

# APPENDIX – C

## Surface Water Assessment

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## Springvale Mine

Springvale Coal Pty Ltd

### Water Assessment - SSD 5594 Modification 2

IA132100-0006-NW-RPT-0006.docx | 2

16 December 2016

SP297020

#### Document history and status

Revision	Date	Description	By	Review	Approved
0	9/12/2016	Draft Report	Dr Justin Bell	Greg Sheppard	N/A
1	13/12/2016	Final Draft Report	Dr Justin Bell	Greg Sheppard	N/A
2	16/12/2016	Final Report	Dr Justin Bell	Greg Sheppard	Dr Justin Bell

## Springvale Mine

Project No: IA132100  
Document Title: Water Assessment - SSD 5594 Modification 2  
Document No.: IA132100-0006-NW-RPT-0006.docx  
Revision: 2  
Date: 16 December 2016  
Client Name: Springvale Coal Pty Ltd  
Client No: SP297020  
Project Manager: Project Manager  
Author: Dr Justin Bell  
File Name: J:\IE\Projects\04\_Eastern\IA132100\21 Deliverables\Reports\IA132100-0006-NW-RPT-0006\_Rev2.docx

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**Appendix A. Toxicological Assessment**

## Executive Summary

The proposed modification to current Conditions of Consent (SSD 5594) at Springvale Mine comprises:

- Amend Schedule 4 Condition 12 of SSD 5594 (Table 6: Water Management Performance Measurements: Mine Water Discharges) as follows:
  - to remove the requirement to “*Meet limits for salinity of 700 (50th percentile), 900 (90th percentile) and 1,000 (100th percentile)  $\mu$ S/cm EC by 30 June 2017*”.
  - to defer to 30 June 2019 the requirement to “*Eliminate acute and chronic toxicity from LDP009 discharges to aquatic species by 30 June 2017, with acute toxicity defined as >10% effect relative to the control group and chronic toxicity defined as >20% effect relative to the control group*”.

The proposed modification will allow the Springvale Mine to continue to discharge mine water to the Coxs River catchment via the mine’s licensed discharge point (LDP) 009 at the current water quality until the proposed Springvale Water Treatment Project (SSD 7592) assessment and construction has been completed. The Springvale Water Treatment Project, once operational, will achieve the 30 June 2019 water quality performance measures stipulated in Schedule 4 Condition 12 of SSD 5594.

Modelling was undertaken using the Regional Water Quality Impact Assessment Model (RWQIAM), which was prepared during the environmental impact assessment of the Springvale Mine Extension Project. Modelling indicates that the removal of the interim 30 June 2017 water quality performance criteria, with respect to salinity, does not lead to a significant difference in predicted water quality (salinity) within the Coxs River, over the prediction period, compared to that currently approved. Modelling indicates no change to modelled median salinity in Lake Burragarang, over the prediction period, compared to that currently approved.

DP&E (2015) define the ‘base case’ with respect to the Neutral or Beneficial Effect test for Springvale Mine as the Environmental Protection Licence (EPL) limit of 1,200 $\mu$ S/cm existing at the time of the development application. On the basis of that definition, the proposed modification, at both a local and catchment scale, is regarded as a neutral impact to the NorBE water quality effect test, since the modification will allow the Springvale Mine to continue to discharge mine water at the current water quality criteria (governed by the EPL) until the Water Treatment Project (SSD 7592) assessment and construction has been completed.

Toxicological assessment indicates the change to flocculent agent and dosing rates, which was implemented between the October 2014 and April 2015 toxicity investigations, have reduced the acute toxicity of LDP009 discharge. Chronic toxicity of mine water discharge, however, has not changed significantly since August 2014, and the chronic toxicological impact will continue until the Springvale Water Treatment Project becomes operational.

With respect to the proposed Modification to Consent, there are no presented changes to surface water management already in place at Springvale Mine, and/or prescribed in the current Conditions of Consent (SSD 5594).

Analysis indicates there will be no change to environmental consequences with respect to geomorphology, flooding or drainage due to the modification compared to that presented in the environmental impact assessment of the Springvale Mine Extension Project.

Given that the modification is a continuation of mine water discharge at current and historical water quality, there is no change to environmental consequences with respect to aquatic ecology (macroinvertebrates) compared to that presented in the environmental impact assessment of the Springvale Mine Extension Project. The modification also does not lead to changes to predicted impacts to endangered ecological communities on the Newnes Plateau (Temperate Highland Peat Swamps on Sandstone).

There are no changes to license requirements (both surface water and groundwater) under the relevant Water Sharing Plans due to the modification.

There are no presented changes to surface water monitoring at Springvale Mine due to the modification.

### Important note about your report

The sole purpose of this report and the associated services performed by Jacobs is to prepare a report on the expected impacts to water of the proposed Modification to Consent (SSD 5594) at Springvale Mine (Modification 2), undertaken in accordance with the Scope of Services set out in the contract between Jacobs and the Client. That Scope of Services, as described in this report, was developed with the Client.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and/or from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Jacobs for use of any part of this report in any other context.

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## 1. Introduction

This chapter introduces the project and the proposed modification, provides objectives and purpose of this report and presents the layout of the assessment.

### 1.1 Overview

Springvale Mine is an underground coal mine located 15km northwest of Lithgow. The Springvale Mine is owned by Centennial Springvale Pty Limited (as to 50%) and Springvale SK Kores Pty Limited (as to 50%) as participants in the Springvale unincorporated joint venture. The Springvale mine is operated by Springvale Coal Pty Limited (Springvale Coal), for and on behalf of the Springvale joint venture participants.

Underground coal mining commenced at Springvale Mine in 1995 and State significant development consent (SSD 5594) for extension of mining operations at Springvale Mine through to 31 December 2028 was granted on 21 September 2015 by the Planning Assessment Commission, under delegation of the Minister of Planning.

The Project Application Area (PAA) for SSD 5594 is presented in **Figure 1.1**.

Springvale Coal is currently seeking to modify the development consent SSD 5594 (the modification).

Jacobs Group (Australia) Pty Ltd has been engaged by Springvale Coal to prepare a Water Assessment of the modification. This report has been prepared based on information current at the time of this report.

### 1.2 Proposed Modification

The modification application seeks to:

- Amend Schedule 4 Condition 12 of SSD 5594 (Table 6: Water Management Performance Measurements: Mine Water Discharges) as follows:
  - to remove the requirement to “Meet limits for salinity of 700 (50th percentile), 900 (90th percentile) and 1,000 (100th percentile)  $\mu\text{S/cm EC}$  by 30 June 2017”.
  - to defer to 30 June 2019 the requirement to “Eliminate acute and chronic toxicity from LDP009 discharges to aquatic species by 30 June 2017, with acute toxicity defined as >10% effect relative to the control group and chronic toxicity defined as >20% effect relative to the control group”.

The proposed modification will allow the Springvale Mine to continue to discharge mine water at the current water quality criteria until the Water Treatment Project (SSD 7592) assessment and construction has been completed. It will thus allow Springvale Mine to remain compliant with its consent conditions.

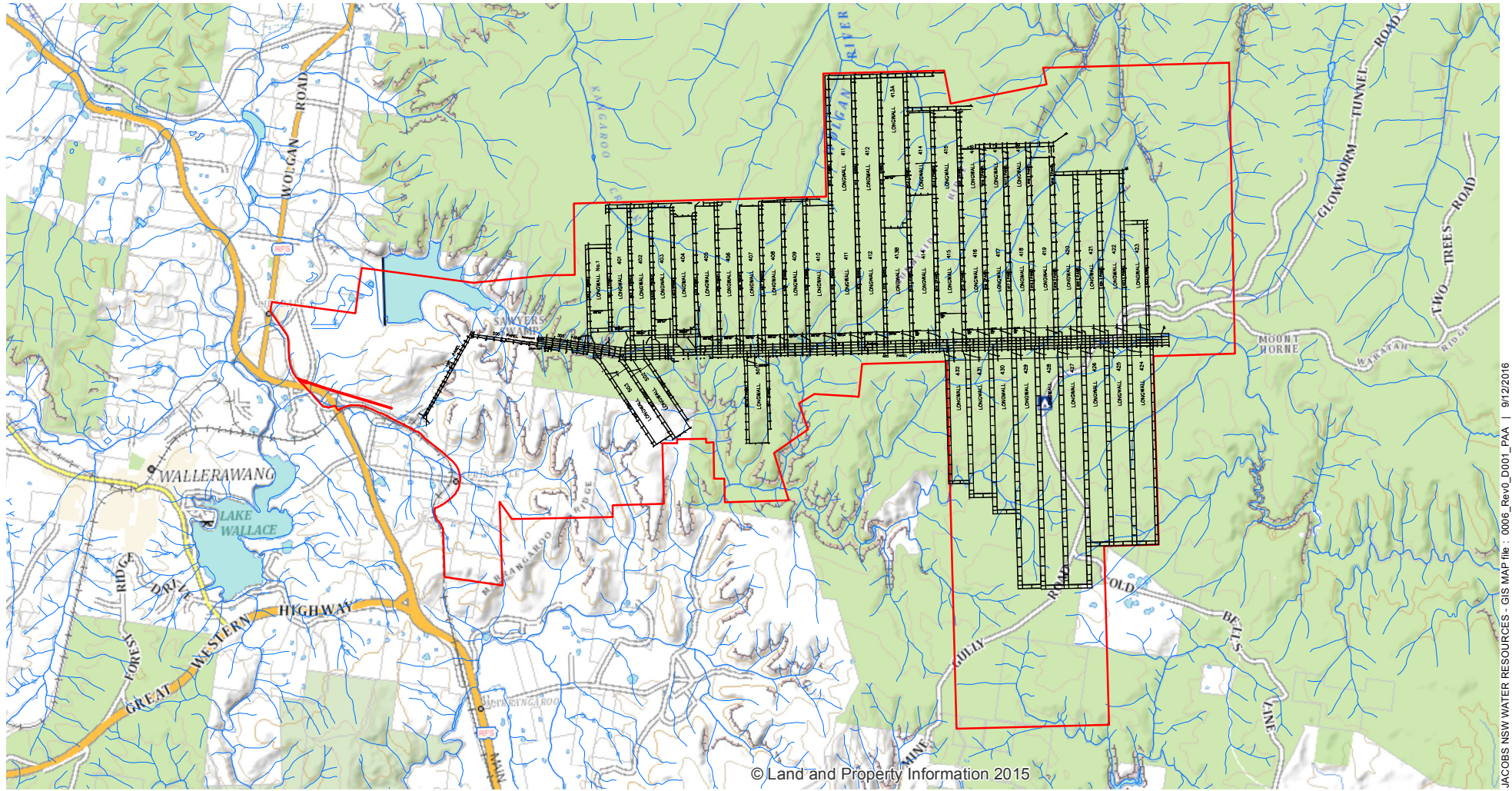
### 1.3 Water Management Strategy

#### 1.3.1 Current Approach

The project comprises underground operations beneath the Newnes Plateau. Underground operations involve dewatering of target coal seams during longwall mining, with discharge of mine water make to Sawyers Swamp Creek via the Springvale Delta Water Transfer Scheme (SDWTS). A small volume is also released from the Pit Top facilities through LDP001. Mean annual daily discharges of 1.8 ML/day from LDP001 to Springvale Creek will continue until end of mine life. Discharge to Sawyers Swamp Creek occurs at licensed discharge point, LDP009, on Springvale Mine’s Environment Protection Licence 3607.

#### 1.3.2 Future Changes

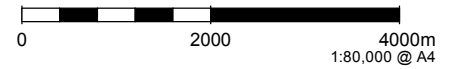
Modification to development consent is being sought to remove the interim water quality criteria scheduled to apply from 30 June 2017 and to defer the requirement to meet acute and chronic toxicity limits from 30 June 2017 to 30 June 2019. These changes will allow Springvale Mine to continue to discharge mine water at



JACOBS NSW WATER RESOURCES - GIS MAP file : 0006\_Rev0\_D001\_PAA | 9/12/2016

**Legend**

— Project Application



Project No. IA132100

**Figure 1-1** | Springvale Mine Extension Project Project Application Area

**Data sources**  
LPI Web Services 2016, Springvale Coal Pty Ltd

LDP009 until the Water Treatment Project (SSD 7592) assessment and construction has been completed and will allow Springvale Mine to remain compliant with its consent conditions till 30 June 2019.

## **1.4 Purpose and Scope of the Report**

The purpose of this report is to present an assessment of the modification on the surface water environment at Springvale Mine, including toxicology.

Modelling prepared during environmental impact assessment of the Springvale Mine Extension Project (RPS, 2014ab and Jacobs, 2015ab) has been used to assess the impact of the proposed modification.

Toxicological assessment has been undertaken by Springvale Mine's consultant, GHD Pty Ltd, and is summarised in this report. **Appendix A** presents the Toxicological Assessment Report.

## **1.5 Layout of the Report**

The layout of the report is as follows:

- Chapter 1 – presents the background to the proposed modification, the objectives and layout of the report and presents water management strategy of the proposed modification
- Chapter 2 – presents the governing legislation and relevant guidelines and policies for the report, including river flow and water quality objectives
- Chapter 3 – presents the environmental setting and describes (including monitoring data, as relevant) the various surface water environments
- Chapter 4 – presents the proposed modification and presents the modelled changes to quality (salinity)
- Chapter 5 – presents the expected impacts of the proposed modification on site water management, surface water environments, surface water users and surface water/groundwater interaction in the context of governing legislation and relevant guidelines and policies
- Chapter 6 – presents licensing, management and monitoring recommendations for the proposed modification.
- Chapter 7 – presents relevant references.

## 2. Legislation, Regulation and Policy

This chapter presents relevant legislation, regulation and policy regarding management of surface water, as it pertains to this project and the proposed modification.

### 2.1 Commonwealth Legislation

#### 2.1.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) is the main Commonwealth environmental legislation that provides legal framework to protect and manage Matters of National Environmental Significance (MNES) including nationally and internationally important flora, fauna, ecological communities, cultural heritage and water resources.

As per the environmental impact statement (EIS), 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 PAA. The proposed modification refers to the water quality of mine water discharge to Sawyers Swamp Creek, which feeds into the Coxs River and then Lake Burragorang. Accordingly, there is no proposed change to groundwater impact to the THPSS as a result of the modification.

Water resources are also an MNES and the potential impact of the proposed modification is considered in this report through the Significant Impact Guidelines for Coal Seam Gas and Large Coal Mining Developments – Impacts on Water Resources (DoE, December 2013) presented in **Section 2.2.1** below.

### 2.2 Commonwealth Guidelines and Policy

Guidelines and policies relevant to the Water Assessment are presented below.

#### 2.2.1 Significant Impact Guidelines: Coal Seam Gas and Large Coal Mining Developments – Impacts on Water Resources 2013

The guidelines have been prepared by the Department of Environment for the Australian Government (DoE, 2013). They define a significant impact on hydrological characteristics as follows:

*“A significant impact on the hydrological characteristics of a water resource may occur where there are, as a result of the action:*

*a) changes in the water quantity, including the timing of variations in water quantity*

*b) changes in the integrity of hydrological or hydrogeological connections, including substantial structural damage (e.g. large scale subsidence)*

*c) changes in the area or extent of a water resource*

*where these changes are of sufficient scale or intensity as to significantly reduce the current or future utility of the water resource for third party users, including environmental and other public benefit outcomes.”* [Page 17 of DoE(2013)].

They define a significant impact on water quality as follows:

*“A significant impact on a water resource may occur where, as a result of the action:*

*a) there is a risk that the ability to achieve relevant local or regional water quality objectives would be materially compromised, and as a result the action:*

- i. creates risks to human or animal health or to the condition of the natural environment as a result of the change in water quality*
- ii. substantially reduces the amount of water available for human consumptive uses or for other uses, including environmental uses, which are dependent on water of the appropriate quality*
- iii. causes persistent organic chemicals, heavy metals, salt or other potentially harmful substances to accumulate in the environment*
- iv. seriously affects the habitat or lifecycle of a native species dependent on a water resource, or*
- v. causes the establishment of an invasive species (or the spread of an existing invasive species) that is harmful to the ecosystem function of the water resource, or*
- b) there is a significant worsening of local water quality (where current local water quality is superior to local or regional water quality objectives), or*
- c) high quality water is released into an ecosystem which is adapted to a lower quality of water.*

*For water-dependent ecosystems, a significant impact is likely if the predicted change in water quality is greater than that required for 'moderately to slightly disturbed' systems as described in the relevant local or regional water quality objectives (typically the 80% to 95% ecosystem protection guideline values listed in ANZECC (2000)). Note that other thresholds may apply where changes in water quality may impact on other matters of national environmental significance, such as threatened species or ecological communities." [Page 18 of DoE(2013)].*

An assessment of the Proposal against the abovementioned guidelines is presented in **Section 5.1.1**.

### **2.2.2 Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000**

The guidelines are prepared by the Australian and New Zealand Environment and Conservation Council and the Agriculture and Resource Management Council of Australia and New Zealand for the Australian and New Zealand Governments (ANZECC, 2000). They set out a management framework to:

- *"identify the environmental values that are to be protected in a particular water body and the spatial designation of the environmental values*
- *identify management goals and then select the relevant water quality guidelines for measuring performance, tailored to local environmental conditions. Based on these guidelines, set water quality objectives that must be met to maintain the environmental values*
- *develop statistical performance criteria to evaluate the resulting of the monitoring programs*
- *develop tactical monitoring programs focussing on the water quality objectives*
- *initiate appropriate management response to attain or maintain the water quality objectives."* [Page 2-1 of ANZECC(2000)].

The selected water quality objectives for the Springvale Mine Extension Project were presented in the EIS and are discussed in **Section 2.4.1** below.

An assessment of the modification against these objects is discussed in **Section 5.1.2** and presented in **Section 5.2.3**.

### **2.2.3 Australian Drinking Water Guidelines 2011**

The guidelines are prepared by the National Health and Medical Research Council for the Australian Government (NHMRC, 2016) and are:

*“...intended to provide a framework for good management of drinking water supplies that, if implemented, will assure safety at point of use. The ADWG have been developed after consideration of the best available scientific evidence. They are designed to provide an authoritative reference on what defines safe, good quality water, how it can be achieved and how it can be assured. They are concerned both with safety from a health point of view and with aesthetic quality.*

*The ADWG are not mandatory standards; however, they provide a basis for determining the quality of water to be supplied to consumers in all parts of Australia. These determinations need to consider the diverse array of regional or local factors, and take into account economic, political and cultural issues, including customer expectations and willingness and ability to pay.*

*The ADWG are intended for use by the Australian community and all agencies with responsibilities associated with the supply of drinking water, including catchment and water resource managers, drinking water suppliers, water regulators and health authorities.” [Page 2 of NHMRC(2016)].*

An assessment of the modification against the ADWG is discussed in **Section 5.1.3** and presented in **Section 5.2.3**.

## 2.3 NSW Legislation

### 2.3.1 Water Management Act 2000

The *Water Management Act 2000* (NSW) presents the framework for sustainable and integrated water management in NSW and its objectives are as follows:

- *“to apply the principles of ecologically sustainable development, and*
- *to protect, enhance and restore water sources, their associated ecosystems, ecological processes and biological diversity and their water quality, and*
- *to recognise and foster the significant social and economic benefits to the State that result from the sustainable and efficient use of water, including:*
  - *benefits to the environment, and*
  - *benefits to urban communities, agriculture, fisheries, industry and recreation, and*
  - *benefits to culture and heritage, and*
  - *benefits to the Aboriginal people in relation to their spiritual, social, customary and economic use of land and water,*
- *to recognise the role of the community, as a partner with government, in resolving issues relating to the management of water sources,*
- *to provide for the orderly, efficient and equitable sharing of water from water sources,*
- *to integrate the management of water sources with the management of other aspects of the environment, including the land, its soil, its native vegetation and its native fauna,*
- *to encourage the sharing of responsibility for the sustainable and efficient use of water between the Government and water users,*
- *to encourage best practice in the management and use of water.” [Chapter 1, Section 3 of the Water Management Act 2000 (NSW)].*

The primary instruments applied to achieve these objectives are the Water Sharing Plans.

### Water Sharing Plans

Water Sharing Plans provide the basis for equitable sharing of surface water and groundwater between water users, including the environment, and are regulations under the *Water Management Act 2000* (NSW).

The majority of NSW is now covered by Water Sharing Plans. If an activity leads to a take from a groundwater or surface water source covered by a Water Sharing Plan, then an approval and/or licence is required.

In general, the *Water Management Act 2000* (NSW) requires:

- a water access licence to take water
- a water supply works approval to construct a work
- a water use approval to use the water.

For surface water, the project resides within the *Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011* (NSW). As presented in the EIS, Springvale Mine is bisected by the Upper Nepean and Upstream Warragamba Water Source (Wywandy Management Zone) (southwest) and the Hawkesbury and Lower Nepean Rivers Water Source (Colo River Management Zone) (northeast).

For groundwater, the project lies within the *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011* (NSW). As presented in the EIS, Springvale Mine is bisected by the Sydney Basin Cocks River Groundwater Source (southwest) and the Sydney Basin Richmond Groundwater Source (northeast). The Sydney Basin Cocks River Groundwater Source is designated by DPIWater to be a Less Productive Groundwater Source (Porous Rock) and the Sydney Basin Richmond Groundwater Source is designated as a Highly Productive Groundwater Source (Porous Rock).

There is no direct extraction from surface water sources at Springvale Mine and the modification, similarly, does not include direct surface water extraction.

Due to indirect change to groundwater contribution to surface watercourses, as a result of mining activity, there is a requirement for water access licences from surface water sources. The proposed modification does not include proposed change to groundwater impact on surface watercourses.

### 2.3.2 Water NSW Act 2014

The *Water NSW Act 2014* (NSW) outlines the objectives and functions of Water NSW (formerly Sydney Catchment Authority and State Water). The *Water NSW Act 2014* also defines various declared and special areas such as the Sydney Drinking Water Catchment.

### 2.3.3 Environmental Planning and Assessment Act 1979

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

The *State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011* (NSW) is an environmental planning instrument under the *Environmental Planning and Assessment Act 1979* (NSW).

