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*Synthesis*

# Joining collective impact and community science: a framework for core collaborative community science

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ABSTRACT. We propose the core collaborative community science framework, an original conceptual framework that integrates and modifies best practices from community science and collective impact groups to support investigations of environmental health and justice. The core collaborative community science framework differs from more typical frameworks for community science, which often frame projects as static and either scientist or community led; these framings can limit the potential for co-production and action-oriented models of science. Frameworks are lacking to help community science collaborators determine the contributions and leadership needed to initiate, sustain, and link together multiple projects that jointly support local learning and action, as well as contribute to broader scientific knowledge of complex social-ecological systems. The core collaborative community science framework offers three main innovations and contributions: (1) It invests in a core collaborative group structure, designed to increase community capacity and resilience through an expanded network of partners dedicated to the reduction of systematic inequities and injustices; (2) It seeds and supports multiple, diverse research projects implemented across complex social-ecological systems, focusing first on community-identified needs, and then on the questions community science can help answer; and (3) It facilitates dynamic shared responsibilities and leadership for partners from community, research, and government institutions, recognizing the need for shared contributions at all project phases. We offer examples from the Green Duwamish Learning Landscape in Washington, USA to show how project partners have coordinated their work focused on social, ecological, and human health and navigated challenges related to funding, staffing, and governance. We share insights on how to help integrate community science within the social fabric of communities, especially those faced with environmental health and justice challenges.

Key Words: *collaboration; collective impact; community science; environmental health; environmental justice; equity*

## INTRODUCTION

The "participatory turn" in science stems from demands for science to be more responsive, accessible, and in the service of societal needs (Bäckstrand 2003, Strasser et al. 2019). In recent years, there has been a proliferation of literature about when, why, and how scientists work collaboratively with local organizations and residents (English et al. 2018, Cordner et al. 2019, Charles et al. 2020). Although researchers have documented outcomes of community science for participants and scientific knowledge, fewer have examined outcomes for communities more broadly, and studies are lacking that examine how community science is used by decision makers to influence social and ecological change (Conrad and Hilchey 2011, Stepenuck and Green 2015). Furthermore, consciousness has risen in the scientific community in recent years about embedded and emergent power dynamics in relationships among community science partners, and the risk of "extractive" or "transactional" relationships (Shirk et al. 2012, Sterling et al. 2017, Strasser et al. 2019).

The collaborative science literature describes many approaches, each with a distinct history and lineage, disciplinary roots, and interconnections with other approaches (e.g., Bäckstrand 2003, Shirk et al. 2012, English et al. 2018, Strasser et al. 2019, Charles et al. 2020). The use of "civic" and "community" science terminology has become increasingly popular (as opposed to "citizen science") to be more inclusive of immigrant and Indigenous communities as research partners (Eitzel et al. 2017, Cordner et al. 2019). Here, we use the term "community science" to include all research approaches in which people who are not professional researchers collect or analyze scientific data, or participate in other parts of the scientific process, with some engagement with professional scientists. We use the term "community science collaboratives" to describe groups composed of scientific researchers, community advocates, residents, government officials, and others.

Trends in the United States show that researchers and participants engaged in community science do not generally reflect the country's demographics, and that historically underserved populations are underrepresented (Pandya 2012, Soleri et al. 2016). At the same time, low-income communities, often with larger populations of racial or ethnic minorities, bear an inequitable burden of industrial and transportation-related pollution and their resultant health and environmental disparities (Abel and White 2011, Lane et al. 2022). Although these communities may have more solidarity for collective action (Gutierrez et al. 2021) and more to gain by engaging in community science, they likely have fewer resources to support action to reduce disparities. Community science offers two ways to work toward environmental justice: through engagements that build scientific capacity among underrepresented groups in science, and through applied research activities that directly lead to improved environmental conditions (Soleri et al. 2016, Ottinger 2017).

[1]United States Department of Agriculture Forest Service, Pacific Northwest Research Station, [2]Green-Duwamish Urban Waters Federal Partnership, [3]Street Sounds Ecology, [4]City of Seattle, Office of Sustainability & Environment, [5]Duwamish Infrastructure and Restoration Training Corps, [6]University of Washington, Department of Environmental and Occupational Health Sciences, [7]King County, Water and Land Resources Division, [8]Coastal Rivers Conservation Trust (current), [9]United States Department of Agriculture Forest Service, Washington Office Business Operations

Two well-defined community science traditions are often described by community science researchers: the first is driven by scientists, and the second is driven by communities (Ottinger 2017, Charles et al. 2020). In the first tradition, researchers design and lead projects that emphasize scientific contributions, with discrete roles for volunteers. In the second tradition, sometimes called "street science," "civic technoscience," or "activism mobilizing science" (Conde 2014, Ottinger 2017, Charles et al. 2020), volunteers drive scientific questions with direct, local applications, with scientists serving in discrete technical roles. Within both traditions, questions have been raised about how community science collaboratives can navigate tensions about rights and access to data, resources, and local and traditional ecological knowledge (Conde 2014, Sterling et al. 2017). Many initiatives fall somewhere between the two traditions, and partnerships often lack frameworks that reflect the realities of shifting roles, needs for leadership and support, and different partners' motivations, goals, and areas of expertise. This lack of realistic models can create challenges for initiating projects, maintaining momentum, forging connections across related projects, and navigating multiple organizational cultures and processes.

An approach equipped to address these challenges is collective impact groups, first described by Kania and Kramer (2011). Though not typically oriented to scientific research, the approach is most applicable where there are many groups and organizations with overlapping interests within a geographic area, but no formal organizational entity that coordinates those interests, resulting in little or no collective action. Collective impact groups can be identified by five key characteristics or "conditions": (1) a common agenda, (2) shared measurement systems, (3) mutually reinforcing activities, (4) continuous communication, and (5) backbone support organizations (Kania and Kramer 2011:39–40). Collective impact introduces a tiered organizational approach in which a backbone group serves to span organizational boundaries, offering facilitation for matchmaking and convening potential project partners and coordinating interests and activities in project teams. Here, we introduce and provide examples from an original conceptual framework, informed by collective impact group processes, that can offer flexible structure to support action-oriented community science in large-scale social-ecological systems. In the two differing project examples we present from the Green Duwamish Learning Landscape, we show how the five conditions of collective impact groups can be adapted to support community science endeavors.

## CORE COLLABORATIVE COMMUNITY SCIENCE

Our core collaborative community science framework is intended to help strengthen community science collaboratives to support locally co-produced knowledge and action that is accessible, responsive, and inclusive. Our conceptual framework builds on best practices from community science and collective impact groups that are intended to support the organizational structures needed to facilitate long-term, large-scale, multi-project efforts (Fig. 1). For example, collective impact helps community science to expand and network its approach across multiple social and ecological issues. It helps bridge bottom-up and top-down interests through structures for collaborative problem identification and by ensuring actionable project designs.

In our framework, concepts from community science and collective impact groups unite to inform how the core collaborative group is convened, emphasizing values of inclusion, relevancy, and power sharing (Fig. 2). These models of collaboration inform how community members, researchers, and others engage with each other and invite others into the group to prioritize community needs, engage community expertise and networks, and identify needed disciplinary knowledge. The core collaborative group serves in a "backbone" role, working with partners to identify potential projects and funding. Initiated projects then proceed through project phases, depicted as cycles (Fig. 2), reflecting an iterative learning and evaluation process. Each community science project will have its own variation in project phases, but all begin with recruiting project teams of community members, researchers, and agency partners to design and implement projects. More than one project team may convene at once, resulting in multiple project cycles occurring in parallel or sequence.

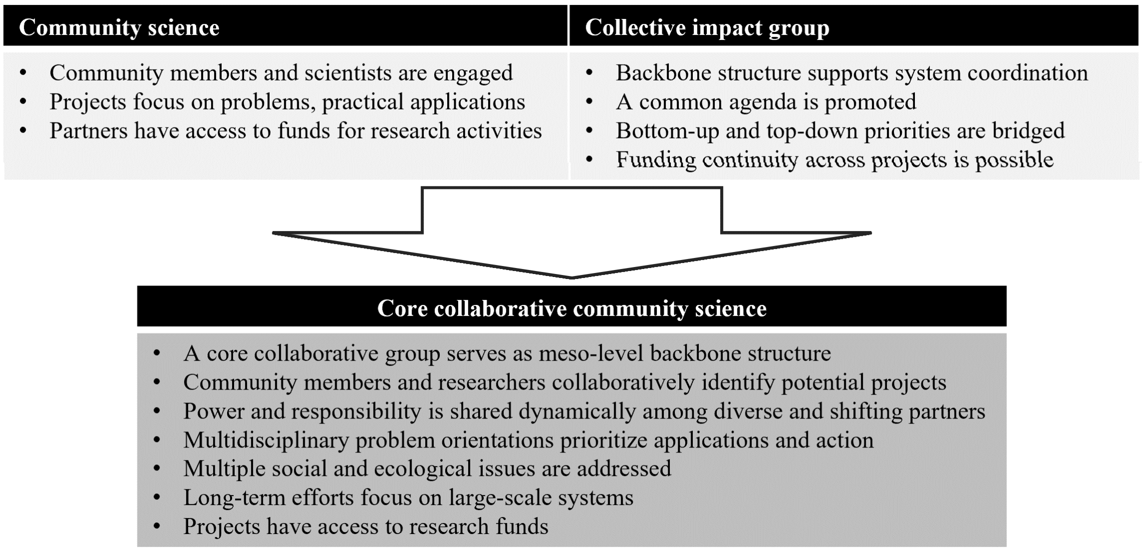
The intent is that the entire core collaborative community science process, not just specific project outcomes, will support the ability of empowered and informed communities to share power in knowledge co-production; to understand the distribution of local environmental goods, services, and hazards; to support education and activation around environmental injustices; and to improve social and ecological conditions. Throughout this process, the core collaborative group helps project teams design governance structures that support partners' various roles, responsibilities, values, commitments, and leadership. Thus, the primary role for core collaborative group members is the overarching process, although some may also participate in project teams. They extend the network of researchers and practitioners to support long-term and large-scale community science collaboration.

