Adaptive Management at the Green Community Garden
A Case Study of Outcomes Monitoring in Civic Ecology Practice
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Partnering Organizations and Initiatives
Public Laboratory for Open Technology and Science
The Green Community Garden
Five Borough Farm
Environmental Leadership Program

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Introduction

Municipal governments throughout the United States are increasingly relying on volunteers to create and manage “green infrastructures” that make cities more environmentally sustainable (Pincetl 2010; Svendsen and Campbell 2008). Yet as grassroots groups claim more and more responsibility for maintaining different patches of urban ecosystems (Pickett et al. 2001), they struggle to set clear goals for their work, track their successes and failures, and adapt their practices on the basis of what they discover. This cycle of goal setting, action, monitoring, reflection, and adaptation corresponds with adaptive co-management in rural forms of natural resource management (Armitage et al. 2008; Charles 2008). However, there seem to be very few actual examples of outcomes monitoring for adaptive management at work in small urban “civic ecology” practices (Silva and Krasny 2014). Volunteers and grassroots organizations often lack the resources to initiate outcomes monitoring research, citing cost, time, and staff capacity as barriers (Silva and Krasny 2013; Svendsen and Campbell 2008). Consequentially, these initiatives lack the basic data necessary to critically evaluate their practices and improve them over time. Further, of the few cases of outcomes monitoring currently found amongst civic ecology practices, little has been done to describe and share those experiences with a wider audience through case studies, articles, or web media—a common problem for action-based research (Greenwood and Levin 1998; Chevalier and Buckles 2013).

Community gardens are increasingly recognized as important forms of green infrastructure, providing urban neighborhoods with a laundry list of social, environmental, economic, and health-related benefits (Alaimo et al. 2008; Glover 2004; Cohen, Reynolds, and Sanghvi 2012). Yet community gardens are no different from any other form of civic ecology practice when it comes to collecting data on the outcomes of their day-to-day work. Community gardens in New York City, for example, have long struggled to prove their worth to local decision-makers and funders. Though academic research points to the general benefits of urban agriculture, individual gardens have had to rely on anecdotal evidence to make a case for their worth. This lack of site-specific data—and the tools and methods to create that data—can also limit the extent to which community gardens take a critical look at their successes and failures and try to make improvements to their practices over time. Community gardens, then, are fertile sites for developing and testing grassroots data collection and analysis tools.

Community gardeners and urban farmers in New York City have been developing, testing, and refining a kit of simple data collection protocols for monitoring the social and environmental outcomes of their work. The Design Trust for Public Space, a local incubator for innovations in open space planning and policy, convened farmers and gardeners to take data collection into their own hands under the auspices of their multi-year Five Borough Farm initiative. A small cohort of gardeners and farmers came together in May 2013 to design a beta-kit of data collection methods that they field-tested and improved during the subsequent two growing
seasons. The toolkit is freely available online at [www.farmingconcrete.org/barn](http://www.farmingconcrete.org/barn), where gardeners can develop web-based repositories for their data and create simple reports to analyze the outcomes of their work.

The Public Laboratory for Open Technology and Science (Public Lab) has also developed a suite of low-cost do-it-yourself environmental sensing tools that are useful for community gardens and urban farms eager to monitor the outcomes of their work. Two tools developed by Public Lab are of particular value to community gardens: aerial mapping rigs and near-infrared imagery kits. The aerial mapping rigs allow users to create high-resolution overhead landscape imagery with little more than a consumer-grade digital camera and a kite, weather balloon, or telescoping pole. The near-infrared imaging kits allow users to hack a consumer-grade digital camera to take near-infrared pictures of plants to measure their photosynthetic activity. Combined, the aerial mapping rigs and near-infrared cameras can give gardeners an insight into comparative plant health across a garden, allowing them to assess the efficacy of different horticultural strategies.

