Strategic Plan for Community Science

Recognizing the immense values derived from engaging our community in helping advance and inform watershed science, restoration, and stewardship, Left Hand Watershed Center (the Watershed Center), in partnership with CitSci.org, developed a Strategic Plan for Community Science. This plan, detailed below, helps us to enact our vision to improve the stewardship ethic of our community for a healthy and resilient watershed.

Mission and Vision

The Community Science Plan aims to provide high-quality community science projects that inform adaptive watershed management and engage our community in place-based learning. All projects offer value in the areas of watershed science, restoration, stewardship, and place-based education. Ultimately, we envision a community of watershed stewards with the knowledge to make science-based decisions, rooted in adaptive management, about the health and resilience of our watersheds.

Community Science Goals

1. Fill data gaps through effective data collection
2. Inform adaptive watershed management
3. Cultivate an active community of stream stewards
4. Educate community members about adaptive management-based watershed stewardship
5. Sustain and grow successful community science projects

Community Science Actions

1. Implement community science projects that fill data gaps
2. Implement community science projects that improve Performance Standards and Management Triggers in the Monitoring and Assessment Framework
3. Increase overall understanding of watershed health and resilience through participation in successful community science projects
4. Facilitate stakeholder collaboration and community participation by co-developing projects
5. Offer projects that engage K-12 students
6. Fully fund each community science project for the length of time needed to meet objectives and answer scientific question(s)

Rooted in Adaptive Management

All community science projects will be rooted in the Watershed Center's Adaptive Management Plan. This plan was developed to assess the trajectory of our watersheds towards health and resilience, as illustrated by a conceptual model showing our goals. Assessing this trajectory involves iterative scientific data collection at meaningful scales over both space and time to evaluate performance standards. Community engagement in this process is necessary because people are part of our watersheds and need to be informed, engaged, and invested in adaptive management decisions that impact their lives.

Steps to Identifying and Vetting a Community Science Project

The following steps describe our procedure for identifying and vetting community science projects. Other organizations can use and modify this process to develop new projects in other watersheds.

Step 1 – Conduct Stakeholder Analysis

Our first step involves interviewing (listening) to stakeholders to discover their needs, motivations, desires, challenges, pain points, and potential benefits related to watershed health topics. Our goal with these interviews was to understand what motivations result in the best participation and most useful outcomes from any given project from the perspective of our community. Overall, we completed more than 15 interviews and gained useful insight that will help make our projects successful.

Although each interview was unique, we generally asked questions to help us better understand each group or individuals (1) data collection goals and needs, (2) common issues/concerns/knowledge gaps that they have identified in the community related to watershed health, and (3) interest in citizen/community science. Below is a list of sample questions:

- What kind of data do you currently collect and do you use community members to collect it?
- What goals do you have in relation to data collection and/or community participation?
- Who do you partner with regarding data collection and post processing? Do you have a plan in place for how data will be collected, analyzed, stored and made accessible to others?
- Looking back in the past year, what are common issues/questions/knowledge gaps in the community related to your work (what is something you wished they better understood)?
- Thinking back on past year, what is one thing you'd like to see improved in your watershed?

Step 2 – Prioritize Stakeholder Needs and Potential Project Ideas

After completing interviews, we developed a stakeholder analysis matrix to track which issues were important to each stakeholder group. This matrix enabled us to quickly assess which issues were common among different stakeholder groups to help prioritize projects that would be most interesting and relevant for our community. The complete matrix is shown on the following page (Table 1).

As we collected information and developed this matrix we also learned that interviewees generally fell into two groups: (1) stakeholder groups that need data and (2) volunteer community scientists that could collect data. Realizing that meeting the needs and interests of both groups is important, we started parsing results based on these two groups.

Additionally, given the importance of adaptive management in guiding data collection, we recognized that a successful project must occur at the intersection of volunteer, stakeholder, and adaptive management interests.

Table 1: This matrix shows commonly important issues for each stakeholder group, as learned through interviews conducted in early 2019.