We next describe three key intertwined features of the core collaborative community science framework: (1) the core collaborative group; (2) multidisciplinary, social-ecological, and justice orientations; and (3) dynamic shared responsibilities and leadership throughout projects.

### Feature 1: core collaborative group

The framework hinges on the establishment of a core collaborative group that is committed to addressing multiple social and environmental issues embedded within a large-scale system. We envision the core collaborative group as a small backbone entity (e.g., three or four people) that strategically organizes project teams to address specific problems related to the common agenda. This group works across organizational boundaries, convening specialists and advocates and initiating and coordinating many potential collaborators into smaller, specialized project teams. This tiered organizational approach, i.e., a core collaborative group organizing multiple project teams, enhances traditional community science approaches. As an informal, loosely structured meso-level entity (Doyle-Capitman et al. 2018), a core collaborative group can bridge bottom-up, community-led efforts with top-down institutional efforts. The group provides an ongoing presence that helps connect diverse and evolving sets of partners and programming, communications, advocacy, and monitoring efforts. In other words, the core

**Fig. 1.** Strengths of community science and collective impact group approaches for collaborative science. The core collaborative community science framework aims to combine the strengths of both.




collaborative group supports the structures and processes for multidisciplinary relationship and trust building that are central to success in collaborative projects (Coleman and Stern 2018).

Even though many research institutions host science collaboratives that fulfill many collective impact group conditions, they rarely use this approach to forge community partnerships, likely because of potential incongruencies between research frameworks and goals and the “common agenda” condition (Flood et al. 2015). Structuring research questions focused on a common agenda requires a shift in priorities from basic scientific contributions to more applied questions, and a shift to longer term questions and monitoring rather than a single assessment or evaluation (Blahna et al. 2017). The core collaborative group can help support these shifts and ensure the applicability of results.

**Feature 2: multidisciplinary, social-ecological, and justice orientations**

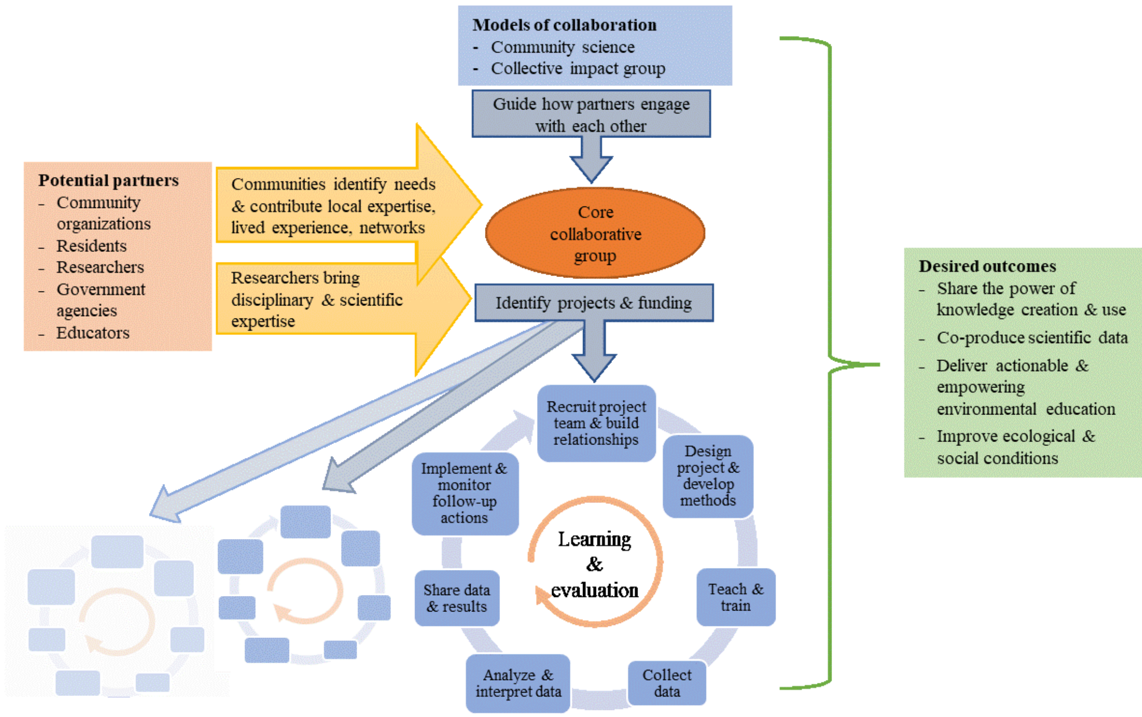
The core collaborative community science framework recognizes that planning for multiple, interacting projects, topics, and temporal and spatial scales is beyond the expertise of any individual or research unit, introducing the need to coordinate collaborators with different social, cultural, and educational backgrounds. Community science is often conducted by a single or small number of academic units or non-profit organizations in which professional scientists tend to be disciplinarily focused and interested in long-term scientific contributions (Bäckstrand 2003, Bonney et al. 2009, Strasser et al. 2019). Community needs, on the other hand, are often practical, multidisciplinary, and immediate. As an entity that can span disciplinary and organizational boundaries, a core collaborative group can work with communities to match needs with multidisciplinary project teams. Whereas most community science tools, frameworks, and evaluations relate to individual projects, collective impact group approaches encourage projects to engage with broader, interconnected systems to evaluate studies’ site-specific and larger scale implications over space and time. Recognizing persistent challenges in bridging siloed entities, our framework encourages a multidisciplinary, social-ecological systems orientation in which a core collaborative group can seek and create synergies among multiple research and monitoring projects across a geographic area, with an underlying interest in action-oriented, community-centered research.

There are concerns that both community science and collective impact group approaches inadequately or only incidentally address social and environmental injustices (which are invariably multidisciplinary and systemic in nature) by limiting the ability for authentic community engagement, shared leadership, and lasting change (Flood et al. 2015, Kania and Kramer 2015, Wolff et al. 2016; https://livingcities.org/blog/power-of-collective-action/; https://www.fsg.org/blog/advancing-practice-collective-impact/; https://nonprofitaf.com/2015/01/are-you-or-your-org-guilty-of-trickle-down-community-engagement/). Typical collective impact approaches struggle to engage in a meaningful way those who are most affected by inequities, and they rarely include policy and systems change as essential and intentional outcomes (Wolff et al. 2016). To address these concerns, the core collaborative community science framework first centers community needs and priorities. It then uses collective impact principles to help identify, seed, and facilitate multiple, diverse research projects. In this way, the core collaborative community science framework seeks to help partners change these dynamics in power, equity, and justice, and actively enhance communities’ ownership and leadership in projects.

**Feature 3: dynamic shared responsibilities and leadership throughout projects**

Our core collaborative community science framework encourages recognition and planning for project team members to shift and share responsibilities over the course of a project, which is not typically described in community science collaborative frameworks. In the community science literature, we identified

**Fig. 2.** Diagram of core collaborative community science concepts, processes, partners, and desired outcomes. The core collaborative group (center) serves in a "backbone" role. Initiated projects proceed through project phases, depicted as cycles (bottom), and multiple projects may occur in parallel or sequence.




two general types of framework that describe community science collaboration styles and activities; we call these "operational" and "project phase" frameworks.

