Town of Littleton Massachusetts

Community Resilience Building Workshop

Summary of Findings

June 2018

Overview and Objectives

The Town of Littleton, Massachusetts completed Community Resilience Building Workshops on May 15 and 22, 2018. Presentations for the workshops are included in Appendices A and B. Theses workshops were funded by a Municipal Vulnerability Preparedness grant administered by the Massachusetts Executive Office of Environment and Energy (EOEE) to provide communities with funding and guidance to support integration of climate change considerations into planning efforts, including hazard mitigation planning. The central objectives of the workshops are to:

- Define top local natural and climate-related hazards of concern;
- Identify existing and future strengthen and vulnerabilities;
- Develop prioritized actions for the Community; and
- Identify immediate opportunities to collaboratively advance actions to increase resilience.

Planning and implementation of the workshops were led by a joint effort of the Littleton Sustainability Committee, the Town Administrator's office, and the Department of Public Works. Guidance and resources on the MA Community Resilience Building website available at: CRB Resources.

Workshop presentations and materials are found in the accompanying appendices.

Context - Littleton Planning

Littleton recently completed processes to update both the Hazard Mitigation Plan (2017) and the Master Plan (2017). For our community, the intent of the MVP program was to bring together Town staff, board and committee members, and representatives of community business sectors, to review the range of potential changes in climatic conditions that Littleton may experience, to identify vulnerabilities and to consider possible mitigation measures.

> **"Many of the natural hazards that Littleton has historically experienced are likely to be exacerbated by climate change in future years. This is particularly true for flooding caused by extreme precipitation and extreme heat"**
>
> **Littleton Hazard Mitigation Plan 2017**

Littleton completed a comprehensive hazard mitigation planning exercise in 2017, resulting in a report that is available here **Littleton Hazard Mitigation Plan 2017**. The purpose of Hazard Mitigation planning is to identify actions that can be taken to reduce the dangers of life and property from natural hazards. Changing climate was identified as a factor that could affect many of the natural hazards that would continue to affect Littleton, and consideration of climate change in town planning was included as a Hazard Mitigation Goal, as follows:

> *Goal 9 : Consider the potential impacts of future climate change. Incorporate climate sustainability and resiliency in hazard mitigation planning.*

The Littleton Master Plan Update (2017) is available at Master Plan Update 2017.

Top Hazards and Vulnerable Areas

Top Hazards

Heavy precipitation

- Snow
- Rain
- Short intense events vs. increasing frequency of events

Drought

- Intensity
- Length of time
- Changes in seasonal timing

Temperature

- Heat

Cold

- Intensity, duration, changes in seasonal timing

Wind

- High gusts during intense storms

Unlike many communities in the northeast, Littleton has experienced little to no flooding of roadways and the drainage infrastructure has effectively managed rain and snow melt events. The Department of Public Works indicated that the only current flood control concern is related to beaver dams affecting local hydrology. Flooding of houses, primarily limited to basements, but widespread through the Town, routinely occurs in areas with high water table or poor natural drainage due to underlying ledge or tight overburden soils.

Areas of Concern

In general, identified hazards would affect the entire area of Littleton. Unlike some other communities, Littleton has not experienced significant flooding in any particular area, or on the transportation routes. Drought, temperature and wind affect all areas of the Town.

Infrastructure of Concern

- Potable water wells and water delivery systems
- Power lines – primarily overhead
- Lifecare Center of Nashoba Valley, Taylor Street
- MBTA train station and parking area, Taylor Street
- Residential septic systems
- Schools
- Littleton Motor Court Residential Community, Ayer Road

Natural Resources of Concern

- Long Lake
- Lake Wattawanakee
- Spectacle Pond
- Groundwater
- Wildlife Habitat

Current Concerns and Challenges Presented by Hazards

Based on the discussions during the two workshops, a risk matrix was developed by the workshop participants to describe, evaluate risk and rank climate-related hazards. This matrix is included in Appendix C. An overview of the principal current concerns and challenges are listed below.

Trees

- Damage to power lines from downed trees
- Loss of trees and loss of cooling effect

Water Conservation

- Increased erosion from intense rain events
- Water quality impacts from runoff and low water levels
- Changes in wetland extents and groundwater levels
    - Possibly leading to changes in design parameters for existing septic systems

Open Space

- Invasive species taking over conservation areas and open space

Agriculture

- New pests and pathogens
- Solar (climate change mitigation) displacing agricultural land
- Decrease in water quality and availability

Current Strengths and Assets

Based on the findings and plans identified during the Hazard Mitigation Planning and Master Plan update processes, Littleton is fortunate to have many strengths that mitigate climate change effects due the

- Littleton Police, Fire, and Public Works Departments have plans in place to support vulnerable populations in cases of emergency events, including extreme weather conditions including snow, flooding, and power outages.
- The Littleton Electric Light and Water Department has effectively maintained power and clean water supplies through extreme weather events through excellent planning, operations, and maintenance procedures.
- Littleton is fortunate not to be located within the flood plain of a major river, and is not prone to extreme flooding.
- Current drainage infrastructure has effectively mitigated flooding and is continually evaluated for effectiveness.
- The major surface waters in Littleton are buffered by vegetated areas to promote good water quality and habitat conservation.
- Littleton is home to an active farming community that practices low impact farming principles aimed at water and resource conservation that mitigate the effects of drought on crops.

Top Recommendations to Improve Resilience

Water Resource Conservation

The primary climate-related concerns identified during the Workshops were related to effects on water resources, including changing patterns of drought, intense rain and snow events, and the potential for negative effects on water quality. High value is put on water resources in Littleton for potable use, agricultural irrigation, recreation, aesthetics, and wildlife habitat. Water conservation measures are put in place annually during summer months. However, information on hydrology, groundwater levels, and flow patterns is not readily available. Several of the groups represented at the Workshop, including the Conservation Commission, Board of Health and the farming community, agreed that groundwater mapping would be useful. Littleton Water Department has groundwater level data that could be used to develop mapping, which would help to understand both existing seasonal conditions and how water resources are affected by climate change over time.

> **Recommendation**: Use available groundwater and surface water level data to develop GIS-based groundwater mapping, and provide Littleton Water Department with a template for future data so that it can be directly loaded into the GIS mapping database.
>
> This recommended action is consistent with the recommendation in the Master Plan Update (2017): *Evaluate the impact of climate change on natural resources and water supplies and draw up appropriate mitigation policies and plans. Establish open space corridors and riparian buffers that anticipate future increases in temperature and precipitation.*

Low Impact Development

Implementation of low-impact development (LID) techniques was also identified as a useful tool for water conservation, especially given the current rate of development in Littleton. This issue was identified during the first Workshop, and an expert in LID was

invited to make a presentation at the second Workshop; this presentation is included here as Appendix B. At the second Workshop, the group voted to apply extra MVP funds to review of the Littleton regulatory code for improvements that could be made to further support and encourage LID in future development projects in Littleton; this review is included here as Appendix D.

Trees

Trees are important for cooling effects, carbon sequestration, erosion control through soil stabilization, and aesthetics. Increasingly intense storms in Littleton have resulted in the loss of trees throughout the Town. The group identified replacement of shade trees as a priority action. Members of the Littleton Shade Tree Committee presented a proposal to plant up to 10 trees in selected locations, which the Group voted to approve using MVP funds to implement. The cost will be jointly shared with the Shade Tree Committee budget, which is severely limited.

Open Space, Conservation Land, and Invasive Species

As pointed out in the Littleton Master Plan Update (2017), establishment of contiguous open space and conservation land is imperative to conservation of native plant and animal species. In addition, new and invasive species may flourish under changing climatic conditions. Consideration of the increased importance of land conservation is important to mitigating the short and long term effects of climate change.

> ***The fragmentation of land from the development process divides populations of native plants and animals and makes each part more vulnerable to the short-term impacts of floods, drought and disease, as well as long-term climate change.***
>
> *Littleton Master Plan Update (2017)*

CRB Workshop Participants

Workshop #1 - Attendees

Committee/Board/Group	Representative
Farming Community	Jamie Cruz
Assessors	Kathy Miller
Asst Town Administrator	Anthony Ansaldi
Bike/Pedestrian Advisory	Vanessa Strong/Nik Bates-Haus
Board of Health	Erin Healy
Building	Roland Bernier
Clean Lakes	Leon Weaver
Conservation Committee	Anna Mayer (Late)
Disability Commission	George Sanders/Heidi Madison
Economic Development	Delisa Laterzo
Elder & Human Services	Liz Tretiak
Finance	Steve Venuti
Fire Department	Chief Scott Wodzinski
Highway	Chris Stoddard/James Clyde
Historical	Linda Stein
Housing Authority	Lisa Larrabee
IT	Nancy Glencross
LCTV	Mark Crory
LELWD	Dave Ketchen
Library	Sam Alvarez
MRC/CERT	Alex McCurdy/Pat Natoli
OARS	No response
Parks & Rec	Alicia Day
Planning	Ed Mullen
Public and Municipal Building Comm.	Rich Crowley
Police Dept	Chief Matthew Pinard
school Committee	Jennifer Wilson
Sustainability Committee	Erin Healy/Derek Bolivar
Sustainability Committee	Don MacIver/Sarah Rambacher
TA's Office	Dianne Dickerson
Town Administrator	Keith Bergman
Town Clerk	Diane Crory

Workshop #2 Attendees

Committee/Board/Group	Representative
Assessors	Kathy Miller
Bike/Pedestrian Advisory	Vanessa Strong/Nik Bates-Haus
Board of Health	Erin Healy
Building	Roland Bernier
Clean Lakes	Leon Weaver
Conservation Committee	Anna Mayer
Disability Commission	George Sanders/Heidi Madison
Economic Development	Delisa Laterzo
Elder & Human Services	Liz Tretiak
Finance	Steve Venuti
Fire Department	Chief Scott Wodzinski
Highway	Chris Stoddard
Historical	Linda Stein
Housing Authority	Lisa Larrabee
IT	Nancy Glencross
LCTV	Mark Crory
LELWD	Connor Reardon
Library	Sam Alvarez
MRC/CERT	Pat Natoli
OARS	No response
Parks & Rec	Alicia Day
Maren Toohill	Planning/ Master Plan Implementation
PMBC	Rich Crowley
School Committee	Jennifer Wilson
Sustainability Committee	Erin Healy/Derek Bolivar
Sustainability Committee	Don MacIver/Sarah Rambacher
Town Adminstrator Office	Dianne Dickerson
Town Administrator	Keith Bergman
Town Clerk	Diane Crory

CRB Workshop Project Team

MVP Provider / Littleton Sustainability Committee	Erin Healy
Sustainability Intern	Derek Bolivar
Town Manager / Climate Change Educator	Keith Bergman
Assistant Town Manager	Anthony Ansaldi

Acknowledgements

Sponsors
Littleton Sustainability Committee
Littleton Town Manager's Office
Littleton Department of Public Works and Highway Department
MA Executive Office of Environment and Energy MVP Program – Katie Theoharides and Margot Mansfield

Extra Help
Town Clerk – Diane Crory

Mapping
LELWD – Connor Reardon and Dave Ketchen

Intern and Assistant (Littleton High School Graduates)
Derek Bolivar
Sarah Elliott

Graphics Guru
Janet Field

Appendix A
Workshop #1 Presentation

Littleton Massachusetts

Municipal Vulnerability Preparedness (MVP)

INTEGRATING CLIMATE CHANGE INTO TOWN PLANNING

Why are we here?

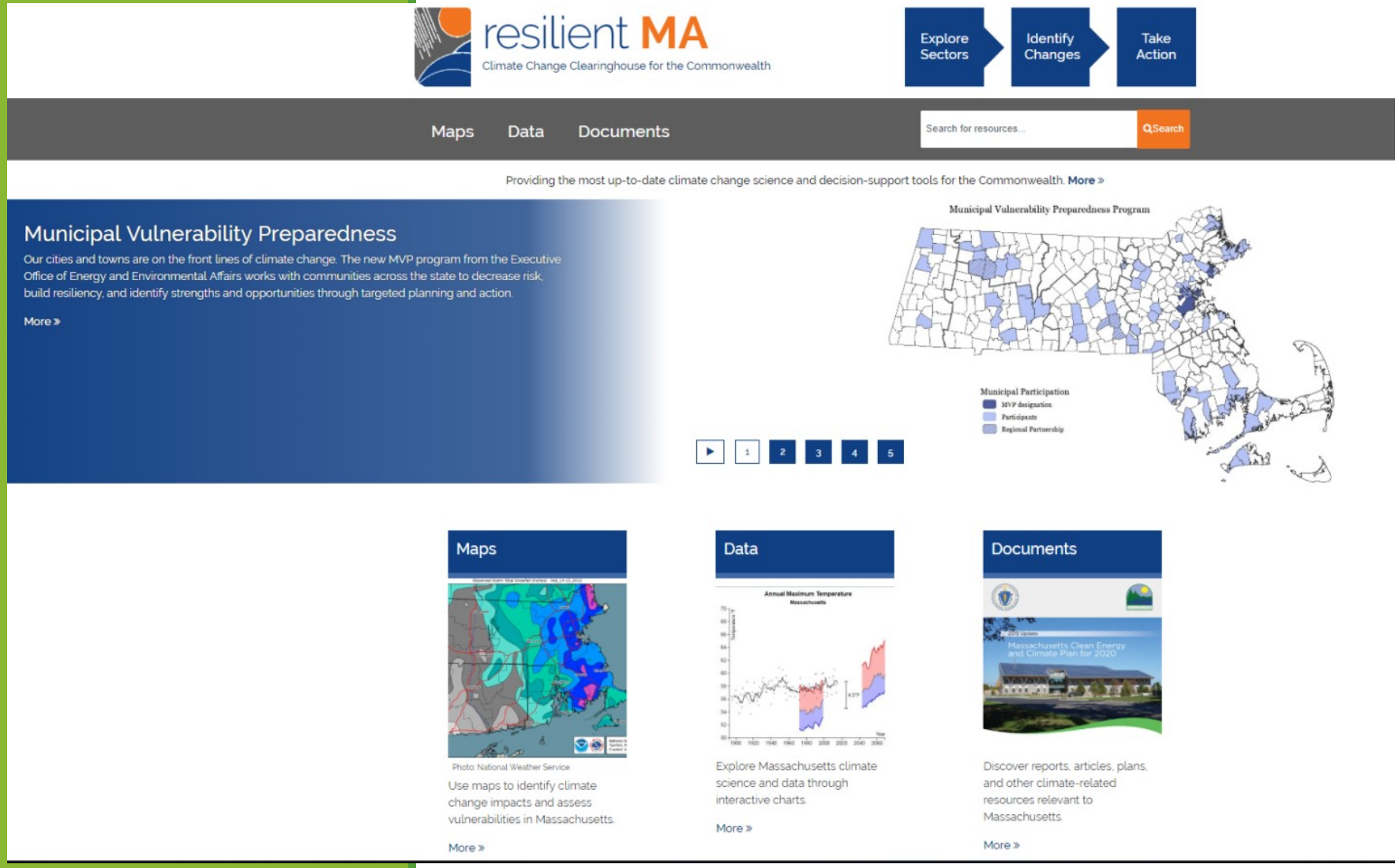
Changes in climate are resulting in new challenges.

- Precipitation – flooding, erosion, drainage infrastructure
- Temperature – extreme heat affects health, agriculture

Our systems are designed based on prevailing climatic conditions, which are changing

State MVP Program

Executive Order | State Program | MVP



Objective

Start to consider current and potential future climatic changes in Town Planning

How this fits into Littleton Planning Efforts

Hazard Mitigation Plan

Master Plan

Master Plan Implementation

Thank You!

Sponsors

Littleton Sustainability Committee

Town Manager's Office – Keith, Anthony and Diane

MA Executive Office of Environment and Energy MVP Program

Extra Help

Town Clerk – Diane

LELWD – Connor Reardon and Dave Ketchen

Intern and Assistant

Derek Bolivar

Sarah Elliott

Graphics Guru

Janet Field

Agenda

Workshop #1

What does climate change look like – today and in the future

Littleton vulnerabilities to climate change effects – identify hazards and vulnerabilities

- Introduction and overview
- Identify 4 top climate change related hazards that could affect Littleton
- Small teams work groups – further discuss and define hazards

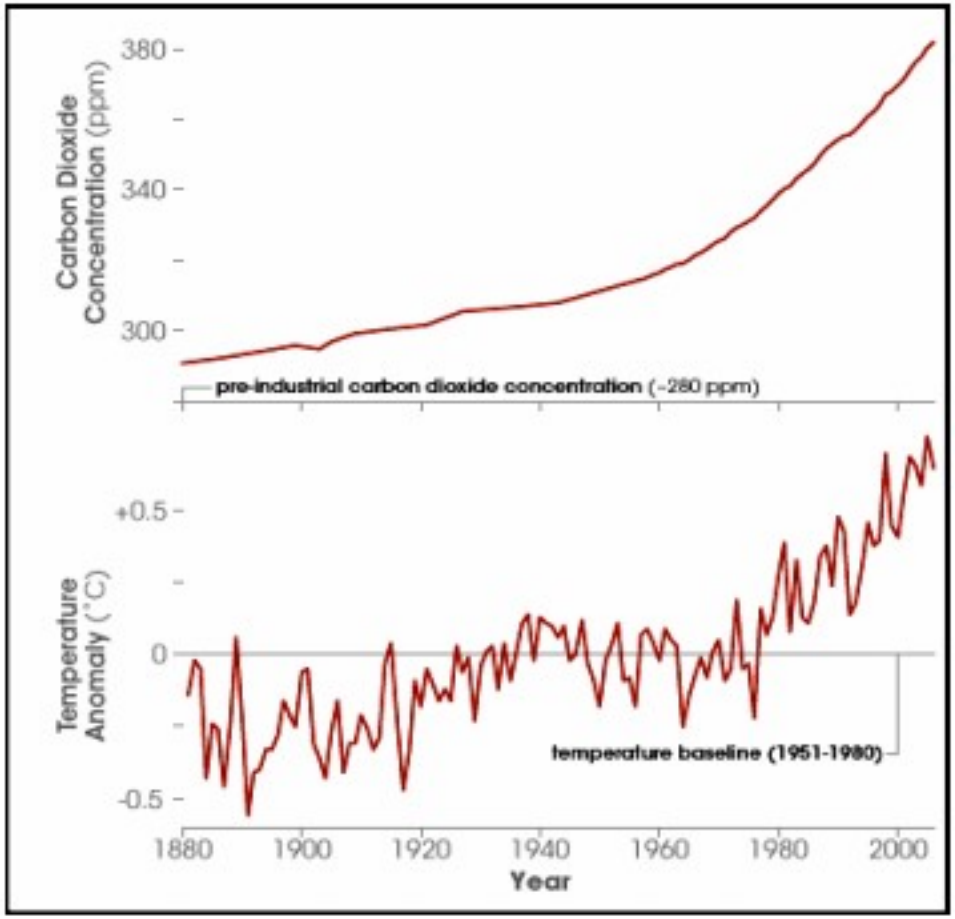
Workshop #2

Develop and rank actions and mitigation measures

Overview of Climate Change Effects

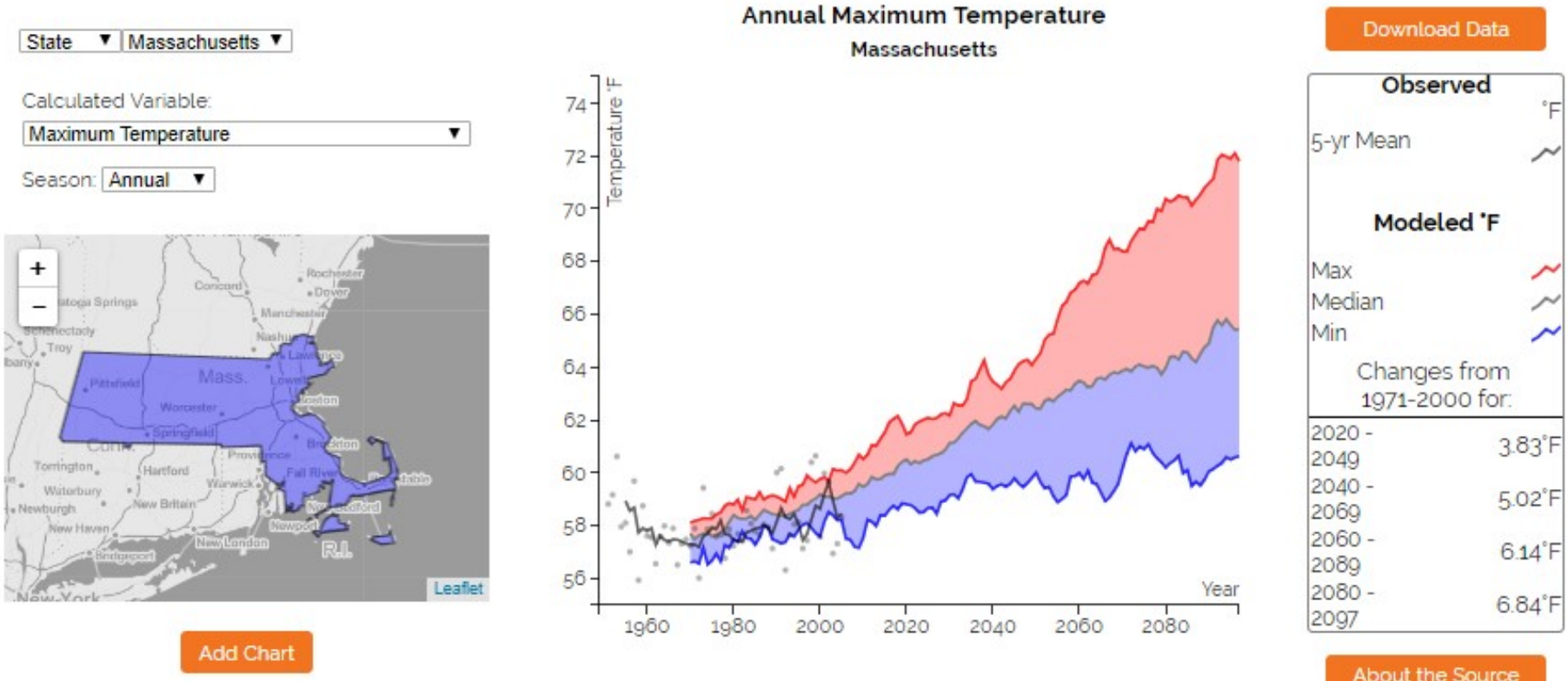
GLOBAL, STATE AND LOCAL CLIMATE DATA

Climate Data - Global



Global Temperature and CO2 Trends
Source: NASA graphs by Robert Simmon, based on carbon dioxide data (Dr. Pieter Tans, NOAA/ESRL) and temperature data (NASA Goddard Institute for Space Studies)

