

As a place, Cape Cod is a mound of glacial till left behind by retreating giants of the last ice age. Rising seas and tides over the next 10,000 years shaped the iconic bent arm that continues that has defined this place and its people for millennia. A place 10 miles at its widest point, 40 miles east to west, 20 miles south to north around the elbow and 25 miles away from the mainland.

The number of Cape Codders remained steady for the 300 years from the Mayflower to the Kennedy's, a family whose most accomplished son declared this place a national treasure. In the 50 years since establishment of the Cape Cod National Seashore, those seeking their own sandy spot to call home grew four fold. They came here for many reasons, most rooted directly or indirectly in the natural surroundings. But everywhere has its limits

As Executive Director of the Cape Cod Commission my top priority is keeping this special place special. Today that means finding the least costly solution to our greatest environmental threat. It's that simple.

The threat is nitrogen contained in the wastewater leaving our homes everyday. It travels through our backyards seeping into our watersheds polluting our estuaries and bays, choking them to the point that the marine

life, once abundant, is now dying or nonexistent. Many of our estuaries are dead or dying. In many of our bays, shellfish no longer grow naturally and the only living things surviving are a few species of worms, the marine equivalent of cockroaches.

The bill is finally due for decades of unprecedented residential development. The confines of our geography leave us with limited options when dealing with the residue of human existence. The effect on our marine water quality, the defining resource of our region, is undeniable. Anyone who has lived here for more than one generation has witnessed this slow destruction that is our quiet crisis.

The existing regulatory and funding mechanisms encourage a fractured answer to a shared problem. The results are predictable: projects that are too costly to build and maintain, and unimaginative designs that lack a sustainable connection to the landscape and marine resources they are intended to protect.

Change is difficult. Our hesitancy as a community is both understandable and inexcusable. If this were only an environmental challenge we might

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consider continuing to work within the existing regulatory and funding structure. But as one community we are at the crossroads of our environment and our economy. The cost of doing nothing is economically devastating to every Cape homeowner. The window is closing on our opportunity to solve this problem on our terms, sensitive to the diverse villages and neighborhoods that populate this peninsula.

What makes Cape Cod a special place? Its difficult to disagree with those who suggest it's the natural beauty, but I would say it's the people and their ability to define this place, not by our differences, but what we share in common.

We can fix this. We must accept our responsibility to the whole in order to protect the best in our individual communities. Our formerly pristine environment can be once again. We can make it affordable and we can improve our economy and our standard of living at the same time. But we can only do it if we stand together and lean forward as one community

This update to the Section 208 Cape Cod Area-Wide Water Quality Management Plan is based on that belief, relying heavily on the input of the citizens and stakeholders of Cape Cod. The extensive public outreach used new tools to support community engagement, but not to shape any particular outcome. It recognized the uniqueness of this place and the people who live here and charts a course for solving our biggest environmental problem without dislocating our economy in a way that would tear the fabric of this community forever.

This plan is dedicated to the 216,000 year-round residents who make this place special. We are the most recent stewards of this fragile outpost. What we have seen spoil in just one generation we can restore in the next.

- Paul Niedzwiecki
Executive Director
Cape Cod Commission

Updating 208

A BRIEF HISTORY OF THIS EFFORT

This report documents an update to the 1978 §208 Plan for Cape Cod. In a January 30, 2013 letter, Massachusetts Department of Environmental Protection Commissioner Kenneth Kimmell directed the Cape Cod Commission to prepare an update to the 1978 Water Quality Management Plan for Cape Cod to address the degradation of Cape Cod's water resources from excessive nutrients, primarily nitrogen.

In 1978 the plan identified increasing residential densities and a three-fold summer population influx as the cause of isolated water quality and wastewater management problems. It anticipated that future growth, primarily in more inland areas where most public water supply wells are located and along the shores of the Cape's many inland ponds, threatened to cause more serious groundwater contamination and increased eutrophication in surface waters.

AUTHORITY

In 1985 the United States Environmental Protection Agency promulgated regulations (40 C.F.R. §130.6) to provide for water quality management (WQM) planning programs, which “consist of initial plans produced in accordance with §208 and §303(e) of the [Clean Water] Act and certified and approved updates to those plans.” As stated in 40 C.F.R. §130.6(e), a State is authorized to update these WQM plans “as needed to reflect changing water quality conditions, results of implementation actions, new requirements or to remove conditions in prior conditional or partial plan approvals.”

As described above, the Commonwealth exerted its authority under §208 of the Clean Water Act and 40 C.F.R. §130.6 to designate an agency and require an update to address the critical need for nutrient remediation in Cape Cod water bodies by designating the Commission as the responsible agency and directing the Commission to update the 1978 §208 Plan in 2013.

PURPOSE

The purpose of the §208 Plan Update is to develop an integrated water and wastewater management system that includes a series of phased approaches that will remediate groundwater and surface water impairments in each watershed.

GOALS

The goals of the §208 Plan Update include:

- To provide an unbiased evaluation of technologies and approaches that may be appropriate in each watershed;
- To promote the use of sustainability criteria in decision making;
- To work with State and Federal partners on regulatory changes necessary to implement adaptive management plans, including the permitting of alternative approaches and appropriate enforcement mechanisms;
- To develop cost effective management strategies for implementing pilot projects, targeted watershed plans, and watershed plans for shared infrastructure; and
- To identify ways to measure and control unanticipated growth made possible through the development of wastewater infrastructure.

PROCESS

The process used to develop these approaches is watershed-based, includes a focus on both stakeholder engagement and technical evaluation, seeks to maximize the benefits of local planning, considers the full range of traditional and non-traditional strategies, and favors allowing local stakehold-

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ers to decide which of a range of options to pursue, instead of mandating a single “optimal” solution. Affordability and ancillary benefits to Cape Cod’s economy and society are considered in the proposed range of approaches.

The Problem – Estuaries, Embayments, Eutrophication and Economics

NITROGEN

The key nutrient of concern for coastal embayments is nitrogen. A healthy coastal ecosystem needs some amount of nitrogen to power this cycle. However, when too much nitrogen is added to an embayment, excessive algae is produced in a process known as eutrophication. The result produces large algal mats that suffocate eelgrass and destroy animal habitat.

Nitrogen enters marine ecosystems from many different sources. For the purpose of this report they are classified as uncontrollable sources, such as the atmospheric deposition of nitrogen, and controllable sources, such as wastewater, fertilizer and collected stormwater. The watershed planning discussed in the report focuses on nitrogen loads from controllable sources. The uncontrollable loads are accounted for in the calculation of the nitrogen capacity for a given waterbody and should continue to be monitored.

Cumulative concentrations of nitrogen in groundwater, which are substantially lower than drinking water standards, have a significant impact on coastal resources. These impacts are due to the incomplete removal of nitrogen from on-site Title 5 septic systems that were found to be adequate solely for drinking water protection in the 1978 §208 Plan.

POPULATION GROWTH

As the population of Cape Cod increased over the last several decades, so did the volume of nutrients entering our coastal waters and freshwater ponds. The population of Cape Cod has increased approximately 60% since the completion of the 1978 Water Quality Management Plan for Cape Cod, developed by the Cape Cod Planning and Economic Development Commission (CCPEDC), the predecessor to the Cape Cod Commission. Development associated with this growth is largely in the form of residential homes. Wastewater from both older and new housing stock is predominately treated by on-site Title 5 septic systems that do not adequately remove nitrogen.

Although conventional wisdom and practice suggests that economies of scale in the construction of wastewater treatment facilities result in the least expensive and most effective treatment, there is valid concern that the case studies supporting this view are from more urban communities with existing but degraded infrastructure. Cape Cod is missing both of these qualifications, having neither the urban designation or corresponding density characteristics nor the existing infrastructure. Cape Cod has less than 4% of the population of the state

and 20% of the septic systems and only 3% of the parcels and 11% of wastewater flows on Cape Cod are centralized. The Cape also has an attribute not shared by other communities - its seasonal second home owner economy, which creates a peak-flow pricing problem when building wastewater treatment facilities and creates a situation where facilities are overbuilt for 48 of 52 weeks a year.

