Engaging Citizens in Science Dialogue: An Evaluation of the Nurture Nature Foundation's Flood Forum Project

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Engaging Citizens in Science Dialogue: An Evaluation of the Nurture Nature Foundation's Flood Forum Project

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RMC RESEARCH

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"It's easy to bring together those people who are already powerfully involved stakeholders in an issue…. Finding ways to include or represent the broader public, especially those whose voices have traditionally been excluded, is a more challenging proposition." Public Agenda (2008)[1]

A NEW MODEL OF PUBLIC ENGAGEMENT IN SCIENCE

The Nurture Nature Foundation's Flood Forum project, funded by a two-year National Science Foundation (NSF) planning grant effective August 1, 2009, explored innovative means to promote science learning by and for local communities. The NSF planning grant allowed Nurture Nature Foundation (NNF) to develop a model of outreach for science centers that engages rural and underserved audiences in public dialogue on the science underlying an issue of high public concern—frequent flooding in Pennsylvania's Lehigh Valley.[2]

Building on a public forum model used by other science centers such as the Museum of Science, Boston, and the North Carolina Museum of Natural Sciences[3], the Nurture Nature Foundation sought to include audiences that that are not generally reached by informal science programs and that are often neglected constituencies, specifically residents of rural areas, low-income and/or minority citizens, first responders, and teenagers. Further, the Nurture Nature Foundation's model based science learning on a foundation of interest in an issue of community concern.

The centerpiece of the pilot project was a series of paired focus groups and forums conducted with citizens in three communities in the Lehigh Valley area within the Delaware River watershed. Focus groups in the three communities targeted the underserved audiences and provided a ground-level profile of community interests, science knowledge, and concerns. Findings from these focus groups shaped forums later held in each municipality that were open to a broader cross-section of citizens in each community, drawing outdoor enthusiasts, environmentalists, artists, business people, and other residents.

The forums were aimed at engaging diverse audiences in dialogue about flooding, land-use, and risk management and related issues, and at building individual and community capacity for participating in discussions leading to decision-making through an enriched scientific understanding of floods. Challenges included engaging a diverse cross-section of local populations and creating a safe space for information-sharing, dialogue, and learning while discussing potentially contentious and divisive issues.

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[1] *Primer for Public Engagement*

[2] Pennsylvania ranks third in the nation (after Texas and Louisiana) in flood-related fatalities, and residents of the Delaware River Basin have experienced four "100-year" floods in the last 75 years, two of them within the last five years, in 2005 and 2006. Those two floods, preceded by a significant flood in 2004, remain powerful memories for the many citizens who lived through them.

[3] Representatives of both organizations served as consultants/ advisors on this pilot project

The results of these community-centered events were presented in two regional flood forums held at the end of the pilot project period. These forums were attended by a mix of past participants, newcomers to the Flood Forum project, scientists, and local decision-makers. The regional forums were designed to continue the community dialogue about flooding across social and economic groups. Findings from community focus groups and forums were summarized in a decision-makers' report and shared at these regional forums. Those findings, along with scientific presentations, served as a jumping-off point for additional discussion of flooding priorities in the region.

While decision-makers were excluded from the community forums to give people a chance to speak freely, decision-makers were included in the regional forums to provide an opportunity for one-on-one dialogue.

EVALUATION FRAMEWORK

RMC Research Corporation, a national evaluation and research firm based in Portsmouth, NH, was contracted to conduct evaluation of the Nurture Nature Foundation pilot. Evaluation activities were designed as an integral component of the science center – community dialogue, both contributing to the dialogue and providing a critical review of the Nurture Nature Foundation's strategy for engaging an economically and ethnically diverse population in a new model of science engagement. Thus, activities were aimed at both providing front-end data for the development of subsequent programming and at assessing the effectiveness of the public forum model in engaging community members in a participatory science learning experience.

RMC evaluation activities included conducting and reporting on focus groups in each of the three communities, data from which informed the subsequent forums. Focus group evaluations thus provided front-end, formative data for project planning. Forum evaluations looked at participant engagement, interest, and learning in order to assess the effectiveness of the forum model. RMC conducted nine focus groups and evaluated seven public forums conducted by Nurture Nature Foundation staff between January and September 2010.

Focus group and forum participants were assembled through intensive recruitment activities conducted by Nurture Nature Foundation staff. Recruitment was considered an important activity in science center outreach and community building.

RMC provided Nurture Nature Foundation with summaries of data collected in each community following the completion of the focus groups and forums shortly after the conclusion of events in each community.

RMC also produced, in collaboration with Nurture Nature Foundation staff, a report to local and regional decision-makers that synthesized high-level findings of interest to decision-makers. The report, which highlights broad interest in flooding and citizen suggestions for governmental action was presented at a regional conference, made available on the Nurture Nature's website (http://www.nurturenaturecenter.org/), and distributed to at least twenty-one decision makers at the regional forums.

This present report, based on RMC's evaluation activities, presents an overview of the Nurture Nature Foundation Flood Forum planning project. The evaluation team was charged with assessing the overall forum model as a strategy for engaging diverse

citizens in science learning. As such, evaluation activities do not neatly fall into formative and summative components; they were rather interrelated pieces of an extended dialogue about flooding and watershed management and about understanding the experiences and perspectives of others.

CONCLUSION (SUMMARY AND RECOMMENDATIONS)

The focus group – forum adaptation of the forum model of science education was unquestionably successful in engaging local residents, creating opportunities for them to apply new knowledge in realistic scenarios, and building allegiance to the new museum. It appears that a number of participants are more likely to participate in future science forums and possess greater confidence in discussing science content with scientists.

In designing the pilot project, the Nurture Nature Foundation posed six key questions aimed at determining the efficacy of the Flood Forum Model. These questions structure the following Summary and Recommendations.

What are appealing entry points into dialogue with low-income residents, teens, and first responders?

The two primary motivations participants cited for attending the community forums were learning about flooding and contributing to the design of a new museum. Flooding was a natural entry point for many. Recent floods were still vivid memories, and for some, a persistent threat, in Easton and Lower Mount Bethel. Allentown participants did not perceive themselves as under threat of flooding and, accordingly, forum attendance was lower.[4]

Beyond the intrinsic draw of *talking* about flooding, it was clear that the opportunity for *learning* about flooding was also strong. Many participants had done extensive research on the recent floods and came to the forums with theories to test with presenting scientists. Particularly in Lower Mount Bethel, participants had developed deep practical knowledge about local rivers; they were keenly sensitive to changes in animal behaviors and skilled readers of water level readings made available through the Internet. They, like the other participants, articulated important questions about the causes of flooding, opportunities for mitigating flood damage, and improved warning systems, among other topics.

Contributing to the design of a new museum appeared to draw participants at two levels. At one level, as evidenced by the range and creativity of museum suggestions, this entry point spoke to the appeal of exercising imaginative power over an essentially "blank slate." At another, the new museum excited interest from participants who perceived its potential for economic revitalization, particularly in Easton.

The most appealing entry point for first responders appeared to the opportunity to better explain their work to other community members. They were appreciative of

[4] Flooding does occur in Allentown in industrial areas, but not in residential areas. Thus flood insurance claim numbers were high but community interest less so.

the attention paid to their work before (and during and after) floods and were eager to share their knowledge of flood safety practices.

A few different groups of teenagers took part in focus groups—students in a high school environmental science class; middle and high school students and young people from the Allentown Boys and Girls Club; and family members (in LMBT and Easton events). While differing significantly in terms of first-hand experience of flooding, prior knowledge, and engagement in the issues, the young people all found the topic of flooding interesting, and were extremely enthusiastic contributors of ideas for the museum.

For immigrants who were relatively new to Easton, the forums appeared to be a useful source of knowledge about the Lehigh Valley weather and ecology. It was also an occasion to reflect on experiences of natural disasters in their native countries and offer suggestions, for example, about types of warning systems, for their adopted city.

Interest in flooding was related to another entry point for many people: the opportunity to communicate with decision-makers. For some participants in Lower Mount Bethel and to a lesser extent in Easton, the pain of flooding had been compounded by frustration with local officials and the Federal Emergency Management Agency. In Allentown and Easton, some economic decisions and opportunities for growth depended on developing the floodplain. The possibility of reaching decision-makers was clearly appealing in all three communities.

Communicating with others, broadly understood, also appeared to be a strong entry point for many participants; all three types of events—focus groups, community forums, and regional forums—were at some level social events. "This was better than television," noted a Lower Mount Bethel focus group participant; another observed that he "could do this every night." "Just the fact that the forum was held" was a source of great value to at least one Lower Mount Bethel forum participant. For many, the opportunity to give testimony to their flooding experiences and hear those of others was a compelling aspect as well. Numerous participants identified discussion with others as a prime value of the events.

What do citizens know about the causes and mitigation of flooding?

Participants came to the NNF events with varying knowledge levels. Some, like the students from the Allentown Boys and Girls Club, had little foundational science knowledge, while others, such as environmentalists with local watershed projects, had a great deal of very specific knowledge. Participants who lived on rivers may have had a close familiarity with the river in times of flooding and otherwise, but a less firm understanding of the underlying physical and biological forces at play. The NNF pilot project designers identified a handful of key concepts they used as indicators of science knowledge: *the causes of flooding*, *the floodplain*, *the 100-year flood*, and *the watershed*. Another fundamental concept was the idea that flooding is a natural process.

The questionnaire for focus group participants asked explicitly about their knowledge of these key terms; based on questionnaire responses, the NNF ensured that presenting scientists discussed and explained those terms, and table discussion prompts at the forums drew participants into discussions based on these concepts.

Among the key concepts, *the floodplain* and the *100-year flood* emerged as areas of greatest participant learning. The explanation of the 100-year flood as a planning construct and the statistical assessment of each flood event appeared to intrigue participants; mention of the 100-year flood was most frequent in response to questions about what participants had learned. Several participants at the regional forums, held in Easton, noted learning that the city included the 500-year floodplain zone in City floodplain regulations.

Learning about the *floodplain* was a close second to the 100-year flood and appeared to elicit even deeper learning among participants, as reflected in comments noting that "the floodplain is an integral part of the river" and conclusions that floods are natural—and inevitable—events. Participants' comments across all of the Nurture Nature Foundation events suggest a shift from a focus on "flood prevention" to "damage mitigation."

Watershed appeared to gain less traction with participants. A notably smaller number of community participants identified watersheds as a source of new knowledge, suggesting that more work can be done to engage participants in a systemic understanding of the water system. Despite this, discussion about possible exhibits for the new museum gave participants an opportunity to apply their new knowledge, and one of the most common suggestions was an interactive watershed model that allowed participants to change variables such as the amount of impervious surface as a way of seeing the effects on runoff and ultimately on flood incidence.

What common associations do people have with the river? With flooding? What language do people use when talking about these issues?

The associations with rivers and flooding that emerged in participants' conversations conveyed the many powerful ways participants connected with rivers. For some, the river was a refuge, a place of solace after personal loss; for others the river was a kind of being, with its own breathing pattern. People described living alongside the river as having a quality of joy no other way of life could duplicate. Living on the river was an intense personal investment. Self-identified "river rats," who live on the river, spoke of the river in terms of both awe and peace, balancing descriptions of fishing or boating with accounts of the intense sound—"like a train"—that a flooding river makes. The way of life was so strong, some said, that they did not stop thinking about the river (and possible flooding) even when they were away on vacation. For participants who did not live directly on rivers, the proximity to rivers was still a highly valued aspect of their lives. The rivers are essential to the identities of all three communities.

Furthermore, a number of participants who had lived through floods saw themselves as "survivors" in positive terms, describing themselves as stronger and more resilient for having undergone the experience.

These affective associations with rivers and flooding emerged most explicitly during the focus groups, when participants were invited to share their personal stories about the river; however, participants also shared flood stories during small-group discussions at forums. There the stories provided an opening for further conversation with other participants.

At the regional forums, which were not set within local communities as the earlier events were and involved much broader audiences, a display of photographs and stories about flooding created a human context for science content on potentially abstract topics such as flood frequency and climate change. Participants concurred that including personal experiences throughout the stages of the project was a powerful way to ground the forum and discussions of flooding in human experience and personal connection to the issues.

What is the educational and motivational value of forum events to these priority audiences?

The NNF Flood Forum model was extremely successful in interesting participants in learning more about rivers and flooding: the fact that nearly 40% of people who had attended one or more previous events attended the regional forums suggests the level of personal investment in the NNF content and process. In interviews, several participants described conducting Internet searches on flooding following their exposure to an NNF event. A strong majority of regional forum participants who had attended earlier NNF events reported that they had sought out additional information about floods, rivers, floodplains, and watersheds following the earlier event, and many forum participants indicated that they intended to share what they had learned with family and friends. Nearly all community forum participants indicated that the experience made them likely to attend another science or flooding forum, and more than half indicated an interest in getting involved in community planning or municipal meetings related to flooding.

