# THE ECONOMIC IMPACTS

*OF*

# ECOLOGICAL RESTORATION IN MASSACHUSETTS

Straits Pond,
Culvert Replacement


North Hoosic River,
Briggsville Dam Removal

MASSACHUSETTS DEPARTMENT OF FISH AND GAME
Division *of*
Ecological
Restoration

September 2011

MASSACHUSETTS DEPARTMENT OF FISH AND GAME

Division *of* Ecological Restoration

Tim Purinton, *Director*



**The Division of Ecological Restoration (DER) was established in July of 2009 with a merger of the Department of Fish & Game's Riverways Program and the Wetlands Restoration Program of the Office of Coastal Zone Management.**

**DER pursues its mission "to restore and protect the Commonwealth's rivers, wetlands and watersheds for the benefit of people and the environment" by working with many different partners on projects that produce the greatest ecological return for the investment while supporting local jobs and the regional economy.**

## As a result of this approach:

- **DER leverages state dollars at a ratio of 1 to 12 (state to non-state funding) and attracts millions of competitive federal dollars annually into the Massachusetts economy.**
- **Our projects produce an average employment demand of 12.5 jobs and $1,750,000 in total economic output from each $1 million spent, contributing to a growing "restoration economy" in Massachusetts.**
- **Our ecological restoration projects help support a number of economic sectors, including design and engineering, construction, wholesale construction materials, nursery products, and non-profit science.**
- **Because of this diversity of contributing sectors and the non-export nature of the projects, the "ripple effects" from a dollar spent on ecological restoration travel widely through the Massachusetts economy.**
- **While not accounted for in this study, the ecosystem services values produced by our partner-based projects (e.g. water quality improvement, flood damage reduction, and increased biodiversity) generate substantial, recurring economic benefits.**
- **Restoration projects generate total economic outputs equal to or greater than other types of capital projects such as road and bridge construction and repair, replacement of water infrastructure, etc.**

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**http://www.mass.gov/dfwele/der/index.htm**

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# Economic Impacts of Massachusetts Ecological Restoration Projects

## *Executive Summary*

Industrial Economics, Incorporated (IEc) analyzed four ongoing or completed restoration projects, using the IMPLAN regional economic impact model, as a means to help the Massachusetts Department of Fish and Game, Division on Ecological Restoration (DER) gain an initial sense of the direct and indirect effects of their activities on a "per restoration dollar" basis. The four projects are:

- **Broad Meadows Restoration** (Quincy), comprising excavation of 60 acres of dredge spoils and re-creation of a salt marsh and tidal creek system.
- **Eel River Headwaters Restoration** (Plymouth), comprising removal of six dams, replacement of two culverts, and naturalization 40 acres of wetland in a former cranberry bog.
- **Stony Brook Restoration** (Brewster), comprising removal of a culvert from a former tidal wetland to restore fish passage and the natural tidal regime.
- **North Hoosic River Restoration** (Clarksburg), comprising removal of a dam to provide upstream flood mitigation benefits and to restore ecological functions and values.

DER provided IEc with the detailed project cost information required to run the IMPLAN model. Based on available information, IEc estimated the share of each cost item that would be considered a "Massachusetts expenditure" in order to isolate in-state (rather than more broadly regional) impacts. These in-state project costs ranged from approximately $630,000 (North Hoosic River) to approximately $5.4 million (Broad Meadows). IEc also tested the sensitivity of the results to the assumptions regarding in-state and out-of-state costs by running IMPLAN a second time and assuming all expenditures occur in Massachusetts.[1]

The modeling results indicate total employment effects ranging from 7.6 to 70 "jobs." Note that the employment effect is not solely the creation of "new" jobs, but rather the creation of employment demand (in "full-time equivalent" units) that may or may not result in a permanent job. The total employment effect includes direct effects (employment that results from a project itself), indirect effects (employment related to the providers of goods and services to the project), and induced effects (employment related to the expenditure of income from direct and indirect employment). In each case, IEc estimates that direct employment accounts for approximately 60 percent of the total employment effect. Per million dollars of restoration cost, these four projects are estimated to result in an employment demand of 10-13 full-time equivalent jobs. The sensitivity analysis indicated an average increase in the total employment effect of approximately 22 percent when individual expenditures were all categorized as in-state.

A second measure of economic activity is total economic output resulting from the "multiplier" effect of restoration expenditures. As with employment, total output is the sum of the output attributable to direct,

[1] Since all expenditures associated with the Broad Meadows project were initially assumed to be in-state, the estimated economic impact of this project did not change.

indirect, and induced effects. IEc estimates total output associated with these four projects to range from approximately $1.4 million to approximately $1.8 million per million dollars of restoration cost. The change in estimated output when all project expenditures were assumed to occur in-state was an average increase of 23 percent.

