VERMONT

Agency of Natural Resources



PROPOSAL FOR SERVICES

Development of a Spatial Municipal Vulnerability Index

Response to RFP

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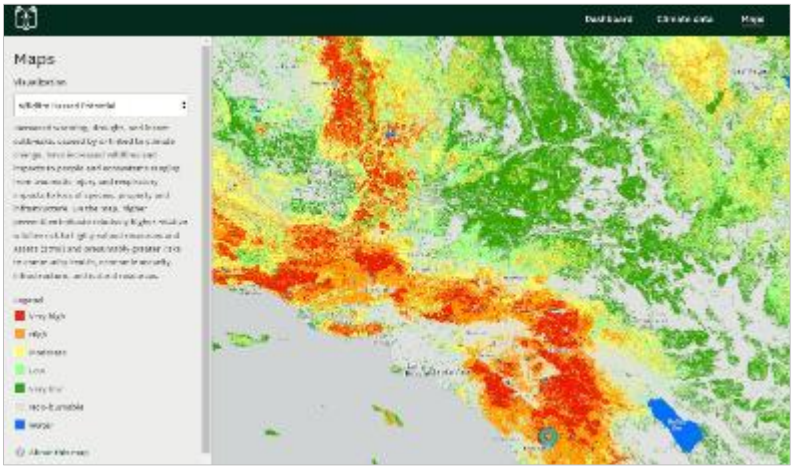
Executive Summary



Azavea is pleased to present our proposal to develop a public-facing Municipal Vulnerability Index tool for the Vermont Agency of Natural Resources that will enable Vermont municipalities to assess their vulnerability to climate change impacts. Azavea is a Philadelphia-based small business that designs and develops award-winning geospatial software, with a strong focus on projects that support climate resilience. Our clients include a number of public sector organizations at the local, regional, state, or federal levels, as well as commercial, academic, nonprofit, and multilateral organizations. Azavea brings many aggregate decades of specialized software design and development, interactive mapping, and research coordination skills to this project. We have the demonstrated ability to build a compelling, easy-to-use municipal vulnerability assessment solution that will support future planning and resource allocation activities throughout Vermont, with particular focus on rural and hard-to-reach communities.

Why Azavea?

Azavea is a purpose-driven, mission-oriented company founded on the principles of public service, innovation, and impact. We are particularly qualified for this project for the following reasons:



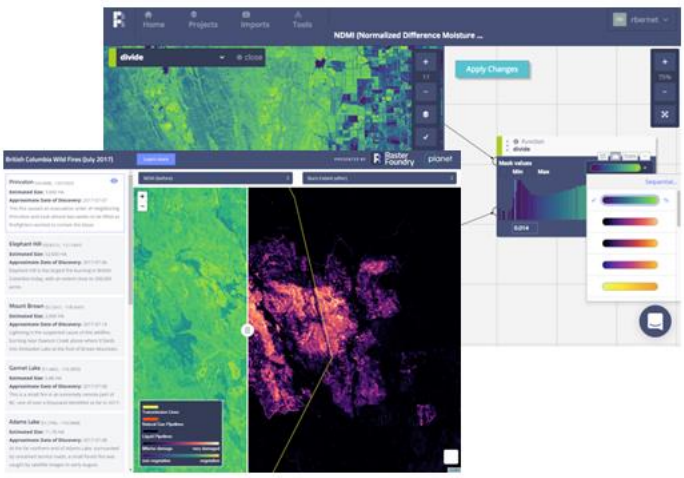
- **Azavea is a pre-qualified State of Vermont Contractor (36973)** on the CPS IT Retainer Contract for Enterprise GIS Services.
- **We have a long history building successful ecological resilience projects**, including climate adaptation planning software, community forestry solutions, ecosystems monitoring tools, conservation prioritization tools, and watershed modeling applications.

- **We have extensive experience developing and enhancing interactive, data-driven mapping solutions** with intuitive user workflows that engage the public.
- **Azavea has a strong background preparing reports** and other documentation to support our clients' needs.

We are pleased to present our qualifications and relevant projects in the pages of this proposal.

Qualifications of the Project Team

Azavea was organized in 2000 to create technologically advanced solutions for geospatial data visualization and analysis. We are a certified B Corporation, a commercial enterprise that operates with a social mission. Our mission is to advance the state of the art in geospatial technology and apply it for civic, social, and environmental impact. Our services include:



- Software engineering
- User experience (UX) design
- Machine Learning and Computer Vision
- Big geospatial data processing
- Data analysis and visualization
- Research and development

The firm provides these services to a growing group of domestic and international organizations. Our team includes software engineers, user experience (UX) designers, GIS analysts, data scientists, project managers, writers, product specialists, and administrative support. These talented people have experience building tools for a broad array of domains, including: climate resilience, water resources, urban ecosystems, and remote sensing.

For the Spatial Municipal Vulnerability Index project, day-to-day workload will be managed by the following individuals. Their roles for this project and two examples of relevant past project experience are briefly summarized in the table below.

Name and Title	Project Team Role	Representative Project Experience
Niki LaGrone, Project Manager	▪ Primary Point of Contact ▪ Oversees Project Activities	▪ World Bank Tree Canopy Modeling ▪ Satellite Imagery Report
Derek Dohler, Senior Software Engineer	▪ Application Development ▪ Documentation	▪ Temperate Climate Vulnerability Tool ▪ Wildfire Risk to Communities
Klaas Hoekema, Software Engineer	▪ Application Development ▪ Documentation	▪ Temperate Climate Vulnerability Tool ▪ Wildfire Risk to Communities
Daniel McGlone, Senior GIS Analyst	▪ Background Research ▪ Define MVI Framework	▪ Trail Health Benefits Analysis Report ▪ Children's Health and Wellbeing Report
Philipp Schmitt, User Experience Designer	▪ Background Research ▪ Define MVI Framework	▪ Lake George Lake Protector ▪ Fieldscope

Brief biosketches for these individuals are provided below, and descriptions of their past projects are included in the "Experience with Climate Vulnerability Tools" and "Capacity to Accomplish the Work" sections of this proposal. While we anticipate that the continuity of our proposed team members will extend through the duration of the project, skills from additional software engineering, User Experience Design, and other Azavea teams may also be integrated when necessary.

Niki LaGrone, Project Manager

Niki LaGrone is Project Manager for the Geospatial Applications Team at Azavea, where she oversees projects focused on climate resilience, water resource management, and sustainable transportation. Her recent projects have included assuming the role of project manager for Headwaters Economics' Wildfire Risk to Communities application, supporting tree canopy mapping for the World Bank, and hydrography feature extraction for a large prime government contractor. She previously provided research coordination for Azavea's GroundWork geospatial imagery annotation solution and Azavea's Cicero district matching and legislator lookup tool. Niki has a Master's of Art in French Literature from the University of Pennsylvania and a Bachelor of Arts in French, Theater, from the University of California, Berkeley. Prior to joining Azavea, Niki had most recently worked providing archival support while studying Library and Information Science. She also spent seven years teaching French at a Philadelphia high school, and led student trips to France, Spain, and Costa Rica.

Derek Dohler, Senior Software Engineer

Derek Dohler is a Senior Software Engineer on Azavea's Geospatial Applications Team, with more than ten years of experience building civic software applications. His recent projects include a Small Business Innovation Research (SBIR) project for the U.S. Department of Agriculture to enhance the Temperate climate adaptation planning application with new features specific to rural and tribal communities, and the Headwaters Economics Wildfire Risk to Communities application, which is intended to deepen the understanding of wildfire risks and inform community decision-makers. Derek has a Juris Doctor from the University of Chicago Law School and a Bachelor of Science in Computer Science from Washington University. Prior to joining Azavea, Derek was head of the web development team at the Georgian chapter of Transparency International, where he oversaw the development of web applications designed to promote government transparency in Georgia.

Klaas Hoekema, Software Engineer

Klaas Hoekema is a Software Engineer on Azavea's Geospatial Applications Team. He brings more than fifteen years of experience to a range of web applications that support sustainable cities and transportation. His recent projects include a Headwaters Economics wildfire risk management solution that enables communities across the United States to understand and respond to wildfire risk, adding new features to the Temperate climate vulnerability assessment solution to support

rural and tribal communities, and a web application for PeopleForBikes that scores bicycle network connectivity. Klaas has a Bachelor of Science in Physics and Computer Science and a Bachelor of Arts in Philosophy from Calvin College. Prior to Azavea, Klaas worked for Solutions for Progress, where he developed web applications to provide the low-income population with free and straightforward tax filing and connect them with the public benefits to which they are entitled.

