MT OWEN COMPLEX

SURFACE WATER MONITORING PROGRAM

November 2011

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SURFACE WATER MONITORING PROGRAM

1. COMMITMENT AND POLICY

1.1 Purpose

This Surface Water Monitoring Program has been developed to ensure compliance with the development consent conditions for Mt Owen, Ravensworth East and Glendell Mines. The objective of this program is to:

- provide details of historical baseline monitoring data in the surrounding watercourses and water storages;
- detail the integrated surface water monitoring strategy for the Mt Owen Complex (MOC), including extending the existing surface water monitoring program to include the monitoring requirements for the Glendell Mine;
- provide information of compliance monitoring and measurement of water discharges from the MOC under the Hunter River Salinity Trading Scheme (HRSTS);
- outline relevant surface water and stream health impact assessment criteria;
- provide details of monitoring of monitoring of stream health and channel stability in creeks and diversion channels;
- establish a protocol for the assessment and response to monitoring data; and
- provide methods to assess compliance with conditions of development consents, environmental protection licences and legislation relating to surface waters.

1.2 Scope

This Surface Water Monitoring Program is part of a set of documents prepared to support the Water Management Plan (WMP) required by the development consents for MOC. This program outlines the surface water monitoring and reporting required to be undertaken at the MOC to meet the requirements of:

- Mt Owen Mine - Condition 35, Schedule 4 of DA 14-1-2004,
- Ravensworth East - Condition 26, Schedule 4 of DA 52-03-99, and
- Glendell Mine- Condition 33, Schedule 3 of DA 80/952.

These requirements are outlined in **Table 1**, with an indication of where in the program each requirement is addressed.

This program also addresses the requirements of the MOC Environmental Protection Licences (EPLs 4460, 10860 and 12840).

All monitoring is to be undertaken in accordance with XMO procedures for environmental monitoring and evaluation outlined in the Mt Owen Complex *Environmental Management Strategy* (EMS).

Table 1- Surface Water Monitoring Program Requirements [1]

Mt Owen DA 14-1-2004 Schedule 4 Condition:	Ravensworth East DA 52-03-99 Schedule 4 Condition:	Glendell DA 80/952 Schedule 3 Condition:	Consent Conditions	Relevant Section of Program
35	26		The applicant shall regularly monitor to the satisfaction of the Governor General:	
35 a)	26 a)		The volume and quality of water discharged from the site under the Hunter River Salinity Trading Scheme;	**Section 3.1**
35 b)	26 b)		Surface water flows and quality upstream and downstream of the development in Yorks Creek, Bettys Creek, Swamp Creek, and Main Creek;	**Section 3.1**
			(c) channel stability in Yorks Creek, Swamp Creek, Bettys Creek and Main Creek;	**Section 4.42**
35 d)	26 d)		Water logging adjacent to the lower reaches of Main Creek;	**Section 4.44**
35 e)	26 e)		Reporting results in the AEMR; and	**Section 5.2**
35 f)	26 f)		Long term monitoring of the condition of the Swamp Creek diversion channel and potentially affected downstream water courses during the life of the mining lease. In the event that the monitoring identifies and adverse impacts occurring, a plan of remediation shall be developed and implemented to the satisfaction of the Director-General.	**Section 4.43**
		33	The Surface Water Management and Monitoring Plan must include:	
		33 a)	detailed baseline data on surface water flows and quality in creeks and other waterbodies that could potentially be affected by the development;	**Section 2.3**
		33 b)	surface water and stream health impact assessment criteria;	**Section 4.1**
		33 c)	a program to monitor surface water flows, quality and impacts on water users (upstream and downstream of the development in Bettys Creek, Swamp Creek and Bowmans Creek);	**Section 4.4**
		33 d)	A program to assess the stream health conditions in Bettys Creek, Swamp Creek and Bowmans Creek;	**Section 4.4**
		33 f)	procedures for reporting the results of this monitoring.	**Section 5.2**

Note 1: The Surface Water Monitoring Program must be consistent with the current version of Approved Methods for the Sampling and analysis of Water Pollutants in New South Wales (Department of Environment and Climate Change - DECC, 2004).

2. PLANNING

2.1 Introduction

The MOC, owned and managed by Xstrata Mt Owen (XMO), is located in the Hunter Valley of NSW. The MOC consists of three adjacent DA approved open cut coal mines; Mt Owen, Ravensworth East (West Pit) and Glendell Mines. Mt Owen Mine is contract mined, currently by Thiess Pty Ltd (Thiess). The Glendell mine is owned and operated by XMO and comprises the Barrett Pit and West Pit (formerly known as Ravensworth East Mine).

The MOC is bounded by Liddell Colliery, Ravensworth Underground, Ravensworth West and Narama open cut mines to the west and Ashton and Glennies Creek underground mines to the south. The MOC comprises land within the catchments of Swamp Creek, Yorks Creek, Bowmans Creek, Main Creek and Bettys Creek. Both Swamp Creek and Bettys Creek flow in a southerly direction into Bowmans Creek which discharges into the Hunter River. The upper reaches of Swamp Creek have been diverted into Yorks Creek to the west of the MOC as part of the mine development. The upper reaches of Bettys Creek are diverted into Main Creek to the east of the MOC under existing licences from the NSW Office of Water (NOW) The lower section of the Bettys Creek diversion has been completed in accordance with the requirements of NOW.

Development and operation of the MOC and the surrounding mines has resulted in extensive modifications to the local topography and the watercourses in the surrounding area. **Figure 1** shows the modifications to the surrounding catchments at the Mt Owen Complex along with the key water management system features.

2.2 History of Surface Water Monitoring at the Mt Owen Complex

Water quality monitoring has been undertaken intermittently for the Mt Owen Complex since the early 1980s. Continuous long-term surface water quality monitoring programs were established at Mt Owen and Ravensworth East Mines in 1995. The full set of historical monitoring data was last reviewed in 2004 as part of the development of an integrated and comprehensive surface water quality monitoring program at the Mt Owen Complex.

2.21 Monitoring Locations on Watercourses

Surface water quality monitoring has been undertaken by XMO in the surrounding catchments at locations upstream and downstream of the Mt Owen Complex. This water quality monitoring has been undertaken at Bowmans Creek, Yorks Creek, Swamp Creek, Bettys Creek and Main Creek. Surface water monitoring locations are presented in **Figure 2.1.**

