APPENDIX 10

# Surface Water Impact Assessment

# Surface Water Impact Assessment

## Chain Valley Colliery Consolidation Project

Umwelt (Australia) Pty Ltd and Delta Coal

7 October 2022

→ **The Power of Commitment**

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# Glossary

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| **Alkalinity** | A measure of the ability of an aqueous solution to neutralise acids. Alkalinity of natural waters is due primarily to the presence of hydroxides, bicarbonates and carbonates. It is expressed in units of calcium carbonate ($CaCO_3$). |
| **Alluvial** | Deposition from running waters. |
| **Ambient** | Pertaining to the surrounding environment or prevailing conditions. |
| **Ash** | A major by-product of coal-fuelled power generation. Bottom ash is collected from the bottom of the boilers while fly ash is an inert mineral matter collected in dust collection plants. |
| **Australian Height Datum** | A common national surface level datum approximately corresponding to sea level. |
| **Baseline monitoring** | Monitoring conducted over time to collect a body of information to define specific characteristics of an area (e.g. species occurrence or water quality) prior to the commencement of a specific activity. |
| **Bore** | Constructed connection between the surface and a groundwater source that enables groundwater to be transferred to the surface either naturally or through artificial means. |
| **Catchment** | The land area draining through the main stream, as well as tributary streams, to a particular location. |
| **Clean water** | Water that has not come into physical contact with carbonaceous material and does not have an elevated sediment load. |
| **Dewatering** | The removal or pumping of water from an above or below ground storage, including the mine water within the water collection system of mine workings. |
| **Dirty water** | Water that has an elevated sediment load. |
| **Discharge** | The quantity of water per unit of time flowing in a stream, for example cubic metres per second or megalitres per day. |
| **Electrical conductivity** | A measure of the concentration of dissolved salts in water. |
| **Ephemeral** | Stream that is usually dry, but may contain water for rare and irregular periods, usually after significant rain. |
| **Goaf** | That part of a mine from which the mineral has been partially or wholly removed, including the waste left in the workings. |
| **Groundwater** | Water occurring naturally below ground level. |
| **Guideline value** | The concentration or load of physicochemical characteristics of an aquatic ecosystem, below which there exists a low risk that adverse ecological effects will occur. They indicate a potential risk of impact if exceeded and should 'trigger' action to conduct further investigations or to implement management or remedial processes. |
| **Hydrology** | The study of rainfall and surface water runoff processes. |
| **Infiltration** | Natural flow of surface water through the ground surface and underlying strata during and following rainfall events. |
| **Licensed discharge point** | A location where the premises discharge water in accordance with conditions stipulated within the Environment Protection Licence. |
| **Median** | The middle value, such that there is an equal number of higher and lower values. Also referred to as the 50th percentile. |
| **Percentile** | The value of a variable below which a certain percent of observations fall. For example, the 80th percentile is the value below which 80% of values are found. |
| **pH** | The value taken to represent the acidity or alkalinity of an aqueous solution. It is defined as the negative logarithm of the hydrogen ion concentration of the solution. |
| **Pool** | Locally deeper areas of a watercourse where water may remain when the watercourse is not flowing. |
| **Potable water** | Water of a quality suitable for drinking. |
| **Reach** | Defined section of a stream with a uniform character and behaviour. |

| | |
|---|---|
| **Riparian** | Pertaining to, or situated on, the bank of a watercourse or other water body. |
| **Runoff** | The amount of rainfall which actually ends up as streamflow, also known as rainfall excess. |
| **Run of mine** | Raw coal production (unprocessed). |
| **Sediment** | Soil or other particles that settle to the bottom of lakes, rivers, oceans and other waters. |
| **Sinkhole** | Abrupt surface depression often initiated without warning due to shallow mine extraction, weak overburden or geological discontinuities. |
| **Stream order** | Stream classification system where order one is for headwater (new) streams at the top of a catchment. Order number increases downstream using a defined methodology related to the branching of streams. |
| **Subsidence** | Vertical lowering, sinking or collapse of the ground surface. |
| **Surface water** | Water that is derived from precipitation or pumped from underground and may be stored in dams, rivers, creeks and drainage lines. |
| **Topography** | The arrangement of the natural and artificial physical features of an area. |
| **Total Kjeldahl nitrogen** | The sum of the concentrations of organic nitrogen, ammonia ($NH_3$) and ammonium ($NH_4^+$) in water. |
| **Total nitrogen** | A measure of organic and inorganic nitrogen forms in water. The sum of concentrations of TKN and nitrite and nitrate as N. |
| **Total phosphorus** | A measure of organic and inorganic phosphorus in particulate and soluble forms. |
| **Total suspended solids** | A measure of the filterable matter suspended in water. |
| **Tributary** | A stream or river that flows into a main river or lake. |
| **Turbidity** | A measure of clarity (turbidity) of water. Turbidity in excess of 5 NTU is just noticeable to the average person. |
| **Watercourse** | A natural or artificial channel through which water flows. |

# Abbreviations

| | |
|---|---|
| **AHD** | Australian height datum |
| **ANZG** | Australian and New Zealand Guidelines for Fresh and Marine Water Quality |
| **BOM** | Bureau of Meteorology |
| **CC Council** | Central Coast Council |
| **CPP** | Coal preparation plant |
| **CVC** | Chain Valley Colliery |
| **DC** | Delta Coal |
| **DE** | Delta Electricity |
| **DEC** | Former NSW Department – Department of Environment and Conservation |
| **DEM** | Digital elevation model |
| **DGV** | Default guideline value |
| **EC** | Electrical conductivity |
| **EIS** | Environmental impact statement |
| **EP&A Act** | Environmental Planning and Assessment Act 1979 |
| **EPA** | Environment Protection Authority |
| **EPBC Act** | Environment Protection and Biodiversity Conservation Act 1999 |
| **EPL** | Environment Protection Licence |
| **GHD** | GHD Pty Ltd |
| **ha** | Hectare |
| **Hunter Unregulated WSP** | Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources |
| **IESC** | Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development |
| **kL/day** | Kilolitre per day |
| **km** | Kilometre |
| **kV** | Kilovolt |
| **LGA** | Local Government Area |
| **LDP** | Licensed discharge point |
| **LOR** | Limit of reporting |
| **m** | Metre |
| **MC** | Mannering Colliery |
| **mg/L** | Milligram per litre |
| **ML** | Megalitre |
| **ML/day** | Megalitre per day |
| **ML/year** | Megalitre per year |
| **mm** | Millimetre |
| **MNES** | Matters of national environmental significance |
| **Mt** | Million tonnes |
| **Mtpa** | Million tonnes per annum |

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|---|---|
| **NRAR** | Natural Resources Access Regulator |
| **NTU** | Nephelometric turbidity unit |
| **POEO Act** | Protection of the Environment Operations Act 1997 |
| **RL** | Reduced level |
| **ROM** | Run of mine |
| **SEARs** | Secretary's environmental assessment requirements |
| **SILO** | Scientific Information for Land Owners |
| **SSD** | State significant development |
| **SSGV** | Site-specific guideline value |
| **SWIA** | Surface Water Impact Assessment |
| **TKN** | Total Kjeldahl nitrogen |
| **tonne/year** | Tonne per year |
| **TSS** | Total suspended solids |
| **TARP** | Trigger, action, response plan |
| **VPPS** | Vales Point Power Station |
| **WAL** | Water access licence |
| **WM Act** | Water Management Act 2000 |
| **WSP** | Water sharing plan |
| **µS/cm** | Microsiemens per centimetre |

# 1. Introduction

GHD Pty Ltd (GHD) was engaged by Umwelt (Australia) Pty Ltd on behalf of Great Southern Energy Pty Ltd trading as Delta Coal (Delta Coal) to prepare a Surface Water Impact Assessment (SWIA) for the Chain Valley Colliery Consolidation Project (the Project). This assessment forms part of an environmental impact statement (EIS) to support a State significant development (SSD) application under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the Project.

## 1.1 Project background

Chain Valley Colliery (CVC) and Mannering Colliery (MC) are underground coal mines located approximately 60 km south of Newcastle, within the Lake Macquarie and Central Coast local government areas (LGAs). The CVC and MC operations are owned and operated by Great Southern Energy Pty Ltd (trading as Delta Coal). Delta Coal seek to consolidate CVC and MC operations to enable the continuation of mining within existing approved areas. The site locality is shown in Figure 1.1.

On 1 April 2019, Delta Coal acquired Lake Coal's CVC assets as well as some coal leases previously held by Centennial Coal. The acquisition also included the MC assets.

Delta Coal operates CVC and MC as an integrated operation with access to the underground mining areas by employees at both sites. Existing operations of CVC and MC are undertaken in accordance with CVC's Development Consent SSD-5465 (as modified), and MC's Project Approval MP 06_0311 (as modified). Both operations are approved to carry out mining operations to 31 December 2027. The operations are approved to provide coal for both export and for domestic power generation however all product coal from the operations is currently supplied to the Vales Point Power Station (VPPS) which is owned and operated by Delta Electricity Pty Ltd.

## 1.2 Chain Valley Colliery Consolidation Project

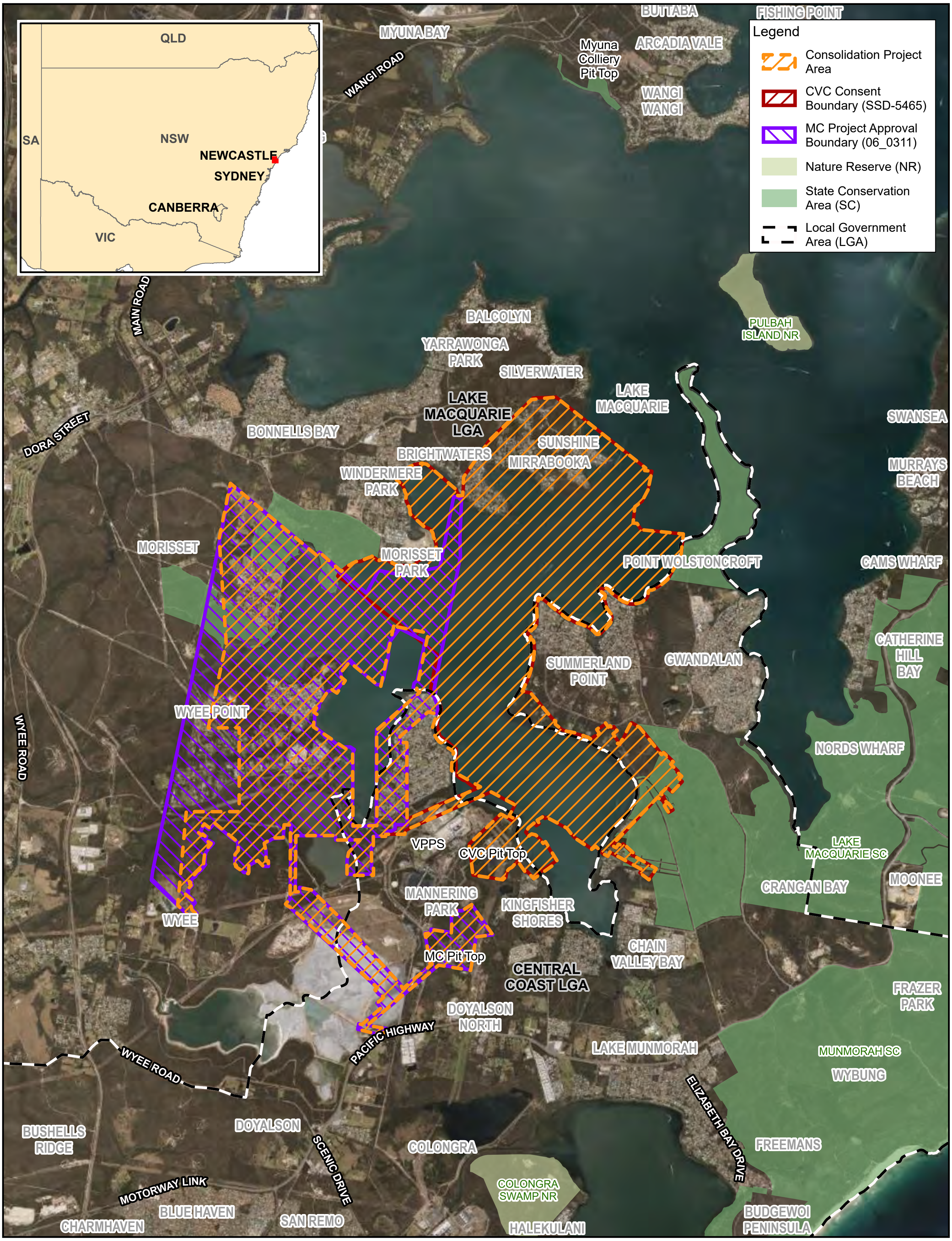
The Project would consolidate the approvals for the existing operations under CVC development consent SSD-5465 (refer to Figure 1.2). The Project would also provide an extension of the life of mine for an additional two years to 2029. This extension would align the life of mining operations at MC and CVC with the planned operational period of the VPPS. Coal will be extracted from existing approved mining areas only.

Delta Coal would retain the ability to bring coal to the surface at either the CVC or MC Pit Top. The combined operations would have a production cap of 2.8 Mtpa Run-of-mine (ROM) coal which is a reduction from the currently approved throughput under the current combined consents of 3.2 Mtpa. The currently approved surface handling limit at CVC of 1.5 Mtpa ROM coal will be retained however the surface handling limit at MC will be increased to 2.8 Mtpa ROM Coal (subject to combined operations remaining below the 2.8 Mtpa ROM coal cap).

The existing infrastructure at CVC and MC will continue to be utilised, with maintenance and upgrades to surface facilities proposed to support the extended operating period and minor changes associated with the increase to ROM throughput at MC. Coal handling infrastructure recently demolished at CVC will also be replaced if required.

No changes are proposed to the approved coal transport arrangements from the CVC (road trucks) and MC (conveyor only) Pit Tops.

The Project will consolidate the existing approved CVC and MC consent boundaries with minor adjustments to align boundaries with existing Delta Coal mining lease areas. Table 1.1 provides a comparison of the Project with existing approved CVC and MC operations.

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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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**Delta Coal**
**Chain Valley Colliery - Consolidation Project**
**Surface Water Impact Assessment**

| | |
|---|---|
| Project No. | **12580250** |
| Revision No. | **2** |
| Date | **04/10/2022** |

**Locality and site context**

**FIGURE 1.1**

G:\22\12519253\GIS\Maps\Deliverables\12580250\12580250_SWIA_2.aprx
Print date: 04 Oct 2022 - 11:01

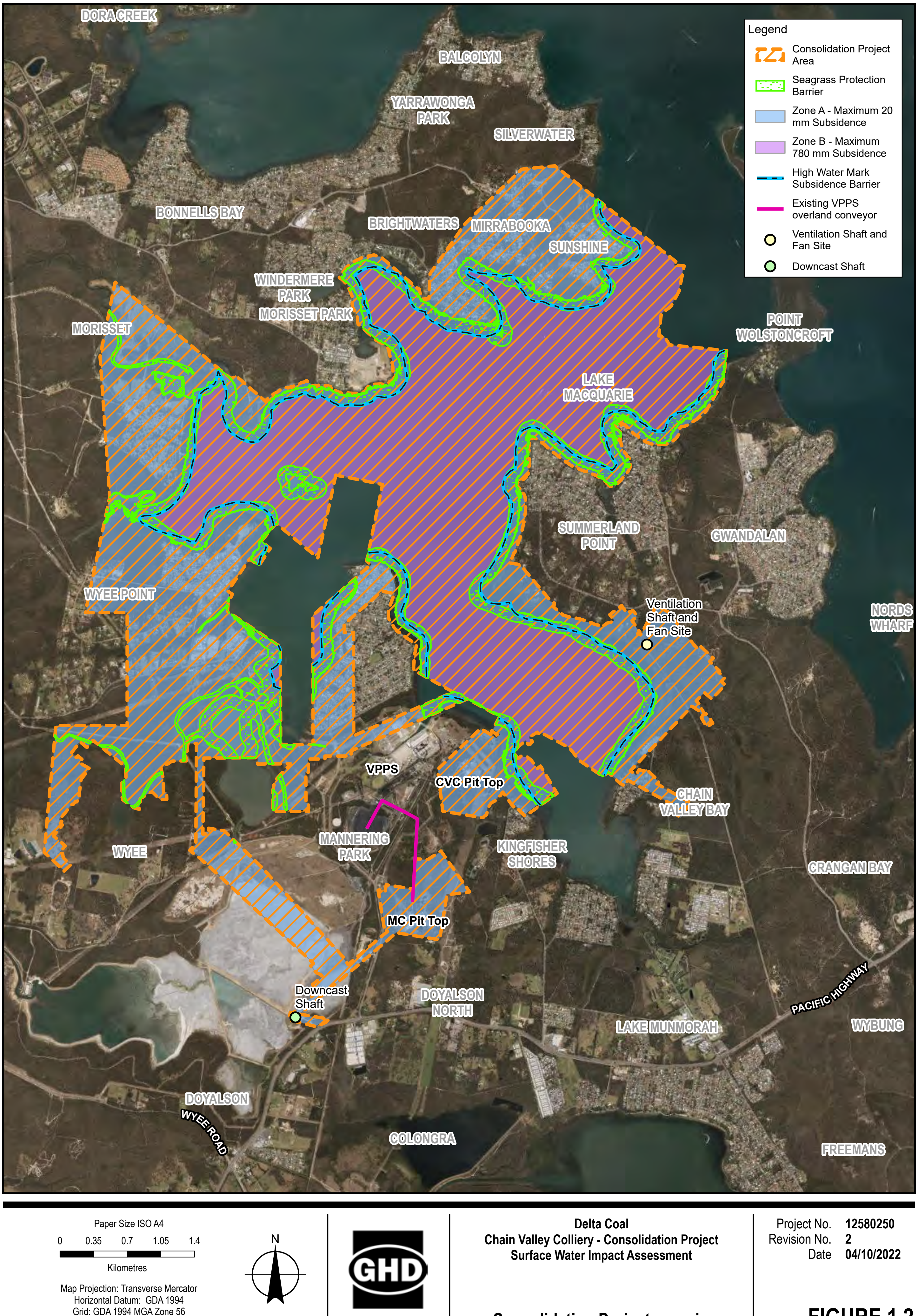
Data source: Umwelt: Mining Areas, CVC & MC Boundaries, 2021; Geoscience Australia: 250k Topographic Data Series 3, 2006; LPI: DTDB / DCDB, 2017; public_NSW_Imagery: © Department of Customer Service 2020. Created by: fmackay

*Table 1.1 Overview of existing operation and consolidation project*

| Project Component | CVC Approved Operations | MC Approved Operations | Consolidation Project |
|---|---|---|---|
| Project Area | Refer to Figure 1.1. | Refer to Figure 1.1. | Consolidated Project boundary to align with adjustments to align with Delta Coal mining tenement boundaries - refer to Figure 1.2 |
| Mine life | Mining operations are approved until 31 December 2027 | Mining operations are approved until 31 December 2027 | Mining operations approved to 31 December 2029 |
| Annual Coal Extraction | Extraction of up to 2.1 Mtpa of ROM coal from the CVC approved mining area | Extraction of up to 1.1 Mtpa of ROM coal from MC approved mining Area | Extraction of up to 2.8 Mtpa total from all mining areas |
| Annual Surface Handling | Up to 1.5 Mtpa ROM Coal (all production at CVC beyond the 1.5 Mtpa ROM coal surface cap to be sent to VPPS via MC) | Up to 2.1 Mtpa ROM Coal | Handling of up to 2.8 Mtpa ROM Coal from MC and 1.5 Mtpa at CVC with overall cap of 2.8 Mtpa |
| Resource | Fassifern seam | Fassifern and Great Northern seams | Fassifern and Great Northern seams |
| Mining Method | Continuous miner (bord and pillar and pillar extraction) and miniwall mining methods<br>Pillar extraction and miniwall mining only under lake and subject to 20 mm vertical subsidence limits on sea grass beds and foreshore areas | First workings only, including use of a herringbone bord and pillar configuration | No change to approved mining methods. First workings only under land areas, foreshore and seagrass beds. Pillar extraction and miniwall mining limited to Fassifern Seam mining areas under Lake Macquarie. |
| Underground Mining Areas | Refer to Figure 1.1. | Refer to Figure 1.1, consistent with Appendix 2 of MC Project Approval | Consolidation of MC and CVC approved Mining Areas |
| Subsidence Commitments | Zone A – Maximum of 20 mm (HWMSB and SPB)<br>Zone B - Maximum 780 mm<br>Chain Valley Bay Mining Area multi-seam feasibility | Maximum of 20 mm subsidence | Zone A – Maximum of 20 mm subsidence<br>Zone B – Maximum 780 mm<br>Refer to Figure 1.2 |
| Mine Infrastructure | Personnel-and-material drifts, ROM coal conveyor drift to MC<br>Upcast and downcast ventilation shaft and fans<br>Coal handling facilities for breaking, crushing, sizing and storing product coal<br>Administration and workshop facilities<br>Water management infrastructure | Coal crushing facility<br>upcast and downcast ventilation shaft and fans<br>Coal handling facilities for breaking, crushing, sizing and storing product coal<br>Overland conveyor (from MC pit top are to VPPS)<br>Underground link road to CVC<br>Administration and workshop facilities<br>Water management infrastructure | Continued use of existing infrastructure<br>Minor upgrades to surface facilities proposed to support extended LOM and the increase to ROM throughput (including water management structures) |

| Project Component | CVC Approved Operations | MC Approved Operations | Consolidation Project |
|---|---|---|---|
| Coal Processing | Screening and ROM coal crushing, no coal rejects are generated | Screening and ROM coal crushing, no coal rejects are generated<br>Surface Rotary Breaker to be decommissioned | Screening and ROM coal crushing, no coal rejects are generated<br>ROM coal to be brought to the surface at MC or CVC |
| Product Coal Handling and Transportation | Product coal from CVC Pit Top to VPPS via truck on private roads only (up to 1.5 Mtpa) | Nil | Up to 1.5 Mtpa product coal transport from CVC to VPPS via internal roads and sections of privately owned construction road |
| | Transport product coal from approved CVC mining area to MC via the existing underground linkage up 2.1 Mtpa, for subsequent delivery to VPPS via conveyor | Up to 2.1 Mtpa ROM Coal via overland conveyor to VPPS. | Up to 2.8 Mtpa product coal transport from MC to VPPS via overland conveyor |
| | A maximum of 660,000 tonnes of product coal per annum on public roads to Port Waratah Coal Services (PWCS) for export (subject to CVC Pit Top handling liming of 1.5Mtpa ROM coal and overall operational limit of 2.8 Mtpa ROM coal) | Nil | No change |
| | A maximum of 180,000 tonnes of product coal per annum on public roads to domestic customers (other than VPPS) (subject to CVC Pit Top handling liming of 1.5Mtpa ROM coal and overall operational limit of 2.8 Mtpa ROM coal) | Nil | No change |
| Rehabilitation | Surface infrastructure will be decommissioned and the site rehabilitated following mine closure | Surface infrastructure will be decommissioned and the site rehabilitated following mine closure | No change. |
| Workforce (Operations) | Up to approximately 330 FTE personnel at CVC and within an overall CVC/MC workforce of approximately 390 | | No change |
| Workforce (Construction) | N/A | N/A | Managed within approved operational workforce limits. |
| Water Discharge Requirements | Licensed daily discharge of up to 12.161 ML/day (EPL) | Licensed daily discharge of up to 4 ML/day (EPL) | No change |

| Project Component | CVC Approved Operations | MC Approved Operations | Consolidation Project |
|---|---|---|---|
| Water Supply and Demand | Potable water utilised for surface facilities and underground operations (160 ML per annum) supplied by Central Coast Council from potable water supply mains | Potable water utilised for surface facilities and underground operations supplied by Central Coast Council via metered pipeline | Potable water utilised for surface facilities and underground operations supplied by Central Coast Council via metered pipeline |
| Exploration | Exploration activities subject to Exploration Activities and Minor Surface Infrastructure Management Plan | Exploration activities subject to Exploration Activities and Minor Surface Infrastructure Management Plan | No change |




Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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**Delta Coal**
**Chain Valley Colliery - Consolidation Project**
**Surface Water Impact Assessment**

Project No. **12580250**
Revision No. **2**
Date **04/10/2022**

**Consolidation Project overview**

**FIGURE 1.2**

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Print date: 04 Oct 2022 - 11:01

Data source: Umwelt: Project Area, 2021; LPI: DTDB / DCDB, 2017;public_NSW_Imagery: © Department of Customer Service 2020 public_NSW_Imagery: © Department of Customer Service 2020. Created by: fmackay

## 1.3 Objectives of the surface water impact assessment

The key objective of the SWIA is to identify and determine the potential impacts of the Project on the surface water environment by addressing the Secretary's environmental assessment requirements (SEARs) for the Project and relevant government agency requirements. The SEARs and additional requirements are presented in Appendix A, along with a reference to where each has been addressed in the SWIA.

The scope of work for the SWIA includes:

- Review existing assessments and data relevant to the Project
- Review relevant statutory requirements
- Establish the existing and/or approved conditions for the surface water systems
- Determine the water management requirements for the Project
- Undertake an assessment of the potential impacts of the Project on:
  - Water and salt balance
  - Surface water quality
  - Downstream water users, including licensed water users and basic landholder rights
- Undertake an assessment of the cumulative impacts of the Project in association with other operations in the region
- Identify licensing requirements
- Develop measures to avoid, minimise and mitigate potential impacts of the Project and provide recommended management, monitoring and reporting requirements

## 1.4 Limitations

This report has been prepared by GHD for Umwelt (Australia) Pty Ltd and Delta Coal and may only be used and relied on by Umwelt (Australia) Pty Ltd and Delta Coal for the purpose agreed between GHD, Umwelt (Australia) Pty Ltd and Delta Coal as set out in Section 1 of this report.

GHD otherwise disclaims responsibility to any person other than Umwelt (Australia) Pty Ltd and Delta Coal arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Umwelt (Australia) Pty Ltd and Delta Coal and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

# 2. Regulatory context

## 2.1 Legislation

### 2.1.1 Environmental Planning and Assessment Act 1979

The EP&A Act is the core legislation relating to planning and development activities in NSW and provides the statutory framework under which development proposals are assessed. The EP&A Act aims to encourage the proper management, development and conservation of resources, environmental protection and ecologically sustainable development.

The SWIA forms part of an EIS to support a development application under Part 4 of the EP&A Act for the Project.

The SWIA has been developed to address the surface water components of the SEARs and accompanying government agency requirements for the Project, which are reproduced in Appendix A, along with a reference to where each requirement has been addressed within this report.

### 2.1.2 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) is administered by the Environment Protection Authority (EPA), which is an independent statutory authority and the primary environmental regulator for NSW. The objectives of the POEO Act are to protect, restore and enhance the quality of the environment, by mechanisms including programs to reduce pollution at the source and monitoring and reporting on environmental quality. The POEO Act regulates and requires licensing for environment protection, including for waste generation and disposal and for water, air, land and noise pollution.

Under the POEO Act, an environment protection licence (EPL) is required for premises at which a ‘scheduled activity’ is conducted. Schedule 1 of the POEO Act lists activities that are scheduled activities for the purpose of the Act. Licence conditions relate to pollution prevention and monitoring and can control the air, noise, water and waste impacts of an activity.

Mining for Coal and Coal works are the current scheduled activities within the existing CVC and MC EPLs. Descriptions of the surface water management requirements specified in the current EPLs held at CVC and MC are presented in Section 4.1.

### 2.1.3 Water Management Act 2000

The aim of the *Water Management Act 2000* (WM Act) is to ensure that water resources are conserved and properly managed for sustainable use benefiting both present and future generations. It is also intended to provide formal means for the protection and enhancement of the environmental qualities of waterways and in-stream uses as well as to provide for protection of catchment conditions.

Historically, the *Water Act 1912* was the main legislation for managing water resources in NSW; however, this Act has been progressively phased out and replaced by water sharing plans (WSPs) under the WM Act. Once a WSP commenced, existing licences under the *Water Act 1912* were converted to water access licences (WALs), water supply works and use approvals (controlled activity approvals) under the WM Act. All new WALs and controlled activity approvals are also issued under the WM Act.

***Water sharing plans***

Fresh water sources throughout NSW are managed via WSPs under the WM Act. Provisions within WSPs provide water to support the ecological processes and environmental needs of groundwater dependent ecosystems and waterways. WSPs also regulate how the water available for extraction is shared between the environment, basic landholder rights, town water supplies and commercial uses. Key rules within the WSPs specify when licence holders can access water and how water can be traded.

The Project Area is covered by the *Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources* (Hunter Unregulated WSP). The WSP commenced in 2009 and manages the unregulated rivers and alluvial groundwater within the Hunter region. The Project Area is entirely covered by the South Lake Macquarie water source described in the Hunter Unregulated WSP.

Under the WM Act, extraction of water for basic landholder rights is protected by allocating and prioritising water for basic landholder rights. There are three types of basic landholder rights in NSW under the WM Act:

– Domestic and stock rights: Landholders are entitled to take water from a river, estuary or lake which fronts their land or from an aquifer which is underlying their land for domestic consumption and stock watering, without the need for a licence. However, a water supply work approval is required to construct a dam or a groundwater bore.
– Native title rights: Anyone who holds native title with respect to water, as determined by the *Native Title Act 1993*, can take and use water for a range of purposes, including personal, domestic and non-commercial communal purposes. There are no native holder rights identified in the water sources covering the Project.
– Harvestable rights: Landholders are entitled to collect a portion of runoff from their property and store it in one or more dams up to a certain capacity that are located on minor streams. This entitlement is known as a ‘harvestable right’ and is determined from the total contiguous area of land ownership. In the Central and Eastern Divisions of NSW (where the Project is located), landholders may capture and use up to 10 percent of the average regional runoff for their property without requiring an approval or licence under the WM Act. The maximum harvestable right is the total volume of runoff that a landholder is entitled to use without requiring a licence. If the maximum harvestable right for a landholding is exceeded, licensing for the volume of water extracted from the surface water source exceeding the harvestable right is required under the WM Act.

Section 4.41 of the EP&A Act removes the need for a number of approvals under the WM Act when development consent has been granted for an SSD. These are a water use approval under section 89 of the Act, a water management work approval under section 90 of the Act and an activity approval (other than an aquifer interference approval) under section 91 of the Act.

There are no surface water access licences or works approvals related to the Project. Surface water storages that form part of the water management system at CVC and MC are exempt from consideration under water access licensing and harvestable rights, as they are dams solely for the capture, containment and recirculation of drainage, consistent with best management practice to prevent the contamination of a water source.

## 2.2 Policies

### 2.2.1 NSW State Rivers and Estuary Policy

The NSW State Rivers and Estuaries Policy (NSW Water Resources Council 1993) provides objectives and principles to achieve sustainable management of rivers and estuaries in NSW to ensure resource use is consistent with the long-term biological and physical function of the natural system. The objectives of the policy are “To manage the rivers and estuaries in NSW in ways which: slow, halt or reverse the overall rate of degradation in their systems; ensure the long-term sustainability of their essential biophysical functions; and maintain the beneficial use of these resources”. The policy details guiding principles for sustainable management of rivers and estuaries.

## 2.3 Guidelines

### 2.3.1 Australian and New Zealand Guidelines for Fresh and Marine Water Quality

The Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018) provide guidance for assessing and managing ambient water quality in a wide range of water resource types and according to specified environmental values, such as aquatic ecosystems, primary industries, recreation and drinking water. The revised Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018) were published in 2018 following scientific review of the ANZECC (2000a) guidelines. The Water Quality Management Framework (ANZG 2018) provides the key requirements for determining appropriate guideline values or performance criteria to evaluate the results of water quality monitoring programs.

The ANZG (2018) guidelines adopt a risk-based approach to assessing ambient water quality by providing the framework to tailor water quality guidelines to local environmental conditions. Guideline values provided by ANZG (2018) can be modified into regional, local or site-specific guideline values (SSGVs) by taking into account factors such as the level of modification of the ecosystem, natural variability in water quality at reference sites, and water hardness. Guideline values are applied to the receiving environment at the edge of the mixing zone and do not apply to mine water at the point of discharge.

### 2.3.2 NSW Water Quality and River Flow Objectives

The *NSW Water Quality and River Flow Objectives* (DECCW 2006) are the agreed environmental values and long-term goals for each catchment in NSW. The objectives are intended to be considered in assessing and managing the potential impacts of activities on waterways.

Water quality objectives for the Lake Macquarie and the Tuggerah Lakes catchment are for the protection of aquatic ecosystems; visual amenity; primary and secondary contact recreation; livestock, irrigation and homestead water supply; drinking water; aquatic foods (cooked); and industrial water supplies. The water quality objectives are consistent with the national framework for assessing water quality provided by ANZG (2018) and have been considered in the assessment of surface water quality, discussed in Section 7.

The river flow objectives for the Lake Macquarie and the Tuggerah Lakes catchment are to: protect pools in dry times; protect natural low flows; protect important rises in water levels; maintain wetland and floodplain inundation; mimic natural drying in temporary waterways; maintain natural flow variability; maintain natural rates of change in water levels; manage groundwater for ecosystems; minimise effects of weirs and other structures; minimise effects of dams on water quality; make water available for unforeseen events; and maintain or rehabilitate estuarine processes and habitats. The river flow objectives have been considered in the assessment of surface water flow discussed in Section 8.

### 2.3.3 Using the ANZECC Guidelines and Water Quality Objectives in NSW

The document *Using the ANZECC Guidelines and Water Quality Objectives in NSW* (DEC 2006) provides guidance on applying the ANZECC (2000a; revised by ANZG 2018) framework for assessing water quality, including the use of water quality objectives for NSW, which is considered in the methodology for assessing water quality in Section 7.

### 2.3.4 Australian Guidelines for Water Quality Monitoring and Reporting

The *Australian Guidelines for Water Quality Monitoring and Reporting* (ANZECC 2000b) sets out a framework and guidance for the monitoring and reporting of fresh and marine surface water and groundwater. ANZECC (2000b) provides information for all aspects of a water quality monitoring program, including setting objectives, designing monitoring and sampling programs, laboratory analyses, data analysis and interpretation and reporting of results and conclusions.

The recommendations water quality monitoring program, presented in Section 9, for the Project were made in accordance with the framework presented by ANZECC (2000b).

### 2.3.5 Approved Methods for the Sampling and Analysis of Water Pollutants in New South Wales

The document *Approved Methods for the Sampling and Analysis of Water Pollutants in New South Wales* (DEC 2004) lists the sampling and analysis methods to be used when sampling water quality for compliance with environmental protection legislation, a relevant licence or relevant notice. All sample collection, handling and analyses undertaken for the purpose of this SWIA is understood to have been undertaken in accordance with the requirements outlined by DEC (2004).

### 2.3.6 Managing Urban Stormwater: Soils and Construction

*Managing Urban Stormwater: Soils and Construction – Volume 1* (the 'Blue Book'; Landcom 2004) outlines the basic principles for the design, construction and implementation of sediment and erosion control measures to improve stormwater management and mitigate the impacts of land disturbance activities on soils and receiving waters. This document relates particularly to urban development sites; however, it is relevant to the Project as it provides guidance on the configuration of erosion and sedimentation controls, which may be necessary during construction and operation of the Project.

*Managing Urban Stormwater: Soils and Construction – Volume 2E Mines and Quarries* (DECC 2008) provides specific guidelines, principles and minimum design standards for good management practice in erosion and sediment control during the construction and operation of mines and quarries. This document relates specifically to this Project as a mine site.

### 2.3.7 Guidelines for controlled activities on waterfront land

The Natural Resources Access Regulator (NRAR) has published a number of guidelines on types of controlled activities and the protection of waterfront land. Waterfront land includes the bed and bank of a river, lake or estuary, and all land within 40 m of the highest bank of the river, lake or estuary.

The guidelines provide recommendations for the design and construction of instream works and an indication of the width of riparian zones to be considered. The guidelines (NRAR 2018) focus on the following key requirements:

– Maintaining the natural geomorphic processes through the accommodation of the existing watercourse, allow for the natural movement of sediment, woody debris and not allowing for an increase or the construction of scour and erosion within the existing watercourse.
– Maintaining the existing watercourse hydrologic function through accommodation of low flows and not altering the natural bank full or flood flows.
– The use of scour protection when required for the protection of existing banks, using placed rock.
– Visual inspections and maintenance on the watercourse during the works.

As discussed in Section 2.1.1, as SSD the Project does not require any controlled activity approvals, nor will it involve any additional disturbance on 'waterfront land' relative to existing approved operations. Despite this, the assessment of potential impacts of the Project on surface water has considered the guidelines for waterfront land and riparian corridors.

# 3. Regional environment

## 3.1 Climate

Climate data were obtained as SILO Patched Point Data from the Science Division of the Queensland Government's Department of Environment and Science. SILO Patched Point Data is based on historical data from a particular Bureau of Meteorology station with missing data “patched in” by interpolating with data from nearby stations.

SILO data were obtained for the grid point located at -33.15 N, 151.55 E, which is located within the Project Area. Average monthly climate data for this point is shown in Figure 3.1. Evaporation varies seasonally, with higher values recorded in summer compared to winter. Average monthly rainfall exceeds evaporation between March and July.

