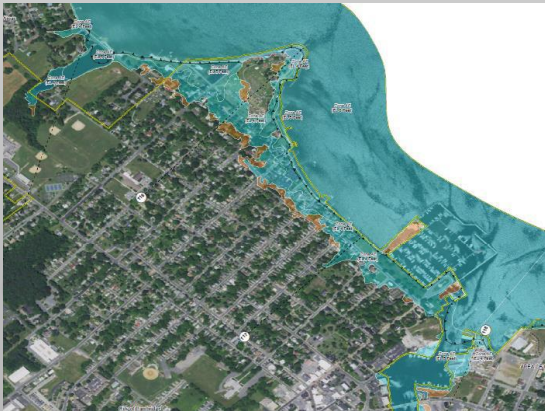




CAMBRIDGE SHORELINE RESILIENCE PLAN

WWW.MAKECAMBRIDGERESILIENT.ORG



COUNCIL OF STATE COMMUNITY DEVELOPMENT AGENCIES

LIVING WITH WATER

LAWRENCE A. WHITE, P.E.
CARL(BUCKY)JACKSON, P.E.

MAKE CAMBRIDGE RESILIENT FLOOD MITIGATION PROJECT

THE PROBLEM

- HIGH TIDES AND MAJOR STORMS FLOOD STREETS PREVENTING ACCESS TO SHORELINE PROPERTIES, AND RECREATIONAL SPACE
- STREET CLOSURES OCCUR 2 TO 3 TIMES PER MONTH ON AVERAGE REQUIRING BARRIERS
- HOMES WITHIN 100-YEAR FLOOD PLAIN SURROUNDED BY WATER ONCE A MONTH WHEN HIGH TIDES EXCEED 3 FT.
- WATER LEVELS REACH ABOUT 3.5 FT ON AVERAGE ABOUT 2 TO 3 TIMES A YEAR
- HIGH TIDES AND STORMWATER INFLOW TO THE WASTEWATER SYSTEM EXCEED PIPE CAPACITIES, RESULTING IN RELEASE OF RAW SEWAGE THROUGH MANHOLES



MAKE CAMBRIDGE RESILIENT FLOOD MITIGATION PROJECT

THE PROBLEM

DAILY HIGH TIDES WITH PROJECTED SEA LEVEL RISE OF 2 FT BY 2050 WILL:

- **INUNDATE ROADS BLOCKING ACCESS TO PROPERTIES , MARINA AND PARKS**
- **INUNDATE 30 + HOMES ONCE A DAY ESSENTIALLY MAKING THEM UNINHABITABLE**
- **BLOCK ACCESS TO CAMBRIDGE YACHT CLUB, MARINA, GERRY BOYLE AND LONG WHARF PARKS**
- **PREVENT ACCESS TO BOAT RAMP AT GERRY BOYLE PARK**
- **MAKE THE IRONMAN, EAGLEMAN AND REGATTA BOAT RACES UNFEASIBLE**
- **PREVENT THE CITY'S STORM AND WASTEWATER SYSTEMS FROM FUNCTIONING PROPERLY**



MAKE CAMBRIDGE RESILIENT FLOOD MITIGATION PROJECT

THE PROBLEM

- SIX OF SEVEN MAJOR STORM THAT HAVE OCCURRED IN THE LAST 20 YEARS HAVE BEEN DECLARED DISASTERS
- CAMBRIDGE IS VULNERABLE TO FLOODING; UP TO 275 PROPERTIES AT RISK OF FLOODING DUE TO A 100-YEAR STORM
- HURRICANE ISABEL WILL HAVE A RECURRENCE FREQUENCY OF 20 YEARS, INSTEAD OF 100 YEARS
- SMALLER SURGE EVENTS WILL OCCUR MORE FREQUENTLY, RESULTING IN GREATER FLOOD DAMAGE



