APPENDIX M
SURFACE WATER ASSESSMENT

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Gilbert & Associates Pty Ltd

REPORT

MT ARTHUR COAL CONSOLIDATION PROJECT

Surface Water Assessment

Prepared for: **Hansen Bailey**

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PO Box 2057
Milton, Qld. 4064

Tel: (07) 3367 2388
Fax: (07) 3367 2833

A.C.N 085 419 852
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CONTENTS Page

FIGURES

ATTACHMENTS

1.0 INTRODUCTION

Mt Arthur Coal is proposing to apply for a new Project Approval under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to gain a single, contemporary planning approval for its open cut operations and the mining of an additional area within Mt Arthur Coal's current Mining Leases (ML) (referred as the Project hereafter). The area of assessment for this report (i.e. the Project Area) is defined by the EA Boundary, as illustrated on Figure 1.

Specifically, the Project comprises the following:

- An extension of the mine footprint to uncover additional coal reserves within the current Mining and Exploration Leases.
- Increase the Mt Arthur Coal complex approved production levels by 8 Mtpa up to 36 Mtpa run-of-mine (ROM) coal. This will be achieved by:
  - Increasing open cut coal production by up to 8 Mtpa; and
  - Having the flexibility to increase either open cut or underground production by an additional 4 Mtpa if the maximum production from either underground or open cut methods is not being met.
- Relocation of a section of Edderton Road in approximately 2019.
- Upgrade of the existing Mt Arthur Coal Coal Handling and Preparation Plant (CHPP) to wash up to 36 Mtpa of ROM coal and allow the inclusion of an ultra-fine coal circuit to re-process fines and facilitate increased resource recovery and reduced water demand.
- An increase in the approved rail haulage capacity in line with the increased ROM coal production from 19 Mtpa to 27 Mtpa, with the construction of a second rail load out facility and associated conveyor system.
- Modifications to existing infrastructure (such as workshop and bath house), construction of additional ROM coal hoppers and the extension of ROM and product coal stockpiles.
- A total workforce of approximately 2,600 at peak production, which represents an increase of approximately 1,610 from current staffing levels and an estimated additional 720 positions directly attributable to Project.

The planned Project life is until the end of 2022 and would involve an ongoing series of linked open cut developments and an underground longwall mine.

Coal would continue to be washed at the existing CHPP, with the product coal either railed to the port of Newcastle or transported by conveyor to the nearby Bayswater Power Station. A proportion of ROM coal would bypass the CHPP (i.e. would not need washing). Tailings (fine reject) material from the CHPP would initially continue to be deposited into a nearby open cut void, followed by the development of an above-ground tailings storage facility at the Bayswater No. 2 colliery (refer Figure1). Overburden and other mining waste, including coarse reject from the CHPP, would continue to be placed in areas adjacent to and within completed open cut areas.

Water for the CHPP, dust suppression and other non-potable uses would be obtained from a variety of sources, including recovery from the tailings storage, mine water storage dams, decommissioned open cuts, active open cuts, underground mining areas, water sourced from Muswellbrook treated sewage effluent and water imported to site from the Hunter River using water licences held by Mt Arthur Coal.

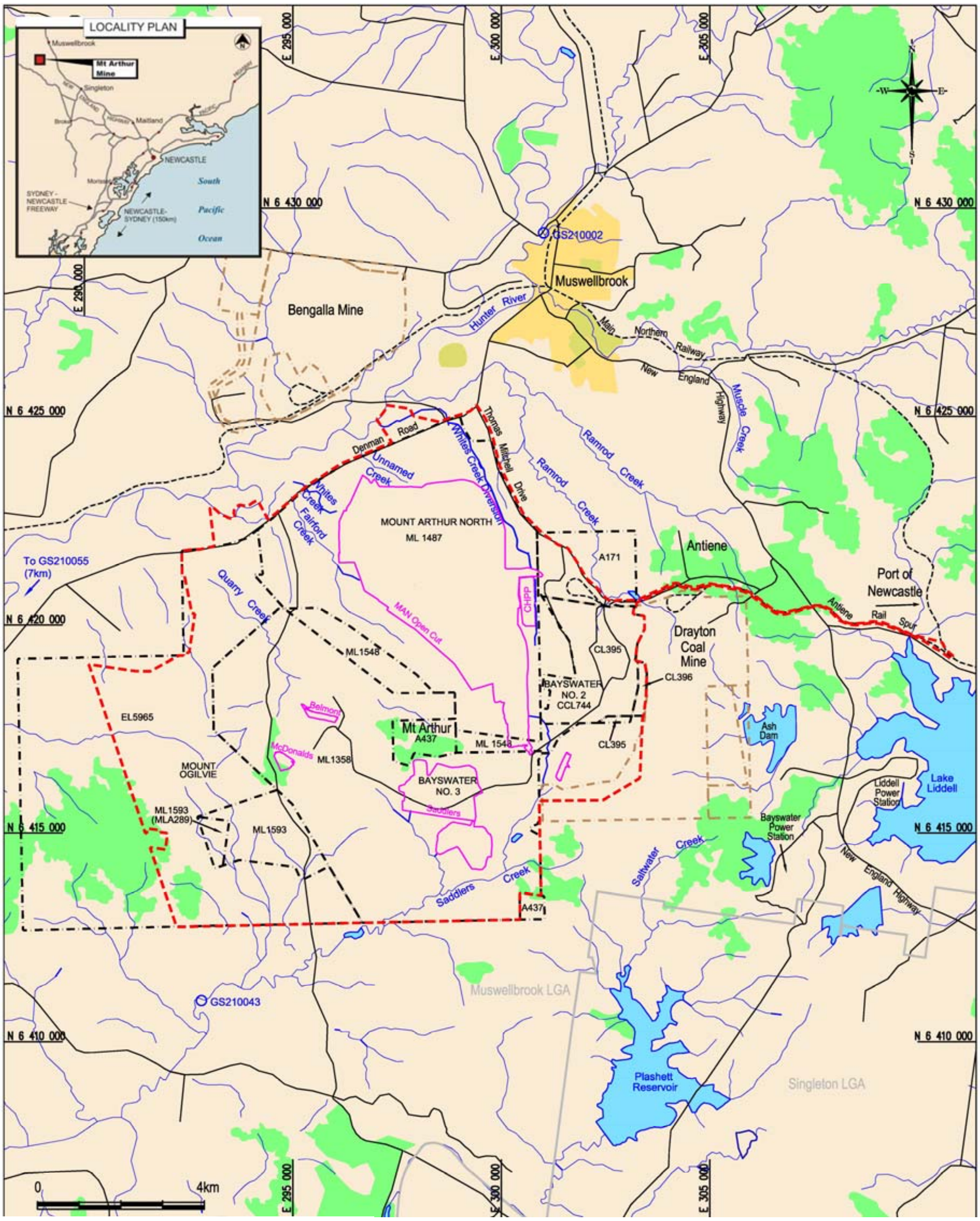
This report summarises the findings of a surface water impact assessment conducted by Gilbert & Associates Pty Ltd to support a Project Approval Application under Part 3A of the *Environmental Planning and Assessment Act 1979*. The specific scope of work for the surface water assessment was to include the following:

- Identification of surface water resources or usage in the vicinity of the site which could be impacted by the Project;
- Assessment of the potential for any surface water impacts resulting from the Project;
- Assessment of post-mine surface water impacts including predicted final void water levels;
- Assessment and description of the existing surface water hydrology, including drainage surface water quality and downstream water usage;
- The development of appropriate surface water management strategies for all water types generated by the Project including mine pit water, process water and runoff from disturbed and undisturbed areas;
- The development of a revised water balance for the site;
- An assessment of any potential for flooding from the Hunter River and/or afflux and recommend any required mitigation measures;
- Identification of any surface water impact mitigation measures necessary for the Project; and
- Identification of any revisions required to the surface water monitoring and management program.

The surface water assessment draws on the results of a hydrogeological study completed for the Project by Australasian Groundwater and Environmental Consultants (AGEC)[1]. Mt Arthur Coal provided information on the existing mining and processing operations and the layout of Mt Arthur Coal. Hansen Bailey provided information on proposed future operations and the future layout of the site as part of the Project.

The Director-General's Environmental Assessment Requirements issued by NSW government agencies in response to the planning focus process are provided in the main text of the Mt Arthur Coal Consolidation Project EA Report.

[1] Appendix G of the Mt Arthur Coal Consolidation Project EA Report.



EA Boundary
Mt Arthur Mining Leases
Other Mining Leases
Roads
Railways
Creeks
Local Government Boundary

Figure 1 Regional Location

2.0 EXISTING SURFACE WATER HYDROLOGY

2.1 Site Location, Topography, Land Use and Drainage

Mt Arthur Coal is located in the central Hunter Valley coalfields, approximately 5 kilometres (km) southwest of Muswellbrook. The EA Boundary covers an area of approximately 113 km^2 and is located south of the Hunter River (refer Figure 1). The site topography comprises mostly undulating hills, with Mount Arthur rising as the dominant landscape feature. Surface elevations vary from approximately 140m AHD along Denman Rd to the north of the Project Area and up to 454m AHD at Mount Arthur.

Land usage other than mining in the local area includes residential and rural residential dwellings and industrial operations, while alluvial lands near the Hunter River are utilised for crop production including vineyards and orchards, thoroughbred breeding and cattle grazing. Much of the surrounding lands have been cleared of original vegetation cover and are predominantly grassland. Areas of original and remnant vegetation are scattered throughout the Project Area especially on Mount Arthur (conservation reserve), within the headwaters of Saddlers Creek (conservation zone) and in the western portions of the Project Area near Mount Ogilvie.

Surface drainage generally comprises ephemeral creeks with headwaters within the Project Area flowing north and south-westwards, ultimately draining into the Hunter River. Quarry Creek, Ramrod Creek, Fairford Creek, Whites Creek and several small unnamed creeks flow northwards into the Hunter River on the northern side of the existing mining operations. Saddlers Creek has its headwaters in the south of the Project Area. Saddlers Creek flows generally to the south-west (refer Figure 1) and joins the Hunter River downstream of Denman. The Hunter is one of the largest coastal catchments in NSW, with a catchment area of some 22,000km^2.

2.2 Climate

Mt Arthur Coal experiences a dry temperate climate with an annual average rainfall of approximately 620mm. Long-term historical rainfall data is available from numerous established Bureau of Meteorology stations in the surrounding region. The closest station with a long-term record is located in Muswellbrook at Lower Hill St (Station No.61053 with 139 years of record). Rainfall statistics calculated from rainfall recorded at Muswellbrook are summarised in Table 1 below.

Whilst rainfall is spread throughout the year, it is on average greater in the summer months. The highest recorded monthly rainfall was 377.6mm recorded in February 1955. The heaviest daily rainfalls have been recorded during late summer (January to March) and early winter (May and June). The maximum rainfalls recorded in the second half of the year have, by comparison, been significantly lower – refer Table 1.

Table 1
Summary of Monthly Rainfall Statistics – mm
(Muswellbrook 61053 (Lower Hill St) – 1870 to 2009)*

Month	Mean	Median	10%ile	90%ile	Highest Monthly	Lowest Monthly	Highest Daily
January	69.3	57.8	17.8	140.2	250.5	0.3	110.5
February	67.2	50.5	7.6	135.4	377.6	0	161.8
March	52.4	40	7.6	105.3	249.9	0	152.1
April	43.7	35	5.2	84.4	191.9	0	77.5
May	41.1	27.9	5.8	97.7	262.4	0	122.7
June	50.9	34.5	9.7	112.8	284.4	0	111.8
July	44.1	35.2	6.6	95.5	193.7	0	78.7
August	38.7	31	8.2	72.4	213.4	0.3	54.1
September	40.9	31	9.7	81.2	172.1	1.8	81.5
October	48.7	41.9	10.8	90	189	0.2	86
November	55	48.6	9.4	104.4	205	0	58
December	67.3	60.2	17.9	134.9	224.9	1	93.6
Annual	620	611.6	397.4	836			

* From www.bom.gov.au

Thematic mapping of evaporation published by the Bureau of Meteorology[2] indicates that areal average potential evaporation at Mt Arthur Coal is approximately 1,740 mm/year – refer Table 2 below. Evaporation data measured at the nearest Bureau of Meteorology pan evaporation station at Scone from 1965 to 2009, located approximately 30 km north of the Project is 1,584 mm/year.

Table 2
Monthly Potential Evapotranspiration and Evaporation at Scone SCS – mm

Month	Average Monthly Point Potential*	Mean Evaporation at Scone**
January	220	217
February	210	175
March	165	155
April	130	108
May	80	68
June	65	48
July	70	56
August	95	81
September	125	121
October	165	153
November	195	189
December	220	213

* Point potential is defined as the evapotranspiration that would take place if there was an unlimited supply of water from an area so small that local effects do not alter air mass properties.

** From www.bom.gov.au

[2] "Climatic Atlas of Australia", Bureau of Meteorology, 2001.

A comparison between mean monthly rainfall and potential evapotranspiration over the data period indicates that the area has an excess evaporative capacity over rainfall in all months on average (refer Table 3), and can be classified as having a semi-arid climate. There is significant variability in monthly rainfall and there will be periods when rainfall will exceed evaporation. These wetter periods may occur at any time during the year and may last for several months.

Table 3
Average Monthly Rainfall and Evapotranspiration - mm

Month	Potential Evapotranspiration	Mean Monthly Rainfall*	Potential Rainfall Excess
January	220	69.3	-150.7
February	210	67.2	-142.8
March	165	52.4	-112.6
April	130	43.7	-86.3
May	80	41.1	-38.9
June	65	50.9	-14.1
July	70	44.1	-25.9
August	95	38.7	-56.3
September	125	40.9	-84.1
October	165	48.7	-116.3
November	195	55	-140
December	220	67.3	-152.7
Annual	1740	619.3	-1120.7

* Muswellbrook Lower Hill St, Bureau of Meteorology

Maps published by the Institution of Engineers Australia (IEAust, 1987) indicate that rainfall intensity generally tends to reduce with distance from the coast. Rainfall intensity is also locally affected by the orographic influence of the Great Dividing Range. Short duration[3] rainfall intensity data from nearby Muswellbrook has been compared with representative areas in the Hunter Valley and nearby coastal centres of NSW in Table 4 below.

Table 4
Comparative Rainfall Intensities – mm/hr

Location	1 in 2 year ARI*, 1 hour	1 in 10 year AR1, 1 hour	1 in 50 year ARI, 1 hour	1 in 100 year ARI, 1 hour
Scone	24.5	34.2	44.5	52
Muswellbrook	22.7	32.5	44.4	49.8
Maitland	29.9	43.6	59	66
Newcastle	35	49.5	66	73
Sydney	41.9	63	87	97

* Average Recurrence Interval

[3] Short duration (one-hour) storm event data was assessed because of its significance to flows in small local catchments such as those at Mt Arthur Coal.

2.3 Catchments

The Project Area is located wholly within the Hunter River catchment, which is one of the six major regulated river basins in NSW. Flow regulation in the Hunter River is provided by three main water storages – Glenbawn, Glennies Creek and Lostock. These storages are operated by the NSW Department of Water and Energy (DWE) to provide flows for irrigation and other uses, including mining and power generation in the valley. Glenbawn Dam also provides flood mitigation in the lower Hunter River with a substantial reserve storage held for this purpose. The NSW Department of Environment and Climate Change (DECC) administers a salt trading scheme on the Hunter River under a statutory regulation as part of the *Protection of Environment Operations Act, 1997*[4] . The scheme is used by a number of coal mines and power stations – it is known as the Hunter River Salinity Trading Scheme (refer Section 2.8).

All creeks within the EA Boundary appear to be ephemeral. The central and northern parts of the Project Area are drained by creeks flowing northward to the Hunter River (refer Figure 1). Some of the creeks' catchments have been modified by mining, including Quarry Creek, Fairford Creek, Whites Creek, a small unnamed tributary and Ramrod Creek. The pre-mine catchment areas of these creeks have been reduced by the development of open cut pits at Mt Arthur Coal (refer Table 5 below). Quarry Creek, which has an estimated total catchment area of 19 km^2, drains the westernmost portion of the Project Area. Fairford Creek, a tributary of Whites Creek has a catchment of 10.8 km^2. Whites Creek, which prior to mining drained an estimated catchment area of 21.5 km^2, has been diverted to the east of the mine. Small unnamed tributaries include a catchment draining the north of the Mt Arthur North Main Pit of 5 km^2. The Ramrod Creek catchment drains some 33 km^2 downstream of the existing mine rail loop and the neighbouring Drayton Coal Mine.

Catchments to the south of the Project Area are bounded by Mount Arthur and an associated ridgeline. Southward flowing tributary gullies report to Saddlers Creek which flows generally in a south-westerly direction (refer Figure 1) towards the Hunter River near Denman. Saddlers Creek has a total catchment of area of 99 km^2.

Table 5
Project Site Catchments – Summary Details*

	Quarry Creek	Fairford Creek	Whites Creek	Whites Creek Diversion	Unnamed Creeks	Ramrod Creek	Saddlers Creek
Total catchment area prior to mining (km^2)	22	10.8	21.5	n/a	4.2	33.4	99
Current catchment area (km^2)	19	10.8	2.2	4.9	5	33.4	93.7
Final landform catchment area (km^2)	21.7	5.8	3.2	17.2	3.7	33.4	93.5

* Derived from 1:25,000 scale Muswellbrook topographic map.

[4] Protection of the Environment Operations (Hunter River Salinity Trading Scheme) Regulation 2002.

2.4 Runoff and Streamflow

As noted in Section 2.3, local streams appear on the basis of site observations to be ephemeral. No local creeks are presently gauged. The only local creek with recorded streamflow data is Saddlers Creek at GS210043 (refer Figure 1) which operated between 1956 and 1981. Summary station details are provided in Table 6[5].

Table 6
Saddlers Creek Gauging Station – Summary Details

Station Number	210043
Period of Record	25/1/56 to 31/10/81
Catchment Area	78 km^2
Average Recorded Flow	1,187 ML/year
Average Rainfall for Recorded Flow Period	618 mm.year
Days with Missing Data	15%
Zero Flow Days	35%
Estimated Baseflow Index*	10%

* Volume of baseflow as a proportion of total flow – derived from daily streamflow hydrograph analysis

A small, although not negligible, spring-fed baseflow component is indicated from analysis of the streamflow record suggesting some flow persistence after rainfall in Saddlers Creek. A low catchment yield of less than 3% is indicated by the data, although this is probably affected by the missing flow data tending to be during periods of higher flow.

The closest gauging stations on the Hunter River are located upstream at Muswellbrook Bridge (GS210002) and downstream at Denman (GS210055) (refer Figure 1). GS210002 has a catchment area of 4,220 km^2 with data available since 1913 (with a large data gap from 1928 to 1960), while GS210055 has a catchment area of 4,530 km^2 with data available since 1959.

2.5 Regional Surface Water Usage

The main surface water usage in the region is from the Hunter River. The Hunter River catchment drains a total of 17,500km^2. Flows in the Hunter River are regulated by the Hunter River Water Sharing Plan under the *Water Management Act, 2000*. They key objective of the Water Sharing Plan is to provide water to support ecological processes and environmental flows in the river, manage water access licences, water allocation, trading of licences and allocations, extraction of water, operation of dams and the overall management of flows. Glenbawn Dam, which is about 30km upstream of the Project Area near Scone, is used to regulate flows downstream including reaches near the Project Area . Water is extracted from the Hunter River for basic landholder stock and domestic rights, while extraction licences for mining, industry, water utility provision, high security and general security entitlements have also been issued. Significant volumes of water are also taken and stored for power station use in Lake Liddell. Downstream of the Project Area, the Hunter River is the major regional source of farm water supply for irrigation, stock watering and domestic use.

[5] Data from DWE Pinneena v9.2 – NSW Surface Water Data Archive.

Agricultural properties located immediately north of the EA Boundary contain on-stream dams which are used for irrigation and stock watering on Whites Creek, Fairford Creek and the un-named creeks to the north-east of the EA Boundary. The majority of these properties are owned by Mt Arthur Coal. Two current private extraction entitlements for less than 16ML of water each for irrigation have been licensed by the DWE on two adjoining properties on Ramrod Creek downstream of the Project Area. Water usage downstream of the EA Boundary at Saddlers Creek includes stock watering and irrigation from on-stream dams. Agricultural users in the region surrounding the EA Boundary may also rely on groundwater bores to provide water for irrigation, stock watering and domestic usage.

2.6 Flooding

The north-western portion of the Project area bordering Denman Road, in the vicinity of Fairford and Whites Creeks, is quite low-lying, with elevations as low as 135m AHD. These areas may be prone to flood waters from the Hunter River in large or extreme floods. The February 1955 flood is widely acknowledged as the largest flood in the region since European settlement. It is estimated[6] that it was equivalent to a 100 year average recurrence interval event. Flow records from GS210001[7] (Hunter River at Singleton) indicate a peak daily flow at this location of approximately 867,000ML – this is more than twice the peak daily flow of approximately 374,000ML recorded at the same station during the recent June 2007 floods. Recorded flood levels along the Hunter River for the 1955 flood have been sourced from Muswellbrook Shire Council. A peak flood level of 135.73m AHD was recorded adjacent to Whites Creek (with the level falling downstream towards Fairford Creek).