The following case study tells the story of a community garden in the Northeastern United States that worked with personnel from Five Borough Farm and Public Lab to monitor some of its seasonal outcomes. An [Environmental leadership Program Innovation Grant](#) funded this project throughout the 2014 growing season. The grant was awarded directly to Philip Silva, Shannon Dosemagen, and Cynthia Mellon, all Senior Fellows of the Environmental Leadership Program. Shannon serves as Executive Director of Public Lab, while Cynthia is an avid practitioner of urban agriculture who lives in Newark and works on regional environmental justice campaigns for a local non-profit organization. Portions of the grant also went toward supporting the work of Carla Green, a community gardener in Newark, NJ, and Liz Barry, director of community development at Public Lab.

**The Green Community Garden**

The Green Community Garden occupies two formerly vacant residential lots in the Fairmount neighborhood of Newark, New Jersey. The more than 2,000 square foot site has been home to a community garden since 2011, when nearby resident Carla Green adopted the conjoined lots through a municipal program aimed at incubating gardens on derelict sites throughout the city. Carla and her partner Frank focused on cultivating 1/4th of the site during the first
growing season. They began by clearing weeds and garbage from the vacant lot, building raised planting beds, and making other basic improvements. The garden received supplemental soil and some additional raised beds from the Greater Newark Conservancy, a citywide greening organization, in its first year.

“I planted flowers all around the perimeter,” Carla recalls. “I planted just about every vegetable I could grow.”

Carla expanded her gardening practices to cover another 1/4th of the site in the garden’s second year, leaving the other half of the site open for meetings and gathering space. The hoop house she and Frank installed in the fall of 2012 survived the winds of Hurricane Sandy but suffered irreparable damage a year later, when a car accidentally veered off the nearby street, through the garden’s chain link fence, and into the middle of the wood and sheet-plastic structure. The hoop house has since been removed, but Carla looks forward to growing winter vegetables again in a new hoop house she plans to install in 2015.

Carla is the primary steward for the garden. She has worked closely with municipal staff to secure small grants that go toward building raised beds, a hoop-house, fencing, and other basic garden infrastructure, but most of the expenses are covered by Carla and Frank. Frank, a local gardening enthusiast with a background in construction, serves as a jack-of-all-trades handyman for the garden. Carla and Frank get help from local residents who periodically stop by the garden to volunteer their labor. They remove weeds and trash, cultivate soil, help harvest ripe produce, and pitch in with other odd jobs that show up on Carla’s to-do list from week to week. In 2015, Carla anticipates having her first regular slate of garden members, with two people receiving their own raised bed for personal planting. Carla and Frank also welcome members of a prison job training and re-entry program through a partnership with local correctional facilities and service-based non-profit organizations.

Carla learned about the Five Borough Farm data collection toolkit in the spring of 2014. She attended a workshop on using the toolkit hosted by the Design Trust for Public Space in New York City. During the workshop, she met Philip Silva and Liz Barry, both Outreach Fellows for the Five Borough Farm initiative. Philip is a Ph.D. candidate at Cornell University researching outcomes monitoring initiatives amongst civic ecology practices in NYC. Barry is a co-founder and the community director for Public Lab, helping local groups use D.I.Y. technologies to do primary research about their local environments. Carla, Liz, and Phil devised a plan to use the Green Community Garden as a test site for outcomes monitoring toward adaptive management using a combination of tools developed through Public Lab and Five Borough Farm.
Outcomes Monitoring and Adaptations at Green Community Garden

Carla, Frank, Liz, Phil, and Cynthia started working together in July of 2014. Their collaboration began on a Sunday afternoon when they met all together at the garden for the first time. Philip and Cynthia joined the first meeting to discuss goals and objectives and review the data collection tools with the team. Carla reflected on her work at the garden during the preceding two years and came up with three basic goals she wanted to monitor: 1) increasing food production; 2) making the garden an relaxing oasis for local residents; and 3) increasing the number of volunteer hours donated to the garden. The team identified three different data collection tools from *Five Borough Farm* and two different tools from Public Lab that could help Carla track the garden’s progress toward achieving these goals.