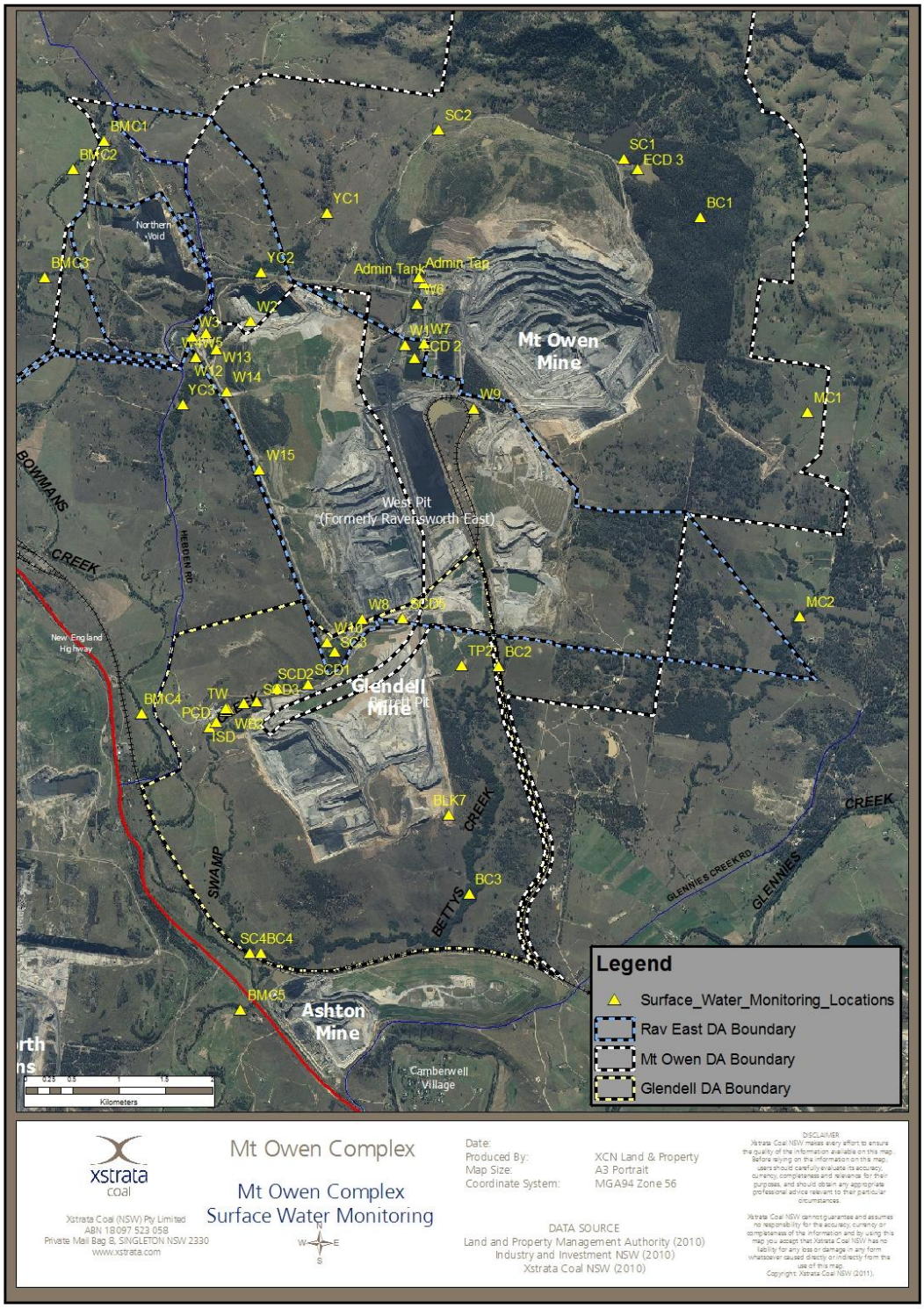

Figure 2 Surface Water Monitoring Locations

Table 2 summarises the locations and periods of monitoring for the surrounding watercourses.

