

# Combined Impacts of Climate Change and Future Development on Water Resources



Sara Burns [sara.burns@tnc.org](mailto:sara.burns@tnc.org)

# Nature-Based Solutions

**Nature-Based Solutions (NBS)** are projects that **rely on nature**, to **protect public health** and **clean water**, to **increase natural hazard resilience**, and to **sequester carbon**. Incorporating NBS in local planning and design projects produces long-term solutions that benefit both human and natural systems.



Existing  
Ecosystems



Green Stormwater  
Infrastructure

# Natural Hazards: weather and other natural impacts that can cause damage



Riverine and  
Stormwater  
Flooding



Drought



Severe  
Storms



Extreme  
Temperatures

# How Does Climate Change Work?

Like a heat-trapping blanket!



- The atmosphere is like a blanket that surrounds the earth.
- When we burn fossil fuels like coal and oil for energy, we add more carbon dioxide to the atmosphere, which is like making the blanket thicker.
- The blanket has become too thick. It's trapping in too much heat, and the planet is warming rapidly.

# Precipitation Impacts: Seasonal Changes and Water Supply



## Changing Seasonal Precipitation:

Warmer springs and more precipitation increase the potential for mixed precipitation and variable spring weather.

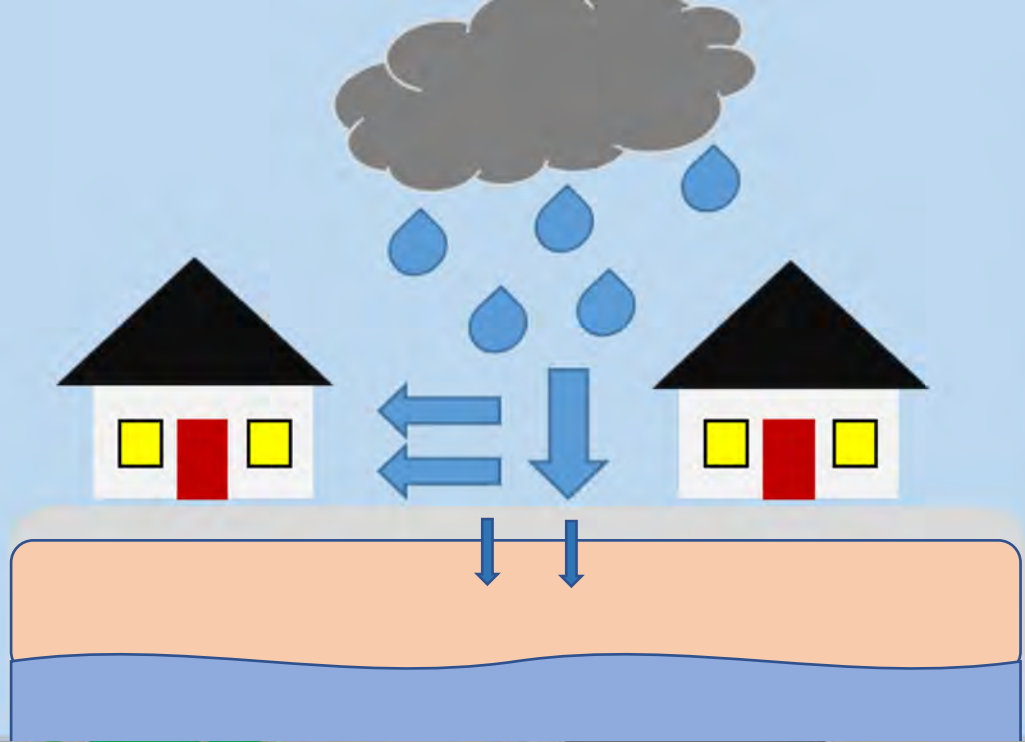


## Summer Water Availability:

Even as annual total precipitation increases, summers may become drier.

