CHAPTER 13

Water quality

ILLABO TO STOCKINBINGAL ENVIRONMENTAL IMPACT STATEMENT

ARTC | INLAND RAIL
An Australian Government Initiative

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13. Water quality

This chapter is a summary of the potential impacts of the Illabo to Stockinbingal project (the proposal) on water quality. It describes the existing environment, assesses the impacts of construction and operation of the proposal, and provides recommended mitigation and management measures. The full assessment results are in Technical Paper 5: Water Quality Impact Assessment.

13.1 Overview

The development of the proposal took into consideration the need to minimise impacts on watercourses. Culverts and bridges for the proposal have been designed to maintain existing flow paths and prevent the formation of new flow paths, therefore reducing potential for erosion and scour. There were no specific issues raised in relation to water quality during stakeholder and community consultation.

The watercourses crossed by the proposal are ephemeral and only have flow after large rainfall events. There are also 14 farm dams located within the proposal site.

During construction, the key potential impacts relate to the erosion and the generation of sediment. These impacts and proposed measures to address them are as follows:

- Excavation, earthworks and other construction activities could potentially lead to changed bed and bank conditions in watercourses, and increased erosion, leading to greater volumes of sediment and pollutants entering watercourses. Mitigation for construction impacts would focus on erosion and sediment control measures, including specific measures and procedures for works within main watercourses, such as silt barriers and temporary creek diversions. These would be implemented in accordance with the Construction Environmental Management Plan (CEMP).
- Dewatering of farm dams that require relocation and/or decommissioning has the potential to input mobilised sediments in receiving waters. Dewatering of the farm dams would occur in accordance with a dedicated dam dewatering protocol, which would consider aspects such as the quality and quantity of water to be released, where relevant.

Implementation of the mitigation measures would ensure that construction of the proposal would not further degrade the water quality environment within and downstream of the proposal site, in line with the NSW Water Quality Objectives.

During operation, the key potential impacts and proposed measures to address them are as follows:

- New culverts and bridges have the potential to impact flow regimes within waterways and may lead to long-term changes in levels of dissolved oxygen, electrical conductivity, turbidity, nitrogen and phosphorus, with potential impacts to aquatic ecosystems. In addition to minimising impacts through design, culverts and bridges would be inspected to ARTC standards and maintained to address any issues that may contribute to the blockage of fish passage.
- The new road overpass over Burley Griffin Way has potential to create pollutant runoff from the road and to release pollutants to the watercourses, including sediment, chemicals and petroleum hydrocarbons from maintenance and operation of trains and vehicles. Pollutant loading would be low as all exposed surfaces would be revegetated and maintenance would meet ARTC's standard operating procedures. A surface water monitoring framework would also be prepared to guide monitoring of water quality, including monitoring locations and frequency.

Consideration would continue to be given during detailed design to opportunities to mitigate changes to flow regimes, and potential operational scour and erosion at culvert and bridge locations.

13.2 Approach

A summary of the approach to the assessments is provided in this section, including the legislation, guidelines and policies driving the approach and the methodology used to undertake the assessments. A more detailed description of the approach and methodology is in Technical Paper 5.

13.2.1 Legislative and policy context to the assessment

The water quality assessment was undertaken in accordance with the Secretary's Environmental Assessment Requirements (SEARs) and with reference to the requirements of relevant legislation, policies and assessment

guidelines. The main NSW legislation relevant to water quality is the *Protection of the Environment Operations Act 1997* (NSW) (POEO Act) and the *Water Management Act 2000* (NSW) (WM Act).

Section 120 of the POEO Act prohibits the pollution of waters by any person. Under section 122, the holding of an environment protection licence (EPL) is a defence against accidental pollution of watercourses to the extent that the EPL allows it. An EPL would be obtained for construction of the proposal, which will be applicable to both construction and the management of water quality. With respect to water quality, the licence requires the occupier to comply with section 120 of the POEO Act.

The WM ACT controls the extraction of water, the use of water, the construction of works such as dams and weirs, and carrying out of activities in or near water sources in NSW. It recognises the need to allocate and provide water for the environmental health of our rivers and groundwater systems, while also providing licence holders with access to water.

The National Water Quality Management Strategy (ANZECC/ARMCANZ, 2018) establishes objectives to achieve sustainable use of the nation's water resources by protecting and enhancing their quality while maintaining economic and social development. The strategy includes guidelines for protection of water resources across Australia. These guidelines have been used to determine the existing condition of rivers and water quality objectives for the proposal.

The *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG) (ANZG, 2018) is a key guideline within the *National Water Quality Management Strategy* that is used to identify catchment—and watercourse-specific water quality management goals. These guidelines are an updated version of the previous guidelines–*Development of assessment criteria based on the Australian and New Zealand Environment and Conservation Council* (ANZECC, 2000). The guidelines provide a process for assessing existing water quality condition and developing water quality objectives to sustain current or likely future environmental values for natural and semi-natural water resources.

The NSW Water Quality Objectives (NSW WQO) (OEH, 2006) are the agreed environmental values and long-term goals for NSW's surface waters. They are consistent with the agreed national framework for assessing water quality set out in the ANZG. For each catchment in NSW, the NSW Government has endorsed the community's environmental values for water and identified water quality objectives. The NSW WQO set out:

- the community's values and uses for rivers, creeks, estuaries and lakes (i.e. healthy aquatic life, water suitable for recreational activities like swimming and boating, and drinking water)
- a range of water quality indicators to help assess the current condition of watercourses and whether they support those values and uses.

The NSW WQO are the specific water quality targets agreed between stakeholders, or set by local jurisdictions, that become the indicators of management performance. These limits or descriptive statements are selected to support and maintain the environmental values of the catchment.

The Murray–Darling Basin Plan (the Basin Plan) (Murray–Darling Basin Authority (MDBA), 2012) was developed to manage water in the basin as a connected system. The aim of the Basin Plan is to bring the basin back to a healthier and sustainable level while supporting farming and other industries. New water quality targets were developed under the Basin Plan for different catchment zones. These water quality targets are recommended to assess water quality at inland monitoring stations.

A detailed description of the legislative and policy context for the assessments is in Chapter 2 of Technical Paper 5.

13.2.2 Secretary's Environmental Assessment Requirements

The SEARs relevant to water quality, together with where they are addressed in the EIS, are in Appendix A.

13.2.3 Methodology

13.2.3.1 Study area

For the purposes of this assessment, the study area is defined as a 2 km buffer area surrounding the proposal site as the focus of the assessment is on the direct impacts to receiving waters from the proposal site. The assessment has also broadly considered the major watercourses and waterbodies downstream of the proposal site that may be indirectly affected by the proposal.

13.2.3.2 Key tasks

A qualitative review was carried out to assess the potential water quality impacts of the proposal. This included:

- review of relevant legislation and guidelines including:
  - *Murrumbidgee River Water Quality and River Flow Objectives* (NSW OEH, 2006)
  - *Lachlan River Water Quality and River Flow Objectives* (NSW OEH, 2006)
  - *Murray–Darling Basin Plan 2012* (MDBA, 2012)
  - *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG, 2018)
  - *National Water Quality Assessment* (Sinclair Knight Merz, 2011)
  - *NSW State of the Environment* (NSW Environmental Protection Authority (EPA), 2018)
- establishing existing environmental conditions using GIS mapping to identify locations of sensitive receiving environments such as channels, watercourses, wetlands, and sensitive land uses
- review of publicly available catchment-scale water quality and flow data and existing and proposed rail corridor hydrological conditions to establish any risks from the relationships between hydrology and water quality
- review of the current proposal design including culverts and other structures located near watercourses
- identification of mitigation and management measures.

All watercourses in the study area are ephemeral streams and there is limited available data on existing water quality. Publicly available catchment data was used to establish the likely water quality of the watercourses surrounding the proposal site.

During groundwater sampling in May 2019, a pool of water was observed at the box culvert crossing of Ironbong Road over Ironbong Creek to the west of the proposal site, allowing for two opportunistic water quality samples to be taken and submitted for laboratory testing. Three additional opportunistic sampling and field parameter readings were recorded in April 2021 at Ironbong Creek at Ironbong Road, Powder Horn Creek at Dudauman Road and Dudauman Creek at Burley Griffin Way. This sampling has provided some information of water quality within the proposal site.

13.2.4 Development of assessment criteria

Development of the proposal has sought to protect downstream environments from the potential impacts of surface runoff and discharge during construction and operation.

A qualitative assessment of the water quality impacts of the proposal was carried out based on the standard trigger values from the ANZG and the *Murray–Darling Basin Plan 2012*. The ANZG identifies different uses and activities for watercourses (e.g. drinking, swimming, crop use) and appropriate water quality values for those uses and activities.

The NSW WQOs establish the environmental values to be adopted for the proposal. A detailed breakdown of the environmental values and associated trigger values and criteria for the Murrumbidgee River and Lachlan River catchments for uncontrolled streams are in section 2.5 of Technical Paper 5.

The environmental values identified for the Murrumbidgee River and Lachlan River catchments relate to:

- aquatic ecosystems
- visual amenity
- secondary contact recreation
- primary contact recreation
- livestock water supply
- irrigation water supply
- homestead water supply
- drinking water at point of supply, disinfection only, groundwater, clarification and disinfection (groundwater applicable to uncontrolled streams in Murrumbidgee catchment only)
- groundwater
- aquatic foods (cooked).

