Science Plan Appendix

Why this approach?

When NBEP published the *State of Narragansett Bay and Its Watershed*, included at the end of each chapter was a list of data gaps, assessment needs, and research needs. These needs were compiled and organized by the Science Advisory Committee to create a draft Science Agenda (Appendix A). This previous effort was never finalized.

Using this information, NBEP conducted individual interviews with 15 of the 16 members of the Science Advisory Committee (SAC) to discuss their current research, and what research needs they note are needed in the region. NBEP also reached out to partners who were funded by NBEP, or sit on other committees for their opinions as well. Topics discussed were included in a lengthy document, which was then organized by the topic areas of Vision 2032 (Appendix B). At an April 2023 meeting, the SAC voted on the ideas/topics that were most important to them and the results of that meeting were summarized in Figure 2.

Most of the needs identified by the SAC were categorized as synthesizing existing data and collecting baseline and applied data. These steps are essential to creating new projects which are responsive to the information we know, and to understand how the ecosystem has changed.

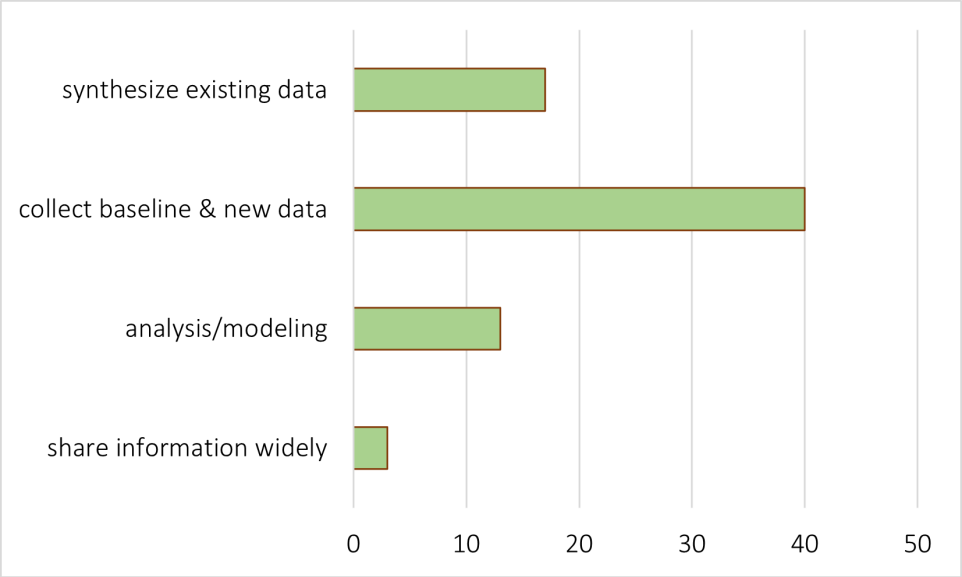

Figure 2. Summary of April 2023 Voting by Topic

Why the limited geography?

The challenge with the topics and questions generated through previous and current efforts is that they are big. They can be addressed anywhere and everywhere in the watershed at the same time. This makes them daunting, both practically and financially. NBEP does not have the funding to fully pursue these questions for every corner of the study region.

NBEP was inspired by partners who have created research collaborations centered around specific geographies to conduct their work. These collaborations include a Living Observatory to study cranberry

bogs, and a Narragansett Bay National Estuarine Research Reserve effort to bring researchers together to study the Succotash Marsh in South Kingstown, RI before, during, and after a massive restoration to the area occurs. These collaborations bring scientists, the public, and managers together into one geography to learn and work together, and share resources.

NBEP focused on four main geographies of the region: urban waters, coastal habitats, upland areas, and the mainstem of Narragansett Bay. Using information gathered in April 2023, NBEP sorted the topics into geographies where the research/need is applicable to that geography. That means it needs to be addressed in that area, or makes sense (*i.e.,* we wouldn't focus on forest loss to solar fields in urban areas). Figure 3 demonstrates that many of the questions and topics brough up by our members could and should be answered in urban waters.