The range of suggestions and participants' enthusiasm in contributing ideas for future forums or other public events also suggests an ongoing interest in the public forum experience.

For a number of participants, particularly in Easton, the economic potential of the museum—and the riverfront itself—was a motivating factor in attending NNF events.

How can we address imminent flooding threats without spreading alarm and panic among the lay public?

The NNF was highly successful in treating a potentially volatile public issue with sensitivity and calm. At no time did the science presenters or NNF personnel discuss flooding in sensational terms that could have evoked alarm. This was of particular importance in discussions with members of the immigrant community, many of whom had first-hand experience with natural disasters. Members of this community were still learning about the level of flood threat in the Lehigh Valley and the available support from local governments.

To be sure, interest in flood warning systems was strong and warnings consistently ranked high among potential museum exhibit topics. The public memory of the floods of the past decades—for a handful of participants the 1955 flood as well—remained vivid and the commitment not to be caught "off guard" was strong. In Lower Mount Bethel, for example, the (volunteer) fire and rescue personnel found themselves building their flood response system in the midst of the first major event, in 2004, and continued to refine that system through subsequent floods. Householders who lived in

flood zones had either raised their homes or developed systems for securing their houses and valuables at the first indication of a flood.

Further testimony to the success of the flood forum model appeared in the fact that, while participants were able to voice and even vent frustrations related to flooding experiences, personal loss, and questions and even anger regarding what was believed to be the mismanagement of upriver reservoirs, at no point did these issues derail the focus group or forum agendas or appear to prevent people from sharing freely.

How can the educational value of forum programs be adjusted to energize debates that use and address lay interests, concerns, terms, and natural modes of dialogue?

The focus group – forum pairing model, an adaptation of forum models used in other science centers, proved effective in building interest among target audiences and in supporting participants in making a personal connection to the issue. The focus group as formative tool allowed the NNF to refine the subsequent forum structure to accommodate opportunities for participants to share personal stories. The refined structure validated participants' personal perspectives and at the same time introduced relevant science content. The small-group discussion questions, which moved from personal concerns to discussions about the best use of floodplain regions in each community, gave participants an opportunity to apply their new science learning to actual issues facing their communities.

RECOMMENDATIONS

The chief recommendation is that the NNF continue to refine and expand on the work it has accomplished. More specific suggestions follow related to programming and to event facilitation.

Programming

- Continue to provide multi-modal and multi-age entry points that will keep participants engaged in learning and using science in the care of their environments.
- Offer opportunities for more intensive engagement, for example, water monitoring, oral history gathering, and school-based programs, for those who are interested.
- Continue to develop science programming informed by knowledge of the community, its interests and concerns, preferred modes of expression and dialogue, and existing science knowledge.
- Explore ways to combine personal narratives related to flooding or other public concerns which science can address with multi-media and Web 2.0 modes of communication.
- Address citizens' concerns about the transparency and practices of the management of the reservoirs on the Delaware River in New York State.
- Design and implement a public education campaign to correct the near-ubiquitous misunderstanding of the 100- or 500-year floodplain terminology.

- Design and implement a public education campaign to raise awareness of watersheds; devote future educational programming to watersheds and systems thinking.
- Develop a flood forum model appropriate for student learners not yet ready to participate in community dialogues.

Event Facilitation

- Continue to experiment with formats to accommodate different styles of conversation—large-group and small-group discussion, and one-on-one conversations with scientists.
- Capitalize on the presence of scientists to offer participants more opportunity to question presenters during or immediately after their presentations.
- Continue to ensure that all voices are heard and that facilitators reflect participants' intended meaning through increased formalization of training for table facilitators.
- Continue to refine the visual presentations away from static PowerPoints and toward a more dynamic and/or interactive medium.

The baseline science knowledge questions were designed for use in this pilot phase to provide actionable information for the development of forums. In the full-scale development, it is suggested that the Nurture Nature Foundation continue this practice of gathering information on science content and conducting pre- and post-studies of participants' knowledge of river ecology. Questions should be drawn from national indicators of watersheds, river ecology, river/flood safety literacy, etc.

Participants entered the dialogue at varying levels of knowledge and expertise. In most cases, the forum model easily accommodated these variations, and participants shared knowledge, alternately serving as experts and learners. However, too-great differences in knowledge can also bog down the experience, as was the case for students from the Allentown Boys and Girls Club, who generally lacked even a rudimentary understanding of the water cycle. That is not to say, however, that such groups should be excluded from NNF activities; the students asked thoughtful questions during both the focus group and forum and were enthusiastic about learning more about the natural environment. Greater accommodation to meet the needs of groups with sharply divergent background knowledge is recommended, as is exploring separate activities to target these groups.

CODA: WHAT DOES IT MEAN TO BE SCIENCE LITERATE?

Current notions of science literacy emphasize literacy as an activity or practice rather than a product.[5] The high levels of Nurture Nature Foundation forum participants' engagement, concern, and active learning about flooding and related policy issues suggest that the Flood Forum pilot project was successful in promoting some forms of science literacy. At a minimum, many participants integrated some of the key

[5] Roth, Wolff-Michael and Angela Calabrese Barton, *Rethinking Scientific Literacy*, RoutledgeFalmer: London, 2004.

scientific concepts in a way that, according to their reports, shifted, even if subtly, their perspectives on rivers, on flooding, on first responders, and on other people.

As the NNF project continues to engage citizens in learning and using science to address environmental and quality-of-life issues it is expected that greater numbers of citizens will become science literate in numerous ways. They may range from possessing a heightened awareness of the forces of nature to engaging directly with nature through water monitoring, record-keeping, art-making, and other forms of stewardship.

INTRODUCTION

"It's easy to bring together those people who are already powerfully involved stakeholders in an issue…. Finding ways to include or represent the broader public, especially those whose voices have traditionally been excluded, is a more challenging proposition." Public Agenda (2008)[6]

A NEW MODEL OF PUBLIC ENGAGEMENT IN SCIENCE

The Nurture Nature Foundation's Flood Forum project, funded by a two-year National Science Foundation (NSF) planning grant effective August 1, 2009, explored innovative means to promote science learning by and for local communities. The NSF planning grant allowed Nurture Nature Foundation (NNF) to develop a model of outreach for science centers that engages rural and underserved audiences in public dialogue on the science underlying an issue of high public concern—frequent flooding in Pennsylvania's Lehigh Valley.[7]

Building on a public forum model used by other science centers such as the Museum of Science, Boston, and the North Carolina Museum of Natural Sciences[8], the Nurture Nature Foundation sought to include audiences that that are not generally reached by informal science programs and that are often neglected constituencies, specifically residents of rural areas, low-income and/or minority citizens, first responders, and teenagers. Further, the Nurture Nature Foundation's model based science learning on a foundation of interest in an issue of community concern. The centerpiece of the pilot project was a series of paired focus groups and forums conducted with citizens in three communities in the Lehigh Valley area within the Delaware River watershed.

Focus groups in the three communities targeted the underserved audiences and provided a ground-level profile of community interests, science knowledge, and concerns. Findings from these focus groups shaped forums later held in each municipality that were open to a broader cross-section of each community, drawing outdoor enthusiasts, environmentalists, artists, business people, and other residents.

The forums were aimed at engaging diverse audiences in dialogue about flooding, land-use, and risk management and related issues, and at building individual and community capacity for participating in discussions leading to decision-making through an enriched scientific understanding of floods. Challenges included engaging a diverse cross-section of local populations and creating a safe space for information-sharing, dialogue, and learning while discussing potentially contentious and divisive issues.

The results of these community-centered events were presented in two regional flood forums held at the end of the pilot project period. These forums were attended by a

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[6] *Primer for Public Engagement*

[7] Pennsylvania ranks third in the nation (after Texas and Louisiana) in flood-related fatalities, and residents of the Delaware River Basin have experienced four "100-year" floods in the last 75 years, two of them within the last five years, in 2005 and 2006. Those two floods, preceded by a significant flood in 2004, remain powerful memories for the many citizens who lived through them.

[8] Representatives of both organizations served as consultants/ advisors on this pilot project

mix of past participants, newcomers to the Flood Forum project, scientists, and local decision-makers. The regional forums were designed to continue the community dialogue about flooding across social and economic groups. Findings from community focus groups and forums were summarized in a decision-makers report and shared at these regional forums. These findings, along with scientific presentations, provided a jumping-off point for additional discussion of flooding priorities in the region.

While decision-makers were excluded from the community forums to give people a chance to speak freely, the regional forums included decision-makers to provide an opportunity for one-on-one dialogue.

EVALUATION FRAMEWORK

RMC Research Corporation, a national evaluation and research firm based in Portsmouth, NH, was contracted to conduct evaluation of the Nurture Nature Foundation pilot. Evaluation activities were designed as an integral component of the science center – community dialogue, both contributing to the dialogue and providing a critical review of the Nurture Nature Foundation's strategy for involving an economically and ethnically diverse population in a new model of science engagement. Activities were aimed at both providing front-end data for the development of subsequent programming and at assessing the effectiveness of the public forum model in engaging community members in a participatory science learning experience.

As a whole, the planning and evaluation of the Flood Forum project was designed to test and address the following questions relevant to the implementation of the model on a wider scale in this and other communities. The Nurture Nature Foundation wanted to know:

- What do citizens know about the causes and mitigation of flooding?
- What is the educational and motivational value of forum events to these priority audiences?
- What common associations do people have with the river? With flooding? What language do people use when talking about these issues?
- What are appealing entry points into dialogue with low-income residents, teens, and first responders?
- How can we address imminent flooding threats without spreading alarm and panic among the lay public?
- How the educational value of forum programs can be adjusted to energize debates that use and address lay interests, concerns, terms, and natural modes of dialogue.

On the broadest level, RMC's evaluation was designed to address these questions.

RMC evaluation activities included conducting and reporting on focus groups in each of the three communities, data from which were used to inform the subsequent forums. Focus group evaluations were thus intended to provide front-end, formative data for project planning. Forum evaluations looked at participant engagement, interest, and learning in order to assess the effectiveness of the forum model. RMC

conducted nine focus groups and evaluated seven public forums conducted by Nurture Nature Foundation staff between January and September 2010.

Focus group and forum participants were assembled through intensive recruitment activities conducted by Nurture Nature Foundation staff. Recruitment was considered an important activity in science center outreach and community building.

Focus Groups

Focus groups conducted by RMC were designed as opportunities to learn about the backgrounds, interests, knowledge, and experiences of diverse audiences in the three communities and to deepen the Nurture Nature Foundation's understanding of potential audiences throughout the Lehigh Valley. Information gathered during focus groups was aimed at building a baseline understanding of citizens' interest in and knowledge of flood-related science on which to build forums and other science center offerings. In particular, the focus groups were tailored to explore the following areas:

- Lay beliefs about flooding and risk management
- Strategies for engaging underserved audiences in discussions about flooding and in the science center community
- Adapting educational experiences for diverse audiences.

Three focus groups were convened in each community. Participants included first responders in each community; immigrant families; low-income, inner city teens; environmental science students; rural residents, river dwellers; and others. Focus groups met in local public spaces, such as libraries, nature centers, community centers, a church, fire stations, and a science center.

As part of the focus group experience, each participant completed a written questionnaire and took part in an hour-long group discussion. The focus groups began with a photo elicitation activity in which participants were asked to select a river image from a collection of approximately 50 post-card sized images of rivers, life on rivers, and flooding, and to speak about how the image related to their associations with rivers and flooding. On the questionnaires, participants were asked to answer questions about the image they selected, the associations they made with floods and river life, and what they hoped to learn about flooding. This activity was used to tap into the rich emotional and personal meanings associated with living on or near major rivers with histories of flooding.

The subsequent whole-group discussion began with participants' sharing flood and river stories; ensuing discussion topics and written questionnaire items were designed to reveal participants' knowledge of key concepts, such as floodplains, watersheds and

the 100-year flood, to capture their perspectives on their main concerns related to flooding in their communities, and to gather their ideas about prospective Nurture Nature Foundation science center exhibits and activities.

Focus group questionnaires and discussion guides appear in Appendix A.

Community Forum Structure

Five community forums, two each in Lower Mount Bethel and Easton and one in Allentown, were held between February 18, 2010 and April 21, 2010. Each forum included presentations and small-group discussions.