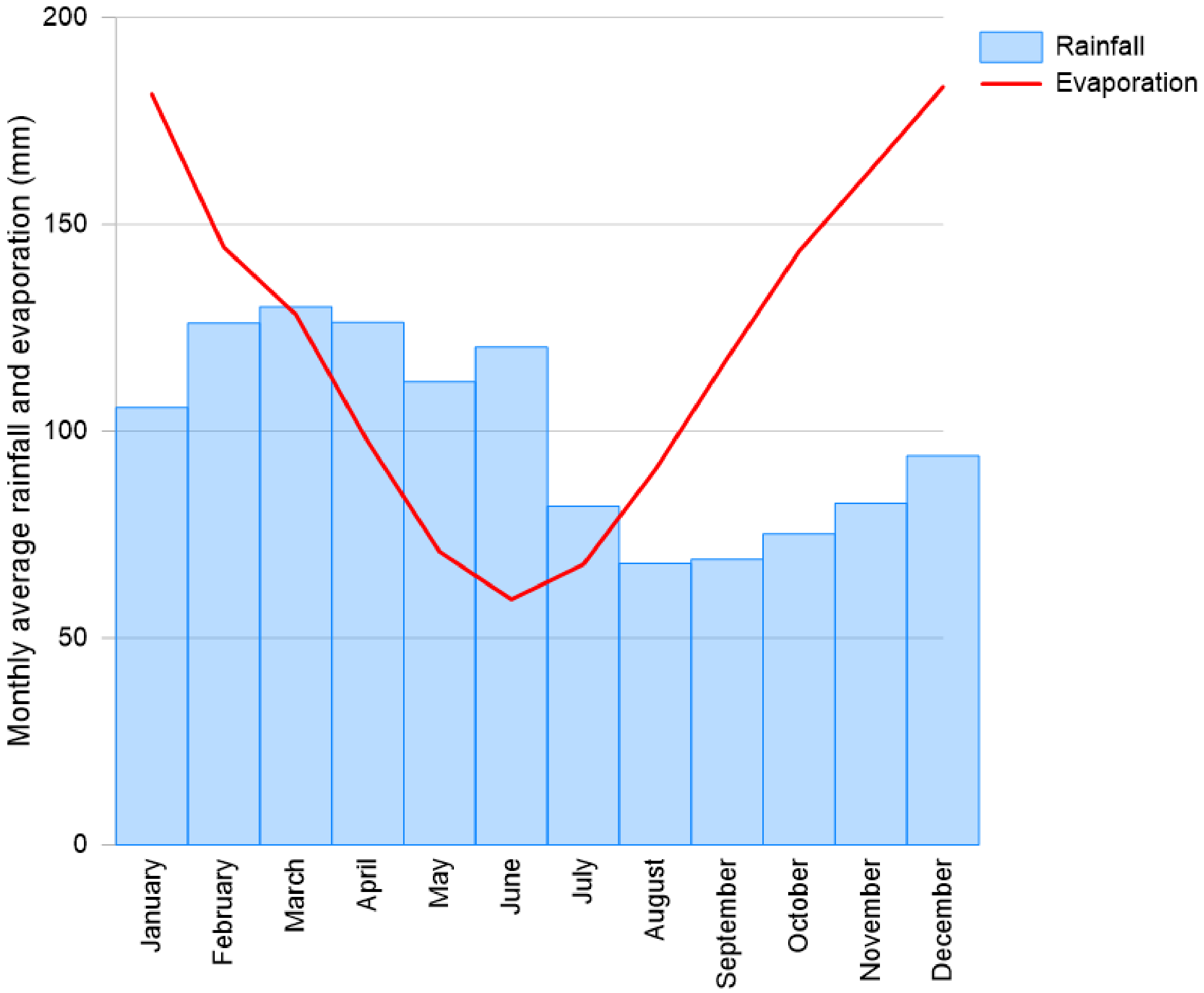



***Figure 3.1 Average climate data (-33.15 N, 151.55 E)***

Historical annual SILO point rainfall data between 1900 and 2020 is shown in Figure 3.2. Annual rainfall statistics associated with this data are summarised below:

– Minimum rainfall – 605 mm in 1944
– Median rainfall – 1,156 mm
– Average rainfall – 1,189 mm
– Maximum rainfall – 2,037 mm in 1950

Annual rainfall was below the annual average in recent years (from 2016 – 2019) and above average in 2020.

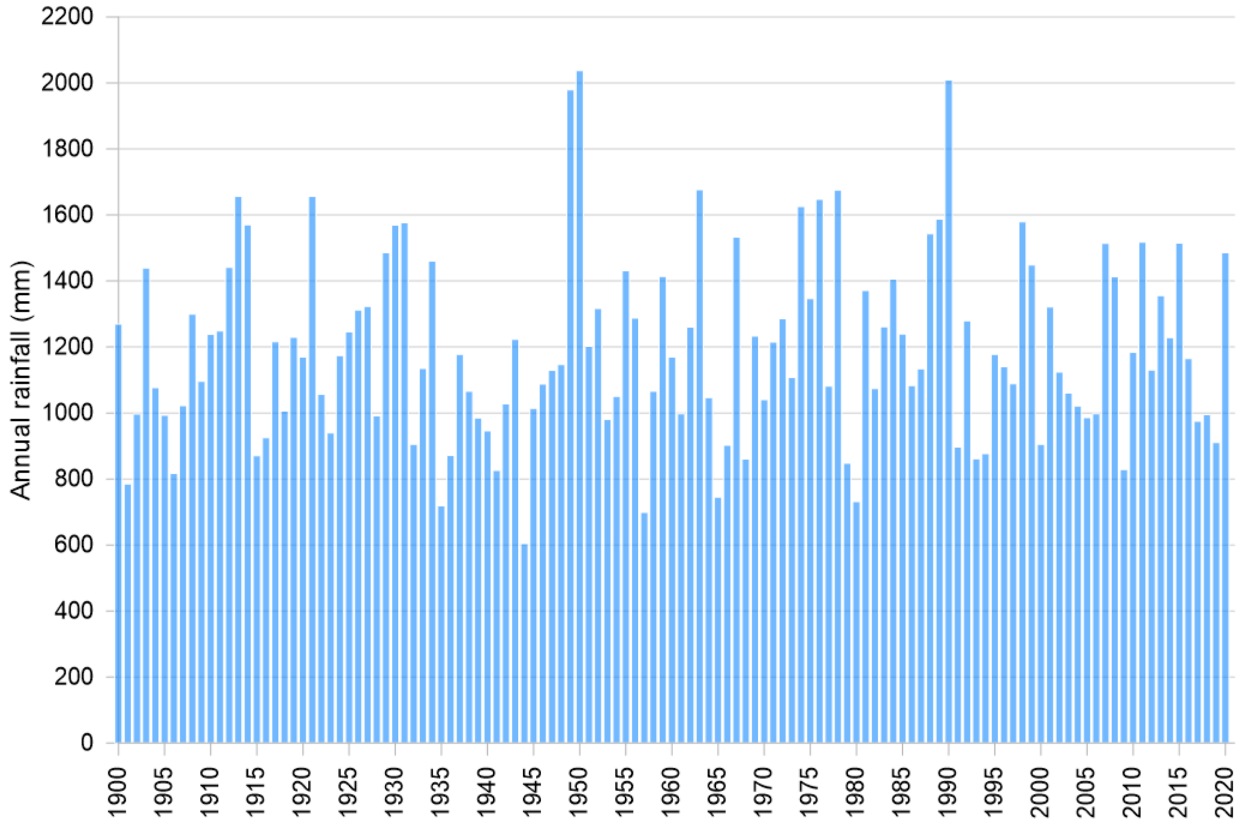



*Figure 3.2 Historical annual rainfall record (-33.15 N, 151.55 E)*

## 3.2 Topography

The topography of the Project Area is generally low lying due to its proximity to Lake Macquarie. The elevation rises approximately 30 km to the west of the Project Area to over 400 m AHD on the Great Diving Range.

## 3.3 Hydrology

The Project Area is located within the catchment area of south Lake Macquarie to the south of the Dora Creek catchment. The main creek systems in the vicinity of the Project Area include Wyee Creek, Cobra Creek and Pourmalong Creek to the west, Swindles Creek and Karignan Creek to the south, Bonny Boy Gully, Mangrove Gully and Tiembula Creek to the east and Postmistress Creek to the north. A number of unnamed tributaries also exist in the vicinity of the Project Area. Watercourse locations are shown in Figure 3.3.

A number of estuarine lakes exist to the south of the Project Area, including Lake Munmorah, Colongra Lake, and Budgewoi Lake.

There are no data regarding creek water levels and flow in the vicinity of the Project Area. In general, creeks are ephemeral and water gaining upstream of the tidal zone. Within the tidal zone there is permanent water in creeks including Swindles Creek.

## 3.4 Land use

The existing SSD-5465 consent boundary includes:

– The CVC operational area, and area under the Vales Point Substation, to the south. This facilitates an underground link road between CVC and MC.
– The CVC Ventilation Compound, northeast of the CVC Pit Top.
– Chain Valley Bay residential areas and the Lake Macquarie State Conservation Area to the southeast.
– Neds Point to the east.

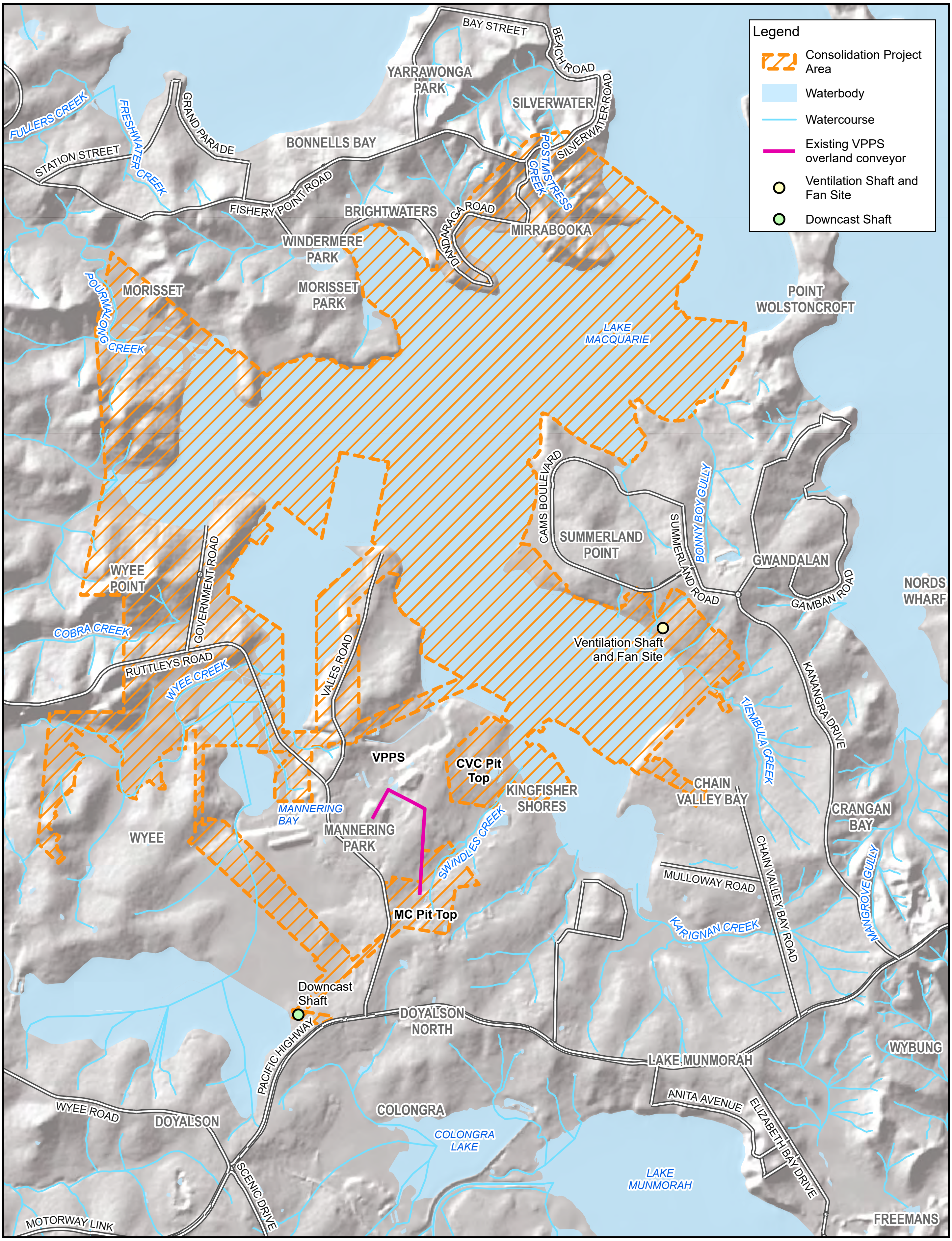
The existing PA 06_0311 consent boundary contains lands including:

– The MC Pit Top operational area
– The MC Downcast Shaft site, southwest of the MC Pit Top

Most of the approved CVC mining area within the Project Area is below Lake Macquarie near the shoreline suburbs of Summerland Point, Chain Valley Bay, Mannering Park, and Morisset East. The Northern Mining Area includes areas below the suburbs of Brightwaters, Mirabooka and Sunshine. The approved MC mining area includes approved mining areas below the suburbs of Wyee Point, Mannering Park and parts of Wyee and Morisset. The Project does not involve any changes to the mining in these currently approved areas that would alter impacts to surface water features relative to existing approved operations.

Major infrastructure located within the Project Area that has the potential to be influenced by surface water impacts related to mine subsidence or changes to surface water management, include:

– Surface facilities at CVC and MC
– Operations at Vales Point Power Station including coal ash emplacement
– Arterial roads, local roads, private mine haul roads and various access tracks
– Major drainage culverts and pipelines
– Communications and electrical infrastructure - substations/power lines and poles

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Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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## Topography and hydrology

# FIGURE 3.3

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Data source: Umwelt: Project Area, 2021; LPI: DTDB / DCDB, 2017; . Created by: fmackay

# 3.5 Geology and soils

## 3.5.1 Geology

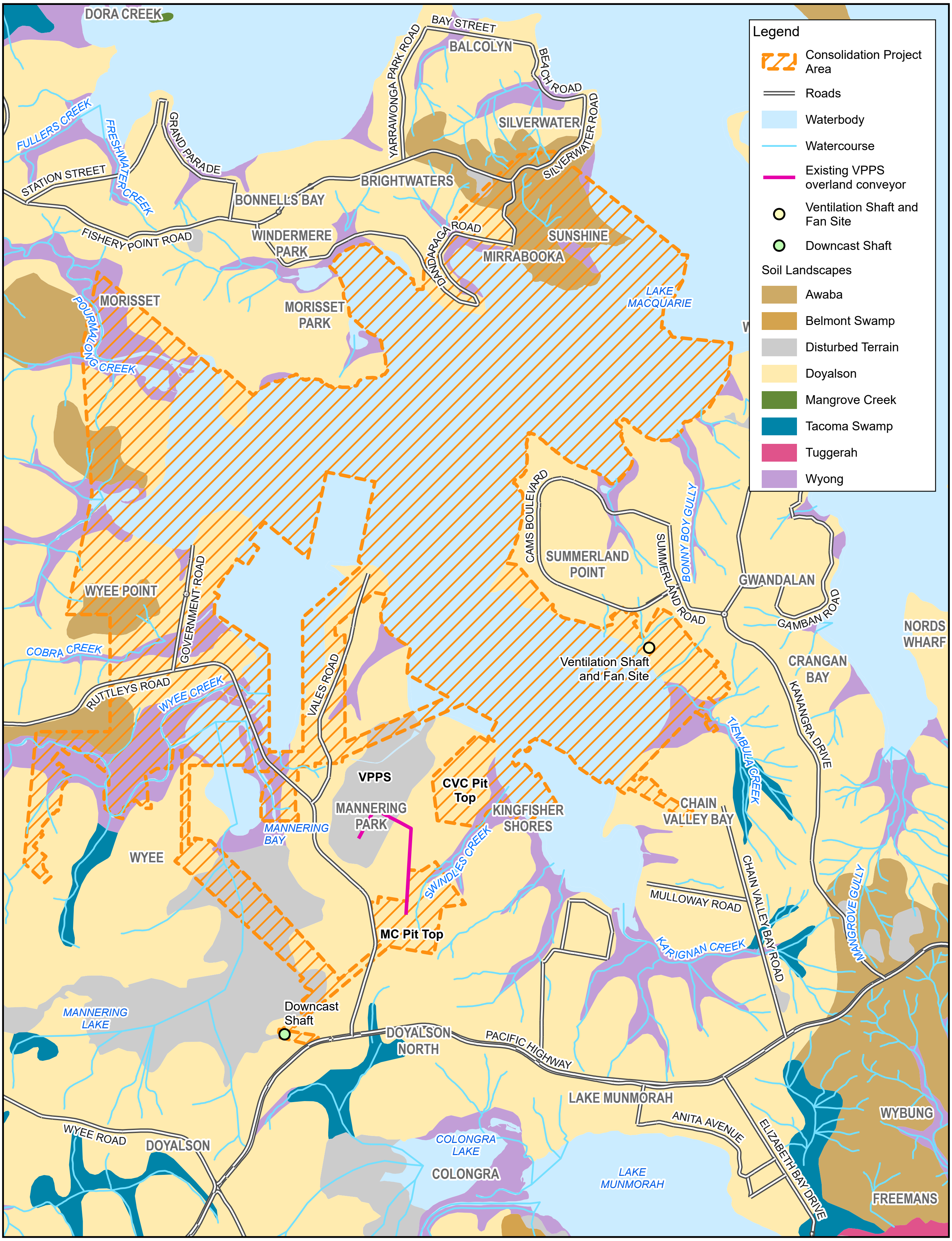
The Project Area is located within the Newcastle Coalfield within the northern portion of the Sydney Basin. The stratigraphy of the region consists predominantly of Triassic and Permian strata overlain by quaternary alluvial and lacustrine deposits overlay the bedrock in some areas. The target seams at CVC, from shallowest to deepest, are the Wallarah Seam, Great Northern Seam and Fassifern Seam.

## 3.5.2 Soil landscapes

The majority of the approved CVC and MC underground mining operations occur below Lake Macquarie. Soil profiles of the surrounding land areas are largely comprised of Wyong, Awaba and Doyalson soil landscapes with smaller areas of Gorokan and Tacoma Swamp soil landscapes. The properties of the main soil landscapes are:

– Wyong: Landscape is made up of quaternary sediments (sand, silt gravel and clay), forming generally poorly drained deltaic floodplains and alluvial flats with low fertility, and high limitations for urban development due to high flooding hazard. Small areas of Tacoma Swamp soil landscape occur on the floodplain.
– Awaba: Landscape comprises both Munmorah Conglomerate Formation (pebbly sandstone, siltstone varieties and claystone) and Newcastle Coal Measures conglomerate subgroups Moon Island, Boolaroo and Adamstown (sandstone, tuff, siltstone, claystone and black coal conglomerate). Moderately inclined to occur on steep slopes (up to >25%), with low to very low fertility and moderate limitations for urban development capability due to moderate foundation hazard (though in localised areas of slopes >20%, mass movement hazards are applicable and therefore severe urban development limitations are present).
– Doyalson: Landscape contains the Munmorah Conglomerate Formation (pebbly sandstone, siltstone varieties and claystone), with small areas of quartz sandstone at the base of Tuggerah Formations included. Small areas of Gorokan soil landscape have been included in the southern locations of the Doyalson soil landscape. Urban development capability is moderate, due to generally low foundation hazards with isolated high plasticity areas forming high foundation hazard. Soil fertility of the Doyalson landscape is generally very low.

The locations of these soil landscapes are shown in Figure 3.4.

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Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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## Soil landscapes

## FIGURE 3.4

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Data source: DPE: Landscape Soils, 2008; Umwelt: Project Area, 2021; LPI: DTDB / DCDB, 2017; . Created by: fmackay

## 3.6 Downstream licensed water users

The NSW Water Register (WaterNSW 2021) was reviewed to identify any licensed surface water users within the South Lake Macquarie water source. No surface water users were identified downstream of the Project area or the LDPs which will be utilised by the Project.

# 4. Water management

## 4.1 Existing water management

The water management system at CVC and MC is generally comprised of clean and dirty surface, potable, waste and underground elements. Sources of water at the surface sites include potable water supply, rainfall, runoff and groundwater inflow into the underground mine workings. The water management at CVC and MC pit top primarily focuses on erosion and sediment control. Water management demands for underground operations include machinery washdown, oil water separator system, effluent management train, operation of the pollution control dams and staff amenities.

Surface water runoff from areas where there is no coal storage, transportation, handling or processing or any disturbance is considered to be clean water, as it is unlikely to be contaminated with coal fines or sediment. Runoff is diverted around dirty water and coal-contact catchments to avoid mixing with clean water runoff. Clean water runoff is typically from natural and impervious catchments such as areas of vegetation, sealed roads and sealed carparks. Dirty water is runoff from disturbed areas and areas likely to contain suspended sediment, oils, grease and hydrocarbons. This typically includes workshop and fuel storage areas. Coal-contact water is runoff from catchments where coal storage, transportation, handling or processing occurs and is managed within the dirty water management systems.

Delta Coal has site-specific water management objectives that include:

- Maximise the separation of clean and dirty surface water systems
- Manage water discharge from the sites, in terms of volume and quality, to a level that is acceptable for environmental management and community expectations
- Minimise water discharges from the premises by maximising, where practicable, opportunities for the reuse and recycling of water on site
- Manage discharge to natural waterways in accordance with the relevant EPL conditions

A schematic of the overall water management system at CVC and MC is provided in Figure 4.1. No major changes to the water management system at CVC or MC are proposed as part of the Project.

### 4.1.1 Underground water system

CVC and MC workings intercepts groundwater in the Wallarah, Great Northern and Fassifern Seams and surrounding formations. The underground mine water management system receives water from the CVC and MC underground workings. This water is transferred to old workings and goafs (which are formed by previous secondary extraction mining) via a series of collection ponds, dams and pumps from various working areas underground. The underground workings have some operational storage capacity and provides a filtration and sediment settlement function prior to the water being pumped to the surface dams at CVC and MC. The underground water management system consists of the following:

- Groundwater inflows enter the underground system throughout various areas via seepage from the coal seam and adjacent strata in the active and old underground workings. Water from these areas is managed through pumping to and from temporary storage areas in the underground workings.
- Potable water is transferred underground for mining processes via the CVC and the MC underground workings. After use, most of this water reports to the underground workings and some is entrained as additional moisture in the ROM coal when it is extracted.
- Water is transferred from the Underground Storage to the Pollution Control Dams at CVC at an average rate of approximately 5.4 ML/day, and to the Settlement Ponds at MC at an average rate of approximately 0.8 ML/day under existing conditions. These surface water storages ultimately discharge into Lake Macquarie via Swindles Creek through LDP001 at CVC and LDP001 at MC.

### 4.1.2 Chain Valley Colliery

The water management system at CVC Pit Top includes the diversion of clean water runoff around upslope areas of the site, the collection of water from disturbed areas and the discharge of water to Lake Macquarie via Swindles Creek. The catchments and clean and dirty water drainage are presented in Figure 4.2. The water management system includes:

- Clean water runoff from vegetated and carpark areas is diverted to discharge off-site. These diversions convey runoff to the western and northern side of the site.
- Dirty water runoff from disturbed and workshop and maintenance areas from the pit top is directed through the dirty water management system. These flows are conveyed through surface water quality control elements to an oil water separator. Water is then discharged to the site's pollution control dams.
- Potable water is provided to surface and underground facilities by CC Council town-water system. Surface operations utilising potable water include the amenities, vehicle washdown bay, bathhouse facilities and dust suppression.
- Water is pumped from the Underground Storage to the Settling and Diffusing Pond D8 at an average rate of approximately 5.4 ML/day. The series of Settling Ponds ultimately discharges into Lake Macquarie via Swindles Creek through LDP001. LDP027 is a high flow discharge point co-located with LDP001.
- Grey water and sewage from the operational bathhouse buildings is currently dosed with Sodium Hypochlorite and directed to Sediment Pond D8 for UV treatment and maturation. It is planned to construct a sewage pump station and rising main pipeline, and pump the grey water and sewage received from the bathhouse buildings to the CC Council sewer independently of the Project as per the approved DA 845-2020.

### 4.1.3 Mannering Colliery

The water management system at MC Pit Top includes the diversion of clean water runoff around the site, the collection of water from disturbed areas, the collection of underground water and the discharge of water to Lake Macquarie via Swindles Creek. The catchments and clean and dirty water drainage components within the MC are presented in Figure 4.3.

The water management system at the site includes the following specific elements:

- Clean water runoff from upslope areas on the southern and eastern portion of the site are diverted to Pond 4.
- Clean water runoff from vegetated areas along the south-west boundary of the site are diverted around the site to discharge off-site to the west and north.
- Dirty water runoff from the disturbed, processing and haul road areas is directed through the dirty water management system to the site sediment ponds, and ultimately discharged via LDP001.
- Potable water is provided to the surface facilities by CC Council through a direct metered pipeline. Surface operations utilising potable water include spraying for dust suppression, the underground workings, administrations, the truck washing bay and bathhouse facilities.
- Underground water is pumped from the underground workings to the Settlement Ponds then to LDP001 at an average rate of approximately 0.8 ML/day. The Settlement Ponds ultimately discharges into Lake Macquarie via Swindles Creek via CVC LDP001.
- Grey water and sewage from buildings directed to the site sewage pump station and directed offsite to the CC Council sewage system.

### 4.1.4 Environment Protection Licence

CVC and MC currently hold EPL 1770 and EPL 191, respectively, which includes requirements to monitor dust, water quality and the quantity and quality of water discharges. CVC and MC are licensed to discharge water under EPL 1770 and EPL 191 through the following LDPs:

***EPL 1770***

- CVC LDP001 – Main discharge point of surface water, mine water make and site runoff into Lake Macquarie via Swindles Creek
- CVC LDP027 – Discharge of surface water runoff through spillway which discharges during significant rainfall events

CVC LDP001 and CVC LDP027 combined are licensed to discharge up to 12.161 ML/day of water and are subject to water quality concentration limits specified in Table 4.1.

*Table 4.1 CVC LDP001 and CVC LDP027 concentration limits*

| Pollutant | Unit | 100th percentile concentration limit |
|---|---|---|
| Faecal coliforms | colony forming 200 units per 100 millilitres | 200 |
| pH | pH units | 6.5 to 8.5 |
| Total suspended solids | mg/L | 50 |

**EPL 191**

MC LDP001 – Main discharge point of surface water, mine water make and site runoff into Lake Macquarie via Swindles Creek.

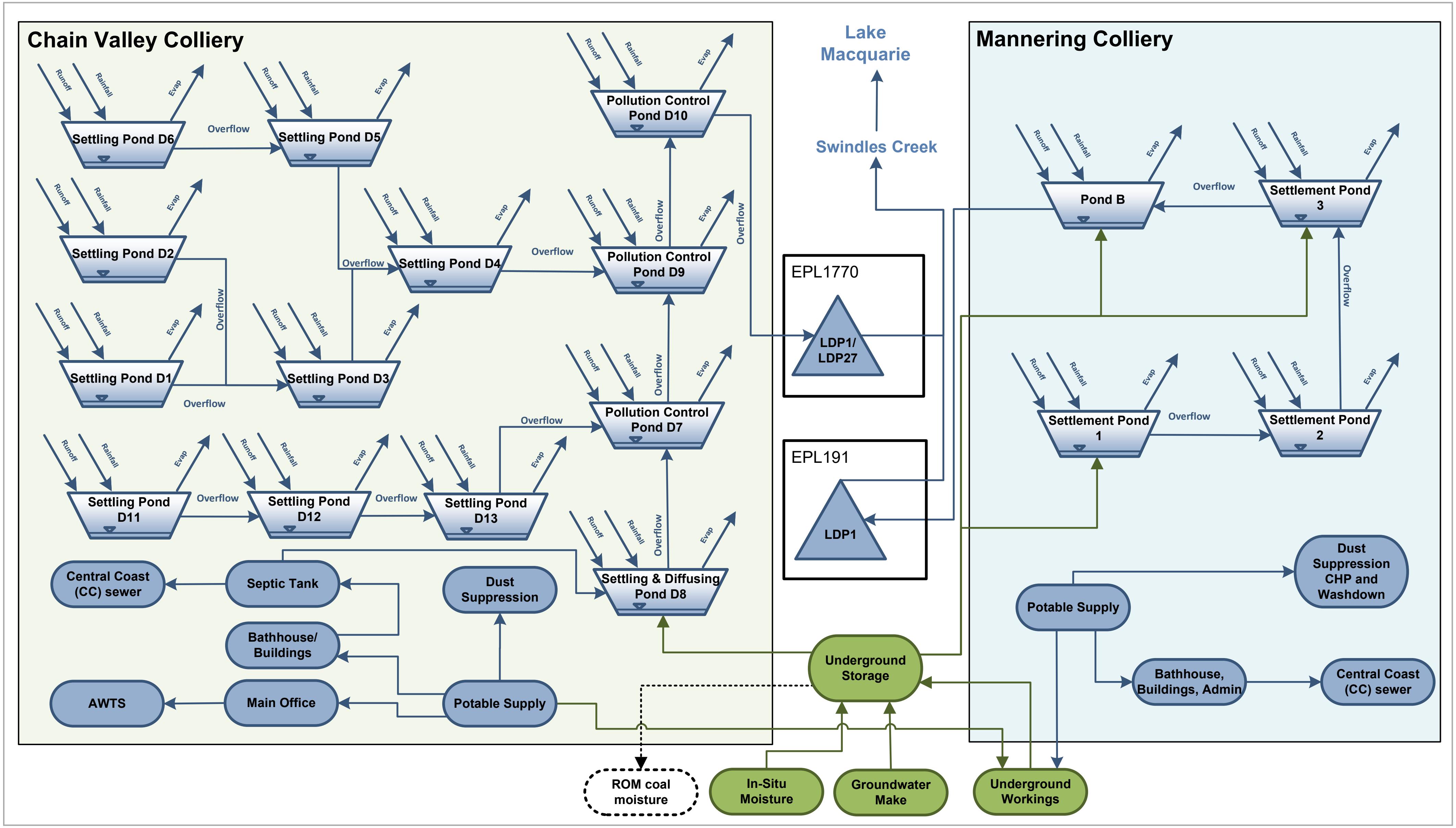
MC LDP001 is licensed to discharge up to 4.0 ML/day and is subject to water quality concentration limits specified in Table 4.2.

*Table 4.2 MC LDP001 concentration limits*

| Pollutant | Unit | 100th percentile concentration limit |
|---|---|---|
| Oil and Grease | mg/L | 10 |
| pH | pH units | 6.5 to 8.5 |
| Total suspended solids | mg/L | 50 |

## 4.2 Proposed water management system

No significant changes to the water management system at either CVC or MC are required as part of the Project.




Legend

Underground storage

Underground process

Surface storage

Surface process

Licensed discharge point

Surface water flow

Groundwater flow

Entrained moisture

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Surface water impact assessment

Water management schematic

Project No. 12580250
Revision No. 0
Date 14/06/2022

FIGURE 4.1

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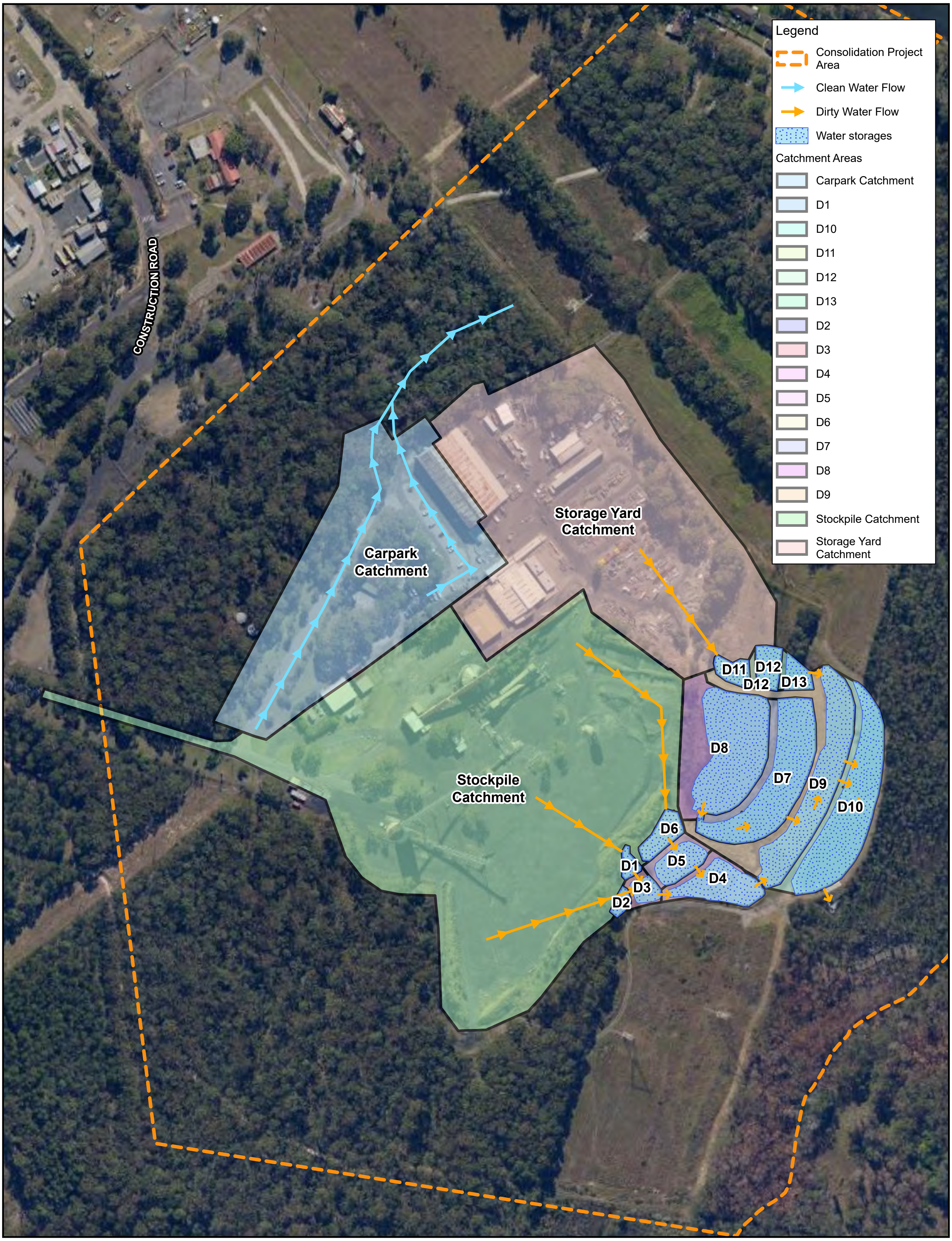


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Delta Coal
Chain Valley Colliery - Consolidation Project
Surface Water Impact Assessment

**Water management system - Chain Valley Collliery**

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**FIGURE 4.2**

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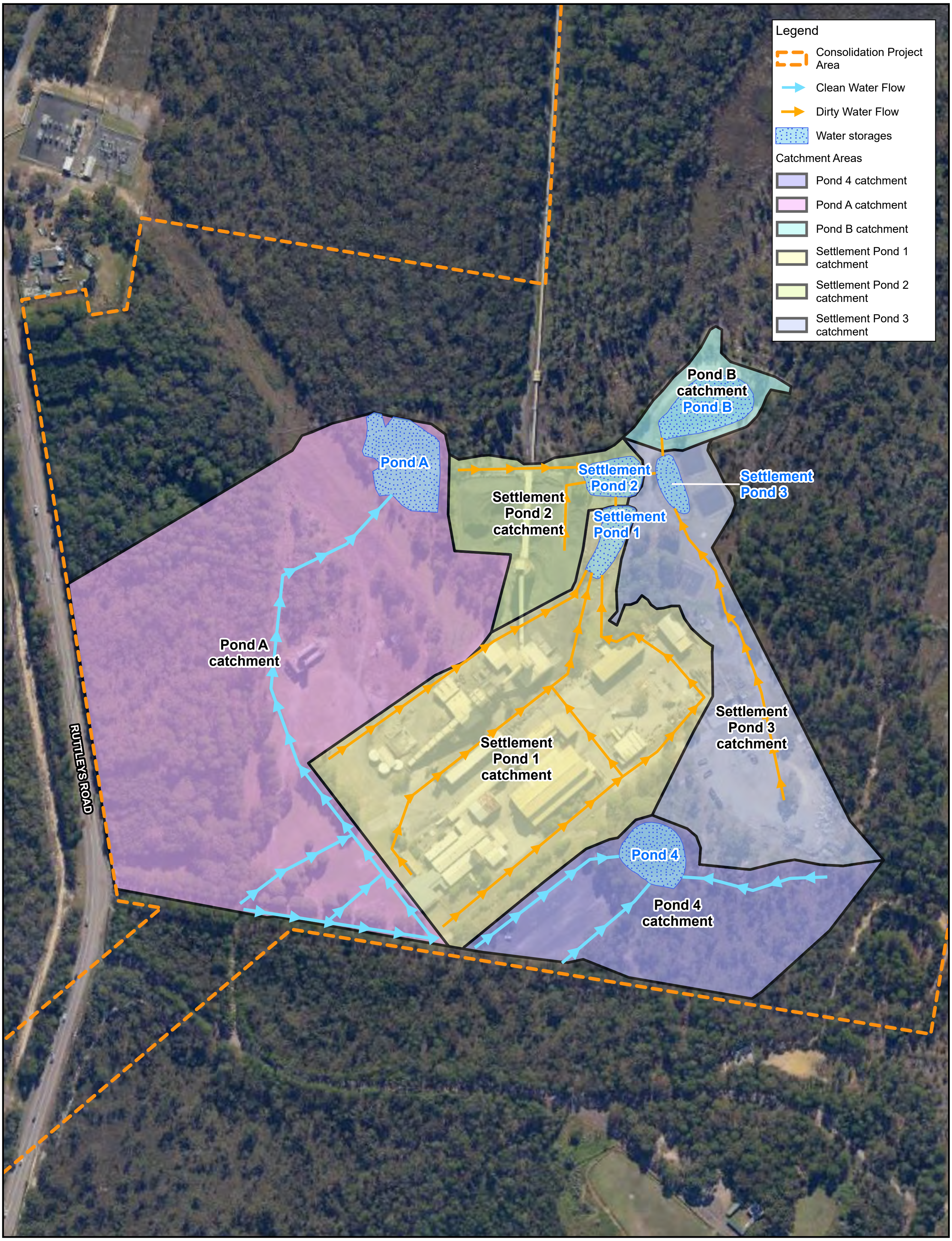


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Delta Coal
Chain Valley Colliery - Consolidation Project
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**Water management system - Mannering Colliery**

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**FIGURE 4.3**

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Data source: LPI: DTDB, 2017;LPI NSW_Imagery: © Department of Customer Service 2020 LPI NSW_Imagery: © Department of Customer Service 2020. Created by: fmackay

# 5. Conceptual hydrological model

A conceptual hydrological model was developed to identify the key hydrological processes and their interactions. It includes the surface water systems, groundwater systems, flow paths, recharge and discharge processes and the interaction between each component. Figure 5.1 presents a conceptual hydrological model of the Project Area and wider region. The key components are discussed in Section 3 and Section 4 and include:

- CVC Pit Top and MC Pit Top within the Project Area.
- The receiving waters of Swindles Creek from discharge from CVC and MC, which reports to Lake Macquarie and ultimately the Pacific Ocean.
- The named watercourses overlying the Project Area: Tiembula Creek, Wyee Creek, Cobra Creek, Post Mistress Creek and Pourmalong Creek.
- The named watercourses of Bonny Boy Creek (located further north of the Project area) does not overly the Project Area.

