THE BASIN PLAN IMPLEMENTATION

Darling Alluvium Water Quality Management Plan

Schedule F

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Acknowledgements

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Acknowledgement of Traditional Owners

The NSW Government proudly acknowledges the Aboriginal community of NSW and their rich and diverse culture and pay respect to their Elders past, present and future.

NSW acknowledges Aboriginal people as Australia's First Peoples practising the oldest living culture on earth and as the Traditional Owners and Custodians of the lands and waters.

We acknowledge that the people of the Barkandji and Maljangapa, Budjiti, Euahlayi, Murrawarri, Ngemba and Wailwan Nations hold a significant connection to the lands in which the Darling Alluvium fall upon.

The Darling Alluvium holds great areas of spiritual, cultural and economic importance to the first nation people and NSW recognises the connection of the water to the people of these nations.

We recognise the intrinsic connection of Traditional Owners to country and acknowledge their contribution to the management of the Darling Alluvium water resource plan area's landscape and natural resources.

The Department of Planning and Environment understands the need for consultation and inclusion of Traditional Owner knowledge, values and uses in water quality planning to ensure we are working towards equality in objectives and outcomes.

The Department of Planning and Environment is committed to continue future relationships and building strong partnerships with our First Nation People.

We thank the Elders, representatives of the Barkandji and Maljangapa, Budjiti, Euahlayi, Murrawarri, Ngemba and Wailwan Nations and Aboriginal community who provided their knowledge throughout the planning process.

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1. About this plan

1.1. The Basin Plan 2012 *(Water Act 2007)*

The Basin Plan provides a coordinated approach to managing Basin water resources across Queensland, NSW, ACT, Victoria and South Australia. In NSW the plan came into effect following the signing of Inter-governmental and National Partnership Agreements in 2014. As lead agency, the Department of Planning and Environment - Water is working together with agencies including Department of Planning and Environment – Environment and Heritage Group and Department of Primary Industries (DPI) Fisheries to implement the plan. The Basin Plan requires NSW to develop water quality management plans for each water resource plan area within the Murray Darling Basin (10.29). The Basin Plan requires groundwater water quality management plans to identify causes, or likely causes of water quality degradation (10.35A), identify water quality target values (10.35B) and to include measures that support the maintenance of water quality within a water resource plan area (10.35C).

BASIN PLAN 10.29 This water quality management plan for the Darling Alluvium water resource plan area (WRPA) has been prepared to meet the requirements of Chapter 10, Part 7 of the Basin Plan.

1.2. Purpose

The purpose of this plan is to contribute to the sustainable and integrated management of water resources in the Darling Alluvium WRPA for the benefit of both present and future generations. The water quality management plan aims to provide a framework to protect, enhance and restore water quality that is fit for purpose for a range of outcomes that:

This plan supports the Darling Alluvium water resource plan and uses best available information to maintain, implement or develop measures to improve water quality for water resource managers.

1.3. What water sources does this plan apply to?

The Darling Alluvium water quality management plan applies to all groundwater within the Darling Alluvium WRPA (Figure 1). This includes the Lower Darling Alluvium and Upper Darling Alluvium. Detailed information about the resource is contained in the Darling Alluvium water resource plan resource description (DPI Water, 2018a). The Darling Alluvium water resource plan resource description provides a description of the plan area including history of groundwater management, land use, geology and topography, groundwater dependent ecosystems and current management. Figure 2 and Table 1 describes the relationship of the water quality management plan with other elements of the water resource planning process.

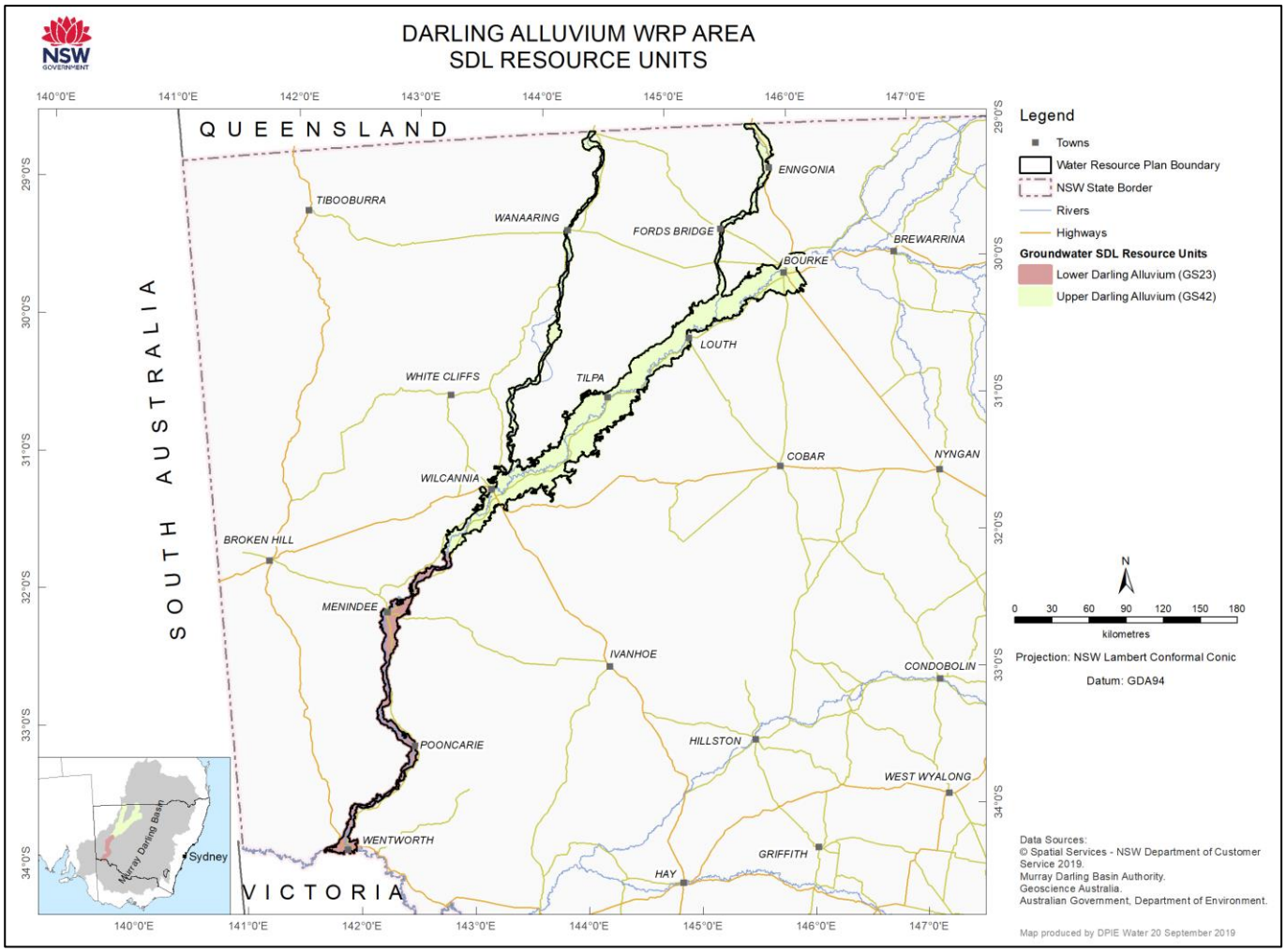


Figure 1. GW7 Darling Alluvium Water Resource Plan Area.

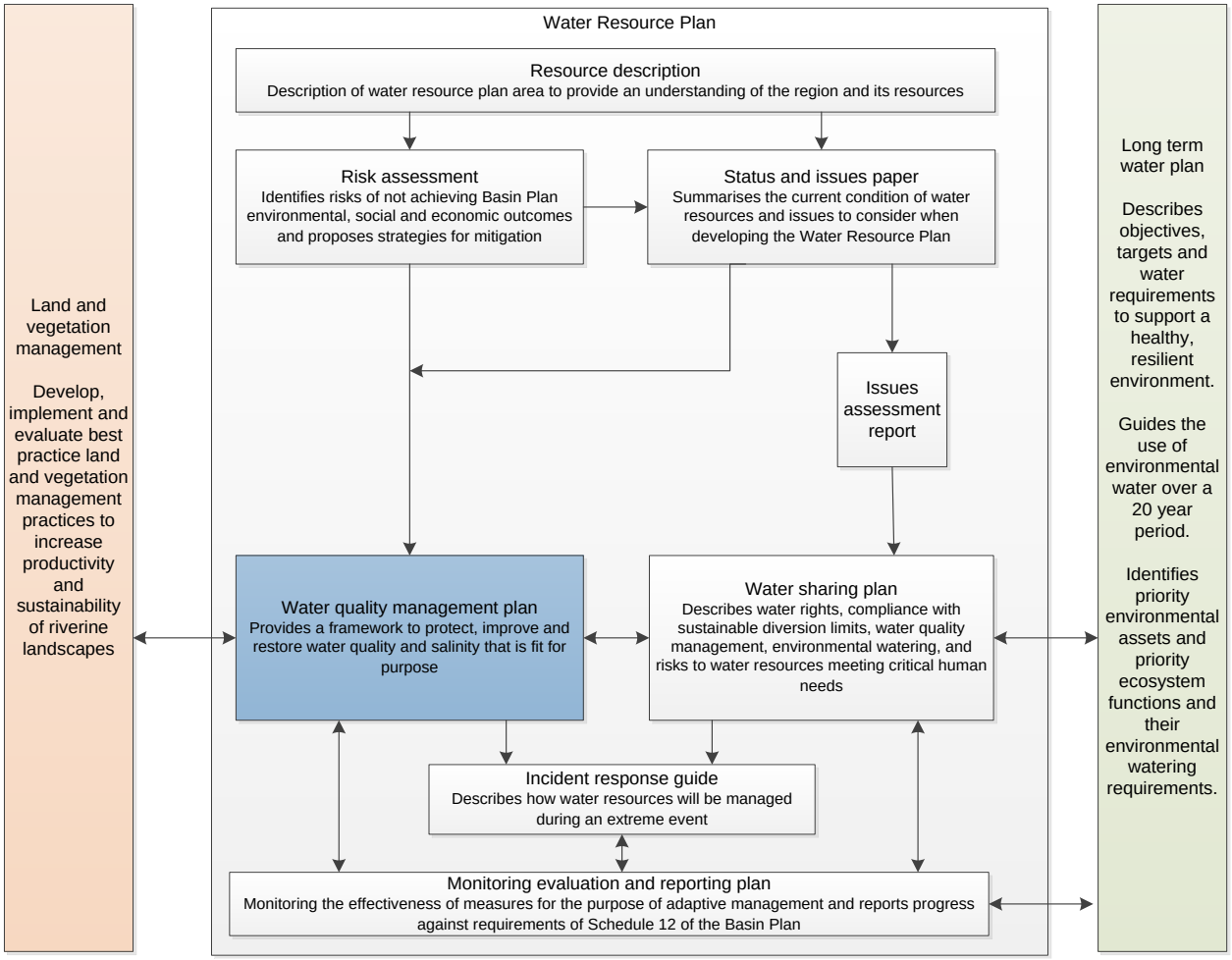


Figure 2. Flow diagram illustrating the components of the Darling Alluvium water resource plan.

Table 1. Basin Plan requirements for water resource plans.

Document	Basin Plan Requirement
Darling Alluvium water resource plan - resource description	Not accredited under Basin Plan. Supplements risk assessment and status and issues paper.
Darling Alluvium water resource plan - status and issues paper	Supplements water resource plan.
Darling Alluvium Risk Assessment GW7 Water Resource Plan Area	Chapter 9 Section 9.02, 9.04 - 9.08, 9.18. Chapter 10 Section 10.35A - 10.35C, 10.41 - 10.43. Chapter 4 Section 4.02, 4.03 Supplements status and issues, water resource plan and water quality management plan.
Incident response guide for groundwater resource plan areas	Chapter 10 Section 10.51. Supplements water quality management plan.
Darling Alluvium water quality management plan	Chapter 9 Section 9.02, 9.04 - 9.09, 9.14, 9.16 - 9.19. Chapter 10 Section 10.29, 10.35A - 10.35D, 10.42, 10.43, 10.51 - 10.55. Supports Long term water plan.

Document	Basin Plan Requirement
Water sharing plan for the Darling Alluvial Groundwater Sources 2020	Chapter 10 Section 10.41. Chapter 5 Section 5.02 – 5.07. Chapter 4 Section 4.02.
Groundwater environmental monitoring, evaluation and reporting plan	Chapter 10 Section 10.46.

1.4. NSW water quality legislative context

The management of groundwater quality in NSW is provided for across several legislative and regulatory instruments and agencies. Figure 3 summarises the objectives of each instrument and the relationship to groundwater quality management in NSW.

