The Practice of Dam Removal and River Restoration in Massachusetts

Presentation to
The International Society of Ecological Economics
June 27, 2016
The mission of the Division of Ecological Restoration is to restore and protect the Commonwealth’s rivers, wetlands and watersheds for the benefit of people and the environment.
Accomplishments

- Over 60 completed projects
- 2,000 acres of coastal wetland restored
- 40 dams removed
- 150 upstream river miles reconnected
- 60 active projects in planning and design
- Hundreds of volunteer hours logged
New England Dams
More than 3,000 dams in MA

- 43 are flood control dams
- 44 licensed hydropower dams
- 164 water supply dams
- Federal, state, NGO, municipal owners
Healthy Rivers

- Move water
- Engage their floodplain
- Move sediment
- Allow for fish & wildlife movement
- Support a variety of species (especially “fluvial specialists”)
• Block fish passage
• Cause warm temperatures
• Trap sediment and nutrients
• Degrade water quality
Segmented Rivers

- Altered hydrology
- Altered hydraulics
- Altered floodplain interaction
- Impounded sediment
- Blocked fish & wildlife movement
- Support fewer fluvial specialists
Over the last 30 years

- Extreme rain / snow events
- Extreme floods
- Old dams
- Public safety threats
Dam removal has been increasing nationally.

Source: American Rivers
New England reflects the national trend.

Source: American Rivers, DER
How do DER’s projects affect the MA economy?

**Jobs & Output**

**Ecosystem Services**
Economics Studies

- Short-term regional economic output
  - Modeled market effects of restoration $ in IMPLAN
  - $1 Million = 12 jobs and 75% output

- Ecosystem services
  - Multi-method study of 4 services from 5 projects
  - Restored functions = savings & avoided costs

- Cost savings for businesses & communities
  - Compared restoration to 50 yr. status quo
  - Restoration almost always cheaper
“People ask us, “Where did your dam go?”. We tell them, “We traded it for a healthy river!”” – Bill and Eileen Teuten, Homeowners adjacent to the Wapping Road Dam Removal in 2011

Ecological Restoration projects like the Wapping Road Dam removal in Kingston, MA can help relieve property owners of enormous financial burden and liability, at the same time eliminating safety threats to the surrounding community and restoring fish passage and other ecological functions that are the bedrock for healthy communities. Head more about the impacts of our work [here](http://example.com).
Future Work

- Incorporate economic data collection.
  - Up-front
  - Post-implementation
- Incorporate resiliency benefits in project selection & communication.
- Continue to streamline project process.
  - Funding
  - Permitting
  - Public perception
Thank you!
Extras
Community Benefits

**Dam Removal**

**Reduced Flood Risk**
- Increased: Property values
- Avoided: Infrastructure damage, Travel delays, Emergency response

**Habitat Improvements**
- Increased: Rec. fishing, Forage = commercial fishing, Tourism
- Additional: Rec. opportunities
Most dams in Massachusetts do not control floods.
## Phase 1 – Regional Economics

Per $1 million investment

<table>
<thead>
<tr>
<th>PROJECT</th>
<th>EMPLOYMENT DEMAND</th>
<th>LABOR INCOME</th>
<th>OUTPUT</th>
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Phase 2 – Ecosystem Services

**Herring River Restoration Project**
Wellfleet/ Truro
Ecosystem Service: Property Values
**Over $10.4 Million Increase**
PLUS: improved recreation, restored fisheries, carbon sequestration

**Muddy Creek Restoration Project**
Chatham/Harwich
Ecosystem Service: **Water Quality**
**Over $14 Million in Savings**
PLUS: improved recreation, restored fisheries, carbon sequestration

**Damde Meadows & Broad Meadows Restoration Projects**
Quincy & Hingham
Ecosystem Service: Carbon Sequestration
**Over $140,000 in Avoided Costs**
PLUS: restored fisheries, improved habitat

**Town Creek Restoration Project**
Salisbury
Ecosystem Service: **Flood Protection**
**Over $2.5 Million in Avoided Costs**
PLUS: restored fisheries, improved habitat
Phase 3 – Barrier Removal, Return on Investment

- Culvert upgrades were less expensive than repairing and maintaining the structures at two of three sites.
  - Up-front costs of culvert upgrades were greater than replacement.
  - However, long-term costs of the upgrade were less than replacement for both Dingle and Drift Road culverts.
- Removing the dams was less expensive than repairing and maintaining them.
  - Dam removal cost less
    - Up-front
    - Long-term
  - Costs of repair/maintenance ranged from 27% greater (Briggsville) to more than 4 times the cost of removal (Whittenton).
Jobs & Output

- **Direct effects** are equal to the costs of the MA DER project, which we assign to appropriate economics sectors.

- **Indirect effects** are the “ripple” impact of local industries buying goods and services from other local industries as a result of the project.

- **Induced effects** are changes in household consumption arising from changes in employment.
Phase 1 (2012)—Regional Economics

North Hoosic Restoration

Broad Meadows Restoration, Quincy
*Excavation of 60 acres of dredge spoils; re-creation of tidal creek system and salt marsh.*

Eel River Headwaters Restoration, Plymouth
*Six dams removed, two culverts replaced, 40 acres of wetland restored in former cranberry bog.*

Stony Brook Restoration, Brewster
*Culvert removal from former tidal wetland to restore fish passage and salt marsh restoration.*

North Hoosic River Restoration Clarksburg
*Dam removal provided upstream flood mitigation benefit and multiple fish and wildlife benefits.*
Methodology

- IEc examined regional economic benefits associated with increased economic activity in Massachusetts resulting from restoration projects.

