Attachment C

PROPOSAL COVER SHEET
Required from all respondents

Please complete and submit this Cover Sheet with your grant The completed Cover Sheet can be scanned and emailed to Thomas.anderson@mass.gov Responses can also be sent in by regular mail to Executive Office of Energy & Environmental Affairs, Division of Conservation Services, 100 Cambridge St., 10th Floor, Boston MA 02114.

Organization information to be used for the contract:

Organization Name: Regenerative Design Group Cooperative Inc

Mailing address: 1 Chevalier Ave, Greenfield MA 01301

Phone: 413-376-5510

Email: bas@rdg.coop

Website: regenerativedesigngroup.com

Commonwealth of Massachusetts, Vendor Code: VC0000993761
(if our organization has one)

CHIEF EXECUTIVE or authorized signatory:
Sebastian Gutwein

PRIMARY CONTACT FOR THIS GRANT REQUEST AND POSITION (provide name, phone, e-mail and address if different from above):

Sebastian Gutwein

Authorized Signature 

Sebastian Gutwein — Print Name

Operations Manager — Title

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FY 25 GRANT PROJECT INFORMATION

GRANT AMOUNT REQUESTED:

Total $ 99,953.00

TOTAL PROJECT BUDGET (from all sources, including grant.)

$ 109,953.00

Total project match

$ 10,000.00

Project name: Healthy Soils Action Plan Ecosystem Carbon Sampling Protocols & Planning Project

SUMMARY OF GRANT PROJECT (limit to 75 words) (Please also forward this summary of project electronically to thomas.anderson@mass.gov so we can easily cut and paste it in summary reports :

To meet Massachusetts climate goals, the HSAP Ecosystem Carbon Sampling Protocol project aims to create a framework to provide vital baseline Massachusetts ecosystem carbon information by establishing criteria with which baseline sampling protocols will be developed, develop protocols for sampling a subset of critical landscapes, provide a format for the database that will be used to store and provide access to the baseline data, and map potential sites for long-term ecosystem monitoring within priority ecosystems.

Healthy Soils Action Plan Ecosystem Carbon Baseline Sampling Planning Project

Healthy Soils Challenge Grant Proposal

Submitted to the Massachusetts Executive Office of Energy and Environmental Affairs

Prepared by Regenerative Design Group in partnership with BSC Group and Woodwell Climate Research Center

November 2024

Challenge Grants Implementing the Commonwealth's Healthy Soils Action Plan
Commbuys Bid #BD-25-1042-ENV-ENV01-108053
RFR ID: BID ENV 25 DCS 12

Regenerative DesignGroup COOPERATIVE

BSC GROUP

Woodwell Climate Research Center

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Contents

Cover Letter

Tom Anderson
100 Cambridge Street
9th Floor
Boston, MA 02114

Dear Mr. Anderson,

The RFR for the Healthy Soils Challenge Grant invites proposals for projects that promote and implement innovative solutions for improving soil health and sustainable land management practices. In response to this call, Regenerative Design Group, together with, BSC Group, Woodwell Climate Research Center, and Matthew Duveneck, is pleased to submit a proposal for a "Healthy Soils Action Plan Ecosystem Carbon Baseline Sampling Planning Project" for consideration.

The Healthy Soils Action Plan (HSAP) identified that there are large gaps in our understanding of carbon stocks and fluxes for a number of the ecosystems and landscape types in Massachusetts. These gaps have made it hard to estimate positive and negative impacts that land use change is expected to have on green house gas emissions and sequestration.

The proposed project aims to create a framework to provide vital baseline Massachusetts ecosystem carbon information by establishing criteria with which baseline sampling protocols will be developed, develop protocols for sampling a subset of critical landscapes, provide a format for the database that will be used to store and provide access to the baseline data, and map potential sites for long-term ecosystem monitoring within priority ecosystems.

We believe that the team assembled for this project is uniquely qualified to develop a clear and effective way forward for the Commonwealth to have baseline carbon data needed to be able to meet its climate priorities and commitments. We welcome any questions you may have.

Thank you for considering this proposal.

Sincerely,

Sebastian 'Bas' Gutwein

Operations Manager, Regenerative Design Group

Healthy Soils Action Plan Ecosystem Carbon Sampling Protocols & Planning Project

Healthy Soils Challenge Grant Proposal

Project Description

Introduction

As described in the Healthy Soils Action Plan (HSAP) Challenge Grant RFR Round 2 (RFR ID BID ENV 25 DCS 12), the RFR states "Ecosystem Carbon information is currently unavailable but needed for any climate resiliency carbon projections." This project aims to create a framework to provide this ecosystem carbon information by establishing criteria with which baseline sampling protocols will be developed, develop protocols for data collection/sampling a subset of critical landscapes, provide a format for the database that will be used to store and provide access to the baseline data, and map potential sites for long-term ecosystem monitoring within priority ecosystems.

Ideally this will be done in conjunction with the **Healthy Soils Action Plan Upland & Wetland Forest Carbon Data Collection & Analysis Project,** another response to this RFR that will take the protocols developed in this project and field test and use the protocols to create baseline ecosystem carbon values for upland and wetland forests. The timelines for the two projects have been coordinated with all investigators to ensure efficient and coordinated completion of both projects prior to June 30, 2026. Additionally, the project managers for both projects have worked together closely on previous projects and, if the projects are funded, will be meeting regularly to coordinate the two projects as they unfold.

The two projects together will leverage the protocols developed from one (Ecosystems Carbon Sampling and Protocols) with the intensive field and lab analysis from the other (Upland and Wetland Forest Carbon Data Collection and Analysis Project), thus allowing sampling from a larger number of sites, enhancing the reliability of the data gathered, and allowing sampling on a wider variety of Massachusetts forest soil types. We choose to separate the proposals in order to maximize the benefits gained from each. The value of the Ecosystem Carbon Sampling and Protocols Project will be greatly enhanced by pairing it with a robust field sampling and laboratory analysis project that will test and refine the proposed protocols and procedures. The hands-on, field and laboratory-focused Upland & Wetland Forest Carbon Data Collection & Analysis Project benefits greatly by accessing well-developed sampling and laboratory protocols and processes. The combined efforts of the two projects are anticipated to be an efficient and cost-effective investment for the Commonwealth.

The Project Team is uniquely qualified to execute this scope of services. World class soil carbon researchers from Woodwell Climate Research Center (Woodwell) (based in Falmouth, MA) and forest ecologist Matthew Duveneck, an expert on above-ground Massachusetts forest carbon who conducts research at Harvard Forest, will be leading development of the carbon field observations & soil sampling protocols. Team members include the lead authors of the HSAP (RDG), a member of the HSAP Working Group (BSC Group (BSC)), and the consulting team from the Massachusetts Department of Environmental Protection (MassDEP) No Net Loss of Wetland Carbon Project (BSC, RDG, Woodwell, and the Massachusetts Association of Conservation Commissions (MACC)).

Goals and Objectives

In order to manage ecosystem carbon for climate resilience and mitigation of greenhouse gasses, reliable and comprehensive, regionally-specific, baseline data are needed. This type of data, specific to Massachusetts ecosystems, is extremely limited or does not exist, and no Massachusetts-focused plans or protocols for gathering, organizing, and making this data accessible have yet been developed.

The soil organic carbon (SOC) estimates contained within the Soil Survey Geographic Database (SSURGO) do provide valuable estimates for agricultural planning, but their suitability for ecosystem carbon accounting is limited by the ways in which soil map boundaries obscure significant internal variation within map units, and conceal widely varying transition zones between soils (Hunter et al., 2009; Nikiforova et al., 2020). The landcover-based adjustments to SSURGO-derived SOC estimates that are currently under development by Regenerative Design Group, and which incorporate information from the 2010 Rapid Carbon Assessment and the MassGIS 2016 Land Cover/Land Use data layer, will provide an improved estimate of SOC throughout the state, but still involve a number of assumptions and approximations that can only be remedied by robust baseline field data. Additionally, the SSURGO database only includes SOC, and an ecosystem carbon sampling plan must integrate SOC with biomass carbon.

Without a comprehensive and standardized dataset for carbon in the landscape, it is functionally impossible to measure shifts in the quantity of carbon stored in the landscape, both in soils and above ground carbon. This project will establish criteria and a clear methodology for gathering data to create baseline measurements of the current ecosystem carbon, including SOC and biomass carbon, in the landscapes of Massachusetts. Once baselines are established, the effects of ecosystem/landscape management practices and the effects of climate change on ecosystem carbon can be measured over time (for this proposal ecosystem carbon refers to the carbon in the soil and biomass in both managed and unmanaged areas). The recommendations in the Healthy Soils Action Plan (HSAP) for soil carbon can be tested, monitored, and adapted once there is a consistent methodology for testing ecosystem carbon and storing the relevant data.

HSAP calls out several specific needs regarding carbon sampling. There are two actions in HSAP that are fulfilled by this project:

- **Enhance the analytical capacity for measuring and monitoring soil health in Massachusetts.** This project will develop standards, protocols, and best practices. This project will standardize methods/protocols for ongoing ecosystem carbon sampling and create a database that can be used for research purposes and expand analytical capacity by establishing an overall plan, protocols, and procedures.

- **Enhance capacity to protect soil health by increasing monitoring + research of ongoing changes to soils from climate change**. This project will create the framework and protocols for ecosystem carbon research and monitoring that are an identified HSAP need.

This project meets all four primary objectives of these healthy soils Challenge Grants in the following ways:

1. **Promote Soil Health:** To support demonstration type projects that document, prioritize and implement practices aimed at improving soil health and fertility.

    - This project will promote soil health by providing methods/protocols to document and quantify soil organic carbon and biomass carbon. Before practices can be prioritized, baseline Massachusetts ecosystem carbon data that identifies carbon differences between ecosystem types/land covers should be developed and analyzed. This project would generate such data and analysis.

2. **Sustainable Land Management:** To encourage innovative approaches to sustainable land management that minimize environmental degradation, enhance biodiversity and/or restore degraded soil health.

    - Promoting innovative approaches requires understanding the impacts those approaches are expected to have. This project will develop the framework needed to be able to understand those impacts that will then inform innovative approaches to sustainable land management, with sustainable approaches/practices integrating an understanding of the carbon differences, and therefore soil health and function, between ecosystems and landscapes and their associated practices.

3. **Community Engagement:** To foster community involvement and education in sustainable land practices and soil health improvement.

    - While this project will not directly engage the general public, the materials will be directly available on the Massachusetts Healthy Soils Website (https://masshealthysoils.org) and findings will be included in talks given at a number of conferences in coordination with other healthy soils projects. The MA Healthy Soils Website was created by the RDG project team for a current HSAP Challenge Grant, and has been set up to be able to incorporate the proposed project work products.

4. **Refine Tools for Municipal Soil Mapping, Assessment + Planning:** Update and distribute assessment and planning tools to enable municipalities, regional planning districts, and conservation organizations to visualize and integrate soil health into regular workflows.

    - The final deliverable for this project will lay the groundwork for municipalities, regional planning districts, and conservation organizations to fund or get funding for ecosystem carbon baseline sampling that will provide critical information to inform local policy and ordinances, and use as a reference for research and demonstration projects.

The Challenges

Outline current soil carbon measurement issues

- **This project would run simultaneously with the Upland and Wetland Forest Carbon Data & Analysis Project.** Responding to this challenge, the Project Teams have coordinated the timelines for the two projects closely, and the Project Teams for the two projects involve the same team members. These team members, including the two project managers, have worked together successfully before on complex, multi-phase, Massachusetts EEA and MassDEP projects. The Project Team organizations have deep benches, and can pull in additional staff, should tasks take longer than anticipated, to keep both projects on track in a coordinated way. Project Team members have strong and tested organizational and communication skills and enjoy working together. This team is passionate about healthy soils, wetlands, forests, and addressing the climate change challenge, with high standards for the quality and timeliness of work products.

- **An exhaustive list of protocols for all land covers is not feasible,** therefore prioritizing those with the most impact will be required. To make this as effective as possible we will generate a prioritized list of ecosystem/ landscape types and clearly define the criteria and standards necessary to create additional protocols in future projects by us and others. These will be provided as a deliverable of this project.

Methodology

This project will meet our goals and objectives while addressing the above challenges through close coordination with the Project Team as well as the BSC-led Project Team running the HSAP Upland & Wetland Forest Carbon Data Collection & Analysis Project. We will also be coordinating with other relevant colleagues, professionals and organizations that we have developed relationships with through the team's long history of working on related projects.

The primary method of achieving this goal is to identify key ecosystems through research, mapping, and literature review, identify potential data collection sites through spatial analysis, and develop protocols for each site type/ecosystem through literature review, on-team expertise, and expert consultation.

Phase 1 – Project Management, Coordination & Communication

Good communication, coordination, and project management is essential for any project. Throughout all of the Phases, the Project Team will actively communicate with EEA staff via email, quarterly Zoom meetings, and quarterly project

status summaries. Additionally, the Project Team will actively communicate and coordinate internally with all team members to ensure the project is accomplishing project milestones in accordance with the project timeline, stays on budget, and the actions of all team members are well coordinated. As project manager, RDG will lead project coordination and communications, such as scheduling Zoom meetings and will compile and submit project status summaries. RDG is experienced in managing projects of this scope, with multiple consulting groups and complex client goals and concerns.

Because this same Project Team is staffing the proposed HSAP Upland & Wetland Forest Carbon Data Collection & Analysis Project, coordination between the two projects will be relatively straightforward. The consulting team has years of experience working together on multiple projects and will plan and execute timely and effective coordination between these two projects, including regular check-in calls between the project managers of the two projects.

Phase 2 – Identify, map, and prioritize ecosystems and field sites

After preliminary coordination with EEA, the initial phase of this project will be to identify the priority ecosystem types within Massachusetts, such as upland and wetland forests and other types of wetlands that are high in carbon (e.g. non-forested peatlands, floodplain wetlands, & bogs; fens; scrub-shrub wetlands; freshwater marshes; salt marshes) and other priority ecosystems poorly represented in the literature. Criteria may include coverage and extent, representativeness, range and importance of ecosystem functions and services, expected carbon densities, current land use, and vulnerability to land use conversion.

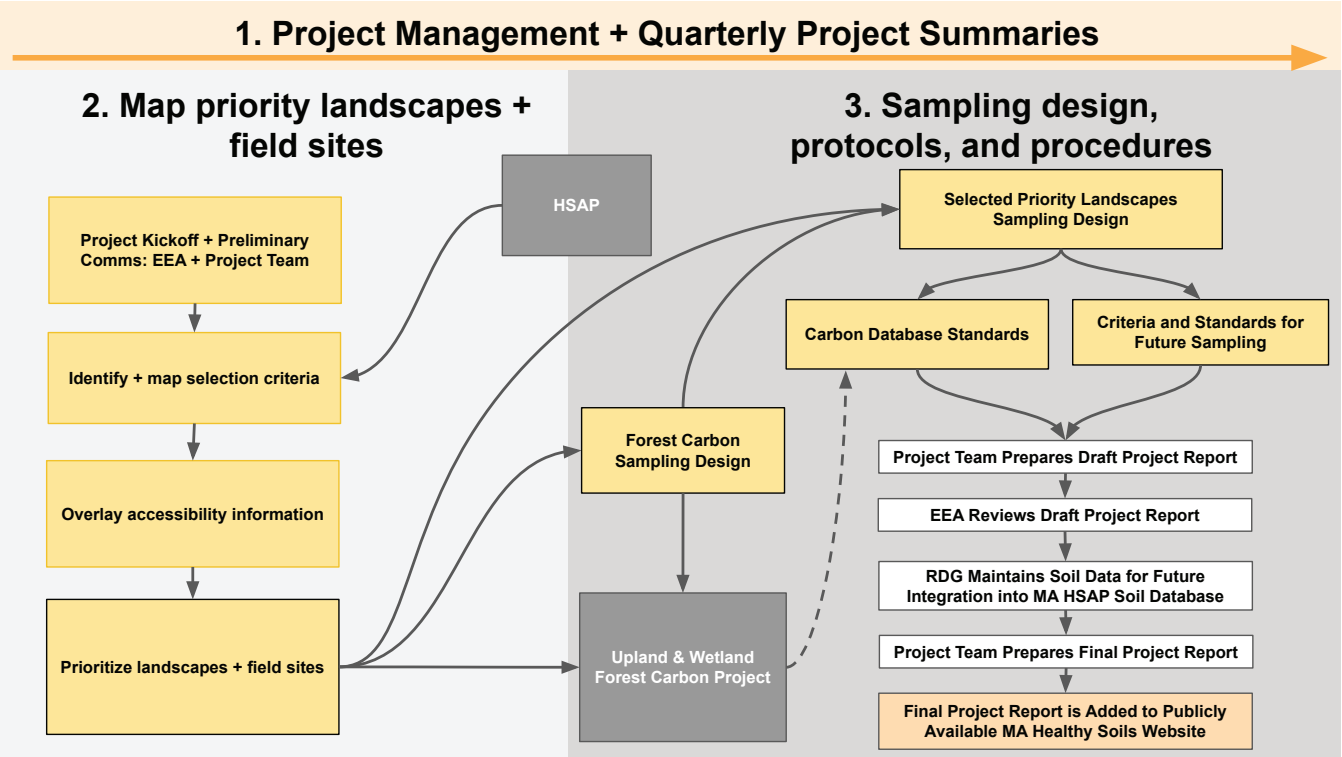
Site selection for baseline sampling requires identifying sites that are both representative of the ecosystem type and legally and physically accessible. Critical site criteria will be mapped to assist in site selection for the priority ecosystem and landscape types in relation to locations likely to be legally and physically accessible such as public and land trust lands. This map will be segmented to identify potential field sites for priority ecosystems/landscapes.

Phase 3 – Develop carbon data collection/sampling design, protocols, and procedures

Alongside identification of priority ecosystem types in Phase 1, the project will begin identifying data collection/sampling designs, field and laboratory protocols appropriate to the priority ecosystems and the goals of the project, sufficient to ensure the highest return of quality baseline data for the investment of available time and resources. Initial work will focus on forest ecosystems in order to provide the companion project HSAP Upland & Wetland Forest Carbon Data Collection & Analysis Project with sampling design and protocols.

Follow up work will focus on data collection/sampling design, field and laboratory protocols, for a limited number of additional ecosystem types, and definition of generalized criteria and standards for data collection/sampling designs and field and laboratory protocols applicable to the remaining priority ecosystems.

In tandem with the project-specific database developed for the HSAP Upland & Wetland Forest Carbon Data Collection & Analysis Project, the Project Team will also develop criteria and standards for the development of a database for ongoing, statewide ecosystem carbon data collection, organization, and storage.



Expected Outcomes and Deliverables

The primary deliverables from this project will be:

- Maps and descriptions of key ecosystems for ecosystem carbon sampling, prioritized by biophysical and practical criteria
- Maps and descriptions of field sites for ecosystem carbon sampling for forest landscapes and other selected priority ecosystems
- Maps and descriptions of areas of interests for potential field sites for remaining priority ecosystems
- Description of optimal sampling designs, field protocols, and lab tests for ecosystem carbon sampling in forest landscapes and other selected priority ecosystems
- Criteria and standards for data collection/sampling protocols and procedures for ecosystem carbon sampling and laboratory testing
- Project-specific soil carbon database for the **HSAP Upland & Wetland Forest Carbon Data Collection & Analysis Project**
- Criteria and standards for a statewide ecosystem carbon database

- Presentation of the use of the project outcomes at no fewer than 3 conferences of likely users.

We are confident this project will fulfill the following key outcomes:

1. Determine and prioritize key ecosystems for ecosystem carbon data collection/sampling in Massachusetts

2. Define criteria and standards for consistent carbon data collection/sampling protocols and laboratory testing procedures for priority ecosystems to provide a clear roadmap for capturing consistent Massachusetts-specific ecosystem carbon data

3. Identify 30 to 40 potential Massachusetts field study sites for the identified priority ecosystems (including a range of potential sites for the **HSAP Upland & Wetland Forest Carbon Data Collection & Analysis Project).**

4. Define criteria and standards for a statewide ecosystem carbon database

5. Develop a soil carbon database for the **HSAP Upland & Wetland Forest Carbon Data Collection & Analysis Project**

The final deliverables for this project will be:

a. Draft and final report containing: All information on select priority Massachusetts ecosystems, including areas of interest, potential field sites, field sampling designs, standards, protocols, and laboratory procedures. Criteria and standards for future sampling designs, field protocols, and lab procedures for other ecosystems identified in this project. Criteria and standards for a future statewide ecosystem carbon database.

b. Integration of final report into MA Healthy Soils Website.

c. GIS layers of all pertinent spatial information, including ecosystem selection criteria, priority ecosystems, and areas of interest.

d. GIS layers and/or spatial coordinates of a variety of potential field sites for HSAP Upland & Wetland Forest Carbon Data Collection & Analysis Project, from which a final list would be confirmed during the HSAP Upland & Wetland Forest Carbon Data Collection & Analysis Project.

e. Maintenance of Massachusetts upland and forest carbon data set provided by **HSAP Upland & Wetland Forest Carbon Data Collection & Analysis Project** for integration into future Massachusetts ecosystem carbon database.

HSAP Ecosystem Carbon Sampling Protocols & Planning Project Budget

		Total Hours	Project Totals
	Total Hours (Proj.)	**714**	
Phase 1	**Prj Mngmt, Coord, Comms**	**30**	**$3,982**
1.1	Kickoff Meeting	12	$1,657
1.2	Quarterly Project Status Summaries	18	$2,325
Phase 2	**Identify Priority Landscapes**	114	**$16,039**
2.1	Identify, select, and map selection criteria	38	$5,328
2.2	Overlay ownership and accessibility information	30	$4,227
2.3	Identification and prioritization of landscapes and sites	46	$6,484
Phase 3	**Develop Carbon Sampling Design and Protocols**	570	**$79,932**
3.1	Forest Carbon Sampling Design	124	$17,012
3.2	Selected Priority Landscapes Sampling Design	104	$14,190
3.3	Criteria and Standards for Sampling	101	$14,020
3.4	Carbon Database Standards	51	$7,578
3.5	Draft Project Report	120	$17,346
3.5	Final Project Report	62	$8,705
3.6	MA Healthy Soils Website	8	$1,080
			$99,953

Proposed Budget

The requested funding for this project is **$99,953** which spans 3 phases and wraps up by the end of June 30th 2026**.** In addition the project team is providing an in-kind match of **$10,000** that will cover the presentation of the use of the project outcomes at no fewer than 3 conferences of likely users.

Team and Organizational Capacity

Key Personnel

Bas Gutwein, Rafter Ferguson PhD, Keith Zaltzberg, Von Harvey *(Regenerative Design Group)*

- **Project management + spatial analysis and mapping priority landscapes and areas of interest + field site selection + lead report preparation and production + MA Healthy Soils Website coordination + technical review + integrate field data and analysis into a future MA Soil Carbon Database**. RDG will act as project Prime with Bas Gutwein as Project Manager. RDG will lead mapping and selection of field sites; support protocol development, lead report preparation and production of final deliverable documents; and present results at conferences if EEA desires this outreach, and coordinate integration of forest carbon data & analysis from field work into MA Healthy Soils Website as well as integrate into a future MA Soil Carbon Database.

Gillian Davies PWS, RSS, NHCWS, CESSWI; Ethan Sneesby, MS; Evan Fox, MNRS; Marleigh Sullivan, MS *(BSC Group)*

- **Field site selection + technical review + report preparation + provide field data and analysis for future MA Soil Carbon Database**. BSC will collaborate on selection of field data collection sites and on development of protocols and procedures; provide technical review and contribute to report preparation; and present results at conferences if EEA desires this outreach.

Jennifer Watts PhD, Taniya Roychowdhury PhD *(Woodwell Climate Research Center)*

- **Sampling design and protocol development + field site selection + technical review + report preparation + provide field data & analysis for future MA Soil Carbon Database.** Woodwell will lead development of sampling design, field protocols, and specification of lab procedures relating to belowground carbon; collaborate on selection of field data collection sites; provide technical review and contribute to report preparation; and present results at conferences if EEA desires this outreach.

Matthew Duveneck, PhD

- **Sampling design and protocol development + field site selection + technical review + report preparation + provide field data & analysis for future MA Soil Carbon Database.** Matthew Duveneck will lead development of sampling design, field protocols, and specification of lab procedures relating to aboveground carbon; collaborate on selection of field data collection sites; provide technical review and contribute to report preparation; and present results at conferences if EEA desires this outreach.

Previous Achievements + Letters of Support

The RDG Project Team for the Healthy Soils Action Plan Ecosystem Carbon Sampling Protocols & Planning Project is comprised of leading organizations who are heavily involved in major climate resilience planning efforts in Massachusetts.

RDG will serve as prime consultant for this proposed project and has joined forces with members of other leading Massachusetts firms, including BSC Group (BSC) and Woodwell Climate Research Center to conduct the Ecosystem Carbon Sampling Protocols & Planning Project. Matthew Duveneck, a forest ecologist with Massachusetts forest carbon expertise, will also join the team. Each of these leaders has unique expertise and together provide unparalleled depth in wetland, forest, and soil science research & practice, GIS, and ecosystem carbon modeling.

The firms and individuals represented in this Project Team have a proven track record of implementing successful projects of this scale. Individually, each of the firms and key team members have been at the forefront of climate resilience, nNature-based and nNatural Climate Solutions, ecosystem, upland and wetland forest carbon, and wetland research, practice, and policy work in their respective fields. Regenerative Design Group (along with Linnean Solutions) led the production of the Healthy Soils Action Plan and was a member of the MassDEP No Net Loss of Wetland Carbon Project consulting team. BSC Group served on the HSAP Working Group and led the MassDEP No Net Loss of Wetland Carbon Project. Woodwell Climate Research Center was a member of the MassDEP No Net Loss of Wetland Carbon Project consulting team and is an award-winning world class ecosystem climate research center with a substantial focus on the carbon dynamics of wetlands and forests (including wetland forests). Additionally, these firms have gone on to collaborate on four MVP Program projects that operationalized the insights and recommendations from the HSAP for municipalities. Matthew Duveneck's work has specialized in Massachusetts forest ecology and forest carbon dynamics, with much of his work conducted as a researcher at Harvard Forest. The appendices include detailed profiles of project team members and a selection of relevant projects from each firm.

Proposed Timeline

1. Phase 1 – Project Management + Coordination + Communication

January 2025 through June 30, 2026

1.1 Project Kickoff + Communications: A 1-hour project kickoff meeting will be held via Zoom or Teams with EEA and the Project Manager to review project goals, tasks, protocols, reporting, and budget/billing, and answer questions. As needed, other communications will occur throughout the project, such as via email, to ensure that the project launch and implementation is efficient, effective, and meets EEA expectations. Internal Team coordination will occur as needed throughout the project.

