SPRINGVALE MINE EXTENSION PROJECT - SURFACE WATER IMPACT ASSESSMENT

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	Name	Position	Signature	Date
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ABBREVIATIONS

AHD	Australian Height Datum
ARI	Average Recurrence Interval
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
AWBM	Australian Water Balance Model
BFI	Base Flow Index
BoM	Bureau of Meteorology
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DGRs	Director-General's Requirements
DP&I	Department of Planning and Infrastructure
d/s	Downstream
EA	Environmental Assessment
EC	Electrical Conductivity
EEC	Endangered Ecological Communities
EIS	Environment Impact Statement
EP&A Act	NSW *Environmental Planning & Assessment Act 1979*
EPBC	*Environment Protection & Biodiversity Conservation Act 1999*
EPL	Environment Protection Licence
GIS	Geographical Information System
ha	hectares
H-N CMA	Hawkesbury-Nepean Catchment Management Authority
IFD	Intensity Frequency Duration
km	kilometre
kL	kilolitre
kL/d	kilolitres per day
LCC	Lithgow City Council
LDP	Licensed Discharge Point
LW	Longwall
m	metres
mBGL	metres below ground level
mg/L	milligrams per litre
ML	Megalitres
mm	millimetres
Mtpa	Million tonnes per annum
NATA	National Association of Testing Authorities, Australia
NOW	New South Wales Office of Water

NPHS	Newnes Plateau Hanging Swamps
NPRSSG	Newnes Plateau Rush Sedge Snow Gum Hollow Wooded Heath Grassy Woodland
NPSS	Newnes Plateau Shrub Swamps
NSW	New South Wales
NTU	Nephelometric Turbidity Units
OEH	Office of Environment and Heritage
POEO Act	*Protection of the Environment Operations Act 1997*
PTC	Pit Top Catchments
ROM	Run of Mine
SDWTS	Springvale Delta Water Transfer System
SCA	Sydney Catchment Authority
SDWC	Sydney Drinking Water Catchment
SEPP	State Environmental Planning Policy
SSTV	Site Specific Trigger Values
t	tonnes
TDS	Total Dissolved Solids
THPSS	Temperate Highland Peat Swamps on Sandstone
TSS	Total Suspended Solids
u/s	Upstream
µS/cm	micro-Siemens per centimetre
WMA	NSW Water Management Act 2000
WSP	Water Sharing Plan
WQOs	Water Quality Objectives
%ile	Percentile

1. INTRODUCTION

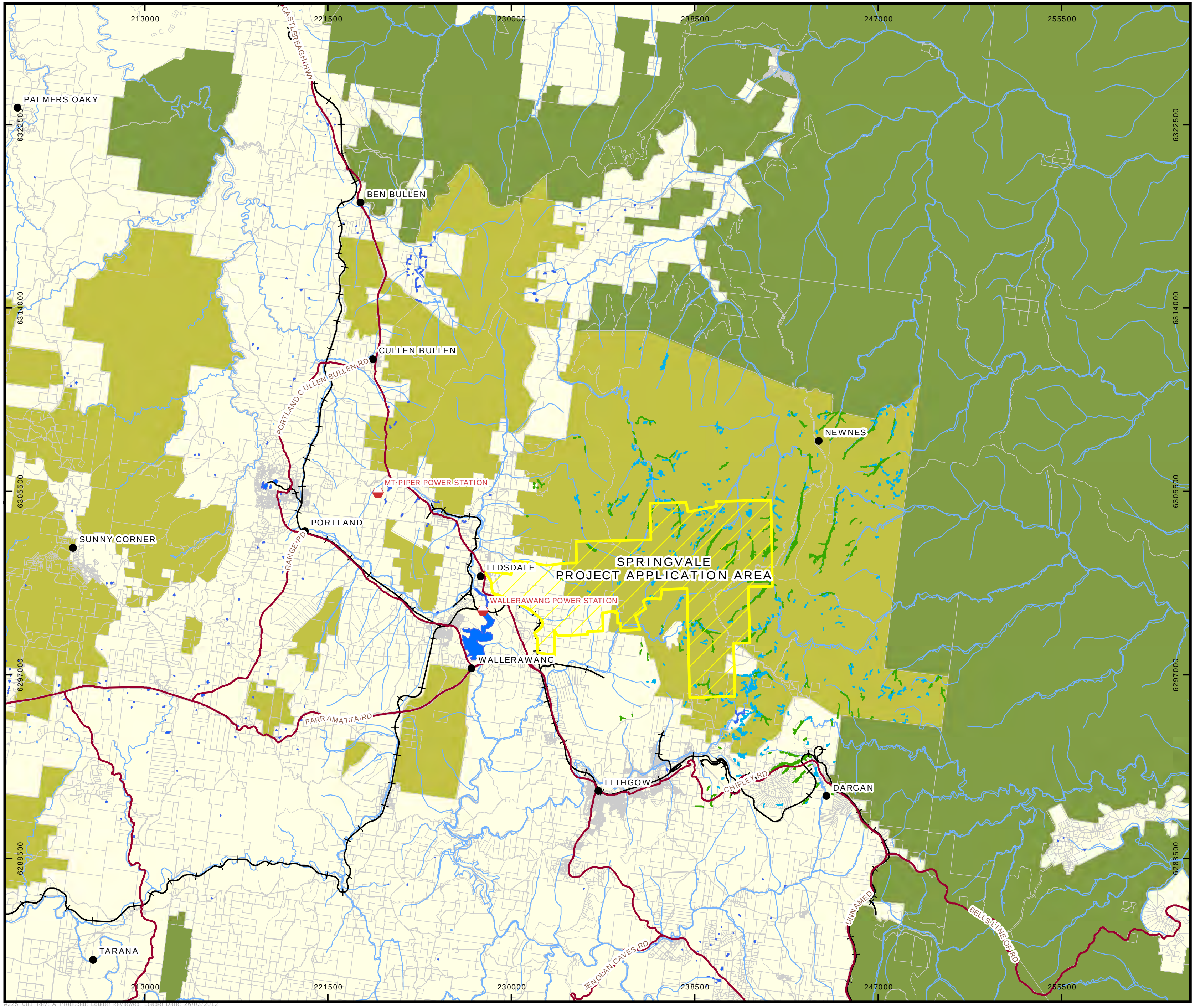
1.1 BACKGROUND AND PROJECT DESCRIPTION

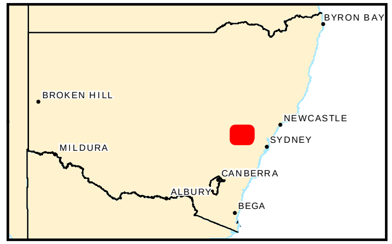
Springvale Mine is operated by Springvale Coal Pty Ltd (Springvale Coal), a wholly owned subsidiary of Centennial Coal Company Limited. The Springvale Mine is owned by Centennial Springvale Pty Ltd (as to 50%) and Springvale SK Kores Pty Limited (as to 50%) as participants in the Springvale unincorporated joint venture. It is located approximately 15km north of the City of Lithgow (Figure 1).

Springvale Coal (the Applicant) proposes to continue its mining operations, using longwall mining techniques, and to extend its mining area to the east, the southeast and the southwest of its existing workings (Figure 2). This proposed Project, the Springvale Mine Extension Project will extend the mine life by approximately 13 years. The Project is a State Significant Development (SSD 12_5594) in accordance with Clause 8 and Schedule 1 (Item 5) of State Environmental Planning Policy (State and Regional Development) 2011. As such, the Applicant is seeking approval under Part 4 Division 4.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The Project will:

The Project will:

- continue to extract up to 4.5 million tonnes per annum of run of mine coal from the Lithgow Seam underlying the Project Application Area;
- extend the life of the mine for an additional 13 years with rehabilitation to be undertaken post this period;
- develop underground access headings and roadways from the current mining area to the east to allow access to the proposed mining areas;
- undertake secondary extraction by retreat longwall mining method for the proposed longwalls LW416 to LW432 and LW501 to LW503;
- continue to use the existing ancillary surface facilities at the Springvale pit top;
- continue to manage the handling of ROM coal through a crusher and screening plant at the Springvale pit top, and the subsequent loading of the coal onto the existing overland conveyor system for despatch to offsite locations;
- continue to operate and maintain the existing ancillary surface infrastructure for ventilation, electricity, water, materials supply, and communications at the Springvale pit top and on Newnes Plateau;
- install and operate two additional dewatering bore facilities (Bores 9 and 10) on Newnes Plateau and the associated power and pipeline infrastructure, and upgrade the existing and construct two new sections of access tracks to Bores 9 and 10 facilities;
- construct a downcast ventilation borehole at the Bore 10 facility location;
- establish a mine services borehole area;
- upgrade the existing Springvale Delta Water Transfer Scheme (SDWTS) comprising construction of new sections of the trenched pipelines to increase the water delivery capacity of SDWTS from the existing 30 ML/day to up to 50 ML/day;
- manage predicted increase in mine inflows using a combination of direct water transfer to the Wallerawang Power Station, via the SDWTS, and discharge through Angus Place Colliery's licensed discharge point LDP001 and Springvale Mine's LDP009;
- continue to undertake exploration activities, predominately borehole drilling to refine the existing geological model;
- continue to undertake existing and initiate new environmental monitoring programmes;
- continue to operate 24 hours per day seven days per week, 52 weeks per year;
- continue to provide employment to a full time workforce of up to 310 employees;
- progressively rehabilitate disturbed areas at infrastructure sites no longer required for mining operations;





LEGEND

- Localities
- Power Stations
- Main Roads
- Railway
- Watercourses
- Hanging Swamp
- Shrub Swamp
- Surface Water Features
- Cadastre
- Forestry Reserve
- Nature Conservation Reserve
- Springvale Project Application Area

N

2.5 0 2.5 5

Kilometers

APPROX SCALE 1:250,000 @ A4

GDA 1994 MGA Zone 56

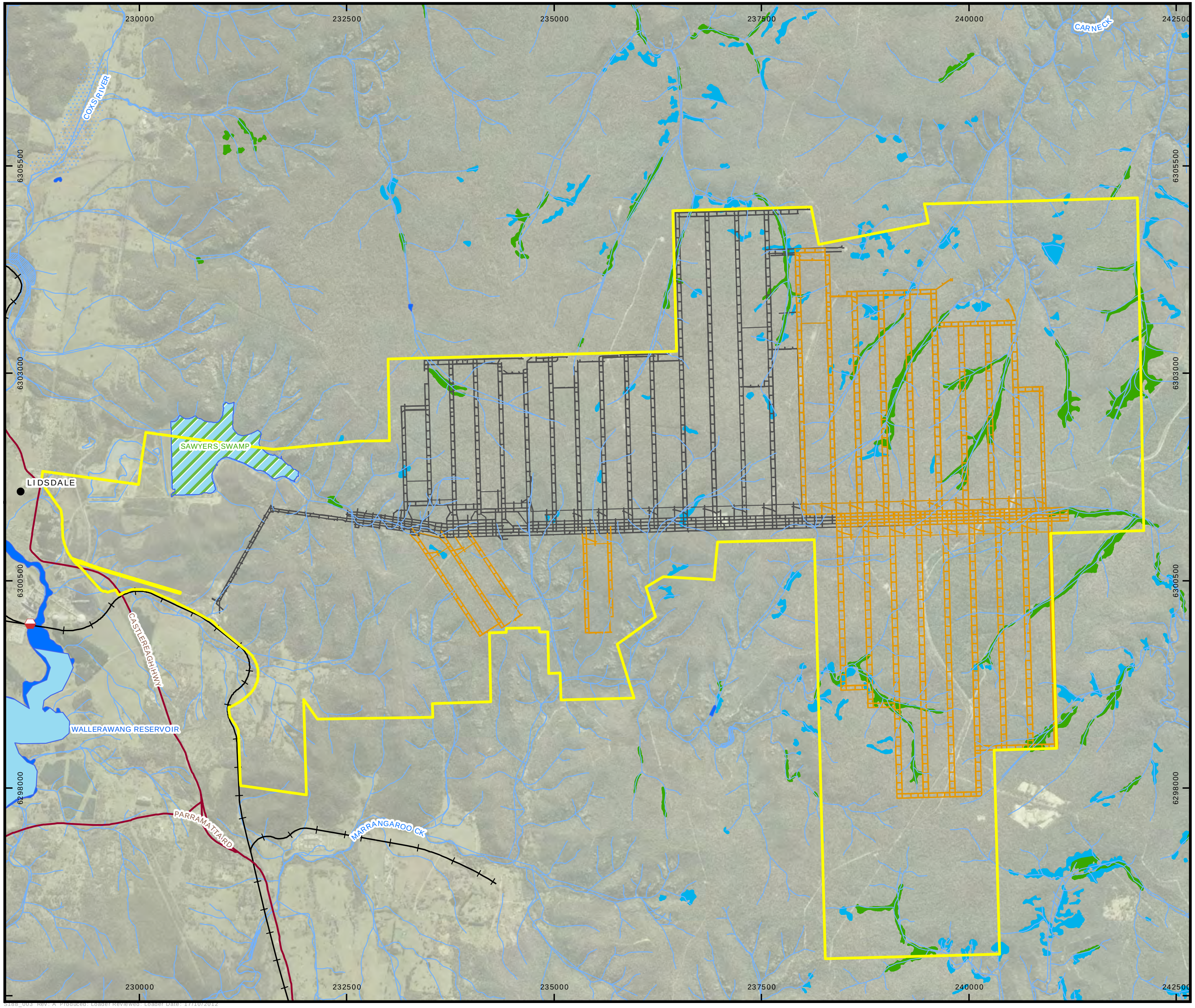
DATA SOURCES
Geoscience Australia
Land and Property Management Authority
Panorama Avenue Bathurst NSW 2795
www.lpma.nsw.gov.au

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Please verify the accuracy of all information prior to use.

RPS Aquaterra

FIGURE 1

Springvale Colliery
Locality Figure



LEGEND

- Main Roads
- Railway
- Watercourses
- Shrub Swamp
- Hanging Swamp
- Surface Water Features
- Sawyers Swamp
- Springvale Project Application Area

Mining Infrastructure

- Proposed Longwall Extension
- Springvale Existing Workings (EOM)

N

1 0 1 2

Kilometers

APPROX SCALE 1:65,000 @ A4

GDA 1994 MGA Zone 56

DATA SOURCES
Geoscience Australia
Land and Property Management Authority
Panorama Avenue Bathurst NSW 2795
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RPS Aquaterra

FIGURE 2

Springvale Colliery
Site Plan

- undertake life-of-mine rehabilitation at the Springvale pit top and the Newnes Plateau infrastructure disturbance areas to create final landforms commensurate with the surrounding areas and the relevant zonings of the respective areas; and
- transfer the operational management and physical infrastructure regarding coal processing and distribution infrastructure to the proposed Western Coal Services Project.

1.2 SITE, SITUATION AND EXISTING APPROVED MINE

Springvale Mine is an underground coal mine located in New South Wales about 120km west-northwest of Sydney. The mine pit top is located off Castlereagh Highway and about 15km north west of Lithgow (Figure 1 and Figure 2).

The mine Project Application Area site is bordered by other mines including Angus Place Colliery to the north and the abandoned Lithgow State mine to the south. The eastern section of the mine area boundary is within the Wolgan Valley and Newnes State Forest. The nearest populated localities includes Lidsdale and Wallerawang to west and Portland and Cullen Bullen to the north.

Other facilities near the Springvale Mine include the Wallerawang Power Station and Mt Piper Power Station, which receive coal from nearby collieries for electricity generation, Lidsdale Coal Siding Storage facility and Springvale Coal Services Site for coal washing.

1.3 LAYOUT OF THE REPORT

The report is presented in the following manner:

- Chapter 1 – Project Description and Water Management Strategy
- Chapter 2 – Relevant Legislation and Guidelines
- Chapter 3 – Existing Environment and Current Monitoring Program
- Chapter 4 – Site Water Management
- Chapter 5 – Surface Water Modelling
- Chapter 6 – Impact Assessment
- Chapter 7 – Licensing, Monitoring and Management
- Chapter 8 – Contingency Response Plans
- Chapter 9 – References

1.4 WATER MANAGEMENT STRATEGY

1.4.1 Current Approach

The project comprises underground operations beneath the Newnes Plateau (elevation ~1150mAHD), with surface operations (pit top, administration and surface water management infrastructure) on the footslopes of the Newnes Plateau (elevation ~920mAHD).

Commercial operations commenced at Springvale Mine in 1992.

At present, underground operations involve dewatering of target coal seams in advance of longwall mining, with disposal of groundwater inflow via transfer to the Springvale Delta Water Transfer Scheme (SDWTS) to meet demand at Wallerawang Power Station.

The SDWTS is a pipeline that transmits extracted groundwater from dewatering bores located at Springvale directly to the Wallerawang Power Station. Dewatering bores at the adjacent project at Angus Place Colliery are also connected to the SDWTS. Springvale has first priority on access to the scheme.

1.4.2 Future Changes

Development consent is being sought for extension to current mining operations at Springvale Mine and, in general, does not constitute a significant change to the current approach to the management of water at Springvale.

Extension of operations at Springvale Mine will result in increased dewatering requirements and increased inflow to underground mine workings that will be required to be managed. The increase in mine water make will be managed through transfer to the SDWTS to the extent of current capacity and at a later project stage, the SDWTS may be upgraded from its current capacity of 30ML/d to 50ML/d, when the combined mine inflow at both Springvale Mine and Angus Place Colliery exceeds 30ML/d, to accommodate increased inflows to Springvale's SDWTS from the adjacent project at Angus Place Colliery.

The predicted increase in discharge to the Coxs River / Lake Wallace reservoir will help satisfy existing excess demand for water by heavy industry in the Coxs River catchment.

The time of predicted peak outflow from the Springvale Mine will coincide with the outflow from the Angus Place Colliery. This combined peak outflow will, however, occur after completion of other mining projects in the Coxs River catchment and thereby the potential cumulative impact is also small.

2. REGULATION AND LEGISLATION

A number of regulations, policies, guidelines, plans and statutory provisions relating to surface water management are referred to in this report and are outlined in the following sections.

2.1 COMMONWEALTH LEGISLATION

2.1.1 Environment Protection and Biodiversity Conservation (EPBC) Act 1999

The Environmental Protection and Biodiversity Conservation Act 1999 is the main Commonwealth environmental legislation that provides legal framework to protect and manage matters of environmental significance including nationally and internationally important flora, fauna, ecological communities and heritage places.

The EPBC Act lists nine Matters of National Environmental Significance (MNES) that must be addressed when assessing the impacts of a proposal. Ecological survey undertaken as part of this project has identified that there are threatened species, ecological communities and migratory species identified as MNES within the Project Application Area.

Temperate Highland Peat Swamps on Sandstone (THPSS) are federally listed Endangered Ecological Communities (EECs) protected under the EPBC Act and have been mapped within the Project Application Area.

Water resources are also an MNES and the potential impact of the Project must be assessed in accordance with the Independent Expert Scientific Committee's Information Guidelines for *Proposals Relating to the Development of Coal Seam Gas and Large Coal Mines where there is a Significant Impact on Water Resources* (IESC, February 2013) and Draft *"Significant Impact Guidelines for Coal Seam Gas and Large Coal Mining Developments – Impacts on Water Resources*" (Department of the Environment, June 2013).

2.2 NSW LEGISLATION

2.2.1 Environment and Planning Assessment Act 1979

The Environmental Planning and Assessment Act (EP&A Act) 1979 provides the overarching statutory framework for assessing development in NSW. The EP&A Act enables the development of State Environmental Planning Policies (SEPPs).

The Springvale Mine Extension Project is classified as a State Significant Development (SSD 5594) listed under Clause 5(3) of Schedule 1 of SEPP (State and Regional Development) 2011, therefore Part 4, Division 4.1 of the EP&A Act applies.

The Director-General's Requirements (DGRs) for SSD 5594 were issued on 6 November 2012. The DGRs for the project that relate to surface water are listed in Table 2.1.

Table 2.1: Director General Requirements – Water Resources

Requirement	Where addressed
A detailed assessment of potential impacts on the quality and quantity of existing surface water and groundwater resources in accordance with the NSW Aquifer Interference Policy, including;	
• impacts on affected licensed water users and basic landholder rights;	Refer to Groundwater Assessment
• impacts on riparian, ecological, geo-morphological and hydrological values of watercourses, including groundwater dependent ecosystems and environmental flows;	Section 5.1, 5.2, 6.1 and 6.2
• whether the development can operate to achieve a neutral or beneficial effect on water quality in the drinking water catchment, consistent with the provisions of State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011;	Section 6.2
A detailed site water balance, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water	Section 4.1 and 5.1

Requirement	Where addressed
discharges), water supply infrastructure and water storage structures;	
Identification of any licensing requirements, including existing or future Environment Protection Licences (EPLs) or Pollution Reduction Programs (PRPs), and approvals under the Water Act 1912 and/or Water Management Act 2000;	Section 2.2 and 7.1
Demonstration that water for the construction and operation of the development can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of any relevant Water Sharing Plan (WSP);	Refer to Groundwater Assessment Section 7.1
A description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant WSP or water source embargo;	Refer to Groundwater Assessment Section 7.1
A detailed description of the proposed water management system (including sewerage), water monitoring program and all other proposed measures to mitigate surface water and groundwater impacts	Section 6.1 and 7.2

Supplementary DGRs were issued on 30 August 2013 (EPBC 2013/6881). The supplementary DGRs are presented in Table 2.2 and reference is provided as to where addressed.

Table 2.2: Supplementary DGRs – Water Resources

Requirement	Where addressed
An assessment of all relevant impacts on water resources and water related values, including:	
• detailed information addressing the Independent Expert Scientific Committee Information Guidelines for Proposals Relating to the Development of Coal Seam Gas and Large Coal Mines where there is a Significant Impact on Water Resources, available at: www.environment.gov.au/coal-seam-gas-mining/pubs/iesc-information-guidelines.pdf	Water Balance – Section 5.1 Impact Assessment including Risk Assessment – Section 6.1 and 6.2 Management & Monitoring – Section 7.2
• detailed information addressing the department's Water Resources Terms of Reference, currently in preparation.	N/A

The requirements of the Office of Environment and Heritage (OEH) are presented in Table 2.3.

Table 2.3: NSW Office of Environment and Heritage Requirements – Water

Office of Environment and Heritage Requirement	Relevant Section of the Report
Describe quality and quantity of water produced through the mining activities	Section 4.2
Specify impacts of modified flow and quality on biodiversity	Refer to Ecological Assessment
Project relationship to Regional Water Strategy	Refer to Main EIS
Mitigation strategies to address impact of mining on swamps	Section 5.5 and 6.4

The requirements of the NSW Office of Water are presented in Table 2.4.

Table 2.4: NSW Office of Water Requirements – Water

NSW Office of Water Requirement	Relevant Section of the Report
Adequate and secure water supply for all mine activities	Section 5.1
Compliance with WSP rules including rules for access licences, and distance restrictions, water quality and surface water and groundwater connectivity	Refer to Groundwater Assessment Section 7.1
Identification of GDEs, assessment for condition and water quality and quantity requirements for terrestrial and aquatic systems, diversity and abundance	Refer to Groundwater Assessment
Assessment of potential effects of mining operation on surface water quality in short and long term	Section 5.2, 6.2 and 6.3
Predictive assessment of drawdown, inflow and potential impacts to groundwater and surface water sources, basic landholders right, licensed water users and	Refer to Groundwater Assessment

NSW Office of Water Requirement	Relevant Section of the Report
GDEs	
Mitigation strategies to address adverse impacts on surface and groundwater sources and GDEs for operational and post mining phases	Section 7.2 and 8.1

2.2.2 Relevant Policies and Guidelines

This report has addressed (as applicable) policies and procedures from the relevant state and commonwealth policies and guidelines:

- National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ, 2000)
- National Water Quality Management Strategy: Australian Guidelines for Water Quality Monitoring and Reporting (ANZECC/ARMCANZ, 2000)
- National Water Quality Management Strategy: Guidelines for Sewerage Systems – Effluent Management (ARMCANZ/ANZECC, 1997)
- National Water Quality Management Strategy: Guidelines for Sewerage Systems – Use of Reclaimed Water (ARMCANZ/ANZECC, 1999)
- Using the ANZECC Guideline and Water Quality Objectives in NSW (DEC)
- State Water Management Outcomes Plan (SWMOP) (NSW Government, 2002)
- Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011
- NSW Government Water Quality and River Flow Objectives (OEH).
- Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (DEC)
- Managing Urban Stormwater: Soils & Construction, Volume 2E, Mines and Quarries (Landcom, 2004).
- Information Guidelines for Proposals Relating to the Development of Coal Seam Gas and Large Coal Mines where there is a Significant Impact on Water Resources (IESC, 2013)
- Significant Impact Guidelines for Coal Seam Gas and Large Coal Mining Developments – Impacts on Water Resources (Department of the Environment, 2013)

2.2.3 Water Sharing Plans and Water Management Act 2000

Water Sharing Plans (WSPs) are being progressively developed for rivers and groundwater systems across NSW following the introduction of the Water Management Act (WMA) 2000. These WSPs are designed to provide long-term environmental protection and sustainability of the water resources as well as directing how water will be allocated and shared among the various water users.

The location of the Project falls within the bounds of the Greater Metropolitan Region Unregulated River Water Sources Water Sharing Plan, which commenced on 1 July 2011. The WSP manages the protection of the environment, water extractions and licences for specific water sources and any water trading within the coverage of the plan.

Water Management Act 2000

Licenses are required for surface water extraction from the WSP. In the case of this project there is no direct extraction of surface water from the WSP. Indirect extraction due to minor reduction in baseflow is also required to be licensed. Details of the potential groundwater impact are presented in the Groundwater Assessment (RPS, 2013b).

Table 2.5 presents the current surface water licenses held in the WSP with respect to the Wywandy Management Zone and Colo River Management Zone of the Upper Nepean and Upstream Warragamba and Hawkesbury and Lower Nepean River Extraction Management Units respectively.

Table 2.5: Details of Current Surface Water Extraction Licenses

	Wywandy Management Zone	Colo River Management Zone
Resources:		
Total Licensed Entitlement	273.3ML/y	2887.3ML/y
Current Licenses:		
NIL	-	-
Total Licenses	0ML/y	0ML/y

Water Act 1912

Groundwater extraction licenses are currently administered under the Water Act 1912 and are in the process of being translated to licenses under the Water Management Act 2000.

Further details of groundwater licenses are presented in the Groundwater Assessment (RPS, 2013b).

2.2.4 State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011

Part 2 of the State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011 requires that all new proposed developments in the Sydney drinking water catchment demonstrate a neutral or beneficial effect on water quality.

"*A proposed development or activity will be found to have a neutral or beneficial effect on water quality if it complies with and demonstrates any of the following:*

1. There are no factors involved that have any potential to impact on water quality.

There will be no changes to site conditions and/or the nature and location of development that could:

a. directly change pollutant loads by introducing or increasing substances into the water cycle (such as waste flows, increased erosion, nutrients and sediments), or

b. indirectly change the quality of water in the hydrological system by changing the bio-physical characteristics of the site in any way that reduces, or significantly threatens to reduce, the capacity of the site and related hydrological/ ecological components to assimilate, treat and otherwise produce water of at least equal quality to the existing systems. Changes relate to the environmental values of the system, and may include:

- *significant changes to water flows (reductions or increases in flows)*
- *clearing or degradation of watercourses or of riparian corridors, or*
- *changing the path of water flows through these assimilative systems.*

2. The development will not adversely affect water quality off-site because:

a. pollutant loads from the development / activity can be transported to acceptable downstream treatment and disposal facilities without adverse off-site water quality impacts, or

b. any water quality issues can be effectively managed on-site so that there are no adverse water quality impacts off-site, or

c. there are no indirect adverse impacts on water quality caused, or likely to be caused, by changes to factors that currently affect water quality off-site such as treatment, assimilation of pollutants, or the hydrological cycle (such as changes to flow or flow paths, water courses or riparian corridors).

The site of a proposed development or activity, to determine water quality impacts, is the land described in the development application, the Part 5 activity documentation, or where relevant, the project application. Pollutant loads or concentrations for each pollutant leaving a site are measured at the site boundary, or at the point where the pollutant enters a drainage depression, waterbody or watercourse."

2.2.5 Protection of the Environment Operations Act 1997

As determined in Section 120 of the Protection of the Environment Operations (POEO) Act 1997, waters are not to be polluted except as expressly provided for in an Environmental Protection Licence (EPL).

Springvale Coal Pty Ltd have been granted an EPL for coal works and mining for coal (EPL 3607), which covers the mining operation, surface facilities, overland conveyors at the Springvale Colliery Site and other related sites.

The provisions of EPL 3607 prescribe water quality and volumetric concentration discharge limits of various surface water pollutants to designated Licensed Discharge Points (LDP). Table 2.6 list the location of LDPs under EPL 3607 (latest revision, 21 May 2013).

Table 2.6: Location of Licenced Discharge Points

Discharge Point	Location and Function	Limit of discharge (kL/d)	Oil & Grease (mg/L)	pH[1]	TSS (mg/L)	Conductivity (µS/cm)
LDP001	Main discharge point of Springvale pit top facilities, collecting the overflows from the Fire Dam, the Primary (or Stockpile) and the Secondary Ponds.	10,000	10	6.5 – 9.0	30	N/A
LDP002	Irrigation area on the north west extend of the site for the discharge of treated waste water effluent	N/A	N/A	N/A	N/A	N/A
LDP004	Emergency discharge point from dewatering bores to unnamed creek leading to Wolgan River.	15,000*	N/A	N/A	N/A	N/A
LDP005	Emergency discharge point from dewatering bores to unnamed creek leading to Wolgan River	15,000*	N/A	N/A	N/A	N/A
LDP006	Outside of Project Application Area (refer to Springvale Coal Services Site)					
LDP007	Outside of Project Application Area (refer to Springvale Coal Services Site)					
LDP009	Springvale Coal's Springvale Delta Water Transfer System (SDWTS) bypass point east of Kerosene Vale Ash Dam	30,000	10	6.5 – 9.0	50	1,200
LDP010	Emergency/maintenance discharge from Springvale Coal's SDWTS upstream of the settling ponds. Formerly Delta Electricity's LDP020.	N/A	10	6.5 – 9.0	N/A	1,200

Notes 1. 100% concentration limit;; * These are emergency discharge locations and operationally, both currently and in the extension of Springvale Mine, water is preferentially discharged to the Coxs River instead.

2.2.6 Threatened Species Conservation Act 1995

The Threatened Species Conservation Act 1995 (TSC Act) is NSW state legislation that provides for conservation of threatened species, populations and ecological communities.

Newnes Plateau Shrub Swamp communities within the Project Application Area fall under the jurisdiction of the TSC Act.

The predicted impact to the hydrologic regime of these communities is presented within this report.

Further details on these groundwater dependent ecosystems are presented in the Terrestrial Ecology Assessment (RPS, 2013a) and Aquatic Ecology Assessment (Cardno Ecology Lab, 2013).

2.3 WATER QUALITY GUIDELINES

There are two sets of water quality guidelines that are referred to in this impact assessment:

- Australian and New Zealand Guidelines for Freshwater and Marine Water Quality (ANZECC/ARMACANZ, 2000)
- Australian Drinking Water Guidelines (NHMRC, 2011).

The guidelines form part of the National Water Quality Management Strategy and provide an approach to the preparation and implementation of water quality management objectives and actions.

The southern half of the Project is located within the Coxs River catchment, which is a significantly disturbed sub-catchment within the Greater Metropolitan Regional Unregulated River Water Source Water Sharing Plan (Upper Nepean and Upstream Warragamba Extraction Management Unit). Accordingly, the catchment falls within the Sydney Drinking Water catchment as defined in the State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011.

Comparison of the existing operation and the extension to the project are presented against the Australian Drinking Water Guideline (ADWG) (NHMRC, 2011), together with ANZECC guideline values (ANZECC, 2000) as outlined.

2.3.1 Environmental Values, Human Uses and Water Quality Objectives

The primary water use in the Coxs River catchment is heavy industry, as influent to the Wallerawang Power Station via direct transfer through the SDWTS or extraction from the Coxs River / Lake Wallace water supply reservoir.

Water supply to the Mt Piper Power Station is also obtained from the Coxs River from the Lake Lyell reservoir, which is situated downstream of the Lake Wallace reservoir. Water is pumped from Lake Lyell to the Mt Piper Power Station via intermediate transfer to Thompsons Creek Dam.

Wallerawang Power Station was commissioned in 1957 and current water demand is 11,000ML/y (30ML/d).

Mt Piper Power Station was commissioned in 1993 and current water demand is 14,200ML/y (38.9ML/d).

It is noted that Lake Wallace reservoir is also a drinking water supply for the township of Wallerawang.

Other environmental values of the water sources in the surrounding area are for recreational uses, irrigation, stock watering and aquatic ecosystems.

2.3.2 Water Quality Issues and Trigger Levels

Key water quality issues that are relevant to water quality surrounding the Project Application Area are pH, salinity, total suspended solids, oil and grease, some dissolved metals and dissolved oxygen.

Trigger levels are “the concentrations (or loads) for each water quality parameter, below which there exists a low risk that adverse biological (or ecological) effects will occur. They are the levels that trigger some action; either continued monitoring in the case of low risk situations or further ecosystem-specific investigations in the case of high risk situations” (ANZECC/ARMCANZ, 2000). The Guidelines state that “they are not intended to be an instrument to assess ‘compliance’ and should not be used in this capacity” (ANZECC/ARMCANZ, pg. 7.4-4, 2000).

The ADWG prescribe a health-related guideline which, based on present knowledge, does not result in any significant risk to the health of consumers over a lifetime of consumption. An aesthetic guideline value, which is the concentration or measure of a water quality characteristic that is, associated with acceptability of water to the consumer, for example, appearance, taste and odour (NHRMC, 2011).

Environmental data tends to be highly variable and therefore at least 24 points of data are generally considered as a basis for a well-rounded interpretation. In this study, most sites were sampled several times within a month over a period of more than two years and therefore meet this general pre-requisite.

Table 2.6 presents the guidance values for 95% protection level of slightly to moderately disturbed freshwater ecosystems (ANZECC,2000), the current 100% concentration limits on EPL 3607 and the ADWG health and aesthetic values (NHRMC, 2011).

Table 2.7: Water Quality Guideline Trigger Values

Parameter	Units	95% Protection level for Slightly to Moderately Disturbed Freshwater Ecosystems (ANZECC, 2000)	EPL 3067 LDP001	EPL3067 LDP009	ADWG Health (NHRMC, 2011)	ADWG Aesthetic (NHRMC, 2011)
Physical Parameters						
pH		6.5 – 8.0	6.5 – 9.0	6.5 – 9.0	c	6.5 – 8.5
EC[1]	µS/cm	350	-	1,200	-	
TDS[1]	mg/L	234.5	-	804	f	Based on taste: < 600 good quality 600 – 900 fair quality
Hardness as $CaCO_3$	mg/L	-	-	-	f	< 60 soft but possibly corrosive 60 – 200 good quality 200 – 500 increasing scaling problems >500 severe scaling
TSS	mg/L	-	30	50	-	-
Turbidity	NTU	2 – 25	-	50	c	5
Oil and Grease	mg/L	-	10	10	-	-
Major Ions						
Na	mg/L	-	-		f	180
Ca	mg/L	-	-		-	-
Mg	mg/L	-	-		-	-
K	mg/L	-	-		-	-
Alkalinity[3]	mg/L	-	-		-	-
Cl	mg/L	-	-		c	250
SO_4	mg/L	-	-		500	250
Trace Ions						
Ag	mg/L	0.00005	-	-	0.1	-
Al	mg/L	0.055 for pH>6.5	-	0.45	c	0.2
As	mg/L	0.024 as As III	-	0.024	0.01	-
B	mg/L	0.37	-	0.37	4	-
Cd	mg/L	0.0002	-	-	0.002	-
Cr	mg/L	0.001 as Cr VI	-	-	0.05 as Cr VI	-
Cu	mg/L	0.0014	-	0.007	2	1
F	mg/L	-	-	1.8	1.5	-
Fe	mg/L	ID	-	0.4	c	0.3
Mn	mg/L	1.9	-	1.7	0.5	0.1
Ni	mg/L	0.011	-	0.047	0.02	-

Parameter	Units	95% Protection level for Slightly to Moderately Disturbed Freshwater Ecosystems (ANZECC, 2000)	EPL 3067 LDP001	EPL3067 LDP009	ADWG Health (NHRMC, 2011)	ADWG Aesthetic (NHRMC, 2011)
Pb	mg/L	0.034	-	-	0.01	-
Se	mg/L	0.011 as Total Se	-	-	0.01	-
Zn	mg/L	0.008	-	0.05	c	3
Nutrients						
NH_3 as N	mg/L	0.013	-	-	c	0.4
NO_3 as N	mg/L	0.015[2]	-	-	11.3	-
Total N as N	mg/L	0.25	-	-	-	-
Total P as P	mg/L	0.02	-	-	-	-

Notes: 1. The assumed conversation factor is EC (µS/cm) x 0.67 = TDS (mg/L) from Section 4.3.3 of ANZECC (2000); 2. NOx (oxides of N); ID. Insufficient data to derive a reliable trigger value; c. Insufficient data to set guideline value based on health considerations; f. No health-based value considered necessary; 3. Alkalinity is Total Alkalinity of CO_3 2-, HCO_3 - and OH-.

3. EXISTING SURFACE WATER ENVIRONMENT

3.1 CLIMATE

The Newnes State Forest is described as a warm temperate climate with an annual rainfall of 1,073mm (Lithgow (Newnes State Forest); BOM Station No. 63062). Summers are mild with average temperatures of 23.5^{o}C and winters are cold with average minimum temperatures of -1.0^{o}C. Rainfall and temperature are highest in summer and lowest during winter.

Springvale Pit Top facilities are located on the footslopes below the Newnes Plateau, about 150m lower in elevation. Climatological characteristics at the Springvale Pit Top is different to that encountered on the Newnes Plateau, with average annual rainfall at Pit Top of 766mm (Lidsdale (Maddox Lane); BOM Station No. 63132).

3.1.1 Rainfall

Rainfall data has been reviewed from stations within the area.

A number of BOM stations have been identified near the Project Application Area and are listed below, in order of preference, taking into consideration locality, altitude and quality of data.

- Lidsdale (Maddox Lane), Station No. 63132 – 01/08/1959 to present.
- Portland (Jamieson St), Station No. 63071 – 01/01/1923 to present.
- Lithgow (Cooerwull), Station No. 63226 – 01/01/1878 to present.
- Sunny Corner (snow line), Station No. 63079 – 01/01/2003 to 29/02/2008.
- Wallerawang Power Station, Station No. 63176 – 01/12/1902 to 31/10/1973.
- Lithgow (Birdwood St), Station No. 63224 – 01/04/1889 to 30/06/2006.
- Lithgow (Kylie Park), Station No. 63164 – 01/09/1959 to 31/09/2009.
- Lithgow (Newnes Forest Centre), Station No. 63062 – 01/04/1938 to 30/11/1999.

The Lithgow (Newnes Forest Centre) (BOM Station No. 63062) station represents the most complete historical rainfall dataset with respect to the Newnes Plateau (elevation above 1,000mAHD). Monitoring at this station ceased in 1999.