The southwesterly catchments within the PAA reside within the Upper Nepean and Upstream Warragamba Water Source (Wywandy Management Zone). Surface water catchments within the Upper Nepean and Upstream Warragamba Water Source are declared by the *State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011* (NSW) to be within the Sydney Drinking Water Catchment.

Part 2, Clause 10 of the *State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011* (NSW) requires that:

“10 Development consent cannot be granted unless neutral or beneficial effect on water quality

(1) A consent authority must not grant consent to the carrying out of development under Part 4 of the Act on land in the Sydney drinking water catchment unless it is satisfied that the carrying out of the proposed development would have a neutral or beneficial effect on water quality.

(2) For the purposes of determining whether the carrying out of the proposed development on land in the Sydney drinking water catchment would have a neutral or beneficial effect on water quality, the consent

authority must, if the proposed development is one to which the NorBE Tool applies, undertake an assessment using that Tool.

Note. The NorBE Guideline provides information and guidance for consent authorities in the use of the NorBE Tool." [Part 2, Clause 10 of State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011]

The NorBE Guideline is published by WaterNSW. From Section 3.1 of WaterNSW(2015):

"A neutral or beneficial effect on water quality is satisfied if the development:

(a) has no identifiable potential impact on water quality, or

(b) will contain any water quality impact on the development site and prevent it from reaching any watercourse, waterbody or drainage depression on the site, or

(c) will transfer any water quality impact outside the site where it is treated and disposed of to standards approved by the consent authority." [Section 3.1 of WaterNSW(2015)]

As noted in Section 2.2 of WaterNSW(2015), State Significant Development, which is assessed under Part 4.1 of the *Environmental Planning and Assessment Act 1979* (NSW), is not subject to the *State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011* (NSW), however, it is suggested by WaterNSW(2015) that the neutral or beneficial effect on water quality guideline may provide a framework to consider State Significant Development. As noted by WaterNSW (2015), under Part 2, Clause 11(4)(a) of the *State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011* (NSW), concurrence of the Regulatory Authority, in this case WaterNSW, is not required if the Minister is the consent authority.

Evaluation of the impact of mine water discharge to the Coxs River is presented in **Section 5.2.2**.

It is noted that the assessment did not use the NorBE Tool (WaterNSW, 2015) because it was not suitable for the assessment of the project at the time. This was permissible under Clause 10 of the *State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011* (NSW), as established above, i.e. the requirement that neutral or beneficial effect on water quality must be assessed using the NorBE Tool does not apply.

The NorBE Tool is an online assessment tool for use in determining whether the effect test is met. The NorBE Tool is primarily tailored to the assessment of the impact of urban development (land use change) by delegated authorities, in general, constituent councils and was not suitable for the assessment of the project. In its place, a regional water quality and flow assessment is utilised and is discussed further in **Section 4.4** below.

### 2.3.4 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (NSW) is the key piece of environment protection legislation administered by the NSW Environment Protection Authority.

Relevant features of this legislation include:

- protection of the environment policies (PEPs)
- integrated environment protection licensing
- regulation of scheduled and non-scheduled activities:
  - the NSW Environment Protection Authority is the regulatory authority for scheduled activities (activities declared under Schedule 1 of the *Protection of the Environment Operations Act 1997*(NSW))
  - the NSW Environment Protection Authority is also the regulatory authority for non-scheduled activities, where activities are undertaken by a public authority.

Springvale Coal has been granted an EPL for mining for coal and associated works (EPL 3607). The EPL covers the mining operation, surface facilities and overland conveyors at the Springvale Mine and other related sites. The EPL 3607 (Condition A1.1) will be subject to a variation following the approval of SSD 5594 – Modification 1 to authorise the increased extraction and handling of ROM coal to 5.5 Mtpa.

The provisions of EPL 3607 prescribe water quality and volumetric concentration discharge limits of various surface water pollutants to designated Licensed Discharge Points (LDP). The location of LDPs under EPL 3607 (latest revision, 26 February 2016) is presented in **Table 2.1**.

**Table 2.1 : Location of Licenced Discharge Points (LDPs) – Current (EPL 3607)**

Discharge Point	Location and Function	Limit of discharge (kL/d)	Oil & Grease (mg/L)	pH	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 <sup>a</sup>	N/A	N/A	N/A	N/A
LDP005	Emergency discharge point from dewatering bores to unnamed creek leading to Wolgan River	15,000 <sup>a</sup>	N/A	N/A	N/A	N/A
LDP006	Condition P1.3 of EPL 3607 is intended to be updated to remove LDP006 and be transferred to a new EPL for the Western Coal Services Project					
LDP007	Condition P1.3 of EPL 3607 will be updated to remove LDP007 and transfer to a new EPL for the Western Coal Services Project					
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 <sup>c</sup>
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 <sup>b</sup>

Note: a) Combined daily limit must not exceed 30,000kL/d; b) Additional constituents include 100 percentile concentration limit: Al 0.45mg/L, As 0.024mg/L, B 0.37mg/L, Cu 0.007mg/L, F 1.8mg/L, Fe 0.4mg/L, Mn 1.7mg/L, Ni 0.047mg/L, Zn 0.05mg/L; c) as for b) as well as TSS 50mg/L and Turbidity 50NTU.

### 2.3.5 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.

There is no predicted change to subsidence predictions as a result of the modification.

## 2.4 NSW Guidelines and Policy

Guidelines and policies relevant to the Surface Water Assessment are presented below.

### 2.4.1 NSW Water Quality and River Flow Objectives 2006

Environmental values have been identified for various catchments within NSW (OEH, 2006).

There are no specific environmental values set for the Hawkesbury-Nepean catchment due to the transition at that time from the Healthy Rivers Commission to the Natural Resources Commission. However, catchments in the vicinity have identified water quality and river flow objectives that are appropriate for the purpose of presenting the impact of the project, and modification, and these are presented below.

It is noted that the environmental values identified in the NSW Water Quality and River Flow Objectives are consistent with the National Water Quality Management Framework presented in ANZECC (2000).

**Table 2.2** presents the adopted Water Quality and River Flow Objectives for the various water sources.

**Table 2.2 : NSW Water Quality and River Flow Objectives within the PAA – Surface Water**

Water Source	Water Quality and River Flow Objective
Wywandy Management Zone	Water Quality Objective: <ul style="list-style-type: none"> <li>• aquatic ecosystems</li> <li>• visual amenity</li> <li>• drinking water – disinfection only (not relevant)</li> <li>• drinking water – clarification and disinfection only (not relevant)</li> <li>• drinking water – groundwater</li> <li>• aquatic foods (cooked) (not relevant)</li> <li>• industrial water supply (not listed but relevant to the Project)</li> </ul> River Flow Objective: <ul style="list-style-type: none"> <li>• protect natural pools in dry times</li> <li>• protect natural low flows</li> <li>• maintain wetland and floodplain inundation (not listed but relevant to this case)</li> <li>• maintain natural flow variability (not listed but relevant to this case)</li> <li>• minimise effects of weirs and other structures (not relevant)</li> </ul>
Colo River Management Zone	As above with exception: <ul style="list-style-type: none"> <li>• industrial water supply (not relevant)</li> </ul>

An assessment of the impact of the modification against the NSW Water Quality and River Flow Objectives is presented in **Section 5.2.3**.

### 2.4.2 Managing Urban Stormwater 2004 & 2008

Erosion and sediment control of projects in NSW is guided by the 'Blue Book', Volume 1 of which was prepared by Landcom (2004). The 'Blue Book' was extended by DECC (2008) for use in other areas in Volume 2, including mines and quarries.

Analysis of the potential for erosion was presented in the EIS, including assessment of sediment capture capacity of existing infrastructure.

The proposed modification does not include any proposed change to site water management infrastructure.

### 2.4.3 Guidelines on Controlled Activities on Waterfront Land 2012

Development within 40m of waterfront land requires a controlled activity approval under the *Water Management Act 2000* (NSW). The *Water Management Act 2000* (NSW) defines waterfront land as the bed of any river, lake or estuary and any land within 40 metres of the river banks, lake shore or estuary mean high water mark.

The project is not located within 40m of a watercourse or waterbody and the modification does not comprise additional physical works. Therefore the project or the modification does not require a controlled activity approval.

### 2.4.4 Maximum Harvestable Right Dam Capacity 2006

Licences are not required for harvestable rights dams built on minor streams that capture 10 per cent of the average regional rainfall run-off on land in the Central and Eastern Divisions of New South Wales, and up to 100 per cent on land in the Western Division. The total capacity of all dams on a property allowed under the harvestable right is called the Maximum Harvestable Right Dam Capacity (MHRDC). If a dam is constructed that is larger than the MHRDC, then a licence will be needed for the volume of water that exceeds the MHRDC, unless it is taken under a basic landholder right. An approval for a dam which exceeds the MHRDC is also needed.

Minor watercourses, under the *Water Management (General) Regulation 2011* (NSW), are defined by the Strahler stream ordering method as first-order and second-order watercourses that do not permanently flow. Watercourses shown as broken or continuous on topographic maps listed in the *Water Management (General) Regulation 2011* (NSW) are deemed to be continuous, even if they lose definition and then reappear.

Dams for the control or prevention of soil erosion (gully control structures), where no water is reticulated or pumped from them and the size of the structure is the minimum necessary to fulfil the erosion control function, are exempt from the MHRDC.

It is noted that construction of the dams listed above may require a water supply work approval from DPIWater.

Sediment control structures associated with the project are constructed consistent with the abovementioned definition and therefore a water access licence is not required and given they already exist, a water supply work approval is assumed is also not required.

As noted in **Section 2.4.3**, the modification does not comprise additional physical works; therefore there is no proposed change to erosion and sediment control infrastructure.

### 2.4.5 NSW Aquifer Interference Policy 2012

Surface water processes can lead to interference to groundwater sources.

**Table 2.3** presents the Level 1 Minimal Harm Considerations for the various water sources relevant to the project.

An assessment of the impact of the modification against the NSW Aquifer Interference Policy is presented in **Section 5.2.5**.

**Table 2.3 : Level 1 Minimal Harm Considerations (DPIWater, 2012)**

Water Source	Level 1 Minimal Harm Consideration
Sydney Basin Coxs River Groundwater Source	Water table: <ul style="list-style-type: none"> <li>• less than 10 per cent cumulative variation in the water table, allowing for typical climatic “post-water sharing plan” variations, 40 metres from any high priority groundwater dependent ecosystem or high priority culturally significant site listed in the Schedule of the relevant water sharing plan</li> <li>• a maximum of a 2 metres decline cumulatively at any water supply work</li> </ul> Water pressure: <ul style="list-style-type: none"> <li>• a cumulative pressure head decline of not more than a 2 metres decline, at any water supply work</li> </ul> Water quality: <ul style="list-style-type: none"> <li>• any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 metres from the activity.</li> </ul>
Sydney Basin Richmond Groundwater Source	As above

### 3. Hydrological Setting

This chapter presents the environmental and hydrological setting of the project, including the modification, as well as available environmental monitoring data with respect to flows and quality.

#### 3.1 Environmental Setting

##### 3.1.1 Climate

The climate at Springvale Mine is typical of a cool temperate mountain climate, characterised by cold winters and warm summers. The highest temperatures occur throughout December, January and February, with the coolest temperatures occurring in July. Snow and/or sleet are common in winter months.

##### 3.1.2 Topography

The topography around Springvale Mine comprises narrow gorges with high ridgelines, and steep sided slopes of sandstone cliffs. The cliffs rise above incised valleys, and hilly areas with relatively flat crests and some spurs with moderately sloped ephemeral drainage lines occur within the valleys.

Rivers and streams in the vicinity of Springvale Mine include Sawyers Swamp Creek, the Coxs River, the Wolgan River and Carne Creek.

##### 3.1.3 Hydrology

Mine water discharge currently occurs to the Coxs River via Sawyers Swamp Creek, through Springvale Mine's LDP009. LDP009 is located adjacent the Sawyers Swamp Creek Ash Dam.

The Coxs River is one of the tributaries of Lake Burragorang. Lake Burragorang discharges into the Nepean River and then the Hawkesbury River. Lake Burragorang is the main drinking water supply catchment for Sydney. The Coxs River has been dammed at Lake Wallace and Lake Lyell to provide a water supply for power generation within the Coxs River catchment.

**Figure 3.1** presents the location of LDP009 together with other relevant hydrological features.

##### 3.1.4 Geology

Mining at Springvale is targeted at the Lithgow Seam, which is part of the Illawarra Coal Measures. The Lithgow Seam generally dips at 1 - 2 degrees to the east northeast.

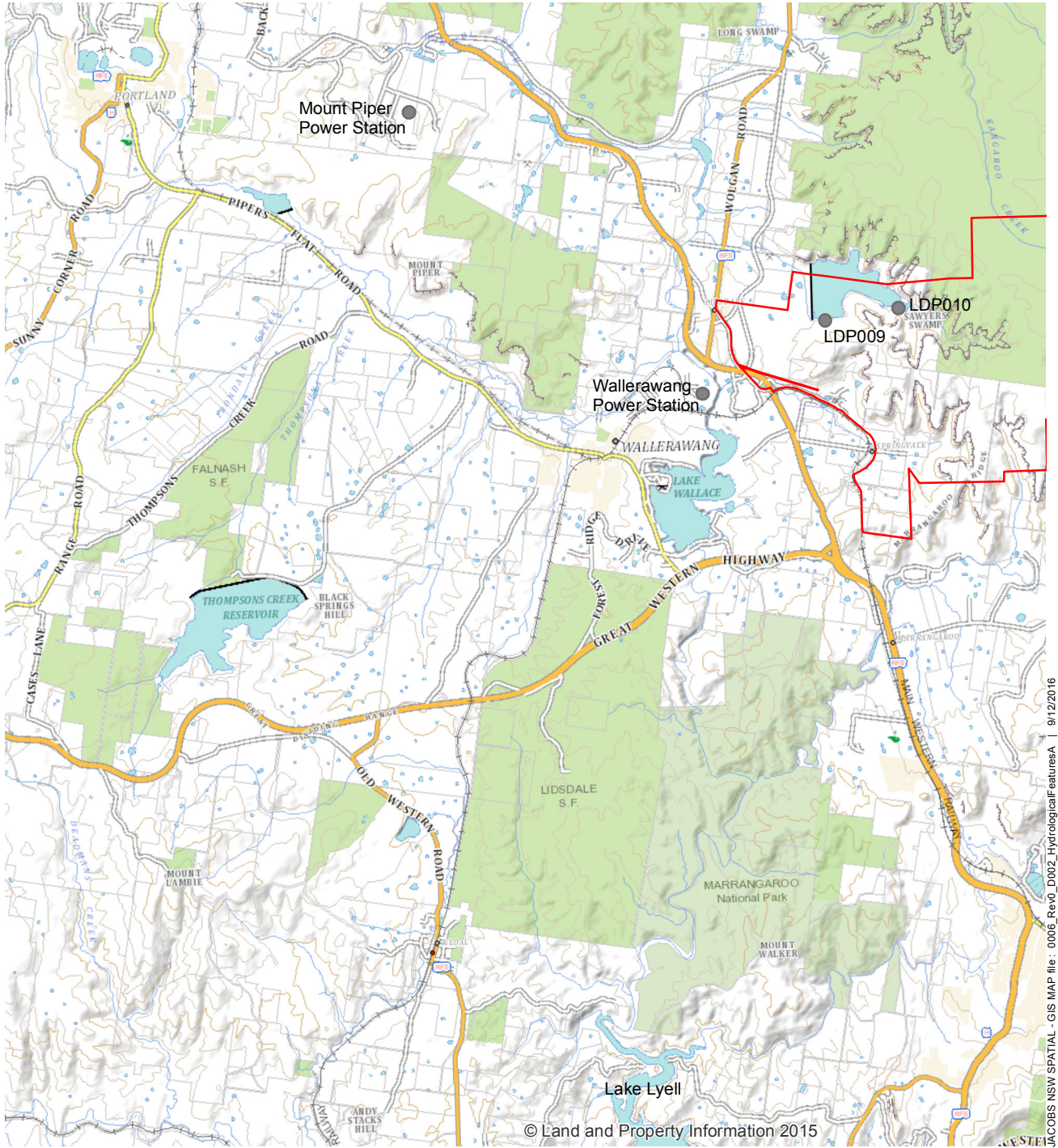
Overlying the Illawarra Coal Measures are the upper Narrabeen Group sandstones and siltstones.

##### 3.1.5 Soil

###### Soil Landscapes

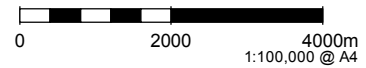
The 1:100,000 soil landscape sheet (Wallerawang) designates the majority of the Upper Coxs River catchment as the Cullen Bullen soil unit. The Cullen Bullen unit is considered to be formed by erosional processes. Australian soil classification is yellow karosols and kandosols (soils with strong texture contrast between A horizons and strongly acid B horizons; generally have unusual subsidence-soils chemistry features such as high Mg, Na and Al). The landscape information sheet indicates moderate gully erosion evident along some drainage lines and minor sheet erosion is common where ground cover has been cleared.

Sawyers Swamp Creek is designated as Disturbed Terrain, reflecting the significant land-use changes in that catchment due to mining as well as waste storage from power generation. Erosion is controlled in Sawyers Swamp Creek through various purpose-built sediment structures. It is noted that there is a surface water



**Legend**

— Project Application Area



Project No. IA132100

**Figure 3-1** | Hydrological Features in the Upper Cocks River Catchment

**Data sources**  
LPI Web Services 2016  
Springvale Coal Pty Ltd

diversion channel around the Sawyers Swamp Creek Ash Dam (SSCAD). The Sawyers Swamp Creek Dry Ash Emplacement Facility, located to the southwest of the SSCAD, is a nil discharge site.

### 3.1.6 Ecology

#### Landscape Units

The Cullen Bullen Landscape Unit comprises extensively cleared, open-woodland, with small isolated remnants of original vegetation comprising various gums (Eucalypt). There is a grass understorey with shrubs such as wattle (Acacia). It is noted that forestry operations have cleared native vegetation and reseeded with pine (Pinus Radiata).

As is expected, the Disturbed Terrain landscape unit reflects the outcomes of past rehabilitation activities.

#### Aquatic Ecology

As identified during the environmental impact assessment of the Springvale Mine Extension Project, there are several indicator species that are subject to toxicological impact due to mine water discharge at LDP009.

As summarised in GHD (2016a), several indicator species were identified as being impacted acutely whilst others were impacted chronically. Investigations concluded that acute impact was associated with the flocculent agent being used to reduce suspended sediment concentration at the point of discharge. A reduction in suspended sediment concentration, which was already low, was a necessary requirement for the water's use at Wallerawang Power Station at the time. The flocculant agent and dosing rate has been changed and the issue of acute toxicity has been ameliorated. Further detail is presented in **Section 4.7** and **Appendix A**.

Analysis suggested that chronic impact may be due to the difference in ionic composition between surface water runoff and groundwater. Further detail is presented in **Section 4.7** and **Appendix A**.

## 3.2 Hydrological Environment

### 3.2.1 Conceptual Model

In the Coxs River catchment, there has been historical disturbance due to past mining activity, including mining within the watercourse directly (such as within Wangcol Creek and Sawyers Swamp Creek), as well as construction of several water supply reservoirs for power generation (Coxs River) and waste disposal facilities (wet and dry ash deposition adjacent Sawyers Swamp Creek). The Coxs River eventually discharges into Lake Burragorang, some 80km downstream of the PAA.

### 3.2.2 Site Water Management

As presented in the Surface Water Assessment at the time of the EIS (RPS, 2014a), the Pit Top consists of structures and facilities such as offices, storage areas, workshops, bathhouse, coal stockpile and mine access amongst others. Some inflows sourced from underground via the Pit Top Collection System are stored in Fire Dam for use as process water.

#### Potable Water Supply

Municipal water supply (potable) is used in the Bathhouse and Administration Buildings to support the existing full-time workforce.

There is no proposed change to water supply requirements associated with the modification.

#### Erosion and Sediment Control

Surface water infrastructure exists at Pit Top to manage sediment generation and potentially contaminated runoff originating from surface activities such as the Workshop.

There is no proposed change to site water management requirement associated with the modification.

### Sewerage

Springvale Mine has been recently (2016) connected to Lithgow City Council's reticulated sewer system. The current and future workforce, including contractors, of 450 full-time-equivalent (FTE) personnel is met by this system.

There is no proposed change to sewerage requirements associated with the modification.

### Mine Water Discharge

Mine water discharge is currently transmitted through the SDWTS to Springvale Coal's LDP009 for discharge to Sawyers Swamp Creek. A small volume is also released from the Pit Top facilities through LDP001. Mean annual daily discharges of 1.8 ML/day from LDP001 to Springvale Creek will continue until end of mine life. Underground inflows to adjacent operation at Angus Place Colliery are also transmitted to Springvale Mine's LDP009. Sawyers Swamp Creek flows into Coxs River and then Lake Wallace.

Amendment to the current Conditions of Consent with respect to water quality of mine water discharge is the subject of this modification. As presented in **Section 1.2**, the interim water quality criterion due to take effect from 30 June 2017 is proposed to be removed. As well, the modification seeks to defer to 30 June 2019, the water quality requirement with respect to ecotoxicology.

Detailed analysis of the impact to regional water quality is presented in **Section 4.4** below. Assessment of ecotoxicology impact is presented in **Section 4.7** and **Appendix A**.

### 3.2.3 Surrounding Land Use

Within the Coxs River catchment, Mount Piper Power Station is situated approximately 10km west-northwest of LW401, adjacent Wangcol Creek. Downstream of Lake Wallace, approximately 13km south-southwest of LW401, is Lake Lyell, which is a water supply reservoir for Mount Piper Power Station, and Wallerawang Power Station when it was operational. Thompsons Creek Reservoir is an offline reservoir and is situated above Mount Piper Power Station, located approximately 12.5km west-southwest of LW401.

