New Storm Water Control Measure Development: Case Studies and Challenges

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Low Impact Development:
is an approach to land development (or re-development) that works with nature to manage stormwater as close to its source as possible. LID employs principles such as preserving and recreating natural landscape features…….(US EPA)

Ecological Restoration:
the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed.
(Society for Ecological Restoration)

Ecological Engineering:
integrating ecology and engineering… design and construction of sustainable ecosystems… to integrate society with the natural environment for the benefit of both . (Howard Odum)

Novel Ecosystem:
ecosystem that has been heavily influenced by humans but is not under human management Nature (2009) 460: 450-453

Regenerative Stormwater Conveyances (RSCs)

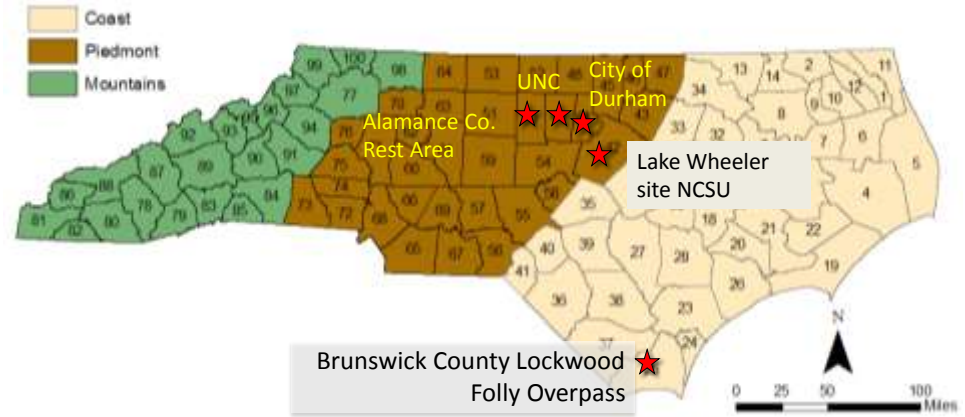
-----Utilize a series of shallow aquatic pools, riffle/grade controls , native vegetation , and an underlying sand/wood chip substrate in degraded flowways (ecological restoration and ecological engineering)

-----intercept stormwater, and filter pollutants from the flow of stormwater in channels that have been incised and degraded by urban runoff (stormwater/LID and novel ecosystems).

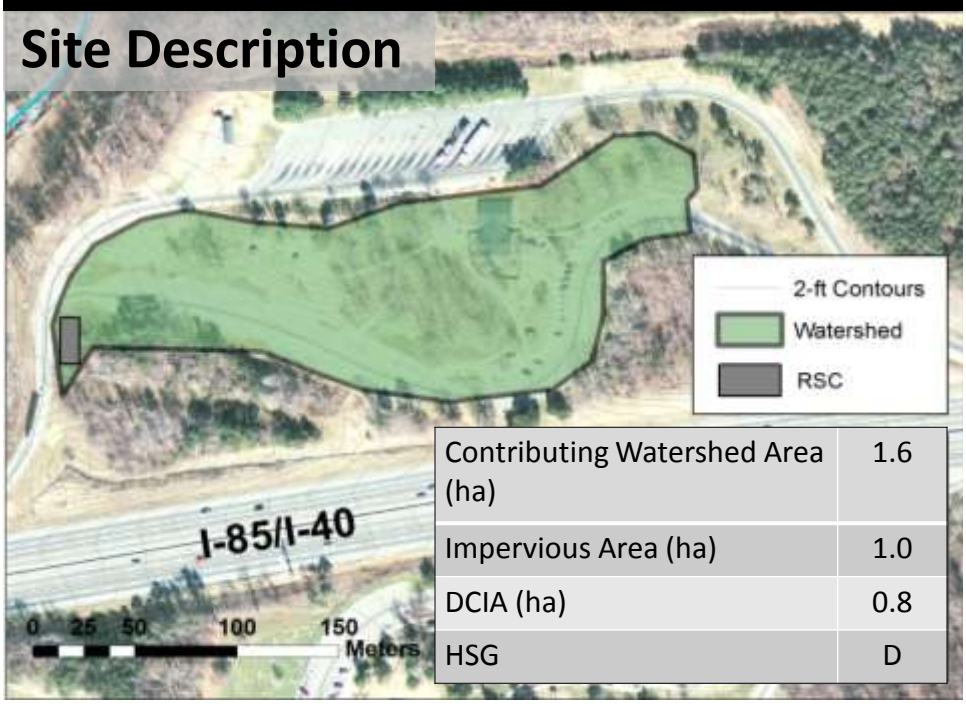
Regenerative Stormwater Conveyance (RSC) History and Development