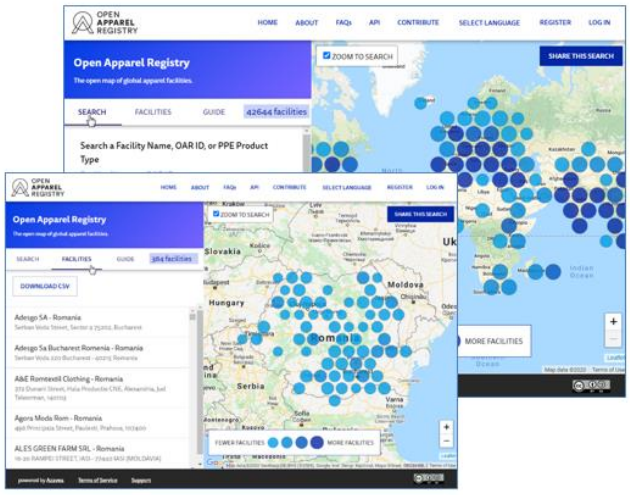
Daniel McGlone, GISP, Senior GIS Analyst

Daniel McGlone is a certified GIS Professional (GISP) and Senior GIS Analyst at Azavea, where he applies more than twelve years of experience maintaining and providing analysis on GIS databases in the public and private sector. He is also Product Manager for the DistrictBuilder collaborative legislative redistricting solution. His recent projects have included a series of Trail Health Benefits Maps and a report for the Delaware and Lehigh Heritage Corridor, a report on children's health and wellbeing disparities in Philadelphia, and interactive mapping and data collection tools for the Inter-American Development Bank and Asian Development Bank that support Guyana and Mongolia, respectively. Daniel has a Master of Urban Spatial Analytics from the University of Pennsylvania and a Bachelor of Science in Geography and Geospatial Imaging from Harrisburg University. He is a certified GIS Professional (GISP) by the GIS Certification Institute (GISCI). Prior to his work at Azavea, Daniel served as a GIS Intern for the Delaware Valley Regional Planning Authority.

Philipp Schmitt, User Experience Designer

Philipp Schmitt is a User Experience Designer at Azavea, where he works alongside software development teams to design interfaces and information for client applications and company products. His recent projects include designs for the Lake George Lake Protector application and the Fieldscope citizen science platform. He has a strong background with Figma, Sketch, Adobe Creative Suite, Git, JavaScript, Python, Arduino, PHP, MySQL, scikit-learn, and PyTorch. He has worked as a designer and creative technologist on various emerging technology projects for academic labs and corporate innovation teams. Philipp has a Bachelor of Arts in Interaction Design from the University of Design Schwäbisch Gmünd in Germany, and a Master's of Fine Arts in Design and Technology from The New School at Parsons School of Design. Before he joined Azavea, Philipp was an Artist-Researcher in a Machine Learning Research Group at New York University, and his artistic work has been shown in museums around the world.

Approach to Completing the Work



The RFP for the Spatial Municipal Vulnerability Index outlines an iterative approach to design and development, with each task informing the others in order to meet evolving client and stakeholder needs. Azavea wholeheartedly agrees with this approach, and it is well-aligned with our client-driven development practices. From an initial discovery phase through design, testing, and development, we stay focused on the highest priority use cases and project goals as we build our clients' applications. This leads to solutions that are customized to user needs, fitting neatly into their existing workflows and expectations, and enabling development to focus on the essentials first.

In short, Azavea's approach to geospatial software engineering is to develop compelling visual experiences and easy-to-understand workflows that will engage and delight our clients and to reduce the cost of future development work by iterating at the design phase.

Design: Azavea employs an iterative, user-centered design process that incorporates stakeholder feedback at every stage. We begin with a discovery phase that clarifies project goals and produces an analysis of the needs, expectations, and existing practices of the intended audiences. We then work with the client to interpret our discovery findings and turn them into a strategic vision for the proposed application. This becomes the foundation for a design phase where we determine key workflows, screens, and interactive components represented through rounds of low-fidelity wireframes and high-fidelity, on-brand mockups. Once designs are finalized, we begin iterative development of the application.

Development: Azavea follows Agile development practices, enabling us to build better, more useful tools by making room for changes in direction and priority as applications are implemented and put to use. To provide the flexibility needed to course correct along the way, we focus first on producing MVPs based on the core requirements identified in design phases, providing useful tools early on and a foundation to add features and complexity that are found to be beneficial over time. We rely on automated tools and standardized review processes to catch errors and deliver consistent, high-quality code. Furthermore, we employ continuous integration and iterative staging deployments to allow clients to review progress as it is made. This works to shorten feedback cycles, heading off wasted effort and providing more opportunities to test, all helping to produce higher quality, more resilient applications that prove valuable to users.

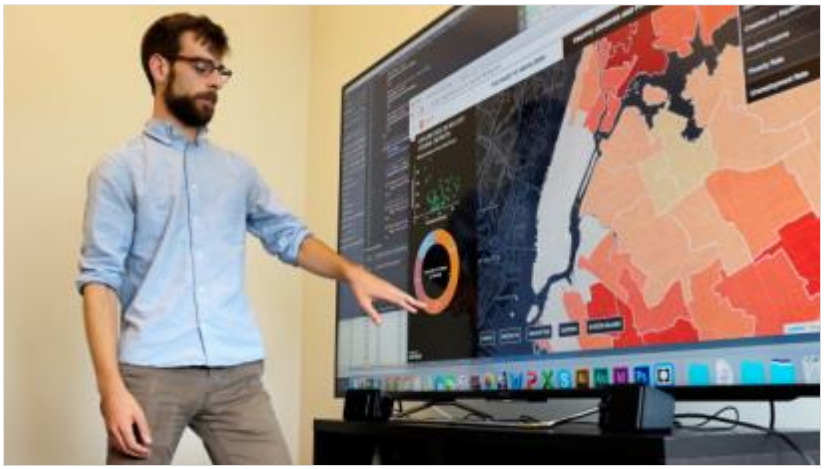
Work Plan

Task 0: Project Management

The Azavea team will meet with the GWSA Director, ANR staff, and other key project partners as necessary for a remote kickoff to review the project work plan, including roles and responsibilities, deliverables, and the schedule for the project's completion. A final work plan will be delivered to the GWSA Director with the understanding that it can be modified in response to changing conditions if mutually agreed upon.

Thereafter, Azavea will meet remotely with the GWSA Director twice monthly to review interim deliverables, discuss tasks underway, identify key decision points, determine what presentations are necessary, and adjust the timeline as necessary. We will also meet remotely with ANR staff and members of the Vermont Climate Council twice monthly to share progress updates and gather feedback.

Task 1: Background Research



Azavea will conduct background research involving the GWSA Director, ANR staff, and other project stakeholders to ensure that we have a grounded understanding of the nuances of the project, context, and target audience. Following a human-centered design approach, we will review existing tools, facilitate a stakeholder workshop, conduct and synthesize user interviews, and convey our findings in a report. These research efforts will directly inform Tasks 2 and 3, resulting in a thoughtful, well-considered approach.

Review of Existing Tools: We will evaluate existing tools that are similar to what is envisioned for the MVI. This will include a review of work completed by the states of Maine and California, Green Mountain Power, and the Vermont Department of Health, as well as tools developed by Vermont's Transportation, Commerce and Community Development, and Natural Resources Agencies. We will also evaluate four to six additional climate change vulnerability index models. This research will inform the Findings Report in which Azavea will document a summary of each tool's data sources, features, as well as advantages and disadvantages. We will also use this research to determine best practices and the state-of-the-art in municipal vulnerability indices, which will be used to define the methodology for the MVI.

Stakeholder Workshop: We will hold two remote, quarter-day workshops with ANR staff and other project stakeholders to:

- Understand the problem we will be attempting to address
- Learn about the MVI's background
- Establish goals for the MVI
- Think strategically about key users to target
- Explore data availability

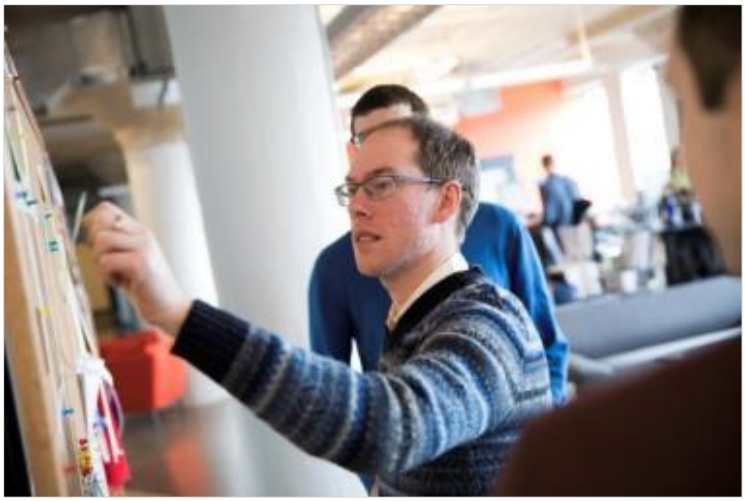
The workshop will accommodate up to ten attendees representing key project stakeholders. We will rely on the GWSA Director to generate a list of participants and help with scheduling the workshops.

User Interviews: We will conduct interviews with up to ten people who represent the tool's target audience. An Azavea designer, project manager, and/or software engineer will hold these hour-long discussions with individual users to gather firsthand information on the needs, expectations, and abilities that might affect how they interact with the application. Azavea will rely on the GWSA Director to identify participants and provide email introductions; Azavea will coordinate dates and times for the interviews.

Findings Report: The findings from the existing tool review, stakeholder workshops, and user interviews will be used to develop a summary report for the MVI. It will include an analysis of observations and patterns of user needs, expectations, and current behaviors organized under the personas established in the stakeholder workshop. We will deliver a draft report to the project partners and incorporate feedback into a subsequent final report.

Task 2: Defining the Framework, Factors, & Method

Guided by the findings gathered under Task 1, Azavea, in collaboration with the GWSA Director, will establish a working framework for the MVI that states the purpose of the tool, outlines supporting goals, defines methodology, and lays out a high-level plan for maintaining the tool over time. This framework will also contain designs for the tool, which will be developed through an iterative process informed by feedback from the project team and result in low-fidelity wireframe designs and high-fidelity mockups.



Framework Generation: Azavea designers will create the framework with collaborative input from the GWSA Director. The framework will include the statement of purpose, goals and objectives, methodology, and maintenance plan for the tool.

