You Sank My Nitrogen!

NEMO's Quest For Coastal Watershed Protection and Restoration

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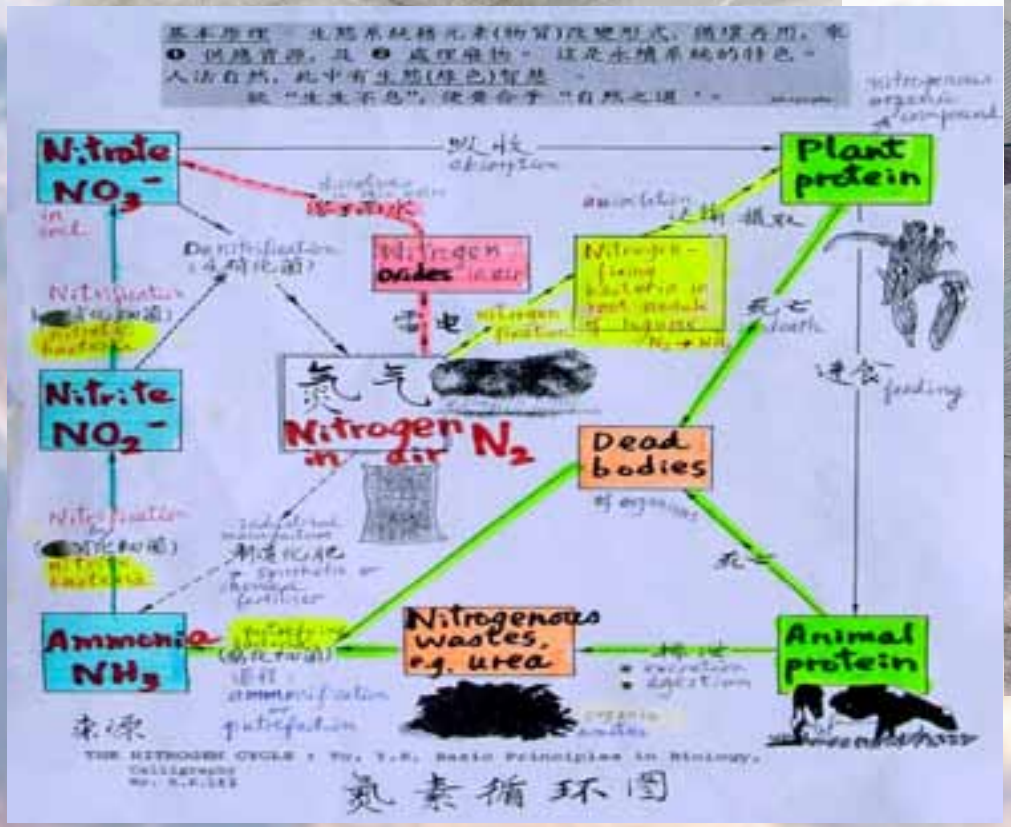
NATIONAL Water Program

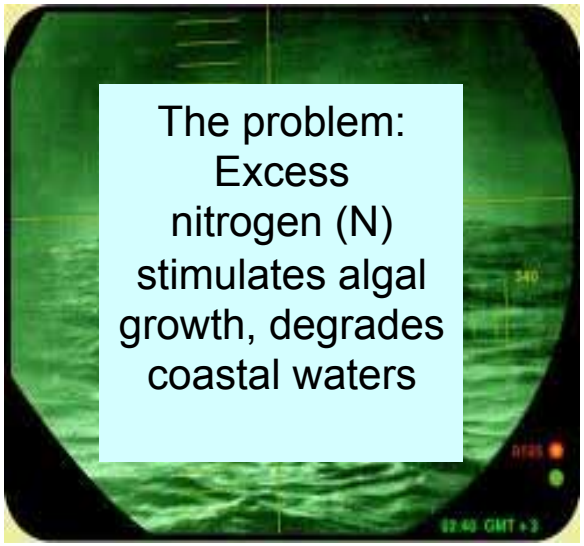
THE UNIVERSITY OF RHODE ISLAND

ASU ARIZONA STATE UNIVERSITY

University of Connecticut

Can NEMO Crack the Nitrate Code?



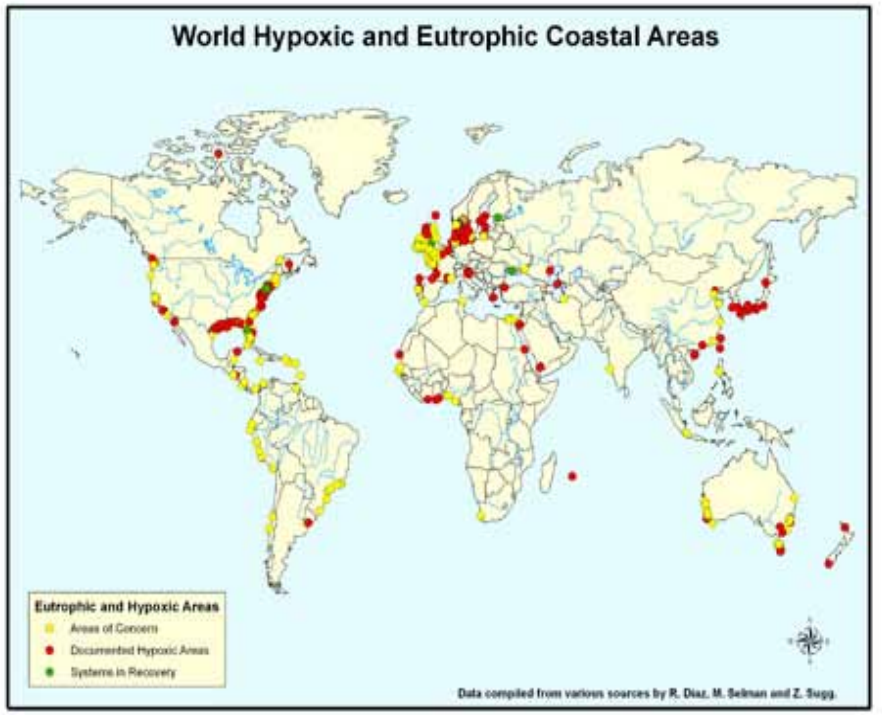


Degraded eelgrass

Nuisance seaweed replaces eelgrass

Greenwich Bay, RI 2006

Dead zones with low oxygen generate fish kills which is a global problem



Local Watersheds Generate High N Loading

1 acre impervious Cover
(Atmospheric Deposition)

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10 dogs

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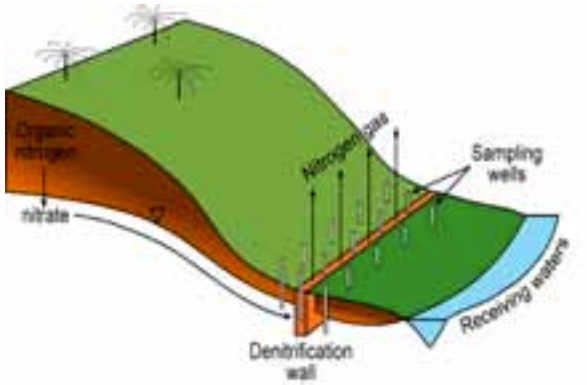
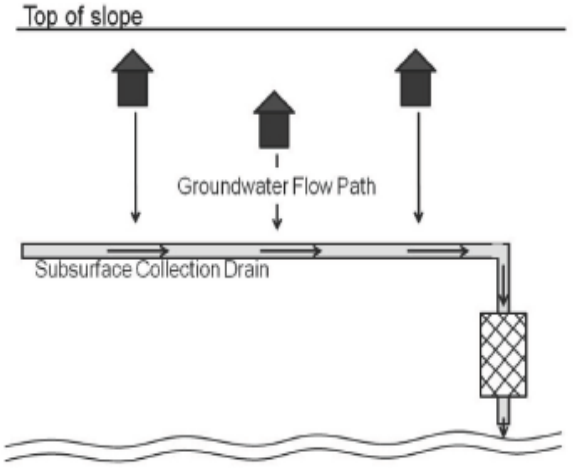
1 home