RMC conducted evaluation activities at each of the seven forums, gathering observations and participant survey data, and debriefing table facilitators and presenting scientists. Four types of data were collected for each forum event:

1. **Observational Data on Engagement:** RMC developed an observational protocol to gather data on the quality of engagement, listening behaviors, and interactions during the phases of the forum. Among the issues examined were: how effectively have issues been framed for deliberation by different audiences? Is the forum productive in building capacity of individuals to engage in problem solving? Does everyone get a chance to speak?
2. **Participant Surveys:** Forum participants were asked to complete surveys to gather information about changes in their scientific knowledge of rivers and flooding and on their expectations of the forum and feedback on the forum structure and moderation. Survey questions asked participants to reflect on whether they learned about different sides of a debate, whether the experience stimulated an intention to follow-up with additional learning or other activities, and impressions and appeal of the new science center.
3. **Moderator and Scientist Debriefings:** Following the forum, RMC conducted moderator, facilitator, and scientist de-briefings as appropriate, to discuss the forum experience, probing issues such as the success of constructive engagement and strategies for recognizing and channeling emotionally charged issues.
4. **Participant Follow-Up Interviews:** In order to gather additional information on community forum outcomes (including behavioral or attitudinal change towards flooding or risk-management) and reflections of forum participants, twelve follow-up interviews were conducted by telephone following the forum programs.

In addition, RMC evaluators participated in informal interviews with Nurture Nature Foundation staff about recruitment and reviewed all forum discussion materials, such as polling data and participants' written notes on question prompts used at the forum tables.

REPORTING

Interim Reports

RMC provided Nurture Nature Foundation with summaries of data collected in each community following the completion of the focus groups and forums. Data summaries from focus groups served to identify issues of interest for forum discussions as well as

science learning needs; earlier forum discussions informed the structure of later forums.

RMC also produced, in collaboration with Nurture Nature Foundation staff, a report to local and regional decision-makers that synthesized high-level findings of interest to decision-makers. The report, which highlights broad interest in flooding and citizen suggestions for governmental action, was presented at a regional conference, made available on Nurture Nature's website (http://www.nurturenaturecenter.org/), and distributed to at least twenty-one decision-makers at the regional forums. These decision-makers included emergency managers from both counties in the Lehigh Valley, municipal officials from all three communities, representatives of regional environmental organizations, planners, and representative from three conservation districts, and a local college, among others.

Final Flood Forum Evaluation Report

The following sections of the present report provide an overview of the Nurture Nature Foundation Flood Forum planning project based on RMC's evaluation activities. The evaluation team was charged with assessing the overall forum model as a strategy for engaging diverse citizens in science learning. As such, evaluation activities do not neatly fall into formative and summative components but were rather, interrelated pieces of an extended dialogue about flooding and watershed management and about understanding the experiences and perspectives of others.

Report sections include findings as well as a summary and recommendations as follows: Findings sections report on community focus groups, community forums, and regional forum findings. This structure loosely follows the unfolding of Nurture Nature Foundation events and illuminates how subsequent activities built on previous ones. The final, concluding, section summarizes evaluation findings in terms of the success of the focus group – forum model and offers recommendations for continued work in this area.

Findings are reported across the three communities except where significant local or sub-group differences had the potential to affect future forums. In those instances, variations by town or sub-group are noted. The sole exception concerns focus group and forum findings from young people from the Allentown Boys and Girls Club, where students' background knowledge diverged sharply from that of other participants. For this reason, views of young people from the Allentown Boys and Girls Club are not included in statistical tallies because their responses reflected such different background knowledge and focus group experience; however, their knowledge and opinions are included in the participants' comments that follow.

Demographic data were collected at different stages of the project. Focus group composition was shaped around key socioeconomic, age, or occupational traits (e.g., first responders, new immigrant families, teens, and river-dwellers) and information about participants' age, gender, and residential zip code was collected. Similar demographic data were collected during community forums, at which point it became clear that the attendance of the programs had diversified significantly. On this basis, participants in the regional forums were asked to indicate their occupations on

questionnaires. This was particularly important in the context of the regional forums, which were attended by very differently positioned stakeholders, from environmental science professionals who were managing watershed and other resources, to elected officials, business owners, and a diverse group of community members and residents of flood-prone areas. For this reason the attribution of comments varies throughout the report and includes occupation in the section on the regional forums only.

PROJECT BACKGROUND

FLOODING IN THE LEHIGH VALLEY

The flood of 2006 exacted severe damage on the newly renovated Grand Eastonian, a prominent hotel in Easton, PA, near the confluence of the Delaware and Lehigh Rivers. The Eastonian's owner, the multi-state Nurture Nature Foundation[9], has as its stated mission reconciling the conflict between environmental protection and economic development. The Nurture Nature Foundation's first-hand knowledge of flooding's devastation presented a rare opportunity to bring community members together to understand and use science in a public and deliberate way. Plans for another property owned by the Foundation in downtown Easton were revised and planning began for a science museum featuring exhibits on flooding. The Flood Forum pilot project is one of the early initiatives in Easton of the Nurture Nature Foundation. It was designed, in part, to inform the development of the structure and programming of the science center (which was undergoing renovation throughout the pilot project period), to provide important community outreach, and to serve the Foundation's mission by helping citizens make informed decisions about flood management based on an understanding of the relevant science.

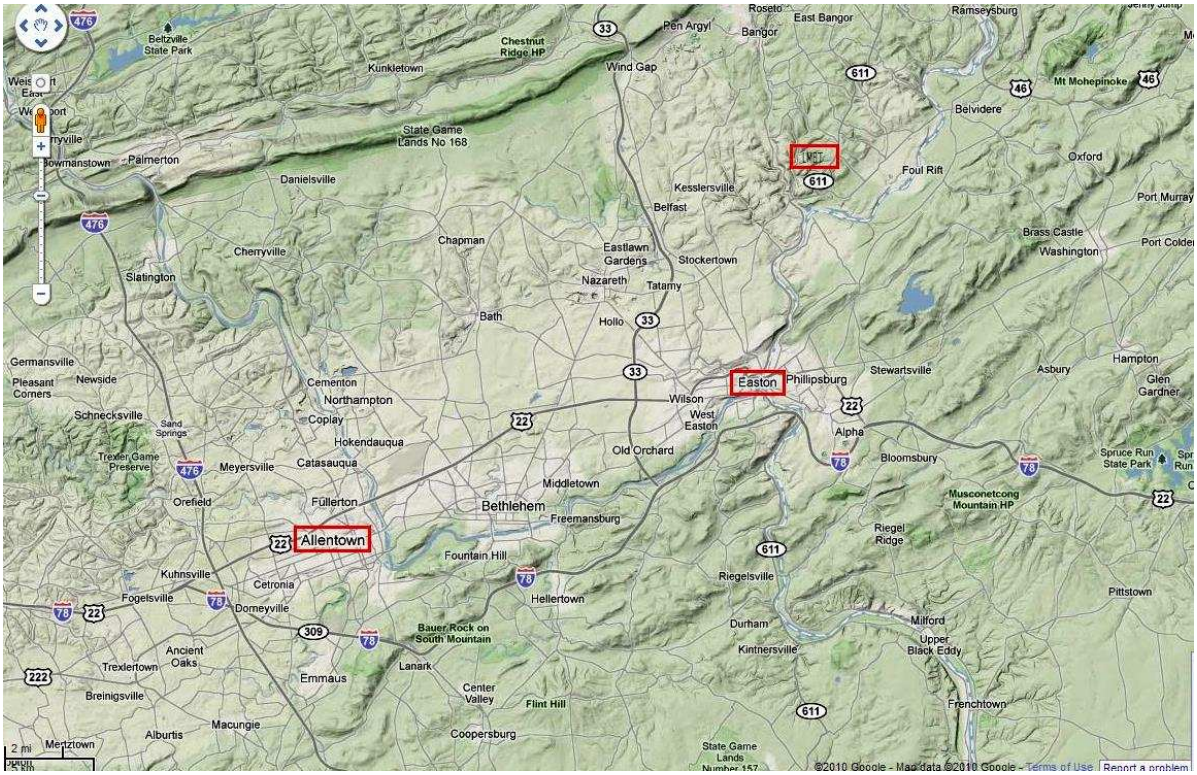
The choice of target audiences for the new pilot was shaped by national statistics about flood damage on the one hand and the identification of particular Lehigh Valley communities at risk on the other. Records from the 2006 Federal Emergency Management Agency (FEMA) National Flood Insurance Program found renters and low-income households at disproportionate risk for flooding devastation. Three local communities—Easton, Lower Mount Bethel Township, and Allentown, Pennsylvania—were identified as communities where residents were subject to flooding, as evidenced by particularly high flood insurance claims, and were also economically marginalized.

Both Easton and Allentown pre-date the American Revolution and enjoyed long periods of prosperity based on manufacturing and transporting goods before they entered the "post-industrial" American economy. Today, median household incomes hover below $35,000. Like many similar cities, their populations are increasingly Hispanic and increasingly poor[10].

The Township of Lower Mount Bethel is more rural and affluent than the two cities, with a median household income of closer to $55,000. Perched at the base of cliffs overlooking the Delaware River and astride Martin's Creek, with steep canyon walls that funnel heavy rains into the Delaware, its citizens have been deeply affected by recent floods, many repeatedly.

[9] For information, visit http://www.nurturenature.org/

[10] Data from the 2006 - 2008 U.S. Census Bureau



*Red boxes identify **Allentown**, on the Lehigh River, **Easton,** at the confluence of the Lehigh and the Delaware Rivers, and **Lower Mount Bethel Township,** on the Delaware River.*

THE FLOOD FORUM PROJECT

As it evolved, the Nurture Nature Foundation's pilot aimed to:

- Mediate public and professional discourse—joint learning and dialogue—about land use and development in known and forecasted floodplains.
- Convene groups of economically and socially diverse citizens to increase their knowledge about the science and technologies of flood risks and mitigation, encourage the exchange of ideas, and prompt critical thinking and problem-solving;
- Foster citizens' use of science knowledge, dialogue, and critical thinking to insert their voices into planning for flood mitigation, land use and development, and other environmental decision-making processes;
- Involve a diverse public constituency in planning for Science Center programs in ways that build trust, integrity, and reputation.

Moving from focus groups to forums in each community, and building up to the regional forums, the project was designed to move community members through levels of engagement in a new model of science education.

Forum Content and Discussion Questions

The forums included scientific presentations and opportunities for discussion in both small groups and as part of the large group.

The forum agenda follows:

- Introduction - 10 minutes
- Science presentation – 20 minutes
- Discussion – 60 minutes
- Table Reports – 10 minutes
- Open Floor – 10 minutes
- Wrap Up and Evaluation – 10 minutes

The forums began with an introductory presentation by the Nurture Nature Foundation, covering an overview of the Nurture Nature Foundation activities, the NSF grant, and relevant facts about flooding, tailored to each local community. For instance, facts presented at Lower Mount Bethel forums included:

- Floods are the most common, costly, and deadly natural disaster in the U.S.
- After the 2004 flood (Hurricane Ivan) and the 2005 flood, Lower Mount Bethel Township had the greatest number of flood insurance claims of any municipality in the Lehigh Valley.
- Starting in 1978, the Township has had $7,222,708 in flood insurance payments.
- Everyone pays for flooding.
- Flood insurance does not pay for infrastructure repairs.

This was followed by a presentation by a local scientist or engineer who spoke about watersheds, floodplains, the causes of floods, flood risks, and mitigating flood damage. Presentations varied slightly depending on the background of the presenter.

Ensuing small-group discussions were structured around four questions, each of which required participants to take a moment to write their responses before sharing them with the rest of the table. Facilitators helped keep discussions on topic, sought expert advice as necessary, and invited all participants to speak. The questions moved from questions about proximity to a river and concern about flooding to questions about exhibits of interest at the new museum, and concluded with a land-use scenario specific to each of the three communities. Data were tallied and shared with participants as the forum concluded; facilitators gave brief reports on the table discussions.

Discussion questions were modified for each forum, based on the success of previous questions in engaging participants in discussion and on information gleaned in focus groups about areas of interest. The following questions were used; maps and other supporting visuals were provided as necessary.

