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CAPE COD COMMISSION

Cape Cod 208 -Wide Water Quality Planning
Panel on Technologies

Thursday, October 10, 2013
Innovation Room, Cape Cod Commission
1pm

Meeting Agenda

1:00	Welcome and Introductions
1:05	Review of Technologies Matrix: missing technologies (rows)
1:20	Review of Technologies Matrix: missing content (columns)
1:50	Discussion of short list: Matrix Content
2:30	Break
2:45	Additional Discussion of Matrix
3:30	Review of Technology Advisory Committee's recommendations
3:45	Next meeting agenda
3:50	Public Comments
4:00	Adjourn

COUNTY OF BARNSTABLE MASSACHUSETTS

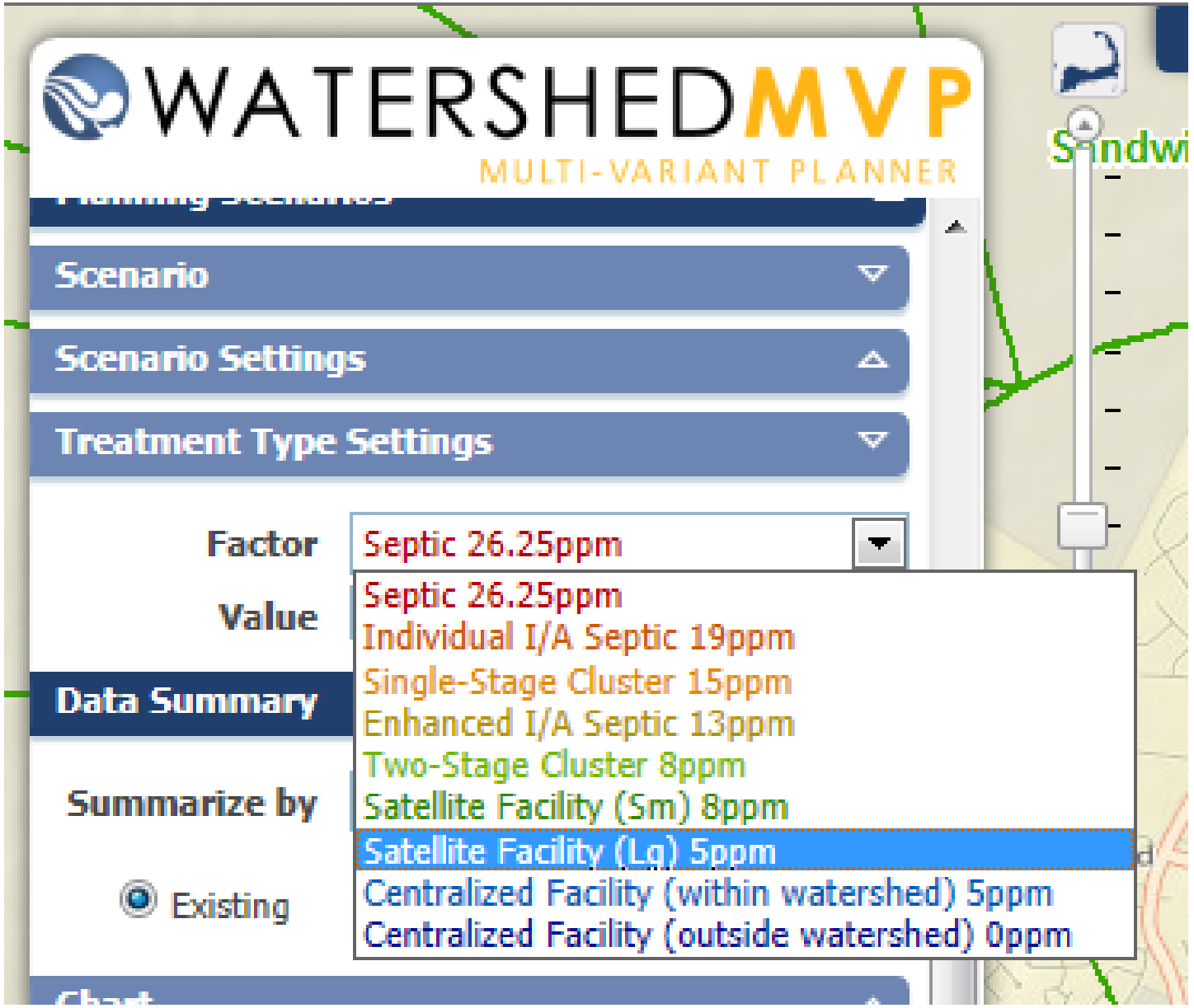
Preview of 10/28 Agenda

Select Watershed Analyses and Adaptive Management Discussion

208 Watershed Solution Conventional Approaches

Bookends to Targeted Solutions

Oct 10, 2013

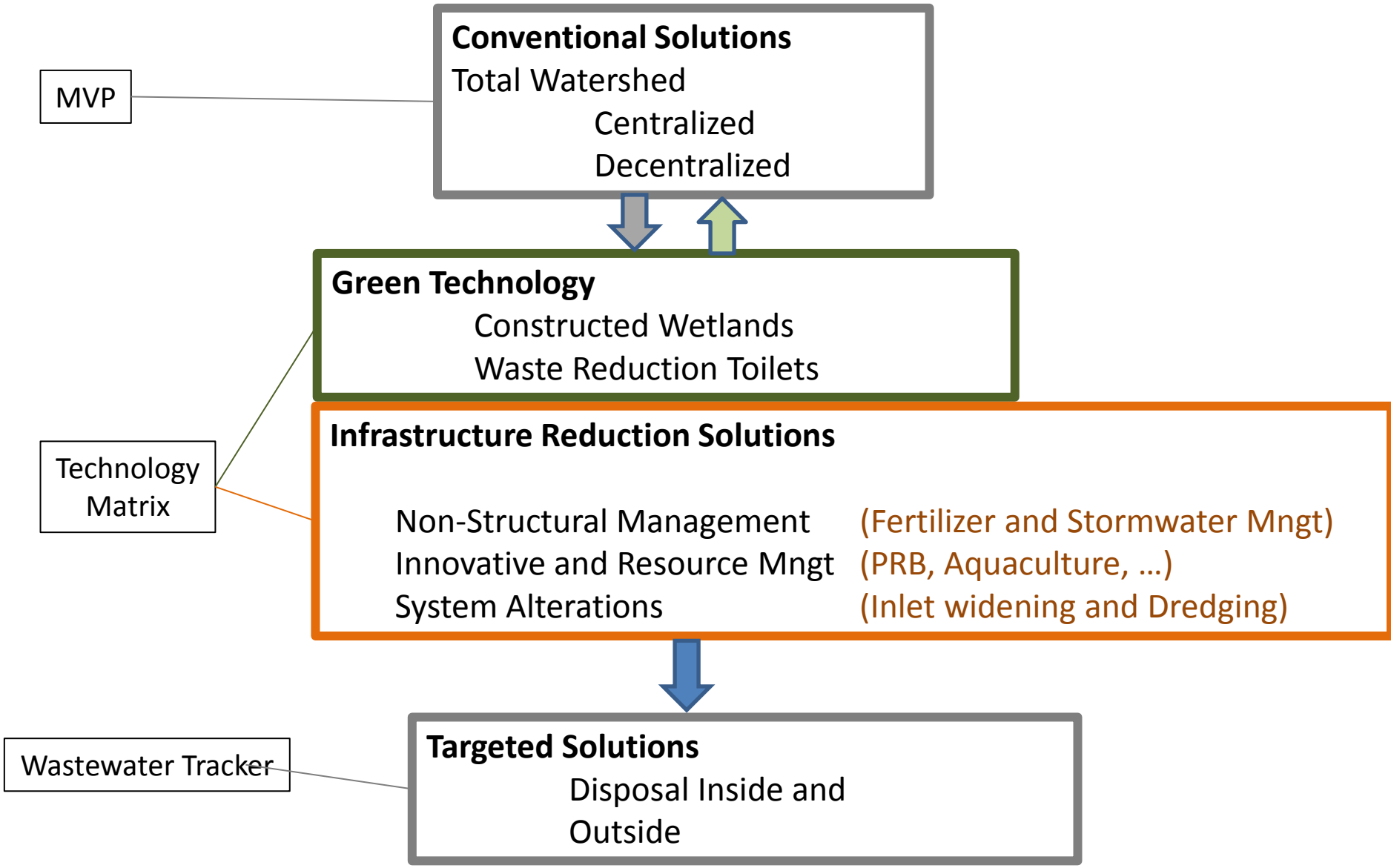

WATERSHEDMVP
MULTI-VARIANT PLANNER
Scenario
Scenario Settings
Treatment Type Settings
Factor
Septic 26.25ppm
Value
Septic 26.25ppm
Individual I/A Septic 19ppm
Single-Stage Cluster 15ppm
Enhanced I/A Septic 13ppm
Two-Stage Cluster 8ppm
Satellite Facility (Sm) 8ppm
Satellite Facility (Lg) 5ppm
Centralized Facility (within watershed) 5ppm
Centralized Facility (outside watershed) 0ppm
Data Summary
Summarize by
Existing

Technology Matrix

Group	Technology/Strategy
Green Infrastructure	Constructed Wetlands - Surface Flow
	Constructed Wetlands - Subsurface Flow
	Constructed Wetlands - Cluster Subsurface Flow (SSF)
	Eco-Machines & Living Machines
	Phytoirrigationand Phytobuffers
	Stormwater: Bioretention / Soil Media Filters
	Stormwater: Constructed Wetlands
Innovative and Resource-Management Technologies	Aquaculture/Shellfish
	Phytoremediation
	Permeable Reactive Barriers (PRBs)
	Fertigation Wells
Waste Reduction Toilets	Toilets: Composting
	Toilots: Packaging
	Toilets: Urine Diverting
Non-Structural Technologies	Fertilizer Management
	Stormwater BMPs
	Remediation of Existing Development
	Compact Development/OSRD
	Transfer of Development Rights
System Alterations	Inlet/Culvert Widening
	Surface Water Remediation Wetlands
	Pond and Estuary Dredging
Gray Infrastructure	Wastewater Treatment
	Title 5 Replacement (Base Line Condition)
	Innovative/Alternative (I/A) Systems
	Innovative/Alternative (I/A) Enhanced Systems
	Cluster Treatment System - Single-stage
	Cluster Treatment System - Two-stage
	Conventional Treatment
	Advanced Treatment
	Satellite Treatment
	Satellite Treatment - Enhanced

