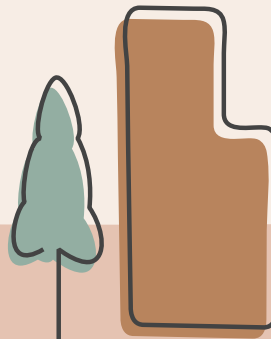
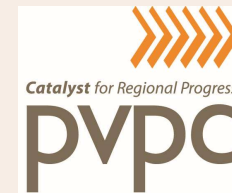


Soaking up the rain: It's all about the soils

Patty Gambarini, Chief Environmental Planner

Kyle Finnell, Senior Land Use and Environment Planner





01 – Workshop context

Mill River Watershed

Planning for Flood Resilience

A two-year project made possible by an Action Grant from the Massachusetts Municipal Vulnerability Preparedness Program to the Town of Williamsburg.



No Loose Braids

Project Elements

Holistic Watershed-Based Plan

- EPA 9-Element Watershed Plan
- Stormwater infrastructure mapping
- Upland watershed stewardship
- Collaborating across town boundaries with other stewards of the watershed

Technical Analysis

- Create up-to-date flood maps that show current and future flooding
- Assess climate vulnerabilities and flood mitigation opportunities in upland areas
- Identify sustainable housing opportunities

Engagement

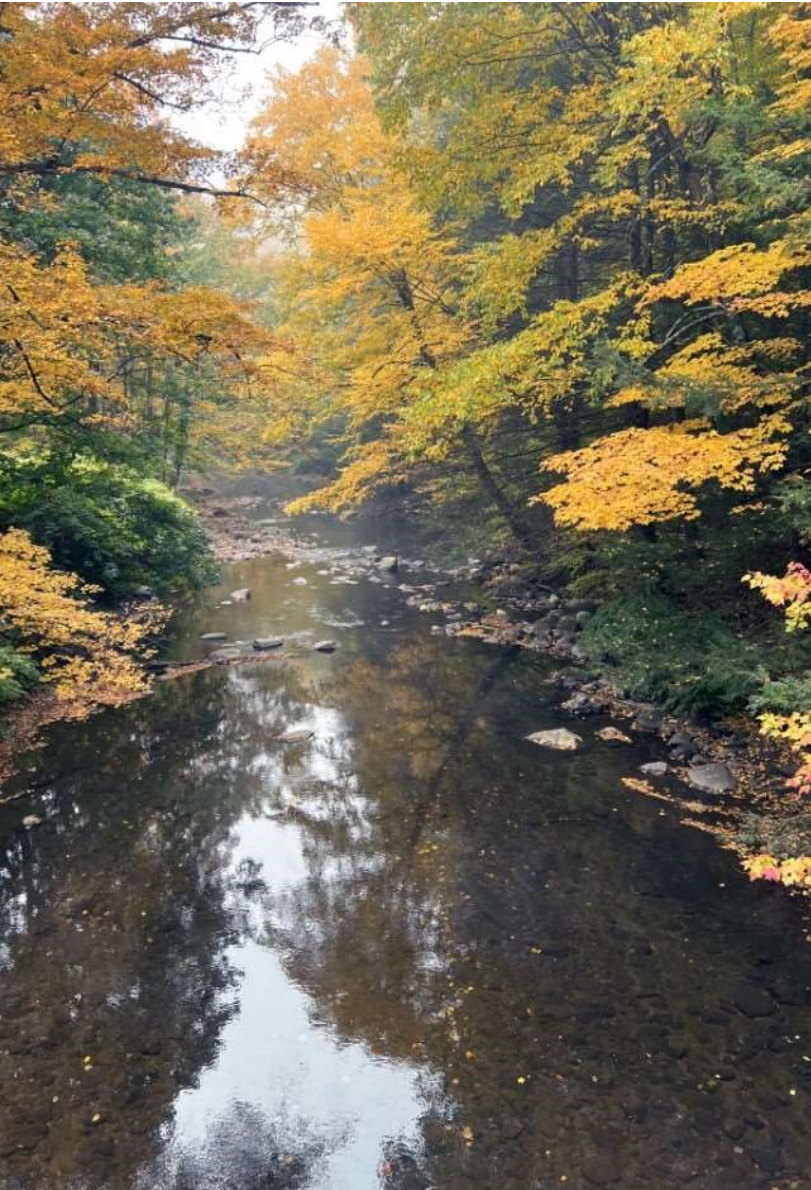
- Town boards - Landowners - Indigenous Land Stewards - Dunphy School
- Greenway Design Charette & community visioning
- Resident involvement in flood solutions
- Backyard workshops to build climate resilience
- Interactive web-based mapping tool with watershed data

Resilience Building

- Community engagement in the project from start to finish
- Public participation in the design of the Mill River Greenway
- Landowner participation in climate-resilient land management strategies throughout the watershed

Regulatory Review

- Review town bylaws and regulations for ways to increase flood protection
- Recommend resiliency standards for bylaws and regulations



Looking at water

- Including current and future flooding
New Flood Maps
Regulations Review
Areas for Improvement
- Water quality
Sources of Pollution
Green Infrastructure



and forests

- Benefit of forests for flood mitigation
- Indigenous land practices with No Loose Braids
- Soil analysis of upland areas
- Balancing climate resilient forest conservation with development needs

What is a watershed?