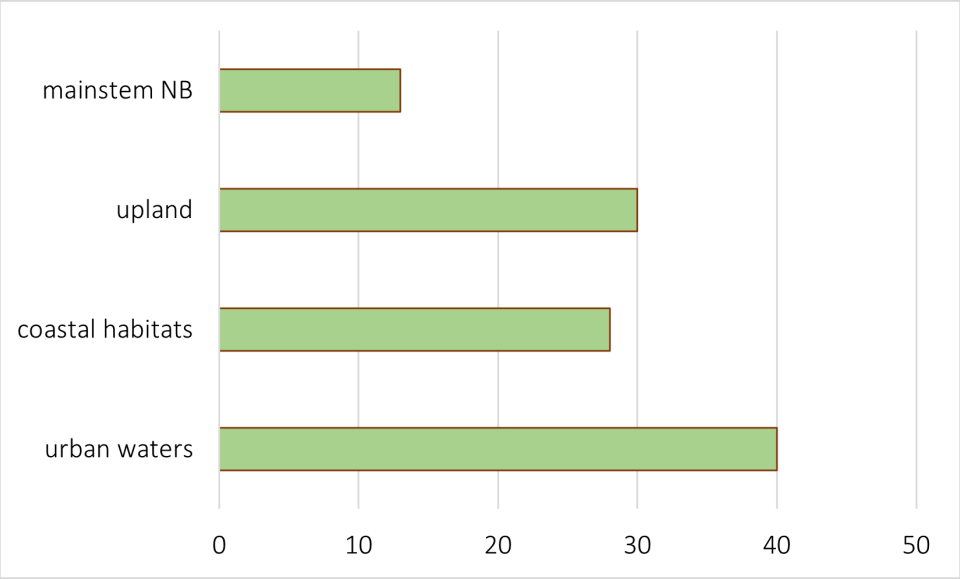

Figure 3. Summary of April 2023 Voting by Geography

Appendix A
2018 Draft Science Agenda

NARRAGANSETT BAY ESTUARY PROGRAM

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DRAFT – Narragansett Bay Estuary Program Science Strategy
Draft as of 12/18/2018

Beginning in 2013, the Narragansett Bay Estuary Program started a process to compile and synthesize sound, peer-reviewed science to better understand the environmental condition of Narragansett Bay and its watershed. During this process, the Management Conference, particularly the Science Advisory Committee, and staff identified 24 environmental indicators of stress and condition (Figure 1). These indicator topics were used to discuss the state of the system as it is now and a retrospective look at trends. The culmination of this process was the 2017 *State of Narragansett Bay and Its Watershed*, a comprehensive, 500-page report detailing the status and trends of this bi-state watershed. The report provided for the first time a unified presentation of the best available data on environmental conditions across the entire bi-state watershed.

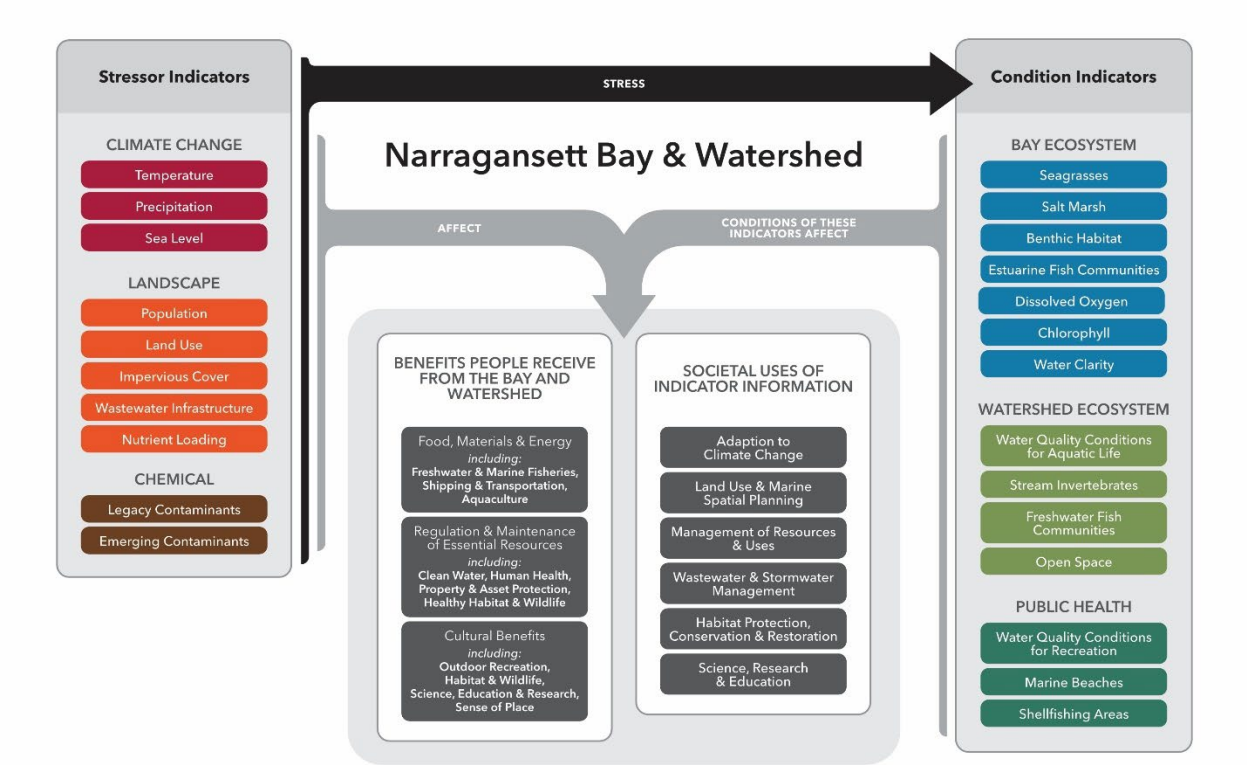


Figure 1. List of stressor and condition indicators. These indicator topics affect the benefits people receive from the Bay and Watershed and the societal uses of indicator information.