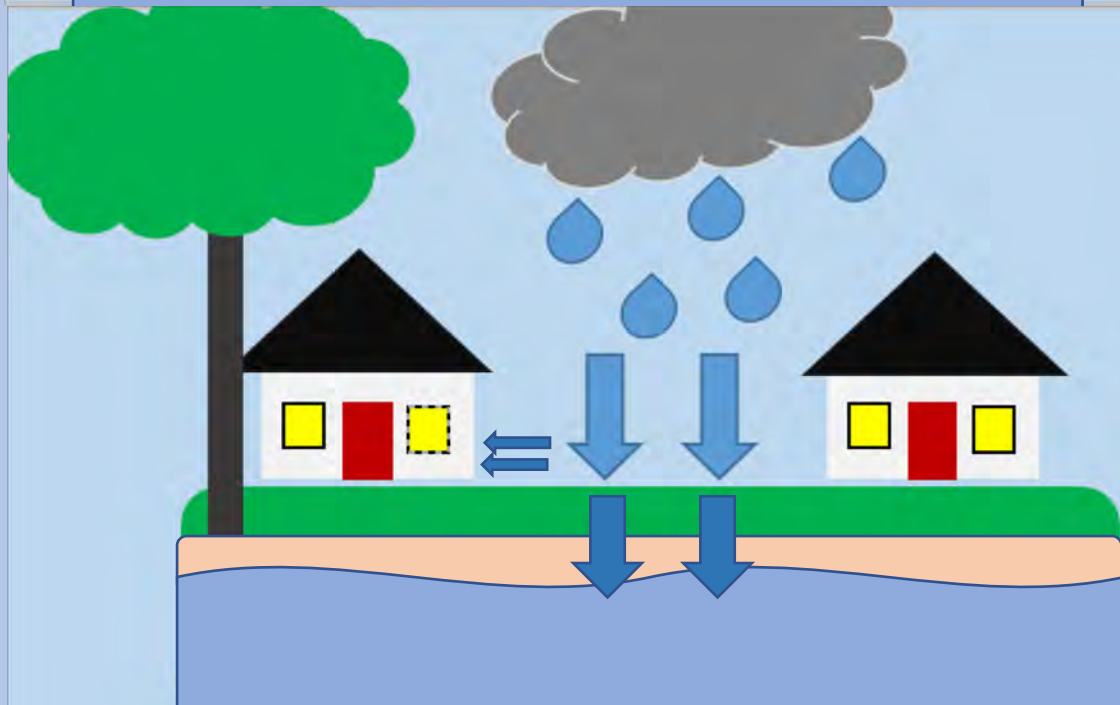
## Increasing Temperatures:

Increases: evaporation, water use



## Challenges of Impervious Cover

- less water infiltration
- more flooding



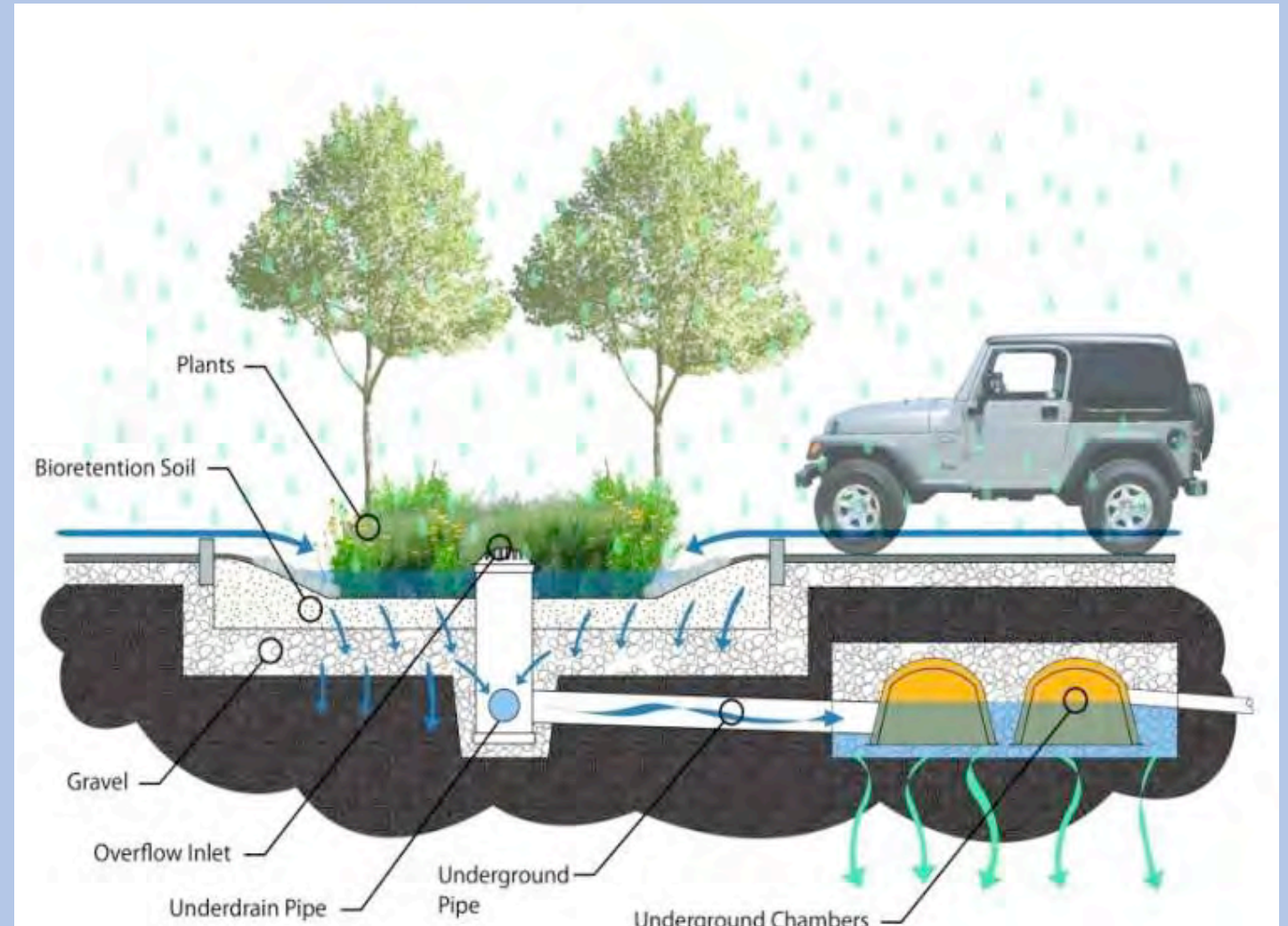
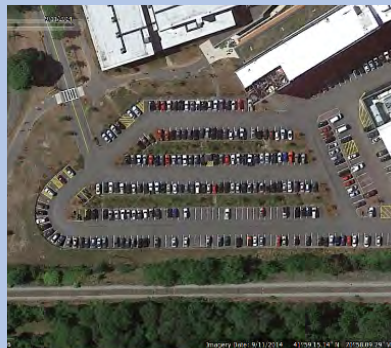
## Benefits of Natural Ground Cover