	Stakeholder or Volunteer?	Water Quality	Flow Level	Clean Drinking Water	Flood Events/Risk	Swimmable Waters	Insect Hatch Timing	Wildlife Habitat	Restoration	Trail Conditions	Climbing Conditions	Soil Health	Climate Change Impacts	Wildfire Risk	Restoration Monitoring Data	Safety	Document Issues	Government role	How to make a difference
Stakeholder		**Water**					**Organisms**		**Restoration**						**Data**			**Roles**	
Anglers	V	x	x		x		x	x	x				x		x	x	x		
Landowners	V	x	x	x	x				x				x			x	x	x	
Boulder/Longmont retired volunteers	V	x	x	x	x				x				x						x
Recreationists (trail runners, mountain/road bikers, climbers)	V				x				x	x	x					x	x		
High School Students	V	x		x		x										x			x
Community members- Mountain Sustainability group	S/V	x	x		x			x					x	x		x	x		x
Farmers/Ag Community	S/V	x	x	x	x				x			x	x		x		x	x	
Passive Recreationists	V	x	x		x			x		x						x	x		
Families	V	x	x	x	x	x		x								x	x		
City of Longmont	S	x	x		x				x						x		x		
City of Boulder	S	x	x		x					x					x	x	x		
State Government	S																	x	
County Government	S																	x	
Wildland Restoration Volunteers	S				x				x	x					x	x	x		
Other coalitions	S	x	x	x	x				x				x		x				
Keep It Clean Partnership	S	x	x	x	x				x				x		x				

Step 3 – Filter Interests to Identify Potential Projects

While the stakeholder analysis matrix (Table 1) provides a helpful snapshot of common issues, we performed further assessment to identify which issues could transfer to specific community science projects with a high likelihood of success. This required identifying potential projects associated with issues. Potential projects were identified through brainstorming and researching existing citizen science efforts. A complete list of potential projects is provided in Table 2, later in this document. To assess each potential project, we used a "SPAR" treatment, as summarized below.

- **S**ize – Size of segment of people who may be interested?
- **P**articipate – How willing might these people be to participate in a related project?
- **A**ccess – How accessible are the people who may want to participate?
- **R**isk – How risky might the related project be for our organization to implement?

We also considered the following facets for each potential project to assess costs/benefits:

- Return On Investment (ROI) – Time invested in training vs. time saved in sampling?
- Fundability – Cost to build/launch; Staff time required; Cost for Materials?
- Relevance to Adaptive Management Plan – How well does data help with known gaps?
- Relevance to Community Science Volunteers – How interested are volunteers in participating?
- Relevance to Stakeholder – How useful and trustworthy are the data for stakeholders?

Step 4 – Develop Research Questions or Monitoring Objectives

For each priority interest considered, we devised focused research questions or monitoring objectives. Some interests had multiple singular research questions or objectives.

In cases where monitoring objectives could be modified to address research questions, we turned monitoring goals into scientific experiments. However, this was not always appropriate, and we acknowledge that some projects meet monitoring objectives rather than research goals. The example below described how a monitoring goal was reframed for research.

- **Re-Framed Research Question** – Is the ecological condition of our watershed improving, declining, or remaining the same each year?
- **Monitoring Objective** – Assess watershed health and resiliency following restoration.

Research Question vs. Monitoring Objective

Research Question – Data collection is to confirm or refute a specific inquiry.

Monitoring Objective – Data collection is to explore and describe a phenomenon.

Step 5 – Are Interests a Good Fit for Community Science?

Pocock et al. (2014) developed a comprehensive decision framework to provide guidance about the suitability of a citizen science approach for any interest or potential project. We evaluated each potential project using this framework to ensure, refine, and clarify our aim. Feasibility, scalability, do-ability, and volunteer safety were key to the evaluation.