It is noted that there is a water distribution network operated by EnergyAustralia between Lake Lyell and Lake Wallace and between Lake Lyell and Mount Piper Power Station/Thompsons Creek Reservoir.

### 3.2.4 Rivers and Creeks

The PAA encompasses two adjacent catchments, the Colo River, of which the Wolgan River, Carne Creek, Nine Mile Creek and Bungleboori Creek are tributaries, and the Upper Coxs River. The catchment divide between these catchments runs in a northwest to southeast direction through the PAA.

**Table 3.1** presents catchment characteristics in the PAA.

**Table 3.1 : Catchment Characteristics in the PAA (after Table 3.3 of RPS (2014a))**

Main Catchment	Sub-Catchment and Strahler Order	Associated Watercourses	Sub-Catchment Area (ha)	% of Catchment Area within PAA (approx.)
Coxs River	Coxs River (5 <sup>th</sup> and 6 <sup>th</sup> )	Wangcol Creek (3 <sup>rd</sup> ), Springvale (2 <sup>nd</sup> ) and Sawyers Swamp Creek (3 <sup>rd</sup> )	13,026	30
	Marrangaroo Creek (4 <sup>th</sup> )	Unnamed watercourses south of PAA	5,495	30%
	Pipers Flat Creek (5 <sup>th</sup> )	Unnamed watercourses	5,948	0%

Main Catchment	Sub-Catchment and Strahler Order	Associated Watercourses	Sub-Catchment Area (ha)	% of Catchment Area within PAA (approx.)
		south of PAA		
Colo River	Wolgan River Western Branch	Wolgan River (4 <sup>th</sup> and 5 <sup>th</sup> )	8,526	9%
	Wolgan River Eastern Branch	Came Creek (5 <sup>th</sup> and 6 <sup>th</sup> )	8,597	30%
	Nine Mile Creek / Bungleboori Creek	Nine Mile Creek (3 <sup>rd</sup> )	4,840	1%

### 3.2.5 Sensitive Environmental Receptors

#### Temperate Highland Peat Swamps on Sandstone

Sensitive environmental receptors include shrub swamps and hanging swamps (THPSS) listed under the EPBC Act. The shrub swamps are also listed under the TSC Act. These ecosystems are considered groundwater dependent.

Discharge to the Newnes Plateau was not proposed as part of the Springvale Mine Extension Project. Potential impact to these ecosystems, as identified in the EIS, is due to subsidence and mining induced change to groundwater contribution to surface water flow.

The proposed modification will not lead to change to predicted impact to the THPSS ecosystems.

#### Coxs River

As presented during the environmental impact assessment for the Springvale Mine Extension Project, ecosystems within the Coxs River catchment are in an already adapted state (Golder Associates, 2014).

The proposed modification is a continuation of historical discharge at current and historical quality, for a further period, prior to commencement of the Springvale Water Treatment Project. Assessment of the impact of the modification to regional water quality is presented in **Section 4.4**. Assessment of the impact on ecotoxicological impact is presented in **Section 4.7** and **Appendix A**.

### 3.2.6 Surface Water Users

**Table 3.2** presents the identified surface water users in the Upper Nepean and Upstream Warragamba Water Source (Wywandy Management Zone) that are downstream of the project and may, potentially, be impacted.

Table 3.2 : Surface Water Users in the Upper Nepean and Upstream Warragamba Water Source (Wywandy Management Zone)

WAL No.	Licence Class and Entitlement (ML)	Works Approval No.	Lot/DP	Location	Comments
<i>Downstream of the project (current)</i>					
25607	Unregulated River (10ML)	10CA103248	8/2452472	Coxs River, 250m downstream of junction with Sawyers Swamp Creek.	3.5km downstream of Springvale LDP009
27428	Major Utility [Power Generation] (25,000ML <sup>a</sup> )	10CA117220	3/1181412	Lake Wallace	7.4km downstream of Springvale LDP009
<i>Downstream of the project (far field)</i>					
27428	Major Utility [Power Generation] (25,000ML <sup>a</sup> )	10CA117220	1181411	Lake Lyell	22.6km downstream of Springvale LDP009
27431	Major Utility [Urban Water] (620,000ML)	10CA117212	n/a	Lake Burragorang	~80 km downstream of Springvale LDP009

Note: a) Entitlement split across Lake Wallace, Lake Lyell and Thompsons Creek Reservoir

### 3.3 Hydrological Investigation

#### 3.3.1 Surface Monitoring Network

Surface water monitoring at Springvale Mine comprises monitoring of flow and quality in rivers and creeks as well as monitoring within shrub swamps (flow and quality). Further detail is presented in RPS (2014a).

#### 3.3.2 Surface Water Flows

DPIWater undertakes surface water flow monitoring at several locations within the Coxs River catchment. Of relevance to Springvale Mine is the gauging station upstream of Lake Wallace (DPIWater Gauge No. 212054). As noted in **Section 3.2.2**, mine water discharge to Sawyers Swamp Creek flows into the Coxs River and then Lake Wallace.

**Figure 3.2** presents daily discharge of the Coxs River at DPIWater Gauge No. 212054. Also presented in **Figure 3.2** is the calibration time-series (Node #047) from the Regional Water Quality Impact Assessment Model (RWQIAM) (Jacobs, 2015a). The RWQIAM is discussed in detail in **Section 4.4**.

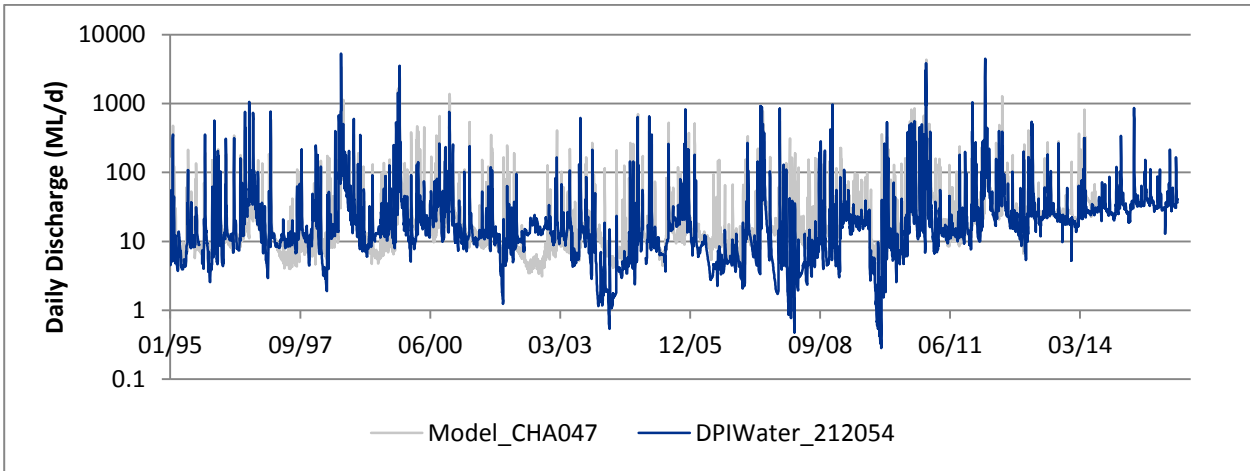


Figure 3.2 : Time-Series Flow at Lake Wallace (Node #047) (DPIWater Station No. 212054)

### 3.3.3 Surface Water Quality

DPIWater also undertakes surface water quality monitoring upstream of Lake Wallace (DPIWater Gauge No. 212054).

Figure 3.3 presents daily water quality (salinity, mg/L; converted assuming translation from electrical conductivity ( $\mu\text{S}/\text{cm}$ ) to salinity (mg/L) is 0.67) upstream of Lake Wallace. Output from the RWQIAM (Jacobs 2015a) is also presented in Figure 3.3.

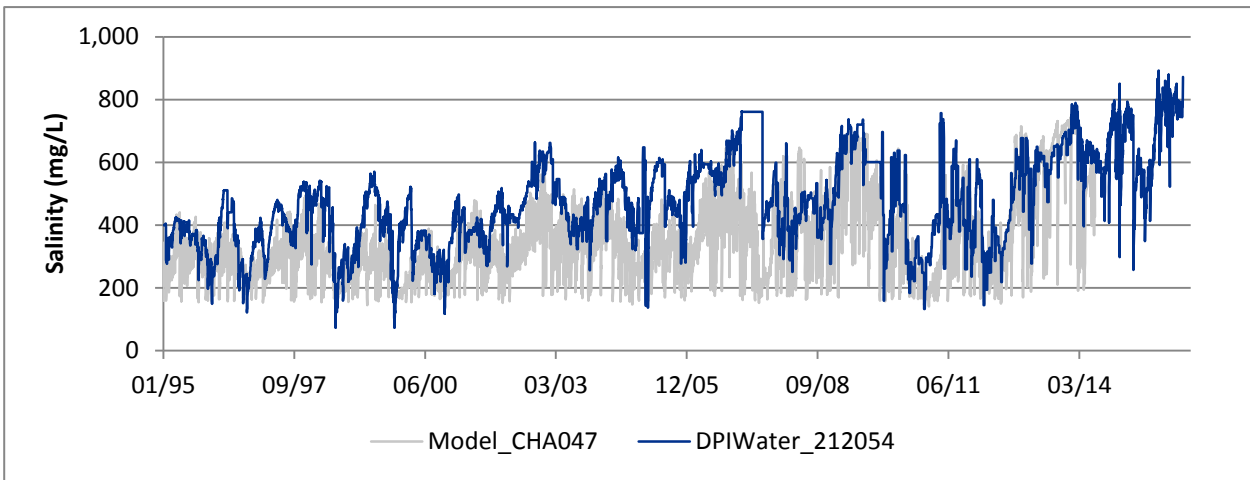


Figure 3.3 : Time-Series Quality at Lake Wallace (DPIWater Station No. 212054)

## 4. Hydrological Analysis

This chapter presents the predicted change to the hydrological environment as a result of the modification.

### 4.1 Proposed Modification

The modification application seeks to:

- Amend Schedule 4 Condition 12 of SSD 5594 (Table 6: Water Management Performance Measurements: Mine Water Discharges) as follows:
  - to remove the requirement to “Meet limits for salinity of 700 (50th percentile), 900 (90th percentile) and 1,000 (100th percentile)  $\mu\text{S/cm EC}$  by 30 June 2017”.
  - to defer to 30 June 2019 the requirement to “Eliminate acute and chronic toxicity from LDP009 discharges to aquatic species by 30 June 2017, with acute toxicity defined as >10% effect relative to the control group and chronic toxicity defined as >20% effect relative to the control group”.

The proposed modification will allow the Springvale Mine to continue to discharge mine water at the current water quality criteria until the Water Treatment Project (SSD 7592) assessment and construction has been completed, and the project has been commissioned.

### 4.2 Site Water Balance

There is no proposed change to the site water balance associated with the proposed modification.

The proposed modification is a continuation of historical discharge at current and historical quality, for a further period, prior to commencement of the Springvale Water Treatment Project.

Assessment of continuation of mine water discharge to LDP009 is presented in **Section 4.4** below.

### 4.3 Erosion and Sediment Control

There is no proposed change to site water management as a result of the proposed modification.

Assessment of continuation of mine water discharge on geomorphology is presented in **Section 4.5** below.

### 4.4 Regional Water Flow and Quality Modelling

#### 4.4.1 Approach to Analysis

During the environmental impact assessment for the Springvale Mine Extension Project, the RWQIAM was developed in 2014 (RPS, 2014b) and then updated in 2015 (Jacobs 2015ab). The RWQIAM was used to predict the impact to flow and quality (salinity) of mine water discharge associated with the Angus Place and Springvale Mine Extension Projects. The update to the model in 2015 incorporated the change in status at Angus Place Colliery to Care and Maintenance.

The RWQIAM has been updated during the current assessment of the proposed modification at Springvale.

As an aside, it is noted that the model used for assessment of the Springvale Water Treatment Project (SSD 7592) is referred to as the Regional Water and Salt Balance. That model was presented as an appendix to the Surface Water Impact Assessment of the Springvale Mine Extension Project (RPS, 2014a) and was subsequently updated for the Springvale Water Treatment Project.

The Regional Water and Salt Balance, which also uses the AWBM, is parameterised in a different way to the RWQIAM, and comprises each of the detailed site water balances integrated into a single water balance. Detail

of the Regional Water and Salt Balance is presented in the Water Resources Impact Assessment for the Springvale Water Treatment Project (GHD, 2016bc).

#### **4.4.2 Model Calibration**

As presented in RPS (2014b) and Jacobs (2015a), the RWQIAM was calibrated to flow and water quality (salinity) at available monitoring locations within the Coxs River catchment, through to Lake Burragorang.

The calibration period was 1 January 1979 to 30 June 2014.

#### **Model Version**

The model was prepared in GoldSIM, Version 10.5.4 and was based on the Australian Water Balance Model (AWBM). GoldSIM is an object-based programming platform, whereas AWBM is the rainfall/runoff code.

During this update, the version of GoldSIM was updated from 10.5.4 to 11.1.6. Review indicated that the change in version of GoldSIM had negligible impact on previously presented results.

#### **Minor Change to Area**

The structure of the RWQIAM was reviewed (280 sub-catchments) and minor corrections to area were made to four (4) model sub-catchments. Those changes led to minor changes in model predictions (both with respect to the calibration and prediction models).

#### **Detailed Site Water Balances**

As noted in Section 3.1.2 of RPS (2014b), mine water discharge dominates outflow from Springvale and Angus Place Mines and local LDPs, such as Angus Place LDP002, Springvale LDP001 and LDP002 (at the time) were assumed to be represented by catchment runoff through sediment retention structures, without attenuation of flow or salinity. In a similar way, the management of water at Lidsdale Siding and Western Coal Services were assumed to be represented by catchment runoff without attenuation of flow or salinity. As presented in RPS (2014b) and Jacobs (2015a), changes to land-use were incorporated in the prediction simulation to represent new development and/or progressive remediation within the catchment, including at Pine Dale Coal Mine and other sites.

Details of site water management within individual site water balances, accordingly, whilst represented generally in the model, are not considered to be critical with respect to the assessment of impact of current and proposed discharge to the Coxs River. This is due to the approach adopted, through use of a null case (no change to currently approved conditions), which allows comparison to the proposed case, independent of residual issues with respect to model calibration and/or assumed conditions in the prediction simulation, since those aspects are included in both the null case (approved conditions) and the proposed case (modified conditions).

#### **Seepage from Mt Piper Ash Placement Facility**

As stated in Jacobs (2015a), there was an assumption regarding potential seepage from the Ash Placement Facility into Wangcol Creek in the original version of the RWQIAM presented in RPS (2014b). As noted in Jacobs (2015a), this was accepted as being overestimated.

The assumption was revisited and the magnitude of assumed seepage was reduced by a factor of 10 to 0.5% of assumed water demand (equivalent to ~2.5L/s at maximum) from the previously used value of 5% of assumed water demand.

In this update, the quality of the fit to salinity data at DPI Water Station No. 212055, upstream of the Springvale Coal Services site, was maintained by also amending the assumed mass flux. As noted in Jacobs (2015a) the change in assumed flow, however, leads to a greater discrepancy in fit to historical flow record at Station No. 212055, and in turn a deterioration in fit to the historical flow record at Station No. 212054 downstream in this

current assessment. The impact of this change is not considered significant in the context of impact assessment of the proposed modification.

In the prediction simulation, presented below, the update to the assumed seepage from Mt Piper, albeit considered to be minor in magnitude, was assumed to be eliminated from 1 July 2017, under the presumption that the issue will be either resolved by that date and/or found to be inconsequential.

### Assumed Water Demand

No change was made to the assumed water demand at Wallerawang Power Station and Mount Piper Power Station from that presented in RPS (2014b) and Jacobs (2015a).

### Assumed Full Storage Level at Lake Lyell

The assumed full storage level at Lake Lyell was updated in both the calibration and prediction models from 34,451ML to 32,109ML.

### Evaporation Factor

The evaporation factor applied to AWBM soil storages was changed from 0.85 to 1.0. This led to only minor improvement to model calibration.

### Parameterisation of AWBM

Parameterisation of the RWQIAM was reviewed; however, no changes were made.

**Table 4.1** presents the calibrated AWBM and water quality parameters (adapted from Jacobs (2015a)).

**Table 4.1 : Calibrated AWBM and Water Quality Parameters (adapted from Table 3.2 of Jacobs (2015a))**

Land-Use	C1 (mm)	C2 (mm)	C3 (mm)	Cave <sup>1</sup> (mm)	BFI <sup>2</sup>	Kb <sup>2</sup>	Ks <sup>2</sup>	Concn <sup>3</sup> (mg/L)
Natural	12.5	128.0	256.0	168	0.25	0.98	0.3	50
Pasture	14.3	146.3	292.7	192	0.25	0.98	0.3	150
Urban	2.0	20.6	41.2	27	0.25	0.98	0.6	400
Disturbed	5.6	60.2	120.4	79	0.25	0.98	0.3	600
Channel	2.0	20.6	41.2	27	0.25	0.98	0.6	325

1. Assumed pattern of distribution of partial areas is  $A_1 = 0.134$ ,  $A_2 = 0.433$ ,  $A_3 = 0.433$  for all land-use classes; 2. BFI is Baseflow Index, Kb is daily baseflow recession constant and Ks is daily surface recession constant; 3. Concn is assumed runoff salinity from each land-use class.

### Model Results

The model control file associated with the updated calibration simulation is:

- 0006\_Rev0\_CAL-Jun14\_02g.gsp

Output from the model is presented at Node #047 in **Figure 4.1**, which is located immediately upstream of Lake Wallace, coincident with the location of DPI Water Station No. 212054. **Figure 4.2** presents the distribution plot for flow and salinity at Node #047 respectively. **Table 4.2** presents the daily statistics with respect to this model node, including comparison to the previous calibration. The location of these points is illustrated in **Figure 4.3**.

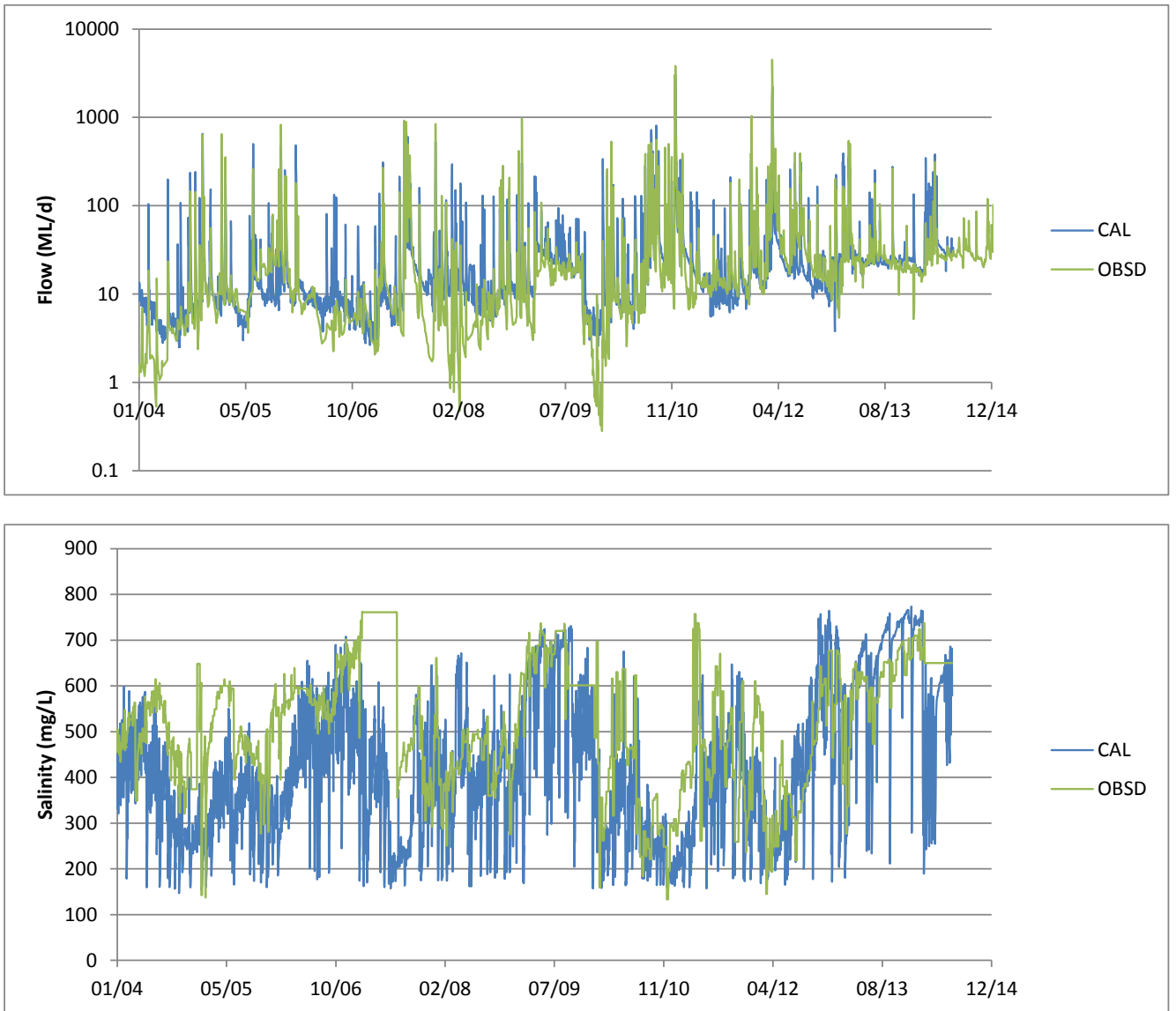


Figure 4.1 : Calibration Model Output (Node#047, Coxs River above Lake Wallace, Gauge No. 212054/WX9/E013)