Table 1: Community Forum Discussion Questions

	Q1	*Q2*	*Q3*	Q4
Lower Mount Bethel	How concerned are you about the issue of flooding? How close are you to a stream or creek that floods?	On a list of township priorities, how important should flooding be to Lower Mount Bethel Township?	In a science center about flooding, what would be the most interesting to you?	The cottages between PPL plant and the Delaware River have been damaged by flooding and some are located within the 100-year floodplain. Indicate how you would best manage areas like these.
Easton	How close do you live to a river or stream that floods?	On a list of city priorities, how important should flooding be to the City of Easton?	In a science center about flooding, what would be the most interesting to you?	Easton's public works complex is located within the 100-year floodplain (shown on the may on your table). Rank A through D from 1 to 4, with 1 being the most important and 4 being the least important in terms of the best ways to manage areas like this. (The second forum adapted the Allentown question, below, for Easton.)
Allentown	Have you ever lived through a flood?	On a list of city priorities, how important should floodplain protection be to the City of Allentown?	In a science center about flooding, what would be the most interesting to you?	Rank the images from 1 through 4 in terms of what you think is the best use of floodplains in Allentown. How would you answer the same question for a rural community in the Lehigh Valley?

Regional Forum Content and Discussion Questions

Regional forums held in September 2010 were designed to engage community members in discussions with others on flood-related issues, deepen their understanding of the science content relevant to flooding issues, and summarize the results of the previous forums for decision makers. They also served to broaden the Nurture Nature Foundation participant base, offer a return opportunity to previous Nurture Nature Foundation participants, and engage local scientists and decision-makers in community discussion.

The regional forums featured a talk by filmmaker and educator Marshall Frech on the portrayal of flooding in the media, the history of the 100-year flood concept, the role of topography in flooding, and the nature of flash flooding. His talk was followed by a brief overview of the Nurture Nature Foundation report to local decision-makers. Small-group discussions were led off by two short presentations by scientists who introduced additional scientific content for discussion, specifically data on the history and frequency of local flooding and current predictions of the effects of climate change on local weather patterns. As at the community forums, participants' responses were collected and tallied for presentation at the end of the small-group discussions and facilitators at each table reported on table discussions.

Table 2: Regional Forum Discussion Questions

	Q1	*Q2*	Q3
Regional Forums	Given the flood record on the Delaware River, do you think that the flood events on the river in 2004, 2005, and 2006 were unprecedented?	Given the predictions for more extreme weather in the future, how do you think your municipality should best prepare?	What else would you like decision makers in your community to know about flooding?

COMMUNITY PARTICIPATION

RECRUITMENT

Efforts to engage a diverse audience were central to the Nurture Nature Foundation pilot effort. In particular, the Nurture Nature Foundation sought to engage residents of communities at risk of flooding, minority residents, young people, and first-responders to flood events. Recruitment efforts were tailored to each of the three communities, with focus group recruitment preceding and paving the way for forum recruitment as the Nurture Nature Foundation made inroads in each community and better understood community dynamics. All registrants were called a day or two before both the focus groups and forums as a reminder to attend.

Focus group recruitment began in Lower Mount Bethel in early November 2009 with presentations made to local city and environmental organizations and to fire station personnel; interviews were conducted with a number of residents. Outreach increased through these personal contacts, who made suggestions about discussion topics, receptive neighborhoods, meeting spaces, and optimal locations for flyers and advertising. Some of these personal contacts conducted outreach themselves. Flyers were posted extensively in public venues, from banks and local stores to restaurants, and were also delivered door-to-door in selected neighborhoods; email outreach was conducted with local schools and environmental groups.

Focus group recruitment in Easton and Allentown began in March 2010 with similar outreach to city officials, first responders, and community leaders. Contact with a community literacy organization in Easton provided outreach to members of the Spanish-speaking community, and flyers, in both English and Spanish, were distributed at the Easton public library, numerous local stores, and to community groups. Email and social media outreach was conducted to environmental groups, community organizations, a high school science class, Lafayette College students, civic improvement groups, and the county genealogical society.

Contacts in Allentown, such as the town sustainability advisor, county watershed specialist, and the directors of local environmental groups advised Nurture Nature Foundation of the small number of residential areas in the city where flooding occurs regularly and situated the issue in the context of a local economic development push. Flyers were distributed widely in Allentown, at youth centers, bowling alleys, religious groups, and the public library; email flyers went to community leaders, the local science center, civic clubs, fire stations, and community activist groups, as well as door-to-door in the flood-prone neighborhoods, which were few. Radio advertisements were prepared for stations in both Easton and Allentown, as were solicitations through Craig's List.

The forum outreach built on contacts made during the focus group outreach, and flyer, email, and social media distribution followed the earlier patterns. Telephone calls were made to all focus group participants, inviting them to attend forums.

The Nurture Nature Foundation quickly learned the importance of getting "buy-in" from trusted local leaders and, on their advice, made extensive personal contacts in all three communities. In Lower Mount Bethel, flyers distributed door-to-door at the

homes of people who lived on the river appeared to be most successful, garnering immediate responses. By contrast, in Allentown, flyers were less effective, and door-to-door contacts did not yield participants.

The greatest number of participants learned of the forum events through personal connections [n=128]:

- 31% had learned of it through friends or family
- 23% by flyer
- 12% through community organizations
- 6% by teachers
- 28% by other means

Learning more about flooding and helping to design a new museum were the two motivations for attending that participants identified most often (some participants identified more than one motivation):

- 29% Learn more about flooding
- 26% Help design a new museum
- 21% Talk with neighbors about flooding
- 14% Better prepare for flooding
- 10% Talk with legislators about flooding
- 1% Other

All of the Nurture Nature Foundation events saw the strongest number of participant sign-ups just prior to the events. Nurture Nature Foundation staff also noted that the further a community was from Easton, and the smaller the number of personal contacts, the greater the recruiting challenge. Recruitment, while highly labor-intensive, was successful.

These efforts resulted in community participation described below. More than 286 distinct individuals participated in the Nurture Nature Foundation Flood Forum events.

FOCUS GROUP PARTICIPANTS

The 121 focus group attendees included a large number of participants at risk of flooding (nearly all of the participants in Lower Mount Bethel and large numbers in Easton). Targeted recruitment activities were further successful in engaging a number of non-traditional and priority science center audiences, including:

- Recent immigrants (Largely Spanish-speaking, but also including a few Arabic speakers) [19]
- Boys and girls club members [9]
- Environmental science students [22]
- First responders [31]

Table 3: Focus Group Dates and Locations

Focus Groups were held in: ***City/ Town***	***Location***	***Date***	**Number**
Lower Mount Bethel	Lower Mount Bethel Volunteer Fire Department	January 25, 2010	21 first responders
Lower Mount Bethel	Lower Mount Bethel Welcome Center	January 26, 2010	15 adults 2 children
Lower Mount Bethel	Lower Mount Bethel Welcome Center	January 27, 2010	11 adults 3 children
Easton	Easton Area High School	March 24, 2010	22 youth
Easton	Easton Fire Department	March 24, 2010	3 first responders
Easton	Project of Easton	March 23, 2010	19 adults
Allentown	DaVinci Science Center	March 22, 2010	8 adults
Allentown	Allentown Fire Department	March 25, 2010	7 first responders
Allentown	Allentown Public Library	March 25, 2010	9 youth

Focus group participants overall were familiar with museums, but not regular attendees, as suggested by survey data. Forty-seven percent had attended a museum in the last year, and another 21% in the last five years. The remaining 32% had last attended a museum five or more years ago (n=109).

FORUM PARTICIPANTS

Forums engaged a broader cross-section of the communities, and included business people, scientists, students, and artists, as well as a cross-section of participants from the focus groups (including minority adults and children, first responders, etc.) and previous forums, as well as other community members. Community forum attendance comprised 120 participants, 37 of whom had attended a focus group and returned for a community forum.

The first forum, held on a weeknight at the community center in Lower Mount Bethel, attracted the largest and most demonstrably interested participation of all the community forums. A number of focus group participants showed up, including a table's worth of first responders who had attended a focus group in Lower Mount Bethel. Several people brought artifacts—photo albums, newspaper clippings, a folder of legal documents. Participants at the second forum, held on a Saturday morning in February at the Lower Mount Bethel Welcome Center included a smaller group of focus-group participants and new participants.

The forum at the Grand Eastonian in Easton drew a mix of home owners and local business people. The second Easton forum, held in the main branch of the public library, included Hispanic residents, for whom the scientist's presentation was simultaneously translated, and home owners, college students, and other adults.

The Allentown forum drew the most diverse audience—half of the participants were teen-aged African American and Hispanic young people, the other half a mix of middle and lower-income participants and English and Spanish-speakers.

With the exception of Allentown participants, at least one, and often several, forum participants had experienced a flood first-hand.

Table 4: Forum Dates and Locations

Forums were held in: **City/ Town**	**Location**	**Date**	**Number**
Lower Mount Bethel	Lower Mount Bethel Community Center	February 18, 2010	26 adults (18+) 2 youth
Lower Mount Bethel	Lower Mount Bethel Welcome Center	February 20, 2010	10 adults (18+) 4 youth
Easton	Grand Eastonian Hotel	April 18, 2010	10 adults (19+) 1 youth
Easton	Easton Public Library	April 21, 2010	25 adults 2 youth
Allentown	Allentown Public Library	April 20, 2010	12 adults (19+) 18 youth

REGIONAL FORUM PARTICIPANTS

Regional forums were designed to broaden the participant base, offer a return opportunity for prior Nurture Nature Foundation participants, and engage local decision-makers in community discussions. The regional forums drew an even more diverse audience of earlier Nurture Nature Foundation event participants, emergency management workers, residents, professionals engaged in environment issues, planners and decision-makers, and students.

Fifty-four people who attended the regional forums, conducted at two sites in Easton, PA, completed evaluation questionnaires. Nearly half of those participants (25) had attended a previous community focus group and/or forum.

Table 5: Regional Forum Dates and Locations

Two Regional (Lehigh Valley) Forums were held in Easton:	**Location**	**Date**	**Number**
Easton: "Continuing the Dialogue"	Grand Eastonian Hotel	September 23, 2010	35
Easton: "Flood Forum"	Lafayette College	September 23, 2010	21

ENGAGEMENT

The level of interest and engagement at all of these events was extremely high, although without question it was highest in Lower Mount Bethel. A focus group participant in Lower Mount Bethel noted that the experience of group discussion on an issue of common concern was "better than television;" another added that "people getting together and talking about important things " is something he would do every

month. The elder statesman of the firefighters in the community expressed gratitude for creating an opportunity for the discussion to take place: "We never talk about it," he said, asserting that he could do this every month. Forum participants from Lower Mount Bethel also brought personal effects, such as photo albums, news articles, and a folder of legal papers. Most remained highly engaged in the science presentation—even, in one instance, when open basketball practice commenced overhead—and all participated in the small-group discussions actively.

While less vocal about the pleasures of living on a river, participants in Easton were nevertheless eager to share stories and learn from one another. In contrast, no participants in Allentown lived on the river. They did, however, share stories about street flooding. Both Easton and Allentown participants spoke of the importance of the rivers for their communities and remained engaged in both focus group and forum events. Forum attendees from both communities were attentive during the science presentation, asked questions of the scientists both during and after the forum, and were active in the small-group discussion.

The Allentown forum was divided between young people from the Boys and Girls Club and local residents; again, participants raised clarifying questions of the presenting scientist and appeared engaged in the small-group discussions. A small number of participants engaged the presenting scientists in questions at the end of the forums.

Participants at the regional forums also brought materials, including charts and legal documents. Several participants at the evening regional forum stayed considerably longer than other participants and engaged the scientists and film-maker in discussion, particularly on the role of New York reservoirs on flooding in the Lehigh Valley.

SUMMARY

NNF recruitment efforts were substantial and highly successful in engaging a diverse group of voices in focus group discussions and in forums. Two-hundred eight-six people attended the events. Focus group recruitment generated a mix of low-income, minority, youth, and first-responder groups, offering a means for traditionally underserved groups to engage in dialogue on flooding issues. With each phase of the community and regional forum recruitment, the pool of project participants widened and ultimately included a diverse group of residents of flood-prone areas, professional scientists and engineers, decision-makers, business persons, students, and artists.

Particularly successful recruitment strategies included identifying trusted opinion-leaders in each community, gaining buy-in from these individuals or respected organizations, and soliciting participation by door-to-door canvassing. As in other efforts, making multiple contacts with individuals was most effective in eliciting the rich turnout. NNF staff, however, learned that while the ground-up recruitment served to deliver a rich and diverse audience base, it was very labor-intensive.

UNDERSTANDING THE THREE COMMUNITIES

INTRODUCTION

Focus groups included an opening photo elicitation exercise aimed at getting information on people's affective and material ties to the rivers in their communities, and was followed by discussion of river knowledge and interest, and finally of ideas for the new museum. One hundred and ten participants completed written questionnaires at the beginning of the focus group experience. The following findings are a synthesis of their written and verbal responses.