During this data discover and writing process, scientists, managers, and practitioners; the staff; and Science Advisory Committee members assembled lists of data gaps, assessment needs and research needs based on their expert opinions. Data gaps are areas (geographical or otherwise) which are true gaps in our knowledge of the indicator and system. Assessment needs are where the data exist to

understand the issue at hand, but those data have not been analyzed or synthesized. Finally, research needs identify basic scientific questions which need to be answered through academic research.

When compiled as a whole, the data gaps and research needs from all 24 indicator chapters span approximately 12 pages in length. They detail every gap and need regardless of priority or current funding going towards those needs. The Science Advisory Committee agreed that the list needed to be prioritized and maintained. The needs were divided into their groups - data gaps, assessment needs, and research needs – and then each group was prioritized. These lists are maintained in a spreadsheet, with columns dedicated to notes and advances made (*i.e.*, work towards filling the gap or understanding the need). These spreadsheets were then synthesized further to show where the gaps and needs overlap, or are included in larger sub-topics. The results of that synthesis are included here, in this Science Strategy.

The aim of this Science Strategy is to translate key science needs identified through the 2017 *State of Narragansett Bay and Its Watershed* process into a concise and consensus-driven summary. These needs represent the gaps in our knowledge and the research and assessment needs required to further understand the environmental condition of Narragansett Bay. This document will channel future efforts towards the most pressing science needs. It will be shared with partners directly and attached to any future NBEP grant programs related to science. It is intended to be used by NBEP and partners to target funding, grants, external sources, and to be a vehicle of communication across the watershed.

The following Strategy is divided into 6 top needs, matching those identified in the *State of Narragansett Bay and Its Watershed*. These needs are: (1) Contaminants (both legacy and emerging); (2) Ecologically significant habitats and species; (3) Habitat restoration and enhancement; (4) Ecological flows (water dynamics); (5) Ecosystem functions (focusing on primary productivity and biology and chemical connectivity); and (6) Human health. These needs are equal and are not further prioritized.

One obvious missing top need is understanding the effects of climate change on our watershed. This need runs through the other needs, and research needs on the effects of climate change are included within each topic.

The NBEP Science Strategy will need to be continually assessed and re-evaluated as an iterative process. As the NBEP community funds (or receives funds for) gaps, assessments, or needs, these priorities will drop, allowing new ones to rise to the top. Therefore, every 5 years, this Science Strategy will be updated by the Science Advisory Committee to account for new topics and needs. The process to update the *State of Narragansett Bay and Its Watershed* will be used as the opportunity to review the data gaps and research needs.

Top Science Needs[1]

Contaminants (both legacy and emerging)
Residual pollution from the watershed's history of manufacturing still plague our fish and shellfish. These legacy contaminants are passed up the food chain and eventually reach humans. Now, we are also beginning to understand that new pollutants, contaminants of emerging concern, can impact human health. These emerging contaminants are from pharmaceuticals or personal care products. We need to understand how pollutants, particularly legacy contaminants and emerging contaminants, will impact human health. Specifically, need to assess the levels of metal contamination in freshwater and estuarine water fish and shellfish and look for hotspots for contamination to better protect human health.

Ecological significant habitats and species
The watershed has key habitats that need to be monitored, such as sea grass, salt marsh, and the benthic habitats. Firstly, we need to implement or augment existing monitoring strategies, particularly for seagrasses and salt marshes. Then, understanding how these habitats will respond to the changes in climate and eutrophication is key to improving habitat resilience throughout the watershed.

Habitat restoration and enhancement
Restoration and enhancement projects are always underway throughout the watershed. These projects aim to restore natural capacity or improve ecosystem services of key habitats. Currently, NBEP is creating a Habitat Restoration and Protection Mapping Tool to assess restoration and enhancement activities already implemented within the watershed to better understand what needs to be done and where. A fundamental need is to also monitor and assess these activities to know if they are working properly, and create adaptive management strategies to ensure the projects longevity.

Ecological flows (water dynamics)
The water budget is an important piece to understand about the Narragansett Bay watershed. Key links between ecology and physical processes need to be understood so that we may be able to track and monitor any changes to the system, like sea level rise or other climate change impacts. Groundwater, drinking water sources, flood plains, and wastewater treatment (particularly onsite systems) are under threat from rising seas. We have models to understand these impacts (i.e. STORMtools), but they need to be applied equally across the watershed. These models rely on understanding basic climate trends, such as the changes to air and water temperature, and the frequency, amount, seasonality, and type of precipitation with time.