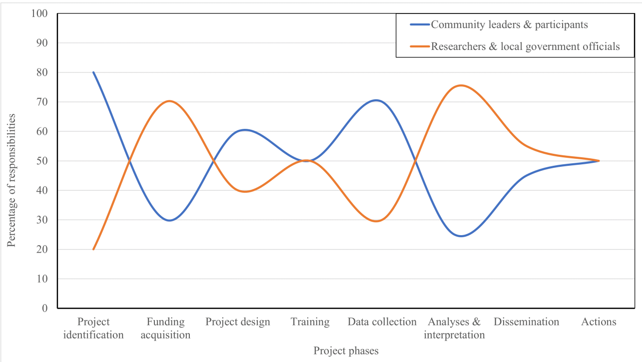
Following the two community science traditions described earlier, operational frameworks describe project-level relationships between researchers and communities, categorizing projects from completely externally driven (i.e., researcher-driven projects in which community participants play support roles), to internally driven (i.e., community-driven projects in which scientists play support roles). Relationships have been represented as a spectrum, a pyramid, a series of levels, a ladder, and otherwise (Arnstein 1969, Durham Community Research Team 2011, Shirk et al. 2012, U.S. Environmental Protection Agency 2013, Wilderman and Monismith 2016, English et al. 2018). Although operational frameworks vary in their terminology, they describe consistent divisions of responsibility, decision authority, and power between researchers and community members for an entire project (e.g., scientists always or never serve as consultants).

In contrast, project phase frameworks take a more nuanced approach to leadership and responsibilities in projects, specifying the nature of community–researcher interactions during each phase of a project. Instead of project-level descriptors, this approach allows for leadership roles that alternate across project phases, recognizing that community members will have more appropriate expertise at certain phases, and researchers will have more appropriate expertise at others (Wilderman 2008, Wilderman and Monismith 2016).

While the alternating responsibilities in project phases are an improvement on more static operational frameworks, the core collaborative community science approach takes this distinction a step further, showing how roles and responsibilities within each phase are shared to varying extents and are rarely the sole responsibility of researchers, local government officials, community leaders, or community participants. As a result, our framework suggests that it is misleading to consider community science projects (or even project phases) as completely "science driven" or "community driven" because that conceals project partners' continuous and diverse contributions. To demonstrate this dynamic, a hypothetical example (Fig. 3) depicts project partners sharing responsibilities in similar proportions for project design, training, disseminating results, and follow-up actions. It shows community leaders and participants holding more responsibility in project identification and data collection, and researchers and local government officials holding more responsibility in acquiring funding and analyzing data.

Every project will have a different pattern of shifting relative levels of responsibility within and across phases, and anticipating these patterns creates more realistic expectations than assuming predetermined or rigid roles. Importantly, in our hypothetical example, no single type of partner holds all the responsibility (or none of it) for any of these project phases. An important responsibility of the core collaborative group is to help project teams anticipate and respond to changing needs and adapt staffing over the course of a project.

**Fig. 3.** Illustration of dynamic shared responsibilities and leadership, showing relative levels of responsibility for project participants in various project phases in a hypothetical community science project. The blue line represents community leaders and participants (e.g., leaders of local non-profits, community participants); the orange line represents researchers and local government officials (e.g., academic and government researchers and representatives from city and regional government agencies).



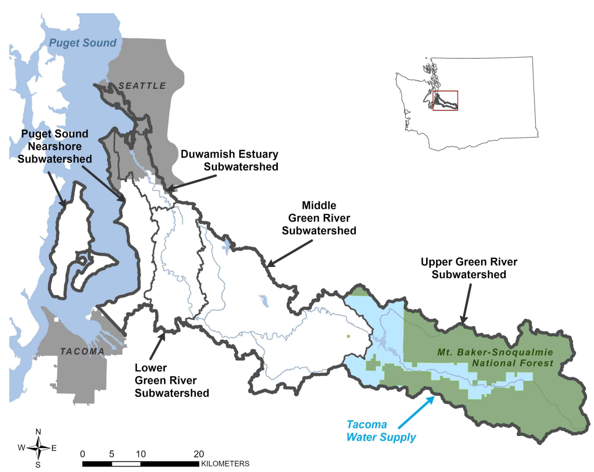

Sketching out dynamic shared responsibilities and leadership across a continuum of project phases (as shown in Fig. 3) is one way to help plan for project needs. This exercise can be helpful for project teams to complete together at the beginning of projects and to revisit and adjust as needed throughout the project. In our hypothetical example, we used binary categories of "community leaders and participants" (e.g., leaders of local organizations, community participants) and "researchers and local government officials" (e.g., academic and government researchers and representatives from city and regional government agencies). Of course, a more nuanced depiction would include more categories to represent the diverse and overlapping identities, affiliations, and contributions of collaborators.

## EXAMPLE APPLICATION: THE GREEN DUWAMISH LEARNING LANDSCAPE

The Green-Duwamish watershed (Fig. 4) is an ethnically, economically, socially, and ecologically diverse watershed in King County, Washington (USA), presenting the opportunity for a complex "learning landscape." In just 150 km, the Green-Duwamish River stretches from the crest of the Cascade Range to Puget Sound in Seattle, traversing national forests, the protected watershed for the City of Tacoma's water supply, and numerous state and local parks. The Muckleshoot Tribe manages a portion of the upper watershed as off-reservation lands, and the Tribe has usual and customary rights to fishing and foraging that drive its engagement in management. The river flows through two agricultural production districts and the Green River Valley, a major employment and manufacturing hub. The lower watershed contains several Superfund sites (designated through a U.S. government program to clean up contaminated sites), a large industrial center, and many urban, suburban, and exurban communities (Our Green Duwamish 2016). Communities in the Green-Duwamish watershed, particularly the Duwamish Valley in the lower portion of the watershed, face numerous social and environmental injustices, including health disparities such as asthma and obesity rates, and a lower life expectancy compared to national and Seattle averages (Gould and Cummings 2013, Our Green Duwamish 2016, City of Seattle 2018). To address these and other disparities and inequities, hundreds of initiatives, agencies, and organizations seek to improve ecological and social conditions in the watershed, though often with insufficient coordination around a common agenda to achieve better ecological and human health outcomes (Sheppard et al. 2017). In 2014, the Green-Duwamish watershed was designated an Urban Waters Federal Partnership site, identifying the area for collaborative urban environmental efforts (https://www.epa.gov/urbanwaterspartners/urban-waters-and-green-duwamish-watershed-washington). This designation built on more than a decade of urban restoration and environmental research in the Seattle area (Street Sounds Ecology 2015) that was initially funded by the *American Recovery and Reinvestment Act* (2009); the Urban Waters designation encouraged continued focus on the Green-Duwamish watershed.

The Green Duwamish Learning Landscape (GDLL) was conceived by researchers at the U.S. Department of Agriculture (USDA) Forest Service's Pacific Northwest Research Station (PNWRS) in 2017 as an initiative that would identify and help coordinate community-based, action-oriented environmental research opportunities in the Green-Duwamish watershed. The GDLL has operated through a core collaborative community science approach that advances ecological restoration, urban greening, and pollution reduction to mitigate long-standing environmental and socioeconomic injustices. Initial funds from two USDA Forest Service units (PNWRS and State and Private Forestry) provided seed funding for projects and staffing to coordinate and convene scientists, community leaders, and agency staff, including wages or participation stipends for community participants whose time was not compensated through employers.

**Fig. 4.** Map of the Green-Duwamish watershed, King County, Washington, USA.



To support the GDLL's efforts, a core collaborative group was formed to serve as a self-perpetuating, boundary-spanning backbone entity, initially composed of three people: an applied social science researcher from the PNWRS, the coordinator of the Green-Duwamish Urban Waters Federal Partnership, and a social science researcher with a split appointment with the University of Washington and the PNWRS. This core collaborative group hosted an initial series of meetings to convene agency, community, and research partners, and to begin to identify priorities and potential projects, building on preexisting and new relationships and networks. Since then, the core collaborative group has engaged more than 30 organizational partners whose work intersects topically or geographically. With a variable role across projects, the core collaborative group has identified, developed, coordinated, and helped implement four projects to date based on community needs. Each of these projects has generated connections with multiple research, monitoring, or action projects that have engaged different combinations of community organizations, residents, researchers, government agencies, and educators.

We next describe two of the GDLL's projects that demonstrate the diversity of its work and support roles. The first is a moss biomonitoring project that focuses on air quality and environmental justice in urban, industrial-adjacent neighborhoods in the Duwamish Valley, and that has expanded to support multiple research, monitoring, and mitigation projects. The second is a pilot temperature monitoring project on Green River tributaries (upstream from the Duwamish Valley), studying water temperature in Soos Creek with a biological and social lens to expand support for, and value of, water monitoring in a suburban setting. (The GDLL's other two projects include a community collaboration to "re-green" the Green-Duwamish River, and an analysis of changing suburban property values to estimate returns on investment from riparian restoration.)

**Project 1: Duwamish Valley moss biomonitoring project**

*Context*

Residents in the Duwamish Valley (located in the Duwamish Estuary subwatershed; Fig. 4) live in close proximity to industrial facilities and transportation corridors and experience higher levels of air pollution, including air toxics, compared to others in the region (Puget Sound Clean Air Agency and University of Washington 2010). Community leaders were concerned about the human health effects of poor air quality but did not have access to information needed to guide mitigation efforts, including about specific pollutants (e.g., heavy metals), their neighborhood-level distribution, or human exposures. They were also concerned about a lack of tree canopy coverage in the Duwamish Valley, which has recently declined and is less than Seattle's overall coverage (City of Seattle 2021).