2.7 Local and Regional Surface Water Quality

2.7.1 Monitoring Program

Mt Arthur Coal have conducted an extensive water quality monitoring program and have provided a database of water quality observations with site data from 1995. Baseline water quality monitoring for the Project has been undertaken at numerous sites, including local creeks and mine site water storage dams. Monitoring locations include sites on Quarry Creek, Fairford Creek, Whites Creek, Whites Creek Diversion, sediment dams, the Environmental Dam, the Bayswater Main Dam, Ramrod Creek and Saddlers Creek (refer Figure 2 for monitoring locations). There is also a significant amount of data available from water quality monitoring studies conducted by others on the Hunter River.

[6] As advised by Muswellbrook Shire Council.
[7] Data for GS210055 and GS210002 near the Project area were not available for this flood.

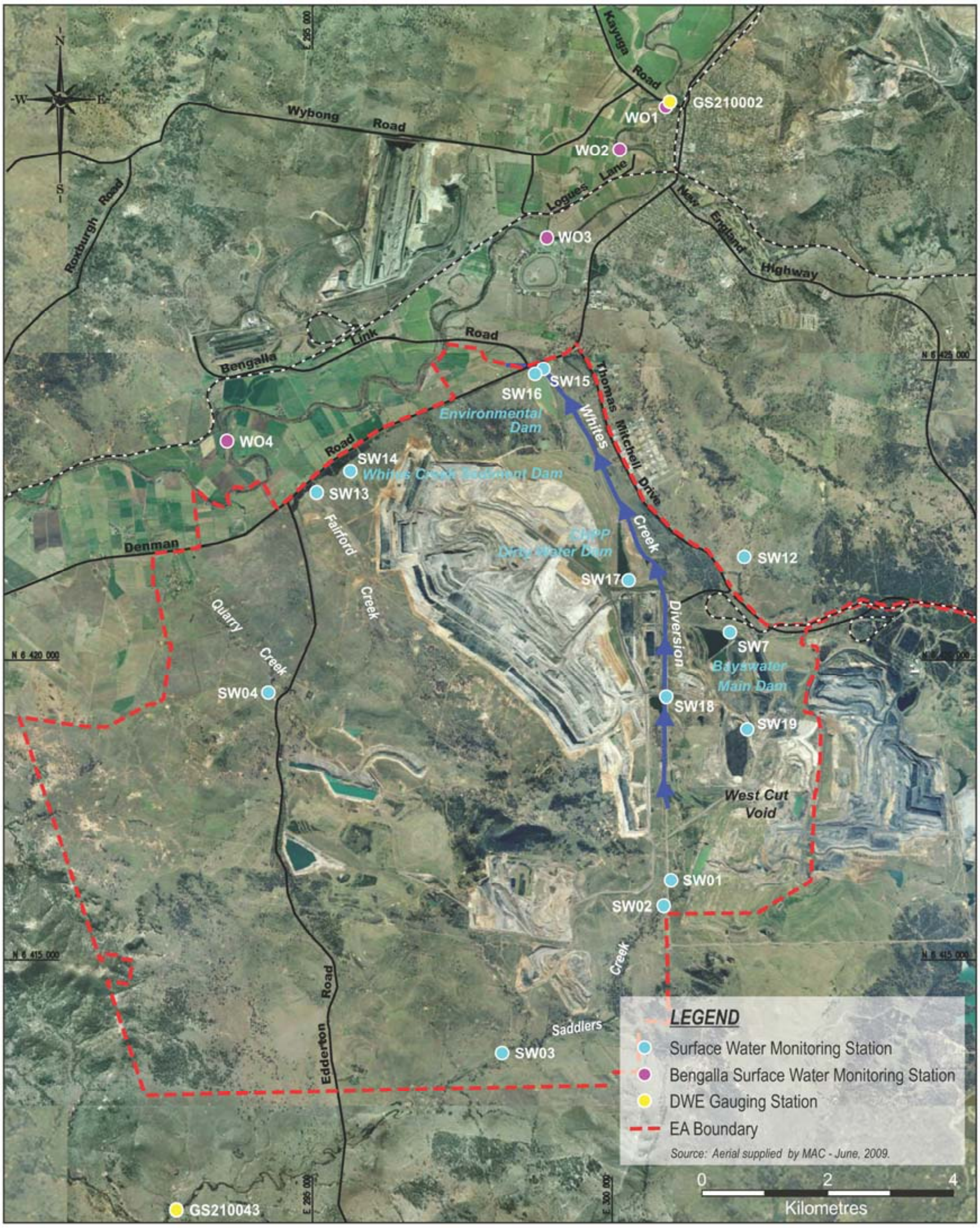


Figure 2 Water Quality Monitoring Locations

2.7.2 Local Creeks

Surface water quality data from the Mt Arthur Coal database has been compared to the ANZECC (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (herein referred to as the 'Guidelines'), which provides a framework for water quality assessment and management (refer Table 7 and Figure 2). Median pH, electrical conductivity (EC), total suspended solids (TSS), totals dissolved solids (TDS), filtered iron, nitrate and sulphate data from the Mt Arthur Coal database were compared with guideline triggers for south-eastern Australian upland rivers, livestock drinking water quality, and aquatic ecosystem condition levels for slightly to moderately disturbed systems. These parameters were chosen for assessment due to their potential for impact by mining related activity and by use of Muswellbrook treated effluent as part of the mine's water supply. Table 7 provides summary statistics for these parameters.

Median pH in local creeks has a tendency to trend towards alkaline levels with the exception being upstream Saddlers Creek within the EA Boundary and Fairford Creek in the northern reaches of the EA Boundary. Median EC (a measure of salinity) was observed to exceed guideline recommended triggers at all monitoring locations. A large variability in EC values was observed at most sites. Median TSS concentrations were within recommended guideline trigger levels for South-east Australian upland rivers at all monitoring locations except for Fairford Creek. A large variability in values was observed at all sites. Median TDS concentrations displayed the same general trend as EC and highest concentrations were observed at upstream Saddlers Creek and Quarry Creek, although all monitoring locations displayed a large variability in recorded values. Median filtered iron concentrations were highest at the monitoring location on Fairford Creek. Median nitrate levels were well below the recommended guideline level for slightly to moderately disturbed ecosystems at creek monitoring sites, except for the Fairford Creek monitoring location. Median sulphate concentrations were highest at the Saddlers Creek and Ramrod Creek monitoring locations and lowest at Fairford and Quarry Creeks. A large variability in recorded values of sulphate was noted at all sites. Sulphate concentrations were generally high, relative to most undisturbed creek systems, and is the dominant cation at all monitoring sites.

Water quality monitoring time series plots are shown in Attachment A.

2.7.3 Mine Water Storages

Water quality in mine water storages is highly variable, depending on prevailing climatic conditions and mining operations. Water quality monitoring time series plots are shown in Attachment A, while Table 8 provides summary statistics. The mine water management system is maintained as a closed system, with controlled releases only occurring from the Environmental Dam under a licence issued by the Department of Environment & Climate Change (DECC) as part of the Hunter River Salinity Trading Scheme (HRSTS).

Table 7
Summary of Statistics of Local Creek Baseline Water Quality Data

	Site:	SW1	SW2	SW3	SW4	SW12	SW13	SW15	SW18	ANZECC (2000) Guidelines (mg/L)		
Parameter		Saddlers In	Saddlers In	Saddlers Out	Quarry Creek	Ramrod Creek	Fairford Creek	Whites Creek Diversion	Above Whites Creek	South east Australia Upland Rivers	Livestock Water Quality	Slightly - Moderately Disturbed Systems
	Dates Sampled	7/1/95 - 17/3/09	2/6/95 - 17/3/09	2/6/95 - 17/3/09	2/6/95 - 17/3/09	6/7/99 - 17/3/09	2/4/01 - 24/8/07	18/9/02 - 17/3/09	8/11/04 - 17/3/09	-	-	-
pH	min	6.4	6.9	6.6	6.9	7.0	0.0	7.2	6.9	6.5 to 8.0	-	-
	max	8.4	8.6	8.7	9.1	9.6	9.0	9.5	9.3			
	median	7.2	7.8	8.1	8.4	7.8	7.4	8.2	8.3			
	mean	7.3	7.7	8.0	8.3	7.8	7.2	8.2	8.3			
EC (µS/cm)	min	1,000	1,380	760	490	980	120	545	1,090	125 to 2,200	-	-
	max	13,300	16,300	10,050	16,730	7,000	1,150	6,800	5,180			
	median	8,550	8,100	6,220	9,045	5,100	420	3,160	2,615			
	mean	8,334	7,793	5,944	9,034	5,069	440	2,894	2,850			
TSS (mg/L)	min	1	1	1	1	1	9	1	2	6 to 50	-	-
	max	363	580	120	240	2,030	3,300	234	450			
	median	9	10	4	5	10	235	18	7			
	mean	24	24	8	16	97	513	22	18			
TDS (mg/L)	min	1,500	870	550	310	2	150	305	700	-	<2,000 to <4,000	-
	max	9,300	15,000	6,200	9,000	4,900	700	4,550	3,800			
	median	6,970	6,600	4,000	5,530	3,600	290	2,320	1,860			
	mean	6,483	6,077	3,771	5,579	3,516	296	1,975	1,993			
Filt Iron (mg/L)	min	0.01	0.01	0.00	0.01	0.00	0.15	0.01	0.00	-	-	-
	max	1.25	0.50	0.30	0.58	0.27	11.0	1.70	0.11			
	median	0.03	0.02	0.03	0.03	0.05	1.68	0.05	0.02			
	mean	0.08	0.06	0.04	0.05	0.04	2.43	0.08	0.03			
Nitrate (mg/L)	min	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-	-	<0.7
	max	16.0	5.3	3.1	5.3	3.1	20.0	7.0	0.8			
	median	0.4	0.4	0.2	0.4	0.2	1.3	0.2	0.2			
	mean	0.6	0.8	0.5	0.9	0.4	3.0	0.6	0.2			
Sulphate (mg/L)	min	220	310	0	14	240	1	75	270	-	-	-
	max	9300	6100	1700	2350	4400	250	1950	1400			
	median	2800	2500	361	250	1300	10	713	800			
	mean	2631	2540	396	328	1404	22	655	820			

Table 8
Summary of Statistics of Mine Water Storage Baseline Water Quality Data

	Site:	SW7	SW14	SW16	SW17	SW19
Parameter		Bayswater Main Dam	Whites Creek Sed. Dam	Environmental Dam	CHPP Dirty Water Dam	West Cut Void
	Dates Sampled	6/02/95 - 21/06/07	17/06/02 - 17/03/09	18/11/02 - 17/03/09	13/01/04 - 17/03/09	2/03/01 - 21/06/07
pH	min	7.5	7.4	7.2	7.3	7.0
	max	10	10.1	10.0	10.2	8.5
	median	8.6	8.7	8.5	8.7	7.6
	mean	8.6	8.7	8.5	8.7	7.7
EC (µS/cm)	min	1,820	120	290	910	1,770
	max	7,100	8,690	5,300	5,250	10,030
	median	3,800	2,845	1,560	3,335	6,520
	mean	3,891	2,764	2,127	3,080	6,383
TSS (mg/L)	min	1	1	3	2	3
	max	130	304	297	432	38
	median	6	19	22	11	11
	mean	19	33	31	26	14
TDS (mg/L)	min	710	140	180	600	1,400
	max	5,800	7,300	3,600	3,600	9,000
	median	2,680	1,630	1,000	2,400	4,900
	mean	2,800	1,769	1,390	2,129	4,921
Filt Iron (mg/L)	min	0.01	0.01	0.00	0.01	0.01
	max	0.17	0.66	0.25	0.10	0.50
	median	0.02	0.05	0.05	0.02	0.04
	mean	0.03	0.06	0.04	0.03	0.08
Nitrate (mg/L)	min	0.1	0.0	0.0	0.0	0.4
	max	9.2	20.0	1.1	0.7	6.6
	median	0.7	0.2	0.2	0.2	2.0
	mean	1.7	0.5	0.2	0.2	2.3
Sulphate (mg/L)	min	100	5	10	59	680
	max	3,000	2,900	1,300	1,400	4,600
	median	1,200	278	280	1,000	2,400
	mean	1,271	322	376	890	2,473

Over the period of available data, pH in mine water storages has ranged from 6.9 to 10.2, while EC has varied between 120 and 10,030 µS/cm. Median values are typical of other mines in the area with moderate salinity. TSS has varied from 1 to 450 mg/L with all storages typically exhibiting a large range in observed concentration. TDS displays the same general trend as EC and has varied from 140 to 9,000 mg/L and was highest at the West Cut Void (tailings storage). Iron ranged from non-detectable to 1.7 mg/L in storages, while median values are low. Nitrate concentrations vary from non-detectable to 20 mg/L and were highest at the Whites Creek sediment dam and at the Bayswater Main Dam where treated effluent water from Muswellbrook Shire Council enters the water management system. Recorded sulphate ranges from 5 to 4,600 mg/L, with a peak recorded in the West Cut Void. All sites exhibited a large range of observed values (refer Attachment A).

2.7.4 Hunter River

Salinity, as indicated by EC has been monitored continuously by the DWE at Muswellbrook Bridge (GS210002) upstream of the EA Boundary since early 1992 and at Denman (GS210055) downstream of the EA Boundary since early 1993. EC at both sites has been highly variable due to varying flow and ranges from 93 µS/cm to 938 µS/cm at the Muswellbrook site, and from 168 µS/cm to 1,176 µS/cm at the Denman gauging station. The upstream location has a median conductivity of 439 µS/cm and the median downstream conductivity is 507 µS/cm. EC is influenced by flow as shown in Figure 3 below. There is considerable scatter evident in the correlation relationship at small flows indicating complex behaviour.

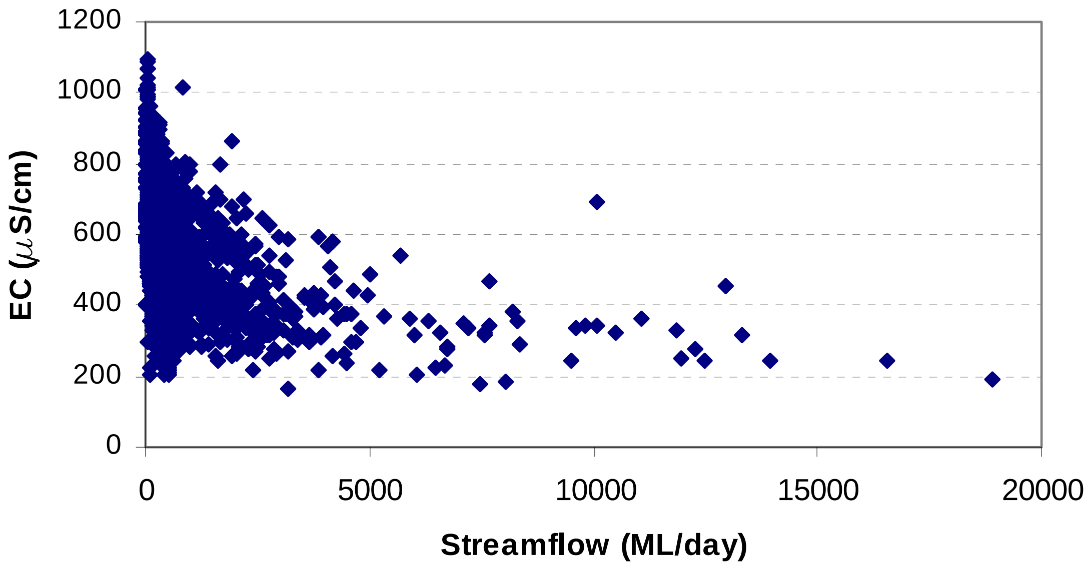


Figure 3 Recorded Electrical Conductivity-Flow Relationships – Hunter River at Denman

The neighbouring Bengalla Coal Mine, located to the north of the EA Boundary on the opposite side of the Hunter River, has monitored pH, EC and TSS in the Hunter River for over four years. Monitoring at monthly intervals and following rainfall events of greater than 15mm in 24 hours have been conducted at four separate monitoring points, which include three upstream monitoring sites and one downstream monitoring site which is located just upstream of the Whites Creek confluence with the Hunter River. The 2008 Bengalla Coal Mine Annual Environmental Management Report (BMC, 2008) has concluded that long term trends for pH and EC indicate that there has been no change to the Hunter River water quality upstream and downstream of the mine.

2.8 Hunter River Salinity Trading Scheme

The HRSTS was originally established by the then Department of Land and Water Conservation (DLWC) and Hunter River Trust in 1995 as a pilot trial to manage salinity discharges to the Hunter, such that salt concentrations would be held below irrigation and environmental standards. The scheme is now managed by the DECC under a statutory regulation attached to the *Protection of Environment Operations Act*

1997[8]. The regulation came into effect on 1 December 2002. The stated objectives of the HRSTS are:

(a) to minimise the impact of discharges of saline water on irrigation, other water uses and on aquatic ecosystems in the Hunter River catchment:

(i) at the lowest overall cost to the community, and

(ii) in a way that provides ongoing financial incentives to reduce pollution, and

(b) to facilitate sustainable water management by industry in the Hunter River catchment.

The scheme attempts to achieve these objectives by prohibiting releases of saline waters during periods of low flow and controlling releases of saline water during periods of high flow such that specific salinity targets at various points in the river are not exceeded. The scheme is administered by a Services Co-ordinator at the DWE, who is responsible for setting and announcing conditions for allowable discharge rates and duration of discharge during periods of high flows in accordance with the salinity targets. The operational parameters used to regulate the scheme are advised on a daily basis for each of the various sections of the Hunter River. The DWE, through the Services Co-ordinator, can apply discount factors and other controls to ensure that the salinity targets are met during announced discharge periods.

Participants in the scheme are issued with tradeable discharge credits. Each credit entitles the holder to a 0.1% share of the available salt discharge capacity announced during high flow periods. The total allowable discharge is determined by the Services Co-ordinator on a day-to-day basis, by reference to salinity targets for the Hunter River catchment – i.e. an EC of 600µS/cm at Denman and 900µS/cm at Glennies Creek and Singleton.

The amount of saline water that may be discharged from a given discharge licence holder is determined by reference to the salinity of the discharge waters, the river flow, the number of credits held and any overriding limit that may be applied as a condition of the licence. Mt Arthur Coal presently holds 25 credits.

[8] Protection of Environment Operations (Hunter River Salinity Trading Scheme) Regulation 2002.

3.0 SURFACE WATER MANAGEMENT

3.1 Existing Water Management System

Mt Arthur Coal's water management system prescribes the system to effectively source, capture, divert, store, monitor, utilise and reticulate water on site. The water management system includes supplies drawn from clean water imported under licence to the mine from the Hunter River, mine water collected from runoff from the mine site, water sourced under agreement from the neighbouring Drayton Coal Mine, water recycling from the CHPP, treated effluent from Muswellbrook and fresh water from the potable water supply system (drawn from Muswellbrook town water).

The water management system is illustrated in schematic form in Figure 4, while Figure 5 shows the layout of the site as at late 2008.