Ecosystem functions (focusing on primary productivity and biology and chemical connectivity)
Ecosystem functions, particularly those associated with nutrient dynamics and primary productivity need understanding. Recently, nutrient loading to the bay was reduced by almost half, and we need to understand how the ecosystem is responding. One avenue necessary to do that is through monitoring of water quality by sustaining the Narragansett Bay Fixed Site Monitoring Network. This network provides us with basic parameters which feed our understanding of ecosystem response to nutrient

[1] As noted, this science strategy stems from gaps and needs as identified in the 2017 *State of Narragansett Bay and its Watershed* report. Therefore, NBEP recognizes there are additional gaps and needs that were either missed in this assessment or were not relevant based on the selected indicators. For example, NBEP's report did not include social indicators and as such, no related gaps and needs are identified here despite the existence of such gaps and needs.

dynamics, physical changes to the water column, and key initial responses, such as phytoplankton blooms through increased chlorophyll production. These data can be used to continually develop and validate ecosystem and hydrodynamic models to further explore nutrient and dissolved oxygen dynamics. Spatial coverage of chlorophyll and water clarity data collection needs to be expanded to understand how nutrient dynamics are impacting the food web and water column. Existing datasets should be examined to inform future sampling plans. Additionally, we need to understand harmful algal and cyanobacteria blooms to understand how they form, and how they can be prevented, which protects human health. Finally, on land, we need to assess areas of high-density onsite systems to contribute pollutants to the watershed and by using soils and groundwater data.

Human Health (focusing on beaches)

Human health is an important aspect of a healthy watershed. We have touched upon this in the *Contaminants* and the *Ecosystem functions* categories. Here we touch upon one of the most economically important features of Narragansett Bay and its watershed – the beaches. The reasons behind beach closures need to be better understood and developing models for beach closures may help. Additionally, relating the beach assessments to water quality assessments of larger water bodies is missing.

original category	Data gap, Assessment need, Research need	category	subcategory
climate	Mesocosm experiments to study Bay response to climate change	habitat	climate
climate	Research methods to improve salt marsh reslience	habitat	climate
climate	Sea level rise trends analysis for Mt. Hope Bay	humans	climate
climate	Analyze impacts of sea level rise on groundwater, drinking water supplies, floodplains and OWTS	humans	climate
climate	Analysis of air and water temperature trends	water	climate
climate	Analysis of frequency, amount, seasonality and type of precipitation over time	water	climate
human health	Legacy contaminants in estuarine fish and shellfish	humans	health
human health	Legacy contaminants in freshwater fish	humans	health
human health	Relate beach assessments to water quality assessment of larger water bodies	humans	health
human health	Research legacy contamination at "hot spot" locations	humans	health
water quality	Monitoring for harmful algal blooms in marine/estuarine waters	humans	health
water quality	Cyanobacteria monitoring in freshwaters	humans	health
models	Mescosm experiments to evaluate response of benthic community to increased clarity and de creased phytoplankton production	habitat	models
models	Continued development and validation of water quality/ecosystem model for Narragansett Bay (nutrient dynamics)	water	models
models	Develop and use models to better understand hydrodyanmics and influence on DO, benthic conditions and overlying DO	water	models
habitat	Implementation of saltmarsh mapping and monitoring (3 -tiered approach)	habitat	monitoring
habitat	Implementation of seagrass mapping and monitoring (3 -tiered approach)	habitat	monitoring
water quality	Sustain Narragansett Bay Fixed Site Monitoring Network (major equipment investment needed)	water	monitoring
water quality	Chlorophyll data - need additional spatial coverage of bay sub-regions	water	monitoring
water quality	Water clarity data for the emabyments	water	monitoring
water quality	Biological indicators of ecological response to nutrient reductions	water	nutrients
water quality	Assess potential for areas of high density OWTS to contribute pollutants using soils and groundwater data	water	nutrients
water quality	Refine assessment of nutrient budgets to account for seasonality and scale and OWTS contribution	water	nutrients
habitat	Assess riparian buffer restoration opportunities	habitat	restoration
river/groundwater	Sustain Streamflow data collection	water	river/gw
river/groundwater	Groundwater quality and quantity, flow and pollutant transport including nutrients	water	river/gw

