

Building Community Resilience Through Local Regulations

Participant Guide to Massachusetts Bylaws & Best Practices



Module 5: Implementing Low Impact Development

Case Studies and Examples

Context

This document is part of a comprehensive curriculum program, *Building Climate Resilience Through Local Regulations*, developed by Mass Audubon in collaboration with other nonprofit organizations and federal, state and regional agencies. The curriculum contains 8 modules, each of which guides the user through different components of improving community resilience through local regulations that support green designs and nature-based climate solutions. Each module includes a participant guide (e.g., this document) and a PowerPoint presentation.

The full curriculum, supplemental resources and additional information on bylaw review and best practices are available through: [Massachusetts Rivers Alliance](#) and [Mass Audubon](#). The [SNEP Network's website](#) provides additional resources including an interactive virtual storymap and webinar recordings.

Acknowledgements

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The Southeast New England Program (SNEP) Network brings together local environmental organizations, academic institutions, regional planners, and consultants who collaborate to provide municipalities, tribes and organizations in Rhode Island and Southeast Massachusetts access to free training and technical assistance to advance stormwater management, ecological restoration, and sustainable financing goals across the region. The SNEP Network is administered through EPA's partnership with the New England Environmental Finance Center, a non-profit technical assistance provider for EPA Region 1. The SNEP Network supports this bylaw review curriculum as a key resource for communities to update their local regulations for improved nature-based climate solution implementation. Find out more about the SNEP Network at www.snepnetwork.org.

Module 5

Implementing LID



Introduction

Previous modules have introduced concepts about nature-based climate solutions and Low Impact Development (LID), and how these techniques can be incorporated into local land use rules. Success stories from other communities can help sustainability proponents overcome the inertia pushing back against progress on such initiatives. This module provides case studies from other communities across the Commonwealth that have successfully implemented LID into their regulations to improve local climate resilience.

Objectives

After completing this module, participants will be able to answer the following questions:

- How have other Massachusetts (MA) communities implemented LID measures?
- In which ordinances and/or bylaws have MA cities and towns adopted LID measures?
- What support and resources are available for communities that adopt and implement LID techniques?

Implementing LID Without a Regulatory Framework

Below is an example of how the Town of Plymouth has implemented LID techniques through various development projects, despite not yet having regulations in place including such principles.

The Town of Plymouth

Plymouth has a Stormwater Management Manual, developed in 1983, that offers guidance for managing runoff associated with new development. In 2009, with state funding, the Town adopted an update to the manual titled, “A Guide for the Design of Storm Drainage Facilities in the Town of Plymouth, Massachusetts Including Low Impact Development (LID) Standards.” Plymouth also has an Municipal Stormwater Sewer System (MS4) General Permit and is thus subject to certain LID requirements. The Town has not yet adopted bylaws or regulations that specify LID stormwater Best Management Practices (BMPs) beyond this guidance document and lacks a strong enforcement mechanism or entity that monitors compliance with the LID standards of the MS4 General Permit.

Plymouth’s zoning does allow higher-density cluster development in conjunction with open space conservation by special permit. Private developers in Plymouth have been instrumental in building new communities according to LID principles.

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For example, the Pinehills and Redbrook developments are both designed to reduce impervious surfaces, conserve open space, and build more sustainable neighborhoods. These developments collectively protect thousands of acres of the town's natural beauty and resources, and their clustered "village" development patterns, shared driveways, and accessible commercial space make these communities more walkable, welcoming, and environmentally friendly than conventional subdivisions.



Figure 1. The Pinehills Development in Plymouth, MA. Source: MA EEA Smart Growth/Smart Energy Toolkit - Case Studies: Low Impact Development (LID).

