

2 Renmark to border LAP area assessment

2.1 Description of the area

The Renmark to border Local Area Planning (RB LAP) area, of approximately 170,500 hectares, is located in the South Australian Riverland (Figure 2.1), in the District Council of Renmark Paringa. Major towns are Renmark, Paringa and Lyrup. The LAP area encompasses a significant expanse of backwaters to the river proper, most of which are accessible for recreational use (eg canoeing, boating).

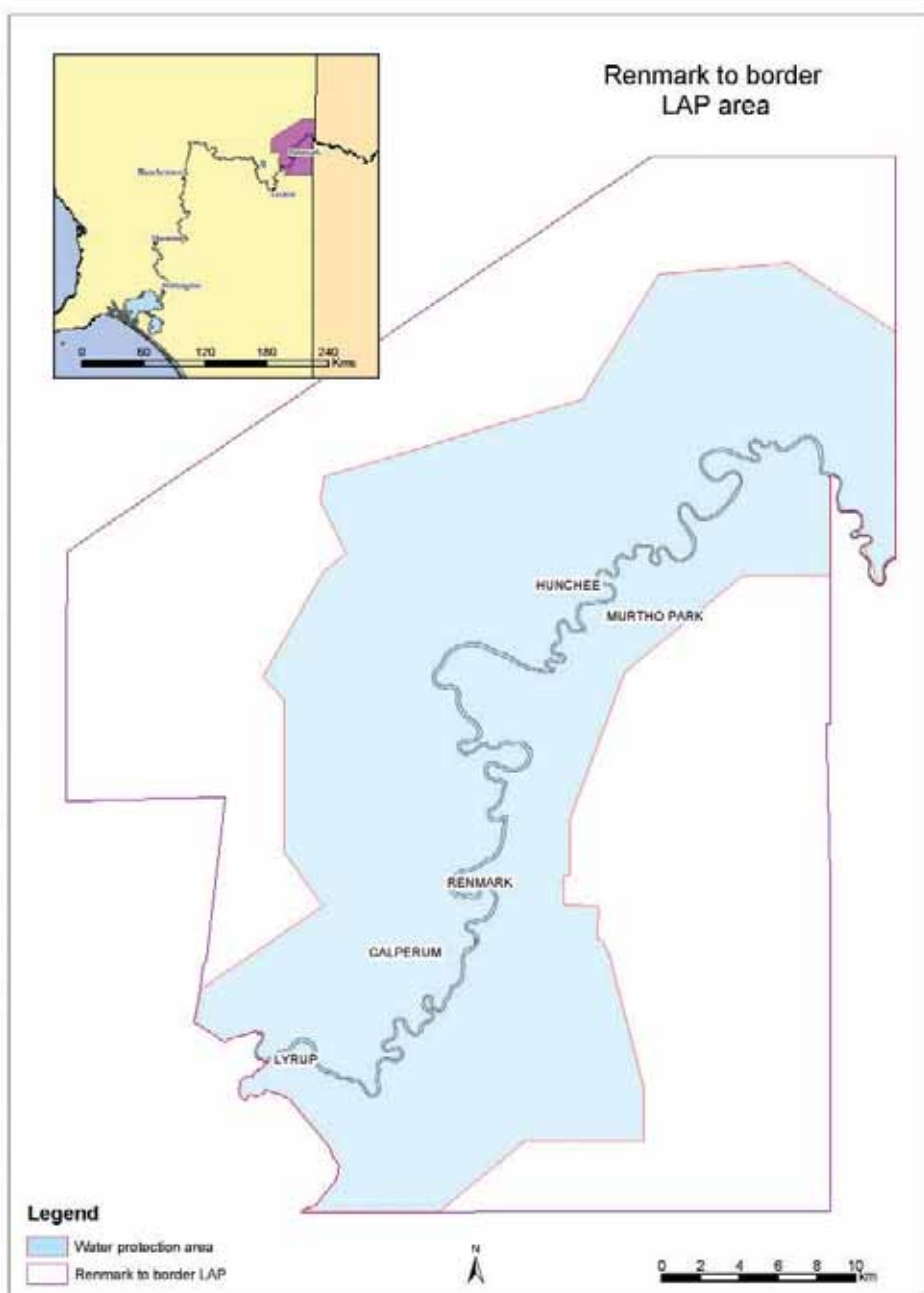


Figure 2.1 Map of Renmark to border LAP area

Land and groundwater salinisation is a major problem in the area, largely the legacy of historical vegetation clearance in the regional catchment. The salinisation problem has been exacerbated in some locations by irrigation creating a 'groundwater mound' and increasing saline groundwater flows to the floodplain and river. Large areas of the Renmark region, currently used for viticulture and citrus horticulture, employ drip and/or under-canopy irrigation practices that are generally much more water efficient than historical flood irrigation methods³. Much of the irrigation drainage is now collected in caissons and pumped to regional disposal basins (eg Noora; DWLBC 2003b), where evaporation delays seepage back into the groundwater or the river. The Renmark Irrigation Trust controls most inland water licences in this area; the Central Irrigation Trust (CIT) also operates in the Chaffey Irrigation Area.

Generally, water quality within the RB LAP area is fair compared to the lower reaches of the river (EPA 2001a). Monitoring is carried out regularly on a wide range of parameters across the border in Victoria (at Rufus River) and just downstream of Renmark (at Lock 5). SA Water also monitors some water quality parameters at the Renmark Water Treatment Plant (WTP) off-take. The 'run of the river' and other salinity surveys (by DWLBC) have identified areas of the river receiving large salt inputs from groundwater (eg Chowilla area). It is also anticipated that a large quantity of salt currently trapped in floodplain sediment will enter the river if the area floods in the future (CSIRO 2003). In terms of this project's framework, saline groundwater inputs were quite difficult to define for a precise hazard location, as they diffuse into the river to varying degrees along its whole length. Specific salinity risks that could be attributed to defined source locations (eg large horticultural areas, saline creek/drainage discharges) are included in this report.

Dissolved nutrient (oxidised nitrogen and phosphate) and *E coli* levels were on average much lower in the RB reach of the river than the Lower Murray (EPA 2001a). Total heavy metal levels at monitoring stations in this LAP area were generally at a low level, with pesticides generally at, or below, detection levels. Turbidity levels in the river are elevated from where the river enters South Australia to its mouth (EPA 2001a). This is significantly influenced by contributions from the Darling River (which has a high clay colloid level) and flood events (MDBC 1988).

2.2 Environmental value zones

Spatial zones assigned for each environmental value allowed hazards to be identified and assessed for risk in manageable amounts.

Aquatic ecosystem zones

Risks to aquatic ecosystem health were assessed in arbitrary three kilometre zones for the length of the river, a total of 38 zones in the RB LAP area.

Raw water supply zones

Three raw water supply zones (from 500 m downstream to three kilometres upstream of each potable water off-take) were identified in the RB LAP area:

³ While water use efficiency based around low rate water application systems is growing, an apparent accumulation of salt in the root zone of the irrigated crop is increasing.

RBRAW001	Renmark and Paringa water supply off-take—Renmark WTP supplies Renmark and a pipeline under the river delivers water to the Paringa system.
RBRAW002	Lyrup water supply—this private system operated by the Lyrup Village Association combines the off-take for raw drinking water and irrigation water.
RBRAW003	Cooltong water supply off-take—located in Ral Ral Creek, this system supplies Cooltong, Monash and Glossop, and shares the off-take with the CIT.

Recreational zones

Seven recreational zones were identified in the RB LAP area:

RBREC001	Chowilla and surrounds (21 km long)
RBREC002	Headings Cliff to Woolenook Bend (5 km long)
RBREC003	Ninkle Nook Bend (2.9 km long)
RBREC004	Renmark and surrounds (16.5 km long)
RBREC005	Plush's Bend and surrounds (1.4 km long)
RBREC006	Lyrup Flats National Park (11.5 km long)
RBREC007	Coolaltit Bend to LAP boundary (4 km long).

2.3 Hazard identification process

A community consultation workshop was held with representatives from the Renmark to border LAP office, District Council of Renmark Paringa, DWLBC, Renmark Irrigation Trust, Murray Darling Association and Renmark River Cruises. The workshop identified the nature and location of potential water quality hazards and recreation zones, and provided useful information for the subsequent risk evaluation process.

2.4 Risks to water quality in the Renmark to border area

Frequency of hazard types

A total of 141 hazards were identified in the Renmark to border LAP area. The highest frequency hazards were stormwater discharge points, diesel pump fuel stores, vessel moorings, informal camping areas (with no facilities), horticulture areas, and creeks and rivers (Figure 2.2).

Frequency (occurrence) does not necessarily indicate risk—a hazard may have a high frequency but a low risk. The cumulative impacts of low-risk activities will be considered and assessed as part of mitigation strategy development.

Risks to aquatic ecosystem health

Figure 2.3 is the key map for risks to the aquatic ecosystem environmental value in the RB LAP area. The attached DVD has individual maps numbered according to the key map.