One of the key limitations of this analysis is its focus (necessitated by data limitations) on the economic impacts of the short-term, construction phases of these projects. Over the longer term, the ecological benefits of the restoration projects are likely to produce additional, positive economic effects, possibly including, but not limited to, those related to increased use of the project site for recreational purposes or to changes in adjacent or nearby property values.[2]

IEc supplemented its modeling of Massachusetts projects by identifying, reviewing, and summarizing published studies that also describe estimates of employment demand and total output attributable to restoration activities. IEc identified four relevant studies, three describing activity in the western United States (California, Oregon, and Montana) and one focused on Massachusetts. The three studies in western states describe total employment effects ranging from approximately 15 to approximately 30 jobs per million dollars of project cost, and total economic output per million dollars ranging from approximately $2 million to approximately $2.6 million. Geographic, activity type, and possibly scale differences likely limit the direct comparability of these studies to the results of the IEc analyses, but they do provide an indication that the Massachusetts results are a good first approximation of economic impacts. The Massachusetts-focused paper, which suggests an employment effect of approximately 40 jobs per million dollars of investment in the "reforestation, land and watershed restoration, and sustainable forest management" sector further supports this preliminary conclusion.

The limited number of projects included in the IEc analysis makes it difficult to draw general conclusions about the economic impacts of these types of activities on a per-dollar basis. However, the consistency of the results across projects, and types, suggests that relatively limited additional analysis could provide a sufficient basis for establishing economic impact "rules of thumb," at least for short-term effects. A larger data collection and analysis effort would be needed to address the (potentially significant) economic impacts that projects like these would be expected to generate over the longer term.

[2] Related to the assessment of long-term benefits, IEc also produced a white paper for DER describing emergent tools and techniques for the quantification and monetization of a variety of "ecosystem services" that restored sites might be expected to provide, such as flood mitigation or carbon sequestration.

IEc

# Economic Impacts of Massachusetts Ecological Restoration Projects

*Final Briefing*

Prepared for
Massachusetts Department of Fish & Game
Division of Ecological Restoration

30 June 2011

COMMONWEALTH OF MASSACHUSETTS
Division *of* Ecological Restoration

INDUSTRIAL ECONOMICS, INCORPORATED

# Study objectives



- Provide the Massachusetts Division of Ecological Restoration (MA DER) with an initial sense of the direct and indirect economic "returns" generated by representative restoration projects in Massachusetts.
  - Regional economic impact modeling of four projects.
  - Comparison to results of similar studies, as documented in the published or grey literature.
- Provide a white paper on the concept of ecosystem service valuation and its application in the context of the state's restoration activities.

# Methodology



- We examine regional economic benefits associated with increased economic activity in Massachusetts resulting from restoration projects.
- We use IMPLAN Version 3.0, with the most recent available data (2009) for MA.
- Project cost details were provided by MA DER.

# Methodology (continued)



- Impacts can be observed in two phases:
  - Short term effects: These are benefits associated with increased demand for employment, materials, and services in Massachusetts during the Construction/Installation Phase of a project. Examples include: construction labor, materials costs, engineering time, permitting activities.
  - Long-term effects: These are benefits associated with the Operational Phase of a project. These may include, for example, expenditures associated with increased boating, hiking, birdwatching, or beach visitation that may result from the project implementation.
- Our study uses IMPLAN to examine the regional economic benefits associated with short-term construction/installation phases of restoration projects.

# Methodology (continued)



- **Direct effects** are production changes or expenditures that result from an activity or policy. In this analysis, 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 (e.g., restoration project requires purchasing plant seeds or cement) within Massachusetts. Additional impacts that occur outside of Massachusetts are not included in these effects.

- **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. For example, these may include additional spending by construction workers with their wages, as well as additional spending by seed growers or cement companies with income received from sales for use in the restoration project.

# Limitations



- 2009 data, model is static in nature.
- Economic activity that does not occur in Massachusetts does not appear in our cost estimates ("leakage").
- We only look at short-term effects. While long-term effects may be substantial, they are harder to measure and require more data.
- Model is linear.

# Description of projects



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

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

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

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

# IMPLAN inputs - Broad Meadows

*Final*

| COST CATEGORY | MA EXPENDITURES | CLASSIFICATION |
|---|---|---|
| Study / Environmental Assessment | $360,000 | ENG |
| Plans and Specifications | $556,000 | ENG |
| Construction Contract | $3,870,500 | CONSTR |
| Construction Contingency | $200,000 | CONSTR |
| Engineering During Construction | $87,000 | ENG |
| Engineering / Construction Oversight | $321,000 | ENG |
| Monitoring and O&M Manual | $25,000 | GOV |
| **TOTAL** | **$5,419,500** | |

