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National Outfall Database: Outfall ranking based on 2021/2022 nutrient loads discharge

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Executive Summary

This report provides an analysis of the Australian coastal outfalls and ranks them according to the total flow volume and nutrients (nitrogen and phosphorus) load to prioritise the potential degree of impact of each source to the environment and human health.

Wastewater quality data was collected from 42 out of 43 water authorities (WTAs) with 178 out of 192 outfall sites (93%) around Australia by either downloading the water quality data reports directly from WTA websites or by formally requesting the data through email.

The pollutant contribution index, based on nitrogen and phosphorus loads, was calculated for each outfall. Nitrogen and phosphorus loads were calculated according to the Load Calculation Protocol of New South Wales Department of Environment and Climate Change. Outfalls were ordered from lowest to highest index value to rank them according to their relative pollutant contribution to the coastal and marine environment. The index is based on a total nutrient load discharge using the variables of flow, nitrogen and phosphorus.

The results show that the outfalls released 1,619 gigalitres of effluent into the marine environment between July 2021 to June 2022. The total nutrient load from individual outfall sites around Australia ranged from 0.007 to 408,474,155 kg with a mean of 5,815,619 kg, and nutrient load per person ranged between 4.72 mg to 430 kg. The ranked loads throughout Australia were mapped by quartiles. The outfalls in the top 25% quartile were more prevalent in regional areas and discharge less nitrogen and phosphorus loads into the coastal and marine environment. The bottom 25% quartile, on the other hand, with higher nutrient loads, principally occur around the major cities. The phosphorus concentrations contribute less to the overall outfall nutrient load and vary less between outfall sites. Nitrogen, on the other hand has a higher median contribution and high variability across the sites.

In general, the outfalls contributing higher nitrogen and phosphorus loads varied more than those discharging lower loads. There may be many reasons for this, but it could be related to treatment plant capacity, population growth, and licensing requirements, resulting in increased discharge at metropolitan outfall sites. There are some exceptions to this pattern where rural/regional sites contributed higher nutrient loads than urban areas (e.g., Warrnambool, VIC). The reasons may vary; however, the main contributor is the level of technology employed to remove nutrients. This ranking of nutrient loads from Australian outfalls by site at a national scale can therefore be useful in prioritising treatment upgrade resources to manage biodiversity impacts and human health concerns.

1. Introduction

The discharge of treated wastewater has the potential to be a major contributor of marine environment pollution, which occurs globally. High concentrations of nutrients, pathogens, microplastics, organic and inorganic pollutants from wastewater discharge can threaten coastal ecology, biodiversity and affect the health of marine environment users, depending on the sensitivity of the receiving environment. (Wear et al., 2021, Boehm et al., 2017, Chahal et al., 2016, Ziajahromi et al., 2016). High loadings of nutrients may cause increased water eutrophication leading to hypoxic events that promote the mortality of marine organisms, including coral reefs (Altieri et al., 2017, Cheng et al., 2019, Whitehead et al., 2015). Harmful algal blooms (HABs) due to excess nutrient can be a major pose to human health by direct contact with water, consuming contaminated seafood and inhalation of the aerosolised algal toxins (Lim et al., 2023, Berdalet et al., 2023). In addition, eutrophication and HABs may also lead to economic losses for the local businesses that rely on the marine environment (Berdalet et al., 2023, Lemée et al., 2012).

To manage and safeguard aquatic and marine environments around Australia from the impacts of wastewater effluent, state/territory governments have each established Environment Protection Authorities (EPA). Each EPA acts as an independent environmental protection regulator to prevent and control pollutant impacts to human health and the environment. For example, in Victoria the EPA was established under section 5(1) of the Environment Protection Act of 1970. In New South Wales, the Protection of the Environment Administration Act (1991) (POEA Act) served as the mechanism to establish the environmental protection regulator. With regards to wastewater effluent each state or territory EPA has a role in regulating wastewater treatment plant (WWTP) discharges. For example, in New South Wales, the EPA regulates water pollution through the establishment of conditions in environmental protection licences. These licences take into account several factors, such as the community value of a waterway, the community's uses of a waterway and practical measures to prevent deterioration of waterway values and uses (EPA NSW, 2013). Any activity that may produce a discharge of waste that by reason of volume, location or composition adversely affects the quality of any segment of the environment will require a licence from the Authority (DECC NSW, 2009). The basic requirement of the licence consists of an explanation of the activity, pollutant loads and discharge limits. The actual load of a pollutant is the mass (in kilograms) of the pollutant (e.g., nitrogen, phosphorus, total suspended solids, oil and grease) released into the environment from the potential emission sources. Throughout each state and territory, emission sources are required to monitor their discharges and to comply with conditions set out in their licences. Each WWTP is required to conduct monitoring within the vicinity of their outfalls, analyse the samples and report the results to the EPA (DECC NSW, 2009, EPA VIC, 2009).

The National Outfall Database (NOD), developed by the Clean Ocean Foundation in collaboration with state and territory governments, provides policy makers with a guide to help prioritise outfall reform and identify public and private sector opportunities for wastewater recycling (Marine Biodiversity Hub, 2015). In collaboration with the National Environmental Science Program, the NOD also provides Australian water authorities and the public an accessible database to help identify pollutant loads and assess any potential health and environmental impact risks of wastewater outfalls on the marine environment and surrounding communities. The NOD provides an unprecedented national collection of water quality data, collected by water authorities and local governments according to guidelines set out in Environment Protection Authority (EPA) licences. Given the NOD's centralised collection of national scale water quality data, the opportunity to examine the comprehensive impacts of wastewater outfalls at regional scales becomes possible.

The aim of this report is to present a collection of discharge monitoring data between July 2021 and June 2022 from outfalls across Australian coastal regions. This report also ranks each outfall according to the total flow volume and nutrients load per capita to prioritise the potential degree of impact of each source to the environment. In general, the results of this analysis will provide stakeholders and the general community a better understanding of the relative pressures of outfalls to their coastal waterways and provide policy makers and managers one of evidence to prioritise outfall infrastructure reform and wastewater recycling initiatives.

