Improving outcomes for a highly fragmented, poorly known River Blackfish population in peri-urban Melbourne.

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Key Points

- Watsons Creek is a rainfall driven creek on the fringes of Melbourne, which supports a poorly known and fragmented River Blackfish (*Gadopsis marmoratus*) population.
- We mapped the distribution of refuge pools and River Blackfish along Watsons Creek.
- While potential high quality refuge pools were present along much of Watsons Creek, River Blackfish were limited to a short reach of the creek, where groundwater likely supports permanent pools and flows are less flashy.
- While some small-scale improvements can be made, management actions to improve River Blackfish habitat are largely limited to landscape scale actions.
- To share knowledge, the Wurundjeri Woi-wurrung Cultural Heritage Aboriginal Corporation (Narrap Rangers) were involved in River Blackfish surveys and refining management actions.

Abstract

Watsons Creek is a seasonal, rainfall-driven creek flowing through bushland, agricultural areas and acreages on the fringe of Melbourne. Historically, Watsons Creek supported a small, fragmented population of River Blackfish (*Gadopsis marmoratus*), which were a favoured food by the Wurundjeri Woi-wurrung. However, the ongoing status of the population was unknown, particularly with flows declining over the past 20 years. Recent eDNA monitoring showed that Blackfish remained in the creek. Melbourne Water wished to better understand the River Blackfish population in Watsons Creek and the distribution of refuge habitat, and to develop management actions to improve habitat. We mapped the distribution and quality of refuge pools along roughly 20 km of Watsons Creek. We then surveyed a subset of refuge pools for River Blackfish. Based on the results of the surveys, we developed management actions to improve habitat. To share knowledge, the Wurundjeri Woi-wurrung Cultural Heritage Aboriginal Corporation (Narrap Rangers) was involved in surveys and refining management actions. We found that potential refuge pools were present along much of Watsons Creek. However, River Blackfish were limited to a short reach of the creek, where groundwater likely supports permanent pools and flows are less flashy. While the population appears healthy, recruitment is limited. Management actions to improve habitat for local River Blackfish are largely limited to the landscape scale. The outcomes of the project highlight the importance of catchment-scale management actions to improve outcomes for aquatic values. These can include catchment-wide measures to minimise water quality impacts, particularly runoff from unsealed roads, and protecting groundwater-surface water interactions.

Keywords

River Blackfish, conservation, refuge habitat, habitat management, indigenous engagement, surface water/groundwater interactions

Introduction

Watsons Creek is a seasonal, rainfall driven tributary of the Yarra River located approximately 30 km north-east of central Melbourne. Watsons Creek rises on the southern slopes of Mt Everard in the Kinglake National Park and flows in a south westerly direction to join the Yarra River at Bend of Islands. The top of the catchment flows through forested area within the Kinglake National Park, while the mid and lower reaches

flow through a mixture of forested areas, cleared grazing and agricultural land and rural-residential areas. However, the entire creekline is contained within a forested riparian corridor that forms part of the Warrandyte-Kinglake Nature Conservation Reserve. Cleared land generally increases further downstream in the catchment. The catchment covers an area of approximately 84 km^2 and includes Sugarloaf Reservoir, and the main channel is approximately 27 km in length. Major tributaries include Five Mile Creek, Long Gully Creek, Kings Gully Road Creek, Sugarloaf Creek and Stevenson Creek. The riparian corridor provides an important biodiversity link between the Yarra River and the Kinglake Ranges and as such Watsons Creek has been recognised as a priority waterway under the Healthy Waterways Strategy (HWS).

Flows in Watsons Creek are strongly seasonal and rainfall driven, with short high flow events following high rainfall. Peak flows tend to occur in winter and spring with periods of cease-to-flow generally in summer and autumn. During cease-to-flow periods permanent habitat is retained in refuge pools, although extended cease-to-flows would see the progressive drying of small and medium sized pools with an overall contraction of refuge habitat. This is likely to be more pronounced in the mid and upper reaches where pools are smaller. Land clearing and water extraction and storage in the catchment has likely exacerbated the patterns of flashiness and extended cease to flows across the catchment.

