2014

# Community Visions for Nutrient Management for the Floyds Fork Watershed

Kentucky Water Resources Research Institute

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Prepared by
Kentucky Water Resources Research Institute
233 Mining and Minerals Building
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Prepared for
Kentucky Division of Water

Acknowledgment: This material is based upon work supported by the Kentucky Division of Water under Award Number 201305201355.

UNIVERSITY OF KENTUCKY

**July 2014**

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This report presents the results of a stakeholder engagement process for the Floyds Fork Watershed in north central Kentucky. The report is meant to inform the local citizens of the watershed, as well as US EPA and the Kentucky Division of Water as part of ongoing watershed management activities within the watershed. The process implemented in this study are intended to provide insights into a range of perspectives and community preferences related to possible nutrient management strategies for use in the Floyds Fork Watershed. The ultimate selection of specific actions will be made by the Kentucky Division of Water in accordance with applicable laws and agreements.

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## ACRONYMS

| | |
|---|---|
| ARS | Audience Response System |
| BOD | Biological Oxygen Demand |
| BMPs | Best Management Practices |
| CBPC | Community-Based Participatory Communication |
| CBPR | Community-Based Participatory Research |
| DO | Dissolved Oxygen |
| DOW | Division of Water |
| DRO | Development Review Overlay |
| EPA | Environmental Protection Agency |
| FFEA | Floyds Fork Environmental Association |
| GPS | Global Positioning System |
| HSPF | Hydrologic Simulation Program Fortran |
| I/I | Inflow and Infiltration |
| IRB | University of Kentucky Non-Biomedical Institutional Review Board |
| KDOW | Kentucky Division of Water |
| KGS | Kentucky Geological Survey |
| KSR | Kentucky State Reformatory |
| KSWS | Kentucky Surface Water Standard |
| KWA | Kentucky Waterways Alliance |
| KWRRI | Kentucky Water Resources Research Institute |
| LID | Low Impact Development |
| MS4 | Municipal Separate Storm Sewer System |
| MSD | Metropolitan Sewer District |
| NLCD | National Land Cover Database |
| NPDES | National Pollution Discharge Elimination System |
| NPL | National Priority List |
| NRCS | Natural Resources Conservation Service |
| OCSD | Oldham County Sewer District |
| PGDP | Paducah Gaseous Diffusion Plant |
| PI | Principal Investigator |
| PLA | Participatory Learning and Action |
| PRA | Participatory Rural Appraisal |
| PRCA | Participatory Rural Communication Appraisal |
| RRA | Rapid Rural Assessment |
| SPI | Structured Public Involvement |
| SSO | Sanitary Sewer Overflow |
| TMDL | Total Maximum Daily Load |
| US EPA | United States Environmental Protection Agency |
| USGS | United States Geological Survey |
| WBP | Watershed-Based Plan |
| WWAH | Warm Water Aquatic Habitat |
| WQTC | Water Quality Treatment Center |
| WWTP | Wastewater Treatment Plant |

## EXECUTIVE SUMMARY

In its capacity as an EPA-recognized Center of Excellence for Watershed Management, the Kentucky Water Resources Research Institute (KWRRI) promotes effective strategies for balancing Kentucky's economic development and environmental stewardship needs through successful watershed management. In 2011, the Kentucky Division of Water asked KWRRI to implement a stakeholder engagement process for the Floyds Fork watershed that would provide insights into a range of perspectives and community preferences regarding possible nutrient management strategies for use in the Floyds Fork Watershed. This objective was driven by previous attempts to develop a comprehensive watershed plan for the area, as well as by ongoing efforts by the Kentucky Division of Water to develop a nutrient and organic enrichment Total Maximum Daily Load (TMDL) for the watershed. TMDLs are important tools for describing the maximum amount of pollutant that a watershed can receive while remaining in compliance with water quality standards, but successfully meeting TMDL goals requires multilateral stakeholder planning and engagement. To help determine how best to insure such stakeholder engagement following the completion of the Floyds Fork TMDL, the Kentucky Division of Water wanted to acquire a better understanding of the perspectives and desires of watershed residents and other watershed stakeholders.

The KWRRI stakeholder engagement methodology employed in this project was originally developed and implemented as part of a collaborative, comprehensive future visioning project for the Paducah Gaseous Diffusion Plant National Priority List (NPL) Superfund site (see www.paducahvision.com). In that study, environmental scientists from KWRRI joined communication and public infrastructure planning experts to construct an engagement approach to identify community-based visions representing a range of perspectives for the site's future after the facility closes.

Successful collaboration requires in-depth understanding of diverse community values, mutual respect and open communication among the collaborators, and a joint willingness to incorporate key values into the planning process. It also requires a bi-directional communication process. Two-way communication means that all parties must educate each other on the technical and policy issues that underlie decisions, committing staff and other resources toward this engagement process. Discussions should take place throughout the planning process and must include issues related both to scientifically-identified environmental impacts and to perceptions of such impacts, recognizing that the two do not always align (Slovic, 2000). Not only is there a need for community members to be educated by federal and state agencies and contractors about technical and regulatory criteria, but agencies and contractors must be educated by the community about its history, goals, and needs.

Regarding stakeholder communication and engagement in the context of watershed management, federal and state agencies should enter into dialogue with local governments and community members to better understand community perceptions that are critical for management – perceptions that often vary from community to community and even among different members of the same community. Such dialogues present the greatest opportunity for various parties to reconcile disparate perspectives, thus facilitating possible agreement or at least understanding on watershed management approaches. Such decisions, even technical ones, often are not solely technically based.

The Floyds Fork project was designed to maximize citizen engagement, as characterized by the Ladder of Citizen Participation (Arnstein, 1969). Not only does the ladder provide a philosophical guideline for the project, it also provides a quantitative way to gauge public perceptions about

past levels of community involvement, as well as preferences for future involvement. The Arnstein Ladder illustrates different levels of public participation that have been observed in policy and infrastructure decisions. A slightly modified version of the ladder is shown in Figure ES1. Although most of the terms used in the steps of the ladder are fairly self-explanatory, more explicit descriptions and explanations of the terminology can be found in Arnstein's original publication – see http://lithgow-schmidt.dk/sherry-arnstein/ladder-of-citizen-participation.html

In general, the steps of the ladder can be grouped into three broad classifications: Non Participation, Tokenism, and Citizen Power, with specific rungs falling within each broad category. In previous studies, most citizens have scored previous levels of involvement in public processes somewhere between informing and placation in the Tokenism section of the ladder; however, the majority of those polled in the past desire levels of participation somewhere between partnership and delegated power in the Citizen Power section of the ladder (Grossardt et al., 2010; KRCEE, 2011). In other words, and perhaps unexpectedly for some agencies and policymakers, most members of the public see a role for technical expertise in planning processes, while very few people feel that complete citizen control is necessary to achieve optimal outcomes.

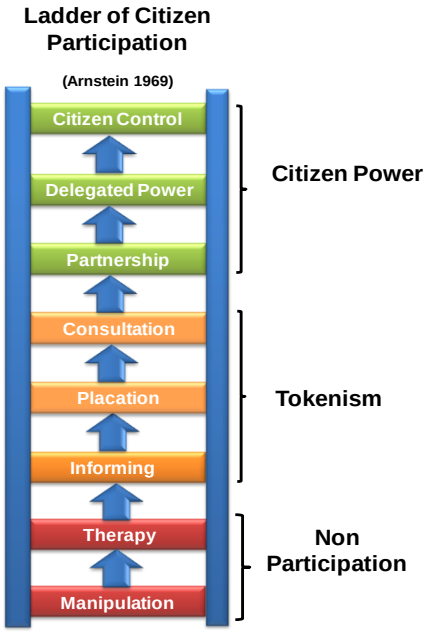



**Figure ES1 Arnstein Ladder of Citizen Participation (Arnstein, 1969)**

Considering the issues raised above, KWRRI has concluded that community engagement is critical at all stages for identifying and evaluating potential nutrient management strategies for the Floyds Fork watershed. As a result, the KWRRI convened a project team to develop a multi-method engagement approach, integrating both qualitative and quantitative data.

The research team's composition reflects a broad range of experience with the technical aspects and regulatory history of the Floyds Fork watershed. Research team members are:

- *Dr. Lindell Ormsbee, Ph.D., P.E., P.H., D.WRE,* is the director of KWRRI. He has been actively engaged in research, teaching, and consulting in water resources and

environmental engineering for three decades. As principal investigator for the Paducah Gaseous Diffusion Plant (PGDP) Stakeholder Future Vision Project, he shepherded the development of the integrated, community-based engagement process that was adapted for the Floyds Fork Watershed Engagement Project.

- *Jim Kipp, M.S.,* is associate director of KWRRI and a registered professional geologist in Kentucky. His interests include research focused on the identification and characterization of groundwater flow systems, at scales ranging from local to regional, based on physical, chemical, and hydro-geological factors. He currently manages activities related to the US Geological Survey-funded water institute program in Kentucky.
- *Ben Albritton, B.S.,* is a scientist and engineer for KWRRI. He has seven years of education experience, including leading an adult education program center in Louisville, KY. He has degrees in mathematics and civil engineering. Since joining KWRRI, he has been intensively involved in TMDL development for several streams in Kentucky. He also has extensive experience with the Hydrologic Simulation Program Fortran (HSPF) watershed model.
- *Anna Goodman Hoover, Ph.D.,* is deputy director of the Public Health Practice-Based Research Network National Coordinating Center, as well as a research faculty member in the University of Kentucky College of Public Health's Department of Health Services Management. As research coordinator for the PGDP Stakeholder Future Vision Project, she provided expertise in participatory communication, contributing to the development of the integrated community-based engagement process implemented in Floyds Fork.
- *Stephanie Jenkins, M.S.,* is program coordinator for KWRRI. Her experience includes implementation, design, and planning for educational programs, as well as research coordination. She recently headed up the Commonwealth Collaborative-designated Water Pioneers program that educated eastern Kentucky youth about Kentucky water resources and engaged them in water-related issues to improve water quality in their local communities.
- *Malissa McAlister, M.S.,* is the Kentucky River Basin Coordinator with KWRRI, where she is responsible for the coordination of several watershed projects within the basin, including: data management and analysis for the Kentucky River Watershed Watch; coordination of the Kentucky River Authority's Watershed Grant Program; and acting as a liaison to the Kentucky Division of Water for the implementation of watershed activities within the Kentucky River Basin.
- *Christie Oliver, MBA, MSMIT.,* is communications director for KWRRI, joining the department in June 2012. She has been at the university for six years coordinating events, student activities, and developed services for industry groups. Christie assisted with meeting logistics and project website maintenance.

For this project, the team employed Community-Based Participatory Communication (CBPC) methods, which use interviews, focus groups, and projective techniques to identify and interact with various community groups. The goal of CBPC is to discover value systems, risk perceptions (Anyaegbunam, Mefalopulos, & Moetsabi, 2004), and in this case, their implications for watershed management strategies. The team then employed Structured Public Involvement (SPI) activities, a democratic process that uses anonymous Audience Response Systems (ARS) or similar feedback methods in large-scale public meetings (Bailey, et al., 2010). In this way, SPI encourages democratic solutions to complex issues while resisting co-optation of the public meeting process by a single interest group.

In the research team's novel deployment of the CBPC-SPI integration, results from an extensive CBPC listening tour assisted in generating specific nutrient management strategies or best management practices (BMPs), which then became discussion triggers for additional CBPC-based focus group interactions, which ultimately fed into a broad-based SPI community forum that quantitatively measured preferences for designated strategies as thoroughly, accurately, and transparently as possible.

The public engagement model for this project included nine steps: 1) iterative stakeholder identification, 2) listening tour, 3) creation and utilization of a pilot test group with members chosen to represent diverse stakeholder interests, 4) stakeholder focus group meetings, 5) creation of a Floyds Fork informational website, 6) a community-based informational meeting, 7) three community-based future vision scenario evaluations, 8) a nutrient management scenario scoring website, and 9) preparation of a final report.. Each of these steps is summarized in the figure below:

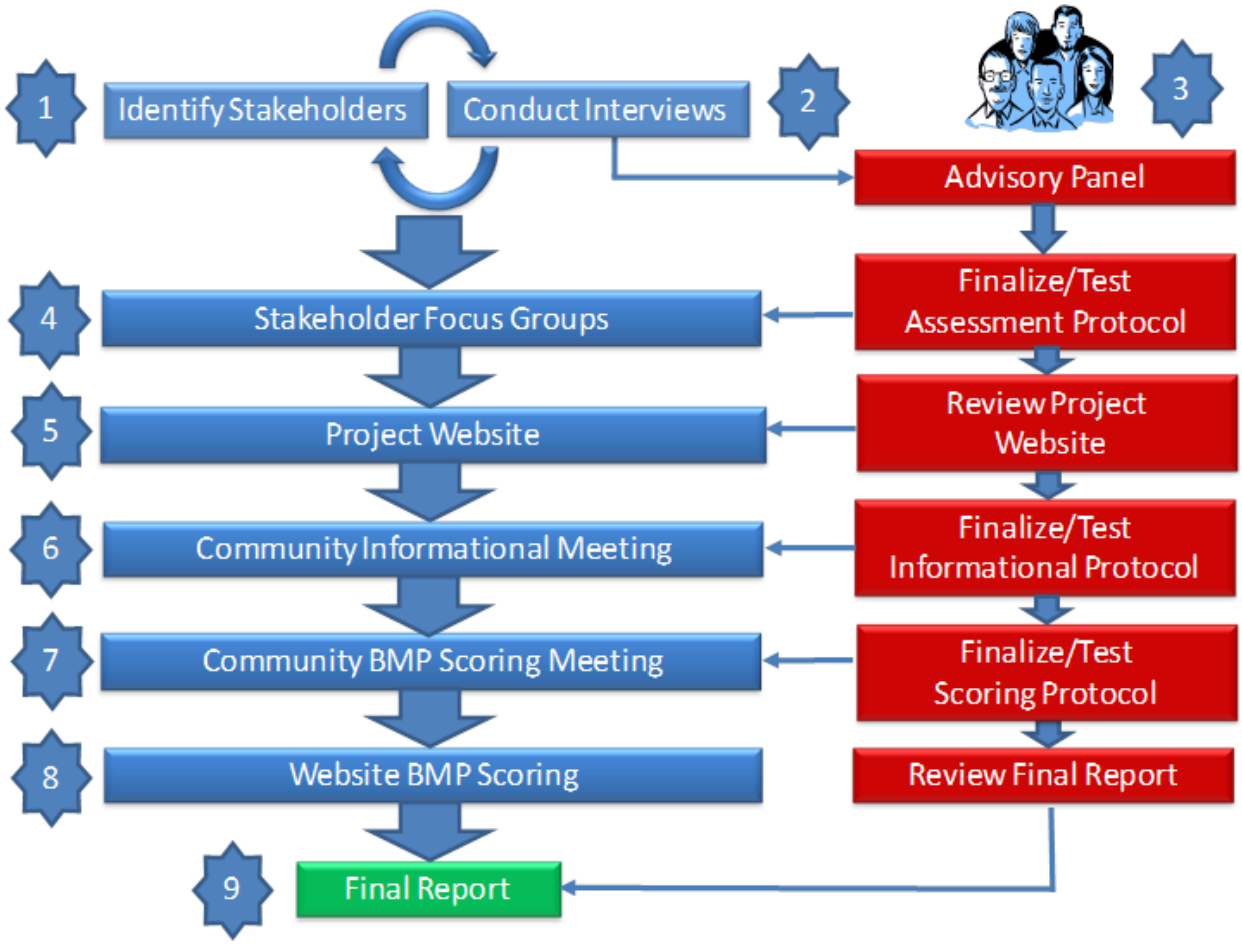



**Figure ES2 Floyds Fork Stakeholder Engagement Project Process**

**Step One – Iterative Stakeholder Identification**

After creating an initial draft guide for the integrated CBPC-SPI process, the next step was the identification of key stakeholder groups affected by and affecting Floyds Fork watershed management decisions. To fulfill this objective, the research team worked with the Kentucky Division of Water to identify as many stakeholders as possible. This initial list was supplemented using feedback provided by stakeholders who participated in the public meetings associated with EPA's modeling project conducted to support TMDL development. These names became a starting point for an iterative process in which stakeholder interactions generated the identification and engagement of other stakeholders, who suggested more stakeholders, until saturation had been achieved, with no additional groups or individuals being identified (Lindlof and Taylor, 2002). Ultimately, the team was able to generate a list that included 116 specific organizations or individuals. These were subsequently assigned to one of 24 distinct stakeholder groups. Because of logistical issues, this list was eventually consolidated into the following 7 clusters of stakeholders.

Government/utilities/health departments/universities
Farmers and agricultural organizations
Environmental groups
Preservation and wildlife groups
Economic development, local businesses and builders
Recreational organizations and golf courses
Residents and neighborhood associations

**Step Two - Listening Tour**

Once a detailed list of stakeholders was compiled, representatives from each of the stakeholder groups were interviewed as part of a listening tour that was conducted during Fall 2011 and Winter 2012. The listening tour allowed the research team to become better acquainted with the importance and place of the Floyds Fork watershed in the context of the larger region in the present and the past as well as into the future. Stakeholder interactions also pointed the researchers to a number of reports related to the watershed's future, many of which were subsequently provided online via a website especially created for the project – www.uky.edu/WaterResources/FF (note: a brief summary of these reports is provided in Appendix A). Finally, the listening tour pointed to the existence of competing commitments and tensions among diverse stakeholder groups. It became clear that this study would need to address all of these issues. After interviewing more than 70 individuals, the research team felt that they had reached a saturation point relative to the acquisition of new information. Based on the feedback from the stakeholders, twelve nutrient management strategies were identified, and these were lumped into four broad categories: 1) wastewater management, 2) agricultural management, 3) urban management and 4) policy strategies. A summary of the various management strategies is provided in Appendix B.

**Step Three - Creation of a Pilot Test Group**

The research team recruited a pilot test group comprised of 12 representatives with a least one representative drawn from each of the seven stakeholder clusters. This pilot group pre-tested individual steps of the engagement process along with initial discussion trigger scenarios prior to community-wide implementation and, where warranted, recommended protocol and/or scenario changes. Members of the pilot test group also helped to recruit additional members of their constituencies into the process.

**Step Four – Stakeholder Focus Groups**

Following creation of the pilot test group, a draft focus group protocol was developed, pre-tested by the pilot group, and slightly amended. The resulting protocol was submitted to and approved by the University of Kentucky non-biomedical Institutional Review Board (IRB) and is included in Appendix C. Forty-nine people subsequently attended seven stakeholder-specific focus groups. These meetings were conducted over a three month period (November 2012 - January 2013) at the Middletown Community Center in Jefferson County.

The CBPC protocol included the evaluation of several potential future nutrient management strategies initially identified by the stakeholders through the listening tour, additional data gathered during the pilot group meeting, and prior reports and recommendations from various entities. To accommodate time constraints and to allow ample time for group evaluations, a limited number of scenarios were selected as focus group discussion triggers. The specific sample scenarios were chosen to provide a robust and representative sample of potential management strategies. Focus group participants discussed the specific hypothetical management strategies in relation to community values, concerns, and beliefs. Following the discussion, participants evaluated each sample strategy anonymously using ARS keypad technology.

Broadly, the focus group discussions painted a picture of a community attempting to balance key values related to environmental responsibility and economic stability. In every session, the issues of both economic development and environmental preservation arose, often revealing internal conflicts for individual participants, as well as resulting in differing assessments of the hypothetical scenarios. A number of knowledge gaps also emerged within the discussions, with participants identifying specific informational needs that would assist them in making suitability determinations about specific scenarios.

**Step Five: Informational Website**

The research team developed a website (www.uky.edu/WaterResources/FF) for documenting information about the Floyds Fork watershed as well as the identified nutrient management strategies based on the information and data gaps identified through the focus group process. The website included a compilation of previous reports about the watershed, data collected within the watershed, scientific background information about nutrients, as well as information on nutrient sources and impacts.

**Step Six: Community Informational Meeting**

Based on the feedback from the focus groups, it was determined that the public would benefit from an informational meeting about the watershed and the proposed nutrient management BMPs prior to convening a meeting for actually evaluating and scoring each BMP. As a result, a draft protocol was developed for a public information meeting. The resulting protocol and PowerPoint presentation were reviewed and modified by the pilot group and then submitted to and approved by the University of Kentucky IRB (see Appendix C). The informational meeting was held on May 30, 2013 at the Parklands of Floyds Fork Gheens Foundation Lodge.

An interactive format was used in conducting the meeting in which informational questions were presented to the participants via a PowerPoint presentation. The participants were asked to select the appropriate answer to each question using the ARS technology. Following the input from the participants, the responses from the audience were displayed along with the actual correct answer

for each question. This format allowed the participants to test their knowledge and helped to inform the research team of any continuing information gaps. During the course of the presentation, questions about the informational items and the presented management scenarios were fielded from the audience. As a result of the feedback and discussion during the meeting, two additional management strategies were added to the policy category: forest preservation and reduction of atmospheric deposition of nitrogen.

**Step Seven – Community Scoring Meetings**

Following the public informational meeting, community meetings were held on August 23 (Middletown, KY); August 26 (LaGrange, KY); and September 9, 2013 (Shepherdsville, KY). A total of 59 individuals attended the three meetings. The purpose of these meetings was to solicit stakeholder feedback on the various nutrient management strategies. This was accomplished by having the meeting participants score each BMP using a Likert scale, where 1 = least preferable and 9 = most preferable. It should be emphasized, that each BMP was scored on its own merits and not in comparison to the other BMPs. The protocol for the meeting (including a PowerPoint presentation) was developed and submitted for approval by the University of Kentucky IRB (see Appdendix C).

Based on the feedback received from the focus groups, the pilot group, and the public information meeting, the original list of nutrient management strategies was expanded from 12 to 20 BMPs, with many of the new BMPs actually representing more detailed breakouts from the original list of 12. The BMPs presented during the public scoring meetings are summarized below, along with a corresponding letter codes used to reference the BMPs in subsequent charts. Once again, these were organized into four major categories:

<u>Wastewater Management</u>

1. Eliminate failing septic systems [WFSS]
2. Eliminate sanitary sewer overflows by reducing stormwater inflows [WSSO(R)]
3. Eliminate sanitary sewer overflows by expanding sewer infrastructure capacity [WSSO(C)]
4. Regionalization [WR]
5. Improve nutrient treatment technologies [WTT]

<u>Agricultural Nutrient Management</u>

6. Fertilizer management [AF]
7. Crop management [AC]
8. Erosion management [AE]
9. Wetlands [AW]
10. Livestock management [AL]
11. Manure management [AM]

<u>Urban Nutrient Management</u>

12. Educational programs for reducing loadings [URL]
13. Reduce runoff through traditional infrastructure [URR(T)]
14. Reduce runoff through green infrastructure [URR(G)]
15. Treat runoff through retention basins and urban wetlands [UTR]

Policy Strategies

16. Land use planning (development review overlays) [PDRO]
17. Land use planning (conservation subdivisions) [PCS]
18. Pollution Trading [PPT]
19. Forest preservation [PFP]
20. Reduce atmospheric deposition [PRAD]

The compiled results of the BMP scoring from all three meetings are provided in Figures ES3 and ES4.

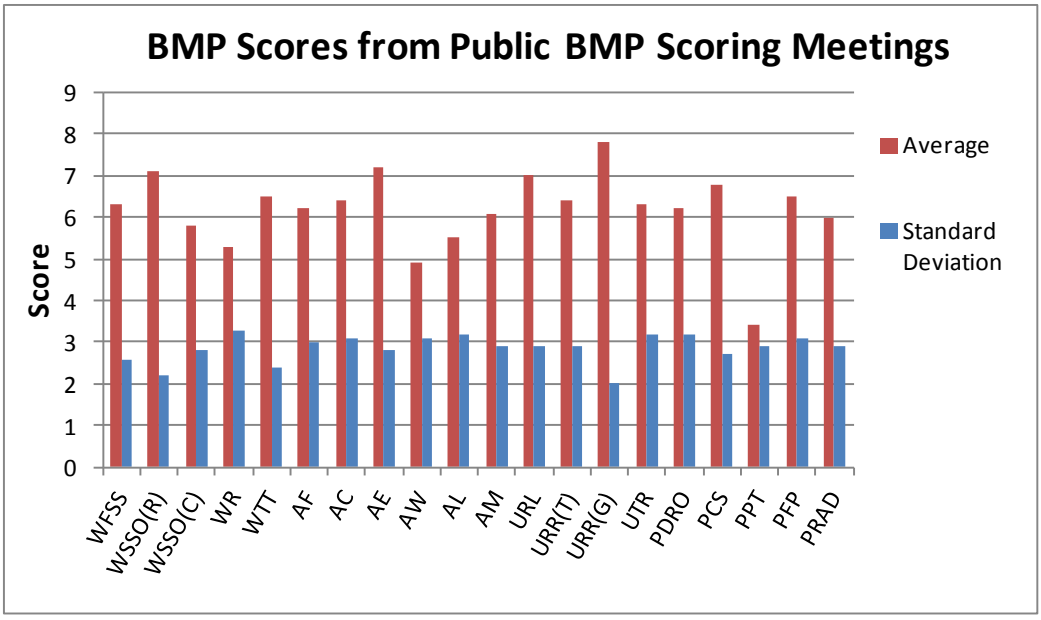



**Figure ES3 BMP Average Score with Standard Deviation from Public BMP Scoring Meetings**
**(Score of 1 = least preferable and a score of 9 = most preferable)**

**Step Eight: Web-based Scoring**

Following the public scoring meetings, additional opportunities for public input on the various BMPs were provided through an online survey that was made available through the project website: www.uky.edu/WaterResources/FF. A total of 51 online survey responses were completed during December 2013. The results of the web-based scoring are provided in Figures ES5 and ES6. The online survey also provided an opportunity for participants to provide written comments about the different scenarios. A compilation of these comments are provided in Appendix D. Additional insights into the potential rationale for variations in the scoring can be found from the qualitative comments obtained during the stakeholder focus group meetings (Chapter 4 in the main report).

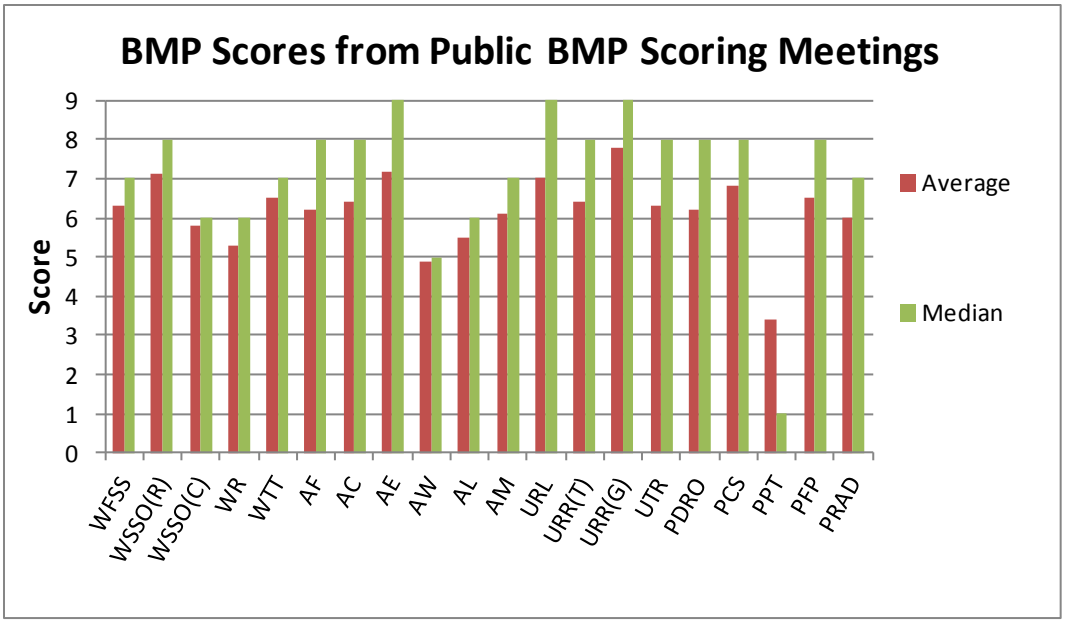



**Figure ES4 BMP Average Score with Median from Public BMP Scoring Meetings**
**(Score of 1 = least preferable and a score of 9 = most preferable)**

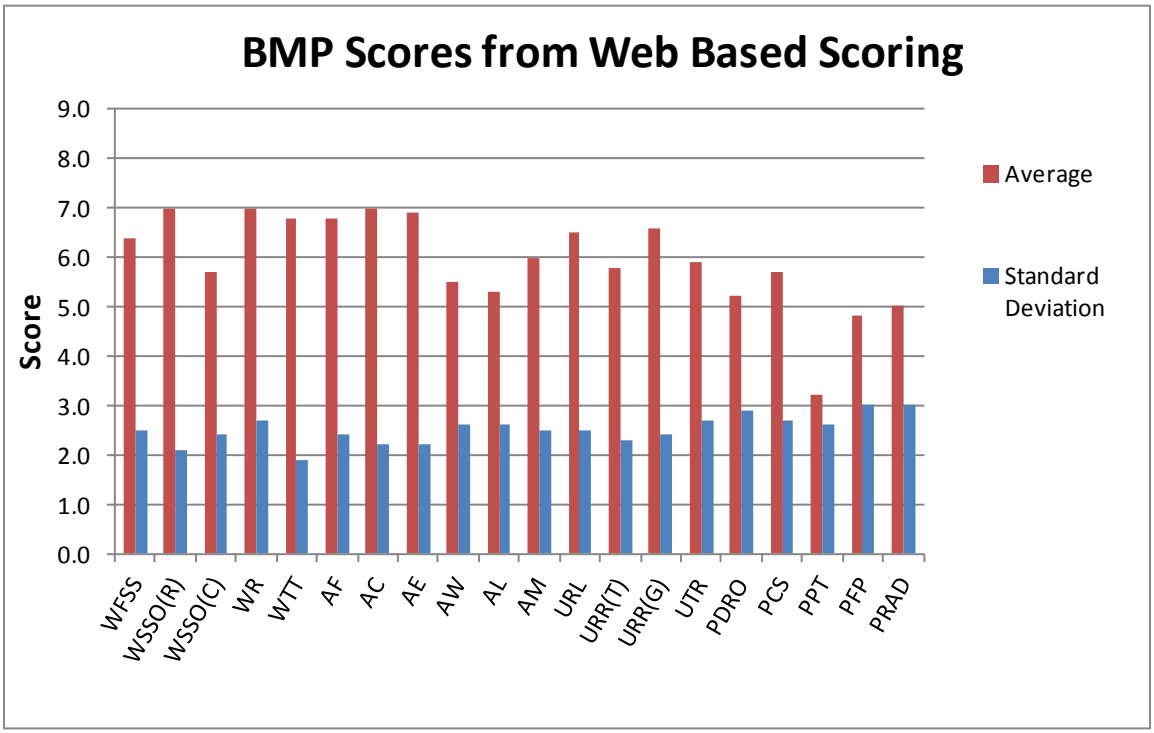



**Figure ES5 Online Survey BMP Evaluation Scores. Average Score with Standard Deviation.**
**(Score of 1 = least preferable and a score of 9 = most preferable)**

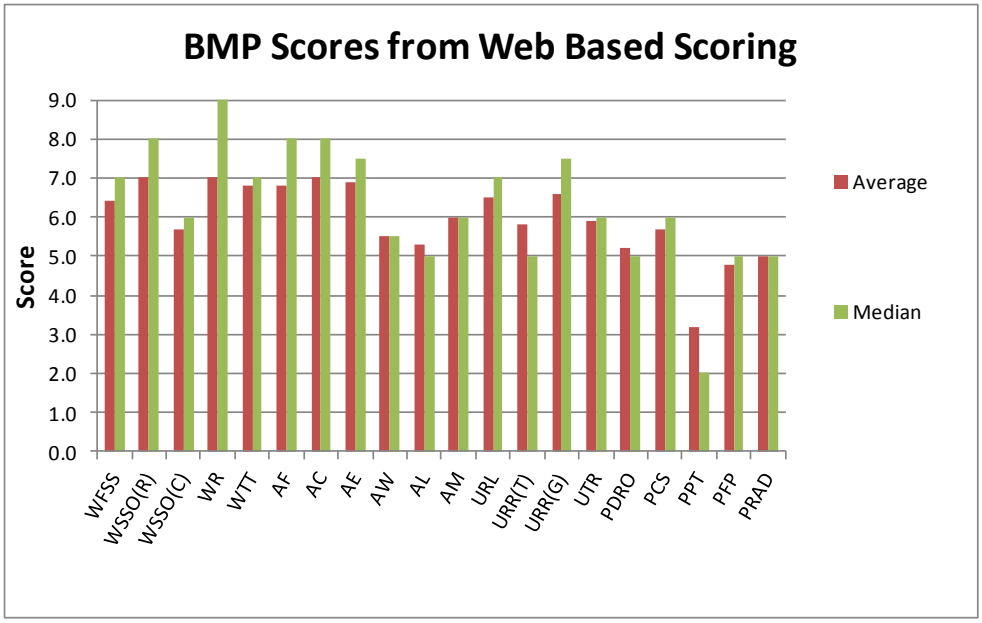



**Figure ES6 Online Survey BMP Evaluation Scores. Average Score with Median**
**(Score of 1 = least preferable and a score of 9 = most preferable)**

The combined results from the public scoring meetings and the web based scoring are provided in Figures ES7 and ES8.

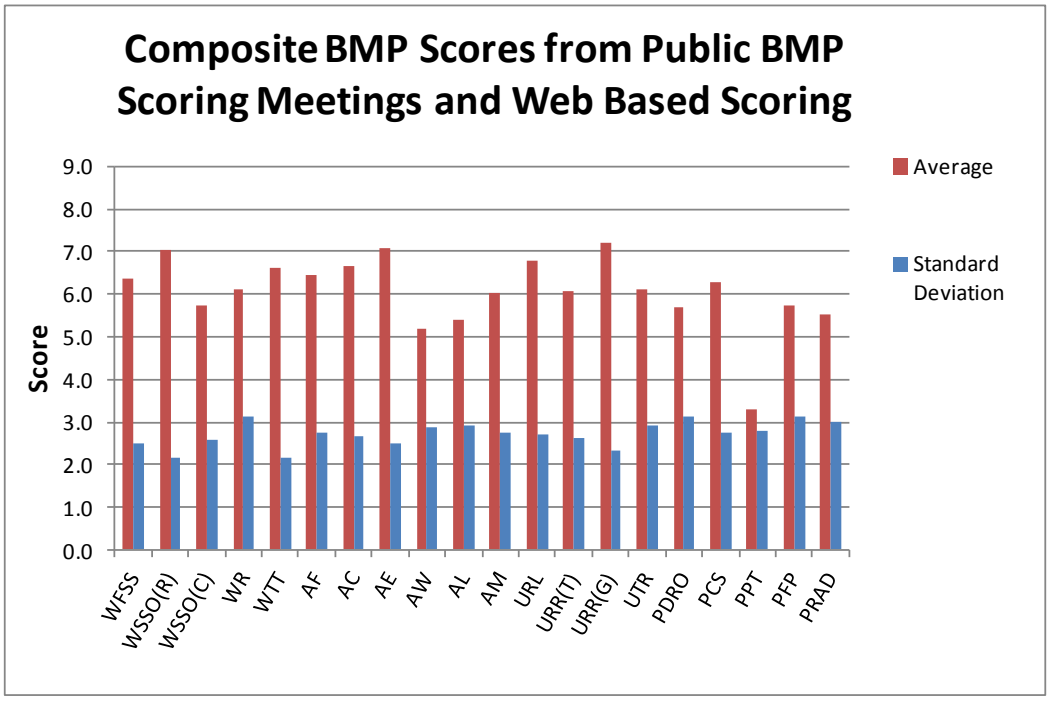



**Figure ES7 Combined BMP Evaluation Scores. Average Score with Standard Deviation**
**(Score of 1 = least preferable and a score of 9 = most preferable)**

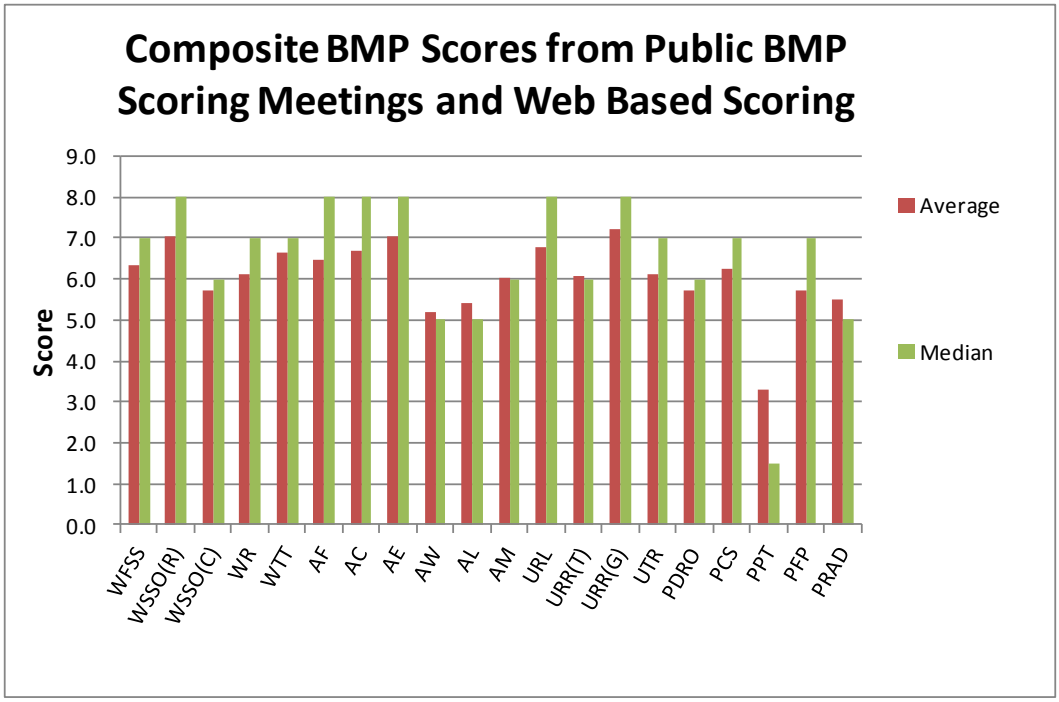



**Figure ES8 Combined BMP Evaluation Scores. Average Score with Median**
**(Score of 1 = least preferable and a score of 9 = most preferable)**

**Scoring Summary**

A compilation of scores from the 3 public meetings and from online scoring suggests that most of the BMPs are generally acceptable (average and median scores of 5 and above for all BMPs except Pollution Trading). Standard deviations were fairly consistent, typically falling between 2 and 3 for most alternatives. However, each of the BMPs received scores across the entire spectrum from "least preferable" to "most preferable" indicating a wide diversity of perspectives in the community with regard to all of the nutrient reduction approaches considered. None of the scoring patterns strongly resemble a normal distribution that might suggest some sort of consensus around a common value in the community. Some participants complained that they were unsure about the costs or the potential effectiveness of the various BMPs and this may have influenced the results of the scoring process to some degree. However, the detailed breakdowns of scores described and illustrated in Chapter 6 provide additional insights related to the BMPs that were considered.

While a general comparison between the different strategies can be obtained by comparing the associated mean or median scores, this metric can be somewhat misleading. Greater insights can be obtained by looking at the actual distribution of scores. For example, two strategies could have the same mean, and yet one strategy may have half the respondents scoring that strategy a 1 while the remaining stakeholders scoring that strategy with a 9. In general, such information provide potential insight into what strategies to avoid if one would like to avoid polarization among the community. With that insight, the strategies scores can be put into four basic clusters: 1) those strategies that were generally scored as favorable by the vast majority of stakeholders, 2) those strategies that the majority of the stakeholder supported but some strongly opposed, 3) those strategies that showed greater diversity or polarization among the scores (i.e. some stakeholders strongly supported while some stakeholders strongly opposed), and 4) those

strategies that were generally scored as unfavorable by the vast majority of the stakeholders. Each of the strategies are summarized below with the mean and median scores in parentheses.

Strategies with generally favorable scores:

- Eliminating failing septic systems (6.2,7)
- Eliminating sanitary sewer overflows by decreasing inflows (7, 8)
- Improving the treatment efficiency of wastewater treatment plants (6.7, 7)
- Controlling agricultural erosion (7, 8)
- Reducing nutrient loading from urban watershed through education 6.8, 8)
- Reducing urban runoff with green infrastructure (7.2, 8)

Strategies with generally favorable scores but some strong opposition:

- Managing the amount of fertilizer applied to crops (6.5, 8)
- Crop management (6.7, 8)
- Manure management (6, 6)
- Treating urban runoff using retention basins or constructed wetlands (6.1, 7)
- Conservation sub-divisions (6.2, 7)
- Reducing urban runoff through traditional stormwater infrastructure (6, 6)

Strategies with polarized scoring

- Eliminating sanitary sewer overflows by increasing sewer capacity (5.8, 6)
- Regionalization of wastewater treatment plants (6.1, 7)
- Livestock management (5.3, 5)
- Treating agricultural runoff with wetlands (5.2, 6)
- Land use planning through development review overlays (5.8, 6)
- Reducing atmospheric nitrogen deposition (5.5, 5)
- Forest preservation (5.8, 7)

Strategies with generally unfavorable scores

- Pollution trading (3.3, 1.5)

Potential insights about the reasons why people tended to score a particular scenario more positively or negatively than others may be inferred from the qualitative comments collected during the focus group meetings. In general, the scoring of the focus group meetings tended to track the scoring from the public meetings, supporting the hypothesis that the reasons identified in the focus group meetings could inform the scoring in the public meetings. Lower scores were typically reflective of some of the following concerns: 1) feasibility of the strategy - either because of technology, implementation, maintenance or policy issues, 2) potential cost of the strategy, 3) concerns about loss of control of private property, 4) potential unintended consequences, 5) impacts on future development (concerns the strategy would either promote or hinder development), and 6) concerns whether the strategy would have any real significant impact.

In some cases, it appeared that different stakeholder groups tended to score those strategies with lower scores if they perceived that a particular strategy might negatively impact their own self interests. For example, it appeared that more stakeholders who identified themselves with

agricultural interests tended to score the agricultural strategies lower. Likewise, it appeared that those stakeholders who identified themselves with development interests tended to score those strategies that could potentially negatively impact development with a lower score. Likewise, it appeared that the preservationists and environmentalists tended to score lower those strategies that might increase development (e.g. regionalization).

**Process Evaluation**

Quantitative assessments of the process used at each of the focus group meetings, as well as the informational meeting and public scoring meetings were obtained using a 9 point Likert scale. The results for each set of meetings are provided in Figures ES9-ES11. The average scores from the informational meeting and the public scoring meetings were very similar and somewhat lower than the focus group meetings. It is speculated that one of the reasons for this result was that stakeholders had more time and opportunity to acquire additional information in the focus groups than in the informational meeting, the public scoring meetings, or online. In particular, because of the nature of the focus group meetings, stakeholders had more opportunities to engage and discuss the various BMPs both with the meeting moderator and amongst themselves. The focus group meetings also scored only 12 nutrient management scenarios (instead of 20). Unfortunately, because of the time constraints and the number of BMPs to be considered, it was not possible to go into as much detail about each of the scenarios at later meetings as was afforded during the initial focus group meetings. Ideally, the intent of the focus groups, the informational meeting, and the informational website was to provide sufficient resources for stakeholders to educate themselves about the details of the individuals BMPs. Nonetheless, the final scoring meetings included some individuals who had not attended any previous meeting or accessed the website. Such individuals might tend to rate the process lower than those who had attended previous meetings and had access to additional information. Alternatively, individuals who attended the original focus meetings and later participated again at a public scoring meeting or completed scoring online may have become frustrated at the redundancy of being asked to consider many of the same BMPs another time.

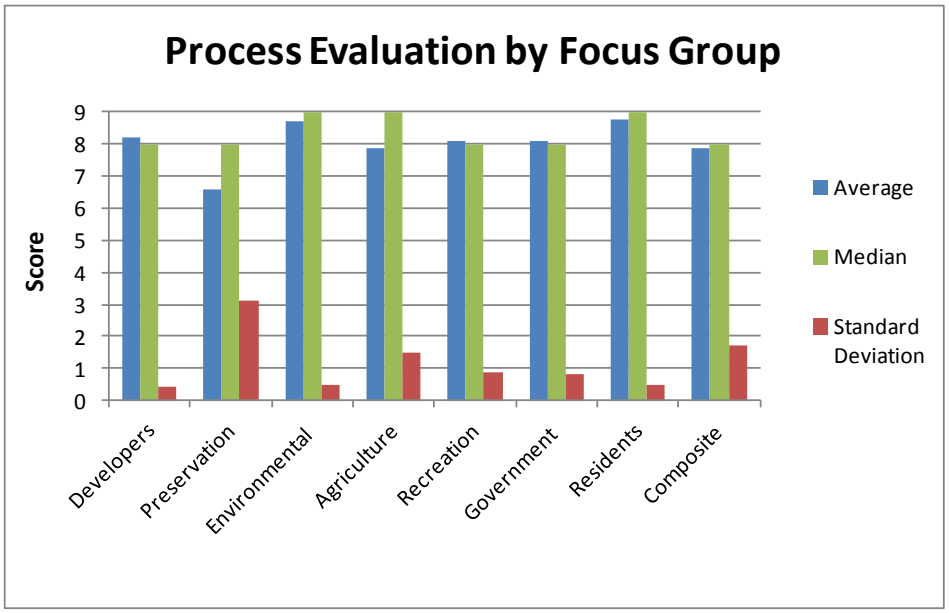



**Figure ES9 Process Evaluation Scores of Focus Group Meetings Using a 9 Point Likert Scale**
**(Score of 1 = very negative and a score of 9 = very positive)**

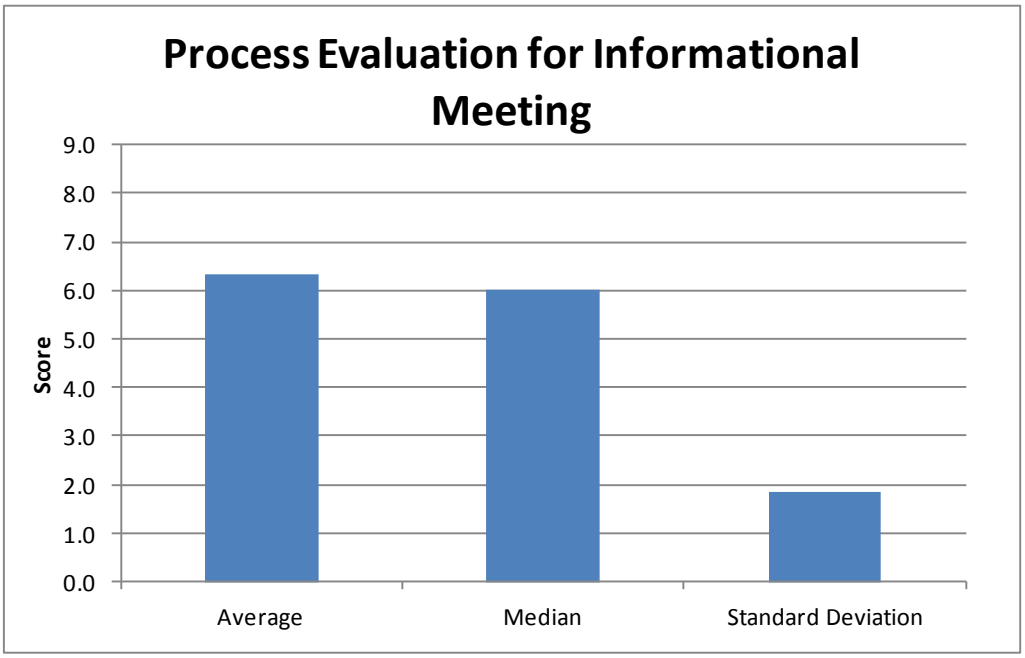



**Figure ES10 Process Evaluation Scores of Informational Meeting Using a 9 Point Likert Scale**
**(Score of 1 = very negative and a score of 9 = very positive)**

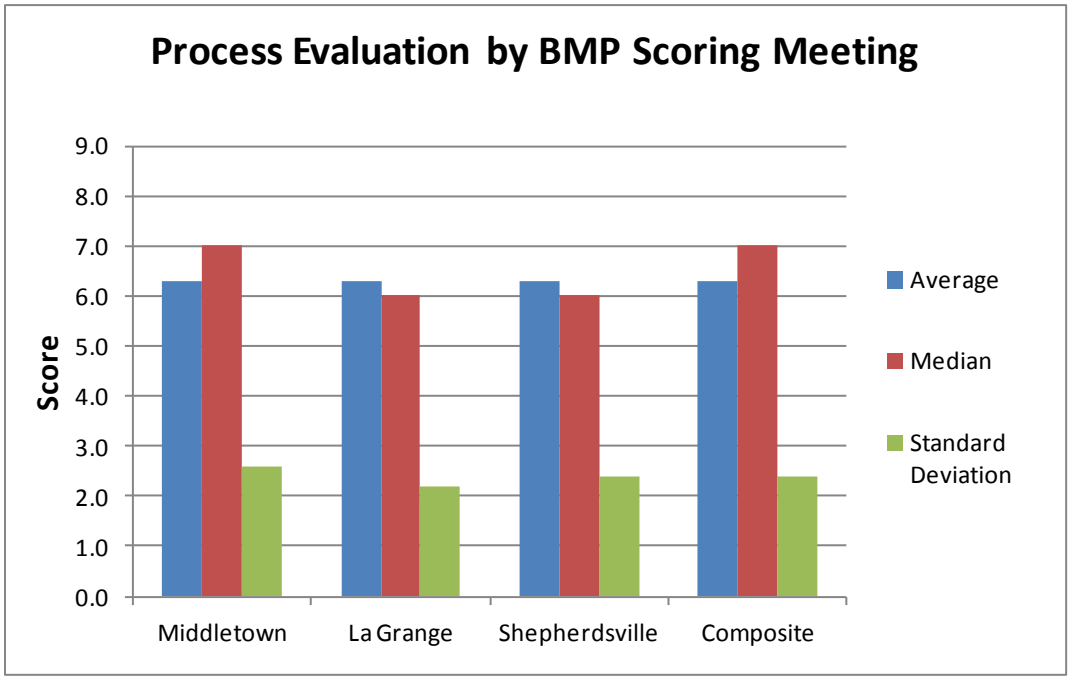



**Figure ES11 Process Evaluation Scores of Public Meetings Using a 9 Point Likert Scale**
**(Score of 1 = very negative and a score of 9 = very positive)**

A quantitative assessment of the utility of the online survey was also obtained using a 9 point Likert scale. Results of this assessment are provided in Figure ES12 and are very similar to those obtained from the informational meeting and the 3 scoring meetings.

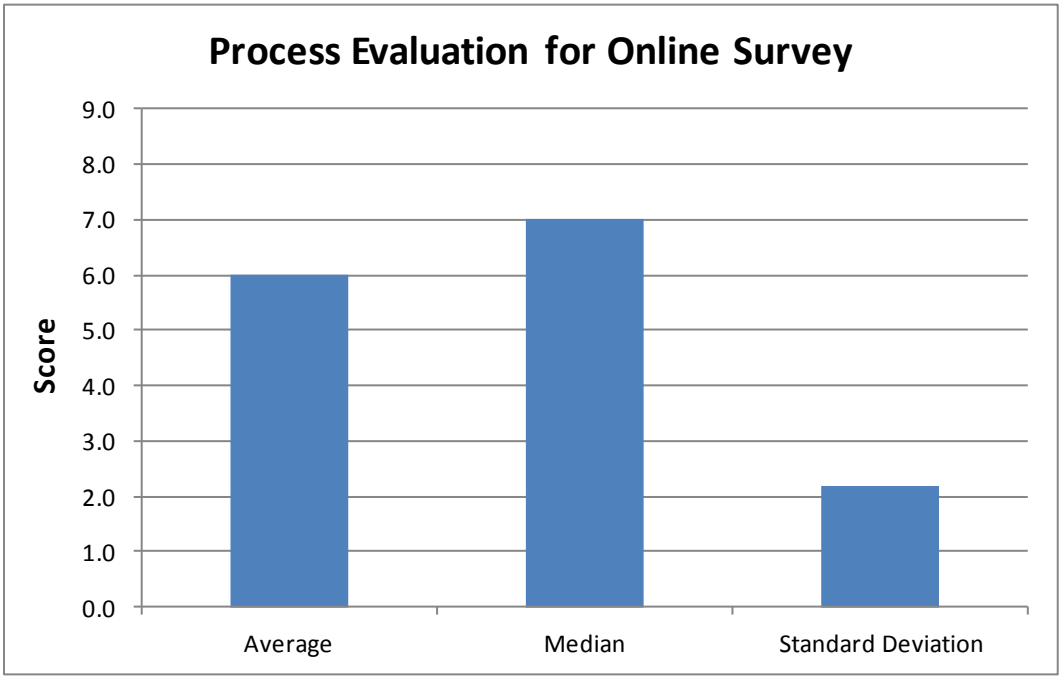



**Figure ES12 Process Evaluation Scores of Online Survey Using a 9 Point Likert Scale**
**(Score of 1 = very negative and a score of 9 = very positive)**

In addition to use of the Likert scale, each of the meetings was also evaluated using the Arnstein Ladder of Public Participation. The mean score from each of the meetings along with participants' previous experiences and expectations are presented in Figures ES13-ES15. In all cases, the Arnstein Ladder scores of the process exceed those of past experiences. In most cases, the scores from the focus group meetings closely approached or even exceeded their expectations. Similar to the Likert Scale scores, the focus group scores were generally higher than those scores associated with either the public informational meeting or the scenario scoring meetings. Because of the lack direct interaction with the audience, the Arnstein Ladder scores were not collected as part of the online survey. In general, the aggregate scores reflect a process that was deemed positively by the vast majority of participants.

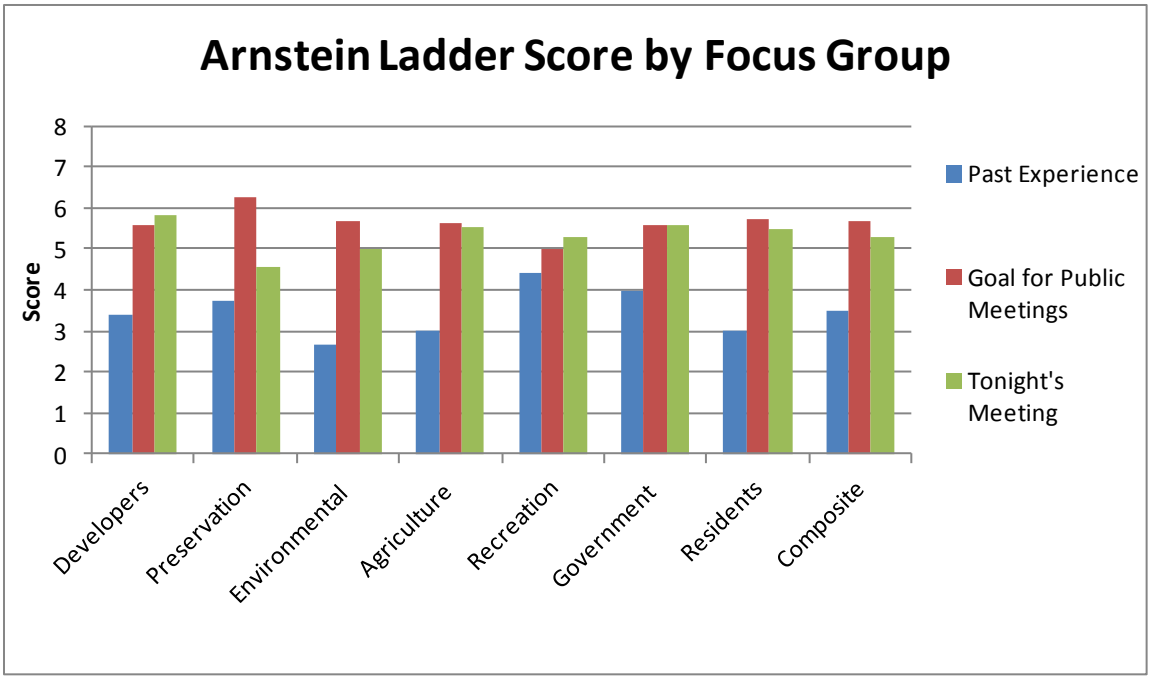



**Figure ES13 Arnstein Ladder Average Scores for Focus Group Meetings**
Note: 1-Manipulation, 2 - Therapy, 3-Informing, 4-Placation, 5-Consultation, 6-Partnership, 7-Delegated Power, 8-Citizen Control

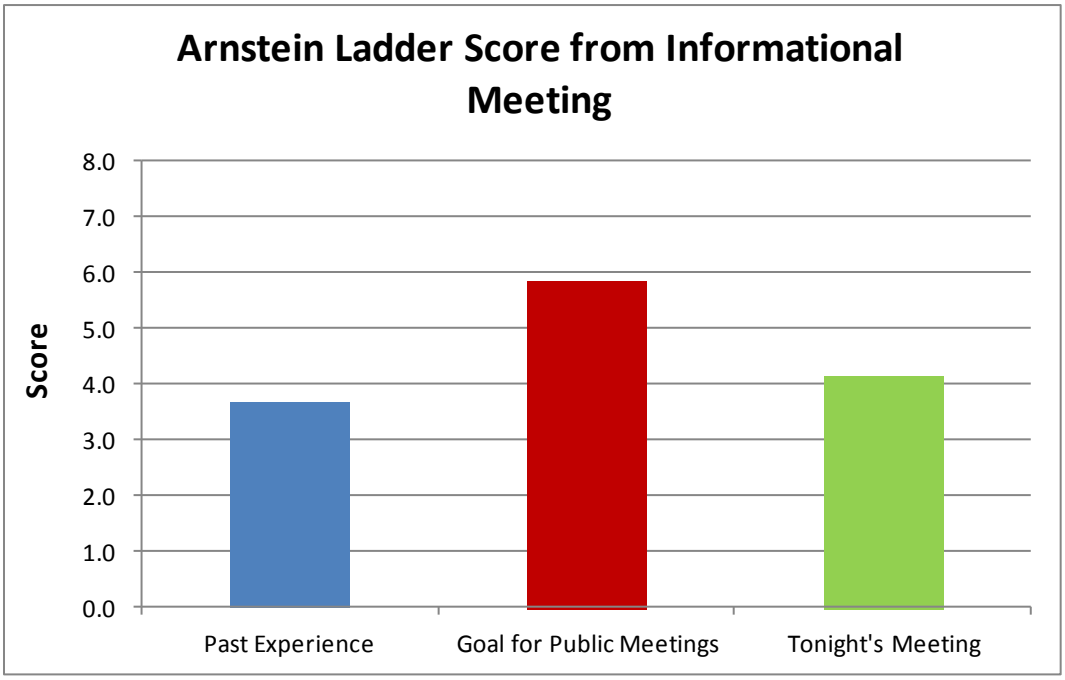



**Figure ES14 Arnstein Ladder Average Scores for Public Information Meeting**
Note: 1-Manipulation, 2 - Therapy, 3-Informing, 4-Placation, 5-Consultation, 6-Partnership, 7-Delegated Power, 8-Citizen Control

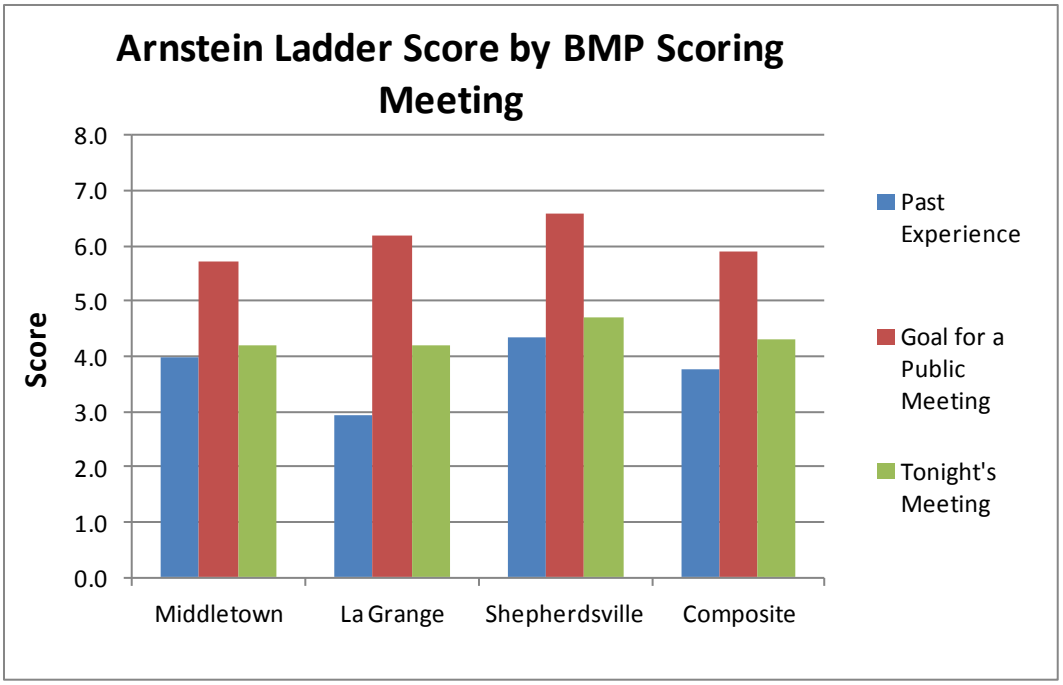



**Figure ES15 Arnstein Ladder Average Scores for BMP Scoring Meetings**
Note: 1-Manipulation, 2 - Therapy, 3-Informing, 4-Placation, 5-Consultation, 6-Partnership, 7-Delegated Power, 8-Citizen Control

## Summary

Ultimately, community values identified through KWRRI stakeholder engagement project support a balance between economic development and environmental stewardship. While local citizens clearly were very concerned about the potential economic impact of nutrient management decisions, they also were concerned that future development not adversely impact the watershed. Some citizens stated that their values and opinions had not been adequately considered in past decisions, despite more recent attempts by US EPA to improve levels of community involvement. Thus, this study supports a shift from the historical one-directional, informative paradigm of community relations toward a multi-level engagement paradigm that includes the public as a collaborator in identifying and developing solutions for admittedly complex problems. When organizations and communities join together in dialogue to identify both broad values and specific preferences, the risk-bearing community becomes an important decision-making partner for developing solutions that seek to achieve the greatest good.

# 1.0. FLOYDS FORK STAKEHOLDER ENGAGEMENT PROCESS

## 1.1 INTRODUCTION

In 2011, the Kentucky Water Resources Research Institute (KWRRI) was designated by EPA Region IV as a Center of Excellence of Watershed Management. In that capacity, the mission of the Institute is to promote watershed management as an effective strategy for balancing economic development and environmental stewardship throughout the state of Kentucky.

In 2011, the Kentucky Division of Water asked the KWRRI to implement a stakeholder engagement process for the Floyds Fork watershed that would provide insights into a range of perspectives and community preferences related to possible nutrient management strategies for use in the Floyds Fork Watershed. This objective was largely driven by previous failed attempts to develop a comprehensive watershed plan for the area as well as by the development by EPA Region IV (through a contract with Tetra Tech) of a nutrient computer model for potential use by the Kentucky Division of Water for developing an nutrient and organic enrichment TMDL for the Floyds Fork watershed.

Prior to consideration of how to proceed following the completion of the TMDL, the Kentucky Division of Water wanted to acquire a greater understanding of the perspectives and desires of the residents and associated stakeholders of the watershed.

The methodology employed in this study is one that was previously developed and implemented by the KWRRI as part of a comprehensive future vision project associated with the Paducah Gaseous Diffusion Plant. In that study, the methodology was used to develop a community-based end state vision encompassing the range of community perspectives for the site's future use after the facility closes.

This report's opening chapters provide an overview of critical factors that could affect future nutrient management decisions within the watershed. Among these factors are a physical description of the watershed (Chapter 2), a summary of previous water quality assessments (Chapter 3), a summary of potential nutrient loading sources (Chapter 4), and a summary of previous watershed management studies (Chapter 5). Chapters 6-9 of the report describe methodology development and implementation for this project, as well as detailed results of specific methodological components, conclusions that can be drawn from these results, and lessons learned through engaging a diverse set of stakeholders.

TMDLs are important tools for describing the maximum amount of pollutant that a watershed can receive while remaining in compliance with water quality standards, but successfully meeting TMDL goals requires multilateral stakeholder planning and engagement. To help determine how best to insure such stakeholder engagement following the completion of the Floyds Fork TMDL, the Kentucky Division of Water wanted to acquire a better understanding of the perspectives and desires of watershed residents and other watershed stakeholders.

## 1.2 WATERSHED DESCRIPTION

The Floyds Fork Watershed lies in northern Kentucky, east of Louisville. The watershed drains parts of the cities of La Grange, Peewee Valley, Middletown, Jeffersontown, and Mount Washington. The watershed covers parts of five counties (Henry, Oldham, Shelby, Jefferson, and Bullitt) and only a small corner of a sixth county, Spencer (see Figure 1.2.1).

Floyds Fork originates in the southwestern portion of Henry County and flows 62 miles southwest to Bullitt County where it joins the Salt River near Shepherdsville. The drainage area is 285 square miles (Tetra Tech, 2013). Moderate to gently rolling slopes characterize the Outer Bluegrass portions of the watershed, while areas within the Knobs are marked by the presence of more or less conical hills rising above stream terraces. Watershed elevations range from 400 feet above means sea level (msl) at the mouth to approximately 900 feet above msl along the Harrods Creek- Little Kentucky River divide (KDOW, 1984). Stream slopes are moderate to nearly flat on the mainstem, but slopes on tributaries are much steeper. Floyds Fork is generally characterized by short riffles between long, sluggish pools (KDOW, 1991).

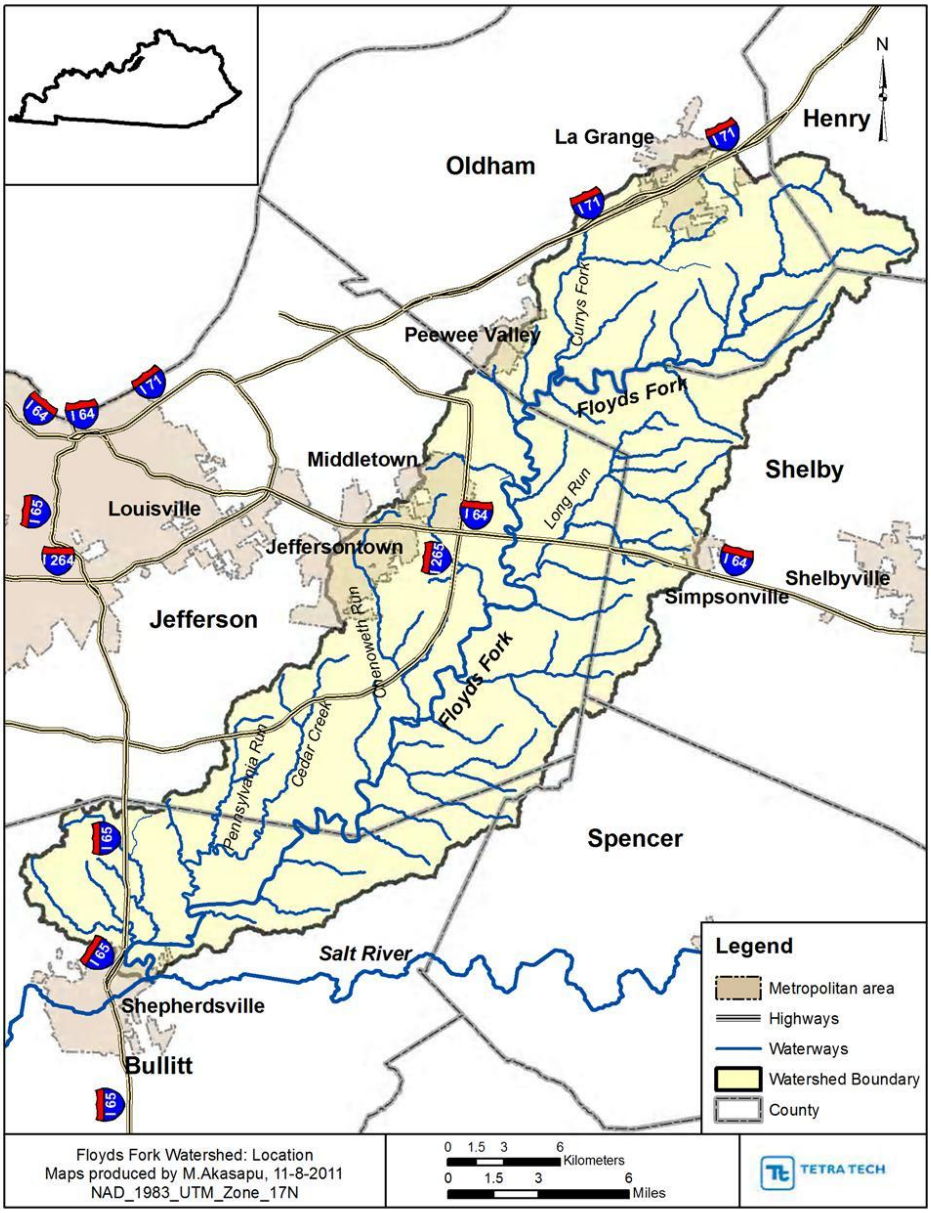



**Figure 1.2.1 Floyds Fork Watershed Location (Tetra Tech, 2013)**

## 1.3 LANDUSE INFORMATION

A map of landuse in the Floyds Fork watershed as derived from the 2006 The National Land Cover Database (NLCD) is shown in Figure 1.3.1. The landuse covers 15 categories: open water, developed open space, developed low intensity, developed medium intensity, developed high intensity, barren, deciduous forest, evergreen forest, mixed forest, shrub/scrub, grassland/herbaceous, pasture/hay, cultivated crops, woody wetlands, and emergent herbaceous wetlands. Approximately 20% of the watershed is developed area, with varying degrees of intensity. Forest covers about 43% of the watershed. Pasture and cropland make up roughly 32% of the landuse. Another 4% of the watershed is grasslands or wetlands, and 1% is open water (Tetra Tech, 2013).

Floyds Fork has been cited in The Nationwide Rivers Inventory (National Park Service, 1982) as having outstanding scenic, recreational, geological, and fishery values. The stream is used for canoeing from the KY 1408 bridge to the confluence with the Salt River. Floyds Fork also provides wadeable and floatable warmwater fisheries for smallmouth and spotted bass. Camping facilities are located near the confluence with the Salt River. Hunting for waterfowl, small mammals, and deer occur throughout the rural areas (KDOW, 1986).

## 1.4 WATERSHED IMPAIRMENTS

The Kentucky Division of Water Integrated Report to Congress (KDOW, 2012) contains the 303(d) list of impaired waters. These are streams that have been determined to not meet the water quality standards for their designated uses (i.e. warm water aquatic habitat, primary and secondary contact recreation). Table 1.4.1 summarizes the various stream segments in the Floyds Fork watershed that have been determined to not meet their designated use due to nutrient impairment.

**Table 1.4.1 List of Nutrient Impaired Streams In The Floyds Fork Watershed**
(Draft 2012 Integrated Report to Congress on the Condition of Water Resources in Kentucky. Volume II. 303 (d) List of Surface Waters http://water.ky.gov/Documents/PublicNotice/2012%20IR%20Document-proposed.pdf)

| Stream Segment Name | River Miles | County | Impairment |
|---|---|---|---|
| Brooks Run into Floyds Fork Bullitt | 0.0 to 2.7 | Bullitt | Nutrient/ Eutrophication Biological Indicators |
| Brooks Run into Floyds Fork Bullitt | 2.7 to 4.4 | Bullitt | Nutrient/ Eutrophication Biological Indicators |
| Brooks Run into Floyds Fork Bullitt | 4.4 to 6.4 | Bullitt | Nutrient/ Eutrophication Biological Indicators |
| UT to Brooks Run into Brooks Run | 0.0 to 2.0 | Bullitt | Nutrient/ Eutrophication Biological Indicators |
| Floyds Fork into Salt River Jefferson | 11.7 to 24.2 | Jefferson | Nutrient/ Eutrophication Biological Indicators |
| Floyds Fork into Salt River Shelby | 34.1 to 61.9 | Jefferson | Nutrient/ Eutrophication Biological Indicators |

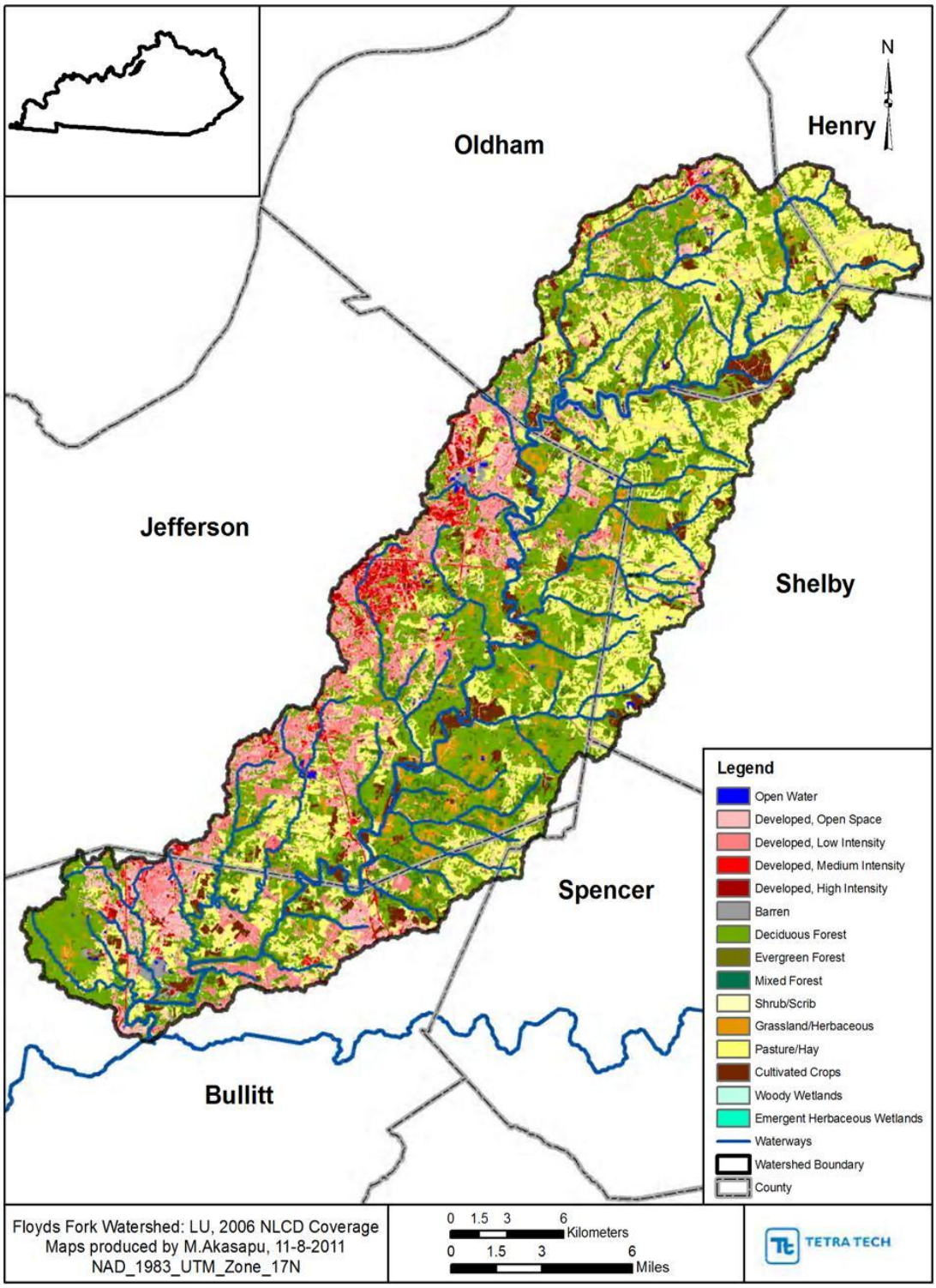



**Figure 1.3.1 Landuse in the Floyds Fork Watershed based upon the National Land Cover Database 2006 (Tetra Tech, 2013)**

In 2011, personnel with the Biology Section of the Kentucky Division of Water conducted a study to develop potential instream nutrient targets for the Floyds Fork Watershed. The instream targets were developed taking into consideration the specific biology and ecosystem characteristics of the watershed. Targets were initially proposed for three different categories of stream size (see Table 1.4.2). Based on a correlation of biologic health and observed nutrient concentrations, attainment of the instream targets was hypothesized to correspond to a satisfaction of the designated use for warm water quality life for the three stream size categories.

**Table 1.4.2 Total Nitrogen and Total Phosphorus Instream Nutrient Targets**
(John Brumley and Lara Panayotoff, 2011)

| Size category | TP target | TP max | TN target | TN max |
|---|---|---|---|---|
| Headwater (<5 sq mi) | 0.09 | 0.12 | 0.70 | 1.0 |
| Wadeable (5-100 sq mi)* | 0.15 | 0.25 | 1.1 | 1.6 |
| Transitional/Boatable (>100 sq mi)** | 0.20 | 0.66 | 2.2 | 2.4 |

* includes tributaries in that size range and Floyds Fork mainstem above (Upper) Chenoweth Run
**includes mainstem of Floyds Fork downstream of (Upper) Chenoweth Run

**target**: not to exceed as an annual (headwater) or growing season geometric mean more than once in a three year period
**max**: never to exceed as an annual (headwater) or growing season geometric mean

In 2012, Division of Water personnel completed a biological assessment of several streams within the Floyds Fork watershed. This assessment was then used to identify candidate stream impairments (due to nutrients) in the Floyds Fork watershed. A map of the candidate stream segments is provided in Figure 1.4.1.

