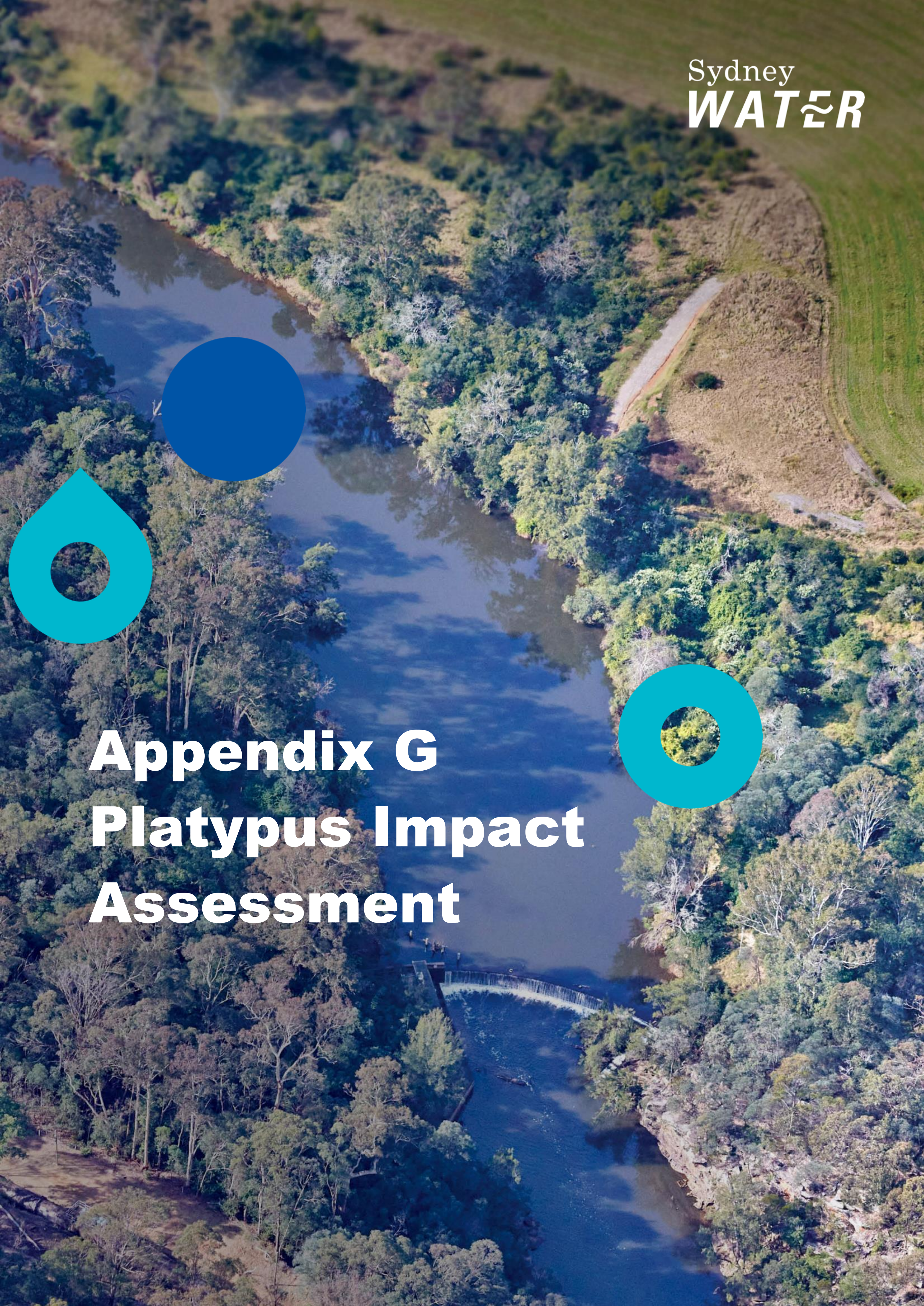


Appendix G
Platypus Impact Assessment

10 September 2021

Elissa Howie
Lead Environmental Scientist
Sydney Water
Level 11, 1 Smith Street
PARRAMATTA NSW 2150