Appendix B
April 2023 Science Advisory Committee Meeting Spreadsheet and Voting

Categories		Science/Research Need	
SAC Topic Area (derived from 4/24 meeting)	**SAC Topic Area (derived from 4/24 meeting) (secondary)**	**Topic Area**	**<u>Goal</u>: Each line is a specific science/research need**
collect data	synthesize existing data	Sea Level	Need to understand when to move people/infrastructure vs. using engineers or nature-based solutions
collect data		Renewable Energy	Impact of windfarm cables on nearshore benthos and land
collect data		Renewable Energy	Impact of solar fields on uplands
collect data		Renewable Energy	Impact of renewable energy infrastructure on water quality
collect data	maintain/update monitoring	Stormwater/non-point source pollution	Explore better ways to reduce impervious cover in urban areas
collect data		Stormwater/non-point source pollution	Understand how to effectively quantify non-point source pollution
collect data	share information widely	Stormwater/non-point source pollution	Understand public's perception of stormwater/NPS and what they would like to see done
collect data	synthesize existing data	Water Availability	Update the water budget for the region to understand groundwater/surface water supply relationships
collect data	synthesize existing data	Water Availability	Understand how pollutants are transferred through groundwater
collect data		Water Availability	Identify the sources of groundwater to estuarine waters and assess water quality of those sources
collect data	synthesize existing data	Water Availability	how best do we do urban/housing development and have water where we need it when we need it
collect data	synthesize existing data	Phytoplankton and Seaweed	Understand seaweed as a source of primary production in the bay, as a habitat/food source, and if species are changing
collect data	maintain/update monitoring	Estuarine Ecosystems	need additional water quality data in embayments
collect data	improve FW & SW habitat	Shellfish Restoration	Understand how decreases in pH will impact shell creation, and what that will mean to restoration

Categories		Science/Research Need	
SAC Topic Area (derived from 4/24 meeting)	SAC Topic Area (derived from 4/24 meeting) (secondary)	Topic Area	Goal: Each line is a specific science/research need
collect data	improve FW & SW habitat	Shellfish Restoration	Understand impacts of shellfish restoration, including bioextraction
collect data	synthesize existing data	Seagrass	Explore why seagrasses have not rebounded yet clarity has returned in many areas
collect data	improve FW & SW habitat	Salt Marsh	Understand best places to facilitate marsh migration
collect data	improve FW & SW habitat	Salt Marsh	Understand how marsh migration works in our region, and what we can do to enhance migration potential
collect data	improve FW & SW habitat	Salt Marsh	Understand the consequences of restoration on nursery habitats, fish communities, etc.
collect data	share information widely	Salt Marsh	Understand what the public feels about these restorations, and if the restorations will increase public access to nature
collect data		Freshwater Connectivity	Need to understand how sediment and the contaminants in sediment are remobilized in dam removal or culvert removal/expansion
collect data	improve FW & SW habitat	Freshwater Connectivity	Understand how ecosystems transition from estuarine water to freshwater with dam or culvert removal to develop metrics for understanding what "done" looks like
collect data	synthesize existing data	Freshwater Connectivity	Connect watershed and bay hydrologic models to fully understand how water moves throughout the region in response to climate change, restoration, or changes in infrastructure
collect data	synthesize existing data	Freshwater Ecosystems	Need to understand the inputs and stream ecosystem responses of generalized stress from watershed distrubance from legacy and existing land use
collect data		Freshwater Ecosystems	Develop methods to link watershed condition to stream biointegrity
collect data	synthesize existing data	Green Infrastrcuture	Model CSOs and flood-prone areas to target best place for green infrastructure
collect data	synthesize existing data	Contaminants	Understand the levels of legacy contaminants in fish/shellfish in estuarine and freshwaters
collect data		Contaminants	Understand the levels of emerging contaminants in fish/shellfish in estuarine and freshwaters
collect data		Contaminants	Understand how contaminants will become more/less bioavailable under changing pH and temperature conditions

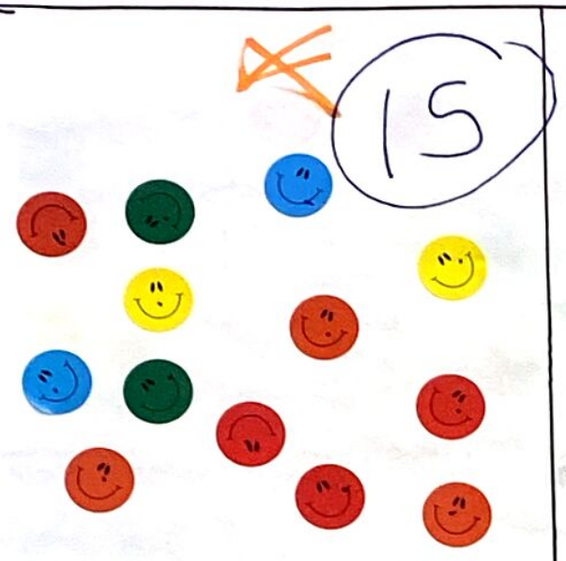
Categories		Science/Research Need	
SAC Topic Area (derived from 4/24 meeting)	**SAC Topic Area (derived from 4/24 meeting) (secondary)**	**Topic Area**	**Goal: Each line is a specific science/research need**
collect data		Contaminants	Understand how microplastics travels through the ecosystem
collect data		Contaminants	Understand the impacts of tire rubber fragments on waters near roadways
collect data	improve FW & SW habitat	Contaminants	Explore which organisms can "clean" the water of contaminants, but not be harvested for consumption
collect data		Mount Hope Bay & Sakonnet	Collect nutrient data in a manner that is comparable to ways data are collected currently
collect data	synthesize existing data	Nutrients	Update nutrient budget to include offshore component
collect data	synthesize existing data	Nutrients	Create a more accurate assessment of nonpoint source nutrient contributions
collect data	synthesize existing data	Rare Species/Wildlife	Understand where key rare species are located in the region
collect data		Rare Species/Wildlife	Unite, update existing information from Wildlife Action Plans to focus on critically important habitats
collect data		Access to Nature	Understand potential exposures to contamination from sediment, water, and air at urban beaches
collect data	share information widely	Access to Nature	Understand how people are using urban waters and pairing it with bio-physical data to understand the "health" of the water/air/sediment
collect data	share information widely	Access to Nature	Understand how people are accessing nature throughout the watershed, and what activities are they doing when in nature
collect data	share information widely	Stories	Develop ways to get more community buy-in for restorations
improve FW & SW habitat		Seagrass	Identify areas for restoration by updating models