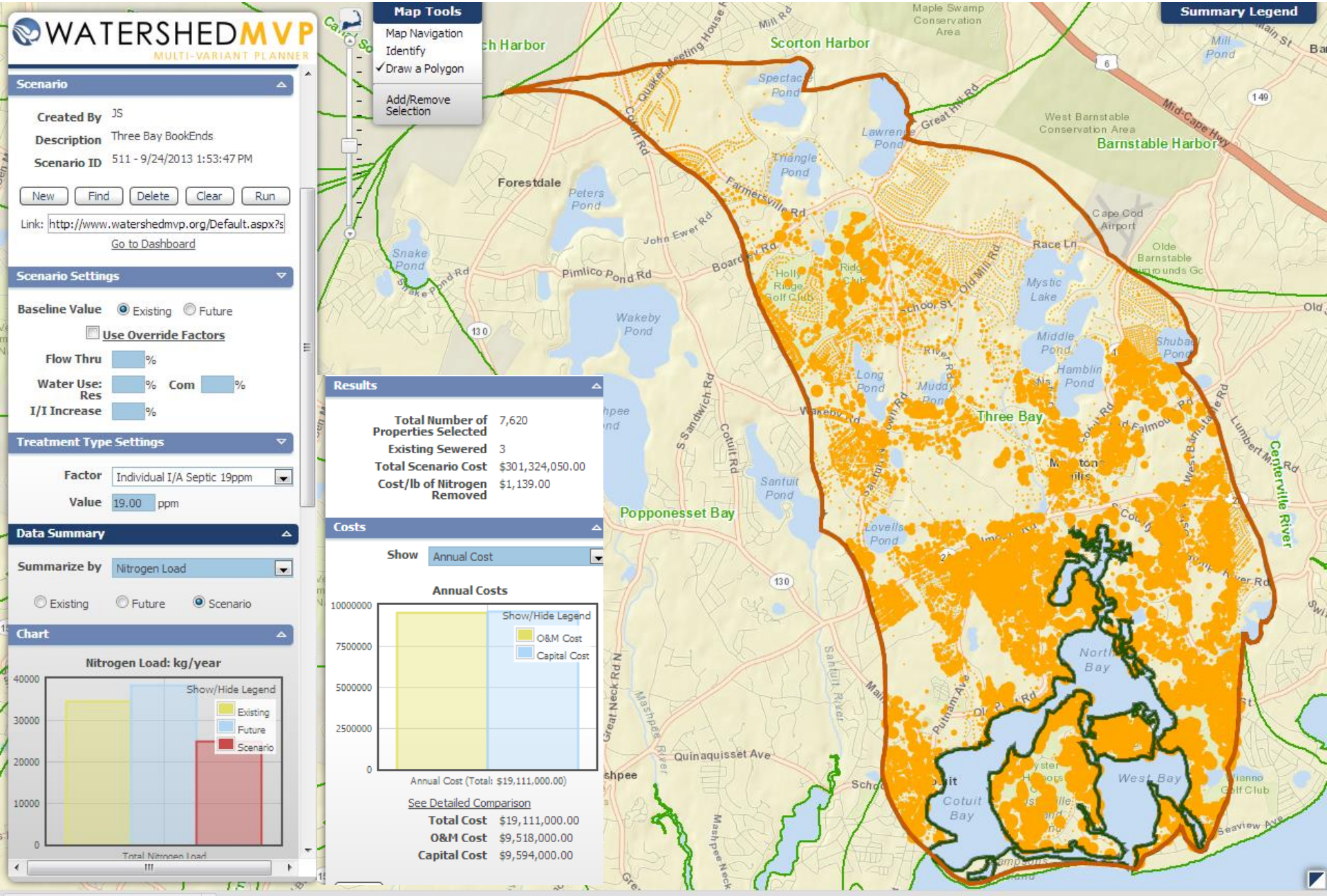
Group	Technology/Strategy
Gray Infrastructure	Collection Systems
	STEG - Collection
	STEP - Collection
	Effluent Disposal - Infiltration Basins
	Effluent Disposal - Soil Absorption System (SAS)
	Effluent Disposal - Injection Well
	Effluent Disposal - Wick Well
	Effluent Disposal - Ocean Outfall
	Effluent Transport out of Watershed to Recharge, Reuse Facility or Ocean Outfall
Onsite-Decentralized and Cluster Systems	Next Generation On-site System Technologies (currently under development)
	BUSSE Green Technologies, Inc. - Small Scale MBR (currently under development)
	On-Site Grey Water Treatment
Other	Digester and Combined Heat Power Unit
	Switch from Fuels that Deliver Nitrogen to Watersheds

Watershed Management Solution Approach

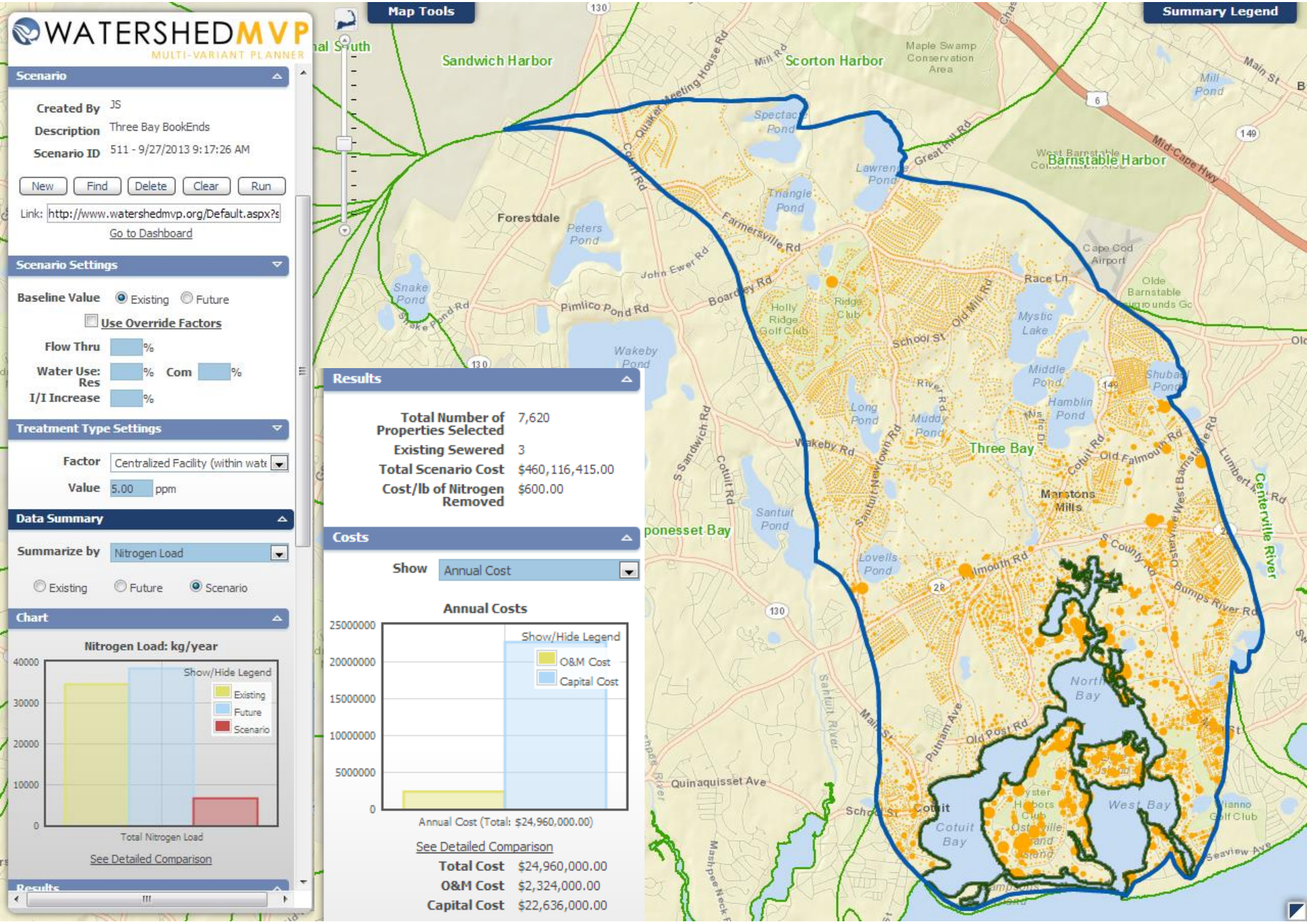


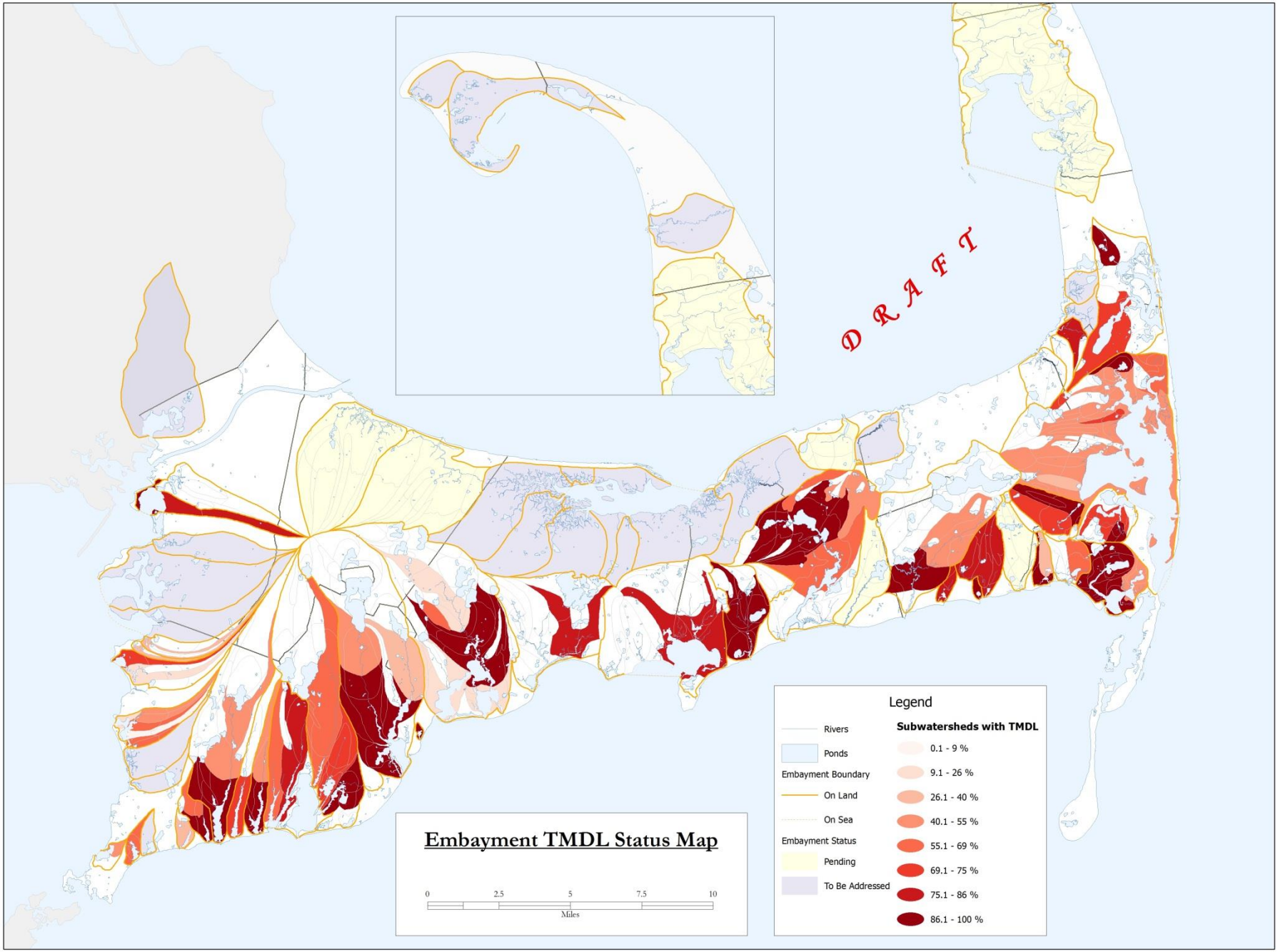
"Panel on Technologies - October 10, 2013"