- more water infiltration
- less flooding

# Drought in Canoe River Aquifer, 2016

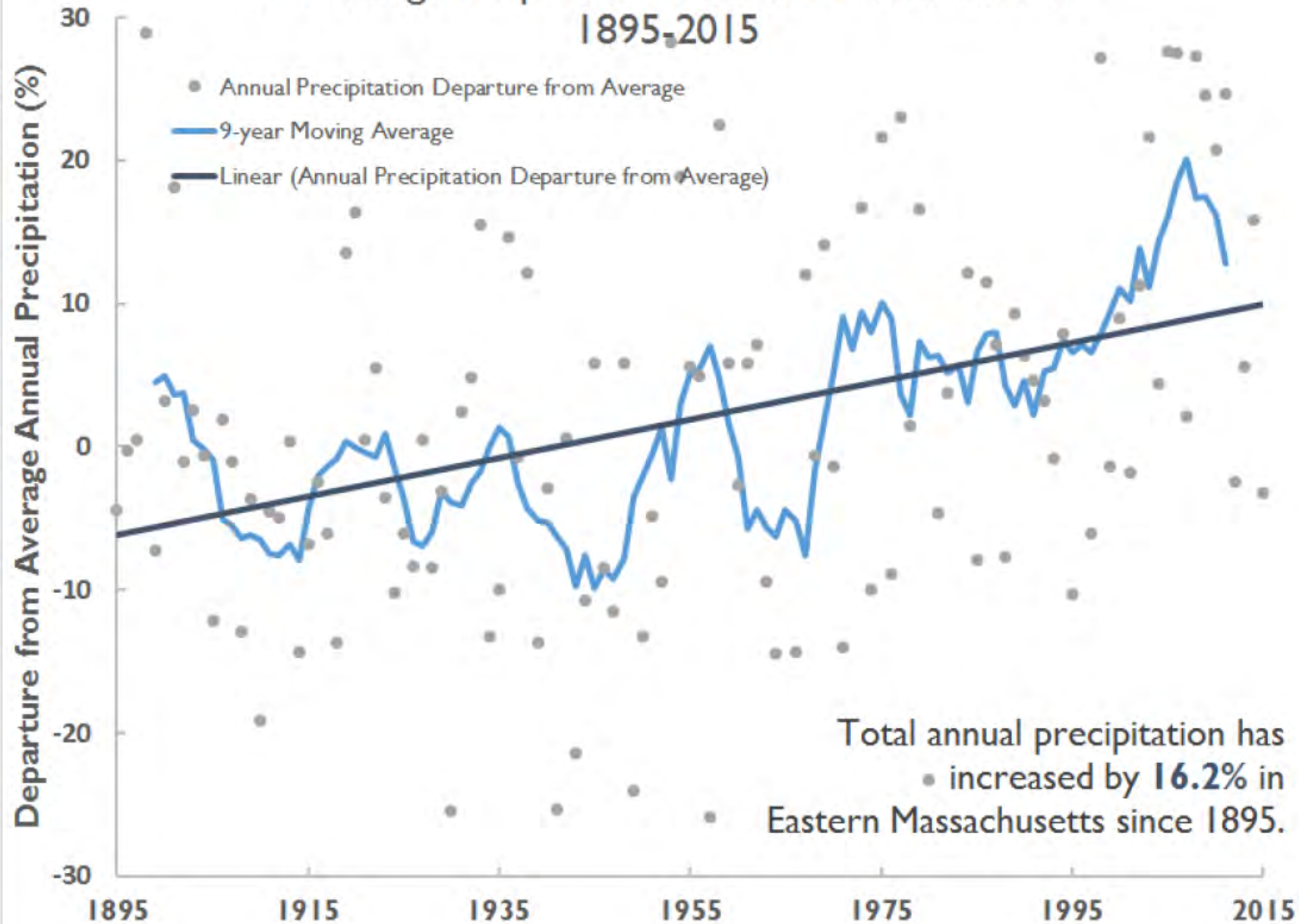


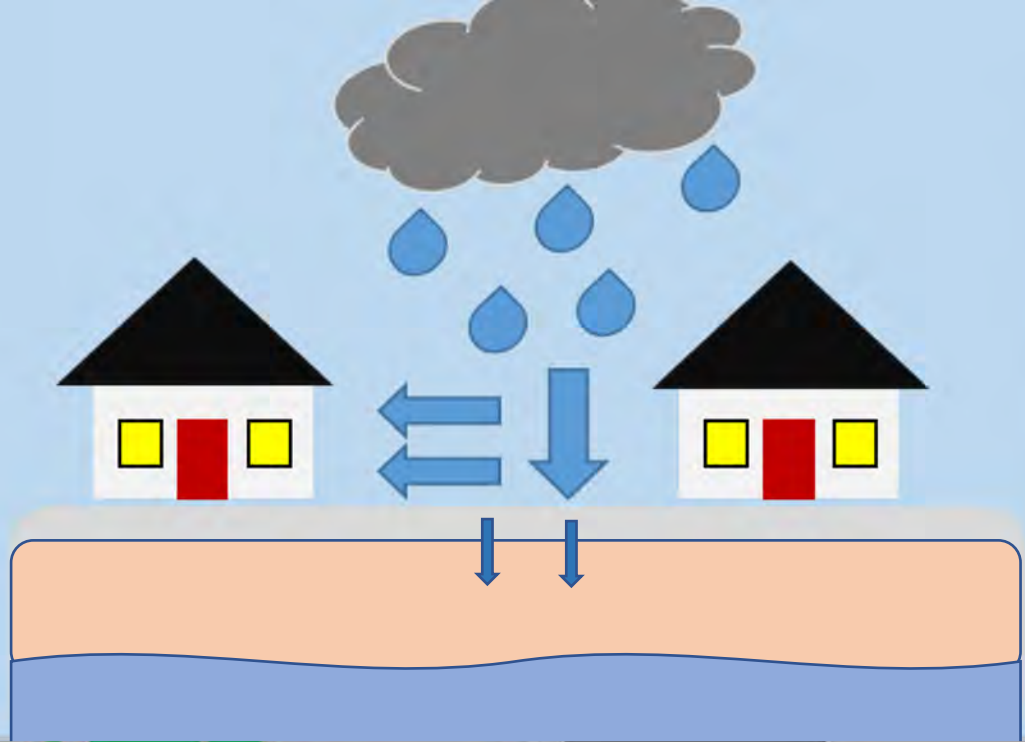
# LID for Drought Remediation – Bridgewater State University