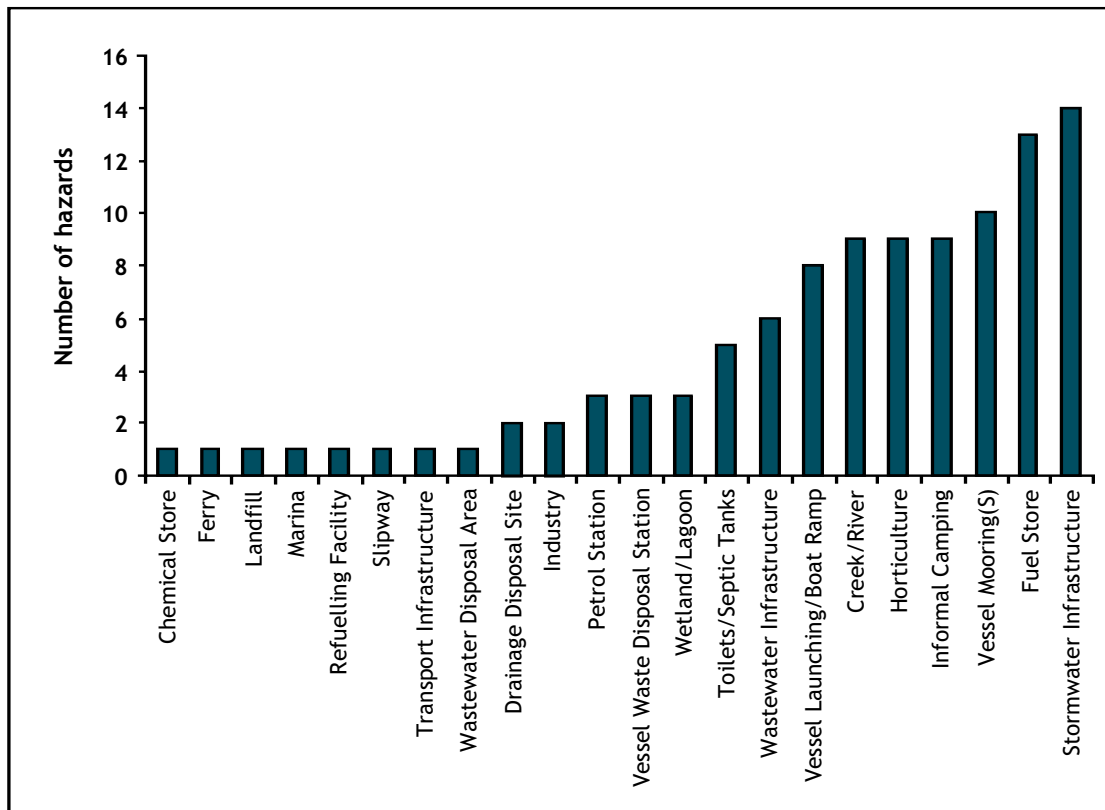
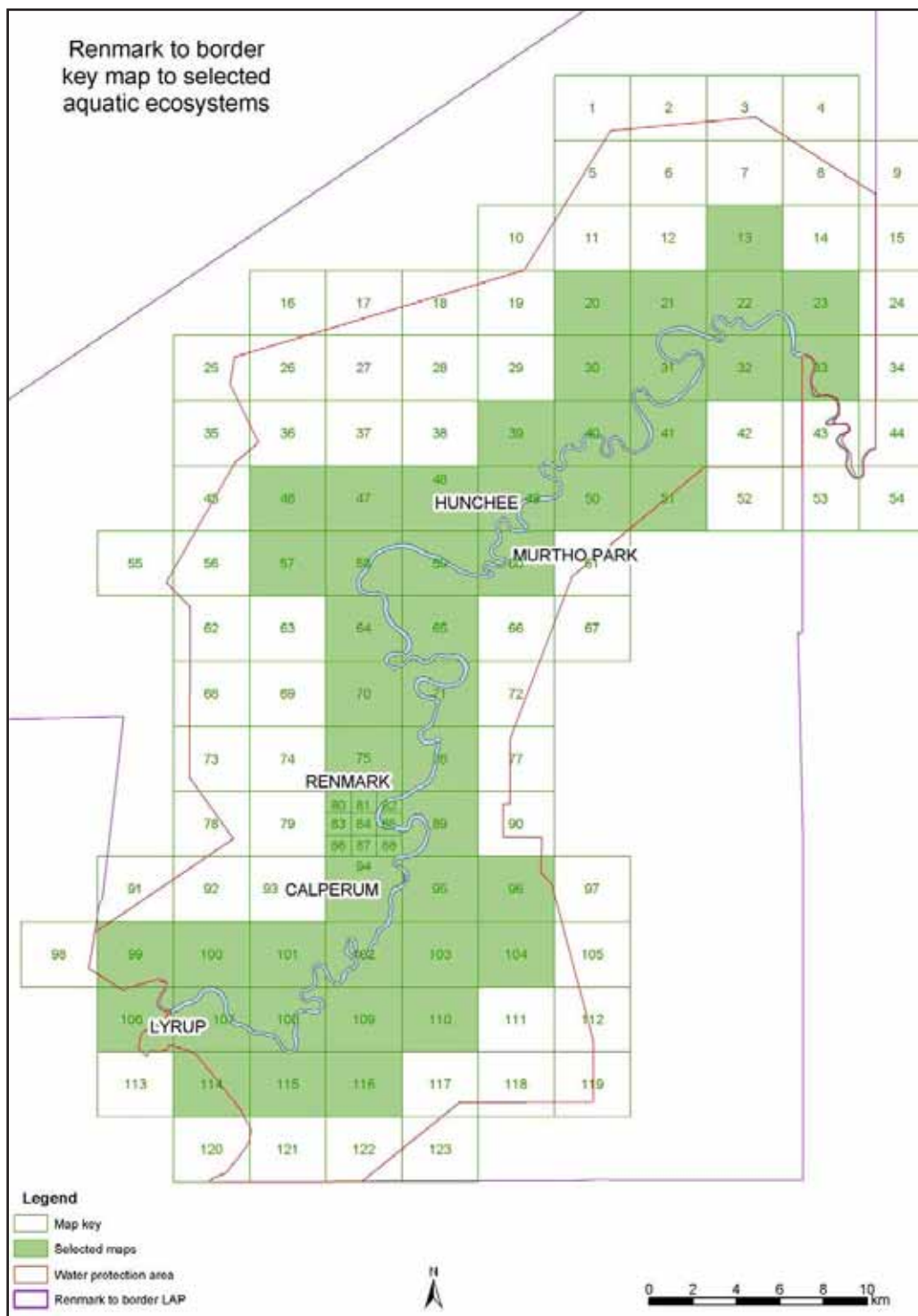


Figure 2.2 Frequency of hazards to water quality, RB LAP area



Figure 2.3 Example of hazard in the RB LAP area: irrigated horticultural area



Note: shaded maps included on attached DVD; not all maps have hazards associated with them

Figure 2.4 Key map for aquatic ecosystem zones, RB LAP area

Each hazard was assessed for relevant water quality stressors (eg stormwater for nutrients, turbidity, organic matter, heavy metals and hydrocarbons). The summary of identified risks to aquatic ecosystem health for water quality stressors (Table 2.1) shows that nutrients have the highest frequency, followed by organic matter, turbidity, hydrocarbons, pesticides, salinity and heavy metals. Most risks were rated as low (173) or moderate (198) but a significant number of high-level (13) risks were recorded.

Table 2.1 Frequency of risks to aquatic ecosystem health, RB LAP area

Risk	Stressor							Total
	NU	TU	OR	HM	PE	HY	SA	
Low	16	34	19	6	39	44	15	173
Moderate	65	24	61	16	2	16	14	198
High	3	1	3	0	0	0	6	13
Very high	0	0	0	0	0	0	0	0
Total	84	59	83	22	41	60	35	384

NU—nutrients; TU—turbidity; OR—organic matter; HM—heavy metals; PE—pesticides; HY—hydrocarbons; SA—salinity

The aquatic ecosystem risks identified in the RB LAP area are summarised in Table 3 and discussed in more detail below for each stressor.

Salinity

Discharges from the Pike River were assigned a very high risk ranking as significant salinity increases were observed where it enters the main stem of the river (and continue for several kilometres downstream). The Pike-Mundic river system receives significant inputs of irrigation drainage from Simarloo and Pike irrigation areas. Chowilla and Ral Ral creeks were assessed as high salinity risks. Chowilla Creek drains a major backwater system to the north and currently discharges about 30 tonnes of salt per day to the river. Ral Ral Creek receives irrigation drainage from Chaffey irrigation area and also drains a backwater system. Event discharges from these other creeks were also rated as a moderate-high risk as salt (currently trapped in floodplains and wetlands) could be mobilised and flushed into the river proper. The ecological impact of salinity from discharges to the river is somewhat uncertain as salinity levels have historically been variable (MDBC 1988).

Groundwater leakage from large horticultural/irrigation areas (Murtho, Chaffey, Simarloo, Renmark, Paringa, Pike) adjacent to the river made up most of the other moderate-high salinity risk ratings, and a pumped drainage discharge to Ral Ral Creek from Chaffey irrigation district also received a high-risk rating. Large areas of irrigated horticultural land adjacent to the river in the Renmark to Border LAP area are predominantly used to grow citrus fruit and grapes.

Bookmark and Nelwart creeks were noted as moderate risks during event discharges (large rainfall events and/or artificial flooding). They may receive irrigation drainage input from Renmark irrigation area and other catchment sources. Flows in and out of Bookmark Creek are regulated, with maximum salinity targets set for the discharge.

Event discharges from wetlands (Whirlpool Corner, Mundic Creek, Templeton) also presented a low-moderate salinity risk. Basic monitoring has recently been conducted at Templeton wetlands as part of the River Murray Wetlands Baseline Survey⁴.

Several management strategies are already in place or planned to reduce the effects of salinity on the river, and floodplain and wetland vegetation. Several district schemes operate to collect and pump irrigation drainage water to regional disposal basins.

⁴ See the website <www.rivermurray.sa.gov.au/major/wetlands.html>

Drainage water from the Disher Creek and Berri basins is pumped to the large Noora drainage disposal basin, where it is unlikely this water will return to the river for a very long period of time (DWLBC 2003b). Over the last 20 years rehabilitation of irrigation systems and improved practices has also reduced the volume of irrigation drainage to the river. Initiatives planned or being enacted include:

- management of Chowilla wetland, including monitoring of artificial flushing effects
- implementation of Pike River and Murtho land and water management plans, and feasibility of a salt interception scheme for Pike irrigation area
- construction of the Murtho salt interception scheme
- water quality investigations for Ral Ral Creek.

Nutrients

Several large horticulture areas (Murtho, Chaffey, Simarloo, Renmark, Paringa, Lyrup, Pike) received a high-risk ranking for leakage of nutrients through groundwater to the river as did some rivers and creeks (Ral Ral Creek, Pike River) that receive irrigation drainage and are permanently connected to the river. The disposal of drainage on the floodplain from Lyrup irrigation area was also assessed as a high risk. Several other horticultural areas received a moderate risk ranking. There was some uncertainty to these assessments due to a lack of monitoring data (other than for salt). The large-scale saline inputs that have been noted from this region led to the assumption that nutrients (in particular nitrate) would also be a significant input. Elevated levels have been reported under irrigation areas in other areas of South Australia (eg Northern Adelaide Plains, EPA 2003a).