Dear Elissa

Re: Upper South Creek Advanced Water Recycling Centre Greater Blue Mountains World Heritage Property assessment – impacts to Platypus

Project no. 31617

Biosis Pty Ltd was commissioned by Sydney Water to provide a species biology and ecology report for Platypus *Ornithorhynchus anatinus* in relation to its occurrence within the Greater Blue Mountains Area in New South Wales (NSW), a listed World Heritage property under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This report supports an assessment of the potential impacts to the World Heritage Property by the proposed Upper South Creek Advanced Water Recycling Centre (AWRC) project (the project), which is currently being prepared in accordance with the *Matters of National Environmental Significance Significant impact guidelines 1.1* (Commonwealth of Australia 2013).

Specifically this report investigates the biology and ecology of the species as it relates to the approximately 13.1 kilometre long, linear section of the Nepean River that occurs within the Greater Blue Mountains World Heritage Property. This river section is located in the Blue Mountains National Park and occurs from the confluence of the Nepean River and Warragamba River extending downstream to the border of the National Park, approximately 2 kilometres south of the Western Motorway bridge crossing over the Nepean River (Figure 1).

The following information has been requested as part of this report:

- Habitat and food source requirements of the Platypus.
- Likelihood of occurrence of platypus in the Nepean River through the Greater Blue Mountains World heritage area (and any evidence from previous studies).
- Brief analysis of likely impacts of treated water releases on the Platypus.

It is understood that the information provided in this report will be used to inform the significant impact criteria assessment of the Greater Blue Mountains World Heritage property.

Habitat and food source requirements

The Platypus is distributed from the cold, high altitudes of Tasmania and the Australian Alps, to the tropical rainforest lowlands and plateaus of far northern Queensland, as far north as Cooktown. Within NSW the species typically occurs in the headwater streams of most west-flowing river systems, where it inhabits streams and suitable freshwater bodies, including some shallow water-storage lakes and ponds (Carrick, Grant, & Temple-Smith 2008). Ideal habitat for the species consists of fairly shallow rivers or streams, with relatively steep earthen banks protected by the roots of native vegetation, with vegetative growth overhanging the bank (Scott & Grant 1997). An ideal river or creek would also have a diverse range of habitats for benthic (bottom-dwelling) invertebrates, the species primary food source, including aquatic macrophytes and logs, and consist of a series of pools of less than five metres deep (Grant 1995).

Diet

Platypus typically feed on a wide variety of benthic aquatic macro-invertebrates, including species from the Trichoptera (caddisfly), Diptera (fly), Coleoptera (beetle), Ephemeroptera (mayfly), and Odonata (dragonfly and damselfly) orders (Carrick, Grant, & Temple-Smith 2008, Serena et al. 2001, Faragher, Grant, & Carrick 1979). Secondary food items include ostracods (seed shrimp), decapod (ten-footed) shrimp, bivalve and gastropod (snail) molluscs, nematomorph (horsehair) worms, salmonid eggs, and small frogs. The dominance of prey items has been shown to vary across its known distribution with the availability of secondary food sources, such as trout eggs in the Thredbo River during winter. However insect material is often a dominant part of the diet and as such the species can be considered an opportunistic feeder on benthic invertebrate species (Faragher, Grant, & Carrick 1979, Grant 1982).

Burrows

The species resides in a burrow when not in the water. The resting burrow is usually a short, simple construction in the river bank or occasionally in accumulated river debris. Breeding females usually construct a more elaborate nesting burrow that may be up to 30 metres long, plugged with earth at intervals, and terminating in a chamber containing a tight nest of herbage (Carrick, Grant, & Temple-Smith 2008). A study investigating occurrence of Platypus burrows in the Yarra River catchment in Victoria found that out of 57 burrows described, 26 occurred along the river, 29 along creeks, and 2 along drains. The horizontal distance from the water's edge to the burrow chamber ranged from 0.4 - 3.7 metres with a mean distance of 1.5 (± 0.9) metres. Burrows were only found in banks that were at least 0.5 metres above the water. Burrow entrances were often believed to be underwater or concealed by undercut banks, with a maximum distance from water's edge to presumed entrance of an occupied burrow of 0.1 metres (Serena et al. 1998).

