

Narbrook Park

Hydrology and Sustainable Stormwater



Altje Hoekstra, LEED AP



The Hydrologic Cycle

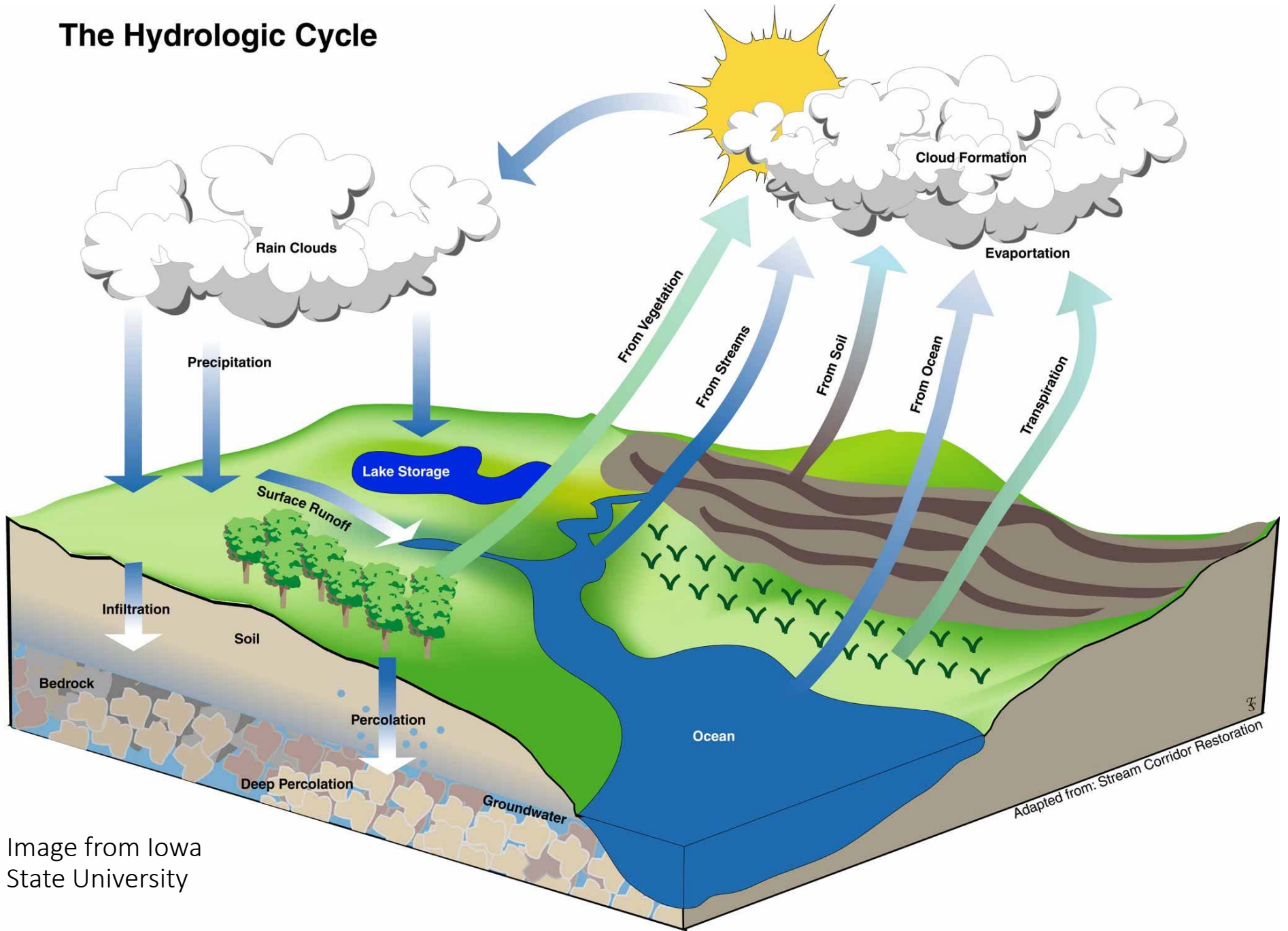


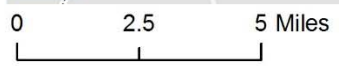
Image from Iowa State University

Adapted from: Stream Corridor Restoration



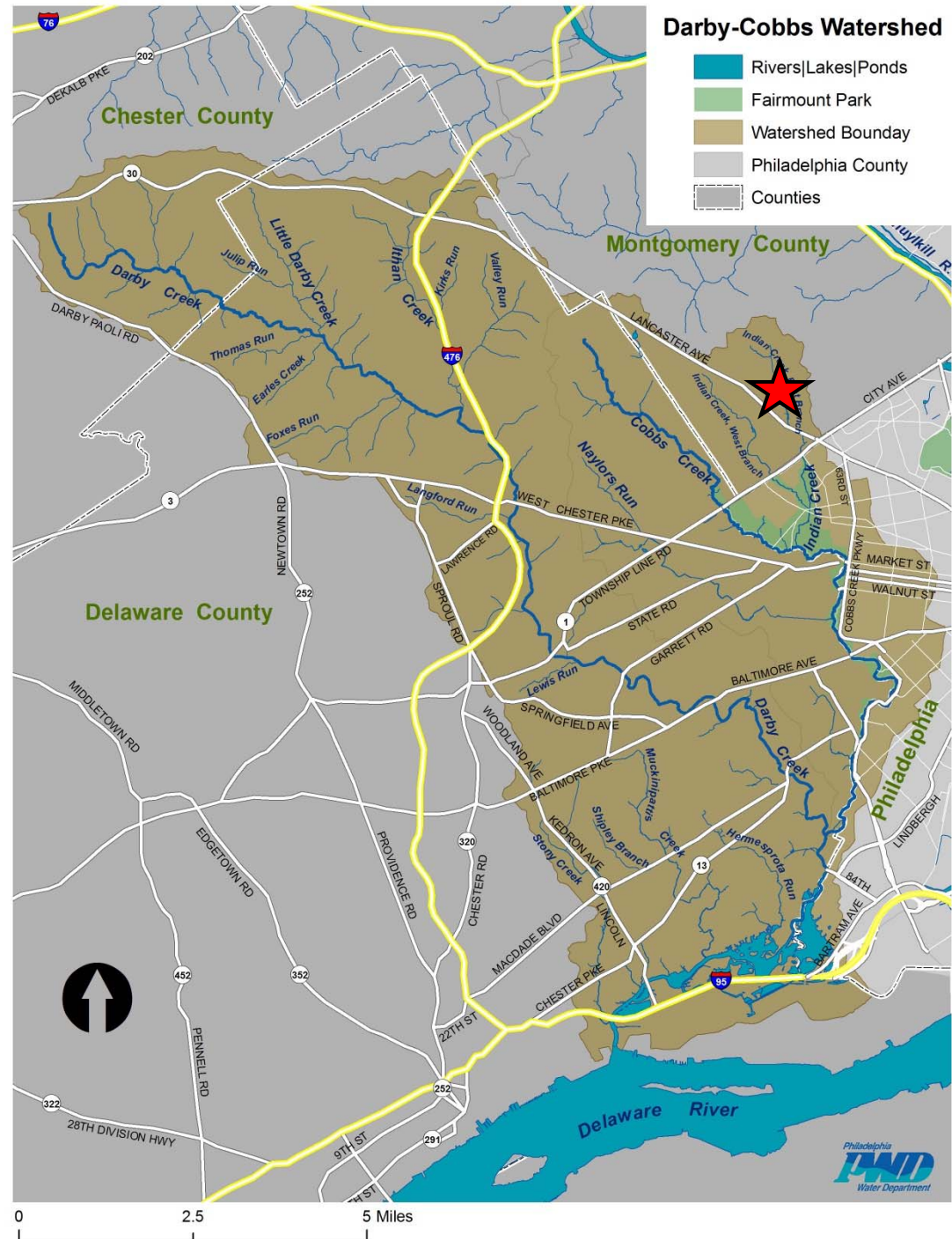
Philadelphia Area Major Watersheds

- Darby-Cobbs
- Delaware Direct
- Schuylkill River
- Pennypack Creek
- Poquessing Creek
- Tookany-Tacony/Frankford Creek
- Wissahickon Creek