# IMPLAN inputs - Eel River

*Final*

| CATEGORY | TOTAL COST | MA PORTION | MA COSTS | CLASSIFICATION |
|---|---|---|---|---|
| Engineering / Design | $327,566 | none | $0 | ENG |
| Implementation | $1,121,610 | all | $1,121,610 | CONSTR |
| Engineering Oversight | $159,723 | 80% (estimated) | $127,778 | ENG |
| Police Detail | $8,961 | all | $8,961 | GOV |
| Construction materials | $480,690 | 95% (estimated) | $456,656 | CEMENT / CONCRETE PIPE |
| Planting / landscaping material | $165,618 | 95% (estimated) | $157,337 | GREENHOUSE / LANDSCAPING |
| DER Project management / permitting | $30,000 | all | $30,000 | GOV |
| Misc. construction costs | $27,395 | all | $27,395 | CONSTR |
| Town of Plymouth management | $117,880 | all | $117,880 | GOV |
| **TOTAL** | **$2,439,443** | | **$2,047,617** | |

# IMPLAN inputs- Stony Brook

*Final*

| CATEGORY | TOTAL COST | MA PORTION | MA COSTS | CLASSIFICATION |
|---|---|---|---|---|
| Engineering / Design | $204,942 | all | $204,942 | ENG |
| Cultural Resources | $50,501 | none (all RI) | $0 | ENG |
| Environmental Permitting | $59,678 | all | $59,678 | GOV |
| Implementation | $650,073 | all | $650,073 | CONSTR |
| Utilities Reconfiguration | $120,586 | all | $120,586 | CONSTR |
| Bid Prep, Engineering Oversight | $50,000 | all | $50,000 | ENG |
| Culvert casting, delivery | $90,985 | none (all NH) | $0 | CONCRETE PIPE |
| DER Project management / permitting | $20,618 | all | $20,618 | GOV |
| Ecological monitoring, 2 years | $60,842 | all | $60,842 | GOV |
| Project audit, 2 years | $11,500 | all | $11,500 | GOV |
| Partner in-kind | $40,000 | all | $40,000 | NGO |
| TOTAL | **$1,359,725** | | **$1,218,239** | |

# IMPLAN inputs – North Hoosic River (Briggsville)

*Final*

| CATEGORY | TOTAL COST | MA PORTION | MA COSTS | CLASSIFICATION |
|---|---|---|---|---|
| Engineering / Design | $171,057 | 75% (estimated) | $128,292 | ENG |
| Implementation | $246,750 | 95% (estimated) | $234,412 | CONSTR |
| Sediment disposal | $110,000 | all | $110,000 | CONSTR |
| Engineering Oversight | $45,530 | none (all CT or VT) | $0 | ENG |
| Planting / landscaping | $19,500 | all | $19,500 | CONSTR |
| Construction materials | $105,750 | 95% (estimated) | $100,462 | CONCRETE PIPE / CONCRETE |
| Planting / landscaping material | $13,000 | all | $13,000 | GREENHOUSE / NURSERY |
| DER Project management / permitting | $22,100 | All | $22,100 | GOV |
| Partner in-kind | $5,000 | all | $5,000 | NGO |
| **TOTAL** | **$ 738,687** | | **$627,767** | |

# Definitions: Impact Metrics

*Final*

- **Output:** Output is defined as the total economic activity or value of production in the state that is generated by an action. In the input-output model employed in this analysis (IMPLAN), outputs are annual production estimates for the year of the dataset (2009 in this case) and are in producer prices.
- **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.* In other words, it is the dollar value of the net additional economic activity related to a project. This measure is analogous to the measurement of gross state product (GSP) at the State level. Included in this measure are payroll taxes, state and local sales and excise taxes, and property taxes, among other tax types.
- **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." Some employment demand reflects new permanent jobs (e.g., if a new facility requires employees for operations), but much of the demand is for additional short-term construction labor or other services. Employment is defined by the Bureau of Labor Statistics as "the total number of persons on establishment payrolls employed full or part time who received pay for any part of the pay period that includes the 12th day of the month." Temporary and intermittent employees are included. Bureau of Labor Statistics, Current Employment Statistics. Accessed at http://www.bls.gov/ces/cescope.htm#3).

*The input-output model employed in this analysis (IMPLAN) defines value added as the sum of: employee compensation, taxes on import and production and imports less subsidies (includes sales and excise taxes, customs duties, property taxes, motor vehicle licenses, severance taxes, other taxes, and special assessments), and gross operating surplus (a profits-like measure that includes proprietors' income, corporate profits, net interest, and business transfer payments). IMPLAN glossary, February 2011. Accessed at http://implan.com.