The environmental values are the same in both catchments apart from 'Drinking water at point of supply—Groundwater' that is only applicable to the Murrumbidgee River catchment. The environmental values are catchment wide; however, near the proposal site the streams are ephemeral and so contact recreation, aquatic foods (cooked), homestead water supply or drinking water at point supply environmental values are unlikely to be relevant values for the users in the study area. Therefore, these values are not adopted for this assessment. All other environmental values have been adopted.

13.2.4.1 Water quality trigger values

The ANZG and the NSW WQOs identify catchment-specific and watercourse-specific water quality management goals and trigger values for different potential pollutants based on the identified environmental values. The purpose of identifying these trigger values is to protect downstream environments from the potential impacts of surface runoff and discharge during construction and operation. The trigger values are not compliance values but values that, if exceeded, would indicate a potential environmental issue, and so 'trigger' a management response, for example further investigation and subsequent refinement of the guidelines according to local conditions. This is consistent with the ANZG and WQO.

Based on the existing environment assessment and impacts identified in section 13.2.1, key pollutants that would be relevant to the proposal include:

- nutrients (nitrogen and phosphorus)—commonly present in agricultural areas and may become mobilised as a result of disturbance of agricultural land
- sediments and soils—present in run-off from construction areas and from any additional scour due to construction and operation
- chemicals, oils, grease and hydrocarbons—from use of plant and equipment during construction and operation
- concrete slurry and wastewater—from mobile concrete batching plants
- contaminants of concern related to previous land uses—heavy metals, total recoverable hydrocarbon (TRH); benzene, toluene, ethylbenzene and xylene (BTEX); polycyclic aromatic hydrocarbons (PAHs),; per- and polyfluoroalkyl substances (PFAS); organochlorine pesticides (OCPs); organophosphate pesticides (OPPs); polychlorinated biphenyl (PCBs); volatile organic compounds (VOCs) and potential asbestos containing material (ACM) (refer to Chapter 20: Soils and contamination).

Based on these likely pollutants, relevant water quality indicators have been selected for the proposal and are shown in Table 13-1 and Table 13-2. Where a contaminant or pollutant is an indicator for more than one environmental value, thereby having multiple trigger values or criteria, the most stringent criteria was adopted.

TABLE 13-1: WATER QUALITY INDICATORS (PHYSICAL AND CHEMICAL STRESSORS)

Water quality indicator	Trigger value or criteria
Total phosphorus	20 µg/L
Total nitrogen	250 µg/L
Dissolved oxygen	90–110%
pH	7.0–8.0*
Electrical conductivity	30–350µS/cm
Turbidity	20*
Oils, petroleum and hydrocarbons	Oils and petrochemicals should not be noticeable as a visible film on the water, nor should they be detectable by odour.

* Murray–Darling Basin Plan value (adopted where the value is more stringent than the ANZG)

TABLE 13-2: WATER QUALITY INDICATORS (TOXICANTS)

Toxicant	Value	Environmental value
Metals and metalloids[1]		
Aluminium (pH>6.5)	0.055 mg/L	Freshwater aquatic ecosystems[2]
Arsenic (III)	0.024 mg/L	Freshwater aquatic ecosystems
Cadmium	0.0002 mg/L	Freshwater aquatic ecosystems
Calcium	1000 mg/L	Livestock
Chromium	0.001 mg/L	Freshwater aquatic ecosystems

Toxicant	Value	Environmental value
Copper	0.0014 mg/L	Freshwater aquatic ecosystems
Iron	0.020 mg/L	Irrigation (long-term value)[2]
Lead	0.004 mg/L	Freshwater aquatic ecosystems
Magnesium	2000 mg/L	Livestock
Mercury	0.0006 mg/L	Freshwater aquatic ecosystems
Nickel	0.011 mg/L	Freshwater aquatic ecosystems
Zinc	0.008 mg/L	Freshwater aquatic ecosystems
Ammonia	0.9 mg/L	Freshwater aquatic ecosystems
Nitrate	0.7 mg/L	Freshwater aquatic ecosystems
BTEX		
Benzene	0.95 mg/L	Freshwater aquatic ecosystems
1,2,4-trichlorobenzene	0.17 mg/L	Freshwater aquatic ecosystems

1. Long-term values are the maximum concentration of contaminant in the irrigation water that can be tolerated assuming 100 years of irrigation.
2. ANZG 2018/ANZECC 2000 value for toxicants at the 95 % species protection level.

13.2.5 Risks identified

The environmental risk assessment for the proposal (refer to Appendix G) included consideration of potential water quality risks. Due to the ephemeral nature of the watercourses within the proposal site, the main potential impacts would occur during and following rainfall events.

Water quality risks with an overall assessed rating of medium or above as identified by the environmental risk assessment (pre-mitigated) included:

- increased sediment loads during rainfall events and from discharge of sediment laden wastewater
- increased alkalinity and pH of watercourses due to runoff from concrete batching plant operations
- increased sediment loads due to changes in surface water flow from the presence of construction infrastructure
- erosion and sediment transport downstream due to works in watercourses
- impacts on water quality from contamination from spills and leaks during construction
- contamination of groundwater from construction activities
- introduction and/or modification of drainage infrastructure and culverts resulting in water quality impacts
- impact to surface water quality and receiving environments due to increased runoff from increase in impervious surfaces
- contamination of groundwater from maintenance procedures during the operational phase
- potential impacts on protected and sensitive lands.

The water quality assessments has considered the potential risks identified by the environmental risk assessment, in addition to the potential risks and impacts identified by the scoping report, the SEARS and relevant guidelines and policies (refer to section 13.1).

13.2.6 How impacts have been avoided or minimised

The development of the proposal took into consideration the need to minimise impacts on watercourses. Potential impacts on water quality would be minimised by managing water quality in accordance with the requirements of the POEO Act and the environment protection licence for the proposal.

Potential impacts that are unable to be avoided would be minimised by designing, constructing, and operating the proposal so that potential impacts on hydrology are minimised, which in turn mitigates the potential for water quality to be impacted by increases in sediment loads in runoff. Design strategies such as locating culverts and bridges to maintain existing drainage characteristics where possible to minimise scour and erosion impacts would be adopted.

Implementation of the design control measures and the water quality measures provided in section 13.7 would enable the proposal to be designed, constructed and operated to avoid or minimise water pollution, and protect human health and the environment.

13.3 Existing environment

The proposal is located within the Murrumbidgee River and Lachlan River catchments, which are sub-catchments of the Murray–Darling Basin. Surface water within the proposal site is comprised of ephemeral watercourses. The watercourses in the proposal site are generally at the top of the catchments and are likely to only flow during rainfall events. Additionally, the rainfall for the region is low, as there is no base flow resulting from groundwater expression (refer to Technical Paper 6: Groundwater Impact Assessment (Technical Paper 6)).

Figure 13-1 shows the catchment areas and the key watercourses and Figure 13-2 shows the stream orders of watercourses as well as other water features within the proposal site.

13.3.1 Watercourses

Table 13-3 shows details of the Strahler stream order of the watercourses crossed by the proposal. The Strahler stream order classification is a 'top down' system in which 1st order rivers are the outermost tributaries. If two streams of the same order merge, the resulting stream is given a number that is one higher. If two rivers with different stream orders merge, the resulting stream is given the higher of the two numbers.

Streams that are 1st to 3rd order are called headwater streams. Streams classified as 4th to 6th order streams are called 'medium streams' and 7th order or larger are called a 'river'.

Table 13-3 shows that most of the named streams that cross the proposal site are third order. These streams feed other streams. In the case of the proposal, these streams are ephemeral and only have flow after large rainfall events. There are two medium streams in the Murrumbidgee catchment—Billabong Creek and Ulandra Creek. These two streams are ephemeral where they cross the proposal site.

TABLE 13-3: STREAM ORDER OF NAMED WATERCOURSES CROSSED BY THE PROPOSAL

Strahler stream order	Named streams intersecting the proposal
1st and 2nd	▸ Nil
3rd	▸ Run Boundary Creek ▸ Dudauman Creek ▸ Powder Horn Creek ▸ Isobel Creek
4th	▸ Nil
5th	▸ Ulandra Creek
6th	▸ Billabong Creek

13.3.2 Farm dams

There are 14 farm dams located within the proposal site and a number of farm dams located within the study area as shown in Figure 13-2. These dams intercept overland flow and may be used as water supply for stock throughout the area.

13.3.3 Water quality

A desktop review was undertaken of existing water quality information. Water quality data from the broader catchment area was reviewed to understand the general water quality of the proposal site. One opportunistic water quality sample and two water quality field parameters recordings were taken at the same location in Ironbong Creek and provide further information of typical water quality of the ephemeral watercourses within the catchment.

13.3.3.1 Broader catchment water quality data

The *National Water Quality Assessment* (Sinclair Knight Merz, 2011) was commissioned as a nationwide water quality assessment to provide a snapshot of water quality across inland waters of Australia. The assessment collated water quality data from a series of sources across Australia and compared them to the relevant water quality objectives for each region.