The most complete dataset with respect to Springvale Pit Top corresponds to the Lidsdale (Maddox Lane) (BOM Station No. 63132) station. This station is located 5km from the Springvale Pit Top. The next closest station to Springvale Pit Top is Portland (Jamieson St) (BOM Station No. 63071); however, there are significant data gaps until 1944 and between 1993 and 2003.

The distribution of the average monthly rainfall throughout the year at the footslopes / Pit Top (Lidsdale – Maddox Lane) and on the Newnes Plateau (Lithgow - Newnes Forest Centre station) is presented in Figure 3.

Table 3.1 presents the tabulated monthly values. The long term average annual rainfall from the collated record is 766mm at the Lidsdale station and is 1,073mm at the Newnes Plateau station.

Table 3.1: Distribution of Average Monthly Rainfall (mm) – Pit Top (Lidsdale (Maddox Lane), Station 63132) and on the Newnes Plateau (Lithgow (Newnes Forest Centre), Station 63062).

Lidsdale (Maddox Lane), Station 63132 (mm)													
Statistic	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Mean	85.1	78.7	64.2	42.4	51.1	48.8	51.6	65.5	53.7	68.4	73.4	72.9	766.1
Lowest	8.0	5.6	3.8	1.2	2.6	2.6	2.7	1.8	3.4	2.4	7.6	0.0	329.8
10th %ile	24.8	17.6	14.2	6.0	7.4	16.5	18.0	16.0	19.6	14.6	18.7	25.7	515.1
Median	76.6	70.4	50.7	32.3	45.2	39.8	43.2	51.6	52.0	73.1	62.5	62.3	765.3
90th %ile	172.5	131.9	120.8	84.9	102.4	83.5	91.2	121.7	91.3	124.2	142.1	133.4	972.7
Highest	213.6	270.4	270.4	202.6	131.2	228.3	214	363.8	123.0	228.4	164.7	217.0	1260.3
Lithgow (Newnes Forest Centre), Station 63062 (mm)													
Statistic	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Mean	121.0	114.1	102.9	79.9	81.3	83	68.3	83.5	67.9	91.5	89	90.4	1073.1
Lowest	18.8	5.6	5.1	6.2	11.0	0.0	2.0	4.6	0.0	6.4	4.7	2.6	495.5
10th %ile	35.3	26.1	24.0	15.8	21.3	13.5	19.0	22.3	24	24.1	26.3	22.1	728.2
Median	133.0	90.8	78.7	59.2	62.6	62.8	53.9	67.2	64.3	80.8	78.6	67.0	1136.9
90th %ile	209.4	244.5	217.1	149.7	174.8	176.7	128.6	165.9	109.4	189.0	162.8	198.2	1452.1
Highest	280.8	338.6	519.4	299.1	286.9	320.0	240.7	412.4	207.2	267.2	209.3	303.2	1889.1

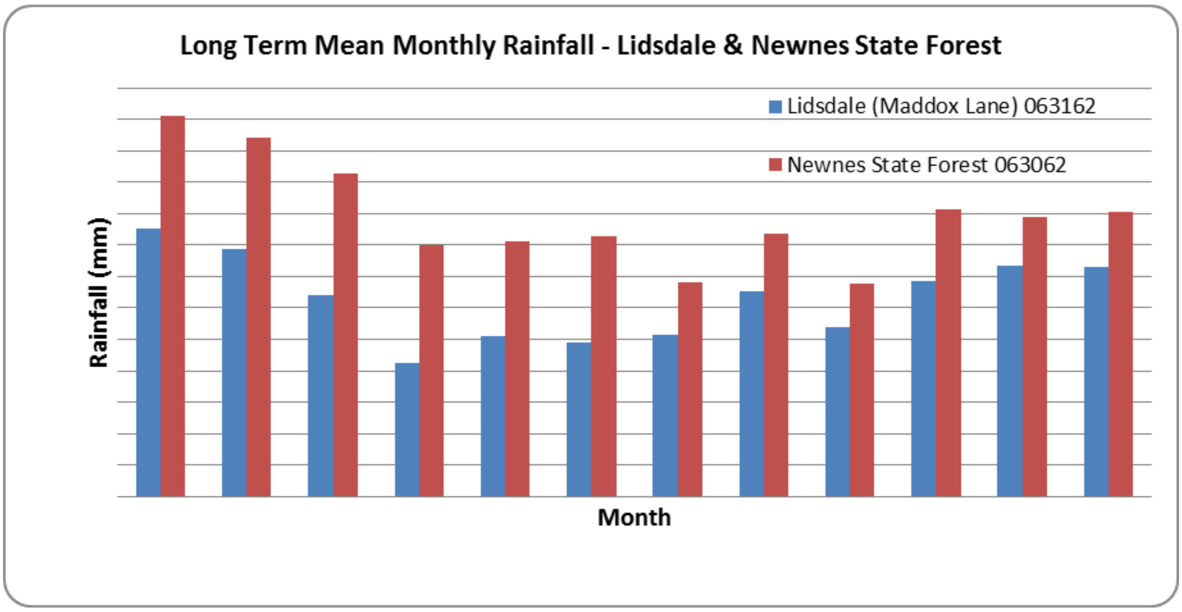


Figure 3: Distribution of Average Monthly Rainfall (mm).

3.1.2 Evapotranspiration

Daily Pan A evaporation has been recorded at the Bathurst Agricultural Station (BOM Station No. 63005) from 1966 to current. The average monthly evaporation rate is presented in Table 3.2. The annual average daily Pan A evaporation rate is 3.7 mm/day. The Bathurst Agricultural Station is the closest monitoring station to Springvale Mine and is 47km to the west.

Pan A evaporation is usually used for estimating evaporation losses from open water surfaces of sediment ponds and dams.

In forested areas, evaporation tends to be low compared to Pan A evaporation, but this is offset by increased transpiration. Analysis of flow gauging at Sunnyside Swamp on the Newnes Plateau suggest actual evaporation may be 35% of Pan A evaporation.

Table 3.2: Average daily Pan A evaporation (mm) (Bathurst Agricultural Station, BOM Station No. 63005).

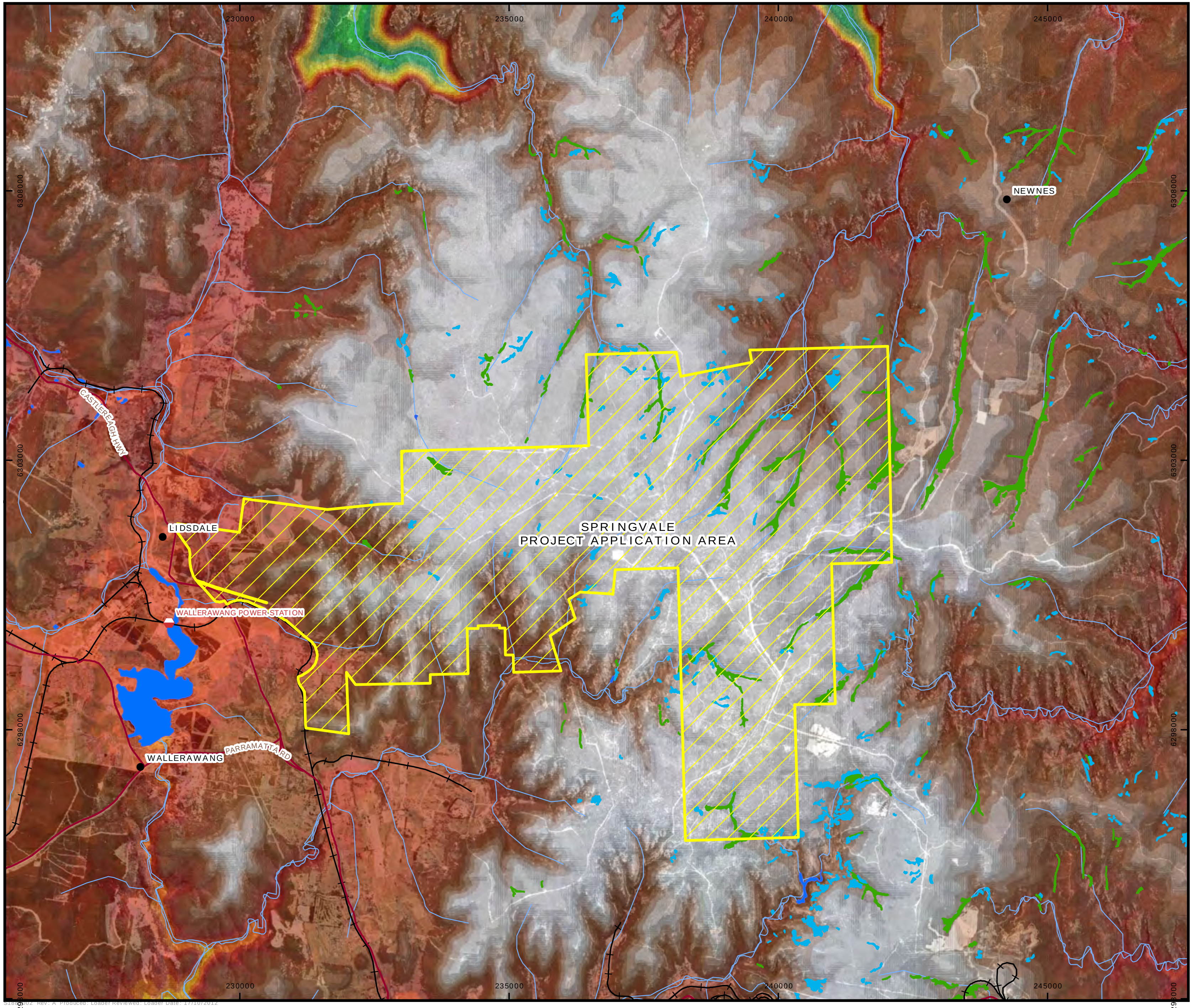
Stat.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	6.8	5.8	4.5	2.9	1.7	1.1	1.2	1.8	2.8	4.0	5.2	6.5	3.7

3.2 TOPOGRAPHY

Topography in the Project Application Area can be described as comprising narrow gorges with high ridgelines, steep-sided slopes and sandstone cliffs above incised valleys and spurs and moderately sloped ephemeral drainage lines. Ground elevations within the Project Application Area range between 850mAHD and 1,200mAHD.

The Newnes Plateau forms a divide between the Wolgan and Coxs River catchments. The plateau itself is characterised by a number of connecting, wide, undulating ridges, dissected by relatively steep–sided valleys, with the floors of the creeks and gullies occurring between 960 and 980mAHD. Sandstone cliffs over 40m in height can be found in the south western and north eastern precincts of the Project Application Area. THPSS that occur on the Newnes Plateau are, in general, underlain by low permeability shale and claystone plies which occur within the Burralow Formation and create a perched groundwater system. Further detail of the hydrogeological systems on the Newnes Plateau is presented in the Groundwater Impact Assessment

The Pit Top is located on the footslopes of the Newnes Plateau and comprises relatively open and flat valleys of the upper Coxs River and tributaries. Figure 4 presents the digital elevation model (DEM) of the Project Application Area and its surrounds.



LEGEND

- Localities
- Power Stations
- Main Roads
- Railway
- Watercourses
- Hanging Swamp
- Shrub Swamp
- Surface Water Features
- Springvale Project Application Area

Elevation (mAHD) (derived from Lidar)

550 - 575	875 - 900
575 - 600	900 - 925
600 - 625	925 - 950
625 - 650	950 - 1,000
650 - 675	1,000 - 1,025
675 - 700	1,025 - 1,050
700 - 725	1,050 - 1,075
725 - 750	1,075 - 1,100
750 - 775	1,100 - 1,125
775 - 800	1,125 - 1,150
800 - 825	1,150 - 1,175
825 - 850	> 1,175
850 - 875	

N

1 0 1 2

Kilometers

APPROX SCALE 1:100,000 @ A4

GDA 1994 MGA Zone 56

DATA SOURCES
Geoscience Australia
Land and Property Management Authority
Panorama Avenue Bathurst NSW 2795
www.lpma.nsw.gov.au

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FIGURE 4

Springvale Colliery
Regional Topography

3.3 RIVERS AND CREEKS

3.3.1 Catchment Descriptions

The Project Application Area encompasses two adjacent sub-catchments, the Wolgan River and the Upper Coxs River. The catchment divide between these catchments runs in a north-west to south-east direction through the Project Application Area.

The Wolgan River is a tributary of the Hawkesbury-Lower Nepean River extraction management unit of the WSP for the Greater Metropolitan Region Unregulated River Water Sources. The Upper Coxs River is a tributary of the Upper Nepean and Upstream Warragamba extraction management unit and is also a sub-catchment within the Sydney Drinking Water Catchment.

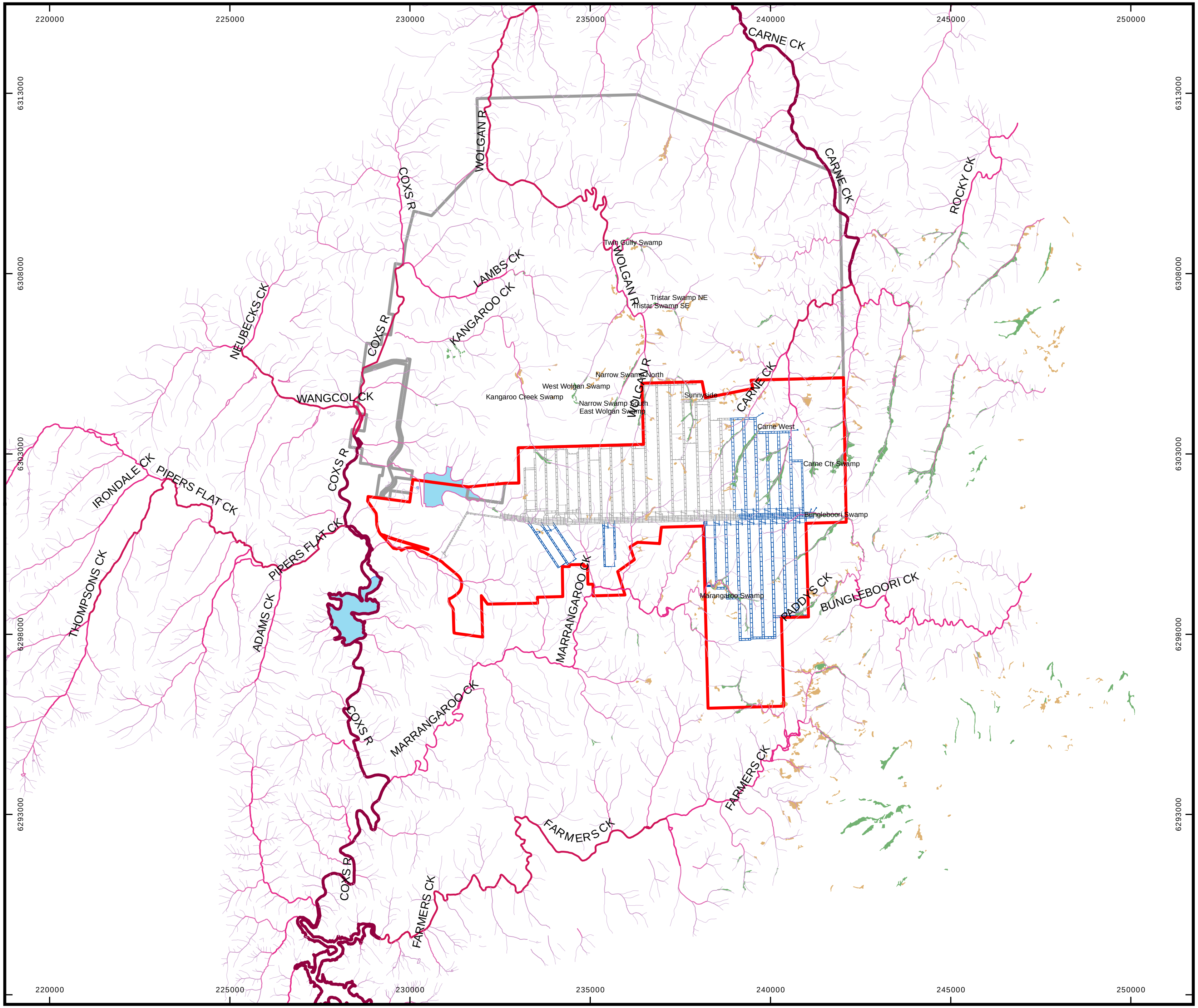
Both the Wolgan River and the Upper Coxs River have tributary watercourses and creeks within the Project Application Area.

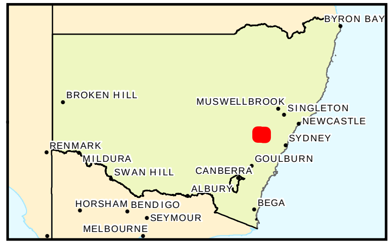
The south-east quadrant of the Project Application Area also contains a small portion of the headwaters of the Colo River Catchment, with the main watercourse in that small portion being Nine Mile Creek and Bungleboori Creek.

Spatial details of the catchments and associated watercourses are summarised in Table 3.3 below and illustrated in Figure 5 and Figure 6. The Strahler Order is also presented in Figure 5.

Table 3.3: Catchment Characteristics in the Project Application Area

Main Catchment	Sub-Catchment	Associated Watercourses	Sub Catchment area (ha)	% catchment area within project boundary (approx.)
Coxs River Catchment	Coxs River (5th & 6th)	Wangcol Creek (3rd), Springvale Creek (2nd), Sawyers Swamp Creek (3rd)	13,026	30%
	Marrangaroo Creek (4th)	Unnamed watercourses south of project boundary	5,495	30%
	Pipers Flat Creek (5th)	Unnamed watercourses south of project boundary	5,948	0%
Wolgan River Catchment	Wolgan River Western Branch	Wolgan River (4th and 5th)	8,526	9%
	Wolgan River Eastern Branch	Carne Creek (5th and 6th)	8,597	30%
Colo River Catchment	Nine Mile Creek/ Bungleboori Creek	Nine Mile Creek (3rd)	4,840	1%





LEGEND

Lakes or Dam

Rivers

Springvale Project Application Area

Angus Place Project Application Area

Strahler Stream Order:

1
2
3
4
5
6

Hanging Swamp

Shrub Swamps

N

500 0 500 1,000

Metres

APPROX SCALE 1:150,000 @ A4

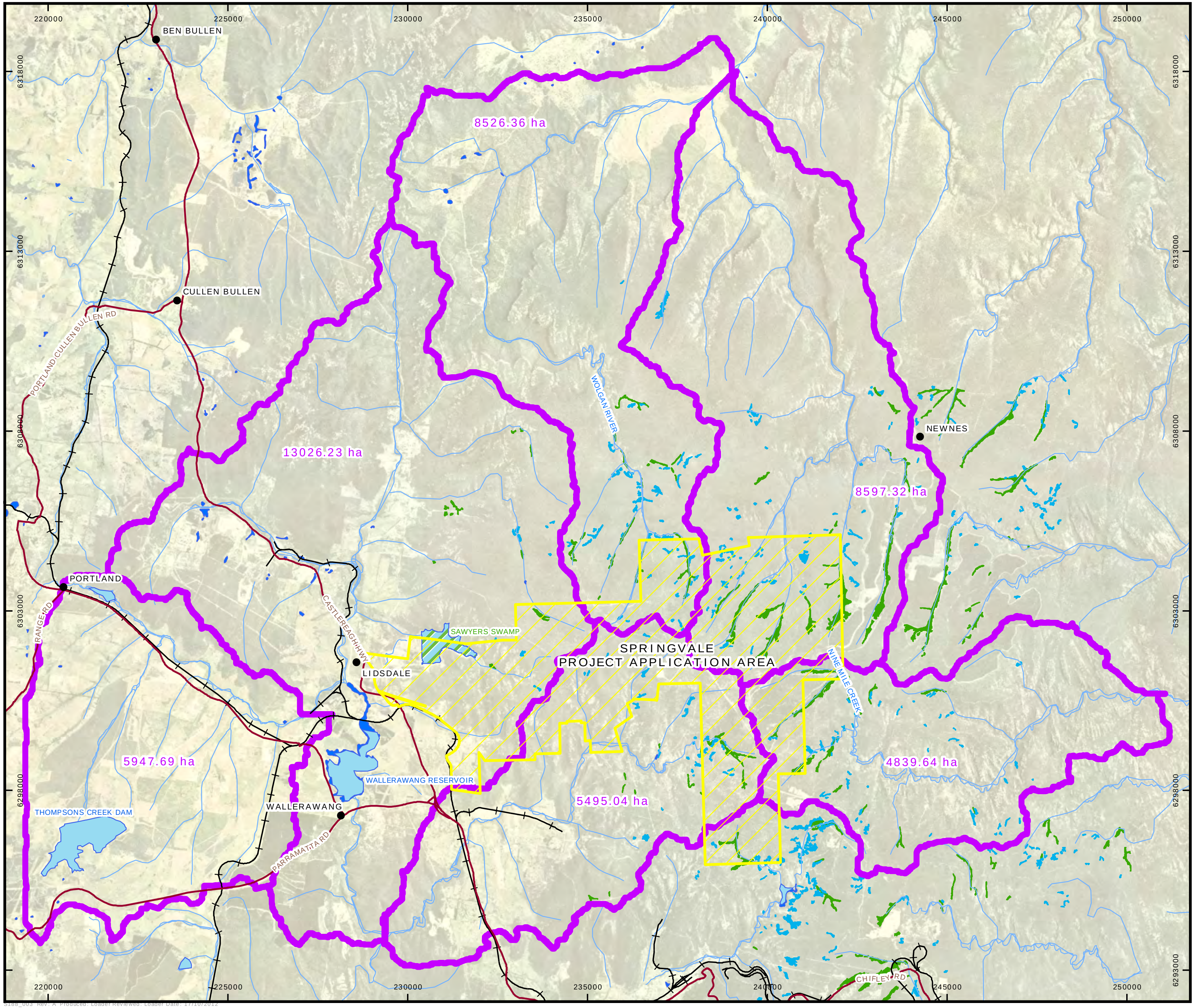
GDA 1994 MGA Zone 56

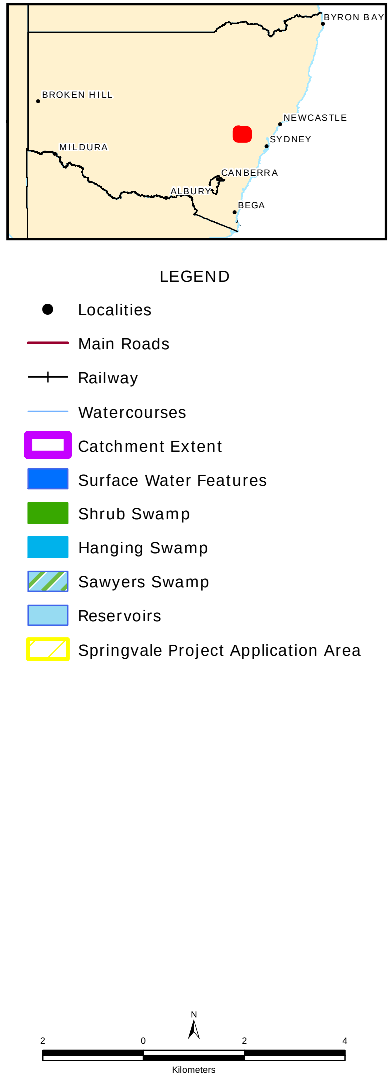
DATA SOURCES:
Centennial Coal
Australia/MapConnect
Land and Property Management Authority

FIGURE 5

Regional Hydrology

S188E/057b_D001_Springvale_Regional_Hydrology.mxd Produced: JRB Reviewed: JRB Date: 25/10/2013





APPROX SCALE 1:150,000 @ A4

GDA 1994 MGA Zone 56

DATA SOURCES
Geoscience Australia
Land and Property Management Authority
Panorama Avenue Bathurst NSW 2795
www.lpma.nsw.gov.au

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FIGURE 6

Springvale Colliery
Major Catchments

Coxs River Catchment

Coxs River

Springvale Mine is situated to the east of the upper reach of the Coxs River. The upper reach of the Coxs River is the major tributary and headwater (elevations over 1,000m) to Lake Wallace, which is the water supply reservoir for the Wallerawang Power Station. Below Lake Wallace (elevation ~870mAHD) is Lake Lyell (elevation ~780mAHD) which is also an important water supply structure and provides water to Mt Piper Power Station via Thompsons Creek Dam. Lake Wallace is also the drinking water source to Wallerawang town.

The dominant water use in the catchment is heavy industry, the primary ones being Delta Electricity's Mount Piper and Wallerawang Power Stations. The immediate receiving waters of Wangcol Creek is derived from the Mount Piper Power Station and flows into the Coxs River upstream of Lake Wallace.

The section (reach) of the river relevant to the Project is described in the Hawkesbury-Nepean River Health Strategy (HNCMA, 2007) as Upper Coxs R3. Reach R3 is situated between the confluence of Wallerawang Colliery Creek and Coxs River, and the Lake Wallace reservoir.

The Upper Coxs Reach R3 has been assessed by the HNCMA (2007) as being in fairly good condition, and has the following reach values in the portion relevant to the Project:

- Popular recreational fishing and non-motor boating
- High public recreational access
- Significant irrigation and water supply.

Under the River Health Strategy (HNCMA, 2007) the riparian land management categories for the Upper Coxs R3 has a focus on revegetation to address riparian weed and erosion protection in the general area. These activities are unrelated to the operation of Springvale Mine; however, there are control mechanisms in place in regard to off-site discharge through Springvale Pit Top (elevation ~920mAHD) with respect to sediment management and water quality.

No wetlands have been identified as associated with Reach R3; however significant gorge environments are located within Marrangaroo National Park headwaters which are within the project boundary. The following sub-catchments are located within the Coxs River catchment:

Marrangaroo Creek

Marrangaroo Creek is a sub-catchment of the Coxs River catchment at the southern edge of the Project Application Area. The main watercourse of the creek flows south-westerly to converge with the Coxs River downstream of Lake Wallace Reservoir. Most of the watercourses at the southern edge of the Project Application Area drain into Marrangaroo Creek.

The reach of the creek in direct proximity to the Project Application Area is named as Marrangaroo R2 by the HNCMA (2007) and is described as being in the section near "Fernbrook" and Hermitage Colliery. The headwaters of Marrangaroo Creek fall within the boundary of the Newnes State Forest.

Pipers Flat Creek

Pipers Flat Creek is a northerly flowing tributary of the Coxs River situated to the south-west of Springvale Mine; however, its catchment lies outside of the Project Application Area.

Springvale Creek

Springvale Creek is a tributary of the Coxs River and is located immediately downstream of the Springvale Pit Top site boundary. Off-site discharge occurs into Springvale Creek. Springvale Creek drains westerly into the Coxs River, immediately upstream of Lake Wallace.

Sawyers Swamp Creek and Ash Dam

Sawyers Swamp Creek Ash Dam is a major artificial surface water body on the boundary between Springvale Mine and Angus Place Colliery. The dam is used for ash disposal from Wallerawang Power Station. There is also an emergency / maintenance discharge point at this dam, associated with the SDWTS (LDP010). The bypass from the SDWTS is located immediately downstream of this dam (LDP009).

Wolgan River Catchment

Wolgan River

The northern portion of the Project Application Area encompasses the headwaters of the Wolgan River catchment. The Wolgan River is a sub-catchment of the Hawkesbury-Nepean River. The Wolgan River flows northerly off the Newnes Plateau into the Wolgan Valley to join the Capertee River and the Wollemi River in the Wollemi National Park, eventually becoming the Colo River.

The Wolgan River catchment has two branches including the Wolgan River Western Branch and the Eastern Branch. Carne Creek is a tributary to the Eastern Branch of the Wolgan River and occupies a significant portion in the eastern half of the Project Application Area.

The Wolgan River catchment is important to this assessment because the two licensed discharge points, LDP004 and LDP005, under the Environmental Protection Licence (EPL 3607) drain into unnamed tributaries of the Western Wolgan River Catchment. Both LDP004 and LDP005 are emergency discharge locations and operationally, with respect to existing operations and the continuation of mining at Springvale Mine, the Coxs River is the preferred point of discharge.

Carne Creek

Carne Creek is a major tributary of the Eastern Branch of the Wolgan River. Carne Creek flows in a north-easterly direction and encompasses approximately 30% of the Project Application Area.

A significant proportion of the extension of the Springvale Mine (LW416-LW428) will be situated underneath this catchment.

Colo River Catchment

Bungleboori Creek

The Bungleboori Creek catchment occupies about 1% of the Project Application Area and is located in the south-eastern corner of the Project Application Area. Bungleboori Creek is a tributary of the Colo River.

3.3.2 Surface Water Monitoring within Rivers and Creeks

An extensive surface water monitoring program already exists at Springvale Mine. The location of monitoring stations is presented in Figure 7.

The objectives of the surface water monitoring program comprise:

- on-going monitoring of upland swamps
- on-going monitoring of relevant watercourses
- regulatory monitoring of LDPs

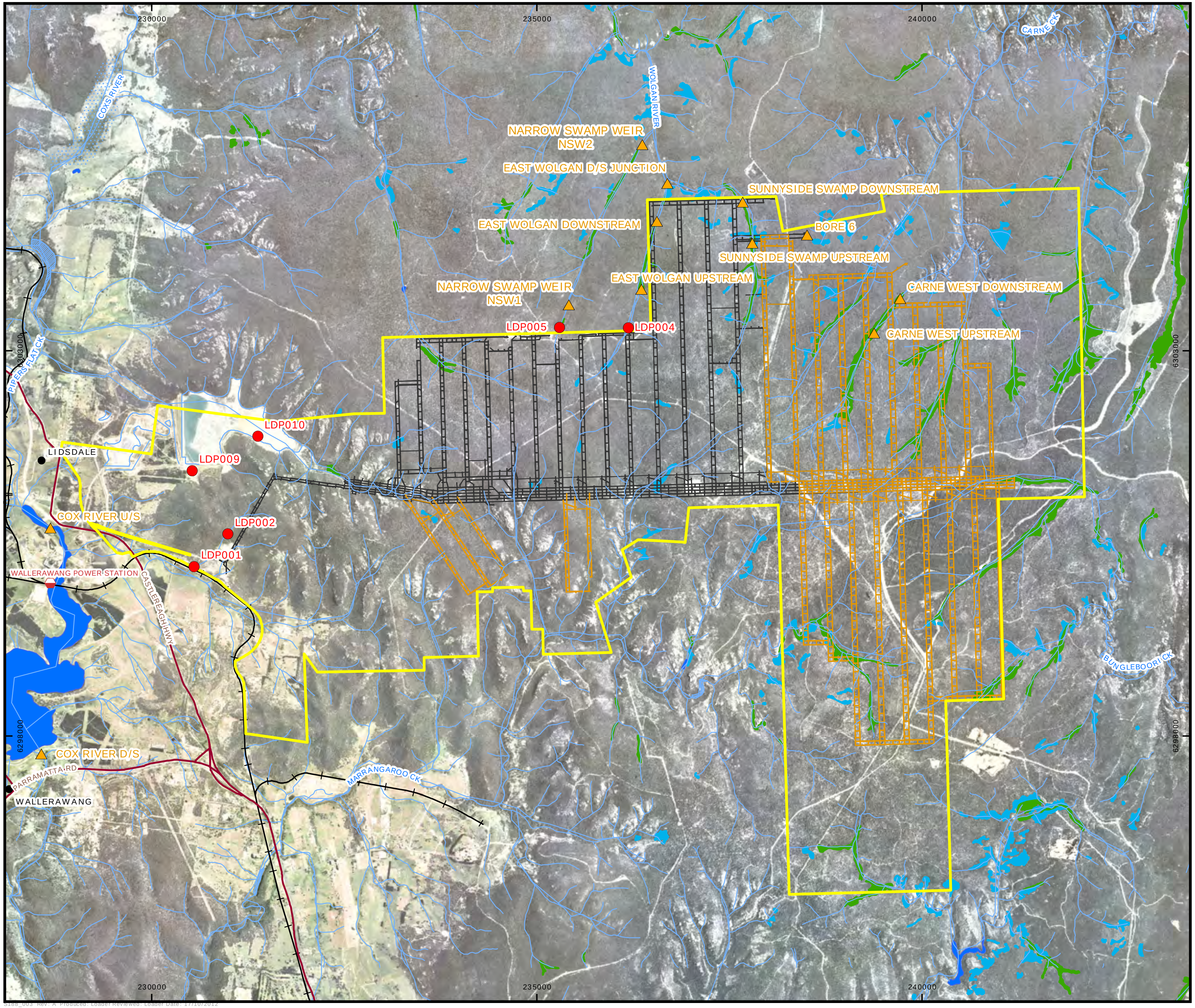
Details of surface water monitoring of rivers and creeks in the vicinity of the Project Application Area are presented in this section, both with respect to flow and quality. Details of the surface water monitoring program on the Newnes Plateau and at Springvale Pit Top are presented below.

A detailed description of the monitoring network for Rivers and Creeks is presented in Table 3.4.

Flow

Wolgan River, Marrangaroo Creek and Kangaroo Creek

Flows within the Wolgan River, Marrangaroo Creek and Kangaroo Creek have been monitored since 2004. Figure 8 presents the recorded streamflow hydrographs of these watercourses, together with the daily rainfall record.



LEGEND

- Monitoring Site
- Local Discharge Point
- Main Roads
- Railway
- Watercourses
- Surface Water Features
- Shrub Swamp
- Hanging Swamp
- Springvale Project Application Area

Mining Infrastructure

- Proposed Longwall Extension
- Springvale Existing Workings (EOM)

1,000 0 1,000 2,000

Metres

APPROX SCALE 1:70,000 @ A4

GDA 1994 MGA Zone 56

DATA SOURCES
Geoscience Australia
Land and Property Management Authority
Panorama Avenue Bathurst NSW 2795
www.lpma.nsw.gov.au

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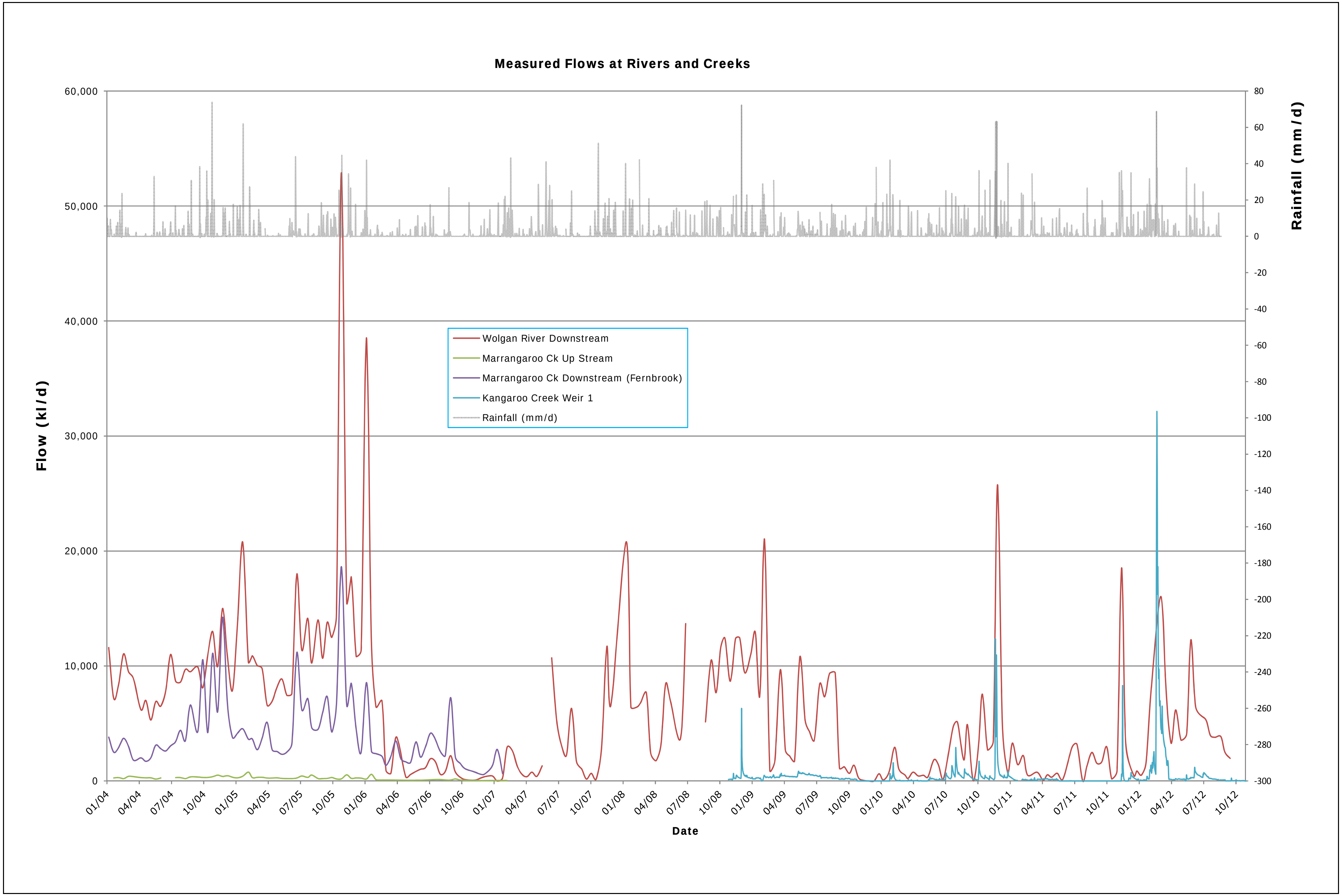
FIGURE 7
Springvale Colliery
LDP & Surface Water Monitoring Sites

Table 3.4: Surface Water Monitoring Stations – Rivers and Creeks

Site Code	Purpose	Status	Frequency (Flow)	Frequency (Quality)	Quality Parameters
COXS RIVER:					
Coxs River U/S	Routine Monitoring	Operational	N/A	Weekly (Jan 2010 – Jan 2011)	Weekly: Field Monthly: Field, TSS, O&G, Mn, Fe
				Weekly (Feb 2011 – onward)	Weekly: Field, O&G, Mn, Fe Fortnightly: Field, TSS, O&G, Major Ions, Trace Ions, Nutrients.
Springvale Creek D/S	Routine Monitoring	Operational	N/A	Fortnightly (Feb 2011 – Mar 2012)	Fortnightly: Field, TSS, O&G, Major Ions, Trace Ions, Nutrients.
				Weekly (Apr 2012 - onward)	Weekly: Field Monthly: Field, TSS, O&G, Major Ions, Trace Ions, Nutrients.
Coxs River D/S	Routine Monitoring	Operational	N/A	Weekly (Jan 2010 – Jan 2011)	Weekly: Field Monthly: Field, TSS, O&G, Mn, Fe
				Weekly (Feb 2011 – onward)	Weekly: Field, O&G, Mn, Fe Fortnightly: Field, TSS, O&G, Major Ions, Trace Ions, Nutrients.
NSW Office of Water: Station No. 212054	Regional Monitoring[1]	Operational	Daily (Jan 1992 – onward)	Daily (Apr 1992 – onward)	Daily: EC
Kangaroo Creek Weir 1	Routine Monitoring	Operational	Daily (Nov 2008 – onward)	N/A	N/A
Marrangaroo Creek U/S	Routine Monitoring	Discontinued (Feb 2007)	Fortnightly (Jan 2004 – Feb 2007)	N/A	N/A
Marrangaroo Creek D/S	Routine Monitoring	Discontinued (Feb 2007)	Fortnightly (Jan 2004 – Feb 2007)	N/A	N/A
WOLGAN RIVER:					
Wolgan River Upstream	Routine Monitoring	Operational	N/A	Weekly (Jan 2010 – Jan 2011	Weekly: Field Monthly: Field, TSS, O&G, Mn, Fe
				Weekly (Feb 2011 – onward)	Weekly: Field, Mn, Fe Fortnightly: Field, TSS, O&G, Major Ions, Trace Ions, Nutrients.
Wolgan River Downstream	Routine Monitoring	Operational	Fortnightly (Jan 2004 – onward)	Weekly (Jan 2010 – Jan 2011	Weekly: Field Fortnightly: Field, Mn, Fe Monthly: Field, TSS, O&G, Mn, Fe
				Weekly (Feb 2011 – onward)	Weekly: Field, Mn, Fe Fortnightly: Field, TSS, O&G, Major Ions, Trace Ions, Nutrients.
COLO RIVER:					
N/A					

1. Station No. 212054 is owned and operated by the NSW Office of Water.



RPS Aquaterra

MEASURED FLOWS AT RIVERS AND CREEKS FIGURE8

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Table 3.5 presents the mean daily flow, sorted per month.

