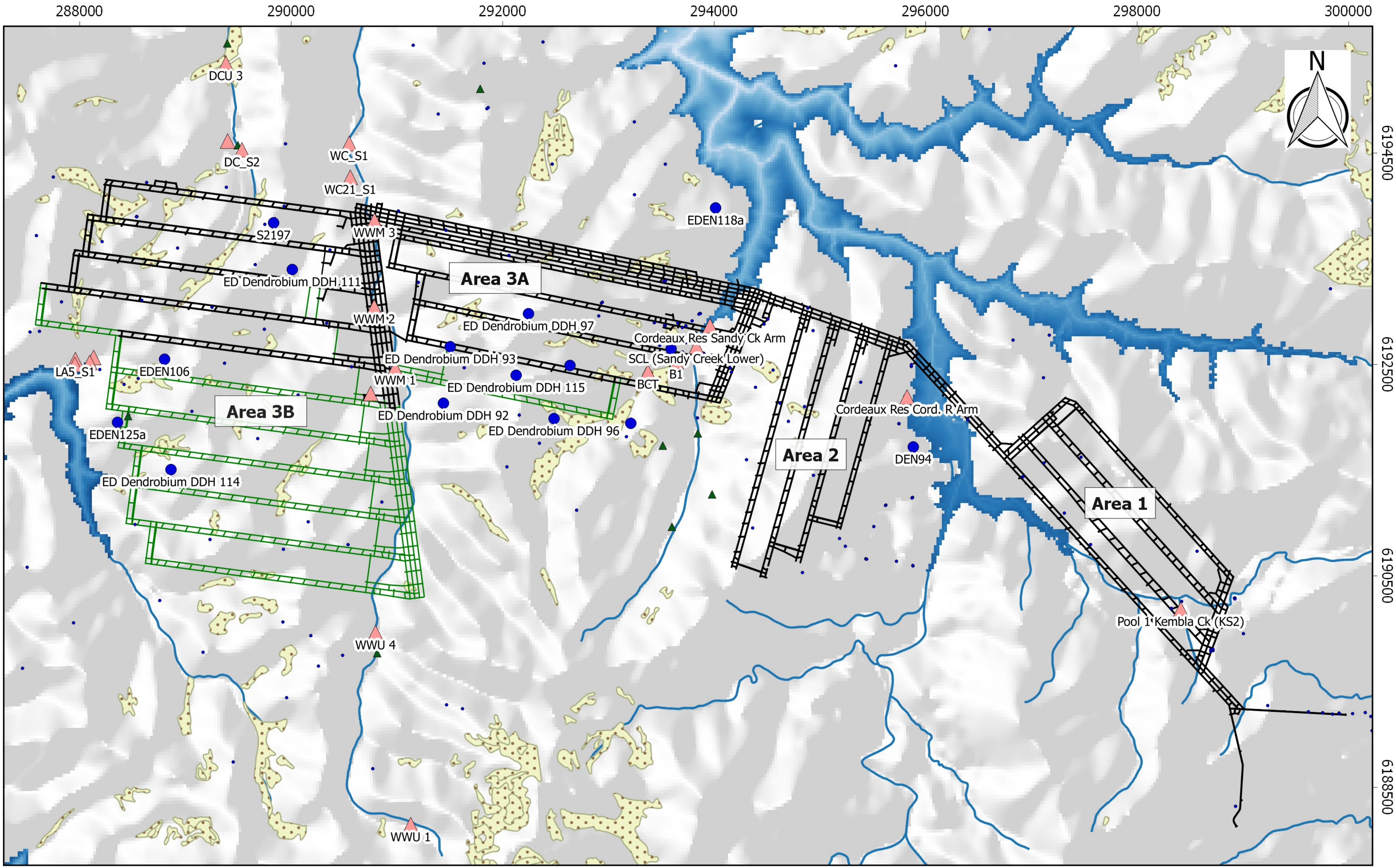
2.4 MINING PROGRESS

The dates for each longwall are provided in Table 2.3 and shown in time-series plots.

Table 2.3. Longwall mining dates

Area	Longwall	Mining start	Mining end
1	1	3 April 2005	11 December 2005
1	2	8 February 2006	22 January 2007
2	3	29 March 2007	15 November 2007
2	4	19 December 2007	2 October 2008
2	5	3 December 2008	18 December 2009
3A	6	9 February 2010	28 March 2011
3A	7	4 May 2011	23 January 2012
3A	8	24 February 2012	29 December 2012
3B	9	9 February 2013	2 June 2014*
3B	10	20 January 2014	20 January 2015
3B	11	18 February 2015	26 January 2016

*Note, for Longwall 9, 2 June 2014 was the final date of extracting equipment. Mining had substantially concluded by 20/1/2014.



HYDROSIMULATIONS

GDA 1994 MGA Zone 56
Scale: 1:47,070 @A4

- Water Quality Monitoring Piezometer
- BHP Bore Database Piezometer
- Surface Water Quality Sample Site
- Surface Water Flow Measurment Site
- Mapped Swamps
- Reservoirs
- Watercourse
- Mined Longwalls
- Proposed Longwalls

Drawing No: 2.1
Revision: 1
Created By: Adam Skorulis
Date: 11/12/2015

South 32 (Illawarra Coal)
Dendrobium Water Quality Report

Surface Water and Groundwater Monitoring Network

Figure 2.1

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Dendrobium Mine
ILLAWARRA COAL
Cordeaux Road Mount Kembla NSW 2526 Australia
ABN 85 098 744 088
SOUTH32

	Name	Date
DRN	D.Baker	15/10/15
REV		
APP		
SCALE	A0	N.T.S

Title **Figure 2.2. Dendrobium Water Sampling Sites**

DRAWING NUMBER DEN-01-3833

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3 PREVIOUS GEOCHEMICAL STUDIES

Monthly geochemical sampling has been carried out since 2005. Data has been reported for each mine area (Area 1, 2, 3A and 3B) on a monthly basis to the NSW Dams Safety Committee. The sampling is focused on analytes that are useful for fingerprinting discrete water sources and identifying potential ingress of low salinity surface waters (rainfall, storage water from Lake Cordeaux or Lake Avon, or creeks) into underground workings.

A summary of major findings of previous investigations is provided below. Time series plots for key water quality indicators are provided in Figure 4.1 to Figure 4.10 for reference.

3.1 WATER CHEMISTRY

More than 2,700 water samples have been collected and analysed at Dendrobium Mine since 2004, providing an extensive database with which to assess mine water chemistry against baseline surface water chemistry. The data have allowed water sources to be uniquely characterised or “fingerprinted” (see below) and characteristic trends to be identified.

In general, the chemistry of mine seepage has been shown to be consistent with water sourced from the Wongawilli Coal Seam and adjacent shales. In addition, the salinity of groundwater seepage to the mine tends to increase during the goafing process as a consequence of ongoing fluid rock interaction with freshly fractured surfaces in and above the goaf (Parsons Brinckerhoff, 2012; Ziegler and Middleton, 2011). In contrast, ingress of water from surface water sources would be identified by temporal and/or spatial trends towards lower salinity waters.

3.1.1 TRITIUM

Tritium (^{3}H) is a short-lived isotope of hydrogen with a half-life of 12.43 years. It is directly incorporated into the water molecule ($^{1}H^{3}HO$ or ^{1}HTO) and so is the only radioisotope that directly dates groundwater (rather than a dissolved constituent). It is commonly used to identify the presence of modern recharge. Tritium is produced naturally in small amounts from the interaction of cosmic radiation with atmospheric oxygen and nitrogen in the troposphere. However, tritium was also produced by thermonuclear bomb testing in the 1950s and 1960s. The concentration of tritium in Australian precipitation reached a maximum level of 160 TU in 1960, during one of the most intense periods of nuclear testing, but has declined to around 1.5 to 3 TU since that time.

Surface waters

Tritium has been analysed for precipitation, and surface waters from Lake Avon and Lake Cordeaux. The average tritium results to date are summarised in Table 3.1:

Table 3.1. Tritium in surface water and rainfall

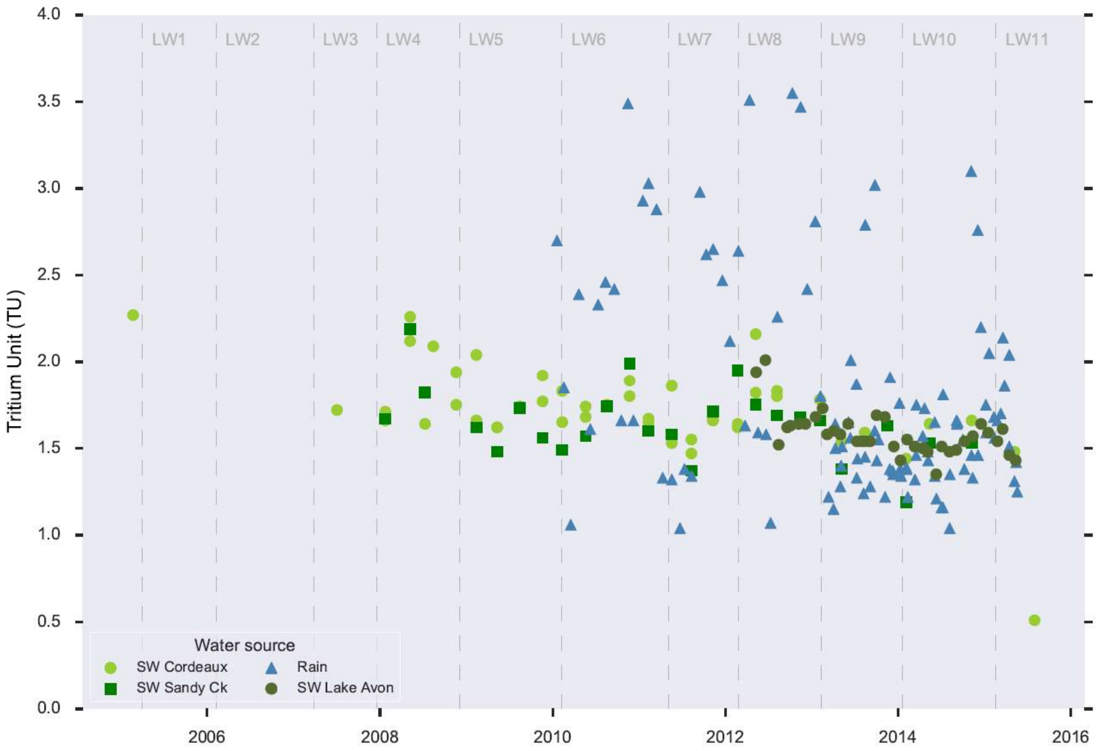
Site	Source	Tritium (TU) mean	Standard deviation	Number of samples
Area 3 Centroid	Rain (Area 3)	2.13	0.74	59
DCU3	Rain (Area 3A)	1.50	0.15	26
WC_S1	Rain (Area 3B)	1.43	0.28	25
DWS80	Lake Avon	1.58	0.13	36
LC_CR	Lake Cordeaux (Cordeaux River Arm)	1.79	0.22	24

LC_SC	Lake Cordeaux (Sandy Creek Arm)	1.65	0.27	29
SCL	Sandy Creek (Lower)	1.64	0.20	26

The tritium values for Lake Cordeaux, Lake Avon and Sandy Creek are not statistically different from each other; nor are they statistically different from mean rainfall across the area. The scatter in tritium values (as indicated by the standard deviation) from rainfall is greater than for surface water samples reflecting the temporal variability in local atmospheric concentrations and the mixing (averaging) of tritium in the streams and reservoirs.

A slight declining trend is evident from monitoring of surface waters near Dendrobium, which probably reflects the declining levels in atmospheric tritium and runoff over time (Figure 3.1). Rain and surface water tritium data provide background values with which to identify any ingress of modern water into underground workings (while noting the wide range in rainfall values).