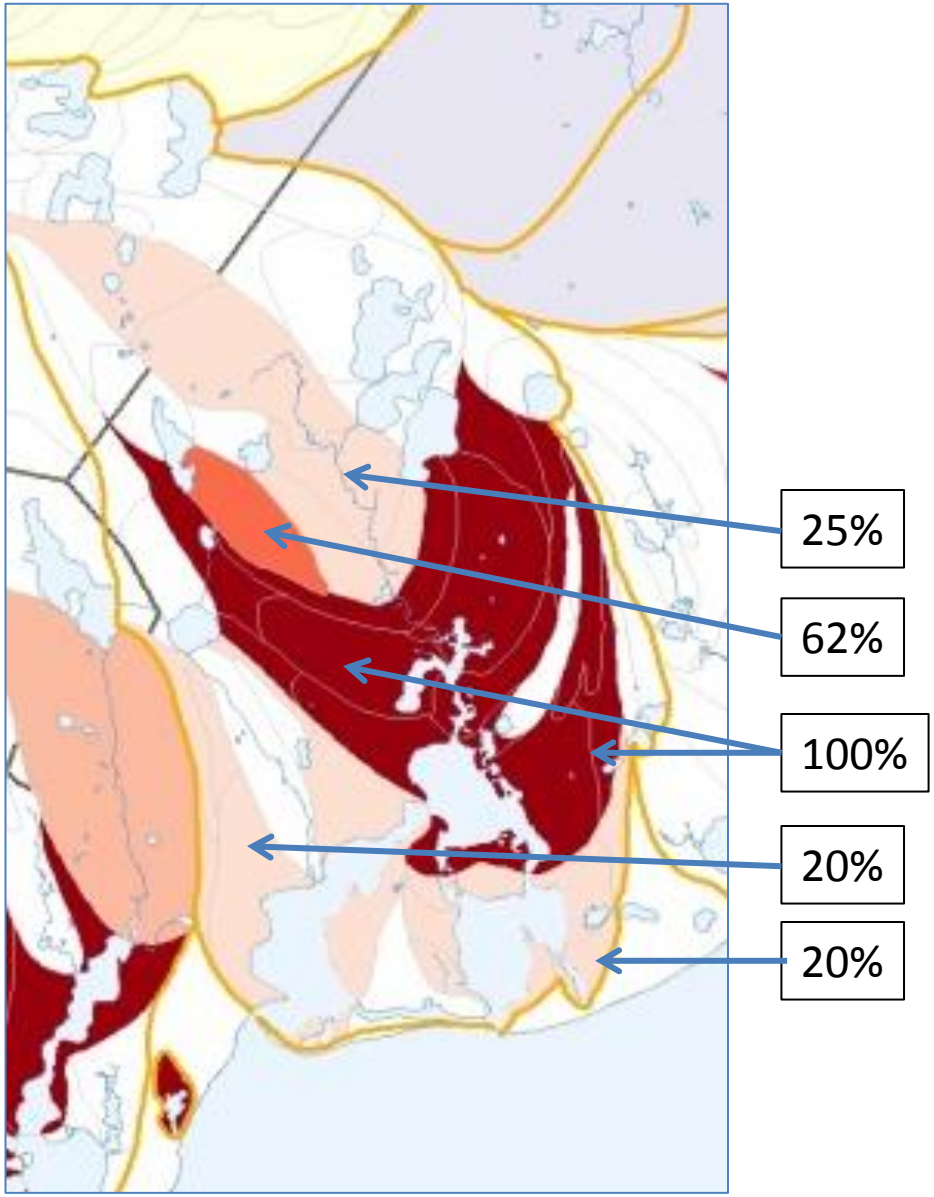
An Entire Watershed



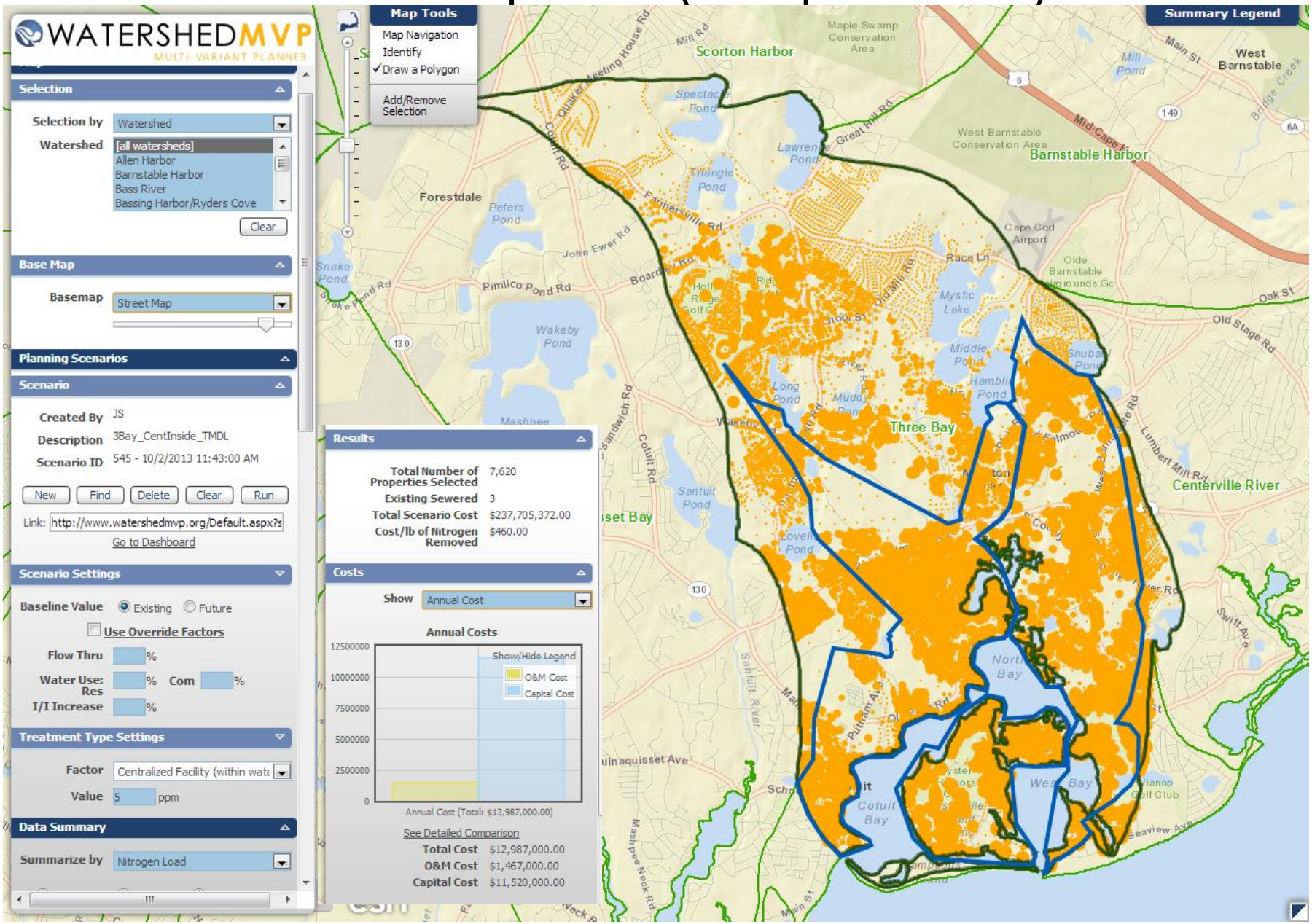
Centralized Treatment Inside Watershed



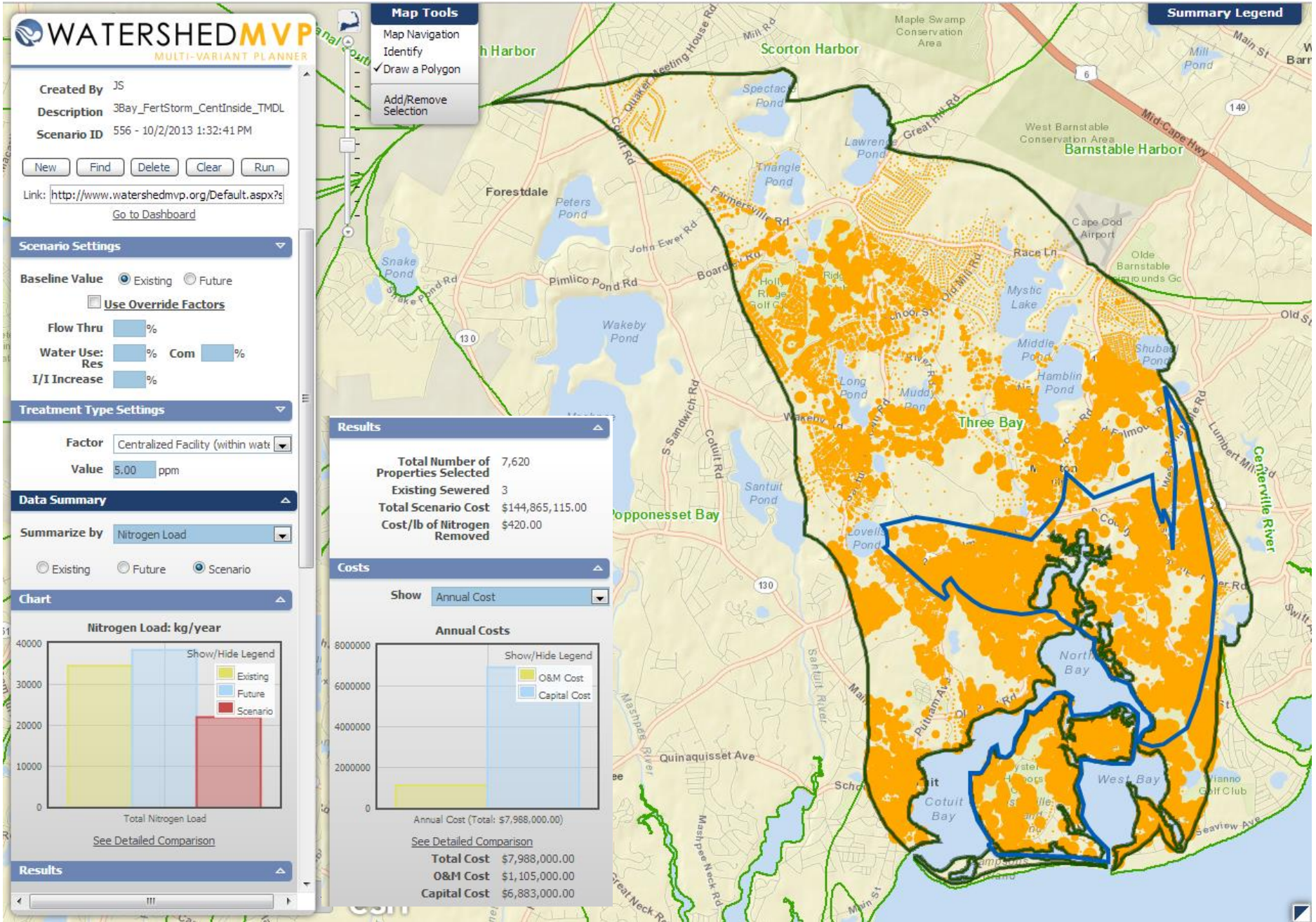

DRAFT
Embayment TMDL Status Map
0
2.5
5
7.5
10
Miles
Legend
Rivers
Ponds
Embayment Boundary
On Land
On Sea
Embayment Status
Pending
To Be Addressed
Subwatersheds with TMDL
0.1 - 9 %
9.1 - 26 %
26.1 - 40 %
40.1 - 55 %
55.1 - 69 %
69.1 - 75 %
75.1 - 86 %
86.1 - 100 %


25%
62%
100%
20%
20%

Three Bay Scenario #1 – Centralized Inside Watershed for TMDL Compliance (3 Disposal Sites)



Three Bay Scenario #1 – Fertilizer & Stormwater Reduction with Centralized Inside Watershed for TMDL Compliance (3 Disposal Sites)



Three Bay Scenario Comparison

Three Bay Scenarios Achieving TMDL Compliance	Annual Cost Total (Capital and O&M)	Sewered Wastewater Flow (g/day)	Percent above TMDL Compliance	Remaining Excess (kg-N/yr)
Centralized Inside Treatment (5 ppm)	$12,987,000	667,380	2%	473
50% Reduction in Fertilizer and Stormwater Contribution with Centralized Inside Treatment (5 ppm)	$7,988,000	440,019	3%	601