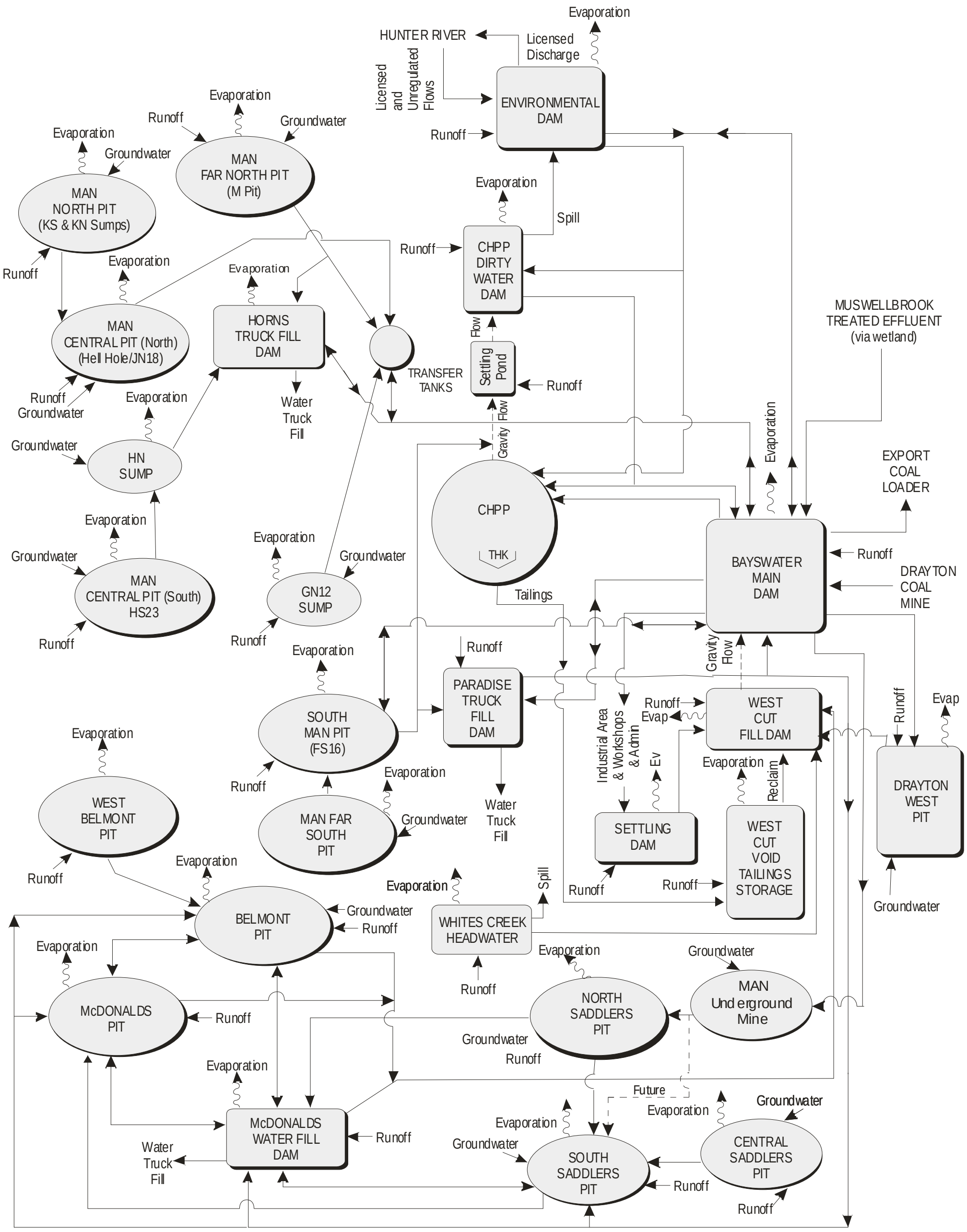


Figure 4 Water management System Schematic

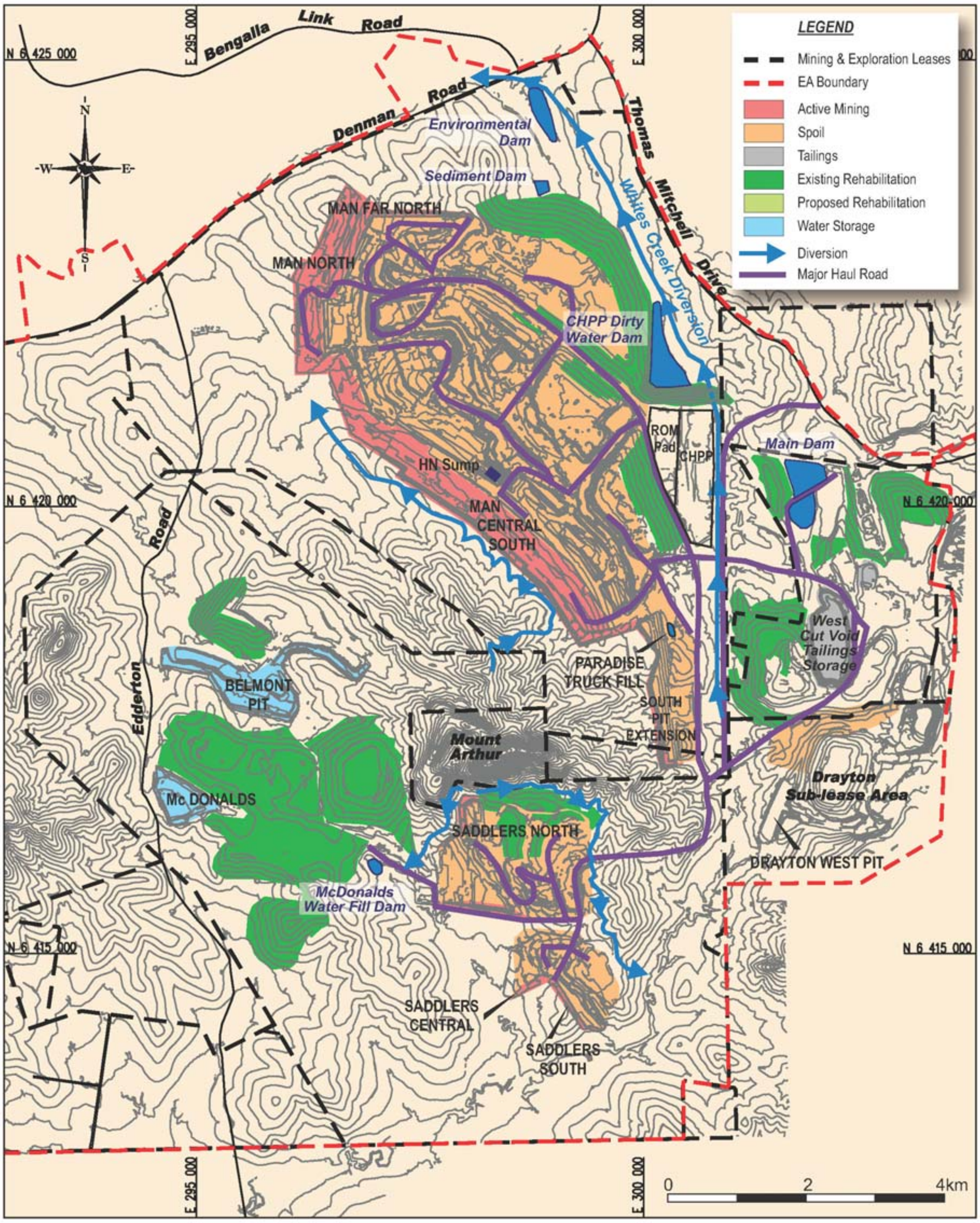


Figure 5 **Existing (2008) Site Layout**

Water supply for the CHPP and other non-potable uses on site is obtained from a network of on-site storages (dams and open cut pits), which provide containment for mine water, runoff and seepage from overburden emplacement areas and runoff from other areas disturbed by the operations. The catchment area of the existing water management system totals approximately 31 km^2. The total capacity of the existing on-site water storages totals approximately 13,500 ML. The CHPP, which is the dominant user of water on site, incorporates a tailings thickener and water recovery system to maximise water recycling. The other significant water use is dust suppression on haul roads and coal stockpile areas. These water requirements are met principally from on-site storages. Potable water is sourced from the Muswellbrook Shire Council mains supply.

The network of on-site storages incorporates separation of undisturbed area runoff from mine water catchment areas. Runoff from areas disturbed by mining is diverted into on-site storages. These storages are used as priority sources of water for the CHPP and dust suppression. Runoff from haul roads and open cut pre-strip operations is either directed to on-site storages or is treated in sediment traps. Runoff from the CHPP area collects in an adjacent sediment pond which overflows to the CHPP dirty water dam, from where it is recycled for site use. Runoff from the industrial area, workshops and administration area collects in a settling dam which is periodically dewatered to a nearby mine water storage dam for site re-use. Treated effluent pumped from Muswellbrook is directed through a wetland for final polishing before flowing into the Bayswater Main Dam. Domestic wastewater is collected and treated in an on-site package plant, prior to being directed to a wetland and then the Bayswater Main Dam.

Mt Arthur Coal has recently secured access to treated effluent from Muswellbrook at a rate of 835 ML/year for a further 10 years (from 1st July 2009). Mt Arthur Coal also envisages that an additional 150 ML/year effluent will be available from mid-2010 following improvements to the Muswellbrook Golf Course irrigation system which uses treated effluent as its primary source of water.

Historically, the majority of off-site make-up supplies have been obtained from licensed extraction from the Hunter River. Mt Arthur Coal presently holds 3,195 ML/year of Hunter River General Security Entitlements (GSE) and 501 ML/year of High Security Entitlements (HSE). Mt Arthur Coal also holds an additional 1,113 ML/year GSE on land which it acquired in the area but which it has leased back to landholders. The volume of water that can be extracted from the Hunter River by licence holders is limited by available water determinations (AWDs) which are announced by the DWE on the 1st July each year (the start of the water year) and then periodically thereafter. At 100% AWD, the full licence volume may be extracted by a licensee in that water year. Historically, during time of drought, AWDs may fall to 0% for GSE and 75% for HSE. However, these AWDs refer only to regulated river flow (i.e. water released from Glenbawn Dam when ordered by the licensee). During periods of naturally high river flow, the DWE may announce ‘off-allocation’ conditions during which AWDs are temporarily suspended and licensees may extract (at a limited rate per day) up to their licensed volume. Water is drawn by Mt Arthur Coal from a pump station on the Hunter River in the north of the Project Area and pumped at a rate of up to 16 ML/day to the Environmental Dam.

Site excess water is transferred from the Bayswater Main Dam to the Environmental Dam from where controlled releases to the Hunter River occur under the HRSTS (refer Section 2.8).

Water liberated from CHPP tailings discharged to the West Cut Void is lost to seepage into adjacent overburden stockpiles. Investigations by Mt Arthur Coal personnel indicate that this water reports to the Drayton West Pit Void (refer Figure 5). Mt Arthur Coal are currently investigating options to recover tailings seepage water. Mt Arthur Coal are also currently in the process of negotiating an agreement with Drayton Coal Mine to access water stored in this void.

The available water sources, the relatively large surface catchment area and storage capacity for mine water have provided Mt Arthur Coal with significant flexibility to manage its water system over a wide range of operational and climatic conditions.

3.2 Project Water Management System – Issues, Principles and Approach

The Project would involve increases in the maximum mining rate over a 13-year forward planning time frame (to mid-2022). Mining rates would ramp up to 24.66 Mtpa by mid-2011 and 36 Mtpa by mid-2014. 3 Mtpa would bypass the CHPP, with the remainder being washed (i.e. maximum 33 Mtpa by mid-2014). The capacity of the CHPP would be increased by constructing three additional modules, each with a nominal capacity of 1,000 tonnes/hour.

Water management for the Project would continue to be based on adherence to well-established, best water management practices in the Australian mining industry[9]. These principles are:

- Efficient use of water based on the concepts of ‘reduce, re-use and recycle’.
- Avoiding or minimising contamination of clean water streams and catchments.
- Protecting downstream water quality for beneficial uses.

As is the case for the current operations, the Project would result in different water types being produced from different areas or parts of the operation.

The principal types of water would be:

- Water dewatered from open cut pits.
- Water dewatered from the underground.
- Runoff and seepage from overburden emplacement areas.
- Runoff and seepage from ROM and product coal stockpiles.
- Supernatant and rainfall yield from the tailings (fine rejects) disposal areas.
- Haul road and hardstand area runoff.
- Runoff from the industrial area, workshop and vehicle re-fuelling area.
- Effluent from the domestic sewage treatment facility.

The management of these waters is dependent on quality, generation rate and the inherent capacity for it to be re-used and/or recycled. The water quality characteristics of the different water types has been assessed from existing experience at Mt Arthur Coal and other coal mines in the region – refer Table 8.

[9] “Mine Site Water Management Handbook”, Minerals Council of Australia, 1997.

Table 8
Indicative Water Quality Characteristics

Water Source/Type	Water Quality Characteristics
Water from open cut pits	Water removed from the open cuts is likely to be saline due to naturally high salt concentrations in groundwater inflows. Some salts will also be leached out of the in-pit overburden emplacements. Moderate suspended solids concentrations are likely to be present in open cut mine water following significant rainfall/runoff events. Past experience at Mt Arthur Coal suggests salinity of water from the open cut would be similar to groundwater salinity in the range 1,750 to 6,500mg/L.
Water from the underground mine	Water removed from the underground will be predominantly groundwater which is likely to have high EC values in the range of 3,500mg/L to 5,500mg/L, with an average pH is typically about 7.5.
Drainage from overburden emplacement areas	Drainage from overburden emplacement areas will report either to the open cut mine workings/voids, or to sediment dams constructed around the perimeter. Based on the results of geochemical investigations[10], it is expected that the water quality of overburden drainage would be better than ANZECC Guideline trigger values for stock water. Leach test EC values were all below 340 µS/cm.
Drainage from ROM and product coal stockpiles	Runoff and seepage from the ROM and product coal stockpiles is likely to contain elevated concentrations of salt and potentially products of sulphide oxidation (predominantly sulphate salts and possibly reduced pH) and will report to the CHPP dirty water dam for re-use in the mine water management system.
Supernatant and internal runoff from the tailings (fine rejects) disposal area	Tailings supernatant will contain salts washed from the coal and reagents (i.e. flocculant) used in the washing process. Based on past experience it is expected that tailings decant water will be moderately saline and the pH will be neutral to slightly alkaline.
Runoff from haul road and hardstand areas	Runoff from these areas is likely to contain elevated levels of fine sediment (wash load) and possibly elevated salinity.
Runoff from the industrial area, export coal loader, workshop and vehicle re-fuelling area	Runoff from these areas is likely to contain elevated levels of fine sediment and possibly hydrocarbons (from minor spills of fuels and oils), although no detectable levels of oil & grease have been recorded in samples from a downstream dam to date.
Effluent from the domestic sewage treatment plant	Effluent from the sewage treatment plant is likely to have elevated levels of suspended solids, nutrients and BOD. Typical water quality parameters from domestic sewage treatment plants are: suspended solids 10-30mg/L, total nitrogen 25-50mg/L, total phosphorus 10-15mg/L and BOD 5-10 mg/L.
Runoff from rehabilitated and revegetated areas	Runoff from rehabilitated areas of the mining operations may initially have elevated suspended solids concentrations, which would then be expected to decline over time as the rehabilitated landform matures.

Ongoing development of the West Cut Tailings storage in conjunction with negotiated access to the Drayton West Pit Void will see tailings water reclaimed for re-use in the water management system via the Bayswater Main Dam. Water recovered from the open cuts and underground operations would continue to be pumped to mine water storages and would also be used to supplement supply to the CHPP.

[10]"Mt Arthur North Coal Project – Geochemical Characterisation of Overburden and Reject Coal", Dames & Moore, April 2000.

During abnormally wet periods leading to an excess of water being generated on site, when the volume of water being held on site was in excess of that required to ensure water supply security and there was an increased risk of disruption to mining as a result of excess water being held in open cut pits, water would be transferred to the Environmental Dam with a view to controlled release under the HRSTS at the next opportunity.

Runoff from haul roads, hardstand and pre-strip areas would either be directed to existing mine water storages (where feasible) or would be captured in sediment retention storages sized to trap silt and other settleable material. During drier weather, water in the sediment dams would be used for dust suppression around the mine. Following prolonged wet periods, water in the sediment retention dams could be released following settlement. Sediment dams would be sized in accordance with the existing Mt Arthur Coal erosion and sediment control plan and with Landcom (2004).

Runoff from workshop, industrial and vehicle re-fuelling areas, which has the highest potential to contain elevated hydrocarbons, would continue to be captured in downslope dams and recycled to the mine water management system. Treated effluent would continue to be recycled to the Bayswater Main Dam via the existing wetland.

Runoff from rehabilitated and revegetated areas would initially either be directed to mine water storages or be directed to sediment retention storages prior to being allowed to drain to local drainages. These areas would be allowed to free-drain as the landform becomes sustainable.

3.3 Water Management System

The water management system at the Mt Arthur Coal Mine comprises the mine and process water circuits (including wastewater and the tailings water) and the inter-linked mine dewatering, water transfer and drainage containment works which are used as water sources for the mining operations. The water management system is shown in schematic form on Figure 4.

3.3.1 System Inflows

The site water sources include groundwater inflow to the underground and open cut mines, which need to be removed to facilitate ongoing safe and efficient mining. Groundwater inflows to both open cut and underground mining activities are predicted to vary over the mine life as the Project evolves. Groundwater inflow predictions for the open cut operations were provided by AGE Consultants and are plotted on Figure 6. In addition, underground mine groundwater inflows have been predicted to vary from approximately 0.5 ML/day at the start of underground mining to approximately 6 ML/day after 21 years (Umwelt, 2008). Water removed from the active mine workings would be pumped to existing mine water supply storages for use in the CHPP and for dust suppression. The mine surface workings would become a sink for incident rainfall and runoff from the open cut and its adjacent un-diverted catchment. This water would also need to be pumped out to enable ongoing safe and efficient access for mining.

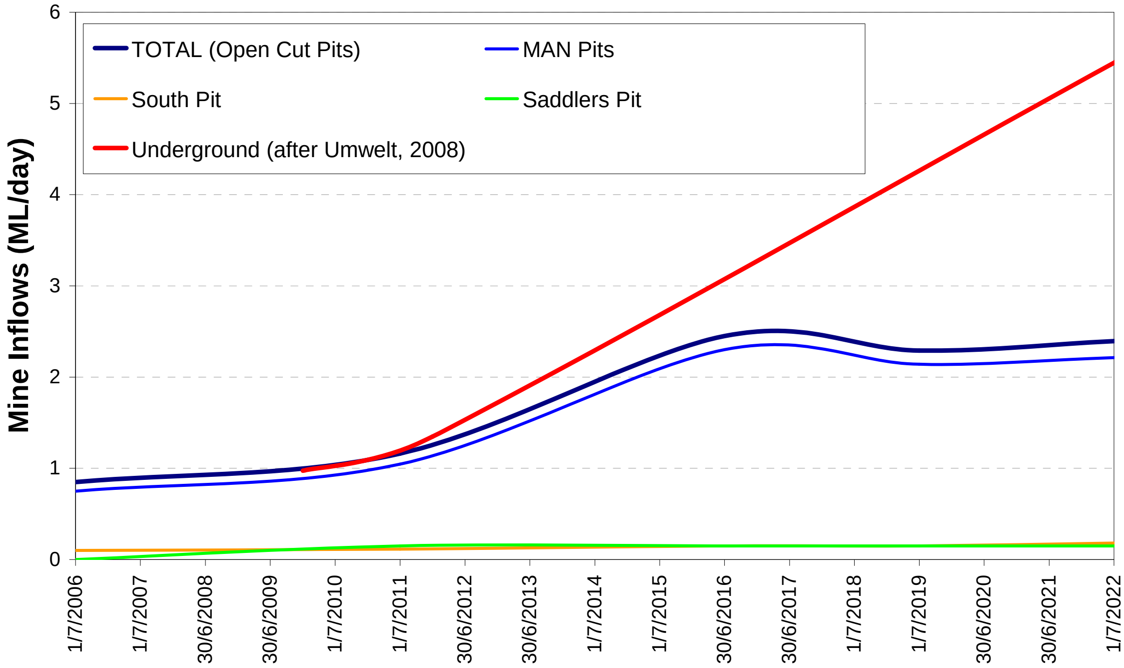


Figure 6 Predicted Mine Groundwater Inflows

Sumps would be excavated in the floor of the active mine open cut pits as part of routine mining operations to facilitate efficient dewatering operations and minimise interruption to mining.

Drainage from overburden emplacement areas would be collected and pumped to water storages for use on site. Where possible, overburden would be placed in worked out areas of the active pits. Drainage from these in-pit overburden emplacement areas would report to the floor of the active pit which advances down dip. Water draining out of the overburden results from both surface runoff and from water infiltrating and seeping through the overburden. Research in the Bowen Basin[11] suggests that infiltration and seepage though coal spoil piles is the main source of drainage.

Supernatant from the tailings storage areas would be captured either directly or via the Drayton West Pit Void and returned to the Bayswater Main Dam for reuse. Incident rainfall over the storage area and the contributing catchment would contribute additional water which would combine with the supernatant generated by the settling and consolidation of the tailings.

3.3.2 Water Use

Water would be needed to operate the CHPP, for dust suppression on haul roads and hardstand areas, for dust emission control sprays in the ROM, product coal and export coal stockpile areas and for the industrial area, principally for wash down of mobile plant. Water would also be used in the underground mine to control dust emissions in active mine areas and for cooling of mine equipment. Some water may also be used for irrigating vegetation establishment areas, fire fighting and other minor non-potable uses.

[11] Issacs L. "Current Research into Open Cut Coal Spoil Hydrology" – 25th Hydrology and Water Resources Symposium, Brisbane, July 1999.

The demand for dust suppression will vary with climatic conditions and with the length of haul roads and area of hardstand that will need to be watered, which will change (increase and decrease) as the Project expands. Similarly the CHPP water demand will vary in accordance with coal production. These water demands have been estimated by factoring current water consumption figures at the mine by the planned coal production schedule for the Project - refer Table 9.

Table 9
Estimated Water Use

Component	Current Rate*	Estimated Future Rate
CHPP Make-up (after thickener recycling)	310L/tonne feed (3,170 ML/a)	310L/tonne feed (up to 10,230 ML/a @ 33 Mt/a)
Haul Road Use	1,170 ML/a	+/- 10%
Industrial Area	45 ML/a	Negligible change
Export Coal Loader (stockpiles)	18 ML/a	Negligible change

* Based on average of 18 months' monitored data to end of April 2009.