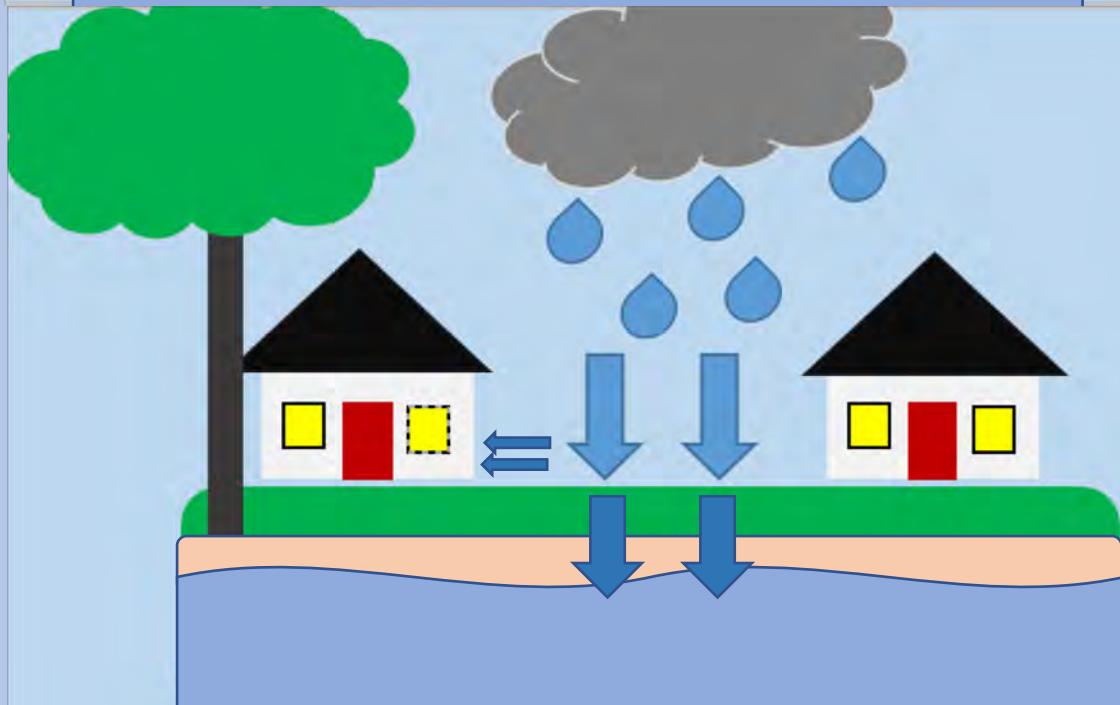
# Increasing Precipitation in Eastern Massachusetts 1895-2015