THE PROBLEM

Too much of a good thing.

The nitrogen from septic systems is released to groundwater and ultimately reaches our surrounding coastal waters. Excessive nitrogen and other nutrients, such as phosphorus, are the documented cause of severe eutrophication in a majority of Cape Cod estuaries and freshwater ponds. These nutrients lead directly to thick mats of algae that kill eelgrass and decrease dissolved-oxygen concentration. These conditions destroy animal habitat and result in frequent violations of water quality standards indicated in part by fish kills and diminished shellfisheries.

TOTAL MAXIMUM DAILY LOADS

How much is too much?

A Total Maximum Daily Load (TMDL) is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. TMDL’s are technical planning documents and are not, in and of themselves,

enforceable documents requiring compliance. Other federal, state, and local authorities are used to implement the TMDL. These may take the form of enforceable legal instruments, such as Massachusetts groundwater discharge permits in the case of some nonpoint sources of pollution or National Pollutant Discharge Elimination System (NPDES) permits in the case of NPDES-regulated point source discharges. TMDL's are useful in quantifying goals for reducing or eliminating pollutants that degrade conditions in a waterbody measured qualitatively by the federal Clean Water Act.

As detailed below, the University of Massachusetts School for Marine Science and Technology (SMAST), established the Massachusetts Estuaries Project (MEP) and has been working to determine the maximum amount of nitrogen degraded Cape Cod marine ecosystems can accept without becoming eutrophic.

THE COST OF DOING NOTHING

Cape Cod's water resources drive the regional economy. They attract visitors in the summer months and make the Cape a desirable place to live for year-round and seasonal residents. Continued nitrogen loading of Cape Cod's embayment watersheds, primarily from residential septic systems, will lead to further degradation of coastal water quality, affecting not only our environment, but our society and economy as well. We can expect that the economic impact of doing nothing to improve coastal water quality to be significant. Ongoing efforts seek to quantify what these impacts might look like.

3VS

The Cape Cod Triple Value Simulation (3VS) model is one resource being developed to consider the broader environmental and societal costs of environmental degradation. As a sustainability assessment tool, the 3VS model applies systems thinking to the problem of nitrogen pollution in Cape Cod embayments. Phase 1 of the model will estimate the potential social, economic and environmental costs of not taking action to mitigate projected increases in nitrogen loadings to Cape Cod embayments. Phase 2 of the model will include a comparison of policy intervention scenarios to evaluate direct and indirect costs and benefits of different potential actions to reduce nitrogen loadings. The 3VS model incorporates data sets from around the country to estimate costs associated with inaction. Data specific to the Cape region is not available.

THREE BAYS: ESTIMATED IMPACT OF NITROGEN ON PROPERTY VALUES

To test the hypothesis that water quality degradation resulting from nitrogen pollution, decreases single-family home sale prices, after controlling for all measurable and available variables, a study was designed to evaluate home prices in the Three Bays area in the Town of Barnstable. The overall study has four components: a Cape wide survey of residents, spatial hedonic modelling, GIS analysis of water quality trend, and focus groups of stakeholders. Single-family properties within 1,000m or about 10 minutes walking distance from the waterfront comprise the study area. The hedonic model estimates the impact of water quality – nitrogen levels – on home sale

prices, controlling for property attributes, macroeconomic influences, proximity to nearest public beaches, distance to water, and being right on the waterfront. The time period of the analysis is between 2005 and 2013.

Based on preliminary results from the hedonic analysis, after controlling for all other factors mentioned above, initial findings show that during the study period a 1% decrease in water quality is associated with a decrease in single-family home sale prices in the range of 0.49% to 0.86% (average 0.68%), at the 95% confidence level. During the study period the water quality in Three-Bays degraded by 15.8%. The above range of estimated impact translates into a noticeable fiscal impact on the community, both in terms of decrease in sale price and consequent impact on the assessed value.

Consider if in 2005 the Town of Barnstable had made a moderate effort to curb the discharge of nitrogen into Three Bays waters resulting in a 3% decrease in total nitrogen level, average single-family home sale prices would be \$20,176 to \$35,228 higher than was in 2013 in the study area. That translates into potential sale value loss (and consequent assessed value loss) in the range of \$49 to \$86 million in the study site alone (1,000m or ten-minute walking distance to the waterfront). No action in 2014 could mean in the next few years the Cape could be seeing another estimate of home value lost due to degrading water quality. Cape Cod's environment, especially its coastal resources, is linked directly to its economy. The nitrogen problem is a significant threat to both. Continued degradation of the coastal resources on Cape Cod will negatively

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impact the seasonal and year-round economies, wound local municipal budgets and decrease property values for year-round residents and second homeowners.

Cape Cod – Defined by Water

Understanding the people and the place before considering solutions.

A glacial deposit created Cape Cod as a peninsula with Cape Cod Bay to the north, Nantucket Sound to the south, the Atlantic Ocean to the east, and a significant part of the western coastline bounded by Buzzards Bay. With the construction of the Cape Cod Canal circa 1914 the land mass became surrounded by water. Cape Cod has 560 miles of coastline, nearly 1,000 kettlehole ponds and below ground is a sole source aquifer.

LAND USE

Cape Cod's great natural beauty, bountiful recreational opportunities and proximity to major urban areas have led to a rapid increase in population over the last half century. The Cape's traditional farming and fishing way of life underwent a slow transformation from the 1870s through the early part of the 20th century as seaside resorts began to attract summer visitors. The advent of rail travel and the adoption of the interstate highway system added to the accessibility and the popularity of Cape Cod. The population began to rise more quickly in the 1950s and even more steeply from the

1970s through the early 2000s, as Cape Cod became a desired location for retirees and second-home buyers. Most of this development was residential with associated commercial, industrial, and tourism-based land uses.

In the past several decades the number of people living year-round on Cape Cod increased, with a concomitant conversion of seasonal homes for year-round use. The 2010 US Census listed about 57,000 seasonal housing units, or approximately one third of the housing stock on Cape Cod. These seasonal homes are much more prevalent in coastal areas than inland on Cape Cod.

Recently, population decreased from about 227,000 in 2001 to an estimated 215,000 in 2011. The decline is attributed, in part, to the increasingly high cost of Cape Cod real estate as the market boomed in the last decades of the 20th century, followed by the swift market decline toward the end of the first decade of the 21st century. As the Woods Hole Research Center notes: "Cape Codders are still grappling with the effects of a population that grew by 400 percent between 1950 and 1990."

The location of infrastructure and public facilities, in addition to zoning, drives land use patterns. The development of infrastructure, from wastewater to telecommunications, will be essential to regional economic growth that doesn't degrade the human or natural environment.

Open space in more sensitive areas should be protected, improving the ability of the natural environment to further absorb human impacts as well as counteracting naturally occurring uncontrollable nitrogen loads from atmospheric deposition.

Conversely, a sprawling pattern of growth not only increases infrastructure costs but also makes the delivery of services such as public transit less practical.

MARINE WATER

Watersheds define the jurisdiction of the problem

Cape Cod is defined by and dependent on the marine environment that surrounds it. Nutrients and pollutants from land use development, including wastewater, are conveyed through groundwater to surrounding marine waters with concentrations and directional flows determined by watersheds.

Similar to water supply wells, the watersheds to the embayments are defined by groundwater flow paths of the aquifer. There are 105 watersheds to the surrounding marine waters. Of those, 57 are watersheds to coastal embayment systems. The coastal embayments are located at the margin of the aquifer and are the ultimate receiver of the aquifer's groundwater discharge.

The watersheds to the coastal embayments extend from the coastline up to the top of the water table lens, located along the spine of the peninsula. They comprise nearly 79% of the land area of Cape Cod. About 21% of Cape Cod is in a watershed where groundwater discharges directly to open coastal water such as the Cape Cod Canal, Nantucket Sound, Cape Cod Bay and the Atlantic Ocean. These are called direct discharge areas and are important areas to consider for potential

wastewater discharges since the nitrogen loads do not impact the coastal embayments.