2. Methods

2.3 Data collection

Wastewater quality data were collected from water treatment authorities (WTAs) around Australia (Figure 1) by either downloading the water quality data reports directly from WTA websites or by formally requesting the data through email. WTA monitoring requirements varied depending on EPA licence requirements. Therefore, the type of pollutant data monitored varied across all outfall locations. In this report, we assess only nitrogen, phosphorus and flow volume (Table 1), for nutrient loads calculation purposes. The population data of each outfall catchment were also gathered from the Australian Bureau of Statistics (2021) to calculate the amount of nutrient produced per capita.

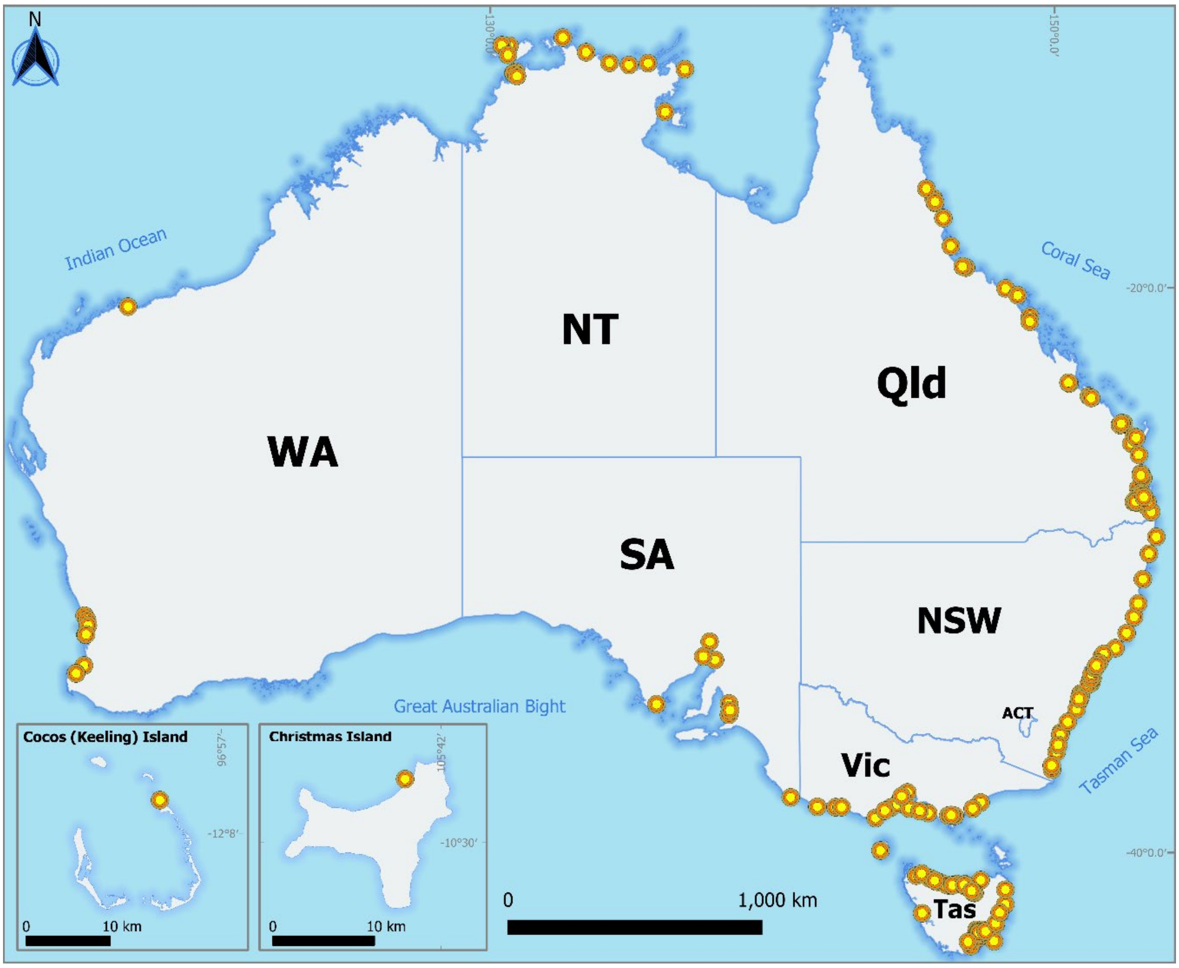

Figure 1. The location of 192 outfall sites managed by 43 water authorities.

Table 1. Number of WWTPs monitored each parameter for 2021/2022 financial year data. In bold, flow volume, total phosphorus and total nitrogen are assessed in this report.

Parameter	Unit	Number of WWTPs
Flow volume	**ML**	**160**
pH	pH	138
Total dissolved solids	mg/L	32
Total suspended solids	mg/L	151
Total phosphorus	**mg/L**	**152**
Total nitrogen	**mg/L**	**152**
Oil and grease	mg/L	84
Surfactants (MBAS)	mg/L	2
E. coli	cfu/100mL	56
Enterococci	cfu/100mL	85
Faecal coliforms	cfu/100mL	73
Turbidity	NTU	13
Colour	Pt.Co. Units	7
Algal blooms	cells/mL	4
Blue green algal bloom	cells/mL	4

2.4 Data Analysis

The pollutant contribution index, based on nitrogen and phosphorus loads, was calculated for each outfall (Figure 1). Outfalls were ordered from lowest to highest index value to rank them according to their relative pollutant contribution to the coastal and marine environment. The index is based on a total nutrient load discharge (see below) using the variables of flow, and nitrogen and phosphorus concentrations.

Nitrogen and phosphorus (nutrient) load was calculated based on the Load Calculation Protocol (DECC NSW, 2009) using

$$L_d(kg) = \sum(V_d * C_d) \qquad (1)$$

$$C_{fw}(ML/kg) = \frac{L_d}{\Sigma(V_{d-i})} \qquad (2)$$

$$N_l(kg) = C_{fw} \times VT \qquad (3)$$

where, N_l is the total nutrient load in kilograms, calculated for the observed load (L_d) of nitrogen and phosphorus concentrations (C_d) and V_d, the day's total voume of discharge from each outfall in megalitres (ML) (1). Nitrogen and phosphorus observed loads were summed and divided by the total volume (V_{d-i}) for those days which resulted as flow-weighted concentration (C_{fw}) (2) and multiplied by total volume (VT) of the licence fee period (ML) (3).

