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Australian Platypus Conservancy

Results of platypus survey work in the Werribee River at Bacchus Marsh and Werribee township: summer 2022

Prepared for: Bacchus Marsh Platypus Alliance and Werribee River Association

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Summary

Background

The Werribee River supports an important platypus population. This report provides an up-to-date assessment of the species' distribution and status in and upstream of Bacchus Marsh, based on two live-trapping surveys conducted in early 2022 along with findings from recent eDNA studies (2016–2020) and a consolidated list of reliable sightings held by the Bacchus Marsh Platypus Alliance (2016–2022). In addition, findings are presented from a platypus live-trapping study conducted in February 2022 at Werribee township.

Principal findings

- Four platypus (2 adult males, 1 subadult male, 1 adult/possibly subadult female) were recorded in or near Bacchus Marsh (near Halletts Way and farther upstream on the property 'Redborough').
- The average frequency of platypus captures in the Bacchus Marsh survey area (or CPUE) in 2022 was 0.4 animals per site per night. Based on the scale adopted across the greater Melbourne region in recent years, platypus abundance in this area is appropriately ranked as being 'Moderate'.
- The distribution of recent platypus sightings, pattern of positive platypus eDNA records and recent live-trapping results indicate that a widespread and reasonably abundant platypus population currently inhabits the Werribee River between Ballan and Melton Reservoir, including within and immediately upstream of Bacchus Marsh township.
- Assuming (conservatively) that the many substantial pools found between Bacchus Marsh Weir and Melton Reservoir support at least 2.5 platypus on average per kilometre of river channel, the minimum platypus population size in this part of the river is estimated to be around 30 animals – numerous enough to constitute a substantial population, but not so large that its long-term survival can or should be taken for granted.
- Three platypus including an adult male, a juvenile male and an adult (or possibly subadult) female were recorded in February 2022 at Werribee township. This is the highest number of animals captured in a given survey session at Werribee township since July 2009. The juvenile male and adult/subadult female were captured in nets set below the Princes Freeway bridge, confirming that platypus continue to breed successfully only a short distance upstream of where the Werribee River becomes brackish as it approaches Port Phillip Bay.
- The average frequency of platypus captures (or CPUE) in the Werribee township survey area in early 2022 was 0.5 animals per site per night, equating to platypus abundance at Werribee township being ranked as 'Moderate'.

Recommendations

- Currently the single biggest threat to the survival of a viable platypus population in the Werribee River is the rapid urban development occurring at Bacchus Marsh and Werribee townships and soon to be initiated at Ballan. A comprehensive set of guidelines for platypus-sensitive urban development is urgently needed to establish a clear decision-making framework that ensures the

most effective strategies and policies for protecting platypus and their aquatic environment are adopted in future.

- Improved knowledge of the platypus's distribution, abundance and demographic attributes (such as prevalence of breeding females and reproductive success) is needed to provide a sound basis for evaluating local species viability and conducting cost-effective monitoring in the future. This will be best achieved using complementary methods: recording sightings, mapping positive eDNA results and conducting targeted live-trapping surveys. Recommended priority areas for additional platypus live-trapping work include the lower reaches of the Lerderderg River and replicated studies in Werribee township to confirm the recent positive findings.

1 Introduction

The Werribee River arises in state forest north of Ballan and flows approximately 110 kilometres before joining Port Phillip Bay near Werribee township, at the southwestern edge of greater Melbourne. Detailed information about the Werribee's catchment and hydrological attributes and biodiversity values is summarised in Jacobs (2014) and Mackintosh (2018).

In brief, this system lies in a rain shadow created by the Otway Ranges, making it one of the driest catchment areas found in Victoria south of the Great Dividing Range. Nonetheless, two-thirds of the Werribee's land catchment is devoted to agricultural activities, including irrigated farming districts located near Bacchus Marsh and Werribee townships that are supplied by water from the major water storages of Pykes Creek Reservoir, Melton Reservoir and Merrimu Reservoir in association with smaller diversion weirs. Though detailed environmental watering plans for the Werribee system have been adopted to help protect the river's natural values, compliance with recommended flow regimes is constrained by the amount of environmental water available in dry years, particularly in and downstream of Werribee township (Jacobs 2014). The river's capacity to support aquatic biota is also being challenged by rampant urban growth, with the number of people occupying the Werribee's catchment predicted to double in the next 20 years (DELWP 2018). As an outcome of these and related pressures, 42% of the length of waterways draining urban or agricultural landscapes in the middle and lower Werribee system has been identified to be in poor condition or flow-stressed (DELWP 2018).

Live-trapping platypus survey work along the Werribee River commenced in the late 1990s when the Australian Platypus Conservancy (APC) conducted fieldwork at Werribee township. The findings indicated that the river supported a breeding population at a minimum estimated density of three resident animals per kilometre of channel. A high percentage of the animals encountered in the course of this work were found either to be entangled in an item of litter or to be scarred in a manner consistent with prior litter entanglement (Williams and Serena 1998; Williams 2000).

Subsequent live-trapping surveys carried out by cesar from 2008 to 2019 recorded substantially fewer animals at Werribee township, with only around one-quarter as many animals captured per unit trapping effort as compared with findings from 1997 to 2000. It was concluded that the platypus population at Werribee township has been subject to ongoing long-term decline and currently occurs at very low abundance (Griffiths et al. 2020). The status of platypus in the Bacchus Marsh area (between Bacchus Marsh Weir and Melton Reservoir) was considered to be even more dire, reflecting the fact that only one animal (an adult or subadult female recorded in 2011) was ever captured by cesar in the course of at least 13 different fyke-netting surveys conducted from 2008 to 2017, with one other animal (an adult male captured in a gill net) recorded in Bacchus Marsh township in 2008 (Mitrovski 2008). Accordingly, it was concluded that 'only occasional vagrant individuals use this stretch of river (including lower Lerderderg River) although anecdotal reports from local residents indicate a more permanent population may have existed prior to the Millennium Drought' (Griffiths and Weeks 2018).