PONDS

The lakes and ponds on Cape Cod formed about 12,000 years ago during the last stage of the Wisconsin glaciation. As glaciers retreated from Cape Cod, large chunks of ice were left behind. As these chunks of ice melted, the landscape above them collapsed, forming large depressions called kettle holes. Where these depressions dip below the groundwater table, they are filled with water and create the hundreds of ponds that exist on Cape Cod today.

Cape Cod has 994 ponds covering nearly 11,000 acres. These ponds range in size from less than an acre to 735 acres, with the 21 biggest ponds making up nearly half of the total Cape-wide pond acreage. Approximately 40% of the ponds are less than an acre. One hundred and sixty five are designated as great ponds of 10 acres or more.

Cape Cod's freshwater ponds are fragile systems especially vulnerable to pollution and human activity. The key nutrient of concern for freshwater ponds is phosphorus. Water quality in Cape Cod ponds is significantly impacted by surrounding development. A comparison of 1948 and 2001 dissolved oxygen concentrations suggest that many of these pond ecosystems are not only impacted, but also seriously impaired.

The fresh water ponds of Cape Cod provide a significant bene-

fit in removing nitrogen as it moves through the watershed. The ponds provide a natural attenuation of nitrogen in groundwater and are an important consideration in watershed planning acting as "nitrogen filters."

GROUNDWATER

The hydrogeology of Cape Cod is largely composed of coarse sands with considerable permeability. The travel time for wastewater pollutants from their initial entrance into groundwater to the point when they reach an embayment is less than 10 years across almost half of Cape Cod. This presents the likelihood that wastewater treatment options, once implemented, will result in water quality improvements within 5-10 years in some of our polluted embayments.

The Cape Cod Aquifer is one of the most productive groundwater systems in New England and provides 100% of the Cape's drinking water. It is a Sole Source Aquifer providing drinking water to over 500,000 people during the peak tourist season and is derived from 158 gravel-packed municipal supply wells providing public water service to 85% of Cape Cod, and hundreds of private wells providing service to 15% of Cape Cod in the communities of Sandwich, West Barnstable, Eastham, Wellfleet and Truro. The aquifer is recharged solely from rain and ultimately conveys that water to the surrounding embayments, if not otherwise captured by wells and groundwater fed ponds.

The Cape Cod Aquifer is extremely susceptible to contamination from various land uses and activities. The aquifer has

been seriously impacted in the past from military activities, gas stations, landfills and other activities. The groundwater of Cape Cod is well protected with the exception of the impacts of nutrients due to the prevalence of on-site septic systems. The quality of Cape Cod's community public drinking water supply is generally very good, but over the past 15 years there has been a trend toward some degradation.

EMERGING CONCERNS

Nitrate can serve as an indicator of other wastewater contaminants, such as disease-causing organisms, solvents, cleaners, petroleum compounds, pharmaceuticals and personal care products (PPCPs) and other contaminants of emerging concern (CECs). CECs are chemicals or microorganisms that are not commonly monitored or regulated in the environment, but are suspected of having potentially adverse ecological and/or human health effects. They can include hormones, human and veterinary pharmaceuticals, and household products like soaps and lotions, insect repellents, perfumes and other fragrances, sunscreens, and hand sanitizers.

In June 2004 the USGS and the Barnstable County Department of Health and the Environment sampled wastewater sources and public and private drinking water supplies on Cape Cod that were thought to be affected by wastewater because of previously high nitrate concentrations. Forty-three of the 85 PPCP and organic wastewater contaminant compounds that wastewater samples were analyzed for were detected. Thirteen were detected in low concentrations (less than 1 microgram/

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liter) in the private and semipublic drinking water supplies and three - an antibiotic, an antidepressant, and a solvent - were detected in the public water supply.

In May 2010 the Silent Spring Institute reported that PPCPs were detected in 75% of 22 public water supply wells sampled on Cape Cod. In general, wells with higher levels of nitrate and higher density land development in the wellhead protection areas had a greater number of detections than those wells that were better protected by lower density and open space.

Although the §208 Plan Update is largely focused on the ecological impacts of nitrogen, particular attention will be focused on drinking water areas and wells that have higher levels of nitrogen as an indicator to address contaminants of emerging concern. Additional investigation on the occurrence of CECs in groundwater will be needed to address the wastewater disposal options for any particular selected site that is located in a Zone II. In any case, substantial costs can be saved by avoiding wellhead protection areas and Zone IIs when locating potential wastewater disposal sites.

Existing Regulatory and Planning Framework

Water quality goals for the nation, the state, municipalities, districts and specifically for Cape Cod are reflected in a number of laws, regulations and plans. Wastewater in Massachusetts primarily involves interaction with the federal Clean

Water Act or the state Title 5 regulations. The Massachusetts Environmental Policy Act, the Cape Cod Commission Regional Policy Plan and other local ordinances also impact the siting of wastewater projects on Cape Cod.

REGULATIONS

CLEAN WATER ACT

The United States Environmental Protection Agency (US EPA) regulates water quality under the federal Water Pollution Control Act of 1972 and its subsequent amendments in 1977, 1981, and 1987. Collectively these are known as the Clean Water Act. The objective of the act is to maintain and restore the chemical, physical and biological integrity of US waters. The act requires states to establish ambient water quality standards for water bodies based on the need to protect the use(s) designated for that water body.

Point Sources

The definition of a point source of pollution as stated in §502(14) of the federal Clean Water Act is “any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged.”

The Clean Water Act authorizes US EPA and states to regulate point sources that discharge pollutants into waters of the United States through the National Pollutant Discharge Elimination System permit program. These “point source” discharges are generated from a variety of residential, municipal and industrial operations, including treated wastewater, process water, cooling water, and stormwater runoff into drainage systems. The NPDES Stormwater Program regulates discharges from municipal separate storm sewer systems (MS4s), construction activities, industrial activities, and those designated by US EPA due to water quality impacts

Nonpoint Sources

The term “nonpoint source” is defined as any source of water pollution that does not meet the above legal definition of a “point source.” Nonpoint sources are typically described as those emanating from precipitation that has picked up natural and human-made pollutants as it moves over and through the ground. The US EPA lists fertilizers, herbicides, pesticides, oil and grease, sediments and bacteria, and nutrients from “faulty septic systems” as examples of nonpoint source pollutants.

At the present time, there is no federal law that requires the regulation of nonpoint source water pollution in a way that gives rise to enforcement actions.

Municipal Separate Storm Sewer Systems (MS4)

The Cape communities south and west of Eastham are currently operating under the 2003 MS4 permit, which expired in 2008 but remains in effect administratively until a new permit is issued. US EPA Region 1 anticipates issuing a new draft small MS4 general permit in 2014. Towns should be prepared to respond to the draft small MS4 general permit soon after its issuance.

State roadways in watersheds to impaired water resources also contribute nutrients and other pollutants from stormwater. US EPA anticipates issuing a separate small MS4 permit for MassDOT in 2014.

State

As noted above, the Clean Water Act regulates point sources under the National Pollutant Discharge Elimination System (NPDES) permit program. In most cases, the NPDES permit program is administered by authorized states on behalf of US EPA. Massachusetts is one of a handful of states that is not a delegated NPDES permit state; however, permits are jointly issued by the US EPA and the MassDEP and are equally and separately enforceable by both agencies.

MASSACHUSETTS SURFACE WATER QUALITY STANDARDS

Following the federal law and as prescribed by the federal Clean Water Act, the Commonwealth of Massachusetts

adopted surface water quality standards for individual water bodies. The standards designate the most sensitive uses for which the water body must be “enhanced, maintained, and protected” (whether or not the designated use is currently attained), prescribe minimum water quality criteria necessary to sustain the designated uses and contain the regulations necessary to achieve and maintain the designated use and, where appropriate, prohibit discharges.

Massachusetts divides coastal and marine surface waters into three classes: SA, SB, and SC, in descending order of the most sensitive uses that water body must attain. Additionally the state has special designations of Outstanding Resource Waters, Special Resource Waters, Shellfish (waters), and Warm Water.