Water quality data from the Murrumbidgee River and Lachlan River catchments from the *National Water Quality Assessment* was compared with the ANZG criteria for slightly disturbed ecosystems in south-east Australia. Table 13-4 shows the compliance of the water quality monitoring for the Murrumbidgee River and Lachlan River catchments in NSW.

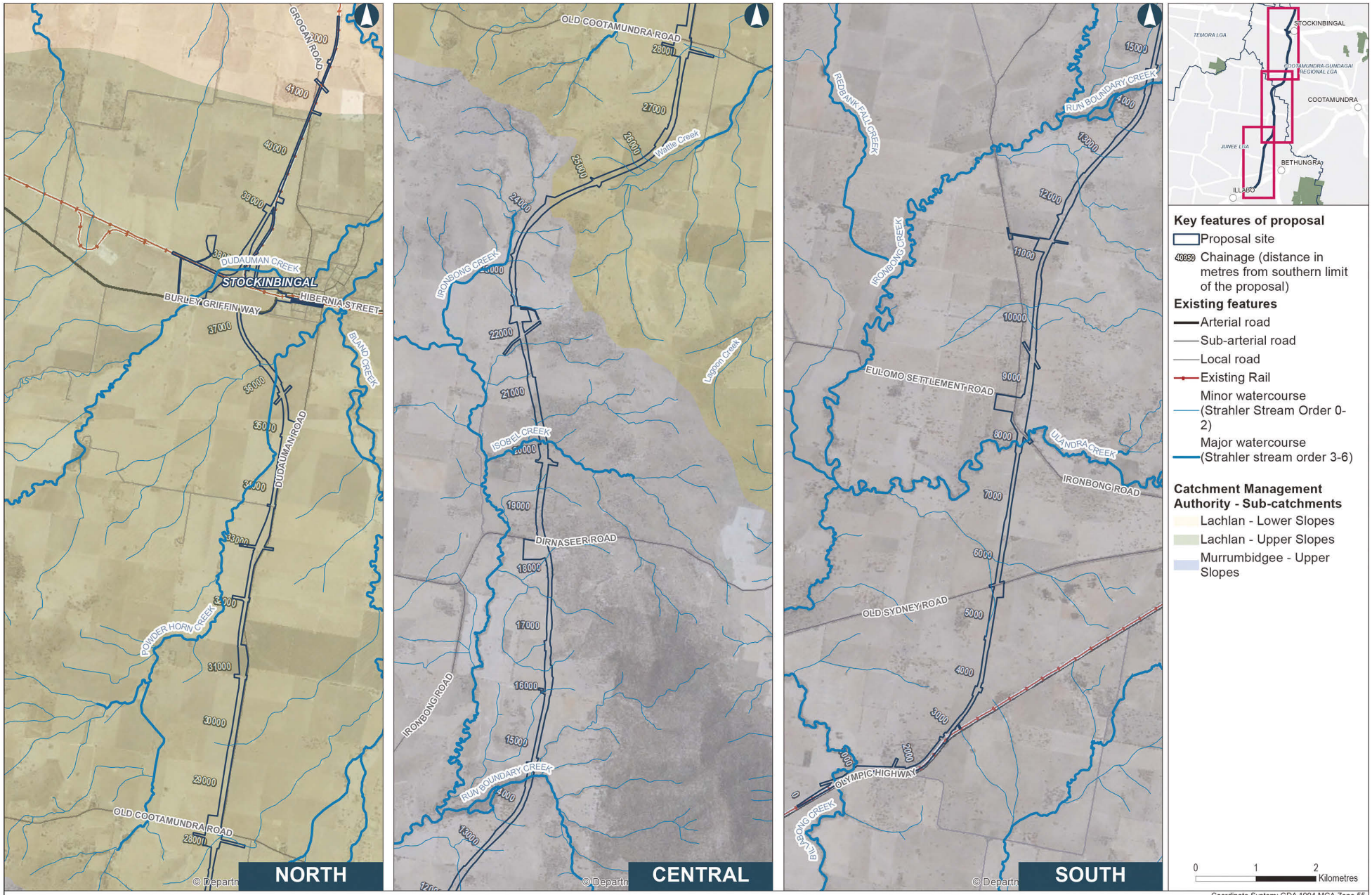
TABLE 13-4: WATER QUALITY COMPLIANCE FOR THE MURRUMBIDGEE RIVER AND LACHLAN RIVER CATCHMENTS IN NSW

Catchment	Turbidity	Salinity	pH	Total nitrogen	Total phosphorus
Murrumbidgee River					
Water quality sample compliance rating*	Good	Good	Good	Poor	Fair
% of samples compliant with trigger values	75%	75%	75%	26%	50%
Lachlan River					
Water quality sample compliance rating*	Fair	Fair	Good	Very poor	Poor
% of samples compliant with trigger values	69%	50%	85%	4%	28%

* Compliance rating based on percentage of samples compliant with trigger values: very poor (0–24%), poor (25–49%), fair (50–74%), good (75–100%)

In the Murrumbidgee River catchment, values for turbidity, salinity and pH were generally 'Good' with 75% of samples compliant with the trigger values. Measured nutrients values exceeded the guidelines and generally had fair to poor compliance. Total nitrogen was rated 'Poor' and total phosphorus was rated 'Fair'. In the Lachlan River catchment, only the pH indicators were rated as 'Good'. Compliance for samples from the Lachlan River catchment for total nitrogen and total phosphorus were rated 'Very Poor' and 'Fair' respectively. Compliance for turbidity samples in the Lachlan River catchment was rated as 'Fair'.

Given the predominantly agricultural land uses and ephemeral nature of the watercourses in the study area, it is unlikely that the watercourses within the proposal site would achieve the water quality trigger values, particularly for nutrients. The sources of the high nutrient levels are likely to be diffuse and related to current and historical agricultural activities within the study area.

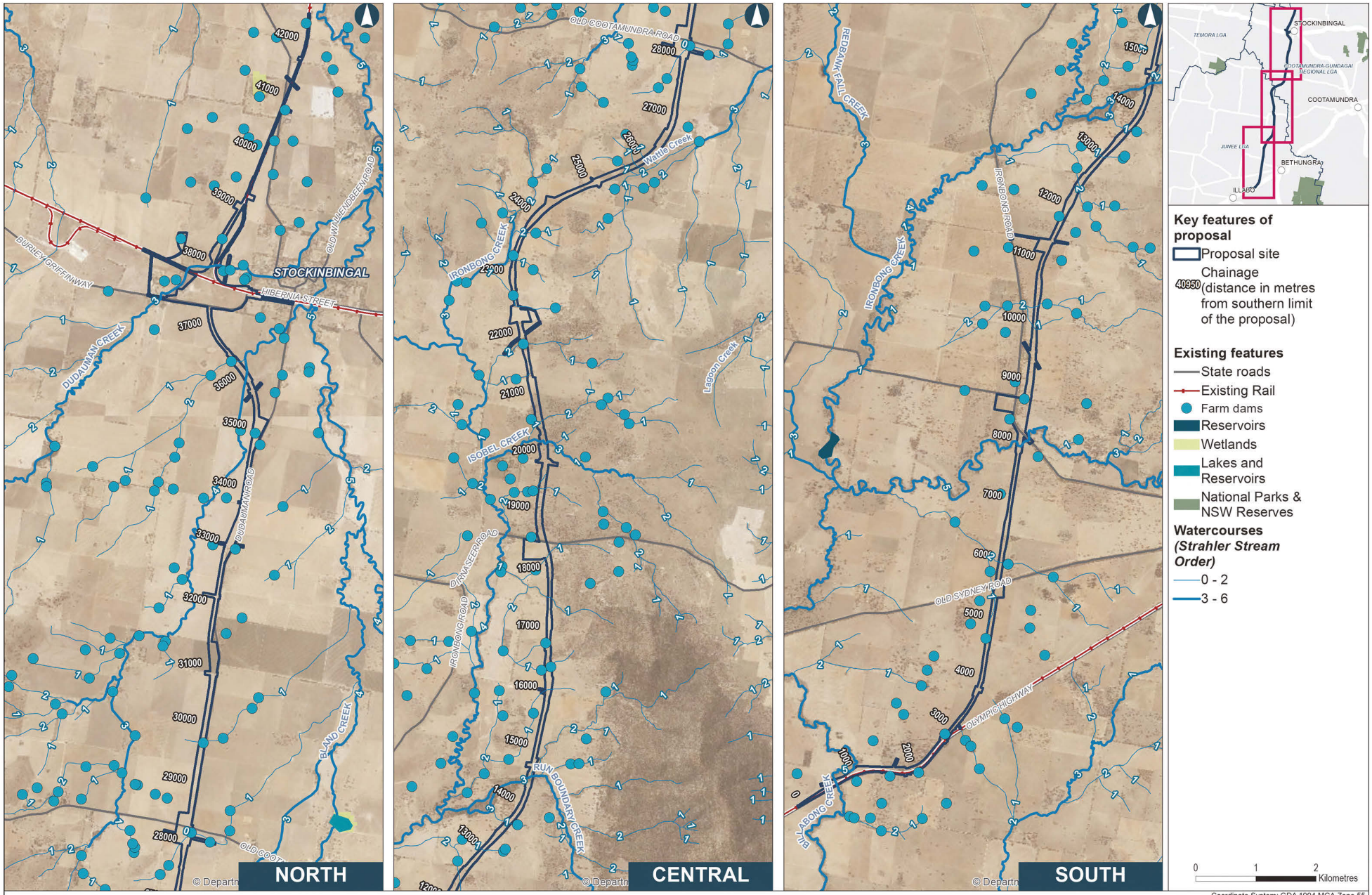


13.1 Catchment areas and key watercourses

Coordinate System: GDA 1994 MGA Zone 55
Paper size: A3 Scale: 1:60,000
Date: 5/16/2021