Wireframes: Azavea designers will develop wireframe designs depicting the site's layout, navigation, and workflows in a barebones style akin to sketches. These will provide an opportunity to cement the basic components of the site before diving into the visual details. Azavea will review up to three iterations of wireframes with an opportunity for the project team to gather feedback in between.

Mockups: Azavea designers will also create visual designs of key screens that communicate the site's overall look and feel, including the application of ANR's branding, colors, typography, and iconography. Azavea will review up to two iterations of mockups with an opportunity for the project team to gather feedback in between.

Methodology: Azavea's Senior GIS Analyst will draft a methodology to calculate the MVI, using research from Task 1. This methodology will incorporate feedback from the Findings Report, define the metrics and data used as inputs in the score and generate an MVI score for each municipality in Vermont. This methodology will be presented to the GWSA Director, ANR staff, and the Vermont Climate Council for feedback.

Framework, Factors, and Methods Document and Presentation: The framework document and design assets will be presented to GWSA Director, ANR staff, and the Vermont Climate Council, and shared via a cloud-based repository and/or as PDFs. It will incorporate feedback and comments given throughout.

Task 3: Develop the MVI Tool



Azavea will start preparing for implementation of the MVI tool, or application, during Task 1. The engineer assigned as the technical lead for the project will sit in on a subset of client and stakeholder meetings, and will work with the designer and researcher to ensure that the proposed features can be implemented within the time and budget allotted for development. The technical lead may also conduct independent research on technical matters that would affect the tool's design (e.g., the availability of data sources in particular formats).

As Task 2 draws to a close, the technical lead will collaborate with other engineers to design a technical architecture for the tool that supports the features to be included. Our technology

decisions involve a range of factors that include user needs and use cases, existing client infrastructures and capabilities, and performance, among other things.

For this application specifically, we currently expect that the desired functionality can be provided by a static site. Static sites usually have lower setup, hosting, and maintenance costs than dynamic architectures, but are best suited for situations where the data does not change frequently and no user-generated information needs to be permanently stored. Our budget estimates reflect these assumptions.

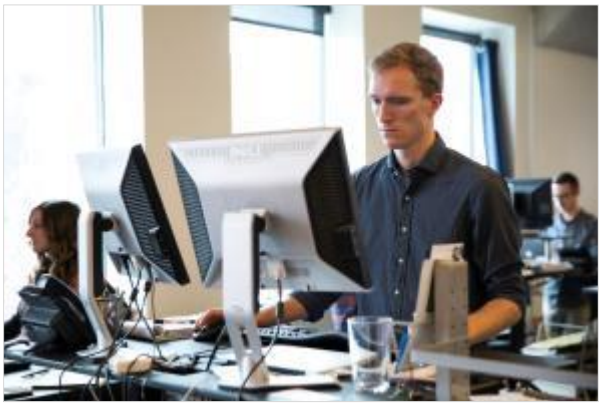
If we discover during Task 1 that either or both of those assumptions are not true, then we may need to choose another architecture. If this increases development costs beyond the proposed budget, then we may need to adjust other aspects of the project scope or budget.

Preferred Technologies

Although we work with a variety of technologies, we make an effort to use open-source software whenever possible, and we will default to using the following if there are no overriding constraints which motivate us to make different choices:

- Amazon Web Services for the cloud hosting provider
- PostgreSQL with the PostGIS geospatial extension for the database (we do not expect that this component will be necessary for this project).
- Python with Django for the dynamic application / API layer (we do not expect that this component will be necessary for this project).
- React for the frontend, often with Typescript and the Redux state management library
- MapLibre / Mapbox GL JS for web mapping

We want to emphasize that these technologies are just our defaults; we have experience with, and use, a wide range of technologies, but we have found that these tools maximize our productivity while maintaining our ability to implement customized application features.



Azavea assumes that we will operate the infrastructure for the MVI tool (including the staging deployment) within an AWS account owned by the Agency of Natural Resources, and that ANR will be responsible for hosting costs. The total hosting cost will depend on the architecture chosen, but in general, annual costs for static sites tend to be under $100; if we are not able to use a static architecture, then annual hosting costs can range from a few hundred to a few thousand dollars for sites of similar scope. We should discuss any hard limits on hosting costs or requirements for different hosting arrangements as

early as possible, so that the architecture can be designed to accommodate. If no special circumstances exist, we will use our best judgment to select an architecture that provides a good balance between cost and site performance. We will advise ANR on the use of AWS best practices, such as instance reservations, to minimize hosting costs for the application.

Development Practices

Once development begins in earnest, our standard practice is to employ continuous integration and iterative deployments to a staging environment while an application is under development. This means that every change an engineer makes to the MVI tool will be automatically checked for certain types of errors, and then deployed into a staging environment that will be accessible to project staff and stakeholders. This will enable ANR and its project partners to immediately review changes as they are made, which can shorten feedback cycles and manage costs by reducing the potential for wasted effort and catching bugs before they can make it to production. We divide our work into two-week "sprints," with a subset of the final functionality delivered to the staging environment at the end of each sprint. During the course of development, the project manager and technical lead will meet with project staff on a regular basis to demonstrate progress and confirm the direction of development over the next sprint or two. This pattern will continue until the Task 3 scope has been implemented and the MVI tool is ready to be deployed to the public-facing production environment.

Production Deployment

The processes that we developed at the beginning of the project to support continuous integration and deployment to a staging environment will generally apply to production deployments as well. This keeps the deployments to the public-facing site straightforward and mostly automatic. We will coordinate with ANR project staff to choose a deployment date, and will then release the application to production at the agreed-upon time.



Task 4: Documentation & Final Report

At the completion of the project, Azavea will prepare a final report that includes an easy-to-understand general audience user guide, as well as documentation on data sources, data processing methods, and recommendations for maintaining the tool over time. The report will contain the relative MVI score for all Vermont municipalities along with five to seven more detailed examples of municipalities from around the state that illustrate the extent of the MVI. A draft report and presentation will be delivered to ANR staff with feedback incorporated into a subsequent final report and presentation to the Vermont Climate Council.

Assumptions

Azavea's scope of work and budget are based on the following assumptions:

- Both the Agency of Natural Resources and Azavea will provide a primary point of contact in order to facilitate clear communication. This point of contact may designate an alternative when travel, vacation or other circumstances prevent the main point of contact from being available.
- Azavea builds software solutions for use with contemporary web browsers, and we assume that users are equipped with the most recent version of Google Chrome, Microsoft Edge Chromium, Mozilla Firefox, or Safari. While some functionality may be usable on mobile phones, the budget does not include time to test and adapt all features of the application for mobile devices.
- The scope does not include support for user accounts or authentication.
- The Agency of Natural Resources will provide timely feedback on interim results. Delays in feedback of more than three business days may extend the delivery deadline.
- The Agency of Natural Resources will make commercially reasonable efforts to provide timely response to requests for clarification and additional information.
- The accuracy, completeness, and compatibility of the data available will be subject to the original data creators.
- Unless expressly prohibited through a separate agreement, Azavea may request to use your Agency's name and logo to identify you as a user of the Services once the contract is signed. Azavea's use of your name and logo does not create any ownership right therein and all rights not granted to Azavea are reserved by you.

Timeline

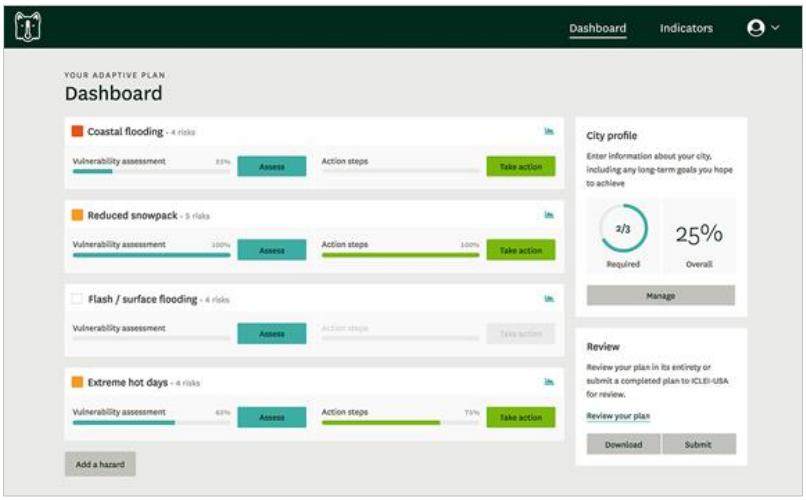
Azavea will perform the work outlined above over a six-month timeline, commencing with the signing of the agreement and ending in February 2023. This timeline assumes a September 2022 start date; if the start date is pushed beyond then, Azavea reserves the right to reconsider the proposed timeline based on our availability.

