COASTAL COMMUNITIES: A DIFFERENT TYPE OF WATER VIEW

RASCL Annual Summit
November 15, 2019

Evan Miller, Projects Coordinator
City of Rehoboth Beach, DE

Private residence on Philadelphia Street in Rehoboth Beach, DE after a heavy rainfall event.

Grove Park in Rehoboth Beach, DE at the end of the recent Junction and Breakwater Trail extension.

Challenges

- Communities experiencing more frequent drainage issues
  - Coastal storms
  - Short but heavy rainfall events
  - Flooding from the ocean, bays and rivers
  - Inadequate infrastructure
- Growth has led to an increase in impervious surface area
  - Redevelopment
  - New development

Winter Storm Jonas
January, 2016

2012

2019

Resilient Communities Partnership (RCP)

- Delaware Department of Natural Resources and Environmental Control (DNREC) Delaware Coastal Programs Office (DCP)
  - Leverages federal funding provided by the National Oceanic and Atmospheric Administration (NOAA)
  - **Goal**: To help communities undertake the necessary planning to become more *resilient* to coastal hazards.
  - Technical assistance grant
  - DCP provides direct staffing, technical support, public outreach and training to support coastal and climate resiliency efforts
    - Bob Scarborough and Kelly Valencik

      2016: Town of Slaughter Beach

      2017: City of New Castle

      2018 - Current: City of Rehoboth Beach and other coastal communities

RCP Partners

- 7 Coastal Communities in Sussex County, DE
  - City of Lewes *
  - Town of Henlopen Acres
  - City of Rehoboth Beach *
  - Town of Dewey Beach *
  - Town of Bethany Beach
  - Town of South Bethany
  - Town of Fenwick Island *

Additional Partners and Stakeholders

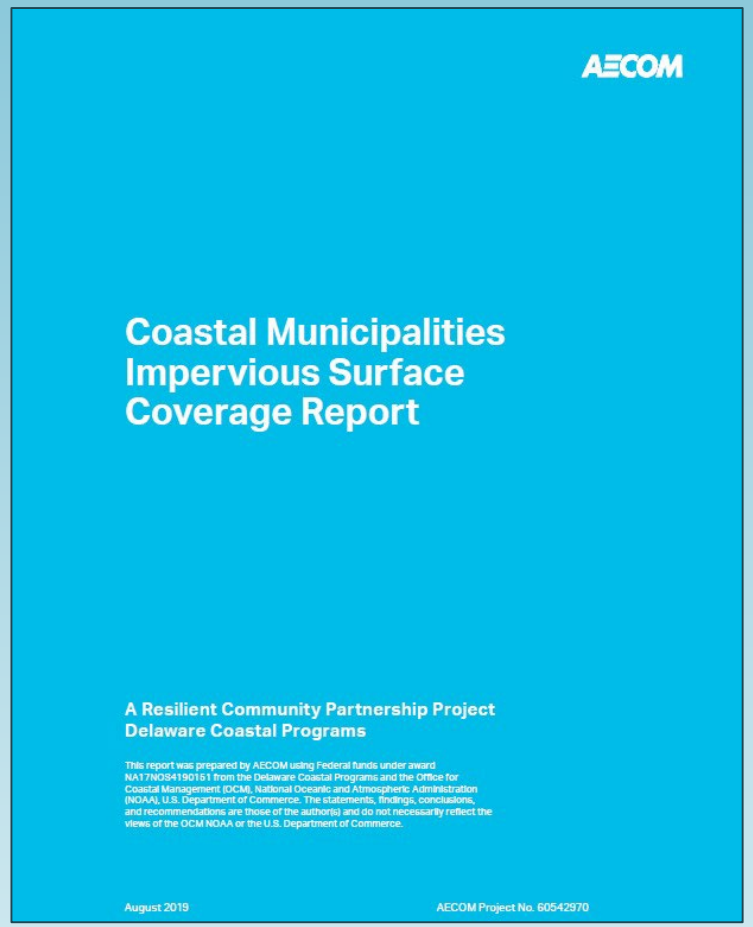
- Funding
  - NOAA
  - U.S. Department of Commerce
- Direct Project Assistance
  - DNREC
    - Delaware Coastal Programs and the Office for Coastal Management
    - Surface Water Discharges Section
  - AECOM and KCI Technologies Inc.
  - University of Delaware
    - Department of Geography
- Stakeholders
  - Delaware Center for the Inland Bays
  - Save Our Lakes Alliance 3

Project Overview

- Three Components
  - Coastal Delaware Best Management Practices (BMP) Guide
    - AECOM
  - Delaware Coastal Communities Impervious Surface Coverage Report
    - University of Delaware, Department of Geography
      - State of Delaware
      - Chesapeake Conservancy
  - Coastal Community Toolkit
    - KCI Technologies Inc.