Table 3.5: River and Creek Flow Monitoring – Mean Daily Flow per month (kL/d)

	Marrangaroo Ck U/S (kL/d)	Marrangaroo Ck D/S (kL/d)	Kangaroo Ck Weir 1 (kL/d)	Wolgan River D/S (kL/d)
Jan	234.7	3974.3	119.8	8207.7
Feb	275.8	3068.3	317.8	7288.6
Mar	229.3	2725.6	1670.5	4915.4
Apr	184.8	3241.0	195.1	3069.4
May	187.1	2082.1	138.0	4010.8
Jun	159.6	2621.5	274.1	5151.7
Jul	212.0	4174.6	275.0	5864.2
Aug	251.8	4548.8	310.5	5220.7
Sep	224.0	4942.4	175.9	5020.2
Oct	202.0	5010.0	135.5	5255.3
Nov	326.0	8317.2	185.9	10195.7
Dec	232.0	6115.5	575.9	7832.5
Ave Monthly Mean	***226.6***	***4235.1***	***364.5***	***6002.7***
Min Monthly Mean	***159.6***	***2082.1***	***119.8***	***3069.4***
Max Monthly Mean	***326.0***	***8317.2***	***1670.5***	***10195.7***

Table 3.6 presents the flow exceedance statistics.

Table 3.6: River and Creek Flow Monitoring – Flow Exceedance Statistics

	Marrangaroo Ck U/S (kL/d)	Marrangaroo Ck D/S (kL/d)	Kangaroo Ck Weir 1 (kL/d)	Wolgan River D/S (kL/d)
Percentile 5	38.3	1011.9	0.0	147.4
Percentile 10	59.0	1590.6	0.0	347.4
Percentile 20	77.0	2081.0	0.0	735.8
Percentile 30	115.0	2510.0	2.6	1395.6
Percentile 40	200.0	2730.6	57.4	2502.6
Percentile 50	221.5	3309.5	128.8	3780.0
Percentile 60	261.0	3704.0	178.0	6473.0
Percentile 70	290.0	4295.0	270.3	8090.0
Percentile 80	315.0	5970.0	373.7	10271.0
Percentile 90	405.0	7269.1	554.2	12417.8
Percentile 95	502.5	10632.5	868.6	15183.0

From Table 3.6:

- Marrangaroo Creek and Wolgan River are perennial and flow occurs throughout the year
- Kangaroo Creek is ephemeral and does not flow for almost 30% of the time.

Hydrographs for each monitored river and creek are presented in Appendix A.

Baseflow separation was undertaken for Kangaroo Creek to ascertain dependence of watercourses on inflows from the local groundwater system using the Lyne and Hollick Filter (Nathan and McMahon, 1990). Table 3.7 presents the results of this analysis.

Graphical output of the calculation is presented in Appendix B.

Table 3.7: Kangaroo Creek – Base Flow Separation Analysis

	Kangaroo Creek (kL/d)	
	Base flow (kL/d)	BFI[1] (%)
Percentile 5 (95% exceedance)	0.0	0%
Percentile 10 (90% exceedance)	0.0	0%
Percentile 20 (80% exceedance)	0.4	2%
Percentile 30 (70% exceedance)	18.5	16%
Percentile 40 (60% exceedance)	41.1	31%
Percentile 50 (median value)	76.5	43%
Percentile 60 (40% exceedance)	107.5	57%
Percentile 70 (30% exceedance)	161.0	68%
Percentile 80 (20% exceedance)	207.1	89%
Percentile 90 (10% exceedance)	255.7	100%
Percentile 95 (5% exceedance)	310.7	100%

1. BFI is Baseflow Index.

Analysis indicates that Kangaroo Creek has intermediate dependence on baseflow from the local groundwater system, accounting for 43% of the total flow (median value) and being 100% of the total flow, 10% of the time. This indicates that baseflow maintains the creek for some time after rainfall but not during prolonged dry weather periods.

Coxs River above Lake Wallace

Flow in the Coxs River, above Lake Wallace, is monitored by NSW Office of Water Station No. 212054. The monitoring station has been in operations since 1992. Figure 9 presents the streamflow record as daily flow (ML/d) and Table 3.8 presents the flow exceedance statistics.

From Table 3.8, median flow in the Coxs River is 12.2ML/d and maximum recorded flow is 5,321ML/d. Table 3.8 also indicates that the Coxs River is perennial, with 5th percentile flow being 2.9ML/d. The flow record indicates that this has been the case since monitoring commenced in 1992.

From Figure 9, the 1 y ARI (Average Recurrence Interval) flow is of the order of 500ML/d (~6m^3/s).

Table 3.8: Coxs River Flow Monitoring (NSW Office of Water Station No. 21054) – Flow Exceedance Statistics

	Stream Flow (ML/d)
Mean	29.9
Maximum	5,321
Minimum	0.30
Percentile 5	2.90
Percentile 10	4.20
Percentile 25	7.40
Percentile (Median)	12.2
Percentile 75	20.2
Percentile 90	42.8
Percentile 95	86.6

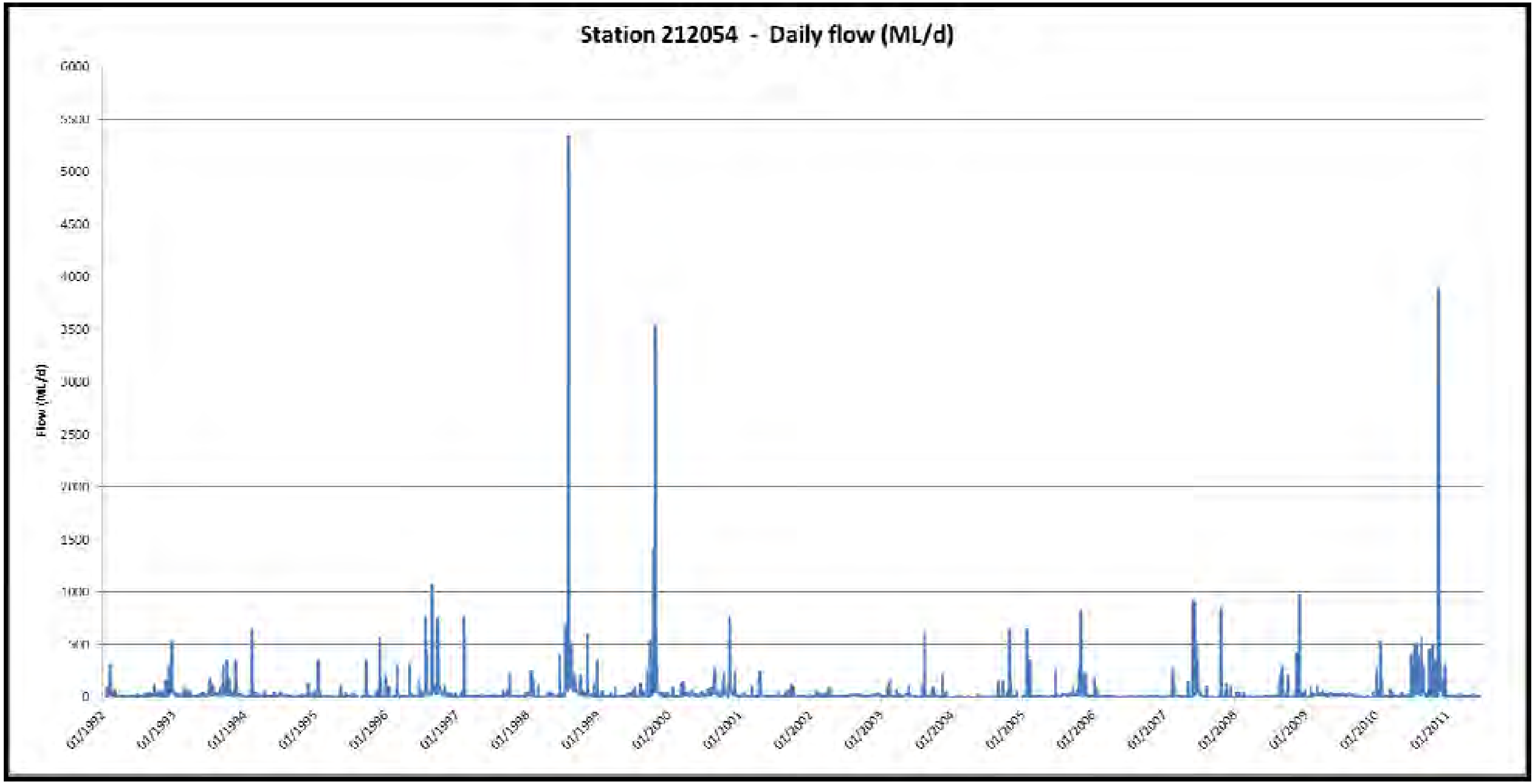


Figure 9: Coxs River Flow Monitoring (NSW Office of Water Station No. 212054) – Daily Streamflow (ML/d)

Quality

Monitoring Approach

The current surface water quality monitoring program is designed to monitor potential contaminants to surface water bodies and discharges and to comply with EPL3607 requirements. The monitoring undertaken at Springvale Mine involves routine water quality sampling at 12 locations (five locations for rivers and creeks, six locations on the Newnes Plateau swamps and one location at LDP001 (other LDPs monitored as required during discharge)). There is also visual inspection of settlement ponds, sumps, culverts and storm water drainage channels. Figure 7 presents the location of the surface water monitoring stations.

The data set presented in this surface water assessment primarily refers to the period between January 2010 and September 2012, however, surface water flow gauging has been on-going at Springvale Mine since 2002. The majority of sites were sampled weekly or fortnightly and occasionally monthly. The parameters and frequency of monitoring at each location is summarised in Table 3.4 for the rivers and creek sites.

All sampling and analysis is understood to be compliant with relevant Australian Standards (including AS/NZS 5667.1:1998 and APHA, 1998 (1060)) and/or NATA registered methods, and Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (DEC). All samples are submitted to a NATA accredited laboratory.

Monitoring results for water quality and usage are maintained in a database, to enable simple collation and presentation to government agencies as required.

Baseline Water Quality

A summary of the baseline data and basic statistical analysis (e.g. to show data spread) is presented in Appendix C (concentrations exceeding trigger values (ANZECC, 2000) are presented in bold). Table 3.9 presents a summary of water quality analysis with median (50^{th} percentile) and range of observed concentrations presented including number of samples. For Major Ions, a consistent dataset from a single sample is more appropriate and the date of the sample is provided. Water quality trend graphs for pH and EC are presented in figures in Appendix C.

Coxs River

The Coxs River is a disturbed environment due to its primary use as a water supply reservoir for the Wallerawang and Mt Piper Power Stations.

The median flow in Wangcol Creek, the western tributary of the Coxs River is only 0.4ML/d and median flow in the Upper Coxs River is only 2.2ML/d (Angus Place Monitoring Station: Coxs River U/S).

Given the water demand of Wallerawang Power Station of 30ML/d (11,000ML/y) is sourced directly from the SDWTS or extracted from the Coxs River or Fish River, the overwhelming proportion of demand is met from discharge of mine water demand at both Angus Place Colliery and Springvale Mine to the Coxs River. Downstream of Lake Wallace there is extraction from Lake Lyell via Thompsons Creek Dam to meet water demand of Mt Piper Power Station of 38.9ML/d (14,200ML/y).

<u>Salinity and pH</u>

Water quality in the Coxs River, including immediately upstream of Lake Wallace reservoir is also generally very good with pH of 7.6 and EC of 600µS/cm (average at NSW Office of Water Station No. 212054 and Springvale Monitoring Station: Coxs River U/S).

Long-term salinity in the Coxs River, immediately above Lake Wallace, is monitored by the NSW Office of Water (Station No. 212054). The monitoring record is presented in Figure 10. Monitoring indicates significant variability in salinity since records commenced in 1992, with overall increasing trend until ~2005 when salinity, as EC, reach 1,100µS/cm. Recent salinity values are ~600µS/cm. Monitoring indicates, however, that the Coxs River has had salinity of >600µS/cm for a period of approximately 20 years.

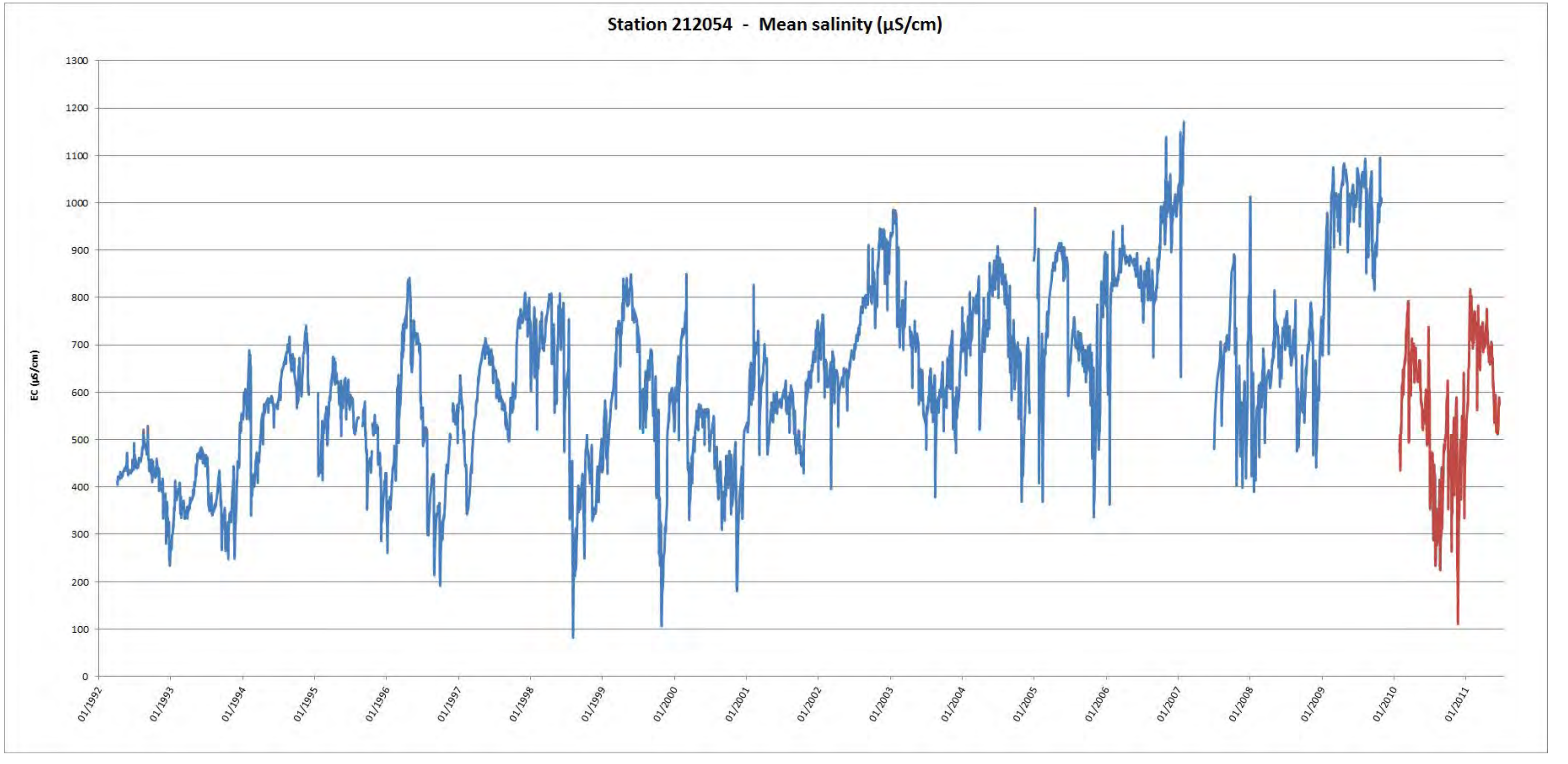


Figure 10: Coxs River Monitoring (NSW Office of Water Station No. 212054) – Daily Conductivity (µS/cm)

Current water quality in the Coxs River is generally consistent with ADWG and ANZECC 2000 for 95% protection of freshwater ecosystems, with the primary exception being EC due to the predominant source of water in the Coxs River being groundwater.

The guideline value for ADWG is aesthetic and is <600mg/L (895µS/cm) for good quality drinking water and is 600 – 900mg/L (895 – 1,345µS/cm) for fair quality drinking water.

Total Suspended Solids, Turbidity and Oil and Grease

Monitoring indicates the current water quality in the Coxs River is consistent with guidance values.

Low TSS and Turbidity in the Coxs River demonstrates that sediment management at site is performing adequately. As will be presented, extension of Springvale Mine will not change the current configuration of settling ponds and associated infrastructure at LDPs.

The measured concentrations of Oil and Grease are <5mg/L and therefore is not a pollutant of concern is this catchment.

Dissolved Metals

Monitoring of dissolved metals indicates that Copper is slightly above ANZECC guidance of 0.0014mg/L but is generally low, with median value of 0.003mg/L, and is well within the ADWG health and aesthetic value.

Nickel concentrations are close to ANZECC and ADWG guidelines but are generally low.

Zinc slightly exceeds the ANZECC guideline values and there is no health related value for Zinc in the ADWG.

Nutrients

Nitrogen and phosphorous monitoring indicates general compliance with ANZECC. Monitoring at Springvale Creek suggests exceedance of Nitrate (NO_3) and Total Nitrogen, are due to activities in the catchment unrelated to mining at Springvale. A similar story can be observed for Total Phosphorous (TP) with Springvale Creek having a median concentration of 0.02mg/L compared to median values at monitoring stations Coxs River U/S and Coxs River D/S; however, concentrations are low.

Wolgan River

The Wolgan River is a relatively undisturbed environment. There are emergency discharge locations (LDP004 and LDP005) located on the Newnes Plateau, upstream of the Wolgan River Monitoring Stations, however, these discharge locations are not currently active and operationally preference is to discharge to the Coxs River.

Salinity and pH

Salinity in the Wolgan River is very low and pH is slightly acidic, as would be expected in an undisturbed catchment.

Total Suspended Solids, Turbidity and Oil and Grease

TSS and Turbidity is low, with median turbidity of 8, again reflecting natural processes in this catchment.

The measured concentrations of Oil and Grease are <5mg/L, as would be expected.

Dissolved Metals

Higher values for Aluminium and Iron reflect natural variation in pH in the catchment and are unrelated to historical discharge to that environment. Concentrations of other metals are very low and / or at detection limit.

Nutrients

Nutrient concentrations, both Nitrogen and Phosphorous, are consistent with ANZECC and are consistent with ADWG values with respect to Nitrate.

Table 3.9: Surface Water Quality – Rivers and Creeks

Parameter	Units	ANZECC 2000	EPL 3067 LDP01	EPL 3067 LDP009	ADWG Health (NHRMC, 2011)	ADWG Aesthetic (NHRMC, 2011)	Bore 6	Coxs River U/S	Springvale Creek D/S	Coxs River D/S	Wallerawang PS LDP D/S of Lake Wallace (December 2013)	Wolgan River U/S	Wolgan River D/S
Physical Parameters													
pH		6.5 – 8.0	6.5 – 9.0	6.5 – 9.0	c	6.5 – 8.5	7.6 (6.1-8.9, n=126)	7.8 (6.4-8.7, n=176)	7.9 (6.7-8.3, n=55)	7.8 (6.2-8.9, n=178)	8.1	7.0 (5.6-8.2, n=136)	6.7 (5.2-7.8, n=177)
EC[1]	µS/cm	350	-	1,200	-		1080 (698-1240, n=126)	590 (199-1130, n=173)	585 (177-1020, n=53)	652 (215-1570, n=175)	1692	45 (29-104, n=129)	40 (6-88, n=168)
TDS[1]	mg/L	234.5	-	804	f	Based on taste: < 600 good quality 600 – 900 fair quality	648 (22-750, n=27)	524 (224-764, n=39)	456 (150-666, n=33)	470 (154-660, n=36)	N/A	50 (5-92, n=41)	40 (3-89, n=37)
Hardness as $CaCO_3$	mg/L	-	-	-	f	< 60 soft but possibly corrosive 60 – 200 good quality 200 – 500 increasing scaling problems >500 severe scaling	5 (2-12, n=27)	187 (95-340, n=36)	49 (18-80, n=36)	163 (61-239, n=38)	N/A	<1	<1
TSS	mg/L	-	30	50	-	-	17 (1-116, n=27)	4 (1-45.6, n=35)	3.5 (1-6, n=9)	4 (1-16, n=28)	4	2.4 (1-30, n=30)	2 (0.6-8.4, n=33)
Turbidity	NTU	2 – 25	-	50	c	5	32 (14-297, n=28)	9 (3-45, n=41)	8 (1-52, n=35)	8 (3-56, n=38)	4	8 (2-21, n=45)	7 (2-42, n=39)
Oil and Grease	mg/L	-	10	10	-	-	N/A	<5	<5	<5	N/A	<5	<5
Dissolved Oxygen	mg/L	90-110%	-	-	-	-	6.0 (3.4-8.6, n=27)	Not Tested	Not Tested	Not Tested	N/A	Not Tested	Not Tested
Major Ions													
Na	mg/L	-	-	-	f	180	313 (20 March 2012)	74 (11 Sep 2012)	108 (11 Sep 2012)	68 (11 Sep 2012)	N/A	7 (11 Sep 2012)	6 (11 Sep 2012)
Ca	mg/L	-	-	-	-	-	3	27	10	25	N/A	1	1
Mg	mg/L	-	-	-	-	-	1	18	6	15	N/A	1	1
K	mg/L	-	-	-	-	-	8	13	10	11	N/A	1	1
Alkalinity[3]	mg/L	-	-	-	-	-	569	173	176	101	N/A	9	8
Cl	mg/L	-	-	-	c	250	6	14	13	21	N/A	6	4
SO_4	mg/L	-	-	-	500	250	22	129	91	157	587	1	1
Trace Ions													
Ag	mg/L	0.00005	-	-	0.1	-	Not Tested	Not Tested	Not Tested	Not Tested	N/A	Not Tested	Not Tested
Al	mg/L	0.055 for pH>6.5	-	0.45	c	0.2	0.09 (0.03-0.56, n=27)	0.05 (0.001-0.39, n=36)	0.04 (0.001-0.2, n=35)	0.01 (0.01-0.51, n=36)	0.0055	0.18 (0.001-0.48, n=46)	0.13 (0.001-0.35, n=40)
As	mg/L	0.024 as As III	-	0.024	0.01	-	0.01 (0.004-0.032, n=36)	<0.001 (n=33)	<0.001 (n=32)	<0.001 (n=30)	0.008	<0.001 (n=43)	<0.001 (n=4)
B	mg/L	0.37	-	0.37	4	-	0.07 (0.06-0.1,	0.225 (0.05-0.36,	0.05 (0.05-0.07,	0.22 (0.06-1.24,	0.25	<0.05 (n=37)	<0.05 (n=37)

Parameter	Units	ANZECC 2000	EPL 3067 LDP01	EPL 3067 LDP009	ADWG Health (NHRMC, 2011)	ADWG Aesthetic (NHRMC, 2011)	Bore 6	Coxs River U/S	Springvale Creek D/S	Coxs River D/S	Wallerawang PS LDP D/S of Lake Wallace (December 2013)	Wolgan River U/S	Wolgan River D/S
							n=34)	n=36)	n=35)	n=39)			
Cd	mg/L	0.0002	-	-	0.002	-	0.0002 (0.0001-0.0013, n=14)	<0.0001 (n=36)	<0.0001 (n=35)	<0.0001 (n=33)	N/A	<0.0001 (n=43)	<0.0001 (n=39)
Cr	mg/L	0.001 as Cr VI	-	-	0.05 as Cr VI	-	Not Tested	Not Tested	Not Tested	Not Tested	N/A	Not Tested	Not Tested
Cu	mg/L	0.0014	-	0.007	2	1	0.004 (0.001-0.08, n=35)	0.003 (0.001-0.03, n=35)	0.003 (0.001-0.018, n=34)	0.004 (0.002-0.025, n=36)	0.015	0.002 (0.001-0.022, n=45)	0.002 (0.001-0.06, n=39)
F	mg/L	-	-	1.8	1.5	-	1.2 (1.1-1.62, n=36)	0.45 (134-0.7, n=36)	0.4 (0.2-1.1, n=35)	0.6 (0.1-0.8, n=39)	1.4	0.1 (0.1-0.5, n=45)	0.1 (0.1-0.2, n=39)
Fe	mg/L	ID	-	0.4	c	0.3	0.06 (0.05-0.11, n=18)	0.11 (0.05-0.88, n=58)	0.1 (0.05-0.3, n=35)	0.06 (0.05-0.85, n=55)	N/A	0.91 (0.13-3.4, n=71)	0.55 (0.006-1.3, n=113)
Mn	mg/L	1.9	-	1.7	0.5	0.1	0.006 (0.001-0.103, n=36)	0.20 (0.054-0.57, n=53)	0.02 (0.003-0.035, n=35)	0.18 (0.016-5.3, n=55)	N/A	0.006 (0.003-0.036, n=63)	0.007 (0.004-0.17, n=109)
Ni	mg/L	0.011	-	0.047	0.02	-	0.003 (0.001-0.005, n=36)	0.014 (0.007-0.037, n=35)	0.002 (0.001-0.005, n=33)	0.008 (0.006-0.024, n=37)	0.011	<0.001 (n=47)	<0.001 (n=39)
Pb	mg/L	0.034	-	-	0.01	-	0.003 (0.001-0.019, n=26)	<0.001 (n=35)	<0.001 (n=34)	<0.001 (n=33)	N/A	<0.001 (n=45)	<0.001 (n=39)
Se	mg/L	0.011 as Total Se	-	-	0.01	-	Not Tested	Not Tested	Not Tested	Not Tested	0.001	Not Tested	0.33 (0.006-0.66, n=2)
Zn	mg/L	0.008	-	0.05	c	3	0.03 (0.007-0.124, n=27)	0.018 (0.005-0.06, n=42)	0.013 (0.005-0.045, n=35)	0.014 (0.005-0.076, n=46)	0.003	0.007 (0.005-0.23, n=52)	0.009 (0.005-0.15, n=43)
Nutrients													
NH_3 as N	mg/L	0.013	-	-	c	0.4	0.07 (0.01-1.25, n=24)	0.04 (0.01-0.32, n=36)	0.01 (0.01-0.17, n=35)	0.06 (0.01-1.02, n=38)	N/A	0.01 (0.01-0.16, n=46)	0.01 (0.01-0.14, n=40)
NO_3 as N	mg/L	0.015[2]	-	-	11.3	-	0.42 (0.28-13.5, n=27)	0.1 (0.01-0.84, n=36)	0.1 (0.01-0.5, n=35)	0.04 (0.01-7.86, n=38)	N/A	0.02 (0.01-4.32, n=46)	0.02 (0.01-4.05, n=39)
Total N as N	mg/L	0.25	-	-	-	-	0.7 (0.3-30.8, n=36)	0.6 (0.2-1.5, n=36)	0.3 (0.2-0.5, n=35)	0.8 (0.07-11.4, n=39)	N/A	0.2 (0.1-5.9, n=46)	0.2 (0.1-0.25, n=38)
Total P as P	mg/L	0.02	-	-	-	-	Not Tested	0.095 (0.01-0.41, n=36)	0.02 (0.01-0.8, n=35)	0.08 (0.01-0.44, n=39)	N/A	0.01 (0.01-0.47, n=46)	0.02 (0.01-0.25, n=40)

Notes: 1. The assumed conversation factor is EC (µS/cm) x 0.67 = TDS (mg/L) from Section 4.3.3 of ANZECC (2000). If laboratory determination of TDS has occurred, results are provided; 2. NOx (oxides of N); ID. Insufficient data to derive a reliable trigger value; c. Insufficient data to set guideline value based on health considerations; f. No health-based value considered necessary. 3. Alkalinity is Total Alkalinity of CO_3^{2-}, HCO_3^- and OH-.

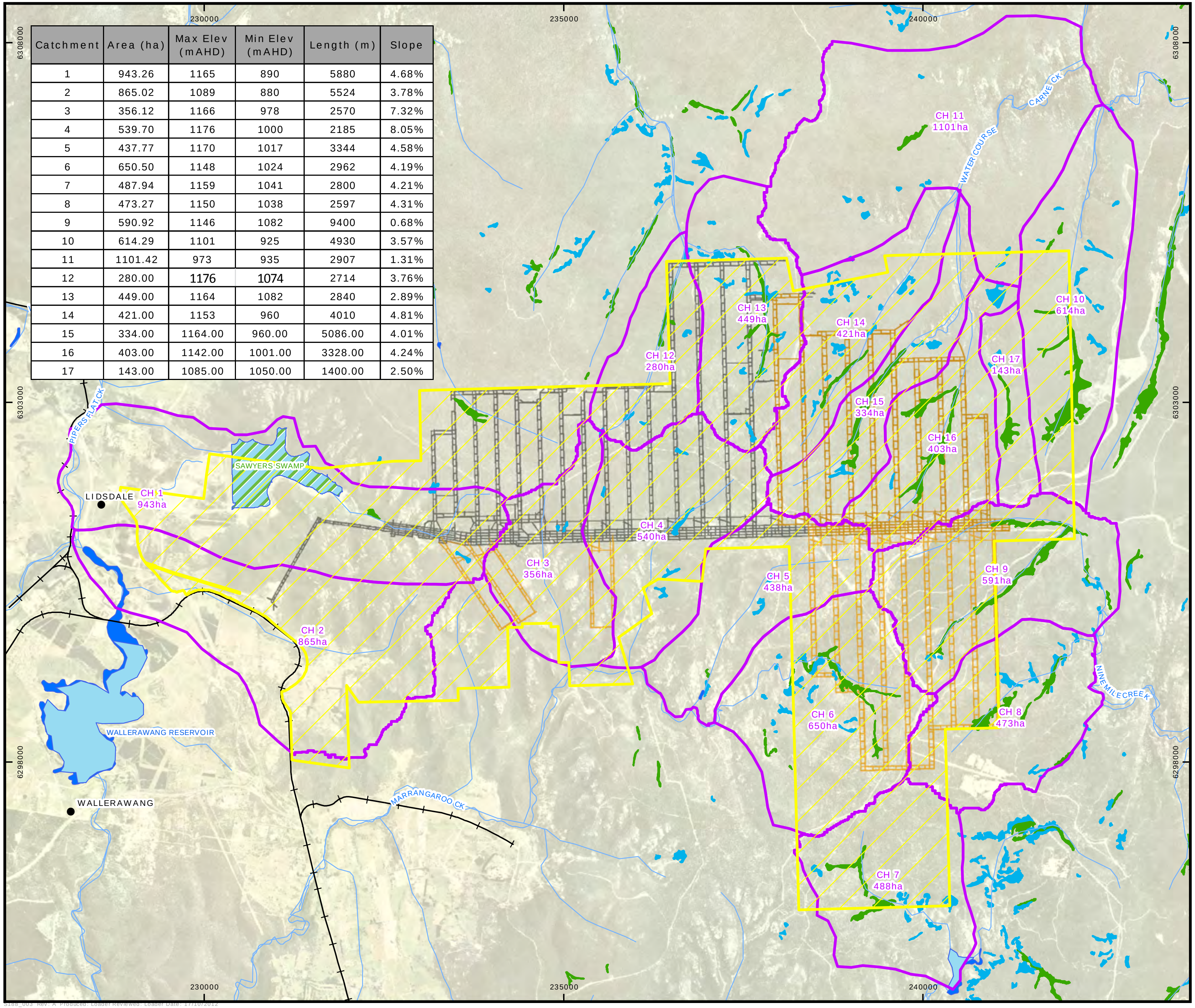
3.3.3 Estimated Peak Runoff (Regional Catchments)

Estimates of peak flood flows were made using the Probabilistic Rational Method (Engineers Australia, 2001). Calculations were performed within the Project Application Area to ascertain the peak flood flows from 1 y ARI (Average Recurrence Interval) to 100 y ARI. Figure 11 illustrates the boundaries of individual sub-catchments as well as catchment labels.

The time of concentration was calculated using the relevant formulae from Australian Rainfall and Runoff (Engineers Australia, 2001). Intensity Frequency Duration (IFD) curves were extracted from Volume 2 of Australian Rainfall and Runoff (Engineers Australia, 1987).

The time of concentration and respective rainfall intensity for each catchment are presented in Table 3.10. The peak flow rates for the respective ARIs are presented in Table 3.11.

Catchment	Area (ha)	Max Elev (mAHD)	Min Elev (mAHD)	Length (m)	Slope
1	943.26	1165	890	5880	4.68%
2	865.02	1089	880	5524	3.78%
3	356.12	1166	978	2570	7.32%
4	539.70	1176	1000	2185	8.05%
5	437.77	1170	1017	3344	4.58%
6	650.50	1148	1024	2962	4.19%
7	487.94	1159	1041	2800	4.21%
8	473.27	1150	1038	2597	4.31%
9	590.92	1146	1082	9400	0.68%
10	614.29	1101	925	4930	3.57%
11	1101.42	973	935	2907	1.31%
12	280.00	1176	1074	2714	3.76%
13	449.00	1164	1082	2840	2.89%
14	421.00	1153	960	4010	4.81%
15	334.00	1164.00	960.00	5086.00	4.01%
16	403.00	1142.00	1001.00	3328.00	4.24%
17	143.00	1085.00	1050.00	1400.00	2.50%



LEGEND

- Localities
- Main Roads
- Railway
- Watercourses
- Catchment Extent
- Surface Water Features
- Shrub Swamp
- Hanging Swamp
- Sawyers Swamp
- Reservoirs
- Springvale Project Application Area

Mining Infrastructure

- Proposed Longwall Extension
- Springvale Existing Workings (EOM)

1 0 1 2

Kilometers

APPROX SCALE 1:75,000 @ A4

GDA 1994 MGA Zone 56

DATA SOURCES
Geoscience Australia
Land and Property Management Authority
Panorama Avenue Bathurst NSW 2795
www.lpma.nsw.gov.au

RPS Aquaterra

FIGURE 11
Springvale Colliery
Subcatchment Details

Table 3.10: Rainfall Intensity (mm/hr) of Regional Catchments within the Project Application Area

Contributing Catchment	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8	CH9	CH10	CH11	CH12	CH13	CH14	CH15	CH16	CH17
Total catchment area (ha)	943	856	356	540	438	651	488	473	591	614	1101	280	449	421	334	403	143
Design Rainfall Intensity of Individual Catchments (mm/hr)																	
Time of concentration (min)	**107**	**103**	**74**	**87**	**80**	**93**	**83**	**82**	**90**	**91**	**113**	**67**	**81**	**79**	**72**	**77**	**52**
1 y ARI	13.2	13.5	16.4	15.0	15.7	14.3	15.3	15.4	14.6	14.5	12.7	17.3	15.6	15.8	16.7	16.0	20.1
2 y ARI	16.9	17.3	21.1	19.2	20.2	18.4	19.7	19.8	18.8	18.7	16.3	22.3	20.0	20.3	21.4	20.5	25.9
5 y ARI	21.5	22.0	26.8	24.4	25.6	23.4	25.0	25.1	23.9	23.7	20.7	28.3	25.4	25.8	27.2	26.1	32.9
10 y ARI	24.2	24.8	30.3	27.5	28.9	26.4	28.2	28.4	27.0	26.7	23.4	32.0	28.7	29.1	30.7	29.4	37.2
20 y ARI	27.9	28.6	34.9	31.7	33.3	30.4	32.5	32.7	31.1	30.8	27.0	36.9	33.1	33.6	35.4	33.9	43.0
50 y ARI	32.9	33.6	41.1	37.3	39.2	35.8	38.2	38.5	36.6	36.3	31.7	43.4	39.0	39.5	41.7	39.9	50.7
100 y ARI	36.7	37.5	45.9	41.7	43.8	40.0	42.7	43.0	40.9	40.5	35.4	48.5	43.5	44.2	46.6	44.6	56.7

Table 3.11: Peaks flood flows (m^3/s) for selected ARIs of Regional Catchments within the Project Application Area

Contributing Catchment	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8	CH9	CH10	CH11	CH12	CH13	CH14	CH15	CH16	CH17
Total catchment area (ha)	943	856	356	540	438	651	488	473	591	614	1101	280	449	421	334	403	143
Peak Flows for individual catchments (m^3/s)																	
1 y ARI	8.97	8.33	4.23	5.83	4.96	6.74	5.39	5.27	6.26	6.45	10.11	3.51	5.06	4.81	4.02	4.65	2.08
2 y ARI	14.2	13.2	6.69	9.23	7.85	10.7	8.54	8.34	9.90	10.2	16.0	5.55	8.01	7.62	6.37	7.36	3.29
5 y ARI	23.1	21.4	10.9	15.0	12.8	17.3	13.9	13.6	16.1	16.6	26.0	9.04	13.0	12.4	10.4	12.0	5.37
10 y ARI	31.8	29.5	15.0	20.7	17.6	23.9	19.1	18.7	22.1	22.8	35.8	12.4	17.9	17.0	14.3	16.5	7.39
20 y ARI	44.3	41.1	20.9	28.8	24.5	33.3	26.7	26.0	30.9	31.8	49.9	17.4	25.0	23.8	19.0	23.0	10.3
50 y ARI	65.5	60.8	30.9	42.6	36.2	49.2	39.4	38.5	45.7	47.0	73.8	25.7	37.0	35.2	29.4	34.0	15.3
100 y ARI	85.7	79.5	40.4	55.7	47.4	64.3	51.6	50.4	59.8	61.6	96.6	33.6	48.3	46.0	38.5	44.5	20.1

3.4 NEWNES PLATEAU SWAMPS

3.4.1 Environmental Setting

The vegetation across the top of the Plateau consists of woodland dominated by *Eucalypt* species. This forest has been subject to selective timber logging over an extended period. Where shrub layers are present, they represent a somewhat low diversity due to a combination of disturbance and context in relation to elevation and soil composition. Ground-cover layers exhibit a relatively diverse assemblage of grasses, herbs and prostrate shrubs in areas that have not been disturbed.

