

Saving Little Creek

Alan Hoban¹, Geoff Vietz², Chris Walsh², Tim Fletcher², Carl Tippler³, Georg Eberl⁴, Stephanie Brown¹

1: Bligh Tanner, Brisbane, Australia,

2: University of Melbourne, VIC

3: CTEnvironmental, NSW,

4: Blacktown City Council, NSW

Extended Abstract

Little Creek is one of the last known intact chain-of-ponds creeks on the Cumberland Plains of Western Sydney as land use change has altered the natural hydrology across majority of the landscape.

This tributary has remained intact because the land surrounding most of it is a restricted access Air Services Australia site. An adjacent tributary is showing signs of erosion and deterioration as a result of a modest amount of urbanisation directly draining into the waterway.

The significant amount of industrial and residential development planned across the top part of the catchment to the Little Creek Tributary poses a major risk.

The challenge was to identify and describe the critical waterway processes for this rare stream type, translate these into appropriate design objectives for this upstream development, and then provide template design solutions for the urban development to demonstrate the application of those design objectives. As is often the case with real world waterway management projects, there was almost no baseline ecological or hydrological data to work with.

Design objectives for the protection of Little Creek are set out in Table 1 below.

Table 1 Little Creek values, objectives and metrics for protection

Important values	Current condition of values (relative to pre-European)	Sensitivity and expected change in values under urbanisation	Objectives	Hydrologic metric for protection of values
Aquatic ecosystem	Its invertebrate fauna is currently dominated by species not found in other urban streams of the region, and taxa that typically dominate urban streams are uncommon.	Conventional urban stormwater drainage would certainly result in the loss or reduction in abundance of the currently dominant sensitive taxa, and the increase in abundance of a small group of urban-tolerant species typical of other degraded streams of the region	Retention of urban stormwater runoff in the catchment to provide a flow- and water-quality regime similar to the current regimes is required to maintain assemblage composition similar to the current state (and dissimilar from the degraded urban state)	Minimization of the frequency and duration of polluted high flow events to near the current level. Provision of dry-weather flow regime similar to the current state. Increased perenniality is likely to result in a shift in assemblage composition that is difficult to predict.

	Algal assemblage composition studies are in train and will also provide an important indicator (that will be a more direct indicator of changes in nutrient concentrations than invertebrates)			Minimization of nutrient (and other pollutant) concentrations during dry-weather flows
Riparian vegetation quality	Limited information, but the current channel form clearly promotes strong hydrologic links between the channel and the floodplain, which is likely to promote high levels of nutrient uptake and loss (particularly N through denitrification)	Incision of the channel is likely to result in increased hydrologic isolation of the floodplain, that is likely to result in altered floodplain vegetation, and potentially a shift from the floodplain acting as a N sink to a N source (Groffman et al. 2003)	Maintain channel form to maintain hydrologic connection between channel and riparian vegetation The minimization of frequency and duration of overbank flows (to a frequency near the current state) is also important to minimize the spread of weeds in the floodplain (Riley and Banks 1996)	See Geomorphic objectives
Water quality	Water quality is reflecting of a “slightly impaired” stream, and while not meeting all ANZECC guidelines (for example for DO, TP and TN), water quality is supportive of a diverse range of macroinvertebrates not found in degraded urban streams.	The water quality parameters which currently exceed the ANZECC trigger values (ANZECC 2000) do so by a relatively small margin (with the exception of DO, which is likely due to low-flow conditions). Conventional stormwater mgt. even with DEC (2006) ‘standard’ pollutant load reduction targets would see almost all parameters exceed ANZECC trigger values, and thus not able to support the current range of organisms.	The ideal water quality target is to: <i>Ensure that water quality meets ANZECC (2000) guidelines.</i> Achieving this will protect current biodiversity and may allow some taxa already lost to return. If this cannot be achieved, the default target shall be to: <i>Ensure that there is no degradation from current water quality.</i> To achieve, this, a minimum standard would be the DEC (2006) “ideal pollutant reduction targets” (100% for gross pollutants, 95% for TSS and TP and 85% for TN). It is noted that gross pollutant targets must not be allowed to reduce natural sediment inputs to the stream.	

Geomorphology/physical habitat				
Mobile substrate sediments	Relatively intact substrate sediments, but evidence of some scour to in-situ clay, and little to no coarse-grained sediment inputs	Sensitive to a range of flows above low flow, and prone to complete removal under increased duration of flow above mobility threshold	Reduce the time flows are greater than the critical flow threshold for sediment mobility	Minimise duration of time above $Q_{critical}$ (flow capable of mobilizing D_{50} of 3 mm, see Figure 1). To be determined based on hydraulic model
Maintain chain-of-ponds style channel	Chain-of-ponds are a rare geomorphic style, particularly within a peri-urban setting, and so the value is in preserving this style in this region	Increases in stormwater runoff as a result of urbanisation almost universally leads to channel incision (deepening and widening)	Reduce the frequency of flows that relate to bankfull discharge to prevent channel incision	Minimise the frequency and duration of $Q_{critical}$ and $Q_{bankfull}$, as defined by the well-defined (cut) sections of the channel
Maintain channel-floodplain engagement	As a chain-of-ponds cut and fill channel the floodplain is readily engaged and this maintains regular watering of vegetation, nutrient exchange etc.	Increases in stormwater runoff as a result of urbanisation almost universally leads to channel incision (deepening and widening), reducing floodplain engagement	Reduce the frequency of flows that relate to bankfull discharge to prevent channel incision and maintain floodplain engagement	Minimise the frequency and duration of $Q_{bankfull}$, as defined by the well-defined (cut) sections of the channel

We examined several management scenarios, including business as usual, conventional WSUD, extensive WSUD and flow diversion. We found that conventional water sensitive urban design approaches would be insufficient to protect the environmental values of this waterway, and extensive suite of controls were needed. Two options found to satisfy most (but not all) of the design objectives. These were:

- Extensive onsite water sensitive urban design practices to make industrial development behave in a similar way to a forested catchment. This involves widespread use of green roofs, water harvesting, and large bioretention systems within every lot. We believe this will likely make development uneconomical.
- Onsite water sensitive urban design practices involving detention tanks and bioretention systems within every lot, with runoff collected in a series of transfer basins and pumped to the catchment immediately to the north. This transfers the problem to another waterway (albeit one of lower ecological value) has a range of direct and indirect costs.