*Initiation and team formation*

In late 2018, the GDLL core collaborative group began to convene community leaders and local government representatives to discuss a community science project that could help address community priorities recently outlined in the Duwamish Valley Action Plan (City of Seattle 2018) and other reports describing community needs. Community interest emerged in the adaptation of a study completed in Portland, Oregon (USA) that used moss samples collected from street trees to identify areas of potential air quality concern at fine spatial scales (e.g., at the block and neighborhood levels) that were not detected by regulatory monitoring systems (Donovan et al. 2016, Gatziolis et al. 2016). Heavy metals observed in moss samples are associated with the concentrations in air and serve as a screening tool for localized air pollution. Therefore, moss samples could provide insight on the existence, magnitude, and spatial distribution of heavy metals in air in the Duwamish Valley.

The GDLL core collaborative group helped recruit a project team, convening leaders from local organizations (e.g., Duwamish River Community Coalition, Dirt Corps, Just Health Action), agencies (e.g., City of Seattle), government researchers with expertise in moss biomonitoring methods, and university environmental and health scientists with expertise in statistical methods. Two of the three members of the GDLL core collaborative group engaged as part of the project team. Approximately $40,000 in USDA Forest Service funding was used for project supplies and community staffing (for approximately 12 participants from four organizations), and another $10,000 was provided by the USDA Forest Service through the Urban Waters Federal Partnership for laboratory analysis. Other project partners contributed their time through their employers or on a volunteer basis. The project team collaboratively designed and implemented the study, which began in spring 2019 with the training and data collection phases of the project. Through a youth corps program managed by the Duwamish River Community Coalition, 26 local teenagers were engaged to collect and prepare samples in the first year of the project (Derrien et al. 2020).

*Governance*

In mid-2020, the project team decided to develop a memorandum of understanding (MOU) to outline explicitly the community science partnership process and desired power dynamics, to add structure to its informal modes of organizing and communicating, to establish shared expectations for the current and future people and organizations to be engaged, and to organize emerging projects. The GDLL core collaborative group supported MOU development, which was finalized in mid-2021 into a non-binding and unfunded agreement that accommodated most of the project team's diverse priorities and legal and ethical needs (see Appendix 1). Over the course of development, the MOU's purview was expanded, evolving from a project-oriented document to one focused more broadly on air quality, human health, and vegetation in the Duwamish Valley. Content specific to the original moss project was put in an addendum, intended to serve as a model for additional projects emerging under the MOU. The MOU outlines expectations and operating procedures for 13 signatories representing nine organizations (two universities, three government entities, and four local organizations), led by a steering committee with rotating co-chairs, one of whom is always a community representative. The MOU documents the project team's general principles of engagement, including data sharing and handling; internal and external communication; steering committee structure and formation; and an internal process for decision making and conflict management.

*Outcomes*

Laboratory analysis quantified the concentrations of heavy metals in moss tissue samples, and further statistical analysis by scientists on the project team examined patterns in their distribution and associations with geographic and sociodemographic factors (Jovan et al. 2022, Kondo et al. 2022). Partnership development, implementation, evaluation, and findings are detailed elsewhere (Derrien et al. 2020, Duwamish River Clean-up Coalition 2020). Aside from contributions to the scientific literature, however, most of the project's outcomes can be measured by the diversity and extent of follow-up monitoring, mitigation, and research projects that it has generated among existing and new project partners.

The team's follow-up work has been led by team members with relevant expertise in education, advocacy, restoration, and research, with responsibilities shared by other project partners and new recruits. Additional projects have focused on areas identified with high metal concentrations in the first year of data collection, including tree planting and green wall and bioswale installations; property owner outreach and education; and other efforts funded by the City of Seattle and USDA Forest Service. The steering committee also has coordinated with the Duwamish River Community Coalition's Duwamish Valley Clean Air Program, including advocating for and advising the Puget Sound Clean Air Agency on a follow-up local air quality monitoring campaign, using the maps of metal concentrations created in the first year of data collection as a guide (https://pscleanair.gov/634/2021-2022-Air-Toxics-Study).

A second moss sampling and analysis campaign was completed in 2021, funded by a U.S. Environmental Protection Agency environmental education grant, engaging 22 youth corps members through the Duwamish River Community Coalition. Dirt Corps trained six local adult learners to provide continuity with project activities, helping bridge data collection and site-specific mitigation phases. To document and share their approach, project partners have created and refined a youth and community curriculum and a how-to guide, which have been distributed broadly to educators, community organizations, and others interested in adapting the approach (Brinkley et al. 2022, Gould et al. 2022).

These ongoing opportunities for engagement for youth participants, community members, scientists, nongovernmental organizations, and agencies demonstrate a reduction in siloed environmental action as new connections have taken hold across disciplines and research, management, and community institutions. Research partners from half a dozen research institutions have been engaged, as well as experts from multiple disciplines, including the social sciences, resource management, biology, lichenology, civic engagement, law, environmental justice, and public health (see, for example, Derrien et al. 2020, Jovan et al. 2022, Kondo et al. 2022). The partnership has engaged multiple community organizations that are not traditional research entities, benefitting from local expertise, political savvy, advocacy, and organizing skills. It has engaged dozens of youth and adult learners in conducting and communicating social-ecological systems science in their own neighborhoods, with an actionable research design geared toward reducing environmental injustices and health inequities. By connecting these diverse entities, the project team has been able to produce a variety of tailored products that advance community priorities, including presentations, data sets, and maps, as well as traditional scientific products such as peer-reviewed journal articles.

### Project 2: Soos Creek temperature monitoring project

*Context*

Chinook salmon in the Green-Duwamish watershed are listed as threatened under the U.S. *Endangered Species Act,* and are the primary food source of the endangered southern resident orca (National Oceanic and Atmospheric Administration 1999, 2005). These two species drive substantial funding, collective action, and community engagement in watershed restoration. Riparian restoration in the Green-Duwamish watershed generally consists of removing ubiquitous species that do not contribute to ecosystem function and replacing them with native vegetation on riverbanks and floodplains. Among other functions, these plantings serve to cool water temperatures, to which salmon are sensitive. Data from temperature monitoring helps gauge the success of restoration projects over time and helps prioritize future project locations (WRIA 9 Riparian Revegetation Work Group 2016).

River temperatures also inform other social and ecological aims such as understanding and mitigating urban heat islands. The Pacific Northwest increasingly experiences extreme heat events, which has consequences for human health, especially in urbanized areas, including many parts of the Green-Duwamish watershed (Fig. 4; CAPA Strategies 2020). In these areas, which are characterized by paved surfaces and a lack of vegetation, heat events are especially dangerous for populations lacking adequate housing, access to healthcare, and financial resources more generally. Monitoring river temperatures can help evaluate and prioritize vegetation and planting projects to reduce urban heat islands and heat-related human health effects. Other important social and ecological applications of river temperature monitoring include managing stormwater and regulating polluters.

*Initiation and team formation*

In 2020, the GDLL core collaborative group initiated conversations about potential projects in the Middle Green River subwatershed (Fig. 4), including potential project partners from the Green River Coalition, King County Water and Lands Division, Urban Waters Federal Partnership, and Washington State Department of Ecology. These conversations identified the value of monitoring water temperatures in rivers as an important social-ecological indicator to meet multiple social, ecological, and policy goals, including (but not limited to) restoring salmon habitat.

These potential project partners connected with Green River College (a local community college) and other local riparian restoration organizations (such as Dirt Corps and Mid-Sound Fisheries Enhancement Group) to form a multidisciplinary project team that could serve these diverse interests. A project team (including one member of the GDLL core collaborative group) formed and co-designed a pilot monitoring effort on Little Soos Creek, a tributary to the Green River, with a central focus on supporting student- and community-developed curriculum using user-friendly temperature monitors. Approximately $8000 in funding was provided by the USDA Forest Service through the Urban Waters Federal Partnership to purchase monitoring supplies and support partner participation. The first year of monitoring was in 2021 and is ongoing, conducted by students at Green River College and volunteers with the Green River

Coalition. The project team has sought to make the curriculum adaptable by communities throughout the Green-Duwamish and other watersheds in the Pacific Northwest.

*Governance*

The temperature monitoring project team's efforts have been guided by a common agenda, which was collaboratively defined to include the team's ecological and social interests in riparian restoration and temperature-related public health issues. To date, the team has remained loosely organized and narrowly focused on this common agenda, without formal governance structures such as MOUs. Funding agreements between the Urban Waters Federal Partnership and the Green River Coalition have created some structure for project responsibilities and deliverables, but because of the college's adoption of the curriculum, the project team has been able to be nimble without the constraints of standard ecological funding or organizational mandates. The high level of mutual benefit, low cost of activities, and lack of reporting requirements have likely led to the ongoing partner engagement to date without need for formal governance structures. The project team member who is part of the GDLL core collaborative group has provided coordination with other GDLL projects.