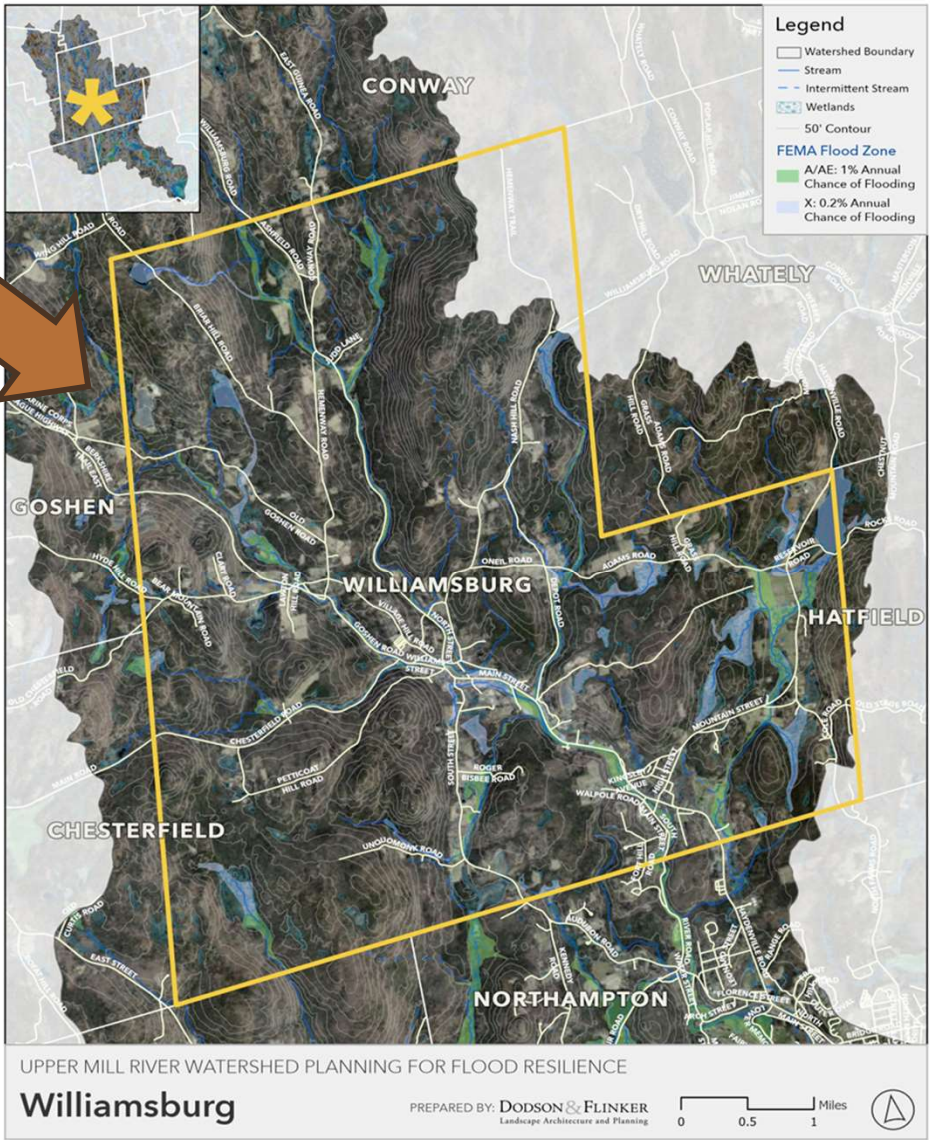


Go from thinking
about just this

TO ALL
OF THIS



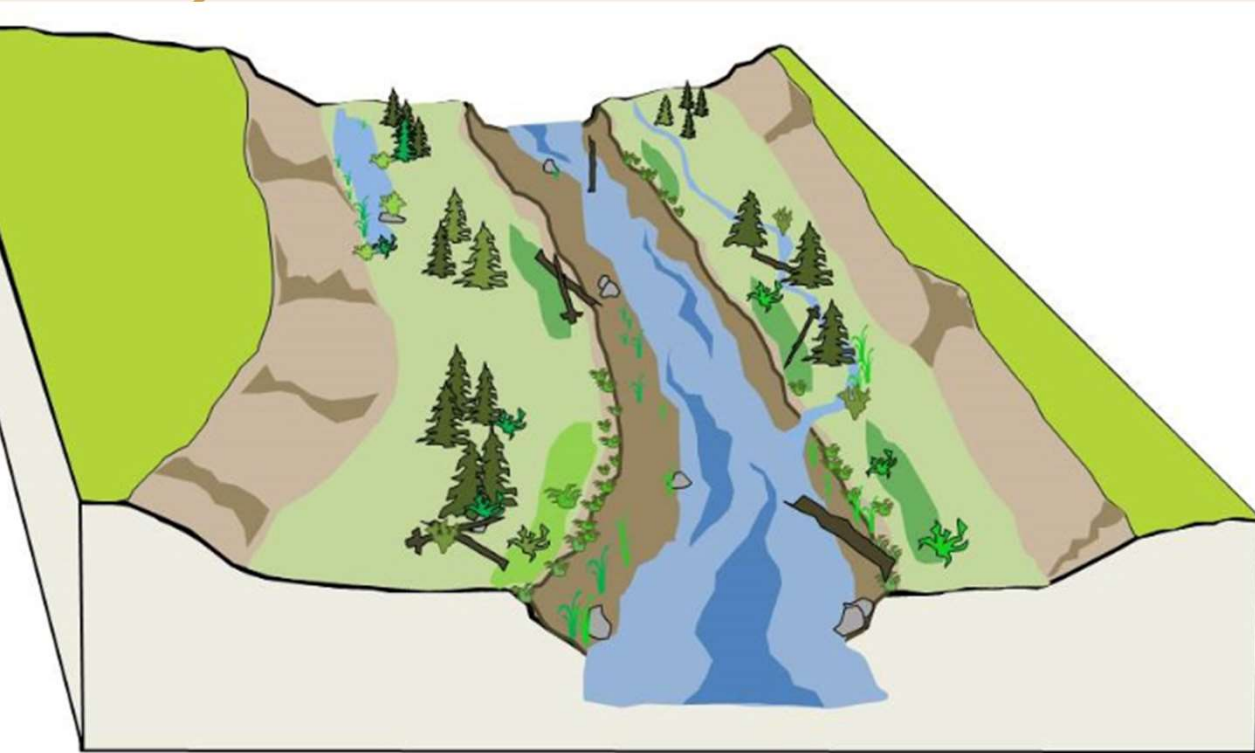
Source: New England Public Media





02 – Land development and unintended consequences

Floodplains



Reconnecting Rivers to Floodplains, American Rivers, 2016

- Lands adjacent to river that are an integral part of the system
- Dynamic land area that regularly disturbed by inundation during high flows
- Form and ecology is shaped over time in response to natural processes driven by periodic flooding



PUBLISHED AND COPYRIGHTED 1886, BY E. R. BURLEIGH.

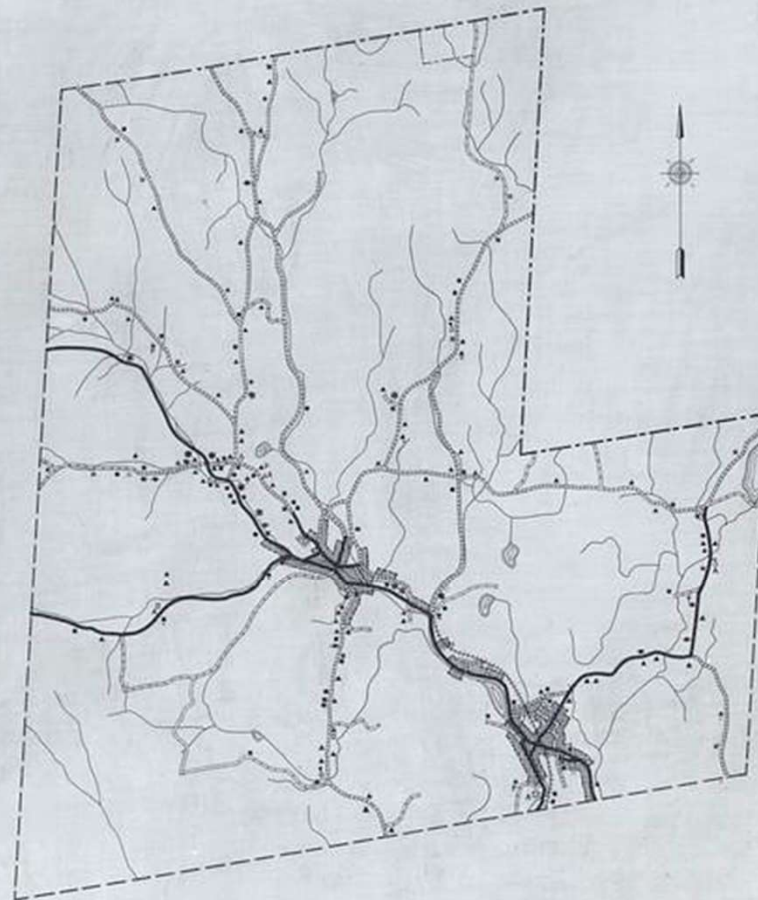
NORTHAMPTON, MASS., 1886, N. Y.

1. Congregational Church.
2. Roman Catholic Church.
3. Public School.
4. Masonic Hall.
5. Railroad Station.

HAYDENVILLE, MASS.

1886.

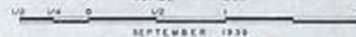
6. Post Office.
7. Haydenville Branch, N. Yorkville, Mass.
8. Haydenville Branch, N. Yorkville, Mass.
9. Haydenville Branch, N. Yorkville, Mass.
10. Haydenville Branch, N. Yorkville, Mass.