# IMPLAN Results – Broad Meadows ($5.4 million)

*Final*

| IMPACT TYPE | EMPLOYMENT | LABOR INCOME | TOTAL VALUE ADDED | OUTPUT |
|---|---|---|---|---|
| Direct Effect | 39.3 | $2,990,000 | $3,230,000 | $5,430,000 |
| Indirect Effect | 11.1 | $693,000 | $1,040,000 | $1,660,000 |
| Induced Effect | 19.6 | $1,010,000 | $1,780,000 | $2,834,000 |
| **Total Effect** | **70.0** | **$4,690,000** | **$6,050,000** | **$9,920,000** |

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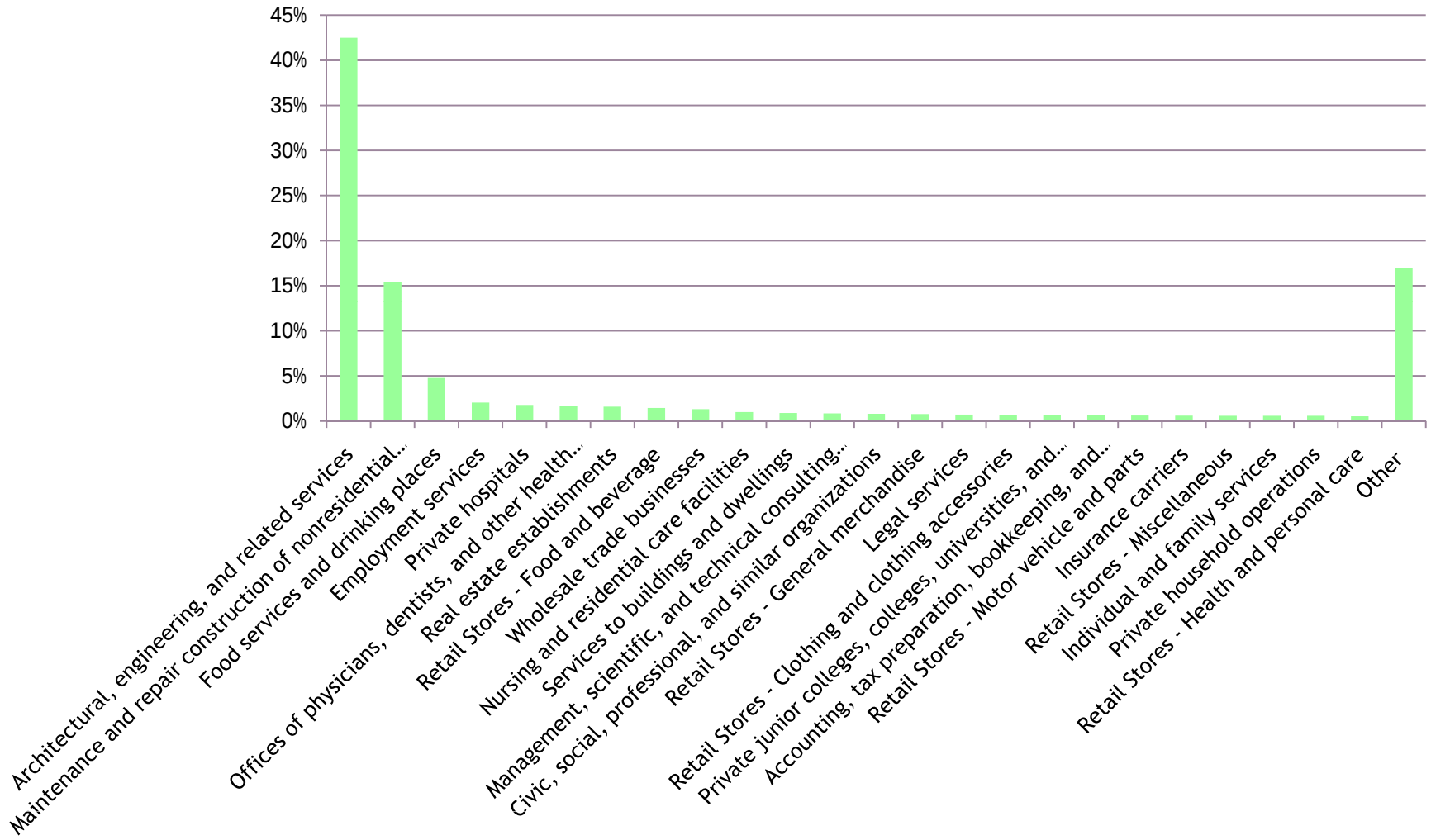
- **Direct effects** are production changes or expenditures that result from an activity or policy.
- **Indirect effects** are the "ripple" impact of local industries buying goods and services from other local industries as a result of the project (e.g., restoration project requires purchasing plant 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.