- Created as a remedy for highly eroded stormwater outfalls and conveyance channels
- Conceptualized in Maryland in 1990's and early 2000's
- Design development and refinement, water quantity/ quality monitoring data was collected and analyzed
- Adoption as SCM in Maryland for nutrient reduction credit in 2014

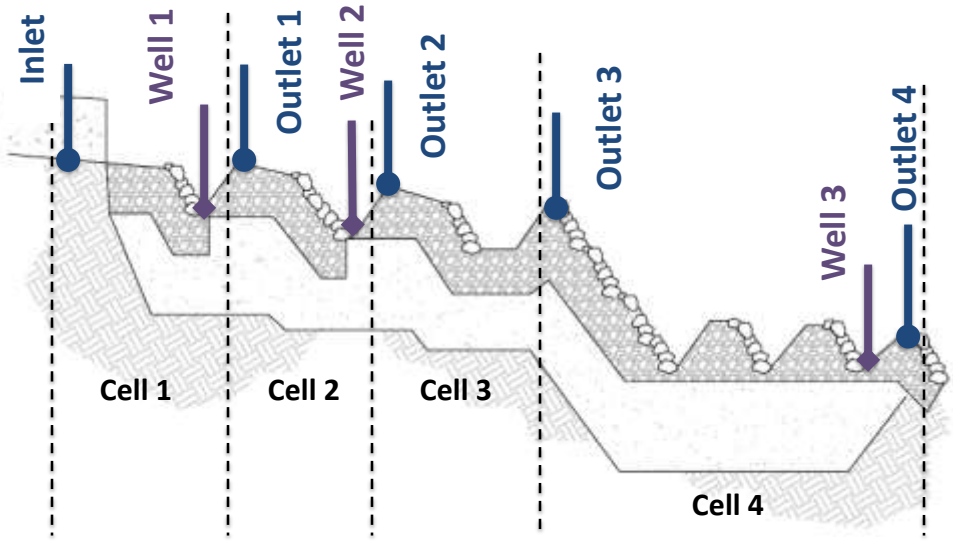

Source of Photos: Underwood & Associates



Site Description



Contributing Watershed Area (ha)	1.6
Impervious Area (ha)	1.0
DCIA (ha)	0.8
HSG	D


Inlet
Well 1
Outlet 1
Well 2
Outlet 2
Outlet 3
Well 3
Outlet 4
Cell 1
Cell 2
Cell 3
Cell 4


Alamance County
Hydrology

Storm Summary

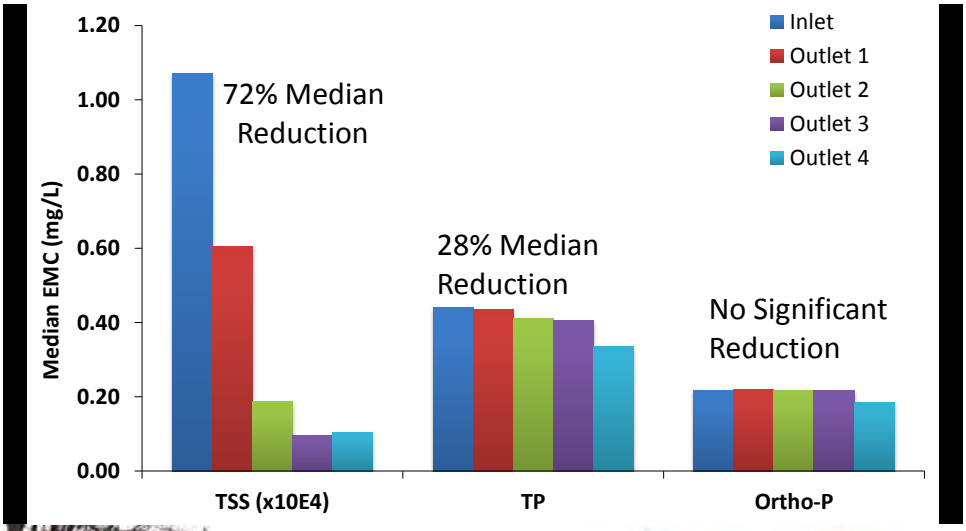
- Monitored 43 inflow producing events between July 2013 and June 2014
- Max Rainfall Depth = 81 mm, 15 cm/hr
  - Inflow Volume = 660 m^3, peak flow = 246 L/s
  - Outflow Volume = 235 m^3, peak flow = 102 L/s