	Months					
Project Tasks	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**
Task 0: Project Management						
Task 1: Background Research						
Task 2: Defining the Framework, Factors, Method						
Task 3: Develop the MVI Tool						
Task 4: Documentation and Final Report						

Experience with Climate Vulnerability Tools

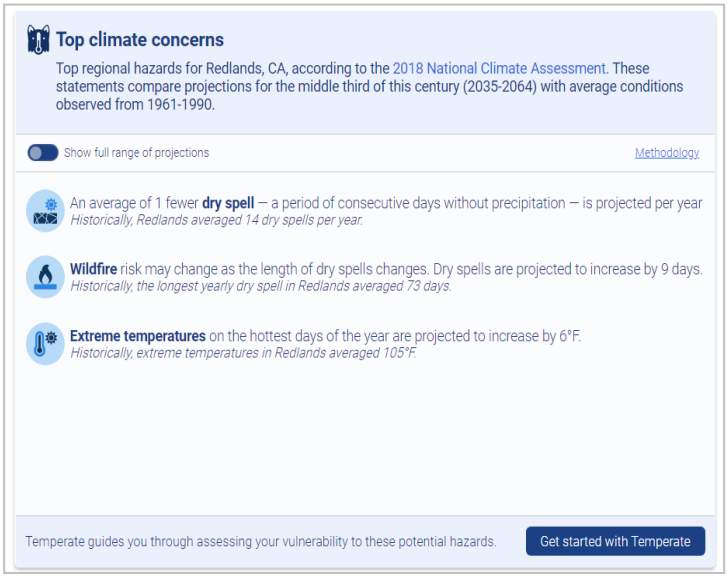
Much of Azavea's environmental work is focused on climate change and the impact it has on diverse global communities. To that end, many of our web applications were designed to help decision-makers identify and implement climate resilience practices that will benefit the populations they serve.

Temperate Climate Adaptation Planning



With funding from the Small Business Innovation Research (SBIR) program at the **U.S. Department of Energy**, Azavea developed a dashboard that takes the complexity out of planning for climate change. **Temperate** guides users step-by-step through the process of creating climate vulnerability assessments that are customized to their geographic locations and relevant risks. In addition to vulnerability assessments, Temperate provides access to hundreds of existing climate change adaptation strategies that are currently being used around the country. It also offers expert support from our partners at **ICLEI-USA**. Additional SBIR funding from the **U.S. Department of Agriculture** enabled us to **enhance Temperate with additional data and maps to meet the needs of rural and tribal communities**.

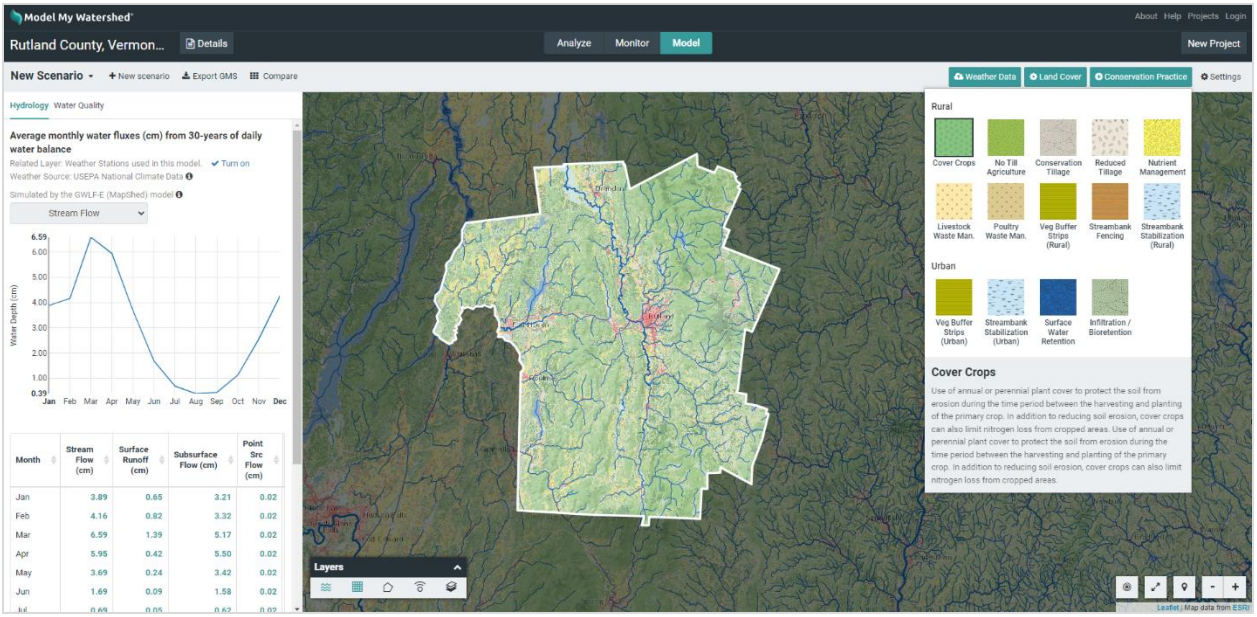
With funding from the NOAA Climate Program Office, Azavea embedded Temperate's "Top Hazards" feature into the national Climate Explorer, an application in the U.S. Climate Resilience Toolkit that was developed by the National Environmental Modeling and Analysis Center (NEMAC) at the University of North Carolina, Asheville and maintained by NEMAC's partner organization, FernLeaf Interactive. This feature enables Climate Explorer users to display the top regional climate hazards for cities nationwide and provides a link to Temperate to support climate vulnerability assessments. Climate



Explorer is the featured tool of the Climate Resilience Toolkit and is utilized heavily by communities nationwide. **Derek Dohler and Klaas Hoekema contributed to Temperate.**

Model My Watershed

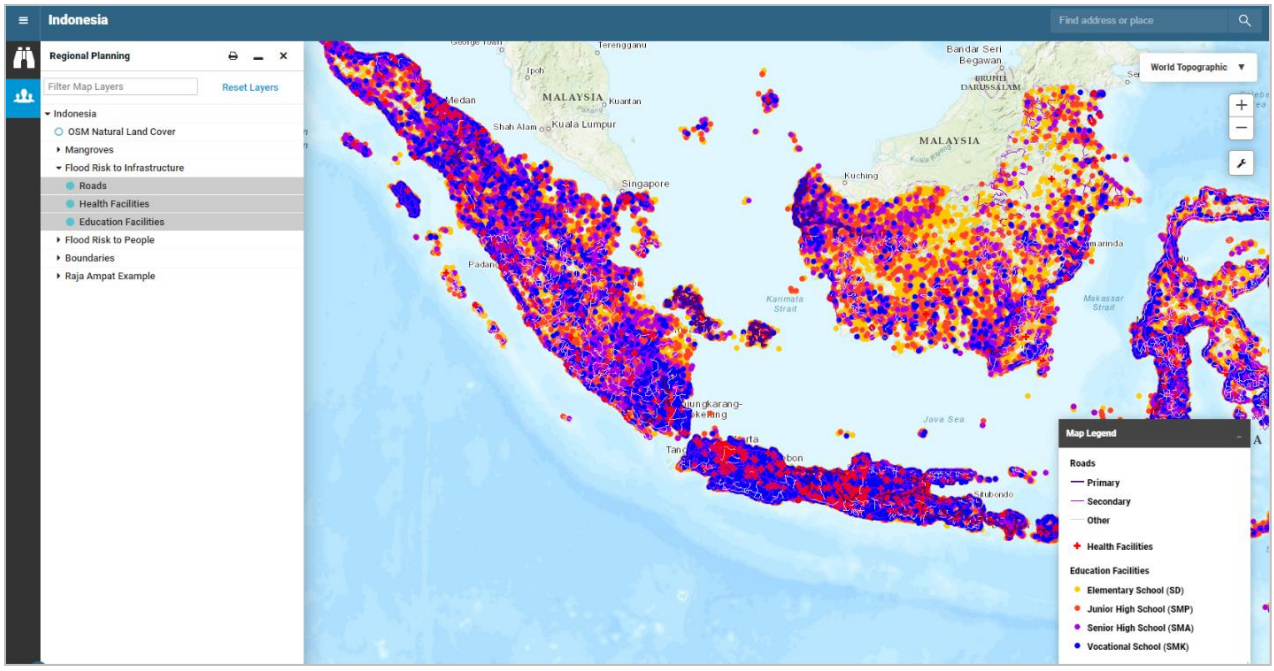
In an effort to advance the knowledge and stewardship of clean, healthy, and resilient watersheds, Azavea has been working with the **Stroud Water Research Center** over the past several years to build and enhance [Model My Watershed], **an easy-to-use, professional-grade stormwater runoff and water quality modeling package that informs land-use decisions, supports resilience practices, and enhances watershed education throughout the United States.** With just a few mouse clicks, users are able to select a geographic extent, analyze real land use and soil data, model stormwater runoff and water-quality impacts, and compare how different conservation or development scenarios can modify runoff and improve water quality for everyone. Multiple rounds of user research and testing informed each stage of application development. Together with Stroud and its partners, we used the results to enhance the effectiveness of the data visualizations in Model My Watershed, improve the associated curricular materials, and redesign the user experience for use on tablet devices. We also extended the impact of the application from Southeastern Pennsylvania to include the entire conterminous United States. **Rutland County, Vermont is shown in the example below.**



Coastal Resilience

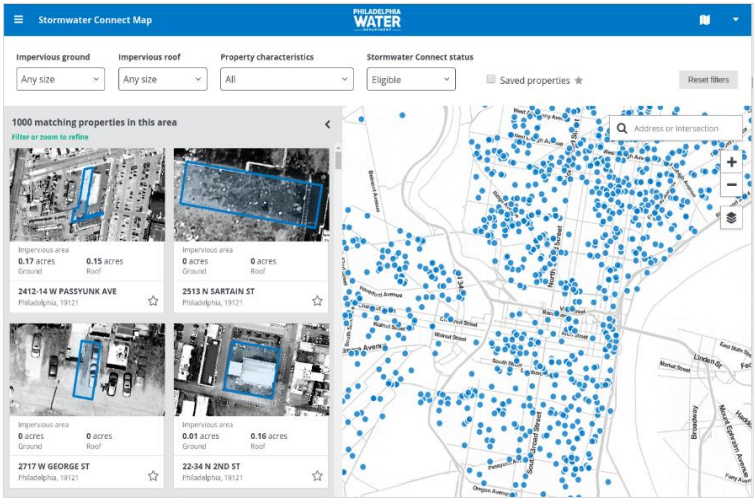
Azavea has also worked with **The Nature Conservancy** on their **Coastal Resilience** program, an effort to explore nature's role in reducing the risks of coastal flooding that are often exacerbated by climate change. In order to provide support for this program, Azavea developed a web-based suite of [Coastal Resilience tools] that includes data visualization, search, measurement, and reporting features, as well as a responsive design that enables the site to be accessed on tablet

devices. This interactive suite of tools, which has already won awards from the United Nations and others, enables users to **examine storm surge, sea level rise, natural resources, and economic assets**. They can create a **map of social vulnerability** and even explore the impact of sea level rise on critical facilities, including hospitals, schools, and airports. Coastal Resilience also enables users to develop risk reduction and restoration strategies specific to their communities using the information derived from the application. Azavea developed the open-source Coastal Resilience web framework as a comprehensive resource for many individual applications produced by Azavea and other developers that support coastal areas in the United States, Australia, Mexico, the Caribbean, Indonesia, and Central America.