3.3.3 Operational Management and Objectives

The water management system would operate predominantly as a closed self-contained system. The water balance of the system would fluctuate with climatic conditions and as the extent and status of the mining operation evolves over time. Depending on the climatic conditions that are experienced during the mine life and the ability to temporarily store water in active open cut pits, there may be periods where discharge of water to the Hunter River may be the best option for managing the system. Under these circumstances, water would be discharged under licence and in accordance with the HRSTS (refer Section 2.8).

There may also be periods when the availability of water on site is insufficient for future site requirements and under these circumstances water would be sourced externally. Water could be sourced either opportunistically from and subject to an agreement with the adjacent Drayton Coal Mine, from Muswellbrook treated effluent or from the Hunter River using licences held by Mt Arthur Coal (refer Section 3.1).

The water management system would continue to evolve over time to meet the changing requirements of the Project. The successful performance of the water management system (as with any mine water management system) would involve having a combination of adequate water infrastructure and the necessary management and monitoring procedures in place to achieve the performance objectives.

The broad objectives of the system are:

1. To maintain a low risk of uncontrolled discharge occurring from the process water (CHPP) or mine water systems over the Project life.

2. To minimise the need to export water and salt to the Hunter River by maximising re-use on site.

3. To minimise the need to extract water from the Hunter River by optimising the reuse and recycling of water on site and by maximising the use of Muswellbrook treated effluent and water from Drayton Coal Mine.

4. To minimise risks of disruption to mining operations by efficient mine dewatering.

5. To ensure that effective control over emission of airborne particulates is not interrupted due to lack of water by maintaining a reliable water supply.

6. To ensure uninterrupted operation of the CHPP by maintaining a reliable water supply.

Mt Arthur Coal would be guided in its decisions on sourcing or discharging water using a recently developed life-of-mine water balance model (refer Section 4.1) which would enable prediction of future water supply security and risks of excess open cut pit water.

3.4 Site Drainage Management Through Project Life

The approach to managing runoff from catchment areas which are undisturbed by surface mining activities is to divert them around surface mining and other disturbance areas, and to isolate mine area runoff from undisturbed areas. The objective of this strategy is to prevent the contamination of water and to reduce the subsequent volumes of water that would otherwise need to be managed on site. Over the life of the Project, this would involve the construction of diversion bunds and drains around the open cut mine and overburden emplacement areas so as to divert runoff from undisturbed and rehabilitated areas to off site drainages. Toe drains and isolation bunds would also be constructed around the perimeter of out-of-pit overburden emplacements and other areas disturbed by mining to collect and convey drainage from these areas to containment storages, thereby isolating mine drainage from undisturbed area runoff. Diversions and drains would be constructed with capacities consistent with their design life and a risk of overtopping determined as part of the on-going revision of the Site Water Management Plan in consultation with the relevant authorities. Drains would be designed to minimize risk of erosion due to high flow velocities by appropriate design of grades, cross-sections and use of vegetation and/or rip-rap. Energy dissipation dams and/or level spreaders would be constructed downstream of all diversions.

The layout and extent of the main drainage management works are shown on Mining Stage Plans, Figure 5 and Figures 7 to 9 and are described below. The concepts presented are subject to final design in the Mining Operations Plan and Site Water Management Plan in consultation with the relevant authorities.

Existing Mine Layout (late 2008)

Figure 5 shows the existing mine layout. Mining is occurring in two areas – Mt Arthur North (MAN) open cut pit and Saddlers open cut (South, Central and North). Overburden is being placed behind mining operations which are advancing down dip (westwards, with the exception of Saddlers Central which is advancing southwards). Runoff and seepage from the overburden emplacements and other areas disturbed by mining activity reports to adjacent active open cut mining areas.

Upslope diversions exist to the north of Saddlers North open cut (directing upslope runoff to a tributary of Saddlers Creek) and to the southwest of the MAN open cut (directing runoff to Fairford Creek). Runoff from a portion of the rehabilitated northern MAN overburden emplacement area is directed via a sediment dam off site.

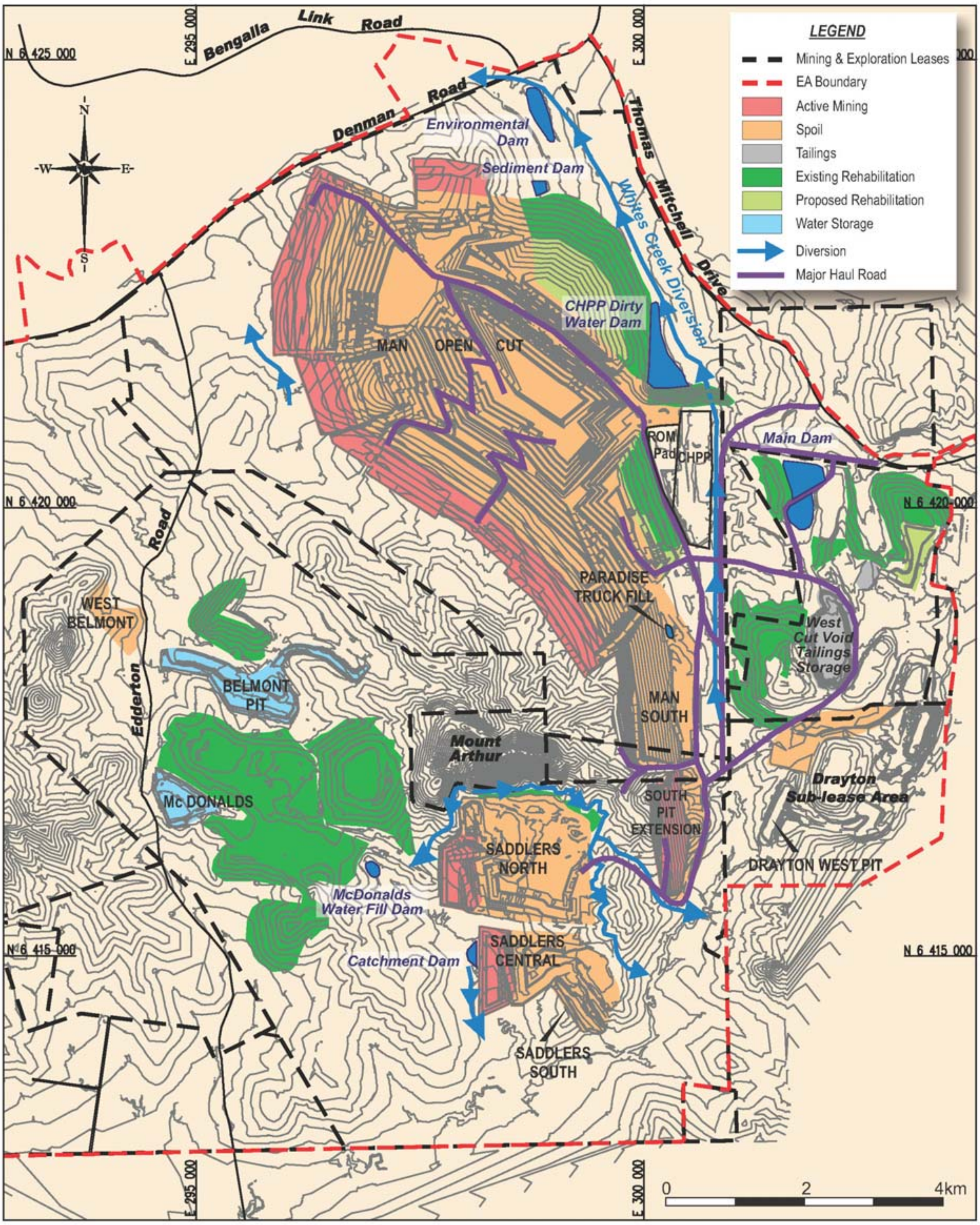


Figure 7 2011 Site Layout

2011 Layout

Figure 7 shows the planned mine layout in 2011. Mining is advancing westwards in the MAN open cut, with an additional pit at the southern end of this strip (MAN Far South). Mining would also have advanced westwards in Saddlers open cut (Central and North). Overburden would continue to be placed behind (generally east of) open cut operations. By this stage, a small satellite pit known as West Belmont would have been developed, with overburden incorporated into the adjacent Belmont Pit overburden emplacement. West Belmont would remain hereafter as a potential access point for the underground mine (prior access was via a drift in Saddlers open cut). Runoff and seepage from overburden emplacements and other areas disturbed by mining activity would continue to report to adjacent active open cut mining areas.

Upslope diversions southwest of the MAN open cut would have been consumed by the advancing mine; with a small diversion of Fairford Creek required around the western extremity of the open cut and a small diversion required around the southwestern extremity of the MAN Far South pit. A diversion around the north-western side of Saddlers North open cut would have been extended, and diversion of a Saddlers Creek tributary would be required to the southwest of Saddlers Central open cut.

Reactivation of overburden placement in the MAN overburden emplacement area would result in runoff from these areas being directed to the Environmental Dam rather than off site.

2016 Layout

Figure 8 shows the planned mine layout in 2016. Mining in the MAN open cut would have advanced further westwards, with continued placement of overburden behind (east of) open cut operations. In addition, overburden from the MAN open cut would be hauled to the McDonalds out of pit overburden emplacement area which would be extended to the north and south to accommodate this material. Mining would also have advanced westwards in Saddlers Central open cut, with overburden placed behind the open cut.

Runoff and seepage from in-pit overburden emplacement areas and most areas disturbed by mining activity would continue to report to adjacent active open cut mining areas. Runoff from the haul road linking the MAN open cut to McDonalds overburden emplacement area would be directed along the road to either the MAN open cut or the Belmont open cut void; while drainage from upslope of the road (through two gully lines) would be directed under the road via culverts. Runoff from the majority of the extended McDonalds overburden emplacement area would be directed to the adjacent McDonalds open cut void. A portion of the overburden emplacement area would drain to the south towards a tributary gully of Saddlers Creek. A catchment dam would be constructed at the head of this gully to capture runoff and seepage from this overburden emplacement area and return captured water to the McDonalds open cut void by pumping. The sizing of this dam would be subject to detailed design as part of development of the Site Water Management Plan in consultation with the relevant authorities.

Upslope diversions southwest of the MAN open cut would be constructed to divert the remaining upper headwaters of Fairford Creek around mining operations. Diversion upslope (west) of Saddlers Central open cut would be relocated further west and extended.

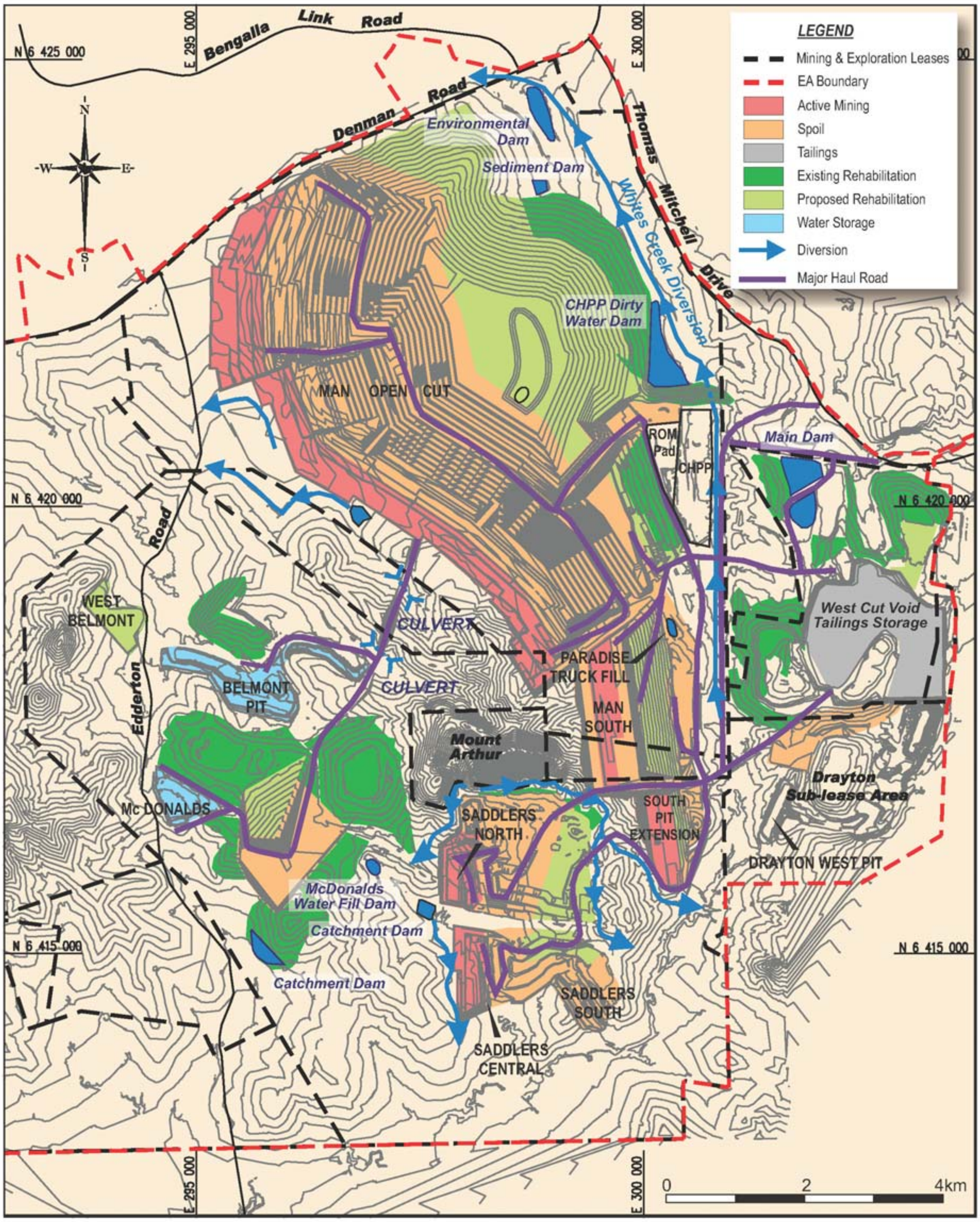


Figure 8 2016 Site Layout

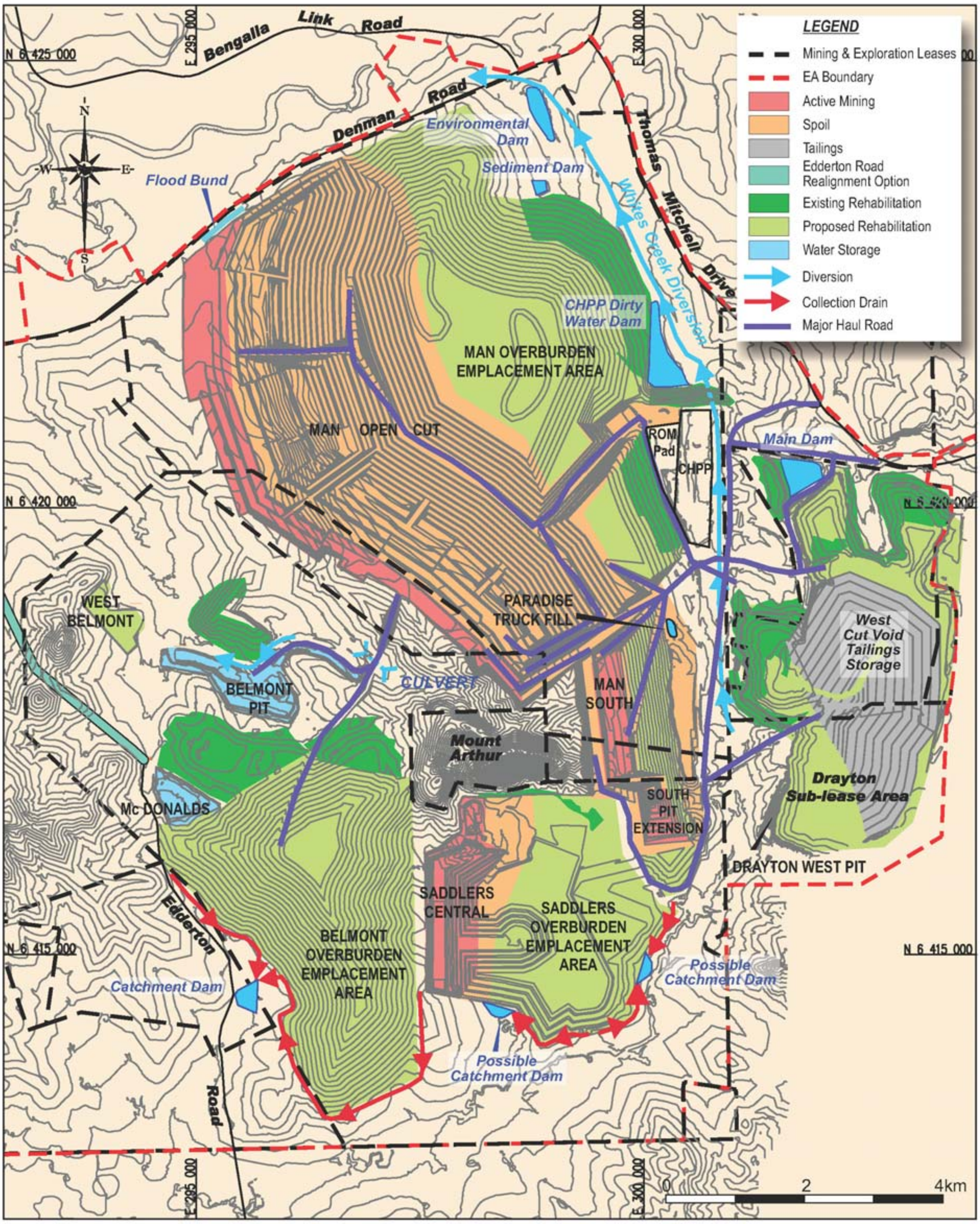


Figure 9 **2022 Site Layout**

It is envisaged that by this stage, runoff from a portion of the rehabilitated northwestern MAN overburden emplacement area would be able to be directed via a sediment dam off site.

2022 Layout

Figure 9 shows the planned mine layout in 2022. Mining in the MAN open cut would have advanced further westwards to encompass most of the Fairford Creek catchment. Overburden from the MAN open cut would continue to be placed to the east of the open cut and in the enlarged McDonalds out of pit overburden emplacement area. Mining would also have advanced westwards in Saddlers Central open cut, forming one large open cut, with overburden placed behind the open cut, backfilling Saddlers South open cut and part of MAN Far South open cut.

Runoff and seepage from in-pit overburden emplacements and most areas disturbed by mining activity would continue to report to adjacent active open cut mining areas. Runoff from the majority of the extended McDonalds overburden emplacement area would be directed to the adjacent McDonalds and Belmont open cut voids or to the Saddlers open cut. A portion of the overburden emplacement area would continue to drain to the south towards a tributary gully of Saddlers Creek and the catchment dam in this gully would be reconstructed downslope (and collection drains/bunds constructed around the toe of the emplacement) to capture runoff and seepage from this overburden emplacement area and return captured water to the McDonalds open cut void by pumping. The sizing of this dam would again be reviewed as part of the revision of the Site Water Management Plan. Runoff from the Saddlers overburden emplacement area should be able to be directed to Saddlers open cut; this would include the construction of toe drains/bunds around the southern perimeter of the emplacement. If directing runoff from this portion of the overburden emplacement area into Saddlers open cut proved impractical by such means, appropriately sized catchment dams would be constructed downslope of the emplacement area in the tributary of Saddlers Creek.

No upslope runoff diversion is envisaged at this stage because, given the topography, the benefit of such diversions is considered low.

Post mining final landform drainage is described in Section 6.1.

3.5 Overburden Emplacement Area Drainage Management

Overburden would be placed in worked out portions of the mine and in designated areas adjacent to the workings. The final surfaces of the overburden emplacements would be constructed to form a regular pattern of ridges and batters. The batters (constructed no steeper than 4H:1V slope) would be shaped into a network of constructed berms which would form “contour” drains at maximum spacings of 150m downslope. Where possible these drains would direct flow to the intersection of the overburden emplacement area and the natural surface. Otherwise flow would be directed to gully lines constructed down the batter. At the end of contour drains and gully lines, sediment traps and settling dams would be constructed for removal of suspended sediment prior to passive drainage off site. These settling dams and ponds would also be constructed at intervals along the gully lines to retard flows and to settle sediment carried in runoff - particularly during the vegetation establishment phase. The settling ponds would be provided with low flow outlets so that the ponds would slowly drain following rainfall-runoff events.

This would achieve a staged approach to removal of suspended sediments from water. Wide shallow by-wash spillways would also be provided to facilitate low energy overflows during the more intense rainfall events. Settling dams would be designed in accordance with Landcom (2004). Within the gully lines where high energy flows or high flow volumes are likely to concentrate, specific hydraulic works such as rip rap scour protection blankets, drop structures or other energy dissipation devices would be installed. A combination of riparian vegetation and rock mulching would be used to stabilise flow pathways in other flow areas in pool and riffle areas respectively.