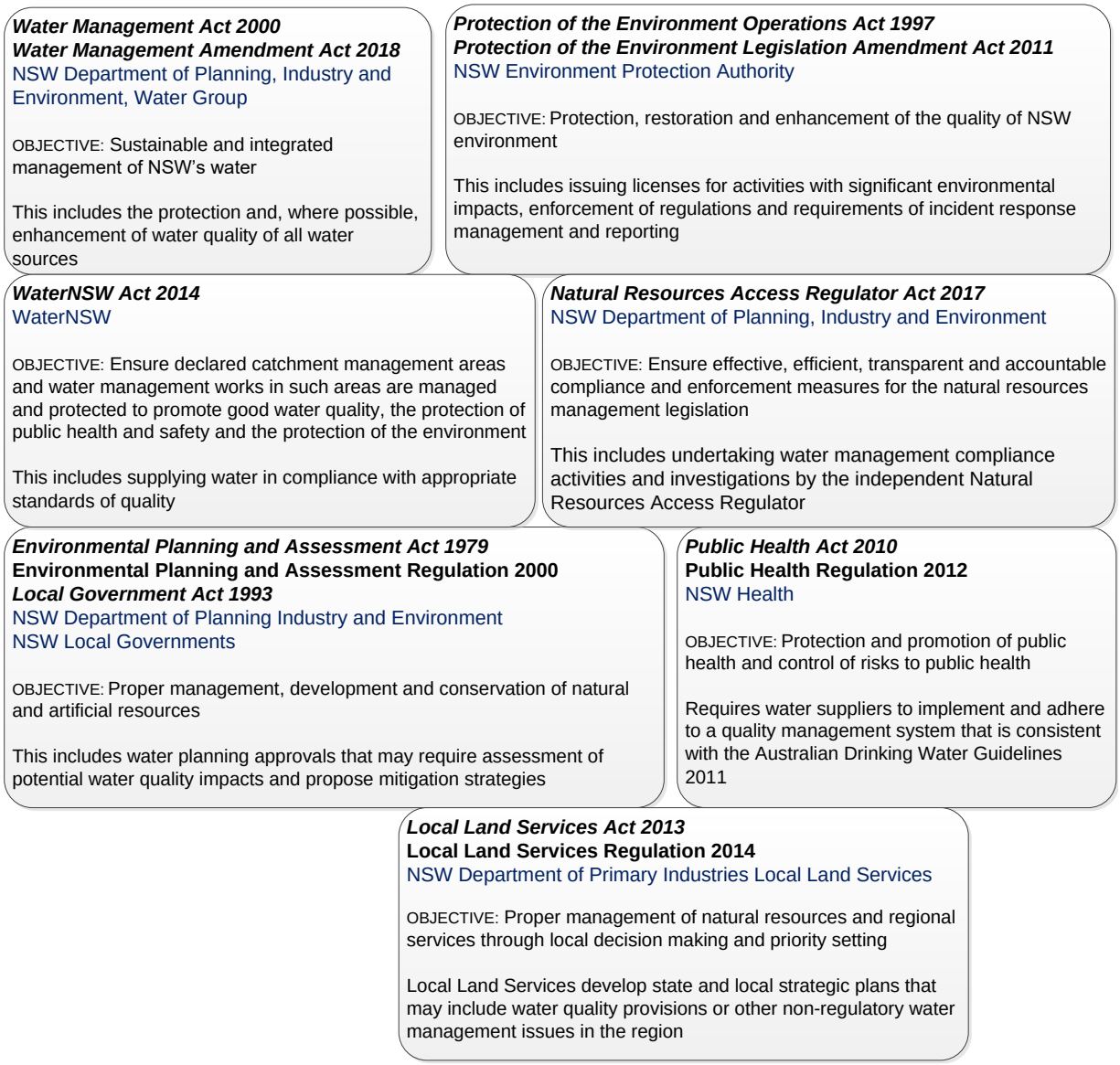


Figure 3. Summary of major water quality legislation and regulations in NSW.

2. Developing water quality management plans in NSW

2.1. Water quality

Water quality describes the condition of water within a water source and its suitability for different purposes. The water quality characteristics of a groundwater system influence how that water can be used for town water or stock and domestic supply, or for commercial purposes such as farming and irrigation. If water quality is not maintained, it can impact on the environment as well as the commercial and recreational value of a groundwater resource.

One measure of quality is the level of dissolved salts present in groundwater, or salinity. The total dissolved solids (or inorganic salts) are measured in a laboratory and is reported as milligrams per litre (mg/L). A much simpler measurement, which can be done in the field, is the electrical conductivity (EC). The more dissolved salts in the water the higher the EC. Measurement of EC can be used to give an estimate of the salinity and is generally reported in microsiemens per centimetre (µS/cm). For convenience, total dissolved solids (TDS) is often estimated from electrical conductivity (EC). An approximate conversion of EC to TDS is EC (µS/cm) x 0.67 = TDS (mg/L) (ANZECC, 2000).

In NSW, groundwater salinity levels can range from that of rainwater, <100 mg/L (150 µS/cm) to greater than that of sea water (~ 40,000 mg/L or 60,000 µS/cm). Groundwater with salinity suitable for a range of productive uses is generally found in the large unconsolidated alluvial systems associated with the major westward draining rivers.

Changes in land use, impact of industry, seasonal variations, and longer-term changes in climate as well as groundwater extraction can all affect groundwater quality.

2.1.1. Beneficial use categories

Beneficial use is a resource management tool to protect groundwater resources. It is a general categorisation of groundwater uses based on water quality and the presence or absence of contaminants. It is typically based on salinity although it can also reference other water quality parameters. The term ‘beneficial use’ is the equivalent to the ‘environmental value’ of water (ANZECC 2000). Each designated use has its own set of water quality requirements or criteria that must be met for the use to be attained.

The NSW Groundwater Quality Protection Policy (DLWC, 1998) adopted the five beneficial use category classification recommended by the Guidelines for Groundwater Protection in Australia (ARMCANZ and ANZECC, 1995). Using the beneficial use approach, the groundwater environment is divided into segments based on the background (naturally occurring) level of total dissolved solids (TDS) reported in mg/L. The groundwater segments are used to determine which segment is applicable to a beneficial use of groundwater. The protection of beneficial uses will be achieved through maintenance of the current level of water quality.

The revised Guidelines for Groundwater Protection in Australia (NWQMS 2013) adopted six Environmental Value categories (formerly beneficial use). Whilst acknowledging the change in nomenclature in the guidelines, the term beneficial use will continue to be used in NSW as it reflects the social and economic values of the resource in conjunction with ecological values. NSW has adopted these revised categories in this water quality management plan. This includes the addition of cultural and spiritual values.

The beneficial use categories include:

- aquatic ecosystem protection
- primary industries (irrigation and general water uses, stock drinking water, aquaculture and human consumers of aquatic foods)
- recreation and aesthetics
- drinking water

- industrial water
- cultural and spiritual values.

Groundwater quality varies spatially throughout a groundwater system reflecting the recharge sources, groundwater–rock interactions and the rate of groundwater flow in the system. In many groundwater systems the natural groundwater quality distribution will range across a number of beneficial use categories, therefore a resource may have more than one beneficial use. These uses primarily depend on groundwater quality and aquifer yield.

Table 2 lists the range of salinity thresholds for each beneficial use category. The overriding principle is that groundwater quality should be maintained within its beneficial use category. This does allow for water quality to vary; however, it should not move out of the acceptable range for each water quality criterion of its beneficial use segment. The upper limit of each category should not be seen as the limit to which the groundwater salinity can be increased. The groundwater quality should be maintained within the range of variation, both spatially and temporally, identified through the establishment of the baseline quality of the resource. If multiple beneficial use categories exist in a water resource, the most sensitive identified beneficial use should be maintained (DLWC, 1998). For example, if beneficial use categories for drinking water (A1), irrigation (B) and stock drinking water (C) have been identified, then the drinking water beneficial use segment A1 should be maintained.

NSW adopted the beneficial use categories in the earlier groundwater water sharing plans (circa 2006). It is also adopted in policies (including the Aquifer Interference Policy) as an objective for protecting the resource by maintaining the beneficial use categories within water sources. A change in beneficial use category may be used as an indicator of increased salinity within the water source.

Table 2. Beneficial use categories of water (based on salinity).

Beneficial use		Salinity (TDS mg/L)						
		A1	A2	A3	B	C1	C2	D
		0 - 600	601 – 900*	901 - 1200	1,201 – 3,000	3,001 – 6,000	6,001 – 10,000	>10,000
Aquatic ecosystem protection		✓	✓	✓	✓	✓	✓	✓
Primary industries	Irrigation	✓	✓	✓	✓			
Primary industries	Stock drinking water	✓	✓	✓	✓	✓	✓	
Recreation and aesthetics		✓	✓	✓	✓	✓	✓	✓
Raw drinking water*		✓	✓	✓				
Industrial water		✓	✓	✓	✓	✓	✓	✓
Cultural and spiritual		✓	✓	✓	✓	✓	✓	✓

* Desirable palatability <600 mg/L(A1); acceptable palatability <900 mg/L(A2) (WHO 2004; ADWG 2011).

Acceptable salinity levels must be viewed along with other water quality parameters, as other natural geogenic contaminants such as arsenic, fluoride or radionuclides may also exceed suitable limits and therefore preclude certain beneficial use categories (NWQMS 2013). Conversion from TDS (mg/L) to EC (µS/cm) is presented in Table 10 (Appendix C).

2.1.2. Sodium Adsorption Ratio (SAR)

There are a number of water quality indicators that inform the suitability of groundwater for a particular use, including the sodium adsorption ratio (SAR). SAR values are used to indicate a possible sodium hazard. It relates the amount of sodium relative to calcium and magnesium in water. SAR should be considered in addition to salinity (which is used to define the beneficial use category) for water that is fit for purpose, as high SAR values may be detrimental to soil structure and plant growth.

The adverse impact of sodicity in water is not directly related to its salinity. There is a risk of both reduced infiltration and declining soil structure if the irrigation water has moderate to high SAR, but low salinity (NSW Department of Industry 2017).

The effects of salinity and sodicity in irrigation waters are situation-specific, making it inappropriate to set water quality trigger values for SAR for general application. Factors which need to be considered include: the type of crop being cultivated and its salt tolerance, the characteristics of the soil under irrigation, soil management and water management practices, climate and rainfall (ANZECC, 2000).

2.1.3. Nutrients

Nitrate occurs naturally in the environment along with ammonium and nitrite in ionic form as the most common inorganic forms of nitrogen. Data on nitrogen in Australian groundwater is very limited. Ammonium is usually converted (oxidised) to nitrite and nitrate by common aerobic bacteria when oxygen is present, even at low oxygen concentrations, so that nitrate predominates in aerobic aquatic environments (Camargo et al. 2005). Nitrate is removed from aquatic environments when taken up as an essential nutrient by plants or converted to nitrogen gas by bacteria in anaerobic situations.

Nitrate is highly soluble and very mobile, which facilitates plant uptake, but also makes it highly susceptible to leaching into groundwater. There are many sources of nitrate, both natural and anthropogenic, that can contribute to groundwater contamination. The anthropogenic sources include intensive agriculture (nitrogen-containing fertilisers), dairy and sewage effluent.

Nitrate contamination in groundwater is dependent on a combination of factors such as geology, soil, land use, land and water management practices, poor bore construction and hydrology. Previous studies have reported that nutrient concentrations vary seasonally, largely in response to changes in rainfall, stream flow and times since the application of fertiliser (Sundaram & Coram 2009).

High levels of nitrate in the environment are a concern due to its toxicity to humans, stock animals and aquatic invertebrates. Nitrate binds to the oxygen-carrying blood pigments (haemoglobin in humans and mammals, haemocyanin in many invertebrates), preventing these pigments from transporting oxygen to body tissues (Camargo et al. 2005).

The Australian Drinking Water Guidelines (2011) value of 50 mg/L provides protection for bottle-fed infants under the age of 3 months. However, adults can safely drink water with up to 100mg/L of nitrate. Concentrations of less than 400 mg/L nitrate in livestock drinking water should not be harmful to animal health. Stock may tolerate higher nitrate concentrations in drinking water, provided nitrate concentrations in feed are not high. Water containing more than 1500 mg/L nitrate is likely to be toxic to animals and should be avoided. Concentrations of nitrite exceeding 30 mg/L may be hazardous to animal health. Both nitrate and nitrite can cause toxicity to animals, with nitrite being far more toxic than nitrate (ANZECC 2000).

Nitrate sensitive crops may be affected by concentrations greater than 22 mg/L nitrate and problems may occur with increasing concentrations up to 133 mg/L nitrate, above which severe problems could arise (ANZECC 2000; Qld DAF 2012; NSW DPI 2014).

Although not routinely monitored in all groundwater sources, nitrate concentrations should be considered as criteria for water use as the salinity levels may depict the beneficial use category but the concentration levels of nitrates and other contaminants such as SAR or pesticides, may deem it unsuitable for a particular use.