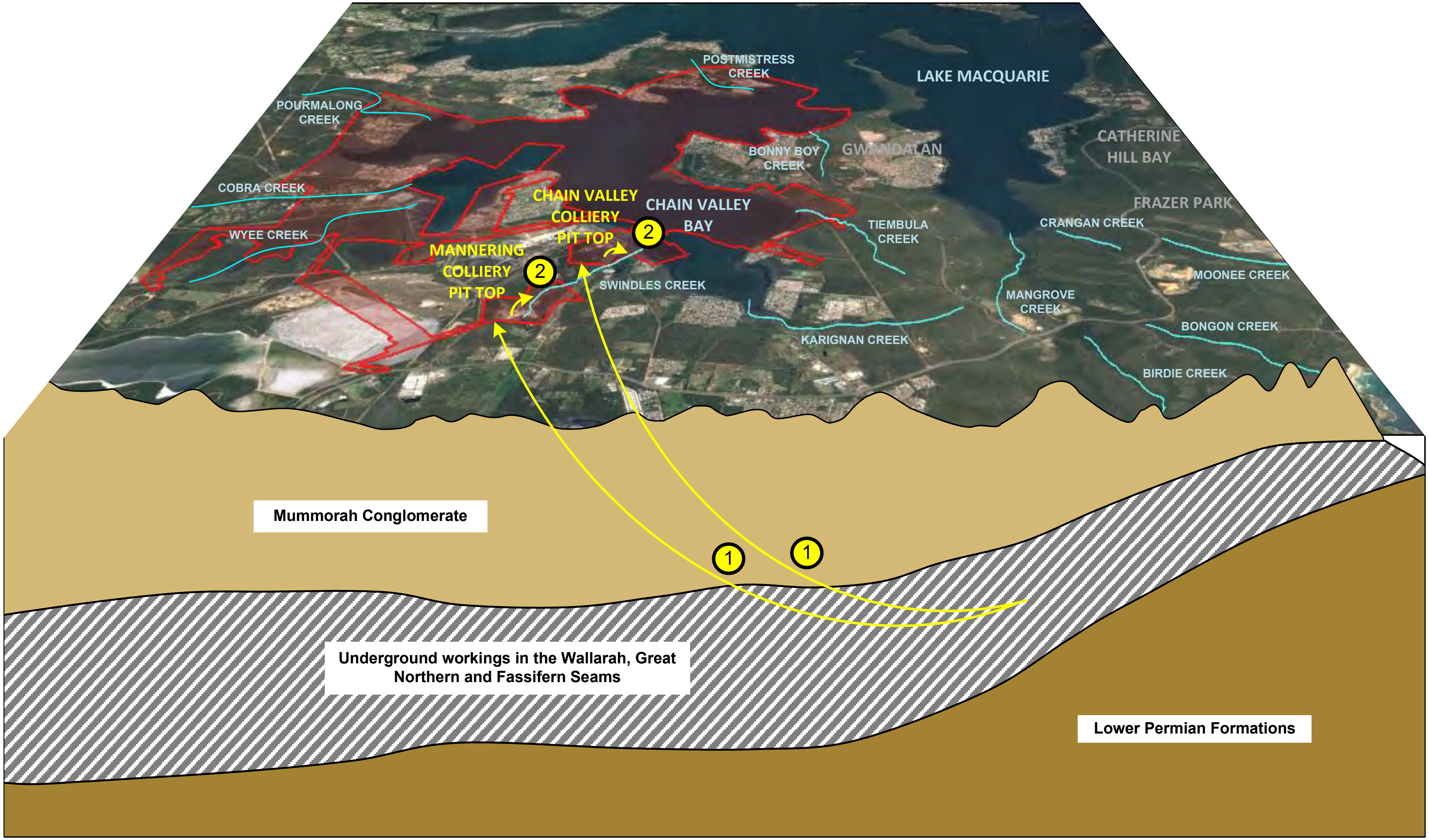
The conceptual model builds on the general hydrologic cycle across the catchment:

1. Rainfall, catchment runoff and recharge of groundwater sources
2. Evaporation from water surfaces and evapotranspiration from vegetation

It also includes the key water flows between the key components, as shown in Figure 5.1 (yellow arrows and numbers):

1. Dewatering from the underground workings to the CVC and MC Pit Top
2. Discharges from CVC and MC Pit Top to Swindles Creek

Based on the conceptual groundwater model developed as part of the Groundwater Impact Assessment (GHD 2022), there is no direct connection due to potential subsidence cracking between the surface watercourses and the underground workings.




Vertically exaggerated; not to Scale

Legend

Named watercourses

Project area

Delta Coal
Chain Valley Colliery – Consolidation Project
Surface water impact assessment

Conceptual hydrological model

Project No. 12580250
Revision No. 0
Date 05/10/2022

FIGURE 5.1

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# 6. Water and salt balance

Throughout the life of the Project mining in different areas and possible secondary extraction in the western parts of the approved mining area below Lake Macquarie have potential to affect the water and salt balance of CVC and MC relative to current mining operations due to changes in mine water inflows. Similar changes would be expected from existing approved operations however the nature and timing of extraction associated with the Project is likely to differ from that contemplated for the existing approved operations due to the extended mining. A site water and salt balance model was developed to quantify the potential impacts under a range of rainfall conditions. The methodology, data, validation and results of the modelling are detailed in Appendix C. The purpose of this section is to provide a brief summary of the key inputs and assumptions and to assess the potential impacts of the Project based on the modelling results.

## 6.1 Modelling methodology

For this assessment, a water and salt balance model has been developed, which includes both Chain Valley Colliery and Mannering Colliery. The model was used to estimate the annual transfers between water cycle components under three conditions:

- **Approved conditions**: this represents the approved operations at CVC and MC including the adopted groundwater flow predictions shown in Table 6.1.
- **Proposed conditions**: this represents the proposed operations as part of the project, including the adopted groundwater flow predictions as shown in Table 6.1.

The increased groundwater inflows for the Proposed conditions conservatively assume higher rates of groundwater inflow associated with possible additional (relative to approved) secondary extraction in the western part of the approved mining area below Lake Macquarie (Fassifern Seam at MC). These rates are based on observed groundwater inflow data for the Fassifern Seam at CVC during miniwall operations (see GHD, 2022). The predicted additional inflows are associated with depressurisation in the strata overlying the secondary extraction area only. There is no historical evidence of connectivity between underground workings and Lake Macquarie and connectivity is not expected from proposed mining operations. If secondary extraction does not occur in the western areas of the approved mining area, groundwater inflows would be expected to be similar to the ‘Approved operations’ scenario given there is no change in approved mining area.

The model was simulated using a historical time series of daily rainfall data extending over 132 years, from January 1889 to January 2021. A total of 132 realizations were applied, with each realisation modelling a different rainfall pattern from the record.

*Table 6.1 Modelled groundwater inflow*

| Condition | Groundwater inflow (ML/day) |
|---|---|
| Approved conditions | 6.7 |
| Proposed conditions | 7.6 |

## 6.2 Water balance results

The combined annual average forecast water transfers for CVC and MC under approved and proposed conditions are compared in Table 6.2.

*Table 6.2 Annual average water balance*

| Water management element | Approved conditions (ML/year) | Proposed conditions (ML/year) |
|---|---|---|
| **Inputs** | | |
| Direct rainfall | 28 | 28 |
| Catchment runoff | 113 | 113 |
| Groundwater inflows | 2446 | 2774 |
| In situ coal moisture | 74 | 64 |
| External potable water supply | 253 | 253 |
| **Total Inputs** | **2913** | **3232** |
| **Outputs** | | |
| Evaporation | 32 | 32 |
| Discharge to Swindles Creek | 2641 | 2988 |
| ROM coal moisture | 224 | 196 |
| Dust suppression | 13 | 13 |
| Discharge to Aerated Wastewater Treatment System (AWTS) | 0 | 0 |
| Discharge to Central Coast (CC) sewer | 3 | 3 |
| **Total Outputs** | **2913** | **3232** |
| **Change In Storage** | | |
| Surface water storages | 0 | 0 |
| Underground Storage | 0 | 0 |
| **Total Change In Storage** | **0** | **0** |
| **Balance** | | |
| Inputs – outputs – change in storage | 0 | 0 |

### 6.2.1 Direct rainfall, runoff and evaporation

No change in direct rainfall, catchment runoff and evaporation at both CVC and MC is expected as a result of the Project reflecting no proposed changes to the water management system.

### 6.2.2 Groundwater inflows

The water balance model results suggest that the key driver of change of the site water balance is the predicted increase in groundwater inflows within the CVC and MC underground workings as a result of the Project. Results show proposed conditions having higher increase in groundwater inflows relative to baseline conditions compared to approved conditions.

### 6.2.3 In situ coal moisture and ROM coal moisture

Both in situ and ROM coal moisture are simulated to decrease as a result of the Project reflecting the decrease in annual ROM production from approved 3.2 Mtpa to proposed 2.8 Mtpa. In reality, the actual coal moisture volumes will be less than these nominal rates and vary proportionally with actual production and with coal properties.

### 6.2.4 Potable water and dust suppression

No change in potable water use or dust suppression demands are expected as a result of the Project.

### 6.2.5 Discharge to Swindles Creek

Discharges to Swindles Creek from CVC LDP001, CVC LDP027 and MC LDP001 are expected to increase as a result of the Project, due to the forecast increase in groundwater inflows, but still remain within the combined 16.161 ML/day discharge rate limit of CVC and MC to Swindles Creek.

### 6.2.6 Discharge to sewer

Discharges to sewer are expected to remain consistent with existing approved operations however the site sewerage systems will be required for an extended period with the extension of the Project life.

### 6.2.7 Change in storage

Overall, no significant change in the volume of water storage underground or in surface water storages is expected as a result of the Project.

## 6.3 Salt balance results

The combined annual average forecast salt transfers for CVC and MC under approved and proposed conditions are compared in Table 6.3.

*Table 6.3 Annual average salt balance*

| Water management element | Approved conditions (2024) (tonne/year) | Proposed conditions (2024) (tonne/year) |
|---|---|---|
| **Inputs** | | |
| Direct rainfall | 1 | 1 |
| Catchment runoff | 20 | 20 |
| Groundwater inflows | 52432 | 59475 |
| In situ coal moisture | 1577 | 1380 |
| External potable water supply | 40 | 40 |
| **Total Inputs** | **54069** | **60915** |
| **Outputs** | | |
| Evaporation | 0 | 0 |
| Discharge to Swindles Creek | 49661 | 57022 |
| ROM coal moisture | 4405 | 3890 |
| Transfers to dust suppression | 2 | 2 |
| Discharge to Aerated Wastewater Treatment System (AWTS) | 0 | 0 |
| Discharge to Central Coast (CC) sewer | 0 | 0 |
| **Total Outputs** | **54069** | **60915** |
| **Change In Storage** | | |
| Surface water storages | 0 | 0 |
| Underground Storage | 0 | 0 |
| **Total Change In Storage** | **0** | **0** |
| **Balance** | | |
| Inputs – outputs – change in storage | 0 | 0 |

Table 6.3 shows that the impact of the Project on the salt balance of CVC and MC is consistent with the water balance, shown in Table 6.2. As groundwater inflows increase, the average salinity of discharges at both discharge locations has the potential to increase slightly, however this change is not expected to be measurable with the operational and natural variability of salinity of discharge water. The potential surface water quality impacts are discussed in detailed in Section 7.

Similarly to the water balance, the salt fluxes associated with coal moisture are simulated to decrease as a result of the Project, but in reality will vary with actual coal production and coal moisture properties.

## 6.4 Security of water supply

As discussed in Section 4.1, the water supply available at CVC and MC is sourced from the CC Council potable mains. The Project is not expected to have any impact of the security of water supply for these operations.

## 6.5 Climate change sensitivity

To consider the potential impacts of climate change on the site water and salt balance, sensitivity scenarios were simulated using the site water and salt balance model in accordance with the CSIRO (2015) for the proposed life of the Project under an intermediate emission scenario. The results of the modelling indicate that the site water and salt balance for the Project is not expected to be sensitive to the potential impacts of climate change.

# 7. Surface water quality

A detailed assessment of existing surface water quality was undertaken to establish baseline water quality values for receiving watercourses. This water quality assessment was undertaken in accordance with the assessment framework and methodologies outlined by ANZG (2018).

The catchments surrounding the Project Area are considered to be 'slightly to moderately disturbed' systems, as the waterways have been adversely affected by human activities by a small to measurable degree.

## 7.1 Monitoring program

Surface water quality monitoring at CVC and MC is undertaken in accordance with the CVC Water Management Plan (WMP) (Delta Coal 2019a), and MC WMP (Delta Coal 2020) respectively at licensed discharge points and upstream and downstream in creeks where surface water is discharged to.

Table 7.1 and Figure 7.1 provide the location of the existing surface water monitoring locations, relevant to the Project. Details of the monitoring locations and the period of record assessed as part of the SWIA are provided in Table 7.1. All locations are monitored monthly by grab sample.

*Table 7.1 Surface water quality monitoring details*

| Site | Monitoring location | Description | Analytes | Period of record reviewed |
|---|---|---|---|---|
| CVC | CVC LDP001 | EPL 1770 Licensed discharge point 1<br>Dam 10 piped discharge | pH*, total suspended solids (TSS)*, biochemical oxygen demand (BOD), faecal coliforms*, Enterococci, oil and grease, electrical conductivity (EC), total nitrogen, total phosphorus, Anionic surfactants (MBAS). | 07/01/2015 - 20/01/2021 |
| | OTC | Outlet where discharged water enters Swindles Creek | | |
| | USSP | Upstream reference location on Swindles Creek | Aluminium [1] , Arsenic [1], Arsenic (total), Beryllium [1], Cadmium [1], Chromium [1], Cobalt [1], Copper [1], Lead [1], Mercury [1], Molybdenum [1], Nickel [1], Nickel[2], Selenium [1], Silver [1], Vanadium [1], Zinc [1] | 12/04/2011 - 17/03/2021 |
| | RW1 | Downstream reference location on Swindles Creek | | |
| MC | MC LDP001 | EPL 191 Licensed discharge point 1<br>Pond B overflow | Aluminium [1], Aluminium (total), Antimony, Arsenic [1], Arsenic [2], Barium, Beryllium [1], Beryllium [1], Boron, Cadmium [1], Cadmium [1], Calcium, Chromium [1], Chromium [2], Cobalt [1], Cobalt [2], electrical conductivity, Copper [1], Copper [2], Iron, Lead [1], Lead [2], Lithium, Magnesium, Manganese [1], Manganese [2], Mercury [1], Mercury [2], Molybdenum [1], Molybdenum [2], Nickel [1], Nickel [2], Nitrogen (ammonia), Oil and Grease*, pH*, Phosphorus, Potassium, Selenium [1], Selenium [2], Silica, Silver [1], Silver [2], Sulfur, Tin, Titanium, Total suspended solids*, Vanadium [1], Vanadium [2], Zinc [1], Zinc [2] | 13/01/2014 – 20/01/2021 |
| | MC Downstream | Downstream reference location on an unnamed creek | | |

* Analyte subject to EPL concentration limits

[1] Dissolved metal laboratory analysis
[2] Total metal laboratory analysis


Paper Size ISO A4

0 80 160 240 320

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

**Delta Coal**
**Chain Valley Colliery - Consolidation Project**
**Surface Water Impact Assessment**

**Surface water monitoring locations**

Project No. **12580250**
Revision No. **2**
Date **04/10/2022**

**FIGURE 7.1**

G:\22\12519253\GIS\Maps\Deliverables\12580250\12580250_SWIA_2.aprx
Print date: 04 Oct 2022 - 11:01

Data source: Umwelt: Project Area, 2021; LPI: DTDB / DCDB, 2017;LPI NSW_Imagery: © Department of Customer Service 2020. Created by: fmackay

## 7.2 Swindles Creek

CVC LDP001 and MC LDP001 have discharged into Swindles Creek since approximately 1963, with the discharge from MC LDP001 essentially forming its headwaters. A study undertaken by Laxton (2013) of the water quality and ecology of Swindles Creek (referred to as Saltwater Creek in that study) concluded that the continuous discharge had led to a unique pattern of inundation which had modified but not harmed the aquatic ecology, which appeared healthy and robust.

Time series of water quality trends are presented in Appendix B. No time based trends were identified based on visual inspection of the graphs. This is consistent with the findings of Laxton (2013) of a modified environment. Therefore, the derivation and application of site specific guideline values (SSGVs) derived from reference sites is not appropriate, as adjacent watercourses are not uniquely modified like Swindles Creek by existing mine water discharges and there are no upstream reference sites, due to the MC Pit Top essentially forming the headwaters of Swindles Creek.

For the purpose of this SWIA and the Project, SSGVs have been developed for the surface water monitoring locations in Swindles Creek at CVC and MC to consolidate the baseline water quality under existing approved operations. The analysis was based on application of the ANZG (2018): *Deriving guideline values using reference-site data* to the three monitoring locations being MC Downstream, USSP and RW1. The guideline values were derived from the 80$^{th}$ percentile of data collected at reference sites (and 20$^{th}$ percentile for pH which is reported as a range), over a period greater than two years of monthly sampling, to cover a range of seasonal, climatic and flow conditions. For statistical calculation, where a result was reported less than the limit of reporting (LOR), half the value of the LOR has been used. Where the LOR is greater than the 80$^{th}$ percentile, the LOR is presented in this instance.

The 80$^{th}$ percentiles of data for each analyte were compared with available ANZG (2018) marine and south east NSW freshwater lowland river default guideline values (DGVs) for 95% level species protection in slightly to moderately disturbed ecosystems. Selection of the DGV was based on selecting the more conservative DGV. This is due to the Swindler Creek system being a highly modified by mine discharges of higher salinity (ANZG 2018), and the receiving water, being the lower reaches of the estuarine Swindles Creek, being influenced by the tidal cycle.

Table 7.2 provides the methodology of selecting a DGV for each analyte.

*Table 7.2 DGV selection methodology*

| Analyte | Units | Freshwater DGV | Marine DGV | DGV selected | Reasoning (see table notes for legend) |
|---|---|---|---|---|---|
| Physicochemical parameters | | | | | |
| EC | µS/cm | 125-2200 | NA | 125-2200 | A |
| pH | pH unit | 6.5-8.0 | 7.0-8.5[3] | 7.0-8.5 | B |
| TSS | mg/L | NA | NA | NA | C |
| BOD | mg/L | NA | NA | NA | C |
| Nutrients | | | | | |
| Ammonia as N | mg/L | 0.9 | 0.91 | 0.9 | D |
| Nitrite and nitrate as N | mg/L | 0.04 | 0.015[3] | 0.015 | D |
| Total Kjeldahl nitrogen (TKN) as N | mg/L | NA | NA | NA | C |
| Total nitrogen as N | mg/L | 0.5 | 0.3[3] | 0.3 | D |
| Total phosphorus as P | mg/L | 0.05 | 0.03[3] | 0.03 | D |
| Other | | | | | |
| Oil & Grease | mg/L | NA | NA | NA | C |

[3] ANZECC 2000 physical and chemical stressors for estuarine ecosystems

| Analyte | Units | Freshwater DGV | Marine DGV | DGV selected | Reasoning (see table notes for legend) |
|---|---|---|---|---|---|
| MBAS | mg/L | NA | NA | NA | C |
| Biological | | | | | |
| Faecal coliforms | CFU/100mL | NA | NA | NA | C |
| Enterococci | CFU/100mL | NA | NA | NA | C |
| Dissolved metals | | | | | |
| Aluminium | mg/L | 0.055 | NA | 0.055 | A |
| Antimony | mg/L | 0.009 | NA | 0.009 | A |
| Arsenic | mg/L | 0.013 | NA | 0.013 | A |
| Barium | mg/L | NA | NA | NA | C |
| Beryllium | mg/L | NA | NA | NA | C |
| Boron | mg/L | 0.94 | NA | 0.94 | A |
| Cadmium | mg/L | 0.0002 | 0.0055 | 0.0002 | D |
| Chromium | mg/L | 0.0033 | 0.027 | 0.0033 | D |
| Cobalt | mg/L | 0.0014 | 0.001 | 0.001 | D |
| Copper | mg/L | 0.0014 | 0.0013 | 0.0013 | D |
| Iron | mg/L | NA | NA | NA | C |
| Lead | mg/L | 0.0034 | 0.0044 | 0.0034 | D |
| Lithium | mg/L | NA | NA | NA | C |
| Manganese | mg/L | 1.9 | 0.08 | 0.08 | D |
| Mercury | mg/L | 0.0006 | 0.0004 | 0.0004 | D |
| Molybdenum | mg/L | 0.034 | NA | 0.034 | A |
| Nickel | mg/L | 0.011 | 0.07 | 0.011 | D |
| Selenium | mg/L | 0.011 | NA | 0.011 | A |
| Silver | mg/L | 0.00005 | 0.0014 | 0.00005 | D |
| Tin | mg/L | NA | NA | NA | C |
| Titanium | mg/L | NA | NA | NA | C |
| Vanadium | mg/L | 0.006 | 0.1 | 0.006 | D |
| Zinc | mg/L | 0.008 | 0.015 | 0.008 | D |

Notes for Table 7.2:

A No available marine guideline for selection

B The pH range is more representative of the estuarine ecosystem

C No DGV available

D The more conservative of the DGVs

Table 7.3 presents the recommended SSGVs for CVC and MC, which are consistent with the ANZG (2018) guidelines. Tables in Appendix B show the derivation of SSGVs for RW1, USSP, and MC Downstream based on the greater of the 80$^{th}$ percentile or the selected DGV.

Parameters of interest were identified for further analysis where median concentrations exceeded the SSGV at any of the reference sites identified (see 'Selected SSGV in Table 7.3 for the most conservative SSGV used). Exceedances of SSGVs are highlighted yellow. Exceedance of a SSGV at an LDP site does not signify a non-conformance against EPL limit. For some parameters, box and whisker plots were prepared to statistically summarise the data and visually assess spatial trends from upstream to downstream locations. A legend for interpreting the box and whisker plots is presented in Figure 7.2.

*Table 7.3* ***Statistical summary of surface water quality – Swindles Creek***

| Analyte | Units | LOR | MC Downstream SSGV | USSP SSGV | RW1 SSGV | Most conservative SSGV | MC LDP1 | MC Downstream | USSP | CVC LDP1 | OTC | RW1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Median | Median | Median | Median | Median | Median |
| Physicochemical parameters | | | | | | | | | | | | |
| EC | µS/cm | 1 | 26300 | 24500 | 31480 | 24500 | 26700 | 24000 | 20700 | 31900 | 31600 | 29850 |
| pH | pH unit | 0.01 | 7.0 - 8.5 | | | 7.0 – 8.5 | 7.8 | 8.2 | 7.79 | 7.76 | 7.88 | 7.825 |
| TSS | mg/L | 1 | 7.4 | 8 | 11 | 7.4 | 3 | 3 | 2.5 | 5 | 2.5 | 2.5 |
| BOD | mg/L | 2 | - | 2 | | 2 | - | - | 2 | 2 | 2 | 2 |
| Nutrients | | | | | | | | | | | | |
| Ammonia as N | mg/L | 0.01 | 0.9 | | | 0.9 | 0.93 | 0.02 | 0.02 | 0.14 | 0.05 | 0.0275 |
| Nitrite and nitrate as N | mg/L | 0.01 | - | 0.25 | 0.572 | 0.25 | - | - | 0.08 | 0.38 | 0.47 | 0.37 |
| Total Kjeldahl nitrogen (TKN) as N | mg/L | 0.1 | - | 0.4 | 0.25 | 0.25 | - | - | 0.25 | 0.25 | 0.25 | 0.25 |
| Total nitrogen as N | mg/L | 0.1 | - | 0.5 | 0.7 | 0.5 | - | - | 0.3 | 0.5 | 0.25 | 0.4 |
| Total phosphorus as P | mg/L | 0.001 | 0.03 | 0.05 | | 0.03 | 0.025 | 0.02 | 0.01 | 0.01 | 0.025 | 0.025 |
| Other | | | | | | | | | | | | |
| Oil & Grease | mg/L | 5 | 5 | | | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| MBAS | mg/L | 0.1 | 0.1 | | | 0.1 | 0.1 | 0.1 | 0.5 | 0.1 | 0.1 | 0.1 |
| Biological | | | | | | | | | | | | |
| Faecal coliforms | CFU/100mL | 1 | - | 1600 | 480 | 480 | - | - | 740 | 18 | 40 | 240 |
| Enterococci | CFU/100mL | 1 | - | 600 | 984 | 600 | - | - | 175 | 82 | 83 | 145 |
| Dissolved metals | | | | | | | | | | | | |
| Aluminium | mg/L | 0.01 | 0.055 | 0.0938 | 0.0924 | 0.055 | 0.01 | 0.01 | 0.0555 | 0.01 | 0.01 | 0.01 |
| Antimony | mg/L | 0.001 | 0.009 | | | 0.009 | 0.001 | 0.001 | 0.001 | 0.001 | - | 0.001 |
| Arsenic | mg/L | 0.001 | 0.024 | | | 0.024 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |

| Analyte | Units | LOR | MC Downstream SSGV | USSP SSGV | RW1 SSGV | Most conservative SSGV | MC LDP1 | MC Downstream | USSP | CVC LDP1 | OTC | RW1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Median | Median | Median | Median | Median | Median |
| Barium | mg/L | 0.001 | 0.2644 | 0.203 | 0.231 | 0.203 | 0.24 | 0.2355 | 0.203 | 0.222 | - | 0.231 |
| Beryllium | mg/L | 0.001 | 0.001 | | | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| Boron | mg/L | 0.01 | 0.94 | | | 0.94 | 0.35 | 0.285 | 0.22 | 0.69 | - | 0.68 |
| Cadmium | mg/L | 0.0001 | 0.0002 | | | 0.0002 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| Chromium | mg/L | 0.001 | 0.0033 | | | 0.0033 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| Cobalt | mg/L | 0.001 | 0.0014 | | | 0.0014 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| Copper | mg/L | 0.001 | 0.0014 | | | 0.0014 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| Iron | mg/L | 0.05 | 0.11 | 0.28 | 0.25 | 0.11 | 0.12 | 0.05 | 0.28 | 0.25 | - | 0.25 |
| Lead | mg/L | 0.001 | 0.0034 | | | 0.0034 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| Lithium | mg/L | 0.001 | 0.651 | - | - | 0.651 | 0.652 | 0.561 | - | - | - | - |
| Manganese | mg/L | 0.001 | 0.08 | | | 0.08 | 0.036 | 0.011 | 0.018 | 0.168 | - | 0.068 |
| Mercury | mg/L | 0.0001 | 0.0006 | | | 0.0006 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| Molybdenum | mg/L | 0.001 | 0.034 | | | 0.034 | 0.011 | 0.009 | 0.0099 | 0.0023 | 0.0024 | 0.001 |
| Nickel | mg/L | 0.001 | 0.011 | | | 0.011 | 0.004 | 0.004 | 0.004 | 0.0009 | 0.0007 | 0.0017 |
| Selenium | mg/L | 0.01 | 0.011 | | | 0.011 | 0.01 | 0.01 | 0.001 | 0.01 | 0.001 | 0.01 |
| Silver | mg/L | 0.001 | 0.001 | | | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| Tin | mg/L | 0.001 | 0.001 | | | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | - | 0.001 |
| Titanium | mg/L | 0.01 | 0.01 | | | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | - | 0.01 |
| Vanadium | mg/L | 0.001 | 0.006 | | | 0.006 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| Zinc | mg/L | 0.005 | 0.008 | 0.0112 | 0.0316 | 0.008 | 0.009 | 0.005 | 0.006 | 0.027 | 0.005 | 0.0155 |

Notes for table:

**Bold yellow** highlight indicates that the value exceeds an SSGV and is of interest.

'-' indicates that no value was recorded for the analyte or insufficient information was available to derive a SSGV

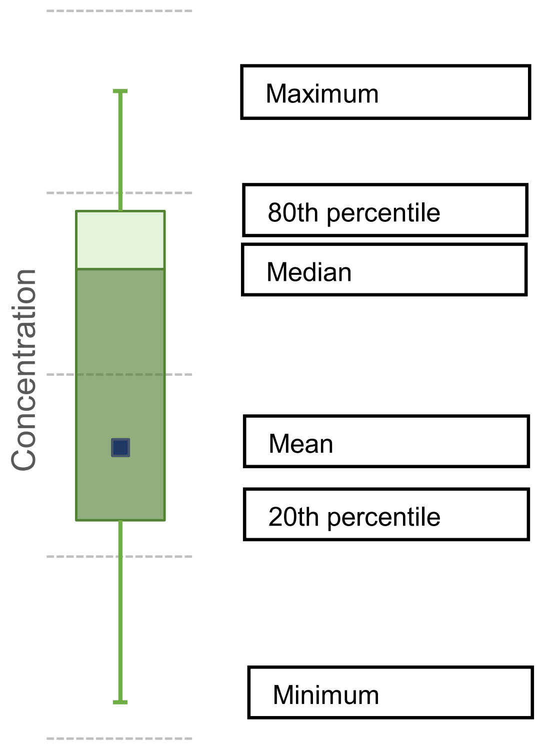


*Figure 7.2* ***Box and whisker plot legend***

**Physicochemical**

Median EC recorded across all locations ranged between 24,000 µS/cm and 31,900 µS/cm. All monitoring locations have much higher EC than the DGV, indicating it is not relevant to the modified environment of Swindles Creek. EC is generally higher at discharge locations than at monitoring locations. This is likely due to some dilution effects downstream of MC LDP001 but upstream of the selected reference site USSP. EC results reduce in a downstream direction of LDPs, potentially due to the mixing of rainfall runoff, tidal flows and upstream estuarine waters of the creeks, as shown in Figure 7.3. There are no visible EC trends in time among both CVC and MC surface water monitoring locations.

TSS concentrations were less than the 50 mg/L EPL concentration limit for LDP's with the exception of one event at MC LDP001 (104 mg/L) on 18/09/2019. 66 mm of rainfall (BOM station 61377) was recorded over the two days prior to sampling, which likely caused turbidity in Pond B and subsequent overflow of elevated TSS surface water through MC LDP001. TSS is largely uncontrolled in creek surface water monitoring locations due to the influence of environmental conditions on TSS within creeks i.e. rainfall, wind, wave motion etc.

pH is generally in the circumneutral range for most surface water monitoring locations with MC Downstream tending towards the slightly alkaline range (median pH = 8.2). All LDP results have been within the EPL concentration limits of 6.5 – 8.5, as shown in Figure 7.4.

BOD is monitored at CVC surface water monitoring locations and regularly records results less than the LOR (<2 mg/L) and is consistent with a conservative SSGV for BOD of 2 mg/L. All CVC locations have exceeded the SSGV on multiple occasions. BOD in the marine environment is typically monitored because of its importance in aquaculture with a guideline of 10 mg/L specified for 'marine fish' in the ANZECC (2000) guidelines. The maximum BOD concentration recorded at CVC LDP001 was 4 mg/L, being well below the ANZECC (2000) guideline.

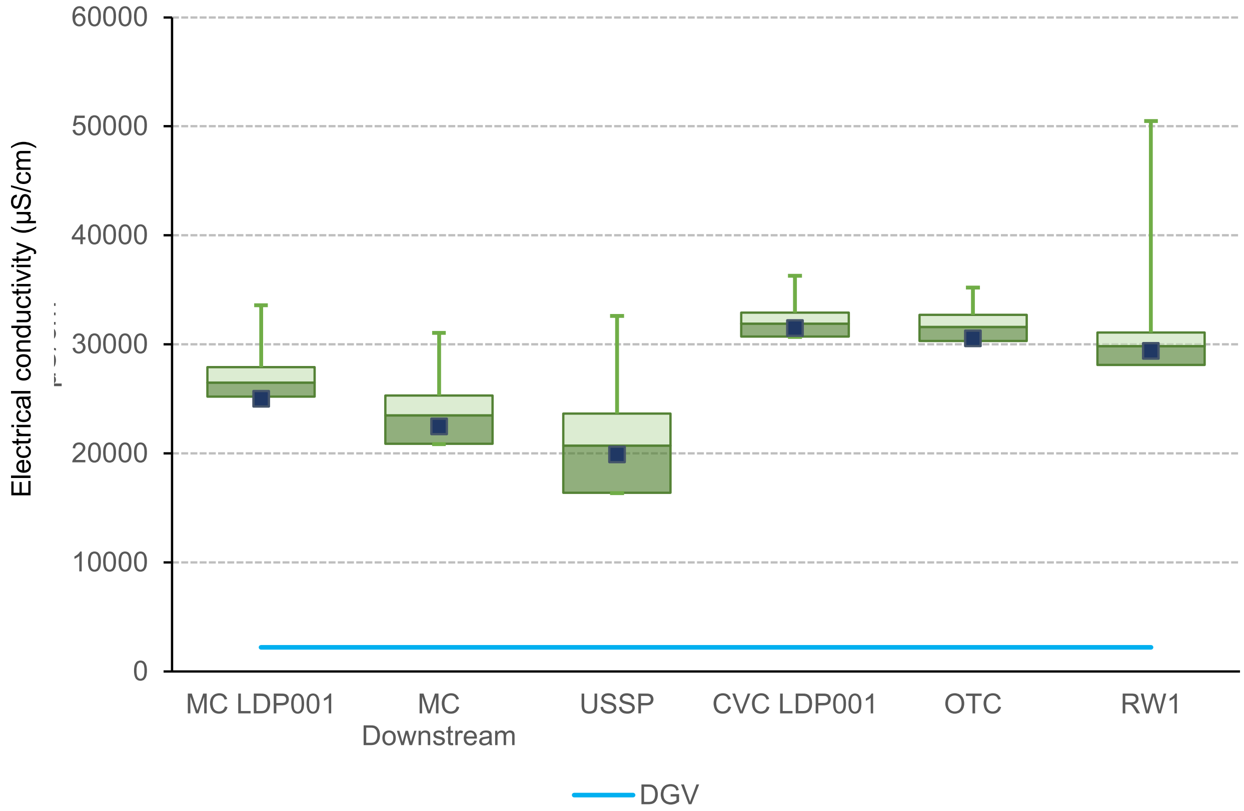


*Figure 7.3* *EC at Swindles Creek sites*

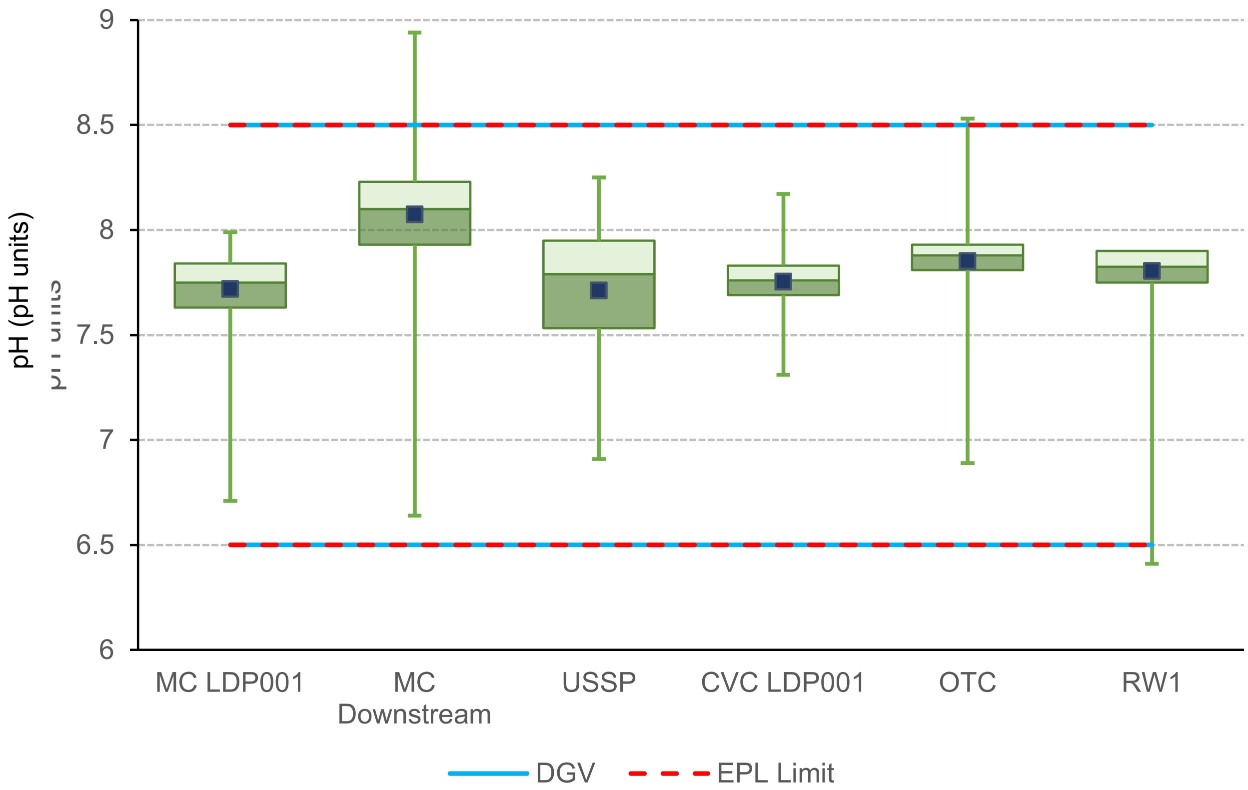


*Figure 7.4* *pH at Swindles Creek sites*

**Nutrients**

Ammonia concentrations are typically highest at CVC LDP001 and MC LDP001 with median concentrations at 0.14 mg/L and 0.93 mg/L respectively which both exceed the medians of MC Downstream, USSP and RW1. ANZG (2018) guidelines recommends an ammonia DGV of 0.9 mg/L for freshwater at a 95% level of species protection. MC LDP001 often exceeds this DGV. It is noted that there is no ammonia concentration limit specified in the EPL. Downstream monitoring locations of MC Downstream and RW1 frequently record ammonia concentrations less than the LOR (<0.01 mg/L), with median concentrations of 0.02 mg/L and 0.025 mg/L respectively, which suggests that the ammonia discharged from the LDPs is sufficiently attenuated within the downstream reach of the creek.

Nitrate + Nitrite as N (Total oxidised nitrogen, TON) median concentrations were greater than the 0.25 mg/L SSGV at CVC monitoring locations. Median TON concentrations were highest at OTC with a result of 0.47 mg/L. CVC LP1 and RW1 median concentrations were 0.38 mg/L and 0.37 mg/L respectively. This may be attributable to the oxidation of ammonia from MC LDP001 as the discharged water interacts with the atmosphere in the downstream reach of the creek.