# IMPLAN Results: Broad Meadows Employment Impacts Detail

*Final*



# IMPLAN Results – Eel River ($2.4 million)

*Final*

| IMPACT TYPE | EMPLOYMENT DEMAND | LABOR INCOME | TOTAL VALUE ADDED | OUTPUT |
|---|---|---|---|---|
| Direct Effect | 15.2 | $884,000 | $1,100,000 | $1,950,000 |
| Indirect Effect | 3.1 | $197,000 | $303,000 | $507,000 |
| Induced Effect | 5.8 | $297,000 | $522,000 | $833,000 |
| **Total Effect** | **24.1** | **$1,380,000** | **$1,920,000** | **$3,280,000** |

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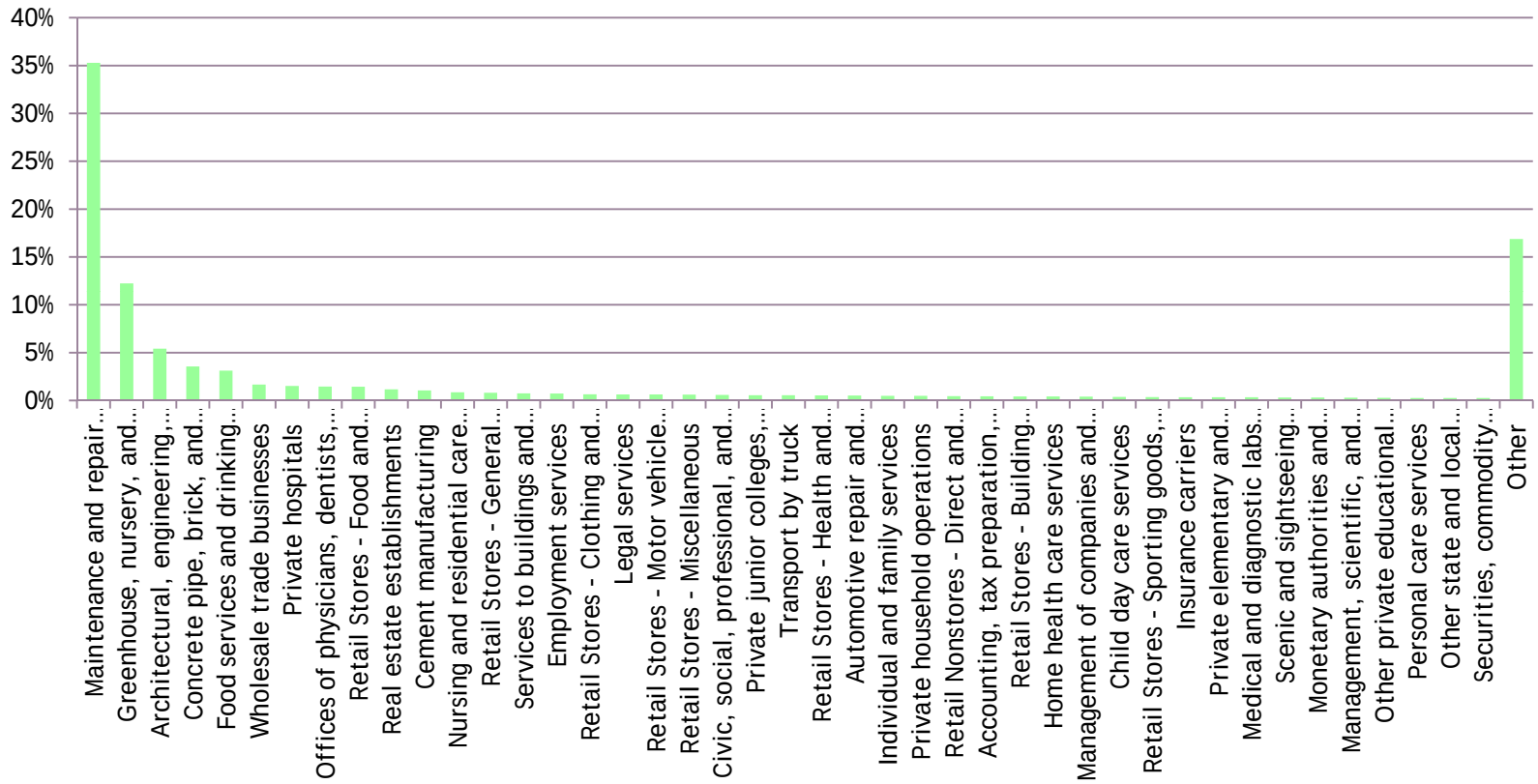
- **Value Added:** Value added is defined in economic modeling as the difference between an industry's or establishment's total output and the costs of its intermediate inputs.
- **Labor Income** is a measure of the employment income received in Massachusetts as part of the employment demand, and includes 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.