## Challenges of Impervious Cover

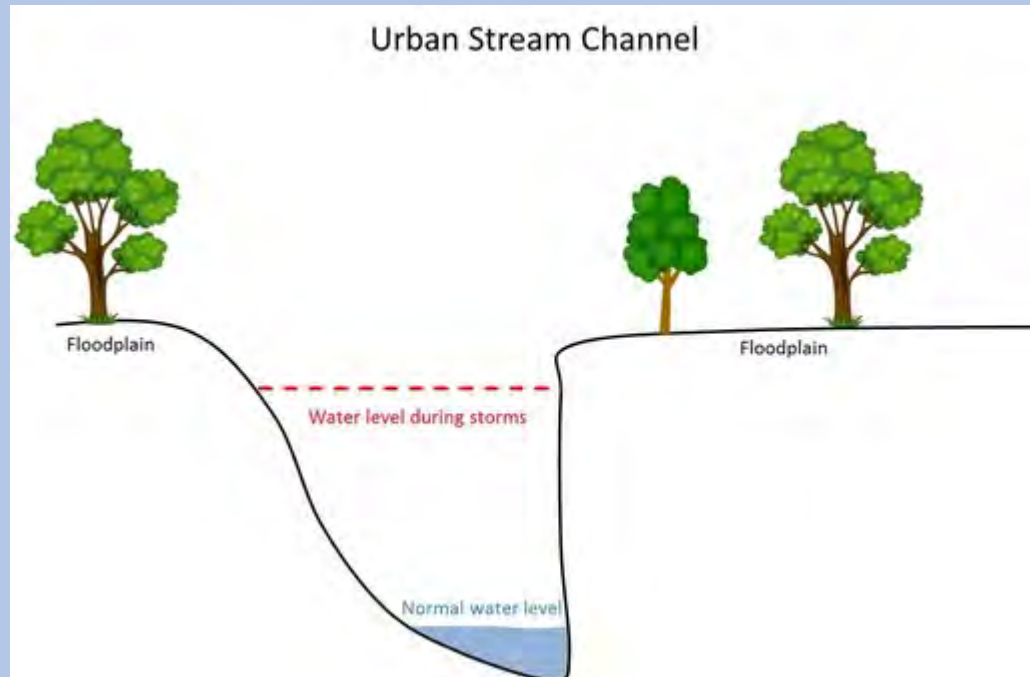
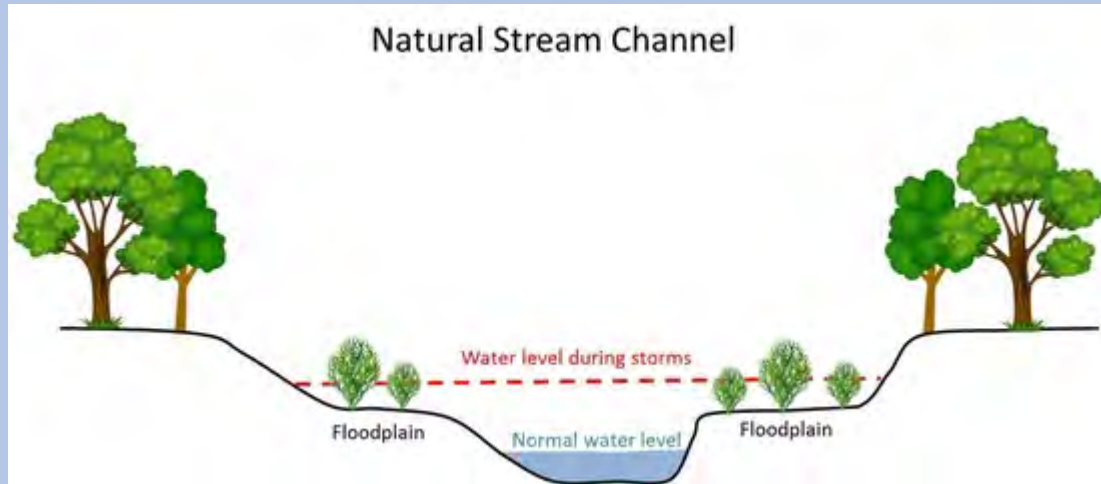
- less water infiltration
- more flooding



## Benefits of Natural Ground Cover

- more water infiltration
- less flooding

# Impacts of Stormwater Runoff



# Inland Flooding



# CRANE FARM PRESERVE STORMWATER IMPROVEMENTS NORTON, MASSACHUSETTS JUNE 2016



Sheet Number	Sheet Title
1	COVER SHEET
2	EXISTING CONDITIONS
3	CONSTRUCTION NOTES
4	DRAINAGE, DRAINAGE, AND DETAILS
5	LANDSCAPE PLAN

