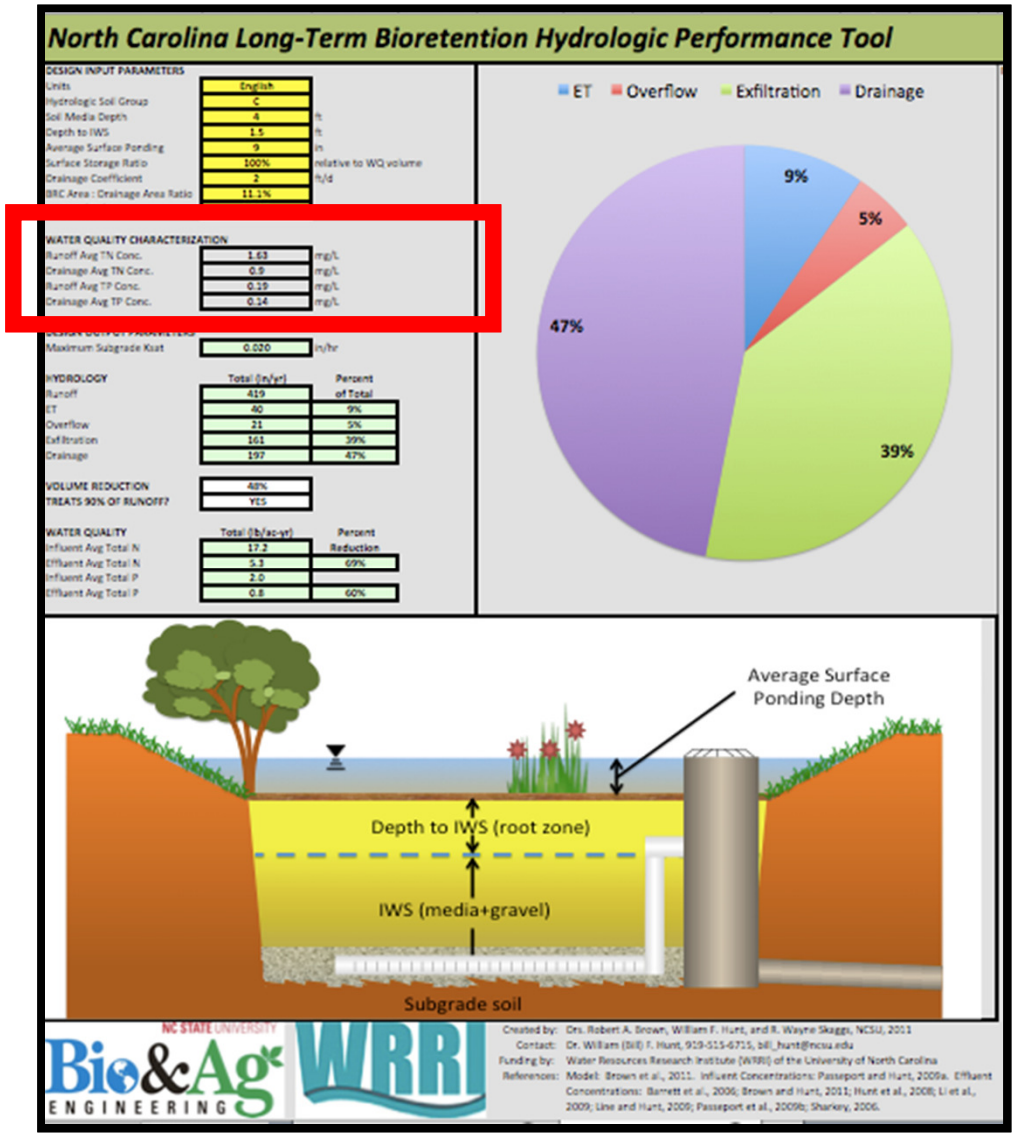
HyPer Tool Interface

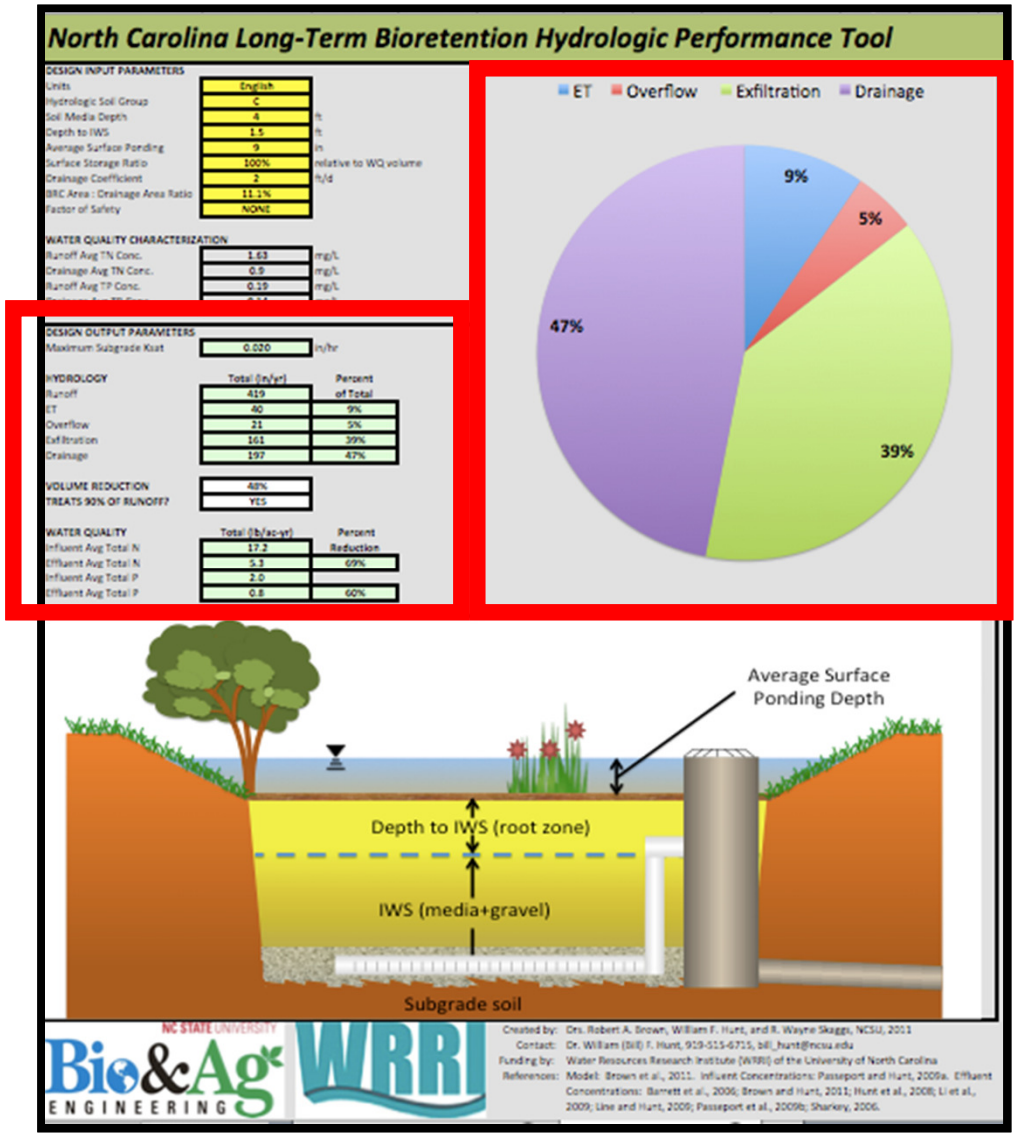


HyPer Tool WQ Inputs

WATER QUALITY CHARACTERIZATION		
Runoff Avg TN Conc.	1.63	mg/L
Drainage Avg TN Conc.	0.9	mg/L
Runoff Avg TP Conc.	0.19	mg/L
Drainage Avg TP Conc.	0.14	mg/L