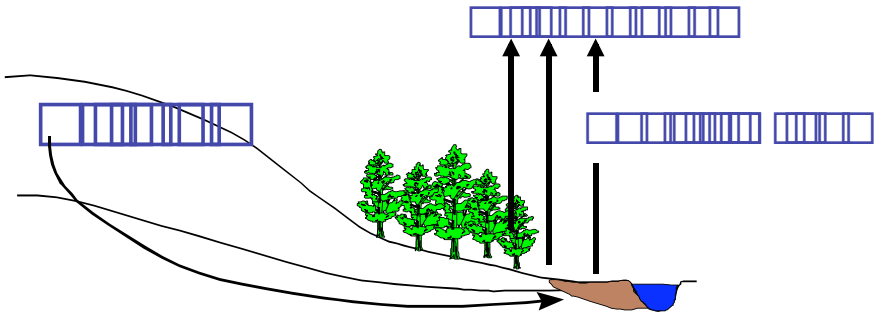
Where to target investments in source controls?





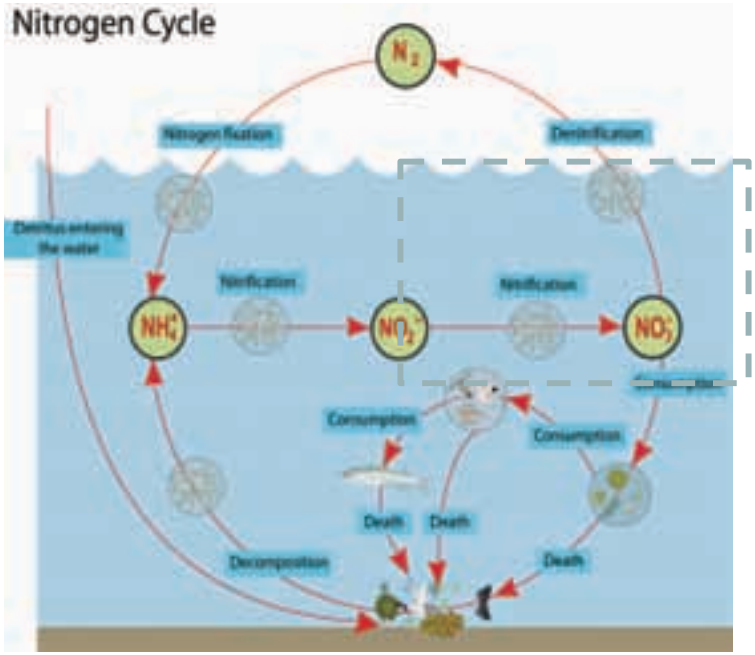
(*Adapted from Gold et al., 1990; Jemison and Fox, 1994; Howarth et al., 2000; Bernhardt, et al., 2008; Ohio State Extension*)

N Removal can occur through denitrification within "hotspots", i.e., localized watershed sinks



Riparian buffers

Lakes and Ponds



Headwater Streams: Hyporheic Zone

Challenges & THE Quest

Can we use our research, spatial data and GIS tools to guide <u>local management</u> of watershed N:

- Where to target source controls?
  - Alternative septic systems
  - Storm water bioreactors

Where to protect and restore?

- Informed restoration of stream buffers
- Prioritize protection (Conservancies)
- Enhance regulations

Mission Objective

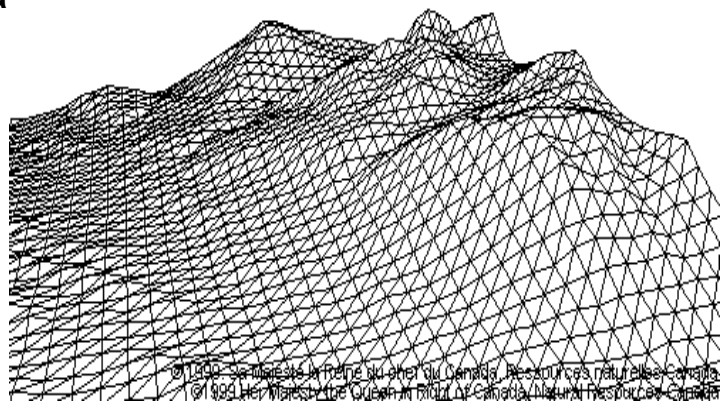
Assist local communities to enhance watershed health and reduce N export using a model based on:

- Widely available geospatial data
- Current findings from peer reviewed literature
- USGS stream gauging data
- Locally based data on selected stream attributes
- Best professional judgment

Tricks and Tools:

Widely available high resolution data

- SSURGO county scale digital soil surveys (1:24,000)
  - Soil wetness (hydric riparian soils)
  - Geomorphology
- Land use
  - 1995 Anderson Level III (1:24,000)
- USGS discharge estimates
  - Normalized by catchment area (discharge/a
- Digital topography & hydrography (1:24,000)
  - Watershed & recharge boundaries
  - Stream network