Stormwater Billing Program

In Azavea's home city of Philadelphia, Green City, Clean Waters is the Philadelphia Water Department's 25-year plan to transform the health of the City's creeks and rivers, primarily through a land-based approach. By implementing **green stormwater infrastructure projects**, such as green roofs and stormwater planters, the City can **reduce water pollution impacts while improving essential natural resources and making local neighborhoods more beautiful and**



resilient. Azavea has worked with the **Philadelphia Water Department** for more than a decade to develop **multiple public and internal applications** to support these goals. Each application consists of a user interface built on top of the City of Philadelphia's server infrastructure, enabling information sharing between city departments whose legacy systems did not easily communicate. The **Philadelphia Parcel Viewer** application was developed first to support a stormwater billing approach that relates a property's burden on the sewer system directly to its stormwater charge by using the property's impervious surface cover as the basis for the fee. The **Credits Explorer** application enables property owners to test environmentally friendly stormwater strategies, such as green roofs and rain gardens, to assess the impact on their stormwater bills, while the **Stormwater Connect** application will support implementation of green infrastructure improvements by connecting interested property owners with potential vendors.

Lake George Lake Protector

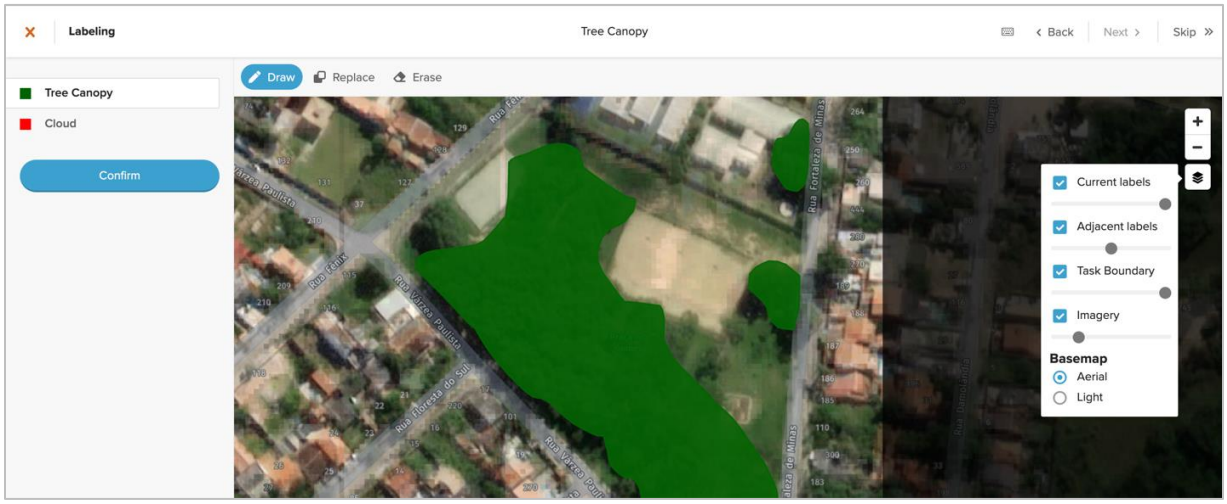


Azavea has partnered with the Lake George Association in their efforts to safeguard Lake George in Upstate New York through a science-guided, partner-driven model of freshwater protection. In 2021, they launched the "Lake Protector" program that encourages property owners, businesses, and organizations across the Lake George watershed to address the greatest threats to the lake's water quality: stormwater and wastewater pollution, invasive species, and excessive winter road salt use. Azavea is helping to increase participation in the Lake Protector program by designing a web application that shows property owners how their properties are contributing to Lake George's water quality issues and tracks their progress in mitigating it. We are currently engaged in the discovery process that will enable the Lake George Association to better understand the needs and expectations of the Lake George watershed property owners that will be using the application in the future. The user experience designs developed during this process will help guide future application development. **Philipp Schmitt is contributing to this ongoing project.**

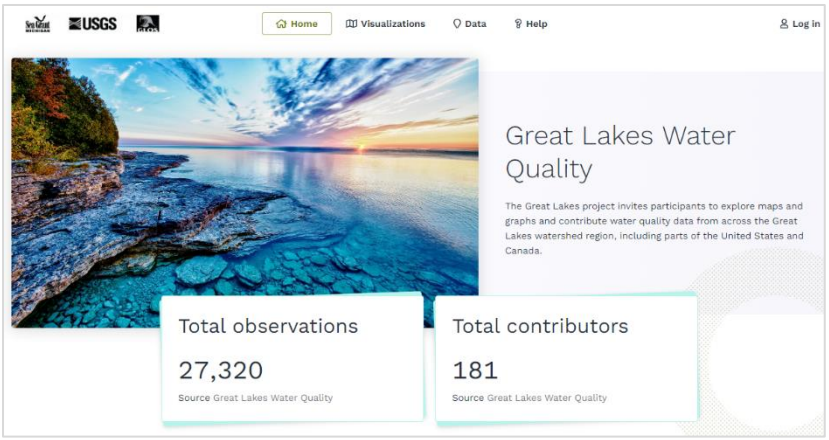
Tree Canopy Extent

Another important part of climate resilience is a healthy tree canopy, especially in urban communities. Healthy street trees slow the accumulation of greenhouse gases, intercept stormwater runoff, improve air quality, reduce noise levels and surface temperatures, create wildlife habitat, and provide shade and windbreak that reduce business and household energy consumption. In an effort to measure the extent of the tree canopy in African cities, Azavea

recently completed a World Bank project to develop and implement a machine learning algorithm to detect urban tree canopy in satellite imagery, beginning with a dual pilot project in Dar es Salaam, Tanzania, and Freetown, Sierra Leone. Rather than generating the training data to predict tree canopy coverage ourselves, Azavea provided capacity-building support for Tanzanian students from Turku University as they generated the training data using the GroundWork annotation tool. The goal was to enable these students to learn advanced digital skills that can help lead to future work prospects, while generating helpful environmental data that an assist with future planning efforts. **Niki LaGrone contributed to this project.**



Fieldscope



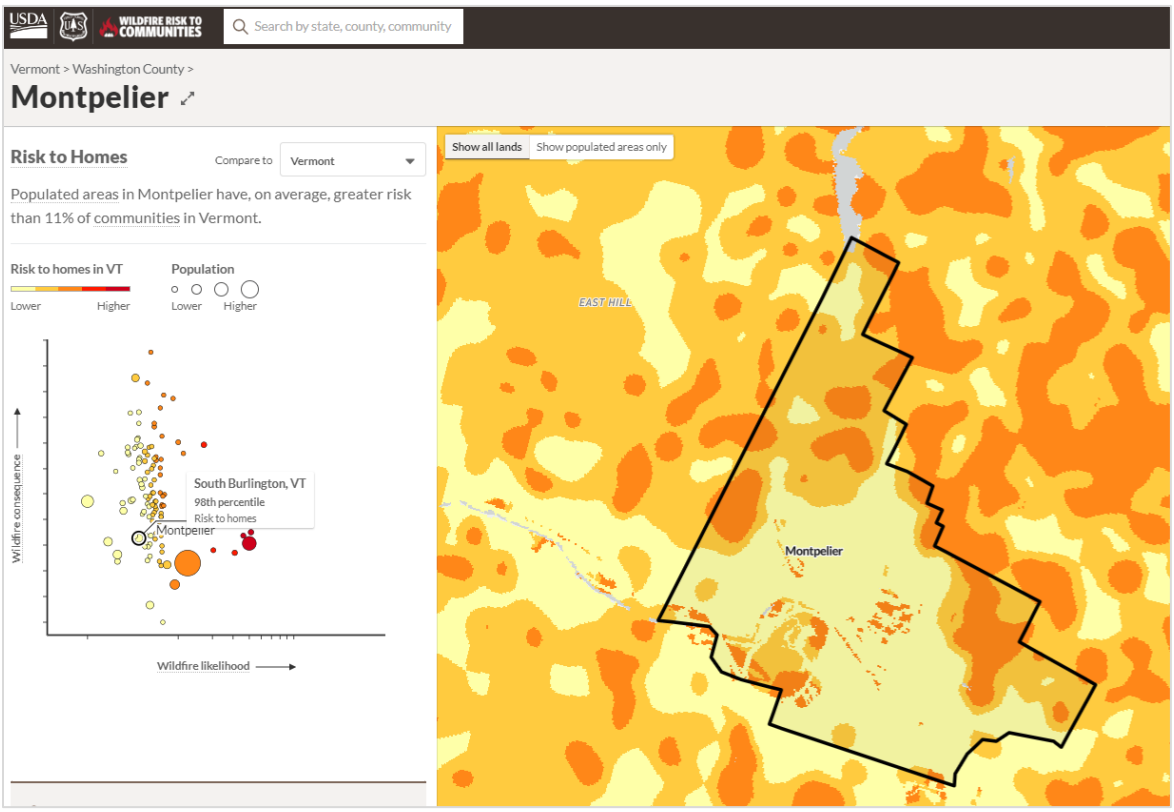
Many citizens want to engage in projects that will support climate resilience in their communities, and the Fieldscope citizen science platform is a great place to start. Azavea is currently supporting a multi-year modernization of **Fieldscope** to make it even more useful and intuitive for its growing user community. Originally developed by the National Geographic Society, Fieldscope is now an engaging interactive platform supported by **BSCS Science Learning** that includes projects ranging from FrogWatch and Budburst to Citizens Restoring American Chestnuts. Climate resilience projects include the Great Lakes project, which invites participants to explore and contribute water quality data across the Great Lakes watershed, and Soil Testing USA, a nationwide effort to monitor soil safety and health data. By providing a platform for field study, Fieldscope enables researchers, educators, scientists,

and students to advance their understanding of the world and become active participants in the scientific process. **Philipp Schmitt is contributing to this ongoing project.**