Based on average effluent concentrations

HyPer Tool Interface



DESIGN OUTPUT PARAMETERS

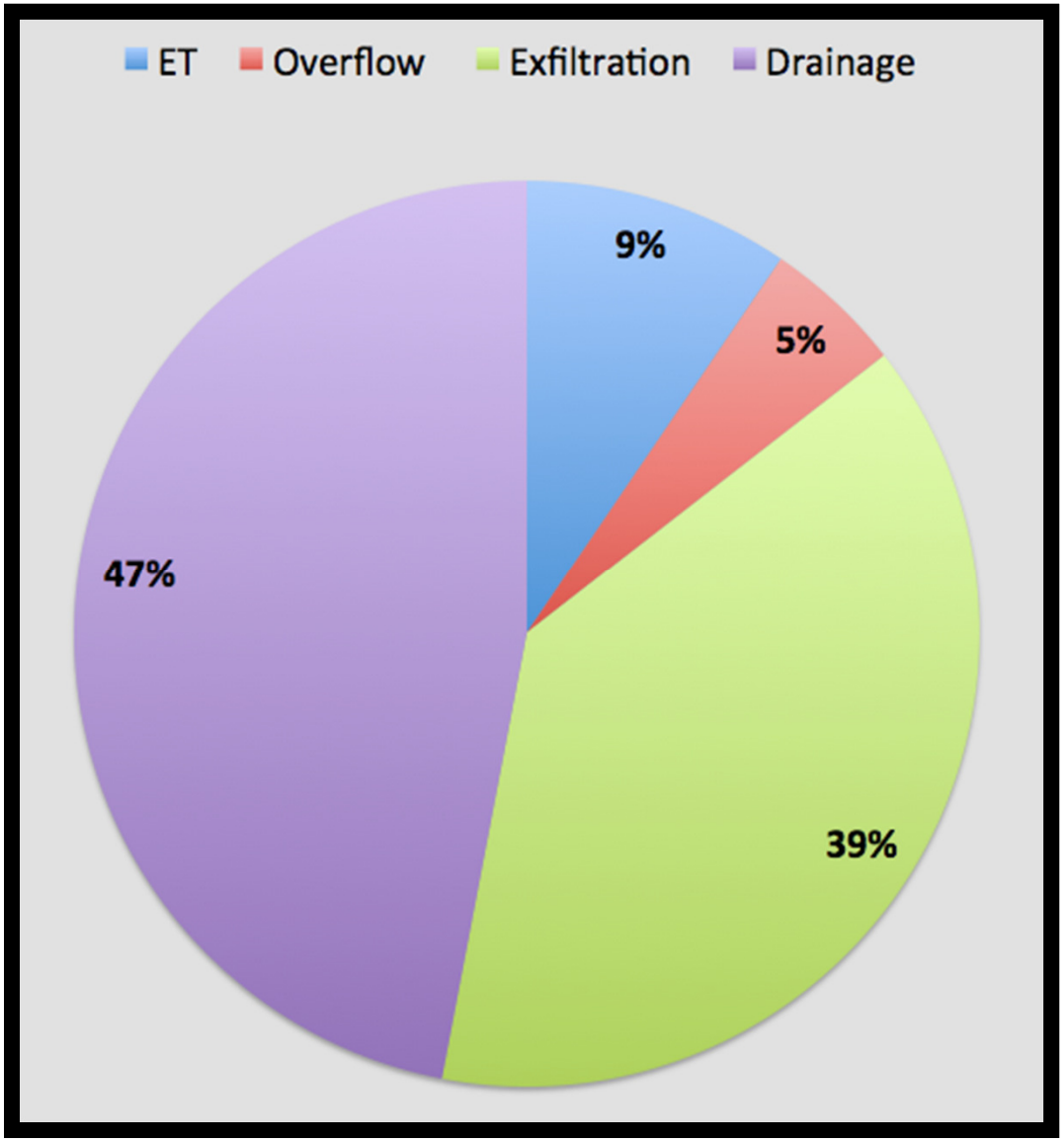
Maximum Subgrade Ksat	0.020	in/hr

HYDROLOGY	Total (in/yr)	Percent of Total
Runoff	419	
ET	40	9%
Overflow	21	5%
Exfiltration	161	39%
Drainage	197	47%

