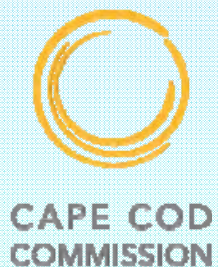
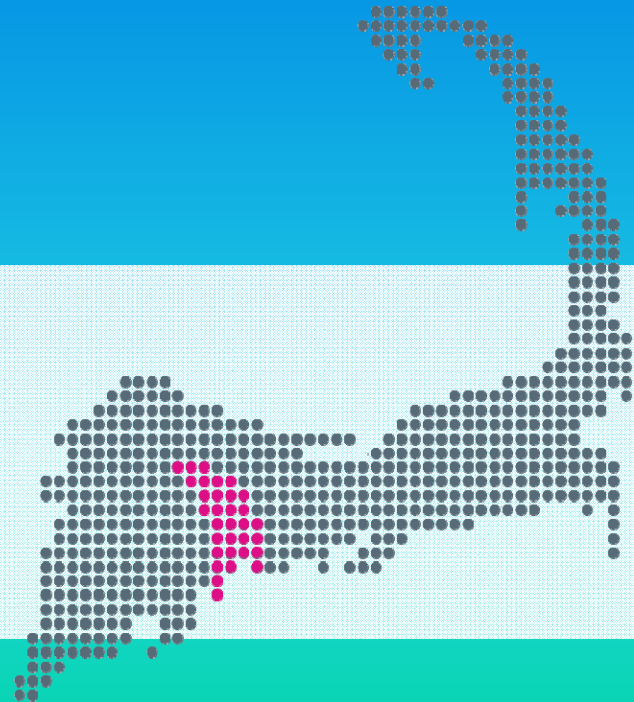


Water Quality and Cape Cod's Economic Future: Nitrogen Pollution's Economic Impact on Homes and Communities



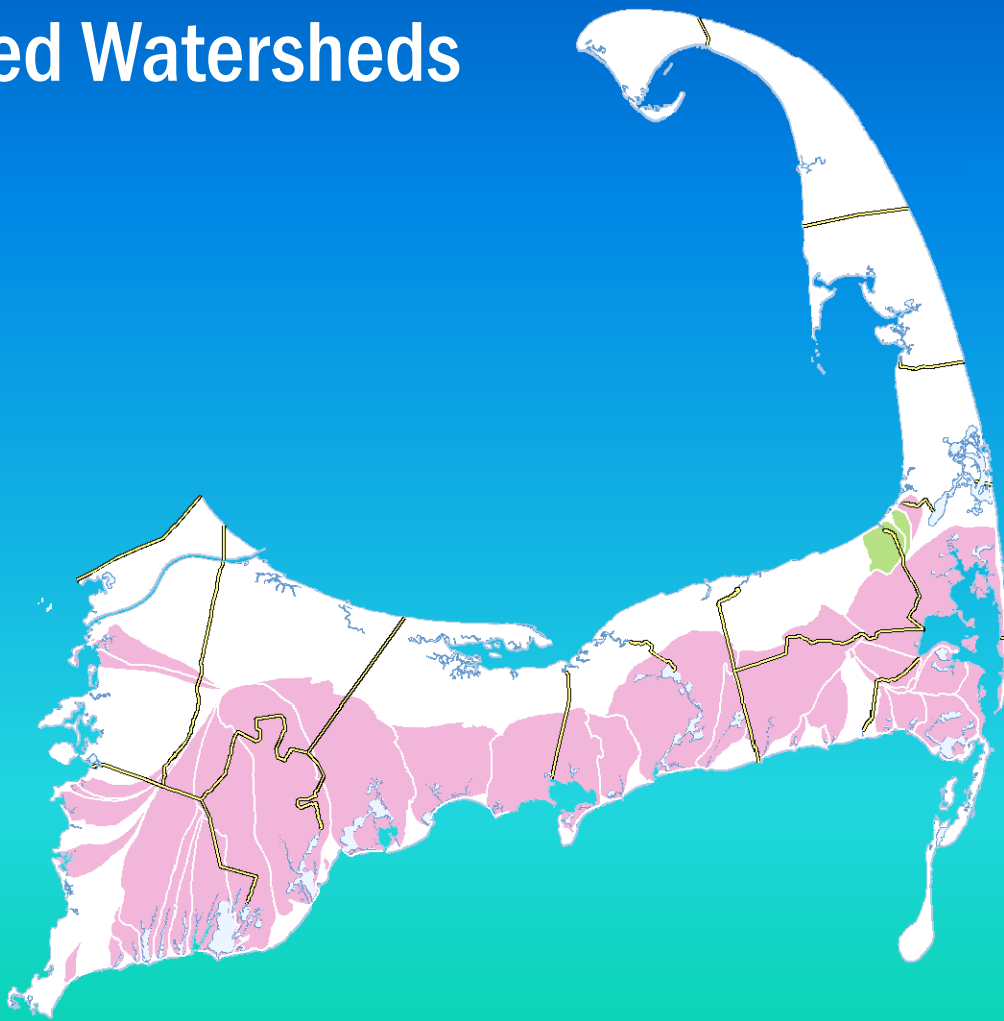
Mahesh Ramachandran, Ph.D.
Environmental Economist
Cape Cod Commission