The final top surfaces of overburden emplacements would also be designed with a network of small drains, directing runoff to the head of batter gully lines.

Freshly placed overburden will have a relatively high infiltration capacity. Water infiltrating the material will either be retained in the pore space or will seep through the overburden. A proportion of the rainfall that infiltrates through the surface of the overburden will be returned to the atmosphere as evapotranspiration. As vegetation becomes established on the rehabilitated overburden emplacements, the hydrological balance will tend to change with a greater proportion of rainfall contributing to evapotranspiration and a reduced proportion of seepage. As the surface vegetation matures moisture levels in the near surface root zone will increase compared to the non-vegetated condition with the result that surface runoff may tend to increase. The erosion potential associated with increased runoff will however tend to reduce by the stabilising and insulating effect of the vegetation, with the result that sediment movement off the rehabilitated and revegetated overburden emplacement areas will tend to reduce.

3.6 Tailings Disposal and Water Recovery

Two waste or rejects streams are produced by the CHPP. It is estimated that approximately 24% by weight of ROM coal feed to the CHPP becomes rejects, with half the rejects coarse and half fine. It is also estimated that the proportion of rejects could rise to as high as 33% by weight of ROM feed. Therefore the rate of future rejects production would increase in line with this and as ROM coal rates increased (refer Section 3.2).

Coarse reject, which has a particle size classification equivalent to a gravel with some silt and clay, is placed as a dry fill incorporated in overburden emplacement areas. It is envisaged that this disposal process would continue as part of the Project.

Fine reject or tailings, which has a particle size classification equivalent to a clayey silt, is pumped as a slurry at 35% solids by weight after thickening in the CHPP (i.e. thickener underflow) to the West Cut Void tailings storage. Water released from settling tailings presently infiltrates into the overburden emplacement abutting the western side of the West Cut Void and is believed to eventually flow into the Drayton West Pit Void. There is no free water pond in the present tailings storage area.

A life of mine tailings storage options study has recently been undertaken (ATC, 2009) which identifies options for disposal of tailings for the life of the Project. The preferred option for future tailings disposal is to continue discharge into the West Cut Void with construction of a confining embankment initially to the north-west of the void as it fills (over the existing West Cut Fill Dam). Additional confining embankments would subsequently be constructed to the south and east of the West Cut Void to form a large tailings storage facility with up to 300ha surface area.

Initial tailings discharge would occur from the south end of the area to “blanket” the overburden at this end of the storage and develop a water pond (water released from settling tailings and surround area rainfall runoff) at the northern end of the storage (by 2012) from where water could be reclaimed by pumping to the Bayswater Main Dam. Once embankments have been constructed around the south and east sides of the area (by around 2014), discharge would occur from the northern and eastern storage periphery forcing the water pond to the storage centre from where gravity decanting of water to the Drayton West Pit Void could occur. Such peripheral discharge would also promote sub-aerial beaching conditions to occur, leading to increased tailings densities, improved storage efficiency and a tailings deposit that is more readily rehabilitated at the end of the Project.

Based on an initial settled density of 0.5 t/m^3 (ATC, 2009), it is estimated that approximately 357 ML of water would be released from settling tailings per million tonnes of tailings. This represents approximately 19% of the volume of water discharged with the tailings or between approximately 1,410 to 1,940 ML/year at 33 Mtpa ROM coal feed.

4.0 SIMULATED PERFORMANCE OF WATER MANAGEMENT SYSTEM

4.1 System Simulation Model

The ability of the water management system to achieve its operational objectives was assessed by simulating the dynamic behaviour of its water balance over the entire Project life under the variable climatic conditions that may be encountered. The water balance model developed for the Project simulates all the inflows, outflows, transfers and changes in storage of water on site on a daily continuous basis from 2009 to 2022. The general components and linkages of the water management system simulated by the model are shown in schematic form on Figure 4.

The model was set up to run over a large number of different daily rainfall sequences compiled from the historical regional record from 1889 onwards. Each sequence comprised a 14-year period – corresponding to the Project life. The sequences were formed by moving along the historical record one year at a time with the first sequence comprising the first 14 years in the record. The second sequence comprised years 2 to 15 in the record while the third sequence comprised years 3 to 16 and so on. The start and end of the historical record was 'linked' so that additional sequences which included years from both the beginning and end of the historical record were combined to generate additional rainfall sequences. Using this methodology 115, 14-year sequences of daily rainfall and evaporation were formulated for use in the model simulations.

The model was based on a water balance model developed for Mt Arthur Coal site personnel and used on site since early 2007, focussing on water supply security. Model operating "rules", storage linkages and pump rates were based on this model. The key aim in the model is to maintain supply to the CHPP (from the Bayswater Main Dam) and the truckfill dams. The model operates using a series of "normal" operating trigger volumes in the water storage dams and voids. In general, when the volume in a storage rises above the high trigger volume, the model attempts to pump water to other storages or (ultimately) to the Environmental Dam for release. When the volume in the Bayswater Main Dam, the Environmental Dam and the truckfill dams falls below a low trigger volume, the model attempts to pump water to these key storages from other storages and from licensed extraction from the Hunter River (in the case of the Environmental Dam).

In order to simulate possible future variations in available water from the Hunter River (one of the key water sources for the Project), the model was integrated with output from the Hunter River IQQM. The IQQM is the model used by the DWE to develop AWDs through the water year (July-June). The IQQM was run using the same climatic data period and Project life sequences as the water balance model, to generate simulated future AWDs and streamflow in the Hunter River near the Project. Available DWE "rules" governing the declaration of "off-allocation" conditions (refer Section 3.1) were incorporated in the model so as to also simulate these events.

The Australian Water Balance Model (AWBM – Boughton, 2004) was used to simulate runoff from rainfall on the various catchments and landforms across the Project Area. The AWBM is a nationally-recognised catchment-scale water balance model that estimates streamflow from rainfall and evaporation. Modelling of the following six different sub-catchment types was undertaken:

- Natural Surface/Undisturbed;
- Overburden Emplacements;

- Rehabilitated Areas;
- Hardstand;
- Open Cut/Mine; and
- Tailings.

AWBM parameters for undisturbed areas were taken from model calibrations undertaken for a nearby stream, while parameters for the remaining sub-catchments were taken from literature-based guideline values or experience with similar projects. Catchment areas were calculated from future mine layout plans provided by Mt Arthur Coal. Figure 10 shows the variation in calculated total catchment and total sub-catchment areas over the Project life. Figure 10 shows that by 2022 the Project catchment would total more than 55 km^2.

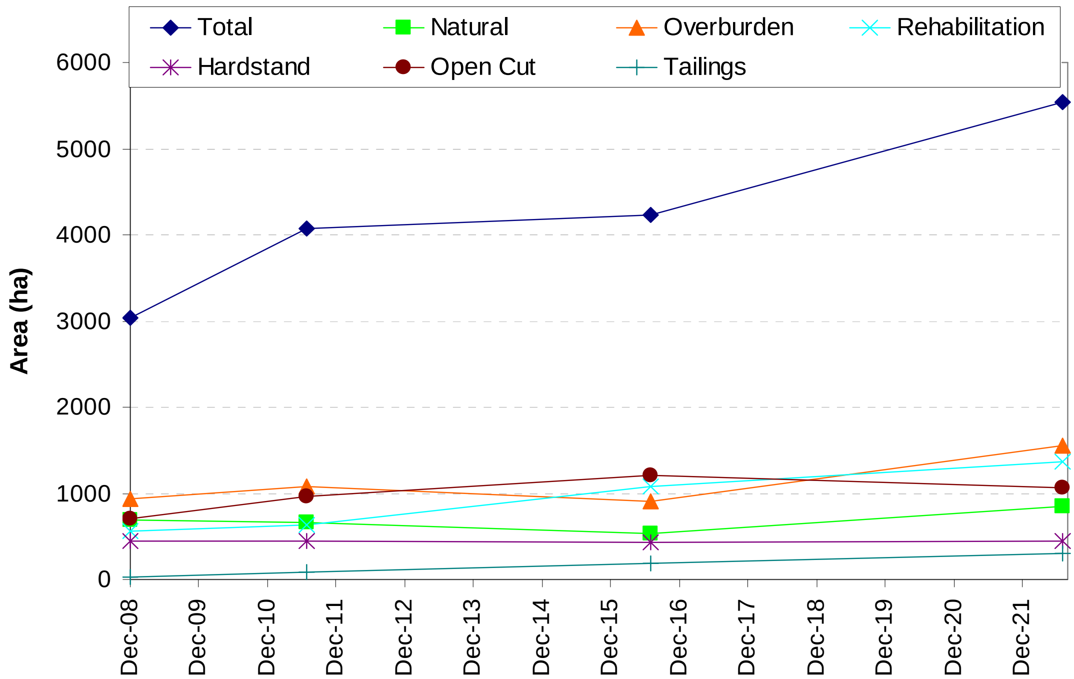


Figure 10 Project Catchment Area Change with Time

Table 10 summarises calculated future water demands used in the model. CHPP demand was based on a make-up requirement of 310 L/t of ROM feed (refer Section 3.3.2).

Table 10
Simulated Project Water Demands (ML/year)

	2009	**2011**	**2014**	**2022**
CHPP	3,410	6,710	10,230	10,230
Truckfill	1,346			
Industrial Area	45			
Export Coal Loader	18			
Underground Demand	82	681		

The model assumes 835 ML/year treated effluent supplied from Muswellbrook, rising by a further 150 ML/year by mid-2010 (refer Section 3.1). Model groundwater inflows were taken from predicted inflow rates by others as detailed in Section 3.3.1. Open cut groundwater inflows were simulated subject to evaporative losses within the open cut. It was assumed that 100 ML/year of the 659 ML/year used in the underground mining operations is recovered as detailed in Umwelt (2008).

Modelling assumed that the Drayton West Pit Void was available for use as an additional water storage, subject to 1,000ML of existing water stored in the pit being kept in reserve for Drayton Coal Mine.

Monitoring data provided by Mt Arthur Coal indicate that approximately 5,500 ML was held in the mine water storages as at the end of April 2009. This was taken as the starting condition in the model.

Current Mt Arthur Coal Hunter River licensed allocations of 3,195 ML/year GSE and 501 ML/year HSE were assumed unchanged for the Project life.

4.2 Simulated System Performance

4.2.1 Overall Water Balance

Figures 11 and 12 below summarise model predicted system inflows and outflows for the Project life averaged over all climatic sequences.

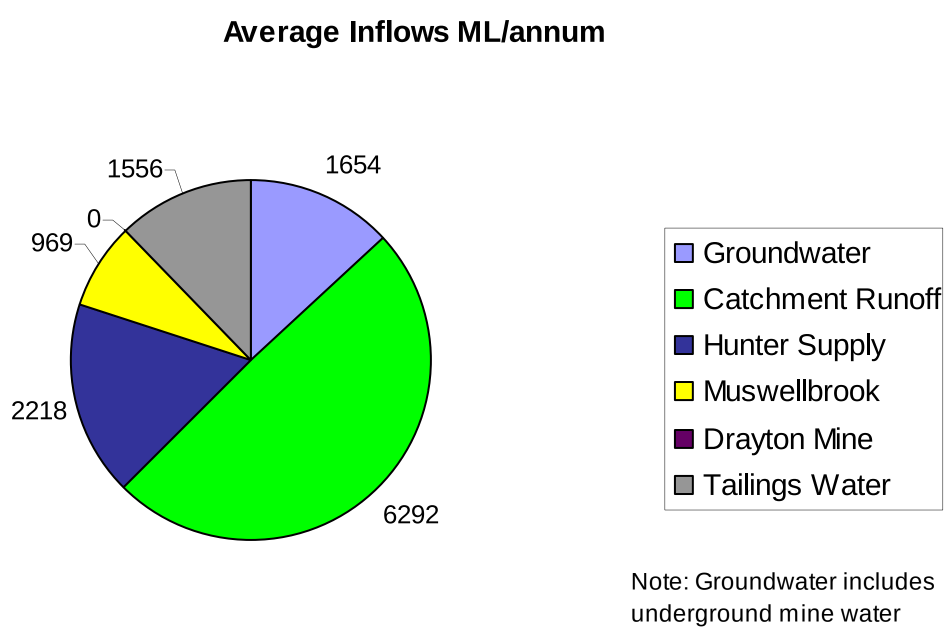


Figure 11 Average Model Inflows

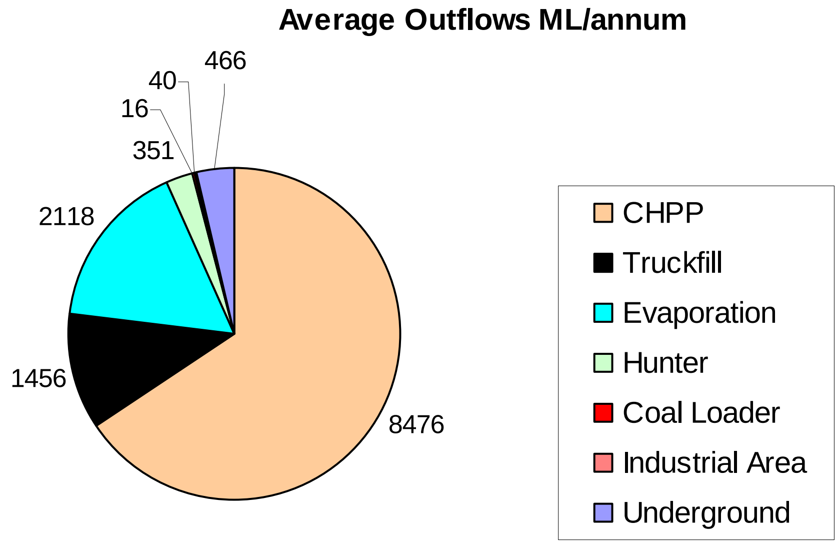


Figure 12 Average Model Outflows

Predicted average inflows total 12,690 ML/year, while average outflows total 12,920ML/year.

Wet (90%ile) and dry (10%ile) rainfall sequences were also simulated. Results of these simulations are summarised in Table 10A below.

Table 10A
Water Balance Model Results
(Averaged over Project Life ML/annum)

	10%'ile Rainfall Sequence (Dry)	Median Rainfall Sequence	90%'ile Rainfall Sequence (Wet)
Inflows			
Catchment Runoff	4967	6271	6992
Groundwater	1660	1654	1649
Hunter River Licensed Extraction	2245	1821	1325
Muswellbrook Treated Effluent	971	970	969
Tailings Water	1239	1239	1239
Outflows			
CHPP	7161	7161	7161
Truckfill (Dust Suppression)	1566	1566	1566
Evaporation	2083	2232	2333
Release to Hunter River	205	267	426
Coal Loader	18	18	18
Industrial Area	44	44	44
Underground	504	504	504

4.2.2 Water Supply

The simulated average water supply reliability for various Project water demands and supply source contributions are summarised in Table 11.

Table 11
Simulated Water Supply Performance

Simulated Performance Indicator	Simulated Value (Averaged over all years in all sequences)
Supply Reliability to:	
CHPP*	95.9%
Haul road dust suppression	93.0%
Underground	92.4%
Coal loader	91.3%
Industrial area	91.3%
Supply source contribution (% of total):	
Catchment runoff	49.6%
Hunter River licensed extraction	17.5%
Tailings water	12.3%
Groundwater**	13.0%
Muswellbrook treated effluent	7.6%

* Reliability expressed as volume of supply divided by volume of demand.
** Groundwater inflow includes underground mine water return (proportion of water supplied).

Model predicted supply reliability assumes that the water supply system would be operated in an unchanged way even if water supplies were drawn down as a result of drought. In reality (as occurred in 2006-07) Mt Arthur Coal would investigate and undertake measures such as use of GSE on land which it has currently leased back to landholders (refer Section 3.1), conversion of GSE to HSE (in accordance with DWE conversion rules) or acquisition of additional Hunter River licences on the open market, either permanent licence or temporary transfer. Mt Arthur Coal would use the water balance model to forecast water supply reliability on an on-going basis and assess the need to implement such measures (refer Section 7).

Model results indicate that on average the majority of site supply would be provided by catchment runoff. Supply from Hunter River licensed extraction would vary through the Project life as indicated in Figure 13 below, which shows average annual calendar year extraction and modelled extremes (annual maxima and minima). Predicted Hunter River extraction correlates with CHPP demand. Note that greater extraction in any calendar year than the total licensed volume of 3,696 ML/year is possible. This is because the licensed volume applies to a water year (July-June) and in practice, it would be possible to extract up to 3,696 ML from January to June of one year and up to another 3,696 ML from July to December of that year (subject to AWDs).

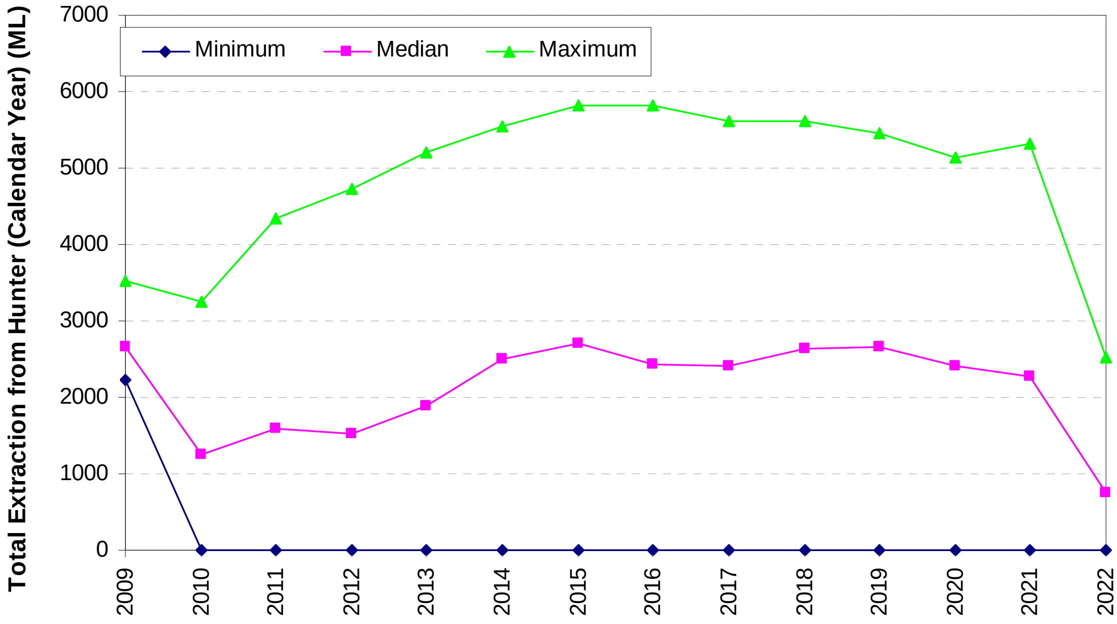


Figure 13 Predicted Annual (Calendar Year) Hunter River Extraction

4.2.3 Controlled Discharge

Figure 14 shows model predicted annual (calendar year) releases from the Environmental Dam – average and modelled annual maxima and minima. Two sets of results are shown: with Project CHPP coal wash tonnages (refer Section 3.2) and with a peak CHPP coal wash tonnage of 25Mtpa (28Mtpa ROM less 3Mtpa bypass) which is the currently approved maximum rate. Any controlled releases from the Project would be made in accordance with the Mt Arthur Coal Environmental Protection Licence and the requirements of the HRSTS. It is estimated that the Project would result in an average decrease of 193 ML/year controlled release from 2012 onwards. The decrease results from a net increase in the demand for water in the CHPP at the proposed higher throughput tonnages.