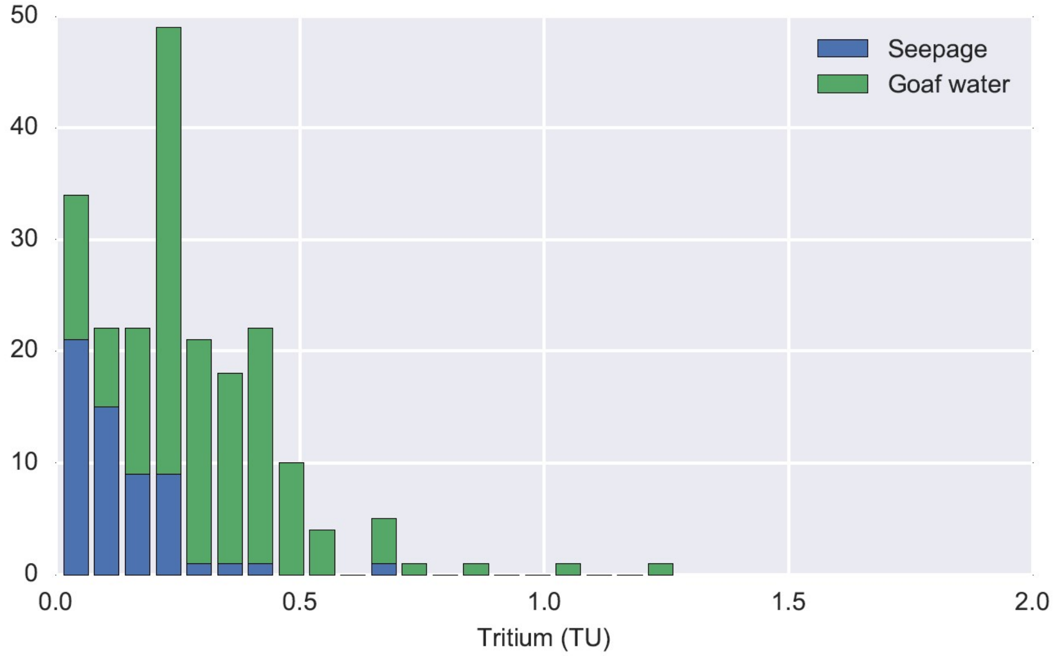
Figure 3.1. Tritium in surface water and rainfall over time



Mine inflow

Tritium concentrations in mine water are typically low (<0.3 TU), consistent with a negligible proportion of surface water entering the mine workings. Samples that are identified as direct mine seepage tend to have lower tritium concentrations that general goaf water samples which can contain water from a mixture of sources including surface water supplies (Figure 3.2)

Figure 3.2. Tritium in mine inflow samples (excluding water supply)



3.2 GROUNDWATER FINGERPRINTING

Background and operational water quality monitoring carried out to date has shown a number of dissolved constituents that are useful in discriminating or “fingerprinting” waters derived from different sources. The most characteristic are:

- **Tritium** (indicating the average time elapsed since the water fell as rain)
- **Electrical Conductivity** (EC, an indicator of salinity or total dissolved salts)
- **Na/Cl ratio** (an indicator of sodium enrichment as a function of aquifer processes)
- **Si** (dissolved silica derived from weathering of silicate minerals)
- **Li, Ba, Sr** (Minor ions liberated during silicate weathering)

Of these, tritium, EC and Na/Cl are identified as the most useful indicators for routine monitoring and reporting. Tritium specifically identifies waters derived from rain within the last ~50 to 70 years (or mixing with a young source). However, groundwater samples from Bulgo Sandstone and Hawkesbury Sandstone can contain elevated tritium levels indicative of relatively recent recharge, and therefore elevated tritium levels in mine inflow cannot be uniquely attributed to a direct surface water source.

EC and Na/Cl are analysed routinely for many sites and each shows a significant difference in composition between surface waters and mine waters (one to two orders of magnitude), making them sensitive indicators. This is illustrated in the bivariate plots in Figure 3.3 and Figure 3.4.

Figure 3.3. Bivariate plot of tritium (TU) versus Na/Cl ratio for all samples

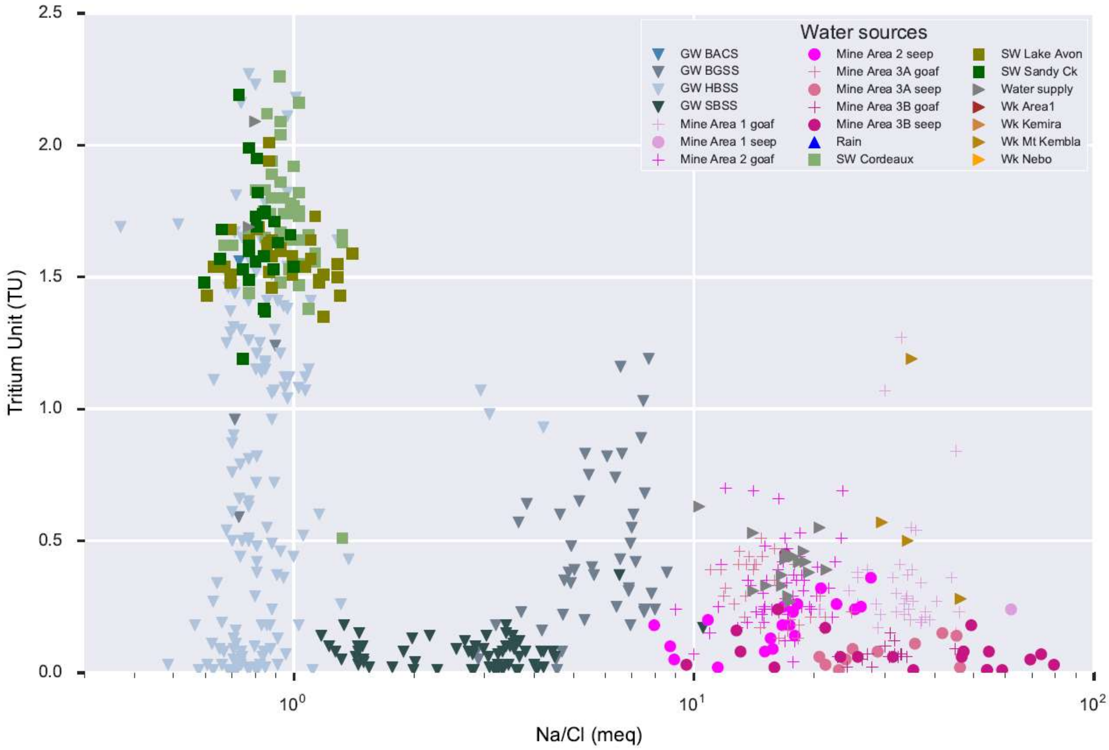
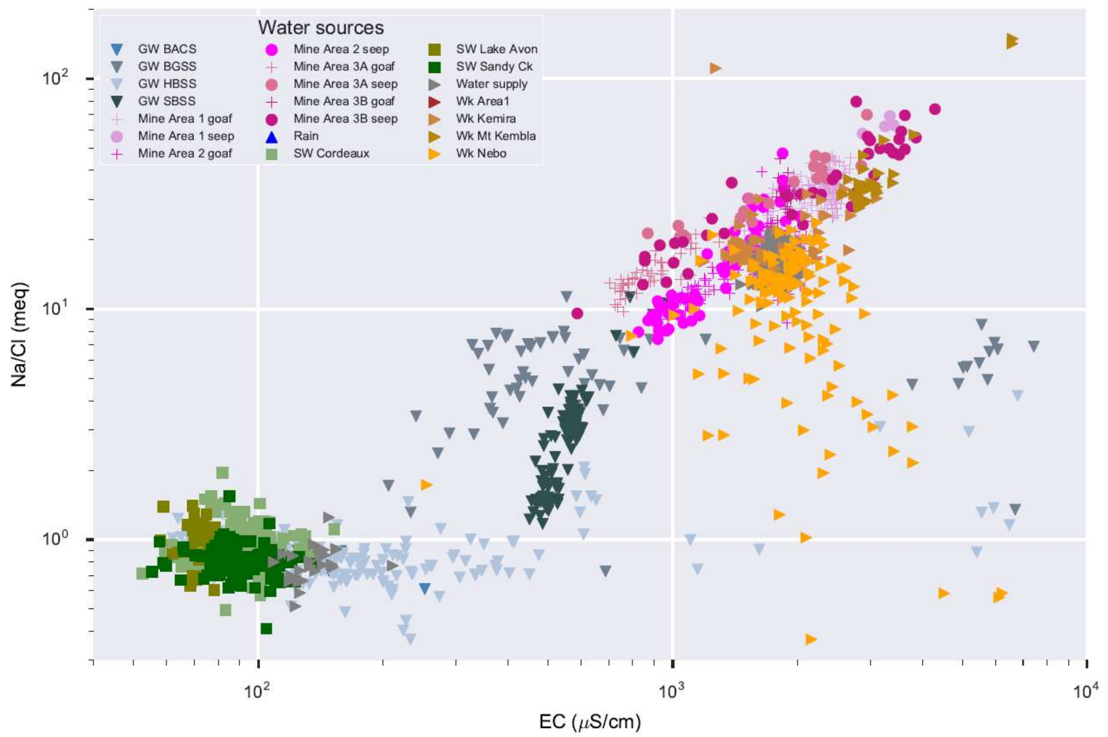


Figure 3.4. Bivariate plot of Na/Cl ratio versus EC for all samples



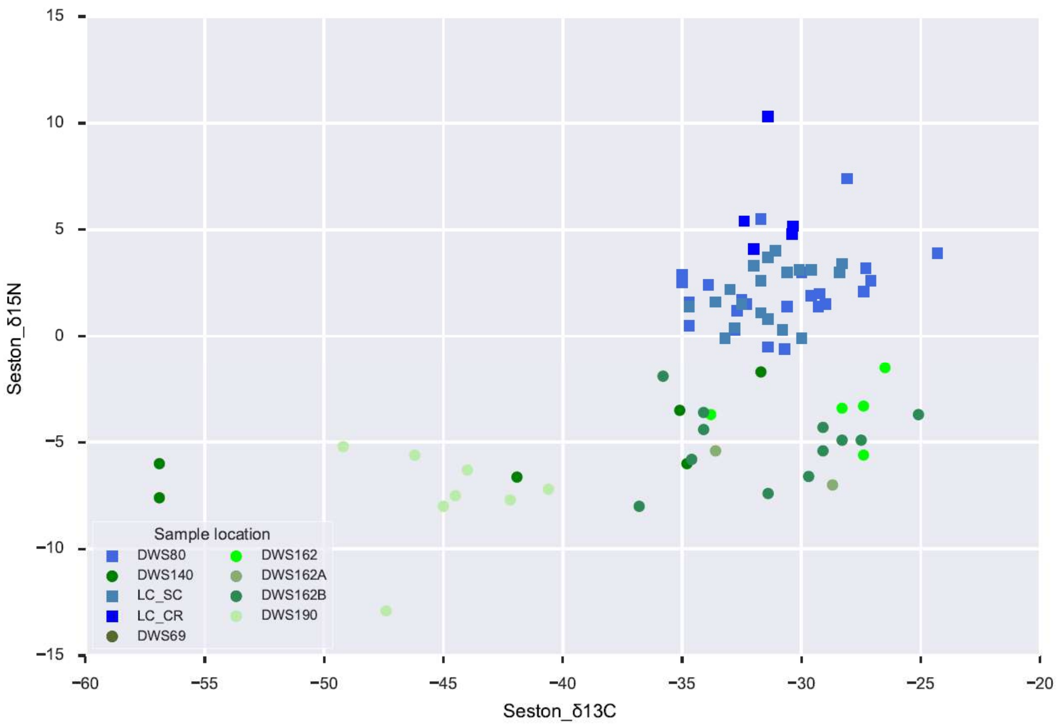
3.3 ALGAE

Algal species detected in Dendrobium goaf waters (Areas 1 to 3B) have typically belonged to *Cyanophyceae* or *Cyanophytes* (Blue-green) algae division. The most commonly occurring species in goaf water, the small-celled marine species *Synechoccus*. *Synechoccus* is rare in Lake Cordeaux (maximum levels at a few hundred cells/mL) and has not been detected in Lake Avon.