Nutrient load values were sorted and ranked for each outfall location and grouped into four quartiles, top 25% quartile (least nutrient load released), 50% quartile, 75% quartile and bottom quartile (most nutrient load released). All outfalls were further calculated by population to examine the amount of nutrient load per person. Few couples of outfalls, which service the same areas and population, have the final nutrient load values combined. These include Sorell and Midway Point (Tasmania), Busselton North and South wetlands (Western Australia) and Christies Beach Northern and Southern (South Australia). Those sites with only nitrogen or only phosphorus monitored for 2021/2022 financial year were not considered in the final nutrient load ranking.

3. Results

NOD has been consistently collecting data from the WTAs since 2015. As for 2021/2022 financial year, wastewater quality data were collected from 41 out of 43 WTAs with 173 out of 192 outfall sites (90%). Across the last eight years, Queensland, South Australia, Tasmania and Western Australia were able to maintain reliability in providing wastewater quality data (Table 2). Despite the complexity having various individual WTAs in Victoria and New South Wales, the NOD has successfully collected wastewater quality data for the 2021/2022 financial year. Due to various circumstances, the Northern Territory experienced difficulties in providing the requested information.

Table 2. Outfalls wastewater quality data collected for 2021/2022 financial year.

States/Territory	Number of outfalls	Data collected (%)
New South Wales	34	100
Northern Territory	14	0
Queensland	55	100
South Australia	10	100
Tasmania	47	100
Victoria	19	79
Western Australia	12	100

There were 144 out of 192 outfall sites analysed in this report. This is due to several combined sites (6), 18 missing sites and 27 sites with incomplete data. The 2021/2022 financial year data shows that 1,619 gigalitres effluent were released transporting a total nutrient load of 837,449 tonnes. Total nutrient load from individual outfall sites ranged from 0.007 to 408,474,155 kg with a mean of 5,815,619 kg, and nutrient load per person ranged between 4.72 mg to 430 kg. Each quartile is represented by 36 outfall sites (Appendix A – Table X). Table 3 shows the top quartile was dominated by Tasmanian outfall sites (19), followed by New South Wales (7), Queensland (6), Western Australia (3) and Victoria (1). The bottom quartile (highest nutrient load) was represented by eight outfall sites from Victoria. New South Wales and Western Australia each had six sites. Queensland, Tasmania and South Australia each had 7, 5 and 4 outfall sites, respectively.

Table 3. Top 25% (green) and bottom 25% (red) quartiles of outfall ranking for 2021/2022 financial year data. BMS = Boneo, Mt Martha and Somers, ETP = Eastern Treatment Plant, WTP = Western Treatment Plant, SWOP = Saline Water Outfall Pipe, ROS = Regional Outfall System.

Rank	State	Outfall	Total nutrient load (kg)
1	Tasmania	Beaconsfield	0.00661
2	Tasmania	Rokeby	0.12
3	Tasmania	Swansea	0.44
4	Tasmania	Boat Harbour	2.9
5	Tasmania	Triabunna	7.1
6	Tasmania	Sisters Beach	7.7
7	Queensland	Karana Downs	9.0
8	New South Wales	Crescent Head	9.5
9	Western Australia	Home Island	11
10	New South Wales	Bermagui	11
11	New South Wales	Iluka	13
12	Tasmania	Port Arthur	16
13	Tasmania	Dover	32
14	Queensland	Bowen	36
15	Western Australia	Christmas Island	40
16	New South Wales	Long Nose (Tomakin)	49
17	Tasmania	Bicheno	60
18	Queensland	Port Douglas	67
19	Tasmania	Stanley	73
20	Tasmania	St Helens	89
21	Tasmania	Sorell and Midway Point	91
22	New South Wales	Merimbula	99
23	Tasmania	Cambridge	107
24	New South Wales	Narooma	127
25	Tasmania	Orford	130
26	Queensland	Bargara	143
27	Tasmania	Currie	155

Rank	State	Outfall	Total nutrient load (kg)
28	Victoria	Lorne	161
29	Queensland	Cannonvale	178
30	New South Wales	Yamba	182
31	Western Australia	Wickham	198
32	Tasmania	Geeveston	251
33	Tasmania	Cygnet	258
34	Queensland	Millbank	262
35	Tasmania	Beauty Point	297
36	Tasmania	Bridport	335
109	Western Australia	Alkimos	66,817
110	Victoria	Altona	100,381
111	Western Australia	Bunbury	103,590
112	Queensland	Cleveland Bay	105,706
113	Queensland	Gibson Island	108,118
114	Tasmania	Rosny	129,120
115	Victoria	McGaurans Beach (SWOP)	136,730
116	Queensland	Loganholme	162,983
117	New South Wales	Winney Bay Kincumber	221,528
118	Tasmania	Prince Of Wales Bay	229,048
119	South Australia	Bolivar High Salinity	280,205
120	Victoria	Delray Beach (ROS)	314,712
121	Queensland	Coombabah	326,871
122	Queensland	Oxley	354,737
123	South Australia	Christies Beach All	402,253
124	Tasmania	Pardoe	423,449
125	New South Wales	Wollongong	451,015
126	Tasmania	Macquarie Point	459,302
127	Tasmania	Ti Tree Bend	489,876
128	Victoria	Warrnambool	534,492
129	Queensland	Kawana	536,642

Rank	State	Outfall	Total nutrient load (kg)
130	New South Wales	Cronulla	762,580
131	Victoria	Boags Rock (BMS)	904,920
132	Western Australia	Point-Peron	1,862,117
133	Victoria	Black Rock	2,151,345
134	South Australia	Glenelg	2,672,049
135	Queensland	Luggage Point	2,972,470
136	New South Wales	Bondi	3,774,585
137	Western Australia	Subiaco	5,070,256
138	South Australia	Bolivar WWTP	9,117,789
139	Western Australia	Beenyup	12,688,374
140	Western Australia	Woodman Point	30,894,846
141	New South Wales	North Head	48,843,588
142	New South Wales	Malabar	79,029,798
143	Victoria	Boags Rock (ETP)	221,292,029
144	Victoria	Port Phillip Bay (WTP)	408,474,155

All sites were further calculated by the population serviced and sorted from lowest to highest (Table 4 and Figure 4). This calculation resulted similar outfall ranking compared to Table 3 with the majority of top quartile outfalls are releasing low amount of nutrient load per capita and high nutrient load values per capita in the bottom quartile outfalls. The lowest amount of nutrient load per capita is from Beaconsfield, Tasmania (5 mg/C) which 99% treated effluent is reused for irrigating approximately 30 ha of eucalyptus forest (Fitzgibbon, 2022). Meanwhile, Port Phillip Bay (WTP), which services most western suburbs of Melbourne, released the highest nutrient load per capita of 430 kg/C. Few outfalls with asterisk (*) are discharging wastewater from areas with no recorded population, such as Point Peron (industrial only) and McGaurans Beach (power stations), which resulted missing nutrient load per capita.