# IMPLAN Results: Eel River Employment Impacts Detail

*Final*



# IMPLAN Results – Stony Brook ($1.4 million)

*Final*

| IMPACT TYPE | EMPLOYMENT DEMAND | LABOR INCOME | TOTAL VALUE ADDED | OUTPUT |
|---|---|---|---|---|
| Direct Effect | 8.6 | $542,000 | $618,000 | $1,090,000 |
| Indirect Effect | 1.9 | $122,000 | $184,000 | $299,000 |
| Induced Effect | 3.5 | $182,000 | $320,000 | $512,000 |
| **Total Effect** | **14.1** | **$846,000** | **$1,120,000** | **$1,900,000** |

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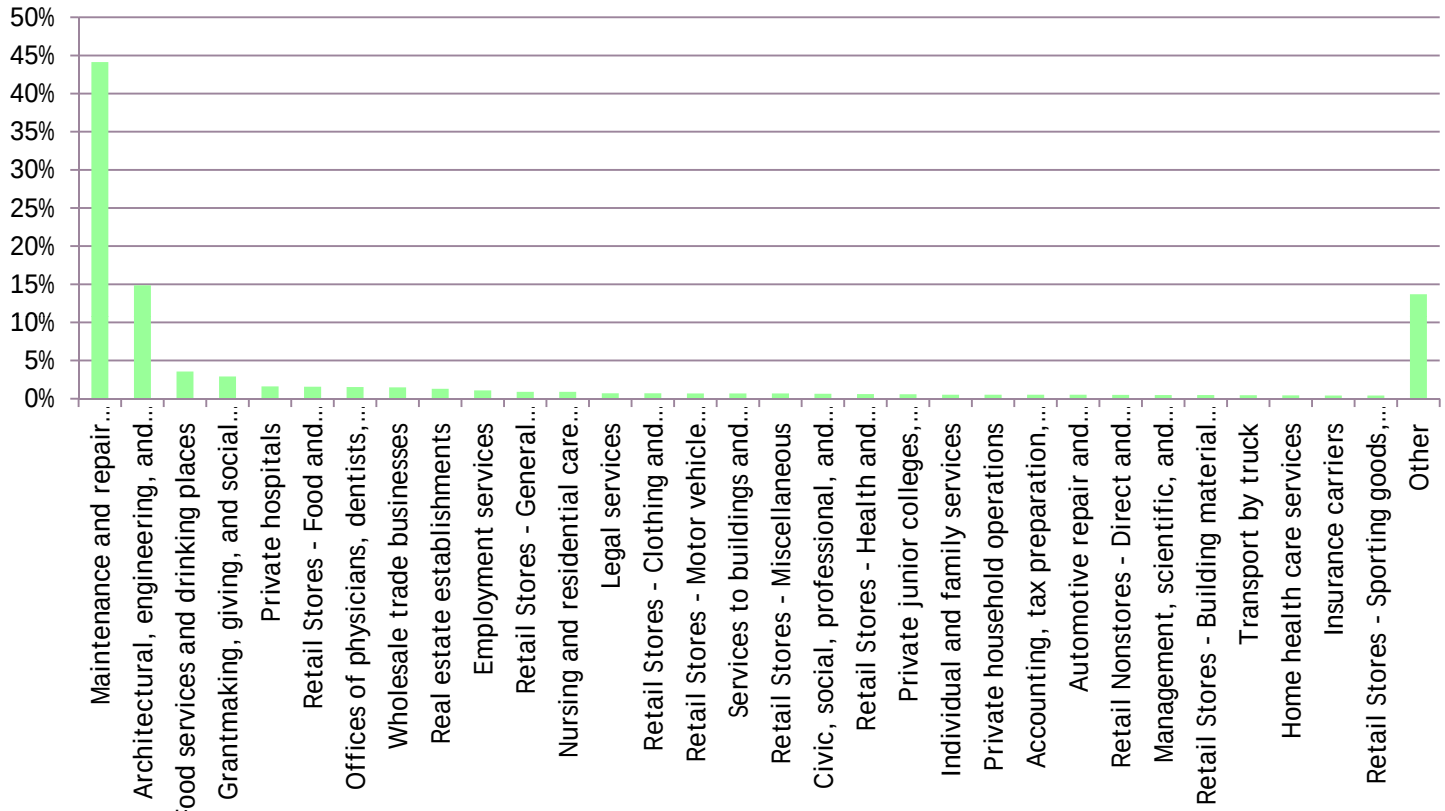
- **Labor Income** is a measure of the employment income received in Massachusetts as part of the employment demand, and includes wages, benefits, and proprietor income.
- **Employment Demand:** Employment Demand, in this context, measures the number of additional employees necessary for the Construction/Installation 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.