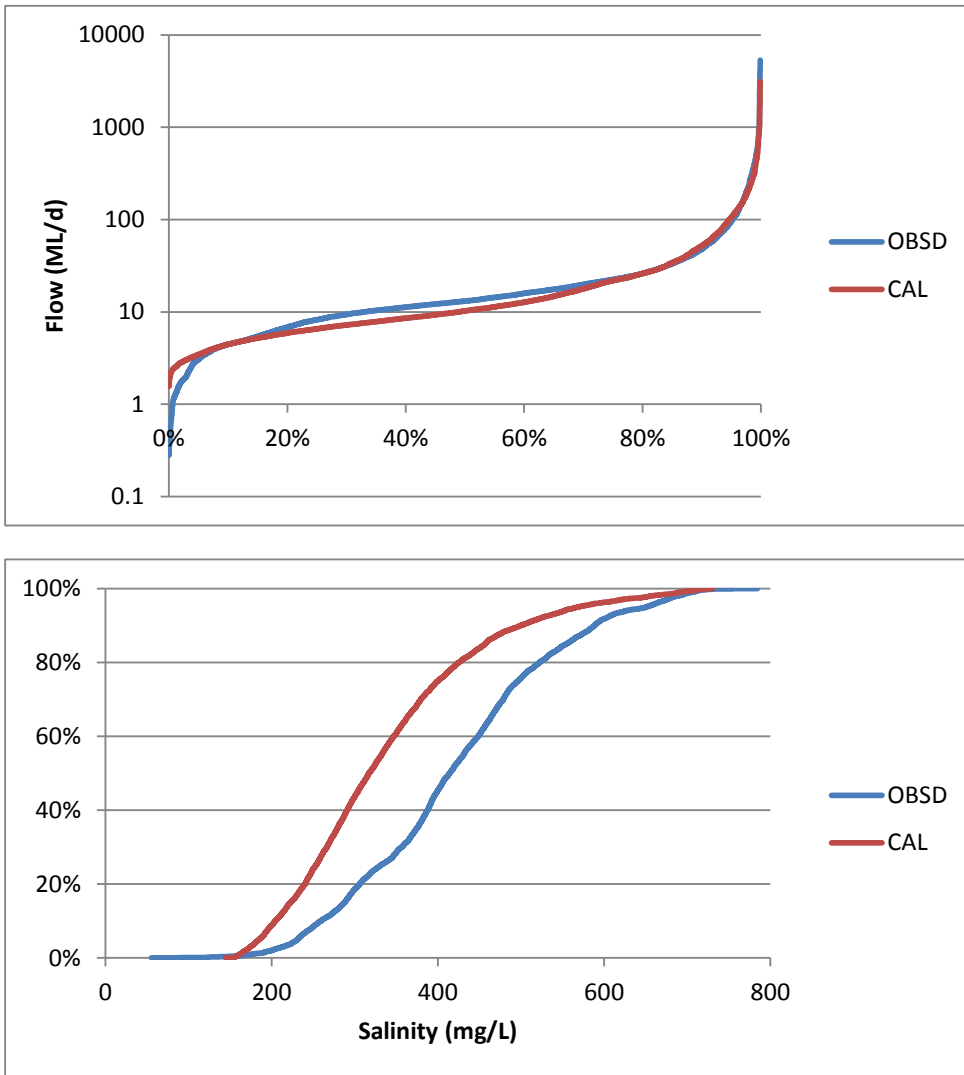
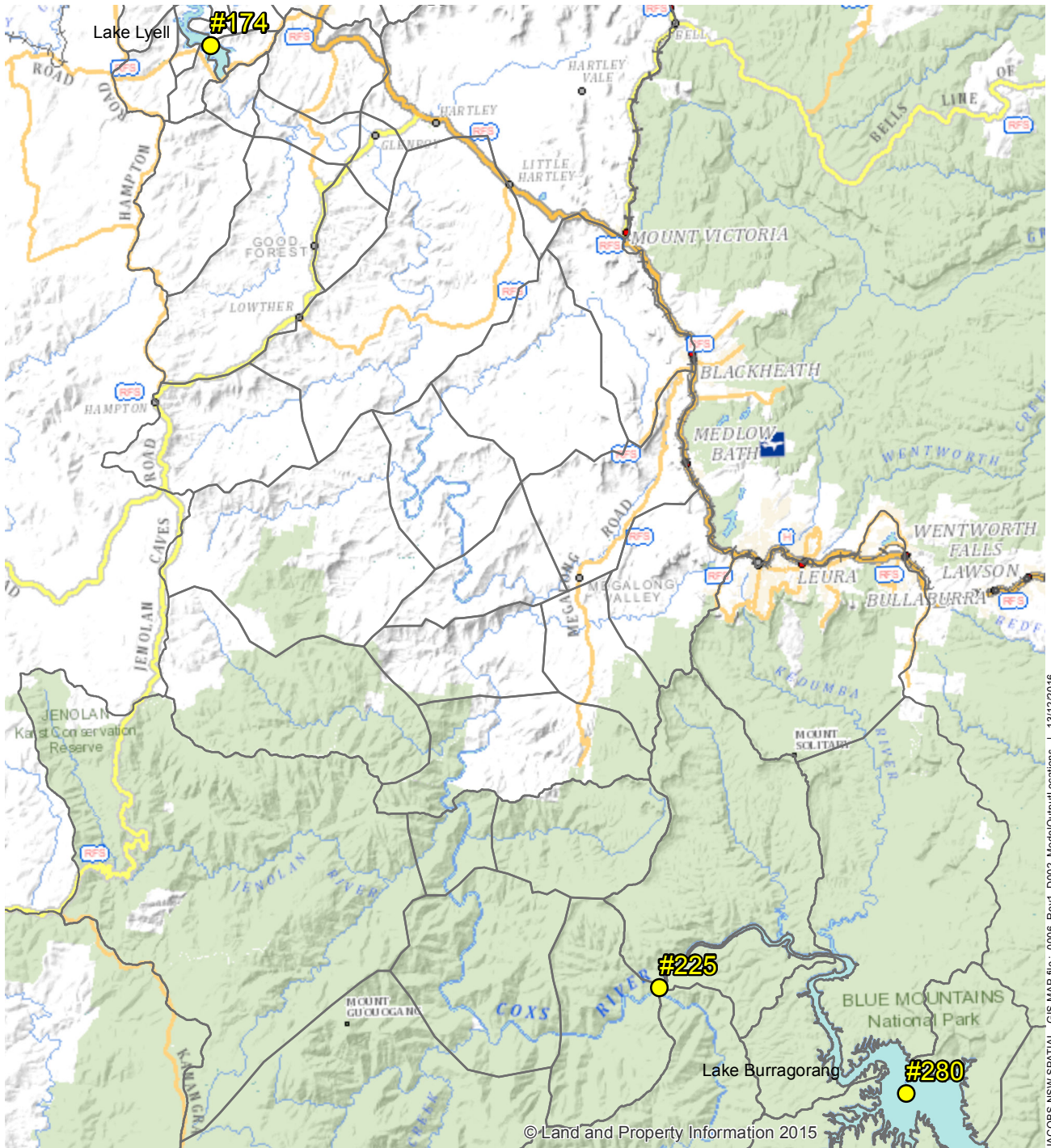


Figure 4.2 : Calibration Distribution Plot (Node#047, Coxs River above Lake Wallace, Gauge No. 212054/WX9/E013)

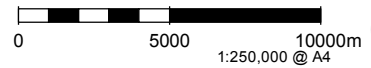
Table 4.2 : Calibration Daily Statistics (Node#047, Coxs River above Lake Wallace, Gauge No. 212054/WX9/E013)

Percentile	Flow (ML/d)			Salinity (mg/L)		
	EIS-CAL	OBSD	CAL	EIS-CAL	OBSD	CAL
Minimum	2.0	0.3	1.6	141	55	145
5%	5.0	3.1	3.5	180	231	185
10%	6.1	4.5	4.5	198	259	205
20%	7.8	6.8	5.9	231	306	240
50%	13	13	10.2	291	414	317
80%	32	26	26	373	522	426
90%	63	47	51	429	588	500
95%	126	93	104	487	651	569
Maximum	4318	5321	3116	733	785	731



**Legend**

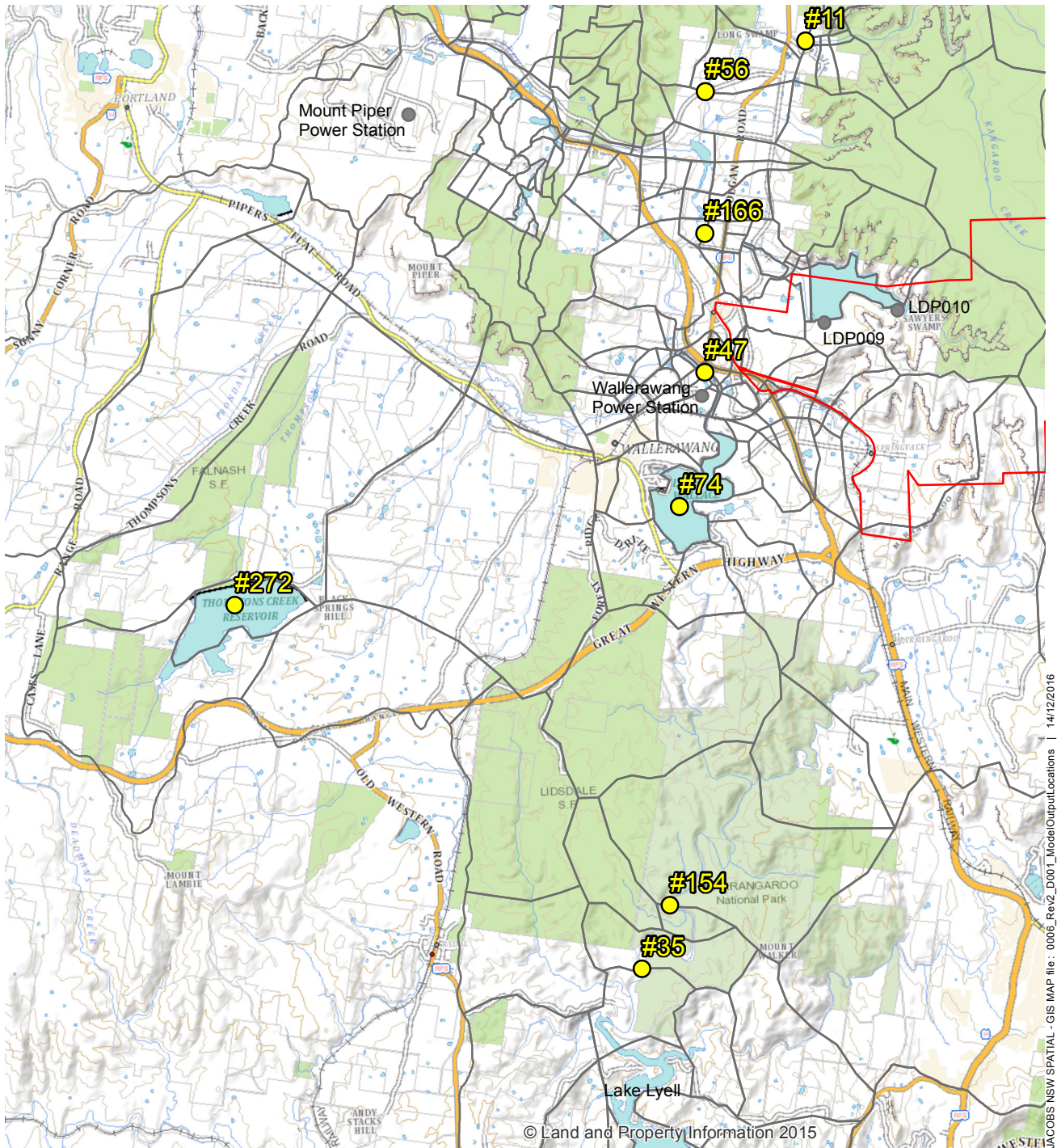
▭ RWQIAM\_SubCatchments



Project No. IA132100

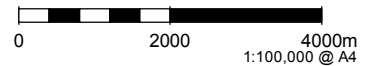
**Figure 4-3** | Model Discretisation and the Location of Model Output

**Data sources**  
 LPI Web Services 2016  
 Springvale Coal Pty Ltd



**Legend**

- Project Application Area
- RWQIAM\_SubCatchments



Project No. IA132100

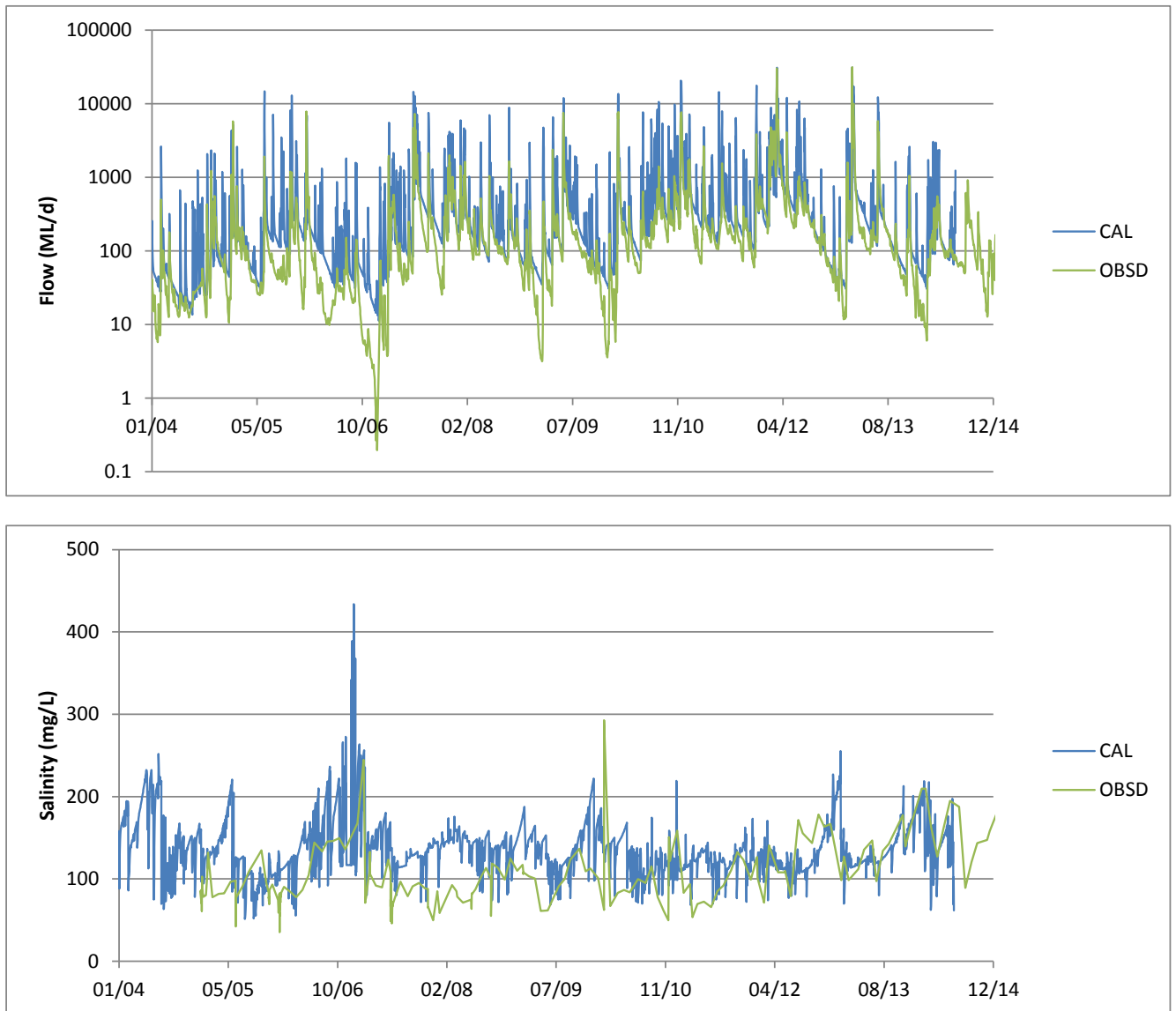
**Figure 4-3** | Model Discretisation and the Location of Model Output

**Data sources**  
 LPI Web Services 2016  
 Springvale Coal Pty Ltd

JACOBS NSW SPATIAL - GIS MAP file: 0006\_Rev2\_D001\_ModelOutputLocations | 14/12/2016

From **Figure 4.1**, **Figure 4.2** and **Table 4.2** it is demonstrated there is a reasonable fit between modelled and observed salinity and flow, and is comparable to that presented in RPS (2014b) and Jacobs (2015a). As noted in the original studies, the fit to flow at Node #047 is superior to the fit to quality (salinity) at this location.

Output from the model at the Coxs River immediately upstream of Lake Burragarang is presented in **Figure 4.4**. That location is associated with Node #225 and corresponds to DPI Water Station No. 212250. **Figure 4.5** presents the distribution plot for flow at Node #225. It is noted that there is not sufficient data to develop a distribution plot for salinity. **Table 4.3** presents the daily statistics with respect to this model node, including comparison to the previous calibration.



**Figure 4.4 : Calibration Model Output (Node#225, Coxs River above Lake Burragarang, Gauge No. 212250/E083)**

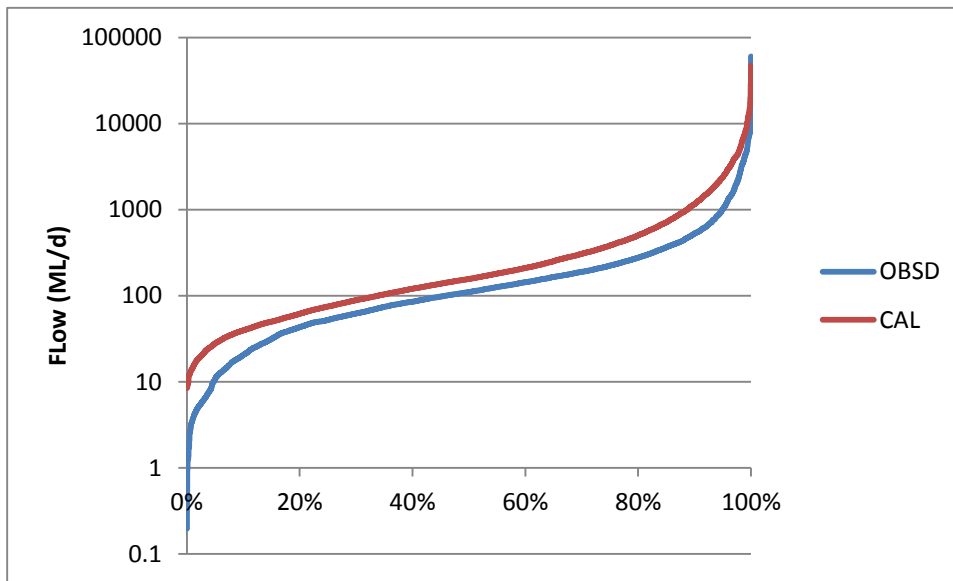


Figure 4.5 : Calibration Distribution Plot (Node#225, Coxs River above Lake Burratorang, Gauge No. 212250/E083)

Table 4.3 : Calibration Daily Statistics (Node#225, Coxs River above Lake Burratorang, Gauge No. 212250/E083)

Percentile	Flow (ML/d)			Salinity (mg/L)		
	EIS-CAL	OBSD	CAL	EIS-CAL <sup>b</sup>	OBSD <sup>a</sup>	CAL
Minimum	9.5	0.2	8.4	52	n/a	51
5%	36	10.8	28	84	n/a	82
10%	51	21	40	94	n/a	92
20%	82	43	62	105	n/a	106
50%	204	111	156	122	n/a	124
80%	650	277	503	139	n/a	144
90%	1530	531	1159	151	n/a	158
95%	3140	1,021	2374	166	n/a	178
Maximum	58207	60201	47040	353	n/a	434

Notes. a) Whilst water quality observation data (salinity) is available at Node #225, the quantity of data is not sufficient to develop a meaningful distribution plot; b) distribution determined using the whole output series;

#### 4.4.3 Model Prediction

As presented in RPS (2014b) and Jacobs (2015a), the RWQIAM was used to predict flow and water quality (salinity) within the Coxs River, through to Lake Burratorang.

The prediction period was 1 July 2014 to 31 December 2032. It is noted that the previously modelled end of the prediction simulation was 31 December 2032 and this was retained in the updated simulation, for the purpose of consistency.

#### Model Version

The prediction simulation was updated from Jacobs (2015a) to the current version of GoldSIM, 11.1.6.

Comparison was made between model output presented in Jacobs (2015a) and updated prediction simulation and it was found that there was negligible difference due to the change in version of GoldSIM.

**Initial Conditions**

Output from the calibration simulation, with respect to water and mass storage in the various modelled reservoirs were used as the initial condition for prediction simulations.

**Seepage from Mt Piper Ash Placement Facility**

The assumed seepage from the Ash Placement Facility into Wangcol Creek was reduced by a factor of 10 to 0.5% of modelled water demand at Mt Piper Power Station, as per the approach adopted for the calibration simulation. The assumed seepage was modelled to apply from 1 July 2014 to 30 June 2017. Following 1 July 2017, the assumed seepage from the facility was disabled, under the presumption that the issue will be either resolved by that date and/or found to be inconsequential.

**Assumed Full Storage Level at Lake Lyell**

The assumed full storage level at Lake Lyell was updated in the prediction simulation from 34,451ML to 32,109ML.

**Mine Water Inflows**

As per the approach adopted in RPS (2014b) and Jacobs (2015a), mine water discharge was assumed to dominate the local site water balance at Springvale and Angus Place. Accordingly, the current revision of predicted inflows to underground workings were used in the prediction simulation. This was based on CSIRO (2016); incorporating the translocation in time for the approved and now modelled other longwalls.

Figure 4.6 presents the assumed mine inflow distribution.