Total nitrogen concentrations generally range between 0.1 mg/L and 1 mg/L with exceedances of the respective SSGVs across all locations at CVC, although median concentrations remain less than the respective SSGVs.

Total phosphorus concentrations frequently return results less than the LOR. Median phosphorus concentrations across all surface water monitoring locations are less than the SSGV of 0.03 mg/L.

The elevated nutrient concentrations in TON and ammonia are most likely attributable to discharge of intercepted groundwater, in which is naturally occurring in groundwater (Lingle 2013), with highest concentrations observed at the discharge locations at both CVC and MC of which dewatered groundwater inflows form a high percentage. Concentrations of ammonia decrease downstream, as indicated in Figure 7.5.

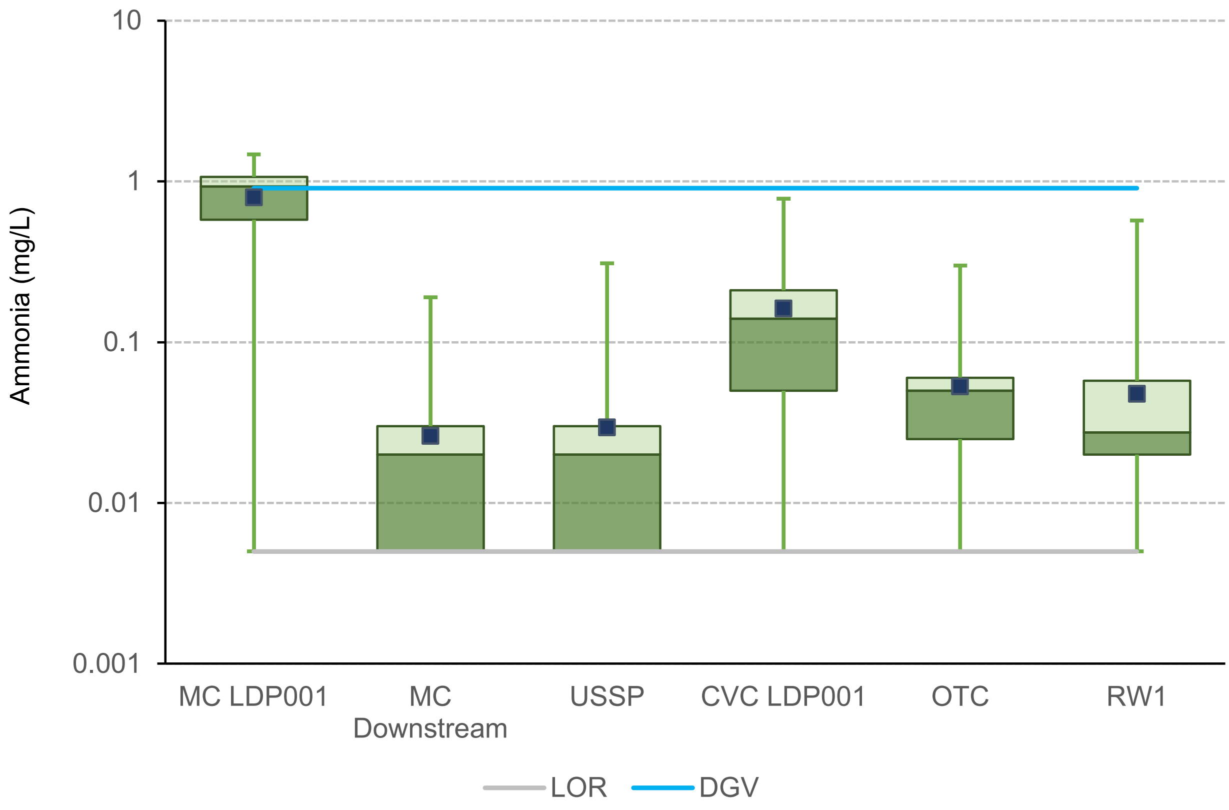


***Figure 7.5 Ammonia concentrations at Swindles Creek sites***

## Biological

Faecal coliforms and Enterococci are monitored at CVC surface water locations only. Concentrations for each analyte are highest at the upstream background monitoring location of USSP with median concentrations of 740 CFU/100mL and 175 CFU/100mL respectively. On only two occasions was the CVC LDP001 Enterococci concentrations greater than the recommended SSGV for USSP.

These elevated biological parameters may be attributable to the presence of the Mannering Park sewage treatment plant located upstream of CVC. The planned connection of the bathhouse buildings septic tanks at CVC to the CC Council sewer is expected to eliminate the potential for CVC operations to influence this parameter, with discharges from CVC LDP001 providing some dilution to any other catchment influences, as shown in Figure 7.6.

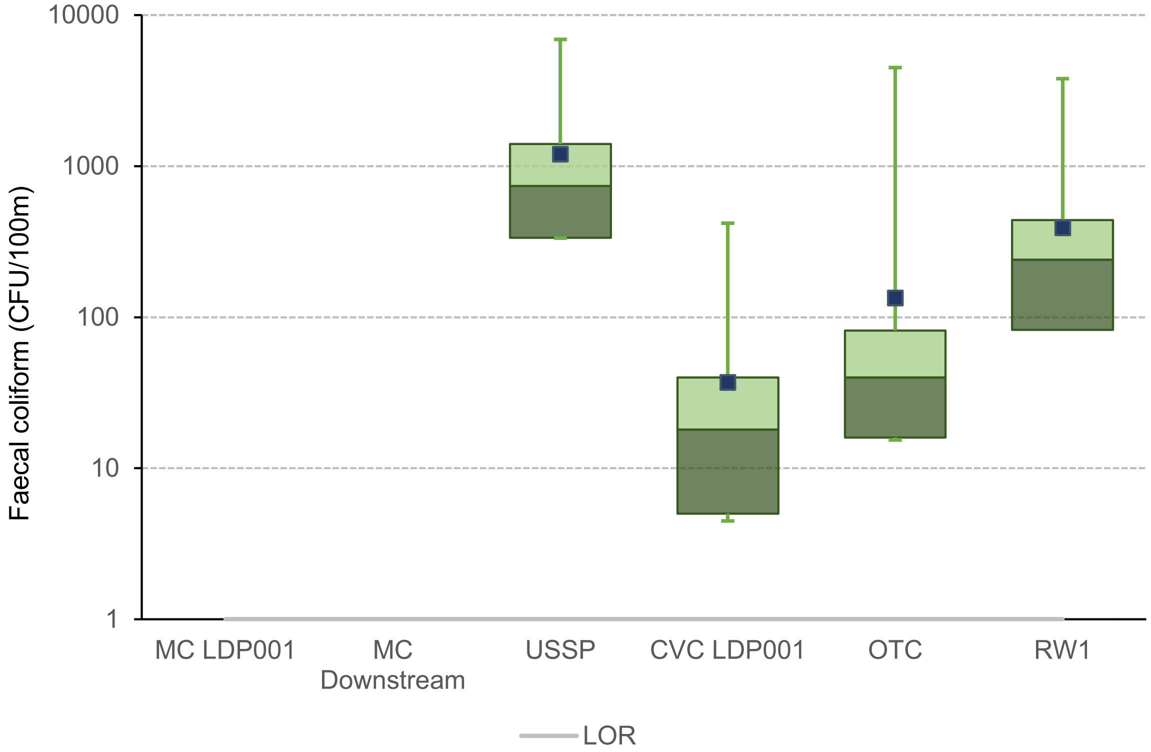


*Figure 7.6* ***Faecal coliform concentrations at Swindles Creek sites***

## Dissolved metals

Both total and dissolved metals are monitored at MC surface water monitoring locations and were historically monitored at CVC monitoring locations from 2011 to 2015. Metals were again monitored at CVC monitoring locations on 17/03/2021 to validate interpretation of the historical data. Only dissolved metal concentrations have been assessed in this SWIA given their bioavailability to aquatic marine species. Median dissolved metals concentrations were generally less than the adopted DGV, with the following exceptions noted:

Dissolved manganese was only analysed on one occasion at CVC monitoring locations with a result at CVC LDP001 of 0.168 mg/L exceeding the 0.080 mg/L DGV. Elevated manganese above the DGV is not generally observed at MC LDP001, and this single elevated result at CVC LDP001 may be subject to sampling or laboratory error. Nevertheless, the median concentration at downstream site RW1 is below the SSGV.

Dissolved zinc concentrations sometimes exceed the DGV at all monitoring locations and is generally exceeded at and downstream of CVC LDP001. Concentrations tend to decrease downstream of discharges as shown in Figure 7.7, similar to the spatial pattern for ammonia, shown in Figure 7.5.

Elevated dissolved metal concentrations may reflect natural surrounding geology.

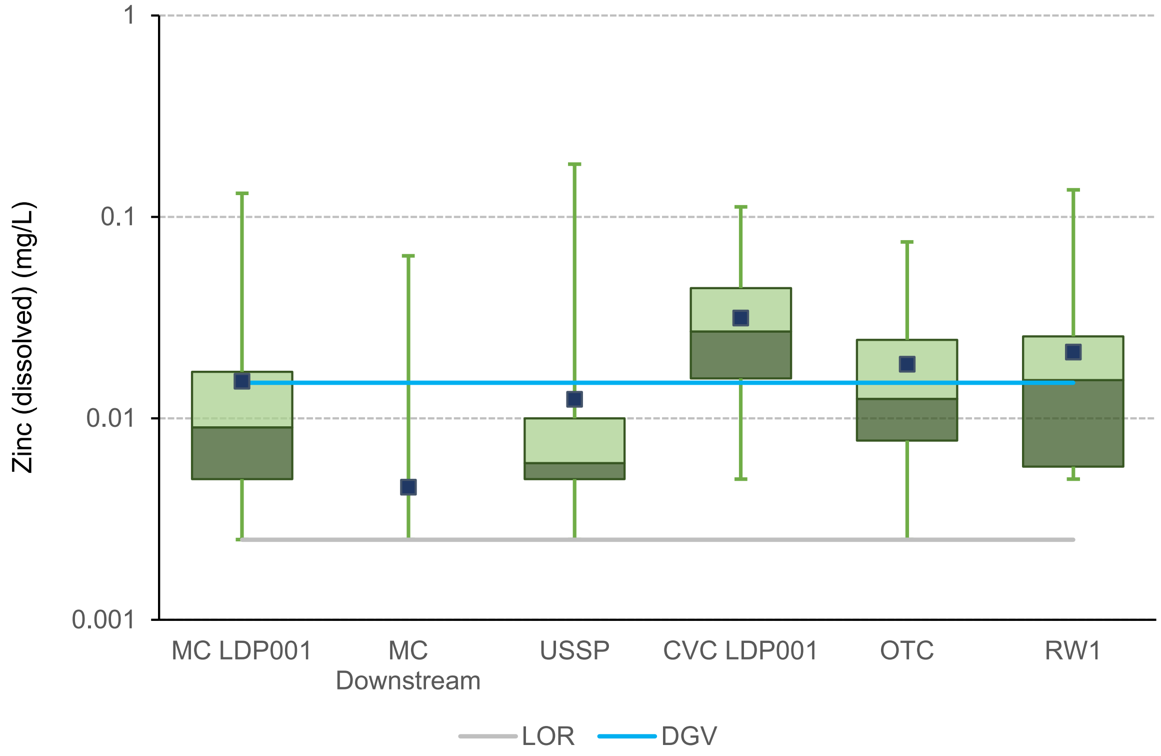


*Figure 7.7* ***Dissolved zinc concentrations at Swindles Creek sites***

**Summary**

Overall, the surface water monitoring results are consistent with a modified estuarine environment in Swindles Creek which has likely existed since discharges commenced around 1963. Water quality is circumneutral, with high salinity (indicated by EC) similar to Lake Macquarie itself at approximately 28 000 µS/cm (Laxton 2013). The planned connection of the septic tank at CVC to the CC Council sewer is expected to eliminate the potential for CVC operations to influence biological parameters, with discharges from CVC LDP001 providing some dilution to any other catchment influences. Comparison to relevant DGVs indicates that ammonia and dissolved zinc are elevated above the DGVs at discharge locations, however trend towards or below the DGVs at downstream monitoring locations.

# 8. Impact assessment

## 8.1 Water management

As part of the Project, underground water will continue to be managed by water transfers within the underground workings and discharge to Swindles Creek via CVC LDP001 and MC LDP001.

The overall surface water management layout of the CVC Pit Top and MC Pit Top will remain unchanged. The likely increases in underground water volume relative to existing conditions as a result of the Project are expected to result in an increase in daily discharges to Swindles Creek via CVC LDP001 and MC LDP001. The existing dewatering infrastructure is expected to be able to cater for the predicted increase in groundwater volumes.

Potable water will continue to be supplied by the existing connections to CC Council's reticulated potable water system. There are not expected to be any appreciable increases in potable water usage as a result of the Project.

## 8.2 Water and salt balance

The Project has the potential to increase the amount of water and salt discharged from CVC LDP001, CVC LDP027 and MC LDP001 due to there being potential for increased volumes of groundwater intercepted relative to approved conditions however this will depend on the timing and rate of extraction and mining methods. The discharged water quantity and quality is expected to remain within the limits of EPL 1770 and EPL 191 and not increase the typical salinity of discharges.

The additional two years of licensed discharges from CVC LDP001 and MC LDP001 to Swindles Creek due to the extended life of operations would result in a corresponding continuation of water flow and quality impacts that would be comparable to impacts under existing approved conditions.

The Project is not expected to have any impact on the security of water supply for these operations.

## 8.3 Surface water quality

The intercepted groundwater is expected to have similar water quality to that currently extracted under approved conditions and the receiving water body of Lake Macquarie. Inorganic nitrogen compounds and dissolved metals exceeding respective SSGVs or DGVs will likely have a greater pollutant mass load discharging into Swindles Creek via CVC LDP001 and MC LDP001, however concentrations, and therefore the level of ecotoxicity, are expected to remain similar.

## 8.4 Flood impacts

Impact from flooding will likely remain as per existing conditions, given the:

– Unchanged overall surface water management layout of the CVC and MC Pit Tops
– Introduction of only minor sediment control infrastructure related to LOM process upgrades (and potable water possible pipeline)
– Negligible terrain chances associated with predicted vertical subsidence impacts of <20 mm

## 8.5 Downstream licensed water users

There were no surface water users identified downstream of the Project Area or the LDPs which will be utilised by the Project.

## 8.6 Cumulative impacts

There are no other potential surface water impacts identified in the Project Area. No potential cumulative surface water impact has been identified as part of this assessment.

## 8.7 Licensing requirements

### 8.7.1 Harvestable rights

There is no interception of clean water by means of a dam on a first or second order stream proposed as part of the Project. Existing dirty water management structures for the capture, containment and recirculation of water to prevent contamination of downstream watercourses will continue to be exempt from licensing consideration under pollution control examples. Therefore, there are no harvestable rights entitlements or requirements relevant to the Project.

### 8.7.2 Surface water licensing

Groundwater modelling indicates that the Project will not have any incremental drawdown impacts on the shallow water table and there will be no impacts to baseflow in creeks. Therefore, there are no additional surface water entitlements expected to be required as a result of the Project.

The Project does not involve any changes to the volume of intercepted surface flows relative to existing operations. Surface water storages that form part of the water management system at CVC and MC are exempt from consideration under water access licensing and harvestable rights, as they are dams solely for the capture, containment and recirculation of drainage, consistent with best management practice to prevent the contamination of a water source.

### 8.7.3 Environment protection licences

The proposed water management system utilises the existing LDPs at CVC Pit Top (under EPL 1770) and MC Pit Top (under EPL 191). No additional LDPs are required for the Project.

The Project has the potential to result in minor increase in the volume of intercepted groundwater compared to existing conditions that requires dewatering and discharge. Based on the results of the water balance modelling the predicted levels of discharge from CVC and MC remain within the currently approved combined volumetric discharge limits at CVC Pit Top and MC Pit Top.

Water quality from discharges associated with Proposed Operations is expected to be similar to those of the existing and approved operations and within existing EPL criteria.

# 9. Mitigation, monitoring and management measures

## 9.1 Flow monitoring

The existing flow monitoring program at CVC and MC should be continued, in particular the continued monitoring of the discharges (via CVC LDP001, CVC LDP027 and MC LDP001) and extractions from the underground workings.

## 9.2 Water quality

### 9.2.1 Water quality monitoring

The water quality monitoring sites detailed in Section 7.1 will continue to be monitored during construction activities and operation of the Project.

The water quality parameters recommended to be monitored over the Project life at the established sites are to include those listed in Table 9.1. Although exceedance of DGVs has likely being ongoing as part of the modified hydrology of Swindles Creek for decades, monitoring should occur to detect potentially adverse changes during the life of the Project.

*Table 9.1 Parameters to be monitored*

| Category | Parameter | Frequency |
|---|---|---|
| **Swindles Creek locations** | | |
| Physicochemical | EC, pH, TSS, turbidity | Monthly |
| Major ions | Alkalinity, chloride, sulfate, calcium, magnesium, sodium, potassium | Quarterly |
| Metals (dissolved) | Aluminium, cadmium, chromium, cobalt, copper, iron, manganese, nickel, zinc | |
| Nutrients | Ammonia, nitrite and nitrate, TKN, total nitrogen, total phosphorus | |

### 9.2.2 Site-specific guideline values

SSGVs derived in Section 7 for Swindles Creek should be incorporated as triggers in the WMP for the Project and revised as necessary following the methodology recommended by ANZG (2018).

## 9.3 Water and salt balance model

The water and salt balance model (refer Section 6 and Appendix C) will be reviewed as part the Water management plan (refer to Section 9.4.1). Any proposed secondary extraction will also require review of potential groundwater impacts as part of the Extraction Plan approval processes. The water and salt balance model will be reviewed should groundwater inflow predictions associated with any proposed secondary extraction indicate inflow rates inconsistent with the most recent operational water balance modelling. The average predicted water balance for the Project will be included in the water management plan (refer Section 9.4.1) and the results for each year will be reported in the Annual Review for the Project.

## 9.4 Management plans

### 9.4.1 Water management plans

The water management plans ensure that each operation, with respect to water, meets all relevant regulatory requirements. The water management plans should be reviewed at a minimum every three years or as a result of any regulatory requirements, any significant changes to water management practices or the development of new mining areas.

TARPs are provided in the site-specific water management plans. Modification and, if required, additional TARPs will be developed as required to provide guidance on the immediate actions that should be taken in response to any impacts of the Project identified as part of the monitoring program within the relevant water management plan. Generally, responses include investigation and monitoring, determination of the risk of impact and remedial measures to be implemented.

The site-specific water management plan for CVC and MC should be merged and updated to include the water management requirements of the Project.

### 9.4.2 Extraction plans

Extraction plans will be developed and implemented for each secondary extraction area prior to mining. Generally, extraction plans describe the applicable regulatory framework, mine planning and management and monitoring measures to be implemented to ensure the protection of all surface/subsurface natural and built features and the protection of public safety during extraction. Each extraction plan for the Project will include a water management plan to manage potential subsidence-related impacts to water resources.

### 9.4.3 Erosion and sediment control plans

Permanent erosion and sediment control will continue to be undertaken in accordance with the erosion and sediment control framework outlined in the CVC WMP and MC WMP. Any construction activities associated with the Project will have a detailed Erosion and Sediment Control Plan (ESCP) prepared based on specific construction methodologies. The objective of the ESCP is to ensure that appropriate structures and programs of work are in place to:

- Identify activities that could cause erosion and generate sediment
- Describe the location, function and capacity of erosion and sediment control structures required to minimise soil erosion and the potential for transport of sediment downstream
- Ensure erosion and sediment control structures are appropriately maintained
- Fulfil the statutory conditions of the project approval
- Consider industry standard practice, specifically:
  - *Landcom 2004. Managing Urban Stormwater – Soils and Construction, Volume 1, 4th Edition*
  - *Department of Environment and Climate Change (DECC) 2008. Managing Urban Stormwater – Soils and Construction, Volume 2E – Mines and Quarries*

# 10. Summary

The SWIA considers the potential impacts of the Project on the surface water environment under the proposed conditions. The assessment of potential impacts associated with the project considered the following:

– Water and salt balance
– Surface water flow
– Surface water quality
– Downstream water users
– Cumulative impacts in association with other operations in the region

A summary of the existing conditions and potential impacts as a result of the Project is outlined in Table 10.1.

*Table 10.1 Summary of potential impacts*

| Component | Existing conditions | Potential impacts |
|---|---|---|
| Water and salt balance | Combined discharges via CVC LDP001 and MC LDP001. | Increased volume and frequency of discharge via CVC LDP001 and MC LDP001 (depending on extraction rate, method and timing). |
| Surface water flow | Continuous discharge into Swindles Creek since approximately 1963 has resulted in modified environment. | No change to flow regime in Swindles Creek relative to existing operations. |
| Surface water quality | Discharges via CVC LDP001 and MC LDP001 meet the water quality requirements of relevant EPLs.<br>Exceedances of the water quality DGVs in watercourses relevant to the Project has been observed. Parameters which have regularly exceeded the DGVs include zinc and ammonia, which are thought to be naturally occurring in the groundwater intercepted during mining. | No material change in water quality of discharges relative to existing operations is expected. Similar exceedances of the water quality DGVs to those observed under existing conditions are expected. |
| Downstream water users | No surface water users identified.<br>No basic landholder rights users identified. | No impacts on water flows or quality predicted.<br>No impacts to downstream water users predicted. |
| Cumulative impacts | No existing cumulative impact identified in downstream watercourses. | No change in cumulative impacts. |

# 11. References


ANZECC (2000a) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, Australia and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand.

ANZECC (2000b) *Australian Guidelines for Water Quality Monitoring and Reporting*, Australia and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand.

ANZG (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Australian and New Zealand Governments and Australian state and territory governments, available at http://www.waterquality.gov.au/anz-guidelines/

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CSIRO and Bureau of Meteorology (2015), Climate Change in Australia Information for Australia's Natural Resource Management Regions: Technical Report, CSIRO and Bureau of Meteorology, Australia.

DEC (2004) Approved Methods for the Sampling and Analysis of Water Pollutants in New South Wales, NSW Department of Environment and Conservation.

DEC (2006) Using the ANZECC Guidelines and Water Quality Objectives in NSW, NSW Department of Environment and Conservation.

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DECCW (2006) *NSW Water Quality and River Flow Objectives*, NSW Department of Environment, Climate Change and Water, available from https://www.environment.nsw.gov.au/ieo/.

Delta Coal (2019a) Chain Valley Colliery Water Management Plan, prepared by EMM Consulting Pty Ltd for Delta Coal.

Delta Coal (2020) Mannering Colliery Water Management Plan, prepared by EMM Consulting Pty Ltd for Delta Coal.

GHD (2022) Chain Valley Colliery: Continued Operations: Groundwater Impact Assessment. Report prepared by GHD Pty Ltd for Delta Coal.

Laxton (2013). Ecology of the Saltwater Creek adjacent to Chain Valley Colliery. Report prepared by J.H. & E.S. Laxton Environmental Consultants Pty Ltd for LDO Lake Coal Pty Ltd.

Landcom (2004) Managing Urban Stormwater: Soils and Construction – Volume 1, 4th Edition, Landcom NSW.

Lingle, "Origin of High Levels of Ammonium in Groundwater, Ottawa County, Michigan" (2013). Master's Theses. 442. https://scholarworks.wmich.edu/masters_theses/442

NRAR (2018) *Guidelines for controlled activities on waterfront land – Riparian corridors*, Natural Resources Access Regulator, NSW Department of Industry.

NSW Water Resources Council (1993) *The NSW State Rivers and Estuaries Policy*, retrieved from http://www.water.nsw.gov.au/__data/assets/pdf_file/0009/548370/nsw_river_estuaries_ policy.pdf.

WaterNSW (2021) *NSW Water Register*, available from https://waterregister.waternsw.com.au/ water-register-frame.

# Appendices

# Appendix A

## Secretary’s Environmental Assessment Requirements

*Table A.1 Assessment requirements*

| Assessment requirement | Where addressed |
| --- | --- |
| Secretary's Environmental Assessment Requirements | |
| A detailed site water balance, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply infrastructure and water storage structures. | Section 6<br>Appendix C |
| Identification of any licensing requirements or other approvals under the Water Act 1912 and/or Water Management Act 2000. | Section 2.1.3<br>Section 8.7 |
| Demonstration that water for the construction and operation of the proposed development can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of any relevant Water Sharing Plan (WSP) or water source embargo. | Section 6.4<br>Section 8.7.2 |
| An assessment of any likely flooding impacts of the development. | Section 8.4 |
| The measures which would be put in place to control sediment runoff and avoid erosion. | Section 9.4.3 |
| An assessment of the likely impacts of the development on the quantity and quality of existing surface and groundwater resources including detailed modelling of potential groundwater impacts, assessment of proposed water discharge quantities and quality against receiving water quality and flow objectives | Section 8.2<br>Section 8.3 |
| An assessment of the likely impacts of the development on aquifers, watercourses, riparian land, water-related infrastructure, and other water users. | Section 8.2<br>Section 8.3<br>Section 8.5 |
| Department of Industry | |
| The identification of an adequate and secure water supply for the life of the project. This includes confirmation that water can be sourced from an appropriately authorised and reliable supply. This is also to include an assessment of the current market depth where water entitlement is required to be purchased. | Section 6.4<br>Section 8.7.2 |
| A detailed and consolidated site water balance. | Section 6<br>Appendix C |
| Assessment of impacts on surface and ground water sources (both quality and quantity), related infrastructure, adjacent licensed water users, basic landholder rights, watercourses, riparian land, and groundwater dependent ecosystems, and measures proposed to reduce and mitigate these impacts. | Section 8<br>Refer to GWIA (GHD 2021) for groundwater dependent ecosystems) |
| Proposed surface and groundwater monitoring activities and methodologies. | Section 9.2 |
| Consideration of relevant legislation, policies and guidelines, including the NSW Aquifer Interference Policy (2012), the Guidelines for Controlled Activities on Waterfront Land (2018) and the relevant Water Sharing Plans (available at https://www.industry.nsw.gov.au/water). | Section 2 |
| Biodiversity and Conservation Division (BCD) | |
| The EIS must map the following features relevant to water and soils including:<br>a. Acid sulfate soils (Class 1, 2, 3 or 4 on the Acid Sulfate Soil Planning Map).<br>b. Rivers, streams, wetlands, estuaries (as described in s4.2 of the Biodiversity Assessment Method).<br>c. Wetlands as described in s4.2 of the Biodiversity Assessment Method.<br>d. Groundwater.<br>e. Groundwater dependent ecosystems.<br>f. Proposed intake and discharge locations. | Section 3<br>Refer to GWIA (GHD 2021) for groundwater dependent ecosystems) |
| The EIS must describe background conditions for any water resource likely to be affected by the development, including:<br>a. Existing surface and groundwater.<br>b. Hydrology, including volume, frequency and quality of discharges at proposed intake and discharge locations. | Section 6<br>Section 7 |

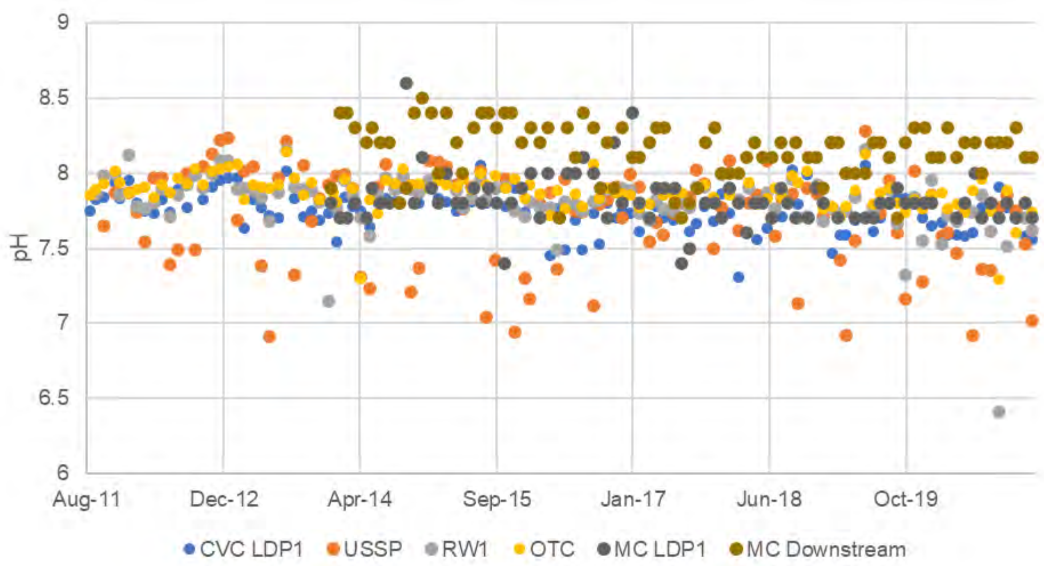
| Assessment requirement | Where addressed |
|---|---|
| c. Water Quality Objectives (as endorsed by the NSW Government http://www.environment.nsw.gov.au/ieo/index.htm) including groundwater as appropriate that represent the community's uses and values for the receiving waters.<br>d. Indicators and trigger values/criteria for the environmental values identified at (c) in accordance with the ANZECC (2000) Guidelines for Fresh and Marine Water Quality and/or local objectives, criteria or targets endorsed by the NSW Government. | |
| The EIS must assess the impacts of the development on water quality, including:<br>e. The nature and degree of impact on receiving waters for both surface and groundwater, demonstrating how the development protects the Water Quality Objectives where they are currently being achieved, and contributes towards achievement of the Water Quality Objectives over time where they are currently not being achieved. This should include an assessment of the mitigating effects of proposed stormwater and wastewater management during and after construction.<br>f. Identification of proposed monitoring of water quality. | Section 8.3 |
| The EIS must assess the impacts of the development on hydrology, including:<br>a. Water balance including quantity, quality and source.<br>b. Effects to downstream rivers, wetlands, estuaries, marine waters and floodplain areas.<br>c. Effects to downstream water-dependent fauna and flora including groundwater dependent ecosystems.<br>d. Impacts to natural processes and functions within rivers, wetlands, estuaries and floodplains that affect river system and landscape health such as nutrient flow, aquatic connectivity and access to habitat for spawning and refuge (e.g. river benches)<br>e. Changes to environmental water availability, both regulated/licensed and unregulated/rules-based sources of such water.<br>f. Mitigating effects of proposed stormwater and wastewater management during and after construction on hydrological attributes such as volumes, flow rates, management methods and reuse options.<br>g. Identification of proposed monitoring hydrological attributes. | Section 8.2<br>Section 8.3<br>Section 8.6 |

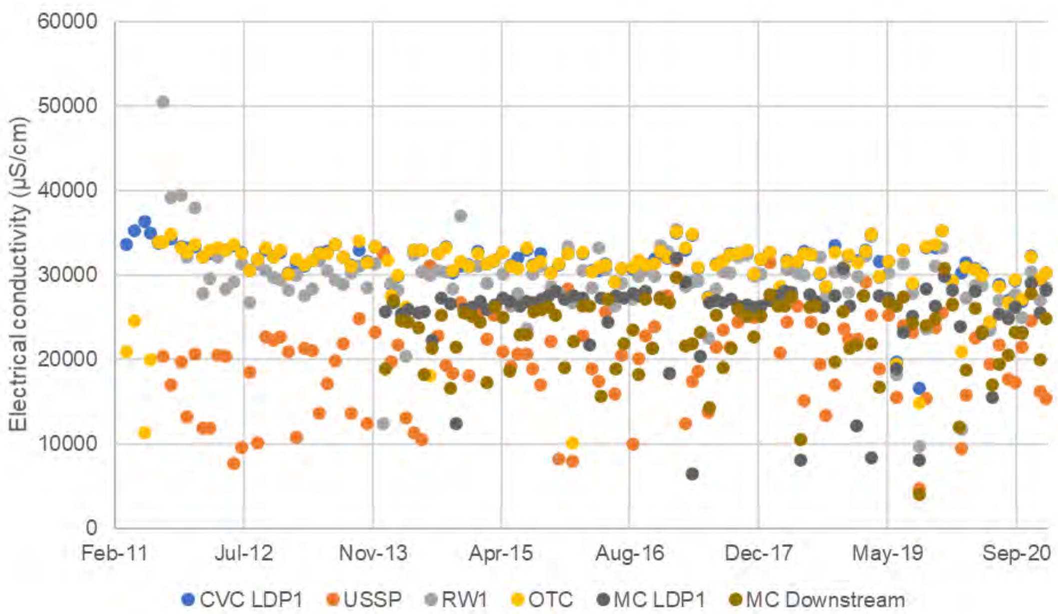
There are no changes from already approved operations associated with the Project that are expected to be potentially impacted by flooding or have potential flooding impacts.