- IEc used IMPLAN Version 3.0, with the most recent available data (2009) for MA.

- Project cost details were provided by MA DER.
Limitations

- 2009 data, model is static and linear in nature.

- Economic activity that does not occur in Massachusetts does not appear in cost estimates ("leakage").

- A look at short-term effects. While long-term effects may be substantial, they are harder to measure and require more data.
## Summary of Results per $1M Investment

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**Plus:**
Phase 2 (2014) – Ecosystem Services

**ECOSYSTEM SERVICES**

- Flood control
- Water quality
- Water supply
- Recreation (e.g., boating, swimming)
- Storm protection
- Commercial fishing and shellfishing
- Recreational fishing and shellfishing
- Hunting
- Wildlife viewing
- Biodiversity
- Climate stability
## Ecosystem Services

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### Many ways to estimate
- Substitutions
- Modeling
- Stated & Revealed Preference

### Spatial and other factors
- How many people affected?
- How many care?
**Muddy Creek Restoration Project**
Chatham/ Harwich

Ecosystem Service: **Water Quality**

**Over $14 Million in Savings**
PLUS: improved recreation, restored fisheries, carbon sequestration

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**Town Creek Restoration Project**
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Ecosystem Service: **Flood Protection**

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Phase 2 – Ecosystem Services

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Phase 3 – Stream Barriers

1. Cost comparison and community benefits
   - Dam removal
   - Culvert upgrades

2. Identify values from other MA investments in Green Infrastructure.

3. Integrate recommendations for project tracking.
Study Sites

- Brigsville Dam, Clarksburg
- Hill Street, Raynham
- Drift Road, Westport
- Dingle Road, Worthington
- Bartlett Pond Dam, Lancaster
- Whittenton Mill Pond Dam, Taunton
Dam Removals: Costs

- Removing the dams was less expensive than repairing and maintaining them.
  - Dam removal cost less
    - Up-front
    - Long-term
  - Costs of repair/maintenance ranged from 27% greater (Briggsville) to more than 4 times the cost of removal (Whittenton).
Culvert Upgrades: Costs

- Culvert upgrades were less expensive than repairing and maintaining the structures at two of three sites.

- Up-front costs of culvert upgrades were greater than replacement.

- However, long-term costs of the upgrade were less than replacement for both Dingle and Drift Road culverts.
# Summary of Findings: Dam Removals

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>BRIGGSVILLE DAM</th>
<th>BARTLETT POND DAM</th>
<th>WHITTENTON DAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dam Owner</td>
<td>Cascade School Supplies (private)</td>
<td>Town of Lancaster</td>
<td>Individual (private)</td>
</tr>
<tr>
<td>Total Removal Costs</td>
<td>$920,000</td>
<td>$320,000</td>
<td>$440,000</td>
</tr>
<tr>
<td>Other Funding Sources</td>
<td>State, Federal &amp; Private</td>
<td>State</td>
<td>State, Federal &amp; Private</td>
</tr>
<tr>
<td>Owner Savings Relative to Costs of Dam Repair</td>
<td>$1,200,000</td>
<td>$610,000</td>
<td>$2,200,000</td>
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<td>Community Benefits</td>
<td>Reduced Flooding, Improved Public Safety, Improved Fisheries, Improved Wildlife Habitat, Enhanced Recreational Opportunities</td>
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Total costs for dam removal are 60% less than repair and maintenance.
Summary of Findings: Culvert Upgrades

<table>
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<tr>
<th>CATEGORY</th>
<th>DINGLE ROAD</th>
<th>HILL STREET</th>
<th>DRIFT ROAD</th>
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<tr>
<td>Culvert Owner</td>
<td>Town of Worthington</td>
<td>Town of Raynham</td>
<td>Town of Westport</td>
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<td>Total Upgrade Cost</td>
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<tr>
<td>Owner Savings Relative to Costs of Culvert Repair and Maintenance</td>
<td>$500,000</td>
<td>$220,000 to $320,000</td>
<td>$560,000 to $700,000</td>
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Total costs for culvert upgrade are **38% less** than repair and maintenance.
### Summary of Results per $1M Investment*

<table>
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<tr>
<th>IMPACT TYPE</th>
<th>EMPLOYMENT DEMAND</th>
<th>LABOR INCOME</th>
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*Assumes ALL direct expenditures are spent in MA.

- **Output**: Output is defined as the total economic activity or value of production in the state that is generated by an action.
- **Value Added**: Value added is defined in economic modeling as the difference between an industry’s or establishment’s total output and the costs of its intermediate inputs.
- **Labor Income**: Labor Income is a measure of the employment income received in Massachusetts as part of the employment demand, and includes wages, benefits, and proprietor income.
- **Employment Demand**: Employment Demand, in this context, measures the number of additional employees necessary for the Construction/Installation and Operations Phases of projects, and is measured in “worker-years.”
- **Direct effects** are production changes or expenditures that result from an activity or policy.
- **Indirect effects** are the “ripple” impact of local industries buying goods and services from other local industries as a result of the project (e.g., restoration project requires purchasing plant seeds or cement) within Massachusetts.
- **Induced effects** are changes in household consumption arising from changes in employment and associated income (which in turn results from direct and indirect effects) in Massachusetts.