# IMPLAN Results: Stony Brook Employment Impacts Detail

*Final*



# IMPLAN Results – North Hoosic River ($0.7 million)

*Final*

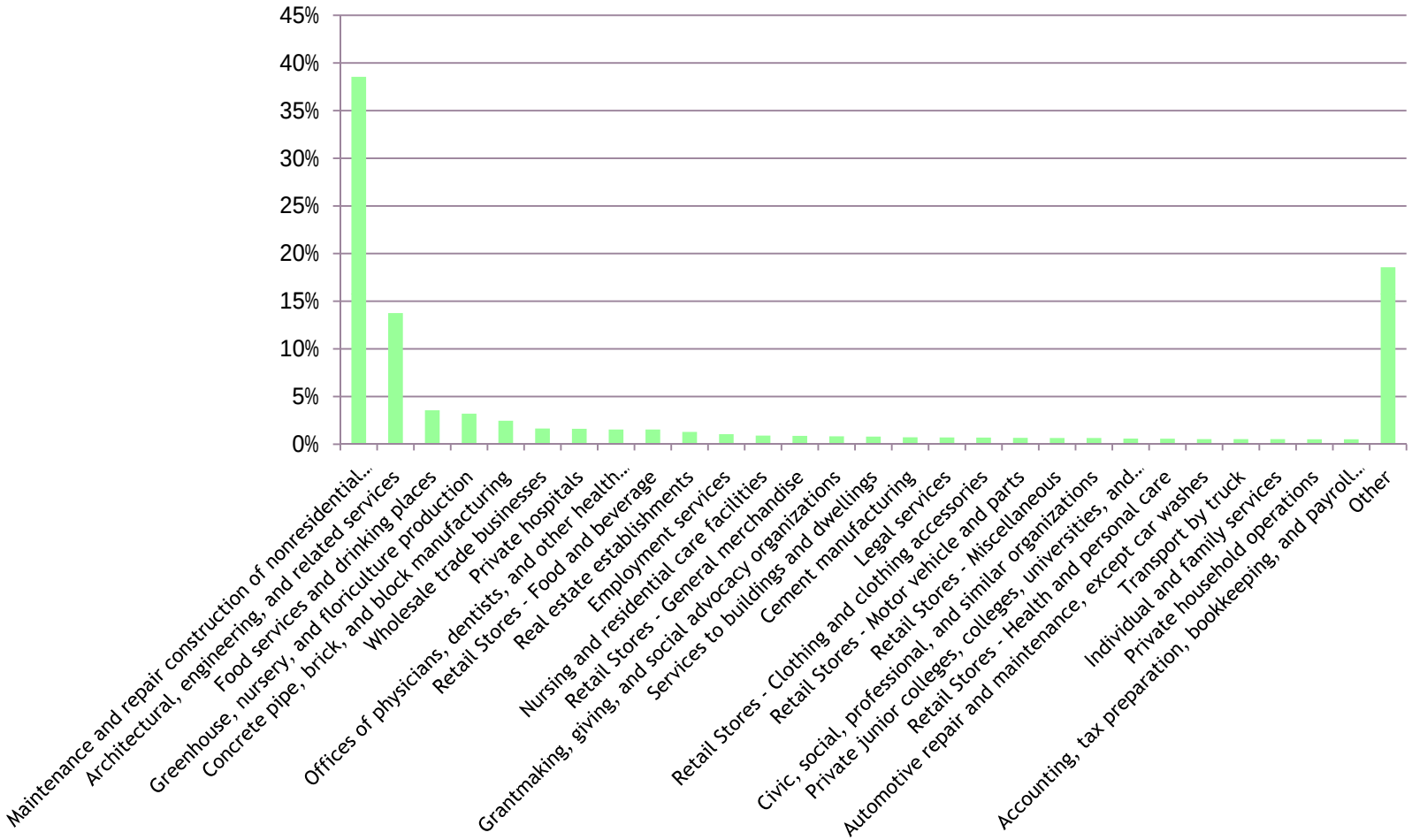
| IMPACT TYPE | EMPLOYMENT DEMAND | LABOR INCOME | TOTAL VALUE ADDED | OUTPUT |
|---|---|---|---|---|
| Direct Effect | 4.6 | $293,000 | $354,000 | $633,000 |
| Indirect Effect | 1.1 | $69,900 | $107,000 | $176,000 |
| Induced Effect | 1.9 | $99,600 | $175,000 | $279,000 |
| **Total Effect** | **7.6** | **$462,000** | **$635,000** | **$1,090,000** |

- **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** 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.

# IMPLAN Results: North Hoosic River Employment Impacts Detail

*Final*



# Sensitivity of Results: Results if all costs are assumed to be incurred in MA

*Final*

| IMPACT TYPE | EMPLOYMENT DEMAND | CHANGE | LABOR INCOME | CHANGE | TOTAL VALUE ADDED | CHANGE | OUTPUT | CHANGE |
|---|---|---|---|---|---|---|---|---|
| Broad Meadows* | 70.0 | 0% | $4,690,000 | 0% | $6,050,000 | 0% | $9,920,000 | 0% |
| Eel River | 32.2 | +34% | $1,904,000 | +38% | $2,620,000 | +36% | $4,440,000 | +35% |
| Stony Brook | 16.1 | +14% | $969,000 | +15% | $1,290,000 | +15% | $2,220,000 | +17% |
| North Hoosic River | 9.0 | +17 | $540,000 | +17% | $740,000 | +17% | $1,270,000 | +17% |

*All Broad Meadows impacts already assumed to be in MA in primary scenario.

- **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** 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.