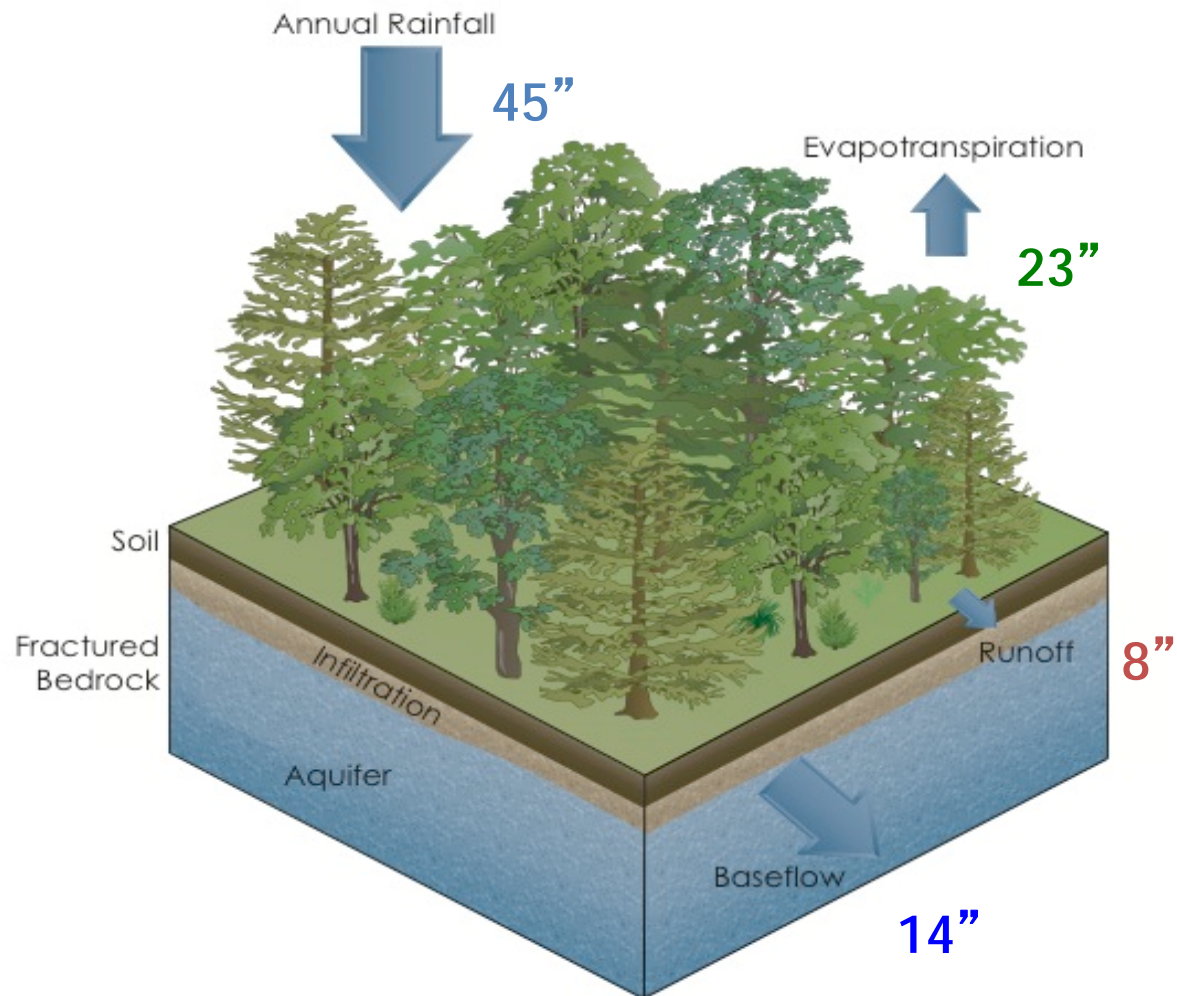
Narbrook Watershed

- Indian Creek East Branch
- Cobbs Creek
- Delaware River



Hydrology

Natural Conditions



Hydrology

Natural Conditions

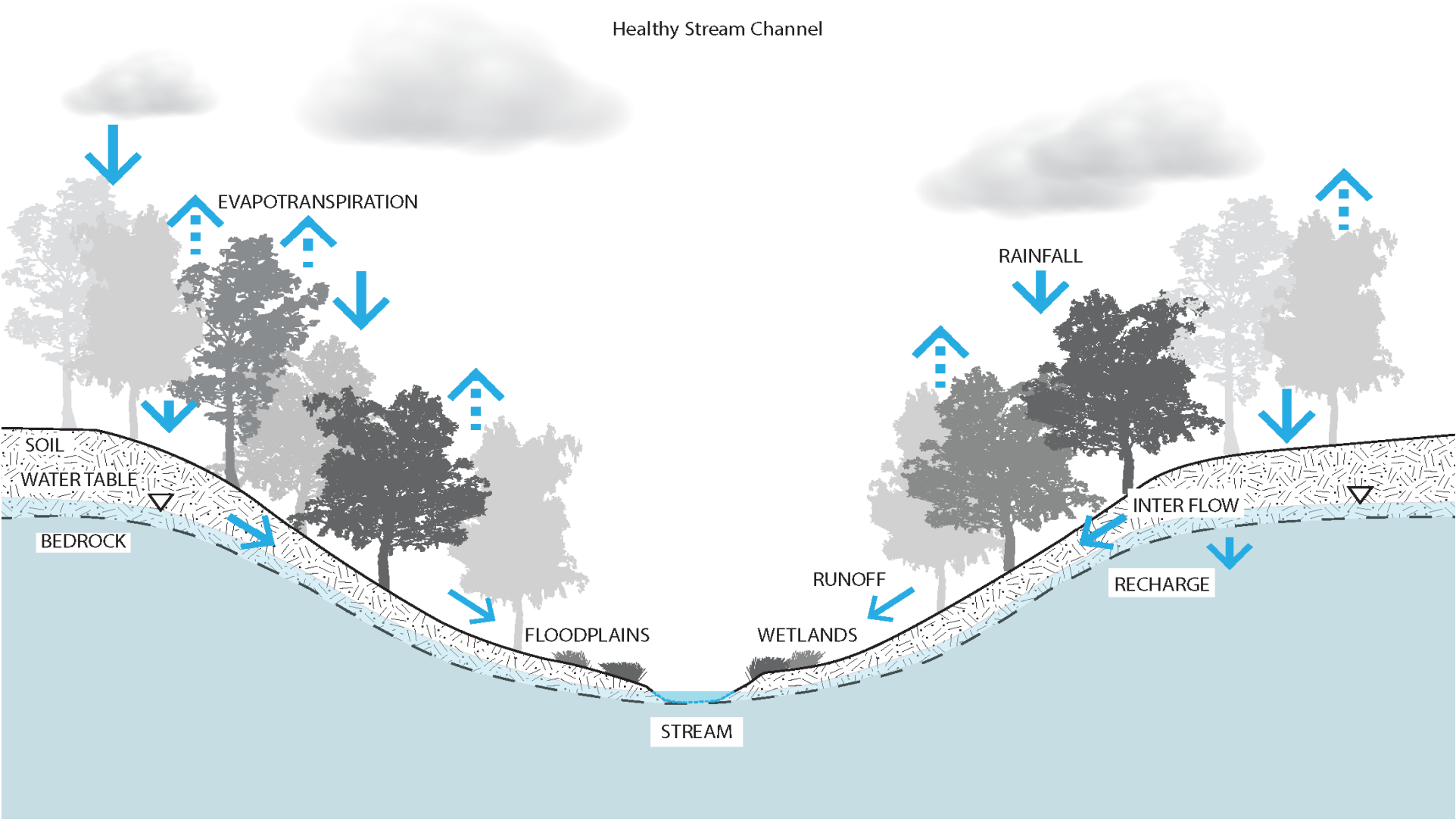


About 1.5 inches of rain has to fall before any runoff begins in a healthy forest.