Wastewater | Existing Water Bodies | Regulatory

Alternatives: Screening Method

1 2 3 4 5 6 7

Targets/ Goals

Present Load: X kg/day — **Target**: Y kg/day = **Reduction Required**: N kg/day

Composite Target Areas

A. High Nitrogen Reduction Areas
B. Pond Recharge Areas
C. Title 5 Problem Areas

Low Barrier to Implementation

A. Fertilizer Management
B. Stormwater Mitigation

Watershed/Embayment Options

A. Permeable Reactive Barriers
B. Inlet/Culvert Openings
C. Constructed Wetlands
D. Dredging

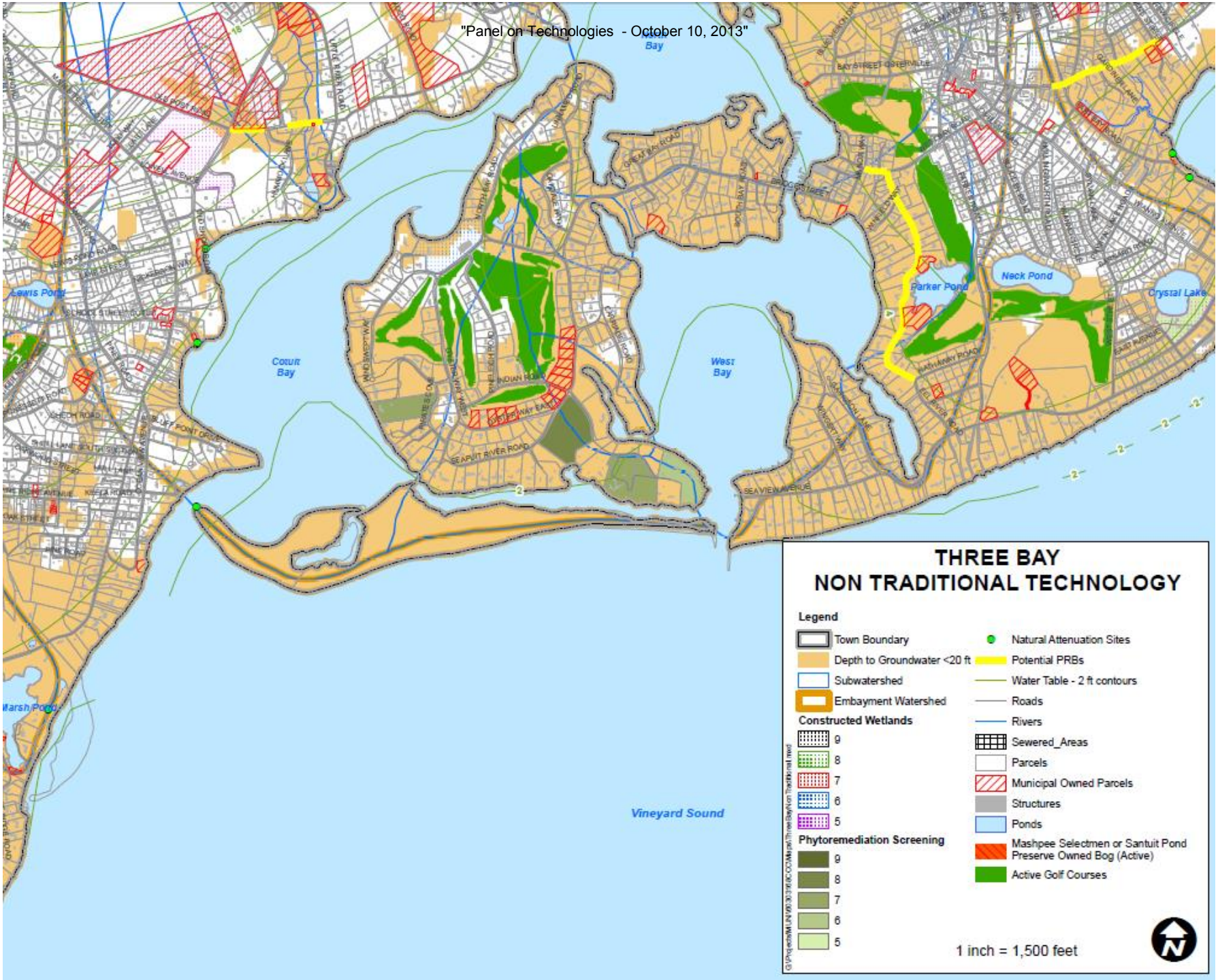
Alternative On-Site Options

A. Eco-toilets (UD & Compost)
B. I/A Technologies
C. Enhanced I/A Technologies
D. Shared Systems

Priority Collection/High-Density Areas

A. Greater Than 1 Dwelling Unit/acre
B. Village Centers
C. Economic Centers
D. Growth Incentive Zones

Supplemental Sewering


Bay
Lewis Pond
Cotuit Bay
West Bay
Parker Pond
Neck Pond
Crystal Lake
Marsh Pond
Vineyard Sound
SEAPUIT RIVER ROAD
SEA VIEW AVENUE
THREE BAY
NON TRADITIONAL TECHNOLOGY
Legend
Town Boundary
Depth to Groundwater <20 ft
Subwatershed
Embayment Watershed
Constructed Wetlands
9
8
7
6
5
Phytoremediation Screening
9
8
7
6
5
Natural Attenuation Sites
Potential PRBs
Water Table - 2 ft contours
Roads
Rivers
Sewered_Areas
Parcels
Municipal Owned Parcels
Structures
Ponds
Mashpee Selectmen or Santuit Pond Preserve Owned Bog (Active)
Active Golf Courses
1 inch = 1,500 feet

Preview of 11/6 Agenda

3VS Model Preview and
GI Screening Criteria

Systems Thinking is a Sustainability Assessment Tool

Systems Models Support Decision Making by Bridging Science, Policy, and Human Values

What do we know today, and what are the unknowns?

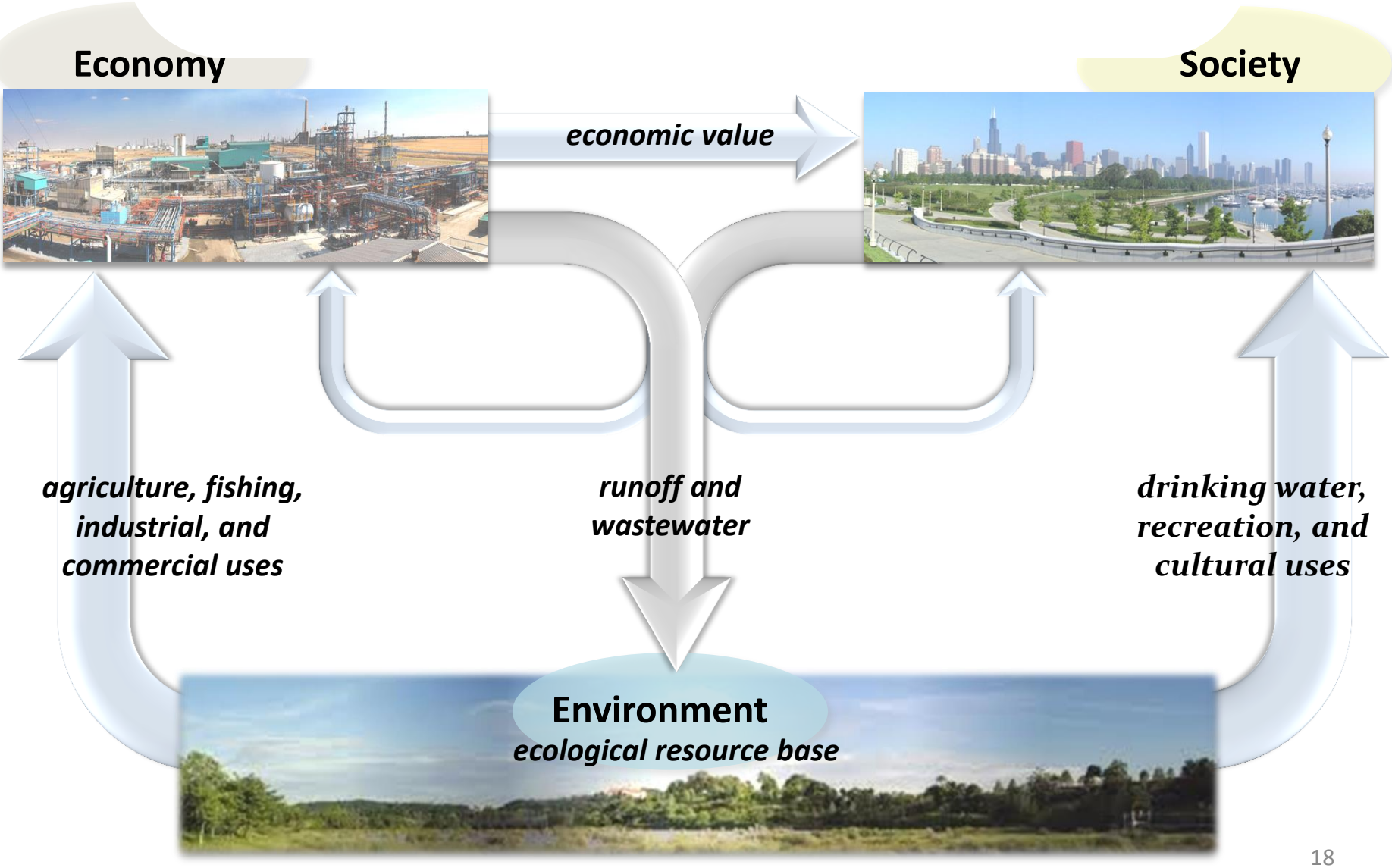
What are our goals and options?

What do we care about most?

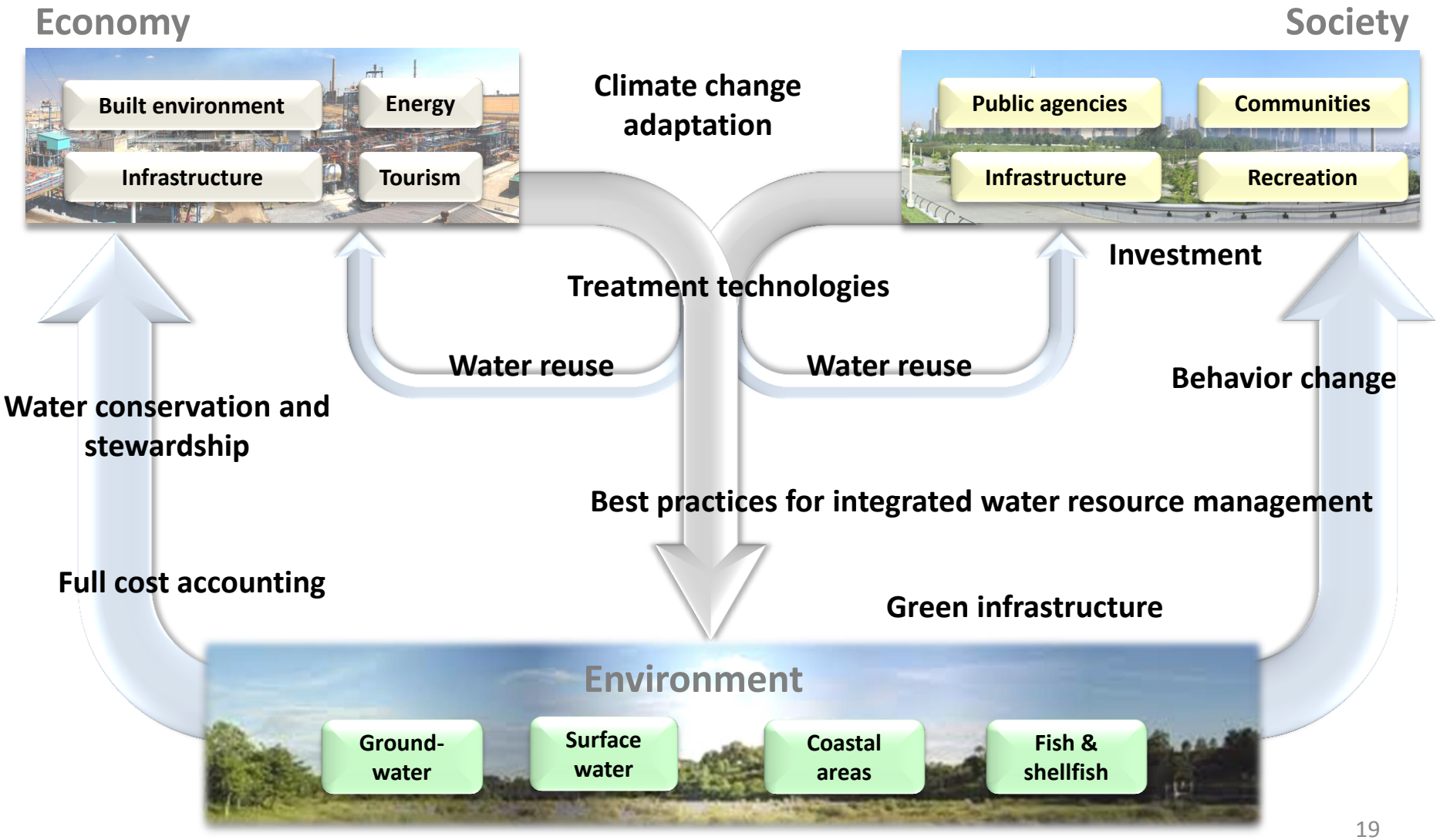
Systems Model

How should we proceed given the uncertainties and ambiguities?