CRANE FARM PRESERVE  
STORMWATER IMPROVEMENTS  
NORTON, MASSACHUSETTS

Town of Norton  
70 East Main Street  
Norton, MA

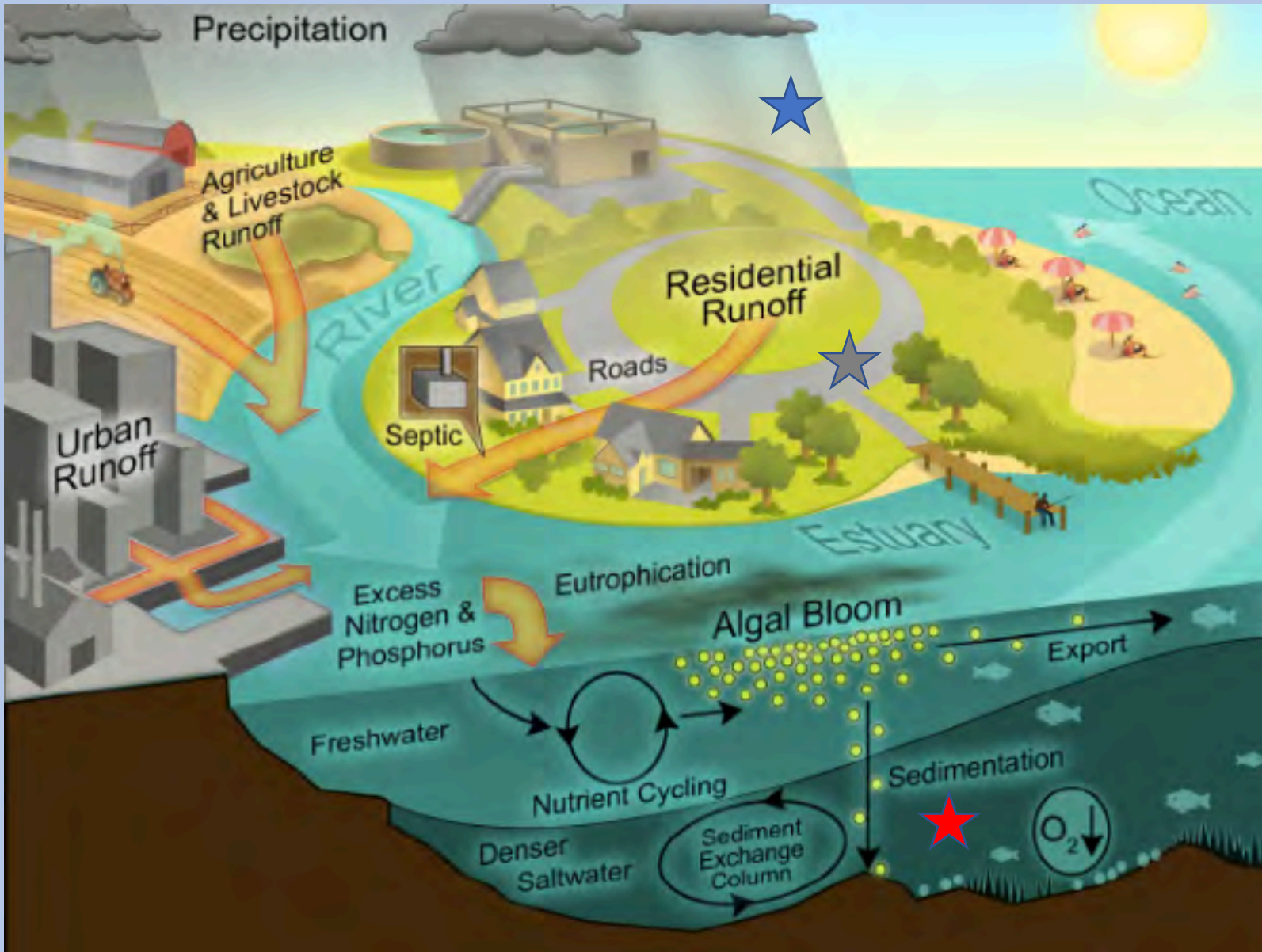
Project No. 16-001  
Scale: 1" = 100 Feet  
Date: 06/01/16