MASSACHUSETTS
STATE PLANNING BOARD
ROADS AND BUILDINGS
TOWN OF WILLIAMSBURG

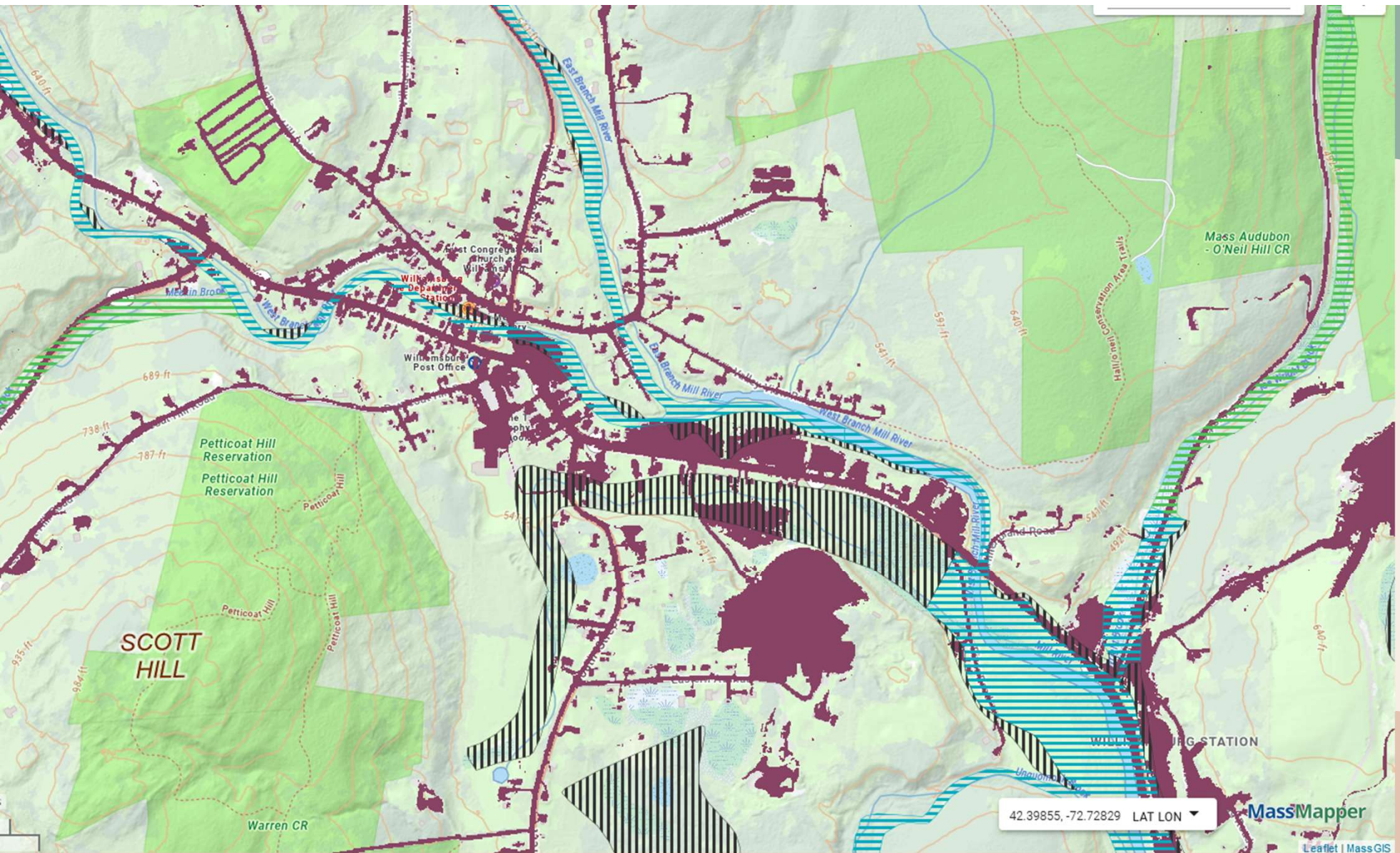
W.P.A. PROJECT NO. 17788

SCALE IN MILES



SEPTEMBER 1939

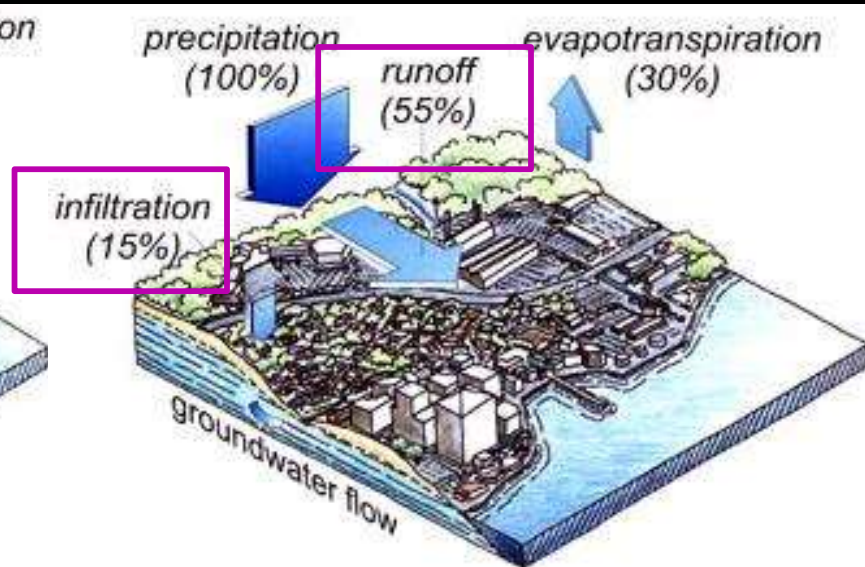
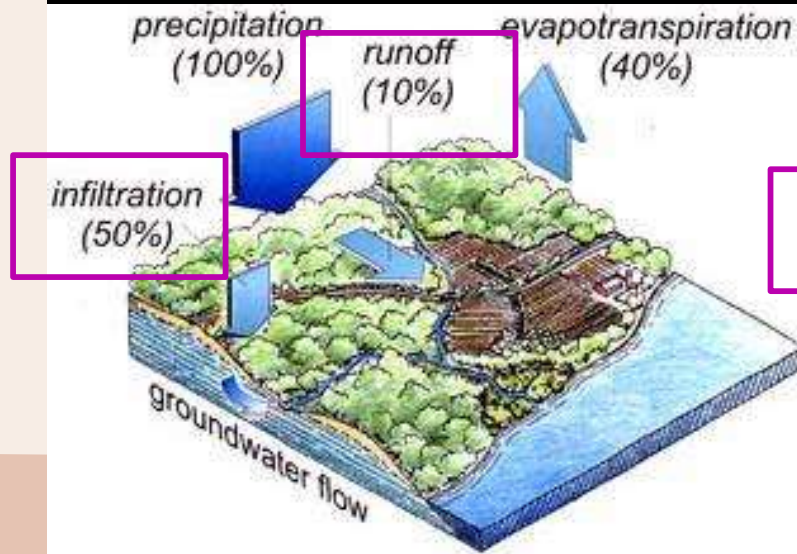
Digital Commonwealth, WPA Project 1939







**Development of land changes the relationship with water,
increases surface runoff**



Historically approach has been to:

- Convey rainfall away...as if a waste product
- Use drinking water to irrigate lawns and gardens



Many impacts associated with “conveyance” approach to stormwater



Rule of Thumb: At ~10% watershed impervious cover we see:

- Water quality issues
- Stream erosion
- Increased flooding
- Reduced groundwater recharge and baseflow to rivers, streams
- Impacts to biological communities
- Loss of recreational uses
- Shellfish bed closures



Increased flooding

The greater the impervious cover, the greater the likelihood of flooding

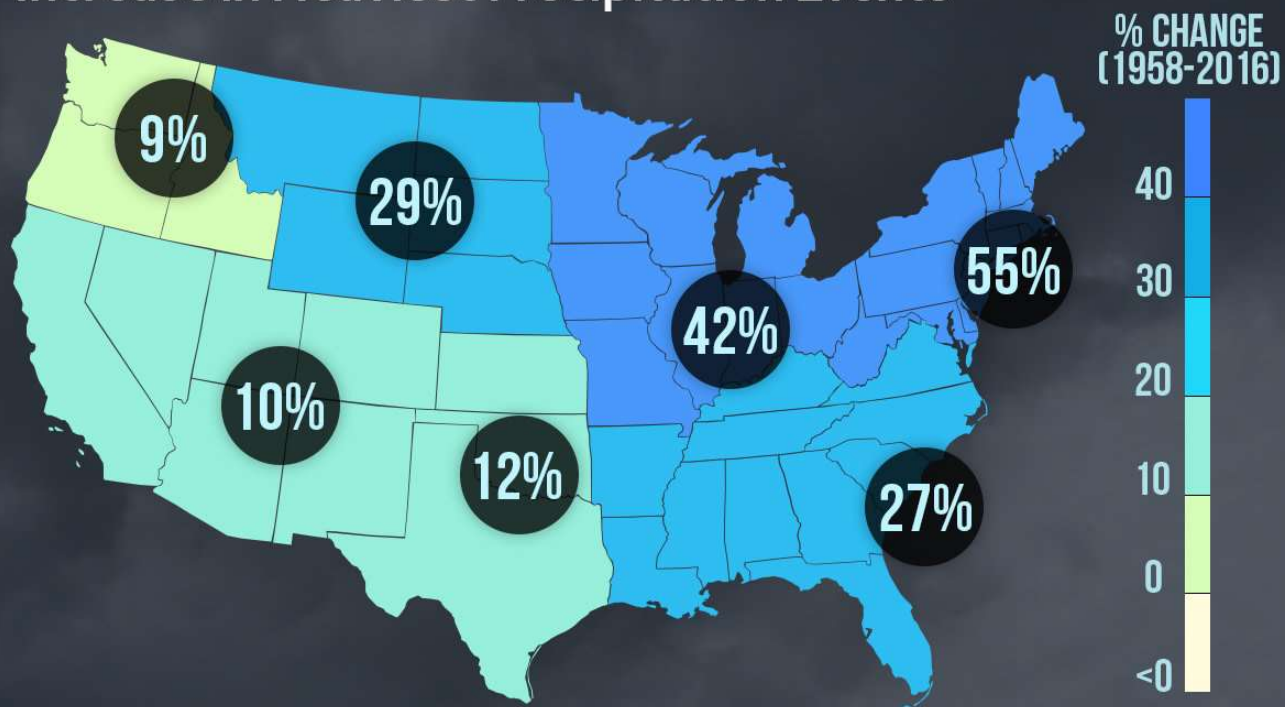
An equation that we are recognizing more and more