NITROGEN POLLUTION

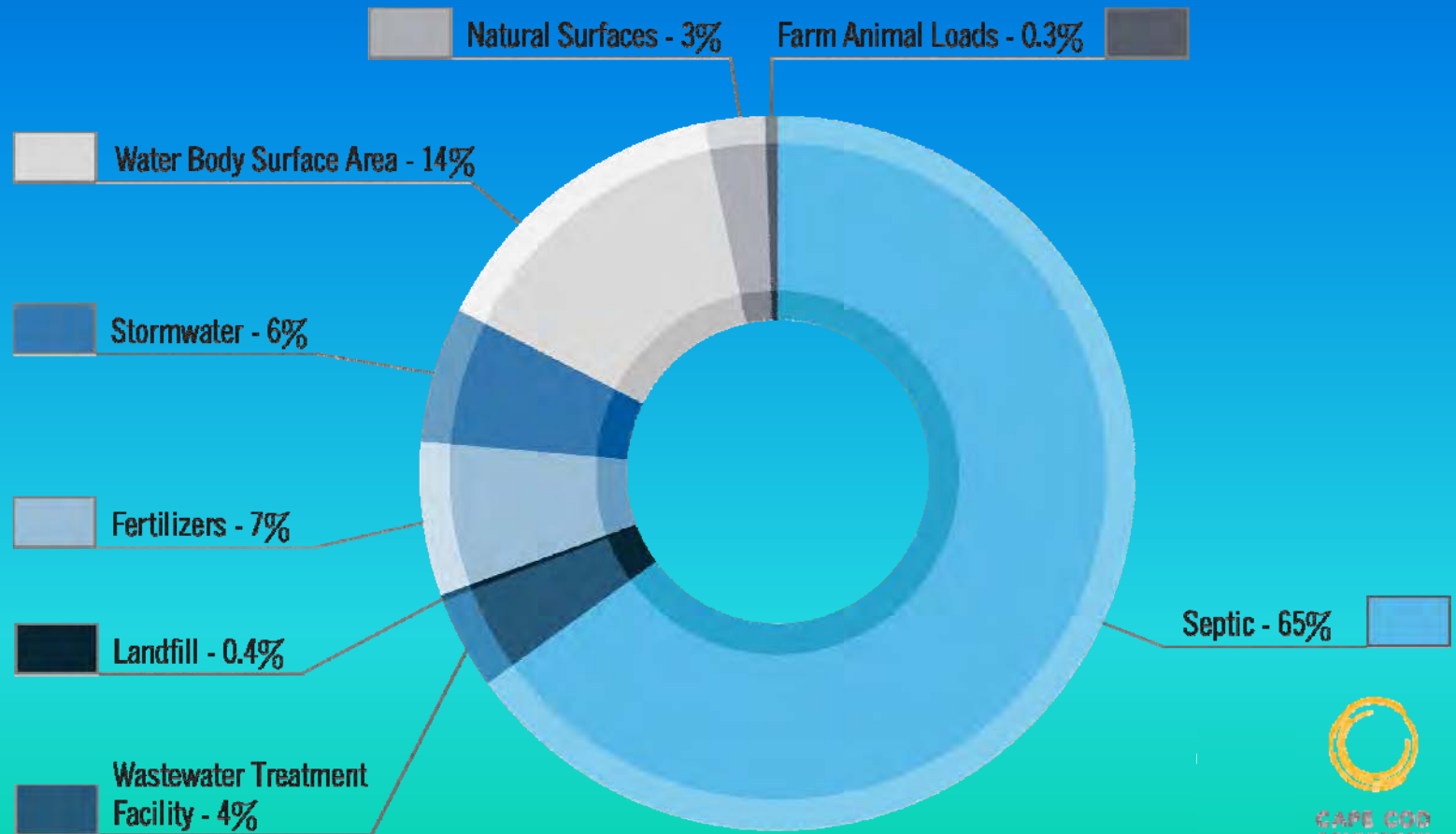
Nitrogen Impacted Watersheds



- Excess Nitrogen Watersheds
- Watersheds without Excess Nitrogen



Sources of Nitrogen



What effect would reduced water quality have on Cape Cod?



=



=



- EUTROPHICATION
- ALGAE BLOOMS
- LOSS OF EELGRASS
- LOSS OF FISH HABITAT
- SHELLFISH CLOSURES
- DECAYING ALGAE
- AESTHETIC IMPACTS
- TOURISM IMPACTS
- FEWER JOBS
- REDUCED REVENUE
- REDUCED PROPERTY VALUE