MAKE CAMBRIDGE RESILIENT FLOOD MITIGATION PROJECT – FLOOD RISK REDUCTION CHALLENGE

- **DORCHESTER COUNTY IS FLAT AND AT NEAR SEA LEVEL -
DIFFICULT TO PLAN AND DESIGN FLOOD PROTECTION**
- **SEA LEVEL RISE IN MARYLAND PROJECTED TO BE 2 FT BY 2050
AND 3-4 FT BY 2100 DUE TO CLIMATE CHANGE**
- **STORM SURGE AND RAINFALL DUE TO HURRICANES &
TROPICAL STORMS IS INCREASING DUE TO WARMING WATERS**
- **WARMING OF ATLANTIC WILL ALSO RESULT IN STORMS
MOVING MORE SLOWLY AND FURTHER NORTH IMPACTING MD**



MAKE CAMBRIDGE RESILIENT FLOOD MITIGATION PROJECT OUR COMMUNITY CAPACITY BUILDING CHALLENGE

DORCHESTER COUNTY LARGELY RURAL WITH SMALL COMMUNITIES THAT DO NOT HAVE THE CAPACITY TO ADAPT TO CLIMATE CHANGE

- **TECHNICAL SUPPORT NEEDED**

- PLANNING AND IMPLEMENTING FLOOD RISK REDUCTION PROJECTS
- REDUCING RISK TO STORM, WATER & WASTEWATER INFRASTRUCTURE
- IMPLEMENTING GREEN INFRASTRUCTURE PLANS

- **FUNDING SUPPORT NEEDED**

- BUILDING RELATIONSHIPS WITH REGULATORS
- UNDERSTANDING AND APPLYING FOR GRANTS
- LEARNING HOW TO BE PATIENT AND SUCCESSFUL



MAKE CAMBRIDGE RESILIENT FLOOD MITIGATION PROJECT PLANNING

WORKING WITH NATURE TO ADAPT TO CLIMATE CHANGE STRATEGICALLY AND SUSTAINABLY.

- **PLANNING PROCESS**-FEMA FMA ADVANCED ASSISTANCE GRANT OCT 2020-SEPT 2022.
- **PROJECT TEAM** - CITY PROJECT MANAGEMENT TEAM, STEERING COMMITTEE, CONTRACTOR SUPPORT, UMCES AT HORN PT
- **APPROACH**- PARALLEL ROBUST PUBLIC OUTREACH AND TECHNICAL EVALUATION PROCESS
- **RESULTS** - HYBRID ENGINEERED NATURE-BASED FLOOD MITIGATION PROJECT AND COMMUNITY DEVELOPMENT PROGRAM
 - RISK REDUCTION STRATEGIES FOR TODAY AND TOMORROW
 - **ENGINEERING WITH NATURE**
 - **DUTCH APPROACH TO LIVING WITH WATER**



Cambridge Shoreline Resilience Plan

Visual Preference Survey

On the following pages there are images of visual preferences used around the world. Please rate your opinion to 5. A score of 1 indicates a very negative opinion. Please rate each image to other images.

Waterfront Park Levee

Reduce the impacts of flooding by creating a space during flood events with minimal damage to the park a single flood event and the damage that it causes.

1. Please rate your opinion on the image:
1 - Very Negative 2 - Negative

CAMBRIDGE SHORELINE RESILIENCE PLAN

OPEN HOUSE & LISTENING SESSION - AUGUST 10, 2021

To engage project stakeholders, an open house and listening session was held on August 10, 2021, at the Danvers Center for the Arts. The open house, held in the gallery area, included graphic displays, informational brochures, and a flood modeling station. The listening session, held in the upstairs Performance Hall, included a brief project overview and then a series of discussion questions that participants discussed amongst those within their table group. Each table group selected a spokesperson who gave a report out to the larger group. The listening session was a great opportunity to hear public concerns specific to flooding and ideas for flood risk reduction solutions for both current and future conditions.

LISTENING SESSION- ICE BREAKER

What do you think is the best thing about living in the City of Cambridge?

The following items were listed by participants and are not presented in any particular order or prioritization.