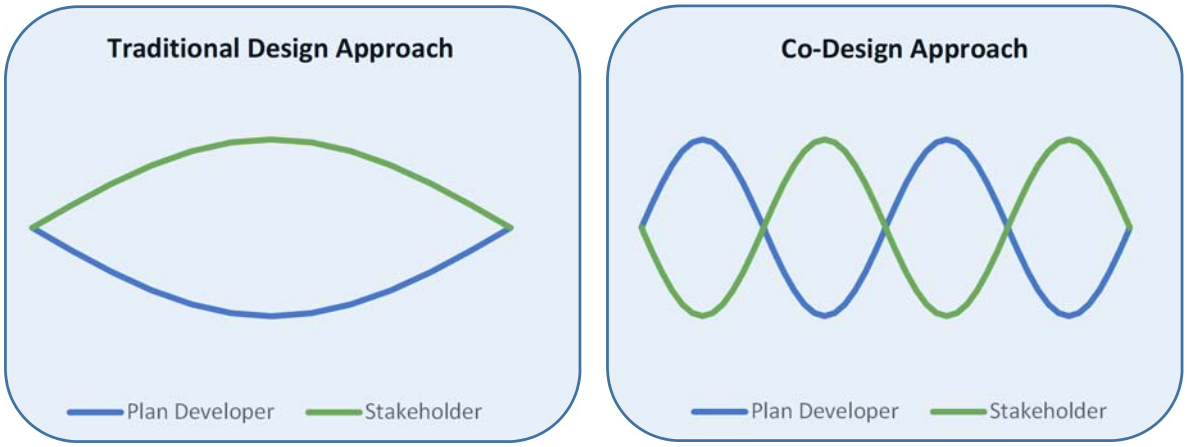
Step 6 – Is Anyone Else Doing Similar Projects?

Checking for existing projects was essential to avoiding reinventing the wheel. With the growing popularity of citizen science, there are many projects that are being implemented by diverse groups. To avoid overlap, we conducted thorough research about existing projects and reached out to national organizations such as US National Phenology Network (NPN) to make sure that we were not repeating existing efforts. Reaching out to others was also critical to ensure that we could incorporate our data into other ongoing efforts where appropriate. For example, by making minor modifications to data entry methods we are ensuring that data collected as part of our "Catch the Hatch" pilot project can be incorporated into the NPN database as part of a larger, long-term effort.

Step 7 – Re-Engage Stakeholders in Designing the Project

As we moved into project design we re-engaged with appropriate stakeholder groups on a regular basis. As illustrated below, a traditional project design approach engages stakeholders at the beginning and end of the process, while a co-design approach engages stakeholders regularly during the design process. This approach enables iterative co-design to ensure that stakeholders have an opportunity to participate in project creation and provide feedback on planning, design, protocols, recruitment strategies, retention strategies, data analyses, participant feedback loops (communication plans), and project evaluation approaches.

As illustrated below, engagement is continuous and iterative throughout the entire process so that stakeholders can have buy-in and ownership of the projects.



Bench of Potential Projects

As mentioned in Step 3 above, we developed a comprehensive "bench" of potential projects. This bench outlines all of the potential projects that we envisioned following completion of steps one through six of the project identification and vetting process. We can move forward projects from this bench as needed, and more projects can be added to this bench as new ideas are generated.

Table 2: A subset of the of potential projects identified in June 2019. A complete bench is available online at https://www.dropbox.com/s/i6a6ig9316pim9y/Project%20Bench.xlsx?dl=0. This bench is a living document, with new projects added and removed as we conduct additional stakeholder analyses. The document specifies Project Name, Project Goals, Project Originator (new projects developed by Left Hand Watershed Center vs existing external projects) and Level of Effort (Green is low; Yellow is medium; Red is high). It also provides links to sample datasheets for each possible project.