Greywater and blackwater discharges from vessel mooring locations were identified as a moderate nutrient risk as were accidental spillages from river vessel waste disposal stations (Customs House, Lock 6 Road and Renmark). The likelihood of deliberate blackwater discharge in this region seems lower than in other stretches of the river where there are long distances between some waste disposal stations (50-100 km).

The Renmark stormwater point discharges were generally categorised as moderate risks. One (Renmark Ave) discharges directly to the river, while the others initially discharge into backwaters or lagoons before entering the river. Old River Creek (receives urban stormwater discharges from Renmark) was rated as a moderate risk for event discharges of nutrients. Several management systems (including wetlands and end-of-line pollutant arrestors) have been installed in Renmark and stormwater infrastructure has been upgraded at 6 of the 13 discharge points, including retention basins in two smaller catchments. A gross pollutant trap (GPT) is installed on the largest catchment discharge point at Renmark Avenue but GPTs only trap a portion of debris and larger sediments; many contaminants, such as hydrocarbons and heavy metals, would still reach the river. A stormwater management strategy exists for Renmark and Paringa (Brown and Root 2001).

Septic tank systems in several locations adjacent to the river were rated as a moderate nutrient risk due to a likelihood of leakage from these systems. The density of septic tank distribution is not as high in this LAP area as in some other however the septic tanks near Lock 5 Road are ageing. The Renmark and Paringa STEDS lagoons located on the floodplain very close to the Bookmark Creek and Mundic river backwater respectively were given a moderate risk ranking for infrastructure failure. Both have been noted to be periodically failing and/or overflowing which is of concern. A winery that irrigates wastewater adjacent to Bookmark Creek was also given a moderate risk ranking.

Discharges from creeks and wetlands contributed to other moderate nutrient risks, particularly from Whirlpool Corner wetland (one of the few permanent wetlands in the region), and Chowilla, Ral Ral, Bookmark and Nelwart creeks. Event discharges from these sources had a lower likelihood but a higher consequence than 'normal' (dry weather) discharges. The degree to which pollutants are flushed out of wetlands or lagoons during significant rainfall events or floods is uncertain.

Organic matter

Moderate-high organic matter risks were attributed to horticultural areas but this assessment is somewhat uncertain (most groundwater monitoring data pertained to salinity). The large horticultural areas noted above and Lyrup drainage disposal areas were given high-risk rankings.

Stormwater discharges, leakage from smaller horticultural areas, vessel and creek discharges, septic tank leakage and the Paringa STEDS lagoons were assessed as a moderate risk for organic matter. In general, the moderate risk ranking for these hazards was derived from high likelihood but low consequence.

Turbidity

The high level of turbidity in the river coming into South Australia makes additional turbidity impacts on the aquatic ecosystem less likely than in many other waterbodies. The few moderate sources of turbidity risk identified were predominantly stormwater and creek or river event discharges.

Most turbidity risks were classified as low. Ferry decks were identified as a low turbidity risk, as sweeping and collection of material from ferry decks is the current preferred method for cleaning (though some ferry decks are still washed down). The Department for Transport, Energy and Infrastructure (DTEI) is currently identifying ferry cleaning and contaminant detainment systems that could be implemented on new ferries.

Hydrocarbons

Urban stormwater from the township of Renmark contributed to moderate hydrocarbon risks. The cumulative risk of these stormwater discharges within a relatively small spatial area is of concern.

Other low hydrocarbon risks included accidental spills of diesel fuel from the motors and fuel tanks of irrigation and stock water pumps. In particular, large stores in the northern region (eg Coombool) pose a risk to the immediately adjacent creek systems.

Heavy metals

Groundwater leakage from the horticultural areas to the river was considered a low-moderate heavy metal risk. There was a lack of certainty to this assessment but groundwater contamination for metals such as cadmium and zinc has been reported under irrigation areas in other areas of South Australia (eg Northern Adelaide Plains, EPA 2003a).

Moderate-risk sources of heavy metals included stormwater discharge points in Renmark. Urban stormwater typically contains a significant amount of heavy metals (eg lead, copper, zinc) during the first flush period. Although the risk was classed as moderate, these metals are likely to be mostly in particulate form (therefore not immediately bioavailable or toxic) but may be accumulating in the immediate vicinity of stormwater outfalls. Wash-off from the Jane Eliza slipway was also classified as a moderate risk hazard for heavy metals due to the likely blasting of metal containing paints (eg vessel exterior and antifouling).

Pesticides

Pesticide use is widespread in the area for horticulture but the risk was assessed as moderate (Murtho, Chaffey, Simarloo, Renmark, Paringa, Lyrup, Pike) to low (smaller irrigation areas). Discharges from Chowilla and Ral Ral creeks and the Pike River were also assessed as a moderate risk. Both these assessments were not certain as there was no direct monitoring data obtained for drainage from these areas. The water quality monitoring data for the region (eg SA Water data for Renmark) typically shows undetectable levels. Pesticide use is regulated through the National Registration Scheme for agricultural and veterinary chemicals (EPA 2003d).

Table 2.2. Summary of risks to aquatic ecosystem environmental values, RB IAP area low=low risk, mod=moderate risk, high=high risk, v high=very high risk risk certainty value (in italics) follows each risk ranking

GEOCODE	HAZARD	EVENT TYPE	NU	TU	OR	HM	PE	HY	SA
RB038C	CHEMICAL STORE Irrigation pump, Templeton CREEK/RIVER	ACCIDENTAL SPILLAGE	mod 2					low 2	
RB005A	Chowilla Creek	DISCHARGE	high 2	mod 2	high 2	mod 2	mod 2	0 0	v high 3
RB005B	Chowilla Creek	EVENT DISCHARGE	high 2	high 2	high 2	mod 2	mod 2	0 0	high 3
RB007A	Creek (adj Dix cutting)	DISCHARGE	mod 2	low 2	mod 2	low 2	low 2	0 0	mod 2
RB007B	Creek (adj Dix cutting)	EVENT DISCHARGE	mod 2	mod 2	mod 2	low 2	low 2	0 0	mod 2
RB014A	Big Hunchee Creek	DISCHARGE	mod 2	low 2	mod 2	low 2	low 2	0 0	mod 2
RB014B	Big Hunchee Creek	EVENT DISCHARGE	mod 2	mod 2	mod 2	low 2	low 2	0 0	mod 2
RB019A	Ral Ral Creek	DISCHARGE	high 2	mod 2	high 2	mod 2	mod 2	0 0	high 2
RB019B	Ral Ral Creek	EVENT DISCHARGE	high 2	high 2	mod 2	mod 2	mod 2	0 0	mod 2
RB024B	Creek (backwater of Old River)	EVENT DISCHARGE	mod 2	mod 2	mod 2	mod 2	low 2	0 0	mod 2
RB054B	Bookmark Creek	EVENT DISCHARGE	mod 3	mod 2	mod 3	mod 2	low 2	0 0	mod 3
RB065A	Pike River	DISCHARGE	v high 2	mod 2	v high 2	mod 2	mod 2	0 0	v high 2
RB065B	Pike River	EVENT DISCHARGE	high 2	high 2	high 2	high 2	mod 2	0 0	high 2
RB080A	Old River Creek	DISCHARGE	mod 2	low 2	mod 2	mod 2	low 2	low 2	high 2
RB080B	Old River Creek	EVENT DISCHARGE	high 2	high 2	mod 2	mod 2	low 2	low 2	mod 2
RB081B	Netwart Island Creek DRAINAGE DISPOSAL SITE	EVENT DISCHARGE	mod 2	mod 2	mod 2	low 2	low 2	0 0	mod 2
RB041A	Irrigation discharge, Chaffey irrigation district	DISCHARGE	mod 2		mod 2	mod 2	low 1		high 2
RB082B	Irrigation drainage disposal site, Lyrup FERRY	LEAKAGE	high 2		high 2	mod 2	mod 2		high 2
RB060B	Ferry, Lyrup	EVENT DISCHARGE	low 3	low 2	low 2	low 2		low 3	
RB060C	Ferry, Lyrup FUEL STORE	ACCIDENTAL SPILLAGE						low 2	
RB029C	Pump fuel store, Coombool Station	ACCIDENTAL SPILLAGE						low 3	
RB032C	Pump fuel store, north of Bunyip Reach	ACCIDENTAL SPILLAGE						low 3	
RB090C	Pump fuel store—irrigation, Kangara Foods	ACCIDENTAL SPILLAGE						low 2	
RB091C	Pump fuel store—irrigation, Dix cutting	ACCIDENTAL SPILLAGE						low 2	
RB092C	Pump fuel store—irrigation, Chowilla Station	ACCIDENTAL SPILLAGE						low 2	
RB093C	Pump fuel store—domestic, Ral Ral Creek	ACCIDENTAL SPILLAGE						low 2	