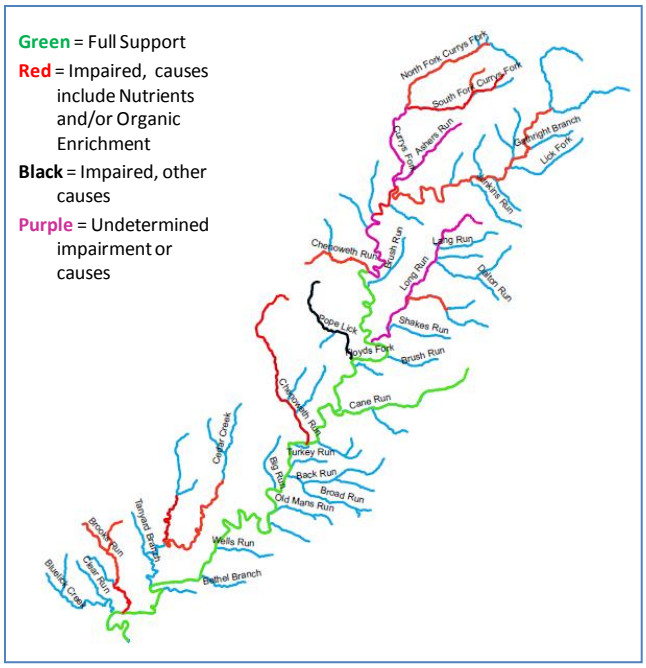



**Figure 1.4.1 Map of candidate impaired stream segments (KDOW, 2013)**

## 1.5 IMPAIRMENT SOURCES

Several potential sources for nutrient (i.e. nitrogen and phosphorus) impairment have been identified in the watershed. These include 1) wastewater sources, 2) agricultural sources, 3) urban runoff sources, and 4) background, legacy, and atmospheric sources. A summary of the estimated total annual loads from each of these sources is illustrated in Table 1.5.1 and Figures 1.5.1 and 1.5.2. These loads were estimated using annual export coefficients from the literature (Reckhow, et al., 1980, Beaulac, et al., 1982, Shaver, et al, 2007), estimated point source loads (Tetra Tech, 2013) and discharge monitoring report records for the various permitted point sources in the watershed (EPA, 2014).

**Table 1.5.1 Estimated Annual Nutrient Loads from Various Sources in the Floyds Fork Watershed.**

| Source | Annual Nitrogen Loading (lbs) | Annual Phosphorus Loading (lbs) |
|---|---|---|
| Urban | 173,518 | 20,996 |
| Forest | 138,818 | 7,635 |
| Agriculture | 105,255 | 19,649 |
| Wastewater | 450,007 | 49,908 |

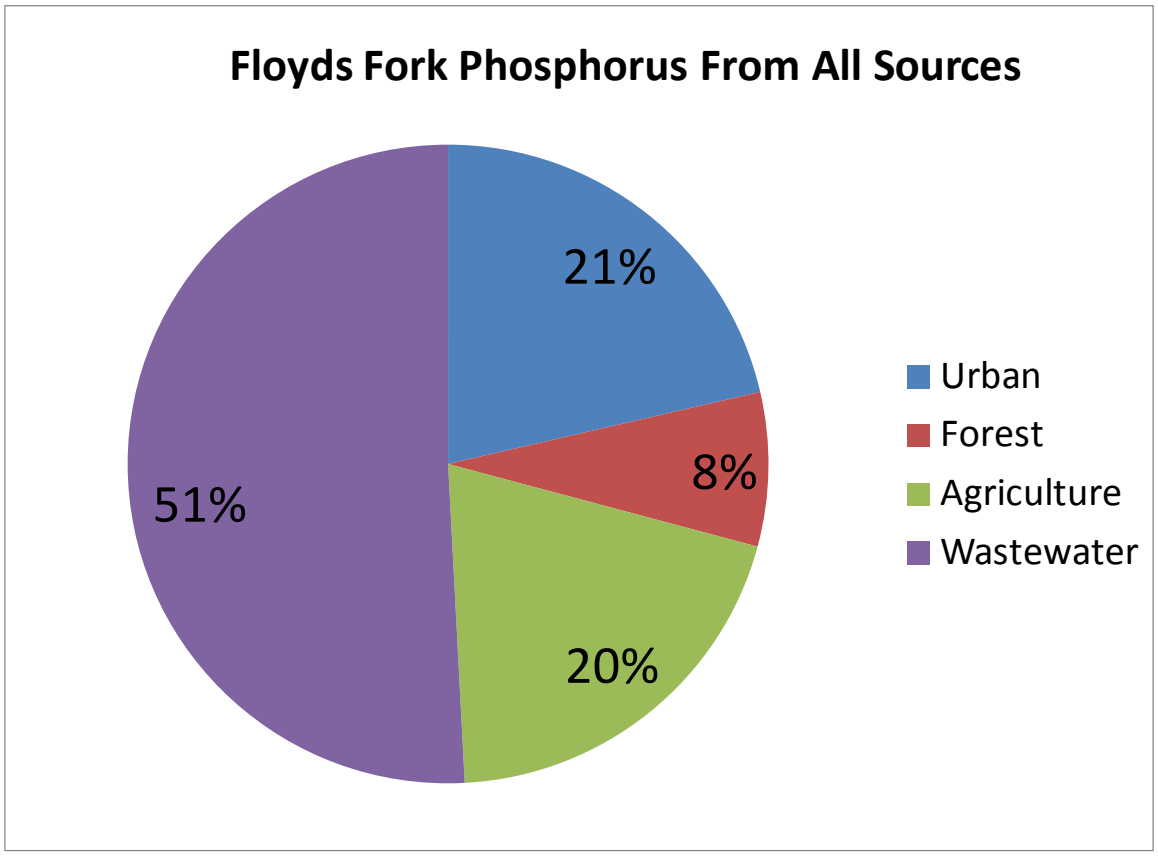



**Figure 1.5.1 Distribution of Total Phosphorus Load Sources in the Floyds Fork Watershed**

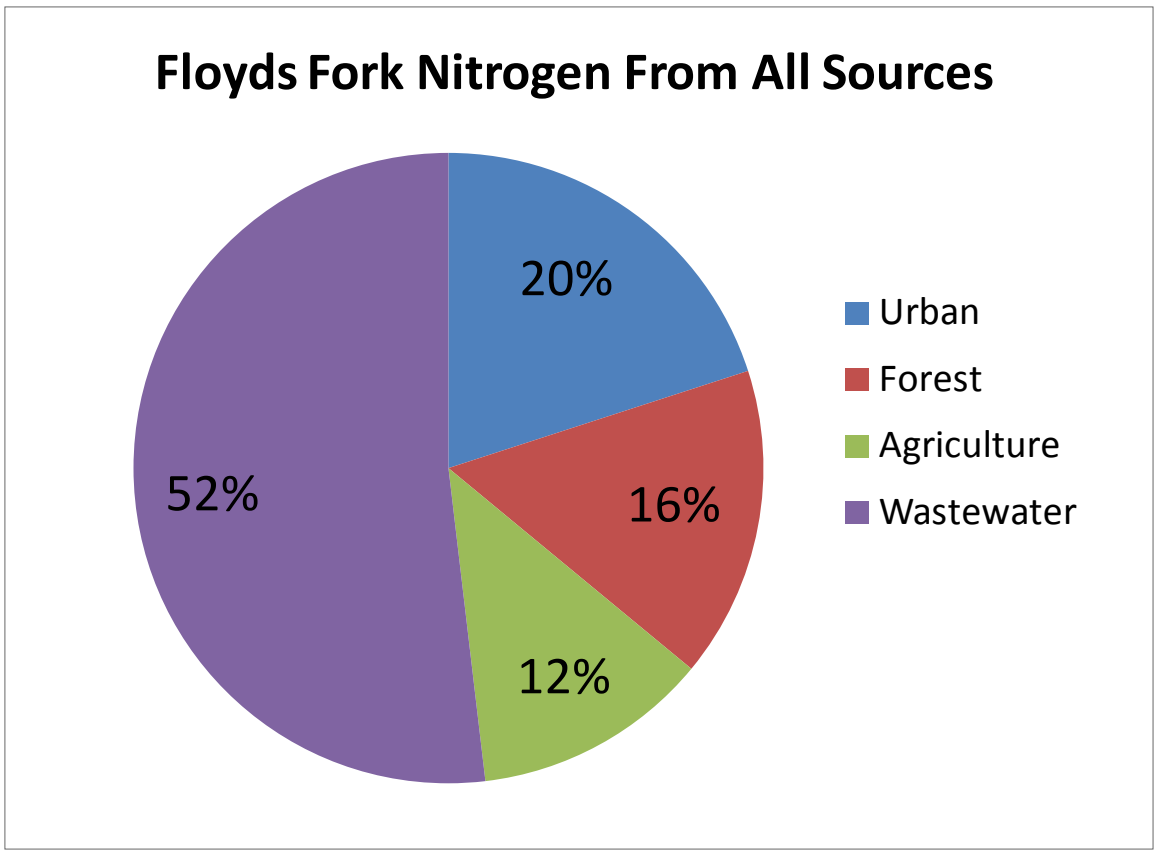



**Figure 1.5.2 Distribution of Total Nitrogen Load Sources in the Floyds Fork Watershed**

### 1.5.1 Wastewater Sources

Wastewater sources of excess nutrients include 1) inefficient wastewater treatment facilities, 2) sanitary sewer overflows, 3) failing septic systems. An illustration of the estimated distribution of nutrient loads from such sources in the Floyds Fork watershed is shown in Figures 1.5.3 and 1.5.4.

**Table 1.5.2 Estimates of Annual Nutrient Loads from Different Wastewater Sources (synthesized from Tetra Tech, 2013; EPA 2014)**

| Source | Annual Nitrogen Loading (lbs) | Annual Phosphorus Loading (lbs) |
|---|---|---|
| Failing Septic Systems | 16,110 | 2,128 |
| Municipal | 330,468 | 20,956 |
| Small Sewage | 8,558 | 2,630 |
| Subdivisions | 86,251 | 22,515 |
| Schools/Residences | 2,013 | 351 |
| Sanitary Sewer Overflows | 6,607 | 1,329 |

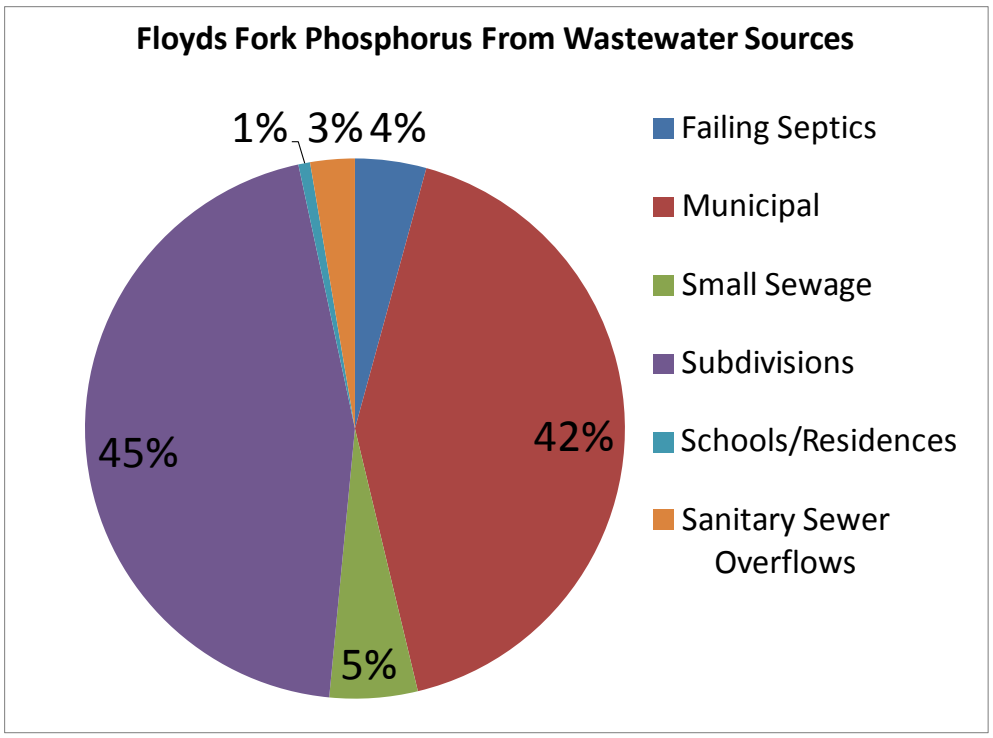



**Figure 1.5.3 Distribution of Total Phosphorus Wastewater Load Sources (synthesized from Tetra Tech 2013, EPA 2014)**

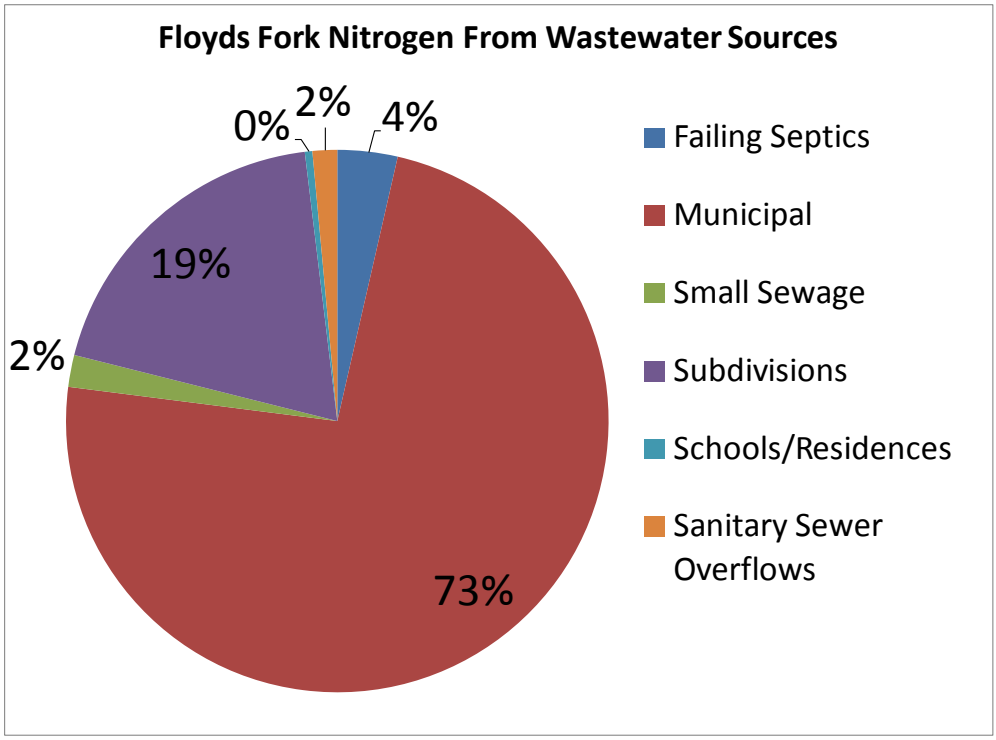



**Figure 1.5.4 Distribution of Total Nitrogen Wastewater Load Sources (synthesized from Tetra Tech 2013, EPA 2014)**

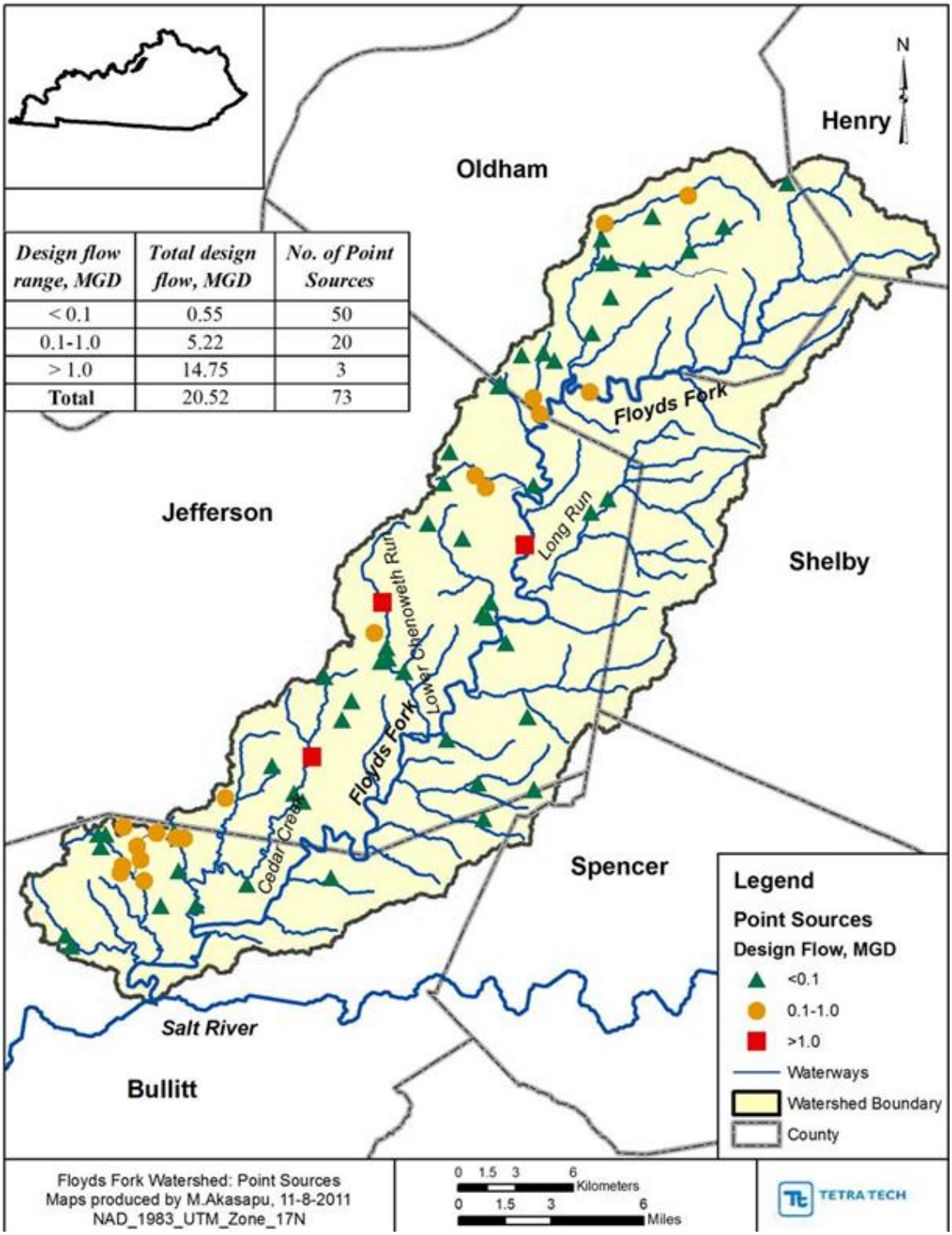
#### 1.5.1.1 Wastewater treatment facilities

All wastewater treatment facilities are required to obtain a permit under the National Pollutant Discharge Elimination System (NPDES). There are 73 permitted point source discharges located in the watershed (Tetra Tech, 2013). There are six municipal point source discharges. Twenty of the point source discharges are subdivisions, four are schools, and 43 are small sewage facilities (including residences). Table 1.5.3 provides a list of point source dischargers within the Floyds Fork Watershed. A map showing the location of the major facilities is provided in Figure 1.5.5. A general estimate of the annual nutrient load from all of these sources can be obtained from the EPA Discharge Monitoring System (2014) which documents monthly or quarterly loads as required by the NPDES permit. Using such an approach, the annual total phosphorus and total nitrogen loads for the Floyds Fork watershed in 2010 was estimated to be 23 tons/year and 214 tons/year respectively. These estimates were used in calculating the distribution of loads shown in Figures 1.5.3 and 1.5.4. It should be emphasized that these totals can vary from year to year by as much as 20%.

**Table 1.5.3 Point Source Discharges within Floyds Fork Watershed (Tetra Tech, 2013)**

| NPDES Number | Facility Name | Facility Type | Receiving Water |
|---|---|---|---|
| KY0020001 | Lagrange STP | Municipal | Currys Fork/North Fork Currys Fork/UT |
| KY0023078 | Whispering Oaks MFG Home Comm | Small Sewage* | Brooks Run/UT/Floyds Fork |
| KY0024724 | Ash Avenue STP | Subdivision | UT/Floyds Fork |
| KY0025194 | Jeffersontown WQTC MSD | Municipal | Chenoweth Run (Lower) |
| KY0026972 | Bates Elementary School | Schools | Big Run/UT |
| KY0029416 | Mcneely Lake WQTC MSD | Subdivision | UT/Pennsylvania Run |
| KY0029441 | Green Valley Apartments | Small Sewage* | UT/South Fork Currys Fork/Currys Fork |
| KY0029459 | Chenoweth Hills WQTC MSD | Subdivision | UT/Chenoweth Run (Lower) |
| KY0031712 | Starview Estates WQTC MSD | Subdivision | Chenoweth Run (Upper) |
| KY0031798 | Cedar Lake Lodge, Inc. | Small Sewage* | UT/North Fork Floyds Fork/Floyds Fork |
| KY0034151 | Hillview Sewer System Plant #1 | Subdivision | Cedar Creek/Tanyard Branch |
| KY0034169 | BCSD Hillview #2 | Subdivision | UT/Brooks Run |
| KY0034177 | BCSD Hillview #3 (Maryville #3) | Subdivision | UT/Brooks Run |
| KY0034185 | Pioneer Village Sewer Plant #1 | Subdivision | Brooks Run |
| KY0034801 | BCSD Bullitt Hills Subdivision | Subdivision | UT/Tanyard Branch |
| KY0036501 | Berrytown WQTC MSD | Subdivision | UT/Chenoweth Run (Upper) |
| KY0038610 | Hunters Hollow Subd | Subdivision | Brooks Run |
| KY0039004 | KJC Institute for Women | Small Sewage* | Floyds Fork |
| KY0039870 | Lakewood Valley Subd STP | Subdivision | UT/South Fork Currys Fork/Currys Fork |
| KY0040193 | Overdale Elementary School | Schools | Tanyard Branch/ Cedar Creek/ Floyds Fork |
| KY0042153 | Cedar Ridge Camp, Inc. | Small Sewage* | UT/Floyds Fork |
| KY0042226 | Chenoweth Run WQTC | Subdivision | UT/Chenoweth Run (Upper) |
| KY0044342 | Lake Of The Woods WQTC MSD | Subdivision | UT/Chenoweth Run (Lower) |
| KY0054674 | Lockwood Estates Subd STP | Subdivision | South Fork Currys Fork/ Currys Fork |
| KY0060577 | Country Village STP | Subdivision | UT/Currys Fork |
| KY0069485 | Friendship Manor | Small Sewage* | UT/Floyds Fork |
| KY0072168 | Big Valley MHP | Small Sewage* | Bluelick Creek |
| KY0073059 | Camp Shantituck Girl Scout CMP | Small Sewage* | Cedar Creek |
| KY0076732 | Centerfield Elementary School | Schools | Currys Fork/South Fork Currys Fork |
| KY0076741 | Cherrytree Apartments | Small Sewage* | Floyds Fork |
| KY0077666 | The Crossings Golf Club | Small Sewage* | Brooks Run |
| KY0077674 | Lake Columbia Subdivision | Subdivision | Cedar Creek/UT |
| KY0086843 | Middletown Industrial Park | Small Sewage* | Chenoweth Run (Upper) |
| KY0090956 | Persimmon Ridge Phase 14 | Subdivision | Floyds Fork |
| KY0094307 | BCSD Willabrook Sanitation | Subdivision | Brooks Run |
| KY0098540 | Cedar Creek WQTC MSD | Municipal | Cedar Creek |
| KY0100994 | Bullitt Co BD of ED | Schools | Brooks Run/UT |
| KY0101419 | Kingswood Subd | Subdivision | Broad Run |
| KY0101885 | Riedling Building | Small Sewage* | Tanyard Branch |
| KY0102784 | Floyds Fork WQTC MSD | Municipal | Floyds Fork |
| KY0102873 | Brooks Mobile Home & RV Park | Small Sewage* | Brooks Run |
| KY0103110 | Buckner STP | Municipal | UT/North Fork Currys Fork |
| KY0103900 | Hillview STP | Municipal | UT/Brooks Run/Floyds Fork |
| KY0105384 | Advanced Child Care West | Small Sewage* | Ditch/UT/Floyds Fork |
| KYG400010 | Edaward A Zuercher Jr. Residence | Small Sewage* | Back Run |
| KYG400028 | Anthony T Aulbach Residence | Small Sewage* | Pope Lick/UT |
| KYG400032 | Melvin & Shirley Williams Residence | Small Sewage* | Cedar Creek |
| KYG400082 | Reed Wilcox Residence | Small Sewage* | Floyds Fork/UT |
| KYG400105 | Maria E McCarson Residence | Small Sewage* | North Fork Currys Fork |
| KYG400112 | Charles G Parrot Residence | Small Sewage* | North Fork Currys Fork |
| KYG400128 | Kamal Fathaltzadeh Residence | Small Sewage* | Long Run/UT |
| KYG400137 | Raymond R Peters Sr. Residence | Small Sewage* | Pennsylvania Run |
| KYG400139 | Ernest & Patricia Entin Residence | Small Sewage* | Cedar Creek/UT |
| KYG400147 | Ebbs Residence | Small Sewage* | Currys Fork/Floyds Fork |
| KYG400150 | Robert & Mary Miller Residence | Small Sewage* | Chenoweth Run (Lower) |
| KYG400153 | Victor J Diorio Jr. Residence | Small Sewage* | Floyds Fork |
| KYG400161 | Mckee Residence | Small Sewage* | Razor Branch |
| KYG400166 | James L Shipp Residence | Small Sewage* | Cedar Creek |
| KYG400177 | William E Berryman Residence | Small Sewage* | Cedar Creek |
| KYG400189 | Susan Weis Residence | Small Sewage* | Brush Run |
| KYG400194 | Ken & Alice Weber Residence | Small Sewage* | Pope Lick |
| KYG400235 | Steven & Cheryl Powers Residence | Small Sewage* | Floyds Fork/UT |
| KYG400250 | Joe and Pam Brooks Residence | Small Sewage* | Long Run/UT |
| KYG400251 | Marguerite R Weber Residence | Small Sewage* | Chenoweth Run (Lower) |
| KYG400259 | Dennis & Sherry Ballard Residence | Small Sewage* | Floyds Fork/ UT |
| KYG400289 | Patricia H Gibson Residence | Small Sewage* | South Fork Currys Fork |
| KYG400329 | Larry & Angelyn Carlisle Residence | Small Sewage* | Brooks Run/UT |
| KYG400403 | Chris Freundenburger Residence | Small Sewage* | Sheckels Run |
| KYG400420 | Melvin Seals Residence | Small Sewage* | Bluelick Creek |
| KYG400613 | Brad Murrell Residence | Small Sewage* | Floyds Fork/UT |
| KYG401875 | Wood Residence | Small Sewage* | Wells Run |
| KYG401905 | Fladung Residence | Small Sewage* | Broad Run |
| KYG402142 | Carpenter Residence | Small Sewage* | Pope Lick |

Small Sewage* includes general residences as well




| *Design flow range, MGD* | *Total design flow, MGD* | *No. of Point Sources* |
|---|---|---|
| < 0.1 | 0.55 | 50 |
| 0.1-1.0 | 5.22 | 20 |
| > 1.0 | 14.75 | 3 |
| **Total** | 20.52 | 73 |

**Figure 1.5.5 Location of Point Sources in the Floyds Fork Watershed (Tetra Tech, 2013)**

#### 1.5.1.2 Sanitary Sewer Overflows

Sanitary sewer overflows (SSOs) are unintentional discharges of untreated wastewater from municipal sanitary sewer systems. These discharges are very damaging to water quality; large volumes of raw wastewater, carrying high levels of bacteria and nutrients, flow to stream channels. Problems that can cause SSOs include too much rainfall infiltrating through the ground into sanitary sewers not designed to hold stormwater, excess water inflowing through illegal connections such as roof drains, blocked pipes, or an infrastructure system that has overreached its design life or capacity. According to the data published on the Project WIN web site (Waterway Improvements Now an MSD program to respond to the federal consent decree, www.msdlouky/org/projectwin/), there are no combined sewer overflows in the watershed, but there have been eight NPDES facilities reported for sanitary sewer overflows. Figure 1.5.6 shows the location of these SSOs. Using the assumed water quality concentrations for SSOs from the 2012 Watershed Hydrology and Water Quality Modeling Report (Tetra Tech, 2012) the average annual total phosphorus and total nitrogen loads from such sources were estimated to be 0.67 tons/year and 3.30 tons/year respectively. These estimates were used in calculating the distribution of loads shown in Figures 1.5.3 and 1.5.4.

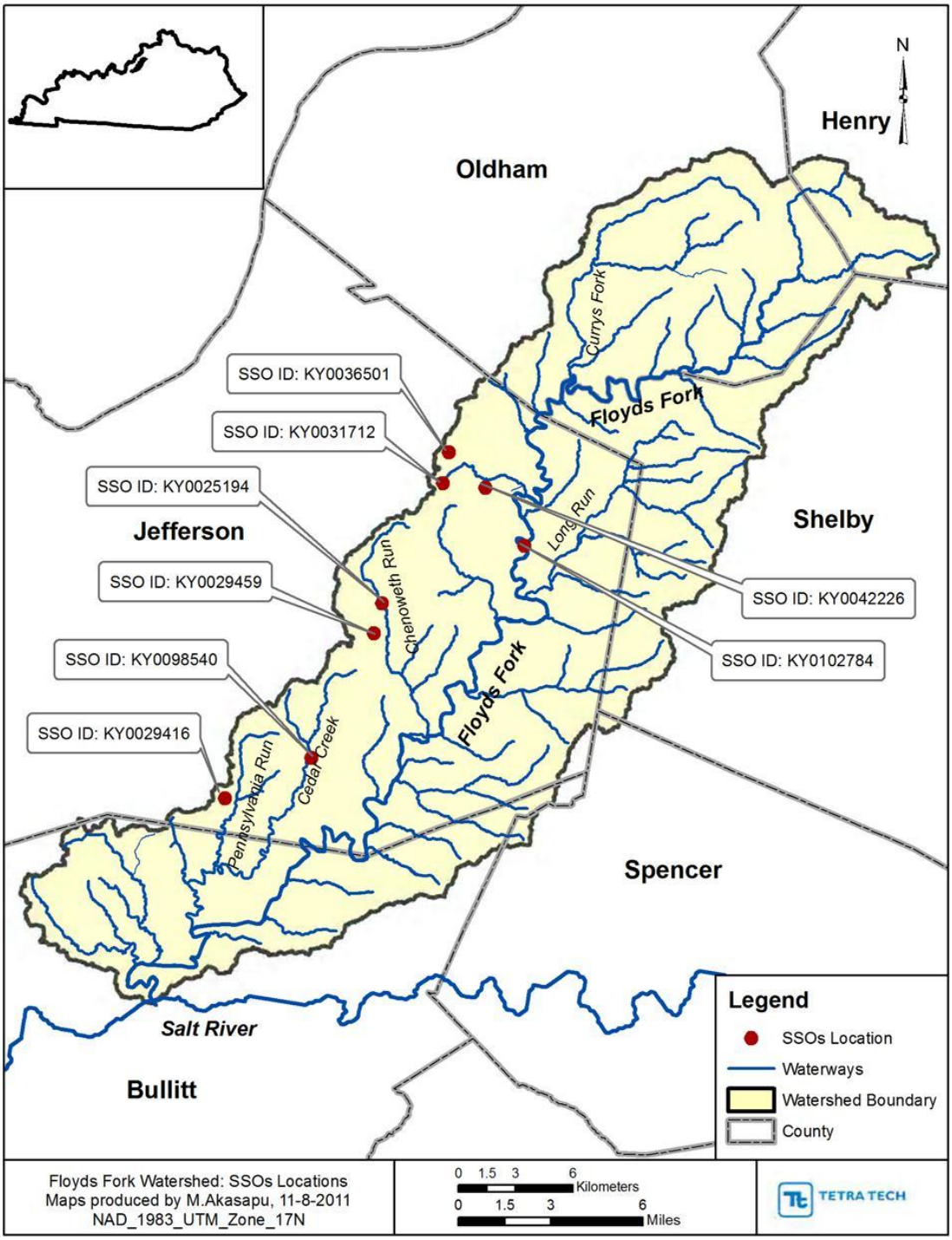



**Figure 1.5.6 Identified Sanitary Sewer Overflows in Floyds Fork Watershed (Tetra Tech, 2012)**

### 1.5.1.3 Septic Tanks

When properly designed, maintained, and used, septic tank systems can provide adequate treatment for most pollutants. However, when septic tank systems are in a failing condition, poorly treated or raw sewage can surface on a residential yard or lawn. The surfaced sewage may then be washed into the watershed resulting in a significant nutrient, bacteria, and BOD load. According to a KWA report, there are an estimated 35,000 onsite wastewater treatment systems in the Floyds Fork Watershed (KWA, 2008). Onsite systems fail due to improper operation, maintenance, design or construction. Even with proper maintenance, a septic system can fail if the type and amount of soil is not appropriate for an onsite system. The Oldham County Sewer District Facilities Plan states that about 75% of the soils in Oldham County are unsuitable for onsite treatment systems (KWA, 2008). Using the assumed water quality concentrations from the 2012 Watershed Hydrology and Water Quality Modeling Report (Tetra Tech, 2012) the average annual total phosphorus and total nitrogen loads from such sources were estimated to be 1 tons/year and 8 tons/year respectively. These estimates were used in calculating the distribution of loads shown in Figures 1.5.3 and 1.5.4.

### 1.5.2 Agricultural Sources

Agricultural sources of excess nutrients include 1) excessive crop fertilizer, 2) erosion, and 3) livestock manure. A general estimate of the annual nutrient load from agricultural sources can be made by multiplying the number of acres of a particular landuse (e.g. cropland, pasture land, grass land) by the estimated annual load per acre for that type of landuse (Reckhow, et al., 1980, Beaulac, et al., 1982, Shaver, et al, 2007). Use of such an approach yields the estimates in Table 1.5.5 and Figures 1.5.7 and 1.5.8 It should be pointed out that such estimates are expected to be less reliable than the estimates for wastewater. Also, these estimates were based on median observed annual loads, and thus one may expect a greater degree of variability from year to year than those associated with the wastewater loads. Nonetheless, the values should give a general idea of the relative proportion of nutrient sources among the various identified sources (i.e. wastewater, agricultural, urban, etc.)

**Table 1.5.4 Estimates of Annual Nutrient Loads from Different Agricultural Landuses**

| Source | Annual Nitrogen Loading (lbs) | Annual Phosphorus Loading (lbs) |
|---|---|---|
| Cropland | 57,418 | 8,799 |
| Pastureland | 42,268 | 9,587 |
| Grassland | 5,568 | 1,263 |

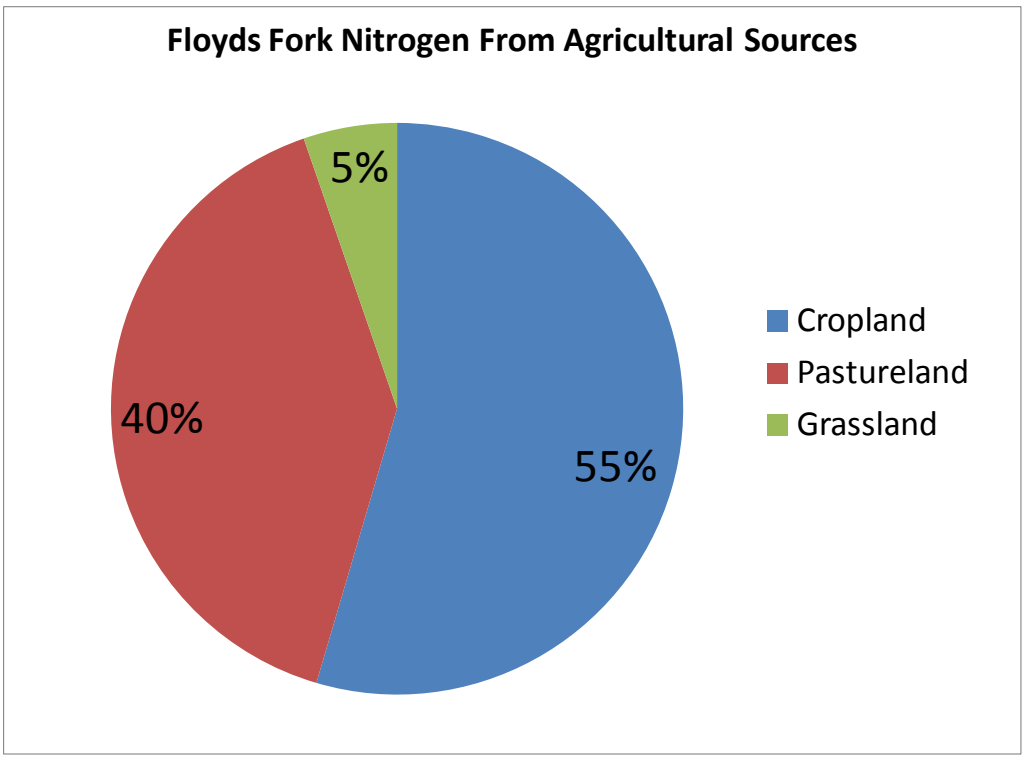



**Figure 1.5.7 Estimated Distribution of Total Nitrogen Loads From Agricultural Sources**

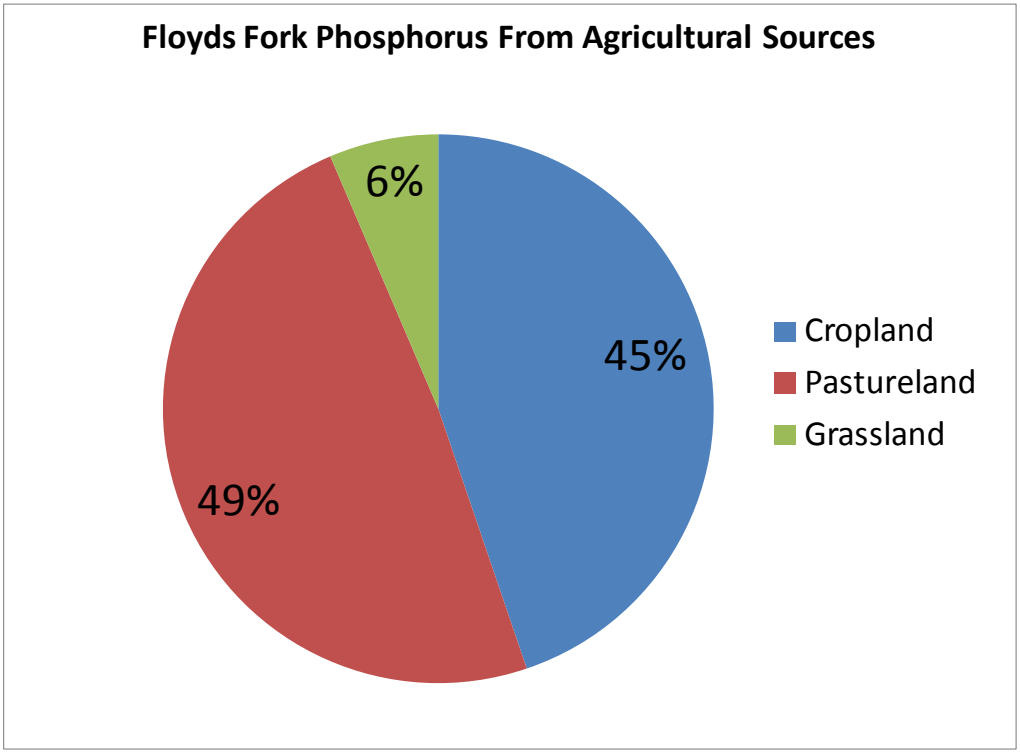



**Figure 1.5.8 Estimated Distribution of Total Phosphorus Load From Agricultural Sources**

### 1.5.3 Urban Runoff Sources

Urban sources of excess nutrients include 1) excessive lawn fertilizer, 2) erosion, and 3) pet litter. A general estimate of the annual nutrient load from urban sources can be made by multiplying the number of acres of urban landuse by the estimated annual load per acre for that type of landuse (Shaver, et al., 2007). Using such an approach, the annual total phosphorus and total nitrogen loads for the Floyds Fork watershed from urban sources were estimated to be 10 tons/year and 87 tons/year respectively. These estimates were used in calculating the distribution of loads shown in Figures 1.5.1 and 1.5.2. It should be pointed out that such estimates are expected to be less reliable than the estimates for wastewater. Also, these estimates were based on median observed annual loads, and thus one may expect a greater degree of variability from year to year than those associated with the wastewater loads. Nonetheless, the values should give a general idea of the relative proportion of nutrient sources among the various identified sources (i.e. wastewater, agricultural, urban, etc.).

### 1.5.4 Forest Sources

Forest loads are used here to mean nutrient loads associated with the natural landscape exclusive of man-made influences (e.g. agricultural and urban sources). For the purposes of our discussion, this will include forested landscape. Nutrient loads associated with forests are expected to be associated with runoff from the landscape as well as manure or litter sources associated with wildlife (e.g. deer, raccoons, geese, etc.). A general estimate of the annual nutrient load from urban sources can be made by multiplying the number of acres of forest landuse by the estimated annual load per acre for that type of landuse (Shaver, et al., 2007). Using such an approach, the annual total phosphorus and total nitrogen loads for the Floyds Fork watershed from forest sources were estimated to be 4 tons/year and 69 tons/year respectively.

### 1.5.5 Legacy Sources

A stream and its ecosystem possess some capacity for assimilating higher concentrations of nutrients. As a result of this assimilation, higher loads of nutrients for a period of time may not become manifest in concentration measurements; however, the excess mass of nutrients do become stored within the system. The nutrient mass stored within a stream system over time is referred to as a legacy source. Some of the nutrients are stored in very small algae species along the substrate of the stream or become stored in the soil column. The stream system mechanisms attempt to maintain an equilibrium nutrient level through this assimilation storage during periods of higher nutrient loading, but also through subsequent release of excess stored nutrients during periods of lower nutrient loading. Therefore legacy nutrient loads have the potential to confound ordinary nutrient load analysis that is based on concentration measurements. Nutrient loading from upstream sources may be higher than concentrations downstream indicate, and similarly, upstream BMPs or management practices that actually are working to reduce nutrient loadings may appear ineffective due to continued downstream levels of nutrient concentrations for a considerable time after their implementation. Legacy sources can also confound ordinary source analysis. Legacy sources may accumulate in the system from point source pollution during low flow periods without being detected by high concentration levels downstream, whereas storm events attended by higher flows can mobilize and release these legacy sources to a degree that high concentrations will result. Ordinary source analysis would conclude that the high concentrations coincident with storm events and high flows are the result of non-point sources, but if the legacy mechanism is dominating the nutrient dynamics, the high concentrations could be due to point source pollution which had been stored over time.

### 1.5.6 Atmospheric Sources

According to the US Geological Survey, atmospheric sources of nutrients are mainly associated with nitrogen (USGS, 2012). Fossil fuel burning power plants are large contributors to nitrogen in the atmosphere. There are a few large coal-fired power plants in the general region of the Floyds Fork watershed. When this nitrogen is deposited on land, it is subject to natural processes of nutrient cycles; therefore some of the nitrogen is effectively removed from the watershed, but the remainder of the nitrogen is subject to being carried by runoff into streams. It should be pointed out that the annual load estimates used in calculating the agricultural, urban, and background loads implicitly include atmospheric deposition.

## 1.6 PREVIOUS WATERSHED STUDIES

Several watershed studies have been completed that focus on all or parts of the Floyds Fork watershed. A summary of the various studies is provided in Table 1.6.1. A more detailed discussion of these studies is provided in Appendix A. Copies of all of these studies can be found at the project website: www.uky.edu/WaterResources/FF.

Most recently, Tetra Tech under contract with US EPA Region 4 completed a water quality modeling study of the watershed which is now being used by the Kentucky Division of Water in support of the development of a organic enrichment TMDL for the Floyds Fork Watershed (Tetra Tech, 2013). Copies of the final report can be found at the Division of Water website: http://water.ky.gov/watershed/pages/TAC.aspx

**Table 1.6.1 Summary of Previous Watershed Studies**

| |
|---|
| 1986 Floyds Fork Drainage Biological and Water Quality Investigation (KDOW, 1986) |
| 1991 Water Quality Study of Floyds Fork Creek by (KDOW, 1991) |
| 1993 Floyd's Fork Development Review Overlay (LDC, 1993) |
| 1994 Floyd's Fork Action Plan ( Louisville MSD, 1994) |
| 1996 Water Quality Study of Chenoweth Run (KDOW, 1996) |
| 1997 Development of an Ultimate Oxygen Demand TMDL for Floyds Fork and its Tributaries (KDOW, 1997a) |
| 1997 Development of a Total Phosphorus TMDL for Chenoweth Run (Phase I) (KDOW, 1997b) |
| 1999 Chenoweth Run Drainage Biological Water Quality Investigation (KDOW, 1999) |
| 1999 Cedar Creek Action Plan (Louisville MSD, 1999) |
| 1999 Waters of Jefferson County – Year Zero (Louisville MSD, 1999) |
| 2001 Hydrologic and Water Quality Characterization and Modeling of the Chenoweth Run Basin (USGS, 2001) |
| 2002 Jeffersontown Facilities Plan (Louisville MSD, 2002) |
| 2004 Sinkholes and Karst Features of Chenoweth Run (KGS, 2004) |
| 2007 Oldham County Facilities Plan (Omni, HDR, Quest, 2007) |
| 2008 Floyd's Fork Watershed Plan (KWA, 2008) |
| 2008 Penn Run Sewer Study (Louisville MSD, 2008) |
| 2008 Integrated Overflow Abatement Plan (Louisville MSD, 2008) |
| 2009 Reduction of Nonpoint Source Urban Runoff in the Floyds Fork Watershed Through a Stormwater Management Plan (Strand, 2009)) |
| 2010 Floyds Fork Area Study (WRT) |
| 2010 Floyd's Fork Action Plan Update (Louisville MSD, 2010) |
| 2011 Oldham County – Curry's Fork Watershed Plan (Strand, 2011) |
| 2011 MS4 Annual Report (Louisville MSD, 2011) |
| 2013 Floyds Fork Watershed Modeling Report Rev6 (Tetra Tech, 2013) |

# 2.0 STAKEHOLDER ENGAGEMENT METHODOLOGY

## 2.1 PROJECT PHILOSOPHY

The KWRRI stakeholder engagement methodology employed in this project was originally developed and implemented as part of a collaborative, comprehensive future visioning project for the Paducah Gaseous Diffusion Plant NPL Superfund site (see www.paducahvision.com) . In that study, environmental scientists from KWRRI joined communication and public infrastructure planning experts to construct an engagement approach to identify community-based visions representing a range of perspectives for the site's future after the facility closes.

Successful collaboration requires in-depth understanding of diverse community values, mutual respect and open communication among the collaborators, and a joint willingness to incorporate key values into the planning process. It also requires a bi-directional communication process. Two-way communication means that all parties must educate each other on the technical and policy issues that underlie decisions, committing staff and other resources toward this engagement process. Discussions should take place throughout the planning process and must include issues related both to scientifically-identified environmental impacts and to perceptions of such impacts, recognizing that the two do not always align (Slovic, 2000). Not only is there a need for community members be educated by federal and state agencies and contractors about technical and regulatory criteria, but agencies and contractors need to be educated by the community about its history, goals, and needs.

Regarding stakeholder communication and engagement in the context of watershed management, federal and state agencies should enter into dialogue with local governments and community members to better understand community perceptions that are critical for management – perceptions that often vary from community to community and even among different members of the same community. Such dialogues present the greatest opportunity for various parties to reconcile disparate perspectives, thus facilitating possible agreement or at least understanding on watershed management approaches. Such decisions, even technical ones, often are not solely technically based.

The Floyds Fork project was designed to maximize citizen engagement, as characterized by the Ladder of Citizen Participation (Arnstein, 1969). Not only did the ladder provide a philosophical guideline for the project, it also provided a quantitative way to gauge public perceptions about past levels of community involvement, as well as preferences for future involvement. The Arnstein Ladder illustrates different levels of public participation that have been observed in policy and infrastructure decisions. A slightly modified version of the ladder is shown in Figure 2.1.1. Although most of the terms used in the steps of the ladder are fairly self-explanatory, more explicit descriptions and explanations of the terminology can be found in Arnstein's original publication – see http://lithgow-schmidt.dk/sherry-arnstein/ladder-of-citizen-participation .html.

In general, the steps of the ladder can be grouped into three broad classifications: Non Participation, Tokenism, and Citizen Power, with specific rungs falling within each broad category. In past studies, most citizens have scored their previous levels of involvement in public processes somewhere between informing and placation in the Tokenism section of the ladder. The majority of those polled in the past desire levels of participation somewhere between partnership and delegated power in the Citizen Power section of the ladder (Grossardt et al., 2010; KRCEE, 2011). In other words, and perhaps unexpectedly for some agencies and policymakers, most members of the public see a role for technical expertise in planning processes, while very few people feel that complete citizen control is necessary to achieve optimal outcomes.

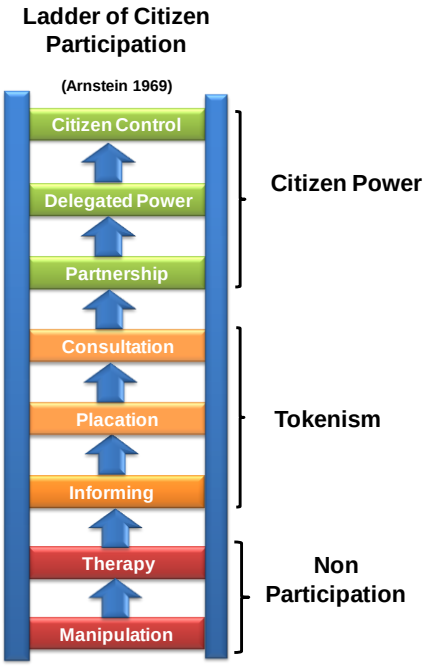



**Figure 2.1.1 Modified Ladder of Citizen Participation (Arnstein, 1969)**

For this project, the team employed Community-Based Participatory Communication (CBPC) methods, which use interviews, focus groups, and projective techniques to identify and interact with various community groups. The goal of CBPC is to discover value systems, risk perceptions (Anyaegbunam, Mefalopulos, & Moetsabi, 2004), and in this case, their implications for watershed management strategies. The team then employed Structured Public Involvement (SPI) activities, a democratic process that uses anonymous Audience Response Systems (ARS) or similar feedback methods in large-scale public meetings (Bailey, et al., 2010). In this way, SPI encourages democratic solutions to complex issues while resisting co-optation of the public meeting process by a single interest group.

In the research team's novel deployment of the CBPC-SPI integration, results from an extensive CBPC listening tour assisted in generating specific nutrient management strategies, which then became discussion triggers for additional CBPC-based focus group interactions, which ultimately fed into a broad-based SPI community forum that quantitatively measured preferences for designated strategies as thoroughly, accurately, and transparently as possible.

## 2.2 STUDY CHALLENGES

The Floyds Fork watershed encompasses a large area (i.e. 285 square miles) and includes parts of six counties (i.e. Henry, Oldham, Shelby, Spencer, Jefferson, and Bullitt counties). The watershed has been the subject of many studies, including an attempt to develop a comprehensive watershed plan which ended prematurely due to litigation. Because the watershed remains largely undeveloped, there exists a natural tension between development and preservation interests. Jefferson County officials have moved to try to control development along the portion of the creek within their county by creation of a developmental review overlay which outlines

restrictions on development. In the past, there has been pressure by development to expand sewer line service throughout the watershed, which has raised concerns about the sufficiency of the existing wastewater infrastructure to accommodate such loads. Both Oldham and Bullitt counties contain several smaller wastewater treatment plants and package plants that have been found to contribute a significant amount of nutrient load to the watershed.

Because of ongoing efforts to control nutrient loads in the Chesapeake Bay, many farmers in the watershed are concerned about possible restrictions that might be imposed by EPA. This has led to some mistrust amongst the agricultural community with regard to the reason Floyds Fork was selected by US EPA Region 4 for the development of a nutrient TMDL. Meanwhile, some members of the environmental and preservation community are suspicious or mistrustful of the Kentucky Division of Water based on past actions regarding the issuance of permits to allow additional wastewater treatment plant effluent to Floyds Fork. All of these issues made some citizens suspicious of the stakeholder engagement process.

While this stakeholder engagement project was independent of the ongoing TMDL efforts in the watershed, including the activities by EPA Region 4 through their contractor Tetra Tech, some citizens assumed that the two activities were either directly related or even the same. Throughout the stakeholder engagement project, KWRRI worked to make sure that the stakeholders were aware of the existence of both projects as well as the differences in focus and funding.

All of these factors made it difficult to solicit objective feedback on possible nutrient management strategies. In response, KWRRI worked to provide room for stakeholders to voice their opinions about a range of issues while working to keep a focus on the goals and objectives of the stakeholder engagement process.

## 2.3 PROJECT TEAM

The KWRRI has concluded that community engagement is critical at all stages for identifying and evaluating potential nutrient management strategies for the Floyds Fork watershed. As a result, the KWRRI convened a project team to develop a multi-method engagement approach, integrating both qualitative and quantitative data.

The research team's composition reflects a broad range of experience with the technical aspects and regulatory history of the Floyd's Fork watershed. Research team members are:

- *Dr. Lindell Ormsbee, Ph.D., P.E., P.H., D.WRE,* Principal Investigator, is director of KWRRI. He has been actively engaged in research, teaching, and consulting in water resources and environmental engineering for three decades. As principal investigator for the Paducah Gaseous Diffusion Plant Stakeholder (PGDP) Future Vision Project, he shepherded the development of the integrated, community-based engagement process that will be adapted for the Floyds Fork Watershed Engagement Project.
- *Jim Kipp, M.S.,* is associate director of KWRRI and a registered professional geologist in Kentucky. His interests include research focused on the identification and characterization of groundwater flow systems, at scales ranging from local to regional, based on physical, chemical, and hydro-geological factors. He currently manages activities related to the US Geological Survey-funded water institute program in Kentucky.
- *Ben Albritton, B.S.,* is a scientist and engineer for KWRRI. He has seven years of education experience, including leading an adult education program center in Louisville,

KY. He has degrees in mathematics and civil engineering. Since joining KWRRI, he has been intensively involved in TMDL development for several streams in Kentucky. He also has extensive experience with the HSPF watershed model.

- *Anna Goodman Hoover, M.A.,* is deputy director of the Public Health Practice-Based Research Network National Coordinating Center, as well as a research faculty member in the University of Kentucky College of Public Health's Department of Health Services Management. As research coordinator for the PGDP Stakeholder Future Vision Project, she provided expertise in participatory communication, contributing to the development of the integrated community-based engagement process that will be implemented in Floyds Fork.
- *Stephanie Jenkins, M.S.,* is program coordinator for KWRRI. Her experience includes implementation, design, and planning for educational programs, as well as research coordination. She recently headed up the Commonwealth Collaborative-designated Water Pioneers program that educated eastern Kentucky youth about Kentucky water resources and engaged them in water-related issues to improve water quality in their local communities.
- *Malissa McAlister, M.S.,* is the Kentucky River Basin Coordinator with KWRRI, where she is responsible for the coordination of several watershed projects within the basin, including: data management and analysis for the Kentucky River Watershed Watch; coordination of the Kentucky River Authority's Watershed Grant Program; and acting as a liaison to the Kentucky Division of Water for the implementation of watershed activities within the Kentucky River Basin.
- *Christie Oliver, MBA, MSMIT.*, is communications director for KWRRI, joining the department in June 2012. She has been at the university for six years coordinating events, student activities, and developed services for industry groups. Christie will be helping with meeting logistics and project website maintenance.

## 2.4 PROJECT MODEL

The public engagement model for this project included nine steps: 1) iterative stakeholder identification, 2) listening tour, 3) creation and utilization of a pilot test group (advisory panel) with members chosen to represent diverse stakeholder interests, 4) stakeholder focus groups, 5) creation of a Floyds Fork informational website, 6) a community-based informational meeting, 7) community-based BMP scenario evaluations, 8) a nutrient management scenario scoring website, and 9) a final report. Each of these steps is illustrated in Figure 2.4.1 and discussed in more detail in Chapter 3.

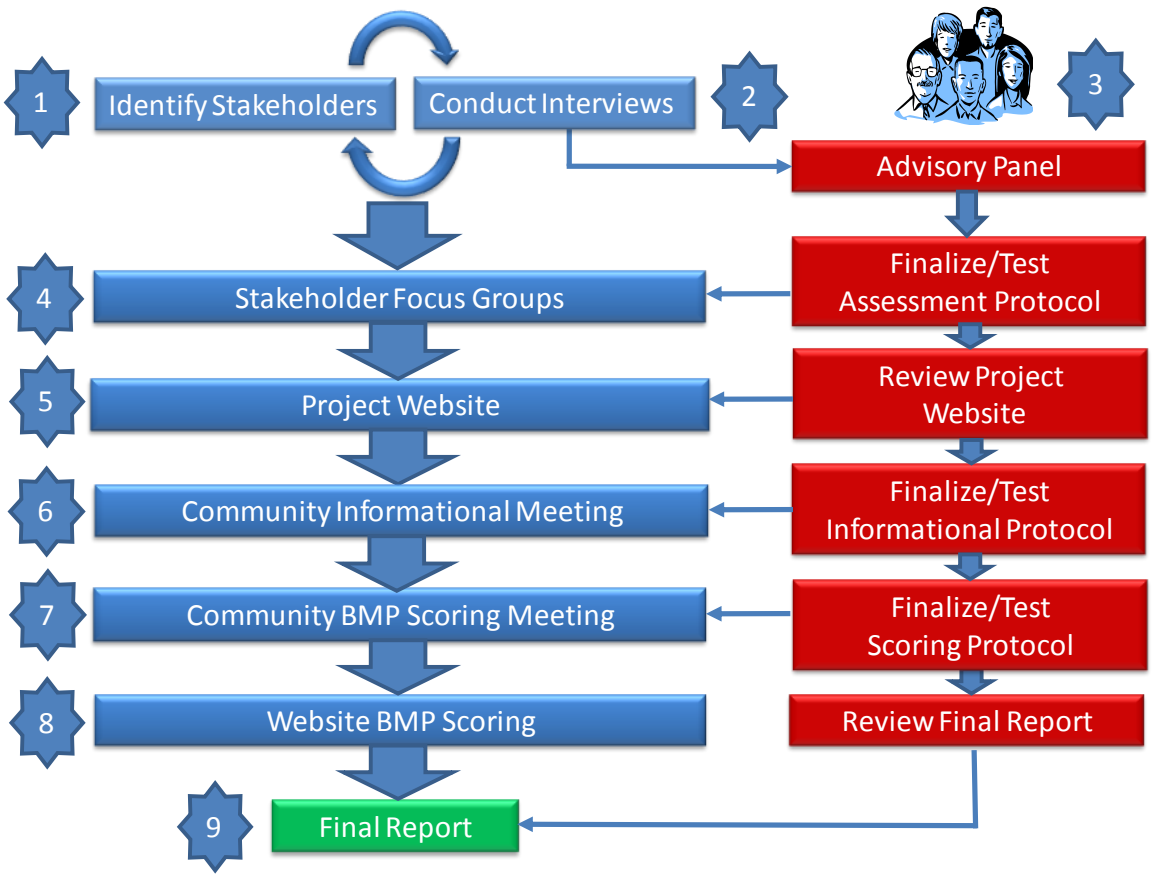



**Figure 2.4.1 Floyds Fork Community Vision Process**

# 3.0 COMMUNITY BASED PARTICIPATORY COMMUNICATION

## 3.1 BACKGROUND

Community-Based Participatory Communication (CBPC) has developed within the broader context of Participatory Communication, Community-Based Participatory Research (CBPR), Participatory Rural Communication Appraisal (PRCA), and other participatory approaches (Beltrán, 1993.). Participatory processes view communication NOT as an instrument of transmission or persuasion but instead as a dialogic process for exchanging views and involving community members in discussing issues that affect their lives. CBPC uses both traditional and modern forms of communication and organization to protect tradition and cultural values, while facilitating the integration of new elements. It creates an environment that empowers individuals and groups, giving them the freedom to voice their perceptions of reality and to act on these realities (Dagron, 2001; Carey, 1989).

CBPC is not simply a community outreach strategy, and it is less focused on widespread generalizability and diffusion (Dagron, 2001). Rather, it emphasizes the building of trust and rapport among all parties, along with the empowerment of individuals and communities, toward truly collaborative decision-making processes to achieve outcomes that resonate with community values, culture and perspectives about the future. CBPC thus favors decentralization and democracy, people involvement and dialogue, interpretive, horizontal, and bottom-up perspectives. It posits an alternative and, to some, a complementary conceptualization of communication that does not model the process as a linear, one-way, top-down transmission of information and persuasive messages (Anyaegbunam, Mefalopulos, & Moetsabi, 1999; Wallerstein & Duran, 2006).

In CBPC, as in CBPR and PRCA, research is a collaborative partnership that strives to equitably involve in every aspect of the process all potentially affected parties, including community members, organizational representatives, and researchers (Israel et al., 2001). Done properly, such research builds bridges between community participants and government agencies, allowing all parties to gain knowledge and experience. All partners contribute their expertise and share ownership of research findings and decisions for action. This collaboration assists in developing culturally appropriate decisions and policies, thus making projects more effective and efficient. Finally, participatory methods can establish a level of trust that enhances both the quantity and the quality of information generated (Anyaegbunam & Kamlongera, 2002; Viswanathan et al., 2004; Cornwall & Jewkes, 1995; Wallerstein, 2000; Fisher & Ball, 2005).

Using visualizations, interviews, and group-work, CBPC facilitates dialogue among community members and between them and researchers. This dialogue enables all parties to reach mutual understandings and to create action plans that are acceptable to the community (Anyaegbunam, Mefalopulos, & Moetsabi, 2004). In CBPC, communication is a two-way process in which all people are seen as important sources of information with ideas worthy of being heard. Passiveness, therefore, is non-existent in this process because it requires active mental cooperation of all the people involved until a common awareness and understanding is reached (Rogers & Kincaid, 1981). It is a process in which all participants decide on a course of action together. This view of communication presupposes the equality of all actors. The convergence model of communication developed by Rogers and Kincaid (1981) best captures this framework.

## 3.2 THE ROOTS OF CBPC

The roots of CBPC can be traced to the work of Lewin (1946), who used the term "action research" to describe an approach that stressed cycles of action and reflection involving both researchers and research participants. After several mutations, Lewin's work found expression in various participatory methods that started to emerge in the 1970s (Beltrain, 1993). During this period, many researchers became increasingly disillusioned with the lack of progress and achievement of development activities, especially in rural areas. The limitations of many traditional communication research methods were becoming apparent. By this time, the assumption that lack of education was a primary impediment to development began giving way to the realization that the wealth of collective indigenous knowledge among rural people could effectively help raise living standards. It also was realized that when rural people are involved in the identification of their own problems and needs, they are more likely to support the necessary actions to address their situations (Anyaegbunam, Mefalopulos, & Moetsabi, 2004).

As such recognition emerged, researchers in the development field began abandoning questionnaire methods, which tended to be too long to administer, very rigid in their formats, lacking in recognition of local realities (as the instruments were usually designed by researchers sitting in urban offices), and complex to process and analyze. Seeking more effective methods of data gathering, development researchers realized that most illiterate or semi-literate people can communicate effectively about any issues that impact them with the help of visual representations.

All of these factors gave birth to Rapid Rural Appraisal (RRA), a great improvement from questionnaire methods. Data were gathered more quickly, and the resulting reports were prepared faster. RRA also better addressed the needs of indigenous people. However, after collecting data in villages, researchers continued to take the information away from the people to analyze it in their own offices with their own sets of assumptions. Thus, RRA is primarily an extractive approach in which outsiders control the research process, going into rural areas, obtaining information from rural people, and taking that information away to process and analyze it (Brown et al., 2002).

As RRA was applied in more situations, it became clear that communities needed to be involved not only in data collection but also in the prioritization and analysis of their problems and needs. Out of this process emerged Participatory Rural Appraisal (PRA) and later Participatory Learning and Action (PLA). PRA and PLA recognized that researchers and subject matter specialists did not know many things about the communities in which they worked and that the only way to learn those things was by listening to the rural people. Similarly, rural people lacked some of the technical knowledge necessary to solve some of their problems. Thus, knowledge *sharing* became an essential component of PRA. PRA has been used extensively in agriculture, forestry, and a number of other areas; however, it has never been used specifically in the communication field, although most of its techniques and tools derive from communication. This disjuncture led to the creation of Participatory Rural Communication Appraisal (PRCA) in 1995 and later to the development of CBPC. CBPC, therefore, belongs to the same family as RRA, PRA, PLA, CBPR, PRCA, and other participatory methods.

## 3.3 INITIAL CBPC PROCESS, METHODS, AND MATERIALS

As part of the stakeholder engagement protocol, the research team jointly drafted a guide for the integrated CBPC-Structured Public Involvement process before identifying as many initial stakeholders as possible. The preliminary, KDOW generated stakeholder list included 44 specific organizations or individuals prior to the research team entering the field. Recognizing themselves as outsiders to the Floyds Fork community, however, the team intended this list only as a starting point from which participation from as many community members as possible would be encouraged through additional snowball sampling (Berg, 1988). As finally developed and implemented in the Floyds Fork watershed, the initial CBPC process involved four basic steps: 1) stakeholder identification, 2) a listening tour, 3) creation of a pilot group, and 4) development of focus groups. Each of these steps is discussed in the following sections.

### 3.3.1 Step One: Stakeholder Identification

After creating an initial draft guide for the integrated CBPC-SPI process, the next step was the identification of key stakeholder groups affected by and affecting Floyds Fork watershed management decisions. To fulfill this objective, the research team worked with the Kentucky Division of Water to identify as many stakeholders as possible. This list was supplemented using feedback provided by stakeholders who participated in the public meetings associated with EPA's TMDL project. This list was intended as a starting point for an iterative process in which additional stakeholder interactions would generate the identification and engagement of other stakeholders, who would identify more stakeholders, until saturation had been achieved, with no additional groups or individuals being identified (Lindlof and Taylor, 2002). Ultimately, the team was able to generate an initial list that included 116 specific organizations or individuals. These were subsequently assigned to one of the following 24 stakeholder groups.

Federal Government
State Government
Local Government
Private Utilities
Public Utilities
Health Departments
Farmers
Agriculture Organizations
Economic Development Organizations
Local Businesses
Builders
Environmental Organizations
Preservation Organizations
Wildlife Organizations
Recreational Organizations
Consulting Firms
Law Firms
Golf Courses
Religious Organizations
Civic Organizations
Universities
Residents
Neighborhood Associations
Media

Given logistical and fiscal constraints related to the KWRRI team's travel between Lexington and the Floyds Fork watershed, it was not practical to schedule 24 separate focus groups targeting each distinct set of stakeholders. However, the team felt it was essential that the groups be populated in a manner that would encourage maximum dialogue. Thus, the team used constant comparative analysis (Strauss, 1987; Lindlof & Taylor, 2002) of existing data to group stakeholders who appeared to have similar backgrounds, relationships to the watershed, and practical and philosophical commitments. As a result, the original list of 24 groups was eventually consolidated into the following seven stakeholder clusters.

Government/utilities/health departments/universities
Farmers and agricultural organizations
Environmental groups
Preservation and wildlife groups
Economic development, local businesses and builders
Recreational organizations and golf courses
Residents and neighborhood associations

### 3.3.2 Step Two: Listening Tour

In adherence to participatory research tenets, the Floyds Fork Stakeholder Engagement project conducted a listening tour that took the KWRRI team to various local, state and federal government offices in Jefferson, Oldham and Bullitt counties, and Frankfort. This first process stage involved individual and small group background interviews with constituencies identified during the brainstorming session, as well as sessions with additional stakeholders of whom the project team became aware through the initial interviews. Stakeholders approached during the listening tour included elected and appointed officials; local opinion leaders; economic development, environmental, preservation, agricultural, and recreational advocates; and general residents of the watershed.

During each session, the team discussed the proposed methodology, describing preliminary plans for the community engagement project and soliciting stakeholder suggestions about the proposed CBPC-SPI approach. Additional questions attempted to identify: 1) specific stakeholder concerns about the watershed; 2) previous studies or reports, 3) possible nutrient management strategies perceived as opportunities and 4) any additional background information that the stakeholders felt the project team should know. In accordance with its iterative stakeholder identification approach, the project team ended sessions by asking interviewees to examine the list of previously identified stakeholders and to recommend any additional individual stakeholders or groups who should be engaged by the process.

In all, 80 stakeholders took part in 23 separate sessions during this first stage. Most interview participants authorized the team to audio record the sessions. These recordings were transcribed for accuracy. Transcription data were later triangulated with the team's field notes. One session was not audio recorded at the request of the participants; in this instance, the project team relied solely upon field notes for information gathering.

### 3.3.3 Step Three: Pilot Group

The project team formed a community consultation panel/pilot test group comprised of one or more representatives from each of the seven stakeholder clusters. This advisory group pre-tested individual research protocols prior to community-wide implementation and, where warranted, recommended modifications to the process and/or its associated components. Consultation panelists also assisted in recruiting participants from their respective stakeholder groups, bringing members of their constituencies into the community engagement process. The ultimate composition of the pilot group is summarized as follows:

University of Louisville professor
Representative of local utility
Economic development organization
Local resident
Representative of environmental organization

Representative of preservation organization
Representative of agricultural organization
Representative of federal organization
Representative of local city government
Representative of neighborhood association
Representative of county government
Representative of local health department

In addition to assisting with the creation of the community consultation panel/pilot test group, data collected from interviews also provided important background information for the remainder of the project. Further, the interview data and background materials gathered during the listening tour informed the development of a focus group discussion guide and hypothetical nutrient management strategies and visualizations that would serve as discussion triggers during a subsequent phase of the project.

### 3.3.4 Step Four: Focus Groups

Following the listening tour, the KWRRI project team developed a preliminary focus group protocol for soliciting community values, visions for the future of the watershed, and information gaps. The draft protocol was provided in written form to community consultation panelists for review and comment. As a result of written comments, changes were made to the draft protocol.

Community consultation panelists pilot-tested the draft protocol during fall 2012. As a result of this pilot test, the research team made additional changes to the amount and form of information provided, as well as expanding upon the number and content of nutrient management strategies included as discussion triggers. An amended version of the protocol was submitted to the University of Kentucky Nonbiomedical Institutional Review Board. Following minor changes to the informed consent language, the focus group portion of the study was approved as IRB Protocol #10-0086-P4S (see Appendix C).

As developed by the KWRRI project team, pilot tested by the community advisory panel, and approved by the university's Institutional Review Board, the focus group protocol was designed to identify the following:

- Both preferred and unacceptable nutrient management strategies for use in the Floyds Fork watershed.

- How the various groups in the community name and frame the following issues related to nutrient management strategies for the Floyds Fork watershed:

    - opportunities
    - strengths
    - challenges
    - weaknesses
    - threats
    - fears
    - risks
    - concerns
    - solutions

- The overall quality of life goals and values of the community and, more specifically, the priority quality of life goals and values that influence the decisions of various groups regarding nutrient management strategies.

- Any additional information that various community groups need to make the best decisions about nutrient management strategies.

- The most accessible and trusted channels for receiving watershed-related information.

Following the approval of the focus group meeting protocol, seven formal focus group meetings were scheduled during November 2012, and January 2013. Focus group participants were recruited with the help of pilot group members and through email invitations and snowball sampling. Specifically, email invitations were sent to all individuals who had been interviewed and to other stakeholders who had been identified by both the project team and interviewees. These invitations included a request that recipients share the invitation with other interested individuals in their cohorts. Individuals who had pilot-tested the protocol were not eligible to participate in the stakeholder-specific focus groups, as their pre-existing familiarity with the processes and materials could have wielded undue influence on group discussions.

During each focus group, facilitators briefly explained the project and why the meeting was convened. Facilitators also reiterated the voluntary nature of participation and advised any participants who did not want to continue the study that they could leave. Assurances of confidentiality were verbally provided in accordance with human research guidelines, and copies of the consent form were given to all participants. The project team then used specific exercises, questions, and prompts to elicit the information identified above.

#### 3.3.4.1 Values and Vision

Focus group attendance generally was in the optimal range of eight to twelve participants (Kitzinger & Barber, 1999). A total of 48 individuals attended at least some portion of seven sessions. The majority of attendees were male, with only fifteen females participating in focus groups. Not all focus group attendees participated in the keypad scoring portion of the protocol.

Focus group sessions began with an overview of the project, followed by participant evaluations of past and ideal levels of community involvement in public processes using the Arnstein Ladder (Arnstein, 1969). According to focus group participants, the community sees its past experiences as located between informing and placation, or rungs 3 and 4 of the Arnstein Ladder, but would prefer to be consulted and treated as partners, or rungs 5 and 6, in community development projects.

The Arnstein evaluation was followed by exercises designed to identify community values and future visions for the watershed. This task was accomplished by asking each participant to name three qualities that make the area near the PGDP a good place to live. A follow-up question asked each participant to imagine the characteristics of an ideal watershed. The ensuing conversations indicated that citizens of and visitors to the region place high importance on:

- The rural character of the watershed
- The history of the watershed
- The natural beauty of the watershed
- The recreational opportunities afforded by the watershed

- The lack of excessive urbanization
- The biodiversity of the watershed
- The presences of wildlife and aquatic species (e.g. mussels)
- The proximity of the watershed to urban centers
- The parks within the watershed
- The accessibility of the watershed to citizens
- The number of farms in the watershed
- The availability of a clean and reliable water source

Characteristics of an ideal watershed included:

- Clean and healthy (meets Clean Water Act standards)
- Public access
- Smart growth
- Sustainable
- Buffer zones and green space
- Supports biodiversity
- Recreational resource
- Agricultural resource

Many of the respondents commented that they thought Floyds Fork was currently an ideal watershed and that they would like to see it preserved in its current form.

**3.3.4.2 Small Group Scenario Discussions**

As part of each focus group meeting, participants were divided into four groups, where each group was randomly assigned a set of envelopes. Each set of envelopes corresponded to one of four major categories of nutrient management strategies: wastewater strategies, agricultural strategies, urban strategies, and policy strategies. The four categories and associated individual management strategies that were distributed for consideration are summarized below:

<u>Wastewater Management</u>

Eliminate failing septic systems
Eliminate sanitary sewer overflows
Regionalization
Improve nutrient treatment technologies

<u>Agricultural Nutrient Management</u>

Crop/fertilizer management
Erosion/runoff management
Animal/manure management
Urban Nutrient Management

<u>Urban Nutrient Management</u>

Behavior/educational programs for litter and fertilizer control
Reduce runoff through grey and green infrastructure
Treat runoff through retention basins and urban wetlands

Policy Strategies

Land use planning (e.g. conservation subdivisions)
Pollution Trading

Each group randomly selected one of the envelopes in their set. For example, the wastewater strategy set contained four envelopes while the policy strategy set only contained two envelopes. The group was asked to look at a picture of a corresponding nutrient management strategy and then discuss and answer the following three questions within their group:

1) What does this picture represent to you?
2) What are the possible advantages or potential benefits of this strategy?
3) What are the possible disadvantages or potential problems with this strategy?

Once the groups recorded their answers, a member of each group presented the results of their discussion to the other three groups. After each presentation, the rest of the members of the focus group were asked to comment on the particular strategy and identify any additional benefits or perceived problems with this strategy. These additional comments were also recorded. This protocol assured that at least one strategy from each of the four major categories would be discussed in some detail at each meeting. Following this discussion, the focus group members collectively scored all twelve of the scenarios using the ARS keypad technology. This was accomplished using a PowerPoint presentation, in which the focus group facilitator presented each strategy along with a screen for soliciting responses from the focus group members. Before scoring, the facilitator would give a short narrative description of the BMP and answer any questions posed by the group. The focus group members were then asked to score each scenario using a Likert scale from 1 to 9, with 1 = least preferable and 9 = most preferable. It should be emphasized, participants were instructed that each BMP was to be scored on its own merits and not in comparison to the other BMPs. Following the scoring, the results were displayed to the focus group. In those cases where the results varied, focus group members were asked to volunteer why they scored the BMPs the ways they did. These responses were recorded and provided valuable insight into focus group member preferences. These discussions also helped to identify potential benefits or problems that might not be readily apparent to the general population. The qualitative and quantitative results from the focus groups are presented in Chapters 4 and 5.

### 3.3.4.3 Informational Gaps

Following the scenario evaluations, facilitators attempted to assess existing community information gaps and trusted information sources for filling those gaps. Specifically, the KWRRI team needed to determine what kinds of information focus group participants required to feel comfortable evaluating potential nutrient management strategies. Questions asked during this segment of the focus group included:

- What sources do you consult for Floyds Fork-related information?
- What are the most (and least) credible sources of information about Floyds Fork?
- What information would have helped you evaluate these hypothetical nutrient management strategies?
- What are the best ways of delivering information about issues related to Floyds Fork to your community?

Cited information needs included the following:

What is the actual problem and why is it important?
What is the status of the Creek biology?
How will EPA determine whether the stream is clean enough?
What are the sources of nutrient impairment and what are their percentages of contributions?
How effective are these different nutrient management strategies?
How much do these strategies cost to implement?
How feasible are some of these strategies?
How could some of these strategies impact businesses, homeowners, and farmers?
What type of maintenance issues are associated with these strategies?

In many cases, different constituent groups were concerned with potential misconceptions by other members of the community with regard to the actual impact of their constituent group (e.g. agricultural, development, golf courses, etc.).

The most frequently cited trustworthy source of information about Floyds Fork was the Kentucky Department of Fish and Wildlife Resources.

### 3.3.5 Summary

Broadly, the focus group discussions painted a picture of a community attempting to balance key values related to environmental responsibility and economic stability. In every session, the issues of both economic development and environmental preservation arose, often revealing internal conflicts for individual participants, as well as resulting in differing assessments of the hypothetical BMPs. A number of knowledge gaps also emerged within the discussions, with participants identifying specific informational needs that would assist in making suitability determinations about specific strategies.