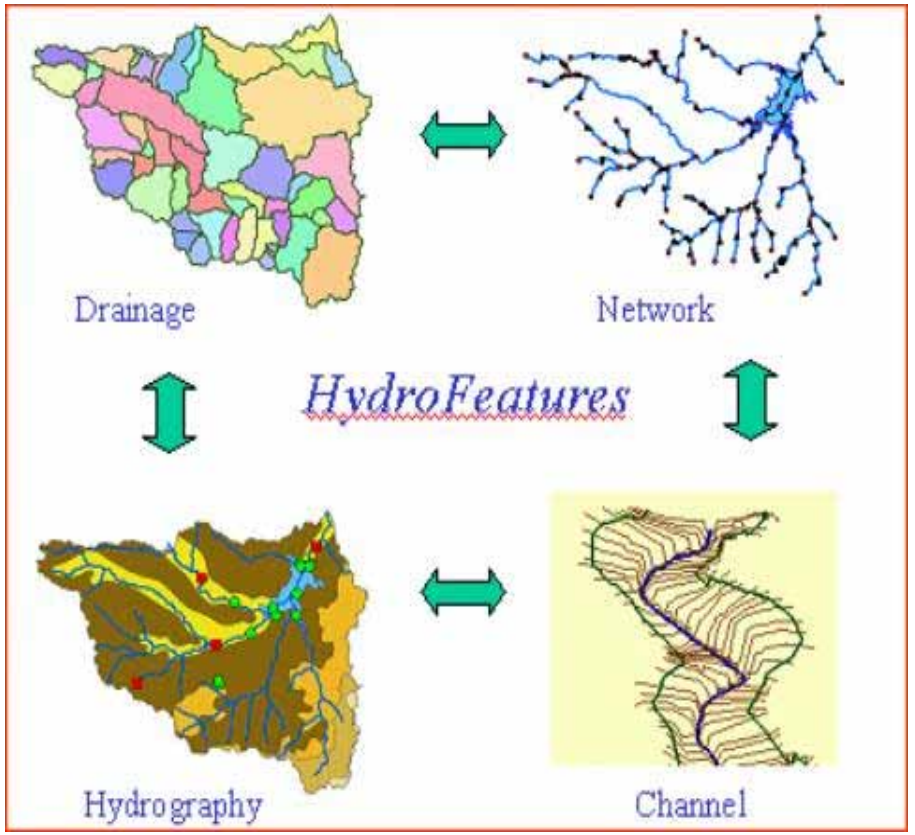


Flowpath Processing: ArcHydro

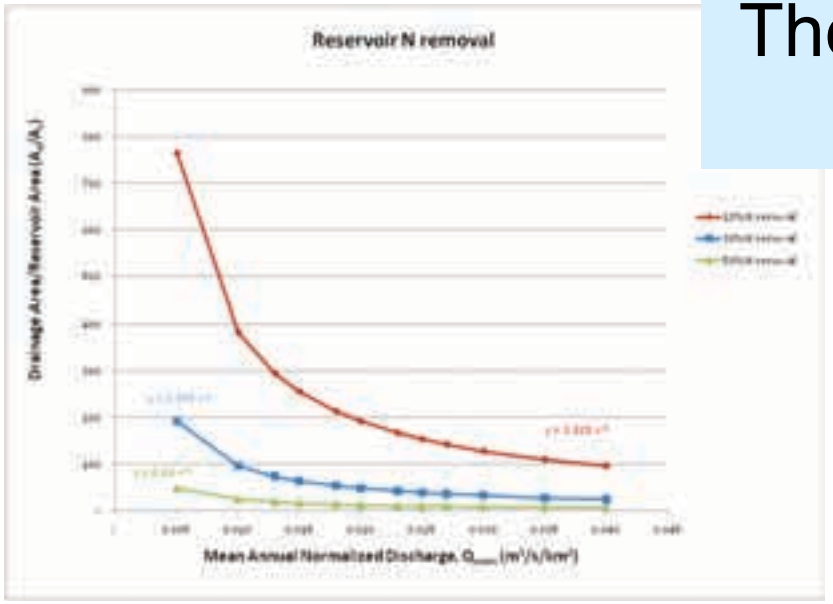
Flow direction & accumulation grids
based on digital elevation models (DEMs)

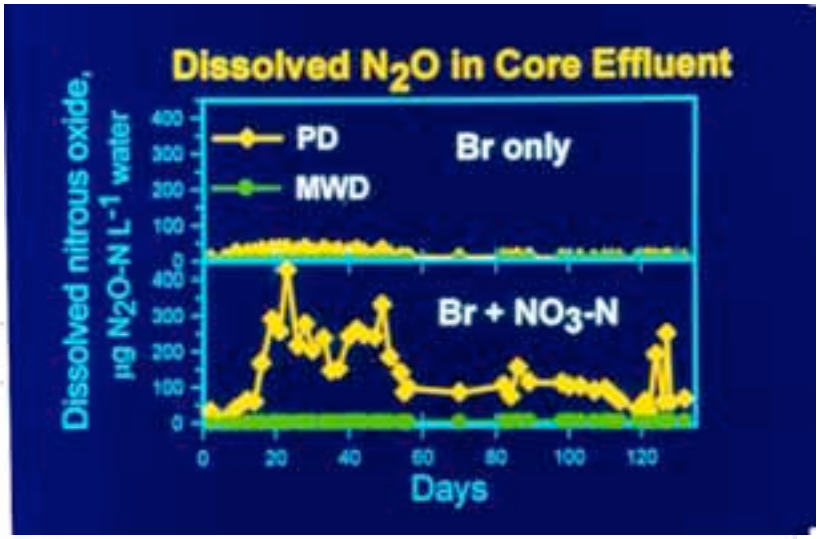
Allows:

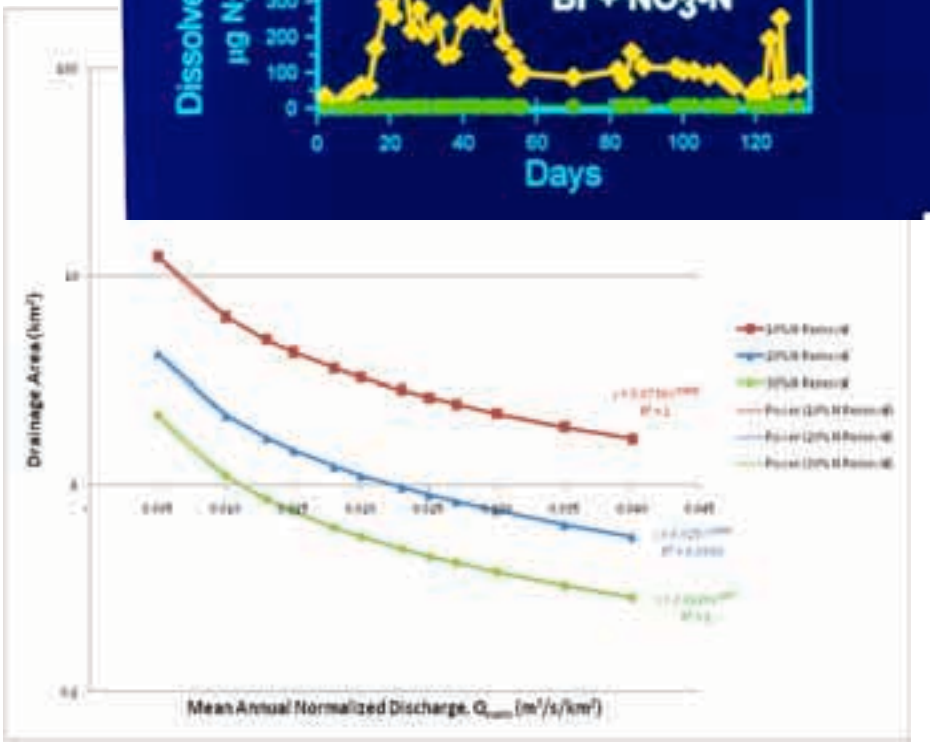
- particle tracking from any source to outlet
- auto-delineation of subcatchment for any point in defined outlet
- (i.e., drainage point)



The *Science* behind those ever elusive N sinks







From Alexander et al. (2007),

N Removal (%) = $1 - \exp(-\theta_{S1} * D^{\theta S2} * T))*100$

where,

θ_{S1} = 0.0513 [m^{-1} d^{-1}]

θ_{S2} = -1.319

D = stream depth (m)

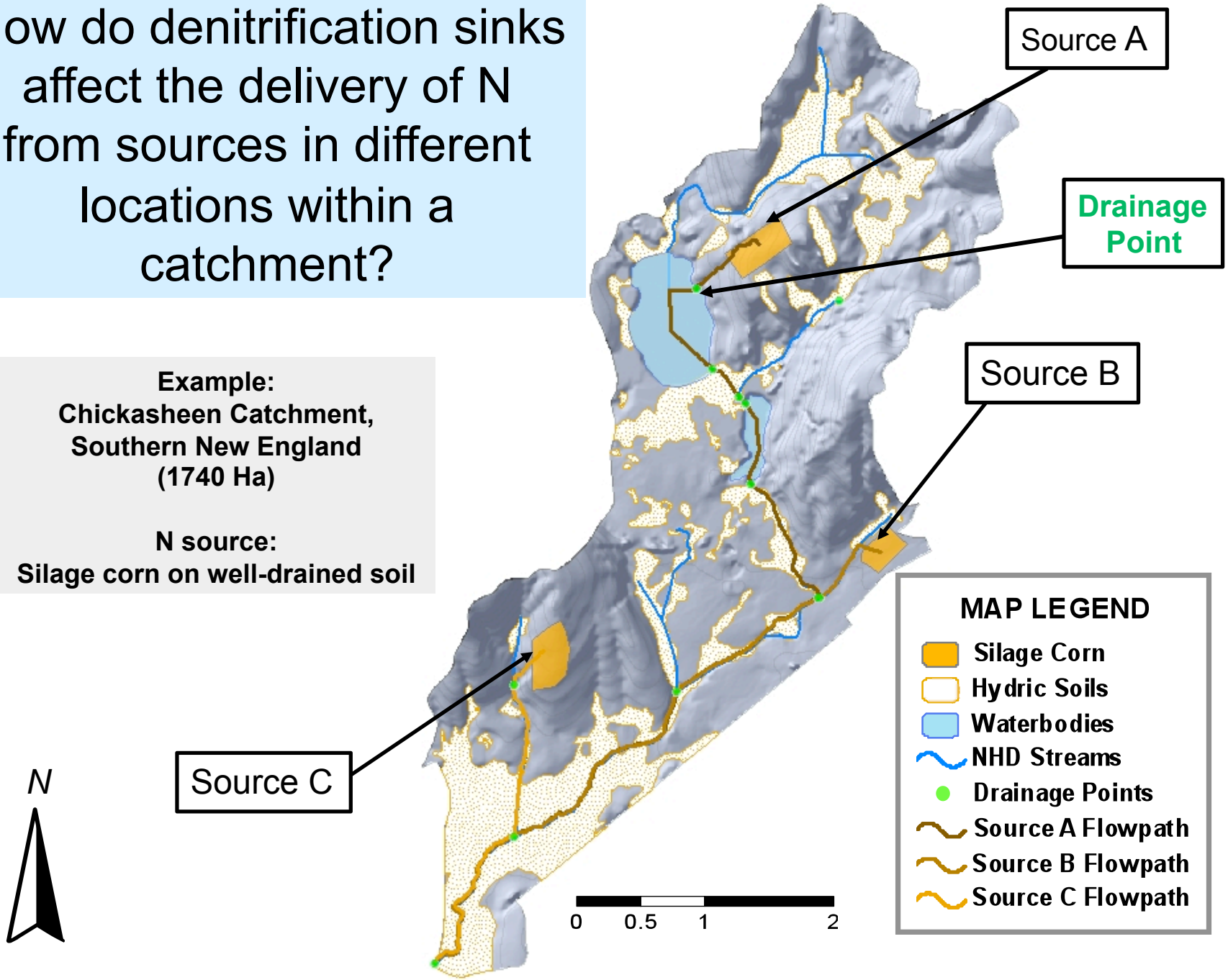
T = time of travel (d) = retention time in reach