Home range

Home range size in Platypus is typically greater in males of the species. Studies in the movement patterns of adult males have found home-ranges vary from 2.9 kilometres to 7 kilometres (Gardner & Serena 1995), with a secondary study finding a slight increase with the maximum linear range being 8.45 kilometres (Hawke et al. 2021). Females typically travel less than males with tagging studies on the Snowy River showing female movement remaining within 1.5 kilometres of the original tagging location (Hawke et al. 2021) and studies at Running Creek in Melbourne ,Victoria showing range of 1.1-1.4 kilometres (Serena et al. 2001). However, studies along the Yarra River in Melbourne have recorded substantially longer home ranges in females of 4.2-4.5 kilometres (Serena et al. 1998). Grant (1995) reported the home range of Platypus across several river systems as follows; Shoalhaven River, 0.2-2.0 kilometres; Thredbo River, 0.4-2.3 kilometres; Badger Creek, 0.3-2.3 kilometres; Watts River and Badger Creek, 2.9-7.0 kilometres; Goulburn River, 0.4-2.6 kilometres.

Likelihood of occurrence within the Nepean River

A linear, approximately 13.1 kilometre long section of the Nepean River occurs within the Greater Blue Mountains World Heritage property, located in the Blue Mountains National Park. The section occurs from the confluence of the Nepean River and Warragamba River and extends downstream through the Blue

Mountains National Park, ending at the border of the National Park, approximately 2 kilometres south of the Western Motorway bridge crossing over the Nepean River (Figure 1).

None of the Bionet records for Platypus within the Greater Blue Mountains World Heritage property, occur directly along the Nepean River (EES 2021). However, there are several records within a four kilometre buffer of the Nepean River (chosen as it includes the most commonly reported home ranges of the species) including:

- Two records inside the boundary of the Greater Blue Mountains World heritage property. These records are associated with tributaries of the Nepean River.
  - One record along Erskine Creek, a Strahler order six waterway, approximately 2.5 kilometres upstream (1 kilometre overland) of the confluence with the Nepean River.
  - One record at Duck Hole, a natural water body along Glenbrook Creek, a Strahler order five waterway, approximately 6 kilometres upstream (4 kilometre overland) of the confluence with the Nepean River.
- 10 records downstream of the Greater Blue Mountains World heritage property.
  - Two records associated with tributaries of the Nepean River (Mulgoa Creek, a Strahler order five waterway and School House Creek, a Strahler order two waterway).
  - Six are associated with individuals foraging within the Nepean River in the vicinity of the Western Motorway overpass. The high number of individuals recorded around the Western Motorway overpass may partly be due to the proximity of Tench Reserve, which allows for easy public access to the Nepean River in this area.
  - Two are associated with injured or deceased individuals.
- One record upstream of the Greater Blue Mountains World heritage property, approximately 720 metres upstream of the Wallacia Weir.

As Platypus records exist within four kilometres upstream and downstream, and along tributaries of the Nepean River located within the World Heritage property (EES 2021)(Figure 1), the species is considered to be present within the 13.1 kilometre section of the Nepean River that occurs within the Greater Blue Mountains World Heritage property. The stream margins and adjoining tributaries of the Nepean River represent potential foraging habitat for the species, as these areas are likely to contain populations of benthic invertebrates.

The inner riparian zone that occurs along the Nepean River represents potential resting and nesting habitat for the species as these areas may include concealed earthy banks that are required for the construction of burrows. Burrowing habitats may be poorly represented along this stretch of the Nepean River if large amounts of bank rock, boulders and cobbles are present as these features decrease the suitability of banks for the construction of burrows (Scott & Grant 1997). These rocky features are likely to be well represented along this section of the Nepean River, owing to the dissected and broken slopes of Hawkesbury sandstone associated with the Kurrajong fault scarp in this area (Colquhoun G.P. et al. 2020, Mitchell 2002).