Hydrology

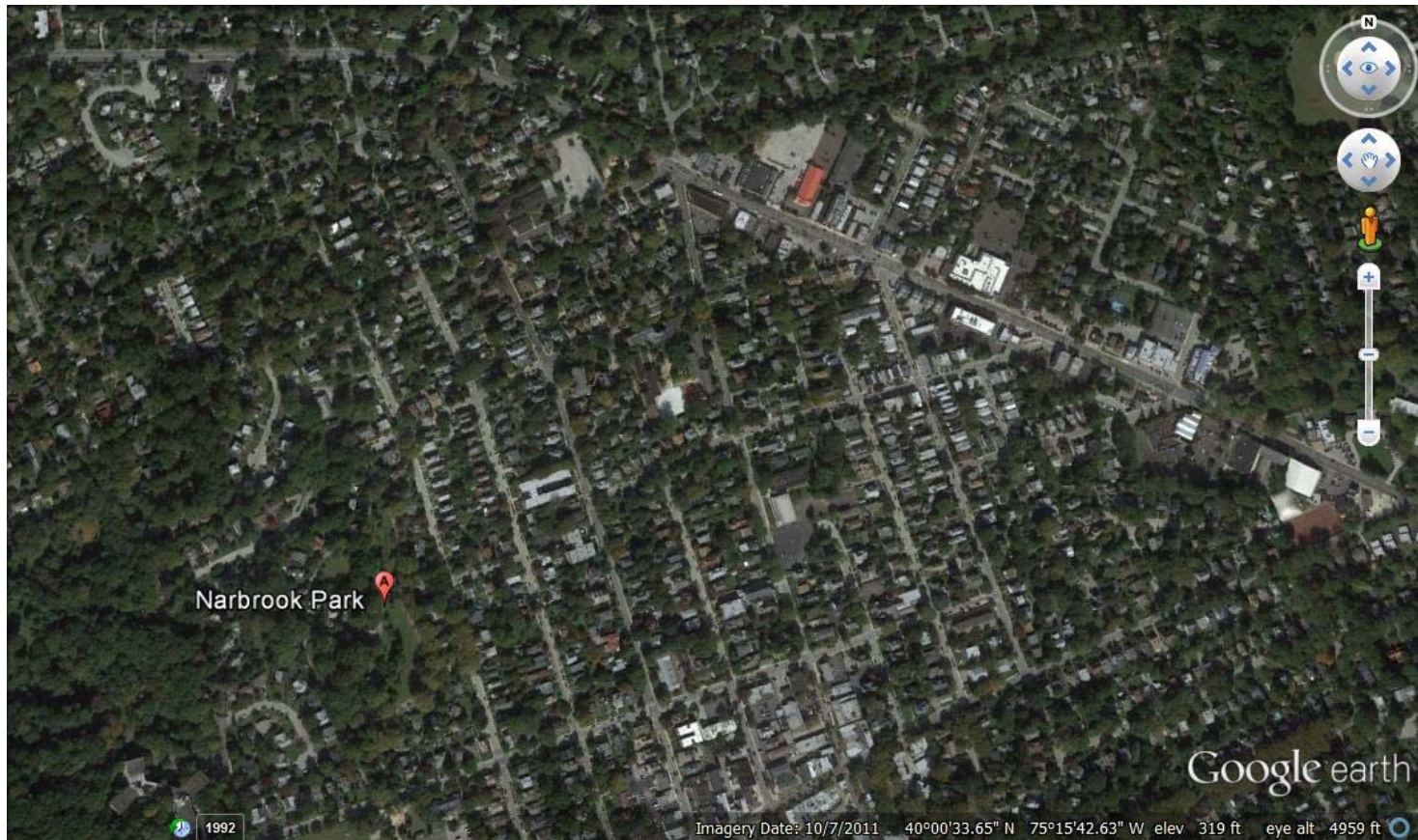
Natural Conditions

Healthy Stream Channel



Hydrology

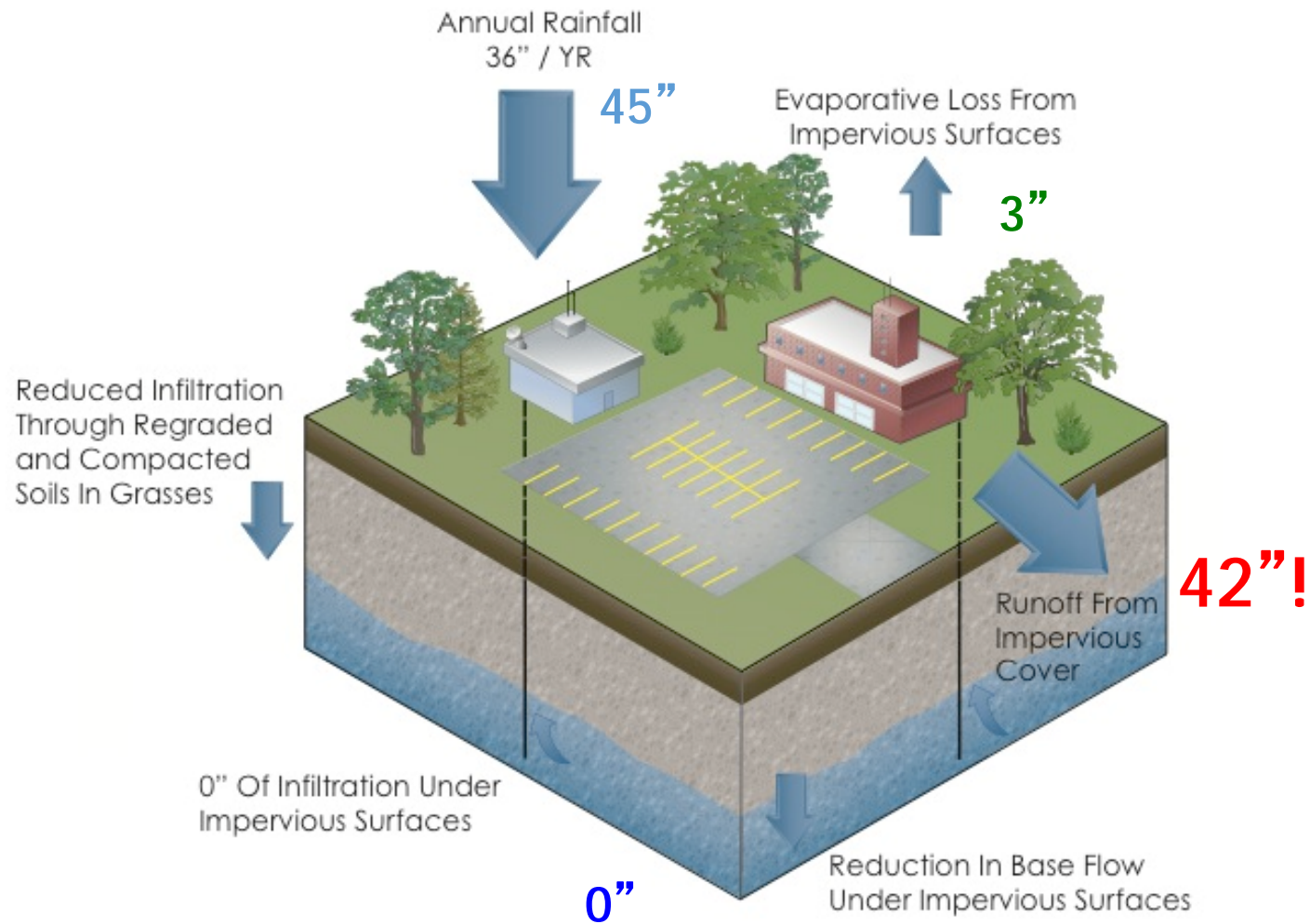
Developed Conditions