Coastal Delaware Best Management Practices (BMP) Guide

- AECOM
  - Best Management Practices (BMP) Guide
    - 12 BMPS
      - Characteristics:
        - Benefits
        - Property Type
        - Feasibility & Maintenance
        - Relative Cost
        - Level of Maintenance
    - Implementation Strategies
      - Regulatory vs. Incentive



Best Management Practice Examples

- Bioretention
- Bioswales
- Infiltration
- Permeable Pavement
- Impervious Surface Removal
- Dry Well
- Rooftop Disconnect
- Green Roof
- Rainwater Harvesting
- Tree Planting
- Conservation Landscaping
- Filtration

10. Tree Planting

Figure 28: Trees at Rehoboth Art League
Trees near the Rehoboth Art League's walking path absorb stormwater runoff.

Trees absorb much more water than typical plants; thus they are an effective way to reduce stormwater runoff. Planting large groups of trees together can result in exponentially greater runoff reduction.

Feasability

The following table lists the feasability requirements for tree planting.

Soils	Minimum depth to bedrock must be 4 feet
Water Table	Depth to seasonally high ground water is required to be greater than 1 foot where trees are planted. Choose tree species that are suited to ground water conditions.
Drainage Area	No restrictions
Slope Restriction	No restrictions
Hot Spot Runoff	No restictions
100-yr Floodplain	No restrictions
Other Restrictions	Infiltration practices should be set back at a distance that will ensure that water infiltrating into the ground will not interfere with surrounding buildlings and basements. The distance should be determined by a qualified engineer.

BMP	Propety Type	Relative Cost	Benefit	Level of Maintenance
Tree Planting	Res, CII	$-$$	Runoff Rate Reduction, Habitat	Low

Figure 29: Ohiopyle State Park
Trees are planted in a streetscaped bioretention area between the sidewalk and street at Ohiopyle State Park in southwestern Pennsylvania.

When planting trees and other vegetation, property owners should maximize their use of native species and ensure that no invasive species are planted. Invasive species have few to no native predators or environmental controls and thus can spread more quickly than native species. Invasive plants and trees choke out native ones and make forested areas uninhabitable for birds and mammals. The following tree species are native to Delaware and are organized by the region in Delaware in which they commonly grow (DNREC, 2019). Before planting a tree that is not one of the following species, consult the University of Delaware's Plants for a Livable Delaware guide to ensure that the species is not invasive and choose alternative species that satisfy particular aesthetic functions.

Native Piedmont Tree Species

Sugar Maple: Acer saccharum	Tulip Tree: Liriodendron tulipfera	Hophornbeam: Ostrya virginiana	Sourwood: Oxydendron arboreum
Swamp White Oak: Quercus bicolor	Shingle Oak: Quercus imbricaria	Chestnut Oak: Quercus prinus	American lindern: Tilia americana

Native Coastal Plain Tree Species

Shadblow: Amelanchier Canadensi	Green hawthorn: Crataegus viridis	Loblolly pine: Pinus taeda

Native Piedmont or Coastal Plain Tree Species

Red maple: Acer rubrum	Ironwood: Carpinus caroliniana	Persimmon: Diospyros virginiana	American sweetgum: Liquidambar styraciflua
Downy serviceberry: Amelanchier arborea	Eastern redbud: Cercis canadensis	American beech: Fagus grandfolia	Sweetbay magnolia: Magnolia virginiana
Apple serviceberry: Amelanchier grandflora	Hackberry: Celitis occidentalis	White ash: Fraxinus americana	Black tupelo: Nyssa sylvatica
Allegheny serviceberry: Amelanchier laevis	White fringetree: Chionanthus virginicus	Green ash: Fraxinus pennsylvanica	Virginia pine: Pinus vriginiana
Common pawpaw: Asimina triloba	Pagoda dogwood: Cornus alternifolia	American holly: Ilex opaca	American sycamore: Platanus occidentalis
River birch: Betula nigra	Eastern flowering dogwood: Cornus florida	Eastern red cedar: Juniperus virginiana	London plane: Plantanus x acerifolia
White Oak: Quercus alba	Scarlet Oak: Quercus coccinia	Bur Oak: Quercus macrocarpa	Willow Oak: Quercus phellos
Red Oak: Quercus rubra	Shumard Oak: Quercus shumardii	Common sassafras albidum	Bald cypress: Taxodium distichum