WWLP, July 2023 flood coverage

MORE DOWNPOURS

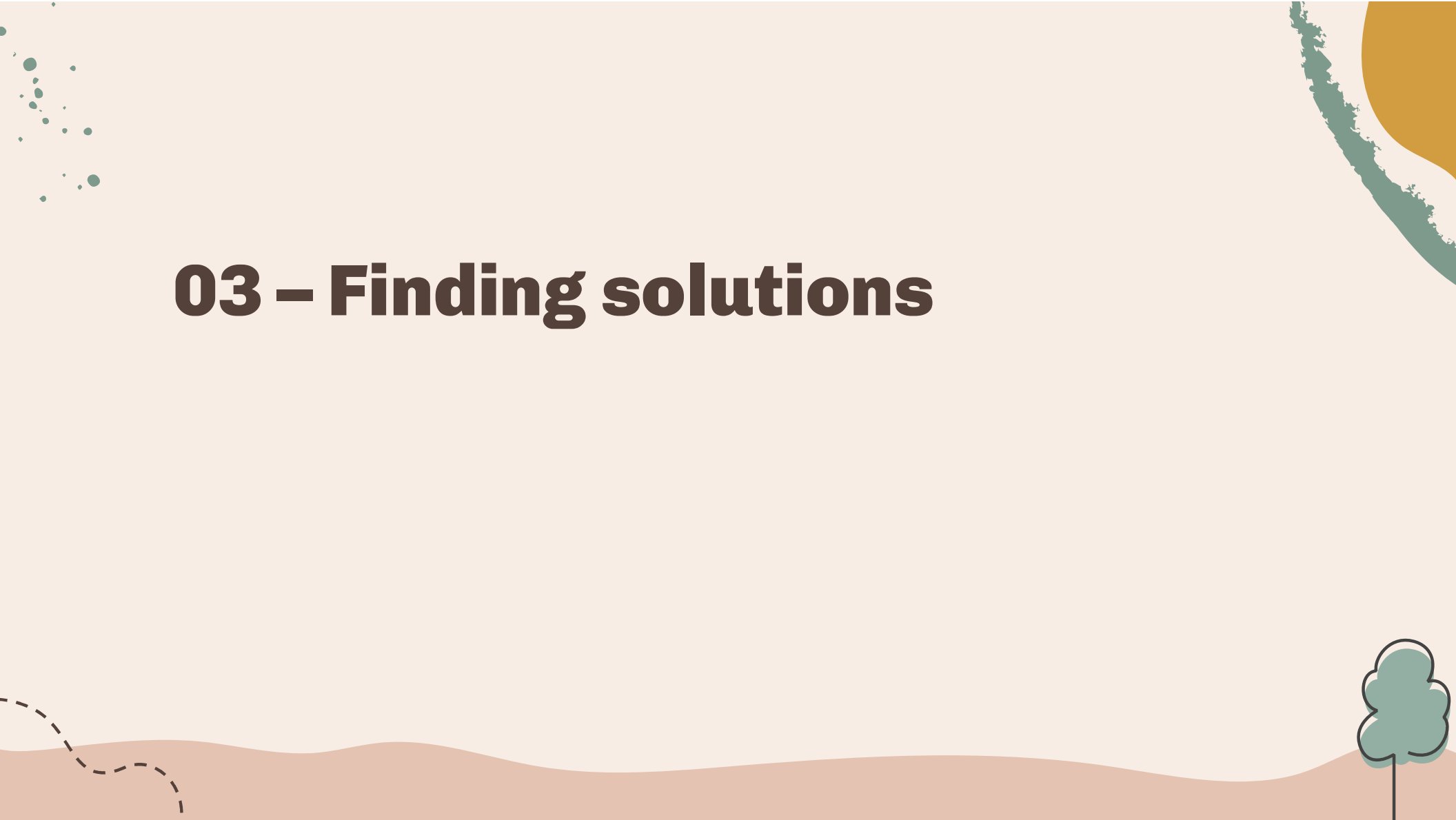
Increase in Heaviest Precipitation Events

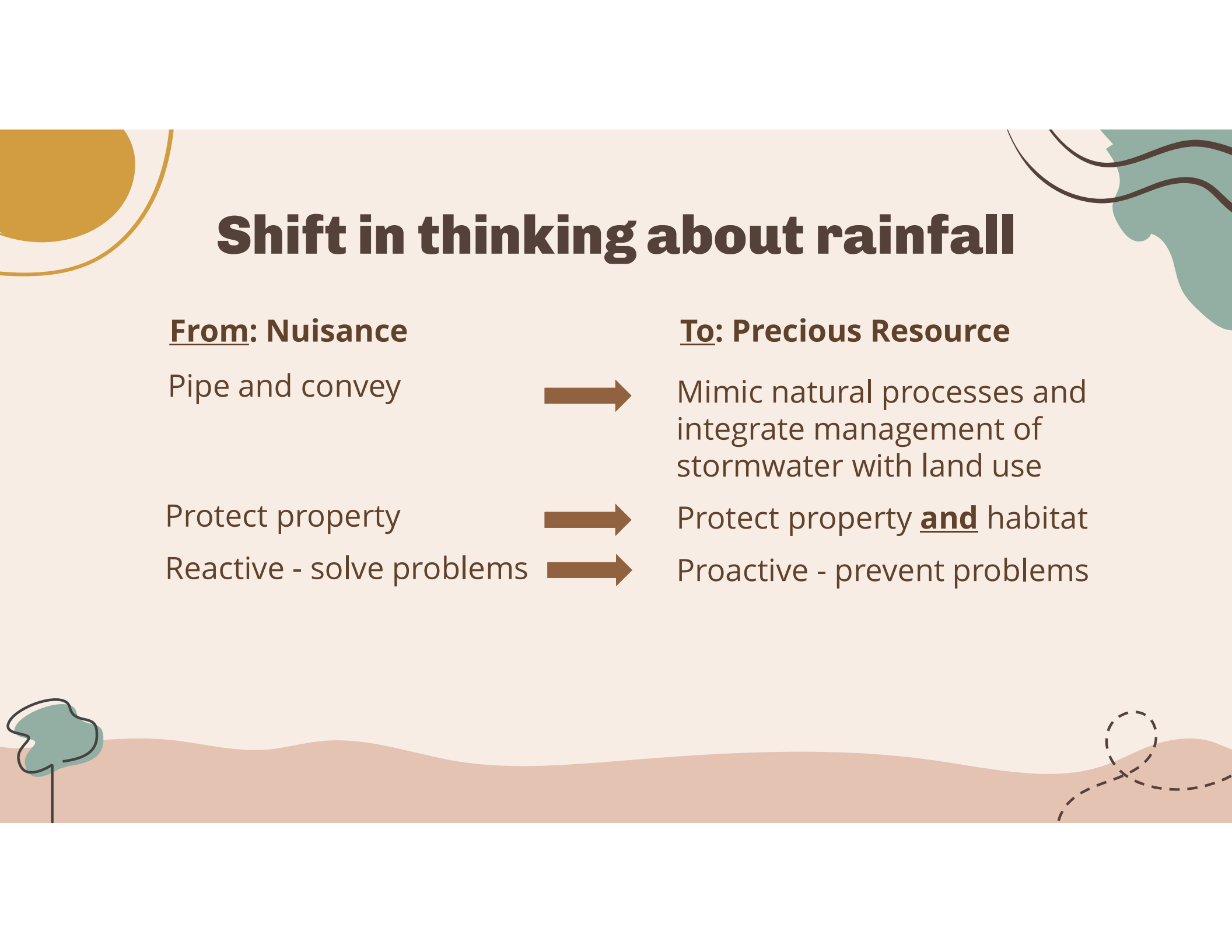


Heaviest events defined as top 1% of events
Source: USGCRP Climate Science Special Report 2017

CLIMATE  CENTRAL

03 – Finding solutions





Shift in thinking about rainfall

From: Nuisance

Pipe and convey

Protect property

Reactive - solve problems



To: Precious Resource

Mimic natural processes and integrate management of stormwater with land use

Protect property and habitat

Proactive - prevent problems

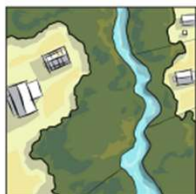


*Cottages on Green, East Greenwich, RI
Photos courtesy of Jonathan Ford,
Horsley Witten Group*

This shift is reflected now at varying scales in:

- Single lot and larger developments – distributed systems to capture, treat, soak up rainfall
- Municipalities – green stormwater infrastructure along streets and on public properties
- Watershed – conserving key lands to promote river function; even buy outs in some places to make “room for the river.”

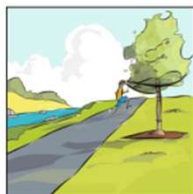
WATERSHED SCALE



LAND CONSERVATION

Land conservation is one way of preserving interconnected systems of open space that sustain healthy communities.

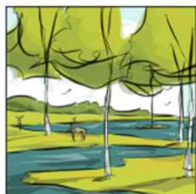
Land conservation projects begin by prioritizing areas of land for acquisition. Land or conservation easements can be bought or acquired through donation.