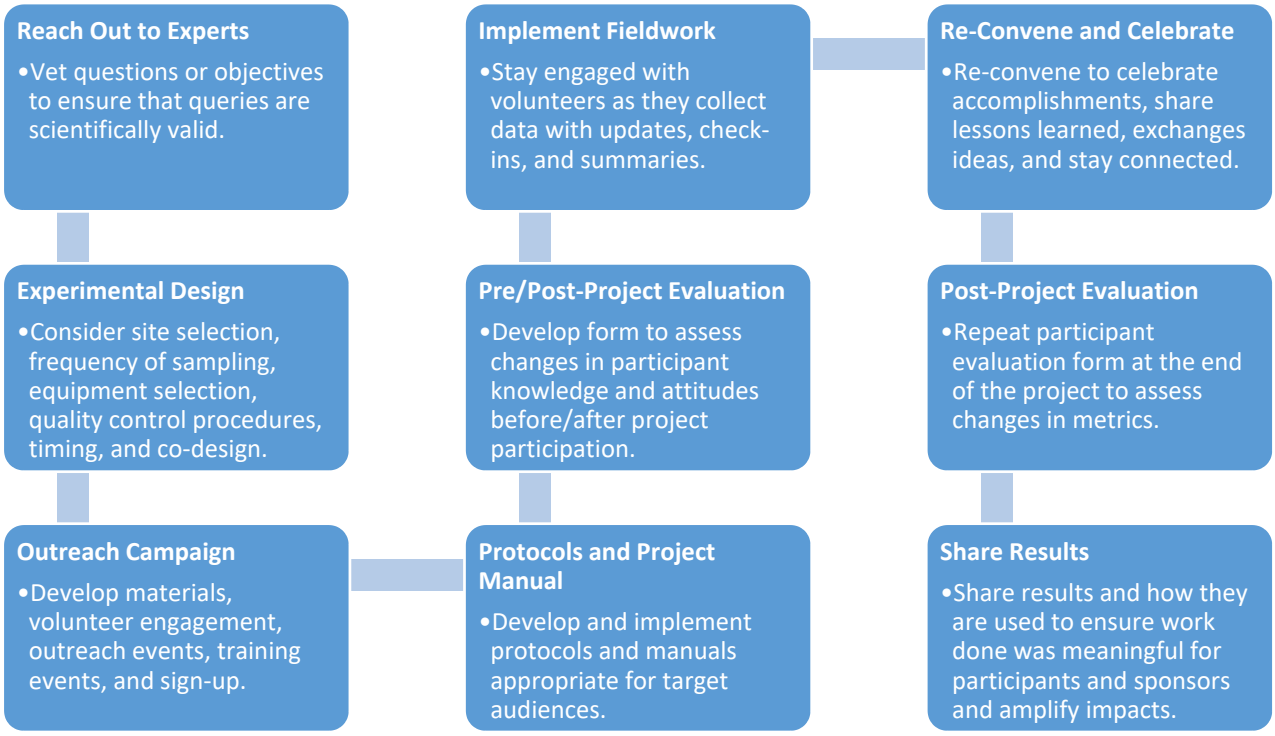
The Watershed Center or others can use this table as a starting place for potential projects. The full online version specifies Science Goals, Education Goals, Potential Target Audiences, Target Levels of Participation, and Recommended Seasonality, among many other factors to help project sponsors narrow in on an appropriate project for their specific needs and preferences.

Project Name	Project Goal	Origin	Effort
AquaBlitz	Identify trends for comparisons upstream and downstream in biodiversity in streams and riparian zones.		
BACI Stream Restoration Success Monitoring	Develop meaningful biological data for use in stream restoration monitoring. Datasheet.		
Rare Bird Detectives	Monitor habitat specialists that are isolated or restricted with a focus on riparian/wetland species of concern.		
HawkWatch	Monitor raptor populations.		
Christmas Bird Count	Understand bird population trends.		
Project FeederWatch	Track long-term trends in bird distribution and abundance.		
Benthic Brigade	Monitor water quality and other indicators of watershed to educate citizens and inform decision makers about the condition of Colorado's waters.		
City Nature Challenge	Make observations of nature in cities around the world.		
Climbers for Bat Conservation	Understand bat ecology.		
CoCoRaHS	Measure and record precipitation across the country.		
CrowdWater	Collect a large amount of data to improve the forecast of hydrological events, such as droughts or floods.		
EarthEcho Water Challenge	Understand the water quality of water bodies around the world (pH, temperature, dissolved oxygen, turbidity).		
iNaturalist	Explore and share observations from the natural world to contribute to biodiversity science.		