Wildfire Risk to Communities

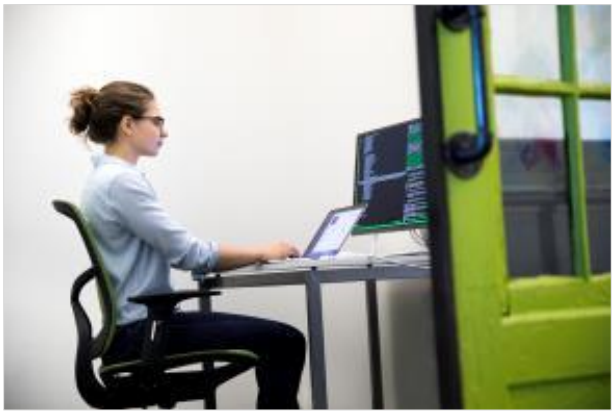
Climate change is also impacting the risk, extent, and severity of wildfires in many areas of the United States. In response to new federal regulations requiring the U.S. Forest Service to publish wildfire hazard severity maps, the Forest Service contracted with **Headwaters Economics**, an independent, nonprofit research group focused on better land management, to develop a web application to disseminate national wildfire hazard data produced by the Rocky Mountain Research Station. The **Wildfire Risk to Communities** application is intended to **deepen the understanding of wildfire risks in communities** and ultimately inform decision-makers in the development of plans to manage and mitigate those risks. Headwater Economics selected Azavea to assist with design, user testing, and development of this mobile responsive web application, marking the first time that maps and data about community wildfire risk have been made available nationwide. Azavea designed the application for use by a lay audience of local government staff, elected officials, fire management personnel, and community partners. It uses 30-meter raster data representing characteristics of wildfire hazards, vector data sets delineating political and geographic boundaries, and tabular data for community-level risk management. **Derek Dohler and Klaas Hoekema are contributing to this ongoing project.**

Montpelier, Vermont is shown in the example below.



Capacity to Accomplish the Work

1. Availability of Azavea's Project Team



Based on the project schedule outlined in the RFP, we currently anticipate that the Azavea staff members listed in our proposal will be available to complete the Spatial Municipal Vulnerability Index project as described in our work plan. If availability unexpectedly changes, we have a deep bench of software engineers, user experience designers, project managers, and other key personnel with similar experience and credentials that we can draw from in order to complete the work in a timely fashion. Our firm has successfully managed hundreds of concurrent projects over the years using a system of client-driven project management and reporting procedures that enable the firm to accelerate our software design and development process; effectively share knowledge; discover impediments early; and create high-quality software solutions that will meet or exceed the current and future needs of our clients. These include a system of weekly project management meetings; daily and bi-weekly team meetings; and an online source control service used for managing issues, milestones, and other project status information.

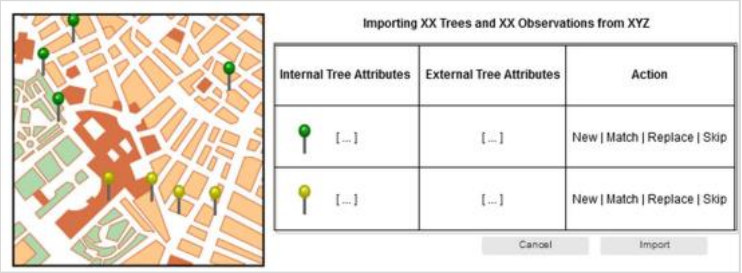
To ensure project coordination, Azavea will meet with the Agency's project team every two weeks following the Kickoff Meeting to gather feedback and provide status updates. Performing our design and development work in short, two-week "sprints" enables us to respond to our clients' evolving needs in a timely and effective manner, while continuing to keep projects moving forward.

In short, while the firm is large enough to have a deep bench of software engineers with the necessary skills to take on a broad range of geospatial projects, it is also small enough to move rapidly and adapt to changing client needs.

2. Report Writing Experience

Azavea has proven experience presenting complex technical and other issues to both technical and non-technical users. We have prepared a broad range of white papers and research reports, software release documentation, user manuals, training webinars, user guides, product demonstrations, and many other materials to suit a diversity of needs and skillsets. A few examples are briefly outlined below, and links to each report are provided to enable Agency staff to take a closer look at the completed documents.

Data Management for Urban Tree Monitoring



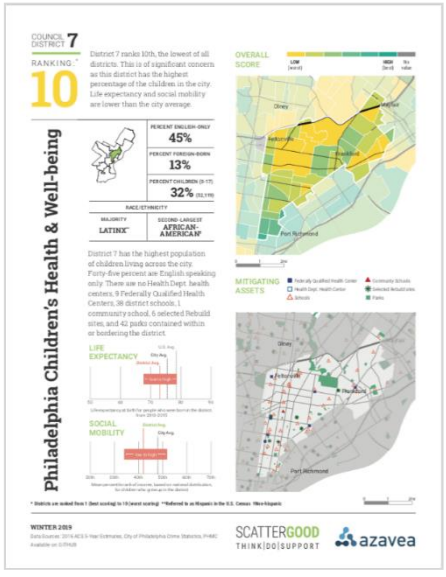
Working in partnership with the Pennsylvania Horticultural Society (PHS) and the USDA Forest Service Philadelphia Field Station, Azavea prepared a data management report that explores how technology can be used to support the long-term systematic monitoring of urban trees, assist with tree planting and maintenance data processes, and enable data to be organized and shared. Similar to the proposed report for the Agency of Natural Resources, this document provides an overview of existing software solutions and makes recommendations for key features that would enable data to be organized and shared between researchers and practitioners.

Finding Satellite Imagery



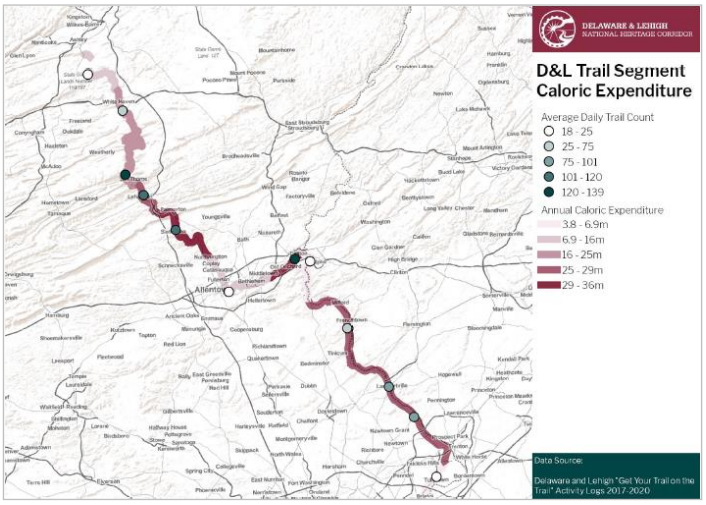
At Azavea, we help our clients use machine learning and satellite imagery to map places all over the world. Since many of our clients have questions about where to find the right imagery to meet their project needs, we put together a report on satellite imagery that includes an analysis of various providers, a decision-support tool, insider tips, and suggestions based on our experience. The report builds on information originally provided in one of our blog posts. **Niki LaGrone contributed to this report.**

Philadelphia Children's Health and Wellbeing



The Thomas Scattergood Behavioral Health Foundation is a Quaker-based, philanthropic organization that seeks to challenge, disrupt, and change how behavioral health is envisioned, organized, and practiced in the Philadelphia region and beyond. Azavea partnered with them to create a report focused on children's health across Philadelphia. We ranked each of Philadelphia's ten city council districts by combining both assets and risks using primarily open data. We used geospatial mapping and analysis to demonstrate the connection between adverse childhood experiences (ACEs), physical health, mental health, and geographic location within the city of Philadelphia. The research discovered there is a twenty-year difference in average life expectancy in different parts of the city. The analysis will be used to support a roadmap for Philadelphia to build upon existing assets and help address inequities. **Daniel McGlone contributed to this report.**

Trail Health Benefits and Data Analysis



The Delaware and Lehigh National Heritage Corridor (D&L), a national heritage area in five counties in Eastern Pennsylvania from Luzerne to Bucks County, selected Azavea to perform data analysis, mapping, and report generation to demonstrate the health benefits of trail access. The Trail Health Benefits Analysis report uses data analysis performed by Azavea to calculate health benefits, statistical summaries, and breakdowns by different categorizations of data from the organization's "Get Your Tail On the Trail" (GYTOT) health incentive program. **Daniel McGlone contributed to this report.**

These and additional reports prepared by Azavea can be found at: azavea.com/reports/

Cost Proposal

1. Task-Based Budget

The following budget estimate is based on Azavea's FY23 billing rates, which are in effect until June 30, 2023, and reflects our standard government discount of 10%. Payment terms will be extended on a Net 30 basis.