1.2 Quarterly Project Status Summaries: Brief project status summaries shall be provided to EEA on a quarterly basis.

Phase 1 Milestones:

- Project Kickoff (EEA + Project Manager)
- Quarterly Project Status Summaries

2. Phase 2 – Identify, map, and prioritize ecosystems and field sites

January 2025 to June 2025

2.1 Identify, select, and map selection criteria: Project Team will review and select criteria, potentially including coverage and extent, representativeness, range and importance of ecosystem functions and services, expected carbon densities, current land use, and vulnerability to land use conversion. The project team will map selected criteria to identify priority ecosystems.

2.2 Overlay ownership and accessibility information: The GIS layers developed in the previous step will be intersected with land owned by the Commonwealth, land trusts, and other non-profits, and any other data identified as pertinent to legal and physical accessibility, in order to identify areas and field sites with the highest probable ease of obtaining permission for access. Prioritizing Commonwealth and land trust land also raises the likelihood that permission will be granted for sites to be used for long-term studies, should additional funding become available in the future.

2.3 Identification and prioritization of ecosystems and sites: The intersection of the GIS layers described above will be used to delineate priority ecosystems for sampling and identify areas of interest within those landscapes for the location of potential specific field sites. For and in tandem with the **HSAP Upland & Wetland Forest Carbon Data Collection & Analysis Project,** this process will extend to identify specific field sites.

Phase 2 Milestones:

- Selection criteria identified and mapped
- Accessibility issues information mapped
- Priority ecosystems and areas of interest for specific field study sites identified across the state
- Preliminary identification of field data collection sites for the **HSAP Upland & Wetland Forest Carbon Data Collection & Analysis Project** (final confirmation of sites, including landowner permission, will occur during the HSAP Upland & Wetland Forest Carbon Data Collection & Analysis Project)

3. Phase 3 – Develop carbon data collection/sampling design, protocols, and procedures

January 2025 through June 2026

3.1 Forest Carbon Data Collection/Sampling Design: Identify data collection/sampling designs, and field and laboratory protocols for the identified priority ecosystems**:** Based on literature review and team expertise, Project Team will identify optimal designs, protocols, and procedures for establishing carbon baseline data. This information would be provided to the **HSAP Upland & Wetland Forest Carbon Data Collection & Analysis Project by early June of 2025** so that field crews would be able to use these data collection/ sampling designs, field protocols, and laboratory protocols during the 2025 growing season. Protocols, etc., for other ecosystems would be developed subsequently, and prior to the end of June 2026 under Tasks 3.2 and 3.3.

3.2 Selected Priority Ecosystems Data Collection/Sampling Design: Identify data collection/sampling designs, field and laboratory protocols, for selected priority ecosystems. The process described in 3.1 will be repeated for a select number of non-forest priority ecosystems.

3.3 Criteria and Standards for Future Data Collection/Sampling: Develop criteria and standards for data collection/sampling designs, field and laboratory protocols for remaining priority ecosystems. The remaining priority ecosystems identified in Phase 2 will have designs and procedures established at a strategic roadmap level level, without being specified to the level of detail as those in 3.1 and 3.2.

3.4 Carbon Database Standards: Generate data requirements necessary to create and maintain a database of ecosystem carbon baseline data. In tandem with the project-specific database developed for the results of the **HSAP Upland & Wetland Forest Carbon Data Collection & Analysis Project,** the Project Team will develop criteria and standards for the development of a database for ongoing, statewide ecosystem carbon data collection, organization, and storage.

3.5 Draft Project Report: Project Team will prepare a Draft Project Report documenting the priority ecosystems, areas of interest, potential field sites, sampling designs, field and laboratory protocols, criteria for further development of data gathering methods, and criteria for a statewide ecosystem carbon database.

3.6 Final Project Report: Project Team will prepare a Final Project Report documenting the priority ecosystems, areas of interest, potential field sites, sampling designs, field and laboratory protocols, criteria for further development of data gathering methods, and criteria for a statewide ecosystem carbon database.

3.7 MA Healthy Soils Website: Final Report will be added to the MA Healthy Soils Website.

Phase 3 Milestones

- Criteria, standards, data collection/sampling, field and laboratory protocols described for priority ecosystems, including for the HSAP Upland & Wetland Forest Carbon Data Collection & Analysis Project
- Criteria and standards described for statewide ecosystem carbon database
- Draft and final project reports completed
- Final report uploaded to MA Health Soils Website

Project Evaluation and Monitoring

Performance Metrics

4. One (1) GIS data layer containing intersection of biophysical and other selection criteria and delineating priority ecosystems and areas of interest for establishment of field sites.

5. 30 to 40 areas of interest for preliminary (i.e. landowner permission and specific detailed data plot locations will not be determined until field study projects occur) selection of field sites are identified for priority ecosystems.

6. Data gathering protocols, including sampling design, field and laboratory protocols, are described for upland and wetland forests, and at least two (2) other selected priority ecosystems.

7. Draft and Final Project Reports documenting all spatial analysis of priority ecosystems, areas of interest, preliminary list of site locations, specification of methods and procedures, criteria and standards for future data gathering and for future MA Soil Carbon Database, will be provided.

Reporting

Progress reports summarizing project activities and accomplishments will be submitted on a quarterly basis with monthly invoices. The progress reports will include any relevant supplemental materials. The final materials will be uploaded to the project webpage and submitted as PDFs to the EEA on or before June 30, 2026.

Sustainability Plan

Post-grant Project Sustainability Assessment

This project represents the continuation of a partnership established between the Regenerative Design Group and BSC Group that was established during the production of the Healthy Soils Action Plan. Since completing the majority of the work in 2021, the firms have gone on to collaborate on four MVP Program projects that operationalized the insights and recommendations from the HSAP for municipalities. This project also continues the partnership between BSC Group, Regenerative Design Group, Woodwell Climate Research Center that formed as the consulting team for the MassDEP No Net Loss of Wetland Carbon Project, a project that provides not just a collaborative team foundation, but also a shared knowledge base about wetland soil and biomass carbon; wetland and soil health; and the extent and carbon content of Massachusetts wetlands. These firms are joined by Matthew Duveneck, who will add outstanding expertise as a forest ecologist who has conducted extensive research in Massachusetts, much of which has been done at Harvard Forest.

Regenerative Design Group is committed to defining and setting system standards for the ecosystem carbon database, and will create the initial database and link it on the Massachusetts Healthy Soils Action Plan Website. During this time an alternate long-term host may be determined, provided they have the reach, commitment, and resources to continue the dissemination of the material.

Following the publication of the ecosystem carbon data collection/sampling protocols, the Project Team intends to continue this work through partnerships with leading researchers, industry actors, and professional associations. As the attached firm profiles demonstrate, each of the Project Team members already has a track record of being an industry leader in bringing healthy soils and the importance of decarbonizing development to our projects and the general public.

We anticipate that the work described in this proposal will reveal additional needs and pathways to promote healthy soils and climate resilience/carbon storage in ecosystem carbon. The team assembled for this project is committed to using the findings from this project to address these gaps through continuing and expanding collaboration.

Risk Assessment for Project, Partners, and Timeline

The members of this team and our partners have an excellent track record of delivering high-quality experiences and work products on-time and on-budget. The attached resumes and project qualification sheets provide documentation of these work products and the high degree of qualification we bring to this project, including numerous professional certifications, advanced degrees, and decades of professional experience. It is notable to mention that two of the larger projects, HSAP and the Apple Country Natural Climate Solutions project, spanned the beginning of the COVID pandemic. This required a hard pivot to remote or distanced options in outreach, education, and field-based events. The success of these projects gives us confidence that we can navigate unforeseen challenges. We have identified the following risks and mitigation strategies for the completion of the Guide:

Staffing changes/disruptions

- Each firm of the project team has a deep bench of staff that could step in should unexpected disruptions require a change of project staffing. In anticipation of this potential, RDG, BSC, and Linnean Solutions will hold regular project meetings internally with understudies and construct a resilient file sharing system accessible to all members of each firm.

Tasks take longer than expected

- As mentioned, each firm on the project team has a deep bench. Should tasks take longer than expected, we have the capacity to pull in additional staff to ensure that key deadlines are met, as well as a solid track record of delivering high caliber work products.

COVID Resurgence / Other Pandemic

- While in person and hybrid events are planned for this project, all events will be designed to allow for remote and asynchronous engagement. Recorded sessions will also serve as resources for future outreach and education.

In summary, we put forward this proposal as a low risk investment due to the capacity of the partners, the ability to deliver this scope of work within this budget and without requiring additional third party funds for completion, and the fact that this work is primarily a compilation of existing primary research and education sources and producing essentially a communications- associated set of deliverables. Success is not contingent upon other third party institutional endorsements or funding.

Appendices

Appendix 1: Firm Profiles & Project Examples

Resilient Communities. Productive Landscapes. Nature-based Solutions.

OUR FIRM

Regenerative Design Group is a worker-owned ecological design practice dedicated to creating productive landscapes and resilient communities. We work across scales, offering innovative, practical, and flexible solutions for individuals, institutions, and communities.

Our capacity for interdisciplinary thinking is informed by our backgrounds in ecology, agriculture, conservation, architecture, and education.

COOPERATIVELY OWNED AND RUN

Founded in 2009, Worker-Owned since 2021

Founding Board of Directors, 2021

OUR WORK

Research

We support clients and their communities in articulating their vision and goals, and bringing rigorous ecological analysis and long-term climate projections to the table.

Master Planning & Campus Design

We develop designs for campuses that combine food production and learning, guiding the transition from high-input management to diverse educational landscapes.

Regenerative Agriculture & Farm Design

We work with communities and farm owners to develop diverse farming and agroforestry systems that support the farm's social, environmental, and economic goals.

Productive Habitats & Ecosystem Regeneration

We work to restore and enhance existing natural systems that provide fresh air, clean water, food, fuel, fiber, wildlife, shelter, and wild forage.

Residential Design & Integrated Homesteads

We help homeowners envision and create beautiful, efficient homes and landscapes that invite engagement through the production of food and integration of natural systems.

Massachusetts Healthy Soils Action Plan

CLIENT

Massachusetts Executive Office of
Energy + Environmental Affairs, 2019-2023

SERVICES + ACCOMPLISHMENTS

Analysis and modelling of Soil Organic Carbon (SOC) stock, segmented by land cover type

Projection of 2050 SOC flux, based on land cover change

Soil-smart planning and management priorities

Stakeholder engagement

Management of 40 person working group

PROJECT OVERVIEW

The Massachusetts Healthy Soils Action Plan (HSAP) is the nation's first effort to understand, protect, and revitalize soil function in all land uses statewide. This Plan, commissioned by Massachusetts Executive Office of Energy and Environmental Affairs, reveals the tremendous impact land use and management has on the soils of the Commonwealth and sets forth strategies and actions to increase soil health as a way to improve food security, ecosystem function, and climate resilience across the region.

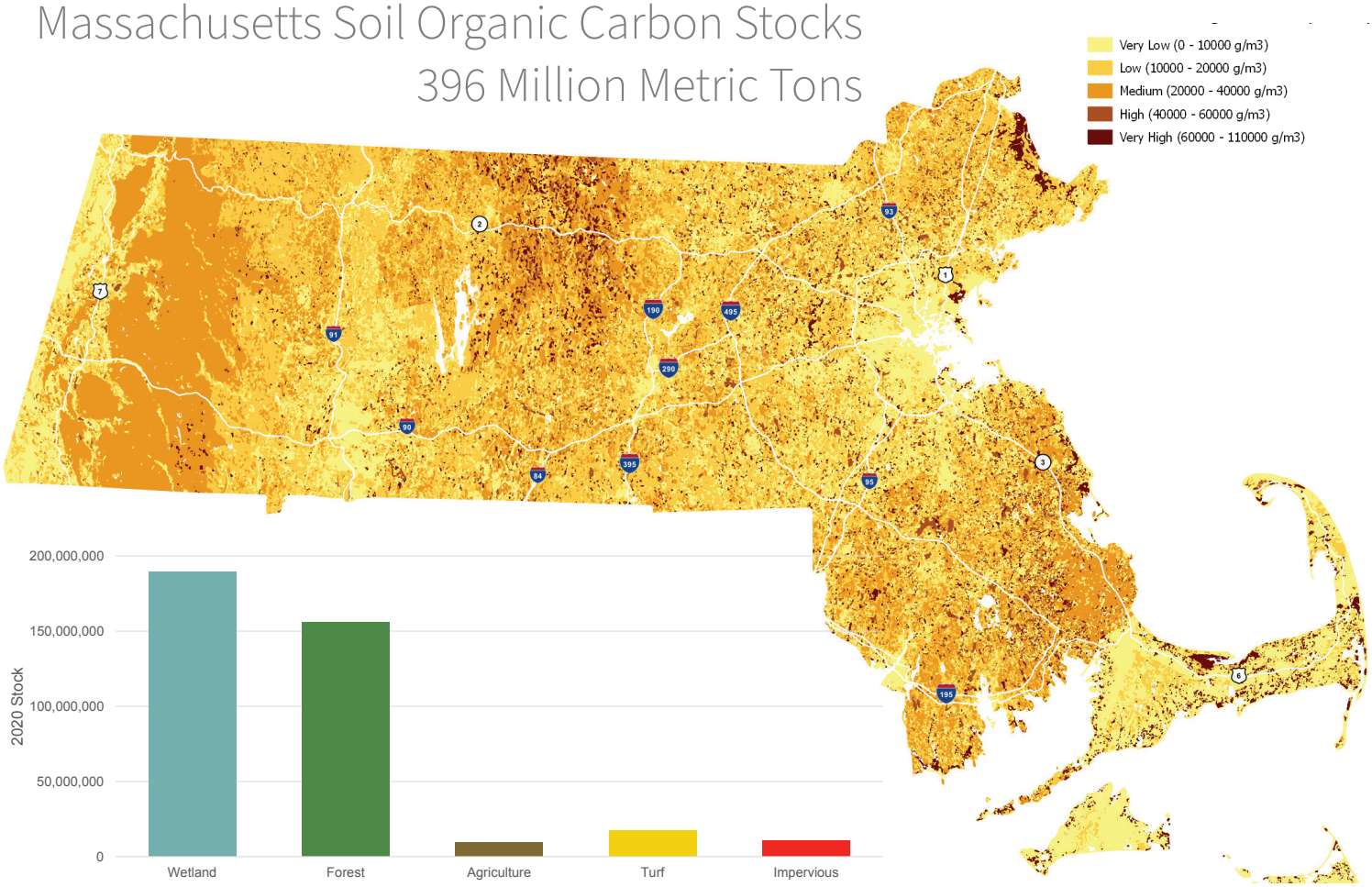
Through an 18-month process the consultant team, led by Regenerative Design Group, conducted a detailed literature review and geospatial analysis to understand the key factors and dynamics that shape soil health. This included the development of a novel method for quantifying soil organic carbon (SOC) based on land cover and drainage classification.

With guidance and review of a 40-member Working Group, representing state and federal agencies, conservation organizations, scientific advisors, and community stakeholders, RDG developed a series of evidence-based strategies and actions aimed at transforming the impact of soil management on climate from a negative to a positive.

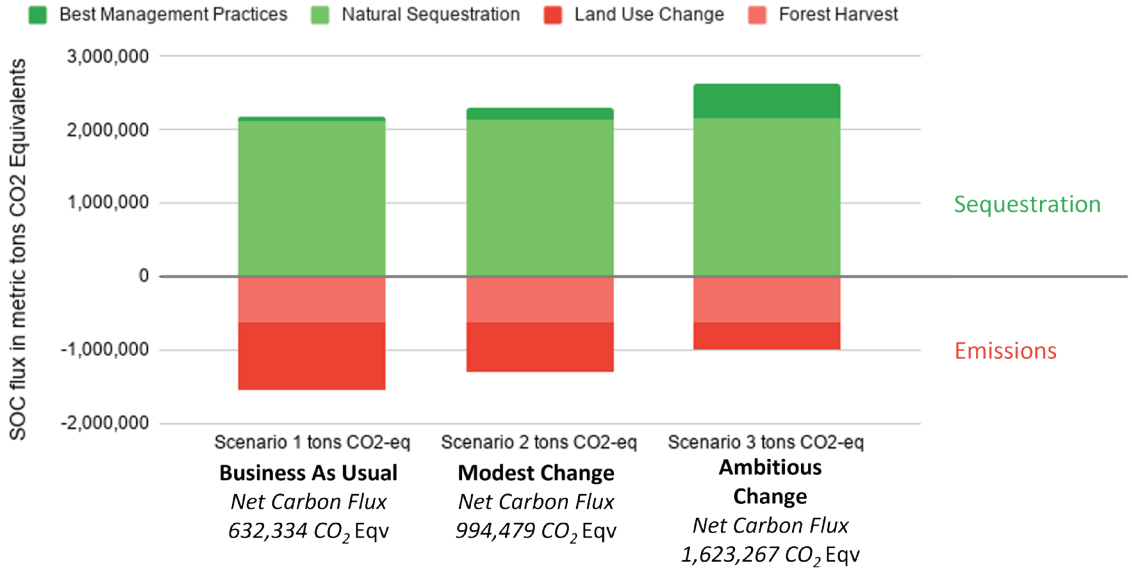
The result is a roadmap for policymakers, land managers, and soil health advocates to understand the interconnected nature of the Commonwealth's landscapes and the role they play in soil carbon sequestration and climate resilience.

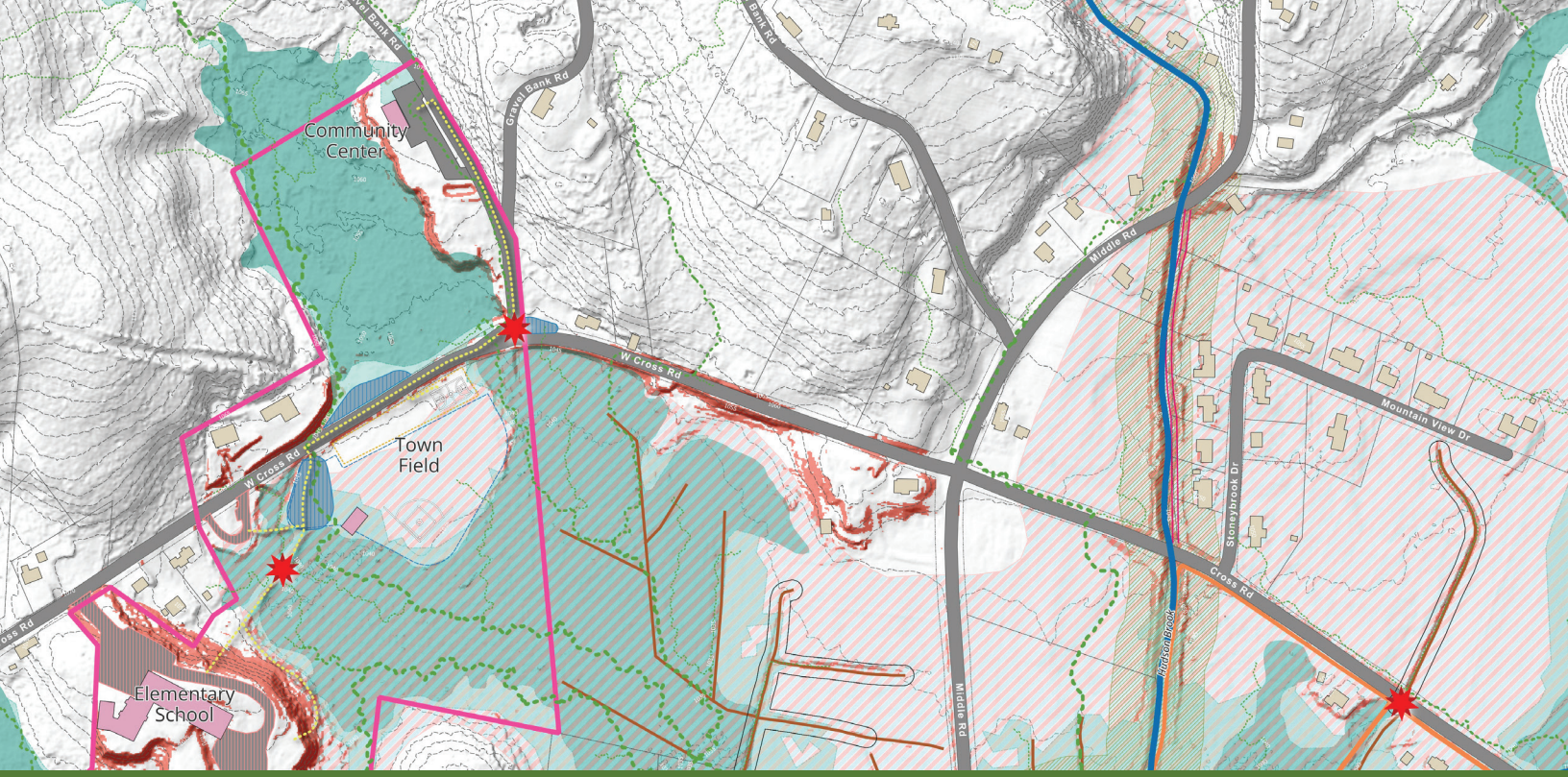
Regenerative DesignGroup

Massachusetts Soil Organic Carbon Stocks
396 Million Metric Tons



2050 Comparison of Annual Soil Organic Carbon Fluxes





Four Corners Floodplain Resiliency Project

CLIENT

Berkshire Regional Planning Commission
Town of Clarksburg, MA

SERVICES + ACCOMPLISHMENTS

Mapping + Site Analysis

Nature-based solutions for stormwater management + flooding

Community workshops, site walks, and listening sessions

Concept designs for stormwater management, floodplain resilience, and recreation

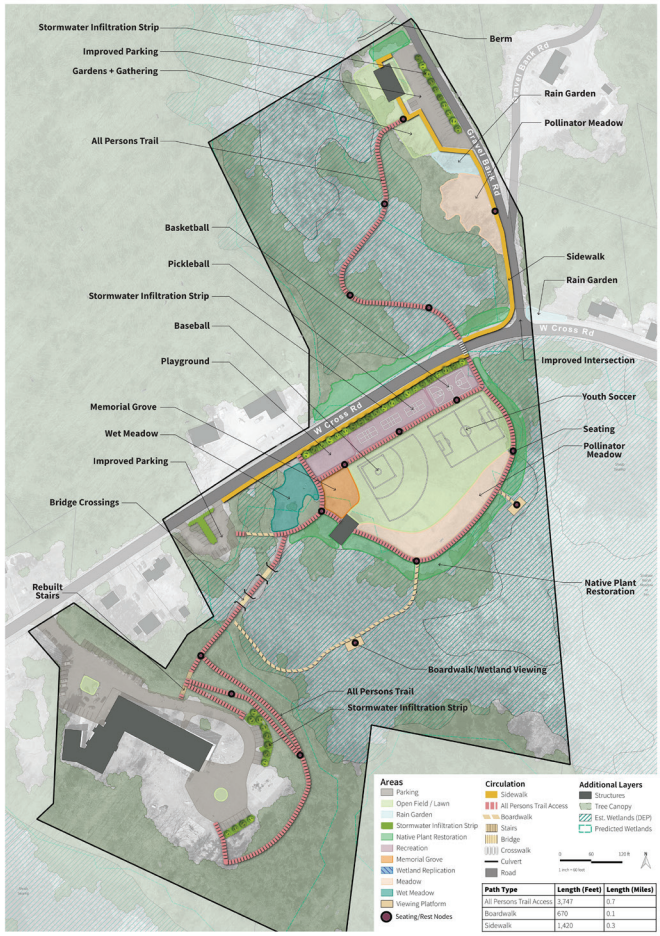
PROJECT OVERVIEW

The Four Corners Floodplain Resiliency Project will identify the most feasible and effective nature-based solutions for several locations throughout the project area that have experienced persistent and problematic flooding. In addition to floodplain resiliency, the project will provide ecologically appropriate conceptual designs for the Town Sites focus area, with a focus on expanding universal accessibility, recreational opportunities, and safety.

Community members gather to review and discuss the pros and cons of preliminary concepts.