Freshwater blue-green algae species which frequently appear in Lake Cordeaux or Avon have only been detected sporadically at low levels in goaf waters: *Pseudanabaena, Merismopedia, Aphanocapsa*. The most common algae in both Lake Cordeaux and Lake Avon is *Cyanogranis libera*.

In addition to identifying algae species, stable isotope analysis of $\delta^{13}C$ of dissolved inorganic carbon (DIC) and the equivalent Seston (particulate organic matter (POM)) (principally blue-green algae) of $\delta^{13}C$, $\delta^{15}N$, carbon/nitrogen mole ratio, and net carbon isotope fractionation ($\Delta\ \delta^{13}C$) were analysed by ANSTO for samples collected lakes Cordeaux and Avon, and underground waters (Area 2 and Area 3B). Data to date has shown that there is not a statistically significant difference in $\delta^{13}C$ DIC, or Seston (POM) $\delta^{13}C$, or $\Delta\ \delta^{13}C$ values for goaf outflow and surface waters. There is however, a statistically significant difference in the Seston (POM) $\delta^{15}N$ between samples of mine inflow water and samples from the reservoirs (Figure 3.5).

Figure 3.5. Carbon and nitrogen isotopic compositions of organic particulate matter



Note: Blue squares are surface water locations and green circles are goaf water samples

4 WATER RESULTS

4.1 WATER CHEMISTRY

Water results for the January 2016 sampling period are summarised in Table 4.1, compared with results for the previous two years. Time series plots for each water source category are shown in Figures 4.1 to 4.10. The plots show all water quality analyses and are colour coded to show individual sample sites.

Note that for mine water inflow, analyses are classified as either *seepage* when the sample is collected directly from water dripping or flowing from a discrete water source, or *goaf water* for samples collected from sites where waters from different sources may have mixed (e.g. from water supply). Mine inflow sites are distinguished on time series plots as '•' (seepage) and '+' (goaf water) symbols. A list of sample location descriptions is in Appendix 2.

Table 4.1. Summary of water quality results for the current period compared with previous

DSC condition	Sampling points	Samples	Median EC (µS/cm)	P5-95 EC previous 2 years	Median Na/Cl (in meq/L)	P5-95 Na/Cl previous 2 years	Median tritium (TU)	P5-95 TU previous 2 years
Entering workings	DWS190 (Area 2 goaf)	1	1640	1594 - 1762	19	13. 8 - 25.1	N/A	0.31 - 0.6
	DWS162B (Area 3B goaf)	1	1850	1783 - 1994	30	24.2 - 39.1	N/A	0.02 - 0.13
	DWS28A (water supply)	1	1760	1596 - 1837	15	12.7 - 18.8	N/A	0.44 - 1.39
Adjacent workings	Not sampled this period							
Groundwater in overlying strata	Not sampled this period							
Surface water	Not sampled this period							
	Not sampled this period							

*Note: Median of three samples collected in July and August 2015, for which results became available during the current reporting period.

In summary, all samples collected during the January 2016 sampling period fall within the 5th to 95th percentile range of results from the previous two years.

No additional Tritium analyses were obtained in this reporting period. Tritium levels in the 8 most recent samples collected from Mine Area 2 between July and October 2015 are the highest since 2008 with a mean of 0.50 TU (n = 8), and exceed the 95th percentile value for Area 2 goaf waters over the last 2 years (P95 = 0.40 TU).

4.2 ALGAE

4.2.1 AREA 3B

Algae assays were last analysed for Area 3B goaf (DWS162) in August 2015. Results from Area 3B goaf outflow water (DWS162) are compared to algal assays from the closest surface water location, Lake Avon for the same time period (Table 4.2).

The principal species of algae in Area 3B goaf outflow water (DWS162) in October and November 2015 were different to those in the closest surface water location (Lake Avon). Data confirm that it is unlikely that any groundwater flows into Area 3B goaf in August 2015 was sourced from Lake Avon in the previous 60-90 days.

Table 4.2. Algal assays DWS162 and Lake Avon

Algae type	DWS162 (Area 3B Goaf)	Lake Avon Native Dog Creek Arm
Blue green algae	100 cells/mL *Synechoccus* (18/11/2015) 375 cells/mL *Synechoccus* (13/10/2015)	4,380 cells/mL *Cyanogranis libera* (1/10/2015) 5,280 cells/ml *Cyanogranis libera* (10/9/15) 2,980 cells/ml *Cyanogranis spp* (7/8/2015)
Green algae	ND	ND
Flagellates	ND	ND
Golden Algae	ND	ND
Diatoms	ND	ND

ND = Not detected

Stable isotope analysis of $\delta^{13}C$ of dissolved inorganic carbon (DIC) and the equivalent Seston (particulate organic matter (POM)) (principally blue-green algae) levels of $\delta^{13}C$, $\delta^{15}N$, carbon/nitrogen mole ratio, and net carbon isotope fractionation ($\Delta\ \delta^{13}C$) were analysed by ANSTO for samples collected from underground waters from Area 3B (Site DWS162) between April 2014 and June 2015. These results are compared to those for the Native Dog Creek Arm Lake Avon collected between May 2013 and October 2015 (Table 4.3).

Table 4.3. Algal assays DWS162 and Lake Avon

Parameter	DWS162 (Area 3B Goaf)	Lake Avon Native Dog Creek Arm
$\delta^{13}C$ DIC (‰ VPDB)	-13.1±1.8 (n=16)	-16.8±5.0 (n=27)
Seston C/N mole ratio	10.7±1.7 (n=14)	10.0±2.2 (n=24)
Seston $\delta^{15}N$ (‰ air)	**-5.0**±1.7 (n=14)	+2.2±1.7 (n=24)
Seston $\delta^{13}C$ (‰ VPDB)	-31.8±3.2 (n=14)	-31.2±2.8 (n=29)
Seston $\Delta\ \delta^{13}C$	+19.2±2.8 (n=14)	+14.7±6.4 (n=26)

Notes: ± 1 standard deviation; Only 3 samples for DWS162 have been corrected for fine coal contamination. Those corrections were based on a high precision carbon and nitrogen stable isotope analysis by ANSTO of local Area 3B coal.

There is a statistically significant difference between the Seston (POM) $\delta^{15}N$ values in Lake Avon and Area 3B goaf (DWS162). These results indicate that Area 3B is unlikely to contain modern surface water from Lake Avon which could have been contributed via short timescales (that is via a fast flow path) commensurate with the timescales over which adaptation of algal metabolism typically occurs (i.e. less than several days up to about 1 week).

4.2.2 AREA 2

The most recent results from algae assays are provided in Table 4.4. Results from Area 2 goaf outflow water (DWS190) are compared to algal assays from Sandy Creek Arm of Lake Cordeaux.

Table 4.4. Algal assays DWS140 and Lake Cordeaux

Algae type	DWS190 (Area 2 Goaf)	Sandy Ck Arm Lake Cordeaux
Blue green algae	760 cells/mL *Aphanocapsa* (18/11/2015) 225 cells/mL *Synechoccus spp.* (13/10/2015) 200 cells/mL *Synechoccus spp.* (10/9/2015) 500 cells/mL *Planktolingba* (3/9/2015)	6,140 cells/mL *Cyanographis libera* (19/11/2015) 400 cells/mL *Cyanographis libera* (19/10/2015) 1,220 cells/mL *Aphanothece* (23/9/2015) 4,020 cells/mL *Aphanocapsa* (31/7/2015)
Green algae	ND	ND
Flagellates	ND	ND
Golden Algae	ND	ND
Diatoms	ND	ND

The data indicates that the principal species of algae in Area 2 goaf outflow water (DWS190) in September to November 2015 were different to those in the closest surface water location (Sandy Creek Arm Lake Cordeaux). Data confirm that it is unlikely that any groundwater flows into Area 2 goaf in June and July 2015 was sourced from Lake Cordeaux in the past 60 days.

Stable isotope analysis of $\delta^{13}C$ of dissolved inorganic carbon (DIC) and the equivalent Seston (particulate organic matter (POM)) (principally blue-green algae) levels of $\delta^{13}C$, $\delta^{15}N$, carbon/nitrogen mole ratio, and net carbon isotope fractionation ($\Delta\ \delta^{13}C$) were analysed by ANSTO for samples collected from underground waters from Area 2 goaf (Site DWS140) between April 2014 and November 2015. These results are compared to those for the Sandy Creek Arm of Lake Cordeaux (Table 4.5).

Table 4.5. Stable isotope data DWS140 and Lake Cordeaux

Parameter	DWS140/190 (Area 2 post-mining Goaf)	Sandy Creek Arm Lake Cordeaux
$\delta^{13}C$ DIC (‰ VPDB)	-22.8±2.4 (n=28)	-17.1±4.7 (n=22)
Seston C/N mole ratio	9.7±1.4 (n=13)	9.8±1.6 (n=22)
Seston $\delta^{15}N$ (‰ air)	**-7.0**±2.4 (n=13)	+2.3±1.5 (n=22)
Seston $\delta^{13}C$ (‰ VPDB)	-45.6±6.6 (n=13)	-31.4±1.6 (n=22)
Seston $\Delta\ \delta^{13}C$	+22.7±6.8 (n=13)	+14.5±5.1 (n=22)

Notes: ± 1 standard deviation; All samples for DWS140/190 have been corrected for fine coal contamination. Those corrections were based on a high precision carbon and nitrogen stable isotope analysis by ANSTO of local Area 2 coal.

There are statistically significant differences between $\delta^{13}C$ DIC and Seston (POM) $\delta^{13}C$, $\delta^{15}N$ and Δ $\delta^{13}C$ values for Lake Cordeaux and Area 2 goaf waters. These results indicate that Area 2 is unlikely to contain modern surface water from Lake Cordeaux which could have been contributed via short timescales (that is via a fast flow path) commensurate with the timescales over which adaptation of algal metabolism typically occurs (i.e. less than several days up to about 1 week).