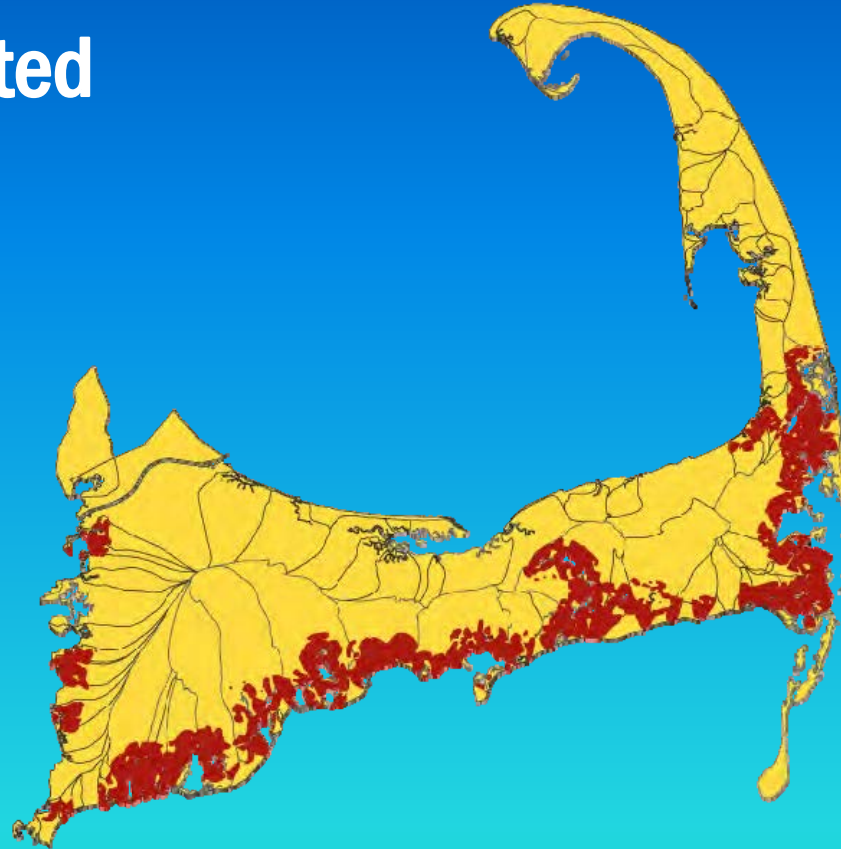


CAPE COD
COMMISSION

Coastal Properties Impacted



PROPERTIES
WITHIN 10 MINUTE
WALK OF NITROGEN
IMPAIRED WATERSHED



SAFE COD
COMMISSION

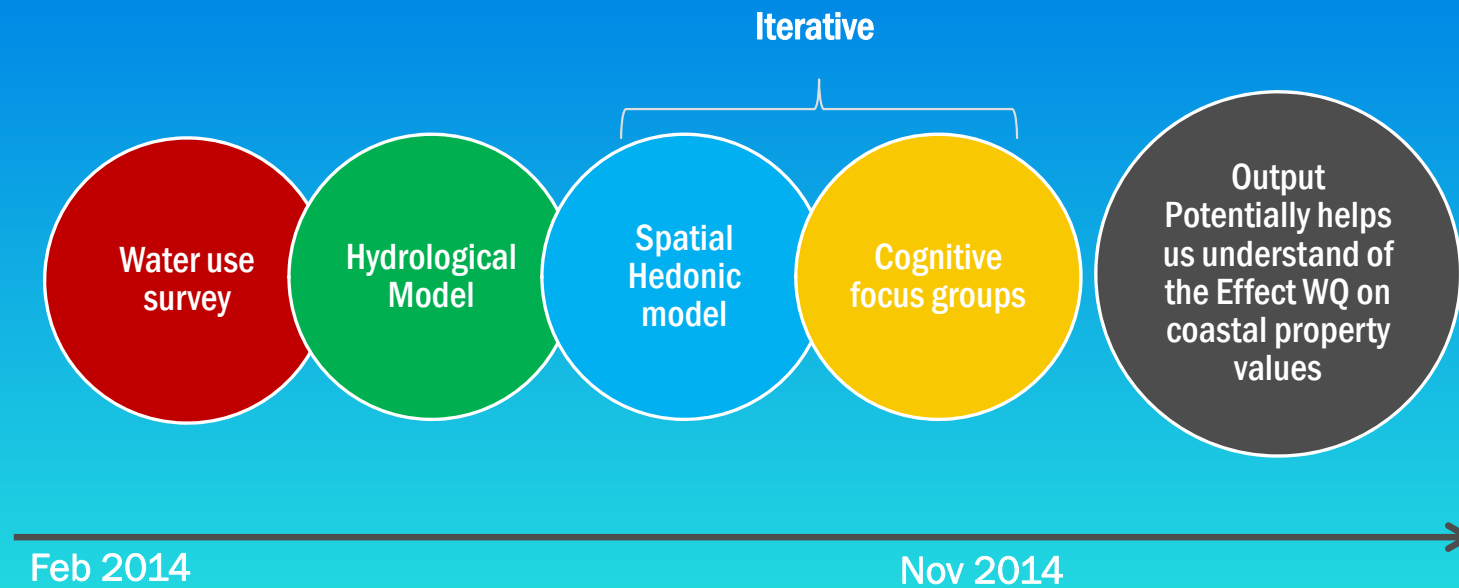
Research Question

Does increase in nitrogen concentration (decrease in water quality) affect coastal property values? If so by how much?