Regenerative DesignGroup

Four Corners Town Sites | Concept A: Maximize Recreation + Connectivity



Safety/Accessibility

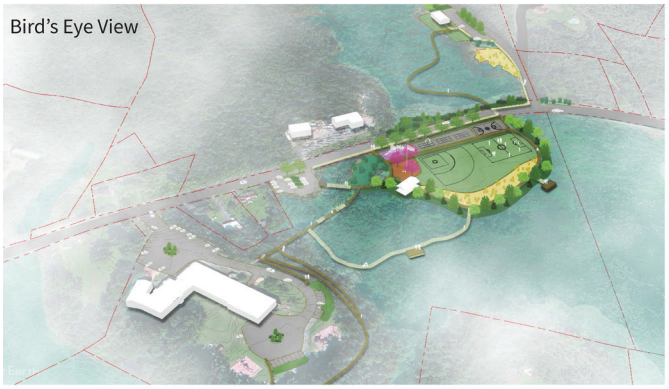
- Accessible trail circuit connects all sites
- Sidewalk runs from Town Field parking lot to the Community Center

Recreation/Nature

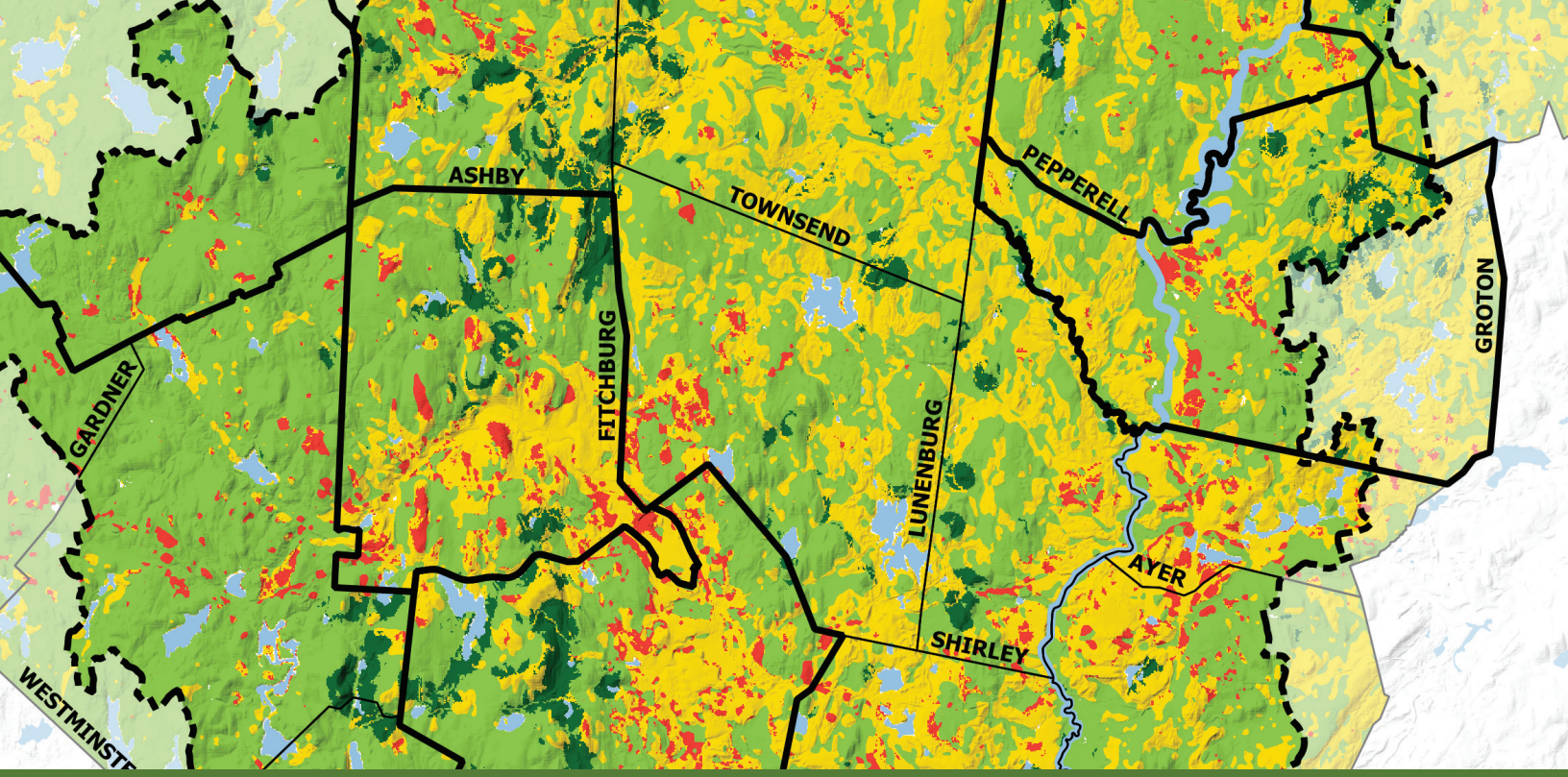
- Sports, play, and gathering zones are expanded/formalized in the Town Field
- Boardwalks/viewing platforms provide access to wetland ecology

Water Management

- Persistent wet areas in Town Field are planted (wet meadow, native plant restoration)
- Rain gardens + infiltration strips capture and utilize stormwater throughout
- Turf areas around the Community Center are improved with meadows and gardens
- Problem culverts are improved



One of three preliminary concepts for the Town Sites focus area in the Four Corners neighborhood.



Fitchburg/Nashua River Watershed-Wide Nature Based Solutions

CLIENT

Towns of Fitchburg, Leominster, Ashburnham, Pepperell, and Groton, MA

SERVICES + ACCOMPLISHMENTS

Mapping and analysis of soil health and land cover types across the Nashua River Watershed

Estimation and assessment of Soil Organic Carbon (SOC) stocks for major land types

Identification of priority sites for nature-based solutions (NbS) to enhance resilience and ecosystem health

Creation of detailed maps on land cover change, development pressure, and soil functions for resilience

Collaboration with local municipalities and stakeholders to guide practices

Integration of environmental justice considerations, overlaying demographic and ecological risk data to target climate-vulnerable communities

Regenerative DesignGroup

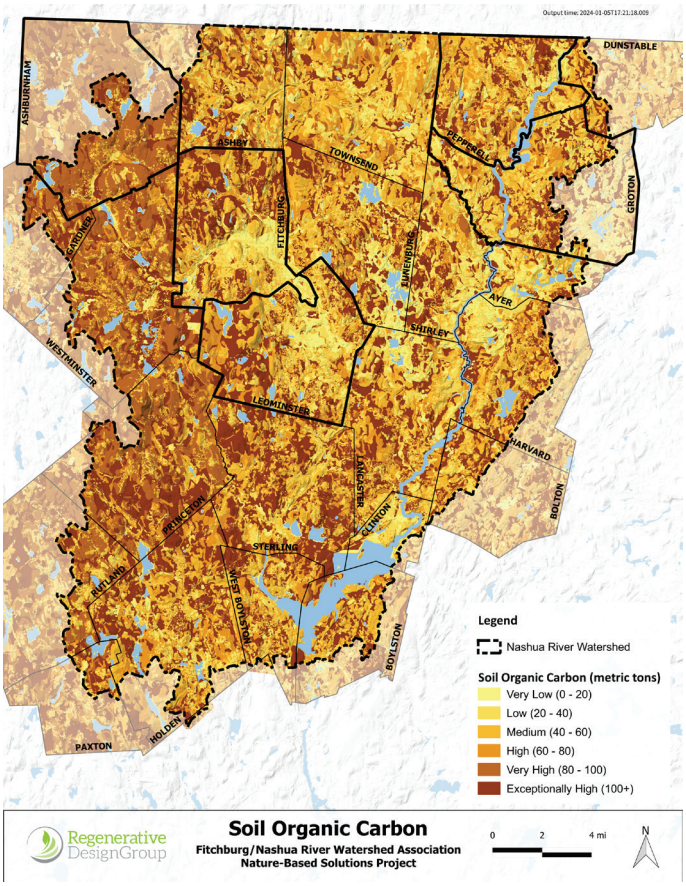
PROJECT OVERVIEW

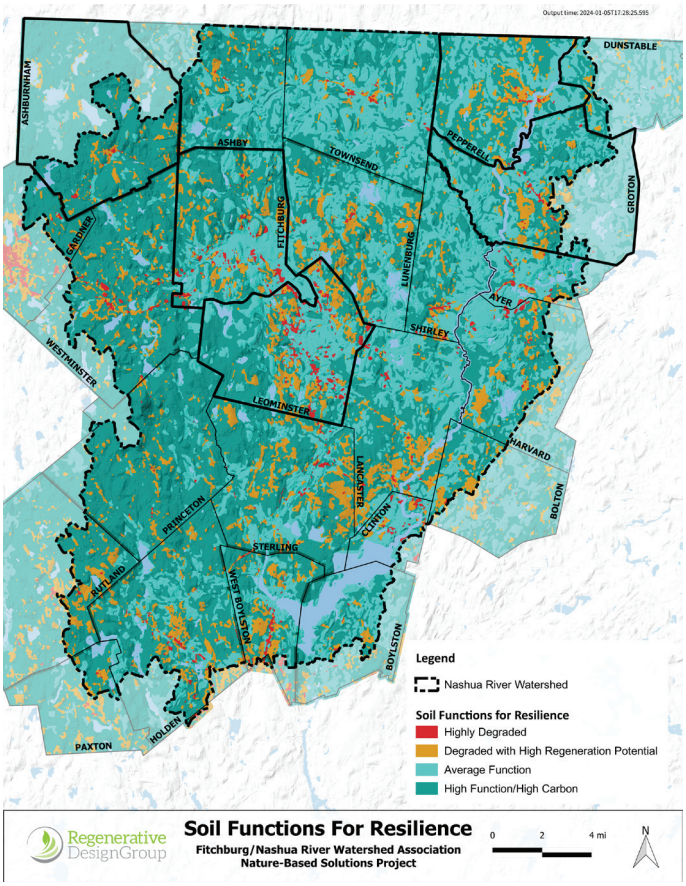
The Fitchburg-Nashua River Watershed Nature-Based Solutions project is a collaborative effort between the Nashua River Watershed Association (NRWA) and Regenerative Design Group (RDG), providing support to five municipalities: Fitchburg, Leominster, Ashburnham, Groton, and Pepperell. The project's goal was to identify strategic sites for nature-based interventions that will enhance climate resilience and soil health across the watershed.

RDG's contributions include mapping and analysis aiding a broad understanding of existing soil health and land cover conditions. Employing and evolving RDG's soil mapping methods, the project resulted in a series of maps, including assessments of soil organic carbon (SOC) stocks, landcover change, and development pressure. Together, these resources help stakeholders prioritize high-impact nature-based solutions (NbS) that maximize soil function and resilience.

After conducting a watershed-wide analysis, RDG zoomed in on specific sites within each of the five municipalities and recommended actions to improve soil health and the resilience of those sites, as well as the larger watershed system.

The project also emphasizes environmental justice by overlaying demographic data with ecological risk factors, allowing for targeted NBS planning that considers the needs of climate-vulnerable populations.





#	SITE	PREDOMINANT SOIL FUNCTIONS FOR RESILIENCE			
		Highly Degraded	High Regeneration Potential	Moderate-Low Function	High Function
1	Phillips Brook/Residential Area on Main St.	◆	◆		◆
2	Pump Station			◆	
3	Sweeney Park	◆	◆		
4	Dump/Transfer Station			◆	
5	Page Ave		◆		
6	High St./Cushing St.	◆	◆		
7	S. Branch Souhegan River		◆		◆
8	Brickford Field			◆	◆

Deerfield Soil Health Plan

CLIENT

Town of Deerfield
Municipal Vulnerability Preparedness Program, 2022

SERVICES + ACCOMPLISHMENTS

Analysis and modelling of Soil Organic Carbon (SOC) stock, segmented by land cover type

Soil-smart planning and management priorities

Intensive stakeholder engagement

Sample bylaws aimed at protecting and improving soil resources

Soil sampling across a variety of land types providing the basis for future soil health tracking

Design and execution of a “soil health field day” for 120 high school students

Awarded by the Massachusetts chapter of the American Planning Association for excellence in Sustainability & Resilience planning

PROJECT OVERVIEW

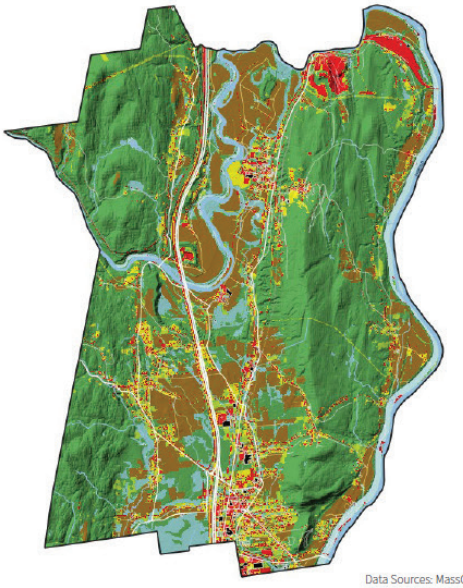
The Deerfield Healthy Soils Project is based on the premise that protecting and improving soil function across land uses is an essential component of climate-resilient planning. The overall goal of this project was to identify the most impactful actions and strategies that the community of Deerfield, Massachusetts can implement to steward its soils in ways that support the myriad of co-benefits and beneficial functions of healthy ecosystems including enhanced carbon sequestration and storage, greater fertility, and improved water dynamics.

Over the course of a year, Regenerative Design Group led a process that included high resolution modeling of Deerfield’s current healthy soil resources; presentations, workshops, and conversations with stakeholders with a special focus on farmers considering the town’s large agricultural community; soil sampling across a variety of land types providing the basis for future soil health tracking; a “soil health field day” for 120 high school students; and the development of several recommendations for potential bylaw improvements aimed at protecting and improving soil resources.

This project was completed in 2022 as part of a larger Municipal Vulnerability Preparedness action in the town of Deerfield, MA. Regenerative Design Group (RDG) worked closely with Chris Curtis (Conservation Works) who was the lead planner for the larger MVP project and who was the lead author of the sample bylaws included in our report. The consultants reported directly to Deerfield’s Climate Change and Energy Committee in carrying out the work of the project. The project was recognized in 2022 by the Massachusetts chapter of the American Planning Association with it’s Sustainability & Resilience Award.

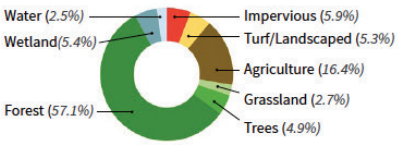
Regenerative DesignGroup

Land cover + Soil Organic Carbon Stocks in Deerfield, MA



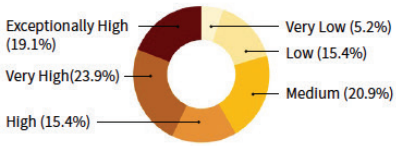
Data Sources: MassGIS 2016 Landcover

Forest	12,525 ac
Agriculture	3,506 ac
Wetland	1,160 ac
Turf & Landscaped Areas	1,123 ac
Trees	1,041 ac
Impervious	965 ac
Grassland or Shrub	571 ac
Open Water	527 ac

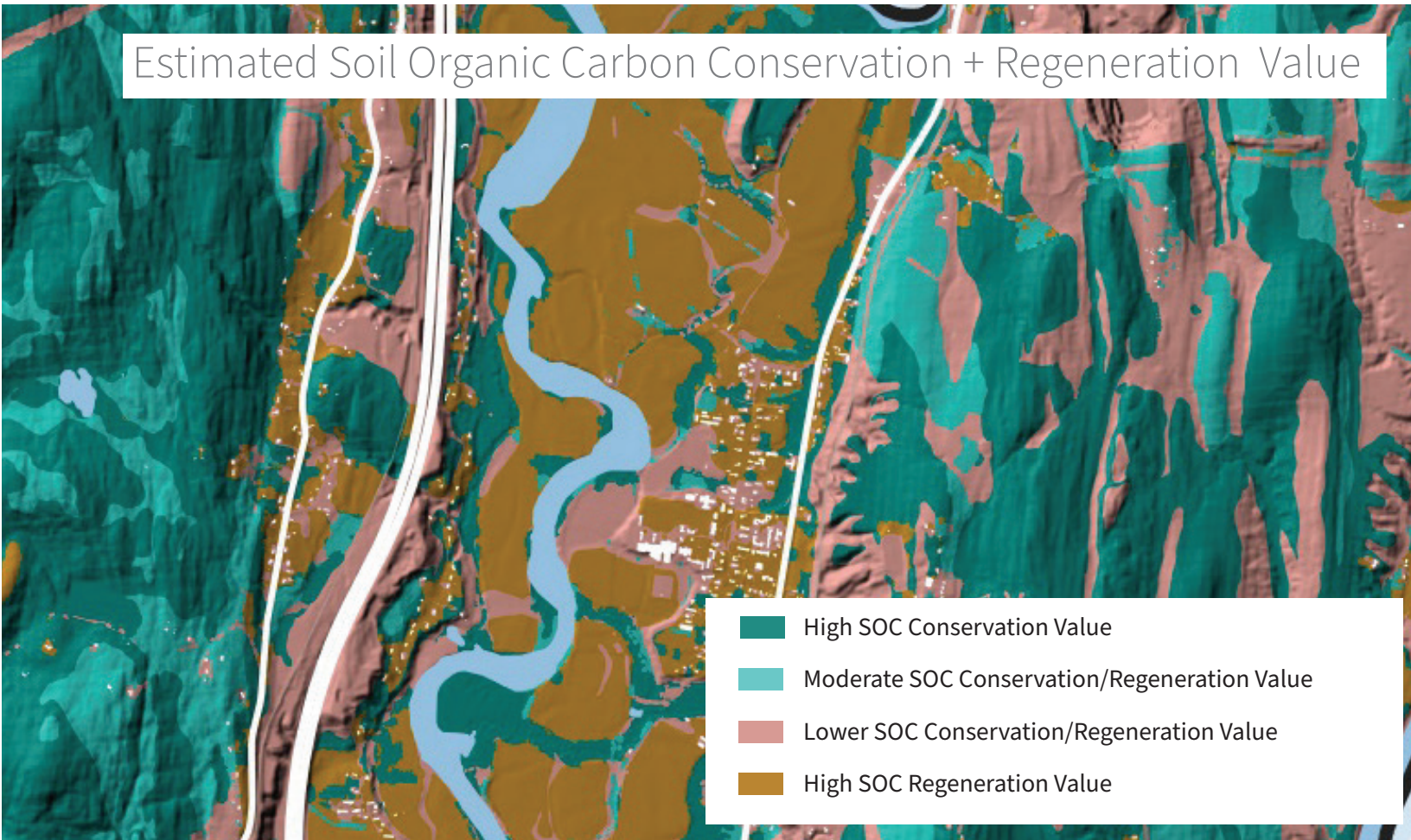


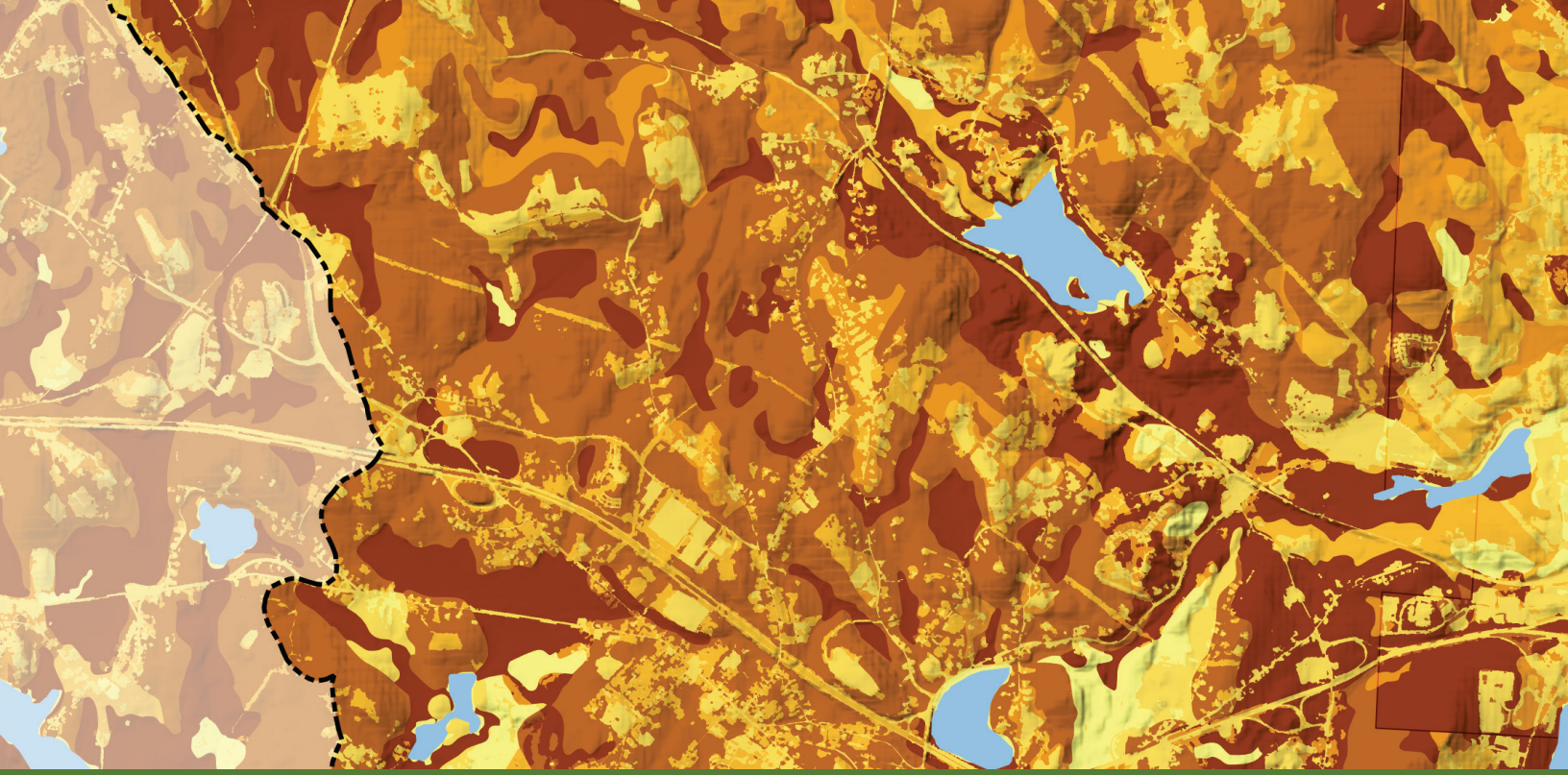
Data Sources: Soils SSURGO-Certified NRCS, NRCS Rapid Carbon Assessment, MassGIS 2016 Landcover

Very Low (0-20 tons/acre)	1,120 ac
Low (20-40 tons/acre)	3,299 ac
Medium (40-60 tons/acre)	4,481 ac
High (60-80 tons/acre)	3,306 ac
Very High (80-100 tons/acre)	5,107 ac
Exceptionally High (100+)	4,097 ac



Estimated Soil Organic Carbon Conservation + Regeneration Value





Statewide Soil Organic Carbon Mapping Project

CLIENT

Commonwealth of Massachusetts, 2024

SERVICES + ACCOMPLISHMENTS

Comprehensive mapping and modeling of Soil Organic Carbon (SOC) stocks across varied land cover types

Production of detailed maps and data visualizations to support planning and decision-making for stakeholders

Stakeholder engagement through workshops and presentations to communicate findings and gather feedback

Collaboration with state and municipal agencies to integrate SOC data into broader climate resilience and land use planning

PROJECT OVERVIEW

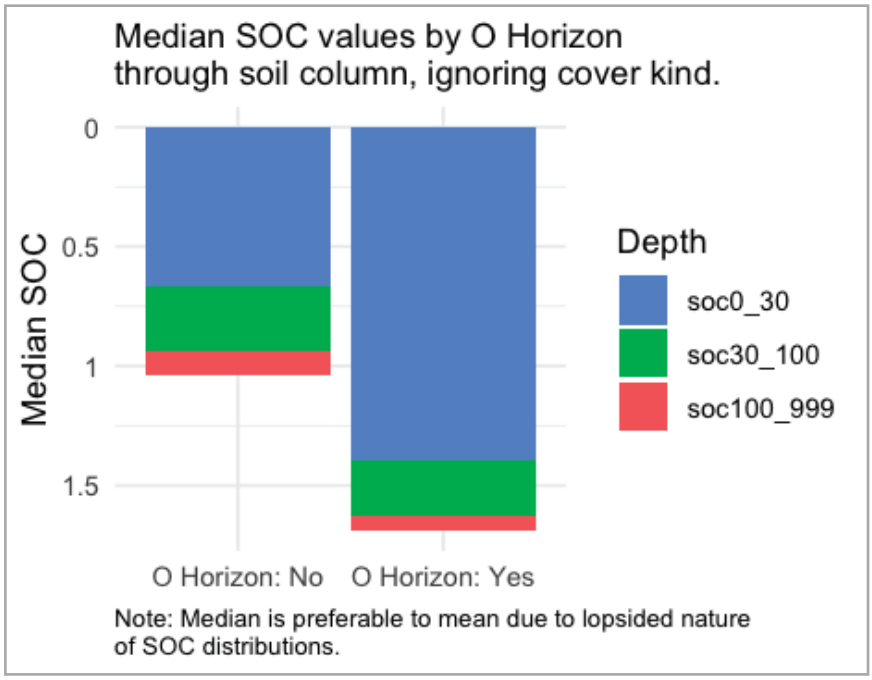
In support of the Massachusetts Healthy Soils Action Plan (HSAP), the Soil Organic Carbon (SOC) Mapping Project provides crucial data for conservation and land-use planning across the state. This project is a collaborative effort led by Regenerative Design Group to produce GIS data layers estimating both current and potential SOC levels in Massachusetts.

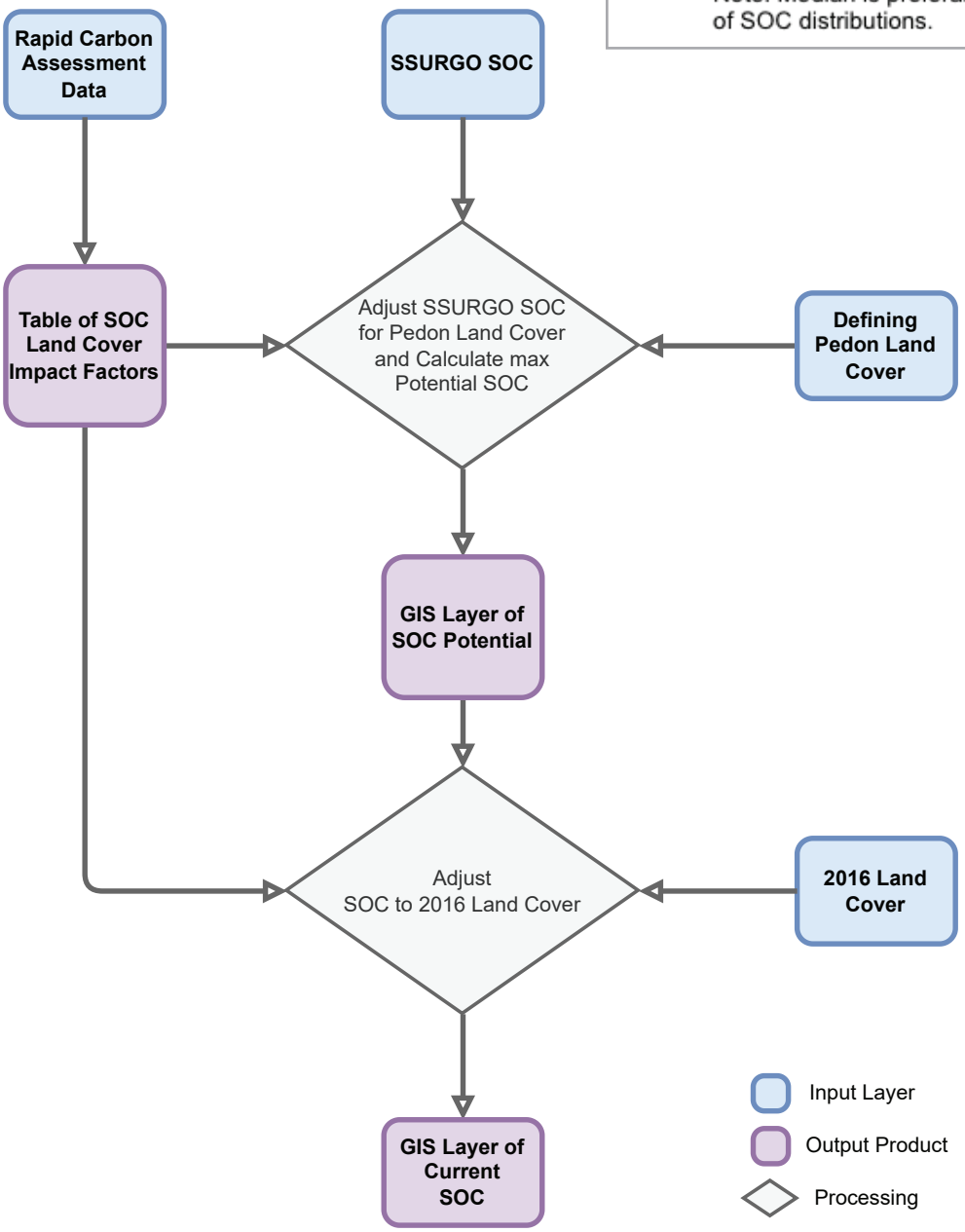
Recognizing that land cover is a primary driver of SOC, the project expands upon existing soils data by adjusting SOC estimates to reflect the influence of different land cover types, including forested, cultivated, and impervious surfaces. To achieve this, the team analyzed data from the NRCS's Rapid Carbon Assessment (RaCA), incorporating region-specific SOC values to produce a refined, high-resolution dataset.