Stormwater runoff increases when hardscape (buildings and pavement) are developed.

Hydrology

Developed Conditions



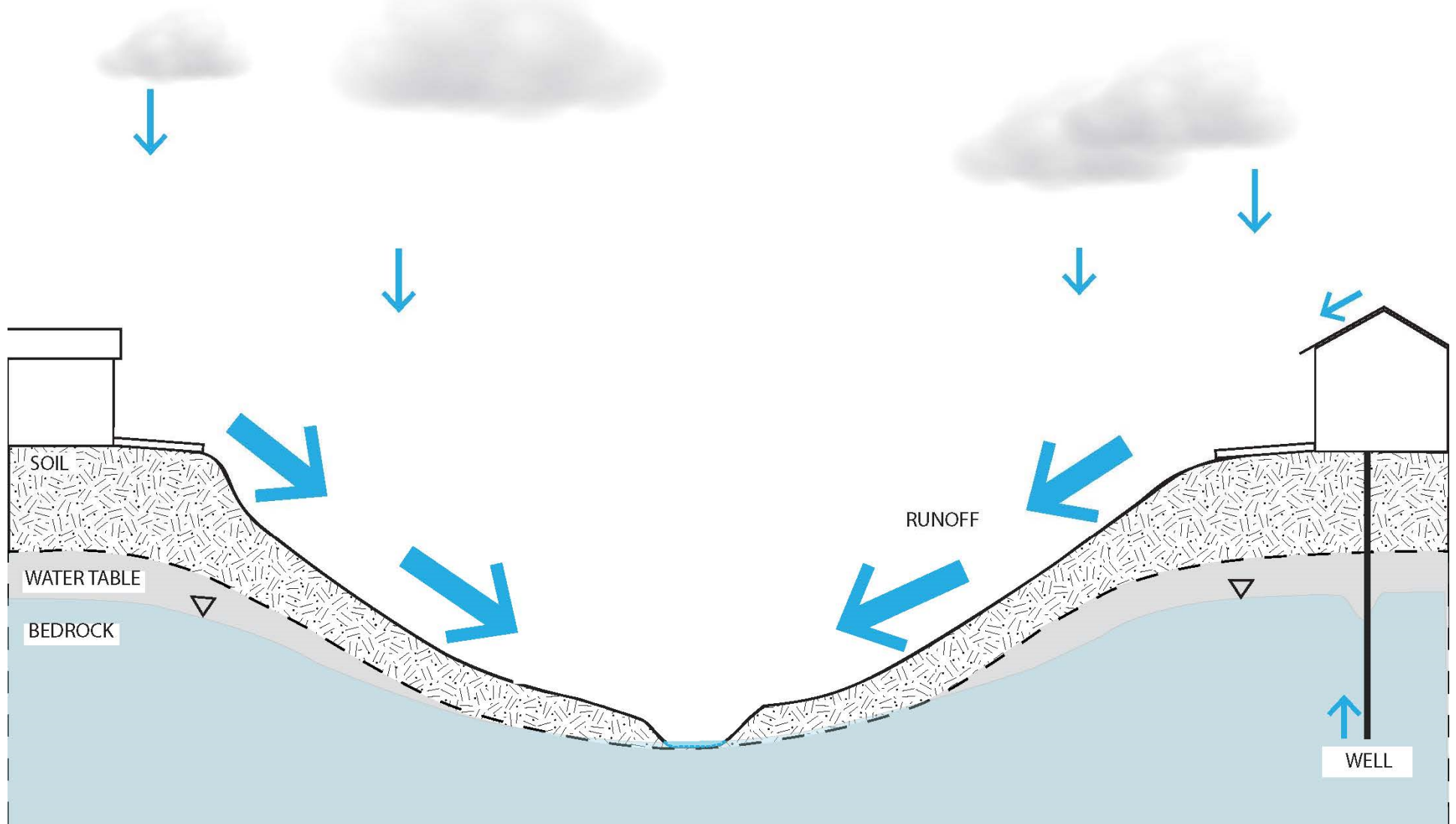
Where does Urban Runoff go?