GEOCODE	HAZARD	EVENT TYPE	NU	TU	OR	HM	PE	HY	SA
RB094C	Pump fuel store—domestic, Calperum Station	ACCIDENTAL SPILLAGE						low 2	
RB095C	Pump fuel store—domestic, Pike backwater	ACCIDENTAL SPILLAGE						low 2	
RB096C	Pump fuel store—domestic, Chowilla Station	ACCIDENTAL SPILLAGE						low 2	
RB097C	Pump fuel store—domestic, Woolshed	ACCIDENTAL SPILLAGE						low 2	
RB098C	Pump fuel store—irrigation, Bullyong Creek	ACCIDENTAL SPILLAGE						low 2	
RB099C	Pump fuel store—irrigation, Old River billabong	ACCIDENTAL SPILLAGE						low 2	
RB100C	Pump fuel store—irrigation, Old River billabong	ACCIDENTAL SPILLAGE						low 2	
	HORTICULTURE								
RB008L	Horticulture, near Wiela	LEAKAGE	mod 2		mod 2	low 2	low 2		mod 2
RB012L	Horticulture, Murtho irrigation area	LEAKAGE	high 2		high 2	mod 2	mod 2		high 2
RB013L	Horticulture, Chaffey irrigation area	LEAKAGE	high 2		high 2	mod 2	mod 2		high 2
RB039L	Horticulture, Warwilla	LEAKAGE	mod 2		mod 2	low 2	low 2		mod 2
RB057L	Horticulture, Simaloo irrigation area	LEAKAGE	high 2		high 2	mod 2	mod 2		high 2
RB073L	Horticulture, Paringa irrigation area	LEAKAGE	high 2		high 2	mod 2	mod 2		high 2
RB118L	Horticulture, Renmark irrigation area	LEAKAGE	high 2		high 2	mod 2	mod 2		high 2
RB119L	Horticulture, near Lock 6	LEAKAGE	mod 2		mod 2	low 2	low 2		mod 2
RB120L	Horticulture, Pike irrigation area	LEAKAGE	high 2		high 2	mod 2	mod 2		high 2
RB121L	Horticulture, Lyrup irrigation area	LEAKAGE	high 2		high 2	mod 2	mod 2		high 2
	INDUSTRY								
RB085D	Winery, EPA Lic #1257—Angoves	INFRASTRUCTURE FAILURE	mod 2		mod 2		low 2		mod 2
RB086D	Winery, EPA Lic #1197—Renmano	INFRASTRUCTURE FAILURE	mod 1		mod 2		low 2		mod 2
	INFORMAL CAMPING								
RB002G	Recreation area, Customs House	HUMAN/ANIMAL EXCRETION	low 2		low 2				
RB011G	Recreation area, Murtho Forest	HUMAN/ANIMAL EXCRETION	low 2		low 2				
RB016G	Recreation area, Lindner's	HUMAN/ANIMAL EXCRETION	low 2		low 2				
RB025G	Informal camping, d/s Lock 5	HUMAN/ANIMAL EXCRETION	low 2		low 2				
RB053G	Informal camping, u/s of Nelwart Island	HUMAN/ANIMAL EXCRETION	low 2		low 2				
RB059G	Informal camping, Lyrup Flats National Park	HUMAN/ANIMAL EXCRETION	low 2		low 2				
RB063G	Informal camping, Lyrup (d/s ferry)	HUMAN/ANIMAL EXCRETION	low 2		low 2				
RB066G	Informal camping, Lyrup Flats National Park	HUMAN/ANIMAL EXCRETION	low 2		low 2				
RB089G	Informal camping, Lyrup Flats	HUMAN/ANIMAL EXCRETION	low 2		low 2				
	LANDFILL								
RB067B	Cleanfill area, top of Pike River	EVENT DISCHARGE		mod 2		low 3			
	MARINA								
RB018Q	Marina, Jane Eliza	MARINA DISCHARGES	mod 3	low 2	mod 2	low 2		low 2	

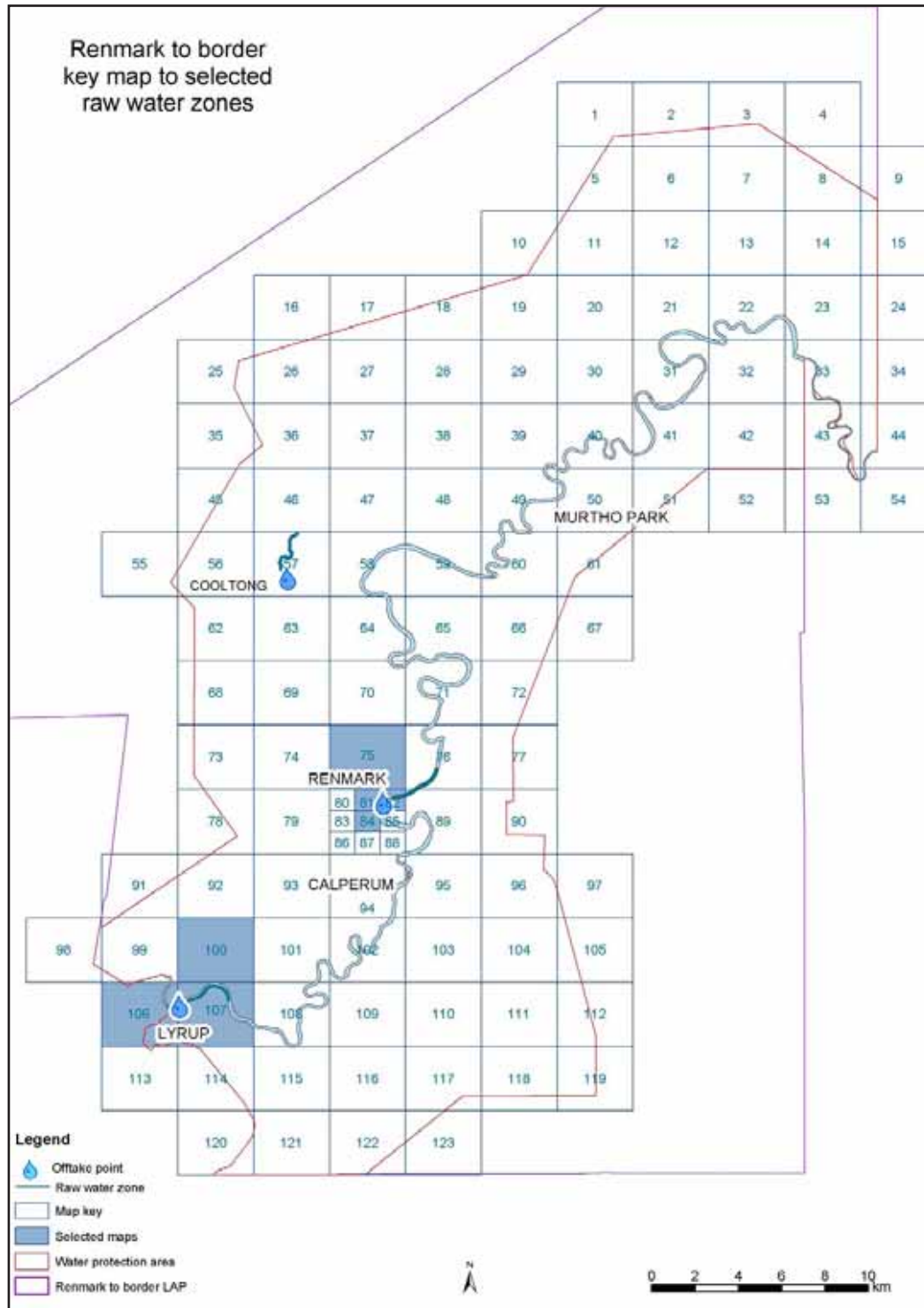
GEOCODE	HAZARD	EVENT TYPE	NU	TU	OR	HM	PE	HY	SA
RB050C	PETROL STATION	ACCIDENTAL SPILLAGE						low	3
RB050L	Petrol station—SAFF, Paringa	LEAKAGE						low	2
RB077C	Petrol station—SAFF, Paringa	ACCIDENTAL SPILLAGE						low	3
RB077L	Petrol station—BP, Renmark	LEAKAGE						low	2
RB078C	<i>Petrol station—BP, Renmark</i>	ACCIDENTAL SPILLAGE						low	3
RB078L	Petrol stations, Renmark								
RB001C	REFUELLING FACILITY	ACCIDENTAL SPILLAGE							
	Refuelling, Customs House							low	2
RB070H	SLIPWAY	WASH DOWN		mod 1		mod 2	mod 2	low	2
	Slipway, Jane Eliza								
	STORMWATER INFRASTRUCTURE								
RB023B	Stormwater discharge, Old River (Patey Dr), Renmark	EVENT DISCHARGE	mod 3	mod 3	mod 1	mod 3	low 1	mod	3
RB101B	Stormwater discharge, Ninth St, Renmark	EVENT DISCHARGE	mod 3	mod 3	mod 3	mod 3	low 1	mod	3
RB102B	Stormwater discharge, Tenth St, Renmark	EVENT DISCHARGE	mod 3	mod 3	mod 3	mod 3	low 1	mod	3
RB103B	Stormwater discharge, Twelfth St, Renmark	EVENT DISCHARGE	mod 3	mod 3	mod 3	mod 3	low 1	mod	3
RB104B	Stormwater discharge, James Ave, Renmark	EVENT DISCHARGE	mod 3	mod 3	mod 3	mod 3	low 1	mod	3
RB105B	Stormwater discharge, Renmark Ave	EVENT DISCHARGE	mod 3	mod 3	mod 3	mod 3	low 1	mod	3
RB106B	Stormwater discharge, Para St, Renmark	EVENT DISCHARGE	mod 3	mod 3	mod 3	mod 3	low 1	mod	3
RB107B	Stormwater discharge, Pyap St, Renmark	EVENT DISCHARGE	mod 3	mod 3	mod 3	mod 3	low 1	mod	3
RB108B	Stormwater discharge, Tapio St, Renmark	EVENT DISCHARGE	mod 3	mod 3	mod 3	mod 3	low 1	mod	3
RB109B	Stormwater discharge, Tolarno St, Renmark	EVENT DISCHARGE	mod 3	mod 3	mod 3	mod 3	low 1	mod	3
RB110B	Stormwater discharge, Twentieth St, Renmark	EVENT DISCHARGE	mod 3	mod 3	mod 3	mod 3	low 1	mod	3
RB111B	Stormwater discharge, Twentyfirst St, Renmark	EVENT DISCHARGE	mod 3	mod 3	mod 3	mod 3	low 1	mod	3
RB112B	Stormwater discharge, Renmark West	EVENT DISCHARGE	mod 3	mod 3	mod 3	mod 3	low 1	mod	3
RB113B	Stormwater discharge, Jane Eliza, Renmark	EVENT DISCHARGE	mod 3	mod 3	mod 3	mod 3	low 1	mod	3
	TOILETS/SEPTIC TANKS								
RB006L	Septic tanks, Woolshed	LEAKAGE	mod 2		mod 2				
RB027L	Septic tanks, Lock 5 bend	LEAKAGE	mod 3		mod 3				
RB035L	Septic tanks, Chowilla Homestead	LEAKAGE	mod 2		mod 2				
RB058L	Septic tanks, near Lyrup Heights	LEAKAGE	mod 3		mod 3				
RB068L	Septic tanks, Lyrup	LEAKAGE	mod 2		mod 2				
RB049C	TRANSPORT INFRASTRUCTURE	ACCIDENTAL SPILLAGE							
	Bridge, Paringa							mod	1