Massachusetts Temperature



http://www.resilientma.org/datagrapher/?c=Temp/basin/maxt/JJA/SuAsCo/

NECSC Northeast Climate Science Center

Massachusetts Temperature

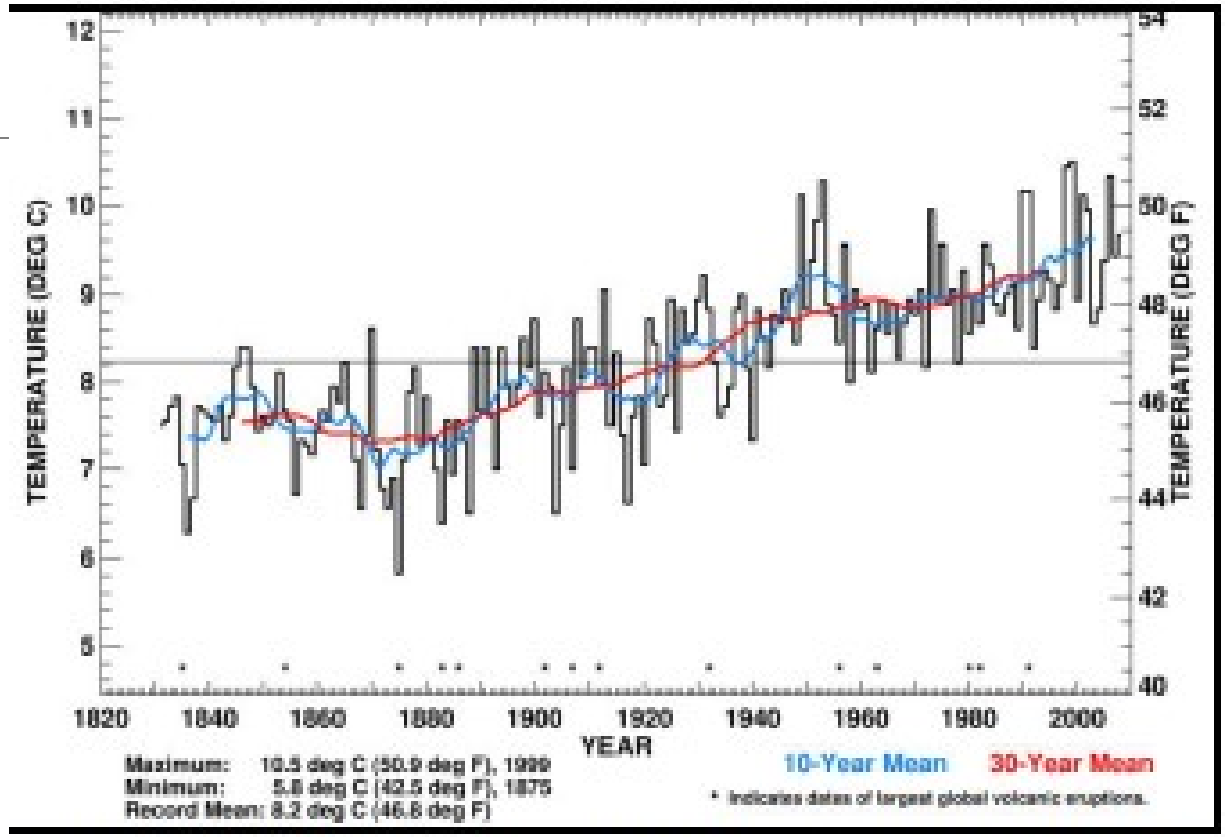


Figure 2: ***Blue Hill Observatory Annual Temperature, 1831–2008***

Source: Michael J. Iacono, Atmospheric and Environmental Research, Inc./Blue Hill Observatory, MA

Note: Plot includes temperature data for 1831–1884 from Milton and Canton that were adjusted to the Blue Hill summit location.

http://www.resilientma.org/datagrapher/?c=Temp/state/maxt/ANN/MA/

Local Climate Projections

Wide range of possible future climatic changes partially driven by levels of future CO2 emissions and varying climate models.

National Climate Science Center at the University of Massachusetts and MA EOEE

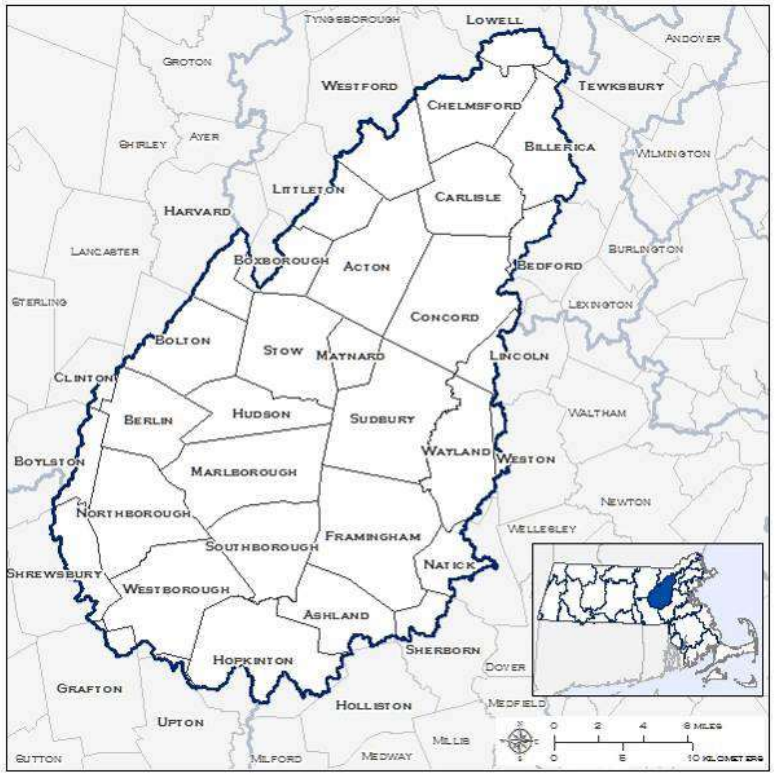
- International Panel on Climate Change (IPCC) climate forecasts
- Different green house gas emissions scenarios
- Models developed by UMass, based on existing climate models

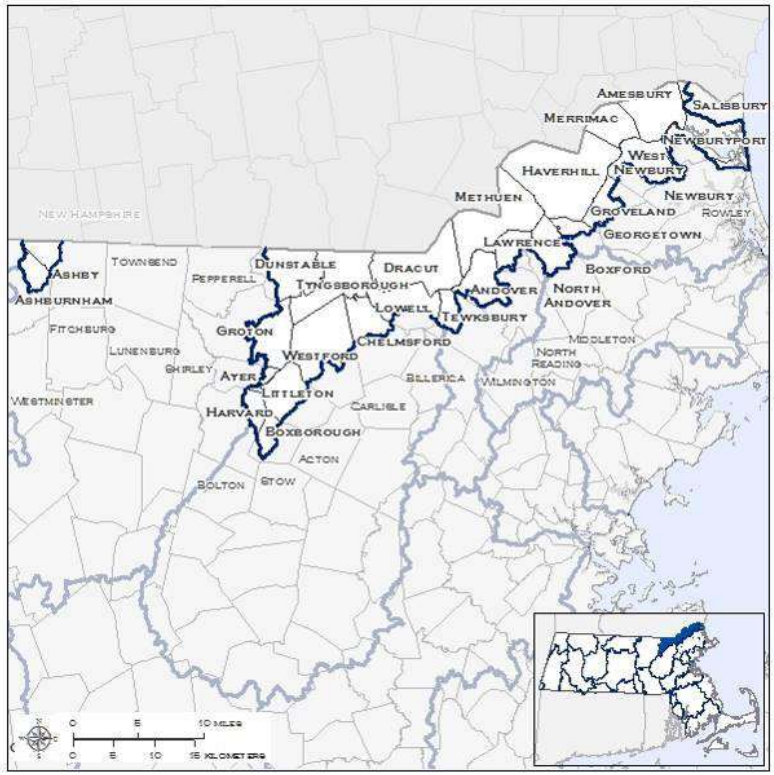
MVP Climate projections summarized by river basins

Littleton River Basins

SuAsCo Basin
(Sudbury, Assabet and Concord River Basins)

Merrimack River Basin





Hot Days

SuAsCo BASIN

SuAsCo Basin		Observed Baseline 1971-2000 (Days)	Projected Change in 2030s (Days)	Mid-Century Projected Change in 2050s (Days)	Projected Change in 2070s (Days)	End of Century Projected Change in 2090s (Days)
Days with Maximum Temperature Over 90°F	Annual	8.07	+7.24 to +20.03	+10.13 to +35.14	+12.20 to +56.37	+14.48 to +76.25
	Winter	0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00
	Spring	0.5	+0.05 to +0.77	+0.28 to +1.74	+0.35 to +2.97	+0.23 to +5.00
	Summer	7.21	+6.54 to +17.38	+8.50 to +29.80	+10.77 to +45.90	+12.66 to +59.87
	Fall	0.36	+0.42 to +2.15	+0.79 to +4.79	+0.58 to +8.98	+1.10 to +12.13
Days with Maximum Temperature Over 95°F	Annual	0.75	+2.02 to +8.21	+3.06 to +16.75	+3.91 to +31.59	+5.51 to +48.44
	Winter	0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00
	Spring	0.03	+0.03 to +0.24	+0.02 to +0.47	+0.05 to +1.08	+0.06 to +1.95
	Summer	0.71	+1.86 to +7.70	+2.75 to +15.30	+3.44 to +28.30	+5.16 to +42.21
	Fall	0.01	+0.07 to +0.61	+0.09 to +1.24	+0.14 to +3.25	+0.24 to +4.72
Days with Maximum Temperature Over 100°F	Annual	0.02	+0.20 to +2.03	+0.32 to +4.87	+0.58 to +11.71	+0.60 to +21.91
	Winter	0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00
	Spring	0.00	+0.00 to +0.02	+0.00 to +0.04	+0.00 to +0.20	+0.00 to +0.45
	Summer	0.02	+0.21 to +1.91	+0.29 to +4.70	+0.52 to +10.99	+0.60 to +20.34
	Fall	0.00	+0.00 to +0.08	+0.00 to +0.21	+0.00 to +0.55	+0.00 to +1.01

Annually, the SuAsCo basin is expected to **see days with daily maximum temperatures over 90 °F increase by 10 to 35 more days by mid-century, and 14 to 76 more days by the end of the century.**

Seasonally, summer is expected to see an **increase of 9 to 30 more days with daily maximums over 90 °F by mid-century.**

Cold Days

SuAsCo BASIN

SuAsCo Basin		Observed Baseline 1971-2000 (Days)	Projected Change in 2030s (Days)	Mid-Century Projected Change in 2050s (Days)	Projected Change in 2070s (Days)	End of Century Projected Change in 2090s (Days)
Days with Minimum Temperature Below 0°F	Annual	5.96	-1.61 to -3.54	-2.03 to -4.25	-2.23 to -4.57	-2.25 to -4.73
	Winter	5.93	-1.63 to -3.34	-2.00 to -4.05	-2.22 to -4.42	-2.23 to -4.57
	Spring	0.03	-0.26 to +0.03	-0.01 to -0.27	-0.01 to -0.32	-0.01 to -0.29
	Summer	0.00	-0.00 to -0.00	-0.00 to -0.00	-0.00 to -0.00	-0.00 to -0.00
	Fall	0.00	-0.00 to -0.00	-0.00 to -0.00	-0.00 to -0.00	-0.00 to -0.00
Days with Minimum Temperature Below 32°F	Annual	143.36	-11.90 to -27.94	-19.26 to -39.80	-22.36 to -55.02	-24.35 to -64.94
	Winter	83.01	-2.19 to -6.66	-3.27 to -11.19	-4.93 to -19.68	-5.77 to -24.53
	Spring	33.93	-3.32 to -11.44	-6.76 to -14.98	-8.06 to -19.33	-8.67 to -20.34
	Summer	0.00	-0.04 to -0.00	-0.04 to -0.00	-0.05 to -0.00	-0.05 to -0.00
	Fall	26.38	-5.23 to -11.1	-8.40 to -13.61	-8.58 to -17.66	-8.19 to -19.77

Precipitation

SuAsCo BASIN

SuAsCo Basin		Observed Baseline 1971-2000 (Inches)	Projected Change in 2030s (Inches)	Mid-Century Projected Change in 2050s (Inches)	Projected Change in 2070s (Inches)	End of Century Projected Change in 2090s (Inches)
Total Precipitation	Annual	45.44	+0.16 to +4.84	+0.56 to +6.06	+1.53 to +7.79	+1.23 to +8.01
	Winter	11.15	-0.38 to +2.08	+0.07 to +2.56	+0.45 to +3.20	+0.38 to +4.05
	Spring	11.57	-0.14 to +2.36	+0.02 to +2.08	+0.28 to +2.58	+0.22 to +2.55
	Summer	10.76	-0.18 to +1.53	-0.47 to +2.20	-0.64 to +2.40	-1.13 to +2.15
	Fall	11.97	-1.19 to +1.08	-1.27 to +1.70	-1.78 to +1.57	-1.54 to +1.35

The **winter** season is expected to experience the greatest change with an increase of 1-23% by mid-century, and of 3-36% by end of century

Drought

SuAsCo Basin		Observed Baseline 1971-2000 (Days)	Projected Change in 2030s (Days)	Mid-Century Projected Change in 2050s (Days)	Projected Change in 2070s (Days)	End of Century Projected Change in 2090s (Days)
Consecutive Dry Days	Annual	16.83	-0.55 to +1.41	-0.40 to +1.98	-0.88 to +2.26	-0.72 to +2.5
	Winter	11.64	-0.90 to +1.21	-0.74 to +1.39	-1.05 to +1.70	-1.13 to +1.70
	Spring	11.04	-1.16 to +0.81	-1.20 to +0.96	-1.46 to +1.09	-1.17 to +0.83
	Summer	12.34	-0.81 to +1.60	-0.74 to +2.42	-1.26 to +2.73	-0.99 to +2.06
	Fall	12.22	-0.01 to +1.94	-0.19 to +2.65	-0.27 to +3.05	-0.03 to +3.13

Hazards and Vulnerability

	Climate Driver	Exposure	Health Outcome	Impact
Extreme Heat	More frequent, severe, prolonged heat events	Elevated temperatures	Heat-related death and illness	Rising temperatures will lead to an increase in heat-related deaths and illnesses
Outdoor Air Quality	Increasing temperatures and changing precipitation patterns	Worsened air quality (ozone, particulate matter, and higher pollen counts)	Premature death, acute and chronic cardiovascular and respiratory illnesses	Rising temperatures and wildfires and decreasing precipitation will lead to increases in ozone and particulate matter, elevating the risks of cardiovascular and respiratory illnesses and death.
Flooding	Rising sea level and more frequent or intense extreme precipitation, hurricanes, and storm surge events	Contaminated water, debris, and disruptions to essential infrastructure	Drowning, injuries, mental health consequences, gastrointestinal and other illness	Increased coastal and inland flooding exposes populations to a range of negative health impacts before, during, and after events
Vector-Borne Infection (Lyme Disease)	Changes in temperature extremes and seasonal weather patterns	Earlier and geographically expanded tick activity	Lyme disease	Ticks will show earlier seasonal activity and a generally northward range expansion, increasing risk of human exposure to Lyme and disease-causing bacteria.
Water-Related Infection (Vibrio vulnificus)	Rising sea surface temperature, changes in precipitation, and runofff affecting coastal salinity	Recreational water or shellfish contaminated with Vibrio vulnificus	Vibrio vulnificus induced diarrhea & intestinal illness, wound and bloodstream infections, death	Increases in water temperatures will alter timing and location of Vibrio vulnificus growth, increasing exposure and risk of water-borne illness.
Food-Related Infection (Salmonella)	Increases in temperature, humidity, and season length	Increased growth of pathogens, seasonal shifts in incidence of Salmonella exposure	Salmonella infection, gastrointestinal outbreaks	Rising temperatures increase Salmonella prevalence in food, longer seasons and warming waters increase risk of exposure and infection.
Mental Health and Well-Being	Climate-change impacts, especially extreme weather	Level of exposure to traumatic events, like disasters	Distress, grief, behavioral health disorders, social impacts, resilience	Changes in exposure to climate- or weather-related disasters cause or exacerbate stress and mental health consequences, with greater risk for certain populations.

Source: US Global Change Research Program, 2016. The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment. Crimmins, A., J. Balbus, J.L. Gamble, C.B. Beard, J.E. Bell, D. Dodgen, R.J. Eisen, N. Fann, M.D. Hawkins, S.C. Herring, L. Jantarasami, D.M. Mills, S. Saha, M.C. Sarofim, J. Trtanj, and L. Ziska, Eds. U.S. Global Change Research Program, Washington, DC, 312 pp.

MA Dept of Public Health
https://matracking.ehs.state.ma.us/Climate-Change/climate_and_health_profile.html

Risk Evaluation

WHAT ARE THE FACTORS THAT INFLUENCE RISK FROM EXTREME WEATHER EVENTS?

Below are examples of factors that may increase the health risks from extreme weather events and that need to be considered to better prepare for and respond to climate impacts.

DEMOGRAPHICS

- Individuals over 65 years old
- Individuals over 65 and living alone
- Children under 5
- Persons of color
- People living in poverty
- The homeless
- People with limited English proficiency

ENVIRONMENT

- Degraded air and water quality
- Coastal erosion
- Ecosystem damage
- Loss of aqua - and agricultural resources

PRE-EXISTING HEALTH CONDITIONS

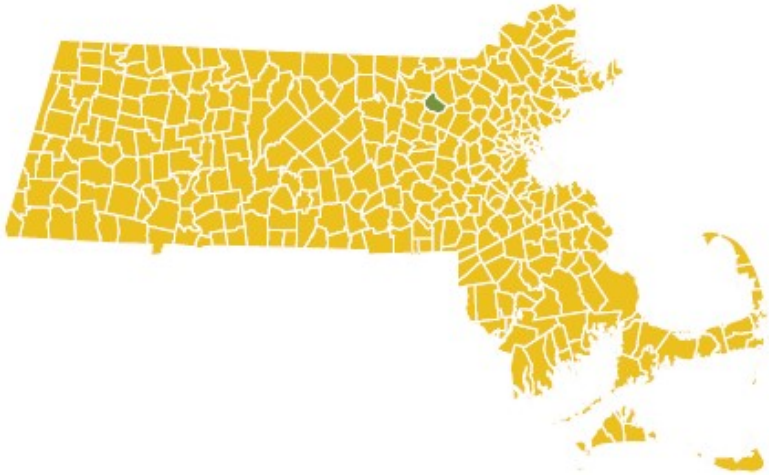
- Adults with respiratory disease (e.g., asthma, COPD) and cardiovascular disease
- Children with respiratory disease (e.g. asthma)
- Individuals using electricity dependent medical equipment
- People living with disabilities or mobility problems

INFRASTRUCTURE

- Interruption of utilities (e.g., electricity, phone service, cable)
- Failure of wastewater treatment systems
- Loss of safe drinking water
- Food shortages
- Disruption of transportation and communication systems

The Littleton Community

Littleton's Geography



Total Area

17.6 square miles

Office of Geographic Information (MassGIS), 2005

Total Population

8,924 people

U.S. Census, 2010

Percent of Land Use

Agriculture - **7.9%**

Forest - **50.8%**

Open space - **6.5%**

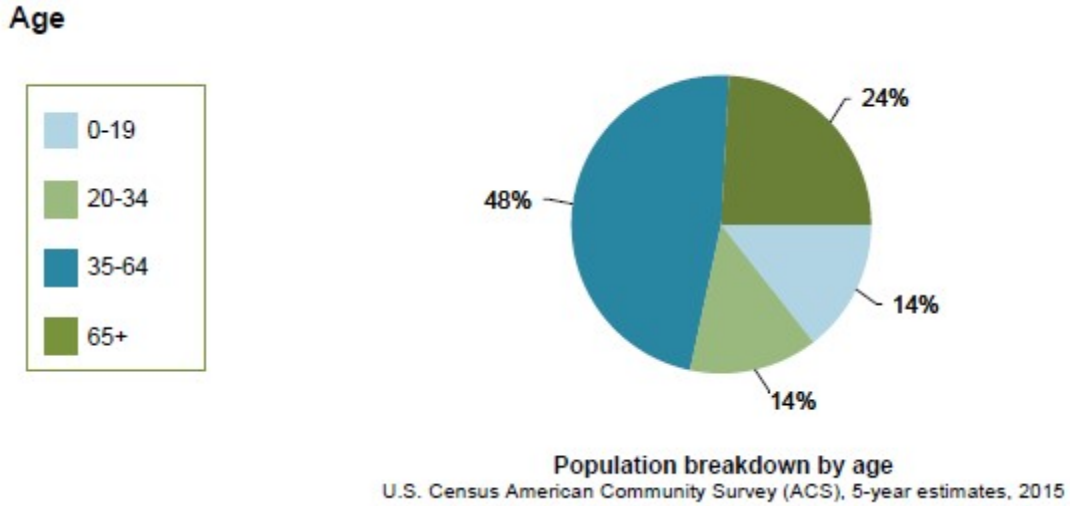
Recreation - **0.8%**

Urban - **28.8%**

Water - **5.3%**

Office of Geographic Information (MassGIS), 2005

Vulnerable Populations



Population breakdown by age
U.S. Census American Community Survey (ACS), 5-year estimates, 2015

Think about all the different health needs of older and younger populations. Older adults are more likely to have many different preexisting health conditions that may be complicated by environmental hazards, while young children have growing bodies that are more sensitive to environmental pollutants.

Environmental justice Communities (one of the following):

- Median annual household income is at or below 65% of the statewide median income;
- 25% or more of the residents are a minority; or
- 25% or more of the residents are not fluent in the English language.

Littleton: 0.0 %

Statewide: 12.1 %

Percentage of population residing in a block group where one or more of the EJ criteria is met, compared to the average percentage for all MA communities, calculated using data from the 2010 U.S. Census and the EOEEA.