SAFE COB
COMMISSION

Project Map

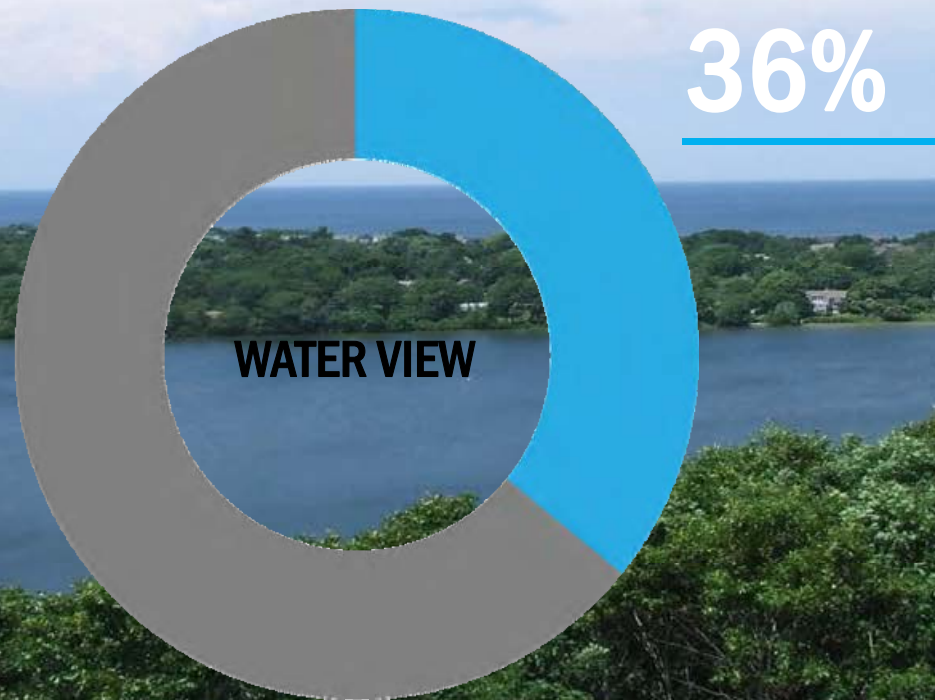




Survey Results

Photo Location: Prince Cove, Three Bays, Cape Cod

WATER ACTIVITIES RESIDENTS ENJOY?



WATER ACTIVITIES RESIDENTS ENJOY?



24%

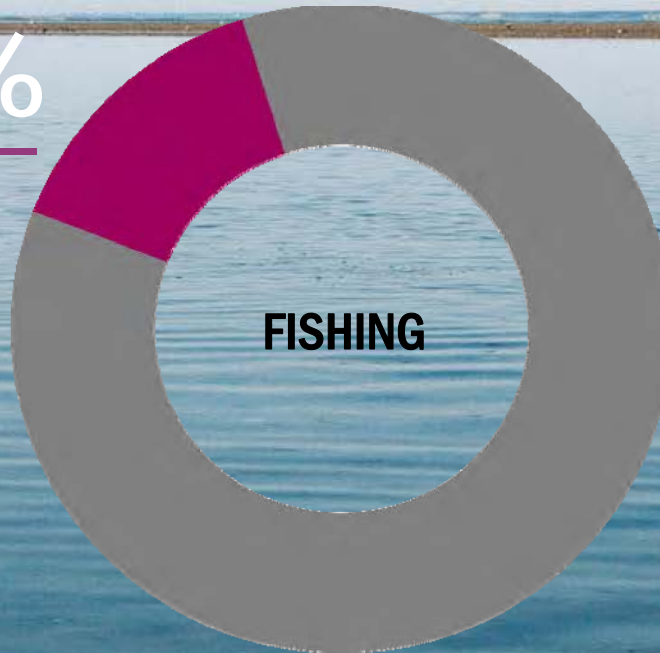
WATER ACTIVITIES RESIDENTS ENJOY?