Temperate Highland Peat Swamps on Sandstone (THPSS) are federally listed Endangered Ecological Communities (EECs) mapped in the Sydney Basin Bioregion that are found within the Springvale Mine Project Application Area. They include:

- Newnes Plateau Shrub Swamps (NPSS).
- Newnes Plateau Rush Sedge Snow Gum Hollow Wooded Heath Grassy Woodland (NPRSSG).
- Newnes Plateau Hanging Swamps (NPHS).

The location of the swamps in the vicinity of Springvale Mine is presented in Figure 12.

The three EECs are protected under the EPBC Act. Under the TSC Act, only the NPSS are listed.

THPSS depend on surface and local groundwater hydrology, therefore potential risk factors include:

- disruption of local aquifers in the strata upon which they reside, due to mining activity and associated subsidence at depth
- direct discharge of groundwater to these water bodies.

In accordance with the Mine Plan, mining activity will occur at depths ranging between 320 and 420m beneath the NPSS and NPHS during the extension of the Springvale Mine. The NPRSSG lie above existing mine workings and will not be affected by the proposed extension.

Further details on the terrestrial and aquatic ecology of the Project Application Area are presented in the relevant Ecological Assessment studies (RPS, 2013a and Cardno Ecology Lab, 2013 respectively).

Coxs River Catchment

Marrangaroo Creek

Marrangaroo Creek is a sub-catchment of the Coxs River catchment at the southern edge of the Project Application Area. NPSS and NPHS occur within the Marrangaroo Creek catchment, namely:

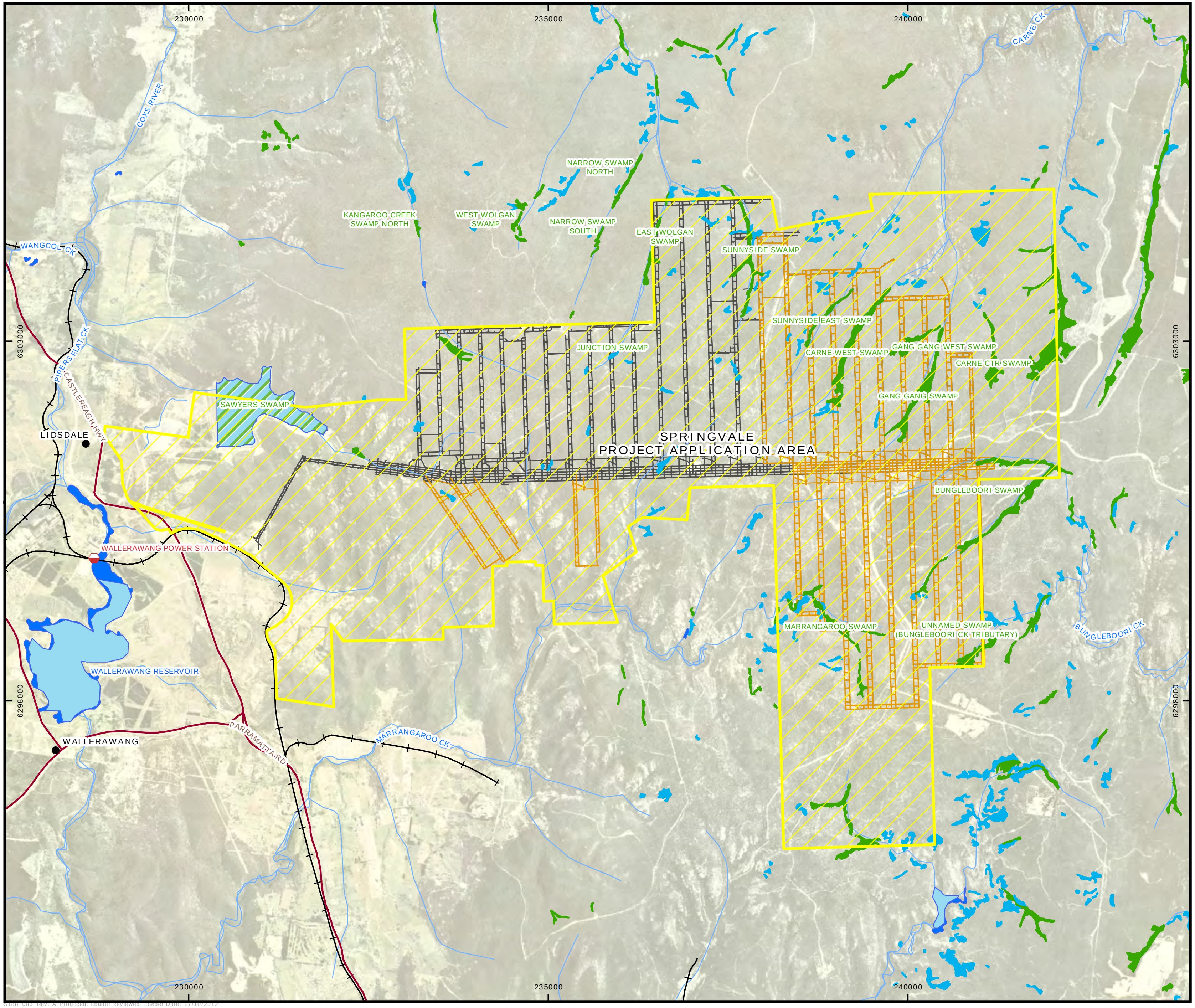
- Marrangaroo Creek Swamp.

Wolgan River Catchment

Wolgan River

The Wolgan River catchment also hosts THPSS ecosystems and include:

- Narrow Swamp, located outside of the Project Application Area but downstream of LDP005
- East Wolgan Swamp, located outside of the Project Application Area but downstream of LDP004
- Junction Swamp
- Sunnyside Swamp
- Sunnyside West / Heath Swamp
- Sunnyside East Swamp
- Carne West Swamp



LEGEND

- Localities
- Power Stations
- Main Roads
- Railway
- Watercourses
- Surface Water Features
- Hanging Swamp
- Shrub Swamp
- Sawyers Swamp
- Reservoirs
- Springvale Project Application Area

Mining Infrastrcture

- Proposed Longwall Extension
- Springvale Existing Workings (EOM)

N

1 0 1 2

Kilometers

APPROX SCALE 1:75,000 @ A4

GDA 1994 MGA Zone 56

DATA SOURCES
Geoscience Australia
Land and Property Management Authority
Panorama Avenue Bathurst NSW 2795
www.lpma.nsw.gov.au

RPS Aquaterra

FIGURE 12
SpringvaleColliery
SwampDetails

S188_003 Rev: A Produced: Loader Reviewed: Loader Date: 17/10/2012

- Gang Gang West Swamp
- Gang Gang Swamp
- Carne Central Swamp
- Barrier Swamp.

Colo River Catchment

Bungleboori Creek

Bungleboori Creek is a sub-catchment of the Colo River and is located in the far south-eastern corner of the Project Application Area. There are NPSS ecosystems within this catchment, namely:

- Bungleboori Swamp (Pine Swamp Upper, Pine Swamp, Nine Mile Swamp)
- Paddys Creek Swamp.

3.4.2 Surface Water Monitoring within Swamps

Extensive hydrological monitoring is undertaken of the THPSS. Monitoring commenced in 2004 and progressively additional monitoring stations have been added to the network.

The monitoring network comprises of the following stations (Table 3.12).

Table 3.12: Surface Water Monitoring Stations – Newnes Plateau Swamps

Site Code	Purpose	Status	Frequency (Flow)	Frequency (Quality)	Quality Parameters
Coxs River Catchment					
N/A	-	-	-	-	-
Wolgan River Catchment					
Narrow Swamp Weir NSW1	Routine	Operational	Daily (May 2008 – onward)	N/A	-
Narrow Swamp Weir NSW2	Routine	Operational	Daily (May 2008 – onward)	N/A	-
Junction Swamp	Routine	Operational	Daily (May 2002 – onward)	N/A	-
East Wolgan Swamp D/S	Routine	Operational	Fortnightly (Apr 2005 – Dec 2009)	Fortnightly (Aug 10 – onward)	Fortnightly: Field, Mn, Fe
East Wolgan Swamp D/S Junction	Routine	Operational	Fortnightly (Mar 2006 – onward)	Fortnightly (Jan 2010 – onward)	Fortnightly: Field, Mn, Fe
Sunnyside Swamp U/S	Routine	Operational	Fortnightly (Dec 2004 – onward)	Fortnightly (Jan 2010 – onward)	Fortnightly: Field, Mn, Fe
Sunnyside Swamp D/S	Routine	Operational	Fortnightly (Jan 2004 – onward)	Fortnightly (Jan 2010 – onward)	Fortnightly: Field, Mn, Fe
Sunnyside Swamp U/S Junction	Routine	Operational	Fortnightly (Mar 2006 – onward)	Fortnightly (Jan 2010 – onward)	Fortnightly: Field, Mn, Fe
Carne Swamp	Routine	Operational	Fortnightly (Dec 2004 – onward)	Fortnightly (Jan 2010 – Jul 2012)	Fortnightly: Field, Mn, Fe
				Fortnightly (Jul 2012- onward)	Fortnightly: Field, Mn, Fe Monthly: Field, TDS, TSS, Turbidity, O&G, Major Ions, Trace

Site Code	Purpose	Status	Frequency (Flow)	Frequency (Quality)	Quality Parameters
					Ions, Nutrients
Colo River Catchment					
N/A	-	-	-	-	-

* Downstream of panel already mined.

It is noted that there are shallow standpipe piezometers installed at Sunnyside Swamp (four stations), Sunnyside East Swamp (three stations), Carne West Swamp (four stations), Gang Gang Swamp, Carne Central Swamp (one station) and Marrangaroo Swamp (one station). The results of routine water quality sampling (Field, Major Ions, Trace Ions, Nutrients) from these shallow piezometers is presented in the Groundwater Assessment (RPS, 2013b). Only surface water flow gauging and quality sampling of those locations are presented in the surface water assessment.

The location of the surface water monitoring stations, both with respect to flow and quality is presented in Figure 7.

Flow

An analysis of the existing environmental database with respect to flow is presented below.

Figure 13 presents the current record of surface water flows within swamps on the Newnes Plateau.

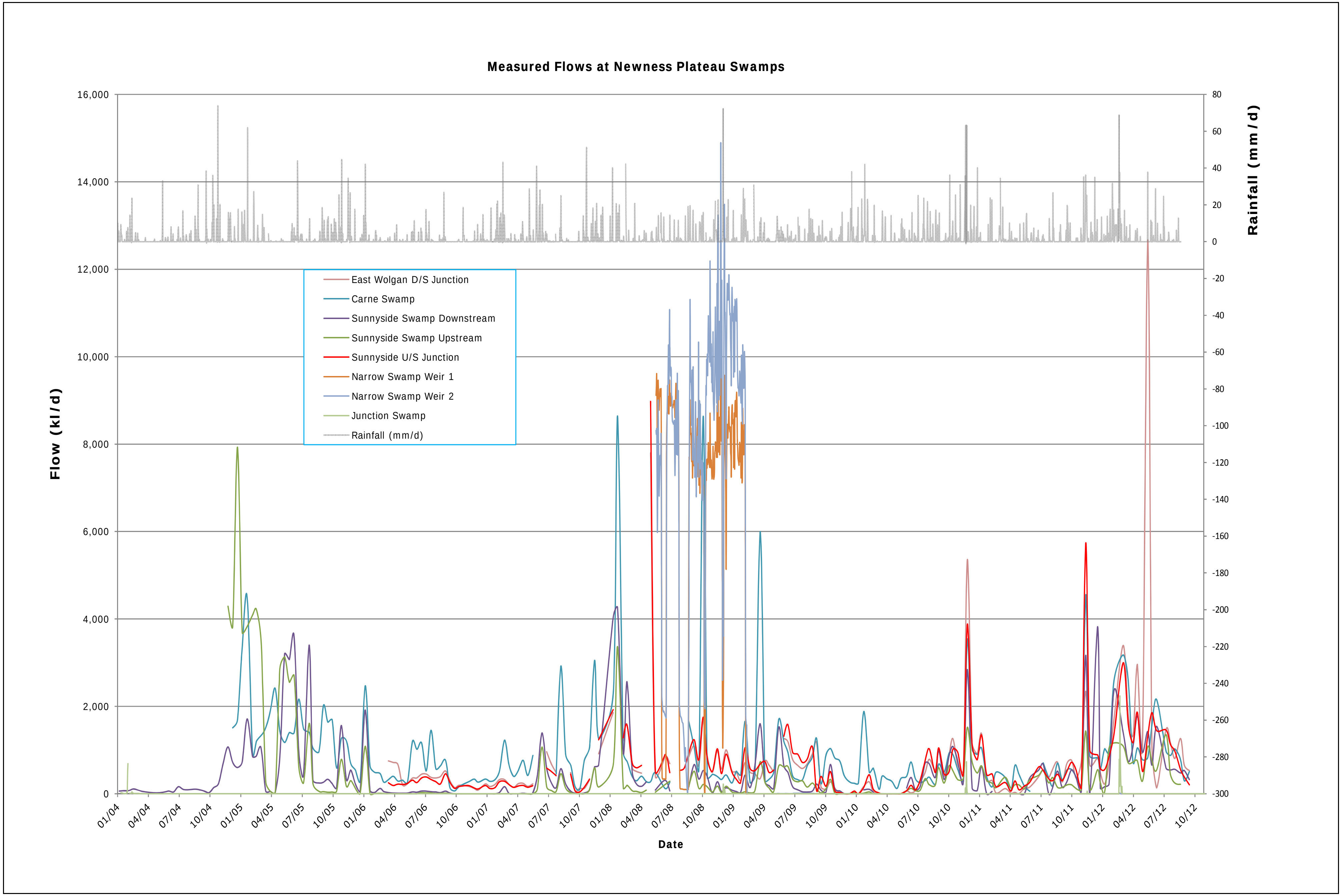
From Figure 13, there is significant fluctuation in surface water flow in the Newnes Plateau swamps; however, it is apparent that there is no medium term gaining or losing trend.

Analysis indicates a reasonably strong correlation with rainfall, as would be expected. A detailed analysis of rainfall and groundwater dependence of swamps at Springvale Mine is presented in the Groundwater Assessment (RPS, 2013b).

Table 3.13 presents the mean daily flow per month. Table 3.14 presents statistical distribution of daily flow record.

From Table 3.13, high flows at monitoring locations are generally observed in spring and summer months (higher rainfall). Periods of low flow vary from one location to another. Sunnyside Swamp and Carne Swamp have perennial flows, whereas Narrow Swamp and East Wolgan Swamp are dry during the autumn and winter (March to August). There is very inconsistent data with respect to Junction Swamp but, in general, the flows are very low.

It is noted that Station East Wolgan Swamp D/S Junction is downstream of both Sunnyside Swamp and East Wolgan Swamp, therefore reflects perennial flow of Sunnyside Swamp.



RPS Aquaterra

MEASURED FLOWS AT NEWNES PLATEAU SWAMPS FIGUR13

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Table 3.13: Swamp Flow Monitoring: Mean Daily Flow per month

	Sunnyside U/S Junction (kL/d)	Sunnyside Swamp U/S (kL/d)	Sunnyside Swamp D/S (kL/d)	Junction Swamp (kL/d)	Carne Swamp (kL/d)	Narrow Swamp Weir 1 (kL/d)	Narrow Swamp Weir 2 (kL/d)	East Wolgan Swamp D/S Junction (kL/d)[1]
Jan	602	936	520	0.5	1,000	2,070	2,610	579
Feb	587	1,160	699	5.8	1,670	1,160	1,450	554
Mar	655	342	440	19.4	819	0.3	0.4	686
Apr	457	173	289	1.1	952	0.0	0.1	570
May	995	560	517	4.3	633	288	251	1,800
Jun	818	691	822	3.8	1,020	982	966	550
Jul	615	308	308	3.5	842	1,780	1,790	639
Aug	567	295	453	5.1	786	234	413	633
Sep	550	161	262	4.6	803	1,520	1,590	637
Oct	524	157	299	3.6	1,110	1,290	1,510	534
Nov	944	312	547	3.3	1,150	1,690	2,170	632
Dec	884	787	690	6.6	879	1,830	2,470	973
Ave Monthly Mean	***683***	***491***	***486***	***5.1***	***972***	***1070***	***1269***	***732***
Min Monthly Mean	***457***	***157***	***262***	***0.5***	***633***	***0.0***	***0.1***	***534***
Max Monthly Mean	***995***	***1,160***	***822***	***19.4***	***1,670***	***2,070***	***2,610***	***1,800***

Notes 1. This monitoring station is downstream of both Sunnyside Swamp and East Wolgan Swamp.

Table 3.14: Swamp Flow Monitoring – Flow Exceedance Statistics

	Sunnyside U/S Junction (kL/d)	Sunnyside Swamp U/S (kL/d)	Sunnyside Swamp D/S (kL/d)	Junction Swamp (kL/d)	Carne Swamp (kL/d)	Narrow Swamp Weir 1 (kL/d)	Narrow Swamp Weir 2 (kL/d)	East Wolgan Swamp D/S Junction (kL/d)[1]
Percentile 5	10.2	0.0	0.0	0.0	166	0.00	0.00	0.0
Percentile 10	71.0	0.0	0.0	0.0	249	0.00	0.00	30.9
Percentile 20	163	2.0	27.8	0.0	308	0.00	0.00	146
Percentile 30	231	27.0	59.0	0.0	382	0.00	0.00	231
Percentile 40	324	64.0	87.2	0.0	491	0.00	0.00	358
Percentile 50	456	129	149	0.0	614	0.00	0.00	488
Percentile 60	527	204	280	0.0	791	0.00	0.11	584
Percentile 70	718	297	474	0.0	974	0.00	0.43	714
Percentile 80	964	592	667	0.0	1,260	0.00	7.95	913
Percentile 90	1,340	1,090	1,180	7.3	1,890	7,580	8,170	1,260
Percentile95	1,650	3,010	2,210	32.4	2,810	8,480	9,670	1,760

Notes 1. This monitoring station is downstream of both Sunnyside Swamp and East Wolgan Swamp.

Some of the conclusions taken from surface water flow monitoring are:

- Although Sunnyside Swamp preserves a mean flow throughout the year, up to 10% of the time there is zero throughflow. This is probably due to impoundment of water in the swamp rather than the swamp being dry. This is confirmed in review of water levels at Sunnyside Weir, which never fall below 18mm above the crest weir level in the period of available data (Aug 2011 to Nov 2012).
- Junction Swamp has no throughflow for more than 80% of the time, and likely will dry out in long periods with no rain recharge.
- Carne Swamp has throughflow 100% of the time.
- Narrow Swamp has no throughflow for 60% to 80% of the time, leading most likely to dry periods especially in March and April.
- East Wolgan Swamp is similar to Narrow Swamp.

Hydrographs at each monitoring location is presented in Appendix A.

Where there is sufficient streamflow data at a particular swamp, a baseflow separation calculation has been carried out using the Lyne and Hollick Filter (Nathan and McMahon, 1990). The outcome of that analysis is summarised in Table 3.15 and is presented graphically in Appendix B.

Table 3.15: Swamp Flow Monitoring – Base Flow Separation Analysis

	Junction Swamp*		Narrow Swamp		Sunnyside Swamp	
	Base flow (kL/d)	**BFI (%)**	**Base flow (kL/d)**	**BFI (%)**	**Base flow (kL/d)**	**BFI (%)**
Percentile 5 (95% exceedance)	0.0	0%	0.0	0%	0.0	0%
Percentile 10 (90% exceedance)	0.0	0%	0.0	3%	0.2	6%
Percentile 20 (80% exceedance)	5.2	13%	0.0	13%	0.3	25%
Percentile 30 (70% exceedance)	8.1	30%	0.0	21%	7.4	42%
Percentile 40 (60% exceedance)	13.1	37%	0.0	30%	30.6	60%
Percentile 50 (median value)	15.4	41%	0.0	41%	93.4	81%
Percentile 60 (40% exceedance)	17.3	48%	16.7	50%	141	100%
Percentile 70 (30% exceedance)	19.3	55%	37.5	50%	172	100%
Percentile 80 (20% exceedance)	21.1	60%	581	50%	262	100%
Percentile 90 (10% exceedance)	22.4	64%	2,050	68%	337	100%
Percentile 95 (5% exceedance)	22.8	68%	3,170	78%	385	100%

* For base flow calculation purposes only the series from May02 to Oct02 was analysed since after that the creek has carried very little flow

Baseflow analysis indicates:

- Junction Swamp and Narrow Swamp have intermediate dependency on base flows, inflows from local groundwater system. Analysis suggests 41% of the total flow (median value) is attributable to baseflow, however, are not entirely baseflow dependent since BFI is <100% at all times. These swamps are therefore described as rainfall dependent.
- Sunnyside Swamp has a high dependency on base flows, accounting for 81% of the total flow (median value) and being 100% of the total flow, 40% of the time. This swamp can therefore be described as groundwater dependent.

Further detailed analysis of the rainfall and groundwater dependence of the THPSS is presented in the Groundwater Assessment (RPS, 2013b).

Quality

Monitoring Approach

There are six (6) surface water monitoring locations that include water quality analysis. In general, the majority of water quality assessment for NPSS and NPHS is presented in the Groundwater Assessment (RPS, 2013b) since monitoring is undertaken via installed shallow piezometers rather than grab samples at surface. Accordingly, a detailed comparison of water quality against ANZECC and ADWG is not presented in tabular format since surface water program at Springvale comprises Field Parameters, Manganese and Iron only.

A summary of baseline data and basic statistical analysis is presented in Appendix C. Water quality trend graphs for pH and EC are presented in Figures in Appendix C.

In general, the Newnes Plateau Swamps are a relatively undisturbed environment with typical variability in local water quality due to natural processes associated with the hydrology of swamps including localised interaction with the perched groundwater system.

There is no discharge from the mine to these environments in recent time and operationally the preference is to discharge to the Coxs River.

Salinity and pH

In general, salinity as EC is very low, and from available monitoring ranges between 20 and 50µS/cm. pH is, in Newnes Plateau Swamps, slightly acidic, with median value across available sites ranging between 5.6 and 6.8, reflecting natural hydrologic processes.

Total Suspended Solids, Turbidity and Oil and Grease

There is monitoring of TSS, Turbidity and Oil and Grease at Sunnyside Swamp and Carne Swamp. Of the results available, TSS is 6mg/L for site SS3 and is 68mg/L for Carne Swamp. There are no mining related activity in Carne Creek and Carne West Swamp has not yet been undermined. High median values therefore reflect natural variation in water quality.

Dissolved Metals

Manganese and Iron are routinely monitored at six locations. From Appendix C, water quality analysis indicates that the concentration of Manganese is low, with median value ranging between 0.006mg/L and 0.019mg/L. Iron concentrations are higher reflecting the same processes that lead to more acidic pH. Results range between 0.2mg/L and 1mg/L. Analysis of other metals from sporadic sampling at Sunnyside Swamp and Carne Swamp are very low and / or close to detection limits.

Nutrients

Nutrients are not a component of regular surface water sampling on the Newnes Plateau. Sporadic sampling (n = 3) has occurred at Sunnyside Swamp and Carne Swamp and results indicate median value of Total Nitrogen of 0.1mg/L and 0.2mg/L respectively. Median value for Total Phosphorous was 0.01mg/L and 0.04mg/L respectively.

4. SITE WATER MANAGEMENT

A Surface Water Management Plan (SWMP) for the Springvale Mine has been developed by Springvale Coal with the aim to comply with legislative and environmental protection requirements relevant to surface water management and also to inform employees and contractors of their responsibilities with regards to water management. The plan details the surface activities that impact on the surface water system within the Springvale Mine area.

4.1 Surface Water Management Infrastructure

4.1.1 Surface Water Storages and Site Layout

The Springvale Mine Pit Top is situated at the footslopes of the Newnes Plateau. The Pit Top consists of structures and facilities such as offices, storage areas, workshops, bathhouse, coal stockpile and mine access amongst others. Surface water is managed on-site by means of several diversion channels, storage and settling ponds. Figure 14 presents a flow diagram.

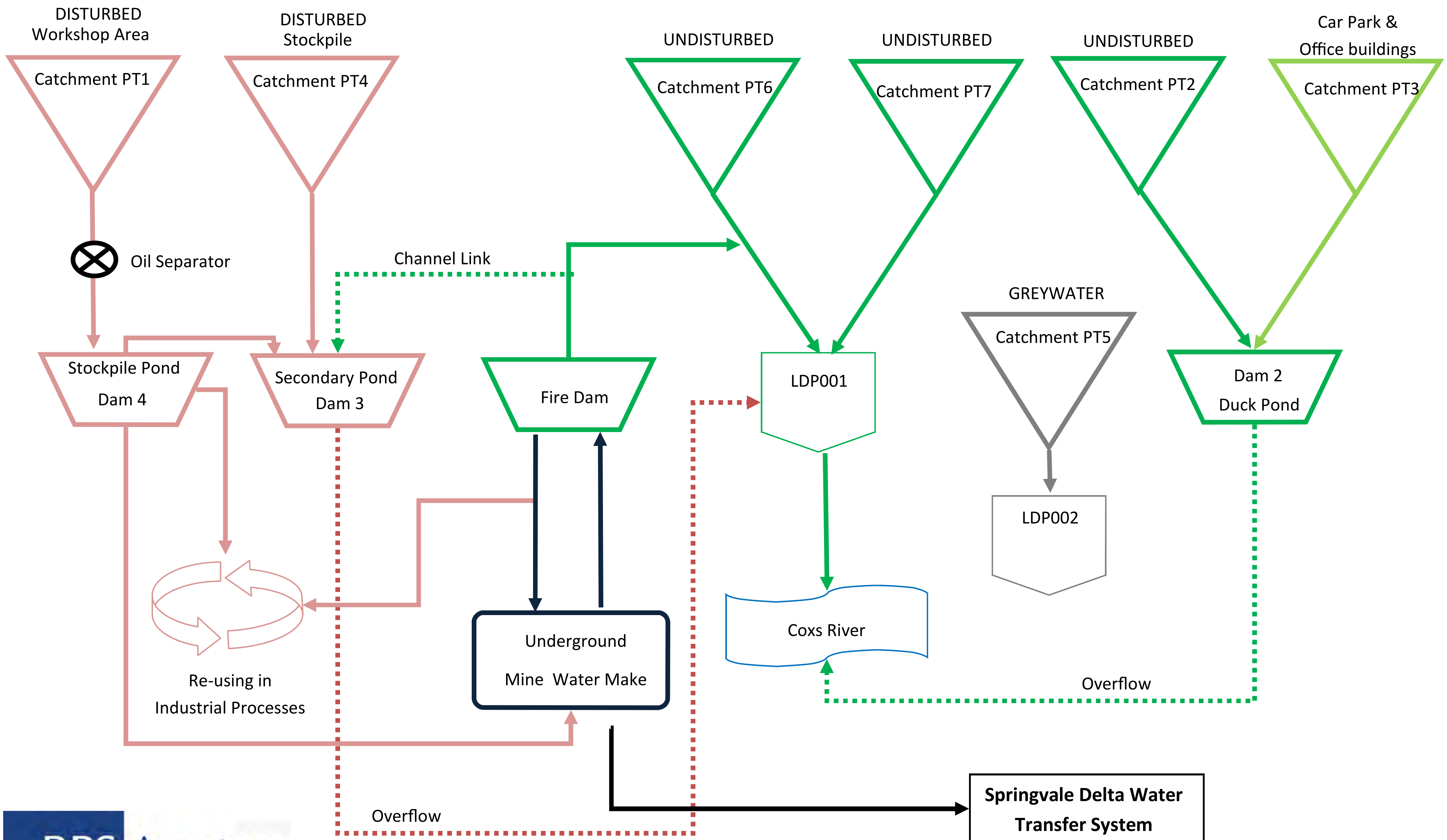
For the purpose of this assessment, the Pit Top was divided into seven catchments. The Pit Top Catchments (PTC) were sub-divided based on an analysis of the Pit Top infrastructure and site topographic contours. Springvale Pit Top Catchments are illustrated in Figure 15 and Figure 16 and are described in Table 4.1. The clean and dirty water circuits at Springvale Pit Top are presented in Figure 17.

Table 4.1: Pit Top Catchment Characteristics

ID.	Area (m^2)	Undisturb'd Area	Disturbed Area	Stockpile Area	Average Slope (%) *	Description
PTC1	93,830	85%	15%	0%	32%	Covers area upslope of the store room down through the wash-down bay, workshop, transport shed, isolator shed. Runoff through this catchment drains to the oil separator and is then pumped up to secondary pond. The catchment is mostly vegetated although there is exposure to polluting activities before runoff drains to the oil separator.
PTC2	62,630	100%	0%	0%	36%	Includes all vegetated areas upslope of the car park. This catchment is connected to catchment PTC3, which drains into the Duck Pond Dam.
PTC3	43,730	40%	60%	0%	10.6%	Catchment PTC3 is made up of the office buildings and the car park. There is also a significant area covered with vegetation. Runoff from this catchment drains into the Duck Pond.
PTC4	134,100	5%	60%	35%	6.0%	Includes the storage supplies area, spray irrigation pump shed, conveyer equipment storage area, stockpile area, mining supplies storage area and the roads leading into these areas. Most of the catchment area is disturbed.
PTC5	3,293	-	-	-	-	Sewage treatment pond discharged onsite via spring irrigation to utilisation area LDP002.
PTC6	273,400	100%		0%	26%	With the exception of the fire dam, Catchment PTC6 is vegetated. It drains through a diversion channel around PTC4 and then to LDP001.
PTC7	585,200	100%		0%	17%	Catchment PTC7 is the largest of all pit top catchments and drains to LDP001. The catchment is mostly vegetated.

* maximum height difference divided by maximum catchment length.

SPRINGVALE PIT TOP CATCHMENTS AND FLOW DIAGRAM



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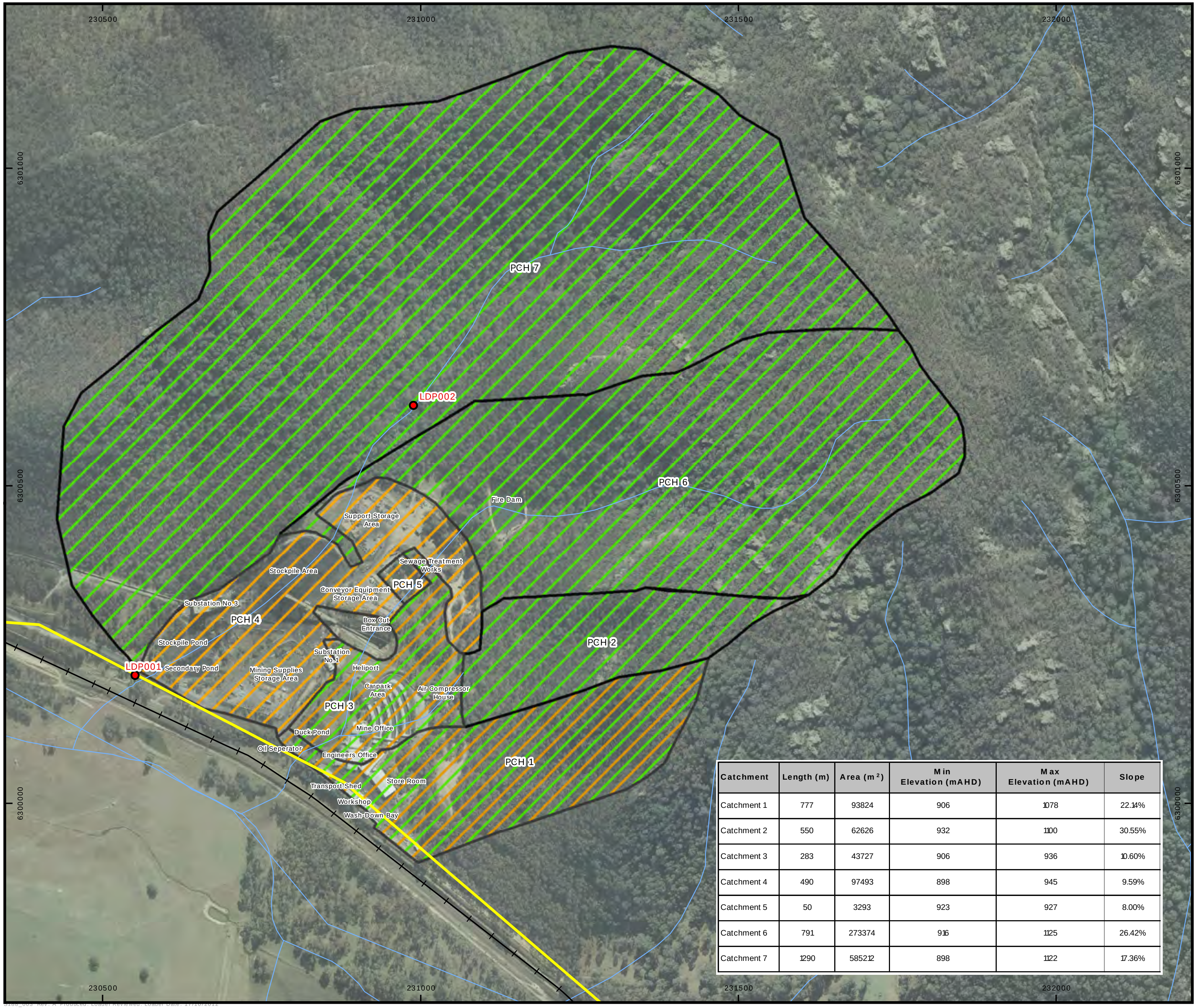

Catchment	Length (m)	Area (m²)	Min Elevation (mAHD)	Max Elevation (mAHD)	Slope
Catchment 1	777	93824	906	1078	22.14%
Catchment 2	550	62626	932	1100	30.55%
Catchment 3	283	43727	906	936	10.60%
Catchment 4	490	97493	898	945	9.59%
Catchment 5	50	3293	923	927	8.00%
Catchment 6	791	273374	916	1125	26.42%
Catchment 7	1290	585212	898	1122	17.36%

LEGEND

- Licensed Discharge Point
- Railway
- Watercourses
- Springvale Colliery Holding Boundary

Pit Catchment Types

- Clean Catchment
- Disturbed Catchment
- Disturbed/Clean Catchment

N

100 0 100 200

Metres

APPROX SCALE 1:8,500 @ A4

GDA 1994 MGA Zone 56

DATA SOURCES
Geoscience Australia
Land and Property Management Authority
Panorama Avenue Bathurst NSW 2795
www.lpma.nsw.gov.au

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FIGURE 15
Springvale Colliery
Pittop Catchments Overview

Catchment	Length (m)	Area (m^2)	Min Elevation (mAHD)	Max Elevation (mAHD)	Slope
Catchment 1	777	93824	906	1078	22.14%
Catchment 2	550	62626	932	1100	30.55%
Catchment 3	283	43727	906	936	10.60%
Catchment 4	490	97493	898	945	9.59%
Catchment 5	50	3293	923	927	8.00%
Catchment 6	791	273374	916	1125	26.42%
Catchment 7	1290	585212	898	1122	17.36%

LEGEND

- Licensed Discharge Point
- Railway
- Roads
- Watercourses
- Springvale Colliery Holding Boundary
- Clean Catchment
- Disturbed Catchment
- Disturbed/Clean Catchment

50 0 50 100

Metres

APPROX SCALE 1:3,500 @ A4

GDA 1994 MGA Zone 56

DATA SOURCES
Geoscience Australia
Land and Property Management Authority
Panorama Avenue Bathurst NSW 2795
www.lpma.nsw.gov.au

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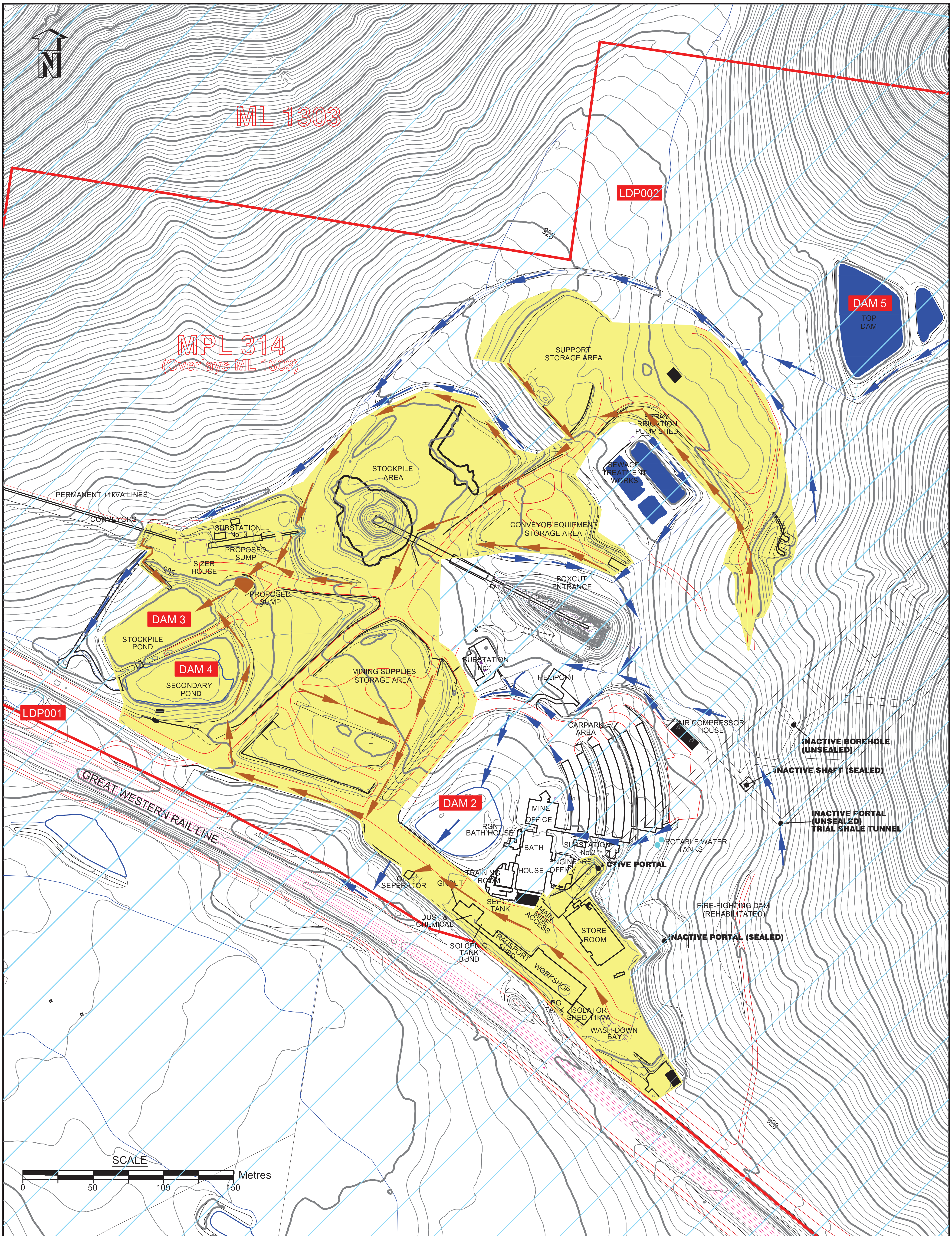
FIGURE 16
Springvale
Pittop Catchments Details



LEGEND:

- Clean Water
- Dirty Water
- Dirty Water Catchment
- Clean Water Catchment

DRAWN: Zac Burley	DATE: 08-02-2012	SPRINGVALE MINE	Springvale Coal
PLAN No: SVY00624/6A	COMPUTER PATH: S:\Survey\Z_Plans	TITLE: AEMR 2011 Figure No.17 Pit Top Plan - Surface Water Management	SPRINGVALE MINE Castlereagh HWY Lidsdale NSW 2790 PO Box 198 Wallerawang NSW 2845 Phone: 02-63501600 Fax: 02-63551052
INFORMATION SUPPLIED BY: -			
SCALE: SCALE 1:2500	A3V Sheet 1 of 1		

S:\Survey\Z_Environmental\AEMR 2011\Dwg's\Fig. No.6A Pit Top Plan-Vectorised Mapping.dwg

A number of dams and sediment basins exist across the Pit Top to provide containment of predominantly surface run-off, as described in the points below.