Carla knew that she wanted to recruit at least two new people to play a regular role as members of the garden. She also knew that she wanted at least one new visitor per month to visit the garden and use it as a source of serenity. Carla did not have a quantitative goal for increasing food production—mostly because she’d never measured her productivity in past years and had no sense of a baseline from which to set a goal. Setting a baseline measure of productivity, then, became her default goal for food production during the project year. Liz and Carla worked together in subsequent weeks to refine her initial goals and objectives, using a shared Google Doc spreadsheet to log and track their ideas (see Image 2).

Having set general goals and clear objectives for the garden, Carla and Liz selected a mix of tools and methods from Public Lab and *Five Borough Farm* to collect data and track progress throughout the 2014 season.

<table>
<thead>
<tr>
<th>Goal</th>
<th>Project / Program</th>
<th>Outcomes</th>
<th>Metrics</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Engage more participation from members in the immediate community</td>
<td>Install a bulletin board and post garden hours. As an “Adopt a Lot” Ambassador, will post flyers and information from access network of farmers’ markets and activities for older people</td>
<td>2 new members from the surrounding neighborhood</td>
<td>Reach of Programs</td>
<td>New York’s Office of Sustainability will fill the out in person at events</td>
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<tr>
<td></td>
<td>Make room for flower beds to attract people with interest in that</td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td>Monitoring / teaching about gardening</td>
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<td></td>
<td>Give food to neighbors as sign of appreciation</td>
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<tr>
<td></td>
<td>Make time to answer questions from neighborhood youth, and engage them more in planting</td>
<td>Celebrity members increase their work time in the garden by 10%</td>
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<tr>
<td></td>
<td>Offer the garden as a location for the Youth Tree Stewards to meet</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>2. Clear out more of the recurring weeds</td>
<td></td>
<td>Participation by Task</td>
<td></td>
<td></td>
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<tr>
<td>3. Plant more food for harvest</td>
<td>Remove a branch from the giant wild cherry to create more solar access</td>
<td>Participation by Project</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Track how much food is grown</td>
<td>Harvest Count</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Set up a comparison between the same crop cultivated differently, and take pictures in infrared, perhaps how much affects water needs. (e.g. count)</td>
<td>[xx]</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[Infrared imagery: data will be in image + map format]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[Public Lab will support field work &amp; map making]</td>
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<td></td>
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<tr>
<td>4. Make the Green Garden a place for all to enjoy</td>
<td>Include diverse spaces in the garden, like multiple resting areas, create a water feature to add peaceful sound</td>
<td>One new person a month comes in to find solace in the garden</td>
<td>Good Foods in the Garden</td>
<td></td>
</tr>
</tbody>
</table>
1. **Increased Food Production—Harvest Count and Infrared & Aerial Photography**

Carla selected the “Harvest Count” method in the *Five Borough Farm* toolkit to measure how many pounds of food she grew and harvested in the garden in 2014. The Harvest Count method invites gardeners to weigh all of the produce they harvest on a standard kitchen scale and log the results over the course of a season. Carla and her fellow gardeners used the Harvest Count method to discover that the garden grew nearly 200 pounds of vegetables from June to November.

Carla also wanted to test the efficacy of mulch in growing spinach at the garden. She worked with Liz to devise two side-by-side test plots in the garden where she grew some spinach *with* hay mulch and some spinach *without* hay mulch. The team planned to take an infrared photograph of the plot at multiple stages of its growth. The infrared image would have shown whether the mulched plot was photosynthesizing with more intensity than the un-mulched plot. However, a garden pest ate through both spinach crops before the test could be completed and the team was forced to postpone the assessment until the 2015 season.

The following is a fictional depiction of how the Harvest Count method works, taken from the *Five Borough Farm* toolkit.

> On August 15th, Susan harvested tomatoes, pole beans, and summer squash from her plot at the Smith Street Community Garden. Before heading home to cook dinner with her harvest, Susan used a kitchen scale stored in the garden’s shed to weigh each harvest separately. Susan found that she had harvested 2 pounds of cherry tomatoes, a half-pound of pole beans, and a three-pound summer squash.