GEOCODE	HAZARD	EVENT TYPE	NU	TU	OR	HM	PE	HY	SA
RB010S	VESSEL LAUNCHING/BOAT RAMP	VESSEL LAUNCHING		low 2				low 2	
RB036S	Recreation area, Lock 6	VESSEL LAUNCHING		low 2				low 2	
RB042S	Boat ramp, Wilkadene	VESSEL LAUNCHING		low 2				low 2	
RB045S	Recreation area, Wynne Haven	VESSEL LAUNCHING		low 2				low 2	
RB052S	Bank erosion, Riverbend Caravan Park	VESSEL LAUNCHING		low 2				low 2	
RB072S	Recreation area, Plush's Bend	VESSEL LAUNCHING		low 2				low 2	
RB072S	Recreation area, Pine View	VESSEL LAUNCHING		low 2				low 2	
RB074S	Bank erosion, Riverfront Caravan Park	VESSEL LAUNCHING		low 2				low 2	
RB075S	Recreation area, Riverfront Caravan Park	VESSEL LAUNCHING		low 2				low 2	
RB084S	Boat ramp, Sandy Beach	VESSEL LAUNCHING		low 2				low 2	
RB003R	VESSEL MOORING(S)	VESSEL DISCHARGES	mod 3	low 2	mod 2			low 2	
RB040R	Houseboats, Customs House	VESSEL DISCHARGES	mod 3	low 2	mod 2			low 2	
RB043R	Houseboats, Ninkle Nook backwater	VESSEL DISCHARGES	mod 3	low 3	mod 2			low 2	
RB047R	Houseboats, Kylie Island	VESSEL DISCHARGES	mod 3	low 2	mod 2			low 2	
RB048R	Houseboats, Reedy Creek	VESSEL DISCHARGES	mod 3	low 2	mod 2			low 2	
RB051R	Houseboats, u/s of Paringa	VESSEL DISCHARGES	mod 3	low 2	mod 2			low 2	
RB051R	Houseboats, d/s of Dix Park	VESSEL DISCHARGES	mod 3	low 2	mod 2			low 2	
RB061R	Houseboats, Lyrup (opposite ferry)	VESSEL DISCHARGES	mod 3	low 2	mod 2			low 2	
RB062R	Houseboats, Lyrup (d/s ferry)	VESSEL DISCHARGES	mod 3	low 2	mod 2			low 2	
RB071R	Houseboats, Pine View	VESSEL DISCHARGES	mod 3	low 2	mod 2			low 2	
RB117R	Houseboats, u/s of Lyrup	VESSEL DISCHARGES	mod 3	low 2	mod 2			low 2	
RB004C	VESSEL WASTE DISPOSAL STATION	ACCIDENTAL SPILLAGE	mod 3	low 2	low 3				
RB009C	River vessel waste disposal, Customs House	ACCIDENTAL SPILLAGE	mod 2	low 2	low 2				
RB046C	River vessel waste disposal, Lock 6	ACCIDENTAL SPILLAGE	mod 2	low 2	low 2				
RB046C	River vessel waste disposal station, Renmark	ACCIDENTAL SPILLAGE	mod 2	low 2	low 2				
RB085L	WASTEWATER DISPOSAL AREA	LEAKAGE	mod 2		mod 2			mod 2	
RB085L	Winery, EPA Lic #1257–Angoves								
RB085L	WASTEWATER INFRASTRUCTURE								
RB017D	STEDS infrastructure, Jane Eliza	INFRASTRUCTURE FAILURE	low 3		low 2				
RB020D	STEDS lagoon, EPA Lic #2208–Renmark	INFRASTRUCTURE FAILURE	mod 2		mod 2				
RB045D	STEDS infrastructure, Riverbend Caravan Park	INFRASTRUCTURE FAILURE	low 3		low 2				
RB055D	Pipeline under river to Noora	INFRASTRUCTURE FAILURE	mod 3		mod 2			low 1	
RB079D	STEDS lagoon, EPA Lic #2053–Paringa	INFRASTRUCTURE FAILURE	mod 2		mod 2				
RB083D	STEDS infrastructure, Riverfront Caravan Park	INFRASTRUCTURE FAILURE	low 3		low 2				

GEOCODE	HAZARD	EVENT TYPE	NU	TU	OR	HM	PE	HY	SA
RB114B	WETLAND/LAGOON	EVENT DISCHARGE	mod	low	mod				mod
RB115A	Wetland, Templeton	DISCHARGE	low	low	low				low
RB115B	Wetland, Whirlpool Corner	EVENT DISCHARGE	mod	low	mod				low
RB116B	Wetland, Whirlpool Corner	EVENT DISCHARGE	mod	low	mod				low
	Wetland, Mundic Creek		2	2	2				2

Risks to raw water supplies

Figure 2.5 is the key map for risks to the raw water supply environmental value in the RB LAP area. The attached DVD has individual maps numbered according to the key map.



Note: only hazards identified in the shaded areas were assessed for risk to raw water supplies

Figure 2.5 Key map for raw water supply zones, RB LAP area

The frequencies of identified risks to raw water supplies for the various water quality parameters are summarised in Table 2.3. The highest frequency of risks was for nutrients and organic matter, followed by pathogens, hydrocarbons, heavy metals, turbidity, salinity and pesticides. All risks were rated as low (55) or moderate (36).

Table 2.3 Frequency of risks to raw water supplies, RB LAP area

Risk	Stressor								Total
	PA	NU	TU	OR	HM	PE	HY	SA	
Low	11	9	4	9	7	1	12	2	55
Moderate	3	6	5	6	6	4	2	4	36
High	0	0	0	0	0	0	0	0	0
Very high	0	0	0	0	0	0	0	0	0
Total	14	15	9	15	13	5	14	6	91

PA—pathogens; NU—nutrients; TU—turbidity; OR—organic matter; HM—heavy metals; PE—pesticides; HY hydrocarbons; SA—salinity

The raw water supply risks identified in RB LAP area are summarised in Table 2.4 and discussed in more detail below for each stressor.

Pathogens

A moderate pathogen risk from discharges from Ral Ral Creek, which discharges about 850 m upstream of the Renmark off-take, was identified. There was uncertainty as to the pathogen levels in the creek (it receives irrigation drainage and drains backwaters).

Jane Eliza marina (approximately one kilometre upstream of the Renmark off-take) received a moderate risk ranking as it contains several houseboats with permanent residents. The risk related to regular greywater discharges (sinks, showers, dishwashers) warrants further examination. The remainder of the pathogen risks, including sources such marina and vessel discharges (eg mooring opposite the Lyrup ferry and Jane Eliza marina), were ranked as low level. The three waste disposal stations in the LAP area (Custom’s House, Lock 6 and Renmark) make the likelihood of deliberate blackwater discharge from vessels low, as was the likelihood of wastewater reaching the off-take point.

The Ninth and Tenth Street stormwater discharges in Renmark are directly adjacent to the raw water off-take and were classed as a moderate risk. The proximity of the Tenth Street discharge to the off-take(20 m) is of concern but the catchment is relatively small and mainly parklands. Runoff from the ferry at Lyrup and stormwater discharges at Renmark also pose a low pathogen risk to raw off-takes.

Other sources of potential pathogen risk were popular recreation areas with no sanitation facilities, particularly Lyrup Flats National Park, which extends for several kilometres along the river. It was rated as a low risk because of its distance from the off-take (>12 km) but this ranking is uncertain, particularly during high occupancies in peak holiday periods.

Nutrients

Leakage from Lyrup irrigation area onto the floodplain immediately upstream of the Lyrup raw water off-take was assessed as a moderate nutrient risk. Uncertainty for the assessment came from a lack of monitoring data on pollutants and volumes being discharged. The Ral Ral Creek event discharge was identified as a moderate nutrient risk and algal blooms⁵ have been recorded in the past in this area. Risk from the creek was assessed as a point source but also includes the risk from other moderately rated hazards such as groundwater leakage from the large Renmark and Chaffey irrigation districts. Chaffey has a direct drainage discharge to Ral Ral Creek, which was assigned a moderate risk although a lack of monitoring data made the assessment uncertain. Algal blooms have also occurred in Jane Eliza lagoon but are infrequent and do not regularly outflow to the river.

The Ninth and Tenth Street stormwater discharges in Renmark were also classed as a moderate risk (see pathogens above). Hazards posing low nutrient risks included vessel and stormwater discharges, septic tanks at the Lyrup township and informal camping facilities.

Organic matter

Organic matter risk sources were similar to those for nutrients (moderate risk for leakage from Ral Ral Creek, Renmark, Chaffey and Lyrup irrigation districts, and drainage discharge from Chaffey and Lyrup). The Ninth and Tenth Street stormwater discharges in Renmark were also classed as a moderate risk for the reasons noted above.

Hydrocarbons and heavy metals

Ral Ral Creek was identified as a moderate heavy metal risk during rainfall event discharges, as was leakage and drainage disposal from the Renmark, Chaffey and Lyrup irrigation areas. No monitoring data was obtained to confirm this assessment but elevated levels have been reported under irrigation areas elsewhere in South Australia (eg Northern Adelaide Plains, EPA 2003a). The Ninth and Tenth Street stormwater discharges in Renmark were also classed as a moderate risk for the reasons noted above and the possibility of deliberate or accidental spills in the catchment area. Low-level hydrocarbon and heavy metal risks came from other Renmark stormwater discharges and the Lyrup vehicle ferry (runoff and spills).

Salinity

A moderate salinity risk was assigned to the drainage disposal (onto floodplain) from Lyrup irrigation area immediately upstream of the Lyrup off-take. This may be masked somewhat by Pike River discharges further upstream. Moderate salinity risks were assigned to the Ral Ral Creek discharge, Renmark and Chaffey irrigation areas, drainage discharge (into Ral Ral Creek) from Chaffey irrigation area.

Pesticides

The low pesticide risk assigned for the Ral Ral Creek discharge and the irrigation areas (Renmark, Chaffey, Lyrup) is supported by monitoring data showing generally undetectable pesticide levels at the Renmark off-take.

Turbidity

The Ninth and Tenth Street stormwater discharges in Renmark were classed as a moderate turbidity risk during rainfall events, as was Ral Ral Creek.