Finally the species is likely to be utilising the Nepean River for dispersal purposes as it is the main aquatic corridor in the locality and links several backwater tributaries that are likely to be utilised by the species (including Glenbrook Creek and Erskine Creek where there are known records of the species).

Analysis of likely impacts from treated water releases

The primary potential impacts to Platypus that may occur as a result of the treated water discharges include:

- Inundation of resting and nesting burrows as a result of water depth increases.
- Increased occurrence, and duration of severe flooding events.
- Reduced foraging capacity associated with increased water depth and water velocity changes.
- Changes in water quality resulting in impacts to benthic invertebrate communities (the primary prey items within the Platypus diet), including decline in abundance and changes to the species composition of these assemblages.
- Changes in water quality resulting in a direct decline in the health of individuals within discharge areas.

Expected changes to hydrological regime

Once built, the Upper South Creek AWRC will have the initial the capacity to process and release 50 ML of treated water per day that is expected to increase to a maximum of 100 ML a day, which is the ultimate dry weather treatment capacity of the AWRC planned for completion in 2036. Treated wastewater discharges to the Nepean River will consist of tertiary and advanced treated water outputs. Within the area of the Greater Blue Mountains World Heritage property, the current median flow in the river system of 229 ML/day, and the future median flows (following the treated water release form the AWRC) of 279 ML/day (with increased 50 ML/day releases) and 329 ML/day (with increased 100 ML/day releases) have been modelled. A maximum water level depth increase of up to 14 centimetres has been calculated based on the increased 100 ML/day release (Streamology 2021), however it should be noted that this 100 ML/day flow is considered as the worst case scenario, possible only once the plant is expanded to its maximum capacity. Releases will be lower when the AWRC is first built and capacity is only 50 ML/day, with discharge levels unlikely to actually reach 100ML/day given recycled water schemes will encompass some of the future releases.

Potential impacts to biodiversity values have been assessed based on the current median flow in the river system of 229 ML/day, and the expected future median flows of 279 ML/day and 329 ML/day. The inundation of native vegetation communities that occur along the banks of the Nepean River within the Blue Mountain World Heritage Area, under these three modelled flows is demonstrated below in Table 1.

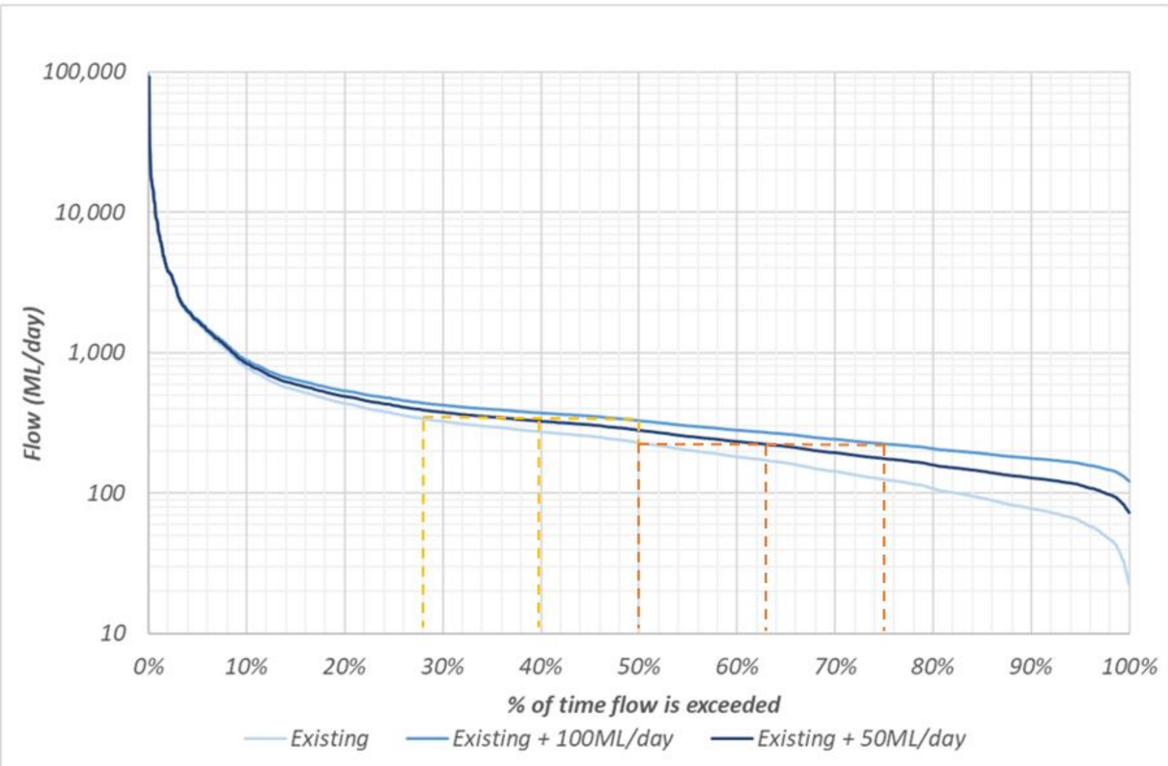
Table 1 Terrestrial biodiversity values mapped along the banks of the Nepean River within the Blue Mountain World Hertiage Aarea