Maintenance

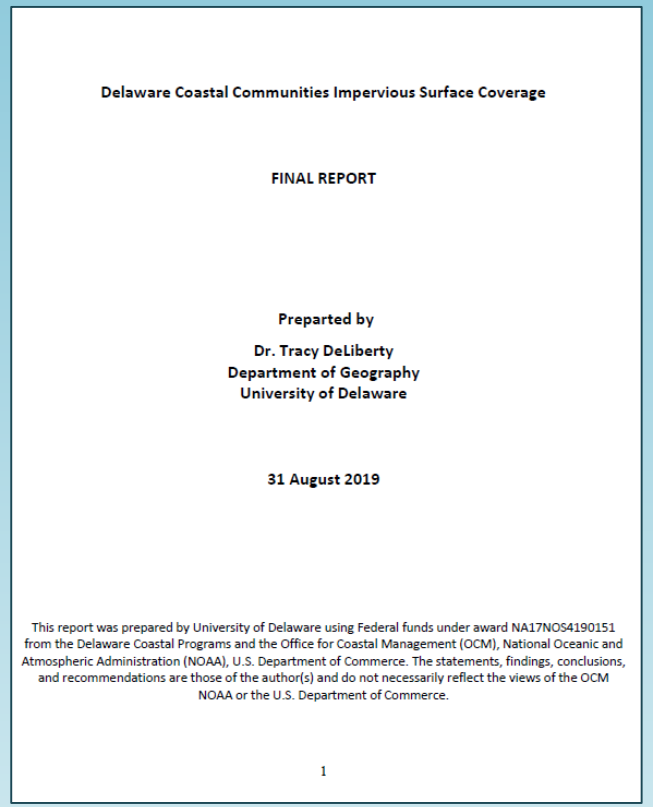
As Needed

- Control invasive plants
- Mow to control weeds and competing undergrowth
- Replant trees that have not survived
- Water trees during the first year of growth

Figure 30: Route 1 Bioswales
Trees are planted along one of the Route 1 Bioswales to help filter stormwater runoff and stabilize the facility.

Delaware Coastal Communities Impervious Surface Coverage Report

- Objectives
  - Assess accuracy of the impervious GIS layers in 2007 and 2016 for the Delaware coastal communities (RCP Participants)
  - Determine the change in impervious surface coverage from 2007 to 2016
- Data Sources
  - State of Delaware impervious surface GIS layer (2007)
  - Chesapeake Conservancy land cover dataset (2016)
    - Using 2013 and 2014 National Agriculture Imagery Program (NAIP) and orthoimagery



Delaware Coastal Communities Impervious Surface Coverage

FINAL REPORT

Preparted by

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31 August 2019

This report was prepared by University of Delaware using Federal funds under award NA17NOS4190151 from the Delaware Coastal Programs and the Office for Coastal Management (OCM), National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of the OCM NOAA or the U.S. Department of Commerce.

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Report Accuracy Assessment

- Accuracy of information is around 92%; therefore the changes that are indicated from 2007 to 2016 are within the margin of error
- Accuracy Assessment
  - Project Raster tool
  - Generated sampling points
  - Random points for comparison
  - Visual sample points (Google Earth & Google Street View)
    - No on site analysis performed