2.1.4. Pesticides

Pesticides include insecticides, herbicides, fungicides and defoliants. Data on pesticides found in Australian groundwater is very limited. Much of the existing groundwater pesticide data has been obtained from either short-term studies or ad hoc monitoring, therefore it is difficult to accurately determine the contamination potential in varying groundwater sources (Sundaram & Coram 2009).

Studies in the Namoi and Gwydir catchments detected Endosulfan in surface water monitoring from 1991 – 2002. Where groundwater contamination has been detected in NSW, it has usually involved triazine herbicides (ATSE 2002). The most commonly detected herbicide in NSW groundwater has been Atrazine (DIPNR 2002). Atrazine has high water solubility and a low ability to bind to soils allowing it to leach into groundwater through soil profiles (APVMA 2008).

2.1.5. Pathogens

Waterborne diseases can spread via groundwater, often through contamination from animal faeces, sewage or septic tank leakage. Common pathogens in faeces are bacteria, viruses, protozoa, and helminths (parasitic worms). Pathogen contaminated groundwater poses significant health risks and may be unsafe to drink.

Drinking water utilities supplying drinking water use multiple barrier treatments ensuring drinking water is safe and aesthetically pleasing to the user. Treatment processes include coagulation/flocculation, sedimentation, filtration and disinfection. Disinfectants ensure that disease causing bacteria, viruses and parasites are destroyed.

The Australian and New Zealand Environment and Conservation Council water quality guidelines (ANZECC Guidelines) (2000) provide trigger values for faecal coliforms and parasites in irrigation water applied to human food crops and animal fodder.

There is no routine monitoring for pathogens in NSW groundwater sources other than those utilised by town water suppliers or required for Environmental Protection Licence (EPL) compliance.

Groundwater used for drinking water (not supplied from a drinking water utility) should undergo a comprehensive range of chemical and physical tests prior to use. The water should be retested if there are any changes in water quality, such as the appearance of odours, taste or colour. Contact your local Public Health Unit for testing advice and refer to the *NSW Private Water Supply Guidelines* for information on groundwater, hazards and testing.

3. Water quality condition and issues in the Darling Alluvium water resource plan area

In the Upper and Lower Darling Alluvium, groundwater monitoring bores were sampled by NSW Government for water quality upon construction, and in some areas periodically for a number of years after construction.

3.1. Water quality in the Lower Darling Alluvium

Groundwater EC in the Lower Darling Alluvium ranges from a fresh value of about 150 mg/L to a hypersaline value of around 70,000 mg/L.

The most saline groundwaters that have been measured occur at the inlet to Menindee Lake and at the lower end of the Darling River immediately north of Wentworth. A major groundwater study at Menindee during 2010 and 2011 recorded EC values of 160 mg/L to 28,800 mg/L and found that the average salinity increases with increasing depth (Lawrie et al. 2012a-c).

Fresh groundwater exists in unconfined alluvium within a few kilometres from the Darling River, its tributaries, and adjacent lakes Menindee and Wetherell, from which it is directly and rapidly recharged. The fresh groundwater thus has a chemical composition similar to that of the surface waters although is commonly slightly alkaline. Recharge is spatially controlled by the variable absence of a confining aquitard (Lawrie et al. 2012b & 2012c).

The fresh groundwater is surrounded by semi-confined to confined, brackish to saline, regional groundwater which has evolved at greater depths and more distally from the surface waters. This is mainly via sediment mineral weathering in the alluvium (Lawrie et al. 2012b & 2012c).

The Curlwaa Salt Interception Scheme manages saline groundwater near Wentworth. Under this scheme groundwater is pumped into a salt management basin to control water table elevations and reduce the risk of salinisation to the irrigation district (MDBA 2011a). The salinity of the intercepted water is variable and ranges between 1,500-20,000 micro-siemens per centimetre (µS/cm) (Kumar and Alamgir 2013).

Based on data, from the NSW Government monitoring bore network as well as private water supply bores, the groundwater salinity of the shallowest aquifer across the area is shown in Figure 4 (Evans et al, 1994).

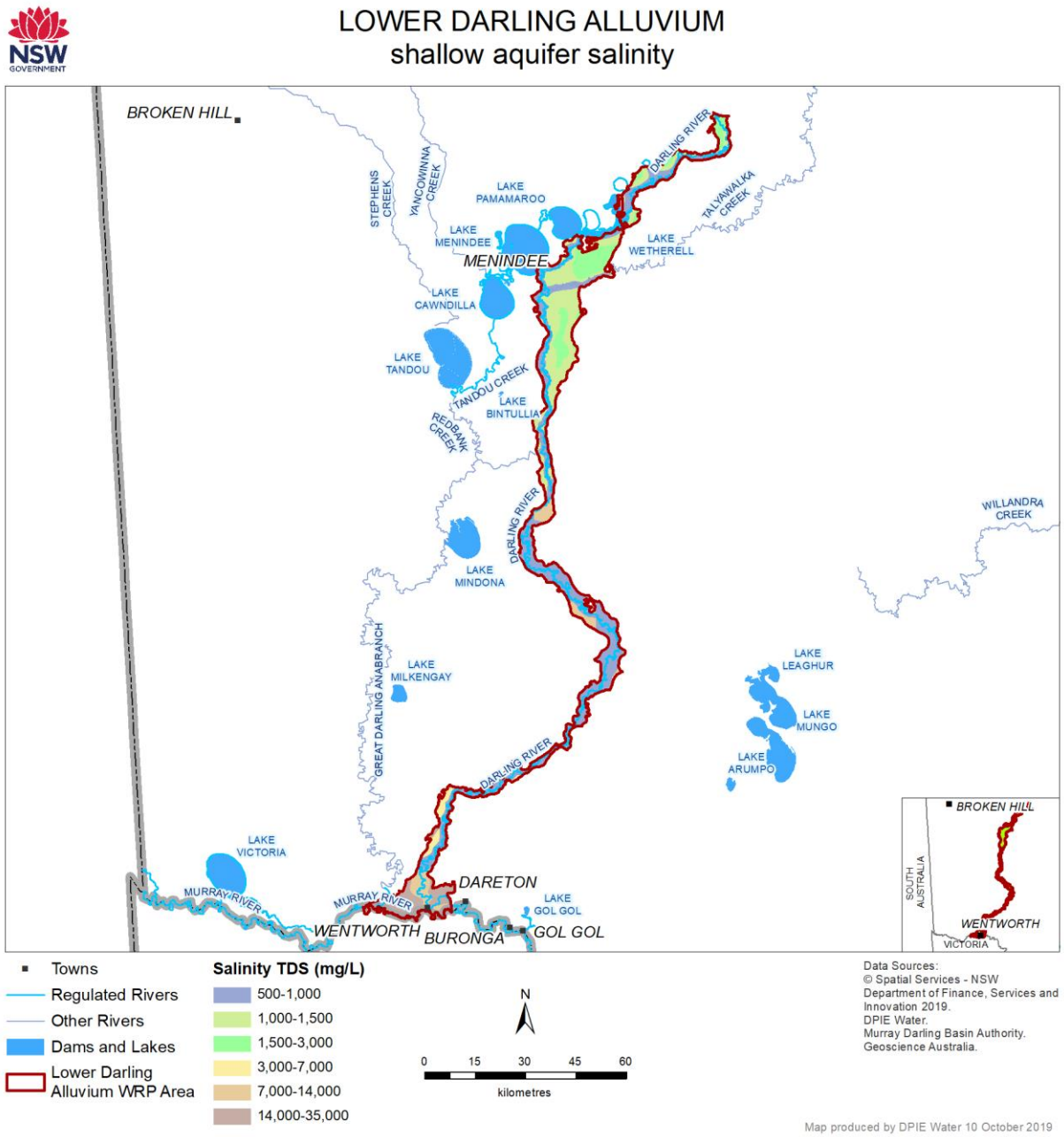


Figure 4. Groundwater salinity in the Lower Darling alluvium (shallow aquifer).

3.2. Water quality in the Upper Darling Alluvium

Groundwater EC in the Upper Darling Alluvium ranges from a fresh value of about 192 mg/L to saline (around 33,300 mg/L). Fresh groundwater in the alluvium is due to rapid recharge mainly via the channel floor of the Darling River during high river flow and through the adjacent floodplain during flood events. Saline groundwater in the alluvium is due to evapo-concentration of the shallow groundwater table during relatively long dry periods and sediment mineral weathering (Meredith et al. 2013, 2015). Saline groundwater discharges from the alluvium into the Darling River where features in the bedrock basement influences the flow of groundwater within the overlying sediments.

Accordingly, shallow groundwater close to the Darling River has a chemical composition similar to that of the river water (after Meredith et al. 2009, 2016). In contrast, deeper groundwater close to the Darling River can be saline due to the mixing of shallow recently recharged fresh water with the discharge of more regionally saline groundwater (Meredith et al. 2013).

Groundwater discharge during drier times and low river flow conditions contribute essentially the entire volume of river water, i.e., the river flow is baseflow (Meredith et al. 2009).

The discharge of saline groundwater is significant at Glen Villa, about 30 kilometres west of Bourke, and is managed via the Upper Darling Salt Interception Scheme. This scheme pumps saline groundwater into a salt management basin to help maintain the health of the river's aquatic ecosystems, improve water quality for downstream town usage, and enable salinity offsets for irrigation agriculture (MDBA 2011b). The Upper Darling Salt Interception Scheme is located on the southern bank of the Darling River approximately 30 km west of Bourke at Glen Villa, New South Wales. The purpose of the scheme is to intercept and reduce saline groundwater inflows to the Darling River by pumping saline groundwater from five interception bores. The intercepted water, with an average salinity of 37,000 µS/cm, is transported to an evaporation basin.

Central Darling Shire Council accesses the Upper Darling Alluvium for town water supply for the Wilcannia township.

3.3. Environmental assets in the Darling Alluvium water resource plan area

The Department of Planning and Environment defines groundwater-dependent ecosystems (GDEs) as '*ecosystems that require access to groundwater to meet all or some of their water requirements so as to maintain their communities of plants and animals, ecological processes and ecosystem services*' (Kuginis et al. 2016). NSW has developed a new approach for identifying the probability of an ecological community being groundwater-dependent including mapping of high probability vegetation GDEs (NSW Department of Industry, Water 2016).

This process has identified significant groundwater dependent ecosystems (GDEs) of high and medium ecological value in the Darling Alluvium WRPA. There were limited areas of very high value in this groundwater source. The Darling alluvium was dominated by the vegetation GDE communities of river red gum woodland wetlands, lignum wetlands, freshwater wetlands, black box woodlands, canegrass swamps, coolabah-river coobah-lignum woodland wetlands and chenopod shrublands. These communities were characterised by having endangered ecological communities, DIWA/Ramsar wetlands (Paroo Wetlands and associated Menindee wetlands), extensive connected riparian corridors and basin target vegetation species (MDBA 2014) of black box, lignum and river red gums. The riparian communities provide vital habitat to nesting species and contributes to ecosystem function of instream ecosystems. Generally, the GDE communities with high ecological value had large vegetation patches, were highly connected (such as riparian corridors) and had a moderate number of threatened species present especially in the wetland areas.

These communities were characterised by having a high number of threatened species, endangered ecological community, extensive connected riparian corridors and basin target vegetation species (MDBA 2014) of coolibah, lignum and river red gums. Figure 5 and Figure 6 show the locations of the groundwater dependent environmental assets identified within the Darling Alluvium WRPA.

Those vegetation ecosystems that have been assessed as having a high probability of being groundwater dependent and also have a very high and high ecological value are considered to be key environmental assets which will be scheduled in groundwater water sharing plans for management purposes as 'high priority GDEs'. The identification of the GDEs in the Darling WRPA also aligns with those included in the Long Term Water Plan developed by Department of Planning and Environment – Environment and Heritage Group. The assigning of an ecological value has been developed using the High Ecological Value Aquatic Ecosystems (HEVAE) framework (Aquatic Ecosystems Task Group 2012).

Terrestrial vegetation GDEs are known to have various tolerances for water quality, particularly salinity. In the Murray Darling Basin, vegetation communities tend to be dominated by river red gums, black box, river cooba, coolabah and lignum. Each of these species tends to have varying tolerances to salinity which is also dependent on location in the landscape such as riparian or

floodplain and also their flooding frequency requirements. River red gums have been recorded to have a maximum salinity tolerance of 20,000 mg/L (30,000 µS/cm) with a requirement of a flooding event every 1.5 years and are generally located within riparian areas. Black box and river cooba have a higher salinity tolerance. Although not conducive with good plant health, they have been found in areas with salinity of approximately 27,000 mg/L (40,000 µS/cm). They require a flooding event every three to five years and are generally located in flood plains (Doody & Overton 2009).