The team also used standard aerial photography to create a detailed image of the garden that Carla and Frank will use for raised bed planning in 2015. The images were taken from a consumer-grade digital camera mounted on a telescoping pole. Liz taught Frank to mount the camera, extend the carbon-fiber pole until it towered over the site, and walk through the garden taking photographs with an automated shutter release process. Liz stitched the resulting images together to make one composite photographic map of the garden.
Making the Garden an Oasis—Good Moods in the Garden

Carla knew that her garden was serving as an informal open space and oasis for local residents. People often stopped by to visit the garden, walk around the vegetable beds and under a tall tree, and sit at the picnic table near the entrance. Carla always made sure visitors left with some freshly harvested vegetables.

“I got hugs. I got tears. I gave a woman so much stuff and she cried,” Carla recalled. “That was very significant for me. She’s come back to help and to thank me.”

Carla wanted to get a better sense of how the garden was serving as a mental and emotional source of strength for the community. She used the “Good Moods in the Garden” method from the Five Borough Farm toolkit to track how people felt when they entered the garden and, again, how they felt when they left the garden.

The following is a fictional description of how the “Good Moods in the Garden” method works, taken directly from the Five Borough Farm toolkit:

Jevon and his friend Samantha are regular volunteers at the Tenth Street Neighborhood Garden. The neighborhood went through some tough times in recent years, and residents looked to the garden as a refuge and a source of hope. Samantha wanted to get a better sense of how people felt after interacting with the garden in order to come up with ways to make the space even more of a resource for local residents. Jevon wanted some evidence that the garden had a positive impact on the neighborhood in order to apply for a $500 grant that would cover the cost of a nicer garden gate.

Jevon and Samantha teamed up to measure the good moods coming out of the garden during the summer. They printed a sheet of mood words and clipped the tags to look like a tear-off flyer on a community bulletin board. They posted the flyer by the garden gate near a cheap mailbox they purchased at the local hardware store. At the first garden meeting of the season, they invited other participants to take a moment upon entering and leaving the garden to pause and choose one word that best described how they felt, tearing the word from the flyers and dropping them into the appropriate envelopes in the mailbox.

After a week, Jevon and Samantha opened the mailbox and counted up the number of words in each envelope. They found that a number of people walked into the garden feeling sad, anxious, or tired, and left feeling peaceful, calm, and rested. They posted fresh sheets at the garden gate, logged the results, and shared them at the next garden meeting. After a few weeks, Jevon had enough data to make the case that Tenth Street Neighborhood Garden had a positive impact on people that came through the gate. He discussed the findings in his grant application. Samantha used the findings to jumpstart a conversation with other...
Carla tweaked the method to serve her purposes. Instead of posting “Mood Words” at the garden gate, she simply greeted her visitors with a sheet of positive and negative word choices cut into tiny slips and invited them to choose the word that best described how they felt at that moment. She repeated the process when she bid visitors farewell. She and Frank also got in the habit of tracking their own moods using the same technique. By the end of the season, Carla saw a trend in the mood words visitors selected when they walked in and out of the garden. She learned that the garden was offering a much-needed respite for some people in the neighborhood—something she already knew anecdotally, but could finally tally up in a quantitative way through the Mood Words she’d collected from week to week.

“People like to come to the garden because it makes them feel better,” Carla reflected. “I didn’t have too many people leaving feeling badly. Most everyone was happy or excited—that’s probably because they worked out whatever was going on with them at the time.”

3. Increasing Volunteer Hours—Participation by Task

Carla and Frank are increasingly relying on volunteers from the neighborhood to take care of basic tasks around the garden. As opportunities for garden membership grow, dividing up the labor and tracking the completion of basic tasks has become one of Carla’s priorities. Carla wanted to get a better sense of what was—and was not—getting done in the garden. She used the “Garden Participation by Task” method in the Five Borough Farm toolkit to assign working visitors discreet tasks and track the number of hours they all put toward working in the garden.

