

# Stream Health Response to Catchment-Scale Stormwater Management

Little Stringybark & Dobsons Creek Projects  
Fact Sheet Series: 10

The Little Stringybark Creek (LSC) and Dobsons Creek projects were long-term catchment-scale experiments designed to test if Stormwater Control Measures (SCMs)—primarily rainwater tanks, raingardens and infiltration systems—applied across an urban catchment can help restore stream condition. Commencing in 2008 the projects were led by The University of Melbourne and Melbourne Water, in collaboration with local government, industry, and property owners. We monitored changes to stream water quality, hydrology, and ecology (Fact Sheet 10), and also assessed techniques for local government collaboration (Fact Sheets 3 & 4), community engagement (Fact Sheet 5), as well as SCM design, performance and maintenance (Fact Sheets 6 & 7).

## About the fact sheets

These fact sheets summarise our scientific and practical findings and insights on catchment-scale stormwater management over the long-term LSC and Dobsons Creek projects. We hope that they might inform and guide the planning and delivery of future waterways management projects for improved stream health.

## Waterway health

This study used a before-after-control-reference-impact (BACRI) design to assess stream health response to catchment-scale stormwater interventions. This involved monitoring two urban control streams (nearby urban catchments where no SCM works occurred), six impact streams (LSC and Dobsons Creek catchments, where SCMs were installed) and three reference streams (nearby forested catchments free from urban impacts).

The two projects collectively constructed close to 1,000 SCMs (620 at LSC and 372 at Dobsons Creek). The majority of these were located on private land and mainly consisted of rainwater tanks designed for water harvesting for reuse (e.g. toilet flushing) and localised infiltration. Participation by homeowners was encouraged through multiple incentive programs (see Fact Sheet 1). Public land installations included a wider variety of SCMs such as rainwater tanks, raingardens,

## Findings and insights

1. Installation of SCMs reduced the volume and magnitude of stormwater runoff
2. Installation of SCMs reduced stream total phosphorus concentrations
3. Installation of SCMs reduced stream dissolved phosphorus concentrations
4. Installation of SCMs reduced summer stream water temperature
5. Installation of SCMs increased the abundance of several moderately-sensitive macroinvertebrate species
6. Installation of SCMs increased the abundance of some more sensitive diatom species, resulting in more even community assemblages
7. Stream restoration requires catching runoff from nearly all hard surfaces

*See over for more details*



vegetated infiltration basins, swales, and membrane filters. These public SCMs were designed, constructed and operated in collaboration with local government and varied in surface area (2 m<sup>2</sup>- 1900 m<sup>2</sup>) and the area of impervious surface they treated (80 m<sup>2</sup>- 5 ha). SCMs in these projects were designed to particularly high standards (i.e., above that required by the Victoria Planning Provisions, which apply the pollution load reduction targets described by EPA Victoria (2021a)) which targeted restoration of both water quality and important elements of the natural flow regime. These high standards were more akin to the water quality and flow targets described by EPA Victoria (2021a).

Between 2001 and 2019, all 11 streams were monitored at varying frequency during both dry and wet weather conditions for stream flow and water quality (including pH, electrical conductivity, temperature, dissolved oxygen, total and dissolved nitrogen, total phosphorus (TP), and dissolved phosphorus). Biological measures of waterway health were incorporated into the study, including aquatic macroinvertebrates (waterbugs), organic matter decomposition, benthic algal biomass and diatom community composition.

Our intensive installation of SCMs across the LSC and Dobsons Creek catchments meant we were able to intercept and treat a considerably greater proportion of stormwater generated in these catchments than has been attempted anywhere previously. Effective imperviousness (EI) is the proportion of the catchment covered by impervious surfaces (areas of hard materials that water cannot soak through, such as roads, roofs and carparks) that are connected to the stormwater drainage network. Stream degradation is strongly correlated with increasing EI, with ecological indicators negatively impacted beyond ~2%. The initial EI across the impact streams ranged from 1.9 – 22.4%. SCM installations resulted in EI reductions at impact streams of 0.2 – 5.8%. In four out of the six impact streams, EI was reduced to less than 3%, a level conducive to improvements in aspects of stream health, as described below.