The Bacchus Marsh Platypus Alliance (BMPA) is a volunteer-driven community group that was set up in mid-2019 to help protect platypus habitat and the animals themselves in nearby parts of the Werribee River. After reaching out to the local community, BMPA was heartened to receive reliable reports that platypus sightings were still being recorded at sites between Melton Reservoir and Ballan (see Results). In addition, positive eDNA results were recorded within this same area in 2016 (Griffiths *et al*. 2017) and also subsequently (see Results). Acting in co-operation with another community conservation group, the

Werribee River Association (WRA), BMPA approached APC to undertake some additional live-trapping work to help support an independent, up-to-date assessment of the platypus's status along the Werribee River in the Bacchus Marsh area in 2021/22.

The main aim of this report is to present the findings from two platypus live-trapping surveys conducted along the Werribee River at Bacchus Marsh by APC in early 2022 (Fig. 1), and infer the likely current status of platypus in the Bacchus Marsh area based on the live-trapping data in addition to recent sightings records and eDNA results. In addition, water quality data collected at Bacchus Marsh from 2006 to the present (available online at the DELWP Water Measurement Information website) are summarised to determine whether levels of dissolved oxygen, nutrient enrichment or suspended solids may potentially be limiting platypus population size in this area (or have affected numbers in the recent past). Last but not least, a summary is provided of the findings from a platypus live-trapping survey conducted by Ecology Australia (EA) along the Werribee River at Werribee township in February 2022.

Figure 1 Removing a captured platypus from the end of a net during recent survey work by the Australian Platypus Conservancy. L to R: Marty White (EA), Geoff Williams (APC), Meysam Khodaparast (PhD student, La Trobe University) (Photo credit, J. Valpied)

2 Study Area

2.1 Bacchus Marsh

Platypus live-trapping surveys were conducted in the Bacchus Marsh area in mid-January and early February 2022. Nets were set at a total of eight sites distributed along approximately 8 km of channel between Bacchus Marsh Weir and Fisken Street in Bacchus Marsh township (Table 1, Appendix 1).

Table 1 Locations of platypus fyke-netting survey sites along the Werribee River in and near Bacchus Marsh township and the event dates when nets were set in early 2022 ('1' denotes nets set on 18–19 January, '2' denotes nets set on 3–4 February.Table caption

Site code	Location	Coordinates (latitude and longitude)	Event date
WE21	0.1 km downstream Bacchus Marsh Weir	-37.6995 144.3771	1
WE21A	0.5 km downstream Bacchus Marsh Weir	-37.6792 144.3811	2
WE22	Paddock off Werribee Vale Road	-37.6831 144.3844	1
WE23	Laneway to property 'Redborough'	-37.6861 144.3938	1 & 2
WE24	0.05 km upstream of Halletts Way	-37.6804 144.4209	1
WE25	0.1 km downstream of Halletts Way	-37.6790 144.4233	1 & 2
WE26	Near end of Meikle Street (d'nstream end of Peppertree Park	-37.6822 144.4320	2
WE27	0.03 km downstream of Fisken Street	-37.6818 144.4437	2

2.2 Werribee township

One platypus live-trapping survey was conducted in Werribee township in February 2022. Nets were set at six sites spread along approximately 6 km of channel between Redgum Close (0.75 km downstream of the Southern/Lower Diversion Weir) and Princes Freeway Bridge (Table 2, Appendix 2).

Table 2 Locations of platypus fyke-netting survey sites along the Werribee River in and near Werribee township (sampled 11-12 February 2022).

Site code	Location	Coordinates (latitude and longitude)
WE2	End of Redgum Close	-37.8828 144.6406
WE3	30 m downstream of Shaws Road bridge	-37.8881 144.6425
WE4	Anembo Court	-37.8962 144.6518
WE5	Just upstream of Bungey's Hole (behind Tennis/Bowls Club)	-37.9056 144.6495
WE6	Synott Street	-37.9079 144.6518
WE8	Princes Freeway bridge	-37.9198 144.6574

3 Methods

3.1 Live-trapping surveys

Live-trapping surveys relied on use of fyke nets, which do not entangle platypus in netting. Instead, animals are directed (by panels of netting stretching on both sides of the main body of a net across the entire channel width) to travel through a series of internal chambers separated by one-way netting funnels. To ensure captured animals had access to air, each net was partly suspended out of the water by fastening its end to a metal stake driven into the channel substrate. Nets were set in pairs in the afternoon (with one net facing upstream and the other facing downstream at each site), checked at regular 2-hour intervals starting just before dusk and continuing thereafter throughout the time that nets were set, and removed from the water shortly after dawn. In order to minimise the likelihood that platypus evaded capture, gaps between the net and channel bed were eliminated by weighting the entire bottom edge of the main body of a net and its lateral wings with rocks, and the wings were stretched well up onto the banks (Fig. 2).