Data Sources: #####

220_0110_EIS_13_1_CatchmentsKeyWatercourses_r1v1.mxd



13.2 Stream orders of watercourses in the proposal site

Coordinate System: GDA 1994 MGA Zone 55
Paper size: A3
Scale: 1:60,000
Date: 8/24/2021

Data Sources: #####

220_0115_EIS_13_2_WaterwaysStreamorder_r1v1.mxd

13.3.3.2 Water quality data

During groundwater sampling in May 2019, a pool water was observed at the box culvert crossing of Ironbong Road over Ironbong Creek to the west of the proposal site. This allowed for opportunistic water quality samples to be taken. Water quality field parameters were taken, and two samples were sent for laboratory analysis.

Water within Ironbong Creek was observed to be present as stagnant pools. The water was observed to have a slight yellow hue, plenty of larvae, with minor amounts of 'free' vegetation present including broken branches and decaying leaves. Water depth was shallow, less than 10 cm in areas and up to a maximum of 20–30 cm near the culvert. The water was stagnant as the culvert lip was raised above the level of the creek bed. Both sides of the creek bank showed signs of moderate to severe gully erosion (refer to Photo 13-1).

Latest rainfall data published for Stockinbingal (Post Office) (station number 073036) and for Eurongilly (Bundaleer) station (station number 073124) indicate that the last rainfall event was 13 May 2019, before sampling occurred on 23 May 2019. Water quality field parameter readings were taken from the same location two days in a row, about 24 hours apart (refer to Table 13-5).

Three additional opportunistic water quality grab samples and field parameter readings were recorded in April 2021. These samples were taken at Ironbong Creek at Ironbong Road, Powder Horn Creek at Dudauman Road and Dudauman Creek at Burley Griffin Way. The results from this event-based sampling are discussed in section 3.2.1 of Technical Paper 5. During the sample collection it was noted, the water within Ironbong Creek was observed to be present as stagnant pools (refer to Photo 13-2) and water at Powder Horn Creek at Dudauman Road was observed to be clear brown in colour and flowing at a very slow rate (refer to Photo 13-3). Water at the Dudauman Creek site was not flowing and was murky brown coloured and vegetation under the bridge and along the banks had been pushed over from higher water levels, likely due to the prior rainfall event as shown in Photo 13-4.

Rainfall data published at Wantabadgery station (station number 073044) was available up until the end of March 2021. This data indicated that the last rainfall event before sampling occurred on 8 April 2021 was from the period 22 to 25 March where 78.6 millimetres were recorded. Total monthly rainfall values for the months of January, February and March were 72.6 mm, 93.4 mm and 90.3 mm, which are more than double the mean monthly values for these months, showing that it had been a wetter than usual period before sampling was carried out.

Table 13-5 presents the comparison of existing water quality measurements and the water quality trigger values identified in Table 13-1. The measurements were within the water quality trigger value range for all parameters except saturated dissolved oxygen and electrical conductivity (bolded figures). While the samples provide additional information on the potential water quality of the existing environment, they do not cover an adequate time period or physical extent of monitoring to conclusively characterise the existing water quality environment of the study area.

TABLE 13-5: EXISTING WATER QUALITY MEASUREMENTS COMPARED TO WATER QUALITY TRIGGER VALUES

Parameter	Trigger values	2019 Measurement 1 (Ironbong Creek)	2019 Measurement 2 (Ironbong Creek)	2021 Ironbong Creek	2021 Powder Horn Creek	2021 Dudauman Creek
Temperature (°C)	N/A	19.2	15.3	22.84	23.6	22.9
Electrical conductivity (µs/cm)	30–350	1600	1618	6970	195	130
Dissolved oxygen (% sat)	90–110	45	45.9	103.9	102.8	97.8
Dissolved oxygen (mg/L)	N/A	4	4.47	8.78	87.2	8.36
pH	7.0–8.0	7.85	7.81	7.85	7.44	7.06
Reduction-oxidation	N/A	220	257.2	180.7	127.8	179.0

Table 13-6 shows the laboratory results that were taken from the samples compared to the trigger values for the 95% protection level in slightly to moderately disturbed freshwater aquatic ecosystems. The results indicate that samples were generally below trigger values for the environmental values (aquatic ecosystems, irrigation, primary and secondary contact, livestock and aquatic foods) for metals and nutrients apart from sodium, chloride and calcium. Electrical conductivity was outside the key water quality objective range.

PHOTO 13-1: PHOTO OF POOL OF WATER IN IRONBONG CREEK. PHOTO FACES UPSTREAM LOOKING TOWARDS THE BOX CULVERT CROSSING AT IRONBONG ROAD (NW). PHOTO TAKEN DURING MAY 2019 SAMPLING EVENT

PHOTO 13-2: PHOTO AT IRONBONG CREEK LOOKING DOWNSTREAM (SOUTH-EAST) FROM IRONBONG ROAD DURING APRIL 2021 SAMPLING EVENT

PHOTO 13-3: PHOTO FROM DUDAUMAN ROAD LOOKING DOWNSTREAM (NORTH-EAST) AT POWDER HORN CREEK DURING APRIL 2021 SAMPLING EVENT

PHOTO 13-4: PHOTO OF DUDAUMAN CREEK LOOKING UPSTREAM UNDER THE ROAD BRIDGE DURING APRIL 2021 SAMPLING EVENT

TABLE 13-6: COLLECTED LABORATORY DATA ASSESSED AGAINST KEY WATER QUALITY INDICATORS AND ENVIRONMENTAL VALUES

		Water quality indicators (trigger values)					Sampling results			
Compound	LOR[1]	Water quality trigger value	Fresh-water aquatic eco-systems[2]	Irrigation	Livestock (for dairy cattle)	Aquatic foods	Ironbong Creek 23-05-19	Ironbong Creek 2021	Powder Horn Creek 2021	Dudauman Creek 2021
EC (µS/cm)	1	30–350	30–350				1680	6930	187	129
TDS (mg/L)	1				2000–5000		1090	4500	122	84
TSS (mg/L)	5	40					21	44	50	15
Turbidity (NTU)	0.1	20	2–25				11.1	21.4	26.2	115
Total alkalinity as CaCO3 (mg/L)	1						196	339	84	51
Sulfate as SO4 (mg/L)	1				1000		37	274	3	<1
Arsenic (mg/L)	0.0002		0.024				0.002	0.003	0.004	0.002
Arsenic (dissolved) (mg/L)	0.0002		0.024	0.1	0.5	0.05	0.001	0.003	0.003	0.001
Cadmium (mg/L)	0.0001		0.0002				0.0005	<0.0001	<0.0001	<0.0001
Cadmium (dissolved) (mg/L)	0.0001		0.0002	0.01	0.01	0.0018	0.0001	<0.0001	<0.0001	<0.0001
Calcium (mg/L)	1				1000		60	237	17	6
Chloride (mg/L)	1			750			425	1860	9	13
Magnesium (mg/L)	1				2000		45	205	5	4
Nickel (mg/L)	0.001		0.011				0.003	0.003	0.003	0.008
Nickel (dissolved) (mg/L)	0.001		0.011	0.2	1	0.1	0.002	0.003	0.004	0.003
Nitrite (mg/L)	0.01				30	0.1	0.01	<0.01	<0.01	<0.01
Nitrate (mg/L)	0.01		0.7		400	50	0.01	0.02	<0.01	<0.01
Potassium (mg/L)	1						12	26	17	8
Sodium (mg/L)	1			460			190	965	9	14

1. LOR: Limit of reporting
2. ANZG value for toxicants at the 95% species protection level

13.3.4 Sensitive receiving environments

13.3.4.1 Aquatic ecosystem

Technical Paper 2: Aquatic Biodiversity Assessment (Technical Paper 2) includes classification of the suitability of watercourses along the proposal site for fish passage. Six named watercourses are intersected by the proposal site: Billabong Creek, Ulandra Creek, Isobel Creek, Run Boundary Creek, Powder Horn Creek and Dudauman Creek. Isobel Creek is classified as 'Class 2—moderate' key fish habitat and 'Type 2—moderately sensitive' in accordance with *Fisheries NSW policy and guidelines for fish habitat conservation and management* (DPI, 2013). This watercourse class has a clearly defined bed and bank, with semi-permanent to permanent waters, and with freshwater aquatic vegetation present. Four of the six watercourses are classified as 'Class 3—minimal' key fish habitat and 'Type 3—minimally sensitive' fish habitat. These watercourses flow intermittently and contain limited refuge pools and limited exotic aquatic vegetation species. They do, however, contain riparian vegetation/shading and, in some cases, associated dams that may provide refuge for aquatic fauna. Powder Horn Creek was classified as 'Class 4—unlikely' as it was highly ephemeral with no connected wetland areas and semi-permanent water in pools only after rain events.