### Project findings and insights

**1. Installation of SCMs reduced the volume and magnitude of stormwater runoff.** SCMs reduced the volume of stormwater runoff into streams from small rainfall events. For example, in rain events up to ~12 mm (around 75% of rain events), SCMs reduced peak flows to levels comparable to those observed in the forested reference streams. SCMs worked most effectively at intercepting stormwater and redirecting it to infiltration, evapotranspiration and consumptive use (e.g. toilet flushing, irrigation) for small rainfall events of between 2 – 8 mm, where their storage capacities were less likely to be exceeded.

**2. Installation of SCMs reduced stream total phosphorus concentrations.** Phosphorus is an essential element in all organisms but can lead to negative impacts on aquatic ecosystems when present in excess, including algal blooms, severe oxygen depletion and degraded habitat for fish and invertebrates. SCMs reduced in-stream TP concentrations during dry weather baseflow and following small to medium rainfall events. Overall, SCM installation reduced TP concentrations during the most frequently occurring flow conditions to below the Victorian government objective for TP (110 µg/L, EPA Victoria 2021b). The effect of SCMs was greatest during dry weather and when rainfall in the preceding 24 hours was 8mm or less (weather conditions which collectively occur 90% of the time), where stream TP concentrations were reduced to levels comparable to those observed in the forested reference streams. The dry weather benefit was achieved by SCMs intercepting polluted dry-weather flows and increasing groundwater flows with stormwater that had been filtered through both SCMs and the catchment soils. For rainfall events of 8 – 20 mm, reductions in TP concentrations became increasingly smaller; while in events beyond 20 mm, SCMs had very little impact on TP concentrations. The reduced effectiveness of SCMs following larger rainfall events was influenced by SCM size and water demand and, ultimately, the increased likelihood that their treatment and storage capacities were exceeded.

**3. Installation of SCMs reduced stream dissolved phosphorus concentrations.** Unlike TP, which includes sediment-bound phosphorus, dissolved phosphorus is available for rapid uptake by plants and algae and can thus lead to more immediate negative impacts. Similar to TP concentrations, SCMs reduced in-stream dissolved phosphorus concentrations during dry weather baseflow and following small to medium amounts of rainfall, but in-stream concentrations were not quite as low as levels in forested reference streams. Similar to what was observed for TP, the effectiveness of SCMs for dissolved phosphorus concentrations reduced with increasing rainfall due to the greater likelihood that SCM treatment and storage capacities were exceeded, resulting in considerable bypass of untreated stormwater.

**4. Installation of SCMs reduced summer stream water temperature.** The installation of SCMs reduced maximum summer stream temperatures during dry weather by 4 – 5 °C, meaning temperatures were reduced to those found in forested reference streams. SCMs also reduced maximum summer stream temperature during wet weather, with the effect greatest during small to medium rainfall events of less than 8 mm. These summer stream temperature reductions were driven primarily by SCMs designed for subsurface filtration and minimal standing water exposed to sunlight and atmospheric temperature exchange. The magnitude of these temperature reductions exceeds the 2050 forecasted increase in daily maximum temperature resulting from climate change in Southeastern

## 10. Stream Health

Australia (1.75 – 1.95°C; 2050 and emissions scenario RCP 8.5; CSIRO and Bureau of Meteorology 2025).

**5. Installation of SCMs increased the abundance of several moderately-sensitive macroinvertebrate species.** The installation of SCMs resulted in little or no change in biotic indices, such as SIGNAL or LUMaR for macroinvertebrate assemblages used in the Environment Reference Standard (EPA 2021b) and Healthy Waterways Strategy (Melbourne Water 2018). There was a positive trend in both SIGNAL and LUMaR in Dobsons Creek since 2013, but not in LSC or its tributaries. This difference may have resulted from the greater pool of colonizing species in the forested headwaters of Dobsons Creek compared to LSC, which has urbanised headwaters. Despite little change in overall indicators of taxonomic presence or absence (like SIGNAL or LUMaR), abundances of individual macroinvertebrate taxa (groups of similar types of macroinvertebrates) did respond to the catchment interventions, with numbers of several moderately-sensitive macroinvertebrate taxa increasing, indicating improvements in biodiversity.