Initial Implementation Tasks	Amount ($)	Gov't Discount ($)	Total ($)
Task 0: Project Management	17,698	(1,770)	15,928
Task 1: Background Research	35,018	(3,502)	31,516
Task 2: Defining the Framework, Factors, Method	35,852	(3,585)	32,267
Task 3: Develop the MVI Tool	99,360	(9,936)	89,424
Task 4: Documentation and Final Report	8,724	(872)	7,852
Labor Total	**$ 196,652**	**$ (19,665)**	**$ 176,987**
Other Costs			
Travel[1]	--	--	--
Hosting[2]	--	--	--
Materials[3]	--	--	--
Other Total			**--**
Total			**$ 176,987**

1. Assumes all work will be performed remotely.
2. Assumes hosting costs will be undertaken by the client using the client's AWS account.
3. Assumes initial development focus will be on no-cost, publicly available datasets.

2. Labor Summary

The total number of hours by labor category/role are provided below for each task. Please note that the hours shown under Software Engineer will be divided among the two engineers assigned to this project.

Project Tasks	Sr. GIS Analyst	UX Designer	Software Engineer	Project Manager
Task 0: Project Management	18	18	17	27
Task 1: Background Research	54	58	18	19
Task 2: Defining the Framework, Factors, Method	51	74	6	18
Task 3: Develop the MVI Tool	5	25	337	43
Task 4: Documentation and Final Report	10	10	10	8
Total Hours	**138**	**185**	**388**	**115**

3. Labor Rates

The following labor rates are in effect at Azavea from project commencement through June 30, 2023. Azavea's 10% government discount rate applies. Software engineering will be provided at the Software Engineer III rate for both the Software Engineer and Senior Software Engineer assigned to this project. The Project Manager II, Senior UX Designer, and Senior GIS Analyst rates will also apply.

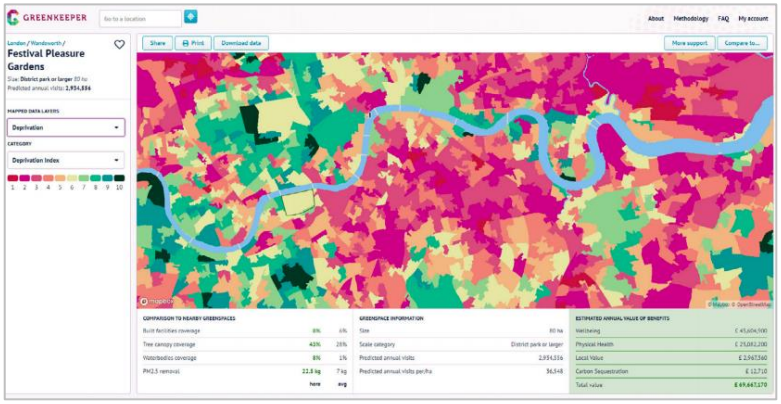
Job Categories	FY2023 Commercial Rate	FY2023 Gov/Org/ Edu Rate
Project Director	324.00	291.60
Senior Project Manager	248.00	223.20
Project Manager II	220.00	198.00
Project Manager I (Niki LaGrone)	**178.00**	**160.20**
Principal Software Engineer	344.00	309.60
Senior Software Engineer	296.00	266.40
Software Engineer III (Derek Dohler / Klaas Hoekema)	**248.00**	**223.20**
Software Engineer II	218.00	196.20
Software Engineer I	176.00	158.40
Senior Data Scientist	234.00	210.60

Data Scientist	188.00	169.20
Senior UX Designer (Philipp Schmitt)	**286.00**	**257.40**
UX Designer III	244.00	219.60
UX Designer II	206.00	185.40
UX Designer I	172.00	154.80
Senior GIS Analyst (Daniel McGlone)	**196.00**	**176.40**
GIS Analyst III	164.00	147.60
GIS Analyst II	132.00	118.80
GIS Analyst I	98.00	88.20
Senior Business Analyst	208.00	187.20
Business Analyst III	192.00	172.80
Business Analyst II	156.00	140.40
Business Analyst I	116.00	104.40
Senior Software Tester	146.00	131.40
Software Tester	86.00	77.40
Technical Writer/Admin II	194.00	174.60
Administrative Support I	144.00	129.60
Data Entry Clerk	58.00	52.20

More About Azavea

1. Qualifications and Capabilities

As a purpose-driven, mission-oriented company, Azavea is proud of our ability to leverage the power of business to effect positive impact on our community and our world through our products and services. The firm has particular expertise creating interactive geospatial applications that bring together multiple data sources to support high quality and visually attractive workflows that effect a greater understanding of climate resilience by users with a broad range of needs and skillsets.



Technology and Partners

Azavea's developers work with a broad range of tools and have particularly strong backgrounds with the Python, Django, .Net, Java, and Scala frameworks. The firm has also established a number of strategic partnerships to enhance our capabilities.

Azavea is an Esri Business Partner and has extensive experience with development and deployment on the ArcGIS platform. Azavea was named ESRI Business Partner-of-the-Year or Foundation Partner-of-the-Year in 2006, 2007 and 2010.

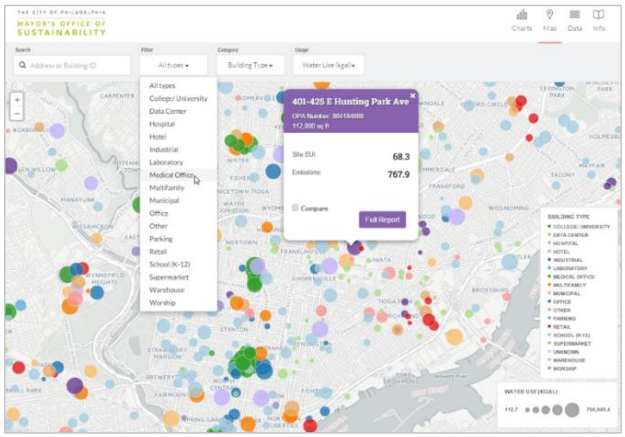
Azavea is also an authorized CARTO partner and has experience implementing solutions using the CARTO infrastructure. In addition, we have a strong background working with Mapbox and Google Maps.

Azavea is a member of the Amazon Partner Network and part of the Public Sector partner program, which recognizes partners with solutions and experience in supporting government, education, and nonprofit customer missions around the world. It also provides us with a higher level of support for the products and services we host in the Amazon Web Services environment.

Azavea staff is experienced creating web software solutions that use online API's such as CARTO, MapBox, Google Maps, ArcGIS Online, and OpenStreetMap. The firm also works with a range of open source tools that accelerate and lower the cost of our software development work. In particular, Azavea has a great deal of experience with creating solutions that bring together the

strengths of both commercial and open source toolkits to create high quality and visually attractive applications. The firm not only has experience with open source solutions, but also contributes to them, including significant contributions to PostGIS, JTS, PDAL, and GDAL. In addition Azavea maintains and supports several significant open source projects, including: GeoTrellis, DistrictBuilder, and OpenTreeMap.

User Experience (UX) Design



Azavea takes great pride in the development of user interfaces that are simple, easy-to-use and are crafted for the specific purpose at hand. Our talented developers and designers work with each client to develop visualizations and applications that are not only functional - they are simple and beautiful.

Commitment to Community

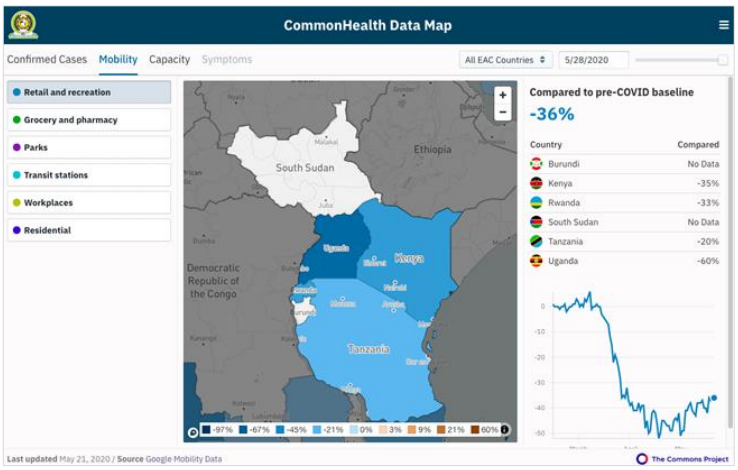
Azavea is committed to working on projects with potential for positive civic, social, and environmental impact. Each of our projects, products and pro bono engagements showcases this commitment. We seek out projects that enhance communities, foster economic development and improve decision-making.