A number of state- and Commonwealth-listed threatened fish species, endangered populations and threatened ecological communities (TECs) are recorded or predicted to occur in the locality (i.e. Murrumbidgee and Lachlan River catchments); however, none of the threatened species or endangered populations are likely to occur in the watercourses within the proposal site due to the absence of preferred habitat.

Technical Paper 2 identified that the following endangered ecological communities listed under the *Fisheries Management Act 1994* (NSW) (FM Act) are present within the study area:

- Lowland Lachlan River aquatic ecological community
- Murray River aquatic ecological community.

None of the threatened species or endangered communities are likely to occur in the watercourses within the proposal site. An assessment of significance of impact of the proposal on these two communities identified that the proposal is unlikely to have an adverse impact on either of these endangered ecological communities with the adoption of appropriately designed fish-friendly crossing structures and other mitigation measures. Further information on these impacts is in Technical Paper 2.

13.3.4.2 Wetlands

No wetlands of international importance (Ramsar wetlands) or wetlands of national importance are located within the study area. Bethungra Dam Reserve occurs approximately 8 km upstream of the proposal site and would not be impacted by the proposal.

13.3.4.3 Groundwater dependent ecosystems

Groundwater dependent ecosystems (GDEs) are communities of plants, animals and other organisms that depend on groundwater for survival (Department of Land and Water Conservation, 2002). A GDE may be either entirely dependent on groundwater for survival or may use groundwater opportunistically or for a supplementary source of water (Evans and Hatton, 1998).

GDEs include wetlands, vegetation, mound springs, river base flows, cave ecosystems, playa lakes and saline discharges, springs, mangroves, river pools, billabongs and hanging swamps and near-shore marine ecosystems. The GDE Atlas (BOM, 2021) categorises GDEs into three classes:

- ecosystems that rely on the surface expression of groundwater—this includes all the surface water ecosystems that may have a groundwater component, such as rivers, wetlands and springs
- ecosystems that rely on the subsurface presence of groundwater—this includes all vegetation ecosystems
- subterranean ecosystems—this includes cave and aquifer ecosystems.

The ecosystems dependent on the surface expression of groundwater include river base flows, floodplains and riparian vegetation. In the proposal site, these ecosystems are associated with the following creeks: Run Boundary Creek, Ulandra Creek, Ironbong Creek, Bland Creek, Isobel Creek, Dudauman Creek and Billabong Creek.

Within the proposal site, eight ecosystems rely on the subsurface presence of groundwater and are known as GDEs and four high potential aquatic (river) GDEs were identified intersecting the proposal site: Billabong, Dudauman, Ironbong and Ulandra Creeks. Four high potential terrestrial GDEs were also identified: Blakely's red gum, yellow box, western grey box and white cypress pine. All identified GDEs within the vicinity of the proposal site are identified in Chapter 14: Groundwater.

13.3.5 Soils and geology

13.3.5.1 Overview

Typical soils along the proposal site include solodic soils and red-brown earths, consisting of a sandy loam to clay loam topsoil with a heavier textured subsoil. The soil landscapes in the north of the proposal site are Tarcutta Channel and Floodplain soils located along the watercourses near the proposal and Springdale Hills soil landscapes. These soils are largely alluvial with some areas of solodic soils. The central section of the proposal is Frampton Volcanics with red podzolic soils and some alluvium and red brown earths. The southern section of the proposal site are Bimbi Plains soil landscapes with mainly alluvium soils, red brown earths.

The soils along most of the proposal site have moderate inherent fertility. Shallower, coarser textured and less fertile soils are found in the steeper areas to the east of the proposal site in the section south of Old Cootamundra Road. Small areas of deeper, more fertile soils are located along watercourses in the proposal area. Geotechnical test results indicated the site soils to be generally non-dispersive except in areas where gully erosion was observed, some geotechnical tests indicated dispersive soils.

13.3.5.2 Erosion characteristics

High erosion hazard has been identified along some sections of the proposal site as part of the agricultural and geotechnical investigation undertaken for the proposal. Sheet and gully erosion have been identified north of Illabo with a potential for seasonal waterlogging near Ironbong Creek. Other instances of erosion noted during geotechnical investigation included:

- significant depths of gully or bank erosion within several incised drainage gullies and watercourse was observed
- soil has eroded on some crests and ridges to expose rock
- rill and sheet erosion in other areas was generally minimal.

Technical Paper 2 also noted some instances of erosion in the form of bank degradation in the following locations:

- Ulandra Creek—within the proposal site
- Isobel Creek—60 m downstream of the proposal site
- Unnamed tributary of Isobel Creek—80 m downstream of the proposal site
- Dudauman Creek—300 m upstream of the proposal site.

13.3.5.3 Salinity

Most of the soil types between Illabo and Stockinbingal have localised salinity hazard listed as a potential limitation. Salinity hazard is complex and relates to the soil type, the landscape features, local hydrology and the development on the land.

Chapter 20: Soils and contamination includes a review of the *Soil and Land Information System* (NSW EES, 2019), which indicated that generally no surface salt was evident at sample locations near the proposal site (within one kilometre). This indicates that the likelihood of salt scalds at the surface is low, but salinisation remains a potential hazard on the site, and could develop in localised areas as a result of the proposed development if not managed.

Soils and associated erodibility and salinity issues identified within the proposal site are discussed further in Chapter 20: Soils and contamination.

13.3.6 Contamination

The potential for contamination to be present within the study area inclusive of the proposal site is presented in Technical Paper 14: Contaminated Land Assessment (Technical Paper 14). This report states that the potential contamination risks would be associated with:

- unknown fill and stockpiling of waste across sections of the proposal site to construct existing nearby roads and rail infrastructure
- agricultural use of land adjacent to the proposal site, presenting a low risk of diffuse agricultural chemical residues and moderate potential for isolated hotspots where machinery maintenance or chemical storage and transfer activities occurred
- use of the railway line, and in particular areas where historical maintenance may have occurred, predominantly around sidings and stations
- various building structures presenting a potential risk of the presence of hazardous or contaminated material

- waste dumping, particularly in locations near existing roads, road crossings, or potentially in infilled gully's or dams that may be discovered during the works
- potential contaminants of concern relating to the above contamination sources include (but are not limited to) TRH, BTEX, PAH, OCPs, OPPs, PCBs, VOCs and potential ACM.

13.4 Impact assessment—construction

13.4.1 Water quality impacts

Construction of the proposal has the potential to release pollutants to watercourses including:

- nitrogen and phosphorus—due to use of pesticides and herbicides for weed control during construction or as a result of release of contaminated soils
- sediment—from soil disturbance and erosion due to vegetation clearing, topsoil removal, earthworks and trenching
- chemicals, oils, grease and petroleum hydrocarbons—from vehicle washdown areas during construction leaks and spills from machinery and fuel storage areas
- concrete slurry and wastewater due to operation of mobile concrete batching plants
- gross pollutants and litter from construction worker areas
- contaminants of concern related to previous land uses—heavy metals, TRH, BTEX, PAHs, OCPs, OPPs, PCBs, VOCs and potential ACM.

There are no sensitive receivers within the study area and all watercourses within the proposal site are ephemeral, meaning there is limited site-specific water quality data available against which to quantify any potential changes. Table 13-7 describes construction activities that, without mitigation measures, represent potential new sources of water quality pollution to watercourses (including farm dams) within the study area. Table 13-7 also identifies potential causes and impacts from the construction activities. Mitigation measures for these impacts are discussed in section 13.7.

TABLE 13-7: CONSTRUCTION ACTIVITIES AND RISKS WITHOUT MITIGATION

Activity	How impact could occur	Potential water quality impact
Vegetation clearing	▸ Increased exposed soils ▸ Increased run-off volumes across exposed areas ▸ Increased pollutant, sediment load or organic matter entering receiving watercourses ▸ Agricultural runoff may increase the conductivity or salinity of the water.	▸ Increased turbidity, lowered dissolved oxygen levels and increased nutrients in watercourses ▸ Reduction in channel habitat from sediment transport and deposition ▸ Increases in conductivity resulting in the dissolution of heavy metals and salts.
Earthworks including cut and fill earthwork for bridges over watercourses, level crossings, new crossing loop and creation of the rail formation	▸ Disturbance of potentially contaminated soils in nearby agricultural lots ▸ Disturbance of contamination from previous land uses, such rail lines, sidings and ballast and waste dumping near rail lines and roads ▸ Disturbance of problem soils (erosive, saline etc) ▸ Increased surface water run-off due to soil stabilisation earthworks. Soil stabilisation may result in change to the permeability of the natural soils.	▸ Release of contaminants and soil associated with agricultural activities such as nutrients from herbicides and pesticides which can increase the likelihood of algal blooms ▸ Release of heavy metals, TRH, BTEX, PAHs, OCPs, OPPs, PCBs and VOCs that may be present due to previous land uses which can affect the health of aquatic organisms ▸ Increased turbidity, lowered dissolved oxygen levels and increased nutrients in watercourses ▸ Flocculation of fine materials due to increased salinity. This may increase potential for algal blooms in suitable environmental conditions ▸ Reduction in channel habitat from sediment transport and deposition.
Earthworks and soil compaction for construction of railway line, access and haulage roads	▸ Disturbance of soil surface making it more susceptible to erosion ▸ Soil compaction may increase risk of runoff.	▸ Increased turbidity, lowered dissolved oxygen levels and increased nutrients in watercourses ▸ Reduction in channel habitat from sediment transport and deposition.