Flow scenario	PCT 835	PCT 1078	PCT 1181	PCT 1284	PCT 1292
Existing conditions					
Biodiversity values within 229 ML/day inundation extent (ha)	0.46	0.04	0.06	0.03	0.03
Increased 50 ML/day release scenario					
Existing conditions: 229 ML/day (ha)	0.46	0.04	0.06	0.03	0.03
+50 ML/day releases: 279 ML/day (ha)	0.55	0.06	0.07	0.03	0.03
% change in inundation	20	50	17	0	0
Hectares change	0.09	0.02	0.01	0.00	0.00

Flow scenario	PCT 835	PCT 1078	PCT 1181	PCT 1284	PCT 1292
Increased 100 ML/day release scenario					
Existing conditions: 229 ML/day (ha)	0.46	0.04	0.06	0.03	0.03
+100 ML/day releases: 329 ML/day (ha)	0.59	0.07	0.07	0.04	0.04
% change in inundation	28	75	17	33	33
Hectares change	0.13	0.03	0.01	0.01	0.01

Terrestrial biodiversity values present within the 'bands' of the river bank between each of the current and future inundation extents are expected to be subject to differing changes of periodic inundation as follows:

- Biodiversity values present between the current low flow extent (25 ML/day) in the river system and current median flow extent (229 ML/day), are currently subject to inundation >50 % of the time.
  - With an increase of 50 ML/day into the river system the frequency with which these biodiversity values will be inundated will increase from >50 % of the time to >63% of the time.
  - With an increase of 100 ML/day into the river system the frequency with which these biodiversity values will be inundated will increase from >50% of the time to >74% of the time.
- Biodiversity values present between the current median flow extent (229 ML/day) and the future median flow extent for 50 ML/day releases (279 ML/day), are currently subject to inundation between 40-50 % of the time, which will increase to >50 % of the time.
- Biodiversity values present between the current median flow extent (229 ML/day) and the future median flow extent for 100 ML/day releases (329 ML/day), are currently subject to inundation between 27-50 % of the time, which will increase to >50 % of the time.



Graph 1 Flow duration curve at Wallacia Weir under Existing conditions, Existing + 50 ML/day and Existing + 100 ML/day

Inundation of resting and nesting burrows

As highlighted above, any Platypus burrows that are located within the current median flow inundation extent (229 ML/day) would experience inundation >50 % of the time. Under the 50 ML/day and 100 ML/day discharge scenarios, any burrows within the median flow extent would instead experience inundation either >63 % or >74 % of the time. However, it is highly unlikely that a Platypus would construct a burrow within the current median flow inundation extent with burrowing flooding, particularly in breeding season, negatively impacting the species though loss of eggs and vulnerable young. Instead studies have shown that Platypus burrows are typically found in banks that are at least 0.5 metres above the water, with the burrows typically inclined upwards (Serena et al. 1998, Scott & Grant 1997). For the water level to increase high enough for burrows to be inundated would require a significant flooding event which would occur very infrequently, with this frequency unlikely to be significantly increased under either the 50 ML/day or 100 ML/day discharge scenarios. For example the current 1 in 10 year food event (which is calculated at 1000 ML/day flow) currently occurs 8 % of the time. Under the worst case 100 ML/day discharge, this 1 in 10 year flood event would instead occur 9 % of the time. As such it is unlikely that significant increases in burrow inundation would occur as a result of the proposed water discharges.

