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# Nitrogen Loading and Water Quality on Cape Cod: Modeling the Costs of Inaction

Presentation by  
Industrial Economics,  
Incorporated

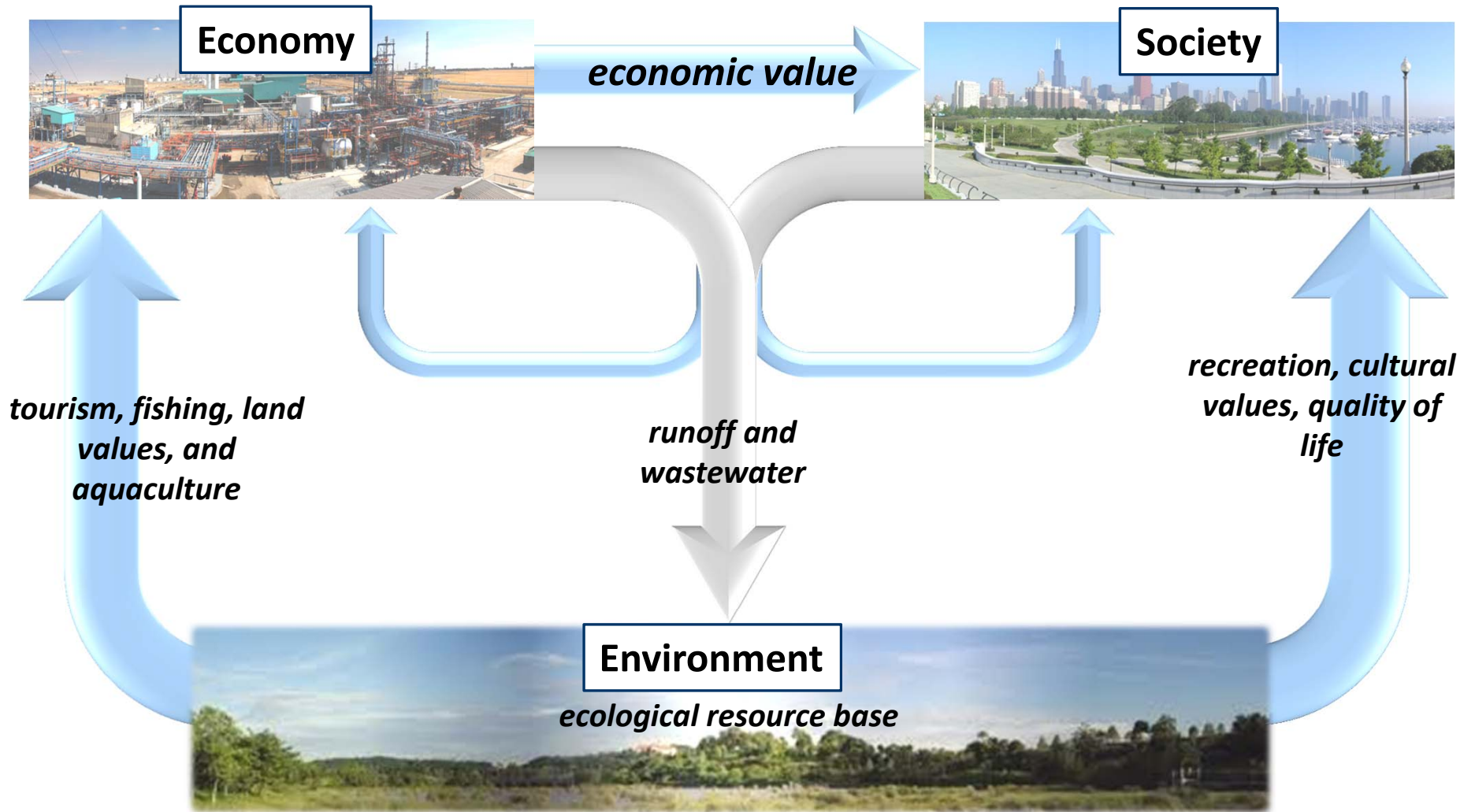
February 6, 2013

# Systems Thinking as a Sustainability Tool

## Sustainable Development



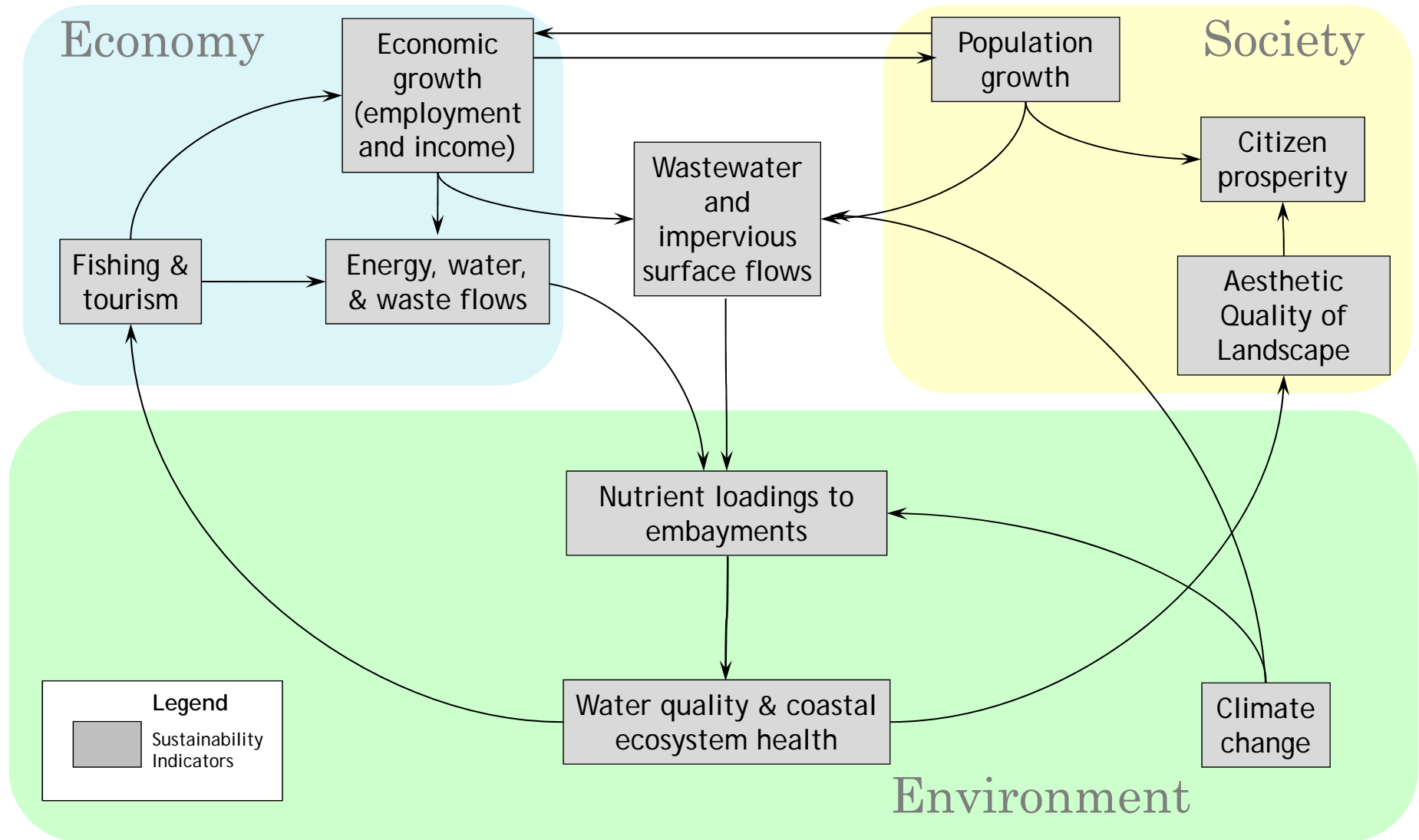
# “Triple Value” Framework



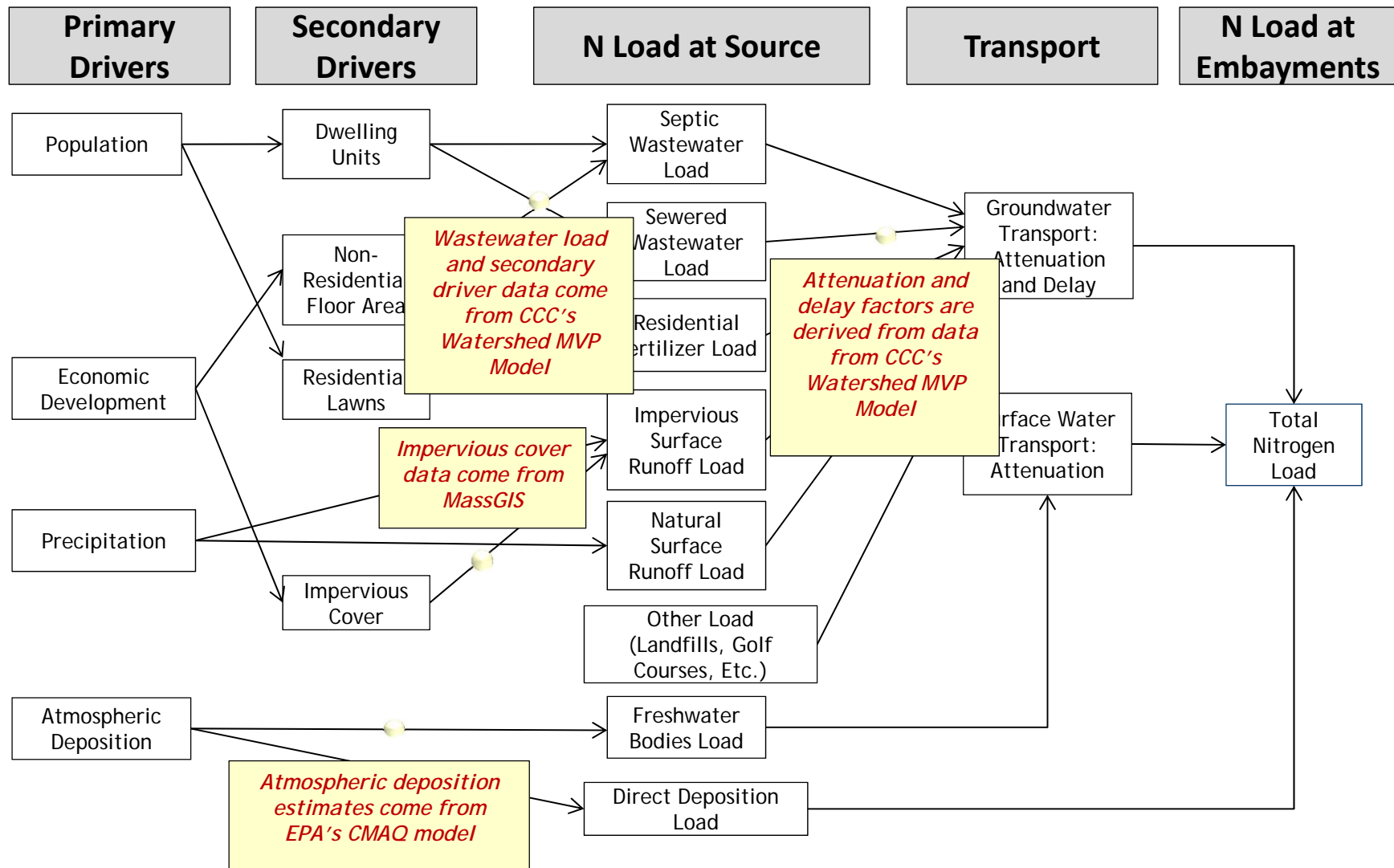
# Introduction to 3VS Modeling

- Systems dynamics models evaluate the implications of large-scale environmental changes, making explicit interactions between the **environment, communities,** and the **economy**.
- Users can define scenarios in the model, selecting different combinations of policy alternatives (including No Action).
- The 3VS model will simulate the scenario and project results 30 years into the future.