# 4.0 QUALITATIVE RESULTS OF FOCUS GROUP MEETINGS

## 4.1 WASTEWATER MANAGEMENT

### 4.1.1 Stakeholder Feedback on Failing Septic Systems

Stakeholders in the Floyds Fork watershed see the following advantages to repairing failing septic systems: improvement in property value, reduction in water pollution, and improved home health environment. The challenges of repairing failing septic systems are seen as: the problem of identifying property owners who have failing septic systems, the cost of repairs, and the need for continued maintenance. Some stakeholders feel that to protect water quality, policies need to be in place requiring more area for septic system installation.

Comments collected from stakeholder input regarding failing septic systems are below.

*Ultimately all septic systems will fail if not properly maintained.*

*Potential benefits, there are a number of them. Reduction in pollution in surface water. Reduction in fecal contamination and biological contaminants in surface water. You get improvement of property values and improvement in the home environment. You get improved health factors for humans and wildlife. Certainly it could improve the wildlife diversity and reduction of odors which are obviously not directly related to streams but certainly it's quality of life.*

*Potential problems with the strategy will always be the cost and then compliance, basically getting people to do this.*

*I think our septic systems are in pretty good shape overall.*

*I've been told that regulators in Kentucky are going to start getting more strict on septic systems and inspections and that would be a concern. Especially if they tried to enforce new standards on old systems. That could cause a significant financial burden for individual homeowners. If they change the standard for what failing is and then there is a cost implication for everyone that has a septic system that passed before but now under the new standards failed.*

*It all goes back to not having enough people willing to properly manage their systems.*

*Just an observation, in Kentucky residential septic systems are regulated by the county health departments.*

*One way to address the problem would be to require individuals to connect to existing sewer systems.*

*My observation has been most of the emphasis is on permitting new systems to see that they are appropriately designed. There is very little emphasis on existing systems and other than when they are in place they usually do not take any action to deal with existing systems. It's strictly complaint driven. There are a lot of failed systems that nobody ever complains about that are making a very significant impact on our water quality. There's just not much movement to deal with them. Thus any solution must address these type of political issues.*

*Obviously anybody would want failing septic systems corrected for the area.*

### 4.1.2 Stakeholder Feedback on Sanitary Sewer Overflows

Two possible strategies were investigated for dealing with sanitary sewer overflows: 1) decreasing the stormwater that gets into the system via cracks or leaks in the sanitary sewer pipes or 2) expanding the capacity of the sewer system to accommodate more customers.

Stakeholders in the Floyds Fork Watershed see that repairing a leaking or failing sewer line system has immediate and certain benefits for water quality. Some stakeholders want to be cautious about investing resources in putting "Band-Aids" on old and failing systems when the only long term solution to the sewer problem is an expansion of infrastructure. Other stakeholders are more comfortable with repairing existing infrastructure because of its benefits to water quality but are cautious about system expansion due to its potential for being a catalyst for that degree of development which would ultimately be detrimental to water quality.

Stakeholders in the Floyds Fork Watershed are divided on the issue of expanding sewer system infrastructure. Some stakeholders see expansion as a better alternative to repairing failing septic systems or patching up existing systems. The main concern among some stakeholders regarding expansion of sewer systems is the opportunity it can create for a sprawl of development; these stakeholders would like to have more conservation minded zoning and development regulations in place before a major sewer system infrastructure expansion takes place. The existing zoning regulations allow a density of development that makes some stakeholders concerned for the future health of the watershed if they are not amended.

Comments collected from stakeholder input regarding sanitary sewer overflows are:

*If they can afford the repairs of the system or to put in a new system, it improves property values. If you don't have the funds to repair it, then the property valuation decreases.*

*It's an issue of capacity in the sewer system that is exceeded by a combination of growth in the community and by infiltration of inflow which is extraneous water that gets into the system which you can never completely eliminate. Some communities have it worse than others. The cost of dealing with either eliminating the flow, stopping growth, or building a higher capacity system is one of the big challenges.*

*It's expensive for communities to deal with.*

*Okay, but this one…I don't think this is a fair question because we know that there are a bunch of illegally tied in sump pumps. You mentioned gutters that are tied in even in the separate sewer system out here in the east end which we end up getting involved in a bunch of discussions. That said it is not acceptable to allow Mr. Homeowner to do something that is illegal. We are going to play by the rules but we want Mr. Homeowner to play by the rules.*

*It would make a better question if it said, "Increase sewer capacity to decrease inflows due to an existing problem." If it said that then that is acceptable I think.*

*Or give your sump pumps up that don't belong there.*

*I think that this is really a Jefferson County question because if you go to Oldham County you don't want to increase sewer capacity, you got to fix what they have.*

*I go back to the old days' philosophy of dilution and when you have it in more areas then it looks to me like you know, if this is all about having clean water then the dilution is part of the equation.*

*I think increasing capacity is a better option than decreasing inflow.*

*I actually reside in Jeffersonville, Indiana, and we're under a consent decree after the Clean Water Act and we're doing exactly this and the sewer bill for the residents have gone up 100 and some odd percent in the last 12 months.*

*Then potential problems with this strategy is finding a place to add the increased capacity. You would possibly have to move discharge farther because nobody wants a sanitary sewer in their backyard.*

*Well it's what I said earlier about the maintenance and about just the cost of putting in some of that structure. You know, some of it works and some of it is questionable or whatever so that's why I was kind of in the middle.*

### 4.1.3 Stakeholder Feedback on Wastewater Treatment Facility Regionalization

The same discussion regarding the expansion of sewer system infrastructure applies to facility regionalization. Some stakeholders can see benefits and advantages to regionalization. Another advantage that stakeholders see is that of having simplified regulatory actions. However, regionalization may open the way for a surge of development growth, which is welcomed by some stakeholders in the Floyds Fork Watershed, but not by others. Challenges with adopting a regional approach is the cost and the probable long term debt, the politics of a system that must bring together several counties and numerous cities, and the logistics of the controlling authority. Another concern stakeholders have is for non-point sources to not be forgotten if a regional solution to wastewater is implemented. The point was also made that if you remove all the point source flows in the watershed, Floyds Fork will have significantly less flow in the upper regions, possibly going dry at times.

Some stakeholders disagree with the General Assembly's findings, and argue that large regional plants mean long distance trunk lines, and the practice of transporting wastewater long distances will always result in sewer overflows and polluted water all along the path of trunk lines. It is argued that invariably too much water gets into the lines in wet weather and major bypasses and overflows will result. Therefore, rather than having a single, low nutrient concentration discharge point in a large waterbody as proponents of regionalization may argue, those opposed to regionalization may argue that the reality will be many, high nutrient concentration overflows into all the streams and tributaries all along the paths of the sewage transport lines. Other concerns regarding regionalization include:

(1) concern about the loss of control by local utilities;
(2) concern that such facilities would lead to out of control over-development and loss of rural landscape;
(3) concern about the associated collection and transmission infrastructure requirements and impacts;
(4) concern that such infrastructure costs are not the most cost effective way to address the water quality problem.

Comments collected from stakeholder input regarding regional wastewater treatment plants include:

*Well now days to build a new one is simple because they make you build it to certain standards.*

*You don't want to rebuild your old one, its better off to take it to a central plant.*
*Management and maintenance could be potential problems.*

*Addressing a specific proposal for building a facility at Fort Knox: Fort Knox is willing, the land is available, it is close to…and it wouldn't even make a fraction of an impact in the Ohio River. So it's a great idea and we are going to work overtime to try to make it a reality in the years to come. Now it is going to take a while to do it.*

*If it is built large enough it takes 100% of the point-sources out of the watershed.*

*I think it's a terrific idea.*

*Potential challenges are obviously all of the politics involved in a regional system that requires several counties and cities to pay.*

*I am concerned that Louisville might try to dominate the process and control the facility.*

*I think the way the legislation is put together insures that it would be a cooperative effort from all of the counties*

*Also you're assuming that when you're talking about regionalization you are talking about regions where it could be complicated. You know looking at, as I said just up the road you can just go up Shelbyville Road and see the effects of regionalization when they have limited so many of package plants and so many of the facilities that are now practical. They have regionalized it and it's working beautifully.*

*I guess I would like to know that for instance the zoning in the watershed would prevent these very intense developments.*

*I haven't heard any disadvantages.*

*I know I have been to multiple meetings about this issue and I remember the chief engineer clearly saying dilution was the solution and so that stuck with me and I thought well that does make perfect sense.*

*I think that the fear is that regionalization will be done and will result in a bunch of development out of control. That will have a negative impact on the area.*

*Is this going to be the justification for running sewer lines through all the watershed and developing the whole area? Just piped all of the way to the Salt River?*

*Just piped all of the way to the Salt River.*

*Regionalization would be acceptable if it's done correctly.*

*Some of the surrounding counties may have some concern about Louisville going to take over this and we're not going to have any influence or any impact in this situation.*

*Theoretically it is a great idea. These larger facilities work more reliably, cost less per gallon to treat the sewage but economically it's a real challenge. The cost of transporting it can make the overall cost much higher than to have more dispersed facilities.*

*I think it would be a cost effective solution.*

*Problems with this strategy include a lack of risk diversification Just like what we do with our investments. We don't put everything all in one thing because if it fails then it is catastrophic. So it seems to me if we go to one large facility we would have to have great confidence in our knowledge today, but we know there are always things that come along that we didn't anticipate where failures can happen. I just think the risk is really much greater than if we have multiple facilities.*

*Problems with the strategy include public acceptance of one system or one plant controlling authority. Who is in charge of that one plant and that one set of collection systems? Normally, more from living it, there are certainly larger expenses, larger capital expenses that it is a long-term debt that you have to deal with and address. Site selection. Where would such a facility be located?*

*There is an economy of scale when you talk about doing one large plant compared to several small plants. There is a concentrated point of impact on the water quality and on the watershed itself. In one case a large plant is better, has more approved treatment ability, and can get it to a higher level of treatment when you have more wastewater to deal with.*

*You will also need to watch those big plants. There is a big one right over there off I 71 and you look at the creek coming out there what's called bubble creek or soapsuds creek. That's all phosphates going right down into the south part.*

*I'm kind of going out on a limb here but the financial part is what worries me the most, as I mentioned earlier.*

*It just seems like there is a more realistic way to spend resources to improve water quality.*

*It was the balance between applicability, affordability, effectiveness and things like that.*

*I am concerned that such a facility would require miles of new collection pipes that would spur growth which could then lead to overdevelopment and a generation of new combined sewer overflows. Just what we don't want.*

*Sewer treatment plants are very expensive to put in and you know you've got an economy that's stale or whatever and if you can take 10 of these small plants off- line and put one large plant in, there is going to be some cost there. I think that long term it is going to save you money, or save the community money because you are not trying to maintain these smaller inefficient plants. Because sewer treatment plants, my understanding is they work a lot more with efficient the bigger they are. You know, work more efficient than these small ones do.*

### 4.1.4 Stakeholder Feedback on Removal Technologies

It may sometimes not be feasible for small package plants to achieve advanced stages of treatment, in which case there may be a more pressing need for consolidation or regionalization to take advantage of economies of scale. One concern some stakeholders in the watershed have about looking to advanced technologies for the wastewater problem solution is that they foresee a high cost in these technologies, with the likelihood of diminishing returns.

Comments collected from stakeholder input regarding enhanced nutrient removal technologies are:

*The negative thing is there is cost in using resources. It takes chemicals to do that and it takes energy to achieve higher nutrient removal levels at our waste treatment facilities.*

*Problems will have to be solved and the facility would have to be maintained.*

*When you get really down to low levels of acceptable nutrient concentration then the cost becomes really prohibitive.*

*I think in Jefferson County there appears to be a good management system on this now in terms of what the requirements are and types of systems that can be used and not used. Unfortunately there are a lot of old systems out there that do have issues.*

## 4.2 AGRICULTURAL MANAGEMENT

### 4.2.1 General Observations

Stakeholders in the Floyds Fork Watershed are in favor of agricultural practices which result in improved water quality. However, some stakeholders are concerned about placing too much of a burden on farmers. Many stakeholders see farmers as an indispensible asset to the local economy and are concerned that farmers may give up farming if environmental policies make farming as a livelihood unprofitable or too difficult. Education, cooperation, and encouragement are generally accepted approaches but the challenge that is seen is how to implement these approaches effectively. Many stakeholders feel that most farmers already implement many of these best management practices as a result of the Kentucky Agriculture Water Quality Act.

The Agriculture Water Quality Act was passed by the Kentucky General Assembly in 1994. The act protects surface and groundwater resources from pollution from agriculture and silviculture practices. The act affects all landowners with 10 or more contiguous acres and who conduct agriculture or silviculture operations on their land. All landowners/land users with 10 or more acres of land that is used for agriculture or silviculture operations must develop and implement a water quality plan based on guidance from the Kentucky Agriculture Water Quality Plan. The plan includes 60 different best management practices (BMPs) that address issues related to fertilizer, crops, and livestock. For more information see:
http://conservation.ky.gov/Pages/AgricultureWaterQuality.aspx

### 4.2.2 General Stakeholder Comments Related to Agricultural Nutrient Management

*In a perfect world, you know a lot of these are great ideas. As an example if it didn't cost anything to (reduce the nutrients) ... if it looked good and if it didn't cost any more money it is a great idea.*

*I don't think DOW has any control over what the farmers do.*

*One of the disadvantages of the strategy also noted is political. The control of the agriculture interest you know. It is pretty important to have food growing in the United States I guess locally or regionally and it would be a pretty tall mountain I would think to climb to get many changes legislatively.*

*Yeah but how much are we going to put on the farmers, too? You know. Look at the crop farm this year. That is just ridiculous.*

*One potential problem with agricultural BMPs is that you're talking about people with individual properties.*

*I just think that's going to be hard to control (agriculture).*

*I was going to say it's another economic hardship (to farmers)*

*In some case there needs to be an economic incentive to them (farmers).*

*Any agricultural BMPs need to make it viable for farmers. The more that we can partner with them in the Floyds Fork Watershed, that would be advantageous.*

*I got the distinct impression in one of the meetings with the EPA that the farmers are really concerned about some type of restriction on the way they farm. They are concerned that somebody is going to dictate to them.*

*I believe there's a range. Everybody's right. There's a real range of opinions amongst those of us who call ourselves farmers. So it is dangerous to make any kind of single thing.*

*Related to testing and technology and the inputs can be more expensive but hopefully you will have a return on those. Again though, best management practices also contribute to that.*

*The thing is most farmers, especially in this watershed, are already installing the BMPs. They've already installed the BMPs.*

*We (farmers) are already doing so much that we used to not do.*

### 4.2.3 Stakeholder Feedback on Fertilizer Management

Stakeholders in the Floyds Fork Watershed see the importance of fertilizer management. In addition to improved water quality through reduced nutrient loads to streams, some see an advantage to farmers in that it can save farmers money by reducing fertilizer expenditure to be only the amount actually needed. Some stakeholders also point out challenges arising from fertilizer management as a strategy for controlling nutrient loads. These challenges include enforcement if nutrient/fertilizer regulatory limits are attempted, the risk of creating a management burden on farm owners to the point that farmers get out of the business of farming, and how to educate and encourage land owners if non-regulatory, voluntary approaches are attempted.

Some comments collected from stakeholder input regarding fertilizer management are listed below.

*Well certainly we are concerned about any sort of limits that might be imposed but I think farmers individually are actually open to… I mean farmers have their best interest in mind which is their budget and if they can reduce their budget, their purchases for fertilizer inputs, and make better decisions that impact the land better I think they're on board with that. So the perspective of an individual famer might be slightly different than an organization representing famers.*

*(This strategy) could decrease revenue from farming (due to) the cost of the GPS, and the education of the property owners.*

*(Farmers) have so many restrictions on them already in terms of the weather that you know you add to that then it certainly would have a negative impact on the yield, decrease the value of the land, and cause them in some cases to not be able to continue to stay in business.*

*(This strategy would) certainly would reduce the nutrient levels in nearby streams.*

*(This strategy could potential impact crop production and yield).*

*Well I think the strategy represents a good idea and something to be considered as a way of managing some of the influence of nutrients getting into the streams as far as just in general. As compared to things like housing development and other infrastructure I think, but you would know better than I, that fertilizers in agriculture uses have much more of a tremendous impact on streams nearby.*

*Biggest problems are cost and enforcement. Who would be policing the farmer to make sure they are doing what they're supposed to do? The cost of soil testing, who is going to pick that up?*

*It's a real management challenge.*

*I know if I were a farmer I wouldn't spend any more money on anything than I had to anyway.*

*With the GPS (technology) that they can put on fertilizer spreaders now, I mean it's certainly do-able. A lot of the big operators are using that technology now.*

*Do you think there is a perception out there by some people that just think farmers just go out there and dump all of this fertilizer?*

*Just the input cost of fertilizer now is $600-$900 a ton for some of those products. You are not going to put on any more than you absolutely have to have.*

*You brought up a brilliant point that I had not thought about. I hadn't even thought about a fair amount of the fertilizer that goes out from a facility like mine is used in industrial applications. So even making the assumption that's it's all going on to Agriculture, I mean they use it for ice melt and they pour it straight into the ground at battery cracking plants it's used for, you know I never even thought about that and I don't know how the records reflect the difference between an ag and an industrial application because the industrial application, all the power plants are receiving urea and other nitrates. Every one of them.*

*Well obviously it should be an economic plus for you assuming you get the Lord shining on you with rain is the biggest thing but this certainly puts you in a better position. Environmental impact and hopefully yield increase on practices that ultimately result in that.*

### 4.2.4 Stakeholder Feedback on Crop Management

Crop management largely involves strategies to prevent field vulnerability to erosion and consequently controlling runoff carrying sediment laden with nutrients. Crop management practices conserves soil and conserves nutrients through strategized crop selection and field planting design. Some comments collected from stakeholder input regarding crop management are listed below.

*It would eliminate erosion. Crop rotation I would think would increase yields for the farmer.*

*I again have a co-benefits idea that there's actually a lot of benefits to improved use of best management practices in terms of agricultural crop rotation and that kind of stuff. Soils, soil quality, energy usage, all that kind of stuff and there are a number of USDA programs out there that provide financial incentives which I think seem to be pretty much how it has to work.*

*I've been participating on the TAC, the technical advisory committee, and there are agricultural interests on the committee and one of our recent subcommittee meetings there were some actual farmers there and they actually talked about they're implementing cover crops and they are doing these sorts of things to try and reduce their nutrient loading impacts and so I think you're right.*

*Of course we can implement more cover crops you know in the future that will do like they're doing in Maryland. There are so much advances that still need to be made that will help clean up these streams and its sustainability.*

*We need a genetically modified fescue so we can sow our waterways and then when you come through to spray Roundup on your crops you won't kill your waterway.*

*I get the impression that people that are farming in the watershed, typically row crops corn and soybean, would have an issue with this.*

### 4.2.5 Stakeholder Feedback on Livestock Management

Stakeholders in the Floyds Fork Watershed have pointed out some advantages and challenges regarding livestock management strategies. In addition to the advantages to water quality in the streams, developing a water source that is drinking access only for livestock will result in livestock drinking cleaner water and will reduce the spread of disease or worms, etc. Challenges to implementing these strategies are resources such as labor, cost of fencing, cost of other construction, and maintenance. There is also concern from some stakeholders that having livestock in close quarters can create such problems as concentrated wastes and the spread of disease from the number of animals being in close contact. The concentrated wastes can actually be made into an advantage, however, if there are practices in place for collecting it and turning the manure to productive uses.

Some comments collected from stakeholder input regarding livestock management are listed below.

*I see cows getting around fences. It seems like in the picture you have corralled cows. The denser your livestock is the more prone to disease and again runoff becomes an issue.*

*So there could be some environmental offsets in terms of cost; drawing water, say for an example, out of an aquifer for the cattle rather than getting it out of the stream. Then also there could just*

*be issues depending on the fencing and the particular arrangements for access to that stream for humans and that kind of thing.*

*You may lose some connectivity between communities, animal communities, anytime you put up a barrier like that and migration is something else to think about.*

*It's going to be a challenge I think again to manage it and you're going to have laws. Farmers don't like to be told how to run their operations and manage their livestock.*

*It's somebody who has way too many horses on too small of a piece of land. That's your real bugger and they're not going to qualify for any of the agriculture programs.*

*Just that you're not regulating the massive deer population, it's pretty much all private property. When I was young we had a lot of dairies and we hardly having any dairies now so I mean from that standpoint beef cattle operation is much less invasive on the watershed than dairy cattle.*

*Agricultural animals are not the only things to contribute to the problem.*

*First of all in McCrearys Fork they were doing studies, and the homeowners came in there and were blaming it all on the livestock and there is no more livestock in McCrearys Fork any more to amount to a hill of beans. They discovered it was deer, raccoons, and things like that. Also when they did a study on Ashleys Run and assumed that is was agriculture. However, when they collected data they found out that the source of the problem was from septic systems.*

*Instead of fencing off the stream you are pushing the animals' habitat.*

*Less expense. It's a way to sell that to farmers. If you have to spend less on dewormer, which is a big expense.*

*Those kinds of things; concentrated waste disposal, increased medical costs to keep those animals on antibiotics, and then devalue meat.*

*We'll have clean, safer water and healthier livestock. The livestock won't be drinking from the water.*

*You go feed them but then that would defeat the whole purpose and that would mean yes they are in jail. That's where they are going to be and that's not natural.*

### 4.2.6 Stakeholder Feedback on Manure Management

Some stakeholders have a concern about confined area feeding operations, in particular, that wastes accumulate in a concentrated area. However, this concentrated waste disposition can make collection more efficient if there are practices in place for recycling the manure for productive uses. Stakeholders see the advantages of using manure for fertilizer or other soil amendments if it can be properly composted and managed.

Some comments collected from stakeholder input regarding manure management are listed below.

*Move (the livestock) around so the manure is used on site, it's put back into the ground, and you are not using energy to drain off farm resources. The more we involve farming techniques to try*

*to approach that kind of ecosystem the less we are going to have to worry about plant sources and tons of manure.*

*I've got mixed emotions about it. You need to manage your manure and manage it properly but that's not the only answer to cleaning up the streams.*

*The downside, like everything else, is cost. Cost for the fencing materials and labor. It can create some serious problems with waste disposal.*

*We have an insufficient structural solution: if you reduce the amount of nutrients going into the water it should show up with cleaner water. I think it's farmer driven management change which is cheap, relatively speaking compared to some things, and it's educational I think primarily although you could fund what measures need to be taken. The biggest thing is it involves these human management tied to integrated livestock or diverse livestock. Some of the rotation programs people are using where they will do chickens and then bring their cattle in. Bring the chickens in first.*

### 4.2.7 Stakeholder Feedback on Erosion and Runoff Control Management

Stakeholders in the Floyds Fork Watershed can see many advantages to these strategies such as the planted vegetation that is involved in these strategies improve water quality, improve stream stabilization where applicable, offer habitat to wildlife, moderate the temperature of the water body, and make the stream corridor and surrounding areas more aesthetically pleasing. Stakeholders have also pointed out some challenges arising from these practices. In some cases, notably in filter strips or riparian buffer zones, farmers are having to give up some portion of the land that could have otherwise been used as productive farmland. However, in some cases the farmland lost due to erosion over time may be more than the land given up to stabilize the health and morphology of a stream, thereby making this management practice the logical course of action. The cost of implementation is another challenge and could possibly be offset by incentive programs. Another concern is how much time or funds may be required to maintain the effectiveness of one of these management practices once installed.

Some comments collected from stakeholder input regarding erosion and runoff control are listed below.

*One of the challenges with the strategy is that it reduces the value of the land if a farmer can't use it they way you currently do.*

*It could cause the value of the land to be used for agricultural uses to go down because it could restrict the use of the farmland.*

*Farmers might have a buffer near the stream without a buffer for the roadway. They've got a buffer for the houses over here you know. Slowly but surely…*

*I mean you see them, I go up and down 64 every once and a while and you see them leaving green strips where the waterways are. Even up in Cincinnati, I mean up near Indiana they're doing that more and more than they used to.*

*It gives that buffer area between the creek and the land to make runoff filter through the grass areas.*

*You've got all buffer and no land, nothing to work with.*

*Can become a wildlife habitat.*

*Benefits could include creation of a natural buffer, erosion prevention for the stream, and runoff filter.*

*Not strips but buffers, substantial buffers along all the tributaries and network a whole system of upper wildlife habitat, filtered water, slowing the water down, clean water, and keep all the other.*

*Improve water quality.*

*Even more deer.*

*Reduction of peak runoff cycles and slowly get the water back into the creek.*

*Could create habitat connectivity for critters, cools and moderates water temperature that's emptied into the stream, and has a scenic plus to the watershed.*

*Limitations include, upfront investment or expenses to do it right - you have to have a considerable amount of investment up front.*

*Real world application given the decline in productive agricultural land and large ownership patterns. Landowners coming up with the funding for these practices because a big chunk of it is shared by the landowners themselves.*

*Limitations include the number of years it takes to establish the forested buffer and then obviously continued maintenance of the buffer.*

*I think some of it is related to acceptability and incentives, especially when you are talking about private property. A lot of it is private property issues.*

*Maintenance could be a problem.*

*Potential benefits, obviously an improved waterway. Other than that we didn't really see any real cost savings for the farmer.*

*If they had a Roundup ready fescue that will keep a lot of soil in place.*

*You can take a spray man by the arm and say, "Do not spray that grass waterway." When you go through there combining its dead. He sprayed it. You know that would be a perennial crop.*

### 4.2.8 Stakeholder Feedback on Agricultural Runoff Treatment

An advantage of these practices is that they use natural biological and ecological processes to reduce nutrient loadings to streams. Another advantage is that these practices can be very effective. A constructed wetland can also provide wildlife habitat. However, a waste treatment lagoon may present the challenge of controlling undesirable odors, but this may not become a problem if the site is chosen well. A potential environmental hazard of the waste treatment lagoon is the possibility of an overflow or a containment failure of some kind. Proper siting,

design, construction, and maintenance should minimize the risk of this hazard. The disadvantages of a constructed wetland are few; constructed wetlands do require land and some stakeholders feel that stream tributaries should be left in their natural state instead of being altered by construction.

## 4.3 URBAN MANAGEMENT

### 4.3.1 Stakeholder Feedback on Reducing Urban Loadings through Behavior Management

An advantage of urban behavioral management is that the behavior of so many people collectively has a large impact on water quality and so being able to influence that effect to the improvement of water quality would be a major environmental gain. However, there are challenges to managing the behavior of people. It is very difficult to alter people's habits and behavior through messages. Therefore, finding effective incentives that motivate people to enact practices beneficial for water quality can be challenging.

Comments collected from stakeholder input regarding urban behavioral management are listed below.

*I just think education and that is one strategy, but people can't keep living the way they've been living and you know so they might as well just face it and I think with the more education to put out there for the next generation the better it's going to be.*

*It's tough to implement. You can't police everybody's management of their lawn. It's just impractical. You could do it educationally by encouraging them to use best management practices with fertilizer.*

*That's about as far as you can go so I think compliance would be somewhat limited but you have to try.*

*You're talking about a huge number of people. Some people who care, some people who don't care at all, and some that say if you tell me to do it I'm not going to do it. It would be impossible.*

*I guess the question is how much do you invest in this for what you get out of it? So like the stuff about where people and school kids and so forth are encouraged to turn off the water while they're brushing their teeth or that kind of stuff. Water conservation.*

*Again that's the same sort of issue but what we find is that with a little bit of investment yeah neither of these could change what they do but you get enough of a change of behavior that it makes a difference. It's a positive. So if you were putting everything into this you wouldn't get enough behavioral change but maybe putting some in gets enough behavioral change that makes an improvement.*

*I don't see the police writing any tickets down there but a lot of neighborhood associations have put up signs encouraging people to deal with the pet litter and I think that's been effective to some degree but not completely.*

*You may still have issues with fertilizer use on lawns and so that would be something that would have to be addressed, possibly in homeowner association rules.*

*Well if they went to the fertilizer companies then we could come up with better ways to… As long as it allowed people to do with their own property what they wanted to do, it may not be an issue. I haven't seen that yet.*

*The government has no real right now to tell people that they have to remove their sump pumps. They have no right to tell people they can't use that fertilizer. They don't have the right to tell them to use paper bags. So I mean you know they have no right.*

*I don't know how you are going to tell Mr. Homeowner he can't put fertilizer on his grass. I would like to see that.*

*I'm really serious about that issue because I think they've overblown the whole thing so everybody has super green yards and mow it every five days.*

*Now all of these lawn care and fertilizer companies have all these systems. It used to be you'd fertilize your yard in the spring and then it got to be well now you've got to do it in the fall so it has something to munch on during the winter and then they have the four seasons bag and now they have a five seasons. I mean are they reducing the amount of fertilizer in order to sell it more often or are they increasing the overall amount of fertilizer applied?*

*What about the golf courses?*

*It gets the urban areas to participate in a solution.*

*No money to really implement those types of strategies in urban areas.*

*It's expensive.*

*It could be economical.*

### 4.3.2 Stakeholder Feedback on Urban Structural Controls –Reduce Runoff

Stakeholders in the Floyds Fork Watershed see the advantages to water quality stemming from such strategies. The benefits of reducing erosion in channels by reducing peak runoff flows through such Best Management Practices (BMPs) is evident to the stakeholders. Furthermore, it is understood that reducing the quantity of runoff also can help reduce the quantity of pollutant loads. As mentioned previously, some stakeholders see an advantage to combining nutrient management with stormwater management. Other advantages that have been pointed out are that many of these BMPs can be made with improved urban aesthetics and in some cases be incorporated with a new park or recreation system. BMPs such as permeable pavers not only reduce stormwater runoff, they also help recharge groundwater systems.

The cost of BMPs is often a challenge and some of these runoff controls are seen as expensive by stakeholders in the watershed, in particular detention basins and other larger scale construction projects. As a result, it can be a challenge to secure funds for such projects. Also, some stakeholders are not enthusiastic about strategies which may target runoff but not have a treatment aspect or target a reduction at the source of nutrient pollution. A significant challenge with some of the storm runoff reducing BMPs is that of maintenance and responsibility. Some stakeholders do not feel like the benefit of a BMP like permeable pavements are worth the maintenance responsibility they create. Some stakeholders see these higher maintenance BMPs

as a factor which will increase the cost of development, and even increase the risk of the failure of a development.

Some comments collected from stakeholder input regarding reducing runoff in an urban area are listed below.

*Potential benefit: it's what I think of as a co-benefits strategy a strategy that can address multiple interconnected issues or problems. Nutrient runoff isn't the only issue that the watershed faces so that involves reduced runoff of nutrients from urban landscapes and that means therefore reduced loading of the nutrients in the surface waters like Floyds Fork. But also just reduced quantity and velocity of runoff that leads to reduced erosion, sediment loading, soil loss, entry of other pollutants into the waters, reduced flash flooding, greener landscapes, air quality benefits, temperature benefits, aesthetics, psychological, biodiversity, and community building.*

*Benefits people just, you know, the ultimate environment will be greener in lots of different ways and it will, you know, have those kinds of benefits. In terms of problems; cost and participation, particularly in retrofitting existing urban development. Much easier to put green practices into new development but there is not enough benefit from just doing a new development. Existing development has to be retrofitted and so certainly that can be done in public areas, you know, on public rights of way along streets and roads. But how do you get private property owners, residential landowners, and commercial/business owners to participate? Some of that may involve incentives, education, access to some of these retrofitting techniques, so for example how readily do people know they have permeable pavement options, where to go to get that, how much it costs, and all that kind of stuff. How to encourage people to participate?*

*Reduce Runoff: Any time that you can stop or reduce sedimentation because that's probably, along with nutrients, one of the biggest problems we have as it relates to our streams. It is very, very beneficial. That is a significant problem especially with our fisheries.*

*The sedimentation in streams. Any time you can slow that, that's a good thing.*

*We deal with these structures all of the time and they are pretty effective. Especially on a regional scale you can get folks in an area to try to put in a structure that is big enough to detain water on a bigger area. They are very effective on flood control and keeping water out of people's basements and those kinds of things. I am more comfortable with the detention basins than I am some of the other structures.*

*There again keeping the chemicals and fertilizers out of the streams. I know they are doing some things out in Oldham County with some of this permeable concrete and that seems to be doing that and you all showed some detention basins a while ago that do the same thing, that capture that and then let it out slowly and filter it out through different types of plants and those kind of things.*

*I think developers would be opposed to detention structures. There're two things: the structural cost of building this detention pond, etc., adding to their development cost, and then they lose lots out of the deal, which is their bottom line. There will be a lot of resistance there.*

*One of the things that would be interesting with this strategy is whether there would be enough locations that it would be worthwhile using public lands. Areas where you are not imposing this on the private land owner or the developer but instead you are using public lands strategically.*

*Trash can accumulate in these basins.*

*We have tried to avoid building facilities which have permanent pools. You can use them for recreation and that sort of thing too without a pool there. Then there's very little maintenance associated.*

*The problem is they are usually constructed wrong. Trying to put a fish or something in it, it comes back to the aquatic plant issue and the aesthetic issue.*

*Maintenance is a big issue. When you got these plants that they put in there a lot of times you know you'll get Johnson grass, you'll get other weeds in there that get out of hand if they don't keep them somewhat trimmed back and whatever.*

*Then it's also some of these more permeable type of structures you know they're not as smooth, they're a little harder to navigate you know you end up falling or turning your ankle and if you're say in a wheelchair or don't walk real well there can be some dangers there with those structures.*

*Increasing groundwater recharge where the soils are appropriate, increased plant habitat diversity, can increase water quality through increased filtering.*

*Problems are the expense to build new things like this, the systems and infrastructure. The public acceptance of change.*

*Management and experience with these systems. Need to know if it's operating properly or successfully and what to do if there is a breakdown.*

*It's small ball for the Floyds Fork watershed.*

*We simply don't have that much impermeable surfaces at this point in time so there are other methods with greater effect.*

*Also one utility put in a test permeable pavement strip in front of their office building. They now are not recommending that solution. They found they've got to be vacuumed and maintained and so forth to keep it open. And so that is real problematic to date. We haven't figured it out yet.*

*There can be significant management and maintenance issues associated with detention basins or bioswales.*

*Some utilities will build it and then you drain it and maintain it periodically then dig it out. However, the way we develop residential communities for example we do it right going in and we don't have to redo it currently.*

*Structural runoff controls work but they do need continued large amounts of maintenance.*

*Even Wal-Mart is starting to think it's (grass roof) is a good idea because they don't have to give up two acres of their land or a parking lot. So they can capture the water on the roof and let it evaporate verses kind of containing it in a hole.*

*Permeable pavers are very expensive.*

*I'm not against it, it's just you know some of that permeable pavement the ones with the grass that grows between it. They did that whole thing down on the waterfront where they had the mat down there that supposed to grow up so they drive on it. If you don't manage it right the grass dies.*

*I mean people like the nice clean driveway. They don't want to see weeds in their driveway. Another thing that came to mind on that and that's probably with everything we're talking about here is the cost to implement.*

*A detention basin in itself may not actually remove nutrients.*

*I mean it gets back to whether detention really treats and to be more effective it would need more land. You know the more effective it needs to be the more land it needs.*

### 4.3.3 Stakeholder Feedback on Urban Structural Controls –Treat Runoff

Stakeholders in the Floyds Fork Watershed see that these strategies can benefit water quality in an urban area. Stakeholders view as an advantage the opportunity to combine nutrient management and stormwater management, and to combine pollution control and erosion control. Stakeholders generally view the increased aesthetics in urban areas due to BMP vegetation and landscaping as a definite advantage. Lastly, many of these BMPs make the task of water quality monitoring easier by controlling the outlet points instead of having a diffuse sheet of runoff from the urban watershed.

The concern stakeholders have regarding urban structural controls is who is going to pay for them. Stakeholders feel that cities do not often have extra funds for these projects; however, there may be available grants for implementing these BMPs. A bigger concern after implementation is that of maintenance. The challenge will become who will be responsible for the work and cost of maintenance. Private entities owning properties or city government may or may not be able to accept the maintenance responsibility. Another significant challenge for BMP structures in urban areas is the challenge of retrofitting existing development or infrastructure. The retrofit could raise difficult design and cost challenges. If the retrofit is desired for private properties, effective incentives may need to be enacted. Even among environmental stakeholder groups, there is some mixed feelings regarding basins, whether they are retention, detention, or other kinds of constructions such as wetlands. The feeling is that these structures require a lot of bulldozing, earthwork, and construction. These activities are seen as a disturbance of the land and unnatural. Some stakeholders feel like the land, especially the tributaries, should be kept in as natural of a state as possible. Some stakeholders see the challenge that these BMPs, especially water bodies, require land, and that that land may not be available in urban areas. Lastly, there is concern regarding safety issues that arise over having larger water bodies, whether they will pose a health or drowning risk .

Some specific comments collected from stakeholder input regarding treating runoff in an urban area are listed below.

*Retention basins: Dealing with a lot of landowners that call in about having a retention pond there's some I guess negatives dealing with these ponds, especially when you've got it in a subdivision. They build those retention ponds but people try to use them as ponds but also since a lot of these are just retention ponds they have a tendency to grow a lot of aquatic plants and stuff like that which becomes a perceived problem for a landowner and there's some cost issues.*

*Wetlands: Maintenance would also be a problem but at the same token it is a very effective tool. They're using this some in Lexington and I have seen, I haven't been onsite, but I have seen some studies and pictures of it. Some of these wetlands can really be effective.*

*Wetlands: If one has protected turtle or bird lands in your wetland you got a whole other can of worms. You've got to deal with that first. It doesn't matter what you originally had planned.*

*There again keeping the chemicals and fertilizers out of the streams. I know they are doing some things out in Oldham County with some of this permeable concrete and that capture water and then let it out slowly and filter it out through different types of plants and those kind of things.*

*We don't need that much concrete out here.*

*We would be better off protecting and keeping our tributaries where they are, as they are, and building in the other spots.*

*There's been I guess proposals on some of the roadways that instead of letting water flow directly into the creek that you go through some type of retention area or wetlands and then filtered into the creek.*

*They continue to treat the nutrients which is positive and what it is supposed to do. The system works on an ongoing basis presuming it's engineered properly. But as far as some of the challenges, we've looked at and talked about bioswales and things like that to try to figure out how to meet some of the requirements. The same is true with basins. You are never done with it. It's not like the hard surface.*

*Because they (green infrastructure implementation at local park) are so relatively new I think the jury is still out, especially like the bioretention basins to see whether they continue to function they way they are supposed to.*

*There have been some examples of trading this area of wetlands to private companies who have arisen that have bought land that was well suited for wetlands and had little other economic value to it and then they sell shares in that to someone who is going to be filling a wetland as part of their development. It's usually a good solution to it.*

*More beneficial to vegetation with increased runoff exposure time allows some of the nutrient uptake and it can maybe reduce wastewater treatment expenditures. We have significantly lost wetlands across the nation whether here or elsewhere, you know wetlands are very much a benefit because that's nature doing what it is supposed to do.*

*Again I just think the multiple benefits, especially if it's wetlands, I mean I am more enthusiastic for wetlands than detention basins. We've lost a lot of our wetlands in Kentucky. Definitely there are maintenance issues and issues with constructing them well but there are lots of benefits that wetlands provide.*

*It's like any bridge runoff problem. You've got your bridge runoff in all directions toward the creek. It just dumps right into it with all the salt and all the oil.*

*It should be run off into a basin to be cleaned up before it goes into the creek.*

*Some of the potential problems are the cost issue in implementing this over just putting a layer of asphalt down over the top of the existing streets. It may reduce the road widths, maybe even sidewalk space. Our seasonal issues like salt applications that may kill the plants and then what do you do?*

*So that's something that could be done after an area is developed, say in individual lots where the homeowner is required not to mow up to so many feet from the tributary?*
*If you do the conservation design in a development you can actually put down a permanent easement on a riparian buffer and that way it's written into the plats and so whenever somebody buys that lot and they have part of that easement on their lot, they cannot then impact that easement.*

*Yeah, if you can engage those landowners and educate them on the value of it, you could get a 50' buffer. Maybe 100' is ideal but maybe you get 50'.*

*You would think that most people that have bought along the tributary that they would be interested in maintaining it.*

*A wetland takes up land that you know cannot be used for other uses which would make it pretty tough to do in a very heavily urban area. Although, it could be put in an area where the land can't be used anyway.*

*And there is an issue of safety with the water body. The attractive nuisance issue.*

*From what we gather these sifting and settling basins and bioswales and things probably have to be massaged every few years to work. Even when they work perfectly we've been told water after a big rain might sit in there for two days before it sifts out. You know those homeowners are not going to understand water standing for 48 hours. Three days maybe.*

*Maintenance and also by the very definition when they work perfectly water sits in there a couple of days I've been told.*

*We went back two years later. It is so overgrown and ugly you wouldn't believe it. We would get ran out of our subdivisions.*

*I am not sure all of the agencies talk to each other. They all talk to us but not at the same time. So we have, it is green to slow the water down so they want us to slow the water down. So make the ditches and the swales to be shallower and get them at a tougher percent. But you know, the health department doesn't like it if there is any standing water of any kind. You know. This might have West Nile and so it's almost like you are going to lose either way. I just want everybody to talk to each other. We have the people, and you are going to get them in groups, you know give us eight foot wide sidewalks. Well that's not very green and certainly it just doesn't make any sense.*

*If you are sticking your neck out to develop 300 acres you better be real sure it is going to work.*

*We haven't worked out with our utility the right kind of way we are going to continue maintaining it for perpetuity. Because homeowners are not equipped for that at all.*

*I think that's important. If somebody invests a half million dollars for a house they are not going to want to see a bunch of weeds out there.*

*It concentrates pollutants in one place. Detention doesn't, we're not sure that detention really does treat nutrients. A detention basin. Maybe the wetland part.*

*Mosquitoes and stuff. If it's not a natural wetland it could be real mosquito laden right?*

*Urban Management Structural Controls: Just the cost associated with it. It's very expensive to go back and retrofit. New development should pass laws that require green treatments.*

*Green Infrastructure -Actually provides incentives and those incentives seem to be paid more attention with development. As much development as there is in the Floyds Fork watershed, it might kind of be a good place to be implemented when we've got so much development going on, and there's really an incentive based improvement in residential development.*

*Green Infrastructure: we need credits for things like that where it has to be maintained.*
*Retention Basin: Ours failed in our subdivision. A big rain came and flooded several homes. As a result the homes became detention basins. Just ran through a supplemental system.*

*Urban Structural Controls: So you know it might be something that is ahead of its time or whatever. But if you build it and they can't sell it, you know then you've got an eyesore there that somebody's got to take care of and whatever.*

*Wetlands: Probably what it boils down to is cost and then space. I would assume that if you fill it with vegetation of other kinds of enclosing turf then the volume has to increase by some proportion.*

## 4.4 POLICY STRATEGIES

Policy strategies include, but are not limited to, landuse planning and pollution trading.

### 4.4.1 Stakeholder Feedback on Land Use Planning

Policy management strategies employ regulations or incentives to cause or promote practices within the watershed which restore and protect water quality. Policy strategies can be very powerful strategies with far reaching impacts. Land use planning represents one type of a policy strategy. Two examples of landuse planning include the use of conservation subdivisions or development review overlays. Specific comments on the use of landuse planning to manage nutrients included:

*We've had areas where like if the slope is steeper than a certain percent then you can't build there. In some cases that is a good idea or you can reduce it and do a conservation subdivision. At least it is a solution to the need for residential development in cases of rough terrain and natural resources.*

*Well if we did it this way we took all of the features that were the tree canopy, the streams, and the area down there that says 100 year flood line. All of the sensitive features it preserved them. It put the roads up there on top of the ridges and then it makes more sense absolutely none of those lots back up to another lot. So there is more open space provided that you could get the same yield as you could if other conservation regulations allow for that to happen. You know, it makes perfect sense. It should be more attractive to home buyers. There ought to be less runoff from stormwater because there is less impervious surface. I don't know about marketing. We*

*think marketing would be a plus but we actually have that in the negative column too because it is new. It would be something that the public is going to have to understand and see the value in.*

*My guess is that it would be more costly. This would be more costly in the development part. I think it would be because it would seem to me that there would be way more road and you are more spread out with the infrastructure.*

*Overall that it probably is still the right thing to do.*

*He said something very important about the marketing side of this. Because while you might get your density, invariably you are going to have smaller lots.*

*The public has got to accept that. Now they have shown a willingness to accept that in certain locations.*

*It is a matter of selling the package. There is a park system, roads… That's the big news.*

*But I do think it has a negative impact on prices. Negative meaning prices could go up in the cost of developing that.*

*I mean most of those don't even have houses on both sides of the street.*
*The detail of this was interesting and public works didn't like it. It still allows you guys to even build a one way street. If you had a ridge, it is small but you can do a one way street and you don't have to do curbs and guttering. You don't have to repave sidewalks. Literally there is a lot of flexibility then you can get for your units.*

*But it is tough to build streets that have lots on just one side. It is really tough to build a lot of roadway with no homes.*

*But it is a good use of certain pieces of ground that have natural resources that deserve protecting.*

*It is better utilization of land which normally would not be suitable for tract development.*

*Potential challenges- One would be cost. The second would be to truly protect the creek. That looks better maybe than our other highly concentrated subdivisions but we could still do damage to the creek. So it would have to be a major factor in designing it.*

*You know, conservation subdivision doesn't mean conservation necessarily. It means all the catchwords of new urbanism comes to development and it's things that burden them in so many ways.*

*The conservation subdivision is being used to push development and conservation is not the way it actually happens.*

*It puts, I have a personal case, where it is going to put that very intense development right next to my property.*

*We want a rural conservation subdivision and we'd all be for that.*

*A lot of the conservation design subdivisions can cost more so a developer will ask more per house.*

*So it ends up pricing out a lot of average Americans I guess. So average citizens around here may not ultimately be able to afford houses in this kind of design but it can be made to work.*

*And then the lower density. I always think in terms of sustainability. Whole system sustainability and so the lower density of this and kind of how it's sprawled out in different areas, ultimately it depends more on the automobile. So in terms of the future, I know we are trying to solve a nutrient issue but this may result in more long term issues outside of just the nutrients, you know as more paving. Those are other things, potential problems outside of just nutrients.*

*There are certainly benefits from them in terms of pollution control, aesthetics, and all those sorts of things but if you're developing residential housing your cost per unit is going to go up.*

*Hot topic but then the development people not only talked about selling them but once you establish these green areas, who's going to maintain it and who's going to get to use it over who else and they had people come to fist fights over park spaces and this kind of stuff.*

*I think a lot of the problem is too much development, you know the over development, and we need to be controlling that. The development comes before the problems are solved. It's all about money. But you also have problems.*
*I think it represents smart planning. This is going to be the wave of the future and I actually see that in my own mind it going forward all of the way down this watershed. All of the way down 21st Century Park. These are the kind of developments that will be on both sides of it hopefully.*

*I would like to see some way that the default zoning process was tied in to the water quality issue. In other words, right now we have what I consider an unacceptable default zone of 4.5 lots per acre. The default zoning doesn't really come into play in the process of land development right now because of the unavailability of sewers, but say sewers become available and then obviously high density housing comes in and you end up with all of the issues of an intensely developed watershed.*

*I think that the process needs to be a bit more protective in the watershed.*

*We need better zoning that is related maybe to the contour of the lands and to the tributaries and to the areas that really shouldn't be the same in respect to zones. But zoning really needs to be looked at as a mechanism.*

*So it can lead to possibly some increased involvement. We get a lot of people because we've got certain programs that we do where you get a lot of people calling in, especially when you start throwing money out there.*

*Urban surface boundary doesn't mean zero growth it means restraining it. Lexington is a great example of that. It squirts out every so often.*

*Potential benefits of this strategy I underlined potential because I think that's a very significant word. I said that it can prevent impacts to sensitive areas and as a result it could end up putting land into preservation permanently, potentially, and that could be ecologically important or historically important land. It also offers, I think, opportunities for integrating other strategies like green infrastructure or general land use or I guess behavioral things such as no mow zones*

*in residential areas. I think it offers adaptability when you preserve a significant amount of land you have adaptability and diversity both in terms of having maybe forest land, residential land, and open space. Then in the future if by chance you need that land for something and the community comes to a consensus and says we need to use this land for something else, it is available.*

*Potential problems with this strategy, even though you are preserving certain areas you are consuming more collective land potentially and maybe having lower density. That can mess with the cumulative amount of the watershed that is developed ultimately.*

*If it works and that meets the aesthetic requirements because in this community people have an expectation of what they want to see when they come into a new community*

*Is there anything like just increasing urban tree canopy that is generally accepted or could be generally accepted?*

### 4.4.2 Stakeholder Feedback on Pollution Trading

Pollution trading is also viewed poorly by some in the environmental community who see it as a shift of responsibility, and would rather see all members of the community doing their part to improve water quality in the watershed. Some stakeholders see many challenges with pollution trading. Getting public and private entities to work together may be a challenge. They believe that pollution trading may have unintended consequences, and at best it would not solve anything. Some stakeholders feel that this strategy will only succeed at distracting attention and resources away from adopting real solutions. The development community is skeptical of this strategy because they are concerned that it may drive regulatory standards unrealistically low. Some members of the wastewater utility industry are also skeptical about how such a system could be efficiently managed, and other utilities feel like they would more likely be in a position to sell versus buy credits, thereby raising into question the overall thesis of the model.

General comments collected from stakeholder input regarding pollution trading issues are:

*It's a natural way to reduce nutrient load in the creeks. It provides some income to farmers without the risk of crop failure.*

*It could allow some nutrient sources not to make any or little effort to resolve their infrastructure and plant capacity inadequacy.*

*They're saying, "I can pay somebody else to implement."*

*I just really don't think that sounds ethical to me. Something's not right about it.*

*What the farmers are getting that's totally different things. It's apples and oranges. What the farmers are putting in and what they're putting in. It's not the same product.*

*So that could be way more poisonous you know*

*Yeah so I mean I just don't trust that.*

*Potentially good for farmers from an income side.*

*Well it could be a benefit for the farmer. Drought and all kinds of things and depending on where the farmer is in his life he might be willing to do that. If he's at the age of retirement or whatever*

*Some could take his whole farm land.*

*The concept sounds really good but I mean if it ends up that the standards of what can go in the stream are so tight then it forces everybody into a pollution trade.*

*It's just distasteful*

*Pollution is pollution.*

*In Floyds Fork the sources can't be compared. I believe that everybody needs to do the right thing.*

*It also gives it, I think a potential benefit is where you can get public and private entities working together.*

*But that can also be put under potential problems because there is always that potential for strife between public and private entities.*

*That was one of our potential problems for that strategy. Working with state government one of the problems we would see is that you've always got governmental bureaucracy. All the red tape that you have to go through to get money paid out and there's always that list of things that you have to go through. Again, working together and the cost. That could possibly be a problem. How is it funded? Who's paying the bill?*

*It's a potential source of income for farmers who are often struggling.*

*Then it's a potential cost savings to the buyers of those credits.*

*How it's designed would make a big difference. It seems like a beneficial idea in theory but a lot of times I think these kinds of pollution trading systems don't work and we just haven't seen a lot of good examples where they work very well. There's not enough of a market for them. It becomes a way to put money in people's pockets without necessarily getting the accompanying environmental benefits. It takes a lot of government participation to make it happen so I mean how to make the trading actually work like trading is supposed to is the challenge.*

*It has to be governmental entities step up to the plate and take charge of the management and that would be a bit challenging.*

*I think it just doesn't evolve independently and its economy wouldn't be sustained without a governmental entity coming in and orchestrating.*

*That's a cost to add additional government service, a cost to take on to make it work.*

*I see that there could be better participation because of that potential for benefits for either one, especially if you got monetary gain associated with it.*

*That's cap and trade and it's destroyed the state of California. This will be the first setup that actually pits farmers against industry and it's already destroyed the state of California with their pollution trading.*

*There's not been a successful cap and trading program since acid rain. Once the grant money ran out for carbon trading programs the organizers cashed out and it dissolved.*

*There's one thing I hadn't thought of and that's to have the industry go to the farmers and say you know we'll pay to put in BMPs to reduce your nutrient load. But what also is to stop them from saying, especially like this year a lot of farms were having a terrible year, I mean farmers were drowning, what's to stop that same industry from coming to this family and saying, "Hey, I'll give you $20,000 for part of your credits."? We're not talking about reduced nutrients, we're talking about selling off your rights. Would there be a mechanism to stop that? You know when somebody is looking to feed their family and they're debating about whether or not they're willing to do another year anyway.*

*The farmer wants to do those activities and doesn't want to be compensated by private businesses for it.*

*There are some policy mechanisms to help them out with that but beyond that though it's just like they said you're pitting farmers against industries and that will not, won't be a good scenario for long.*

*And again, are you getting cleaner water? They're paying you for them to dump more in it and then we're not letting it get in it anyway much.*

*It would raise the awareness for need. It's a really good PR story. It's a really good topic of discussion that does raise the profile of an issue. It would secondly alleviate the stress of facilities to reach a goal that might not be reachable.*

*Or if it is reachable in theory, it may not be efficiently reachable or attainable from a cost perspective or something like that. By reaching that goal they would spend an amount of money that could be used to do something else.*

*A potential problem is you know the eventual placing of players against each other without really improving water quality. Beyond that incentive for fraud.*

*If you try to make it anonymous or try to make it a relationship directly with the two individuals then the fraud could occur and not change water quality. Thirdly, creating a marketing scheme, creating a prize for something is really the first step in requiring the behavior or creating a fine for that. You know for not adhering to required behavior. So you know it could lead to an improper use of the tools.*

*That scares me more than anything that you've said.*

*The pollution credit traders and brokers would make lots of money and people would pay more taxes. Some people could feel good about solving the problem without really solving anything.*

*This solution is fraught with potential for unintended consequences. People would sell credits that they weren't going to use anyway and the buyers would do what they were going to do anyway. It would distract attention and resources from finding and adopting real solutions.*

# 5.0 FOCUS GROUP QUANTITATIVE RESULTS

## 5.1 BMP SCORING

After focus group participants were satisfied that they understood all 12 of the BMPs (see Table 5.1.1) and their implications, participants in each group were asked to score the BMP scenarios anonymously using an Audience Response System (ARS). A single criterion termed "preferability" was the metric used for evaluation. The scale used is a variation of a Likert system with a range from 1 (not acceptable) to 9 (acceptable). The results for each BMP were shown to the audience immediately after the scoring was completed for that BMP. Each scenario was presented and scored in turn until all had been evaluated. The composite results from seven focus groups meetings are shown in Figure 5.1.1.

**Table 5.1.1 Nutrient Management BMPs**

| BMP ID | Best Management Practice (BMP) Description |
|---|---|
| WFSS | Eliminate Failing Septic Systems |
| WSSO | Eliminate Sanitary Sewer Overflows |
| WR | Wastewater Regionalization |
| WTT | Improve Nutrient Treatment Technologies |
| ACF | Crop/Fertilizer Management |
| ARE | Runoff/Erosion Management |
| AAM | Animal/Manure Management |
| URL | Reducing Loadings (lawn fertilizer and pet litter) |
| URR | Reduce Runoff (green infrastructure) |
| UCR | Control Runoff (detention basins, urban wetlands) |
| PLP | Landuse Planning |
| PPT | Pollution Trading |

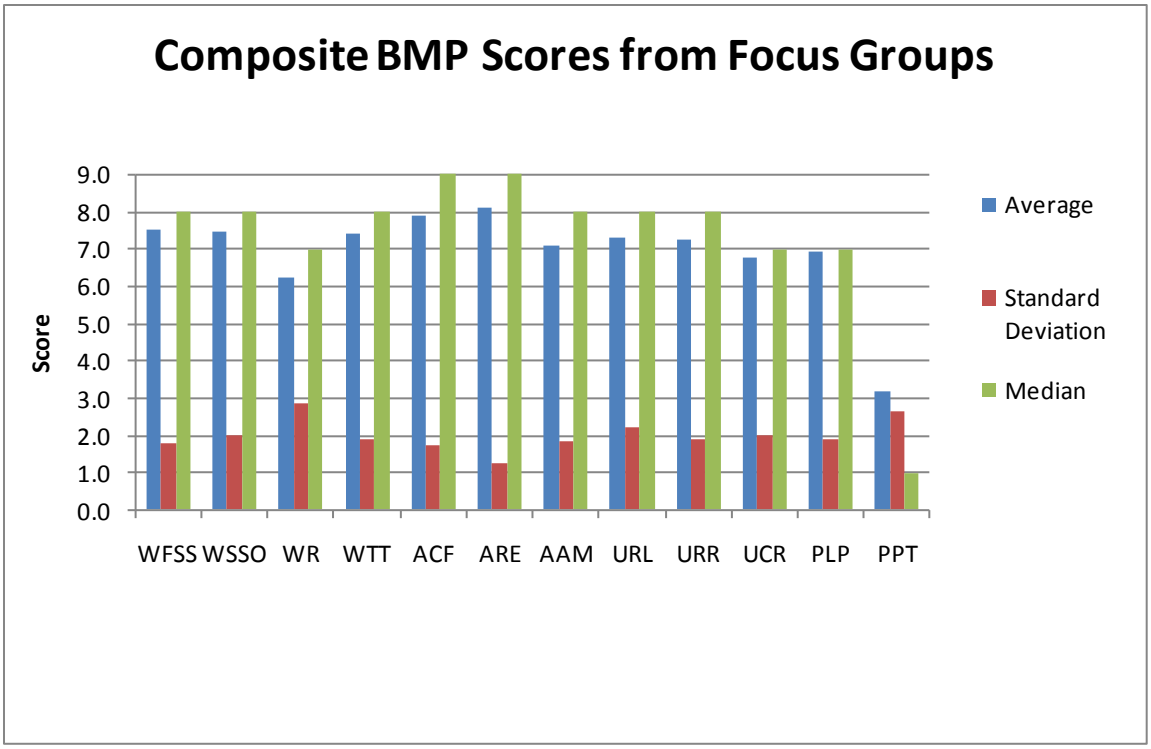



**Figure 5.1.1 Composite BMP Scores from all Focus Groups**
**(Score of 1 = not acceptable and a score of 9 = acceptable)**

## 5.2 FOCUS GROUP ARNSTEIN LADDER RESULTS ANALYSIS

Figure 5.2.1 represents the average Arnstein Ladder scores collected from the seven focus group meetings who evaluated best management practices for nutrient management in the Floyds Fork watershed. During the last ten years, Bailey and Grossardt (2010) have collected similar data from over 2000 public participants and professionals at public meetings and at professional conferences, including the Transportation Research Board, the American Planning Association, the Environmental Water Resources Institute, and dozens of smaller conferences involving planners, civil engineers, architects, bridge designers, and landscape architects (see Figure 5.2.3). The Floyds Fork results are consistent with that data, in that citizens agree that a) the desired level of public engagement is close to Level 6, defined as 'partnership' on the Arnstein ladder; and b) the actual level of public engagement experienced in the past is between 3 (Informing) and 4 (Placation) on the Arnstein ladder. While academics have quibbled over the exact meaning of each term on the Ladder, public citizens, over the past 10 years, have had no difficulty providing assessments of the quality of their experience, and where they would like that relationship to be (Bailey and Grossardt, 2010).

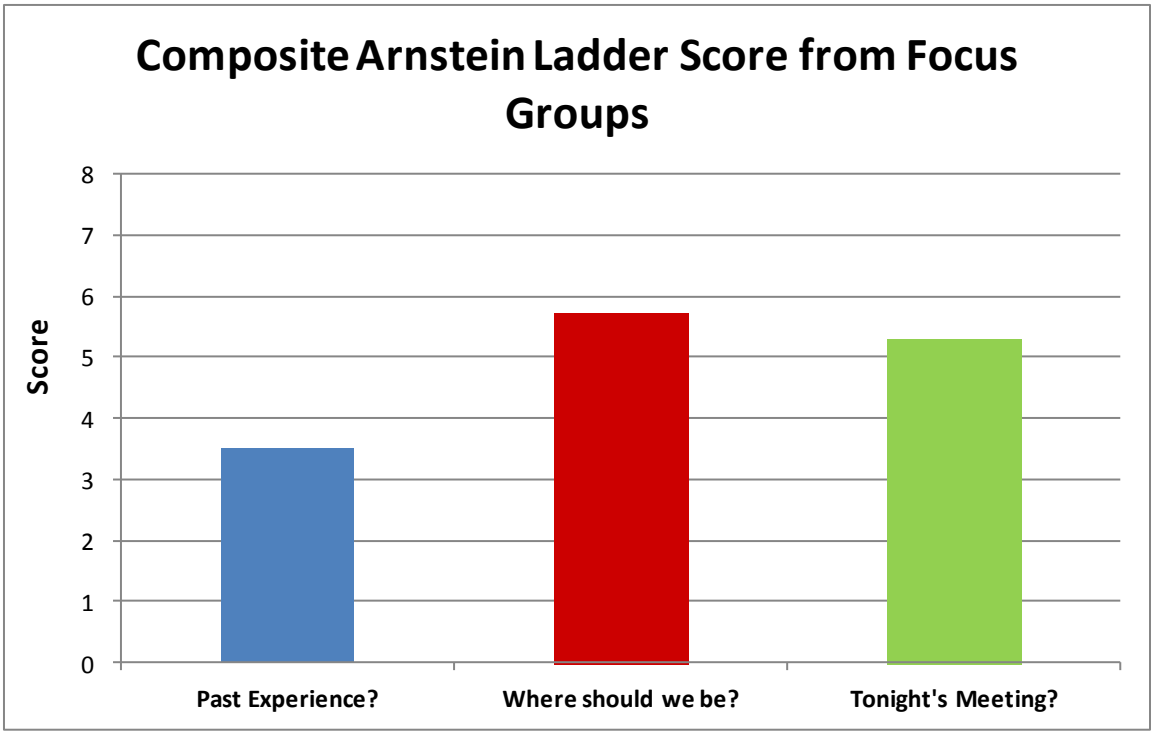



**Figure 5.2.1 Composite Arnstein Ladder Average Score from all Focus Groups**
Note: 1-Manipulation, 2 - Therapy, 3-Informing, 4-Placation, 5-Consultation, 6-Partnership, 7-Delegated Power, 8-Citizen Control

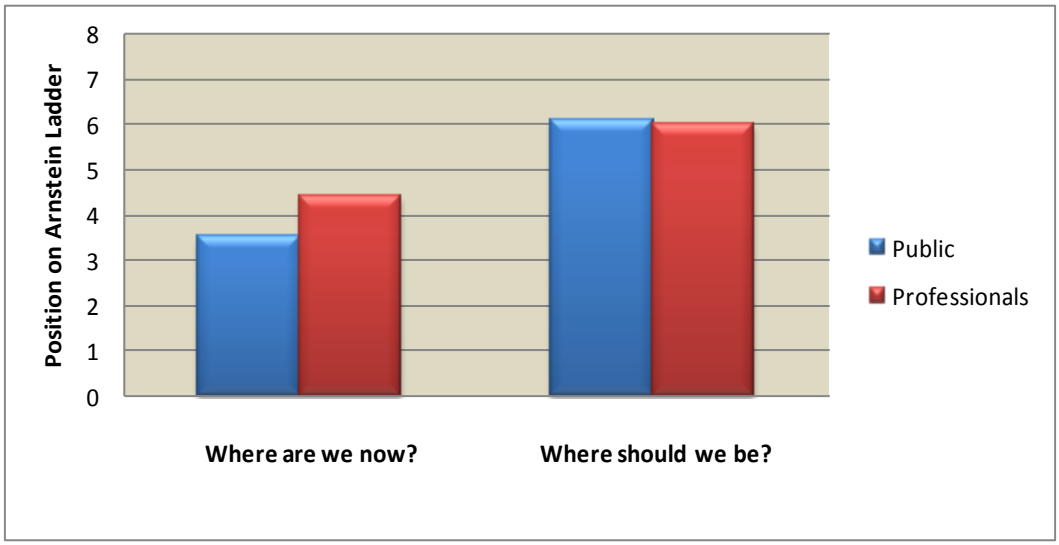



**Figure 5.2.2 Summary of Arnstein Results from Professionals and > 2000 Citizens (Bailey et al., 2010)**

Additional insights into the diversity of perspectives are evident when comparing scores across the Floyds Fork Focus Groups (see Figure 5.2.3). In general, the environmental and agricultural focus group had the lowest scores based on past experiences while the recreation group had the highest score. The preservation focus group had the highest expectation score followed by the residents and environmental focus groups, although nearly all groups had average scores between

5 and 6. In general, most focus groups felt that the stakeholder engagement process employed in this study met their expectations. The two groups that showed the widest variation in that area were the preservation and environmental focus groups.

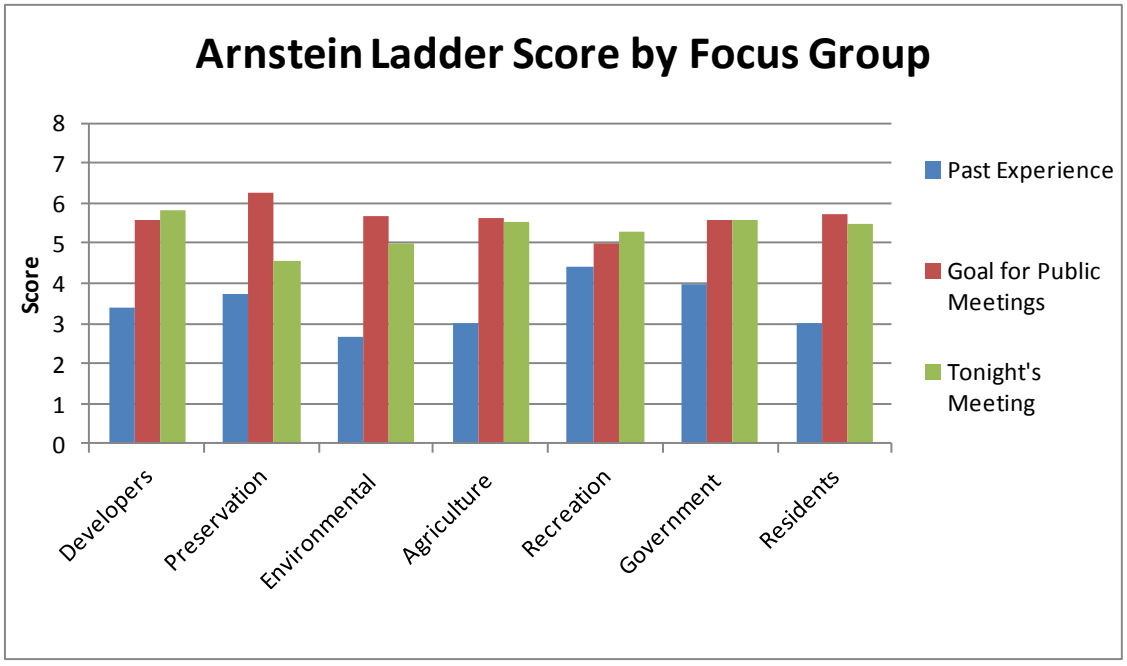



**Figure 5.2.3 Arnstein Ladder Average Score by each Focus Group**
Note: 1-Manipulation, 2 - Therapy, 3-Informing, 4-Placation, 5-Consultation, 6-Partnership, 7-Delegated Power, 8-Citizen Control

## 5.3 DETAILED FOCUS GROUP BMP SCORING RESULTS

The focus groups tested the extent to which the nutrient management scenarios were deemed acceptable for the Floyds Fork watershed. Participants were asked to provide their preference for each scenario for 'acceptability' for the watershed, where 1 = not acceptable and 9 = acceptable. Because focus groups were not intended to be a statistically significant sample of the population, their assessments and comments helped the team identify whether the alternative BMPs effectively generated differences in scores -- that is, whether these were the conditions that mattered to people. A simple evaluation of the average scores obtained from the focus group meetings (see Figure 5.1.1) may lead one to conclude that the community as a whole tends to accept most of the strategies fairly equally (with the exception of the pollution trading strategy.) However, a more thorough examination of each focus group's detailed scoring reveals a much more diverse set of opinions.

For example, development and government focus groups (which include public utilities) tended to favor wastewater strategies, while preservation and environmental focus groups tended to favor other strategies, including urban strategies, which were rated lower by the development group. It is perhaps not surprising that the development group and the preservation group tended to have different distributions of scores. Of particular interest was the fact that the environmental group and the agricultural focus group score distributions were very similar. Figures 5.3.1 – 5.3.7 show how each focus group scored the twelve nutrient management strategies on average.

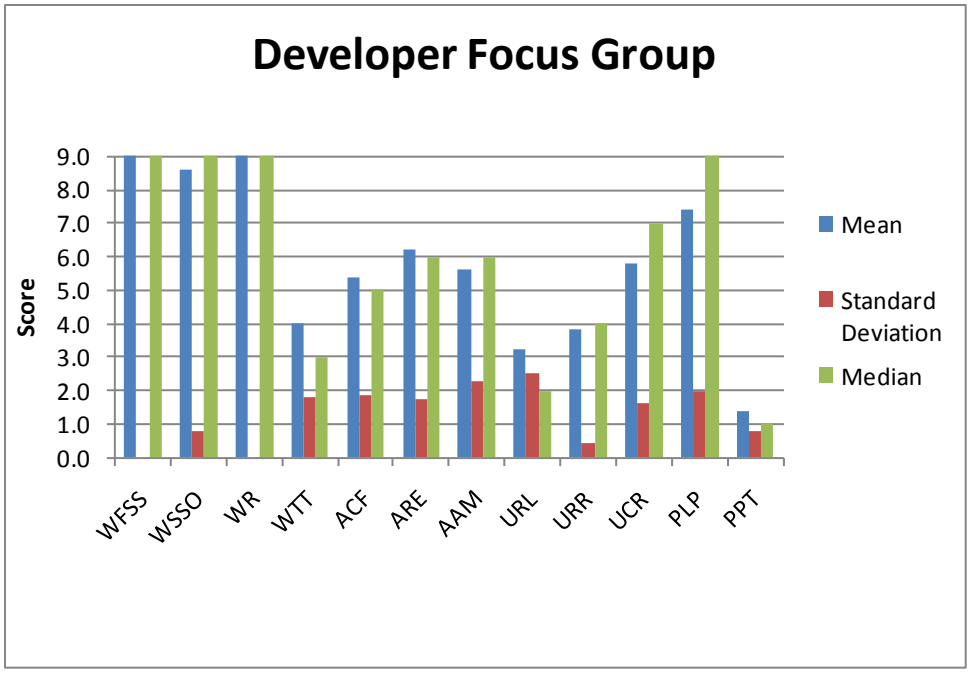



**Figure 5.3.1 Economic Development Focus Group BMP Scores**
**(Score of 1 = not acceptable and a score of 9 = acceptable)**

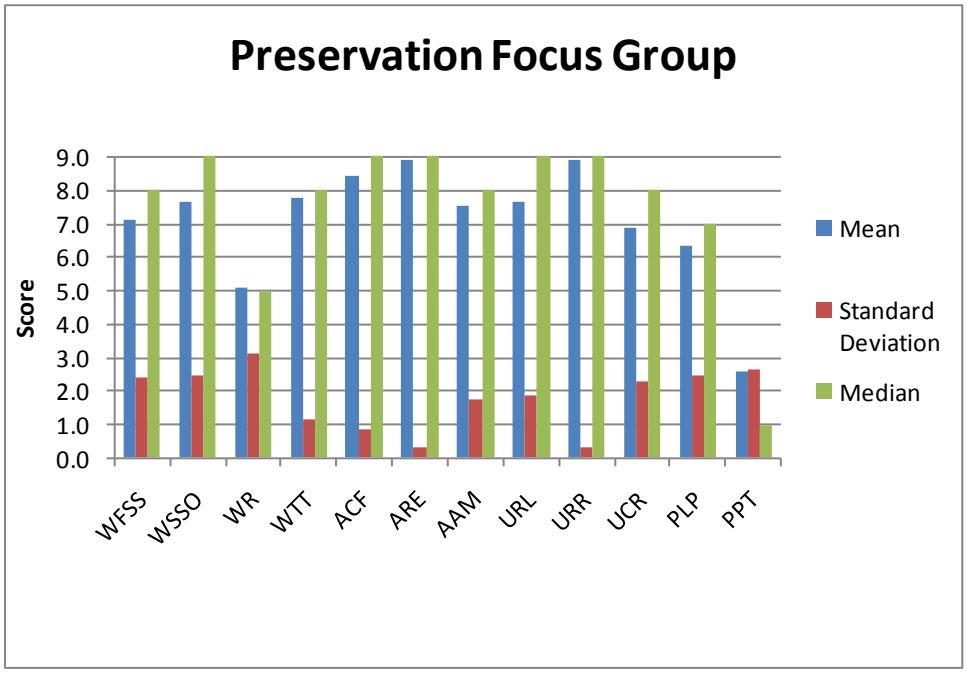



**Figure 5.3.2 Preservation Focus Group BMP Scores**
**(Score of 1 = not acceptable and a score of 9 = acceptable)**

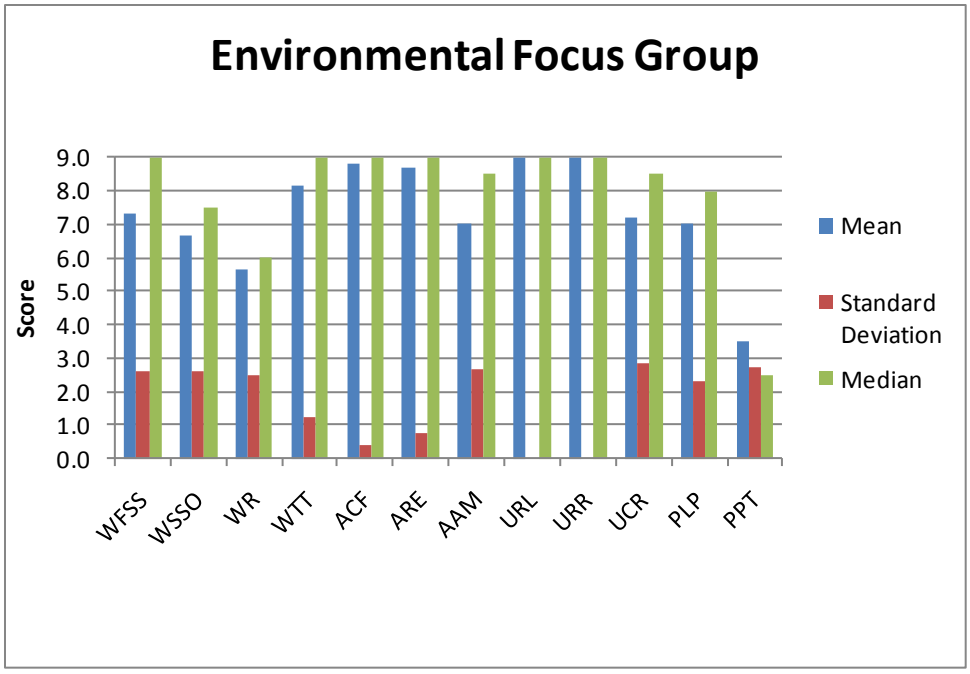



**Figure 5.3.3 Environmental Focus Group BMP Scores**
**(Score of 1 = not acceptable and a score of 9 = acceptable)**

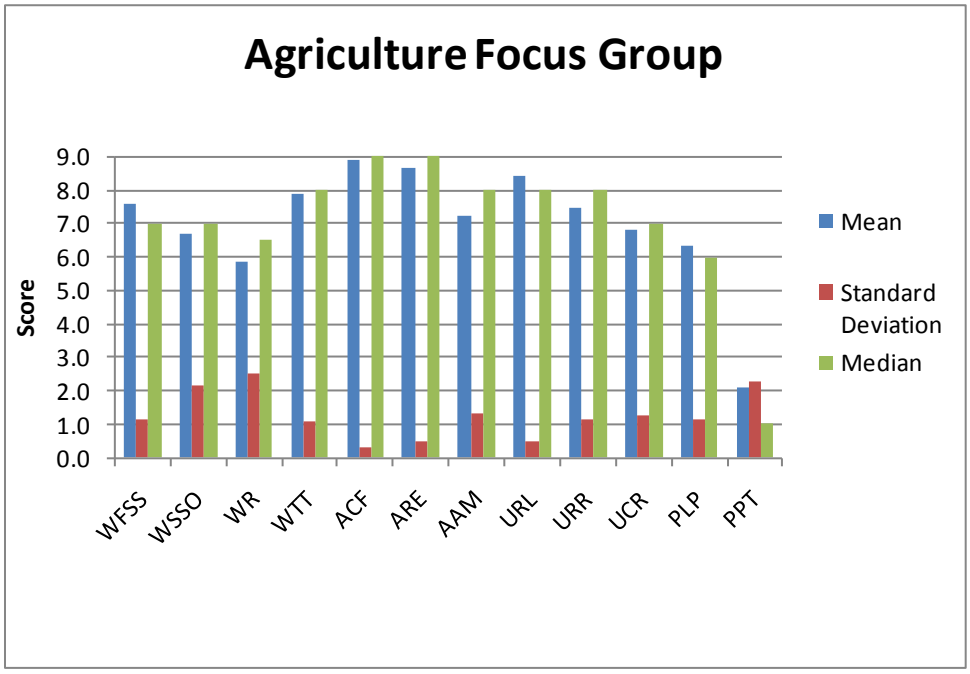



**Figure 5.3.4 Agricultural Focus Group BMP Scores**
**(Score of 1 = not acceptable and a score of 9 = acceptable)**

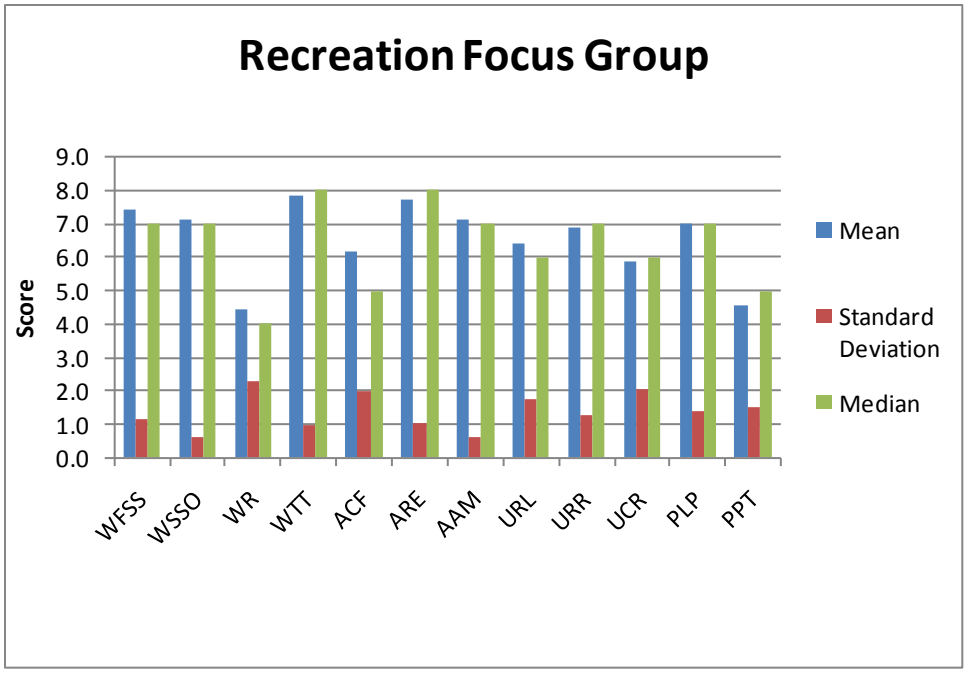



**Figure 5.3.5 Recreation Focus Group BMP Scores**
**(Score of 1 = not acceptable and a score of 9 = acceptable)**

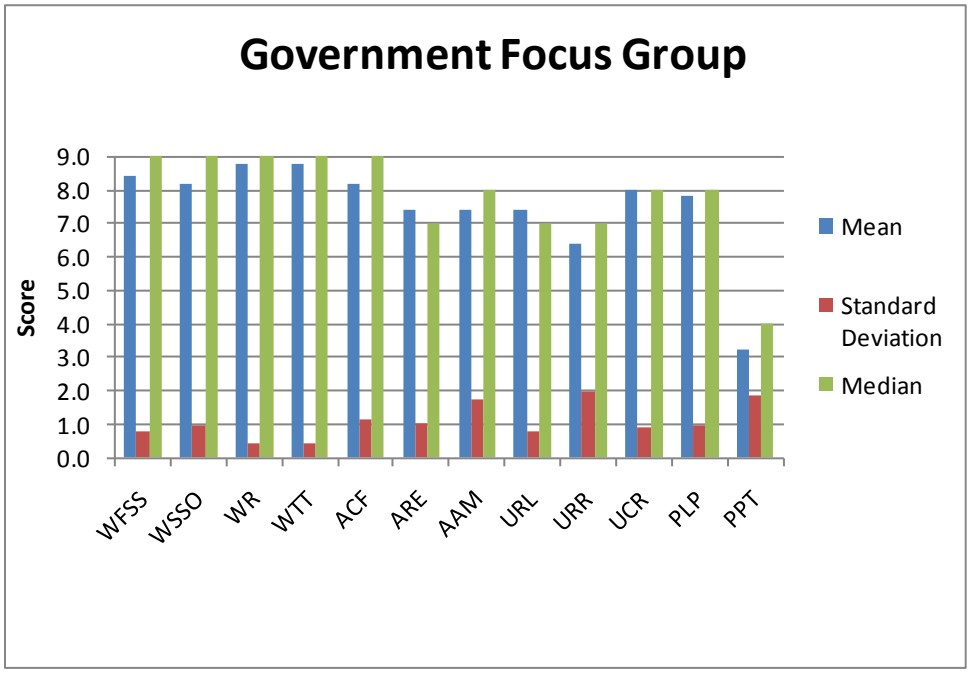



**Figure 5.3.6 Government Focus Group BMP Scores**
**(Score of 1 = not acceptable and a score of 9 = acceptable)**

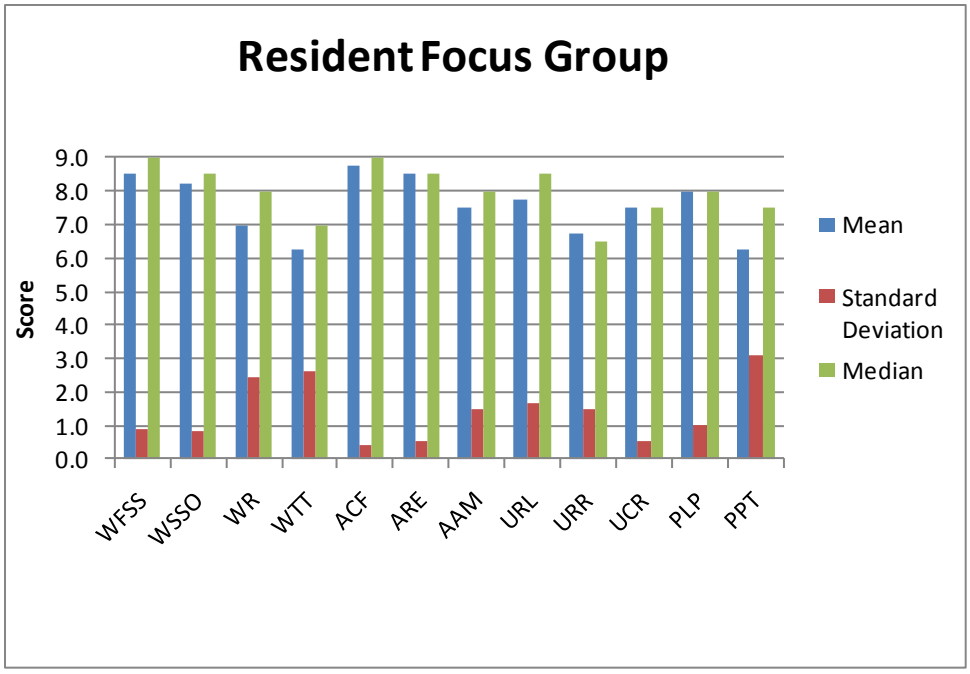



**Figure 5.3.7 Local Resident Focus Group BMP Scores**
**(Score of 1 = not acceptable and a score of 9 = acceptable)**

Chapter 4 discussed some reasons for the disparities across focus groups, which also were reflected by individuals within focus groups. It cannot be assumed that all the participants in a particular focus group shared the same preferences. These graphs represent only the average scores for each group and do not illustrate individual scores. Just as different focus groups had different distributions from the composite set of all the focus groups, so individuals within specific focus groups expressed different preferences from each other. However, some measure of the variability is reflected in the standard deviation of the scores as illustrated in each of the figures.