Table 4. Total nutrient load per population for 2021/2022 financial year. BMS = Boneo, Mt Martha and Somers, ETP = Eastern Treatment Plant, WTP = Western Treatment Plant, SWOP = Saline Water Outfall Pipe.

Rank	Outfall	State	Total nutrient load (kg)	Nutrient/Pop (kg/C)
1	Beaconsfield	Tasmania	0.0066	0.000005
2	Rokeby	Tasmania	0.12	0.000008
3	Swansea	Tasmania	0.44	0.0004
4	Karana Downs	Queensland	9	0.002
5	Bermagui	New South Wales	11	0.002
6	Bowen	Queensland	36	0.004
7	Crescent Head	New South Wales	9	0.006
8	Merimbula	New South Wales	99	0.006
9	Boat Harbour	Tasmania	3	0.006
10	Iluka	New South Wales	13	0.007
11	Penguin Heads (REMS)	New South Wales	786	0.008
12	Triabunna	Tasmania	7	0.008
13	Long Nose Tomakin	New South Wales	49	0.008
14	Port Douglas	Queensland	67	0.01
15	Sorell and Midway Point	Tasmania	91	0.01
16	Ulladulla	New South Wales	439	0.01
17	Port Arthur	Tasmania	16	0.01
18	Bargara	Queensland	143	0.02
19	Sisters Beach	Tasmania	8	0.02
20	Edmonton	Queensland	405	0.02
21	Cannonvale	Queensland	178	0.02
22	Millbank	Queensland	262	0.02
23	Marlin Coast	Queensland	617	0.02
24	Narooma	New South Wales	127	0.02
25	Christmas Island	Western Australia	40	0.02
26	Skennars Head (Lennox Head)	New South Wales	716	0.03
27	Yamba	New South Wales	182	0.03
28	Home Island	Western Australia	11	0.03
29	Camden Haven	New South Wales	550	0.03
30	Landsborough	Queensland	365	0.03
31	Stanley	Tasmania	73	0.03
32	Capalaba	Queensland	1,027	0.03
33	Dover	Tasmania	32	0.04
34	Cambridge inc. Hobart Airport	Tasmania	107	0.04
35	Victoria Point	Queensland	1,307	0.04
36	Mackay North (Bucasia)	Queensland	792	0.04
107	Gibson Island	Queensland	108,118	2

108	Wollongong	New South Wales	451,015	2
109	Newnham	Tasmania	31,377	2
110	Burnie	Tasmania	46,754	2
111	Selfs Point	Tasmania	46,668	3
112	Christies Beach All	South Australia	402,253	3
113	Wynyard	Tasmania	18,814	3
114	Cameron Bay	Tasmania	55,307	3
115	Cronulla	New South Wales	762,580	3
116	Kawana	Queensland	536,642	3
117	Latrobe	Tasmania	17,194	3
118	Luggage Point	Queensland	2,972,470	4
119	Rosny	Tasmania	129,120	4
120	Delray Beach	Victoria	314,712	4
121	Bolivar High Salinity	South Australia	280,205	5
122	Boags Rock (BMS)	Victoria	904,920	5
123	Ulverstone	Tasmania	62,526	5
124	Prince Of Wales Bay	Tasmania	229,048	7
125	Black Rock	Victoria	2,151,344	8
126	Glenelg	South Australia	2,672,049	9
127	Port Fairy	Victoria	37,117	11
128	Smithton	Tasmania	45,513	12
129	Bondi	New South Wales	3,774,585	12
130	Macquarie Point	Tasmania	459,301	13
131	Pardoe	Tasmania	423,449	13
132	Warrnambool	Victoria	534,492	15
133	Subiaco	Western Australia	5,070,256	17
134	Beenyup	Western Australia	12,688,374	19
135	Bolivar low salinity	South Australia	9,117,789	19
136	Ti Tree Bend	Tasmania	489,875	22
137	North Head	New South Wales	48,843,588	36
138	Woodman Point	Western Australia	30,894,846	39
139	Malabar	New South Wales	79,029,798	46
140	Boags Rock (ETP)	Victoria	221,292,029	116
141	Port Phillip Bay (WTP)	Victoria	408,474,155	170
142	Luggage Point Advanced*	Queensland	*1,400*	*1,400*
143	Mcgaurans Beach*	Victoria	*136,729*	*136,729*
144	Point Peron*	Western Australia	*1,862,117*	*1,862,117*

The boxplot (Figure 2) illustrates the difference between the median contributions of nitrogen and phosphorus in the total nutrient loads across 144 sites. The outliers were removed to show clearer figure. Phosphorus concentrations consistently contribute less to the overall outfall nutrient load and vary less between outfall sites. Meanwhile, nitrogen has a higher median contribution and high variability across all sites. The outfalls contributing higher nitrogen and phosphorus loads vary more than those releasing lower loads.