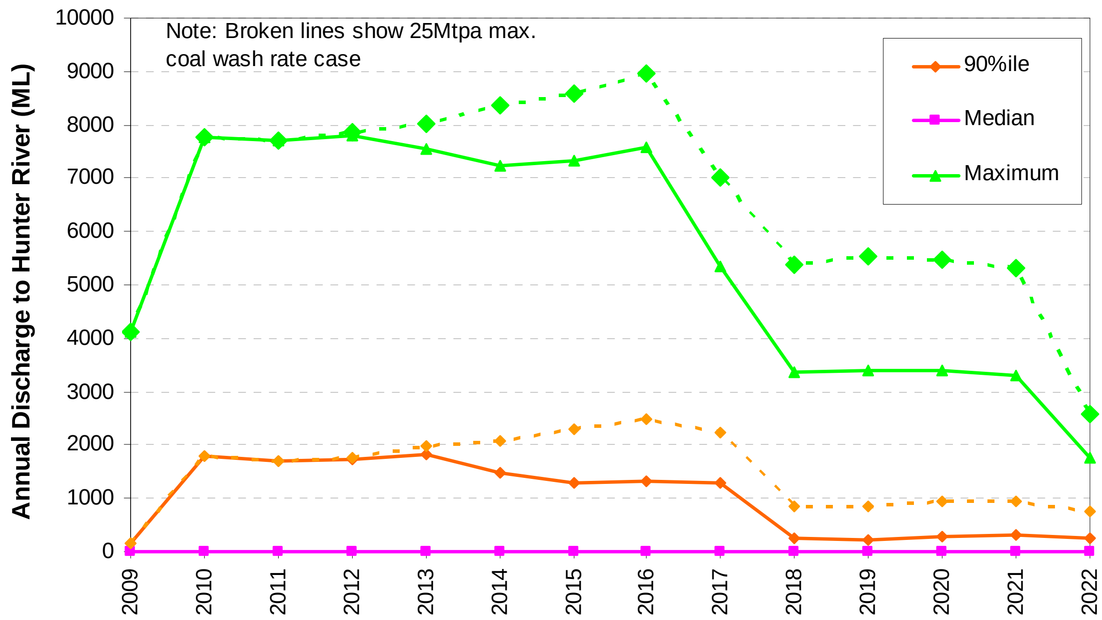


Figure 14 Predicted Annual Hunter River Controlled Discharge

4.3 Water Management Implications

A significant component of the water in the water management system will be derived from drainage from the overburden emplacement areas which will, by 2022, cover more than approximately 1,500 ha (refer Figure 10). Management of these areas will be an important aspect of both water management and the ultimate rehabilitation requirements of the Project. Detailed catchment plans should be developed in advance of mining. These plans should address sediment and erosion control measures required for the initial development (clearing and initial overburden stripping operations), overburden emplacement areas and landform drainage design and re-vegetation scheduling. Drainage design will need to accommodate the changing hydrological response of overburden emplacement areas following rehabilitation and the need to optimise the diversion of runoff from rehabilitated areas away from active mine disturbance areas.

The water balance for the Project will be affected by climatic conditions. The system has the flexibility to accommodate this variability through transient storage in the substantial storage volume available on site and through the ability to both discharge excess water off site and to import water to reduce risk of shortfall. Discharge water to the Hunter River is regulated by the HRSTS to ensure that salinity levels in the river do not exceed target levels required to meet defined beneficial uses. The ability to discharge water to the Hunter River is also dependent on the number of salt credits held (currently 25) and the ability to source water from the Hunter River is dependent upon the licence volume held (currently 3,696 ML/year in total). By monitoring and reviewing the operational performance of the water management system, and using the developed water balance model as a tool, it will be possible to assess the adequacy of the credits and licence volume held by Mt Arthur Coal and to purchase additional credits/licence as required.

5.0 ASSESSMENT OF PROJECT SURFACE WATER IMPACTS

The potential impacts of the Project on local and regional surface water resources are:

- Changes to flows in local creeks due to expansion and subsequent capture and use of drainage from mine area catchments.
- Potential for export of contaminants (principally sediments and soluble salts) in mine area runoff and accidental spills from containment storages (principally sediments, soluble salts, oils and greases), causing degradation of local and regional water courses.
- Short term increases in salinity during periods of licensed discharge under the HRSTS.

5.1 Flow Regime in Local Creeks

The effect of runoff capture from the expanding mine area on local creek catchment yield would be in direct proportion to the change in contributing catchment area which are summarised in Table 12 below.

Table 12
Changes to Contributing Catchment of Local Creeks (km^2)

	Quarry Creek	Fairford Creek	Whites Creek	Whites Creek Diversion	Unnamed Creeks	Saddlers Creek
Total catchment area prior to mining (km^2)	22	10.8	21.5	n/a	4.2	99
Current catchment area (km^2)	19	10.8	2.2	4.9	5	93.7
Maximum extent of mining catchment area (km^2)	18.6	2.7	2.2	6.3	2.8	88.1
Final landform catchment area (km^2)	21.7	5.8	3.2	17.2	3.7	93.5

* Total catchments measured to the Hunter River
** Derived from 1:25,000 scale Muswellbrook topographic map.

The catchments of all existing natural creeks may be seen to reduce by maximum Project development. The catchment of the Whites Creek diversion would increase due to the contribution of progressively rehabilitated overburden areas. It is likely however that peak flows in the diversion would not increase significantly because of the routing effect of settling dams proposed as part of the rehabilitation (refer Section 3.5). The diversion is an engineered structure – its ability to cater for the increased contributing catchment area would be checked as part of ongoing development of the Site Water Management Plan and, if necessary, modifications to the design implemented.

5.2 Flooding

It is anticipated that flood bunding would be constructed between Denman Road and the EA Boundary to at least the recorded 1955 peak flood level in the Hunter River plus 0.5m freeboard. In order to achieve this minimum level, the height of such a flood bund would therefore be approximately 1.4m within the former Whites Creek channel, with only a small (less than 0.5m high) bund away from the channel. Based on available topographic information, it is not anticipated that any flood bunding would be required in the Fairford Creek area. Figure 9 shows the conceptual plan location of such a bund. The calculated loss of flood storage in a 1955-magnitude flood as a result of this bunding is estimated at approximately 20 ML. In the context of the flood storage of a large river such as the Hunter, this loss of storage is considered negligible.

In the context of local flooding along Denman Road, the catchment area of Whites and Fairford Creeks has been and will continue to be reduced as a result of Project-related open cut development westwards (refer Sections 2.3 and 5.1). As a result of catchment area reductions, flows and local flooding in these creeks would likewise be reduced.

5.3 Release of Contaminants in Drainage Off Site

Sediment dams capturing runoff from areas of pre-strip and rehabilitation will be designed in accordance with the provisions for sediment retention basins in Landcom (2004). Runoff from the planned haul road linking the MAN open cut to McDonalds out of pit overburden emplacement area would be directed along the road to open cuts. Sediment controls would be implemented during haul road construction in accordance with the guidelines in Landcom (2004), including the use of sediment basins, sediment filters and filter strips. The batters of the haul road would be selectively constructed of coarse rock overburden material to minimise potential for sediment generation following construction. Sediment controls would be maintained following construction until outer surfaces had stabilised and road surface drainage had been completed.

Catchment dams downslope of out of pit overburden emplacements in the headwaters of Saddlers Creek would be constructed with adequate capacity to capture catchment runoff so as to maintain an acceptably low risk of spill until upslope areas had been stabilised by rehabilitation. Dams would be dewatered by pumping to nearby water storages in between rainfall events. Dam sizing would be subject to detailed design as part of development of the Site Water Management Plan in consultation with the relevant authorities.

Upslope diversion drains would be designed to minimize the risk of erosion due to high flow velocities by appropriate design of grades, cross-sections and use of vegetation and/or rip-rap. Energy dissipation dams and/or level spreaders would be constructed downstream of all diversions. Sediment controls would be implemented during haul road construction in accordance with Landcom (2004) guidelines.

5.4 Salinity in Hunter River Due to Controlled Releases

The water management system would continue to be developed in accordance with best management principles including minimising contamination of site water, maximising reuse of mine water on site and managing water so that any releases from site are controlled in accordance with the HRSTS. By segregation and preferential re-use of the more saline water on site (such as occurs in the tailings storage), off site discharges of salt to the Hunter River would be controlled.
If the proposed water management system is maintained, no other significant contaminant would be discharged from site. Water with other contaminants (e.g. hydrocarbons) would be retained and reused on site.

As indicated in Section 4.2.3, it is estimated that on average the Project would result in a decrease of 193 ML/year controlled release to the Hunter River under the HRSTS. Based on a median TDS of 1,000 mg/L (from Environmental Dam monitoring), this represents an average decrease in salt discharge of 193 t/year. It should be emphasised that discharges would occur during periods of high flow (as mandated in the HRSTS) and would therefore not affect river low flows.

6.0 POST MINING SURFACE WATER MANAGEMENT

6.1 Concepts for Final Landform Drainage

Figure 15 shows the final landform drainage plan[12]. The final landform includes two remnant voids from the MAN pit and Saddlers pit. Dominant final reshaped landforms also include the overburden emplacement areas to the east and north of the MAN final void and to the east and west of the Saddlers final void. The rehabilitated tailings storage located in the Bayswater No. 2 colliery area forms an elevated final landform above the surrounding surface.

Post mining runoff from rehabilitated and revegetated areas of the Project would be directed to the local drainage network. Drainage control works and a stable drainage system as described in Section 3.5 would be designed to direct runoff from the rehabilitated Project area to local creeks. Around the outer edge of final voids isolation bunds would be constructed for safety and to protect against external flooding. The drainage density of the decommissioned Project area would be returned to as close as possible to the existing site. All areas of the site, with the exception of the final voids and their surrounding catchments would be free draining. The aim of this is to maintain the effective catchment contribution and yield to the Hunter River following the cessation of mining. The total catchment reporting to the MAN and Saddlers final voids is estimated to be approximately 16 km^2.

The final landform includes reconstruction of the channel of Fairford Creek over overburden placed within the northeastern portion of the MAN open cut and a small tributary of Saddlers Creek within overburden placed within the MAN South and Far South open cuts. Creek reconstruction would be designed and planned to integrate with mining operations. Creek reconstruction would involve controlled placement of overburden within the creek corridors, including a zone of selected overburden placed by paddock dumping methods which would be spread and compacted in lifts using mine plant so as to minimise long term settlement of the overburden. The surface topography of reconstructed creeks would mimic existing topographic and channel form, which would be determined by detailed survey prior to mining. Pre-stripping activities in the creek areas (prior to mining) would recover existing alluvial/colluvial material which would be preserved and used in creek reconstruction. Reconstructed creeks would be revegetated with native species prevalent within the existing creek channels. Sediment basins would be established downstream of and possibly at intermediate points within the reformed channels and maintained until vegetation establishment. Temporary stabilisation measures (e.g. rip-rap) may also be required. Reconstructed creek design would include detailed hydrologic modelling of the creek catchments, which include significant areas of rehabilitated overburden and other mine areas, to ensure that the reconstructed channels were stable in a wide range of flows.

At Project completion, all mine infrastructure would be decommissioned and removed from the Project area and former infrastructure sites and landforms would be progressively rehabilitated and become free draining to local catchments.

[12] Developed from final landform contour plan provided by Mt Arthur Coal. It is understood that the plan is a high-level conceptual final landform which would form the basis form rehabilitation design in the unlikely event that the Mt Arthur Coal Mine was to close at 2022.

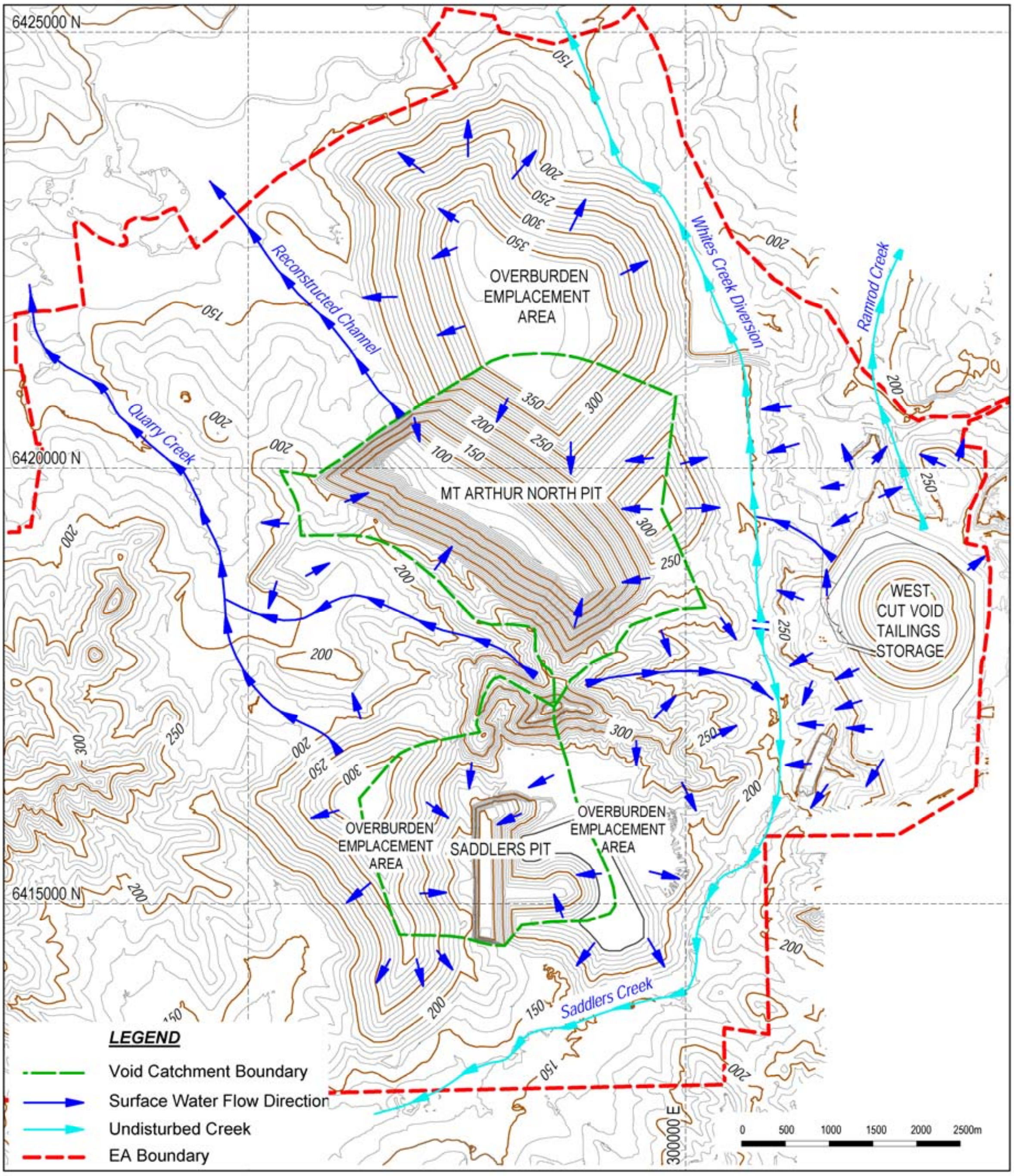


Figure 15 Final Landform Drainage Plan

6.2 Final Void Model Findings

Inflows to voids comprise incident rainfall over the void lake surface, runoff and seepage from the sides of the voids and their adjacent contributing catchment and seepage from coal seam groundwater and overburden infiltration. Final void water balance models have been developed for the two final voids to predict the long term behaviour of the final void water bodies.

Post recovery groundwater seepage rates (including overburden infiltration) to the voids were advised by AGE Consultants. Inflow rates were estimated for different final void water levels (reducing with rising water level). Maximum groundwater and seepage inflow rates of 0.18 ML/day and 1.37 ML/day were estimated for the Saddlers and MAN final voids respectively.

Rainfall runoff from the void catchments was estimated using the AWBM applied to the final void subcatchments (in a manner similar to the mine water balance model – refer Section 4.1). Daily rainfall and evaporation data was taken from regional records and data from the beginning of the record added to data after 2008 to generate additional years for the model simulation.

Model results are shown in Figures 16 and 17 below for the MAN and Saddlers final voids, in terms of predicted final void water levels versus time.

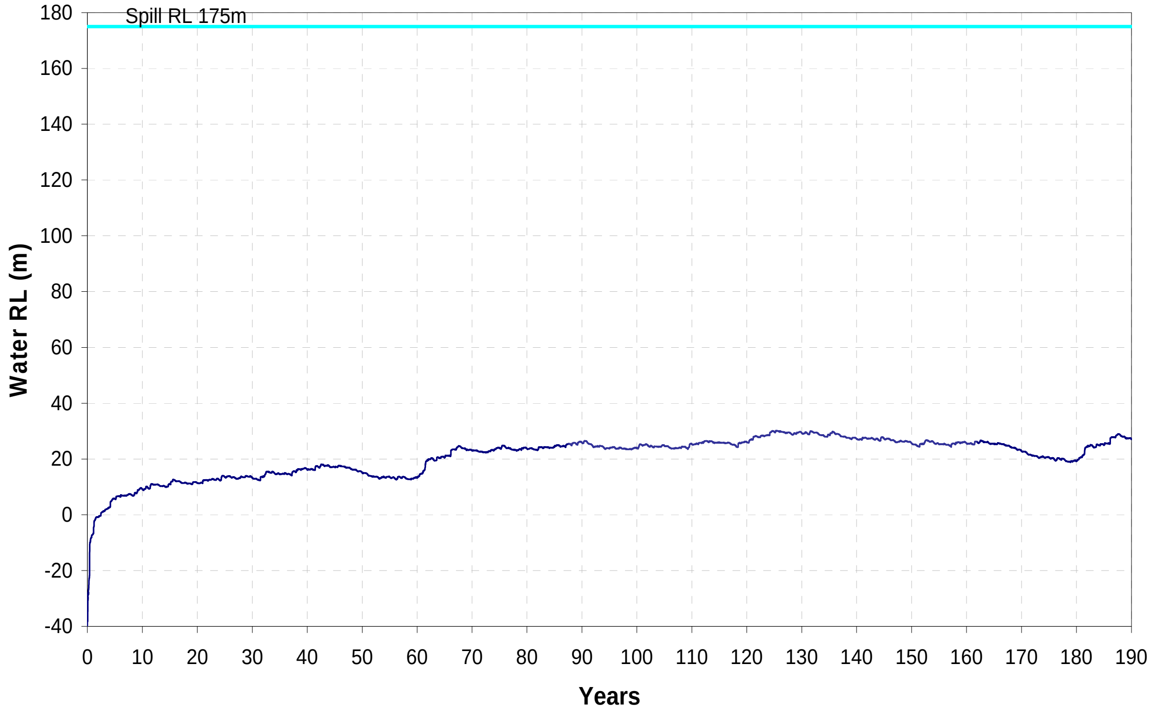


Figure 16 Predicted MAN Final Void Water Levels

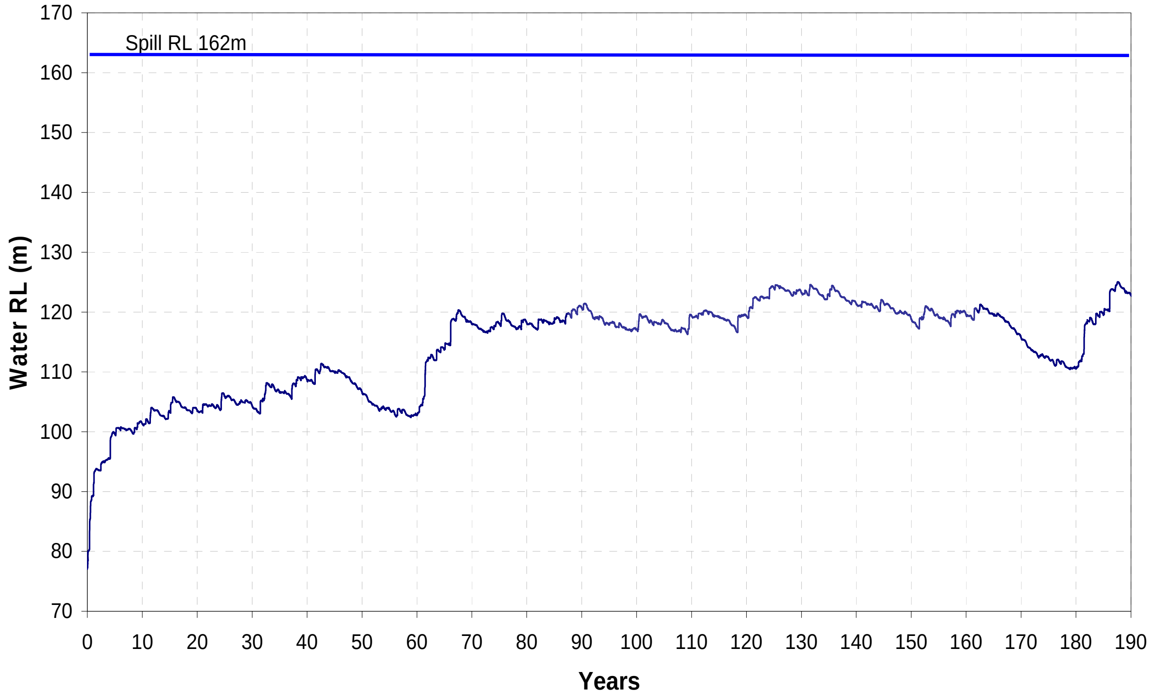


Figure 17 Predicted Saddlers Final Void Water Levels

Figure 16 shows that predicted water levels in the MAN final void would stabilise after about 70 years at a level more than approximately 145m below spill level. Figure 17 shows that predicted water levels in the Saddlers final void would stabilise after about 90 years at approximately 40m below spill level. No spill is predicted in the long term from either of the final voids. Both final long term final void water levels are below regional groundwater levels and should therefore form sinks for groundwater. The salinity of void waters would slowly increase with time, as a result of ongoing slow migration of saline groundwater and flushing of residual salts from the overburden. In the longer term salt concentrations would also be affected by evapo-concentration.

7.0 SURFACE WATER MONITORING AND OTHER RECOMMENDATIONS

Mt Arthur Coal undertake extensive monitoring of surface water in the Project Area catchments and of the associated operational water management system. The current monitoring, review and reporting system should continue throughout construction and operational phases of the Project and information should be added to the water quality database on a continual basis.