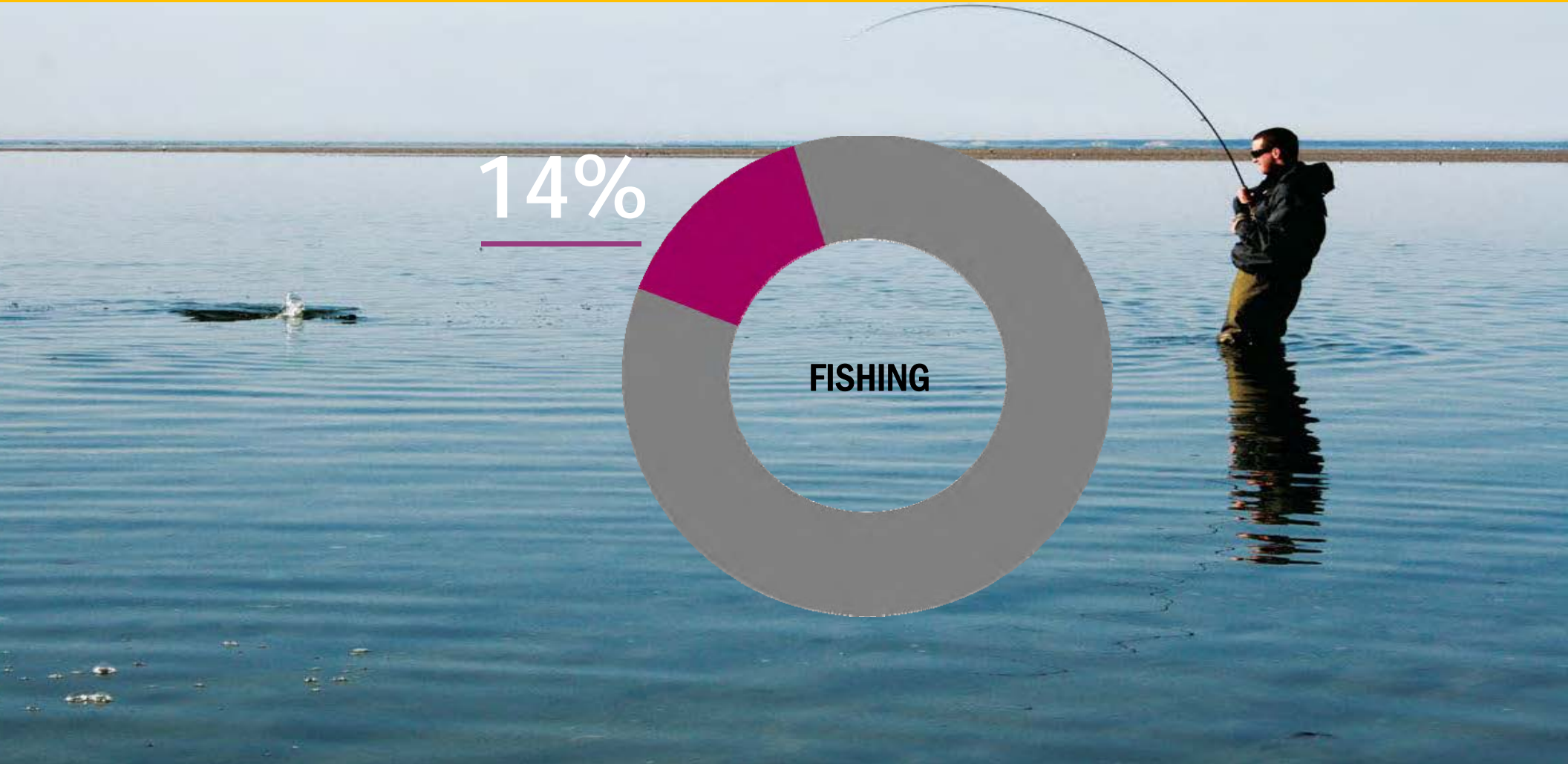
21%

WATER ACTIVITIES RESIDENTS ENJOY?

14%



FISHING



How would reduced water quality change your behavior?

SURVEY



8%
Would leave
Cape Cod



12%
Would
change
behavior



THREE BAYS STUDY SITE



LOCATION: BARNSTABLE, MA

Size: 19.46 Square Miles

Households in embayment: 6,285

WATER QUALITY: **IMPAIRED**

2,435

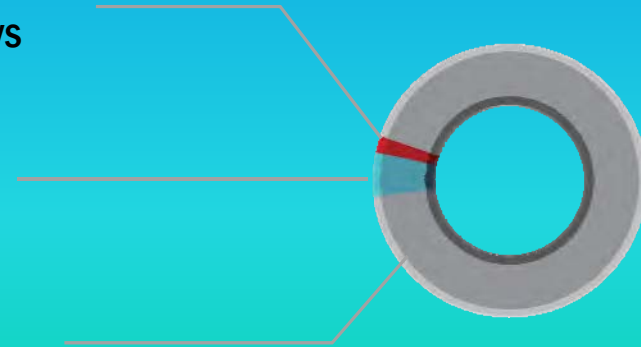
Households within 10
Minute walk of water in 3 bays