In normal operation the Primary or Stockpile Pond discharges to the Secondary Pond and only in case of emergency it overflows to LDP001.

Water from the Secondary Pond is pumped underground into the Renown Colliery workings for percolation through the workings to remove sediment prior to collection within the Pit Top Collection System for use as process water. Only in case of emergency it overflows to LDP001. The main facilities include the following (refer to Figure 16 for details). Table 4.2 summarises their key features.

The Secondary Pond supplies water to the underground workings and only in case of emergency it overflows to LDP001. The main facilities include the following (refer to Figure 16 for details). Table 4.2 summarises their key features.

Primary or Stockpile Pond

This is the primary settling pond for the dirty water catchment around the Pit Top and receives surface runoff from disturbed areas including:

- the stockpile and crusher area
- the conveyor equipment storage area
- the support storage area.

Secondary Pond

The Secondary Pond receives:

- overflow from Stockpile Pond
- surface runoff from the mining supplies storage area
- drainage from the workshop and store room area, after it has been treated by the oil-water separator.

Duck Pond

Duck Pond receives:

- surface run-off from the administration building area and car park.
    - overflow from this dam discharges off-site to Springvale Creek
    - in the circumstance of unusually oily or turbid water entering the pond, there is a pumping system which allows transfer to Secondary Pond for re-use.

Fire Dam

The primary purpose of Fire Dam is to store mine inflows, sourced from underground via the Pit Top Collection System, for use as process water. Fire Dam receives:

- water from the underground mine dewatering system, which is aerated on discharge to Fire Dam.

Outflows from Fire Dam comprise:

- process water for mining operation
- process water for dust suppression operations
- fire suppression to underground workings in the event of emergency

Overflow from the Fire Dam is transmitted via a shotcrete-lined channel to LDP001. Further detail on water demand is presented below.

Table 4.2: Pit Top Surface Water Infrastructure

Name	Main Function	Receives water from	Discharges to	Measured Surface Area (m^2)	Estimated Storage Volume (ML)
Stockpile pond	Sediment Settlement Pond	Disturbed areas	Secondary Pond	2,103	7
Secondary pond	Sediment Settlement Pond	Stockpile Pond	Reused on Industrial processes	2,575	7
Duck Pond	Sediment Settlement Pond	Green area and roof & car park drainage	Springvale Creek	1,846	2
Fire Dam	Mine water storage	Underground Mine water make	Reused on Industrial processes & LDP001	4,995	8
Sewage Treatment Ponds	Wastewater treatment	Administration Building and Bathouse sewage	LDP002	2,390	1

It is noted that there is no contributing catchment to Fire Dam, rather Fire Dam is a 'Turkeys Nest'. The potential catchment area upstream of Fire Dam is diverted around Fire Dam via a shotcrete-lined channel to LDP001.

Sewage Treatment Ponds

Wastewater from the Administration Building and Bathhouse is discharged into the sewage treatment works before being disposed of on-site via LDP002 (spray irrigation of treated effluent).

4.1.2 Site Water Sources

Potable Supply

Municipal water supply (potable) is used in the Bathhouse and Administration Buildings to support the full-time workforce of up to 310 persons. There is no change in expected demand for potable water from continuation of mining at Springvale Mine.

Surface Runoff

Runoff from disturbed catchments is stored at Stockpile and Secondary Ponds and is re-used for industrial purposes including mining operations

Runoff from undisturbed areas is diverted around surface water management infrastructure and is not captured or used for any industrial purpose.

Springvale Mine Water Make

Mine water make, sourced from the underground via the Pit Top Collection System (bore licence 10BL602017), is stored at the Fire Dam and the majority is re-used for industrial purposes including supply to mining operations. Dewatering in advance of mining is managed through the existing dewatering bore, Bore 8 facility (bore licence 10BL601863) and the Ventilation Shaft 3 boreholes (bore licence 10BL603519) and directly fed into the SDWTS.

Mine water make from existing workings at Springvale Mine is ~12ML/d and will increase to ~19ML/d in 2022 associated with the extension at Springvale. Figure 18 presents the modelled mine water work at Springvale Mine, as represented in the Site Water Balance. Further detail on mine water make is presented in the Groundwater Assessment (RPS, 2013b).

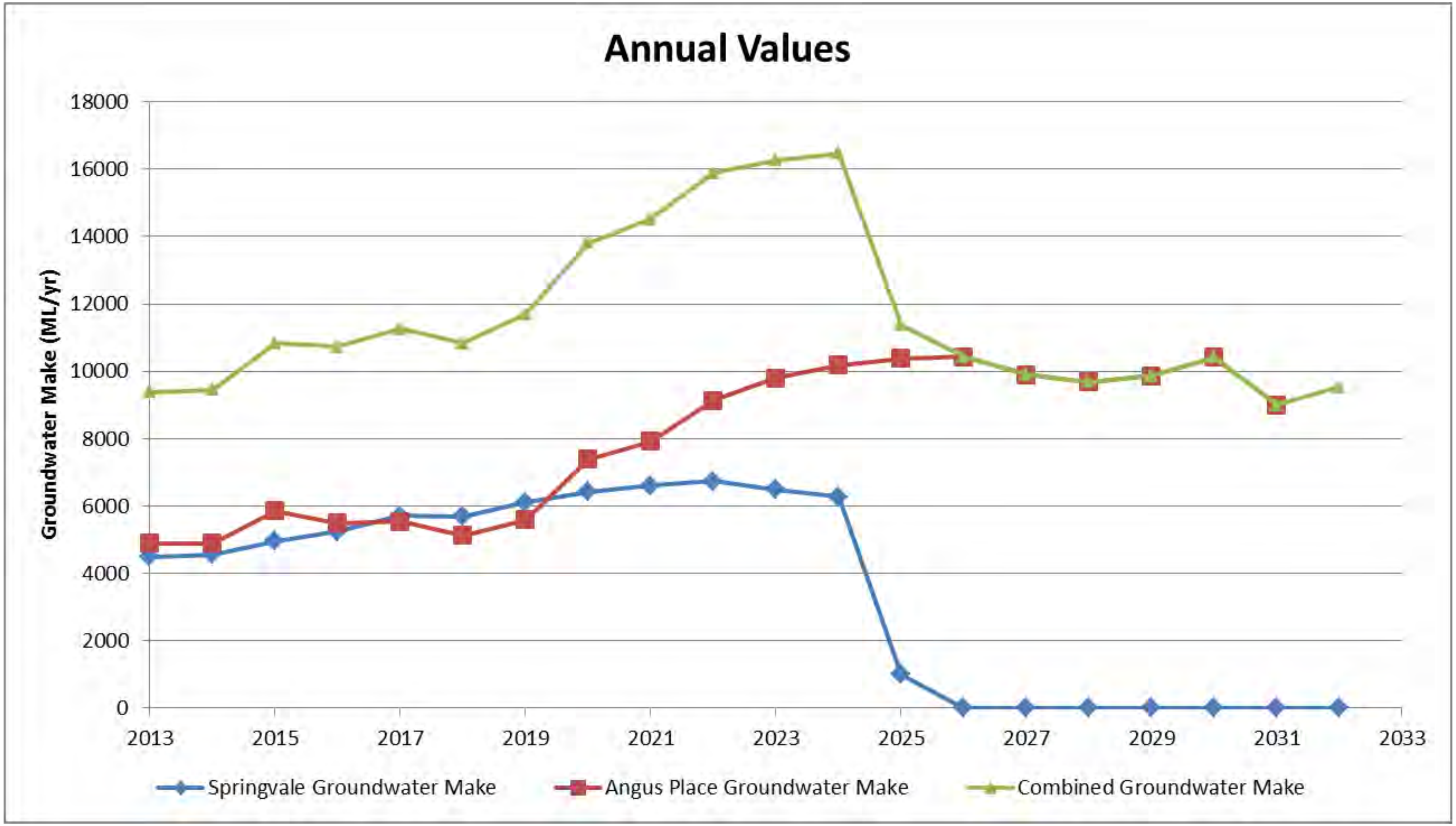


Figure 18: Modelled Mine Water Make in the Site Water Balance (GHD, 2013)

Inflow from Angus Place Colliery

In addition to mine water make from Springvale Mine itself, there is also contribution to the SDWTS from the adjacent project, Angus Place. The current mine water make at Angus Place Colliery is ~13ML/d and this is expected to increase to 29ML/d in 2030 associated with the Angus Place Mine Extension Project.

The combined mine water make from both mines is expected to increase from 25ML/d to a peak of about 45ML/d in 2024/25 before declining to 26ML/d in 2032 following completion of mining at Springvale Mine in 2025 and dewatering at Springvale ceasing. Groundwater level at Springvale will then start to recover. Mining at Angus Place Colliery is completed in 2032 and dewatering ceases in 2032. Groundwater levels will then start to recover at Angus Place Colliery.

As will be described below, the primary water demand from Springvale Mine is the SDWTS, which supplies water directly to the Wallerawang Power Station. Both Springvale Mine and Angus Place Colliery contribute to the SDWTS.

4.1.3 Site Water Demands

Water on-site is used for:

- dust suppression on haul roads and the coal stockpile
- workshop and vehicle wash-down
- coal crusher and screening plant
- underground mining and longwall excavation
- bathhouse and administrative buildings (potable water).

Table 4.3 summarises the on-site water demands at Springvale Mine. Table 4.4 presents the off-site demand in the Coxs River catchment and is discussed further below.

Table 4.3: On-Site Water Demands

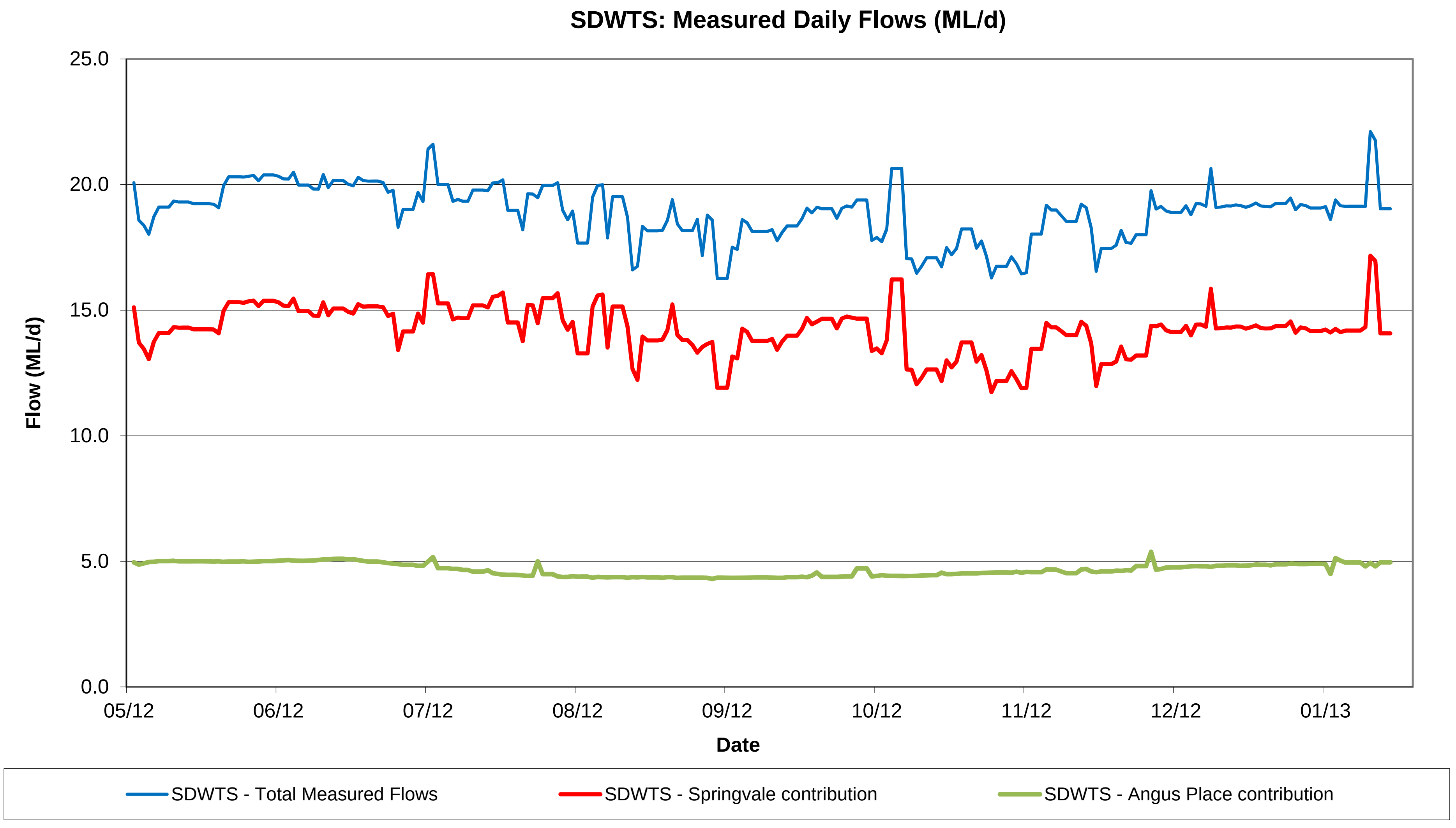
Raw (Primary)	Average Water Demand (ML/yr)	Average Water Demand (ML/d)
Dust Suppression	3	0.0082
Workshop	30	0.082
Vehicle Wash-down	30	0.082
Crusher and Screening Plant	138	0.378
Mining Equipment	138	0.378
Bath House & Admininistration Building (potable water)	10	0.027
TOTAL Water Demand	**349**	**0.955**

Table 4.4: Off-Site Water Demands – Coxs River Catchment

Raw (Primary)	Average Water Demand (ML/yr)	Average Water Demand (ML/d)
Wallerawang Power Station	11,000	30
Mt Piper Power Station	14,200	38.9
TOTAL Water Demand	**25,200**	**68.9**

The primary water demand at Springvale Mine is off-site demand by the Wallerawang Power Station that is met by the SDWTS. The average water transfer from Springvale to the SDTWS is 14ML/d. The contribution from Angus Place Colliery to the SDTWS is ~5ML/d. Figure 19 presents the measured daily flows through the transfer scheme.

From Figure 19, ~70% of the current transfer to the SDWTS is from Springvale Mine. The remaining demand at Wallerawang Power Station is met from direct extraction from the Coxs River / Lake Wallace reservoir.


SDWTS: Measured Daily Flows (ML/d)
25.0
20.0
15.0
10.0
5.0
0.0
Flow (ML/d)
05/12
06/12
07/12
08/12
09/12
10/12
11/12
12/12
01/13
Date
SDWTS - Total Measured Flows
SDWTS - Springvale contribution
SDWTS - Angus Place contribution

Demand from the Mt Piper Power Station is also met from the Coxs River catchment, via extraction from Lake Lyell, which is located down-gradient of Lake Wallace. Water extracted from Lake Lyell is supplied to Mt Piper Power Station via intermediate transfer to Thompsons Creek Dam.

The upgrade to this pipeline will follow the same route wherever possible. Further detail on the proposed route of the pipeline is presented in the main EIS.

As will be outlined below, water management at Springvale Mine will comprise utilisation of existing capacity in the SDWTS and then increased discharge to the Coxs River via Springvale|LDP009 and upgrade of the SDWTS from its current capacity of 30ML/d to 50ML/d, when combined inflow to Springvale and Angus Place Collieries exceed 30ML/d, with discharge to the Coxs River via Springvale|LDP009.

4.2 Surface Water Monitoring at LDPs

Discharge to the environment is governed by EPLs issued under the Protection of the Environment Operations Act 1997. At Springvale Mine, discharge of water is administered via EPL 3607. There are six locations in EPL 3607 that refer to contributions from Springvale Mine. There are two other locations identified in EPL 3607 that are now part of Western Coal Services Project and therefore outside of this assessment (LDP006 and LDP007).

Monitoring comprises of the stations presented in Table 4.5.

Table 4.5: Surface Water Monitoring Stations – Licensed Discharge Points

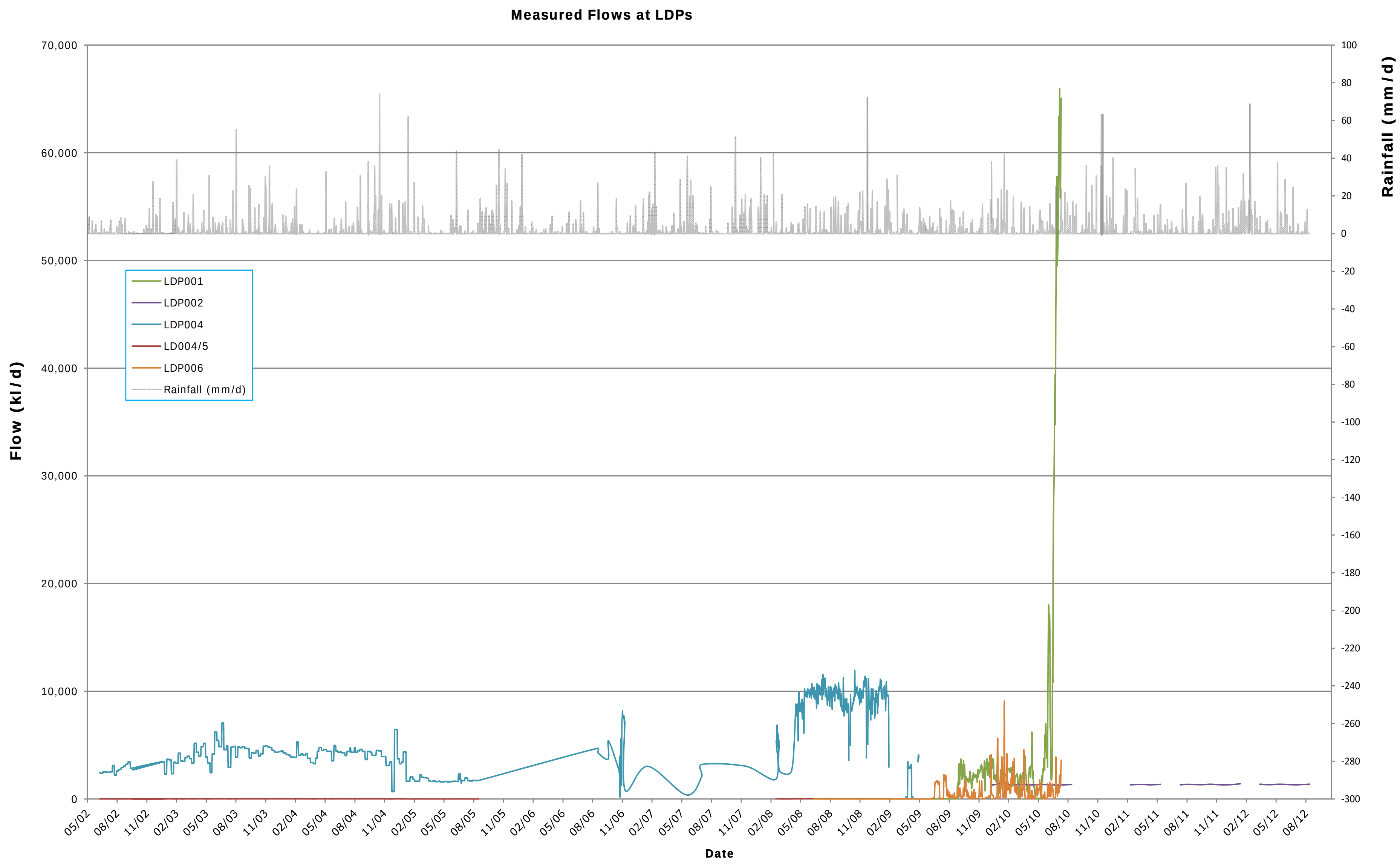
Site Code	Purpose	Status	Frequency (Flow)	Frequency (Quality)	Quality Parameters
LDP001	Licensed Discharge Point	Operational	Daily (Jul 2008 – onward)	Weekly (Jan 2010 – onward)	Weekly: Field Monthly: Field, TSS, O&G, Mn, Fe
LDP002	Licensed Discharge Point	Operational	Monthly (Jan 2010 – onward)	N/A	-
LDP004	Licensed Discharge Point	Operational	Daily (during discharge) {Jul 2002 - May 2009}	Daily (during discharge)	Daily: Field, Turbidity. Weekly: Field, TSS, Turbidity, O&G, Mn, Fe
LDP005	Licensed Discharge Point	Operational	Daily (during discharge) {Jul 2002 - Feb 2009}	Daily (during discharge)	Daily: Field, Turbidity. Weekly: Field, TSS, Turbidity, O&G, Mn, Fe
LDP006	N/A	-	-	-	Refer to Western Coal Services
LDP007	N/A	-	-	-	Refer to Western Coal Services
LDP009	Licensed Discharge Point	Operational	Daily (during discharge)	Weekly (during discharge)	Weekly: Field, TSS, Turbidity, O&G, Trace Ions.
LDP010	Licensed Discharge Point	Operational	Daily (during discharge)	Weekly (during discharge)	Daily: Field, TSS, Turbidity, O&G, Trace Ions.

4.2.1 Flow

Discharge of water at LDPs has been monitored since 2002. Figure 7 presents the location of LDPs. Figure 20 presents the available flow record at LDP001, LDP002, LDP004 and LDP005 including the recorded rainfall record corresponding to the monitoring period.

There were no records of flow from LDP009 and LDP010. It is understood that there has not been discharge from LDP010 in recent history.

Table 4.6 presents a statistical distribution of discharges at different LDPs, except for LDP002. Flow rate hydrographs at each LDP are presented in Appendix A.



RPS Aquaterra

MEASURED FLOWS AT LDP'S FIGURE 20

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Table 4.6: LDP Flow Monitoring – Flow Exceedance Statistics

	LDP001 (kL/d)	LDP004 (kL/d)	LDP005 (kL/d)	LDP009 (kL/d)	LDP010 (kL/d)
Percentile 5	0.0	1623	3.3	No data	No data
Percentile 10	0.0	1674	3.4	No data	No data
Percentile 20	0.0	2440	5.0	No data	No data
Percentile 30	0.3	3278	6.7	No data	No data
Percentile 40	169	3850	7.8	No data	No data
Percentile 50	475	4189	8.5	No data	No data
Percentile 60	807	4409	8.9	No data	No data
Percentile 70	1232	4774	9.6	No data	No data
Percentile 80	1874	7050	14.1	No data	No data
Percentile 90	2755	9565	19.2	No data	No data
Percentile 95	3818	10146	20.4	No data	No data
Maximum	7974	11950	23.9	No data	No data
Discharge Limit (EPL 3607)	**10,000**	**15,000**	**15,000**	**30,000**	**N/A**

LDP002 is associated with disposal of treated effluent from on-site sewerage system via spray irrigation. Figure 21 presents the distribution of discharge from LDP002 since 2010.

From Figure 21, the average monthly discharge is ~800kL/month, or 25kL/d. This is not anticipated to change with the extension of Springvale Mine since the current workforce level will be maintained.

4.2.2 Quality

Monitoring Approach

As per the requirements of the EPL, monitoring is undertaken at all LDPs, except for LDP002. LDP002 refers to effluent disposal via spray irrigation. There has been no discharge from Newnes Plateau LDP004 and LDP005 in recent time and therefore there are no water quality monitoring results available with respect to these locations. Location LDP001 is the primary monitoring location and there has been continuous monitoring since January 2010. There is monitoring at LDP009, which is the bypass from the SDWTS.

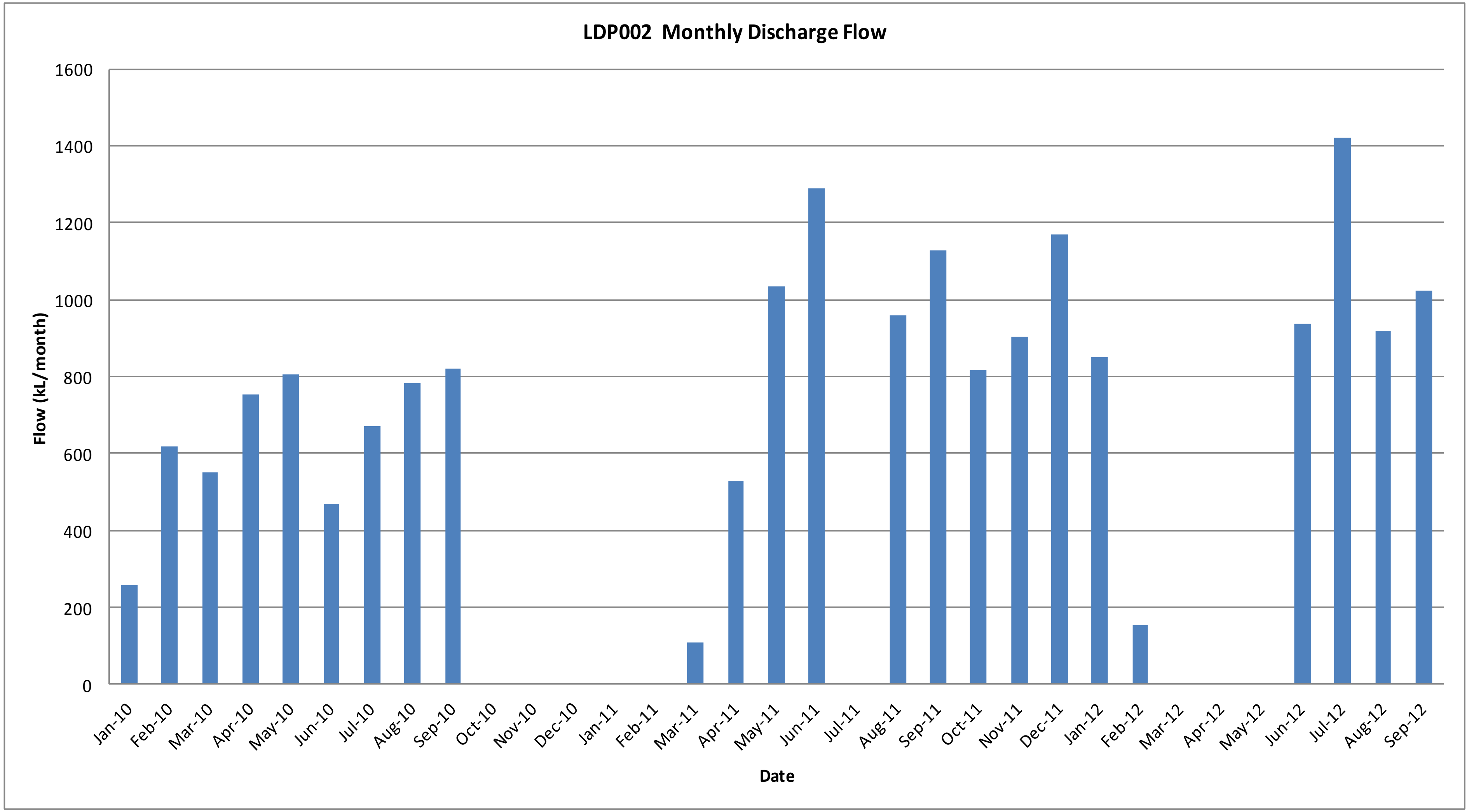
A summary of the water quality database is presented in Appendix C and time-series variation of water quality at LDP001 and LDP009 is also presented in Appendix C. Table 4.7 presents a comparison of various LDPs against EPL3607, ANZECC 2000 and ADWG. The median value is presented for Field Parameters, Physical Parameters, Minor Ions and Nutrients where available, together with the observed range and number of observations. For Major Ions, water quality analysis results from the most recent sample are presented, including date of sample.

In general, water quality of discharge from LDP001 and LDP009 is very good, with near neutral pH and salinity that is essentially consistent with ADWG, including concentrations of dissolved metals and nutrients.

Salinity and pH

The median salinity at LDP001 is 910µS/cm (measured TDS was 580mg/L) and median pH is 8.3. There are less samples obtained at LDP009, however, of the data available, median salinity is 1,055µS/cm (TDS of 710mg/L, noting that TDS is not measured directly at LDP009). Median pH at LDP009 is 7.9.

Median value of salinity at LDP001 is consistent with the aesthetic value of ADWG and LDP009 is also consistent with ADWG, however, with respect to fair drinking quality water since TDS is



LDP002 MONTHLY DISCHARGED FLOWS FIGURE 21

Table 4.7: Surface Water Quality – Licensed Discharge Points

Parameter	Units	ANZECC 2000	EPL 3067 LDP001	EPL 3067 LDP009	ADWG Health (NHMRC, 2011)	ADWG Aesthetic (NHMRC, 2011)	LDP001	LDP009
Physical Parameters								
pH		6.5 – 8.0	6.5 – 9.0	6.5 – 9.0	c	6.5 – 8.5	8.3 (3.15-9.47, n=171)	7.9 (7.8-8.0, n=8)
EC[1]	µS/cm	350	-	1,200	-		910 (32-1,830, n=203)	1,055 (1,030-1,100, n=8)
TDS[1]	mg/L	234.5	-	804	f	Based on taste: < 600 good quality 600 – 900 fair quality	581 (96-720, n=158)	~710 (N/A)
Hardness as $CaCO_3$	mg/L	-	-	-	f	< 60 soft but possibly corrosive 60 – 200 good quality 200 – 500 increasing scaling problems >500 severe scaling	48 (46-55, n=5)	Not Tested
TSS	mg/L	-	30	50	-	-	7 (1-30, n=47)	4 (3-5, n=8)
Turbidity	NTU	2 – 25	-	50	c	5	16 (3-189, n=164)	3.5 (3-10, n=8)
Oil and Grease	mg/L	-	10	10	-	-	<5	<5
Major Ions								
Na	mg/L	-	-	-	f	180	19 (21 Sep 2012)	Not Tested
Ca	mg/L	-	-	-	-	-	19	Not Tested
Mg	mg/L	-	-	-	-	-	224	Not Tested
K	mg/L	-	-	-	-	-	12	Not Tested
Alkalinity	mg/L	-	-	-	-	-	83	Not Tested
Cl	mg/L	-	-	-	c	250	1	Not Tested
SO_4	mg/L	-	-	-	500	250	11.2	Not Tested
Trace Ions								
Ag	mg/L	0.00005	-	-	0.1	-	<0.001	Not Tested
Al	mg/L	0.055 for pH>6.5	-	0.45	c	0.2	0.02 (0.001-0.5, n=35)	0.085 (0.05-0.14, n=8)

Parameter	Units	ANZECC 2000	EPL 3067 LDP001	EPL 3067 LDP009	ADWG Health (NHRMC, 2011)	ADWG Aesthetic (NHRMC, 2011)	LDP001	LDP009
As	mg/L	0.024 as As III	-	0.024	0.01	-	0.001 (0.001-0.008, n=39)	Not Tested
B	mg/L	0.37	-	0.37	4	-	0.05 (<0.001-0.11, n=44)	0.075 (0.06-0.09, n=4)
Cd	mg/L	0.0002	-	-	0.002	-	<0.0001	Not Tested
Cr	mg/L	0.001 as Cr VI	-	-	0.05 as Cr VI	-	0.001 (0.001-0.01, n=7)	Not Tested
Cu	mg/L	0.0014	-	0.007	2	1	0.003 (0.001-0.061, n=41)	Not Tested
F	mg/L	-	-	1.8	1.5	-	0.6 (0.1-1.4, n=41)	Not Tested
Fe	mg/L	ID	-	0.4	c	0.3	0.05 (<0.001-0.73, n=51)	0.05 (0.05-0.05, n=8)
Mn	mg/L	1.9	-	1.7	0.5	0.1	0.01 (0.004-2.74, n=50)	0.007(0.003-0.018, n=8)
Ni	mg/L	0.011	-	0.047	0.02	-	0.002 (0.001-0.012, n=40)	Not Tested
Pb	mg/L	0.034	-	-	0.01	-	0.001 (0.001-0.003, n=41)	Not Tested
Se	mg/L	0.011 as Total Se	-	-	0.01	-	0.01 (0.01-0.18, n=7)	Not Tested
Zn	mg/L	0.008	-	0.05	c	3	0.022 (0.008-0.05, n=44)	Not Tested
Nutrients								
NH_3 as N	mg/L	0.013	-	-	c	0.4	0.02 (0.01-0.12, n=43)	Not Tested
NO_3 as N	mg/L	0.015[2]	-	-	11.3	-	0.45 (0.23-2.64, n=34)	Not Tested
Total N as N	mg/L	0.25	-	-	-	-	1.0 (0.45-3.5, n=43)	Not Tested
Total P as P	mg/L	0.02	-	-	-	-	0.025 (0.01-0.28, n=42)	Not Tested

Notes: 1. The assumed conversation factor is EC (µS/cm) x 0.67 = TDS (mg/L) from Section 4.3.3 of ANZECC (2000). If laboratory determination of TDS has occurred, results are provided; 2. NOx (oxides of N); ID. Insufficient data to derive a reliable trigger value; c. Insufficient data to set guideline value based on health considerations; f. No health-based value considered necessary. 3. Alkalinity is Total Alkalinity of CO_3 2-, HCO_3 - and OH-.

between 600 and 900mg/L. It is noted that there is no health-based value for salinity considered necessary.

TSS, Turbidity and Oil and Grease

Median value of TSS and Turbidity at both LDP001 and LDP009 (7mg/L and 16NTU; 4mg/L and 4NTU) is consistent with EPL 3607 and ANZECC criteria. The ADWG aesthetic value for Turbidity is 5NTU; therefore discharge at LDP001 is in excess of this value, however, not significantly so.

Monitoring indicates Oil and Grease is <5mg/L at both LDP001 and LDP009.

Dissolved Metals

Median value of Aluminium of 0.02mg/L at LDP001 and 0.085mg/L at LDP009 exceeds ANZECC guideline value marginally, and is less than ADWG aesthetic value. There is no health relative criteria in ADWG for Aluminium due to insufficient data.

All other metals except Zinc are consistent with ANZECC. Median values for Zinc at LDP001 is 0.022mg/L compared to ANZECC value of 0.008mg/L.

Nutrients

There is no monitoring of nutrients at LDP009 and it is not a current requirement of EPL3607.

Observed value of Nitrate (NO_3) at LDP001 of 0.45mg/L is in excess of ANZECC guideline value but is far below the ADWG health value of 11.3mg/L. Discharge at LDP001 exceeds ANZECC guideline for Total Nitrogen, with median value of 1.0mg/L compared to guideline of 0.25mg/L, however, is not significant. Similarly, concentration of Total Phosphorous is slightly in excess of ANZECC guidance value; however, there is no ADWG value with respect to either health or aesthetics. There is also no concentration limit in regard to Total Phosphorous on the EPL.

4.3 Estimated Peak Runoff (Local Catchments)

Estimates of peak flood flows were made using the Probabilistic Rational Method (Engineers Australia, 2001). Calculations were performed on sub-catchments contributing to Springvale Pit Top to ascertain the peak flood flows from 1 y ARI (Average Recurrence Interval) to 100 y ARI. Figure 22 illustrates the boundaries of individual sub-catchments as well as catchment labels.

The time of concentration was calculated using the relevant formulae from Australian Rainfall and Runoff (Engineers Australia, 2001). Intensity Frequency Duration (IFD) curves were extracted from Volume 2 of Australian Rainfall and Runoff (Engineers Australia, 1987).

The time of concentration and respective rainfall intensity for each catchment are presented in Table 4.8. The peak flow rates for the respective ARIs are presented in Table 4.9.

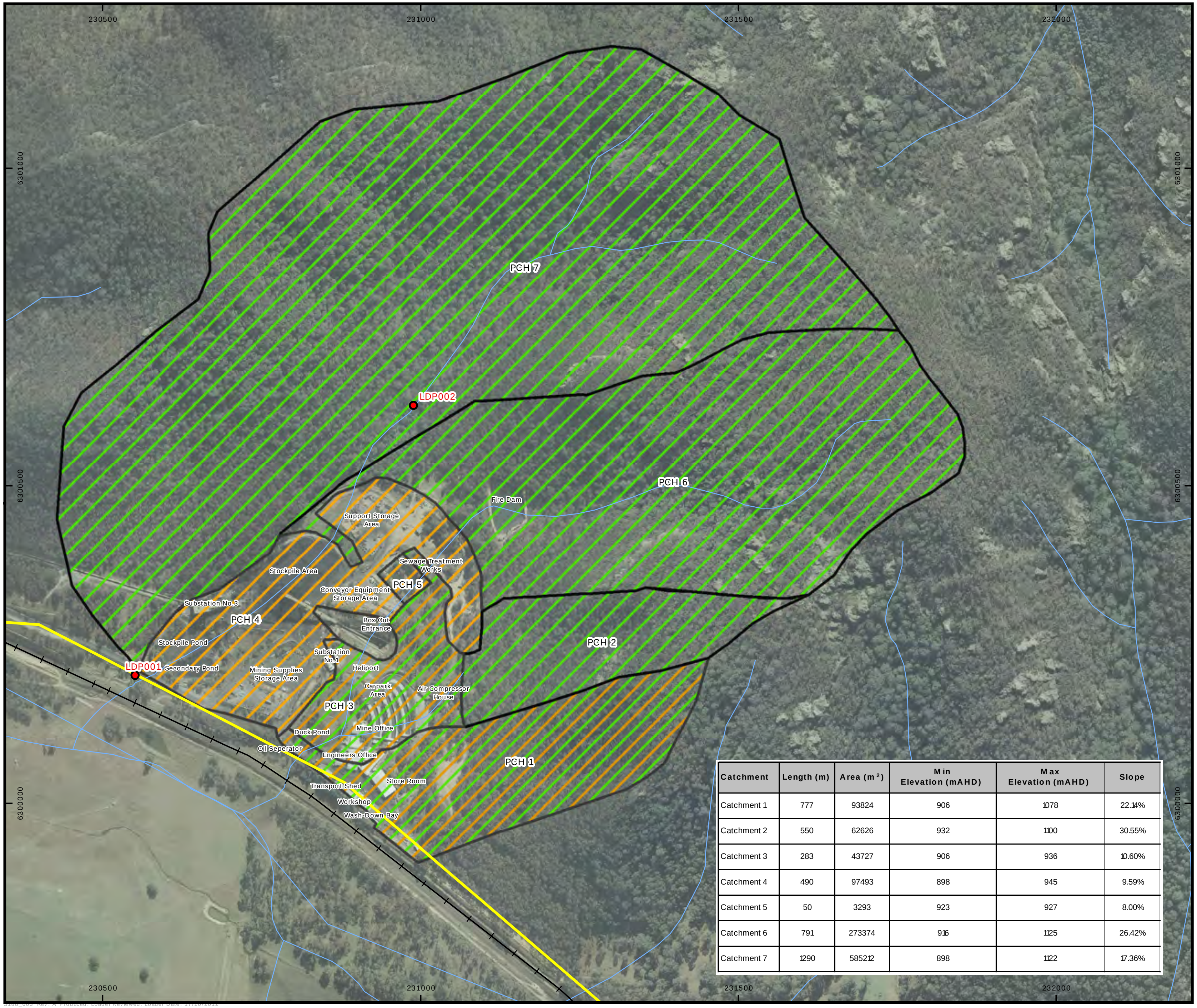
4.4 Soil Loss and Sediment Pond Evaluation

4.4.1 Soil Loss Estimate

The catchment conditions have been examined and the annual sediment production amounts for each catchment located within or draining across the Pit Top Area were quantified using the Revised Universal Soil Loss Equation (RUSLE) method.