As the project has taken shape, responsibilities have increased for Green River College partners (college instructors, students) and non-profit partners (Green River Coalition and other local organizations), who designed and are implementing the ongoing monitoring. Levels of responsibility have decreased for government partners, who played a larger role in project initiation, funding acquisition, and team formation phases. Project team membership and responsibilities have continued to adjust across project phases and monitoring cycles, most recently adapting to emerging research questions about the accuracy and effectiveness of regulatory temperature monitors, and emerging information needs from partners and communities, such as the relationship between air and water temperature. As the project evolves, this flexibility and adaptability will likely lead to continuing shifts in project team composition and responsibilities.

*Outcomes*

The development and refinement of an applied undergraduate curriculum for water temperature monitoring has been a primary outcome for the project team's work. So far, the curriculum has been implemented for two terms, engaging more than a dozen students and several community volunteers in monitoring. Students have been engaged in deploying monitors, completing data entry and descriptive analysis tasks, and communicating findings. Instructors at Green River College continue to refine the curriculum, with the goals of sharing it with other local colleges and communities for local monitoring as well as expanding their efforts to other parts of the Green River.

Green River College, with its local student population, has been well poised to foster the engagement of local youth and organizations in growing environmental stewardship networks. The collaborative monitoring project has shown promise for leveraging mutual benefits to support, evaluate, and prioritize community restoration efforts, which rely heavily on non-profit and volunteer efforts, with limited budgets and ability to conduct monitoring (Sheppard et al. 2017). In doing so, the project has helped the Green River Coalition and their partners begin to build necessary linkages between the siloed efforts of salmon recovery and human health equity, both related to urban heat islands. For example, Washington State Department of Ecology's efforts to develop water temperature regulations is now also considering human health co-benefits of shading the river.

The project has also informed the methods used in larger scale salmon recovery efforts led by county, state, and federal governments. For example, it has provided a needed tool for shade-oriented restoration efforts (e.g., WRIA 9 Riparian Revegetation Work Group 2016). The first year of monitoring contributed to a complete data set currently being considered by King County and partners in their Green Duwamish Revegetation network for applications in riparian restoration and stormwater management. Although the project team's interest in having its monitoring data inform the development of a temperature-related total maximum daily load to regulate temperature inputs into the river was deemed infeasible (because it did not meet Washington State Department of Ecology's standards for device sensitivity and sampling methods), the monitoring data have nevertheless been used to provide insight and context to inform ongoing restoration investments.

## DISCUSSION

The GDLL demonstrates the potential for integrated and scalable scientific endeavors using a core collaborative community science framework. This approach is well poised to help investigate complex and transboundary environmental health and justice issues and influence interacting social-ecological systems at different spatial and temporal scales (Lee 1993, Peterson and Parker 1998, Berkes et al. 2000). It departs from traditional landscape modeling approaches such as national forest and national park plans that focus on documenting and moving an entire system toward a desired idealized state, investing instead in the coordination of multiple, incremental problem-oriented efforts (Blahna et al. 2017). In other words, we have used core collaborative community science to study and restore social-ecological systems from the bottom up, rather than seeking large-scale, top-down changes that are often expensive, politically unpalatable, exceedingly complex, and rarely implemented (Hoos 1983). In this way, the three key features of our framework (core collaborative group; multidisciplinary, social-ecological, and justice orientations; dynamic shared responsibilities and leadership throughout projects) advance efforts toward environmental justice in community science. This progress is not without associated challenges, though, which we describe next for each of the features.

### Core collaborative group coordination for advancing environmental and social justice

Our core collaborative community science framework seeks to increase community capacity and resilience through an expanded network of partners dedicated to the reduction of systematic injustices, inequities, and exclusion. Although projects within our framework can originate from a range of actors, including residents, workers, scientists, or others, the framework recognizes that often those with lived experience in an area can most effectively prioritize the most pressing needs or consequential actions (Conde 2014, Cordner et al. 2019). In our example projects, community priorities have led project identification, with local and disciplinary expertise guiding project team recruitment. Our examples show that criticisms of collective impact (such as a lack of focus on justice; Wolff et al. 2016) are not inherent to the collective impact concept, but rather a reflection of how and where it has been applied.

One central challenge that remains is the ability of core collaborative groups to secure long-term coordination-oriented funding to establish and sustain core collaborative support, which is generally more difficult to acquire than short-term, project-oriented funding that fits particular agency or scientific silos (Kania and Kramer 2011, Wolff et al. 2016). Even with funding, groups experience challenges with recruiting and sustaining members to serve as the backbone (FSG 2015). For the GDLL, many funding sources have only been available on a year-to-year basis, limiting organizational development and its ability to engage with potential and existing research and action. Creative commitments have been needed to navigate bureaucratic norms to repurpose funds for projects that serve community needs. Furthermore, while we prioritized project funds for community partners whose time was not compensated by their employers (enabling engagement for many), even when sufficient funds were available, community partners' available time was sometimes the larger constraint.

Because the core collaborative community science framework has evolved alongside the GDLL, the framework has not always been clearly applied, and the very recognition of project partners' shifting and overlapping roles have sometimes made the core collaborative group less visible. Currently staffed by two agency and agency-supported staff members who juggle this role among others, the core collaborative group would benefit from staffing by a more diverse set of institutions, including community, agency, and university representatives from across the watershed. This change would help ensure relevance and power sharing. However, organizational silos still hinder the engagement of a core collaborative group, whose work often falls between or across organizational mandates, making it difficult for organizations to justify using staff time for coordination.

**Multidisciplinary, social-ecological, and justice orientations for science at relevant scales**

Scale matters. Focusing first on the questions or problems that community science can help address, and then determining the appropriate geographic area for study, ensures that study areas are at an appropriate scale for action-oriented research. This is a key function of the core collaborative group: helping identify the most appropriate scale of the study area based on the questions, partners, and available funding. There are few examples in which multiple projects have been implemented in a similar geographic context over multiple decades (but see Wilderman 2008, Wilderman and Monismith 2016). Other long-term examples focus on intermittent community monitoring for enforcement and accountability for specific industrial emitters (Overdevest and Mayer 2008).

Large-scale and long-term engagements have proven helpful for the GDLL, which offers an example of community science coordination at a watershed scale with long-term goals. Many partners worked together before the GDLL concept emerged and have continued to work together in various capacities for more than a decade, which has been especially important for building community–agency and community–researcher relationships and trust. The continued collaborations were encouraged by the Urban Waters Federal Partnership designation for the Green-Duwamish watershed, which provided an impetus for the GDLL's watershed-scale focus and goals to address social and ecological priorities through community partnerships.

The core collaborative group encourages that attention be given to social or economic factors in social-ecological systems, beyond community science projects' typical attention to specific biophysical or ecological conditions or questions (Pandya 2012, Soleri et al. 2016). Although a few studies have examined the intersection of community science and complex environmental conservation needs, they have not been integrated with larger scale goals within a community science framework (Shirk et al. 2012). This typical narrow focus results in a lack of engagement with multidisciplinary environmental justice and social equity concerns.

To staff projects with appropriate multidisciplinary scientific expertise, the GDLL has mostly relied on in-kind contributions. In our moss project example, we required highly technical expertise in several project phases (including methods development, training, lab analysis, and statistical analysis and interpretation). Although we were able to leverage our professional networks to meet these needs, demands for scientists' time often outweigh supply, and opportunities to scale up to create efficient and meaningful contributions are needed. More engagement by researchers (especially those early to mid-career) could be encouraged if scientific reward structures better recognized the types of outcomes sought through core collaborative community science.

In the Duwamish Valley, the moss project helped create the space for agency and community leaders to share resources to develop multiple complementary projects, such as a regulatory agency's air quality monitoring campaign. It also provided scientific evidence to support community leaders' desires to enhance public health through targeted local improvements in green infrastructure. These outcomes did not all happen in short time frames, though. For example, it took several years of ongoing engagement for trees to be planted along a street the moss project had helped to prioritize. This engagement over time has helped build trust so that a common agenda can be leveraged to promote mutually reinforcing activities (Coleman and Stern 2018).

Changing the science paradigm to address environmental injustices at relevant scales requires a different cultural and structural approach for identifying and organizing community science efforts, recognizing that the conditions that produce environmental injustices (such as the Duwamish Valley's poor air quality) also create grounds for collective action (Gutierrez et al. 2021). A community's ability to organize and act collectively is a powerful force in community science partnerships. A focus on environmental justice and equity suggests flipping the assumed causal chain of "normal science" (Williams 2017) away from first identifying biophysical phenomena to be studied, to first identifying social, health, or economic disparities that may have an environmental foundation (Soleri et al. 2016). In other words, addressing environmental justice requires an initial social *problem* focus (e.g., health inequities) rather than the normal, *disciplinary* approach to environmental science (e.g., air quality).