# Generalized Framework of 3VS model



# Cape Cod Model – Nitrogen Loading



# Cape Cod Model – Economic Indicators of Concern

Stakeholder outreach conducted by Adem Delibas (M.I.T.) identified key concerns with respect to increased nitrogen loading across the Cape:



## **Property Values (Primary Concern)**



Tourism spending



Household income

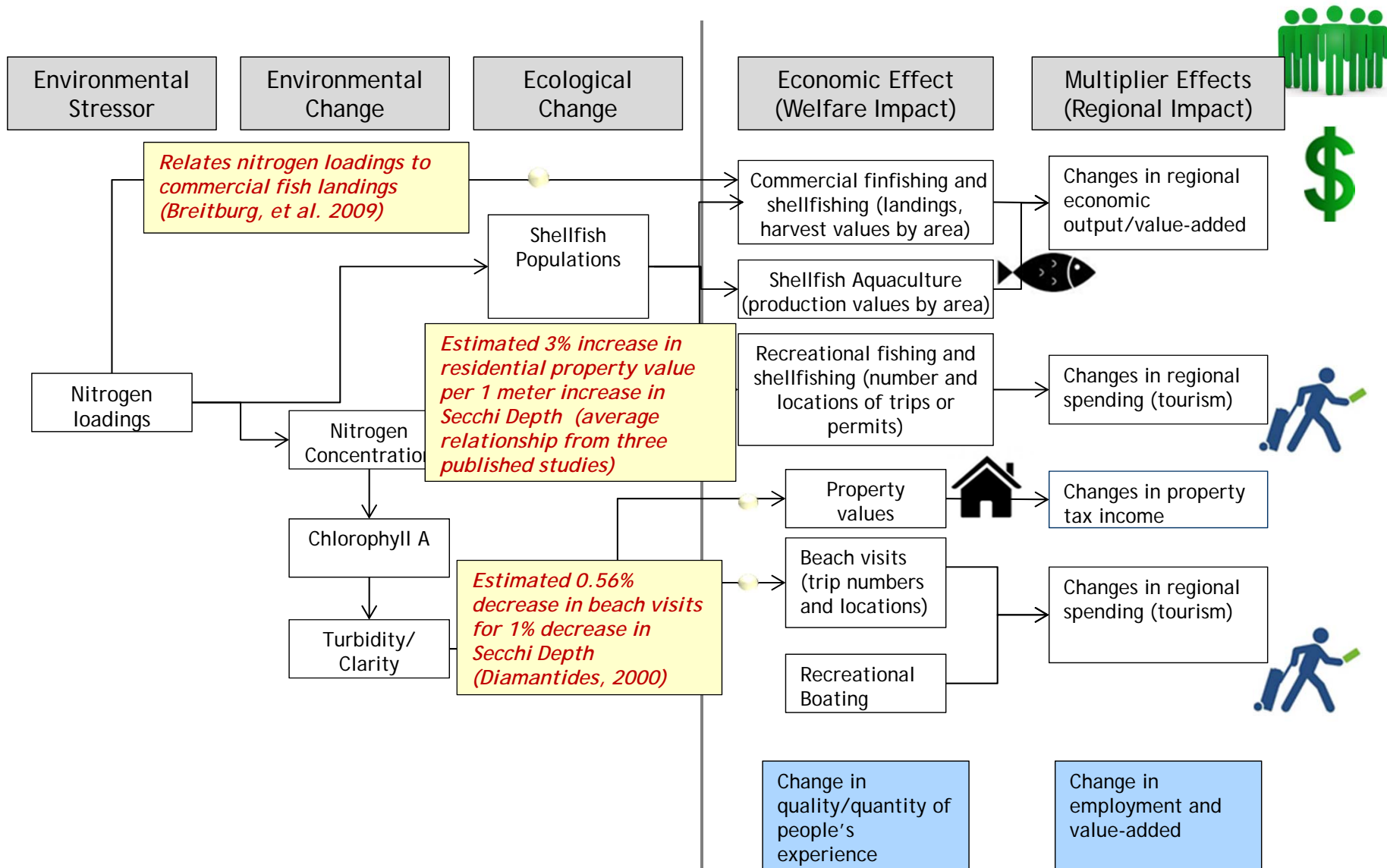


Employment



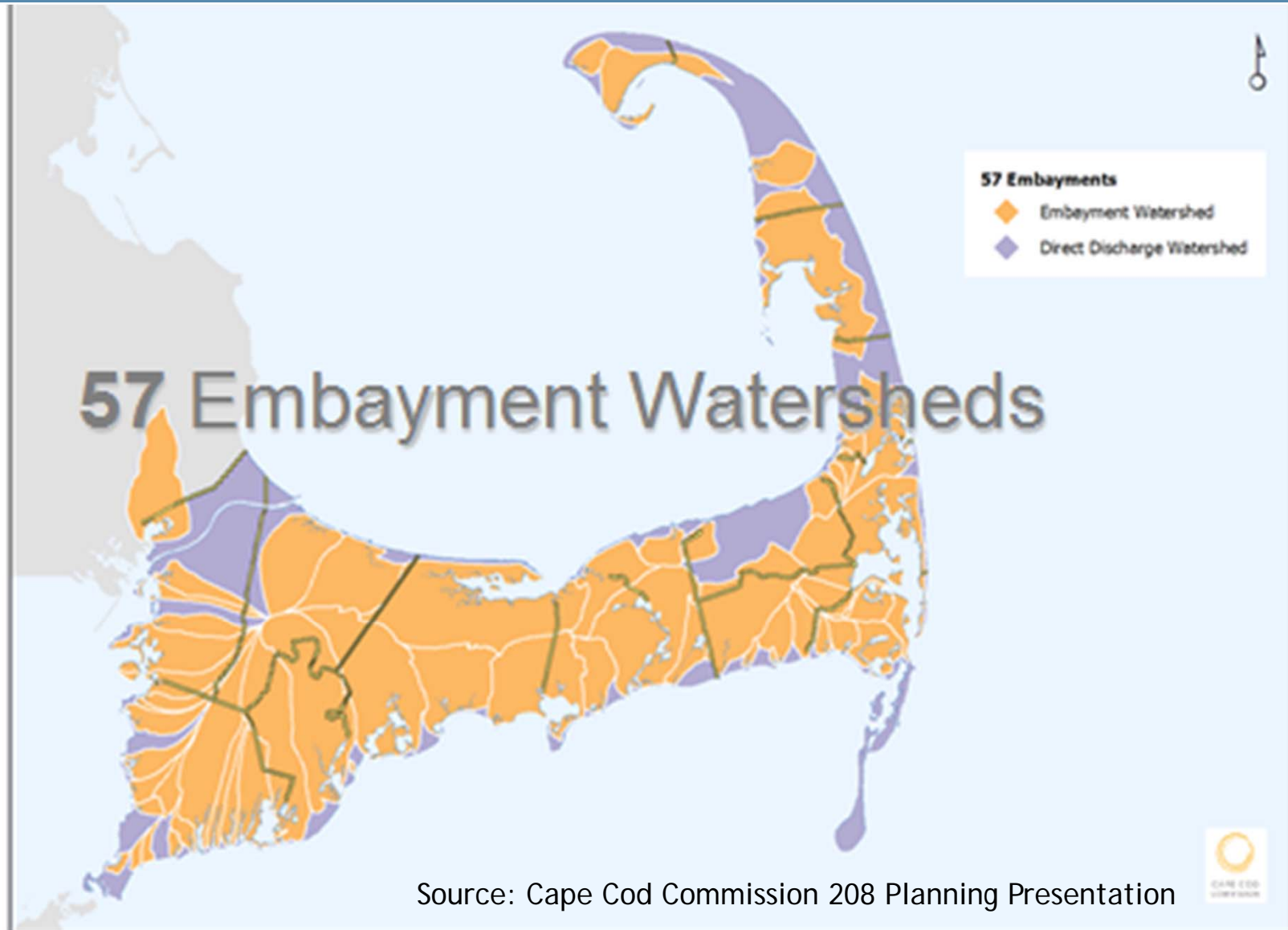
Natural resource revenue

# Cape Cod Model – Economic Indicators

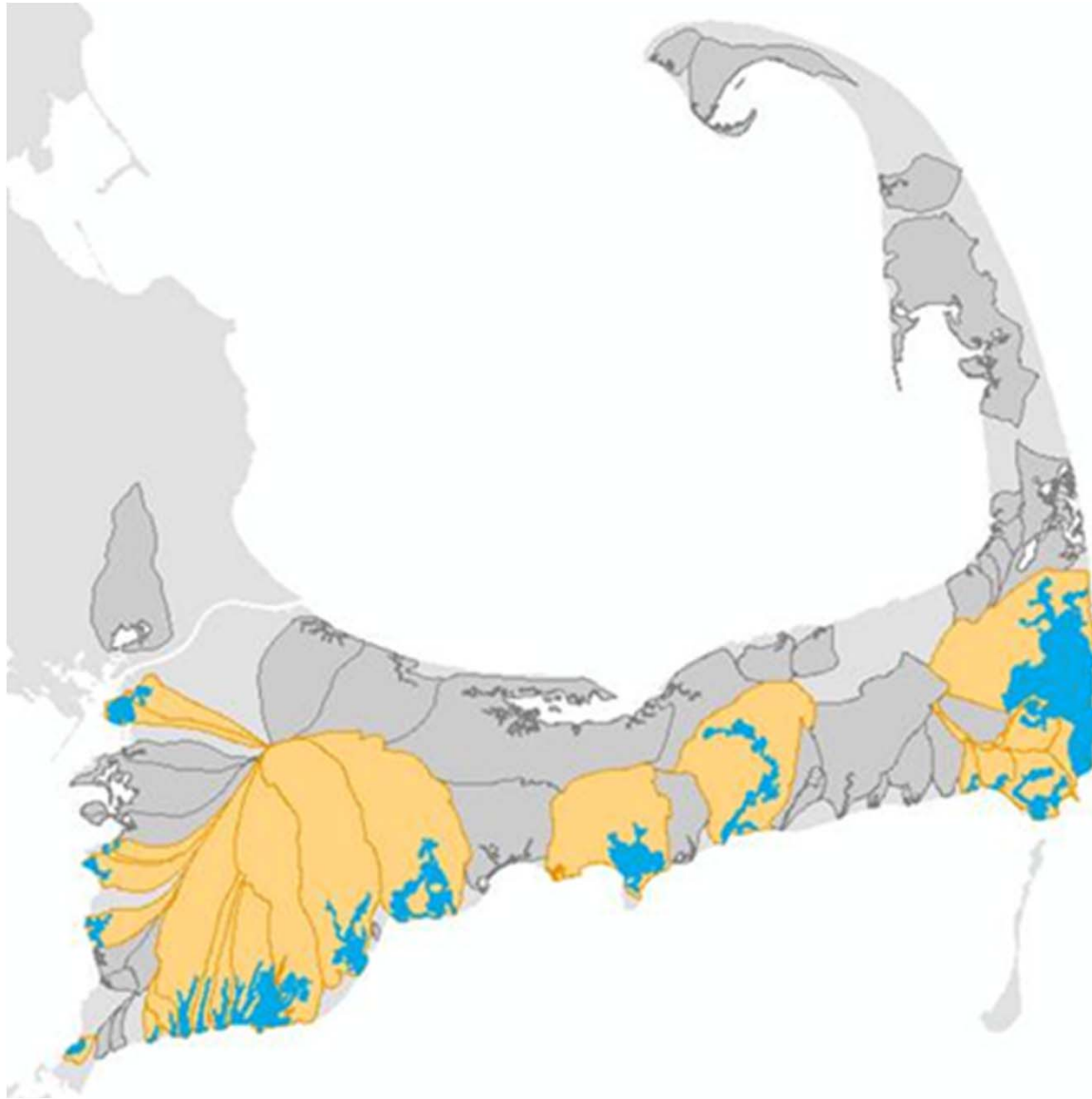