Despite Watsons Creek being relatively short, the underlying geology varies substantially across the length of the catchment (Geological Survey of Victoria 2023). This results in variable habitat along the length of the creek due to regular changes in substrate, different levels of folding in bedrock potentially leading to variability in the depth and size of pools and differenced in groundwater permeability, seasonality and availability. Groundwater salinity is highly variable across the Watsons Creek catchment. Mapping indicates that groundwater salinity is <3500 mg/L across much of the catchment with areas well below that, however in a short section salinity is higher (3500-7000 mg/L). The upper half of Watsons Creek has been identified as having a high potential of being a groundwater dependent ecosystem, whereas downstream there is a moderate likelihood (BOM 2022).

Although Watsons Creek retains a near natural form and is generally protected within a well vegetated riparian corridor and public land reserve, predictive habitat models developed to inform the HWS identified Watsons Creek as having a low habitat rating for Platypus (*Ornithorhynchus anatinus*) and a moderate habitat rating for fish, including River Blackfish. Despite these poor habitat ratings, historical monitoring (as recently as 2006) (McGuckin 2007; DELWP 2022) and recent eDNA surveys (2021 and 2022) (Melbourne Water 2023) have recorded Platypus and River Blackfish in Watsons Creek, indicating that the creek is capable of supporting important ecosystem values. Historical River Blackfish records are almost entirely limited to a short section of Watsons Creek in an area referred to as Happy Valley in the mid-upper reach (McGuckin 2007; DELWP 2022). While eDNA sampling indicates the creek supports River Blackfish and Platypus, positive records are patchily distributed and the size and status of the population is unknown (Melbourne Water 2023). In addition, the distribution of suitable habitat along the creek, in particular refuge habitat is unknown.

To ensure Watsons Creek can continue to support these important biodiversity values Melbourne Water engaged Jacobs to improve their understanding of instream aquatic habitat along Watsons Creek, in particular the distribution of areas of high-quality instream habitat and drought refuges along the creek. In addition, Melbourne Water wishes to improve their understanding of the distribution of River Blackfish within the catchment. Melbourne Water also wish to assess macroinvertebrate communities across the catchment, potentially to determine whether River Blackfish distribution is related to prey abundance. Finally, Melbourne Water wish to develop a management plan to improve habitat for River Blackfish in Watsons Creek. While River Blackfish are the primary focus of this project, Platypus will also be considered as well as general improvements to aquatic ecosystems.

Methodology

The project has three main components; (1) Refuge pool identification and habitat assessment, (2) Fish and macroinvertebrate survey of target refuge pools and reaches and (3) development of a management plan for River Blackfish in Watsons Creek. The methodology for the first two components are described below.

Refuge pool habitat assessment

This project components aimed to map and characterise the refuge pools along the length of Watsons Creek. While initially we considered the use of Lidar data and/or drones to map habitat pools along Watsons Creek, these approaches were considered unsuitable due to the narrow stream width and thick riparian tree cover. Based on the limitations associated with those two methods, we conducted ground-based field surveys supplemented with existing available high resolution aerial photography where needed.

The on-ground assessment involved walking along Watsons Creek, to identify and quantify the habitat present in potential refuge pools. The location of the top and bottom of refuge pools was recorded and photos were taken. A datasheet was filled in for each pool to give a standard, qualitative assessment of habitat quality at each pool. Standard measures of habitat quality were documented, as well as habitat features favored by River Blackfish and Platypus. Other habitat features of note (e.g. natural or artificial potential barriers to fish movement or areas of significant erosion) were also documented. Pools were then mapped, and habitat quality rated as Low, Medium, High or Very High quality.

The on-ground surveys were undertaken on 5th and 21st April 2023 and 5th May 2023 along Watsons Creek from Henley Road to Buttermans Track (Figure 1), equating to approximately 20 km of river distance. Surveys were undertaken when flows and water levels were low and largely comparable between days (e.g. flows 2.5-3 ML/day, which is roughly at or below the median flow rate for Watsons Creek) (BOM 2023). Conditions were good for identifying breaks between pools under regular flow conditions and quantifying habitat quality.

Fish and macroinvertebrate surveys

Based on the distribution of high-quality habitat and the location of historical records, two fish survey approaches were used. The first approach surveyed fish at 10 high quality refuge sites relatively evenly spaced along Watsons Creek (Figure 1, excluding the Happy Valley area) using backpack electrofisher following a modified version of the Sustainable Rivers Audit methods (MDBC 2008). The second approach was used to intensively target the Happy Valley area where River Blackfish had been recorded historically and habitat quality for River Blackfish was very high. The intensive approach involved backpack electrofishing the entire selected length of creek between site 7 and 15 (Figure 1) equating to approximately 6550 m of creek distance, with all representative habitat types being fished including runs and riffles between pools. All fish captured were weighed and measured and other species of note were recorded.