The variability of focus group preferences also can be explored through the scores from each focus group for the individual nutrient management strategies as shown in Figures 5.3.8 to 5.3.19 In general, the results show fairly uniform responses for most BMPs. Notable exceptions include wastewater regionalization which is more strongly supported by development and government focus groups. Conversely, the development focus group tended to score the rest of the BMPs, with the exception of landuse planning, lower than the other focus groups. All of the focus groups selected pollution trading as the least preferred of the 12 management strategies considered.

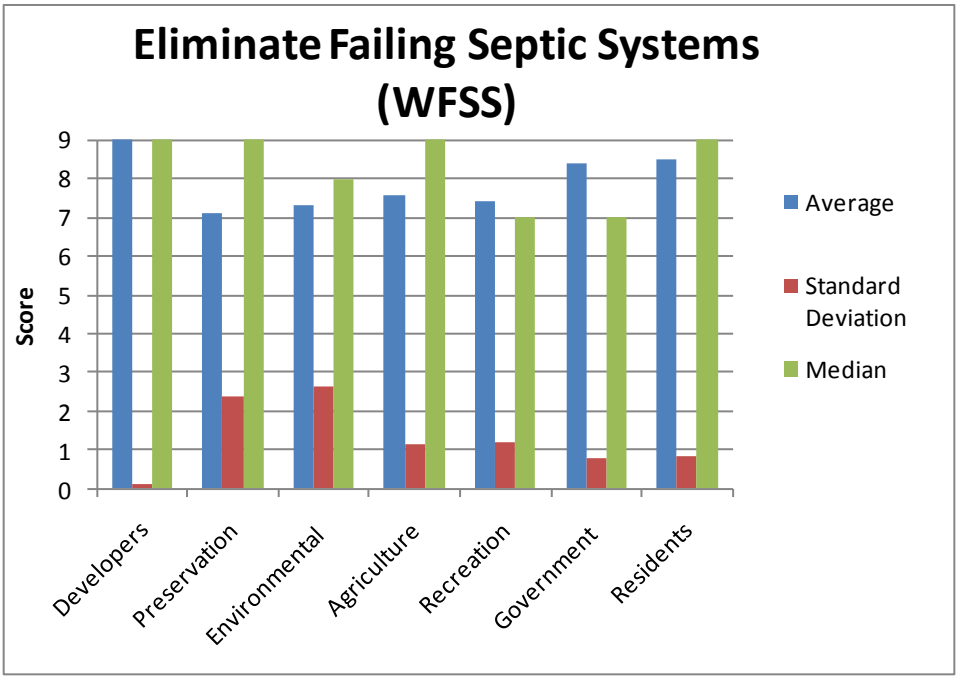



**Figure 5.3.8 Eliminate Failing Septic Systems Score by Focus Group**
**(Score of 1 = not acceptable and a score of 9 = acceptable)**

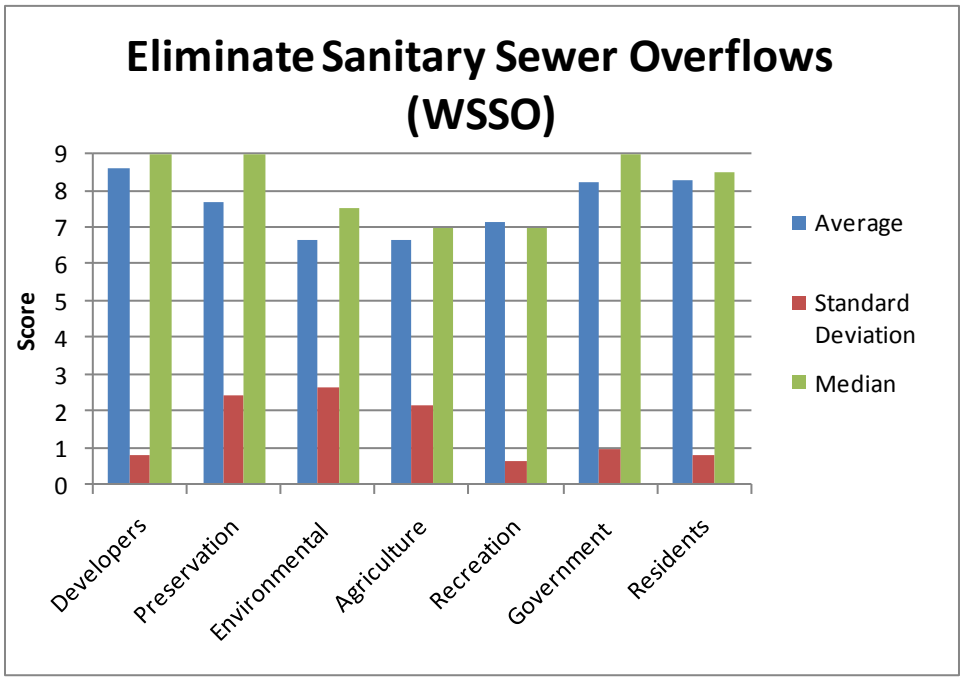



**Figure 5.3.9 Eliminate Sanitary Sewer Overflows Score by Focus Group**
**(Score of 1 = not acceptable and a score of 9 = acceptable)**

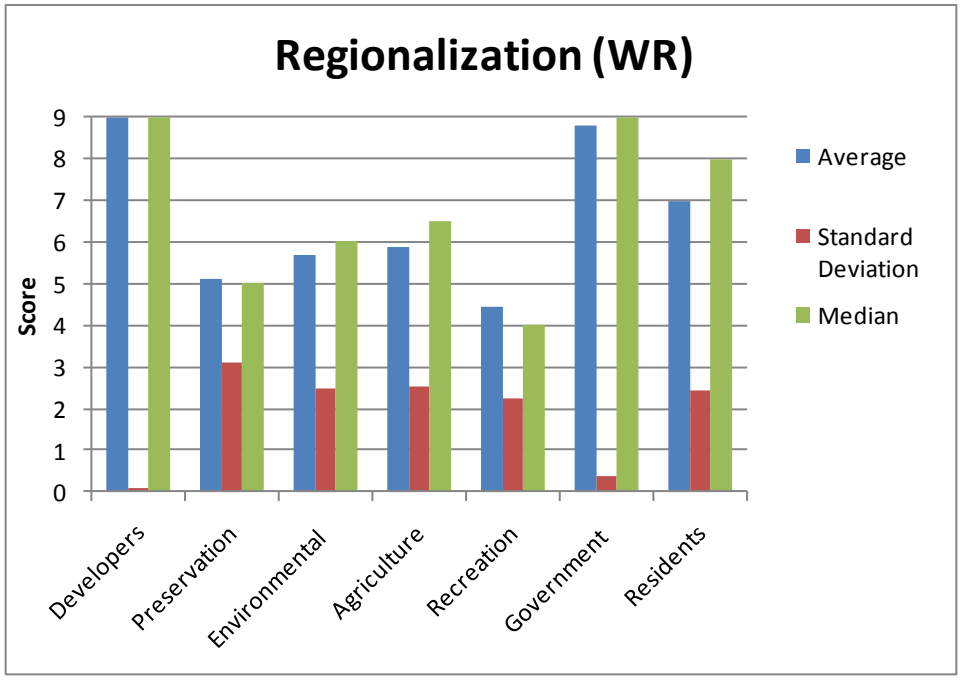



**Figure 5.3.10 Regionalization Score by Focus Group**
**(Score of 1 = not acceptable and a score of 9 = acceptable)**

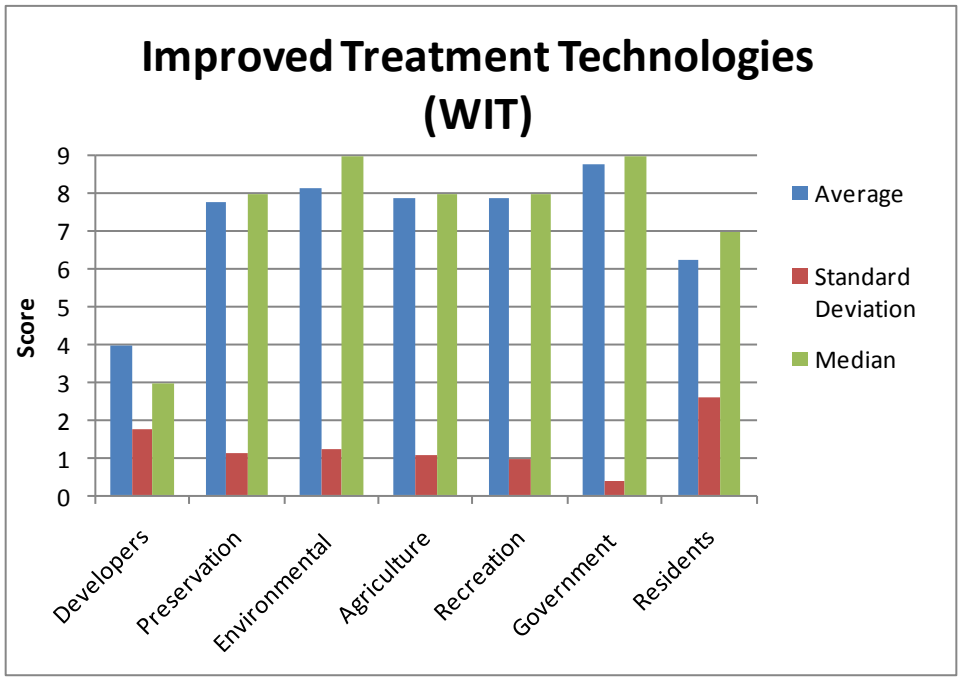



**Figure 5.3.11 Improved Treatment Technologies Score by Focus Group**
**(Score of 1 = not acceptable and a score of 9 = acceptable)**

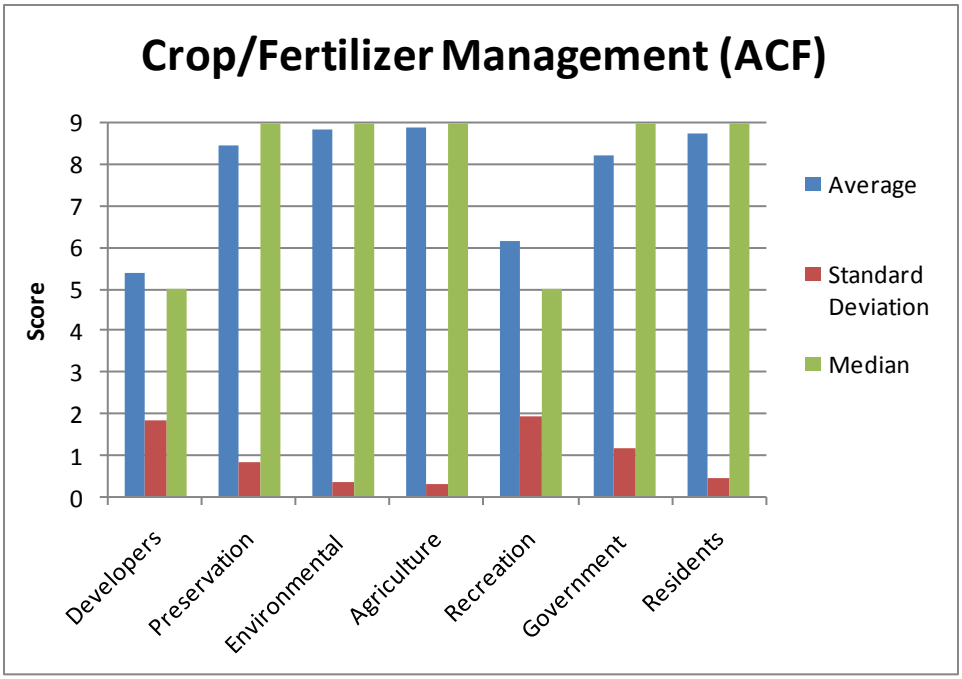



**Figure 5.3.12 Crop/Fertilizer Management Score by Focus Group**
**(Score of 1 = not acceptable and a score of 9 = acceptable)**

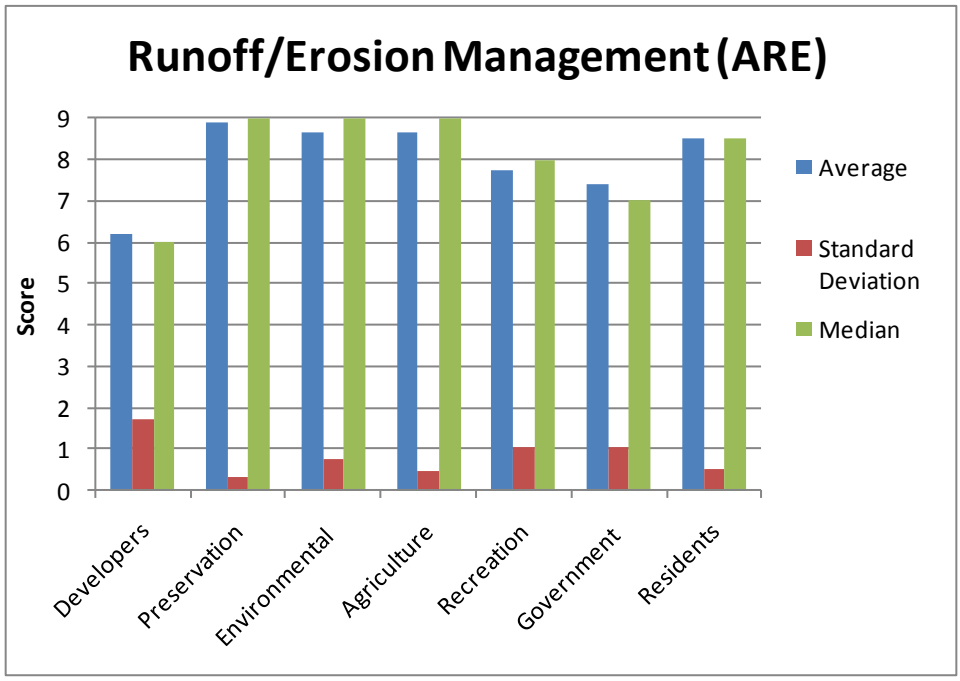



**Figure 5.3.13 Runoff/Erosion Management Score by Focus Group**
**(Score of 1 = not acceptable and a score of 9 = acceptable)**

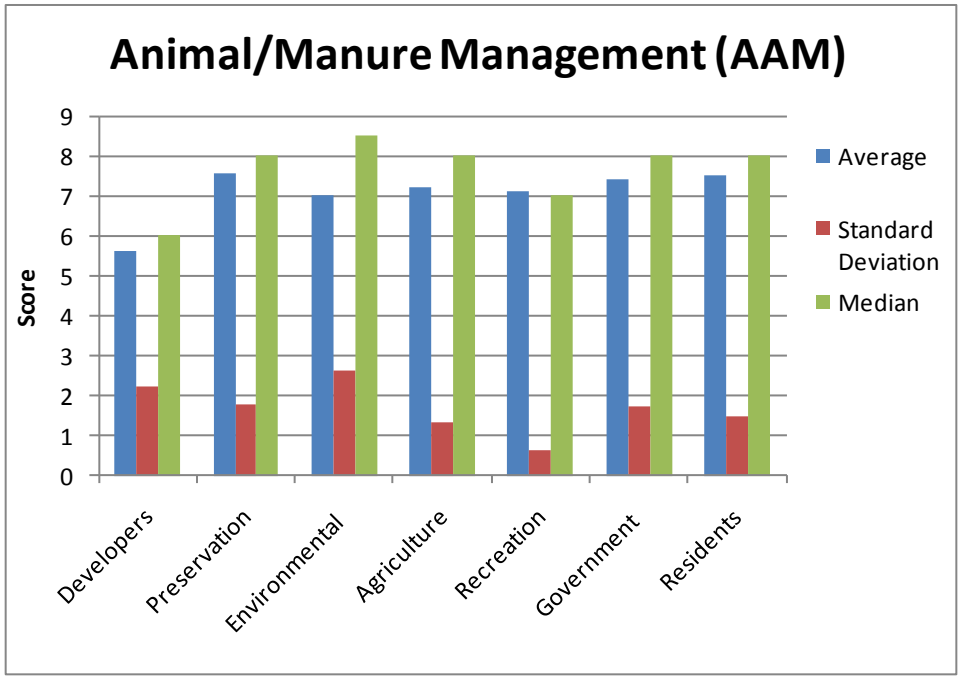



**Figure 5.3.14 Animal/Manure Management Score by Focus Group**
**(Score of 1 = not acceptable and a score of 9 = acceptable)**

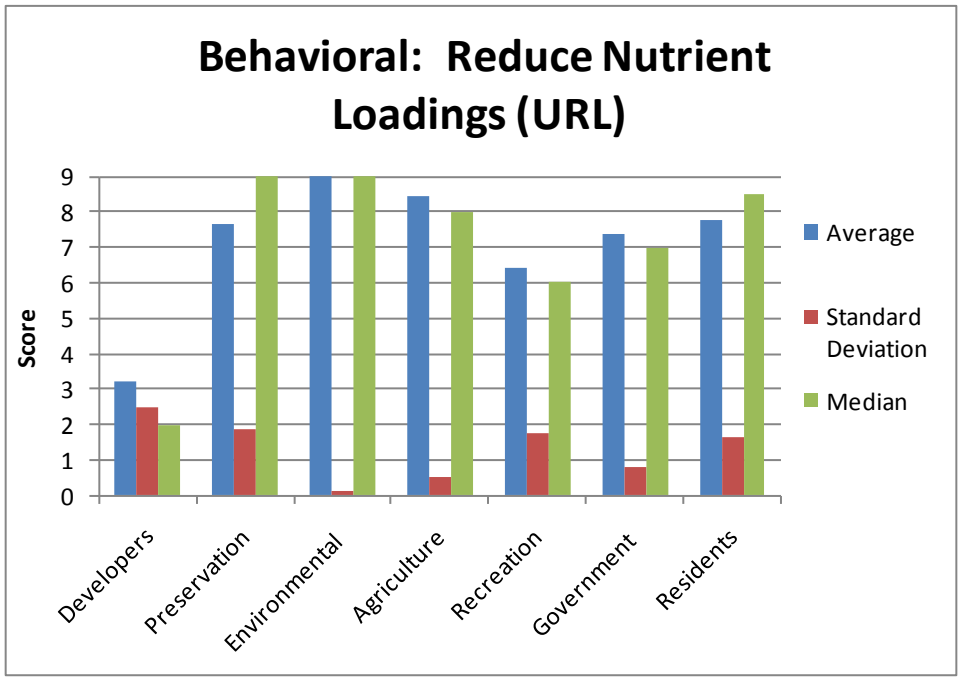



**Figure 5.3.15 Reduce Urban Nutrient Loadings Score by Focus Group**
**(Score of 1 = not acceptable and a score of 9 = acceptable)**

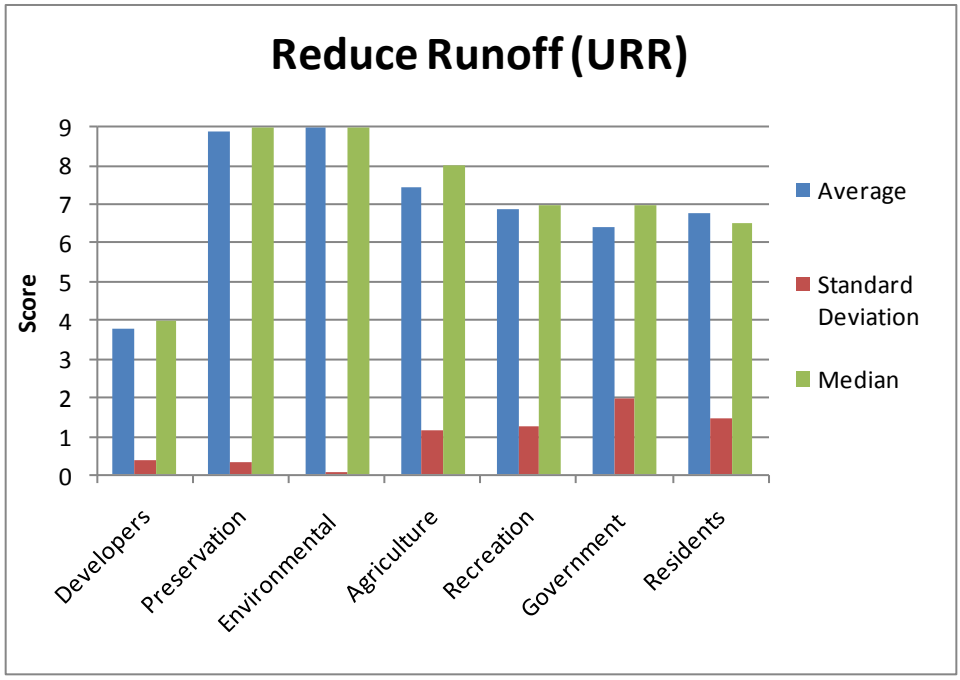



**Figure 5.3.16 Reduce Urban Runoff Score by Focus Group**
**(Score of 1 = not acceptable and a score of 9 = acceptable)**

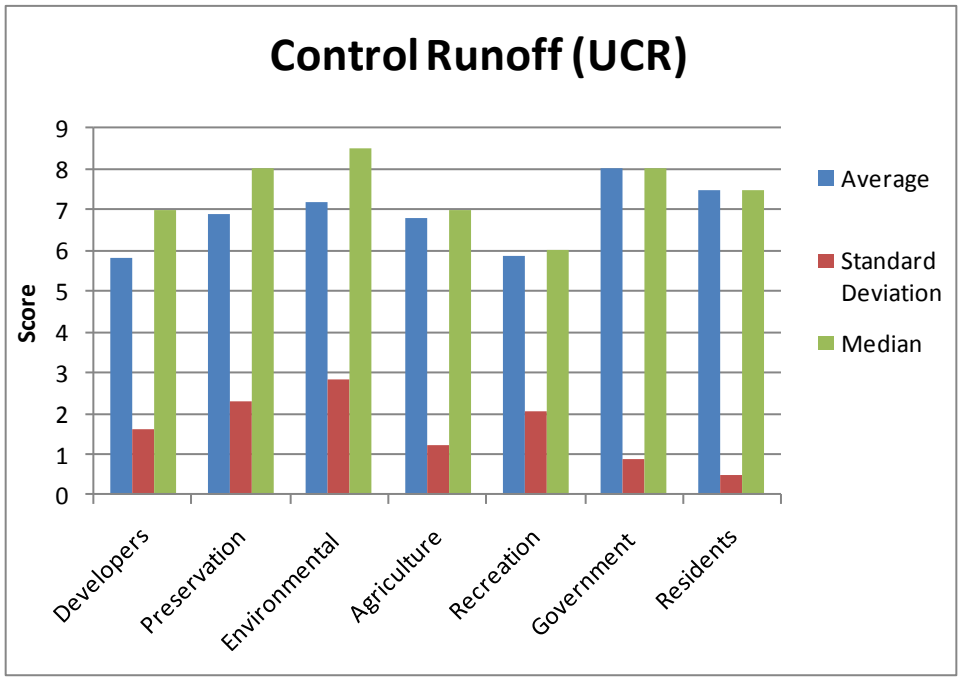



**Figure 5.3.17 Control Urban Runoff Score by Focus Group**
**(Score of 1 = not acceptable and a score of 9 = acceptable)**

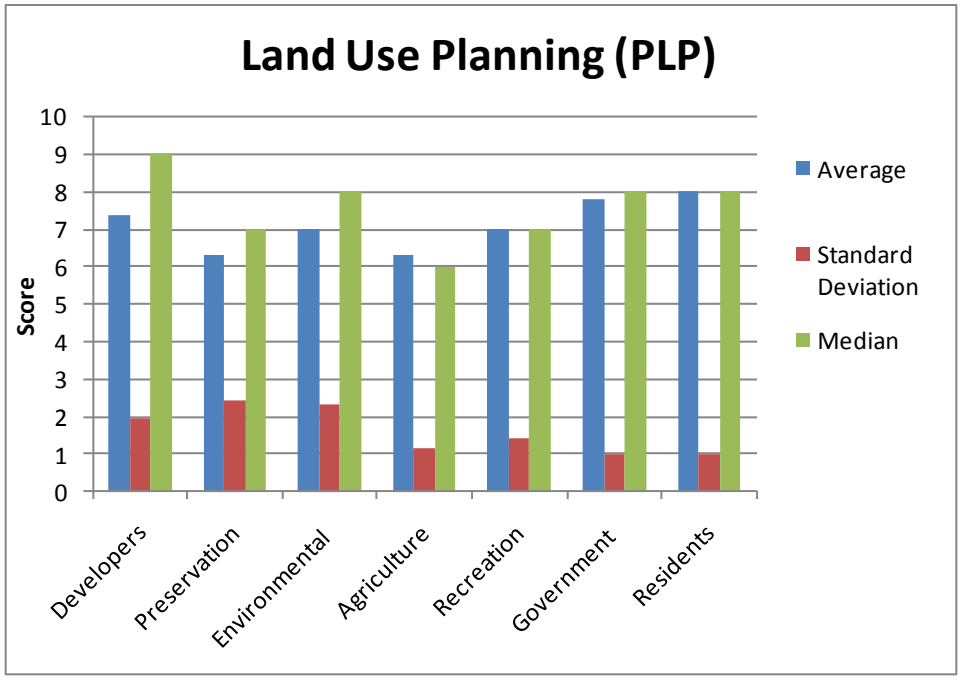



**Figure 5.3.18 Land Use Planning Score by Focus Group**
**(Score of 1 = not acceptable and a score of 9 = acceptable)**

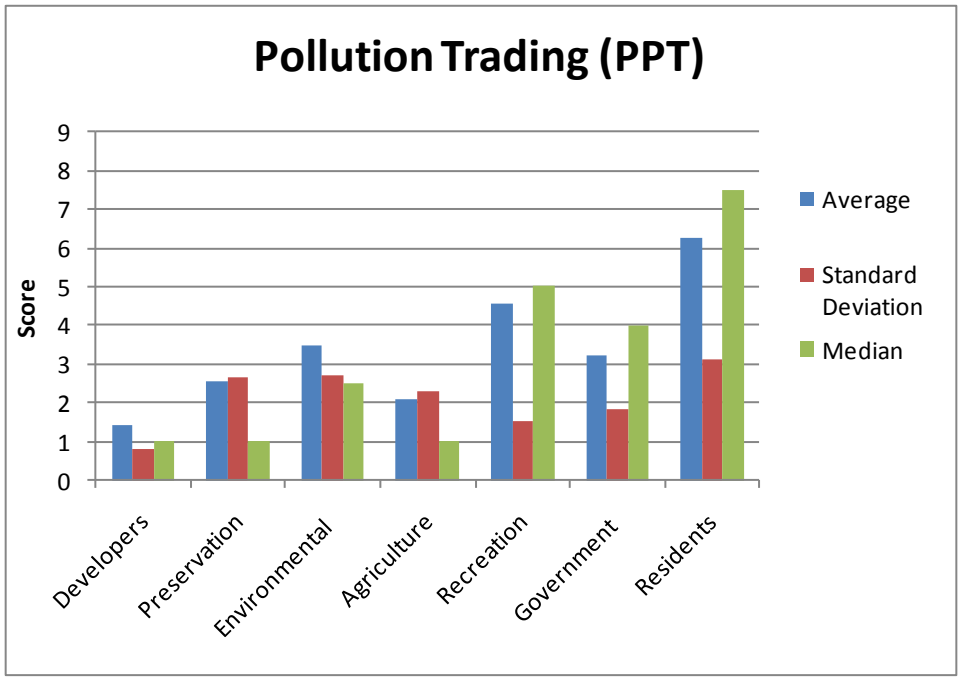



**Figure 5.3.19 Pollution Trading Score by Focus Group**
**(Score of 1 = not acceptable and a score of 9 = acceptable)**

## 5.4 PROCESS EVALUATION

At the end of each focus group meeting, the participants registered their evaluations of the focus group process through the Audience Response System. Participants were asked "How do you feel about the process used in tonight's meeting?" and responded using a 1-9 scale where 1 = very negative and 9 = very positive. Participant assessments were quite positive, with specific focus group means ranging from 6.5 to 8.9 and a combined mean of almost 8 for all sessions. A breakout of the process evaluation scores by focus group is provided in Figure 5.4.1.

In addition to evaluating the meeting using the Likert scale, participants were also asked to evaluate the meeting using the Arnstein Ladder of Public Participation. A breakout of the average Arnstein Ladder scores by focus group is provided in Figure 5.4.2. In general, the majority of focus group participants found that the meeting either met or nearly met their expectations. The main exception to that trend was the preservation focus group, which also had the highest variability in evaluation scores.

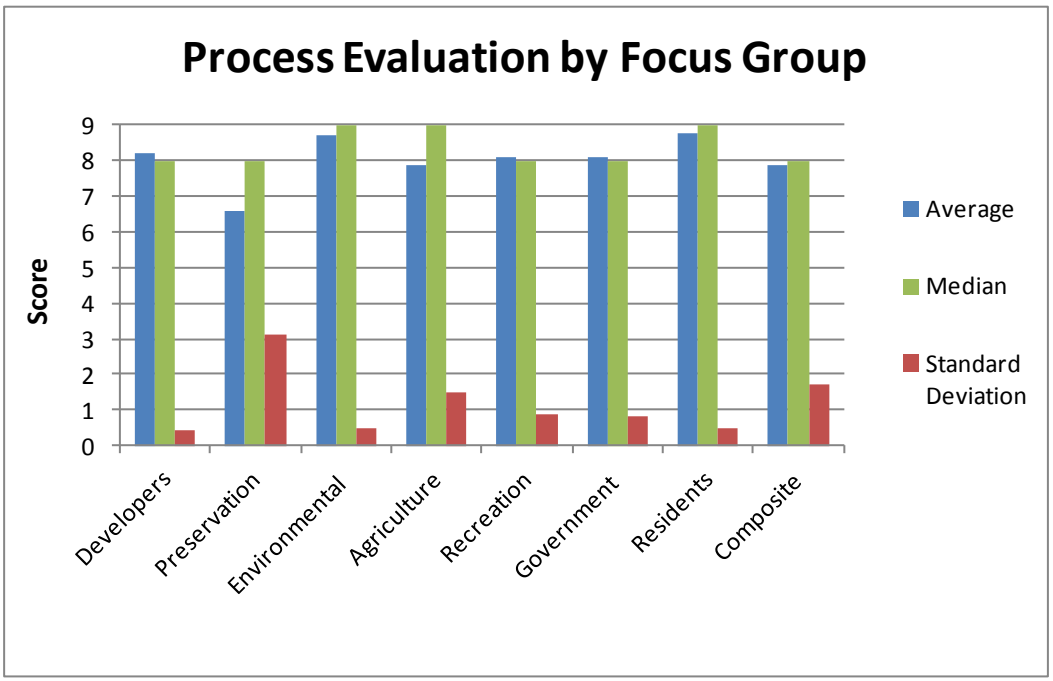



**Figure 5.4.1 Process Evaluation Scores by Focus Group**
**(Score of 1 = very negative and a score of 9 = very positive)**

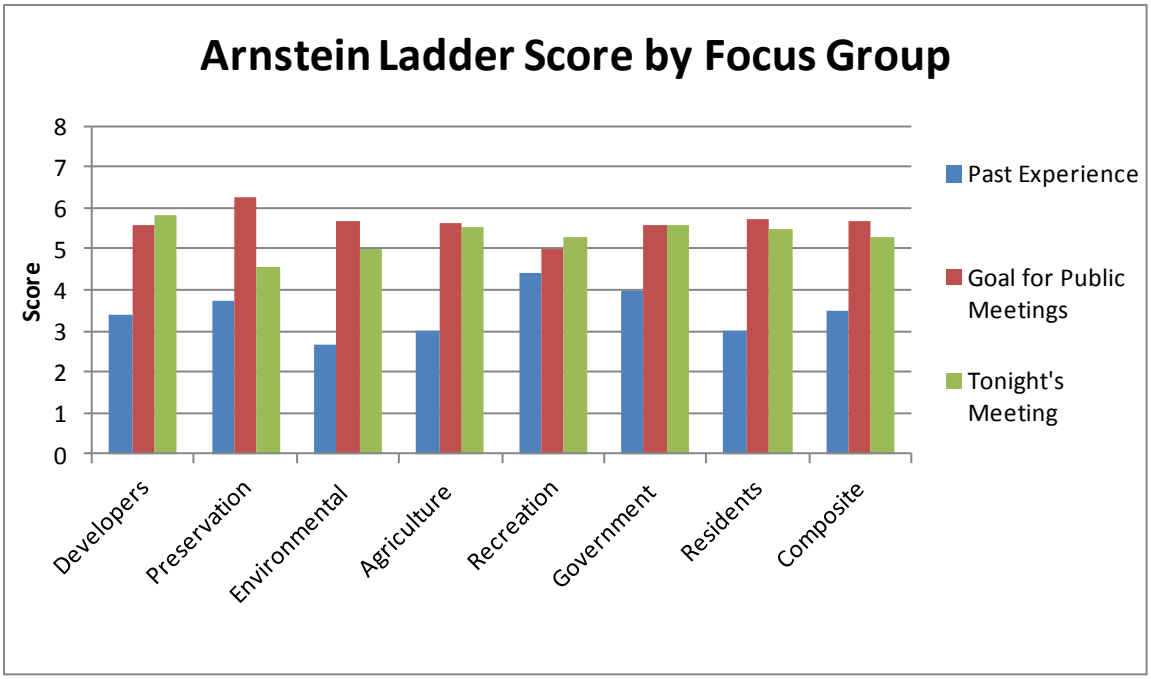



**Figure 5.4.2 Focus Group Average Arnstein Ladder Scores**

Note: 1-Manipulation, 2 - Therapy, 3-Informing, 4-Placation, 5-Consultation, 6-Partnership, 7-Delegated Power, 8-Citizen Control

# 6.0 PUBLIC INFORMATIONAL AND SCENARIO SCORING MEETINGS

## 6.1 INFORMATIONAL WEBSITE

Based on the information and data gaps identified through the focus group process, the research team developed a website (www.uky.edu\WwaterResources\FF) for the purpose of documenting information about the Floyds Fork watershed and the identified nutrient management strategies. The website included a compilation of previous reports about the watershed, data collected within the watershed, scientific background information about nutrients, as well as information on nutrient sources and impacts.

## 6.2 COMMUNITY INFORMATIONAL MEETING

Based on the feedback from the focus groups, it was also determined that the public would benefit from an informational meeting about the watershed and the proposed nutrient management BMPs prior to convening a meeting for actually evaluating and scoring each BMP. As a result, a draft protocol was developed for a public information meeting. The resulting protocol and PowerPoint presentation were reviewed and modified by the pilot group and then submitted to and approved by the University of Kentucky non-biomedical Institutional Review Board (see Appendix C). The informational meeting was held on May 30, 2013, at the Parklands of Floyds Fork Gheens Foundation Lodge. A total of 36 individuals attended the public informational meeting.

An interactive format was used in conducting the meeting. Questions were presented to the participants via a PowerPoint presentation and the participants were asked to select the best answer to each question using the ARS technology. Following the input from the participants, the responses from the audience were displayed along with the correct answer. This format allowed for the participants to test their knowledge and helped to inform the research team of any continuing information gaps. During the course of the presentation, questions about the informational items and the presented management scenarios were fielded from the audience. As a result of the feedback and discussion during the meeting, two additional management strategies were added to the policy category: forest preservation and reduction of atmospheric deposition of nitrogen.

At the end of the meeting, the participants evaluated the process using a scoring range of 1 to 9, with 1 = very negative and 9 – very positive (see Figure 6.2.1). The mean score for the meeting was 6.3. Paper comment cards provided opportunities for participants to register concerns about specific questions and/or answers and to point researchers to alternative information sources.

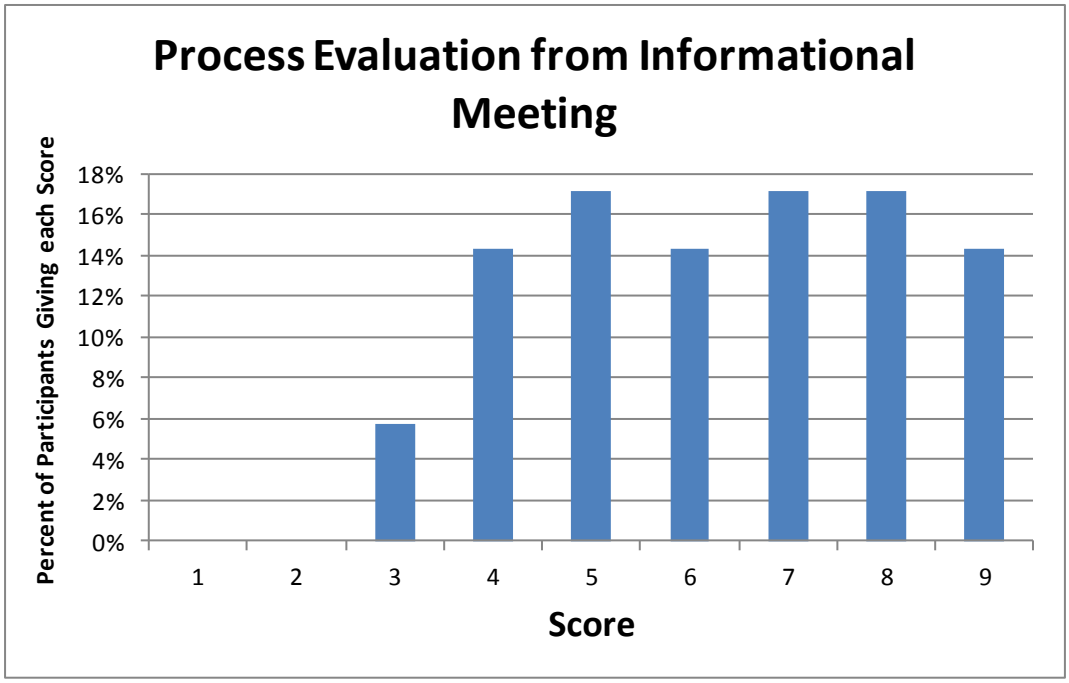



**Figure 6.2.1 Process Evaluation from Public Informational Meeting**
**(Score of 1 = very negative and a score of 9 = very positive)**

## 6.3 COMMUNITY SCORING MEETINGS

### 6.3.1 Theoretical Considerations

It is useful to understand the distinctive nature of every public engagement project. Borrowing from the literature and their experience, the KWRRI research team evaluated several factors in developing the final community engagement protocol as well as the structure and content of both the informational and scenario scoring meetings. Such factors included: project time frame; spatial extent; complexity of the problem; specific concerns of the various stakeholder groups; uncertainties; the breadth and depth of public impact; different perspectives; and the public level of trust of governmental agencies.

While the number and complexity of such factors can present challenges, steps can be taken to mitigate the effects of at least some of these issues. SPI integrates dialogic group methods and tools, representation technologies, and decision support modeling tools to help realize fundamental principles of fairness. For each project, the particular combinations of tools and strategies are customized to deal with its specific properties and challenges. Such was the case in this project.

The Floyds Fork Stakeholder Engagement process represents an extension of the Structured Public Involvement (SPI) protocol into the domain of environmental management (Bailey et al., 2010). The intent of applying the Structured Public Involvement process to this challenging issue is to improve the quality of the decision making process by more fairly, and more accurately, eliciting and incorporating stakeholder valuations into potential nutrient management decisions

for the Floyds Fork watershed. Decision process quality results from such criteria as the inclusion of both a large number and a wide range of stakeholders; the quality of the data obtained; the efficiency of the overall protocol in time and money expended; and, ultimately, real-time anonymous stakeholder performance evaluation of the process. SPI protocols have been applied to numerous other public infrastructure processes over the previous ten years with notable success in terms of these criteria. In particular, high process efficiency and high process quality values for large-scale open stakeholder evaluations have been documented (Bailey et al., 2001; Bailey, Grossardt and Pride-Wells, 2007; Jewell et al., 2009).

To achieve these performance aims with respect to potential nutrient management decisions for the Floyds Fork watershed, the first step was to embed the SPI process within the larger framework for stakeholder value elicitation (Anyaegbunam et al., 2010). The SPI framework was adapted to identify key informational elements from the initial round of focus group meetings. These valuations were incorporated into the ultimate development of PowerPoint visualizations of 20 separate nutrient management BMPs.

The ultimate goal of the BMP scoring meetings was to build a database of community preferences for different nutrient management strategies for both the local community and the Kentucky Division of Water. The dynamic visual evaluation phase helps large groups of stakeholders evaluate visualizations of potential BMPs in real time, exploring the BMPs qualities as perceived by a cross-section of attendees. This data becomes the basis for the community preferences model.

Because the SPI protocol is designed to be scalable and modular, the team worked toward the maximum possible participation. The larger the audience, the greater the volume of data, and the more robust the conclusions derived from the community knowledge base. At previous SPI project meetings, up to three hundred attendees have been accommodated per session, although groups of thirty to eighty are more manageable. To facilitate the participation of as many community members as possible, the meetings can be repeated in the same format at different times and at various locations in the study area. Data can then be aggregated for final evaluation.

Anonymity is preserved by the electronic polling system. Each keypad possesses a unique identifier. At open public meetings, the team does not record who takes possession of which keypad; therefore, all scores are recorded anonymously and simultaneously. Moreover, all participants can see these features of the process during the meeting. These properties of transparency and integrity resist interest-group gaming and are critical in terms of delivering high levels of process justice from the viewpoint of the stakeholders. These properties account for a portion of the high performance documented in previous SPI evaluations (Bailey and Grossardt, 2010).

### 6.3.2 Evaluated Nutrient Management Strategies

Based on the feedback received from the focus groups, the pilot group, and the public information meeting, the original list of nutrient management strategies was expanded from 12 to 20 BMPs, with many of the new BMPs actually representing a more detailed breakout from the original list of 12. A list of the BMPs presented during the public scoring meetings is provided in Table 6.1.1 Detailed descriptions are provided in Appendix B. Once again these were lumped into four major categories.

**Table 6.1.1 Final List of Nutrient Management Strategies**

| BMP ID | Best Management Practice (BMP) Description |
|---|---|
| **Wastewater IDs (W-)** | |
| WFSS | Eliminate Failing Septic Systems |
| WSSO(R) | Eliminate Sanitary Sewer Overflow (by Infrastructure Repair) |
| WSSO(C) | Eliminate Sanitary Sewer Overflow (by Increasing Capacity) |
| WR | Consolidate smaller inefficient wastewater plants through regionalization |
| WTT | Improve nutrient treatment technologies of existing plants |
| **Agriculture IDs (A-)** | |
| AF | Fertilizer Management |
| AC | Crop Management |
| AE | Erosion Control |
| AW | Agricultural Wetlands |
| AL | Livestock Management |
| AM | Manure Management |
| **Urban IDs (U-)** | |
| URL | Reduce Loadings (lawn fertilizer and pet litter) |
| URR(T) | Reduce Runoff with Traditional Infrastructure |
| URR(G) | Reduce Runoff with Green Infrastructure |
| UTR | Treat Runoff |
| **Policy IDs (P-)** | |
| PDRO | Development Review Overlays |
| PCS | Conservation Subdivisions |
| PPT | Pollution Trading |
| PFP | Forest Preservation |
| PRAD | Reduce Atmospheric Deposition (Nitrogen Air Emissions) |

### 6.3.3 Public Scoring Meetings

Separate community meetings were held on August 26 (Middletown, KY); August 29, (LaGrange, KY); and September 9, 2013, (Shepherdsville KY). The purpose of these meetings was to solicit stakeholder feedback on the various nutrient management strategies. The protocol for the meeting (including a PowerPoint presentation) was developed and submitted for approval by the University of Kentucky non-biomedical Institutional Review Board (IRB) (see Appendix C).

At the public meetings, visualizations of each of the BMPs were shown, scored and verbally evaluated by the participants. Verbal evaluations can be of assistance in cases of high or low suitability, or where the standard deviations are large, i.e. where there is a lack of agreement about the value of the scenario. The process also elicits hidden concerns and identifies value polarities among stakeholders regarding specific features or parameters of the scenarios.

The participants were asked to score each BMP separately and anonymously using an Audience Response System (ARS). A single criterion termed "preferability" was the metric used for evaluation. The scale used is a variation of a Likert system, with a range from 1 (least preferable) to 9 (most preferable). It should be emphasized, that each BMP was scored on its own merits and not in comparison to the other BMPs. The results were shown in real time to the audience. Each scenario was presented and scored in turn until all had been evaluated. The composite results from all three public scoring meetings are shown in Figures 6.3.1 and 6.3.2. Not all participants chose to answer every question asked. The average total number of respondents to any one question was 54.

Reduction of runoff and nutrient loadings through the use of green infrastructure received the highest mean score. Pollution trading received the lowest mean score. Among the wastewater BMPs, the elimination sanitary sewer overflows received the highest mean score, while fertilizer management BMPs received the highest mean score among the agricultural BMPs. Among the policy BMPs, conservation subdivisions received the highest mean score. In general, each average score demonstrated a fairly large standard deviation (2 to 3).

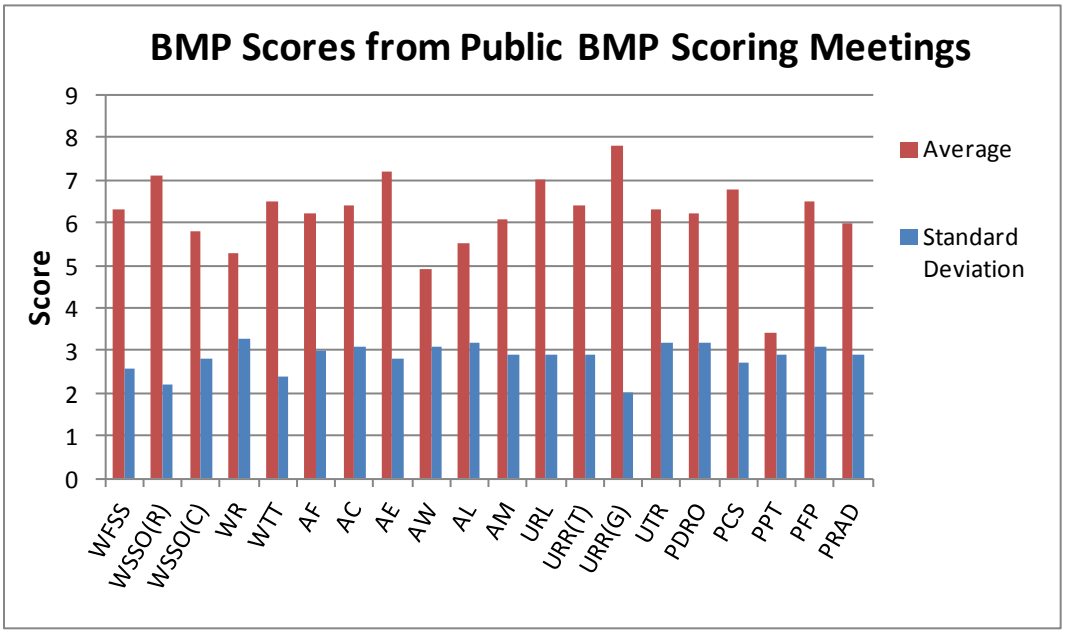



**Figure 6.3.1 BMP Scores From Public Meetings Evaluating 20 BMPs. Average Score with Standard Deviation**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

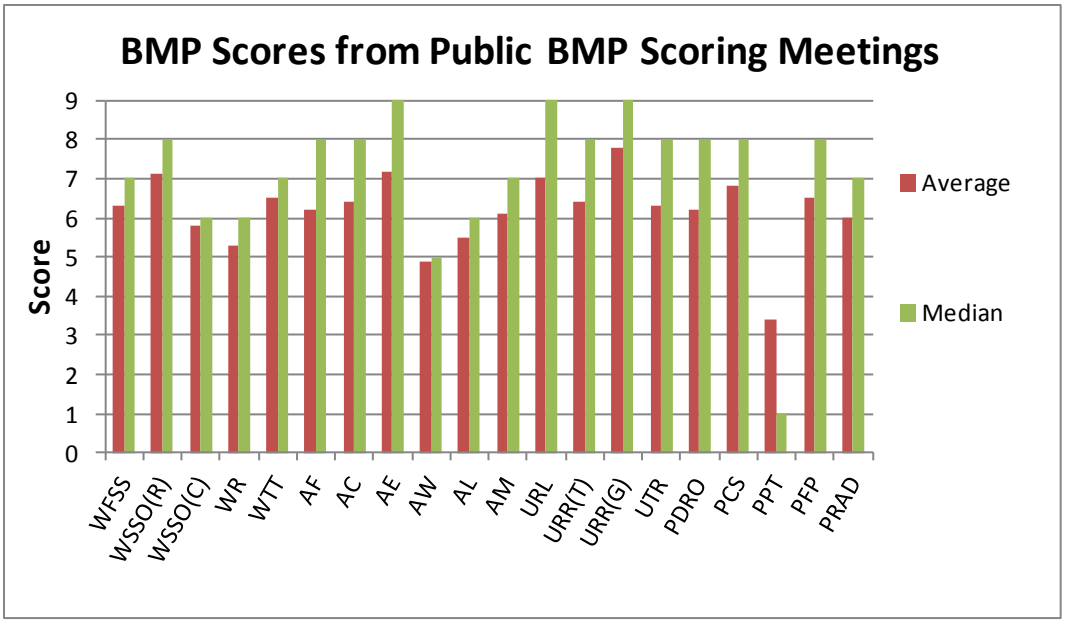



**Figure 6.3.2 BMP Scores From Public Meetings Evaluating 20 BMPs. Average Score with Median Score**
**(Score of 1 = least preferable and a score of 9 = most preferable)**

Following the scoring of the BMPs, the audience was asked to evaluate the meeting process using both a 9 point Likert scale and the Arnstein Ladder of Public Participation. The composite results for all three meetings are provided in Figures 6.3.3 through 6.3.6. In general the Likert scale results were fairly uniform across all three meetings with similar medians and standard deviations. Similar results were obtained for the Arnstein Ladder scores. In each case, the composite averages were slightly less than those obtained from the focus group meetings. This is somewhat expected due to the time limitations associated with the public meetings (larger number of BMPs scored). Nonetheless, the scores were fairly positive, especially when considering the distribution of scores shown in Figures 6.3.4 and 6.3.6.

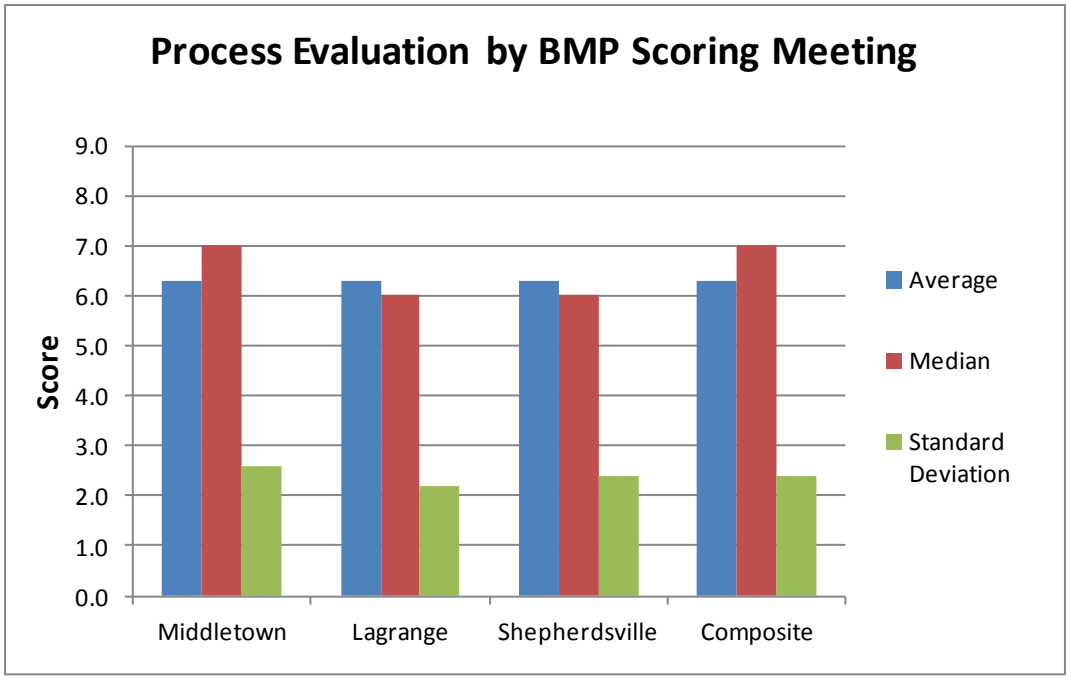



**Figure 6.3.3 Process Evaluation Scores from all three BMP Scoring Meetings**
**(Score of 1 = very negative and a score of 9 = very positive)**

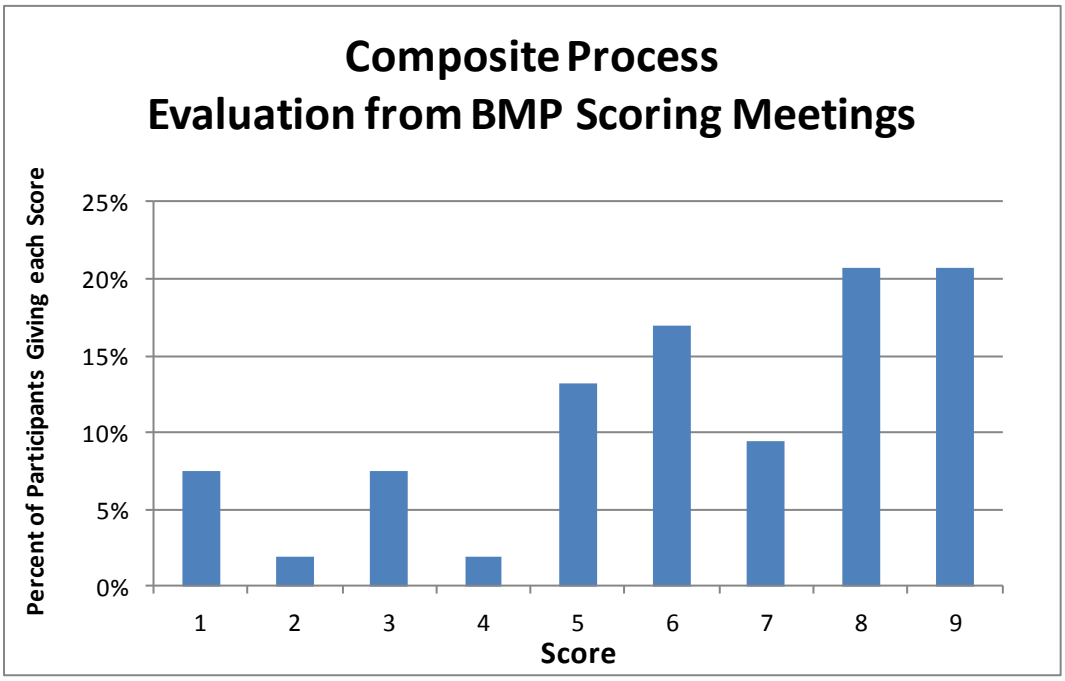



**Figure 6.3.4 Distribution of Composite Process Evaluation Scores**
**(Score of 1 = very negative and a score of 9 = very positive)**

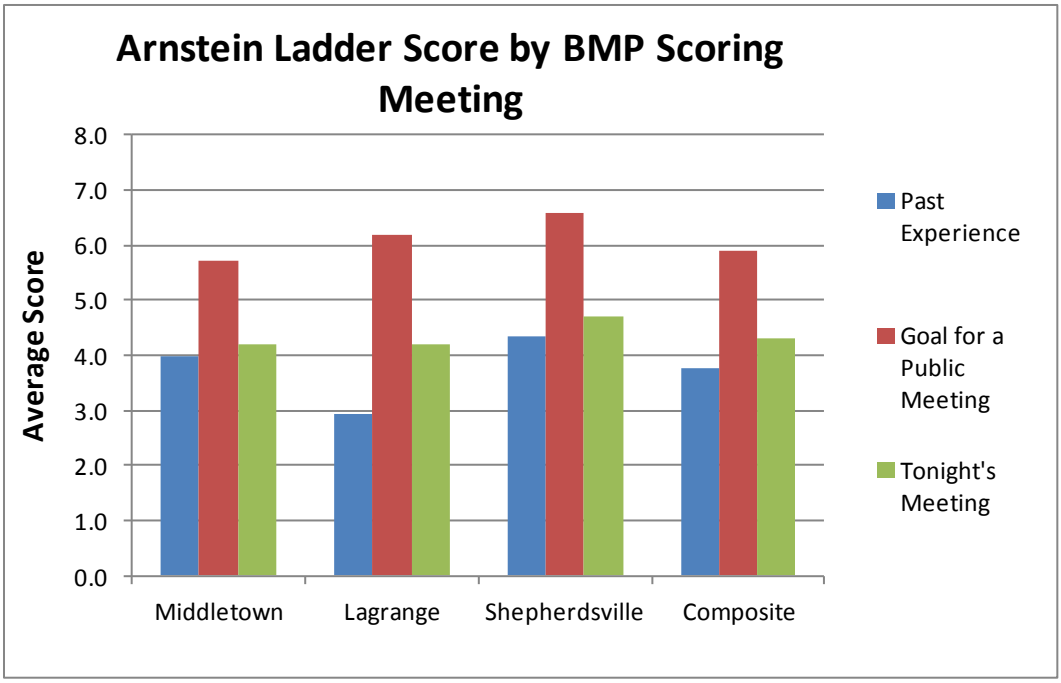



**Figure 6.3.5 Arnstein Ladder Scores from all three BMP Scoring Meetings**
Note: 1-Manipulation, 2 - Therapy, 3-Informing, 4-Placation, 5-Consultation, 6-Partnership, 7-Delegated Power, 8-Citizen Control

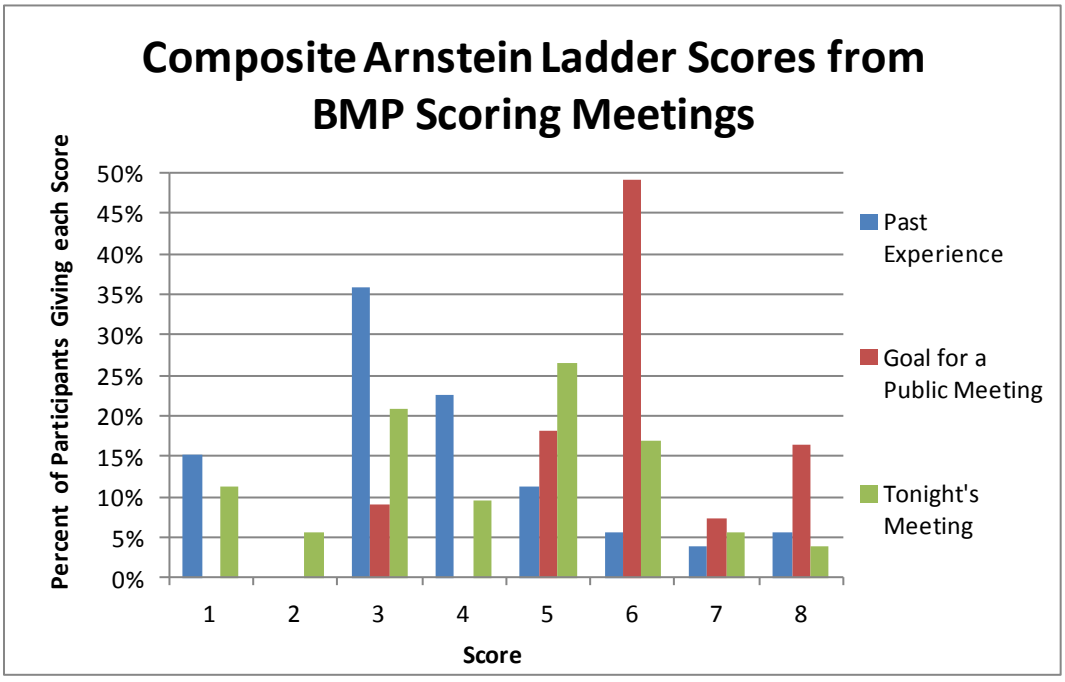



**Figure 6.3.6 Distribution of Composite Arnstein Ladder Scores**
Note: 1-Manipulation, 2 - Therapy, 3-Informing, 4-Placation, 5-Consultation, 6-Partnership, 7-Delegated Power, 8-Citizen Control

## 6.4 WEB BASED SCORING

Following the public scoring meetings, the research team decided to solicit additional BMP scoring through its interactive website: www.uky.edu/WaterResources/FF. The website was configured to allow visitors to experience the same guided presentation given at the public scenario scoring meetings. At the end of the guided presentation, a visitor could indicate their preferences for each of the 20 BMPs that had been presented in the public meetings. Resulting data were recorded for analysis and inclusion in the final project report. The results of the web-based scoring are provided in Figures 6.4.1 and 6.4.2. A composite of scores from both the public face-to-face meetings and the web-based scoring is provided in Figures 6.4.3 and 6.4.4. More in-depth insights to the rationale for variations in the scoring can be found from the qualitative comments obtained during the stakeholder focus group meetings. Process evaluation scores for the web-based survey are provided in Figure 6.4.5. Figure 6.4.6 shows how the process was evaluated by each of the three public scoring meetings and by the online participants.

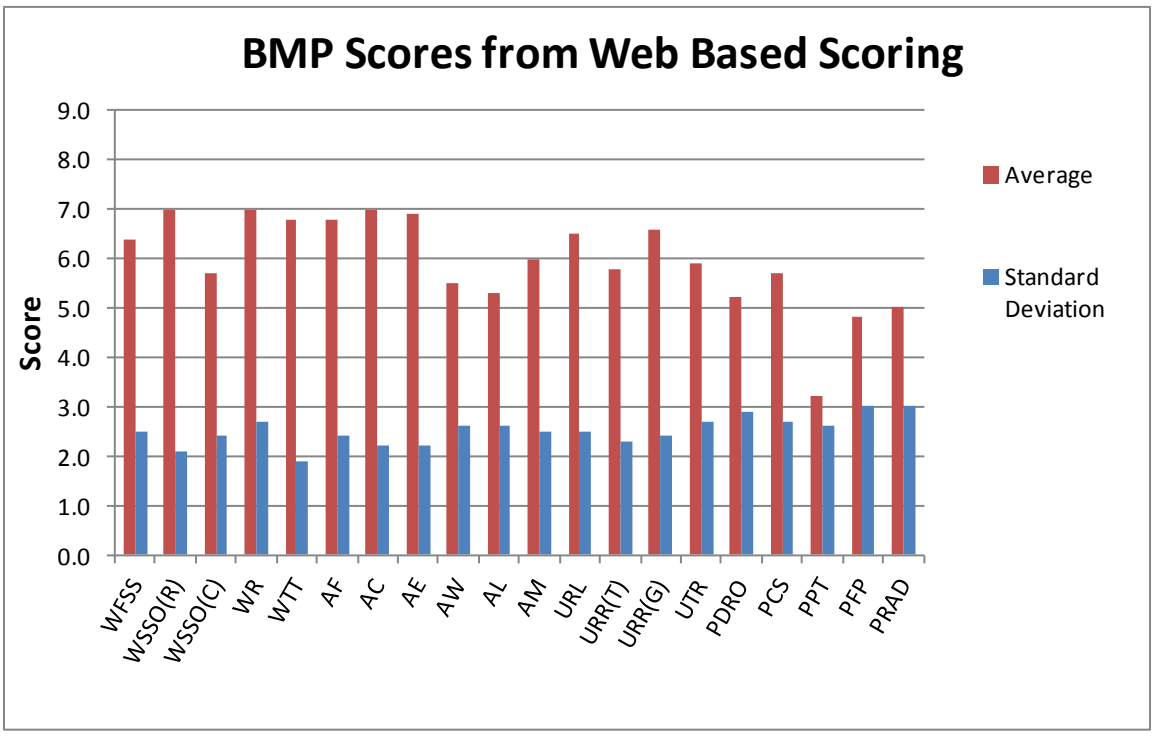



**Figure 6.4.1 BMP Scores from Online Survey. Average Score with Standard Deviation**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

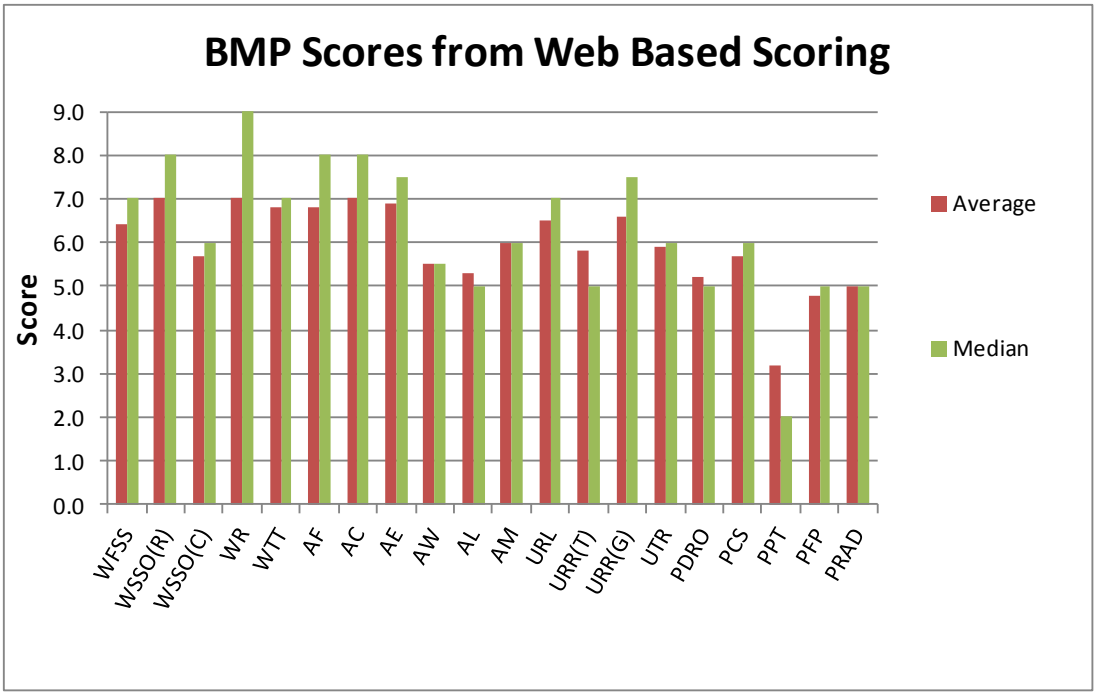



**Figure 6.4.2 BMP Scores From Online Survey. Average Score with Median Score**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

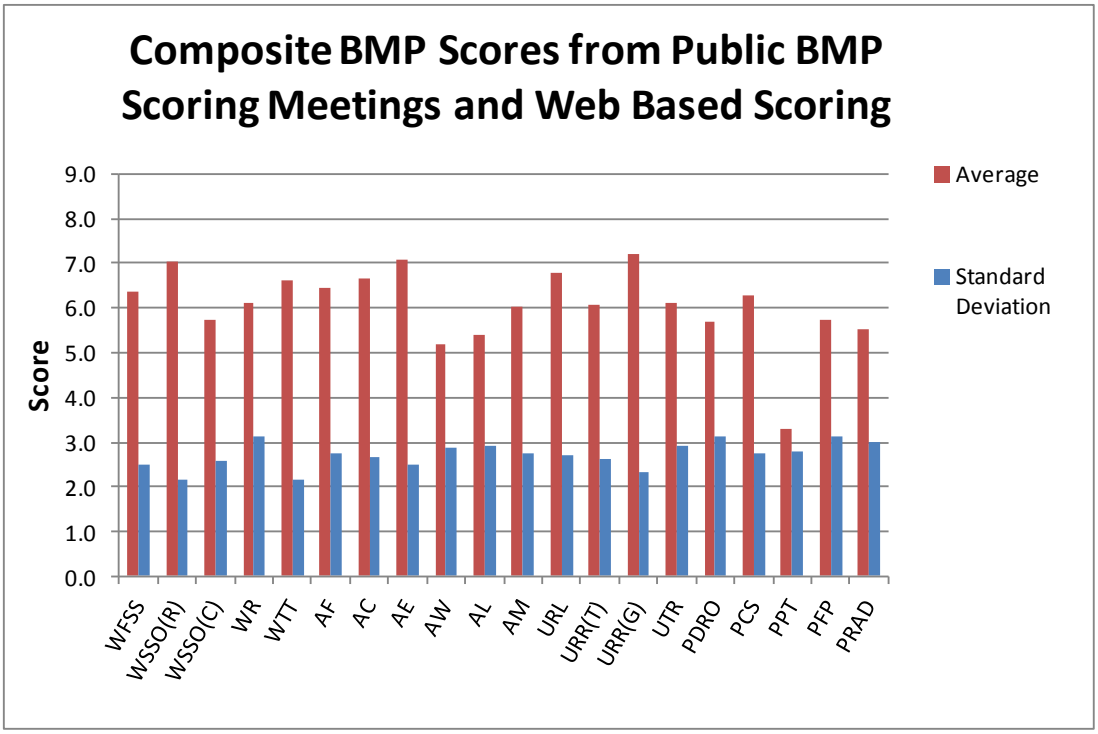



**Figure 6.4.3 BMP Scores from Combined Public BMP Scoring Meetings and Online Survey. Average Score with Standard Deviation**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

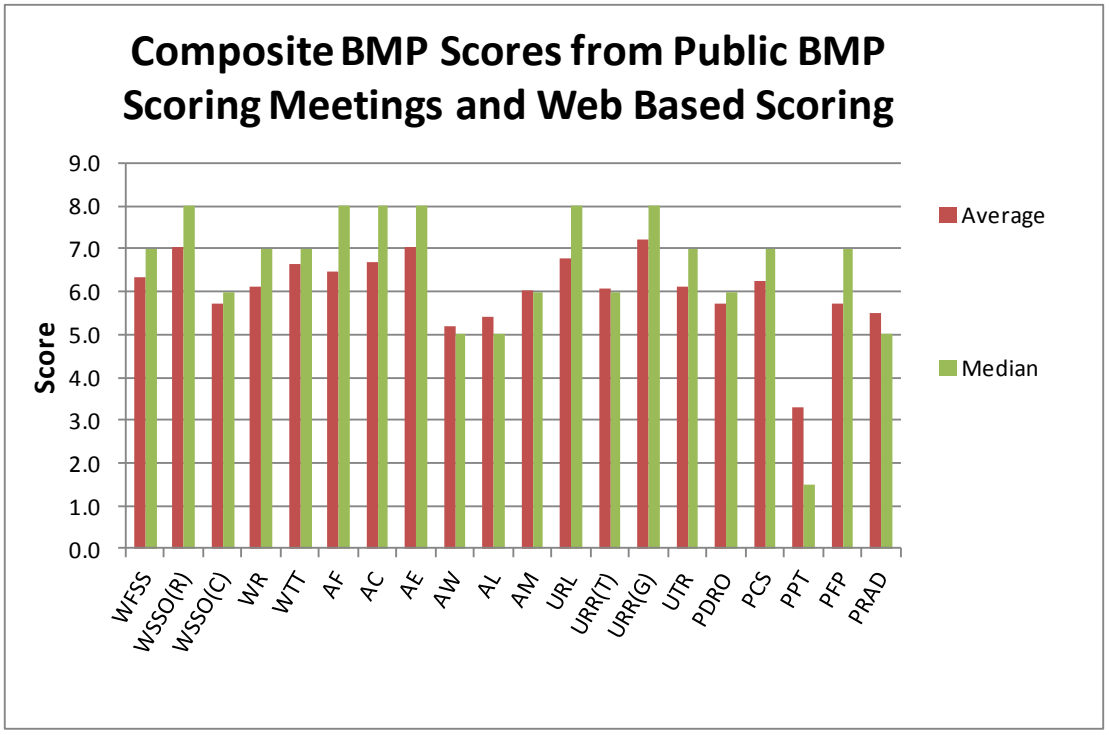



**Figure 6.4.4 BMP Scores from Combined Public BMP Scoring Meetings and Online Survey. Average Score with Median Score**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

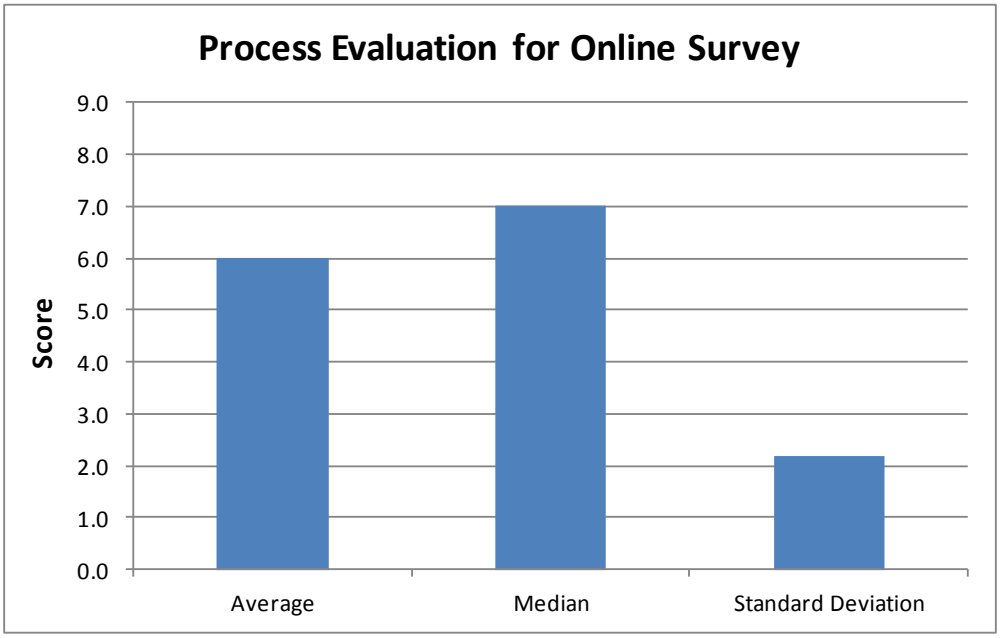



**Figure 6.4.5 Process Evaluation for BMP Scoring Online Survey**
**(Score of 1 = very negative and a Score of 9 = very positive)**

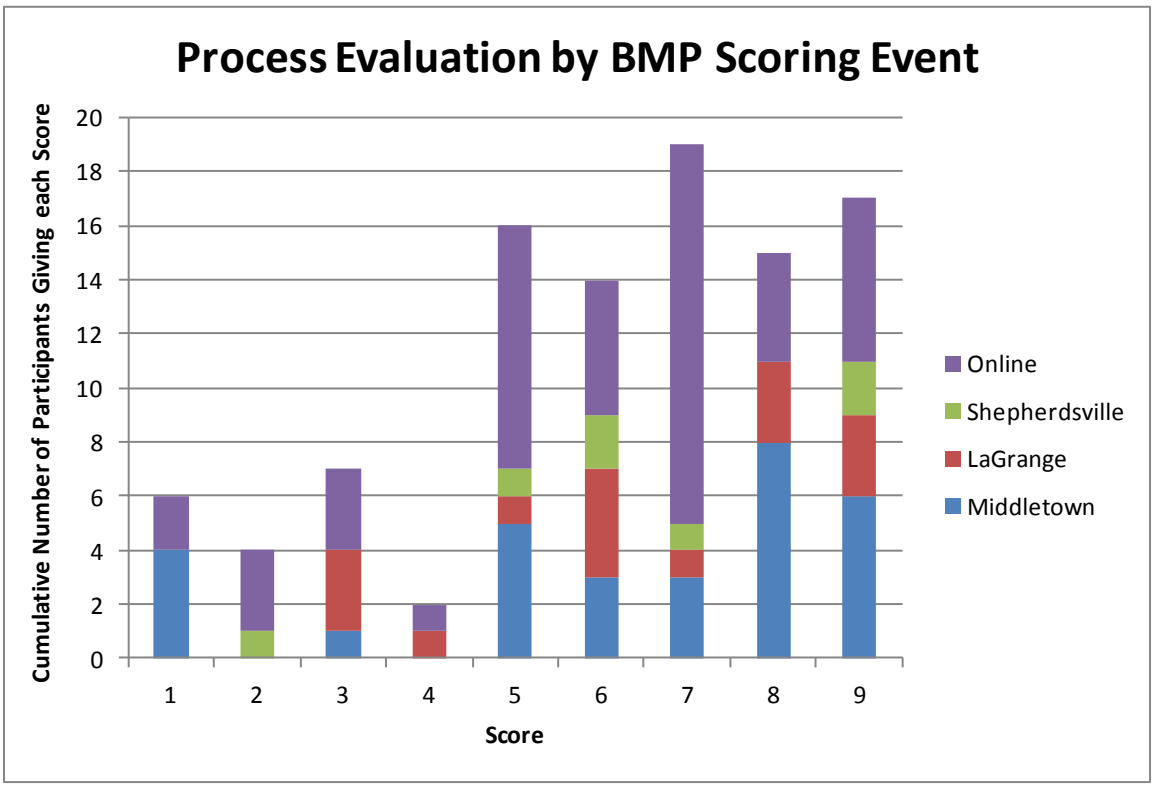



**Figure 6.4.6 Process Evaluation Scores by each BMP Scoring Event**
**[horizontal axis – 1=very negative to 9=very positive] from Public Meeting and Website Responses [vertical axis – e.g. 3 people from the Middletown meeting gave a response of 7, while 1 person from the LaGrange and Shepherdsville meetings gave a response of 7, and 14 people from the online survey gave a response of 7, for a total of 19 responses rating the process a 7]**

## 6.5 DEMOGRAPHIC ANALYSIS

To have a better sense of the general characteristics of the respondents, participants at both the public meetings and the website survey were asked several demographic questions, including age, gender, county of residence, and whether they lived, worked or recreated in the Floyds Fork watershed. The responses are shown in Figures 6.5.1 through 6.5.6.