The Pinehills Development Project

Following extensive community and developer input, Plymouth passed in 2000 a special "Open Space Mixed Use Development" (OSMUD) designation overlay within their Rural Residential Zone. The Pinehills Development Project, permitted under this zoning, won top honors from the National Association of Home Builders (NAHB) for Best Master-Planned Community in the Nation in 2003, and was recognized for Best Smart Growth Community in 2005.¹

The Pinehills Project employed several LID techniques and stormwater BMPs to minimize impacts from construction, stormwater runoff, and irrigation. The community has vegetated swales around developed areas to provide runoff pre-treatment, and a robust wastewater treatment system implementing several BMPs outlined in the Massachusetts Stormwater Handbook (see Module 7) that mitigate the need for fertilizer use.²

The community has since grown, spanning more than 3,000 acres as of 2021, with plans underway to continue expanding. Yet less than one-third of the land area is buildable: nearly 70% percent of the development is dedicated to four golf courses and conserved natural lands. The approved plan for full build-out is 3,052 housing units, with an overall density of about one residential unit per acre. The village clusters, with a 6,000 sq ft minimum lot size, have densities of eight or more units per acre. While conventional subdivisions in Plymouth require 200 ft frontage, the Pinehills OSMUD Special Permit authorizes significant reductions. One area, for example, has eight residences along 300 ft of roadway averaging only 37.5 ft frontage.³ Frontage reductions and smaller lot sizes minimize impervious surface in residential communities, thus reducing stormwater runoff. The developers also requested (and received) flexibility for road widths in their permitting process, which enabled them to further decrease impervious surface within the development.



Throughout the design of the Pinehills neighborhoods, this project emphasizes retention of the native trees and other vegetation and minimization of land clearing and grading through designs that work with the natural sloped land features. This further reduces the overall impact of the development, retains significant natural habitat, and minimizes the need for landscape irrigation and fertilization within the neighborhoods.

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The Pinehills Development Project is now Plymouth's single-largest generator of tax revenue.⁴ It includes a mix of housing types, including single- and multi-family units.

The Redbrook Development Project

Plymouth has another unconventional subdivision just south of the Pinehills, called the "Redbrook Development Project," situated on 1,400 acres. Redbrook also follows a village cluster pattern under a Special Permit within Plymouth's Rural Residential zoning district. The Traditional Rural Village Development (TRVD) area is similar to the OSMUD, but goes further to encourage more walkable, self-contained neighborhood development patterns. Once fully built-out, one quarter of the Redbrook Project's 1,400 acres will be home to 1,175 households. The (remaining ~1000 acres is conserved in its natural state. This approach to low-impact site design is a highly effective strategy for managing the stormwater impact of new development.

Redbrook homes are also built for energy efficiency; on average, they are 40% more efficient than today's standard newly-constructed homes.^{5,6} Additionally, Redbrook's private wastewater treatment facility aims to meet the "no net nitrogen standard," and the development's land stewardship initiatives (e.g., rain barrel installations, native plantings, etc.) aid homeowners in reducing the "nitrogen footprint" of their properties.⁷ Redbrook also helps Plymouth meet affordable housing demand without cutting corners on sustainability; the development includes a mix of housing types ranging in price from \$350,000 - \$700,000, with roughly 10% designated as affordable housing.- includes single-family detached homes, apartments, and attached twin homes and townhouses.

Adopting LID Standards in Massachusetts Communities

Conducting a thorough review of local bylaws and regulations is an important step to incorporating LID principles into new and redevelopment projects. The communities featured below have achieved positive outcomes from undertaking this review process.

The Town of Natick

In 2016, the Town of Natick received a grant from the Foundation for MetroWest to work with Mass Audubon, the Charles River Watershed Association (CRWA), and the Massachusetts Rivers Alliance to review its land use bylaws and regulations. Mass Audubon analyzed Natick's bylaws and regulations (including five Cluster Bylaws, Stormwater Bylaw, Zoning, and Subdivision Rules and Regulations), for effectiveness in promoting LID and Open Space Residential Design (OSRD). Mass Audubon provided a short report on the findings of the review along with recommendations to reduce stormwater pollution tailored to Natick's existing built landscape and natural environment, in order to preserve the community's character.