The method is based on the contribution of the following factors:

- rainfall erosivity factor, R
- soil erodibility factor, K
- slope length / gradient factor, LS
- erosion control practice factor, P
- ground cover and management factor, C.



Catchment	Length (m)	Area (m²)	Min Elevation (mAHD)	Max Elevation (mAHD)	Slope
Catchment 1	777	93824	906	1078	22.14%
Catchment 2	550	62626	932	1100	30.55%
Catchment 3	283	43727	906	936	10.60%
Catchment 4	490	97493	898	945	9.59%
Catchment 5	50	3293	923	927	8.00%
Catchment 6	791	273374	916	1125	26.42%
Catchment 7	1290	585212	898	1122	17.36%

LEGEND

- Licensed Discharge Point
- Railway
- Watercourses
- Springvale Colliery Holding Boundary

Pit Catchment Types

- Clean Catchment
- Disturbed Catchment
- Disturbed/Clean Catchment

N

100 0 100 200

Metres

APPROX SCALE 1:8,500 @ A4

GDA 1994 MGA Zone 56

DATA SOURCES
Geoscience Australia
Land and Property Management Authority
Panorama Avenue Bathurst NSW 2795
www.lpma.nsw.gov.au

RPS Aquaterra

FIGURE 22
Springvale Colliery
Pittop Catchments Overview

Table 4.8: Rainfall Intensity (mm/hr) of Local Catchments at Springvale Pit Top

Water Storage/ Discharge Site	Oil water separator	Duck Pond Dam (Dam 2)	Stockpile Pond and secondary Pond (Dam 3 and 4)	LDP001	LDP002	LDP001	LDP001
Contributing Catchment	PTC1	PTC2	PTC3	PTC4	PTC5	PTC6	PTC7
Total catchment area (ha)	9.4	6.3	4.4	9.7	0.33	27.3	58.5
Design Rainfall for individual storage Ponds and Dams (mm/hr)							
Time of concentration (min)	**19 mins**	**16 mins**	**14 mins**	**19 mins**	**5 mins**	**28 mins**	**37 mins**
1 y ARI	34.9	37.7	40.2	34.7	60.2	28.4	24.3
2 y ARI	45.3	48.9	52.2	45.0	78.5	36.7	31.3
5 y ARI	58.7	63.6	68.1	58.3	103.7	47.2	40.1
10 y ARI	66.9	72.6	77.8	66.4	119.5	53.5	45.4
20 y ARI	77.9	84.6	90.8	77.3	140.3	62.1	52.5
50 y ARI	92.7	100.8	108.4	92.0	168.6	73.6	62.1
100 y ARI	104.4	113.6	122.2	103.5	191.0	82.6	69.6

Table 4.9: Peaks flood flows (m^3/s) for selected ARIs of Local Catchments at Springvale Pit Top

Water Storage Site/ Discharge site	Oil water separator	Duck Pond Dam (Dam 2)	Stockpile Pond and secondary Pond (Dam 3 and 4)	LDP001	LDP002	LDP001	
Contributing Catchment	PTC1	PTC2	PTC3	PTC4	PTC5	PTC6	PTC7
Contributing area (ha)	9.4	6.3	4.4	9.7	0.33	27.3	58.5
Peak Flows for Individual Storage Ponds and Dams (m^3/s)							
1 y ARI	0.25	0.17	0.16	0.26	0.02	0.56	1.03
2 y ARI	0.40	0.27	0.25	0.42	0.02	0.89	1.63
5 y ARI	0.67	0.45	0.42	0.69	0.04	1.47	2.67
10 y ARI	0.93	0.63	0.59	0.96	0.06	2.03	3.69
20 y ARI	1.30	0.89	0.83	1.35	0.08	2.86	5.17
50 y ARI	1.95	1.33	1.24	2.02	0.12	4.25	7.68
100 y ARI	2.57	1.76	1.64	2.66	0.17	5.59	10.1

The various parameters for the RUSLE were derived based on the methodologies presented in the 'Blue Book' (Landcom, 2004 and DECCW, 2008). Table 4.10 presents the adopted values.

Table 4.10: Soil Loss Estimate – RUSLE Input Parameters

Landscape Description	Rainfall Erosivity, R	Soil Erodibility, K	Slope Length / Gradient, LS	Erosion Control Practice, P	Ground Cover and Management, C
Undisturbed	1,560	0.043	3 – 12	0.9	0.05
Disturbed	1,560	0.06	2 – 3	1.1	0.3
Stockpile	1,560	0.055	2 – 3	1.2	1.0

Soil loss from each catchment at Springvale Pit Top was then calculated using the RUSLE method. Table 4.11 presents a summary of the results. Figure 22 presents the catchment layout.

Table 4.11: Soil Loss Estimate – RUSLE Predictions for Pit Top Catchments

Catchment No	Area (ha)	Average Slope *	% Undisturbed Area	% Disturbed Area	% Stockpile Area	Annual Soil Loss (t/year)
PTC1	9.38 ha	22.1%	85%	15%	0%	511
PTC2	6.26 ha	30.5%	100%	0%	0%	226
PTC3	4.37 ha	10.6%	60%	40%	0%	181
PTC4	9.75 ha	9.6%	5%	60%	35%	1,375
PTC5	0.33 ha	8.0%	100%	0%	0%	21.1
PTC6	27.3 ha	26.4%	100%	0%	0%	799
PTC7	58.5 ha	17.4%	100%	0%	0%	965
Draining to Duck Pond	10.6 ha	PTC 2 + PTC3				405
Draining to Stockpile + Secondary Pond	19.1 ha	PTC 1 + PTC4+ PTC6				2,685
Draining to STW Ponds	0.33 ha	PTC 5				21.1
Draining away from the site	58.5 ha	PTC 7				965
TOTAL	**116 ha**					**4,076**

* maximum height difference divided by maximum catchment length.

From Table 4.11, the highest sediment contribution is derived from catchment PTC4, due to this being the active area, including stockpile. In contrast, the undisturbed areas have the lowest sediment yield, if normalised with respect to catchment area, which is expected.

4.4.2 Sediment Pond Size Evaluation

The requirements for storage dimensions for sediment control ponds at Springvale Pit Top have been evaluated against the standard procedures presented in Landcom (2004).

The Pit Top catchments have been grouped according to the water storage ponds they drain to:

- catchments draining to Duck Pond: PTC2 and PTC3
- catchments draining to Stockpile and Secondary Ponds: PTC1, PTC4 and PTC6
- catchments draining to the STW ponds: PTC5.

Type D and Type F Soils

PTC3, PTC4 and PTC5 collect runoff from disturbed areas with a high potential content of fine suspended particles. Sub-catchments PTC3 and PTC5 have been classified as Type D Hydrologic Soil Type whereas PTC4 has been classified Type F Hydrologic Soil Type due to the potential presence of coal fines.

Accordingly, sediment basin size requirements from these sub-catchments were evaluated assuming the Type D and Type F Hydrologic Soil Type.

The minimum required storage capacities of these ponds have been calculated so as to contain runoff expected from up to the 5 day, 95th percentile rainfall depth. The relevant rainfall station from Landcom (2004) was Lithgow, NSW, with a 5 day, 95th percentile rainfall depth of 56.4mm.

The total storage capacity required is the sum of the sediment settling volume plus the sediment storage volume. For disturbed and stockpile areas, the sediment storage volume is equal to 50% of the calculated sediment settling volume.

A summary of the relevant input data is:

- 5 day, 95th rainfall depth is 56.4mm
- volumetric run-off coefficient is 0.39.

Type C Soils

PTC1, PTC2 and PTC6 collect runoff from undisturbed upstream catchments before discharge off-site. The minimum storage requirements are less severe in this case.

The settling volume is calculated to provide capacity to allow the design particle size (i.e. 0.02mm in equivalent diameter) to settle in the peak flow expected from the design storm (i.e. 0.25-year ARI or 3 month design storm event). Peak flow/discharge for the 0.25-year ARI is estimated to be ½ of the 1 y ARI peak flow, in accordance with the methodology presented in Landcom (2004). The design particle size is assumed to be 0.02mm and is the default value (conservative) in the methodology presented in Landcom (2004).

The volume of the basin settling zone is determined as the product of the settling surface area and a standard settling depth (i.e. 0.6m).

The total storage capacity required is the sum of the sediment settling volume plus the sediment storage volume. For Type C sub-catchments, the required sediment storage volume is equal to 100% of the sediment settling volume.

Calculated Storage Volumes

The calculated storage requirements are presented in Table 4.12 and indicate that Duck Pond, Stockpile Pond and Secondary Pond have additional capacity compared to the requirements outlined in the Landcom (2004) methodology.

Analysis is based on a conservative requirement to retain the 5 day, 95th rainfall depth.

It is noted that the sediment capture requirements were calculated on individual sub-catchments and were aggregated where there was a mixture of Hydrologic Soil Types such that storage volumes accounted for mixed sediment sources.

The current program of routine maintenance and sediment extraction should be continued and, at a minimum, sediment basins should be excavated every 2 years.

Table 4.12: Pit Top Catchments – Sediment Pond Size

Sub-Catchment	Hydrologic Soil Type	Catchment Area (ha)	Draining to	Existing Storage Capacity (m^3)	Required Storage Capacity				Meets requirements?
					Settling (m^3)	Storage (m^3)	Total Individual (m^3)	Total Combined (m^3)	
PTC2	Type C	6.26 ha	Duck Pond	2,000	276	276	553	1,996	**Yes**
PTC3	Type D	4.37 ha			962	481	1,443		
PTC1	Type C	9.38 ha	Stockpile Pond + Secondary Pond	14,000	339	339	677	8,836	**Yes**
PTC4	Type F	9.75 ha			2,144	1,072	3,217		
PTC6	Type C	27.3 ha			2,471	2,471	4,942		
PTC5	Type D	0.33 ha	STW Ponds	1,000	73	36	109	109	**Yes**

5. SURFACE WATER MODELLING

5.1 WATER BALANCE MODELLING

5.1.1 Model Setup

A water balance model has been developed for Springvale Mine using the surface water balance modelling platform GoldSIM.

The model comprises all surface water management infrastructure identified at Springvale Mine as well as predicted mine water inflow. The model also includes all surface water infrastructure at Angus Place Colliery and mine water make at Angus Place. Figure 18 presents the mine water make at both Springvale Mine and Angus Place Colliery. Further detail on mine water inflow to both Springvale and Angus Place, including the assumptions, is presented in the Groundwater Assessment (RPS, 2013b).

Each element in the water balance model is linked by a rate exchange and these can be structured such that operational priorities are appropriately represented.

The GoldSIM model utilises the Australian Water Balance Model (AWBM) to represent runoff from various surface water catchments. Other factors such as evaporation from the surface of dams and reservoirs are also represented. It is noted that the water balance model only incorporates surface runoff from catchment contributing to LDPs. Runoff from catchments that are diverted around LDPs are not considered in the water balance.

The model uses a daily time-step and is executed in stochastic mode (Monte Carlo). This involves sampling the historical rainfall record with different starting positions. Using this approach, a suite of different realisations can be generated whilst still being consistent with the inherent variability of the rainfall record in the area.

The water balance was prepared by GHD and is attached as Appendix D to this report (GHD, 2013a). Further detail on the setup of the GoldSIM model is presented in Appendix D.

A regional water balance has also been prepared by GHD and comprises both Angus Place Colliery and Springvale Mine but also all other water uses in the Coxs River catchment. This regional water balance is attached as Appendix E (GHD, 2013b).

The objective of the regional water balance is to enable consideration of the impact of the extension of Springvale Mine in context of the potential impacts of other activities in the catchment.

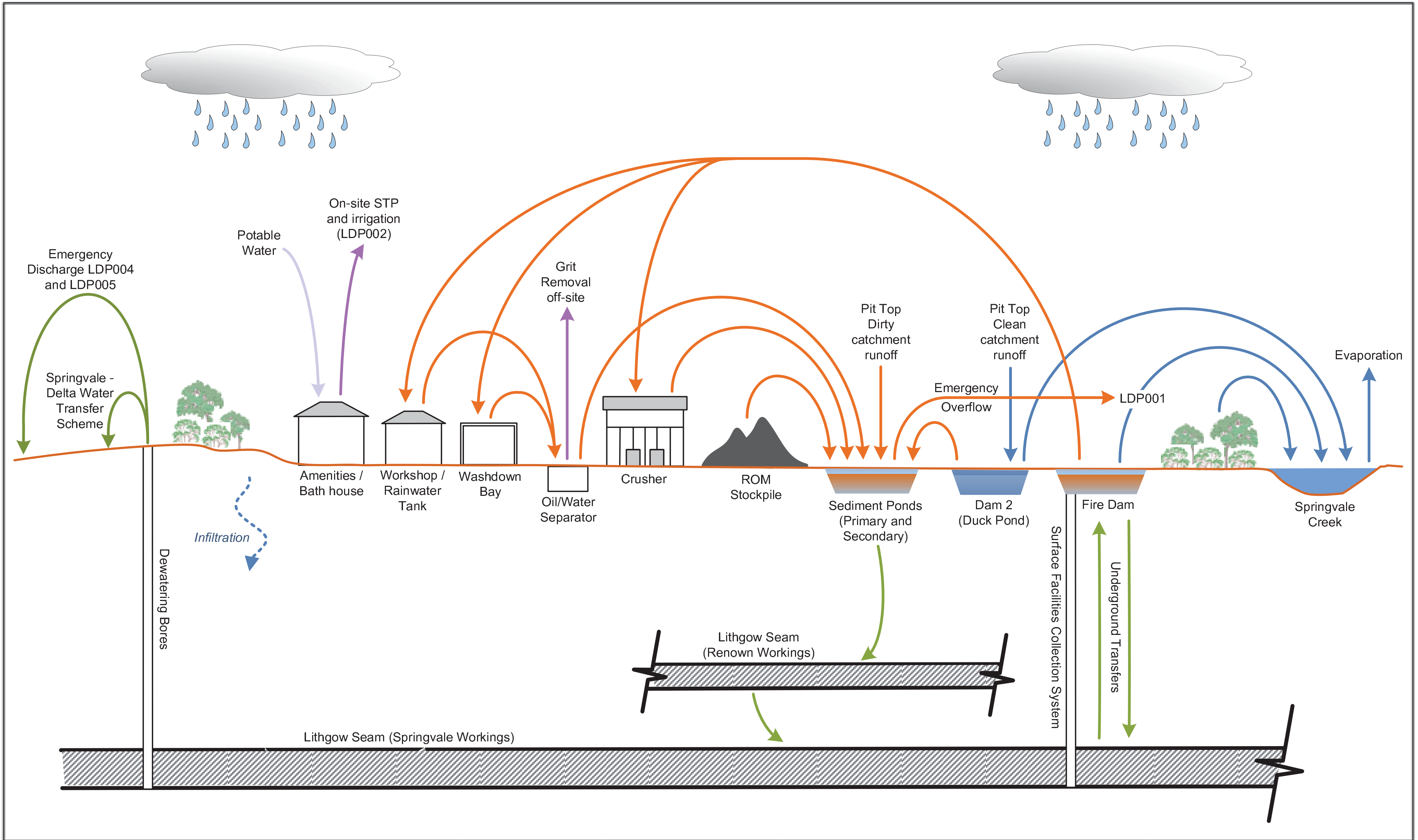
Figure 23 presents the schematic of water management at Springvale Mine, as represented in the model.

5.1.2 Model Calibration

Once the model was constructed, the GoldSIM model was calibrated using either monitored site inflows and / or assumptions. Outflows at various LDPs and transfers between surface water management infrastructure were compared to observation to confirm model representation was appropriate.

For current conditions, calibrated to July 2013, the largest water transfers are associated with mine water make, including underground transfers and transfers from the underground to the surface. In general, runoff from surface water catchments is inconsequential compared to mine water make. It is noted that the model was calibrated to a period where there was limited discharge at the adjacent project at Angus Place through their LDP001. Mine water make was being stored temporarily underground during the period March to July 2013. Discharge at Angus Place|LDP001 has now resumed at an annual rate of 731ML (2ML/d).

Demand for water from the workshop, wash-down, dust suppression and operation of continuous mining machinery is also small compared to inflows of groundwater into the underground workings. Further details of on-site water demand are presented in Section 4.1.



LOCATION	Springvale
SEAM	Lithgow
DRAWN	SM
CHECKED	RT
APPROVED	
SCALE	NTS

Springvale Colliery Extension Project
Water and Salt Balance Assessment

Overall Water Management Schematic

SpringvaleCoal

DATE January 2013

Figure 2.1

G:\22\16599\Visio\2216599_FIG2-1_Springvale Overall Water Management Schematic.vsd

Predicted mean annual discharges from Springvale Mine under existing conditions are:

- 648ML (1.8ML/d) at LDP001, with additional outflow from Dam 2 (Duck Pond) of 14.5ML (0.04ML/d)
- 4,555ML (12.5ML/d) to the SDWTS.

The contribution of Springvale Mine to the SDWTS is 12.5ML/d, which accounts for about 70% of the total water transferred by the scheme. The other 30% comes from the Angus Place Colliery. The average daily contribution to the SDWTS is 20.9ML/d, which is below the current capacity of the pipeline of 30ML/d.

Review of simulated discharges compare reasonably with site observation. The results from calibration simulation also indicate that flow limits, as specified in EPL 3607, are currently met at the various LDPs.

The sensitivity of model simulation of existing conditions was then investigated by generating multiple realisations from the historical rainfall record. Table 5.1 presents the outcome of sensitivity analysis with respect to rainfall.

From Table 5.1, outflows from LDP001 are not particularly sensitive to rainfall, with 90th percentile daily flow being 2.1ML/d compared to mean daily flow of 1.8ML/d.

Table 5.1: Model Calibration: LDP001 – Flow Exceedance Statistics

Discharge Point	LDP001
Daily limit of discharge (ML/d)	**10**
Annual Mean flow (ML/y)	648
Daily Mean Flow (ML/d)	1.8
Daily flow – 10th Percentile (ML/d)	1.5
Daily flow – 90th Percentile (ML/d)	2.1

5.1.3 Model Results

There are two model scenarios presented:

- Existing Conditions (Year 2013)
    - Pit Top water management infrastructure:
        - inflows to underground workings via Collector System (10BL602017) as currently configured
    - Transmission to the SDWTS:
        - dewatering in advance of mining via Bore 6 (10BL603519) as currently configured
        - inflows to Shaft 3 – Ventilation (10BL601863) as currently configured.
- Proposed Conditions
    - Pit Top water management infrastructure:
        - inflows to underground workings via Collector System (10BL602017) as currently configured; update to inflows from numerical groundwater model.
    - Transmission to the SDWTS
        - dewatering in advance of mining via Bore 8 (10BL603519) – change in location with relevant approval already in place, otherwise consistent with current configuration; with updated inflows.
        - inflows to Shaft 3 – Ventilation (10BL601863) as currently configured; with updated inflows.
        - upgrade capacity of SDWTS from 30ML/d to 50ML/d, via duplication of pipeline along existing route where applicable, when combined inflow at Springvale Mine and Angus Place Colliery exceeds 30ML/d.

Table 5.2 presents the time-series outflow from the water balance. The model results considering existing infrastructure as well as upgrade to the SDWTS is presented.

It is noted that whilst there are emergency discharge locations on the Newnes Plateau at LDP004 and LDP005, operationally these are considered a decision of last resort and discharge is preferred to the Coxs River. The last emergency discharge at these LDPs occurred in April 2010.

Table 5.2: Model Results: Discharge (ML/d) at LDP001, LDP009 and Contribution to SDWTS

Year	Discharge (ML/d) with SDWTS at 30ML/d				Discharge (ML/d) with SDWTS at 50ML/d			
	LDP001	LDP009	Springvale to SDWTS	Total SDWTS	LDP001	LDP009	Springvale to SDWTS	Total SDWTS
2013	1.8	0.0	12.5	20.9	1.8	0.0	12.5	20.9
2014	1.8	0.0	10.9	19.4	1.8	0.0	10.9	19.4
2015	1.8	0.0	12.0	23.7	1.8	0.0	12.0	23.7
2016	1.8	0.0	12.8	27.4	1.8	0.0	12.8	27.4
2017	1.8	0.0	14.1	28.9	1.8	0.0	14.1	28.9
2018	1.8	0.0	14.0	27.9	1.8	0.0	14.0	27.8
2019	1.8	0.0	15.1	29.6	1.8	0.1	15.1	30.2
2020	1.8	0.0	16.0	29.9	1.8	5.9	16.0	36.0
2021	1.8	0.0	16.5	29.9	1.8	7.8	16.5	37.9
2022	1.8	0.0	16.9	29.9	1.8	11.5	16.9	41.7
2023	1.8	0.0	16.2	29.9	1.8	12.6	16.2	42.7
2024	1.7	0.0	15.6	29.9	1.7	13.1	15.6	43.8
2025	0.5	0.0	2.5	28.5	0.5	0.6	2.5	30.7
2026	0.2	0.0	0.0	28.3	0.2	0.0	0.0	28.3
2027	0.2	0.0	0.0	26.9	0.2	0.0	0.0	26.9
2028	0.2	0.0	0.0	26.3	0.2	0.0	0.0	26.3
2029	0.1	0.0	0.0	26.9	0.1	0.0	0.0	26.9
2030	0.1	0.0	0.0	28.6	0.1	0.0	0.0	28.6
2031	0.0	0.0	0.0	24.4	0.0	0.0	0.0	24.4
2032	0.0	0.0	0.0	25.7	0.0	0.0	0.0	25.7

Under future conditions, the critical year is 2022, which is associated with peak mine inflow. Mean annual discharges in that year will comprise:

- 648ML (1.8ML/d) at LDP001, with additional outflow from Dam 2 (Duck Pond) of 14.5ML (0.04ML/d)
- 6,169ML (16.9ML/d) transmitted to the SDWTS.

Under future conditions, the total transfer to the SDWTS will increase to 29.9ML/d, in the critical year of 2022, the limit of the capacity of the SDWTS pipeline. Of the 29.9ML/d, 16.9ML/d will be contributed by Springvale Mine and 13.0ML/d will originate from Angus Place Colliery.

As presented above, the water management strategy at Springvale Mine also includes the option to upgrade the capacity of the SDWTS pipeline from 30ML/d to 50ML/d, upstream of Springvale|LDP009, once the combined inflow from Springvale Mine and Angus Place Colliery exceed 30ML/d. Under this scenario, the total transmission through the SDWTS will increase to 43.8ML/d, however, given the total water demand at Wallerawang Power Station is 30ML/d, the remaining 13.8ML/d will be discharged to the Lake Wallace reservoir via Sawyers Swamp Creek through Springvale|LDP009. Any overflow from Lake Wallace is transmitted to Lake Lyell, which is the water supply reservoir for Mt Piper Power Station via intermediate transfer to Thompson's Creek Dam. Extension of the Project, with associated increase in groundwater inflows, therefore provides an opportunity to substitute water currently sourced from the Fish River Water Source by the power stations and thereby reduce their impact on that Water Source.

Figure 24 presents the modelled outflow from Springvale Mine to the SDTWS, including contribution from the adjacent project at Angus Place Colliery. Figure 25 and 26 present the modelled outflow from Springvale to LDP001 and LDP009. Model results from both components of the water management strategy are presented.

In the circumstance that Wallerawang Power Station is temporarily offline, all flow within the SDWTS would be discharged at Springvale|LDP009 to Lake Wallace.

If the extension of the adjacent project at Angus Place Colliery does not proceed then the existing capacity of the SDWTS is sufficient to accommodate for expected increased groundwater inflows to Springvale Mine without need to upgrade the pipeline.

5.2 SALT BALANCE MODELLING

5.2.1 Model Setup

A salt balance has been prepared based on the outcomes of water balance modelling including the regional water balance in regard to potential cumulative impact.

Current water quality in the Coxs River above Lake Wallace has a median EC of ~600µS/cm (NSW Office of Water Station No. 212054) and from streamflow gauging at this location, median flow (50th percentile) is 12.2ML/d; the ‘dry’ flow (5th percentile) is 2.9ML/d.

Wangcol Creek is a minor western tributary of the Coxs River. Currently water quality within Wangcol Creek has mean salinity of ~900µS/cm (Monitoring Station: Wangcol Ck Far D/S (RPS, 2013c)). Within the catchment of Wangcol Creek there is Springvale Coal Services Site, Neubecks Coal Mine, Pine Dale Coal Mine and Mt Piper Power Station. Median flow (50th percentile) in Wangcol Creek is 0.72ML/d (predicted). From the regional water balance, Appendix E, outflow from Wangcol Creek may increase due to changes at Neubecks and Pine Dale Coal Mines. Modelling indicates peak flow from Neubecks may reach 2,000ML/y (5.5ML/d) in 2015/16 and peak flow from Pine Dale may reach 3,700ML/y (10.1ML/d) in 2016. The Neubecks operation will be an open cut coal mine. The Pine Dale Mine is currently operating as an open cut coal mine (Stage 1) and there is a proposal to expand the current open cut mine (Stage 2). Each of these operations are targeting the Illawarra Coal Measures and groundwater quality is anticipated to be consistent with that encountered at Springvale Mine.

A salt mass balance has been prepared based on expected influent to the Coxs River with respect to time. These inflows include the contribution from the adjacent project at Angus Place Colliery, which also discharges to the Coxs River, as well as expected contributions from other operations within the catchment. The model approach is based on expected influent from mining and other operations and does not take into account non-average conditions such as flood flows. Typical catchment runoff is assumed to be encapsulated by assumed median flow and ‘dry’ flow at NSW Office of Water Station No. 212054.

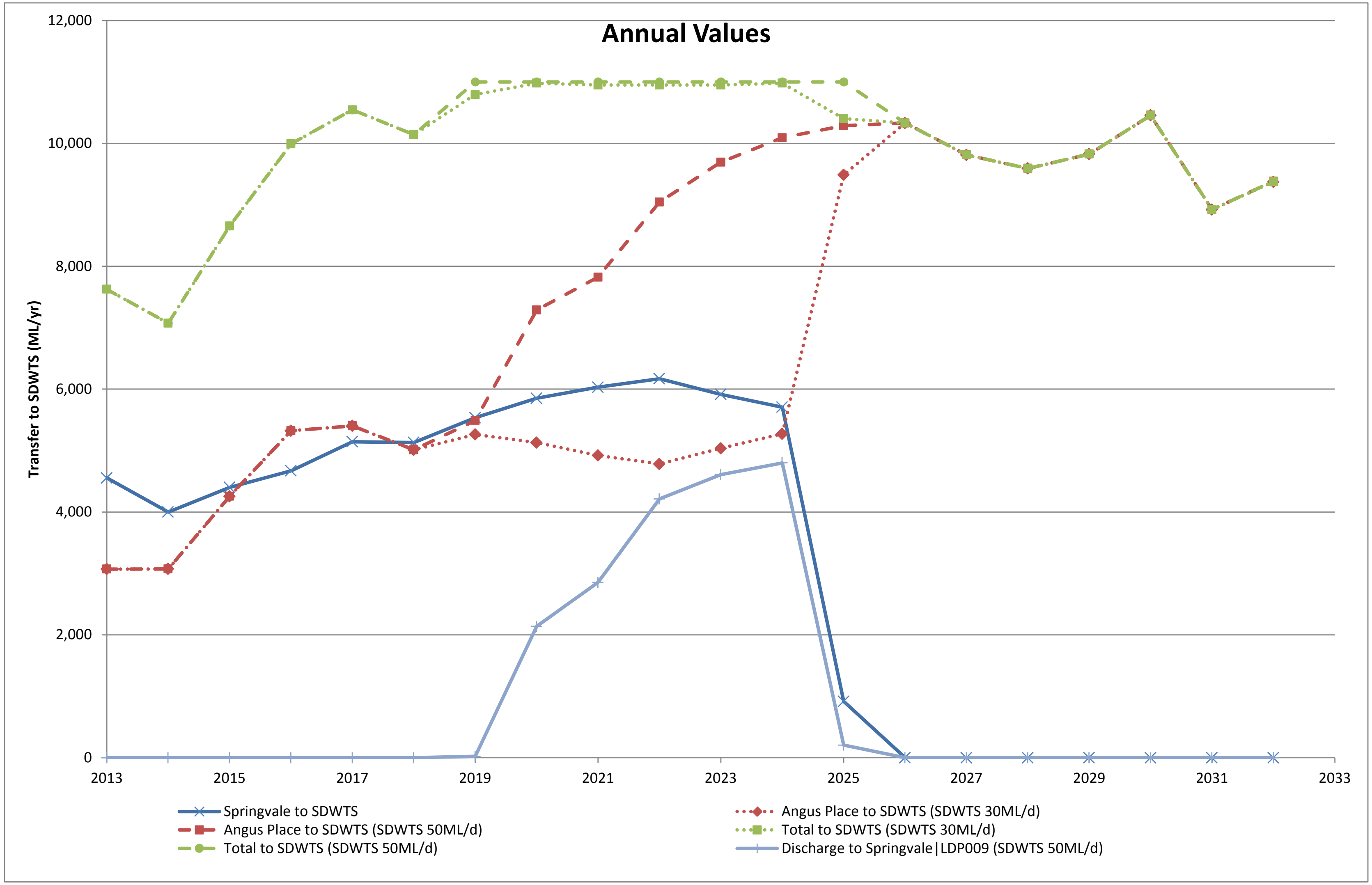


Figure 24: Water Balance Model – Predicted Transfer to SDWTS

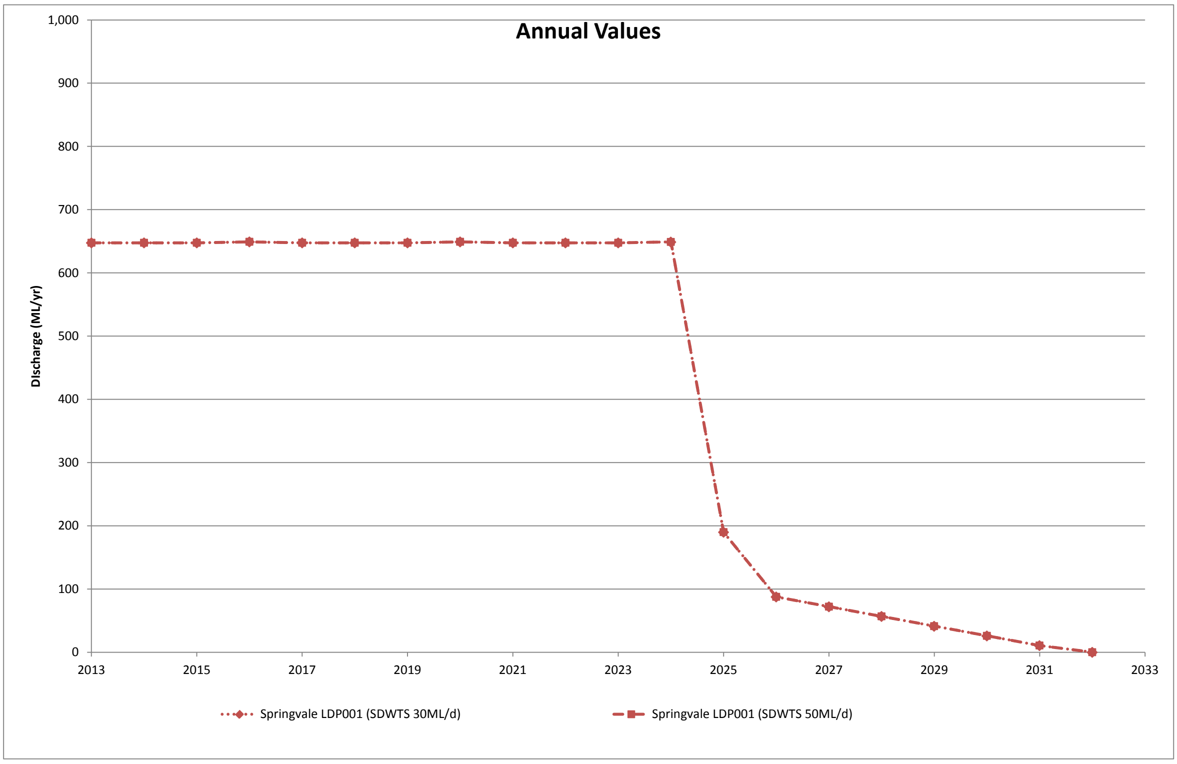


Figure 25: Water Balance Model – Predicted Discharge at LDP001

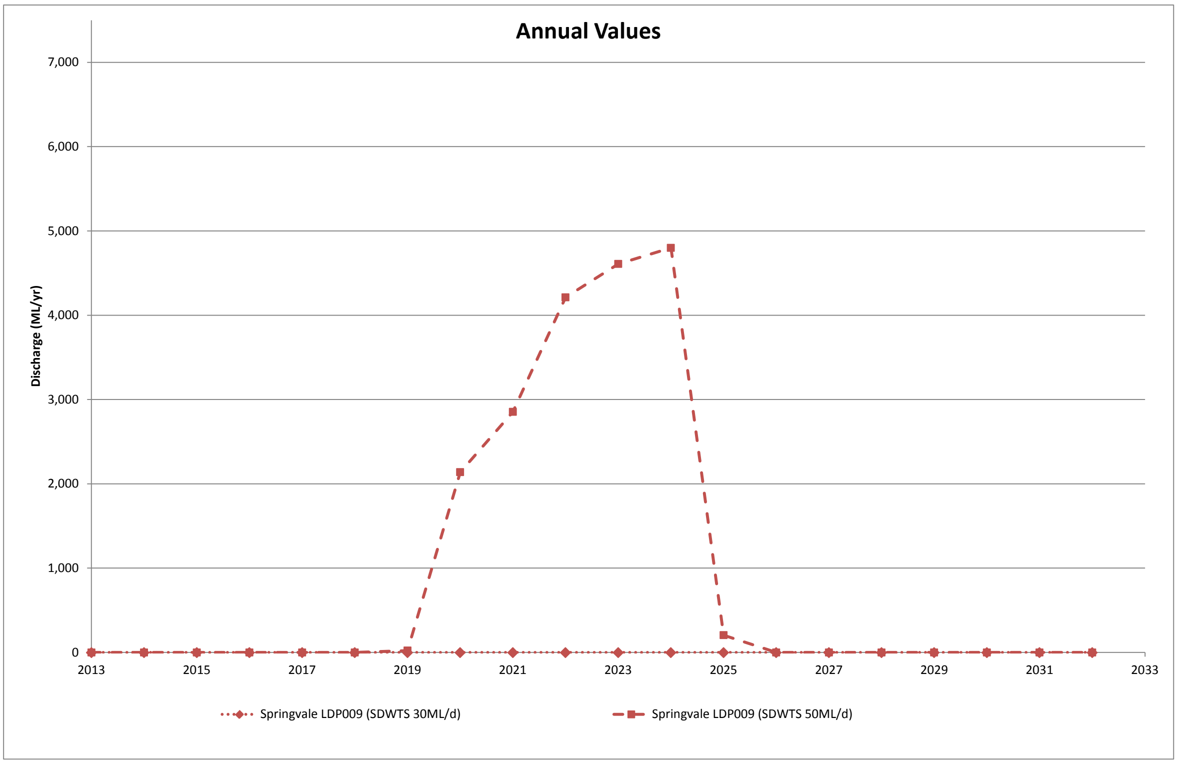


Figure 26: Water Balance Model – Predicted Discharge at LDP009

Time-series flow hydrographs presented in Section 5.1 for Springvale Mine were extracted to use as the basis of time-series salt mass balance modelling. In addition, the surface water assessment that has been prepared for the extension of the Angus Place Colliery was reviewed to obtain the predicted outflow from LDPs at Angus Place. Other hydrographs were obtained from the regional water balance model (Appendix E) or assumed. It is noted that the contribution to the Coxs River from Pipers Flat Creek was assumed to 4.9ML/d (median) and 1.1ML/d during drought conditions.

For the purpose of modelling, calculations were undertaken for the Coxs River at a point immediately upstream of Lake Wallace, corresponding to the NSW Office of Water Monitoring Station No. 212054 and Springvale Monitoring Station No. Coxs River U/S.

Table 5.3 presents the assumed water quality from each potential source.

It is noted that pH of influent to the Coxs River lie within the range 6.3 – 8.3 and is consistent with median pH at the monitoring station Coxs River U/S and therefore was not modelled.

Table 5.3: Salt Mass Balance Model – Assumed Source Concentrations

Potential Source	Median EC(µS/cm)	Median pH
Angus Place|LDP001	1,010µS/cm	7.9
Angus Place|LDP002	315µS/cm	7.8
Angus Place|Coxs River U/S	110µS/cm	6.7
Angus Place|Kangaroo Creek U/S	65µS/cm	6.3
Wangcol Creek	~900µS/cm	6.5 to 7.0
Pipers Flat Creek D/S[a]	530µS/cm	N/A
Springvale|LDP001	900µS/cm	8.3
Springvale|LDP009	1,055µS/cm	7.9

a. from RPS, 2012.

Table 5.4 presents the current water quality at Springvale Monitoring Station No. Coxs River U/S.

Table 5.4: Salt Mass Balance Model – Existing Conditions

Potential Source	Median EC(µS/cm)	Median pH
Coxs River U/S	600µS/cm	7.8
NSW Office of Water No. 212054	600µS/cm	N/A

5.2.2 Model Results

A salt balance model was prepared based on expected influent and salinity as EC through simple dilution.

Figure 27 presents the predicted average salinity in the Coxs River at a point immediately upstream of Lake Wallace. Two flow conditions are considered in the salt mass balance model, median flow in the Coxs River is 12.2ML/d and a 'dry' condition flow of 2.9ML/d.

The salt mass balance model was then amended to ascertain the contribution of Springvale Mine to salinity in the Coxs River, in isolation of other activity in the catchment. Figure 28 presents the contribution of Springvale, on its own, to salinity in the Coxs River. It is noted that the large component of Springvale's predicted contribution in the circumstance that SDWTS is upgraded, is due to Angus Place Colliery's increased transmission to the SDWTS, with flow in excess of Wallerawang Power Station's demand being discharged via Springvale|LDP009.

From Figure 27, peak average salinity in the Coxs River occurs in 2024 and is 965µS/cm associated with drought conditions and SDWTS upgraded to 50ML/d and is 814µS/cm under 'normal' conditions.