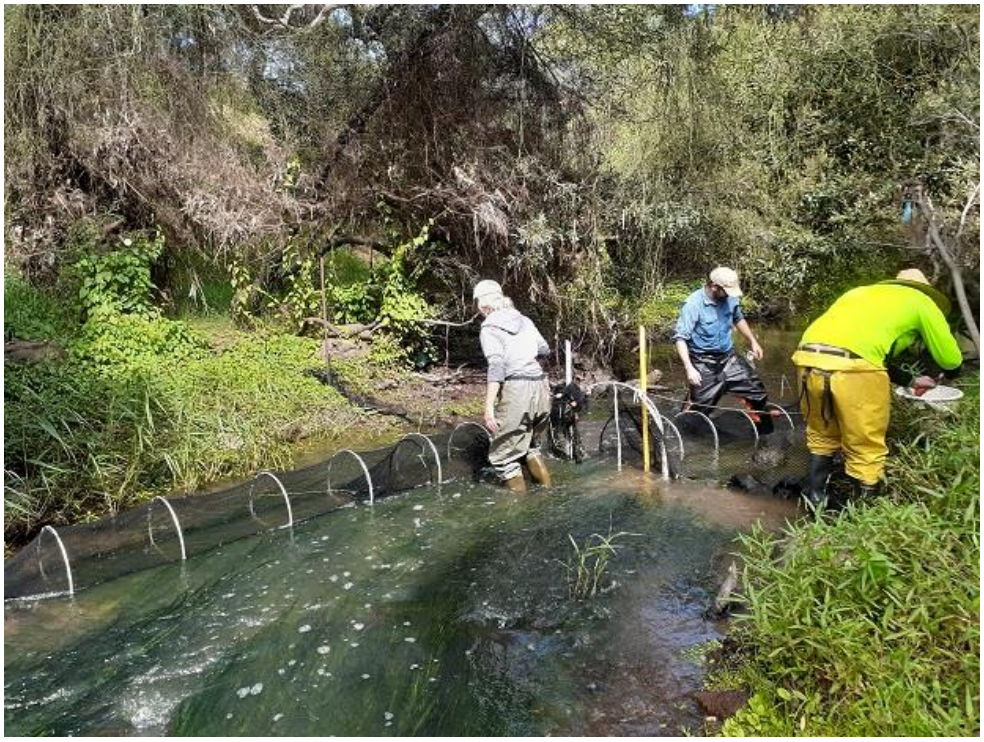

Figure 2 A pair of fyke nets being set by a team of Ecology Australia and Australian Platypus Conservancy biologists in the Werribee River at Werribee township in February 2022 (Photo credit: Australian Platypus Conservancy).

All captured platypus were permanently marked with microchip transponder tags implanted just under the skin between the shoulder blades (Grant and Whittington 1991).

In addition to standard morphometric measurements, the physical condition of each animal was assessed using the standard 5-point scale developed by Grant and Carrick (1978). Sex and age class was assigned based on the size and appearance of spurs present on the heels, enabling three male classes (first-year juvenile, second-year subadult, adult > 24 months old) and two female classes (first-year juvenile, adult or subadult > 12 months old) to be distinguished reliably (Williams and Serena 2012).

Non-target species including fish, turtles and ducks were identified and released when first encountered (apart from declared noxious fish species, which were humanely euthanased and disposed of). The occurrence of Australian water-rats/rakali (*Hydromys chrysogaster*) was most often inferred from holes created when an animal chewed its way through a net, generally at a point just above the water line. It should be noted that the fyke netting methods used in this study were designed to maximise the capture of platypus rather than fish.

3.2 Sightings

The Bacchus Marsh Platypus Alliance (BMPA) kindly shared its consolidated list of reliable platypus sightings reports for the Werribee River (Melton Reservoir to Ballan) and Lerderderg River (near Bacchus Marsh); the period of record extended from January 2016 to February 2022.

3.3 Environmental DNA (eDNA)

BMPA kindly shared its consolidated list of platypus eDNA results obtained from studies funded by Melbourne Water in the upper and middle reaches of the Werribee River between Ballan and Bacchus Marsh from 2016 to 2020. Testing was conducted at a total of seven sites distributed from downstream of the Old Melbourne Road near Ballan to Woolpack Road at the downstream end of Bacchus Marsh. For details of how water samples were collected and analysed, see Griffiths *et al*. (2017).

3.4 Water quality and flows

Measurements of discharge volume (ML/day), dissolved oxygen (ppm, effectively equivalent to mg/L at typical ambient temperatures: Mackintosh 2018), total suspended solids (mg/L), total phosphorus (mg/L) and total Kjeldahl nitrogen (mg/L) collected at site 231200 (Werribee River at Bacchus Marsh) from January 2006 to December 2021 were downloaded from the DELWP Water Measurement Information website (https://www.data.water.vic.gov.au) on 19 February 2022.

4 Results

4.1 Bacchus Marsh

4.1.1 Platypus live-trapping survey work

Pairs of fyke nets were set by Australian Platypus Conservancy to target platypus captures at each of five sites on the afternoons of 19 January and 3 February, with two sites sampled on both occasions and eight locations sampled in all. Four animals were captured at sites located at or near the upstream edge of Bacchus Marsh, including an adult male and adult (or possibly subadult) female encountered in the January session and an adult male and subadult male encountered in the February session. Two animals were rated as being in average condition, with the other two rated as being at the upper end of the average range (Table 3).

Table 3 Locations and dates when platypus were captured at sites along the Werribee River in and near Bacchus Marsh township in early 2022, and their physical and demographic attributes. Sex = M (male), F (female). Age class = A (adult, > 24 months old), S (subadult, 12–23 months old), J (juvenile, < 12 months old). TVI = Tail Volume Index (1 = very fat, 2 = above average condition, 3 = average condition, 4 = below average condition, 5 = very thin). Animals were marked with Trovan microchip transponders. See Table 1 for details of trapping site locations.

Microchip ID code	Location site code	Date	Direction of travel	Sex/age class	Weight (g)	Bill width (mm)	TVI
06F051ED	WE23	19 Jan	Upstream	MA	1628	50.8	3
06F11239	WE23	19 Jan	Upstream	FA or S	1235	42.2	3+
06F0FF77	WE25	3 Feb	Upstream	MA	1573	51.1	3
06F11BA1	WE23	3 Feb	Upstream	MS	1695	54.0	3+

Five non-target species were recorded in platypus survey nets at Bacchus Marsh, including indigenous short-finned eel (*Anguilla australis*), three introduced fish species (roach *Rutilus rutilus*, redfin *Perca fluviatilis*, common carp *Cyprinus carpio*) and Australian water-rat or rakali (*Hydromys chrysogaster*) (Table 4). Of the two sites where nets were set on two occasions, non-target species were not recorded at WE23 on the second occasion, whereas holes created by water-rats/rakali were recorded (in one of two nets) at WE25 on the second occasion.