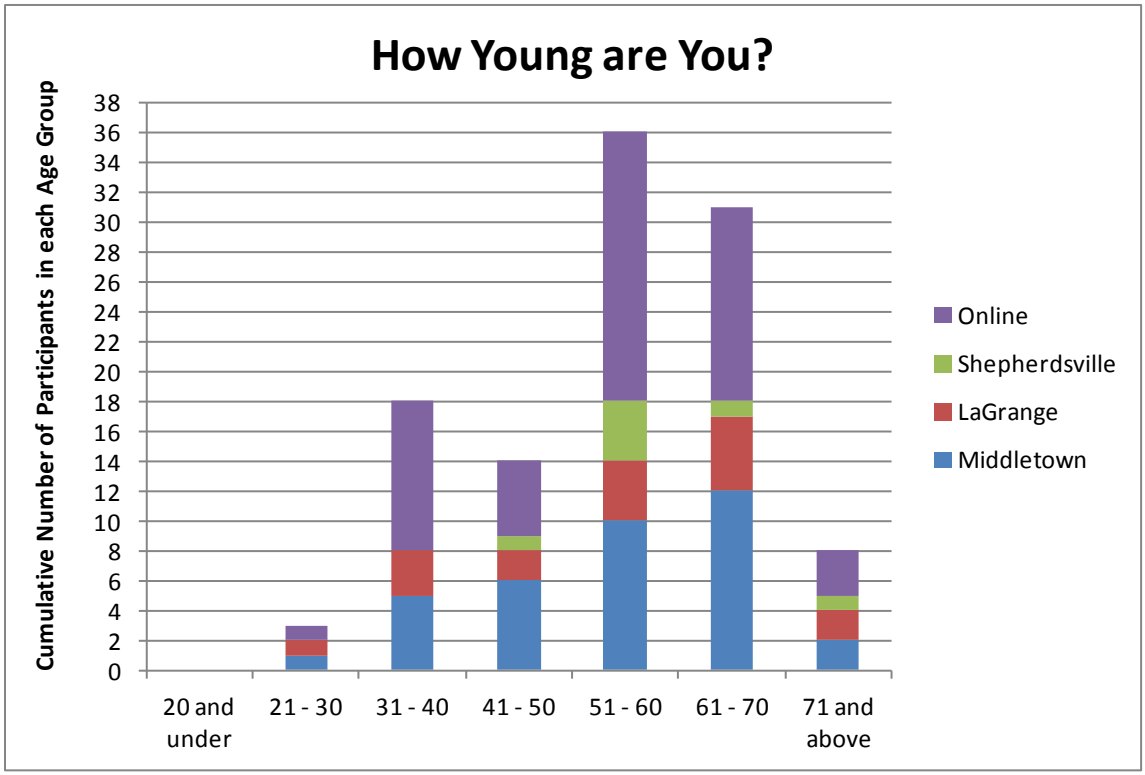



**Figure 6.5.1 Age Statistics of the Public Meeting and Website Survey Participants**

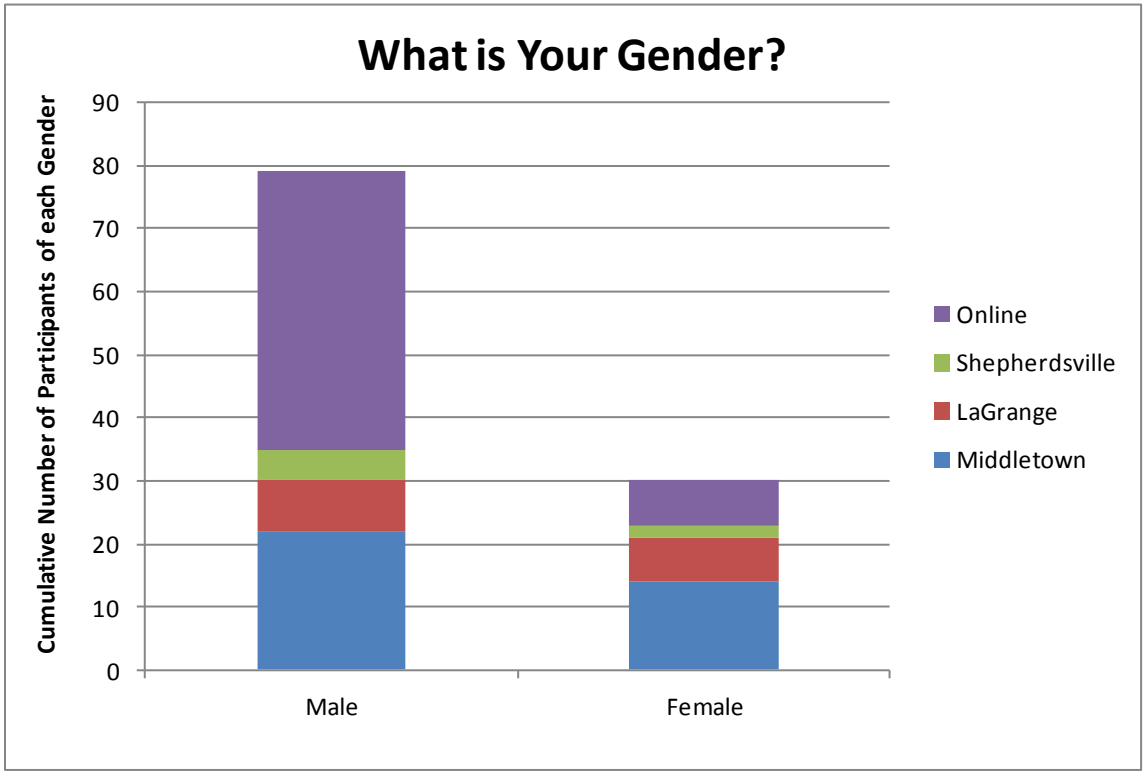



**Figure 6.5.2 Gender of the Public Meeting and Website Survey Participants**

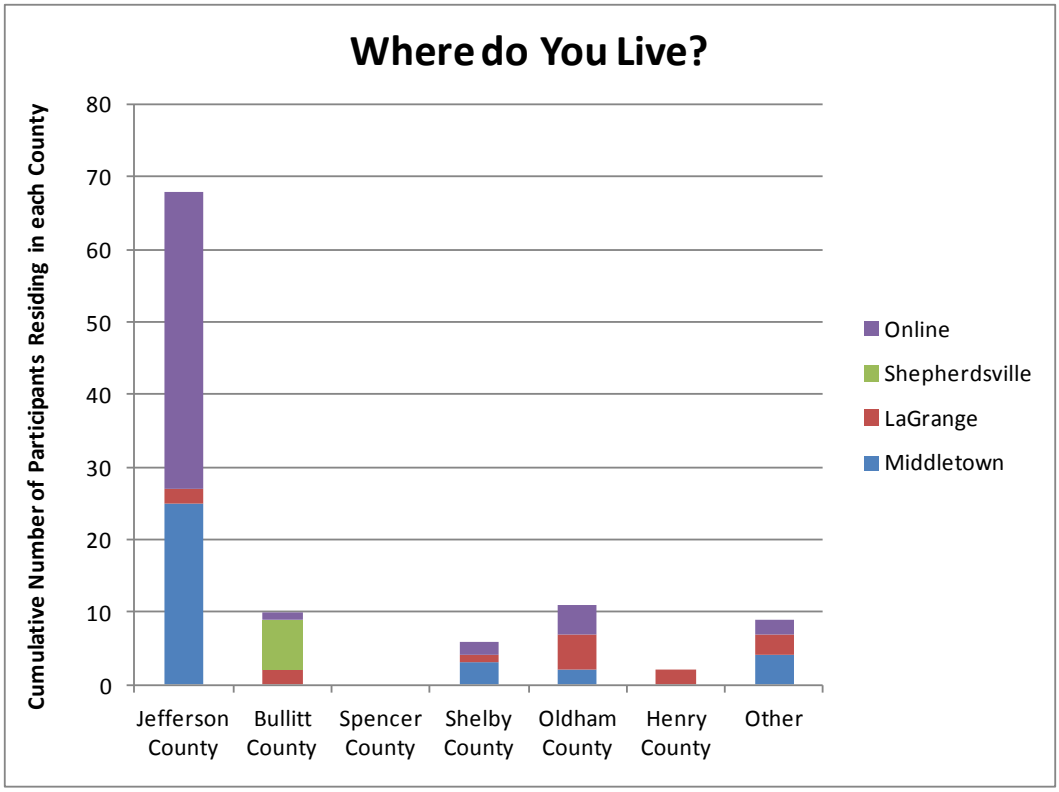



**Figure 6.5.3 County Residence of the Public Meeting and Website Survey Participants**

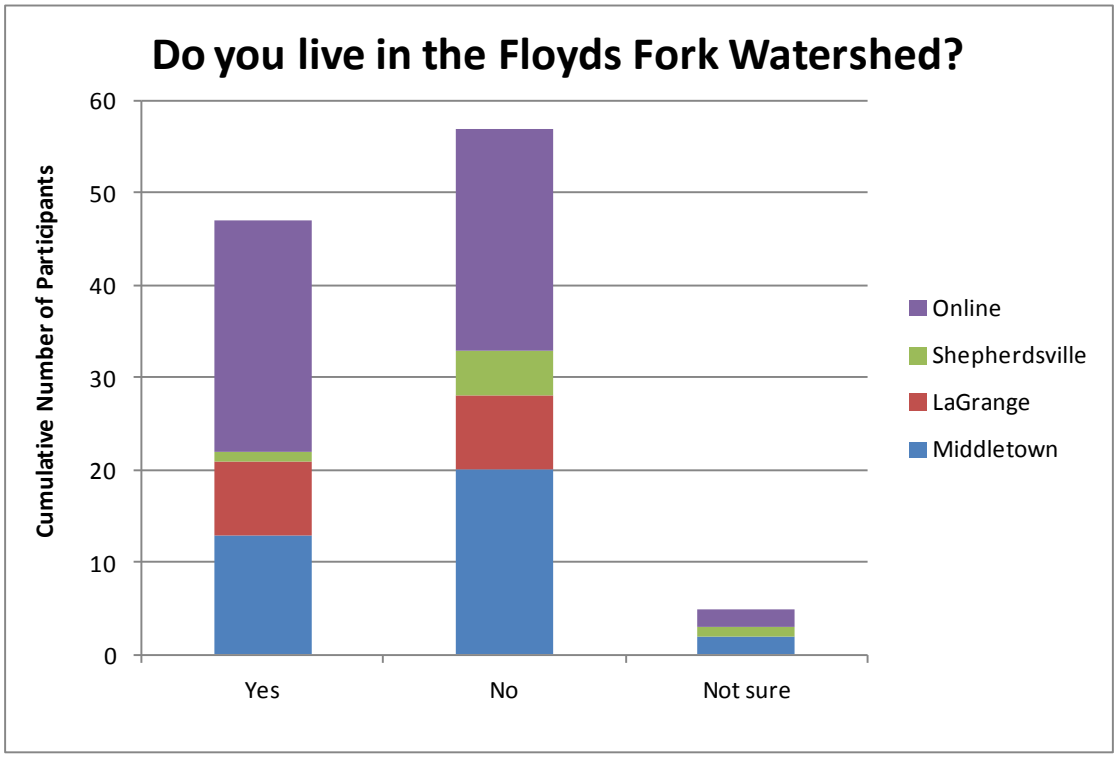



**Figure 6.5.4 Do you live in the Floyds Fork Watershed?**

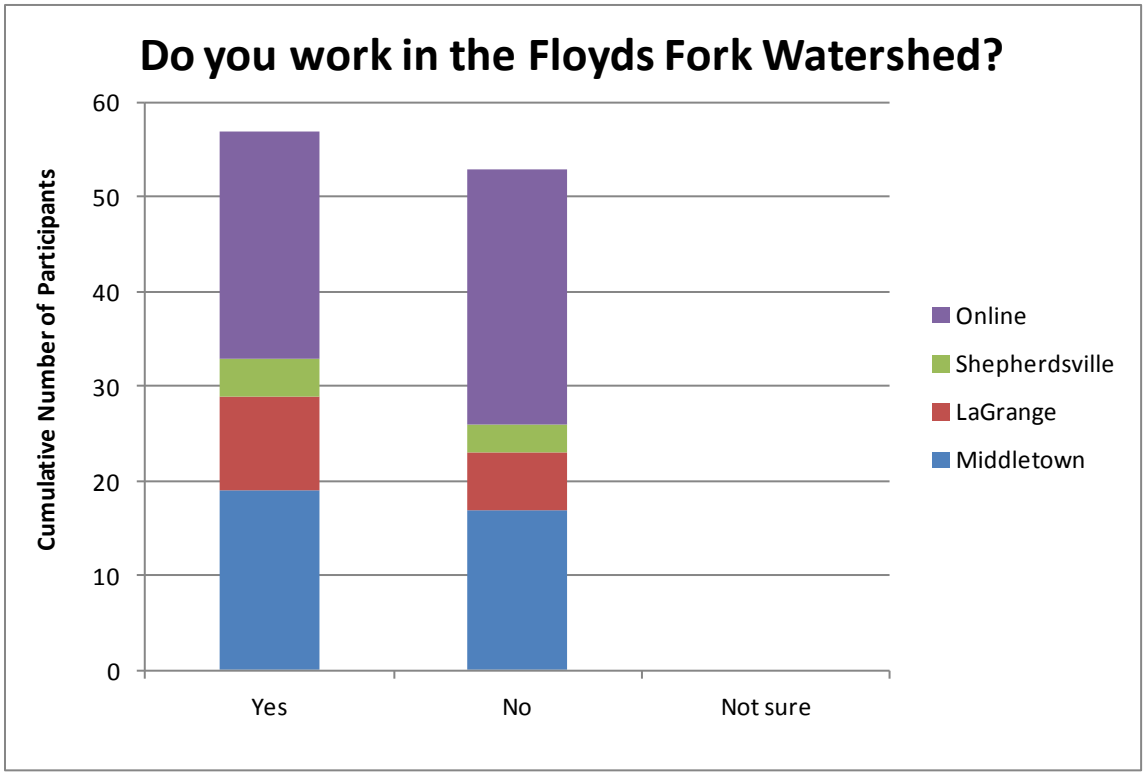



**Figure 6.5.5 Do you work in the watershed?**

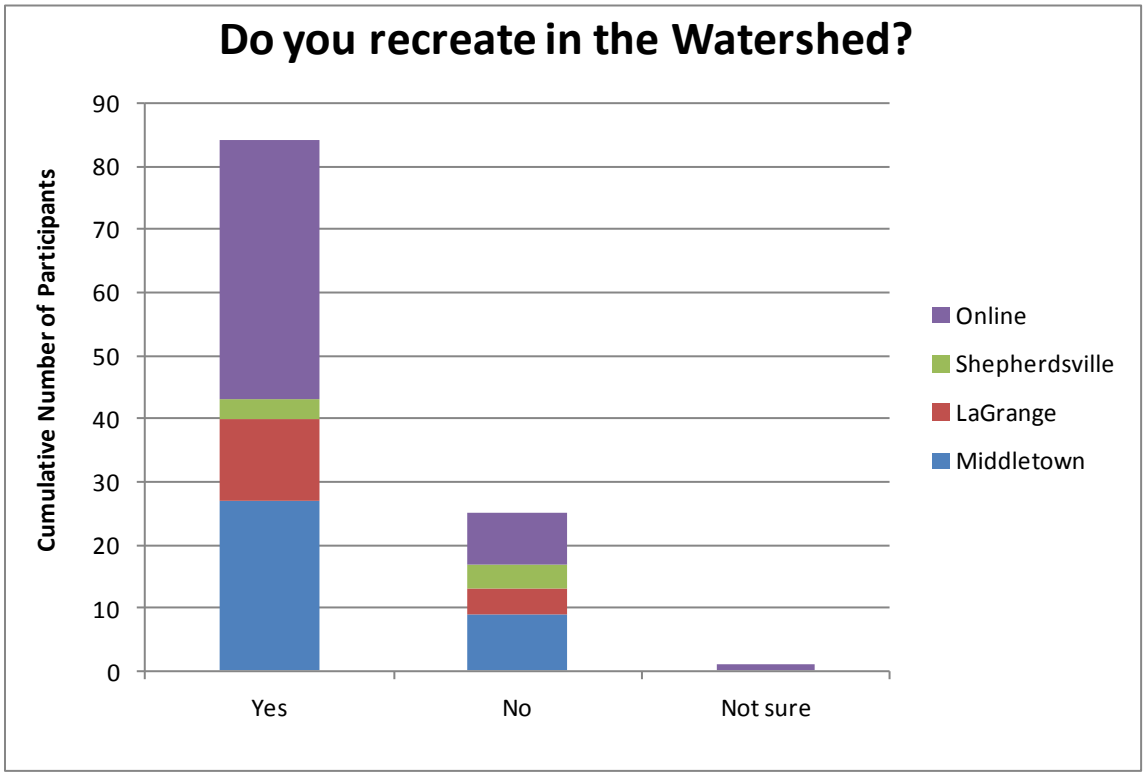



**Figure 6.5.6 Do you recreate in the watershed?**

## 6.6 BMP SCORING DATA ANALYSIS

A simple averaging of public meeting and online BMP scores (Figure 6.4.4) could lead to a conclusion that almost all of the BMPs are generally acceptable (average and median scores of 5 and above for all BMPs except Pollution Trading). However, the detailed breakdowns of the scores for each BMP provide considerable additional insight (Figures 6.6.1 to 6.6.20).

Each of the BMPs received scores across the entire spectrum from "least preferable" to "most preferable" indicating a wide diversity of perspectives in the community with regard to all of the approaches considered for nutrient reduction. None of the response patterns resemble a simple normal distribution that might indicate some sort of consensus around a common value within the range of the scale. Some distributions were skewed to the right (for example Figure 6.6.2 Eliminate SSOs) or to the left (Figure 6.6.18 Pollution Trading). Others were bimodal with the most popular responses falling at both extremes (Figure 6.6.4 Regionalization of Wastewater Treatment Plants).

Some bimodal distributions at the extremes also exhibit a large cluster of responses at 5 (midway between least preferable and most preferable) such as in Figures 6.6.9 (Agricultural Wetlands), 6.6.10 (Livestock Management) and 6.6.20 (Reduce Atmospheric Deposition). Other BMPs also had 5 as the second or third most popular response. It is unclear whether scores of 5 represent actual ambivalence toward a particular BMP or rather a general inability (or unwillingness) to express a positive or negative opinion about it. Some participants complained that they were unsure about the cost and the potential effectiveness of the various BMPs and it may be that this contributed to numerous scores of 5 for some BMPs.

The factors affecting an individual's preference for or against the implementation of a particular nutrient management BMP can be quite varied beyond cost and effectiveness. Whether the approach will be implemented by numerous private individuals, by a commercial concern, or as a large publicly funded project may influence their assessment. Some BMPs could be required by permit through a regulatory program, while others would need to be adopted voluntarily by numerous concerned members of the community. Health and safety concerns can also weigh into some decisions as well as a need and responsibility for long term operation and maintenance. Loss of local control is another consideration. Moral issues may also be relevant in some cases (take care of our own wastes rather than sending them outside of the watershed). Some participants likely engaged in strategic scoring largely unrelated to nutrient reduction (for example, expressing a preference against increased wastewater treatment capacity in hopes of limiting further development pressures).

Variability in the results from the public meetings and the online scoring may be related to differences in the populations who participated. The age distributions were similar for both groups (Figures 6.6.21 and 6.6.22), but the interests represented varied considerably (Figures 6.6.23 and 6.6.24). Agriculture was the primary interest group represented at the public meetings, while economic development had a larger presence in the online scoring.

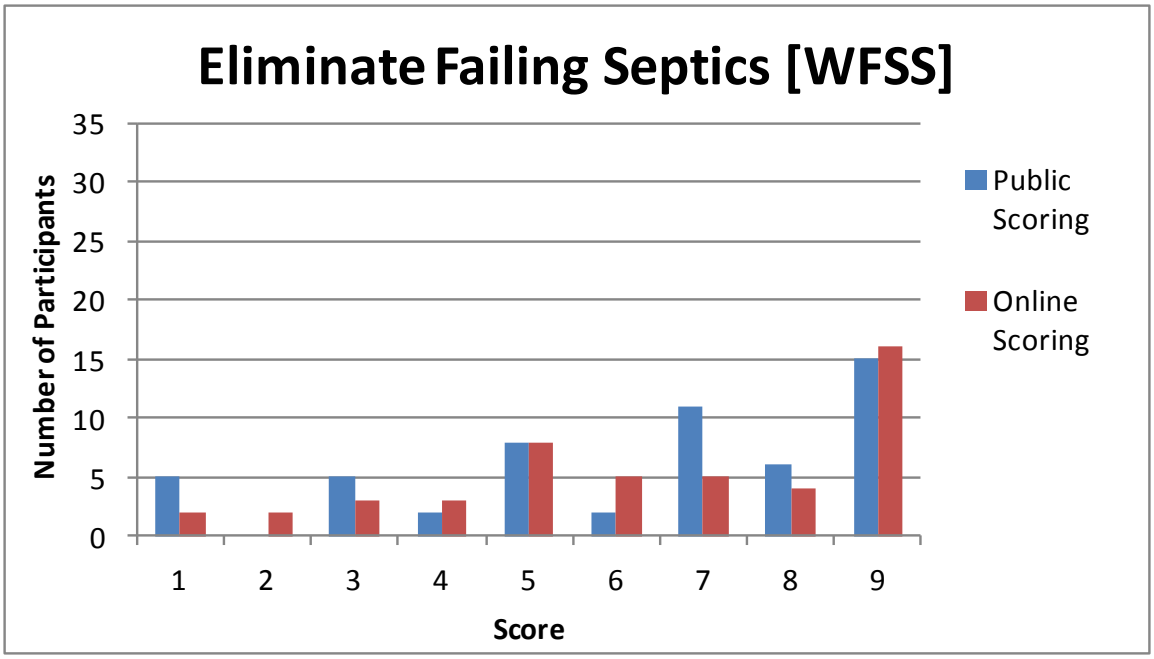



**Figure 6.6.1 Public Scores for Eliminating Failing Septics**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

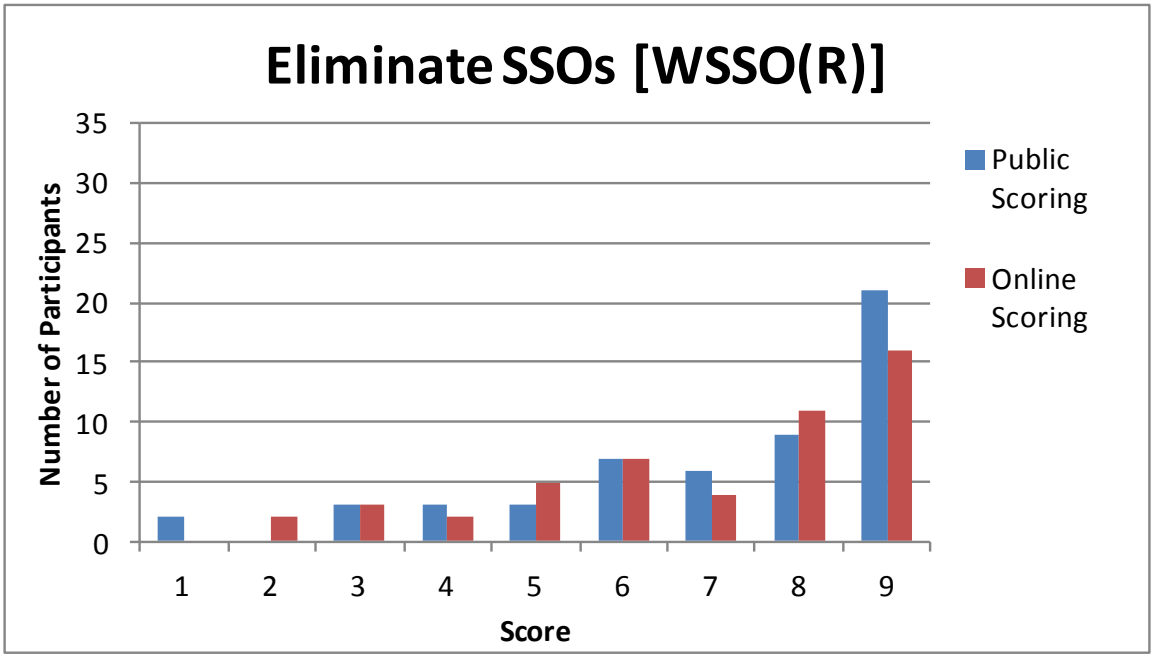



**Figure 6.6.2 Public Scores for Eliminating Sanitary Sewer Overflows through Repairing Existing Infrastructure**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

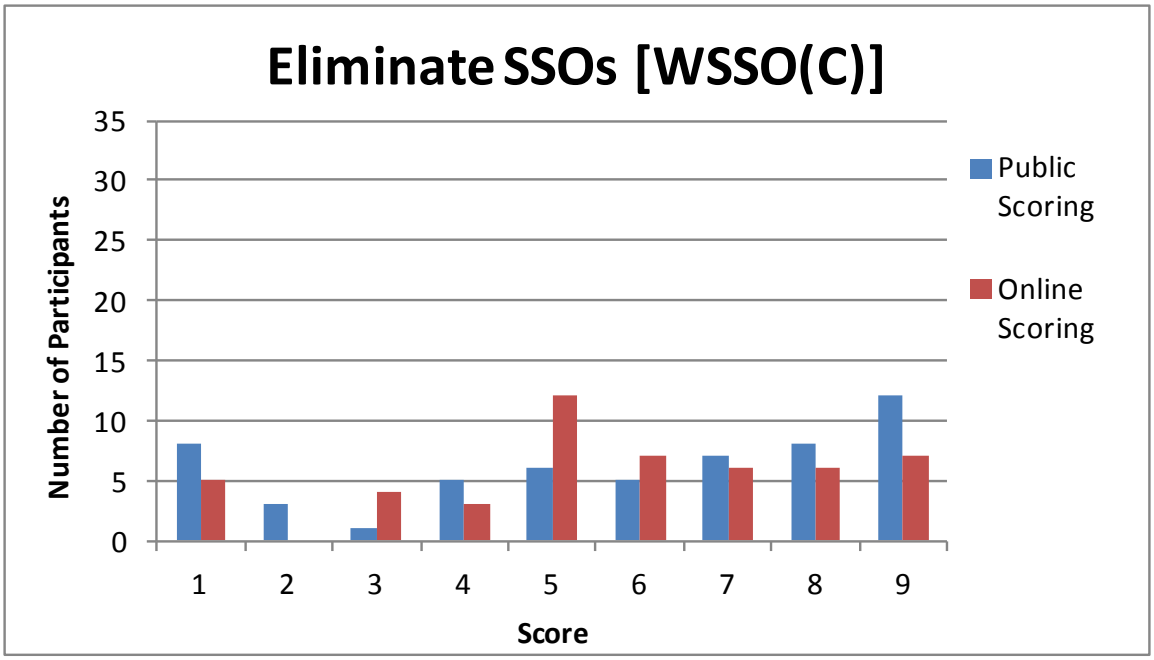



**Figure 6.6.3 Public Scores for Eliminating Sanitary Sewer Overflows through Increasing Capacity of Infrastructure**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

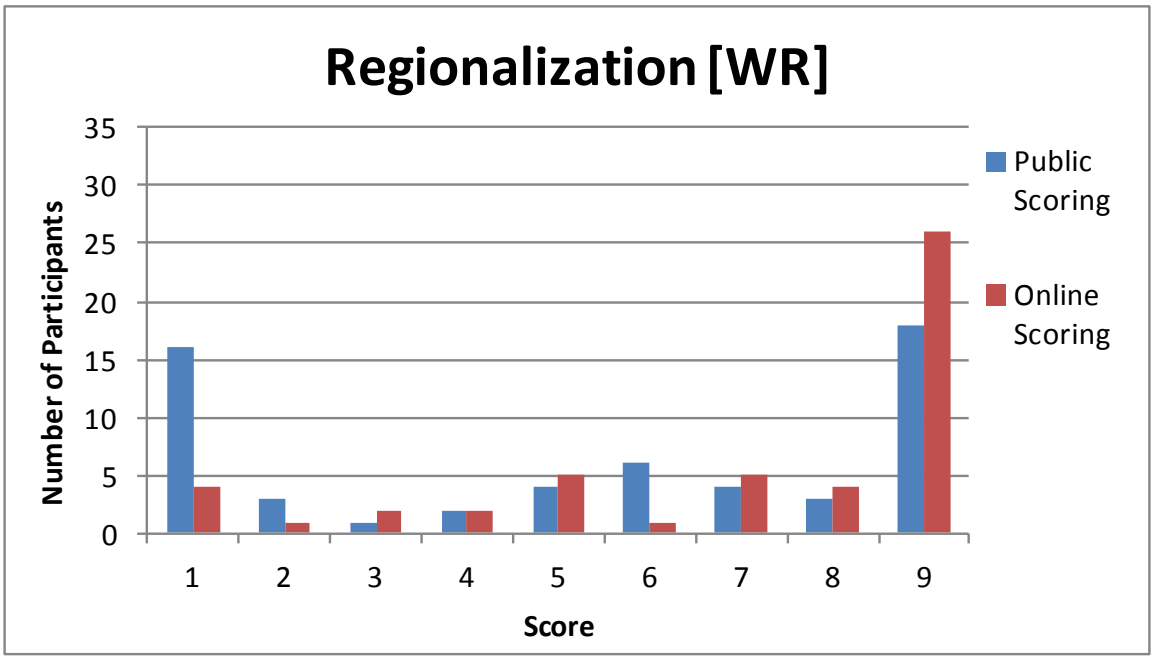



**Figure 6.6.4 Public Scores for Regionalization of Wastewater Treatment Plants**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

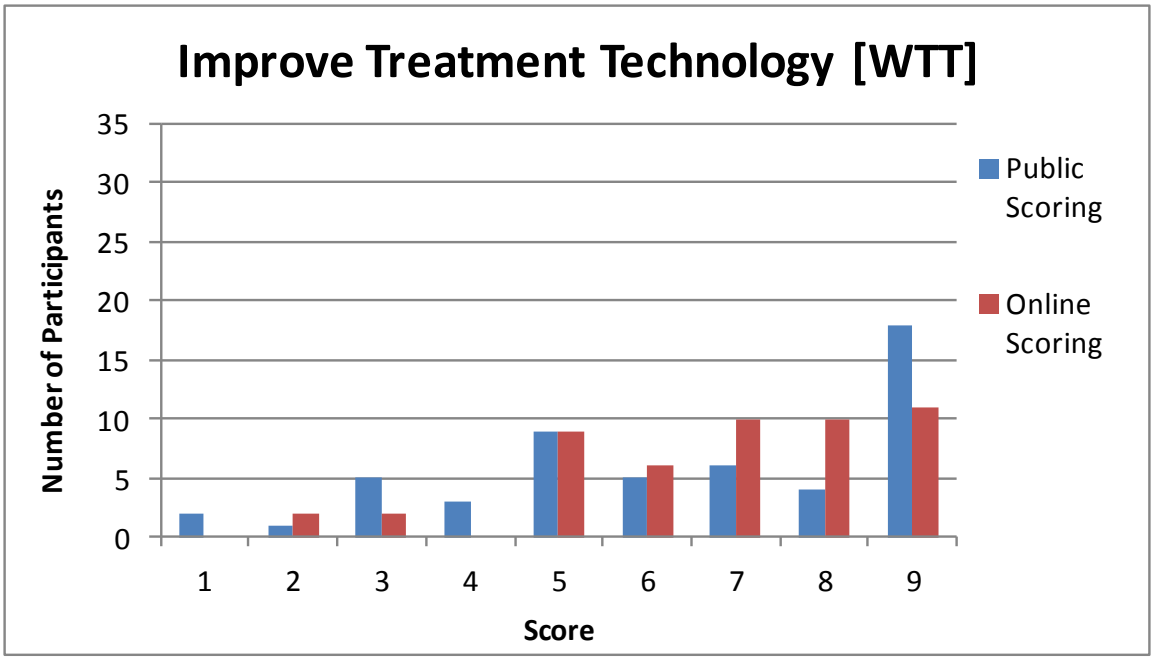



**Figure 6.6.5 Public Scores for Improving Treatment Technology in Existing Treatment Plants**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

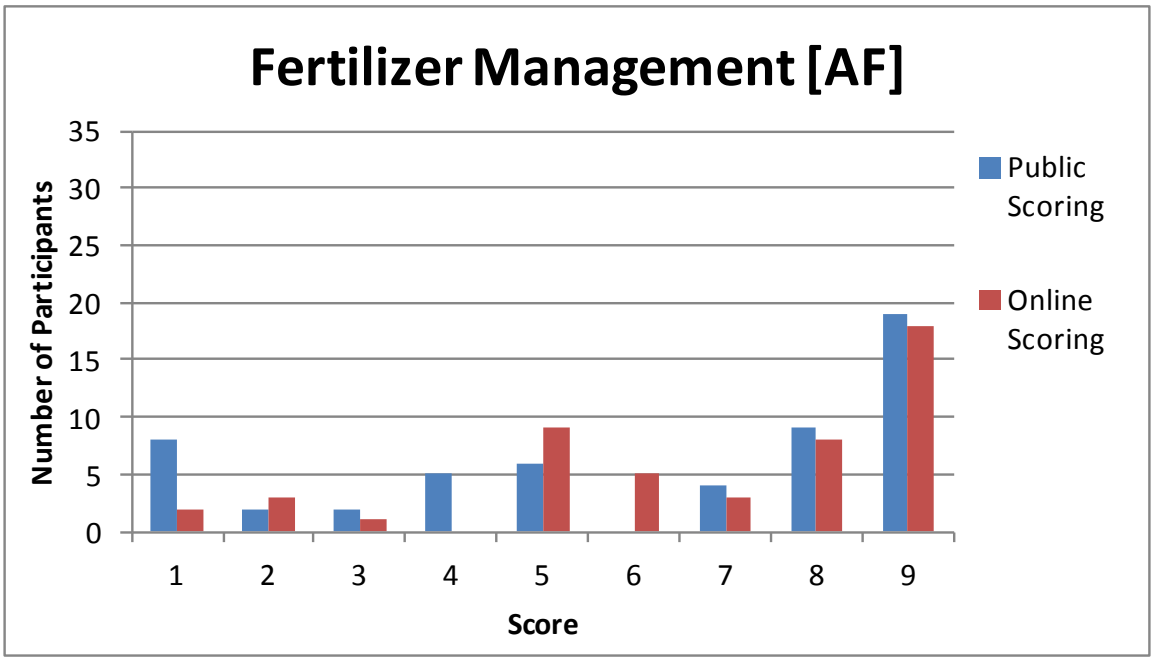



**Figure 6.6.6 Public Scores for Best Management of Agricultural Fertilizer**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

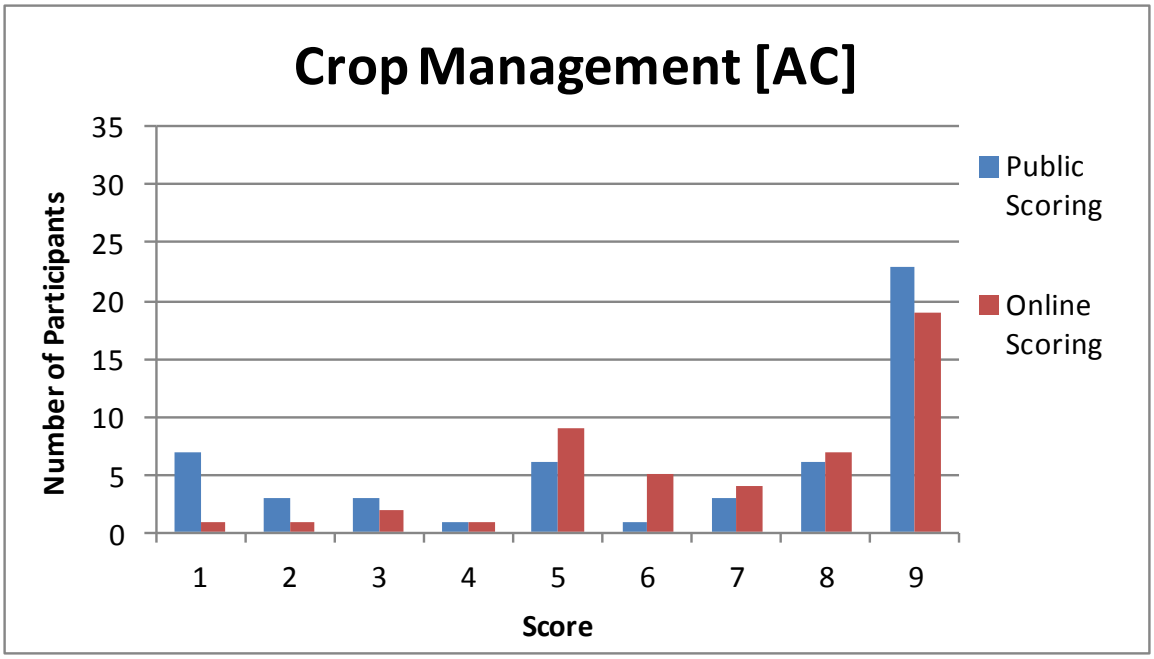



**Figure 6.6.7 Public Scores for Best Management of Agricultural Crops**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

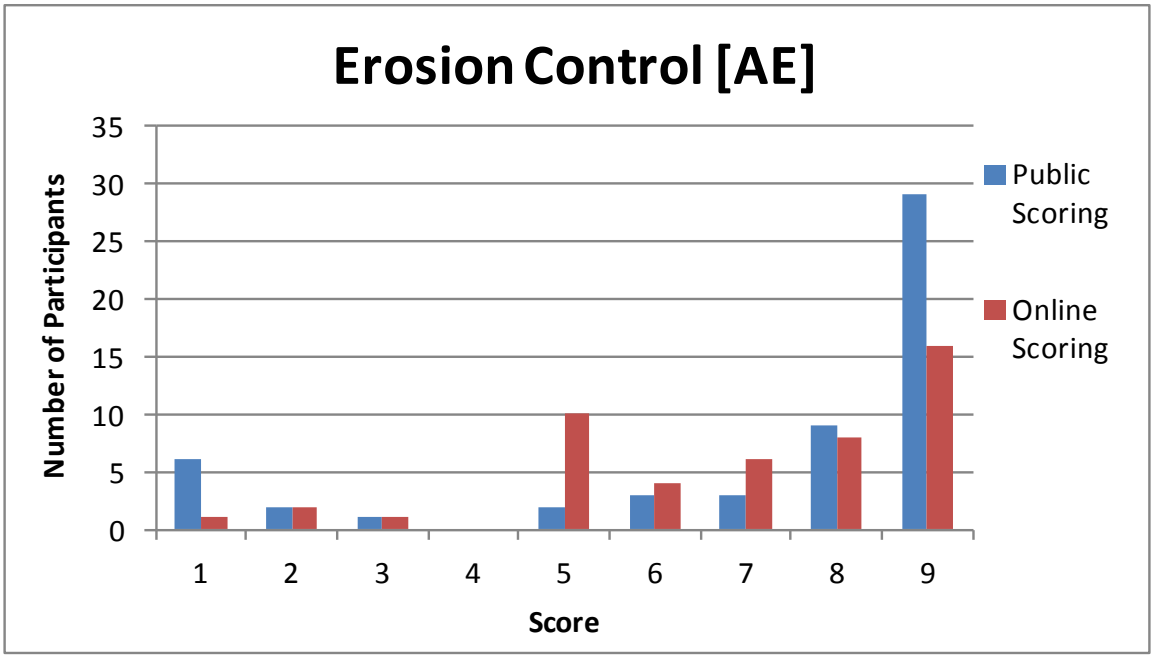



**Figure 6.6.8 Public Scores for Erosion Control Practices for Agricultural Operations**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

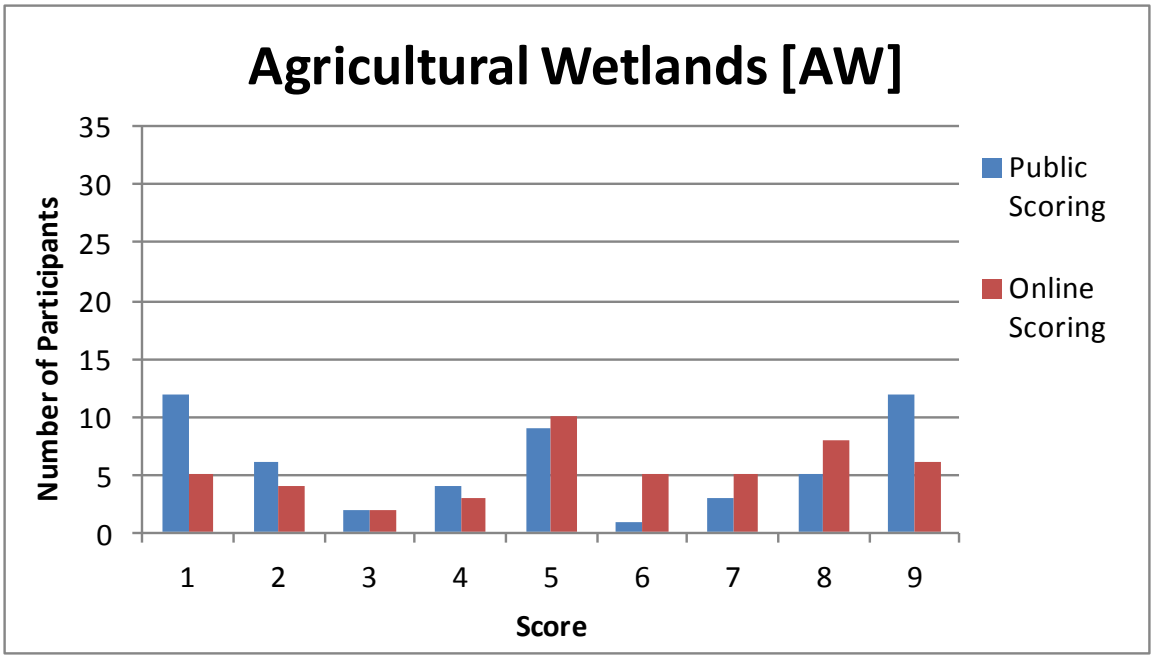



**Figure 6.6.9 Public Scores for Agricultural Wetlands**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

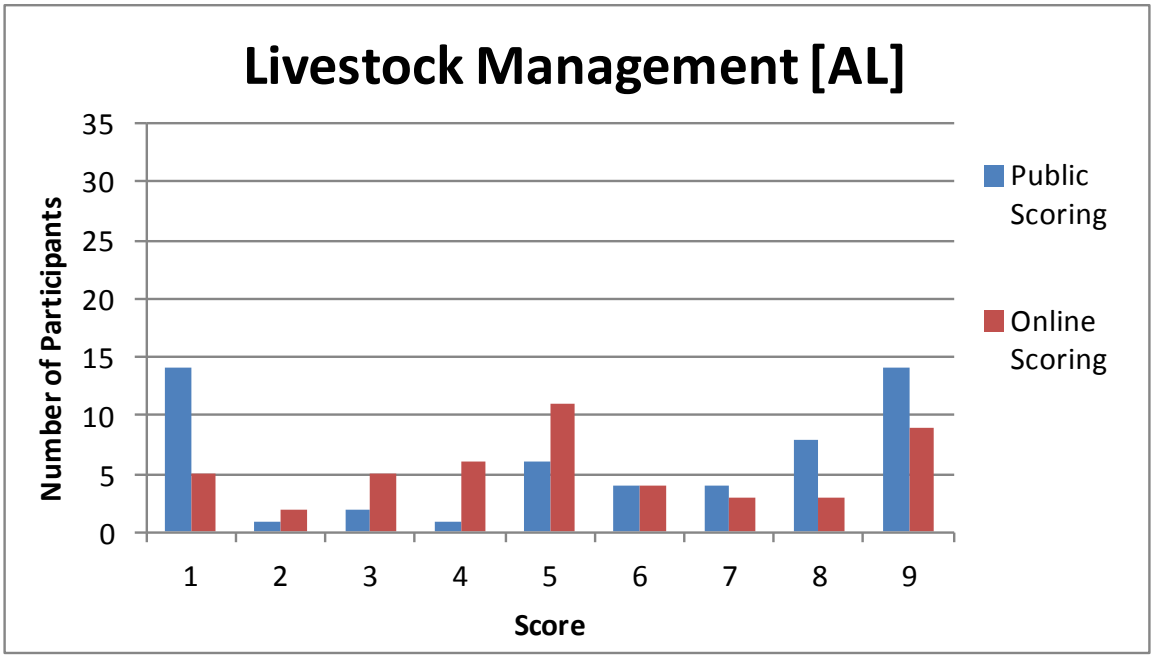



**Figure 6.6.10 Public Scores for Best Management of Livestock Operations**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

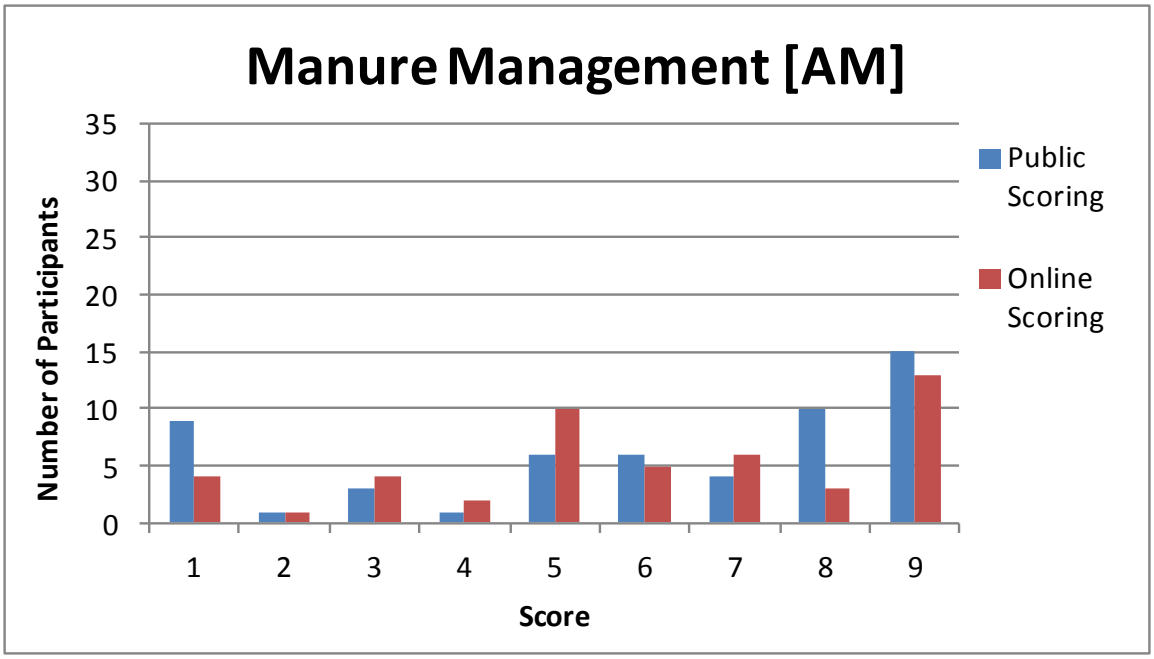



**Figure 6.6.11 Public Scores for Best Management of Manure Storage and Disposal**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

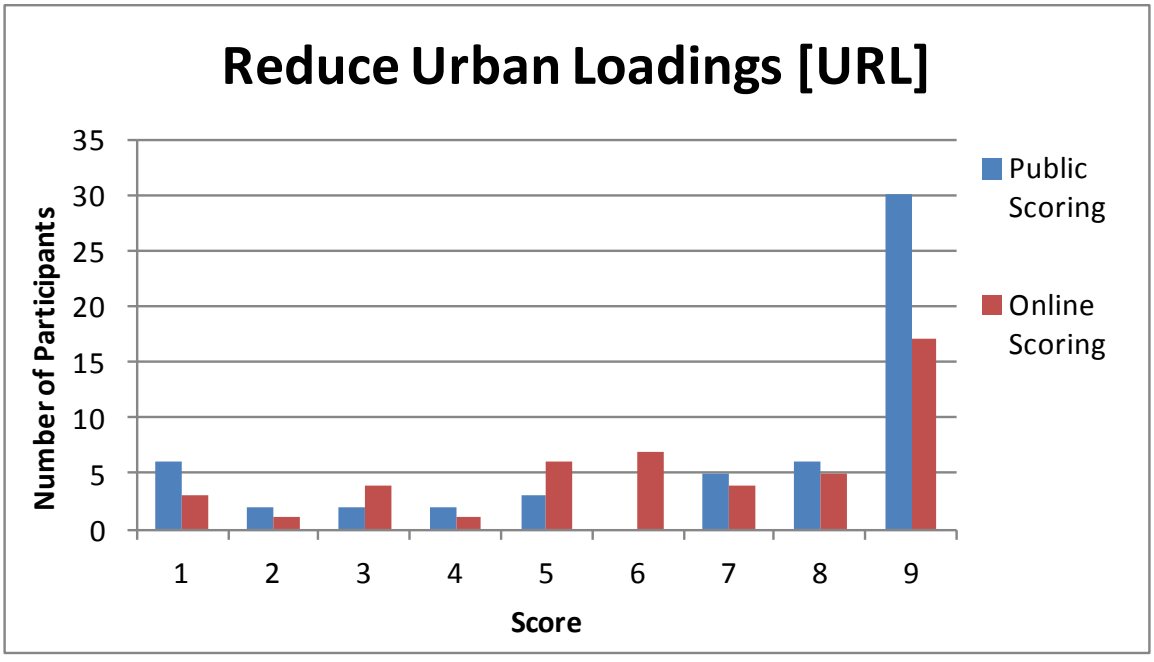



**Figure 6.6.12 Public Scores for Reducing Nutrient Loadings in Urban Watersheds**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

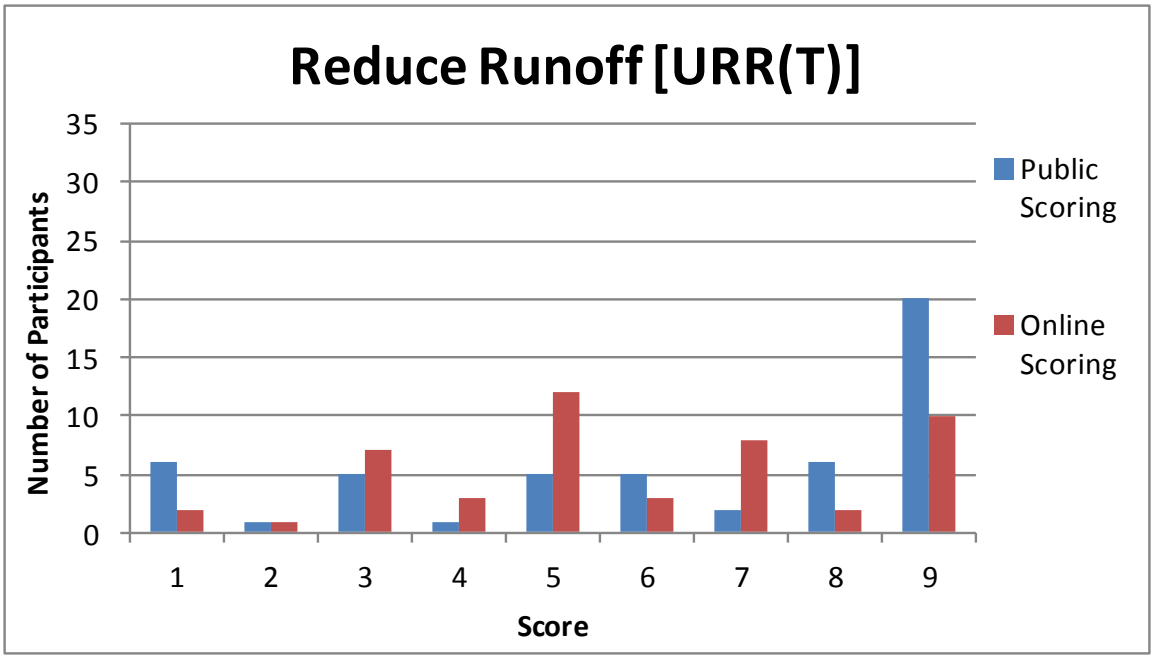



**Figure 6.6.13 Public Scores for Reducing Urban Runoff through Traditional Infrastructure**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

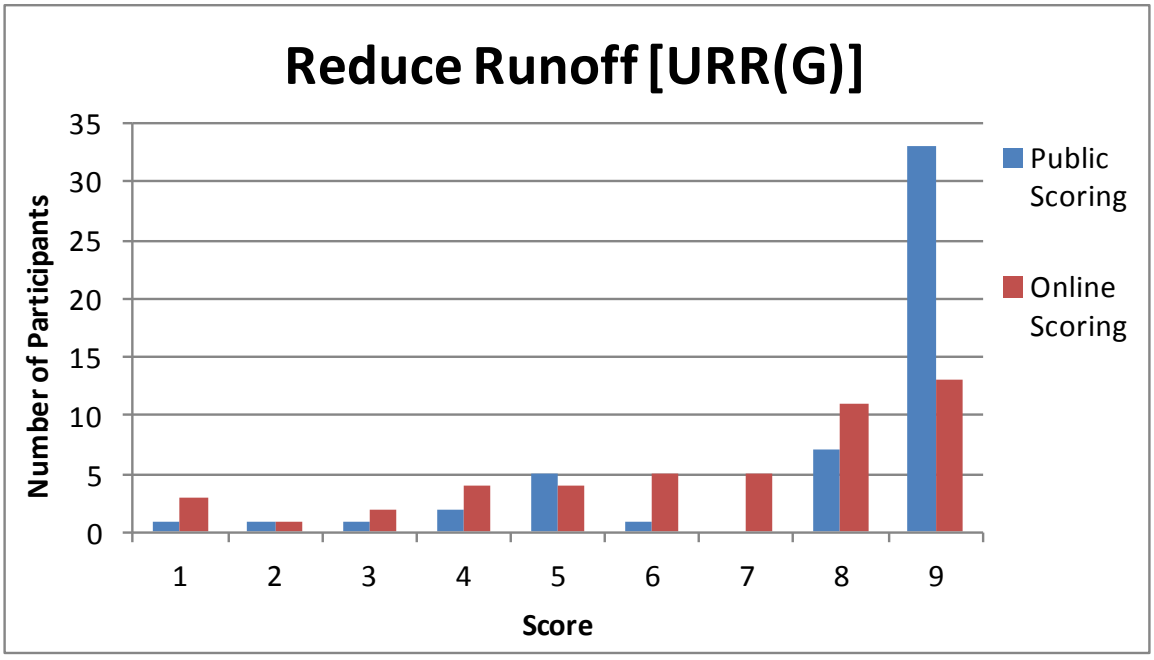



**Figure 6.6.14 Public Scores for Reducing Urban Runoff through Green Infrastructure**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

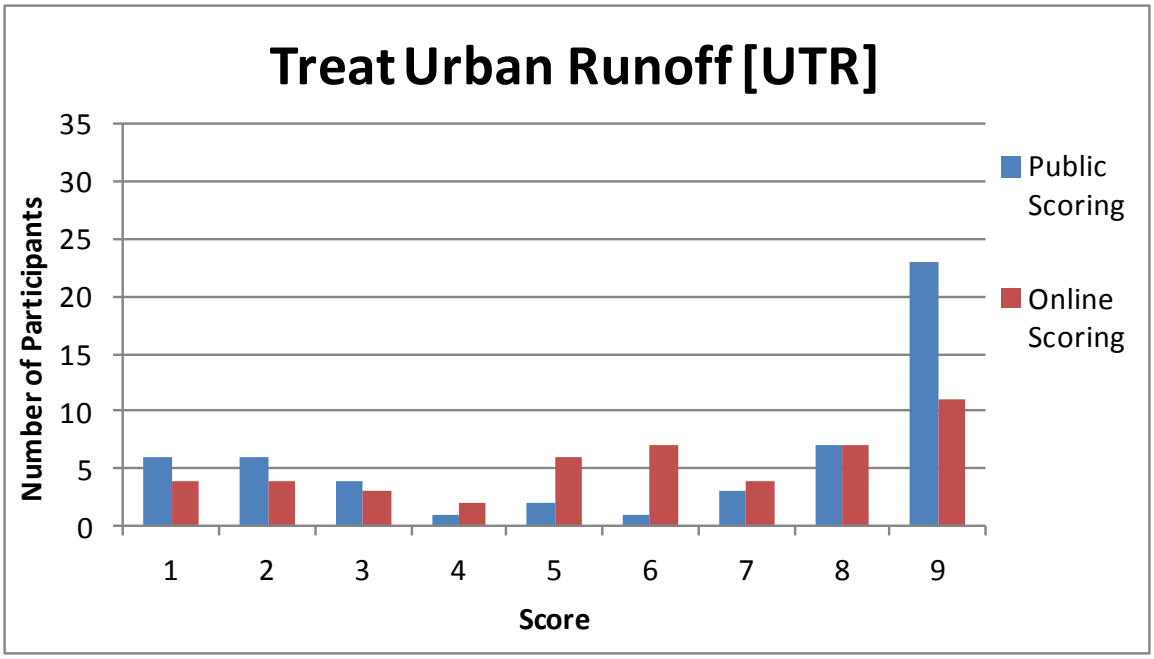



**Figure 6.6.15 Public Scores for Treating Urban Runoff**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

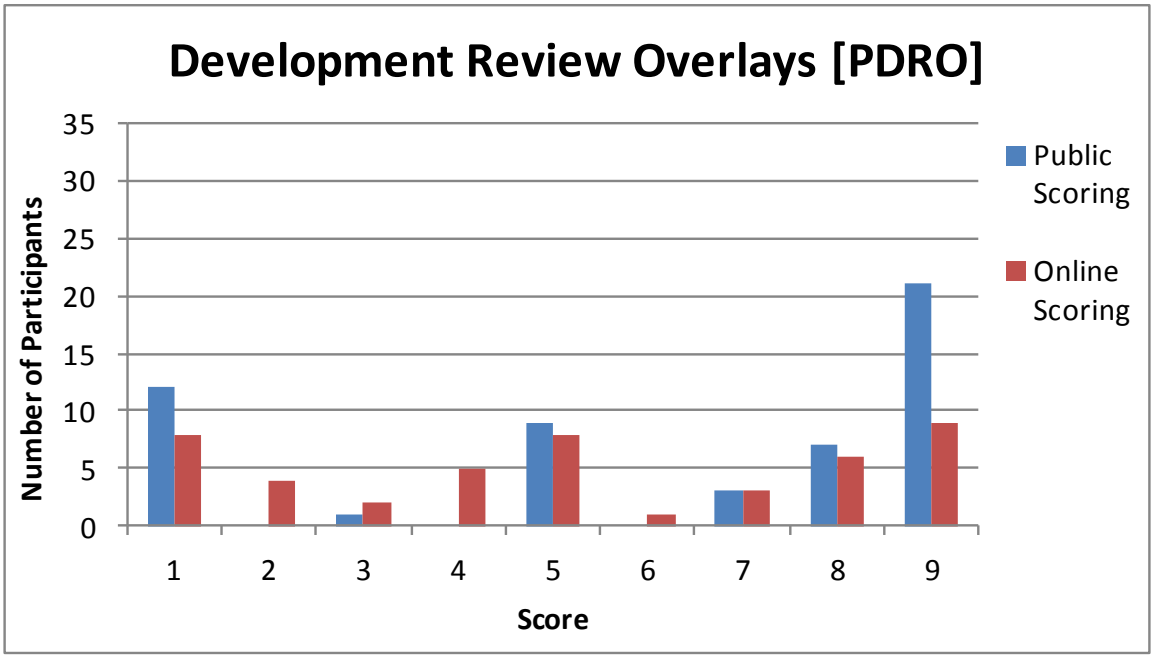



**Figure 6.6.16 Public Scores for Employing Development Review Overlays**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

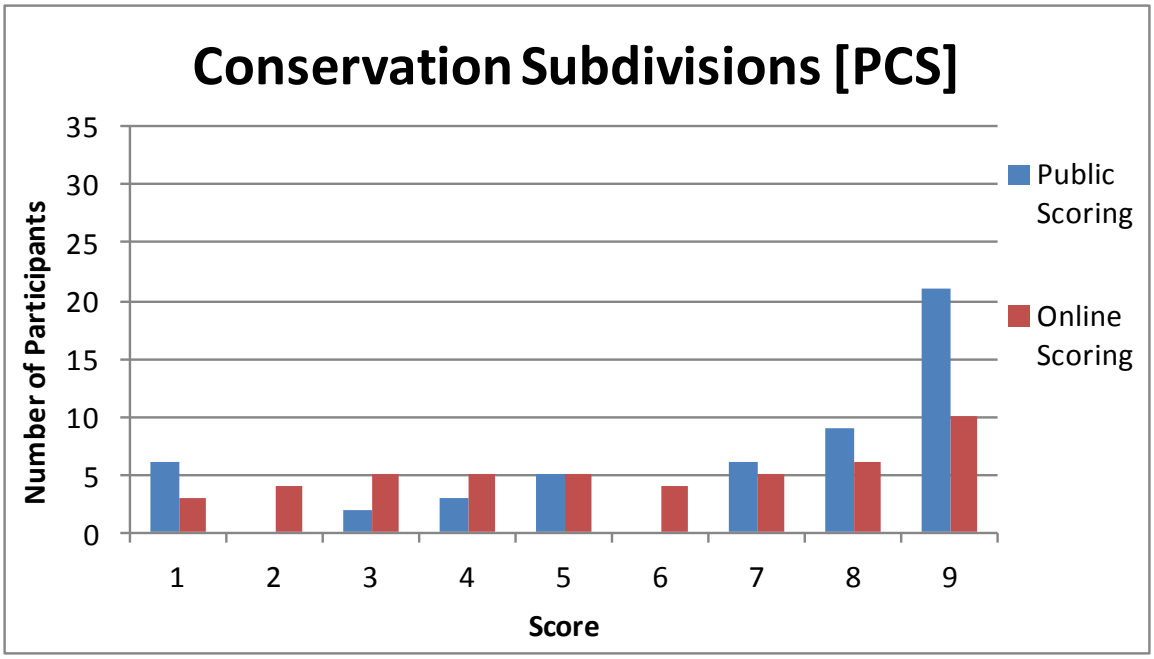



**Figure 6.6.17 Public Scores for Employing Conservation Subdivisions**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

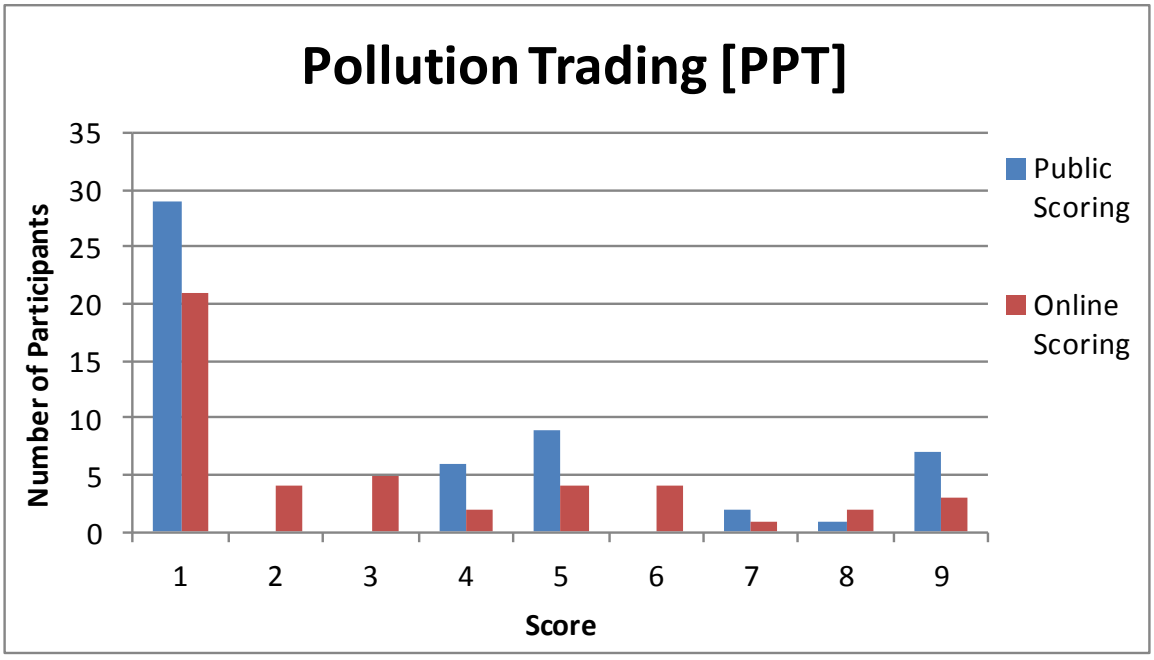



**Figure 6.6.18 Pubic Scores for Pollution Trading**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

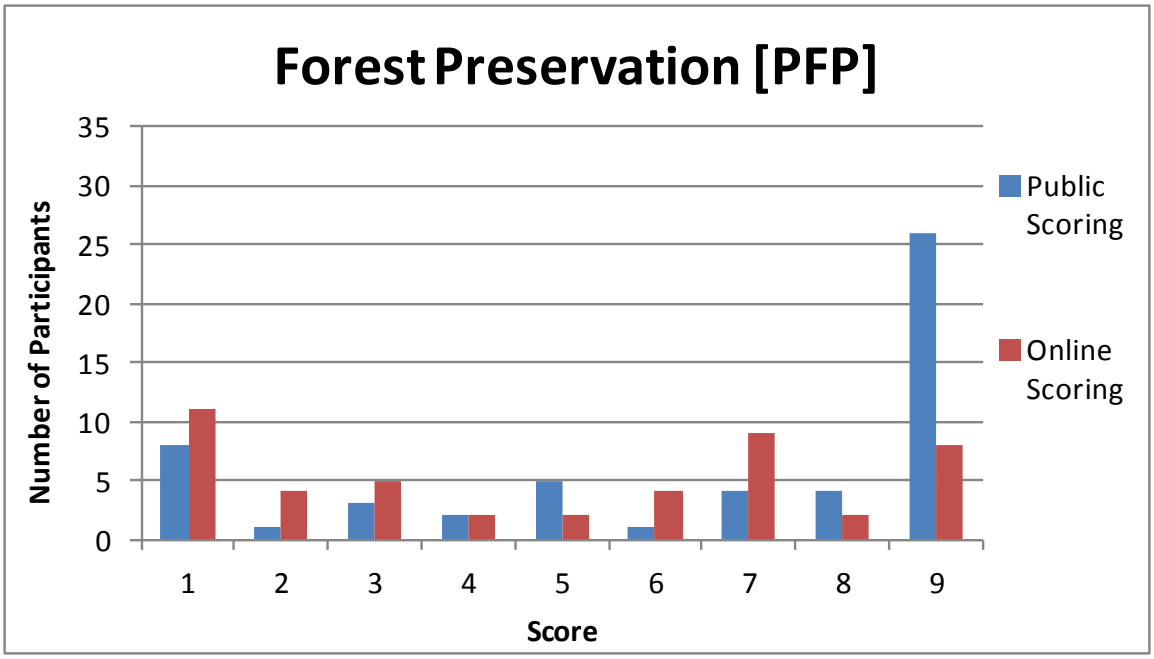



**Figure 6.6.19 Public Scores for Forest Preservation as Nutrient Management**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

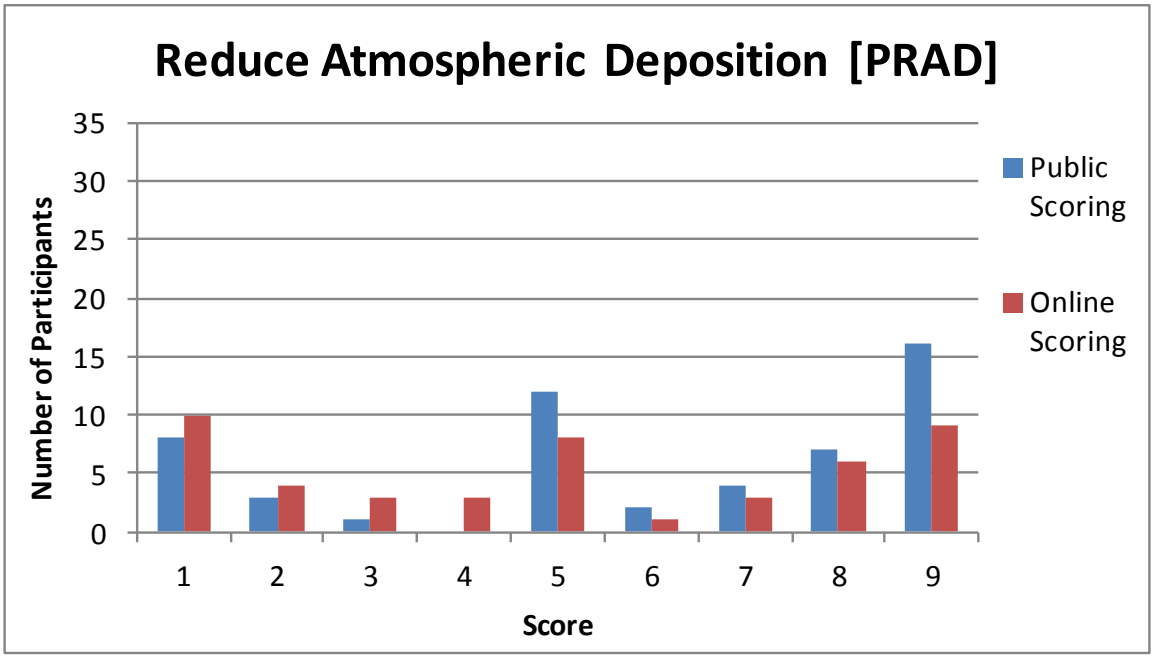



**Figure 6.6.20 Public Scores for Reducing Atmospheric Deposition as Nutrient Management**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

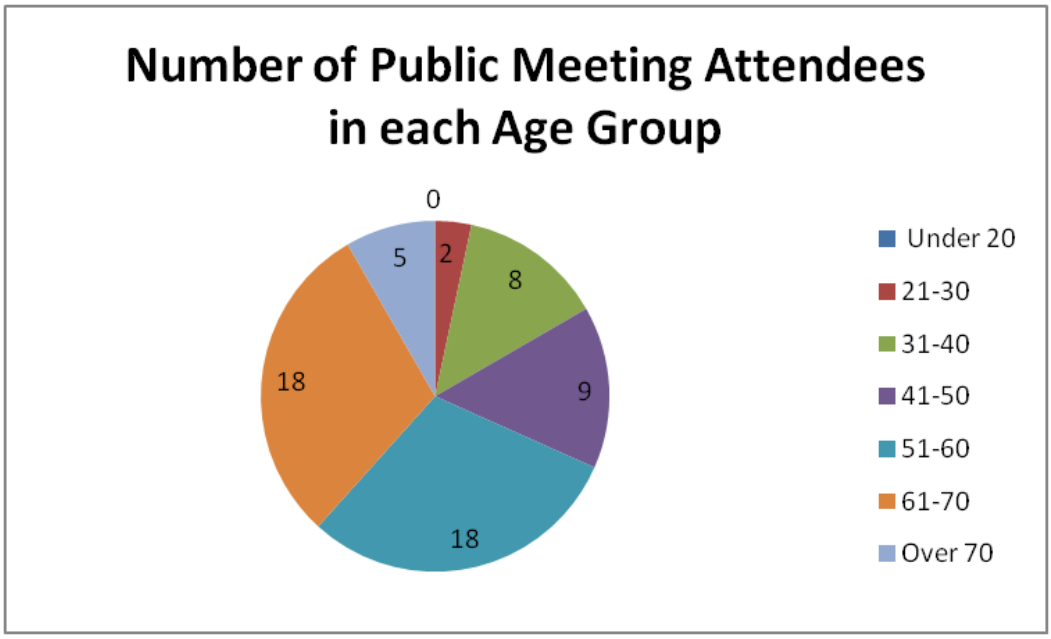



**Figure 6.6.21 Number of Public Meeting Attendees in each Age Group**

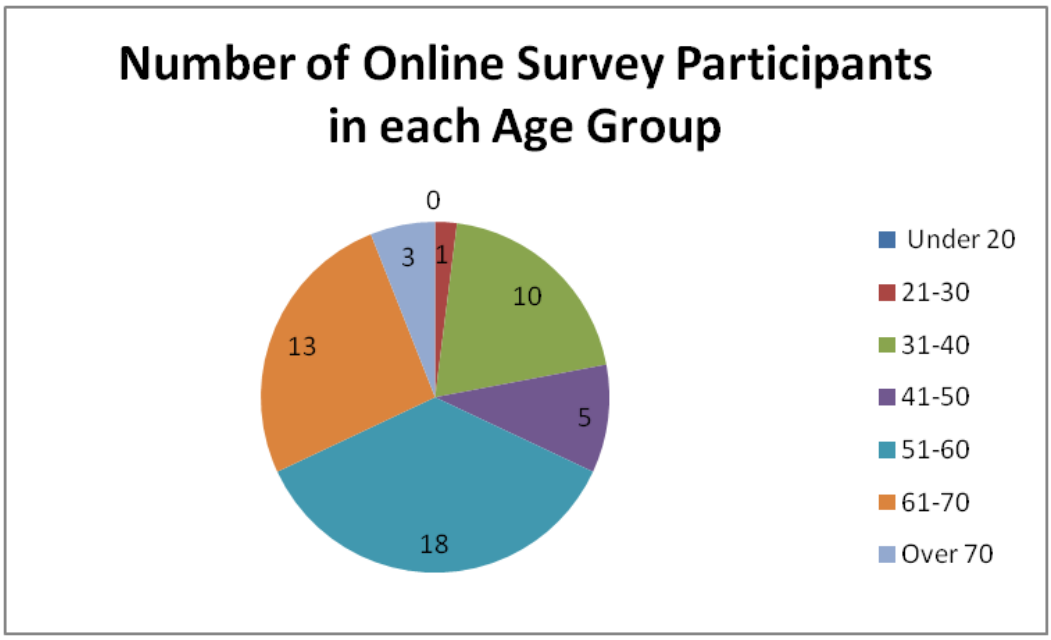



**Figure 6.6.22 Number of Online Survey Participants in each Age Group**

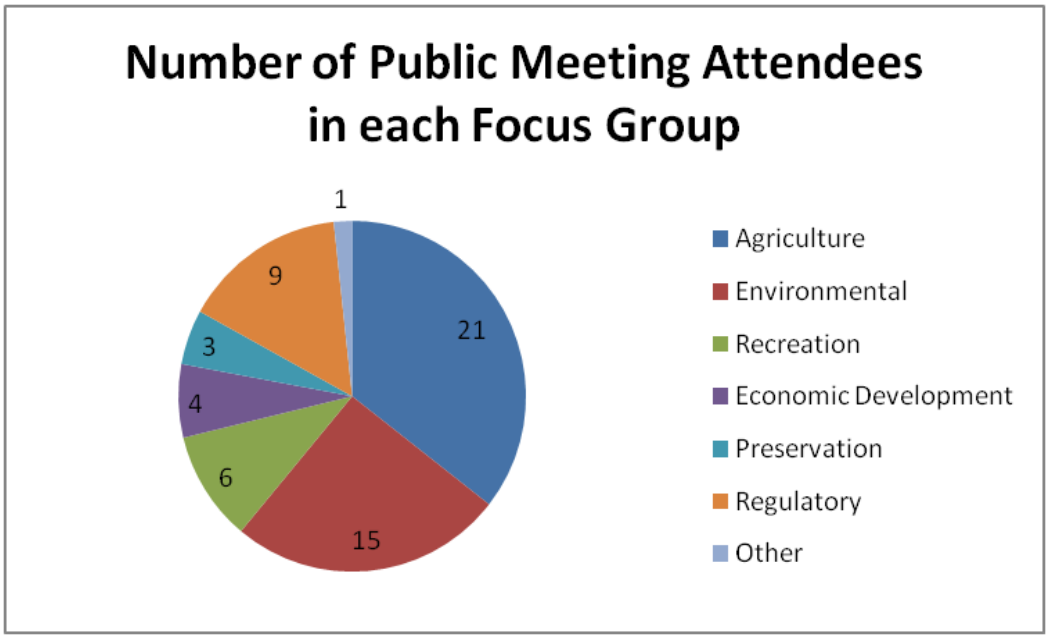



**Figure 6.6.23 Number of Public Meeting Attendees in each Focus Group**

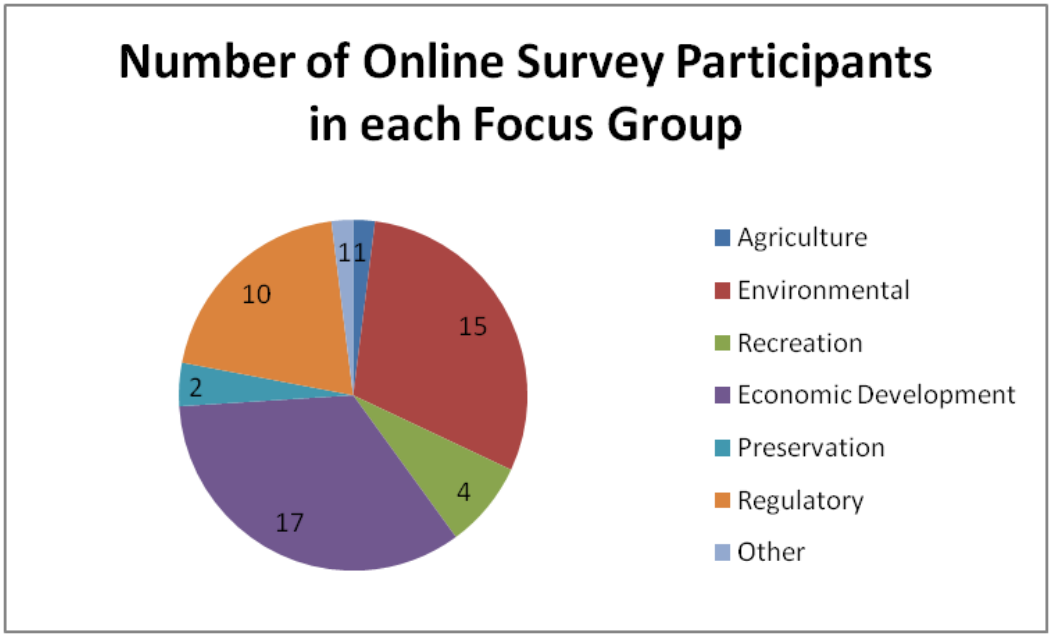



**Figure 6.6.24 Number of Online Survey Participants in each Focus Group**

### 6.6.1 Scenario Scoring Preferences by Age

Collection of demographic data such as age and gender allows for a more detailed examination of the BMP preferences. Breakouts of BMP preferences by age category are provided in Figures 6.6.25 - 6.6.28. While the general pattern of preference is often maintained across age groups, there are several differences. The size of the age groups varied considerably. Almost one-third of the participants were in the 51-60 age group followed closely in number by the 61-70 age group (28%). Only 3 individuals were in the 21-30 age group. This disparity in sample sizes could potentially bias the results compared to the general population of the community.

