# Estimates of Ecosystem Service Values from Ecological Restoration Projects in Massachusetts

## *Summary of Report Findings*


Massachusetts Department of Fish and Game
Division of Ecological Restoration


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# Estimates of Ecosystem Service Values from Ecological Restoration Projects in Massachusetts – Report Synopsis

The MA Department of Fish and Game, Division of Ecological Restoration (DER) works with many partners "to restore and protect the Commonwealth's rivers, wetlands and watersheds for the benefit of people and the environment." Restoration projects, such as dam deconstruction, culvert replacement, fill removal, and streamflow enhancement, provide many benefits to local communities in the form of improved ecosystem services. Examples of these services include flood protection, improved water quality, climate change mitigation, and increased landscape appeal. But what is the economic effect of ecosystem service improvements in dollars and cents?

In 2012-2013, DER contracted with ICF International to help begin answering that question by analyzing the economic benefits of four ecosystem services enhanced by DER projects. The study found that restoration of aquatic habitats and the services they provide can generate significant economic value. While these example ecosystem service values are impressive in their own right, they represent only one of many services improved by each project. Thus, the total per-project value of all ecosystem service enhancements combined is anticipated to be much higher.

**The Value of Restored Ecosystem Services**

**FLOOD PROTECTION** – Salisbury businesses and residents will benefit from increased flood protection provided by the Town Creek Restoration Project that will reduce economic impacts from flood damage and lost business by an estimated **$2.5 million** over the next 30 years.

**WATER QUALITY** – The planned Muddy Creek Estuary Restoration Project in Chatham and Harwich will help those two towns save an estimated **$3.9 million** over 30 years to meet mandatory water quality standards by reducing wastewater infrastructure construction and operating costs.

**CARBON SEQUESTRATION** – The Damde Meadows and Broad Meadows salt marsh restoration projects in Hingham and Quincy are estimated to prevent **$86,000 and $138,000**, respectively, in damages caused by greenhouse gases through 2050. The projected increase in carbon storage resulting from restoration of these two wetlands is equivalent to avoiding the combustion of over **800,000 gallons of gasoline**.

**LANDSCAPE APPEAL** – In the towns of Wellfleet and Truro, the planned 1,000-acre Herring River Restoration Project is projected to improve the value of over **1,400 properties** as a result of being closer to healthy tidal wetlands after restoration, generating a total estimated property value increase of **$10.4 million**.

# Preface

The Massachusetts Department of Fish and Game, Division of Ecological Restoration (DER) collaborates with federal, state, and local partners to implement aquatic habitat restoration projects across the Commonwealth. These projects are planned and designed based on rigorous science and engineering to restore river and wetland habitats and their ecosystem services. The term ecosystem services refers to the goods and services that healthy ecosystems provide to humans, such as clean and plentiful water, flood storage, biodiversity, fisheries production, and recreational opportunities. Collectively, these services form a 'green infrastructure' foundation that supports economic prosperity, public health and safety, and a high quality of life for Massachusetts residents.

It has long been recognized that healthy ecosystems hold important societal value and that restoration of degraded habitats generates significant benefits for people and the environment. Prior to this study however, the benefits of ecological restoration had not been translated into monetary effects on the Massachusetts economy. To address this information gap, DER initiated a two-phase study in 2011 to begin to estimate the economic value and return on investment of restoration projects in Massachusetts. The goal of the study was to improve our understanding of economic effects and to underpin the qualitative benefits of restoration with quantified dollar value estimates.

In 2011, DER contracted with economists from Industrial Economics, Inc. to complete phase 1 of the valuation study. Design and construction expenditures from four representative DER projects (one dam removal, one culvert replacement, and two multi-practice wetland restoration projects) were analyzed using the IMPLAN model of the Massachusetts economy. The results revealed extensive ripple effects from these investments in indirect and induced economic activity. The analysis showed that the average economic output of DER projects generates a 75% return on investment and creates or maintains 12.5 full-time-equivalent jobs for every $1 million spent. These results equal or exceed those for other capital projects such as road and bridge construction, and replacement of water infrastructure.

Phase 2 of the study estimates the economic value of selected ecosystem services improved by DER projects. Under contract with DER in 2012-2013, economists from ICF International analyzed four types of ecosystem service enhancements: flood protection, water quality, carbon sequestration, and landscape appeal. The findings show a significant increase in value for the selected ecosystem services which represent just one of many service benefits resulting from each restoration project. This document provides a summary of findings from the phase 2 ICF International full report.

The combined findings of DER's two-phase study demonstrate that ecological restoration projects stimulate regional economic activity through design and construction expenditures, and generate substantial economic value by improving ecosystem services.