GREENWAYS

Greenways are corridors of protected open space managed for both conservation and recreation.

Greenways often follow rivers or other natural features. They link habitats and provide networks of open space for people to explore and enjoy.



WETLAND RESTORATION AND PROTECTION

Restoring and protecting wetlands can improve water quality and reduce flooding. Healthy wetlands filter, absorb, and slow runoff.

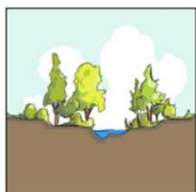
Wetlands also sustain healthy ecosystems by recharging groundwater and providing habitat for fish and wildlife.



STORMWATER PARKS

Stormwater parks are recreational spaces that are designed to flood during extreme events and to withstand flooding.

By storing and treating floodwaters, stormwater parks can reduce flooding elsewhere and improve water quality.



FLOODPLAIN RESTORATION

Undisturbed floodplains help keep waterways healthy by storing floodwaters, reducing erosion, filtering water pollution, and providing habitat.

Floodplain restoration rebuilds some of these natural functions by reconnecting the floodplain to its waterway.

NEIGHBORHOOD OR SITE SCALE



RAIN GARDENS

A rain garden is a shallow, vegetated basin that collects and absorbs runoff from rooftops, sidewalks, and streets.

Rain gardens can be added around homes and businesses to reduce and treat stormwater runoff.



VEGETATED SWALES

A vegetated swale is a channel holding plants or mulch that treats and absorbs stormwater as it flows down a slope.

Vegetated swales can be placed along streets and in parking lots to soak up and treat their runoff, improving water quality.



GREEN ROOFS

A green roof is fitted with a planting medium and vegetation. A green roof reduces runoff by soaking up rainfall. It can also reduce energy costs for cooling the building.

Extensive green roofs, which have deeper soil, are more common on commercial buildings. Intensive green roofs, which have shallower soil, are more common on residential buildings.



RAINWATER HARVESTING

Rainwater harvesting systems collect and store rainfall for later use. They slow runoff and can reduce the demand for potable water.

Rainwater systems include rain barrels that store tens of gallons and rainwater cisterns that store hundreds or thousands of gallons.



PERMEABLE PAVEMENT

Permeable pavements allow more rainfall to soak into the ground. Common types include pervious concrete, porous asphalt, and interlocking pavers.

Permeable pavements are most commonly used for parking lots and roadway shoulders.



TREE CANOPY

Tree canopy can reduce stormwater runoff by catching rainfall on branches and leaves and increasing evapotranspiration. By keeping neighborhoods cooler in the summer, tree canopy can also reduce the "urban heat island effect."

Because of trees' many benefits, many cities have set urban tree canopy goals.



TREE TRENCHES

A stormwater tree trench is a row of trees planted in an underground infiltration structure made to store and filter stormwater.

Tree trenches can be added to streets and parking lots with limited space to manage stormwater.



GREEN STREETS

Green streets use a suite of green infrastructure practices to manage stormwater runoff and improve water quality.

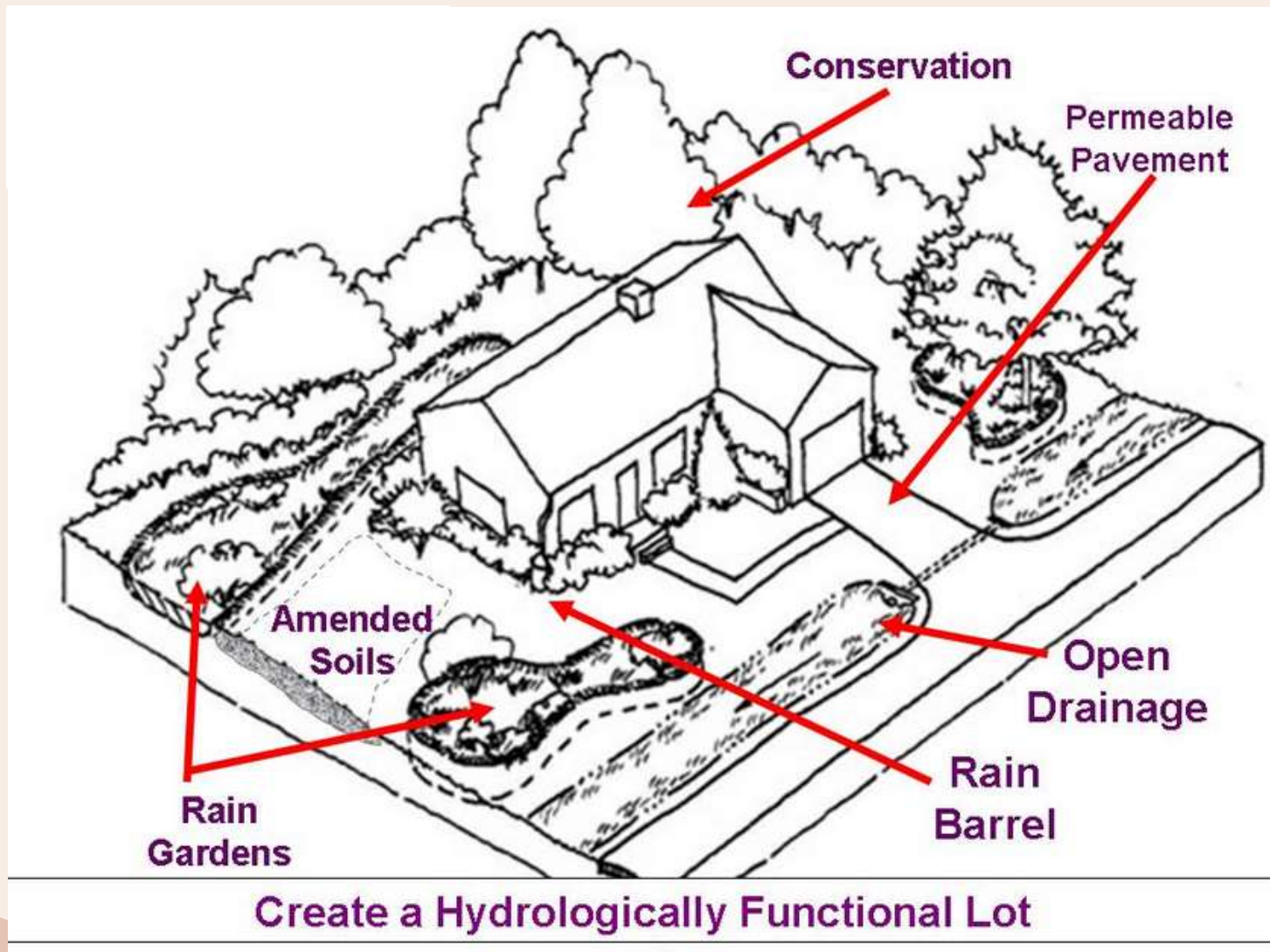
Adding green infrastructure features to a street corridor can also contribute to a safer and more attractive environment for walking and biking.

Source: FEMA

Soaking up the rain = facilitating the natural water cycle



- Protect natural drainage systems and pathways
- Preserve natural areas and native vegetation – trees especially!
- Reduce/remove “impervious” cover
- Find ways to disconnect areas from draining to roadways/municipal storm system/nearby rivers and streams
- Manage rainfall and snowmelt as close to source as possible



04 – Why soils matter



Soil type has a lot to do with how well rainwater soaks into the ground.

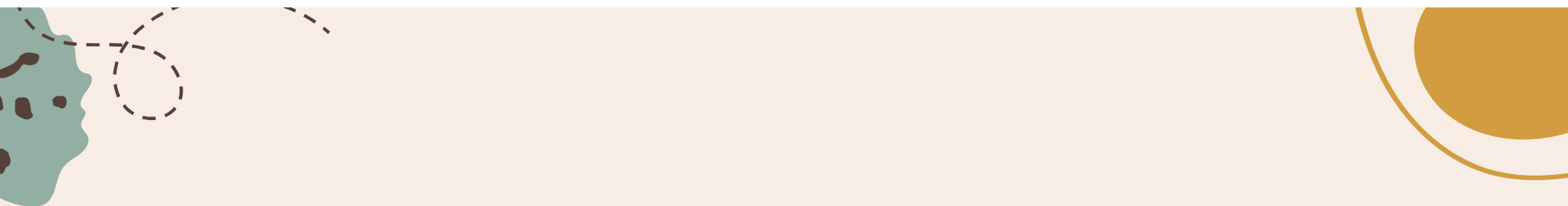
Sandy, loamy soil soaks up water quickly.

Heavier soils with clay don't soak up as well.



Max Graham, Yale Climate Connections





Description — Hydrologic Soil Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.