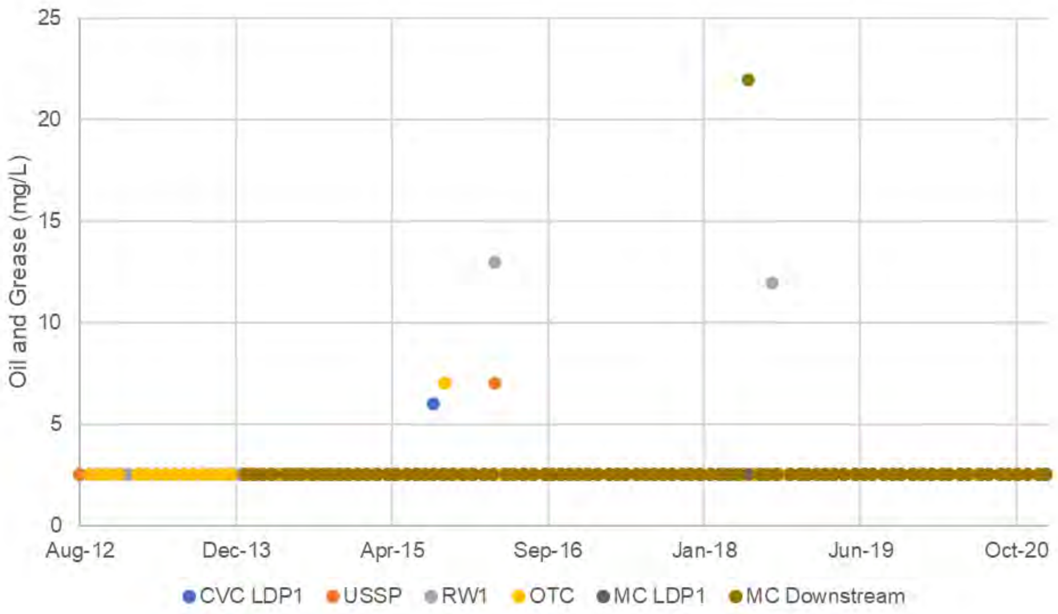
# Appendix B

## Water Quality Time Series

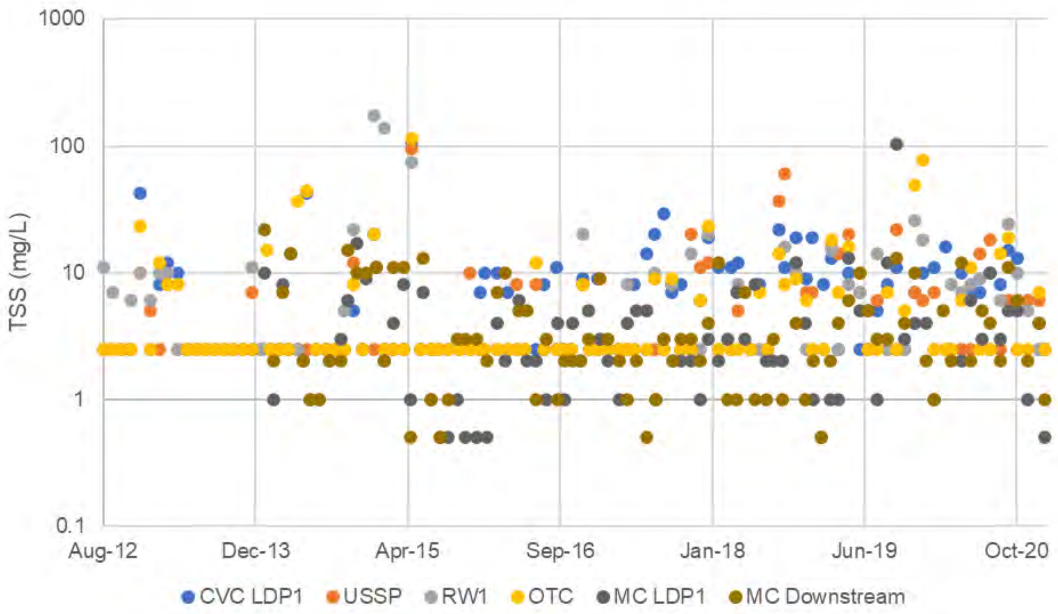
## Physiochemical



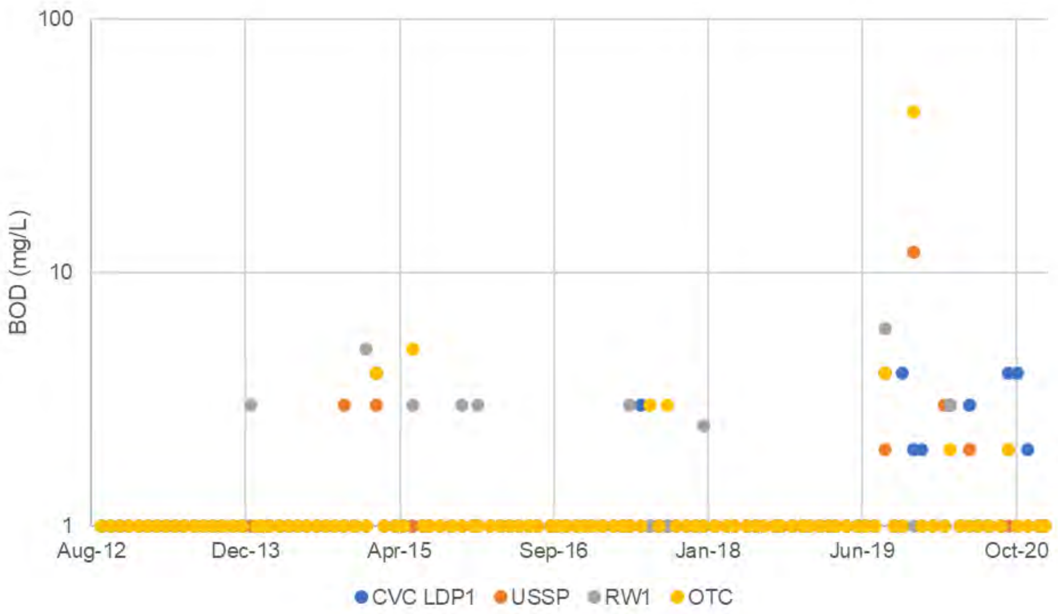





Oil and Grease (mg/L)
25
20
15
10
5
0
Aug-12
Dec-13
Apr-15
Sep-16
Jan-18
Jun-19
Oct-20
CVC LDP1
USSP
RW1
OTC
MC LDP1
MC Downstream

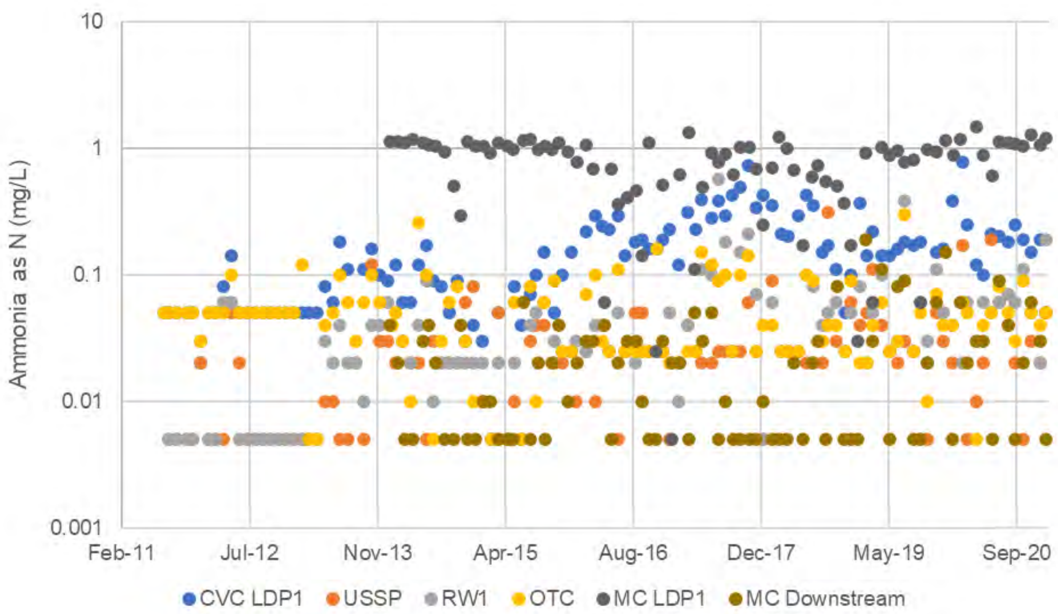



TSS (mg/L)
1000
100
10
1
0.1
Aug-12
Dec-13
Apr-15
Sep-16
Jan-18
Jun-19
Oct-20
CVC LDP1
USSP
RW1
OTC
MC LDP1
MC Downstream

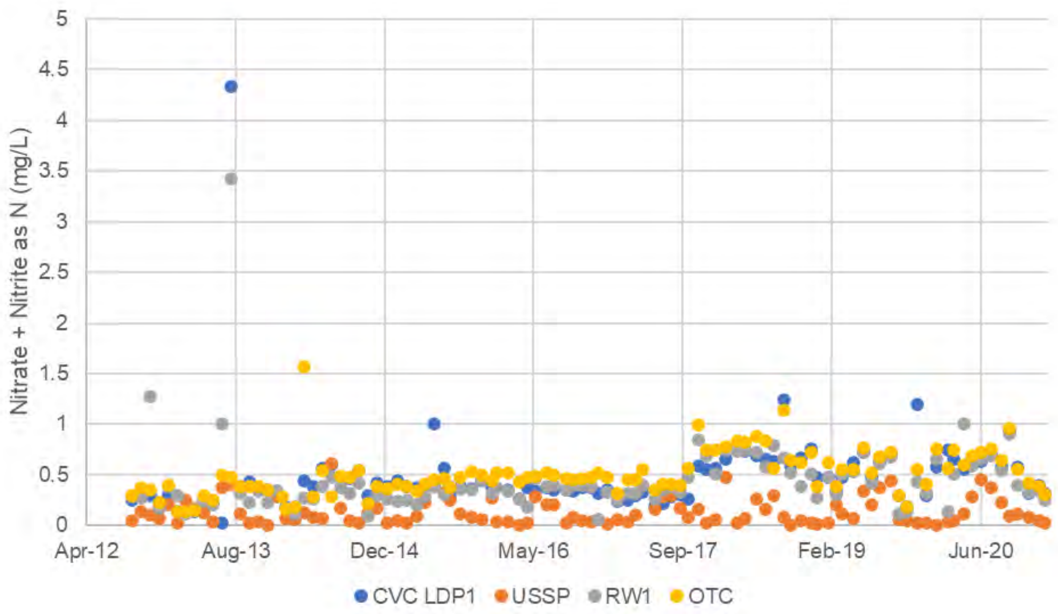


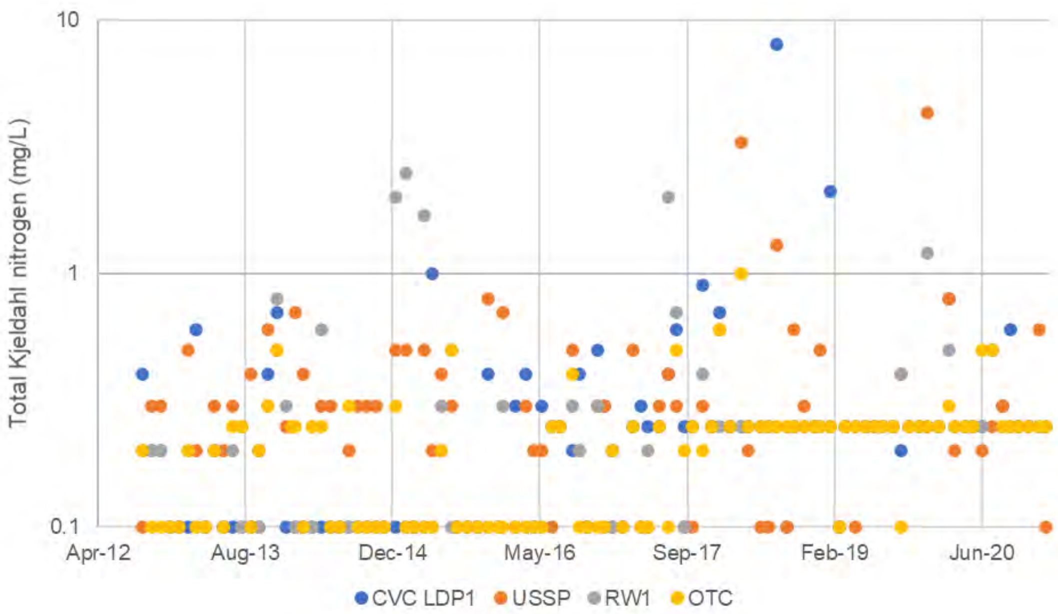
100
10
1
BOD (mg/L)
Aug-12
Dec-13
Apr-15
Sep-16
Jan-18
Jun-19
Oct-20
CVC LDP1
USSP
RW1
OTC

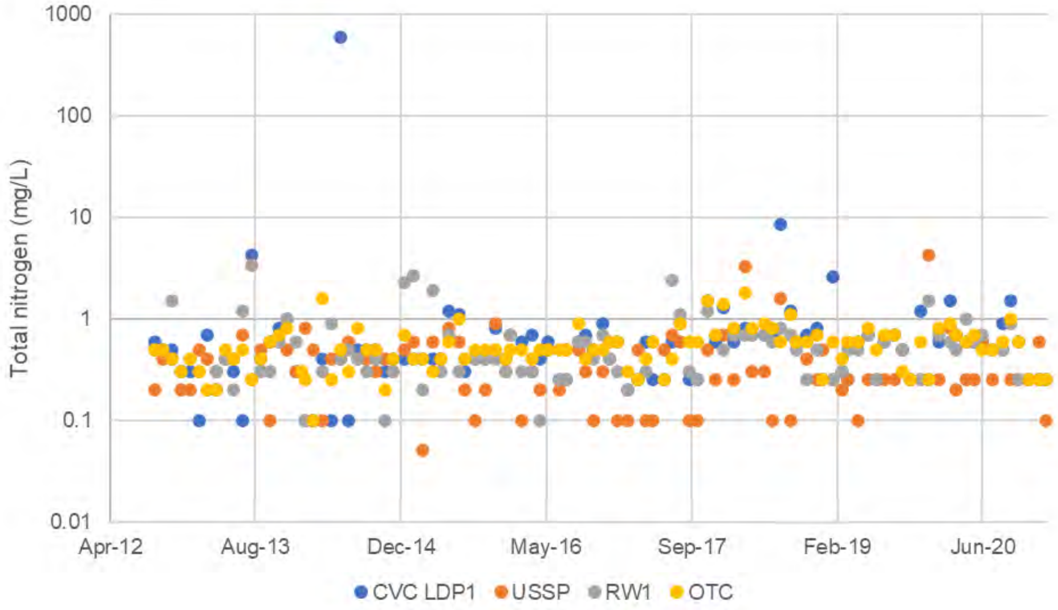

## Nutrients

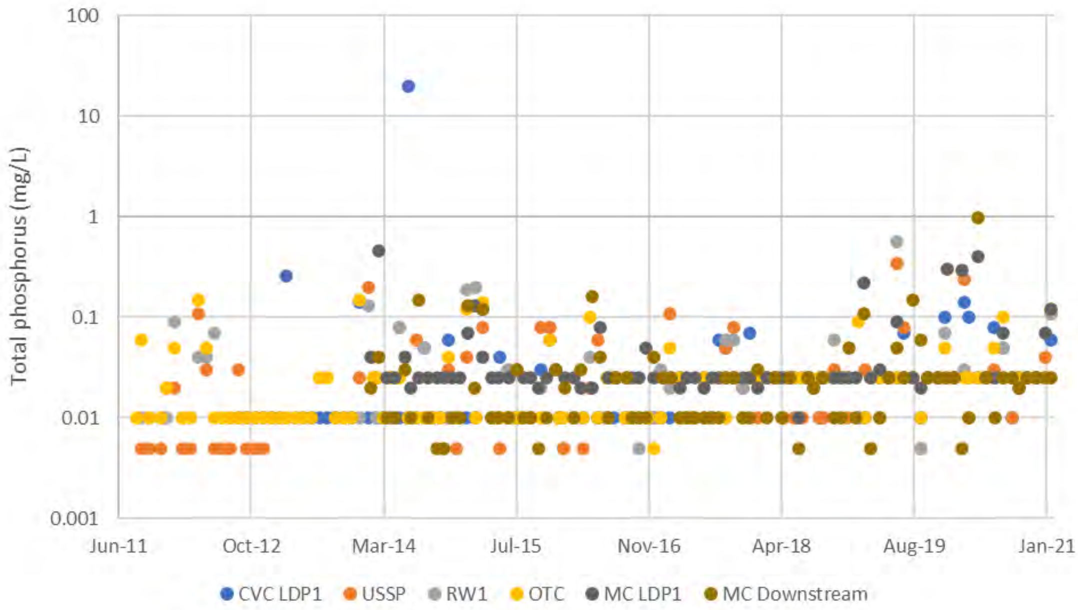


10
1
0.1
0.01
0.001
Ammonia as N (mg/L)
Feb-11
Jul-12
Nov-13
Apr-15
Aug-16
Dec-17
May-19
Sep-20
CVC LDP1
USSP
RW1
OTC
MC LDP1
MC Downstream

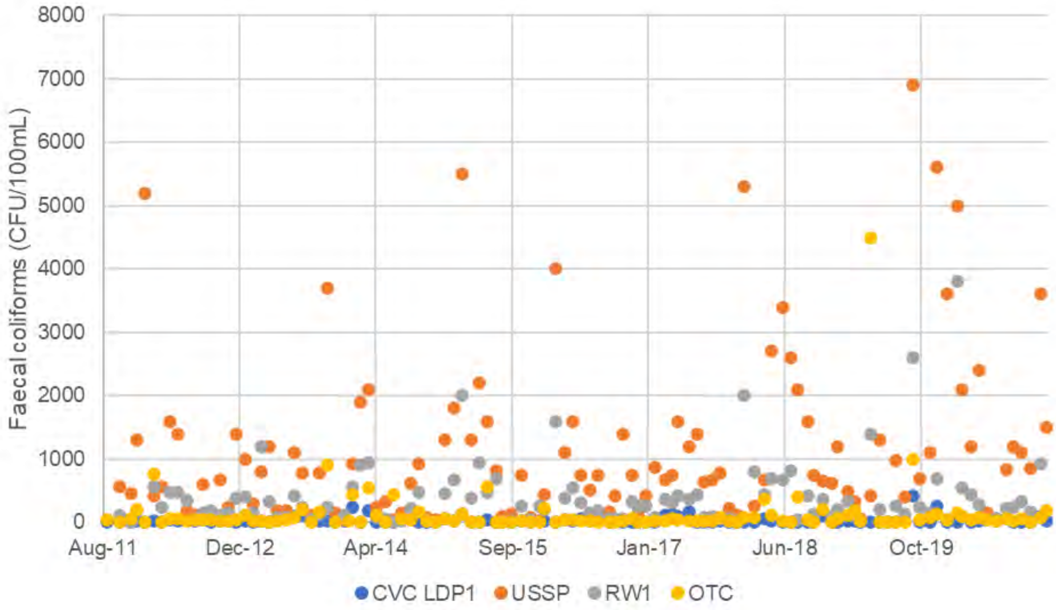

Nitrate + Nitrite as N (mg/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Feb-19
Jun-20
CVC LDP1
USSP
RW1
OTC


Total Kjeldahl nitrogen (mg/L)
10
1
0.1
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Feb-19
Jun-20
CVC LDP1
USSP
RW1
OTC

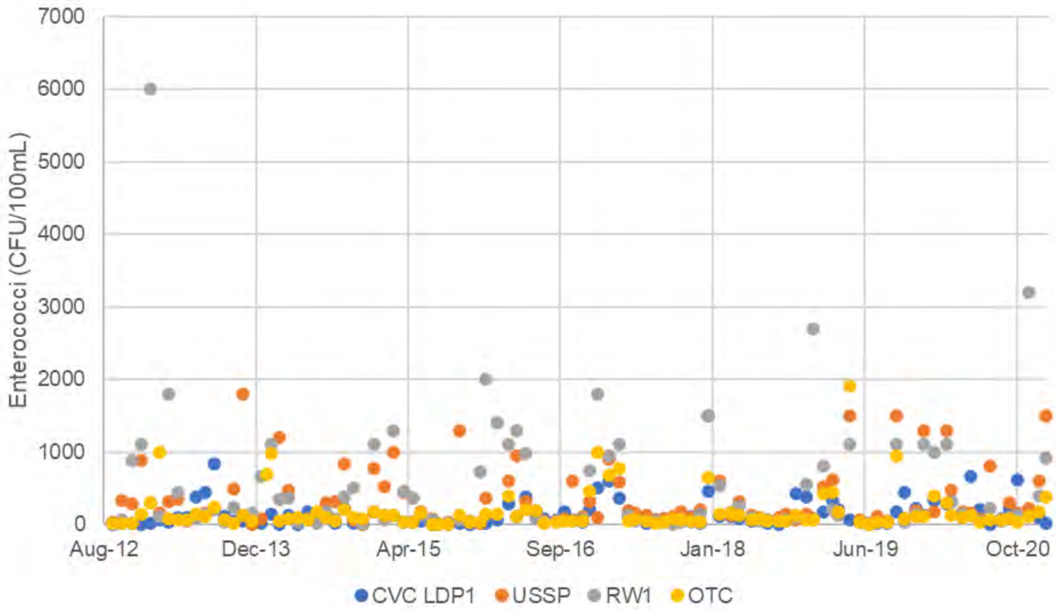

1000
100
10
1
0.1
0.01
Total nitrogen (mg/L)
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Feb-19
Jun-20
CVC LDP1
USSP
RW1
OTC


100
10
1
0.1
0.01
0.001
Total phosphorus (mg/L)
Jun-11
Oct-12
Mar-14
Jul-15
Nov-16
Apr-18
Aug-19
Jan-21
CVC LDP1
USSP
RW1
OTC
MC LDP1
MC Downstream

## Biological

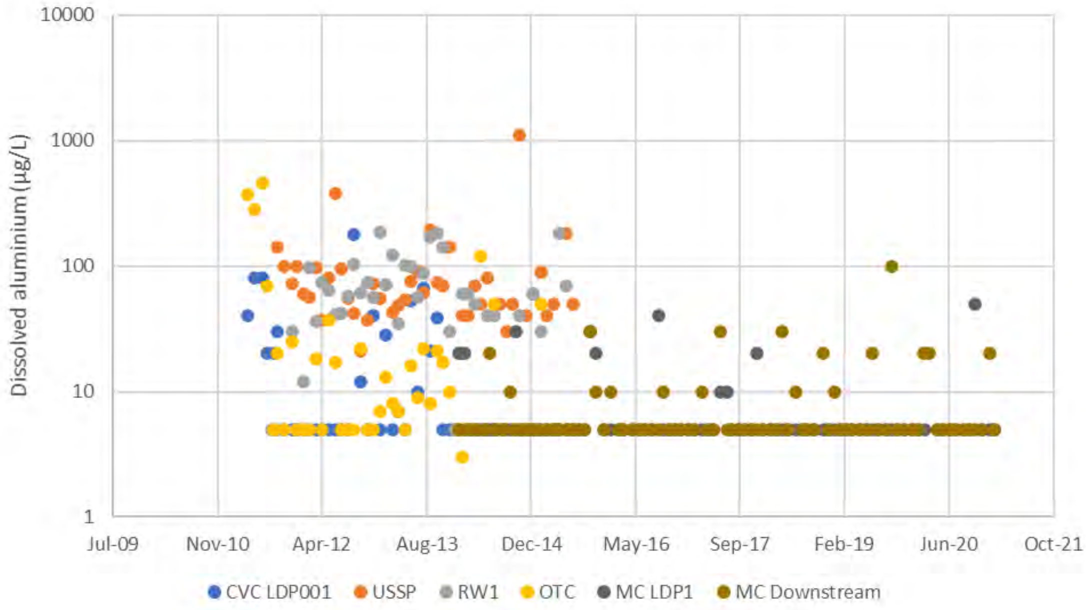


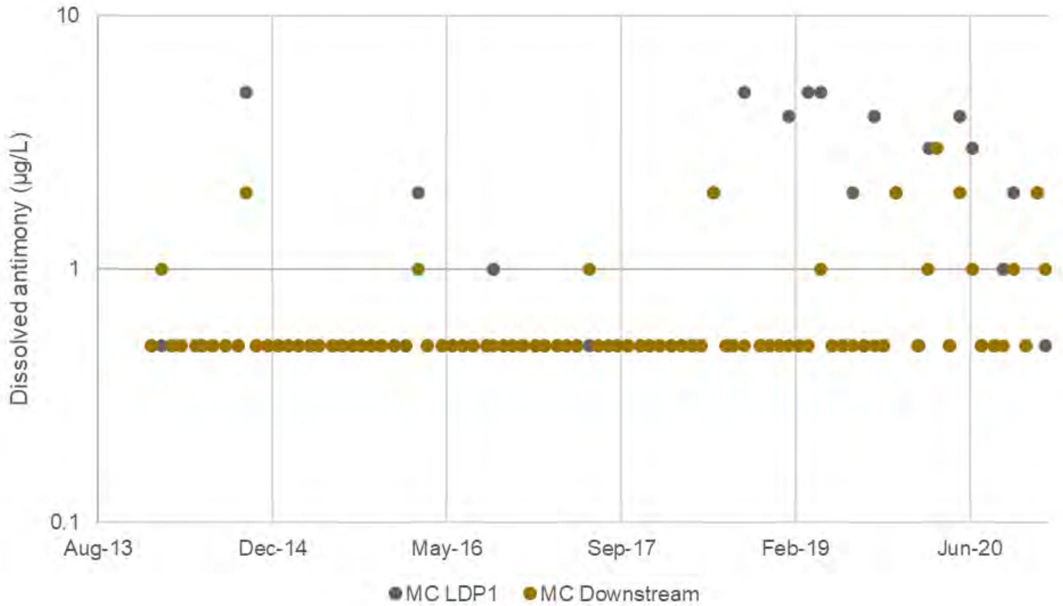
8000
7000
6000
5000
4000
3000
2000
1000
0
Faecal coliforms (CFU/100mL)
Aug-11
Dec-12
Apr-14
Sep-15
Jan-17
Jun-18
Oct-19
CVC LDP1
USSP
RW1
OTC

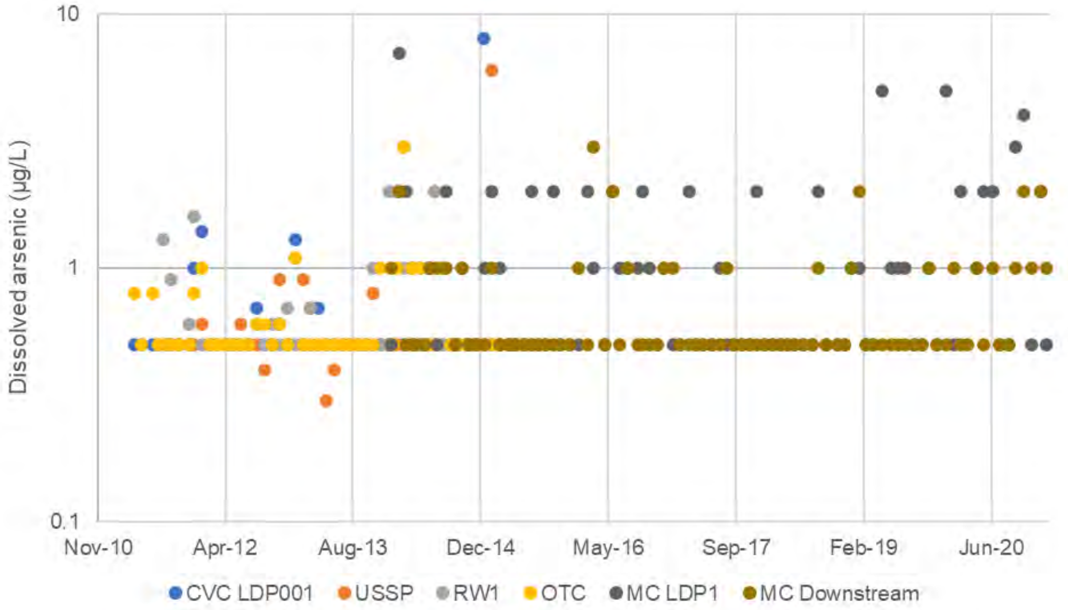



7000
6000
5000
4000
3000
2000
1000
0
Enterococci (CFU/100mL)
Aug-12
Dec-13
Apr-15
Sep-16
Jan-18
Jun-19
Oct-20
CVC LDP1
USSP
RW1
OTC

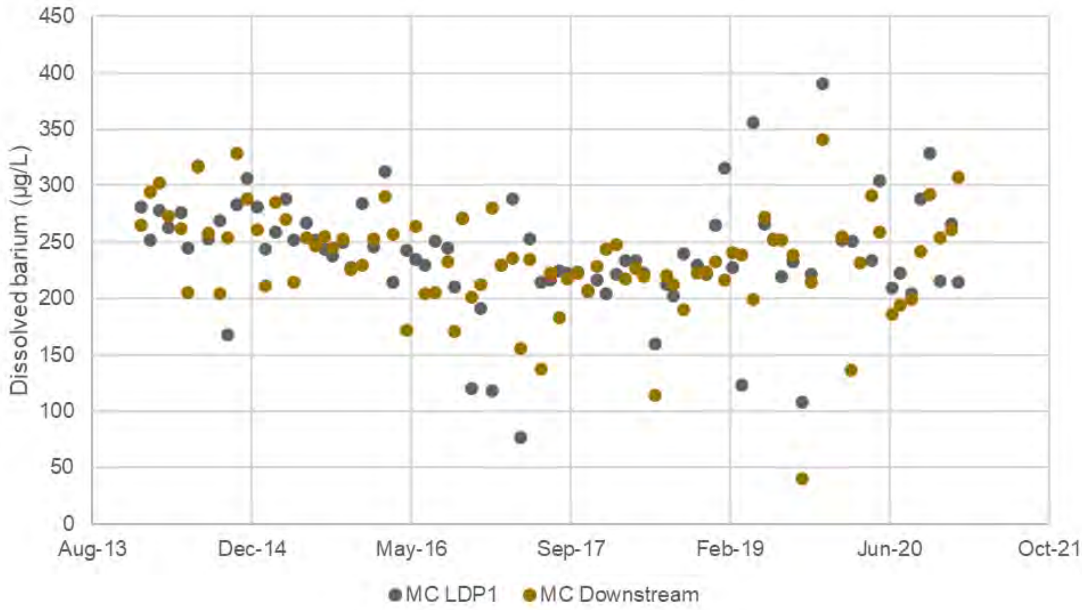
## Dissolved metals



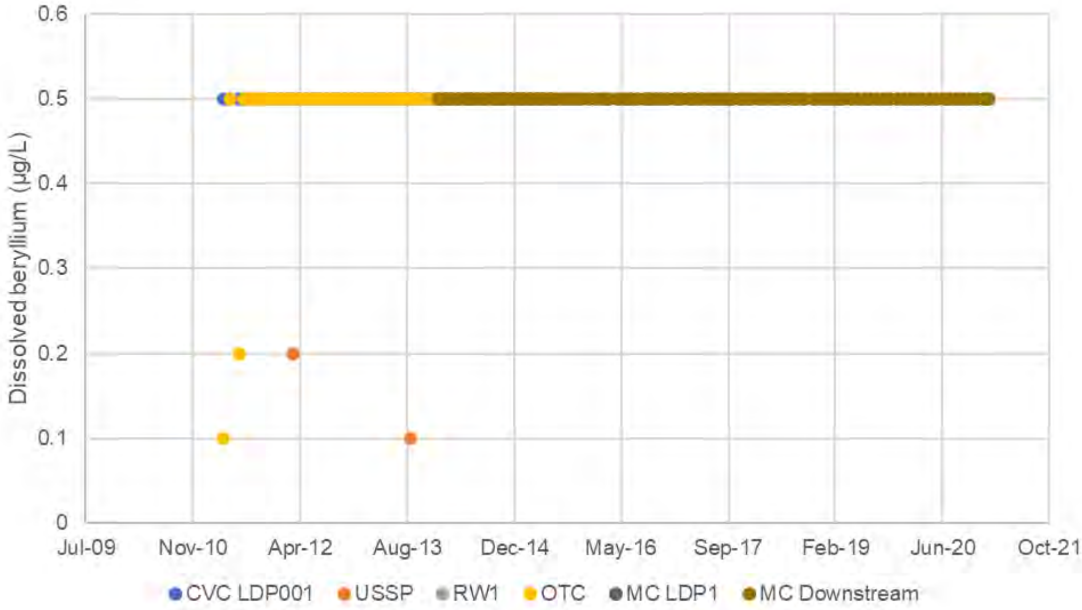



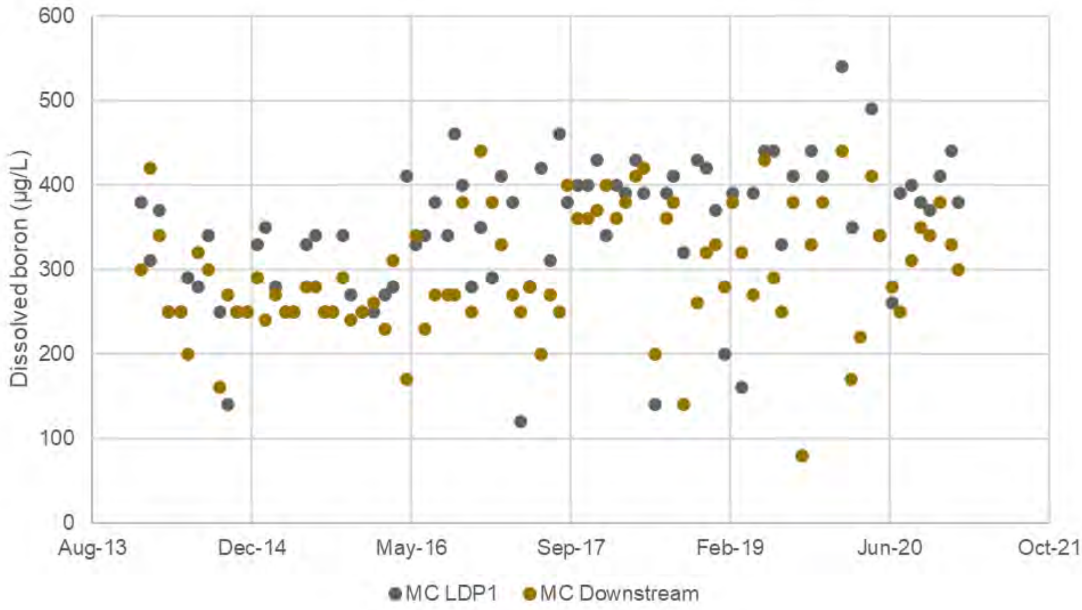


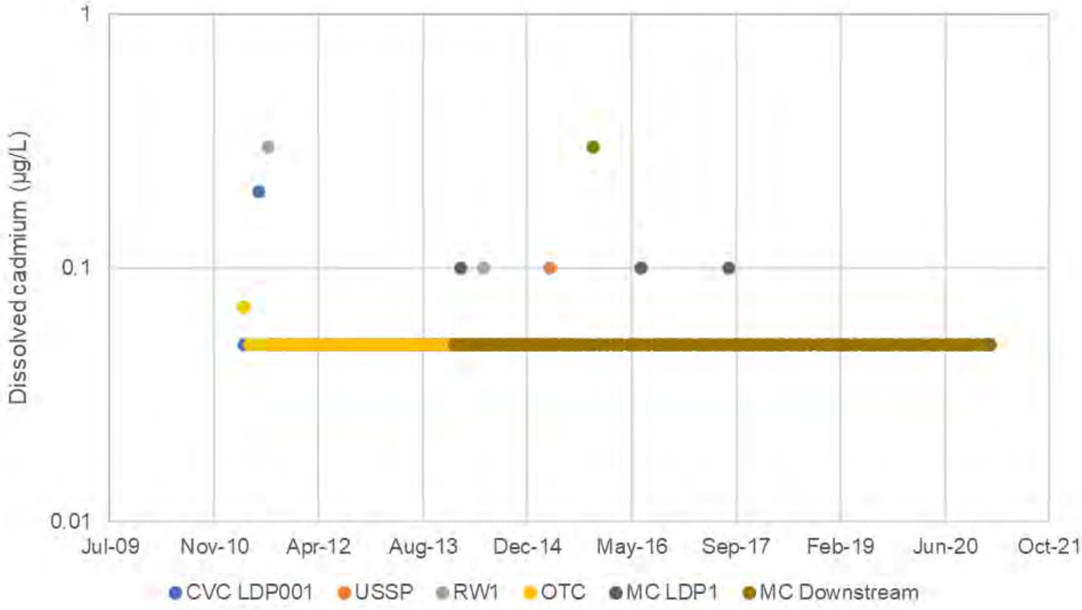
10
1
0.1
Dissolved arsenic (µg/L)
Nov-10
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Feb-19
Jun-20
CVC LDP001
USSP
RW1
OTC
MC LDP1
MC Downstream

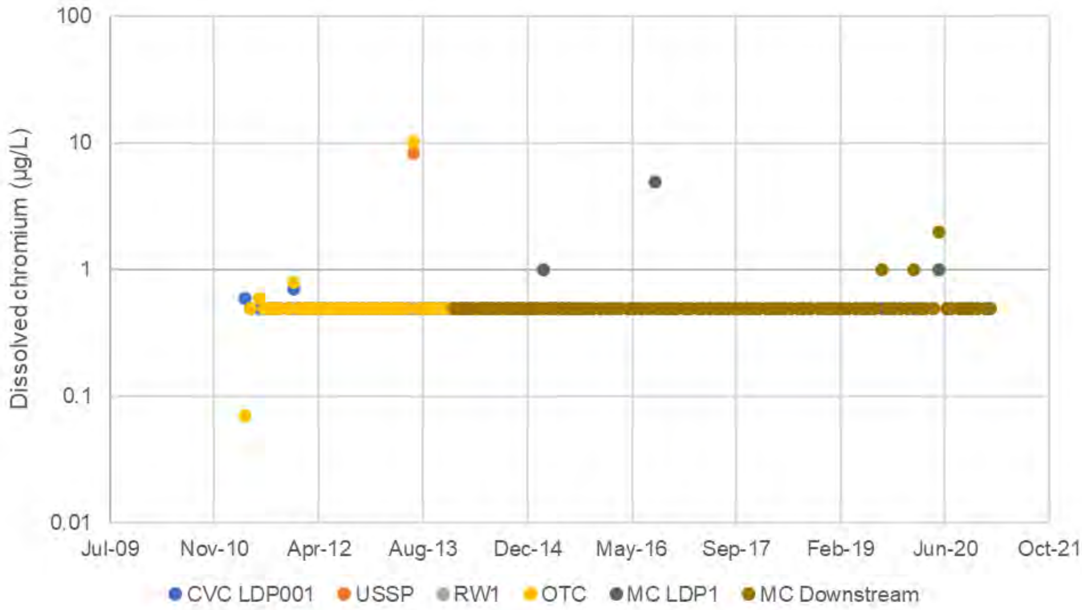
450
400
350
300
250
200
150
100
50
0
Dissolved barium (µg/L)
Aug-13
Dec-14
May-16
Sep-17
Feb-19
Jun-20
Oct-21
MC LDP1
MC Downstream


0.6
0.5
0.4
0.3
0.2
0.1
0
Dissolved beryllium (µg/L)
Jul-09
Nov-10
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Feb-19
Jun-20
Oct-21
CVC LDP001
USSP
RW1
OTC
MC LDP1
MC Downstream

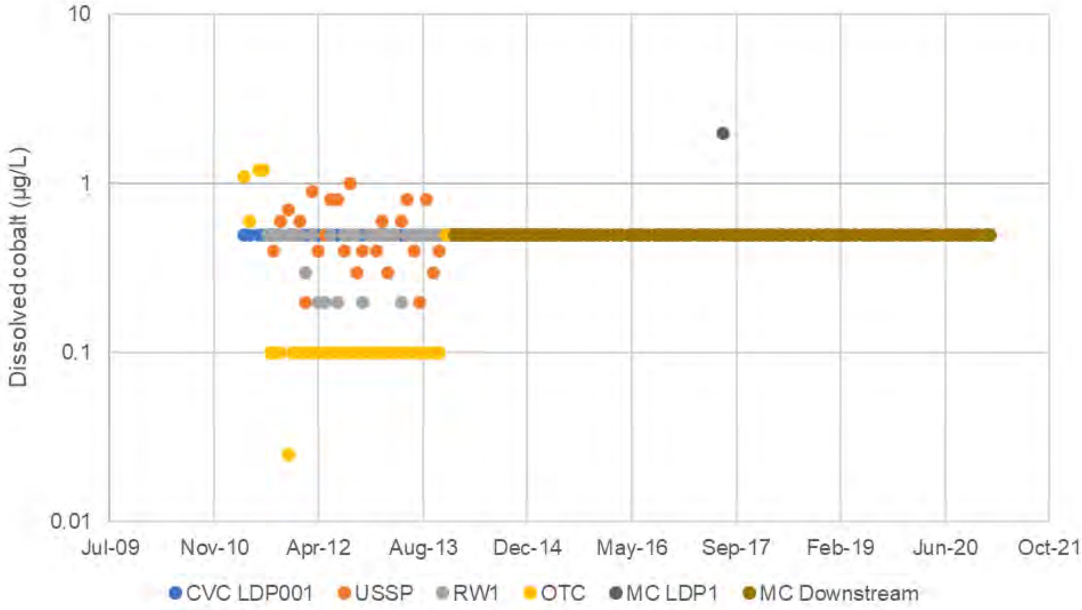

600
500
400
300
200
100
0
Dissolved boron (µg/L)
Aug-13
Dec-14
May-16
Sep-17
Feb-19
Jun-20
Oct-21
MC LDP1
MC Downstream



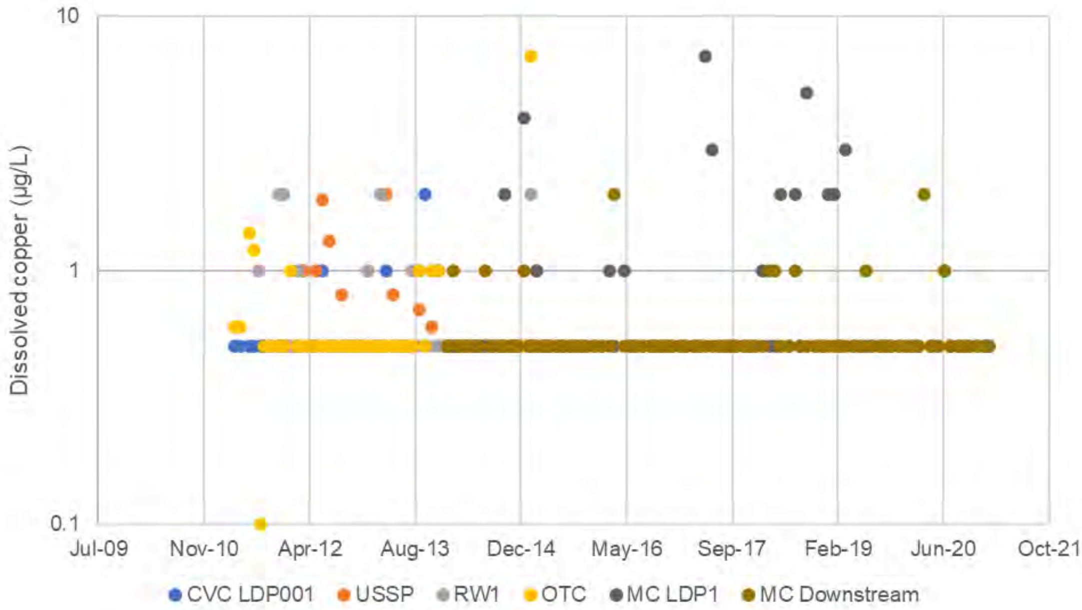
Dissolved cadmium (µg/L)
1
0.1
0.01
Jul-09
Nov-10
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Feb-19
Jun-20
Oct-21
CVC LDP001
USSP
RW1
OTC
MC LDP1
MC Downstream