**Read the full phase 2 report, including study methods and data sources, at:**
**http://www.mass.gov/eea/docs/dfg/der/pdf/eco-services-full-ma-der.pdf**

# Flood Protection

Many parts of Massachusetts' coast are home to vibrant industries, critical infrastructure, and thousands of homes practically at the water's edge. In these places, restoring tidal hydrology to coastal wetlands requires balancing ecological benefits with protection of low-lying properties. Tidal restoration designs must also account for projected increases in sea levels due to a warming climate.

The town of Salisbury was battered by major coastal floods in 2005, 2006, and 2007 when an old railroad dike and tide gate breached. Several businesses were damaged and a portion of Route 1 was closed for days. These losses spurred an ambitious project to improve flood protection around the Town Creek basin while enhancing tidal flow in the estuary to restore water quality and wetland habitat.

Breach in the Town Creek railroad dike following a strong spring storm in 2007.

The project is designed to prevent flooding from the same kinds of storms that produced heavy economic losses in the mid-2000s. To estimate the value of future flood damage prevented by the restoration project, we used IMPLAN to estimate the losses over a 30-year timeframe.

| 30-Year Avoided Costs (all events) | |
|---|---|
| Town Infrastructure Losses | $796,000 |
| Cost to Businesses (inventory & infrastructure) | $1,348,000 |
| Lost Business Activity | $350,000 |
| **Total** | **$2,494,000** |

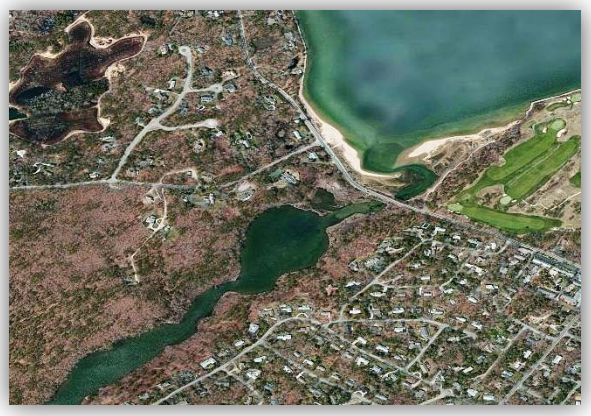
In addition to the extensive benefits to water quality and aquatic habitat, the Town Creek restoration project will result in almost $2.5 million in avoided flood losses over the next 30 years (present value with 7% discount rate). As shown in the table at left, most of those losses would have otherwise been borne by local businesses in the form of damaged assets and lost inventory and sales.

# Water Quality

When coastal embayments are restricted from tidal flushing, they become sinks for nutrients entering from their watersheds. As a result, water quality in these embayments can decline significantly, resulting in substantial impact to ecological and human health. Some communities have sought to address this issue by building sewers in neighborhoods where septic systems are contributing nutrient rich effluent. As an alternative in appropriate locations, restoring tidal flushing to restricted embayments can be a cost-effective option to help reduce nutrient concentrations.

Muddy Creek in Chatham and Harwich is a tidally-restricted estuary that currently exceeds its Total Maximum Daily Load (TMDL) limit for nitrogen. In this analysis we estimated the costs of implementing a tidal restoration project compared to the costs of sewer construction that would achieve the same amount of nitrogen reduction. The restoration project alone would not meet the TMDL. However, enlarging the tidal inlet to Muddy Creek will increase tidal flushing, decrease nitrogen concentrations, and reduce the amount of the watershed that would otherwise need to be sewered.

Over 30 years the tidal restoration project, coupled with sewering less than half of the watershed, will meet the TMDL and save nearly $4 million in sewer construction and operating costs (with 7% discount rate). It will also reduce export of water from the watershed and enhance a number of other ecological services, each with their own economic benefits.



Aerial Photo showing Muddy Creek and road crossing

| | 30-yr cost (7% DR) | Meets TMDL | Other Benefits |
|---|---|---|---|
| **Sewering** | $16,724,323 | √ | |
| **Restoration + Partial Sewering** | $12,808,305 | √ | Improved: wetland habitat, aesthetics, carbon sequestration, groundwater recharge, recreational opportunities, commercial and recreational fisheries habitat… |
| **Savings** | **$3,916,018** | | |

# Carbon Sequestration

Restoring tidal flows or removing historic fill from a salt marsh re-establishes natural wetland soil-building processes. As the marsh plants grow, die, and decay, they build dense, peat-based soils that store tons of carbon from the air.