Example of Potential Impacts and Responses – Agriculture

Example - Agriculture

Climate Drivers

- Drought
- Heat

Potential Results

- Weeds and invasive species
- New pests and pathogens

Example – Weeds, Invasives

4.2 Weed responses to CO_2

There are two lines of evidence suggesting that weeds will respond to a greater extent than crops to increasing atmospheric CO_2, projected to reach 550 and 970 ppm by 2100 with the B1 and A1fi scenarios, respectively (Nakićenović et al. 2000). First, weed species have a greater genetic diversity than most crops. Consequently, if a resource (e.g., light, water, nutrients or CO_2) changes within the environment, it is more likely that weeds will have a greater capacity for growth and reproductive response than crops (see Vengris et al. 1955 for nitrogen).

Example – Possible Responses

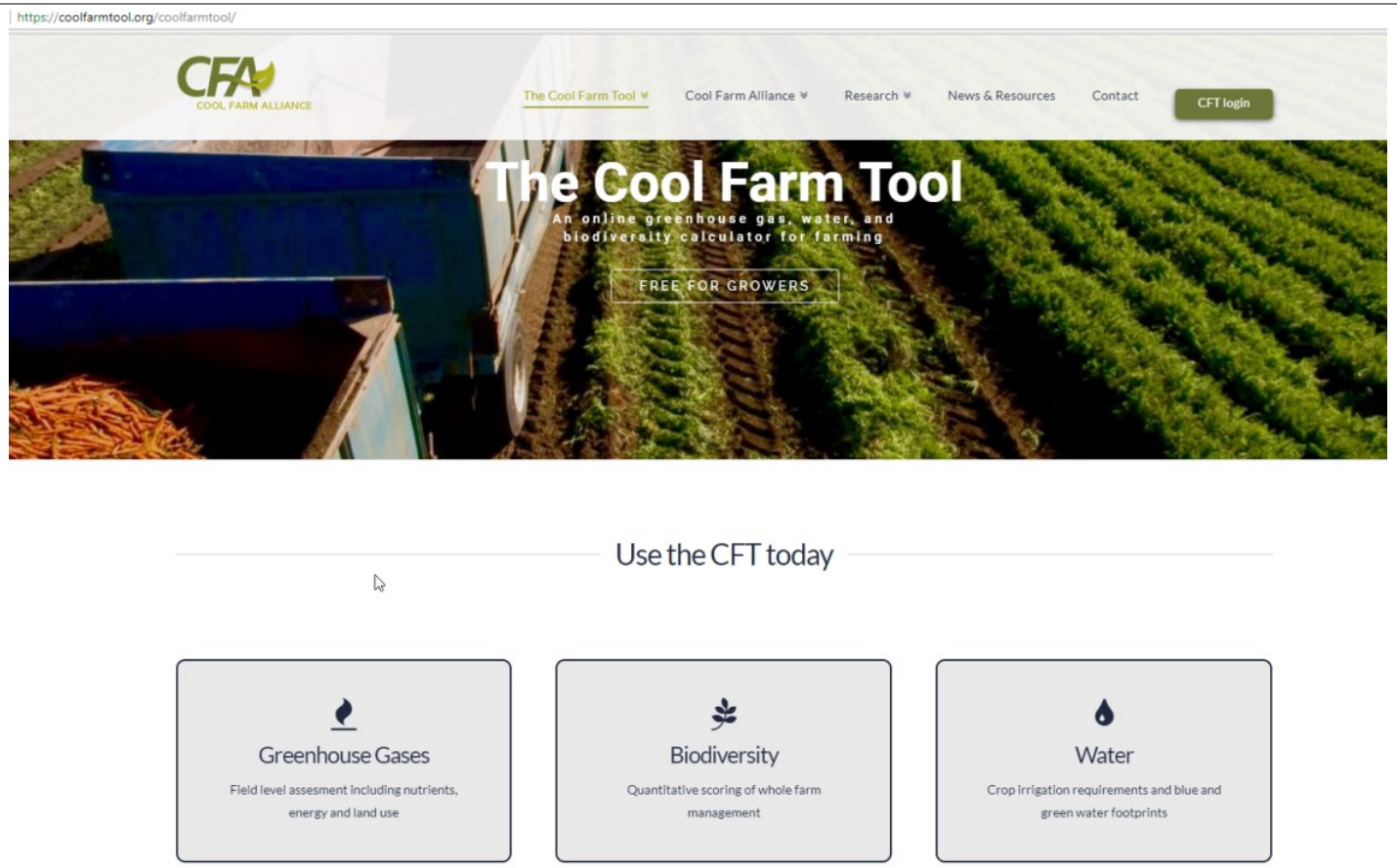
7.4 Increase water, fertilizer, herbicide, pesticide use

Warmer temperatures, longer growing seasons, and increased drought will lead to increase agricultural water use. Obtaining the maximum "CO_2 fertilization" benefit often requires increases in water and fertilizer to support bigger plants (Wolfe 1994). As discussed previously, farmers are likely to respond to more aggressive and invasive weeds, insects, and pathogens with increased use of herbicides, insecticides, and fungicides. Although in some cases changes in the crop–weed–pest complex may favor the crop and lead to reduced usage. Where increases in water and chemical inputs become necessary, this will not only increase costs for the farmer, but will have society-wide impacts by depleting water supply, increasing reactive nitrogen and pesticide loads to the environment, and increasing risks to food safety and human exposure to pesticides.

7.5 New capital investments

Climate change could require significant capital investment for survival of the business, or to take advantage of new opportunities. Examples would include new irrigation or drainage systems, improved cooling facilities for livestock, or new or expanded crop storage facilities. The challenge will be strategic investment in relation to the timing and magnitude of climate change.

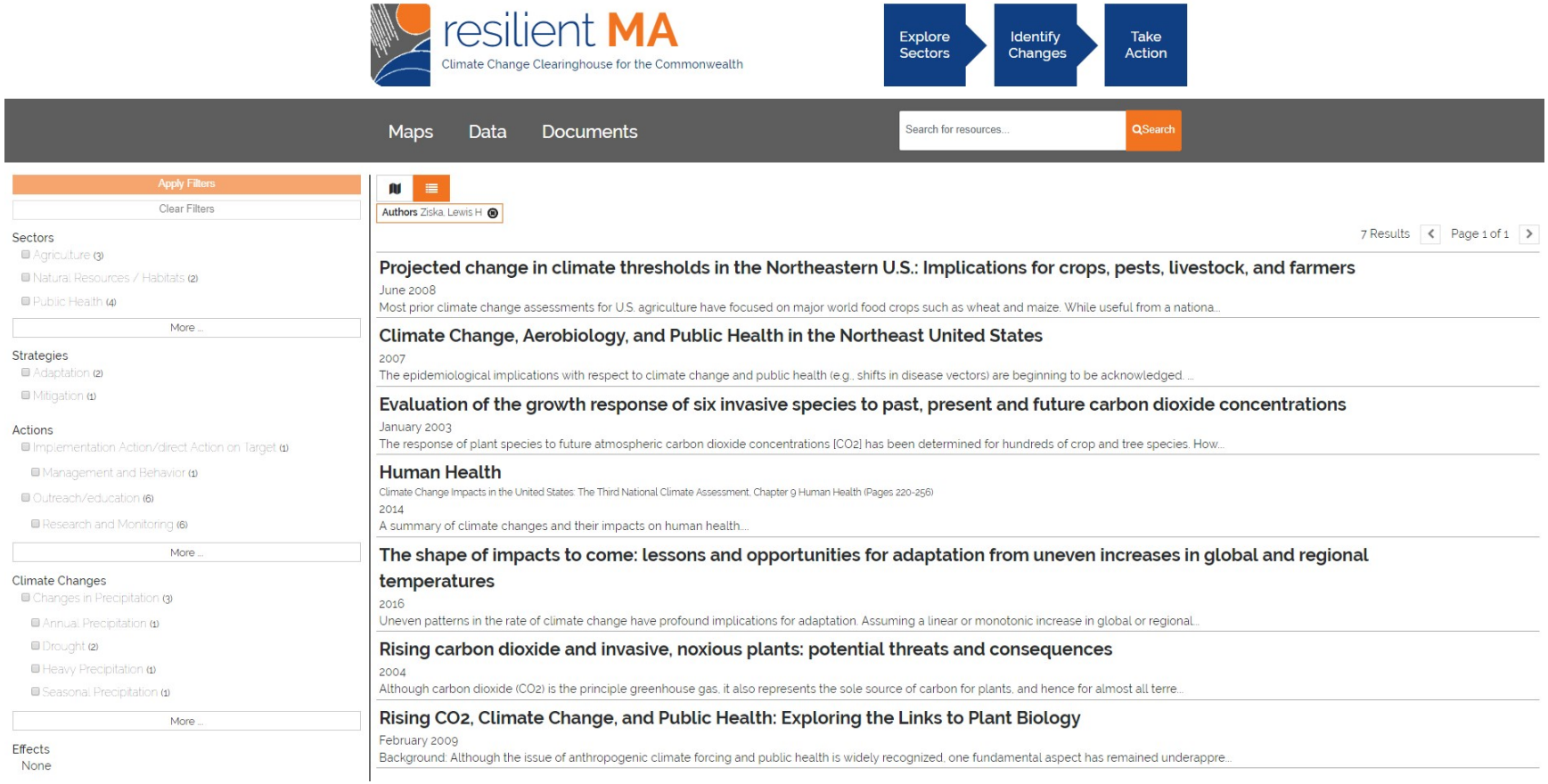
Example –Other Responses??



https://coolfarmtool.org/coolfarmtool/

Online tools

Resilient Massachusetts



http://www.resilientma.org/search?page=1&climate_changes=ma%253A%253Aextreme%2520weather%253A%253Adrought&sort_by_center_lat=42.377417&sort_by_center_lng=-71.925258&states=MA&per_page=20

resilient MA

Climate Change Clearinghouse for the Commonwealth

Explore Sectors | Identify Changes | Take Action

Maps Data Documents

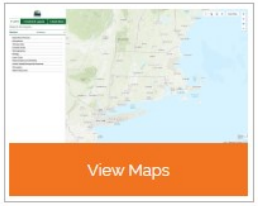
Search for resources... Search

Sectors

The Baker-Polito Administration is combatting and preparing for the impacts of climate change across state and local government and all sectors of the economy. The impacts of climate change will vary by geography, with flooding risks greater in coastal and floodplain areas, while extreme temperatures may be more challenging in urban environments. Climate change will also vary temporally—some of the impacts may not be felt for another 30 years or further in the future, while others are already upon us.

Already we're seeing that climate change is increasing the frequency of extreme weather events. In the future, Massachusetts may experience large-scale catastrophic events, but it may also see smaller but incremental changes that could have long-term impacts on freshwater resources, fisheries, food crops, coastal properties, and the economy.

Various opportunities and strategies are available to address climate change impacts. While areas of concern and adaptation actions will vary by sector, the Baker-Polito Administration is committed to a targeted and holistic approach to combatting further climate change and building resilience across the Commonwealth.



View Maps

View Datagrapher

Agriculture

The Agriculture page focuses on issues related to livestock, dairy, and crop production, as well as the economically important greenhouse and nursery, cranberry, and poultry sectors.

View Agriculture Sector

Coastal Zones

The Coastal Zones page focuses on the climate change impact in regions close to the ocean.

View Coastal Zones Sector

- Agriculture
- Coastal Zones
- Economy
- Energy
- Forestry
- Infrastructure
- Local Government
- Natural Resources / Habitats
- Public Health
- Public Safety / Emergency Response
- Recreation
- Transportation
- Water Resources

http://www.resilientma.org/sectors

Workshop

Hazards

Hazards are causes of impacts or aspects of climate change that result in impacts

Identify TOP 4 hazards

Identify past, current and future hazards

- Heavy precipitation
  - Snow
  - Rain
  - Short intense events vs. increasing frequency of events
- Drought
  - Intensity
  - Length of time
  - Changes in seasonal timing
- Temperature
  - Heat
  - Cold
  - Intensity, duration, changes in seasonal timing
- Any others?

B Characterize Hazards

Section B Objective: Develop agreement among Workshop participants on top four hazards for facilitated discussions on vulnerabilities and strengths of the community's people, infrastructure, departments, supply chain, and natural resources among others.

1

Identify past, current, and future hazards (large team).

Direct participants to make a list of hazards (causes of impacts) that the community has dealt with currently faces, and anticipates experiencing in the future (i.e., tornados, ice/wind storms, drought, wildfire, tsunamis, sea level rise, landslides, earthquakes, etc.). Utilize the following triggering questions to accelerate dialogue and surface initial agreement on top four hazards.

- What hazards have impacted your community in the past? Where, how often, and in what ways?
- What hazards are impacting your community currently? Where, how often, and in what ways?
- What effects will these hazards/changes have on your community in the future (5, 10, 25 years)?
- What is exposed to hazards and climate threats within your community?
- What have been the impacts to operations and budgets, planning and mitigation efforts?
- Others concerns or considerations related to impacts?

A **Hazard** is like the sun. The **Risk** from that hazard is sunburn. The **Vulnerability** includes the length of **Exposure** of skin to the sun. The **Action** to reduce risk from the hazard is to apply sunscreen or seek shade.

Top to bottom: © Rich Reid/TNC, © Devan King/TNC, © Jay Harrod/TNC

The Matrix

Community Resilience Building Workshop Risk Matrix

Top 4 Hazards (tornado, floods, wildfire, hurricanes, snow/ice, drought, sea level rise, heat wave, etc.)

H-M-L priority for action over the Short or Long term (and Ongoing)
V = Vulnerability S = Strength

Features	Location	Ownership	V or S	Coastal Flooding	Extreme Precipitation Events	Heat Waves	Wind	Priority H - M - L	Time Short Long Ongoing
Infrastructural									
Societal									
Environmental									

Vulnerabilities

Infrastructure

Examples of Vulnerabilities:

- Main road floods during storms, blocking emergency response.
- Power outages during heat waves lead to health concerns.
- Wildfire and high winds resulting in supply chain interruptions.
- Sewer pump stations become submerged and inoperable.
- Compromised rail system due to heat-related warping of tracks.

Examples of Strengths:

- Critical road elevated and passable by emergency management.
- Hurricane roof installed at school with improved sheltering capacity.
- Hardened utility lines reduce outages due to ice storms.
- Undersized culvert replaced to reduce flooding in key intersection.
- Improvement to communication systems during extreme weather.

Environmental

Examples of Vulnerabilities:

- Beachfront development reducing protection provided by dunes.
- Proliferation of subdivisions in wildfire and flood prone areas.
- Lack of urban tree canopy increasing heat island effects.

Examples of Strengths:

- Oyster reefs and tidal wetlands help reduce wave damage to property.
- Forested watersheds maintain drinking water supply during droughts.
- Native, vegetated slopes remain stable after intense 24-hour rain events.
- Floodplains provide stormwater storage and downstream flood reduction.

Social/Community

Examples of Vulnerabilities:

- Senior housing without back-up generators during heat waves.
- Residents without access transportation during hurricane evacuation.
- Household contaminate and sewage mobilization during flooding.
- Limited areas of refuge in elementary schools during tornados.

Examples of Strengths:

- Reliable communications protocols across departments for all employees.
- "Neighbor-helping-neighbor" program aligned with emergency operations.
- Well-supported volunteer organizations (fire, ambulance, CERTs).
- Faith-based and civic groups with hazard preparedness plans.

See you Next Week!

For questions or suggestions please contact

Erin Healy

erinhea@gmail.com

Appendix B

Workshop #2 Presentations (including Low Impact Development Presentation)

Littleton Massachusetts

Municipal Vulnerability Preparedness (MVP) - Workshop #2

INTEGRATING CLIMATE CHANGE INTO TOWN PLANNING

Why are we here?

Changes in climate are resulting in new challenges.

- Precipitation – flooding, erosion, drainage infrastructure
- Temperature – extreme heat affects health, agriculture

Our systems are designed based on prevailing climatic conditions, which are changing

Objective

Start to consider current and potential future climatic changes in Town Planning

How this fits into Littleton Planning Efforts

Hazard Mitigation Plan

Master Plan

Master Plan Implementation

Thank You!

Sponsors

Littleton Sustainability Committee

Town Manager's Office – Keith, Anthony and Diane

MA Executive Office of Environment and Energy MVP Program

Extra Help

Town Clerk – Diane

LELWD – Connor Reardon and Dave Ketchen

Intern and Assistant

Derek Bolivar

Sarah Elliott

Graphics Guru

Janet Field

Agenda

Workshop #1

What does climate change look like – today and in the future

Littleton vulnerabilities to climate change effects – identify hazards and vulnerabilities

- Introduction and overview
- Identify 4 top climate change related hazards that could affect Littleton
- Small teams work groups – further discuss and define hazards

Agenda

Workshop #2

1. Review Hazards identified in Workshop #1
2. Low Impact Development and Water Conservation
3. Review and Modify Matrix - Possible solutions to address, mitigate or reduce identified hazards/vulnerabilities
4. Report out and ranking

Objective: Short list of next steps

Top Identified Hazards

Trees
- Damage to power lines from downed trees
- Loss of trees and loss of cooling effect

Water Conservation
- Increased erosion from intense events
- Water quality impacts

Changes in wetland extents and groundwater levels
- Change in design parameters for septic systems

Open Space
- Invasive species

Agriculture
- New pests and pathogens
- Solar (climate change mitigation) displacing agricultural land

Water Conservation and LID

STEVEN P. ROY, LEED AP

Climate Adaptation, Green Infrastructure and Low Impact Development Stormwater Controls

Steven P. Roy has more than 40 years of professional experience in the field of environmental program management and administration, specializing in water resources management, Low Impact Development stormwater management, water conservation, and environmental impact assessment. His work focuses on the assessment of water resource impacts from land use activities. Mr. Roy has worked at the local, state, and federal levels of government developing and managing groundwater protection and water management programs. He has served in the Environmental Protection Agency as the manager of the Wellhead Protection Program, where he developed programs, policies, and technical documents for the protection of groundwater quality. He is on the Board of Directors of the Low Impact Development Center and is a LEED Accredited Professional. He has presented at numerous technical conferences and has published many technical journal articles.

Mr. Roy has lead the design of over 250 LID features including several structures in the Town of Littleton, MA including a stormwater treatment wetland, raingardens, outfall daylighting, porous pavement, bioretention and Filterra tree box filters.