Figure 4.1: Surface water chemistry

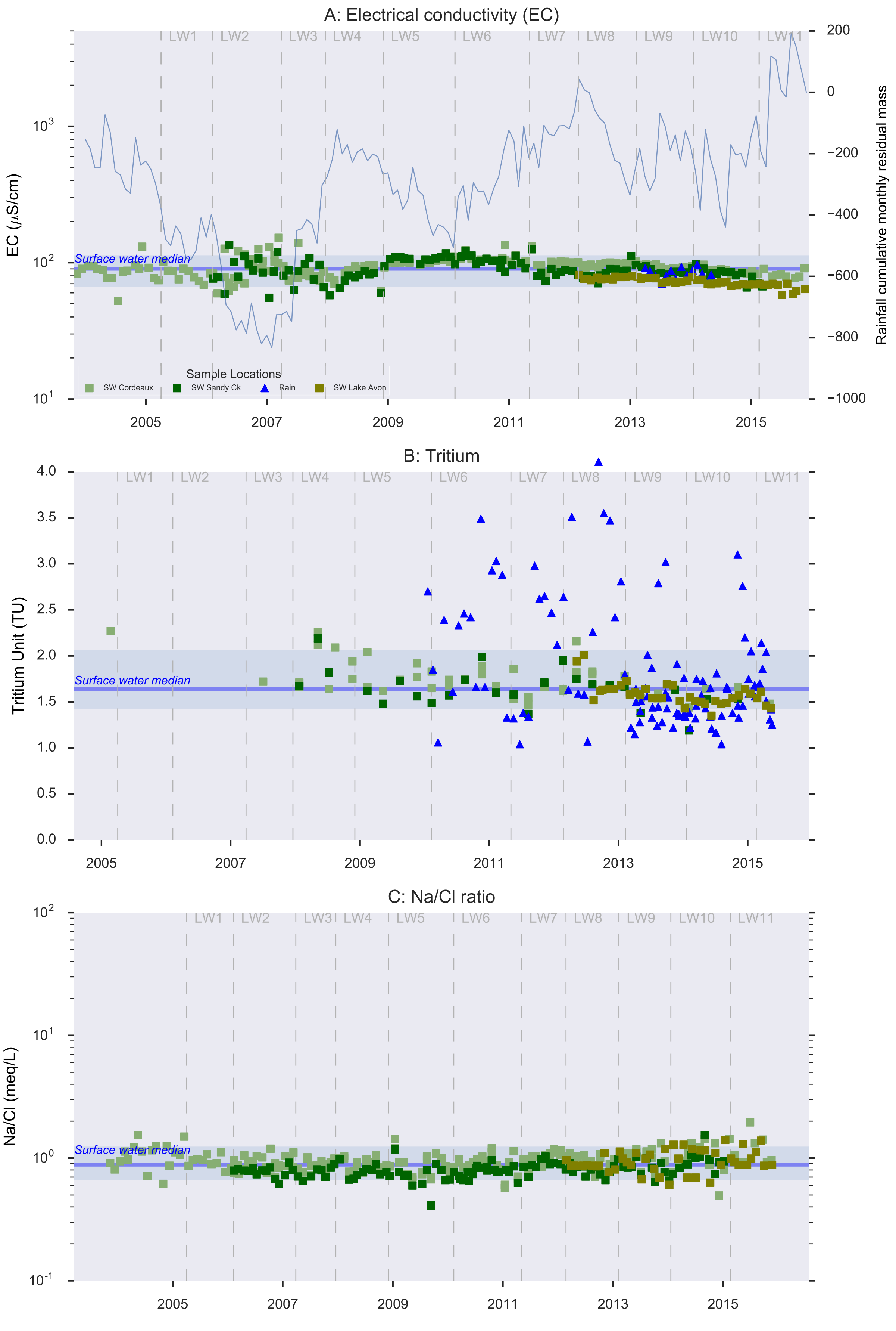


Figure 4.2: Mine inflow chemistry: Area 3B

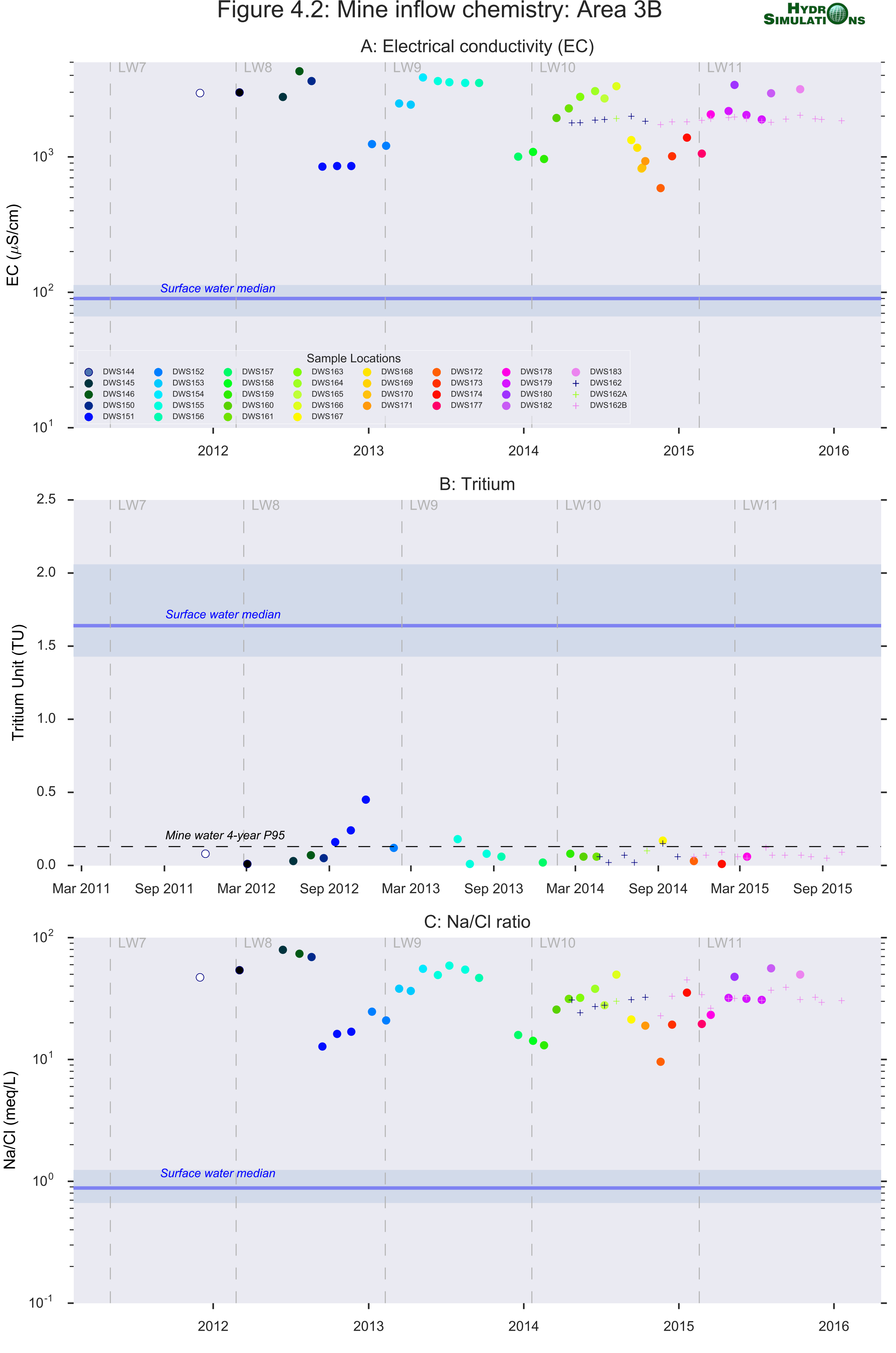


Figure 4.3: Mine inflow chemistry: Area 3A

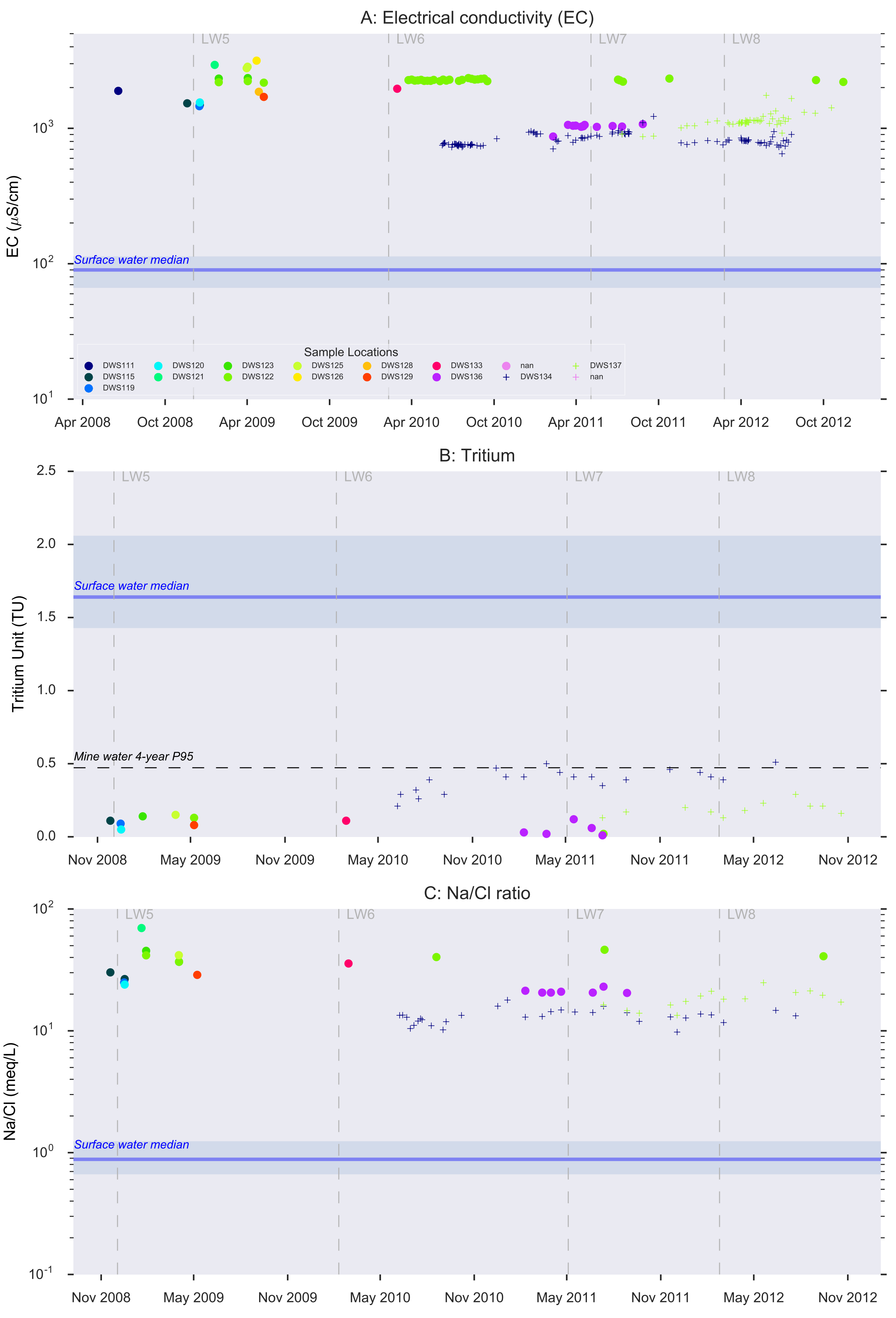
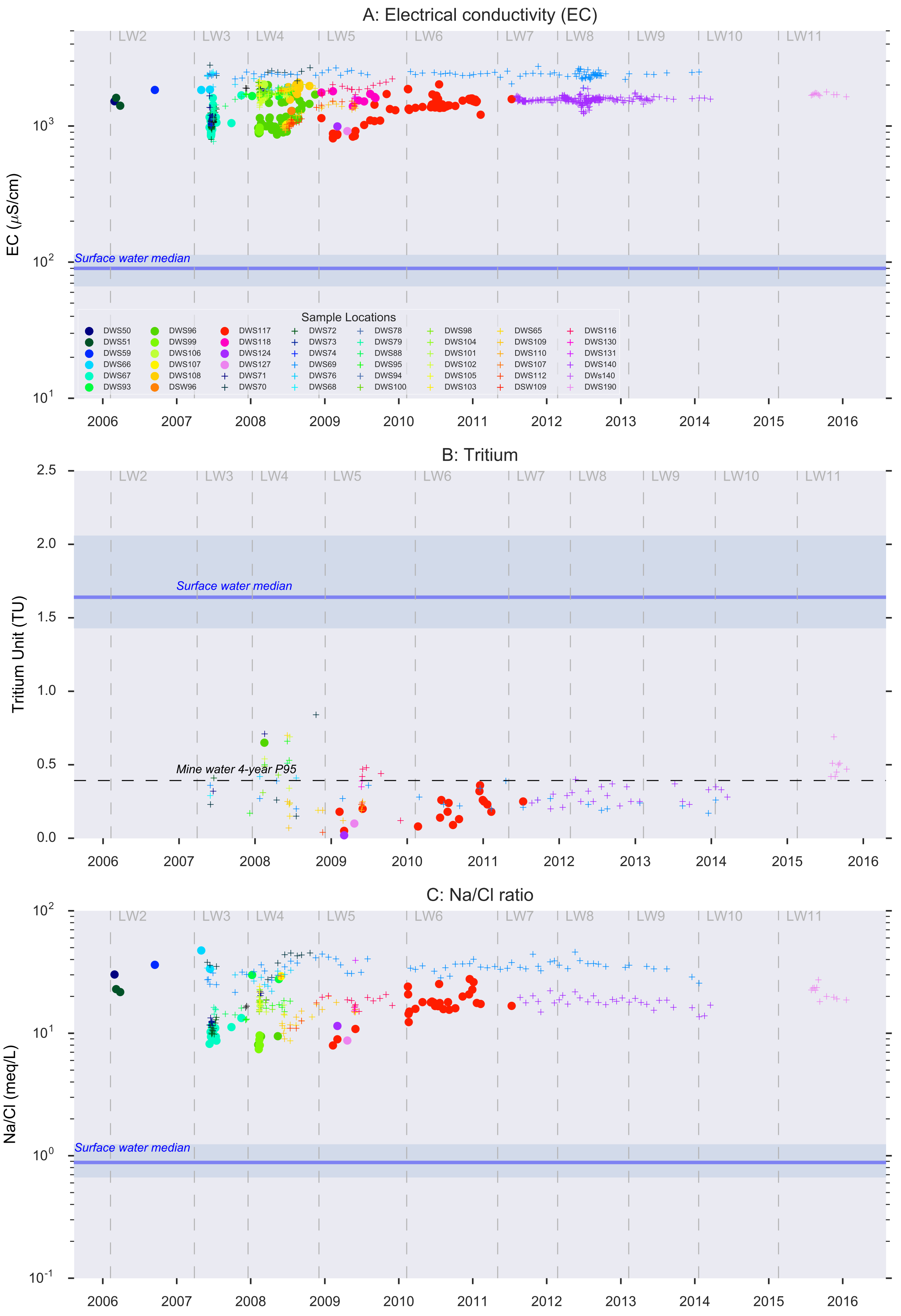