IMPAIRED WATERS AND TOTAL MAXIMUM DAILY LOADS

The Clean Water Act, under §303(d), requires states to assess the quality of surface waters based on the intended uses on a regular basis and to develop a list, referred to as the 303(d) list, of impaired waters—those waters that do not meet the intended uses. The most recent list for Cape Cod waters is the Cape Cod Coastal Drainage Areas 2004-2008 Surface Water Quality Assessment Report. Under §303(d) of the Clean Water Act, states are required to:

- Identify those water bodies that are not expected to meet the Surface Water Quality Standards from technology-based controls; and,

- Establish, subject to US EPA approval, for those waters total maximum daily loads (TMDLs)—the maximum amount of a pollutant from any source and of any kind that a water body can have without violating water quality standards.

On Cape Cod, state-developed TMDLs are based on technical reports prepared by the Massachusetts Estuaries Project (MEP). TMDLs are formulated by the Massachusetts Department of Environmental Protection and submitted to the US Environmental Protection Agency for approval after public comment. TMDLs are enforceable under the federal Clean Water Act.

SAFE DRINKING WATER ACT

The Safe Drinking Water Act (SDWA), administered by the US EPA, is the main federal law that protects the quality of drinking water and the rivers, lakes, reservoirs, springs and groundwater wells that are the source of drinking water. The Act authorizes the US EPA to set standards for drinking water quality to protect against natural and human-caused contaminants and to oversee the implementation of those standards on the state, local and water supplier levels. At present, there are standards that regulate 83 different contaminants. Cape Cod was designated a Sole-Source Aquifer under the Safe Drinking Water Act (SDWA) in 1982. There are 17 SDWA regulated public water suppliers on Cape Cod.

The US EPA Primacy Agent for the federal Safe Drinking Water Act is the Massachusetts Department of Environmental Protection, Division of Watershed Management’s Drinking

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Water Program. On behalf of the US EPA, MassDEP regulates water quality monitoring, new source approvals, water supply treatment, distribution protection and the reporting of water quality data.

The regulations define a Zone I as “the protective radius required around a public water supply well or wellfield” and a Zone II as “that area of an aquifer that contributes water to a well under the most severe pumping and recharge conditions that can be realistically anticipated.” Zone IIs are also known as wellhead protection areas and all Cape towns have protected them through zoning and Board of Health bylaws. Municipalities identify areas as potential Zone IIs and submit them to the state.

Over the last several decades water planners combined their knowledge of groundwater with policy mechanisms to protect Cape Cod drinking water. Adoption of wellhead protection areas (or Zone IIs) was a major strategy to protect the land area that receives precipitation to recharge the pumping wells. Today each town has zoning and Board of Health bylaws to protect their wellhead protection areas.

Wellhead protection areas and Zone IIs comprise a large percentage of Cape Cod’s geographic footprint. This will impact potential siting of wastewater treatment facilities given the substantial costs associated with the enhanced treatment that would be required before discharge in those protected areas would be allowed.

TITLE 5

The Massachusetts Department of Environmental Protection regulates wastewater flows less than 10,000 gallons per day under 310 CMR 15.000: The State Environmental Code, Title 5: Standard Requirements for the Siting, Construction, Inspection, Upgrade and Expansion of On-Site Sewage Treatment and Disposal Systems and for the Transport and Disposal of Septage (typically referred to as Title 5). Title 5 covers such uses as conventional on-site septic systems, alternative systems, such as denitrifying systems (often called “Innovative/Alternative,” or I/A, systems), as well as composting toilets and other kinds of systems in use on individual properties or cluster developments. Title 5 presumes residential wastewater flows at 110 gallons per day per bedroom (e.g., Title 5 presumes that a four-bedroom house will generate 440 gallons per day). Non-residential wastewater generation is typically based on use and square footage, or the number of restaurant seats.

MassDEP may identify certain areas as particularly sensitive to pollution from on-site wastewater systems and therefore require the imposition of loading restrictions. These Nitrogen Sensitive Areas (NSAs) include:

- Interim Wellhead Protection Areas and department-approved Zone IIs of public water supplies
- Areas with private wells
- Nitrogen-sensitive embayments or other areas, which are designated as nitrogen sensitive under Title 5 based on appropriate scientific evidence

The nitrogen-loading restrictions in NSAs apply to new construction only and do not affect existing Title 5 systems unless they are deemed to have failed or are required to be upgraded at the time of property transfer. To date, MassDEP has not designated any area on Cape Cod as an NSA.

GROUNDWATER DISCHARGE PERMIT PROGRAM

Flows in excess of 10,000 gallons per day are regulated under the state Groundwater Discharge Permit Program. Systems requiring a groundwater discharge permit require significant removal of nitrogen because the Cape Cod Aquifer is designated as a non-degradation resource. Groundwater discharge permits for Cape Cod require an effluent treatment level of at least 10 milligrams per liter of nitrate, which is almost a two-thirds reduction in the amount of nitrogen leaving a septic system. In the last 10 years, groundwater discharge permits for projects located in watersheds to impaired embayments have been held to a “no-net nitrogen” standard by MassDEP. This means that any nitrogen released into the watershed must be “offset” by the removal of nitrogen from an existing source. To date, this typically occurs by connecting a nearby existing development to remove nitrogen via wastewater treatment.

MASSACHUSETTS ENVIRONMENTAL POLICY ACT AND OTHER STATE REGULATIONS

Comprehensive Wastewater Management Plans (CWMPs) typically require Massachusetts Environmental Policy Act (MEPA) review prior to state and regional permitting. MEPA

review involves scoping proposed projects for their potential environmental impacts, identifying alternatives, and avoiding, minimizing or mitigating environmental impacts. CWMPs are typically filed first as an Environmental Notification Form (ENF) or Expanded ENF with a Draft Environmental Impact Report (DEIR) and released for public comment. At the end of public comment, the Secretary of Energy and Environmental Affairs will issue a Certificate of Adequacy that outlines additional information or analysis that should be conducted prior to the next MEPA filing. The final MEPA filing is a Final Environmental Impact Report (FEIR). Upon the Secretary's issuance of a Certificate of Adequacy for an FEIR, appropriate state agencies and the Cape Cod Commission then commence their regulatory reviews. In addition to MassDEP regulatory review, other state agency permits may include: Massachusetts Natural Heritage and Endangered Species Program; Massachusetts Historical Commission; Massachusetts Division of Marine Fisheries, and others.

CAPE COD COMMISSION ACT

The Cape Cod Commission, the Cape's regional planning agency, was created by an act of the Massachusetts Legislature and ratified by the voters of Barnstable County in 1990 in response to the rapid development pressure of the 1980s. The increased pace of development focused attention on the need to manage growth, guide land use, promote balanced economic growth, provide for adequate capital facilities and infrastructure, and protect environmental resources. The Commission has planning, technical and regulatory tools that can be applied to

water quality management on Cape Cod. The Commission has independent statutory authority and is a department within the structure of Barnstable County government.

Regional Policy Plan

The Cape Cod Commission Act (Act) established a Commission regulatory function to review and approve, condition, or deny development projects that exceed Development of Regional Impact (DRI) thresholds. The Act includes a provision that the Commission develop and implement a Regional Policy Plan (RPP) that contains the minimum performance standards (MPS) for its regulatory review of proposals. The Commission published the first version of the Regional Policy Plan in 1991; it has been updated and revised every five years. All revisions to the RPP are approved as ordinances by the Barnstable County Assembly of Delegates, the regional government's elected legislative body.

A Development of Regional Impact is a proposed development that is likely to present development issues significant to more than one municipality in Barnstable County. Projects are referred to the Cape Cod Commission for review as DRIs by a variety of means.

Municipalities are typically required to file an Environmental Impact Report (EIR) with the MEPA Unit for the development of CWMPs. The Cape Cod Commission Act (§12(i)) requires that the Commission shall review as a DRI any proposed development project for which the Massachusetts Secretary of Energy and Environmental Affairs requires the preparation of an EIR. As

a result, the Commission conducts a regulatory review, generally concluding with a written approval decision containing findings and conditions for all CWMPs proposed by Cape Cod towns. CWMPs typically trigger EIR review because they involve construction of a new wastewater treatment and disposal facility with a capacity of 2,500,000 gallons per day, or because they result in construction of one or more new sewer mains 10 or more miles long. CWMPs may also trigger mandatory EIR thresholds for land and wetland alterations, impacts to endangered or threatened species or archeological sites, and other factors.