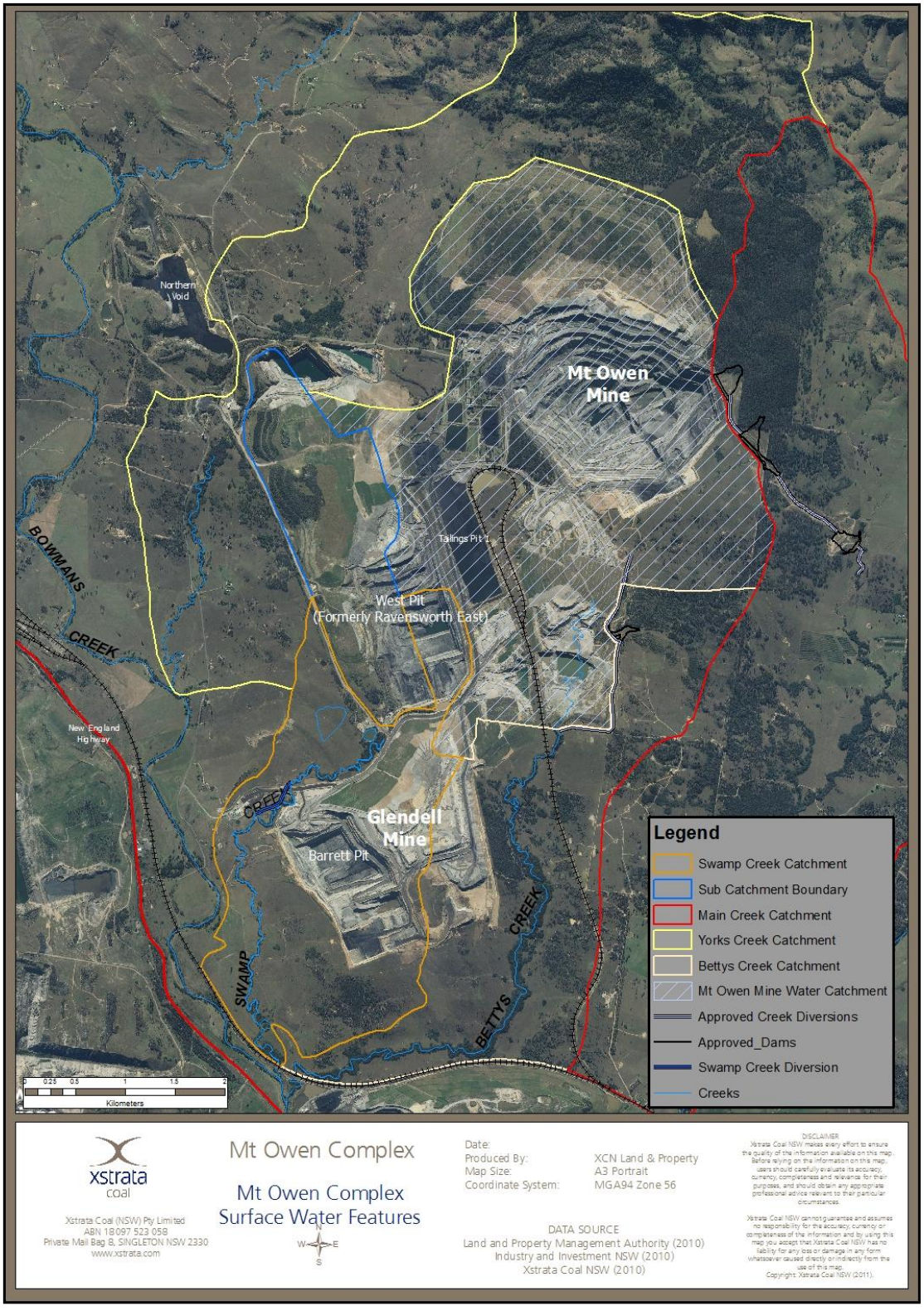

Figure 1: Surface Water Features

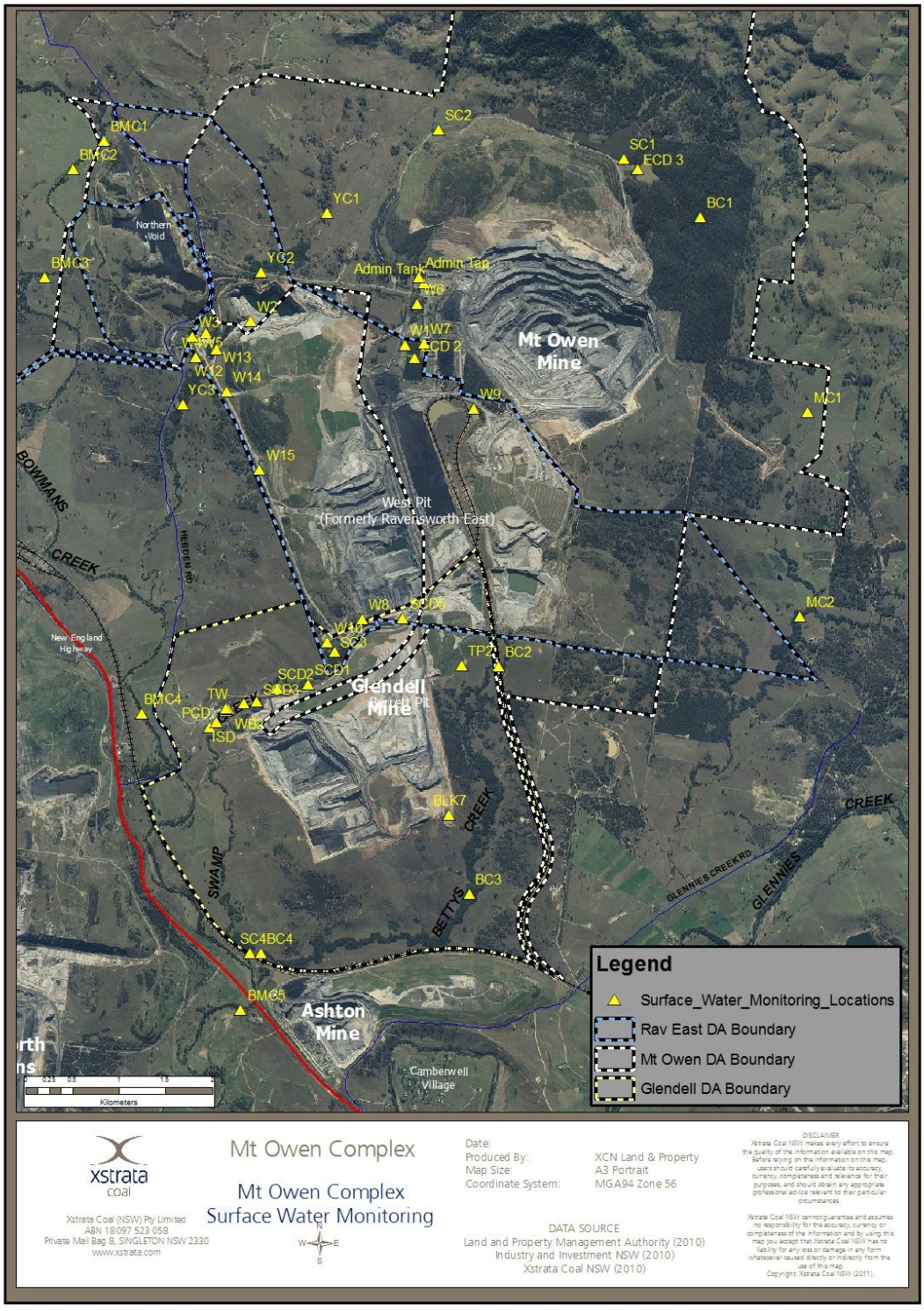

Figure 2 Surface Water Monitoring Locations

Table 2 – Period of Record of Surface Water Quality Monitoring in Watercourses

Watercourse	Monitoring Location	Period of Record
Bowmans Creek	BMC1	August 2005 to date
	BMC2	August 2005 to date
	BMC3	August 2005 to date
	BCM4	February 2008 to date
	BCM5	Not yet commenced
Yorks Creek	YC1	January 2000 to date
	YC2	July 1996 to date
	YC3	January 2004 to date
Swamp Creek	SC1	January 1995 to date
	SC2	August 1999 to date
	SC3	January 2004 to date
	SC4	August 2006 to date
Bettys Creek	BC1	August 1992 to date
	BC2	August 1992 to date
	BC3	August 2005 to date
	BC4	Not yet commenced
Main Creek	MC1	August 2006 to date
	MC2	January 2004 to date

2.22 Monitoring Locations at On-Site Water Storages

Surface water quality has been monitored at the on-site water storages at the Mt Owen Complex including water supply dams, mine voids, irrigation water storages, sediment dams and environmental control dams. As part of this program, water quality is also monitored in the mine water dam, Environmental Control Dam 2 (ECD2). This dam is used for off-site discharge to Swamp Creek under Hunter River Salinity Trading Scheme (HRSTS).

Surface water monitoring locations are presented in **Figure 2** and **Table 3** summarises the locations and periods of monitoring for the onsite water storages.

Table 3 – Period of Record of Surface Water Quality Monitoring at Onsite Water Storages

Water Storage	Monitoring Location	Period of Record
Tailings Pit 1	W1	August 2005 to date
North Void	W2	January 2004 to date
Coal Stockpile Dam	W3	January 2004 to date
Infrastructure Dam	W4	January 2004 to date
Crushing Plant Dam	W5	January 2004 to date
Mt Owen Sewerage	W6	August 2006 to date
Process Water Dam	W7	January 1997 to date
Southern Void	W8	January 2004 to date
Rail Loop Dam	W9	January 1997 to date
Southern Dam	W10	January 2004 to date
RE Irrigation Water Storage	W11	January 2004 to date
RE Industrial Water Storage	W12	January 2004 to date
Ramp Sediment Dam 1	W13	January 2004 to date
Ramp Sediment Dam 2	W14	January 2004 to date
Ramp Sediment Dam 3	W15	January 2004 to date
Environmental Control Dam 2	ECD2	January 1995 to date
Environmental Control Dam 3	ECD3	August 1998 to date
Swamp Ck Sed Dam 1	SCD 1	November 2008 to date
Swamp Ck Sed Dam 2	SCD 2	November 2008 to date
Swamp Ck Sed Dam 3	SCD 3	November 2008 to date
Swamp Ck Sed Dam 4	SCD 4	November 2008 to date
Swamp Ck Sed Dam 5	SCD 5	May 2011 to date

TP2 Sed Dam	TP2	September 2009 to date
Pollution Control Dam	PCD	January 2009 to date
Infrastructure Sed Dam	ISD	January 2009 to date
Block 7 Sed Dam	BLK7	May 2011 to date
Wash Bay 1	WB1	December 2009 to date
Wash Bay 2	WB2	December 2009 to date
Truck Wash	TW	December 2009 to date

The water quality of surface dams including the licensed discharged point (ECD2) has been monitored in accordance with the Hunter River Salinity Trading Scheme (HRSTS) regulations since January 1995. To date, there have been no HRSTS discharges from the MOC (refer to **Section 2.37**).

2.23 Monitoring Program Parameters

The Surface Water Monitoring Program requires the continuation of monitoring at the locations outlined in **Sections 2.21** and **2.22**. This program requires the monthly monitoring at all monitoring locations for the following parameters:

- flow (by way of observation as streams are ephemeral);
- pH;
- electrical conductivity (EC);
- total suspended solids (TSS); and
- total dissolved solids (TDS).

Additional monthly monitoring of discharge parameters is to be undertaken in accordance with HRSTS regulations and EPLs (refer to **Section 3.1**).

The schedule for ongoing monitoring at each monitoring location is presented in **Section 4.4**.

2.3 Baseline Data

The development consents for Mt Owen, Ravensworth East and Glendell Mines require that the Surface Water Monitoring Program details baseline data on surface water flows and quality in watercourses that could be affected by the operation of the MOC (refer to **Section 1.1**). The results of the monthly surface water quality monitoring program outlined in **Section 2.23** are summarised in **Sections 2.31** to **2.36**. Graphs of key parameters are and long-term monitoring data is presented in the Annual Environmental Management Reports (AEMR).

2.31 Bowmans Creek

The natural catchment area of Bowmans Creek (including Stringybark Creek in the upper reaches) is approximately 24,000 hectares. The Bowmans Creek catchment comprises Yorks, Swamp and Bettys Creeks and flows into the Hunter River approximately 3.5 kilometres upstream of the confluence with Glennies Creek (refer to **Figure 1**). Although substantially disturbed by agriculture and mining activities Bowmans Creek has sufficient contributing catchment to maintain flows under most climatic conditions (Umwelt, 2007).

The Mt Owen Complex Surface Water Monitoring Program for Bowmans Creek comprises monthly monitoring at locations BC1, BC2 and BC3 (refer to **Figure 2**). The range in water quality of Bowmans Creek based on historical monitoring data is outlined in **Table 4**. Breaks in the graphical data sets represent dry periods where samples could not be obtained.

Table 4 - Monthly Water Quality Monitoring at Bowmans Creek

Water Quality Variable	Minimum	80th Percentile	Maximum
pH	6.8	7.3 – 8.0	8.2
Conductivity (µS/cm)	427	2,208	2,730
Total Suspended Solids (mg/L)	1	35	191
Total Dissolved Solids (mg/L)	286	1,480	1,930

2.32 Yorks Creek

Yorks Creek has been highly modified due to the surrounding mining operations with the upper reaches of Swamp Creek diverted west around the Mt Owen mining operations into the Yorks Creek catchment. The contributing catchment of Yorks Creek is approximately 1200 hectares and is insufficient to maintain continuous flow in the creek during dry conditions. The creek system is predominantly dry; however some pools of semi-permanent water are present in the downstream reaches of the creek and typically exhibit high salinity levels as shown in **Table 5**.