In this study we calculated the areal extents of different plant communities before and after restoration. We then assigned rates of carbon sequestration from the scientific literature to those plant communities. This allowed us to compare the carbon sequestration rate for the project site before and after the restoration work.

To get an idea of the range of carbon sequestration enhancement, we performed this analysis for two wetland restoration projects with different characteristics:

## Damde Meadows, Hingham

- 20 acres
- Removed two undersized culverts to restore full tidal influence to salt marsh.
- Net increase in carbon sequestration: 76 metric tons of $CO_2$ per year.

See more photos of Damde Meadows here.

## Broad Meadows, Quincy

- 60 acres
- Removed over 4 feet of wetland fill to restore salt marsh & grassland habitats.
- Net increase in carbon sequestration: 101 metric tons of $CO_2$ per year.

See more photos of Broad Meadows here.

# Carbon Sequestration (continued)

In order to establish dollar values for the increased carbon sequestration resulting from restoration of these two sites, we employed the Social Cost of Carbon. This value estimate was initially published in 2010 by an interagency working group of experts in the United States. It represents a model-based accounting of the costs to society caused by changes in infectious diseases, agricultural productivity, and other climate change impacts resulting from carbon dioxide emissions. You can learn more about the Social Cost of Carbon here.

By applying the Social Cost of Carbon values to the net increase of $CO_2$ equivalent sequestered as a result of restoration (vs. un-restored conditions), we were able to estimate the value of avoided climate change damages through the year 2050.

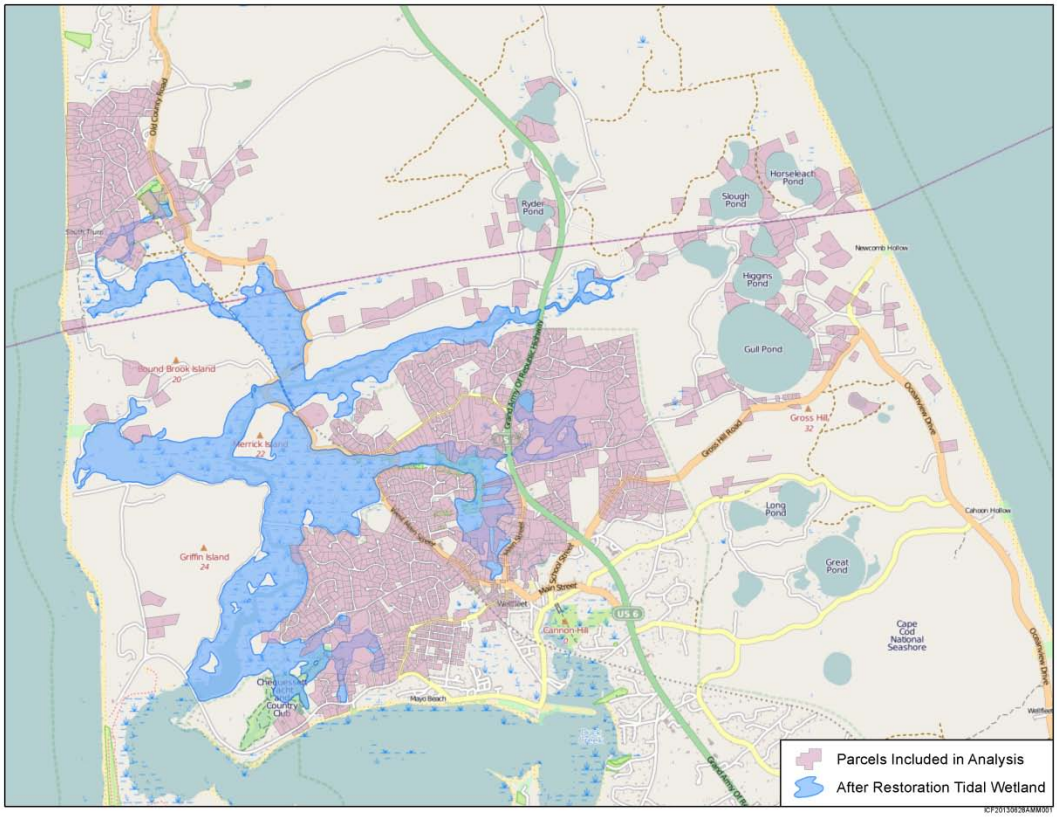
| **Carbon-Related Damages Avoided through 2050 (3% discount rate)** | | | |
|---|---|---|---|
| **Project Site** | **Net Increase in $CO_2$ Sequestered (metric tons)** | **Value** | **Equivalent Gallons of Gasoline** |
| **Damde Meadows** | 2,889 | $86,414 | 306,464 |
| **Broad Meadows** | 4,609 | $137,885 | 507,522 |

As the table shows, the net increase in carbon sequestered in the restored wetlands vs. un-restored conditions is equal to that which would be emitted through the burning of over 800,000 gallons of gasoline over the 37-year analysis period.