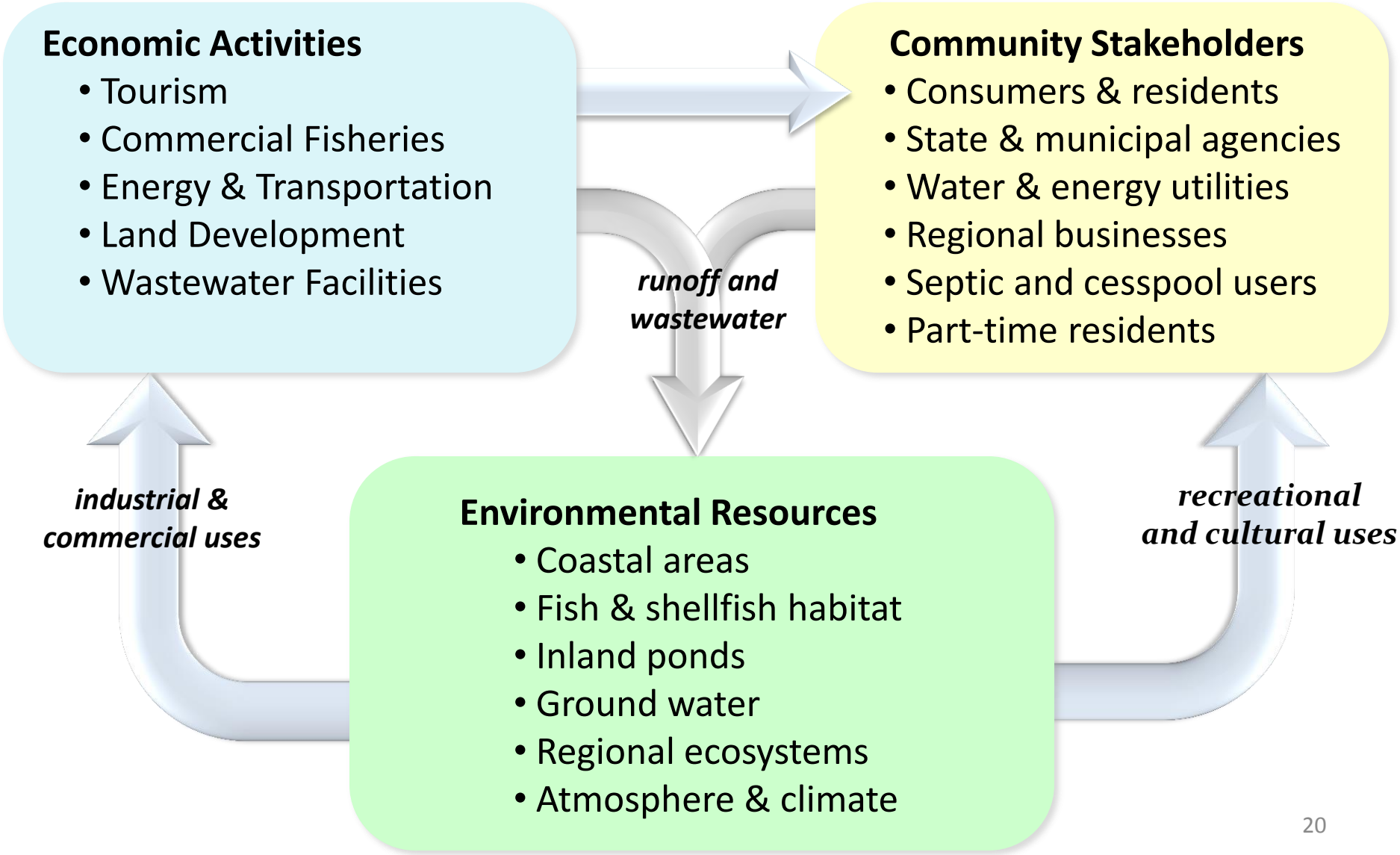
"Triple Value" Framework



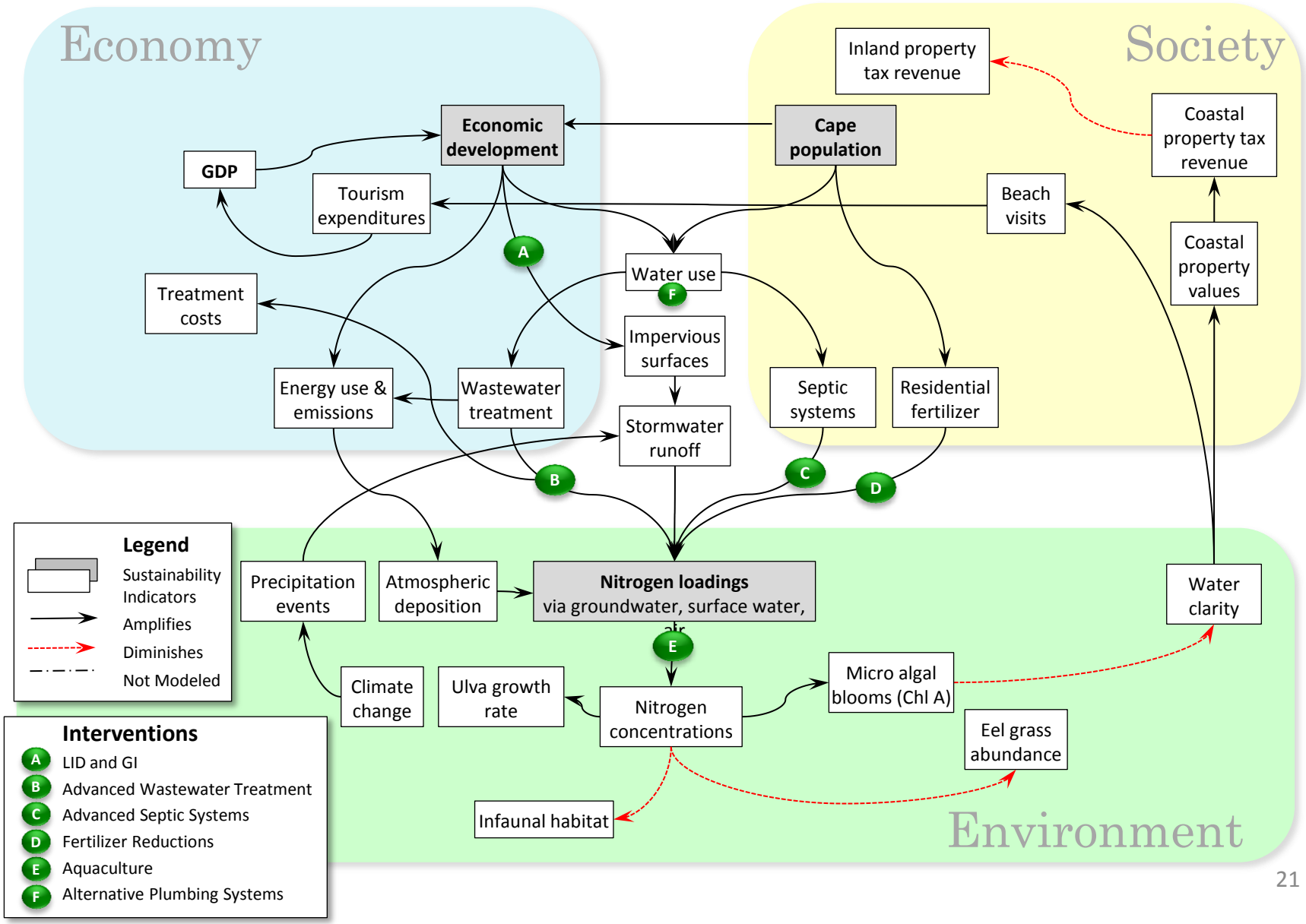
Potential Interventions to Improve Sustainability of Water Resources



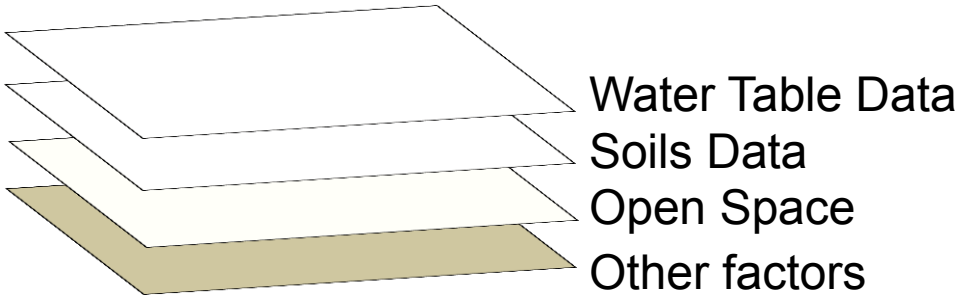
Modeling the Cape Cod System with a Triple Value Simulation (3VS) Model



Cape Cod 3VS Schematic: Initial Model



Developing a Green Infrastructure Site Selection Methodology



Goal: Develop a siting criteria matrix to use in GIS analysis

Task: Identify siting criteria for individual green technologies and apply these to GIS analysis

Treatment Options Evaluated

- Constructed wetlands
- Phyto-technology
- Permeable Reactive Barriers (PRBs)