The Mt Owen Complex Surface Water Monitoring Program for Yorks Creek comprises monthly monitoring at locations YC1, YC2 and YC3 (refer to **Figure 2**). The range in water quality of Yorks Creek based on historical monitoring data is outlined in **Table 5**.

Table 5 - Monthly Water Quality Monitoring at Yorks Creek

Water Quality Variable	Minimum	80th Percentile	Maximum
pH	6.0	6.7 – 8.0	8.6
Conductivity (µS/cm)	230	6,916	16,730
Total Suspended Solids (mg/L)	1	49	640
Total Dissolved Solids (mg/L)	170	5,258	13,028

2.33 Swamp Creek

Swamp Creek has been significantly impacted by mining. The upper reaches of Swamp Creek are diverted into Yorks Creek to the west of Mt Owen mining operations. A remnant flow line along the original alignment of Swamp Creek has also been maintained and is used for conveying discharges (under HRSTS) from ECD2 to Swamp Creek. The catchment area of Swamp Creek has been heavily impacted by mining operations and approval has been granted to divert sections of the original downstream flow line (south of Ravensworth East Mine) around the approved Glendell Mine infrastructure area (refer to **Figure 1**). The creek system is predominantly dry, however some pools of semi-permanent water are present in the downstream reaches of the creek and typically exhibit high salinity as outlined in **Table 6**.

The Mt Owen Complex Surface Water Monitoring Program for Swamp Creek comprises monthly monitoring at locations SC1 and SC2 (refer to **Figure 2**).The range in water quality of Swamp Creek, based on historical monitoring data, is outlined in **Table 6**.

Table 6- Monthly Water Quality Monitoring at Swamp Creek

Water Quality Variable	Minimum	80th Percentile	Maximum
pH	6.4	7.2 – 8.8	10.0
Conductivity (µS/cm)	110	2,600	14,900
Total Suspended Solids (mg/L)	1	34	290
Total Dissolved Solids (mg/L)[1]	196	6,026	10,000

Note 1: Limited data available

2.34 Bettys Creek

Bettys Creek has been significantly impacted by mining operations at the Mt Owen Complex, with several diversions implemented around the Mt Owen Mine open cut pit and the Eastern Rail Pit. The upper reaches of Bettys Creek are diverted into Main Creek and the middle reaches of Bettys Creek have been diverted around the West Dump and Eastern Rail Pit (refer to **Figure 1**). Approval has also been granted to divert the southern most section of Bettys Creek around the Glendell Mine open cut pit.

The Bettys Creek catchment comprises an area of approximately 1640 hectares which extends from the confluence of Bowmans Creek and Swamp Creek north to the Ravensworth State Forest. Bettys Creek flows into Bowmans Creek approximately 5.9 kilometres upstream of the confluence of Bowmans Creek and the Hunter River. Bettys Creek is an ephemeral creek system with flows only occurring in the creek during storm events or after prolonged periods of rain. As a result the creek system is predominantly dry, however some pools of semi-permanent water are present in the downstream reaches of the creek. These typically exhibit high salinity as outlined in **Table 7**.

The Mt Owen Complex Surface Water Monitoring Program for Bettys Creek comprises monthly monitoring at locations BC1 and BC2 (refer to **Figure 2**). The range in water quality of Bettys Creek, based on historical monitoring data, is outlined in **Table 7.**

Table 7- Monthly Water Quality Monitoring at Bettys Creek

Water Quality Variable	Minimum	80th Percentile	Maximum
pH	5.4	7.0 – 8.4	9.4
Conductivity (µS/cm)	74	5,920	18,000
Total Suspended Solids (mg/L)	2	47	900
Total Dissolved Solids (mg/L)	78	3,880	11,000

2.35 Main Creek

Main Creek is an ephemeral creek system with a catchment area of approximately 1750 hectares. Main Creek flows in a southerly direction and joins Glennies Creek approximately 6.5 kilometres upstream of the Glennies Creek confluence with the Hunter River (refer to **Figure 1**).

As discussed in **Section 2.34** the upper reaches of Bettys Creek have been diverted into Main Creek to allow for the continued mining operations at the Mt Owen Complex. This diversion has been designed and constructed ensure that peak flows within the creek system do not increase as a result of the diversion.

The Mt Owen Complex Surface Water Monitoring Program for Main Creek comprises monthly monitoring at locations MC1 and MC2 (refer to **Figure 2**). The range in water quality of Main Creek based on historical monitoring data is outlined in **Table 8**.

Table 8- Monthly Water Quality Monitoring at Main Creek

Water Quality Variable[1]	Minimum	80th Percentile	Maximum
pH	6.1	6.9 – 8.8	8.9
Conductivity[1] (µS/cm)	306	14,000	16,000
Total Suspended Solids (mg/L)	3	26	312
Total Dissolved Solids (mg/L)	314	9,380	11,000

Note 1: Limited data sets available for period of December 2005 to January 2007 due to dry climatic conditions

2.36 On-Site Water Storages

Surface water monitoring has been undertaken monthly at the major water storages at the Mt Owen Complex. The water storages include the water storage dams (W3, W4, W5, W7, W9 and W10), North and South Voids (W2 and W8), sewerage overflow (W6), sediment dams (W13, W14 and W15), Environmental Control Dams (ECD2 and ECD3), irrigation and industrial water storages (W11 and W12) and the tailings supernatant dam (W1) (refer to **Figure 2**).

The ranges in water quality at the Mt Owen Complex on-site dams and water storages, based on historical monitoring data, are outlined in **Table 9**.

Table 9 – Historical Monthly Water Quality Monitoring at Onsite Water Storages 1 (Pre 2008)

Water Storage	pH	EC (µS/cm)	TSS (mg/L)	TDS (mg/L)
Tailings Pit 1	8.0 - 9.9	3,180 – 9,880	2 - 68	2,090 – 5,930
North Void	7.9 - 8.6	2,710 – 8,860	1 - 35	1,570 – 5,516
Coal Stockpile Dam	8.8 - 10.1	3,630 – 11,900	1 - 35	2,391 – 5,320
Infrastructure Dam	8.3 - 9.4	1,540 – 8,990	1 - 62	918 – 4,990
Crushing Plant Dam	8.3 - 9.8	889 – 11,800	1 - 250	528 – 8,310
Mt Owen Sewerage	7.2 - 7.8	904 – 1,190	13 - 168	322 – 1,100
Process Water Dam	7.2 - 9.5	3,200 – 8,910	1 - 140	2,150 – 5,820
Southern Void	8.3 - 9.4	6,300 – 8,400	2 - 90	3,944 – 5,210
Glennies Creek Dam	6.5 - 9.7	244 - 670	2 - 160	130 - 378
Southern Dam	8.1 - 10.1	785 – 10,150	2 - 54	456 – 6,060
RE Irrigation Water	6.5 - 8.2	269 – 1,540	2 - 796	284 - 908
RE Industrial Water	6.9 - 9.8	685 – 6,400	4 - 310	438 – 4,910
Ramp Sediment Dam 1	6.9 - 10.3	750 – 6,340	1 - 120	507 – 4,960
Ramp Sediment Dam 2	7.7 - 9.7	905 – 8,800	6 - 190	564 – 6,060
Ramp Sediment Dam 3	7.7 – 10.0	364 – 1,960	14 - 444	206 – 1,380
Environmental Control Dam 2	6.7 - 10.6	1,400 – 6,960	1 - 190	800 – 5,200
Environmental Control Dam 3	6.6 - 8.7	150 - 660	3 - 390	210 - 408

Note 1: refer to Table 3 for Onsite Water Storage Monitoring Locations

2.37 HRSTS Discharges

The quality of any waters discharged from the licensed discharged point (ECD2) is monitored in accordance with the HRSTS. Under the HRSTS conditions outlined in EPL 4460, XMO is licensed to discharge a maximum of 66 ML/day from ECD2. Mt Owen Complex currently holds 12 credits in the HRSTS. In the event of any discharge event pH, TDS and TSS will be monitored daily and flow rate and conductivity will be monitored continuously. To date there has not been a HRSTS discharge at Mt Owen Complex.