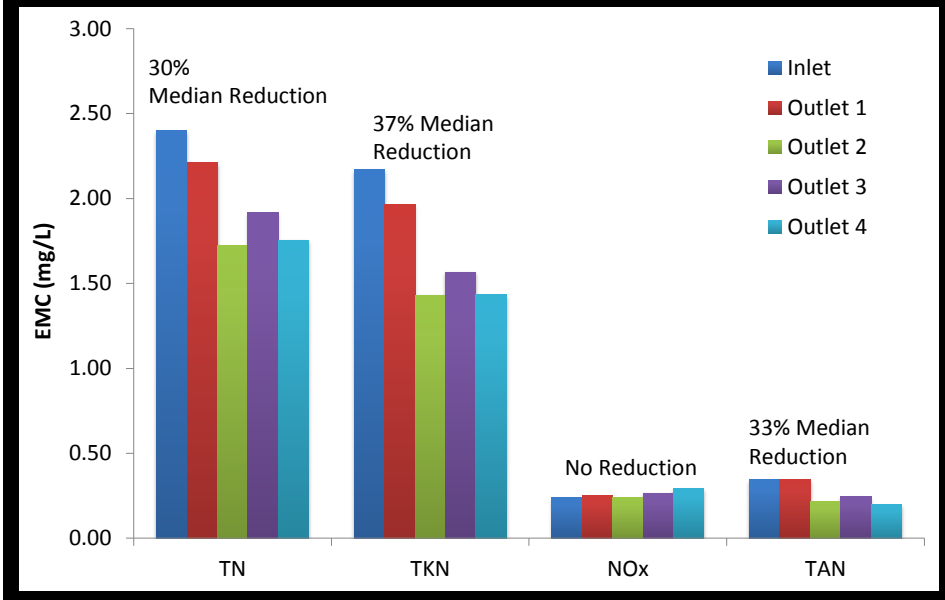
64% Volume Reduction
58% Peak Flow Reduction