From Figure 28, the contribution of Springvale Mine to the increase in salinity ranges between 0 µS/cm and 302µS/cm. For the purpose of this analysis, it is assumed that inflow from Angus Place

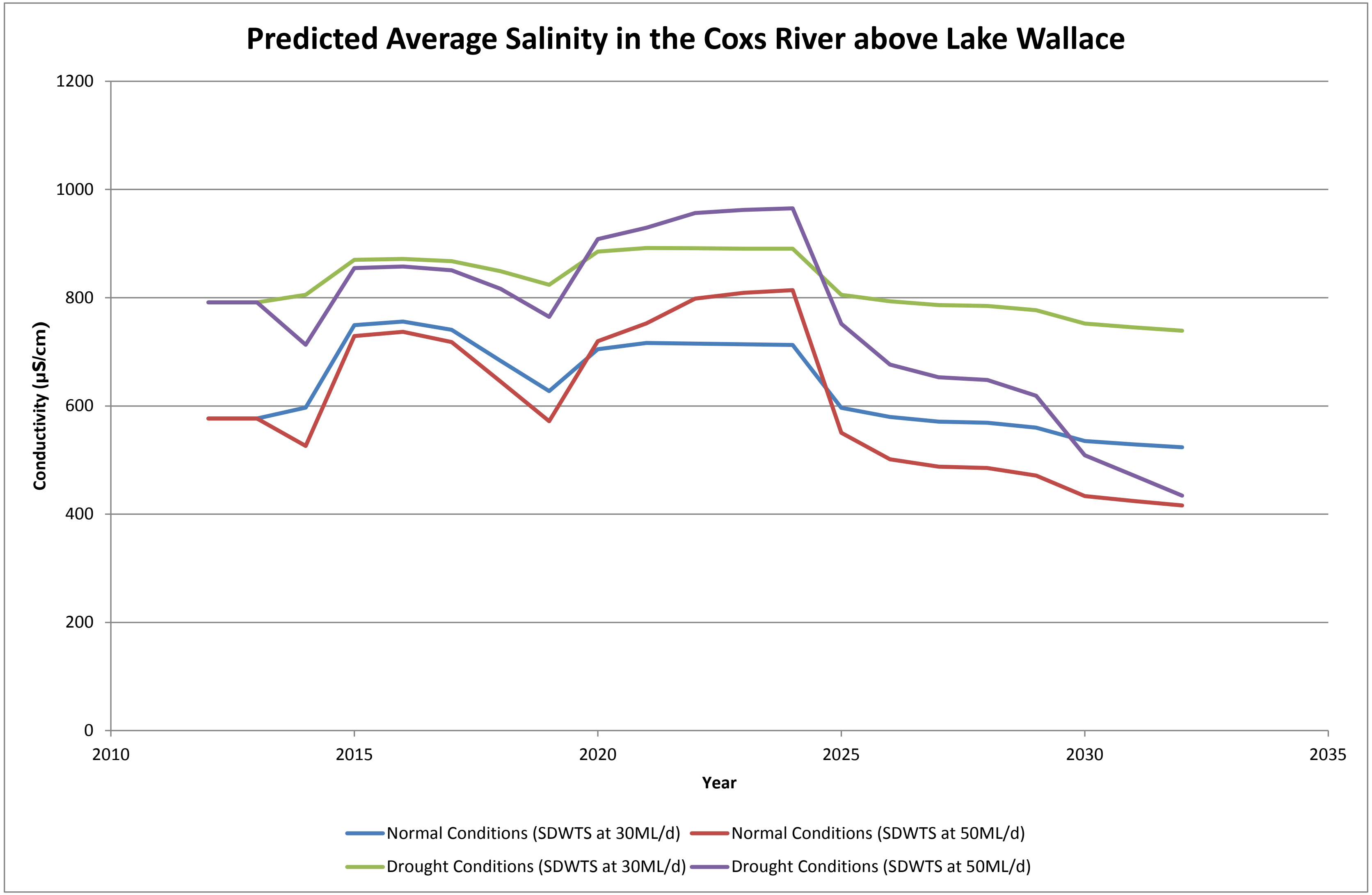


Figure 27: Predicted Cumulative Change in Salinity at NSW Office of Water Station 212054

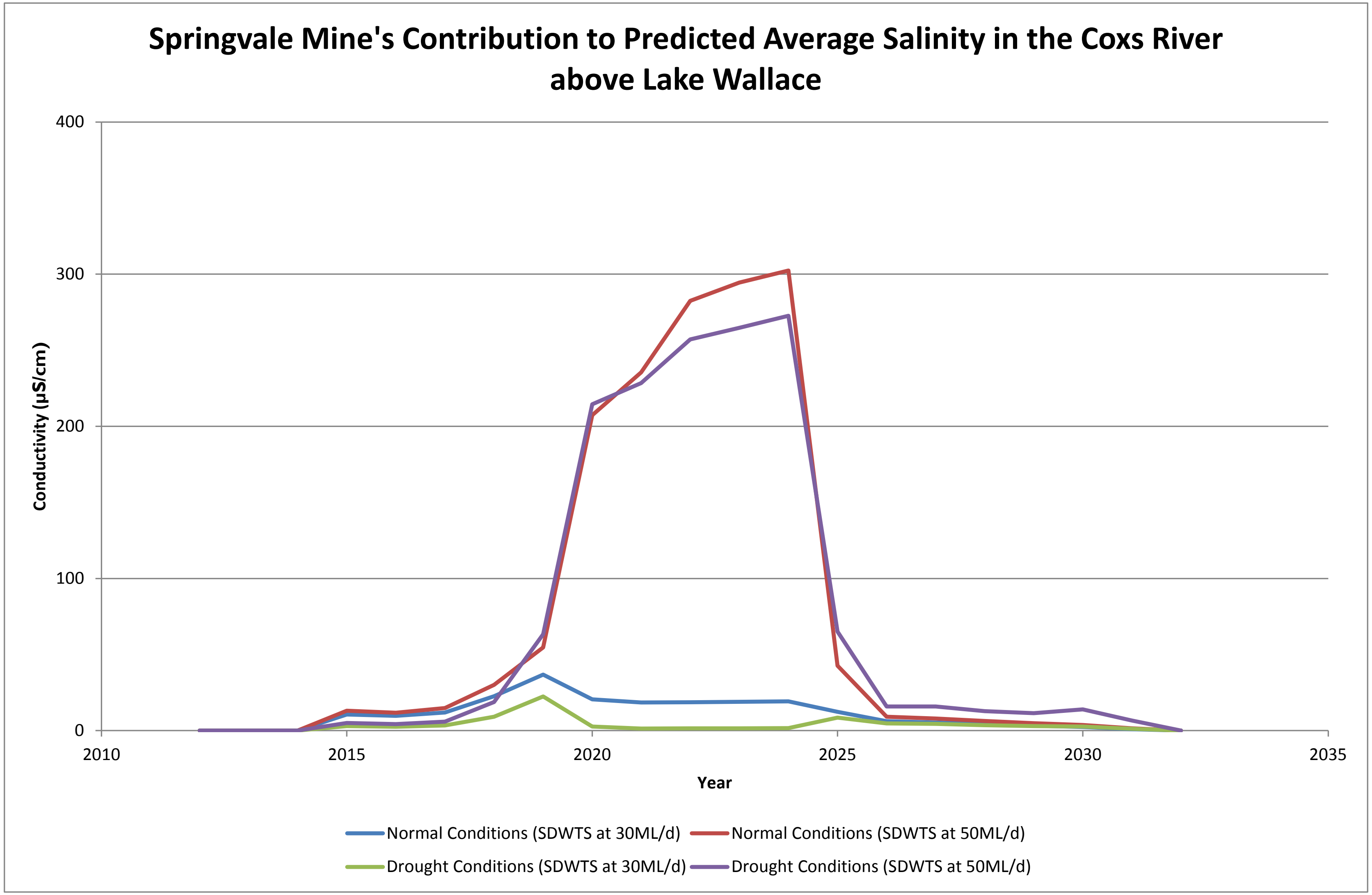


Figure 28: Springvale's Contribution to Predicted Change in Salinity at NSW Office of Water Monitoring Station 212054

to Springvale Mine's SDWTS will become the responsibility of Springvale Mine. The majority of modelled contribution from Springvale in the 50ML/d upgrade case is from discharge of excess through Springvale|LDP009.

An assumption in this analysis is also that transfer from SDWTS will take precedence over other water sources to meet 30ML/d demand at Wallerawang Power Station. Currently, there is ~8.8ML/d sourced from the Fish River Water Source. Further detail on water sources for the Wallerawang Power Station is presented in Appendix E.

Table 5.5 summaries the outcome of salt mass balance modelling.

Table 5.5: Salt Mass Balance Model – Predicted Average Salinity (µS/cm) in the Coxs River above Lake Wallace

Year	SDWTS at 30ML/d				SDWTS at 50ML/d			
	Normal Conditions		Drought Conditions		Normal Conditions		Drought Conditions	
	Cumulative	Springvale[1]	Cumulative	Springvale[1]	Cumulative	Springvale[1]	Cumulative	Springvale[1]
2012	577	0	791	0	577	0	791	0
2013	577	0	791	0	577	0	791	0
2014	597	0	805	0	526	0	713	0
2015	749	11	870	3	729	13	855	5
2016	756	10	872	3	737	12	858	4
2017	741	12	868	3	718	15	851	6
2018	683	23	849	9	645	30	816	19
2019	628	37	824	22	572	55	764	63
2020	705	21	885	3	720	207	908	215
2021	716	18	892	1	753	235	929	228
2022	715	19	891	1	798	283	956	257
2023	714	19	891	2	809	294	962	265
2024	713	19	890	2	814	302	965	273
2025	596	12	805	9	550	43	752	65
2026	580	6	793	5	501	9	677	16
2027	571	5	786	4	488	8	653	16
2028	569	4	785	4	485	6	648	13
2029	560	3	777	3	471	5	619	12
2030	535	2	752	3	434	4	509	14
2031	529	1	745	1	424	2	472	7
2032	524	0	739	0	416	0	434	0

1. Springvale Mine's contribution to predicted average salinity in the Coxs River.

5.3 SUBSIDENCE ANALYSIS

5.3.1 Analysis

Subsidence analysis has been undertaken by MSEC (MSEC, 2013) to determine:

- total predicted subsidence
- predicted change in streambed profile
- predicted tensile and compressive strain

The model was calibrated based on site observation and an extensive library of mining-induced subsidence in the NSW Coalfields.

Further detail on model approach is presented in MSEC (2013).

5.3.2 Predictions – Rivers and Creeks

Coxs River Catchment

Coxs River

The Coxs River flows in a south-easterly direction toward the Lake Wallace Reservoir.

Subsidence analysis presented by MSEC (2013) indicates that there is a <20mm predicted total subsidence beyond 50m from any longwall panel. Figure 29 presents the predicted total subsidence contours for Springvale Mine.

From the results presented in Figure 29, there is no predicted change in gradient in the Coxs River and therefore it can be concluded that there is minimal impact on the Coxs River due to mining-induced subsidence.

Marrangaroo Creek

The potential impact to Marrangaroo Creek is presented in Section 5.3.3 in regard to the predicted impact to Marrangaroo Creek Swamp.

Pipers Flat Creek, Springvale Creek and Sawyers Swamp/Ash Dam

Subsidence analysis indicates these water courses would be subject to a <20mm predicted total subsidence and therefore predicted impact due to subsidence is considered negligible.

Wolgan River Catchment

Wolgan River

The Wolgan River flows in a northerly direction toward the Wolgan Valley. As outlined in Section 3.4.2, flow monitoring (Station No. Wolgan River D/S) indicates that the Wolgan River is perennial, being recharged from local perched groundwater system during extended dry periods. The streambed of the Wolgan River comprises fine-grained sediment from weathering of the Burralow Formation and elsewhere outcropping of sandstone bedrock.

Subsidence analysis indicates that the Wolgan River, in the immediate vicinity of the proposed longwalls, is predicted to experience a total subsidence of 40mm due to both existing mining and proposed extension. The predicted subsidence due to extraction of existing panels only (LW401 to LW415) is 40mm. The Extraction Area is defined as the area above the proposed longwalls, at ground surface, beyond which predicted subsidence is no predicted subsidence.

The natural gradient within the Wolgan River in the immediate vicinity of proposed longwalls ranges between 2.5% and 20% and is, on average, 7.5%. The predicted total subsidence of 40mm is insignificant compared to the natural gradient of 7.5% and therefore no expected change in longitudinal streambed profile. Accordingly, there is no expected change in ponding, inducement of scour and / or change to flooding characteristics.

Subsidence analysis predicts additional compressive strain due to valley closure movement along the Wolgan River is 0.5 to 1.0mm/m. MSEC (2013) state that fracturing of sandstone is rarely observed where compressive strains are less than 2mm/m and coincide with limited likelihood of significant fracturing.

Carne Creek

Carne Creek is the main tributary of the Wolgan River in its upper section. There are also several other adjacent unnamed tributaries that, combined, constitute the Eastern Branch of the Wolgan River. Subsidence analysis predictions have been undertaken for Carne Creek as well as NPSS and NPHS that reside within the Eastern Branch of the Wolgan River. The results of subsidence analysis for Carne Creek is presented here since Carne Creek continues upstream of Sunnyside East Swamp. Further discussion of the impact on Sunnyside East Swamp is presented in

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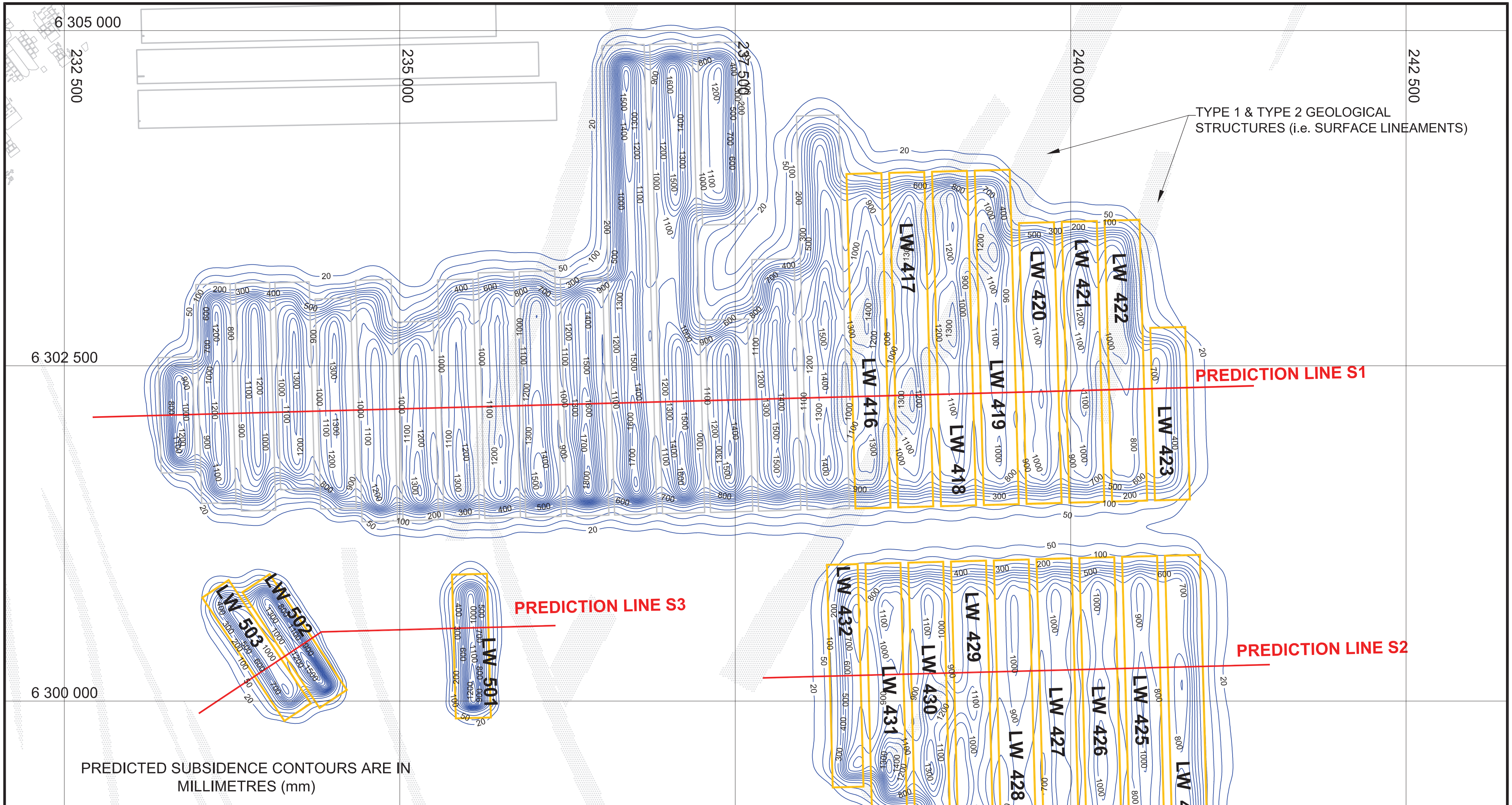
Figure 29



PREDICTED SUBSIDENCE CONTOURS ARE IN MILLIMETRES (mm)

msec mine subsidence ENGINEERING CONSULTANTS

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SPRINGVALE COLLIERY

PREDICTED TOTAL SUBSIDENCE CONTOURS DUE TO LW1 TO LW432 & LW501 TO LW503

DATE:	SCALE:	DRAWING No:	Rev No
18-Jan-2013	1:40000	MSEC594-11	02

Section 5.3.3. The results of subsidence analysis for Carne West Swamp and Gang Gang West Swamp and Gang Gang Swamp is presented in Section 5.3.3.

Carne Creek above Sunnyside East is ephemeral and rainfall dominated as indicated by water level monitoring of shallow piezometers installed into the swamp matrix (RPS, 2013b). Analysis indicates that total subsidence will vary between 1000 and 1400mm, dependent on whether the creek section is located above a longwall, a chain pillar or partially thereof. Review of the streambed profile indicates natural longitudinal gradient along Carne Creek is ~4% above Sunnyside East Swamp. Predicted streambed profile following mining, presented in Section 5.3.3, however, indicates there is no significant reduction in grade or reversal in grade (MSEC, 2013). Accordingly, there is no expected adverse change to ponding or scour within Carne Creek.

Fracturing of uppermost bedrock is associated with predicted tensile strains greater than 0.5mm/m or where compressive strains are greater than 2mm/m. Analysis indicates that compressive strain along Carne Creek will be 5 to 15mm/m due to valley related movement. MSEC (2013) state that where streambed comprise natural surface soils, it is possible that potential fracturing in bedrock would not be seen at surface and in the event of fracturing, fractures are likely to be infilled during subsequent flow events. Where bedrock is exposed, which is an isolated occurrence in Carne Creek, fractures may lead to localised diversion into dilated strata, to reappear further downstream. Depth of fracturing, if it occurs, is expected to be less than 10 to 15m. Routine inspection of surface water courses is therefore recommended and post-mining significant surface cracks that are found to have not been infilled naturally can be remediated, if required.

Colo River Catchment

Bungleboori Creek

The potential impact to Bungleboori Creek due to subsidence is presented in Section 4.3.3 in regard to Pine Swamp and Paddys Creek Swamp.

5.3.3 Predictions – Newnes Plateau Swamps

Coxs River Catchment

Marrangaroo Creek Swamp

Marrangaroo Creek is a tributary of the Coxs River and flows in a westerly direction, joining the Coxs River below the Lake Wallace reservoir.

The Marrangaroo Creek Swamp is located on Marrangaroo Creek and is a NPSS with NPHSS on valley sides.

The upstream elevation of the Marrangaroo Creek Swamp is 1120mAHD and is 1030mAHD at its downstream end and has a natural gradient of ~4%. Subsidence analysis predictions have been extracted along the streambed of Marrangaroo Creek and is presented in Figure 30.

From Figure 30, there is no significant reduction in streambed gradient and there is no reversal of streambed gradient. As such, there is no predicted impact on ponding or scour due to subsidence.

Marrangaroo Creek Swamp lies overlies the proposed longwalls and therefore subsidence analysis predicts there is potential for fracturing of the uppermost bedrock beneath this swamp. MSEC (2013) indicates that the depth of fracturing will be less than 10 to 15m, in general. It is anticipated that for NPSS, given the composition of their bases being soil and peat that any fractures are likely to be filled by sediment. For NPHS, the expected extent of fracturing is less due to their location on valley sides (MSEC, 2013). Again, due to the composition of their bases, any fracturing is likely to be infilled by sediment.

Experience at Springvale Mine and the adjacent project at Angus Place Colliery of previous undermining of swamps has not identified adverse subsidence-related impacts. Further detail is presented in the Groundwater Assessment (RPS, 2013b). It is noted that the longwall panel width of proposed panels is narrower compared to those previously extracted at Springvale Mine.

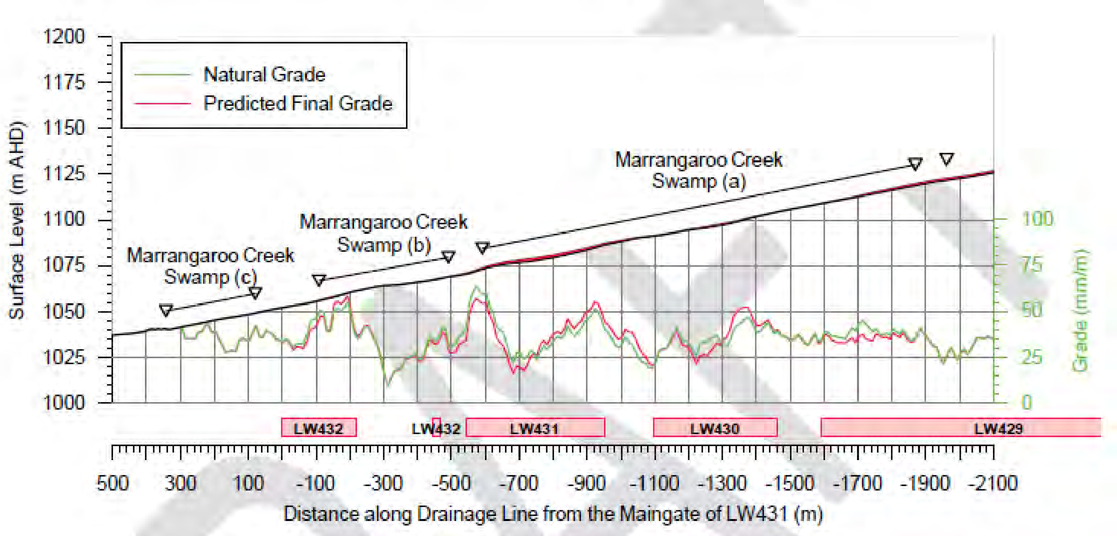

Figure 30: Natural and Predicted Post-Mining Streambed Profiles – Marrangaroo Creek

Potential mitigation measures in the event that there is minor surface cracking is presented in Section 7.2.1.

A detailed monitoring network is already in place and comprises water level monitoring of piezometers installed in swamps (RPS, 2013b), water quality sampling as well as flow gauging at selected locations. The surface water monitoring network is presented in Section 3.5.2.

Wolgan River Catchment

There are four THPSS within the Wolgan River catchment that are potential directly impacted by subsidence due to mining activity beneath them at depth. These include:

- Sunnyside East Swamp (located along Carne Creek)
- Carne West Swamp
- Gang Gang West Swamp
- Gang Gang Swamp.

Figure 31 to Figure 34 present the predicted change in streambed profile due to mine subsidence.

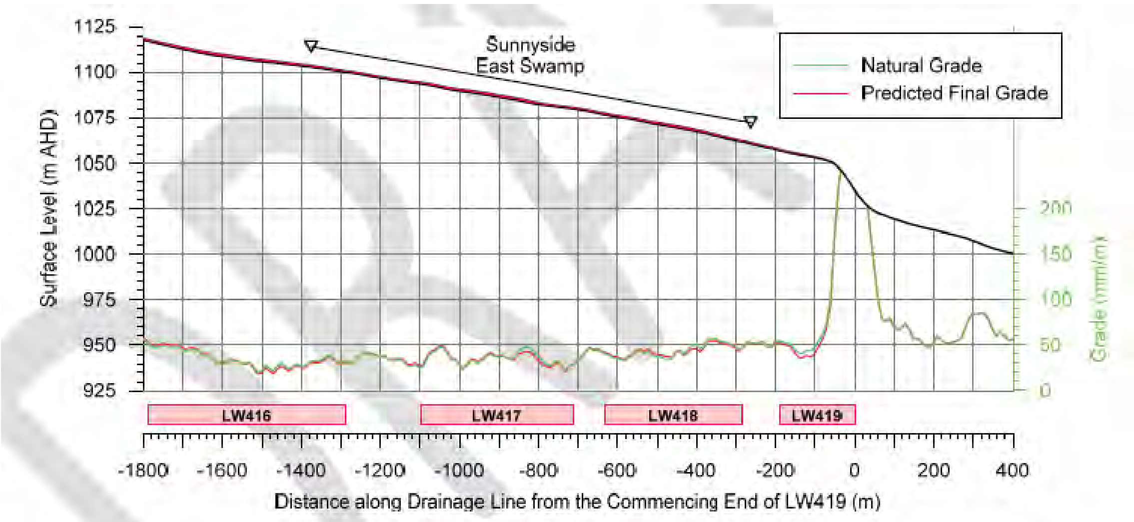

Figure 31: Natural and Predicted Post-Mining Streambed Profiles – Sunnyside East Swamp

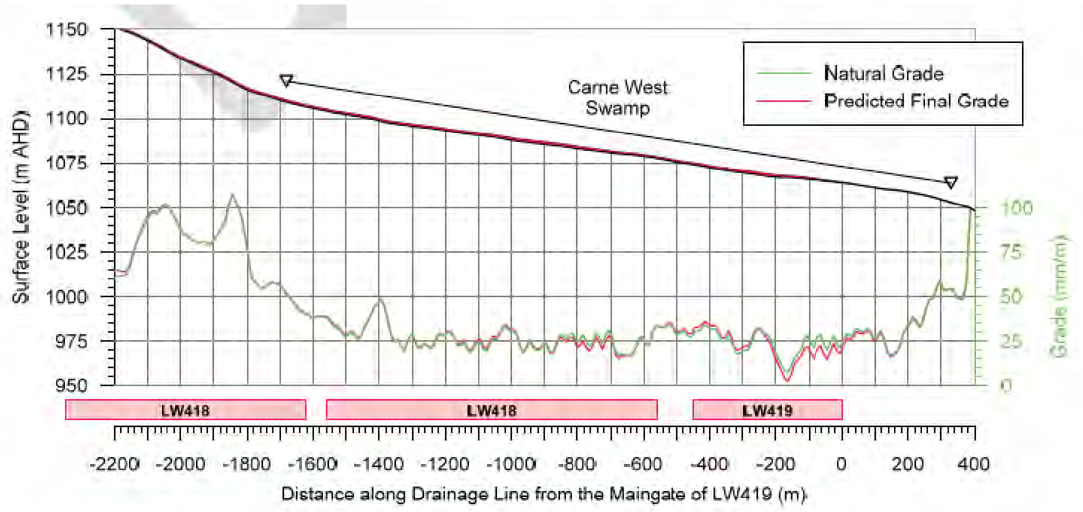

Figure 32: Natural and Predicted Post-Mining Streambed Profiles – Carne West Swamp

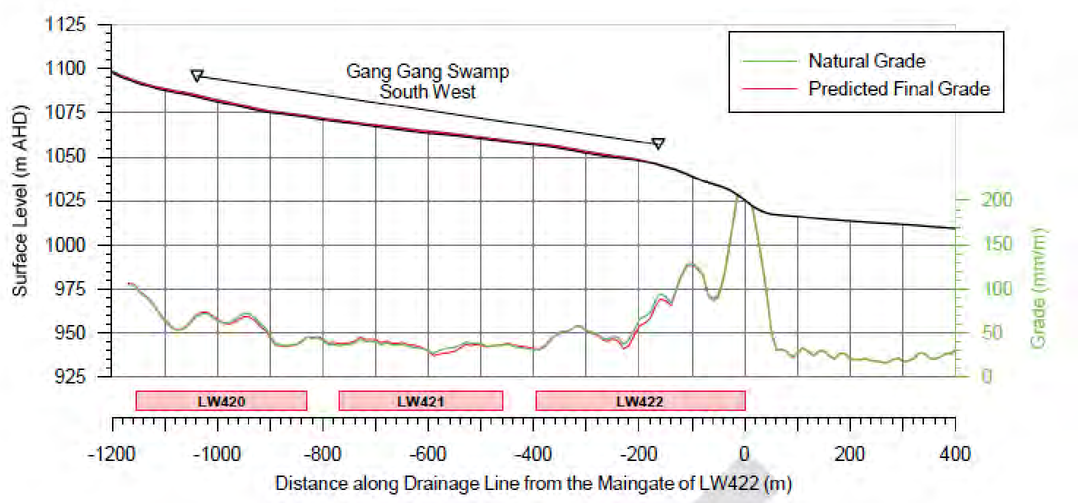

Figure 33: Natural and Predicted Post-Mining Streambed Profiles – Gang Gang West Swamp

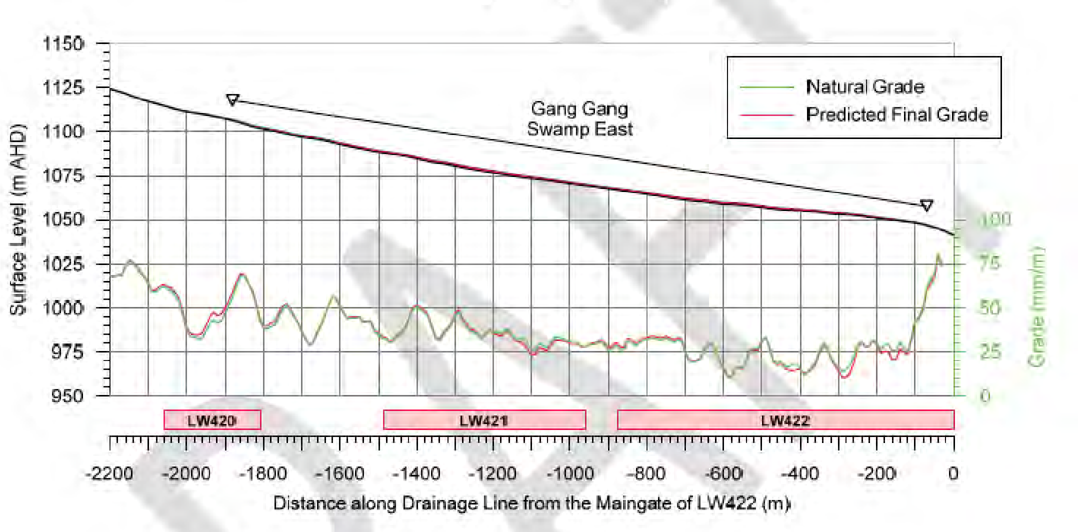

Figure 34: Natural and Predicted Post-Mining Streambed Profiles – Gang Gang Swamp

From Figures 31 to 34, there is limited change to streambed gradient and there is no reversal of gradient or sharp change either increase or decrease. As such, subsidence analysis indicates there is limited potential impact on ponding and / or scour expected due to mining. Overall subsidence at ground surface is of the order 1,000 to 1,500mm however this does not lead to adverse differential settlement.

As presented above, fracturing is predicted in the uppermost bedrock within these swamps, however, the potential impact is considered to be small due to minor cracking being readily in-filled by sediment. Infilling can be expected because of the composition of the bases of the swamps.

Colo River Catchment

Bungleboori Creek

There are three THPSS associated with Bungleboori Creek and Paddys Creek catchments:

- Pine Swamp
- Nine Mile Swamp
- Paddys Creek Swamp.

Subsidence analysis predictions indicate there is limited change to streambed profile due to mining-induced subsidence. Figure 35 presents the natural streambed profile and modelled post-mining gradient at Pine Swamp. Figure 36 presents the predicted change at Paddys Creek Swamp.

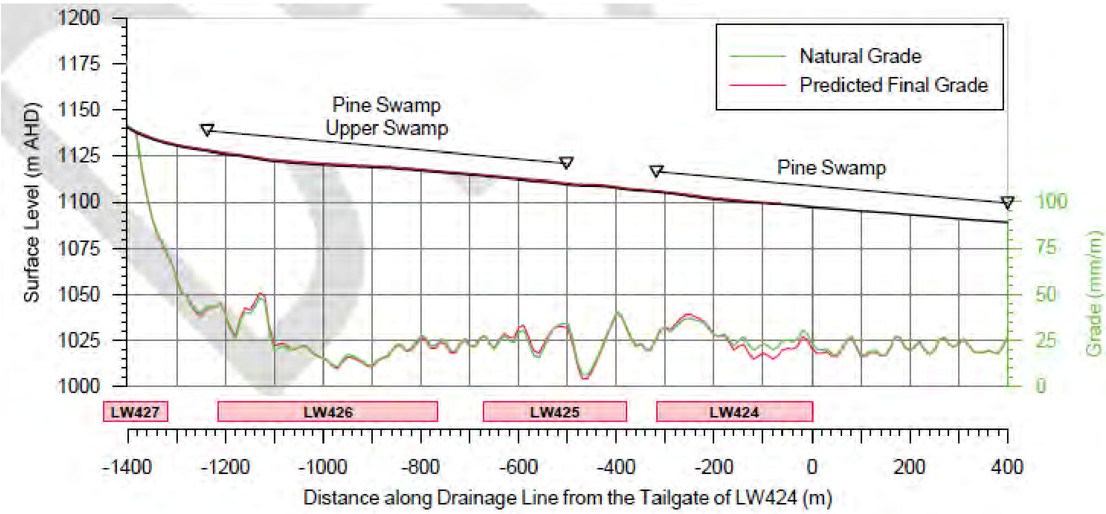

Figure 35: Natural and Predicted Post-Mining Streambed Profiles – Pine Swamp

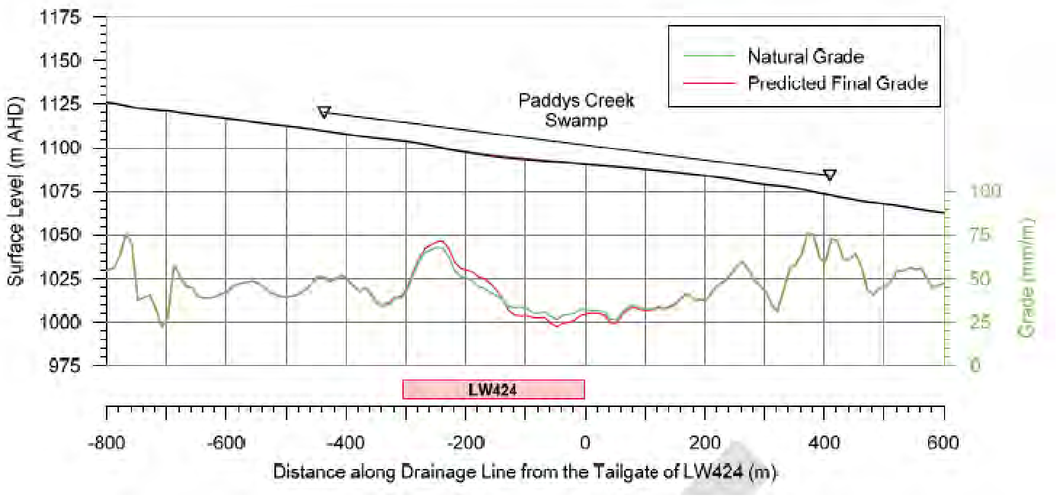

Figure 36: Natural and Predicted Post-Mining Streambed Profiles – Paddys Creek Swamp

From Figure 35 and Figure 36, there is no significant change in streambed gradient and there is no reversal in gradient. Accordingly the potential for mining-induced subsidence leading to additional ponding or scour is small.

As presented above, fracturing is predicted in the uppermost bedrock due to tensile and compressional change, however, the potential impact is considered to be small.

Further detail on the potential mitigation measures that can be applied to these catchments is presented in Section 7.2.1, together with an overview of proposed monitoring plan.

6. IMPACT ASSESSMENT

6.1 IMPACT TO SITE MANAGEMENT AND DISCHARGE VOLUMES

6.1.1 Site Management

There is no proposed change to surface water management infrastructure at Springvale Pit Top. As presented in Section 4.4, there is sufficient capacity in current sediment control structures to accommodate existing throughflows. Water balance modelling presented in Section 5.1.3 indicate there is no proposed increase in discharge at LDP001 and therefore no proposed change to management infrastructure is required.

The current monitoring program at LDPs will be continued as per EPL 3607. Further detail is presented in Section 7.2.1.

The water management strategy at Springvale comprises an option to duplicate the existing SDWTS pipeline up-gradient of Springvale|LDP009 when the combined mine inflow at Springvale and Angus Place exceeds 30ML/d. The proposed route of the new pipeline will be along the alignment of the current pipeline. The layout of the current pipeline is presented in Section 4.1. Detail of the impact of the pipeline on terrestrial ecology and other factors is presented in the main EIS.

Extension of the Springvale Mine also includes the construction of one new ventilation downcast shaft and two new dewatering boreholes with associated surface infrastructure. The construction of the surface infrastructure will require a final cleared area, access tracks, construction of drilling pads, installation of erosion and sediment controls and trenching for utilities. Detail of potential impact due to the construction of the ventilation shafts and dewatering boreholes is presented in the Groundwater Assessment (RPS, 2013b).

6.1.2 Discharge Volumes

Extension of operations at Springvale Mine will result in increased dewatering requirements and increased inflow to underground workings that will be required to be managed. The increase in mine water make will be managed through transfer to the SDWTS to the extent of current capacity and at a later project stage, the SDWTS will be upgraded from its current capacity of 30ML/d to 50ML/d, when the combined mine inflow from Springvale Mine and Angus Place Colliery exceeds 30ML/d. The upgrade will be required to accommodate increased inflows to Springvale Mine's SDWTS from the adjacent project at Angus Place Colliery.

A regional water balance has been prepared (Appendix E) which includes all water users and water sources within the Cox's River catchment. Modelling indicates that current demand at Wallerawang Power Station is 11,000ML/y (30ML/d), of which 7,630ML/y (20.9ML/d) is met by the SDWTS and the remainder obtained from the Fish River Water Supply Scheme or extracted from the Coxs River. In addition, overflow from Lake Wallace is captured by Lake Lyell which is the water supply reservoir for the Mt Piper Power Station via intermediate transfer to Thompson's Creek Dam. The current modelled demand from Mt Piper Power Station is 14,200ML/y (38.9ML/d) and comprises 12,600ML/y (34.5ML/d) from the Coxs River and 1,600ML/y (4.4ML/d) from the Fish River.

Accordingly, the consequence of increased discharge to the Coxs River is not significant since there is excess demand for this water resource in this catchment. For reference, monitoring indicates that the median flow (50th percentile) in the Coxs River immediately upstream of the Lake Wallace reservoir is 12.2ML/d (Station No. NSW Office of Water 212054) and therefore the direct transfer of groundwater to Wallerawang Power Station via the SDWTS meets a significant proportion of the everyday requirements of the power station.

As part of this development consent, the discharge limit at Springvale|LDP009 is required to be increased from the current value of 30ML/d to 50ML/d to cover the circumstance that the SDWTS is unavailable and all transfer from the SDWTS will be directed to Lake Wallace via Sawyers

Swamp Creek/Coxs River. This discharge limit encompasses the cumulative impact of both the extension at Springvale Mine and extension of the adjacent project at Angus Place Colliery.