Details of the procedures to discharge under the HRSTS are presented in **Section 3.11**.

3. IMPLEMENTATION

3.1 HRSTS Discharges

The HRSTS is regulated by the Office of Environment and Heritage (OEH) under the licensing provisions of the *Protection of the Environment Operations Act 1997*. In order to participate in the HRSTS, mines and power stations are required to hold an EPL that permits water discharge based on salt credit holdings. A total of 1000 salt credits are available under the HRSTS. Each credit represents 1/1000 of the total amount of salt able to be discharged during a particular flow event.

Under the HRSTS, discharges from mines and power stations are not permitted during periods when flow in the Hunter River is low. Discharge is permissible when flow in the Hunter River is high, providing that sufficient salt credits and a discharge licence is held by the respective operation. When the river is in flood flow, discharges are permitted without the requirement to hold salt credits providing the salt concentration does not exceed 900 µS/cm. However, a discharge licence is still required for discharge when the river is in flood flow and compliance is required with any overriding limits applied by the DECC as a condition of the licence. Further details of the workings of the HRSTS are contained in the *Protection of the Environment (Hunter River Salinity Trading Scheme) Regulation 2002*.

MOC may discharge surplus water under the HRSTS into Swamp Creek via dams ECD2. The maximum licensed discharge rate from ECD2 during flood flow in the Hunter River is currently 66 ML/day.

Mt Owen Complex currently holds 12 credits in the HRSTS, however, through short term trading of credits with surrounding mining operations, up to 200 credits may be held during a discharge event (Umwelt, 2003).

3.11 Discharge Procedure

The MOC can discharge surplus mine water to the Middle Sector of the Hunter River, as defined under the HRSTS. The salinity target in this sector of the river during high and flood flows is 900 µS/cm at Glennies Creek gauge station, which is located immediately upstream of the confluence of the Hunter River and Glennies Creek.

The flow categories for discharges to the Middle Sector of the Hunter River under the HRSTS are provided in **Table 10**.

Table 10-HRSTS Discharge Opportunities

HRSTS Category	Hunter River Flow Rate (ML/day)	Discharge Opportunity[1]
Low Flow	0 -1800 ML/day	Discharge not permitted
High Flow	1800 - 6000 ML/day	Discharge permitted using credit system
Flood Flow	> 6000 ML/day	Unlimited discharges permitted as long as the salt concentration does not exceed 900 µS/cm

Source: *Hunter River Salinity Trading Scheme* (NSW EPA, 2003).

Note 1: The discharge rate is limited to the maximum limit on EPL regardless of total allowable discharge under the HRSTS.

All discharges from ECD2 will be undertaken in accordance with procedures outlined in the HRSTS. A summary of this procedure includes is presented below:

Notification of Discharge Event

Notification of a discharge event is provided by the OEH in the form of a River Register. The register shows:

- total allowable discharge in tonnes;
- the block classification for the sector; and
- the discharge start and stop times.

The current status of the flow rate in the Hunter River is available via the Hunter Integrated Telemetry System (HITS) website (www.hits.nsw.gov.au).

Calculating Discharge Volume

The volume able to be discharged into a particular block during a discharge event is calculated using the steps outlined in **Table 11.**

Table 11- Calculation of Volume Discharge Limit

Step	**Calculation**[2]
1: Determine the number of credits the licence holder can use for the block [1]	Available credits: E = Cr x D (credits) Cr = credit holding D = discount factor on River Register (usually 1) *Mt Owen Complex Available Credits: 3*
2: Determine the licence holder's individual salt discharge limit	Salt discharge limit: L = T x E/1000 (tonnes per day) T = total allowable discharge for the block (e.g. 100 tonnes per day) E = available credits *Mt Owen Complex Salt Discharge Limit:* *100 tonnes/day*3 credits/1000 = 0.3 tonnes per day*
3: Calculate the salt concentration of the water to be discharged	Salt concentration: C = EC x F/1000 (tonnes per ML) EC = mean electrical conductivity of discharge water (µS /cm) (e.g. 2000 µS/cm) F = 0.6 (conversion factor on EPL) *Mt Owen Complex Salt Concentration:* *2000 µS/cm*0.6 = 1.2 tonnes/ML*
4: Determine the volume discharge limit	Volume discharge limit: V = L/C (ML) *Mt Owen Complex Volume Discharge Limit:* *7.5 tonnes/day/ 1.2 tonnes/ML = 0.36 ML/day*

Source: *Protection of the Environment (Hunter River Salinity Trading Scheme) Regulation* 2002.

Note 1: A block is defined by the EPA as a body of water that flows down the Hunter River and is predicted to pass through the lower sector reference point in a 24-hour period.

Note 2: Worked example based on a total allowable discharge to the block of 100 tonnes/day and salt concentration of 2000 *µS/cm.*

The discharge volume is calculated using the flow gauge on the discharge pipe from ECD2. Note that the daily discharge limit is the lesser of the volume discharge limit allowable under the HRSTS and the EPL licensed discharge limit (currently 66 ML/day).

Discharge Actions

The following actions are to be undertaken prior to and during a discharge event:

- take at least three readings of water level and conductivity;
- revise the calculations if conductivity or water level varies from the initial calculation;
- continuously monitor flow and electrical conductivity during the discharge;
- take at least one water sample per block for analysis of pH and TSS;
- record water level on completion of discharge event;
- record discharge details on the discharge worksheet; and
- report discharge event as per HRSTS requirements

3.2 Investigation Protocol

Where the surface water monitoring reports results outside the surface water and stream health impact assessment criteria presented in **Table 14** the MOC E&C Manager shall act in accordance with Section 3.3.2.3 of ANZECC (2000) as follows:

> *The guideline trigger values are the concentrations (or loads) of the key performance indicators, below which there is a low risk that adverse biological effects will occur. The physical and chemical trigger values are not designed to be used as 'magic numbers' or threshold values at which an environmental problem is inferred if they are exceeded. Rather they are designed to be used in conjunction with professional judgement, to provide an initial assessment of the state of a water body regarding the issue in question.*

Section 3.3.2.3 of ANZECC (2000) suggests that that if a trigger value is exceeded the aim of further site-specific investigations is to assess if a 'potential risk' or an actual problem exists. The surface water and stream health impact assessment criteria listed in **Table 14** represent the 80th percentile of the historical baseline monitoring data.

In the event that any water quality measurement is found to deviate from background trends and/or record levels outside the surface water and stream health impact assessment criteria presented in **Table 14** the Mt Owen Complex E&C Manager will be responsible for initiating further site-specific investigations when:

- in his/her professional judgement, the deviation from background trends and impact assessment criteria could result in environmental harm;
- three (3) consecutive values are outside the impact assessment criteria presented in **Table 14**; or
- the measurement varies significantly from background water quality trends.

A site-specific investigation will then be instigated in accordance with the protocols outlined in the *Surface and Groundwater Response Plan* prepared as part of the *Mt Owen Complex WMP*.

When a water quality measurement has been investigated the findings of the investigation will be reported in the AEMR.

4. MEASUREMENT AND EVALUATION

4.1 Surface Water Impact Assessment Criteria

4.11 Trigger Value Determination

The Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000) (ANZECC) apply to the quality of both surface waters and groundwaters since they have been developed to protect environmental values relating to above-ground uses and so that quality of the water does not have a detrimental impact on water quality objectives of the surrounding ecosystem.

ANZECC (2000) recommends that wherever possible site-specific data is used to define trigger values for physical and chemical factors which can adversely impact the environment. However, the default values provided by ANZECC(2000) can be used where there is insufficient baseline data available.