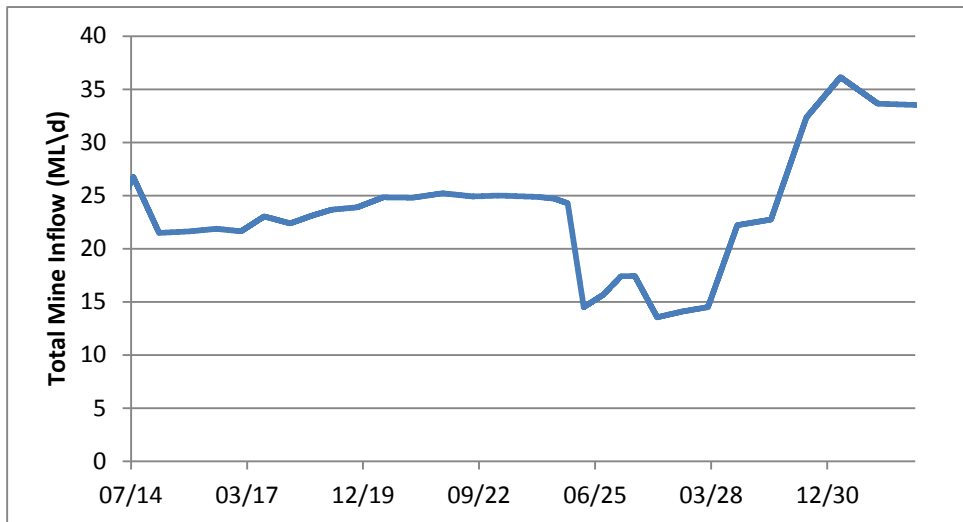


Figure 4.6 : Assumed Mine Inflow Distribution (ML/d, adapted from CSIRO (2016))

It is noted that Water Strategy WS2b from Jacobs (2015a) was adopted in the simulations presented in this report. Water Strategy WS2b comprised an assumed discharge at Angus Place LDP001 of 2ML/d, with the remainder discharged at Springvale LDP009. The capacity of infrastructure to transfer greater than 30ML/d to LDP009 was assumed to be available and is understood can be achieved using existing infrastructure. For the purpose of the simulation, it was assumed that the current limit to discharge at LDP009 (EPL) of 30ML/d was assumed to be increased to 50ML/d, as per the EIS.

As noted in Jacobs (2015a), results from the RWQIAM, with respect to Water Strategy WS2a and WS2b, are identical from above Lake Wallace through to Lake Burragorang. Water Strategy WS2a considered discharge at LDP009 to 30ML/d and Angus Place LDP001 at 2ML/d, with mine inflows greater than 30ML/d discharged via Angus Place LDP001. The current limit to discharge at Angus Place LDP001 (EPL) of 2ML/d was not considered in that simulation. Only the results from the WS2b-S simulation are presented in this report.

### Water Quality Criteria

There are several water quality criterion specified in Table 6: Water Management Performance Measures of the Conditions of Consent (SSD 5594) with respect to mine water discharge. These are quoted as follows:

- *“Discharge all groundwater inflow mine water (except from the Renoun workings) through the Springvale Delta Water Transfer Scheme*
- *Meet limits for salinity of 700 (50<sup>th</sup> percentile), 900 (90<sup>th</sup> percentile) and 1,000 (100<sup>th</sup> percentile)  $\mu\text{S/cm EC}$  by 30 June 2017*
- *Meet a limit for salinity of 500 (90<sup>th</sup> percentile)  $\mu\text{S/cm EC}$  by 30 June 2019*
- *Eliminate acute and chronic toxicity from LDP009 discharges to aquatic species by 30 June 2017, with acute toxicity defined as >10% effect relative to the control group and chronic toxicity defined as >20% effect relative to the control group”.*

The above conditions refer to mine water discharge quality. There is not an equivalent condition with respect to mine water discharge quantity. Discharge of water to land is administered through the Environmental Protection Licence system. At Springvale, a quality and quantity limit is specified at most Licensed Discharge Points.

The proposed modification, as outlined in **Section 1.2** and with respect to the above, refers to the omission of point two and the deferral of point three. Point two is assessed using the RWQIAM and is discussed below. Point three is addressed separately in **Section 4.7**.

It is noted that the June 2019 water quality criteria provides the opportunity for emergency discharge, should it be required, noting, however, that the limits to acute and chronic toxicity would still need to be met.

#### 1 July 2017 to 30 June 2019

For the period 1 July 2017 to 30 June 2019, water quality (salinity) must exhibit the following characteristics:

- 700 $\mu\text{S/cm}$  for 50<sup>th</sup> percentile
- 900 $\mu\text{S/cm}$  for 90<sup>th</sup> percentile
- 1000 $\mu\text{S/cm}$  for 100<sup>th</sup> percentile

There are two interpretations of the above criteria:

- Linear Fit
- Stepped Fit

The Linear Fit assumption assumes a linear difference between the 0<sup>th</sup> percentile (set at 500 $\mu\text{S/cm}$ ) and the 50<sup>th</sup> percentile (700 $\mu\text{S/cm}$ ), a linear difference between the 50<sup>th</sup> and the 90<sup>th</sup> percentile (900 $\mu\text{S/cm}$ ) and a linear difference between the 90<sup>th</sup> percentile (900 $\mu\text{S/cm}$ ) and the 100<sup>th</sup> percentile (1000 $\mu\text{S/cm}$ ).

The Linear Fit assumption is presented in **Figure 4.7**.

An alternative interpretation is the Stepped Fit assumption. The Stepped Fit assumption assumes a constant value for salinity between the 0<sup>th</sup> percentile (set at 700 $\mu\text{S/cm}$ ) and the 50<sup>th</sup> percentile (700 $\mu\text{S/cm}$ ), and a constant value for salinity between 51<sup>st</sup> percentile (900 $\mu\text{S/cm}$ ) and the 90<sup>th</sup> percentile (900 $\mu\text{S/cm}$ ) and a constant value between 91<sup>st</sup> percentile (1000 $\mu\text{S/cm}$ ) and the 100<sup>th</sup> percentile (1000 $\mu\text{S/cm}$ ).

The Stepped Fit assumption is presented in **Figure 4.8**.

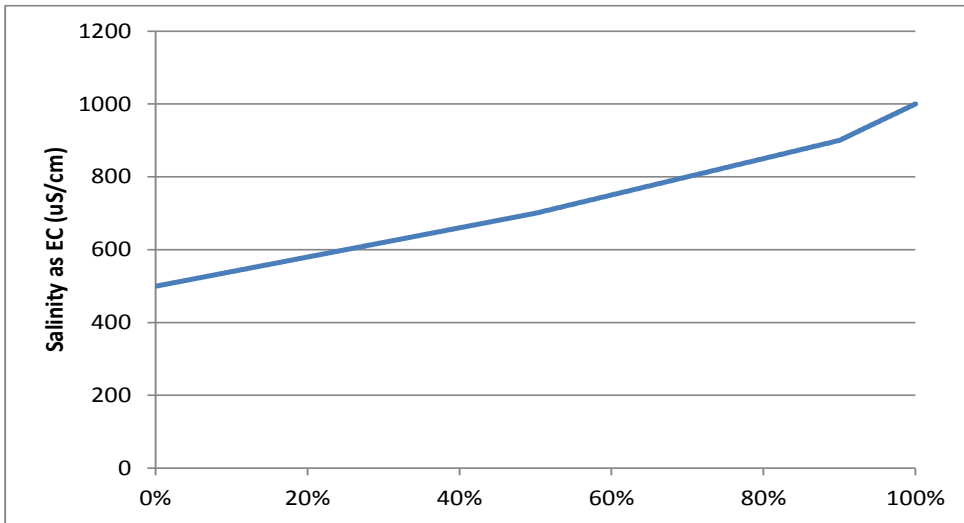


Figure 4.7 : Linear Fit assumption for the 2017 Water Quality Criteria

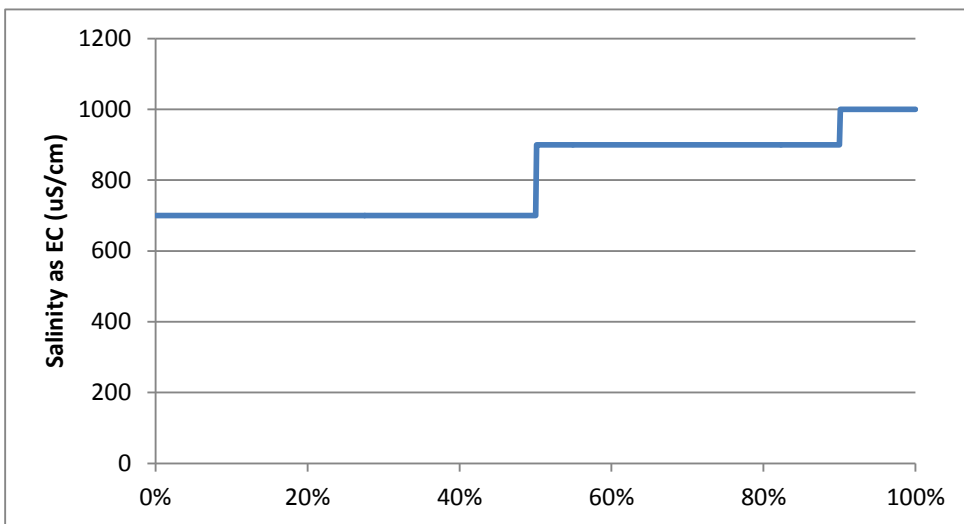


Figure 4.8 : Stepped Fit assumption for the 2017 Water Quality Criteria

1 July 2019 to 31 December 2032

For the period 1 July 2019 to 31 December 2032 water quality (salinity) must exhibit the characteristic specified below:

- 500µS/cm for 90<sup>th</sup> percentile

There are again two interpretations of the above water quality criteria:

- Linear Fit
- Stepped Fit

The Linear Fit assumption, as modelled, assumes a linear difference between 0<sup>th</sup> percentile (set at 350µS/cm) and 50<sup>th</sup> percentile (set as 400µS/cm), a linear difference between the 50<sup>th</sup> percentile and the 90<sup>th</sup> percentile (500µS/cm) and a linear difference between the 90<sup>th</sup> percentile (500µS/cm) and the 100<sup>th</sup> percentile (set at 1200µS/cm, consistent with the salinity of current mine water discharge and the current EPL limit at LDP009).

The Linear Fit assumption for the period 1 July 2019 to 31 December 2032 is presented in **Figure 4.9**.

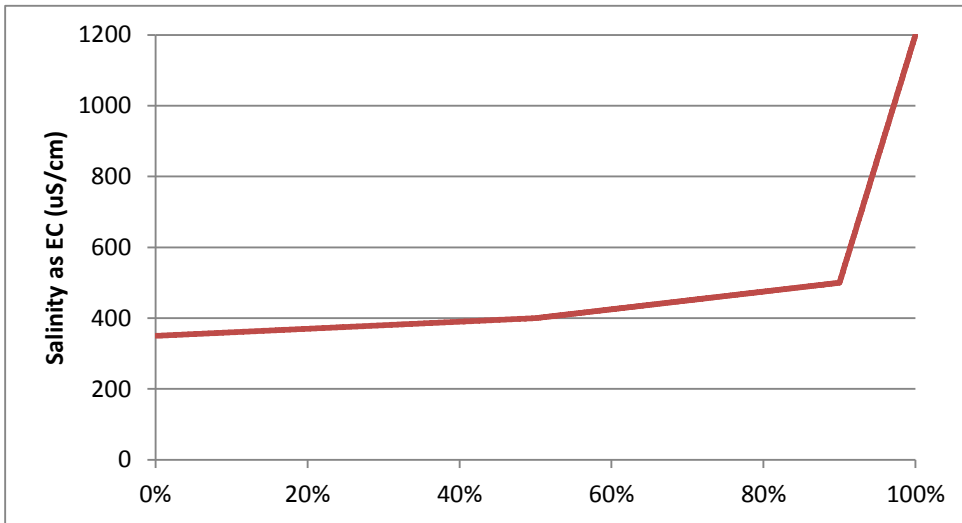


Figure 4.9 : Linear Fit assumption for the 2019 Water Quality Criteria

The Stepped Fit interpretation assumes a constant value for salinity between the 0<sup>th</sup> percentile (set at 500µS/cm) and the 90<sup>th</sup> percentile (500µS/cm), and a constant value for salinity between 91<sup>st</sup> percentile (set at 1200µS/cm, consistent with the salinity of current mine water discharge and the current EPL limit at LDP009) and the 100<sup>th</sup> percentile (set at 1200µS/cm).

The Stepped Fit assumption for the period 1 July 2019 to 31 December 2032 is presented in **Figure 4.10**.

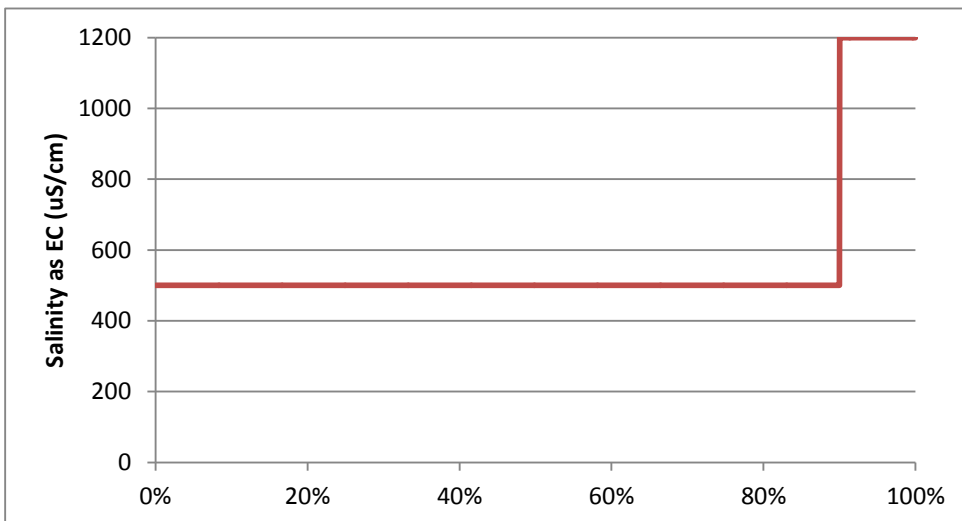


Figure 4.10 : Stepped Fit assumption for the 2019 Water Quality Criteria

### Mine Water Discharge

To assess the impact of the proposed modification in the RWQIAM, several time-series were generated.

The approach adopted in the assessment is an improvement to the approach presented in RPS (2014b) and Jacobs (2015b), insofar as it attempts to incorporate the observed natural variability in the salinity of mine water discharge, as opposed to assuming a constant static value.

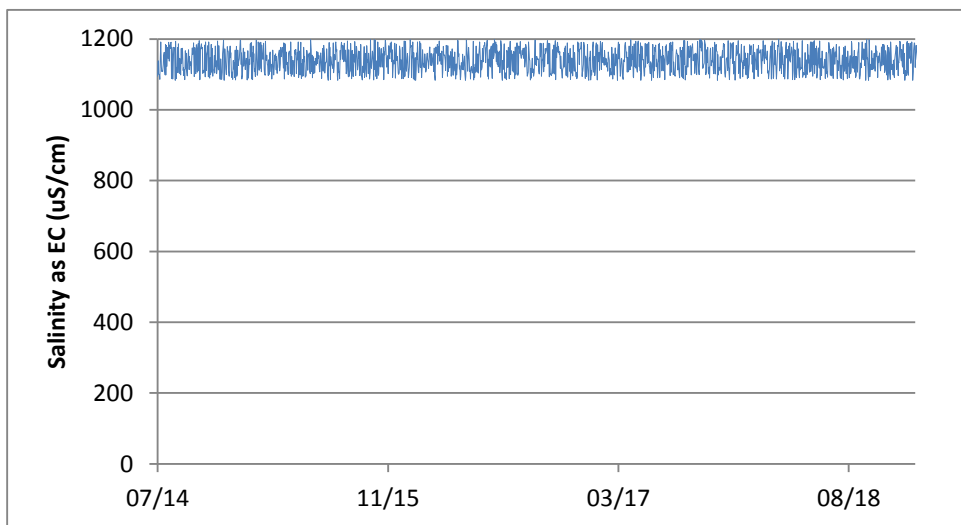
### Angus Place Colliery

At Angus Place LDP001, for the period 1 July 2014 to 31 December 2032, a randomly generated salinity time-series, with a mean of 1140 $\mu$ S/cm and a standard deviation of 30 $\mu$ S/cm was determined.

The mean and standard deviation were obtained from review of the historical water quality record (selected) at Springvale LDP009.

The generated time-series was used in the Approved and the Proposed simulations at Angus Place LDP001.

**Figure 4.11** presents an extract of the generated time-series.



**Figure 4.11 : Extract of the Randomly Generated Salinity Time-Series used at Angus Place LDP001**

### Springvale Mine

#### *Approved Simulation*

The Approved Simulation (null case) comprised a simulation complying with both the 2017 and the 2019 water quality criteria.

The following time-series were used in the Approved Simulation:

- For the period 1 July 2014 to 30 June 2017, a randomly generated salinity time-series, with a mean of 1140 $\mu$ S/cm and a standard deviation of 30 $\mu$ S/cm, was determined. It is noted that this was a separate series to that used at Angus Place LDP001.
- For the period 1 July 2017 to 30 June 2019, a time-series was generated by randomly sampling the water quality criteria function presented in **Figure 4.7** (Linear Fit) and **Figure 4.8** (Stepped Fit).
- For the period 1 July 2019 to 31 December 2032, a time-series was generated by randomly sampling the water quality criteria function presented in **Figure 4.9** (Linear Fit) and **Figure 4.10** (Stepped Fit).

**Figure 4.12** presents the adopted time-series for the period 1 July 2014 to 1 July 2017.

**Figure 4.13** and **Figure 4.14** present the adopted time-series for the period 1 July 2017 to 30 June 2019. There are two fits, the Linear Fit and the Stepped Fit to the water quality criteria (2017).

**Figure 4.15** and **Figure 4.16** present the adopted time-series for the period 1 July 2019 to 31 December 2032, for the Linear and the Stepped Fit to the water quality criteria (2019).

It is noted that a linear transformation was assumed between Salinity as EC ( $\mu\text{S}/\text{cm}$ ) and Salinity as TDS ( $\text{mg}/\text{L}$ ) as follows:

- Salinity as EC ( $\mu\text{S}/\text{cm}$ ) \* 0.67 = Salinity as TDS ( $\text{mg}/\text{L}$ )

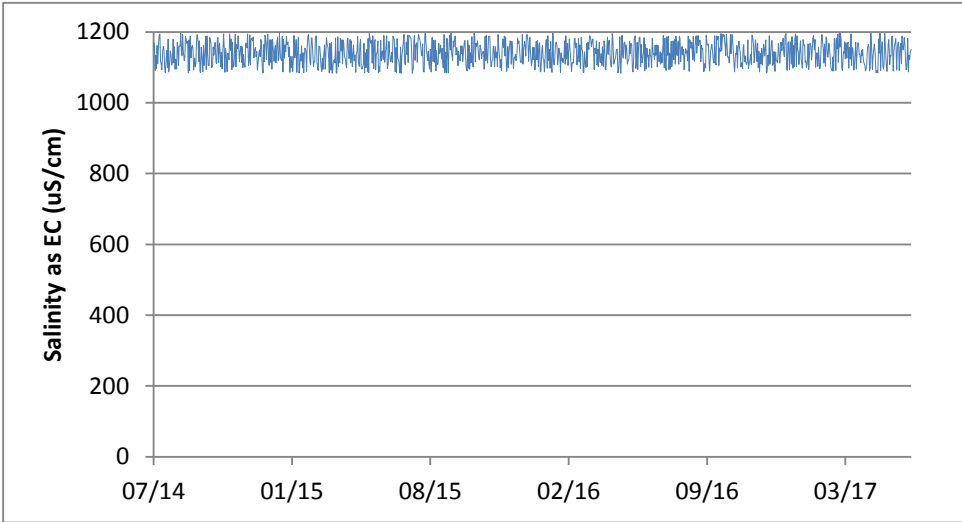


Figure 4.12 : Randomly Generated Salinity Time-Series used at Springvale LDP009 (July 2014 to June 2017)

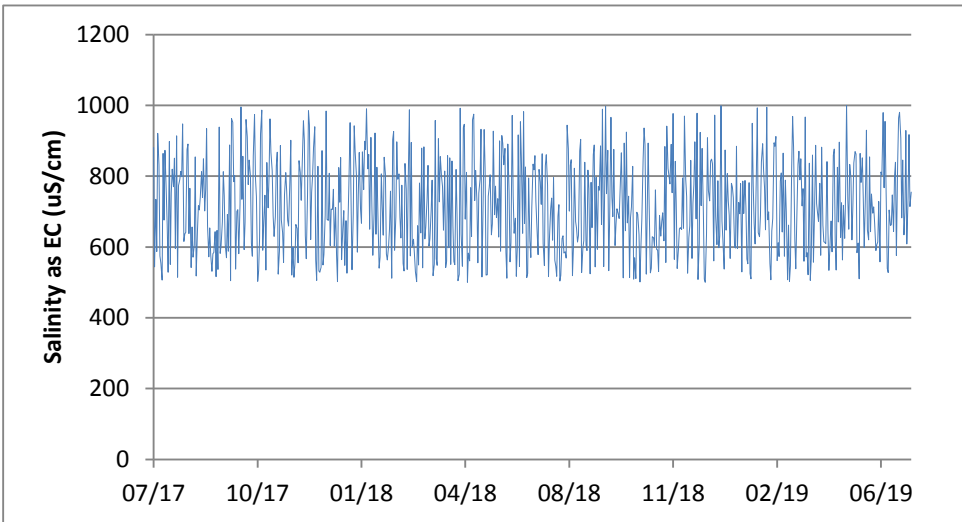


Figure 4.13 : Randomly Sampled Salinity Time-Series at Springvale LDP009 (Linear 2017 Water Quality Criteria Fit)