Surface water monitoring results should continue to be reported in the Annual Environmental Management Report (AEMR).

The following modifications are recommended as a result of this surface water assessment of the Project:

1) The current surface water monitoring programme should be augmented to include any new water storage dams, sediment or catch dams and the Drayton West Pit Void to assist in on-going monitoring of the water management system.

2) Sampling and analysis following significant rainfall (greater than 25mm in 24 hours) should be undertaken at all baseline water quality monitoring sites listed in this report.

The site water balance should be reviewed at least annually to update predictions of water supply security and the need to release water. Cumulative flow meters should be installed on all major pumped water streams shown in Figure 4 and flows recorded monthly. This data should be used, together with monitored levels in water storages, in the water balance reviews to calibrate various components of the model, including the rainfall runoff component (following periods of rainfall) and open cut groundwater inflows (during periods of low or no rainfall).

A geomorphological survey should be conducted along those reaches of creeks that will be mined through and which are planned for reinstatement over mine overburden backfill. This data would be able to be used in design of creek reconstruction.

It is also recommended that a study be undertaken to confirm the fate of seepage from the West Cut Void tailings storage and that seepage is migrating to either Drayton or Mt Arthur Coal open cuts or to mine water storages.

8.0 REFERENCES

ANZECC (2000). 'Australian and New Zealand Guidelines for Fresh and Marine Water Quality'. Australian and New Zealand Environment and Conservation Council, Canberra, October.

ATC (2009). 'BHP Mt Arthur Coal Pty Ltd Life of Mine Tailings Storage Options Study'. Australian Tailings Consultants Report Ref 104035R03, Mordialloc, March.

BMC (2008). 'Annual Environmental Management Report 2008'. Bengalla Mining Company Pty Limited.

Boughton, W.C. (2004). 'The Australian Water Balance Model'. Environmental Modelling and Software, 19:943-956.

IEAust (1987). 'Australian Rainfall and Runoff A Guide to Flood Estimation Volume 2'. Institution of Engineers Australia, Barton, ACT.

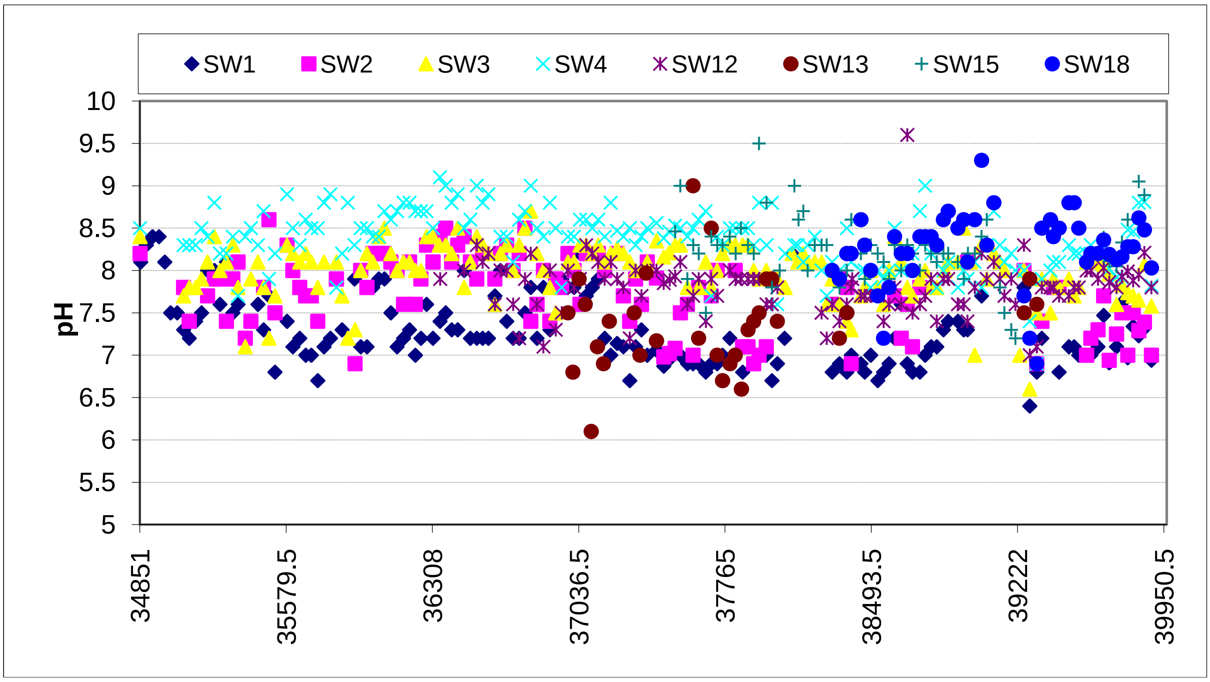
Landcom (2004). 'Managing Urban Stormwater'. Fourth edition, NSW Government.

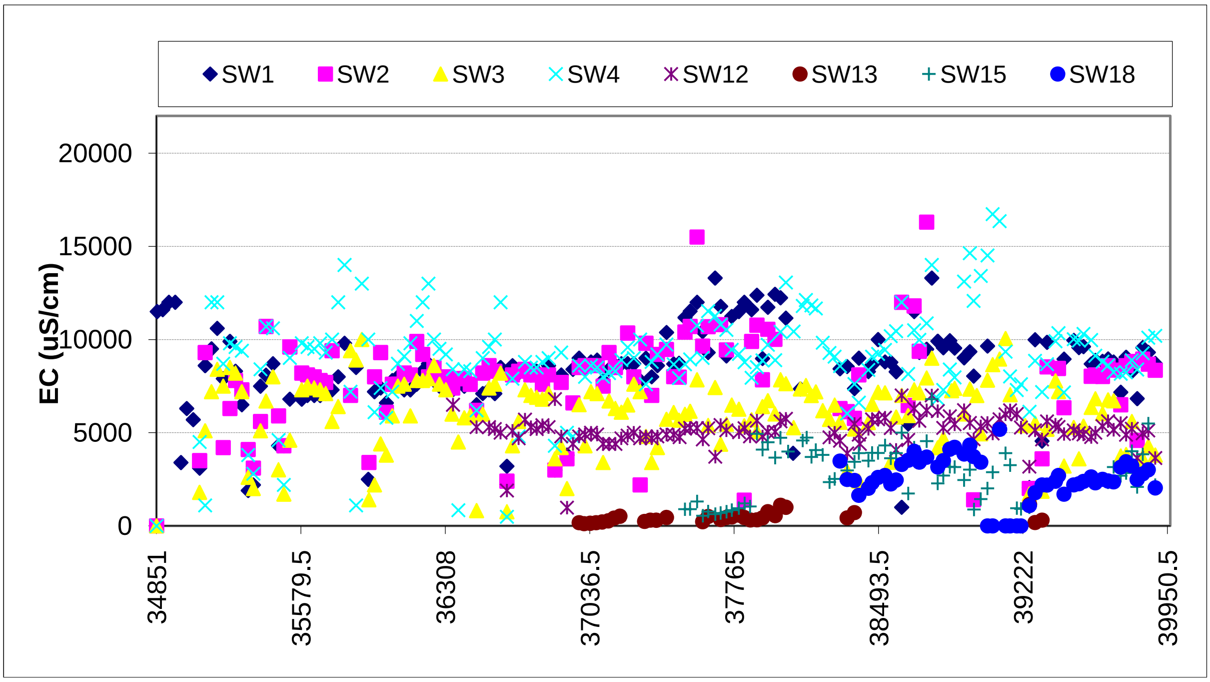
Umwelt (2008). 'Environmental Assessment Proposed Mt Arthur Underground Project'. Umwelt (Australia) Pty Limited, Toronto, January.

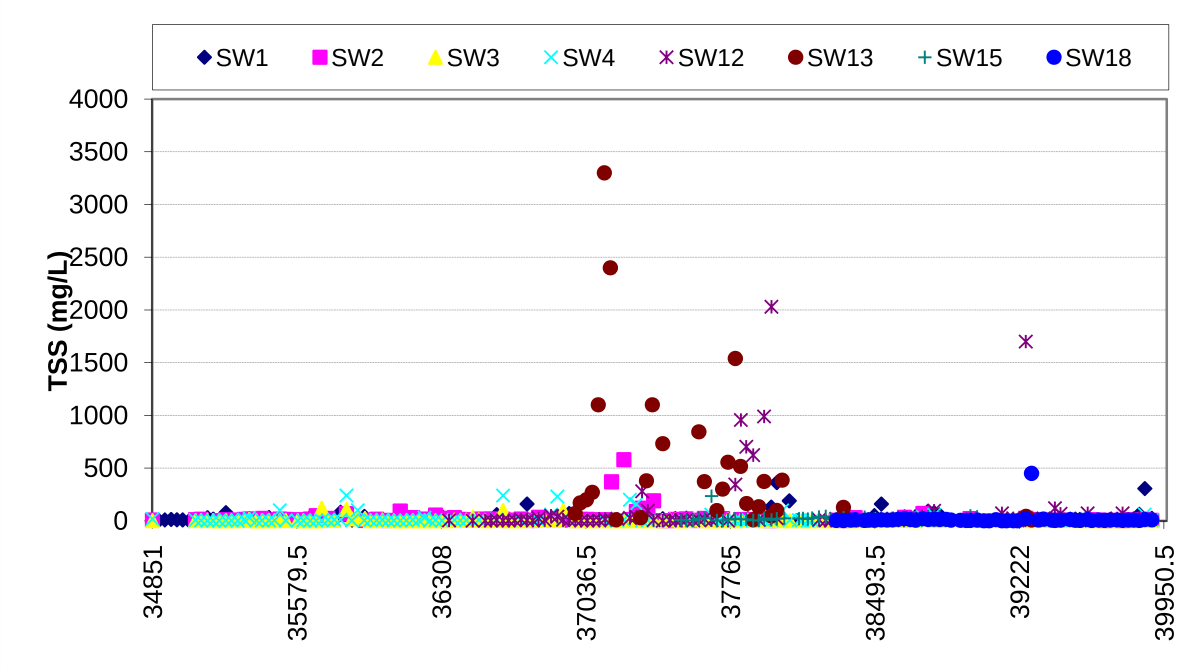
ATTACHMENT A
WATER QUALITY MONITORING DATA

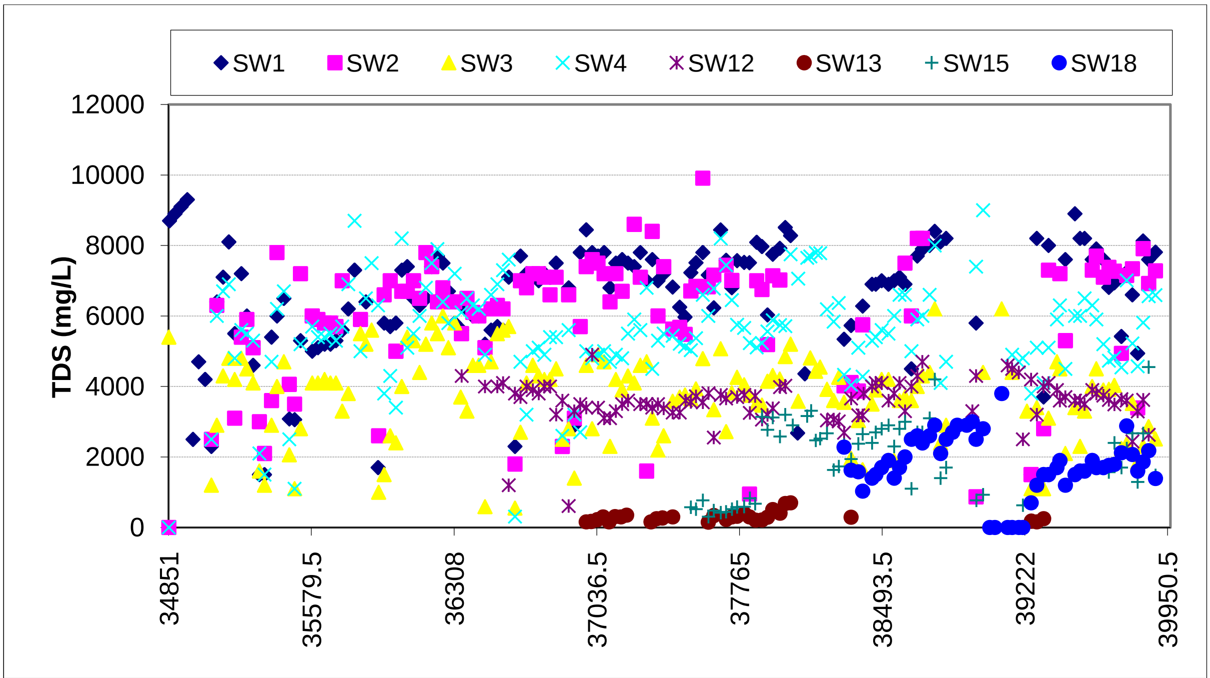
ATTACHMENT A
WATER QUALITY MONITORING DATA

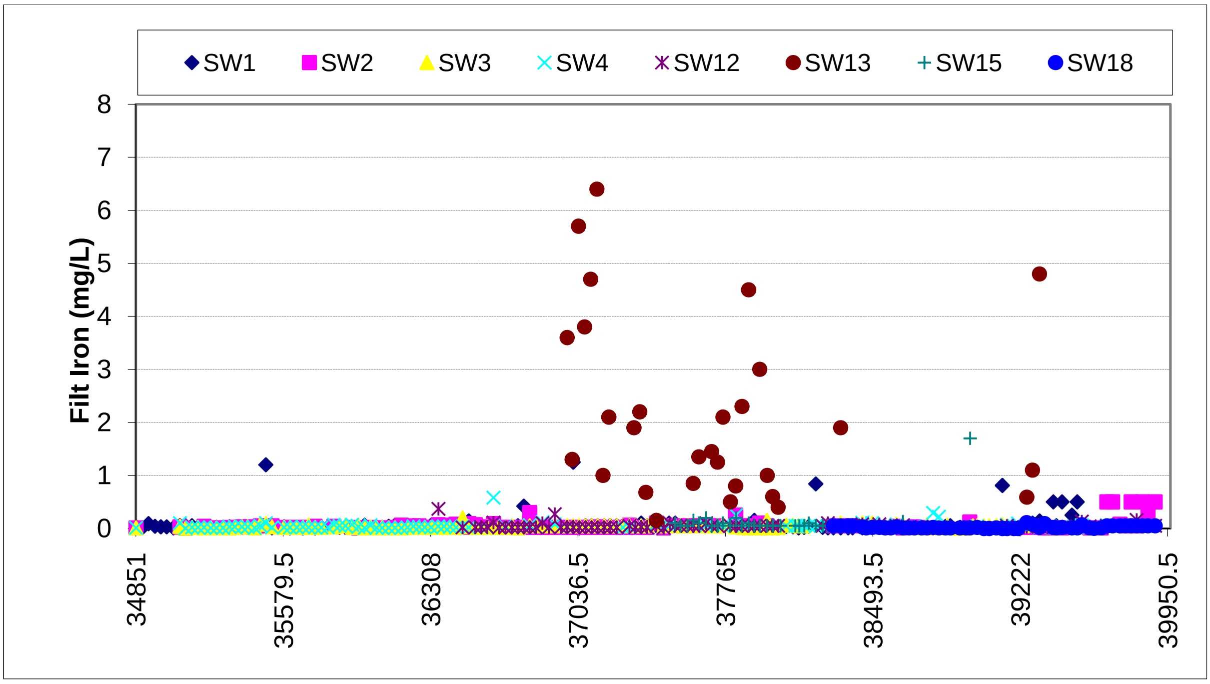
Local Area Creeks

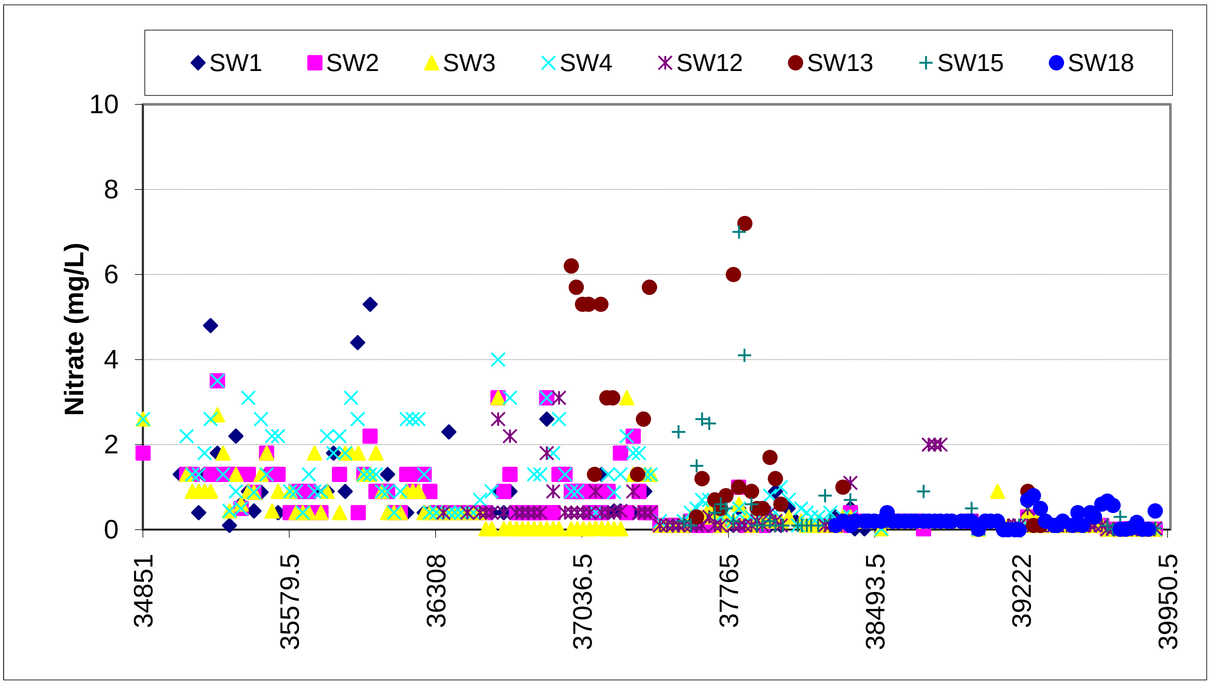


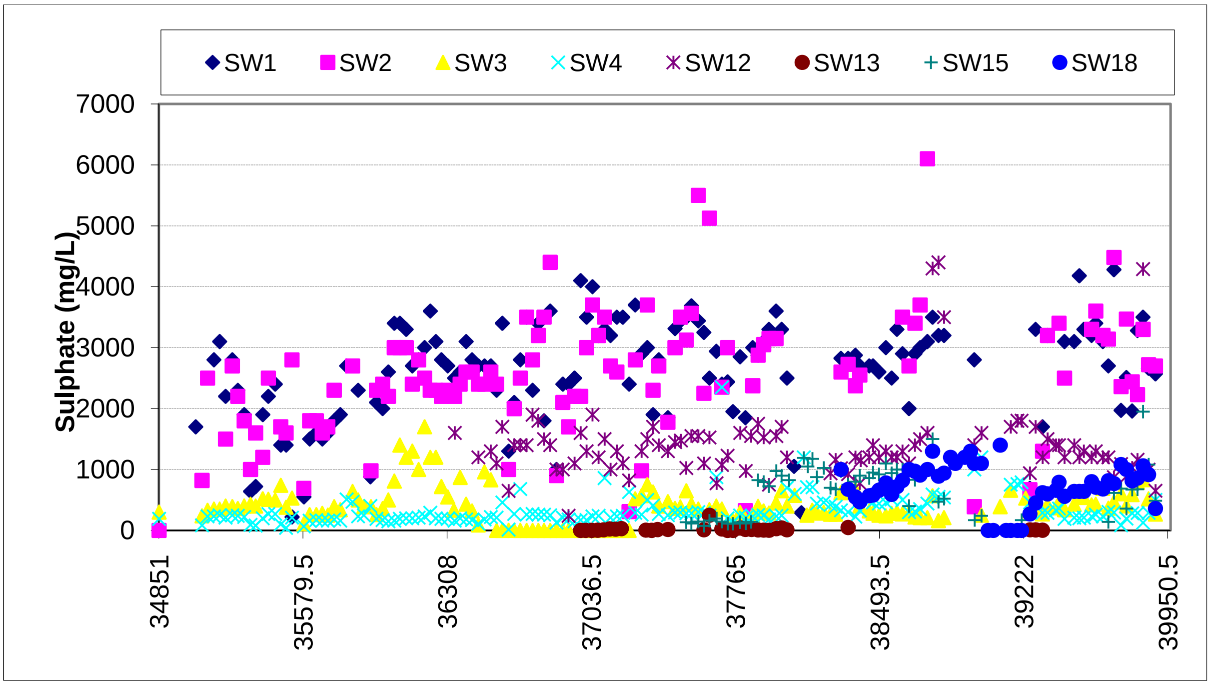



SW1
SW2
SW3
SW4
SW12
SW13
SW15
SW18
TSS (mg/L)
4000
3500
3000
2500
2000
1500
1000
500
0
34851
35579.5
36308
37036.5
37765
38493.5
39222
39950.5