Key outputs of this project include GIS layers for current and potential SOC, as well as a table detailing SOC impacts of land cover conversion. These data products are designed to help conservationists and planners identify areas for protection, restoration, and intervention based on soil health and carbon sequestration capacity.

Alongside the GIS layers, the project included a series of workshops and conference presentations to support stakeholders in using these datasets effectively. RDG is currently working with the EOEEA to host these data layers publicly through MassGIS, making them accessible for climate resilience and healthy soils planning efforts statewide.

Regenerative DesignGroup


Median SOC values by O Horizon through soil column, ignoring cover kind.
Median SOC
0
0.5
1
1.5
O Horizon: No
O Horizon: Yes
Depth
soc0_30
soc30_100
soc100_999
Note: Median is preferable to mean due to lopsided nature of SOC distributions.


Rapid Carbon Assessment Data
SSURGO SOC
Table of SOC Land Cover Impact Factors
Adjust SSURGO SOC for Pedon Land Cover and Calculate max Potential SOC
Defining Pedon Land Cover
GIS Layer of SOC Potential
Adjust SOC to 2016 Land Cover
2016 Land Cover
GIS Layer of Current SOC
Input Layer
Output Product
Processing

Trustees of Reservations Soil Productivity Assessment

CLIENT

Trustees of Reservations

SERVICES + ACCOMPLISHMENTS

Classification of soil carbon conservation and regeneration values across seven agricultural sites

Recommendations for regenerative agriculture practices to enhance soil carbon and ecosystem services

Soil carbon stock quantification to guide carbon-focused interventions in over 2,000 acres of mixed-use lands

Strategic recommendations for forest, pasture, and wetland management to align with climate resilience goals

Initiate soil health assessment and monitoring program, including periodic testing and documentation for long-term tracking

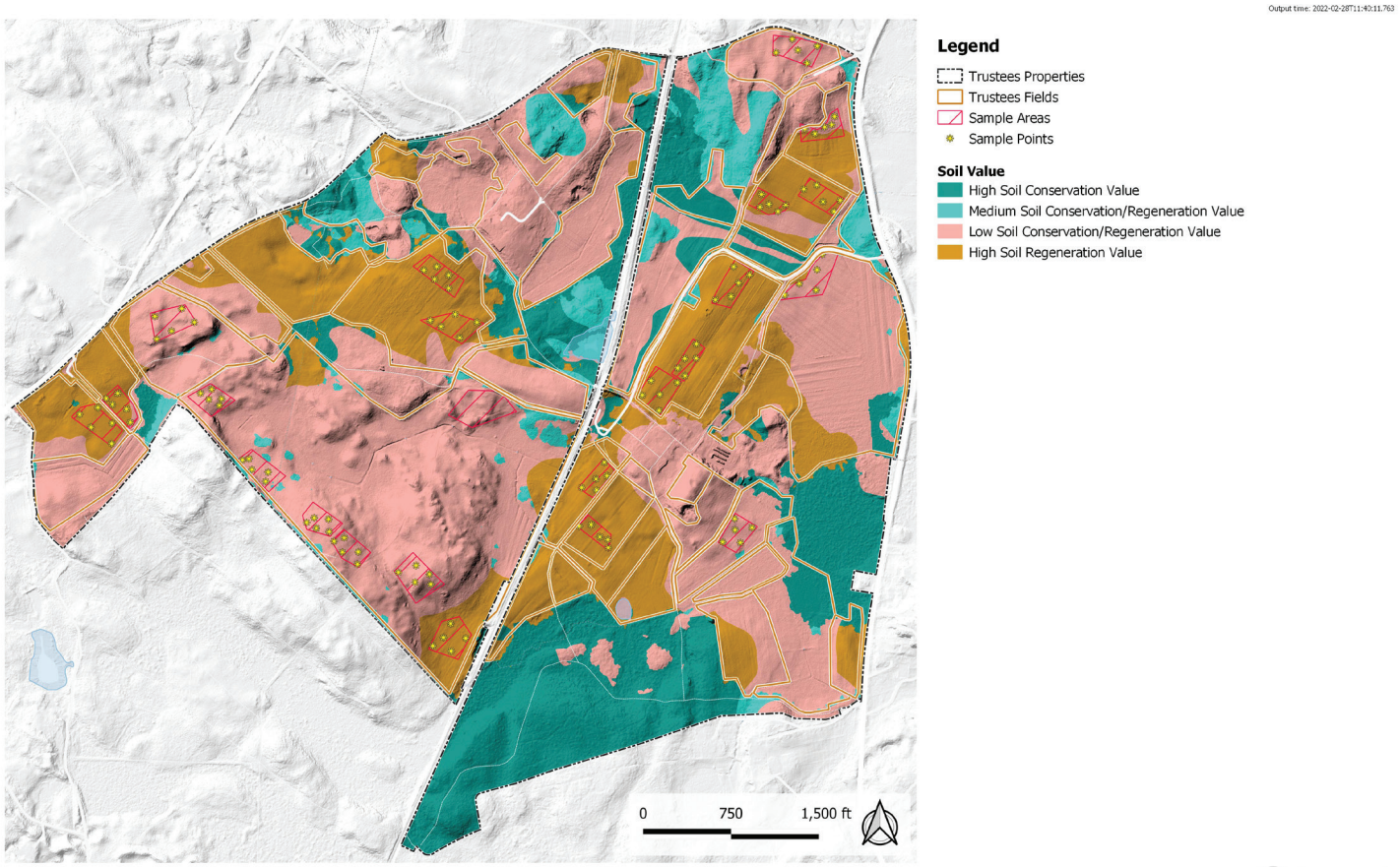
PROJECT OVERVIEW

The Soil Productivity Assessment Project is a collaboration with The Trustees of Reservations to support climate resilience, biodiversity, and food system goals across more than 2,000 acres of farmland in Massachusetts. The project centers on analyzing soil health and productivity to enhance ecological value and inform sustainable land management practices.

Through detailed soil organic carbon (SOC) mapping and classification of soils by conservation and regeneration potential, this project aims to optimize carbon sequestration while supporting productive agricultural practices. Forests, wetlands, grasslands, and cultivated fields were analyzed to estimate current SOC stocks, evaluate sequestration capacity, and recommend site-specific management strategies.

Informed by this analysis, The Trustees are equipped with a decision-making framework to guide whole-farm and field-specific management at seven diverse sites. Recommendations include regenerative land management practices such as rotational grazing, reduced tillage, and improved drainage. The project establishes a foundation for long-term soil health monitoring, which will track SOC and other soil health indicators to ensure that these lands continue to thrive amidst a changing climate.

Regenerative DesignGroup



Appleton Farms
Trustees of Reservations

Soil Conservation-Regeneration Value

Regenerative DesignGroup

Estimating land cover-based soil organic carbon to support decarbonization and climate resilience planning in Massachusetts

CLIENT

Journal of Soil Security, 2022

SERVICES + ACCOMPLISHMENTS

Meta-analysis of scientific literature on soil organic carbon in various land cover types

Development of land cover SOC averages

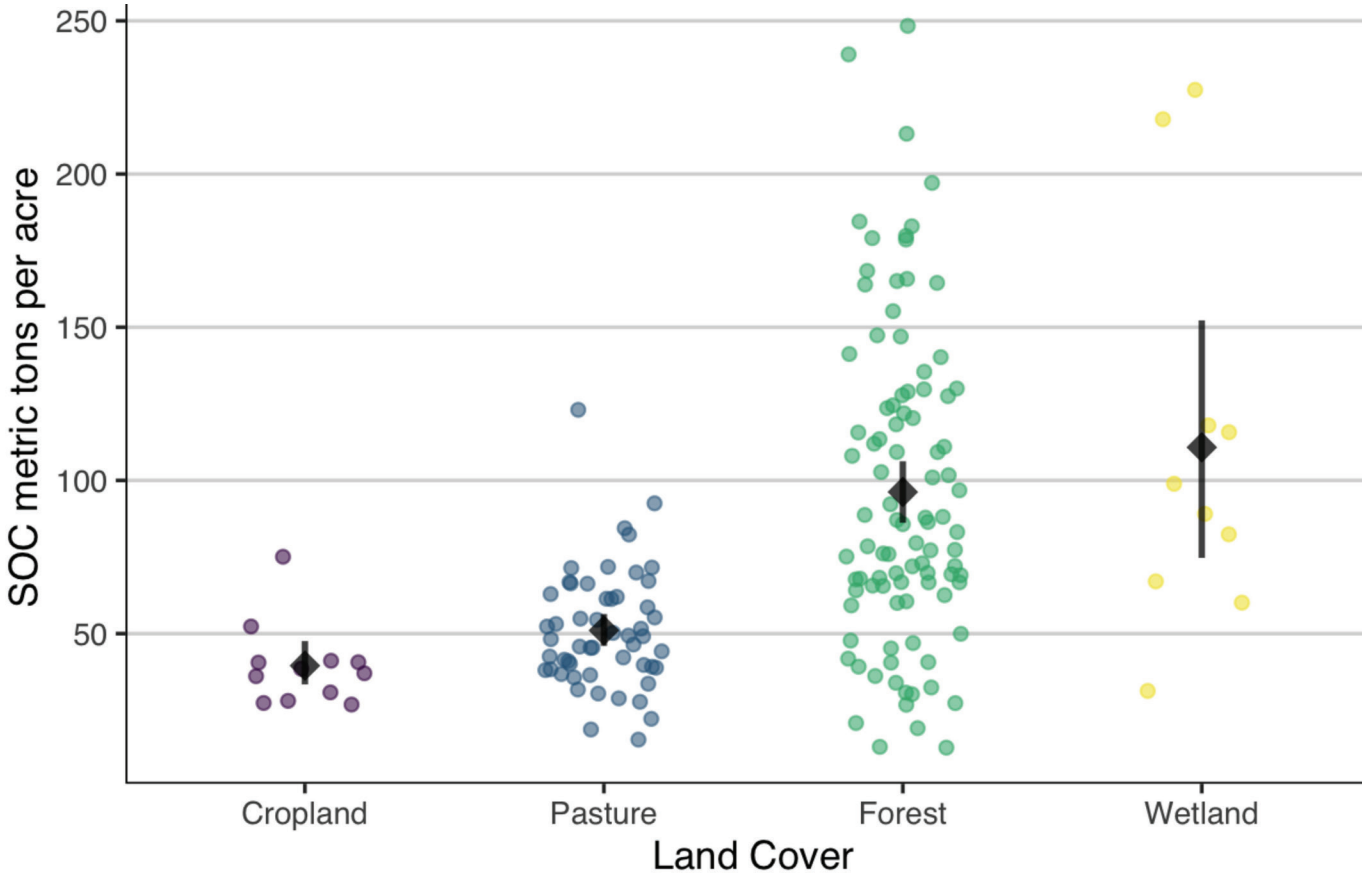
Estimation of total SOC statewide SOC stocks for Massachusetts

ABSTRACT

Land management and land cover change exert a strong influence on soil organic carbon (SOC) storage. As scientific, political, and business communities increase their awareness of the essential roles SOC plays in climate regulation and ecosystem functions, efforts to quantify the impacts of land use and management on SOC have increased rapidly. Existing methods of estimating SOC stocks from widely available data do not account for land cover, and are therefore of limited usefulness in understanding the impacts of past and future land use change.

This project explores a method of linking land cover to SOC, using data from public data sets and the scientific literature, to provide an SOC Inventory for Massachusetts and compares the results to those derived from a common baseline approach. Our method derives average land cover SOC values by combining data from the USDA-NRCS Rapid Carbon Assessment and the National Cooperative Soil Characterization Database with values from a meta-analysis of scientific literature. These are applied to the total area of the 20 most abundant landcover classes of Massachusetts. We compare this land cover-based approach with a baseline using SOC values found in the Soil Survey Geographic Database (SSURGO), applied to each soil map unit found within Massachusetts.

Our approach produced an estimated stock of 481 million metric tons of SOC, 29% and 109 million metric tons greater than the SSURGO baseline. We use these estimates to explore the use of the land cover based SOC values to project the impacts of likely land cover change by 2050.



CONTEXT + KEY FINDINGS

After the completion of the Massachusetts Healthy Soils Action Plan, members of RDG's consulting team published an article on the novel approach to estimating soil organic carbon at the state or larger regional scale.

Figure 3 (above) graphs the SOC mt/ha to a 1 meter depth for 172 samples tested by the National Resource Conservation Service from within 100 miles of the Massachusetts border. Cropland

An excerpt from Table 1 (right) contains the average SOC values for each major land cover type found in Massachusetts.

2016 High Resolution Land Cover Class	Average Soil Organic Carbon MT ha 1m depth	Source of SOC Value
Impervious (2)	54	Meta-analysis/ SSURGO
Developed or Open Space (5)	99	Meta-analysis/ SSURGO
Cultivated Crops (6)	81	RaCA/SCDB
Pasture or Hay (7)	126	RaCA/SCDB
Grassland or Herbaceous (8)	113	RaCA/SCDB
Deciduous Trees- non forest (9)	54	Meta-analysis/ SSURGO
Evergreen Trees- non forest (10)	54	Meta-analysis/ SSURGO
Forest (11)	214	RaCA/SCDB
Scrub/Shrub (12)	121	Meta-analysis/ SSURGO
Palustrine Forested Wetland (13)	825	RaCA/SCDB
Palustrine Scrub/Shrub Wetland (14)	825	RaCA/SCDB
Palustrine Emergent Wetland (Persistent) (15)	825	RaCA/SCDB
Estuarine Forested Wetland (16)	398	Meta-analysis/ SSURGO
Estuarine Scrub/Shrub Wetland (17)	398	Meta-analysis/ SSURGO
Estuarine Emergent Wetland (18)	398	Meta-analysis/ SSURGO

BSC GROUP

WWW.BSCGROUP.COM

AT A glance

OFFICE LOCATIONS

HEADQUARTERS

Boston, MA

Andover, MA

West Yarmouth, MA

Worcester, MA

Glastonbury, CT

Manchester, NH

1965
BSC FOUNDED

200
TEAM MEMBERS

CORE SERVICES

Ecological Science

Permitting & Regulatory Compliance

Climate Resilience

Flood Risk Information & Modeling

Environmental Engineering

Land Surveying, GIS, Mapping & Analysis

Custom Software & Spatial Data Integration

FIRM OVERVIEW

At BSC, we partner with our clients to deliver creative and practical transportation, land development, and environmental solutions. We also help them find climate-resilient solutions. Clients trust BSC to work with them to expertly guide siting, strategically navigate regulatory processes, and holistically design infrastructure to help achieve their vision.

BSC's engineers, planners, and scientists take pride in their ability to respond nimbly to move projects forward.

We solve complex challenges by applying expertise across disciplines, sharing ideas and perspectives to see a project from every side.

The purpose of our work is to improve the quality of life in and around our communities using our skills and experience to promote balance between the built and natural environment.

Proudly employee-owned, our people are the heart of our company.

AREAS OF EXPERTISE

- Wetland and Soil Science
- Wetland Delineation
- Wetland Permitting
- Floodplain Management
- Water Quality/Water Resources Ecology
- Marine, Aquatic and Terrestrial Biology
- Botanical Surveys
- Wildlife Surveys
- Rare and Threatened Species Surveys
- Threatened and Endangered Species Permitting
- Ecological Restoration
- GIS Mapping and Assessment
- Drone-based Field Survey
- GIS Hazard and Natural Resources Mapping
- Stormwater Management and Flood Protection
- Construction Oversight and Monitoring

REPRESENTATIVE CLIENTS

MASSACHUSETTS DEPARTMENT OF CONSERVATION AND RECREATION

MASSACHUSETTS BAY TRANSIT AUTHORITY (MBTA)

MASSACHUSETTS DEPARTMENT OF TRANSPORTATION (MASSDOT)

NATIONAL GRID

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION (MASSDEP)

EVERSOURCE

BORREGO SOLAR

GREAT RIVER HYDRO

NATIONAL GRID I135/J136 UTILITY ROAD PROJECT

WINCHENDON, MA

CLIENT

National Grid

SERVICES

Climate Resilience

Wetland Carbon Conservation

Wetland Restoration

Wetland Creation

Wetland Delineation

Permitting

GIS Mapping

GPS Survey

As part of our on-call licensing and permitting contract with National Grid, BSC provided ecological services for the design and construction of a permanent utility-grade road along the I135N and J136N transmission lines in Winchendon, MA. During the field investigation phase, BSC completed wetland delineation and GPS survey, GIS mapping of wetlands and environmental constraints, and local, state, and federal permit plans.

BSC guided and oversaw wetland restoration and creation activities and provided an innovative approach to wetland replication that fostered the conservation of soil carbon (climate mitigation) and enhanced drought survival (climate resilience).

This innovative approach led to:

1. An acceleration of establishing the wetland vegetative cover as well as preserving soil carbon, structure, and function by transferring intact soil profile and surface vegetation from impact area to restoration and mitigation area.
2. A reduction of both environmental impacts and financial costs: reduced area of exposed soil, eliminated need to stockpile soils, reduced work hours required to construct wetland, and reduced number of plants and supplemental soil to be purchased and the carbon emissions associated with their transport.

BSC GROUP

ROCKPORT COASTAL RESILIENCE PROJECT

ROCKPORT, MA

CLIENT

Town of Rockport

SERVICES

Nature-based Solutions

Climate Resiliency

Coastal Ecology

GIS

Community Engagement

BSC collaborated with the Rockport community to identify coastal Nature-based Solutions (NbS) to climate change. This town is a front-line coastal community experiencing significant impacts from sea level rise and coastal storms; includes environmental justice populations; an artists' community; and supports multiple harbors for one of the largest lobster fishing fleets in the area.

Natural coastal ecosystems and features have been identified as opportunities for broader climate resilience planning; a community-driven assessment of NbS will increase the capacity of the community to protect, restore, and enhance coastal ecosystem services; and educational materials and opportunities have been developed and provided, including a project website, sets of coastal ecosystem, coastal Nature-based Solutions, and freshwater ecosystem infographics, and StoryMap.

Community engagement included establishing a core team, conducting a site walk to identify priority NbS sites, promoting the project and NbS at multiple community events, conducting a youth event focused on coastal ecological science, NbS, and art, and leading a field trip to share knowledge and science about the coastal ecosystem that protects the town.

A prioritized list of NbS appropriate for approximately a dozen coastal locations will be provided to the town at the end of the project, along with a preliminary scope of work and cost estimate to implement each NbS, allowing them to respond quickly to grant funding opportunities.

BSC GROUP

ENVIRONMENTAL MONITORING SERVICES FOR THE CROSBY CORNER INTERCHANGE IMPROVEMENT PROJECT

CONCORD AND LINCOLN, MA

CLIENT

Massachusetts Department of Transportation (MassDOT)

SERVICES

Construction Oversight

Environmental Compliance Monitoring

Surveying

Wildlife Habitat Monitoring

Wetland and Stream Restoration Monitoring and Design

BSC acted as the environmental monitor during the construction of the Route 2 Safety Improvement Project in Concord and Lincoln, MA, to ensure compliance with the Massachusetts Department of Environmental Protection variance, the Army Corps of Engineers individual permit, and the National Pollutant Discharge Elimination System permit program. Requirements include construction monitoring and reporting, preparation of requests for plan changes, wetland and stream restoration and mitigation monitoring and design.

As part of wetland mitigation monitoring, BSC installed IRIS tubes to monitor development of hydric soils in mitigation wetlands, and monitored stream restoration of a previously piped stream. BSC also conducted wildlife monitoring and reported on a new wildlife tunnel, including the use of track beds and camera traps.

For Phase 2 of this project, MassDOT retained BSC again to perform wetland mitigation services for the roadway reconstruction project. For this new task assignment, BSC developed design and construction drawings to construct two potential new wetland mitigation areas in the Town of Concord, one of which is a parcel of land owned by MassDOT, and the other to include the restoration of an area owned by the Town of Concord. BSC conducted existing conditions topographic surveys and prepared ROW plans.

BSC GROUP

GUIDE FOR IMPLEMENTING THE HEALTHY SOILS ACTION PLAN IN DESIGN AND CONSTRUCTION

CLIENT

Massachusetts Executive office of Energy and Environmental Affairs

SERVICES

Ecological Services

Landscape Architecture

Civil Engineering

Climate Resilience

Transportation Engineering

Environmental Engineering

The Healthy Soils Action Plan (HSAP) released by the Massachusetts Executive office of Energy and Environmental Affairs provides an assessment of the condition of our soils and a blueprint for how we can effectively conserve and protect, restore, and properly manage our soils to improve the vitality of nature around us, resilience to climate change, and the health and quality of life of our residents. However, many of the recommendations either lack a clear path to implementation or are in conflict with typical practices of the development and construction industries.

BSC is working with Regenerative Design Group and others in the development of an implementation guide for the HSAP. The guide will serve as a roadmap towards engaging a cross-section of professionals in construction, development, engineering, and design in a series of coordinated events to promote general awareness of the HSAP, distill industry input and additional research and make recommendations for improving typical soil management practices and standards, and address problems. BSC's role on the project includes serving as liason to MassDOT to coordinate conversations, solicit participation and materials, and sharing insights and experience, and:

- Participating in and hosting industry work groups
- Providing technical review and production support
- Case study collection
- Reviewing of soil specifications and MassDOT specifications
- Contributing to current & recommended best practices
- Identification of existing challenges to achieving better soil health
- Supporting the development of presentation and website materials

BSC GROUP

AYER-DEVENS MAIN STREETS POCKET FOREST PILOT PROJECT

AYER & DEVENS, MA

CLIENT

Towns of Ayer and Devens

SERVICES

Climate Resilience

Forest Carbon / Climate Mitigation

Environmental Justice

Public Outreach

BSC, along with project team members Linnean Solutions and Regenerative Design Group, collaborated with the Ayer and Devens communities to design and plant a pilot pocket forest in an environmental justice neighborhood that experiences heavy freight train and truck traffic, thereby improving community resilience, health, and well-being by improving air quality and reducing the heat island effect. BSC and the project team organized a community process to select four additional sites for future pocket forests, two in Devens and two in Ayer. BSC conducted a permitting assessment for the sites and prepared educational materials about pocket forests, including a detailed “How to Pocket Forest” guide and a project website. The project team convened various community events, including a community pilot pocket forest planting day.

175 MILLWOOD STREET ENVIRONMENTAL MONITORING

FRAMINGHAM, MA

CLIENT

Framingham Conservation Commission

SERVICES

Environmental Monitoring

Wetland Restoration

Wildlife Conservation

Landscape Architecture

Stormwater Management

Environmental Engineering

BSC coordinated and managed the environmental monitoring for the construction of a residential subdivision on a former golf course. Our multi-disciplinary team of wetland scientists, landscape architects, and engineers provided full-service environmental monitoring. The project entailed supervision of daylighting and restoration of a stream, wetland restoration, review of stormwater management structures during construction, post-storm inspections, weekly environmental monitoring and associated reports, review of plan changes including changes to sewer line Installation, protection of nesting migratory birds during construction phase, assisting Conservation Commission with amending Order of Conditions, and responding to issues as they arose.

LAGOON POND BASCULE BRIDGE REPLACEMENT

OAK BLUFFS/TISBURY, MA

CLIENT

Massachusetts Department of Transportation (MassDOT) Highway Division

SERVICES

Wetlands/Salt Marsh Delineation

Essential Fish Habitat Assessment

Environmental Permitting

Environmental Mitigation Planning and Design

Bathymetric Surveying

Land Surveying

Ecological Mitigation

Ecological Resiliency

In collaboration with Parsons, BSC provided environmental permitting, survey, and ecological services for the MassDOT's replacement of the bascule bridge carrying Beach Road over Lagoon Pond in Oak Bluffs/ Tisbury. BSC was selected to assist with the design and permitting for the permanent replacement of the bridge because it was structurally deficient.

BSC integrated ecological resiliency into the natural and altered coastal ecosystem directly adjacent to the project area through ecological assessments and the planning efforts for salt marsh replication and eelgrass restoration activities.

Our services included:

- Ecological investigations included the identification of eelgrass, salt marsh and wetland resource areas (state and federal), as well as an essential fish habitat assessment, shellfish survey and rare and endangered species assessment to support permitting efforts with the U.S. Coast Guard, U.S. Army Corps of Engineers, and the Massachusetts Department of Environmental Protection.
- Permitting included Section 10/Section 404, Section 401, US Coast Guard Bridge, MA Coastal Zone Management Consistency Determination, Massachusetts Endangered Species Act, and Section 4(f) and 6(f) permitting and support.

- As a component to project permitting, BSC prepared design review and evaluation of alternative approaches to mitigating the effects of erosive stormwater discharges toward salt marsh, and the mitigation approach and design for unavoidable impacts to salt marsh and eel grass beds. The final plan included salt marsh replication, eelgrass restoration, and preparation of public educational signage for eelgrass conservation.
- Survey services involved hydrographic soundings of the channel and adjacent shorelines for the preparation at existing conditions plans.
- Preparation of environmental construction specifications and ongoing construction support services in conjunction with the design consultant.

As a part of the permitting and mitigation plan for the Lagoon Pond Bridge, BSC developed public educational signage for the conservation of eelgrass, such as:

- Eelgrass, (*Zostera marina*) is a species of seagrass, which are rooted, flowering plants that can form dense, underwater beds, are highly productive ecosystems that can directly support commercially important marine species. In Lagoon Pond, eelgrass beds may have declined as much as 50% since 1995.
- What can you do?