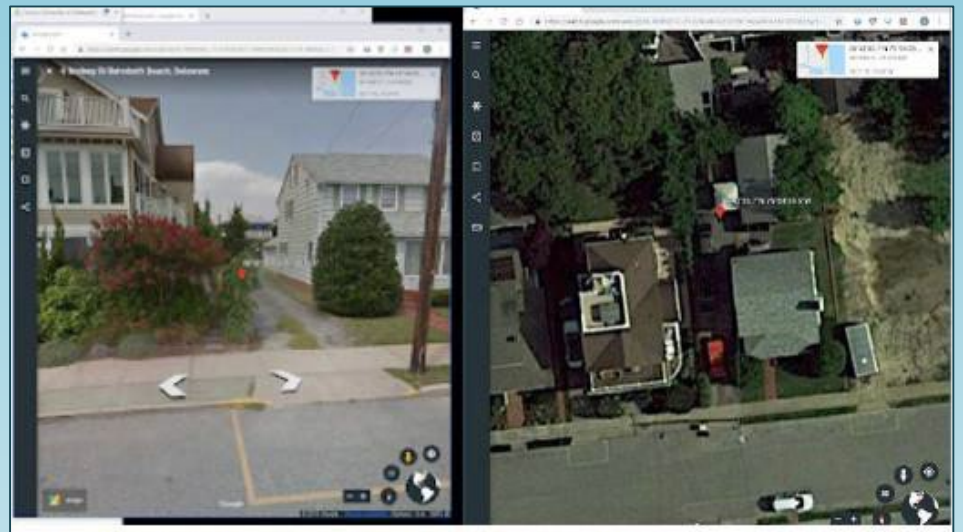


Figure 5. Google Earth Street View (left) and Aerial View (right)

Assessment Results

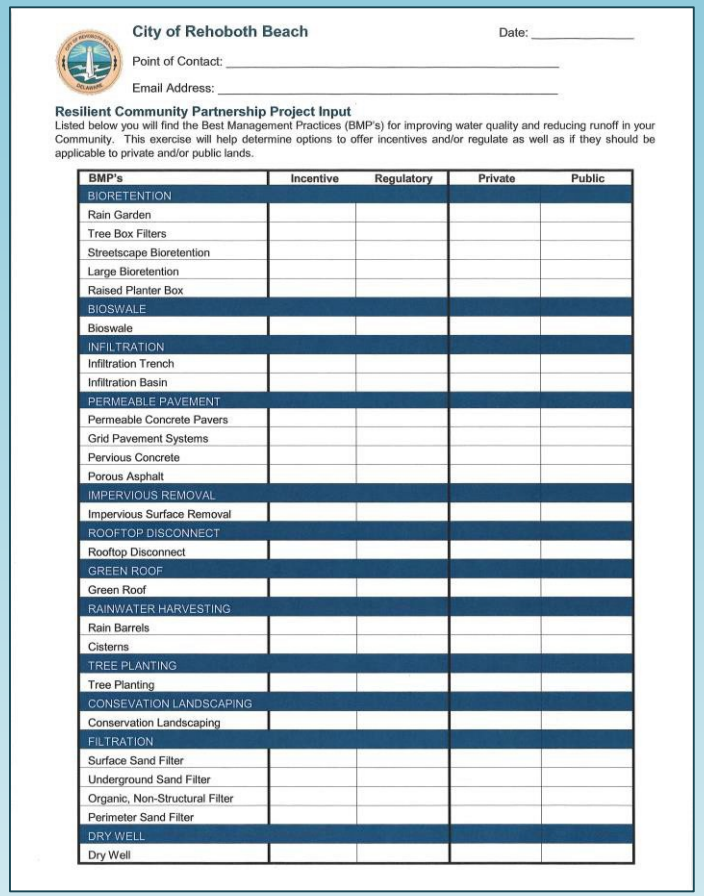
- On average, the beach towns' impervious surface area was 32% of the town area in 2007 with an increase to 35% by 2016.
- Revealed a 3% increase in impervious surface area in the Delaware Beach Communities over the 10 year period. The private designated areas within the towns reveals a 2% increase (in comparison to total town area) from 2007 to 2016.

Municipality	Private Area[1]	2007 Delaware Layer			2016 Chesapeake Layer			% Private Parcel[4]	% Private Total[5]
		Private Imp Sfc[1]	% Imp Sfc Parcel[2]	% Imp Sfc Town[3]	Private Imp Sfc[1]	% Imp Sfc Parcel[2]	% Imp Sfc Town[3]		
Bethany Beach	2.18	0.78	30.79	25.70	0.89	35.06	29.26	4.26	3.56
Dewey Beach	0.54	0.35	**52.92**	**29.64**	0.34	52.56	29.44	-0.36	-0.20
Fenwick Island	0.58	0.29	46.99	22.43	0.35	**56.64**	27.04	**9.66**	4.61
Henlopen Acres	0.37	0.09	17.69	13.06	0.09	17.66	13.04	-0.02	-0.02
Lewes	**4.90**	**1.21**	12.52	10.10	**1.36**	14.07	11.35	1.55	1.25
Rehoboth Beach	1.69	0.82	38.34	20.90	0.82	38.59	21.03	0.25	0.14
South Bethany	0.79	0.34	37.09	24.71	0.41	44.98	**29.97**	7.89	**5.26**

The table summarizes the private impervious surface in comparison to the total parcel area (excludes lakes, canals, beaches) and total town area delineated by the Municipality layer.

