Technical Memorandum: March 2016

Amendment of Infiltration Basin Soil to Create Phosphorus Retention Capacity

Important waterways on the Swan Coastal Plain are experiencing significant ecological degradation caused by excessive inputs of phosphorus which are carried into the waterways by stormwater drainage and groundwater baseflow. The ultimate source of phosphorus loadings are fertilisers and atmospheric fallout to the land surface.

Water quality improvement plans (WQIP) prepared by the Environmental Protection Authority have recommended that amendment of natural coastal plain sandy soils to improve their phosphorus retention capacity (PRI) presents an opportunity to mitigate phosphorus export to waterways by capturing soluble and particulate phosphorus within the soil profile.

Whilst broadacre/landscape scale soil amendment can be carried out effectively, there is also the opportunity to use infiltration basin soil amendment to mitigate phosphorus entry to the shallow groundwater system, which discharges to the adjacent waterway.

At the present time, technical literature published by the State Government Department of Water proposes the use of “biofilters” also known as biofiltration systems, bioretention systems and rain gardens to remove pollutants from stormwater runoff.

Whilst these are described as excavated basins filled with porous filter media and planted with vegetation to remove pollutants from stormwater, in practice they are simply more technical advanced versions of the commonly used infiltration basins to which stormwater from impervious area are directed for disposal.

A copy of a generic design for a biofilter sourced from the Department of Water’s Better Urban Water Management policy is attached.

Whilst the processes of filtration, and biological uptake can be effective in retaining pollutants within the biofilter structure, the use of a high PRI soil to

form the “filter” zone of the biofilter structure will significantly improve phosphorus retention.

It has been shown by research at local universities and research organisations including CSIRO and Chemistry Centre of WA, that soils which are high in aluminium, iron and calcium have high PRI.

Research by these organisations has also shown that the sandy soils which form the Swan Coastal Plain and support urban, industrial and agricultural development typically have very low phosphorus retention capacity, and hence applied fertilisers readily leach through the soil profile into groundwater and surface water features.

The Eclipse Soils’ product we market as Phosphorus Retentive Filter Media, containing SIRG (super iron rich gravel), is intended to be used as a filter medium in biofilters and infiltration basins which can impart high PRI and hence high phosphorus removal capacity to these structures.

It has the added beneficial feature of having a coarse-grained soil texture (hence “gravel”) and therefore high hydraulic permeability, which is important in that infiltration basin areas can be minimized.

The process of sizing infiltration basins in regard to area, depth and phosphorus removal lifetime must account for a range of factors including:

- catchment area,
- design storm for infiltration,
- percentage of catchment area devoted to infiltration
- type of infiltration structure to be used, ie roadside pits, soakwells, basins,
- infiltration rate of basin substrate.

These factors are site specific and must be calculated individually for each stormwater catchment.

The phosphorus adsorption lifetime of a particular soil medium depends on its PRI, the concentration of phosphorus in the stormwater which it infiltrates and the total amount of stormwater directed to the basin.

Basin lifetime can be modeled using a procedure referred to as a “***convective,***

dispersive solute transfer model with a sink term", a highly sophisticated mathematical/geochemical model. There are many assumptions made to conduct this modelling as well as a range of geochemical parameters which are determined empirically by geochemical laboratory testing.

We have an internal model at Eclipse which we have used to estimate the depth of our SIRG product required to achieve various phosphorus removal lifetimes.

Recognising the range of assumptions that must be made to account for variables in the whole process of designing a site specific stormwater systems it is nevertheless possible to estimate a depth for a Phosphorus Retentive Filter Media layer within a biofilter to achieve a particular phosphorus removal lifetime.

Applying this process for Eclipse's SIRG product with a PRI of 100, within a biolfiltration basin designed to infiltrate the 1:1 year ARI storm, and covering between 2% to 6% of the impervious portion of the stormwater catchment, it is possible to derive a **minimum depth of SIRG of approximately 300mm** to achieve a nominal 100 year phosphorus adsorption lifetime for stormwater which conforms to Department of Water data in regard to phosphorus content.

This compares to the DoW specifications for biofilters which specifies a depth of sandy loam filter media of 300 mm to 800 mm, but as it does not specify a minimum PRI implicitly proposes that phosphorus removal is achieved mainly by filtration of particulate matter and plant uptake.

A minimum depth of 300 mm of the Eclipse SIRG product within a biofilter design in general accordance with the DoW design could be reasonably expected to have a phosphorus removal lifetime of 100 years.

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