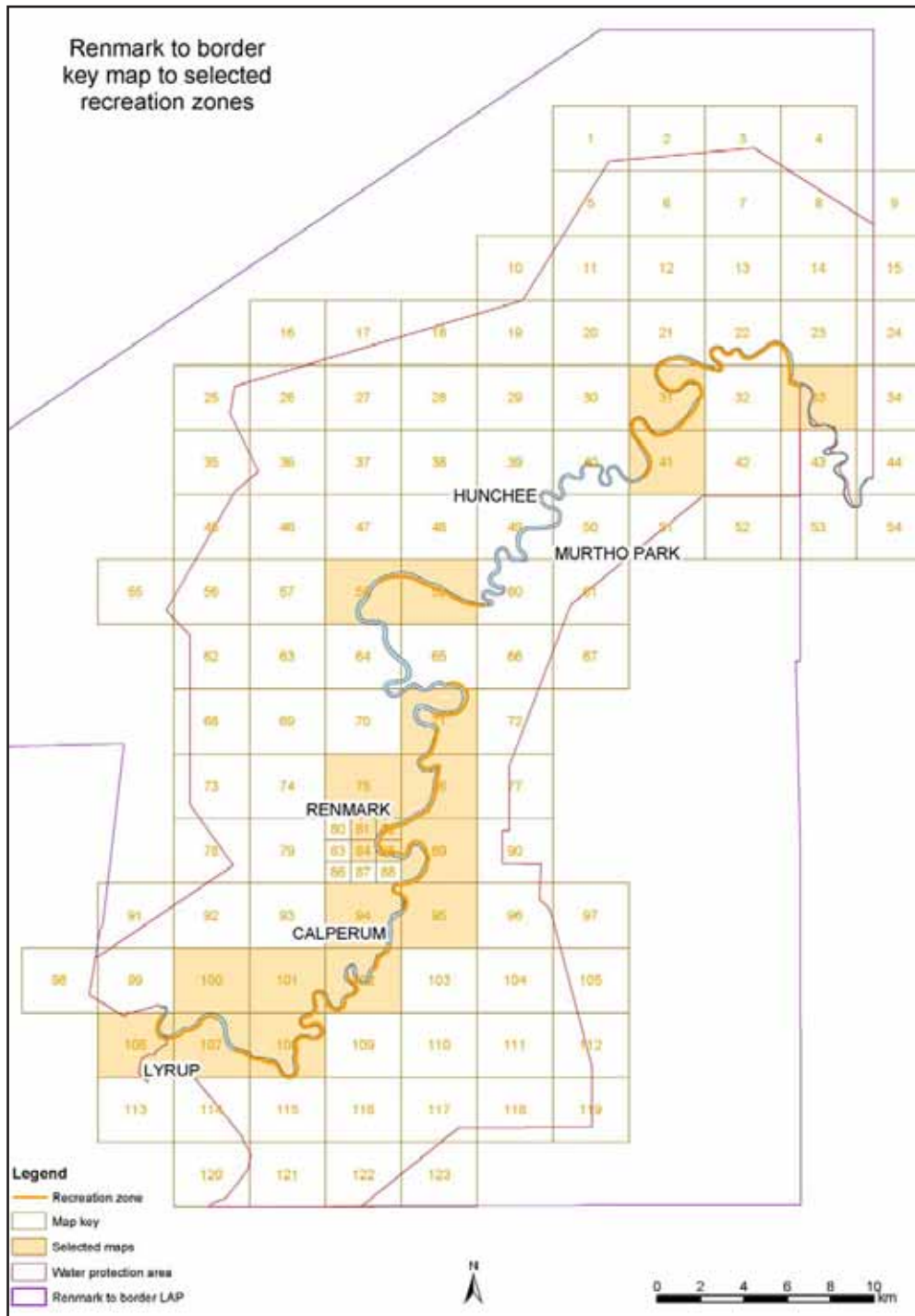
⁵ The cause of the algal blooms is unclear but several other factors (eg light, water temperature) may contribute in addition to nutrient levels.

Table 2.4 Summary of risks to raw water supply environmental values, RB IAP area
 low=low risk, mod=moderate risk, high=high risk, v high=very high risk
 certainty value (in italics) follows each risk ranking

GEOCODE	HAZARD	EVENT TYPE	PA	NU	TU	OR	HM	PE	HY	SA
RB019A	CREEK/RIVER Creek discharge, Ral Ral	DISCHARGE	mod 2	mod 2	low 2	mod 2	mod 2	low 2		mod 2
RB019B	Creek discharge, Ral Ral	EVENT DISCHARGE	mod 2	mod 2	mod 2	mod 2	mod 2	low 2		mod 2
RB041A	DRAINAGE DISPOSAL SITE Irrigation discharge, Chaffey irrigation district	DISCHARGE	mod 2	mod 2	mod 2	mod 2	mod 2	low 2		mod 2
RB082L	Irrigation drainage disposal site, Lyrup	LEAKAGE	mod 2	mod 2	mod 2	mod 2	mod 2	low 2		mod 2
RB060B	FERRY Ferry, Lyrup	EVENT DISCHARGE	low 3				low 3		low 3	
RB060C	Ferry, Lyrup	ACCIDENTAL SPILLAGE							low 2	
RB013L	HORTICULTURE Horticulture, Chaffey irrigation area	LEAKAGE		mod 2		mod 2	mod 2	low 2		mod 2
RB118L	Horticulture, Renmark irrigation area	LEAKAGE		mod 2		mod 2	mod 2	low 2		mod 2
RB121L	Horticulture, Lyrup irrigation area	LEAKAGE		mod 2		mod 2	mod 2	low 2		mod 2
RB059G	INFORMAL CAMPING Informal camping, Lyrup Flats National Park	HUMAN/ANIMAL EXCRETION	low 3	low 3		low 2				
RB063G	Informal camping, Lyrup (d/s ferry)	HUMAN/ANIMAL EXCRETION	low 2	low 2		low 2				
RB018Q	MARINA Marina, Jane Eliza	MARINA DISCHARGES	mod 3	low 2	low 2	low 2	low 1		low 2	
RB070H	SLIPWAY Slipway, Jane Eliza	WASH DOWN					low 3	low 2	low 3	
RB101B	STORMWATER INFRASTRUCTURE Stormwater discharge, Ninth St, Renmark	EVENT DISCHARGE	mod 3	mod 3	mod 3	mod 3	mod 3		mod 3	
RB102B	Stormwater discharge, Tenth St, Renmark	EVENT DISCHARGE	mod 3	mod 3	mod 3	mod 3	mod 3		mod 3	
RB103B	Stormwater discharge, Twelfth St, Renmark	EVENT DISCHARGE	low 3	low 3	low 3	low 3	low 3		low 3	
RB104B	Stormwater discharge, James Ave, Renmark	EVENT DISCHARGE	low 3	low 3	low 3	low 3	low 3		low 3	
RB105B	Stormwater discharge, Renmark Ave	EVENT DISCHARGE	low 3	low 3	low 3	low 3	low 3		low 3	
RB113B	Stormwater discharge, Jane Eliza, Renmark	EVENT DISCHARGE	low 3	low 3	low 3	low 3	low 3		low 3	
RB068L	TOILETS/SEPTIC TANKS Septic tanks, Lyrup	LEAKAGE	low 2	low 2		low 2				
RB061R	VESSEL MOORING(S) Houseboats, Lyrup (opposite ferry)	VESSEL DISCHARGES	low 2	low 2	low 2	low 2			low 1	

Risks to recreational use

Figure 2.6 is the key map for risks to the recreational environmental value in the RB LAP area. The attached DVD has individual maps numbered according to the key map.



Note: only hazards identified in the shaded areas were assessed for risk to recreation

Figure 2.6 Key map for recreation zones, RB LAP area

Frequencies of identified risks to recreation for the various water quality parameters are summarised in Table 2.5. The highest frequency of risks to recreational values was for pathogens, followed by nutrients, turbidity and hydrocarbons. The majority of these risks (124) were assessed as low level, although a significant number (69) of moderate-level risks were identified, mostly pathogen risks.

Table 2.5 Frequency of risks to recreational values, RB LAP area

Risk	Stressor				Total
	PA	NU	TU	HY	
Low	9	40	32	43	124
Moderate	44	9	15	1	69
High	0	0	0	0	0
Very high	0	0	0	0	0
Total	53	49	47	44	193

PA—pathogens; NU—nutrients; TU—turbidity; HY—hydrocarbons

The recreational risks identified in this LAP area are summarised in Table 2.6 and discussed in more detail below for each stressor.

Pathogens

A large number (44) of moderate pathogen risks were identified relating to a number of different hazards. Event discharges from creeks and rivers were assessed as a moderate risk, as were Renmark urban stormwater event discharges. The actual risk could be lower as people would tend not to swim or ski during or immediately following rainfall events. High-use recreational camping areas lacking sanitation facilities (eg Lyrup area, downstream of Lock 5 and upstream of Nelwart Island) were also classed as a moderate risk with community concern expressed as to widespread human excreta at these sites following holiday periods. The Sustainable Recreation Strategy is currently prioritising recreation sites along the River Murray and Lower Lakes for rehabilitation and/or additional recreation facilities (Sustainable Recreation Project 2005). Septic tanks at Lyrup and Lock 5 road were identified as a moderate risk, as were riverfront wastewater (STEDS) infrastructure.

Jane Eliza marina (approximately one kilometre upstream of the Renmark off-take) received a moderate risk ranking primarily related to greywater discharges (sinks, showers, dishwashers). Most vessels were noted to pump out effluent at the Renmark vessel waste disposal station; two or three pump out with a contracted tanker. The risk of a vessel accidentally spilling sewage at the river vessel waste disposal stations was also given a moderate risk ranking to recreational values.

Other moderate sources of pathogen risk include leakage from septic tanks (Lyrup township and houses near Lock 5 bend) and infrastructure failure at a caravan park effluent/STEDS system leading to spillage of effluent.

Nutrients

Several (9) hazards posing a moderate nutrient risk were identified including leakage from large horticultural areas (Renmark, Paringa, Lyrup), Renmark stormwater inputs, discharges from creeks or rivers (Big Hunchee, Ral Ral, Pike River) and vessels at Jane Eliza marina. The septic systems for the dwellings on Lock 5 Road and in Lyrup were assessed as a moderate risk but there was some uncertainty to the level of nutrient (in particular nitrate) leakage from these sites. Mundic Creek and Whirlpool Corner wetland were rated as low nutrient risks, but it was noted that they are located in popular swimming areas.