Analysis presented in Section 5.1 indicates other projects in the Coxs River catchment, namely Neubecks Open Cut Coal Mine and Pine Dale Coal Mine will contribute 5.5ML/d at peak in 2015/16 and 9.5ML/d in 2015/16 respectively. These peak contributions occur well before peak contribution from Springvale Mine, and also the adjacent Angus Place Mine Extension Project, and therefore do not adversely impact the proposed water management strategy.

6.2 IMPACT ON WATER QUALITY AND SALINITY

Current water quality in the Coxs River upstream of Lake Wallace is generally fresh, with mean EC of 600µS/cm (range of 400µS/cm to 1,200µS/cm since records commenced in 1992; Station No. NSW Office of Water 212054). The Coxs River is a disturbed ecosystem and as such that ANZECC 2000 95th percentile water quality criteria for slightly to moderately disturbed ecosystems is not directly revelant. The primary use of water in the Coxs River catchment is for industrial purposes in the Wallerawang and Mt Piper Power Stations. The Coxs River, however, lies within the Sydney Drinking Water Catchment and as such current and proposed water quality is compared to the ADWG so as to address the requirement under the State Environmental Planning Policy (Sydney Drinking Water Catchment) that proposed conditions have a neutral or beneficial impact on water quality.

Analysis indicates that groundwater quality is fresh, being $Na\text{-}HCO_3$ type water, with EC of ~1,100µS/cm and pH of 7.8. Review of groundwater quality against the ADWG indicates it is essentially consistent, with the exception of salinity where the drinking water standard considers a TDS of 600mg/L (~895µS/cm) to be good quality drinking water and a TDS of between 600 and 900mg/L (~895µS/cm to 1,345µS/cm) to be fair quality drinking water. It is noted that the guidance values for salinity in the ADWG is an aesthetic-based value and is not a health-based value.

Salt mass balance modelling indicates that predicted peak in average salinity in the Coxs River above Lake Wallace, is 815µS/cm in ‘normal’ conditions and is 965µS/cm in drought conditions, assuming the SDWTS is upgraded to 50ML/d.

As such, the proposal has a neutral effect on water quality since the beneficial use of that water as potential drinking water is maintained.

Specifically the project meets the neutral or beneficial effect test:

“2. The development will not adversely affect water quality off-site because:

a. pollutant loads from the development / activity can be transported to acceptable downstream treatment facility and disposal facilities without adverse off-site water quality impacts; or

c. there are no indirect adverse impacts on water quality caused, or likely to be caused, by changes to factors that currently affect water quality off-site such as treatment, assimilation of pollutants, or the hydrological cycle (such as changes to flow or flow paths, water courses or riparian corridors).”

In the case of the Project, the downstream treatment and disposal facility being use of groundwater discharged to the Coxs River by heavy industry within Wallerawang Power Station and Mt Piper Power Stations; and consequential to the net excess demand for this water there are no indirect adverse impacts, outside of this local catchment, due to minimal discharge from the Coxs River via Lake Wallace and Lake Lyell.

The current water quality requirement at points of discharge of pH of 6.5 - 9.0, TSS of 30mg/L and Oil & Grease of 10mg/L should be maintained, with treatment being required should water quality be outside of these ranges.

6.3 IMPACT ON GEOMORPHOLOGY AND FLOODING

Extension of operations at Springvale Mine will lead to increased groundwater inflows to underground workings during mining. These increased inflows will be managed by transfer to the SDWTS to meet water demand at Wallerawang Power Station. The water management strategy at Springvale Mine comprises of continuation of transfer to the SDWTS as per current practice whilst utilising the full 30ML/d capacity of the pipeline or at a later project stage upgrading of the pipeline above Springvale|LDP009 to 50ML/d, with excess transfers diverted to Lake Wallace via Sawyers Swamp Creek / Coxs River.

Water balance modelling indicates that discharge to Springvale|LDP009 may increase to 13.1ML/d (0.15m^3/s) under the circumstance that the SDWTS pipeline is upgraded. In the circumstance that the SDWTS is unavailable, the total discharge to Springvale|LDP009 would be 43.8ML/d (0.51m^3/s). The expected increase in flow is, however, small compared to the 1 y ARI peak flood flow in Sawyers Swamp Creek of 8.97m^3/s, as presented in Table 3.11.

To consider the potential impact of discharge through LDP001 on Kangaroo Creek, the channel velocity was estimated using Manning's equation, based on an assumed trapezoidal type section. Table 6.1 presents a summary of pertinent input to that calculation.

Figure 37 presents the flow velocity on a standard Hjulstrom Diagram. In Figure 37, the range for grain size is: silt (0.002mm to 0.063mm); sand (0.063mm to 2mm); and gravel (>2mm).

Table 6.1: Estimated Channel Velocity (m/s) – Sawyers Swamp Creek

Parameter	1 y ARI Peak Flow	LDP009 at 43.8ML/D	LDP009 at 13.1ML/d
Bo, Bottom Width	1.5 m		
s, Side Slope	2		
So, Bed Slope	1.9% (940mAHD - 888mAHD / 2750m)		
Q, Discharge	8.97m^3/s	0.51m^3/s	0.15m^3/s
n, Manning's Roughness	0.050		
y_n, normal depth	1.14m	0.27m	0.14m
V_n, velocity at normal depth	2.1m/s	0.94m/s	0.61m/s

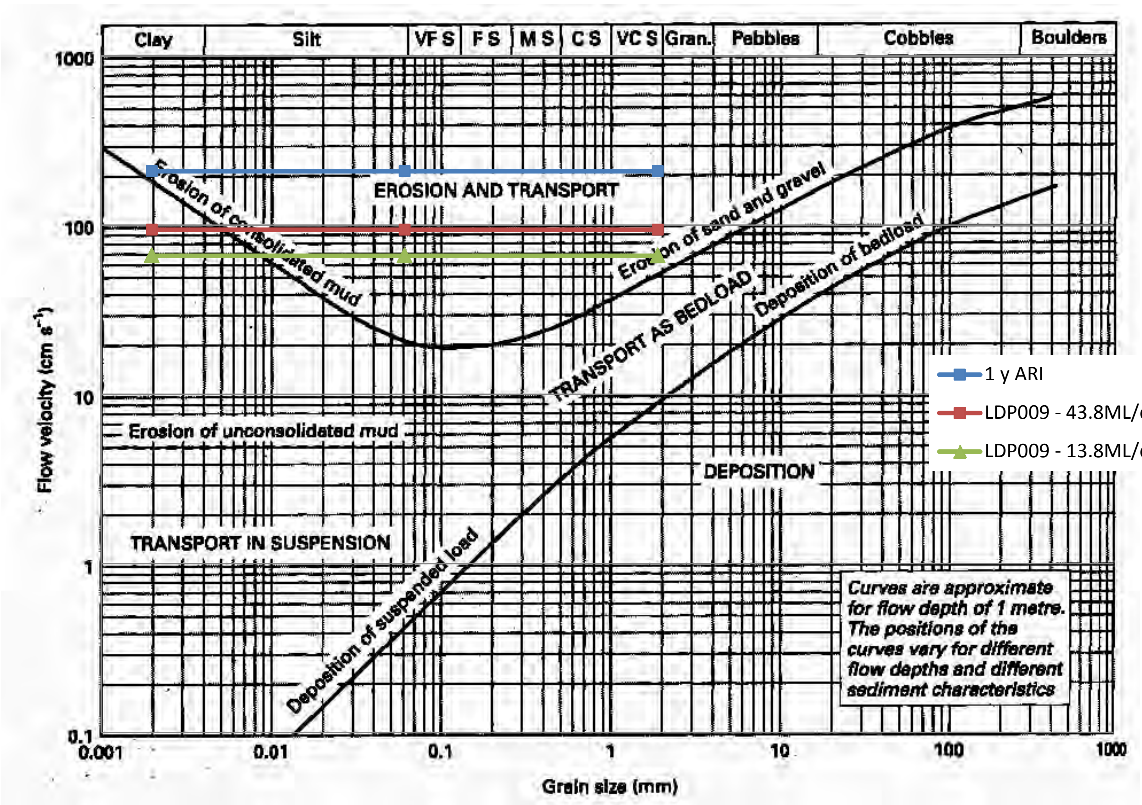

Figure 37: Hjulstrom Diagram – Discharge at LDP009 into Sawyers Swamp Creek

From Figure 37, comparison of estimated channel velocity under discharge conditions indicates erosion potential is low. It is noted that the Hjulstrom Diagram does not consider the impact of vegetation. As indicated in the 'Blue Book' (Landcom, 2004 and DECCW, 2008), whilst bare soil has critical velocity with respect to erosion of only 0.5m/s, when vegetated, the critical velocity increases to 1.8m/s.

Given that there is not a streambed erosion issue currently in Sawyers Swamp Creek, the potential impact of discharge through LDP009 on geomorphology is considered to be small since the average channel velocity (2.1m/s) experienced in a typical large rainfall event is much higher than proposed channel velocities of 0.94m/s and 0.61m/s respectively.

There are no hydraulic structures proposed to be installed in any waterway and therefore there is no expected change in hydraulic regime. As such the extension at Springvale Mine does not constitute a controlled activity under the Water Management Act as there are no works within 40m of a watercourse.

Flow within the Coxs River will be 'normal' depth until it discharges to Lake Wallace. Proposed discharge will not result in significant impact to flooding and drainage within the Coxs River since increased daily flow will remain in-bank, defined notionally to contain the 2 y ARI flood event.

6.4 IMPACT OF SUBSIDENCE

Detailed subsidence analysis has been undertaken and is presented in Section 5.3.

6.4.1 Rivers and Creeks

Modelling indicates there is negligible impact, <20mm, beyond 50m from any excavated longwall panel and accordingly there is no predicted impact on the Coxs River or the Lake Wallace reservoir.

Subsidence analysis indicates that total subsidence along the Wolgan River is <40mm and accordingly, there is negligible impact on streambed gradient. Modelling indicates that additional compressive strain due to valley closure along the Wolgan River is 0.5 to 1.0mm/m. MSEC (2013) indicate that compressive strain <2mm/m is rarely associated with fracturing of uppermost bedrock and therefore the potential impact on the Wolgan River due to fracturing is considered negligible.

Potential impact to Carne Creek is presented with respect to impact to Newnes Plateau Swamps.

6.4.2 Newnes Plateau Swamps

Coxs River Catchment

There is one THPSS within the Coxs River catchment will that will be undermined by the extension to Springvale Mine. This encompasses Marrangaroo Creek Swamp. Further detail is presented in MSEC (2013).

Subsidence analysis indicates that whilst there is a 1,000 to 1,400mm total subsidence, dependent on proximity to either centre of longwall or centre of chain pillar, there is no adverse differential settlement that leads to either reversal of streambed gradient or significant localised change in gradient.

Modelling predictions of valley closure above active longwall panels is more than tensile strain of 0.5mm/m and compressive strain of 2mm/m and accordingly there is potential for fracturing of uppermost bedrock. The predicted depth of fracturing is less than 10 to 15m and where streambed comprises fine-grained surface sediments, such as is the case with NPHS and NPSS, minor surface cracking will be naturally infilled by subsequent surface runoff.

Details of proposed monitoring and mitigation methods are presented in Section 7.2.1.

Wolgan River Catchment

There are THPSS within the Wolgan River catchment that will be directly undermined at depth by the extension to Springvale Mine. These include: Sunnyside East Swamp, Carne West Swamp, Gang Gang West Swamp and Gang Gang Swamp. Further detail is presented in MSEC (2013).

Modelling indicates there is no predicted reversal in streambed gradient that would lead to ponding and there is no localised adverse change in gradient that would lead to increased scour potential.

As presented above, modelling indicates there is potential for minor surface cracking of uppermost bedrock, however, is expected to not be seen due to the composition of the base of NPSS. It is noted that the impacts to NPHS is reduced since valley closure movements occur at base of valley whereas NPHS are situated on valley sides. Any minor surface cracking is expected to be in-filled naturally. Should surface cracking remain post-mining, there is potential to remediate as per method presented in Section 7.2.1, as required.

Colo River Catchment

There are three THPSS within the Bungleboori and Paddys Creek catchments, namely Pine Swamp, Nine Mile Swamp and Paddys Creek Swamp. Further detail is presented in MSEC (2013).

Subsidence analysis indicates there is no adverse differential settlement predicted along streambed of these swamps.

Again, modelling indicates there is potential for minor surface cracking of uppermost bedrock. The consequence of fracturing, however, is minor because bedrock is only exposed in isolated locations and due to the composition of the base of these NPSS, any surface cracking will be in-filled by natural processes and can be remediated post-mining, if required.

7. LICENSING, MONITORING AND MANAGEMENT

7.1 LEGISLATION AND LICENSING

7.1.1 Water Management Act 2000

The Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources administers water extraction from surface water. The project is located on the boundary of the Upper Nepean and Upstream Warragamba and the Hawkesbury and Lower Nepean Rivers Extraction management units with respect to that Water Sharing Plan.

Licensing Requirement

Surface Water

Extraction of surface water due to current activity and the extension to mining operation is required to be licensed.

At Springvale Mine there is currently no extraction of surface water from the Coxs River or any other waterway and this will also be the case when the mine is extended. Indirect extraction of surface water through reduction in baseflow contribution is discussed below.

Discharge to surface watercourses is administrated under EPLs and is presented below.

Groundwater

Variations to groundwater contribution to surface watercourses, including THPSS, require access to a surface water licence.

Detail as to licensing requirements due to groundwater impact are presented in the Groundwater Assessment (RPS, 2013b).

7.1.2 Protection of the Environment Operations Act 1997

Discharge to the environment is administered via EPLs. In the case of this project, there is an existing EPL (No. 3607) governing activities at Springvale Mine.

EPLs refer to administrative conditions, discharges to air and water and application to land, limits, operating conditions, monitoring and recording conditions as well as reporting requirements and current pollution studies and reduction programs.

Licensing Requirements

EPL3607

The extension of Springvale Mine will lead to increased groundwater inflows to underground workings during mining. As well, as identified in the cumulative impact assessment, there is increased predicted transfer to Springvale Mine's SDWTS from the adjacent project at Angus Place Colliery.

As outlined above, this water will be managed by transfer via the SDWTS to Wallerawang Power Station. At a later stage, the capacity of the SDWTS will also be upgraded from its current capacity of 30ML/d to 50ML/d, to accommodate increased inflows from the adjacent project at Angus Place Colliery, with excess water disposed of via Springvale|LDP009 to the Coxs River / Lake Wallace. Project Approval is being sought for both components of the water management strategy.

The current water demand at Wallerawang Power Station is 30ML/d. This is sourced either directly from SDWTS or extraction from the Coxs River / Lake Wallace. There is also currently some extraction from the Fish River Water Supply Scheme.

Modelling indicates that outflow from Springvale Mine is predicted to increase from 22.7ML/d (20.9ML/d to SDWTS and 1.8ML/d via LDP001) to 45.6ML/d (43.8ML/d to SDWTS and 1.8ML/d via LDP001) associated with extension of Springvale Mine and increased inflow from the adjacent project at Angus Place. Outflow in excess of the demand at Wallerawang Power Station (13.8ML/d being difference between 43.8ML/d and demand at Wallerawang Power Station of 30ML/d) will be disposed of via Springvale|LDP009. Modelling indicates that there is no predicted increase in outflow from Springvale|LDP001.

As outlined in Section 3.5.2, discharge to existing LDPs on the Newnes Plateau is deliberately minimised. This is intended to continue with extension to Springvale Mine.

Table 7.1 presents the current licence requirements for EPL3607 and the proposed new licence requirements. Pollutant concentrations presented in Table 7.1 are 100 percentile concentration limits.

Table 7.1: EPL3607 – Current and Future Licence Requirements

Analyte	Current Condition	Future Condition	Change Required
LDP001 (Discharge through Settling Ponds)			
Flow	10,000kL/d	10,000kL/d	-
Conductivity	N/A	N/A	-
Iron (dissolved)	N/A	N/A	-
Manganese (dissolved)	N/A	N/A	-
Oil and Grease	10mg/L	10mg/L	-
pH	6.5-9.0	6.5-9.0	-
Total Suspended Solids	30mg/L	30mg/L	-
LDP002 (Discharge of Treated Effluent via Spray Irrigation)			
Flow	N/A	N/A	-
LDP004 (Emergency discharge to Wolgan River on Newnes Plateau)			
Flow	15,000kL/d	15,000kL/d	-
Conductivity	N/A	N/A	-
Iron (dissolved)	N/A	N/A	-
Manganese (dissolved)	N/A	N/A	-
Oil and Grease	N/A	N/A	-
pH	N/A	N/A	-
Temperature	N/A	N/A	-
Total Suspended Solids	N/A	N/A	-
Turbidity	N/A	N/A	-
LDP005 (Emergency discharge to Carne Creek on Newnes Plateau)			
Flow	15,000kL/d	15,000kL/d	-
Conductivity	N/A	N/A	-
Iron (dissolved)	N/A	N/A	-
Manganese (dissolved)	N/A	N/A	-
Oil and Grease	N/A	N/A	-
pH	N/A	N/A	-
Temperature	N/A	N/A	-
Total Suspended Solids	N/A	N/A	-
Turbidity	N/A	N/A	-
LDP009 (SDWTS Bypass)			
Flow	30,000kL/d	50,000kL/d	increase to 50,000kL/d

Analyte	Current Condition	Future Condition	Change Required
Aluminium (dissolved)	0.45mg/L	0.45mg/L	-
Arsenic	0.024mg/L	0.024mg/L	-
Boron (dissolved)	0.37mg/L	0.37mg/L	-
Conductivity	1,200µS/cm	1,200µS/cm	-
Copper (dissolved)	0.007mg/L	0.007mg/L	-
Fluoride	1.8mg/L	1.8mg/L	-
Iron (dissolved)	0.4mg/L	0.4mg/L	-
Manganese (dissolved)	1.7mg/L	1.7mg/L	-
Nickel (dissolved)	0.047mg/L	0.047mg/L	-
Oil and Grease	10mg/L	10mg/L	-
pH	6.5-9.0	6.5-9.0	-
Total Suspended Solids	50mg/L	50mg/L	-
Turbidity	50NTU	50NTU	-
Zinc (dissolved)	0.05mg/L	0.05mg/L	-
LDP010 (Emergency Outflow from SDWTS)			
Flow	N/A	N/A	-
Aluminium (dissolved)	0.45mg/L	0.45mg/L	-
Arsenic	0.024mg/L	0.024mg/L	-
Boron (dissolved)	0.37mg/L	0.37mg/L	-
Conductivity	1,200µS/cm	1,200µS/cm	-
Copper (dissolved)	0.007mg/L	0.007mg/L	-
Fluoride	1.8mg/L	1.8mg/L	-
Iron (dissolved)	0.4mg/L	0.4mg/L	-
Manganese (dissolved)	1.7mg/L	1.7mg/L	-
Nickel (dissolved)	0.047mg/L	0.047mg/L	-
Oil and Grease	10mg/L	10mg/L	-
pH	6.5-9.0	6.5-9.0	-
Total Suspended Solids	50mg/L	50mg/L	-
Turbidity	50NTU	50NTU	-
Zinc (dissolved)	0.05mg/L	0.05mg/L	-

There are currently three (3) Pollution Reduction Programs (PRP) nominated on EPL3607, however these do not apply to Springvale Mine and refer to the Western Coal Services operation.

It is noted that, in general, the water management strategy at Springvale Mine does comprise continued discharge of groundwater to the Coxs River. As presented in Section 6.2, the outcome of the impact assessment, including cumulative impact, is that this strategy does not lead to a change in beneficial use of this watercourse and is consistent with water quality and river flow objectives, in general, and is also compliant with State Environmental Planning Policy (Sydney Drinking Water Catchment) requirement to demonstrate neutral or beneficial effect on water quality.

7.2 MONITORING AND MANAGEMENT

7.2.1 During Mining

Management

Subsidence Related Impacts

To date, the Project mine design has considered sensitive surface features such as swamps, cliff-lines, significant rock features, watercourses and sites of cultural significance on the Plateau. Through conservative mine planning, Springvale Mine has sought to avoid or reduce the potential impacts on these sensitive surface features.

Any surface cracking would tend to be naturally filled with soil over time, especially during times of heavy rainfall. If any surface cracks were found not to fill naturally, remedial measures can be undertaken following the completion of mining, as required. Where required, significant localised surface cracks can be remediated by infilling with soil or other suitable materials.

Management plans have been developed for the swamps on the Newnes Plateau which have been previously undermined at Springvale Mine should the circumstance arise where there has been adverse impact due to subsidence. Current rectification works on the Newnes Plateau refer to impact on East Wolgan Swamp due to surface discharge via LDP004 and LDP005 and are not related to typical subsidence impacts. As presented in the main EIS, anomalous subsidence at East Wolgan Swamp was the result of concurrence of geological lineament, critical panel width, orientation of panel and other contributing factors. These risks have been minimised in the new mine plan. As outlined above, operationally, the preference is to discharge to the Coxs River and discharge to the Newnes Plateau is a decision of last resort and only in emergency.

The following methods of remediation have been successfully applied to THPSS environments and comprise:

- Soft engineering solutions – such as coir logs, jute matting, geotextile, rock armouring and timber log water dissipaters
- Hard engineering solutions – such as the use of concrete and various grouting techniques.

Management plans developed by Springvale Mine under the current development consent in relation to Springvale Mine's EPBC Approval 2011/5949 prior to commencement of mining beneath the THPSS.

The current monitoring program with respect to visual inspection and survey where required will be continued.

The potential impact to baseflows from local perched groundwater system will be closely monitored. In the event there is identification of a change in hydrologic regime in any THPSS, the proposed response plan, outlined in Section 8.1.2, will be activated.

Discharge Volumes

Groundwater modelling predicts an increase in inflow to underground workings during extension of Springvale Mine. As detailed in Section 5.1, groundwater inflow is the dominant component of surface water management at Springvale. Inflows to underground will be monitored and should inflow exceed the expected range, with allowance for short-term variability, the contingency response plan outlined in Section 8.1.1 will be enacted.

In accordance with industry best-practice (Barnett et. al., 2012), after two years of mining, an audit of groundwater model predictions should be undertaken. Following this review, if necessary, the groundwater model should be re-calibrated and refined forward predictions be made and reported against in the Annual Review.

Should the updated model prediction be significantly different to that presented in the Project Approval then the NSW Office of Water and Department of Planning & Infrastructure, as appropriate, would be consulted to develop an appropriate response action.

Surface Water Management Infrastructure

Following development consent, the current clean and dirty water circuits should be reviewed during preparation of the updated Water Management Plan. This should include review of:

- current dust suppression activity
- management of local run-off from the Coal Stockpile Area and the Crusher and Screening Plant
- storage and use of chemicals and fuel at Springvale Pit Top.

Surface Water Quality

Salt mass balance modelling indicates the maximum predicted average salinity in the Coxs River, immediate upstream of Lake Wallace, is 965µS/cm, including consideration of potential cumulative impacts.

Groundwater quality will be monitored as well as discharge at LDPs. Should an adverse change in water quality condition be identified, outside of expected natural variability, the contingency plan outlined in Section 8.1.3 should be enabled.

Geomorphology

In the immediate vicinity of Springvale|LDP009, local scour protection works should be undertaken where these have not already been implemented. This should comprise shotcrete lining of the outlet channel from Springvale|LDP009 to Sawyers Swamp Creek and a gabion mattress/energy dissipation structure at the confluence with Sawyers Swamp Creek, as required.

Monitoring and Reporting

There is an extensive surface water monitoring network at Springvale Mine including the Coxs River and THPSS on the Newnes Plateau. The current network will be maintained, with only minor revision of the current analytical suite.

Following development consent, during preparation of the Water Management Plan at Springvale Mine, we will consult with the OEH, SCA and the NSW Office of Water as to additional requirements, if any.

The monitoring program should include:

- Surface water flow measurement
- Surface water quality sampling

Table 6.2 presents the proposed monitoring network including the analytical suite and frequency.

The water quality analytical suite should consist:

- Field Parameters (Field pH, Field Temperature, Field Conductivity (EC), Field DO)
- Physical Parameters (pH, Conductivity (as TDS), TSS, Turbidity, Oil and Grease)
- Major Ions (Na, Ca, Mg, K, Alkalinity, Cl, SO_4)
- Trace Ions (Al, As, B, Cd, Cr, Cu, Fe, F, Mn, Ni, Pb, Zn)
- Nutrients (NH_3, NO_3, Total N, Total P)

It is noted that Major Ions, Minor Ions and Nutrients should be analysed based on filtered samples, as applicable.

It is noted that there is a water level and water quality monitoring program of shrub swamps on the Newnes Plateau via a network of shallow piezometers installed into the swamp matrices. Detail of this monitoring program is provided in the Groundwater Assessment (RPS, 2013b).

In the circumstance that there is a duplication of proposed streamflow or water quality sampling at a NPSS presented in Table 7.2, deferral is made to the groundwater sampling program.

Following undermining, the frequency of water quality monitoring at NPSS will be reviewed.

Table 7.2: Proposed Surface Water Monitoring Network

Site Code	Frequency (Flow)	Frequency (Quality)	Quality Parameters
RIVERS AND CREEKS:			
COXS RIVER			
Coxs River U/S	Not Monitored	Weekly	Weekly: Field (pH, T, EC, DO) Monthly: Field (pH, T, EC, DO), Physical (pH, TDS, TSS, Turbidity, O&G), Major Ions, Trace Ions, Nutrients.
Springvale Creek D/S	Not Monitored	Weekly	Weekly: Field (pH, T, EC, DO) Fortnightly: Field (pH, T, EC, DO), Physical (pH, TDS, TSS, Turbidity, O&G), Major Ions, Trace Ions, Nutrients.
Coxs River D/S	Not Monitored	Weekly	Weekly: Field (pH, T, EC, DO) Monthly: Field (pH, T, EC, DO), Physical (pH, TDS, TSS, Turbidity, O&G), Major Ions, Trace Ions, Nutrients.
Kangaroo Creek Weir 1	Daily	Not Monitored	N/A
WOLGAN RIVER			
Wolgan River Upstream	Not Monitored	Weekly	Weekly: Field (pH, T, EC, DO) Monthly: Field (pH, T, EC, DO), Physical (pH, TDS, TSS, Turbidity, O&G), Major Ions, Trace Ions, Nutrients.
Wolgan River Downstream	Weekly		
NEWNES PLATEAU SWAMPS:			
COXS RIVER CATCHMENT			
Marrangaroo Creek Swamp	Daily	*Before Undermining:* Fortnightly *During Undermining:* Weekly	*Before Undermining:* Fortnightly: Field (pH, T, EC, DO) Monthly: Field (pH, T, EC, DO), Physical (pH, TDS, TSS, Turbidity, O&G), Major Ions, Trace Ions, Nutrients. *During Undermining:* Weekly: Field (pH, T, EC, DO) Fortnightly: Field (pH, T, EC, DO), Physical (pH, TDS, TSS, Turbidity, O&G), Major Ions, Trace Ions, Nutrients.
WOLGAN RIVER CATCHMENT			
Narrow Swamp Weir NSW1	Weekly	Not Monitored	N/A
Narrow Swamp Weir NSW2	Weekly	Not Monitored	N/A
Junction Swamp	Weekly	Not Monitored	N/A
East Wolgan Swamp D/S	Fortnightly	Fortnightly	Fortnightly: Field (pH, T, EC, DO) Monthly: Field (pH, T, EC, DO), Physical (pH, TDS, TSS, Turbidity, O&G), Major Ions, Trace Ions, Nutrients.
East Wolgan Swamp D/S Junction	Fortnightly	Fortnightly	Fortnightly: Field (pH, T, EC, DO) Monthly: Field (pH, T, EC, DO), Physical (pH, TDS, TSS, Turbidity, O&G), Major Ions, Trace Ions, Nutrients.
Sunnyside Swamp U/S			
Sunnyside Swamp D/S	Daily		
Sunnyside U/S Junction			
Sunnyside East Swamp	Daily	*Before Undermining:* Fortnightly *During Undermining:* Weekly	*Before Undermining:* Fortnightly: Field (pH, T, EC, DO) Monthly: Field (pH, T, EC, DO), Physical (pH, TDS, TSS, Turbidity, O&G), Major Ions, Trace Ions, Nutrients. *During Undermining:* Weekly: Field (pH, T, EC, DO) Fortnightly: Field (pH, T, EC, DO), Physical (pH, TDS,
Carne West Swamp			
Gang Gang West Swamp			
Gang Gang Swamp			

Site Code	Frequency (Flow)	Frequency (Quality)	Quality Parameters
			TSS, Turbidity, O&G), Major Ions, Trace Ions, Nutrients.
Carne Central Swamp	Daily	Fortnightly	Fortnightly: Field (pH, T, EC, DO) Monthly: Field (pH, T, EC, DO), Physical (pH, TDS, TSS, Turbidity, O&G), Major Ions, Trace Ions, Nutrients.
COLO RIVER CATCHMENT			
Pine Swamp	Daily	*Before Undermining:* Fortnightly *During Undermining:* Weekly	*Before Undermining:* Fortnightly: Field (pH, T, EC, DO) Monthly: Field (pH, T, EC, DO), Physical (pH, TDS, TSS, Turbidity, O&G), Major Ions, Trace Ions, Nutrients. *During Undermining:* Weekly: Field (pH, T, EC, DO) Fortnightly: Field (pH, T, EC, DO), Physical (pH, TDS, TSS, Turbidity, O&G), Major Ions, Trace Ions, Nutrients
Nine Mile Swamp			
Paddys Creek Swamp			
LICENSED DISCHARGE POINTS:			
LDP001	Daily (during discharge)	Weekly (during discharge)	Weekly: Field (pH, T, EC, DO) Monthly: Field (pH, T, EC, DO), Physical (TSS, Turbidity, O&G), Trace Ions (Mn, Fe). Quarterly: Field (pH, T, EC, DO), Physical (pH, TDS, TSS, Turbidity, O&G), Major Ions, Trace Ions, Nutrients.
LDP002	Daily (during discharge)	Not Monitored	N/A
LDP004	Daily (during discharge)	Daily (during discharge)	Daily: Field (pH, T, EC, DO), Turbidity Weekly: Field (pH, T, EC, DO), Physical (TSS, Turbidity, O&G), Trace Ions (Mn, Fe). Fortnightly: Field (pH, T, EC, DO), Physical (pH, TDS, TSS, Turbidity, O&G), Major Ions, Trace Ions, Nutrients.
LDP005	Daily (during discharge)	Daily (during discharge)	Daily: Field (pH, T, EC, DO), Turbidity Weekly: Field (pH, T, EC, DO), Physical (TSS, Turbidity, O&G), Trace Ions (Mn, Fe). Fortnightly: Field (pH, T, EC, DO), Physical (pH, TDS, TSS, Turbidity, O&G), Major Ions, Trace Ions, Nutrients.
LDP009	Daily (during discharge - estimate)	Weekly (during discharge)	Weekly: Field (pH, T, EC, DO), Physical (TSS, Turbidity, O&G), Trace Ions. Monthly: Field (pH, T, EC, DO), Physical (pH, TDS, TSS, Turbidity, O&G), Major Ions, Trace Ions, Nutrients.
LDP010	Daily (during discharge - estimate)	Weekly (during discharge)	Weekly: Field (pH, T, EC, DO), Physical (TSS, Turbidity, O&G), Trace Ions. Monthly: Field (pH, T, EC, DO), Physical (pH, TDS, TSS, Turbidity, O&G), Major Ions, Trace Ions, Nutrients.

7.2.2 Requirements Post-Mining (2025)

Management

Following completion of mining at Springvale, dewatering activity will cease and groundwater levels will commence recovering. Existing surface water management infrastructure at Springvale Pit Top will be maintained, however, Springvale's contribution to the SDWTS will cease. Local LDPs, LDP001 and LDP002 will be retained during the rehabilitation stage and it is expected that the current monitoring program will continue to operate. Accordingly, it is expected that the existing LDP009 and LDP010 will be required to be maintained since the adjacent project at Angus Place Colliery will continue operating until 2032. It is anticipated that the current commercial arrangement for access to the SDWTS by Angus Place Colliery will be extended.

During the rehabilitation phase, the removal of infrastructure at Springvale Pit Top has the potential to impact drainage patterns. At Pit Top, the final landform will be contoured to ensure effective drainage and minimise potential soil erosion including revegetation as required. Compliance with the water quality monitoring program and established water management plan will ensure management of potential contamination during rehabilitation. Further detail on rehabilitation of the site following mining is presented in the main EIS.

Monitoring and Reporting

During rehabilitation it is anticipated that the monitoring program will include surface water flow and surface water quality sampling for a period of two years after completion of mining. An exception is monitoring of the LDPs, LDP001 and LDP002, which will continue to operate until the mine is completely rehabilitated.

Table 6.3 presents the proposed monitoring network, post-mining, including analytes and frequency.

The water quality analytical suite should consist:

- Field Parameters (Field pH, Field Temperature, Field Conductivity (EC), Field DO)
- Physical Parameters (pH, Conductivity (as TDS), TSS, Turbidity, Oil and Grease)
- Major Ions (Na, Ca, Mg, K, Alkalinity, Cl, SO_4)
- Trace Ions (Al, As, B, Cd, Cr, Cu, Fe, F, Mn, Ni, Pb, Zn)
- Nutrients (NH_3, NO_3, Total N, Total P)

It is noted that Major Ions, Minor Ions and Nutrients should be analysed based on filtered samples, as applicable.

Table 7.3: Proposed Surface Water Monitoring Network – Post-Mining (2025)

Site Code	Frequency (Flow)	Frequency (Quality)	Quality Parameters
RIVERS AND CREEKS:			
COXS RIVER			
N/A	-	-	-
WOLGAN RIVER			
N/A	-	-	-
NEWNES PLATEAU SWAMPS (for a period of two years following completion of mining):			
COXS RIVER CATCHMENT			
Marrangaroo Creek Swamp	Weekly	Fortnightly	Fortnightly: Field (pH, T, EC, DO) Monthly: Field (pH, T, EC, DO), Physical (pH, TDS, TSS, Turbidity), Major Ions, Trace Ions, Nutrients.
WOLGAN RIVER CATCHMENT			
Sunnyside Swamp D/S	Weekly	Fortnightly	Fortnightly: Field (pH, T, EC, DO) Monthly: Field (pH, T, EC, DO), Physical (pH, TDS, TSS, Turbidity), Major Ions, Trace Ions, Nutrients.
Sunnyside U/S Junction			
Sunnyside East Swamp			
Carne West Swamp			
Gang Gang West Swamp			
Gang Gang Swamp			
Carne Central Swamp[a]			
COLO RIVER CATCHMENT			
Pine Swamp	Weekly	Fortnightly	Fortnightly: Field (pH, T, EC, DO)

Site Code	Frequency (Flow)	Frequency (Quality)	Quality Parameters
Nine Mile Swamp			Monthly: Field (pH, T, EC, DO), Physical (pH, TDS, TSS, Turbidity), Major Ions, Trace Ions, Nutrients.
Paddys Creek Swamp			
LICENSED DISCHARGE POINTS (until Springvale Pit Top is completely rehabilitated):			
LDP001	Daily (during discharge)	Weekly (during discharge)	Weekly: Field (pH, T, EC, DO) Monthly: Field (pH, T, EC, DO), Physical (TSS, Turbidity, O&G), Trace Ions (Mn, Fe). Quarterly: Field (pH, T, EC, DO), Physical (pH, TDS, TSS, Turbidity, O&G), Major Ions, Trace Ions, Nutrients.
LDP002	Daily (during discharge)	Not Monitored	N/A

a. Carne Central Swamp will not be undermined and sampling should continue, as a control site, until of all mining at Springvale.

8. CONTINGENCY RESPONSE PLANS

8.1 RECOMMENDATIONS FOR DEVELOPMENT OF RESPONSE PLANS

As part of the update to the Water Management Plan for Springvale, a contingency response program should also be prepared such that there is a clear plan of action in the event of unforeseen adverse impacts on the surface water environment.

Due to the natural variation in surface water flow and quality over time, a trigger level based on a specific flow rate or a specific water quality concentration is not considered suitable.

Water quality will fluctuate in response to normal climatic variation. There will also be seasonal variation in water quality due to surface water/groundwater interaction, as well as other changes associated with recovery of groundwater levels post-mining. It is therefore recommended that the assessment is made based on the variation of flow and quality from the baseline range, together with the results of on-going monitoring program and in context with the predicted magnitude of variation due to the project itself.

It is recommended that the trigger levels be set with reference to the baseline data records available and revised as appropriate through consultation with the NSW Office of Water.

8.1.1 Discharge Volumes to the Coxs River

Surface water quality at Springvale Mine is dominated by groundwater inflows to underground workings, the majority of which is transmitted to the SDWTS to meet the demand at Wallerawang Power Station. There is considerable variability in mine water make, as would be expected. Should groundwater inflows, in average, exceed expected rates, as per Figure 18, by more than 25%, for a consecutive period of three months then monitoring data should be referred to an appropriately qualified hydrogeologist for review. The reviewer should assess the data to establish the reasons for it and should recommend an appropriate response action plan for implementation in consultation with the NSW Office of Water.

The response action may involve:

- review of mine plan in context of local geological structures
- reduction in pumping for a specific bore or bores
- continuation of pumping and dewatering, with closer monitoring
- no change to operations.

8.1.2 Preservation of Baseflow of Newnes Plateau Swamps

Groundwater modelling and subsidence analysis does not predict significant impacts on THPSS, however, the existing surface water and groundwater monitoring network should be maintained, including post-mining, as outlined in Section 7.2.1 and 7.2.2 and the monitoring data should be reviewed each year as part of preparation of the Annual Review.

If there is an identified change in hydrologic regime, aside from regular subsidence-related impact inspection and survey, in excess of typical climatic variation, the data should be referred to an appropriately qualified hydrologist for review. A key indicator would be a significant increase in salinity, TSS and /or turbidity compared to baseline data. An initial trigger value for salinity may be 150µS/cm and 100mg/L for TSS.

Should the outcome of the review identify that there is potential adverse impact to the integrity of the bases of the THPSS or interruption to surface water/groundwater interaction with local perched groundwater system, then, in consultation with the NSW Office of Water and commencing with detailed investigation, potential methods of remediation include:

- Soft engineering solutions – such as coir logs, jute matting, geotextile, rock armouring and timber log water dissipaters
- Hard engineering solutions – such as the use of concrete and various grouting techniques.

The response action may involve:

- remediation works to the relevant THPSS
- review of mine plan in context of local geological structures
- continued operation, with closer monitoring
- no change to operation.

8.1.3 Surface Water Quality in the Coxs River

The Project consists of extension of dewatering and extraction of the Illawarra Coal Measures. Accordingly, it is not anticipated that there will be a change in groundwater quality of mine water make that will lead to a significant change in surface water quality discharged at LDP009.

Water quality of discharge at LDP001 is not expected to change due to no change to surface water management at Springvale Pit Top.

Water quality triggers for LDP001 and LDP009 should be focussed on pH and salinity as a first measure against any change in water quality. Should pH fall outside of the range of 6.5-9.0 or salinity exceed baseline water quality by 25%, allowing for climatic variation, for three consecutive months, then the monitoring data should be referred to an appropriately qualified hydrologist for review.

The reviewer should assess the data and recommended an appropriate response action plan, in consultation with the NSW Office of Water.

The response action may involve:

- reconfiguration of Pit Top surface water management infrastructure
- reduction in pumping from a specific bore or bores
- continuation of operations, with closer monitoring
- no change to operations.

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