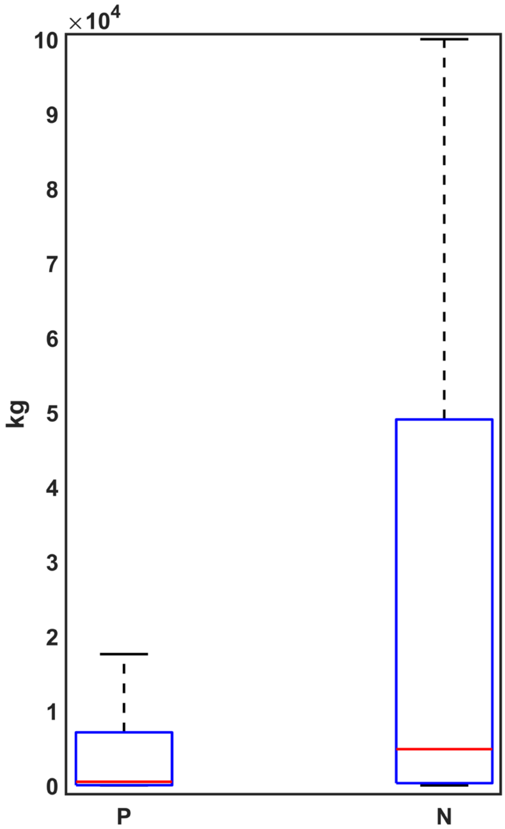

Figure 2. A boxplot of nitrogen (N) and phosphorus (P) loads in kg for each outfall reported data (n = 144).

Figure 3 shows the map of ranked outfalls distribution throughout Australia grouped by quartiles. The top quartile (lowest nutrient load) outfalls are spread dominantly in regional areas which mostly utilise tertiary treatment and discharge less nutrient into the coastal and marine environment. Discharges in the top quartile ranged between 0.0067 to 335 kg (Table 3). The 50th and 75th quartiles consist of the outfalls that are mixed of metro and regional areas across six states. The bottom quartile with higher nutrient loads appears to occur around the major cities. The total load discharged by this quartile ranged between 66,817 to 408,474,155 kg. In addition, the pattern on both maps (Figure 3 and 4) seems to be fairly similar. Surprisingly, in metropolitan area residents are likely to released higher load compared to small population areas (Table 4). While some regional areas appear to be producing higher load, other areas were releasing between 5 mg/C to 1.4 kg/C. Any outfall sites that have no population were not plotted on the map. Each quartile consisted of 36 outfalls.

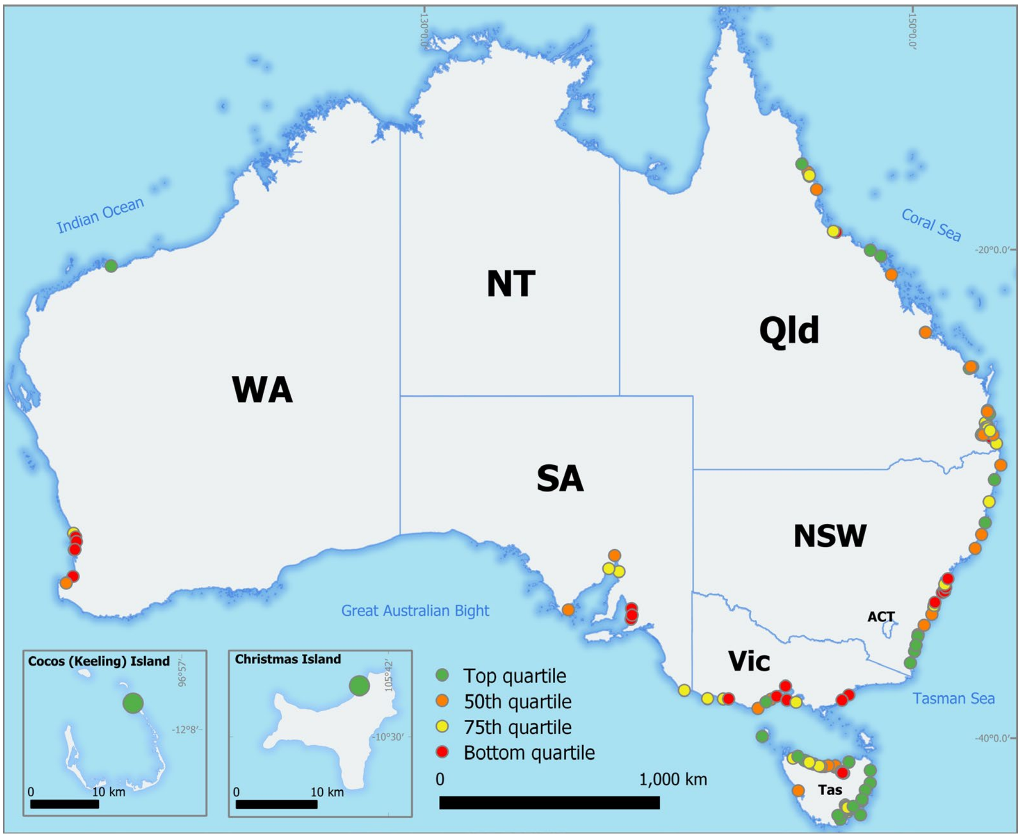

Figure 3. Australian coastal and estuarine/riverine outfalls ranked by quartiles for 2021/2022 financial year data. Cocos (Keeling) and Christmas islands are not in position.