-The friendly giving people - Laid back environment - peaceful - Small town atmosphere - The waterfront - Choptank River - Heights - Sense of Community - Activities, especially water-related - Walkability from West End to Downtown - Culture & Heritage - Seafood (Rockfish) - Architecture - Yacht Club - Sailing - Events - Location is far enough away from congestion, but not too far away from more urban areas - Great Marsh Park - Volunteer participation in local events and politics - Walkability & biking - Access to water and boating - Water access to other areas around Eastern Shore and the Chesapeake Bay.

LISTENING SESSION- FLOODING ISSUES

#1 Who in the community is most at-risk to flooding?

The following items were listed by participants and are not presented in any particular order or prioritization.

-Those within the floodplain area - Area between Choptank River and Hambrooks - also area along Water Street up to the 100 block - Residents in the West End - Business owners & employees - Waterfront homes in low lying areas - Residents in the West End (Choptank, Water, Hill, West End, Clarke, Wills, Belvidere) - People along Water Street & Hambrooks Blvd. - Elderly & infirm - Public Schools - First responder stations.

MAKE CAMBRIDGE RESILIENT FLOOD PROTECTION PLAN PROJECT PLAN

- **RISK REDUCTION FOR TODAY - ENGINEERING WITH NATURE**
FLOOD MITIGATION PROJECT TO MITIGATE IMPACTS OF SLR AND MAJOR STORMS (FEMA APPROVAL OF FUNDING PENDING)

- SHORELINE FLOOD PROTECTION
- STORMWATER MANAGEMENT
- GREEN INFRASTRUCTURE



- **RISK REDUCTION FOR TOMORROW - LIVING WITH WATER LIKE DUTCH** - COMMUNITY DEVELOPMENT FLOOD MITIGATION PROGRAM CITY WIDE TO MITIGATE RISK OF SLR OUT TO 2100 (FEMA GRANT APRIL 2023)-

- INTEGRATION OF FLOOD MITIGATION INTO CITY PLANNING
- COMMUNITY WIDE GREEN INFRASTRUCTURE PLAN IMPLEMENTATION
- FLOOD MITIGATION FOR BUSINESSES AND RESIDENTS

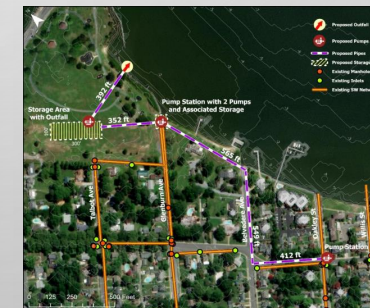
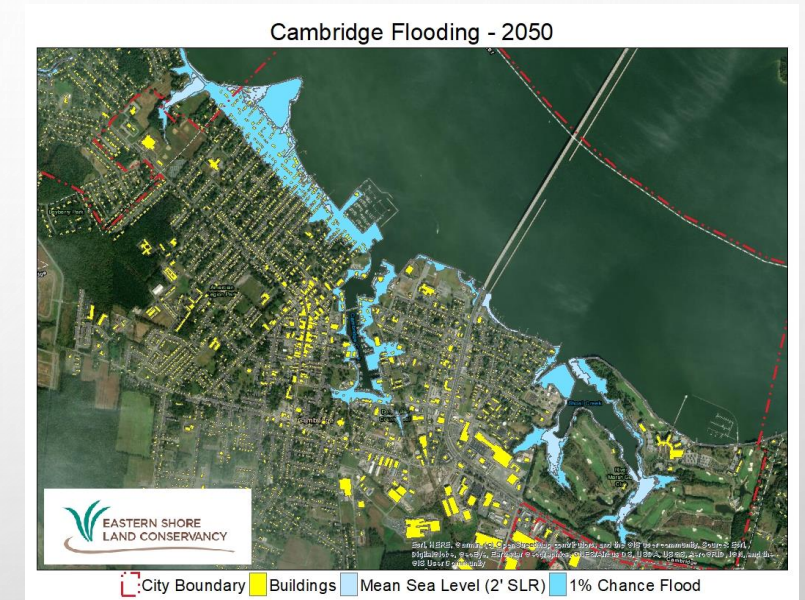