GDEs including terrestrial (vegetation), aquatic (wetlands, springs and baseflows) and subterranean (aquifer) are highly diverse. As a result, assigning one water quality target for all GDEs is problematic. Previous studies have reported that aquatic biota would be adversely affected when salinity exceeds 1,000 mg/L (1,500 µS/cm) (Hancock and Boulton 2008; Nielsen et al. 2003). Groundwater dependent biota are found most commonly in fresh to brackish water, less than 3,350 mg/L or 5,000 µS/cm (Hose et al. 2015), but have also been found in very high electrical conductivities, approaching that of seawater, between 36,300 and 54,800 µS/cm. There may be a range of environmental attributes that influence the distribution of aquatic biota, including habitat, site, water quality (organic carbon, dissolved oxygen, nitrate and ammonia) and climate variables (Korbel 2012). Water quality targets for the vegetation GDEs identified in the Darling Alluvium WRPA are discussed further in section 5.

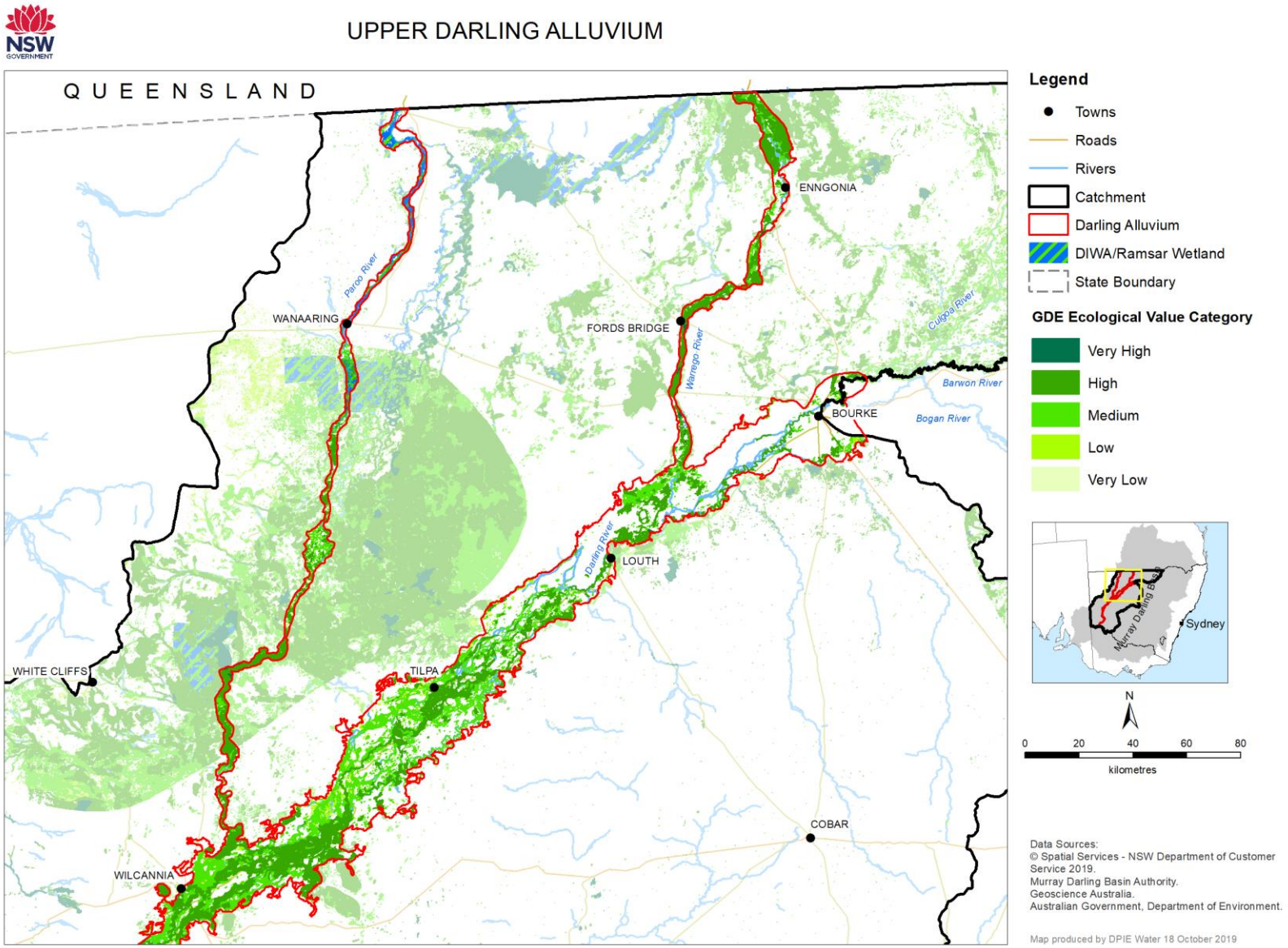


Figure 5. Groundwater dependent environmental assets within the Upper Darling Alluvium WRPA.

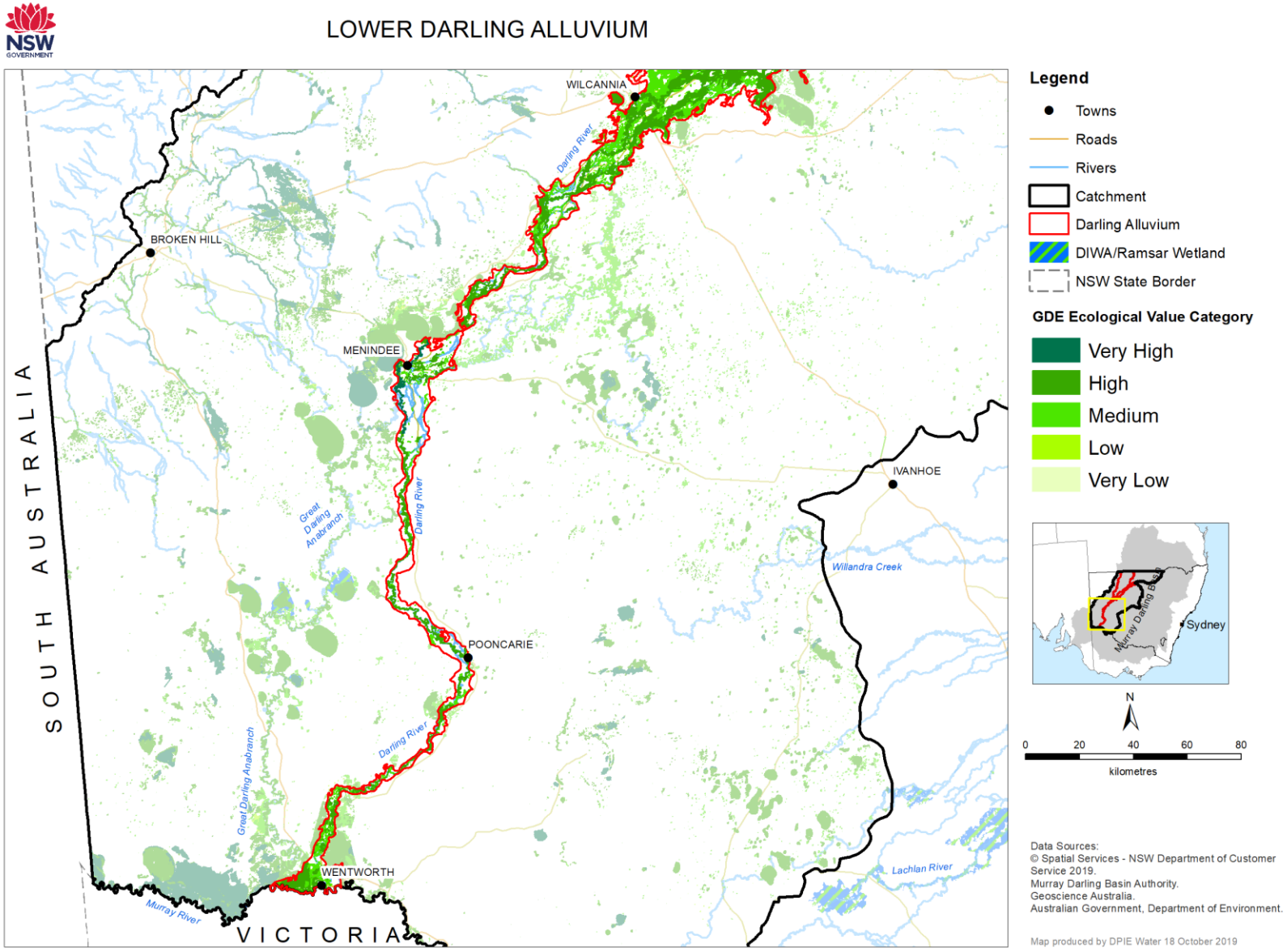


Figure 6. Groundwater dependent environmental assets within the Lower Darling Alluvium WRPA.

3.4. Likely causes of water quality degradation in the Darling Alluvium water resource plan area

BASIN PLAN 10.35A. The causes, or likely causes of water quality degradation in the Darling Alluvium WRPA are presented in Table 3. These have been prepared having regard to the risk assessment and key causes of water quality degradation identified in Part 2 of Chapter 9 and set out in Schedule 10 of the *Basin Plan*.

Identifying and understanding why water quality degradation occurs is essential for sustainable management of water resources. Table 3 presents the causes, or likely causes of water quality degradation in the Darling Alluvium WRPA based on best available water quality data and knowledge. Table 8 (Appendix A) lists all key causes of water quality degradation as set out in Schedule 10 of the Basin Plan. Water quality degradation issues from elevated suspended sediment, cyanobacteria counts and temperature, dissolved oxygen and pH outside of natural ranges are more appropriate for surface water and are therefore not included as causes of water quality degradation in the Darling Alluvium water quality management plan.

Table 3. Causes, or likely causes of water quality degradation in the Darling Alluvium WRPA based on Schedule 10 of the Basin Plan.

Type of water quality degradation	Cause of water quality degradation	Where it occurs
C1. Elevated levels of salinity (s 10.41(2)(d))	Drawdown in an aquifer that is hydraulically connected to saline groundwater	Upper and Lower Darling Alluvium Low risk identified in Darling Alluvium Risk assessment (Schedule D: R2 - Risk of groundwater extraction inducing connection with poor quality groundwater)
C2. Elevated levels of nutrients	Nutrients entering Darling Alluvium water resources through both point and diffuse sources. The key sources of nutrients are: • soil and organic matter • animal waste • fertilisers • sewage and industrial discharges.	Knowledge gap Potential risk as activities that cause water quality degradation are present in the WRP area Risk – Low - QAL (identified in Darling Alluvium Risk Assessment Schedule D: QL5 - Risk of poor water quality to the environment (GDEs and instream ecological values)) *
C3. Elevated levels of pesticides and other contaminants	Poor management practices including the following: • Allowing pesticides or other contaminants to leach into ground water • Inappropriate disposal of pesticides • Inappropriate disposal and management of industrial and other waste (including from mining and coal seam gas extraction).	Knowledge gap Refer to the EPA for a list of contaminated sites Potential risk as activities that cause water quality degradation are present in the WRP area Risk – Low - QAL (identified in Darling Alluvium Risk Assessment Schedule D: QL5 - Risk of poor water quality to the environment (GDEs and instream ecological values)) *
C4. Elevated pathogen counts	Pathogens entering water resources through both point and diffuse	Knowledge gap

Type of water quality degradation	Cause of water quality degradation	Where it occurs
	sources. The key sources of pathogens are: • Human and animal waste • Sewage discharges	Potential risk as activities that cause water quality degradation are present in the WRP area. Risk – Low - QAL (identified in Darling Alluvium Risk Assessment Schedule D: QL5 - Risk of poor water quality to the environment (GDEs and instream ecological values)) *

*This is a qualitative assessment of existing processes based on Department of Planning and Environment – Water groundwater quality specialist expert opinion and available information from other NSW government agencies. As such no data has been reviewed and so a low confidence according to the criteria in Table 2-5 of the Darling Alluvium Risk Assessment (Schedule D) applies. Measures that contribute to the mitigation of risk consequences are located in Table 6; explanatory text is included in Table 11.

4. Managing water quality in the Darling Alluvium

4.1. Basin Plan water quality objectives

The water quality objectives presented in Table 4 apply to the waters of the Darling Alluvium WRPA. They contribute to the overall objective for the Murray Darling Basin to maintain appropriate water quality, including salinity, for environmental, social, cultural, and economic activity (BASIN PLAN 5.02 - 5.04).

BASIN PLAN 10.52, **9.03-9.06** and **9.08** Water quality objectives for Darling Alluvium water resources are listed in Table 4. These objectives reflect those set out for Basin water resources with the exception of recreational water as it is not relevant for the Darling Alluvium water resource plan area.

Table 4. Basin Plan Water quality objectives for the Darling Alluvium WRPA.