› Install a conservation mooring instead of a traditional mooring for your boat

› Discuss preferred locations for shell fishing with your Harbormaster or Shellfish Constable

› Reduce or avoid use of fertilizers on lawns or gardens

› Contain any oil or fuel spills and avoid washing cars and boats near storm drains

› Use appropriate boat pumpout facilities

› Use established boating channels in and around Lagoon Pond to avoid eelgrass

› Avoid anchoring in eelgrass beds and trim the engine up through shallow water

MASSDEP NO NET LOSS OF WETLAND CARBON

CLIENT

Massachusetts Department of Environmental Protection (MassDEP)

SERVICES

Development of Innovative Wetland Carbon Protection and Restoration Strategy, Policy, and Regulations

Software Development

Wetland Carbon Accounting Science

Wetland Extent and Wetland Carbon Data Set + Mapping + Machine Learning

Leading a consulting team, BSC is working with MassDEP to identify innovative strategies, approaches, concepts, and regulatory recommendations to achieve No Net Loss of Wetland Carbon in Massachusetts and to meet wetlands-related climate goals outlined in the *Massachusetts Clean Energy and Climate Plan for 2025 and 2030, Chapter 8: Protecting Our Natural and Working Lands*. Our project team includes BSC, Regenerative Design Group, the Massachusetts Association of Conservation Commissions (MACC), and the Woodwell Climate Research Center.

BSC researched wetland carbon policies, regulations, and projects in all 50 states as well as in other countries, researched wetland carbon bylaws and regulatory provisions in Massachusetts municipalities, and led the project team in developing innovative wetland carbon protection and restoration strategies, approaches, and regulatory recommendations, including collaborating with MACC as they updated their local wetland bylaw database.

Project team member Woodwell Climate Research Center developed Massachusetts-relevant science-based wetland carbon accounting approaches, consistent with best available wetland carbon science.

Project team member Regenerative Design Group developed a cutting-edge wetland mapping approach based on machine learning that identifies previously cryptic wetlands, such as forested wetlands, which traditional mapping methods often have difficulty detecting.

The project final report is now being reviewed by MassDEP.

BSC GROUP

This mapping, combined with Woodwell Climate Research Center's research on inland/freshwater and coastal/saltwater carbon accounting tools and current science on wetland greenhouse gas fluxes, provided the necessary inputs for BSC to develop the requirements, recommendations, and mock-ups for an interactive Massachusetts carbon accounting tool for both inland/freshwater and coastal/saltwater wetlands.

APPLE COUNTRY ECOLOGICAL CLIMATE RESILIENCY AND CARBON PLANNING AND ASSESSMENT

BOLTON, MA

CLIENT

Towns of Bolton and Harvard and the Devens Regional Enterprise Zone

SERVICES

Climate Resilience Planning

Climate Vulnerability Assessment

Community Stakeholder Engagement

Development of Educational Resources

Ecological Carbon Assessment

Grant Proposal Preparation

Identification of Nature-based Solutions

As part of a regional approach to climate resilience planning, BSC worked with the Towns of Bolton and Harvard and the Devens Regional Enterprise Zone (Devens) and led a multi-disciplinary consulting team that included healthy soils experts (Linnean Solutions and Regenerative Design Group) and a forest ecologist and forest carbon expert (Woodwell Climate Research Center) to provide climate resiliency and carbon planning assessment services. The project was funded by an MVP Action Grant awarded to the communities following a BSC-supported application process.

Apple Country's vast landscape of forests, farmland, wetlands, and active floodplains is essential in the area's ecological functioning, carbon functioning, and regional community and environmental resiliency. BSC's team of ecologists, landscape architects, climate resilience specialists, designers, engineers, and GIS specialists analyzed local ecological resources, conducted community outreach and engagement, and developed GIS mapping to produce predicative climate-focused documents and maps that identify and prioritize Nature-based Solutions (NbS) and best management practices and policies.

The project report highlighted opportunities for resilience and protection of wetland and forest carbon using NbS and implemented climate-smart best management practices and policies. The resulting report provided a regional perspective, analysis, and recommendations, as well as town-specific assessment and recommendations.

Public engagement played a significant role in the project, requiring meaningful community input.

BSC implemented a process to understand community opinions, local knowledge, needs, and future visions, including print, digital, and COVID-compliant online and in-person involvement opportunities. To encourage engagement, a project website included interactive data-viewer mapping, surveys, educational materials, and project documents.

Additionally, core team meetings and site tours were held to encourage cross-town discussion of regional solutions and identify site-specific NbS. A self-guided site tour of natural resources and NbS was provided in addition to a COVID-19-safe online community meeting.

Woodwell Climate Research Center

CLIMATE SCIENCE FOR CHANGE

We face the greatest challenge of our time: restoring a safe and stable climate, while adapting to inevitable impacts. Science is the core of our success. Woodwell Climate Research Center is dedicated to climate science pursued in partnership with stakeholders and decision-makers to produce maximum societal benefit. Our renowned researchers investigate how human activities are affecting the flow of carbon and water—key climate factors—through the world's most critical ecosystems, from the Arctic to the tropics. Together with our global network of partners, we generate breakthrough insights into the risks we face, and the just, effective solutions we can develop.

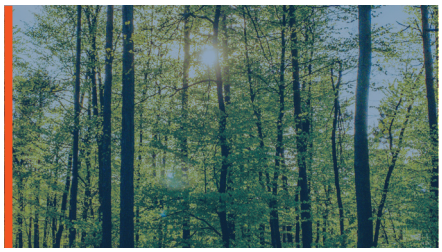
CREATING BREAKTHROUGH INSIGHTS

Our scientists are experts in combining field data with large-scale satellite monitoring and computer modeling to generate insights that scale from local to global. Woodwell Climate experts are:

Making climate risk actionable Decision-makers need trustworthy, relevant, and detailed information about the risks we face now and in the next few decades. We work with partners to advance understanding of climate hazards, like extreme weather and fire, and their socioeconomic and geopolitical impacts, from water and food scarcity, to labor impacts, conflict, and migration.

Filling gaps in carbon accounting Thawing of Arctic permafrost could release enough greenhouse gases to threaten our climate targets, but these emissions aren't in models and budgets. Burning trees for energy emits more carbon than fossil fuels, but is often incentivized as carbon neutral. We bring rigorous, independent science to the table to ensure realistic goals and effective policies.

Realizing the potential of natural climate solutions Forests, wetlands, and soils provide our best hope for cooling the planet. We integrate ecological and social science to develop equitable, cost-effective, and evidence-based strategies ranging from finance for forest conservation, to soil carbon monitoring, wetland restoration, and agricultural land management.



WORKING IN CONCERT FOR OUTSIZED IMPACT

We work with partners, stakeholders, and government officials in more than 20 countries across six continents—from the Arctic to the Amazon, and D.C. to D.R.C. We engage throughout the research process to ensure that our insights can be integrated into real-world decision-making. This approach has delivered outsized impact for over 35 years. Woodwell Climate researchers have:

- Helped shape the UN Framework Convention on Climate Change
- Provided Congressional testimony or briefed Hill staffers dozens of times in the past five years
- Shaped the first guidelines for corporate disclosure of physical climate risk
- Informed critical Brazilian legislation to protect 30 million acres of Amazon forest
- Contributed to more than a dozen reports by McKinsey & Company on climate risk and net zero pathways

BY THE NUMBERS

PRINCIPAL INVESTIGATORS	18
TOTAL STAFF	120+
CORE PARTNERS	30+
SCIENTIFIC PUBLICATIONS	120+/yr
MEDIA MENTIONS	6,500+/yr

Methane Cycling in Northern Forests

Understanding the biophysical drivers of methane source and sink transitions in a northern forest in Maine.

photo by Dave Hollinger

Research area

Carbon

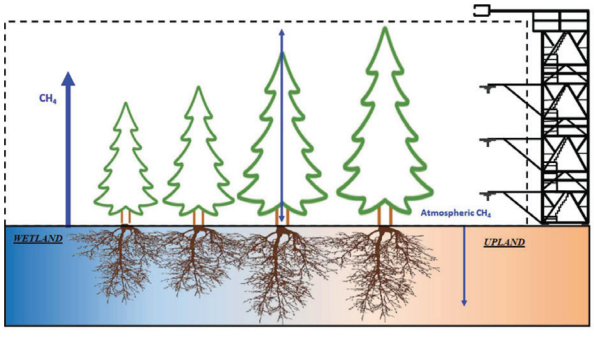
Methane is second only to carbon dioxide (CO_2) in its contribution to human-induced climate change, thanks to its global warming potential—34x greater than CO_2.

However, we understand very little about methane flux in forests, the processes and feedbacks that drive it, and how methane emissions or uptake will evolve with a changing climate.

Our Work

At the Howland Research Forest, ME, we are taking on this priority for biological research and improving methane flux models. Our innovative, multi-scale, and cross-disciplinary study is identifying the conditions and mechanisms driving methane sink/source activity across soil moisture gradients in northern forests.

Led by Woodwell Climate Research Center, in collaboration with the University of Maine, Emory University, Arizona State University, San Diego State University, and the USDA Forest Service, this research uses new DNA/RNA sequencing techniques that allow us to study microbial traits. Measuring these traits across different environmental conditions ultimately helps us learn how microbes' sequestration of methane in sub-boreal forests may be offsetting methane emitters globally, and how this may change under future climate conditions. The Howland Research Forest serves as a case study to identify drivers and functional relationships across wet to dry soils, and from soils to canopy.



Team

Jennifer D. Watts
Arctic Program Director, Associate Scientist

Kathleen Savage
Senior Research Scientist

Zoë Dietrich
Research Assistant

Collaborators

Shawn Fraver
Associate Professor of Forest Ecology, University of Maine

Debjani Sihi
Assistant Professor, Emory University

Hinsby Cadillo-Quiroz
Associate Professor, Arizona State University

Xiaofeng Xu
Associate Professor of Ecology, San Diego State University

David Hollinger
Research Plant Physiologist, USDA Forest Service

Andrew Ouimette
Ecologist, USDA Forest Service

Appendix 2: Team Member Profiles and Resumes

Regenerative DesignGroup

Sebastian Gutwein

Managing Director, GIS Specialist, Worker-Owner

Sebastian is a living systems designer whose extensive experience draws from the arts, ecology, politics and place. His extensive experience allows him to integrate diverse disciplines into comprehensive planning strategies that address complex challenges such as water conveyance, agricultural programming, and intricate GIS analysis. Since 2015, Sebastian has been the Land Surveying and Digital Design Instructor at The Conway School. He continues to expand his expertise in leveraging geospatial technology for innovative landscape planning and management solutions.

FOCUS AREAS

- Resilience Planning & Site Design
- Whole Systems Integration
- Landscape Analysis & Assessment
- Food Systems Evaluation & Design
- Implementation, Construction & Project Management
- Solar Site Design & Housing Layout

TECHNICAL SKILLS

- Digital Rendering
- GIS Analysis + Assessment
- Document Production & Design
- Land Surveying

SELECTED PROJECTS

MA No Net Loss of Carbon in Wetlands | MassDEP

Lead data and GIS analyst for a wetland mapping approach based on machine learning that identifies previously ambiguous wetlands. This project aims to identify innovative strategies, approaches, concepts, and regulatory recommendations to achieve No Net Loss of Carbon in Wetlands in Massachusetts. Project team includes BSC Group, the Massachusetts Association of Conservation Commissions (MACC), and the Woodwell Climate Research Center.

Soil Resource Assessment & Planning | Commonwealth of Massachusetts

Lead data and GIS analyst. Developed novel, data-driven model to quantify statewide soil organic carbon stocks and assess impact of land cover change on soil carbon.

Municipal Vulnerability Preparedness Projects: Soil Resilience Planning | Various Municipalities, MA

Lead data and GIS analyst. Development of unique and comprehensive models that combine soil and other ecological data with social and cultural information to identify high impact locations for nature based solutions for climate resilience. Mapping and research support for community engagement workshops and outreach events.

Greenhouse Gas Environmental Impact Assessment | Massachusetts Environmental Policy Act Office

Land use and carbon analyst. Directed development of environmental impact assessment model for greenhouse gas emissions and carbon sequestration loss from tree clearing associated with proposed expansion of a utility right of way.

Regenerative Land Use Experiment | Major Northeast Utility Company

Land use and carbon analyst. Assessed potential for additional carbon sequestration through innovative land and vegetation management practices on ROW lands across three state for a major utility. Conducted in-depth study of current land cover, carbon stocks, and management practices to develop high level toolkits for land management teams.

SELECTED PUBLICATIONS

Gutwein, S., Zaltzberg-Drezdahl, K., Toensmeier, E., & Ferguson, R. S. (2022). Estimating land cover-based soil organic carbon to support decarbonization and climate resilience planning in Massachusetts. Soil Security, 9, 100076. https://doi.org/10.1016/j.soisec.2022.100076

Regenerative DesignGroup

Rafter Ferguson

Senior Researcher

Rafter is a researcher and educator with a broad background in quantitative and qualitative analysis at the intersections of climate resilience, sustainable agriculture, and social justice. His multidisciplinary background enables him to lead complex modeling projects while ensuring that models are understood critically, within their limitations and context. After receiving his Ph.D. from the University of Illinois, and postdoctoral work at the University of Lisbon and Haverford College, he spent three years in the Food and Environment program at the Union of Concerned Scientists. Since joining RDG in 2023, he has led modeling efforts to produce a new statewide map of probable wetland areas.

FOCUS AREAS

- Leading research, modeling, and data analytics for Natural Resource Planning projects
- Technical Skills
- Scientific and technical advising
- Modeling, machine learning, and multivariate statistics
- Data visualization
- R/RStudio and tidyverse

EDUCATION

- University of Illinois at Urbana-Champaign Ph.D., Crop Sciences, 2015
- University of Vermont M.S., Plant and Soil Science, 2011
- Bard College B.A., Anthropology, 2001

SELECTED PROJECTS

MA No Net Loss of Carbon in Wetlands | MassDEP

Lead modeler for a statewide wetland detection project that used machine learning and publicly available spatial data to identify probable wetland areas missing from the official state inventory, improving estimates of total state wetland area. The wetland detection project was part of a larger project to identify innovative strategies, approaches, concepts, and regulatory recommendations to achieve No Net Loss of Carbon in Wetlands in Massachusetts. Project team includes BSC Group, the Massachusetts Association of Conservation Commissions (MACC), and the Woodwell Climate Research Center.

Soil Resource Assessment & Planning | Commonwealth of Massachusetts

Scientific advisor and analyst. Supported the development of novel, data-driven model to quantify statewide soil organic carbon stocks and assess impact of land cover change on soil carbon.

PROFESSIONAL EXPERIENCE

Interlace Commons | 2022-Present

Justice, Equity, and Diversity Consultant

- Qualitative research with BIPOC farmers to address barriers to agroforestry adoption
- Co-author of report “From the Roots Up: Centering racial justice to build transformative agroforestry” (with Ruth Tyson)
- Co-author of curriculum for technical service providers “Working with People, Working Across Difference: Social Competencies to Grow Agroforestry” (with Ruth Tyson)

Union of Concerned Scientists — Washington, DC | 2018-2021

Scientist, Food and Environment Program

- Research, communication, and advocacy bridging agroecology and sustainability with farmer-centered equity issues
- Build and manage relationships with grassroots coalition partners with a focus on BIPOC-led and -centered organizations

Haverford College — Haverford, PA | 2016-2018

Mellon Postdoctoral Fellow and Visiting AP of Environmental Studies

- Developed and ran original courses on politics and science of sustainable agriculture, the climate crisis, and related issues
- Organized "Beyond the Grassroots," a 1-day symposium bringing together agroecology researchers, organizers, and farmer-activists

University of Lisbon — Lisbon, Portugal | January-July 2016

Postdoctoral Research Fellow with EU project "Bottom-up Climate Adaptation Strategies Towards a Sustainable Europe"

- Designed, co-organized, and taught an international course on research design for research professionals, graduate students, and grassroots activists
- Facilitated visioning and strategy sessions for interdisciplinary research on bottom-up adaptation strategies with lab members in the Centre for Ecology, Evolution, and Environmental Change

SELECTED PUBLICATIONS

Ferguson, R. S., Gutwein, S., Giordano, E., & Zaltzberg-Drezdahl, K. (In review). Mapping Wetland Probability Across Massachusetts with Machine Learning and Multiscale Predictors.

Gutwein, S., Zaltzberg-Drezdahl, K., Toensmeier, E., & Ferguson, R. S. (2022). Estimating land cover-based soil organic carbon to support decarbonization and climate resilience planning in Massachusetts. Soil Security, 9, 100076. https://doi.org/10.1016/j.soisec.2022.100076

Tyson, R., & Ferguson, R. S. (2023). Up From The Roots: Centering racial justice to build transformative agroforestry. Interlace Commons. https://www.interlacecommons.org/s/Up-From-The-Roots_final.pdf

Ferguson, R. S. (2021). Losing Ground: Farmland Consolidation and Threats to New and Black Farmers and the Future of Farming. Union of Concerned Scientists. https://tinyurl.com/29b39754

Toensmeier, E., Ferguson, R., & Mehra, M. (2020). Perennial vegetables: A neglected resource for biodiversity, carbon sequestration, and nutrition. PLOS ONE, 15(7), e0234611. https://doi.org/10.1371/journal.pone.0234611

Ferguson, R. S., Dahl, K., & DeLonge, M. S. (2019). Farmworkers at Risk: The growing dangers of pesticides and heat. Union of Concerned Scientists. https://tinyurl.com/3n4ubcw9

Ferguson, R. S., & Lovell, S. T. (2017). Diversification and labor productivity on US permaculture farms. Renewable Agriculture and Food Systems, 1–12. https://doi.org/10.1017/S1742170517000497

Ferguson, R. S., & Lovell, S. T. (2017). Livelihoods and production diversity on U.S. permaculture farms. Agroecology and Sustainable Food Systems, 41(6), 588–613. https://doi.org/10.1080/21683565.2017.1320349

Regenerative DesignGroup

Keith Zaltzberg-Drezdahl

Managing Director, Head of Planning, Worker-Owner

Keith is a founding partner of Regenerative Design Group where he leads planning initiatives focused on ecological resilience and community well-being. With a background rooted in resilience planning, urban agriculture, and permaculture design, Keith combines rigorous analysis with a strong social justice mission to shape landscapes rooted in place and community. His approach to planning is grounded in understanding the ecological and social potential of place, rigorous analysis, and systematic assessment. His work includes leadership roles in projects such as the Massachusetts Healthy Soils Action Plan, where he played a pivotal role in understanding the impact of land use on soil health and carbon sequestration. His strategic insights have also guided regional climate resilience initiatives, contributing to the development of nature-based solutions that enhance environmental quality and community resilience. He shares his expertise as a lecturer and instructor at The Conway School and Smith College, focusing on sustainable design principles and environmental stewardship, and holds a BS in Environmental Design from UMass-Amherst.

FOCUS AREAS

- Landscape Carbon Accounting & Planning
- Resilience Planning & Adaptive Design
- Soil Resource Planning
- Regenerative Agriculture & Urban Farm Design
- Project Management

TECHNICAL SKILLS

- GIS Mapping and Analysis
- AutoCAD
- Adobe Creative Suite

LECTURES + WORKSHOPS

- Soil Organic Carbon Estimation, Soil Science Society of America.
- Developing Healthy and Resilient Communities: A Case Study, Architecture Boston Expo
- Regenerative Design for Change Makers, Omega Institute

SELECTED PROJECTS

MA No Net Loss of Carbon in Wetlands | MassDEP

Development of a wetland mapping approach based on machine learning that identifies previously ambiguous wetlands. This project aims to identify innovative strategies, approaches, concepts, and regulatory recommendations to achieve No Net Loss of Carbon in Wetlands in Massachusetts. Project team includes BSC Group, the Massachusetts Association of Conservation Commissions (MACC), and the Woodwell Climate Research Center.

Nashua River Watershed-Wide Nature Based Solutions | Fitchburg, Leminster, Ashburnham, Pepperell, and Groton, MA

MVP Project. Produce a multi-layered analysis of soil health challenges and opportunities for the 454 square mile Massachusetts portion of the Nashua River Watershed. Part of a larger MVP project to determine priority sites for nature-based solutions in the five project communities.

Hudson-SuAsCo Nature Based Solutions Project| Hudson, Framingham, and Natick, MA

MVP Project. Use a robust process of remote data analysis and community engagement to identify high impact sites for nature-based olutions that will support the towns' climate resilience. Focus on soil-carbon and landcover mapping and analysis to guide priority sites.

Nashua River Resilient Lands Management | Clinton and Bolton, MA

MVP Project. Development of management and stewardship guides and identification of leverage points for town bylaws changes to increase the resilience and functioning of important landscapes and ecosystems in Clinton and Bolton.

Soil Health Assessment | Deerfield, MA

MVP Project. Analysis of exisiting soil function by land cover and assessment of vulnerabilities and opportunities for soil health. Scope included healthy soils workshops and outreach events. *2022 Sustainability + Resiliency Award from the American Planning Association - Massachusetts Chapter*

Soil Health Productivity Assessment & Planning | Trustees of Reservations

Collaborated with American Farmland Trust to assess field-specific soil health and whole-site ecological health of seven Trustees farm properties. Designed and facilitated three workshops for Trustees staff and land managers. Final report included recommendations for soil health management, agroecological interventions and a discussion of trade-offs.

Climate Resiliency and Carbon Planning | Apple Country, MA

MVP Project. Collaborated with BSC Group and Linnean Solutions to assess and analyze ecological resources, and provide recommendations for nature-based solutions in the Towns of Bolton and Harvard and the Devens Regional Enterprise Zone. Extensive mapping, community outreach, site walks, and soil health assessments.

Soil Resource Assessment & Planning | Massachusetts Healthy Soil Action Plan

Project lead for a 10-person project team and 50-person working group in GIS-analysis, scientific literature review, expert interviews, and broad stakeholder engagement to develop a comprehensive Healthy Soils Action Plan for all major land uses in Massachusetts. *2023 Special Recognition Award for Significant Value to Landscape Architecture from the Boston Society of Landscape Architects*

Greenhouse Gas Environmental Impact Assessment | Massachusetts Environmental Policy Act Office

Provided QAQC and technical team support in the development of a model to estimate greenhouse gas emissions and carbon sequestration loss from tree clearing associated with proposed expansion of a utility right of way.

Regenerative Land Use Experiment | Major Northeast Utility Company

Assessment of potential for additional carbon sequestration through innovative land and vegetation management practices on ROW lands across three state for a major utility. Led in-depth study of current land cover, carbon stocks, and management practices to develop high level toolkits for land management teams.

SELECTED PUBLICATIONS

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Regenerative DesignGroup

Von Harvey

Communications Specialist

Von is a communicator and designer who applies user experience (UX), web, graphic, and marketing design to tell stories and engage with people and communities. She believes technology should have a positive impact on humanity, which includes being equitable and sustainable. Von holds a BA from Hampshire College and has professional certifications in UX design, graphic design, and digital marketing.

FOCUS AREAS

» Web and digital user experience (UX) and accessibility design
» Digital Marketing + Content Strategy

TECHNICAL SKILLS

» WordPress, Drupal, Squarespace, and Webflow CMS platforms
» MailChimp Email Marketing
» Google Analytics
» Adobe Creative Cloud

SELECTED PROJECTS

Massachusetts Healthy Soil Guide | Greenfield, MA

Created WordPress-based website for the Massachusetts Healthy Soil Guide for Construction and Development, making soil health practices and resources accessible and actionable for site construction and landscaping professionals.

PREVIOUS POSITIONS

Center for New Americans | Northampton, MA | 2023–present

Communications Specialist

- Manage WordPress CMS-based website, including content, usability, and layout updates
- Provide content and marketing strategy for social posts, blog content, and print materials

Vinka Design | Florence, MA | 2012–present

Prinicipal

- Design and implement digital marketing and advertising, content strategy, UX, and Websites for clients with a focus on artists and authors; examples include betsyhartmann.com and onematchfilms.com

UMass Amherst College of Engineering | Amherst, MA | 2021-2022

Associate Director of Communications and Digital Media

- Coordinated with team and senior leadership to ensure all digital content, including a 5,000-page website and 3 social channels, was accurate, strategic, and reflective of the user journey for various audiences
- Designed print and digital marketing materials and collateral for various offices and departments, including significant development campaigns

BSC GROUP

Gillian

Davies, PWS, RSS, NHCWS, CESSWI

Senior Ecologist/Natural Climate Solutions Specialist

Senior Associate

YEARS OF EXPERIENCE

33

EDUCATION

MES, Ecosystem Ecology
Yale University School of the Environment

BA, Psychology
Williams College

Certificate of Completion in the New England Regional Soil Science Certificate Program
University of Massachusetts

AFFILIATIONS

Global Development and Environment Institute, Tufts University, Visiting Scholar (2018-present)

Society of Wetland Scientists -Chair WOTUS ad hoc Committee, Co-Lead Climate Change & Wetlands Initiative; 2016-2017 President, Past President, President Elect

MEET GILLIAN

Gillian provides expertise and innovative solutions encompassing peer-review for Conservation Commissions, ecosystem-based climate change resiliency and mitigation assessment and planning, state and federal permitting, wetland delineation, impact analysis, wetland restoration/mitigation planning, design and monitoring, expert witness testimony, and environmental construction/post-construction inspection.

A well-respected leader in the field of wetland sciences, Gillian holds many prestigious titles at industry organizations dedicated to promoting the understanding, conservation, protection, restoration, science-based management, and sustainability of wetlands. She currently serves as Chair of the SWS WOTUS ad hoc Committee and Co-Lead of the SWS Climate Change and Wetlands Initiative. She is also a Visiting Scholar at the Tufts University Global Development and Environment Institute. In the past she has held such titles as Society of Wetland Scientists (SWS) President, SWS Professional Certification Program President, SWS New England Chapter President, and Association of Massachusetts Wetlands Scientists President.

Gillian has worked extensively with Massachusetts Conservation Commissions as a peer-reviewer and previously as an education/outreach specialist for the MassDEP. She has provided numerous workshops and presentations to Conservation Commissions and other members of the wetland's professional community in Massachusetts and internationally.

AFFILIATIONS (CONT.)

Society of Wetland Scientists Professional Certification Program, 2021-2022 President; President Elect

Society of Wetland Scientists New England Chapter; 2014-2015 President, Vice President

INTECOL (International Association for Ecology) Wetlands Working Group, Member (2021-present)

Association of Massachusetts Wetlands Scientists; 2002-2003 President, Vice President

REGISTRATIONS

Registered Soil Scientist, Society of Soil Scientists of Southern New England

CERTIFICATIONS

Professional Wetland Scientist, Society of Wetland Scientists #2181 (2011)

Certified Wetland Scientist – NH #071 (1999)

Certified Erosion, Sediment, and Storm Water Inspector, Envirocert International, Inc.

Certified Municipal Vulnerabilities Preparedness Provider – MA

GOVERNMENT SERVICE

MA Executive Office of Energy and Environmental Affairs & Commission for Conservation of Soil, Water & Related Resources Healthy Soils Action Plan Work Group (2019–2020)

GOVERNMENT SERVICE (CONT.)