VOLUME REDUCTION	48%
TREATS 90% OF RUNOFF?	YES

WATER QUALITY	Total (lb/ac-yr)	Percent Reduction
Influent Avg Total N	17.2	
Effluent Avg Total N	5.3	69%
Influent Avg Total P	2.0	
Effluent Avg Total P	0.8	60%

HyPer Tool Outputs



HyPer Tool Live Demonstration

Summary and Implications

- HyPer Tool references a database of 432 DRAINMOD simulations for your **convenience**
- Allows for custom analysis and design of bioretention cells using predicted **long-term hydrology and water quality**
- Encourages design standard **paradigm shift – one size does NOT fit all**

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  - CICEET (The Cooperative Institute for Coastal and Estuarine Environmental Technology)
  - N.C. DENR (North Carolina Department of Environment and Natural Resources)

Open Discussion

Vertical Conductivity of Restricting Layer

- Hydrologic Soil Group A
  - Measured exfiltration rates
    - **Rocky Mount Sand Cell = 6 to 9 cm/hr**
  - Sat. Hydraulic Conductivity – Rawls et al. (1998)
    - **Sand = 6.40 cm/hr**
    - **Loamy Sand = 3.05 cm/hr**

- DRAINMOD → 3.0 cm/hr

Vertical Conductivity of Restricting Layer

- Hydrologic Soil Group B
  - Measured exfiltration rates
    - **Rocky Mount SCL Cell = 0.21 to 0.33 cm/hr**
    - **Graham-South = 0.37 cm/hr**
  - Sat. Hydraulic Conductivity – Rawls et al. (1998)
    - **Sandy Loam = 0.51 cm/hr**
    - **Loam = 0.28 cm/hr**

- DRAINMOD → 0.35 cm/hr

Vertical Conductivity of Restricting Layer

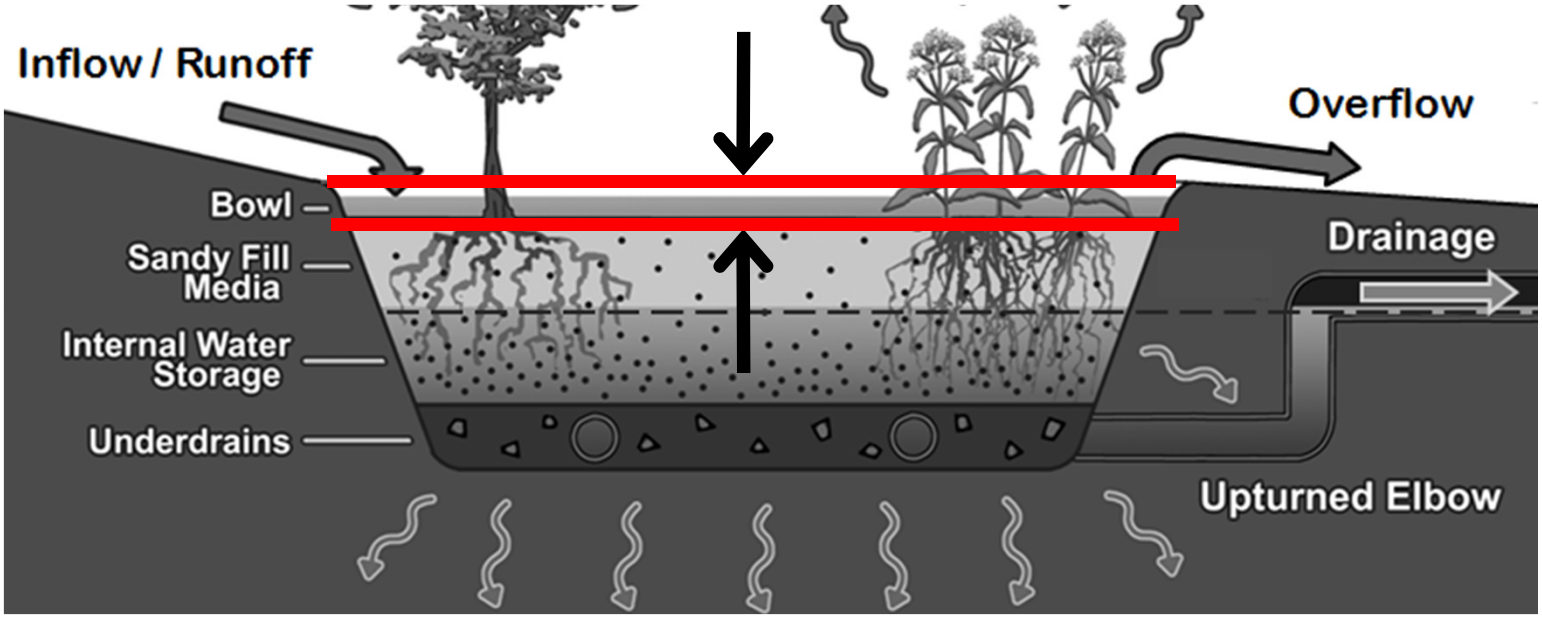
- Hydrologic Soil Group C
  - Measured exfiltration rates
    - **Greensboro-1 = 0.03 to 0.05 cm/hr**
    - **Graham-North = 0.02 cm/hr**
    - **Knightdale-Small = 0.05 to 0.08 cm/hr**
    - **Knightdale-Large = 0.03 to 0.04 cm/hr**
  - Sat. Hydraulic Conductivity – Rawls et al. (1998)
    - **Sandy Clay Loam = 0.10 cm/hr**
    - **Sandy Clay = 0.03 cm/hr**
    - **Clay Loam = 0.02 cm/hr**
- DRAINMOD → 0.05 cm/hr

