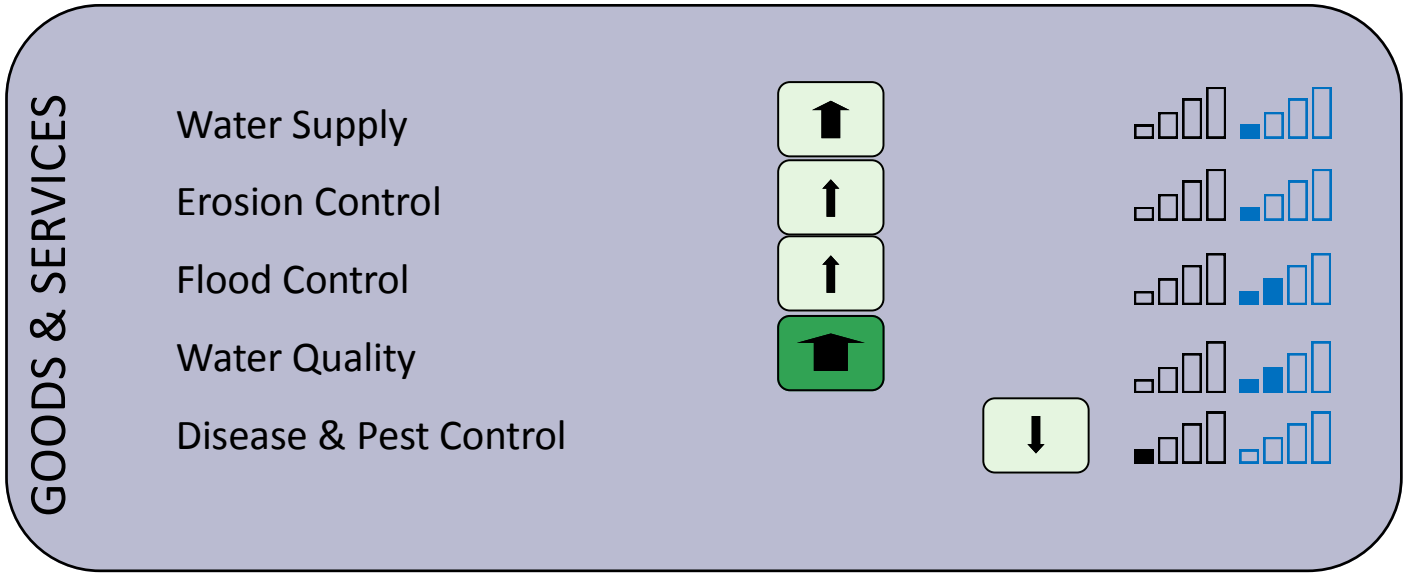
Implement a range of structures to absorb water run-off from impervious areas.