6,285

Households in 3 bays

120,117

Households on Cape Cod

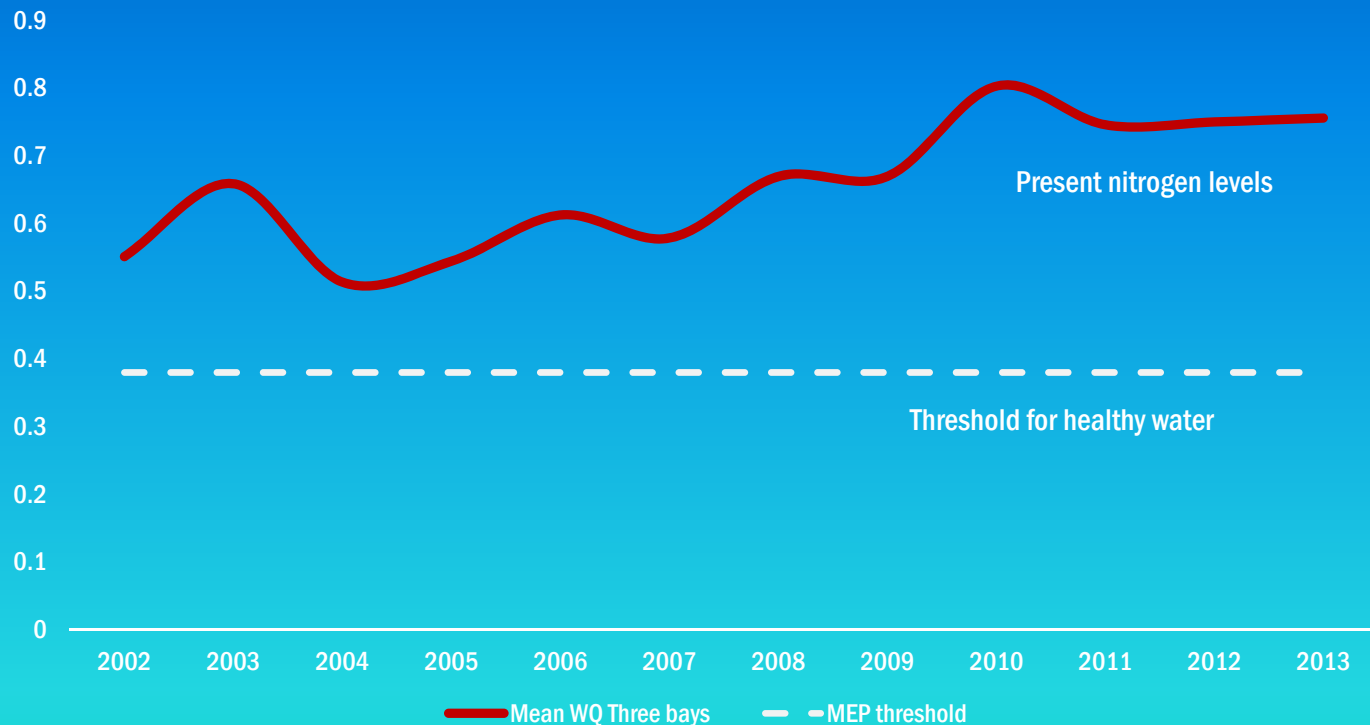


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Water Quality

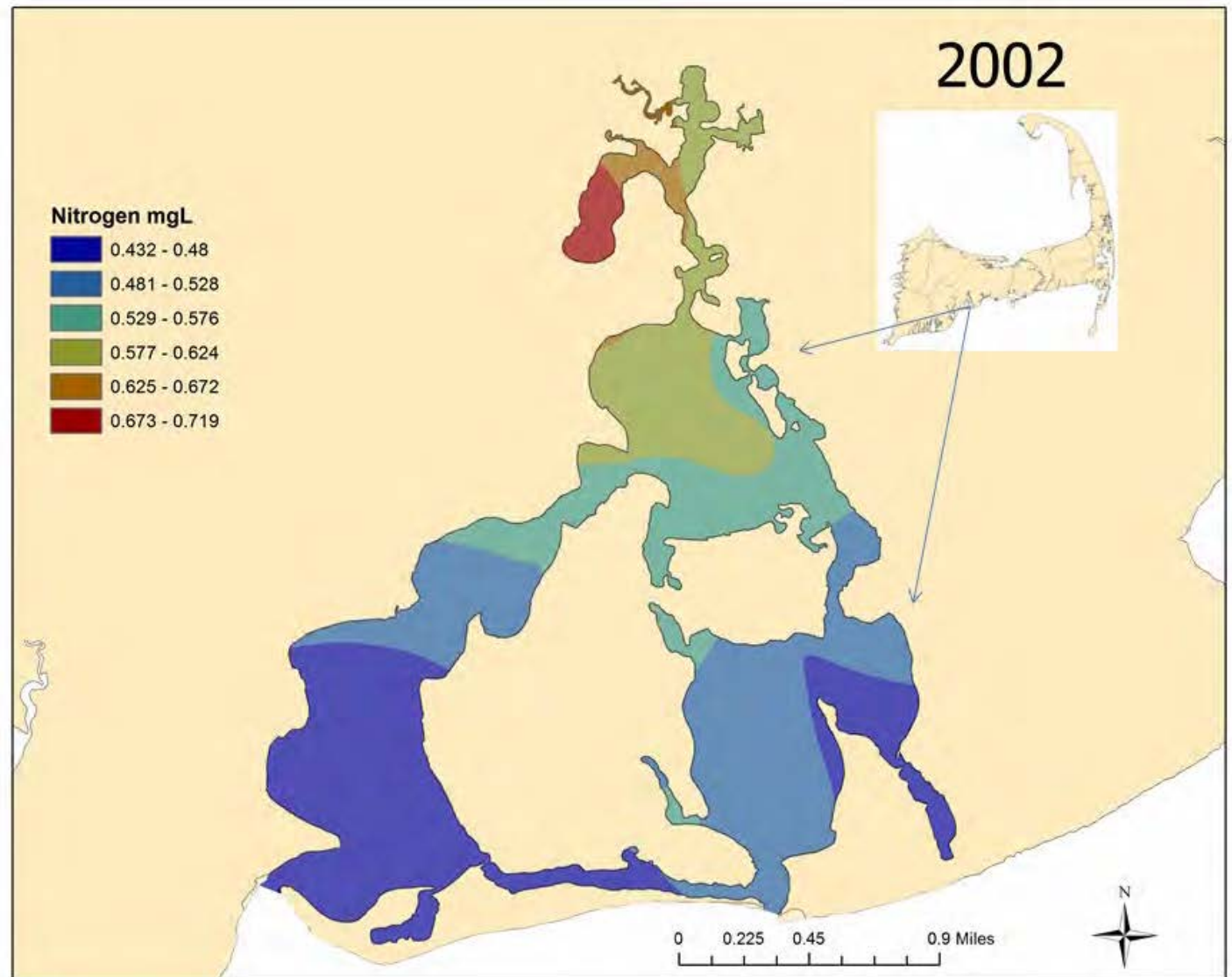
Nitrogen Concentration Levels in Three Bays, Cape Cod



Massachusetts Estuaries Project's Threshold is the ideal level of nitrogen for a healthy water body



Spatially Interpolated Model of Nitrogen concentration in Three Bays





Hedonic Analysis & Focus Groups



What is hedonic analysis?