Pool macroinvertebrate communities were sampled at 15 sites along Watsons Creek (Figure 1). These equated to the 10 fish sites, plus 5 pools in the Happy Valley area. The approach followed the Ausrivas protocol (Chessman 2001), and utilised a qualitative dipnet/sweep samples from the edge habitat of pools. Two sweep samples were collected from edge habitats at each site to determine the macroinvertebrate communities present in the pool. The semi-quantitative edge sample was collected and live-picked in the field and then processed in the field using the rapid bioassessment method with biological indices (e.g. SIGNAL Scores) calculated as per the Ausrivas and rapid bioassessment protocols (Chessman 2001; EPA 2003).

Surveys were undertaken between 30 October and 3 November 2023, and on 16 December 2023.

Results

Refuge pool surveys

Approximately 20 km of Watsons Creek was assessed for refuge pools location and quality. One hundred and seventy-six pools were identified along Watsons Creek (Figure 1). As outlined above, some of these pools contained short (<5m), shallow breaks, but these pools likely functioned as a single pool when there was flow. Based on habitat characteristics, Watsons Creek was split into 4 reaches. These reaches were (1) Lower Reach (Henley Rd to Eltham Yarra Glen Rd), (2) Middle Reach (Eltham Yarra Glen Rd to Clintons Rd), (3) Upper Reach (Clintons Rd to One Tree Hill Rd) and (4) Top Reach (One Tree Hill Rd to Buttermans Tk) (Figure 1).