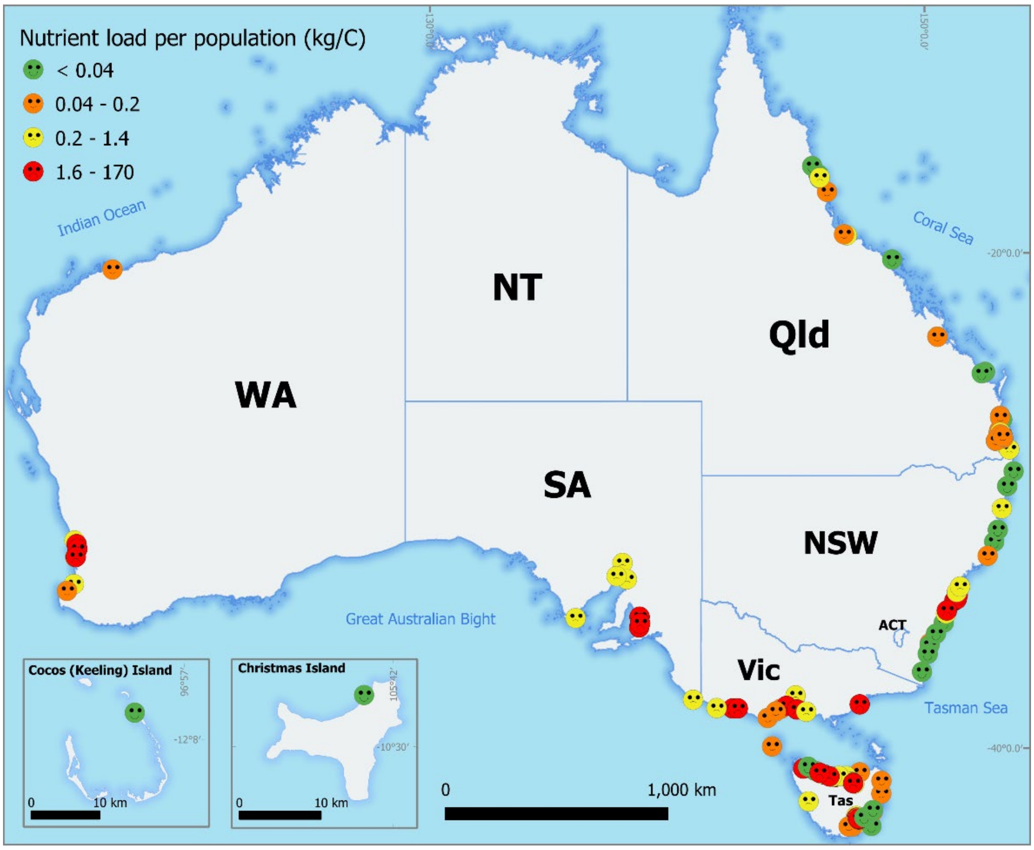

Figure 4. Nutrient load per population for 2021/2022 financial year data. Cocos (Keeling) and Christmas islands are not in position.

4. Discussion

Nitrogen, phosphorus, and flow volume data were collected from 144 (75%) coastal outfall sites across six states, Queensland, New South Wales, Western Australia, South Australia, Victoria and Tasmania. These outfalls were ranked according to their total nutrient load (nitrogen and phosphorus). General patterns show that the highest nutrient loads tend to occur through those outfalls serving metropolitan and surrounding areas. Lower nutrient loads outfalls seem to occur in regional areas, however, the loads varied across individual outfalls. Sites with higher discharge load of nitrogen exhibited greater variability in discharge, compared to sites with lower discharge. This trend is most likely due to high population levels in urban areas which cause increasing in general discharge at metropolitan outfall sites. However, it seems that in metropolitan areas, people tend to release higher nutrient load compared to small population areas. In addition, higher nutrient loading could be related to high levels of industrial influent to WWTPs within service areas, such as in Smithton, Tasmania; Warrnambool, Victoria; and Point Peron, Western Australia.

Licence conditions are determined by a variety of factors, including the conditions of the waterway being discharged to, and the community uses of the waterway (EPA NSW, 2013, EPA VIC, 2017). For instance, although it is required to monitor, Pardoe does not have a concentration limit condition for nitrogen and phosphorus, compared to Macquarie Point, TAS that has the concentration limit of 38 mg/L and 8 mg/L for nitrogen and phosphorus, respectively (EPA Tasmania, 1998, EPA Tasmania, 2013). In addition to existing conditions and the uses of waterways, available resources for treatment plant upgrades and community pressure may also contribute to WWTP loading. For example, Boags Rock outfall, serving ETP and BMS, were under significant community pressure in the past and upgraded to tertiary treatment in 2012 (Melbourne Water, 2022). Another example related to the community pressure is the VCAT order for Warrnambool WWTP to upgrade the current wastewater treatment by 31 December 2025 (VCAT, 2021).

Several outfall sites that ranked in the bottom quartile do not have concentration limits for nitrogen and phosphorus in their licence conditions. Despite having no concentration limits, these sites are not considered to be breaching their licences regardless the amount of nitrogen and phosphorus loading into the marine and coastal environments. For example, the Eastern Treatment Plant in Victoria has no nitrogen concentration limit restriction listed in its license (EPA VIC, 2023). This, however, is a tertiary treatment plant which tends to be more efficient at the removal of bacteria and the further reduction of organics, turbidity, nitrogen and phosphorus (Roberts et al., 2010, EPA VIC, 2002, ANZECC and ARMCANZ, 1997). In addition, this plant has been consistently listed in the bottom quartile in the last four years, including current 2020/2021 financial year data, due to high flow volume (Rohmana et al., 2019, Rohmana et al., 2020a, Rohmana et al., 2021).

As illustrated here, this ranking and the identification of nutrient loads by site can therefore be useful in prioritising treatment upgrade resources. In addition, the discrepancies in treatment level and license conditions, as well as wastewater reuse policies, warrant further examination at a national scale. This may indicate that bottom quartile outfalls should be the primary target for an upgrade in order to achieve the greatest benefit of water investment (Blackwell and Gemmill, 2019, Blackwell and Gemmill, 2020, Rohmana et al., 2020b). In addition, some sites (e.g., Beaconsfield in Tasmania and Lucinda in Queensland) reported almost zero discharge (NOD, 2023, Fitzgibbon, 2022). These sites are already fully recycling and diverting their wastewater to agricultural use, highlighting the success of a program that could be implemented in other areas.

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Appendix A – Outfall ranking

Table 5. Outfall rankings based on the total nutrients (kg) for the 2021/2022 financial year data. BMS = Boneo, Mt Martha and Somers, ETP = Eastern Treatment Plant, WTP = Western Treatment Plant, SWOP = Saline Water Outfall Pipe, ROS = Regional Outfall System.

Rank	State	Location	Total nutrient (kg)	Population	Nutrient load per population (kg/C)
1	Tasmania	Beaconsfield	0.007	1,400	0.0000047
2	Tasmania	Rokeby	0.1	14,500	0.0000084
3	Tasmania	Swansea	0.4	1,000	0.0004
4	Tasmania	Boat Harbour	3	450	0.006
5	Tasmania	Triabunna	7	900	0.008
6	Tasmania	Sisters Beach	8	500	0.02
7	Queensland	Karana Downs	9	6,000	0.002
8	New South Wales	Crescent Head	9	1,500	0.006
9	Western Australia	Home Island	11	400	0.03
10	New South Wales	Bermagui	11	6,000	0.002
11	New South Wales	Iluka	13	1,764	0.007
12	Tasmania	Port Arthur	16	1,150	0.01
13	Tasmania	Dover	32	900	0.04
14	Queensland	Bowen	36	9,900	0.004
15	Western Australia	Christmas Island	40	1,692	0.02
16	New South Wales	Long Nose (Tomakin)	49	6,000	0.008
17	Tasmania	Bicheno	60	1,050	0.06
18	Queensland	Port Douglas	67	5582	0.01
19	Tasmania	Stanley	73	2,200	0.03
20	Tasmania	St Helens	89	600	0.1
21	Tasmania	Sorell and Midway Point	91	7,000	0.01
22	New South Wales	Merimbula	99	15,500	0.006
23	Tasmania	Cambridge inc. Hobart Airport	107	2,900	0.04
24	New South Wales	Narooma	127	6,300	0.02
25	Tasmania	Orford	130	680	0.2
26	Queensland	Bargara	143	9,500	0.02
27	Tasmania	Currie	155	750	0.2