The trigger values are not assessment criteria but are used to initiate investigations into the surface water quality as reported by the monitoring program.

The approach recommended by ANZECC (2000) for developing site-specific trigger values for highly disturbed ecosystems is to formulate trigger values based on the 80th percentile of the site-specific monitoring data. The objective of this approach is to develop conservative, site-specific trigger values for use as a means to improve water quality in highly disturbed ecosystems.

This approach to the defining of site-specific trigger values simplifies the dynamics of individual ecosystems and does not account for the water quality variability due to climatic conditions and the ephemeral nature of the creek systems present at the Mt Owen Complex. It is therefore considered that applying a 80th percentile trigger value may not adequately reflect the water quality dynamics for highly disturbed ecosystems with ephemeral creek systems.

A more appropriate approach involves the statistical analysis of baseline monitoring data to determine trigger values that consider the flow characteristics of the creeks, with trigger values developed for flow and non-flow conditions in the creeks at the time of sampling.

The results of the baseline monitoring data are discussed in **Section 4.2**.

In the event that suitable site-specific trigger values cannot be developed, the default trigger values defined by ANZECC (2000) for lowland rivers in slightly disturbed ecosystems in south-east Australia are given in **Table 4.1**.

Table 12- ANZECC (2000) Default Trigger Values for Key Water Quality Parameters

Water Quality Variable	Trigger Value
pH range	6.5 – 8.0
Conductivity (µS/cm)	125 - 2200

Source: ANZECC (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*

4.2 Discussion of Baseline Data

Baseline data has been collected as part of the Mt Owen Complex Surface Water Monitoring Program. As described in **Section 2.31**,Bowmans Creek has sufficient contributing catchment to maintain flows under most climatic conditions. The remaining watercourses are ephemeral, as described in **Sections 2.32** to **2.35**, with flows only occurring in the creeks during storm events or after prolonged periods of rain. As such the baseline monitoring data presented in **Section 2.3** has been analysed for flow and non-flow conditions to provide an indication of water quality surrounding the Mt Owen Complex.

4.21 Bowmans Creek

Bowmans Creek is the only creek that has a sufficiently sized contributing catchment area to maintain consistent water flow. The monitoring data collected from this watercourse is considered to provide representative water quality data for the watercourses in and around the Mt Owen Complex during flow conditions.

The pH levels recorded in Bowmans Creek ranged from 6.8 to 8.2 and the conductivity ranged from 427 µS/cm to 2730 µS/cm during the monitoring period (refer to **Section 2.31**). The TSS monitoring results ranged from 1 mg/L to 191 mg/L while the TDS results ranged from 286 mg/L to 1930 mg/L.

Monitoring location BMC2 experienced sharp increases in the recorded levels of electrical conductivity, TSS and TDS from October 2006 and May 2007 (refer to **Figure 2**). These results coincided with a period of very low rainfall, and can be attributed to low/no flow conditions.

The 80th percentiles of the monitoring data reported for Bowmans Creek, refer to **Table 4**, are within the default trigger values defined in ANZECC (2000) in **Table 142**.

4.22 Ephemeral Creeks

Yorks Creek, Swamp Creek, Bettys Creek and Main Creek are ephemeral creeks and typically exhibit high salinity levels due to intermittent flow events. The monitoring data reflects the water quality in these creeks during extended periods of no flow.

pH levels recorded in the ephemeral creeks generally ranged from 6.0 to 9.4, with samples collected at Swamp Creek recording levels up to pH 10.0 between September 2000 and November 2004 and samples collected in Bettys Creek recording levels down to pH 5.4 in February and March 2008.

The electrical conductivity recorded in the ephemeral creeks varied considerably from 190 µS/cm to 16,000 µS/cm, with two samples collected in Bettys Creek recording levels of up to 18,000 µS/cm.

The TSS levels recorded in the ephemeral creeks generally ranged from 1 mg/L to 650 mg/L, with two samples collected at Bettys Creek recording levels of up to 1300 mg/L. The variability of the results is primarily attributable to the change in flow conditions associated with rainfall. The results in **Table 5** to **Table 8** show that 80th percentiles of the TSS monitoring data reported for ephemeral creeks is less than 50 mg/L.

The TDS levels recorded in the ephemeral creeks ranged from 100 mg/L to 13,000 mg/L with samples collected from Swamp and Main Creek recording levels up to 35,000 mg/L. These typically occurred in periods where there was no flow in the creek. The maximum, minimum and 80th percentiles of the monitoring data reported for all the ephemeral creeks are given in **Table 13**.

Table 13- Monthly Water Quality Monitoring for Ephemeral Creeks

Water Quality Variable[1]	Minimum	80th Percentile	Maximum
pH	5.4	7.0 – 8.6	10.0
Conductivity[1] (µS/cm)	74	5,400	16,440
Total Suspended Solids (mg/L)	1	35	1,300
Total Dissolved Solids (mg/L)	78	4,700	12,240

4.3 Adopted Surface Water Impact Assessment Criteria

Comparison of the baseline monitoring results to the ANZECC (2000) default trigger values indicates that the existing water quality in the creek systems surrounding the Mt Owen Complex can exceed the ANZECC (2000) default trigger values for pH, electrical conductivity and TSS. The baseline monitoring results (refer to **Section 4.2**) also indicate that the ephemeral creeks record significantly higher electrical conductivity and TSS levels than those recorded in flowing creeks. This can be attributed to salt accumulation following periods of no rainfall. These results demonstrate the variability of water quality in flow and non-flow conditions.

Based on the monitoring results for Bowmans Creek, the trigger values for flow conditions in all creeks would be the ANZECC(2000) default trigger values. The 80th percentile values determined from the long term monitoring results for all the ephemeral creeks provides appropriate trigger values for no flow conditions in the ephemeral creeks The trigger values developed for the Surface Water Monitoring Program for the Mt Owen Complex are presented in **Table 14**. Where the 80th percentile value is lower than the ANZECC(2000) guidelines, the ANZECC(2000) default trigger values have been selected as the trigger value for that specific parameter.

Table 14 – Adopted Trigger Values for Key Water Quality Parameters

Water Quality Variable	Bowmans Creek	Ephemeral Creek Systems	
		Flow Conditions	No Flow Conditions
pH	6.5 – 8.0 [1]	6.5 – 8.0 [1]	6.5 [2] – 8.6
Conductivity[1] (µS/cm)	2,200 [1]	2,200 [1]	5,400
Total Suspended Solids (mg/L)	50 [1]	50 [1]	50 [1]
Total Dissolved Solids (mg/L)	1,480	1,480	4,700

Note 1: Use ANZECC (2000) criterion

Note 2: Use ANZECC (2000) criterion of 6.5 as the lower limit

ANZECC (2000) does not define trigger values for TDS. The triggers determined in **Table 14** were compared to guidelines for acceptable drinking water quality for beef cattle outlined by the Queensland DNRW (2007).The current land use, apart from mining, in the catchments surrounding the Mt Owen Complex is grazing for beef cattle. The guidelines for acceptable drinking water quality for electrical conductivity range from 5970 µS/cm to 7460 µS/cm and TDS from 4000 mg/L to 5000 mg/L (Queensland DNRW, 2007). These guidelines indicate that the trigger values developed for the MOC TDS are appropriate for the protection of the surrounding ecosystems.

4.31 Inorganic Substances

ANZECC (2000) outlines trigger values for a range of inorganic substances. There is insufficient baseline data for inorganics available from the baseline monitoring undertaken during the previous surface water monitoring program at the MOC to facilitate an analysis of the background trends.

It is proposed that the monitoring of inorganics be continued as part of the ongoing monitoring program, and the results be reviewed progressively during the life of the monitoring program to help determine appropriate trigger values for inorganics at the MOC.

4.4 Surface Water Monitoring Program

This program includes monitoring of the following elements of the MOC water management system and surrounding creeks:

- surface water flows and quality in upstream and downstream watercourses;
- channel stability in upstream and downstream watercourses;
- condition of Swamp Creek diversion channel;
- stream health conditions in upstream and downstream watercourses; and
- on-site water management.