welcome

transform your environment

Low Impact Development/Green Infrastructure and Sustainability

Presentation to Littleton MVP Committee

May 22, 2018

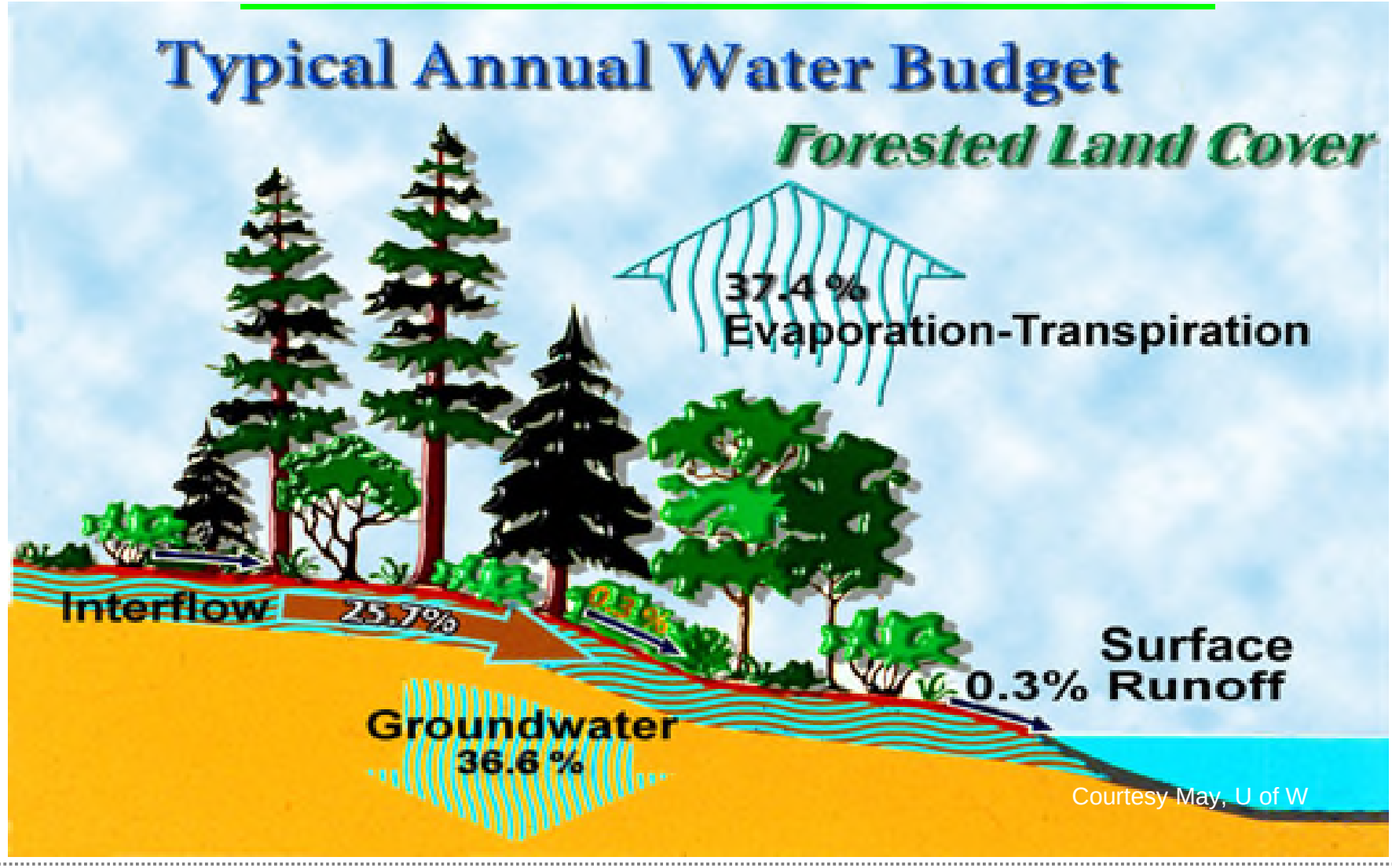
Steven Roy, LEED® AP

Weston & Sampson℠

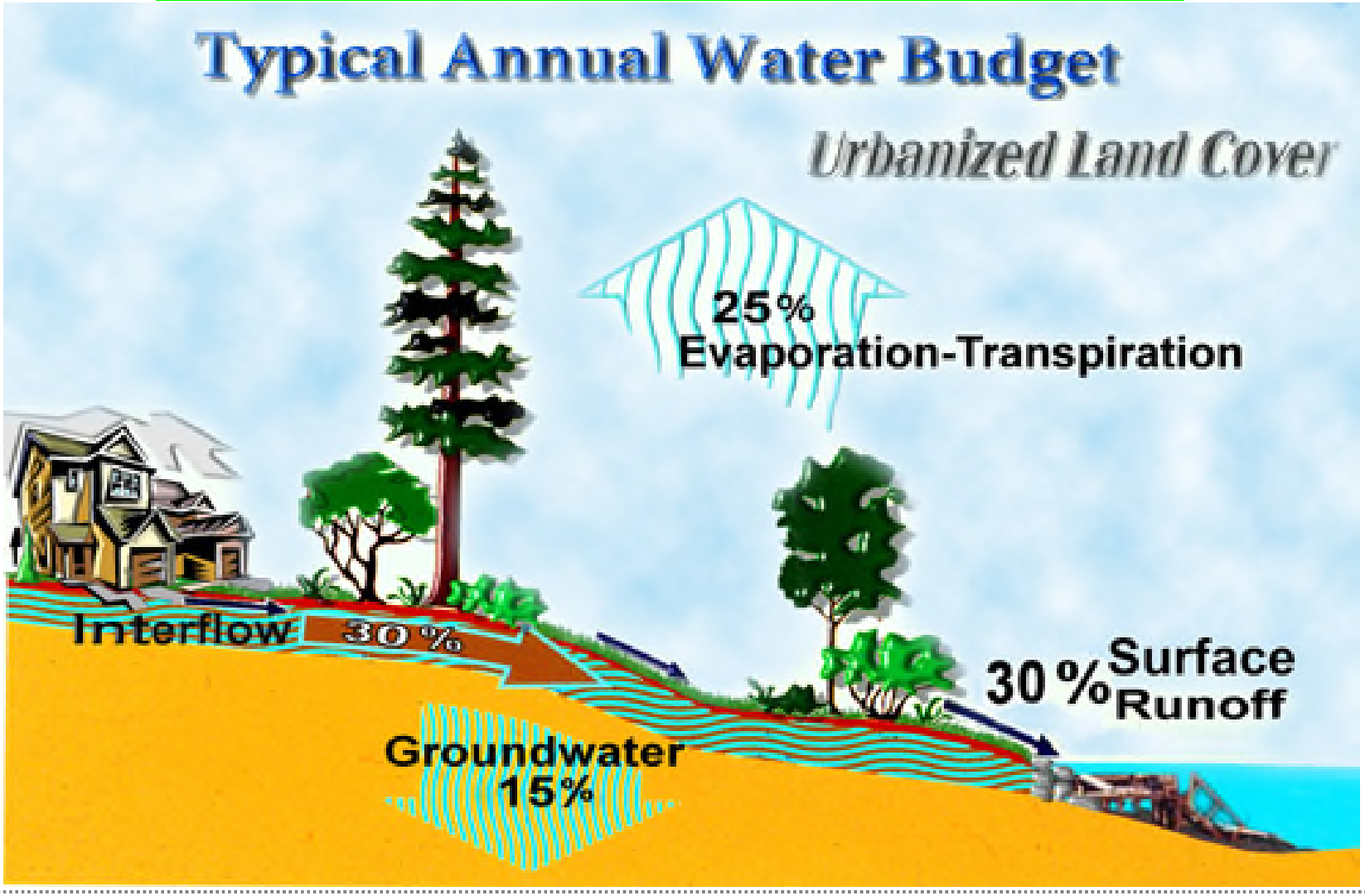
Low Impact Development

An innovative, ecosystem-based approach to land development and stormwater management

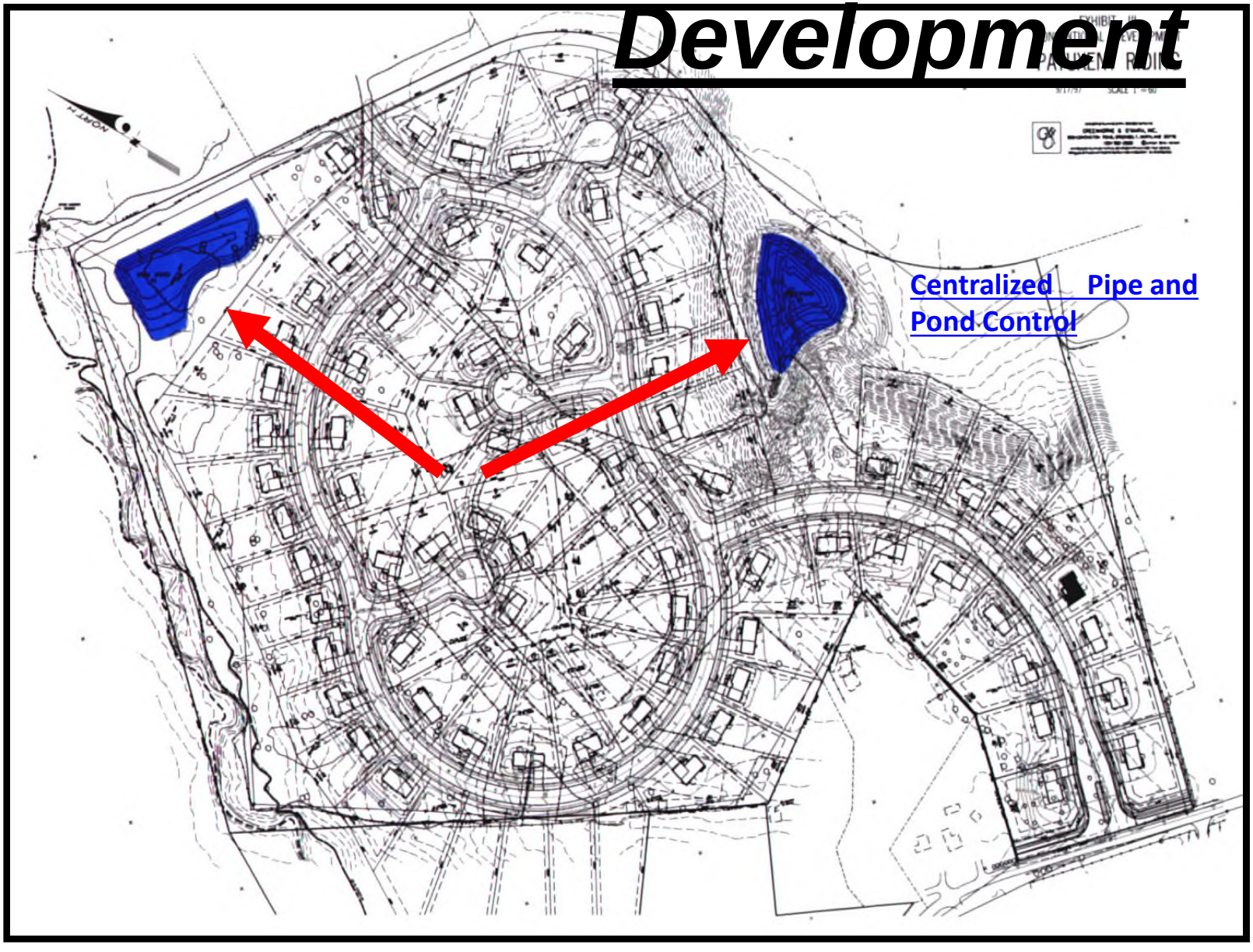
Natural Conditions



Developed Conditions

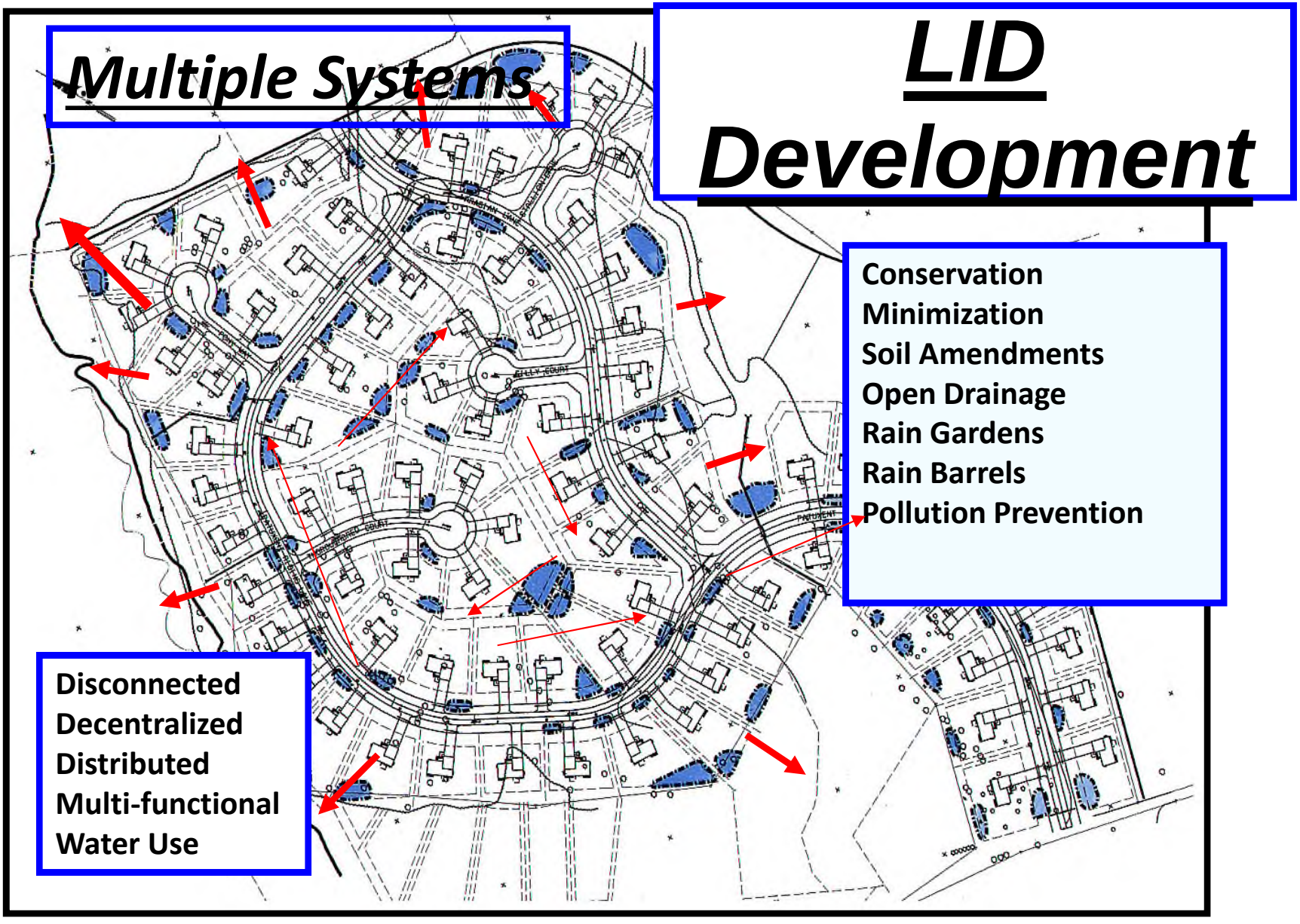


Conventional Development



LID Development

Multiple Systems



Conservation
Minimization
Soil Amendments
Open Drainage
Rain Gardens
Rain Barrels
Pollution Prevention

Disconnected
Decentralized
Distributed
Multi-functional
Water Use

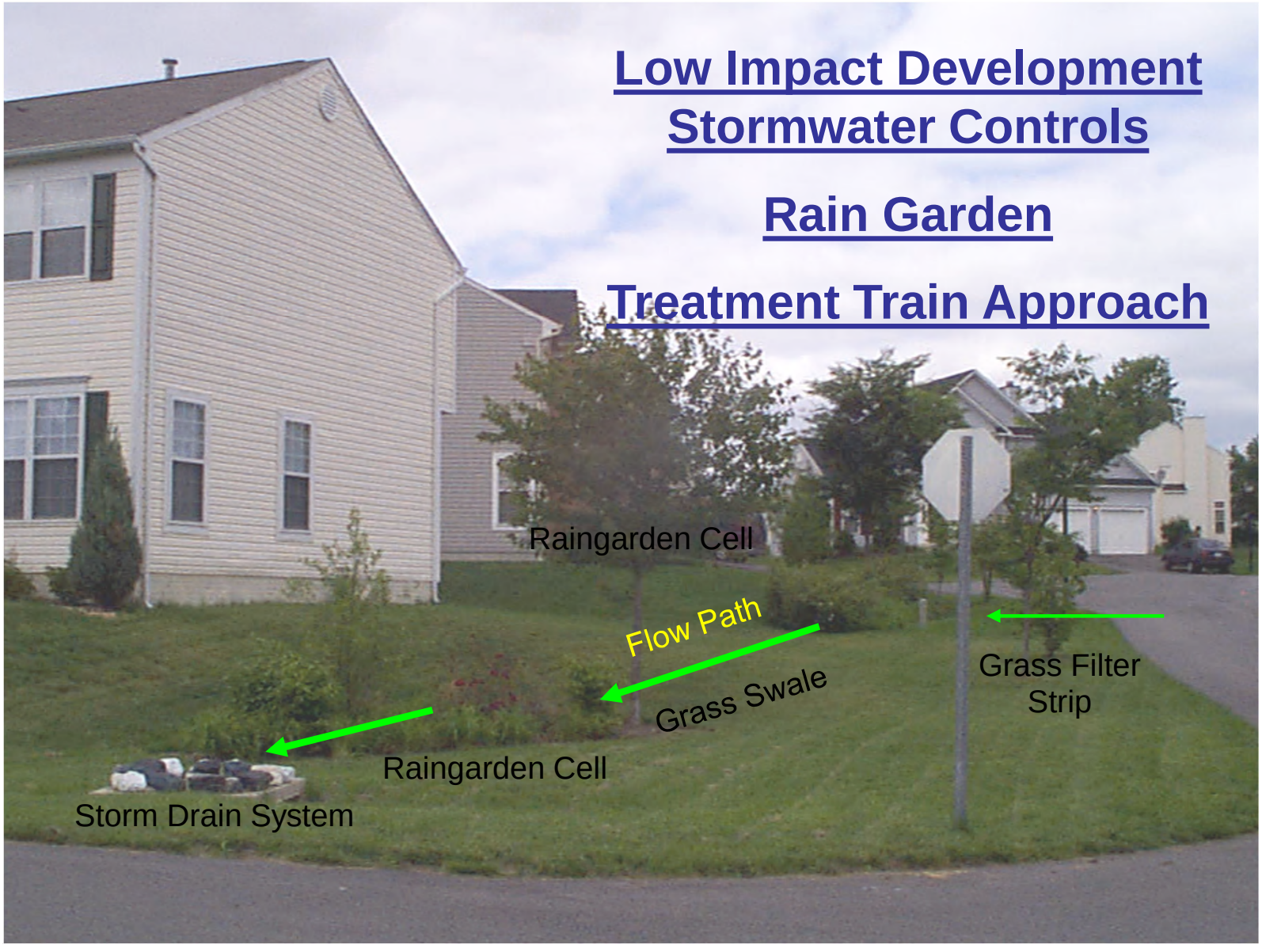
Basic LID Principles

- Conserve natural areas
- Minimize development impacts
- Maintain site runoff rate
- Use integrated stormwater management practices
- Implement pollution prevention, proper maintenance and public education programs

Low Impact Development Stormwater Controls

Rain Garden

Treatment Train Approach



Conventional vs. LID Approach to Stormwater

- Conventional
  - Collect
  - Convey
  - Discharge
- LID Approach
  - Reduce volume
  - Minimize impacts
  - Distributed controls
  - Treatment trains
  - Infiltration
  - Hybrid systems
  - Mimic the predevelopment hydrology

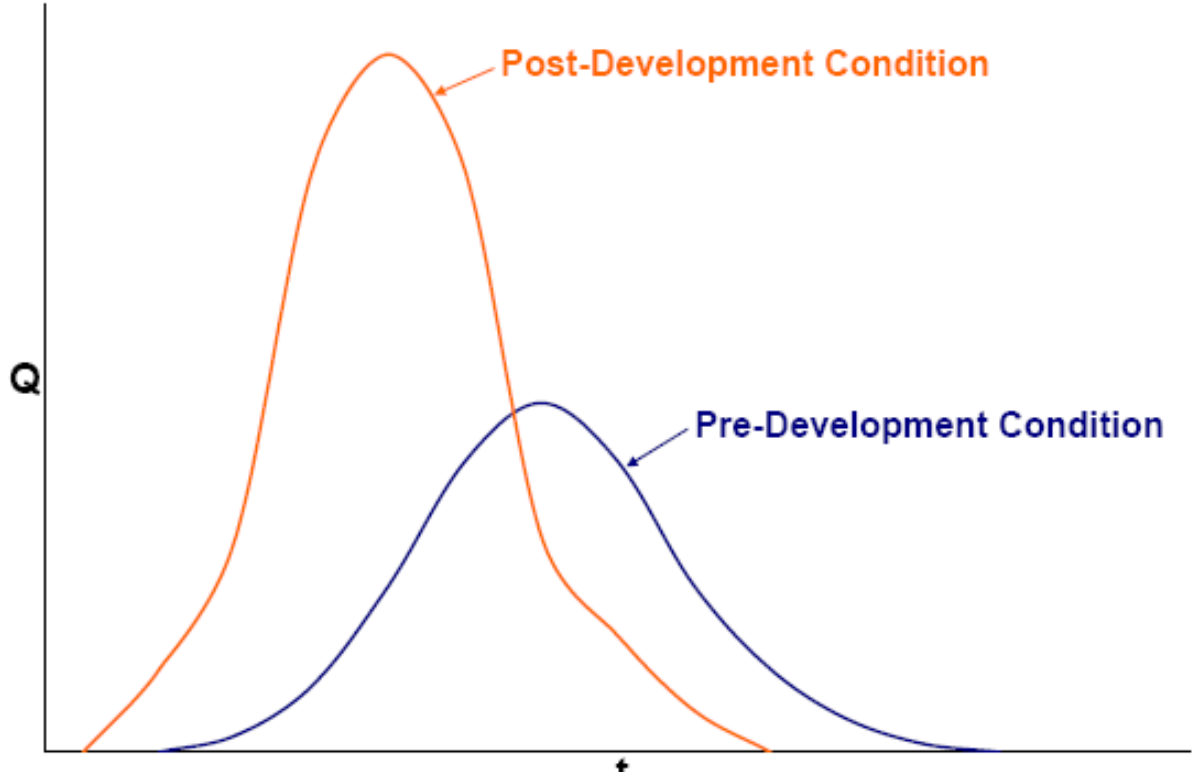

Conventional
Low Impact
Conventional
Functional Landscape Design

Design each site to protect or restore the natural hydrology of the site. This is done by creating a "hydrologically" functional landscape.

Make This

Function Like This

Development increases stormwater volume, peak flow, and duration



Post Development Hydrograph

Q= flow rate

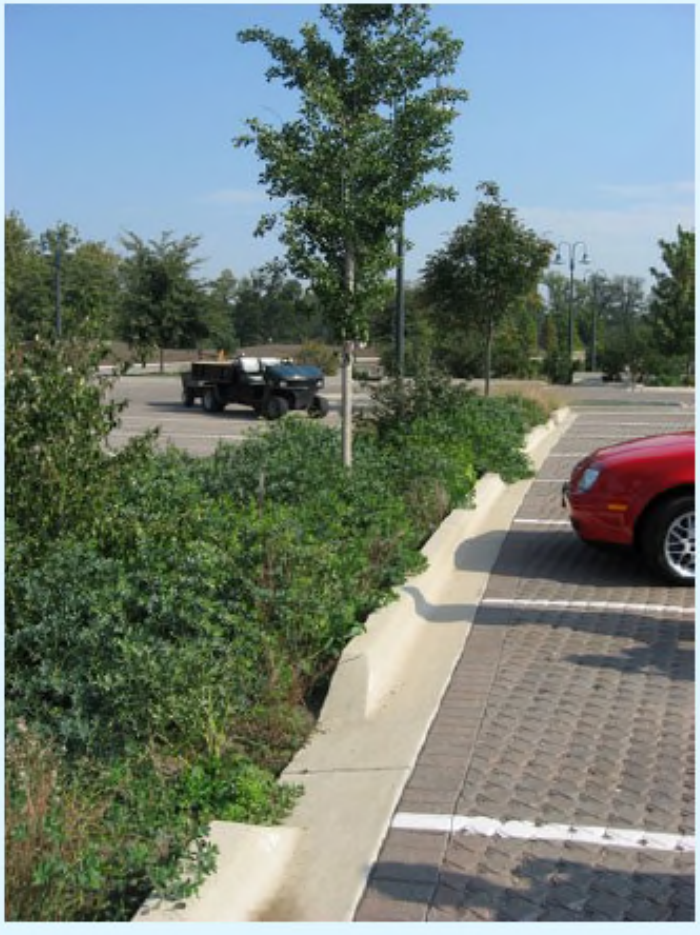
t= time

Federal Facility Stormwater Requirements

United States Environmental Protection Agency
Office of Water (4503T)
Washington, DC 20460
EPA 841-B-09-001
December 2009
www.epa.gov/owow/nps/lid/section438

Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act

www.epa.gov/owow/nps/lid/section438



EISA Section 438

Text of Section 438:

"Storm water runoff requirements for federal development projects. The sponsor of any development or redevelopment project involving a Federal facility with a footprint that ***exceeds 5,000 square feet*** *shall use site planning, design, construction, and maintenance strategies for the property to* ***maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow."***

Performance Standard

- Control 95th Percentile Rainfall Event
  - Manage rainfall onsite
  - Infiltrate, Evapotranspirate, Harvest and Infiltrate, and Reuse Runoff

Note: The 95th percentile rainfall event is the event whose precipitation total is greater than or equal to 95 percent of all 24-hour storms on an annual basis.