MA Department of Transportation Wetland Mitigation Banking Group (2018)

MA Executive Office of Energy and Environmental Affairs Natural Resources and Habitat Subcommittee to the Climate Change Adaptation Advisory Committee (2009)

MA DEP Wetlands & Waterways Circuit Rider (1999-2003)

OTHER VOLUNTEER

National Academy of Sciences, Engineering, and Medicine Transportation Research Board Panelist (2018–2022)

PROJECT EXPERIENCE HIGHLIGHTS

MassDEP No Net Loss of Carbon in Wetlands in Massachusetts Project: Statewide

Project Manager & Senior Ecologist

Led multidisciplinary team to develop strategies and methodologies for No Net Loss of Wetland Carbon in Massachusetts policies and regulations. Consulting team developed innovative wetland soil carbon mapping using machine learning and researching and developing concepts and preliminary design for an interactive carbon accounting tool for both Teal Carbon (inland freshwater) wetlands and Blue Carbon (coastal saltwater) wetlands.

SuAsCo Natural Climate Solutions Project: Hudson, Framingham, and Natick

Project Manager & Natural Climate Solutions Specialist

Coordinated consulting team and 3 urban/suburban communities with Environmental Justice communities to identify Nature-based Solutions (NbS) to climate change and biodiversity loss. Project identified opportunities for wetlands, floodplains, forests, and other ecosystems to support broader resilience planning efforts, and expanded communities' capacity to protect, restore and enhance carbon sequestration and other ecosystem services through community-driven assessment of NbS; and developed educational materials and opportunities.

Ayer-Devens Main Streets Pocket Forest Pilot Project, MA

Project Manager & Natural Climate Solutions Specialist

Coordinated consulting team and 2 communities with Environmental Justice communities to improve community health and resilience through: the design and planting of a pilot pocket forest; community-driven selection of, and permitting assessment for, four additional pocket forest sites; development of a project website and pocket forest educational materials; and a variety of community events including a community planting day at the pilot pocket forest.

MassDEP Coastal Floodplain Outreach

Senior Ecologist

Advised project team on coastal floodplain ecological features and functions, and effectiveness of visual and text communications to inform development of a public education outreach campaign focused on the climate resilience benefits provided to coastal communities by the coastal floodplain. The campaign included development of a coastal floodplain video, pamphlet, and StoryMap.

Apple Country Natural Climate Solutions Project: Bolton, Harvard, and Devens Regional Enterprise Zone

Project Manager & Senior Ecologist

Coordinated team of consultants and 3 communities to identify Nature-based Solutions (NbS) to climate change and biodiversity loss. Project identified opportunities for wetlands, floodplains, forests, and other ecosystems to support broader resilience planning efforts, and expanded communities' capacity to protect, restore and enhance carbon storage and sequestration and other ecosystem services by providing a model for community-driven assessment of NbS; providing recommendations to improve regulations; and developing and providing educational materials and opportunities.

Rockport Coastal Resilience Project, Rockport, MA

Project Manager & Natural Climate Solutions Specialist

Led interdisciplinary team to identify coastal Nature-based Solutions. Project identified opportunities for coastal NbS to support broader climate resilience planning efforts, and expanded communities' capacity to achieve greater resilience to sea level rise and coastal storms through community-driven assessment of NbS; and developed educational materials and opportunities, including a website, StoryMap, and infographics.

Massachusetts Department of Transportation, Route 2, Lincoln and Concord, MA

Senior Wetland & Soil Scientist; & Certified Erosion, Sediment & Storm Water Inspector

Provided environmental monitoring services for complex highway improvements project (construction of new interchange, road widening, safety improvements), including monitoring of two large wetland replication areas (totaling 77,963 s.f.), with relocated streambeds. During monitoring of wetland mitigation areas, responsible for implementing innovative approach (IRIS tubes) to assessing hydric status of soils. The project area encompassed approximately 60 acres, is 2,751 meters long, and included multiple work areas operating simultaneously. Environmental Monitoring included responsibility for monitoring project compliance with MA Wetlands Protection Act Variance and Stormwater Pollution Prevention Plan conditions, preparing numerous reports, developing solutions to emerging issues, and coordinating with state and federal regulatory agencies, as well as MassDOT and the project contractor.

Massachusetts Department of Transportation, Route 18, Weymouth, Abington, Southfield, MA

Senior Wetland & Soil Scientist; & Certified Erosion, Sediment & Storm Water Inspector

Provided environmental monitoring services for complex highway widening projects (road widening, bridge replacement, safety improvements), including monitoring construction of wetland replication area (totaling 42,210 s.f.) and wetland restoration areas. The project area was 4.1 miles long and included multiple work areas operating simultaneously. Environmental Monitoring included responsibility for monitoring project compliance with MA Wetlands Protection Act and Water Quality Certification Variance and Stormwater Pollution Prevention Plan conditions, preparing numerous reports, developing solutions to emerging issues, and coordinating with state and federal regulatory agencies, as well as MassDOT and the project contractor.

Nashua River Communities Resilient Lands Management Project

Natural Climate Solutions Specialist & Senior Ecologist

Collaborating with the Massachusetts Association of Conservation Commissions, Gillian led development of wetland climate change by-laws and regulations for Massachusetts municipalities and tailored those bylaws and regulations to the specific needs of the Towns of Bolton and Clinton. This project aimed to improve community climate resilience and ecosystem carbon mitigation by protecting and restoring ecosystem services through the development and adoption of better land management practices and articulated through the writing of forest management and lawns and landscaping management guides.

Nashua River Watershed Natural Climate Solutions Project, Ashburnham, Fitchburg, Groton, Leominster, Pepperell, MA

Senior Ecologist

Advised consulting team for 5 urban/suburban communities with Environmental Justice communities on project to identify Nature-based Solutions to climate change and biodiversity loss. Project identified opportunities for wetlands, floodplains, forests, and other ecosystems to support broader resilience planning efforts, and expanded communities' capacity to protect, restore and enhance carbon sequestration and other ecosystem services through community-driven assessment of NbS.

Route 44 Relocation Project Wetland Mitigation Monitoring, Carver/Kingston, MA

Senior Wetland & Soil Scientist

Responsible for monitoring inland wetland replication/restoration areas associated with construction of relocated Route 44, for assessing invasive species, as well as report preparation. A total of 16.58 acres of wetland replication was constructed for this project, with an additional 0.4 acres of wetland restoration.

Municipal Vulnerability Preparedness Planning Projects: Amesbury, Bolton, Georgetown, MA

Project Manager & Senior Ecologist

Responsible for projects in each municipality to work with municipal staff, stakeholders, and community members to identify existing climate vulnerabilities and community strengths, future opportunities for building community climate resilience, and prioritization of those opportunities. This work provided the communities with the basis for specific, action-oriented projects to improve infrastructure, social and environmental community climate resilience, and prioritization of actions. The Georgetown MVP Planning Project included integration of the Georgetown Hazard Mitigation Plan Update.

Massachusetts Association of Conservation Commissions Wetland Buffer Zone Guidebook Project, Belmont, MA

Project Manager & Lead Author

Responsible for project to research and write comprehensive guidebook on the science and regulation of wetland resource area buffer zones and Riverfront Areas under the Massachusetts Wetlands Protection Act and local bylaws and ordinances. Preparation of guidebook includes supervision of junior staff and coordination with Massachusetts Association of Conservation Commission Buffer Zone Guidebook review team, scientific literature search, and development of recommendations for science-based review of projects under existing state regulations and local bylaws/ordinances, as well as how to develop local bylaws and ordinances supported by current scientific findings. The guidebook provides a discussion of wetland, buffer zone and Riverfront Area regulation in the context of climate change, outlining how buffer zones contribute to protection of carbon in wetlands, support climate adaptation and climate resiliency ecosystem services that wetlands provide, and protect wetlands from the impacts of climate change.

BSC GROUP

Ethan Sneesby

Wetland Scientist

Associate

YEARS OF EXPERIENCE

5

EDUCATION

MS, Crop and Soil Environmental Science
Virginia Tech University

BS, Environmental Science and Management
University of Rhode Island

CERTIFICATIONS

- 40-Hour OSHA

AFFILIATIONS

- SSSNE Member

MEET ETHAN

Ethan is experienced with various methods of soil and wastewater sampling and analysis as well as GPS and GIS related to utility projects and open water bathymetric and soil mapping. Ethan has his master's degree in crop and soil environmental science from Virginia Tech. As a graduate assistant, he worked on the evaluation of wetland water budget modeling software as well as on the construction of a library of target hydroperiods for common wetland types in Virginia, Maryland, and North Carolina. Ethan has extensively studied wetlands, soil morphology, soil conservation and their impact on environmental quality.

Ethan's advanced skillsets are put to use supporting BSC's peer review efforts, working on National Grid and Eversource projects, and assisting the firm's environmental engineering group. Ethan has a strong background in soils and wetland hydrology which serve as a boon when performing review of disturbed or complicated wetland systems where vegetation cannot be relied upon to protect our resources adequately.

PROJECT EXPERIENCE HIGHLIGHTS

Melink Solar Development, 179 Greenwich Road, Ware Conservation Commission, Ware, MA
Wetland Scientist & Soil Scientist

Responsible for wetland delineation peer review including Riverfront Area and review of two Notices of Intent on two parcels (37 acres and 38 acres). Ethan reviewed the project for compliance with Ware Conservation Commission Wetland Protection Bylaw (Chapter 30-3) and the Massachusetts Wetlands Protection Act (WPA) (M.G.L. c. 131, s. 40) and associated regulations (310 CMR 10.00 et al.). Additionally, BSC provided findings and comments relative to the project's compliance with MassDEP Wetlands Program Policy 17-1: Photovoltaic System Solar Array Review 225 CMR 20.00: Solar Massachusetts Renewable Target (Smart) Program.

Spencer Conservation Commission, 10 Meadow Road, Notice of Intent, Spencer, MA
Wetland Scientist

Responsible for the wetland delineation peer review including BVW and associated Buffer Zone, and 200-foot Riverfront Area. Reviewed the project for compliance with the Wetlands Protection Act (WPA) (M.G.L. c. 131, s. 40) and associated regulations (310 CMR 10.00 et al.).

Amesbury Conservation Commission, Notice of Intent for 9, 14, and 15 Estes Street and Estes Street Improvements. Amesbury, MA
Wetland Scientist

Responsible for Wetland Delineation peer review regarding the Notice of Intent (NOI) for a site identified as Overlook at Estes, Amesbury, MA comprising 9 Estes Street, Map 63, Parcel 22, 14 Estes Street, Map 63, Parcel 21, 15 Estes Street #R, Map 63, Parcel 19, and Estes Street Improvements. Reviewed the project for compliance with the Amesbury wetland regulations, and Wetlands Protection Act (WPA) (M.G.L. c. 131, s. 40) and associated regulations (310 CMR 10.00 et al.).

Robbins Road over Robbins Brook Bridge Replacement, Winchendon, MA
Wetland Scientist

Performed wetland delineation services in support of the Town of Winchendon's replacement of the Robbins Road over Robbins Brook Bridge. Prior to BSC's design of the bridge's replacement, Ethan demarcated the boundaries of jurisdictional wetland resources (e.g., inland bank and bordering vegetated wetland), which contributed to the preparation of a Bordering Vegetated Wetland Field Data Form for inclusion with the Notice of Intent Application (NOI).

Bellingham Conservation Commission, Peer Review of Abbreviated Notice of Resource Area Delineation 180 Paine Street, Bellingham, MA,
Wetland Scientist

Responsible for the wetland delineation peer review including BVW and associated Buffer Zone, Isolated Vegetated Wetland (IVW), Bank to a Pond, Inland Bank to Streams (intermittent and perennial) and associated Buffer Zone, Bordering Land Subject to Flooding (FEMA Flood Zone AE), and 200-foot Riverfront Area. Reviewed the project for compliance with the Bellingham wetlands protection by-law, and Wetlands Protection Act (WPA) (M.G.L. c. 131, s. 40) and associated regulations (310 CMR 10.00 et al.).

Amesbury Conservation Commission, Peer Review of Abbreviated Notice of intent, 91 Macy Street, Amesbury, MA
Wetland Scientist

Responsible for the wetland delineation peer review Including Riverfront area. Reviewed the project for compliance with the Amesbury wetland regulations, and Wetlands Protection Act (WPA) (M.G.L. c. 131, s. 40) and associated regulations (310 CMR 10.00 et al.).

National Grid, Wetland Delineation and GIS Mapping Services for E5F6 Transmission Line Insulator Replacement Project, Shelburne to Millbury, MA
Wetland Scientist

Responsible for providing National Grid with wetland delineation and GIS mapping support services for the proposed Transmission Line Insulator Replacement Project (IRP). Ethan performed wetland delineation mapping services, including data collection of dominant plant species, characterization of soils, and general hydrological field indicators within the project right of way. Data collection also included all major features (e.g., wetlands, beaver dams, crushed culverts, culvert crossings, stone walls, pipelines, and fences), which were geotagged with photographs using Trimble units/ESRI's collector. Collected features were stored in an online geodatabase, allowing the photographs and data to be intuitively viewed within an ESRI web application.

Eversource Energy, F132 Line Structure Replacement Project, Pittsfield and Lanesborough, MA
Wetland Scientist

Responsible for providing environmental consulting services for a Line Structure Replacement project from Pittsfield to Lanesborough, MA. for BSC's contract with Eversource Energy. Ethan performed field identifications of wetlands within the limits of the project right of way and prepared federal wetland field data forms to document the delineation of federal wetlands at locations where wetland impacts were likely to occur. This data collection also included obtaining stream and access road widths for construction planning purposes.

BSC GROUP

Evan
Fox

Field Oversight Technician
Wetland Scientist

YEARS OF EXPERIENCE

6

EDUCATION

MNRS, Natural Resources Stewardship
Colorado State University

BS, Environmental Design
University of Massachusetts

CERTIFICATIONS

- OSHA 10 Hour
- Wilderness First Aid
- S130/S190 Wildland Firefighting
- S212 Chainsaw
- Pesticide Applicator- Colorado
- CGP Site Inspector Certificate

AFFILIATIONS

- Town of Gill Conservation Commission - Member
- Society of Ecological Restoration- Member
- Native Plant Trust – Member
- Association of Massachusetts Wetland Scientists – Member
- Massachusetts Association of Conservation Commissions – Member

MEET EVAN

Evan is a Field Oversight Technician and Wetland Scientist with experience in habitat management and ecological restoration, herbicide application to manage invasives and various natural resource assessments. He performs wetland delineations and construction monitoring and reporting. He's also on the Wetland Subject Matter Expert (SME) team and is responsible for continuing to modernize data collection efforts within the Ecology Team.

PROJECT EXPERIENCE HIGHLIGHTS

National Grid, E5/F6 ACR, Western MA
Wetland Delineator

Responsible for accurate delineation, flagging and GPS recording of wetland boundaries in accordance with USACE standards.

National Grid, I135/J136 Tower Painting, Southern NH
Wetland Delineator

Responsible for accurate delineation, flagging and GPS recording of wetland boundaries in accordance with USACE standards.

Eversource, CT-26 Vegetation Management, Central CT
Wetland Delineator

Responsible for accurate delineation, flagging and GPS recording of wetland boundaries in accordance with USACE standards.

National Grid, E5/F6 ACR Project, Various Towns, MA
Wetland Delineator

Conducted wildlife habitat evaluations in multiple towns along the transmission line, using the Massachusetts Department of Environmental Protection Wildlife Habitat Protection Guidance.

Stamford City Parks Invasive Species Plan, Stamford, CT Invasive Species Survey Design, Implementation, & Management Plan Development
Ecological Scientist

Responsible for identifying and mapping floral invasive species as well as developing a treatment and adaptive management plan for the City of Stamford, CT parks.

National Grid, K137/L138 OPGW, Ayer, MA
Replication Specialist

Responsible for the planning and coordination of a wetland replication. This task included selecting appropriate plants and soils, consulting and supervising a construction crew in the creation of additional wetland based on design standards approved by our in-house landscape architects.

Everett STEM Class Field Event, Everett, MA
Educator
Helped lead a volunteer day with 30 middle school students in making trail and habitat improvements in Rivergreen Park. Sharing knowledge about invasive species, wildlife habitat, and practicing safety guidelines with hand tools.

PRIOR TO JOINING BSC, EVAN CONTRIBUTED TO THE FOLLOWING PROJECTS:

Highlands Ranch Metro District, Dad Clark Gulch River Restoration, Highlands Ranch, CO
Project Manager
Oversaw the soil stabilization and revegetation efforts of a .5 mile stretch of perennial stream and over 6 acres of riparian and upland areas. Supervised a crew of 12 employees and personally operated machinery including skid-steers, excavators, and trucks hauling said equipment on trailers. Coordinated with clients, engineers, ecologists, and suppliers, and reported progress with weekly production logs. Performed follow-up vegetation management with mechanical and chemical applications.

Kankakee Sands Prairie Restoration, Newton County, IN
Restoration Technician
Managed invasive species using herbicides and machinery such as brush cutters and chainsaws and mimicked natural processes by using prescribed burns and assisting with rotational grazing to lay the groundwork for eventual introduction of Bison. Collected and processed native seed for ongoing restoration plantings.

Colorado Natural Heritage Program, Wetland and Riparian Assessment, Inventory, and Monitoring, Various Locations CO and WY
Crew Lead
Performed vegetation sampling, soil profile characterization, water quality sampling, and evaluation of land use stressors utilizing Line Point Intercept and other standardized methods to develop a baseline inventory of wetlands on Bureau of Land Management parcels across the Intermountain West. Was responsible for the planning and oversight of a 3 person teams efforts to visit 30 wetlands each field season for 2 summers, traveling hundreds of miles on 7-day long trips in remote country.

BSC GROUP

Marleigh Sullivan

Ecological Scientist

Associate

YEARS OF EXPERIENCE

12

EDUCATION

MS, Soil and Water Resources Management
University of New Hampshire

BS, Environmental Conservation
University of New Hampshire

AFFILIATIONS

- NH Association of Natural Resource Scientists Board of Directors, Treasurer

MEET MARLEIGH

Marleigh is an ecological scientist with expertise in soil science, hydrology, water biogeochemistry, plant biology, and ecology. She is experienced with wetland delineation methodology conforming to the USACE Wetland Delineation Manual. Specifically, Marleigh is experienced with hydric soil indicators and soil profile descriptions; plant taxonomy and field identifications in both upland and wetland environments; and her background in hydrology and water chemistry is particularly valuable for identifying indicators of hydrology. She also performs vegetation surveys for restoration projects and performs rare plant surveys in NH, MA, RI, and CT. Marleigh is also familiar with stormwater, surface water, and groundwater hydrology beneficial in managing construction sediment/erosion controls.

PROJECT EXPERIENCE HIGHLIGHTS

1421/1512 Line Uprate, Eversource Energy, Lee, Becket, Otis, Blandford, and Russell, MA
Compliance Inspector

Performed environmental compliance monitoring for Eversource's Line Uprate Project of the 1421/1512 transmission lines extending from Lee to Granville, MA. Marleigh was responsible for all construction-phase field monitoring for the project to ensure compliance with applicable local, state, and federal environmental regulations and permits and company best management practices (BMPs). This includes overseeing construction on a weekly basis; reviewing sediment/erosion controls and other BMPs; reviewing construction restoration and mitigation efforts; providing contamination spill response; identifying environmental concerns and proposing responsive actions through coordination with the construction crews and comprehensive reporting.

Storm Hardening Initiative, Eversource Energy, Various Locations, CT
Wetland Delineation Specialist

Performed wetland delineation for the Storm Hardening Initiative projects in Connecticut and Massachusetts. Marleigh was responsible for field wetland delineations and field location of wetland flags; evaluating permit requirements; preparing and filing required permit applications including Category 1 Notifications in accordance with the Connecticut General Permit and individual 401 Water Quality Certification application in Massachusetts.

MA Department of Conservation and Recreation (DCR) Invasive Species Management Plan, Various Locations, MA
Compliance Inspector

Developed a survey protocol for mapping invasive plants throughout approximately 60 DCR owned and managed parks throughout Massachusetts. Led a team of ecological scientists to collect data on foot in the most efficient and useful manner possible within a tight budget. The collected data was used to develop an invasive species management plan to help DCR prioritize locations and species to target, as well as proposed methods and means of performing management (e.g. hand pulling, mowing, herbicide, etc.).

Massachusetts Division of Fisheries and Wildlife (MDFW) Hockomock Swamp, West Bridgewater, Easton, and Raynham, MA
Compliance Inspector

Developed and protocol and performed survey and mapping of Common Reed (*Phragmites australis*) and other incidentally observed invasive plant species within the 5,000 acres of MDFW-owned and managed portions of Hockomock Swamp in West Bridgewater, Raynham, and Easton, MA. Field surveys were used to supplement BSC-collected aerial drone photography and ultimately used to develop an invasive species management plan.

Cabot Taps Separation Project, National Grid, Greenfield and Montague, MA
Compliance Inspector & Permitting Specialist

Provided Inspection and permitting services for the Cabot Taps Separation Project for National Grid, which involved investigatory soil borings used to design structure foundations, followed by the relocation of existing double-circuit lines onto of new pairs of single circuit structures. Marleigh played a key role in field assessments, permitting, and monitoring for both phases of the project. The project included a variety of environmental permitting hurdles including rare species, vernal pools, and wetland resource areas. Marleigh was responsible for ensuring compliance with applicable regulations and permits through coordination with work crews and comprehensive environmental reporting. In particular, she led full-time and weekly compliance monitoring for both phases of the project, lead coordination and communication with construction personnel, and communication with permitting agencies. She continues to perform biannual wetland restoration monitoring for the project.

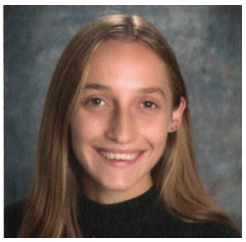
Interstate Reliability Project (IRP), National Grid, Millbury, Sutton, Northbridge, Uxbridge, Millville, MA
Compliance Inspector

Responsible for performing compliance inspections for the 15.4-mile-long Massachusetts portion of the Interstate Reliability Project that extends from Millbury, MA to North Smithfield, RI. This project includes a new 345-kV line and major improvements to an existing line including the expansion of the ROW, removal of existing 69 kV structures, and installation of new 345kV structures. Marleigh is part of a team of wetland professionals who provide full-time monitoring for the project. She performs inspections and reporting necessary to ensure compliance with applicable regulations and permits, and to ensure strict adherence to approved drawings and specifications, which include monitoring, tree clearing operations, removal of lead-contaminated structures, road construction, drilling operations, dewatering and structure installation, sediment and erosion controls, mitigation practices, rare species monitoring, and to provide guidance to construction personnel.

1361/1242 Line Pole Replacement and Reconductoring Project, Eversource Energy, Greenfield and Deerfield, MA
Compliance Inspector

Performing environmental compliance monitoring for the pole replacement and reconductoring of Eversource's 1361 and 1242 double-circuit lines in Greenfield and Deerfield, MA. Marleigh is currently responsible for ensuring environmental compliance with applicable local, state, and federal regulations and permits and company best management practices (BMPs) for all construction activities including investigatory soil borings, road and construction pad building, swamp mat placement, reconductoring of the lines, and the implementation of BMPs. Marleigh oversees construction on a weekly basis to assess erosion/sediment controls and other BMPs; identify environmental concerns and to provide insight on appropriate prevention or mitigation measures; coordinating with construction crews to facilitate environmental compliance; and provide comprehensive reporting.

BSC GROUP



Marabelle Tucci

Wetland Scientist

YEARS OF EXPERIENCE

1

EDUCATION

BS, Environmental Science (Soils and Land Use) and Horticulture, Delaware Valley University

3-year Horticulture Program, Berks Career and Technology Center

CERTIFICATIONS

- APSS (in progress)
- OSHA 10HR #06941221
- CGP Site Inspector Certificate
- National Occupational Competency Testing Institute (NOCTI)
- Pesticide Sprayer Cleanup (Penn State Online Course)

AFFILIATIONS

- Delaware Valley University Soil Judging Team

MEET MARABELLE

Marabelle is an Ecologist in the Ecological Services Department of BSC's Glastonbury office. She assists with various natural resource assessments such as wetland delineations, vernal pool surveys, and invasive and rare plant surveys. In addition, she performs construction monitoring and assists with project reporting and permitting. Marabelle is experienced with various methods of soil and wastewater sampling, and processing and interpreting data. Her technical skills include R (Statistical Computing) and SAS (Statistical Analysis Software), ArcGIS, and ArcMap.

Marabelle has a strong background in soils, land use, and plant science. She is highly skilled in conducting research and collecting and interpreting data.

PROJECT EXPERIENCE HIGHLIGHTS

38A1 Distribution Line Rebuild Project, Conway, MA

Assisted in wetland and stream delineations along 38A1 distribution line.

Woonasquatucket River Gas Line Bridge Crossing Project, Providence, RI

Assisted in wetland investigations and stream delineations along the Woonasquatucket River.

1773 Line ACR & OPGW Installation Project, Rocky Hill, CT

Assisted in wetland delineation and US Army Corps of Engineers Wetland Determination Data Form.

315 Transmission Line Asset Condition Refurbishment Project, Woonsocket, Cumberland and North Smithfield, RI

Provided environmental compliance inspections and reporting (including monthly reporting to RIDEM) for an eight (8) mile transmission line rebuild project in northern Rhode Island.

Marabelle Tucci

PRIOR TO JOINING BSC GROUP, MARABELLE CONTRIBUTED TO THE FOLLOWING PROJECTS:

Ace Mechanical OBX, Manteo, NC

On-site Wastewater Maintenance Technician

Responsibilities included daily maintenance, repairs, and inspection of on-lot wastewater treatment systems in the Outer Banks.

Rodale Institute- Kutztown PA

Agricultural Research Intern

Responsibilities included aiding agricultural research projects, collecting and interpreting data, leading and participating in group discussion.

JENNIFER D. WATTS

CURRICULUM VITAE

October 2024

Woodwell Climate Research Center

149 Woods Hole Road, Falmouth, MA 02540-1644 USA

C: (406) 581-8449 | E-mail: jwatts@woodwellclimate.org

Woodwellclimate.org/staff/Jennifer-watts

Researchgate.net/profile/Jennifer-Watts-7

EDUCATION

2017 Ph.D., Systems Ecology (*Remote Sensing and Ecosystem Modeling*);
College of Forestry and Conservation, University of Montana, Missoula.
Dissertation: Potential contrasts in CO_2 and CH_4 flux response under changing climate conditions: a satellite remote sensing driven analysis of net ecosystem carbon budget for arctic and boreal.