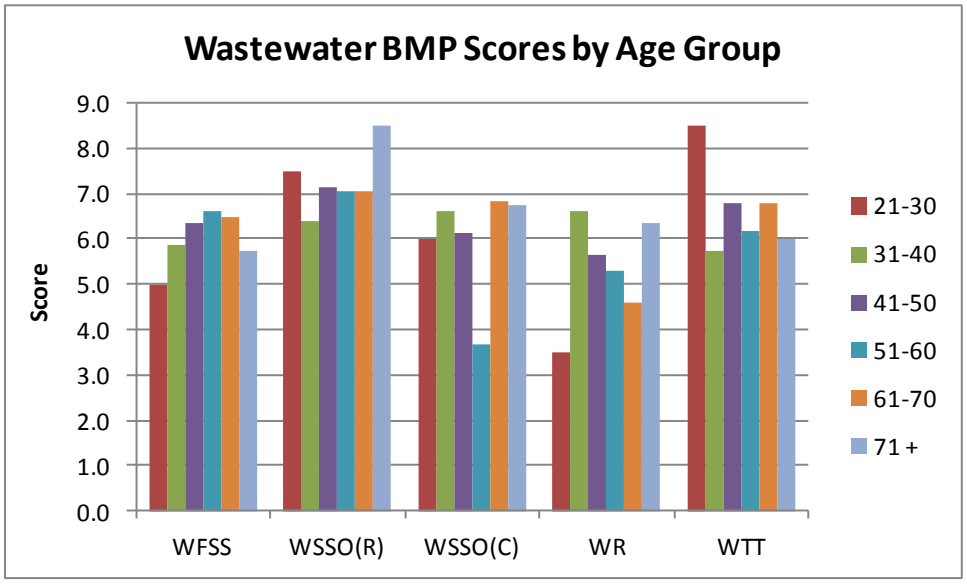



**Figure 6.6.25 Wastewater BMP Average Scores by Age Group**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

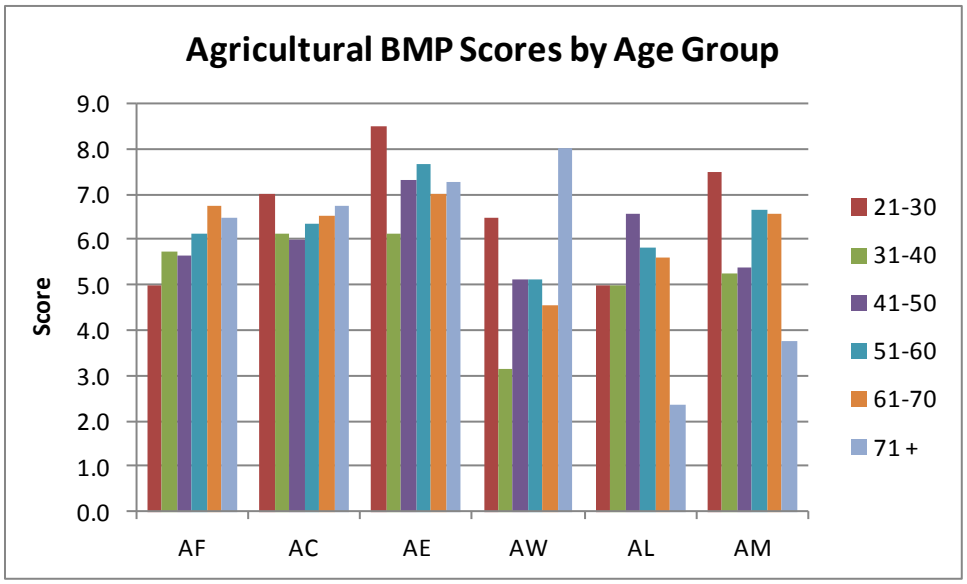



**Figure 6.6.26 Agricultural BMP Average Scores by Age Group**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

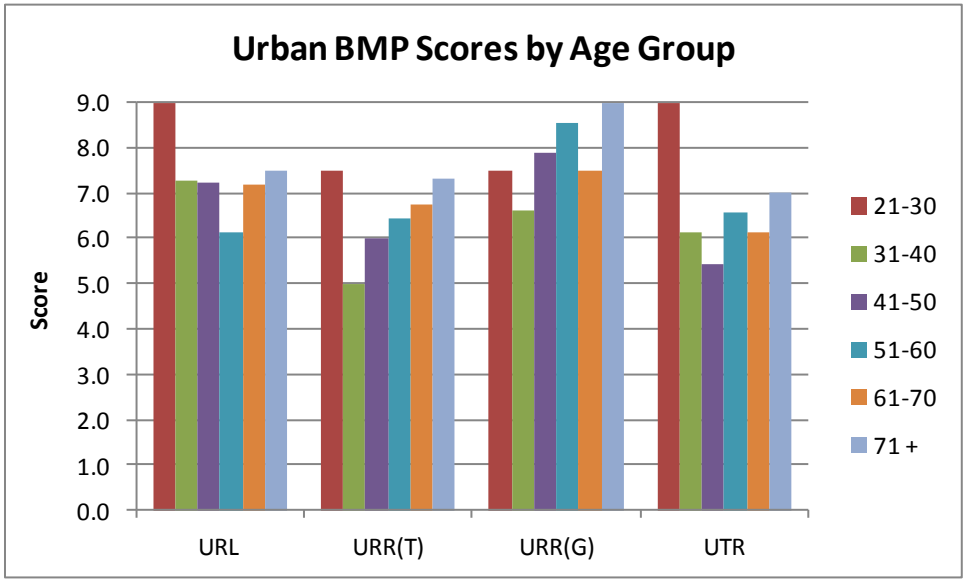



**Figure 6.6.27 Urban BMP Average Scores by Age Group**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

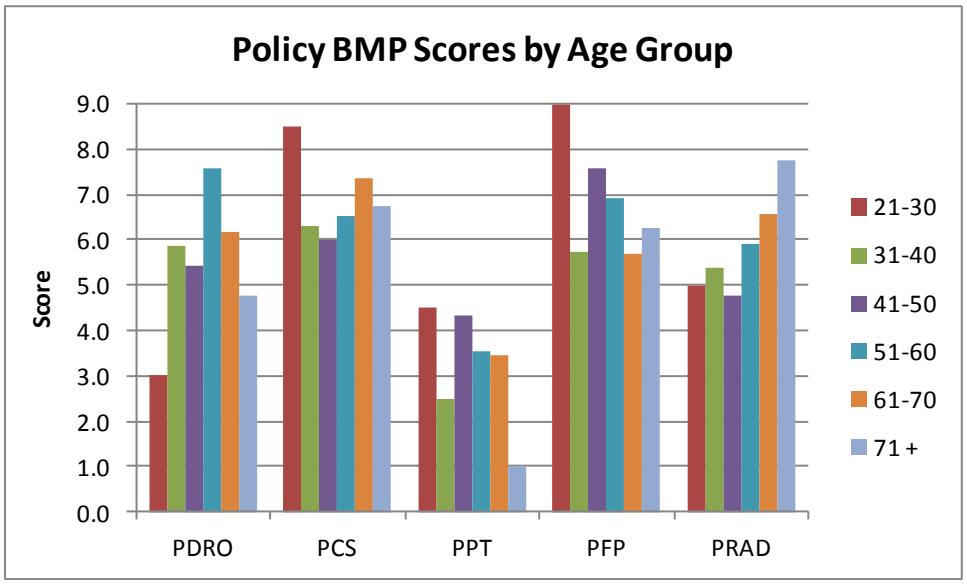



**Figure 6.6.28 Policy BMP Average Scores by Age Group**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

### 6.6.2 Scenario Scoring Preferences by Gender

A breakout of BMP preferences by gender is provided in Figure 6.6.29. Over 70% of the participants were male (Figure 6.5.2). However, the relative preferences between men and women were generally consistent with the average scores typically exhibiting differences of no more than one unit. All average scores by gender were within 1.5 units. Average scores from females were higher than males for 11 BMPs, while average scores from males exceeded female scores for 9 BMPs. It does not appear that balancing the gender composition of the participants would yield greatly different summary results.

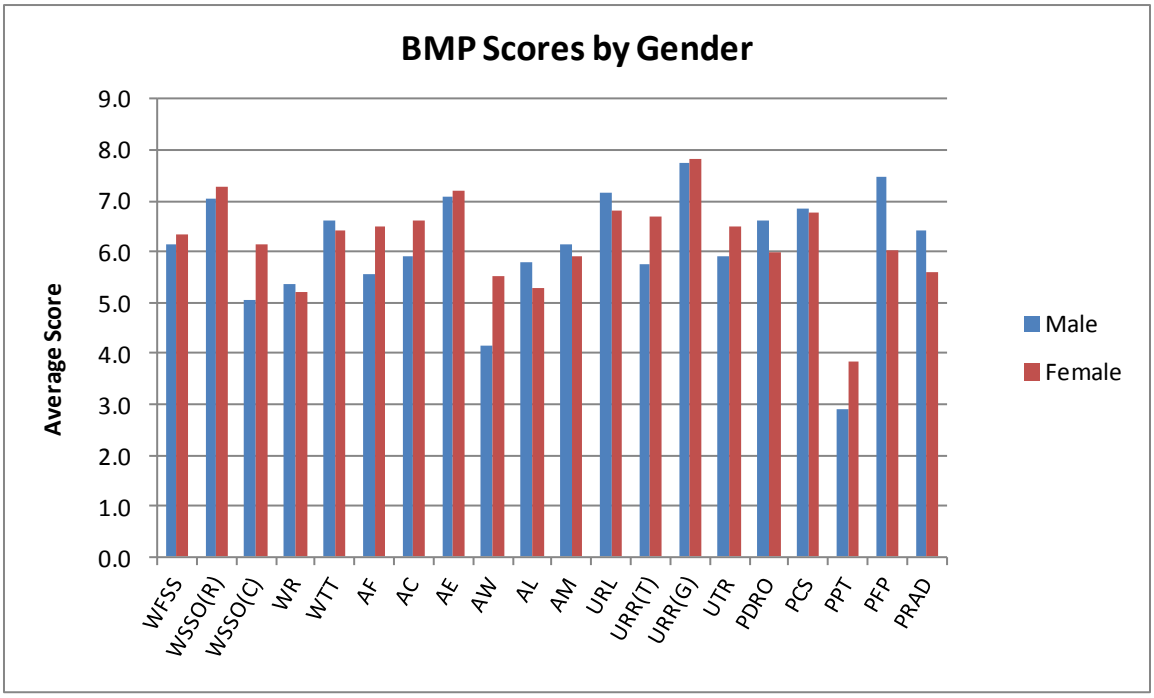



**Figure 6.6.29 BMP Average Scores by Gender**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

### 6.6.3 Scenario Scoring Preferences by Place of Residence

Breakouts of BMP preferences by county of residence are provided in Figures 6.6.30 - 6.6.33. Almost two-thirds of the participants resided in Jefferson County (Figure 6.5.3). Small numbers from the other counties may render the average scores from those counties somewhat suspect as being representative, particularly for Shelby and Henry Counties.

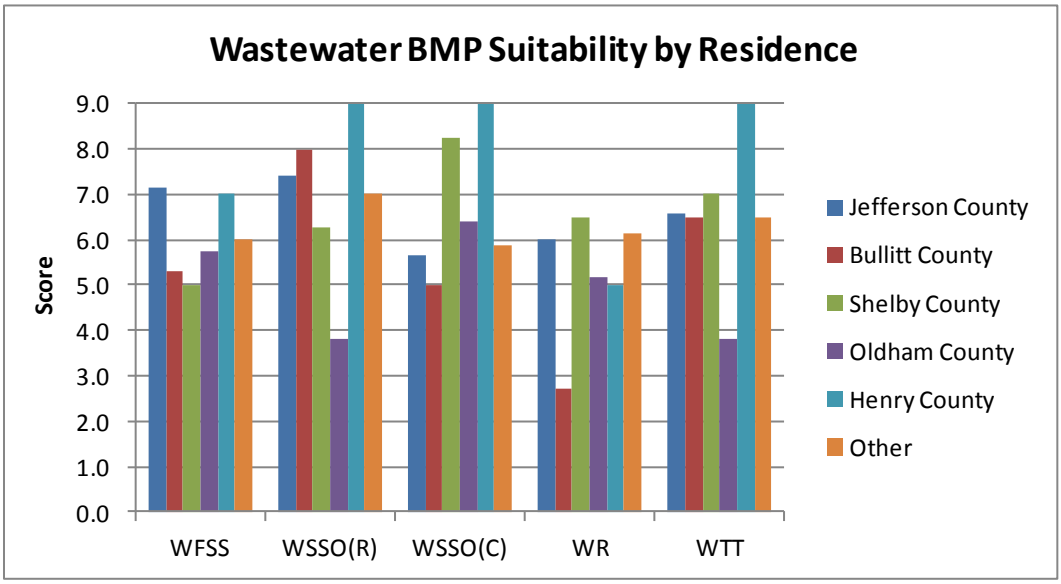



**Figure 6.6.30 Wastewater BMP Average Scores by Place of Residence**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

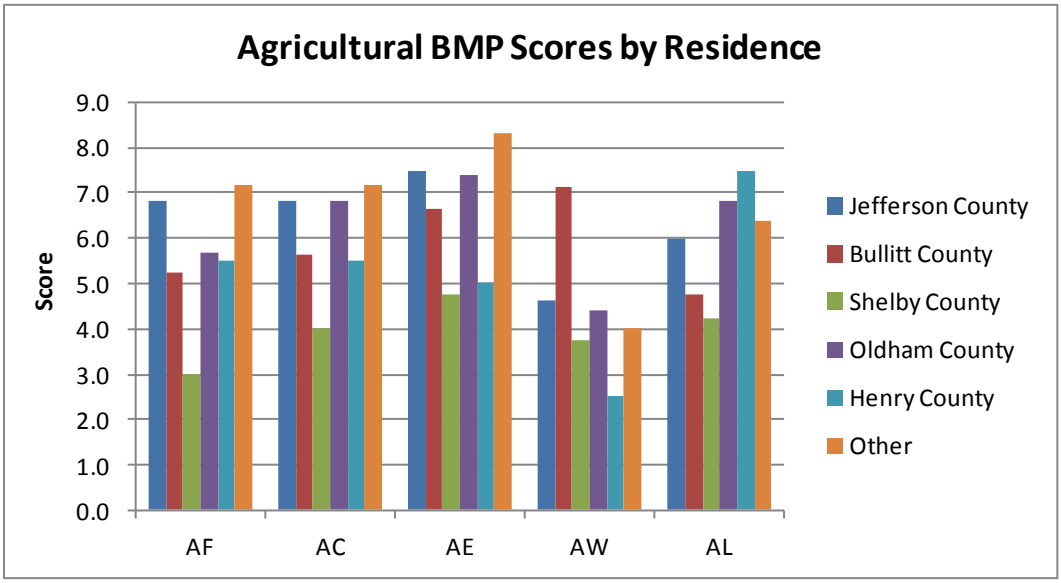



**Figure 6.6.31 Agricultural BMP Average Scores by Place of Residence**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

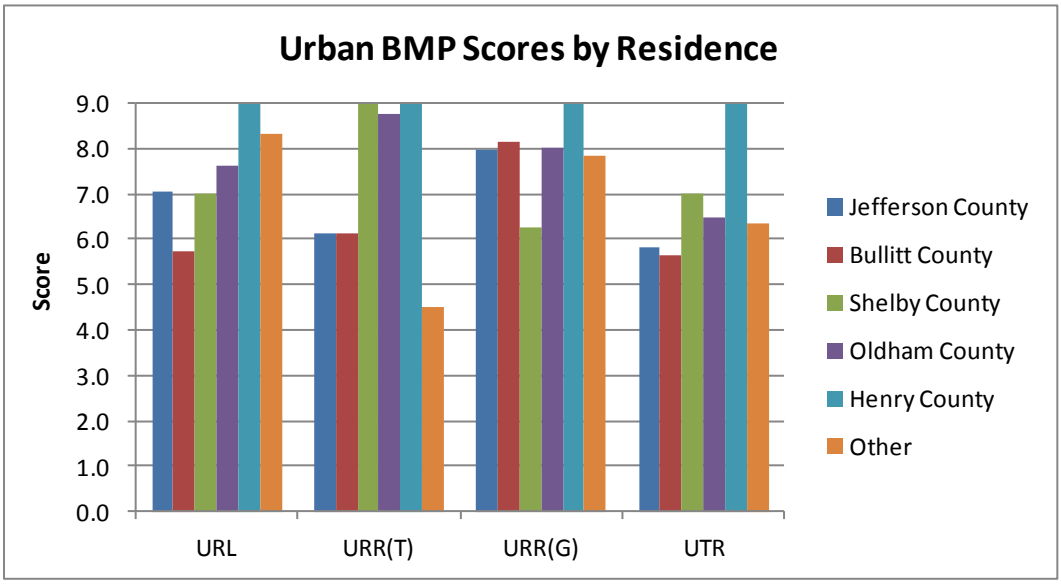



**Figure 6.6.32 Urban BMP Average Scores by Place of Residence**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

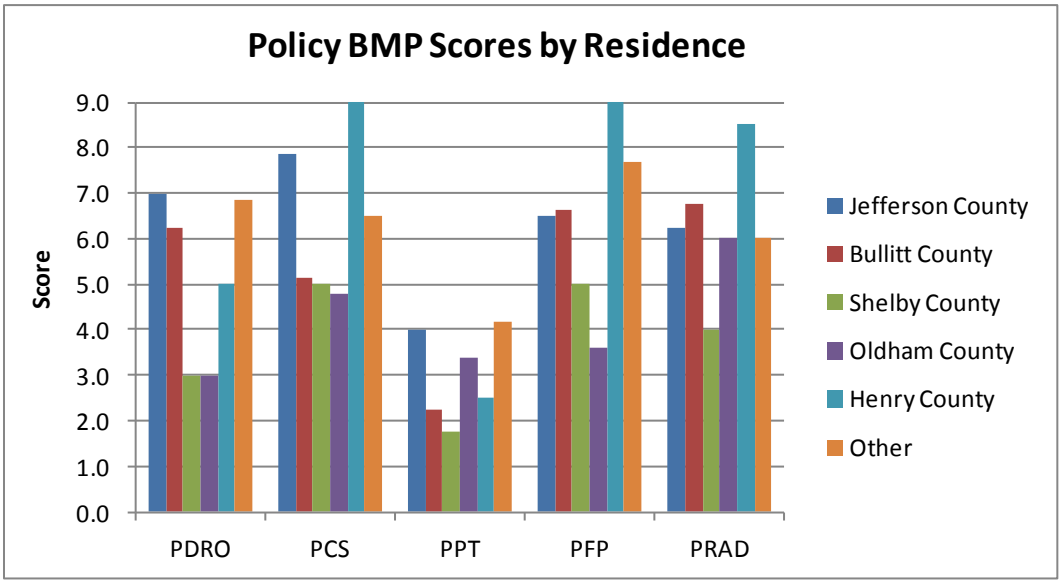



**Figure 6.6.33 Policy BMP Average Scores by Place of Residence**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

## 6.7 BMP PREFERENCES BY SCORING EVENT

Twenty nutrient BMPs (Table 6.7.1) were scored at 3 public meetings (Middletown, LaGrange, and Shepherdsville) and online. Most BMPs had fairly consistent scores as illustrated in Figures 6.7.1 - 6.7.4, but several BMPs showed more variability. The wastewater BMP scores for eliminating sanitary sewer overflows by increasing capacity (WSSO(C)) and wastewater regionalization (WR) had low levels of support at the Shepherdsville scoring event. The use of agricultural wetlands (AW) had higher scores at Shepherdsville than at the other venues. The use of development review overlays (PDRO) was less popular at the La Grange meeting and online than the results from Middletown and Shepherdsville.

**Table 6.7.1 List of Nutrient BMPs for Public Scoring Meetings**

| BMP ID | Best Management Practice (BMP) Description |
|---|---|
| Wastewater IDs (W-) | |
| WFSS | Eliminate Failing Septic Systems |
| WSSO(R) | Eliminate Sanitary Sewer Overflow (by Infrastructure Repair) |
| WSSO(C) | Eliminate Sanitary Sewer Overflow (by Increasing Capacity) |
| WR | Regionalization |
| WTT | Improve Nutrient Treatment Technologies |
| Agriculture IDs (A-) | |
| AF | Fertilizer Management |
| AC | Crop Management |
| AE | Erosion Control |
| AW | Agricultural Wetlands |
| AL | Livestock Management |
| AM | Manure Management |
| Urban IDs (U-) | |
| URL | Reduce Loadings (lawn fertilizer and pet litter) |
| URR(T) | Reduce Runoff with Traditional Infrastructure |
| URR(G) | Reduce Runoff with Green Infrastructure |
| UTR | Treat Runoff |
| Policy IDs (P-) | |
| PDRO | Development Review Overlays |
| PCS | Conservation Subdivisions |
| PPT | Pollution Trading |
| PFP | Forest Preservation |
| PRAD | Reduce Atmospheric Deposition (Nitrogen Air Emissions) |

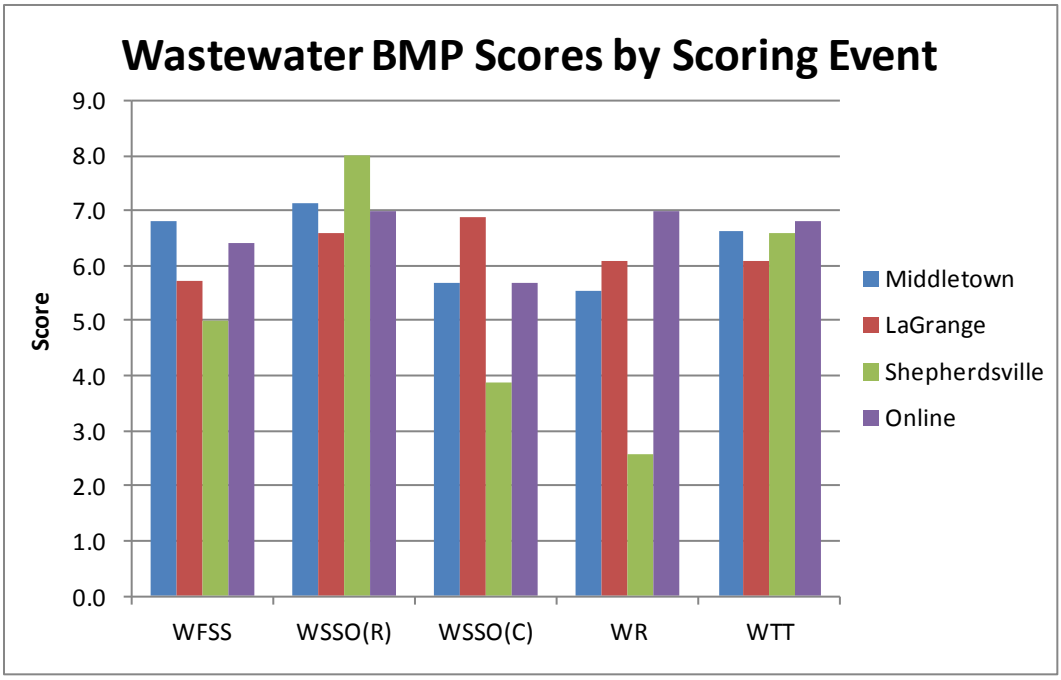



**Figure 6.7.1 Wastewater BMP Average Scores by Scoring Event**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

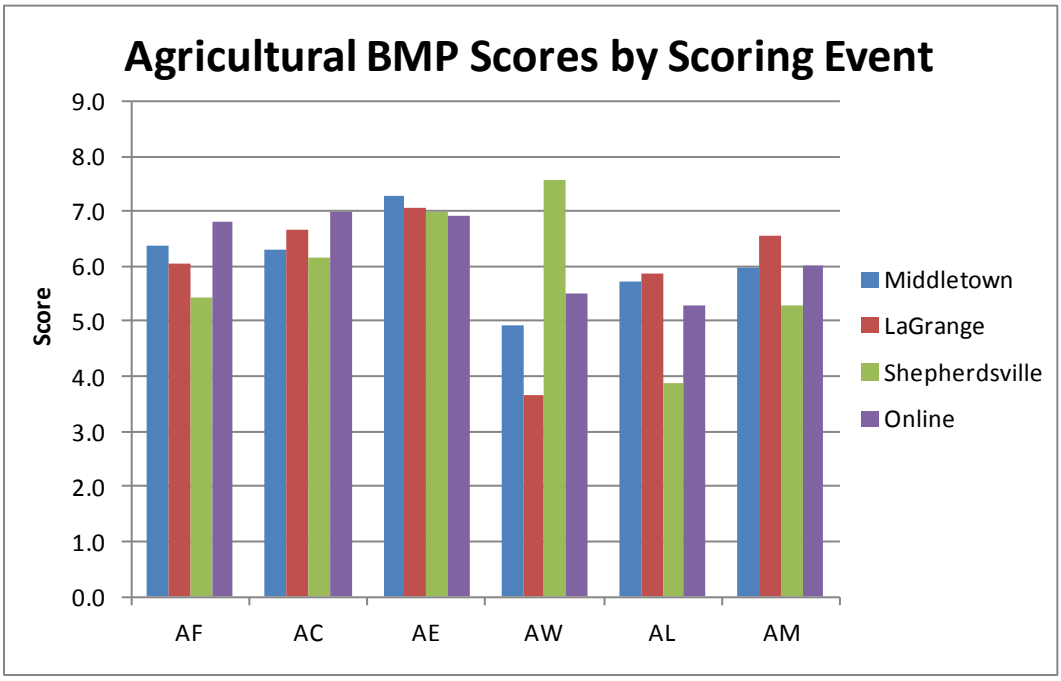



**Figure 6.7.2 Agricultural BMP Average Scores by Scoring Event**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

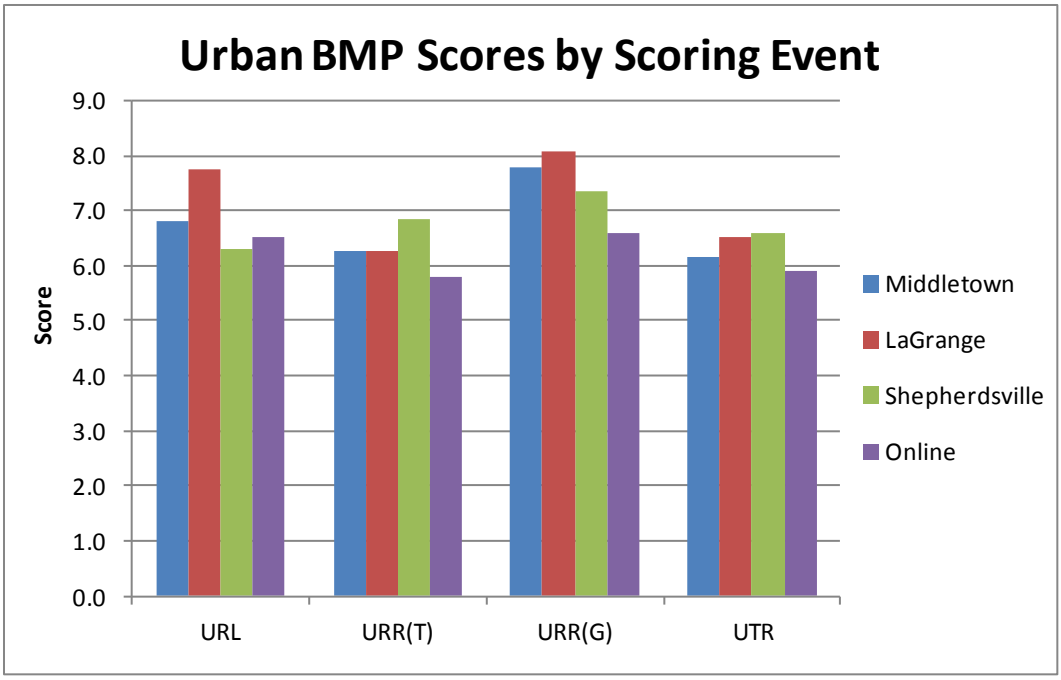



**Figure 6.7.3 Urban BMP Average Scores by Scoring Event**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

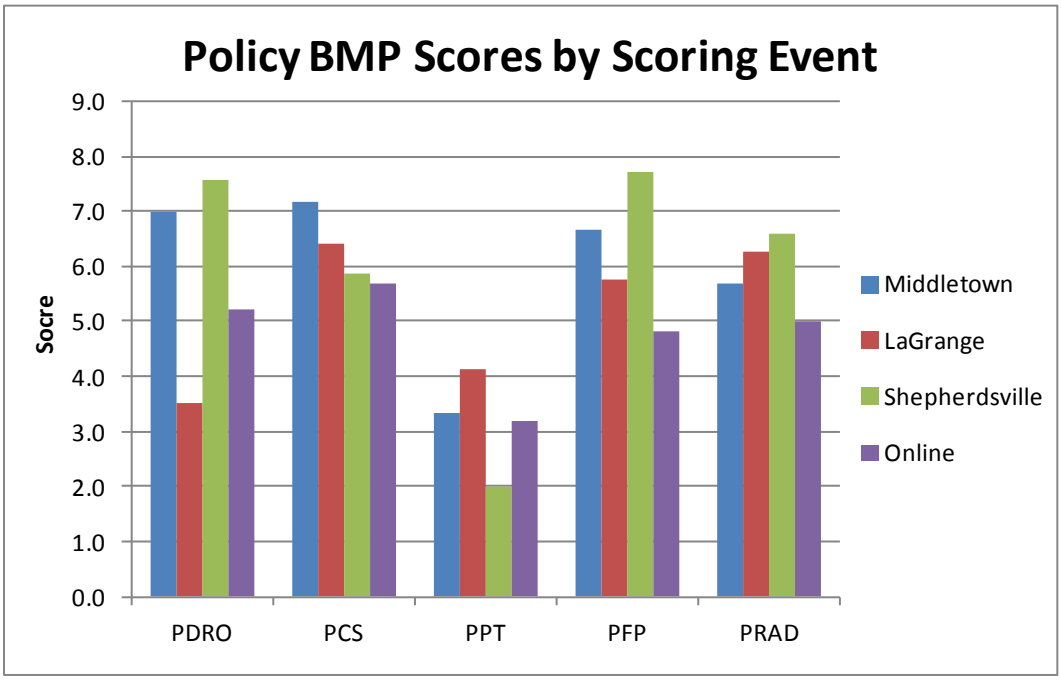



**Figure 6.7.4 Policy BMP Average Scores by Scoring Event**
**(Score of 1 = least preferable and a Score of 9 = most preferable)**

Additional comparisons can be made between the results of the focus group meetings and the public meeting/online BMP scores. Table 6.7.2 lists the BMPs considered at the time of the focus group meetings. In making comparisons between both groups of meetings, only those scenarios that were considered in both groups of meetings compared (i.e. the 12 scenarios shown in Table 6.7.2).

Although the rating scale range was consistent during both phases of the project (with the spectrum ranging from 1 to 9) the actual nomenclature used to describe the scale changed. The focus group scale was described as 1 = not acceptable to 9 = acceptable, while the public meetings and online scoring used a scale ranging from 1 = least preferable to 9 = most preferable. The results were similar for the two processes, but the average scores for the focus groups were slightly higher than the subsequent scores for the public meetings and online scoring. This may be due to either the change in terminology or perhaps to a greater opportunity provided during the focus meetings for group discussions and consideration of a more abbreviated list of BMPs.

Despite these slight differences, the relative scores for the different scenarios obtained from the two groups of meetings have similar frequency distributions. This fact was used to support the hypothesis that the range of qualitative assessments from the focus groups could also help inform some of the differences in scoring from the public scoring meetings.

**Table 6.7.2 List of BMPs Developed at the time of Focus Group Meetings**

| BMP ID | Best Management Practice (BMP) Description |
|---|---|
| WFSS | Eliminate Failing Septic Systems |
| WSSO | Eliminate Sanitary Sewer Overflows |
| WR | Regionalization |
| WTT | Improve Nutrient Treatment Technologies |
| ACF | Crop/Fertilizer Management |
| ARE | Runoff/Erosion Management |
| AAM | Animal/Manure Management |
| URL | Reducing Loadings (lawn fertilizer and pet litter) |
| URR | Reduce Runoff (green infrastructure) |
| UCR | Control Runoff (detention basins, urban wetlands) |
| PLP | Landuse Planning |
| PPT | Pollution Trading |

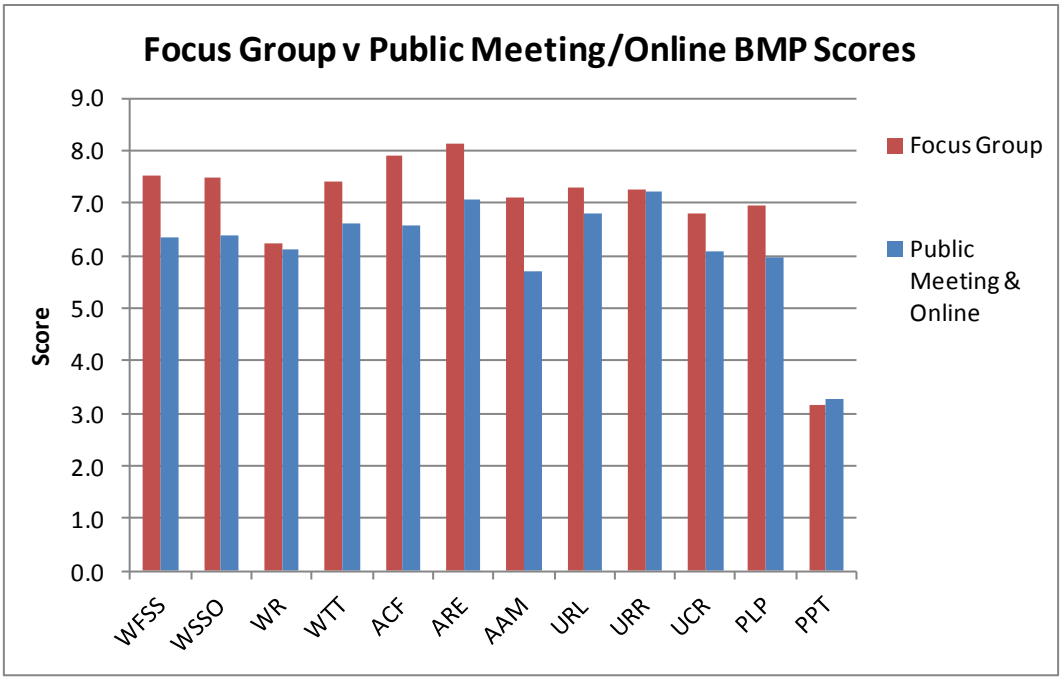



**Figure 6.7.5 Comparison of Focus Group and Public Meeting/Online Average BMP Scores**
**(Score of 1 = least suitable and a Score of 9 = most suitable)**

## 6.8 PROCESS SATISFACTION SCORING ANALYSIS

Process satisfaction scoring results were compiled for the 3 public scoring meetings and the online scoring. Figure 6.8.1 shows the results. Although scores ranged across the entire spectrum, participants generally regarded the process as positive and less than 20 percent indicated negative scores. Average and median scores for process satisfaction were fairly consistent and ranged from 6 to 7 for all scoring events (Figure 6.8.2).

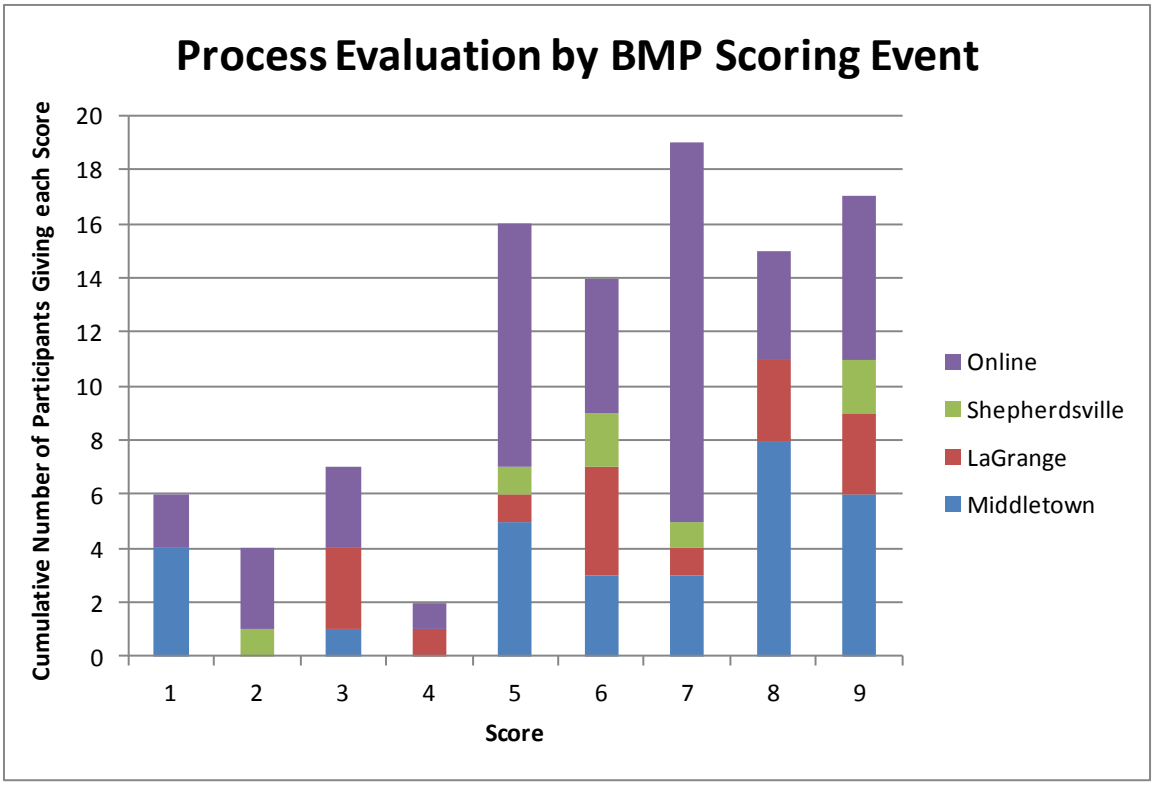



**Figure 6.8.1 Process Evaluation Scores Distribution by Scoring Event**
**(Score of 1 = very negative and a Score of 9 = very positive)**

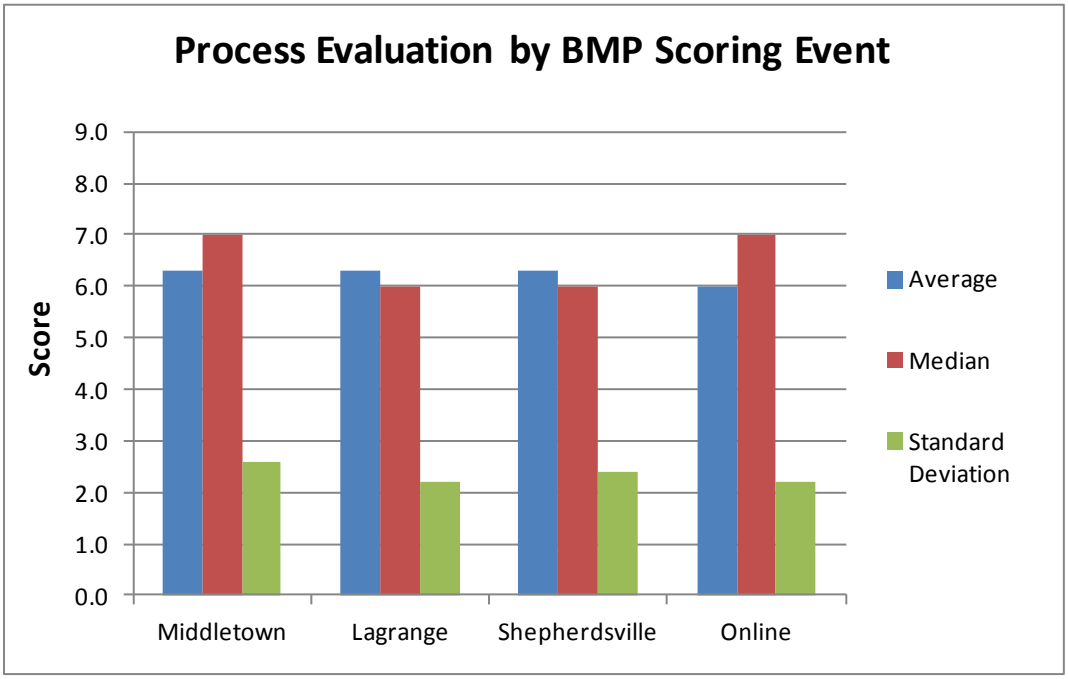



**Figure 6.8.2 Process Evaluation Score Statistics by Scoring Event**
**(Note: Y axis = process quality score: 1=very negative to 9 = very positive)**

## 6.9 PROCESS RELIABILITY ANALYSIS

An extensive literature exists in the field of stakeholder participation in environmental management that discusses factors affecting the quality of this representation (Wellstead et al., 2003). Valuations that are elicited from small groups, or that are unrepresentative of the range of valuations, are generally not viewed as reliable for planning and management purposes. It is likely that planning or future use recommendations derived from unrepresentative data will be resisted because they will not be viewed as legitimate by large numbers of stakeholders (Rowe and Frewer, 2004). In particular, members of the public who have not been involved, either because they chose not to become involved or were not aware of the public meetings at which values were solicited, can view the results and the analyses with some skepticism.

Some unique process challenges existed prior to the initiation of this nutrient BMP visioning project for the Floyds Fork. First, the relative costs and effectiveness of the various BMPs were not precisely known. This is not unusual in environmental management issues, but because of the sensitive nature of the ongoing nutrient TMDL development process these considerations were at the front of some participants' minds. Second, the values of participants from whom scores were elicited during the focus group phase and during the public scoring may not correspond necessarily with the valuations of the public at large. Although efforts were made to include a broad cross-section of interests from the community there is no guarantee that the results reflect the preferences of the public at large in the entire geographical area represented by the watershed. With respect to the potential correspondence between valuations documented here and those of the public who did not attend the scoring meetings or participate in online scoring, the project team cannot know if the people who did not participate possess valuations that are more, or less, polarized than those who were polled.

Nonetheless, the use of snowball sampling efforts (Berg, 1988) as well as the similarity of scores from the focus group meetings, public scoring meetings, and online meetings tends to support the hypothesis that these results provide a representative sample of the larger population of individuals who are interested in nutrient management issues associated with the watershed. This assumption is further supported by the fairly equal composite representation of participants from the agricultural, development, environmental, and regulatory communities.

# 7.0 SUMMARY AND CONCLUSIONS

## 7.1 PROJECT GOALS AND GUIDELINES

This report has focused on assessing community perspectives regarding nutrient management approaches in the Floyds Fork watershed. Study results should help inform the Kentucky Division of Water regarding acceptability of nutrient reduction approaches as expressed by residents of the watershed for future use in planning implementation of a nutrient/organic enrichment TMDL for the basin.

The project utilized an effective process for public engagement that started with initial stakeholder interviews to assist in identifying relevant focus groups. Community Based-Participatory Communication and Structured Public Involvement were employed to provide an effective methodology for solicitation of community values and preferences. Public empowerment through the use of anonymous keypad technology allowed for accountability through real-time process evaluation and the ability to demographically determine who was participating. The keypads also enabled the tracking of preference patterns for a variety of nutrient reduction strategies or Best Management Practices (BMPs). The project assembled potentially relevant information into a single repository and made it publically available online at www.uky.edu/WaterResources/FF.

Scoring opportunities allowed for documentation of preferences related to 20 BMPs identified as potentially applicable for the reduction of nutrient levels in Floyds Fork. Scores varied across the rating spectrum for all BMPs, but several nutrient reduction strategies appear to be deemed generally acceptable overall by the participants. Pollution trading was clearly identified as the least preferable approach by the focus groups and during the public scoring process.

## 7.2 STAKEHOLDER IDENTIFICATION

The study team utilized a snowball sampling method to ultimately identify 116 specific organizations or individuals that expressed an interest in nutrient management issues in the Floyds Fork watershed. These were subsequently assigned to one of 24 distinct stakeholder groups. Because of logistical issues, this list was eventually consolidated into the following 7 clusters of stakeholders.

Government/utilities/health departments/universities
Farmers and agricultural organizations
Environmental groups
Preservation and wildlife groups
Economic development, local businesses and builders
Recreational organizations and golf courses
Residents and neighborhood associations

Separate focus group meetings were held with each cluster of stakeholders. Representatives from each of the stakeholder groups ultimately participated in the public meetings (based on anonymous feedback from the meetings). However, the largest number of participants came from 1) agricultural interests, 2) environmental interests, and 3) economic development interests. In general the percent of participation at the public meetings and the online scoring were fairly consistent, with the one exception that more agricultural interests participated in the public meetings and more economic interests participated in the online scoring.

## 7.3 SUMMARY OF QUALITATIVE RESULTS (FOCUS GROUP ANALYSIS)

As part of the focus group process, stakeholders were also asked to identify potential concerns and information needs. Among the stated concerns/perceptions were the following statements:

"US EPA is "out to get" farmers"
"US EPA wants to repeat in Kentucky what they did in Chesapeake Bay"
"The Division of Water is anti-farmer"
"Most of the nutrient problem is due to agriculture"
"The Kentucky Division of Water is a rubber stamp for big business"
"EPA/Division of Water have already made up their mind on what they are going to do"
"Developers are out to destroy the environment"
"Those environmentalists just want to stop development."
"This study is a waste of tax payer's money"
"The nitrogen problem is largely due to coal burning power plants."
"Regionalization is the solution"

Such comments are generally reflective of past negative experiences or perceptions derived from such experiences. In some cases, these perceptions were simply based on a lack of factual information or "urban legends" that tend to emerge when dealing with environmental issues. Where possible, the study team tried to address these issues by providing relevant factual information on the project website or through the subsequent public informational meeting. One of the secondary benefits of the focus group meetings was the ability for the different groups to learn that the vast majority of all the stakeholders shared the same values and vision for the watershed. These values included:

- The rural character of the watershed
- The history of the watershed
- The natural beauty of the watershed
- The recreational opportunities afforded by the watershed
- The lack of excessive urbanization
- The biodiversity of the watershed
- The presences of wildlife and aquatic species (e.g. mussels)
- The proximity of the watershed to urban centers
- The parks within the watershed
- The accessibility of the watershed to citizens
- The number of farms in the watershed
- The availability of a clean and reliable water source

The stakeholders were also asked to identify what they considered to be the characteristics of an ideal watershed. These included:

- Clean and healthy (meets Clean Water Act standards)
- Public access
- Smart growth
- Sustainable
- Buffer zones and green space
- Supports biodiversity
- Recreational resource

- Agricultural resource

Some of the respondents commented that they thought Floyds Fork was currently an ideal watershed and that they would like to see it preserved in its current form.

Among the cited information needs were the following:

- What is the actual problem and why is it important?
- What is the status of the creek biology?
- How will the EPA determine whether the stream is clean enough?
- What are the sources of nutrient impairment and what are their percentages of contributions?
- How feasible are some of these strategies?
- How effective are these different nutrient management strategies?
- How much do these strategies cost to implement?
- What type of maintenance issues are associated with these strategies?
- How could some of these strategies impact businesses, homeowners, and farmers?

These information needs helped inform the content of the project website as well as the information presented at the public meetings.

Those organizations deemed most trustworthy relative to information about the watershed were:

- The Kentucky Division of Fish and Wildlife
- The University of Kentucky Cooperative Extension Service
- The US Geological Survey

**7.4 SUMMARY OF QUNATITATIVE RESULTS (PUBLIC MEETINGS/ONLINE)**

Quantitative analysis of the final 20 nutrient management strategies were obtained through three public meetings and an online website. In each case the respondents were asked demographic questions as well as evaluation scores for both the individual strategies as well as the overall process. The demographic data set allowed the study team to gain additional insights into the subsequent stated preferences. For example, the data allowed the study team to see if those stakeholders who indicated a particular interest (i.e. agriculture, environment, development, etc.) tended to vote in similar patterns. While that tended to be true in many situations, each individual still tended to vote independently. In fact, in nearly all cases, each of the 20 strategies had at least one score in all nine of the preference categories.

While a general comparison between the different strategies can be obtained by comparing the associated mean or median scores, this metric can be somewhat misleading. Greater insights can be obtained by looking at the actual distribution of scores. For example, two strategies could have the same mean, and yet one strategy may have half the respondents scoring that strategy a 1 while the remaining stakeholders scoring that strategy with a 9. In general, such information provides potential insight into what strategies to avoid if one would like to avoid polarization among the community. With that insight, the strategies scores can be put into four basic clusters: 1) those strategies that were generally scored as favorable by the vast majority of stakeholders, 2) those strategies that the majority of the stakeholders supported but some strongly opposed, 3) those strategies that showed greater diversity or polarization among the scores (i.e. some stakeholders strongly supported while some stakeholders strongly opposed), and 4) those

strategies that were generally scored as unfavorable by the vast majority of the stakeholders. Each of the strategies are summarized below with the mean and median scores in parentheses.

Strategies with generally favorable scores:

- Eliminating failing septic systems (6.2,7)
- Eliminating sanitary sewer overflows by decreasing inflows (7, 8)
- Improving the treatment efficiency of wastewater treatment plants (6.7, 7)
- Controlling agricultural erosion (7, 8)
- Reducing nutrient loading from urban watershed through education (6.8, 8)
- Reducing urban runoff with green infrastructure (7.2, 8)

Strategies with generally favorable scores but some strong opposition:

- Managing the amount of fertilizer applied to crops (6.5, 8)
- Crop management (6.7, 8)
- Manure management (6, 6)
- Treating urban runoff using retention basins or constructed wetlands (6.1, 7)
- Conservation sub-divisions (6.2, 7)
- Reducing urban runoff through traditional stormwater infrastructure (6, 6)

Strategies with polarized scoring

- Eliminating sanitary sewer overflows by increasing sewer capacity (5.8, 6)
- Regionalization of wastewater treatment plants (6.1, 7)
- Livestock management (5.3, 5)
- Treating agricultural runoff with wetlands (5.2, 6)
- Land use planning through development review overlays (5.8, 6)
- Reducing atmospheric nitrogen deposition (5.5, 5)
- Forest preservation (5.8, 7)

Strategies with generally unfavorable scores

- Pollution trading (3.3, 1.5)

Potential insights about the reasons why people tended to score a particular scenario more positively or negatively than others may be inferred from the qualitative comments collected during the focus group meetings. In general, the scoring of the focus group meetings tended to track the scoring from the public meetings, supporting the hypothesis that the reasons identified in the focus group meetings could inform the scoring in the public meetings. Lower scores were generally reflective of some of the following concerns: 1) feasibility of the strategy - either because of technology, implementation, maintenance or policy issues, 2) potential cost of the strategy, 3) concerns about loss of control of private property, 4) unintended consequences, 5) impacts on future development (concerns the strategy would either promote or hinder development), and 6) concerns whether the strategy would have any real significant impact.

In some cases, it appeared that different stakeholder groups tended to score those strategies with lower scores if they perceived that a particular strategy might negatively impact their own self interests. For example, it appeared that more stakeholders who identified themselves with agricultural interests tended to score the agricultural strategies lower. Likewise, it appeared that

those stakeholders who identified themselves with development interests tended to score those strategies that could potentially negatively impact development with a lower score. Likewise, it appeared that the preservationists and environmentalists tended to score lower those strategies that might increase development (e.g. regionalization).

## 7.5 PROCESS EVAULUATION

Both the focus group and public meeting process were evaluated anonymously and in real time using electronic keypad technology. Two evaluation metrics were used in this process: 1) the Arnstein Ladder of Public Participation, and 2) a simple nine point Likert scale. Website scoring participants were also provided with an opportunity to evaluate their online experience using the same nine point Likert scale. In each case, the scores were favorable, although the focus group scores were slightly better than the other scores. This is not unexpected, since the focus group meetings provided a greater opportunity for participation by the stakeholders, as well as an opportunity to provide greater insights into each of the potential strategies. In general, the preservation community tended to provide the lowest evaluation scores. Based on an analysis of their Arnstein Ladder scores, this may be reflective of greater past negative experiences with public notification or engagement processes. Nonetheless, the general favorable scores may provide some potential justification for using a similar process in future engagement activities.

## 7.6 SUMMARY OF PROJECT ACCOMPLISHMENTS

The distinct accomplishments of the project may be summarized as follows:

1) Utilized an effective process for public engagement that integrates:

    - Community Based-Participatory Communication (a basis for qualitative analysis)
        - Unique use of visual instruments for discussion facilitation
        - Provides framework for citizen ownership of process
        - Provides an effective methodology for solicitation of community values

    - Structured Public Involvement (a basis for quantitative analysis)
        - Use of computer visualizations for discussion facilitation and analysis
        - Public empowerment through anonymous use of keypads
        - Public accountability through real-time process evaluation
        - The ability to demographically and anonymously measure who is in the room, and to track the varying pattern of their preferences
        - The ability to prevent domination of the discussion by a single participant
        - The ability to maximize the amount of material that can be covered in a reasonable amount of time

2) Developed an effective process for public engagement that:
    - Assesses and incorporates community values
    - Fosters community trust by providing accountability and transparency:
        - Stakeholder Pilot Group
        - Real-time results via anonymous response key pads
        - Arnstein Ladder/Likert Scale
    - Provides equal voice to all participants

3) Identified a diverse set of stakeholder groups

4) Identified and documented community:

- Values
- Concerns
- Data needs
- Trusted data sources

5) Documented community experiences and expectations with public engagement process:

- Community does not expect full citizen control
- Present expectations may be influenced by past experiences

6) Assembled a significant amount of relevant project information into a single repository and published through www.uky.edu/WaterResources/FF

- Informational narrative summaries
- FAQ
- Document database
- Description of BMPs

7) Documented community preferences related to nutrient management best management practices

## 7.7 STUDY CHALLENGES AND METHODS

Like many projects that involve engagement with the public, this project was faced with many challenges. This included:

- The lack of a close proximity of the site to the institution doing the study (i.e. UK)
- Concern over the level of independence of the study because of the funding source (i.e. the Kentucky Division of Water)
- Previous watershed planning activities in the basin that had been terminated prematurely due to litigation
- Advocacy of particular positions in the local press
- A perceived mistrust of Louisville MSD by some members of the surrounding counties
- A parallel EPA nutrient modeling/TMDL study that was not well received by some stakeholders
- Confusion between the stakeholder engagement project and the EPA nutrient modeling/TMDL study
- Concerns by some stakeholders about perceived motives of EPA and the Kentucky Division of Water

In order to address these issues, the study team worked very hard to maintain itself as a neutral party in all discussions and to develop a transparent engagement process that was as democratic and inclusive as possible. This process was then used to solicit both the potential nutrient management strategies and their evaluation (both qualitatively and quantitatively). The study team also developed an extensive website that pulled together a significant amount of data and reports so as to provide the stakeholders the greatest amount of factual information possible so that all stakeholders could make informed decisions.

Unlike many public involvement or notification processes, the study team did not develop the different management strategies nor were they provided by the funding agency (i.e. the Division of Water). Instead, the management strategies were compiled based on those strategies identified by the stakeholders through interviews, focus groups, and public meetings.

As with any public engagement process involving federal or state funding, all of the methodologies and protocols employed in this study were reviewed and approved by the University of Kentucky Institutional Review Board, which was instituted in response to federal regulations to insure the protection of all participants. In addition, the research team constituted a separate pilot group made up of representatives of all of the identified stakeholder groups for the purposes of screening all of the materials and methods employed in the study, thus further insuring the partnership of the engaged community in the development of the actual engagement process. Finally, the study team employed two different evaluation metrics that allowed the study team and the process to be evaluated by the stakeholders in real time and in fully public display. This again allowed full transparency of the process. In general the evaluation scores from both the focus groups and the public meetings were generally favorable of the process.

While ever attempt was made to provide the greatest amount of information to the stakeholders, some participants expressed general frustration that actual costs and the overall effectiveness of the individual BMP strategies for reducing nutrient loads were not available during this evaluation process. Unfortunately, this type of information was not readily available for most of the suggested BMPs. A tool that would better enable residents to incorporate this information in their assessments would be a welcome addition for future public evaluations of nutrient management approaches.

## 7.8 PROJECT LIMITATIONS

All public engagement process will typically involve some limitations. This study is no exception. Potential limitations of the study include:

1) Sample Population Concerns

- Relatively low participation by some age groups
- Low participation from some counties
- Variation in the number of participants by venue

2) "Self-selection" by the participants

- Participants were those who had the time/interest/ability/trust in the process to participate and, therefore, may or may not be truly representative of the actual overall population.

3) History/maturation issues

- Ongoing US EPA sponsored nutrient modeling effort in Floyds Fork
- Previous failed Floyds Fork watershed based planning process
- Concern by members of various groups that additional regulations will likely result from this process. These fears may have led to strategic scoring by some wishing to protect their own interests.

## 7.9 FINAL PROCESS OBSERVATIONS

Public engagement should no longer be viewed as a single project, or as an add-on to a larger effort. It also cannot be viewed as a series of disjointed projects. Instead, it must be viewed and implemented as an ongoing, iterative, and evolving process that:

- Involves the total community
- Is tailored to the local community
- Incorporates community values
- Fosters collaboration
- Provides accountability and invokes trust
- Continues to inform and educate stakeholders
- Provides for an inclusive and truly democratic way for the concerns and preferences of the local citizens to be both heard and valued

In this context, we believe the results of this study should not be viewed solely as a means to an end, as important as the findings may be, but instead as the first step toward building a more effective process of public engagement with regard to environmental and water resource issues. We believe that the methodologies that have been brought together in this project provide the tools and strategies to achieve such a goal.

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## Appendix A: Historical Floyds Fork Studies

### A.1 1986 Floyds Fork Drainage Biological and Water Quality Investigation (KDOW, 1986)

This study was conducted in 1981 and released in 1986. Of the 164 miles in the entire Floyds Fork system, 51 miles were not supporting designated uses, 77 miles were partially supporting designated uses, and 12 miles were unknown. The recommended designated uses under this study were warm water aquatic habitat (WWAH) and primary and secondary contact recreation. Kentucky surface water standards (KSWS) were violated for dissolved oxygen, pH, phthalate esters, cadmium, Al, Fe, Hg, and $H_2S$. Sediments were also found to be contaminated with heavy metals and pesticides; some reaches were heavily polluted with arsenic and moderately polluted with chromium, lead, and zinc. PCP was also detected. (KDOW, 1986).

Wastewater treatment plant (WWTP) discharges are regarded in this study as the primary cause of use impairment. At the time of the study, there were 103 wastewater point source discharges in the basin, and some of them have caused continual major problems. By 1980, Lakewood Valley Subdivision WWTP had been cited 20 times for effluent violations; Ash Avenue Sewer Company had consistently discharged effluent well above KSWS. The study states that the designated uses are attainable with the application of appropriate point source pollution control technology. Agricultural and urban runoff are regarded by the study as secondary impacts in the basin, and the study states: "it is anticipated that non-point sources will not affect the attainability of these uses." (KDOW 1986).

Stream habitats were found to be diverse, including but not limited to: pools, riffles, rock ledges, undercut banks, root mats, and submerged logs. The riparian vegetation was generally considered in good condition. The basin is home to 46 species of fish, 18 species of mussel (13 of those were found only as relic shells), and 139 taxa of aquatic macroinvertebrates. However, Floyds Fork was found in the study to have a nutrient enrichment problem, creating dense growths of algae and leading to degradations in water quality. Although the study found diverse aquatic fauna, it noted that there were adverse aquatic community impacts in the areas affected by the WWTP discharges and elevated water column nutrient concentrations. (KDOW, 1986).

### A.2 1991 Water Quality Study of Floyds Fork Creek by (KDOW, 1991)

The 1991 Water Quality Study of Floyds Fork by KDOW focused on dissolved oxygen under low flow stream conditions. The study found that Floyds Fork consistently had violations of Kentucky's standards for dissolved oxygen. The main cause of this impairment is the numerous wastewater treatment plants, especially poorly operating plants and low functioning package plants. A notable example was the malfunctioning wastewater treatment facility for the Kentucky Correctional Institute for Women. At the time of the study, a new facility was under construction for the correctional institute. The study recommended that no new wastewater treatment plants be approved on the main stem of Floyds Fork or on the tributaries of Upper and Lower Chenoweth Run, Cedar Creek, or Brooks Run. However, a new regional facility that could remove numerous existing package plants would be supported. KDOW stated support in the report that it supports regional plans being developed for Oldham and Jefferson Counties. Bullitt County was urged to develop plans to eliminate the numerous wastewater facilities in the Brooks Run and Cedar Creek areas within Bullitt County. (KDOW, 1991).

The dissolved oxygen depletion due to wastewater effluent is exacerbated by the water withdrawals that occur along the stream. Permits for water withdrawals will limit or stop withdrawals when flow in Floyds Fork drops below a certain low level. Floyds Fork was also

found to have significant nutrient enrichment problems. Aside from direct physical evidence, specific conductance and pH data indicated that Floyds Fork was experiencing nutrient enrichment. (KDOW, 1991).

The report stated that other issues significantly affecting water quality in developing areas was soil erosion and urban runoff. Regulatory programs were recommended to control stormwater and other nonpoint source pollution. Proper management practices for construction projects, golf course maintenance, and residential lawn care can and will affect the ability of Floyds Fork to become a healthy stream. (KDOW, 1991).

**A.3 1993 Floyd's Fork Development Review Overlay (LDC, 1993)**

The 1993 Floyds Fork Development Review Overlay (DRO) was intended to insure that new development within the Floyds Fork Corridor is designed to aid in maintaining excellent quality for land and water resources and an aesthetically pleasing, rural atmosphere. The DRO provided special protection for the stream corridor, trees and vegetation, drainage and water quality, hillsides, historic elements, and vistas and appearances. A 100 foot wide riparian buffer was required along the main corridor and 50 foot wide buffers were required for tributaries. Impervious surfaces were required to be at least 200 feet from the stream banks. Existing wooded areas were to be retained where possible. Developers were required maintain vegetative cover on graded slopes. Wetlands were to be preserved in their natural state. Erosion and sediment control was required for development in progress. The DRO also called for clustering of residential use to achieve a comparable amount of development while leaving more area undisturbed. The DRO applied to all new development, including subdivisions, new construction, and clearing and grading of land. Existing homes and farms were not required to meet these standards. (LDC, 1993).

**A.4 1994 Floyd's Fork Action Plan (MSD, 1994)**

This comprehensive plan outlined the future of sanitary sewer service for the Floyds Fork watershed service area and provided, on a priority basis, sewer service for new developments. The purpose of the Floyds Fork Action Plan (February 1994) was to develop an implementable work plan for providing sanitary sewer service and treatment facilities in the Floyds Fork service area. The plan was the first phase in the provision of sewer service and was used as a guide for planning and expansion of future sewer service in the Floyds Fork area. The Action Plan determined the area to be included in the Floyds Fork WQTC sewer service area, as well as the recommended schedule for providing sanitary sewer service to the service area over the next 20 years. The Action Plan provides two recommended alternatives; the North Alternative, which is the Floyds Fork WQTC service area, and the South Alternative, which is the Cedar Creek WQTC service area. Recommendations for the North Alternative include the elimination of several existing small package treatment plants in the service area and consolidation of wastewater treatment at a centralized Floyds Fork WQTC. (MSD, 1994).

**A.5 1996 Water Quality Study of Chenoweth Run (KDOW, 1996)**

The 1996 Water Quality Study of Chenoweth Run by the Kentucky Division of Water considered the following parameters: BOD, ammonia, DO, temperature, pH, total phosphorus, nitrite and nitrate nitrogen, suspended solids, and metals. Primary sources of concern were the Jeffersontown Wastewater Treatment Plant and urban runoff above the plant. (KDOW, 1996).

Median total phosphorus concentrations were 0.04 mg/L above the Jeffersontown WWTP, 2.5mg/L in the plant effluent, and 1.4 mg/L a short distance downstream of the plant. Phosphorus concentrations remained elevated throughout Chenoweth Run to its confluence with Floyds Fork. The study noted that the value for phosphorus concentration commonly recommended by the EPA is 0.1 mg/L, but also that there is no official stream standard for phosphorus. The data collected shows that the Jeffersontown WWTP has the greatest impact on phosphorus in Chenoweth Run during low to normal streamflow. During high streamflow events, concentrations are essentially the same (about 0.3 mg/L) above the plant as below it. A likely source for phosphorus during these high streamflow events is fertilizer runoff from urban area lawns. The study stated that MSD was undertaking a study to determine the amount of phosphorus reduction needed for the Jeffersontown Plant. KDOW stated in the study that a 1 mg/L limit would be applied to the plant's June 2000 permit if the MSD study did not have anything conclusive by that time. Follow up monitoring was to be conducted to determine if a stricter limit for phosphorus would be necessary. (KDOW, 1996).

BOD and ammonia were found to be fairly low throughout the stream. The pH was sometimes as high as 9.5 units; the study attributed the spikes in pH to algal activity and noted that at pH above 8.5, ammonia could become toxic to aquatic life even at the low levels of ammonia found in Chenoweth Run. Total suspended solids were found to be high after storm events, even reaching 440 mg/L above the treatment plant. Runoff from urban, industrial, and construction site areas carry these solids and with them come metals and other chemicals. The study recommended the need for increased riparian zones and stormwater runoff controls. The study concluded that "Reducing storm flow runoff and associated pollutants is likely as important to the long term health of Chenoweth Run as reducing the summertime nutrient load from point sources." (KDOW, 1996).

### A.6 1999 Chenoweth Run Drainage Biological Water Quality Investigation (KDOW, 1999)

The 1999 Chenoweth Run Drainage Biological Water Quality Investigation by the Kentucky Division of Water was undertaken for the purpose of determining if a phosphorus reduction in the stream may decrease the problem of nuisance algal growth. The study noted that the point sources for phosphorus were the Jeffersontown WWTP and minor other plant effluents. Nonpoint sources for phosphorus were urban runoff in the upper reaches of the stream and pastureland runoff in the lower reaches. (KDOW, 1999).

The study found that it is difficult to define the relationship between nutrients and algal growth in streams because of abiotic factors that affect algal growth (temperature, current velocity, turbidity, light availability, grazing, and scouring of streambeds). Under ideal environmental conditions for algal growth that occurred in April of 1995, the study found that "high nutrient concentrations in Chenoweth Run led to nuisance algal growth." However, the algal growth was present during that time in the study only, and heavy storms in May scoured the substrate and the algal growth never reached previous levels. As a result of this uncontrollable abiotic factor, it was concluded overall that "this study did not produce enough information to answer whether the control of nutrients, specifically phosphorus, from the Jeffersontown WWTP would decrease the potential for nuisance algal growth downstream of the discharge point." (KDOW, 1999).

### A.7 1999 Cedar Creek Action Plan (MSD, 1999)

The Cedar Creek Action Plan provides a detailed study of existing infrastructure, population projections, flow projections, and recommended alternatives to provide service to the Cedar Creek Service Area. The population projections estimated a 1999 population of 22,700 people

and estimated 75,000 for the 20-year projection based on the Cornerstone 2020 data. The recommended conveyance alternative was compiled for 2-year, 10-year, and 20-year timeframes. In the first two years, it was recommended to eliminate the Birchwood WQTC and conduct an inflow and infiltration (I/I) investigation. In the 3- to 10-year timeframe, the Cedar Creek Road Pumping Station, Billtown Road Pumping Station, Rehl Road Pumping Station, and interceptors were recommended for construction. From 11 to 20 years, South Bardstown Road Pumping Station and various interceptors were proposed to be constructed. The wastewater treatment plant was recommended to expand to 7.5 million gallons per day (mgd) by construction of a Vertical Loop Reactor. Additional recommendations included conducting additional conveyance system investigation including smoke testing and identification of rehabilitation work. (MSD, 1999).

### A.8 2001 Hydrologic and Water Quality Characterization and Modeling of the Chenoweth Run Basin (USGS, 2001)

Rainfall, streamflow, and water-quality data collected in the Chenoweth Run Basin during between 1996 and 1998, in combination with the available historical sampling data, were used to characterize hydrologic conditions and to develop and calibrate a Hydrological Simulation Program Fortran (HSPF) model for continuous simulation of rainfall, streamflow, suspended-sediment, and total-orthophosphate (TPO4) transport relations. The results of this study provided an improved understanding of basin hydrology and a hydrologic-modeling framework with analytical tools for use in comprehensive water resource planning and management. (USGS, 2001).

Chenoweth Run Basin contains expanding urban development, particularly in the upper third of the basin. Historical water-quality problems have interfered with designated aquatic-life and recreation uses in the stream main channel (approximately 9 mi in length) and have been attributed to organic enrichment, nutrients, metals, and pathogens in urban runoff and wastewater inflows. Hydrologic conditions in Jefferson County are highly varied. In the Chenoweth Run Basin relief is moderately sloping to steep. Also, internal drainage in pervious areas is impeded by the shallow, fine-textured subsoils that contain abundant silts and clays. Thus, much of the precipitation here tends to move rapidly as overland flow and (or) shallow subsurface flow (interflow) to the stream channels. Data were collected at two streamflow gaging stations, one rain gage, and four water quality sampling sites in the basin. Precipitation, streamflow, and, consequently, constituent loads were above normal during the data collection period of this study. Nonpoint sources contributed the largest portion of the sediment loads. However, the three wastewater treatment plants (WWTPs) were the source of the majority of estimated total phosphorus (TP) and TPO4 transport downstream from the WWTPs. The HSPF model was used to represent several important hydrologic features of the Chenoweth Run Basin including (1) numerous small lakes and ponds, through which approximately 25 percent of the basin drains; (2) potential seasonal groundwater seepage losses in stream channels; (3) contributions from WWTP effluents and bypass flows; and (4) the transport and transformations of sediments and nutrients. (USGS, 2001).

http://pubs.er.usgs.gov/publication/wri004239

### A.9 2004 Sinkholes and Karst Features of Chenoweth Run (KGS, 2004)

This document prepared by the Kentucky Geological Survey includes general background information on karst topography and a map (at a scale of 1:48,000) of the known karst features in Chenoweth Run (including sinkholes identified on Louisville Metro Maps, sinkholes mapped by

the NRCS, and karst springs with database ID number). Suggested management practices to help protect karst aquifers are also provided. (KGS, 2004).

Sinkholes can develop in the watershed of Chenoweth Run because it is mostly underlain by bedrock that can dissolve. Approximately 63 percent of the area of Jefferson County is underlain by soluble rocks that have developed karst topography and aquifers. Most of the karst occurs in the uplands away from the Ohio River. Karst refers to a landscape that has sinkholes, sinking streams, caves, and springs. Karst landscapes form when mild acids found in rain and soil water gradually dissolve the limestone bedrock. A sinkhole is a natural depression formed by the slow dissolution of the limestone that drains underground. The classic sinkhole is bowl-shaped with gently sloping sides. All of the rock and soil eroded from a sinkhole is transported underground. A karst spring is where groundwater discharges to the surface. It may be from an opening similar to a cave or it can be covered by fallen rock or other debris. (KGS, 2004).