Categories		Science/Research Need	
SAC Topic Area (derived from 4/24 meeting)	**SAC Topic Area (derived from 4/24 meeting) (secondary)**	**Topic Area**	**<u>Goal</u>: Each line is a specific science/research need**
improve FW & SW habitat	maintain/update monitoring	Seagrass	Understand consequences of restoration
improve FW & SW habitat		Permitting Challenges	Need to assess ways to permit shellfish restoration projects so they are not grouped with aquaculture site leases
improve FW & SW habitat		Permitting Challenges	Streamline and understand permitting challenges for restoration projects in MA
improve FW & SW habitat	share information widely	Collaborations/Synthesis	CreateLiving Observatories. An example is Succotash Marsh - what researchers want to do their research there while the restoration is going on? This includes social scientists to understand how neighbors think about the restoration, or what it takes for people to be supportive of these restorations.
analysis/modeling	synthesize existing data	Phytoplankton and Seaweed	Monitor harmful algal blooms (HABs), nuisance algal blooms
analysis/modeling	collect data	Seagrass	Monitor seagrass, and understand the conditions needed to expand seagrass acreage
analysis/modeling	collect data	Seagrass	Refine seagrass monitoring protocol
analysis/modeling		Salt Marsh	Monitor salt marsh habitat; extend monitoring in restored areas
analysis/modeling	improve FW & SW habitat	Salt Marsh	Continue to understand how large scale restoration (like thin-layer deposition) impacts the ecosystem as a whole, and what a maintenance schedule may look like, if needed
analysis/modeling	synthesize existing data	Freshwater Connectivity	Improve monitoring of fish passage (upstream and downstream) to better prioritize dam removals, culvert replacements, or fish passage projects
analysis/modeling	share information widely	Freshwater Connectivity	Understand the consequences of restoration and connectivity on the ecosystem and people
analysis/modeling	improve FW & SW habitat	Freshwater Ecosystems	Expand cyanobacteria monitoring and develop ways to reduce cyanobacteria blooms
analysis/modeling		Green Infrastrcuture	Continue to monitor success of green infrastructure projects throughout region
analysis/modeling		Green Infrastrcuture	Create decision-based support tool to choose best management practices for a specific site

Categories		Science/Research Need	
SAC Topic Area (derived from 4/24 meeting)	**SAC Topic Area (derived from 4/24 meeting) (secondary)**	**Topic Area**	**Goal: Each line is a specific science/research need**
analysis/modeling		Green Infrastrcuture	Understand how green infrastructure works in different urban environments
analysis/modeling		Access to Nature	Optimize and implement more rapid bacterial detection techniques to prevent unnecessary beach closures
analysis/modeling	share information widely	Collaborations/Synthesis	Need long-term monitoring to make sure projects and restorations are still working, and what the lifetime of the restorations are
N/A	N/A	Permitting Challenges	Need people who can provide technical assistance to independently verify restoration techniques are best for the site
share information widely	synthesize existing data	Collaborations/Synthesis	Create guidebook for restoration techniques using a gradient of degradation before restoration. At each level of degradation, useful techniques would be listedn, and then show if degradation improves after restoration and by how much. Can also show how long it took to determine success.
share information widely		Stories	Develop mechanisms to share peer-reviewed information to a more "public" realm
share information widely		Stories	Develop better mechanisms for communities to learn about advisories (unsafe beaches, fishing, cyanobacteria, etc.)
synthesize existing data	collect data	Precipitation	Understand the frequency, amount and seasonality and type of precipitation over time
synthesize existing data	collect data	Precipitation	Understand the impacts of increased precipitation (amount and intensity) on existing infrastructure and new development
synthesize existing data	collect data	Sea Level	analyze impacts of sea level rise on groundwater, drinking water supplies, floodplains, and OWTS
synthesize existing data	collect data	Sea Level	Understand sea level rise trends in region
synthesize existing data	collect data	Temperature	Analyze air and water temperature trends for region
synthesize existing data	collect data	Climate Change	Understand how human health will be impacted through the combined impacts of climate change, nutrient changes, and eco/environmental toxicology
synthesize existing data	collect data	Climate Change	understand changes to ecosystem from climate change - how primary production will change, changes to shellfish (coastal ocean acidification) or fish populations