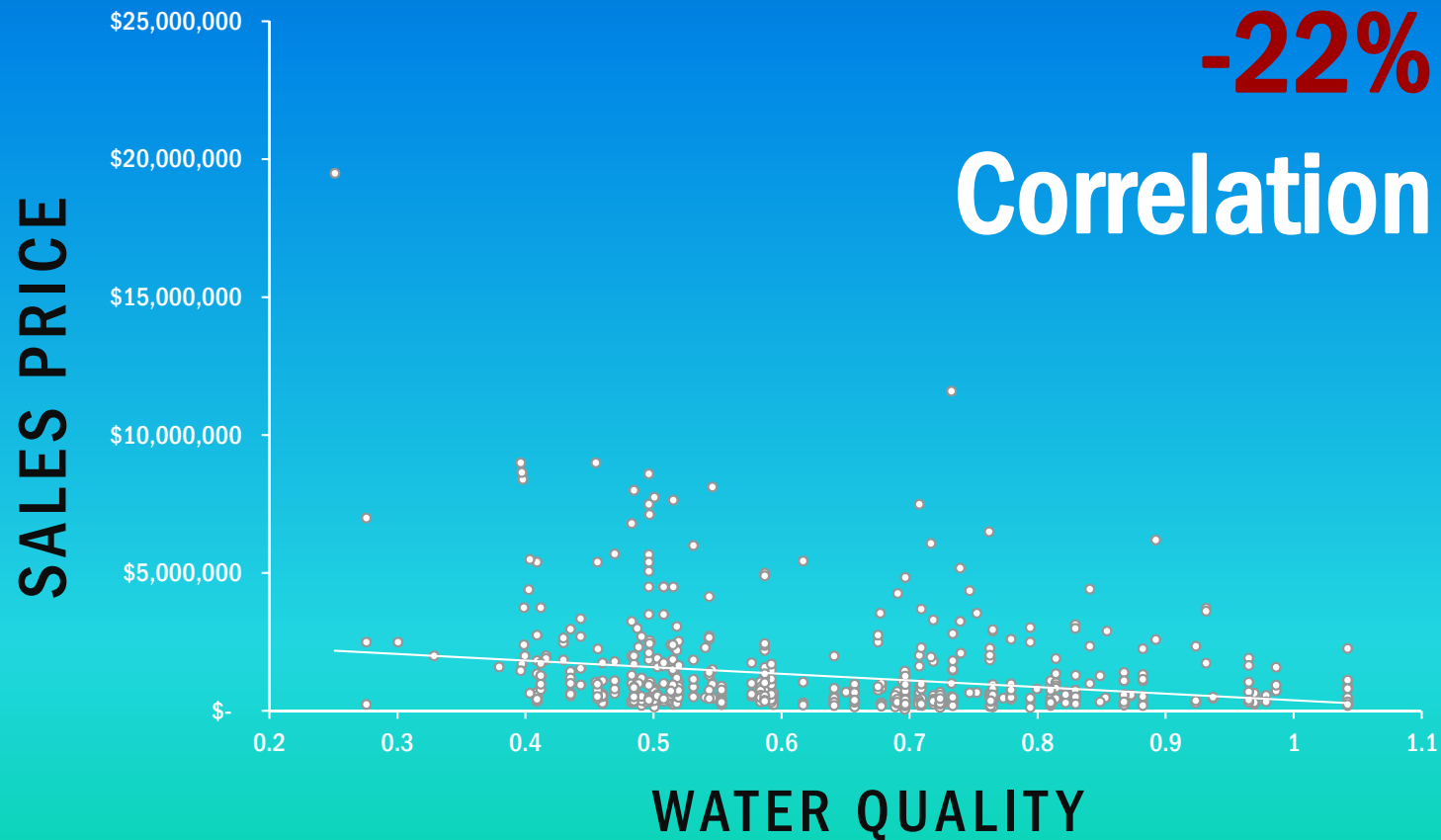
1. In the real world, decision to buy homes are based on number of factors (like location, property characteristics etc.)
2. However homes are sold as a single unit, and the sale price does not "itemize".
3. In Hedonic analysis, we try to reverse engineer by disaggregating a single home price into "itemized" values or implicit prices of amenities and disamenities



Data overview

- Study period 2005-2013
- Single-Family Property sale prices
- Property attributes from assessment data
- Water Quality data from 18 monitoring stations
- GIS – parcel maps and embayment





Spatial Hedonic Model

$$\begin{aligned} \ln(\text{Price}) \\ = & \beta_0 + \beta_1 \text{waterfront} + \beta_2 \ln(WQ) + \beta_3 \ln(\text{Distance}) + \gamma'X + \varphi'Z \\ & + \psi'L + \varepsilon \end{aligned}$$

The terms X , Z and L are vectors of property attributes, binary variable controls, for unobserved fixed effects and time periods.

Estimation Strategy: Random Effects Generalized Least Squares

Water Quality Perception Issue

Poor et al. (2001, p. 484), “While these data may be scientifically accurate, individual consumers are more likely to make purchase decisions based on their subjective perceptions of [quality], which may or may not be correlated with scientific measures. Unless these scientific measures serve as a suitable proxy for relevant perceptions, the use of these measures in hedonic property-value models may create an error-in-variables problem for the estimation of implicit prices of environmental quality (Lang and Jones 1979; Atkinson and Crocker 1987).”

Wanted



Human molecule

Outreach Partner

THREE BAYS
PRESERVATION, INC.

EVENTS PROJECTS RESOURCES SCIENTIFIC ABOUT [DONATE](#)