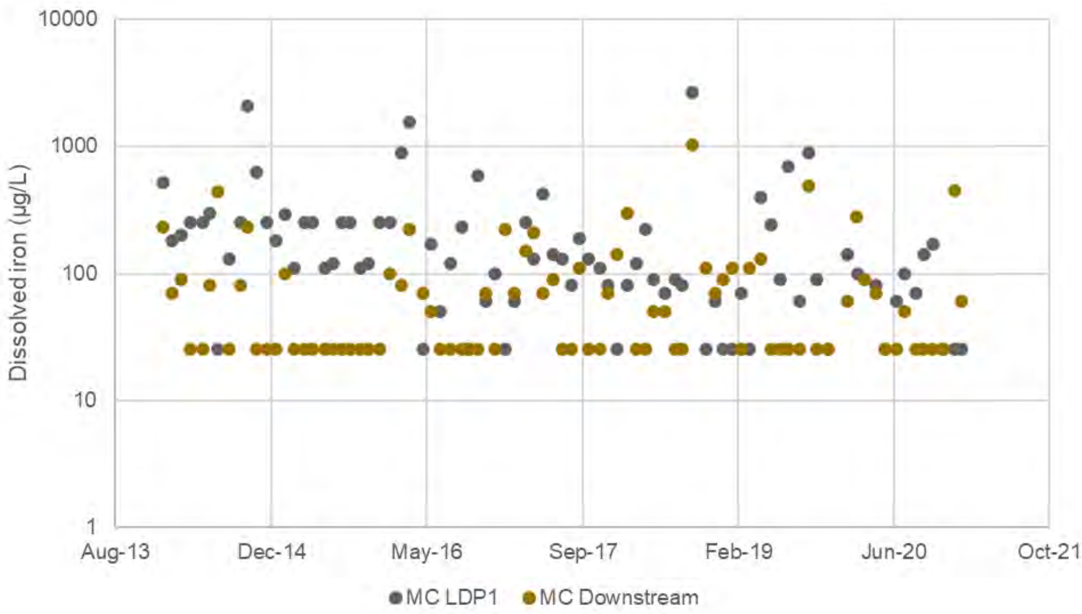
Dissolved chromium (µg/L)
100
10
1
0.1
0.01
Jul-09
Nov-10
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Feb-19
Jun-20
Oct-21
CVC LDP001
USSP
RW1
OTC
MC LDP1
MC Downstream

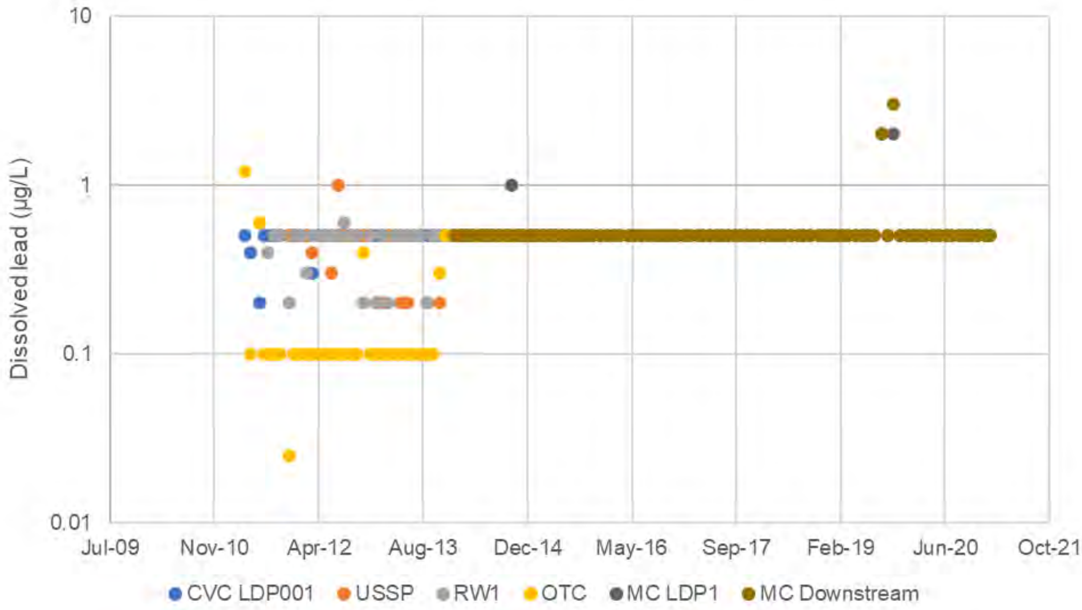


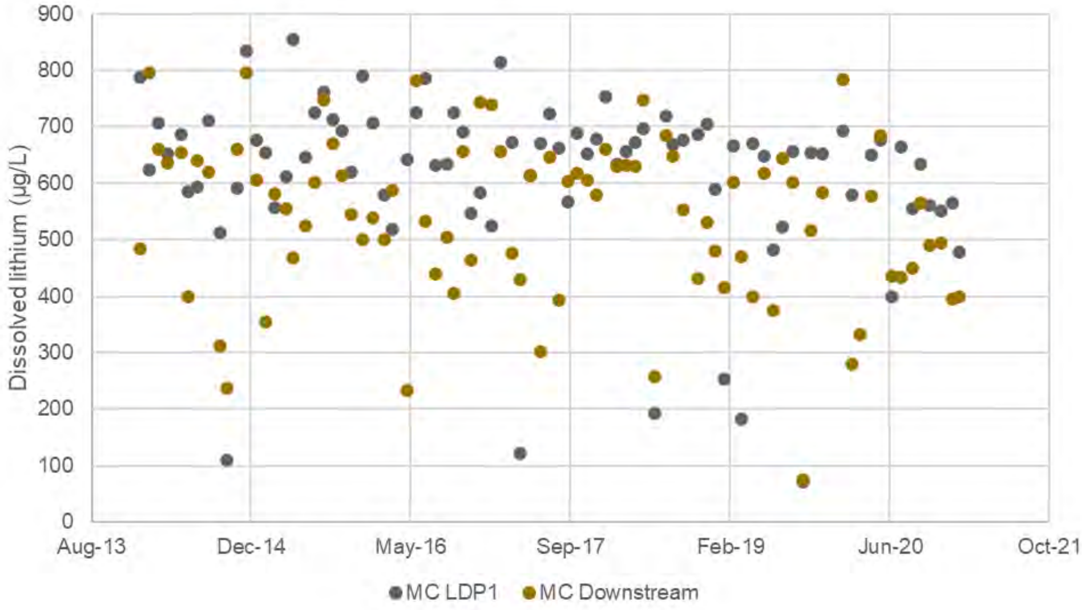
10
1
0.1
0.01
Dissolved cobalt (µg/L)
Jul-09
Nov-10
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Feb-19
Jun-20
Oct-21
CVC LDP001
USSP
RW1
OTC
MC LDP1
MC Downstream

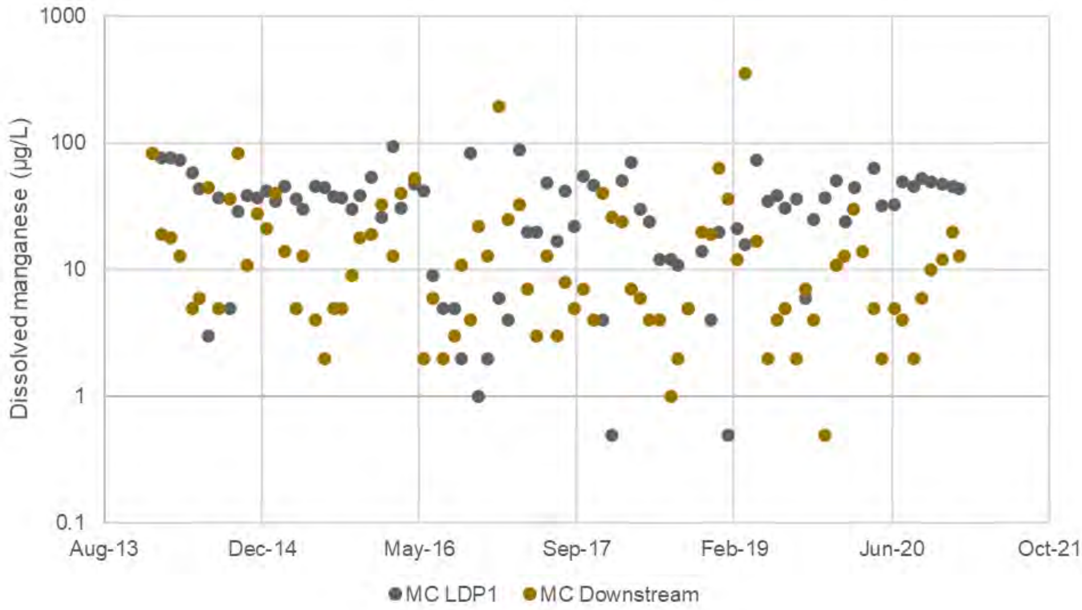
10
1
0.1
Dissolved copper (µg/L)
Jul-09
Nov-10
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Feb-19
Jun-20
Oct-21
CVC LDP001
USSP
RW1
OTC
MC LDP1
MC Downstream


10000
1000
100
10
1
Dissolved iron (µg/L)
Aug-13
Dec-14
May-16
Sep-17
Feb-19
Jun-20
Oct-21
MC LDP1
MC Downstream

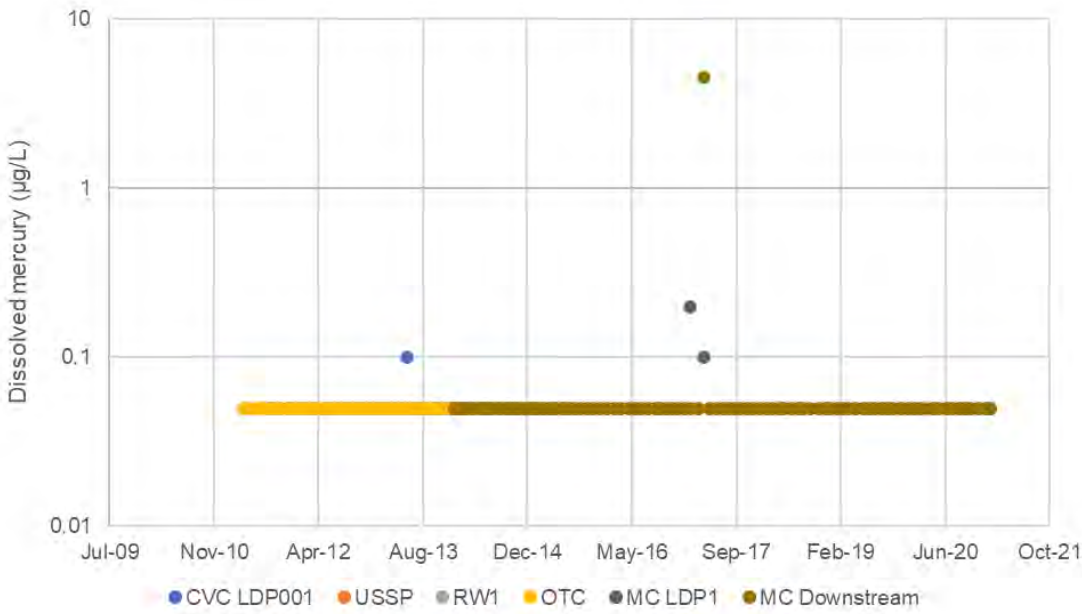

10
1
0.1
0.01
Dissolved lead (µg/L)
Jul-09
Nov-10
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Feb-19
Jun-20
Oct-21
CVC LDP001
USSP
RW1
OTC
MC LDP1
MC Downstream



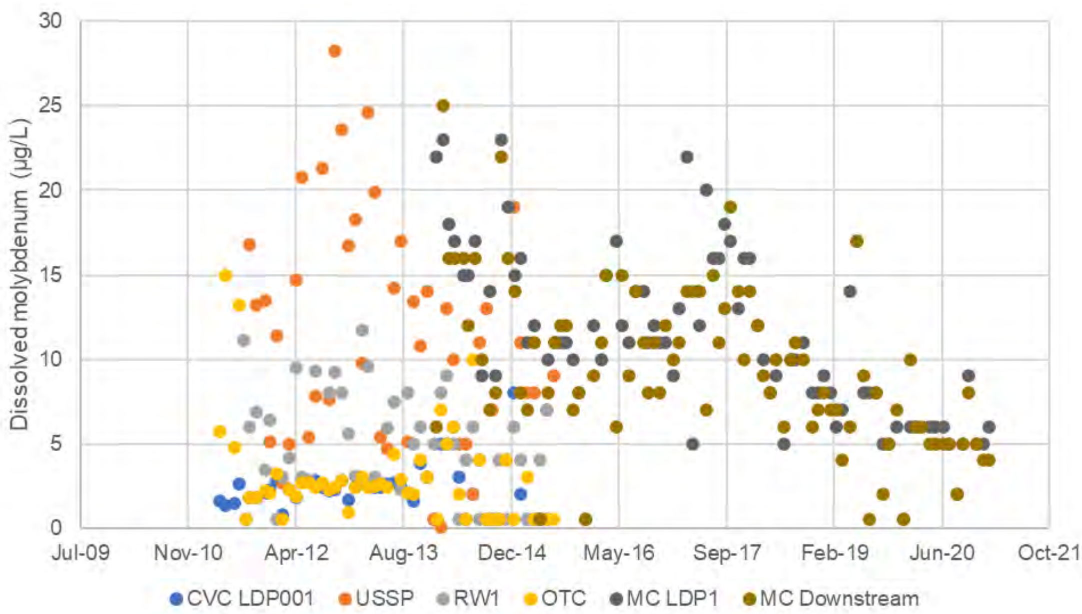
900
800
700
600
500
400
300
200
100
0
Dissolved lithium (µg/L)
Aug-13
Dec-14
May-16
Sep-17
Feb-19
Jun-20
Oct-21
MC LDP1
MC Downstream

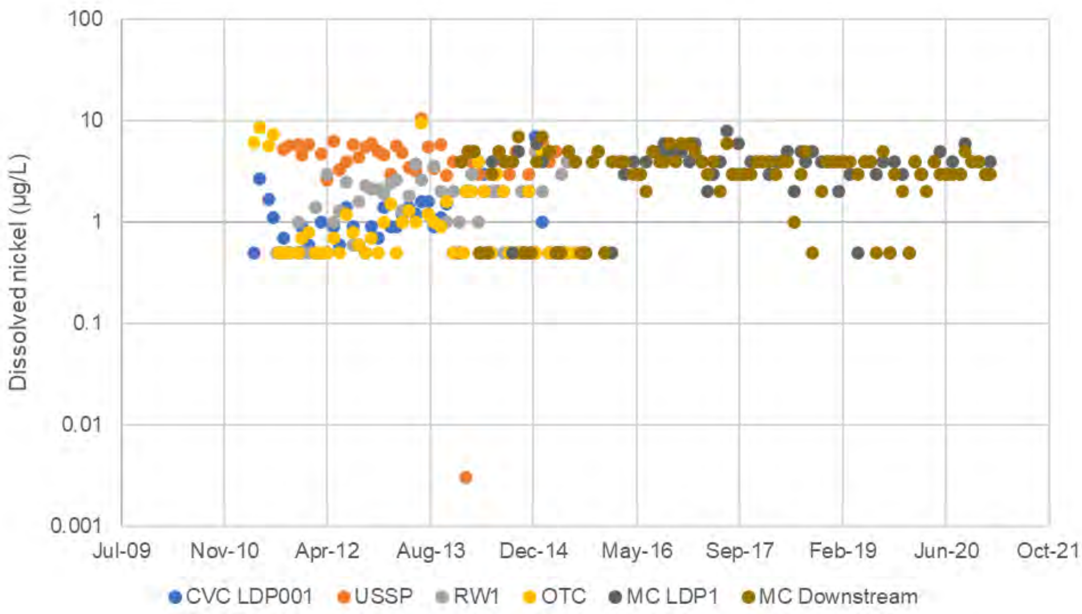
1000
100
10
1
0.1
Dissolved manganese (µg/L)
Aug-13
Dec-14
May-16
Sep-17
Feb-19
Jun-20
Oct-21
MC LDP1
MC Downstream

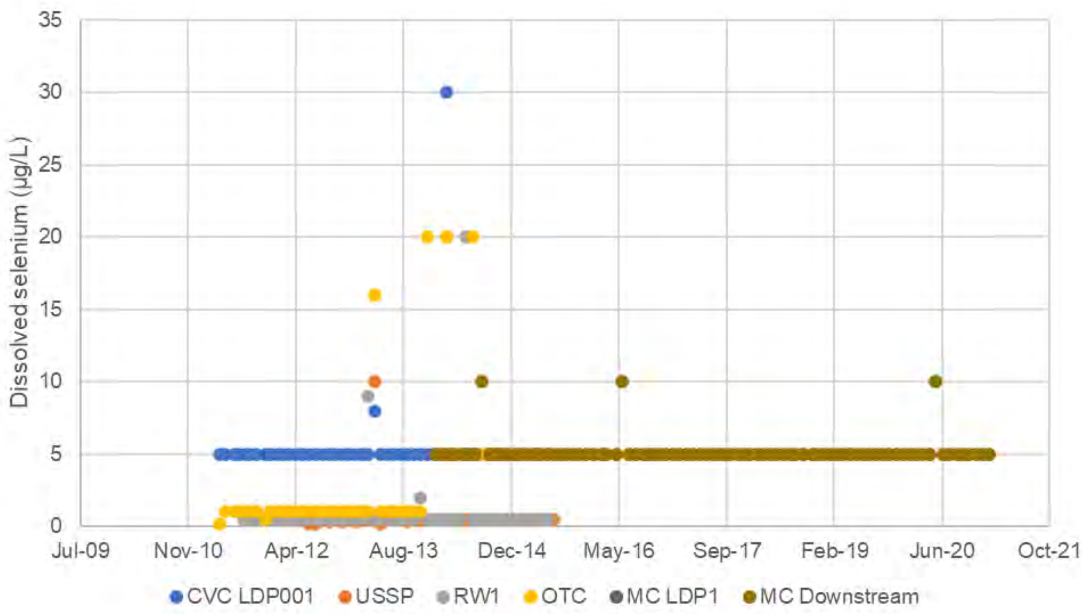


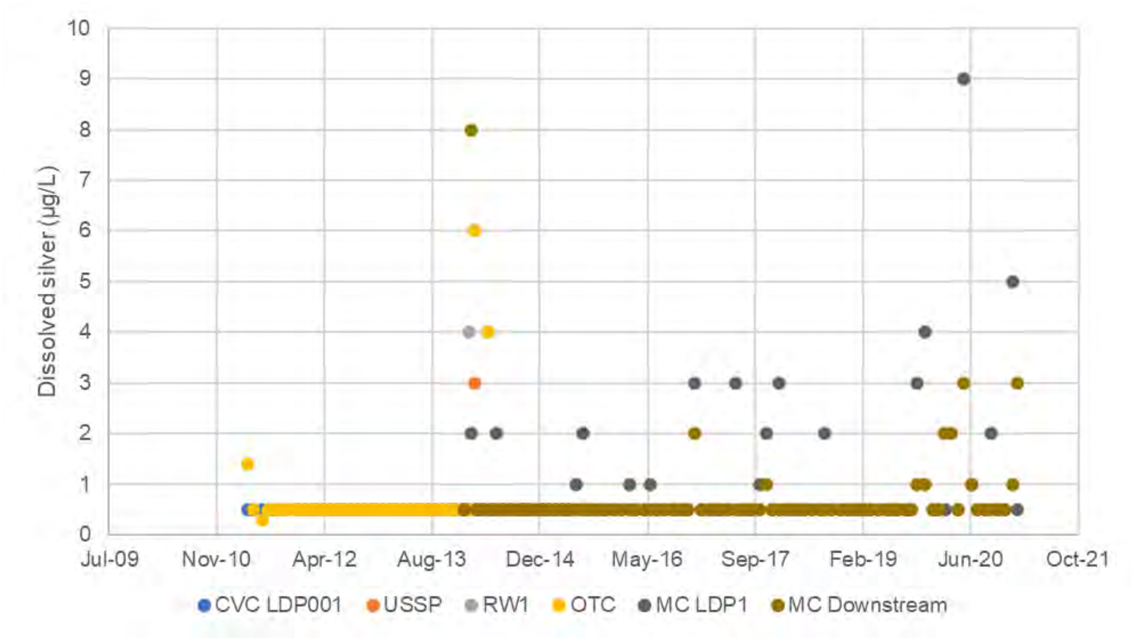
Dissolved mercury (µg/L)
10
1
0.1
0.01
Jul-09
Nov-10
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Feb-19
Jun-20
Oct-21
CVC LDP001
USSP
RW1
OTC
MC LDP1
MC Downstream

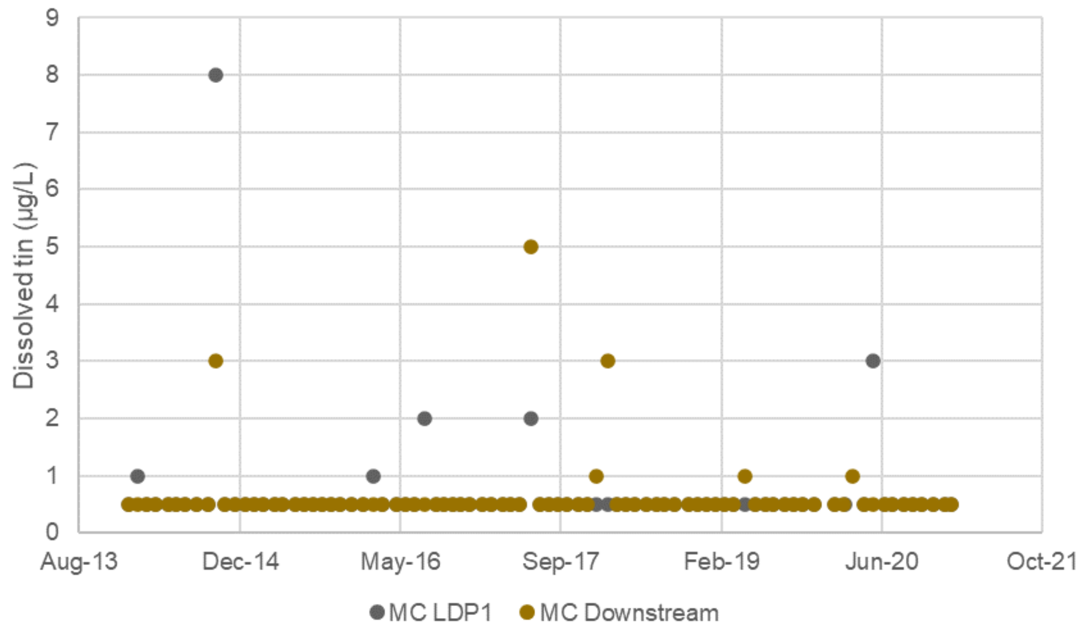
Dissolved molybdenum (µg/L)
30
25
20
15
10
5
0
Jul-09
Nov-10
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Feb-19
Jun-20
Oct-21
CVC LDP001
USSP
RW1
OTC
MC LDP1
MC Downstream


100
10
1
0.1
0.01
0.001
Dissolved nickel (µg/L)
Jul-09
Nov-10
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Feb-19
Jun-20
Oct-21
CVC LDP001
USSP
RW1
OTC
MC LDP1
MC Downstream

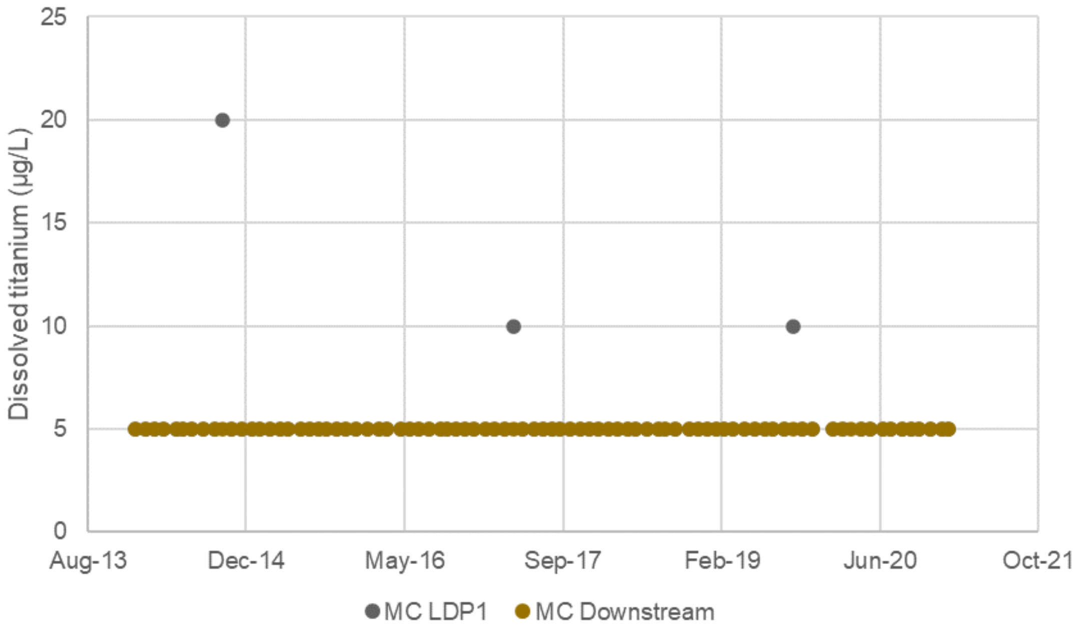

35
30
25
20
15
10
5
0
Dissolved selenium (µg/L)
Jul-09
Nov-10
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Feb-19
Jun-20
Oct-21
CVC LDP001
USSP
RW1
OTC
MC LDP1
MC Downstream



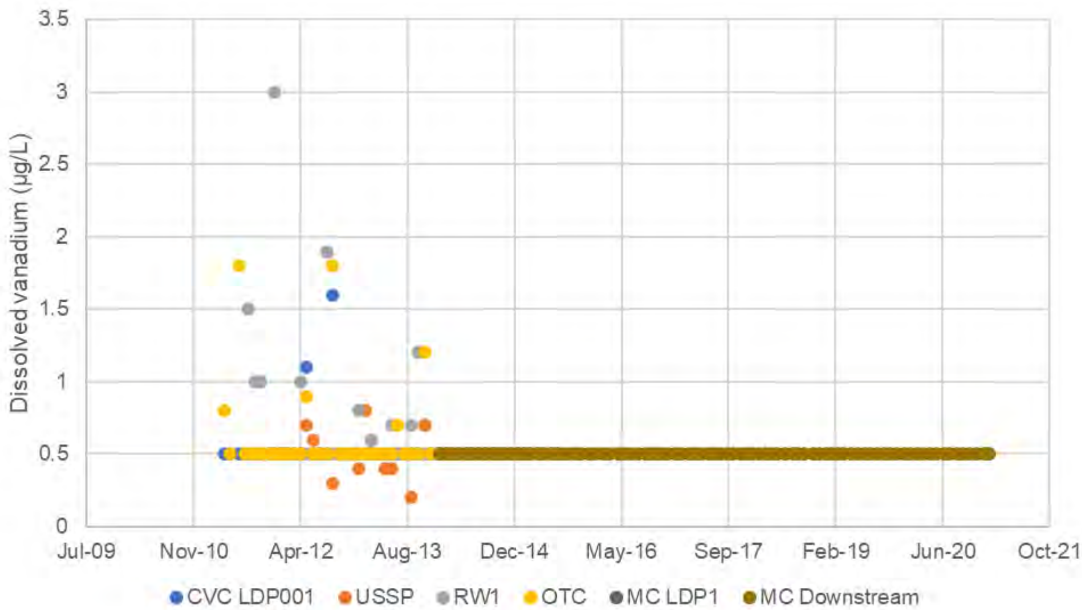
Dissolved silver (µg/L)
0
1
2
3
4
5
6
7
8
9
10
Jul-09
Nov-10
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Feb-19
Jun-20
Oct-21
CVC LDP001
USSP
RW1
OTC
MC LDP1
MC Downstream

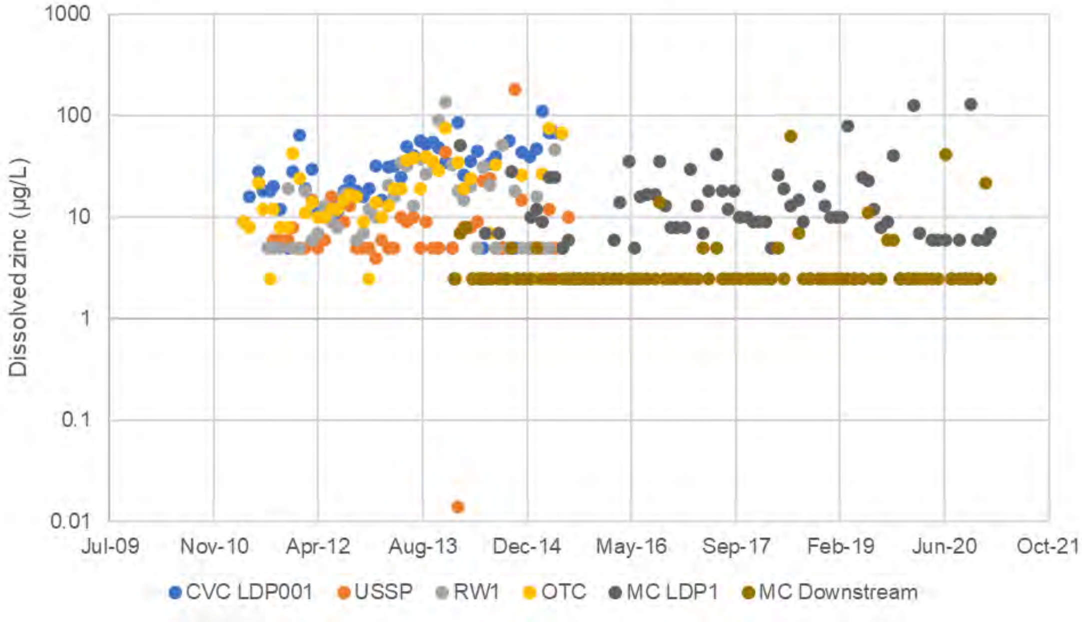
Dissolved tin (µg/L)
0
1
2
3
4
5
6
7
8
9
Aug-13
Dec-14
May-16
Sep-17
Feb-19
Jun-20
Oct-21
MC LDP1
MC Downstream



25
20
15
10
5
0
Dissolved titanium (µg/L)
Aug-13
Dec-14
May-16
Sep-17
Feb-19
Jun-20
Oct-21
MC LDP1
MC Downstream

3.5
3
2.5
2
1.5
1
0.5
0
Dissolved vanadium (µg/L)
Jul-09
Nov-10
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Feb-19
Jun-20
Oct-21
CVC LDP001
USSP
RW1
OTC
MC LDP1
MC Downstream


1000
100
10
1
0.1
0.01
Dissolved zinc (µg/L)
Jul-09
Nov-10
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Feb-19
Jun-20
Oct-21
CVC LDP001
USSP
RW1
OTC
MC LDP1
MC Downstream

# B-1 Derivation of SSGVs

## MC Downstream

| Analyte | Units | LOR | DGV | MC Downstream | | |
|---|---|---|---|---|---|---|
| | | | | 80th %ile | Count | Recommended SSGV |
| Physicochemical parameters | | | | | | |
| EC | µS/cm | 1 | 125 - 2200 | 26300 | 85 | 26300 |
| pH | pH unit | 0.01 | 7.0 - 8.5 | 8 - 8.3 | 85 | 7.0 - 8.5 |
| TSS | mg/L | 1 | NA | 7.4 | 85 | 7.4 |
| Nutrients | | | | | | |
| Ammonia as N | mg/L | 0.01 | 0.9 | 0.04 | 85 | 0.9 |
| Total phosphorus as P | mg/L | 0.001 | 0.03 | 0.03 | 85 | 0.03 |
| Other | | | | | | |
| Oil & Grease | mg/L | 5 | NA | 5 | 85 | 5 |
| Silica | mg/L | 0.1 | NA | 14.6 | 85 | 14.6 |
| Sulfur | mg/L | 1 | NA | 146 | 85 | 146 |
| Dissolved metals | | | | | | |
| Aluminium | mg/L | 0.01 | 0.055 | 0.006 | 85 | 0.055 |
| Antimony | mg/L | 0.001 | 0.009 | 0.001 | 84 | 0.009 |
| Arsenic | mg/L | 0.001 | 0.024 | 0.001 | 85 | 0.024 |
| Barium | mg/L | 0.001 | NA | 0.2644 | 84 | 0.2644 |
| Beryllium | mg/L | 0.001 | NA | 0.001 | 85 | 0.001 |
| Boron | mg/L | 0.01 | 0.94 | 0.374 | 84 | 0.94 |
| Cadmium | mg/L | 0.0001 | 0.0033 | 0.0001 | 85 | 0.0002 |
| Chromium | mg/L | 0.001 | 0.001 | 0.001 | 85 | 0.001 |
| Cobalt | mg/L | 0.001 | 0.0014 | 0.001 | 85 | 0.0014 |
| Copper | mg/L | 0.001 | 0.0014 | 0.001 | 85 | 0.0014 |
| Iron | mg/L | 0.05 | NA | 0.11 | 84 | 0.11 |
| Lead | mg/L | 0.001 | 0.0034 | 0.001 | 85 | 0.0034 |
| Lithium | mg/L | 0.001 | NA | 0.651 | 84 | 0.651 |
| Manganese | mg/L | 0.001 | 1.9 | 0.0252 | 85 | 1.9 |
| Mercury | mg/L | 0.0001 | 0.0006 | 0.0001 | 85 | 0.0006 |
| Molybdenum | mg/L | 0.001 | 0.034 | 0.014 | 85 | 0.034 |
| Nickel | mg/L | 0.001 | 0.011 | 0.0042 | 85 | 0.011 |
| Selenium | mg/L | 0.01 | 0.011 | 0.01 | 85 | 0.011 |
| Silver | mg/L | 0.001 | 0.00005 | 0.001 | 85 | 0.001 |
| Tin | mg/L | 0.001 | NA | 0.001 | 84 | 0.001 |
| Titanium | mg/L | 0.01 | NA | 0.01 | 84 | 0.01 |
| Vanadium | mg/L | 0.001 | 0.006 | 0.001 | 85 | 0.006 |
| Zinc | mg/L | 0.005 | 0.008 | 0.005 | 85 | 0.008 |

| Analyte | Units | LOR | DGV | MC Downstream | | |
|---|---|---|---|---|---|---|
| | | | | 80th %ile | Count | Recommended SSGV |
| Major ions | | | | | | |
| Calcium | mg/L | 1 | NA | 198.4 | 85 | 198.4 |
| Magnesium | mg/L | 1 | NA | 280 | 85 | 280 |
| Potassium | mg/L | 1 | NA | 38.2 | 85 | 38.2 |

## USSP

| Analyte | Units | LOR | DGV | USSP | | |
|---|---|---|---|---|---|---|
| | | | | 80th %ile | Count | Recommended SSGV |
| Physicochemical parameters | | | | | | |
| EC | µS/cm | 1 | 125-2200 | 24500 | 114 | 24500 |
| pH | pH unit | 0.01 | 6.5-8.0 | 7.42 - 7.97 | 114 | 7.0 - 8.5 |
| TSS | mg/L | 1 | NA | 8 | 114 | 8 |
| BOD | mg/L | 2 | NA | 2 | 101 | 2 |
| Nutrients | | | | | | |
| Ammonia as N | mg/L | 0.01 | 0.9 | 0.04 | 114 | 0.9 |
| Nitrite and nitrate as N | mg/L | 0.01 | 0.04 | 0.25 | 102 | 0.25 |
| Total Kjeldahl nitrogen (TKN) as N | mg/L | 0.1 | NA | 0.4 | 102 | 0.4 |
| Total nitrogen as N | mg/L | 0.1 | 0.5 | 0.5 | 102 | 0.5 |
| Total phosphorus as P | mg/L | 0.001 | 0.05 | 0.03 | 104 | 0.05 |
| Other | | | | | | |
| Oil & Grease | mg/L | 5 | NA | 5 | 102 | 5 |
| MBAS | mg/L | 0.1 | NA | 0.1 | 112 | 0.1 |
| Biological | | | | | | |
| Faecal coliforms | CFU/100mL | 1 | NA | 1600 | 111 | 1600 |
| Enterococci | CFU/100mL | 1 | NA | 600 | 100 | 600 |
| Dissolved metals | | | | | | |
| Aluminium | mg/L | 0.01 | 0.055 | 0.0938 | 48 | 0.0938 |
| Antimony | mg/L | 0.001 | 0.009 | 0.001 | 1 | 0.009 |
| Arsenic | mg/L | 0.001 | 0.024 | 0.0006 | 48 | 0.024 |
| Barium | mg/L | 0.001 | NA | 0.203 | 1 | 0.203 |
| Beryllium | mg/L | 0.001 | NA | 0.001 | 48 | 0.001 |
| Boron | mg/L | 0.01 | 0.94 | 0.22 | 1 | 0.94 |
| Cadmium | mg/L | 0.0001 | 0.0002 | 0.0001 | 48 | 0.0002 |
| Chromium | mg/L | 0.001 | 0.0033 | 0.001 | 48 | 0.001 |
| Cobalt | mg/L | 0.001 | 0.0014 | 0.0006 | 48 | 0.0014 |
| Copper | mg/L | 0.001 | 0.0014 | 0.00058 | 47 | 0.0014 |
| Iron | mg/L | 0.05 | NA | 0.28 | 1 | 0.28 |
| Lead | mg/L | 0.001 | 0.0034 | 0.001 | 48 | 0.0034 |

| Analyte | Units | LOR | DGV | USSP | | |
|---|---|---|---|---|---|---|
| | | | | 80th %ile | Count | Recommended SSGV |
| Lithium | mg/L | 0.001 | NA | - | - | - |
| Manganese | mg/L | 0.001 | 1.9 | 0.018 | 1 | 1.9 |
| Mercury | mg/L | 0.0001 | 0.0006 | 0.0001 | 48 | 0.0006 |
| Molybdenum | mg/L | 0.001 | 0.034 | 0.01676 | 48 | 0.034 |
| Nickel | mg/L | 0.001 | 0.011 | 0.00562 | 48 | 0.011 |
| Selenium | mg/L | 0.01 | 0.011 | 0.01 | 48 | 0.011 |
| Silver | mg/L | 0.001 | 0.00005 | 0.001 | 48 | 0.001 |
| Tin | mg/L | 0.001 | NA | 0.001 | 1 | 0.001 |
| Titanium | mg/L | 0.01 | NA | 0.01 | 1 | 0.01 |
| Vanadium | mg/L | 0.001 | 0.006 | 0.001 | 48 | 0.006 |
| Zinc | mg/L | 0.005 | 0.008 | 0.0112 | 48 | 0.0112 |