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The analysis found that Natick's Stormwater Bylaw, adopted in 2006, guided compliance with MassDEP Stormwater Management Standards, but did not consider LID principles. Due to large lot size requirements, 90% of Natick's private properties were not subject to the Town's stormwater regulations.⁸ The bylaw was successful, though, in going beyond state and federal standards during the construction phase of development. As a result of this robust analysis, the Town of Natick received a state Municipal Vulnerability Preparedness (MVP) Program grant to support climate resilience community planning and action, as well as updating their Stormwater Bylaw. Experts representing many of the Town's boards, committees, and departments, as well as Mass Audubon and MassDEP, collaborated in the bylaw update process.

The Stormwater Bylaw updates include improvements in its applicability to parcels and projects, and promoting LID principles directly in the bylaw language. While these are great strides, Natick has identified remaining challenges yet to be addressed. For example, the bylaw needs to be more relevant to

redevelopment projects with extensive impervious surface. Despite great success with the bylaw updates, Natick faced challenges throughout the process. Securing technical expertise on LID implementation and enforcement was particularly difficult. The Town received assistance from the Department of Public Works—for whom these updates can result in additional review and upkeep—during the process in order to ensure that the revised bylaw complies with MS4 General Permit standards.

According to the Town, collaborating with Mass Audubon on the bylaw review and update has served as a “spark that created this fire in us that's growing.” Natick now intends to close the remaining gaps they identified and pursue a tree preservation bylaw in the next round of updates, as well as other initiatives for climate resilience⁹ and natural resource protection, in the near future.

The Town of Mendon

In 2016, the Town of Mendon worked with Mass Audubon and the Central Massachusetts Regional Planning Commission (CMRPC) as part of a Blackstone Valley regional technical assistance project. As a small municipality with limited staff capacity, Mendon relied on outside technical assistance throughout the entire review and update process. Using Mass Audubon's OSRD and general LID Best Practices tools, the team audited Mendon's existing regulations and developed recommendations for residential development. Prior to the review, Mendon already allowed OSRD by-right, as well as a Stormwater Bylaw that designates LID as the preferred design method. The review team's recommendations included strengthening the town's existing regulations and adding more references to LID throughout the Town's Zoning Bylaw and Subdivision Rules and Regulations.

Because the Town of Mendon lacked the expertise or capacity to implement the review team's recommendations, they secured a 2018 MVP grant for technical assistance from CMRPC to do so.

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Figure 2. Historical events - the 1938 hurricane and 1955 flood - in Mendon, MA.

The project proponents had an important internal discussion whether to adopt a separate LID bylaw or to integrate LID elements into multiple separate locations throughout the Town's bylaws and regulations. Ultimately, they determined it made the most sense for Mendon to leave the LID regulations where they were. The Town feared that a separate LID bylaw would be more easily forgotten or ignored, thus increasing the likelihood of inconsistencies across different bylaws and regulations.

The proposed changes passed at Mendon's 2020 Town Meeting with little controversy, due in part to how the proponents approached adoption. They secured a trusted community leader (the Land/Energy Use Committee Chair, among other roles) to champion the project and lend her credibility to the proposed changes. They also garnered support from all relevant Town boards and committees early in the process and kept the public informed throughout. This transparent and inclusive process enabled the team to anticipate and address the public's concerns, thus ensuring that Town Meeting voters already understood what they were voting on.

Several developers have already undertaken by-right OSRD subdivision projects without requesting a Special Permit for a conventional

subdivision development. The Town worked proactively to identify and remedy deficiencies along the way. For example, after a parcel of shared open space was created that could only be accessed through a private yard, the regulations were amended to require shared access to open space. While the 2020 zoning amendments are too new to fully evaluate, it is safe to call Mendon's OSRD regulations a success.

The Town of Ayer

In 2014, the Mass Audubon report, [*Losing Ground: Planning for Resilience*](#), identified the Town of Ayer as having the highest rate of development in the Commonwealth; they had recently permitted several large subdivisions to replace forested areas. In the next edition, *Losing Ground: Nature's Value in a Changing Climate* (2020), Ayer is highlighted as "a model of smart local planning."

