



Shoreland Best Management Practices

Amy Picotte, Vermont Shorelands Program
2020 Natural Shoreland Erosion Control Certification Training



Mergansers on Maidstone Lake by Rebecca Scott



Belted kingfisher by Helene Grogan



by Kate Jerome















Traditional Shoreland Development

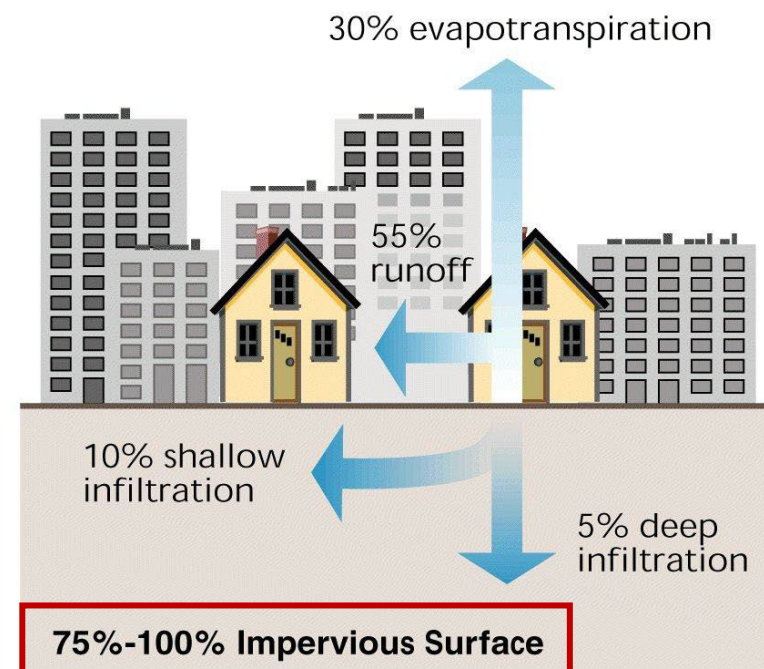
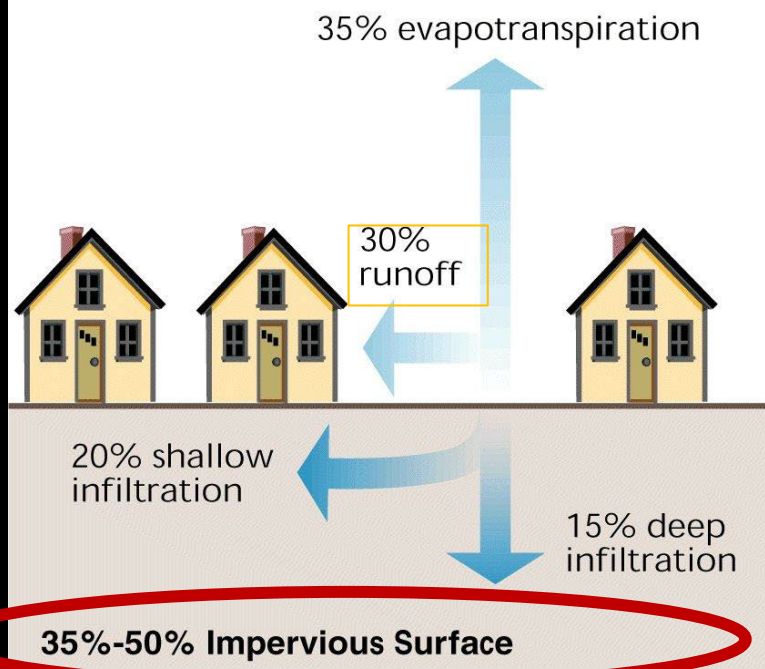
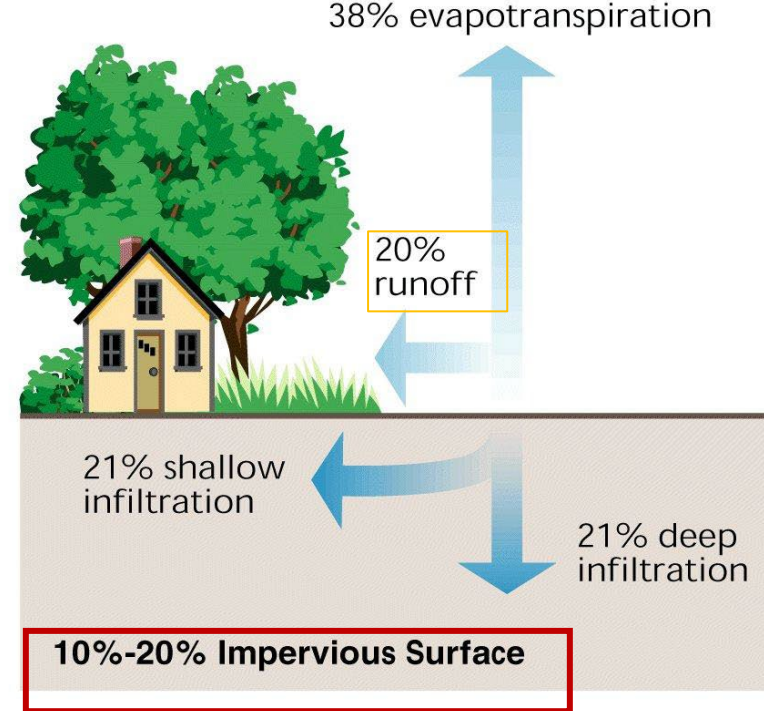
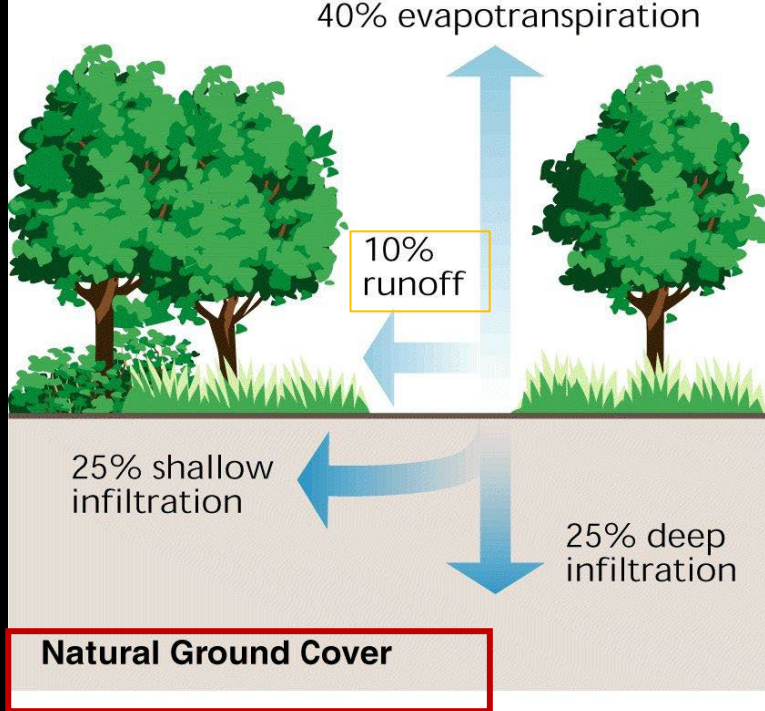