95% Storm Event

City	95th Percentile Event Rainfall Total (in)	City	95th Percentile Event Rainfall Total (in)
Atlanta, GA	1.8	Kansas City, MO	1.7
Baltimore, MD	1.6	Knoxville, TN	1.5
Boston, MA	1.5	Louisville, KY	1.5
Buffalo, NY	1.1	Minneapolis, MN	1.4
Burlington, VT	1.1	New York, NY	1.7
Charleston, WV	1.2	Salt Lake City, UT	0.8
Coeur D'Alene, ID	0.7	Phoenix, AZ	1
Cincinnati, OH	1.5	Portland, OR	1
Columbus, OH	1.3	Seattle, WA	1.6
Concord, NH	1.3	Washington, DC	1.7
Denver, CO	1.1		

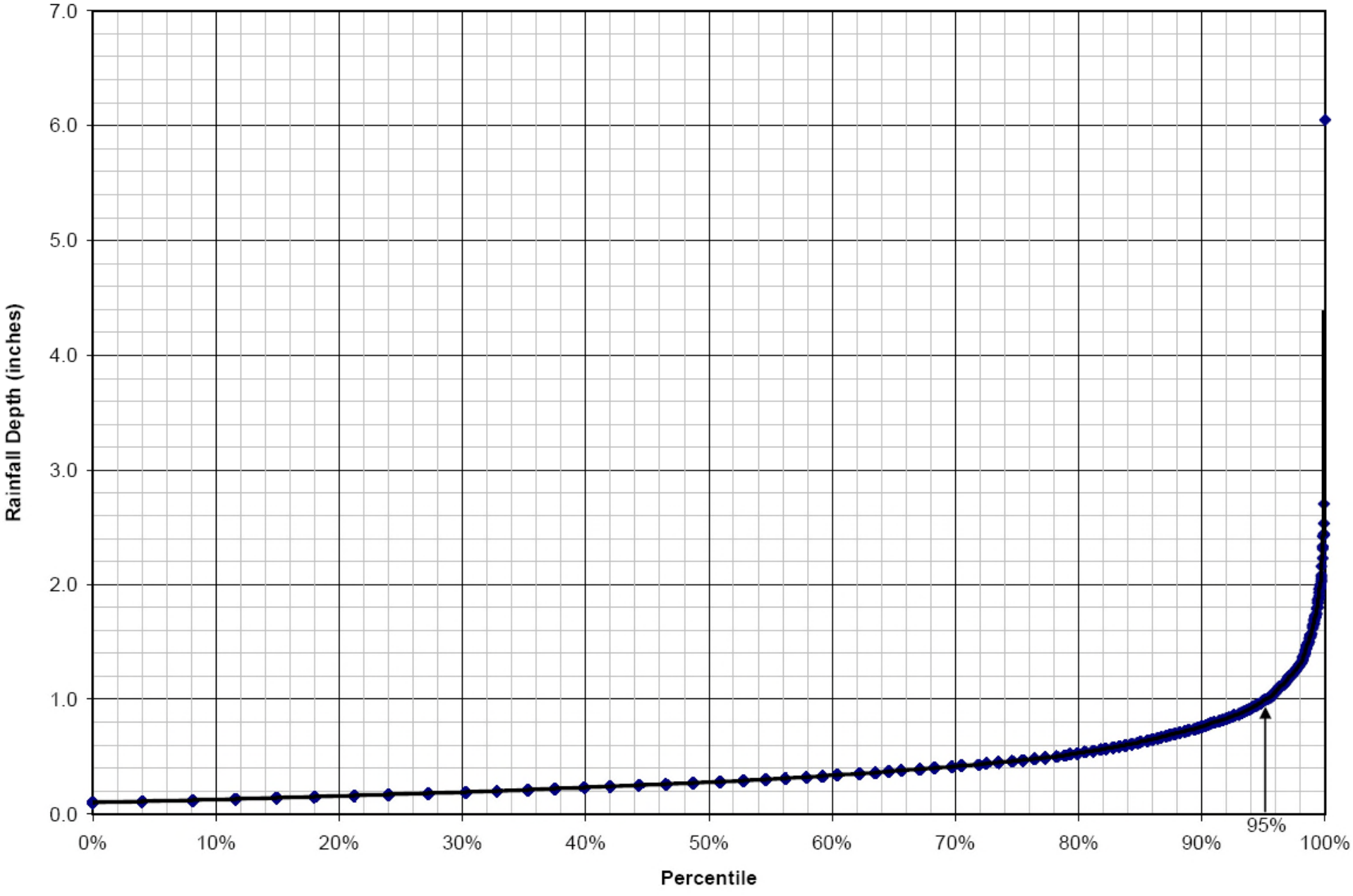


Figure 6. Rainfall Frequency Spectrum showing the 95th percentile rainfall event for Portland, OR (~1.0 inches)

Era of the Big Basin – Gone!

Stormwater management designs that manage only peak discharge rates often exacerbate the problem.

Natural-based systems respond to runoff volumes, frequencies, durations and temperatures as well.


Maintain Natural Vegetation

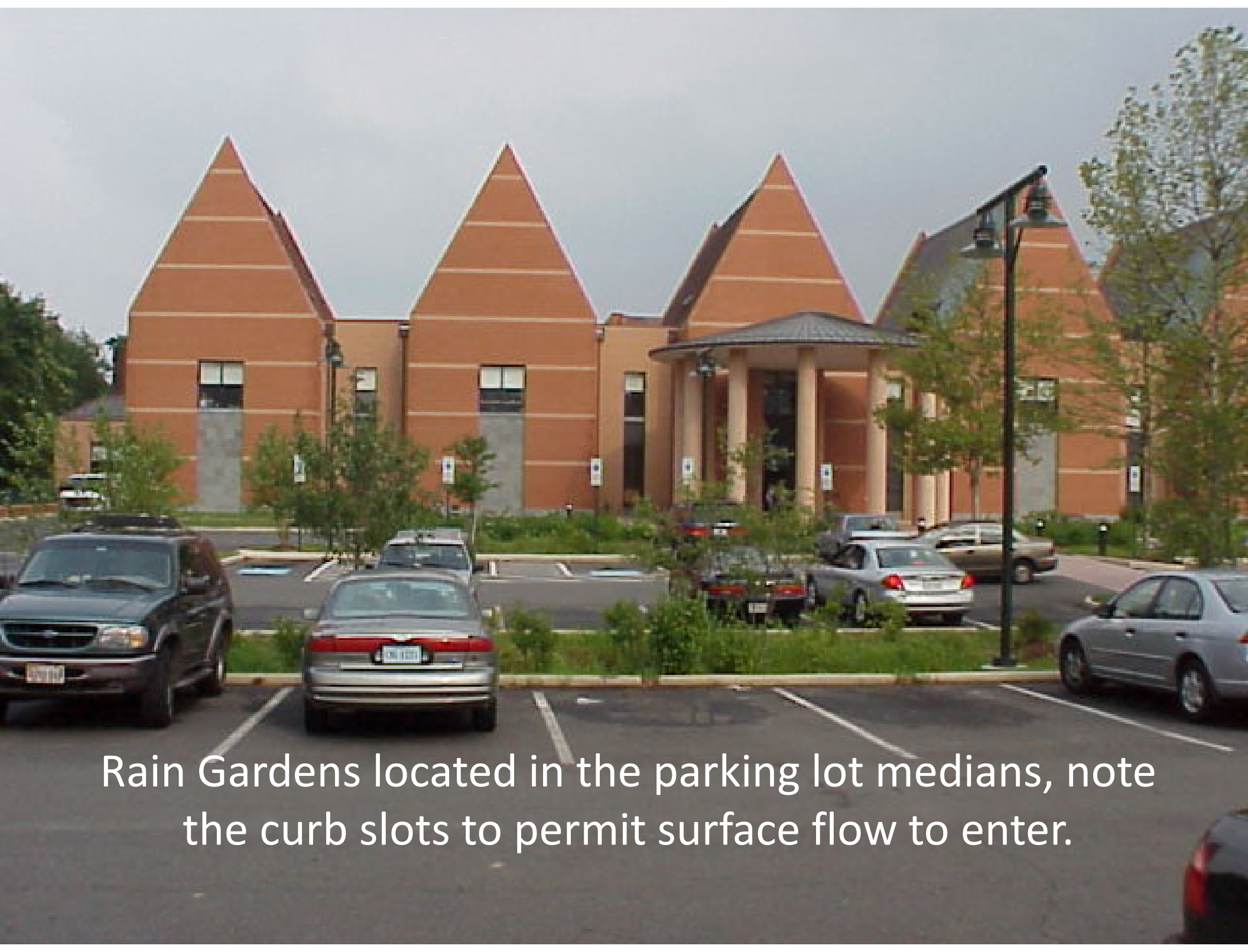
Porous Pavers. Funnel-like openings in the pavement surface facilitate rainwater infiltration, thereby reducing stormwater runoff and maximizing groundwater recharge and/or storage.

Permeable Pavement - Turfstone

Porous Asphalt and Permeable Pavers

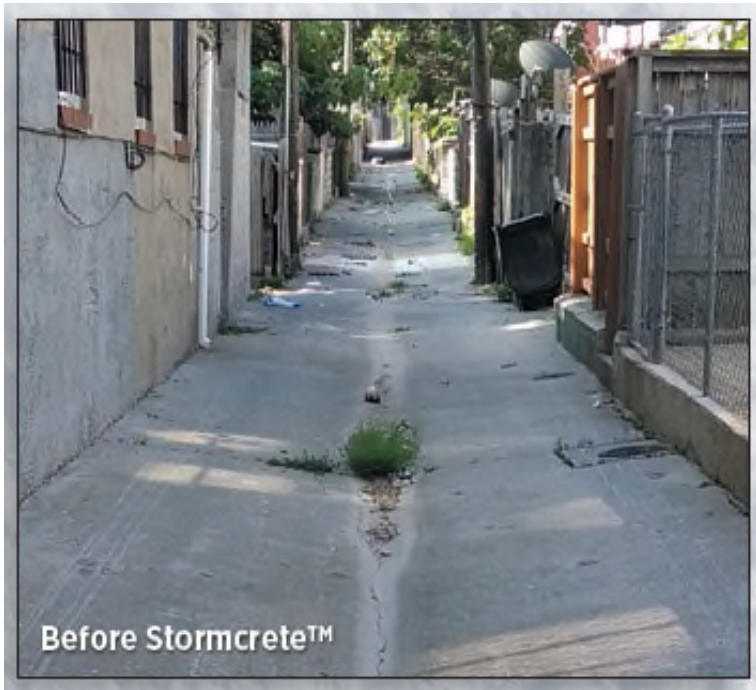
Rain Garden in a median strip of a townhouse project. Please note the depressed curb and grate inlet structure

Rain Garden (in use) in a highly landscaped commercial site.



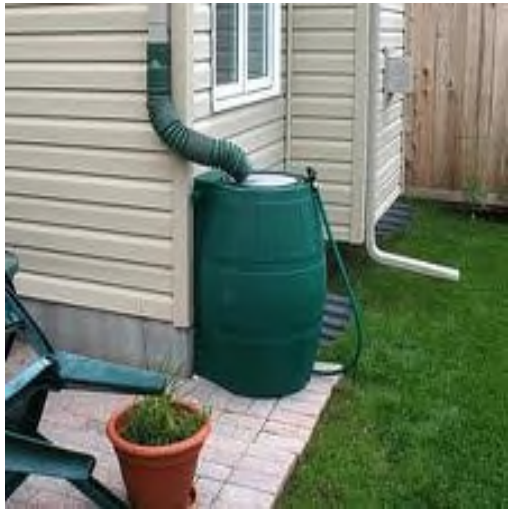
Rain Gardens located in the parking lot medians, note the curb slots to permit surface flow to enter.

Porous Pavement



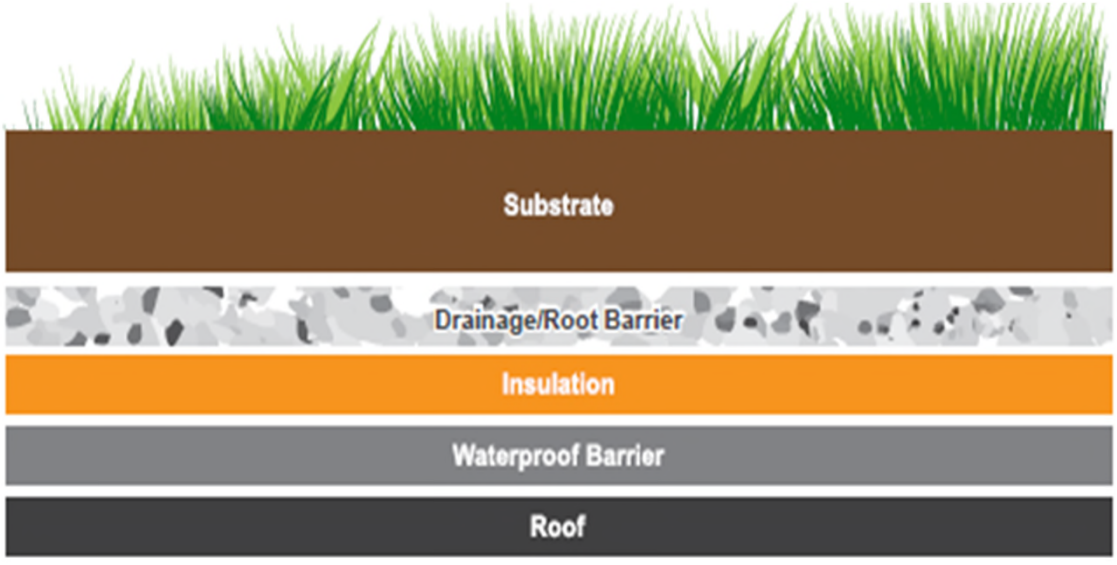
Porous Concrete and Asphalt

Rainwater Harvesting and Water Reuse



Rainwater Harvesting.
From small rain barrels to large underground storage cisterns and systems.

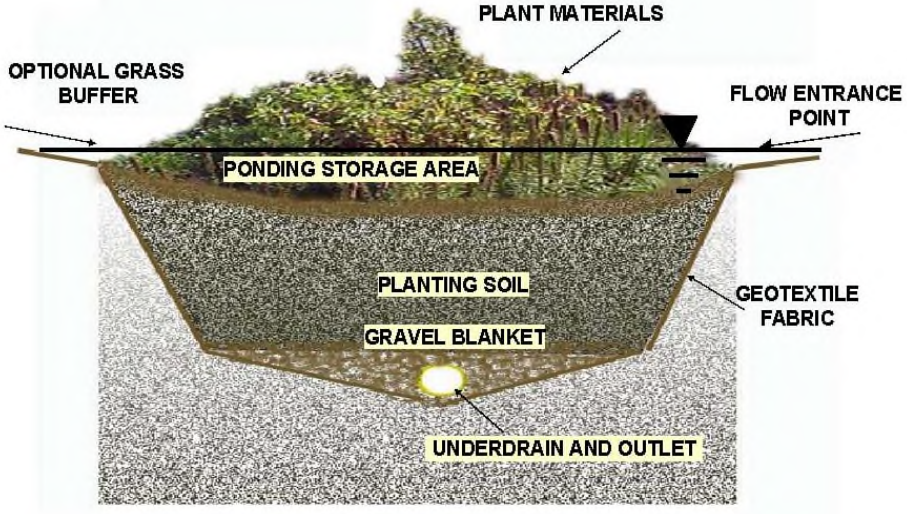
Green Roofs



Saturated Weight of Green Roof 26/lb/ft^2 -85/lb/ft^2

Bioretention Cells

Bioretention Cells

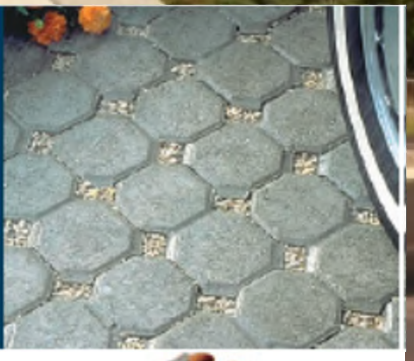



Bioretention cell with overflow- Townsend, MA
Net Zero Energy Development


Bioretention Cells

Porous Pavements (Silver Lake, Wilmington MA)

- Interlocking Concrete Pavers
- Porous Asphalt / Concrete
- FlexiPave



Filterra™ Unit

Weston & Sampson℠

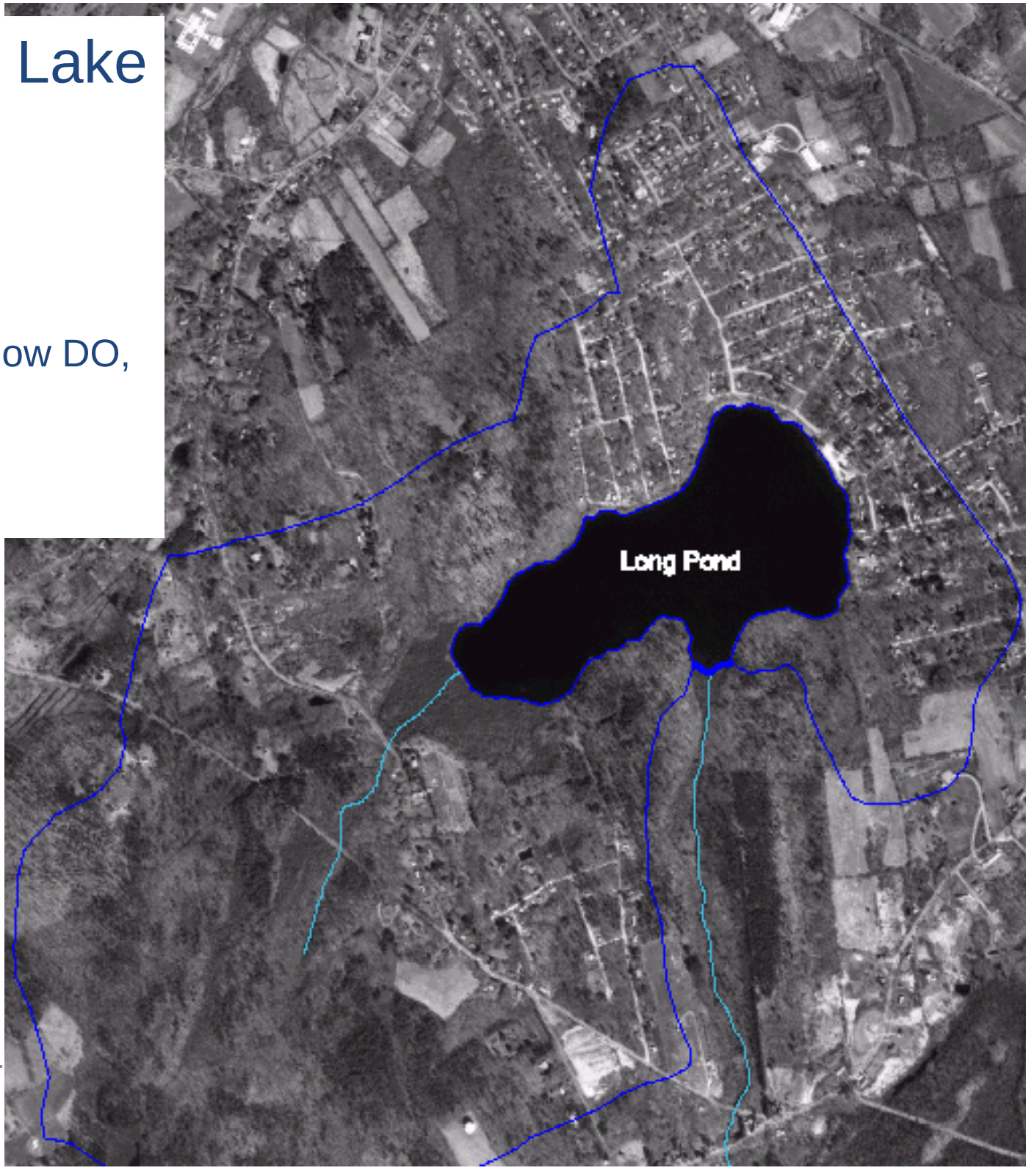

Planter Box for Roof Runoff (Plymouth, MA)

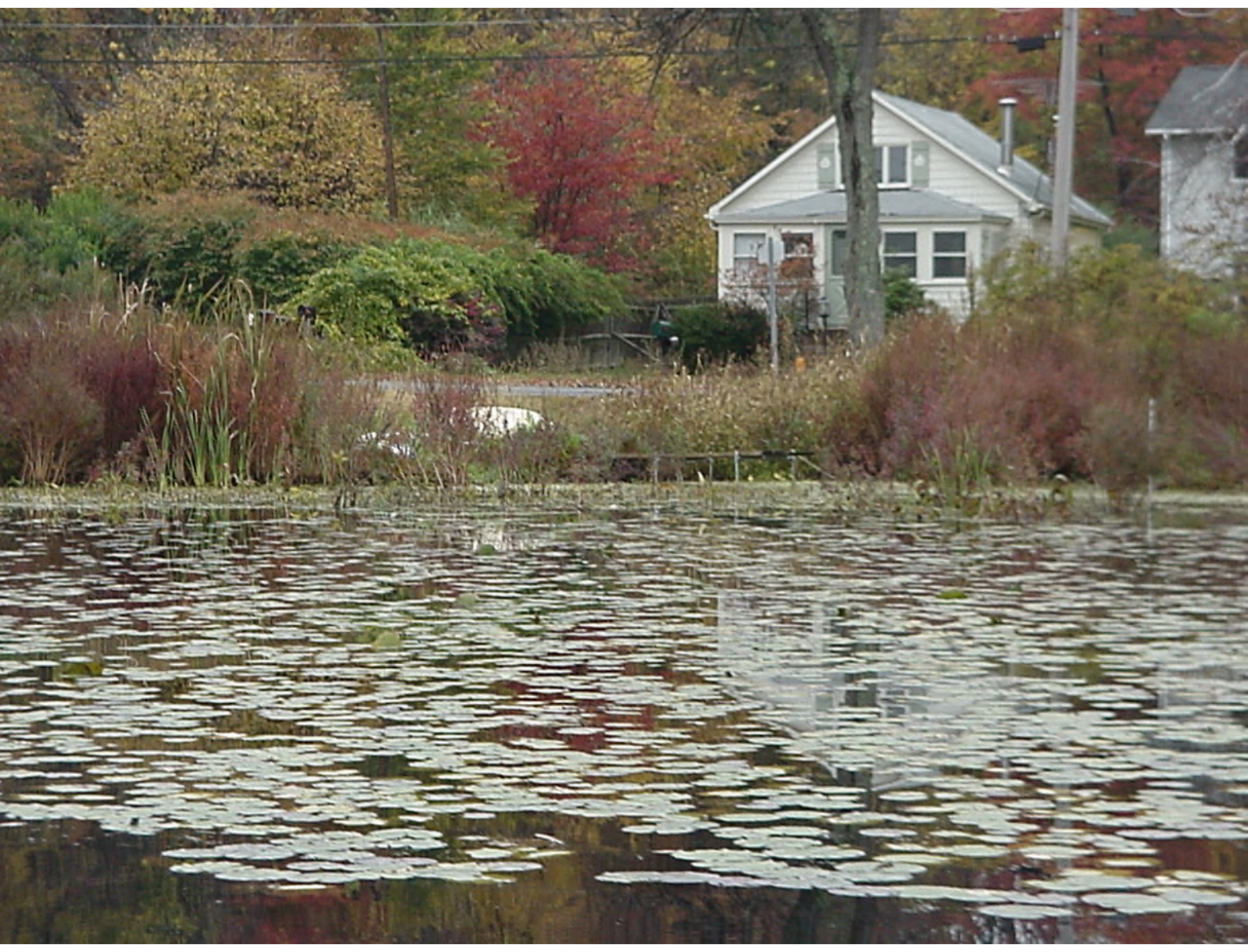
New Innovative GI Practices

Specified High Flow media (100” per hr) with detention storage
Pollutant specific media – metals, nutrients, bacteria