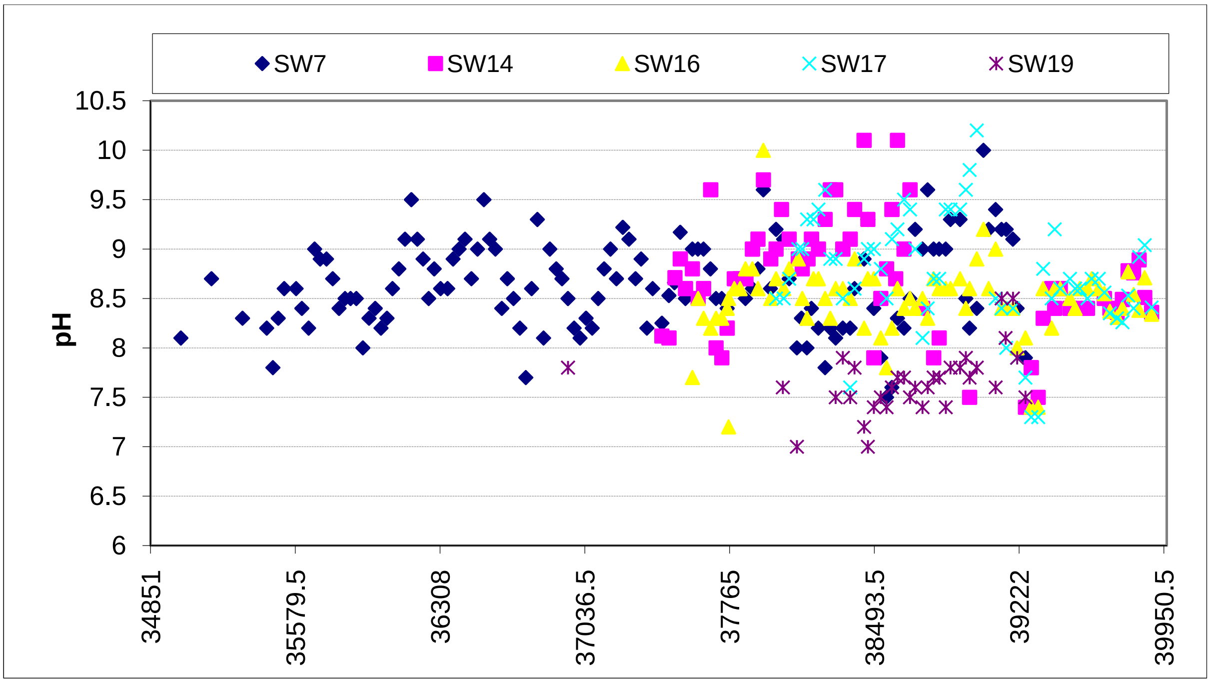

SW1
SW2
SW3
SW4
SW12
SW13
SW15
SW18
TDS (mg/L)
12000
10000
8000
6000
4000
2000
0
34851
35579.5
36308
37036.5
37765
38493.5
39222
39950.5

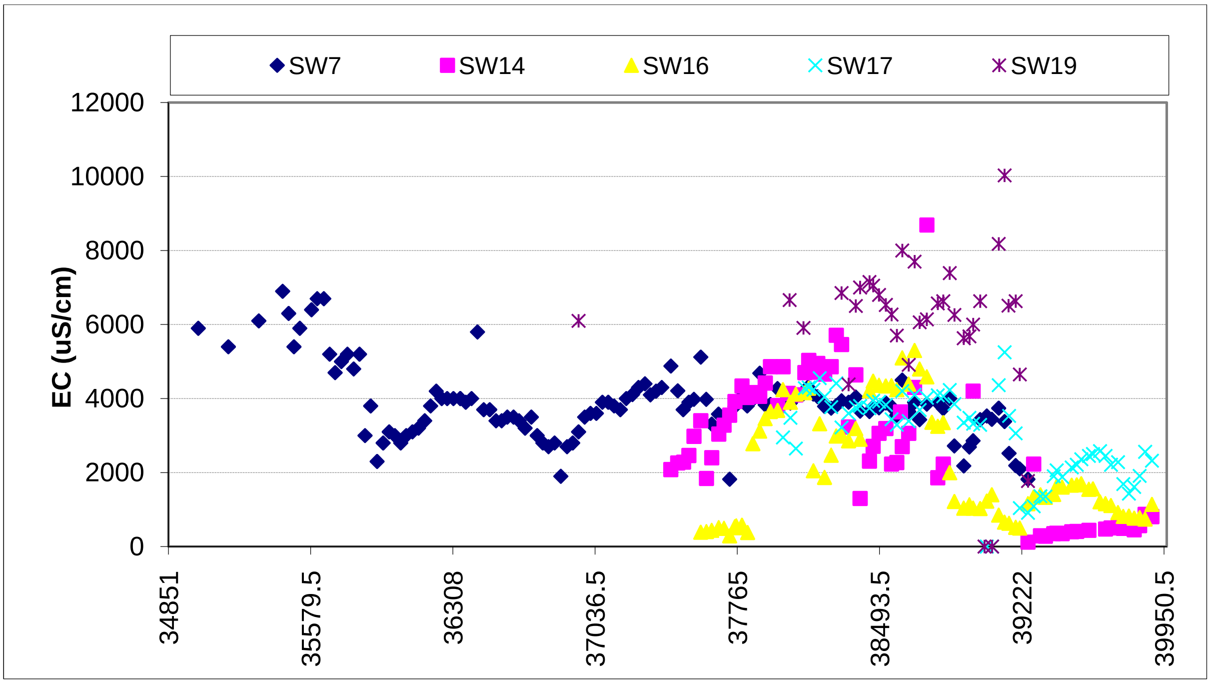

SW1
SW2
SW3
SW4
SW12
SW13
SW15
SW18
Filt Iron (mg/L)
8
7
6
5
4
3
2
1
0
34851
35579.5
36308
37036.5
37765
38493.5
39222
39950.5

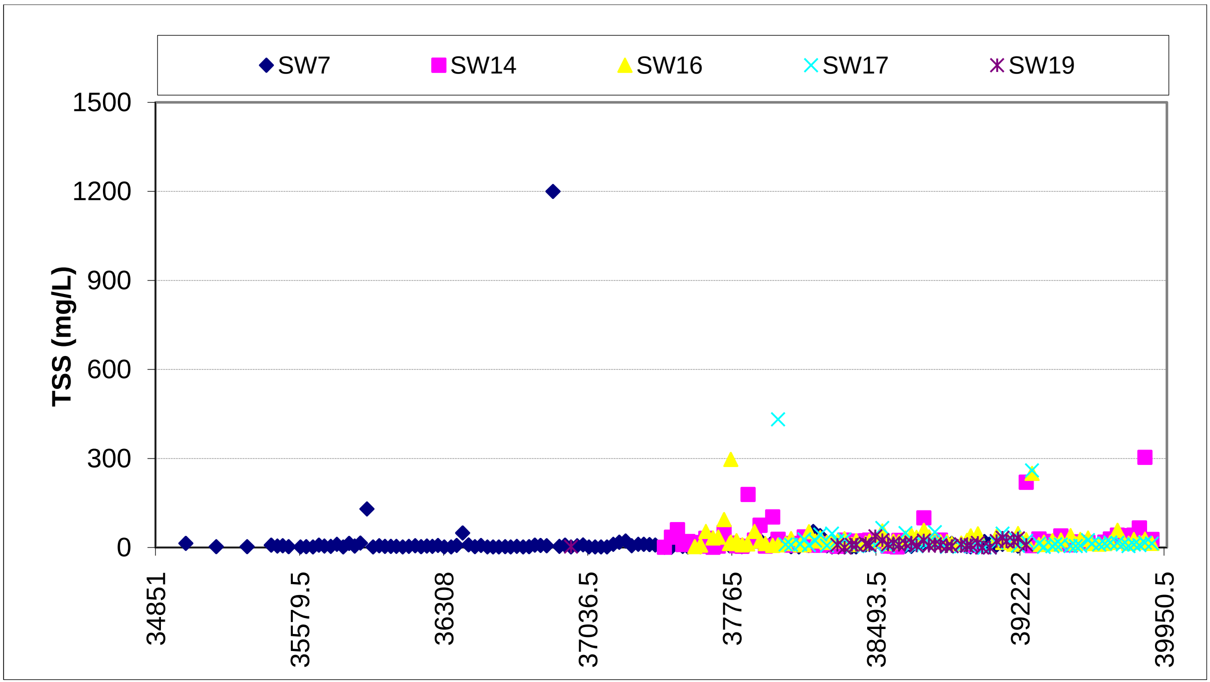

SW1
SW2
SW3
SW4
SW12
SW13
SW15
SW18
Nitrate (mg/L)
10
8
6
4
2
0
34851
35579.5
36308
37036.5
37765
38493.5
39222
39950.5

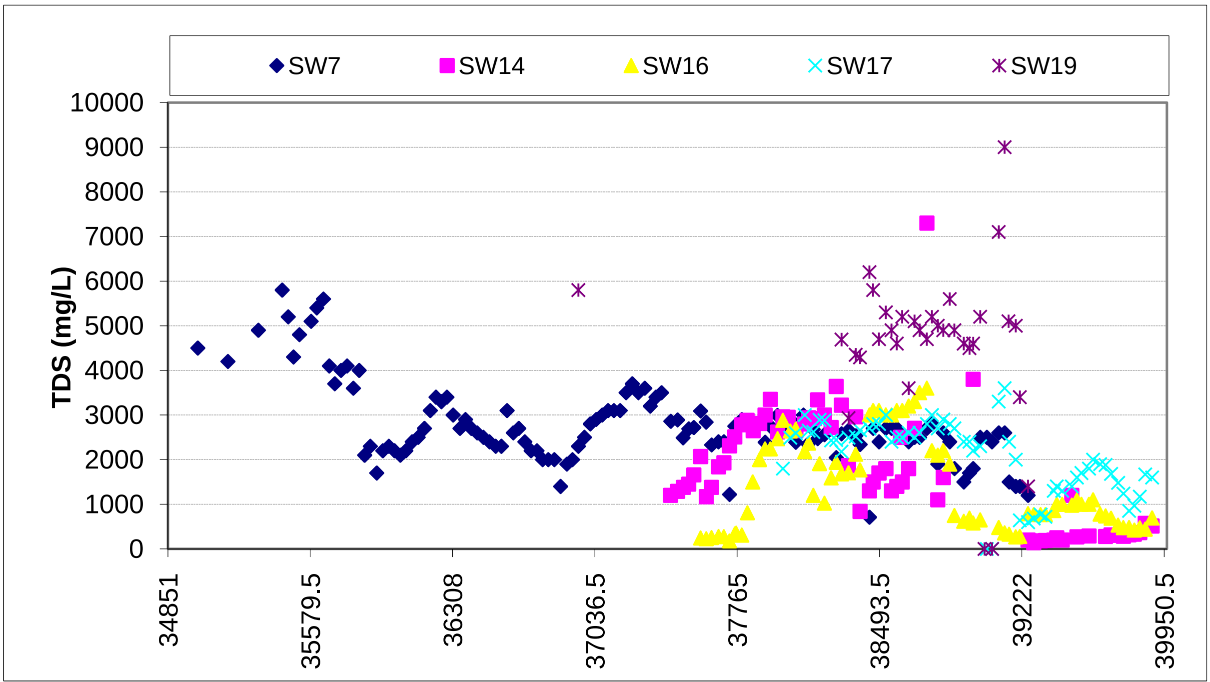

SW1
SW2
SW3
SW4
SW12
SW13
SW15
SW18
Sulphate (mg/L)
7000
6000
5000
4000
3000
2000
1000
0
34851
35579.5
36308
37036.5
37765
38493.5
39222
39950.5

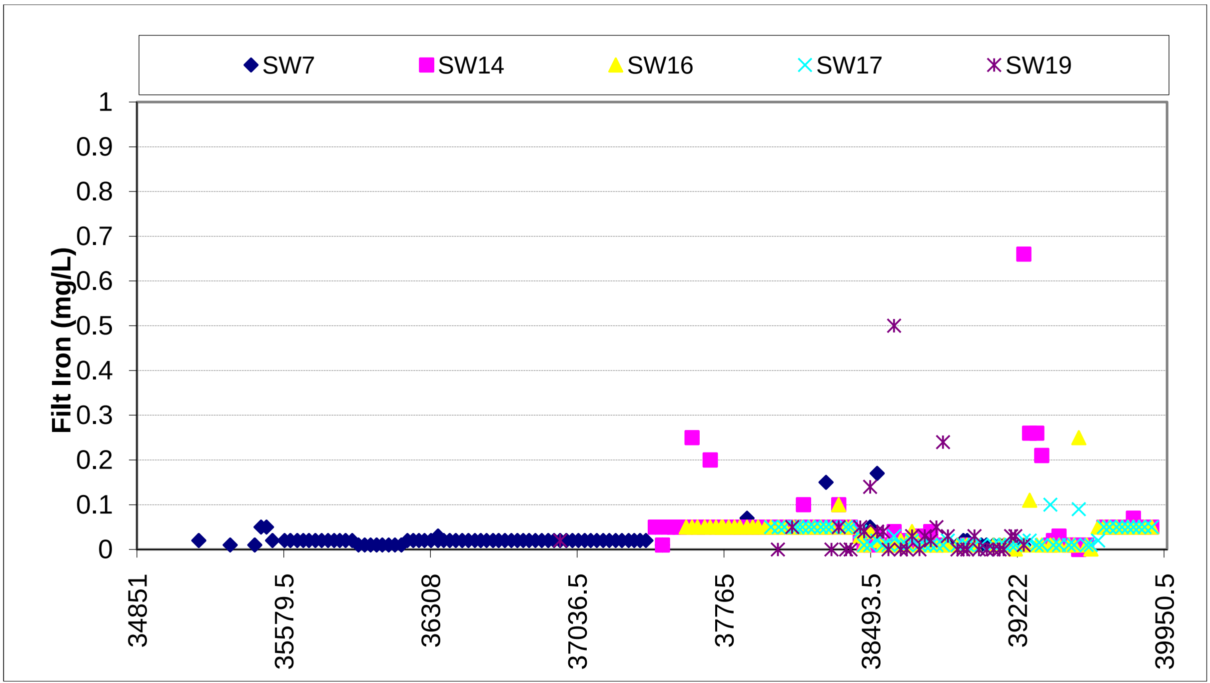
Project Water Storages

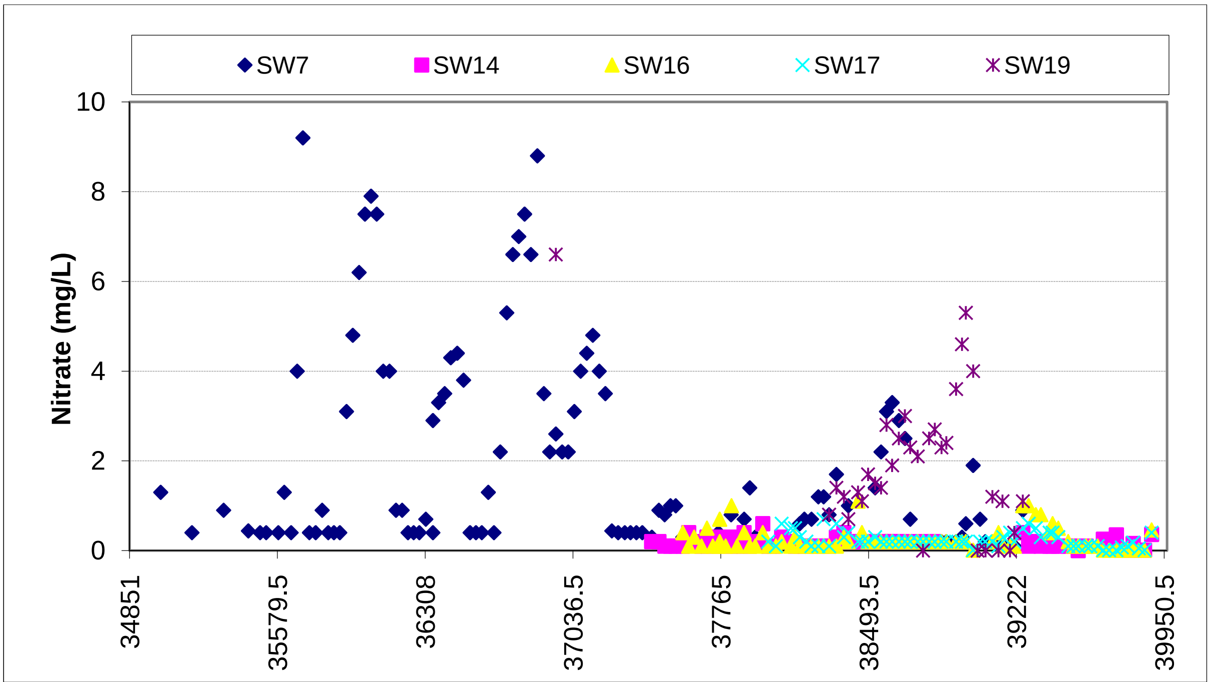


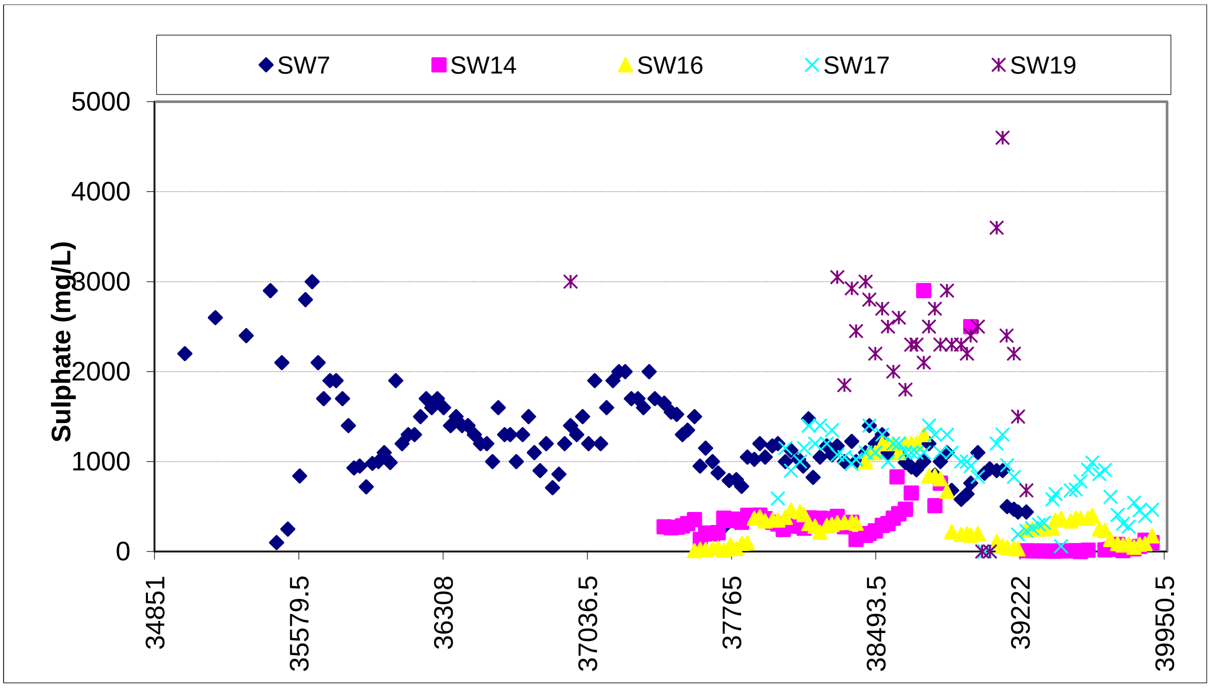



SW7
SW14
SW16
SW17
SW19
TSS (mg/L)
1500
1200
900
600
300
0
34851
35579.5
36308
37036.5
37765
38493.5
39222
39950.5


SW7
SW14
SW16
SW17
SW19
TDS (mg/L)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
34851
35579.5
36308
37036.5
37765
38493.5
39222
39950.5


SW7
SW14
SW16
SW17
SW19
Filt Iron (mg/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
34851
35579.5
36308
37036.5
37765
38493.5
39222
39950.5


SW7
SW14
SW16
SW17
SW19
Nitrate (mg/L)
10
8
6
4
2
0
34851
35579.5
36308
37036.5
37765
38493.5
39222
39950.5


SW7
SW14
SW16
SW17
SW19
Sulphate (mg/L)
5000
4000
3000
2000
1000
0
34851
35579.5
36308
37036.5
37765
38493.5
39222
39950.5