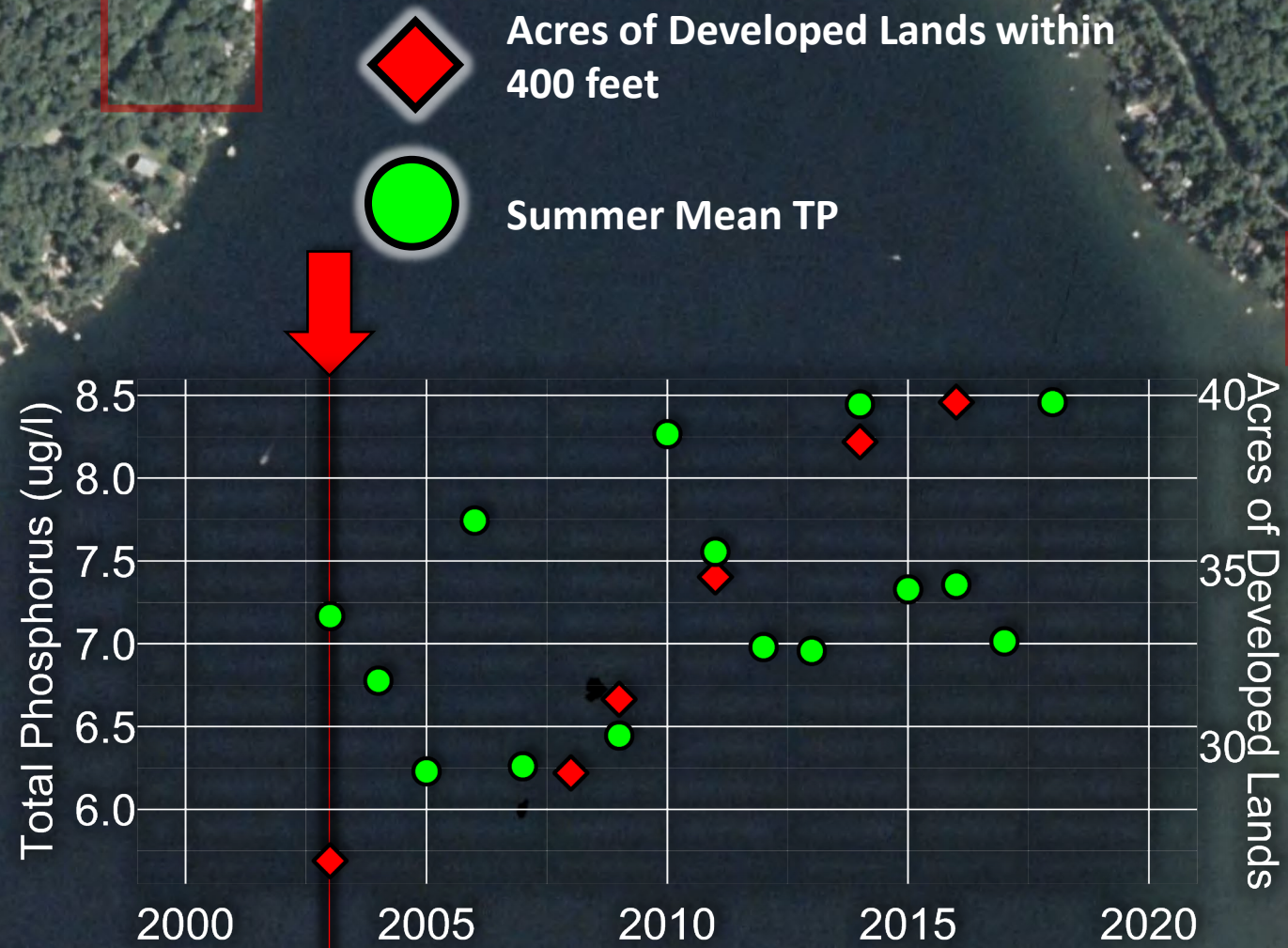
The Greatest Density of Residential Development is Along Lakeshores