Overview of Long Lake

- 99 acre glacial lake
- 1.5 sq. miles
- 600 houses
- Septic systems
- 1/3 acre lots
- 303(d) listed for nutrients, low DO, and aquatic plants






Constructed Wetland with Sediment Forebay
(Long Lake, Littleton, MA)

100 ft Bioretention Cell in Parking Lo


Stream Daylighting
(Long Lake, Littleton, MA)
AUG 1 2005

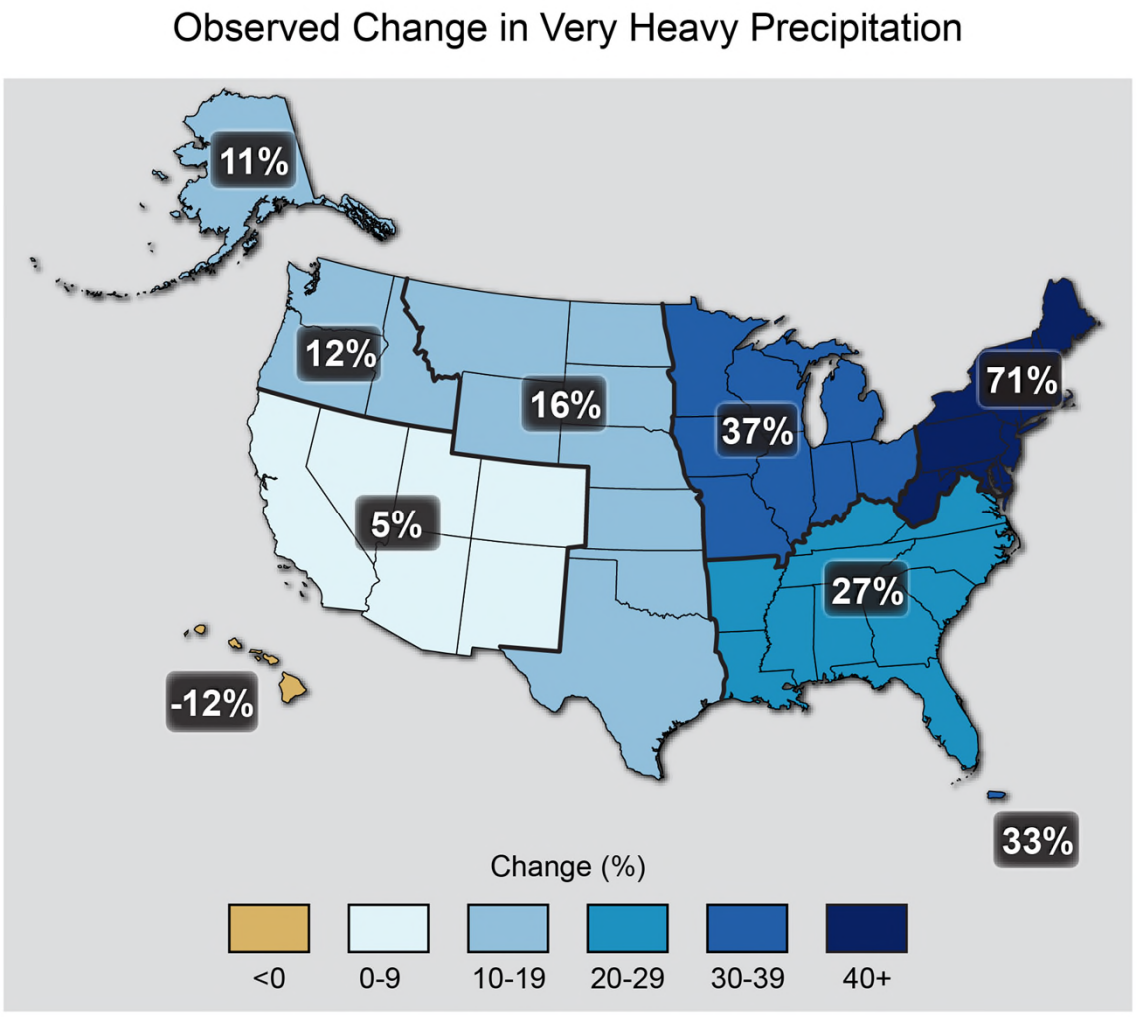
Boat Ramp with Porous Pavers (Long Lake, Littleton, MA)

AUG 1 2005

Climate Change - Increase in extreme precipitation events

FM Global – Coping With Extremes, 2016

Increasing frequency of extreme precipitation events is a major risk facing US businesses



Source:

Climate Change Impacts in the US: The Third National Climate Assessment, 2014

NYC Precipitation Projections

Mean annual precipitation is projected to **increase**

- 4 to 11 percent* by the 2050s
- 5 to 13 percent* by the 2080s

Boston Area – 44” – 50”

Source: NYC Panel on Climate Change, 2015

Landscaping Changes Overtime

- Irrigated/Manicured → Natives, Low Maintenance

MATTHEÆUSGADE - CLOUDBURST STREET

MATTHEÆUSGADE - CLOUDBURST STREET

MATTHEÆUSGADE - CLOUDBURST STREET

Hans Tavsens Park - The night-time summer rain disappears within a few hours and the rolling grass plains again fill up with people.

Hans Tavsens Park - Peace of mind after the cloudburst

LID/Sustainability Approaches

- Think BIG
  - –Barriers
  - –Incentives
  - –Gaps

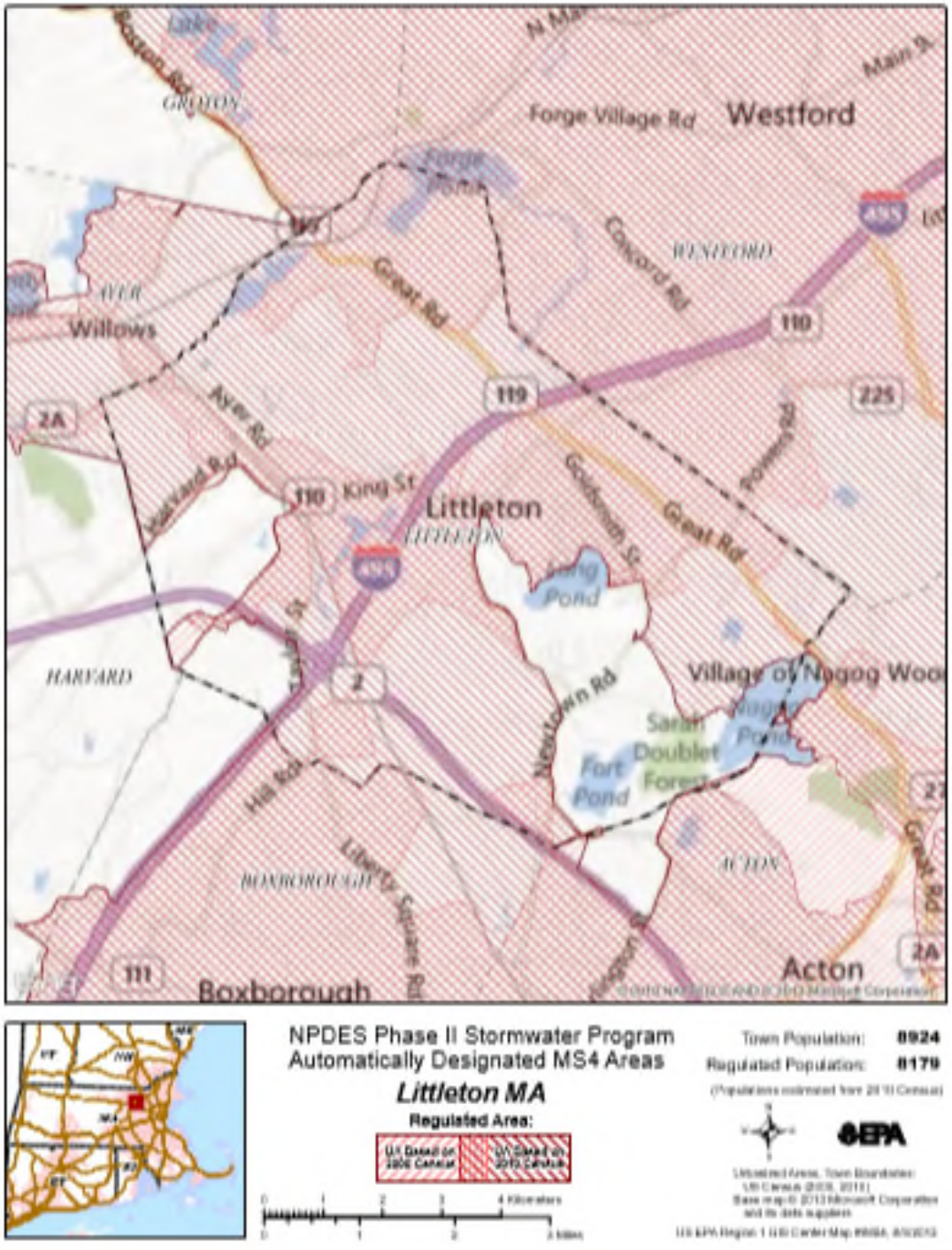
- Barriers – Allow mixed use development by right w/o special hearings or conditions
- Incentives- Offer more flexible development standards for infil
- Gaps – Fill regulatory gaps i.e. water efficient landscaping, water reuse, LID Stormwater, energy efficient designs, climate adaptation

Local Regulatory Tools

- Master Plan
- Zoning Bylaws
  - Littleton Aquifer and Watershed Protection Bylaw
  - Littleton Stormwater Bylaw
- Site Plan Review
- Subdivision Regulations
- BOH Regulations/Bylaws

A Path Forward

- **Conduct pilots** to allow for further understanding and acceptance of green infrastructure technologies at the local level. Pilot projects also allow departments to work together to identify possible road blocks – such as incompatible codes or safety concerns.
- **Remove obstacles** to LID/GI design by reviewing and amending planning documents, zoning, or codes.
- **Create incentives** to motivate developers and property owners to implement LID/GI technologies.
- **Set standards** based on performance criteria for new development or redevelopment, as well as the underlying construction & specialty codes, to encourage the adoption of new control strategies.
- **Identify goals, policies, and strategies** that can be interwoven into long-term planning documents or updates to further define how the community envisions LID/GI fitting into overall objectives. Describe how water infrastructure systems relate to growth and sustainable planning, and make LID/GI an integral part of community and neighborhood development.



NPDES Phase II Stormwater Program
Automatically Designated MS4 Areas

Littleton MA

Regulated Area:

UA Dated on 2000 Census | UA Dated on 2010 Census

0 1 2 3 4 Kilometers

0 1 2 3 Miles

Town Population: **8924**

Regulated Population: **8179**

(Populations estimated from 2010 Census)

EPA

Urbanized Areas, Town Boundaries:
US Census (2000, 2010)
Base map © 2013 Microsoft Corporation and its data suppliers

US EPA Region 1 GIS Center Map #####, 8/30/2013

transform your environment

thank you

Steve Roy
westonandsampson.com

Appendix C
Risk Matrix

Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.org

H-**M**-**L** priority for action over the **S**hort or **L**ong term (and **O**ngoing)
V = Vulnerability **S** = Strength

Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

Features	Location	Ownership	V or S	Wind	Temperature	Snow	Precipitation	Priority (H - M - L)	Time (Short Long Ongoing)
Infrastructural									
Mobile Home Park	Ayer Road	Private	V	Not sufficiently tied down; arranged for shelter at Gemini; LFD coordinated; are there grants ?				M	O
Trees - storm damage hazard	Town-wide		S	Falling on buildings and overhead lines				L	O
Structural integrity (roofs)	Public Buildings	Town	V			Heavy snow on school roofs; code has been updated to accommodate heavier loads, although current school buildings are built to old code - shovel roofs: School Comm evaluate options - heating pads		M	O
Electric and water	Town-wide	LELD	S			Historically very limited power outages. Generator for Town Hall evaluated but not feasible		L	O
Roads/Access	Town-wide	Town	S			Excellent clearing; snow dispoal is an issue; Beaver dams off Taylor St could result in Taylor St flooding; DPW pulls dams apart; need larger beaver deceivers	Good drainage; road flooding has not been an issue; ongoing drainage evaluation	M	O
Septic Systems	Town-wide	Residents/ Commercial	V				If water table rises; design parameters change	H	O
Potable Water	Town-side Groundwater	LEWD and Community	V				Drought and Intense rainfall conditions; groundwater mapping grant proposal	H	S
Drainage	Town-wide	Town	S/V				Minimal flooding; beaver dams	L	O
Societal									
Emergency Communication		LFD and LPD	S	Back up systems				L	O
Vunerable Populations			S	LPD and LFD check in with elderly and disabled				L	O
Agricultural lands		Private	V		Changing seasonal temperatures and precipitation could affect ; consider agriculture co-use for large solar arrays. Make sure code does not present barriers to sustainable management			O	O
Environmental									
Water Conservation		LWD and residents	V				Increased runoff from intense storms could impact water quality; consider using closed quarry as water source; review of code for LID recommendations.	H	S/O
Open Spaces		All	V		Invasive species with changing climate		Create a clean lands committee; look into grazing (goats and sheep) or haying	M	O
Wetlands		All	V				Possible expansion of wetland areas with increasing precipitation; impacts on infrastructure and environmental quality	H	O
Tree loss		All	V		Loss of cooling effect; increased erosion and water quality effects; Shade Tree Committee needs regular town funding			H	S/O

Appendix D

Littleton Regulatory Review - Low Impact Development

No.	Category	Subcategory	Key Question	Findings	Code / Ordinance	Section Reference	Comments	Recommendation	Priority
1	Vegetation and Landscaping	Preservation of natural areas	Site plan applicants required to provide layout of existing vegetated areas	Y	Littleton Zoning Code Part 2, v. 45	Article XVII	See §173-88 Special Permit for Major Commercial and Industrial Uses, Part C Major Projects Part 1) "A Schematic development plan, indicating the location of the boundaries of the lot, buildings, roads, drives, parking, reserved open space, wells, on-site disposal facilities, drainage system, topography and grading, areas of retained vegetation and planting areas." Similar language exists in section § 249-32 the Definitive Plan of the Littleton Subdivision of Land Regulations.	None	
2	Vegetation and Landscaping	Preservation of natural areas	Presence of maximum as well as minimum yard sizing ordinance	N	-	-	-	Consider creating language that clearly defines minimum and maximum lot coverage of parcels in each district of town. Lot coverage is defined as the percentage of the lot covered by building area and other impervious surfaces.	
3	Vegetation and Landscaping	Preservation of natural areas	Residential restrictions for enlarging existing turf lawn areas	N	-	-	-	Consider placing limits on (or incentivizing reductions of) the percentage of landscapable area that can be in turf grass. EPA's Watersense program recommends 40%. See http://epa.gov/watersense/docs/home_turfgrass-report508.pdf	
4	Vegetation and Landscaping	Preservation of natural areas	Provides incentives for using vegetation to filter stormwater runoff	N	-	-	Vegetative filtration of stormwater is encouraged by the Littleton LID/BMP Manual, but no incentive structure has been proposed or implemented.	Explore the possibility of creating incentives for installations of BMPs on residential properties.	
5	Vegetation and Landscaping	Preservation of natural areas	Require a specific percentage of permanently protected open space for cluster development	Y/N	Littleton Zoning Code Part 2, v. 45	Article XIX	See §173-95, Applicability, Part A and B. They State that any residential project on 10 acres or more requires a permit to develop open space. The Planning Board can waive this application to allow conventional subdivision concept upon review	Consider clarifying language to encourage developments of a certain size to develop open space and that space be permanently protected. Open space is defined as including conservation and recreational uses; however, these two uses can be conflicting. Clarify the purpose and percentage of open space required for conservation purposes for planned developments. Model ordinance language provided by the US EPA suggests a minimum percent open space requirement of between 35 – 50%, depending on base density. For more information, see: http://water.epa.gov/polwaste/nps/mol3.cfm	
6	Vegetation and Landscaping	Tree Protection Ordinance	Existence of a tree protection ordinance	Y/N	Littleton Zoning Code Part 2, v. 45	Article XIV	See §173-61 Use Regulations, under Uses, Paragraph 6. It states "Other Characteristics: for use other than single family dwellings, retention of less than 30% of lot area in its natural state with not more than minor removal of trees and ground vegetation."	Language could be more specific to include native species protection or specific tree removal allowances in a separate Tree Preservation and Removal Ordinance.	
7	Vegetation and Landscaping	Tree Protection Ordinance	Existence of a forest protection ordinance	N	-	-	-	Require a percentage of canopy to be retained after construction, possibly located in a separate Tree Protection Ordinance	
8	Vegetation and Landscaping	Tree Protection Ordinance	Requirements for protecting % of existing forest	N	-	-	-	Require a percentage of canopy to be retained after construction, possibly located in a separate Tree Protection Ordinance	
9	Vegetation and Landscaping	Landscaping Island and Screening Ordinance	Require landscaping in parking lots	Y	Littleton Zoning Code Part 2, v. 45	Article VII	See §173-32 Parking Requirements, Part C, Parking Area Design, Part 6. It states that "To reduce stormwater discharge and improve the attenuation of pollutants, applicants are required to use stormwater control Best Management Practices (BMPs) and Low Impact Development (LID) techniques in parking lot design (i.e., interior landscaping, vegetated/grassy swales, infiltration planters, permeable pavement, rain gardens, etc.)	The language of the ordinance could easily be adjusted to require vegetation that is more beneficial for stormwater quality. However, as it currently reads, the ordinance's primary concern is reducing the visual expanse of pavement areas. Consider changing to: "Landscaped edges and islands for all parking areas shall be provided which function as stormwater management features and incorporate well screened by berms, plantings and, or other screening methods to minimize their visual impact of the parking area."	

No.	Category	Subcategory	Key Question	Findings	Code / Ordinance	Section Reference	Comments	Recommendation	Priority
10	Vegetation and Landscaping	Landscaping Island and Screening Ordinance	Allow the use of bioretention islands and other stormwater practices within landscaped areas or setbacks	Y	-	-	There is an entire handbook detailing possible LID and Stormwater BMP implementation that is relevant to Littleton. Some of these control measures include permeable pavements, infiltration basins, parking lot planters/buffers, parking groves, infiltration trenches for infiltration; Swales, rain barrels, rooftop detention, and dry ponds for attenuation; filter strips, green roofs, rain gardens, tree box filters, wet ponds, sand/organic filters, stormwater wetlands, urban forestry, catch basin filters, and swirls/separators for treatment. The town encourages the use of BMPs and LID methods but does not impose any regulations that would be stricter than the Massachusetts Stormwater Policy Handbook (March 1997), except where the wetland protections act has jurisdiction. In reviewing the Wetlands Protection bylaw, "any activity proposed or undertaken within the "buffer zone" as defined in G.L. c. 131 § 40 and 310 CMR 10.02(2)(b) or areas subject to protection (collectively the "resource area") is subject to regulation…"	Consider also using this reference as a guideline for creating LID bylaws: https://www.mass.gov/service-details/smart-growth-smart-energy-toolkit-module-bylaws This serves as a model for LID Management Plans and all components that could be included within a comprehensive plan to encourage and implement stormwater structural and non-structural BMPS.	
11	Vegetation and Landscaping	Landscaping Island and Screening Ordinance	Require screening from adjoining properties to encourage using vegetation in lieu of walls and berms	Y	Littleton Zoning Code Part 2, v. 45	Article IX	See § 173-43 Screening, Parts A and B. Only development in Industrial A Districts are required to use vegetation as screening, but all outdoor sales display areas require screening. The Littleton Subdivision Regulations also mandates that any property that has been subdivided to install street trees on either side of the road, spaced 40 feet apart (§ 249-43 Streets and Paths Part E)	Consider language that encourages vegetation for all screening implementation more strongly, instead of as a possible addition.	
12	Vegetation and Landscaping	Riparian Buffers	Presence of a stream buffer or floodplain ordinance	Y	Littleton Zoning Code Part 2, v. 45	Article XVI	See § 173-72 Applicability and 73 Uses Permitted. This section describes what is classified as a Floodplain – "all land lying below certain control elevation as shown on the zoning map shall be considered wetlands, deemed to be subject to seasonal or periodic flooding." These areas are protected and uses of them can only be permitted after review by the Board of Appeals.	Consider adding specific values for the size and placement of the buffer or fleshing out a section referring to stream and river corridor protection and management specifically.	