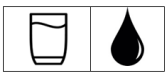
CODE	Basin Plan Water Quality Objectives	Basin Plan
	**Maintain water quality to protect First Nations people's water dependent values and uses** The objective is to ensure water quality is sufficient to maintain the spiritual, social, customary and economic values and uses of water by First Nations people.	**10.52**
	**Maintain water quality to protect and restore water dependent ecosystems** The objective is to ensure water quality is sufficient to: • Protect and restore ecosystems and ecosystem functions • Ensure ecosystems are resilient to climate change, • Maintain the ecological character of the Darling Ramsar wetlands.	**9.04**
	**Maintain the quality of raw groundwater for treatment for human consumption** The objective is to minimise the risk that the quality of raw water taken for human consumption results in: • Adverse human health effects • The odour of drinking water being offensive to consumers The objective also aims to maintain the palatability of rating of drinking water at the level of good as set out in the Australian Drinking Water Guidelines.	**9.05**
	**Maintain the quality of groundwater for irrigation use** The objective is to ensure the quality of groundwater, when used in accordance with the best irrigation and crop management practices and principles of ecologically sustainable development, does not result in crop yield loss or soil degradation.	**9.06**
	**Maintain good levels of water quality** The objective is to maintain the value of a water quality characteristic if it is at a level that is better than the target value set out in Section 5.	**9.08**

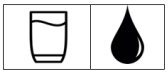
4.2. Measures that contribute to achieving Basin Plan water quality objectives in the Darling Alluvium water resource plan area

Ensuring water quality remains fit for purpose and able to achieve objectives requires coordinated water and land resource management. The measures presented in Table 5 consist of plans, strategies and frameworks developed by NSW Government agencies that support the maintenance of water quality in the Darling Alluvium WRPA against the effects of elevated levels of salinity and other types of water quality degradation identified in Table 3. These measures also contribute to achieving the Basin Plan water quality objectives (Section 4.1).

Measures contributing to Basin Plan water quality objectives are listed in Table 5. These measures have been prepared having regard to the causes, or likely causes of water quality degradation listed in Table 3 and the water quality targets listed in Table 7.

Table 5. Measures that contribute to achieving water quality objectives in the Darling Alluvium WRPA.

Objectives	Strategic, plans and frameworks
	***Water Sharing Plan for the Darling Alluvial Groundwater Sources 2020***
	The *Water Sharing Plan for the Darling Alluvial Groundwater Sources 2020* aims to protect water resources in groundwater systems for the long term and provide a critical balance between water users and the environment. It establishes rules for sharing water between different types of water use such as town supply, rural domestic supply, stock watering, industry and irrigation and ensure that water is provided for the health of the system.
	**Western Local Land Services local strategic plan 2016-2021**
	The *Western Local Land Services Local Strategic Plan* assists Local Land Services to achieve its vision of resilient communities in productive healthy landscapes. It aligns with Local Land Services' State Strategic Plan and exists as part of an overall framework that links NSW, Australian and Local Government plans and initiatives.
	**The Basin salinity management strategy 2030 (BSM2030)**
	The *Basin salinity management strategy 2030* builds on the successes of the Basin salinity management strategy (2001-2015) to deliver a strategic, cost-efficient and streamlined program of coordinated salinity management for the next 15 years.
	**NSW Safe and Secure Water Program**
	The *NSW Safe and Secure Water* Program supports the critical needs of regional industries and communities by ensuring water security and quality of supply. It provides $1 billion funding for water and sewerage infrastructure projects in regional NSW. Eligible projects must deliver public health, environmental and/or social benefits for their communities.
	NSW Drinking water management systems

Objectives	Strategic, plans and frameworks
	The *Public Health Act 2010* and Public Health Regulation 2012 require drinking water suppliers in NSW to develop and adhere to a Drinking Water Management System. The System is a quality assurance framework that identifies and manages Critical Control Points through a risk based approach. Critical Control Points are essential to prevent a water quality hazard or reduce it to an acceptable level.
	**Department of Primary Industries Agriculture – Grazing management guidelines and advisory services**
	The Department of Primary Industries Agriculture provides information, education and training on sustainable agriculture practices. They provide a range of guidelines for best practice grazing management including for production in the Darling Wetlands, acid-sulfate soils and fertiliser or pesticide use. These assist agricultural industries minimise and mitigate potential water quality issues such as erosion and contaminants in runoff and leaching.
	**NSW Environment Protection Authority**
	The NSW Environment Protection Authority (EPA) is the primary environmental regulator for New South Wales. They have responsibilities and powers under a range of NSW environmental legislation. They are responsible for: • issuing environment protection licences • requiring strict operating conditions and pollution reduction programs • monitoring compliance with licence conditions and investigating pollution reports • ordering the clean-up of pollution • imposing fines or prosecuting organisations and individuals who break the law. • respond to and manage pollution incidents involving hazardous materials (in collaboration with other government agencies)
	**NSW Aquifer Interference Policy 2012**
	Policy developed for the licensing and impact assessment processes for aquifer interference activities. It addresses take, minimal impact considerations on water table levels, water quality and water-dependent ecosystems.
	**NSW State Groundwater Policy Framework Document 1997**
	Provides an overall direction for groundwater management in NSW, with broad objectives and principles to guide decisions.
	**NSW State Groundwater Quality Protection Policy 1998**
	A Component Policy of the NSW State Groundwater Policy which provides a comprehensive set of policy principles for groundwater quality protection.
	**NSW Private Water Supply Guidelines**
	Guidance for private water suppliers on applying the Australian Drinking Water Guidelines and to assist in meeting the quality assurance program provisions of the NSW Public Health Act 2010 and Public Health Regulation 2012.

4.3. Measures that support the maintenance of water quality against the effects of elevated levels of salinity and other types of water quality degradation

The measures presented in Table 6 have been developed to support the maintenance of water quality against the effects of elevated levels of salinity and other types of water quality degradation in the Darling Alluvium WRPA. These measures take into account the causes, or likely causes of water quality degradation identified in Table 3 and the target values identified in Table 7.

Based on the water quality data and information available, water quality objectives for the Darling Alluvium WRPA have been formulated where there are 'levers' available to water managers. Where appropriate, opportunities for infrastructure, land and vegetation management have also been identified.

BASIN PLAN 10.35C(1) & (3) Measures that support the maintenance of water quality against the effects of elevated levels of salinity and other types of water quality degradation in the Darling Alluvium water resource plan area are listed in Table 6. The measures have been prepared having regard to the causes, or likely causes of water quality degradation listed in Table 3 (s.10.35A) and the water quality target values listed in Table 7 (s10.35B). These measures also contribute to achieving Basin Plan objectives listed in Table 4 and align with the risks identified in the Darling Alluvium Risk Assessment GW7 Water Resource Plan Area.

BASIN PLAN 10.35C(2)(a) -(c) Measures included in Table 6: WQ1 provide rules under the *Water Sharing Plan for the Darling Alluvium Groundwater Sources 2020* that specify locations, rates, extraction limits and restrictions that contribute to the maintenance of salinity levels and other types of water quality degradation.

BASIN PLAN 10.35C(2)(d) A water quality monitoring program for NSW groundwater is proposed. Following this the Department of Planning and Environment - Water will establish a register of monitoring bores for salinity.

BASIN PLAN 10.35(D) As the Darling Alluvium water resource plan area does not include the water resource plan areas listed in this clause, this requirement is not relevant for this water quality management plan.

Note on inclusion of strategies to address risks to First Nations people's water quality dependent values and uses.

The Darling Alluvium WRPA is located within the traditional lands of, and significant to the Barkandji and Maljangapa, Budjiti, Euahlayi, Murrawarri, Ngemba and Wailwan Aboriginal Nations. NSW Department of Planning and Environment-Water has spent time engaging and consulting with Senior Traditional Owners and members of these Aboriginal Nations to identify and record objectives and outcomes in regard to Aboriginal water dependent values and uses within the Darling catchment. This process has also recorded a range of water quality based issues observed by and important to First Nations people within the Darling catchment. A number of significant values and uses remain yet to be tabled and require additional work to be completed. Future provisioning of water quality management will need to consider this additional information as it arises.

Table 6. Measures that support the maintenance of water quality against the effects of salinity and other types of water quality degradation in the Darling Alluvium WRPA.

Objectives	Strategies	Water management actions and mechanisms	Management plan
WQ1) Manage groundwater salinity by ensuring extraction does not result in a change in the beneficial use category Risk identified for induced connection with poor quality water (R2): ***Low Risk*** *Lower Darling Alluvium and Upper Darling Alluvium* 10.41(2)(d) (Darling Alluvium Risk Assessment GW7 WRPA (NSW Department of Planning and Environment, Water 2022). 	Limit seasonal drawdown in high risk areas	Manage extraction at water supply works to prevent decline in groundwater levels resulting in poor water quality to maintain GDE vegetation. Set back distance rules to limit drawdown Set bore extraction limits on production bores in high risk areas to limit drawdown	**A**[1] *Water Sharing Plan for the Darling Alluvial Groundwater Sources 2020* Part 9 Clauses 38, 39, 40, 41, 42, 43, 44 Part 11 Clause 57. **A** *Water Management Act 2000* s.100, s102
		Temporarily restrict access under the WMA 2000 s.324 when there are water shortages	**A** *Water Management Act 2000* s.324
	Limit total water extraction (basic rights and groundwater take) between and within each groundwater source/SDL resource unit to predetermined sustainable levels.	Reserve all water above the long-term average annual extraction limit (LTAAEL) for the environment as PEW Sustainable Diversion Limits Manage compliance to limits Require all take to be licensed except for BLR or where a policy indicates otherwise. Trade limits or prohibitions between surface water plan areas, water sources, and management	**A** *Water Sharing Plan for the Darling Alluvial Groundwater Sources 2020* Part 4 Clauses 16, Part 6 Clauses 24, 25, 26, 27, 28 Part 10 Clauses 46, 47, 48, 49 & 50 **A** *Water Management Act 2000* s.60A, s.100, s.102

[1] **A** marks instruments 'for accreditation' under the Basin Plan while **N** marks instruments 'not for accreditation' under the Basin Plan

Objectives	Strategies	Water management actions and mechanisms	Management plan
		zones to manage extraction. Prohibit trade between surface water and groundwater sources. Set bore extraction limits on production bores in high risk areas to limit drawdown Compliance with individual extraction limits	
	Ensure bore construction standards are adhered to	Manage to standards to reduce risk of cross-contamination of aquifers with different quality groundwater.	**A** *Water Sharing Plan for the Darling Alluvial Groundwater Sources 2020* Part 9 Clauses 38, 40, 44, Part 11 Clauses 57 & 59.
	Reduce induced flow from high salinity groundwater	Manage assessment criteria considering minimal impacts to aquifer	**N** Aquifer Interference Policy
		For the majority of water access licences in the Lower Darling Alluvium, water must not be taken unless EC<3000uS/cm, preventing saline water incursion to freshwater lenses.	**A** *Water Sharing Plan for the Darling Alluvial Groundwater Sources 2020* Part 8 Clause 37(1), 37(2), 37(5) and 37(7)
		Temporarily restrict access under the WMA 2000 s.324 when there are water shortages, threat to public health or safety, or to manage water for environmental purposes.	**A** *Water Management Act 2000* s.324

Objectives	Strategies	Water management actions and mechanisms	Management plan
	Improve knowledge used to assess risks and evaluate the effectiveness of existing strategies.	Reviews resulting from application of risk treatments will contribute to filling knowledge gaps and evaluating effectiveness of existing strategies.	**N** Groundwater Environmental Monitoring, Evaluation and Reporting Plan
WQ2) Manage salinity in connected surface waters 	Limit impact of saline groundwater discharges on surface water systems.	The Curlwaa and Upper Darling salt interception schemes. Contribute to the end of basin salinity target by diverting saline groundwater before it enters the River Murray through salt interception and drainage diversion schemes.	**N** BSMS 2030
	Improve land management practices including the planting of deep-rooted vegetation to reduce rainfall recharge displacing saline groundwater to surface water systems.	No levers within scope of water planning. Natural resource management agencies provide advisory services that support and enable landholders to implement improved natural resource and agricultural management practices.	**N** Western Local Land Services Local Strategic Plan
WQ3) Manage nutrients from organic matter, animal waste, fertilisers, wastewater discharges (sewage treatment facilities, septic and stormwater) entering the groundwater SDL resource unit. ***Knowledge gap*** *All areas* Risk rating: Low –QAL (Darling Alluvium Risk Assessment GW7	Reducing nutrients entering the water resource is largely related to land, vegetation and natural resource management. Strategies include best management practices for chemical handling and application, cropping	No levers within scope of water planning to reduce nutrients entering groundwater source. WSP rules have offset distances from known contamination sites and plumes to limit mobilisation of plume induced from pumping	**A** *Water Sharing Plan for the Darling Alluvial Groundwater Sources 2020* Part 9 Clauses 40, Part 11 Clause 57(1)(e), 57(2) & 57(3).