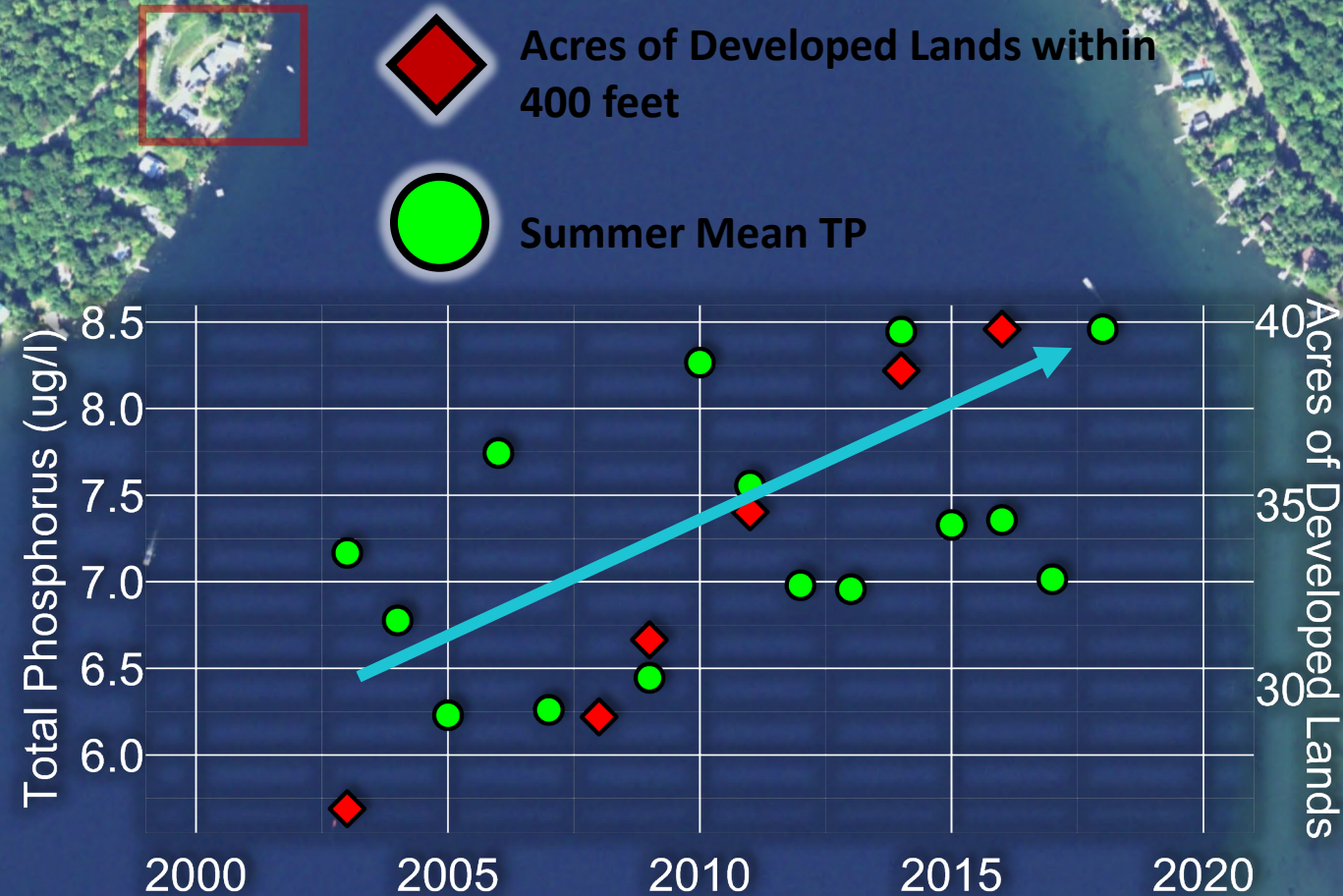
**Period of
Shoreland
Restoration**



MAIDSTONE 2003



MAIDSTONE LAKE

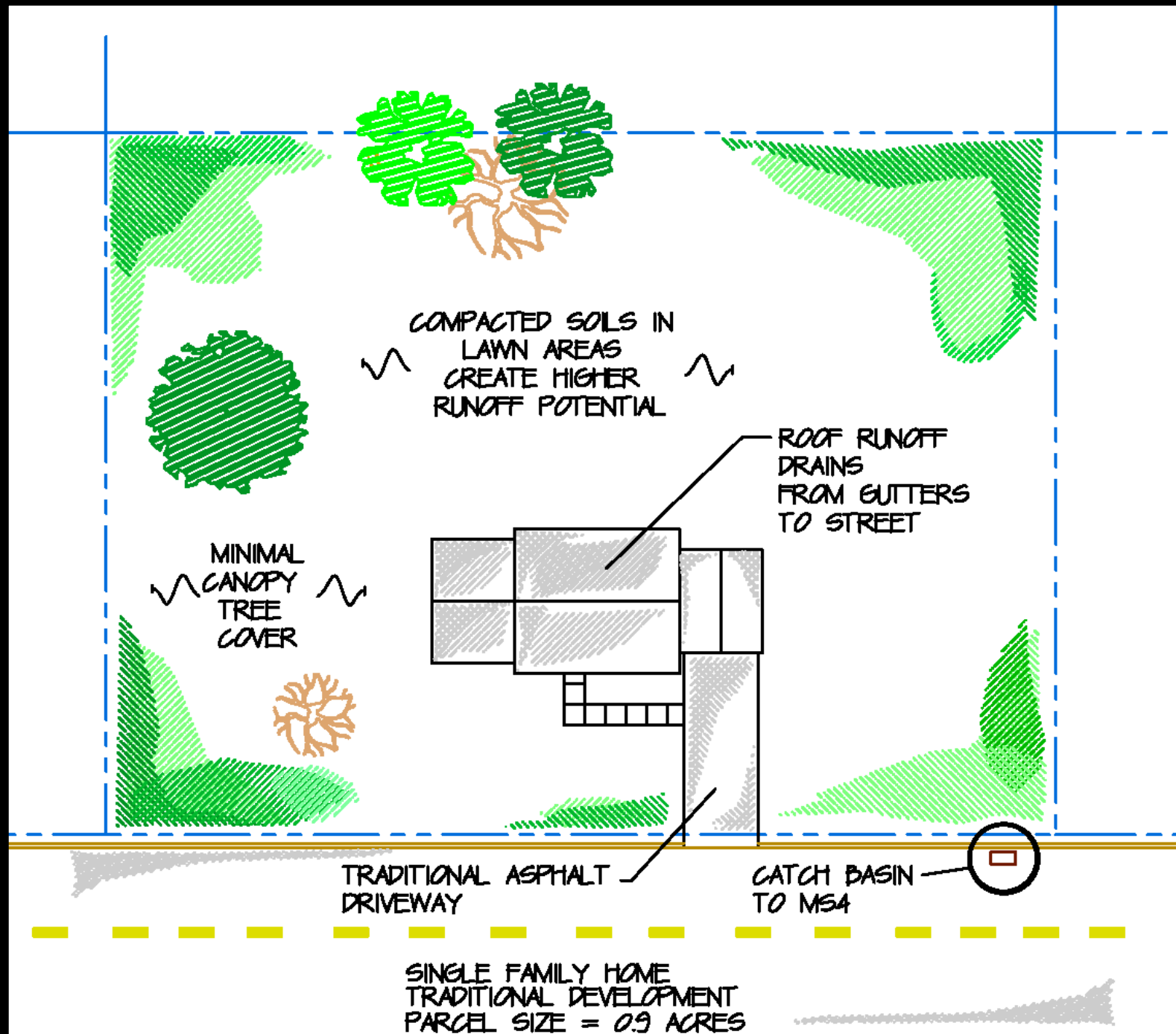


37% Increase in Impervious Surface and 10% Increase in TP

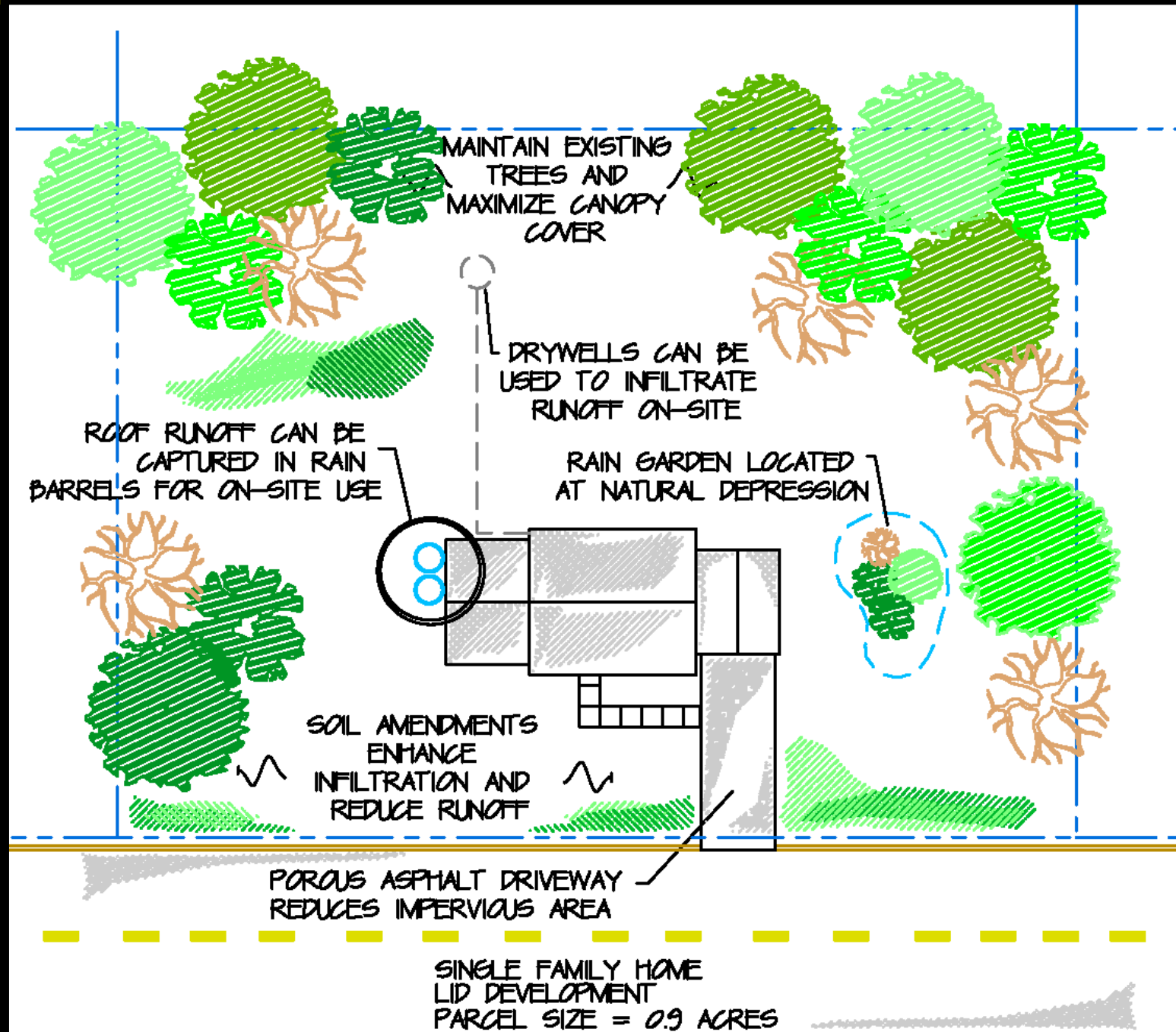
Nashoba Brook Watershed, MA

Traditional Suburban Development

- Runoff: 8.9 in/yr
- Infiltration: 28.1 in/yr
- TSS: 213 lb/ac/yr
- TP: 0.72 lb/ac/yr



Nashoba Brook Watershed, MA

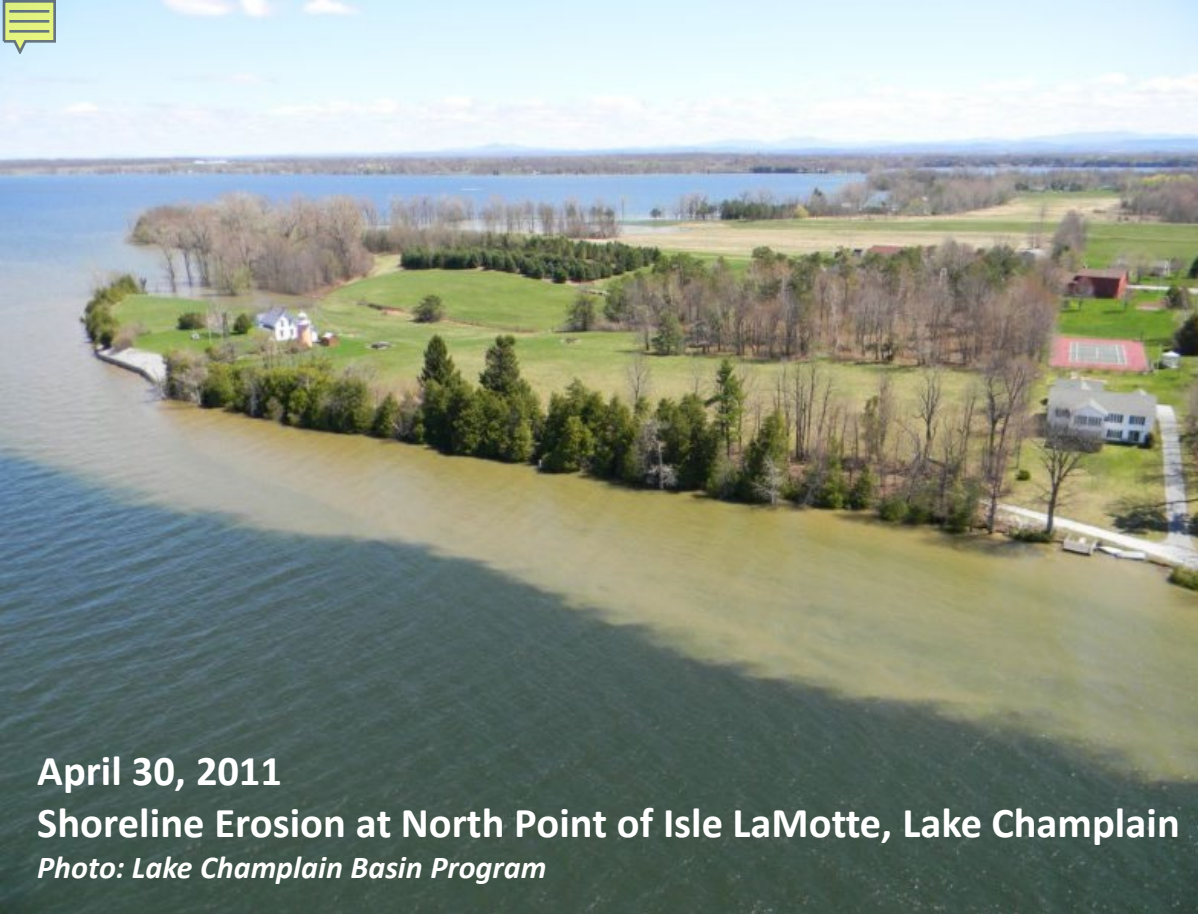


- ↓ ■ **Runoff: 1.9 in/yr**
- ↑ ■ **Infiltration: 35.2 in/yr**
- ↓ ■ **TSS: 68 lb/ac/yr**
- ↓ ■ **TP: 0.27 lb/ac/yr**



What are Lake-friendly Practices?