4.41 Flows and Surface Water Quality

Surface water monitoring is to be undertaken at the monitoring locations described in **Section 2.2** on a monthly basis. Monitoring of the licenced discharge point at ECD2 will also be undertaken prior to any active discharges in order to comply with relevant EPL conditions (EPL 4460) and the conditions of the HRSTS (refer to **Section 3.1**).

Monitoring at ECD2 is to comprise the collection of composite samples at sufficient depths to ensure that the samples are representative of the quality of the water being discharged. This is specifically required in order to overcome the potential effects of stratification associated with periods of rainfall which can lead to significant variations in water quality with depth. Monitoring of water quality in site water management dams may be undertaken at other times for site environmental management purposes.

The monitoring schedule presented in **Table 15** outlines the frequency and parameters for each water sampling location. Parameters monitored at each sampling location are shaded in **Table 15**. Definitions for the parameters monitored are provided in **Section 5.1**. A monthly review of water quality data will be undertaken and will include consideration of relevant flow and rainfall data.

If monitoring of these parameters is proposed to be discontinued, XMO will consult with the OEH and the Department of Planning and Infrastructure (DoPI) during the revision of the monitoring program. For any variations to discharges or monitoring required under the HRSTS a variation to the EPL will be required. Any revisions to the monitoring program will also be discussed in the AEMR.

Table 15 – Mt Owen Complex Monthly Surface Water Monitoring Schedule

Monitoring Location [1]	Site Description	Flow [2]	pH	EC (µS/cm)	TSS (mg/L)	TDS (mg/L)	Cl (mg/L)	N (mg/L)	SO4 (mg/L)	COD (mg/L)	Mg (mg/L)	Ca (mg/L)	Tot. P (mg/L)	O & G (mg/L)	FC (cfu/100mL)	BOD (mg O_2/L)	Nitrate (mg/L)
BMC1	Bowmans Creek Up																
BMC2	Bowmans Creek Mid																
BMC3	Bowmans Creek Down																
YC1	Yorks Creek Up														Ceased 2006		
YC2	Yorks Creek Mid														Ceased 2006		
YC3	Yorks Creek Down														Ceased 2006		
SC1	Swamp Creek Up																
SC2	Swamp Creek Mid																
SC3	Swamp Creek Down																
BC1	Bettys Creek Up																
BC2	Bettys Creek Down																Ceased 2006
MC1	Main Creek Up																
MC2	Main Creek Down																
W1	TP1																
W2	North Void																
W3	Coal Stockpile Dam																
W4	Infrastructure Dam																
W5	Crushing Plant Dam																
W6	Mt Owen Sewerage												Added 2006				Added 2006
W7	CPD																
W8	Southern Void																
W9	Glennies Creek Dam																
W10	Southern Dam																
W11	RE Irrigation Water												Added 2006				Added 2006

Table 4.4 – Mt Owen Complex Monthly Surface Water Monitoring Schedule (cont.)

Monitoring Location 1	Site Description	Flow 2	pH	EC (µS/cm)	TSS (mg/L)	TDS (mg/L)	Cl (mg/L)	N (mg/L)	SO4 (mg/L)	COD (mg/L)	Mg (mg/L)	Ca (mg/L)	Tot. P (mg/L)	O & G (mg/L)	FC (cfu/100mL)	BOD (mg O2/L)	Nitrate (mg/L)
W12	RE Industrial Water																
W13	Ramp Sediment Dam 1																
W14	Ramp Sediment Dam 2																
W15	Ramp Sediment Dam 3																
ECD 2 3	ECD 2																Added 2006
ECD 3	ECD 3																
BMC4 4	Bowmans Creek 4																
BMC5 4	Bowmans Creek 5																
SC4 -4	Swamp Creek 4																
BC3 4	Bettys Creek 3																
BC4 4	Bettys Creek 4																

Note 1: refer to **Tables 2.1** to **2.3** for historical monitoring locations

Note 2: measured by way of observation as streams are ephemeral

Note 3: During HRSTS discharge events pH, ECC and TSS to be monitored daily and flow rate and EC monitored continuously (refer to **Section 3.1**)

Note 4: refer to **Table 2.1** for additional monitoring locations

4.42 Channel Stability and Stream Health

Monitoring of channel stability in Yorks Creek, Swamp Creek, Bettys Creek and Main Creek will involve detailed inspections annually or after large runoff events. This monitoring will include survey and photographic records at selected locations based on observations of stream and riparian vegetation cover, bed condition, active erosion points and potential areas of instability determined by the creek line inspections. Current stability assessment locations are shown in **Table 16**.

Table 16 – Mt Owen Complex Existing Monitoring Program for Channel Stability and Stream Health

Site Description	Sampling Location	Annual Monitoring
Yorks Creek 1 (YC1)	Upstream	Stability Assessment and Stream Health Transects
Yorks Creek 2 (YC2)	Midstream	Stability Assessment and Stream Health Transects
Yorks Creek 3 (YC3)	Downstream	Stability Assessment and Stream Health Transects
Swamp Creek 1 (SC1)	Upstream	Stability Assessment and Stream Health Transects
Swamp Creek 2 (SC2)	Midstream	Stability Assessment and Stream Health Transects
Bettys Creek 1 (BC1)	Upstream	Stability Assessment and Stream Health Transects
Bettys Creek 2 (BC2)	Downstream	Stability Assessment and Stream Health Transects
Main Creek 1 (MC1)	Upstream	Stability Assessment and Stream Health Transects
Main Creek 2 (MC2)	Downstream	Stability Assessment and Stream Health Transects
Swamp Creek 3 (SC3)	Midstream	Stability Assessment and Stream Health Transects
Swamp Creek 4 (SC4)	Downstream	Stability Assessment and Stream Health Transects
Bettys Creek 3 (BC1)	Upstream of the proposed Bettys Creek diversion	Stability Assessment and Stream Health Transects
Bettys Creek 4 (BC2)	Downstream of the proposed Bettys Creek diversion	Stability Assessment and Stream Health Transects
Bowmans Creek 1 (BMC1)	Upstream	Stability Assessment and Stream Health Transects
Bowmans Creek 2 (BMC2)	Midstream	Stability Assessment and Stream Health Transects

Site Description	Sampling Location	Annual Monitoring
Bowmans Creek 3 (BMC3)	Downstream	Stability Assessment and Stream Health Transects

The requirement for the monitoring program of the realigned section of Bettys Creek across the Eastern Rail Pit are addressed in Bettys Creek Diversion Stage 2 Monitoring and Maintenance (Parsons Brinckerhoff, 2007) and is incorporated into the Water Management Plan.

4.43 Condition of Swamp Creek Diversion Channel

As part of the long term surface water quality monitoring program additional sites have been selected to monitor the stability and stream health conditions for the Swamp Creek diversion channel.

Part 2 Permits (*Water Act 1912*) are currently being prepared for the Bettys Creek and Swamp Creek diversions associated with the Glendell Mine. These permits outline the stability and stream health monitoring programs for these diversions.

These monitoring programs contain such aspects as:

- photographic monitoring records;
- visual inspections;
- monitoring of key transects;
- monitoring of vegetation; and
- monitoring of the channel and bank stability.

4.44 Water Logging in Main Creek Catchment Area

Inspections of the land adjacent to the lower reaches of Main Creek for potential problems with water logging will be undertaken after large storm events. In the event that the monitoring identifies any adverse impacts, a plan of remediation shall be development and implemented. The remediation plan may include aspects, such as:

- analysis of flow conditions in Main Creek and potential flooding extents and durations during major storm events;
- analysis of areas of remnant ponding due to topography of the lower reaches of the catchment; and
- development of surface water runoff controls for major storm events which consider the interactions of Main Creek with the flows from the Bettys Creek diversion.

4.45 On-Site Water Management

This review will include details of rainfall on site, all water used on site, discharges off site, water imported to site, overflows from sediment dams and transfers to, from and around the site, including major dam water levels. Details of the onsite water management interactions are outlined in the water balance undertaken as part of the MOC WMP.