### Dynamic shared responsibilities and leadership for inclusive science

Our framework emphasizes that, even after centering community priorities, different roles and levels of responsibilities are needed depending on project contexts. Relationships and structures supporting projects need to adapt to accommodate emergent goals, shifting project partners, and funding availability. Both operational and project phase frameworks generally suggest that community-driven projects are more likely to address community needs, produce findings that will be used by community members, and lead to potential benefits to local communities (Soleri et al. 2016). We suggest, however, that no community science projects are either entirely community driven or scientist driven, and that to be truly collaborative, they need to be jointly driven, with varying shared roles and responsibilities throughout. Explicit communication about goals, sharing power and control, and cultural differences among project partners promotes equitable processes and outcomes and can be supported by various tools, frameworks, and processes, including the MOU development process (Ramirez-Andreotta et al. 2014). Such communication is helpful at the beginning and should be revisited throughout a project.

Our core collaborative community science framework recognizes community and researcher responsibilities in all project phases (Fig. 3), promoting shared responsibilities and roles that shift to accommodate project needs. For example, in the Soos Creek project, initial project scoping and initiation was conducted by government and non-profit partners; methods and curriculum were developed by non-profit and community college partners; data collection was implemented by community college faculty, students, and volunteers; and users of the produced data sets have included government and non-profit partners.

Our framework has helped project teams navigate tensions between the scientific process and the desire to use science as a tool to advocate for change. In many collaborations, there is an internal struggle over the value of research that may meet community needs directly (e.g., through demonstrating the need for policy change or increased regulatory enforcement) or indirectly (e.g., through community education or youth skill development), but in which the most immediate outputs for researchers may not explicitly serve communities (e.g., through peer-reviewed publications). The core collaborative community science framework promotes explicit and ongoing dialogue about desired project timelines, outcomes, and outputs (e.g., through drafting an MOU or drafting potential relative responsibilities; Fig. 3), ensuring that commitments and expectations are negotiated and understood early in the project and revisited throughout. This approach helps to establish a shared vocabulary for constructive communications and guidelines for the group's uses of shared resources.

We reinforce through our framework that sharing leadership, responsibilities, and power *equitably* does not suggest that these need to be shared *equally* or consistently within or across projects. These factors are project and project-phase specific. Furthermore, the process of negotiating project leadership and responsibilities can help ensure substantial and meaningful participation by all team members and avoid instances where "participation" is just a nominal role (Bonney et al. 2009, Shirk et al. 2012, Ottinger 2017, Strasser et al. 2019). For example, incorporating participation to get "buy-in" is different than participation that enables social transformation, and the quality of participation can be a primary measure of project outcomes (Shirk et al. 2012).

In the Portland moss biomonitoring study that inspired the Duwamish Valley moss project, scientists followed a standard scientific model of designing and implementing the project independently, engaging most community and government entities once findings were available. The approach led to considerable uncertainty and concern from residents, community groups, and even agency officials as findings reached the local media (Johnson 2016). That approach contrasts with the GDLL approach of early and ongoing community and agency leadership and a focus on co-production, demonstrating the potential for standard scientific approaches to be adapted and democratized.

## CONCLUSION

Community science partnerships are context dependent and variable over the course of a project, requiring supportive structures beyond individual relationship building. We have described how community science frameworks tend to focus on singular projects, topics, or types of research, and tend to be organized around narrow scientific and organizational outcomes. Such frameworks yield little insight into how the relationships among community, agency, and research institutions can be fostered to adapt to changing needs and conditions and advance enduring solutions to social-ecological disparities for communities and systems. We introduced the core collaborative community science framework and used the GDLL to demonstrate how community science can have broader engagement and influence when organized according to best practices from collective impact group processes, including a core collaborative backbone group that serves to coordinate multiple jointly driven project teams. We make the case for a fundamentally different relationship among community, agency, and research institutions to focus efforts on social, ecological, and human health goals in a particular community or system. In effect, this framework helps integrate community science within the social fabric of communities, especially those struggling with environmental health and justice challenges. Further development and implementation of the core collaborative community science framework is needed to refine the types of questions and issues for which it holds the highest potential.

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**Data Availability:**

*Data and code sharing are not applicable to this article because no data or code were generated in this study.*

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**Memorandum of Understanding**

**V11 - 2021**

Between individuals from:

**Duwamish River Cleanup Coalition/ TAG**
**USDA Forest Service, Pacific Northwest Research Station**
**and the Northern Research Station**
**Duwamish Infrastructure Restoration Training (DIRT) Corps**
**University of Washington, EDGE Center, Community Engagement Core**
**City of Seattle, Office of Sustainability & Environment**
**Just Health Action**
**Green-Duwamish, Urban Waters Federal Partnership**
**Western Washington University, Huxley College of the Environment**

**I: Title: Partnership for Community-led Air Quality Projects in the Duwamish Valley**

**II: Purpose:** This Memorandum of Understanding (MOU) is a non-binding non-funded agreement for the purpose of outlining a cooperative relationship among the Participants to facilitate the sharing of information and the development of proposals for Community-Led Air Quality Projects in the Duwamish Valley. This MOU documents the partnerships and operating procedures for community-driven action conducted by the partners in the Duwamish Valley (particularly South Park and Georgetown) in Seattle. It lays the foundation for project(s) processes and operation, and provides guidance for a Steering Committee that will continue to guide specific project activities to meet the needs of the MOU signatories (partners).

**III: Background:** In 2018 organizations working in the Duwamish Valley gathered to identify priority research and action projects under the idea of developing a coalition called the Green Duwamish Learning Landscape (GDLL). Utilizing priorities established in the joint City-community developed *Duwamish Valley Action Plan*, an initial project was selected. Though initiated and first coordinated by USDA Forest Service PNW Research and State and Private Forestry and the Urban Waters Partnership

Ambassador, this project was established by organizational capacity, funding, and volunteer assistance provided by all partners.

This partnership is large with many different partners and projects. The partners agree that it would be beneficial to document the roles and responsibilities, as well as also lay the foundation for a group of partners to convene as a Steering Committee that will provide process guidance, conflict management, and help coordinate future activities of the broader partnership. This MOU may serve for constructing other research endeavors as well. The Partners confirm their intention to develop under separately negotiated Agreements, Terms and Conditions for the carrying out of the "research data/results publication" and other new development projects if the Parties identify a project where each determines they would wish to work in conjunction with the other.

**IV: Definitions:**

Definitions are provided for understanding only:

1. Material is defined as "the elements, constituents, or substances of which something is composed or can be made"
2. Data is defined as "information/outcomes that that are produced from the material"
3. Outcomes is defined as "consequences and dissemination"

**V: Principles:** The partners collectively agree to the below principles to guide their project efforts:

1. Respect each other, and the communities.
2. Maintain open, clear communication with all partners and to create space for diverse communication and participation styles.
3. Respect each partner's ideas and resources and to maintain a long-term relationship of trust; to assume positive intent in all interactions and own the impact of our words and actions.
4. Welcome participation from partners in all project phases. As much as possible, allow for timeframes that accommodate each partner's processes and needs.
5. Commit to a community leadership model of decision-making by empowering and actively involving communities in all aspects of the project and related research.

6. Undertake research that may contribute something of value to the community in which the research is being conducted.
7. Work with partners and community collaboratively in the design, implementation, analysis, interpretation, conclusion, reporting, and publication, and next steps of the project.
8. Ensure the design, implementation, analysis, interpretation, reporting, publication, and distribution of the research may both be culturally relevant to the community and in agreement with the standards of competent research.
9. Address any issues that are raised as a result of project activities; stay involved in the outcomes after research is complete.
10. There is understanding of analysis of project data by the communities impacted by the results and outcomes.
11. Promote both academic and audience relevant diffusion of knowledge through written publications, presentations, and community engagement. This may include the documentation of collaborative processes and results.
12. Support action related to principles of reducing racial inequities and health disparities and building community capacity and leadership.

**VI: Statement of Interests and Benefits**: The partners understand and endeavor to measure the effectiveness of the public health and environmental justice benefits of this collaboration for community-engaged research. The Partners understand the approach to research outlined here.

It has been documented that the neighborhoods of South Park and Georgetown are burdened with some of the most polluted air in the state. These communities are also lower income, ethnic minority neighborhoods with some of the most egregious human health disparities in the state. Many of the poor health outcomes may be associated with poor air quality (Daniell et al. 2013), and air pollution is consistently identified in studies and community forums as one of highest ranked community concerns. Local level data are also necessary for monitoring effectiveness of mitigation measures over time, and for providing an understanding of public health implications of air pollution for community residents and local workers. This partnership offers the possibility for action that could help mitigate some of these concerns. Finally, this partnership demonstrates the ability for communities to build capacity and empowerment, addressing issues of power and environmental equity.  This is accomplished through utilizing community leadership to advance an open, collaborative processes towards action.