Hydrology

Developed Conditions

INTERCEPTION, INFILTRATION, AND RECHARGE LOST



And even in small storms, our streams can look like this because there is more runoff...



Pollutants and sediment wash downstream

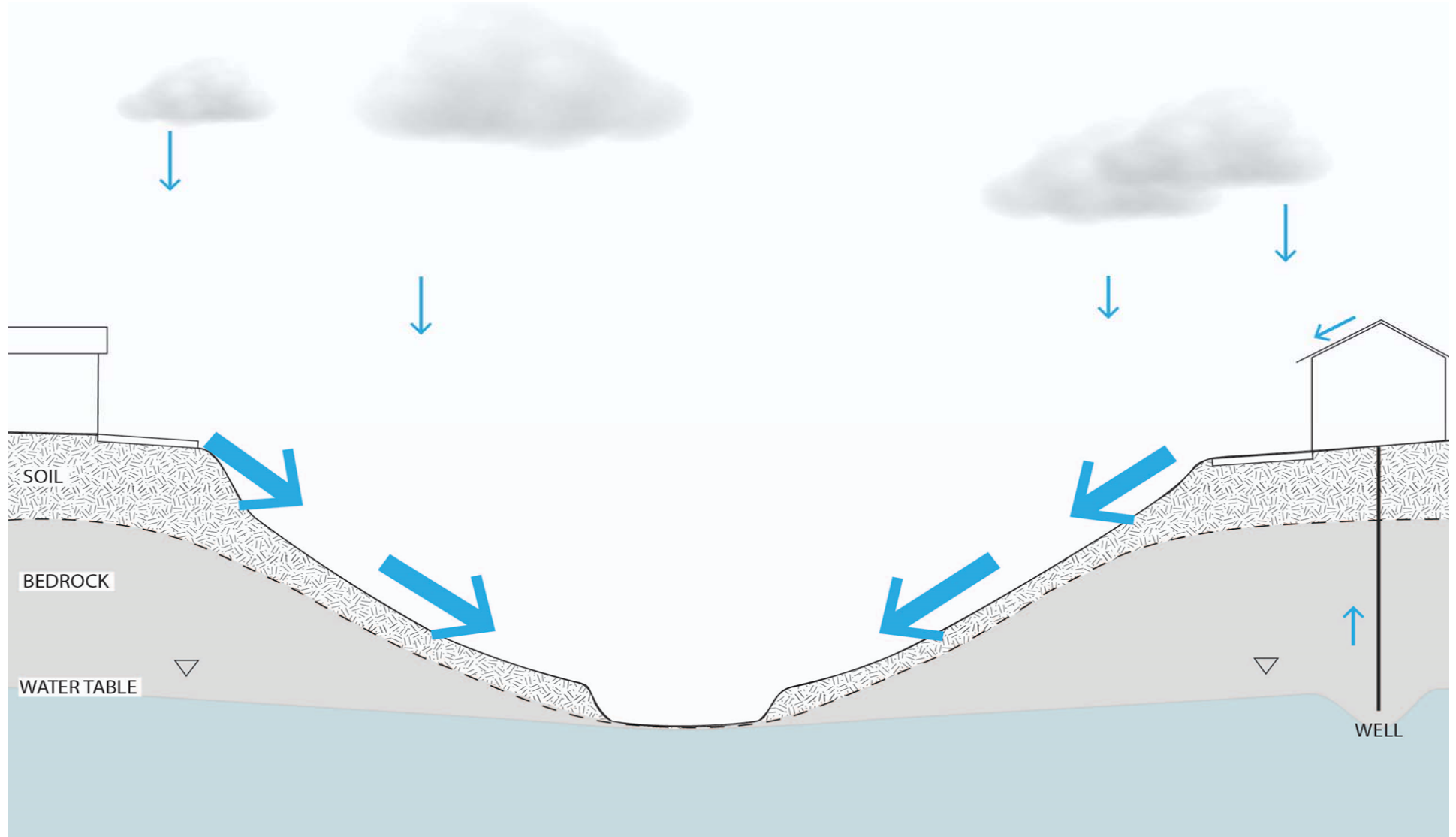
After the rain passes....

- The channel erodes so it can carry more water
- Sediment is released
- The stream is deeper and flows cannot reach floodplain
- Less recharge = less baseflow
- Small streams can go dry
- Gullies form on slopes
- Soil moisture seeps into gullies
- Pools and riffles are lost



Hydrology

Developed Conditions



Healthy streams

- Easily overflow to the floodplain
- Stay about the same temperature year round
- Need woody debris and leaves
- Small streams need shade
- Organic material feeds a fungal and microbial community
- Do not have steep, eroded banks

All streams move location, but slowly in a healthy watershed.