GI Siting Criteria

GI Technologies Siting Criteria

Notes

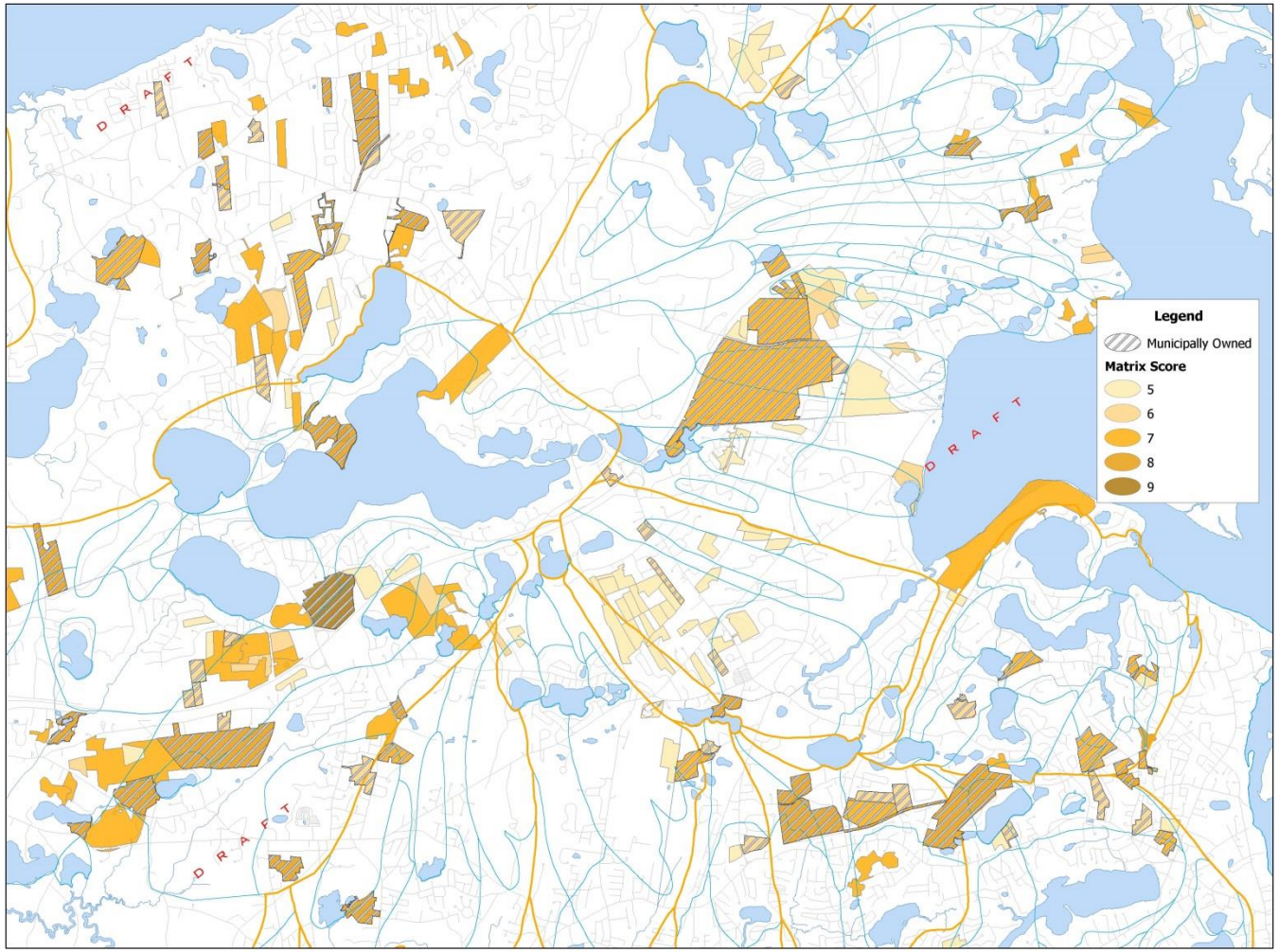
x = all parcels which contain these positive siting criteria (desirable for project siting)

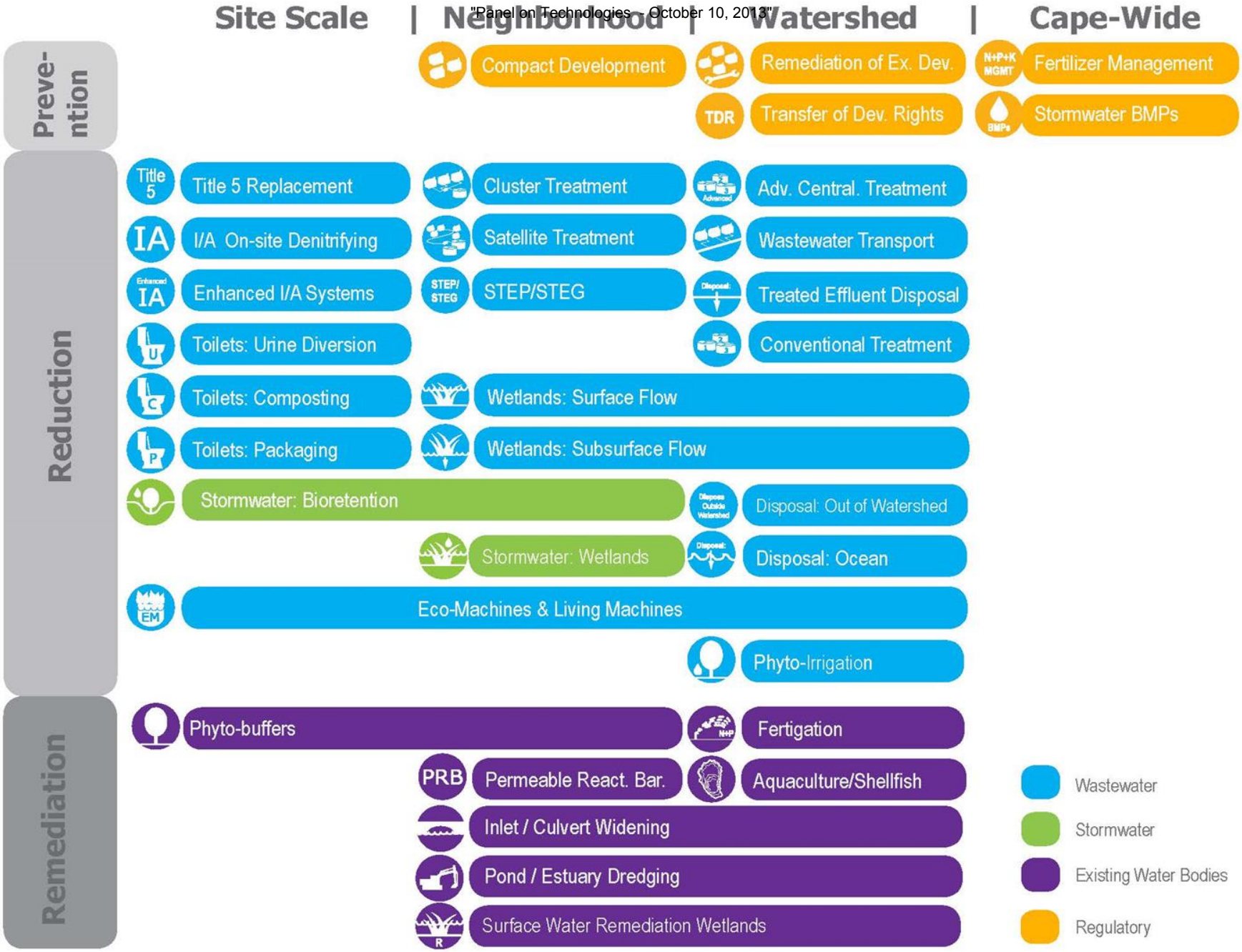
Mandatory siting criteria

Bonus siting criteria

Siting Criteria	GI - Wastewater: Constructed Wetlands	Permeable Reactive Barriers	Phyto technology
outside 100 year floodplain	x		
100 - 50 ft buffer to wetland	x	x	x
Zone II's - wellhead protection areas		x	
Soils: disturbed	x	x	x
Soils: well drained			x
Soils: poorly drained, clay (per soil survey)	x		
not protected open space	x	x	x
outside priority habitat	x	x	x
depth to groundwater > 4'	x		
depth to groundwater <10'		x	x
parcels >5 acres	x		x
municipally owned, not protected open space	x	x	x

Potential Constructed Wetlands




Site Scale
Neighborhood
Watershed
Cape-Wide
Preve-ntion
Reduction
Remediation
Compact Development
Remediation of Ex. Dev.
Fertilizer Management
TDR
Transfer of Dev. Rights
Stormwater BMPs
Title 5 Replacement
Cluster Treatment
Adv. Central. Treatment
I/A On-site Denitrifying
Satellite Treatment
Wastewater Transport
Enhanced I/A Systems
STEP/STEG
Treated Effluent Disposal
Toilets: Urine Diversion
Conventional Treatment
Toilets: Composting
Wetlands: Surface Flow
Toilets: Packaging
Wetlands: Subsurface Flow
Stormwater: Bioretention
Disposal: Out of Watershed
Stormwater: Wetlands
Disposal: Ocean
Eco-Machines & Living Machines
Phyto-Irrigation
Phyto-buffers
Fertigation
PRB
Permeable React. Bar.
Aquaculture/Shellfish
Inlet / Culvert Widening
Pond / Estuary Dredging
Surface Water Remediation Wetlands
Wastewater
Stormwater
Existing Water Bodies
Regulatory

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CAPE COD COMMISSION

Cape Cod 208 Water Quality Planning Panel on Technologies

Minutes – October 10, 2013

The meeting of the Cape Cod 208 Water Quality Planning Panel on Technologies convened on Thursday, October 10, 2013 at 1:00 p.m. in the Strategic Information Office/Innovation Room, Barnstable, MA.

Panelists Present:	Ivan Valiela, Marine Biological Laboratory (MBL) Chris Neill, Marine Biological Laboratory (MBL) Eric Davidson, Woods Hole Research Center Anamarija Frankic, UMASS Boston
Remote participation via Conference Call:	Sarah Slaughter, Built Environment Coalition
CCC Staff :	Paul Niedzwiecki, Executive Director Heather McElroy, Natural Resources Specialist Scott Michaud, Hydrologist Patty Daley, Deputy Director Tom Cambareri, Water Resources Program Manager Erin Perry, Special Projects Coordinator
CCC Consultants:	Scott Horsley, Horsley Witten Group Tom Parece, AECOM Mark Owen, AECOM Betsy Schreve-Gibb, AECOM Kate Kennen, Offshoots, Inc. (phone)

Welcome and Introductions

Paul Niedzwiecki welcomed everyone to the meeting. He explained that the Commission had just completed the first round of stakeholder meetings in 11 watershed working groups. The goal of these meetings was to establish a baseline of information in every watershed. This is one in a series of 3 stakeholder meetings in each of the 11 watershed working groups taking place between September and December. About 170 people are engaged in the process Cape-Wide.

The next round of meetings begins in two weeks and will be used to discuss potential technologies and approaches. The third round of meetings will be used to apply the facts we

know about each watershed and the technologies and approaches we think are viable to generate a series of potential scenarios for water quality remediation.

Through the stakeholder process to date we have received a lot of great feedback, we have recorded a lot of information, we now have chronologies of local wastewater information from each community dating back to the 1970s, and we have a list of necessary data sets and action items in each community.

Today's work is important as we try to get a handle on this matrix. We need to focus on whether we have left any viable technologies off, whether there are points of view or filters we should be applying to the columns in the matrix, and whether there is additional information to collect for all of the technologies and approaches. We have developed a short list of technologies and approaches where we have questions to discuss with the panel today.

The matrix has been reviewed by DEP, EPA, and the Technical Advisory Committee, which includes a seat for each town to appoint a representative. Your input on this matrix is appreciated.

The Technical Advisory Committee of the Cape Cod Water Protection Collaborative has grouped technologies by those that are permittable and those that are not permittable. Today, your thoughts on other ways we might group technologies or any other useful ways to think about the technologies and explain to stakeholders the various groups of technologies will be helpful. We think it might be useful to start classifying them by % reduction required in the watersheds - what technologies or approaches are most useful in each watershed?

Next meeting we will discuss the watershed approach by previewing the approach in a couple of watersheds. We would like your feedback on that process.

The stakeholder process is moving forward uniformly across Cape Cod. Some concerns have come up, most unique to a particular community and not part of the agenda for the stakeholder meetings. We have engaged with the Consensus Building Institute to help us take some of these discussions offline. We have begun some of these discussions in the Pleasant Bay area watersheds to discuss some issues there and will continue to meet to clarify differences and hopefully come to an agreement.

Most of the issues that have come up tend to be about data and science used by the State and Federal government to develop total maximum daily loads (TMDLs). The 208 Plan Update must use the established targets. If there are specific data sets that are of concern, we want to know. If there is a way to accommodate concerns through the planning process we are open to discussing this.

We have a very tight agenda for this panel and we are going to stick to that tight agenda, but you are all welcome to participate in these offline conversations if you would like to.

Review of Technologies Matrix: missing technologies (rows)

Heather McElroy started the conversation about technologies included in the matrix by asking the panel if they think we are missing anything.