Figure 4.4: Mine inflow chemistry: Area 2



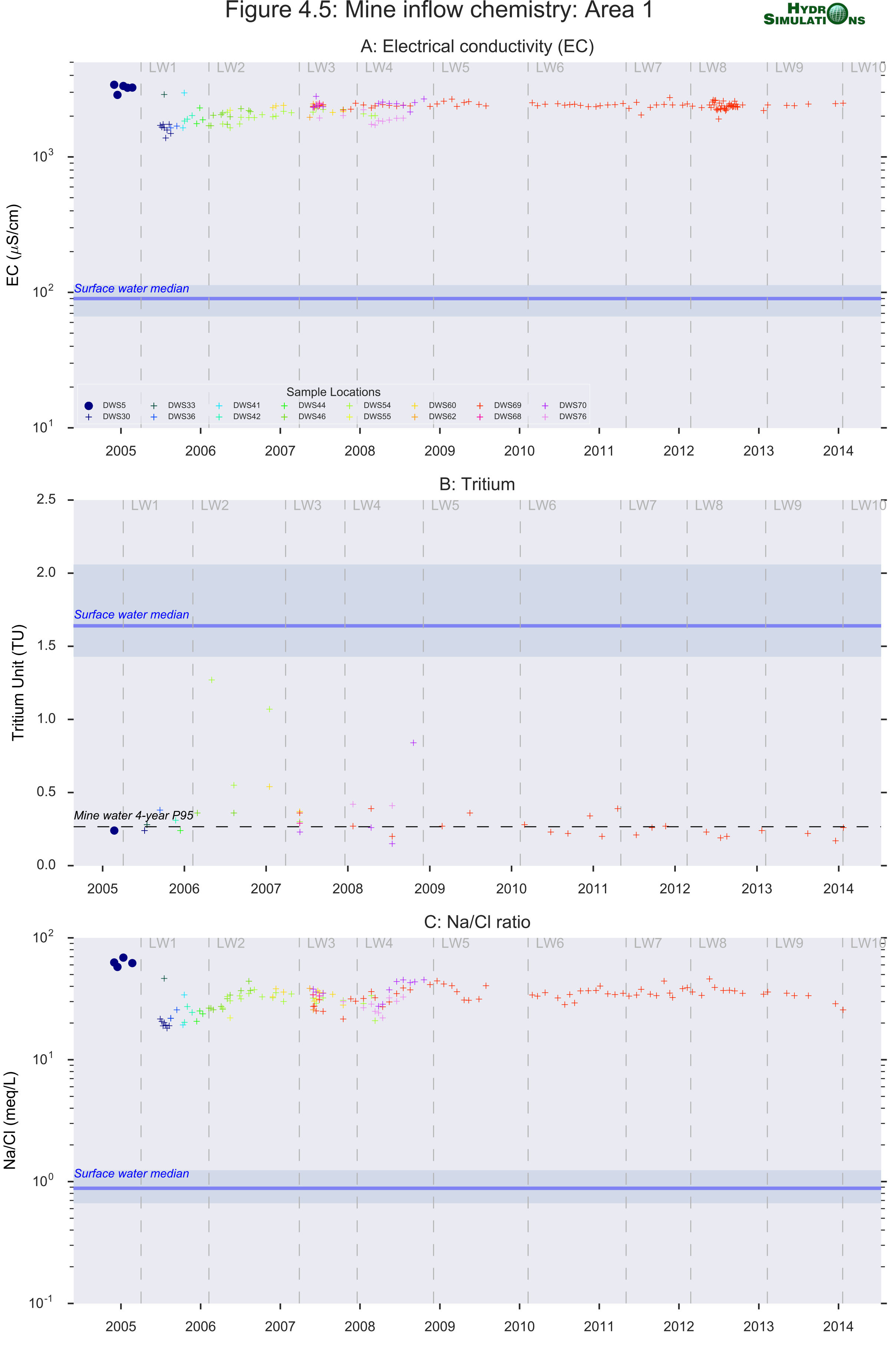


Figure 4.5: Mine inflow chemistry: Area 1
HYDROSIMULATIONS
A: Electrical conductivity (EC)
EC (μS/cm)
Surface water median
Sample Locations
DWS5
DWS30
DWS33
DWS36
DWS41
DWS42
DWS44
DWS46
DWS54
DWS55
DWS60
DWS62
DWS69
DWS68
DWS70
DWS76
LW1
LW2
LW3
LW4
LW5
LW6
LW7
LW8
LW9
LW10
B: Tritium
Tritium Unit (TU)
Surface water median
Mine water 4-year P95
C: Na/Cl ratio
Na/Cl (meq/L)
Surface water median
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014