Table 4 Non-target species encountered in platypus survey nets set in early 2022 at sites along the Werribee River in and near Bacchus Marsh township. The presence of Australian water-rat/rakali was identified in all cases by the occurrence of characteristic holes left in nets. See Table 1 for details of trapping site locations.

Location site code	Initial (or only) date when nets were set	N of short-finned eels	N of redfin perch	N of roach	N of carp	N of nets with rakali holes
WE21	18–19 Jan	1	1		1	
WE21A	3–4 Feb	2		2		
WE22	18–19 Jan			2		2 of 2
WE23*	18–19 Jan		4	4		
WE24	18–19 Jan	2			1	
WE25*	18–19 Jan		1		1	1 of 2
WE26	3–4 Feb	1		6		
WE27	3–4 Feb		1	8	1	

*Nets also set on 3–4 Feb (see text for details of associated non-target captures).

4.1.2 Environmental DNA (eDNA)

In the period from 2016 to 2020, platypus eDNA qPCR analysis was conducted on 1 to 4 occasions by enviroDNA after water samples were collected at sites distributed along the Werribee River between the Old Melbourne Road near Ballan and Woolpack Road at the downstream end of Bacchus Marsh (Table 5). A positive result was recorded on at least one occasion at all sites apart from Woolpack Road, with a pattern of consistently positive or equivocal findings recorded at sites from the Werribee Gorge Circuit Track downstream to Peppertree Park in Bacchus Marsh.

Table 5 Results of eDNA testing (using qPCR) at sites located along the Werribee River from Ballan (downstream of Old Melbourne Road) to the downstream end of Bacchus Marsh township (near Woolpack Road) in the period from 2016 to 2020. Six tests were conducted at each site in a given year based on drawing 3 subsamples from each of two independently collected water samples. An outcome was deemed to be positive (platypus DNA considered to be present) if two or more tests yielded positive results, equivocal (the positive finding could be an artifact of contamination or the like) if just one test yielded a positive result, and negative if all six tests yielded negative results. Data supplied courtesy of Melbourne Water.

Location	N of positive annual outcomes	N of equivocal annual outcomes	N of negative annual outcomes
Ballan (downstream of Old Melbourne Road)	1	0	3
Myrniong (Garrards Lane)	1	1	1
Werribee Gorge (Circuit Track)	2	1	0
Werribee Gorge (Meikles Point)	2	1	0
Downstream of Bacchus Marsh Weir	1	0	0
Bacchus Marsh (Peppertree Park)	2	2	0
Bacchus Marsh (Woolpack Road)	0	1	1

4.1.3 Platypus sighting records

A total of 37 reliable platypus sightings were recorded in the period from Jan 2016 through Feb 2022 for the Werribee and Lerderderg Rivers between Melton Reservoir and Ballan (Table 6). In the case of the Werribee River, sightings were largely confined to the area downstream of the point where summer irrigation inflows are received from Pykes Creek Reservoir, thereby also coinciding with a channel form dominated by substantial pools. In the case of the Lerderderg River, sightings were confined to its downstream end, within 6.5 kilometres of where it joins the Werribee River.

Interestingly, three-quarters of all platypus sighting records were reported to organisations based in the Bacchus Marsh area, presumably attesting to both strong recent efforts by locally based groups to elicit sightings and the fact that locally based groups provide a more effective conduit for platypus sightings to be reported as compared to websites. It logically follows that we also would be inclined to ascribe the large jump in the number of sightings recorded since January 2020 to the fact that the Bacchus Marsh Platypus Alliance was set up in mid-2019, i.e. as opposed to indicating that the number of animals has itself increased greatly in the past two years.

Table 6 Temporal and geographic distribution of platypus sightings recorded from Jan 2016 to Feb 2022 from Melton Reservoir upstream to Ballan. Sightings were originally received by the Bacchus Marsh Platypus Alliance (*n* = 20), Friends of Werribee River through Bacchus Marsh (*n* = 7), Friends of Werribee River and Long Forest Mallee (*n* = 1), PlaypusSpot website (*n* = 6) and Atlas of Living Australia website (*n* = 3). 'WR' denotes sites along the Werribee River; 'LR' denotes sites along the Lerderderg River. 'Distance from confluence' denotes the approximate distance measured along the river channel from the sighting location(s) downstream to the confluence of the Werribee and Lerderderg Rivers.

Sighting location	Distance from confluence (km)	Jan 2016–Dec 2017	Jan 2018–Dec 2019	Jan 2020–Feb 2022	Jan 2016–Feb 2022
Boyes Close, Bacchus Marsh (WR)	5.0	1		1	2
Peppertree Park, Bacchus Marsh (WR)	6.0	2	5	8	15
Halletts Way, Bacchus Marsh (WR)	6.8			1	1
Bacchus Marsh Weir area (WR)	12.5		1	3	4
Werribee Gorge, Meikles Point (WR)	14.5			5	5
Werribee Gorge, Circuit Track (WR)	14.7–17.7		2	2	4
Between Circuit Track and Ballan* (WR)	20.5–25		2		2
Ballan township (WR)	40			1	1
Rupert Moon Reserve (LR)	0.7			2	2
Gisborne Road bridge (LR)	6.5			1	1

*Sighting locations were near The Granites and Lake Dewar, respectively.

4.1.4 Water quality

Dissolved oxygen

The platypus's diet mainly comprises aquatic insect larvae (McLachlan-Troup et al. 2010; Marchant and Grant 2015), many of which rely on gills to extract dissolved oxygen (DO) from water to breathe. In practice, Serena and Pettigrove (2005) found that there was no significant difference between mean DO concentrations in creeks and small rivers in the greater Melbourne area that were deemed to support a breeding platypus population (including the Werribee River at Werribee township) and those lacking a resident population, suggesting that DO concentration did not typically serve as the critical factor limiting platypus food resources.