PERSPECTIVES ON RIVER LIFE

> "Living near a river is the most beautiful experience because the air is more pure. I would like to know a lot more because [flooding] is an issue that affects all of us, even those who don't live near a river." *A 39-year old female who has lived in Phillipsburg for four years*

In the photo elicitation exercise, participants were asked to talk about their experiences of and feelings about living near the Delaware or Lehigh Rivers or one of the lesser creeks. They were provided an array of images depicting river life during floods and quiet times, historical images, images of farms and industrialization, and recreation on the river from which to choose.

In all three communities, participants chose a variety of images and told stories reflecting a wide range of associations with life along rivers, including but extending beyond the experiences of flooding. They included discussions of the dangers and power of flood waters, the experiences, challenges and heroism of first responders and stories of the destructive nature or simply extremes of flooding. Other stories touched on the beauty of rivers and natural areas, the river as a site of relaxation and tranquility, recreational activities enjoyed by many such as fishing and boating, and concerns about water quality both during floods and at other times.

There were some differences in both the content and emotional tone of stories in the different communities. Most noticeably, participants in Lower Mount Bethel spoke with great emotion about learning to live through floods and adapting to them and were enthusiastic about their river lifestyles. Participants in both Lower Mount Bethel and Easton related first-person stories of flood evacuation, damage, and clean-up. In contrast, respondents in Allentown included few personal stories of flooding and instead introduced concerns about the use of the riverfront areas and urban planning.

> "Nature is hard to predict, but we can help prevent disasters." *A 48-year old female who has lived in Easton three years*

Participants were also asked to share what they wanted to learn or know about rivers. Most were interested in learning more about why rivers flood, what can be done to prevent or mitigate flooding and flooding damage, the role of reservoirs and dams in flooding, seasonal flood patterns, and how to ameliorate urban drainage issues. A few had questions about river

ecology, such as the response of animals to flooding and the benefits of flooding for river systems.

SCIENCE CONTENT KNOWLEDGE

On questionnaires completed at the beginning of focus groups, participants were asked questions about their knowledge of riverine systems that would be useful for refining the scientific content delivered in forums. Responses indicated that 80% of participants understood flooding to be a "natural part of a river's cycle."[11] In contrast, only 22% correctly identified the definition of the "100-year flood" as being "a flood which has a one-in-100 (1%) chance of occurring in a given year," from a list of options. Thirty-five percent believed the term referred to "floods which only occur once a century" and 24% indicated they "don't know."[12]

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Additional questions included: How is a floodplain formed? and What role does a watershed play in flooding? While most participants were familiar with these terms, and had at least a rudimentary knowledge of the dynamics of rivers, the responses suggested great variation in participant knowledge of the scientific models used to understand rivers. For instance, many participants explained floodplain formation in terms of one or more of the following processes: flooding, deposits of river sediments, and/or process of erosion. Others described it simply in terms of too much rain or the lack of space for water to flow, and a handful in each group indicated they didn't know.

Responses about the role of the watershed in flooding were similarly varied. Many did not know what a watershed was; others correctly identified its role in funneling water from the mountains into rivers and described the watershed as concentrating the runoff, or talked about proper watershed management.

Additional questions were asked about factors which contribute to flooding. Asked to identify contributing factors from a list, more than 80% of participants identified heavy rainfall, snow melt, and development as contributing to flooding; between 70% and 80% identified rain on frozen ground and rain on cement, pavement or roofs; and only 65% identified climate change as contributing to flooding.

In another question about the importance of different factors in contributing to flooding in the future, most participants rated increased development in both the watershed and floodplain as a 4 or 5 (very important); this was followed by reservoir

[11] One hundred and six participants responded to this question across the three communities. 85% indicated "yes".

[12] A total of 114 participants responded to this question, including 25 who selected the correct definition, 40 who identified the 100 year flood as occurring once a century, and 27 who didn't know. The remaining respondents chose alternative responses or did not respond.

and dam operation, with climate change as the least important factor across most of the groups.[13]

> "I live at the top of the hill but the property has the Little Lehigh River to the south and the Little Cedar Creek to the north. When they flood the city closes the streets and I am unable to traverse away from my home." *A 46-year old female who has lived in Allentown 42 years*

A similar range of knowledge was seen across all the adult groups as well as the high school environmental science students. The only exception was found during the focus group with inner-city students from Allentown. In part, this was due to the wider range of ages (some were as young as eleven years old), but also because the students had little understanding of river dynamics, or even of the water cycle. In some cases, they were skeptical about the importance of river ecology as a community priority, seeing issues such as housing and jobs as more pressing. Despite these obstacles, the students were very eager to learn, asked thoughtful and imaginative questions, such as, "Who's crazy enough to live [by a river that floods]?" "How does water get into the house when it floods?" "When water gets in the house, does it cut off the electricity?" "What does a dam do?" and "Why don't they build walls alongside the river [to prevent flooding]?" and were truly appreciative of the time taken for explanations.

COMMUNITY ISSUES

Focus groups with first responders in each of the communities provided great detail into the work of firefighters and others prior to, during and following a flood. The discussions illuminated not only the different phases of their involvement, but the very different types of training they had received, as well as some commonalities, such as experiences of river dwellers' resistance to calls for evacuation, subsequent pleas for rescue, and safety concerns related to river and street flooding.

In a few cases, particularly in the Lower Mount Bethel focus groups, participants expressed anger and frustration at local township officials, FEMA policies, and at the impacts of management of New York City reservoirs on lower Delaware River communities.

> "I enjoy canoeing and living near a major river provides activities and another way of transportation." *A 17-year old male student, who has lived in Allentown five years*

Many residents in Lower Mount Bethel were intimately aware of flood warning sites and systems and described in great detail their own river monitoring activities. In contrast, participants in the Easton immigrant group in particular—many of whom shared stories of flooding and other natural disasters in their home countries—were interested in learning more about and making suggestions for warning systems.

[13] Although outside of the scope of this project, this finding contributed to a decision to develop future forums specifically on the impact of climate change on flooding.

Economic development played a larger role in discussions in Easton and Allentown. Allentown has extensive river frontage for which a major development project is planned, which entered into the focus group discussion. In Easton, participants expressed interest in the economic and touristic potential of the new museum.

> "Because we come from the West, where there wasn't the abundance of rivers as here, I was surprised more towns and people didn't center on river recreation more. I soon learned that flooding was an issue for most towns located on or near water ways." *A 56-year old female who has lived in Allentown six years*

MUSEUM SUGGESTIONS

On a survey question about interest in different types of science center offerings, participants were enthusiastic about a range of offerings, and 57% looked forward to exhibits; 48% community events; 43% films; and 36% were interested in additional forums.

Participants eagerly generated ideas about content and exhibit types that could be included in the new museum. Their suggestions emphasized the importance of local accounts and personal testimonies of people's flood experiences, as in, "somehow convey the smell and feel of the mud and aftermath" and included offers of photographs and video footage from residents. In addition to pictures, videos, and testimonials, respondents suggested hands-on, interactive exhibits, films, speakers, maps and games, and exhibits of special appeal to young children, such as those featuring animals. Teen participants from both the Easton High School and Allentown Boys and Girls Club were excited about immersive, interactive exhibits, especially thrilling experiences related to the dangers of flooding.

To some extent, all elements of flooding appeared to merit attention and the issue was more a matter of focus; however, one person spoke for many when he or she wrote "No matter what type [of museum], it should always end with warning and protection information." In an instance of the power of small-group discussion for personal learning, a participant wrote, "I actually changed my previous decision because as I am sitting here listening things are [be]coming more real and of more importance."

Many emphasized the importance of the museum for educating children. They warned against focusing too narrowly on flooding, and suggested including other aspects of life by rivers. Some expressed concern about creating exhibits that would be too static, so that people would only visit once or twice. Lower Mount Bethel participants noted that the river community extends across the river to New Jersey, and suggested that those residents should also be considered as part of the area served.

Content Ideas

Flood safety before, during, and after a flood was a common theme for museum content and participants suggested emphasizing safety practices such as evacuation, turning off electricity, and securing propane tanks before floods, using caution when traveling during floods, and minimizing post-flood pollution and debris on the river. Specific safety ideas included warnings about hazardous behaviors, such as driving or walking through flood waters, as well as post-flood safety practices such as testing drinking water. A related suggestion involved highlighting the work of fire fighters and first responders during floods. Other suggestions were to explain the causes of flooding, including the role of reservoirs, and to find ways to make the visceral experience of a flood more real to visitors.

> "Well, I have lived next to the Delaware River for the past 13 years, and have been through several floods. Although I love the water, it can be very scary. The thoughts that go through your head about losing everything and watching others you know lose everything is very sad and painful." *A 34-year old female Lower Mt. Bethel resident*

Suggestions for museum exhibits also included historical accounts of flooding and the rivers' use in transportation and industry, international perspectives on flooding, and the impact of climate change. A number of participants suggested broadening the museum content to include information about river ecosystems and the lives of animals such as turtles and sea bass and to address river management issues such as restoring and maintaining river banks. Water quality issues related both to flooding and to agricultural runoff were also proposed for museum content.

Participants also offered a number of ideas for science center events or special offerings, such as inviting the author of *Devastation on the Delaware* (an account of the 1955 flood) to speak, developing a model flood preparation kit, conducting field trips on the river, working with volunteers to test water quality and monitor flood gauges, and incentives to draw Allentown residents to the museum, such as tours connected with the Canal Museum, school field trips, and discounts to Easton restaurants.

SUMMARY

As a front-end research tool, the nine focus groups conducted in the Lehigh Valley provided Nurture Nature Foundation with information about local understanding of science related to flooding and attitudes toward river life, flooding and flood management.

> "What we as a community need to do during a catastrophe—come together to help one another clean up and help residents directly involved get back on their feet and start fresh and new." *A 28-year old female firefighter from Lower Mt. Bethel*

Focus groups revealed the many associations Lehigh Valley residents have with the rivers and creeks in their vicinity, and also suggested that these river

resources are important to the very identity of the places they live. Whether they were "river-rats" of Lower Mount Bethel, who value the unique opportunities of living right along the Delaware River, or urban dwellers in Allentown and Easton who recognize the aesthetic, historic, and recreational value of the rivers running through their cities, all valued the rivers as important features of their communities.

In discussions and questionnaires, it was clear that while many residents, particularly those in Lower Mount Bethel, had extensive knowledge of the flora and fauna associated with the rivers, and those along the river were proficient in monitoring river levels both in their own backyards and using websites, participants' knowledge of scientific concepts—such as floodplains and watersheds—was often limited. Similarly, understandings of the impacts of development, climate change and other factors on flooding were limited. The amount of rainfall was sometimes cited as a main factor causing flooding, with varying understanding of how rainfall amounts interacted with different factors, such as already saturated or frozen ground.

With the exception of the greater knowledge of river rhythms and naturalist observations by the Lower Mount Bethel participants, knowledge across the communities was fairly consistent, varying more by individual than by group. The one exception was the group of Boys and Girls Club Students in Allentown, whose knowledge and understanding of flooding and river systems was significantly more limited.

> "Because the river, sea or ocean is like life, and when you get a blow from nature people must be always willing to help others with good disposition and love."
>
> *A 67-year old male who has lived in Easton four years*

Participants from the three communities varied in their perception of important community issues. Lower Mount Bethel participants were particularly concerned about local ordinances, the accuracy of maps which affected flood insurance claims, and the management of the New York City reservoirs. Participants from the more urban cities of Easton and Allentown were concerned about the potential roles their rivers could play in economic development, and also voiced concerns about maintaining water quality.

These focus group findings were shared with presenting scientists and used to structure the subsequent public forums in each community. For instance, focus group findings served to inform NNF organizers that pre-existing community concerns and the reality of flooding were primary motivators in Easton and Lower Mount Bethel, and that even residents not directly linked to flooding or potential flooding were drawn into the concerns of neighbors and community members. The focus group experience in Allentown helped NNF better understand the relative lack of residential flooding as a pressing concern in that community, and shaped forum and future engagements around broader issues of planning, riverfront use, and economic development. The economic development and riverfront use were relevant as well to the urban community of Easton, while less of a concern to the rural Lower Mount Bethel residents.

> "I don't have a house on the Delaware; I have a house in the Delaware." *A female resident of Martins Creek, age 18*

The Nurture Nature Foundation provided summary focus group findings to the presenting scientists prior to each forum. In at least one case, the scientist found this information useful, particularly in gaining a better understanding of the scientific understanding of flooding—sometimes higher than expected—that community residents held. For instance, this presenter explained, "It was not as obvious to me that people were as tuned in. They knew a lot more than I thought going in."