Groundwater flows in conduits and caves in karst. Precipitation runs in rapidly through sinkholes and sinking streams. Conduits can extend beneath drainage basin divides. Sinkholes that seem to be outside of a watershed may actually drain into the watershed. Groundwater flow in conduits has little opportunity for contaminants to be filtered or immobilized by reaction with the aquifer materials. The unknown routes, poor filtration, and fast flow of groundwater in karst aquifers make them highly vulnerable to pollution. (KGS, 2004).

**A.10 2007 Oldham County Facilities Plan (Omni, HDR|Quest, 2007)**

The facilities plan for the Oldham County Sewer District (OCSD) was prepared by OMNI Engineering Inc. and HDR|QuestEngineers in 2007. The objectives of the plan are: to determine how to serve Oldham County's wastewater needs in a cost effective and environmentally sound manner, eliminate package wastewater treatment plants and pursue regional solutions, plan for future needs, solicit stakeholder input, and obtain grants and low-interest loans to minimize financial impact on OCSD customers. (Omni, HDR|Quest, 2007).

The plan includes a discussion of project background and planning areas, a review of the existing environmental conditions, an evaluation of the existing wastewater treatment and conveyance facilities, projections of future population and wastewater flows, development and evaluation of wastewater system alternatives, selection of a cost-effective improvement plan, development of an implementation strategy, and documentation of the public participation program. (Omni, HDR|Quest, 2007).

The Oldham County Sewer District planning area was divided into four planning areas for the evaluation of alternatives. The alternative selected for the Kentucky State Reformatory Service Area was a 1.28 MGD tertiary WWTP on KSR property with a discharge to North Fork of Cedar Creek and a 1.35 MGD tertiary WWTP at the existing Buckner WWTP with discharge to North Curry Fork. The alternative selected for the Crestwood Service Area was to pump all flows in the service area to the existing MSD Hite Creek WWTP. The alternative selected for the Ohio River Service Area was to construct a regional WWTP on the Ohio River at the existing Cardinal Harbour WWTP and convey all flows from the service area to the facility, eliminating the five existing package plants. Lastly, the alternative selected for the South Floyds Fork Service Area was to convey all flows from the service area to the existing MSD Floyds Fork WWTP. (Omni, HDR|Quest, 2007).

### A.11 2008 Floyd's Fork Watershed Plan (KWA, 2008)

The purpose of the project was to create a watershed-based plan for the Floyds Fork watershed to restore and protect designated uses in the watershed. Funding was provided in part by a grant from the U.S. Environmental Protection Agency (USEPA) through the Kentucky Division of Water, Nonpoint Source Section, to Kentucky Waterways Alliance, Inc. (as authorized by the Clean Water Act Amendments of 1987, §319(h) Nonpoint Source Implementation Grant #C9994861-03). There was widespread engagement in the project; about 50 people were solidly engaged, and hundreds were supportive and assisted in some way. The Steering Committee and project partners assembled an extensive library of materials and conducted a successful Roundtable. A Technical Advisory Committee analyzed existing watershed data and conducted watershed assessments. A Land Use Committee analyzed local land use and land use policies and practices. The WBP was ultimately left incomplete, but the WBP Final Report documents project progress and accomplishments and focuses on the process and lessons learned during the effort. (KWA, 2008).

The plan examined both technical scientific issues and land use policy issues. The technical scientific issues covered water quality concerns such as bacteria, organic enrichment, nutrients, low dissolved oxygen, metals, pesticides, habitat alteration, illegal dumping, and litter; the potential sources of these concerns were also discussed: sewage and package plants, wet weather discharges, urban stormwater, construction site runoff, and agriculture. The land use policy issues covered using codes and ordinances to allow for open spaces, green retrofitting existing development, inter-county planning and jurisdictional coordination, and the need for enforcement of existing codes and ordinances. (KWA, 2008).

### A.12 2009 Bullitt County – Floyd's Fork Watershed Plan (Strand, 2009)

Funding for this project was provided in part by a grant from the U.S. Environmental Protection Agency (USEPA) through the Kentucky Division of Water, Nonpoint Source Section, to Bullitt County Fiscal Court as authorized by the Clean Water Act Amendments of 1987, 319(h) Nonpoint Source Implementation Grant #C9994861-03. The report was produced by Strand Associates, Inc. The Floyds Fork watershed in Bullitt County is impaired and has consistently been included on the Kentucky Division of Water's (KDOW) 303(d) list of impaired streams. The Bullitt County Fiscal Court proposed to implement a variety of stormwater control measures that were identified in a comprehensive stormwater management plan. The grant allowed the use of funding for implementing the NPDES Phase II MS4 permit requirements. (Strand, 2009).

Major accomplishments of the project were as follows: the development of a water quality curriculum for elementary schools in the county, gaining public input and participation, creating a housekeeping database, creating a partnership between the county and the five local cities, BMP inspections, and the adoption of three stormwater ordinances. The stormwater ordinances were: an illicit discharge detection and elimination ordinance, an erosion prevention and sediment control ordinance, and a post construction stormwater runoff ordinance. The county attempted to obtain conservation easements along fifteen properties adjacent to Floyds Fork but the property owners were unwilling to grant the easements. (Strand, 2009).

### A.13 2010 Floyds Fork Area Study (WRT, 2010)

The project aimed to balance land conservation and population growth, create compact, mixed-use centers to limit sprawl, preserve existing natural resources, integrate mixed-use centers with Floyds Fork Greenway and the City of Parks Louisville Loop trail, promote best development and

conservation practices and implement design and development guidelines. A series of seven presentations were provided between June 2008 and October 2010 by Wallace, Robert, and Todd, LLC. (WRT, 2010).

The growth Framework divides the Floyds Fork area into subareas to which different growth and conservation strategies would apply. The Neighborhood Development Area would consist of existing developed areas west of Floyds Fork, applying the strategy of filling in these areas where possible. The Core Conservation Area is along the Floyds Fork main corridor. The Low Impact Development Area is east of the corridor and aims at allowing for new development while trying to maintain the rural character of the land. Then the "Centers" are areas of compact, mixed development use. There are four centers that are proposed, three west of Floyds Fork and one center right on Floyds Fork. (WRT, 2010).

**A.14 2010 Floyd's Fork Action Plan Update (MSD, 2010)**

This update was intended to provide the Louisville and Jefferson County Metropolitan Sewer District (MSD) with a near-term plan for providing effective and efficient sanitary sewer service to its customers and to identify the improvements required (with recommended priority and timing to meet projected customer needs for the next ten years). The report describes the condition and capacity of existing conveyance and wastewater treatment facilities in the planning area. It also includes a plan for the future and alternatives for growth areas. The collaborative effort included personnel from MSD and a consultant team including Strand Associates, Inc., Jacobi, Toombs, and Lanz, Inc., CH2M-Hill, and Coulter Mapping Solutions. The Action Plan Update was prepared to meet Kentucky Division of Water (KDOW) guidelines for a regional wastewater facility plan. Acceptance and approval by KDOW would enable MSD to undertake the recommended projects. (MSD, 2010).

**A.15 2011 Oldham County – Curry's Fork Watershed Plan (Strand, 2011)**

A watershed management plan was developed for the Oldham County Fiscal Court by Strand Associates, Inc. as part of a 319(h) grant from the Kentucky Division of Water. The report includes an inventory of the assets of the watershed as well as recent water quality sampling. It also includes watershed goals and objectives as well as key components for insuring plan success. USEPA Grant No.: C9994861-06,KDOW Application Number: 06-06, Memorandum of Agreement Number: PON2-129-0600002538. (Strand, 2011).

The study named pathogens, nutrients, low dissolved oxygen, and excess sediment as water quality issues of concern. The study listed and prioritized several action recommendations to address water quality issues. Some of the priority recommendations are as follows: elimination of identified package treatment plants, elimination of sewer overflows, identification and correction of failing on-site septic systems, the engagement and education of the public, implementation of enhanced guidelines for future development and retrofitting existing development, incentives for green infrastructure, stream restoration for identified sections, continued water quality monitoring, agricultural BMPs, the expansion of riparian buffer zones, and the purchasing of property or development rights or conservation easements along streams to preserve them. (Strand, 2011).

**A.16 2006 National Land Cover Database Map (Tetra Tech, 2013)**

A 2006 National Land Cover Database map of the watershed is provided in Figure A.16.1. The landuse covers 15 categories: open water, developed open space, developed low intensity,

developed medium intensity, developed high intensity, barren, deciduous forest, evergreen forest, mixed forest, shrub/scrub, grassland/herbaceous, pasture/hay, cultivated crops, woody wetlands, and emergent herbaceous wetlands. Approximately 20% of the watershed is developed with varying degrees of intensity. Forest covers about 43% of the watershed. Pasture and cropland make up roughly 32% of the landuse. Another 4% of the watershed is grasslands or wetlands, and 1% is open water (Tetra Tech, 2013).

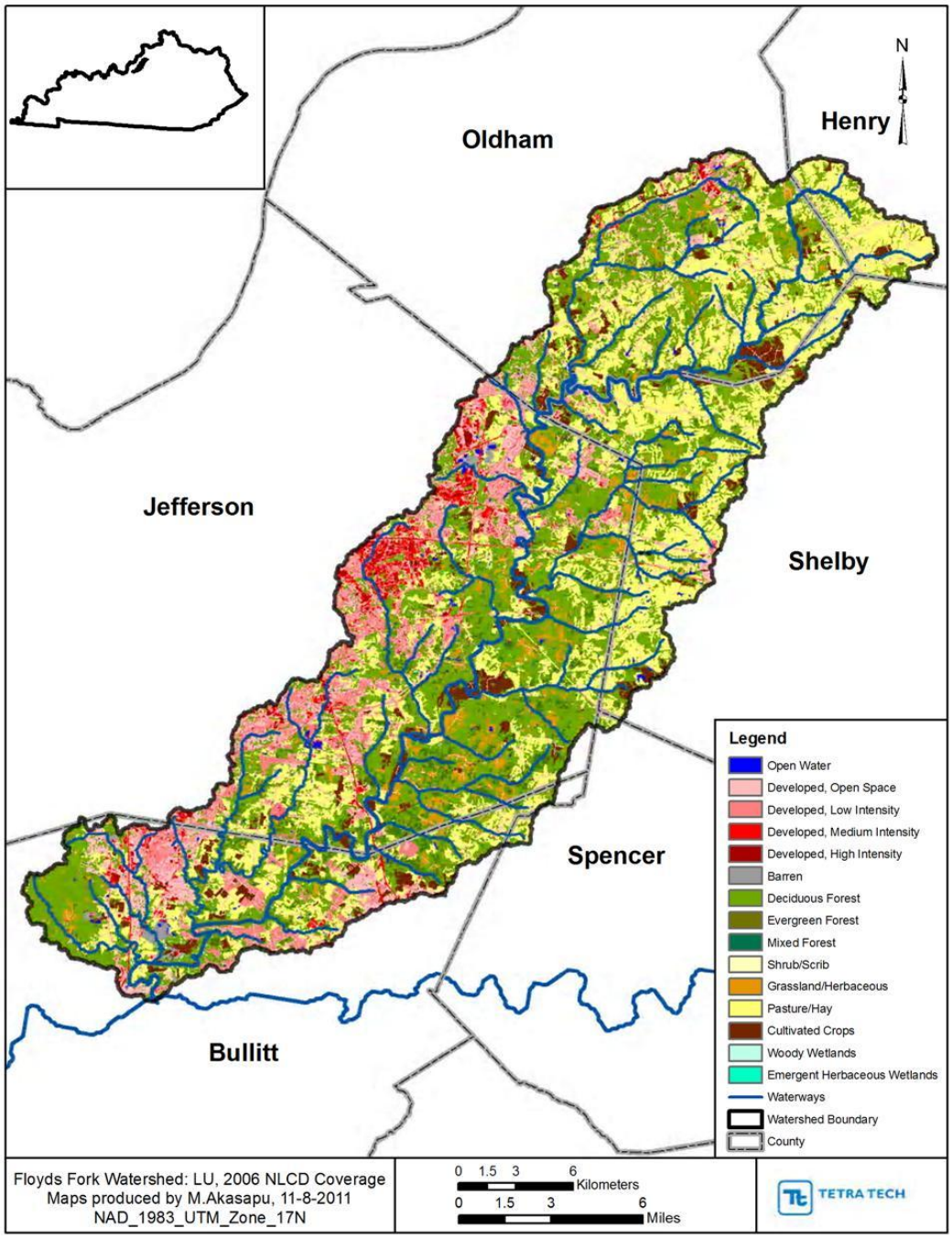


**Figure A.16.1 Landuse in the Floyds Fork Watershed (NLCD, 2006)**

### A.17 MSD MS4 Annual Report (October 31, 2011)

This is a report for the baseline permit year (July 1, 2010- June 30, 2011) compiled and submitted by the Louisville and Jefferson County Metropolitan Sewer District (MSD). It documents efforts to improve water quality of local streams and tracks progress in varying areas. MSD has been responsible for flood control and drainage for developed areas of Jefferson County since 1985. MSD began comprehensive water quality monitoring of local streams in collaboration with the U.S. Geological Survey in 1988. When the Municipal Separate Storm Sewer KPDES permitting program began in the early 1990s, KYS000001 was the first Large MS4 Permit issued in the region. The requirements in the latest permit represent the Kentucky Division of Water's determination of maximum extent practicable (MEP) for the Louisville MSD and Jefferson County communities covered by the permit (MSD, 2011).

### A.18 Floyds Fork Watershed Modeling Report (Tetra Tech. February 8, 2013)

This is a technical report on the development of a watershed model for the Floyds Fork watershed. It does not include any analysis or recommendations on the management of the watershed, but it does contain much information about the watershed as it pertains to hydrologic or water quality elements relevant to the development of the computer model. The report provides location maps for streams, USGS stations, weather stations, sinkholes, springs, point source discharges, and SSO events. The report also provides map coverages of the watershed soils, land cover, and land use. Lists or catalogs of information including KPDES permitted dischargers, permitted industrial water withdrawals, and estimated loading rates from various sources are also provided in the report.

## Appendix B: Nutrient Management Strategy Descriptions

In this appendix, nutrient management strategies are examined and described, strategies ranging from agricultural management, urban management, wastewater management, and policy management. In general, only the first and second tier strategies (e.g. B.1, B.1.1) were discussed and evaluated by the stakeholder as part of this process. Where possible, additional examples of these strategies (e.g. B.1.1.1, etc) have been provided for further insights.

### B.1 Agricultural Nutrient Management

Agricultural nutrient management encompasses many aspects of agricultural operations. Management begins with field and farmland preparation, implementing best management practices with fertilizers and crop planting design. Agricultural management considerations are comprehensive, involving all the aspects from planting to harvesting, managing livestock activities, waste disposal or reuse, erosion and stormwater runoff control, and stormwater treatment options. Table B.1 lists the broader categories of agricultural nutrient management strategies covered in this document.

Table B.1 Agricultural Nutrient Management Strategies

| | |
|---|---|
| B.1.1 | Fertilizer Management |
| B.1.2 | Crop Management |
| B.1.3 | Livestock Management |
| B.1.4 | Manure Management |
| B.1.5 | Erosion and Runoff Control |
| B.1.6 | Agricultural Runoff Treatment |

### B.1.1 Fertilizer Management

Fertilizer management strategies must address the amount of fertilizer application, the chemical content of fertilizer applied, the application timing, and technologies that could potentially optimize fertilizer application. Soil testing is critical for applying the right amount of fertilizer. Chemical content of fertilizer should be appropriate for the soil type and crop. Applying fertilizer close to when the crops will begin to grow maximized fertilizer benefit and minimizes annual fertilizer waste to runoff. GPS technology is able to use spatial data to automatically optimize fertilizer application in fields. Table B.1.1 lists the considerations for fertilizer management.

Stakeholders in the Floyds Fork watershed see the importance of fertilizer management. In addition to improved water quality through reduced nutrient loads to streams, some see an advantage to farmers in that it can save money by reducing fertilizer expenditure to only the amount actually needed. Some stakeholders also point out challenges arising from fertilizer management as a strategy for controlling nutrient loads. These challenges include enforcement if nutrient/fertilizer regulatory limits are attempted, the risk of creating a management burden on farm owners to the point that farmers get out of the business of farming, and how to educate and encourage land owners if non-regulatory approaches are attempted.

Table B.1.1 Fertilizer Management Strategies

| | |
|---|---|
| B.1.1.1 | Fertilizer Amount |
| B.1.1.2 | Fertilizer Content |
| B.1.1.3 | GPS Technology |
| B.1.1.4 | Application Time |

B.1.1.1 Appropriate Fertilizer Amount

To determine the appropriate amount of fertilizer application, assess the existing nutrient content of the soil. Take a 1 inch diameter, 7 inch deep, sample of soil from each 2.5 acre area, and analyze the sample for pH, phosphorus, potassium, zinc, magnesium, and calcium. For pastures or no-tilled areas, a depth to 3 to 4 inches is sufficient. Be aware that results vary somewhat between fall and spring. A spring soil sample gives a more accurate picture of what will be available to the plants that year, but a fall soil sample allows time for planning of the coming crops and gives lime time to react prior to spring planting. Soil testing prevents excess fertilizer application leading to nutrient problems in the watershed while saving the resources of farmers. Farmers save resources by not having to acquire and apply more fertilizer than they need for optimum agricultural benefit.

For more information see: http://www.ca.uky.edu/agc/pubs/agr/agr1/agr1.pdf

Figure B1. Soil testing.

### B.1.1.2 Appropriate Fertilizer Content

In addition to planning the amount of fertilizer that is needed for a given field of soil, soil testing can be an important part of planning the appropriate fertilizer content and form for the soil. Applying the right fertilizer content or form to the given soil limits the amount of nutrients lost to leaching, and allows crops to utilize the nutrients efficiently. Limiting the amount of nutrients lost to leaching in turn limits the impacts of excess nutrients to surface or groundwater. Heavy soils are not prone to leaching, but sandy soils leach quickly. Use fertilizers which contain nitrogen in greater percentages of the ammonium form for soils that are more prone to leaching. In order of increased likelihood of leaching, recommended nitrogen forms for fertilizer are anhydrous ammonia, urea, urea ammonium nitrate solutions, and ammonium nitrate.

### B.1.1.3 GPS Technology

"Smart" fertilizer application technology is available via GPS systems. Given the spacial variability of existing nutrient content in the soil, when the fertilizer application vehicle knows its precise location via a GPS system, it can adjust the application rate to meet the soil needs. In this manner, the whole fertilizer application area is provided with the optimum amount of fertilizer which meets the needs of the crops while benefiting water quality in the watershed. Some stakeholders question whether or not the gain in application accuracy is worth the cost of the technology.

B.1.1.4 Appropriate Application Time

In addition to providing crops with the correct amount and form of fertilizer, provide crops with the optimum time of fertilizer application to optimize crop production and to minimize undue nutrient loading in the watershed. Applying fertilizer close to when the crops will actually begin to need is recommended. Applying fertilizer in the fall results in losses due to runoff and other factors. One hundred pounds of applied fertilizer in the spring is often better than 120 pounds of fertilizer applied in the fall. However, if needed, applying lime in the fall allows time for the lime to react with the soil prior to spring planting.

Figure B2. Fertilizer application.

### B.1.2 Crop Management

Crop management largely involves strategies to prevent field vulnerability to erosion and consequently controlling runoff carrying sediment laden with nutrients. Crop management practices conserves soil and conserves nutrients through strategized crop selection and field planting design. Table 5.1.2 lists several management strategies for crop planting and field design.

Stakeholders in the Floyds Fork Watershed are in favor of agricultural practices which result in improved water quality. However, some stakeholders are concerned about placing too much of a burden on farmers. Many stakeholders see farmers as an indispensible asset to the local economy and are concerned that farmers may give up farming if environmental policies make farming as a livelihood unprofitable or too difficult. Education, cooperation, and encouragement are generally accepted approaches but the challenge that is seen is how to implement these approaches effectively.

Table 5.1.2 Crop Management Strategies

| | |
|---|---|
| B.1.2.1 | Strip Cropping and Contouring |
| B.1.2.2 | Conservation Cover |
| B.1.2.3 | Conservation Tillage |
| B.1.2.4 | Crop Rotation |
| B.1.2.5 | Cover Cropping |
| B.1.2.6 | Critical Planting |
| B.1.2.7 | Drip Irrigation |

B.1.2.1 Strip Cropping and Contouring

Strip cropping is a cropping system of growing two different crops in alternate strips, one being a strip of grass, small grain, or other close growing crop and the other being a strip of row crop. Contour farming is farming in such a way that all operations such as plowing, planting, and harvesting are across the slope, rather than up and down the slope. The benefit of this practice is that it can greatly reduce the risk of erosion and cut surface water runoff in half. With less surface water runoff and less erosion, less nutrients will be lost from crops and end up impacting water quality in streams.

For more information see: http://www.ca.uky.edu/agc/pubs/agr/agr98/agr98.htm

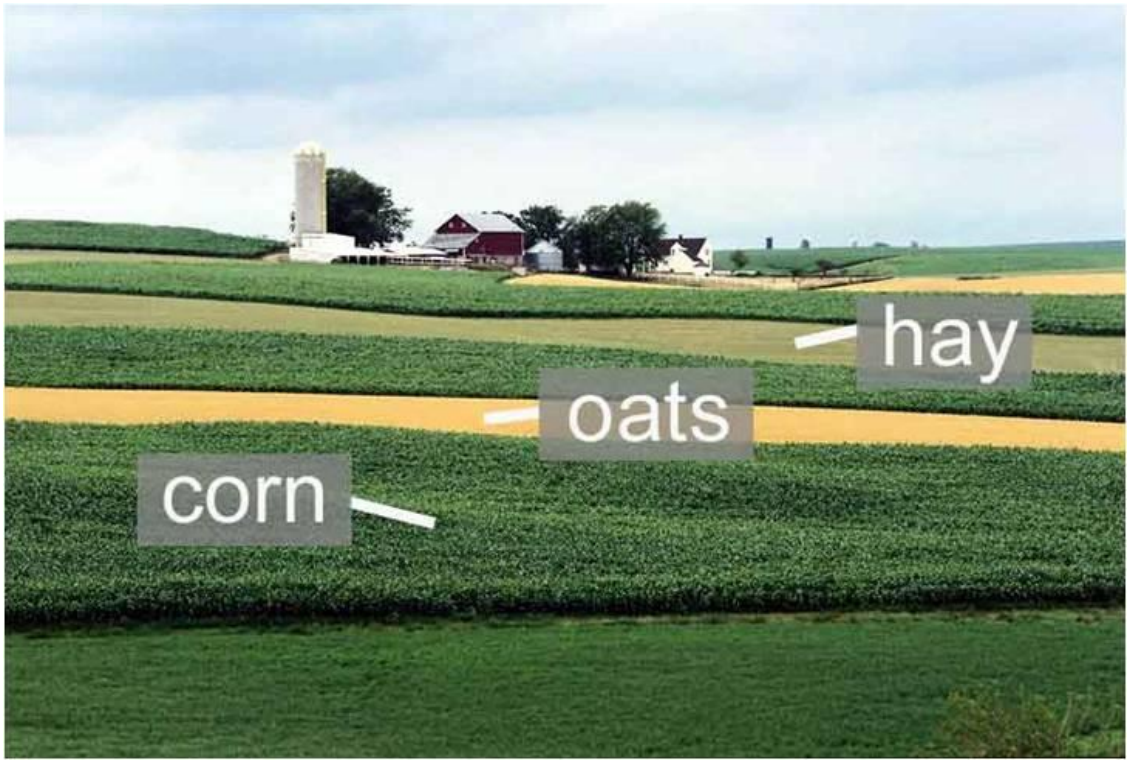


Figure B3. Strip cropping scenario.

B.1.2.2 Conservation Cover

Conservation cover is the establishment of perennial vegetative cover such as grass, legumes, trees, or shrubs, to protect soil and water resources on land retired from agricultural production and dedicated to wildlife and pollinators. Grasses, forbs, and legumes planted in mixes helps to promote diversity. Selecting species from each part of the growing season is recommended: species early in the growing season (April – June), in the middle (June – August), and late (August – September). This diversity will provide habitat for the entire growing season. During seedling period, keep mowing height above the height of the grass or legume seedlings. To protect wildlife, always mow after nesting seasons. Noxious weeds such as Multi-flora Rose, Johnson grass, and thistles can be controlled with herbicide spot treatments. Monitoring and controlling weeds is very critical in the first and second years.

Figure B4. Cover crop blend.

B.1.2.3 Conservation Tillage

A heavy rain on a field that has just been tilled can remove massive amounts of topsoil, wiping out much of the land's productivity. This erosion is not only a loss to the land owner, but is also a problem where it is deposited, such as in streams. Conservation tillage is a system in which enough of the soil surface is covered by plant residue after planting to control soil erosion by water. It is recommended that at least 30% of the soil surface is covered with crop residue (e.g. from fall harvest) through spring planting. Shallow tillage equipment tends to preserve more residue than deep tillage equipment. In addition to reducing erosion, crop residues increase the soil's water holding capacity and decrease its water evaporation rate.

For more information see: http://www.ca.uky.edu/agc/pubs/agr/agr99/agr99.htm

Figure B5. Conservation tillage in practice.

B.1.2.4 Crop Rotation

Crop rotation is a management strategy in which crops to be planted on a given field are changed year by year in a planned sequence. The sequence is designed to provide adequate organic residue for maintenance or improvement of soil tilth. The benefits of a crop rotation, or a conservation cropping sequence, include saving topsoil, increasing organic matter, sustaining production, improving weed control, controlling insect and plant pests by breaking their reproductive cycle, preventing disease buildup, and improving water quality. Crop rotation is a common practice on sloping soils because of its potential for conserving soil. To be effective, choose crops suited to your soil type and include rotations of small grains or pasture/hay. Also use high residue crops such as corn to replace soybeans or any other low-residue crop.

Figure B6. Crops in planned sequence.

B.1.2.5 Cover Cropping

A cover crop is a close growing crop such as a grass, legume, or small grain, grown primarily for the purpose of temporarily protecting the soil from erosion and improving the soil tilth. A cover crop is especially helpful at preventing erosion through fall and winter rains. Cover crops have the ability to provide moisture-conserving residues as well as nitrogen for the succeeding crop. Cover crops can help improve water quality by taking up and holding nutrients that were not used by the previous crop, thereby reducing the risk of the nutrients moving through the soil and into the waterways. Crops such as cereal rye, oats, and winter wheat can temporarily protect the ground when crop residues are not adequate following crop production. Having a cover crop also aids in nitrogen fixation, keeping the soil fertile.

For additional information see: http://www.ca.uky.edu/agc/pubs/id/id113/id113.pdf

Figure B7. Cover cropping with a grass.

B.1.2.6 Critical Planting

Critical planting is used to protect small, isolated areas in a field that are being damaged by excessive erosion. These vulnerable areas often require special planting and management techniques to overcome unfavorable soil site conditions. Grass, legumes, trees, shrubs, or vines can be used. If crops such as hay grasses or legumes are not suitable for the soil conditions, then plants with wildlife habitat value can be used. Where possible, reduce unfavorable site conditions such as low acidity, low fertility, or compaction with corrective measures before seedbed preparation. If vegetation is an insufficient control measure, then plan complementary structural BMPs, such as riprap or grade stabilization structures. Critical planting is important to water quality because it can capture nutrients and chemicals that would otherwise run off into streams.

Figure B8. Critical planting strips.

B.1.2.7 Drip Irrigation

Drip irrigation is an irrigation method that saves water and fertilizer by allowing water to drip slowly to the roots of plants, either onto the soil surface or directly into the root zone. Drip irrigation is carried out through a network of valves, pipes, tubing, and emitters. Advantages of drip irrigation are many: fertilizer and nutrient loss is minimized due to localized application and reduced leaching, water application efficiency is very high, field leveling is not necessary, fields with irregular shapes are easily accommodated, soil erosion is minimized, and drip irrigation operates at lower pressure than other types of pressurized irrigation, thereby reducing energy costs. Disadvantages to drip irrigation are that the initial cost can be more expensive than overhead irrigation systems and that some herbicides or top dressed fertilizers need sprinkler irrigation for activation.

Figure B9. Drip irrigation in practice.

### B.1.3 Livestock Management

Livestock can have a formidable effect on the health of streams if not managed according to best practices. If livestock have uncontrolled access to a stream, the stress of their weight on the streambanks can produce excessive erosion and stream habitat deterioration. Furthermore, when livestock are in a stream, they may deposit manure directly into the water; this manure is heavily loaded with nutrients and pathogens, all of which lead to water quality problems. Structures such as fences and designated stream crossings can prevent or mitigate these undesirable effects livestock can have on the condition of a stream habitat and water quality. Livestock also must eat and the procedure for feeding should also follow best practices. Table B.1.3 lists the livestock management strategies covered in this section of the report.

Stakeholders in the Floyds Fork Watershed have pointed out some advantages and challenges regarding livestock management strategies. In addition to the advantages to water quality in the streams, developing a water source that is drinking access only for livestock will result in livestock drinking cleaner water and will reduce the spread of disease or worms, etc. Challenges to implementing these strategies are resources such as labor, cost of fencing, cost of other construction, and maintenance. There is also concern from some stakeholders that having livestock in close quarters can create such problems as concentrated wastes and the spread of disease from the number of animals being in close contact. The concentrated wastes can actually be made into an advantage, however, if there are practices in place for collecting it and turning the manure to productive uses.

Table B.1.3 Livestock Management Strategies

| | |
|---|---|
| B.1.3.1 | Livestock Access to Water |
| B.1.3.2 | Stream Crossings |
| B.1.3.3 | Livestock Feeding Areas |

B.1.3.1 Livestock Access to Water

When livestock have access to streams they may cause deleterious effects such as nutrient loading through direct deposition of manure into the stream and streambed and bank destabilization. Best management practices would include limiting livestock access to streams by fencing structures and providing livestock access to alternative water systems. An alternative water system may be a developed spring, pipeline, or tank. The benefits of this management practice include reducing nutrient loading to the stream, minimizing soil erosion, and improving aquatic habitat for the stream.

For more detail on developing an alternative water source see:

http://www.ca.uky.edu/agc/pubs/aen/aen98/aen98.pdf

For incentives on fencing streams see:

http://www.ca.uky.edu/enri/pubs/enri131.pdf

Figure B10. Fenced stream.

B.1.3.2 Stream Crossings

Placing and providing crossings for animals and farm equipment prevents undue erosion from occurring and prevents livestock from depositing manure directly into the stream. Crossings should be constructed at low water points and in a manner that does not obstruct the normal flow of the stream. Ideally crossings should minimize removal of streamside vegetation. Crossings should be checked after flooding and any damage should be repaired as soon as possible.

For more detail about stream crossings for cattle see:

http://www.ca.uky.edu/agc/pubs/aen/aen101/aen101.pdf

Figure B11. Stream crossing BMP.

B.1.3.3 Concentrated Livestock Feeding Areas

A designated area structured and designed for livestock feeding activities offers many advantages. Concentrated or heavily used areas such as feeding areas can result in concentrated manure depositions, which if not managed, could result in a detrimental nutrient and pathogen load to streams via stormwater runoff; however, it is easier and more efficient to collect livestock manure when it is deposited in one area such as a livestock feeding facility. The manure, when collected, is no longer a threat to water quality and may furthermore be put to beneficial uses. Another problem related to livestock feeding is erosion within the feeding area. Concentrated livestock areas can be designed to prevent erosion. Ideally, heavy use areas should be located where little surface flow or runoff will come through the area. To keep runoff clean, diversion practices can be implemented. By diverting runoff from these areas, the manure based nutrient load to streams is significantly reduced. Even if the farm has holding ponds, such runoff diversions alleviate the load on the holding ponds and thus increase4 their effectiveness. Diversion can be accomplished using structures, vegetative filter strips, or rock lined channels.

For more informations see:

http://www.ca.uky.edu/agc/pubs/aen/aen103/aen103.pdf

Figure B12. Livestock feeding area.

### B.1.4 Manure Management

Manure management deals with where manure is deposited, how it is stored or disposed, and how it may be used in a controlled manner. Where manure is deposited is a concern that must be managed when manure is deposited out in fields or in concentrated areas. Composting is a productive method for storing and disposing of manure wastes. Composted manure can be used as fertilizer but should be applied at controlled rates that benefit the land without polluting it also. Environmental concerns arising from manure deposition can also be addressed by managing the runoff that carries the manure contamination. Table B.1.4 lists the manure management strategies covered in this section. Some stakeholders have a concern about confined area feeding operations, in particular, that wastes accumulate in a concentrated area. However, this concentrated waste disposition can make collection more efficient if there are practices in place for recycling the manure for productive uses. Stakeholders see the advantages of using manure for fertilizer or other soil amendments if it can be properly composted and managed.

Table B.1.4 Manure Management Strategies

| | |
|---|---|
| B.1.4.1 | Feeding and Heavy Use Area |
| B.1.4.2 | Manure Storage Facility |
| B.1.4.3 | Manure Composting |
| B.1.4.4 | Manure Composting Facility |
| B.1.4.5 | Manure Application Rates |

B.1.4.1 Feeding and Heavy Use Area Management

Feeding areas, watering facilities, animal trails, and other heavy use areas can undergo significant soil erosion and generate runoff water with high concentrations of animal waste, nutrient levels, and sediment. To control erosion, surface the heavy use area with geotextile fabric and rock or concrete. Runoff from heavy use areas can be directed and treated. Ideally, heavy use areas should be located where little surface flow or runoff will come through the area. To keep clean runoff clean, diversion practices can be implemented. By diverting runoff from these areas, the manure based nutrient load to streams is significantly reduced. Even if the farm has holding ponds, such runoff diversions alleviate the load on the holding ponds and thus increase their effectiveness. Diversion can be accomplished using structures or vegetative filter strips or rock lined channels.

For more information see:

http://www.ca.uky.edu/agc/pubs/aen/aen103/aen103.pdf

Figure B13. Heavy use area for cattle.

B.1.4.2 Manure Storage Facilities

A manure storage facility prevents nutrient contamination of water via storm runoff. The facility should be at least 100 feet from wells and streams. The facility should be essentially water tight, having a concrete floor with curbing, covered with a roof or tarp, and outfitted with roof gutters and downspouts to carry rain water away from the manure piles.

Figure B14. Manure storage facility

B.1.4.3 Manure Composting

Composting livestock manure is an excellent manure management technique, especially for smaller farms. Composted manure allows for the management of biological and nutrient loads from livestock manure. Collecting manure on a daily or weekly basis from paddocks, stalls, and confinement areas for composting has several benefits: it provides the farmer with fertilizer material for crops and pastures; it reduces the chance of manure contaminated runoff polluting surface and ground water; it has several other benefits for the farmland including reducing flies, reducing livestock disease risks, and reducing invasive weed spreading. Composted manure is more easily transported to farther areas of the farm or off the farm. A compost site should be selected that is a high and dry area of the property, not a low lying area or in an area that receives surface flows.

Figure B15. Manure compost.

B.1.4.4 Manure Composting Facility

A composting facility is a facility to process raw manure into biologically stable organic material. A composting facility reduces pollution of water by agricultural wastes. The facility should be at least 100 feet from wells and streams. The facility should be essentially water tight, having a concrete floor with curbing, covered with a roof or tarp, and outfitted with roof gutters and downspouts to carry rain water away from the manure piles. Collecting manure on a daily or weekly basis from paddocks, stalls, and confinement areas for composting has several benefits: it provides the farmer with fertilizer material for crops and pastures; it reduces the chance of manure contaminated runoff polluting surface and ground water; it has several other benefits for the farmland including reducing flies, reducing livestock disease risks, and reducing invasive weed spreading. Composted manure is more easily transported to farther areas of the farm or off the farm. A compost site should be selected that is a high and dry area of the property, not a low-lying area or an area that receives surface flows.

For detailed information on composting horse manure see:

http://www.ca.uky.edu/agc/pubs/id/id168/id168.pdf

Figure B16. Manure composting facility.

B.1.4.5 Accurate Manure Application Rates

Manure is a rich soil amendment which improves the health of both plants and the soil. Especially in a composted form, it improves the physical structure by making it more porous, fertile, and able to hold moisture. However, manure must be applied in appropriate rates to reap its benefit without causing an undue nutrient pollution load on the watershed. To determine accurate manure application rates for soil fertilization, determine the nutrient content of the manure stored on your farm, determine the nutrient needs of your crop, and then calibrate manure application equipment to supply the deficiency.

For more information on assessing nutrient content of manure see:

http://www.ca.uky.edu/agc/pubs/id/id123/id123.pdf

For more information on applying manure as a fertilizer see:

http://www.ca.uky.edu/agc/pubs/agr/agr165/agr165.pdf

Figure B17. Manure application.

### B.1.5 Erosion and Runoff Control Management

Sediment heavily entrained with nutrients can result in a pollutant loading which causes poor water quality. Therefore, controlling erosion can be an important water quality consideration. Stormwater runoff from agricultural landuses can carry this nutrient entrained sediment as well as applied nutrients to streams. Therefore, controlling the quantity of runoff from these lands can also be an important water quality consideration. Erosion and runoff control strategies covered in this section of the report are listed in Table B.1.5.

Stakeholders in the Floyds Fork Watershed can see many advantages to these strategies such as the planted vegetation that is involved in these strategies improve water quality, improve stream stabilization where applicable, offer habitat to wildlife, moderate the temperature of the water body, and make the stream corridor and surrounding areas more aesthetically pleasing. Stakeholders have also pointed out some challenges arising from these practices. In some cases, notably in filter strips or riparian buffer zones, farmers are having to give up some portion of the land that could have otherwise been used as productive farmland. However, in some cases the farmland lost due to erosion over time may be more than the land given up to stabilize the health and morphology of a stream, thereby making this management practice the logical course of action. The cost of implementation is another challenge and could possibly be offset by incentive programs. Another concern is how much time or funds may be required to maintain the effectiveness of one of these management practices once installed. Herbicide applications to row crops need to avoid damaging vegetation used for erosion and runoff control.

Table B.1.5 Erosion and Runoff Control Strategies

| | |
|---|---|
| B.1.5.1 | Filter Strips |
| B.1.5.2 | Terraces |
| B.1.5.3 | Diversions |
| B.1.5.4 | Grassed Waterways |

B.1.5.1 Filter Strips

A filter strip is a strip of close growing dense vegetation planted as permanent cover. The filter strip helps to control the quantity of runoff by capture and it helps to control the quality of runoff by filtering sediment, organic matter, nutrients, and pathogens from the runoff before it enters a stream. Filter strips on nearly level uniform slopes are the most effective. Filter strips on slopes greater than 5% may not be effective. Locate filter strips on the lower edge of row crop fields, especially if adjacent to intermittent or perennial streams, sinkholes, wells, or lakes.

For more information see:

http://www.ca.uky.edu/enri/pubs/ENRI-107%20Filter%20Stripsrev.pdf


Figure B18. Filter strips as part of a watershed management plan.

B.1.5.2 Terraces

A terrace is an earthen embankment or ridge around a sloping hillside. Terraces can also include channel systems. Terraces reduce erosion by slowing and redistributing surface runoff to stable outlets that increase the distance of overland runoff flow. The terrace can be designed to store or guide runoff. Storage can mitigate the runoff and sediment loads to streams and redirection can be used to move runoff to a treatment BMP. Terraces may not be suitable for rocky or sandy soil because these soil types may not adequately redirect flows. To be effective, terraces must be sited in areas where suitable runoff outlets are available; acceptable outlets include grassed waterways or vegetated areas. Inspect terraces after major storms to ensure that they have remained structurally sound.

Figure B19. Terraces between plots.

B.1.5.3 Diversions

Diversions can be constructed as simply as an earthen embankment. This BMP can serve the purpose of diverting contaminated runoff towards a collection facility, where the collection facility can have a treatment component. This BMP can also serve the purpose of preventing runoff contamination by diverting runoff from entering an area where there is a high risk of the occurrence of water quality problems. For example, a diversion may be installed to make runoff bypass a concentrated livestock feeding area. Clean runoff entering such an area would most likely pick up high loads of nutrients, bacteria, or other pollutants, and then carry these pollutant loads into nearby waterways. Installing diversions around other heavy use areas with high erosion potential would also result in the protection of soil and water resources. See also sections B.1.3.4, B.1.3.5, and B.1.5.5.

Figure B20. Earthen diversion

B.1.5.4 Grassed Waterways

A grassed waterway is a shaped or constructed channel that is vegetated with appropriate grass and legumes. Grassed waterways are usually broad and shallow and graded to help convey runoff from a field, terrace, diversion, or other area to a suitable outlet. The vegetated waterway helps control the quantity and quality of runoff and prevents excess sediment transport. The grasses act as a filter to absorb some of the chemicals and nutrients in the runoff water. Grassed waterways are best suited for areas with favorable subsoil and sufficient depth to rock. Grassed waterways may need additional drainage structures along the waterway if the site has a high water table. To protect the grassed waterway, lift plows and other equipment when crossing the waterway and turn off herbicide or other chemical spraying equipment.

For more information see:

http://www.ca.uky.edu/enri/pubs/ENRI-108%20Grassed%20Waterwaysrev.pdf

Figure B21. Grassed waterways.

### B.1.6 Agricultural Runoff Treatment

Agricultural landuses often produce pollution loads that can be carried into streams by stormwater runoff. After both pollution loading on the land and stormwater runoff have been controlled and reduced, the remaining pollution load carried by stormwater runoff may still have a significant impact on water quality. However, there are effective ways to treat agricultural runoff to protect water quality. Waste treatment lagoons and constructed wetlands are the two best management practices for treating agricultural runoff discussed in this section of the report (see Table B.1.6).

An advantage of these practices is that they use natural biological and ecological processes to reduce nutrient loadings to streams. Another advantage is that these practices can be very effective. A constructed wetland can also provide wildlife habitat. However, a waste treatment lagoon may present the challenge of controlling undesirable odors, but this may not become a problem if the site is chosen well. A potential environmental hazard of the waste treatment lagoon is the possibility of an overflow or a containment failure of some kind. Proper siting, design, construction, and maintenance should minimize the risk of this hazard. The disadvantages of a constructed wetland are few; constructed wetlands do require land and some stakeholders feel that stream tributaries should be left in their natural state instead of being altered by construction.

Table B.1.6 Agricultural Runoff Treatment Strategies

| | |
|---|---|
| B.1.6.1 | Waste Treatment Lagoon |
| B.1.6.2 | Constructed Wetlands |

B.1.6.1 Waste Treatment Lagoons

A waste treatment lagoon is an impoundment made by excavation or earthfill to biologically treat livestock manure or other agricultural waste. The lagoon treatment reduces pollution and protects water quality. When livestock wastes are not used as fertilizers, lagoons can biologically treat waste to reduce nutrient content. Excess effluent may be removed from the lagoon by irrigation or hauling if necessary. Lagoons may be aerobic or anaerobic in function. Lagoons that undergo anaerobic require less surface area but they may produce odor. Anaerobic lagoons work best at a depth of 8 to 15 feet. Aerobic lagoons are shallow with a depth of 3 to 5 feet. When choosing a site for a waste treatment lagoon, check soils, rock depth, topography, and underlying geology for site suitability. Ideally, locate the lagoon on soils that can seal through biological action to prevent leakage.

Figure B22. Waste treatment lagoon.

B.1.6.2 Constructed Wetlands

Nutrient rich runoff can be diverted into a wetland area for treatment benefits to protect water quality. A constructed wetland can be effective in preventing nitrogen from reaching the streams; in fact, a wetland can remove more than two-thirds of the nitrogen that enters it. Wetlands provide significant pollutant removal using several mechanisms: sedimentation, adsorption, biodegradation, filtration, and bioaccumulation. There is a symbiotic relationship between the plants, mirco-organisms, substrate, soil, and nutrients in the stormwater. Cattails are common in constructed wetlands because of their widespread abundance, ability to grow at different water depths, and broad tolerance of water quality composition. Maintenance of these systems is minimal and applicability is widespread. An additional benefit of a constructed wetland is that it provides habitat for birds and wildlife.

Figure B23. Constructed wetland.

## B.2 Urban Nutrient Management

Nonpoint pollution in urban areas can cause major problems, especially if there is a high percentage of impervious area. Urban nutrient management encompasses such strategies as capturing and treating stormwater runoff, reducing stormwater runoff, and managing public behavior in ways that are conducive to protecting and restoring water quality. Table 5.7 below lists these urban nutrient management strategies.

Table B.2 Urban Nutrient Management Strategies

| | |
|---|---|
| B.2.1 | Urban Behavioral Management |
| B.2.2 | Urban Structural Controls – Runoff Quality |
| B.2.3 | LID Urban Structural Controls – Runoff Quantity |
| B.2.4 | Traditional Urban Structural Controls - Runoff Quantity |

### B.2.1 Urban Behavioral Management

Urban behavioral management focuses on the benefits to water quality to be gained when residents in urban areas adopt certain practices or behaviors. Residents make many decisions that affect water quality in their watershed such as how much fertilizer to apply to their lawn, how they dispose of yard trimmings and other organic matter, whether to take responsibility for their pet's waste, or how they will wash their cars. Table B.2.1 lists the urban behavioral management strategies covered in this section of the report.

An advantage of urban behavioral management is that the behavior of so many people collectively has a large impact on water quality and so being able to influence that effect to the improvement of water quality would be a major environmental gain. However, there are challenges to managing the behavior of people. It is very difficult to alter people's habits and behavior through messages. Therefore, finding effective educational approaches that motivate people to enact practices beneficial for water quality would be a challenge. Equally challenging would be finding a politically acceptable incentive or regulatory approach to managing people's behavior.

Table B.2.1 Urban Behavioral Management Strategies

| | |
|---|---|
| B.2.1.1 | Lawn Fertilizer Management |
| B.2.1.2 | Yard Trimmings Management |
| B.2.1.3 | Composting |
| B.2.1.4 | Pet Litter |
| B.2.1.5 | Car Washing |
| B.2.1.6 | Conservative Watering |

5.2.1.1 Lawn Fertilizer Management

When residents apply fertilizers to lawns in quantities too large or too frequently, the nutrients contained in the fertilizers can be washed off into streams and can lead to eutrophication conditions in the stream. Therefore it is important to use appropriate application quantity, frequency, and application timing. Excess fertilizer leads to excess nutrient loads. Fertilizers should not be applied to turf when the soil is frozen because turf cannot utilize the nutrients and runoff rates will be high. Fertilizer applied right before a rain event will be more likely to be washed away into streams. Application rates for fertilizers are best based on soil tests. Where soil samples cannot be taken, regional application recommendations should be followed. Fertilizers are available that do not contain one of the three common nutrients (nitrogen, phosphorus, and potassium). For example, if soil tests indicate phosphorus levels are adequate for turf growth, fertilizers can be used which contain no phosphorus.

Figure B24. Healthy lawn.

B.2.1.2 Yard Trimmings Management

When yard trimmings, leaves, grass clippings, twigs, and branches are stored in a way that is vulnerable to storm runoff, rain can wash them into storm drains and into the local streams. In the streams, yard trimmings and other organic matter become a source of excess nutrients, leading to eutrophication problems. One strategy for dealing with yard waste is to minimize the production of yard wastes. Excess fertilizer causes excess yard growth therefore limiting fertilizer can keep yard growth rates manageable. Landscaping with less disease prone trees and shrubs minimizes the generation of yard trimmings. If grass is mowed at half the grass blade length, then grass clippings will dry and filter down to the soil for decomposition and virtually disappear. Yard trimmings can also be used as mulch to enrich the soil.

Much detailed information can be found here on managing leaves and yard trimmings:

http://clean-water.uwex.edu/pubs/pdf/managlt.pdf

Figure B25. Gathering yard leaves.

B.2.1.3 Composting

Composting is the biological decomposition of organic matter. The microbiological organisms that do the decomposition also need air and water for the process. Air is provided by mixing and aerating. Water can be provided in controlled amounts. The proper balance of organic waste, air, and water, combined in volume sufficient to hold heat will sustain the composting process until the final product is reached. The final product is called compost or humus. This compost can be used as a rich soil amendment. Grass and yard clippings, fruit peels, vegetables, tea bags, and coffee grounds, eggshells, and many other organic wastes can be composted. For backyard operations, small bins or a series of bins will work. Composting yard wastes instead of allowing them to be washed off into the watershed reduces nutrient loadings and provides valuable lawn and garden material.

Figure B26. Composting household organic garbage.

B.2.1.4 Pet Litter

An important urban behavior that impacts water quality is picking up pet litter. When pet waste is not properly disposed of, it can be washed into stormdrains and into nearby waterways by stormwater runoff. Stormdrains do not connect to treatment facilities in separated sewer systems, and so untreated pet feces can end up in streams and lakes. Pet litter contains high amounts of nutrients, bacteria, and organic matter which has a high oxygen demand, all of which create significant water quality problems in waterbodies. Public awareness programs can help residents understand how pet waste can affect the water quality of the watershed in which they live. Some municipalities enact ordinances that provide a legal enforcement mechanism for pet owners who do not properly dispose of their pet's waste. Pets can be fenced out of streams where it is needed.

Figure B27. Playing with pet on lawn area.

B.2.1.5 Washing Cars

A major environmental problem with car wash detergents is their probability of containing nutrients, such as nitrogen and phosphorus. Phosphates (or their chemical replacement NTA) are a standard component of most car wash detergents. Soap suds are harmful to aquatic life even in concentrations as low as 2 ppm. Many cities are recommending the use of commercial car washes because there the chemicals are filtered and sent to a water treatment facility for cleaning. If residents must wash their car at home they can try using only water and a rag, using the minimum amount of soap (a little goes a long way), and they should wash their car on the lawn where the yard can act as a sponge and prevent to soapy water from flowing into street drains.

For more information see:

http://sharepoint.snoqualmie.k12.wa.us/ckms/spiesse/Lists/Announcements/Attachments/43/carwash.pdf

http://www.imagesautospa.com/Environmental.html

Figure B28. Washing a car.

B.2.1.6 Conservative Watering

Urban residents may use water outdoors for washing automobiles, maintaining swimming pools, or cleaning sidewalks and driveways, but more than half of outdoor water use is for watering lawns and gardens. Many people water their lawns too often and for too long. It is not necessary to water grass every day. If a patch of grass springs back after being stepped upon, then it does not need watering. Overwatering lawns may directly or indirectly result in runoff carrying fertilizer into the local watershed. If the soil's infiltration capacity remains close to full, then storm water will run off of the lawn much like an impervious surface, carrying nutrients with it. Designing a water-efficient landscape of choice plants and trees, can potentially cut outdoor water use by half.

Figure B29. Watering a lawn area.

### B.2.2 Urban Structural Controls – Runoff Quality

Urban structural controls that have the benefit of treating or improving the water quality of stormwater runoff may also have some runoff reduction benefit as well, and vice versa. The management strategies discussed in this section have an emphasis on treatment and water quality improvement. These structures or landscaping devices function largely on the same basic principal or mechanism. They each take advantage of either the filtering and cleansing properties of plants or the symbiotic and balancing processes that occur in natural ecosystems. The different structures covered in this section of the report (See Table B.2.2) describe different settings or contexts in which these advantages can be designed and implemented.

Stakeholders in the Floyds Fork Watershed see that these strategies can benefit water quality in an urban area. In addition to reducing pollutant loads to streams through treatment virtues, advantages also occur to improved groundwater recharge where permeable land area is dedicated to receiving stormwater runoff. Stakeholders view as an advantage the opportunity to combine nutrient management and stormwater management, and to combine pollution control and erosion control. Stakeholders generally view the increased aesthetics in urban areas due to BMP vegetation and landscaping as a definite advantage. Lastly, many of these BMPs make the task of water quality monitoring easier by controlling the outlet points instead of having a diffuse sheet of runoff from the urban watershed.

The concern stakeholders have regarding urban structural controls is who is going to pay for them. Stakeholders feel that cities do not often have extra funds for these projects; however, there may be available grants for implementing these BMPs. A bigger concern after implementation is that of maintenance. The challenge will become who will be responsible for the work and cost of maintenance. Private entities owning properties or city government may or may not be able to accept the maintenance responsibility. Another significant challenge for BMP structures in urban areas is the challenge of retrofitting existing development or infrastructure. The retrofit could raise difficult design and cost challenges. If the retrofit is desired for private properties, effective incentives may need to be enacted. Even among environmental stakeholder groups, there is some mixed feelings regarding basins, whether they are retention, detention, or other kinds of constructions such as wetlands. The feeling is that these structures require a lot of bulldozing, earthwork, and construction. These activities are seen as a disturbance of the land and unnatural. Some stakeholders feel like the land, especially the tributaries, should be kept in as natural of a state as possible. Some stakeholders see the challenge that these BMPs, especially water bodies, require land, and that that land may not be available in urban areas. Lastly, there is concern regarding safety issues that arise over having larger water bodies, whether they will pose a health or drowning risk .

Table B.2.2 Urban Structural Management Strategies for Runoff Quality

| | |
|---|---|
| B.2.2.1 | Riparian Buffers |
| B.2.2.2 | Vegetated Median Strips |
| B.2.2.3 | Infiltration Basins |
| B.2.2.4 | Retention Basins |
| B.2.2.5 | Rain Gardens |
| B.2.2.6 | Wetlands |

B.2.2.1 Riparian Buffers

Riparian buffers consist of a zone of trees, shrubs, and other native plants growing along the banks of a stream. Riparian buffers have a filtering action on pollutants in storm runoff and also stabilize the stream banks from excess erosion. Excess erosion can release entrained nutrients into the stream. Protecting, restoring, or establishing riparian buffers can therefore be an important step toward improving water quality. Development review overlays can specify the minimum width to be maintained for riparian buffers along streams. The required width of riparian buffers can sometimes be a controversial issue since environmental groups would usually prefer wider riparian buffers while developers would usually prefer more freedom to landscape or build lots to better accommodate market and commercial interests. The same polarity arises around which waterways would merit riparian buffer considerations. Even small intermittent streams play their role in water quality. Stakeholders have also pointed out that although riparian buffers along urban streams would be great to have for water quality, it may be difficult to carry out this strategy consistently where a stream is contained in a residential area or other privately owned lands. In some cases, easements or other forms of compensation could be sought.

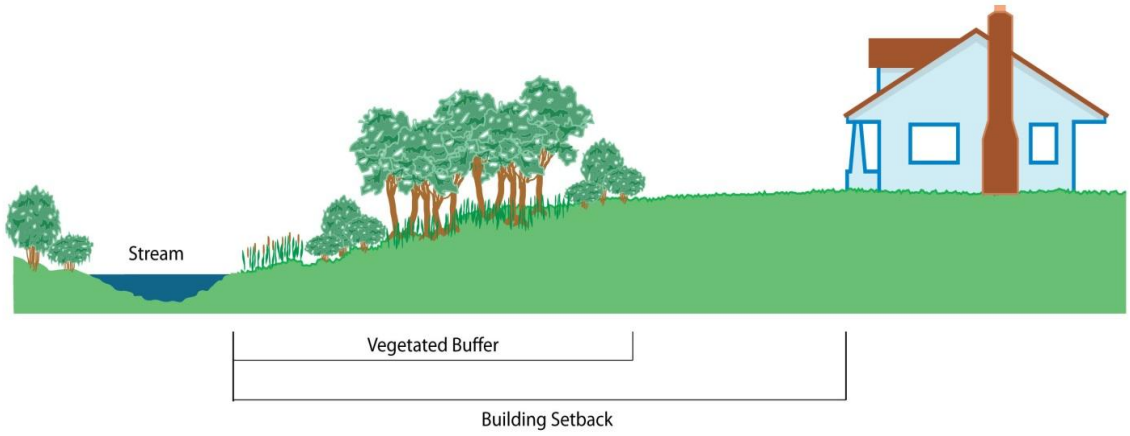


Figure B30. Diagram of a riparian buffer.

B.2.2.2 Vegetated Median Strips

Vegetated median strips can be utilized to collect most or all of the sheet flow from impervious areas such as roadways or parking lots. The vegetated median strip offers some degree of infiltration and filtration of the stormwater runoff. The median strips can be designed to drain to a wetland or a further infiltration basin or detention basin. Vegetated median strips installed in regions having colder climates may entail additional concerns regarding the health and maintenance of the vegetation in the median strip. Colder climates usually have to apply heavy doses of salts to their roads and other impervious surfaces in the winter. The salts from the roads and other impervious surfaces will inevitably end up in the vegetated median strips where they may affect the health of the plants. An additional benefit of vegetated median strips is the enhanced aesthetic value of the city landscape. A drawback or challenge stakeholders have pointed out is that this strategy reduces road and land widths. In areas where existing urban infrastructure would need to be retrofitted, this additional width requirement could pose a challenge.

Figure B31. Vegetated median strip.

B.2.2.3 Infiltration Basins

An infiltraton basin is a stormwater-holding basin that instead of being designed to discharge to a surface water body, are designed to infiltrate storm water into permeable soil. Infiltration basins are designed so that under most storm conditions, all storm runoff is able to infiltrate into the soil, but infiltration basins are also designed with overflow structures that operate during flood conditions. Infiltration basins keep nonpoint pollutants from entering the stream, and thus enhance water quality. Infiltration basins work best with soils that are more permeable and may fail in areas with high clay soil content. In addition to immediate improvements to water quality, reducing the impact of impervious surfaces by allowing stormwater to infiltrate back into the soil allows recharge of groundwater systems that may underlie the urban area. Infiltration basins can be landscaped to be aesthetically pleasing. Some plants or trees also help uptake of water and stabilize the structure of the soil.

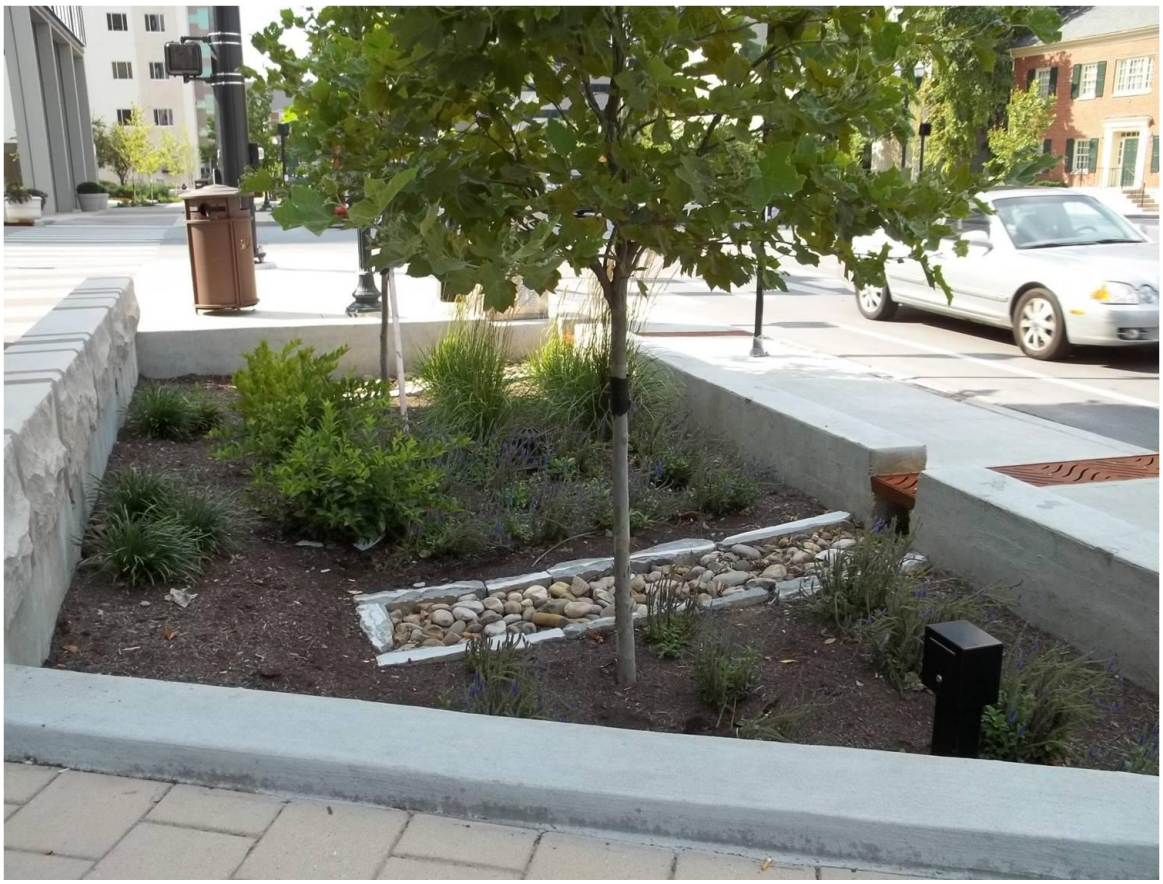

Figure B32. Infiltration basin.

B.2.2.4 Retention Basins

A retention basin is similar to an infiltration basin, in that it also stores stormwater, but the storage of the stormwater is on a more long term basis. Some volume is lost to evaporation and some volume infiltrates into the soil. The evaporation and infiltration reduces the quantity of stormwater runoff reaching the streams. Infiltration allows recharge to groundwater systems. A retention basin has a water quality component while a detention basin is mostly a water quantity BMP. High removal rates of particulate and soluble pollutants (such as nutrients) can be achieved in retention basins through gravitational settling, biological uptake, and decomposition. Retention basins can be landscaped to be aesthetically pleasing and may even become a recreational park area. The area may also afford opportunities for public education on urban water quality issues.

For more information see:

http://www.dcr.virginia.gov/stormwater_management/documents/Chapter_3-06.pdf


Figure B33. Diagram of retention basin.

B.2.2.5 Rain Gardens

A rain garden is a planted depression that allows rainwater runoff from impervious urban areas like roofs, driveways, walkways, parking lots, and compacted lawn areas the opportunity to be absorbed. This reduces rain runoff by allowing stormwater to soak into the ground (as opposed to flowing into storm drains and surface waters which causes erosion, water pollution, flooding, and diminished groundwater). They can be designed for specific soils and climates. The purpose of a rain garden is to improve water quality in nearby bodies of water. Rain gardens can cut down on the amount of pollution reaching creeks and streams by up to 30%. The plants (usually a selection of wetland edge vegetation, such as wildflowers, sedges,rushes, ferns, shrubs and small trees) take up excess water flowing into the rain garden. Water filters through soil layers before entering the groundwater system. Root systems enhance infiltration, maintain or even augment soil permeability, provide moisture redistribution, and sustain diverse microbial populations involved in biofiltration. Also, through the process of transpiration, rain garden plants return water vapor to the atmosphere.

Figure B34. Rain garden.

B.2.2.6 Wetlands

A wetland constructed to treat urban stormwater is a basin whose soils are saturated with water or flooded with shallow water such that it can support rooted, floating, or emergent aquatic vegetation. Stormwater treatment wetlands are usually small, constructed ecosystems designed to enhance water quality. They provide significant pollutant removal using several mechanisms: sedimentation, adsorption, biodegradation, filtration, and bioaccumulation. There is a symbiotic relationship between the plants, mirco-organisms, substrate, soil, and nutrients in the stormwater. Maintenance of these systems is minimal and applicability is widespread. Wetlands can also provide or restore habitat for birds and wildlife. The wetland area may be designed to be a scenic park area with opportunities for public education on urban water quality issues.

For more details see:

http://www.northinlet.sc.edu/training/media/resources/Constructed%20Wetlands%20for%20Urban%20SW%20Mgt%20AL.pdf

Figure B35. Typical wetland area.

### B.2.3 Low Impact Development Urban Structural Controls – Runoff Quantity

In urban areas, impervious surfaces cause increased runoff volume and intensity. For this reason, urban structural controls that aim to manage runoff quantity utilize some mode of storage. In some cases, this means reducing the area of impervious surfaces and allowing the soil's natural storage capacity to take effect. In other cases, this means having structures that have a physical storage volume. The stored volume of stormwater can gradually released or even reused. Table B.2.3 lists the urban structural strategies for managing runoff quantity.

Stakeholders in the Floyds Fork Watershed see the advantages to water quality stemming from these strategies. The benefits of reducing erosion in channels by mitigating the peak runoff flows through these BMPs is evident to the stakeholders. Furthermore, it is understood that reduced quantity of runoff also can help reduce the quantity of pollutant loads. As mentioned previously, some stakeholders see an advantage to combining nutrient management with stormwater management. Other advantages that have been pointed out are that many of these BMPs can be made coexistent with improved urban aesthetics and in some cases be coexistent with a new park or recreation or educational display system. BMPs such as permeable pavers can not only reduce stormwater runoff but help recharge groundwater systems.

The cost of BMPs is often a challenge and some of these runoff controls are seen as expensive by stakeholders in the watershed, in particular detention basins and other larger scale construction projects. Then it becomes a challenge as to where funds will come from for implementation of these projects. Also, some stakeholders are not enthusiastic about strategies which may target runoff but not have a treatment aspect or target a reduction at the source of nutrient pollution. A significant challenge with some of the storm runoff reducing BMPs is that of maintenance cost and responsibility. Some stakeholders do not feel like the benefit of a BMP like permeable pavements are worth the maintenance responsibility they create. Some stakeholders see these higher maintenance BMPs as a factor which will increase the cost of development, and even increase the risk of the failure of a development.

Table B.2.3 Urban Structural Management Strategies for Runoff Quantity

| | |
|---|---|
| B.2.3.1 | Low Impact Development |
| B.2.3.2 | Rain Barrels |
| B.2.3.3 | Permeable Pavements |
| B.2.3.4 | Green Roofs |
| B.2.3.5 | Cisterns |
| B.2.3.6 | Native Vegetation |
| B.2.3.7 | Reducing Lawn Size |

B.2.3.1 Low Impact Development (LID)

LID is a comprehensive land planning and engineering approach with a goal of maintaining and enhancing the pre-development hydrologic regime of urban and developing watersheds. LID emphasizes conservation and use of on-site natural features to protect water quality. This approach implements engineered small-scale hydrologic controls to replicate the pre-development hydrologic regime of watersheds through infiltrating, filtering, storing, evaporating, and detaining runoff close to its source. LID is more than just implementing a list of practices and products; it is a strategic design process to create a sustainable site that is appropriate for the proposed land use.

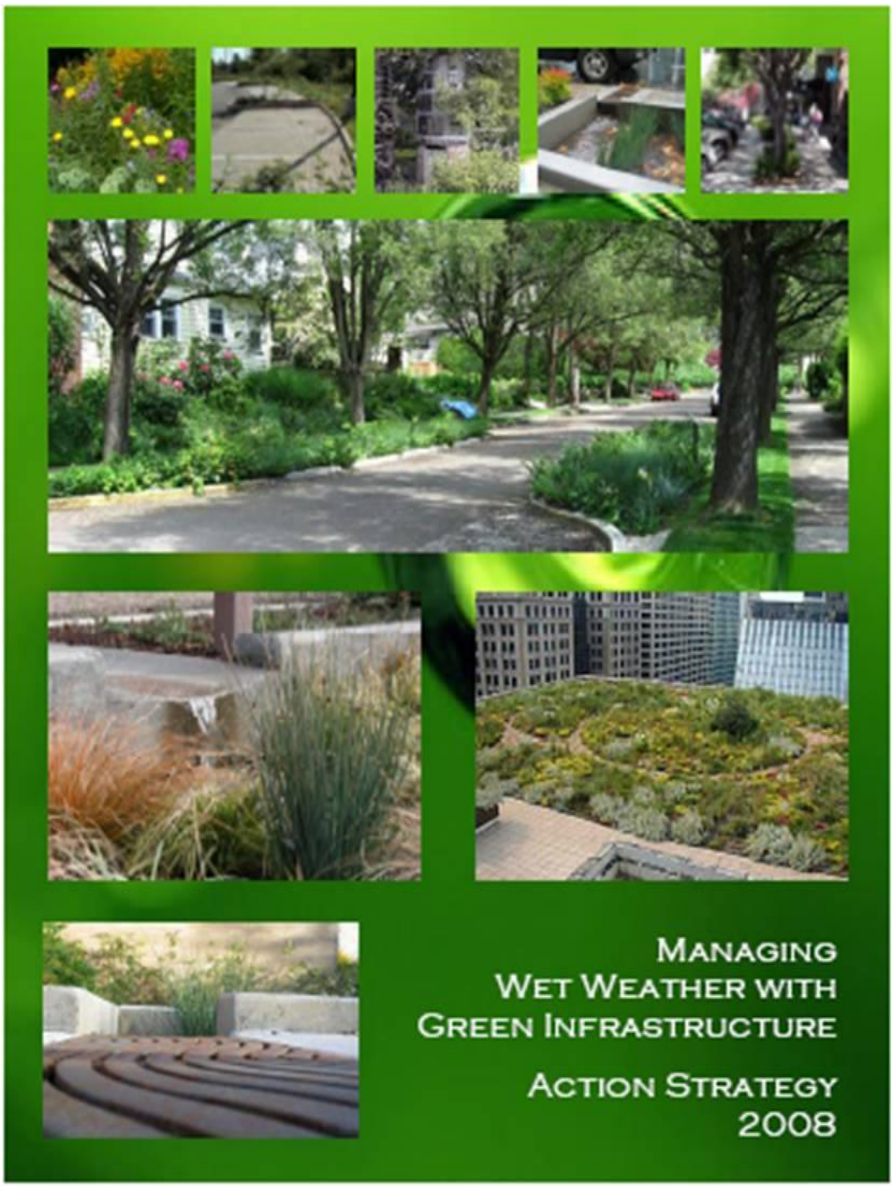


Figure B36. Low impact development techniques.

B.2.3.2 Rain Barrels (or Rainwater Tanks)

A rain barrel is a rainwater water tank used to collect and store rain runoff, typically from rooftops via rain gutters. A collection system can yield 623 gallons of water from 1 inch of rain on 1,000 square feet of roof. Widespread use in an urban area would therefore significantly reduce the amount of stormwater runoff and consequently its entrained pollutant load. There are many beneficial uses of the rainwater collected in rain barrels; the rainwater may be used for watering gardens, agriculture, flushing toilets, or washing cars. However, if the rainwater that fills the rain barrel is not reused or gradually released before the next storm event, the rain barrel will not be able to serve its purpose since it will still be full and cannot collect any more stormwater. Rain barrels can be painted and turned into community art projects. As such, there is high potential for community promotion of rain barrels and public education on urban stormwater issues.

Figure B37. Household rain barrel.

B.2.3.3 Permeable Pavements

Impervious surfaces (paved areas such as roads, driveways, parking lots, sidewalks, and rooftops) in urban and developing areas significantly alter the hydrologic characteristics of the local watershed. The runoff from impervious surfaces is of greater intensity and volume, carrying nonpoint pollution to the streams. Permeable pavements are a way of reducing the impervious area in urban localities, thereby reducing the quantity of stormwater runoff. There are several types of permeable pavements: pervious concrete, pervious asphalt, permeable interlocking concrete pavers, concrete grid pavers, and plastic reinforced grass pavement. Permeable pavements can reduce runoff by 60% in some cases. Mixed testimonies regarding permeable pavements exist. There is some concern regarding the maintenance needs of pervious pavements. The concern is that if the pervious pavement becomes clogged with highly compacted dirt and other debris, then it loses all of its pervious properties.

Figure B38. Permeable pavements.

B.2.3.4 Green Roofs

Similar to permeable pavers, the problems addressed by green roofs are associated with impervious areas. Rooftops collectively amount to a considerable amount of impervious area and generate intense runoff. Rain barrels usually address rooftop runoff in urban residential areas, but rooftop runoff can be altogether reduced by landscaping the rooftop with appropriate soils and plants to absorb rainfall. The soils and plants on the roof will undergo natural hydrological cyclic processes such as evaporation and transpiration that further reduce the volume of stormwater to manage. Green roofs have the additional benefit of decreasing roof temperature and hence decreasing energy costs in warm weather. The increased insulation value of green roofs may also help to reduce winter heating costs.

Figure B39. Green roof in urban area.

B.2.3.5 Cisterns

A cistern is a large water-tank used to collect and store rain runoff, typically from rooftops via rain gutters. Since a large quantity of rainwater discharges from rooftops, widespread use of a rainwater collection system in an urban area would significantly reduce the amount of stormwater runoff. Reducing the quantity of stormwater runoff means also reducing the quantity of its entrained pollutant load. There are many beneficial reuses of the rainwater collected in cisterns; the rainwater may be used for watering gardens, agriculture, flushing toilets, or washing cars. However, if the rainwater that fills the cistern is not reused or gradually released before the next storm event, the cistern will not be able to serve its purpose since it will still be full and cannot collect any more stormwater. Cisterns serve the same function and purpose as rain barrels, but they are larger collection systems.

Figure B40. Household cistern for collecting rainwater.

B.2.3.6 Native Vegetation

Landscaping is a critical element to improve both the function and appearance of stormwater BMPs. Introduced species can often escape cultivation and begin reproducing in the wild. This is significant ecologically because many introduced species out-compete native species and begin to replace and take over naturally occurring species at an alarming rate. By planting native species in stormwater management facilities, the ecological richness and heritage of a geographic area can be preserved. Plants are able to reduce the quantity of water to be managed because of the natural hydrologic processes such as transpiration and evaporation. Plants also take up nutrients and solidify the integrity of soil structure. An aesthetically pleasing landscaped BMP can increase public acceptance and afford opportunities for public education on native plants and urban stormwater issues.

For more information see:

http://www.epa.gov/greenacres/conf12_04/conf_knwldge.html

Figure B41. Mixed landscape yard.

B.2.3.7 Reducing Lawn Size

Converting a lawn to a mixed landscape can have many benefits. Because turf requires two to three times the water of a sustainable mixed landscape, converting lawn turf to a mixed landscape will result in a substantial savings in fresh water. A mixed landscape also produces less yard waste and requires less maintenance. The most important benefit to water quality, however, is that mixed landscapes reduce the need for fertilizers and herbicides, and reduced fertilizers and herbicides applied on lawns in turn leads to reduced nonpoint pollution in the watershed. To reduce lawn size, lawn areas can be replaced with appropriate ground cover plants that spread across the ground but do not grow tall, deciduous shrubs that give seasonal color and texture to the landscape. Mixed landscapes also increase biodiversity and offer shelter and habitat for birds and small wildlife.

For more information see: http://eartheasy.com/article_lawn_reduce.htm

Figure B42. Household outdoor seating area.

### B.2.4 Traditional Urban Structural Controls – Runoff Quantity

B.2.4.1 Detention Basin

The urbanization of a watershed has a significant impact on its characteristic hydrology. One of the biggest impacts of urbanizing a watershed is a damaging increase in peak runoff. The high peak runoff intensity carries much heavier sediment loads to the waterway and once in the waterway, it scours the stream banks and beds, further increasing the sediment load. The nutrients contained within the sediment load become available in the water column and can lead to significant eutrophication problems. A detention basin can mitigate runoff peaks by storing the necessary volume of stormwater and then gradually releasing it after the storm has passed. A detention basin is distinguished from an infiltration basin by being designed to discharge to a downstream water body. However, some infiltration may still take place in a detention basin. This infiltration has the added benefit of reducing the overall volume of stormwater that has to be managed. The basin functions by allowing a large volume of water to enter while limiting the outflow downstream. The challenge with detention basins are that they take up land, and they need to take up more land to be more effective. In some urban areas, that land may not be available, and costs for new development could rise.

Figure B43. Dry detention basin designed to temporarily detain runoff during storm events.

## B.3 Wastewater Management

Because wastewater contains very high concentrations of nutrients, managing the wastewater generated in a watershed is a critical piece of the nutrient management puzzle. Depending on the nature of the area, wastewater management may take the form of management of on-site wastewater treatment septic systems or much more infrastructure intensive considerations regarding sewer overflows or the replanning the sewer system of large areas. Wastewater management also concerns scientific advancements in nutrient removal technology. Wastewater reuse is a management strategy which solves a water source problem while eliminating a water pollution problem. Table B.3 lists the wastewater management strategies covered in this section of the report.

Table B.3 Wastewater Management Strategies

| | |
|---|---|
| B.3.1 | Eliminate Failing Septic Systems |
| B.3.2 | Eliminate Sanitary Sewer Overflows |
| B.3.2a | Repair Existing Sanitary Sewer Infrastructure |
| B.3.2b | Expand Infrastructure of Existing Facilities |
| B.3.3 | Wastewater Treatment Facility Consolidation |
| B.3.4 | Wastewater Treatment Facility Regionalization |
| B.3.5 | Enhanced Nutrient Removal Technologies |
| B.3.6 | Wastewater Reuse |

Strategies B.3.1 thru B.3.5 were suggested and evaluated by the project stakeholders. One additional potential strategies, wastewater reuse was not suggested or evaluated, but is listed and described as another potential alternative.

### B.3.1 Eliminate Failing Septic Systems

When properly designed, maintained, and used, septic systems can provide adequate treatment for most pollutants. However, a significant percentage of septic systems within a watershed can be in a failing condition. One common category of septic system failure is when poorly treated sewage surfaces on a residential yard or lawn. Poorly treated sewage contains excessive nutrients and when these wastes rise to the surface they can be washed into the streams during storm events. When a septic system needs repair, the local county health department can help identify the problem and provide a list of professionals in the area who can assist the homeowner. If a septic system can be repaired, then it will not be a significant source of nutrients in the local watershed; however, some septic systems may be on sites that are not conducive to onsite septic system such as sites with shallow bedrock. In these cases, connection to a sewer system may be more appropriate than onsite fixes.

Stakeholders in the Floyds Fork watershed see the following advantages to repairing failing septic systems: improvement in property value, reduction in water pollution, and improved home health environment. The challenges of repairing failing septic systems are seen as: the problem of identifying property owners who have failing septic systems, the cost of repairs, and the need for continued maintenance. Some stakeholders feel that to protect water quality, policies need to be in place requiring more area for septic system installation. Some stakeholders suggest that septic system problems can be addressed by constructing a wetland on the site.

For more information about septic system issues see:

http://ohioline.osu.edu/aex-fact/0741.html

Figure B44. Failing septic system.

### B.3.2 Eliminate Sanitary Sewer Overflows

Sanitary sewer overflows (SSOs) are discharges of untreated wastewater from municipal sanitary sewer systems. These discharges are very damaging to water quality; large volumes of untreated wastewater, carrying high levels of bacteria and nutrients, flow to stream channels. Problems that can cause SSOs include: too much rainfall infiltrating through the ground into sanitary sewers not designed to hold stormwater, excess water inflowing through illegal connections such as roof drains, blocked pipes due to oil or grease being poured down drains, or an infrastructure system that has overreached its design life or capacity. Many of the following wastewater strategies may reduce or eliminate SSOs.