4.5 Independent Review

If a landowner considers the operation to be in exceedance of the relevant criteria, they may request an independent review of the effects of the operation on their land. Such a request must be made in writing to the Director-General of DoPI. If the Director-General determines that an independent review is to be undertaken, MOC must follow the procedures outlined in the relevant development consent.

5. REVIEW AND IMPROVEMENT

5.1 Program Review

This monitoring program shall be reviewed every three years including a review of monitoring locations and parameters for analysis. If any significant changes to the program are required as an outcome of the review, the DoPI will be consulted and the revised program submitted to the DoPI. Any revisions to the monitoring program will also be reported in the AEMR.

5.2 Reporting and Review of Results

5.21 Flows and Water Quality

All monitoring is to be undertaken in accordance with XMO procedures for environmental monitoring and evaluation and mine water discharge outlined in the MOC Environmental Management Strategy (EMS). The MOC E&C Manager will be responsible for the monthly review of the monitoring results and associated trends in water quality. Measured values will be compared to background trends in water quality and an investigation of potential cause undertaken when a deviation from background trends is identified and/or when water quality parameters record levels outside the surface water and stream health impact assessment criteria presented in **Table 16**. This investigation will be undertaken by the MOC E&C Manager following the investigation protocol described in **Section 3.2**.

Monitoring results will be reviewed annually and reported as required in the AEMR and reported to the MOC Community Consultative Committee in accordance with the MOC procedure for environmental reporting outlined in the MOC Environmental Management Strategy (EMS). Reporting will include a comparison of water quality trends with those of previous years and will highlight any results that are inconsistent with trends in baseline data.

All monitoring data will be retained in an appropriate format on site and will be used to review the effectiveness of the MOC water management system on an ongoing basis.

5.22 Channel Stability, Stream Health Conditions and Condition of Diversion Channel

The MOC E&C Manager will undertake regular monitoring annually and after large runoff events. The results of this monitoring will be reviewed annually and reported as required.

5.23 On-Site Water Management

The MOC E&C Manager will review all water management data annually and these results will be included as part of the AEMR for the site. This review will include details of rainfall on site, all water used on site, overflows from sediment dams and transfers to, from and around the site.

5.24 Reporting of Exceedances

If monitoring results identify an exceedance of the performance criteria outlined in **Section 4.1** of this Plan, XMO will notify DoPI of the exceedance/incident. Notified parties will be provided with quarterly monitoring results until it can be demonstrated that the operation is compliant with the relevant criteria.

6. DEFINITIONS

Term	Definition
Alluvium	Sediment deposited by a flowing stream, e.g. clay, silt, sand, etc.
AEMR	Annual Environmental Management Report
Aquifer	A water-bearing rock formation
BOD	Biological Oxygen Demand
Ca	Calcium
Cl	Chlorine
COD	Chemical Oxygen Demand
DA	Development Application
DECC	Department of Environment and Climate Change
DNR	Department of Natural Resources
DoP	Department of Planning
DWE	Department of Water and Environment
EA	Environmental Assessment
EC	Electrical Conductivity
ECD	Environmental Control Dam
EIS	Environmental Impact Statement
EMS	Environmental Management Strategy
Environmental Planning and Assessment Act 1979	NSW Government Act to provide for the orderly development of land in NSW
Environment Protection and Biodiversity Conservation Act 1999	Commonwealth legislation that regulates development proposals that have an actual or potential impact on matters of national environmental significance.
EPA	Environmental Protection Authority
EPL	Environmental Protection Licence
FC	Faecal Coliform
HRSTS	Hunter River Salinity Trading Scheme
HSEC	Health, Safety, Environment and Community
µS/cm	Micro siemens per centimetre is the standard measure of conductivity
Mg	Magnesium
ML	Mega litres or millions of litres, e.g. 5 ML is the same as 5 million litres

Term	Definition
Mtpa	million tonnes per annum
N	Nitrogen
O&G	Oil and Gas
Piezometer	A small diameter bore lined with a slotted tube used for determining the standing water level of groundwaters
pH	A measure of acidy
Protection of the Environment Operations Act 1997	NSW legislation administered by DECC that regulates discharges to land, air and water
SO_4	Sulphate
TDS	Total Dissolved Solids
Tot P	Total Phosphorus
TSS	Total Suspended Solids
WMP	Water Management Plan
XMO	Xstrata Mt Owen Pty Ltd

7. ACCOUNTABILITIES

The MOC E&C Manager is responsible for managing the Surface Water Monitoring Program. This duty includes assessing the compliance of the MOC with the conditions listed in the relative development consents and EPLs for the MOC. The MOC Operations Manager is responsible for providing adequate resources to undertake the activities required by this program.

If a contractor is engaged to undertake surface water monitoring on behalf of XMO, all monitoring undertaken by the contractor must be in accordance with this Surface Water Monitoring Program and all relevant monitoring standards (as outlined in **Section 8.1**).

Role	Accountabilities for this document
E&C Manager	Responsible for ensuring that monitoring, periodic environmental inspections and site-specific investigations are undertaken
Operations Manager	Responsible for providing adequate resources to undertake the activities required by this program

8. REFERENCES

8.1 Monitoring Standards

Surface water monitoring at the MOC will be undertaken in accordance with relevant Australian Standards, legislation and the NSW OEH approved methods for sampling including (but not limited to):

8.2 Legislation

- Department of Natural Resources and Water (Queensland), 2007, *FACTS Land Series, Measuring Salinity.*
- NSW DEC, 2004, Approved Methods for the Sampling and Analysis of Water Pollutants in New South Wales
- NSW EPA, 2003, *Hunter River Salinity Trading Scheme*.

8.3 Australian Standards

- AS/NZS 5667.1:1998 Water Quality – Sampling – Guidance on the Design of Sampling Programs, Sampling Techniques, and the Preservation and Handling of Samples.
- AS/NZS 5667.10:1998 Water Quality – Sampling – Guidance on Sampling of Waste Waters.
- Australian and New Zealand Environment and Conservation Council, Australian and New Zealand Guidelines for Fresh and Marine Water Quality, 2000.

8.4 Xstrata Coal NSW

- Standard 10 - Environment, Biodiversity and Landscape Functions

8.5 Other

- Umwelt (Australia) Pty Limited, 2002, *Draft Application for Part 2 Permit Under the Water Act*. Prepared for Hunter Valley Coal Corporation Pty Limited.
- Umwelt (Australia) Pty Limited, 2003, *Mt Owen Operations Environmental Impact Assessment, Appendix 5 Surface Water Assessment*. Prepared for Hunter Valley Coal Corporation.
- Umwelt (Australia) Pty Limited 2007, *Environmental Assessment for Modification of Glendell Mine Operations, Volumes 1-3, dated August 2007*. Prepared for Xstrata Mt Owen Pty Limited.
- Umwelt (Australia) Pty Limited, 2008, *Mt Owen Complex Water Management Plan*. Prepared for Xstrata Mt Owen Pty Limited.
- Xstrata Mt Owen Pty Limited, 2005, *Mt Owen Complex Water Management Plan*.
- Xstrata Mt Owen Pty Ltd, 2005*, Annual Environmental Management Report* (Period 01 August 2004 to 31 July 2005)
- Xstrata Mt Owen Pty Ltd, 2006*, Annual Environmental Management Report* (Period 01 August 2005 to 31 July 2006)
- Xstrata Mt Owen Pty Ltd, 2007, *Annual Environmental Management Report* (Period 1 August 2006 – 30 June 2007)

9. APPENDICES

Nil

10. CONTROL AND REVISION HISTORY

10.1 Document information

Property	Value
Approved by	<<Type name of document approver>>
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10.2 Revisions

Version	Date reviewed	Review team (consultation)	Nature of the amendment
1		HSEC Manager	Development of the Document
2	Nov 2011	MOC E&C Manager, E&C Coordinator	Review of the document in line with current practises and standards
3			