What changed? This drastic improvement is attributable to several regulatory updates, including: mandatory open space residential design (OSRD) by-right; changes to support more transit-oriented development zoning; and new requirements in the stormwater bylaw.

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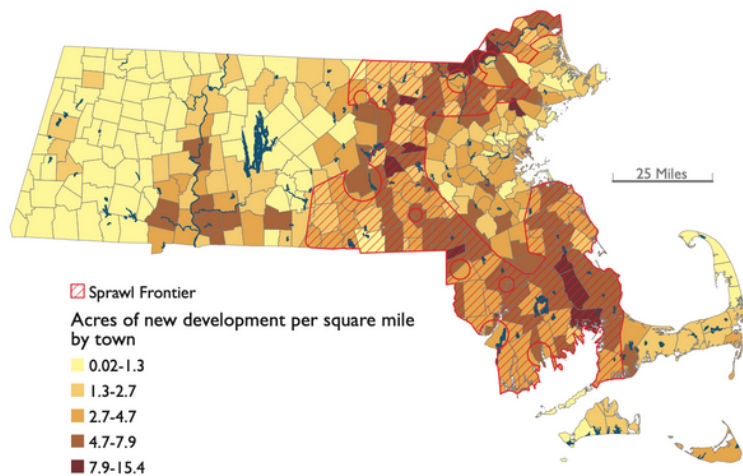


Figure 3. Development trends in MA from 2005-2013. Source: *Mass Audubon Losing Ground: Planning for Resilience* (2014 edition).

Ayer updated its zoning to allow OSRD without a minimum parcel size or number of lots. For sites served by a public sewer system, 50% of open space must be conserved; for non-sewered sites, 40% percent of open space must be conserved. The Town took the requirement a step further in 2018, amending the bylaw to consider the *quality* of open space being preserved. Ayer reports that without specifications on the type of open space required, undevelopable land such as wetlands and steep slopes were included in calculations as conservation.

The updated bylaw now requires the development's conserved open space to include at least a proportional amount of the site's buildable land. That is, "if jurisdictional wetlands and steep slopes comprise 25% of the parent parcel, then up to 25% of the required protected open space can contain such jurisdictional wetlands and steep slopes." ¹⁰

Since the adoption of these and other zoning updates, the quality of proposed development projects in Ayer has improved. These updates, along with recent planning efforts, demonstrate that open space and natural resource conservation are a high priority for the Town of Ayer. The Town updated its Open Space and

Recreation Plan in 2019, with the help of the Nashua River Watershed Association, and conducted a study with the Montachusett Regional Planning Commission to identify Priority Preservation Areas (PPAs). So far, there have been no requests to waive OSRD requirements in any of the four subdivision applications (all of which have now gone through the permitting process) since these updates went into effect.

Stormwater management in Ayer is regulated under the Town's Stormwater Bylaw, which was updated with the assistance of the Central Massachusetts Regional Stormwater Coalition and adopted at a town meeting in 2021. The bylaw now requires LID site planning and design strategies to the maximum extent feasible, with the Town's Conservation Agent ensuring the requirements include maintenance of LID BMPs for each new project.



The updated bylaw also contains language on nature-based solutions for climate resilience, instituted as a result of the Town being designated a Municipal Vulnerability Preparedness (MVP) community: the Petapawag Area of Critical Environmental Concern (ACEC), located along and to the east of the Nashua River, extends north from Ayer into New Hampshire. While the updates are too new to fully evaluate at the time of this writing, it is reasonable to expect they will be highly successful in achieving Ayer's resilience goals.



Creative Approaches to LID Adoption and Implementation

The following two case studies provide examples of communities going above and beyond standard bylaw review and update to achieve multiple benefits of LID and stormwater best practices. These examples provide inspiration for municipalities in non-traditional contexts or facing particularly challenging issues not addressed in other sections of this module.