[illegible]

How do denitrification sinks affect the delivery of N from sources in different locations within a catchment?

Example:
Chickasheen Catchment,
Southern New England
(1740 Ha)

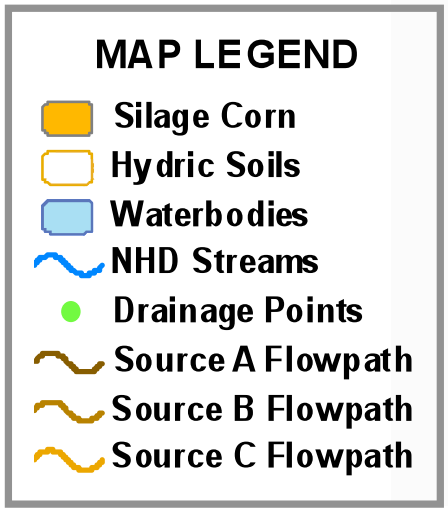
N source:
Silage corn on well-drained soil

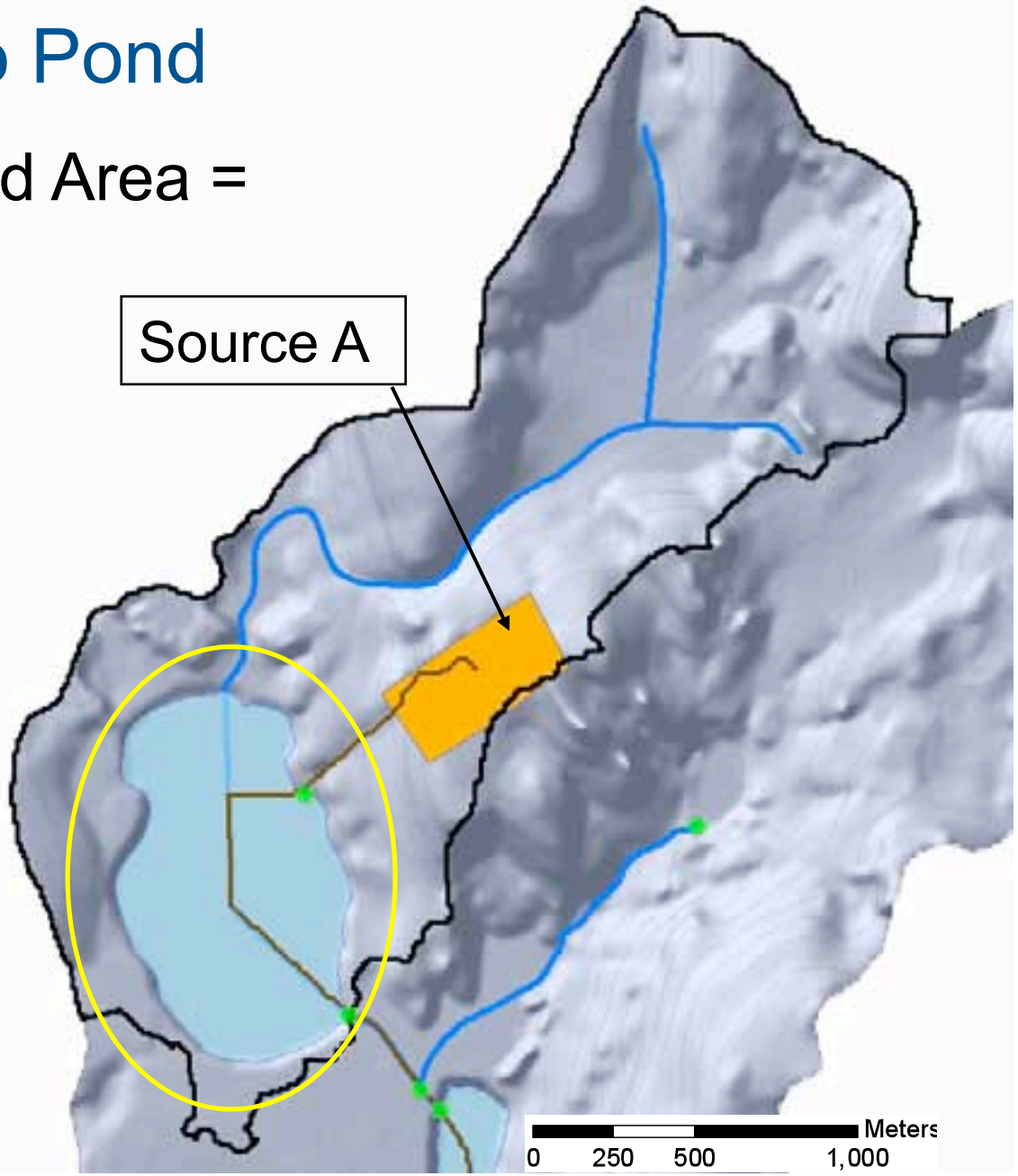


Example: Yawgoo Pond

Drainage Area/Pond Area = 6.3

N retention in pond = 68% of N entering pond