**95% of America
Converted from Natural Landscape**



April 30, 2011

Shoreline Erosion at North Point of Isle LaMotte, Lake Champlain

Photo: Lake Champlain Basin Program

Vegetative

- Infiltrate
- Filter
- Benefit Wildlife

Structural

- Infiltrate
- Filter

Shoreland BMPs

DRIVEWAY

Standards

- Defined and minimized driveway
- Minimized soil compaction
- No erosion
- Runoff channeled away from the lake

BMPs

- Crowned drive-ways, good gravel, & rock or grass-lined drainage ditches
- Open-top culverts & rock aprons
- Infiltration trenches
- Vegetated Swales
- Turn-outs
- Waterbars
- Pervious pavement

RECREATION AREA

Yards, Footpaths, Gardens, Patios

Standards

- Minimum of 15 ft of vegetation from shoreline
- Minimal lawn area
- Soil erosion is not occurring on site
- No pet waste accumulation
- No solid waste scattered
- No pesticide, fertilizer, or runoff to lake

BMPs

- Infiltration steps
- Rain gardens
- Waterbars
- Vegetative swales
- **Vegetated Berms**
- Establishing no-mow zones
- Planting and maintaining vegetative zones
- Planning pathways
- Lake-friendly yard maintenance

STRUCTURES/SEPTIC

Standards

- Less than 20% of property contains impervious surfaces
- Properly functioning leach field
- No uncovered oil tanks
- No erosion caused from impervious surface runoff

BMPs

- Dripline trenches
- Infiltration trenches
- Rooftop downspout disconnection and drywells
- Rain gardens
- Vegetated swales
- Septic system primer
- Ensuring septic system quality
- Non-structural

SHOREFRONT

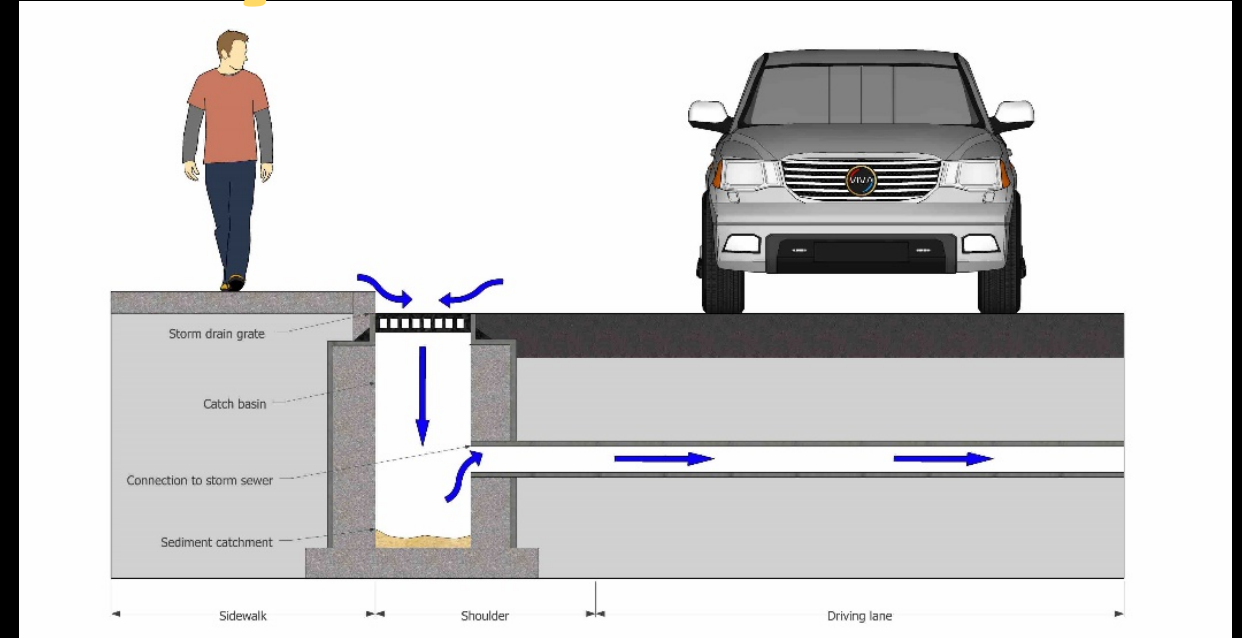
Standards

- Natural conditions
- Stable bank
- Minimum of 15 ft width of vegetation area for developed sites
- Minimum of 100 ft width for undeveloped sites
- No unfiltered runoff to the lake
- Shallow water areas natural and not "cleaned up"

BMPs

- Conserving lake-shores
- Managing shoreland vegetation
- Resloping, rock toe & riprap
- Live staking
- Establishing no-mow zones
- Planting and maintaining vegetated areas
- Planning pathways
- Waterbars
- Permits needed?

Conventional or “Grey” Stormwater



Convey Stormwater Away Without Treatment

(Farrelly & Brown, 2011; Rowe et al., 2016)

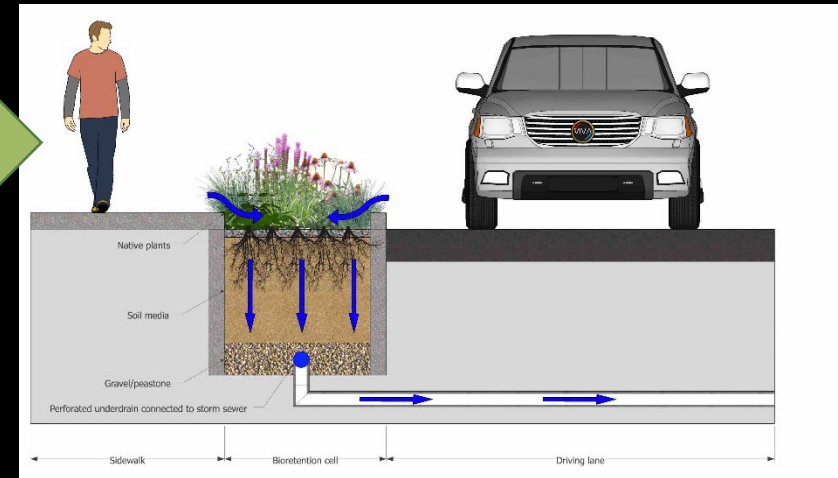
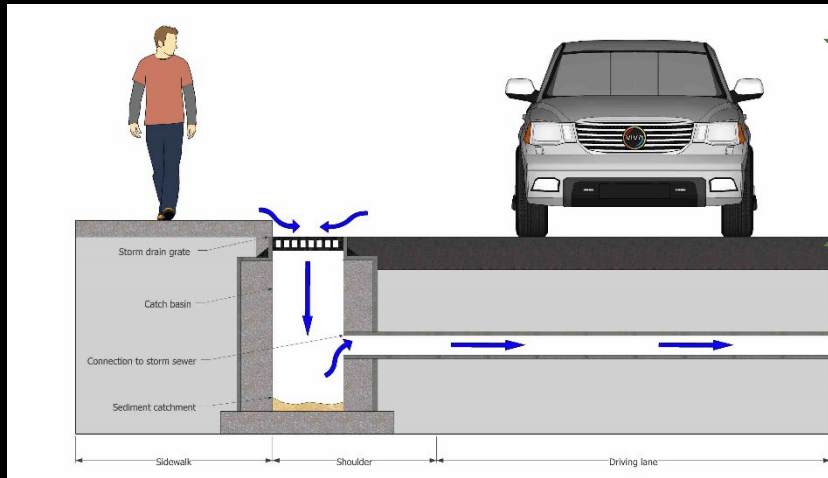
- Drains, Catch Basins, Pipes, Storm Sewers
- Ditches, Culverts