CRANE FARM PRESERVE  
STORMWATER IMPROVEMENTS  
NORTON, MASSACHUSETTS

Scale: 1" = 100 Feet  
Date: 06/01/16

Sheet No. 1 of 5  
C-1





**Strong Storms**

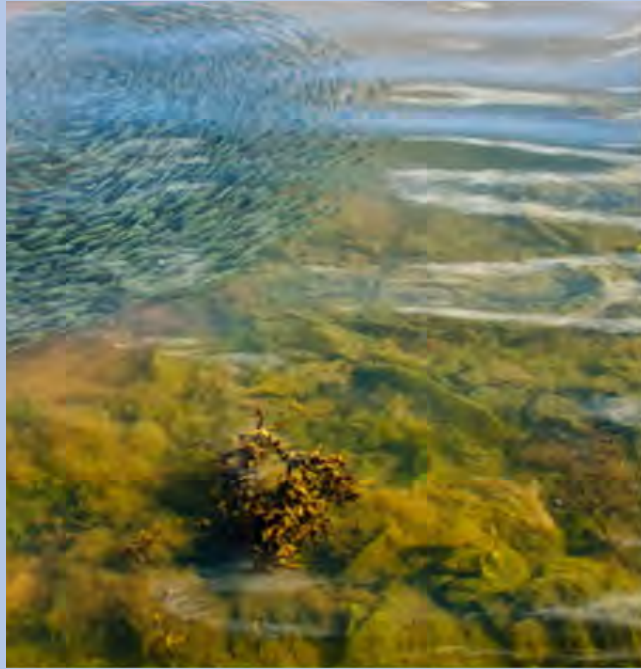


**Impervious Cover**



**Temperature**

# Water Pollution



## Coastal

Loss of Habitat

Decline in Property Values and  
Recreation

Loss of Fishing Industry – shell and  
fin



## Fresh

Impacts to water supplies

Loss of Habitat

Decline in Property Values and  
Recreation

Loss of Fishing Industry – shell and  
fin



## How to Compare Local Land Use Regulations with Best Practices

### Key Areas of Analysis

The following analysis framework is designed to assist communities in Massachusetts in applying cost-effective Low Impact Development (LID) techniques. Specifically, this template enables you to evaluate local land use regulations in relation to models and examples from the Commonwealth of Massachusetts' Smart Growth/Smart Energy Toolkit and other sources in relation to the use of LID and Green Infrastructure (GI) techniques. The focus is primarily on residential development, but the concepts are also applicable to other forms of development and redevelopment.

Best practices minimize the alteration of natural green infrastructure such as forests; reduce creation of impervious surfaces; support retention of naturally vegetated buffers along wetlands and waterways; minimize grading and alterations to natural flow patterns; and support the use of LID techniques as the preferred, most easily permitted methods for managing stormwater.

Get more details on LID's many cost-savings and other benefits, and our customizable bylaw review chart, at: [www.massaudubon.org/LIDCost](http://www.massaudubon.org/LIDCost).

Local coordination across municipal boards and permits is also important for supporting LID. Application of these practices can result in significant savings in infrastructure maintenance costs, as well as improved water quality and protection of water supplies, while supporting property values and overall quality of life. Sustainable development

# Make Your Regulations Work Towards Your Goals!

Review bylaws, ordinances, zoning, and other considerations for overall site design, LID project standards, and maintenance and operations considerations.



# The power of a bylaw: Westford

- Open Space Design as a preferred by – right option

## Benefits

- 1,700 Acres of land Protected
- Preserved local habitat and water resources
- Created 13 miles of hiking trails & public recreation
- Town saved millions of dollars



Rail Trail in Westford

# Strategic Planning for NBS

Planning Document	Regional Capacity	Funding Opportunities	Opportunity to strategize NBS
MVP	Yes	Action Grant	Yes
Hazard Mitigation	Possible	Hazard Mitigation Grant	Yes
Open Space and Recreation Plan	Possible	Local Budgets, State and Federal Grants	Yes
Master Plan	Possible	Local Budgets, State and Federal Grants	Yes