**<u>VII. Statement of Potential Harms</u>**: Commit to communicate openly about potential harms of a project to allow for proactive and preemptive action. Potential harms could include disruption of privacy, sharing of protected information, continuation of institutionalized injustices and prejudices, erosion of existing organizational or individuals trusts, or damage to professional reputation. Additional harms are also possible to non-partner entities. These include the production and distribution of misleading, confusing, or needlessly alarming information. Each of these potential risks are exacerbated by the established inequities present in communities impacted by the outcomes of this project. Partners agree to work together to mitigate these risks to the best of their abilities.

**<u>VIII: Roles:</u>** The Parties attempt to implement a fully collaborative community-led research process, where everyone's expertise and contributions as professional or community scientists are recognized. This MOU outlines a collaboration were all participants are different types of scientists; community-focused, agency based, or research focused.

Throughout the process, different partners may take both leadership roles and supporting roles. These roles may shift and change along with the stage of the process, skills of different partners, and application circumstances. The dominant theme is sharing responsibility for lead and support roles throughout.  Sharing tasks may be conducted by less than the whole group, though those actions must be sanctioned by the steering committee, if necessary using the shared decision process outlined in section XI. A lead role does not denote power or control, but rather who is taking on completing a task. For all roles, decision making is a collaborative process under community direction. Chairs may be designated to reflect community leadership (described in detailed below in VIII. Steering Committee). Project specific roles and responsibilities are presented in the addendums.

**<u>IX: Data Responsibilities:</u>**

**1. Data Terminology**

A. In accordance with section IV Definitions, data may include (see addendums for project specific details):

a. Physical samples (physical samples will differ by project and should be addressed in project addendum)
b. Inventory and tracking for physical samples
c. Spreadsheets and databases associated with data
d. Maps, graphs, and charts representing the data
e. Survey response forms or other evaluative materials

**2. Data Sharing and Confidentiality and Outcomes**

The Participants confirm their intention to exchange, to the extent deemed necessary by the Steering Committee, information on a confidential basis relevant to potential Research Projects within the agreed Field of Research. Including:

A. Copies and digital scans of the paper forms of data
B. Photos, images, or other visual references
C. Community stories/ narratives

**3. Data Management, Security, and Storage**

A. Data shall be stored at least by the entity conducting initial analysis, though others too may retain copies of the data.
B. Long-term storage may be completed by a different entity, to ensure long-term security and accessibility.
C. Not all types of data the project collects/creates are the same, and should therefore not be treated the same.
D. Data shall be shared securely, protecting privacy and personally identifying information, unless required by law.

**4. Public Records Act Compliance and Procedures**

As state or local agencies or divisions within public institutions, several Partners (i.e., City of Seattle, Office of Sustainability & Environment; University of Washington EDGE Center, Community Engagement Core; and Western Washington University, Huxley College of the Environment), are subject to the Public Records Act, Chapter 42.56 RCW (the “Act”).

Under the Act, all materials prepared, owned, used, or retained by these Partners or a functional equivalent of their employees are considered public records. The Act requires that public records be promptly produced by these Partners unless the Act or an “other statute” exempts such records from production. These Partners are under no obligation to assert an exemption from disclosure under the Act for any record, whether or not in the possession of another Partner.

To the extent that a Partner possesses records that any public agency or division within determines it needs in order to respond to a request under the Act, the Partner agrees to cooperate fully in identifying and assembling such records and to make them promptly available to the Partners upon request. Pursuant to Chapter 40.14 RCW, Partners shall retain all records associated with this Agreement in accordance with the applicable retention schedule.

Similarly, The USDA Forest Service and other federal government partners will treat all information generated or gathered under this agreement in accordance with the Freedom of Information Act, 5 USC section 552.

**5. Credit and Permissions as outlined by the Steering Committee**

A. Use of novel concepts, ideas, and unpublished materials generated by project team should be used only with permission of the author/s.
B. Credit of ownership and reference, if applicable, should be properly displayed for all photos and images, figures, plots, diagrams, and graphs.
C. Photo releases of individuals identifiable in photos should be used as needed, particularly in photo use of minors.

**6. Materials and Products**

A. Non-academic materials and products (presentations, briefings, curricula, protocols, flyers, webpages, papers, etc.) derived from our data and materials can be created by any member of the project team.
B. Permission to use data or materials to create products should be asked of the steering committee.
C. For non-academic, co-authorship or review opportunities should be offered to project team members when non-academic materials are created.

D. For academic materials, all participants whose efforts warrant inclusion shall be granted authorship, and when appropriate, all team member contributions shall be acknowledged if they do not rise to the level of authorship.

E. Recognition of all project partner organizations should be provided on all products. Logos and individual names should be used with permission only.

F. Recognition of funding or other notifications may also be required or requested to be included on products.

## X. Communications Plan

**1. Internal Communications:**

A. Expectations. Regular meetings should be held for the Steering Committee to insure the project partners are all well informed of project aspects. Meetings should be held monthly, with an expectation of 1 to 2 hours for each meeting. An additional 2-3 hours a week expectation should be needed from signatories towards participation in the Steering Committee, in addition to their project work. Key non-Steering Committee communication professionals at participating organizations will be identified and notified on matters of press, media, and communications as needed.

B. Administration. Steering Committee members should have an opportunity to suggest agenda items to the Chairs for discussion at meetings. Agendas will be distributed prior at least 48 hours to Steering Committee meetings. Meeting minutes shall, at a minimum, include a record of: attendees, decisions, and actions needed. Meeting agendas and minutes shall be kept and posted to a secure downloadable location and made available to all Steering Committee members.

**2. External:**

A. Communication Plan. Each project as described in “III Background” shall develop a specific communication plan. The plan should include at a minimum: Goals and Objectives, Audiences, Messaging, and Sensitivities. The plan should provide that all news releases, announcements, electronic messages and publicity relating to completion of the project, and any subsequent promotions or public communications related to the project, should include all relevant parties as jointly agreed in the media relations strategy. Further, the plan should include a contingency plan should unsolicited inquiries come from the media prior to an official announcement date or event.

B. Other Communication.

a. All partners should be named in news releases, media advisories and other media materials.

b. All media materials should include contact information for each partner's communications contact. The communications contact should be responsible for managing incoming media calls and, as they choose, directing reporters to their designated interviewee(s) as outlined in the public relations strategy.

c. The date and timing of the release of announcements to the media should be jointly agreed upon by the project partners.

d. News releases will be distributed to media, posted to Web sites and otherwise released externally on the same date.

e. Partners may not offer story advances or exclusives to reporters without prior approval from all communications representatives.

f. In the event of unsolicited media inquiries regarding this joint project, each liaison will be notified in a timely manner.

g. Responses to unsolicited media calls should follow procedures outlined in the project's public relations plan, using agreed-upon messages.

C. Subcommittee. A Press and Communication Subcommittee should be formed as needed (described in IX. Steering Committee below). The Committee should be comprised of one member of each participating organization. Generally, the subcommittee should:

a. Write outline or first draft of news release

b. Circulate media materials to designated liaisons for review

c. Incorporate edits into final documents(s)

d. Distribute materials and pitch to media

e. All liaisons should provide final, written approval on media materials to core communications team before any materials are released to media.

**XI. Steering Committee:** Given the large number of partners, the numerous stages of the project, shifting nature of responsibilities, and the potential for creating an ongoing civic science collaboration that could monitor and conduct future air quality research in the LDV, the Parties should establish here a committee to provide a forum for partners to interact and collaborate. Personal interaction is important for transparency and trust. The Steering Committee should be comprised of signatories to this agreement. Steering Committee meetings should also include project work and are likely to include guests who are formal members. Steering Committee will meet monthly unless otherwise stated. The Steering Committee will consider other operating procedures moving forward.

1. **Committee Composition:** The Committee should be comprised of all MOU signatories willing to continue as members of the Steering Committee. Two Co-Chairs of the Committee should be selected annually by Committee members to direct efforts, including setting agendas. One chair should be a Steering Committee representative from the community, the other will be any member of our Steering Committee, regardless of their affiliation. The Steering Committee may also choose to appoint an alternate co-chair. Chairs will serve for 12 months, 2 consecutive terms allowed. Vacancies shall be filled at earliest possible date.
   A. The responsibilities of Co-Chair may include:
      a. Establishing agendas for Steering Committee meetings, and prioritizing directions and actions for Committee to address.
      b. Facilitating and guiding Steering Committee meetings.
      c. Serve as de facto spokesperson for the Steering Committee, when specific contact is unknown, unspecified, or unneeded.
      d. Calling for Steering Committee votes on decisions, when necessary to proceed or when direction is unclear (separate language below specifying equitable decision processes, voting, and vetoes).
      e. Establishing a mediation process that may be needed for conflict management.
      f. Working with the secretary, appointed by the Co-Chairs, to ensure administration of Steering Committee is carried out.
      g. Ensure necessary subcommittees are staffed and filled, assigning members if needed.
      h. Establish processes for updating the MOU. (This MOU may be modified or extended by a mutual determination of all Participants in writing.)
   B. **Expansion of the Steering Committee.** The Steering Committee may be formally expanded by adding signatories to this MOU. New formal members should be put forth by the Co-Chairs for consideration and vote by the full Committee using consensus

decision making, as outlined below. Additionally, other projects may warrant the creation of new Steering Committee's specific to that scope of work. Additionally, signatories may opt out of the MOU with written resignation submitted to Co-Chairs.