Based on the fact that DO concentrations in the Werribee River near Bacchus Marsh have consistently remained above 5 mg/L since 2005, Jacobs (2014) concluded that low DO is unlikely to be an important threat to aquatic fauna in this part of the Werribee system. Similarly, Mackintosh (2018) noted that although some DO measurements obtained between 2005 and 2017 for the Werribee River at Bacchus Marsh and in and near Werribee township fell below the ANZECC trigger level denoting poor water quality, DO concentrations generally remained at an acceptable level throughout this period.

To provide updated insight into recent DO levels in the Werribee River at Bacchus Marsh and how they compare with those from previous years, Table 7 summarises the mean (or average) and minimum values recorded at DELWP water monitoring site 231200 on an annual basis since 2006. In brief, DO levels appear to have remained very near or above 5 mg/L since 2011 (following the end of the Millennium Drought), with the highest mean annual concentration recorded in 2021. However, as a caveat, it should be noted that DO can vary substantially and predictably even within a given 24-hour period (due to variation in water temperature and photosynthetic activity), so these factors ideally should be taken into account when interpreting DO data. As relevant supplementary information is not held on the DELWP website, the DO values presented here are appropriately viewed as being indicative rather than definitive.

Table 7. Mean (or average) and minimum concentrations of dissolved oxygen (DO, mg/L) recorded from 2006 to 2021 in the Werribee River at Bacchus Marsh (DELWP water monitoring site 231200).

Year (*n* of samples)	Mean DO	Minimum DO
2006 (11)	8.4	7.2
2007 (19)	8.4	3.6
2008 (24)	7.1	3.8
2009 (24)	6.8	3.4
2010 (24)	7.1	3.8
2011 (23)	8.5	5.2
2012 (20)	8.4	6.3
2013 (24)	8.3	4.9
2014 (21)	9.0	6.8
2015 (18)	8.4	6.0
2016 (15)	8.0	5.4
2017 (12)	8.6	6.4
2018 (12)	8.9	6.7
2019 (12)	8.4	6.0
2020 (13)	8.5	7.3
2021 (12)	9.1	7.0

Nutrients (phosphorus and nitrogen)

Serena and Pettigrove (2005) identified a significant negative linear relationship between platypus population density (as inferred from CPUE, defined as the mean or average number of adult or subadult platypus captured per site per night in a given creek or river) and both mean total phosphorus (TP) and mean total Kjeldahl nitrogen (TKN, defined as comprising organically bound nitrogen and ammonia). In other words, the frequency of platypus captures fell progressively as TP and TKN concentrations increased, with the upper boundary values for the mean nutrient concentrations compatible with a healthy platypus population (defined by animals being captured on average at every site where nets are set) respectively being approximately 0.06 mg/L (TP) and 0.5 mg/L (TKN). The authors hypothesised that nutrient enrichment may both reduce the availability of preferred platypus prey items (such as relatively large-bodied mayfly and caddisfly nymphs) and impede the platypus's ability to detect and capture prey due to excessive growth of algae.

Table 8 summarises the mean (or average) annual concentrations of TP and TKN recorded in the Werribee River at Bacchus Marsh since 2006. Although mean TP has remained below the healthy platypus population threshold value of 0.06 mg/L in most years over that period, the level of

phosphorus in river water has approached or (in one case) exceeded 0.06 mg/L in each of the three most recent years (2019–2021). Similarly, the level of nitrogen in river water has matched or exceeded the platypus threshold value of 0.5 mg/L in each of the five most recent years (2017–2021).

Table 8. Mean (or average) values of total phosphorus (TP, mg/L) and total Kjeldahl nitrogen (TKN, mg/L) recorded from 2006 to 2021 in the Werribee River at Bacchus Marsh (DELWP water monitoring site 231200).

Year (*n* of samples)	Mean TP	Mean TKN
2006 (11)	0.02	0.34
2007 (19)	0.03	0.46
2008 (24)	0.03	0.49
2009 (24)	0.035	0.48
2010 (24)	0.09	0.81
2011 (23)	0.05	0.63
2012 (20)	0.055	0.64
2013 (24)	0.04	0.44
2014 (21)	0.03	0.42
2015 (18)	0.02	0.44
2016 (15)	0.03	0.45
2017 (12)	0.03	0.50
2018 (12)	0.04	0.53
2019 (12)	0.065	0.73
2020 (13)	0.05	0.51
2021 (12)	0.055	0.57

Total suspended solids

Creeks and small rivers that support a breeding platypus population near Melbourne have been found to carry lower loads of suspended solids (SS) as compared to waterways that do not support this species. The groups differed most strongly (and significantly) when SS was high, for example following storms (Serena and Pettigrove 2005). The actual range of SS concentrations (90th percentile) recorded in 10 reaches supporting a breeding population was 24–57 mg/L, as compared to 44–203 mg/L in 10 reaches lacking resident animals.

The platypus normally closes its eyes underwater (Pettigrew et al. 1998) and often forages nocturnally, so turbidity *per se* is unlikely to compromise its foraging ability. However, plausible negative impacts of high SS on platypus include fewer food resources when the arrival of fresh sediment triggers mass emigration by aquatic macroinvertebrates (potentially reducing prey densities by more than 50% in 24 hours: Culp et al. 1986) and degraded habitat quality due to excessive sediment smothering the channel bed, filling pools and reducing habitat complexity (substrate heterogeneity and interstitial spaces).

In practice, studies in the wild have found that platypus avoid foraging at sites where the bed holds a high proportion of fine inorganic material (Worley and Serena 2000; Serena et al. 2001).