The Commission's regulatory review of a CWMP is presently guided by the planning guidance and minimum performance standards of the Regional Policy Plan. The pertinent technical sections of the RPP include water resources, open space, natural resources, planning and historic preservation. Some of the requirements are similar to MassDEP requirements, but some are quite different.

The 2009 Regional Policy Plan changed the "no net" policy to reflect the newly adopted TMDLs by MassDEP and US EPA as the critical nitrogen loading limit. The performance standard interprets the adopted TMDL as a "fair share." The fair share is the TMDL equivalent load to be allocated to contributing towns on a per-acre rate using the watershed and sub-watershed area.

LOCAL REGULATION

Local zoning, board of health regulations and conservation commission regulations also often impact the selection and siting of wastewater treatment technologies and approaches.

EXECUTIVE SUMMARY

PLANNING

CAPE COD COMMISSION TECHNICAL SERVICES

As the region's planning agency, the Cape Cod Commission supports its regulatory and planning mission with the provision of technical services by professional staff in almost every issue area for various county, local, state and federal agencies. In the area of water resources, Commission staff has provided support on issues including water supply, freshwater ponds, coastal water quality, wastewater management, and groundwater cleanup. The Commission has been successful in finding cost-effective solutions for common problems shared across the region and has provided fundamental expertise in the development of local and regional wastewater management planning and in the development of the tools and resources developed as part of the §208 Plan Update.

COMPREHENSIVE WASTEWATER MANAGEMENT PLANS

Currently, individual municipalities develop Comprehensive Wastewater Management Plans (CWMPs) within town boundaries. These plans include watersheds that are both wholly within town boundaries, and shared with a neighboring town(s). MassDEP considers requests for municipal permits and financing after the state level environmental scoping review is conducted under the Massachusetts Environmental Policy Act.

The MassDEP Division of Municipal Services Guide to Comprehensive Wastewater Management Planning outlines

the process for development of a CWMP. According to the guidance, "The planning exercise requires a community to perform a needs analysis: identifying problem areas."

CWMPs have traditionally recommended conventional wastewater sewer collection and treatment facilities, which require groundwater discharge permits and sewer construction permits.

What Is Being Done?

MASSACHUSETTS ESTUARIES PROJECT

In 2001 MassDEP and the University of Massachusetts School for Marine Science and Technology, in collaboration with the Cape Cod Commission, established the Massachusetts Estuaries Project.

MEP scientists developed models that link nitrogen loading in a watershed to coastal water quality. Inputs into the models include data on coastal water quality, tidal flushing, bathymetry, pond water quality, current and historic eelgrass coverage, water use, wastewater treatment plant performance (if any), landfill monitoring, watershed delineations, sediment nutrient regeneration, and nitrogen attenuation from wetlands, rivers and freshwater ponds. The modeling results confirmed earlier studies identifying on-site septic systems as the major source of nitrogen to coastal embayments.

In response to concerns raised by some Cape Cod communities regarding the validity of the MEP scientific approach,

the Barnstable County Commissioners directed the Cape Cod Water Protection Collaborative (Collaborative) to undertake a scientific peer review of the MEP process. In 2011, the Collaborative organized an independent scientific peer review of the MEP methodology for developing appropriate TMDLs for the estuaries and embayments of Cape Cod, and for the use of that methodology as a basis for wastewater and nutrient management planning and implementation on Cape Cod. The scientific peer review process was independent and objective, and operated externally from the Collaborative and from any other Cape Cod stakeholders.

The peer review panel found the MEP modeling approach to be appropriate and useful for evaluating alternative scenarios and informing nutrient management plans, and also found the MEP to be consistent with existing nationwide TMDL practices. The panel also found that the MEP modeling approach is scientifically credible, and the modeling approach is consistent with current understanding of existing conditions for Cape Cod estuaries, based on available data. The components in the approach are well known and documented. Computation of watershed nitrogen loads is strongly data-driven and quantitatively linked to estuarine nitrogen concentrations.

The MEP partnered with Cape Cod communities to evaluate coastal water quality and develop technical reports recommending TMDLs for nitrogen in accordance with the requirements of the Clean Water Act. Model results are presented in published technical reports, which identify how much nitrogen must be removed from wastewater to meet the TMDL in a particular coastal embayment.

EXECUTIVE SUMMARY

The MEP was estimated to cost \$12 million over six years. Funding is broad-based with half coming from the state and the other half coming from local and other agency sources. Barnstable County, through the Cape Cod Commission, provided over \$700,000 to the MEP over the last eight years as direct assistance to participating Cape Cod towns. The MEP's regionally consistent methodology provides technical work and documents at significant cost savings over towns undertaking similar work individually.

The MEP developed a rigorous Linked-Model approach that includes components of the various disciplines necessary to understand and project how nonpoint source nitrogen loading in a watershed translates into coastal water quality deterioration. Data input into these models includes: three years of volunteer-collected coastal water quality data, tidal flushing data, bathymetric information for estuaries and freshwater ponds, pond water quality data, current and historic eelgrass coverage, water use information, wastewater treatment plant performance, landfill monitoring data, watershed delineations, sediment nutrient regeneration, and wetland nitrogen attenuation.

Embayments on the southern coast of Cape Cod are typically more susceptible to impacts because the tidal range is generally 1/2 to 1/3 of the range observed in Cape Cod Bay to the north.

As of July 2014, 41 MEP technical reports are complete, one is in draft form and five are pending. There are 12 embayments that are not scheduled for study by MEP.

The MEP provides specific documentation, based on water quality testing, that many of Cape Cod's watersheds have

impaired water quality and ecological damage due to nitrogen loading. Nitrogen from septic systems accounts for approximately 80% of the watershed load, with stormwater and fertilizers accounting for the remainder of the locally-controllable nitrogen load. Atmospheric deposition of nitrogen in rainfall is another source accounted for in the stormwater runoff contribution for the watershed and as direct rainfall on the embayment itself.

The MEP technical reports and TMDLs contain estimates for how much watershed nitrogen needs to be removed to meet the TMDL. Since septic system contributions represent the greatest controllable nitrogen load in Cape Cod watersheds, TMDLs also specify how much wastewater nitrogen from septic systems would need to be removed to meet the TMDL. The average removal rate for septic nitrogen load to meet water quality standards would exceed 50% Capewide.

CAPE COD COMMISSION

Concurrent with the beginning of our awareness about coastal waters, the Commission adopted a regulatory requirement that development projects within watersheds to water quality impaired embayments should have no-net nitrogen loading. In other words, the amount of nitrogen added by the project must be offset by an equivalent reduction. Several County Task Force committees that reviewed the Commission's regulatory program accepted this requirement as a necessary interim step to halt continued degradation of the Cape's coastal water quality. Over the years, it became increasingly clear to organizations

involved in assessing and protecting embayments that a comprehensive effort to link regulatory and scientific activities was necessary to realize solutions for observed coastal water quality problems.

POND AND LAKE STEWARDSHIP

In 2001 a coalition of groups interested in protecting ponds received a \$30,000 grant to develop a Cape Cod pond stewardship strategy from the Massachusetts Watershed Initiative, known as the Ponds and Lakes Stewardship (PALS) project. The Cape Cod Pond and Lake Atlas, published by the Cape Cod Commission in 2003, provides a status report on the PALS program. It documents the outreach and education activities leading to the creation of the PALS program, reviews water quality data collected by volunteers during the 2001 PALS Snapshot from over 190 ponds, uses this data to develop Cape Cod-specific indicators of pond impacts, reviews data collected in previous studies, and details further efforts necessary to move pond protection and remediation forward on the Cape.