Figure 4.6: Mine water chemistry: Mine workings

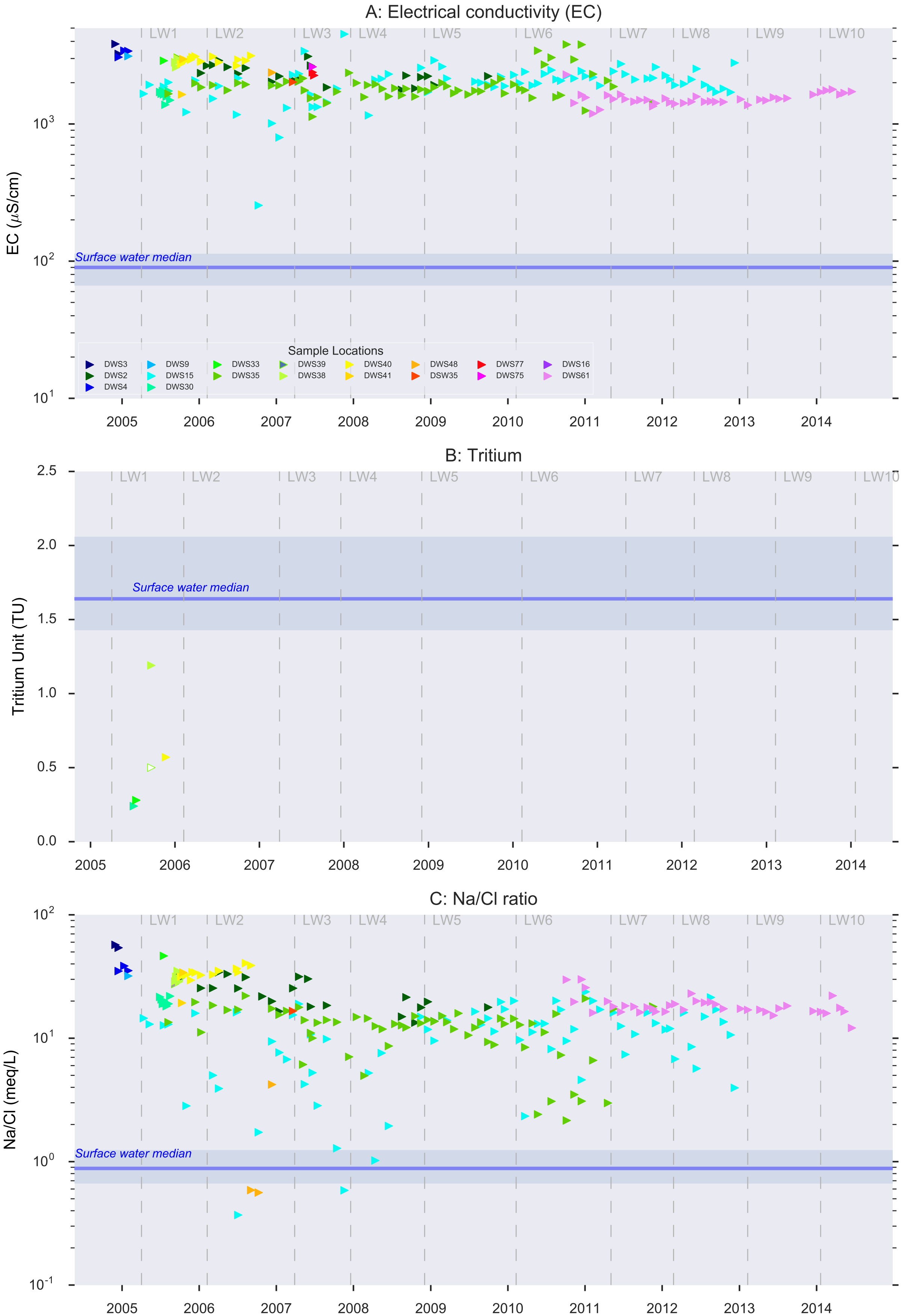


Figure 4.7: Mine water chemistry: Water supply

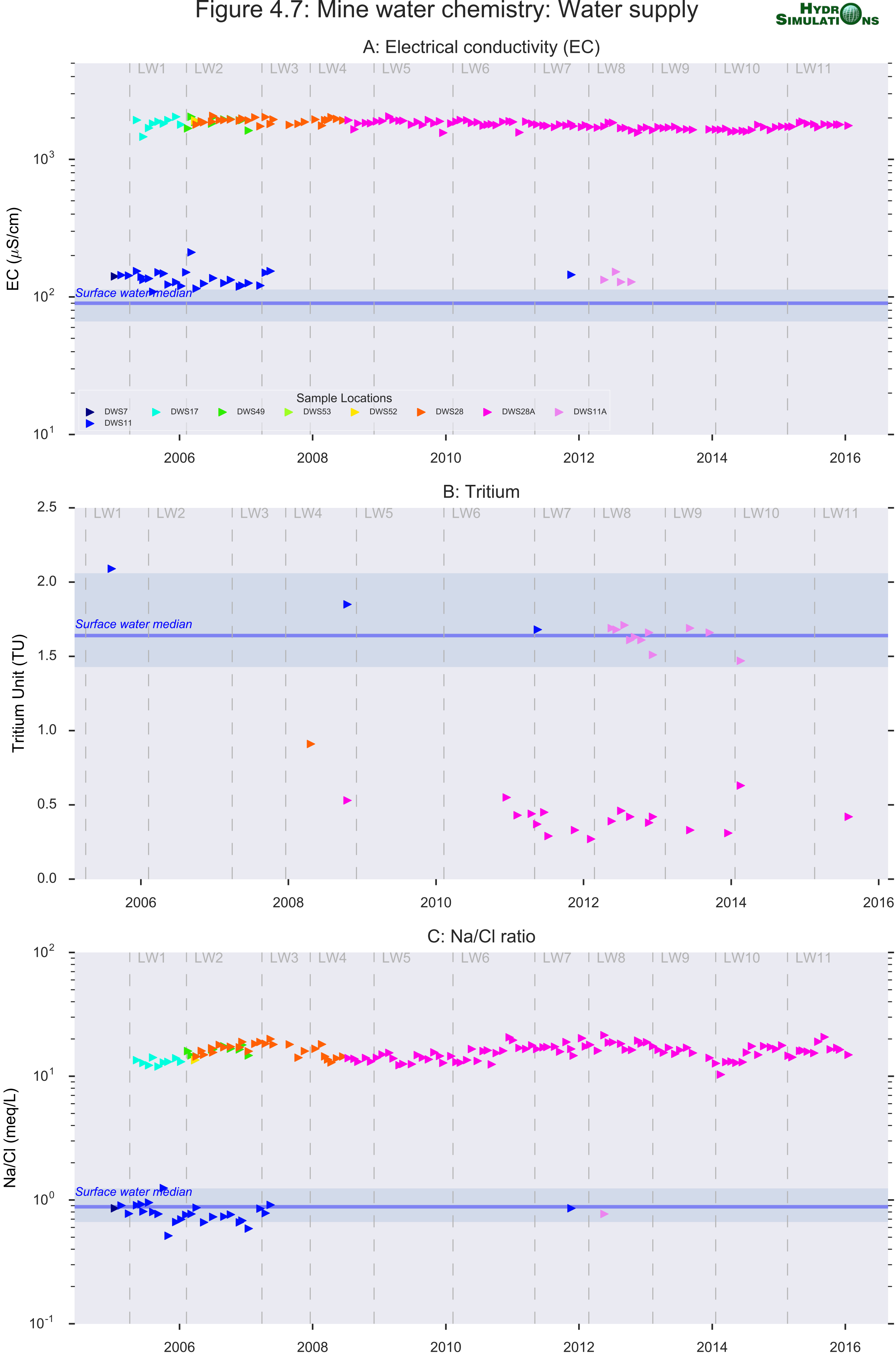


Figure 4.8: Groundwater chemistry: Hawkesbury Sandstone

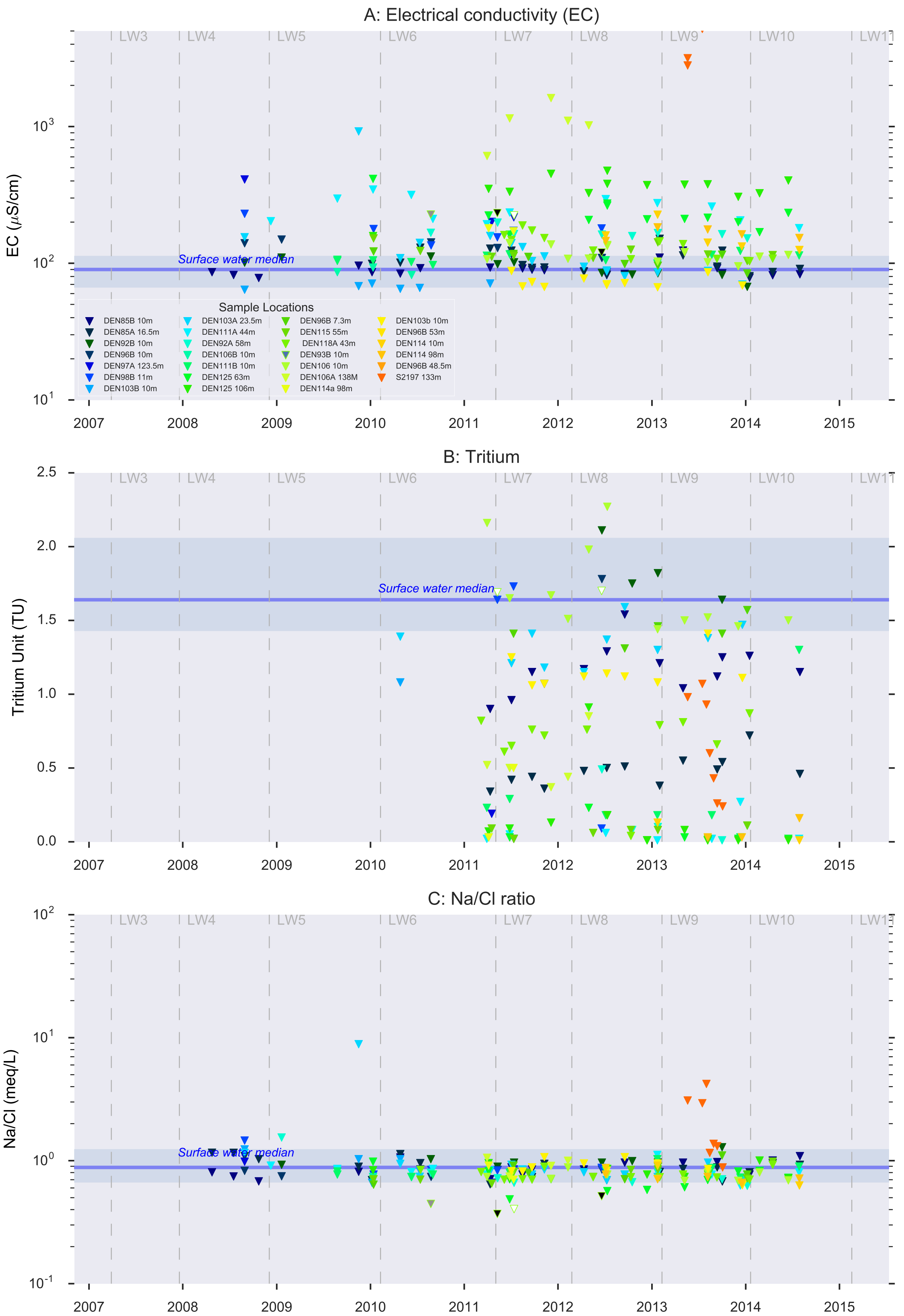


Figure 4.9: Groundwater chemistry: Bulgo Sandstone

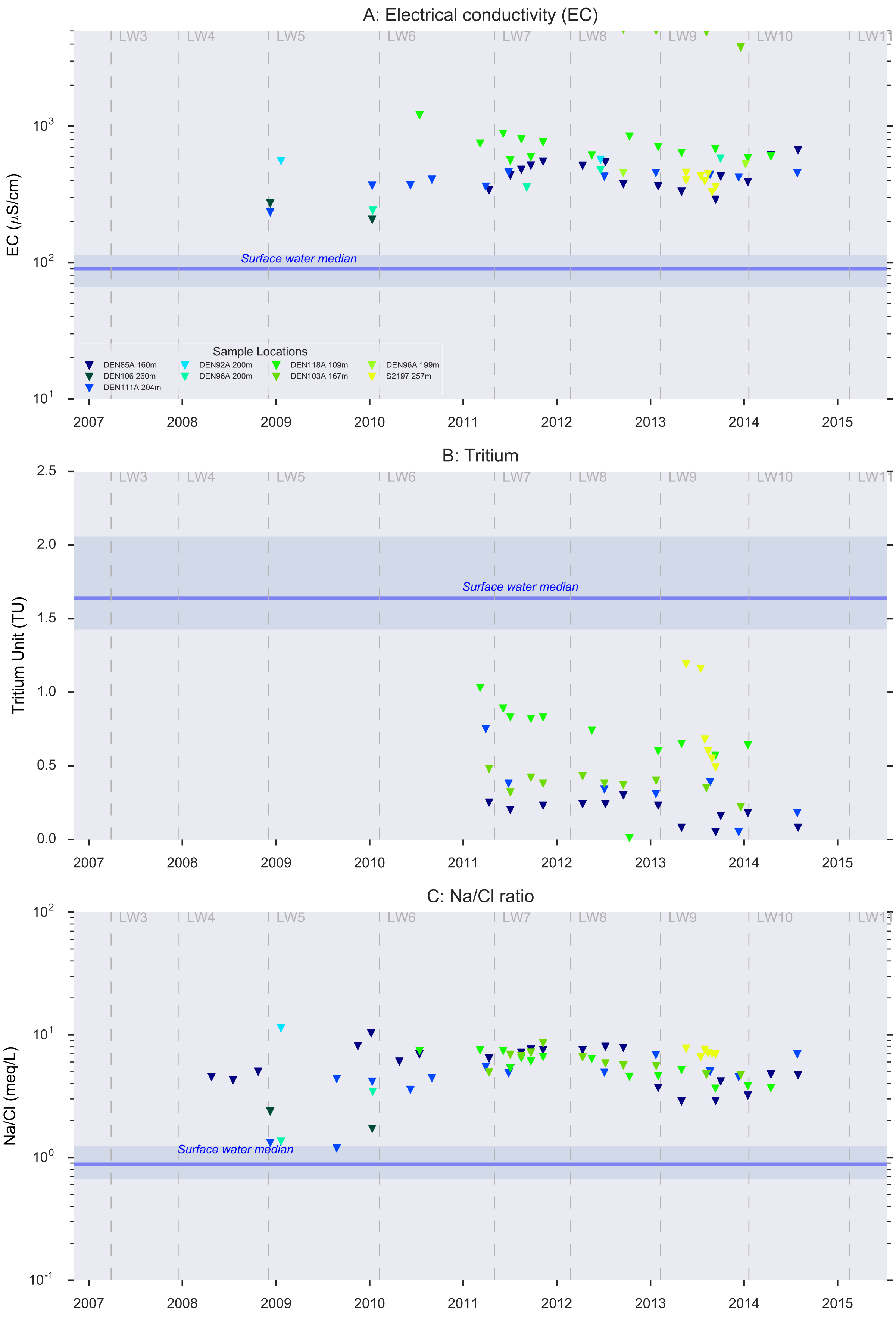
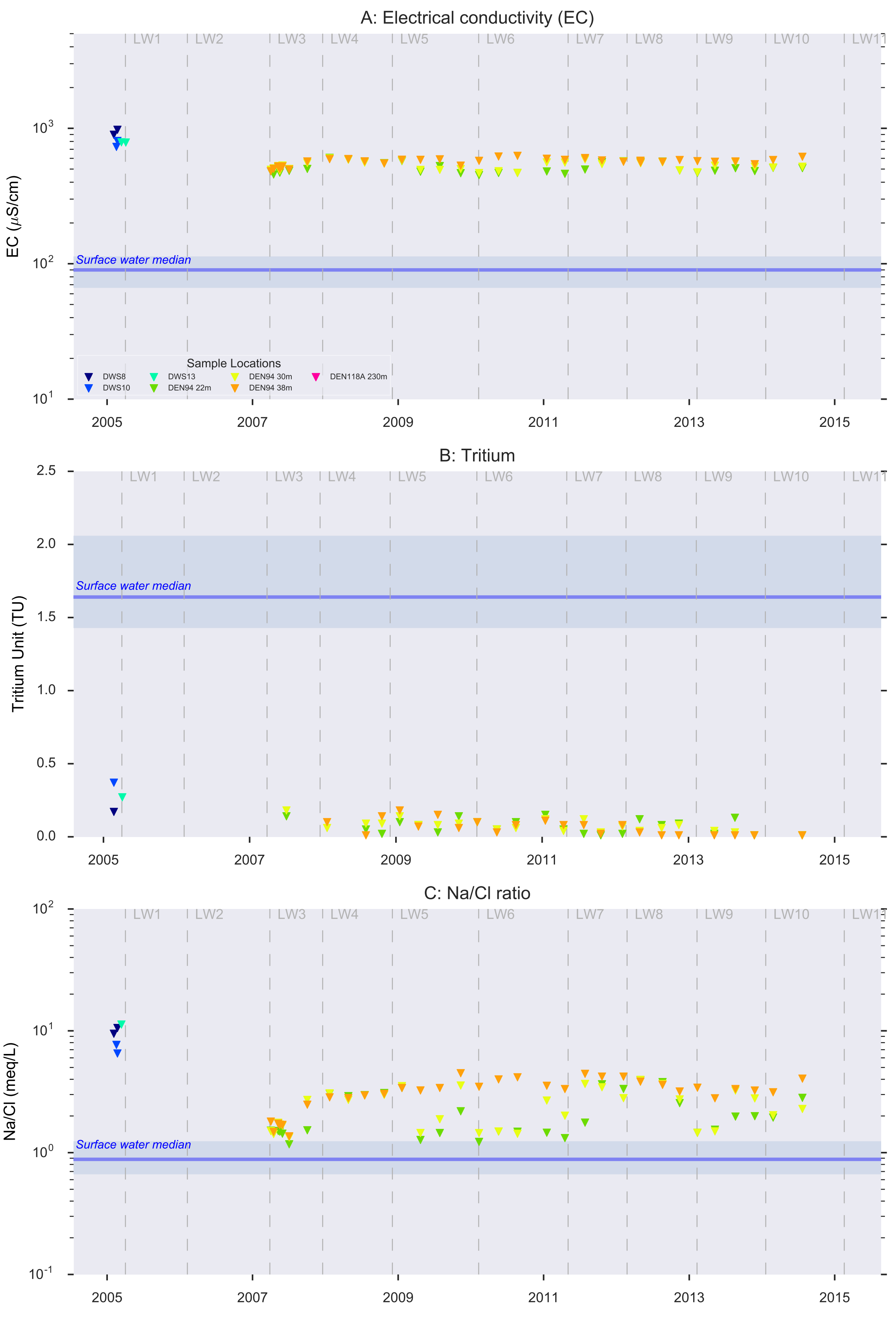


Figure 4.10: Groundwater chemistry: Scarborough Sandstone



5 RECOMMENDATIONS

The following recommendations are made with respect to future monitoring rounds:

1. Investigate the source of water with elevated Tritium at location DWS190 in Mine Area 2. This may include inspection of water flow pathways to the sampling location and additional sampling and analysis.