Chris Neill said he likes the way the matrix is organized and he thinks the groupings are good. One thing he thinks could be added is the idea that if we restore or naturalize existing wetlands or rivers by increasing woody debris, we can increase places where denitrification occurs in a system. This could be an add on for additional removal and provide other benefits, such as restoration of fish habitat. There is research out of Chesapeake Bay that demonstrates enhanced nitrogen removal due to the modification of an existing system.

Ivan Valiela said that the conservation of green forest land may yield good results. Changing regulations and zoning to manage, preserve, or enhance forest cover may yield better results than some technologies that are in the matrix.

Paul Niedzwiecki said he would agree. We want to be able to classify technologies or approaches based on where they have an impact - reduction, remediation, prevention. If we do preserve or enhance forest cover, how will that change the target we need to meet?

Ivan Valiela said he thinks classifying as post facto vs. prevention would be helpful - which has the biggest impact?

Scott Horsley brought up the golf course industry and pointed out that taking back some of the managed rough and revegetating that could add up on an incremental basis.

Ivan Valiela said these approaches could fall in to phytoremediation category. The idea is to use natural areas, keep them intact, and/or enhance them.

Heather McElroy asked if approaches like compact development or transfers of development rights fit in with this.

Scott Horsley said many of the watersheds are over capacity, so preserving land won't solve the problem. In some cases we can preserve land and in others we will need to revegetate.

Paul Niedzwiecki asked if is there a higher value to having larger tract of forest or many smaller tracts of forest?

Ivan Valiela and Chris Neill agreed that it is largely proportional to area. Chris said that if you are talking about absorbing atmospheric nitrogen, every acre is absorbing about the same. For other benefits, such as recreation, it might be better to have larger tracts. Ivan said we need to keep in mind that interception of nitrogen is faster at the early stages of revegetation. Older forests hit a plateau.

Eric Davidson said another area of prevention would be in air pollution regulations. We have a voice in the federal discussion. A big piece of the nitrogen is coming from the atmosphere. A lot of this is from near source traffic and we have some control over these issues. Transportation work could benefit communities by reducing nitrogen impacts from this source.

Paul Niedzwiecki said the Commission could address transportation and traffic.

Eric Davidson also pointed out that emissions from a car when it's cold and when it's hot are very different. There are engineering approaches that one could take to address this.

Anamarija Frankic said she worked in the Chesapeake Bay for 10-15 years to address how the ecosystem used to look like. Here we are trying to cluster technologies (saltmarshes, shellfish beds, aquaculture, etc) when we need a whole system approach. We have an opportunity to put this together here. You start with in situ process in the location where the human impact is.. If we just do aquaculture, that's not going to get the job done. You are removing your sink during harvest in just a few years. In Massachusetts you can shellfish anywhere that is not closed and collect any shellfish species. In Wellfleet we proposed no-take zones so that shellfish can remain on site, capture, and hold nutrients.

We are adding more nutrients today than in the past and there are no sinks to deal with it. In the Chesapeake region we competed between shellfish, saltmarsh restoration, eelgrass restoration, all based on resources and priorities.

If we establish a priority – nutrient reduction – we need to take a whole systems approach to improve habitat, erosion, biodiversity, etc to meet our goals.

Paul Niedzwiecki pointed out that Wellfleet suggested we separate the aquaculture, saltmarsh, habitat restoration approaches.

Paul said we need to keep track of where the resources are going to come from to fund these efforts. There is a Southeast New England Watershed Restoration Council which is trying to expand the definition of restoration to include nutrients. This group may have some money to fund watershed or subwatershed level projects. The State has the Environmental Bond Bill with an earmark for some of these watershed projects.

Anamarija Frankic said that she has found that getting funding is difficult when the area you are working in is too small. But restoring shellfish and saltmarsh in one small space that will make a big impact.

Heather McElroy said this doesn't fit in to this matrix in particular, but how do we reflect this in the plan.

Scott Horsley suggests we might add a category for restoration.

Sarah Slaughter says that there seems to be two parallel conversations going on - one is about the restoration of natural systems and one is about process. The matrix includes elements that could be used in the process. When you think about the process, what kinds of solutions and approaches are most promising during which stage of the process?

A member of the public proposed an additional technology be added that is part of the ecotoilet solution - processing that takes place in a composting facility.

Tom Parece replied that a section is being added to the matrix on biosolids. We are currently filling this piece out and it includes digestors, pelletizing, compost, food waste, etc. Much of the information is being taken from EPA fact sheets in order to populate matrix.

Mark Owen suggested the addition of one additional technology - enhanced embayment flushing. There are a couple of disadvantages to inlet widening - it can be difficult with flooding and other storm event issues. Enhanced embayment flushing involves piping that goes in to the ocean and during high tide water flows in to the lower portion of the water body, during low tide, water from higher portion flows out. This type of system can be set off during storms to prevent flooding. This is place specific and may not work without large tides.

Anamarija Frankic said she would like to see some of the metadata from the matrix as there are some things she doesn't understand.

Heather McElroy said this is a good segue in to our next agenda item - to look at the columns.

Review of Technologies Matrix: missing content (columns)

Anamarija Frankic said that ecosystem services, the value of the natural features, all needs to be included in the matrix.

Eric Davidson said that it seems that we are currently using the advantages and disadvantages columns to address cost issues. He said there is a value to that and he thinks it should be left that way. He also suggests having another column where you capture the broader scale, bigger picture co-benefits, such as how it fits in to green space conservation, recreation, etc. This should be kept somewhat separate from the advantages and disadvantages of cost.

Chris Neill suggests striving for some simplicity and not adding a lot of additional ecosystem services columns. It is already very complex.

Heather McElroy said we will add one more column to address the ecosystem services/co-benefits.

Chris Neill said yes, for things that are less site based or cost based.

Ron Zweig, from the public, said that once a month you have a full exchange of loading in Little Pond in Falmouth. When you think of seasonal aspects of the problem, it arises in the summer. Shellfish are ready to work during that time, when the problem is at its greatest.

Laura Kelley, from the public, suggested that we need to set up a solution that is more sustainable, not a man-made system. A combination of the two will make a difference for future generations.

Hilde Maingay, from the public, said that instead of nitrogen removal we need nitrogen recovery, which is a totally different point of view that you want to start from. This should be a cobenefit. The benefits should not be if a system can make energy on the side, but if it can reduce energy or avoid energy use to begin with.

Chris Neill agreed with Hilde's comment and suggests highlighting the potential for nutrient recovery for each technology. Does the technology have a change for energy recover? Does the technology use a lot of energy or use little energy?

Ivan Valiela suggests adding a benefits column.

Heather McElroy asked if any columns should be eliminated and no one expressed an opinion that any should be eliminated.

Kate Kennen said she supports an ecosystem services column. When we look at applying these technologies on a system wide scale these can help us think about other components of the system like flood control and habitat enhancement. What are the other criteria that you would be looking at for larger overall benefit?

Sarah Slaughter said that ecosystem services include buffers for extreme storm surge and groundwater discharge during drought.

Jeff Eagles, from the public, said that when you talk about ecosystem services that's management in the estuary (in-situ) and other approaches are controls.

Heather McElroy asked Jeff if he was advocating for one thing or another.

Jeff said he thinks items that are nitrogen management in the water system need to be identified.

Scott Horsley pointed out that the matrix is currently classified by the point at which it impacts the nutrients– reduction, remediation, and prevention.

Heather McElroy said that while we are happy to take public comment, we need to be able to allow panel to discuss matrix, and we're going to hold the remaining public comments and we will come back to it.

Heather reviewed that we would add a new column to the matrix that addresses ecosystem services, and we will categorize technologies as remediation, reduction, and recovery.

Discussion of short list: Matrix Content

Heather McElroy said that we have a short list of technologies that we'd like to spend some time on. These are the technologies that we have questions on or are less comfortable with. The short list includes:

1. Phytoirrigation and Phytobuffers
2. Phytoremediation
3. Aquaculture/Shellfish
4. Constructed Wetlands: Surface Flow
5. Permeable Reactive Barriers
6. Fertigation Wells
7. Stormwater: Bioretention/Soil Media Filters

Heather started with aquaculture/shellfish and said that the removal rates are all over the place, they seem to be very site dependent, and the animals are not just isolating the nutrients, but also excreting nitrogen in other forms. How can we refine the research around this approach?

Scott Horsley asked specifically how many kg/year of nitrogen can we remove per unit (shellfish or acre). Looking at the Mashpee numbers and some of the Wellfleet numbers we see some high nitrogen removal rates. What's the right number for this?

Anamarija Frankic said she doesn't know, but the more the better.

Ivan Valiela said that the one study that he has the most contact with and confidence in is the Carmichael study. It made a lot of assumptions. You seem to need a lot of bivalves to make any difference at all. You can remove measurable amounts of nitrogen with a large area. Carmichael has estimates of just less than 400 oysters per square meter. If you take that density and assume that 1% of the surface of the estuary is covered by culture, at most, less than 15% of land derived nitrogen loads could be accounted for in the shells and flesh of the animals. Large amounts of culture can lead to load reduction.

Scott Horsley says that the nitrogen in the animal is a ½ gram per oyster and we know the number of oysters coming out of a given system. Lets say the Massachusetts Estuaries Project says we have to remove 5000 kg of nitrogen per year, and 1 acre removes 1000 kg, that means we only need 5 acres? If we can take that as a credit against nitrogen removal is that an accurate way to calculate the amount needed?

Anamarija Frankic said that, based on the TMDL for Duck Creek/Mayo Creek in Wellfleet, about 8 million oysters would be needed to reduce the load.

Eric Davidson said that if you look at the nitrogen captured in a composting toilet you know that nitrogen is not going to go to a water body. It originated on land and was making it's way to water body. The nitrogen that a bivalve captures can come from the tide and from land. You probably can not take the nitrogen in a bivalve times the number of bivalves to calculate the impact on land derived nitrogen, because it's likely only a percentage of the total.

Ivan Valiela said that is the very reason for combining all of these technologies in one place.

Eric Davidson asked Ivan Valiela if his citation was estimating land derived nitrogen, based on a fraction of weight of the bivalve.

Ivan said no, but it shows strong evidence, based on sulfur content, that the nitrogen came from land.

Chris Neill said this may change from place to place and also depending on the location of the shellfish.

Ron Zweig, from the public, said they are doing a demonstration project in Falmouth to look at the growth and nutrients in shellfish. They are monitoring with the School of Marine Science and Technology (SMAST) at UMASS Dartmouth and this data is being measured against the sentinel station. It isn't just what goes in the oyster, but the feces and pseudofeces from the animal contribute to enhancement of denitrification in the water column. In Falmouth we are looking at two things - the uptake of nitrogen and the impact on biota.

Eric Davidson said that using a calculation of grams times the number of animals would be conservative.

Ron Zweig, from the public, said there is a good article by Lisa Kellog from the Chesapeake on an in situ project that saw a 40 fold increase in nitrogen removal.

Chris Neill said there is the potential for year to year changes. If there is an extreme weather event you may get mortality or a disease outbreak. The impact to the oysters may not be permanent, but it may create years where service being provided by those oysters is lost. This is a risk. Some technologies are high risk and some are low.

Ron Zweig, from the public, said that shellfish aquaculture on Cape Cod has been stable for 30 years. The risk associated with aquaculture has been muted in the last decade.

Tom Parece asked if you can overpopulate the shellfish.

Anamarija Frankic said carrying capacity is crucial, especially when considering a whole system approach.

Tom Parece asked if the recommendation is to stay as close to the natural system as possible.

Ivan Valiela said this is very difficult because we have so many baselines. For example, if the temperature increases you may not be able to hit the target established by your baseline ever again. Things are changing so fast with sea level rise, temperature, etc.

Tom Parece asked if we should we say we believe from our research we can meet a particular level of reduction, but include a confidence factor.

Chris Neill said that area constraints are largely political.

Eric Davidson asked what the scientific basis for a carrying capacity is.