BARNSTABLE COUNTY HEALTH DEPARTMENT

MASSACHUSETTS ALTERNATIVE SEPTIC SYSTEM TEST CENTER

The Massachusetts Alternative Septic System Test Center opened in 2000 to research and test advanced on-site wastewater treatment systems. The Center is operated by the

EXECUTIVE SUMMARY

Barnstable County Department of Health and the Environment (BCDHE) and is located at Joint Base Cape Cod. Although the Center's initial emphasis was on nutrient-reducing technologies, more recently it has conducted research on the efficacy of commercial and soils-based septic systems for removal of pharmaceuticals and personal care products. The Center has been instrumental in forming and conducting many internationally recognized standards for both secondary and tertiary wastewater treatment. Ancillary projects include the support of research efforts on wastewater diversion techniques, such as composting toilets and urine diversion, and their efficacy for addressing the nutrient management issues in sensitive watersheds.

The majority of the systems tested at the Center are proprietary systems and the efficacies of non-proprietary denitrification strategies are less understood, primarily due to the lack of financial incentives to develop and promote them. It is clear, however, that Cape Cod communities are interested in exploring all options available to reduce nitrogen that enters the groundwater. Through this update of the §208 Plan for Cape Cod, funding was provided to the County Department of Health and the Environment to investigate non-proprietary means to remove nitrogen by enhancing and/or manipulating soils-based systems.

INNOVATIVE/ALTERNATIVE SEPTIC SYSTEMS PERFORMANCE TRACKING

More than 1,500 innovative/alternative (I/A) septic systems have been installed on Cape Cod in an attempt to reduce the amount of nitrogen discharged into the groundwater. These systems range in their complexity, but all require regular maintenance and monitoring. Since 1999, BCDHE has maintained a database to assist regulators in the task of tracking performance and adherence to maintenance schedules. Regular performance and compliance updates are provided to local regulatory boards. More recently, to aid the public and engineering professionals, the department has created an interactive tool to chart performance of all technologies used within Barnstable County. This tool assists wastewater planners to develop realistic performance expectations, thus facilitating accurate CWMPs. Occasionally printed compendia of the information are distributed to local boards and commissions. The department also maintains training tools to instruct boards of health regarding the proper application of these technologies.

COMMUNITY SEPTIC MANAGEMENT LOAN PROGRAM

The Barnstable County Department of Health and the Environment initiated the Community Septic Management Loan Program to assist homeowners by defraying the costs of septic system upgrades through provision of 20-year betterments. More recently the program has assisted in providing support for the actual connection costs to centralized systems or combined

packaged or cluster treatment systems. Barnstable County administers this program regionally for all Cape Cod towns.

BARNSTABLE COUNTY WATER PROTECTION COLLABORATIVE

The Cape Cod Water Protection Collaborative was created by county ordinance in 2005 and exists to offer a coordinated approach to enhance the water and wastewater management efforts of towns, the regional government and the broader community. The Collaborative seeks to protect Cape Cod's shared water resources and to provide access to cost effective and environmentally sound wastewater infrastructure. The Collaborative seeks funding support for Cape communities, establishes priorities, directs strategy, builds support for action, and fosters regionalism.

TOWNS

All 15 Cape Cod towns have engaged to some degree in the process of developing CWMPs over the last 10 years. Several towns are in the MEPA review process. A Cape Cod Commission regulatory review file of comments letters, public hearings and decision documents are available for each town that is undergoing the MEPA/DRI review process for their CWMP. Towns with existing wastewater infrastructure including Barnstable, Chatham, Falmouth and Provincetown, completed wastewater facilities plans prior to or in conjunction with nutrient planning.

Why Hasn't There Been More Progress?

Despite the efforts described above, few communities have implemented nitrogen remediation programs that will meet water quality standards.

Cost has been the major impediment to wastewater plans on Cape Cod. The existing wastewater costs to homeowners are hidden. Most people don't recognize the annualized expense of owning and maintaining a Title 5 system.

More than 30% of the housing stock in the region is seasonal. In some Towns that figure is as much as 60%. This creates a peak-flow-pricing issue for most Towns because treatment facilities have to be sized for peak flow which happens four weeks a year, the last two weeks of July and the first two weeks of August. Less than 4% of the state's population lives on Cape Cod yet the region is home to 20% of the Title 5 systems.

Towns need to stimulate their tax base in order to afford the wastewater costs necessary to meet water quality standards and, at the same time, the economic development necessary to achieve that result is limited by the problem that needs to be solved. Without additional ability to treat wastewater, towns don't have the capacity for appropriate patterns of growth that don't add to the cost of remediating our marine ecosystems.

Progress on water quality issues related to wastewater is always challenging. The solutions are generally expensive

and it is difficult to get people to care what happens after they flush. Education efforts on Cape Cod have been successful in identifying wastewater as a problem but more work is necessary for a majority of people to recognize that septic systems contribute most to the problem.

Local planning and zoning were ineffective in stopping sprawled residential development that increases the cost of conventional wastewater solutions.

The regulatory framework in place was built to solve other problems. Existing regulatory drivers overbuild expensive solutions dependent on point-source technologies to solve a nonpoint source problem. This doesn't account for the unique challenges of Cape Cod as a coastal community with a marine water quality issue caused by nutrients and a relatively low-density development pattern.

The politics of wastewater is difficult. On the Cape, towns are the primary fiscal agents involved in building wastewater systems. Appropriations on a municipal level that authorize borrowing require a two-thirds vote of the local legislative body. In the Town of Barnstable that is the Town Council. In the other 14 towns the legislative body is town meeting.

ENFORCEMENT

Federal and state enforcement tools are imperfect and rely on permitting dischargers. Current enforcement actions would lead to expensive compliance requirements without resulting in achieving water quality goals.

A New Approach

Overcoming these significant challenges to restoring many of Cape Cod's marine ecosystems requires a new approach. The §208 Plan Update reflects a new approach with five basic principles.

The plan is watershed based. The most effective and efficient solutions are found by beginning the consideration of solutions within the jurisdiction of the problem.

The plan leverages existing local plans by making use of the enormous amount of data and input already collected by Towns as part of their comprehensive wastewater management planning to date.

All solutions are considered – everything has to be on the table. The plan takes into account all technologies and strategies that may be successful on Cape Cod. It evaluates each individually and then looks for appropriate places for its use as part of a watershed scenario.

The purpose of the plan is to set the parameters for the discussion of solutions on a watershed basis. The watershed scenarios developed represent a range of options. They do not suggest an optimal solution.

Cost is considered as part of every watershed scenario and the impact on individual homeowners is a primary concern. If a solution isn't affordable, it's not doable.

EXECUTIVE SUMMARY

The Cape Cod Model

COMMUNITY ENGAGEMENT

The Cape Cod Commission committed to an extensive public engagement process to bring more voices to the table in order to develop consensus around a range of solutions to solve water quality problems. The public participation and engagement process consisted of both Cape-wide, sub-regional watershed groupings and watershed specific opportunities.

EXISTING TEAMS

Existing Cape-wide organizations already working on wastewater and nutrient management issues were enlisted to avoid redundant effort, transfer existing knowledge, expertise and data sets.

CAPE COD WATER PROTECTION COLLABORATIVE GOVERNING BOARD AND TECHNICAL ADVISORY COMMITTEE

The governing board of the Collaborative reinstated its monthly meetings in May 2013 to follow the §208 Plan Update process. The governing board is a 17-member board that approves all expenditures, policies and strategies of the Collaborative. Membership consists of an appointed member from each town in addition to two County Commissioners' appointees.

The Technical Advisory Committee (TAC) of the Cape Cod Water Protection Collaborative was reformed and rechartered

to look at some of the technical aspects of the §208 Plan Update. Specifically, the TAC reviewed and commented on the technologies matrix and helped to develop and refine a series of one-page fact sheets for watershed stakeholders and community use. The TAC consists of one appointed representative from each town and a MassDEP representative to provide the regulatory, permitting and technical perspectives.

NEW TEAMS

Temporary teams were created, as necessary, to provide overall guidance on the plan's progress and separate subject matter advice. Each team established a timeframe for performance and an agreed upon statement of purpose.