Coastal Community Toolkit Development (December 2019)

- KCI Technologies Inc.
  - Identify BMP's considered with each Municipality (private & public)
  - Summarize Coastal Community unique challenges
  - Finalize Coastal Community ordinance matrix
  - Implementation recommendations/next steps
  - Identify funding opportunities



City of Rehoboth Beach Date: _____

Point of Contact: _____

Email Address: _____

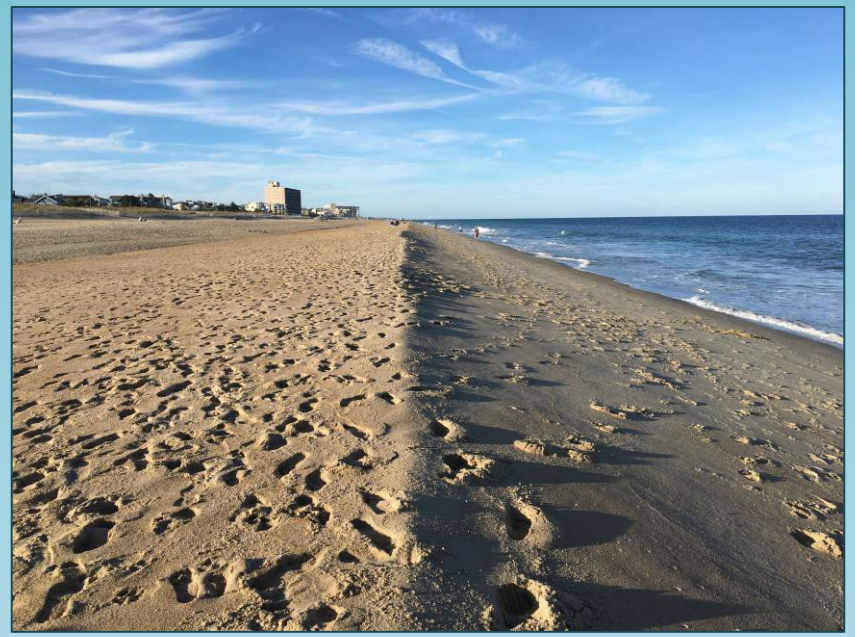
Resilient Community Partnership Project Input

Listed below you will find the Best Management Practices (BMP's) for improving water quality and reducing runoff in your Community. This exercise will help determine options to offer incentives and/or regulate as well as if they should be applicable to private and/or public lands.

BMP's	Incentive	Regulatory	Private	Public
BIORETENTION				
Rain Garden				
Tree Box Filters				
Streetscape Bioretention				
Large Bioretention				
Raised Planter Box				
BIOSWALE				
Bioswale				
INFILTRATION				
Infiltration Trench				
Infiltration Basin				
PERMEABLE PAVEMENT				
Permeable Concrete Pavers				
Grid Pavement Systems				
Pervious Concrete				
Porous Asphalt				
IMPERVIOUS REMOVAL				
Impervious Surface Removal				
ROOFTOP DISCONNECT				
Rooftop Disconnect				
GREEN ROOF				
Green Roof				
RAINWATER HARVESTING				
Rain Barrels				
Cisterns				
TREE PLANTING				
Tree Planting				
CONSEVATION LANDSCAPING				
Conservation Landscaping				
FILTRATION				
Surface Sand Filter				
Underground Sand Filter				
Organic, Non-Structural Filter				
Perimeter Sand Filter				
DRY WELL				
Dry Well				

Project Deliverables

- Completed
  - Coastal Municipalities Impervious Surface Coverage Report
  - Delaware Coastal Communities Impervious Surface Coverage Report
- Pending (December 2019)
  - Municipal Toolkit
    - Implementation recommendations/next steps
    - Funding opportunities
- Continued Coordination



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