Hydrocarbons

Several Renmark stormwater discharges and diesel fuel stores contribute to low risks to recreational values. There is also a dry-dock area associated with the marina and a re-fuelling facility. Accidental fuel spillage on the Lyrup ferry poses a moderate risk to recreation areas in the immediate vicinity.

Turbidity

Event discharges from creeks or rivers and stormwater discharges were ranked as moderate turbidity risks to recreational values. However, people are unlikely to swim or ski during rainfall conditions so the risk may be mainly to aesthetic values. Wake-induced erosion of riverbanks in high-use recreation areas was a common community concern. This was assessed as a low risk but its actual impact on recreational values was difficult to quantify.

Table 2.6 Summary of risks to recreational environmental values, RB IAP area
 low=low risk, mod=moderate risk, high=high risk, v high=very high risk
 risk certainty value (in italics) follows each risk ranking

GEOCODE	HAZARD	EVENT TYPE	PA	TU	NU	HY
RB014A	CREEK/RIVER	DISCHARGE		low	mod	2
RB014B	Big Hunchee Creek	EVENT DISCHARGE	mod	2	low	2
RB019A	Big Hunchee Creek	DISCHARGE	mod	2	mod	2
RB019B	Ral Ral Creek	EVENT DISCHARGE	mod	2	mod	2
RB054B	Bookmark Creek	EVENT DISCHARGE	mod	2	low	3
RB065A	Pike River	DISCHARGE		low	mod	2
RB065B	Pike River	EVENT DISCHARGE	mod	2	low	2
RB080A	Old River Creek	DISCHARGE		low	mod	2
RB080B	Old River Creek	EVENT DISCHARGE	mod	2	low	2
RB081B	Nelwart Island Creek	EVENT DISCHARGE	mod	2	low	2
RB082L	DRAINAGE DISPOSAL SITE					
	Irrigation area drainage disposal site, Lyrup	LEAKAGE			mod	2
RB060B	FERRY	EVENT DISCHARGE	low	3		low
RB060C	Ferry, Lyrup	ACCIDENTAL SPILLAGE			mod	2
	Ferry, Lyrup					
	FUEL STORE					
RB032C	Pump fuel store, north of Bunyip Reach	ACCIDENTAL SPILLAGE				low
RB098C	Pump fuel store—irrigation, Bulyong Creek	ACCIDENTAL SPILLAGE				low
RB099C	Pump fuel store—irrigation, Old River billabong	ACCIDENTAL SPILLAGE				low
RB100C	Pump fuel store—irrigation, Old River billabong	ACCIDENTAL SPILLAGE				low
	HORTICULTURE					
RB073L	Horticulture, north of Paringa	LEAKAGE			mod	1
RB118L	Horticulture, adj Renmark	LEAKAGE			mod	1
RB121L	Horticulture, Lyrup irrigation area	LEAKAGE			mod	1
	INFORMAL CAMPING					
RB002G	Recreation area, Customs House	HUMAN/ANIMAL EXCRETION	mod	2	low	2
RB011G	Recreation area, Murtho Forest	HUMAN/ANIMAL EXCRETION	mod	2	low	2
RB016G	Recreation area, Lindner's	HUMAN/ANIMAL EXCRETION	mod	2	low	2
RB025G	Informal camping, d/s Lock 5	HUMAN/ANIMAL EXCRETION	mod	2	low	2
RB053G	Informal camping, u/s of Nelwart Island	HUMAN/ANIMAL EXCRETION	mod	2	low	2

GEOCODE	HAZARD	EVENT TYPE	PA	TU	NU	HY
RB059G	Informal camping, Lyrup Flats National Park	HUMAN/ANIMAL EXCRETION	mod 2		low 2	
RB063G	Informal camping, Lyrup (d/s ferry)	HUMAN/ANIMAL EXCRETION	mod 2		low 2	
RB066G	Informal camping, Lyrup Flats National Park	HUMAN/ANIMAL EXCRETION	mod 2		low 2	
RB089G	Informal camping, Lyrup Flats	HUMAN/ANIMAL EXCRETION	mod 2		low 2	
RB018Q	MARINA Marina, Jane Eliza	MARINA DISCHARGES	mod 3		mod 3	low 2
RB050C	PETROL STATION Petrol station—SAFF, Paringa	ACCIDENTAL SPILLAGE				low 3
RB050L	Petrol station—SAFF, Paringa	LEAKAGE				low 2
RB077C	Petrol station—BP, Renmark	ACCIDENTAL SPILLAGE				low 3
RB077L	Petrol station—BP, Renmark	LEAKAGE				low 2
RB078C	Petrol stations, Renmark	ACCIDENTAL SPILLAGE				low 3
RB001C	REFUELLING FACILITY Refuelling, Customs House	ACCIDENTAL SPILLAGE				low 2
RB070H	SLIPWAY Slipway, Jane Eliza	WASH DOWN		low		low 2
RB101B	STORMWATER INFRASTRUCTURE Stormwater discharge, Ninth St, Renmark	EVENT DISCHARGE	mod 2	mod 3		low 3
RB102B	Stormwater discharge, Tenth St, Renmark	EVENT DISCHARGE	mod 2	mod 3		low 3
RB103B	Stormwater discharge, Twelfth St, Renmark	EVENT DISCHARGE	mod 2	mod 3		low 3
RB104B	Stormwater discharge, James Ave, Renmark	EVENT DISCHARGE	mod 2	mod 3		low 3
RB105B	Stormwater discharge, Renmark Ave	EVENT DISCHARGE	mod 2	mod 3		low 3
RB106B	Stormwater discharge, Para St, Renmark	EVENT DISCHARGE	mod 2	mod 3		low 3
RB107B	Stormwater discharge, Pyap St, Renmark	EVENT DISCHARGE	mod 2	mod 3		low 3
RB108B	Stormwater discharge, Tapio St, Renmark	EVENT DISCHARGE	mod 2	mod 3		low 3
RB109B	Stormwater discharge, Tolarno St, Renmark	EVENT DISCHARGE	mod 2	mod 3		low 3
RB027L	TOILETS/SEPTIC TANKS Septic tanks, Lock 5 bend	LEAKAGE	mod 3		mod 3	
RB068L	Septic tanks, Lyrup	LEAKAGE	mod 2		mod 2	
RB049C	TRANSPORT INFRASTRUCTURE Bridge, Paringa	ACCIDENTAL SPILLAGE				low 1
RB010S	VESSEL LAUNCHING/BOAT RAMP Recreation area, Lock 6	VESSEL LAUNCHING		low 2		low 2
RB042S	Recreation area, Wynne Haven	VESSEL LAUNCHING		low 2		low 2

GEOCODE	HAZARD	EVENT TYPE	PA	TU	NU	HY
RB045S	Bank erosion, Riverbend Caravan Park	VESSEL LAUNCHING		low 2		low 2
RB052S	Recreation area, Plush's Bend	VESSEL LAUNCHING		low 2		low 2
RB072S	Recreation area, Pine View	VESSEL LAUNCHING		low 2		low 2
RB074S	Bank erosion, Riverfront Caravan Park	VESSEL LAUNCHING		low 2		low 2
RB075S	Recreation area, Riverfront Caravan Park	VESSEL LAUNCHING		low 2		low 2
	VESEL MOORING(S)					
RB003R	Houseboats, Customs House	VESSEL DISCHARGES	mod 3	low 2	low 3	low 2
RB040R	Houseboats, Ninkle Nook backwater	VESSEL DISCHARGES	mod 2	low 3	low 2	low 2
RB043R	Houseboats, Kylie Island	VESSEL DISCHARGES	mod 2	low 3	low 2	low 2
RB047R	Houseboats, Reedy Creek	VESSEL DISCHARGES	mod 3	low 3	low 2	low 2
RB048R	Houseboats, u/s of Paringa	VESSEL DISCHARGES	mod 2	low 3	low 2	low 2
RB051R	Houseboats, d/s of Dix Park	VESSEL DISCHARGES	mod 3	low 3	low 2	low 2
RB061R	Houseboats, Lyrup (opposite ferry)	VESSEL DISCHARGES	mod 3	low 2	low 2	low 2
RB062R	Houseboats, Lyrup (d/s ferry)	VESSEL DISCHARGES	mod 3	low 2	low 2	low 2
RB071R	Houseboats, Pine View	VESSEL DISCHARGES	mod 3	low 2	low 2	low 2
RB117R	Houseboats, u/s of Lyrup	VESSEL DISCHARGES	mod 2	low 3	low 2	low 2
	VESEL WASTE DISPOSAL STATION					
RB004C	River vessel waste disposal, Customs House	ACCIDENTAL SPILLAGE	mod 2	low 2	low 2	low 2
RB009C	River vessel waste disposal, Lock 6	ACCIDENTAL SPILLAGE	mod 2	low 2	low 2	low 2
RB046C	River vessel waste disposal station, Renmark	ACCIDENTAL SPILLAGE	mod 2	low 2	low 2	low 2
	WASTEWATER INFRASTRUCTURE					
RB045D	STEDS infrastructure, Riverbend Caravan Park	INFRASTRUCTURE FAILURE	mod 2		low 2	low 2
RB083D	STEDS infrastructure, Riverfront Caravan Park	INFRASTRUCTURE FAILURE	mod 2		low 2	low 2
	WETLAND/LAGOON					
RB115A	Wetland, Whirlpool Corner	DISCHARGE	low 2		low 2	low 2
RB115B	Wetland, Whirlpool Corner	EVENT DISCHARGE	low 2	low 2	low 2	low 2
RB116B	Wetland, Mundic Creek	EVENT DISCHARGE	low 2	low 2	low 2	low 2

2.5 Options for management of risks, RB LAP area

Several current and future potential options to manage risks identified in the RB LAP area are shown in Table 2.7 in the categories of: capital and on-ground works, capacity building, monitoring, compliance, policy planning, and research and development.

The suggestions as to which stakeholders may take responsibility for undertaking management options do not imply that they should, or will, be performed by those parties. Management options and stakeholder responsibilities will be examined in much more detail in Stage III of this project, following further consultation and more in-depth examination of priority risks.

Funding would be required for some strategies and funding sources are yet to be determined. Uncertainties in risk assessment rankings may also need to be addressed before management decisions can be made.