Objectives	Strategies	Water management actions and mechanisms	Management plan
WRPA: QL5 *Risk of poor water quality to the environment* (NSW Department of Planning and Environment, Water 2022). 	practices, runoff management from agricultural land and licence assessment and conditions for onsite and sewage treatment plants	Natural resource management agencies provide advisory services that support and enable landholders to implement improved natural resource and agricultural management practices	**N** Western Local Land Services Local Strategic Plan
		Manage known or potential sources of nutrients entering the groundwater source causing a decline in groundwater quality including assessments during licence approvals and licencing conditions.	**N** *Protection of the Environment Operations Act 1997* **N** *Local Government Act 1993*
WQ4) Manage pesticides and other contaminants including industrial discharges entering the groundwater SDL resource unit.  ***Knowledge gap*** *All areas* Risk rating: Low –QAL (Darling Alluvium Risk Assessment GW7 WRPA: QL5 Risk of poor water quality to the environment (NSW Department of Planning and Environment, Water 2022).	Reducing pesticides and other contaminants from entering the water resource is largely related to land, vegetation and natural resource management. Strategies include best management practices for chemical handling, application and waste management, runoff management from agricultural land and discharges from industries and mine sites.	No levers within scope of water planning to reduce pesticides entering groundwater source. Natural resource management agencies provide advisory services that support and enable landholders to implement improved natural resource and agricultural management practices.	**N** Western Local Land Services Local Strategic Plan
		Manage known or potential sources of groundwater contamination to limit decline of groundwater quality.	**N** *Protection of the Environment Operations Act 1997* **N** Aquifer Interference Policy
		WSP rules have offset distances from known contamination sites and plumes to limit	**A** *Water Sharing Plan for the Darling Alluvial Groundwater Sources 2020*

Objectives	Strategies	Water management actions and mechanisms	Management plan
		mobilisation of plume induced from pumping	Part 9 Clause 40, Part 11 Clauses 57(1)(e), 57(2) & 57(3).
		Temporarily restrict access under the WMA 2000s.324 when there are water shortages, threat to public health or safety, or to manage water for environmental purposes.	**A** *Water Management Act 2000* s.324
WQ5) Manage contamination from pathogens entering the groundwater source  ***Knowledge gap*** *All areas* Risk rating: Low –QAL (Darling Alluvium Risk Assessment GW7 WRPA: QL5 Risk of poor water quality to the environment (NSW Department of Planning and Environment, Water 2022).	Reduce microbial contamination to groundwater sources from animal faeces.	No levers within scope of water planning to reduce pathogens entering the groundwater source. Natural resource management agencies provide advisory services that support and enable landholders to implement improved natural resource and agricultural management practices.	**N** Western Local Land Services Local Strategic Plan
	Reduce point and diffuse contamination from discharges from sewage – onsite and sewage treatment facilities.	Manage known or potential sources of groundwater contamination to limit the decline of groundwater quality including assessments during licence approvals and licencing conditions.	**N** *Protection of the Environment Operations Act 1997* **N** *Local Government Act 1993*
		WSP rules have offset distances from known contamination sites and plumes to limit mobilisation of plume induced from pumping	**A** *Water Sharing Plan for the Darling Alluvial Groundwater Sources 2020* Part 9 Clause 40,

Objectives	Strategies	Water management actions and mechanisms	Management plan
			Part 11 Clauses 57(1)(e), 57(2) & 57(3).

Explanatory text is provided in Table 11 showing how the measures relate to the causes and target values.

N highlights measures that will not be accredited by the MDBA during assessment of the WRP

A highlights measures that will be accredited by the MDBA during assessment of the WRP

5. Water quality targets

The Basin Plan sets out water quality targets and target application zones in Schedule 11. They provide a guideline for appropriate water quality required for environmental, social and economic outcomes in the Murray–Darling Basin for streams, rivers, lakes and wetlands.

Groundwater specific water quality targets are not included in Schedule 11 of the Basin Plan. The salinity target listed in Schedule 11 of the *Basin Plan* is a surface water salinity target for the purpose of long-term salinity planning managing (s9.19) of the Basin Plan and not appropriate for groundwater management. Therefore, NSW has adopted alternative water quality targets to fulfil the requirements of the Basin Plan (s10.35B(3)).

The *Basin Plan* requires the water quality management plan to identify water quality target values ((10.35) (2) (a-c)) for:

- Fresh water-dependent ecosystems identified in the Darling long term watering plan for surface water that are also groundwater dependent (s9.16 of the Basin Plan);
- Irrigation water (salinity and SAR) where an irrigation infrastructure operator is present (s9.17 of the Basin Plan); and
- Recreational water (s9.18 of the Basin Plan).

NSW has adopted beneficial use categories outlined in *The NSW Groundwater Quality Protection Policy 1998* and determined in accordance with procedures set out in ANZECC 2000 Guidelines for:

- tolerances of plants to salinity in irrigation water,
- suitability of water for stock watering and
- the World Health Organisation (2004) for palatability drinking water guideline to fulfil the water quality objectives (s9.05 - 9.08 of the Basin Plan).

Beneficial use categories provide a set of environmental values that are to be protected, upper thresholds that serve as performance indicators that can be measured, evaluated and reported on. They set water quality objectives that must be met to maintain the beneficial uses of the water resource (MDBA: Position statement 7B).

As yet, no water quality targets or thresholds have been defined for Aboriginal cultural, spiritual or ceremonial outcomes.

5.1. Water quality targets for water resource plans

BASIN PLAN 10.35B. The water quality targets listed in Table 7 apply to the Darling Alluvium water resource plan area.

The water quality target for fresh water-dependent ecosystems (10.35B(2)(a)) specify alternative values (10.35B(3)) to those referred to in s9.16 of the Basin Plan. The water quality parameters shown in Schedule 11 of the Basin Plan are surface water parameters and are not appropriate for gauging groundwater quality. Salinity is used to describe the water quality within the aquifer and the suitability of its use.

The salinity target listed in Schedule 11 of the Basin Plan is a surface water salinity target for the purpose of long-term salinity planning managing (s9.19). The adoption of the alternative salinity target value listed for the Darling Alluvium WRPA will have no adverse impact on the End-of-Valley surface water targets for salinity as it is a groundwater resource. Progress towards these water quality targets is reported every five years in accordance with Schedule 12, Matter 12 of the Basin Plan as part of the Groundwater environmental monitoring, evaluation and reporting (EMER) plan.

For water used for irrigation purposes (s10.35B(2)(b)), the water quality target value for irrigation water set out in s9.17 and objective s9.06of the Basin Plan, is not required as there are no infrastructure irrigation operators that deliver services in the Darling Alluvium water resource plan area.

For the purpose of section 10.35(2)(c) of the Basin Plan, water quality target values for recreational purposes set out in s.9.18 and objectives s.9.07 are not provided as groundwater is not used for recreational purposes in the Darling Alluvium WRP area.

5.1.1. Water quality targets for water-dependent ecosystems

The Basin Plan water-dependent ecosystem targets listed in Schedule 11 of the Basin Plan were developed following the methods outlined in the *ANZECC Guidelines (2000)* for streams, rivers, lakes and wetlands to assess the suitability of water to support healthy water-dependent ecosystems. As discussed above, as the targets were more relevant to surface water and not appropriate to groundwater, NSW has adopted an alternative salinity target that will provide a level of protection for the fresh water-dependent ecosystems identified in the Darling Alluvium WRPA. Water is considered fresh when salinity is less than 3,000 mg/L (Nielsen et al. 2003). Fresh water-dependent ecosystems access water at a range of salinities dependent on their tolerances and accessibility to fresher water.

Table 7 shows the salinity target values for fresh water-dependent ecosystems (terrestrial vegetation) Water quality targets for all SDL units within the Darling Alluvium WRPA (including the Upper Darling Alluvium and the Lower Darling Alluvium) have been divided into zones, as salinity levels vary within the water resources. Vegetation GDEs associated with aquatic ecosystems that rely on surface expression of groundwater have a water quality target application zone 900 mg/L and applies to the riparian zone of 100m (zone 1). The target value of 900 mg/L is equivalent to the Australian drinking water guideline for acceptable drinking water (WHO 2004; ADWG 2011) and the beneficial use segment A2. All remaining terrestrial GDEs accessing fresh water will have a target value of less than 3, 000 mg/L (zone 2) which is equivalent to beneficial use segment B. The water quality targets in Table 7 apply to the GDEs illustrated in Figure 5 & Figure 6.

Table 7. Water quality targets in the Darling Alluvium WRPA.

	Location	Target value (salinity mg/L)**		Basin Plan requirement and justification
Fresh water-dependent ecosystems	Upper Darling Alluvium Lower Darling Alluvium	Zone 1	900	Alternative target value for 10.35B(2)(a) provided under s10.35B(3): Target values are consistent with objectives in Part 3 Chapter 9 and developed in accordance with ANZECC Guidelines procedures. The measures provided in Table 6 take account of the ANZECC Guidelines and the target values
		Zone 2	<3,000	
Irrigation water	-	Not relevant for Darling Alluvium WRP area		s10.35B(2)(b) s9.17 Not relevant in the Darling Alluvium WRP area as there is no irrigation infrastructure operator* present
Recreational water	-	Not relevant for Darling Alluvium WRP area		s10.35B(2)(c) s9.18 Not relevant in the Darling Alluvium WRP area (MDBA position statement 7A, 2017) as groundwater is not used for recreational purposes in this WRP area

* In NSW, irrigation infrastructure operators are defined as a separate third party that holds a water access entitlement and delivers water to shareholders. These include NSW Irrigation Corporations, Private Irrigation Districts and Private Water Trusts.

** Target values for water quality parameters other than salinity are not provided.

Section 6.6 of the Darling Alluvium Risk Assessment (Schedule D) assesses risks to groundwater dependant ecosystems (GDEs) attributable to land and waste management practices as low-QAL.

In the absence of comprehensive monitoring, NSW considers the EPA's risk based licensing and approval system adequately manages the major causes of water quality degradation from major contaminants (other than salinity) entering the groundwater SDL source units and hence adequately mitigates likelihood. Further explanation is provided in Table 11

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Appendices

Appendix A: Key causes of water quality degradation (Schedule 10)

Table 8. Basin Plan key causes of water quality degradation.

Type of water quality degradation	Cause of water quality degradation
Elevated levels of salinity	(1) The process of mobilisation of salt stores in the landscape and geological predisposition to salinity development, including by: (a) the following processes and activities relating to water flow or water management: (i) saline groundwater and surface water discharges into surface water systems. (ii) increased deep drainage below irrigated agricultural land displacing saline groundwater to surface water systems. (iii) saline surface and shallow groundwater drainage from irrigated agricultural land into surface water systems. (iv) irrigation at high salinity risk locations without adequate drainage management. Example: Locations where there is a high risk of recharge to groundwater resulting in saline discharges to surface waters. (v) de-watering of saline groundwater which mobilises salt into surface water systems. (vi) reduction in stream flows, limiting the dilution of salinity. (b) land management practices involving the replacement of deep-rooted vegetation with shallow-rooted crops and pastures, resulting in increased rainfall recharge displacing saline groundwater to surface water systems. (2) The use of groundwater for irrigation purposes at locations where highly saline upper aquifer water drains to the lower aquifer. (3) With respect to soil degradation, the use of water with a high ratio of sodium to calcium and magnesium for irrigation.
Elevated levels of suspended matter*	Sediments entering Basin water resources, which is contributed to by: (a) the following land management practices: (i) inappropriate frequency, timing and location of cultivation. (ii) overgrazing of catchments and grazing of riverbanks and floodplains. (iii) poor soil conservation practices. (iv) practices that over the long-term cause decline of stream morphology, leading to near stream processes of gully erosion, side wall cut and head migration; and (b) the following water management practices: (i) rapid drawdown of water within a surface water resource. (ii) the volume or manner of release of water, resulting in back or bed erosion; and (c) wave wash (for example, that caused by speedboats).

