Key recommendations for design of biofiltration systems
Biofilter Design

Design will depend primarily on

– System objectives
  • Pollution control
  • Runoff reduction (volume, frequency)
  • Stormwater harvesting, etc

– Site characteristics
  • Climate
  • Available size
  • Opportunities & constraints
1. Soil Filter Media
• **Hydraulic conductivity**
  – depends on objectives and site
  – Ks of 100-300mm
  – Must be tested!
  – Design/model at 50% of design value

• **Particle Size Distribution** (PSD):
  – clay and silt fractions (< 6um) less than 3 %,
  – continuous size grading;

• **Minimal organic matter** and TP content < 100 mg/kg;

• Soils used in the filter should be *structurally stable*
2. Selecting vegetation
Vegetation

• Plants are critical for nutrient removal & hydraulic conductivity

• Selection for N is critical
  – Best genera so far: Carex, Melaleuca, Juncus, Goodenia, Ficinia

• Mix required for sustainability
3. Saturated zone with carbon to enhance nitrogen removal
Design Examples: With Anoxic Zone

AEROBIC SOIL (unsaturated)

ANAEROBIC ZONE (saturated)

Transition layer

Drainage layer

Drain

Sub-surface drain

TREATED STORMWATER

Su.

Drainage layer

Transit layer

RIVER SAND

GRAVEL

FILTER MEDIA

200 SAND & CARBON SOURCE

300-600 FILTER MEDIA

200 SAND & CARBON SOURCE

100 RIVER SAND

150 GRAVEL

EDAW | AECOM

FAWB
Facility for Advancing Water Biofiltration

MONASH University
Anoxic Zone with Carbon

- **450 mm deep** (consisting of sand or gravel) **with a carbon source** such as hardwood chips (5% by volume)

- Help to buffer against dry periods
4. Hydraulic conductivity
What governs hydraulic performance?

• The media type is critical
  – Initial Ks of filter media
  – Soil structural stability

• As well as:
  – System size
  – Inflow with high silt loads
  – Presence of thick-rooted vegetation
Consider Ks as one of 3 factors in design

Area  →  Ks  ←  Detention depth

50% “safety coefficient” in Ks
5. Treatment Performance
What performance can we expect?

If designed properly vegetated, soil-based biofilters will reduce

- Over 95% of TSS,
- Over 85% of TP,
- Over 50% of TN (even over 70% for some configurations)
- Over 90% of heavy metals
- High level of pathogen removal (>80%)
6. Combining WQ & flow management

• Aim is generally to manage both water quality and flow impacts of urbanisation
• Design features to help flow management:
  – unlined wherever possible
  – maximise opportunity for infiltration and evapotranspiration
  • Elevated outlet or no overflow only (infiltration)
7. Construction and Maintenance
BIORETTENTION BASINS – Stage 1

1:4 max

'Primary' Filter Media

Mass Planting ground cover vegetation

Overflow pit

Perforated under drain (100mm dia 0.5% slope)

Impervious Liner (if required)

0.2m Drainage Layer

0.3 – 0.8m Filter Media

0.30m Extended Detention Depth

0.1m Transition Layer (if required)

2yr ARI pipe

0.2m Drainage Layer
Key findings from field studies

• Some **leaching of silt and nutrients** during establishment phase (2-6 months).

• Effective communication between **designers and construction contractors is essential**

• **Maintenance requirements** initially high but reduces as vegetation grows (**higher planting density helps**)
Last chance for Discussion