Azavea R&D and Learning Program



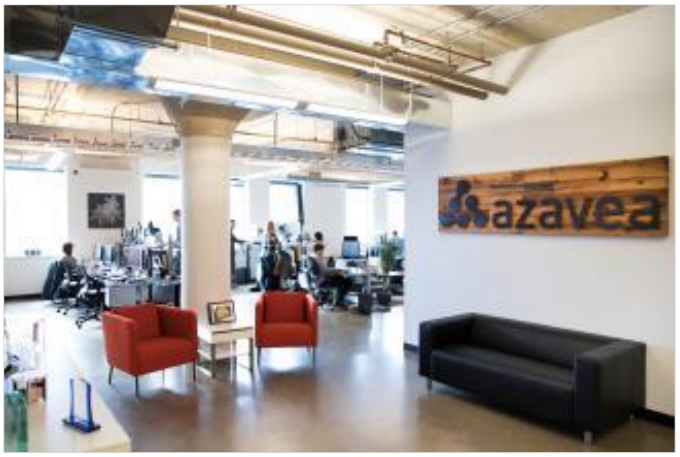
Azavea has an active research and development program through which the firm invests substantial resources toward the development of new solutions and techniques as well as the professional development of our staff. Each employee is encouraged to develop research and learning projects that will both engage the employee and extend the capabilities of the organization. Current research projects include: developing geospatial processing libraries in Python; using Spark to accelerate spatial-temporal data processing; mapping trees from Google Street View to accelerate urban street tree data collection; computer vision and machine learning; and developing a library for working with space-filling curves. While not all of these research projects results in measurable commercial success, they are an important part of a culture at Azavea that encourages and takes pride in innovative applications of geospatial technology.

As an alternative to a research project, Azavea staff can use their 10% time for professional development activities that include attending conferences, training classes, webinars, and workshops. Some of our software developers have also used their time to participate in code sprints or hackathons that help them learn new programming languages or create open source solutions that benefit local communities, including a number of projects focused on the global response to COVID-19.



2. Azavea's Environmental Policy

Azavea's mission is based on the idea that technology can have a positive impact on individuals, our society, and the planet. This beautiful planet has finite resources and centuries of poor management has led us to the brink of catastrophic breakdown of its systems. Azavea sees an urgent need to pursue client projects and embrace environmental sustainability practices that provide the potential to bring about critical change.



As a certified B Corporation, we undergo a rigorous scoring process conducted by B Lab that evaluates the organization for its environmental impact, corporate structure, employment policies, community impact, and mission focus. The certification must be renewed every three years. Azavea has gone through multiple certifications since 2017, and our B Corporation status represents a cornerstone in the firm's operating approach.

Azavea measures and tracks our energy usage and estimates our annual greenhouse gas generation. We encourage our employees to use public transit for commuting and reimburse employees for their public transit costs up to the maximum amount allowed by the federal government. Even on business trips outside Philadelphia, employees are asked to use public transit options whenever possible. We also encourage the use of remote client meetings or training options if on-site travel is not required.



In addition to public transit, Azavea encourages its employees to use bicycles as an alternative to private vehicles and will similarly reimburse them for doing so. We provide bike parking, lockers, changing rooms, and showers to encourage these responsible commuting practices and significantly reduce the firm's carbon footprint on the community.

Azavea's commuting policy extends to its supply acquisition as well. Azavea seeks to do business with local suppliers whenever possible as a means of reducing its environmental footprint and supporting other companies with green commuting practices. The firm also uses a bicycle-based courier service for local package pick-up and delivery.

Finally, our Cicero product team is proudly contributing to emerging carbon removal technologies through the use of Stripe Climate to service our credit card customers. After spending more than $1 million on carbon credits last year, Stripe Climate now enables firms like Azavea to help support efforts by committing a portion of our customer credit card revenue to this important initiative.

3. Past Performance

Azavea has an excellent record of past performance and successful relationships with our clients. Perhaps the most important demonstration of this is the growing number of public and private sector organizations that have worked with our firm across multiple projects and succeeding years. Representatives from these organizations recently contributed to a Past Performance Evaluation completed by Dun and Bradstreet, which ranked Azavea in the top percentile of customer satisfaction in comparison to its peers. The firm was rated on factors ranging from reliability and responsiveness to customer support and timeliness, receiving an overall score of 96 out of 100. We look forward to the opportunity to provide a similar level of service to the Vermont Agency of Natural Resources.

Appendix: Certificate of Compliance

Azavea's signed Certificate of Compliance follows this page.

CERTIFICATE OF COMPLIANCE

For a bid to be considered valid, this form must be completed in its entirety, executed by a duly authorized representative of the bidder, and submitted as part of the response to the proposal.

A. **NON COLLUSION:** Bidder hereby certifies that the prices quoted have been arrived at without collusion and that no prior information concerning these prices has been received from or given to a competitive company. If there is sufficient evidence to warrant investigation of the bid/contract process by the Office of the Attorney General, bidder understands that this paragraph might be used as a basis for litigation.

B. **CONTRACT TERMS:** Bidder hereby acknowledges that is has read, understands and agrees to the terms of this RFP, including Attachment C: Standard State Contract Provisions, and any other contract attachments included with this RFP.

C. **FORM OF PAYMENT:** Does Bidder accept the Visa Purchasing Card as a form of payment?

_X_ Yes ____ No (Azavea supports Visa Purchasing Card via Stripe or PayPal. For payments over $2,000, a 3% surcharge is added to the invoice).

D. **WORKER CLASSIFICATION COMPLIANCE REQUIREMENT:** In accordance with Section 32 of The Vermont Recovery and Reinvestment Act of 2009 (Act No. 54), the following provisions and requirements apply to Bidder when the amount of its bid exceeds $250,000.00.

Self-Reporting. Bidder hereby self-reports the following information relating to past violations, convictions, suspensions, and any other information related to past performance relative to coding and classification of workers, that occurred in the previous 12 months.

Summary of Detailed Information	Date of Notification	Outcome
N/A		

Subcontractor Reporting. Bidder hereby acknowledges and agrees that if it is a successful bidder, prior to execution of any contract resulting from this RFP, Bidder will provide to the State a list of all proposed subcontractors and subcontractors' subcontractors, together with the identity of those subcontractors' workers compensation insurance providers, and additional required or requested information, as applicable, in accordance with Section 32 of The Vermont Recovery and Reinvestment Act of 2009 (Act No. 54), and Bidder will provide any update of such list to the State as additional subcontractors are hired. Bidder further acknowledges and agrees that the failure to submit subcontractor reporting in accordance with Section 32 of The Vermont Recovery and Reinvestment Act of 2009 (Act No. 54) will constitute non-compliance and may result in cancellation of contract and/or restriction from bidding on future state contracts.

E. **Executive Order 05 – 16: Climate Change Considerations in State Procurements Certification**

Bidder certifies to the following (Bidder may attach any desired explanation or substantiation. Please also note that Bidder may be asked to provide documentation for any applicable claims):

1. Bidder owns, leases or utilizes, for business purposes, space that has received:
   - ❑ Energy Star® Certification
   - ❑ LEED®, Green Globes®, or Living Buildings Challenge℠ Certification
   - ❑ Other internationally recognized building certification:

_____

2. Bidder has received incentives or rebates from an Energy Efficiency Utility or Energy Efficiency Program in the last five years for energy efficient improvements made at bidder's place of business. Please explain:

_____

3. Please Check all that apply:
   - ❑ Bidder can claim on-site renewable power or anaerobic-digester power ("cow-power"). Or bidder consumes renewable electricity through voluntary purchase or offset, provided no such claimed power can be double-claimed by another party.
   - ❑ Bidder uses renewable biomass or bio-fuel for the purposes of thermal (heat) energy at its place of business.
   - ❑ Bidder's heating system has modern, high-efficiency units (boilers, furnaces, stoves, etc.), having reduced emissions of particulate matter and other air pollutants.
   - ☑ Bidder tracks its energy consumption and harmful greenhouse gas emissions. What tool is used to do this? Philadelphia Green Business Commitment GHG Calculator (part of our B Corp Certification process).
   - ❑ Bidder promotes the use of plug-in electric vehicles by providing electric vehicle charging, electric fleet vehicles, preferred parking, designated parking, purchase or lease incentives, etc..
   - ❑ Bidder offers employees an option for a fossil fuel divestment retirement account.
   - ❑ Bidder offers products or services that reduce waste, conserve water, or promote energy efficiency and conservation. Please explain:

_____

_____

4. Please list any additional practices that promote clean energy and take action to address climate change:

As a certified B Corporation since 2010, Azavea undergoes a rigorous scoring process conducted by B Lab that evaluates organizations for environmental impact, corporate structure, employment policies, community impact, and mission focus. We have consistently scored well. We offer public transit and biking reimbursement plans for our employees, as well as bike parking, lockers, changing rooms, and showers for our planet-friendly bikers to encourage environmentally responsible commuting practices. We encourage non-local work-related travel to be completed by train/public transit when possible. We also support remote work, meeting, and training options. In addition, we buy locally to reduce our carbon footprint, we select green utility options, we use a composting program for waste disposal, and a bicycle-based courier option for local pickups and deliveries. We also use Stripe Climate to service our credit card customers using our Cicero product, which enables us to contribute to emerging carbon renewal technologies.

F. Acknowledge receipt of the following Addenda:

Addendum No.: Q&A (1)	Dated: 2 June 2021
Addendum No.: Q&A (2)	Dated: 2 June 2021
Addendum No.:	Dated:

Bidder Name: Azavea Contact Name: Robert Cheetham

Address: 990 Spring Garden Street, 5th Floor Fax Number: 215-925-2663

Philadelphia, PA 19123 Telephone: 215-701-7713

E-Mail: cheetham@azavea.com

By: _____ 23 June 2022 Name: Robert Cheetham, President

Signature of Bidder (or Representative) (Type or Print)

END OF CERTIFICATE OF COMPLIANCE