Pleasant Bay Alliance

With a 2021 US EPA grant from the Southeast New England Program (SNEP), the Cape Cod Commission (CCC) used the Mass Audubon Bylaw Review Tool to conduct an assessment of regulations governing land use, development, and natural resource protection in four Cape Cod communities: Orleans, Chatham, Harwich, and Brewster. These towns comprise the Pleasant Bay watershed area, designated by DCR as an ACEC. The towns formed the Pleasant Bay Alliance (PBA), as a result of this designation, to protect and manage the area's natural resources.

The CCC followed the three principles of the SNEP Network in their bylaw review process:

- Conserving resources that already exist to preserve existing function(s);
- Integrating green infrastructure and Low Impact Development (LID) strategies into all development; and
- Working within existing development patterns to restore functions that are lost, including natural hydrology.¹¹

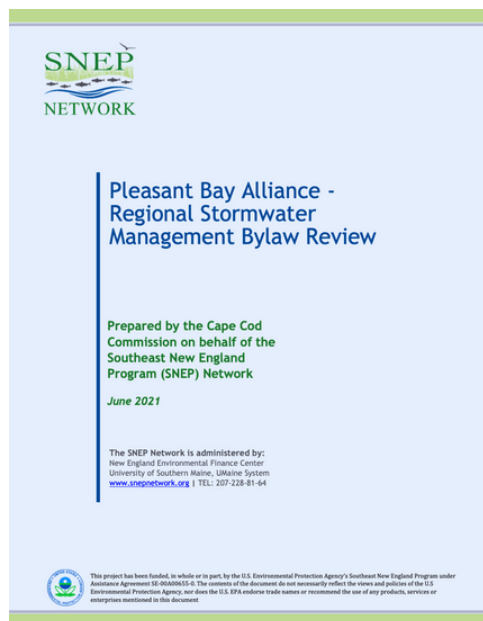
The CCC identified all relevant bylaws and regulations subject to their analysis: zoning, wetland protection, subdivision rules and regulations (including Board of Health regulations), site plan review, and stormwater management. The results of CCC's work contributed to updates of the Mass Audubon Bylaw Review Tool, further assisting communities across the Commonwealth concerned with MS4 permit compliance.

The CCC first conducted analysis on the regulatory framework of each community, and then generated municipality-specific reports, as well as a region-wide report with key recommendations for bylaw updates. This regional approach honored the unique community context of each town, while transcending the Bylaw Review Tool's usual scope in order to acknowledge that watersheds and water bodies are interconnected across town boundaries.

The regional summary provides specific examples of strengths and opportunities for each community, and highlights notable examples where communities already encourage LID. Some of the highlighted strategies include:

- Density bonuses to incentivize LID BMPs (Brewster);
- Roadway reduction allowances for at least 50 percent open space (Harwich);
- Easy LID feature siting in business and industrial districts (Chatham); and
- Provisions that discourage wetland buffer disturbance by requiring analysis of surface and underground drainage systems (Orleans).

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The CCC's Final Report highlights how regionalizing stormwater management policies can benefit the greater community while leveraging existing communication and coordination:

*"Requiring similar performance for new and redevelopment throughout the entire town or Pleasant Bay watershed would further emphasize the importance of water resources of the Pleasant Bay region. The PBA offers its member towns a regular forum and a regional mechanism through which regional regulatory consistency could be assessed and implemented more easily than in many shared watersheds."*¹⁴

Recognizing the achievements of each municipality provides a reference for other communities interested in pursuing similar strategies. Each of the Towns in the PBA has its own structure for encouraging and enforcing LID standards and requirements, but there are notable similarities between their goals. Each town has regulatory mechanisms for open space conservation and natural resource protection:

*"to encourage preferred development designs that include LID features such as preserving open space and minimizing disturbance to existing topography and natural features."*¹²

The CCC recommends encouraging the use of these provisions by allowing them by-right and simplifying permitting processes. As stated in the Report:

*"all four PBA towns utilize language that promotes LID in some parts of their local regulations. The recommendations provided in this summary are not necessarily to add something new or different, but rather to apply these good concepts that already exist in a more efficient or widespread manner."*¹³

The Pleasant Bay Alliance now has an opportunity to encourage regional consistency in stormwater management across its member communities, which would improve compliance and reduce confusion. (Module 7 outlines ways that Regional Planning Agencies (RPAs) can help to coordinate planning and resource sharing). The CCC identified that developers can implement LID techniques more often and more effectively if the rules are the same across a broader service area.