Rank	State	Location	Total nutrient (kg)	Population	Nutrient load per population (kg/C)
28	Victoria	Lorne	161	1,350	0.1
29	Queensland	Cannonvale	178	10,700	0.02
30	New South Wales	Yamba	182	7,000	0.03
31	Western Australia	Wickham	198	2,300	0.09
32	Tasmania	Geeveston	251	2,000	0.1
33	Tasmania	Cygnet	258	1,700	0.2
34	Queensland	Millbank	262	14,000	0.02
35	Tasmania	Beauty Point	297	1,300	0.2
36	Tasmania	Bridport	335	1,700	0.2
37	Queensland	Landsborough	365	11805	0.03
38	Queensland	Edmonton	405	24,814	0.02
39	Victoria	Apollo Bay	431	2,300	0.2
40	New South Wales	Ulladulla	439	32,000	0.01
41	Tasmania	East Strahan	488	700	0.7
42	New South Wales	Camden Haven	550	18,500	0.03
43	Tasmania	Risdon East	552	7,000	0.08
44	Queensland	Marlin Coast	617	30,740	0.02
45	Victoria	Anglesea	624	3,200	0.2
46	Queensland	Fairfield	644	15,200	0.04
47	New South Wales	Bombo	664	16,180	0.04
48	New South Wales	Forster	695	14,700	0.05
49	New South Wales	Skennars Head (Lennox Head)	716	28,000	0.03
50	New South Wales	Penguin Heads (REMS)	786	102,500	0.008
51	Queensland	Mackay North (Bucasia)	792	20,000	0.04
52	Tasmania	Turners Beach	849	3,400	0.2
53	New South Wales	Batemans Bay	862	18000	0.05
54	Queensland	Capalaba	1,027	30,000	0.03
55	Tasmania	Legana	1,271	4,800	0.3
56	Queensland	Victoria Point	1,307	34,000	0.04
57	Queensland	Luggage Point Advanced	1,400	N/A	N/A
58	Queensland	Innisfail	1,426	9,600	0.1
59	Tasmania	Somerset	1,836	4,000	0.5

Rank	State	Location	Total nutrient (kg)	Population	Nutrient load per population (kg/C)
60	Queensland	Wacol	2,016	37,000	0.05
61	Queensland	Thorneside	2,076	30,000	0.07
62	Queensland	Rubyanna	2,087	50,000	0.04
63	Queensland	Nambour	2,629	49102	0.05
64	Queensland	Coolum	2,775	31106	0.09
65	Queensland	Carole Park	3,344	23,000	0.1
66	Western Australia	Busselton (South and North)	3,541	40,600	0.09
67	South Australia	Port Lincoln	4,453	16,300	0.3
68	South Australia	Port Augusta East	4,792	13,950	0.3
69	Queensland	South Rockhampton	5,013	71,851	0.07
70	Tasmania	Port Sorell	5,204	5,200	1
71	Tasmania	George Town	5,739	7,000	0.8
72	Queensland	Burpengary East	5,798	65546	0.09
73	Queensland	Mt St John	6,285	106,000	0.06
74	Tasmania	Bridgewater	6,782	15,000	0.5
75	Queensland	Wynnum	7,404	45,000	0.2
76	Queensland	Southern WWTP (Woree)	8,126	25,000	0.3
77	South Australia	Whyalla	8,581	21,000	0.4
78	Queensland	Goodna	9,615	60,000	0.2
79	Queensland	Beenleigh	9,716	55,000	0.2
80	Western Australia	East Rockingham	9,906	135,500	0.07
81	Victoria	Portland	11,837	11,200	1
82	Tasmania	Riverside	14,826	12,000	1
83	Tasmania	Hoblers Bridge	15,629	11,000	1
84	Victoria	Phillip Island	15,848	15,500	1
85	Tasmania	Latrobe	17,194	5,000	3
86	Queensland	Caboolture South	17,821	73067	0.2
87	Queensland	Murrumba Downs	18,610	147003	0.1
88	South Australia	Port Pirie	18,728	13,000	1
89	Tasmania	Wynyard	18,814	6,900	3
90	Queensland	North Rockhampton	19,032	45,000	0.4
91	New South Wales	Coffs Harbour	20,028	51,000	0.4

Rank	State	Location	Total nutrient (kg)	Population	Nutrient load per population (kg/C)
92	Queensland	Redcliffe	21,057	65377	0.3
93	Queensland	Maroochydore	22,474	86459	0.3
94	Queensland	Sandgate	25,209	125,000	0.2
95	Tasmania	Blackmans Bay	25,379	38,000	0.7
96	Tasmania	Newnham	31,377	13,600	2
97	Queensland	Bundamba	31,625	133,000	0.2
98	New South Wales	Shellharbour	33,671	77,280	0.4
99	South Australia	Finger Point	34,584	29,500	1
100	Victoria	Port Fairy	37,117	3,500	11
101	New South Wales	Warriewood	39,565	74,440	0.5
102	Tasmania	Smithton	45,513	3,900	12
103	Tasmania	Selfs Point	46,668	18,300	3
104	Tasmania	Burnie	46,754	19,900	2
105	Queensland	Elanora	48,729	100,000	0.5
106	Tasmania	Cameron Bay	55,307	18,800	3
107	Tasmania	Ulverstone	62,526	11,600	5
108	Queensland	Merrimac	66,553	150,000	0.4
109	Western Australia	Alkimos	66,817	205,000	0.3
110	Victoria	Altona	100,381	150,000	0.7
111	Western Australia	Bunbury	103,590	76,500	1
112	Queensland	Cleveland Bay	105,706	126,000	0.8
113	Queensland	Gibson Island	108,118	68,000	2
114	Tasmania	Rosny	129,120	32,500	4
115	Victoria	Mcgaurans Beach	136,729	N/A	N/A
116	Queensland	Loganholme	162,983	300,000	0.5
117	New South Wales	Winney Bay Kincumber	221,528	160,000	1
118	Tasmania	Prince Of Wales Bay	229,048	32,200	7
119	South Australia	Bolivar High Salinity	280,205	59,250	5
120	Victoria	Delray Beach	314,712	77,000	4
121	Queensland	Coombabah	326,871	360,000	0.9
122	Queensland	Oxley	354,737	315,000	1
123	South Australia	Christies Beach North and South	402,253	150,000	3