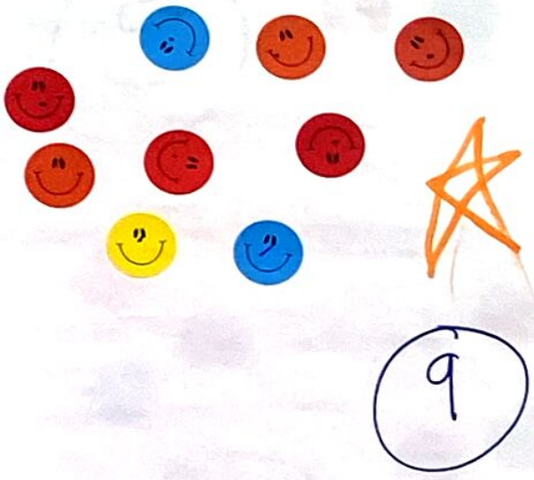
Categories		Science/Research Need	
SAC Topic Area (derived from 4/24 meeting)	**SAC Topic Area (derived from 4/24 meeting) (secondary)**	**Topic Area**	**Goal: Each line is a specific science/research need**
synthesize existing data	collect data	Stormwater/non-point source pollution	Understand how stormwater and hydrology impacts urban areas
synthesize existing data	maintain/update monitoring	Phytoplankton and Seaweed	Understand how winter-spring bloom impacts fisheries production and how that may be impacted by climate or other change in nutrient availability
synthesize existing data	maintain/update monitoring	Estuarine Ecosystems	analyze water clarity information as part of larger water quality monitoring and understanding
synthesize existing data		Contaminants	Identify "hot spots" for legacy and emerging contaminants in the watershed
synthesize existing data	collect data	Contaminants	Develop "action levels" for drinking water and surface water for PFAS and other emerging contaminants
synthesize existing data		Mount Hope Bay & Sakonnet	What data are missing?
synthesize existing data	collect data	Nutrients	Refine nutrient budget to account for seasonality in inputs
synthesize existing data	collect data	Nutrients	Understand the total amount of nutrients the bay can assimilate while keeping nutrient-driven hypoxia low, water clarity elevated, and supports primary and secondary production
synthesize existing data	share information widely	Collaborations/Synthesis	Pull data sources together to answer larger complex questions - how are coastal habitats doing after large scale restorations are in place (such as the fisheries work in the Providence River)
synthesize existing data	share information widely	Collaborations/Synthesis	Understand stressor-relationships to use a stressor-response approach to develop TMDLs or ecosystem-based management actions
Cells this color come from S&T Data gap, assessment need, research need			

CHAPTER 1: PEOPLE



TOPIC: Collaboration / Synthesis

- tackle cross-cutting issues such as climate change impacting primary and secondary production and/or impacting human health
- create living observatories to develop collaborations and more complete understanding of large-scale ~~pro~~ projects



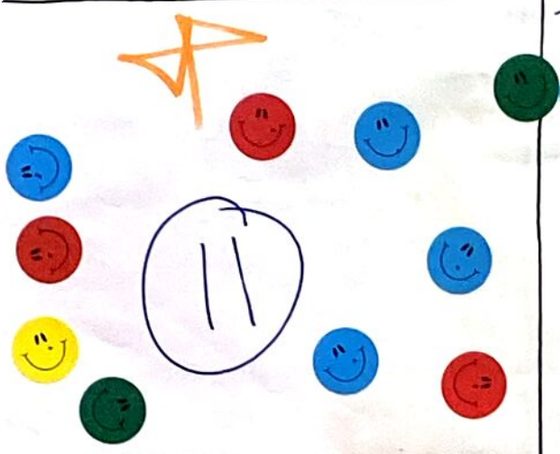
TOPIC: Information + Storytelling

- create guides for restoration techniques
- invest in long-term monitoring
- develop mechanisms for more complete community learning

TOPIC: Governance

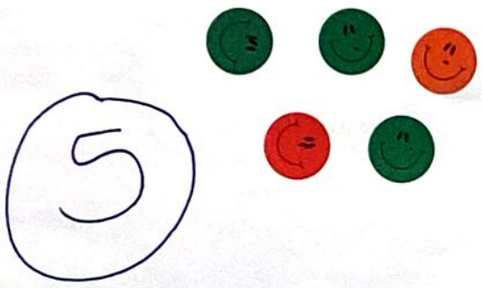
- Streamling permitting + guidance
- provide technical assistance to independently verify sound restoration techniques