Increased occurrence and duration of flood events

With the increased discharge of 100 ML/day, the incidence of flooding events will increase as will the level of saturation on higher areas of the bank. This increased discharge is likely to result in the current 1 in 10 year flood event (which is calculated at 1000 ML/day flow), which currently occurs 8% of the time, increasing to 9% of the time (Streamology 2021).

Mortality of platypuses has been reported following flooding events, particularly if the river bank is eroded and burrows are destroyed (Scott & Grant 1997, Grant 1995). However, the species has occupied rivers of mainland Australia for at least 50,000 years and has likely evolved strategies to cope with natural flooding events. This may include moving into surrounding backwaters and billabongs till flood water subside (Scott & Grant 1997, Grant 1995). It is unknown how the increased rate of flooding as a result of anthropogenic interference would affect the species. Increased severe flooding events have the potential to cause increased mortality, increased destruction of burrows, and a reduction in the foraging capacity of the species as it rebuilds burrows and is unable to forage till floodwaters have receded. However, the increase in flood occurrence and duration as a result of the proposed discharges is considered negligible.

Reduction in foraging capacity

Grant and Temple-Smith (2003) have suggested that upstream increases in water levels, associated with dam construction and operation, that change relatively shallow and productive lotic stream and river environments into deep, less productive lentic ones, may cause the main impact on platypus populations. Platypuses appear to be unable to forage successfully for small food items at depths greater than about 5–10 metres (Grant & Temple-Smith 2003). A study on the diving behaviour of the species found a mean dive depth of 1.28 metres, with increased water depth leading to increases in both dive duration and surface recovery duration (Bethge et al. 2003). This may be due to the species being mainly an aerobic diver, with an aerobic dive limit of approximately 40 seconds after which oxygen stores are depleted and anaerobic mechanisms take over (Bethge et al. 2003). At greater water depths the species would be unable to forage effectively in its aerobic dive phase, placing it at energetic disadvantage.

Similar to the modelled inundation extents discussed above, the proposed water discharges will result in the median water depth, as exhibited under the current median flow conditions, occurring more often. There will also be a slight increase in the mean depth of the system. In the worst case scenario, this would result in an increased depth of 14 centimetres in the deepest parts of the system. The increased frequency and depth of the system would mean foraging Platypus would need to dive deeper to forage more often, if they were to remain feeding in the same locations. However, it is more likely that benthic communities which comprise the Platypus' diet would adapt to the slight increase in water depth and frequency which, in turn, would cause foraging Platypus to target the new locations of the benthic communities. As such the foraging capacity of individuals is unlikely to be significant compromised by the proposed discharges.

Water quality impacts on benthic invertebrates

Benthic macroinvertebrate assemblages are highly variable, being dependent on a range of abiotic and biotic factors. Urban and agricultural land-uses greatly alter both the physical and chemical characteristics of the aquatic environment, which can alter the structure of macroinvertebrate communities. The susceptibility of these organisms to changes in water quality are well researched, and they are often used in bio-assessments of stream ecosystem health (Kenney et al. 2009). As the treated water discharges from the Upper South Creek AWRC will meet water quality criteria for recycled water prior to discharge, this water is likely to be higher quality than water run-off already entering the Nepean River from urban and agricultural inputs. However, should any trace organic pollutants remain, they are likely to cause an increase in the overall biomass of tolerant macroinvertebrates (e.g. chironomid larvae and tubifex worms) although species diversity may decrease (Grant & Temple-Smith 2003, Scott & Grant 1997). This finding is consistent with a study of organically polluted water discharges from the Blackheath sewage treatment plant which found that snail, ribbon worm, black fly, caddisfly, and clam macroinvertebrate families all collectively increased their abundance in the presence of sewer effluent (Wright & Burgin 2009). As platypuses appear to consume benthic invertebrate in proportion to the occurrence of species in an area, non-toxic organic pollution is unlikely to negatively affect the species (Grant & Temple-Smith 2003).