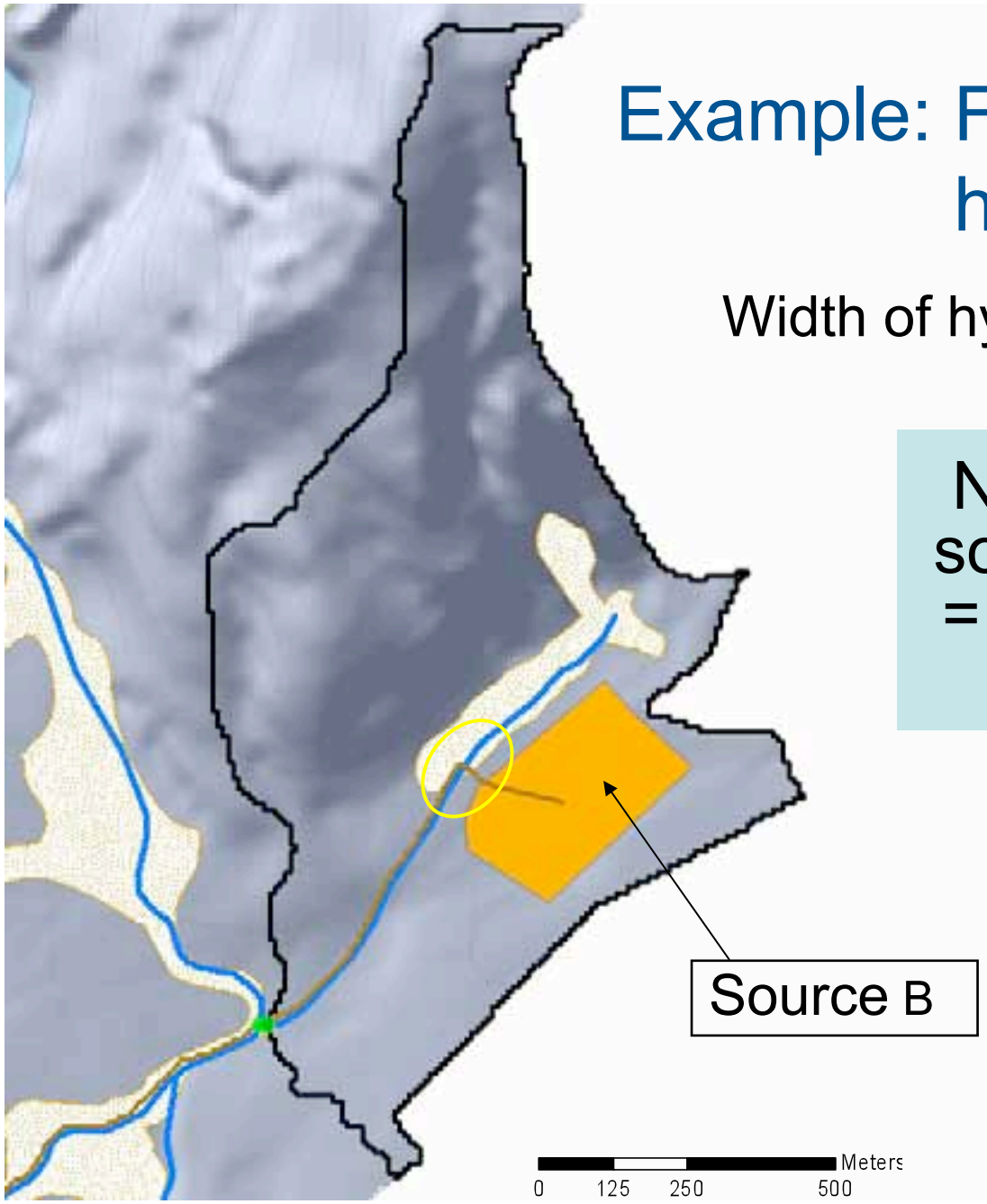




Example: Flow path crosses hydric riparian zone

Width of hydric soils in riparian zone = 12 m

N removal in hydric soils in riparian zone = 40% of N entering riparian zone

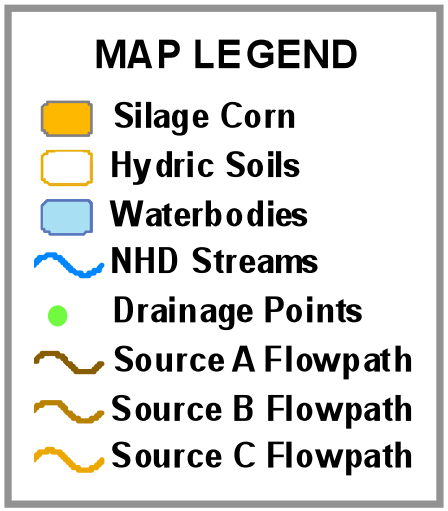


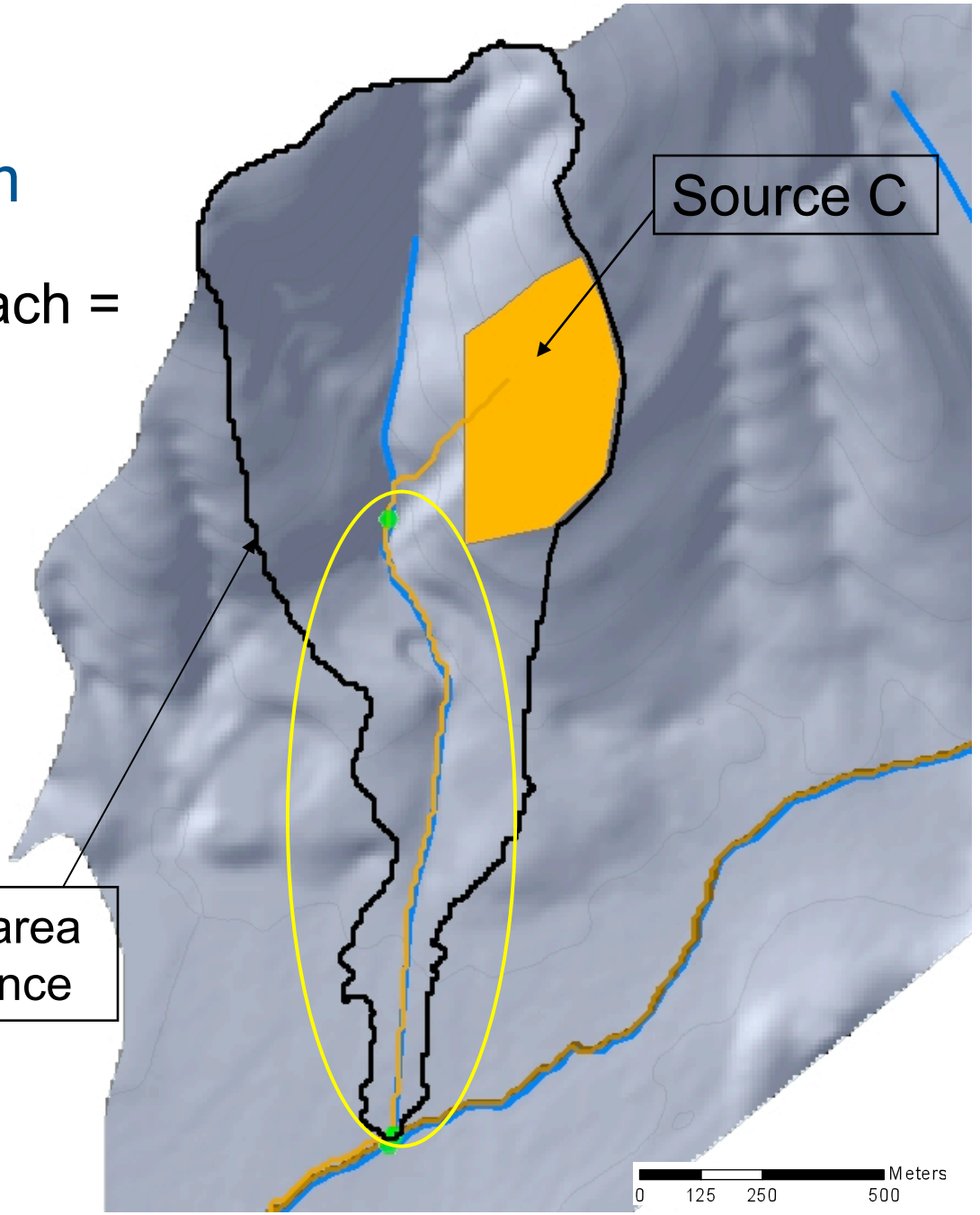
Example: Flow path along first order stream

Time of travel in stream reach = 3.3 hrs (0.14 days)