CHAPTER 2: WATER



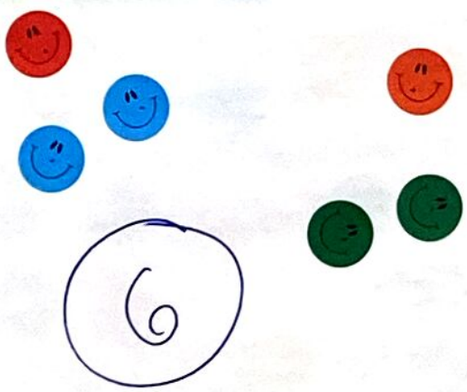
TOPIC: POINT + NONPOINT SOURCE POLLUTION

- quantify point and nonpoint source pollution
- better understand public's perception of stormwater
- understand best places to site green infrastructure projects
- update nutrient budget to include offshore and seasonality
- expand modeling to understand total amount of nutrients bay can assimilate



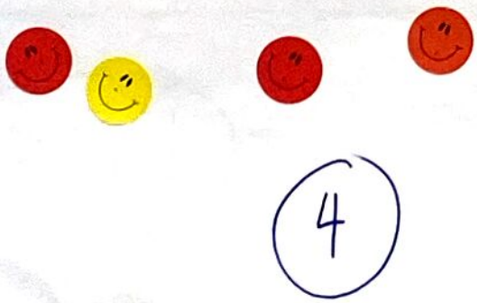
TOPIC: Trash and Contaminants

- develop 'action levels' for key contaminants
- identify 'hot spots' of contamination
- understand how climate impacts contaminant mobilization



TOPIC: Sea level rise and flooding

- understand how increased precipitation impacts existing infrastructure and new development
- understand / create guidance on when to move people / infrastructure versus other options



TOPIC: Water Supply

- update water budget to understand groundwater / surface water relationships
- understand how pollutants transferred through groundwater

CHAPTER 3: HABITAT AND WILDLIFE

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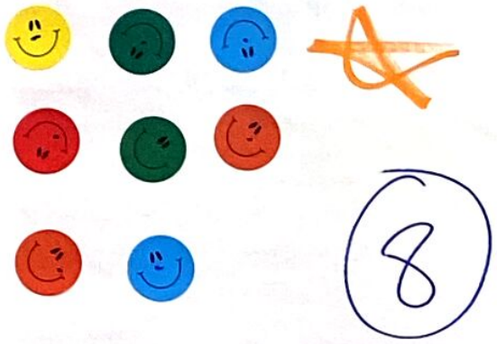
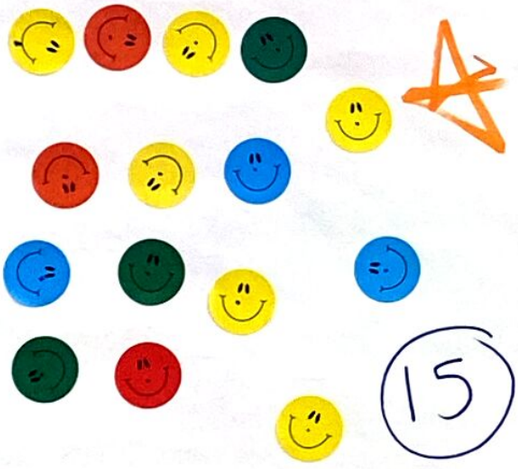
TOPIC: LAND USE

- understand impact of renewable energy on the landscape



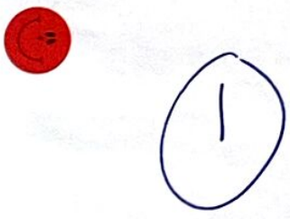
TOPIC: Freshwater Living resources

- improve monitoring to better prioritize fish passage and habitat connectivity projects
- understand transition from freshwater to estuarine systems with dam / culvert removal and passage projects
- connect watershed and bay hydrologic models
- expand cyanobacteria monitoring and research to reduce blooms



TOPIC: Estuarine living resources

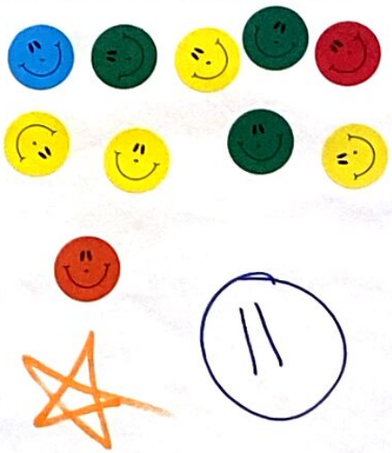
- understand how undersea cables impact benthos
- understand primary and secondary production changes to bay under climate change and nutrient changes
- monitor / understand harmful / nuisance algal blooms
- understand impacts of shellfish restoration
- monitor seagrass and understand conditions needed to expand acreage
- monitor salt marsh and understand marsh migration and enhance potential
- understand consequences of large-scale restoration on ecosystem



Topic: Wildlife

- Update existing information for wildlife action plans and other resources

CHAPTER 4: PUBLIC SPACES



TOPIC: Public Access

- understand how/where people access nature
- understand potential exposures to contamination
- optimize and implement more rapid bacterial detection techniques