MAKE CAMBRIDGE RESILIENT FLOOD MITIGATION

PROJECT PLAN COMPONENTS

A HYBRID ENGINEERED NATURE-BASED FLOOD MITIGATION PROJECT

- INTEGRATED LIVING SHORELINE - EARTH/ROCKFILL EMBANKMENT FLOOD PROTECTION
(DESIGNED FOR OVERTOPPING AND ALLOWING ADDING TO FLOOD PROTECTION LEVEL IN FUTURE IF NEEDED)
- INTEGRATED ENGINEERED/NATURE-BASED STORM WATER MANAGEMENT SYSTEM
- EVOLVING NATURE-BASED CITY-WIDE GREEN INFRASTRUCTURE PLAN



MAKE CAMBRIDGE RESILIENT FLOOD MITIGATION

PROJECT ALIGNMENT AND CONCEPT DESIGN



Cambridge Shoreline Resilience Plan - Project Areas

- RISK ASSESSMENT OF FIVE DISTINCT AREAS
- ESTABLISHED FLOOD PROTECTION LEVEL AT ELEV 7 FT ABOVE MSL – 2 FT ABOVE BFE
- RANGE OF MITIGATION OPTIONS IDENTIFIED AND EVALUATED
- PUBLIC INPUT ON PREFERENCES
- DETAILED MATRIX TECHNICAL ANALYSIS OF OPTIONS
- PUBLIC OUTREACH SESSIONS ON RESULTS
- REGULAR BRIEFING TO CITY COUNCIL AND PRESENTATIONS TO VARIOUS ORGANIZATIONS

CAMBRIDGE SHORELINE RESILIENCE PLAN

OPEN HOUSE & LISTENING SESSION – AUGUST 10, 2021

To engage project stakeholders, an open house and listening session was held on August 10, 2021, at the Dorchester Center for the Arts. The open house, held in the gallery area, included graphic displays, informational brochures, and a flood modeling station. The listening session, held in the upstairs Performance Hall, included a brief project overview and then a series of discussion questions that participants discussed amongst those within their table group. Each table group selected a spokesperson who gave a report out to the larger group. The listening session was a great opportunity to hear public concerns specific to flooding and ideas for flood risk reduction solutions for both current and future conditions.



MAKE CAMBRIDGE RESILIENT FLOOD MITIGATION

INTEGRATED LIVING SHORELINE WITH EMBANKMENT CONCEPT

LEVERAGING BEST FEATURES OF EACH

- **EARTH & ROCK FILL EMBANKMENT** – ALLOWS ELEVATION OF SALT MARSH TO REDUCE IMPACT OF STORM SURGE AND PREVENTS WATER LEVELS EXCEEDING DBF OF 7 FT ABOVE MSL.
- **ELEVATED MARSH- MITIGATES STORM SURGE AND** ALLOWS DEPOSITION OF NUTRIENT AND GROWTH OF VEGETATION WITH INCREASING SEA LEVEL RISE
- **ROCK SILL** –RIPRAP BREAKWATER FIRST LINE OF DEFENSE, CALMS FLOOD WATERS
- **OYSTER REEF-** AT TOE OF ROCK SILL SUPPORTS WAVE ATTENUATION , INCREASES LIVING SHORELINE HABITAT DIVERSITY& ENHANCES WATER QUALITY