Existing Sustainability in Narbrook



Impervious
Disconnection



Some stable banks
and vegetation



Large Mature Trees

Opportunities for Improvement



Extensive Mowing



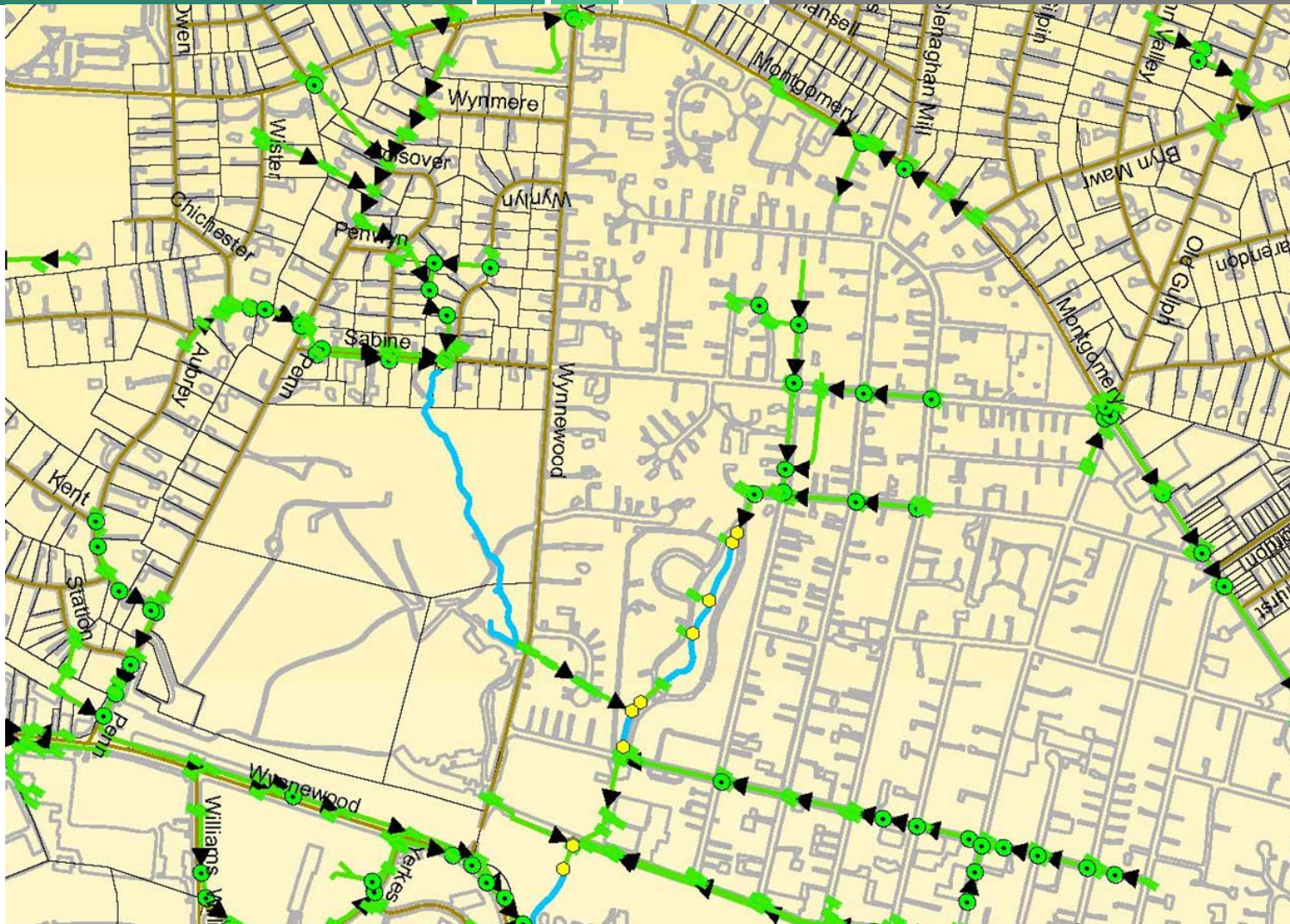
Bank Erosion



Direct Discharges

Sewershed

Narbrook Park



Sustainable Stormwater Management

Structural

- Porous Pavement
- Planter Boxes & Bumpouts
- Green Roofs
- Infiltration Beds and Trenches
- Cisterns and Rain Barrels
- Rain Gardens / Bioretention

Restorative or “Non-Structural”

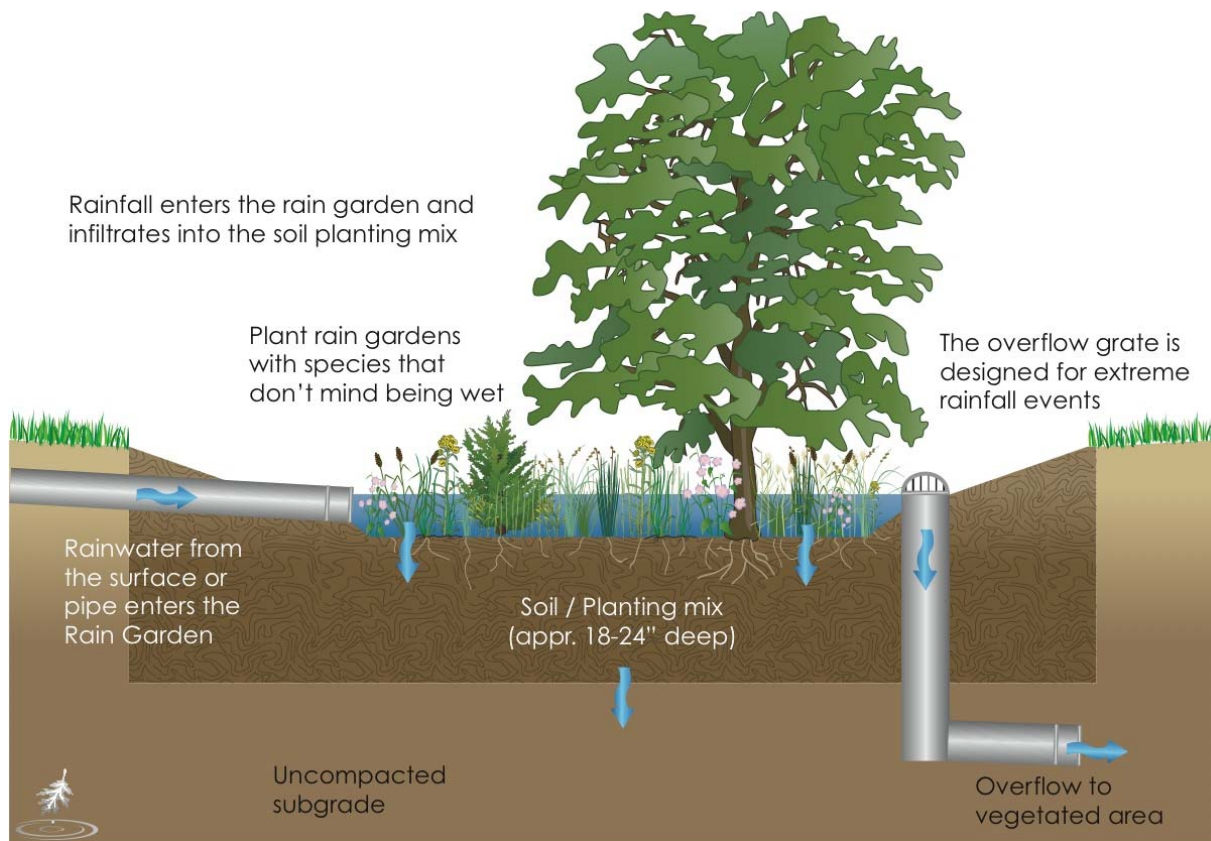
- Lawn to Meadow
- Soil and Landscape Restoration
- Tree Planting / Reforestation
- Riparian Buffers
- Disconnect Impervious