Focus group findings were also used to refine the forum content by Nurture Nature Foundation planners. For example, it was decided that forum presentations should address basic definitions of the concepts and processes underlying flooding, including floodplains, watersheds, and the 100-year flood. In addition, the fact that so few Allentown residents are at risk for flooding resulted in a forum focused more heavily on land-use planning in relationship to local rivers than on flooding.

COMMUNITY FORUM FINDINGS

Community forum findings, presented below, are based on 110 questionnaires completed at the end of the forums, as well as observations and review of participant discussion and polling data. In addition, three debriefing interviews were conducted with presenting scientists shortly after the forums, and twelve follow-up interviews were conducted with participants approximately one month after a forum.

Because the responses of the Allentown youth who attended the forum in that community diverged greatly from other respondents and often reflected a greater lack of science and community knowledge, their responses have been excluded from statistical data. They were, however, actively engaged in discussions and interested learners and their comments are included as appropriate.

FORUM APPEAL

Overall Success

Participants were asked whether they disagreed strongly, disagreed, agreed, or agreed strongly with a series of statements about the forum. These findings suggest the forums' overall success in creating a positive, inclusive experience:

- 98% agreed (68% strongly)that they "enjoyed the experience" [n=82]
- 98% agreed (60% strongly) that they "felt comfortable voicing my opinions" [n=84]
- 98% agreed (58% strongly) that "based on this experience, I am likely to attend another science center forum [n=84]
- 94% agreed (41% strongly) that "the experience matched my expectations" [n=83]
- 94% agreed (51% strongly) that "the information presented is important for people like me," [n=83]

Differences in responses by community suggest the lesser relevance of flooding in Allentown in comparison with Easton and Lower Mount Bethel. For instance, a somewhat smaller number (84%) of Allentown participants indicated that the information was important for people like them, compared with nearly unanimous figures for Lower Mount Bethel and Easton (96% and 97%).

Forum Components and Value

On questionnaires, participants ranked all four components of the forum highly. All (100%) rated the small-group discussions highest, followed by the scientist presentation (98%) and introduction (97%), and finally the open floor (93%), likely due to the relative lack of time for open floor activities.

Asked more specifically about what they valued in the forum experience, participants primarily named opportunities to talk about flooding, to learn science, and to talk with others. Comments described the experience as "thought-provoking" and noted the value of "perspective from an informed organization." Participants called the experience educational and praised the science presentations, mentioning the

"scientist" or "presenter" explicitly as a source of valued learning. Many named terms they valued understanding better, such as watershed, floodplain, and the 100-year floodplain.

For many, new knowledge emerged both from the science presentations and from other participants. As one participant noted, "[I valued] hearing from the geologist and hearing from my table mates who live in the floodplain." "Discuss our experiences" was a common response to a question about the forum's value, as were "listening to others" and to a lesser extent "coming together." These responses appeared to focus on insights into other people's *experiences* even more than their *opinions*. Stories participants shared about their experiences seemed genuinely compelling to others.

This word cloud shows the incidence of terms participants used to describe what they valued about the forum; "floods" and "flooding" are omitted to highlight other valued features.

Learning that others shared their concerns was a source of value to some participants, as was the opportunity to learn more about their communities' plans for development and flood mitigation; a couple of participants mentioned specific outcomes concerning "the reservoirs" that they hoped the forum would lead to, such as "I hope the message will get back about the dams" and "If this forum produces protection from non-natural causes—would be the plus." The opportunity "to learn about developing a museum" and "the time you are taking to include [a] Spanish translation" also received mentioned as highly valued elements of the forum experience.

Asked what improvements to the forum model they suggested, participants recorded "no change" most often. Participants in all three communities did make some suggestions concerning time, as in "more time, especially for questions" and also requested more local photographs, history, and information about specific flooding threats citizens in each community face. Some participants also noted that the small-group discussion facilitation could have been improved, reflected in comments that some facilitators did not paraphrase with adequate detail or "smoothed over" the conversation. One participant made an implicit suggestion by noting the absence of information about the flow of the Delaware River being "altered by man-made reservoirs up north."

Interviews held with forum participants subsequent to the forums all stressed the professionalism of the forums.

LEARNING

Science Content

High numbers of participants agreed that after taking part in a forum, they were better informed. The strongest agreement on new learning was about science:

- 93% agreed (50% strongly) that they were "better informed about **the science** of flooding" [n=84]
- 84% agreed (37% strongly) that they were "better informed about **flooding issues** in my community [n=83]
- 79% agreed (35% strongly) that they were "better informed about how I can **prepare** for or take action related to flooding [n=83]"

In a series of questions about how much they had learned about the key science concepts presented:

- 78% of participants indicated they had learned a lot about the causes of flooding [n=84]
- 67% indicated that they had learned a lot about what a floodplain is [n=83]
- 66% indicated they had learned a lot about what a watershed is [n=87].

An additional 16% to 26% indicated they learned a little about each of these areas.

Responses varied by community: On average, 83% of participants in Easton and Allentown indicated they learned a lot about the three topics, while only 60% of Lower Mount Bethel did. This disparity may be attributed to a variety of factors, including the different emphases of the various presenters, as well as variations in pre-existing knowledge prior to the forum (for instance, Lower Mount Bethel residents in general had the greatest knowledge coming in and were least likely to indicate that they had "learned a lot," although their comments elsewhere suggest that they greatly valued the scientists' presentations.

Responses and comments throughout the survey provide additional detail about what people learned. Many participants named terms they valued understanding better, such as watershed, floodplain, and the 100-year floodplain; many also mentioned learning about this history and causes of flooding, for example, "[I learned] about the continuity of flooding, that it is better to leave the zones alone and not to build there" and "the floods we've been experiencing aren't completely abnormal." Some participants also indicated they had learn cautionary lessons, such as "[I learned] location is important and my 'right to know' if I'm living in a "flood zone." Several participants mentioned learning about the museum and the Nurture Nature Foundation.

Asked about what they learned from the forum that they had not known before, participants mentioned science content primarily, with a small number indicating that they had also learned more about understanding other peoples' opinions and concerns.

This word cloud shows the incidence of terms participants used to describe what they learned that that they didn't know before; "flood" and "flooding" are omitted.

Comments suggest that a great deal of new learning was conveyed through presenters' definitions and discussion of the "100-year floodplain," a term many people appeared to be familiar with but did not understand its specific meaning and use. Many had inferred that the 100-year flood occurred only once in a century and were surprised to learn that it was a statistical projection, a planning and engineering "rule of thumb" based on records of measured floods which may only comprise a little more than 100 years of data, as is the case for the Delaware River.

In the course of learning about the 100-year floodplain, participants also appeared to have gained a more nuanced understanding of the complexity of riverine systems and about the floodplain as the site of naturally occurring changes in water flow. For example, "[I learned the issue is] flood control, not flood prevention."

Several comments in the "suggestions for improvement" area of the survey expressed a wish for more information about preparing for floods. It is possible that some participants anticipated getting more practical than scientific knowledge.

Complete data can be found in Appendix D, Forum Summary Reports.

Changes in Participants' Priorities

Participants in Easton and Allentown were asked about the extent to which forum participation changed their priorities.[14] Changes in how participants understood or saw other people's perspectives was most frequently mentioned in comments on the surveys, framed either as understanding or appreciating other people's "perspectives" "priorities" of "points of view." "It really opened the dialogue for me for the first time," one Easton participant wrote" and "I [have] a better understanding of what flood victims have been through," wrote another.

The other area where participants noted shifts in their priorities concerned understanding the complexities both of river systems and of human policy-making. Participants in both cities noted the inevitability of flooding and reported shifts in

[14] This question was added after the Lower Mount Bethel forums were held.

their priorities that favored regulation and enforcement. "I always thought of floods as things we could not control and therefore didn't appreciate the value of information dissemination and policy adjustments," wrote one participant. Noted another, "It has made me realize the importance of regulating future development to prevent damage in the future," adding that he came to this realization through small-group dialogue.

One Easton participant noted that "many people are fixated on the 'reservoir' issue," and suggested the forums address that question, noting "I would feel more comfortable if I believed that all the past flooding was related to environmental issues only."

A small number of people reported that their priorities had not changed at all.

Anticipated Outcomes

Changes in Personal Behavior

A series of questions on the forum questionnaire inquired about the kinds of behaviors participants were likely to engage in following forum participation.

Participants were most likely to continue their participation with other Nurture Nature Foundation events:

- 96% were likely (60% very likely) to attend additional forums on flooding or other topics [n= 83]
- 94% were likely (76% very likely) to visit the science center when it opens [n=83]

Participants also suggested that, as a result of the forum, they might apply their experience in social settings:

- 93% were likely (58% very likely) to share this information with friends, families and/or colleagues [n=84]
- 88% were likely (52% very likely) to get involved in community planning or attend municipal meetings related to flooding [n=83].

Although smaller numbers, many forum participants also indicated they intended to apply some of what they had learned at the forum to behaviors related to personal safety and property damage:

- 78% were likely (46% very likely) to take precautions against flooding when traveling [n=84]
- 72% were likely (51% very likely) to protect their home from flooding [n=76]
- 57% were likely (36% very likely) to review their current insurance policy [n=75]
- 48% were likely (30% very likely) to protect their business from flooding [n=76]

Contributing to Civic Dialogue

Forum participants were told that their perspectives and forum findings would be put into a report and shared with local decision-makers. Asked about the importance of having their voices heard:

- 94% agreed (57% strongly) that "knowing that my opinions will be shared with decision makers is important to me" [n=84]

In a question about whether they believed that the Nurture Nature Foundation report based on the forums would be effective in reaching decision-makers, 95% answered affirmatively [n= 95].

Comments about the report's effectiveness included arguments such as "collective voices are more easily heard" and the fact that the information would be objective, honest, and documented. For the most part, participants indicated belief that their opinions would be listened to. One or two comments suggested that officials would listen to the Nurture Nature Foundation more than to local residents.

A small number of participants indicated that they did not feel their voices would be heeded. The largest proportion of these (18%) came from the first Lower Mount Bethel forum [n=28].

SUMMARY

The community forums successfully engaged citizens in the target communities in a rich science learning experience that introduced them to new science content while validating their views and opinions and provided opportunities for discussions with neighbors, community members, and presenting scientists. Community forums were well-attended, and enthusiastically received. Both rating questions and comments suggest the structure and atmosphere of the events was well-designed to enable participants to take engage in learning and open discussion.

Participants were eager contributors to discussions about their own experiences of flooding, community priorities, and suggestions for the new museum. The format accommodated adults with different first-hand experiences with flooding, scientific knowledge, and historical knowledge of flooding in the community; participants ranged from fourth-generation residents of Lower Mount Bethel to recently arrived Hispanic families in Easton. While teenagers attending as part of family groups in Lower Mount Bethel, in particular, were easily integrated into the discussion, those from the Allentown Boys and Girls Club required additional attention and explanation to bring them up to speed in understanding flooding in both its human dimension and scientific underpinnings.

Participants indicated increases in knowledge across all key concepts presented and had the opportunity to use the newly introduced science content in discussion of flooding priorities and future museum offerings, among others. Opportunities to learn about a topic of local importance, to contribute to the new museum, and to have their concerns shared with decision-makers were all powerful motivators for the experience.

Participants anticipated positive changes in their behavior ranging from an ongoing pursuit of learning and engagement in flooding to taking personal precautions. They

were nearly unanimous in their interest in attending additional forums and visiting the new science center. A large majority was also likely to share the information with others and get involved in community planning and meetings related to flooding.

REGIONAL FORUM FINDINGS

The following synthesis is drawn from 59 questionnaires completed at the conclusion of the regional forums. Where possible, comments are linked to participants' occupations, a factor whose relevance became apparent during community forums, which drew a greater diversity of participants than did focus groups. Complete responses, by question, appear in Appendix F.

IMPACTS OF PREVIOUS NURTURE NATURE FOUNDATION ACTIVITIES

Impact and Ongoing Engagement

Twenty five Regional Forum attendees had previously attended other Nurture Nature Foundation events. In survey questions directed at assessing the impacts on their behavior of these earlier activities:

- 96% agreed that they were more open to perspectives and opinions of others related to flooding since the prior Nurture Nature Foundation event

Comments included, "The more different outlooks I hear, the more accepting I become of those unlike my own; I may not agree, but I understand the need to be respectful," and another simply characterized the issues as "complex, and multi-layered."