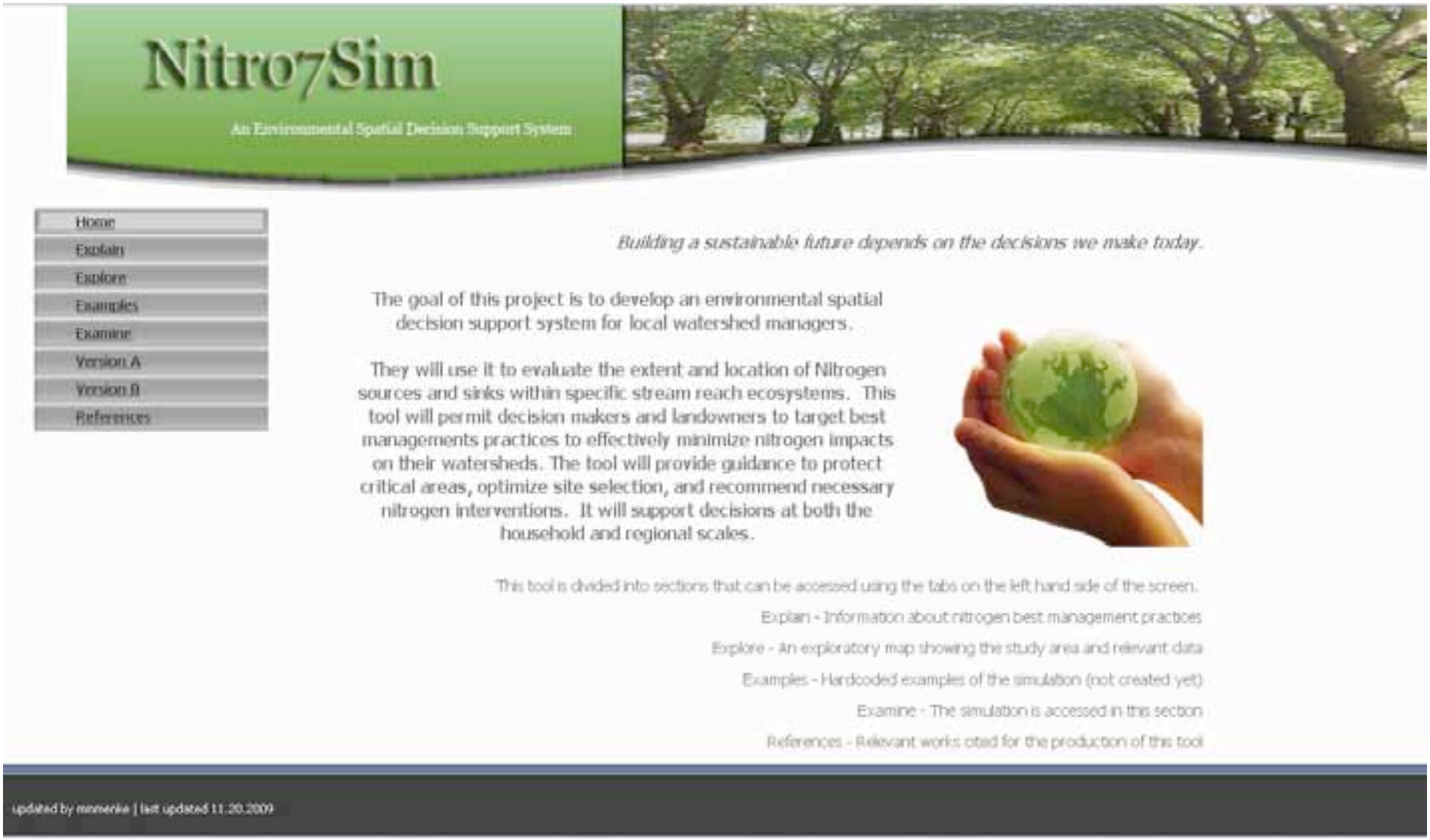
Depth: 0.1 m

N removed in stream reach = 17% of N entering at top of reach





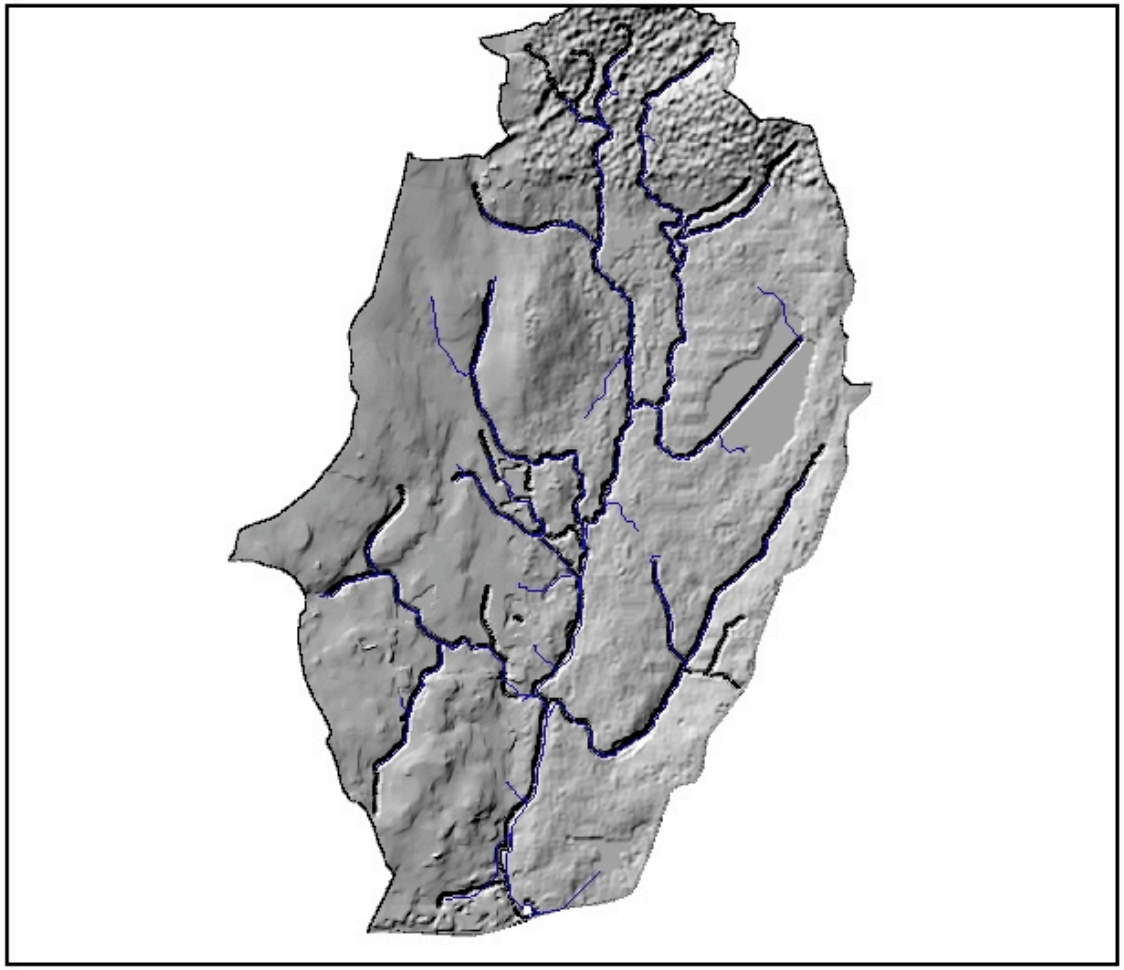
YOUR Portal to the World of N Sinks



Nitro7Sim

Version A

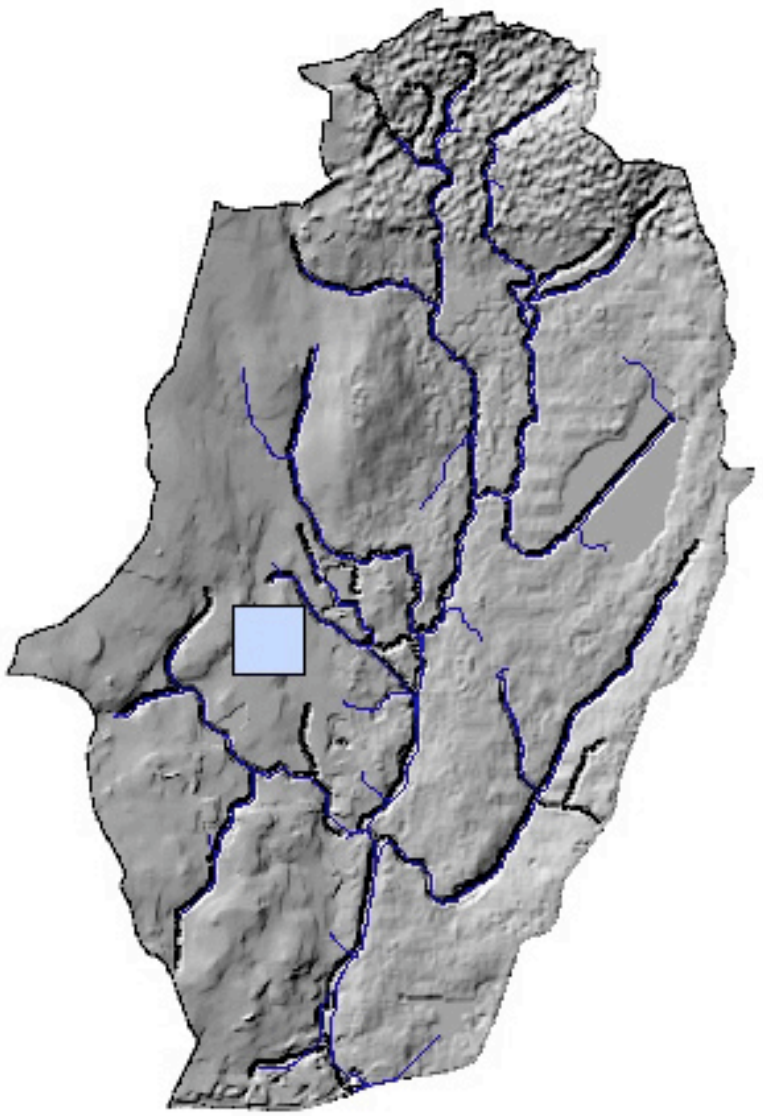
1. Enter Development size: 100 Acres
2. Select Development Type: Medium Density Residential