Type of water quality degradation	Cause of water quality degradation
Elevated levels of nutrients	Nutrients entering Darling Alluvial water resources through both point and diffuse sources. The key sources of nutrients are: (a) soil and organic matter. (b) animal waste. (c) fertilisers. (d) sewage and industrial discharges. (e) nutrients from water storages released as a result of storage management practices.
Elevated levels of cyanobacteria cell counts or biovolume and toxins and odour compounds*	The interaction of the following factors: • A water body with little or no flow • Stratification in the water body • Sunlight • The availability of phosphorus and nitrogen in the water • Seeding from upstream (although cyanobacteria blooms may occur without this factor).
Water temperature outside of natural ranges*	(1) The key cause of water temperature of Basin water resources below natural ranges is the release of stored water from below the thermocline from large water storages in spring, summer and autumn. (2) The key causes of water temperature of Basin water resources above natural ranges are the following: (a) the release of stored water from large water storages in winter. (b) the removal of shading riparian vegetation. (c) reduced flow.
Dissolved oxygen outside of natural ranges*	(1) Micro-organisms consuming organic matter and depleting oxygen at a rate faster than it can be replenished. (2) Bottom release from, or overturn within, a stratified water storage. (3) Eutrophication leading to excessive plant growth causing high diurnal variations in dissolved oxygen levels, both above and below natural ranges.
Elevated levels of pesticides and other contaminants	Poor management practices including the following: (a) pesticide spray drift. (b) allowing pesticides or other contaminants into surface water runoff. (c) allowing pesticides or other contaminants to leach into groundwater. (d) allowing erosion of contaminated soil. (e) inappropriate disposal of pesticides. (f) inappropriate disposal and management of industrial and other waste (including from mining and coal-seam gas extraction).
pH outside natural ranges*	(1) The exposure to the air of soils containing iron sulphide minerals. (2) Agricultural practices that lead to the acidification of soils. (3) Eutrophication leading to excessive plant growth causing high diurnal variation in pH.
Elevated pathogen counts	Pathogens entering Basin water resources through both point and diffuse sources. The key sources of pathogens are: • Human and animal waste • Sewage discharges

*Not applicable to groundwater – surface water quality parameters

Appendix B: Risk assessment summary

Table 9. Summary of risk outcomes for induced connection with poor quality water (salinity).

SDL Resource Unit	Consequence	Likelihood	Overall risk
Upper Darling Alluvium	Low	Low	Low
Lower Darling Alluvium	Low	Low	Low

A full list of risks identified in the Darling Alluvium WRPA can be found in the Darling Alluvium Risk Assessment GW7 Water Resource Plan Area (NSW Department of Planning and Environment, Water 2022).

Appendix C: Conversion EC and TDS

Table 10. Conversion of TDS (mg/L) to electrical conductivity (µS/cm).

Beneficial use segment	A1	A2	A3	B	C1	C2	D
TDS (mg/L)	0 - 600	601 – 900	901 - 1200	1,201 – 3,000	3,001 – 6,000	6,001 – 10,000	>10,000
EC (µS/cm)	896	897 - 1343	1344 - 1791	1792 - 4478	4479 - 8955	8956 – 14,925	>14,925

Appendix D: Explanation of accredited measures – how they meet Basin Plan requirements

Measures required under s10.35C of the *Basin Plan* are listed in Table 6. They support the maintenance of water quality within the groundwater SDL resource unit against the effects of elevated levels of salinity and other types of water quality degradation. Causes or likely causes of water quality degradation relevant to groundwater resource units are listed in Table 3, required under s10.35A of the *Basin Plan*. Regard has been had for the key causes of water quality degradation identified in Schedule 10 of the *Basin Plan*. The measures presented in Table 6 align with the strategies to address medium and high risks against induced connection with poor water quality (salinity) as identified in the Darling Alluvium Risk Assessment GW7 Water Resource Plan Area (Schedule D: Tables 4-9 & 8.7- R2 Risk of groundwater extraction inducing connection with poor quality groundwater) and likely causes of water quality degradation identified in Table 3, required under s10.35C(2) (a-c) of the *Basin Plan*.

The water quality target values required under s10.35B of the *Basin Plan* are listed in Table 7. The Basin Plan objectives relevant to groundwater (excluding recreation) are listed in Table 4. Each objective is represented by symbol (also illustrated in Table 4) and highlights the Basin Plan corresponding objective. Table 5 lists measures that contribute to achieving those water quality objectives listed in Table 4 with the corresponding symbol, illustrating which objective the measure contributes to. This is also included in the first column of Table 6. A brief description of either the strategy, plan or framework that contributes to reducing the risk of water quality degradation in the SDL resource unit are listed in Table 5. These measures have been prepared having regard to the causes of water quality degradation listed in Table 3 and the water quality targets listed in Table 7.

Table 11 describes the linkage between the measure required under 10.35C and how it relates to the water quality target values (s10.35B), the causes, or likely causes of water quality degradation (s10.35A), and the alignment of the measures addressing risks assessed in Darling Alluvium Risk Assessment GW7 Water Resource Plan Area (Schedule D) (NSW Department of Planning and Environment, Water 2022). It also provides explanation of how water sharing plan rules limiting extraction contribute to the maintenance of salinity in the aquifer.

Table 11. Relationship between the measures that support the maintenance of water quality against the likely causes of water quality degradation, and how the measures relate to water quality target values.

Objective	Type of WQ degradation (Schedule 10)	Cause of WQ degradation	Linkage	Explanatory note
WQ1	Elevated levels of salinity (Item 1)	Drawdown in an aquifer that is hydraulically connected to saline groundwater	Table 3: C1: 10.35C(2) (a-c)	Elevated levels of salinity from the causes, or likely causes of water quality degradation identified in Table 3 (C1) are addressed by measure WQ1. Rules in the *Water Sharing Plan for the Darling Alluvial Groundwater Sources 2020* contribute to the maintenance of salinity levels in the SDL resource unit. Rules in the *Water Sharing Plan for the Darling Alluvial Groundwater Sources 2020* limit extraction; set conditions for volumes and rates of extraction; provide distance rules to limit drawdown and protect GDEs; preserve water for the environment (PEW); have trade restrictions and provide for bore construction standards that contribute to the maintenance of salinity levels in the SDL resource unit (10.35C(2)(a)). Rules are also included to manage groundwater extraction at a local scale within water sources and SDL management units to prevent or manage localised drawdown related impacts. This strategy allows consumptive groundwater extraction to be limited on a smaller scale than a water source or SDL unit to manage localised impacts. Water sharing plan rules limit consumptive water extraction thereby maintaining resource condition limits for salinity (10.35C(2)(b)). Objectives included in the WSPs include maintaining salinity within ranges that maintain beneficial use categories within the resource. The upper salinity limit (TDS) of the highest beneficial use category (e.g., segment A) for the water source is used as the resource condition limit. An elevation in salinity levels could indicate a change to the beneficial use category. Beneficial use categories (including upper thresholds) are provided in Table 2. A change in beneficial use category due to salinity levels exceeding the upper threshold of that category would trigger investigation processes consistent in the Incident Response Guide (Schedule I) to initiate a management response. Relevant clauses in the WSP that relate to rules are listed in Table 6 (column 4).
			Table 8-7: R2 – - Risk of groundwater extraction inducing connection with poor quality	Measure WQ1 addresses the risk of elevated salinity (C1). This aligns with strategies to address risk listed in Table 8-7: strategies 1, 2 & 7 to address R2 (Schedule D). Strategies for addressing risks are required if the level of risk is medium or high (10.43(1)(a)). Elevated levels of salinity from induced connection with poor water quality (R2) were assessed as a low risk in the Upper and Lower Darling Alluvium (Schedule D of the Darling Alluvium WRP).

Objective	Type of WQ degradation (Schedule 10)	Cause of WQ degradation	Linkage	Explanatory note
			groundwater (Schedule D of the Darling Alluvium WRP)	The risk results for induced connection with poor water quality (salinity) in the Darling Alluvium WRPA was low, however, strategies and mechanisms are established in the WSP to manage local drawdown impacts that could lead to elevated salinity levels. Under the *Water Management Act 2000*, the Minister may also apply restrictions on extraction to maintain, protect or improve the quality of water in an aquifer (s. 324).
			Table 7	Measures were developed with regard to target values in Table 7 for fresh water-dependent ecosystems (10.35B(2)(a)). Measure WQ1 addresses the causes, or likely causes of elevated salinity that could impact fresh water-dependent ecosystems (C1). Targets in Table 7 have been developed for the protection of fresh water-dependent ecosystems against elevated salinity levels. The target values in Table 7 are alternative salinity targets to those listed in Schedule 11 of the Basin Plan (10.35B(3). These targets are consistent with the water quality objectives in Part 3 of Chapter 9 of the Basin Plan. Rules in the WSP support the maintenance of water quality (salinity) and contribute to achieving the target values, as elevated salinity levels could impact GDEs. Limiting the total water extraction (basic rights and groundwater take) within each groundwater source/SDL resource unit to predetermined sustainable levels ensures a share of the water remains for the environment to protect groundwater quality and hydraulic relationships and maintains resource condition limits for salinity and other water quality degradation (10.35C(2)(b)). Rules preserve water for the environment and limit consumptive water extraction to prevent exceedance of resource condition limit (10.35C(2)(c)).
WQ2	Elevated levels of salinity (Item 1)	Displaced saline groundwater entering surface water systems	Table 3: C1	Measure WQ2 addresses the causes or likely causes of elevated salinity levels entering surface water systems (C1). There are limited levers within scope of water planning. Saline groundwater is diverted before it enters the River Murray through salt interception and drainage diversion schemes (Upper Darling and Curlwaa Salt Interception Schemes. Measures include improved land management practices including the planting of deep-rooted vegetation to reduce rainfall recharge displacing saline groundwater to surface water systems. This measure is outside the scope of water planning. Implementation of the Basin Salinity Management 2030 to assist in achieving the end-of-valley surface water salinity targets.

Objective	Type of WQ degradation (Schedule 10)	Cause of WQ degradation	Linkage	Explanatory note
				As there are limited levers within scope of water planning, measures include those established by Natural Resource Management agencies to provide advisory services that support and enable landholders to implement improved natural resource and agricultural management practices. These management measures contribute to reducing saline groundwater entering the SDL resource unit. The measures are not accredited as they are outside the scope of the Basin Plan. They are denoted by N highlighting they are not accredited by the MDBA during assessment of the WRP.
WQ3	Elevated levels of nutrients (Item 3)	Nutrients entering SDL resource unit from animal waste, fertilisers and sewage discharges.	Table 3: C2:QL5 Risk of poor water quality to the environment (GDEs and instream ecological values)	Measure WQ3 addresses the causes or likely causes of elevated levels of nutrients the SDL resource unit (C2) and aligns with risk QL5 (Schedule D of the Darling Alluvium WRP: Table 4-18). The risk of nutrients entering the SDL resource unit via onsite sewage discharges are managed under the local government management framework provided in the application for installation. A risk classification is determined by the local government during the approval phase. Under the Local Government Act 1993, local councils are responsible for regulating the installation, operation and maintenance of septic systems, conducting audits and inspections and keeping a register of systems in use in the council area. Under the Protection of the *Environment Operations Act 1997* (POEO Act), the Environment Protection Authority (EPA) uses a risk-based licensing system that aims to ensure that all environment protection licensees receive an appropriate level of regulation based on the environmental risk of the activity taking into account site specific risks. Licenced industries include sewage treatment plants. Licensing conditions also include a monitoring and reporting component for compliance. Licence conditions relate to pollution prevention and monitoring. The EPA undertakes risk assessments of all licensed premises in NSW. Based on the results from these EPA risk assessments, licensees are allocated an overall environmental risk level. Licensees with a higher risk level will receive an increased level of regulatory and compliance oversight. In NSW the EPA and local councils implement a risk based approach to the management of potential point source groundwater contaminants under the Protection of the *Environment Operations Act 1997*, the *Local Government Act 1993* and the Local Government (General) Regulation 2005. The EPA is responsible for event monitoring as a result of licence compliance issues. Data gathered during monitoring is temporally and spatially localised and not considered representative of the water quality of an SDL resource unit, groundwater source or management zone. As there is no routine water quality monitoring conducted within the WRP area for nutrients, there is insufficient data to conduct a quantitative risk assessment.

Objective	Type of WQ degradation (Schedule 10)	Cause of WQ degradation	Linkage	Explanatory note
				In the absence of comprehensive monitoring, NSW considers the EPA's risk based licensing and approval system and local councils' regulation of onsite sewage management adequately manages the major causes of water quality degradation from nutrients entering the groundwater SDL source units and hence adequately mitigates likelihood. This is noted as a knowledge gap. Should a monitoring program or the acquisition of reliable data from an external source become available in the future, a quantitative risk assessment may be conducted using the improved knowledge which would increase the confidence in the risk outcome. Short-term monitoring in a small number of bores in the Lower Darling Alluvium, reported low concentration levels of nitrates. However, data collected during this study had poor temporal and geographic spread resulting in low confidence and therefore could not be included in a quantitative risk assessment as it would not be representative of the SDL resource unit. A quantitative assessment of this risk has not been included in Schedule D of the Darling Alluvium WRP as the available data does not adequately characterise the risk across an appropriate scale, however NSW considers there is a potential risk from these contaminants as activities contributing to contamination are present in the WRPA. A qualitative assessment of existing processes based on Department of Planning and Environment -Water groundwater quality specialist expert opinion and available information from other NSW government agencies. As such no data has been reviewed and so a low confidence according to the criteria in Table 2- 4 (of Schedule D of the Darling Alluvium WRP) applies. A risk rating of Low – QAL has been applied for nutrients entering the Darling Alluvium SDL resource units as legislated or other risk based management is in place to reduce the likelihood of nutrients entering the groundwater sources and legislated risk based management is in place that adequately manages the raw water being of a quality unsuitable for treatment for human consumption. Local water utilities accessing water for town water supply have a Framework for Management of Drinking Water Quality. The Framework provides a structured risk-based approach to drinking water management. The WSP, WRP, WQMP and information provided from NSW Health, all advise groundwater used for drinking water (not supplied from a drinking water utility) should undergo a comprehensive range of chemical and physical tests prior to use. The water should be retested if there are any changes in water quality, such as the appearance of odours, taste or colour. Contact your local Public Health Unit for testing advice and refer to the NSW Private Water Supply Guidelines for information on groundwater, hazards and testing. The risk of consuming contaminated water is reduced by this risk based framework and community advice regarding treatment of groundwater prior to drinking.