# Watersheds Flowing into Embayments

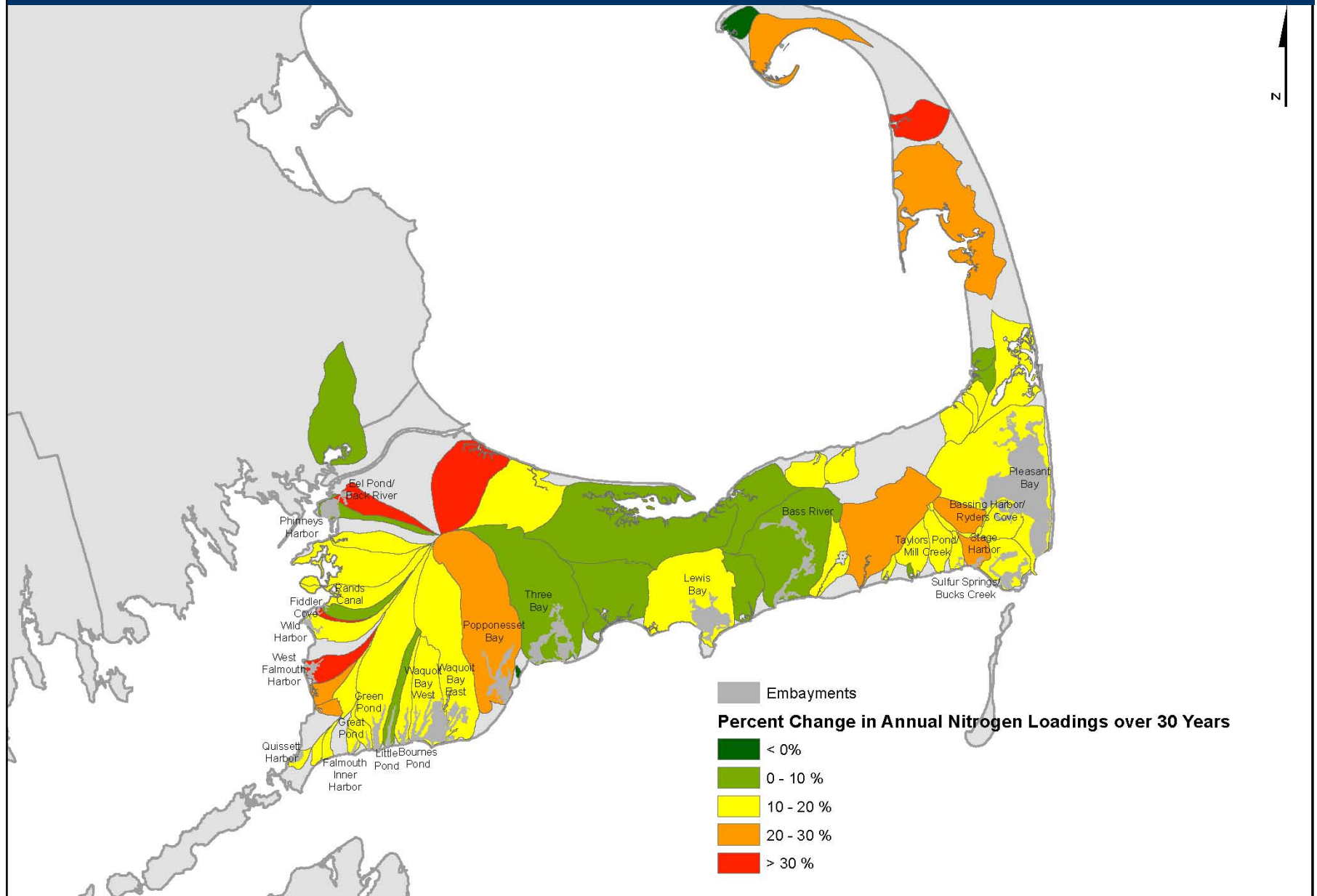


# Watersheds Containing Embayments

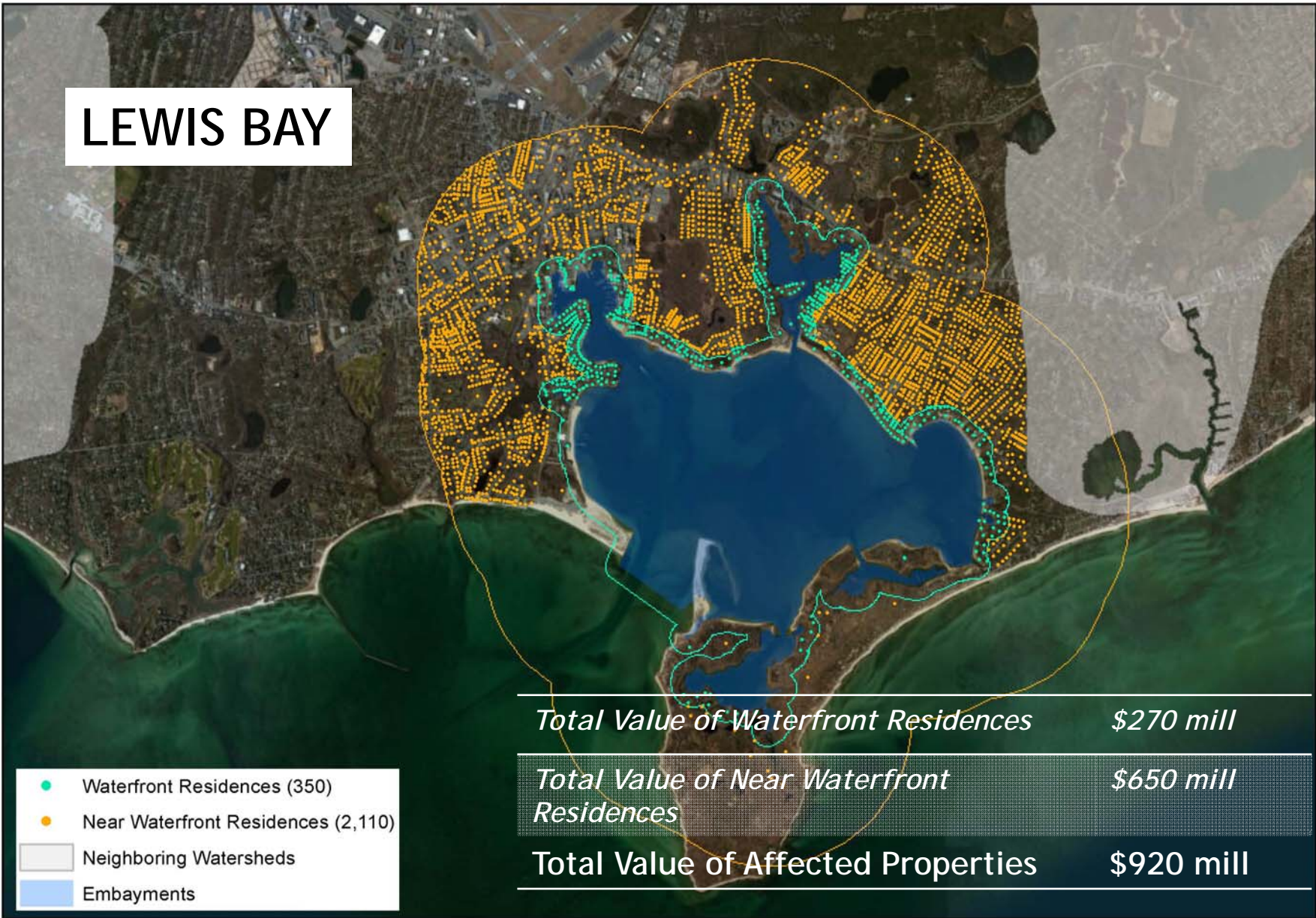


- Of the 57 watersheds that flow into embayments, **23** contain embayments and were the subject of MEP reports, allowing us to project effects of N loading on water quality indicators.
- 3VS model quantifies and reports effects of N loading by watershed.
- Model focuses on marine systems and not freshwater systems, which may also be impaired by N loading.