Activity	How impact could occur	Potential water quality impact
Installation of impervious areas and site compounds	▸ Increased flow volumes and velocities to receiving watercourses ▸ Potential increased pollutant loads.	▸ Increased scour and erosion ▸ Changes to sediment mobilisation and deposition ▸ Impacts to immediate and downstream aquatic ecosystems.
Use of water for construction activities such as dust suppression	▸ Increased run-off volumes into the receiving watercourses ▸ Potential for contamination of run-off travelling through site areas.	▸ Increased turbidity, lowered dissolved oxygen levels and increased nutrients in watercourses ▸ Potential reduction in channel habitat from sediment deposition.
Connection to existing rail lines at the Stockinbingal and Illabo	▸ Disturbance of contaminants associated with rail activities, including total recoverable hydrocarbons (TRH), monocyclic aromatic hydrocarbons (e.g. Benzene, toluene, ethylbenzene and xylene) and heavy metals (arsenic, lead, zinc, cadmium, chromium and iron).	▸ Release of hydrocarbons, fuels and heavy metals into watercourses which can affect the health of aquatic organisms. *
Preparation and use of concrete during proposal construction, particularly for culvert structures	▸ Spills of concrete slurry and wastewater from concrete batching plants.	▸ Change to pH of receiving environment and subsequent impact to aquatic and riparian ecosystems.
Construction of culverts and bridges in watercourses	▸ Disturbance of watercourse beds and banks for any instream works ▸ Increased exposure of soils and increased erosion and localised mobilisation of sediments from vegetation clearing on watercourse banks and earthworks in and around watercourses ▸ Leakage/spills of chemicals or hydrocarbons from machinery and vehicles ▸ Spills of concrete slurry and wastewater from concrete batching plants.	▸ Scour and deposition of sediments due to changes in flow rates and paths ▸ Increased turbidity lowered dissolved oxygen levels and increased nutrients. Potential for increased disturbed contaminants and bed scouring ▸ Release of hydrocarbons, fuels and heavy metals into watercourses which can affect the health of aquatic organisms ▸ Changes to alkalinity, pH and chromium levels from concrete slurry which can affect the health of aquatic organisms. *
Construction of Burley Griffin Way overpass	▸ Increased exposed soils, excavated areas and exposed soils ▸ Increased run-off volumes across exposed areas ▸ Increased pollutant, sediment load or organic matter entering receiving watercourses.	▸ Increased turbidity, lowered dissolved oxygen levels and increased nutrients in watercourses ▸ Reduction in channel habitat from sediment transport and deposition.
Stockpiling of spoil and construction materials exposing sediment	▸ Increased pollutant, sediment load or organic matter entering receiving watercourses ▸ Increased heavy metals entering watercourses.	▸ Increased turbidity, lowered dissolved oxygen levels and increased nutrients in watercourses ▸ Increased mobilised contaminants, sediments and heavy metals in watercourses which may affect aquatic organisms and human health ▸ Change in channel habitat from sediment transport and deposition.
Inadequate containment of spills or leaks of fuels chemicals from construction plant, equipment and activities	▸ Release of contaminants, oils, fuels and grease into watercourses.	▸ Increased pollutants and contaminants in watercourses which may affect aquatic organisms. *
Contaminants from areas of potential environmental concern as identified in Technical Paper 14.	▸ Disturbance and release of heavy metals, asbestos, PAHs, TRH, BTEX, PAHs, OCPs, OPPs, paint and/or dust containing lead.	▸ Increased contaminants in watercourses which may affect aquatic organisms and human health ▸ Release of hydrocarbons, fuels and heavy metals into watercourses that can affect the health of aquatic organisms*
Litter from construction site and activities.	▸ Gross pollutants and litter entering watercourses.	▸ Increased contaminants in the watercourse which may affect aquatic organisms and human health.

Activity	How impact could occur	Potential water quality impact
Decommissioning of farm dams	▸ Dewatering and infilling activities may mobilise soils and increase sediment, nutrient or contaminant loads entering the watercourses.	▸ Increased pollutants and contaminants in watercourses which may affect aquatic organisms ▸ Nutrient pollution can create dead zones—areas in water with little or no oxygen—where aquatic life cannot survive.

* Heavy metals are extremely toxic to aquatic organisms and accumulate in different organs of the fish, causing mortality (Section 8.3 of the ANZECC & ARMCANZ (2018))

13.4.2 Soil erodibility

Sections of the proposal have been identified as being located within a high erosion hazard area. Sheet and gully erosion has also been identified north of Illabo with a potential for seasonal waterlogging near Ironbong Creek.

During construction, sediment may be eroded and transported into watercourses during rainfall events. This may in turn cause temporary increases in turbidity along the proposal site with potential impacts to downstream aquatic ecosystem.

13.4.3 Salinity

Overall, the potential for saline soils to be encountered during construction is low; however, there is salinity hazard associated with some of the soil types located throughout the proposal site and therefore potential for localised salinisation if not managed properly.

Salinisation may affect the quality of water for irrigation. Salt also causes flocculation of fine materials that may allow greater sunlight penetration to rivers and greater potential for algal blooms in suitable environmental conditions. Dryland salinity is also linked to other soil degradation issues, including soil erosion. Salinity is often associated with prolonged wetness and lack of surface cover and therefore increases the vulnerability of soils to erosion.

13.4.4 Contamination

During construction earthworks and land clearing, there is potential for mobilisation of contaminants such as heavy metals, TRH, BTEX, PAHs, OCPs, OPPs, PCBs, VOCs and potential ACM that may be present in the soil due to previous land uses. The potential contamination is likely to be localised and manageable. Chapter 20: Soils and contamination identifies Areas of Potential Environmental Concern where contamination may be present.

13.4.5 Farm dams

During construction there would be direct impacts to 14 farm dams and potential impacts to a number of other farm dams located close to the proposal. All construction facilities will be located away from existing surface water farm dams where possible. However, where dewatering of farm dams is required, the dewatering process has the potential to impact water quality in receiving waters, through the input of mobilised sediments.

13.4.6 Summary of construction impact

The proposal site makes up a small component of the overall Murrumbidgee River and Lachlan River catchments and is not located near major watercourses. As described in section 13.3.3, the sources of water quality pollutants are likely to be diffuse. The existing water quality is varied with some records of poor water quality, particularly for nutrients values, with total nitrogen rated ‘poor’ or ‘very poor’ in each catchment and total phosphorus rated ‘poor’ in the Lachlan River catchment. The existing water quality in the study area is unlikely to meet the water quality objectives for the catchments.

Construction activities such as vegetation clearing and grubbing, excavations and earthworks, movement of materials and use of various machinery will be carried out along the length of the proposal site. As such there is the potential to impact the watercourses in the study area through increased sedimentation and erosion to watercourses, changed runoff volumes and flow-on effects to water quality parameters and potential impact to downstream aquatic ecosystem. There is also potential for release of chemicals, oils and contaminants from use of construction machinery and plant and release of contamination, saline soils or acid sulfate soils from disturbance of surrounding land.

Water quality impacts from construction of the proposal are anticipated to be short term and limited due to the ephemeral nature of the watercourses, absence of sensitive environmental receivers and progressive nature of construction limiting work areas within which impacts may occur. Further, the existing water quality of the study area indicates that the receiving environment is not sensitive to potential change and therefore there is unlikely to be an impact on the environmental values of watercourses.

13.5 Impact assessment—operation

Operation of the proposal has potential to release the following pollutants to the watercourses:

- sediment—from brake dust of operational trains, maintenance of access roads, maintenance of or failure track formation, changes to flow regimes and in the event that rehabilitation of disturbed areas are not effective
- chemicals, oils, grease and petroleum hydrocarbons—due to leaks and spills from maintenance and operation of freight trains and runoff from the new Burley Griffin Way
- gross pollutants and litter from operating vehicles.

Table 13-8 describes operational activities that would be potential new sources of water quality pollution, as well as potential causes and impacts to water quality from operational activities.