2008 M.S., Land Resources Management (*Land Rehabilitation*);
Department of Land Resources & Environmental Sciences, Montana State University, Bozeman.
Thesis: Monitoring of cropland practices for carbon sequestration purposes.

2006 B.S., Land Resources Management (*Soils and Geospatial Technology*);
Department of Land Resources & Environmental Sciences, Montana State University,

PROFESSIONAL EXPERIENCE

July 2024-	Associate Scientist & Program Director, Woodwell Climate, Falmouth, MA.
July 2019 -	Assistant Scientist, Woodwell Climate Research Center, Falmouth, MA.
Sep 2017-	Affiliate Professor of Remote Sensing, Montana State University, Bozeman, MT.
2017-2019	Postdoctoral Researcher, Woodwell Climate Research Center, Falmouth, MA.
2016-2017	Postdoctoral Researcher, NTSG, University of Montana, Missoula, MT.
2010-2016	Research Assistant, NTSG, University of Montana, Missoula, MT.
2009-2010	Research Assistant, Spatial Science Center, Bozeman, MT.
2008-2009	USGS Northern Rocky Mountain Science Center, Bozeman, MT.

PEER-REVIEWED JOURNAL ARTICLES (SELECTED)

1) Xia, Y, J Sanderman, JD Watts, et al. (2024) Coupling remote sensing with a process model for the simulation of rangeland carbon dynamics. *J. Advances Modeling Earth Systems*. In Press.
2) Virkkala, A, B Rogers, **JD Watts**, KA Arndt, S Potter, et al. (2024) An increasing arctic-boreal CO_2 sink offset by wildfires and source regions. *Nature Climate Change*. In Press.
3) Xia, Y, J Sanderman, **JD Watts**, MB Machmuller, S Ewing, C Rivard (2024) Leveraging legacy data with targeted field sampling for low-cost mapping of soil organic carbon stocks on extensive rangeland properties. *Geoderma,* 448. https://doi.org/10.1016/j-geoderma.2025.116952.
4) **Watts, JD**, M Farina, JS Kimball, L Schiferl, Z Liu, K Arndt, D Zona, et al. (2023) Carbon uptake in Eurasian boreal forests dominates the high-latitude net ecosystem carbon budget. *Global Change Biol.*, https://doi.org/10.1111/gcb.16553

5) Mullen, AL, **JD Watts,** BM Rogers, ML Carroll, CD Elder, J Noomah, Z Williams, JA Caraballo-Vega, et al. (2023) Using high-resolution satellite imagery and deep learning to track dynamic seasonality in small water bodies. *Geophysical Res. Lett*., https://doi.org/10.1029/2022GL102327.

6) Du, J, J Kimball, R Bindlish, JP Walker, **JD Watts** (2022) Local scale (3-m) soil moisture mapping using SMAP and Planet SuperDove. *Remote Sensing*, 14, 3812. https://doi.org/10.3390/rs14153812.

7) Miller SM, MA Taylor, **JD Watts** (2018) Understanding high-latitude methane in a warming climate. *Earth & Space Science News*, https://doi.org/10.1029/2018EO091947

8) ***Watts JD***, JS Kimball, A Bartsch, KC McDonald (2014) Surface water inundation in the boreal-Arctic: impacts on regional methane emissions. *Environmental Res. Lett*, 9, https://doi.org/10.1088/1748-9326/9/7/075001

PROFESSIONAL REPORTS (SELECTED)

1) Pan-Arctic Methane: Current monitoring, capabilities, approaches for improvement, and implications for global mitigation targets. https://www.wilsoncenter.org/publication/pan-arctic-methane-current-monitoring-capabilities-approaches-improvement-and
2) Carbon Monitoring Plan for Northern Great Plains Grazing Lands. Woodwell Climate. Prepared for the National Fish and Wildlife Foundation. In Press.
3) MA – No Net Loss of Carbon in Wetlands scoping study. BSC Group. Prepared for MA DEP and EEA.

PROFESSIONAL ACTIVITIES AND SERVICE (SELECTED)

Workshop/Meeting Organizing Committees (Recent, External):

2024-present: NASA Earth Science Advisory Committee member
2024-present: Meridian Group NRCS Carbon working group Chair
2023-present: National Fish & Wildlife Foundation carbon MMRV co-lead
2019-present: Woodwell Rangeland Carbon science co-lead
2022-present: Woodwell Wetland CH_4 emission mapping lead
2023: WMO International GHG Symposium, Observations & Models Session Chair
2023: 103rd AMS High-latitude Water and Carbon Cycles in a Warming World Session Co-chair
2022: Woodwell/Turner/Montana State Rangeland Carbon Workshop, Co-Lead Organizer
2020: Woodwell High Latitude CO_2 and CH_4 Flux Workshop Co-organizer
2019: NASA ABoVE Data and Model Synthesis Group Co-chair

Journal Reviewer

Science; *Nature*; *Global Change Biology*; *Geophysical Research Letters*; *Remote Sensing of Environment*; *Remote Sensing*; *Biogeosciences*; *Wetlands Ecology & Management*; *Environmental Research Letters*

Taniya RoyChowdhury, Ph.D.

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A. Education and Training

Pacific Northwest National Laboratory	Microbiology	Post-doc	2017
Oak Ridge National Laboratory	Biogeochemistry	Post-doc	2015
The Ohio State University, USA	Soil Science	Ph.D.	2012
University of Calcutta, India	Agricultural Chemistry & Soil Science	M.S.	2005
University of Calcutta, India	Chemistry (Honors)	B.S.	2003

B. Professional Experience

2022-Present	Research Scientist II, Woodwell Climate Research Center, Falmouth, MA
2020-2022	Research Soil Scientist, USDA-ARS, Davis, California
2018-2020	Principal Faculty Specialist, Environmental Science & Technology Department, University of Maryland, College Park
2008-2011	Graduate Teaching Associate, Soil Science, The Ohio State University
2007-2008	University Fellow, Soil Science, The Ohio State University
2005-2006	Post-Masters Research Fellow, Microbiology, University of Calcutta, Kolkata, India

C. Research Emphasis: Soil Microbial Ecology, Biogeochemistry, Carbon Cycle, Global Change

D. Selected Projects

1. **Shallow or Deep: Can cover crops make soil carbon stick**? The emerging complexities of soil microbial carbon cycling, stabilization and destabilization mechanisms must inform cover crop management to more accurately predict climate benefits of cover cropping, yet are almost completely ignored in the current discussion on climate smart agriculture. Here we interrogate the impacts of mixed-species cover crops on microbially-mediated carbon dynamics along soil depth increments up to 60 cm that is expected to represent a gradient of cover crop root density.
2. ***represent a gradient of cover crop root density*** **Pathways of carbon metabolism under cover crops.** Soil carbon sequestration has a high potential to mitigate climate change, but our predictive understanding of soil organic carbon stabilization mechanisms remains uncertain due to over simplistic accounting of microbial properties in biogeochemical models used to evaluate outcomes of agronomic management. Using a cutting-edge highly-resolved data science approach to quantification of the chemically diverse carbon substrates available for microbial uptake, this project will determine the impacts of carbon chemical diversity on soil carbon and nutrient cycling.
3. **Impact of cover crops on full soil profile carbon.** This project seeks to understand the impact of cover crops on soil carbon properties down to one meter depth by sampling at a number of replicated cover crop trials on commercial farms.
4. **Leading indicators of soil carbon change.** Change in soil carbon often takes many years to a decade to detect. This project seeks to understand if other measurements of forms of organic matter and microbial functions can be good predictors for longer term soil carbon change.

E. Professional Service

1. Guest Editor: Frontiers in Microbiology, 2022; Frontiers in Agronomy & JoVE, 2023
2. *Ad hoc* reviews for scientific journals: Applied & Environmental Microbiology, Ecological Engineering, Environmental Microbiology, Environmental Science & Technology, Journal of Geophysical Research-Biogeosciences, PLoS One, mBio, Microbial Ecology, mSystems, Soil Biology & Biochemistry, Soil Systems, Microorganisms, Global Change Biology, mSphere, Microorganisms
3. *Ad hoc* proposal review panelist for the Department of Energy, National Science Foundation, USDA-NIFA

F. Synergistic Activities

1. Advisory Board Member of Applied Microbiology International
2. Professional Memberships: International Society of Microbial Ecology; American Society of Microbiology, American Geophysical Union; Soil Science Society of America (Tri-Societies).
3. Conference Session Convener and Chair: American Geophysical Union Fall Meetings (2023, 2016); Soil Science Society of America: Division of Soil Biology & Biogeochemistry (2016)

G. Honors and Awards

2023	Recipient of Christiana Figueres Prize at Applied Microbiology International. The prize is awarded to a scientist who uses microbiology to help further our understanding of climate change or directly in solutions thereof.
2023	Travel Award Agricultural Microbiomes Thinkathon: A community-based Interactive Workshop organized by the American Phytopathological Society
2014	American Society of Microbiology Science Teaching Fellowship
2011	Edward J. Ray Travel Award for Scholarship and Service, Council of Graduate Students, The Ohio State University
2011	Young Scientist Travel Award, International conference on "Enzymes in the Environment", Bad Nauheim, Germany
2010	Rhonda and Paul Sipp Wetland Research Award, The Ohio State University
2007	University Fellowship, The Ohio State University
2005	First in First Class, Gold Medalist, University of Calcutta, India

H. Relevant Publications (2019 - 2024)

1. **RoyChowdhury, T.,** Rubin, R., ***Jacques, M., Mullen, A., Martin, A., Caroll, M., Oldfield, E., Sanderman, J. Cover crops and full-profile soil carbon stocks: Observations from commercial trials. *Environmental Research Letters*. In prep.
2. Hamovit, N., **RoyChowdhury, T.**, Akob, D.M., Zhang, X., McCarty, G., Yarwood, S.A. Comparative assessment of a restored and natural wetland using ^{13}C-DNA SIP reveals a higher potential for methane production in the restored wetland. *Applied Environmental Microbiology*.
3. Li, Y., Xue, Y., **RoyChowdhury, T.**, Graham, D.E., Tringe, S.E., Jansson, J.K., Tas, Neslihan. Genomic insights into redox-driven microbial processes for carbon decomposition in thawing Arctic soils and permafrost (2024). *mSphere*, e00259-24.
4. Oldfield, E.E., Lavallee, J.M., and others. Greenhouse gas mitigation on croplands: clarifying the debate on knowns, unknowns and risks to move forward with effective management interventions (2024). *Carbon Management*, 15(1), 2365896.
5. **RoyChowdhury, T.,** Bramer, L., Brown, J., Kim, Y.-M., Metz, T. O., Hoyt, D., McCue, L.A., Diefenderfer, H.L., Bailey, V.L. Soil metabolomics predict microbial taxa as biomarkers of moisture status in soils from a tidal wetland (2022).

Microorganisms, Special Issue: Advances in Soil Microbiome, 10 (8), 1653. https://doi.org/10.3390/microorganisms10081653

6. Shaffer-Nothias-Thompson et al. and the Earth Microbiome Project (500) Consortium. Standardized multi-omics of Earth's microbiomes reveals microbial and metabolite diversity. *Nature Microbiology, 7, 2128-2150*.
7. Patel, K.F., Fansler, S., Campbell, T., Bond-Lamberty, B., Smith, P.A., **RoyChowdhury, T.**, McCue, L.A., Bailey, V.L. Soil texture and environmental conditions influence the biogeochemical responses of soils to drought and flooding (2021). *Communications Earth & Environment*, **2 (1),** 127.https://doi.org/10.1038/s43247-021-00198-4
8. Metz, T., Xu, C., Couvillion, S., Sontag, R., Isern, N., Maezato, Y., Lindemann, S., **RoyChowdhury, T.,** Zhao, R., Morton, B., Moore, R., Jansson, J., Bailey, V., Mouser, P.J., Romine,M., Frederickson, J. (2021). MetFish: A metabolomics pipeline for studying microbial communities in chemically extreme environments. *mSystems.*
9. **RoyChowdhury, T.,** Berns, E.C., Moon, Ji-Won, Gu, B., Liang, L., Wullschleger, S.D, Graham, D.E. Temporal, Spatial and Temperature controls on methanogenesis and organic carbon mineralization in Arctic soils from high-centered polygons (2020). *Frontiers in Microbiology. Special issue on the Microbial Communities of Polar and Alpine Soils,* 11. https://doi.org/10.3389/fmicb.2020.616518
10. McClure, R., Lee, J.-Y., **RoyChowdhury, T.**, Bottos, E.M., White III, R.A., Kim, Y.-M, Nicora, C.D., Metz, T.O., Hofmockel, K.S., Jansson, J.K., Song, H.-S. Integrated network modeling approach defines key metabolic responses of soil microbiomes to perturbations (2020). *Scientific Reports,* 10(1), 10882 https://doi.org/10.1038/s41598-020-67878-7
11. **RoyChowdhury, T.**, Lee, J.-Y., Bottos, E.M., White III, R.A., Bramer, L., Brown, J., Zucker, J., Kim, Young-Mo, Brislawm, C.J., Fansler, S.J., Metz, T.O., McCue, L.A., Callister, S.J., Song, H.-S., Jansson, J.K. Metaphenomic responses of a native prairie soil microbiome to moisture perturbations (2019). *mSystems*, 4(4) https://doi.org/10.1128/msystems.00061-19
12. Vera-Gargallo, B., **RoyChowdhury, T.**, Brown, J., Fansler, S.J., Duran-Viseras, A., Sanchez-Porro, Bailey, V.L., Ventosa, A., Jansson, J.K., Ventosa, A. Spatial distribution of prokaryotic communities in hypersaline soils (2019). *Scientific Reports*, 9:1769. https://doi.org/10.1038/s41598-018-38339-z

MATTHEW J. DUVENECK

EDUCATION

- PhD, Environmental Science & Resources. Portland State University. 2014
- M.S., Forest Resources. University of Massachusetts 2005
- B.S., Resource Conservation. University of Montana 2000
- A.S., Fire Science. Southern Maine Technical College 1996

RESEARCH INTERESTS

Landscape ecology, forest management, fire ecology and behavior, simulation modeling, climate change, disturbance interactions, ecosystem resilience, geographic information science, remote sensing.

APPOINTMENTS

- *Liberal Arts Department- Professor*
  2017-Present New England Conservatory

- *Research Associate*
  2017-Present Harvard Forest, Harvard University

- *Post-Doctoral Fellow*
  2014-2017 Harvard Forest, Harvard University

- *Fire Science Department Chair- Professor*
  2005–2010 Southern Maine Community College

- *Research Technician*
  2000–2002 USFS Fire Science Laboratory

- *Firefighter*
  1998-99 Helena Helitack/Arrowhead Hotshots

PUBLICATIONS

42). Herb W. R., K. Blann, L. Johnson, M. White, **M. J. Duveneck**, R. Garono, J. Jereczek. (*In review)*. Projecting the impacts of climate change and forest transition on streamflow in Lake Superior tributaries. Journal of Hydrology.

41). Zhou, Z., S. V. Ollinger, A. P. Ouimette, B. R. Miranda, E. J. Gustafson, **M. J. Duveneck**, J. R. Foster, D. R. Bronson, D. Laflower (*In review*). Integrating nitrogen and carbon cycling into LANDIS-II/PnET-Succession to improve forest landscape modeling: Methods and sensitivity analyses.

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40). Reese, G., C. Dymond, K. Quigley, **M. J. Duveneck,** M. Russell, E. Gustafson, R. Scheller, B. Miranda, and B. Sturtevant. (*2024*). Best practices for calibration of forest landscape models using fine-scaled reference information. Canadian Journal of Forest Research. https://doi.org/10.1139/cjfr-2024-0085.

39) Gustafson, E., B. Miranda, B. Sturtevant, and **M. J. Duveneck**, (2024) Overcoming conceptual hurdles to accurately represent trees as cohorts in forest landscape models. Ecological Modeling. https://doi.org/10.1016/j.ecolmodel.2024.11065

38). Hof, A.R., J. Lundström, **M. J. Duveneck** (2023). Modeling the Impacts of Climate Change on Ecosystem Services in Boreal Forests. In: Girona, M.M., Morin, H., Gauthier, S., Bergeron, Y. (eds) Boreal Forests in the Face of Climate Change. Advances in Global Change Research, vol 74. Springer, Cham. https://doi.org/10.1007/978-3-031-15988-6_25.

37). Hassan, M. M., **M. J. Duveneck,** J. Southwork. 2023. Tracking forest cover change and fragmentation in Teknaf following a massive influx of Rohingya refugees. Ecological Informatics. https://doi.org/10.1016/j.ecoinf.2022.101966.

36). Liang, Y., E.J. Gustafson, H.S. He., J. Serra Diaz, **M. J. Duveneck,** J. R. Thompson. 2022. What is the role of disturbance in catalyzing spatial shifts in forest composition and tree species biomass under climate change? Global Change Biology. https://doi.org/10.1111/gcb.16517.

35). Lucash, M., S. Weiss, **M. J. Duveneck**, R. Scheller. 2022. Managing for red-cockaded woodpeckers is more complicated under climate change. Journal of Wildlife Management. http://doi.org/10.1002/jwmg.22309.

34). Mina, M. Messier C., **M. J. Duveneck**, M Fortin, N. Aquilué. 2022. Managing for the unexpected: building resilient forest landscapes to cope with global change. Global Change Biology. https://doi.org/10.1111/gcb.16197.

33). Sirén, A, C. Sutherland, A.Karmalkar, **M. J. Duveneck**, & T. L. Morelli. Forecasting species distributions: Correlation does not equal causation. *2022*. Diversity and Distributions. https://doi.org/10.1111/ddi.13480.

32). Soucy, A., P.Rahimzadeh-Bajgiran, S. De Urioste-Stone,r A. Weiskittel, **M. J. Duveneck**, B. McGreavy. A Comprehensive and Spatially Explicit Regional Vulnerability Assessment of the Forest Industry to Climate Change. *2021*. Journal of Forestry. https://doi.org/10.1093/jofore/fvab057.

31). Sotnik, G. B.A. Cassell, **M. J. Duveneck**. R.M. Scheller. A new agent-based model provides insight into deep uncertainty faced in simulated forest management. *2021*. Landscape Ecology. 1-19. https://doi.org/10.1007/s10980-021-01324-5.

30). **Duveneck, M. J.** (co-lead author), MacLean, M. G. (co-lead author), Plisinski, J., Morreale, L. L., Laflower, D., & Thompson, J. R. (*2021*). Forest carbon trajectories: Consequences of alternative land-use scenarios in New England. Global Environmental Change, 69, 102310. https://doi.org/10.1016/j.gloenvcha.2021.102310.

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29). Fer, I., Gardella A., Shiklomanov A. N., Serbin, S. P., De Kauwe M. G., Raiho A., Johnston M. R., Desai A., Viskari, T., Quaife, T., LeBauer D. S., Cowdery E. M., Kooper R., Fisher J. B., Poulter B., **Duveneck M. J.**, Hoffman, F. M., Parton W., Mantooth J., Campbell E.E., Haynes, K. D., Schaefer K., Wilcox K. R, Dietze M. C. *2020.* Beyond Modeling: A Roadmap to Community Cyberinfrastructure for Ecological Data-Model Integration. Global Change Biology. https://doi.org/10.1111/gcb.15409.

28). Pearman-Gillman, S. B, **M. J. Duveneck**, J. D. Murdoch, and T. M. Donovan *2020*. Wildlife resilience and protection in a changing New England landscape PlosOne. E 15(9): e0239525 https://doi.org/10.1371/journal.pone.0239525.

27). Schrum, P., R. Scheller, M. Lucash, and **M. J. Duveneck**. *2020*. Base-Hurricane: A new extension for the Landis-II forest landscape model. Environmental Modelling & Software, 104833. https://doi.org/10.1016/j.envsoft.2020.104833.

26). De Jager, N. R., J. J. Rohweder, and **M. J. Duveneck**. *2020*. Climate Change Is Likely to Alter Future Wolf–Moose–Forest Interactions at Isle Royale National Park, United States Frontiers in Ecology and Evolution. 8. https://doi.org/10.3389/fevo.2020.543915.

25). Mina, M., C, Messier, **M. J. Duveneck**, M. Fortin, and N. Aquilué. *2020*. Network analysis can guide resilience-based management in forest landscapes under global change. Ecological Applications. 30(7), 1-18. https://doi.org/10.1002/eap.2221.

24). Thompson J., J. Plisinski, K. Fallon Lambert, **M. J. Duveneck**, L. Morreale, M. McBride, M. G. MacLean, M. Weiss, and L. Lee. *2020*. Spatial Simulation of Co-Designed Land-Cover Change Scenarios in New England: Alternative Futures and Their Consequences for Conservation Priorities. Earth's Future. 8(7). https://doi.org/10.1029/2019EF001348.

23). Pearman-Gillman, S. B., **M. J. Duveneck**, J. D. Muroch, and T. M. Donovan. 2020. Drivers and Consequences of Alternative Landscape Futures on Wildlife Distributions in New England, USA.. Frontiers in Ecology and Evolution, 8. https://doi.org/10.3389/fevo.2020.00164.

22). MacLean, M., J. Holt, M. Borsuk, M. Markowski-Lindsay, B. Butler, D. B. Kittredge, **M. J. Duveneck,** D. Laflower, D. Orwig, D. Foster, and J. R. Thompson. 2020. Potential impacts of insect-induced harvests in the mixed forests of New England. Forests. 11(5), 498. https://doi.org/10.3390/f11050498.

21). Markowski-Lindsay, M., D. Kittredge, J. Holt, J. Thompson, D. Orwig, D. Laflower, B. Butler, M. Borsuk, **M. J. Duveneck**, and M. G. MacLean. 2020. Compounding the disturbance: Family forest owner reactions to invasive forest insects. Ecological Economics. *167*, 106461. https://doi.org/10.1016/j.ecolecon.2019.106461.

20). **Duveneck, M. J.,** and J. R. Thompson. 2019. Social and biophysical determinants of future forest conditions in New England: Effects of a modern land-use regime. Global Environmental Change. 55 (2019): 115-129. https://doi.org/10.1016/j.gloenvcha.2019.01.009,

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19). McKenzie, P.F., **M. J Duveneck**, L. Morreale, and J. R. Thompson. *2019*. Local and global parameter sensitivity within an ecophysiologically based forest landscape model. Env. Software and Modeling. https://doi.org/10.1016/j.envsoft.2019.03.002.

18). McBride, M. F., **M. J. Duveneck**, K. Fallon-Lambert, K.A. Theoharides, and J. R. Thompson. 2018. Perspectives of resource management professionals on the future of New England's landscape: Challenges, barriers, and opportunities. Landscape and Urban Planning. https://doi.org/10.1016/j.landurbplan.2018.10.019.

17). Janowiak, M. K., A. D'Amato, C. W. Swanston, L. Iverson, F. Thompson III, W. Dijak, S. Matthews, M. Peters, A. Prasad, J.S. Fraser, L.A. Brandt, P.R. Butler, S.D. Handler, P.D. Shannon, D. Burbank, J. Campbell, C. Cogbill, **M. J. Duveneck**, M. Emery, N. Fisichelli, J. Foster, J. Hushaw, L. Kenefic, A. Mahaffey, T.L. Morelli, N. Reo, P. Schaberg, K.R. Simmons, A. Weiskittel, S. Wilmot, D. Hollinger, E. Lane, L. Rustad, P. Templer. 2018. New England Forest ecosystem vulnerability assessment: a report from the New England Climate Change Response Framework. Gen. Tech. Rep. NRS-173. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 234 p. https://doi.org/10.2737/nrs-gtr-173.

16). Thompson, J.R., J.S. Plisinski, P. Olofsson, C.E. Holden, **M. J. Duveneck**. 2017. Forest loss in New England: A projection of recent trends. *PloS one*. *12*(12). https://doi.org/10.1371/journal.pone.0189636.

15). **Duveneck, M. J.,** J. R. Thompson. 2017. Climate change imposes phenological tradeoffs on forest net primary productivity. Journal of Geophysical Research-Biogeosciences. https://doi.org/10.1002/2017JG004025.

14). Liang, Y., **M. J. Duveneck,** E. J. Gustafson, J. Serra Diaz, J. R. Thompson. 2017. How disturbance, competition and dispersal interact to prevent tree range boundaries from keeping pace with climate change. Global Change Biology. https://doi.org/10.1111/gcb.13847.

13). **Duveneck, M. J.,** J. R. Thompson, E. J. Gustafson, Y. Liang, and A. M.G. de Bruijn. 2016. Recovery Dynamics and Climate Change Effects to Future New England Forests. Landscape Ecology. https://doi.org/10.1007/s10980-016-0415-5.

12). Mallampalli V. R., J. Thompson, **M. J. Duveneck**, S. Meyer, A. Ligmann-Zielinska, C. G. Druschke, K. Hychka, M. A. Kenney, K. Kok, and M.E. Borsuk. 2016. Methods for Translating Narrative Scenarios into Quantitative Assessments of Land Use Change. Environmental Modeling and Software. 7-20. https://doi.org/10.1016/j.envsoft.2016.04.011.

11). **Duveneck, M. J.**, and R. M. Scheller. 2015. Measuring and managing resistance and resilience under climate change in northern Great Lake forests (USA). Landscape Ecology. https://doi.org/10.1007/s10980-015-0273-6.

10). **Duveneck, M. J.**, and R. M. Scheller. 2015. Climate change effects to productivity and functional diversity in northern Great Lake forests with climate suitable planting. Ecological Applications. 25-6. Pages 1653-1668. https://doi.org/10.1890/14-0738.1.

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9). Truitt, A., E. Granek, **M. J. Duveneck**, K. Goldsmith, M. Jordan, S. Copp, K. Yazzie. 2015. What's novel about novel ecosystems: Managing change in an ever-changing world. Environmental Management. Pages 1-10. https://doi.org/10.1007/s00267-015-0465-5.

8). **Duveneck, M.J.**, Jonathan R. Thompson, and B. Tyler Wilson. 2015. Imputed Forest Composition Map for New England Screened by Species Range Boundaries. Forest Ecology and Management. 347-1. Pages 107-115. https://doi.org/10.1016/j.foreco.2015.03.016.

7). **Duveneck, M. J.**, R. M. Scheller, and M. White, A. 2014. Effects of alternative forest management strategies in the face of climate change in the northern Great Lake region. Canadian Journal of Forest Research. 44-700-710 (2014). https://doi.org/10.1139/cjfr-2013-0391.

6). **Duveneck, M. J**., R. M. Scheller, M. White, A, S. Handler, and C. Ravenscroft. 2014. Climate change effects to northeastern Minnesota and northern lower Michigan forests: A case for preserving diversity. Ecosphere. 5(2): art23. https://doi.org/10.1890/ES13-00370.1.