# Landscape Appeal

Ecological restoration projects often have a dramatic impact on site aesthetics and other characteristics that influence landscape appeal and property value. Hundreds of acres of habitat viewscapes can be improved just by restoring natural hydrology. When coupled with associated improvements to water quality, wildlife use, and recreation opportunities that usually follow, ecological restoration projects can increase the value of properties surrounding the project area.

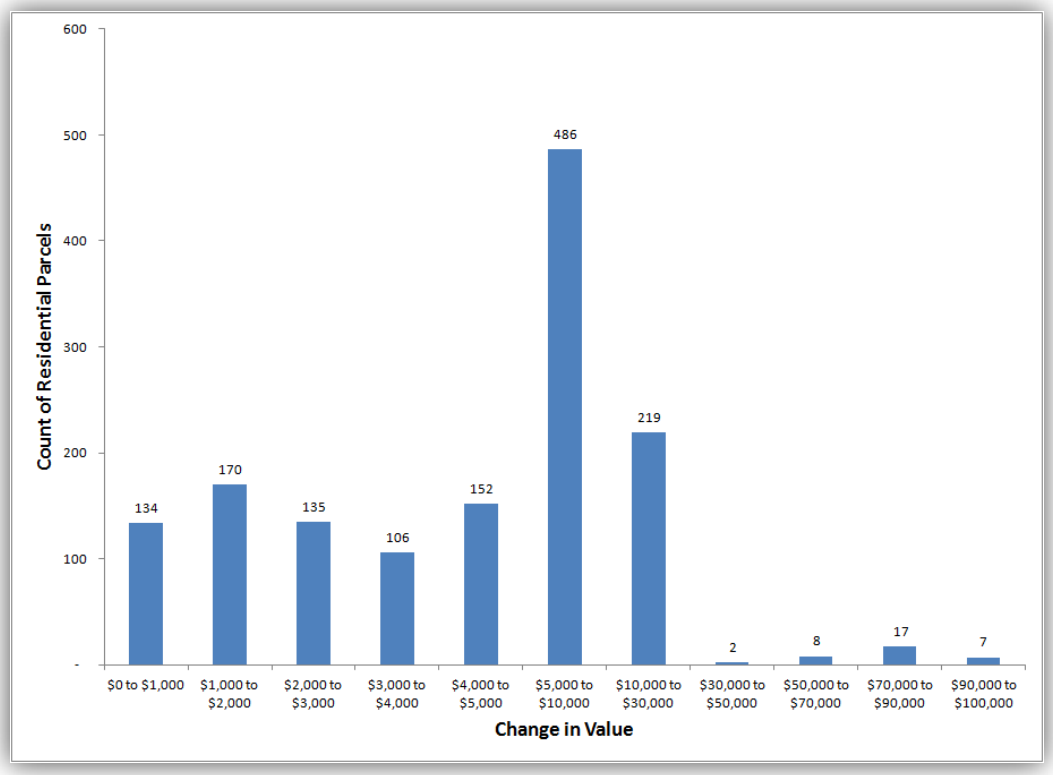
The proposed Herring River Restoration Project in Wellfleet and Truro will restore tidal flow to roughly 1,000 acres of severely degraded historic tidal wetlands. As a result, what is now a dense, largely forested landscape will revert to an open vista of salt marsh, emergent wetlands, and tidal creeks with expanded viewscapes and many other appealing features. In this analysis we estimated the increase in property values resulting from closer proximity to restored tidal wetlands.




An image from the GIS model predicting area of restored tidal wetland (dark blue) and resulting associated land parcels with projected increased value (pink).

# Landscape Appeal (continued)

We employed a benefits transfer methodology to estimate the project's effect on residential property values based on a prior study conducted in North Carolina for land with similar wetland and development characteristics. This approach was chosen because it provides a legitimate estimate of the effect of Herring River restoration on property values using the economic function and rigorous data analysis that are transferrable to the Herring River region. The North Carolina study isolated and determined the dollar value effect of property distance to coastal vs. inland wetlands. In short, the closer a property is to tidal wetlands, the greater the associated increase in value. As applied to the Herring River restoration, the analysis identified over 1,400 properties that are projected to increase in value after tidal wetlands are restored, as shown in the table below.




While most of these projected increases are relatively modest on a per-parcel basis, collectively they add up to approximately $10.4 million in added property value across Wellfleet and Truro.