TABLE 13-8: OPERATION ACTIVITIES AND RISKS WITHOUT MITIGATION

Activity	How impact could occur	Potential water quality impact
Formation failure	▸ Failure of rail infrastructure and disturbance of soils releasing pollutants, sediment load or organic matter to watercourses.	▸ Increased turbidity, lowered dissolved oxygen levels and increased nutrients in watercourses.
Operation of new or upgraded culverts and cross-drainage structures	▸ Increased concrete and physical structures that may increase the velocity of the watercourses when in flow ▸ Impacts to flow regimes causing stagnation or changes to scour and erosion.	▸ Increased scour and erosion to watercourses banks and beds causing increased turbidity and changes to sedimentation transport that may change channel habitat for aquatic ecosystems.
New bridges in watercourses	▸ Impacts to flow regimes causing stagnation or changes to scour and erosion.	▸ Long-term changes in levels of turbidity, nitrogen and phosphorus with potential impacts to aquatic and riparian ecosystem.*
New impervious areas at the of Burley Griffin overpass	▸ Increased runoff volumes and velocity from the road.	▸ Increased sediment and pollutants entering watercourse and subsequent changes to water quality indicators.
Operational wear of track infrastructure (for example ballast and sleepers)	▸ Increased likelihood of spills of chemicals or sediment.	▸ Increased pollutants and contaminants in watercourses that may impact aquatic ecosystem.*
Operation of rolling stock along the rail line	▸ Disturbance of dust and sediment due to passing of rolling stock.	▸ Increased mobilised sediments in watercourses which may cause increased turbidity and changes to channel form.
Rail accidents	▸ Spills or leaks of chemicals, oils and petrols ▸ Disturbance of soils and rail infrastructure releasing sediment, pollutants or organic matter into watercourses.	▸ Increased pollutants and contaminants in watercourses may impact aquatic ecosystem* and human health.
Use of chemicals, oils and petrol for rolling stock	▸ Spills or leaks of chemicals, oils and petrols including total recoverable hydrocarbons, monocyclic aromatic hydrocarbons (e.g. Benzene, toluene, ethylbenzene and xylene) and heavy metals (arsenic, lead, zinc, cadmium, chromium and iron).	▸ Increased chemicals in watercourses which may impact aquatic ecosystem and human health.
Maintenance activities	▸ Inadequate containment of litter and gross pollutants during maintenance activities.	▸ Increased litter and gross pollutants in watercourses.

* Heavy metals are extremely toxic to aquatic organisms and accumulate in different organs of the fish, causing mortality (Section 8.3 toxicants of the ANZECC & ARMCANZ, 2018)

13.5.1 Summary of operation impact

Once construction is complete, all exposed areas would be revegetated. The rail formation would be capped with ballast and have all embankments revegetated. This would reduce the risk of soil erosion and would provide some water treatment through filtration through the ballast. As such, water quality impacts from the proposal would not be anticipated to impact existing water quality conditions against the NSW WQOs. Longitudinal drainage channels will largely be grassed, which will provide additional water treatment for sediments from the rail track. There will be some locations where the drainage channels will be concrete lined due to gradient requirements. Scour protection has been provided at the outlets to culverts and along longitudinal drainage to mitigate scour and erosion risk at the outlets.

Installation of new culverts and bridges have the potential to impact flow regimes within watercourses and may lead to long-term changes in levels of dissolved oxygen, electrical conductivity, turbidity, nitrogen and phosphorus with potential impacts to aquatic ecosystems. New culverts and bridges for the proposal have been designed to maintain existing flow paths and prevent the formation of new flow paths and therefore reduce potential for erosion and scour. Implementation of design measures to limit changes to flow regime will minimise the scour and erosion potential from new in-stream structures and will limit water quality impacts during operation.

The new road overpass over Burley Griffin Way has potential to create pollutant runoff from the road. However, the new road overpass is replacing the existing road and the existing road will be covered, landscaped and vegetated. As such, there is expected to be negligible change in pollutant loading to the overall environment due to construction of the Burley Griffin Way road overpass.

There is risk of release of minor quantities of chemicals into watercourses from accidental spills, leaks or runoff from maintenance during operation of the proposal. The rail line will be operated and maintained in accordance with ARTC's standard operating procedures that would include procedures for operating vehicles, maintaining the rail line and clean-up of any chemical or other spills that may occur during operation and as such the residual risk of impacts from accidental spills, and leaks of chemicals and other contaminants is considered low.

13.6 Performance against NSW Water Quality Objectives

The water quality environments of the broader Murrumbidgee River and Lachlan River catchments are varied, with good to fair values for turbidity, salinity and pH and poor values for nutrients. As discussed in section 13.3.3, sampling in May 2019 from a pool of stagnant water at Ironbong Creek returned values for dissolved oxygen and electrical conductivity that were above the water quality objectives. Laboratory results indicate that samples were generally below trigger values for the environmental values for metals and nutrients that were sampled for.

The proposal site makes up a small component of the overall Murrumbidgee River and Lachlan River catchments and is not located near major watercourses. Sources of pollution, particularly nutrient pollution in the catchment are diffuse and difficult to quantify and progress towards meeting the water quality objectives in the Murrumbidgee River and Lachlan River catchments will depend on activities in the catchment as a while. Additionally, the predominantly agricultural land uses and the ephemeral nature of the watercourses in the proposal site mean that it is unlikely that all the identified water quality objectives are currently being met.

Water quality impacts from construction of the proposal are anticipated to be short term and limited due to the ephemeral nature of the watercourses. It is anticipated that implementation of appropriate soil and water construction management measures would minimise these impacts further. As such, construction of the proposal would not cause significant changes to the water quality environment against the identified NSW WQO.

The rail formation will be capped with ballast and have all embankments revegetated which would reduce the risk of soil erosion. As such, water quality impacts from the rail alignment of the proposal would not be anticipated to impact existing water quality conditions.

13.7 Mitigation and management

13.7.1 Approach to mitigation and management

13.7.1.1 Approach to managing the key potential impacts identified

The assessment identified that if construction is not adequately managed, including managing the potential for erosion and sedimentation, it would have the potential to impact water quality in receiving watercourses. Standard construction management and mitigation strategies (as recommended in the *Managing Urban Stormwater: Soils and construction—Volume 1* (Landcom, 2004) (Blue Book) and widely adopted across the construction industry) would be adopted during construction of the proposal to minimise sediment disturbance, mobilisation and runoff (refer to section 13.7.4).

The main risks to water quality are associated with erosion and sedimentation and works within watercourses. All construction impacts and mitigation measures would be documented in a soil and water management plan as part of the construction environmental management plan (CEMP). It is considered that implementation of the mitigation measures would ensure that construction of the proposal would not further degrade the water quality environment within and downstream of the proposal site regarding the NSW Water Quality Objectives. Given the short-term nature of construction work and the application of appropriate construction mitigation measures, there would be a low residual risk of minor impact to watercourses and sensitive receiving environments.

Consideration would be given during detailed design to opportunities to mitigate changes to flow regimes and potential operational scour and erosion at culvert and bridge locations. Implementation of the mitigation measures during operation will result in a low likelihood of impact to watercourses and sensitive receiving environments. These mitigation measures are documented in accordance with guidelines identified in section 13.7.4. An event-based water quality monitoring program is proposed during pre-construction and construction phases to ensure maintenance of water quality values and identify non-conformances.

Design mitigation measures

All culverts and bridges would be located to maintain existing drainage characteristics where possible to minimise scour and erosion impacts. Culvert and bridge design have sought to allow for passage of the 1 per cent AEP peak flood flows to maintain existing flood levels.

Culverts would be placed at a skew angle to the rail line where appropriate to match the existing watercourses and maintain the flow paths. This prevents the formation of new flow paths or changes to existing flow paths and therefore reduces potential for erosion and scour. Additionally, while the suitability of the existing watercourses within the proposal for fish passage is minimal, design of the culverts to skew angle would maintain the ecological and drainage functionality of watercourses along the proposal.

Rip-rap structures would also be included at culverts to reduce flow velocity across the culvert and reduce potential scour and disturbance of bed sediments. Full details of the hydrological assessment of the proposal are described in the Technical Paper 4: Hydrology and Flooding Impact Assessment.

Potential increase in pollutants from bridges would be mitigated through provision of water quality treatment devices such as gross pollutant traps or swales as part of the drainage infrastructure design. These would be further developed during the detailed design of bridges and culverts at watercourse crossings.

The longitudinal drainage for the proposal has been located to direct surface runoff away from the rail formation. Where the rail line is in cut, longitudinal drainage directs run-off along the top of cuttings to prevent surface runoff over the cutting face. Longitudinal drainage would be included at the base of all fill embankments and along the top of cutting.

Longitudinal drainage channels will largely be grass lined that will provide additional water treatment for sediments from the rail track. There will be some locations where the drainage channels will be concrete lined due to gradient requirements. In these locations, appropriate scour protection would be provided to mitigation scour and erosion risk at the outlets.

At the Burley Griffin Way bridge, longitudinal pit and pipe drainage would be included to allow for the capture of flows from the bridge deck and at the edge of the pavement. The longitudinal drainage design for all components will continue to be refined during detailed design to reduce impacts as far as practicable to the hydrology and water quality of the proposal site.

Surface water quality monitoring

A surface water quality monitoring program would be implemented for 12 months prior to construction and during construction of the proposal. The program would be implemented as part of the CEMP and in line with the ARTC surface water monitoring framework.

Due to the ephemeral nature of the watercourses in the proposal site, it is not considered practical to implement a routine monitoring program. Instead an opportunistic, event-based sampling program is proposed. Water NSW operates a gauge on Wattle Creek approximately 600 m from the proposal site that may be used to assist in identifying high runoff periods.