## RW1

| Analyte | Units | LOR | DGV | RW1 | | |
|---|---|---|---|---|---|---|
| | | | | 80th %ile | Count | Recommended SSGV |
| Physicochemical parameters | | | | | | |
| EC | µS/cm | 1 | 125-2200 | 31480 | 114 | 31480 |
| pH | pH unit | 0.01 | 6.5-8.0 | 7.716 - 7.91 | 114 | 7.0 - 8.5 |
| TSS | mg/L | 1 | NA | 11 | 114 | 11 |
| BOD | mg/L | 2 | NA | 2 | 101 | 2 |
| Nutrients | | | | | | |
| Ammonia as N | mg/L | 0.005 | 0.9 | 0.06 | 114 | 0.9 |
| Nitrite and nitrate as N | mg/L | 0.01 | 0.04 | 0.572 | 102 | 0.572 |
| Total Kjeldahl nitrogen (TKN) as N | mg/L | 0.1 | NA | 0.25 | 102 | 0.25 |
| Total nitrogen as N | mg/L | 0.1 | 0.5 | 0.7 | 102 | 0.7 |
| Total phosphorus as P | mg/L | 0.001 | 0.05 | 0.028 | 108 | 0.05 |
| Other | | | | | | |
| Oil & Grease | mg/L | 5 | NA | 5 | 100 | 5 |
| MBAS | mg/L | 0.1 | NA | 0.1 | 112 | 0.1 |
| Biological | | | | | | |
| Faecal coliforms | CFU/100mL | 1 | NA | 480 | 111 | 480 |
| Enterococci | CFU/100mL | 1 | NA | 984 | 100 | 984 |
| Dissolved metals | | | | | | |
| Aluminium | mg/L | 0.01 | 0.055 | 0.0924 | 48 | 0.0924 |
| Antimony | mg/L | 0.001 | 0.009 | 0.001 | 1 | 0.009 |
| Arsenic | mg/L | 0.001 | 0.024 | 0.00096 | 48 | 0.024 |
| Barium | mg/L | 0.001 | NA | 0.231 | 1 | 0.231 |

| Analyte | Units | LOR | DGV | RW1 | | |
|---|---|---|---|---|---|---|
| | | | | 80th %ile | Count | Recommended SSGV |
| Beryllium | mg/L | 0.001 | NA | 0.001 | 48 | 0.001 |
| Boron | mg/L | 0.01 | 0.94 | 0.68 | 1 | 0.94 |
| Cadmium | mg/L | 0.0001 | 0.0002 | 0.0001 | 48 | 0.0002 |
| Chromium | mg/L | 0.001 | 0.0033 | 0.001 | 48 | 0.001 |
| Cobalt | mg/L | 0.001 | 0.0014 | 0.001 | 48 | 0.0014 |
| Copper | mg/L | 0.001 | 0.0014 | 0.001 | 47 | 0.0014 |
| Iron | mg/L | 0.05 | NA | 0.25 | 1 | 0.25 |
| Lead | mg/L | 0.001 | 0.0034 | 0.001 | 48 | 0.0034 |
| Lithium | mg/L | 0.001 | NA | - | - | - |
| Manganese | mg/L | 0.001 | 1.9 | 0.068 | 1 | 1.9 |
| Mercury | mg/L | 0.0001 | 0.0006 | 0.0001 | 48 | 0.0006 |
| Molybdenum | mg/L | 0.001 | 0.034 | 0.008 | 48 | 0.034 |
| Nickel | mg/L | 0.001 | 0.011 | 0.00256 | 48 | 0.011 |
| Selenium | mg/L | 0.01 | 0.011 | 0.01 | 48 | 0.011 |
| Silver | mg/L | 0.001 | 0.00005 | 0.001 | 48 | 0.001 |
| Tin | mg/L | 0.001 | NA | 0.001 | 1 | 0.001 |
| Titanium | mg/L | 0.01 | NA | 0.01 | 1 | 0.01 |
| Vanadium | mg/L | 0.001 | 0.006 | 0.0007 | 48 | 0.006 |
| Zinc | mg/L | 0.005 | 0.008 | 0.0316 | 48 | 0.0316 |

# Appendix C

## Site Water and Salt Balance Modelling

# Site Water and Salt Balance

## Chain Valley Colliery – Consolidation Project

Umwelt (Australia) Pty Ltd

8 July 2022

→ **The Power of Commitment**

| Project name | Delta Coal - Consolidation Project - Groundwater and surface water assessment | | | | | | |
|---|---|---|---|---|---|---|---|
| Document title | Site Water and Salt Balance \| Chain Valley Colliery – Consolidation Project | | | | | | |
| Project number | 12580250 | | | | | | |
| File name | 12580250-REP_Site Water and Salt Balance.docx | | | | | | |
| Status Code | Revision | Author | Reviewer | | Approved for issue | | |
| | | | Name | Signature | Name | Signature | Date |
| S4 | 0 | J M Macatanong | T Tinkler | [signature] | S Gray | [signature] | 08/07/22 |
| | | | | | | | |
| | | | | | | | |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# 1. Introduction

GHD Pty Ltd (GHD) was engaged by Great Southern Energy Pty Ltd trading as Delta Coal to prepare a Surface Water Impact Assessment (SWIA) for the Chain Valley Colliery Consolidation Project (the Project) which proposes the consolidation of the existing Chain Valley Colliery (CVC) and Mannering Colliery (MC) approvals and ongoing coal production from the Delta Coal assets through to 2029.

## 1.1 Purpose of this report

This report has been prepared only as technical appendix to support the SWIA and must be read only as part of the SWIA. The objective of the water balance is to quantify the water budget, including inflows, outflows and net change in storage, for surface water and groundwater at CVC and MC under existing, approved and, proposed project conditions.

## 1.2 Scope

The scope of work for the water and salt balance is as follows:

- Collation and review of data relating to CVC and MC.
- Develop a GoldSim water and salt balance model for the mine to reflect existing, approved and proposed site conditions, including transfer and discharge rates.
- Review the capacity of volumetric discharges from CVC and MC operations against Environment Protection Licence 1770 (EPL 1770) for CVC and Environment Protection Licence 191 (EPL 191) for MC limits.

The focus of this report is the surface water management system at CVC Pit Top and MC Pit Top. Due to the essentially continuous discharge, the hydraulic residence time of the underground water management system is relatively low. The potential surface water impacts are therefore considered independent of the operation of the underground water management system and it may therefore be idealised as a single element for the purpose of the site water and salt balance model as part of the SWIA.

## 1.3 Overview of site operations

### 1.3.1 Site features

***Chain Valley Colliery***

CVC Pit Top includes administration buildings and bathhouse, carpark, mechanical workshop and store, irrigation area, compressors, oil discharge tank, compressor oil separator, oil/ water separator, equipment and materials storage areas, machinery washdown bay, fire station, electrical sub-station and coal stockpile area. The site has existing connections to the Central Coast Council town potable water system. Water is discharged from CVC to Swindles Creek under CVC Licensed Discharge Point 001 (LDP001) and CVC LDP027. CVC LDP027 is a high flow bypass at essentially the same location as LDP001. For the purpose of the site water and salt balance, CVC LDP001 and LDP027 are considered collectively.

***Mannering Colliery***

MC Pit Top includes mechanical workshops, administration buildings and bathhouse, drift drive house, carpark, supplies shed, oil shed wash bay, diesel shed, compressors and water management infrastructure. Water is discharged from MC to Swindles Creek via MC LDP001.

### 1.3.2 Environment Protection Licence

CVC and MC currently hold EPL 1770 and EPL 191, respectively, which includes requirements to monitor dust, water quality and the quantity and quality of water discharges. CVC and MC are licensed to discharge water under EPL 1770 and EPL 191 through the following LDPs:

**EPL 1770**

- LDP001 – Main discharge point of surface water, mine water make and site runoff into Lake Macquarie via Swindles Creek.
- LDP027 – Discharge of surface water runoff through spillway which discharges during significant rainfall events.
- LDP001 and LDP027 combined are licensed to discharge up to 12.161 ML/day of water from CVC.

**EPL 191**

- LDP001 – Main discharge point of surface water, mine water make and site runoff into Lake Macquarie via Swindles Creek. Discharge rate limit is up to 4.0 ML/day.

## 1.4 Limitations

This report: has been prepared by GHD for Umwelt (Australia) Pty Ltd and may only be used and relied on by Umwelt (Australia) Pty Ltd for the purpose agreed between GHD and Umwelt (Australia) Pty Ltd as set out in this report.

GHD otherwise disclaims responsibility to any person other than Umwelt (Australia) Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

# 2. Water management

## 2.1 Water management system

The CVC Pit Top and MC Pit Top are located in the catchment of Swindles Creek. The headwaters of Swindles Creek are essentially formed by the MC Pit Top and it discharges to Lake Macquarie shortly downstream of the CVC Pit Top.

The water management system at CVC and MC is generally comprised of clean and dirty surface, potable, waste and underground elements. Sources of water at the surface sites include potable water supply, rainfall, runoff and groundwater inflow into the underground mine workings. The water management at CVC and MC pit top primarily focus on erosion and sediment control. Water management demands include underground operations, machinery washdown, oil water separator system, effluent management train, operation of the pollution control dams and staff amenities.

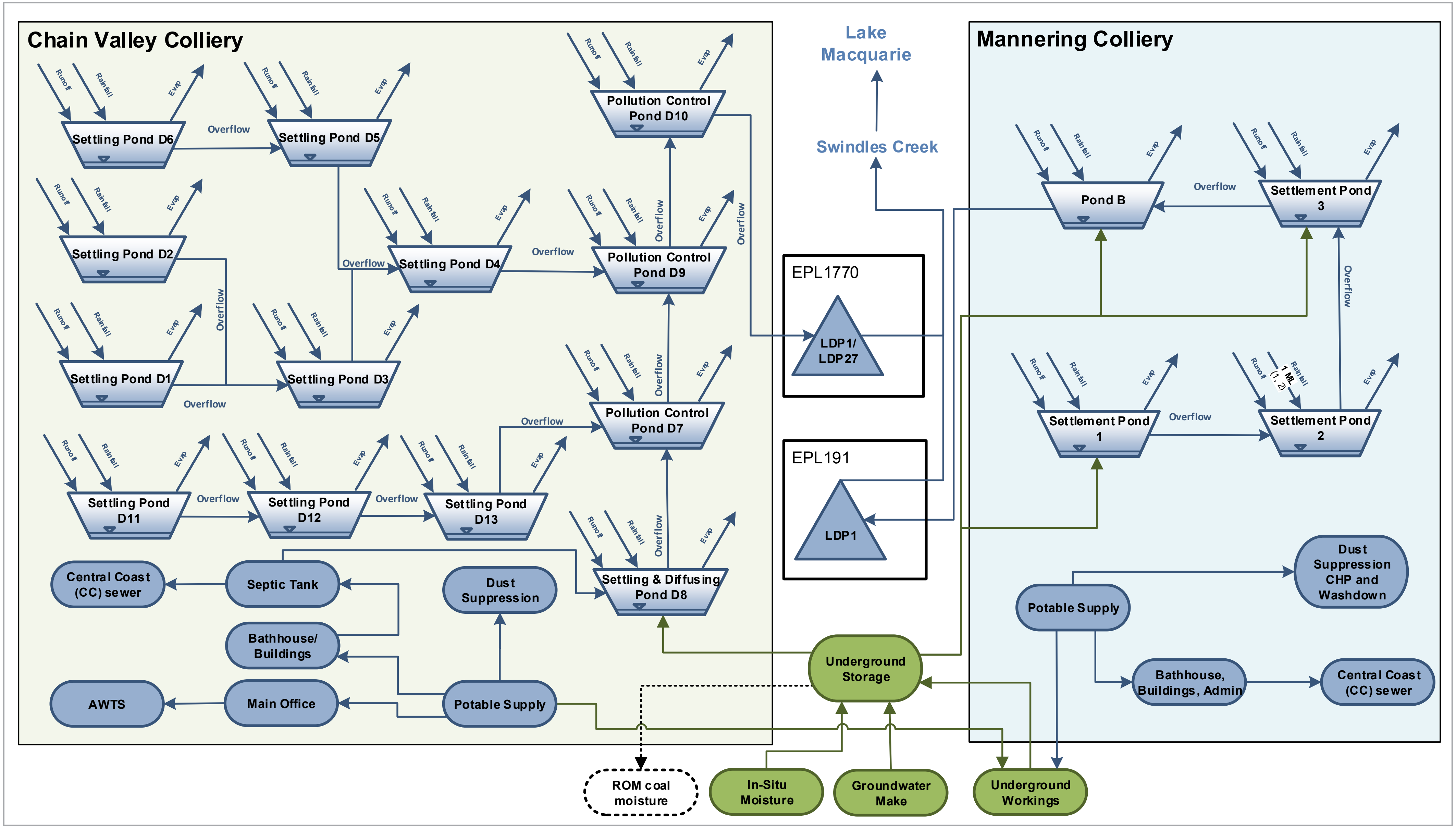
## 2.2 Water management features

The existing and proposed water management system at CVC and MC were conceptualised as a network of water management features representing surface water storages, operational processes, discharge points and receiving waters. Each water management feature was defined by its connection to other water management features by inflows and outflows of water. The water management features considered are summarised in Table 2.1. All surface water storages receive direct rainfall and catchment runoff and lose water by evaporation, which, for brevity, is not included in Table 2.1.

***Table 2.1 Water management features***

| Feature | Water storage | Surface water catchments | Inflows | Outflows |
|---|---|---|---|---|
| **Chain Valley Colliery** | | | | |
| Settling Pond D1 | Yes | Yes | | Overflows to Settling Pond D5 |
| Settling Pond D2 | Yes | Yes | | Overflows to Settling Pond D3 |
| Settling Pond D3 | Yes | Yes | Overflows from Settling Pond D2 and D6 | Overflows to Settling Pond D4 |
| Settling Pond D4 | Yes | Yes | Overflows from Settling Pond D3 and D5 | Overflows to Pollution Control Pond D9 |
| Settling Pond D5 | Yes | Yes | Overflows from Settling Pond D1 | Overflows to Settling Pond D4 |
| Settling Pond D6 | Yes | Yes | | Overflows to Settling Pond D3 |
| Pollution Control Pond D7 | Yes | Yes | Overflows from Settling Pond D13 and Settling and Diffusing Pond D8 | Overflows to Pollution Control Pond D9 |
| Settling and Diffusing Pond D8 | Yes | Yes | Dewatering from Underground Storage | Overflows to Pollution Control Pond D7 |
| Pollution Control Pond D9 | Yes | Yes | Overflows from Settling Pond D4 and Pollution Control Pond D7 | Overflows to Pollution Control Pond D10 |
| Overflows to Pollution Control Pond D10 | Yes | Yes | Overflows from Pollution Control Pond D10 | Overflows to LDP001 |
| Settling Pond D11 | Yes | Yes | | Overflows to Settling Pond D12 |

| Feature | Water storage | Surface water catchments | Inflows | Outflows |
|---|---|---|---|---|
| Settling Pond D12 | Yes | Yes | Overflows from Settling Pond D11 | Overflows to Settling Pond D13 |
| Settling Pond D13 | Yes | Yes | Overflows from Settling Pond D12 | Overflows to Pollution Control Pond D7 |
| **Mannering Colliery** | | | | |
| Settlement Pond 1 | Yes | Yes | Dewatering from Underground Storage | Overflows to Settlement Pond 2 |
| Settlement Pond 2 | Yes | Yes | Overflows from Settlement Pond 2<br>Dewatering from Underground Storage | Overflows to Settlement Pond 3 |
| Settlement Pond 3 | Yes | Yes | Overflows from Settlement Pond 2<br>Dewatering from Underground Storage | Overflows to Pond B |
| Pond B | Yes | Yes | Overflows from Settlement Pond 3<br>Dewatering from Underground Storage | Overflows to LDP001 |
| **Underground Workings** | | | | |
| Underground Storage | Yes | No | Groundwater intercepted by underground workings<br>In situ coal moisture<br>Transfers from Potable water system | Moisture associated with extracted ROM coal<br>Dewater to Settling and Diffusing Pond D8 (CVC)<br>Dewater to Settlement Pond 1, 2, 3 and Pond B or discharge to LDP001 (MC) |




Legend

| | | | |
|---|---|---|---|
| Underground storage | Surface process | Surface water flow | Entrained moisture |
| Underground process | Licensed discharge point | Groundwater flow | |
| Surface storage | | | |

Delta Coal
Chain Valley Colliery - Consolidation Project
Surface water impact assessment

Water management schematic

Project No. 12542548
Revision No. A
Date 07/04/2021

FIGURE 2.1

Created by: Tyler Tinkler

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# 3. Data

The development of the site water and salt balance model for existing and proposed operations at CVC and MC involved the collation and interpretation of data and operational processes from various sources. The purpose of this section is to outline the data and assumptions used in developing the site water and salt balance model. The sources of data for the water balance are summarised in Table 3.1.

*Table 3.1 Data Sources*

| Source | Item |
|---|---|
| Provided by Delta Coal | Water storage operation and management rules |
| | Maximum water transfer rates |
| | Recorded LDP001 discharge rates |
| | Recorded dewatering rates |
| Derived from information provided by Delta Coal | Areas of surface water storages |
| | Catchment areas |
| | Surface storage capacities |
| | Potable water usage |
| | Storage capacities |
| | Underground storage volume |
| | ROM coal moisture losses |
| Department of Lands | Topographic information |
| Bureau of Meteorology | Daily rainfall and evaporation |
| GHD (2021) | Forecast groundwater inflows |

## 3.1 Climate data

Point data were obtained from the Scientific Information for Land Owners (SILO) database operated by the Queensland Department of Science, Information Technology and Innovation. SILO patched point data is based on historical data from a particular Bureau of Meteorology (BOM) station with missing data 'patched in' by interpolation with nearby stations. For this assessment, SILO patched point data was obtained for the Wyee (Wyee Farms Rd) Station (BOM station number 61082), which is located approximately 10 km west of CVC.

Figure 3.1 presents the historical annual SILO point rainfall data between 1889 and 2020. The annual statistics associated with the SILO data presented in Figure 3.1 are:

– Minimum rainfall total – 600 mm in 1944
– Median rainfall total – 1164.9 mm
– Average rainfall total – 1208.4 mm
– Maximum rainfall total – 2030.6 mm 1990

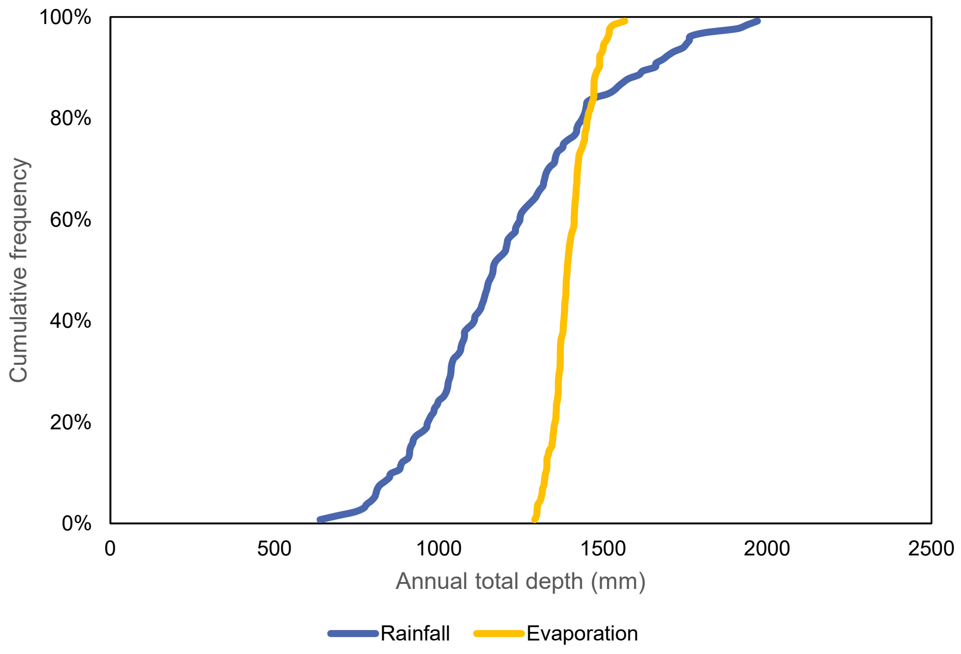



*Figure 3.1* ***Historical annual rainfall record***

The total annual SILO rainfall recorded for 2020 was 1468 mm, which is above the average annual rainfall total of 1209 mm.

Average daily rainfall and evaporation rates per month determined from the historical SILO data between 1889 and 2020 are presented in Figure 3.2.

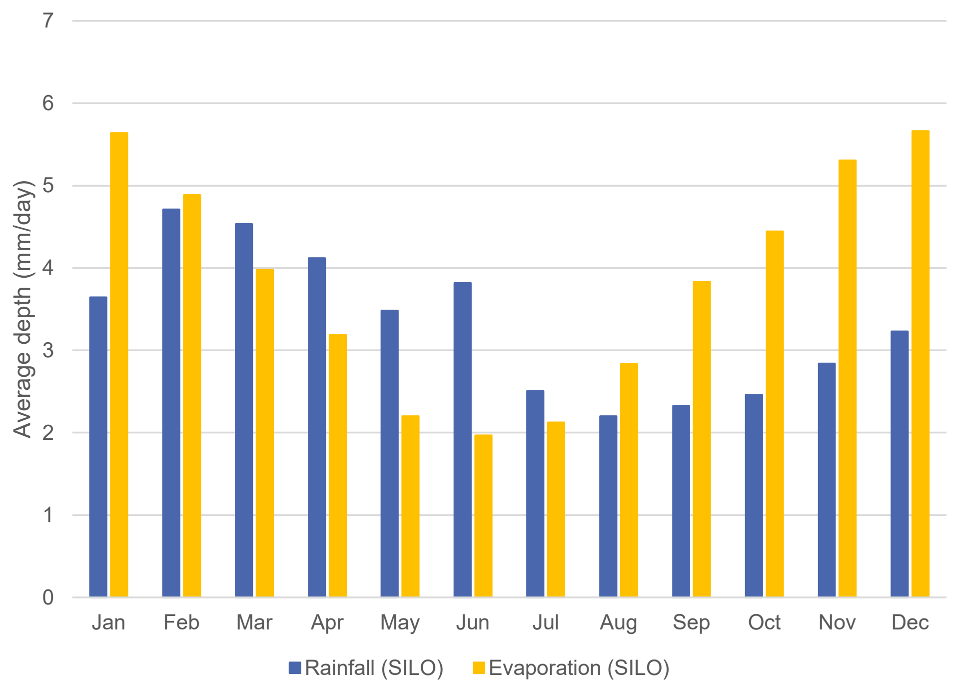



*Figure 3.2* ***Average daily rainfall and evaporation rates***

Total average annual evaporation is approximately 1401.1 mm, compared to the average annual rainfall total of 1208.4 mm. This gives an annual deficit (difference between annual rainfall and annual evaporation) of approximately 192.7 mm.

## 3.2 General operational data

Operational data and site infrastructure information relating to water management at CVC and MC were used to develop the water and salt balance model. This site-specific information was used as input to the model (i.e. modelling parameters) and is listed in Table 3.2.

*Table 3.2 Modelling parameters*

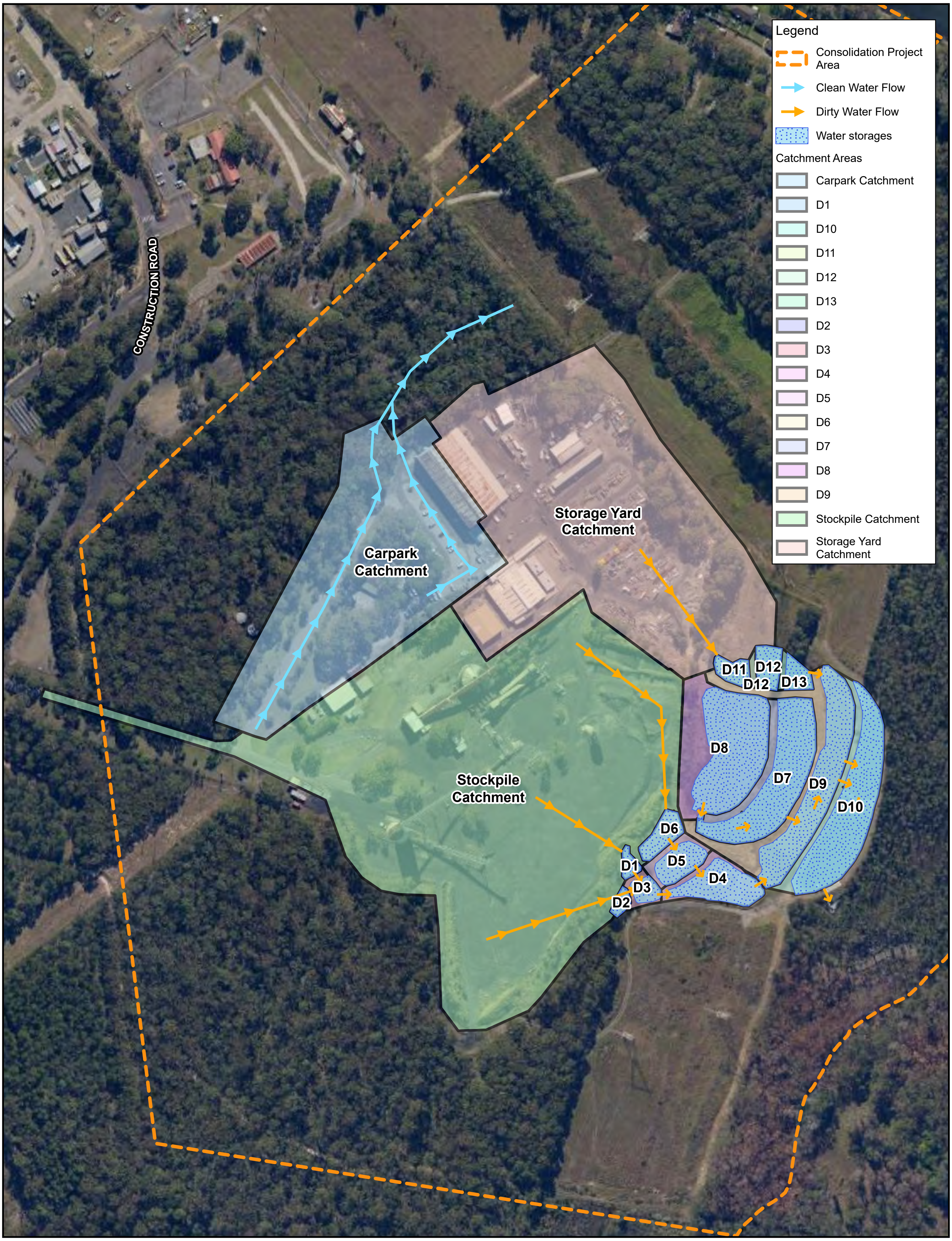
| Category | Parameter | Input |
|---|---|---|
| Operational data | Combined approved ROM extraction rate | 3.2 Mtpa (approved)<br>2.8 Mtpa (proposed) |
| | Average potable water usage per person<br>(CVC) | 156.25 L/day |
| | Main Office potable water demand | 211 L/day |
| | Dust Suppression Demand<br>(CVC) | 11.28 ML/year |
| | Underground operations usage<br>(CVC) | 139.58 ML/year |
| | Average potable water usage per person<br>(MC) | 156.25 L/day |
| | Dust Suppression Demand<br>(MC) | 1.9 ML/year |
| | Underground operations usage<br>(MC) | 87.8 ML/year |
| Mining support operations | Underground mining production water lost through extracted ROM coal moisture (% of coal production mass) | 7.0% |
| | In situ ROM coal moisture | 2.3% |
| Pump/decant rates | Underground workings to Settling and Diffusing Pond D8<br>(CVC) | 10.5 ML/day |
| | Underground workings to either Settlement Pond 1,2,3, Pond B or LDP001<br>(MC) | 10.5 ML/day |

The catchments and clean and dirty water drainage components within CVC and MC are presented in Figure 3.3 and Figure 3.4 respectively. Catchment and water storage information input into the model are presented in Table 3.3.

*Table 3.3 Catchment and water storages data*

| Storage | Capacity (ML) | Catchment area (ha) | Catchment type |
|---|---|---|---|
| **Chain Valley Colliery** | | | |
| Settling Pond D1 | 0.08 | 1.92 | 15% Vegetated, 51% Hardstand, 34% Stockpile |
| Settling Pond D2 | 0.05 | 1.92 | 15% Vegetated, 51% Hardstand, 34% Stockpile |
| Settling Pond D3 | 0.28 | 0.05 | 100% Vegetated |
| Settling Pond D4 | 0.55 | 0.17 | 100% Vegetated |
| Settling Pond D5 | 0.77 | 0.11 | 100% Vegetated |
| Settling Pond D6 | 0.57 | 1.96 | 17% Vegetated, 50% Hardstand, 33% Stockpile |
| Pollution Control Pond D7 | 3.86 | 0.40 | 100% Vegetated |
| Settling and Diffusing Pond D8 | 2.93 | 0.54 | 100% Vegetated |
| Pollution Control Pond D9 | 3.80 | 0.54 | 100% Vegetated |
| Pollution Control Pond D10 | 4.80 | 0.46 | 100% Vegetated |
| Settling Pond D11 | 0.30 | 3.52 | 32% Vegetated, 68% Hardstand |
| Settling Pond D12 | 0.23 | 0.07 | 100% Vegetated |
| Settling Pond D13 | 0.17 | 0.05 | 100% Vegetated |
| **Mannering Colliery** | | | |
| Settlement Pond 1 | 1.12 | 4.22 | 19% Vegetated, 81% Hardstand |
| Settlement Pond 2 | 1.11 | 0.99 | 25% Vegetated, 22% Hardstand, 53% Stockpile |
| Settlement Pond 3 | 0.52 | 2.25 | 45% Vegetated, 55% Hardstand |
| Pond B | 1.63 | 0.46 | 100% Vegetated |
| **Underground workings** | | | |
| Underground storage | 505 | N/A | N/A |

The water storage capacity of the underground workings shown in Table 3.3 is nominally based on Delta Coal's underground operations. This site water and salt balance is insensitive to this nominal water storage capacity.

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Delta Coal
Chain Valley Colliery - Consolidation Project
Site Water and Salt Balance

Project No. 12580250
Revision No. 2
Date 04/10/2022

Catchments and land uses
- Chain Valley Collliery

FIGURE 3.3

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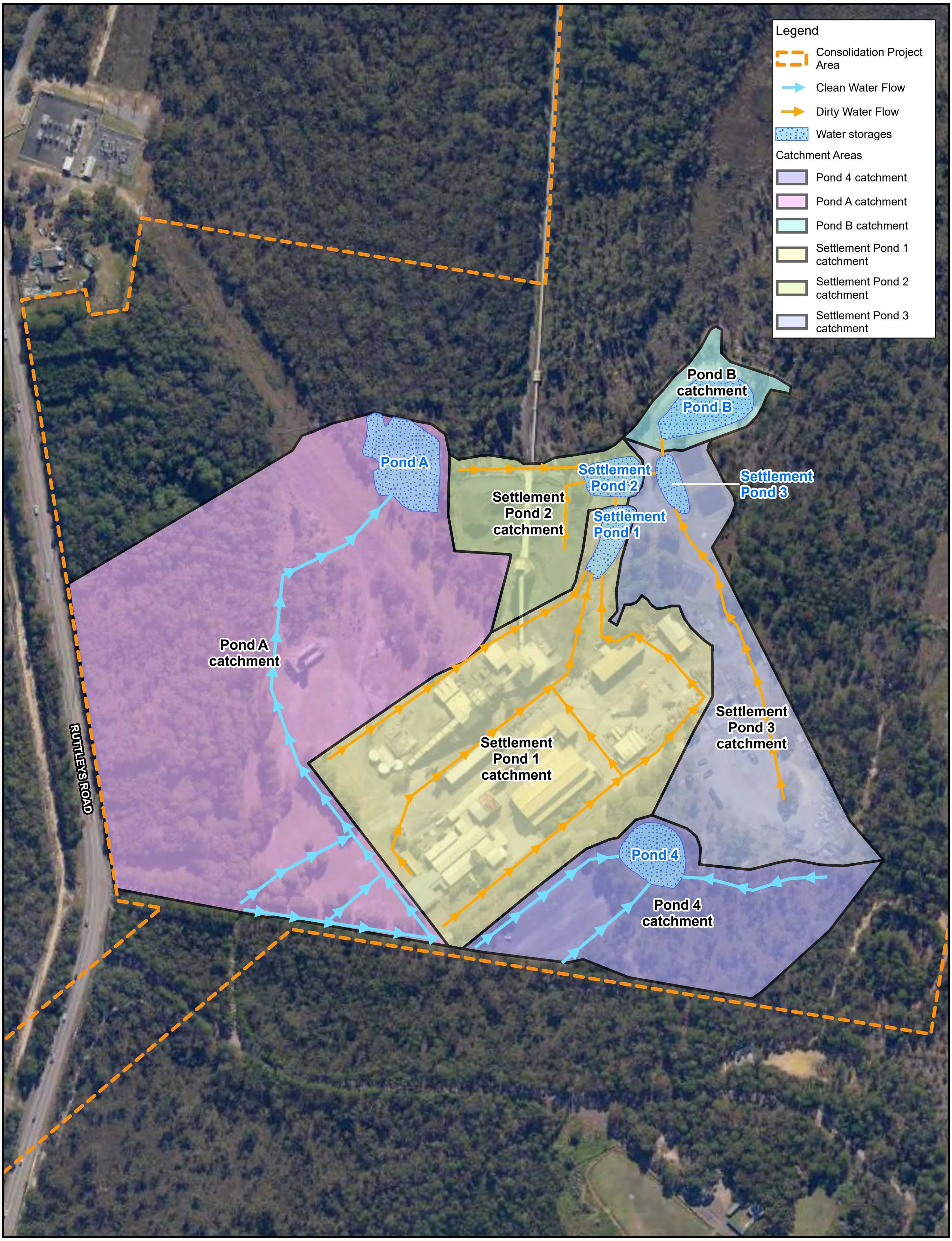


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Delta Coal
Chain Valley Colliery - Consolidation Project
Site Water and Salt Balance

**Catchments and land uses - Mannering Colliery**

Project No. 12580250
Revision No. 2
Date 04/10/2022

**FIGURE 3.4**

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## 3.3 Groundwater inflows

Characteristic groundwater inflows were estimated based on analysis of historical inflows in the context of the conceptual hydrogeological model, as presented in the Groundwater Impact Assessment (GHD 2022), and were used to estimate the future groundwater inflows into the CVC and MC underground mine workings, as shown in Table 3.4.

*Table 3.4 Modelled groundwater inflow*

| Condition | Groundwater inflow (ML/day) |
| --- | --- |
| Approved conditions | 6.7 |
| Proposed conditions | 7.6 |

# 4. Model methodology

The site water balance for CVC and MC was modelled as a semi-distributed mass balance, implemented in Goldsim (refer to Section 4.7). The site water management features described in Section 2 were linked together to simulate rainfall, runoff, evaporation, overflows pumped transfers, and operations over time, based on the data described in Section 3. The estimation of catchment runoff, based on rainfall and potential evaporation, is itself simulated by the Australian Water Balance Model, described in Section 4.4.

## 4.1 Water and salt balance

The water and salt balance for the Project was modelled as a semi-distributed mass balance, considering the existing and proposed water management features, as described in Section 2.2. A site-specific water balance equation was derived from the catchment scale water balance equation described by Ladson (2008). The water balance equation applies conservation of mass to derive an ordinary differential equation that describes how the volume of water $V$ changes over time $t$:

$$\frac{dV}{dt} = R + C + G_{in} + P_{in} + Q_{in} - E - G_{out} - P_{out} - Q_{out}$$

The water balance considered the inflows into each storage:

– Direct rainfall $R$, estimated from the simulated water surface area of the storage and the simulated rainfall intensity.
– Catchment runoff $C$, using the Australian Water Balance model (AWBM) (Boughton & Chiew, 2003) and accounting for the change in simulated water surface area.
– Groundwater inflows $G_{in}$, as described in Section 3.3.

The water balance considered the outflows from each storage:

– Evaporation $E$, estimated from the simulated water surface area of the storage. A pan factor of 0.9 was adopted to the pan evaporation to estimate both potential evaporation and potential evapotranspiration from simulated pan evaporation.

The water balance considered transfers between storages:

– Pumped transfers $P_{in}$ and $P_{out}$, according to site-specific operating rules and pump rates, as described in Section 3.2.
– Overland channel and gravity pipe flow $Q_{in}$ and $Q_{out}$, due to overflows from one storage to another.

A salt mass balance was coupled to the water balance. The salt transfer corresponding to each water transfer was calculated based on the simulated salinity of the respective water storage, assuming instantaneous and complete mixing.

## 4.2 Rainfall variability

Rainfall variability was considered in the site water and salt balance by sampling simulated rainfall from the historical rainfall record (refer to Section 3.1). A series of simulations were performed, each beginning in a different year of the historical rainfall record and proceeding consecutively through the record (and looped where required).

This approach assumes that the historical rainfall record is characteristic of future rainfall variability and does not consider inter-annual climate patterns such as the El Niño Southern Oscillation.

## 4.3 Climate change sensitivity

### 4.3.1 Industry guidance and data sources

For both the approved and proposed operations at CVC and MC, climate change has the potential to influence the key climate drivers of the site water and salt balance: rainfall (precipitation) and potential evaporation. This in turn may influence the volume and frequency of the licensed discharges. Although prescriptive guidance is available on the direct influence of average temperature changes on rainfall intensity during intense rainfall events (Ball et al 2019), the potential changes to the overall hydrologic cycle are less certain and the industry guidance less prescriptive.