# Effects of No Action – Map of Forecast Change in N Loading



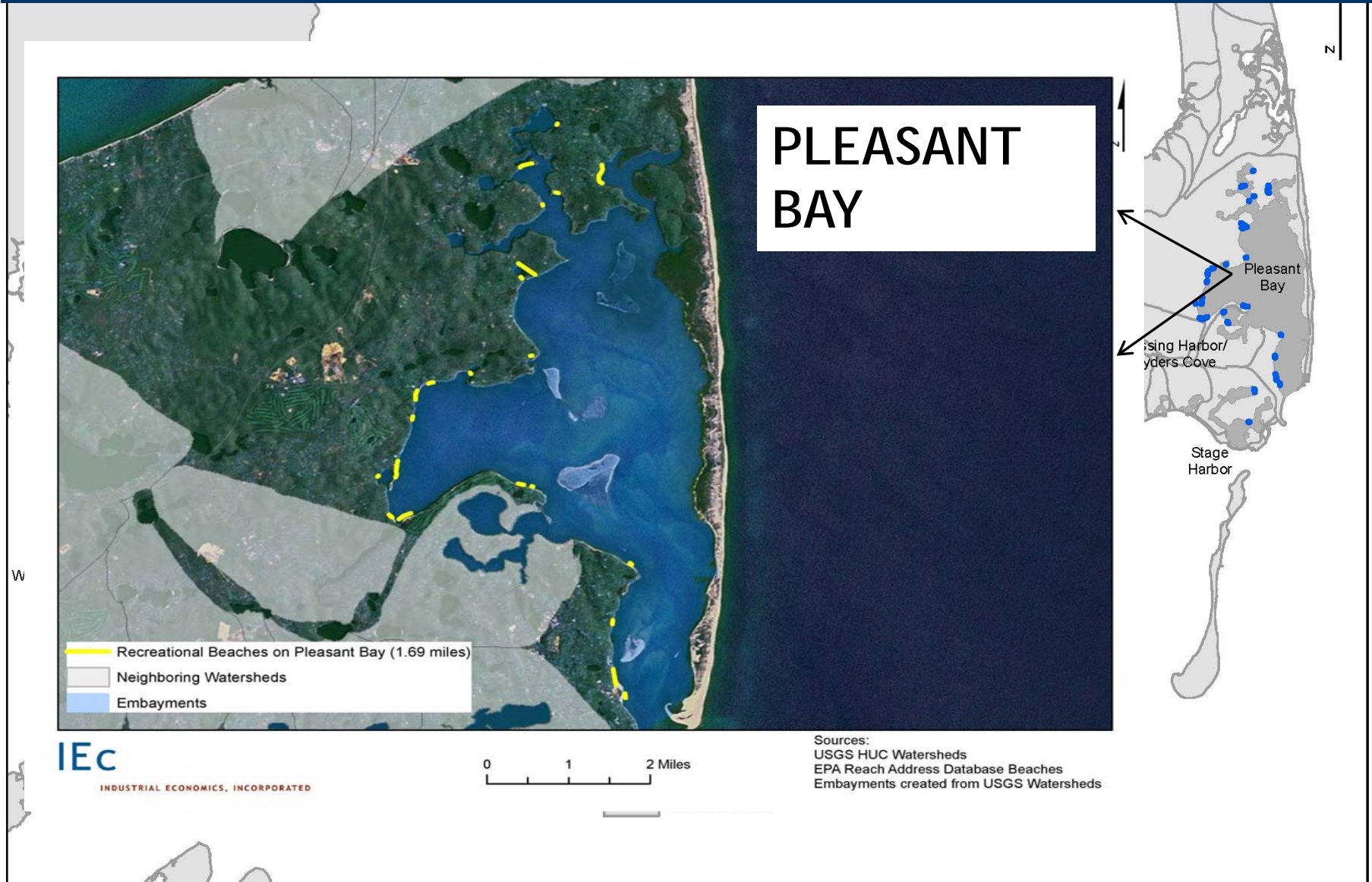
# LEWIS BAY



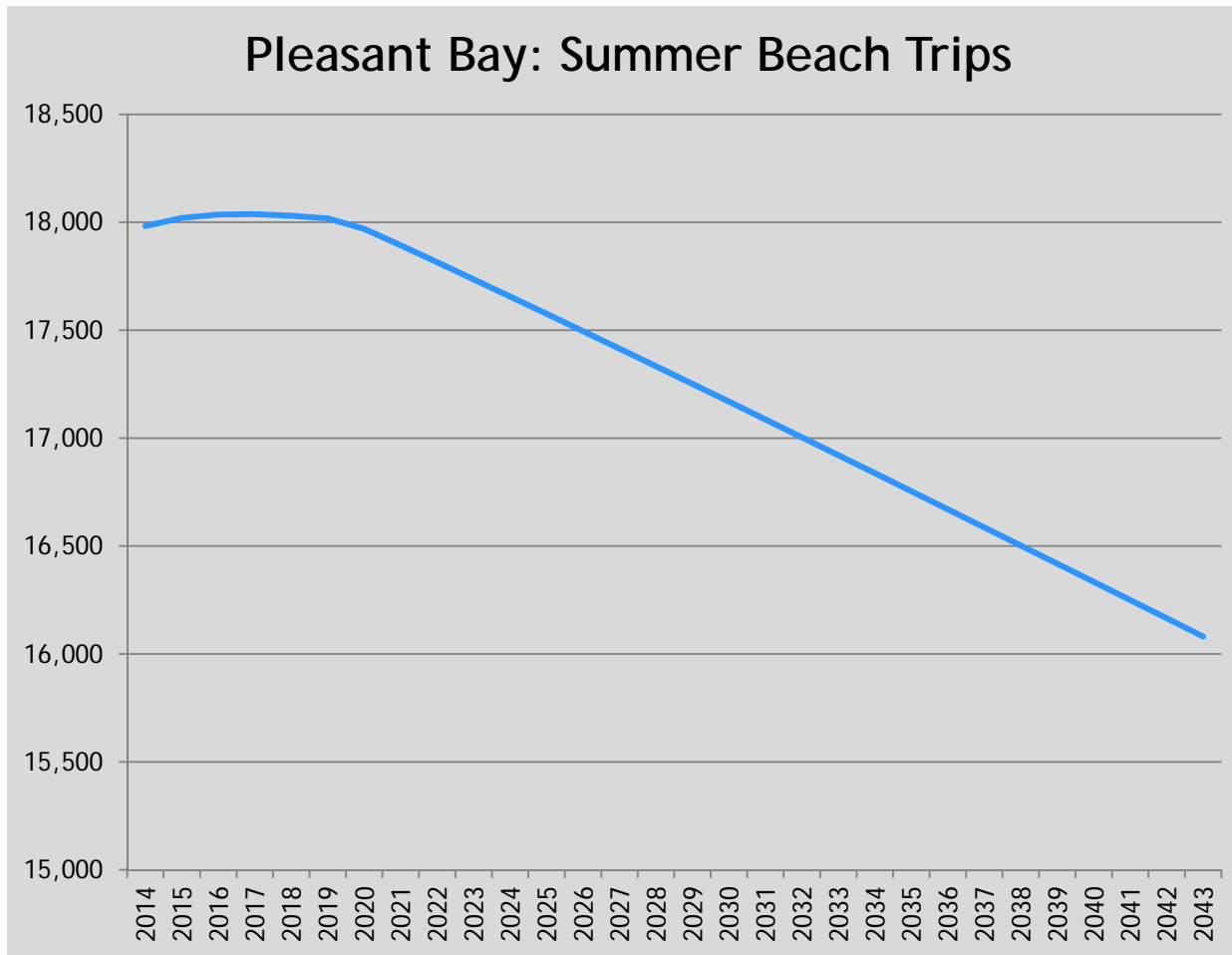
## Effects of No Action – Nitrogen and Property Value Effects

- As N loading is projected to increase in multiple embayments, including Lewis Bay, property value reductions are expected.
- With baseline property values for waterfront and near waterfront residences in our example watershed totaling approximately \$920 million, **even small percentage changes (e.g., 0.5 percent effect on value over 30 years) generate an embayment-level effect on the order of millions of dollars.**
- Furthermore, the reduction in property values likewise reduces the property tax base for the municipality. For Lewis Bay, **property value reductions in the millions means tens of thousands less in annual property tax revenue.**
- Calculating these impacts Cape-wide, N loadings increasing under the No Action scenario can measurably effect indicators of community well-being.