REGULATORY, LEGAL AND INSTITUTIONAL TEAM

A Regulatory, Legal, and Institutional (RLI) Work Group, with representation from MassDEP, US EPA, the Cape Cod Commission, and other State and Federal partners, as necessary, addressed the potential need for regulatory reform and other challenges associated with planning and implementation. Increased coordination between local, state and federal regulatory requirements was identified by the Commission as a need moving forward and the group meets monthly to discuss this and other opportunities and challenges related to the §208 Plan Update.

ADVISORY BOARD

A six-person advisory board, which meets monthly, was convened with representation from the four subregional planning

areas, along with two ad hoc members. Members have current or prior experience in municipal government and/or experience with other regional-scale issues, such as the groundwater cleanup at Joint Base Cape Cod and regionalizing school districts. The mission of the board is to support the §208 planning process by providing advice on the overall approach, reviewing draft work product and offering insight on strategic and tactical decision-making.

FINANCE COMMITTEE

A Finance Committee, which meets monthly, was convened with representation from local communities and support from consultants to the Cape Cod Commission for the §208 Plan Update. Members include a town administrator, a finance director, and a municipal finance committee member. The mission of the committee is to work with the consultants to the Commission to establish a factual basis for discussing issues of affordability, financing, and resources related to the §208 Plan Update.

TECHNOLOGIES PANEL

A Technologies Panel, which met four times over the course of two months, was convened to review, confirm, and expand upon the matrix of technology options developed through and used in the §208 Plan Update process, review the overall planning approach in each watershed, and provide input on a site screening methodology for green infrastructure technologies. The panel consisted of local, national, and international experts on the impact of nutrients in coastal waters, remedia-

tion approaches, and emerging technologies.

MONITORING COMMITTEE

A Monitoring Committee, which meets monthly, was convened in April 2014. The mission of the committee is to provide advice and guidance on appropriate monitoring protocols for technology efficiency and total maximum daily loads, while identifying a process for consolidating all available monitoring data in a central location and format. Members include representatives from MassDEP, US EPA, academic institutions, non-profit organizations, and other government agencies. Among the roles and responsibilities of this committee are to:

- Establish performance monitoring protocols for technologies that may be a part of watershed permits in the future;
- Establish compliance monitoring protocols for meeting total maximum daily loads (TMDLs) in the water body;
- Establish process and structure for consolidating and cooperation of existing monitoring programs and data in to a centralized location; and
- Identify region-wide monitoring needs and develop proposals.

WEB-BASED CAPE-WIDE ENGAGEMENT

In an effort to reach groups not normally associated with wastewater or planning project in general we employed a web-based cape-wide engagement project. In conjunction with

Emerson College's Engagement Game Lab and using their Community PlanIt platform to create and run CAPE20, an on-line game-based engagement tool. Two different three-week games saw more than 900 people register and generated more than 6,000 comments on water quality issues. CAPE20 introduced players to the nutrient problems on Cape Cod through different problem-solving perspectives including science, civics, economics and consensus building.

STAKEHOLDER ENGAGEMENT

WATERSHED WORKING GROUPS

Working groups, made up of 15-20 self-selected stakeholders (about 170 people Cape-wide), are associated with each watershed group and subregional group. Each working group consists of the following general representation:

Local Elected Officials, Wastewater Committee Members, Town Professional Staff, Local Business Owners/Operators, Local Environmental Organizations, Civic Group Members, Alternative Technology Interests, Development/Real Estate Community and Interested/concerned citizens.

In Fall 2013, each working group met three times in four-hour-long meetings – once in September to discuss the baseline information in each of their watersheds, including land use, nitrogen related water quality impairments, pond water quality, and existing and proposed infrastructure, once in October to discuss the range of technologies and approaches

that might be used on Cape Cod, and once in December to discuss the process for applying technologies and approaches in each watershed.

SUBREGIONAL WORKING GROUPS

To start the stakeholder process, two meetings were held in each of the four subregions – one in July 2013 to introduce the process and develop the watershed working groups and one in August 2013 to introduce information around affordability of infrastructure and discuss what people on Cape Cod are currently paying for water and wastewater infrastructure. These meetings helped to engage the communities and establish the watershed working groups discussed above.

Following the three sets of watershed working group meetings the conversation shifted from discussing the jurisdiction of the problem, at the watershed level, to the jurisdiction of the solution, at the subregional level. In early 2014, watershed working groups were asked to self-select in to subregional groups, with representation from each of the watershed working groups and in each of the categories established as part of the watershed working group process.

The structure of the subregional meetings was different from the watershed working group meetings, which had discrete topics associated with each meeting. The subregional meetings were iterative, with a standing agenda that included scenario planning; regulatory, legal, and institutional issues; and implementation. Meetings included representation from MassDEP and US EPA Region 1.

EXECUTIVE SUMMARY

CAPE-WIDE MEETINGS

On November 13, 2013, the Commission held a Watershed Event to conclude the Cape20 game, award prizes to participants and provide funding to top projects associated with the game. About 120 people attended, including stakeholders and Cape20 players, regulatory agency staff, and members of the public. Speakers included Cape and Islands Senator Dan Wolf, as well as representatives from the US EPA and MassDEP. In addition to discussing the outcomes of the Cape20 game the time was used to begin the discussion around structuring the second half of the stakeholder engagement process – the subregional working group meetings.

On February 6, 2014, the Commission held a day-long Stakeholder Summit to review the work to date and discuss the path forward toward development of the draft §208 Plan Update. About 270 stakeholders, regulatory agency staff, and members of the public attended the event. Speakers included the State Treasurer, MassDEP Commissioner, CEO of the Cape Cod Chamber of Commerce, representatives from the US EPA and the Cape Cod Commission. The discussion focused on the importance of community involvement in the §208 planning process and the need to meet water quality goals in Cape Cod's estuaries. Breakout sessions included preliminary conversations on scenario planning, regulatory, legal, and institutional issues, and implementation issues, in order to set the stage for the upcoming Subregional Working Group sessions.

TECHNICAL REVIEW

A WATERSHED APPROACH

A watershed approach looks at the jurisdiction of the problem – all of the contributing sources within a watershed (or the receiving water itself), without regard to political boundaries. A watershed is a geographic area separated from other regions by drainage divides, within which all water flows to a common outlet, such as an embayment. There are 105 watersheds that flow to the surrounding marine waters of Cape Cod. Fifty-seven of those are watersheds flowing to semi-enclosed coastal embayments. The remainder flow directly to Cape Cod Bay, Nantucket Sound, Buzzards Bay or the Atlantic Ocean.

Watersheds do not follow the municipal boundaries separating one town from another. Of the 57 watersheds to coastal embayments addressed in this document, 32 are shared by more than one town. Although much good wastewater planning has been underway on Cape Cod for more than a decade, the current process remains uncoordinated and in many areas represents only a partial solution to the problem resulting in approval of municipal CWMP's that will not meet water quality standards in shared water bodies.

SOLUTIONS CLASSIFIED AND EVALUATED

This report examines 10 categories and a total of 67 nutrient reduction and remediation technologies and approaches. Both conventional and alternative means are represented in those groupings. This work is embodied in the Water Quality

Technologies Matrix and then simplified based on the point of intervention and the scale of the technology or approach.

At what point in the nitrogen cycle the intervention takes place determines if the effort is reducing the nitrogen load at the source or reducing the impact of nitrogen already loaded into the ground water or the affected water body. This report classifies technologies and approaches as Prevention, Reduction or Remediation interventions.

Technologies and approaches considered can be more or less effective and efficient depending on the scale of use. This report groups them based on Site, Neighborhood, Watershed or Cape-wide applicability. It is important to note that not every technology and approach is appropriate for every watershed. Evaluation of these options with the tools developed as part of the 208 update and detailed below is necessary as a preliminary step placing selected options in a watershed-specific scenario.

INFORMATION AND DECISION SUPPORT TOOLS

The process of collecting and analyzing such a large and comprehensive amount of information and a need to organize and analyze many geospatial data layers simultaneously produced a number of important new information products. These new decision support tools and the supporting databases and methodologies will be available through the Cape Cod Commission's Watershed Team technical assistance program. These tools will make complex data sets more easily understood and provide an avenue for increased informed deliberation at the

local and hyper-local planning levels. This will expedite the selection and implementation of watershed solutions.