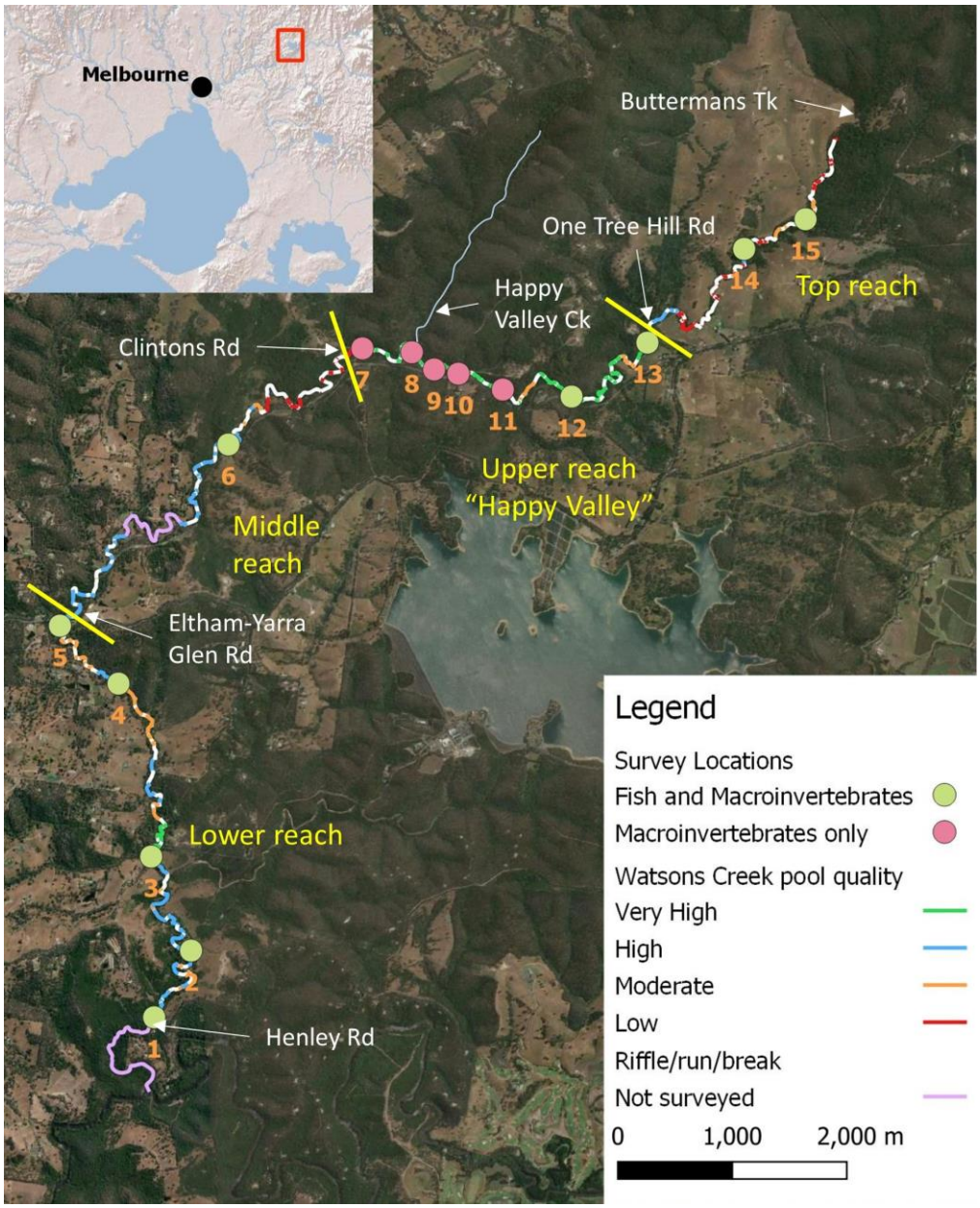

Figure 1. Location and quality of refuge pools along Watsons Creek, macroinvertebrate and fish survey sites and other landmarks. Yellow lines indicate breaks between reaches. Imagery copyright ESRI 2024.

Pools are relatively evenly distributed across the surveyed area (Figure 1). Pool length was greatest at the lower reach of Watsons Creek, but were relatively uniform throughout the rest of the creek. Breaks between pools were shorter in lower and upper reaches of Watsons Creek (Table 1), indicating connectivity may be higher in these reaches, particularly for River Blackfish which are quite sedentary (Koster and Crook 2008).

Table 1. Mean and median pool length, length of gaps between pools and number and percentage of pools of each habitat quality (low, moderate, high, very high) in different reaches of Watsons Creek.

Reach	Location	# of pools	Pool Length (m)		Breaks between pools (m)		Number and % of pools of each habitat quality			
			Mean	Median	Mean	Median	Low	Moderate	High	V. High
Lower	Henley Rd to Eltham Yarra Glen Rd	51	79.1	51.3	36.2	25.1	-	27, 53%	19, 37%	5, 10%
Middle	Eltham Yarra Glen Rd to Clintons Rd	43	56.0	40.1	62.9	47.0	13, 30%	3, 7%	27, 63%	-
Upper	Clintons Rd to One Tree Hill Rd	50	50.2	43.5	32.7	22.1	-	6, 12%	-	44, 88%
Top	One Tree Hill Rd to Buttermans Tk	32	52.1	34.4	55.4	36.7	22 69%	5, 16%	5, 16%	-

Habitat quality was also relatively high in the lower reach, which supported a number of relatively long high to very high-quality pools. These pools were longer and wider than the upper reaches (~4m wide) and many of them were quite deep, including areas >1 m deep (Table 1, Figure 1). The pools supported abundant woody debris and other complex habitat. Substrates tended to be dominated by sediments and gravel, with some areas of rock slab.

The middle reach supported moderate to high quality habitat similar to that found in the lower reach (Figure 1, Table 1). However, in the upper third of this reach habitat quality declined markedly to low quality. The top reach was dominated by low quality pools, as pools became small and shallow which was likely to impact their permanence (Figure 1, Table 1). Despite their size, pools generally supported complex habitat.

Fish surveys

In total 172 fish were captured during fish surveys. This included 5 species of native fish and two invasive species. The most abundant fish were the Southern Short-finned Eel (*Anguilla australis*), with 107 individuals recorded and individuals were spread across the entire surveyed area. The River Blackfish was the second most abundant fish species captured, with 35 individuals recorded in total. Ten Common Galaxias (*Galaxias maculatus*) and 12 Climbing Galaxias (*Galaxias brevipinnis*) were recorded in the lower to upper reaches. A single Flathead Gudgeon (*Philypnodon grandiceps*) was caught at the downstream end of Watsons Creek.

Invasive species Eastern Gambusia (*Gambusia holbrooki*) and Brown Trout (*Salmo trutta*) were relatively sparse and were restricted to the lower reaches of the catchment, with Brown Trout only recorded up to site 4 at the end of Bills Track and Eastern Gambusia only found at a single site (Site 2).