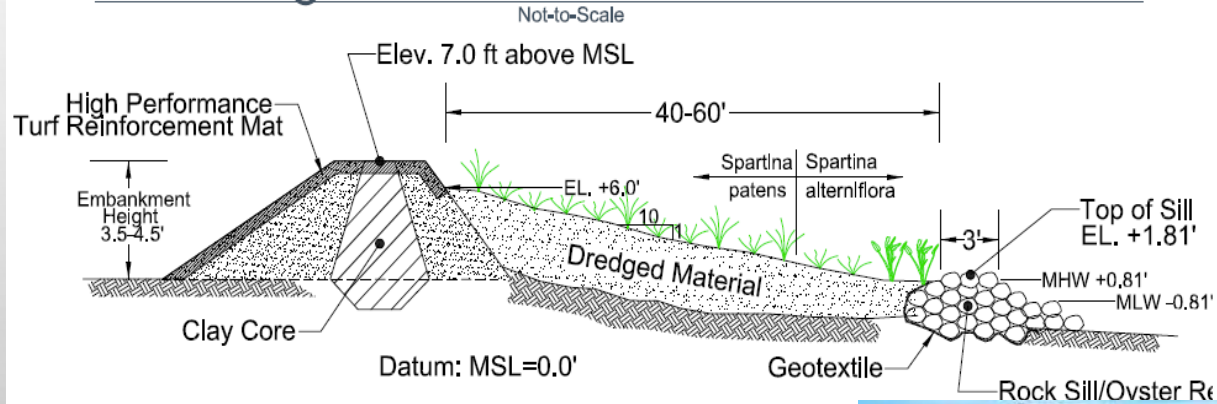


MAKE CAMBRIDGE RESILIENT FLOOD MITIGATION

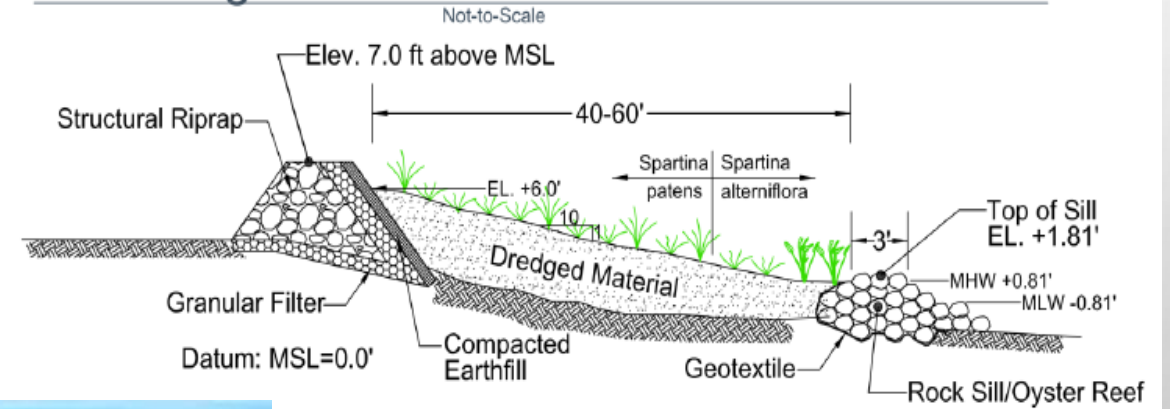
INTEGRATED LIVING SHORELINE WITH EMBANKMENT CONCEPT DESIGN

LEVERAGING BEST FEATURES OF EACH

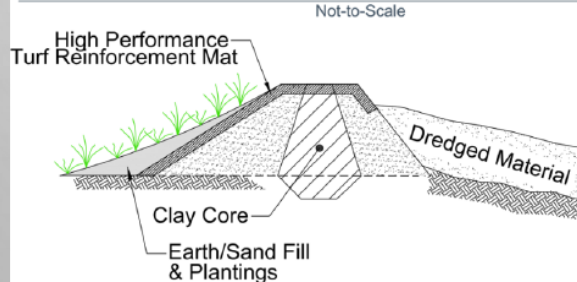
Living Shore w/ Earthfill Embankment



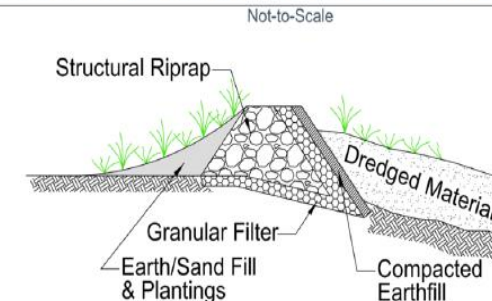
Living Shore w/ Rockfill Embankment



Earthfill Embankment Landscaping



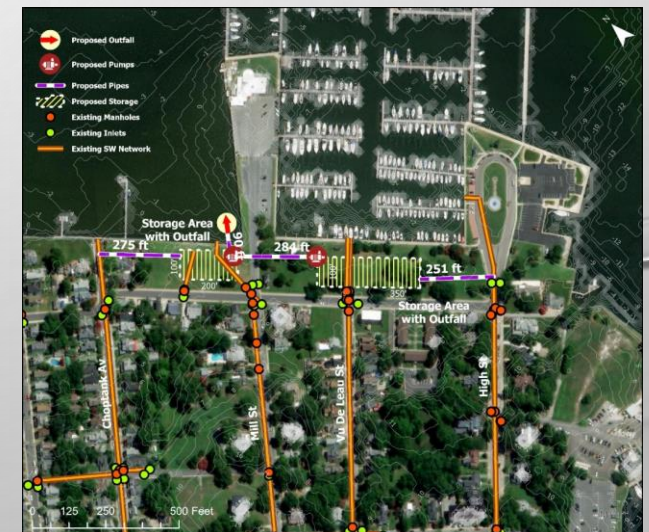
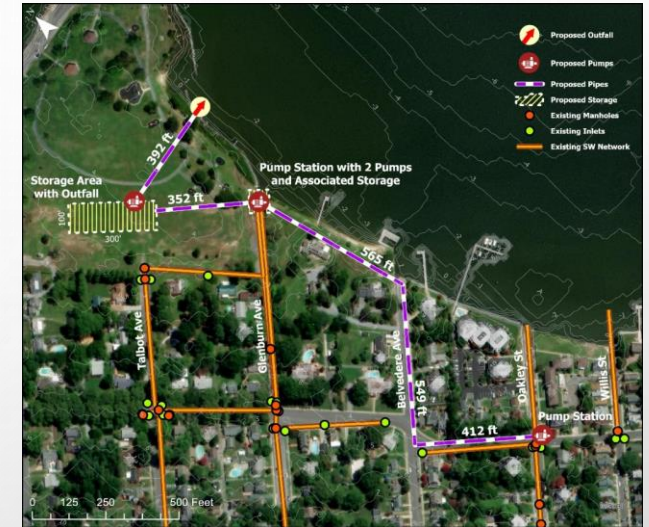
Rockfill Embankment Landscaping



MAKE CAMBRIDGE RESILIENT FLOOD MITIGATION

INTEGRATED ENGINEERED/NATURE-BASED STORM WATER MANAGEMENT SYSTEM

- **BACKFLOW PREVENTERS AT THE ENDS OF EXISTING STORM WATER LINES TO PREVENT HIGH TIDES BACKING UP INTO THE STREETS**
- **NEW STORM WATER MANAGEMENT SYSTEM LANDSIDE TO COLLECT, STORE, AND CONTROL RELEASE OF STORMWATER BACK TO THE RIVER**
- **NATURE-BASED CITY-WIDE GREEN INFRASTRUCTURE PLAN TO FURTHER REDUCE FLOOD RISK AND IMPROVE WATER QUALITY BY CAPTURING, STORING AND TREATING STORM WATER RUNOFF BEFORE IT REACHES THE RIVER**