These tools include the following:

- **WatershedMVP (multi-variant planner):** A dynamic web-based, geospatial scenario planning tool developed by the Cape Cod Commission that allows technical experts and the general public to compare various wastewater treatment options at scales ranging from the neighborhood, watershed and subregional level.
- **Watershed Tracker:** A companion tool to WatershedMVP that tracks parcel-specific wastewater loads to subembayments within a major watershed for analysis of strategic removal to non-nitrogen sensitive areas.
- **Watershed Calculator:** A tool used in the adaptive management framework to track cumulative nitrogen reductions through the layered application of technologies in specific watersheds to meet reduction targets.
- **Barnstable County Cost Report Update:** An update by AECOM to the 2010 Wright-Pierce report on Cape-wide collection, treatment, and disposal costs prepared to provide an updated basis for financial decisions in the §208 Plan Update.
- **Triple Bottom Line (TBL):** A tool to consider the financial, environmental, and social consequences of water quality investments and policies on Cape Cod by evaluating downstream consequences of water quality investments to reduce nutrients.
- **Triple Value Simulation (3VS):** A sustainability assessment tool that considers the broader environmental and societal costs of environmental degradation based on community actions, as represented by model inputs.
- **Technologies Matrix:** A flexible, dynamic and continually updated source of information on currently available technologies for collection, treatment, disposal and solids processing and their applicability for use on Cape Cod.
- **Site Screening for Non-Traditional Technologies:** A GIS-based analysis of non-traditional technologies and approaches to weigh potential nitrogen attenuation enhancements, improvements to existing green infrastructure networks and conditions necessary to maximize effectiveness.
- **Financial Model:** A decision support tool that estimates the total cost to build, finance and operate a proposed set of wastewater solutions and determine if it is affordable to households, within the financial capacity of affected towns and evaluates potential revenue sources to pay for the scenario proposed.
- **Watershed Scenarios:** A set of possible actions and interventions to solve issues identified in the planning process and test the effectiveness of one or more combinations of potential solutions within a watershed.

TWO PERSPECTIVES FOR ONE PROBLEM

Implementation of wastewater solutions have failed to garner the 2/3rds Town Meeting votes necessary to appropriate money to build in most communities. Many of the plans have suffered a “death by a thousand cuts.” The arguments against tend to fall into three categories: Science, Solutions (proposed strategies and technologies) and Cost.

As noted above, a group of experts was empaneled to review the scientific underpinning of the Massachusetts Estuary Project and approved its use by communities in making directionally correct decisions regarding solutions.

This document outlines a technical review process designed to provide insight into the remaining two categories, Solutions and Cost. The concerns often resulted in polarizing local debates, sometimes discussed in terms of centralized versus de-centralized approaches or traditional solutions versus alternative solutions. One of the key distinctions depends on a considered option’s reliance on a permanent physical connection among multiple sources, a collection system. The process outlined in this report grouped points of view associated with these categorizations into two approaches to solving Cape Cod’s nitrogen problem, a traditional approach and a non-traditional approach.

EXECUTIVE SUMMARY

Two teams worked independently of each other in the application of agreed upon conditions.

- Both approaches consider the entire controllable load, not just MEP septic load targets.
- Both start with identified nitrogen reduction targets.
- Both agree that nutrient reduction goals can be adjusted based on a watershed's adoption of certain policies that will reduce or eliminate nutrient loading from certain sources, fertilizer reduction and stormwater management.
- Both approaches illustrate an attempt to solve the problem within the boundaries of the watershed as an environmentally preferable result when possible.
- As a mutual point of reference, the traditional team evaluated a hypothetical analysis of an "all sewer" scenario and compared it to an "all innovative/alternative septic system" scenario. Neither was a best choice for taxpayers or the environment. This evaluation suggested scenario approaches be targeted and mixed, where appropriate.

TRADITIONAL APPROACH PROCESS

The traditional (collection system) approach considered the greatest controllable source of pollution as a percentage of the whole, aggregated nitrogen in the most efficient grouping of sources, and suggested collection and treatment options.

Starting with the agreed upon nitrogen removal target, the review team applied low barrier technologies and approaches, applying nitrogen reduction credits to the watershed for fertilizer reductions and stormwater management. They targeted and identified nitrogen loads and an appropriate collection system to treat and dispose effluent within the watershed. Next the team adjusted the size of the necessary collection by considering treatment and disposal outside of the watershed. The process illustrates the cost and effectiveness of traditional strategies, potential economies of scale with shared treatment and disposal, and potential limitations to the environmentally preferred option of a watershed-based solution. The traditional approach provides an instructive backdrop for an adaptive management approach to managing nitrogen in watersheds.

NON-TRADITIONAL APPROACH PROCESS

The Non-Traditional (or enhanced natural systems) approach started with the premise that collection systems should be avoided or minimized to the greatest extent possible. Although conventional wisdom and practice suggests that economies of scale in the construction of wastewater treatment facilities result in the least expensive and most

effective treatment, there is valid concern that the case studies supporting this view are from more urban communities with existing but degraded infrastructure. Cape Cod is missing both of these qualifications, having neither the urban designation or corresponding density characteristics nor the existing infrastructure. Cape Cod has less than 4% of the population of the state and 20% of the septic systems and only 3% of the parcels and 11% of the wastewater flows on Cape Cod are centralized. The Cape also has an attribute not shared by other communities - its seasonal second home owner economy, which creates a peak-flow problem when building wastewater treatment facilities and creates a situation where facilities are overbuilt for 48 of 52 weeks a year.

Additionally, there are people in every community advocating for wastewater solutions that rely less on structural interventions and that may be less sustainable over time than strategies that favor enhanced natural systems. The technologies and strategies prioritized in the non-traditional approach also tend to result in less movement of water between watersheds and put a greater emphasis on comprehensive system restoration or improvement.

The non-traditional approach team began with the same nitrogen removal target as the traditional team and applied low barrier technologies and approaches, assigning nitrogen reduction credits to the watershed for fertilizer reductions and stormwater management. It then considered an array of watershed/embayment options, as detailed in the Technologies Matrix, consisting of a broad range of innovative and

non-traditional nitrogen management strategies to either intercept and treat nitrogen in the groundwater or to assimilate and treat them in the receiving waters.

Watershed practices include permeable reactive barriers (PRBs), constructed wetlands, phytoremediation, and fertigation wells, among others. Embayment treatment practices include, but are not limited to, shellfish bed restoration, aquaculture, floating wetlands, dredging and inlet modifications.

The next step considered alternative on-site options that have been screened for geographic suitability. A number of alternative wastewater source controls were evaluated in this step. These include ecotoilets and I/A septic systems. Ecotoilets are alternative toilets that target the source within the building. These include urine diversion (UD), composting, incinerating, and packaging toilets where the waste materials are collected and temporarily stored before processing. These technologies allow little or no human waste to enter the septic system (only gray water from the shower, laundry and sinks).

Social acceptability and significant, but improving, regulatory impediments had the team using these strategies in a targeted way, schools for example.

The non-traditional approach produced a targeted starting point for consideration as part of an adaptive management program in most watersheds.

A HYBRID APPROACH

Although two independent watershed evaluation strategies were used the results have produced a recommended watershed planning approach. Included in this approach is the consideration of additional non-nitrogen collection needs in the watershed.

ADAPTIVE MANAGEMENT

This recommended approach creates a predictable framework for adaptive management. It will allow communities to move forward in a targeted manner to begin to address marine water quality issues now.

MONITORING

In order for a broader range of technologies and options to be considered a long-term monitoring program should be established to provide technology specific monitoring protocols to assess the effectiveness of deployed technologies as well as an enhanced water quality monitoring program in the degraded water bodies.

Conclusion

The plan outlines a path forward with recommendations for implementation. It also identifies areas where more information is needed, where more support can be offered, where regulatory reforms are necessary and suggests options for additional financial support.

Section 208
Area-Wide Water Quality
Management Plan Update
Lower Cape Area



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