No.	Category	Subcategory	Key Question	Findings	Code / Ordinance	Section Reference	Comments	Recommendation	Priority
13	Vegetation and Landscaping	Riparian Buffers	Consistency of stream/riparian requirements with state regulatory requirements	Y/N	Massachusetts Wetlands Protection Act	10.02 Section 2 part b	Refer to: https://www.mass.gov/files/documents/2016/08/vy/310cmr10a.pdf, and see section 10.02 (2)(b) Activities Within the Buffer Zone. Any activity to take place within 100 feet of the Buffer zone is subject to the regulations contained in the regulations. This Wetlands protections act is consistent with Littleton's WPA. However, there is a MA Building code that is located here: https://www.mass.gov/guides/floodplain-management and any town specific ordinance should be consistent with this. According to Littleton Zoning Code Part 2 v. 45 references Chapter 131 Section 40 of the Massachusetts General Laws in § 173-73 Part G.	None.	
14	Vegetation and Landscaping	Riparian Buffers	Buffer areas protected by conservation easement or other permanent restrictions	Y	Littleton Zoning Code Part 2, v. 45	Article XVIII	See § 173-89 Master Planned Developments, Part B Submittals, Part 2. "A site landscaping plan, indicating buffer areas to be maintained in natural landscaping; areas to be kept free of parking, storage or service yard; areas to be kept free of buildings; and proposed landscaping." In addition, the Littleton Subdivision Regulations state in § 249-52 Erosion and Sediment Control Part D states: "Water Resources shall be protected, including but not limited to floodplains, wetlands, aquifer recharge areas, and Town well fields."	The language could be less ambiguous to protect riparian buffer zones by deeming them conservation easements or other specific delineation.	
15	Vegetation and Landscaping	Riparian Buffers	Ordinance identifies or limits when stormwater outfall structures can cross the buffer	N	-	-	-	Consider adding a section to the Stormwater Management and Erosion Control Regulations detailing standards for discharges from outfalls into buffer zones to be in compliance with the most current EPA MS4 permit and any other applicable state or town regulation.	
16	Vegetation and Landscaping	Riparian Buffers	Specify what maintenance /activities are allowed within the buffer	Y/N	Littleton Zoning Code Part 2, v. 45	Article XVII	Only mention of maintenance of buffer zone is as follows: See § 173-89 Master Planned Developments, Part B Submittals, Part 2. "A site landscaping plan, indicating buffer areas to be maintained in natural landscaping; areas to be kept free of parking, storage or service yard; areas to be kept free of buildings; and proposed landscaping." But no specifics are noted.	Consider adding a section detailing regulations for encroachment or previous development.	

No.	Category	Subcategory	Key Question	Findings	Code / Ordinance	Section Reference	Comments	Recommendation	Priority
17	Minimize Land Disturbances	Limits of Disturbance	Identify environmentally critical/constrained areas as part of existing conditions	Y/N	Littleton Zoning Code Part 2, v. 45	Article XXI	See § 173-133 Site Plan Approval Part C which discusses eligibility for Site Plans to be approved by the Planning Board is contingent on proximity to endangered species (within 200 feet), bodies of water, historic sites, landscape features, and other buildings. The Littleton Stormwater Regulations also mentions that any land disturbance must be in compliance with the Stormwater Permit.	Clarify whether environmentally critical or constrained areas and limits of disturbance are identified on grading plans, regardless of whether a site plan is submitted. Consider requiring a natural resources and hydrologic soils inventory plan be required to be approved by the department prior to any grading plan or Minor Subdivision and Minor Site Plan submissions	
18	Minimize Land Disturbances	Limits of Disturbance	Ability to reduce setbacks	Y	Littleton Zoning Code Part 2, v. 45	Article XXVII	See § 173-192 Special Permit Conditions, Intensity of Use Schedule matrix on the last page of the document. It details that in some cases, where "either the topography of the site and its vegetation provide adequate visual screening for the building despite the smaller setback or the proposal is harmonious with its surroundings in architectural scale, use of materials, colors, and landscape treatment and also that there is public interest benefits from the smaller setback, such as superior protection of natural features of the site or avoidance of sensitive areas or making feasible a desirable development not otherwise possible." If these two stipulations are met, the Panning Board may authorize a smaller setback through the use of a special permit.	Consider allowing for reduced setbacks in residential developments where it allows increased access and proximity to communal open space and a strong sense of neighborhood community	
19	Minimize Land Disturbances	Limits of Disturbance	Include maximum turf grass or impervious cover limits in setbacks	N	–	–	–	Consider creating provisions for a limit of impervious area or turf cover of setbacks specifically.	
20	Minimize Land Disturbances	Limits of Disturbance	Prohibit clear-cutting of construction project site	N	-	-	-	Require a percentage of canopy to be retained during and after construction, possibly located in a separate Tree Protection Ordinance	
21	Minimize Land Disturbances	Limits of Disturbance	Limit traffic of heavy construction vehicles to specific areas	N	-	-	-	Consider adding provisions to include measures to identify and prevent soil compaction of soils with the highest infiltration capacity, and to require the identification and use of specified travel paths for heavy construction equipment to limit overall site compaction, in addition to preventing and controlling soil erosion and sedimentation. Also require the placement of temporary construction trailers to be shown on plans to ensure they are placed outside of environmentally sensitive areas and off soils with the highest infiltration capacity	
22	Minimize Land Disturbances	Limits of Disturbance	Require identification of specific areas that provide significant hydrologic functions.	Y/N	Littleton Zoning Code Part 2, v.45	-	Most submission requirements for types of development requires a comprehensive site plan which includes wetlands, buffers, forested areas, and other significant natural features.	Include a checklist of areas that should be identified on plans, and a format by which they should be submitted to the Planning Board for review.	
23	Minimize Land Disturbances	Limits of Disturbance	Require as-built inspections before issuance of occupancy that includes id of compacted areas	N	-	-	-	Consider revise as-built inspection process to ensure that soil compaction is addressed and mediated prior to the issuance of occupancy.	

No.	Category	Subcategory	Key Question	Findings	Code / Ordinance	Section Reference	Comments	Recommendation	Priority
24	Minimize Land Disturbances	Limits of Disturbance	Require restoration of compacted areas in accordance with soil erosion and sediment plan	N	-	-	No specific mentions of compacted soils exist within the erosion control regulations.	Add provisions to the Littleton Planning Board Stormwater Management and Erosion Control Regulations to restore overall soil conditions at construction sites after construction is completed.	
25	Minimize Land Disturbances	Open Space and Cluster Development	Allow open space or cluster developments	Y	Littleton Zoning Code Part 2, v. 45	Article XIX	Article XIX Open Space Development details the need for open space as more housing development continues in Littleton.	None	
26	Minimize Land Disturbances	Open Space and Cluster Development	Allow for flexible site design incentives for open space or cluster design	Y	Littleton Zoning Code Part 2, v. 45	Article XIX	See § 173-95 Applicability, Part A details that any project involving the subdivision of ten (10) acres or more of land is required to apply for open space development. This can be waved at the decision of the Planning Board. No specific mention of projects requiring less than 10 acres to comply with the open space development requirements.	Consider adding a minimum percentage requirement of the development that must remain open space. Set priorities for what open space should preserve	
27	Minimize Land Disturbances	Open Space and Cluster Development	Set limits on allowable disturbance of existing vegetation	N	-	-	-	Establish limits on the allowable disturbance of existing vegetated areas in open space	
28	Minimize Land Disturbances	Open Space and Cluster Development	Reestablish vegetated areas in disturbed open space	N	-	-	-	Set requirements for re-establishing vegetation in disturbed areas dedicated to open space.	
29	Minimize Land Disturbances	Open Space and Cluster Development	Set limits on allowable impervious cover in open space	Y	Littleton Zoning Code Part 2, v. 45	Article XXV	See § 173-179 Relationship to Aquifer and Water Resources Districts, Part B Site Coverage. “Unless otherwise specified in the Littleton Village Overlay District West – Beaver Brook Area bylaw, the maximum impervious site cover shall be limited to 0 percent of the total lot area in the Aquifer District and 50 percent in the Water Resource District…” It is unclear if similar regulations exist for areas not in the West – Beaver Brook Area District	Consider making the language less ambiguous to apply to the whole Town. Establish maximum allowable impervious cover limits for open space areas in planned developments.	
30	Impervious Area Management	Streets and Driveways	Evaluate minimum widths of streets to ensure narrowest possible	Y	Chapter 249 Subdivision of Land Regulations	Article IV	See § 249-43 Streets and Paths, Part A Basic Design Controls, Part 1. “The traveled way width, exclusive of curbing, shall be as specified… as follows: a) Lane – 22 ft, b) Minor Street – 24 ft, c) Collector Street – 30 ft, d) Arterial Street – Pursuant to MassDOT PD&DG for applicable traffic volumes and design speed.”	Also consider allowing street pavement widths between 18 to 22 feet, with curb pullouts for passing of large vehicles.	
31	Impervious Area Management	Streets and Driveways	Allow/require street features to receive runoff	Y	Chapter 249 Subdivision of Land Regulations	Article IV	See § 249-51Stormwater Management. The Regulations provide guidance on installing Catch Basins, Stormwater Manholes, culverts, and detention/retention basins.	Consider inserting specific language to allow landscaped islands to receive runoff or consolidate travel lanes and on-street parking to create space for bioretention.	
32	Impervious Area Management	Streets and Driveways	Allow the use of curb cuts or flush curbs	Y	Chapter 249 Subdivision of Land Regulations	Article IV	Sidewalk ramp cuts are mentioned in § 249-51 Stormwater Management, Part D in relation to the fact that no catch basin may be located in the cut. In addition, the Littleton Zoning Code Part 2 v. 45 Article XXV § 173-176 Design Standards Paragraph 5 Landscaping and Public Realm Enhancements states that “Curb cuts shall be minimized.”	Revise curbing standards to allow curb cuts or flush curbs with curb stops to be utilized as an alternative to raised curbs, as well as grass swales or bioretention swales instead of curb or gutter.	
33	Impervious Area Management	Streets and Driveways	Reduce minimum cul-de-sac radius or require center island landscaped	Y	Chapter 249 Subdivision of Land Regulations	Article Iv	See § 249-43 Streets and Paths, Part E Landscaping and Aesthetics, Part 1. “Cul-de-sac center islands shall be landscaped. 8 feet width of gravel is required on the perimeter of the cul-de-sac, inside the curb. Low-maintenance groundcover (juniper or similar) shall be planted with topsoil and bark mulch, with trees screening any transformers or electrical equipment. Do not obstruct access.”	Allow for smaller minimum cul-de-sac radii (such as 35 feet or less) or include landscaped islands that can receive stormwater runoff in the center.	
34	Impervious Area Management	Streets and Driveways	Allow alternative turnarounds for low-density residential streets	Y	Littleton Zoning Code Part 2, v. 45	Article XX	See § 173-127 Design Criteria, Part I: “At the end of a shared driveway, a turnaround shall be constructed with a 75 foot minimum turning radius.”	Revise street design standards to allow for alternative turn-arounds such as "hammerheads" on short streets in low density residential developments.	

No.	Category	Subcategory	Key Question	Findings	Code / Ordinance	Section Reference	Comments	Recommendation	Priority
35	Impervious Area Management	Streets and Driveways	Allow minimum driveway widths to be reduced	Y/N	Littleton Zoning Code Part 2, v. 45	Article XX	See § 173-127 Design Criteria Part B: "The minimum width of the shared driveway shall be sixteen (16) feet."	Consider adding language that allows for the reducing of the width of all driveways, not just shared driveways. Single car driveways can be as narrow as 9 feet, or as wide as 12 feet. Double car driveways can be between 20 and 24 feet wide. To allow for door swing and area for passengers to step onto hard surfaces, consider encouraging decorative, permeable bands of 2 ft. in width where absolute minimum driveway widths are utilized (e.g., 9 feet may mean that guests are stepping in grass or dirt as they exit their vehicles).	
36	Impervious Area Management	Streets and Driveways	Permit shared driveways in residential developments	Y	Littleton Zoning Code Part 2, v. 45	Article XX	Article XX Shared Residential Driveways	None	
37	Impervious Area Management	Parking areas and Sidewalks	Ability to reduce parking ratios	N	-	-	-	Consider re-examining parking demand in urban areas where land and parking costs are higher and transportation alternatives exist in order to determine whether minimum parking standards can either be reduced or eliminated completely. Reducing minimum parking requirements will help to create more livable communities by reducing the abundant supply of free parking and encouraging transit use. As stated in the Master Plan, Transit-Oriented Districts are a priority for the town and this principle could be applied elsewhere.	
38	Impervious Area Management	Parking areas and Sidewalks	Establish maximum parking requirements	N	-	-	No Specification on Minimum or Maximum number of parking spaces offered is mentioned in either the Zoning code or the Subdivision Regulations but there are stipulations for lots with over 8 spaces.	Consider setting a maximum number of parking spaces in areas serviced by public transit to discourage use of personal vehicles. This could be a helpful guideline: https://www.mass.gov/files/documents/2017/11/03/Smart%20Parking.pdf	
39	Impervious Area Management	Parking areas and Sidewalks	Allow for the use of shared parking arrangements	Y	Littleton Zoning Code Part 2, v. 45	Article VII	See § 173-32 Parking Requirements, Part B. "…Applicant is encouraged to consider shared parking as a possible means of reducing total parking area, subject to Planning Board approval."	None	
40	Impervious Area Management	Parking areas and Sidewalks	Provide a model shared parking agreement	N	-	-	While the Town does allow and encourage shared parking, no model agreement currently exists within the ordinance. One challenge with shared parking is working out an agreement between land owners or developers if the uses are not all on the same property	Consider providing an example agreement like the ones that can be found at the following link: https://www.mapc.org/resource-library/shared-parking/	
41	Impervious Area Management	Parking areas and Sidewalks	Allow for reduced parking ratios where mass transit exists	N	-	-	In the 2017 Littleton Master Plan, Part 2 Land Use, Section 5, the town makes it very clear that by promoting a more usable form of public transportation, it hopes to discourage the use of personal vehicles, but there is no specific language to support this in the zoning codes.	Consider setting a definable goal of how many parking spaces can be reduced by the encouragement of transit.	
42	Impervious Area Management	Parking areas and Sidewalks	Allow min. stall width of 9 ft.	N	-	-	The Littleton Zoning Code Part 2, v. 45 Article VII Parking and Loading Requirements, § 173-32 Parking Requirements, Part C Parking Area Design, Part 4 states that parking space dimensions shall meet standards established by the Planning Board but does not list them here.	Create definitive design requirements for regular and compact cars, such as a minimum stall width of 9 ft for regular cars, and 7.5 ft for compact cars. In addition, provide language for the percentage of available spaces that will be designed for and dedicated to compact cars.	
43	Impervious Area Management	Parking areas and Sidewalks	Allow min. stall length of18 ft.	N	-	-	See Above	Create definitive design requirements for regular and compact cars, such as the minimum stall length of 18 ft for regular cars, and 15 ft for compact cars. In addition, provide language for the percentage of available spaces that will be designed for and dedicated to compact cars.	

No.	Category	Subcategory	Key Question	Findings	Code / Ordinance	Section Reference	Comments	Recommendation	Priority
44	Impervious Area Management	Parking areas and Sidewalks	Allow reduction in stall lengths for vehicle overhang in vegetated areas	N	-	-	See Above	Consider adding language within the space design that allows for the special case of overhang in vegetated areas.	
45	Impervious Area Management	Parking areas and Sidewalks	Allow permeable materials for overflow parking	Y	Littleton Zoning Code Part 2, v. 45	Article VII	See § 173-32 Parking Requirements, Part C. Parking Area Design Part 6 states that all new development must employ a stormwater BMP in it's design. It mentions permeable materials as an option but does not specifically have language regarding overflow parking.	Consider encouraging the use of pervious parking lot surfaces by allowing the majority of the pervious parking surfaces provided to be excluded when calculating allowable lot coverage. This allows a developer to increase a proposed building footprint because when less of the parking area is counted towards allowable lot coverage, more of that coverage becomes available for building space. See p. 20 of http://www.fhiplan.com/PDF/NW%20Parking%20Study/NW%20Connecticut%20Parking%20Study%20Phase%202.pdf for some possible ideas.	
46	Impervious Area Management	Parking areas and Sidewalks	Allow for multi-level parking	N	-	-	There is no language prohibiting it but does not specifically have regulations for multi-level parking.	Create Language to directly address and encourage multi-level parking.	
47	Impervious Area Management	Parking areas and Sidewalks	Provide incentives to reduce impervious cover in parking	Y/N	-	-	In the Littleton Zoning Code Part 2 v. 45 Article XIV Aquifer and Water Resource District, § 173-63 Design and Operations Guidelines, part D, there are percentages of impervious coverage at which drainage provisions and BMPs must be employed, but no Impervious coverage limit, nor are there directly laid out incentives for the active reduction in impervious coverage.	The town may want to investigate creating an incentives system to encourage commercial and private dwellings to employ BMPs.	
48	Impervious Area Management	Parking areas and Sidewalks	Allow for pervious sidewalks	Y	Chapter 249 Subdivision of Land Regulations	Article V	See § 249-81 Sidewalks Part A states that "There shall be sidewalks 5 feet in width on both sides of all collector streets and on 1 side of all minor streets. As indicated in Figures 1, 2, & 3, cement concrete is required for all sidewalks unless a written waiver is obtained by the Applicant." In addition, the Littleton LID/BMP Manual discusses Pedestal Sidewalks (pours pavers) in Part 2.3 BMPs Relevant to Littleton Part 1 Infiltration.	The town may want to consider requiring sidewalks to be permeable, or, could take a less prescriptive approach and just require a certain percentage of surfaces in front yards be permeable (for example, 50%) by using porous asphalt, porous concrete, interlocking pavers, bricks, or landscaping. Areas counted towards the landscaping requirement (e.g., 20% of the required setback area) could also be credited towards the permeability requirement. The City of San Francisco has some good ordinance language for the latter here: http://www.sf-planning.org/ftp/files/publications_reports/Guide_to_SF_Green_Landscaping_Ordinance.pdf	
49	Impervious Area Management	Parking areas and Sidewalks	Allow alternate pedestrian networks to be substituted for sidewalks	N	-	-	In the Littleton Zoning Code Part 2, v. 45 there is a mention of trails and paths and links to be used between properties to serve as pedestrian networks, but wide sidewalks are predominantly encouraged and all others are only mentioned to say that some version of a pedestrian corridor should be present.	Revise language to not so blatantly favor sidewalks and provide more detailed alternatives that can be used to satisfy the town's mandate of a pedestrian corridor.	

No.	Category	Subcategory	Key Question	Findings	Code / Ordinance	Section Reference	Comments	Recommendation	Priority
50	Impervious Area Management	Unconnected Impervious Area	Require developers to disconnect impervious surfaces	N	-	-	No mention of requiring non-structural stormwater management measures to be implemented or included in the design, although there are there specific examples given in the Littleton LID and BMP manual.	Require the employment of non-structural BMPs to disconnect impervious area on completed construction sites.	
51	Impervious Area Management	Unconnected Impervious Area	Allow runoff volumes to be reduced when reinfiltrated into vegetated areas	Y	Littleton Zoning Code Part 2, v. 45	Article IV	See § 173-18 Design Requirements Part F states "Methods of stormwater control and treatment as outlined in the Town of Littleton Low Impact Design/Best Management Practices Manual... are utilized to the maximum extent practicable." Within the Manual, many attenuation practices were detailed such as parking lot planters/buffers, infiltration basins and trenches, and swales (section 2.3.1 and 2.3.2)	None.	
52	Impervious Area Management	Unconnected Impervious Area	Allow flush curbs and/or curb cuts to allow for sheet flow discharge	N	-	-	Curb cuts are mentioned multiple times throughout the Littleton Zoning Code, but in the context of minimizing the presence of curb cuts.	Revise curbing standards to allow curb cuts or flush curbs with curb stops to be utilized as an alternative to raised curbs, as well as grass swales or bioretention swales instead of curb or gutter.	
53	Vegetated Open Channels	Vegetated Channels	Allow/require vegetated open channel conveyance	Y	Littleton Zoning Code Part 2, v. 45	Article VII	See § 173-32 Parking Requirements Part C Parking Area Design Part 6 states "To reduce stormwater discharge and improve the attenuation of pollutants, applicants are required to use stormwater control Best Management Practices (BMPs) and Low Impact Development (LID) techniques in parking lot design (i.e., interior landscaping, vegetated/grassy swales, infiltration planters, permeable pavement, rain gardens, etc.)"	None.	
54	Vegetated Open Channels	Vegetated Channels	Establish design criteria for vegetated channels	Y	Littleton LID/BMP Manual	Section 2.3.2	"For design recommendations, see http://www.georgiastormwater.com/vol2/3-2.pdf or http://www.dcr.virginia.gov/sw/docs/swm/chapter_3-13.pdf "	Consider including a set of criteria specific to Littleton in an existing bylaw.	
55	Impervious Area Management	Unconnected Impervious Area	Distinguish between connected & disconnected impervious	N	-	-	The only definition of impervious surfaces that exists within the Zoning code and subdivision regulations is "parking and building coverage." There is no distinction between connected and disconnected areas.	Revise language in definitions to provide a clear and concise definition of impervious surface and what disconnecting impervious surfaces would be defined by and what it hopes to accomplish. As an example: "In order to prevent compounding amounts of runoff from impervious surfaces from being loading onto existing infrastructure that was not originally designed to handle such a volume, impervious surfaces must be interspersed with areas that can slow or infiltrate stormwater on site. Examples of such areas include but are not limited to depressed vegetative islands in parking lots or small amounts of green space between the building footprint and parking."	