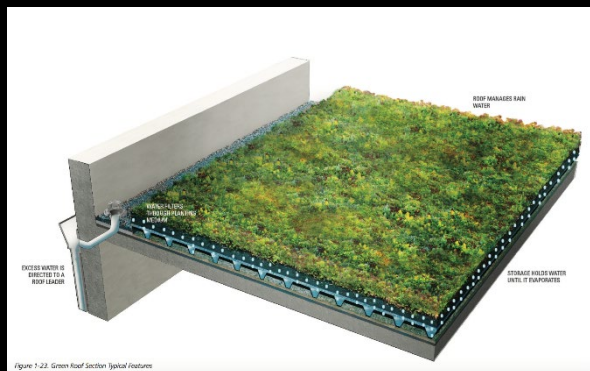
Green Stormwater Infrastructure

Ecosystem Services

Flood Control, Water Purification, Carbon Storage, Temperature Control, Clean Air, Habitat



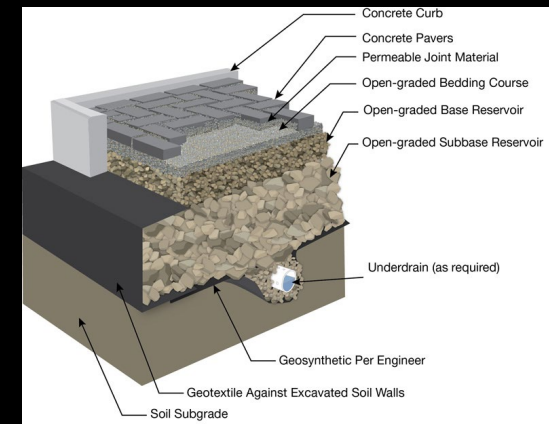
Infiltration Trench



Green Roof



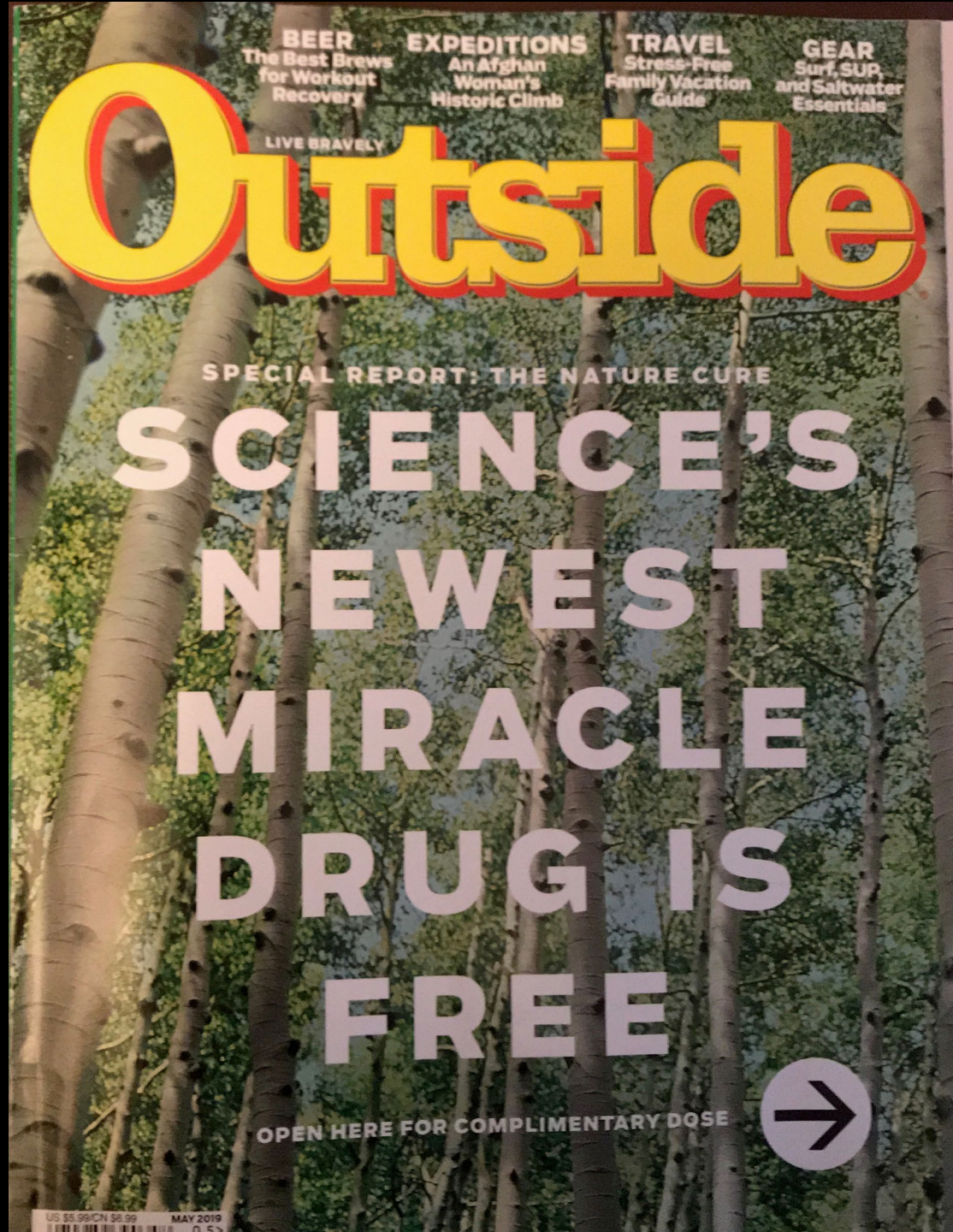
Storm Water Tree Pits



Pervious Pavers & Pavement

Cultural Services

Social benefits to
being near nature



...Nature Makes Us Smarter!

Apple – Google – Facebook – Samsung – YouTube – Airbnb
They're ALL using GSI and building Biophilic Offices



Apple 3 LEED-Platinum office in Santa Clara, CA

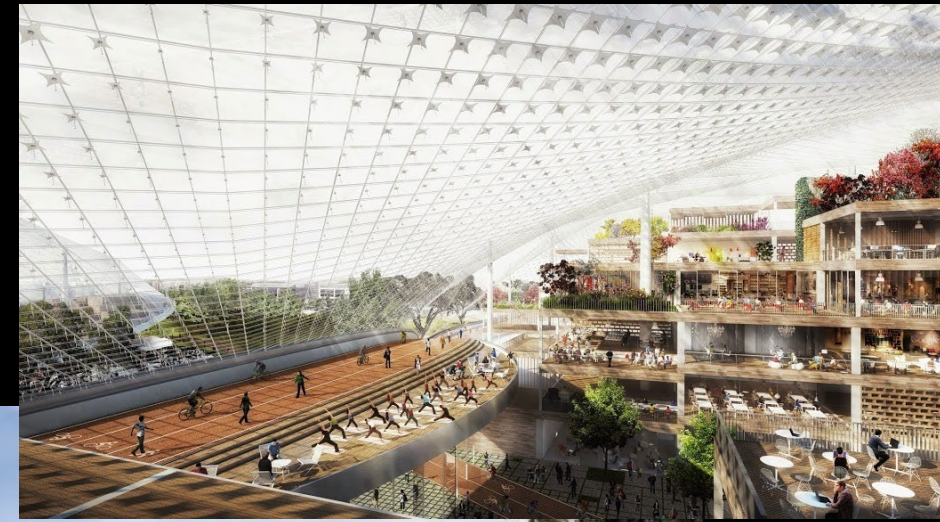


- 15% higher level of well-being
- 6% more productive
- 15% more creative overall

Google's New Campus

Design by BIG and Heatherwick Studio

- Restored natural habitat shelters cafes and a bike path
- Parking is hidden underground, below gardens



BLUEPRINT FOR THE PLANET

Architect Bjarke Ingels is drawing up a plan to save the world
By Ciara Nugent

BJARKE INGELS CAN SOMETIMES SOUND LIKE A MAD scientist. "One thing I've learned a lot about over the past year is stone flour," the 46-year-old Danish architect says over Zoom from his couch in Copenhagen. A mischievous smile spreads over Ingels' tanned, boyish face as he explains: during the last ice age, glaciers ground rocks down into a fine, nutrient-rich substance, which stimulated flora and fauna in some parts of the world. Geologists are now investigating stone flour's ability to bring life to infertile areas. "So say that in each container ship that sails across the oceans, you reserve four containers, fill them with stone flour and inject some when you cross a marine desert," he says. As plants grow, they would draw down carbon from the atmosphere, reducing the greenhouse effect. "Then you can turn on the carbon-sucking capacity of the oceans."