C. **Subcommittees and Other Positions**. Additionally, the Steering Committee should include various subcommittees. These should include but not be limited to a Press and Communications Subcommittee, a Data Analysis and Interpretation Subcommittee, a Community Engagement and Outreach Subcommittee, and an Action and Mitigation Subcommittee. Subcommittees may be changed following the consensus process described below.

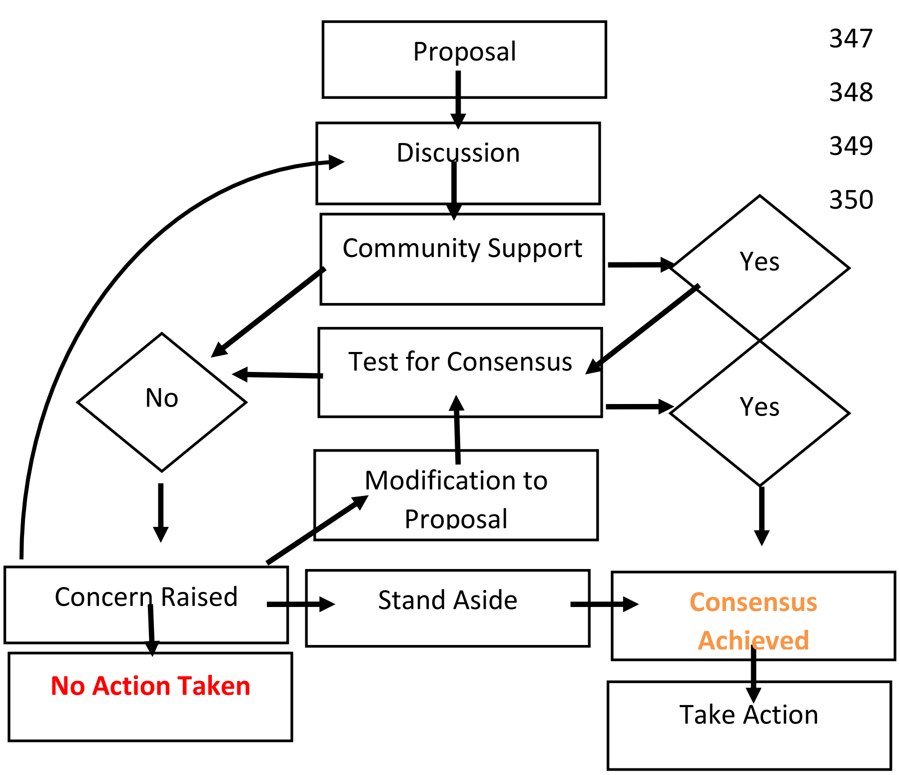
The Steering Committee endeavors to engage members of the Duwamish Valley Youth Corps (DVYC) and other youth and community groups in ongoing project work. Potential considerations include adding community representatives as members of the Steering Committee, or other roles to ensure their contributions continue throughout the program. The Co-Chairs may also identify a Secretary from the Steering Committee to carry out administrative functions including scheduling and keeping of meeting minutes.

2. **Roles and Responsibilities**: Initial roles of the Steering Committee may include:
   A. Consider a **forum for community** driven needs, input, and concerns about research,
   B. Consider **scientific integrity** of the work,
   C. Consider **environmental justice** concerns are central in all stages of the process,
   D. A **consensus decision-making** process will be followed for all matters relating to the specific Addendum scope of work requiring decision by only the members associated with that scope of work. The Steering Committee may strive to ensure this process is:
   a. Inclusive: as many members as possible are involved in group decisions;
   b. Participatory: all steering committee members are allowed a chance to contribute to the discussion;
   c. Egalitarian: all Steering Committee members should afford, as much as possible, equal input into the process;
   d. Collaborative: the committee constructs proposals together that meet the concerns of all members rather than those of individual contributors;
   e. Agreement seeking: the committee aims to generate as much agreement as possible;

f. Cooperative: Steering Committee members strive for the best possible decision for the group as a whole, rather than competing for personal preferences;

g. Any decision made by the Steering Committee members should involve at a minimum the following elements:

- Clear presentation of the issue
- Time for clarifying questions;
- Discussion of the issue;
- Support from community representatives on the Steering Committee (proposal does not proceed without unanimous support to advance, one vote to each participating organization);
- Test for consensus;
- Discussion of any raised concerns;
- Modification to proposal (if necessary to proceed);
- If the mediation process steps have been exhausted, the steering committee agrees to use “unanimity minus one vote” decision rule. Two or more member entities of the committee can therefore block a proposal. Committee members can also abstain when a participant does not support a group decision but they do not wish to block it as illustrated in the decision tree, below;




Adapted from: Hartnett, Tim. "The Basics of Consensus Decision Making"

http://www.groupfacilitation.net

2. **Conflict management** among partners and/or outside entities: If a potential conflict develops, the conflicting parties agree to make every effort possible to resolve the dispute. Meetings of all parties may be agreed to as part of the process. If they fail to resolve the dispute, the Co-Chairs shall establish a mediation subcommittee consisting of one impartial executive from each conflicting institution and a third impartial executive mutually agreed upon by both parties; no members of the arbitration committee will be directly involved in the disagreement;

3. Identify **future research/monitoring/mitigation needs** and collaborate to obtain funding;
4. **Communicate** with wider audience of stakeholder and community members; and
5. **Update, expand, and ratify this MOU and its signatories as needed,** including at a minimum a review and re-ratification every two years.
6. **Evaluation:** The Steering Committee may engage in participatory evaluation to assess success and challenges on multiple metrics of this program. Evaluation should be at the conclusion of

the program, or if the program continues with an on-going Steering Committee, evaluation should be conducted annually, or with another relevant periodicity.

**XII. Concurring Parties:** Beyond the signatories to this MOU, a series of other collaborators have contributed to and might contribute to this effort. These are regarded here as concurring parties. These entities are past and potential contributors as well as additional future signatories or Steering Committee contributors, if relevant for the development of the project.

- Additional members from the MOU signatory (partner) organizations
- University of Washington School of Public Health, Department of Environmental and Occupational Health Sciences
- Agency for Toxic Substances and Disease Registry
- Environmental Coalition of South Seattle (ECOSS)
- US Environmental Protection Agency
- WA State Department of Health
- WA State Department of Ecology
- The Port of Seattle
- Puget Sound Clean Air Agency
- Seattle - King County Public Health
- Seattle Public Schools

**XIII. Signatures:** The signatories below commit to work together following the principles, roles, and spirit of collaboration described in this MOU:

Paulina Lopez
Duwamish River Clean Up Coalition

Signature: ________________________

Date: ________________

Dale Blahna
USDA, Forest Service, Pacific Northwest Research Station, Goods, Services, and Values Program

Signature: ________________________

Date: ________________

Sarah Jovan

USDA, Forest Service, Pacific Northwest Research Station, Resource Monitoring and Assessment Program

Signature: ________________________

Date: ________________

Andrew Schiffer

DIRT Corps

Signature: ________________________

Date: ________________

Roseann Barnhill

DIRT Corps

Signature: ________________________

Date: ________________

Alberto J. Rodríguez

City of Seattle, Office of Sustainability & Environment

Signature: ________________________

Date: ________________

Michelle Kondo

USDA, Forest Service, Northern Research Station, Urban Forests, Public Health, and Environmental Quality

Signature: ________________________

Date: ________________

Linn Gould

Just Health Action

Signature: ________________________

Date: ________________

Weston Brinkley

Urban Waters Federal Partnership, Green-Duwamish

Signature: ________________________

Date: ________________

Troy Abel

Western Washington University,

Huxley College of the Environment

Signature: ________________________

Date: ________________

Amanda Bidwell

Amanda Bidwell, LLC

Signature: ________________________

Date: ________________

Monika Derrien, USDA Forest Service, Pacific Northwest Research Station, Goods, Services, and Values Program

Signature: ________________________

Date: __________________

BJ Cummings

University of Washington, EDGE Center,

Community Engagement Core

Signature: ________________________

Date: ________________

**XIV. Literature Cited:**

1. Daniell W, Gould l, Cummings BJ, Childers J, lenhart A. Health Impact Assessment: Proposed Cleanup Plan for the lower Duwamish Waterway Superfund Site; Final Report. Seattle, WA: University of Washington, Just Health Action, and Duwamish River Cleanup Coalition/Technical Advisory Group. September 2013.

**XV. Appendices to follow**