Project Name	Project Goal	Origin	Effort
ISeeChange	Combine anecdotal observations of change with sensor, satellite data to create a record of climate change over time.		
Stream Team	Identify potential flood vulnerabilities.		
StreamTracker	Improve intermittent stream mapping and monitoring with observations of streamflow presence and absence.		
Well Watchers	Monitor groundwater quality.		
The Bees Needs	More information on declining native bees.		
Trail Trackers	Quantitatively assess trail conditions and potential sediment load contributions.		
Wildlife Watchers	Determine species presence/absence, and abundance.		
Cat Cam Crew	Understand mountain lion and other wildlife population abundance trends.		
Fire Resilience Team	Assess, monitor, and reduce fuels loading in forests adjacent to streams and creeks of interest.		
Crowd-out the Crowds	Assess resource conditions as they relate to recreational use.		
Weed Warriors	Predict current and future weed distributions; prioritize control.		

Steps to Designing and Implementing a Project

The following steps describe our general procedure for designing and implementing a selected project from the "bench," however steps will vary depending on the unique goals and needs of each project.



Assessing Project Performance

The table below described how we quantitatively assess project performance relative to our overall community science goal and actions.

Community Science Goal	Potential Success Metric
Fill data gaps through effective data collection.	Measure of data gaps filled, new data sets created, or research questions answered.
Inform adaptive watershed management.	Measure of parameters assessed or sites monitored.
Cultivate an active community of stream stewards.	Measure of number of stakeholder groups involved in co-creation or number of participants reporting changed attitude, knowledge, or behavior.
Educate community members about adaptive management-based watershed stewardship.	Measure of number of participants reporting changed attitude, knowledge, or behavior. Measure of number of K-8 place-based learning opportunities or workshops. Measure of number of outreach information materials (e.g. blogs, articles, or stories) shared.
Sustain community science efforts.	Measure of budget raised or active projects.

2019 Community Science Projects List

The table below is a list of our current on-going community science projects.

Project Name	Project Type	Project Goal	Resource Page
Catch the Hatch	Research Question	Advance understanding of mayfly emergence phenology	Project Website
Pebbles	Monitoring Objective	Advance understanding of riffle habitat quality	TBD, In progress anticipated Feb 2020
Pools	Monitoring Objective	Advance understanding of pool habitat quality	TBD, In progress anticipated Sep 2019
Run Off	Monitoring Objective	Advance understanding of high flows	TBD, In progress anticipated Feb 2020
Low Flow	Monitoring Objective	Advance understanding of low flow and water needs	TBD, In progress anticipated Feb 2020
Fishes	Monitoring Objective	Advance our understanding of fish populations, distributions, and conditions	TBD, In progress anticipated Feb 2020

In 2019 the Watershed Center we will implement monitoring projects during Front Range Watershed Days on September 28th. This event will entail a community celebration of watershed health and resilience, as well as a dedicated monitoring event using standardized protocols by community members across watersheds. By integrating celebration and monitoring we hope to raise awareness about watershed resiliency, help people connect to watershed issues, and generate region-scale scientific data about our watersheds.

Looking to the Future

Moving forward, the Watershed Center will work to meet our community science goals by growing our existing projects and developing and implementing new projects from our bench of potential projects (Table 2). Throughout this process we will continue to adapt our efforts to the needs of our community by evaluating our projects and iterating the stakeholder engagement and interview process to update Table 1. Using project evaluations and performance metrics, we will assess the benefits of each project annually to guide decisions about which projects should be continued or how they may need to be modified. We will update this plan and our approach as new information is learned.