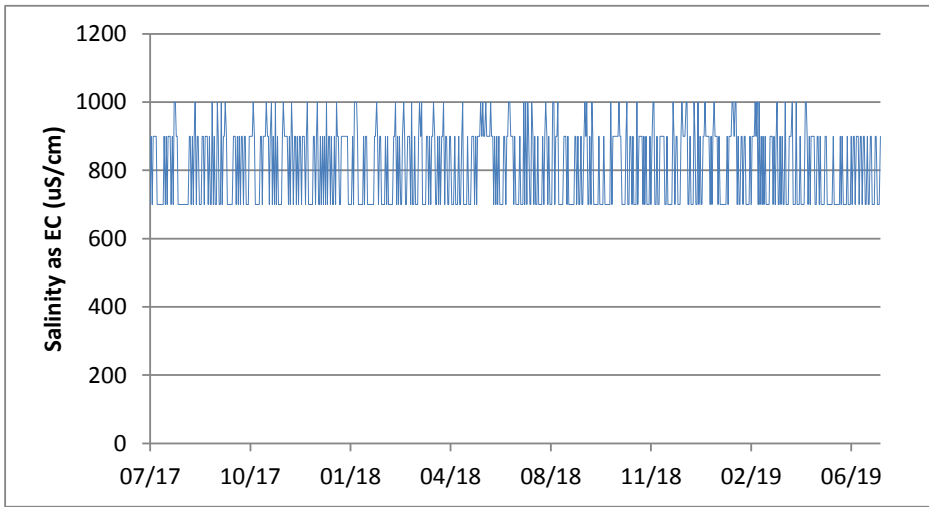


Figure 4.14 : Randomly Sampled Salinity Time-Series at Springvale LDP009 (Stepped 2017 Water Quality Criteria Fit)

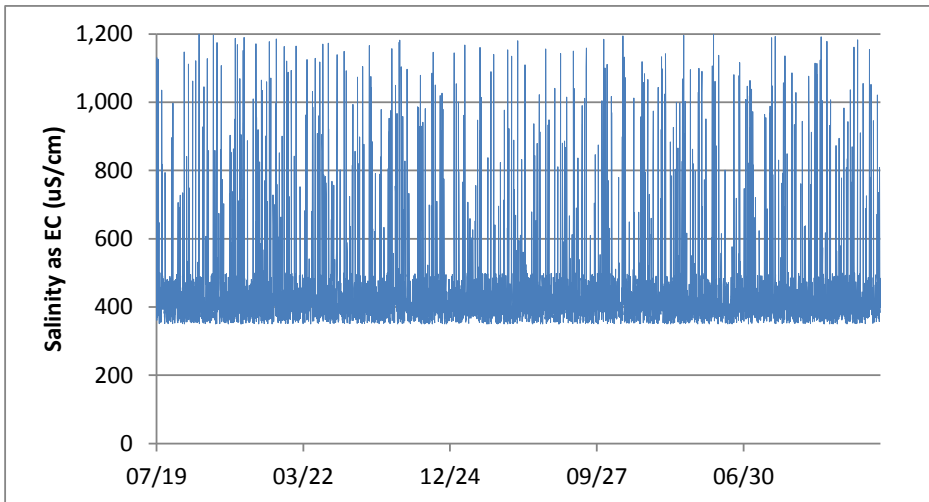


Figure 4.15 : Randomly Sampled Salinity Time-Series at Springvale LDP009 (Linear 2019 Water Quality Criteria Fit)

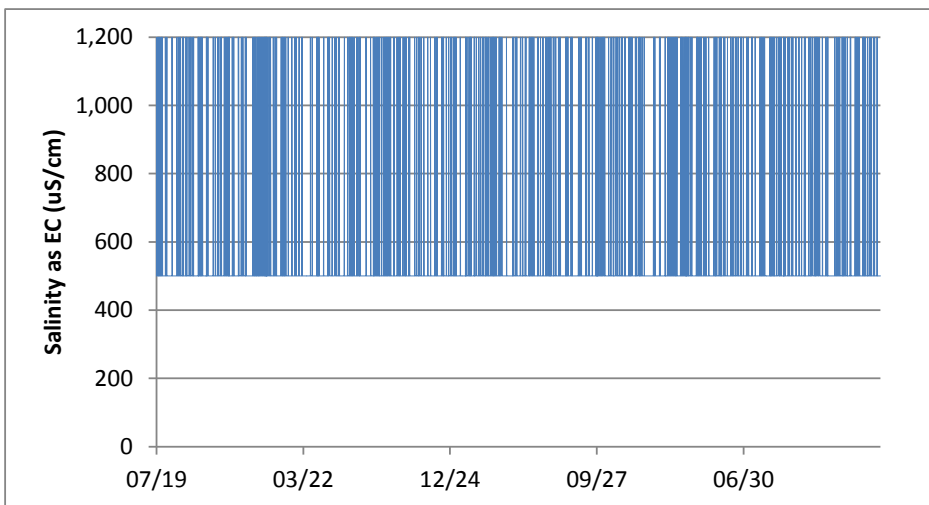


Figure 4.16 : Randomly Sampled Salinity Time-Series at Springvale LDP009 (Stepped 2019 Water Quality Criteria Fit)

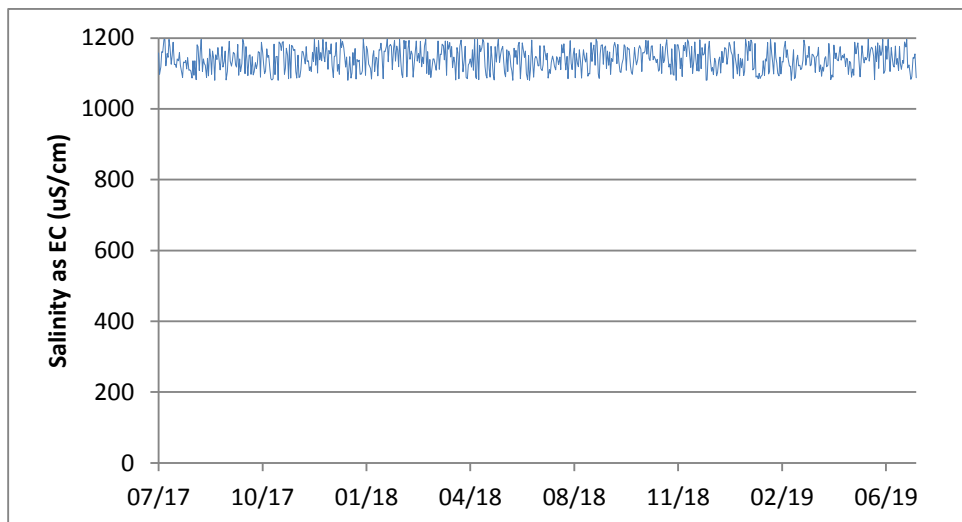
### Proposed Simulation

The Proposed Simulation was the same as the Approved Simulation (null case), except for the omission of the 2017 water quality criteria.

The following time-series were used in the Proposed Simulation:

- For the period 1 July 2014 to 30 June 2017, a randomly generated salinity time-series, with a mean of 1140 $\mu$ S/cm and a standard deviation of 30 $\mu$ S/cm, was determined. This was the same series as adopted for the Approved Simulation.
- For the period 1 July 2017 to 30 June 2019, a separate randomly generated salinity time-series, with a mean of 1140 $\mu$ S/cm and a standard deviation of 30 $\mu$ S/cm, was determined.
- For the period 1 July 2019 to 31 December 2032, a time-series was generated by randomly sampling the water quality criteria function presented in **Figure 4.9** (Linear Fit) and **Figure 4.10** (Stepped Fit). This was the same as adopted for the Approved Simulation.

**Figure 4.17** presents the adopted time-series for the period 1 July 2017 to 30 June 2019.



**Figure 4.17 : Randomly Generated Salinity Time-Series used at Springvale LDP009 (July 2017 to June 2019)**

### Model Results

The model control files associated with the prediction simulations were:

- 0006\_Rev0\_PRD-WS2b-S\_05a.gsp (Proposed – Linear Water Quality Criteria Fit)
- 0006\_Rev0\_PRD-WS2b-S\_05a\_NUL.gsp (Approved – Linear Water Quality Criteria Fit)
- 0006\_Rev0\_PRD-WS2b-S\_Step\_01a.gsp (Proposed – Stepped Water Quality Criteria Fit)
- 0006\_Rev0\_PRD-WS2b-S\_Step\_01a\_NUL.gsp (Approved – Stepped Water Quality Criteria Fit)

Model output was generated at locations consistent with RPS (2014b) and Jacobs (2015a). **Figure 4.3** presents the locations of these model output.

#### Kangaroo Creek and Coxs River above Wangcol Creek/Blue Lagoon

Time-series prediction simulation in Kangaroo Creek at Node #011 is presented in **Figure 4.18** with respect to salinity (mg/L) and in **Figure 4.19** with respect to flow (ML/d).

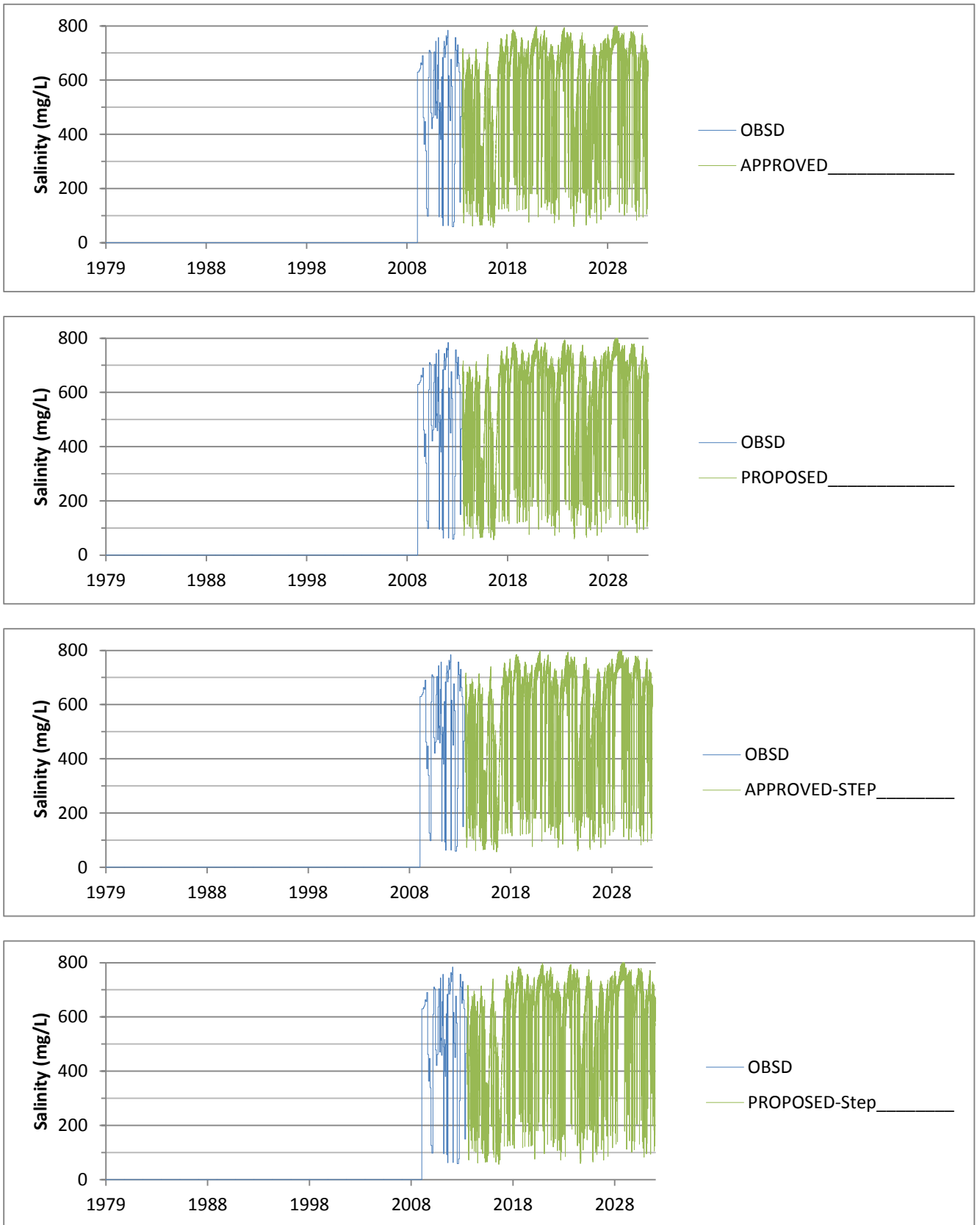
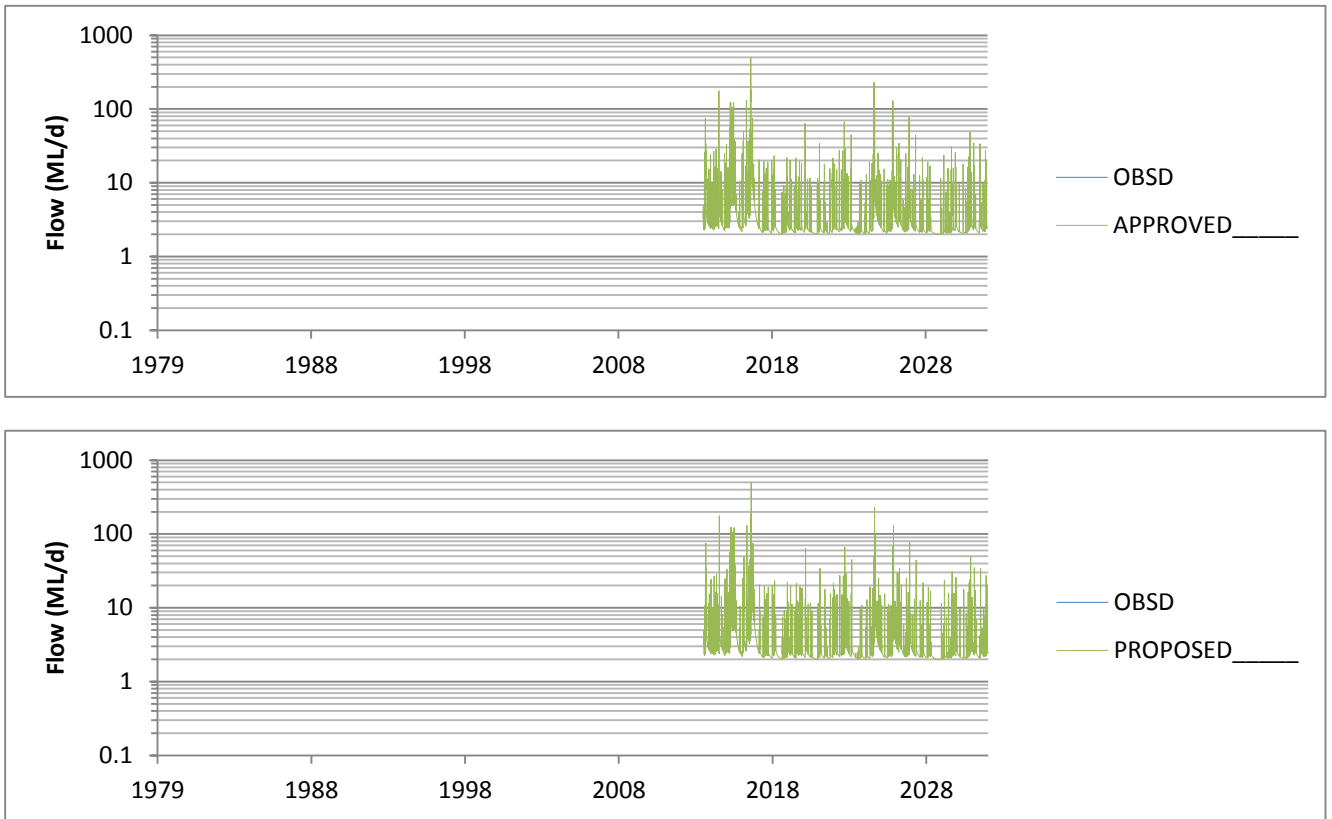


Figure 4.18 : Prediction Time-Series Chart at #011 (Kangaroo Creek, downstream of Angus Place LDP001) – Salinity mg/L



**Figure 4.19 : Prediction Time-Series Chart at #011 (Kangaroo Creek, downstream of Angus Place LDP001) – Flow ML/d**

A distribution plot of model output is presented in **Figure 4.20** (salinity) and **Figure 4.21** (flow).

**Table 4.4** and **Table 4.5** present a summary of that distribution plot output.

From the output presented in **Figure 4.18**, **Figure 4.19**, **Figure 4.20**, **Figure 4.21**, **Table 4.4** and **Table 4.5**, with respect to Kangaroo Creek, there is no change in flow or salinity due to the modification, as is expected.

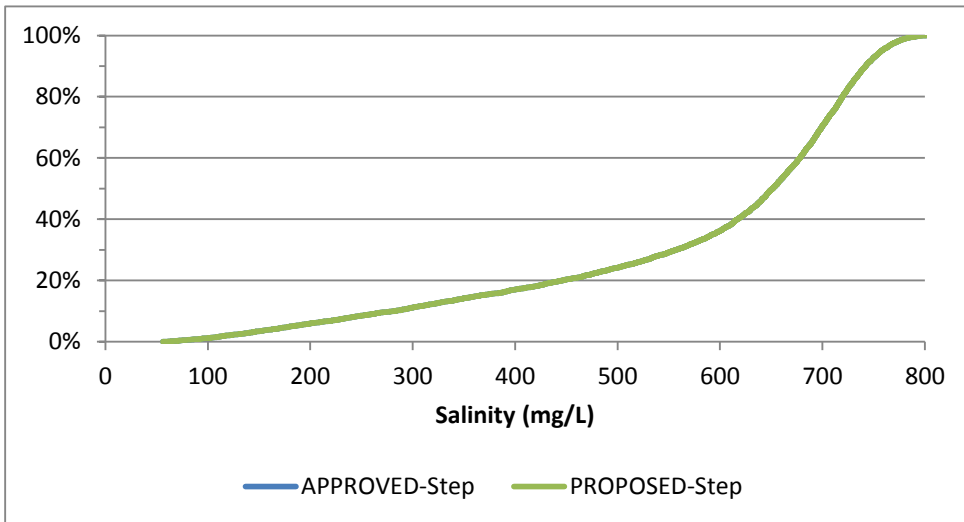
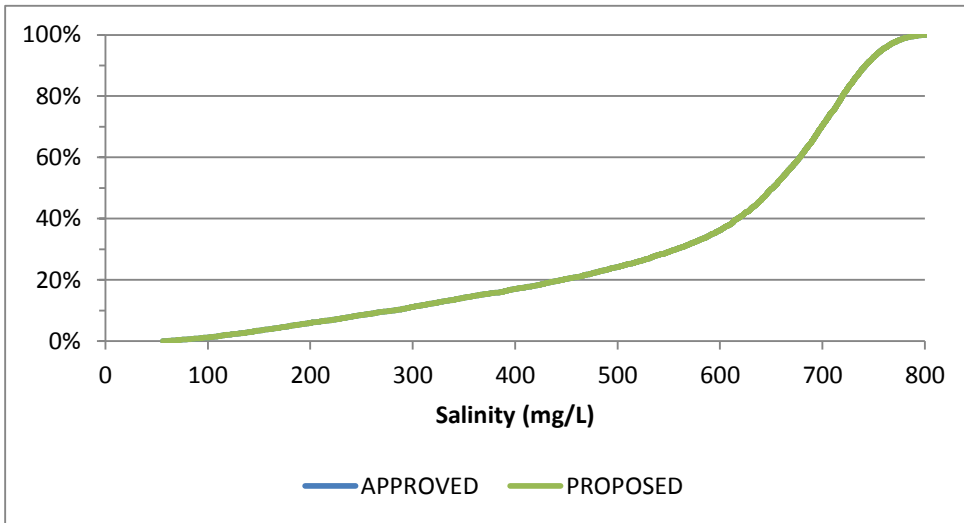


Figure 4.20 : Prediction Distribution Plot at #011 (Kangaroo Creek, downstream of Angus Place LDP001) – Salinity mg/L

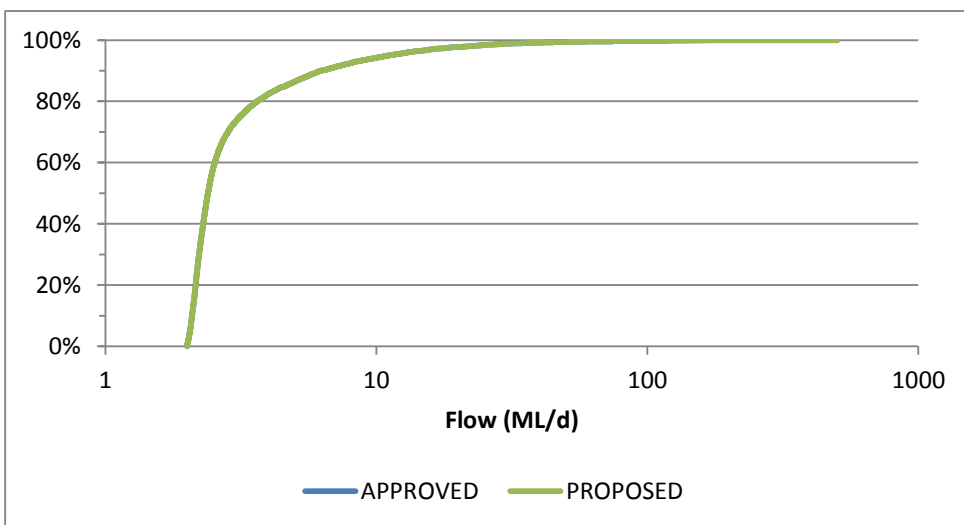


Figure 4.21 : Prediction Distribution Plot at #011 (Kangaroo Creek, downstream of Angus Place LDP001) – Flow ML/d

**Table 4.4 : Prediction Daily Statistics at #011 (Kangaroo Creek, downstream of Angus Place LDP001) – Salinity mg/L**

Percentile	Salinity (mg/L) – Linear Water Quality Criteria		Salinity (mg/L) – Stepped Water Quality Criteria	
	APPROVED	PROPOSED	APPROVED	PROPOSED
Minimum	56	56	56	56
5%	180	180	180	180
10%	282	282	282	282
20%	446	446	446	446
50%	652	652	652	652
80%	720	720	720	720
90%	742	742	742	742
95%	758	758	758	758
Maximum	801	801	801	801

**Table 4.5 : Prediction Daily Statistics at #011 (Kangaroo Creek, downstream of Angus Place LDP001) – Flow ML/d**

Percentile	Flow (ML/d)	
	APPROVED	PROPOSED
Minimum	2.0	2.0
5%	2.1	2.1
10%	2.1	2.1
20%	2.2	2.2
50%	2.4	2.4
80%	3.6	3.6
90%	6.3	6.3
95%	11.1	11.1
Maximum	502	502

The time-series chart for Node #056 is presented in **Figure 4.22** and **Figure 4.23**. The node is located on the Coxs River above the confluence with Wangcol Creek and is the site of Angus Place Colliery monitoring station, AP\_COXS\_DOWNSTREAM.