3. Select Development Location using image below (click on image):



Version A: Locating your target

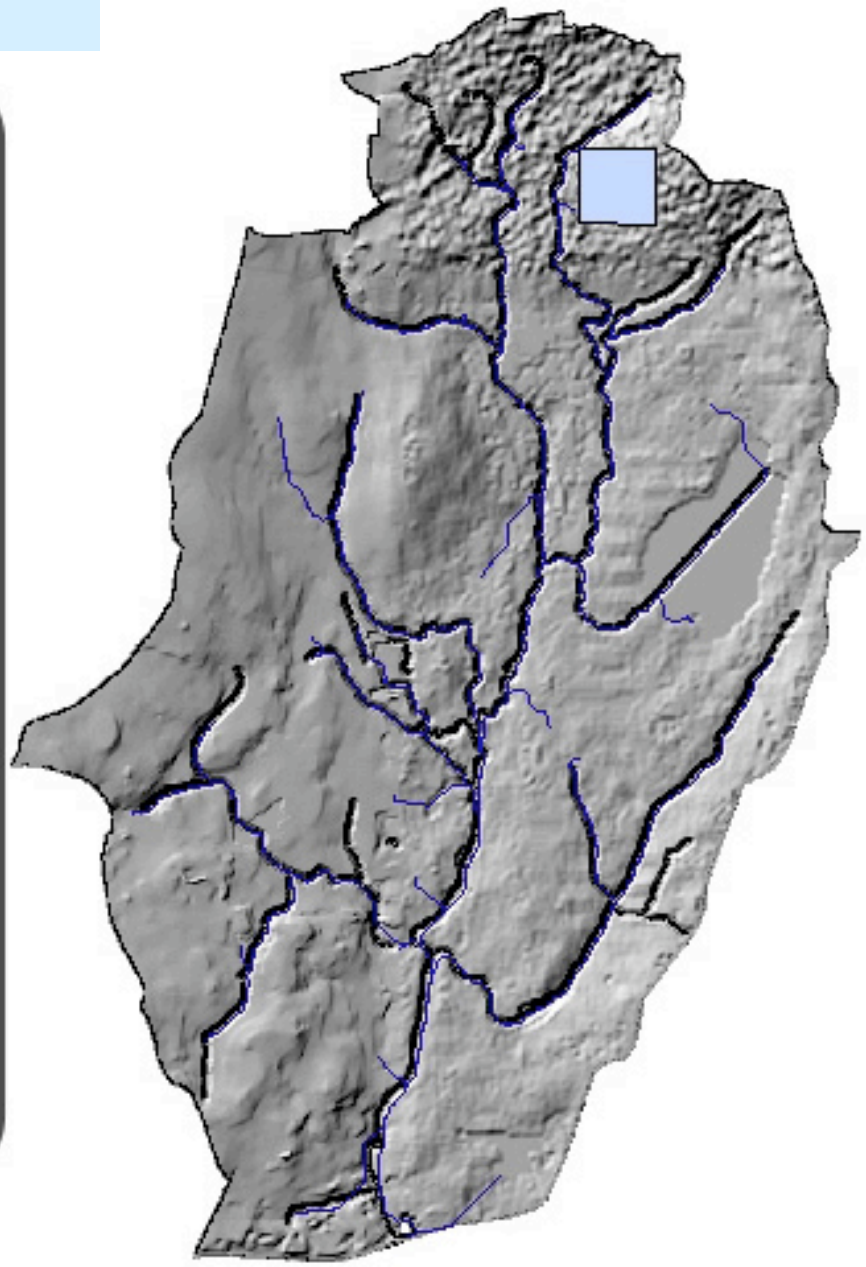
Version A: Target Details

Development Size:	100 acres
Development Type:	Med. Dens. Residential
Nitrogen Load at Development:	4170 lb/yr
Nitrogen load at end of system (sensitive areas):	3915 lb/yr
Nitrogen Impact Rating:	Medium