MANAGING ECOSYSTEM SERVICES

URBAN

ESTABLISH RAIN GARDENS & DEVELOP BALANCING PONDS

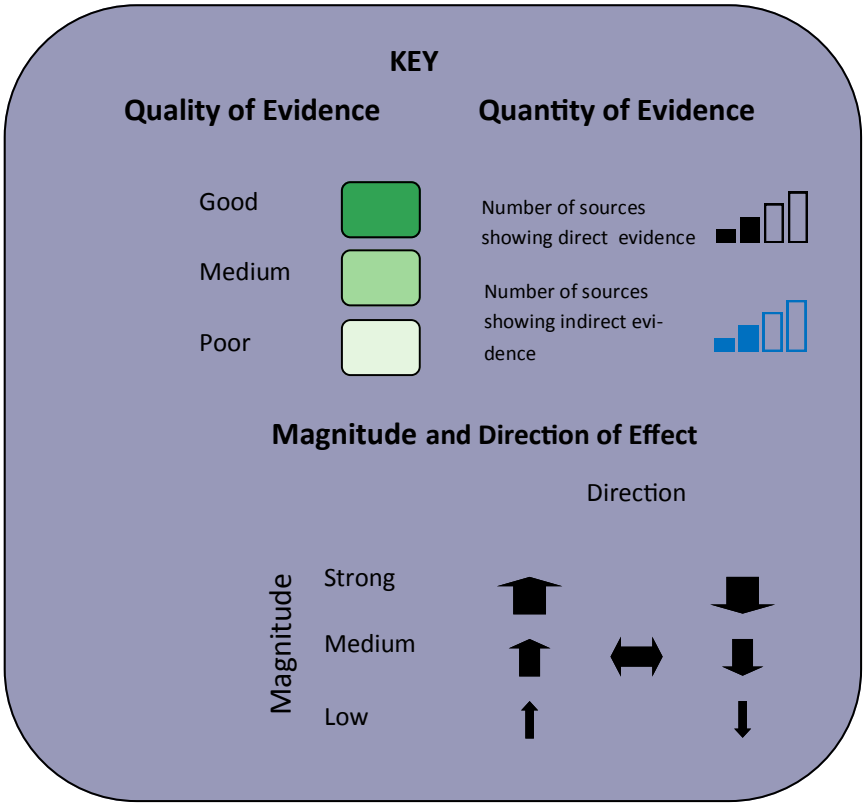
GOODS & SERVICES



These pages represent a review of the available evidence linking management of habitats with the ecosystem services they provide. It is a review of the published peer-reviewed literature and does not include grey literature or expert opinion. There may be significant gaps in the data if no published work within the selection criteria or geographical range exists. These pages do not provide advice, only review the outcome of what has been studied.

Full data are available in electronic form from the Evidence Spreadsheet.

Data are correct to March 2015.



MANAGING ECOSYSTEM SERVICES

URBAN

ESTABLISH RAIN GARDENS & DEVELOP BALANCING PONDS

Provisioning Services—providing goods that people can use.

Cultural Services—contributing to health, wellbeing and happiness.

Regulating Services—maintaining a healthy, diverse and functioning environment.

PROVISIONING

Water Supply: ***Strong Evidence***:- Rain garden effectiveness depends on the structure of the soil. Rain gardens on Eden soil in the USA (a slowly permeable silty loam) would contribute about 2 cm to annual groundwater recharge, while fine silty soils would contribute around 6 cm to re-charge[1]. In a simulation study, if 30% of the roof surfaces were covered with green roofs and all run-off was directed via swales, then groundwater would return to pre-development levels[2].

REGULATING

Erosion Control: ***Weak Evidence:-*** A review of storm-water management suggests that increased urbanisation and run-off is responsible for increased stream flows with resulting erosion. Increased infiltration at source using rain gardens and temporary storage using balancing ponds could potentially reduce this[3].

Flood Control: ***Moderate Evidence:-*** Soil type is important in rain gardens for retarding storm -water run-off. Some soil types may allow better storm water abatement than others[1] ***Weak Evidence:-*** Impermeable surfaces in urban environments are responsible for stream 'blow-out' and localised flooding events. Increased infiltration at source using rain gardens and temporary storage using storage in detention and retention (balancing) ponds could potentially reduce this[3].

Water Quality: Moderate Evidence:- A review of waste water management policy suggests that the best way to both reduce flooding and improve nutrients and pollutants is to manage storm water at the level of the property[3]. Vegetation in small urban wetlands can reduce metal contaminants such as copper, lead and zinc, with *Typha latifolia* showing good uptake[4]. Good nutrient and pollutant removal depends on a mix of strategies. A study at an industrial site in Boston USA found that ponds and biofilters were needed in combination but can attain a 75% reduction in Phosphorus[5]. A study of two urban runoff sites in the UK found that the highest concentrations of metals are in sediments, and that uptake by plants is quite variable but greatest during storm events[6]. A similar study in Greater London found that metal removal at urban runoff wetlands was around 70-80% for most metals apart from Nickel which was 34%[7]. In general, small scale wetlands appear to function better at removing pollutants during storm conditions rather than in drier conditions[8]. A detailed study of two urban run off wetlands suggest that inlet flow velocities should not exceed $0.7ms^{-1}$ and that substrate depth should be a minimum of 0.6 m. Optimum retention times are 10-15 hours to maximise pollutant removal[9].

Disease & Pest Control: ***Strong Evidence:-*** A study from Ohio, USA found that urban wetlands created for storm-water retention had high levels of mosquito larvae[10]. Flow-through wetlands had significantly less mosquito larvae than ponds and storm-water wetlands, and mixed vegetation environments, especially with emergent vegetation promoting mosquito breeding. Some of the mosquito species present were capable of transmitting disease to humans[10].

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