Table 2.7 Current and potential future options for management of risks, RB IAP area
 EV= environmental value, ECO=aquatic ecosystem EV, RAW=raw water supply EV, REC=recreational EV
 risk management options which are already being implemented are in italics

Activity	Stressor	EV	Current and potential future options						Lead stakeholder(s)
			Capital on-ground works	Capacity building	Monitoring	Compliance	Policy planning	Research and development	
HIGH RISKS									
Creek/river discharges: * Ral Ral Creek * Chowilla Creek * Pike River * Old River Creek	SA NU OR	ECO RAW	Pike/Murtho salt interception scheme funding and implementation Chaffey irrigation water diverted to disposal basin rather than directly to Ral Ral Creek Revegetation of catchments and creation of riparian buffers	<i>Education on sustainable irrigation practices</i> <i>Funding for conversion to drip irrigation systems</i>	Examine DWLBC monitoring study data for Ral Ral Creek and other systems where available Monitoring of artificial flooding impacts at Chowilla	<i>Water use and efficiency auditing</i>	Liaison and policy development with DWLBC re: water efficiency and drainage water quality relationship	Investigate land uses and catchment drainage network in more detail Research risk from Ral Ral Creek in more detail and possible mitigation action by SA Water Catchment water quality modeling	SA Water, Renmark Paringa Council, DWLBC, Irrigation trusts & irrigators, LAP groups, EPA, SA Water
Horticulture/irrigation areas: * Murtho * Renmark * Paringa * Chaffey * Pike Simarloo * Lyrup	SA NU OR	ECO	Salt interception scheme implementation (Pike/Murtho) Chaffey irrigation water diverted to disposal basin rather than directly to Ral Ral Creek Divert Lyrup irrigation drainage off floodplain	<i>Education on sustainable irrigation practices</i> <i>Funding for conversion to drip irrigation systems</i>	Monitoring of irrigation discharge water and groundwater quality	<i>Water use and efficiency auditing</i>	Liaison and policy development with DWLBC re: water efficiency and drainage water quality relationship	Review previous data on contaminants (nutrients, organic, matter, pesticides) in drainage water Catchment and ground water quality modeling, incorporating research into the impact of diffuse runoff SA Water to examine more closely risks arising from discharge from Lyrup irrigation area	Irrigation trusts & irrigators, LAP groups, EPA, DWLBC

Activity	Stressor	Current and potential future options						Lead stakeholder(s)
		Capital on-ground works	Capacity building	Monitoring	Compliance	Policy planning	Research and development	
MODERATE RISKS								
Marina, Jane Eliza	NU (mod OR PA)		Education of boat owners on appropriate waste disposal	Monitoring of nutrient levels in marinas Survey/audit how often boats move mooring locations and frequency of vessels who use a contractor to pump out blackwater	Audit and enforce Code of Practice for Vessel and Facility Management: Marine and Inland Waters and/or licence	Marina planning guidelines for new marinas	Research possible effect of greywater discharges (from permanent vessels) on the Renmark raw water supply off-take	BIASA, Marina owners/operators, EPA, Planning SA, DWLBC, SA Water
Stormwater: Ninth and Tenth streets, Renmark (risk to Renmark off-take)	PA NU TU OR HM HY	ECO RAW REC	Currently has GPT Additional treatment required due to proximity to off-take such as diversion to a retention basin	Monitoring of discharge quality and effects on off-take during rainfall events (e.g. turbidity spikes)	Auditing of industries within the catchment	Contingency plan for SA Water in case of a large rain event or spill in catchment	SA Water to examine options for reducing risk to off-take and alternative options for stormwater detention basins/wetlands	SA Water, EPA, Renmark Paringa Council
Chaffey drainage disposal discharge	SA OR NU	ECO RAW	Chaffey irrigation water diverted to disposal basin rather than directly to Ral Creek	Monitoring of discharge water quality and effect on Ral Ral Creek	Enforce Water Quality EPP (EPA 2003c) if required		Investigate possible effect on Cootlong off-take	CIT, EPA, SA Water
Wastewater/STEDS lagoons * Paringa * Renmark	NU OR	ECO	Upgrade system to reduce risks and/or move off flood plain		Audit and enforce licence conditions and/or Water Quality EPP	Plan for necessary upgrades	Research water quality impacts in more detail	Renmark Paringa Council, EPA
River vessel waste disposal stations: * Custom's House * Lock 6 Rd * Renmark	NU PA	ECO REC	Education of vessel users on the operation of stations Emergency procedures in place in the event of station failure	Auditing systems to record numbers of boats using the stations			Surveys on station use to determine if the station and disposal area capacity is appropriate	DWLBC, BIASA, Houseboat Hirers Association, Renmark Paringa council

Activity	Stressor	EV	Current and potential future options						Lead stakeholder(s)
			Capital on-ground works	Capacity building	Monitoring	Compliance	Policy planning	Research and development	
Vessel mooring: * d/s Dix Park * Lyrup (opp ferry) * Reedy Creek * Pine View * Customis House * Ninkle Nook backwater * u/s of Lyrup	NU OR (mod PA)	ECO RAW REC		Education and awareness of river vessel users on blackwater disposal stations and greywater management	Monitoring of greywater discharge concentrations Survey/audit of how often boats move mooring locations	Audit and enforce COP for Vessel and Facility Management: Marine and Inland Waters	Introduce requirement for all houseboats (including non-commercial) to be stripped and surveyed	Development of affordable and effective greywater treatment systems	BIASA, EPA, Renmark Paringa council, Houseboat Hirers Association
Pipeline under river to Noora	SA	ECO				Ensure pipeline is appropriately maintained, reducing risk of spillage			DWLBC
Creek discharge, Bookmark	OR SA	ECO			Monitoring of water quality entering river	Enforce Water Quality EPP (EPA 2003c) if required			DWLBC, EPA
Toilet/septic tanks systems * Lock 5 Rd * Lyrup	NU PA	ECO REC	Upgrade of systems to STEDS or similar	Education on the importance of regular auditing and management practices	Monitoring on the influence of septic tank disposal trenches on groundwater contamination	Auditing and enforce the Public and Environmental Health Act or Water Quality EPP if necessary			Renmark Paringa council, EPA, SAMDB NRM, Department of Health
Slipway, Jane Eliza	HM HY	ECO REC RAW		Emergency response procedures in the event of a spillage		Audit and enforce COP for Vessel and Facility Management: Marine and Inland Waters. License if required			EPA

Activity	Stressor	EV	Current and potential future options							Lead stakeholder(s)
			Capital on-ground works	Capacity building	Monitoring	Compliance	Policy planning	Research and development		
STEDS: * Jane Eliza * Riverbend Cvan Pk * Riverfront Cvan Pk	PA	ECO REC		Emergency response procedures in the event of pump/storage failure		Audit systems and enforce licence conditions and/or Water Quality EPP if required	Ensure applications for development take into account effluent disposal system capacity		Research and development	Remark Paringa Council, EPA, SAMDB NRM
Stormwater: * Remark West * 20th St East, Remark * Various others	NU TU PA HY OR HM	ECO REC RAW	Treatment/reuse alternatives (e.g. Bookmark Creek for Remark West catchment)	Public education on avoiding pollution of the stormwater system	Monitoring of discharge quality Monitoring of water quality in Jane Eliza lagoon and its outflow to river	Auditing of industries within the catchment	New developments should be required to incorporate stormwater management systems (e.g. retention basins and wetlands) and use water-sensitive urban design principles	Investigate treatment/reuse alternatives Catchment water quality modeling		Local council, EPA, SAMDB NRM
Wetland: * Whirlpool Corner * Mundic Creek	NU TU OR SA PA	ECO REC			Monitor water quality of wetlands			Research required assessing the potential of wetlands to discharge a pulse of contaminants following significant rain events		SAMDB NRM, DWLBC, EPA
Informal camping areas: * Lyrup Flats Nat Pk and d/s ferry * Murtho Forest * Customs House * Lindner's * d/s Lock 5 * u/s of Nelwart Is	PA	ECO REC RAW	Construction of sanitation facilities	Continual education and signage for campers is recommended to encourage appropriate waste disposal	Survey of campsites looking at the frequency of use and density of campers	Enforcing Public Environmental Health Act or Water Quality EPP if required	Implement Sustainable Recreation Strategy (2005) Designate camping sites that require permits, allowing greater control over use Limit access around off-takes	Research whether permit systems can be introduced		Councils, Riverland Tourism Association, Sustainable Recreation Project/MDA, campers, EPA, Department of Health, SA Water

Activity	Stressor	EV	Current and potential future options							Lead stakeholder(s)
			Capital on-ground works	Capacity building	Monitoring	Compliance	Policy planning	Research and development		
Winery: EPA Lic # 1257–Angoves	NU OR	ECO				<i>Enforcement of licence conditions</i> Ensure wastewater irrigation practices are sustainable and relevant back-up systems are present			EPA, winery operators	
LOW LEVEL & CUMULATIVE RISKS										
Pump fuel stores Irrigation, Bulyong Ck Irrigation, Chowilla Stn Irrigation, Old River billabong Stock watering, Coombool Stn	HY	ECO	Bunding of all stores that pose a risk to the river	Presence of spill kits and education in their use					Any new storage applications are required to be banded	EPA, Renmark Paringa council, DWLBC
Petrol stations	HY	ECO REC		Education on emergency response procedures in the event of a fuel spill Presence of spill kits			Auditing of fuel storage tanks		Research into seepage of fuel from underground storage tanks	EPA, station operators, local councils
Infrastructure and ferries: * Bridge, Paringa * Ferry, Lyrup	HY	ECO RAW		Emergency response procedures in event of spill and presence of spill kits						DTEI, Renmark Paringa council

Activity	Stressor	EV	Current and potential future options						Lead stakeholder(s)
			Capital on-ground works	Capacity building	Monitoring	Compliance	Policy planning	Research and development	
Bank erosion due to recreation: * Riverbend Cvan Pk * Riverfront Cvan Pk * d/s of Heading's Cliff * Lindheris	TU	ECO REC		Designate specific zones for recreation river craft Increase the number of speed restricted zones	Possible monitoring of effects on turbidity and bank erosion			Investigate the use of geo-textile bags on the river bank	Renmark Paringa council, EPA, local community