While 35 River Blackfish were recorded in total, these River Blackfish were limited to approximately 3700 m of Watsons Creek between Happy Valley Creek (Site 8) and One Tree Hill Road (Site 13, Figures 1 and 3). Few River Blackfish recruits or 1 year old fish were recorded during surveys (Figure 2). While there were a number of 2-3 year old fish, the vast majority of fish were old and large (>>4 years old). This indicates that successful recruitment of River Blackfish and survival to adulthood appears to be low in Watsons Creek except during specific years. However, once a large enough size class is reached, fish persist in the creek. 32 out of 35 River Blackfish were recorded in pools, and only 3 River Blackfish were recorded in shallow habitat between pools (including riffles and runs). However, all of the Blackfish recorded in shallow habitat were small (≤110 mm), and small River Blackfish recorded in pools were restricted to the shallow margins.

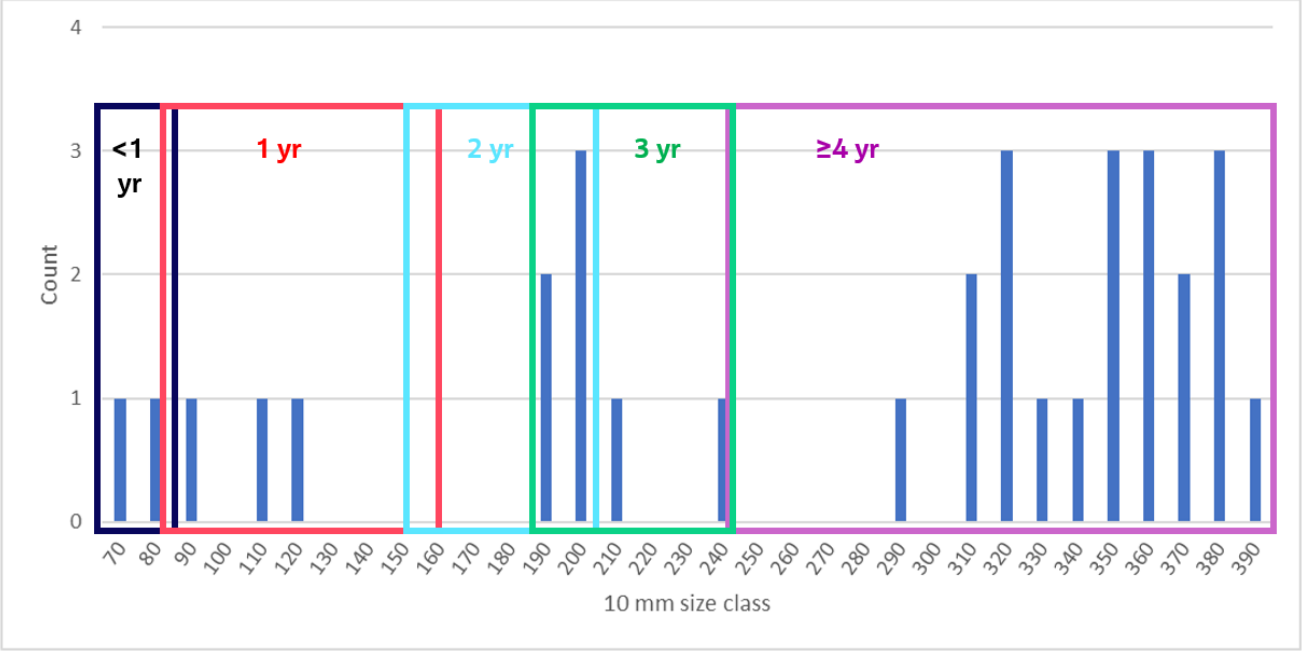

Figure 2. Size classes of River Blackfish caught in Watsons Creek. Age classes taken from Hammer (2009)

Figure 3. Locations and number of River Blackfish captured in Watsons Creek and habitat quality. Pools and riffles where River Blackfish were recorded are outlined in white, with number of fish per pool/riffle in bold white text. Site numbers are orange font. Imagery copyright ESRI 2024

Macroinvertebrate surveys

Macroinvertebrate indices were generally highest in the downstream reaches of the catchment, and then declined at sites further upstream, except at sites 11 to 13 where indices increased again. River Blackfish presence and abundance does not appear to be correlated to these indices. A number of River Blackfish were caught at or near sites 8 and 10 where a number of indices, particularly AUSRIVAS were low compared to other sites. River Blackfish were also caught near sites 11 to 13 where indices were higher. River Blackfish abundance also did not appear to be correlated with macroinvertebrate abundance.