Direct water quality impacts on platypus

In addition to water quality impacting on Platypus prey items, water quality can also directly impact the species should water quality deteriorate to the point where it becomes toxic. Platypus have been recorded foraging in streams that would be considered unsuitable for primary human contact (i.e. swimming), as well as within the zone of probable downstream influence of 26 separate sewage outfalls, discharging primary, secondary or tertiary treated effluent from country towns in NSW (Grant & Temple-Smith 2003). As such the species is likely to handle some organic pollution to the aquatic environment. The treated water quality discharges are expected to be of high quality, so organic impacts are likely to be negligible.

As the Platypus primarily forages at night in turbid water the species relies upon its highly specialised bill to find its prey. This bill has highly developed sensory organs located in pits along the muzzle and frontal shield that allows the Platypus to detect small electrical fields, as well as being highly responsive to tactile stimuli (Grant 1995). However, this specialisation does make the species susceptible to changes in electrical fields, with one study showing sensitivity to small electrical fields and waveforms that imitate that of fleeing prey (Manger & Pettigrew 1995). Whilst captive populations of Platypus have been recorded in freshwater of up to 547 – 567 mS/cm (Stannard, Wolfenden, & Old 2010), it is generally considered that lowered impedance (increased conductivity) will impact on the species ability to sense electrical fields and therefore reduce its foraging capacity (Grant & Temple-Smith 2003). If treated water discharges from the AWRC were to significant increase the electrical conductivity of the Nepean River within the Greater Blue Mountains World Heritage property, there is potential to negatively impact the foraging capacity of impacted individuals. Such as increase would be outside of the accepted water quality guidelines (ANZECC 2000) and is therefore unlikely.

Increases in the concentration of water-borne heavy metals could negatively impact the species through direct toxicity as well as through pollutants reducing the benthic macroinvertebrate food resource (Serena & Pettigrove 2005). The effects of pollutants such as pesticides and heavy metals on the species were reportedly poorly known by Scott and Grant (1997), and there appears to be a similar dearth of species specific information in the contemporary literature. Treated water discharges are not expected to result in increases in heavy metal concentrations and as such these have not been discussed further.

Conclusion

This report has been a desktop review of the possible impacts to Platypus occurring within the Greater Blue Mountains National Park World Heritage Property as a result of the expected treated water discharges associated with the proposed Upper South Creek AWRC. The following conclusions have been made in regards to the investigated impacts:

- Loss of resting and nesting burrows through inundation is unlikely to occur however there may be a marginal decrease in the availability of banks at suitable heights as a result of more frequent inundation.
- Minor increases in the extent and frequency of flood events with the inundation extent of the current 1 in 10 year flood event occurring 8 % of the time, increasing to 9 % of the time under the worst case 100 ML/day discharge modelling.
- The slight increase to mean water depth and the increased frequency at which it occurs would result in foraging individuals needing to undertake deeper dives more often to target the same feeding areas. However it is likely that the benthic communities would adapt to the new mean depth and frequency and Platypus individuals would adapt to target these new foraging areas. Therefore it is unlikely to impact individuals foraging along the margins of these water courses.
- Water quality impacts on benthic invertebrates (food source for Platypus) are likely to be negligible, based on the available information of the proposed treated water discharges.
- Direct water quality impacts on Platypus including effluent and heavy metal toxicity, and reduced foraging capacity due to electrical signalling impacts are considered unlikely given the restrictions on treated water discharges.

As such the overall impacts to Platypus within the Greater Blue Mountains World Heritage Property as a result of the proposed development are likely to be minor, and are considered unlikely to constitute a significant or substantial threat to individuals within the area, or the local population as a whole. However, it should be noted that these conclusions have been developed based on a desktop review of available scientific literature. No field-based investigations have been undertaken to support this assessment.

I trust that this advice is of assistance to you however please contact me if you would like to discuss any elements further.