The outlandish scale of Ingels' thinking won't come as a surprise to anyone who's followed his career. Over the past decade, Ingels has gone from the enfant terrible of architecture—known for head-turning innovations like a mountain-shaped apartment block or a pair of twisting towers in Miami—to one of the busiest architects in the world. Bjarke Ingels Group, fittingly known as BIG, has won

BIG's ski slope on top of a power plant, opened to the public in Copenhagen in October 2019, embodies Ingels' ethos of "hedonistic sustainability"

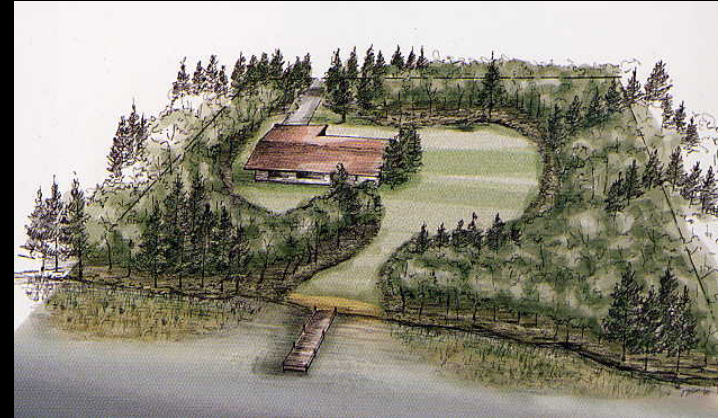
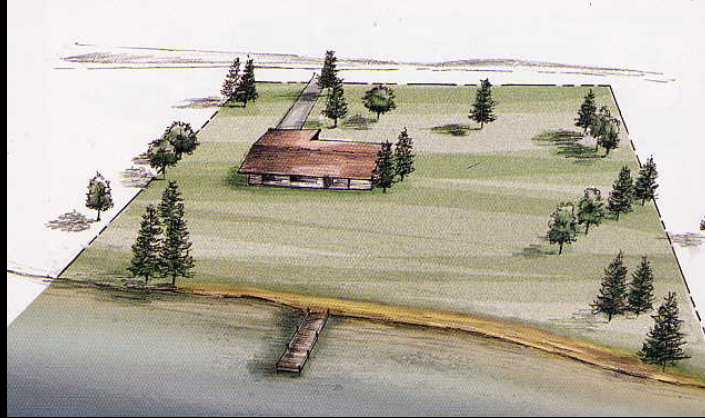


November 9, 2020 Time Magazine

GSI High Tech Solutions



GSI Low Tech Solutions



Minimal Disturbance for Maximum Benefits





Roads and Driveways

Open Top Waterbars



Decorative Waterbar



Infiltration Trenches Defined Parking Areas











Bioengineering – Encapsulated Soil Lifts



Municipal Roads General Permit

What does this mean for Lakes?

NO Cutting of Vegetation within 250 feet of a Lake!

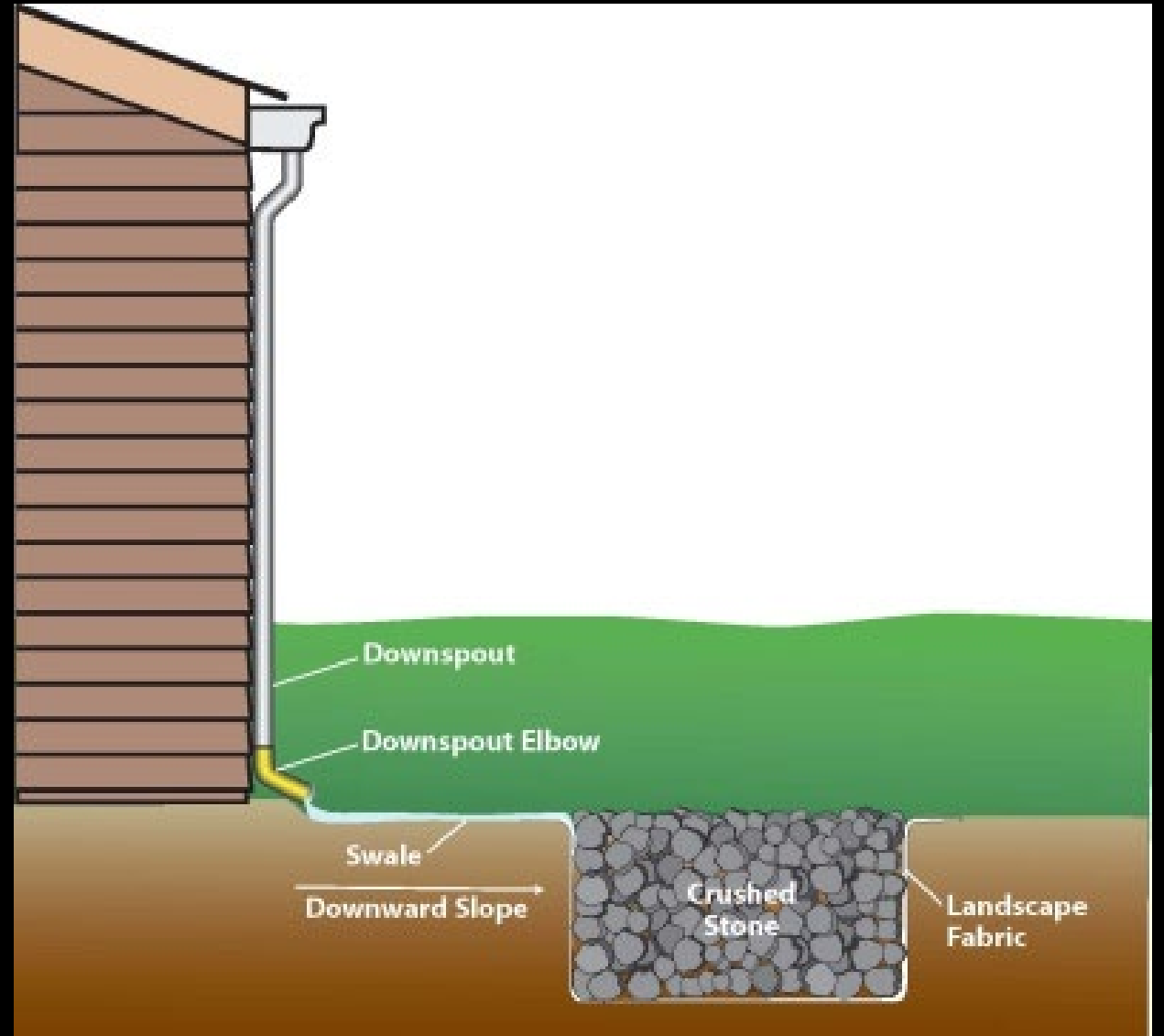




Septic and Structures



Drip Line Trenches



Dry Wells

- Most BMPs sized and designed for the 1" rainstorm
- 1,000 square feet of impervious surface generates 620 gallons of runoff