Elevated stormwater management concerns on Cape Cod have resulted in relatively widespread allowances for LID techniques.

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Three of PBA communities currently have a Stormwater Bylaw, and one community was in the process of adopting a Stormwater Bylaw (as of fall 2021):

*"Improvements could include requiring LIDs to the maximum extent practicable and incentivizing LID and green infrastructure BMPs through "by right" processes making the permitting and implementation easier for town employees, boards, and developers. They could also include requiring that stormwater management BMPs be specifically designed to remove the contaminant of concern (e.g., phosphorus or nitrogen) depending on nearby resource areas and the concentration and speed of transport of contaminants. Any of these improvements should include adequate mechanisms to enforce LID maintenance agreements, including the ability to levy fines for non-compliance."*¹⁵

The CCC Report balances common strategies to simplify and streamline administrative processes while acknowledging the different regulatory frameworks that guide each town's land use. Results of the CCC bylaw review for the four PBA communities illustrates that natural resource protection and climate resilience in a sensitive, shared watershed is both a cooperative process and the individual responsibility of each town.

The Town of Provincetown

While this module generally focuses on residential development, communities can implement LID and stormwater management measures in other contexts as well. Communities located in flood-prone and/or nutrient-sensitive watershed areas, such as Provincetown, additional protections beyond updating regulations may be necessary.

Provincetown sought assistance from the University of New Hampshire's Stormwater Center to address significant flooding of the



Town's iconic Commercial Street. Flooding was exacerbated by unique topography, limited drainage capacity, dense areas of impervious cover, and poor road conditions due to patching from sewer installation and utility maintenance.

Between 2012 and 2019, Provincetown rehabilitated Commercial Street in five phases. The Town engaged in a robust and transparent public engagement process because of the disruptions associated with road closures; it included a door-to-door campaign to meet residents and business owners to discuss impacts of each phase of the project. The Town documented residents' concerns, current building conditions, and existing flood-prone areas to ensure that the community was heard and acknowledged.

Provincetown's well-draining soil (primarily sand) provides an excellent sub-base for porous asphalt, one of the permeable paving options discussed in Module 2 (note: in communities with less favorable soil types, additional costs may be associated with bringing in substrate material). Costs for the project, completed in 2019, were roughly \$9 million, 35% of which was paid by the town. Grants from MassWorks and MassDEP covered the remaining cost.

The Town's road's rehabilitation may be too recent to provide significant information about the



Figure 4. Image depicting the before and after of the Commercial Street Rehabilitation project in Provincetown. Source: “Provincetown Stormwater Program Revitalizes Downtown and Improves Beach Water Quality using Porous Asphalt,” Soak Up the Rain New England Webinar Series, EPA. July 28, 2020.

longevity of porous asphalt in Provincetown, but evaluation after six years indicates that, despite frequent street cleaning and some clogging at the curbline, the pavement structure remains in excellent condition. A significant drop in beach closures (previously associated with pollution from road runoff) in the years immediately following the road rehabilitation demonstrates the incredible success of this strategy. Figure 5 on the following page demonstrates this change, from a peak total of 17 beach closures in 2010 down to only 1 in 2016.