Table 9 summarises the mean (or average) and maximum levels of SS recorded annually in the Werribee River at Bacchus Marsh since 2006. Although maximum SS values have in most years stayed below the highest 90th percentile value associated with a breeding platypus population in Serena and Pettigrove (2005), this threshold has been exceeded in five of the years, including each year from 2019 to 2021.

Table 9. Mean (or average) and maximum values of suspended solids (SS, mg/L) recorded from 2006 to 2021 in the Werribee River at Bacchus Marsh (DELWP water monitoring site 231200).

Year (*n* of samples)	Mean SS	Maximum SS
2006 (11)	16	40
2007 (19)	16	26
2008 (24)	26	100
2009 (24)	18	36
2010 (24)	19	36
2011 (23)	19	35
2012 (20)	26	33
2013 (24)	23	100
2014 (21)	12	18
2015 (18)	11	17
2016 (15)	13	34
2017 (12)	15	28
2018 (12)	16.5	43
2019 (12)	32	59
2020 (13)	30	69
2021 (12)	38.5	170

4.2 Werribee township

4.2.1 Platypus live-trapping survey work

Pairs of fyke nets were set by Ecology Australia and APC to target platypus captures at five sites on the afternoon of 11 February. Three animals were encountered, including an adult male captured at Anembo Court and a juvenile male and adult (or possibly subadult) female captured at the downstream end of Werribee township under Princes Freeway. Two animals were rated as being in average condition, with the other rated as being at the lower end of above average (Table 10).

Table 10. Locations and dates when platypus were captured at sites along the Werribee River in and near Werribee township in early 2022, and their physical and demographic attributes. Sex = M (male), F (female). Age class = A (adult, > 24 months old), S (subadult, 12-23 months old), J (juvenile, < 12 months old). TVI = Tail Volume Index (1 = very fat, 2 = above average condition, 3 = average condition, 4 = below average condition, 5 = very thin). Animals were marked with Biomark APT12 FDX-B microchip transponders. See Table 2 for details of trapping site locations.

Microchip ID code	Location site code	Date	Direction of travel	Sex/age class	Weight (g)	Bill width (mm)	TVI
989.001039147545	WE4	11 Feb	Upstream	MA	1802	53.2	3
989.001039144299	WE8	11 Feb	Downstream	MJ	823	44.2	2-
989.001039141551	WE8	11 Feb	Upstream	FA or S	961	42.9	3

Six non-target species were recorded in platypus survey nets at Werribee township, including indigenous short-finned eel (*Anguilla australis*), tupong (*Pseudaphritis urvilli*), Pacific black duck (*Anas superciliosa*) and Australian water-rat or rakali (*Hydromys chrysogaster*), introduced goldfish *Carassius auratus*, and the native but non-indigenous (in the context of the Werribee system) Murray short-necked turtle *Emydura macquarii* (Table 11).

Table 11. Non-target species encountered in platypus survey nets set in early 2022 at sites along the Werribee River in and near Werribee township. The presence of Australian water-rat/rakali was confirmed at sites WE4 and WE8 by the presence of an individual in a net; otherwise by the occurrence of characteristic holes left by this species in nets. See Table 2 for details of trapping site locations.

Location site code	Date when nets were set	N of short-finned eels	N of tupong	N of goldfish	N of Pacific black duck	N of Murray turtle	N of nets with rakali and/or holes
WE2	11 Feb						
WE3	11 Feb						1 of 2
WE4	11 Feb		1	1	3	1	1 of 2
WE5	11 Feb						1 of 2
WE6	11 Feb						
WE8	11 Feb	1					1 of 2

5 Discussion

5.1 Bacchus Marsh findings

5.1.1 Platypus distribution and status

A number of lines of evidence indicate that the Werribee River in and near Bacchus Marsh supports a resident platypus population:

- Positive platypus eDNA outcomes have been reported for six of the seven sites tested between 2016 and 2020 in the area stretching from the Old Melbourne Road at Ballan to the downstream end of Bacchus Marsh township (see Table 5).
- Reliable platypus sightings have been reported for multiple sites between Ballan and Melton Reservoir since 2016, with many sightings recorded within Bacchus Marsh township (see Table 6).
- The platypus live-trapping work conducted in early 2022 confirmed that the Bacchus Marsh area supports both males and females, consistent with the occurrence of a breeding population (see Table 3).
- The mean (or average) frequency of platypus captures in the Bacchus Marsh survey area (or CPUE) in 2022 was 0.4 animals recorded per site per night. Based on the scale adopted across the greater Melbourne region in recent years (Griffiths et al. 2020), the abundance of the Bacchus Marsh platypus population is appropriately ranked as being 'Moderate'.

Given the above, we conclude that platypus are widely distributed and reasonably abundant in the Werribee River between Ballan and Melton Reservoir, including within and immediately upstream of Bacchus Marsh township. There is currently insufficient evidence to calculate platypus population size in any part of the Werribee River accurately. However, assuming (conservatively) that the many substantial pools found between Bacchus Marsh Weir and Melton Reservoir support at least 2.5 individuals on average per kilometre of channel, minimum platypus population size between Bacchus Marsh Weir and Melton Reservoir is estimated to be around 30 animals – numerous enough to constitute a substantial population in its own right, but not so large that its long-term survival should be taken for granted.

5.1.2 Potential impacts of water quality on platypus numbers

Concentrations of dissolved oxygen in the Werribee River at Bacchus Marsh appear to have generally remained above the threshold required by gilled organisms in recent years, including the aquatic insect larvae commonly eaten by the platypus (Mackintosh 2018; this report).

In contrast, available evidence suggests that concentrations of nutrients (especially nitrogen) and suspended solids in river water at Bacchus Marsh may sometimes now exceed the threshold compatible with the occurrence of a healthy platypus population (this report). Our findings parallel those of Mackintosh (2018), who concluded that both turbidity and nitrogen levels in the Werribee River at Bacchus Marsh often exceed standard State Environmental Protection Policy water quality objectives.