# Effects of No Action – Potentially Affected Beaches

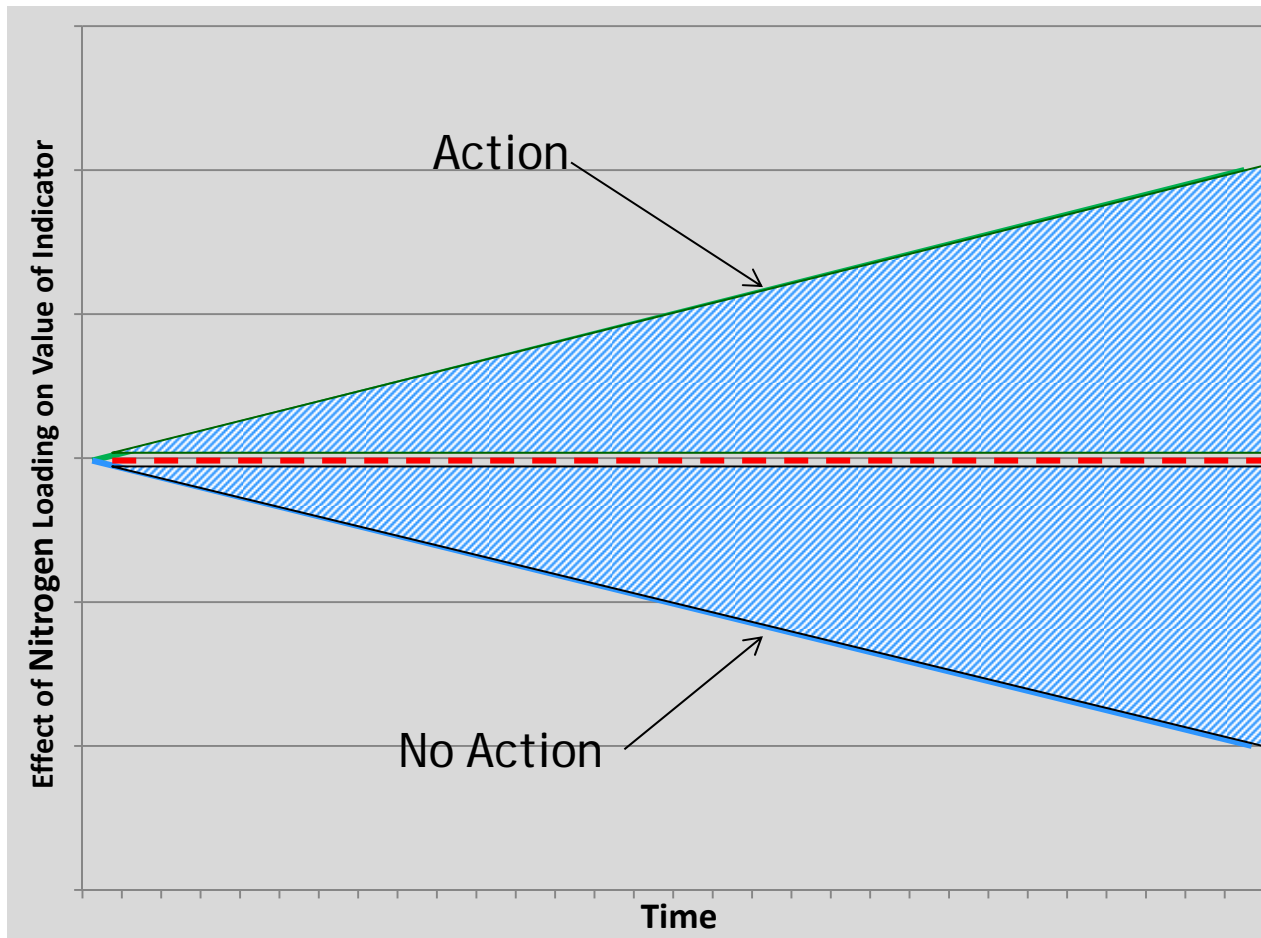


# Effects of No Action – Nitrogen and Beach Visits Effects



- Approximate 16% reduction in annual summer beach trips (May-Sept) at Pleasant Bay beaches over 30 years.
- Associated reduction in regional beach recreation-related spending (food, gas, lodging, entertainment).
- Multiplier effects on regional employment opportunities and economic output.

# Benefits of Taking Action



- Taking action to reduce N loading can improve water quality above and beyond baseline levels.
- In addition to improving the ecological, social, and economic indicators directly affected by water quality improvements, innovative interventions to control N can generate co-benefits.



## Next Steps– Complete Phase I

Phase I of the modeling effort involves evaluating the ecological and economic implications of the “No Action” scenario:

- Increase geographic scope of model by integrating additional watersheds, as needed.
- Integrate costs in no action scenario (e.g., for maintaining septic systems).
- Incorporate additional categories of ecological and economic impacts (e.g., commercial and recreational finfishing and shellfishing, wildlife viewing, eelgrass communities, macroeconomic effects).

## Next Steps– Phase II

Phase II of the model development focuses on modeling the costs and benefits of interventions to mitigate nitrogen loading:

- Scenario-based approach.
- Explores traditional and alternative interventions.
- Considers co-benefits of interventions (beyond reducing nitrogen loading- e.g., increased open space, carbon sequestration).
- Integrates intuitive user interface to allow stakeholders to run different scenarios by altering assumptions and parameters.