6 REFERENCES

Parsons Brinckerhoff. (2012) Independent review of Dendrobium Area 2, and 3A hydrochemical data. Report commissioned by Illawarra Coal, p. 118.

Ecoengineers (2015), Monthly assessment for August 2015 of geochemistries of Dendrobium Mine Areas 1, 2 and 3 for NSW NSW Dams Safety Committee. Report commissioned by South23 (Illawarra Coal), September 2015.

Clark, I., and P. Fritz (1997), Environmental isotopes in hydrogeology, CRC Press, New York.

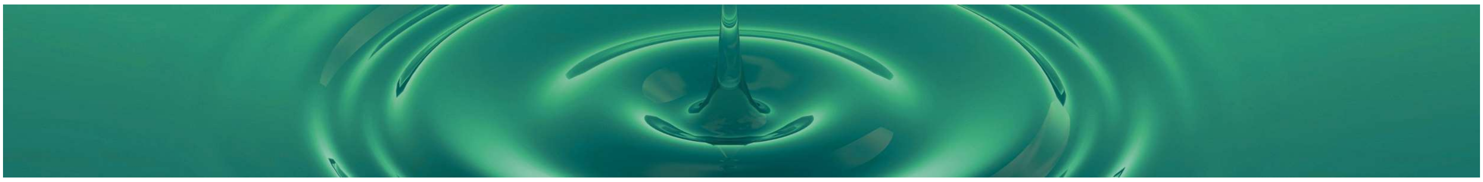
APPENDIX A

Summary of results for this monitoring period

Water chemistry results for the January 2016 Reporting period

HYDRO SIMULATIONS

Date_time	Units	19/01/2016	19/01/2016	19/01/2016
Lab_Report		EW1600247	EW1600247	EW1600247
Location_ID		DWS162B	DWS28A	DWS190
Loc_description		TG9 8c/t seal	Nebo Non-potable Supply	Area 2 goaf LW5 FacemG
Mine_Area		Area 3B	Nebo mains	Area 2
Water_source		Mine goaf	Water supply	Mine goaf
pH_field	pH	7.89	7.98	8.02
EC_field	uS/cm	1850	1760	1640
pH_lab	pH	7.77	7.8	7.81
EC_lab	uS/cm	1960	1750	1670
Tot_Alk	mg/L (CaCO3)	1060	909	877
SO4	mg/L	0.5	0.5	0.5
Si	mg/L	5.32	5.71	5.68
Cl	mg/L	23	41	32
Ca	mg/L	15	23	25
Mg	mg/L	8	19	10
Na	mg/L	454	396	388
K	mg/L	6	7	7
Al	mg/L	0.005	0.005	0.005
As	mg/L	0.02		0.016
Ba	mg/L	1.43	1.19	1.82
Cs	mg/L	0.002	0.005	0.001
Cu	mg/L			0.002
Li	mg/L	0.475	0.148	0.212
Mn	mg/L	0.027	0.035	0.076
Ni	mg/L	0.007	0.006	0.002
Rb	mg/L	0.01	0.007	0.01
Se	mg/L			
Sr	mg/L	0.876	1.16	1.17
U	mg/L	0.023	0.004	0.007
Zn	mg/L	0.005	0.018	0.043
B	mg/L	0.09	0.05	0.07
Fe	mg/L	0.15	0.06	0.025
Br	mg/L			0.1
F	mg/L	0.2	0.4	0.2
NH3-N	mg/L	1.56	1.12	1.27
NOx-N	mg/L	0.06	0.02	0.03
TKN	mg/L	2	1.2	1.9
TP	mg/L	0.05	0.01	0.07
RP	mg/L	0.01		
DOC	mg/L	1	0.05	12
CH4	ug/L	259	2070	54
Org-N	mg/L	0.44	0.08	0.63
TN	mg/L	2.06	1.22	1.93



APPENDIX B

List of sample locations

Water Sample No.	Description	Borehole Number	Sample Location
DWS1 (INVALID)	Nebo Mains 10.5 c/t pump station - Nebo Wkgs water	NIS7	NM B Hdg 10.5c/t Stub
DWS2	Kemira Mains 6.5 D Hdg water drainage borehole - Kemira Wkgs water	KIS7	KM D Hdg 6.5c/t Stub
DWS3	MG1 Cross Measure Probe Borehole - Mt Kembla Colliery water	MG1CM2	MG1 B Hdg 3c/t Stub
DWS4	MG1 Roof Fall 5-6c/t - connected to cross measure boreholes drilled from 6c/t.	-	MG1 B Hdg 79m Inbye of 5c/t
DWS5	Inseam borehole that intersected dyke area to NW of LW2.	NIS13	MG1 B Hdg 26c/t
DWS6	Minor roof fall MG1 B Hdg 24c/t - water flow from roof strata.	-	MG1 B Hdg 24c/t
DWS7	Fresh water taken from portal hydrant location	-	Dendrobium Tunnel Portal
DWS8	Vertical Borehole for DSC/Piezometer Monitoring	S1588	TG1 19c/t A-B Hdg (Packer lost in hole)
DWS9	Mt Kembla water taken from Vertical Borehole KM A Hdg	MU35	KM A Hdg 12c/t
DWS10	Vertical Borehole for DSC/Piezometer Monitoring (grouted)	S1656	NM 28c/t B-C Hdg (Near Stopping)
DWS11	Potable Water taken from water inflow line near 3c/t flow meter		NM B Hdg 3 1/2 c/t Fire Hydrant
DWS11A	Potable Water supply for longwall hydraulic emulsion, taken from surface.		Cold tap at the sink next to the ice machine near the ready-room of the bathhouse
DWS12	2nd Vertical Borehole TG1 19c/t for Piezometer Monitoring (grouted)		TG1 19c/t A-B Hdg (closest to c/t)
DWS13	Vertical Borehole for DSC/Piezometer Monitoring	S1655	NM 28c/t B-C Hdg (closest to c/t)
DWS14	Maingate 1 Return water pipeline inbye water monitoring location		MG1 B Hdg 1 c/t LHS Pipeline
DWS15	DT1 Drill Stub Return Water Pipeline prior to entering injection boreholes		DT1 Stub at base of U-bend
DWS16	Longwall 1 Water sample taken at MG1 23 c/t (LW at CH 1721m)		Longwall at CH1721
DWS17	Maingate 1 Potable water pipeline inbye water monitoring location		MG1 B Hdg 1 c/t RHS Pipeline
DWS18	LW1 Face Water sample	-	LW1 (CH1648, Chock15, 3/05/05)
DWS19	LW1 Face Water sample	-	LW1 (CH1617 between Chock 3 and 5, 13/05/05)
DWS20	LW1 Face Water sample	-	LW1 (CH1616.5, Chock 2, 20/05/05)
DWS21	LW1 Water sample taken TG1 20c/t from seal.	-	LW1 (CH1616.5, 20c/t from seal, 20/05/05)
DWS22	LW1 Face Water sample	-	LW1 (approx CH1590, Chock 2, 2/06/05)
DWS23	LW1 Face Water sample	-	LW1 (approx CH1570, Chock 3, 7/06/05)
DWS24	Water Storage Tank at Dendrobium	-	At tap by road on surface prior to tank.
DWS25	Nebo Mains 10.5 c/t pump station - sump water	-	NM B Hdg 10.5c/t Stub
DWS26	LW1 Face Water sample	-	LW1 (CH approx. 1515, Chock 15, 17//6/05)
DWS27	LW1 Face Water sample	-	LW1 (CH approx. 1466. Chock 12, 24//6/05)
DWS28	Nebo Mains 10.5 c/t pump station after hypochlorite dosing unit.Taken from tap in water line feeding	-	NM B Hdg 10.5c/t Stub
DWS28A	Nebo Mains 10.5 c/t pump station before hypochlorite dosing unit.		NM B Hdg 10.5c/t Stub
DWS28B	Nebo Mains 10.5 c/t pump station after hypochlorite dosing. At far end of baffle tank (outlet end).		NM B Hdg 10.5c/t Stub
DWS29	LW1 Face Water sample	-	LW1 (CH approx 1407.5, Chock 30, 30/06/05)
DWS30	LW1 Goaf Water sample MG1 21 c/t	-	LW1 (CH approx 1407.5, 21 c/t, 30/06/05)
DWS31	LW1 Face Water sample	-	LW1 (CH approx 1373, Chock 50, 7/07/05)
DWS32	LW1 Face Water sample	-	LW1 (CH approx 1299, Chock 29, 14/07/05)
DWS33	Mt. Kembla water	-	MG1 6 c/t tap at boreholes (roof)
DWS34	Kemira Water	-	KM B hdg drill stub
DWS35	Return water from Nebo Mains	-	19.5 CT stub
DWS36	LW1 Goaf Water sample MG1 18 c/t	-	MG1 18c/t seal
DWS37	Mixed chock emulsion	-	Pump sled, from tap after mixing
DWS38	MG 1 11c/t drain hole from Kembla		From valve, MG 1 11c/t drain hole from Kembla
DWS39	MG 1 12c/t drain hole from Kembla		From valve, MG 1 12c/t drain hole from Kembla
DWS40	MG 2 9 c/t drain hole from Kembla		From valve, MG 2 9c/t drain hole from Kembla
DWS41	LW Goaf sample MG end	-	LW Goaf sample MG end, between chock 3 and 4
DWS42	LW Goaf sample MG1 12c/t seal	-	LW Goaf sample MG1 12c/t seal
DWS43	31 cut through pump out line	-	31 cut through pump out water from sump tank
DWS44	LW Goaf Sample LW1	-	Seepage from goaf LW1 final position (ch=0m) from approx 50 chock
DWS45	Dripping flexi-bolt in NWM. Sample of pooled water off floor from pum believed to be predominately	-	NWM D hdg 50m inbye of 4 c/t, 50m outbye of working face
DWS46	Sample of pooled water on floor in MG1 9-12 c/t. LW1 Goaf Water.	-	MG1 11 c/t floor
DWS47	Licence Discharge Point 4	-	On surface next to diesel haulage portal
DWS48	MG2 Return Water Pumpout line	-	MG2 pumpout line valve at B Hdg 3c/t
DWS49	Maingate 2 water In	-	MG2 Water In (6" Line). B hdg hydrant adj. 2c/t
DWS50	Dripping Clock-It in TG3, B3 intersection	-	TG3 B3 Intersection
DWS51	Dripping Clock-It in TG3, A3 intersection	-	TG3 A3 Intersection
DWS52	North West Mains 2 c/t Supply Water (Fire Hydrant)	-	NW Mains B Hdg 2c/t Fire Hydrant
DWS53	Nebo Mains 15c/t Supply Water (Fire Hydrant)	-	Nebo Mains B Hdg 15c/t Fire Hydrant
DWS54	LW2 Goaf Water Sample. TG2 23-24c/t	-	TG2 23-24c/t. Water leaking through Goaf seal
DWS55	LW1 Goaf Water Sample. TG2 7c/t	-	TG2 7c/t. Water leaking through Goaf seal
DWS56	MU63. Borehole into Mt Kembla Workings	-	MG2 12c/t
DWS57	MU71. Borehole into Mt Kembla Workings	-	MG2 12c/t
DWS58	MUXX? (Borehole closest to LW2 Block). Borehole into Mt Kembla Workings	-	MG2 7c/t
DWS59	Dripping Clock-It in NW Mains 9C/T B Hdg	-	NW Mains 9 C/T B Hdg
DWS60	MG2 9c/t goaf seal	-	MG2 9 C/T
DWS61	Kemira Mains Injection (Water from MG5 Dam Pump Station)	-	KM 14 stub
DWS62	NM sump (water from Bridge Rd - Area 1)	-	NM 31c/t sump
DWS63	TG3 fire hydrant	-	TG3 A15 intersection
DWS64	MG3 fire hydrant	-	MG3 B2 intersection
DWS65	MG3 goaf seal (to be setup at the completion of LW3)	-	MG3 3c/t final goaf seal
DWS66	MG5 A2 intersection Clockit, water dripping from clockit.	-	MG5 A2 intersection Clockit
DWS67	LW3 Face water sample	-	along MG3 as the LW retreats
DWS68	Water from LW2 goaf.	-	MG 2, 19 C/T Goaf Seal.
DWS69	Water from LW2 goaf.	-	MG 2, A1.5 Goaf Seal.
DWS70			
DWS71	MG3 14c/tLW3 goaf water	-	MG3 14c/tLW3 goaf water
DWS72	MG3 13c/t LW3 goaf water	-	MG3 13c/t LW3 goaf water
DWS73	MG3 15c/t LW3 goaf water	-	MG3 15c/t LW3 goaf water
DWS74	MG3 16c/t LW3 goaf water	-	MG3 16c/t LW3 goaf water
DWS75	fresh sample when water in abundance was found after the water increase in MG3 after the rains	-	NM C30int
DWS76	TG1 A20int	-	TG1 A20int
DWS77	fresh sample when water in abundance was found after the water increase in MG3 after the rains	-	Bridge Road B4int
DWS78	MG3 12c/t LW3 goaf water	-	MG3 12c/t LW3 goaf water
DWS79	MG3 13-14c/t LW3 goaf water	-	MG3 13-14c/t LW3 goaf water
DWS80	Lake Avon water sample (LA5_S2)		
DWS81	Distilled water		
DWS82	MG3 11c/t LW3 goaf water	-	MG3 11c/t LW3 goaf water
DWS83	MG3 11-12c/t LW3 goaf water	-	MG3 11-12c/t LW3 goaf water from V Notch
DWS84	spare		
DWS85	spare		
DWS88	MG3 9c/tLW3 goaf water		MG3 9c/tLW3 goaf water from V Notch (taken directly from goaf seal)
DWS90	MG5 @ Miner		
DWS91	MG5 B 1 + 30 (auger hole)		Sample from the auger hole in the floor on the block side.
DWS92	Inseam borehole NWM 17 c/t stub.		
DWS93	B20 Drippers NWM		
DWS94	MG3 Goaf water between 6-7 C/T B Hdg MG3		Between 6-7 C/t B Hdg MG3
DWS95	MG3 Goaf water 6 C/T MG3 from behind seal		6 C/T MG3 from behind seal
DWS96	LW4 Face Sample. MG End.		LW4 Face. MG End.
DWS97	Inseam borehole NWIS7 NWM B20.5 Stub		NWM B20.5 Stub
DWS98	MG3 Goaf water from dam at 5.5 c/t		MG3 Dam at 5.5
DWS99	MG4 Goaf water from 16c/t behind #1 chock (LW face sample, this is essentially the same as DWS96)		
DWS100	MG3 goaf water 2c/t dam		
DWS101	MG3 2c/t A-B		