Soils in Williamsburg

Map Unit Name	Drainage Class
Hinckley and Windsor soils, 25 to 35 percent slopes	Excessively drained
Hinckley loamy sand, 0 to 3 percent slopes	Excessively drained
Pits, gravel	Excessively drained
Windsor loamy sand, 15 to 25 percent slopes	Excessively drained
Gloucester fine sandy loam, 3 to 8 percent slopes, stony	Somewhat excessively drained
Hollis-Chatfield association, 15 to 45 percent slopes, very rocky	Somewhat excessively drained
Merrimac fine sandy loam, 0 to 3 percent slopes	Somewhat excessively drained
Westminster-Millsite association, 25 to 35 percent slopes, extremely stony	Somewhat excessively drained
Agawam fine sandy loam, 3 to 8 percent slopes	Well drained
Charlton and Gloucester fine sandy loams, 25 to 35 percent slopes, very stony	Well drained
Charlton fine sandy loam, 15 to 25 percent slopes, very stony	Well drained
Charlton-Hollis- Rock outcrop complex, 15 to 25 percent slopes	Well drained
Charlton-Paxton association, 15 to 45 percent slopes, extremely stony	Well drained
Charlton-Rock outcrop-Hollis complex, sloping	Well drained
Chatfield-Hollis complex, 25 to 60 percent slopes, rocky	Well drained
Colrain fine sandy loam, 8 to 15 percent slopes, very stony	Well drained
Haven very fine sandy loam, 3 to 8 percent slopes	Well drained
Marlow-Berkshire association, 35 to 60 percent slopes, extremely stony	Well drained
Paxton fine sandy loam, 0 to 8 percent slopes, very stony	Well drained
Shelburne-Ashfield association, steep, extremely stony	Well drained
Tunbridge-Lyman association, 15 to 60 percent slopes, extremely stony	Well drained
Udorthents, smoothed	Well drained
Amostown fine sandy loam, 3 to 8 percent slopes	Moderately well drained
Ashfield-Shelburne association, rolling, extremely stony	Moderately well drained
Belgrade silt loam, 0 to 3 percent slopes	Moderately well drained
Boxford silt loam, 3 to 8 percent slopes	Moderately well drained
Ninigret fine sandy loam, 0 to 3 percent slopes	Moderately well drained
Peru-Marlow association, 3 to 15 percent slopes, extremely stony	Moderately well drained
Pootatuck fine sandy loam, 0 to 3 percent slopes	Moderately well drained
Sudbury fine sandy loam, 0 to 3 percent slopes	Moderately well drained
Woodbridge fine sandy loam, 0 to 3 percent slopes	Moderately well drained
Pillsbury-Peacham-Wonsqueak association, 0 to 8 percent slopes, extremely stony	Poorly drained
Raynham silt loam, 0 to 3 percent slopes	Poorly drained
Ridgebury fine sandy loam, 0 to 3 percent slopes	Poorly drained
Rippowam fine sandy loam, 0 to 3 percent slopes	Poorly drained
Walpole sandy loam, 0 to 3 percent slopes	Poorly drained
Freetown muck, central lowland, 0 to 1 percent slopes	Very poorly drained
Maybid silt loam, 0 to 3 percent slopes	Very poorly drained
Saco silt loam, 0 to 3 percent slopes	Very poorly drained
Scarboro mucky fine sandy loam, 0 to 3 percent slopes	Very poorly drained
Swansea muck, 0 to 1 percent slopes	Very poorly drained

Area of Interest (AOI) | Soil Map | Soil Data Explorer | Download Soils Data | Shopping Cart (Free)

Search ⌵
Area of Interest ⌴
Import AOI ⌵
Quick Navigation ⌴
Address ⌵
State and County ⌵
Soil Survey Area ⌵
Latitude and Longitude or Current Location ⌵
PLSS (Section, Township, Range) ⌵
Bureau of Land Management ⌵
Department of Defense ⌵
Forest Service ⌵
National Park Service ⌵
Hydrologic Unit ⌵

Area of Interest Interactive Map ⌵
Legend
⌕ 🔍 🖱 🌐 📏 📐 📊 📋 📄 📅 📖 📗 📙 📚 📛 📞 📠 📡 📢 📣 📤 📥 📦 📧 📨 📩 📪 📫 📬 📭 📮 📯 📰 📱 📲 📳 📴 📵 📶 📷 📸 📹 📺 📻 📼 📽 📾 📿
View Extent Contiguous U.S. Scale (not to scale)

0 700 mi

Search

Properties and Qualities Ratings

Open All | Close All

Soil Chemical Properties

Soil Erosion Factors

Soil Health Properties

Soil Physical Properties

Soil Qualities and Features

AASHTO Group Classification (Surface)