**Figure 4.24** and **Figure 4.25** present the distribution plot of the prediction simulation, and is summarised in **Table 4.6** and **Table 4.7**.

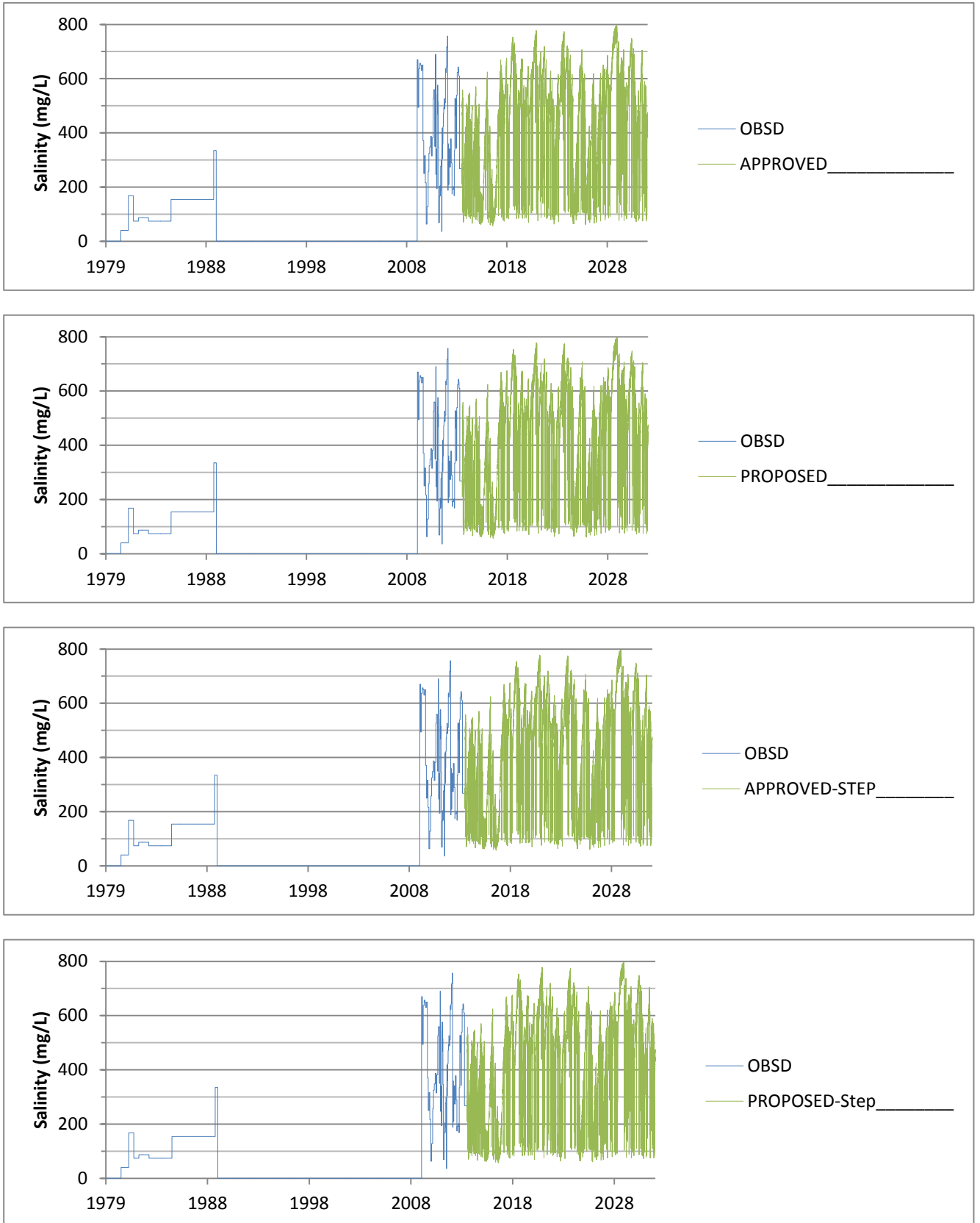


Figure 4.22 : Prediction Time-Series Chart at #056 (Coxs River above Wangcol Creek / Blue Lagoon) – Salinity mg/L

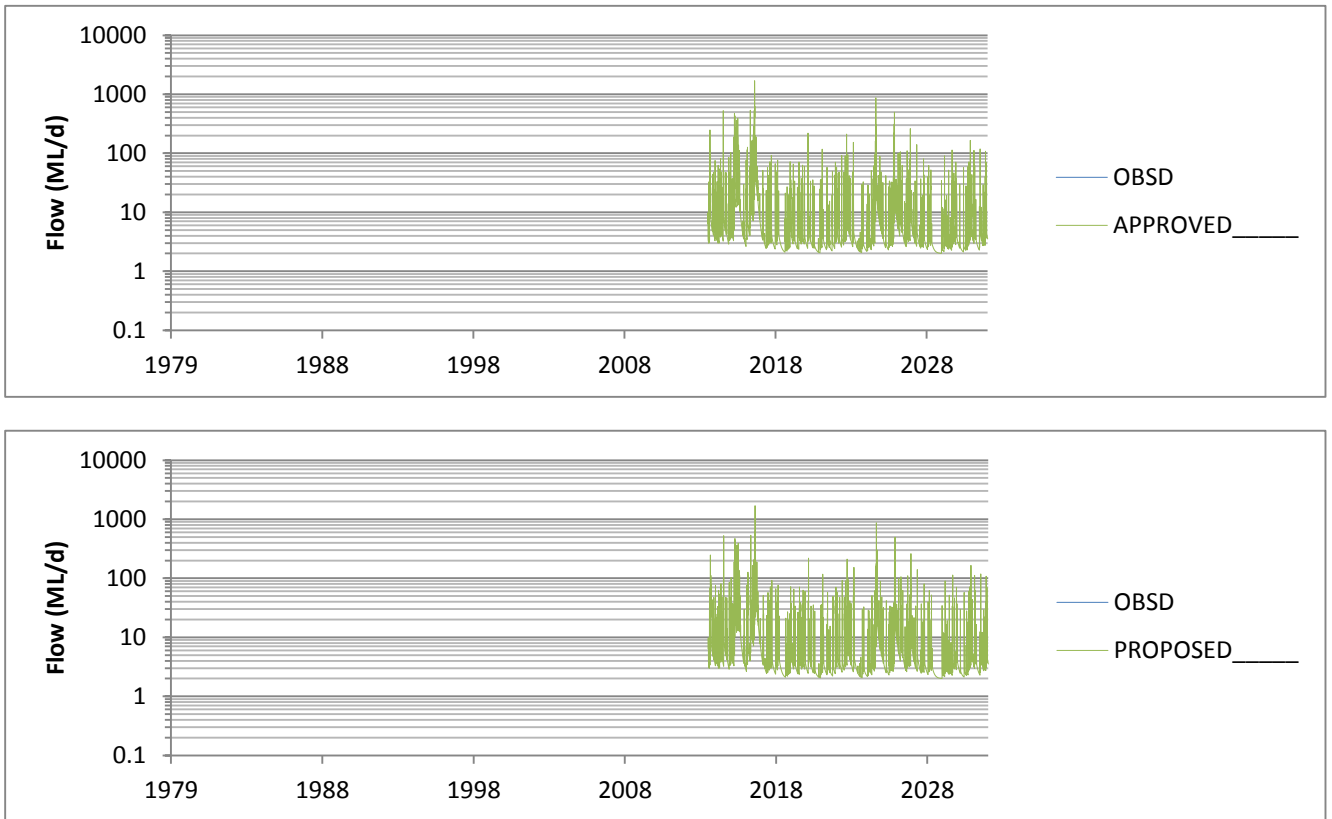


Figure 4.23 : Prediction Time-Series Chart at #056 (Coxs River above Wangcol Creek / Blue Lagoon) – Flow ML/d

From the output presented in **Figure 4.22**, **Figure 4.23**, **Figure 4.24**, **Figure 4.25**, **Table 4.6** and **Table 4.7** with respect to the Coxs River at this location, there is no change in flow or salinity due to the modification, as is expected, since discharge from Springvale Mine to the Coxs River is received further downstream.

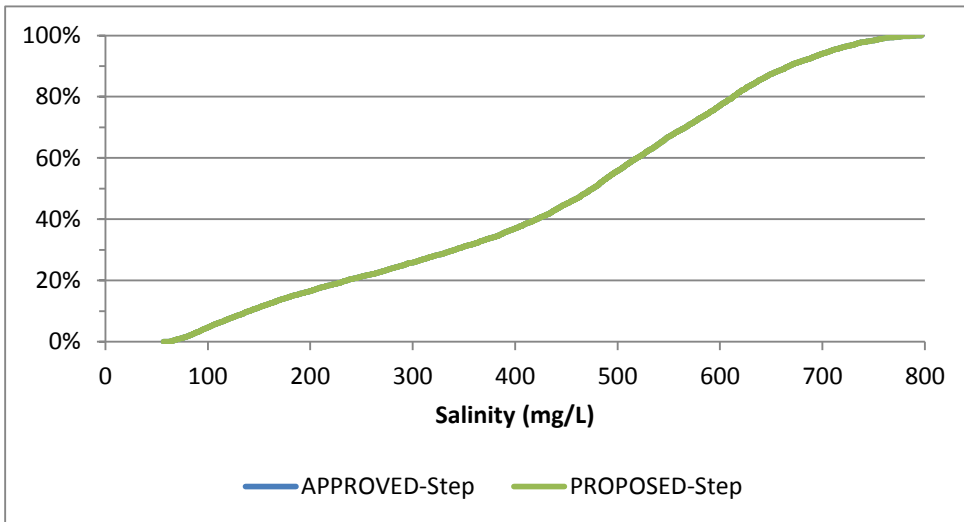
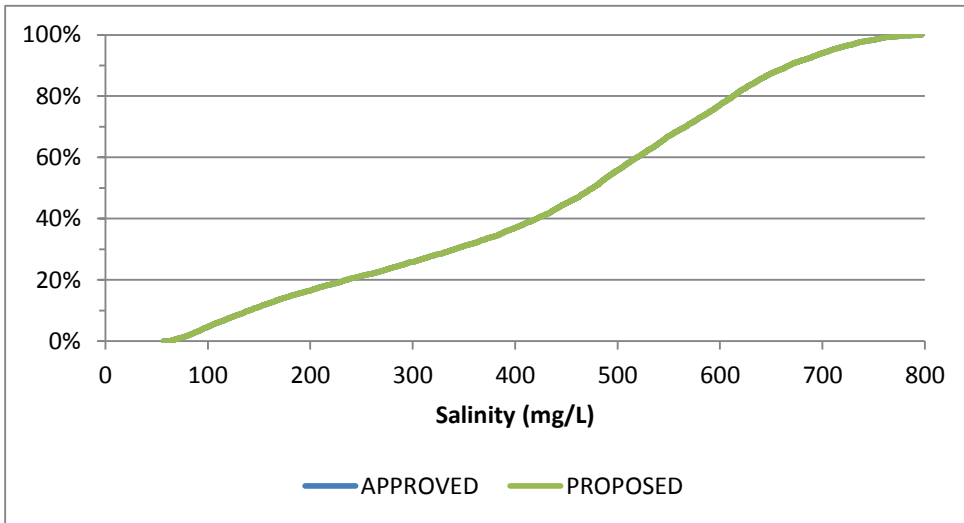


Figure 4.24 : Prediction Distribution Plot at #056 (Coxs River above Wangcol Creek / Blue Lagoon) – Salinity mg/L

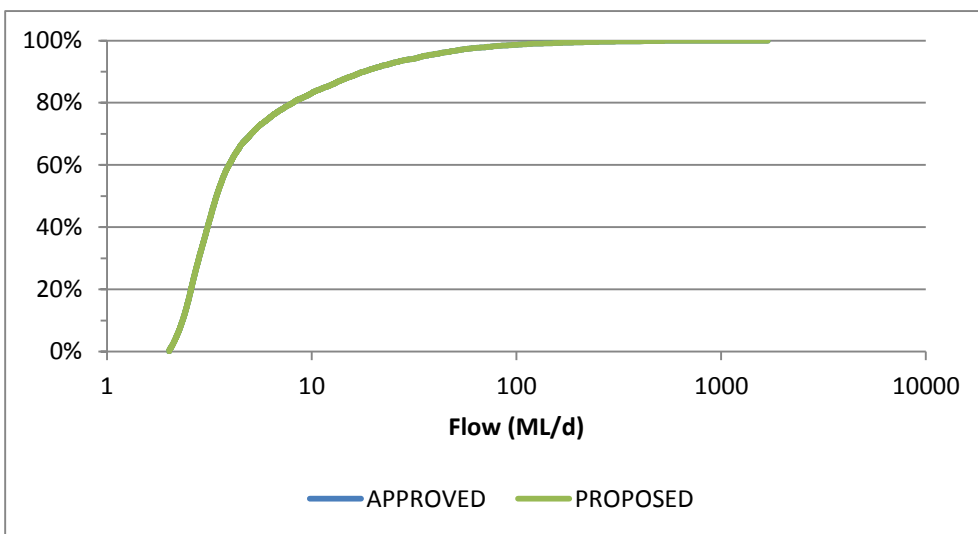


Figure 4.25 : Prediction Distribution Plot at #056 (Coxs River above Wangcol Creek / Blue Lagoon) – Flow ML/d

**Table 4.6 : Prediction Daily Statistics at #056 (Coxs River above Wangcol Creek / Blue Lagoon) – Salinity mg/L**

Percentile	Salinity (mg/L) – Linear Water Quality Criteria		Salinity (mg/L) – Stepped Water Quality Criteria	
	APPROVED	PROPOSED	APPROVED	PROPOSED
Minimum	57	57	57	57
5%	103	103	103	103
10%	140	140	140	140
20%	235	235	235	235
50%	476	476	476	476
80%	613	613	613	613
90%	667	667	667	667
95%	709	709	709	709
Maximum	797	797	797	797

**Table 4.7 : Prediction Daily Statistics at #056 (Coxs River above Wangcol Creek / Blue Lagoon) – Flow ML/d**

Percentile	Flow (ML/d)	
	APPROVED	PROPOSED
Minimum	2.0	2.0
5%	2.2	2.2
10%	2.3	2.3
20%	2.6	2.6
50%	3.4	3.4
80%	8.1	8.1
90%	18.0	18.0
95%	35.1	35.1
Maximum	1694	1694

Sawyers Swamp Creek

Node #166 is located on Sawyers Swamp Creek immediately above the Coxs River. Sawyers Swamp Creek receives mine water discharge via Springvale LDP009. Springvale LDP009 is located adjacent the Sawyers Swamp Creek Ash Dam.

**Figure 4.26** and **Figure 4.27** present the time-series model prediction at Node #166.

The distribution plot of model output is presented in **Figure 4.28** (salinity) and **Figure 4.29** (flow). **Table 4.8** and **Table 4.9** present a summary of the distribution plot output.

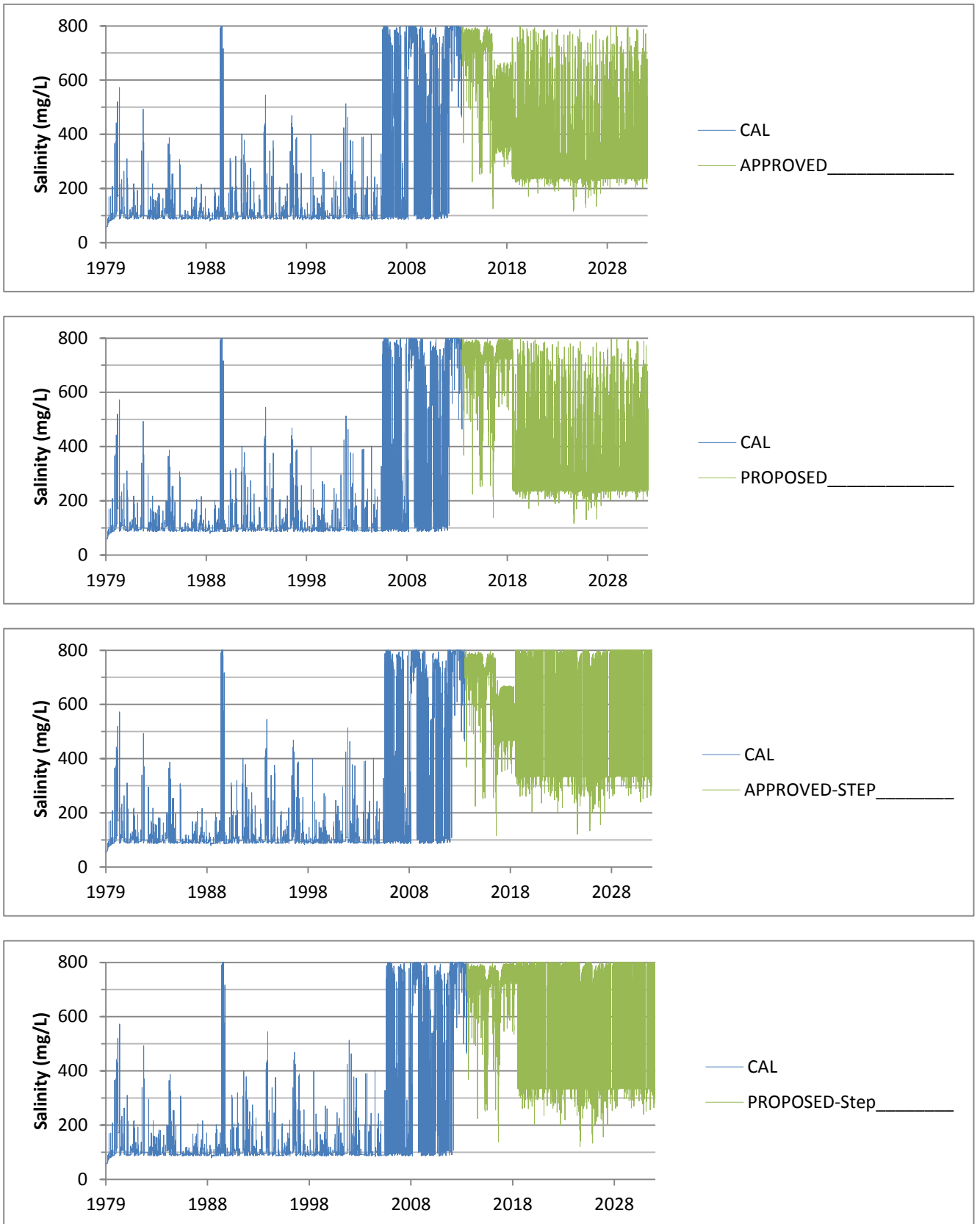
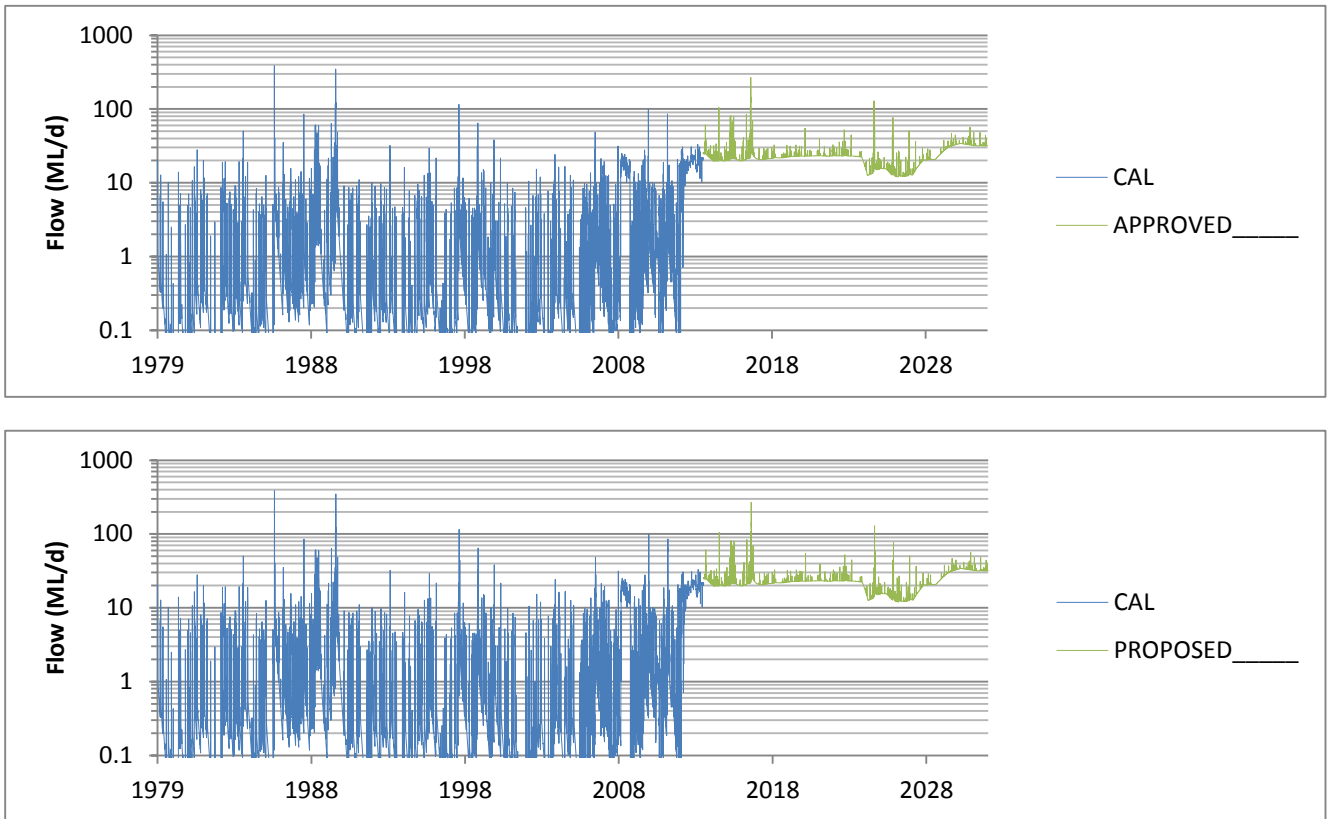


Figure 4.26 : Prediction Time-Series Chart at #166 (Sawyers Swamp Creek above Coxs River) – Salinity mg/L



**Figure 4.27 : Prediction Time-Series Chart at #166 (Sawyers Swamp Creek above Coxs River) – Flow ML/d**

From **Figure 4.26**, the difference in the period 1 July 2017 to 30 June 2019 is apparent. There is no difference in flow in **Figure 4.27** (summarised in **Table 4.9**) due to no change in mine water discharge (quantity) being proposed.