124 five-gallon buckets



FIGURE A:
Rain Garden Details

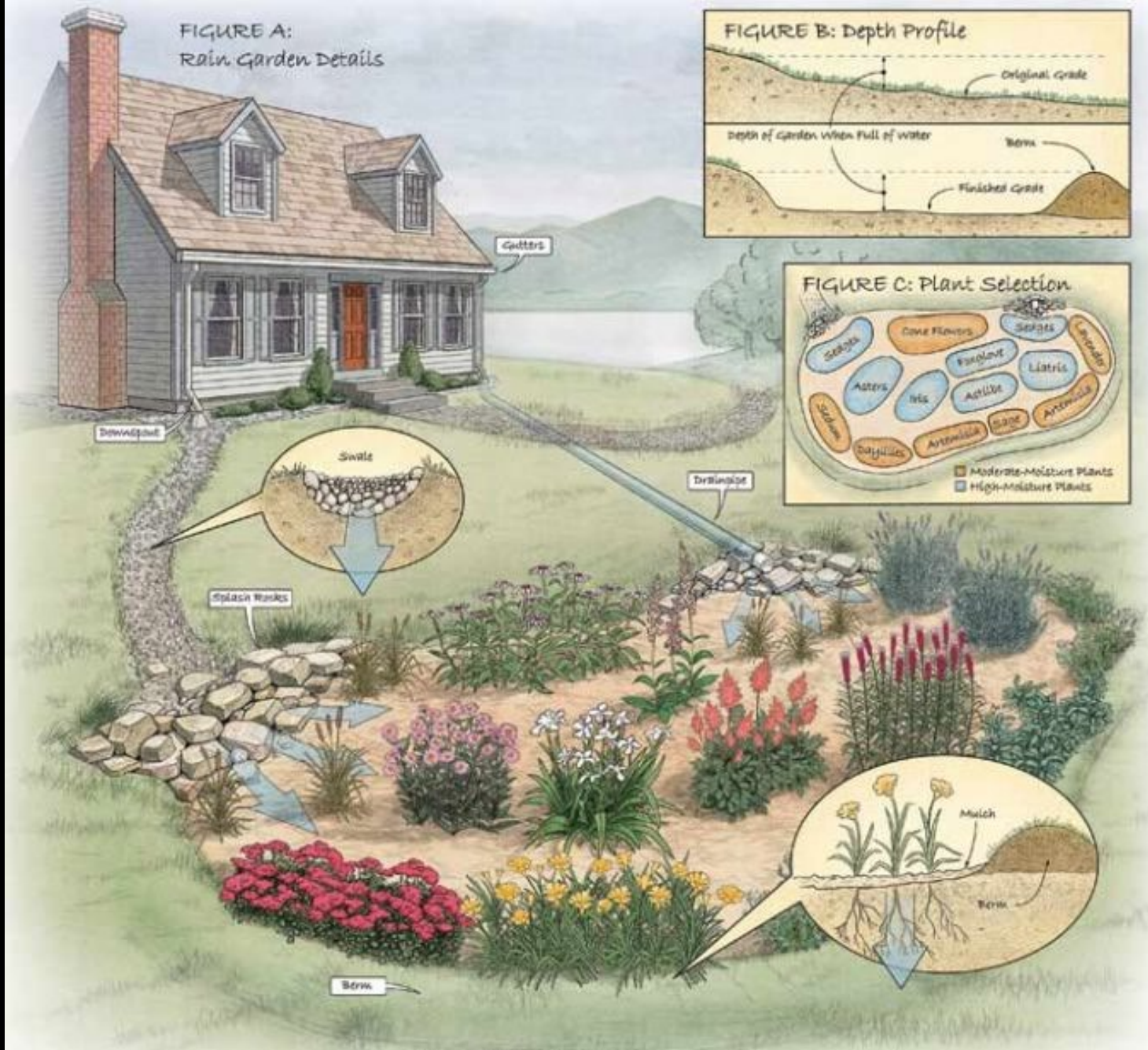


FIGURE B: Depth Profile

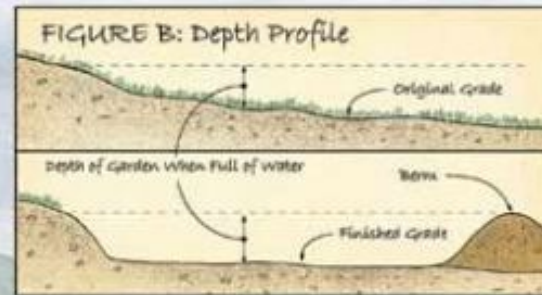


FIGURE C: Plant Selection







Street Edge Alternatives (SEA)

Functional Landscape

Reduced Impervious Area

**98% Stormwater volume
reduction for 2-year storm**

Sizing BMPS – Vermont Rain Garden Manual

1. Calculate area of impervious surface runoff

1000sqft

2. Calculate Slope

<4%, then 3-5" depth

| Slope | Depth |
|-------|--------|
| < 4% | 3-5 in |
| 5-7% | 6-7 in |
| 8-12% | 8 in+ |

3. Determine soil type

SILT

| Soil Type | Depth | | |
|-----------|--------|--------|--------|
| | 3-5 in | 6-7 in | 8 in + |
| Sand | 0.19 | 0.15 | 0.08 |
| Silt | 0.34 | 0.25 | 0.16 |
| Clay | 0.43 | 0.32 | 0.20 |

4. Plug info into the Sizing Table

$$\frac{0.34}{\text{Size Factor}} \times \frac{1000}{\text{Drainage Area}} = \frac{340 \text{ sq ft}}{\text{Rain Garden Area}}$$

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.

Sizing BMPs

VERMONT GREEN STORMWATER INFRASTRUCTURE (GSI) SIMPLIFIED SIZING TOOL FOR SMALL PROJECTS

This tool is designed to:

- Treat the first 1" of stormwater runoff from developed sites.
- Treat between 2,500sqft to a 1/2 acre of impervious surface.
- No more than 10,000 sqft of impervious surface should be directed to any single BMP.

Example Raingarden

Sited to receive and treat the max stormwater runoff.

Size depends on impervious area, soil media and ponding depth.

Minimum soil infiltration rate of 0.5 inches/hour.



Septic - Alternatives







Recreation Area





Before



After



Permeable Pavers

Silver Lake State Park, Barnard





Infiltration Stairs

Before

After



Maidstone Lake

Open Top Waterbar Draining to Raingarden



Shadow Lake, Glover



Harvey's Lake, Barnet
Federation of Vermont Lakes and Ponds



Before



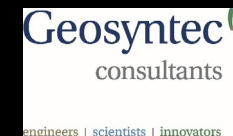
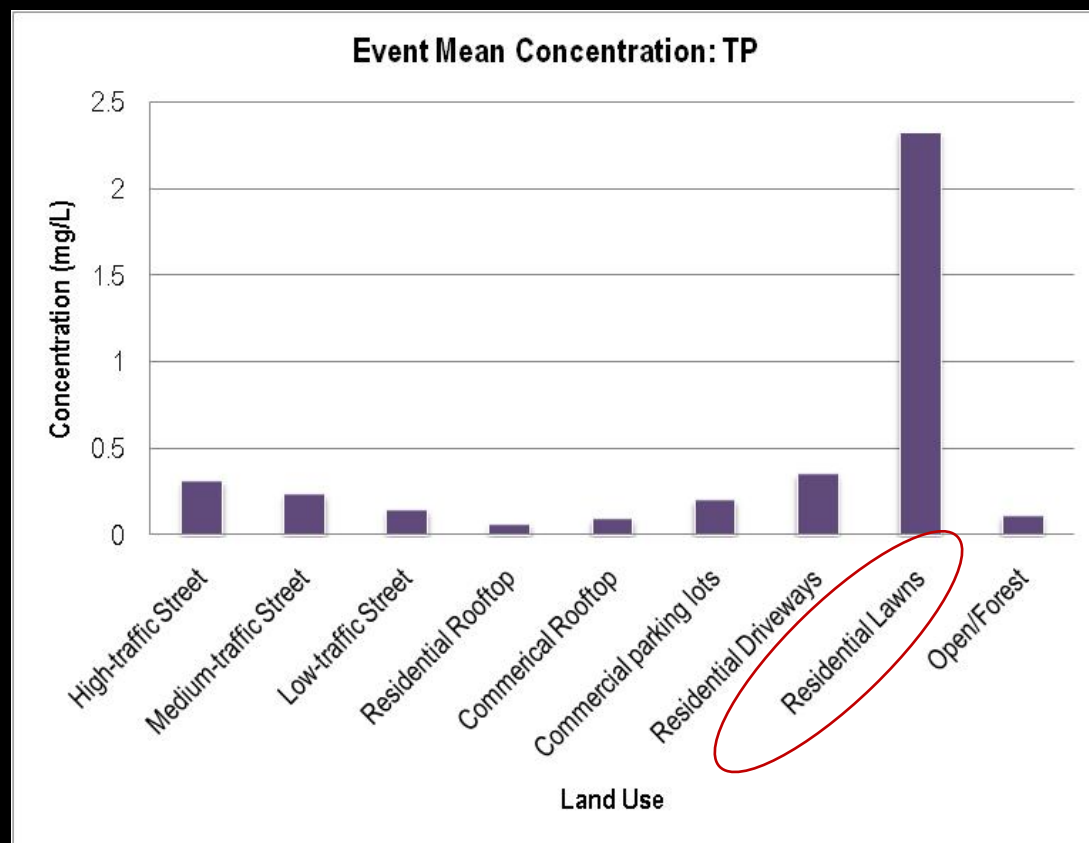
After





Shoreland





**Nashoba Brook
Watershed, MA**



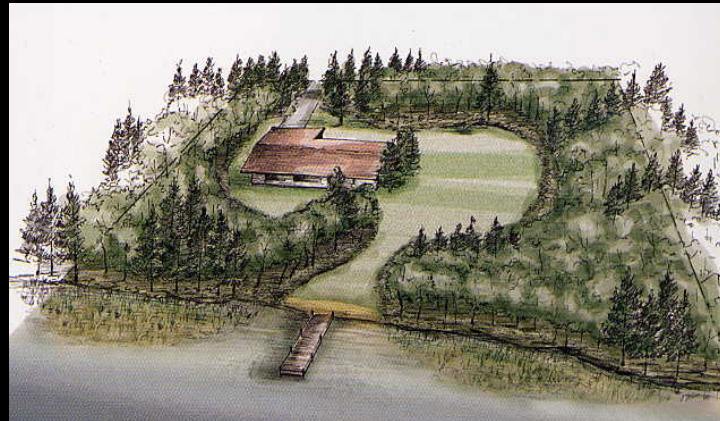
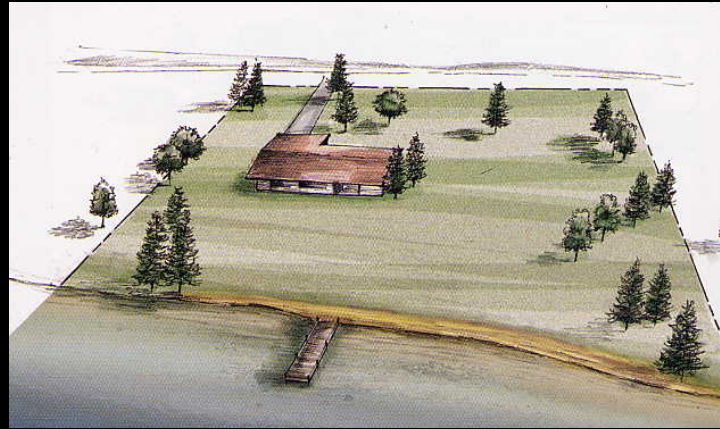
Create New Homegrown National Park