The method uses 5.5 inch x 4.25 inch “Task Cards” that depict different routine chores around the garden: tidying up, composting, watering, weeding, pruning, planting, coordinating, and maintaining open gate hours. Volunteers or members working in the garden track their time working toward any of these tasks by filling out a card and dropping it in a mailbox or handing it to a coordinator (see Image 3).
The following is a fictional description of how the “Garden Participation by Task” method works, taken directly from the *Five Borough Farm* toolkit:

*All of the members of Beagle Street Farms donate volunteer service hours to keep the garden running smoothly. On Tuesday, Jonathan stopped by after work and spent an hour watering the garden’s communal beds. On Wednesday, Samantha spent half an hour turning compost and another half-hour tidying up the garden’s shed. Both Jonathan and Samantha filled out garden task cards before leaving, dropping them in a mailbox in the shed to log the hours they’d donated to the garden that week. On Sunday morning, José gathered up all of the cards in the mailbox and tallied up the hours spent on each task, logging them in the Participation by Task form.*

“I found that people give me quite a bit of their time,” Carla reflected at the end of the season. “I got two additional people this last year so I found that the garden was better kept.”

Tracking garden tasks helped Carla realize the value of maintaining open hours for the garden—an activity directly related to her goal of making the garden an open oasis for local residents. The process of keeping tabs on work activities also helped cultivate two new regular members for the garden—a goal that Carla set out to achieve at the start of the project. Carla and Frank plan to build and install new private garden beds for these members at the start of the 2015 season—a first for the Green Community Garden and a sign of growing investment on the part of local residents.

Carla, Frank, and the wider community of participants at the Green Garden had some successes and some roadblocks to measuring the outcomes of their work in 2015. A garden pest thwarted an infrared analysis of the efficacy of mulching spinach beds. The mid-season start made it difficult for Carla, Liz, and the rest of the research team to think strategically about goal setting. In spite of these challenges, the project helped Carla set a baseline for food production in 2015. She plans to harvest more than the 200 pounds she tracked during the project year. The experience also helped Carla gain direct evidence of the way her garden improves the lives of people in the community—and the amount of time those people are giving back to the garden as volunteers and members.

Carla and Frank plan to use the same tools and methods from *Five Borough Farm* and Public Lab to track their progress during the 2015 gardening season. Carla aims to overhaul the garden’s composting efforts and measure the amount of compost produced using the *Five Borough Farm* “Compost Output” measuring method. She also wants to start tracking the amount of rainwater the garden harvests in a new set of rooftop collection cisterns slated to be installed in the spring of 2015.
Conclusion: Insights and Outcomes from the Project

The Green Community Garden has become a place where gardeners track the outcomes of their work together and use the data they generate to reflect on—and, sometimes, improve—their day-to-day practices. This pilot project helped to cement outcomes monitoring habits at The Green Community Garden. It demonstrated that gardeners could use low-cost and accessible methods to capture evidence of what already works and what might need to be improved in their daily practices. To that end, this project serves as a template for other community gardens interested in monitoring the outcomes of their own work using their own selection of tools and methods to get the job done.

Perhaps the most lasting outcome of the project involves Carla’s growing involvement with the international network of researchers, technologists, and community activists that make up the Public Laboratory for Open Technology and Science. Carla attended the November 2014 Public Lab Barn Raising, an annual event that brings together Public Lab personnel from around the world for a three-day symposium on participatory science. Carla and Liz presented on their work together throughout the summer of 2014 and discussed other gardening data collection strategies with members of the wider Public Lab network.

The Public Lab website has become a repository for tools and strategies developed during this collaborative project. Any other garden hoping to duplicate and, perhaps, improve upon the experience of the Green Community Garden can find a trove of free resources at http://publiclab.org/wiki/gardening-toolkit. This one-of-a-kind toolkit has step-by-step instructions for starting an outcomes monitoring project, setting goals and objectives, using Public Lab technologies, and reflecting on the strengths and weaknesses of different garden management practices. The site is set up as a Wiki—anyone can register to edit, add, and improve the toolkit based on their own experiences in the field.