The most likely source of high nutrient loads in the Werribee River at Bacchus Marsh includes drainage from agricultural enterprises and areas of urban development (Jacobs 2014; Mackintosh 2018), with any

areas of unvegetated or poorly vegetated ground potentially contributing to turbidity and unacceptably high loads of suspended solids via soil erosion. More specifically, turbidity readings obtained in 2019 at 10 sites by the Bacchus Marsh Platypus Alliance in association with Melbourne Water indicated that sediment runoff between Bacchus Marsh Weir and Bacchus Marsh township mostly originated from areas that had been recently cleared for urban development (J. Valpied, pers. comm.). As discussed by Jacobs (2014), these management issues can only be addressed effectively by identifying the source of specific pollutants and then taking action to prevent their entry to the river.

5.2 Werribee township findings

5.2.1 Platypus distribution and status

It is outside the scope of this report to comment on the overall status of platypus in the Werribee River at Werribee township, as extrapolated from recent sightings and eDNA results as well as live-trapping results. However, the live-trapping survey led by Ecology Australia in February 2022 has provided two interesting and important findings.

First, it confirmed that platypus continue to breed successfully in the Werribee River to as far downstream as the Princes Freeway, i.e. only a short distance above where the Werribee River becomes brackish as it approaches Port Phillip Bay.

Second, the number of platypus captured in February 2022 comprised the highest total recorded in any platypus fyke-netting survey conducted in the Werribee River at Werribee township since July 2009. The mean (or average) frequency of platypus captures (or CPUE) in the 2022 survey area was 0.5 animals recorded per site per night (including juveniles, as per the calculation method adopted by cesar). Based on the scale adopted across the greater Melbourne region in recent years (Griffiths et al. 2020), this value is consistent with platypus abundance at Werribee township being ranked as ‘Moderate’. However, as this result was obtained from a single survey, the finding requires confirmation through additional future survey work, ideally using the same field personnel to ensure consistency in the way nets are set.

6 Recommendations

Platypus abundance may potentially be influenced by a wide range of factors related to habitat suitability, reproductive success and mortality rates. These include (though are not limited to): inappropriate recreational angling practices (Serena and Williams 2010); prevalence of litter (Serena and Williams 2010, 2022); fox and dog predation (Serena and Williams 2010); excessive or inadequate flow (Serena and Williams 2010; Serena et al. 2014; Serena and Grant 2017); channel depth (Worley and Serena 2000; Bethge et al. 2003; Grant 2004); the nature of the channel substrate and distribution of large woody instream habitat (Worley and Serena 2000; Serena et al. 2001; Grant 2004); the amount of cover provided by bank vegetation (Worley and Serena 2000; Serena et al. 1998, 2001); water quality and the concentration of heavy metals in sediment (Serena and Pettigrove 2005); the prevalence of unguarded irrigation pump intake points (Serena and Williams 2010); the design of weirs and other manmade structures in the channel (Serena and Williams 2010); and the design and extent of urban stormwater drainage systems (Martin et al. 2014).

The Australian Platypus Conservancy website (https://www.platypus.asn.au) provides a convenient entry point to learn more about how individual management issues affect the platypus and what steps can be taken to reduce or eliminate adverse impacts. In addition, a checklist of positive management actions that are predicted to be relevant to platypus populations throughout the greater Melbourne area (adapted from Jacobs, APC and cesar 2016) is included in this report (Appendix 3).

With respect to how the Bacchus Marsh Platypus Alliance and Werribee River Association can continue to work most productively to assist platypus conservation, we offer the following suggestions.

First, the single biggest threat to the long-term survival of a viable platypus population in the Werribee River is undoubtedly the very rapid urban expansion that is occurring at Bacchus Marsh and Werribee township and is predicted to be initiated soon at Ballan.

To reduce associated risks and identify opportunities for positive habitat improvement on behalf of this species, we recommend that BMPA and WRA work with shire environmental and planning personnel/engineers (with additional input from Melbourne Water and persons with substantial expertise in (1) platypus ecology and (2) best-practice water-sensitive urban design principles and technology) to develop a comprehensive set of guidelines for platypus-sensitive urban development. This document would aim to provide a clear and comprehensive decision-making framework to ensure that the most effective strategies and policies for protecting the animals and their aquatic environment are adopted in future.

To the best of our knowledge, such a document has never previously been developed anywhere in the platypus's geographic range, so it presumably will be useful not only in the context of the Werribee catchment but much more broadly. As previously discussed with BMPA, the Australian Platypus Conservancy is willing to provide the requisite platypus-related input to such a project on a pro bono basis, if this will help to ensure that the project can be initiated within the next 12 months (i.e. with a starting date of April 2023 or sooner).

Second, we recommend that BMPA and WRA continue to contribute to improved understanding of the current distribution and status of platypus in the Bacchus Marsh area (and elsewhere in the Werribee catchment) through the following actions:

- Continue to elicit and record reliable platypus sightings. As noted elsewhere in this report, BMPA is ideally placed as a locally based non-profit environmental organisation to receive and collect sighting records pertaining to the Bacchus Marsh area (as is the Werribee River Association for sightings occurring in Werribee township).
- Support additional eDNA testing to provide a more detailed picture of where platypus occur, potentially including application of the new LAMP methodology currently being developed by La Trobe University.
- Support additional live-trapping studies where these are most likely to be of value in complementing the more cost-effective information obtained through sightings and eDNA studies. For example, in the Bacchus Marsh area it would be very useful to set nets in the lower Lerderderg River to assess the actual number and sex/age class of platypus that are captured there. As mentioned previously in this report, it would also be of great interest to find out if the increased frequency of platypus captures recorded in the lower Werribee River by Ecology Australia in early 2022 can be consistently confirmed through follow-up survey work.