No.	Category	Subcategory	Key Question	Findings	Code / Ordinance	Section Reference	Comments	Recommendation	Priority
56	Impervious Area Management	Streets and Driveways	Allow travel lanes travel lanes to be from 12 to 10 ft. (or less) with curb pullouts for passing	Y/N	Chapter 249 Subdivision of Land Regulations	Article IV	See §249-43 Streets and Paths Part A. Basic design Controls Part 1 "The traveled way width, exclusive of curbing, shall be as specified in Figures 1,2 & 3 and as follows: a) Lane 22 feet, b) minor street 24 feet, c) collector street 30 feet, d) arterial street, pursuant to MassDOT PD&DG…"	Consider allowing smaller lane width and curb pullouts.	
57	Impervious Area Management	Streets and Driveways	Allow the use of curb bumpouts for traffic calming and bioretention	N	-	-	-	Consider allowing curb bumpouts/extensions near intersections and mid-block for traffic calming and bioretention opportunities.	
58	Impervious Area Management	Streets and Driveways	Allow pervious parking for alleyways & on-street parking	N	-	-	Pervious pavement was mentioned in the Littleton as an alternative material for sidewalks but was not considered outright for alleyways and on-street parking.	Include language to include all possible implementations of pervious parking materials (such as sidewalks, alleyways, on-street parking, bikeways, trails and walkways) in one sentence. Require those applying for development or redevelopment to investigate the possibility of employing such measures and include the investigation as part of the application to the Planning Board to encourage their installation.	
59	Vegetation and Landscaping	Landscaping Island and Screening Ordinance	Allow GI techniques to replace grass strips between sidewalk and curb	N	-	-	Grass strips/screens between the sidewalks and curbs are not mentioned int the zoning code or subdivision regulation. Curb cuts plus bioretention areas/swales/and other green infrastructure practices within the area between the sidewalk and curb are a useful tool for retrofitting existing neighborhoods with green infrastructure practices without major reconstruction. It is significantly cheaper than working to collect stormwater via in-street practices.	In addition to modifying the ordinance to allow for curb cuts, also consider placing emphasis on the use of bioretention, swales, and other green infrastructure practices between the curb and sidewalk, and to incorporate specific design specs for doing so (see http://watershedmg.org/sites/default/files/greenstreets/WMG_GISWNH_1.0.pdf as an example).	
60	Impervious Area Management	Streets and Driveways	Require site designs to reduce overall street length	N	-	-	Language exists that ensures that streets be designed to accommodate maximum traffic safely along with parking and loading needs and access to emergency services.	Encourage site designers to analyze different layouts to see if they can reduce street length and submit multiple alternatives to the Planning Board for review.	
61	Impervious Area Management	Parking areas and Sidewalks	Allow parking lot drive aisles to be 22 ft.	Y/N	Chapter 249 Subdivision of Land Regulations	Article IV	See §249-43 Streets and Paths Part A. Basic design Controls Part 1 "The traveled way width, exclusive of curbing, shall be as specified in Figures 1,2 & 3 and as follows: a) Lane 22 feet, b) minor street 24 feet, c) collector street 30 feet, d) arterial street, pursuant to MassDOT PD&DG…"	By utilizing 45- and 60-degree parking, drive aisles may be able to be even smaller.	
62	Impervious Area Management	Parking areas and Sidewalks	Reduced parking ratio of 3.0 spaces per 1,000 sq. ft. gross floor area	Y	Littleton Zoning Code Part 2, v. 45	Article VII	See § 173-32 Parking Requirements Part B Schedule of Parking Area Requirements Part 4 Offices: "One space per 250 square feet of gross floor area or… one space per 1.25 employees on the largest shift [if determined that occupancy can be controlled]."	Reevaluate minimum parking standards, where utilized, to ensure that standards are not higher than necessary.	
63	Impervious Area Management	Parking areas and Sidewalks	Reduced parking ratio of 2 to 4.5 spaces for 1,000 sq. ft. gross floor area for commercial centers	Y	Littleton Zoning Code Part 2, v. 45	Article VII	See § 173-32 Parking Requirements Part B Schedule of Parking Area Requirements Part 3 Retail Stores: "One space per 150 square feet of leasable floor."	Reevaluate minimum parking standards, where utilized, to ensure that standards are not higher than necessary.	

No.	Category	Subcategory	Key Question	Findings	Code / Ordinance	Section Reference	Comments	Recommendation	Priority
64	Impervious Area Management	Buildings	Requirements for rooftop structures & materials allow/encourage green roofs	Y	Littleton LID/BMP Manual	Figure 4	See Figure 4, pg. 2-10 to see Green Roofs assessed for viability in the Town of Littleton. They do not suggest implementing this BMP for residential use and cite the high O&M burdens to not recommend wide implementation. However, they do cite http://www.psat.wa.gov/Publications/LID_studies/green_roofs.htm and http://www.lid-stormwater.net/greenroofs/greenroofs_commercial.htm As design recommendations.	Pursue the development of detailed design guidelines and standards at the state level that can be integrated into local building codes	
65	Impervious Area Management	Buildings	Allow bioretention areas, swales, rain barrels & cisterns near building foundations, if properly designed	Y	Littleton LID/BMP Manual	Section 2.3	The Manual set forth by the town outlines design recommendations and information about Littleton specific BMPs and the zoning code suggests consulting the manual to employ BMPs with new developments.	Pursue revisions to Stormwater BMP specifications to include information on/requirements for locating BMPs near buildings. Ensure specifications for rain barrels & cisterns exist, if not yet available.	
66	Vegetation and Landscaping	Preservation of natural areas	Limit site designs to areas of lesser slope and farther from watercourse	N	-	-	Slopes are only mentioned in the Zoning Code in reference to Telecommunications towers being built	Consider adding language about limiting or restricting development to areas with slopes higher than 25 or 30% without obtaining special permissions after an assessment made by a Geotech professional.	
67	Minimize Land Disturbances	Transit Oriented Development	Encourage higher density development to be centered around transportation corridors	Y	Town of Littleton Master Plan 2017	Section 2	See Part 5 which states "By Applying the principles of Transit-Oriented Development to the area, the town could encourage development of homes and businesses within a walkable neighborhood, catering to people using transit rather than cars." There is no specific code or ordinance that offers incentives to implement these principles, but the value to move in that direction is well stated in the Master Plan.	Incorporate language that specifically encourages expanding public transit reaches or encourages smaller amounts of parking available in areas serviced by public transportation.	
68	Minimize Land Disturbances	Limits of Disturbance	Require disturbance of vegetated areas to be phased	N	-	-	-	Consider requiring a phasing plan to be appended to the application for all development and redevelopment with details about which native and non-native species will be affected and how that affect can be mitigated.	

No.	Category	Subcategory	Key Question	Findings	Code / Ordinance	Section Reference	Comments	Recommendation	Priority
69	Minimize Land Disturbances	Limits of Disturbance	Minimize hydrologic alterations to existing wetlands.	Y	Littleton Zoning Code Part 2, v. 45	Article XIX, XVI	See § 173-98 Submission Requirements Part C. Development Plans Part 9 "General analysis of the effect of the development on surface water flow to offsite or nearby wetlands." And § 173-73 Uses Permitted Part G "Development in the floodplain… must be in compliance with… the Wetlands Protection Regulations, DEP and Inland Wetlands Restriction, DEP…" In addition, the Subdivision Regulations state in § 249-52 Part D "Water Resources shall be protected including… wetlands."	None.	
70	Minimize Land Disturbances	Limits of Disturbance	Require/encourage building footprints to avoid highly erodible high permeability (Soil Groups A and B).	N	-	-	Specific Soil types are not discussed, but the percolation tests performed prior to development which can only proceed if conditions prove to be favorable. (Article XIX Open Space Development, §173-104 Density Calculation Part A)	Include a description and identifying matrix to qualify hydrologic soil groups and limit or prohibit development on soil types deemed unstable and erodible.	
71	Vegetation and Landscaping	Riparian Buffers	Require/encourage a 50 ft. min wetland buffer	N	-	-	Buffers are discussed within the Littleton Wetlands Protection Bylaw Chapter 171 but not in a spatial relation to existing wetlands, just to say that the buffer zone is subject to protection and regulation.	Directly mention in chapter 171, Wetlands Protection bylaw that there is a minimum 50 foot buffer between development and existing wetlands.	
72	Rainwater Harvesting	Plumbing	Allow interior or exterior cisterns	Y/N	Chapter 249 Subdivision of Land Regulations	Article IV	See § 249-51 Stormwater Management Part A "Stormwater management shall be designed and implemented in conformance with the Stormwater Management Handbook as established by the latest Massachusetts Department of Environmental Protection." This leaves room for the planning board to take individual consideration of stormwater BMPs and according to the Littleton LID/BMP Handbook, Rain Barrels are a viable and encourage control measure.	Directly mention rain barrels or cisterns as a method of water collection inside and outside of structures. Consider adding incentives for their installment in private residences. As an example for working language of amendments have been made to a state plumbing code to allow for rainwater collection, see North Carolina's Appendix C-1, Rainwater Recycling Systems, which added requirements for rain water connections, collection reservoir, filtration, overflow and makeup water related to the use of cistern-collected rainwater for flushing toilets and irrigation. In addition, rainwater harvesting guidelines outlining when a permit or site plan approval is required, design specifications, etc., would benefit developers and homeowners alike. An example guideline (Berkeley, CA) can be found here: www.ci.berkeley.ca.us/uploadedFiles/Planning_and_Development/Level_3_-_Energy_and_Sustainable_Development/rainwater.pdf In addition, a list of and information on states with rainwater harvesting statutes, programs and legislation is available here: www.ncsl.org/issues-research/env-res/rainwater-harvesting.aspx.	

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73	Rainwater Harvesting	Plumbing	Require BMP maintenance plan for cisterns	N	-	-	-	Implement specifications for using rainwater harvesting systems and give examples of operation and maintenance plans.	
74	Rainwater Harvesting	Plumbing	Allow harvested rainwater to be used for non-potable interior uses (e.g., toilet flushing)	N	-	-	State law does not current have any restrictions on the use of harvested rainwater currently. Mass.gov has this to say about the use of rainwater harvesting by rain barrel: "Rain barrels are a great way to conserve water and reduce storm water runoff. Use the collected water for household chores." Although this is not specific or comprehensive of the typical or possible uses of that harvested rainwater, it does clarify the state's encouraging position of its implementation.	Consider working with the state to identify how rainwater can be used for nonpotable interior uses and provide a list of examples of encouraged uses in a bylaw.	
75	Rainwater Harvesting	Plumbing	Allow personal treatment systems to be used for potable water supplies	N	-	-	-	If the use of rainwater for non-potable uses is a high priority for the city, consider working with public officials at the city and state level to determine the personal treatment measures necessary for allowing rainwater to be used for potable uses.	
76	Rainwater Harvesting	Building & Zoning Code	Allow downspouts to be disconnected into a rain barrel or yard	N	-	-	This could be an example of the practice of disconnecting impervious area.	Identify common uses of cisterns or rain barrels for home owners and clarify them within the language of the bylaw or on the town's website. As an example, see Virginia's amendments (search for "rain water") to its 2009 codes, also derived from the International Building Codes, and available here: http://www.dhcd.virginia.gov/StateBuildingCodesandRegulations/PDFs/2009/Code%20-%20VCC.pdf	
77	Rainwater Harvesting	Building & Zoning Code	Allow interior or exterior cisterns	N	-	-	-	See Above	
78	Rainwater Harvesting	Building & Zoning Code	Allow rain barrels to be placed within standard zoning setback areas	N	-	-	A setback can be defined as an area extending the full width of the lot between the street right-of-way and the required yard within which no buildings or parts of buildings may be erected.	Revise the zoning and development code to expressly allow rain barrels to encroach into required zoning setbacks	

No.	Category	Subcategory	Key Question	Findings	Code / Ordinance	Section Reference	Comments	Recommendation	Priority
79	Rainwater Harvesting	Building & Zoning Code	Allow cisterns to be placed on rooftops for rainwater harvesting	N	-	-	Building height is defined by the Littleton Zoning Code to be "The vertical distance from the mean finish grade of the ground adjoining the building to the highest point of the roof (or parapet) for flat or shed roofs, to the deckline for mansard roofs and to the mean height between eaves and ridge for gable, hip and gambrel roof. Not included are spires, cupolas, television antennas or other parts of structures which do not enclose potentially habitable floor space." There is no specification on a maximum height of a building other than any "mechanical equipment located on roofs shall be screened, organized and designed as a component of the roofscape…" Although this is not expanded upon.	Review/revise the zoning code to allow cisterns to exceed building height requirements (building height definition). Review/revise the building code for allowing cisterns to be placed on rooftops, with identified maintenance requirements	
80	Vegetation and Landscaping	Landscaping Island and Screening Ordinance	Give bioretention areas "credit" as landscape areas to count as a percent of required landscaping	N	-	-	No such credit program exists but is discussed to be established within the Littleton LID/BMP Handbook on page 1-2 and 1-2.	Should the town decide to employ an incentive program for private residences, they should ensure that bioretention areas, rain gardens, and other vegetated LID BMPs receive partial or full credit towards meeting % pervious cover requirements.	
81	Vegetation and Landscaping	Landscaping Island and Screening Ordinance	Require landscaping plans to include less water-intensive, native vegetation	Y	Littleton Zoning Code Part 2, v. 45	Article XXV	See §173-176 design Standards: "All developments shall be landscaped with appropriate low-water native vegetation. Landscaping and screening plant materials within the Littleton Village Overlay District West – Beaver Brook Area shall not encroach on the public walkways or roadways in a way that impedes pedestrian or vehicular traffic r blocks views of signs within the roadway alignment. Vehicle, pedestrian, and bicycle features shall be designed to provide a network of pathways and promote walking within the Littleton Village Overlay District West – Beaver Brook Area."	Rework language to be less ambiguous about this design standard being applicable to the whole town, not just the Beaver Brook Area.	
82	Vegetation and Landscaping	Landscaping Island and Screening Ordinance	Allow the use of raingardens, tree boxes, & other LID BMPs for tree planting requirements	N	-	-	No specific guidelines for native species are defined, nor are there restrictions that BMPs not be included in landscaping. Rain gardens are a type of BMP given as an encouraged BMP for parking structure construction.	Revise tree selection and design guidelines to allow the use of bioretention areas, tree boxes, and other GSI practices for tree planting requirements. Consider allowing for certain practices to receive partial or full credit for tree planting requirements as an incentive.	

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83	Vegetation and Landscaping	Landscaping Island and Screening Ordinance	Require weather-based irrigation controls	N	-	-	-	Suggesting using rain water harvested from cisterns or rain barrels as lawn irrigation for private residences or underground rainwater harvesting systems for larger landscaped areas. The town should investigate other possible options for irrigation systems for public landscaped spaces.	
84	Vegetation and Landscaping	Invasive Plant Species Control	Identify invasive plant species	N	-	-	-	Consider including a direction to the Massachusetts Invasive Plants Advisory Group's list of Invasives to aide in identification (https://www.massnrc.org/mipag/invasive.htm) and include language such as "Prior to the commencement of work on site, the Applicant shall survey this site for the presence of invasive plant species within the approved limits of work. If found, a written Invasive Plant Management Strategy (IPMS) proposal and schedule of control shall be created. The IPMS shall include a description of treatment areas including plant identification and photos, delineation of treatment areas including a freehand sketch drawn on construction plants, proposed methods of treatment, proposed time of treatment based on the construction schedule, method for disposing of invasive plant materials, general monitoring schedule, preliminary re-treatment schedule, and proposed performance metrics or measure of treatment success."	
85	Vegetation and Landscaping	Invasive Plant Species Control	Ensure the stop of spreading of invasive species	N	-	-	-	Consider creating language to target possible sources of invasive species, similar to "The applicant shall ensure that no invasive plant species, as defined and listed by the Massachusetts Invasive Plant Advisory Group, are introduced to or moved around the site by construction activities, including importation of infected materials such as borrow, compost, nursery stock, seed, or hay bales."	
86	Vegetation and Landscaping	Invasive Plant Species Control	Require the removal of any invasive plants on the work site	N	-	-	-	Consider creating language that makes clear any purpose of implementing corrective measures, and possibly provide examples. A sample of this language could be similar to: "Corrective measures shall be implemented for as long as necessary to eliminate the introduced invasive plant species and prevent re-establishment of same. The Applicant shall satisfactorily dispose of all cleared, invasive plant material (seeds, roots, woody vegetation, associated soils, etc.). The Applicant shall take measures to prevent viable, invasive plant materials from leading to further infestations while stockpiled, in transit, or at final disposal locations. All precautions shall be taken to avoid contamination of natural landscapes with invasive plants or invasive plant material.	
87	Manage Stormwater to Sustain Stream Function	Performance Standards	Require stormwater to be retained/ infiltrated onsite (bioretention, natural areas, and swale infiltration) where possible	Y	Chapter 249 Subdivision of Land Regulations	Article IV	See § 249-51 Stormwater Management Part B: "It is the intent of these regulations that stormwater shall be recharged wherever recharge is environmentally preferable to discharging to surface water and feasible from an engineering standpoint. If discharge to surface water is used, the developer will be required to demonstrate that one of these conditions is not met. It is recommended that the developer consult with the Planning Board and with the Littleton Water Department before designing a surface discharge system."	None.	

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88	Manage Stormwater to Sustain Stream Function	Performance Standards	Provide sufficient storage volume via stormwater management practice standards & sizing requirements	Y	Chapter 249 Subdivision of Land Regulations	Article IV	See § 249-51 Stormwater Management Part F "Runoff calculations shall be performed in accordance with SCS TR55or TR20, using SCS Type III rainfall distribution, unless prior approval for deviations from these procedures has been obtained from the Planning Board. Such approval will be granted if the engineer satisfies the Board that the nature of the subdivision makes the SCS methods impractical and that the alternate method is of equal or greater reliability. Peak runoff rates shall be estimated for every subcatchment, reach and detention pond provided for the 2-year, 10-year, 25-year, 50-year and 100-year frequency storms the drainage system shall be designed such that there is no increase in the peak rates and total volume of runoff from any of the watershed areas at the discharge point(s) from the site for any of the modeled storms. At drainage discharge points, provision shall be made for velocity reduction using appropriate technologies so as to prevent erosion at the point of discharge and down gradient."	None.	
89	Manage Stormwater to Sustain Stream Function	Performance Standards	Ensure adequate water quality, channel protection, and flood control performance	Y	Chapter 249 Subdivision of Land Regulations	Article IV	§ 249-51 Stormwater Management Part J ssinctly states that "Street drainage shall not be channeled into a wetland or water body without first being treated by one or more treatment Best Management Practices (BMPs)."	None.	

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90	Manage Stormwater to Sustain Stream Function	Performance Standards	Ensure adequate applicability thresholds for performance standards	Y	Littleton Zoning Code Part 2, v. 45	Article XXVI	§ 173-179 Relationship to Aquifer and Water Resources Districts Part B: "The Planning Board, by Special Permit, may allow for redevelopment that is equivalent to the same percentage lot coverage as the existing impervious lot coverage, even if it exceeds the 30% and 50% thresholds, provided that both of the following criteria are met; 1) the development incorporates current MA Department of Environment Protection (DEP) best management practices for storm water management, and the Storm Water Quality Control and Storm Water Quality Practices outlined in the Town of Littleton Low Impact Design/Best Management Practices Manual and 2) There is no net increase in impervious site coverage." (This passage is related to Commercial use of solar photovoltaic installations but is worded generally for any development and could be used for other projects). The Littleton LID/BMP Handbook also notes that 80% removal of total suspended solids is required by the Massachusetts State Stormwater Management Policy (Standard Number Four). Other exact thresholds for water treatment are not listed, but in the matrix listed as figure 4 in the LID/BMP Manual, the ability of each BMP to treat stormwater quality is evaluated.	None.	
91	Manage Stormwater to Sustain Stream Function	Performance Standards	Require outfalls to be stabilized to reduce erosion	Y	Chapter 249 Subdivision of Land Regulations	Article IV	§ 249-51 Stormwater Management Part F "…At drainage discharge points, provision shall be made for velocity reduction using appropriate technologies so as to prevent erosion at the point of discharge and down gradient."	None.	
92	Manage Stormwater to Sustain Stream Function	Inspections and Maintenance	Require inspectors during and routinely after construction	Y	Littleton Stormwater Regulations	Section 5	See Section 5.4.2 "Conditions may be imposed by the Planning Board… to periodically conduct and document inspections of all control measures (before, during and/or after construction) and submit reports to the Board."	Stormwater inspection requirements during installation are unclear. Consider revising to require a Stormwater Observation Report (SOR) be submitted prior to the issuance of the Certificate of Occupancy, esp. for complex projects. It is suggested that the SOR be prepared, signed, and stamped by the engineer of record (e.g., a licensed civil engineer or qualified professional), certifying that: (S)he is the engineer or architect responsible for the approved LID technique and; (s)he or the designated staff under his/her responsible charge has performed the required site visits at each significant construction stage and at completion to verify that the BMPs shown on the approved plan have been constructed and installed in accordance with the approved plan. Also consider reviewing landscape maintenance & inspection requirements, and revising debris and weed control maintenance requirements (see p. 467+) to allow for maintenance of vegetated stormwater BMPs. As it currently reads, turf, weeding and mowing requirements may conflict with maintenance requirements of stormwater BMPs	

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93	Manage Stormwater to Sustain Stream Function	Inspections and Maintenance	Require maintenance agreements	Y	Littleton Stormwater Regulations	Section 4	Section 4.1 lays out the requirement to create and Operation and Maintenance Plan as specified by the Bylaw to include measures to minimize phosphorus discharge, any non-structural BMPs that treat for pollution causing impairments, and ongoing reports.	Expand this section to identify the responsible party for continuing operation and maintenance, tasks and schedules, cost estimates, and that no part of this agreement conflicts with any other section of the stormwater regulations.	
94	Manage Stormwater to Sustain Stream Function	Inspections and Maintenance	Require inspectors to be trained and certified	N	-	-	-	Consider adding in language that any owner or developer must appoint a state licensed professional engineer or equivalent to sign all reports and conduct all inspections. Clarify any necessary training requirements and the aspects that an inspection would be verifying.	
95	Manage Stormwater to Sustain Stream Function	Inspections and Maintenance	Require maintenance to be performed by a certified professional	N	-	-	-	Consider adding language to clearly define certification requirements for BMP maintenance in the stormwater ordinance, and that a state licensed professional engineer or equivalently trained person is able to perform such maintenance.	
96	Water Conservation	Residential and Commercial Development	Implement water conservation incentives	N	-	-	Littleton's Light and Water Department has the authority to provide incentives such as rebates for installation of water smart appliances (examples listed here: http://www.epa.gov/watersense/), implement price signals to reduce inefficient and nonessential use (such as seasonal, tiered, and drought or scarcity rates), or developing an educational campaign.	If an incentive program was to be implemented to encourage the adoption of stormwater LID BMPs into residential and commercial development, this could be a secondary portion to that program. The town should assess the viability of many incentive programs and determine what type of structure works best within the town's operating practices.	
97	Water Conservation	Residential and Commercial Development	Determine water conservation goals	N	-	-	The most current draft of the Massachusetts Water Conservation Standards sites a changing climate (condensing the yearly rainfall into fewer, more intense storms that are harder to recharge water tables and higher annual summer temperatures that increase the need for water and increase evapotranspiration) as a main motivator to call to action to use less water. This reduction will preserve water resources, sustain water supplies for future needs, protect aquatic ecosystems, reduce utility costs, and spur economic development.	Work with local and state levels to assess current reserves of water and develop numeric reductions that make sense for the town. The EPA suggests striving for a residential use of 65 gallons per capita per day or less, a commercial and industrial use of less than 50,000 gpd and encouraging more efficient equipment throughout the town.	
98	Water Conservation	Residential and Commercial Development	Require non-water efficient fixture be upgraded and replaced	N	-	-	A large part of water conservation is identifying sources of water loss and remediating those sites. The first step in doing so is performing a town-wide water audit and account for billed authorized consumption, non-billed authorized consumption, commercial losses and physical losses. The town should take steps to address these findings through physical repair of leaks or pressure systems or through a water loss control program that can target unmetered non-billed water losses.	The Massachusetts Water Conservation draft recommends regular water audits, pressure management, service connection leakage control, leak detection services, automated leak reduction, pressure reduction, and fines/penalties for stealing water.	