- 84% had sought out additional information about rivers, flooding, floodplains, or watersheds

Participants noted, "Internet reading" and "I'm always looking for new flood info to keep my book updated." A few mentioned their prior attention to these issues, such as "Have already undertaken many of these activities/measures before."

- 52% indicated they had become more involved in Nurture Nature Foundation activities

"I've already extended an offer to help/participate as needed," noted one participant and another commented, "Slowly working towards educational collaboration." One participant noted simply, "Well, I'm here. Hi!"

At least four participants had taken additional precautions to ensure their personal safety and three had taken additional precautions to ensure the safety of their businesses.

Images and Narratives of Flooding

A series of questions on the regional forum questionnaire sought to learn how participants valued the sharing of stories and images of flood experiences as a feature of science forums.

Toward this end, previous Nurture Nature Foundation focus group attendees were asked about their experience of looking at images and sharing stories at the beginning of the focus groups. Seventeen participants responded. Some remarked that seeing the photos and stories added to people's understanding of the issues, for example, "Enhanced my knowledge base on flooding," "It opened a better understanding of

flooding in Delaware Region listening to the residents after explaining the causes, since they are often very knowledgeable and passionate about the cause," and "Made me realize severity of flooding in my community." Others stated that the stories added the "human element to flooding," made the flooding more visceral and concrete, and served as "venting."

FORUM EXPERIENCE

Overall Impressions

Strong majorities of participants were extremely enthusiastic about the regional forums. In response to questions about the experience, participants rated a series of statements as follows:

- 100% agreed (61% strongly) that the information presented was important for people like them [n=57]
- 100% agreed (45% strongly) that they enjoyed the experience [n=58]
- 98% agreed (70% strongly) that as a result of this experience, they felt better able to make a positive contribution to their community [n=57]
- 98% agreed (49% strongly) that they felt comfortable voicing their opinions [n=53]
- 93% agreed (65% strongly) that Seeing the images and stories of others about flooding made me reflect on my own experiences and knowledge of the issues [n=57]

Participant comments were largely positive, as in "Well done. Appreciate the immediate tallies using presentation software on PowerPoint presentation. Would appreciate more detail than just pie chart," and "Very good venue and speakers." "You are doing good. Keep it up. Tell the government," noted one regional forum participant.

Despite best efforts to ensure a mix of people at each table by assigning participants to specific tables, in a few cases, participants were not entirely satisfied with the distribution of students, scientists, and decision-makers around the room.

Participants also recognized and valued the Nurture Nature Foundation's role in initiating the public conversation on flooding and creating a platform for ongoing education and exchange. One participant expressed gratitude: "Someone is listening/ an organization is listening" and another praised "The associations' concern, preparedness and openness to comments, experiences expanded to other state concerns and global!"

Complete data appear in Appendix F, Regional Forums Summary Report.

Forum Value

In an open-ended question about the value of the forum experience, responses were nearly equally divided between those who noted the scientific presentations and content knowledge they gained and those who pointed to the opportunities to share with others. Their many responses are summarized below.

Most responses simply noted the "knowledge" gained or the scientists' presentations, for example, "[The] scientific views—it's nice to get actual facts in addition to a bunch of subjective opinions." Some noted the depth or pertinence of the information, or the "excellence" of the speakers.

A few noted particular things they learned, such as "Learning about the inevitability of flooding in flood zones," "Scientific presentations about Delaware River gauges and climate," "Information/ awareness of flooding and global warming in my community," and "Learning and wanting to learn the correct precautions to take in the event flooding would happen to me."

Several recognized the regional nature of flooding, as in "Opened my eyes to the lack of attention to the biggest threat upstream—the NYC reservoirs (river advocate)," and "This is more of a regional problem than just folks along the river (elected official)."

Many comments reflected general appreciation for the "discussion at the table," "learning from other's perspectives," and the opportunity to have "articulated experience of trauma—flooding" through conversations. Of particular note was the way in which conversations built bridges in the community; participants recognized the value of conversations that traversed decision-maker and citizen lines as well as occupational lines. For instance, a city planner valued "Learning what other people perceived of what was important with flooding" and an environmental educator noted "meeting with others and sharing with others." "The interaction with others," noted an emergency services director, and a professor enjoyed "Hearing from ordinary citizens." A student mentioned "Meeting people in the community," and an elected official prized access to "The opinions of others." Another student noted the "Collaboration of students and professionals during discussion" and a watershed specialist cited the value of "Hearing residents' answers to questions."

Participants also described gains in their awareness of differences in perspectives among those in the room. For example, "People who live outside a floodplain or flood community have different views on the importance of flooding" (city planner), "People's varying opinions regarding flooding" (draftsperson), and "There is great dispute between officials and community members and there needs to be some sort of agreement" (student). Noted an engineer, "[There are] many ways (valid) to view the same information." A professor remarked that "People make decisions for irrational reasons."

Some regional forum participants pointed to specific learning, as in "Opened my eyes to the lack of attention to the biggest threat upstream—the NYC reservoirs" (river advocate)," and "Effect of reservoirs" (student), while others appeared heartened by the promise of action: "People are responding to floods, including Forks Township" (student) and "[The] community is interested in helping" (business executive), or by finding their voice: 'Saw value in not having to depend on others to speak for my perception" (engineer).

Participants also reflected on the process of making community changes. Some noted the potential and need for coming together as a community, noting that "Nature can

bring us together," "How engaged the community is on this issue," and "Feel more strongly that cooperation is essential."

Others reflected on the dynamics of decision-making, as in, "Residents may not realize that in order for positive change to occur at the municipal level, municipal officials often have to be required to enact certain regulations (watershed specialist)," and "There are many opinions and views to be considered in order to form a policy program" (emergency services director). "Power lies in municipal government, noted a health specialist and safety engineer. "Flood protection takes far more coordination of people and agencies than I realized (watershed specialist)."

Several participants noted the importance of viewing flooding from a systemic perspective, for example, "We really need watershed scale management" (student). One participant expressed skepticism: "People are not ready to accept responsibility for where they choose to live."

LEARNING: UNDERSTANDING FLOODING

Participants identified a wide range of things they had learned during the forum, including the causes of flooding and flash flooding, the seasonal effects of flooding, the geology behind flooding, and the links between climate change and flooding. A few noted learning that Easton adopted the 500-year floodplain zone for planning or that uplifts (escarpments) play a role in flooding. Others noted, "I feel I will be better able to articulate the connections between the climate crisis and flooding" (community organizer) and "I learned that runoff is more destructive in the winter. I also learned how dangerous the three reservoirs in New York can be" (student). A few noted that the forum affirmed their own knowledge, for example "[I learned] that I have a pretty good grasp of flooding concepts" (writer).

Eighty-four percent of participants responding (n=49) indicated they now have a better understanding of the level of risk of flooding they face. Many explained this in terms of new knowledge about flood management and the science of flooding. Particularly singled out in comments were an improved understanding of the concepts of the100-year flood and floodplain and a firmer sense of the inevitability of flooding. Other comments touched on learning about the impacts of building, of reservoirs, and insights into the community discourse.

A further 68% indicated that this and other Nurture Nature Foundation experiences have changed how they view people's role in flooding [n=53]. In comments, participants observed that the human role was "More important than I realized," or reflected on the ways in which people can and cannot control flooding and its consequences. Other comments called for "cooperation" and declared, "We all have a duty to protect each other and the environment." Several noted the need for more education for citizens. Others noted tensions between the different roles people assume during floods, as in, "Decision makers have a very different role than homeowners," "Municipalities must help themselves and not wait for state or fed assistance," and "I felt like there was dispute between community members and decision makers on what should be done—and I still feel like there's little agreement."

BUILDING DIALOGUE

Recruitment for the Regional Forums targeted local environmentalists, urban planners, and legislators as well as citizens in an effort to enrich the community dialogue on flooding. The display of personal stories collected during the focus groups along with images of rivers and flooding in lobby areas connected with the forums was designed to further validate the voices and experiences of citizens. Survey questions addressed the effectiveness of these elements in building community dialogue.

Eighty-nine percent of participants indicated they felt the forum was effective in facilitating communication between decision-makers and community members. However, comments suggest that many participants did not know how to assess the communication, for example, "I hope so," or "Not sure," or "It's a start. The first footsteps in a long journey." Comments also suggested that opinions varied on the number of decision-makers present, noting, "It didn't seem like many decision-makers were present" as well as, "To a degree, many opinions from both sides were heard." Others either felt a more public meeting might also be valuable, or suggested that seating in future forums should be mixed to ensure a distribution of decision-makers, scientists, and students at each table.

Eighty-two percent of respondents (n=45) agreed that "as a result of any or all of [my] Nurture Nature Foundation experiences, [I] feel more comfortable engaging with scientists or science issues related to flooding." Participants noted that, "Knowledge gained is always a good thing," and "I don't think I know enough yet to speak with them about how to prevent flooding. But I do have enough concerns to address issues with them." One participant expressed confidence: "Absolutely, I have a clear understanding how precipitation, global warming [affects] the flooding, to list a few" and another found value in both in the informational and social elements: "More knowledge—more comfortable. Furthermore, speaking with strangers on the subject makes me more comfortable to speak on the topic."

More than half (57%) of all regional forum attendees indicated they had looked at the exhibit of photos and stores displayed in the lobby areas outside the forum [n=54]. In comments about the value these photos and stories of other community members added to the experience, they noted that they personalized the issues, for example, "[flooding] became more of a human experience," "Helped make it personal," provided "Greater understanding of other's situations," and "Puts a 'real' face on concepts that can seem rather far off and abstract." A handful of responses also noted the value of the images and stories specifically for the forum experience, in that they "Set the stage" and "Graphically drove home the need for this forum and its purpose." A handful of those who looked at the exhibit indicated that it had inspired their own recollections of flood experiences, including the recent local flooding in '04, '05 and '06, the Johnstown, PA flood of 1977, and flooding downriver in New Hope. One of the academics presented noted that the exhibit "Made me realize no matter how much I know from all my research, there's always more to learn."

SUGGESTIONS FOR FUTURE NURTURE NATURE FOUNDATION EVENTS

Many participants simply suggested more forums and more educational experiences.

Other suggestions mentioned specific topics; five participants proposed sessions to address the NYC reservoirs impact on flooding, such as inviting Dr. Ruggles of Lafayette College to speak and address the causes of past floods. Requests included: "Good, clear scientific descriptions of the causes of the floods—differences in weather, etc. for 1996, 2006, 2005, 2004 and clear descriptions of NYC reservoir issues," and "Pay attention to the reservoir issue. If you don't people who live along the river will not listen, or believe you care about their plight."

Other suggestions for topics of potential future sessions included fracking (hydraulic fracturing), climate change and future weather forecasting, zoning measures, and storm water management.

Suggestions also included conducting educational river paddle or boat rides (3), conducting workshops for public officials (3), hosting a film series and discussion (1), conducting a public awareness event (1), and collaborating on educational displays and holding teacher trainings and more at Nurture Nature Foundation (1), and hosting events in different areas to try to attract different groups of people (1). Another simply expressed excitement about the new museum, stating "Looking forward to the finished exhibits."

SUMMARY

The regional forums built on and expanded the community dialogue on flooding. They drew both past participants and newcomers, and continued to reflect a wider cross-section of Lehigh Valley citizens. The basic forum structure, mixing the introduction of scientific content by visiting scientists with opportunities for small- and large-group discussions, and validating individual opinions and learning trajectories along with practical experiences for engaging science content, continued to find success. The scientific content appropriately offered a regional view (suggesting the need to view management from a watershed rather than community perspective), a historical view (the frequency of flooding events over a one hundred year period), and a global view (how climate change would affect flooding locally).

Participant comments about learning reflected the value of the conversations with diverse stakeholders as well as the broadening of their perspectives on flooding. Persistent concerns about the role of reservoir management upstream were again raised. Additional issues emerged concerning the most effective means of bringing citizen concerns to decision-makers. Finally, participants expressed an ongoing commitment to the issue through their extensive suggestions for future Nurture Nature educational programs and events.

CONCLUSION (SUMMARY AND RECOMMENDATIONS)

The focus group – forum adaptation of the forum model of science education was unquestionably successful in engaging local residents, creating opportunities for them to apply new knowledge in realistic scenarios, and building allegiance to the new museum. It appears that a number of participants are more likely to participate in future science forums and possess greater confidence in discussing science content with scientists.

In designing the pilot project, the Nurture Nature Foundation posed six key questions aimed at determining the efficacy of the Flood Forum Model. These questions structure the following Summary and Recommendations.

What are appealing entry points into dialogue with low-income residents, teens, and first responders?