Water Sample No.	Description	Borehole Number	Sample Location
DWS102	MG3 Goaf water 7 C/T MG3 from behind seal		
DWS103	MG3 11c/t LW3 goaf water (The same as DWS82)	-	MG3 11c/t LW3 goaf water
DWS104	MG3 14c/tLW3 goaf water (The same as DWS71)	-	MG3 14c/tLW3 goaf water
DWS105	MG3 Goaf water 6 C/T MG3 from behind seal (The same as DWS95)		6 C/T MG3 from behind seal
DWS106	Dripping Clock-It in NW Mains 22C/T C Hdg		NW Mains 22C/T C Hdg Clock-It
DWS107	Dripping Clock-It in South Mains 1C/T B Hdg		South Mains 1C/T B Hdg Clock-It. Next to crib room.
DWS108	LW4 Face Sample - TG End.		LW4 Face. TG End.
DWS109	MG4 10c/t LW4 goaf water	-	MG4 10c/t LW4 goaf water - recently goafed and sealed.
DWS110	MG4 9c/t LW4 goaf water	-	MG4 9c/t LW4 goaf water - recently goafed and sealed.
DWS111	Dripping Roof Bolt	-	D4 Intersection West Mains
DWS112	MG4 8c/t LW4 goaf water	-	MG4 8c/t LW4 goaf water - recently goafed and sealed.
DWS113	Vent Shaft 2 Dewatering Line	-	Vent shaft 2 dewatering standpipe
DWS114	MG4 7c/t LW4 goaf water	-	MG4 7c/t LW4 goaf water - recently goafed and sealed.
DWS115	Dripping Clock-It in MG6 4C/T B Hdg		Dripping Clock-It in MG6 4C/T B Hdg
DWS116	MG4 3c/t LW4 goaf water	-	MG4 3c/t LW4 goaf water - recently goafed and sealed.
DWS117	Water from Area 2 Goaf		MG5 B1.5 goaf seal - in front of Dam wall
DWS118	LW5 Face Sample - TG End.		LW5 Face Sample - TG End.
DWS119	Inseam Borehole		Tailgate 6 Inseam Borehole 1
DWS120	Dripping Clock-It in MG6 9C/T B Hdg		Dripping Clock-It in MG6 9C/T B Hdg
DWS121	Inseam Borehole		Maingate 6 Inseam Borehole 1
DWS122	Water dripping from 4m strand in roof		Inbye Margin of Dyke West Mains D4 Stub
DWS123	Water dripping from 4m strand in roof		1m Inbye of Margin of Dyke West Mains D4 Stub
DWS124	MG5 18 c/t seal		MG5 18 c/t seal
DWS125	Inseam Borehole NWM D19 Stub NWIS6		NWIS6 NWM D19
DWS126	Inseam Borehole MG6IS5		MG6 17ct Stub
DWS127	MG5 16 c/t seal. LW5. Goaf water.		MG5 16 c/t seal
DWS128	MG6 roof dripper B18-19		MG6 roof dripper B headings 18-19
DWS129	MG6 roof dripper B20 Clock-IT		MG6 roof dripper B20 Clock-IT
DWS130	MG4 2 c/t		MG4 2 c/t Water Pooled on Roadway
DWS131	MG4 5 c/t		MG5 5 c/t Seal
DWS132	Surface to Inseam Borehole Intersected 28ct MG6		Surface to Inseam Borehole Intersected 28ct MG6
DWS133	LW6 Bleeder Heading Roof Dripper (MG6A33)		LW6 Bleeder Heading Roof Dripper A33 Intersection
DWS134	LW6 Water MG END. (MG6 A33 Goaf Seal)		MG6 A33 Goaf Seal
DWS135	LW6 Water TG END. (TG6 B30 Goaf Seal)		TG6 B30 Goaf Seal
DWS136	LW6 Bleeder Road Roof Dripper		LW6 Bleeder Road Roof Dripper - Near the Double Doors
DWS137	LW7 Water TG END. (TG6 A27.5 Goaf Seal) At discharge from pipe (3 m from seal)		TG6 A27.5 Goaf Seal
DWS137A	LW7 Water TG END. (TG6 A27.5 Goaf Seal) At leaking pipe/seal joint.		TG6 A27.5 Goaf Seal
DWS138	*designated for the LW8 bleeder		
DWS139			
DWS140	MG5 Dam, Area 2 Goaf Water. From Pipe that extends through dam wall and seal into goaf. NO LONGER A SAMPLE SITE.		MG5 B1.5 goaf seal - in front of Dam wall, Second pipe from the right, Closest to the ground.
DWS141			
DWS142			
DWS143			
DWS144	Wonga Mains 4 CT Drilling stub. Drill hole extending into LW9		Wonga Mains 4 CT Drilling stub
DWS145	Dripping Clock-It in TG9 5C/T A Hdg		TG9 A5 Clock-It with drainage hose
DWS146	Dripping Roof Bolt at TG9 8C/T A Hdg		TG9 A8 intersection roof bolt
DWS147			
DWS148			
DWS149			
DWS150	Dripping Roof Bolt at MG9 13C/T A Hdg		MG9 A13 intersection roof bolt
DWS151	Dripping Roof Bolts at WoM 12C/T E Hdg collecting into drum		WoM E12 intersection roof bolts
DWS152	Dripping Roof Bolts at MG10 5.5 c/t collecting into drum		MG10 5.5 c/t
DWS153	Dripping roof bolts at MG10 8 c/t, collecting into drum		MG10 8 c/t
DWS154	Dripping drill hole in roof at MG10 between A17 and B17		MG10 17c/t
DWS155	Dripping Clock-it at MG10 B17		MG10 B17
DWS156	Dripping Roof Bolt at MG10 B17		MG10 B17
DWS157	Dripping Roof Bolt at MG11 A5		MG11 A5
DWS158	Dripping Rock-It at MG11 A8		MG11 A8
DWS159	Dripping Rock-It at MG11 A5		MG11 A5
DWS160	Dripping Rock-it at MG11 A11		MG11 A11
DWS162A	TG9 9c/t goaf seal		TG9 9ct goaf seal
DWS162	TG9 14c/t goaf seal		TG9 14ct goaf seal
DWS167	Sample taken from MG12- A5, dripping roof bolts.		MG12 A5
DWS168	Sample taken from MG12 - A5 to A6 dripping 2.4 metre roof bolt.		MG12 A5-6
DWS169	Sample from roof dripper MG12 B Heading, Ch58mtr (Approx location B7). Comment on ID tag attached to coke bottle read: '		MG12 B7
DWS170	Samples from MG12 A6+60 metres, dripping roof bolt. 1 litre in 3 minutes.		MG12 A6+60m
DWS171	Sample taken from MG12 B6+20 metres. Dripping TG bolt.		MG12 B6+20m
DWS166	Sample taken from MG11 20A dripping rock-it		MG11 A20
DWS161	Sample from roof dripper (Rock-it) at MG11 12A		MG11 A12
DWS163	Sample taken from MG11 14c/t travel road. Dripping Rock-it		MG11 A14
DWS164	Sample taken from MG11 17c/t travel road. Dripping rock-it.		MG11 A17
DWS165	Sample taken from MG11 14c/t travel road. Dripping rock-it.		MG11 A14
DWS172	Sample from MG12 B7+75M. Dripping 8metre bolt. 30 metres inbye of Fault.		MG12 B7+75m
DWS173	MG12 A9 dripping rock it.		MG12 A9
DWS174	MG12 A6 dripping rock-it.		MG12 A6
DWS176	MG9 B23		TG9 Bleeder - MG9 B23
DWS177	MG12 A12 dripping rock-it		MG12 A12
DWS178	MG12 A16 dripping rock-it		MG12 A16
DWS179	MG12 A18 dripping rock-it		MG12 A18
DWS180	MG12 A21 dripping rock-it		MG12 A21
DWS181	MG10 B24 Bleeder Sample (Sample Labelled "Bleeder 04/06/2015")		MG10 B24 Bleeder sample
DWS182	MG12 Dripper A24 - Dripping rock-it		MG12 A24
DWS183	MG12 Dripper A25 (Dripper water collected from Metal Drum)		MG12 A25
DWS184			
DWS185			
DWS186			
DWS187			
DWS188			
DWS189			
DWS190	Area 2 GOAF site - MG5 A Heading 2 1/2 CT		MG5 A Heading 2 1/2 CT