AASHTO Group Index

Depth to a Selected Soil Restrictive Layer

Depth to Any Soil Restrictive Layer

Depth to Bedrock

Drainage Class

Frost Action

Frost-Free Days

Hydrologic Soil Group

View Description | View Rating

View Options

Map ☒

Table ☒

Description of Rating ☒

Rating Options

☐ Detailed Description

Advanced Options

Aggregation Method: Dominant Condition

Component Percent Cutoff

Tie-break Rule

☐ Lower

☒ Higher

View Description | View Rating

Map Unit Name

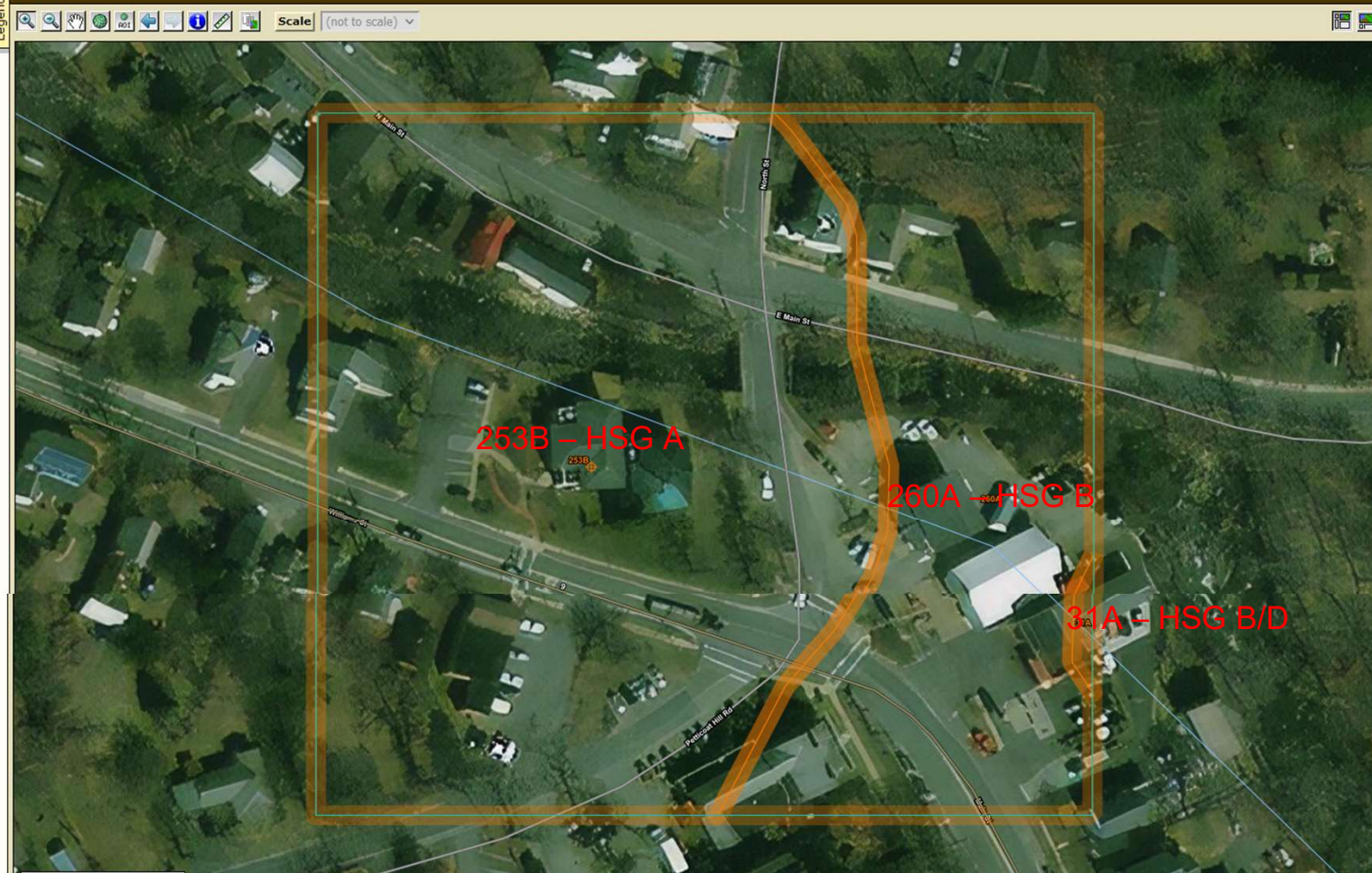
Parent Material Name

Representative Slope

Soil Slippage Potential

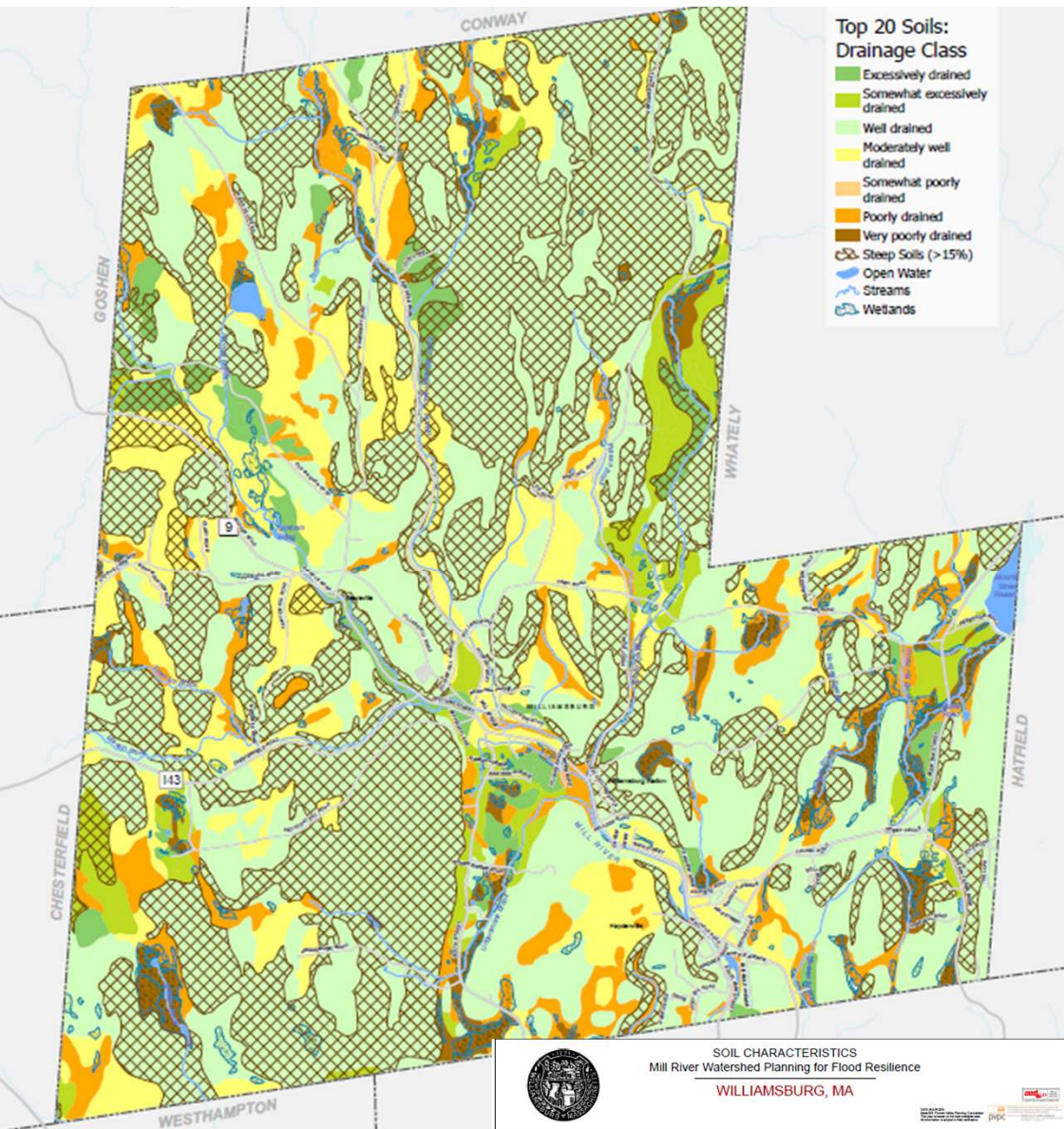
Subsidence, Initial

Soil Map



Tables — Hydrologic Soil Group — Summary By Map Unit

Summary by Map Unit — Hampshire County, Massachusetts, Central Part (MA609)				
Summary by Map Unit — Hampshire County, Massachusetts, Central Part (MA609)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
31A	Walpole sandy loam, 0 to 3 percent slopes	B/D	0.0	0.4%
253B	Hinckley loamy sand, 3 to 8 percent slopes	A	4.5	66.7%
260A	Sudbury fine sandy loam, 0 to 3 percent slopes	B	2.2	32.9%
Totals for Area of Interest			6.7	100.0%



Activity!

Get an idea of soil at your home or business



Simple Infiltration Test

Purpose

This test will help determine whether an infiltration type stormwater practice can be installed in a proposed location. This simplified test is intended for use with smaller, more residential scale infiltration practices. For larger projects and for projects in highly urbanized locations, this test can provide a preliminary understanding of soil conditions, but a more in depth soil investigation is essential at such sites before design and construction.

Timing

Tests should not be conducted in the rain or within 24 hours of significant rainfall (>0.5 inches) or when the temperature is below freezing. Preferred testing time is between end of March and June, the presumed wet season here in the Northeast.

Tools

Shovel, tarp, yardstick ruler, watch or clock, clipboard, pen, field data sheet. You will also need to make sure you have a source of water, either a hose that can reach the hole that you dig or enough buckets of water so that you can properly conduct this test.

What is Dig Safe?

For a safe digging project, contact Dig Safe first to request utility marks on your property.

A safe excavation project starts by first contacting Dig Safe to request utility marks on your property. Call Dig Safe at 811 or submit a request online using Exactix at www.digsafe.com/exactix.php.



Why should I contact Dig Safe?

Damaging an underground facility is dangerous – for you, and for the people around you. A broken pipe or cable also causes outages, expensive repairs and legal problems.

This is why state law requires contractors and homeowners to notify Dig Safe *before digging*, even on private land.



When should I contact Dig Safe?

Even small, shallow jobs are a risk if you don't know where utilities are buried. Contact Dig Safe any time you dig, for any type of project.

- Landscaping
- Retaining Wall
- Dog Fence
- Basketball Hoop
- Root Removal
- Fencing
- Clothesline
- Swing Set
- Planting
- Walkway
- Irrigation
- Mailbox
- Driveway
- Patio

How much notice should I give?

State law requires at least 72 hours notice in Massachusetts, Maine, New Hampshire and Rhode Island; 48 hours in Vermont – excluding weekends and holidays.

Before contacting Dig Safe, you must first "pre-mark" the area where you plan to dig, with white stakes, paint or flags.

This helps the locating technician reduce excess markings where you don't need them.



How do I contact Dig Safe?

To request a utility mark-out on your property, submit a Dig Safe "ticket" with Exactix, our web-based platform at www.digsafe.com/exactix.php.

Or, call a Dig Safe Customer Service Representative at 811, from 6am to 6pm, Monday through Friday.

Who marks the lines?

Utility companies (NOT Dig Safe) mark their own lines. Dig Safe is the communication network that notifies these companies to respond for a mark-out. Some utility members use contract locating companies to mark their lines.

Member companies are not responsible to mark privately owned facilities.

What information do I need?

Please provide the following information to submit a request for utility marks:

- Where is the physical address where the work will take place?
- What is the nearest intersecting street?
- What type of work are you doing?
- Where on your property will the work take place?
- Is the area pre-marked?
- Is there any other information that will help the utility companies find where you are working?
- If not yourself, who is doing the digging?



What happens next?

After submitting a request for utility marks with Exactix at www.digsafe.com/exactix.php or by calling 811, the participating utility companies will respond within 72 business hours (48 hours in Vermont) to mark the location of their underground facilities.

Underground pipes and cables are marked out by the utility companies' locating technicians using colored paint, stakes, or flags.



The Color Coding System

Color coded paint or flags are used to identify the type of underground facilities.

RED	Electric Power Lines, Cables, Conduit and Lighting Cables
YELLOW	Gas, Oil, Steam, Petroleum or Gaseous Materials
ORANGE	Communication, Alarm or Signal Lines, Cables or Conduit
BLUE	Potable Water
GREEN	Sewers and Drain Lines
PURPLE	Non-Potable Water: Reclaimed Water, Irrigation and Slurry Lines
PINK	Temporary Survey Markings
WHITE	"Pre-mark" for Proposed Excavation

How can I get more information?