The two primary motivations participants cited for attending the community forums were learning about flooding and contributing to the design of a new museum. Flooding was a natural entry point for many. Recent floods were still vivid memories, and for some, a persistent threat, in Easton and Lower Mount Bethel. Allentown participants did not perceive themselves as under threat of flooding and, accordingly, forum attendance was lower.[15]

Beyond the intrinsic draw of *talking* about flooding, it was clear that the opportunity for *learning* about flooding was also strong. Many participants had done extensive research on the recent floods and came to the forums with theories to test with presenting scientists. Particularly in Lower Mount Bethel, participants had developed deep practical knowledge about local rivers; they were keenly sensitive to changes in animal behaviors and skilled readers of water level monitoring made available through the Internet. They, like the other participants, articulated important questions about the causes of flooding, opportunities for mitigating flood damage, and improved warning systems, among other topics.

Contributing to the design of a new museum appeared to draw participants at two levels. At one, as evidenced by the range and creativity of museum suggestions, this entry point spoke to the appeal of exercising imaginative power over an essentially "blank slate." At another, the new museum excited interest from participants who perceived its potential for economic revitalization, particularly in Easton.

The most appealing entry point for first responders appeared to the opportunity to better explain their work to other community members. They were appreciative of the attention paid to their work before (and during and after) floods and were eager to share their knowledge of flood safety practices.

A few different groups of teenagers took part in focus groups—students in a high school environmental science class; middle and high school students and young people from the Allentown Boys and Girls Club; and family members (in LMBT and Easton events). While differing significant in terms of first hand experience of flooding, and

[15] Flooding does occur in Allentown in industrial areas, just not on a residential level. That's why the flood insurance claim numbers are high, but the community interest less so.

prior knowledge and engagement in the issues, the young people all found the topic of flooding interesting, and were extremely enthusiastic contributors of ideas for the museum.

For immigrants who were relatively new to Easton, the forums appeared to be a useful source of knowledge about the Lehigh Valley weather and ecology. It was also an occasion to reflect on experiences of natural disasters in their native countries and offer suggestions, for example, about types of warning systems, for their adopted city.

Interest in flooding was related to another entry point for many people: the opportunity to communicate with decision-makers. For some participants in Lower Mount Bethel and to a lesser extent in Easton, the pain of flooding had been compounded by frustration with local officials and the Federal Emergency Management Agency. In Allentown and Easton, some economic decisions and opportunities for growth depended on developing the floodplain. The possibility of reaching decision-makers was clearly appealing in all three communities.

Communicating with others, broadly understood, also appeared to be a strong entry point for many participants; all three types of events—focus groups, community forums, and regional forums—were at some level social events. "This was better than television," noted a Lower Mount Bethel focus group participant; another observed that he "could do this every night." "Just the fact that the forum was held" was a source of great value to at least one Lower Mount Bethel forum participant. For many, the opportunity to give testimony to their flooding experiences and hear those of others was a compelling aspect as well. Numerous participants identified discussion with others as a prime value of the events.

What do citizens know about the causes and mitigation of flooding?

Participants came to the NNF events with varying knowledge levels. Some, like the students from the Allentown Boys and Girls Club, had little foundational science knowledge, while others, such as environmentalists with local watershed projects, had a great deal of very specific knowledge. Participants who lived on rivers may have had a close familiarity with the river in times of flooding and otherwise, but a less firm understanding of the underlying physical and biological forces at play. The NNF pilot project designers identified a handful of key concepts they used as indicators of science knowledge: *the causes of flooding*, *the floodplain*, *the 100-year flood*, and *the watershed*. Another fundamental concept was the idea that flooding is a natural process.

The questionnaire for focus group participants asked explicitly about their knowledge of these key terms; based on questionnaire responses, the NNF ensured that presenting scientists discussed and explained those terms, and table discussion prompts at the forums drew participants into discussions based on the concepts.

Among the key concepts, *the floodplain* and the *100-year flood* emerged as areas of greatest participant learning. The explanation of the 100-year flood as a planning construct and the statistical assessment of each flood event appeared to intrigue participants; mention of the 100-year flood was most frequent in response to questions about what participants had learned. Several participants at the regional forums, held

in Easton, noted learning that the city included the 500-year floodplain zone in City floodplain regulations.

Learning about the *floodplain* was a close second to the 100-year flood and appeared to elicit even deeper learning among participants, as reflected in comments noting that "the floodplain is an integral part of the river" and conclusions that floods are natural—and inevitable—events. Participants' comments across all of the Nurture Nature Foundation events suggest a shift from a focus on "flood prevention" to "damage mitigation."

Watershed appeared to gain less traction with participants. A notably smaller number of community participants identified watersheds as a source of new knowledge, suggesting that more work can be done to engage participants in a systemic understanding of the water system. Despite this, discussion about possible exhibits for the new museum gave participants an opportunity to apply the new knowledge, and one of the most common suggestions was an interactive watershed model that allowed participants to change variables such as the amount of impervious surface as a way of seeing the effects on runoff and ultimately on flood incidence.

What common associations do people have with the river? With flooding? What language do people use when talking about these issues?

The associations with rivers and flooding that emerged in participants' conversations conveyed the many powerful ways participants connected with rivers. For some, the river was a refuge, a place of solace after personal loss; for others the river was a kind of being, with its own breathing pattern. People described living alongside the river as having a quality of joy no other way of life could duplicate. Living on the river was an intense personal investment. Self-identified "river rats," who live on the river, spoke of the river in terms of both awe and peace, balancing descriptions of fishing or boating with accounts of the intense sound—"like a train"—that a flooding river makes. The way of life was so strong, some said, that they did not stop thinking about the river (and possible flooding) even when they were away on vacation. For participants who did not live directly on rivers, the proximity to rivers was still a highly valued aspect of their lives. The rivers are essential to the identities of all three communities.

Furthermore, a number of participants who had lived through floods saw themselves as "survivors" in positive terms, describing themselves as stronger and more resilient for having undergone the experience.

These affective associations with rivers and flooding emerged most explicitly during the focus groups, when participants were invited to share their personal stories about the river; however, participants also shared flood stories during small-group forum discussions. There the stories provided an opening for further conversation with other participants.

At the regional forums, which were not set within local communities as the earlier events were and involved much broader audiences, a display of photographs and stories about flooding created a human context for science content on potentially abstract topics such as flood frequency and climate change. Participants concurred that including personal experiences throughout the stages of the project was a

powerful way to ground the forum and discussions of flooding in human experience and personal connection to the issues.

What is the educational and motivational value of forum events to these priority audiences?

The NNF Flood Forum model was extremely successful in interesting participants in learning more about rivers and flooding: the fact that nearly 40% of people who had attended one or more previous events attended the regional forums suggests the level of personal connection they felt to the NNF content and process. In interviews, several participants described conducting Internet searches on flooding following their exposure to an NNF event. A strong majority of regional forum participants who had attended earlier NNF events reported that they had sought out additional information about floods, rivers, floodplains, and watersheds following the earlier event, and many forum participants indicated that they intended to share what they had learned with family and friends. Nearly all community forum participants indicated that the experience made them likely to attend another science or flooding forum, and more than half indicated an interest in getting involved in community planning or municipal meetings related to flooding.

The range of suggestions and participants' enthusiasm in contributing ideas for future forums or other public events also suggests an ongoing interest in the public forum.

For a number of participants, particularly in Easton, the economic potential of the museum—and the riverfront itself—was a motivating factor in attending NNF events.

How can we address imminent flooding threats without spreading alarm and panic among the lay public?

The NNF was highly successful in treating a potentially volatile public issue with sensitivity and calm. At no time did the science presenters or NNF personnel discuss flooding in sensational terms that could have evoked alarm. This was of particular importance in discussions with members of the immigrant community, many of whom had first-hand experience with natural disasters. Members of this community were still learning about the level of flood threat in the Lehigh Valley and the available support from local governments.

To be sure, interest in flood warning systems was strong and warnings consistently ranked high among potential museum exhibit topics. The public memory of the floods of the past decades—for a handful of participants the 1955 flood as well—remained vivid and the commitment not to be caught "off guard" was strong. In Lower Mount Bethel, for example, the (volunteer) fire and rescue personnel found themselves building their flood response system in the midst of the first major event, in 2004, and continued to refine that system through subsequent floods. Householders who lived in flood zones had either raised their homes or developed systems for securing their houses and valuables at the first indication of a flood.

Further testimony to the success of the flood forum model appeared in the fact that, while participants were able to voice and even vent frustrations related to flooding experiences, personal loss, and questions and even anger regarding what was believed to be the mismanagement of upriver reservoirs, at no point did these issues derail the focus group or forum agendas or appear to prevent people from sharing freely.

How can the educational value of forum programs be adjusted to energize debates that use and address lay interests, concerns, terms, and natural modes of dialogue?

The focus group – forum pairing model, an adaptation of forum models used in other science centers proved effective in building interest among target audiences and supporting participants in making a personal connection to the issue. The focus group as formative tool allowed the NNF to refine the subsequent forum structure to accommodate opportunities for participants to share personal stories. The refined structure validated participants' personal perspectives and at the same time introduced relevant science content. The small-group discussion questions, which moved from personal concerns to discussions about the best use of floodplain regions in each community, gave participants an opportunity to apply their new science learning to actual issues facing their communities.

RECOMMENDATIONS

The chief recommendation is that the NNF continue to refine and expand on the work it has accomplished. More specific suggestions follow related to programming and to event facilitation.

Programming

- Continue to provide multi-modal and multi-age entry points that will keep participants engaged in learning and using science in the care of their environments.
- Offer opportunities for more intensive engagement, for example, water monitoring, oral history gathering, and school-based programs, for those who are interested.
- Continue to develop science programming informed by knowledge of the community, its interests and concerns, preferred modes of expression and dialogue, and existing science knowledge.
- Explore ways to combine personal narratives related to flooding or other public concerns which science can address with multi-media and Web 2.0 modes of communication.
- Address citizens' concerns about the transparency and practices of the management of the reservoirs on the Delaware River in New York State.
- Design and implement a public education campaign to correct the near-ubiquitous misunderstanding of the 100- or 500-year floodplain terminology.
- Design and implement a public education campaign to raise awareness of watersheds; devote future educational programming to watersheds and systems thinking.
- Develop a flood forum model appropriate for student learners not yet ready to participate in community dialogues.

Event Facilitation

- Continue to experiment with formats to accommodate different styles of conversation—large-group and small-group discussion, and one-on-one conversations with scientists.
- Capitalize on the presence of scientists to offer participants more opportunity to question presenters during or immediately after their presentations.
- Continue to ensure that all voices are heard and that facilitators reflect participants' intended meaning through increased formalization of training for table facilitators.
- Continue to refine the visual presentations away from static PowerPoints and toward a more dynamic and/or interactive medium.

The baseline science knowledge questions were designed for use in this pilot phase to provide actionable information for the development of forums. In the full-scale development, it is suggested that the Nurture Nature Foundation continue this practice of gathering information on science content and conducting pre- and post studies of participants' knowledge of river ecology. Questions should be drawn from national indicators of watersheds, river ecology, river/flood safety literacy, etc.

Participants entered the dialogue at varying levels of knowledge and expertise. In most cases, the forum model easily accommodated these variations, and participants shared knowledge, alternately serving as experts and learners. However, too-great differences in knowledge can also bog down the experience, as was the case for students from the Allentown Boys and Girls Club, who generally lacked even a rudimentary understanding of the water cycle. That is not to say, however, that such groups should be excluded from NNF activities; the students asked thoughtful questions during both the focus group and forum and were enthusiastic about learning more about the natural environment. Greater accommodation should be provided to meet the needs of groups with sharply divergent background knowledge, including exploring separate activities to target these groups.

CODA: WHAT DOES IT MEAN TO BE SCIENCE LITERATE?

Current notions of science literacy emphasize literacy as an activity or practice rather than a product.[16] The high levels of Nurture Nature Foundation forum participants' engagement, concern, and active learning about flooding and related policy issues suggest that the Flood Forum pilot project was successful in promoting some forms of science literacy. At a minimum, many participants integrated some of the key scientific concepts in a way that, according to their reports, shifted, even if subtly, their perspectives on rivers, on flooding, on first responders, and on other people.

As the NNF project continues to engage citizens in learning and using science to address environmental and quality-of-life issues it is expected that greater numbers of citizens will become science literate in numerous ways. They may range from possessing a heightened awareness of the forces of nature to engaging directly with

[16] Roth, Wolff-Michael and Angela Calabrese Barton, *Rethinking Scientific Literacy*, RoutledgeFalmer: London, 2004.

nature through water monitoring, record-keeping, art-making, and other forms of stewardship.