**6. Installation of SCMs increased the abundance of some more sensitive diatom species, resulting in more even community assemblages.** The installation of SCMs had little effect on diatom (microscopic algae) community health as measured by the DSIAR (a biotic index used in Australia to assess freshwater ecological condition based on diatom communities). A single common diatom species, *Achnanthes oblongella*, which tends to be found in less urban streams, increased in relative abundance following SCM installation. At the same time, 12 other diatom species of varying sensitivity to urban impacts became relatively less abundant. The overall effect was to increase the evenness of the diatom assemblage, which generally indicates reduced environmental stress (e.g. elevated nutrient concentrations, flow disturbance). We do not yet know whether the change in diatom assemblage composition was matched by a drop in algal growth (biomass) as data analyses were still in process at the time of writing. If algal biomass is

found to be lower after SCM installation, that would provide further evidence of improved ecosystem health.

**7. Stream restoration required catching runoff from nearly all hard surfaces.** While the LSC and Dobsons Creek projects were successful at improving aspects of stream water quality, hydrology and ecology, stormwater drainage impacts were not fully mitigated. This was largely because there wasn't enough public space to build the necessary SCMs to adequately treat all of the impervious surfaces draining to the creek, not all private landowners took part in the project, and there wasn't enough demand for using the captured stormwater (which reduces the performance of the SCMs). Additionally, a proportion of the SCMs on private property were non-operational at times, reducing the overall effectiveness of stormwater treatment. These factors meant that the projects were unable to achieve the desired level of 'disconnection', meaning that not enough stormwater could be caught, treated, soaked into the ground, evapotranspired, or used. This likely limited the extent of stream restoration. Nevertheless, both projects clearly demonstrated the capability of SCMs to improve aspects of waterway health in existing urban areas, including hydrology, water quality and ecological condition, which is an important step forward in opportunities for urban stream management.

### References

- CSIRO and Bureau of Meteorology (2025) Climate Futures Exploration Tool (Available from: <https://www.climatechangeinaustralia.gov.au/en/projections-tool/climate-futures-tool/projections/>)
- EPA Victoria (2021a), "Urban stormwater management guidance", Publication 1739.1, State of Victoria (Environment Protection Authority Victoria)
- EPA Victoria (2021b), "Guide to the Environment Reference Standard", Publication 1992, State of Victoria (Environment Protection Authority Victoria)

### For more details on the outcomes of this project, please refer to:

- Walsh, C. J., D. G. Bos, M. J. Burns, M. Imberger and T. D. Fletcher (2023), "Restoring the health of urban streams through stormwater management: A synthesis of the Little Stringybark and Dobsons Creek research projects", Technical report 23.2, Melbourne Waterway Research-Practice Partnership.
- Little Stringybark Creek and Dobsons Creek Projects: Fact Sheet Series
  1. Managing Stormwater at the Catchment Scale
  2. Collaborative Stormwater Management: Co-design and Co-delivery for Long-Term Success
  3. Collaborating with Local Government on Stormwater Management
  4. Enacting Stormwater Management through Local Government Planning Schemes
  5. Enhancing Community Engagement and Participation in Stormwater Management
  6. Design and Performance of Stormwater Control Measures for Stream Protection
  7. Operation and Maintenance of Stormwater Control Measures for Stream Protection
  8. The Stormwater Metric 'S': A Tool for Predicting Benefits from Improved Stormwater Management
  9. Monitoring the Effectiveness of Stormwater Control Measures
  10. Stream Health Response to Catchment-Scale Stormwater Management