Tallamy's Challenge: Give Back Half of the 40 Million Acres of Lawn

Under 20 Million Acres

Adirondacks +
Yellowstone +
Yosemite +
Grand Tetons +
Canyonlands +
Mount Ranier +
North Cascades +
Badlands +
Olympic +
Sequoia +
Grand Canyon +
Denali +
Great Smoky Mountains

REMOVE Lawn to Make More Habitat



- Up to 40% of fresh water fish protein comes from insects dropped into the water from native plants



Raponda Town Beach, Wilmington



Vegetated Swale

Lake Raponda
Wilmington



Waterbars



Lake Wise Award



Lake Elmore – Lamoille County NRCD Lake Wise Project – No Mow Plantings

Echo Lake, East Charleston - No Mow Zone

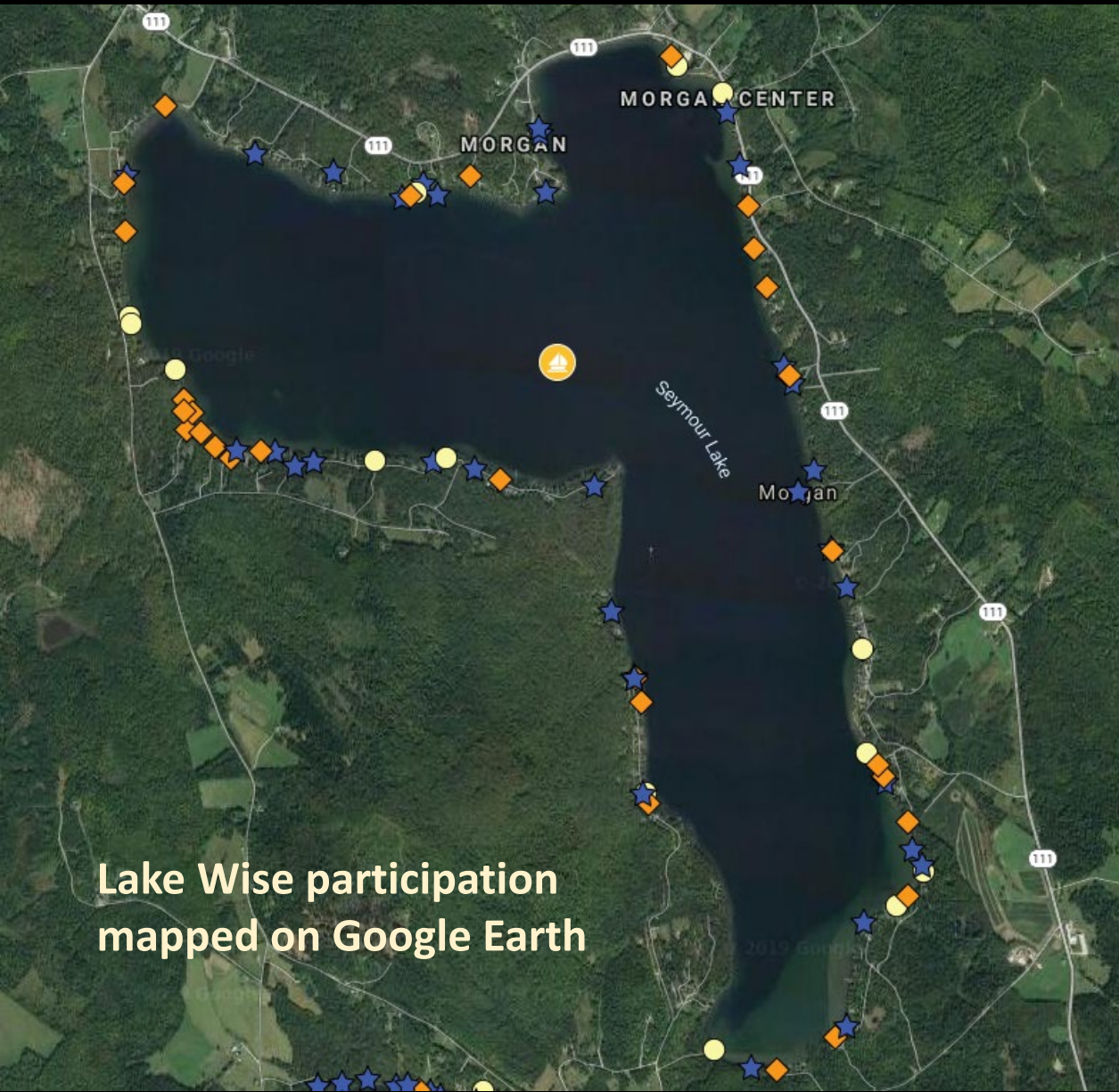




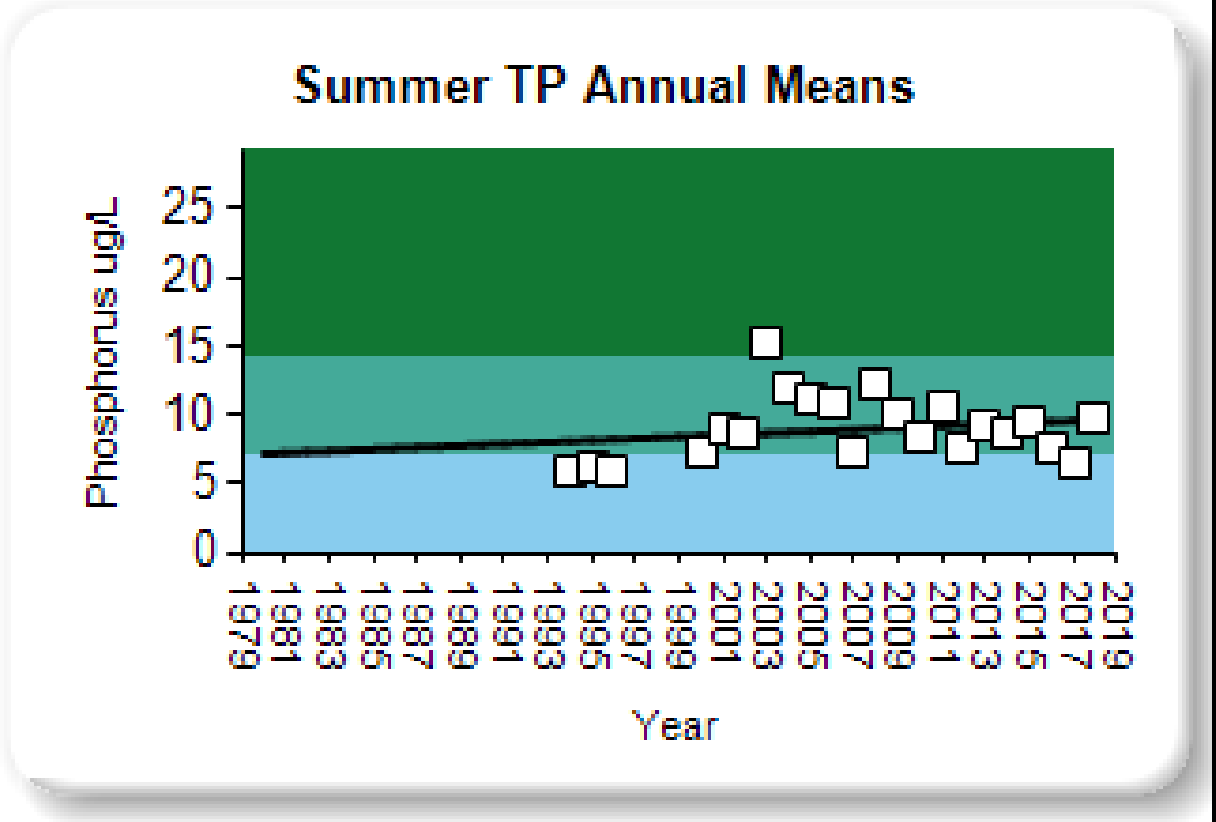
Lake Iroquois, Williston – No Mow

2020 Projects





Summer TP Trend: $p = 0.3183$ | CV = 22
Stable



Governor Phil Scott Awards The FIRST GOLD LAKE AWARDS to Seymour & Echo Lakes





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