Yours sincerely

Matthew Hyde

Matthew Hyde

Consultant Zoologist

Figures

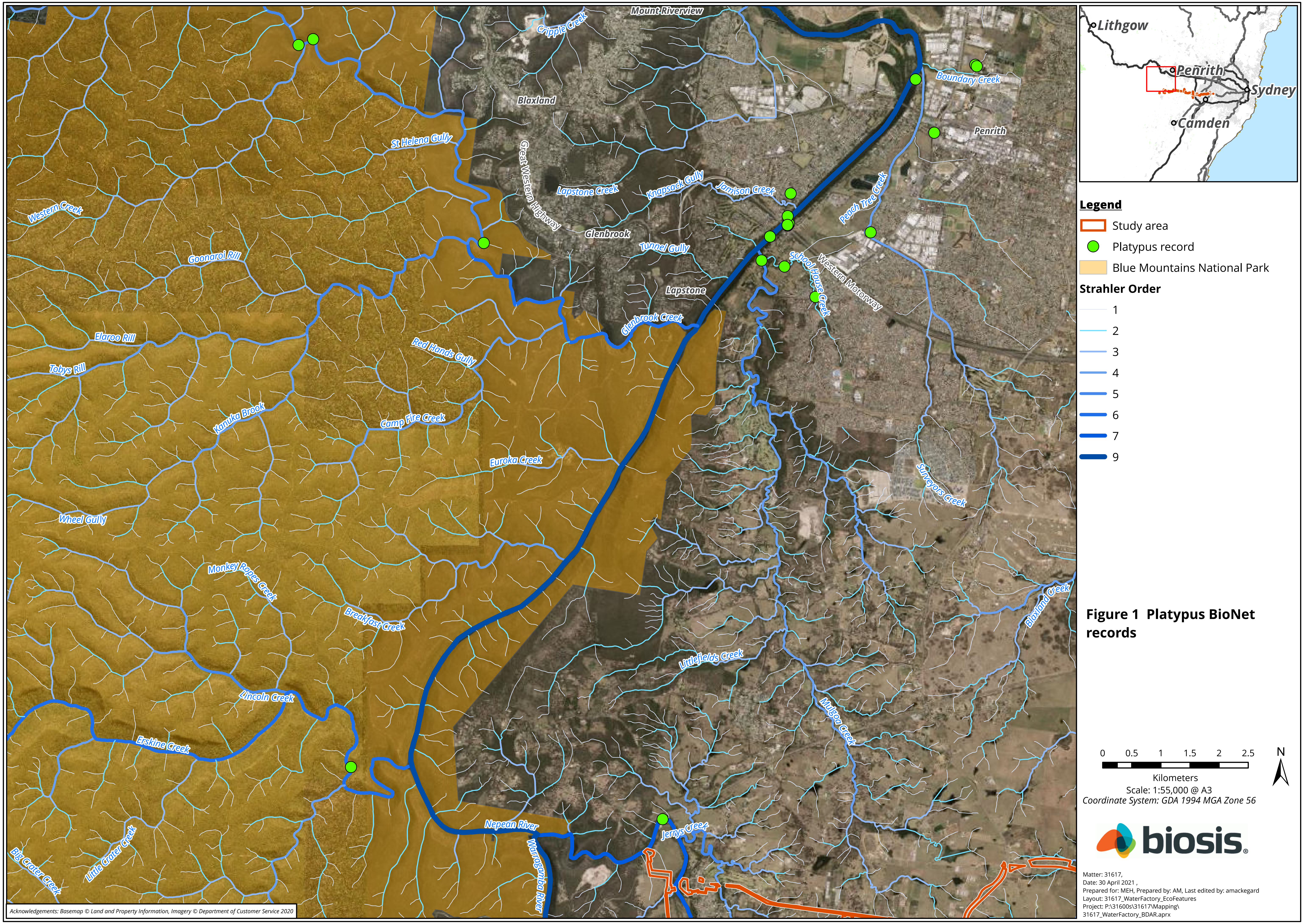


Figure 1 Platypus BioNet records

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