Back at the Green Community Garden, Frank has become an expert aerial photographer and Carla has learned to accurately calibrate the camera for infrared photography. Carla uses the Five Borough Farm “Mill” website to log data on the pounds of food she harvests and the good moods she creates when she opens the garden gate. The Green Community Garden has become a data-savvy civic ecology practice and its leaders are eager to keep the momentum going in the next gardening season. We hope their story inspires other community gardeners and urban farmers to cultivate the same practices for themselves.
References


Appendix 1: BARN Report for Green Community Garden
Keeping track of your crop count helps you get a handle on the annual productivity of your garden. This report displays total number of crops in a garden, and how many plants of each crop type measure by bed, row feet or square feet.

<table>
<thead>
<tr>
<th>Crop Type</th>
<th>Number of Plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>tomatoes (cherry)</td>
<td>2</td>
</tr>
<tr>
<td>tomatoes</td>
<td>12</td>
</tr>
<tr>
<td>squash (summer)</td>
<td>1</td>
</tr>
<tr>
<td>pumpkin</td>
<td>1</td>
</tr>
<tr>
<td>peppers (hot)</td>
<td>11</td>
</tr>
<tr>
<td>peppers</td>
<td>10</td>
</tr>
<tr>
<td>okra</td>
<td>1</td>
</tr>
<tr>
<td>melons</td>
<td>3</td>
</tr>
<tr>
<td>lettuce</td>
<td>96</td>
</tr>
<tr>
<td>kale</td>
<td>3</td>
</tr>
<tr>
<td>herbs (unspecified)</td>
<td>15</td>
</tr>
<tr>
<td>fennel</td>
<td>12</td>
</tr>
<tr>
<td>eggplant</td>
<td>16</td>
</tr>
<tr>
<td>cucumbers</td>
<td>2</td>
</tr>
<tr>
<td>collard greens</td>
<td>35</td>
</tr>
<tr>
<td>callaloo</td>
<td>40</td>
</tr>
<tr>
<td>cabbage</td>
<td>61</td>
</tr>
<tr>
<td>beans (bush)</td>
<td></td>
</tr>
</tbody>
</table>

This data was collected with the Five Borough Farm Data Collection Toolkit. To see the full protocol please visit farmingconcrete.org/barn.
This report tallies up all of the pounds of produce harvested in your garden this year. Keeping track of your produce helps you quantify the wealth of fruits and vegetables grown in your garden.

193.3 POUNDS

- tomatoes (cherry): 5
- tomatoes: 15
- swiss chard: 21
- squash (unspecified): 1
- squash (summer): 8
- peppers (sweet): 11
- peppers (hot): 1
- okra: 4
- kale: 8
- herbs (unspecified): 9
- eggplant: 8
- cucumbers: 18
- collard greens: 40
- beans (pole): 15
- beans (bush): 22
- basil: 0
- New Zealand Spinach: 4

This data was collected with the Five Borough Farm Data Collection Toolkit. To see the full protocol please visit farmingconcrete.org/barn.
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2.2

PARTICIPATION BY TASK

01/01/2014 – 12/31/2014
CREATED: Jan. 28, 2015

THE GREEN GARDEN 1 114 S 8th St

This data was collected with the Five Borough Farm Data Collection Toolkit. To see the full protocol please visit farmingconcrete.org/barn.
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Community gardens and green spaces are believed to positively impact emotional wellbeing of people they serve. They reduce stress and increase feelings of happiness and peacefulness. In order to evaluate this valuable quality of your garden, this report measures all of the good and bad moods people registered as they walked in and out of your garden in a particular period. The following results will help you understand your garden’s emotional value and might also lead to different ways to make your space have an increased positive impact on participants and visitors.

**3.2 GOOD MOODS IN THE GARDEN**

**THE GREEN GARDEN 1 114 S 8th St**

3 records

![Bar chart showing change in positive moods between entering and leaving the garden.]

**CHANGE IN POSITIVE MOODS BETWEEN ENTERING AND LEAVING THE GARDEN**

![Bar chart showing change in negative moods between entering and leaving the garden.]

**CHANGE IN NEGATIVE MOODS BETWEEN ENTERING AND LEAVING THE GARDEN**