Rain Barrels



Rain Gardens



Converting Lawn to Meadow



Converting Lawn to Meadow

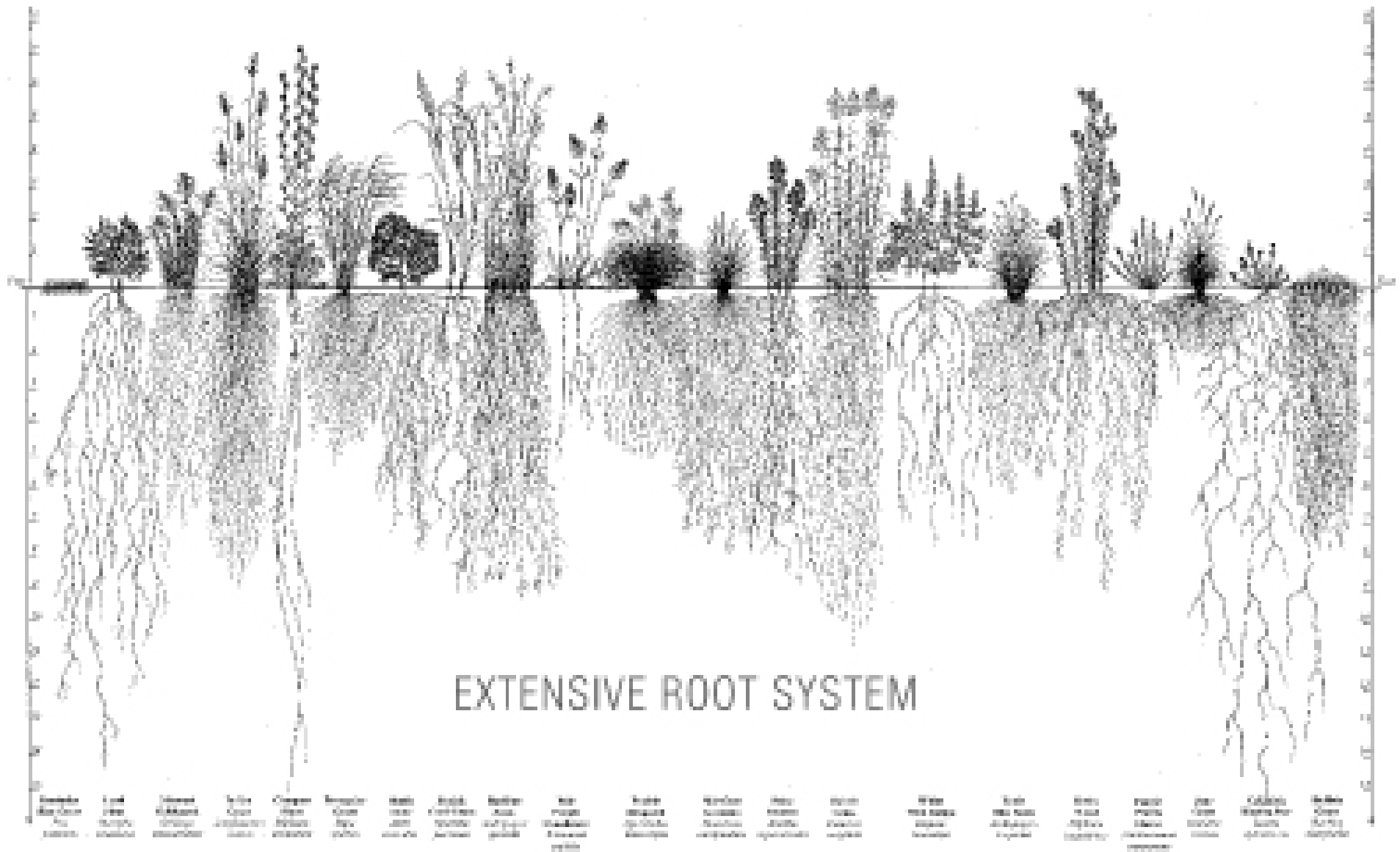
Seeding

1st year

2nd year

3rd year

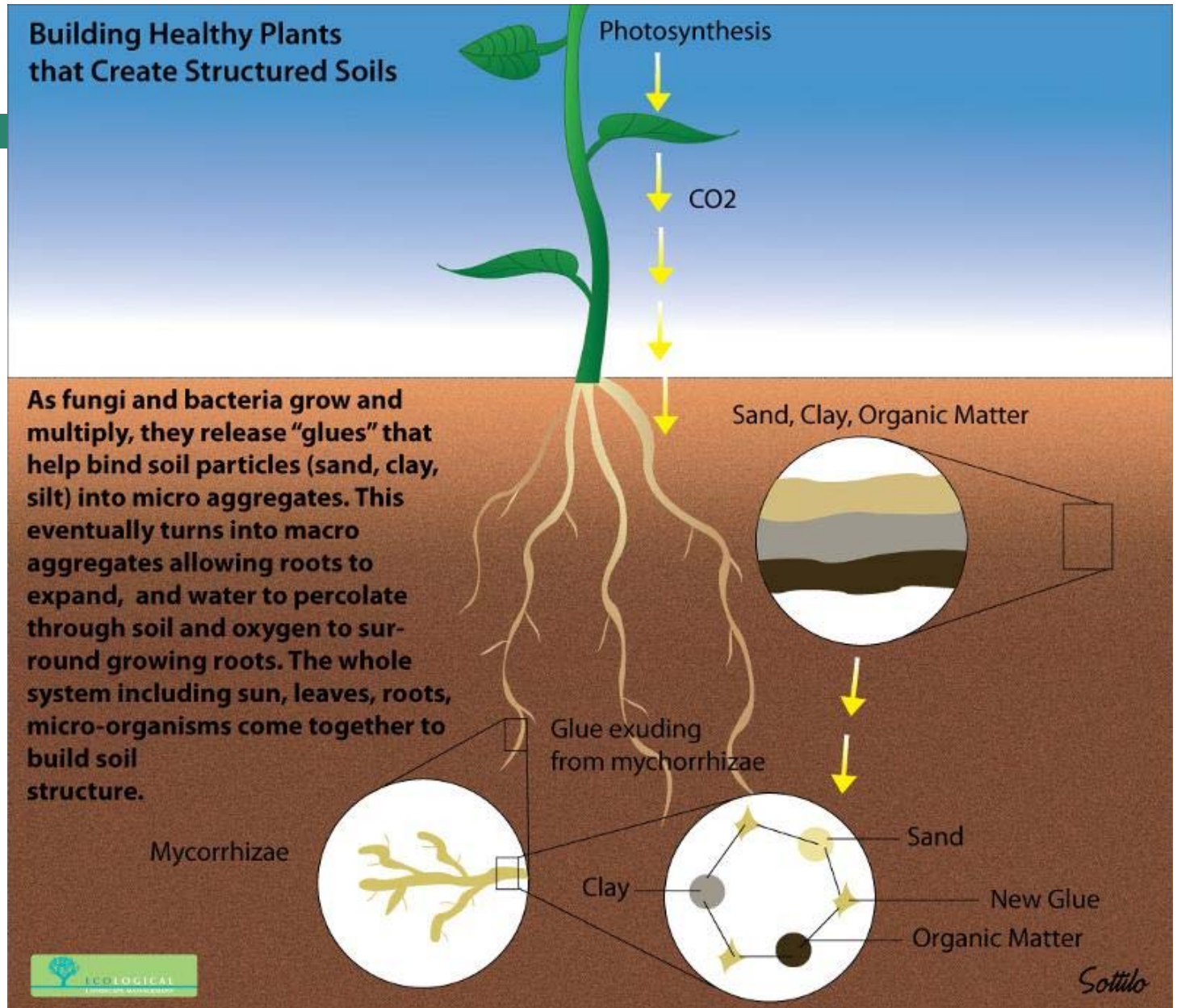
Lawn to Sustainable Meadows



Vegetation works to facilitate the movement of water and air into and out of soil and holds soil in place.