The overall aim of the surface water monitoring program is to demonstrate that trigger values are not exceeded, and/or that the proposal does not have a material adverse impact on water quality. The surface monitoring framework and water quality objectives would be developed prior to construction in consultation with agencies including but not limited to DPI (Water) and the NSW EPA. Recommendations for the framework are provided below.

The objectives of pre-construction monitoring are to:

- identify parameters for monitoring during construction
- determine the indicative existing water quality.

The objectives of monitoring during construction would be to:

- identify if any water quality problems are occurring as a result of construction activities
- demonstrate compliance with legal and other monitoring requirements including the proposal construction EPL.

Surface water quality sampling locations would be selected based on further pre-construction environmental risk assessment. The risk assessment would include consideration of the location of construction compounds, culvert and bridge construction and identification of any areas of potential contamination, salinity or acid sulfate soils.

The following sampling locations are recommended:

- Ironbong Creek at Ironbong Road
- Ulandra Creek at Ironbong Road; Bland Creek at Stockinbingal
- Bland Creek at Burley Griffin Way.

Bland Creek is considered to be the most likely location at which flow will be present. Sampling locations would be selected upstream and downstream of construction areas where feasible.

Surface water quality monitoring will be undertaken for the potential contaminants associated with construction activities for the proposal. Indicative parameters for the surface water quality monitoring program are summarised in Table 13-9. More site-specific parameters may be adopted following further discussion with the NSW EPA and NSW DPI.

TABLE 13-9: PARAMETERS FOR SURFACE WATER QUALITY MONITORING PROGRAM

Category	Analytes
Physical parameters	pH, total dissolved solids, total suspended solids, dissolved oxygen, oils and grease
Nutrients	Total nitrogen and phosphorus (total and reactive)

The monitoring data will be assessed against the proposal trigger values will to establish the baseline condition of the existing environment and where possible, site-specific trigger values will be prepared based for the site in accordance with the ANZG.

13.7.1.2 Approach to managing other potential impacts

Preparation of strategies for the construction phase and implementation of environmental controls are key methods of addressing other potential impacts to water quality. For impacts from actions such as spills and leaks, preparation and use of concrete and decommissioning of farm dams, relevant measures provided in section 13.7.4 would be implemented.

13.7.2 Expected effectiveness

The implementation of erosion and sediment control measures to manage water quality and hydrology impacts would be in accordance with the requirements of the Blue Book. The measures contained in the Blue Book are based on field experience, tailored to particular project types, and have been extensively used and demonstrated to be effective. In general, the implementation of measures in accordance with the Blue Book will either result in a reduced impact or the impact will be avoided.

The approach to managing water quality within receiving watercourses has been developed with reference to the water quality management framework defined in the ANZ guidelines These guidelines provide a leading practice framework for managing water quality; therefore, any mitigation measures developed through consideration of this framework would also be expected to be effective.

Monitoring during construction would be undertaken to ensure with a view to ensuring that the mitigations measures are effective.

13.7.3 Interaction between measures

Mitigation measures to control impacts on water quality may overlap with mitigation measures proposed for the control of Chapter 10: Biodiversity, Chapter 12: Hydrology and flooding, Chapter 20: Soils and contamination, Chapter 25: Health and safety, and Chapter 21: Waste.

All mitigation measures for construction of the proposal would be consolidated and described in the CEMP. The plan would identify measures that are common between different aspects. Common impacts and common mitigation measures would be consolidated to ensure consistency and implementation.

13.7.4 Recommended mitigation measures

The measures outlined in Table 13-10 will be implemented to mitigate the potential water quality impacts.

TABLE 13-10: SUMMARY OF WATER QUALITY MITIGATION MEASURES

13.7.5 Managing residual impacts

Residual impacts are impacts of the proposal that may remain after implementation of:

- design and construction planning measures to avoid and minimise impacts (refer to section 13.2.6 and Chapter 8: Proposal description—construction)
- specific measures to mitigate and manage identified potential impacts (refer to section 13.7.4).

The key potential water quality issues and impacts originally identified by the environmental risk assessment (refer to Appendix G) are listed in Table 13-11. The (pre-mitigation) risks associated with these impacts, which were identified by the environmental risk assessment, are provided. Further information on the approach to the environmental risk assessment, including descriptions of criteria and risk ratings, is provided in Appendix G.

The potential issues and impacts identified by the environmental risk assessment were considered as part of the water quality impact assessment, summarised in sections 13.4 and 13.5. The mitigation and management measures (listed in Table 13-10) that would be applied to manage these impacts are also identified. The significance of potential residual impacts (after application of these mitigation measures) is rated using the same approach as the original environmental risk assessment.

Provided the mitigation measures are implemented accordingly, the proposal poses a negligible to low risk of impacting the water quality as identified by the risk assessment in Table 13-11.

Ref	Impact	Mitigation measure	Timing
WQ-1	Water quality	The construction impact zone defined for the proposal would allow sufficient room for provision of temporary and permanent erosion and sediment control measures or pollution control measures, where required, based on consideration of overland flow paths and flood risk. Water quality control measures would be designed to capture and treat the 80th percentile five-day rainfall event and any other requirements as outlined in the Blue Book.	Detailed design/ pre-construction

Ref	Impact	Mitigation measure	Timing
WQ-2	Surface water monitoring	A surface water monitoring framework would be developed and implemented as part of the soil and water management plan in the CEMP. It would identify: ▸ monitoring locations at discharge points and selected watercourses where works are being undertake ▸ monitoring parameters ▸ frequency and duration of monitoring. The monitoring framework would include relevant water quality objectives, parameters and criteria. It would be developed in consultation with the NSW Department of Planning and Environment and the NSW Environment Protection Authority.	Detailed design/ pre-construction
WQ-3	Sedimentation and erosion management	A soil and water management plan would be prepared and implemented as part of the CEMP. The plan would include measures, processes and responsibilities to minimise the potential for soil and water impacts (including impacts to groundwater and geomorphology) during construction.	Construction
WQ-4	Dewatering of farm dams that require relocation and/or decommissioning	A dam dewatering protocol would be developed as part of the soil and water management plan. It would consider: ▸ options for reuse of water in the dam ▸ licensing and approval requirements, where relevant ▸ the quality and quantity of the water to be released, where relevant ▸ strategies to minimise impacts on native, threatened or protected species ▸ strategies to minimise spread of nuisance flora and fauna species.	Construction
WQ-5	Disposal of wastewater (concrete batching plants)	All wastewater from concrete batching plants would be captured and would either be disposed of to an appropriately licensed facility or treated prior to discharge to surface water bodies. All discharge water would comply with the water quality objectives and the relevant environment protection licence requirements: ▸ measures to prevent or minimise mud and dirt being tracked onto public roadways by trucks and any equipment leaving the site ▸ requirements for training, inspections, corrective actions, notification and classification of environmental incidents, record keeping, monitoring and performance objectives for handover on completion of construction ▸ any other requirements necessary to comply with conditions of approval subsequent approvals or regulatory requirements ▸ erosion and sediment control plans and Soil and Water Management Plan (SWMP) will be signed off by a Suitably Qualified Person (e.g. Certified Professional in Erosion and Sediment Control (CPESC) in accordance with regulatory requirements.	Construction
WQ-6	Flooding impacts	The proposal would be managed in accordance with the water quality management requirements specified in the environment protection licence.	Operation

TABLE 13-11: RESIDUAL IMPACT ASSESSMENT—WATER QUALITY

Phase	Potential impacts	Pre-mitigated risk			Mitigation measures (refer to Table 13-10)	Residual risk			How residual impacts would be managed
		Likelihood	Consequence	Risk rating		Likelihood	Consequence	Risk rating	
Construction	Increased sediment loads during rainfall events and from discharge of sediment laden wastewater.	Possible	Major	High	WQ-1 to WQ-2	Unlikely	Moderate	Low	n/a
	Increased alkalinity and pH of watercourses due to runoff from concrete batching plant operations.	Unlikely	Major	Medium	WQ-5	Rare	Moderate	Low	n/a
	Increased sediment loads due to changes in surface water flow from the presence of construction infrastructure.	Unlikely	Major	Medium	WQ-2 to WQ-3	Rare	Moderate	Low	n/a
	Erosion and sediment transport downstream due to works in watercourses.	Possible	Major	High	WQ-1 to WQ-3	Rare	Moderate	Low	n/a
	Impacts on water quality from contamination from spills and leaks during construction.	Unlikely	Major	Medium	WQ-2 to WQ-3, WQ-5	Unlikely	Moderate	Low	n/a
	Contamination of groundwater from construction activities.	Possible	Major	High	WQ-3	Unlikely	Moderate	Low	n/a
Operation	Introduction and/or modification of drainage infrastructure and culverts resulting in water quality impacts.	Likely	Moderate	High	WQ-1, WQ-4	Unlikely	Moderate	Low	n/a
	Impact to surface water quality and receiving environments due to increased runoff from increase in impervious surfaces.	Likely	Moderate	High	WQ-6	Rare	Moderate	Low	n/a
	Contamination of groundwater from maintenance procedures during the operational phase.	Unlikely	Major	Medium	WQ-6, SC-10	Rare	Moderate	Low	n/a