Median Volume Reduction = 84%
Median Peak Flow Reduction = 80%

Storm Summary

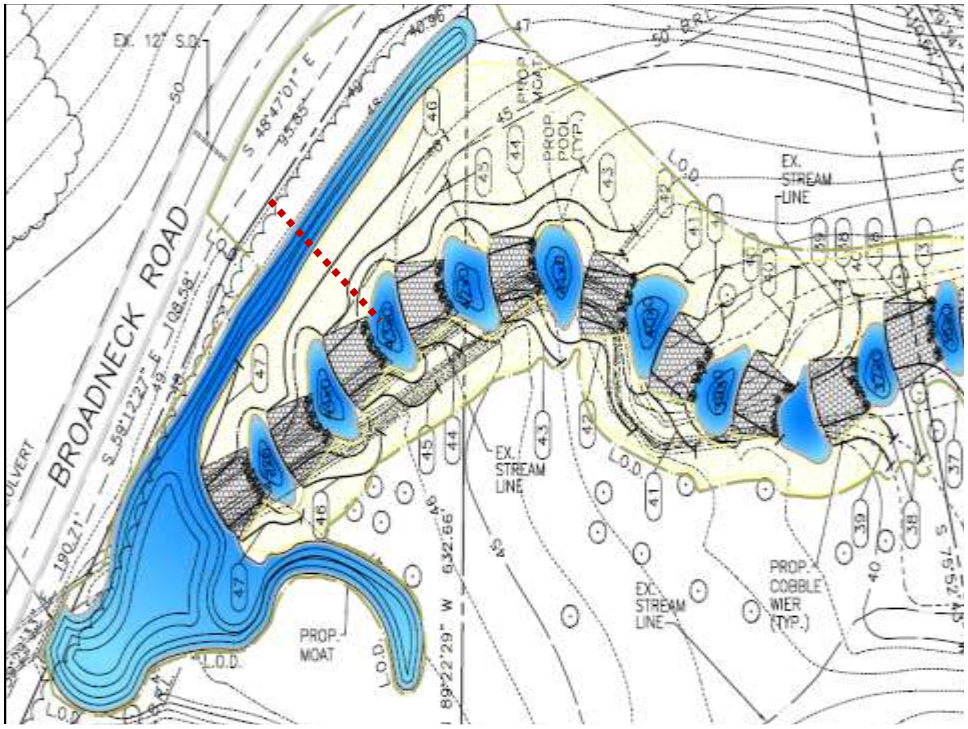
- Monitored 20 water quality events between July 2013 and June 2014
- **Inflow** concentrations
  - **TN**: median = 2.40 mg/L, range = 1.59 to 9.96 mg/L
  - **TP**: median = 0.44 mg/L, range = 0.24 to 2.14 mg/L
    TSS: median = 69.1 mg/L, range = 8.82 to 297 mg/L
- **Outflow** concentrations
  - **TN**: median = 1.76 mg/L, range = 1.05 to 3.85 mg/L
  - **TP**: median = 0.34 mg/L, range = 0.18 to 1.23 mg/L
  - **TP**: median = 11.56 mg/L, range = 7.57 to 68.5 mg/L

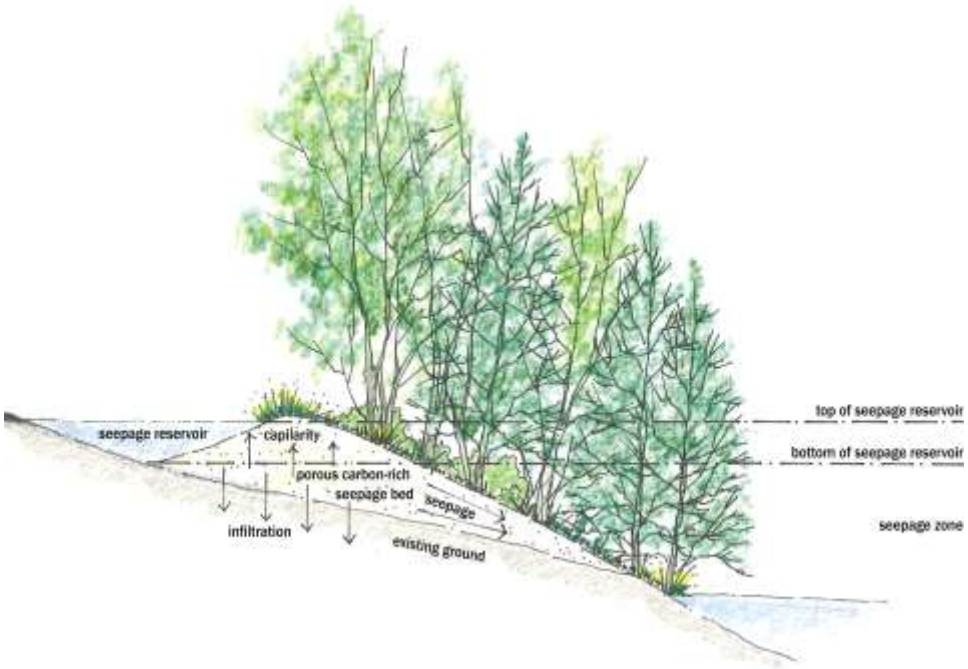




Sand Seepage Berms

- used to divert high flows from the conveyance channel to the floodplain, where it is temporarily stored
- much of the water seeps through the sand berm. by gravity flow, back to the channel
- It is filtered as the process proceeds
- Has been incorporated into stormwater and stream restoration designs in Maryland