Plant Root Systems

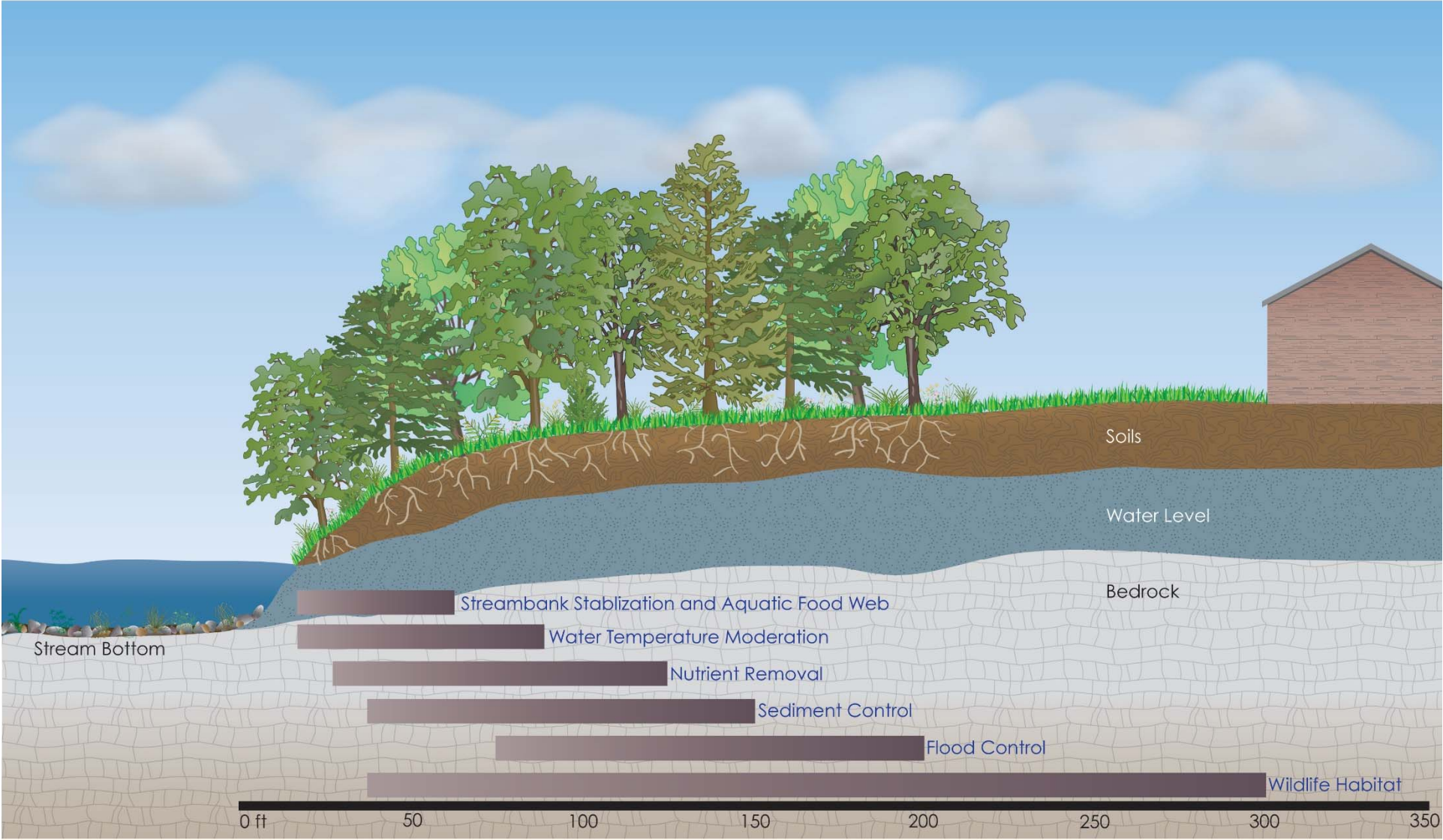
Image by Ecological
Landscape Management



Riparian buffers: filter pollutants, provide floodplain, create shade, maintain temperature.



Riparian Buffers



Thank you!



Altje Hoekstra, LEED AP