Discussion

While there are occasional records up and downstream, the core River Blackfish population in Watsons Creek appears to be limited to approximately 3700 m of creekline between approximately Happy Valley Creek and One Tree Hill Road. This is despite much of the creek supporting extensive areas of high-quality River Blackfish habitat (slow flowing, moderately (~1 m) deep pools, areas of riffle and complex habitat for shelter and breeding) similar to the core area for River Blackfish. Food availability does not appear to be higher in core River Blackfish habitat. Hence, neither habitat nor food availability appear to be limiting the distribution of River Blackfish in Watsons Creek.

Instead, a number of other processes may be limiting the population of River Blackfish in Watsons Creek. River Blackfish recruitment appears to be low and patchy, with occasional good years for recruitment. As Watsons Creek is constrained to a narrow channel, flow velocities are likely to be high which may lead to the displacement and/or death of Blackfish eggs, larvae and juveniles. It is possible recruitment only occurs in years where there are wet winters and early springs that contribute to baseflows over summer, but no major flow events over late spring, summer and into autumn that displace eggs, larvae and juveniles. In very dry years, or years where there is a number of high flow events into summer, recruitment appears to fail. In addition, spawning or nursery habitat may also be impacting recruitment.

In addition, there are a number of catchment scale processes that may be influencing the local River Blackfish population. Hydrology may be influencing the suitability of habitat. It may be that the Happy Valley area

represents a "goldilocks" zone for River Blackfish where hydrological conditions are suitable for maintaining populations, whereas areas downstream are too flashy and areas upstream are too ephemeral. Groundwater contributions also appear substantial in the Happy Valley area, so this likely means the area supports more permanent habitat during cease to flow events. More intensive land uses and a higher number of dirt roads may be impacting habitat quality in the lower catchment by increasing the flashiness of flows and reducing water quality (primarily reduced turbidity due to sediment inputs).

Management of River Blackfish in Watsons Creek

Management actions are split into two main categories, local actions in core River Blackfish habitat and catchment scale management actions.

Local scale management actions are limited to the provision of additional spawning habitat and delivery of top up flows during extended cease to flow events. While habitat quality was very high in core River Blackfish habitat between Happy Valley Creek and One Tree Hill Road, woody debris (particularly hollow bearing woody debris) did not appear very abundant through this section. As recruitment is low in Watsons Creek, the provision of additional high quality spawning habitat (hollow logs and PVC/concrete pipe) through this section of creek may help increase recruitment. In addition, with the climate likely to become drier and more extreme leading to increased number and duration of cease to flow events, Melbourne Water should investigate opportunities to deliver environmental water to core Blackfish habitat during extended cease to flow events.

At landscape/catchment scale, the following additional management actions should be undertaken to improve habitat for River Blackfish in Watsons Creek:

- As River Blackfish (particularly spawning and recruitment) are vulnerable to the effects of sedimentation, Melbourne Water should work with local council and landholders to reduce sediment runoff into streams. Dirt roads are likely to be important point sources of sediment runoff. Working with council to reduce runoff from key dirt roads would likely improve River Blackfish habitat, particularly in the lower reaches where dirt roads are more abundant.
- As groundwater is likely important for maintaining key refuge habitat in the relatively small and shallow refuge pools along Watsons Creek, it is important to preserve local surface water-groundwater interactions. Melbourne Water should work to ensure local bores are used sustainably, groundwater recharge is maintained, riparian buffers are preserved and land use is appropriate.
- Melbourne Water should work with local council and landholders to revegetate cleared areas where possible to reduce the flashiness of flows in Watsons Creek.
- Watsons Creek has been identified as a high risk area for deer, and the impacts of deer were commonly observed along the creekline. Melbourne Water should work with government departments and agencies, local councils and landholders to control deer along Watsons Creek. Key habitat along Happy Valley Creek could be fenced to reduce damage from deer.
- A number of potential artificial barriers to movement were observed along Watsons Creek. Where possible these should be removed to improve connectivity, starting with disused barriers.

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