# Summary of Impacts: per $1M Investment*

*Final*

| IMPACT TYPE | EMPLOYMENT DEMAND | LABOR INCOME | TOTAL VALUE ADDED | OUTPUT |
|---|---|---|---|---|
| Broad Meadows | 12.9 | $865,000 | $1,120,000 | $1,830,000 |
| Eel River | 9.9 | $565,000 | $789,000 | $1,350,000 |
| Stony Brook | 10.4 | $622,000 | $826,000 | $1,400,000 |
| North Hoosic River | 10.4 | $626,000 | $860,000 | $1,470,000 |

*Assumes some direct expenditures not 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** 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.

# Summary of Impacts: per $1M Investment, all MA scenario*

*Final*

| IMPACT TYPE | EMPLOYMENT DEMAND | LABOR INCOME | TOTAL VALUE ADDED | OUTPUT |
|---|---|---|---|---|
| Broad Meadows | 12.9 | $865,000 | $1,120,000 | $1,830,000 |
| Eel River | 13.2 | $781,000 | $1,070,000 | $1,820,000 |
| Stony Brook | 11.8 | $713,000 | $949,000 | $1,630,000 |
| North Hoosic River | 12.2 | $731,000 | $1,000,000 | $1,720,000 |

*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** 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.

# Literature review



- Purpose is to compare our results to those presented in similar studies.
- Four studies included in our review:
  - Ecotrust, *Preliminary Economic Assessment of Dam Removal: The Klamath River*, January 31, 2006
  - Montana Departments of Natural Resources and Conservation and Labor and Industry, *An Estimation of Montana's Restoration Economy*, September 2009
  - University of Oregon, Institute for a Sustainable Environment, *Economic and Employment Impacts of Forest and Watershed Restoration in Oregon*, Spring 2010
  - University of Massachusetts, Political Economy Research Institute, *How Infrastructure Investments Support the U.S. Economy: Employment, Productivity and* Growth, January 2009

# Literature review – Klamath River dam removal

*Final*

- Prospective analysis of the benefits of removing four dams from the Lower Klamath (and restoring upstream access for salmon).
- Applies Regional Input-Output Modeling System (RIMS) II multipliers for California.
- "Jobs created" per $1M in construction expenditures: **21.5**
- Indirect and induced jobs per job created: **2.1**
- Dollar change in total output per expenditure dollar: **2.4**

*In addition:*

- Jobs created per 1,000 commercially caught salmon: **1.5**
- Jobs created per 1,000 recreationally caught salmon: **4**

# Literature review – OR forest/watershed restoration

*Final*

- Application of IMPLAN 3.0 to estimate impact of public investments (random sample of 99 Oregon Watershed Enhancement Board restoration grants).

- Modeled four types of *contracted* restoration work:
  - Equipment-intensive watershed work (e.g., stream habitat construction)
  - Equipment-intensive forestry work (e.g., forest thinning)
  - Labor-intensive work (e.g., site prep, tree planting)
  - Technical planning and design work (e.g., field surveys, planning document development)

- Separately modeled projects by combining *contracting model* with a *project management* model.

# Literature review – OR forest/watershed restoration

*Final*

For each $1M invested in contracted work:

- Total employment effect (direct, indirect, induced): **15.7 - 23.8 jobs**
- Total economic output: **$2.1M - $2.4M**

For each $1M invested in a restoration project
(assuming 55% project management, 45% contracted costs):

- Total employment effect (direct, indirect, induced): **14.7 - 23.1 jobs**
- Total economic output: **$2.2M - $2.5M**

# Literature review – OR forest/watershed restoration

*Final*

Authors' observations and conclusions:

- Use of economic models built on characterization of "traditional" activities can limit the accuracy of estimated impact of investment in a new/emerging sector.
- In general, labor-intensive contracting creates less economic activity than equipment-intensive contracting, but more jobs
- IMPLAN reflects an urban bias; modifications necessary when work is largely rural.

# Literature review – Montana restoration economy

*Final*

- Application of IMPLAN to mining-related restoration activities
- Total employment effect (direct, indirect, induced) per $1M in restoration funding: **31.53** jobs
- Total economic output per $1M in restoration spending: **$2.59M**
- Authors note the impermanence of jobs and economic output and the possibility that calculated multipliers in this mining-related restoration context may not be readily transferable.

# Literature review – UMass infrastructure investment

*Final*

- Application of IMPLAN to estimate the impact of infrastructure investment in key sectors.
- Supplemental results by industry include the "reforestation, land and watershed restoration, and sustainable forest management" sector.
- Total employment effect (direct, indirect, induced) per $1M invested in this sector: **39.7** jobs

# Concluding observations

*Final*

- Our work is generally in line with other findings from similar efforts.
- Impacts across the four projects were not significantly different in terms of short-term impacts per $1M investment.
- Broad Meadows had somewhat higher impacts per $1M effort—this is likely the difference from assuming all activity occurs in MA.