MAKE CAMBRIDGE RESILIENT FLOOD MITIGATION

EVOLVING NATURE-BASED CITY-WIDE GREEN INFRASTRUCTURE PLAN

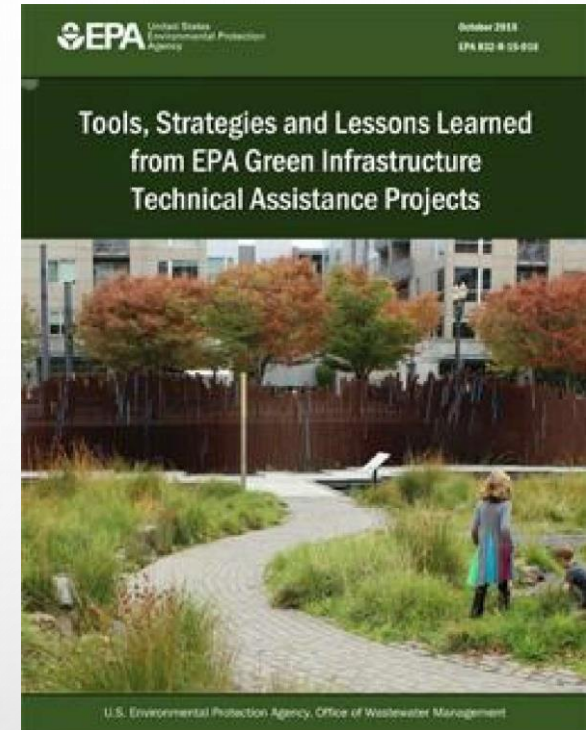
FEMA COMMUNITY DEVELOPMENT PROGRAM GRANT AWARDED APRIL 2023

- **SUPPORT CITY PLANNING** OF INFRASTRUCTURE PROJECTS SUCH AS THE COMPREHENSIVE PLAN, PUBLIC UTILITIES, PARKS AND ROADS
- **CITY WILL DEVELOP A GREEN INFRASTRUCTURE PLAN** BASED ON AVAILABLE OPEN SPACE, PRESENCE OF OR ABILITY TO CREATE PERMEABLE SURFACES. AND SITE CHARACTERISTICS
- **INTEGRATE NATURE-BASED STORMWATER MANAGEMENT FEATURES** WITH OUR EXISTING GREY INFRASTRUCTURE TO REDUCE/TREAT SURFACE WATER
- **NATURE-BASED SOLUTIONS** MAY INCLUDE STORMWATER PARKS, BIOSWALES, RAIN GARDENS, PERMEABLE PAVEMENT, GREEN STREETS ETC.
- **SUPPORT BUSINESSES AND RESIDENTS** IN SECURING GRANT FUNDING FOR NATURE-BASED FLOOD MITIGATION PROJECTS (E.G. CAMBRIDGE CREEK)



MAKE CAMBRIDGE RESILIENT FLOOD MITIGATION PLAN GOING FORWARD

- **DEVELOP CLIMATE ADAPTATION CENTER OF EXCELLENCE – ENGINEERING WITH NATURE**
 - PLANNING, DESIGN AND CONSTRUCTION OF HYBRID NATURE-BASED GREEN-GREY FLOOD PROTECTION INFRASTRUCTURE
 - COMMUNITY DEVELOPMENT PROGRAMS INCLUDING PUBLIC OUTREACH AND TECHNICAL SUPPORT FOR GREEN INFRASTRUCTURE
 - DESIGN PROJECTS FOR OPTIMIZING FLOOD. ENVIRONMENTAL PROTECTION AND SOCIAL CO-BENEFITS
- **SUPPORT NEIGHBORING COMMUNITIES IN CLIMATE ADAPTATION- LIVING WITH WATER**
 - COLLABORATE WITH DOCO, UMCES AND MDEM ON NOAA RESILIENCE REGIONAL CHALLENGE
 - WORKING WITH REGULATORS VIA STEERING COMMITTEE IN TAKING ADVANTAGE OF GRANT PROGRAMS FOR FUNDING PROJECTS
 - WORKING WITH SHORE RIVERS LLC AND OTHER NON-PROFITS IN ENHANCING WATER QUALITY





MAKE CAMBRIDGE RESILIENT FLOOD MITIGATION

QUESTIONS