Objective	Type of WQ degradation (Schedule 10)	Cause of WQ degradation	Linkage	Explanatory note
				There are no accredited levers within scope of water planning in NSW to reduce nutrients entering the SDL resource unit from animal faeces and fertilisers. Natural Resource Management agencies provide advisory services that support and enable landholders to implement improved natural resource and agricultural management practices that could reduce this risk. These management measures that contribute to reducing nutrients entering the SDL resource unit (C2) include improved land management practices and best farm management practice. The measures are not accredited as they are outside the scope of the Basin Plan. They are denoted by N highlighting they are not accredited by the MDBA during assessment of the WRP. Measures to reduce the mobilisation of nutrients within the SDL unit are established by setting distance rules in the WSP from known contamination sites and plumes to limit mobilisation of plume induced from pumping. The relevant clauses for the WSP are included in Table 6: column 4 for accreditation. As denoted by A.
WQ4	Elevated levels of pesticides and other contaminants (Item 7)	Poor management practices – leaching of pesticides into groundwater.	Table 3: C3: QL5	Measure WQ4 addresses the causes or likely causes of elevated levels of pesticides or other contaminants entering the SDL resource unit (C3). In NSW the Environment Protection Authority (EPA) and local councils implement a risk based approach to the management of potential point source groundwater contaminants under the *Protection of the Environment Operations Act 1997,* the *Local Government Act 1993* and the *Local Government (General) Regulation 2005*. The EPA regulates the proper use of pesticides through the provisions of the *Pesticides Act 1999* and Pesticides Regulation 2017. The Australian Pesticides and Veterinary Medicines Authority (APVMA) controls which pesticides are registered and sold in Australia. The EPA administers regulations, and conducts investigations and campaigns, to protect people and animals from being harmed by pesticides. Campaigns focus on educating people about the correct use of pesticides. The EPA also investigates allegations of pesticide misuse and determines whether further compliance and enforcement action is needed. Misuse includes failing to follow label or permit instructions, improper storage of pesticides, placing pesticides or empty pesticide containers in waterways and disposing of a pesticide or its container illegally. Other contaminants or toxicants are regulated under the EPA. The EPA issues environment protection licences to the owners or operators of various industrial premises under the POEO Act. Licence conditions relate to pollution prevention and monitoring. The EPA's risk-based licensing system aims to ensure that all environment protection licensees receive an appropriate level of regulation based on the level of risk they pose. The EPA undertakes risk assessments of all licensed premises in NSW. Based on the results from the risk assessments licensees are allocated an overall environmental risk

Objective	Type of WQ degradation (Schedule 10)	Cause of WQ degradation	Linkage	Explanatory note
				level. Licensees with a higher risk level will receive an increased level of regulatory and compliance oversight. Industries such as mining may be potential sources of groundwater contamination. All exploration and mining activity in New South Wales (NSW) must be conducted under an exploration, assessment or mining title. All mining and petroleum projects and most exploration activities require environmental assessment under the *Environmental Planning and Assessment Act 1979* (EP&A Act) before they can commence. Water management is considered during the approval process. This stringent regulatory approach works to ensure that all projects, including exploration, mining and petroleum activities, are thoroughly assessed and their environmental impacts are properly regulated and controlled. Potential sources of contamination from mining are mitigated by licencing conditions (EPL) and the Aquifer interference policy. In NSW the EPA implements a risk based approach to the management of potential point source groundwater contaminants under the Protection of the *Environment Operations Act 1997*. The EPA is responsible for event monitoring as a result of licence compliance issues. Data gathered during monitoring is temporally and spatially localised and not considered representative of the water quality of an SDL resource unit, groundwater source or management zone. As there is no routine water quality monitoring conducted within the WRP area for pesticides and other toxicants, there is insufficient data to conduct a quantitative risk assessment. Additionally, there is inadequate data to ascertain if the EPA's risk management framework is adequate to mitigate the risk of water quality degradation from nutrients entering groundwater sources across individual SDL resource units and the WRP area. In the absence of comprehensive monitoring, NSW considers the EPA's risk based licensing and approval system adequately manages the major causes of water quality degradation from major contaminants (other than salinity) entering the groundwater SDL source units and hence adequately mitigates likelihood. This is noted as a knowledge gap. Should a monitoring program or the acquisition of reliable data from an external source become available in the future, a quantitative risk assessment may be conducted using the improved knowledge which would increase the confidence in the risk outcome. Local water utilities accessing water for town water supply have a Framework for Management of Drinking Water Quality. The Framework provides a structured risk-based approach to drinking water management. The WSP, WRP, WQMP and information provided from NSW Health, all advise groundwater used for drinking water (not supplied from a drinking water utility) should undergo a comprehensive range of chemical and physical tests prior to use. The water should be retested if there are any changes in water quality, such as the appearance of odours, taste or colour. Contact your local Public Health Unit for testing advice and refer to the NSW Private Water Supply Guidelines

Objective	Type of WQ degradation (Schedule 10)	Cause of WQ degradation	Linkage	Explanatory note
				for information on groundwater, hazards and testing. The risk of consuming contaminated water is reduced by this risk based framework and community advice regarding treatment of groundwater prior to drinking. A quantitative assessment of this risk has not been included in Schedule D of the Darling Alluvium WRP as the available data does not adequately characterise the risk across an appropriate scale, however NSW considers there is a potential risk from these contaminants as activities contributing to contamination are present in the WRPA. A qualitative assessment of existing processes based on Department of Planning and Environment- Water groundwater quality specialist expert opinion and available information from other NSW government agencies. As such no data has been reviewed and so a low confidence according to the criteria in Table 2- 5 of the Risk assessment of the Darling Alluvium WRPA (Schedule D) applies. A risk rating of Low – QAL has been applied for pesticides and other contaminants entering the Darling Alluvium SDL resource units as legislated or other risk based management is in place to reduce the likelihood of contaminants entering the groundwater sources and legislated risk based management is in place that adequately manages the raw water being of a quality unsuitable for treatment for human consumption. There are no accredited levers within scope of water planning to reduce pesticides entering the SDL resource unit. Natural Resource Management agencies provide advisory services that support and enable landholders to implement improved natural resource and agricultural management practices that contribute to reducing pesticides and other contaminants entering the SDL resource unit (C3). These include improved land management practices, industry best practice guidelines (e.g., Cotton Australia), improved pesticide handling, application and appropriate disposal of pesticide containers, equipment and waste that pose a risk to groundwater sources. The measures are not accredited as they are outside the scope of the Basin Plan. They are denoted by N highlighting they are not accredited by the MDBA during assessment of the WRP. Measures to reduce the mobilisation of contaminated sites and plumes within the SDL unit by setting distance rules are established in the WSP. The distance rules limit the mobilisation of plume induced from pumping. This strategy aims to protect overlying ground and surface water sources and public health and safety by limiting exposure to and mobilisation of contamination sources. Relevant clauses in the WSP are included in Table 6: column 4 (WQMP) for accreditation. As denoted by A.
WQ5	Elevated pathogen counts (Item 9)	Pathogens entering SDL resource units from human and animal	Table 3: C4: QL5	Measure WQ5 addresses the causes or likely causes of elevated pathogen counts entering the SDL resource unit (C4). In NSW, the EPA and local councils implement a risk based approach to the management of potential point source groundwater contaminants under the *Protection of the Environment Operations Act 1997*, the *Local Government Act 1993* and the *Local Government (General) Regulation 2005*.

Objective	Type of WQ degradation (Schedule 10)	Cause of WQ degradation	Linkage	Explanatory note
		waste and sewage discharges.		The risk of pathogens entering the SDL resource unit via onsite sewage discharges is managed under the local government management framework provided in the application. A risk classification is determined by the local government during the approval phase. Under the Local Government Act 1993, local councils are responsible for regulating the installation, operation and maintenance of septic systems, conducting audits and inspections and keeping a register of systems in use in the council area. Under the *Protection of the Environment Operations Act 1997* (POEO Act), the Environment Protection Authority (EPA) uses a risk-based licensing system that aims to ensure that all environment protection licensees receive an appropriate level of regulation based on the environmental risk of the activity taking into account site specific risks. Licenced industries include sewage treatment plants. Licensing conditions also include a monitoring and reporting component for compliance. Licence conditions relate to pollution prevention and monitoring. The EPA's risk-based licensing system aims to ensure that all environment protection licensees receive an appropriate level of regulation based on the level of risk they pose. The EPA undertakes risk assessments of all licensed premises in NSW. Based on the results from these EPA risk assessments, licensees are allocated an overall environmental risk level. Licensees with a higher risk level will receive an increased level of regulatory and compliance oversight. The EPA is responsible for event monitoring as a result of licence compliance issues. Data gathered during monitoring is temporally and spatially localised and not considered representative of the water quality of an SDL resource unit, groundwater source or management zone. As there is no routine water quality monitoring conducted within the WRP area for contaminants other than salinity, there is insufficient data to conduct a quantitative risk assessment. Additionally, there is inadequate data to ascertain if the EPA's risk management framework is adequate to mitigate the risk of water quality degradation across individual SDL resource units and the WRP area. In the absence of comprehensive monitoring, NSW considers the EPA's risk based licensing and approval system and local councils' regulation of onsite sewage management adequately manages the major causes of water quality degradation from major contaminants (other than salinity) entering the groundwater SDL source units and hence adequately mitigates likelihood. This is noted as a knowledge gap. Should a monitoring program or the acquisition of reliable data from an external source become available in the future, a quantitative risk assessment may be conducted using the improved knowledge which would increase the confidence in the risk outcome. Local water utilities accessing water for town water supply have a Framework for Management of Drinking Water Quality. The Framework provides a structured risk-based approach to drinking water management. The WSP, WRP, WQMP and information provided from NSW Health, all advise

Objective	Type of WQ degradation (Schedule 10)	Cause of WQ degradation	Linkage	Explanatory note
				groundwater used for drinking water (not supplied from a drinking water utility) should undergo a comprehensive range of chemical and physical tests prior to use. The water should be retested if there are any changes in water quality, such as the appearance of odours, taste or colour. Contact your local Public Health Unit for testing advice and refer to the NSW Private Water Supply Guidelines for information on groundwater, hazards and testing. The risk of consuming contaminated water is reduced by this risk based framework and community advice regarding treatment of groundwater prior to drinking. A quantitative assessment of this risk has not been included in Schedule D of the Darling Alluvium WRP as the available data does not adequately characterise the risk across an appropriate scale, however NSW considers there is a potential risk from these contaminants as activities contributing to contamination are present in the WRPA. A qualitative assessment of existing processes based on Department of Planning and Environment groundwater quality specialist expert opinion and available information from other NSW government agencies. As such no data has been reviewed and so a low confidence according to the criteria in Table 2- 4 (Schedule D) applies. A risk rating of Low – QAL has been applied for pathogens entering the Darling Alluvium SDL resource units as legislated or other risk based management is in place to reduce the likelihood of contaminants entering the groundwater sources and legislated risk based management is in place that adequately manages the raw water being of a quality unsuitable for treatment for human consumption. There are no accredited levers within scope of water planning in NSW to reduce pathogens entering the SDL resource unit from animal waste. Natural Resource Management agencies provide advisory services that support and enable landholders to implement management measures that contribute to reducing pathogens entering the SDL resource unit (C2) from animal waste. These include improved land management practices, best farm management practice including the fencing of rivers to control stock access. Animal faeces in streams are a risk factor to groundwater in connected systems. These measures are not accredited as they are outside the scope of the Basin Plan. They are denoted by N highlighting they are not accredited by the MDBA during assessment of the WRP. Measures to reduce the mobilisation of pathogens within the SDL unit are established by setting distance rules in the WSP from known contamination sites and plumes to limit mobilisation of plume induced from pumping. The relevant clauses for the WSP are included in Table 6: column 4 for accreditation. As denoted by A.