Visit www.digsafe.com for everything you need to know about our free safety service.

To request utility marks on your property any time, submit a request online with Exactix, our web-based platform: www.digsafe.com/exactix.php

Or, call us at 811 during business hours: Monday through Friday, from 6am to 6pm.



DATE OF LAST REVISION - JANUARY 2023



**Don't dig yourself into trouble.
Contact Dig Safe before you dig.
It's Smart. It's Free. It's the Law.**



<https://digsafe.com/data/how-it-works/a27fd434-4e88-47c0-81a5-9c0f4508a583.pdf>

Procedure

1. Dig a hole a minimum of 2 feet in diameter and 1 to 2 feet deep. As you dig, put excavated dirt on tarp to avoid spread of dirt on nearby sidewalk, lawn, or driveway. If the hole fills with water on its own, *choose a new location*.
2. Take a handful of soil from the bottom of the hole and determine the type and texture of the soil through a "ribbon test," following steps from the *Vermont Rain Garden Manual* shown at right. Record results on the field data sheet. If soil is clay, *choose a new location*.
3. Fill the hole with water to moisten the soil, being careful to avoid splashing, which could erode the sides of the hole.
4. Allow the hole to drain completely. If it does not drain completely, *choose a new location*.
5. Place a yard stick in the hole and fill the hole with water a second time. Note the water level and time. After 30 minutes, check the water level again and note the new water level. Multiply the change in water level by 2 to get the number of inches of infiltration in one hour. Record the depth on the field data form.

1. Grab a handful of moist soil and roll it into a ball in your hand.
2. Place the ball of soil between your thumb and the side of your forefinger and gently push the soil forward with your thumb, squeezing it upwards to form a ribbon about 1/4" thick.
3. Try to keep the ribbon uniform thickness and width. Repeat the motion to lengthen the ribbon until it breaks under its own weight. Measure the ribbon and evaluate below:

Courtesy of
North Dakota State University



The ribbon formed here depicts a clay soil because it is greater than 1.5" in length.

SAND: Soil does not form a ribbon at all.
SILT: A weak ribbon < 1.5" is formed before breaking.
CLAY: A ribbon > 1.5" is formed.



Field Data Sheet
Simple infiltration test

Location: _____

Person(s) conducting test: _____

Date: _____

Time: _____

Starting water level in hole: _____ inches

Ending water level after 30 minutes: _____ inches

Difference: _____ inches

Difference multiplied by 2: _____ inches per hour

Soil Type (check one)	Infiltration Rate (check one)
☐ No ribbon will form = Sand	☐ ≥ 1 inch per hour (test indicates that good location for infiltration type stormwater practice)
☐ Weak ribbon < 1.5 " = Silt	☐ < 1 inch per hour (if less than 1 inch per hour, choose a different location)
☐ > 1.5 " = Clay	

Soil Organic Matter and Water Retention

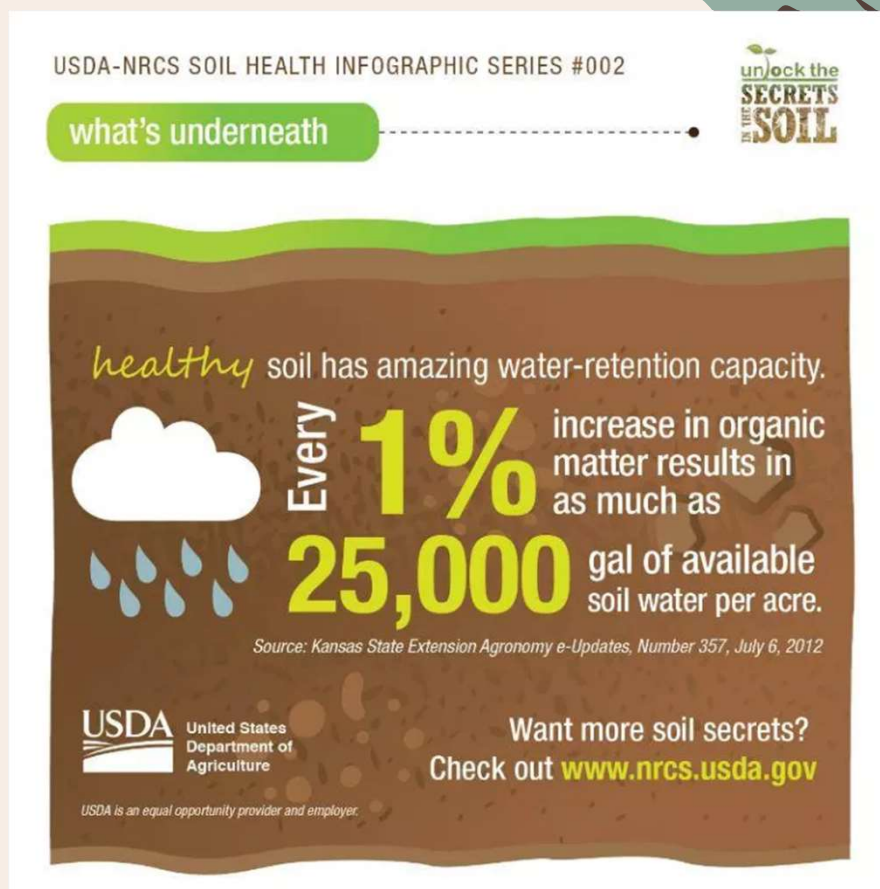
- The topmost layer of the soil is where organic matter is found, averaging only about 5% by volume.
- Of that average 5% - 80% is humus, 10% is roots, and 10% is organisms.



Topsoil Pros

- By feeding the 20% or so of living organisms (plants, animals, and micro-organism), the amount of humus increases.
- For every 1% of organic matter increase in the topsoil, water is retained and stored inground – as much as 25,000 gallons per acre.

That's the same amount of water as a 33' round above-ground swimming pool with 5' of water!



Amending Topsoil, Adding Organic Matter

- It's considered best practice to get a soil test completed so you know how much organic matter exists in your soils.
- UMass-Amherst conducts soils analysis for property owners (\$20), with organic matter at an additional price (\$6).

UMass Soil Lab:

<https://ag.umass.edu/services/soil-plant-nutrient-testing-laboratory>

Soil testing order form:

https://ag.umass.edu/sites/ag.umass.edu/files/pdf-doc-ppt/routine_home_grounds_101019.pdf

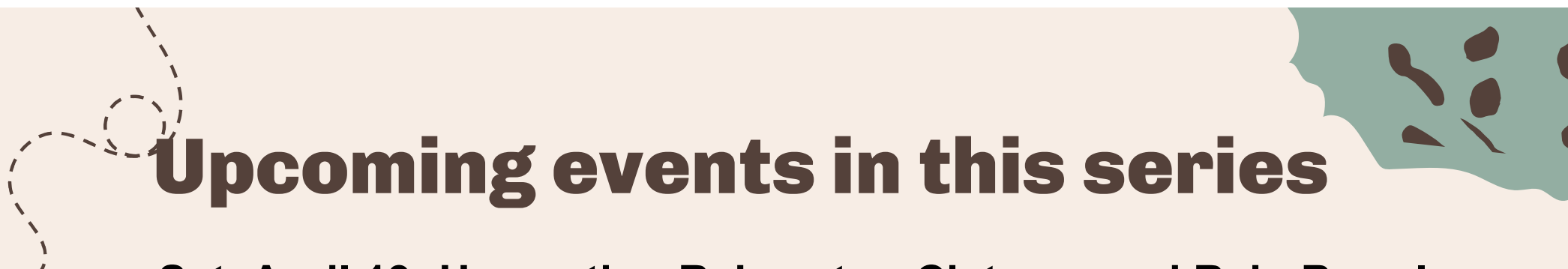


Soil and Plant Nutrient Testing Laboratory

- Strategies to amend your topsoil to increase organic matter varies depending on your ground cover, i.e. lawn versus gardens vs forests
 - For lawns, consider applying a thin layer of organic compost in the late fall and switching to a more organic approach to lawncare.
 - For gardens, use non-dyed mulches, leaf litter, or wood chips
 - In wooded areas, best to let nature take the lead and keep your forest healthy!



UNH Extension



Upcoming events in this series

Sat, April 13: Harvesting Rainwater: Cisterns and Rain Barrels

Patty Gambarini and Kyle Finnell

Pioneer Valley Planning Commission

Sat April 27: Soak Up the Rain: Rain Gardens and Bioswales

Rachel Lindsay, Regenerative Design Group

Sat. May 4: Soak Up the Rain: Porous Paving

Rachel Loeffler, Berkshire Design Group



www.hilltownlandtrust.org/get-involved/events

05 – Questions and discussion