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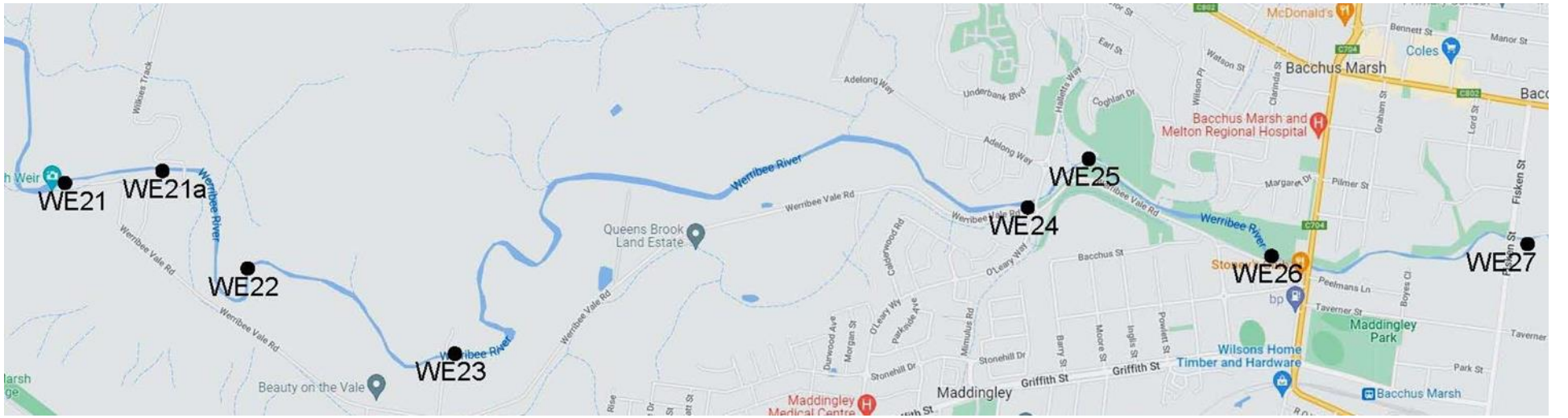
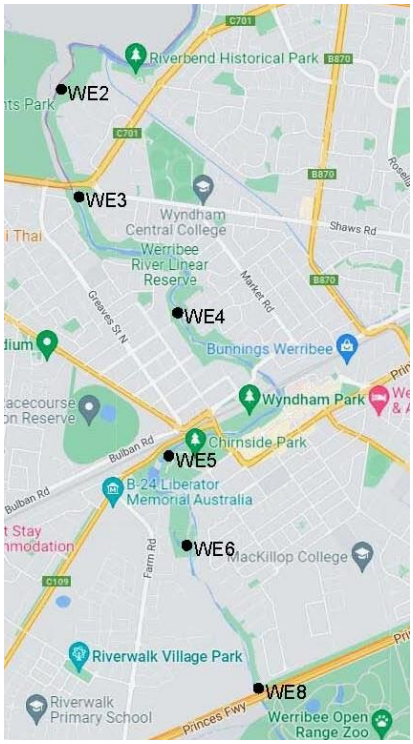
Appendix 1 Locations of platypus live-trapping sites along the Werribee River between Bacchus Marsh township and Bacchus Marsh Weir where sampling was conducted on 18-19 January and/or 3-4 February 2022.



Appendix 2 Locations of platypus live-trapping sites along the lower Werribee River where sampling was conducted on 11-12 February 2022.



Appendix 3 A list of complementary actions to support platypus-appropriate flow regimes in the greater Melbourne area (adapted from Jacobs, APC and cesar 2016)

- Protect and/or restore self-sustaining corridors of native riparian vegetation, including trees, shrubs and ground cover plants, on stream and river banks.
- Remove willows and other invasive woody weeds from stream and river banks in a manner that minimises risk of bank erosion and always maintains adequate cover from predators on at least one bank.
- Reduce adverse impacts of stock access along water courses by working with landowners to fence off damaged banks and create alternative watering points.
- Retain and potentially augment the amount of instream woody habitat (logs and large branches) present in creek and river channels.
- Ensure that the amount of urban stormwater runoff conveyed by conventional drainage systems (Directly Connected Imperviousness, DCI) does not increase as an outcome of urban development, and that DCI is progressively reduced in established urban environments.
- Take steps to ensure that urban stormwater, road drainage, farming runoff and runoff during the construction and pre-construction phases of urban development do not contribute to sediment and nutrient loads in natural water courses.
- Ensure that man-made structures located along natural channels or associated earthen channels (including weir walls, culverts, pipes, grates, grilles, etc.) do not hinder or discourage safe passage by platypus. Amend problematic existing structures (e.g. by installing platypus-friendly fish ladders at barriers) as opportunities arise to do so.
- Ensure that contractors operating heavy equipment on or near creek or river banks do not conduct this work in places and at times of year that could compromise successful platypus reproduction in nesting burrows.
- Ensure that all instream pumps, mini-hydroelectric turbines, etc. are fitted with appropriate guard structures around intake points to prevent platypus (and other wildlife) being drawn into the mechanism while it is being operated.
- Reduce the impact of feral predators on platypus by implementing control programs for foxes/feral cats and by restoring/maintaining dense vegetation cover along the banks, especially in places where water is shallow (seasonally or throughout the year).
- Continue to foster community awareness that platypus are widely present in aquatic environments, and promote positive and informed community attitudes to waterway and platypus conservation activities.
- Work vigorously to raise awareness of (1) high rates of platypus entanglement in litter and its adverse consequences for the animals, (2) platypus-friendly angling practices and how to deal most humanely and safely with a platypus that is hooked accidentally, and (3) the rules governing use of fish nets and yabby traps in Victoria and the problems that their illegal use poses to platypus and other aquatic wildlife such as turtles and rakali.