5). Handler, S., **M. J. Duveneck**, L. Iverson, E. Peters, R. M. Scheller, K. R. Wythers, L. Brandt, P. Butler, M. Janowiak, C. Swanston, K. Barrett, R. Kolka, C. McQuinston, B. Palik, P. B. Reich, C. Turner, M. A. White, C. Adams, A. W. D' Amato, S. Hagell, R. Johnson, P. Larson, M. Larson, S. Matthews, R. Montgomery, S. Olson, M. Peters, A. Prasad, J. Rajala, P. D. Shannon, J. Daley, M. Davenport, M. R. Emery, D. Fehringer, C. L. Hoving, G. Johnson, L. B. Johnson, D. Neitzel, A. Rissman, C. Rittenhouse, and R. Ziel. 2014. Minnesota Forest Ecosystem Vulnerability Assessment and Synthesis: A report from the Northwoods Climate Change Response Framework. Gen. Tech. Rep. NRS-133. Newtown Square, PA; U.S. Department of Agriculture, Forest Service, Northern Research Station. 228 p. https://doi.org/10.2737/NRS-GTR-133.

4). Handler, S., **M. J. Duveneck**, L. Iverson, E. Peters, R. M. Scheller, K. R. Wythers, L. Brandt, P. Butler, M. Janowiak, C. Swanston, A. C. Eagle, J. G. Cohen, R. Corner, P. B. Reich, T. Baker, S. Chhin, E. Clark, D. Fehringer, J. Fosgitt, J. Gries, K. R. Hall, C. Hall, R. Heyd, C. L. Hoving, I. Ibanez, D. Kuhr, S. Matthews, H. Muladore, K. Nadelhoffer, D. Neumann, M. Peters, A. Prasad, M. Sands, R. Swaty, L. Wonch, J. Daley, M. Davenport, M. R. Emery, G. Johnson, L. B. Johnson, D. Neitzel, A. Rissman, C. Rittenhouse, and R. Zeil. 2014. Michigan Forest Ecosystem Vulnerability Assessment and Synthesis: A report from the Northwoods Climate Change Response Framework. Gen. Tech. Rep. NRS-129. Newtown Square, PA; U.S. Department of Agriculture, Forest Service, Northern Research Station. 229 p. https://doi.org/10.2737/NRS-GTR-129.

3). Skowronski, N. S., K. L. Clark, **M. J. Duveneck**, and J. Hom. 2011. Three-dimensional canopy fuel loading predicted using upward and downward sensing LiDAR systems. Remote Sensing of Environment. 115, 703-714. https://doi.org/10.1016/j.rse.2010.10.012.

2). Clark, K. L, N. Skowronski, J. Hom, **M. J. Duveneck**, Y. Pan, S. Van Tuyl, J. Cole, M. Patterson and S. Maurer. 2009. Decision support tools to improve the effectiveness of

hazardous fuel reduction treatments in the New Jersey pine barrens. International Journal of Wildland Fire. 18, 268–277. https://doi.org/10.1071/WF08080.

1). **Duveneck, M. J.** and William A. Patterson III. 2007. Characterizing Canopy Fuels to Predict Fire Behavior in Pitch Pine Stands. Northern Journal of Applied Forestry. 24 (1) 2007. https://doi.org/10.1093/njaf/24.1.65.

REPORTS AND THESES

- **Duveneck, M. J.**, W. Xi, and R. M. Scheller. Chapter 7: Understanding Model Outputs; and Scheller, R. M. and **M. J. Duveneck.** Chapter 13: Simulating Forest Management with the Base Harvest Extension. In Scheller, R.M. and MS Lucash. Editors. 2014. Forecasting Forested Landscapes: An Introduction to LANDIS-II with Exercises. Self-Published. ISBN: 9781722654924.

- **Duveneck, M. J.** 2013. Managing for Resistance and Resilience of Northern Great Lakes Forests to the Effects of Climate Change. Doctoral Dissertation. Portland State University, Portland, OR. https://doi.org/10.15760/etd.1550.

- Williams, B. J., B. Song, J. Hom, and **M. J. Duveneck**. 2008. Wildfire Visualization Using GIS and Forest Inventory Data. In Proceedings of the 6th Southern Forestry and Natural Resources GIS Conference (2008).

- Patterson, W.A. III, D. Crary Jr. and **M. J. Duveneck**. 2008. The impossible summer burn: Techniques for fuel reduction, habitat restoration and happy locals in northeastern pine barrens. Fire Science Brief. 13 (2008).

- **Duveneck, M. J.** 2005. Characterizing Canopy Fuels as They Affect Fire Behavior in Pitch Pine. Master's Thesis. University of Massachusetts. Amherst, MA.

- Patterson, William A. III and **M. J. Duveneck**. 2004. Fire Management Plan for The Maine Army National Guard Hollis Training Site. University of Massachusetts Forestry Program.

- Patterson, W. A. III, D. Crary Jr., and **M. J. Duveneck**. 2004. Managing pitch pine to Reduce Crown Fire Potential. In Managing fuels in northeast barrens: A field tour sponsored by the Joint Fires Sciences Program for northeastern fire managers. University of Massachusetts Forestry Program.

TEACHING EXPERIENCE

New England Conservatory

- Natural Disasters & Catastrophes (Fall 2017, Fall 2020, Fall 2023)
- Energy in the 21st Century (Fall 2017, Fall 2020, Fall 2023)
- Freshman Seminar: Complexities in Repairing the Environment (Fall 2017, Fall 2018, Fall 2019, Fall 2020, Fall 2021, Fall 2022, Fall 2023)
- Watershed Hydrology: Understanding Water in the Environment (Spring 2018, Spring 2021)
- Climate Change Adaptation (Spring 2018, Spring 2021, Spring 2024)

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52 Robie Street, Gorham, Maine 04038

- Social Dance (Spring 2018, Spring 2019, Spring 2020, Spring 2022, Spring 2023, Spring 2024)
- Mapematics: Introduction to Geographic Information Science (Fall 2018, Spring 2020, Spring 2022, Spring 2023)
- Forest Ecology (Fall 2018, Fall 2021, Fall 2024)
- Intro to Probability and Mathematical Modeling (Spring 2019, Fall 2021, Fall 2024)
- Our Cosmic Origins (Spring 2019, Spring 2022)
- Sustainable Societies (Fall 2019. Fall 2022)
- Evolution of Life on the Planet (Spring 2020, Spring 2023)
- Introduction to Physical Geography (Fall 2019, Fall 2022)
- Introduction to Botany and Plant Physiology (Spring 2021, Spring 2024)

University of Massachusetts-Amherst

- Ecology, Economy, and Future of Maple Syrup (Guest lecturer, 2016)

Northeastern University

- Architecture and Land Use (Guest lecturer, 2016)

LANDIS-II Forest Simulation Model Training

- Introduction to LANDIS-II (Instructor, 2013 Portland, OR; 2014 Harvard Forest, MA, 2021 Remote)

Portland State University

- Landscape Ecology (Guest lecturer, 2013)
- Intro Environmental Management (Guest lecturer, 2013)
- Investigating Forest Ecosystems (Teaching Assistant, 2010)
- Old Growth Forest Ecology (Teaching Assistant, 2011)

Southern Maine Community College

- Fire Service Building Construction (Fall: 2005).
- Fire Service Hydraulics (Spring: 2006, 2007, 2008).
- Service Learning (Fall: 2005, 2006; Spring: 2007).
- Wildland Fire Management (Fall: 2008, 2009; Spring: 2009, 2010).
- Wildland Fire Behavior (Spring: 2008, 2009).
- Fire Inspector (Spring: 2006, 2007, 2008, 2009, 2010).
- Fire Protection Systems (Fall: 2005, 2006, 2007, 2008, 2009).

Peninsula School, Menlo Park, California

- 7th and 8th grade (Teaching Assistant, 2000-2001)

University of Montana

- Dendrology (Teaching Assistant, 1999-2000)
- Wood Identification (Teaching Assistant, 2000)

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Visiting social dance Instructor

- Pinewoods American Dance/Music Week, Plymouth, MA (2009, 2011, 2018).
- BACDS American & English Week, Mendocino, CA (2009, 2010, 2011).
- Winter Dance Week, Brasstown, NC (2007, 2008, 2009, 2010, 2012, 2013, 2014).
- Bates College Tango Club, Lewiston, ME (2007, 2008).
- Davis Elkins College/Augusta Dance Week, Elkins, WV (2007, 2008).
- Stanford University Waltz Week, Stanford, CA (2007).
- Timber Ridge Dance Week, High View, WV (2006, 2008).
- Chesapeake Dance Weeekend, MD (2010, 2011, 2015).
- Music City Masquerade, TN (2012)
- New England Conservatory, MA (2014, 2015, 2019, 2021)

SERVICE AND OUTREACH

- Executive Board (2022-Present), LANDIS-II foundation.
- Academic Technology Committee (2022-present). New England Conservatory.
- Board of Directors, Nominating Committee, and Program Committee; Director. Harry F. Guggenheim Foundation. 2011-Present. Foundation sponsors scholarly research addressing problems of violence, aggression, and dominance.
- Undergraduate Curriculum Committee (2020-2022); Chair. 2021-2022. New England Conservatory.
- Advisory Board; Advisor. North Atlantic Fire Science Consortium. 2014-2019. Consortium provides link with fire science, management, and policy in the North Atlantic region.
- Search Committee Chair; Southern Maine Community College, Maine Fire Training Director. September 2009
- Search Committee Chair; Southern Maine Community College, Fire Science Professor. April 2009
- Co-organized Symposium; "Simulating Forest Dynamics Using LANDIS-II" for the International Association of Landscape Ecologist meeting in Portland, Oregon, July 2015.
- Reviewer; Ecological Economics (2017), Forest Ecology and Management (2017), Ecological Applications (2017), Canadian Journal of Forest Research (2016), Environmental Research Letters (2016), International Journal of Wildland Fire (2015), Landscape Ecology (2015, 2016, 2018), Environmental Modeling and Software (2015), Ecological Modeling (2014, 2016), Pearson Education (2006), International Journal of Remote Sensing (2019), Frontiers in Forests and Global Change (2022).
- Student Committee: Núria Aquilué Junyent (PhD, Université du Québec à Montréal 2018).

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GRANTS & CONTRACTS

- Messier, C. et al. (**Duveneck, M. J**, cooperator). 2024. Pan-Canadian NSERC Alliance. Simulating Forest Change Across Canadian Forests. $6 million (CAN).

- **Duveneck, M. J.** 2024. The Nature Conservancy Central Appalachians Program, LANDIS Modeling for USFS Region 8 Appalachians Climate Change Vulnerability Assessment. $57,000.

- **Duveneck, M. J.** 2022. Second Century Stewardship. Parameterization and simulation of Acadia National Park forests, Maine. Schoodic Institute. $20,000.

- **Duveneck, M. J.** 2018. Consulting and parameterization of forest simulation model in Fort Bragg, North Carolina. Portland State University. $1800.

- **Duveneck, M. J.** 2018. Modeling forest change in Northeast National Parks. University of Massachusetts. $5000.

- **Duveneck, M. J.** 2018/2019. Consulting and parameterization of forest simulation model in Quebec. Université du Québec à Montréal. $1000.

- **Duveneck, M. J.** 2016. Consulting and development of vegetation map in Pennsylvania to initialize forest simulation model. Pennsylvania State University. $8000

- Ayers, M. P., C.F. Aoki, K.L. Clark, R.M. Scheller, **M. J. Duveneck** (Cooperator). R. Billings. 2016-2017. Southern pine beetle range expansion: Forecasting SPB population dynamics and impacts of disturbance interactions on future forests of New York, New Jersey and New England. USDA Forest Service. Northeastern Area State & Private Forestry.

- Scheller, R. M., C. Swanston, S. Handler, M. White, **M. J. Duveneck**. (Assisted writing) 2011-2013. Scenarios for forest reserve and adaptive management under alternative climate change scenarios in the northern Great Lakes. Upper Midwest and Great Lakes Landscape Conservation Cooperative. $111,404.

- **Duveneck, M. J.** 2010. Development of operations manual and provide training for Mobile Fire Sprinkler & Alarm Simulator. Portland, Maine Area Metro Fire Departments. $6000.

- **Duveneck, M. J.** 2008. Characterizing canopy fuels with indirect upward looking LiDAR in Montana conifer forests. USFS Global Change Program. Northern Research Station. $4000.

- **Duveneck, M. J.** 2007**.** Parameterize crown fuels in New Jersey Pine Barrens with Upward LiDAR. USFS Global Change Program. Northern Research Station. $2000.

- **Duveneck, M. J.** 2007. SMCC Mini-Grant. Curriculum Update for "Building Construction for the Fire Service". $400.

- **Duveneck, M. J.** 2007. SMCC Mini-Grant. Course development for: "Wildland Fire Ecology & Behavior". $400.

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- **Duveneck, M. J.** 2006. FARSITE modeling for New Jersey Pine Barrens. USFS Global Change Program. Northern Research Station. $1000.

- **Duveneck, M. J.** 2006. SMCC Mini-Grant. Course development for: "Introduction to Forest Fire Management". $400.

AWARDS

- Portland State University; Environmental Science & Management Bushby Graduate Scholarship. Portland, OR. June 2013. $4500.

- Portland State University; Academically-Controlled Auxiliary Activities (AAA) Student Travel Award, Portland, OR. February 2013. $750.

- U.S. Regional Association of the International Association for Landscape Ecology; Student Travel Award. Austin, TX. April 2013. $500.

- Portland State University; Environmental Science & Management Bushby Graduate Travel Award. Portland, OR. June 2012. $475.

- Michigan State University-NASA; Professional Enhancement Award. Annual Symposium of the U.S. Regional Association of the International Association for Landscape Ecology. Newport, RI. April 2012. $700.

- Portland State University; Dean's Award. Portland, OR. September 2010. $7500.

- National Institute for Staff and Organizational Development (NISOD); Teaching Excellence Award. International Conference on teaching & Leadership Excellence. Austin, TX. May 2008.

- University of Massachusetts Department of Natural Resources Conservation; Herschel G. Abbott Award; Amherst, MA. April 21, 2004. $700.

- University of Massachusetts Department of Natural Resources Conservation; Membership Xi Sigma Pi Forestry Honor Society; Amherst, MA. April 21, 2004.

- USFS Fire Sciences Lab; Fire/Fire Surrogate Research Burn Award. July 2002. $500.

PRESENTATIONS (Oral and Posters)

- **Duveneck, M. J**., M. MacLean, D. Laflower, and J. Thompson. Management response to insect outbreaks: Are the effects larger than insects themselves? (Invited Seminar). International Association of Landscape Ecologists. March 2023. Riverside, California.

- **Duveneck, M. J.** Stories from Schoodic Institute. (Invited Seminar). The Story Collider. June 2022. Schoodic Institute. Winter Harbor, Maine.

- **Duveneck, M. J**., M. MacLean, and J. Thompson. The effect of climate, the modern land-use regime, and alternative future scenarios on forest carbon in New England, USA. (Invited

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Seminar). International Association of Landscape Ecologists. July 2019. Milan, Italy.

- Scheller, R.M., M.S. Lucash, **M.J. Duveneck**. Managing forests for change: Simulations suggest radical innovations in management will be necessary. (Seminar). Ecological Society of America 104th Annual Meeting. August 2019. Louisville, Kentucky.

- De Jager, N.R. **M.J. Duveneck**, and J.J. Rohweder. Interactive effects of wolf predation and climate change on moose-forest interactions at Isle Royale National Park, USA (Seminar). International Association of Landscape Ecology Meeting. April 2019. Chicago, IL.

- **Duveneck, M. J.** Crown fuel and fire modeling in pitch pine (Field tour). North Atlantic Fire Science Exchange. Montague Plains Field Trip. August 2018. Montague, MA.

- MacLean, M. G., **M. J. Duveneck**, D. Laflower, A. Chmurzynski, J. Thompson. The importance of interacting global change drivers when modeling forest disturbance in New England (Seminar). Ecological Society of America Conference. August 2018. New Orleans, LA.

- Thompson, J., **M.J. Duveneck**, K. Fallon-Lambert, J. Plisinski, L. Morreale. Land-use regimes and the future of New England's forest carbon (Seminar). Ecological Society of America Conference. August 2018. New Orleans, LA.

- **Duveneck, M.J.** Artists are engaged by science (Seminar). Consortium for the Liberal Education of Artists Conference. April 2018. Baltimore, MD.

- **Duveneck, M.J.** Effects of the modern land-use regime on future New England forests (Seminar). Ecological Society of America Conference. August 2017. Portland, OR.

- **Duveneck, M. J.** Interactions of climate and land use in New England: Simulating alternative scenarios of future forests (Seminar). Wildfire in the Northeast Conference. December 2016. Mystic, CT.

- **Duveneck, M. J.** Future forests, climate and land use in New England (Seminar). Visionary Meeting on Understanding and Forecasting the Impact of Climate Change on Maine's Forest. November 2016. Portland, ME.

- **Duveneck, M. J.** and J. Thompson. Tradeoffs between increased gross photosynthesis and increased respiration demand under climate change: Seasonal and spatial variability in New England (Seminar). International Association of Landscape Ecology Meeting. April 2016. Asheville, NC.

- **Duveneck, M. J**., and J. Thompson. Effects of seasonal phonological changes to future forest productivity (Invited Presentation). Harvard Forest Research Symposium. March 2016. Petersham, MA.

- Rapp, J.M., **M.J. Duveneck**, and J. R. Thompson. Expansion of the maple syrup industry in New England: projecting where the taps will be in a changing environment (Poster). Harvard Forest Research Symposium. March 2016. Petersham, MA.

- **Duveneck, M. J**., J. Thompson, L. Morreale, and J. Plisinski. Future Effects to New England Forests: Scenarios of Harvest, Development, and Climate Change (Invited Presentation). International Association of Landscape Ecology Meeting. July 2015. Portland, OR.

- **Duveneck, M. J.** Measuring and Managing Resilience under Climate Change and Alternative Scenarios in Northern Great Lake Forests (Invited Presentation). US Forest Service NYC Urban Field Station. June 2015. Bayside, NY.

- **Duveneck, M. J.** Forest Management for Resilience under Climate Change: Case Studies of Alternative Silviculture in the Great Lakes Region (Invited Presentation). Northeastern Area Association of State Foresters Annual Meeting. Climate Change: Climate Preparedness for a Changing Forest. June 2015. Petersham, MA.

- **Duveneck, M. J.** Managing for Resilience in Multiple Dimensions under Climate Change: Informing Forest Managers in the Great Lake Region with Alternative Scenarios (Seminar). Harvard Forest Seminar Series. March 2015. Petersham, MA.

- **Duveneck, M. J.**, Jonathan R. Thompson, B. Tyler Wilson, Sofie McComb, and Luca Morreale Plot-Level Forest Composition Data at a Regional Scale (Poster). October 2014. Scenarios to Solutions Harvard Forest Research Coordination Network Planning Workshop, South Casco, ME.

- **Duveneck, M. J.** Measuring and Managing Resilience Under Climate Change in Northern Great Lake Forests (Seminar). University of Vermont. Gund Institute Seminar Series. September 2014. Burlington, VT.

- **Duveneck, M. J.** Climate Change Effects to Northern Great Lakes Region Forests: Managing for Resistance and Resilience (Webinar). April 2014. The Nature Conservancy, Field Climate Forum.

- White, M., **Duveneck, M. J.**, Scheller, R. M. How Do We Manage Forests For Climate Change? Forest Restoration and Management in Changing Climate: Implications for Lake Superior Watersheds (Seminar). January 2014. Duluth, MN.

- **Duveneck, M. J.** How Do We Manage Forests For Climate Change? Assessing Resistance and Resilience of Northern Great Lake Forests. (Seminar). Portland State University, Dissertation Defense. November 2013. Portland, OR.

- **Duveneck, M. J.** Climate Change Vulnerability Assessment and Declining Resistance and Resilience in the Northern Great Lakes Region. (Seminar). Portland State University, Forest Ecology and Management Seminar Series. October 2013. Portland, OR.

- **Duveneck, M. J**. ,R. M. Scheller, and M. White. A Landscape Comparison of Potential Climate Futures in Minnesota and Michigan. (Prepared presentation for seminar). Ecological Society of America 98th Annual Meeting. August 2013. Minneapolis, MN.

- **Duveneck, M. J**. and R. M. Scheller. Climate Change in Northern Minnesota and Northern Lower Michigan Forests: Assessing the Effect of Latitude. (Seminar). International Association of Landscape Ecology Meeting. April 2013. Austin, TX.

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- Falkowski, M. J., A.T. Hudak, N. L. Crookston, R. M. Scheller, **M .J. Duveneck**, L. M. Nagel, and R. E. Froese. Enhancing Tools and Geospatial Data to Support Operational Forest Management and Regional Forest Planning in the Face of Climate Change. (Poster). NASA Land Use/Land Cover Change meeting. April 2013. Rockville, MD.

- Scheller, R. M., and **M. J. Duveneck**. Future forest scenarios under climate change in Northern Lower Michigan. (Seminar). Michigan Climate Change Response Framework Workshop. September 2012. Pellston, MI.

- **Duveneck, M.J**. and R.M. Scheller. Climate Change Adaptation: Forest Management Scenarios in Northern Minnesota. (Seminar). Purdue University/North Carolina State University Summer Field Tour. July 2012. Portland, OR.

- Scheller, R. M., **M. J. Duveneck**, M. White. Scenarios of alternative forest management under climate change scenarios in the northern Great Lakes. (Seminar). Minnesota Climate Change Response Framework Workshop. July 2012. Grand Rapids, MN.

- **Duveneck, M. J.,** R. M. Scheller, M. White, S. Handler, C. Swantson. Assisted Migration for Climate Change Adaptation: Forest Management Scenarios in Northern Minnesota. (Invited Presentation). International Association of Landscape Ecology Meeting. April 2012. Newport, RI.

- White, M., **M. J. Duveneck**, and R. M. Scheller. Forest Restoration and Biodiversity Conservation in a Changing Climate. (Prepared presentation for seminar). Adaptive Management In the Face of Climate Change Workshop. February 2012. Cloquet, MN.

- Scheller, R. M., **M. J. Duveneck**, M. White, S. Handler, C. Swanston. Scenarios of alternative forest management under climate change scenarios in the northern Great Lakes. (Webinar). Upper Midwest and Great Lakes Landscape Conservation Cooperative Project Sub-topic Meeting. January 2012. East Lansing, MI.

- **Duveneck, M. J**. and R. M. Scheller. Assisted migration for climate change adaptation. (Poster). LANDIS-II Conference. January 2012. Madison, WI.

- White, M., R. M. Scheller, **M. J. Duveneck**. Understanding Climate Change in Northeastern Minnesota. (Webinar). September 2011. Minnesota Science Team Meeting.

- Scheller, R. M. , J. Thompson, M. White, C. Ravenscroft, **M. J. Duveneck**, D. Mladenoff. Tree species migration in Wisconsin, Minnesota, and Massachusetts: A model comparison of potential limiting factors under climate change. (Prepared presentation for seminar) Ecological Society of America 96th Annual Meeting. August 2011. Austin, TX.

- Carr, T, **M. J Duveneck**, and L. West. Service learning as a tool for civic engagement. (Seminar). Maine Community College System Dirigo Institute. June 2006. New Harbor, ME.

- **Duveneck, M. J**. Characterizing canopy fuels as they affect fire behavior of pitch pine (*Pinus rigida*). (Seminar). Maine Forest Service-Regional Forest Ranger Meeting. November 2005. Gray, ME.

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Appendix 3: Letters of Support

United States Department of Agriculture

Natural Resources Conservation Service
Massachusetts State Office, 451 West Street, Amherst, MA 01002
413-253-4350 | fax 855-596-7666 | www.ma.nrcs.usda.gov

November 18, 2024

Re: Regenerative Design Group Ecosystem Carbon Baseline Sampling Proposal

To Whom It May Concern:

I am writing to acknowledge that as a soil scientist with USDA NRCS Soil and Plant Science Division working on soil carbon monitoring, I will serve in an advisory capacity to the Ecosystem Carbon Baseline Sampling Planning Project proposed by the Regenerative Design Group to provide guidance on the development of ecosystem carbon sampling protocols.

Sincerely,

MARGOT PAYNE Digitally signed by MARGOT PAYNE
Date: 2024.11.18 08:04:18 -05'00'

Maggie Payne
National Coordinator for Project Management
Soil Carbon Monitoring Network | Soil and Plant Science Division

USDA Natural Resources Conservation Service
U.S. DEPARTMENT OF AGRICULTURE

Amherst State Office
451 West Street, Suite 1
Amherst, MA 01002

November 18, 2024

Re: Regenerative Design Group Ecosystem Carbon Baseline Sampling Proposal

To Whom It May Concern:

I am writing to acknowledge that as Acting NRCS State Soil Scientist for Massachusetts, I will serve in an advisory capacity to the Ecosystem Carbon Baseline Sampling Planning Project proposed by the Regenerative Design Group to provide guidance on the development of ecosystem carbon sampling protocols.

Sincerely,

DAVID ZIMMERMANN Digitally signed by DAVID ZIMMERMANN
Date: 2024.11.18 09:07:02 -05'00'

Dave Zimmermann
Acting State Soil Scientist, USDA-NRCS

HARVARD UNIVERSITY
HARVARD FOREST

324 NORTH MAIN STREET
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FAX 978•724•3595
HTTP://HARVARDFOREST.FAS.HARVARD.EDU

November 17, 2024

Tom Anderson
Massachusetts Executive Office of Energy and Environmental Affairs
100 Cambridge Street, 10th Floor
Boston, MA 02114

Dear Tom Anderson,

I am writing to express my support for Regenerative Design Group's (RDG) proposal to develop **HSAP Ecosystem Carbon Sampling Protocols** as a response to the Challenge Grants Implementing the Commonwealth's Healthy Soils Action Plan (HSAP) Round 2.

This project will address gaps in our understanding of landscape carbon values and their measurement. Understanding existing carbon stocks is key to being able to value that carbon and understand the impacts of landscape change on carbon stocks and soil health.

I wholeheartedly endorse Regenerative Design Group's application for the Healthy Soils Challenge Grant and believe that this project will significantly contribute to the objectives set forth in the HSAP. If further information or clarification is required, please do not hesitate to contact me.

Thank you for considering this letter of support.

Sincerely,

Sincerely,

Jonathan R. Thompson
Research Director & Senior Ecologist
Lead PI: Harvard Forest LTER Program

1 Chevalier Avenue
Greenfield, MA 01301
info@regenerativedesigngroup.com
(413) 658-7048

Draft Revised: November 19, 2024