Review of **Table 4.8** indicates the difference in modelled median salinity, over the period of prediction, is small. Modelled salinity at 90<sup>th</sup> percentile is 754mg/L in the proposed case and is 732mg/L in the approved case, assuming a linear fit to the water quality criteria. Modelled salinity at 90<sup>th</sup> percentile is 775mg/L in the proposed case and is 764mg/L in the approved case, assuming a stepped fit to the water quality criteria.

The modelled change, whilst being an increase compared to approved conditions, is not considered to be significant, given the significantly altered and disturbed state of Sawyers Swamp Creek.

Water quality in Sawyers Swamp Creek will improve upon completion and commissioning of the Springvale Water Treatment Project.

An assessment of the proposed modification with respect to the NorBE water quality effect test is presented in **Section 5.2.2**.

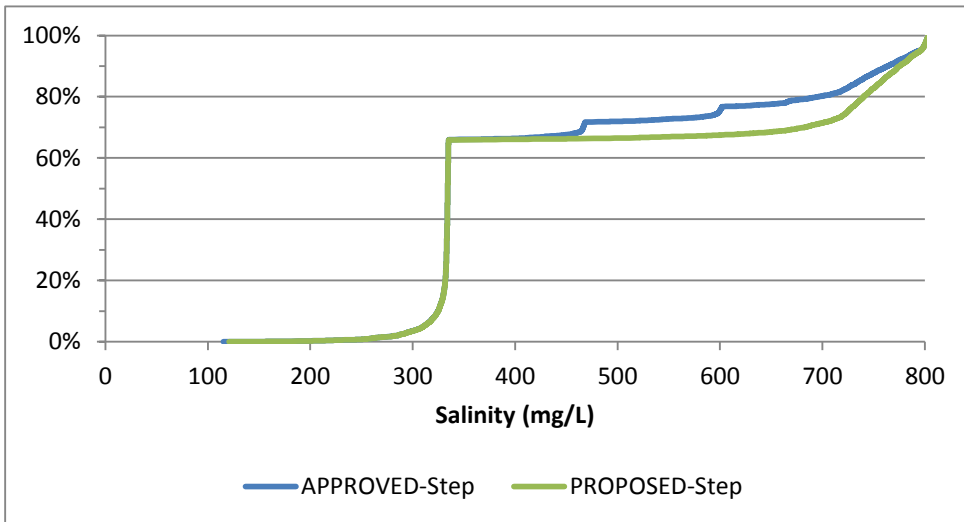
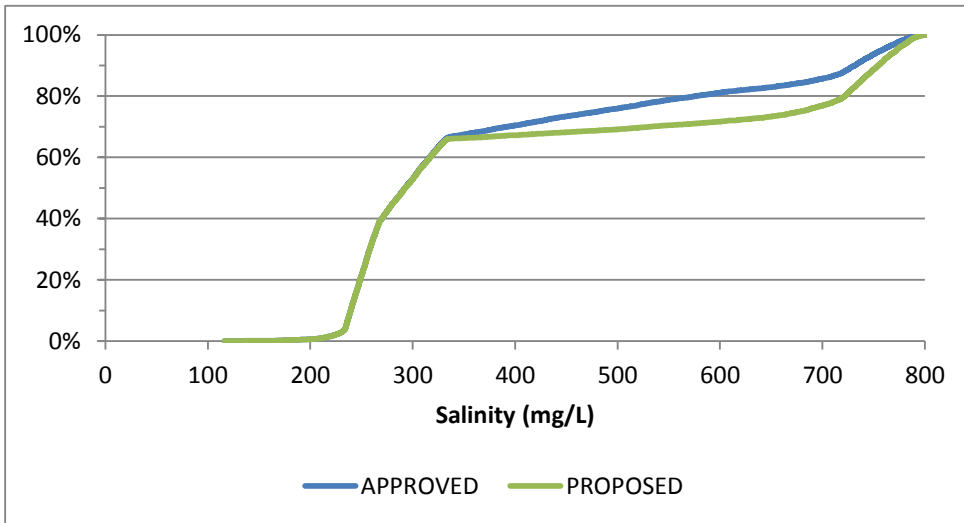


Figure 4.28 : Prediction Distribution Plot at #166 (Sawyers Swamp Creek above Coxs River) – Salinity mg/L

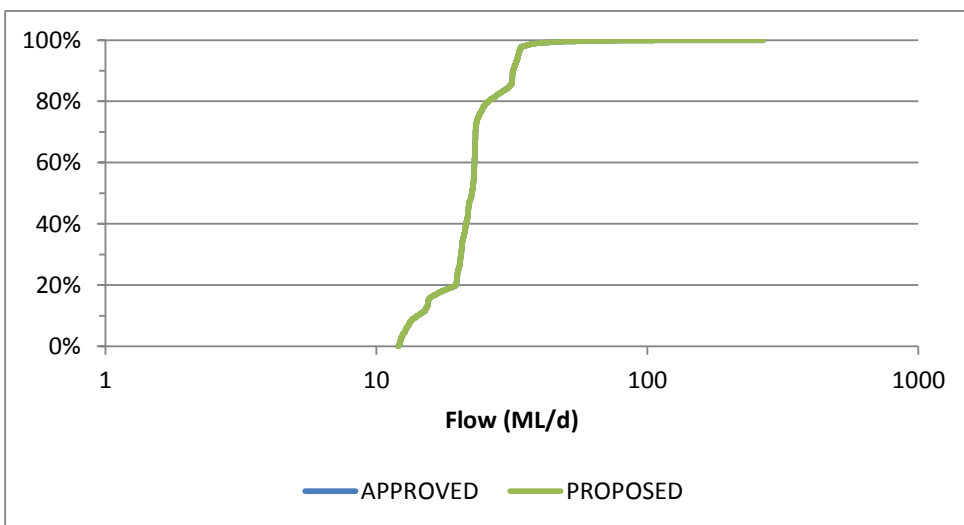


Figure 4.29 : Prediction Distribution Plot at #166 (Sawyers Swamp Creek above Coxs River) – Flow ML/d

**Table 4.8 : Prediction Daily Statistics at #166 (Sawyers Swamp Creek above Coxs River) – Salinity mg/L**

Percentile	Salinity (mg/L) – Linear Water Quality Criteria		Salinity (mg/L) – Stepped Water Quality Criteria	
	APPROVED	PROPOSED	APPROVED	PROPOSED
Minimum	116	116	115	121
5%	235	235	311	311
10%	239	239	325	325
20%	249	249	332	332
50%	292	293	334	334
80%	576	722	696	740
90%	732	754	764	775
95%	758	772	795	796
Maximum	803	803	804	804

**Table 4.9 : Prediction Daily Statistics at #166 (Sawyers Swamp Creek above Coxs River) – Flow ML/d**

Percentile	Flow (ML/d)	
	APPROVED	PROPOSED
Minimum	12.1	12.1
5%	12.8	12.8
10%	14.2	14.2
20%	19.7	19.7
50%	22.5	22.5
80%	25.9	25.9
90%	32.0	32.0
95%	33.4	33.4
Maximum	268	268

Lake Wallace

**Figure 4.30** and **Figure 4.31** present output of the model for salinity and flow at Node #047, which is located upstream of Lake Wallace, coincident with the location of DPIWater Station No. 212054.

**Figure 4.32** and **Figure 4.33** present the distribution plot of model output. **Table 4.10** and **Table 4.11** presents a summary of the distribution plot output.

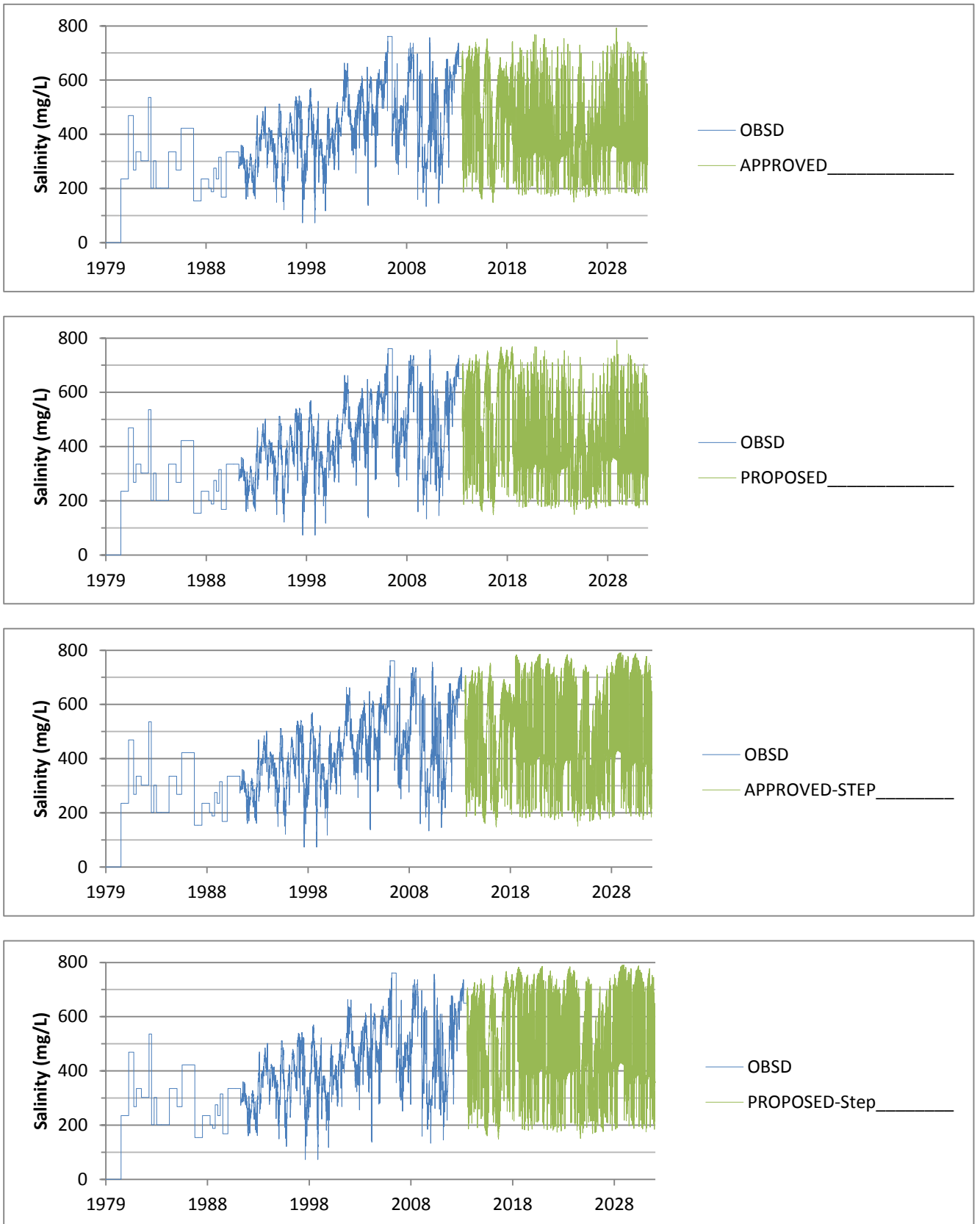


Figure 4.30 : Prediction Time-Series Chart at #047 (upstream of Lake Wallace, DPI Water Station No. 212054) – Salinity mg/L

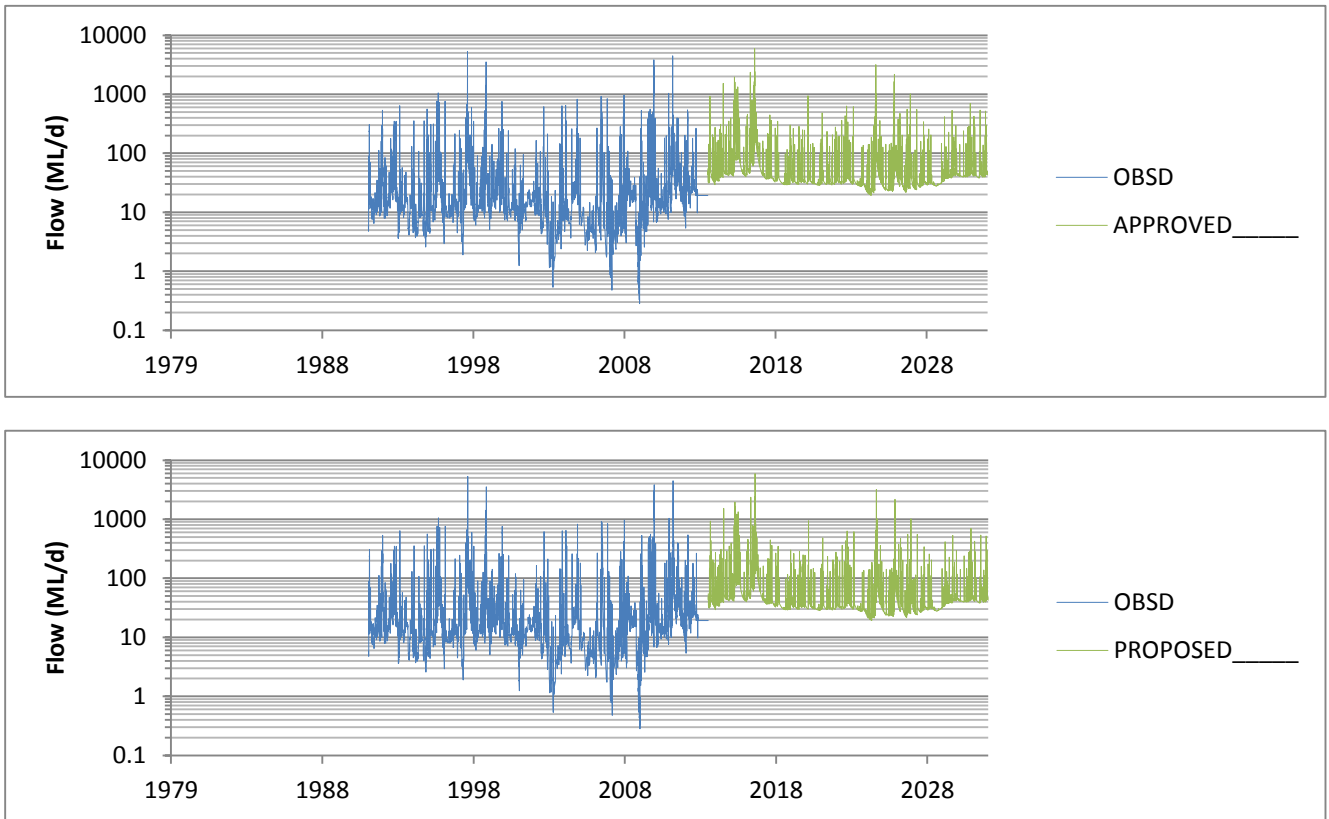


Figure 4.31 : Prediction Time-Series Chart at #047 (upstream of Lake Wallace, DPI Water Station No. 212054) – Flow ML/d

Results upstream of Lake Wallace (Node #047), summarised in **Table 4.10**, indicate a change in median salinity from 359mg/L to 360mg/L, assuming a linear fit to the water quality criteria, and a change from 396mg/L to 397mg/L, when assuming a stepped fit to the water quality criteria.

From **Table 4.10**, at 90% distribution, the increase is from 614mg/L to 670mg/L (linear) and is 656mg/L to 694mg/L (stepped). At maximum modelled salinity in **Table 4.10**, there is no change between the approved and the proposed case.

As summarised in **Table 4.11**, there is no modelled change in flow due to the proposed modification.

With respect to the duration of the prediction period, the change due to the modification, at this location, is considered to be minor.

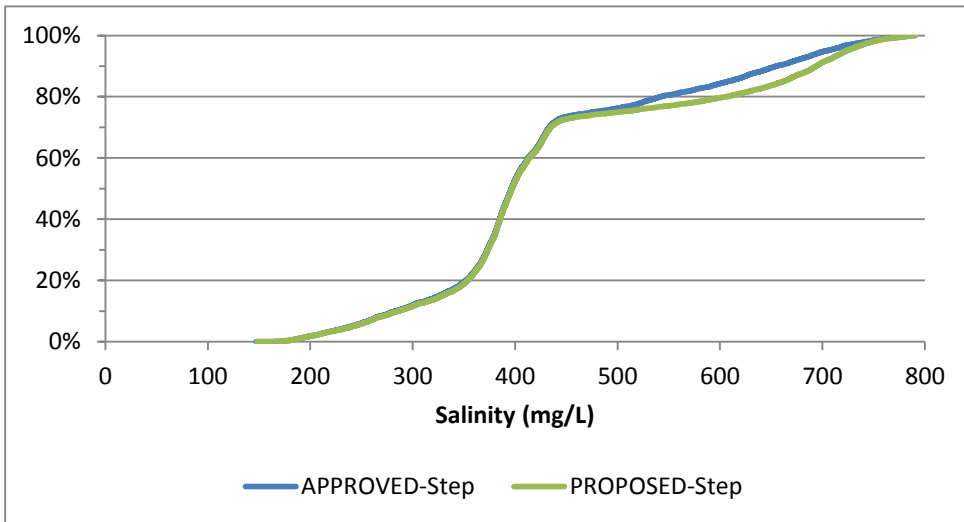
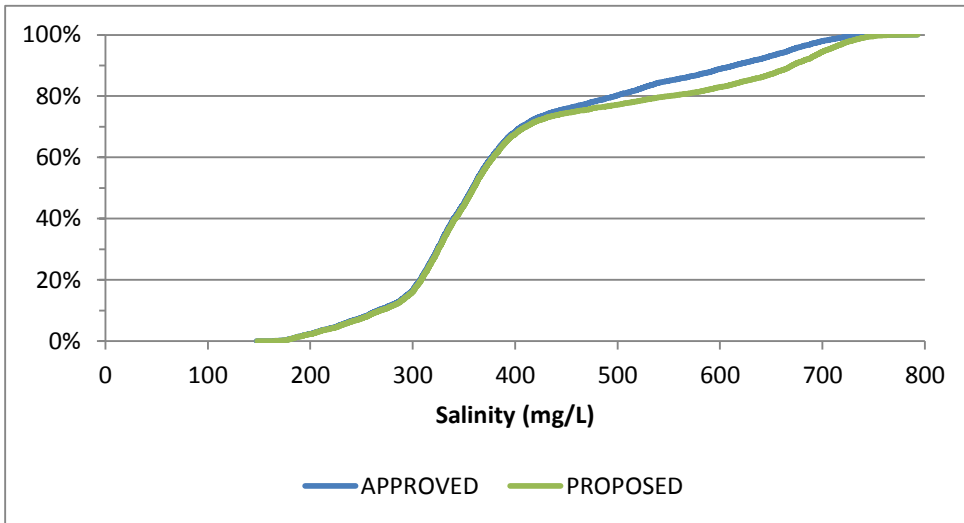


Figure 4.32 : Prediction Distribution Plot at #047 (upstream of Lake Wallace, DPI Water Station No. 212054) – Salinity mg/L

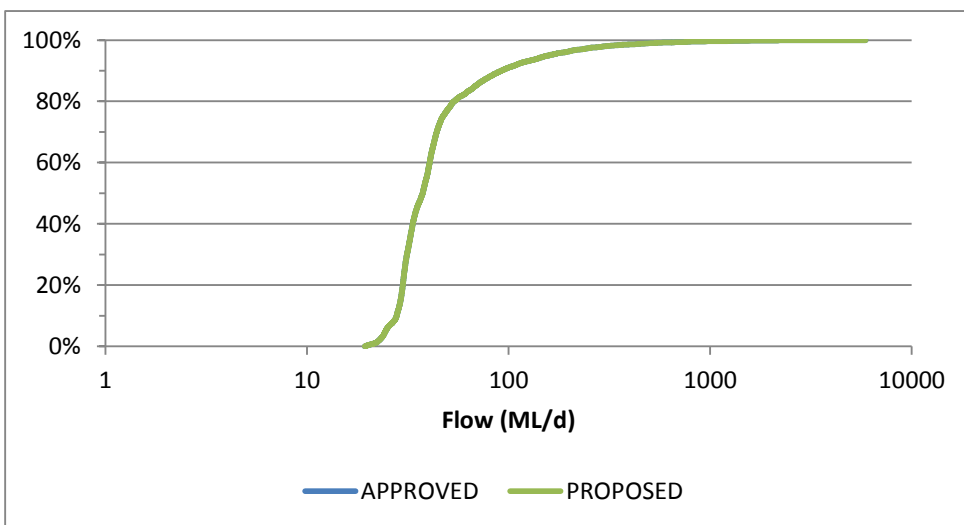


Figure 4.33 : Prediction Distribution Plot at #047 (upstream of Lake Wallace, DPI Water Station No. 212054) – Flow ML/d