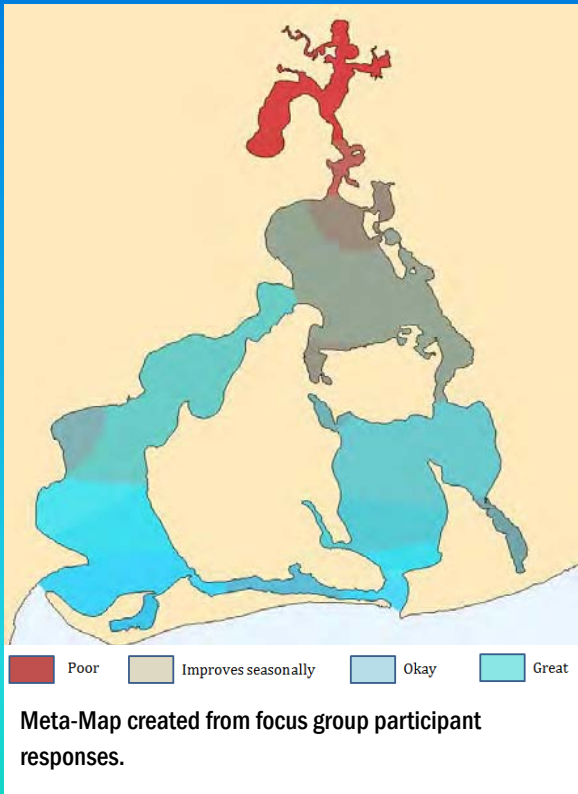
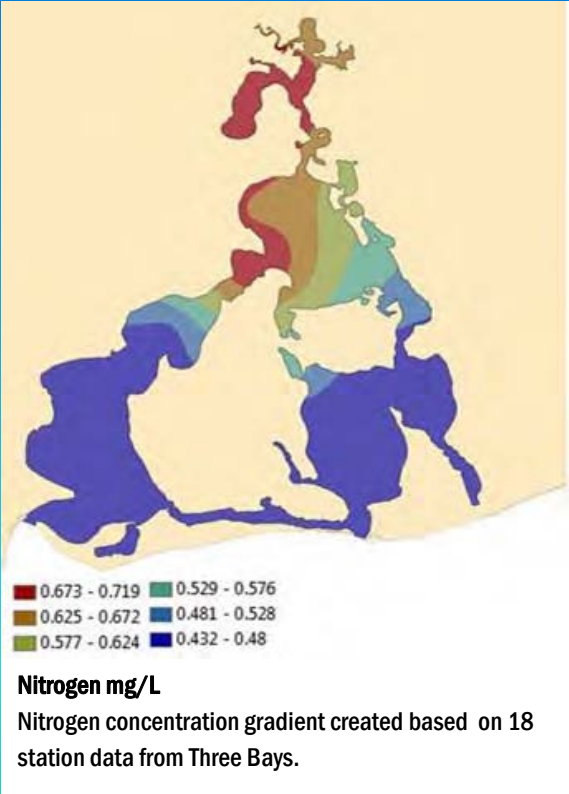
Sustainability
STARTS WITH YOU
[LEARN MORE](#)

Preserve, Maintain, Protect and Enhance

We are a group of residents who came together in 1996 to address the troubling problems of pollution in our beloved Cotuit, North, and West Bays, as well as the rapid erosion of the barrier beaches of Dead Neck/ Sampson's Island. In the 18 years since, more than 1,000 of our friends and neighbors have joined us in our efforts, and Three Bays Preservation has grown into a major organization of dedicated people who donate their time and resources for the preservation of our aquatic environment.

Focus group results :

Nitrogen concentration levels and water quality perception by residents based on daily use



Estimation Results

	Model (1)	Model (2)	Model (3)	Final Model
Water quality (Nitrogen levels)	-	-0.668*** (-7.69)	-0.673*** (-7.22)	-0.607*** (-5.95)
Waterfront	0.858*** (9.54)	0.839*** (9.83)	0.829*** (9.59)	0.900*** (9.75)
Distance from water	-0.205*** (-4.27)	-0.231*** (-5.05)	-0.229*** (-4.96)	-0.199*** (-3.99)
Distance to nearest public beach	-	-	0.00108 (0.04)	0.00588 (0.20)
Number of rooms in the home	-	-	-	0.0319*** (3.45)
Age of the home	-	-	-	0.0000821 (0.13)
Macroeconomic Influences and Market trend (Time fixed effects)	<i>Binary variables for 8 years (2005 - 2013)</i>			
Initial quality of construction of the property	<i>Binary variables for 19 levels of property quality</i>			
Constant	14.25*** (41.41)	14.05*** (42.87)	14.02*** (36.60)	13.63*** (33.19)
R-squared	68.00%	71.30%	71.30%	72.30%
Z statistics in parentheses				
* p<0.05 ** p<0.01 *** p<0.001				

Main Finding



After accounting for other factors

Property sale price was lower by 0.61% for every 1% increase in nitrogen compared to the level sale prices would have been had the water quality not decreased

An aerial photograph of a coastal landscape during the 'golden hour' of sunset or sunrise. The sky is a deep, dark blue, transitioning into a bright, golden glow over the water. The water's surface is textured with small waves and reflects the low sun. In the foreground, a dark, rocky coastline curves along the water's edge. The overall mood is serene and contemplative. The text 'So What?' is centered in the middle of the image in a clean, white, sans-serif font.

So What?

Water quality in Three Bays decreased by
15.8% between 2005-2013

IF
ACTION
HAD BEEN TAKEN IN
2005
TO REDUCE
NITROGEN
DISCHARGE



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IF THAT
ACTION
RESULTED IN
3% LESS
TOTAL NITROGEN BY
2013



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AVERAGE HOME PRICE WOULD BE

\$16,662

to

\$32,962

HIGHER IN

2013



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IN THREE BAY STUDY AREA
ALONE
THAT REPRESENTS A
\$41-80 MILLION
SALE VALUE LOSS



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CAPE-WIDE
LOSS COULD BE IN
HUNDREDS OF MILLION
OVER THE NEXT 30 YEARS



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If the value of coastal properties continue to get affected...

Potential additional property taxes every year on non-coastal properties



a scenario...



SAFE COD
COMMUNITY

For more information visit
www.capecodcommission.org/3bays



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