Ron Zweig, from the public, said yes, you can go too far. They've done studies in China to model and understand the proper balance. Oysters are much more efficient than quahogs or other shellfish.

Heather McElroy suggested we jump to fertigation wells.

Tom Cambareri said that as it was reflected in the matrix, the concept was a capture well downgradient of a golf course to redistribute groundwater on the turf. If you think about the technology to use wells to capture a source of nitrogen, you could put it almost anywhere – dense residential areas, treatment facilities, etc. You can also use the water for a number of things – turf management, constructed wetland for uptake?

Ivan Valiela asked if we were thinking of this as something you can sell? Effluent to water lawns? He said it is a great idea except for the energy and piping involved to implement.

Chris Neill said to keep in mind unexpected consequences of long term application of enriched water on to vegetation. Unless you institute this practice over very large areas of land you load small areas of land with lots of water. He pointed out an example where a pitch pine forest was converted in to phragmites as a result.

Ivan Valiela said that is not a fair example because it used a standard engineering approach and projects like this require site specific engineering.

Chris Neill said he was just pointing out that there can be unexpected consequences. Depending on the concentration of groundwater you are pulling up, you can quickly saturate area you are applying water to.

Sarah Slaughter said you could pull out concentrated nitrogen and phosphorus and concentrate it for revenue.

Chris Neill said you would have to pull up a large amount of water and get little nitrate and phosphorus from it.

Eric Davidson asked where there are places with large amounts of nitrate that it is worth removing. Are there golf course near wastewater treatment plants? These might be places where this would work.

Tom Cambareri asked about high density quarter acre development areas. There are high concentrations in these types of development.

Ivan and Chris agreed that yes, that's plenty of concentration.

Scott Horsley pointed out that there are high density developments with golf courses near by in the Waquoit watershed.

Ivan Valiela said yes, in certain localities.

Scott Horsley said that the presumption is that golf courses are irrigating already and there could be a savings by using this approach.

Laura Kelley, from the public, pointed out that there are parks and soccer fields and schools, and many other large areas other than golf courses that are already established.

Chris Neill said that the concentration you are pumping won't vary seasonally much, but the ability of the area you are spraying to absorb will vary seasonally.

Tom Cambareri suggested that a gravel wetland could get year round removal.

Kate Kennen pointed out that phytoirrigation is very similar to fertigation wells. Phytoirrigation is just a larger concept, with source of water coming from a well or groundwater or a wastewater treatment facility. Fertigation is a type of phytoirrigation. Should we lump

these two technologies together? She doubts the Cape is a place we would consider growing biofuels. If you have a landfill site without a lot of uses, you could cap it with willow or poplar trees, which grow fast and make larger scale sites that might be unproductive a place you could discharge a lot of water. The lumber industry is looking at this in Portland, Oregon and in Maine. The trees could be used for chipping or compost here.

Tom Parece asked if everyone is confident with some of the information that is there for the remaining short list of technologies.

Kate Kennen pointed out that there is much less published information on some of these technologies that are critical strategies we need to consider. Some are not very energy intensive and might be cost effective. For the phytoremediation information we identified 10 case studies and contacted consultants for information. Kate has lists of others that we could ask for information but she doesn't think it's going to be found in published data. She feels that, in terms of low hanging fruit, nitrate is a no-brainer with these deep rooted trees, which are planted as twigs, and remove upwards of 400 lbs/acre/year of nitrate from groundwater.

Eric Davidson asked Kate if she could give us some examples where she thinks this might fit. Is it land area where groundwater source is close and the concentration of nitrate is high?

Heather McElroy talked about a demonstration project the Commission did at the Hyannis Treatment Facility. Poplars and willows were planted in in test cells, dosed with effluent from the treatment facility to look at nutrient removal rates. We saw high nutrient reduction in this small scale study, but larger scale studies will be important.

We are trying to fit this in by applying some general siting criteria to identify sites in the region that might be suitable, using GIS. Some of the criteria include depth to groundwater, parcels not in protected open space, parcels outside of rare species habitat, parcels with disturbed soils, well field protection, and ownership.

Chris Neill asked what kind of trees are used. What type of poplar?

Kate Kennen responded that hybrid poplar grow the fastest. On Cape Cod we could use native cotton wood. These will also provide habitat benefits. You need to plant male forms so they don't spread seed.

Chris Neill said it would be interesting to look at a couple of cases, because you don't want to replace one type of plant that has a value to the region with something else.

Kate agreed. She also suggested that these trees can be used in additive spaces in a watershed.

Chris Neill said that Cape Cod is not known for its high abundance of marginal lands. The places where these type of approaches should really go is at the lower end elevation of lawns along great ponds.

Kate said this is the difference between a phytobuffer and phytoremediation.

Chris said that areas with low depth to groundwater around ponds, since ponds already function as effective nitrogen removal sites, will have less impact to watershed than if you planted these trees closer to estuaries.

Tom Parece said that, through the screening process, sites have been identified throughout the watersheds.

Kate Kennen reminded everyone that most of the work is being done below the surface (8-9 feet).

Heather McElroy suggested moving on to the next technology – surface flow constructed wetlands.

Tom Parece started by explaining that we have some questions around surface flow wetlands because you likely have to have a primary treatment system in front of it and it's likely to be in a place that didn't have a wetland before.

Ivan Valiela asked if you have to excavate to the water table.

Heather McElroy responded no, you would probably use a liner.

Anamarija Frankic asked if these are floating wetlands.

Chris Neill said no, you are excavating and putting a liner in and then developing a wetland.

Kate Kennen said she has seen this done two ways – one way is with a liner and the other is like the Talking Waters example in Oregon. Here, the wetland provides tertiary treatment for an industrial wastewater facility. An algae layer develops on the surface and eventually creates its own liner. These types of systems lose a lot of water to groundwater in the first year while the algae liner is developing.

Anamarija Frankic asked if you might need to disinfect influent.

Tom Parece responded that it depends on the type of treatment prior to entering wetland.

Anamarija Frankic asked if all surface flow discharges require a NPDES permit.

Mark Owen said that a constructed wetland might need a NPDES permit if going in to stream, but if the effluent is going back to the groundwater that might be different.

Anamarija Frankic said this may be a proven technology, but it needs monitoring and reporting.

Kate Kennen said that there have been quite a few failures and success of the system is highly dependent on who is designing it and how many have they done before. The technology has come a long way, but it requires site specific construction plans. You also have to consider other issues, such as geese wiping out plantings.

Anamarija Frankic pointed out that floating wetlands are not included in the matrix.

Kate Kennen said that we had it there originally and ended up lumping it in with eco machines, but these have really become a tank based ecosystem. We could put it back in as a separate line item.

Chris Neill said that he doesn't have much recent experience with treatment wetlands, but based on previous experience, he feels like the effectiveness is still not consistent. Expertise could be developed here on the Cape to explore them further.

Tom Cambareri said he had thought these would be placed within the surface water, but they are really a man made constructed garden structure and he is not sure what the track record is for these types of systems.

Anamarija Frankic and Kate Kennen said that there is a lot of data out there.

Anamarija Frankic said that she designed floating wetlands with hanging shellfish beds.

Chris Neill asked if these would be located in what is now surface water in an estuary.

Anamarija replied that they are best used where there is little space but a large amount of nutrients.

Chris asked if around docks were a good place and asked if they would be shading the eelgrass.

Anamarija said they work well with the eelgrass.

Kate Kennen said that John Todd is working on this with moorings.

Heather McElroy suggested we move forward and discuss the rest of the technologies on the short list.

Mark Owen said he has information on permeable reactive barriers (PRBs) from his colleagues at AECOM, but he is looking for additional sources of information on these. He wants to know if the panel feels comfortable with the ranges of nutrient removal that are in the matrix. He is wondering if anyone has thoughts on the PRB wall vs. injection sites PRB?

Chris Neill said that based on his experience with the PRBs in Falmouth the numbers in the matrix seem too high. He said that you do get quite a bit of nitrate removal. There are two PRBs in Falmouth and one works better than the other, likely based on how deeply it's installed.

Tom Parece asked if he could suggest a better range for us to use.

Chris Neill suggested better than 50%?

Ivan Valiela pointed out one advantage to this technology is that it intercepts all the sources, not just the wastewater.

Chris Neill said that PRBs could be improved as we learn with more installations, but using 90% removal is probably too high.

Ivan Valiela said that the other issue is how long do they last.

Chris Neill said that the effect of having anoxic water seep in to estuary is an unknown. There might be some reoxygenation that occurs, but we're not sure. The ones around Waquoit Bay are along the beach and they do seem to work.

Ivan Valiela said that occasionally they do meet the level we have in the matrix, but we need to learn how to optimize them to meet that level more regularly.

Heather McElroy suggested we move on to stormwater bioretention and soil media filters.

Mark Owen asked for thoughts on cost and efficiency.

Heather McElroy said that James Sherrard, a Commission hydrologist, observed that stormwater is a smaller amount of the problem and the range in stormwater removal is so great that it may not be useful to spend too much time around this topic.

Eric Davidson said the stormwater management has been implemented around Oyster Pond and he feels like it's made a big difference. A lot of our roads are near water bodies so this approach can be targeted to be specific to the roads near the water bodies.

Tom Camberari said that EPA has phase 2 regulations here on the Cape, but that our stormwater management has been limited because of our soils. Our soils are accepting. Based on research from the University of New Hampshire (UNH) Stormwater Center, gravel wetlands and bioretention type systems are promising and could help optimize nutrient removal. The removal rates in the matrix are taken from UNH Stormwater Center.

Review of Technology Advisory Committee's Recommendations

Erin Perry said that fact sheets have been generated from the matrix as a way to introduce stakeholder groups to the range of technologies. The Commission just finished up an extensive review with the Technical Advisory Committee (TAC) of the Cape Cod Water Protection Collaborative.

We started with graphics, a short description, average removal rates, considerations (advantages and disadvantages) and a "more information" link.

After reviewing these with the TAC, we have added an operations and maintenance responsibility section and a regulatory section, as well as made modifications to some of the descriptions and considerations to clarify information and, in some cases, provide more detail.

With the TAC's help, we drafted a cover letter that clarifies the basis for nutrient reduction percentages and explains the need for monitoring and reporting for any technology or approach to receive credit for nutrient reduction toward a TMDL.

As Paul Niedzwiecki mentioned at the start of the meeting, the TAC began to group technologies and approaches based on whether or not they can be permitted in Massachusetts.

Next Meeting Agenda

Heather McElroy reminded everyone that the next panel meeting with take place on 10/28 at 1pm and that the agenda will include a closer look at the process for applying technologies to watersheds.

Ivan Valiela said the one other thing he would like to know if he were participating as a stakeholder is level of certainty around the effectiveness of each technology.

Erin Perry asked if we should include ranges (highs and lows) for nitrogen and phosphorus removal instead of averages and everyone agreed that would be more appropriate.

Heather McElroy said that we will also discuss adaptive management at the next meeting. At the final meeting we will discuss the triple value model development.

Public comment

Hilde Maingay suggested a water use column (water use per capita). She also feels that a week in advance of the next stakeholder meeting is not enough for stakeholders to review the fact sheets and she would like to see the full matrix as soon as possible. She said that the more information you give the more you will get back and, while it might be difficult to deal with, you could get some good stuff out of it.

Ron Zweig said that in terms of understanding a system another dimension is also the threshold or target. We have situation with fish kills and odors and they are occurring at a level that is extreme. There is an urgency to deal with those things. In those heavily impacted estuaries should you look at how to prevent odors and fish kills as an intermediate to reaching the TMDL? Start by improving the situation and look to reach the ideal/TMDL over time.

Jeff Eagles asked how the EPA information on life cycle cost analysis, energy use, social and economic information be delivered to stakeholders? He said the information continues to bias the larger systems, which get better performance. The stakeholders need to be incorporated in to the development of the triple value model.

Erin Perry said that stakeholders were involved in the development of parts of this model last year and that we expect to include a subset of stakeholders in further development of the model.