Rank	State	Location	Total nutrient (kg)	Population	Nutrient load per population (kg/C)
124	Tasmania	Pardoe	423,449	32,000	13
125	New South Wales	Wollongong	451,015	209,690	2
126	Tasmania	Macquarie Point	459,301	35,700	13
127	Tasmania	Ti Tree Bend	489,875	22,070	22
128	Victoria	Warrnambool	534,492	35,533	15
129	Queensland	Kawana	536,642	157,169	3
130	New South Wales	Cronulla	762,580	240,720	3
131	Victoria	Boags Rock (BMS)	904,920	168,000	5
132	Western Australia	Point Peron*	1,862,117	N/A	N/A
133	Victoria	Black Rock	2,151,344	271,000	8
134	South Australia	Glenelg	2,672,049	290,000	9
135	Queensland	Luggage Point	2,972,470	807,000	4
136	New South Wales	Bondi	3,774,585	315,730	12
137	Western Australia	Subiaco	5,070,256	300,000	17
138	South Australia	Bolivar WWTP	9,117,789	470,000	19
139	Western Australia	Beenyup	12,688,374	660,000	19
140	Western Australia	Woodman Point	30,894,846	790,000	39
141	New South Wales	North Head	48,843,588	1,358,440	36
142	New South Wales	Malabar	79,029,798	1,652,070	48
143	Victoria	Boags Rock (ETP)	221,292,029	1,900,000	116
144	Victoria	Port Phillip Bay (WTP)	408,474,155	2,400,000	170
Total			**837,449,081**		

Note:

(green)	= Top quartile
(orange)	= 50th quartile
(yellow)	= 75th quartile
(pink)	= Bottom quartile

Appendix B – Distribution list

Clean Ocean Foundation	John Gemmill
University of Tasmania	Andrew Fischer
Federal	
Minister for Environment and Water	The Hon. Tanya Plibersek MP
Assistant Minister for Waste Reduction and Environmental Management	The Hon. Trevor Evans MP
Minister for Agriculture, Fisheries and Forestry and Emergency Management	Senator the Hon. Murray Watt
Minister for Infrastructure, Transport, Regional Development and Local Government	The Hon. Catherine King MP
Minister for Health and Aged Care	The Hon. Mark Butler MP
Senator for Victoria	Senator Linda White
Victoria	
Minister for Environment	Ingrid Stitt MLC
Minister for Water	The Hon. Harriet Shing MLC
EPA Victoria	Lee Miezis
EPA Victoria - Victoria's Chief Environmental Scientist	Prof. Mark Patrick Taylor
Barwon Water	Luke Christie
Greater Western Water (Previously City West Water)	Joshua Mah
Gippsland Water	Boon Huang Goo
Melbourne Water	Marcus Mulcare
South East Water	Ben Spedding

South Gippsland Water	Bree Wiggins
Wannon Water	Jimena Harrington
Westernport Water	Johanna Randall
New South Wales	
Minister for Environment	The Hon. Penny Sharpe, MLC
Minister for Water	The Honourable Rose Jackson MLC
EPA New South Wales – Chief Executive Officer	Tony Chappel
Bega Valley Shire Council	Ken McLeod
Ballina Shire	Thomas Lees
Clarence Valley	Greg Mashiah
Coffs Harbour	Sam Pinnuck
Kempsey	Bobbie Brenton
Port Macquarie-Hastings Shire	Belinda Green
Midcoast City Council	Craig Dowler
Hunter Water	Darren Cleary
Sydney Water	Sharmila Lakshmanaa
Shoalhaven City Council	Daniel Page
Eurobodalla Shire Council	Brett Corven
Central Coast Council	Stephen Shinners
Queensland	
Minister for the Environment and the Great Barrier Reef	The Hon. Meaghan Scanlon MP
Minister for Water	The Hon. Glenn Butcher MP
Department of Environment and Science (WaTERs)	Dr Vaitea Pambrun

Northern Territory	
Minister for Environment, Climate Change and Water Security	The Hon. Lauren Moss ML
EPA Northern Territory	Dr Paul Vogel AM
Power and Water Corporation	Ms Djuna Pollard
Western Australia	
Minister for Environment	The Hon. Reece Whitby MLA
Minister for Water	The Hon. Simone McGurk MLA
EPA Western Australia - Director General of the DWER	Ms Michelle Andrews
EPA Western Australia	Prof. Matthew Tonts
Water Corporation	Gillian Griffin
South Australia	
Minister for Climate, Environment and Water	The Hon. Susan Close MP
EPA South Australia	Keith Baldry
SA Water – Chief Executive Officer	David Ryan
SA Water	Julia De Cicco
Tasmania	
Minister for Environment and Climate Change	The Hon. Roger Jaensch MP
Minister for Primary Industries and Water	The Hon. Jo Palmer MLC
EPA Tasmania	Jason De Weys
TasWater	Kate Westgate

Other Bodies	
Australia Institute	Richard Dennis
Australia New Zealand Society for Ecological Economics	Dr Boyd Blackwell
Australian Conservation Foundation	Liana Downey
Environment Victoria	Tyler Rotche
Friends of the Earth	Cam Walker
Ocean Decade Australia	Jas Chambers
ORCV	Tim Boucat
SO Shire	Sarah-Jo Lobwein
Surfrider Australia	Damien Cole
Water Services Association Australia	Adam Lovell
Western Sydney University	Assoc Professor Ian Wright

Marine and Coastal

National Environmental Science Program

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