Climate Change in Australia (CCIA) (CSIRO 2019) is published on the climate futures website by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the BOM to provide information about climate change projections for Australia. CCIA presents the results from a range of climate models based on the most recent set of simulations as part of the Coupled Model Intercomparison Project Phase 5 (CMIP5).

The NSW and ACT Regional Climate Modelling (NARCliM) Project is a research partnership between the NSW and ACT governments and the Climate Change Research Centre at the University of NSW. The NARCliM projections use four global climate models (GCMs) from the earlier CMIP3 project, dynamically downscaled by three regional climate models (RCMs).

Although the NARCliM projections are downscaled, they are based on the earlier CMIP3 project. There have been several advances since CMIP3 that are captured in CMIP5:

- Many more global climate models were applied.
- More models have higher resolution.
- Many more experiments have been performed leading to a much greater availability of different climate simulations.

For the purpose of this analysis, the CMIP5 projections presented in CCIA were used rather than NARCliM as they allow for a greater variety of climate science questions to be studied.

### 4.3.2 Representative concentration pathways

Notwithstanding the uncertainty in the climatic processes represented by the range of GCMs, climate change projections also depend on future anthropogenic forcings. Representative concentration pathways (RCPs) are prescribed pathways for greenhouse gas and aerosol concentrations, together with land use change, which are consistent with a set of broad climate outcomes used by the climate modelling community. The pathways are characterised by the radiative forcing produced by the end of the 21st century. Radiative forcing is the extra heat the lower atmosphere will retain as a result of additional greenhouse gases, measured in $W/m^2$.

Compared to CMIP3, the RCPs represent a wider set of futures than that used by the previous emissions scenarios used by the climate modelling community, and now explicitly include the effect of mitigation strategies. No particular scenario is deemed more likely than the others, however, some require major and rapid change to emissions to be achieved.

For the purpose of this assessment, RCP4.5 was adopted as the most likely scenario consistent with the Project. RCP4.5 represents a scenario where $CO_2$ concentrations are slightly above those of RCP6.0 until after mid-century, but emissions peak earlier (around 2040), and the $CO_2$ concentration reaches 540 ppm by 2100.

### 4.3.3 Modelling methodology

For the purpose of this analysis, a risk assessment methodology was developed based on the guidance provided by CCIA, as outlined in Table 4.1.

*Table 4.1 Climate change risk assessment approach*

| Assessment stage | Consideration |
|---|---|
| Establishment of context | The overall context of the project is established in the EIS and SWIA. |
| Identification of known risks | The known risks associated with the site water and salt balance is the changes to the volume, quality and frequency of licensed discharges from CVC and MC. |
| Risk analysis | The risks associated with the Project are analysed in terms of the range of potential volume, quality and frequency of licensed discharges from CVC and MC. |
| Planning horizon | The temporal scale is limited to the project life until end of 2029. |
| Analysis method and data sources | The Delta Change Method was selected as the most appropriate method considering the advantages and disadvantages identified in the CCIA guidance:<br>– *Advantage*: Simple to implement and suitable for many applications. Facilitates assessment of outputs from a large number of GCMs<br>– *Disadvantage*: Limited applicability where changes in variance are important. This is not relevant as changes in variances are likely to be buffered out by the continuous discharge regime.<br>– *Disadvantage*: May not capture projected climate behaviour around complex topography. This is not relevant as the site is located on the low-lying areas near Lake Macquarie. |

Based on Table 4.1, the delta change method was selected. The delta change method applies the projected changes in mean climate, as simulated by a climate model, to observed climate data. The same groundwater inflows were used for the climate change sensitivity scenario.

### 4.3.4 Projection data selection

Climate science provides a range of possible regional climate change responses for any given increase in greenhouse gas. This range in regional response is not usually reduced to a single best estimate (based on the model mean or median), and instead the full range of projections relevant to the application are considered. The literature maintains emphasis on the range of plausible climate change scenarios and does not highlight detailed aspects (such as fine spatial detail) of the climate model simulations available as confidence in this detail is generally low.

CCIA provides the Australian Climate Future tool to assist understanding and application of climate change projections for impact assessment and adaptation planning. It provides methods to explore the projected changes in two climatic variables simultaneously. The key variables for this assessment were rainfall and potential evaporation. A combination of reduction in rainfall and increase in potential evaporation would result in lower licensed discharges on average. Similarly, a combination of increase in rainfall and reduction in potential evaporation would result in higher licensed discharges on average. Based on these considerations, results produced by Australian Climate Futures tool are summarised in Table 4.2.

*Table 4.2 East Coast Climate Futures representative models (2030)*

| Emission Scenario | Case | Representative Model | Consensus |
|---|---|---|---|
| RCP 6.0 | Highest discharge | MIROC5 | High |
| | Lowest discharge | HadGEM2-CC | Very low |
| | Maximum Consensus | MIROC5 | High |

Site specific percent annual changes for rainfall and potential evapotranspiration were applied to the simulated rainfall and potential evaporation data (refer to Section 4.2). This produces a “new” projected rainfall and potential evaporation data from the simulation period. The percent annual change applied to the water and salt balance model is presented in Table 4.3.

*Table 4.3 Percent annual change for rainfall and potential evapotranspiration (2030)*

| Selected model | Scenario | Percent annual rainfall change | Percent annual potential evapotranspiration change |
|---|---|---|---|
| MIROC5 | Highest discharge | 0.6% | 2.9% |
| HadGEM2-CC | Lowest discharge | -18.7% | 3.5% |

# 4.4 Hydrologic model

To estimate the runoff contributing to the surface water storages at CVC and MC, the Australian Water Balance Model (AWBM) was incorporated into the wider water balance model. The AWBM was adopted as the most suitable model as it is widely used throughout Australia in mine water balances, has been verified through comparison with large amounts of recorded streamflow data and literature is available to assist in estimating input parameters based on recorded streamflow data (Boughton and Chiew, 2003). Another advantage of the AWBM is the consideration of soil moisture retention when determining runoff.

The AWBM is a catchment water balance model that calculates runoff from rainfall after allowing for relevant losses and storage. As seen in Figure 4.1, the model consists of three storages (with surface areas $A_1$, $A_2$ and $A_3$) representing elements such as infiltration into the soil. Rainfall initially enters these storages and once a storage element is full, any additional rainfall is considered to be excess rainfall. Of this excess rainfall, a proportion is routed to the groundwater/baseflow storage (BS) while the remainder is routed to the surface storage (SS). The discharge from the groundwater storage and surface storage is estimated as a proportion of the volume of the storages at the end of each day. The total daily runoff is equal to the combined volume of water discharged from these two storages. The definition of AWBM parameters is provided in Table 4.4.

*Table 4.4 Description of Australian Water Balance Model parameters*

| Parameter | Description |
|---|---|
| A1, A2, A3 | The partial areas of the overall catchment contributing to storages 1, 2 and 3 respectively. |
| C1, C2, C3 | The capacity of storages 1, 2 and 3 respectively. |
| BFI | The proportion of excess rainfall flowing to the baseflow. |
| Kb | The proportion of the volume of the baseflow storage remaining in the storage at the end of each day. Not applicable for this water balance model as there is no baseflow component. |
| Ks | The proportion of the surface storage remaining in the storage at the end of each day. |
| Excess | Excess from storages C1, C2 and C3. |
| SS | Surface storage recharge. |
| BS | Baseflow storage recharge. |

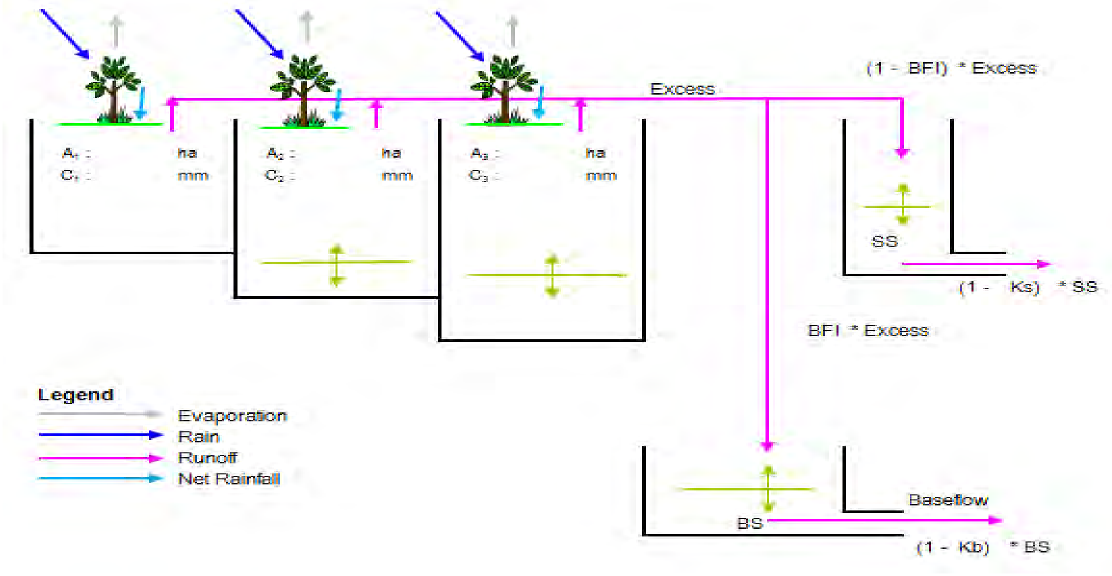



*Figure 4.1 Australian Water Balance Model representation*

Site catchments were divided into land uses representing bushland/vegetation and impervious areas. Each land use was assigned an AWBM parameter set, which are presented in Table 4.5.

The parameters for bushland/vegetated areas were determined based on available literature where historical streamflow data had been used to provide recommendations on parameter selection. The nearest location for which AWBM model parameters had been calibrated by Boughton and Chew (2003) was Jigadee Creek, located about 15 km north west of the CVC and MC. The recommended parameters relating to baseflow were adjusted to reflect the ephemeral nature of drainage lines within the site.

The impervious areas were modelled without infiltration into the soil and without surface storage or baseflow storage. Only one storage was assigned a non-zero capacity. This storage represents depression storage of 5 mm for impervious areas.

The adoption of regional and industry standard runoff parameters were considered reasonable given the lack of site-specific flow gauging data.

*Table 4.5 Australian Water Balance Model parameters adopted*

| Parameter | Bushland/vegetation areas | Impervious areas | Stockpile areas |
|---|---|---|---|
| A1, A2, A3 | 0.134, 0.433, 0.433 | 1.0, 0.0, 0.0 | 0.134, 0.433, 0.433 |
| C1, C2, C3 | 8.96, 91.45, 182.91 | 5.0, 0.0, 0.0 | 2.24, 22.86, 45.73 |
| BFI | 0.0 | 0.0 | 0.0 |
| Kb | N/A | N/A | N/A |
| Ks | 0.5 | 0.0 | 0.5 |
| Average annual runoff coefficient (%) | 28 | 66 | 47 |
| Average annual runoff yield (ML/ha/year) | 3.4 | 8.0 | 5.7 |

# 4.5 Salinity model

The salinity of the inputs of salt to the site salt balance were estimated based on site observations and validated as part of the model validation described in Section 5. The salinity of rainfall was adopted after DRNW (2007). EC was assumed equivalent to salinity with a factor of 0.67 (mg/L)/(µS/cm) (DNRW, 2007).

The salinity parameters adopted are summarised in Table 4.6.

*Table 4.6 Adopted salinity parameters*

| Parameter | Electrical conductivity (µS/cm) |
|---|---|
| Rainfall | 30 |
| Groundwater inflows | 32000 |
| Vegetated runoff | 50 |
| Hardstand runoff | 250 |
| Stockpile runoff | 600 |
| Potable supply | 240 |

# 4.6 Geometric approximation

In the absence of survey or design stage storage relationships, the geometry of the surface water storages was estimated using a power law approximation after Brooks and Hayashi (2002), where the depth $d$ of a solid of revolution was related to its volume $V$ as:

$$d = d_{max}\left(V\frac{1+{}^{2}/_{p}}{A_{max}d_{max}}\right)^{\frac{p}{p+2}}$$

where $d_{max}$ was the maximum depth, $V_{max}$ was the capacity of the storage, $A_{max}$ was the maximum surface area of the storage and $p$ was dimensionless shape parameter.

# 4.7 Numerical implementation

The operation of the water cycle for site conditions was modelled in GoldSim (version 12.1). This software is a graphical object orientated system for simulating either static or dynamic systems. It is like a 'visual spreadsheet' that allows the visual creation and manipulation of data and equations representing system behaviour.

GoldSim solves the mass conservation equations using an explicit scheme. A daily time step was used, consistent with the daily rainfall data, with shorter time steps dynamically inserted as required. The following simplifications were used:

– Transfer rates were modelled using daily time steps. In reality, transfer rates are determined during the day on an 'as needs basis' and may operate over periods smaller than a day.
– The rate of delivery of potable water to surface facilities and underground potable demand were input at constant rates. This was determined from average annual data obtained from Delta Coal. In reality the demand for potable water to surface facilities and underground varies daily.
– Idealised operating conditions were established within the model in accordance with advice from the Delta Coal personnel.
– Rainfall and runoff are represented in daily time steps and therefore short duration, high intensity events are not accurately represented by the model. In reality, more overflows from surface water storages may occur than represented by the water balance model.

# 5. Model validation

The water balance model for CVC and MC was simulated from 1 January 2019 to 1 January 2021 (the validation period). The simulation used observed site rainfall and operated under the existing conditions. The purpose of validation is to test whether the model is of adequate accuracy for the purpose of making predictions (refer to Section 6).

The objectives of the validation were:

1. Matching cumulative LDP001 discharge volume at CVC and MC by simulating the observed dewatering pumping to target the observed cumulative discharge rate. This is representative of the fitness of the model to replicate the average water balance of the site.
2. Matching LDP001 EC data at CVC and MC. This is representative of the fitness of the model to replicate the average salt balance of the site.

The model was initialised with all surface water storages at their 95% capacity and all soil moisture storages in the hydrologic model empty.

## 5.1 LDP001 discharge

A comparison of the observed and modelled cumulative LDP001 discharge volumes at CVC and MC are shown in Figure 5.1 and Figure 5.2 respectively.


***Figure 5.1 Observed and modelled cumulative LDP001 discharge volume at Chain Valley Colliery***

Figure 5.1 shows that the modelling slightly underestimates the cumulative discharge via CVC LDP001 over time but replicates similar trends over time.

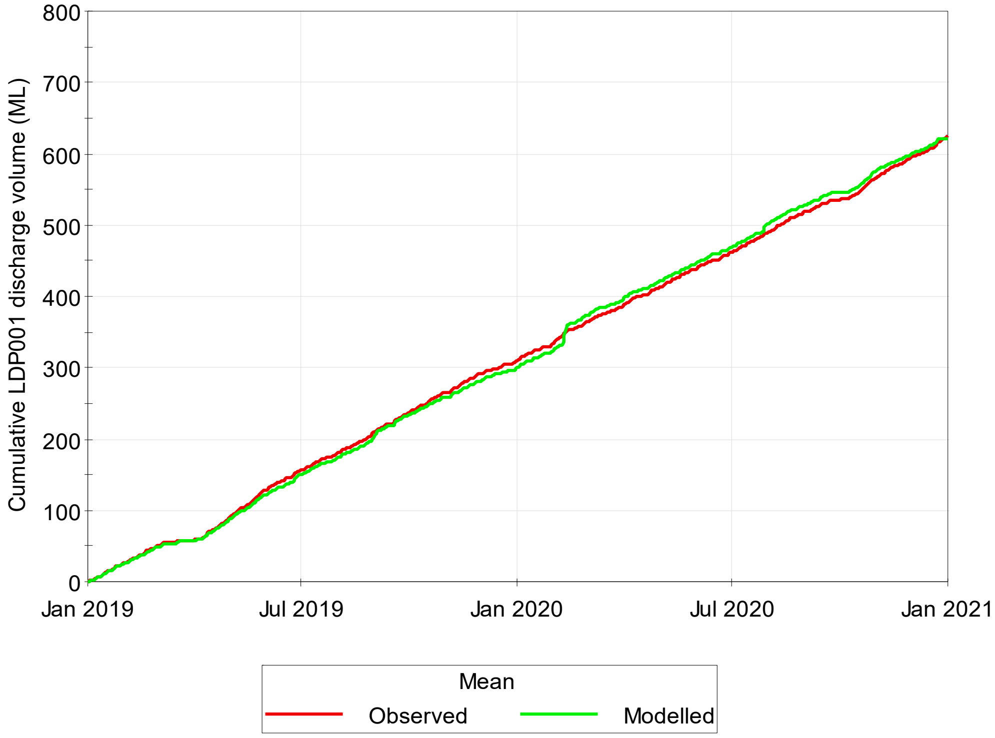



***Figure 5.2 Observed and modelled cumulative LDP001 discharge volume at Mannering Colliery***

Figure 5.2 shows that the discharge via MC LDP001 is increasing proportionally with period of time. The validation suggests that the model is able to produce the same general trend over time.

## 5.2 LDP001 electrical conductivity

A comparison of the observed and modelled LDP001 electrical conductivity at CVC and MC are shown in Figure 5.1 and Figure 5.2 respectively.


*Figure 5.3* *LDP001 electrical conductivity – Chain Valley Colliery*

Figure 5.3 shows that the model replicated the average of EC at LDP001 at CVC but was not able to capture the upper and lower bounds of EC at LDP001, especially during the 2019.


*Figure 5.4* *LDP001 electrical conductivity – Mannering Colliery*

Figure 5.4 shows that the model replicated the average of EC at LDP001 at MC, while at the same time was able to capture the upper bounds of EC at LDP001.

# 6. Model results

The site water and salt balance model was simulated over the period from 1 January 2021 to 1 January 2030. The prediction simulations were initialised with the final values of the validation simulation, discussed in Section 5. For the purpose of this assessment, three scenarios were considered:

– **Approved conditions**: this represents the approved operations at CVC and MC including the adopted groundwater flows predictions described in Section 3.3.
– **Proposed conditions**: this represents the proposed operations as part of the project, including the adopted groundwater flows predictions described in Section 3.3.

## 6.1 Interpretation of results

To consider potential climate variability, a total of 132 different rainfall patterns were simulated (as described Section 4.2). The results presented show the average, 10th percentile and 90th percentile values. The purpose of displaying the three results is to indicate both the average value and the likely possible range. The 10th percentile represents the value at which 10% of the modelled outputs were less than this value. Similarly, the 90th percentile represents the value at which 90% of the modelled outputs were less than this value.

The 10th and 90th percentile values have been used rather than minimum and maximum values to exclude infrequent extreme wet and dry conditions. The set of 10th or 90th percentile values do not necessarily all correspond to the same rainfall series, that is, they do not correspond to a 10th percentile “dry” or 90th percentile “wet” year.

## 6.2 Water balance

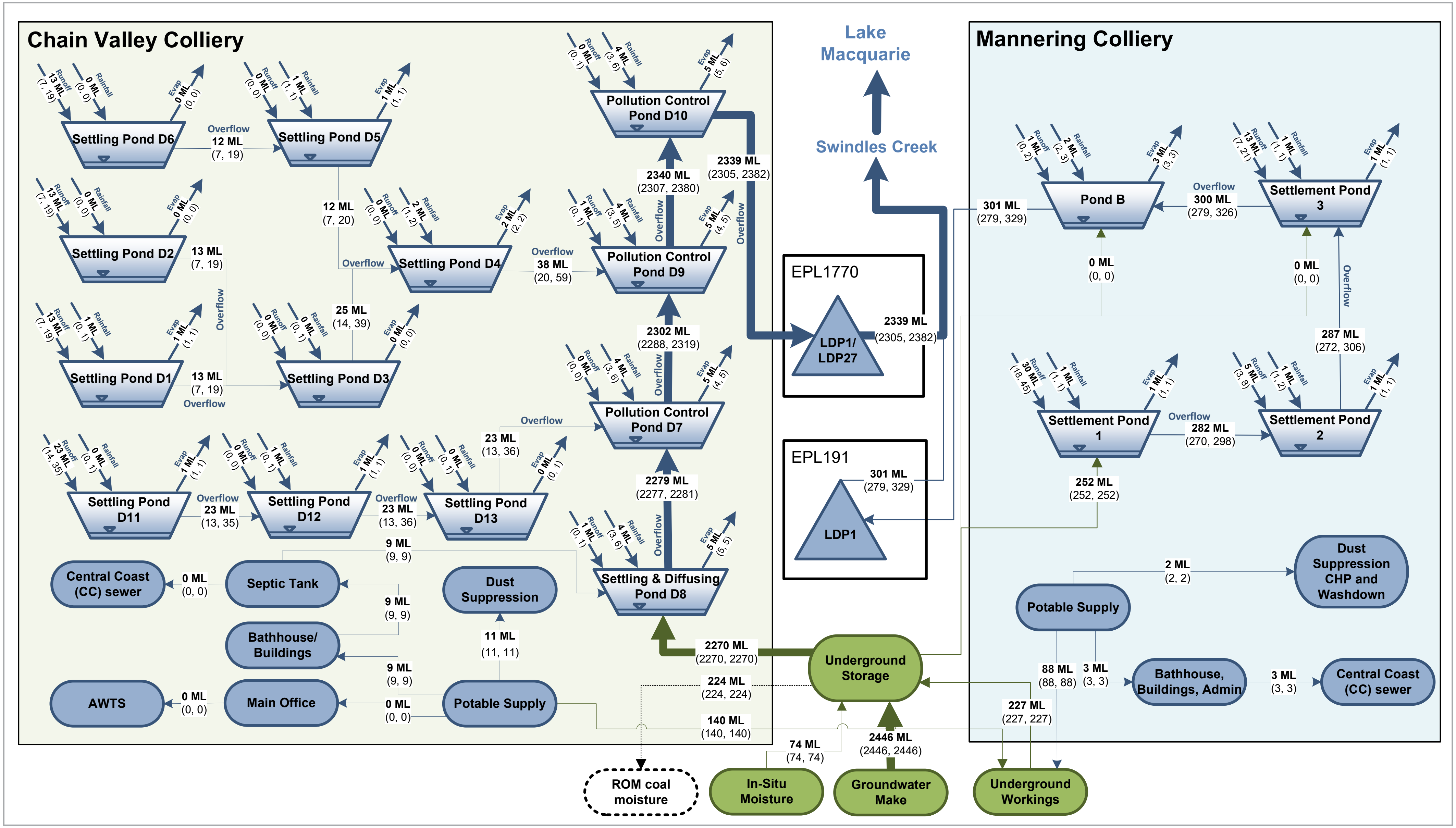
The annual forecast water transfers for CVC and MC under approved and proposed conditions are shown in Figure 6.1, and Figure 6.2 respectively.

The combined annual average water balance results are presented and interpreted in the SWIA.

## 6.3 Salt balance

The annual salt transfers for CVC and MC under approved and proposed conditions are shown in Figure 6.3 and Figure 6.4, respectively.

The combined annual average salt balance is presented and interpreted in the SWIA.




Legend

- Underground storage
- Underground process
- Surface storage
- Surface process
- Licensed discharge point
- Surface water flow
- Groundwater flow
- Entrained moisture
- X (X,X) — **Mean** (10th percentile, 90th percentile)

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Delta Coal
Chain Valley Colliery - Consolidation Project
Surface water impact assessment

Water management schematic
Annual water transfers
Approved conditions

Project No. 12580250
Revision No. 0
Date 06/07/2022

FIGURE 6.1

Created by: Tyler Tinkler

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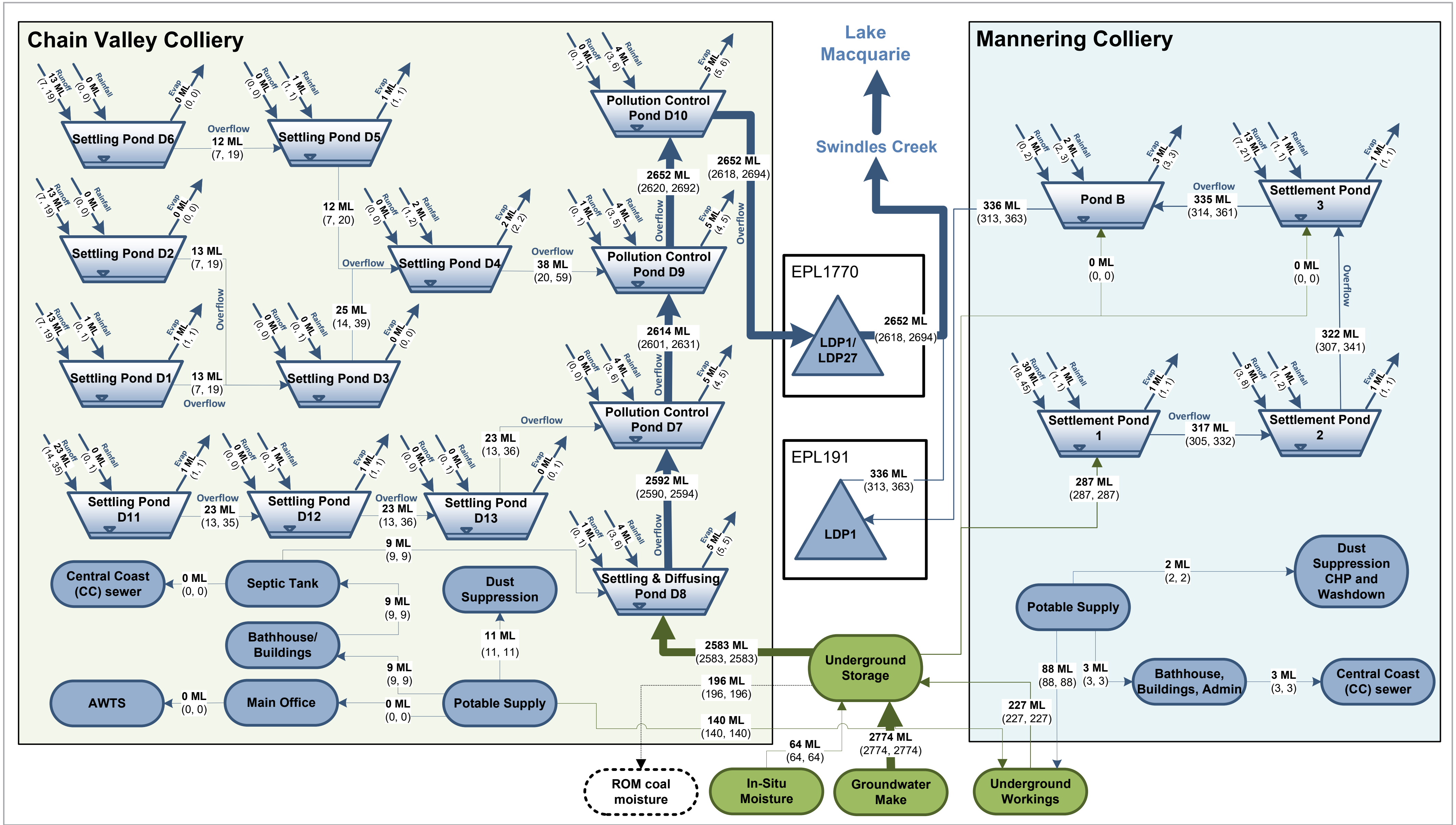


Legend

| | | | |
|---|---|---|---|
| Underground storage | Surface process | Surface water flow | Entrained moisture |
| Underground process | Licensed discharge point | Groundwater flow | |
| Surface storage | | X (X,X) | Mean (10th percentile, 90th percentile) |

Delta Coal
Chain Valley Colliery - Consolidation Project
Surface water impact assessment

Water management schematic
Annual water transfers
Proposed conditions

Project No. 12580250
Revision No. 0
Date 06/07/2022

FIGURE 6.2

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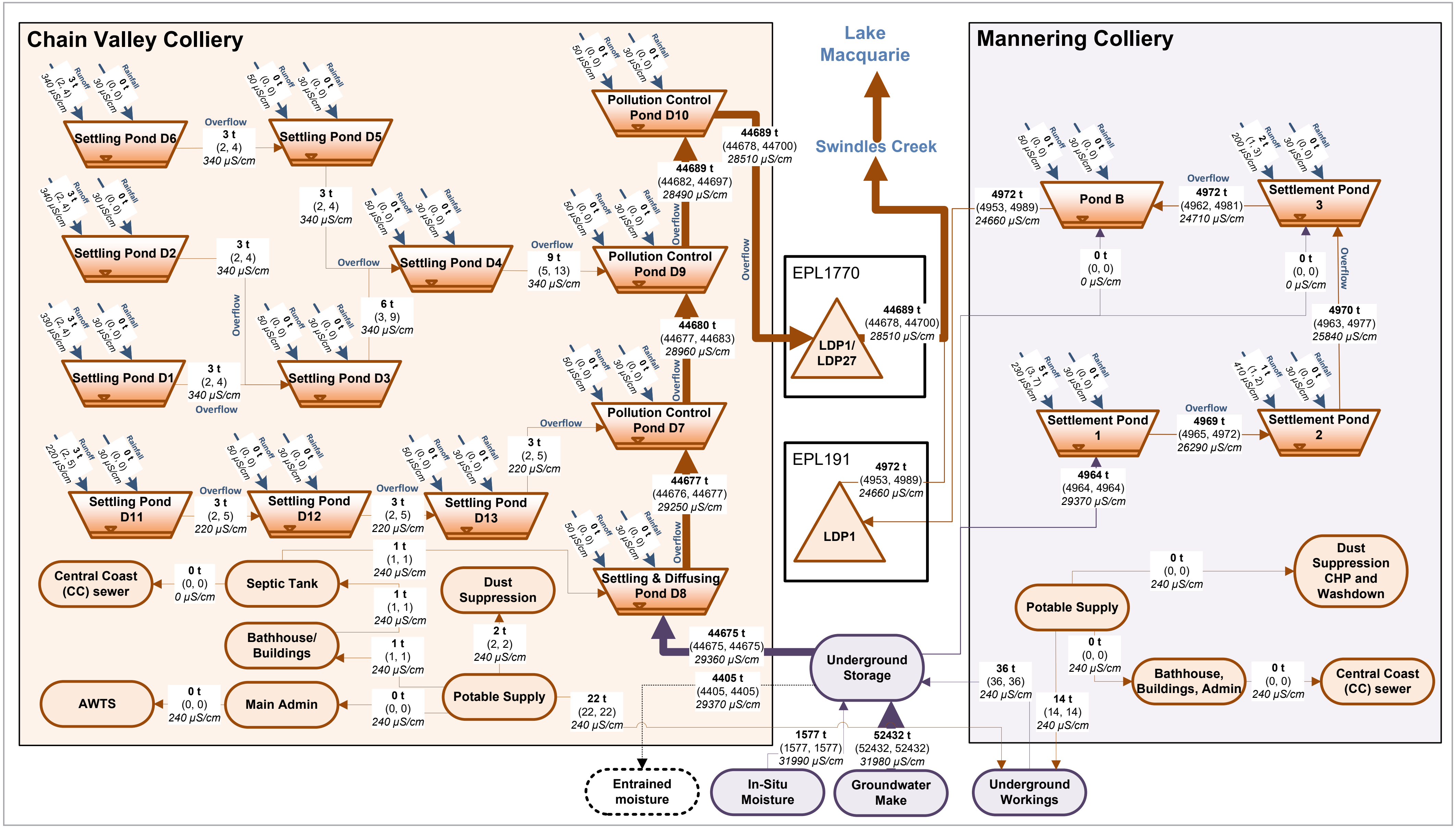


Legend

- Underground storage
- Underground process
- Surface storage
- Surface process
- Licensed discharge point
- Surface water flow
- Groundwater flow
- Entrained moisture
- X (X,X) XX — **Mean** (10th percentile, 90th percentile) *Mean EC*

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Delta Coal
Chain Valley Colliery - Consolidation Project
Surface water impact assessment

Water management schematic
Annual salt transfers
Approved conditions

Project No. 12580250
Revision No. 0
Date 06/07/2022

FIGURE 6.3

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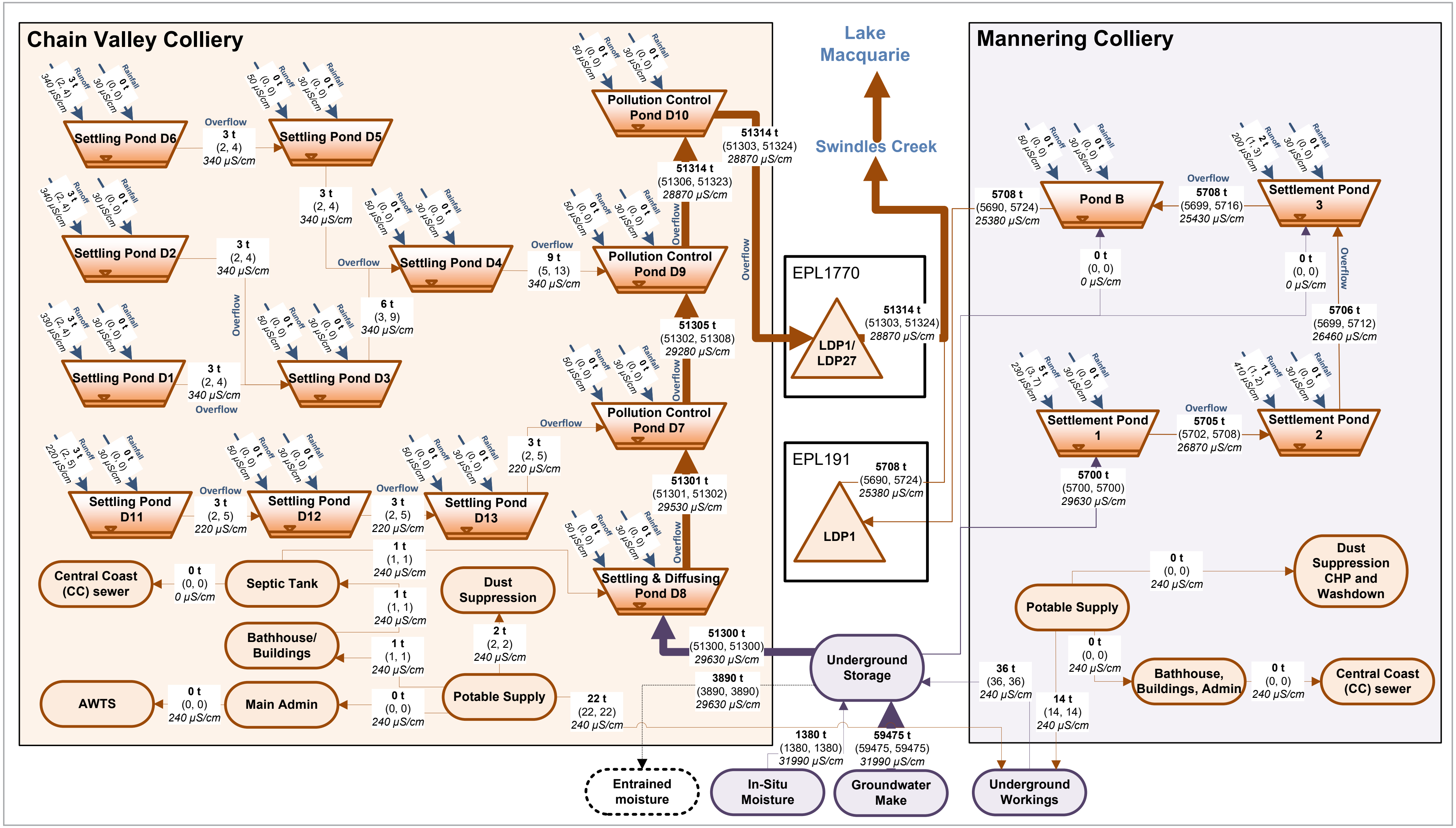


Legend

| | | | |
|---|---|---|---|
| Underground storage | Surface process | Surface water flow | Entrained moisture |
| Underground process | Licensed discharge point | Groundwater flow | |
| Surface storage | | X (X,X) XX | **Mean** (10th percentile, 90th percentile) *Mean EC* |

Delta Coal
Chain Valley Colliery - Consolidation Project
Surface water impact assessment

Water management schematic
Annual salt transfers
Proposed conditions

Project No. 12580250
Revision No. 0
Date 06/07/2022

FIGURE 6.4

Created by: Tyler Tinkler

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## 6.4 Sensitivity of model to climate change

The sensitivity of the water and salt balance model to climate change was assessed to determine potential impacts of climate change to water and salt transfers CVC and MC under proposed conditions, based on the methodology discussed in Section 4.3.

Comparison of annual average water transfers between the wet and dry case scenario with climate change factors and base case (no climate change) are summarised in Table 6.1.

*Table 6.1 Forecasted annual water transfers under proposed conditions*

| Water management element | Proposed conditions – base case (ML/year) | Proposed conditions – highest discharges (ML/year) | Proposed conditions – lowest discharges (ML/year) |
|---|---|---|---|
| **Inputs** | | | |
| Direct rainfall | 28 | 28 | 22 |
| Catchment runoff | 113 | 113 | 81 |
| Groundwater inflows | 2774 | 2774 | 2774 |
| In situ coal moisture | 64 | 64 | 64 |
| External potable water supply | 253 | 253 | 253 |
| **Total Inputs** | **3232** | **3232** | **3194** |
| **Outputs** | | | |
| Evaporation | 32 | 33 | 33 |
| Discharge to Swindles Creek | 2988 | 2987 | 2949 |
| ROM coal moisture | 196 | 196 | 196 |
| Transfers to dust suppression | 13 | 13 | 13 |
| Discharge to Aerated Wastewater Treatment System (AWTS) | 0 | 0 | 0 |
| Discharge to Central Coast (CC) sewer | 3 | 3 | 3 |
| **Total Outputs** | 3232 | 3232 | 3194 |
| **Change In Storage** | | | |
| Surface water storages | 0 | 0 | 0 |
| Underground Storage | 0 | 0 | 0 |
| **Total Change In Storage** | 0 | 0 | 0 |
| **Balance** | | | |
| Inputs – outputs – change in storage | 0 | 0 | 0 |

Table 6.1 show that the lowest discharges scenario projects lower direct rainfall and catchment runoff values compared to base case. Correspondingly, a decrease in discharge to Swindles Creek is forecast. The results for the wet case scenario show similar inflows and outflows to the base case except for the slight increase in evaporation. No change on other water management elements are expected due to the potential effects of climate change. Similarly, slight changes were estimated for the site salt balance, which is not included for the purpose of brevity.

Overall, the potential impacts of climate change on the site water and salt balance of the Project are considered negligible.

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