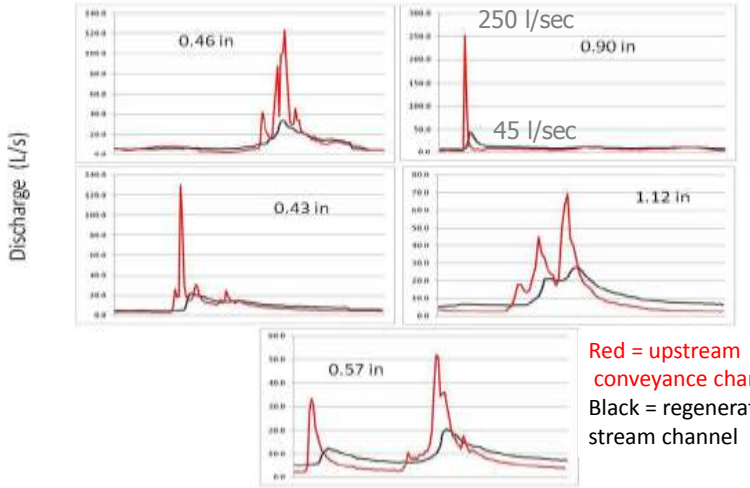

BROADNECK ROAD
EX. 12" S.D.
S 48°47'01" E
95.85'
PROP. MOAT
PROP. POOL (TYP.)
EX. STREAM LINE
L.O.D.
EX. STREAM LINE
EX. STREAM LINE
PROP. COBBLE WIER (TYP.)
PROP. MOAT
L.O.D.
S 89°22'29" W 632.66'
S 76°57'45" E
190.21'
S 58°12'27" E 108.58'
CULVERT


top of seepage reservoir
bottom of seepage reservoir
seepage zone
seepage reservoir
capilarity
porous carbon-rich
seepage bed
seepage
infiltration
existing ground


Wielinor Estates, Edgewater, MD 21037, USA
Google earth


Wielinor Estates, Edgewater, MD 21037, USA
Google earth

Hydrographs during individual storms WILELINOR



Red = upstream conveyance channel
Black = regenerative stream channel

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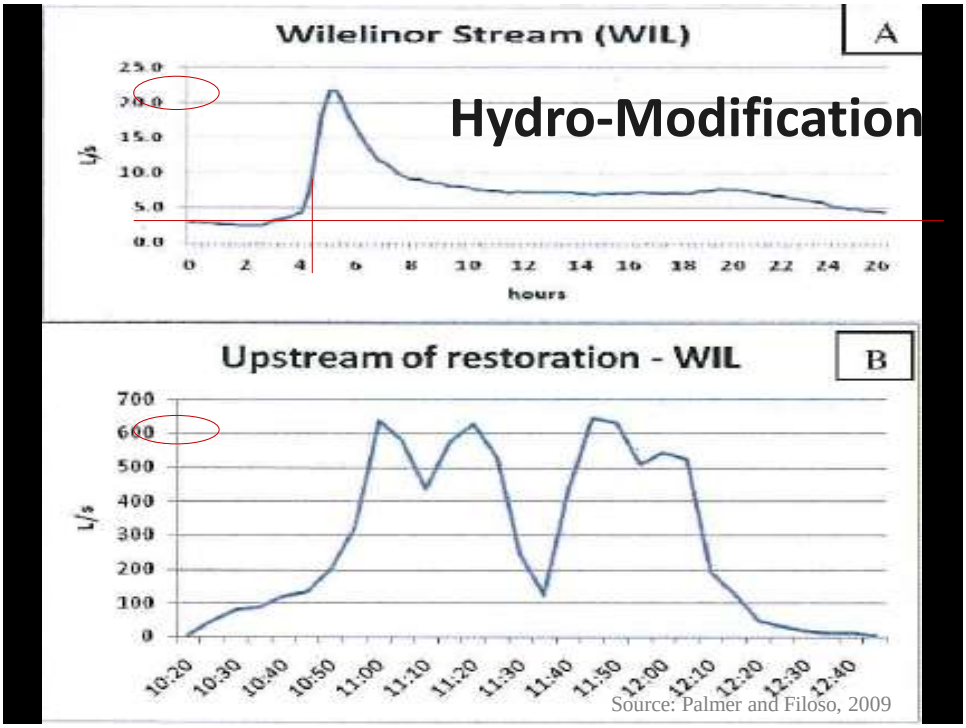

Source: Palmer and Filoso, 2009