At the conclusion of the project, the EPA cited more than \$10 million in avoided costs, as well as the following additional successes:

- An overwhelmingly positive response from residents and business owners;
- Merchants commenting on the lack of puddles in the community;
- Significant improvements to handicap accessibility; and
- Overall aesthetic improvement to the project areas.¹⁶

Conclusion

This module provided examples from several Massachusetts communities that successfully implemented LID techniques into recent development projects. Some communities amended their bylaws to enable or encourage LID, and to influence future development. Others followed alternative approaches to achieve the same climate resilience goals. The examples provided are just a narrow cross-section of community experiences and contexts, identified through interviews conducted while developing this training curriculum. Subsequent modules will demonstrate how to leverage the resources available to communities seeking to assess and/or update existing regulations for improved climate resilience and natural resource protection.

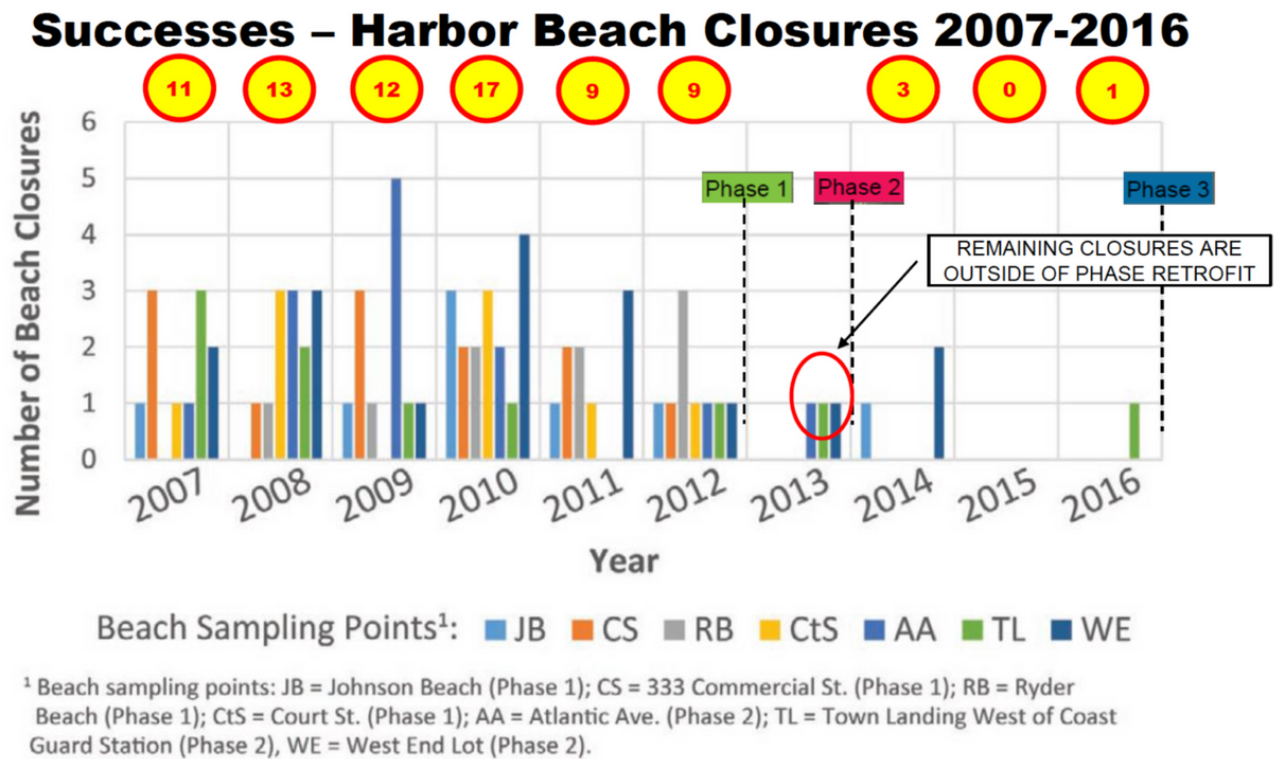


Figure 5. Bar graph of beach closures between 2007 and 2016. Source: “Provincetown Stormwater Program Revitalizes Downtown and Improves Beach Water Quality using Porous Asphalt,” Soak Up the Rain New England Webinar Series, EPA, July 28, 2020.

End Notes

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