Vertical Conductivity of Restricting Layer

- Hydrologic Soil Group D
  - Measured exfiltration rates (**None)**
  - Sat. Hydraulic Conductivity – Rawls et al. (1998)
    - **Clay = 0.03**
  - *Seemed high for Triassic Basin soil in central NC, so I reduced HSG C by an order of mag.*
- DRAINMOD → 0.005 cm/hr
  - Shuster et al. (2007)
    - Measured Ksat 0.01 cm/hr for Eden soil (HSG D)
    - *J. of Soil & Water Cons.* "Prospects for Enhanced Groundwater Recharge via Infiltration of Urban Storm Water Runoff: A Case Study"

Surface Storage Depth

- Based on NC regulations
  - **23 cm (9 in) or 30 cm (12 in)**



Drainage Configuration

- Drain Spacing = 4.5 m (15 ft)
- Drain Diameter = 15 cm (6 in)
  - Effective drain radius = 7.5 cm (3 in)
    - = to actual radius b/c gravel surrounding drain pipe
- Drains are placed in 20 cm (8 in) of gravel which is below 10 cm (4 in) of sand

Drainage Configuration

- Conventional Drainage or IWS Zone
  - Drainage Coefficient (cm/day)
    - Unrestricted drainage network = 60 cm/day
      - All conventional drainage & some IWS zone simulations
    - Restricted drainage network = 20 or 40 cm/day
      - IWS reduces hydraulic gradient on outlet
      - Data collected at Knightdale bioretention cells Luell's (2011) thesis confirmed this
        - » Max. drainage rate from 2 cells → 15 & 21 cm/day
  - IWS depth from surface of media
    - HSG: A & B – 30 cm (12 in)
    - HSG: C & D – 45 cm (18 in)
      - Slower exfiltration, so we made the outlet deeper

Media Depth

- HSG A
  - 0.6-m & 0.9-m (2-ft & 3-ft)
- HSG B
  - 0.9-m & 1.2-m (3-ft & 4-ft)
- HSG C
  - 0.9-m & 1.2-m (3-ft & 4-ft)
- HSG D
  - 0.9-m, 1.2-m, & 1.5-m (3-ft, 4-ft, & 5-ft)