Maintenance regimes affect stormwater quality improvement device performance

Dr Peter Scanes[1], Mr Aaron Wright[1]
[1]*OEH, Lidcombe, Australia*

Maintenance of water sensitive urban design devices is an ongoing concern. It is believed that constructed wetlands require routine maintenance to remain effective at removing pollutants from stormwater runoff.

This project aimed to assess pollutant removal efficiency before maintenance and after maintenance. The focus was on vegetation removal as a maintenance activity. The output of this project was advice to council about what scale of maintenance activities results in greatest improvements to urban stormwater pollutant removal efficiency. Water quality was measured in two constructed wetlands that receive runoff from urban landuse areas. Prior to sampling both were overgrown with aquatic vegetation, including a mix of native and exotic species. In this condition sampling was carried out for approximately 10 months and included samples from dry weather flow conditions and rainfall events. Samples were collected at the inlet and outlet of each device. Samples were analysed for total suspended solids, total nitrogen and total phosphorous and the respective dissolved and particulate fractions. Water quantity at the inlet and outlet of each device was also measured. Event mean concentrations (EMCs) for each pollutant were determined at the inlet and outlet in each device.

In one device, all emergent and riparian vegetation was removed using an aquatic excavator. In the other, only the exotic species were removed manually. Intensive sampling was carried out during the vegetation removal process and EMCs were calculated. Sampling was carried out following the maintenance activities for approximately 8 months, again during dry weather flow conditions and rainfall events and EMCs were calculated. The pollutant removal efficiency during each stage of the sampling (before maintenance, during maintenance and after maintenance) was calculated.

In the device where all vegetation was removed: prior to maintenance the wetland was removing nitrogen, primarily in the form of bioavailable nitrogen (NOx). The device was acting as a source of total phosphorous and total sediment, due to a large export of particulate phosphorous which can adsorb to sediment particles. After maintenance, there was an increase in efficiency of total phosphorous and total sediment removal efficiency due to the ability of sediment to settle out in the device, but the device was still a net source of phosphorus. Nitrogen removal efficiency decreased, due to decreased removal of bioavailable forms of nitrogen, but the device remained a net sink.

In the device where only exotic vegetation was removed: prior to maintenance the device was acting as a source of all pollutants, exporting more than it was receiving. After maintenance, the removal efficiency of phosphate decreased and the device was exporting more phosphate (and phosphorus) than before maintenance. Removal efficiency of NOx increased and ammonia decreased, but overall the device moved from a net source of nitrogen to a slight sink. Total sediment exports decreased.

Immediately after maintenance, both devices showed a very large export of all three pollutants for a short time. This study has shown that actual performance of stormwater treatment devices is very different from modelled performance, and may be declining over time as plant biomass grows and senesces as sediment is stored. This has large implications for models of system performance.

Neither complete vegetation removal or vegetation thinning improved removal efficiency of total phosphorous. Vegetated wetlands are more effective at removing total nitrogen than unvegetated wetlands and removing exotic species and reducing biomass can improve nitrogen removal efficiency. Decaying plants in waterlogged soils can contribute nutrients to waterways

The physical disturbance of removal of vegetation by mechanical means very quickly reversed the benefits of the long term removal that occurred in the device.

Some maintenance activities are optimal for some pollutants while simultaneously sub-optimal for others:

- selective thinning is good for TN removal, but not for sediment
- removing all vegetation allows sediment to be stored, at the cost of short term large scale export of all pollutants.