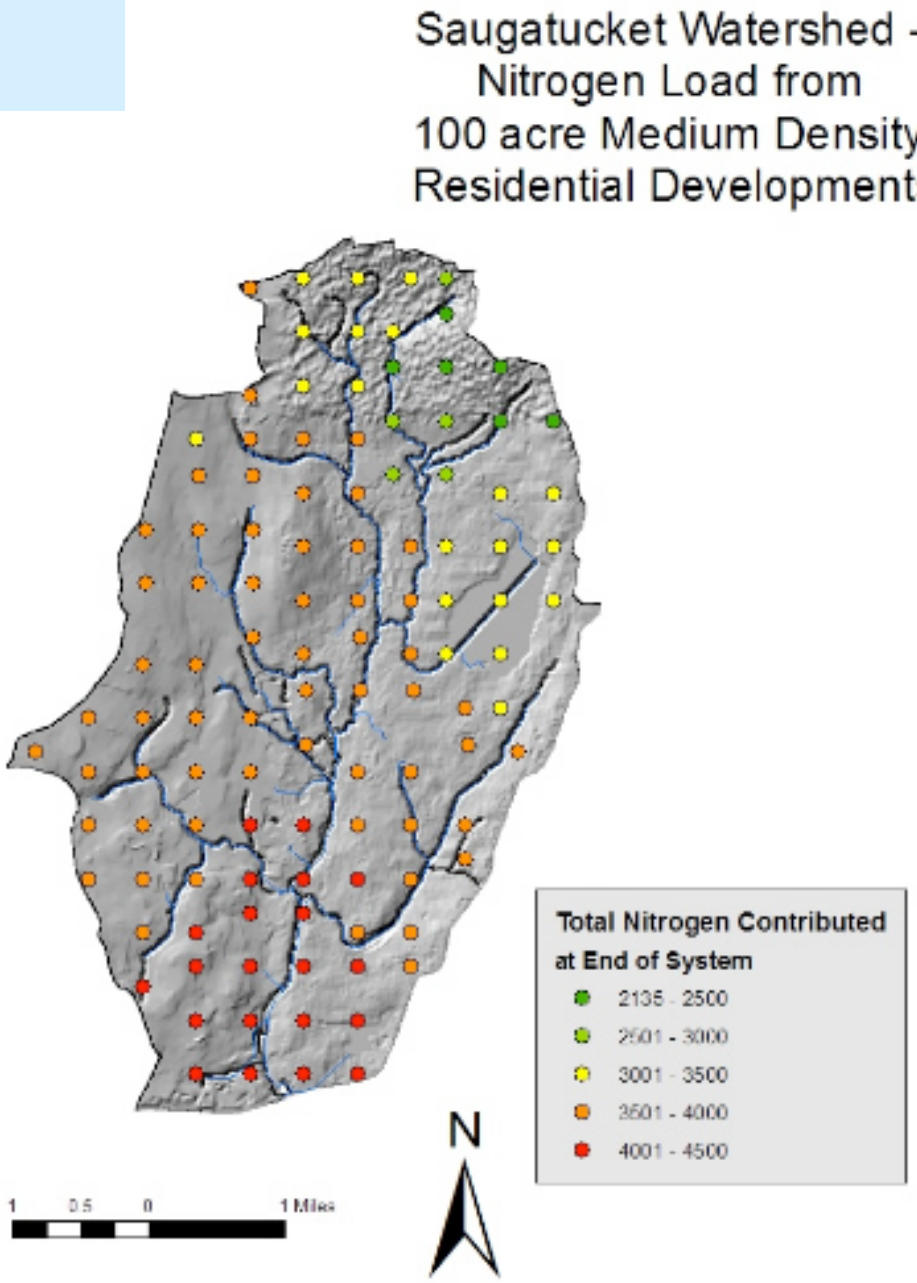


Version A: Alternate Target Details
-fewer casualties expected

Development Size:	100 acres
Development Type:	Med. Dens. Residential
Nitrogen Load at Development:	4170 lb/yr
Nitrogen load at end of system (sensitive areas):	2224 lb/yr
Nitrogen Impact Rating:	Low

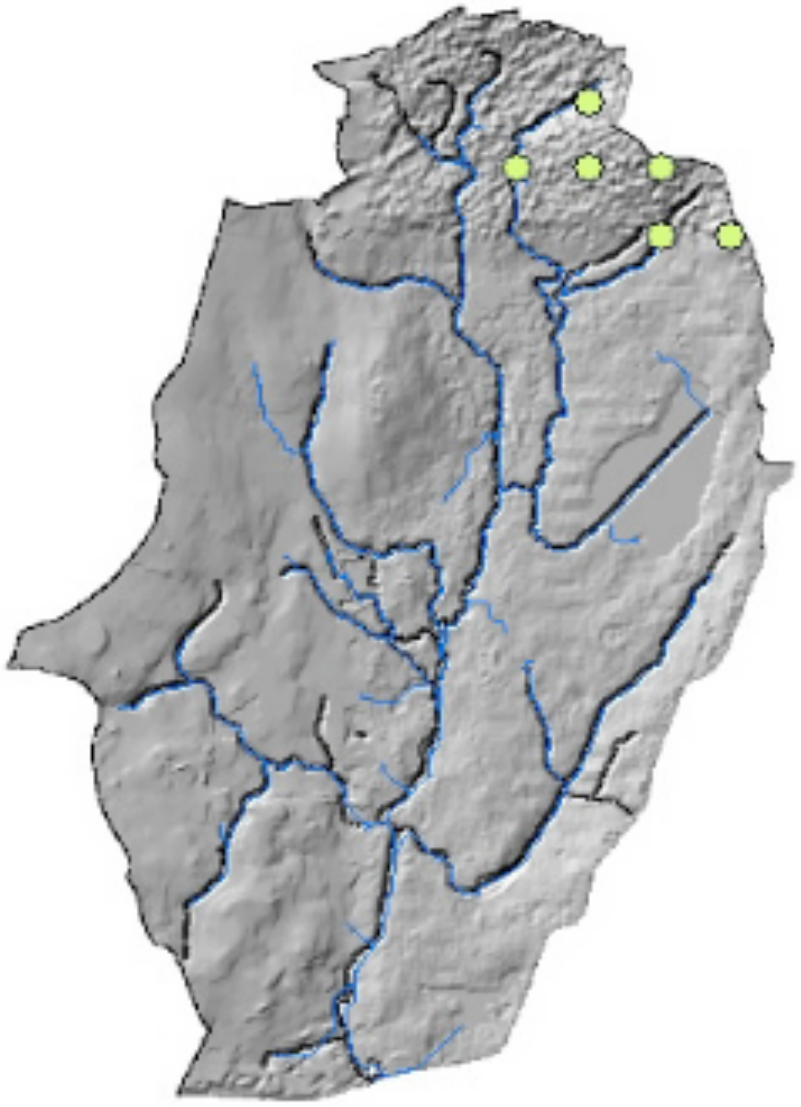


Version B:
The overall scenario



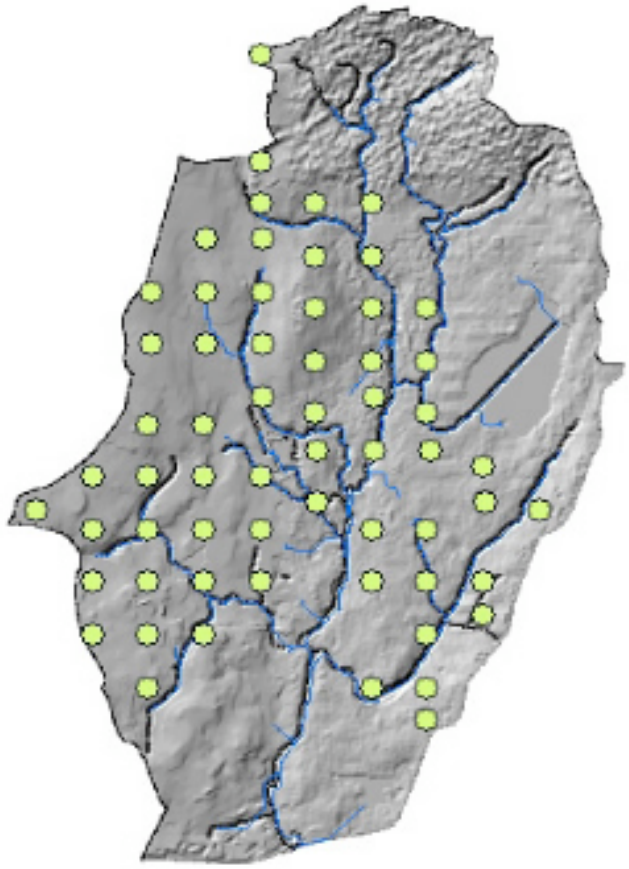
Version B: Target Details

Development Size:	100 acres
Development Type:	Medium Dens. Res.
Nitrogen Load at Development:	4170 lb/yr
Nitrogen load at end of system (sensitive areas):	2001-2500 lb/yr
Nitrogen Impact Rating:	Low



Version B: Alternate Target Details

Development Size:	100 acres
Development Type:	Medium Dens. Res.
Nitrogen Load at Development:	4170 lb/yr
Nitrogen load at end of system (sensitive areas):	3501-4000 lb/yr
Nitrogen Impact Rating:	Medium



Mission not quite complete.
Next Steps: Nitro7Sim & the Sink Quest

- Map and Show Importance of Natural Sinks
- Develop hotlinks with information on each sink and source area
- Test Usability and Usefulness of System with NEMO (will you be an associate in cracking the N code?!) and NRCS
- Provide access and links to national databases