Figure B45. Sanitary Sewer Overflow.

B.3.2a Repair Existing Sanitary Sewer Infrastructure

By far the most common cause of sanitary sewer overflows is large volumes of stormwater entering the sewerage lines. The combined flow of wastewater and stormwater exceeds the capacity of the sewer system and untreated sewage is released into local waterways. Inflow becomes possible when pipes become old and deteriorate, or become cracked due to the growth of tree roots or mechanical fracturing from the overburden of soil or heavy buildings. There are many possibilities for repairing failing sewer lines, from excavation and replacement to liners or coatings.

Stakeholders in the Floyds Fork Watershed see that repairing a leaking or failing sewer line system has immediate and certain benefits for water quality. Some stakeholders want to be cautious about investing resources in putting "Band-Aids" on old and failing systems when the only long term solution to the sewer problem is an expansion of infrastructure. Other stakeholders are more comfortable with repairing existing infrastructure because of its benefits to water quality but are cautious about system expansion due to its potential for being a catalyst for that degree of development which would ultimately be detrimental to water quality.

For extensive information on the assessment and rehabilitation of sewer system infrastructure, see:

http://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=30004DAX.txt

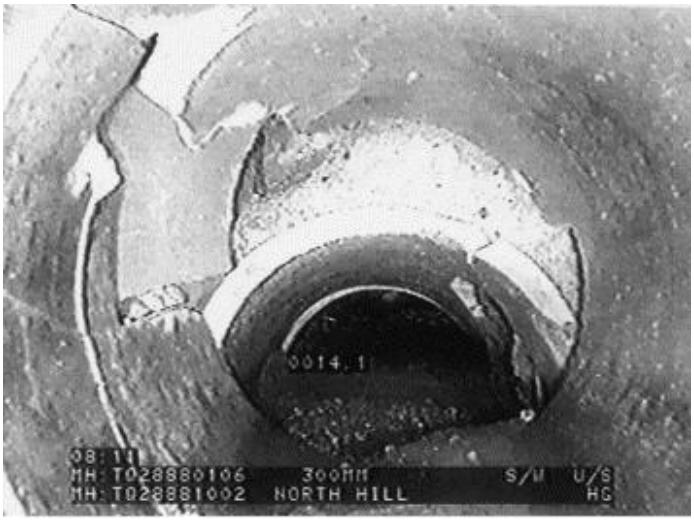


Figure B46. Cracked sewage pipe.

B.3.2b Expand Infrastructure of Existing Facilities

In addition to repairing failing sewer lines, lines may be replaced with larger lines or parallel lines may be added to a sewer system to increase the overall system capacity. Increased capacity of the sewer system lowers the likelihood and magnitude of sanitary sewer overflow events. The expansion of sewer infrastructure as a management strategy is viewed differently by different parts of the community. The developer usually welcomes sewer system expansion because an increased capacity of the sewer system makes room for increased housing developments. These housing developments could be more easily approved if the new homes could connect onto a sewer systems with ample capacity to receive them. The environmental community desires the elimination of sanitary sewer overflows, but they may view sewer system expansion with caution for the same reason that developers view it favorably: it may open possibilities for increased development in the area serviced by the sewer system.

Stakeholders in the Floyds Fork Watershed are divided on the issue of expanding sewer system infrastructure. Some stakeholders see expansion as a better alternative to repairing failing septic systems or patching up existing systems. The main concern among some stakeholders regarding expansion of sewer systems is the opportunity it can create for a sprawl of development; these stakeholders would like to have more conservation minded zoning and development regulations in place before a major sewer system infrastructure expansion takes place. The existing zoning regulations allow a density of development that makes some stakeholders concerned for the future health of the watershed if they are not amended.


Figure B47. Sewage pipe being replaced.

### B.3.3 Wastewater Treatment Regionalization

In some areas with numerous, older, small package wastewater treatment plants, many of these plants may not meet effluent standards. Regionalization is a strategy that examines the feasibility of decommissioning the smaller plants and instead pumping wastewater in the area to a larger regional facility. The larger facility may be one with appropriate excess capacity, or it may be a new facility constructed with the required capacity at an existing wastewater treatment facility site. The larger facility can take advantage of the economy of scale, having reduced operating costs. The consolidated facility will have overall lower maintenance costs and overall lower energy costs. The main benefit will be to water quality. The consolidated facility will allow the elimination of nonconforming facilities and discharge effluent treated at a level conducive to protecting water quality standards. Challenges to wastewater consolidation are engineering considerations and costs such as system infrastructure and site selection in addition to the challenge of local political agreements.

The same discussion regarding the expansion of sewer system infrastructure applies to facility regionalization. Regionalization may open the way for a surge of development growth, which is welcomed by some stakeholders in the Floyds Fork Watershed but not by others. Stakeholders can see benefits and advantages to improving water quality by regionalization. Another advantage that stakeholders see is that of having simplified regulatory actions. Challenges with adopting a regional approach are the cost (and the probable long term debt), the politics of a system that must bring together several counties and numerous cities, and the logistics of the controlling authority. Another concern stakeholders have is for non-point sources to not be forgotten if a regional solution to wastewater is implemented.

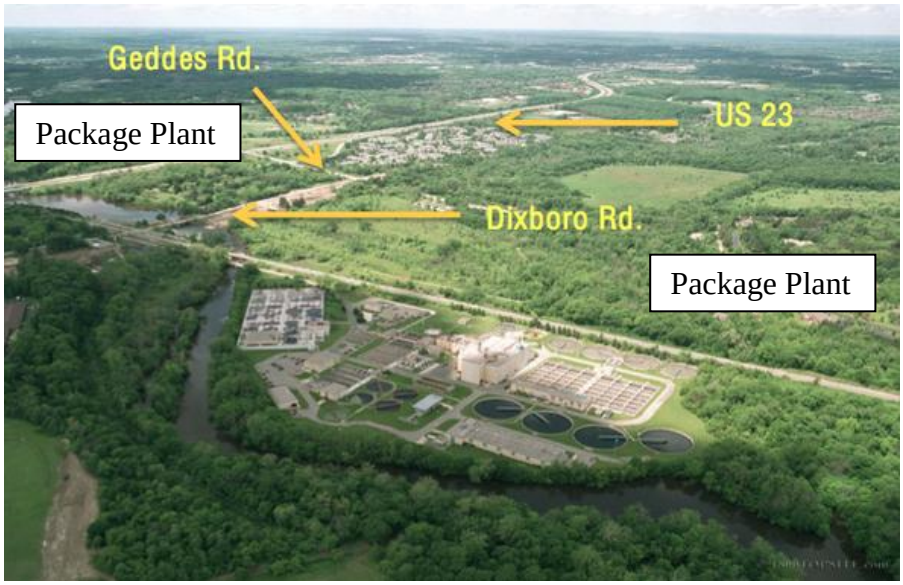


Figure B48. Wastewater treatment plant.

### B.3.4 Enhanced Nutrient Removal Technologies

Whether improved levels of nutrient removal are enforced through quantitative standards and permits (see B.4.6 Policy) or are encouraged through incentives or other policies, enhanced nutrient removal treatment to some degree may be critical for restoring and protecting water quality in some streams that are dominated by point source discharge pollution. Nitrogen removal technologies are usually based on biological nitrification-denitrification. Both chemical and biological methods exist for phosphorus removal. It may sometimes not be feasible for small package plants to achieve advanced stages of treatment, in which case there may be a more pressing need for consolidation or regionalization to take advantage of economies of scale. One concern some stakeholders in the watershed have about looking to advanced technologies for the wastewater problem solution is that they foresee a high cost in these technologies, with the likelihood of diminishing returns.

For detailed information on nutrient removal technologies and case study data, see:
http://water.epa.gov/scitech/wastetech/upload/mnrt-volume1.pdf

Figure B49. Enhanced Nutrient Removal Treatment Technology.

### B.3.5 Wastewater Reuse

Wastewater can be very high in nutrients, and when discharged into the local waterways these nutrients are a pollutant but when reused on a crop or turf, they can become a resource. In addition to wastewater reuse turning wastewater into a resource, when wastewater is reused, it is not available to directly pollute a stream. There are many beneficial purposes for reused wastewater including landscape or agricultural irrigation, industrial uses, and fire protection. Required treatment levels for wastewater vary depending upon the reuse application. High quality reclaimed wastewater is required for irrigation of food crops. Wastewater reuse has the potential to reduce many wastewater pollution problems, including problems such as SSOs or CSOs: if significant portions of the waste stream are reused or recycled, then the loading on the treatment system's capacity is significantly reduced.

For more information see: http://www.nesc.wvu.edu/ndwc/articles/OT/WI05/reuse.pdf

Figure B50. Wastewater Resuse

## B.4 Policy Strategies

Policy management strategies employ regulations or incentives to cause or promote practices within the watershed which restore and protect water quality. Policy strategies can be very powerful strategies with far reaching impacts. Policy strategies include, but are not limited to, the development of quantitative nutrient standards, the promotion of conservation subdivisions, the creation of development review overlays, and the development of a nutrient pollution trading system. Table B.4 lists the policy management strategies covered in this section of the report.

Table B.4 Policy Management Strategies

| | |
|---|---|
| B.4.1 | Conservation Subdivisions |
| B.4.2 | Development Review Overlay |
| B.4.3 | Pollution Trading |
| B.4.4 | Forest Preservation |
| B.4.5 | Reduce Air Emissions of NOX |
| B.4.6 | Quantitative Nutrient Standards |
| B.4.7 | Wastewater Management Districts |

Management strategies B.4.1 thru B.4.5 were originally evaluated by the stakeholders as part of the public and online scoring process. Strategies B.4.4. and B.4.5 were added to the list in response to comments received during the public information meeting. Strategies B.4.6 and B.4.7 have already been developed or implemented for the basin and are listed here for completeness.

### B.4.1 Conservation Subdivisions

Conservation subdivisions are characterized by common open space and clustered compact lots. The purpose of a conservation subdivision is to protect farmland and/or natural resources while allowing for the maximum number of residences under current community zoning and subdivision regulations. In some cases a greater density (density bonus) may be offered in the local ordinance to encourage this approach to residential development planning. Generally, this tool is used for parcels 40 acres or larger. Conservation subdivisions offer higher home values, preserve wildlife habitat, and preserve more pervious open spaces which mitigate stormwater related issues. The development community is skeptical of conservation subdivisions because they must strongly consider market trends and consumer preferences in the style of developments they build. The environmental community is skeptical of conservation subdivisions because they worry that the word "conservation" may be in name only, and that in reality conservation subdivisions would result in mere development and no conservation.


Figure B51. Conceptual plan using conservation design principles.

### B.4.2 Development Review Overlays (DRO)

A development review overlay specifies regulations pertaining to land development within a certain area. Development overlays may impose additional requirements or relax requirements imposed by the underlying zoning district. Development review overlay zones or districts are applicable when there is a specific public interest in a geographical area that does not coincide with the primary district boundaries. The DRO may target several preservation or conservation interests. The DRO may specify regulations intended to protect stream corridors, trees and vegetation within the area, water quality, natural features such as hillsides and topography, and historic features within the area. The role of DROs in protecting water quality is that they can specify a requirement to conserve riparian buffer zones along stream corridors, regulations regarding the placements of impervious surfaces, and also many erosion control practices. A DRO can call for existing wooded areas and existing wetlands to be preserved in their natural states. A DRO can be politically sensitive also. Some members of the community are very glad for the DRO to protect irreplaceable natural resources while other members of the community feel that DRO's often go too far in restricting their freedom, options, and opportunities to make a livelihood.

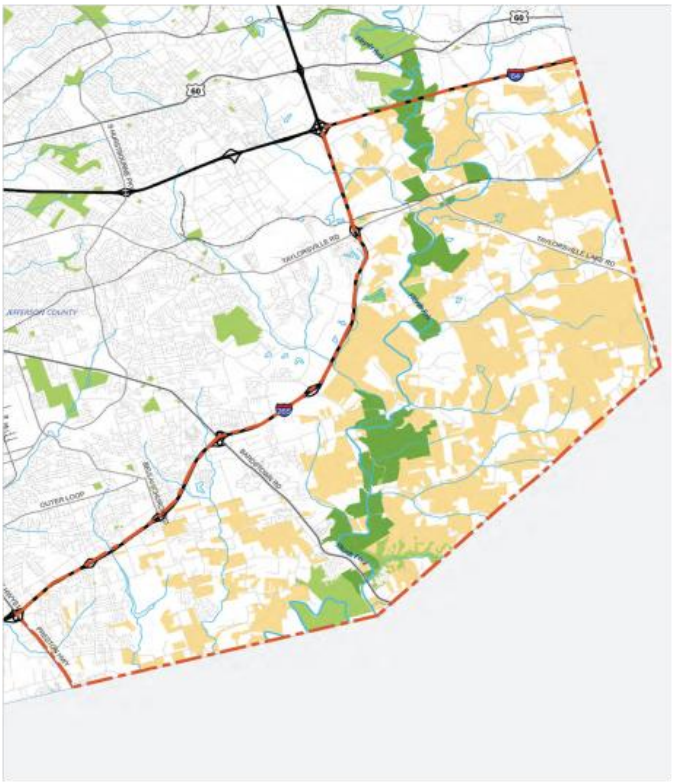

Figure B52. Development Review Overlay

### B.4.3 Pollution Trading

Pollution trading is a system that employs the buying and selling of pollution reduction credits. The idea behind pollution trading is that it creates a cost efficient method of reducing overall pollution and thereby reaching water quality goals. A credit is the amount of pollutant reduced below a source's acceptable discharge. In the context of nutrient management, nutrient credits would be bought and sold with the goal of reducing the overall loading of nutrients in the watershed. One scenario may be a credit exchange between a wastewater treatment plant and an agricultural land manager. One problem with pollution trading is that no matter how the trading is scheduled or organized in a time frame, point sources and non-point sources pollute waters on fundamentally different time scales. A point source issues a constant stream of pollution at all times and in all flows, and becomes especially critical in low flows; non-point source pollution, on the other hand, is only activated during a storm event. Therefore, if a farmer reduced his loading and a treatment plant kept its loading too high, a look at the daily water quality in the stream would still show high nutrient levels in the stream except during storm events when the benefit from the farmer's work would take effect. Pollution trading is also viewed poorly by the environmental community where they see it as a shift of responsibility. The environmental community would rather see all members of the community doing their part to improve water quality in the watershed. Some stakeholders see many challenges with pollution trading. They see getting public and private entities to work together as one challenge. They believe that it is fraught with the potential for unintended consequences, and at best it would not solve anything; that people would see credits they weren't going to use anyway and that buyers would do what they were going to do anyway. Some stakeholders feel that this strategy will only succeed at distracting attention and resources away from adopting real solutions. The development community is skeptical of this strategy because they are concerned that one consequence of it will be to drive regulatory standards unrealistically low.

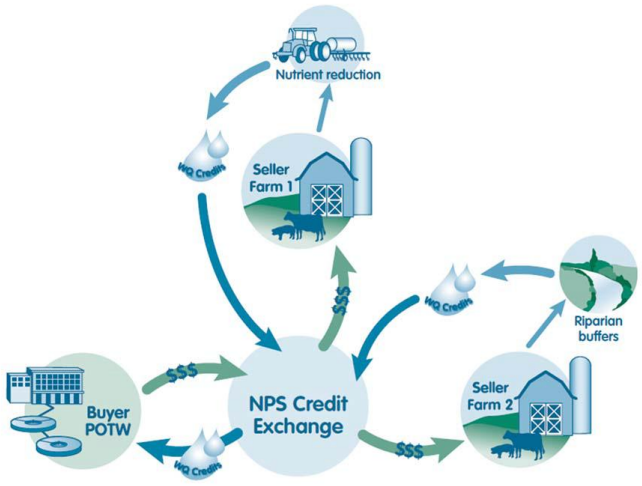


Figure B53. Conceptual example of a pollution trading scenario.

### B.4.4 Forest Preservation

As can be seen from the landuse map below, forests make up a significant fraction of the total landuse of the Floyds Fork watershed. In general, forests release lower concentrations of nitrogen and phosphorus to the streams than do other landuses (e.g. urban and agricultural). As a consequence, one way to reduce future nutrient loads would be to maintain or increase the amount of forest cover to the watershed.

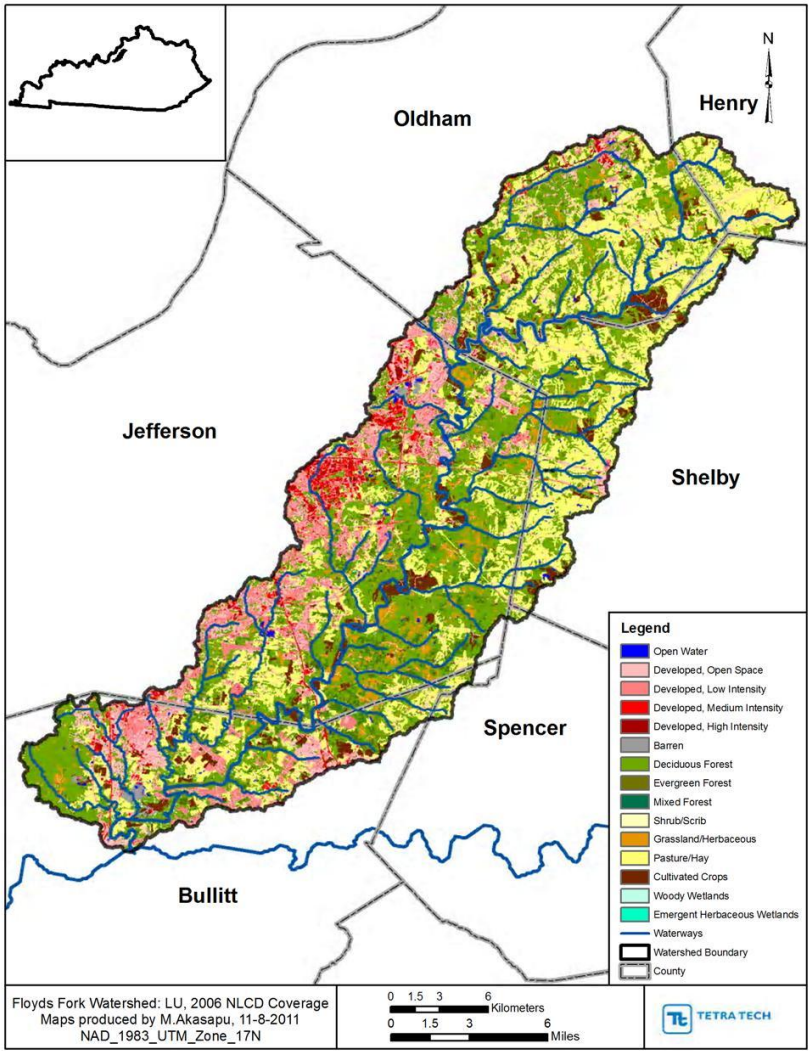


Figure B54. Land use in Floyds Fork watershed.

**B.4.5 Reduction of Air Emissions of NOX**

Part of the nitrogen load to the Floyds Fork watershed comes from the deposition of nitrogen species from the air. The US Geological Survey has estimated that the average load to the watershed may be as high as 1.7 tons/sqmi/year. Part of the source of this atmospheric nitroghen can come from air emissions of nitric oxide from coal burning power plants. There are currently three coal burning power plants just west of Louisville as shown in the figure below. Additional coal burning power plants also exist to the west of Louisville in Indiana. One potential way to decrease the nitrogen load to the watershed would thus be to decrease such emissions.

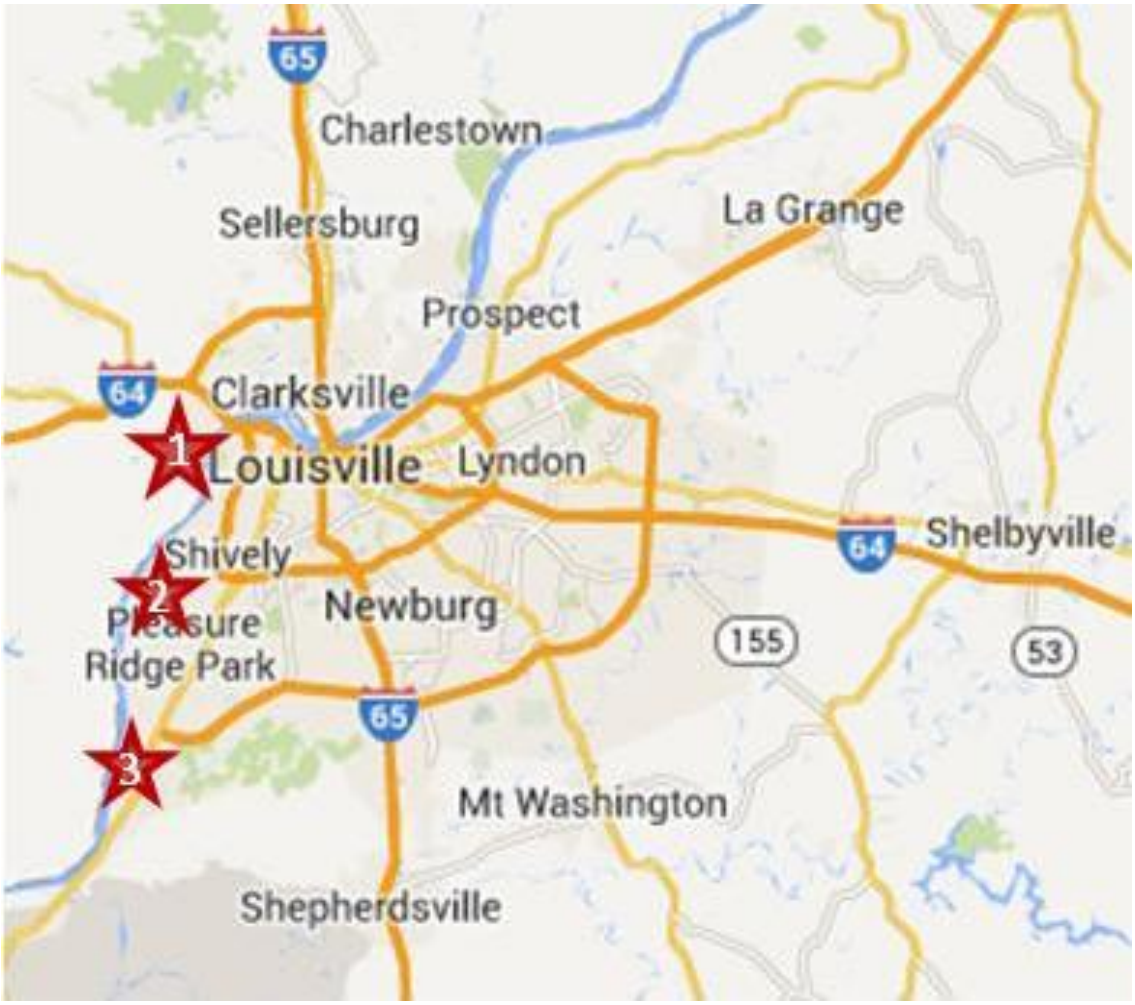


Figure B55. Approximate locations of major coal-fired power plants near Floyds Fork watershed.

### B.4.6 Quantitative Nutrient Targets

The effluent from wastewater treatment plants is sometimes still high in nitrogen and phosphorus even after current levels of treatment. The development of defensible quantitative nutrient targets would enable such standards to become part of NPDES permitting. When point source dischargers must comply with their NPDES permit, and hence a water quality standard, treatment levels and methods must arise which protect streams from the harmful effects of excess nutrient concentrations. One challenge to developing quantitative nutrient standards is that different regions of the country have existing background nutrient levels due to their soils and geology. Quantitative nutrient standards would have to take these background levels into account and not require unreasonable treatment from facilities. Quantitative nutrient standards are politically sensitive. Environmental government agencies are working to develop scientifically defensible values.

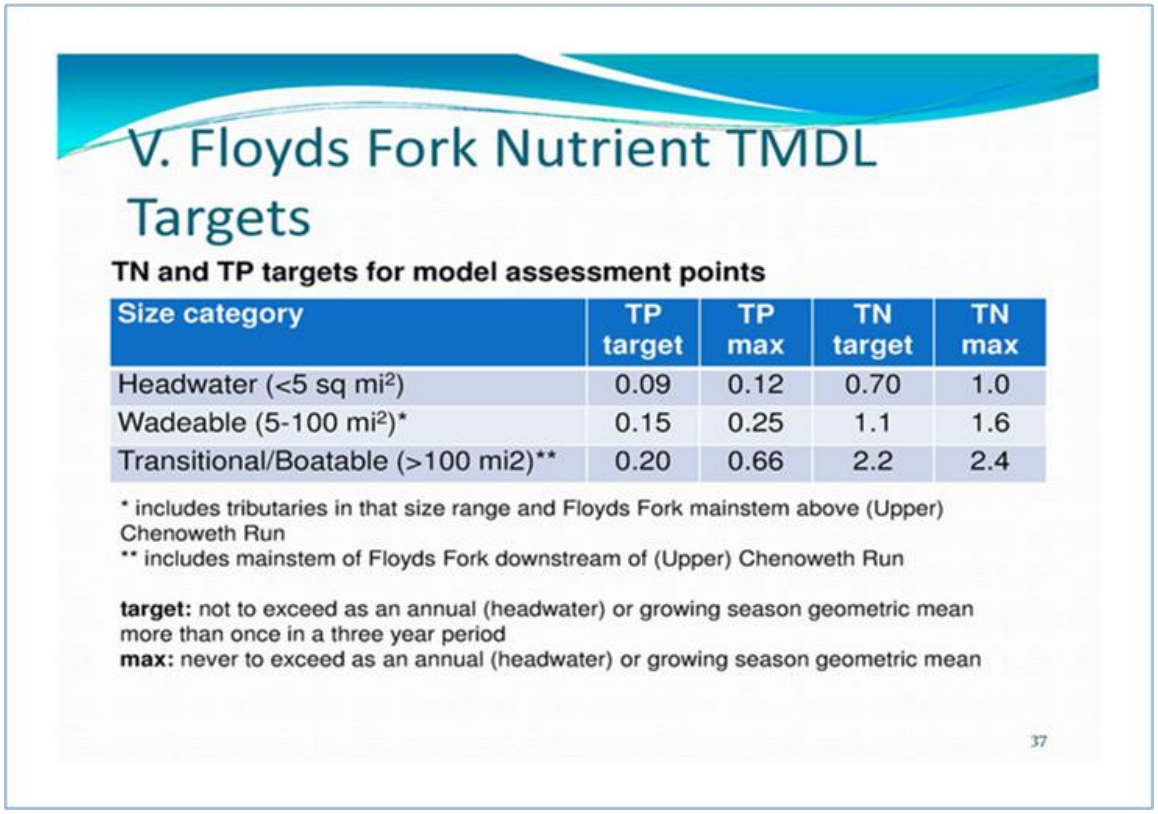


Figure B56. Floyds Fork nutrient TMDL targets

### B.4.7 Wastewater Management Districts

A wastewater management district can occur within or around natural rather than political boundaries. The General Assembly of the Commonwealth of Kentucky has provided the authority to create a regional wastewater commission within the counties of Bullitt, Hardin, Jefferson, Meade, and Oldham. Entities eligible to participate in the wastewater commission are: a city that owns a wastewater system, an urban-county government that owns a wastewater system, a sanitation district created pursuant to KRS Chapters 67 and 220, a metropolitan sewer district or a joint sewer agency established under KRS Chapter 76, a water district that owns a wastewater system established under KRS Chapter 74, and an agency of the federal, state, or local government owning a wastewater system subject to regulation by the Kentucky Division of Water. A legislative act of the General Assembly has provided authority for the commission to possess certain powers and duties. The authority for the commission was established because the General Assembly finds that regionalization of utility services can benefit Kentuckians by sharing the capital and operating costs of facilities among many users while protecting and enhancing the water quality of the Commonwealth's watersheds, creeks, lakes, and rivers. The commission approach will offer economies of scale when contracting, better treatment performance, lower operating costs, lower administrative costs, which all result in more affordable rates. The regionalization approach allows for expansion of infrastructure to make possible economic growth while the commission's authority can insure that economic growth takes place in a manner that safeguards the waters of the Commonwealth from pollution. Further environmental benefits of the cooperative, regional approach of the wastewater commission is that it will result in fewer wastewater discharge points and increased consistency in meeting water quality standards. See Section B.3.4 for a discussion on stakeholder views regarding support and opposition to a regionalization approach.


Figure B57. Conceptual plan for regional wastewater management.

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## APPENDIX C: IRB PROTOCOLS

All research projects conducted by the University of Kentucky that involve human subjects (for either medical or non-medical research) require direct overview by a university Institutional Review Board as consistent with the ethical principles and guidelines for the projection of human subjects for research developed by the National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, otherwise known as the Belmont Report (1979). These guidelines require that all researchers must undergo a formal training process to insure that the researchers are culturally competent in research. Furthermore, the guidelines require that all research protocols, narratives and materials must be reviewed and approved by the university IRB prior to implementation. This process was explicitly followed in this project. The IRB approved materials that were used as part of this project are summarized in this appendix. These materials included:

C.1 Project protocol
C.2 Informed consent for project interview
C.3 Discussion guide for project focus groups
C.4 Informed consent for focus group participation
C.5 Flyer for public information meeting
C.6 Discussion guide for public information meeting
C.7 Flyer for public scoring meeting
C.8 Discussion guide for scenario scoring meeting
C.9 Powerpoint presentation for public scoring meeting

### C.1 Project Protocol

**1. Background:** This project will implement a community-based participatory engagement process employing both qualitative and quantitative methods to document stakeholder preferences for future nutrient and watershed management strategies. The project focuses on: 1) identifying various watershed management strategies that have been proposed previously by diverse entities (e.g., state and/or local government, environmental advocacy organizations, etc.); 2) identifying additional strategies that are of interest to stakeholders; 3) documenting community values that affect the perceived acceptability of specific management strategies; 4) identifying community concerns related to specific management approaches; 5) discovering technical and/or scientific knowledge gaps that impair the capacity for informed decision making by stakeholders; 6) identifying trusted information sources for providing information to reduce these knowledge gaps; and 7) ultimately documenting stakeholder preferences for the identified watershed management strategies.

This project replicates an integrated community engagement process that combines Community-Based Participatory Communication (CBPC) and Structured Public Involvement (SPI) methodologies to increase stakeholder involvement in planning processes. Initially implemented for the Paducah Gaseous Diffusion Plant Stakeholder Future Vision Project (KRCEE, 2011), this approach attempts to identify diverse perspectives on complicated public issues while documenting overall community preferences for specific solutions to complex environmental challenges.

The first two stages of the process utilize CBPC-based interview and focus group protocols to elicit participant values and the ways in which these values inform perceptions about acceptable and unacceptable strategies for managing the Floyds Fork watershed.

CBPC is not simply a community outreach strategy, and it is less focused on widespread generalizability and diffusion. Instead, it emphasizes the building of trust and rapport, along with the empowerment of individuals and communities, toward collaborative decision-making processes to achieve outcomes that resonate with community values, culture and perspectives about the future. CBPC favors decentralization and democracy, people involvement and dialogue, interpretive, horizontal, and bottom-up perspectives. In these ways, it does not model communication as a linear, one-way, top-down transmission of information and persuasive messages (Anyaegbunam, Mefalopulos, & Moetsabi, 1999; Wallerstein & Duran, 2006).

In CBPC, research is a collaborative partnership that equitably involves in every aspect of the research process all parties affected by the issue being studied, including community members, organizational representatives, and researchers (Israel et al., 2001). Such research benefits both community participants and government agencies by creating communicative bridges that allow all parties to gain knowledge and experience. This collaboration assists in developing culturally appropriate decisions and policies, thus making projects more effective and efficient. Finally, participatory methods have the capacity to establish a level of trust that enhances both the quantity and the quality of information generated (Anyaegbunam & Kamlongera, 2002; Viswanathan et al., 2004; Cornwall & Jewkes, 1995; Wallerstein, 2000; Fisher & Ball, 2005).

CBPC uses elements from various participatory approaches to involve community members, organizational and government representatives, and researchers in all aspects of the project to enhance understanding of specific phenomena, integrating the knowledge gained with policies and action to improve the well-being of community members. All partners contribute their expertise and share ownership of the research findings and decisions for action. The process uses interviews and group-work to facilitate dialogue among community members, enabling parties to reach mutual understandings and to create action plans that are acceptable to the community (Anyaegbunam, Mefalopulos, & Moetsabi, 2004).

CBPC is built on the definition of communication as an interactive process that is characterized by the exchange of ideas, information, points of view, and experiences between persons and groups. In CBPC, communication is a two-way process in which all the people are seen as important sources of information. It is a process in which all participants decide on a course of action together. This view of communication presupposes that all participants are equal. The convergence model of communication developed by Rogers and Kincaid (1981) best captures this framework.

In the third and final stage of this project, public meeting protocols will be based upon the Structured Public Involvement (SPI) methodology. To insure democratic outcomes in public decision making, SPI incorporates the use of Audience Response Systems (ARS), or anonymous keypads that allow each public meeting participant to register his or her preferences (Bailey & Grossardt, 2010; Grossardt, Bailey, & Ripy, 2010; KRCEE, 2011). This insures that all participants can have an equal impact upon the documented results of a public meeting, as the aggregate results of each polling question are displayed anonymously in real time, allowing participants to verify for themselves the legitimacy of the information gathering process. In addition to providing thorough documentation of perspectives and building trust between participants and researchers, this method helps illustrate the diversity of group opinions, which can be surprising for individuals who believe that they are speaking on behalf of a silent majority. Further, because each keypad holds a unique ID, the project team can gather demographic information by subgroup without impacting the anonymity of the individual (KRCEE, 2011).

**Stage One**

In-depth interviews will be conducted with approximately 50 community opinion leaders, state and federal agency personnel, environmental activists, technical consultants, landowners, journalists, and other stakeholders who will compose the project's pilot consultation panel and who will be charged with recruiting focus group participants from their specific constituencies. These interviews will largely involve the collection of background data about previously proposed watershed management strategies, current watershed uses, community concerns, and other related issues. Upon completion of the interview phase, the project team will identify various stakeholder subgroups.

**Stage Two**

Focus groups will be convened to identify the specific perspectives of the various stakeholder subgroups identified in Stage One. This stage will provide additional insights into the preferred and unacceptable management strategies for specific stakeholder groups, as well as stakeholder group values, how diverse groups name and frame specific issues related to the watershed (e.g., challenges, opportunities, risks, fears), and stakeholder group-specific information gaps, as well as trusted information sources through which additional information about watershed management strategies can be provided.

**Stage Three**

Potential watershed management strategies identified in previous phases, along with necessary technical and scientific information for understanding each, will be provided in community-wide public meetings at which, using SPI-based approaches, individuals will register their preferences for each of the specific management strategies. The anonymous quantitative data gathered in this stage will be joined with previously-gathered qualitative data to provide an in-depth view of community perspectives about and preferences for Floyds Fork Watershed management strategies. This report will be made available to the Kentucky Division of Water and local stakeholders to guide future decision-making processes in the watershed.

**2. Objectives**

The proposed research focuses on seven primary objectives:

1) identifying various watershed management strategies that have been proposed previously by diverse entities (e.g., state and/or local government, environmental advocacy organizations, etc.);

2) identifying additional strategies that are of interest to stakeholders;

3) documenting community values that affect the perceived acceptability of specific management strategies;

4) identifying community concerns related to specific management approaches;

5) discovering technical and/or scientific knowledge gaps that impair the capacity for informed decision making by stakeholders;

6) identifying trusted information sources for providing information to reduce these knowledge gaps; and

7) ultimately documenting stakeholder preferences for the identified watershed management strategies..

**3. Study Design:** As described above, this project implements a three-stage public engagement process based in the methodological approaches of Community-Based Participatory Communication and Structured Public Involvement.

**Stage One** will involve In-depth interviews of approximately 50 community opinion leaders, local, state and federal agency personnel, environmental activists, technical consultants, landowners, journalists, and other stakeholders. These interviews will largely focus on identifying background information about previously proposed watershed management strategies, current watershed uses, community concerns, and other related issues. The interviews also will assist the project team in identifying various stakeholder subgroups from which to recruit a pilot consultation panel. This group will review project protocols for clarity, cultural relevance, and/or specific community concerns about the process. The protocol then will be amended as necessary and approved by the University of Kentucky Institutional Review Board before implementation.

**Stage Two** will involve a number of stakeholder-specific focus groups. The pilot consultation panel will help recruit focus group participants from their specific constituencies using formal invitations, newsletters, mailing lists, and other stakeholder-appropriate methods. In some instances, and with the approval of the relevant panelists, multiple stakeholder groups with similar backgrounds, experience, and knowledge bases could be clustered together for a single focus group for budgetary and efficiency purposes. Each focus group will independently participate in the approved protocol, with the goal of gathering data that address the aforementioned issues.
Upon completion of all focus groups, the research team will analyze the data, evaluating the ways in which disparate stakeholder groups differentially identified base-knowledge, values, beliefs, expectations, information and channel preferences, and trusted information sources. Using these data and in coordination with the pilot consultation panel, the team will begin drafting materials, information, and protocols for SPI-based public meetings. Again, the protocol will be amended as necessary and approved by the University of Kentucky Institutional Review Board before implementation.

**Stage Three** will involve a minimum of two public meetings. The first public meeting (Stage 3A) will involve a **public information meeting** which will be used to introduce basic facts about the Floyds Fork watershed, sources of nutrient pollution, and potential management strategies for use in addressing the pollution as identified by the focus groups. During the meeting, demographic and general knowledge information will be solicited from the participants anonymously using an electronic keypad technology. This information will be subsequently analyzed to identify possible information gaps of the meeting participants for use in updating the project website. Following the public meeting, three separate **public scoring meetings** will be held to solicit feedback on 20 separate nutrient management strategies. During the meeting, demographic information and nutrient management strategy preferences will be solicited from the participants anonymously using an electronic keypad technology. This information will be subsequently analyzed to identify community preferences for the different management strategies. This data will then be analyzed and summarized in a final project report. Following the public scoring meetings, the presentation and associated scoring questions will be placed on the project website: www.uky.edu/WaterResources/FF for access by additional stakeholders. The responses to the on-line scoring questions will then be compiled and analyzed and then summarized in the final project report.

**4. Study Population:** Community members will self-select for participation and will be drawn primarily from the Floyds Fork Watershed basin in North Central Kentucky, which includes parts of Jefferson, Oldham, Bullitt, Henry, Shelby, and Spencer counties. Approximately 50 individuals aged 18 and above are expected to be interviewed; approximately 100 more are expected to participate in a series of about 10 focus groups; and another 150 are hoped to attend public meetings. We expect participation to reflect the demographic distribution of the Floyds Fork watershed. It is important that participants provide a representative sample of women and minority groups to ensure that the data gathered reflect the disparate views of the community at large. No subpopulation will be excluded. No special cases are expected.

**5. Subject Recruitment Methods and Privacy**: Initial stakeholder interviews in Stage One will be conducted with individuals who have been identified as active in current watershed management, usage, advocacy, or other areas. From that point, snowball sampling will lead to the identification of additional stakeholders for interviews, with each session ending with the question, "Can you tell us the names of any other individuals with whom we should talk about these issues?" The pilot consultation panel will be comprised of interviewees to ensure that each identified stakeholder group has representation. For Stage Two focus groups, contact with the disparate populations in the Floyds Fork Watershed area will be initiated through the relevant stakeholder group's member of the pilot consultation panel, through both word-of-mouth and via mailing lists maintained by those gatekeepers and/or their relevant organizations. The research team will not have access to these mailing lists. Memos and flyers outlining focus group process and goals, along with date, time, and location information, will be distributed by specific pilot consultation panel members, as well as on church and workplace bulletin boards in the counties. The focus groups will take place at locations convenient to participants. Focus groups will be audio recorded, and the data will be transcribed within three weeks of the meetings. Transcriptions will not use names or other identifiers that could affect data confidentiality and/or participant privacy.

**6. Informed Consent Process**: Past experience has shown us that some members of the population are suspicious of signing "government documents" such as consent forms before oral discussion and other focus group activities. Such suspicion will lead to refusals and loss of enrollment. Thus, we have applied for a "waiver of written informed consent."

**Stage One**

Where possible, interview subjects will be provided with the consent form via email or surface mail prior to the in-person meeting. Once at the interview, the informed consent document will be read orally to potential interviewees. Participants will be advised that should they elect not to participate in the study after hearing the consent form contents, we will thank them for their time and ask them to contact us in the future if they would like to participate. Interview questions will begin only after attendees have had an opportunity to ask questions about informed consent and choose whether to participate.

**Stage Two**

Using Form C, Stage 2, the informed consent document will be read orally to potential participants by the investigators and questions will be solicited from the group. Participants also will be provided with paper copies describing informed consent for the project. Food and beverages will then be offered to participants. Participants will be advised that should they elect not to participate in the study after hearing the consent form contents, they will be able to partake in refreshments and leave. Once everyone has refreshments, participants will be asked to

reconvene for the focus group conversations. After being seated, participants will be informed of restroom locations. Focus group discussions will begin only after attendees have had an opportunity to ask questions about informed consent and choose whether to participate. Please see attached Form F.

**Stage Three - A**

Using Form C, Stage 3A, the informed consent document will be read orally to potential participants at the **public information meeting** by the investigators and questions will be solicited from the group. Participants also will be provided with paper copies describing informed consent for the project. After being seated, participants will be informed of restroom locations. Discussions will begin only after attendees have had an opportunity to ask questions about informed consent and choose whether to participate. Please see previously submitted Form F.

**Stage Three - B**

Using Form C, Stage 3B, the informed consent document will be read orally to potential participants at the **public scoring meetings** by the investigators and questions will be solicited from the group. Participants also will be provided with paper copies describing informed consent for the project. After being seated, participants will be informed of restroom locations. Discussions will begin only after attendees have had an opportunity to ask questions about informed consent and choose whether to participate. Please see previously submitted Form F.

**Stage Three - C**

Using Form C, Stage 3C, the informed consent narrative will be posted on the website containing the **online survey instrument**. Participants will be able to access the survey through the project website: www.uky.edu/WaterResources/FF. Participants will then be able to move through the survey materials at their own pace.

**7**. **Research Procedures:**

**Stage One**

This stage of the study will rely on standard interview procedures. The interviews will be conducted at sites convenient to the interviewee. The initial meeting will begin with introductions. This will be followed by a team member reading the informed consent form. If the interviewees agree to continue with the interview process, members of the interview team (minimum of two) will use the following list of questions to guide the interview process. Where appropriate, the interview team will allow the interviewees to expand on the questions as warranted:

1. How do you currently use the watershed?

2. What do you think are appropriate uses of the watershed?

3. What issues prevent it from being used to its fullest capacity?
4. To what extent are nutrient loadings in the watershed an issue of concern?

5. Are there any particular nutrient management strategies that you think would be appropriate for this watershed?

6. What do you see as potential barriers to the implementation of such strategies?

7. What are some of the primary stakeholders and stakeholder groups in the watershed?

8. How do stakeholders' actions affect the watershed and its potential uses?

9. How do Kentucky Division of Water actions affect this watershed and its potential uses? EPA actions?
10. How are watershed management decisions currently made and enforced? By whom?

11. Ideally, how *should* watershed management decisions be made and enforced? By whom?

12. Do you have specific concerns about the watershed that we have not yet discussed?

13. What kinds of information do you think would help stakeholders make decisions about how the watershed should be used in the future?

14. Are there specific historical or political issues with this watershed of which we should be aware as we enter the communities?

15. Who are some of the key individuals and organizations we should speak to during process?

16. Do you have anything else to add or any final questions or concerns?

The team will thank that person for his or her time and remind them that if any questions specifically about this study arise, they can contact the project PI or if they have questions about rights as a human research subject they can contact ORI, as described in their consent form.

**Stage Two**

This stage of the study will rely on standard focus group procedures. After the group has been gathered together, the project has been described in depth, and informed consent has been gained, warm-up questions will encourage general discussion of what people enjoy about living in their communities. Facilitators will use this discussion to illustrate that there are no right or wrong answers to the questions that will be asked, only opinions.

Following the warm-up questions, the group will be randomly subdivided into smaller groups, each of which will be asked to select one of several manila envelopes. Each envelope will contain materials (photos, visual representations, messages, etc.) related to watershed management strategy that will serve as a discussion trigger. The sub-groups will break into their own discussions, where they will prepare to present their specific strategy to the entire group, with a focus on the issues of whether the strategy is acceptable, why, and potential risks and benefits of implementing the strategy.

After each presentation, the group as a whole will be asked to discuss the specific watershed management approach, offering their understanding of and concerns about the strategy, along with other related issues. After all strategies have been presented, the group will be asked to

imagine, discuss, and/or recommend other watershed management approaches that have not yet been presented.

Following the presentations, all participants will be prompted with specific questions to provide information relevant to the issues listed above, as well as questions to identify knowledge gaps and trusted information sources. Before departing, participants will be given an opportunity to identify anything that the research team might have "missed" during the discussion.

**Stage Three - A**

This stage of the study will rely on standard public meeting procedures. The meeting will be conducted using a formal meeting script (see attached). Upon arrival, participants will be provided an information packet and an electronic keypad and asked to take a seat. The information packet will include: Handout A1 - informed consent, Handout A2 - meeting etiquette, Handout B - copy of Powerpoint presentation to be used during the meeting, and a blank card for use in providing any questions or information needs, or general meeting feedback. After the participants have arrived and taken their seats, the meeting agenda will be presented, and informed consent will be solicited. Following the informed consent process, general guidelines for meeting etiquette will be presented. Next the general goals of the project will be provided. The participants will then be introduced to the electronic keypad technology using an Arnstein ladder exercise. Following this exercise, general demographic information will be solicited anonymously from the participants using the electronic keypad technology. This information will include: 1) county of residence, 2) whether the participants live in the watershed, work in the watershed, or recreate in the watershed, 3) their primary interest in the watershed: agriculture, environmental issues, recreation, economic development, preservation, regulator issues, or other, 4) participant age, and 5) participant gender. Following these questions, the participants will then be asked some general questions related to their knowledge of the watershed and nutrient pollution. Participants will then be introduced to the major sources of nutrient impairment in the watershed (i.e. wastewater, urban runoff, agricultural runoff) followed by questions about such sources. Participants will then be introduced to the different management strategies (suggested through Stage One and Two of the project) followed by questions about such management strategies. Participants will be asked to evaluate the meeting using both a 9 point Likert scale as well as the Arnstein ladder. Participants will then be provided an opportunity to ask any remaining questions.

**Stage Three - B**

This stage of the study will rely on standard public meeting procedures. The meeting will be conducted using a formal meeting script (see attached). Upon arrival, participants will be provided an information packet and an electronic keypad and asked to take a seat. The information packet will include: Handout A1 - informed consent, Handout A2 - meeting etiquette, Handout B - copy of Powerpoint presentation to be used during the meeting, and a blank card for use in providing any questions or information needs, or general meeting feedback. After the participants have arrived and taken their seats, the meeting agenda will be presented, and informed consent will be solicited. Following the informed consent process, general guidelines for meeting etiquette will be presented. Next the general goals of the project will be provided. The participants will then be introduced to the electronic keypad technology using an Arnstein ladder exercise. Following this exercise, general demographic information will be solicited anonymously from the participants using the electronic keypad technology. This information will include: 1) county of residence, 2) whether the participants live in the watershed, work in the watershed, or recreate in the watershed, 3) their primary interest in the watershed: agriculture,

environmental issues, recreation, economic development, preservation, regulator issues, or other, 4) participant age, and 5) participant gender. Participants will then be introduced to the different management strategies (suggested through Stage One and Two of the project) followed by questions about such management strategies. Participants will be asked to evaluate the meeting using both a 9 point Likert scale as well as the Arnstein ladder. Participants will then be provided an opportunity to ask any remaining questions.

**Stage Three -C**

This stage of the study will rely on the use of an online survey that will be accessible via the project website: www.uky.edu/WaterResources/FF. The survey will incorporate a slightly modified informed consent narrative along with a online version of the presentation and questions asked during Stage 3B.

**8. Resources:** Members of the research team have expertise in watershed management, participatory and risk communication, science education, public decision-making, and technical risk assessment. They are all employees of the University of Kentucky and current or past staff members of the Kentucky Water Resources Research Institute (KWRRI). Research team meetings and administrative tasks take place in the KWRRI offices in the Mining & Minerals Resources Building at the University of Kentucky. Computers, data storage, projectors, digital audio recorders, and software are provided by the KWRRI. Staff support for the focus group phase of this project includes the director, associate director, program director, watershed management specialist, scientist, and former communications director of the Kentucky Water Resources Research Institute (administrative, logistical, and analytical tasks, methodological development, research support, focus group facilitation).

The focus group meetings will be conducted at sites in or near the Floyds Fork Watershed. These sites will be selected with input from the pilot consultation panel to insure their convenience for potential participants.

**9. Potential Risks:** The research team does not believe that there are any risks to participants in this study. If participants feel uncomfortable participating in any elements of the discussion, they may choose to withdraw at any time.

**10. Safety Precautions:** The information collected from the survey participants will be accessible only to project investigators. Interview and focus group transcripts will not include names or other identifiers that could be linked to specific speaker identities. All data, including audio recordings of the focus groups, will be confidentially located on the research coordinator's password-protected hard drive, which is locked nightly in 233 Mining and Minerals Building. A back-up copy will be maintained in a locked filing cabinet in 233 Mining & Minerals Building. Audio recordings will be destroyed after a period not to exceed one (1) year following completion of the study.

**11. Benefit vs. Risk:** The research team does not believe that there are any risks to participants in this study beyond those encountered in everyday life; however, there are a number of benefits. By participating in this study, participants may affect decision-making about appropriate management strategies for the Floyds Fork Watershed. Participants will help to ensure that the cultural values and perceptions of all community segments are taken into consideration when environmental decisions are made.

**12. Available Alternative Treatment(s):** Not applicable.

**13. Research Materials, Records, and Privacy:** Focus group sessions will be audio recorded to ensure that participant opinions are accurately documented; the recording protocol will be explained to participants during the informed consent process. These recordings will be transcribed; however, any names or other identifiers that could be linked to specific speaker identities omitted from the transcription. All data, including audio recordings of the focus groups, will be confidentially located on the research coordinator's password-protected hard drive, which is locked nightly in 233 Mining & Minerals Building. A back-up copy will be maintained in a locked filing cabinet in 233 Mining & Minerals Building. Audio recordings will be destroyed after a period not to exceed one (1) year following completion of the study.

**14. Confidentiality:** Every effort will be made to prevent anyone who is not on the research team from knowing that a participant gave us information, or what that information is. Any raw data that contain participants' names or other identifiers generated from the study will be stored under lock and key in a secure cabinet at the PI's office, 233 Mining & Minerals Building, until they are destroyed. Data from this study will be kept for a minimum of 6 years after the study closure.

**15. Payment**: The only incentives will be the availability of snacks and beverages for participants at the focus groups.

**16. Costs to Subjects**: The only costs incurred by participants will be the time that they spend in the focus group and transportation to the focus group. Every effort will be made to reduce the latter cost by selecting local focus group venues that will be convenient for participants.

**17. Data and Safety Monitoring:** The research team believes that this study involves minimal risk to participants. Data storage, privacy issues, and confidentiality are outlined above.

**18. Subject Complaints:** During the informed consent process, participants will be provided with contact information for both the primary investigator and the University of Kentucky Institutional Review Board.

**19. Research Involving Non-English Speaking Subjects or Subjects from a Foreign Culture:** Not applicable.

**20. HIV/AIDS Research:** Not applicable.

## C.2 Informed Consent Form for Project Interviews

You are invited to take part in a study which will document stakeholder preferences for future watershed management strategies for the Floyds Fork Watershed. Funding from the Kentucky Division of Water supports this study. The person in charge of this study is Dr. Lindell Ormsbee from the Kentucky Water Resources Research Institute at the University of Kentucky. The other people on the project team are Ben Albritton, Stephanie Jenkins, Jim Kipp, and Malissa McAlister, also of the Kentucky Water Resources Research Institute, along with Anna Hoover of the University of Kentucky College of Public Health.

You were selected to take part in this study because you are a stakeholder of the Floyds Fork Watershed. You are one of about 50 people from different background with different points of view who will participate in interviews.

By conducting these interviews, we hope to identify: 1) various watershed management strategies that have been proposed by diverse entities over the last several years; 2) additional strategies that have not been formally proposed but that are of interest to stakeholders; 3) community values that could affect whether certain management strategies would be deemed acceptable or unacceptable; 4) concerns related to specific management approaches; 5) key issues related to the Floyds Fork Watershed; 6) which strategies you personally find acceptable; 7) additional information that might be beneficial for individuals trying to make decisions about the acceptability of specific strategies; and 8) trusted information sources that could help fill these knowledge gaps.

If possible, the research team would like to audio record this session so that all comments can be reviewed thoroughly. If you elect for the session to be recorded, the audio will be transcribed for data collection purposes following the session. Audio recordings will be destroyed immediately following transcription. You also may request at any time that the recording be stopped so that you may make comments "off the record." Alternately, you may request that the research team not record your interview at all; in this case, team members will make a concerted effort to document your thoughts to the best of our ability. Your opinions are very valuable to us, but you are free to end the discussion at any time. Your responses will be added to the responses of other participants for reporting purposes, and every effort will be made to protect your confidentiality. All the information you give us will be kept secure and will only be accessible to project personnel. The tape recording, transcript, and/or team notes will be confidential, with no identifiers being used. Neither your name nor your position title will be associated with remarks reported in any future publications.

There are no known risks to you or your family if you participate in this study. You will not be paid for your participation. There are no costs to participate other than the time spent in the interview session. We will keep private all research records that identify you to the extent allowed by law. However, although unlikely, there may be circumstances in which we may be required to show your information to other people. For example, the law may require us to show your information to a court should the information you provide relate to any ongoing legal actions. Also, we may be required to show information which identifies you to individuals from such organizations as the University of Kentucky or the funder of this research (Kentucky Division of Water) to verify we have done the research correctly. If you have questions about the study, you may contact Stephanie Jenkins at 859-257-1299, or email swjenk2@uky.edu. If you have any questions about your rights as a volunteer in this research, contact the Office of Research Integrity at the University of Kentucky at 859-257-9428 or toll free at 1-866-400-9428.

Please indicate whether our team may record the session. We will collect this document during our meeting.

☐ Yes, the University of Kentucky research team may audio record our session.
☐ No, I would prefer that our session not be audio recorded

## C3. Discussion Guide for Focus Group Meetings

### [ ] A. ARRIVAL AND INFORMED CONSENT

[ ] Have the opening slide of the ppt presentation showing **[SLIDE 1]**

[ ] Welcome participants at registration table

[ ] Hand them an informational folder

[ ] Ask them to read the informed consent handout **(Green)**

[ ] Give participants name tents. Ask participants to write their nicknames, first names or pseudonyms on both sides of the tent so that all participants can see each other's names or nicknames--this encourages discussion.

[ ] Invite them to select some beverage and take a seat.

[ ] As soon as all the participants arrive, Introduce yourself, thank the attendees for Coming.

[ ] Remind people about location of bathrooms and ask them to mute cell phones

[ ] Explain the contents of the informational folder:

**Handout A:** The Informed Consent and Project Description **[Green]**
**Handout B:** The Demographic Survey **[Blue]**
**Handout C:** Powerpoint Presentation on Overview of the Project

[ ] Show **[SLIDE 2]** of ppt and summarize the activities for that evening.

[ ] Show **[SLIDE 3**] of ppt: informed consent process

[ ] Ask participants to pull out **Handout A [GREEN]**

[ ] Solicit participants participation through use of the Informed Consent using **Script A** Format for oral presentation of informed consent. Reiterate that participation is voluntary and that any participants who do not want to continue the study can leave.

***SCRIPT A***

***Why are we here? Oral Presentation of Informed Consent***

**Informed Consent Procedures for the Floyds Fork Stakeholder Engagement Meetings**

We are doing an interesting study for which we need your help. In order to proceed we need your verbal consent.

I am going to ask 10 questions to explain the purpose of the study. I will then answer each of these questions. You can interrupt me at any point and ask questions.

1. Who are we?

   *We're a team of researchers from the Kentucky Water Resources Research Institute located at the University of Kentucky. We are conducting this study to assist the local community to identify preferences for nutrient management strategies for the Floyds Fork watershed.*

2. Why are we here?

   *We're here to explain the study to you and to ask you to be involved in this important project. If you agree you will participate in a discussion about what you think would be effective nutrient management strategies for the Floyds Fork watershed. The information you provide to us today will help us learn more about what your community thinks and wants for the watershed and how best to achieve these wishes. We also want to find out what additional information you need about the stakeholder engagement process and what the best means of getting that information to you is. During this meeting, we will discuss the concerns and major issues that are important to your community in relation to nutrient issues in the watershed. We will guide the discussion, listen to, and record your ideas.*

3. are we asking you to do and why?

   *The Kentucky Division of Water is currently investigating potential strategies for improving the water quality of the Floyds Fork watershed. During the past few years, several groups of people from your community and from many organizations, including the Division of Water, have suggested different nutrient management strategies for the watershed. We'll show you a sample of these suggestions and ask you to evaluate them based on what you think will be in the best interest of your family, your constituents, and the community*
      - *Which suggestions do you think make sense, are worth doing, and would you support and why?*
      - *Which suggestions do you think don't make sense and why?*
      - *What are your recommendations and why?*

4. Why were you asked to participate in this study*?*

   *You have been identified as important stakeholders in the Floyds Fork watershed.*

5. Why do we need your permission and how will you grant us permission to participate?

   *All studies of this type require that the participants be told what the study is about and what they are being asked to do. That is what we are doing now. We have provided you with a one-page description of the project goals (green handout) and your role in the project. If you agree all you need to do is to take part in a discussion as soon as we finish this presentation. During the discussion you can choose to participate or not participate at any time, or to leave at any time.*

6. What are the risk/benefits for you if you decide to participate in this study?

   *As far as we know there are no risks from participating in this study. There are a number of benefits. By participating in this study, your views may affect what should be done with regard to nutrient management decisions that could affect the water quality in the Floyds Fork watershed. By sharing your ideas and experience with us, you will be part of a sample of several hundred community members from the Floyds Fork watershed and surrounding*

*areas who are working with the project team to ensure that the voice and opinions of all community segments are taken into consideration when future decisions are made with regard to nutrient management issues that affect the Floyds Fork watershed.*

7. Will you receive any rewards for participating in this study?

   *You will receive no rewards for participating in this study other than the provided refreshments. You will receive the refreshments whether of not you chose to participate in the study.*

8. What will it cost you to participate in this study?

   *The only cost to you is the time required to travel to and from the meeting and the time involved for the discussion.*

9. Will your identity and statements remain confidential?

   *Yes. No one outside of our group will know exactly what you said. We never use names when we review your comments. We will also ask you to complete a one-page questionnaire about your connection to the watershed* ***(blue handout).*** *Do not write your name on the questionnaire. That way your comments and identity will remain anonymous.*

10. If you have questions, whom do I contact?

    *If you have questions about the study you can ask them now or at any time during the meeting. You can also call Dr. Lindell Ormsbee, the principal investigator of this study at any time at 859-257-1299. You can also call the University of Kentucky Office of Research Integrity at 859-257-9428 or toll free at 1-866-400-9428.*

**[ ] B. INTRODUCTIONS AND OVERVIEW**

[ ] Request participants fill out **Handout B [BLUE]**: The Demographic Survey

[ ] Ask participants to introduce themselves

**[PROJECT OVERVIEW SLIDES - 4 THRU 9]**

[ ] Briefly describe the project for the participants using a PowerPoint of the Project in **Handout C.** Mention that the protocol we are using tonight has been reviewed by the pilot group and formally reviewed and approved by UK's office of Research Integrity

[ ] Provide an introduction to the discussion process using **Script B**.

***SCRIPT B***

***Discussion Introduction***

*Hello! My name is Lindell Ormsbee, and I am with the Kentucky Water Resources Research Institute at the University of Kentucky. We are interested in hearing your thoughts about potential nutrient management strategies for the Floyds Fork. The information you provide us today will help us to*

*learn more about the kinds of strategies that local people find acceptable and what strategies might be less appropriate for this community.*

*You were all invited here today because it is important that we hear from you, how you feel about the things we will talk about. However don't worry that anyone outside of our group will know exactly what you said. We never use names when we review your comments to help us. Also, we ask you to respect the privacy of the other group members. Perhaps most importantly, we aren't asking you to tell us personal stories unless you want to, but we are interested in what you think and how the watershed-related issues we discuss affect your life.*

*Please note the small tape recorder(s) on which our discussion will be recorded. We do this because we want to remember everything you share, and so we won't be distracted taking notes while we are talking. One challenge related to recording the conversation is that it is hard to hear voices when more than one person is speaking. Please help us with this by speaking one at a time.*

*If you need to leave the discussion for some reason, please feel free to step outside. Participating in this conversation is completely voluntary, and you may leave at any time, although we hope you will stay with us for the duration.*

*Our discussion today will focus on some of the nutrient management strategies that have come up over the years in various settings, including public meetings, research studies, and interviews that we conducted earlier with a variety of local citizens from different walks of life. We are interested in learning what you like, what you don't like, and whether you need additional information to feel comfortable making decisions about which approaches might be better than others.*

**[ ] C. ARSTEIN LADDER OF PUBLIC PARTICIPATION**

**[ARSTEIN SLIDE - 10]**

*Before we get started with a discussion about Floyds Fork, we would first like to get a sense of you past experiences and expectations of citizen involvement in public decision processes. To do this, we will be using Arnstein's Ladder of Public Participation.*

**[KEYPAD SLIDE - 11]**

*To register your experiences and expectations, we will be using a key-pad technology that uses these small transmitters to register your responses.*

***Handout keypads***

**[PAST EXPERIENCES SLIDE 12]**

*First, we would like you to look at the ladder and select the level or rung that best corresponds with the word that characterizes your past experiences in public meetings involving some type of public or government agency.*

**[DESIRED EXPECTATIONS SLIDE - 13]**

*Second, we would now like you to look at the different options and select the number that corresponds to the word that best characterizes what you think is the appropriate level of citizen empowerment.*

**[ ] D. VALUE AND IDEAL DISCUSSION [FLIP CHART]**

*First, please ensure that you've written your first name or a nickname on both sides of the tent so we all can see everyone's name. Thanks.*

*To begin our discussion, I would like to start with two ice breaker questions.*

**[VALUES/VISION SLIDE - 14]**

*The first question is:* ***What do you value about the Floyds Fork watershed?***

*Now that we have discussed what you value about the Floyds Fork watershed, I would like to ask you a second question.*

*The second question is:* ***What would be your idea of the ideal watershed?***

**SCRIPT C**

*If you go outside this building and ask someone "what is the temperature right now at this spot?" there is a right answer and a wrong answer that you can check with a thermometer. However, what we are discussing today is how you and your friends feel about things, and there could be as many different opinions as there are people in this room. Guess what? Every one of those opinions is important! Remember, we aren't here to convince anyone of something in particular or to change anyone's mind. We are here to discuss things and to hear what each and every one of you has to say.*

*Sometimes, you will find that many people in the room have your opinion, and other times you will be the only one with that opinion. But it is important for us to learn about all the opinions because even if you are the only one in this room who holds that opinion, there may be other people in your community who feel just as you do. Most importantly, every opinion counts -- so please feel free to share your thoughts.*

**[ ] E. Discussion of Floyds Fork Watershed Nutrient Management Strategies**

**[4 Packettes with 2-4 Envelopes]**

*As a result of the interview process, the research team has documented 12 different nutrient management strategies that have been suggested by the various stakeholders. These strategies have been lumped into 4 broad categories:*

*Wastewater management*
*Agricultural management*
*Urban nutrient management*
*Policy strategies*

**[STRATEGY DESCRIPTION SLIDES - 15 THRU 27]**

*We will now ask the participants to describe and provide their perspectives on one of several different nutrient management strategies. To do this we will be forming four teams – expected to include 3 to 5 people.*

*We will now be coming around to each team and let them chose from one of four envelopes. Inside each envelope will be several different management strategies associated with a general management category. Each team should select one of the envelopes from the packette and then open it.*

**[STRATEGY EVALUATION QUESTION SLIDES - 28]**

*The envelop will contain a picture of a particular management strategy along with a brief description. There will also be include a sheet with 3 questions which we want each group to answer. These questions are:*

1. **What do you think this strategy represents?**

2. **What are some potential benefits of this strategy?**

3. **What are some potential problems with this strategy?**

*Record you answers on the sheet provided. Make sure everyone in your group has a chance to look at the packet of information and has an opportunity to express his or her ideas. When you finish, your group will be asked to make a two-minute oral report about your observations and ideas, while information from the packet is shown to the rest of the group.*

**[ ] F. Discussion of Floyds Fork Watershed Nutrient Management Strategies**

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**[SHOW ASSOCIATED SLIDE]**

After approximately ten minutes, ask each group to explain the management strategy and to describe to the entire group what they think about how/whether the strategy would accomplish goals and what the consequences will be for the community. As each group presents, display their scenario on the screen. Once the group has finished with their presentation, open the discussion up to the rest of the group.

1. *What does this nutrient management plan mean for the community?*
2. *How does it relate to your lives? Your families? Your constituents? Your communities?*
3. *What are the most important issues related to the strategy: opportunities, strengths, challenges, weaknesses, threats, fears, risks, concerns, and solutions?*
4. *What are the barriers to implementing this strategy in your community?*
5. *In what ways can these barriers be overcome?*

**[ ] G. Strategy Polling**

**[STRATEGY EVALUATION SLIDES - 29 thru 52]**

Now that we have had a chance to discuss at least one scenario from each of the four major categories, we will now walk you through the complete list of 12 scenarios that have been

proposed by members of the community. After we have presented each scenario, we will then go back through the list and ask you to score each scenario from 1 to 9, with 9 being the most preferred. Following each scoring, have participants discuss their results.

1. *Why did you rate this scenario with a high score?*
2. *Why did you rate this scenario with a low score?*

**[ ] H. Additional Strategy Solicitation**

**[ADDTIONAL STRATEGY EVALUATION SLIDE - 53 THRU 54]**

**[ ] I. Identifying Knowledge Gaps and Community Trusted Information Channels**

**[FLIP CHART] [SLIDE - 55]**

**Discussion Questions**

1. *In thinking about the nutrient management strategies that you have been provided, what other information would enable you to better evaluate this situation?*

2. *Which would be the most credible source of information about potential watershed management strategies?*

3. *What would be the best ways of delivering information about nutrient management strategies to your community? [Let people volunteer responses first then probe with these choices.] Printed materials like brochures? Video? Extension representatives? Etc.*

**[ ] J. Possible Additional Questions**

4. *What types of information would you normally seek about the watershed?*
5. *What sources do you consult for this type of information? [Let people volunteer responses first then probe with these choices.] Do you ask friends, neighbors, go to the library, watch television, read it in magazines, go on the Internet?*
6. *Why do you use these sources? What problems have you had getting information that you want (examples: hard to find, too technical, didn't relate to my situation, confusing navigation online etc.)?*
7. *Which sources of information about the watershed are the easiest to understand and most helpful to you?*
8. *Which sources of information about the watershed are the hardest to understand and least helpful to you?*
9. *What information do you think would be most important to the community when making decisions about how best, ultimately, to manage the watershed?*

**[ ] K. Process Review**

**[FINAL EVALUATION SLIDE - 56]**

Now that you have gone through this focus group meeting, how would you rate the process?

Do you have any suggestions on how it could have been improved?

**[FINAL ARNSTEIN LADDER EVALUATION SLIDE - 57]**

*We previously introduced the Arnstein Ladder of Public Participation. How would you characterize tonight's meeting on this ladder.*

**[ ] L. Conclusion**

*We have had a great discussion and you have offered very valuable insights and opinions.* ***Is there anything we missed during this discussion on the project you would like to add?***

*We want to thank all of you for participating in our discussion.*

## C4. Informed Consent Form for Focus Group Meetings

**Consent to Participate in a Focus Group Discussion of Floyds Fork Watershed Management Strategies**

You are invited to take part in this study, which will document community preferences for the Floyds Fork Watershed. Funding from the Kentucky Division of Water supports the study. The person in charge of this study is Dr. Lindell Ormsbee from the Kentucky Water Resources Research Institute at the University of Kentucky. The other people on the project team are Ben Albritton, Stephanie Jenkins, Jim Kipp, and Malissa McAlister, also of the Kentucky Water Resources Research Institute, along with Anna Hoover of the University of Kentucky College of Public Health.

You were selected to take part in this study because you are a stakeholder in the Floyds Fork Watershed. You are one of about 100 people from the communities the watershed who will participate in this series of focus groups. The group discussion will take about two hours of your time. By conducting these focus groups, we hope to identify: 1) preferred and unacceptable watershed management strategies in the Floyds Fork Watershed; 2) how various groups affecting and affected by Floyds Fork management decisions name and frame management issues in terms of opportunities, strengths, challenges, weaknesses, fears, risks, concerns, and solutions; 3) overall community goals and values that influence decisions community regarding acceptable management strategies for Floyds Fork; 4) information gaps related both to Floyds Fork and to specific watershed management strategies; and 5) appropriate sources for providing watershed management information to stakeholders.

The discussion will be audio recorded so that the researchers can review all of the comments thoroughly. This recording will be kept secure until information can be collected from it and then the recording will be destroyed. You are encouraged to voice your opinions; however, your participation in the discussion is voluntary. Your opinions are very valuable to us, but you are free to leave the discussion at any time. Your responses will be added to the responses of other participants for reporting purposes, and every effort will be made to protect your confidentiality. However, others participating in the focus group will know what was said by whom and we cannot guarantee they will not share information outside of the focus group, so please disclose only information that you would feel comfortable being made public. The information you give to the research team WILL be kept in a secure place, WILL NOT include identifying participant information once transcribed from audio to written paper transcripts, and WILL ONLY be accessible to project personnel.

There are no known risks to you or your family if you participate in this study. By participating, you may help affect decisions about watershed management in Floyds Fork. By sharing your ideas and experience with us you will be part of a sample of about 100 community members the watershed who are working with the project team through these focus groups to ensure that the voices and opinions of all community segments will be taken into consideration when management strategy decisions are made. We will keep private all research records that identify you to the extent allowed by law. However, although unlikely, there may be circumstances in which we may be required to show your information to other people. For example, the law may require us to show your information to a court should the information you provide relate to any ongoing legal actions. Also, we may be required to show information which identifies you to individuals from such organizations as the University of Kentucky or the funder of this research (Kentucky Division of Water) to verify we have done the research correctly.

You will not be paid for your participation although refreshments will be provided. There are no costs to participate other than the two hours you will spend with others in the discussion. If you decide to take part in the group discussion, it should be because you really want to volunteer. You will not lose any benefits or rights that you would normally have if you choose not to volunteer. You can stop at any time during the study. If you do not want to be in the study, you may choose not to participate. If you have questions about the study, you may contact Stephanie Jenkins at 859-257-1299, or email swjenk2@ uky.edu. If you have any questions about your rights as a volunteer in this research, contact the staff in the Office of Research Integrity at the University of Kentucky at 859-257-9428 or toll free at 1-866-400-9428.

**C5. Flyer for Public Information Meeting**

# Floyds Fork Watershed Informational Meeting

**Informational Meeting**

Learn about existing nutrient sources and potential nutrient management strategies for the Floyds Fork Watershed

**When and Where:**

May 30, 2013 at 7 pm to 9 pm

The Parklands of Floyds Fork: Gheens Foundation Lodge

*This meeting is part of the Floyds Fork Stakeholder Engagement Project which is being administered by Kentucky Water Resources Research Institute and funded by the Kentucky Division of Water. For more information please visit http://www.uky.edu/WaterResources/FF or call 859-257-1299.*

**Directions:** Take I-64 East to exit 19B to merge onto I-265N/Gene Snyder Fwy • Take exit 27 for US-60/Shelbyville Rd • Go right off the exit onto US-60 E/Shelbyville Rd• Take a right onto S. Beckley Station Rd • Travel about 1 mile to park entrance on left• Follow signs to Creekside Center, Gheens Foundation Lodge
**Website:** http://theparklands.org/meeting-and-event-venues/gheens-lodge/

## C6. Discussion Guide for Public Information Meeting

**[ ] A. ARRIVAL AND INFORMED CONSENT**

[ ] Have the opening slide of the ppt presentation showing **[SLIDE 1]**

[ ] Welcome participants at information table

[ ] Hand them an informational folder and Keypad

[ ] Ask them to read the informed consent handout **(Green Handout)**

[ ] Invite them to select some beverage and take a seat.

[ ] As soon as all the participants arrive, Introduce yourself, thank the attendees for Coming.

[ ] Remind people about location of bathrooms and ask them to mute cell phones

[ ] Explain the contents of the informational folder:

> **Handout A:** The Informed Consent and Project Description **[Green]**
> **Handout B:** Meeting Ground Rules **[Green]**
> **Handout C:** Powerpoint Presentation on Overview of the Project

[ ] Show **[SLIDE 2]** of ppt and summarize the activities for that evening.

[ ] Show **[SLIDE 3**] of ppt: informed consent process

[ ] Ask participants to pull out **Handout A [Green]**

[ ] Solicit participants participation through use of the Informed Consent using **Script A**. Reiterate that participation is voluntary and that any participants who do not want to continue the study can leave.

**SCRIPT A**

***Why are we here? Oral Presentation of Informed Consent***

**Informed Consent Procedures for the Floyds Fork Stakeholder Engagement Meetings**

We are doing an interesting study for which we need your help. In order to proceed we need your verbal consent.

I am going to ask 10 questions to explain the purpose of the study. I will then answer each of these questions. You can interrupt me at any point and ask questions.

1. Who are we?

*We're a team of researchers from the Kentucky Water Resources Research Institute located at the University of Kentucky. We are conducting this study to assist the local community to identify preferences for nutrient management strategies for the Floyds Fork watershed.*

2. Why are we here?

*The Kentucky Division of Water is currently investigating potential strategies for improving the water quality of the Floyds Fork watershed. During the past few years, several community members and organizations have suggested different nutrient management strategies for the watershed. We have been asked by the Kentucky Division of Water to identify community suggested management strategies and to collect information that may be useful in helping members of the community evaluate management scenarios in a future meeting. Today our purpose is to introduce the scenarios and to identify any additional information needs. We will then ask you to attend a second meeting to evaluate the actual nutrient management scenarios.*

3. What are we asking you to do and why?

*During this meeting, we will show you examples of management strategies and then ask questions to identify any additional information needs that you may have. In order to do this we will ask you to provide some information about yourself, your knowledge of issues about the watershed, and your knowledge about the potential nutrient management strategies. This information will be collected anonymously through the use of the small electronic keypads that you were given when you checked in at the information table.*

4. Why were you asked to participate in this study*?*

*You have been identified as a resident or important stakeholders in the Floyds Fork watershed.*

5. Why do we need your permission and how will you grant us permission to participate?

*All studies of this type (where we are asking you to provide us with information) require that the participants be told what the study is about and what they are being asked to do. That is what we are doing now. We have provided you with a one-page description of the project goals (green handout) and your role in the project as well as a list of the ground rules for tonight's meeting (back side of the green sheet). If you agree all you need to do is to continue to take part in the meeting. During the meeting you can choose to participate or not participate at any time, or to leave at any time.*

6. What are the risk/benefits for you if you decide to participate in this study?

*As far as we know there are no risks from participating in this study. There are a number of benefits. By participating in this study, your views may affect what should be done with regard to nutrient management decisions that could affect the water quality in the Floyds Fork watershed.*

7. Will you receive any rewards for participating in this study?

*You will receive no rewards for participating in this study other than the provided refreshments. You will receive the refreshments whether of not you chose to participate in the study.*

8. What will it cost you to participate in this study?

*The only cost to you is the time required to travel to and from the meeting and the time involved for the discussion.*

9. If you have questions, whom do I contact?

*If you have questions about the study you can ask them now or at any time during the meeting. You can also call Dr. Lindell Ormsbee, the principal investigator of this study at any time at 859-257-1299. You can also call the University of Kentucky Office of Research Integrity at 859-257-9428 or toll free at 1-866-400-9428.*

**[ ] B. REVIEW OF MEETING GROUND RULES**

The primary purpose of this meeting is information exchange. We will be providing you information about different nutrient management strategies and soliciting your feedback using the electronic keypads that you were given when you checked in at the information table. You will also be provided an opportunity to ask questions following each the five presentations identified in the meeting agenda. We will also provide an opportunity for folks to provide written questions at the end of the meeting. In asking any questions we request that each person adhere to the following general ground rules.

1) We have a lot of material to cover this evening so we would please ask that members of the audience refrain from interrupting the speaker during each presentation. At the end of each presentation, the presenter will field any questions related to the material presented.

2) In order to respect the time of the other attendees:

a) Please be respectful of others

b) Please keep your questions brief and to the point.

c) Please refrain from making speeches on comments unrelated to the presented material

d) Please refrain from making disparaging comments about individuals or organizations

3) If someone chooses to violate these rules, we will use the keypad technology to poll the audience to determine if the conversation should continue or if we should move on.

4) By continuing to stay and participate in the meeting you are giving nonverbal consent of your agreement to the meeting ground rules.

**[PROJECT OVERVIEW SLIDES - 4 THRU 6]**

**[ ] C. PROJECT OVERVIEW REVIEW**

**[PROJECT OVERVIEW SLIDES - 7 THRU 10]**

[ ] Briefly describe the project for the participants using a PowerPoint of the Project in **Handout C.** Mention that the protocol we are using tonight has been reviewed by the pilot group and formally reviewed and approved by UK's office of Research Integrity

**[ ] D. ARNSTEIN LADDER OF PUBLIC PARTICIPATION**

**[KEYPAD SLIDE - 11]**

*To register your experiences and expectations, we will be using a key-pad technology that uses these small transmitters to register your responses.*

**[ARNSTEIN SLIDE - 12]**

*Before we begin our presentation tonight, we would first like to get a sense of you past experiences and expectations of citizen involvement in public decision processes. To do this, we will be using Arnstein's Ladder of Public Participation.*

**[PAST EXPERIENCES SLIDE 13]**

*First, we would like you to look at the ladder and select the level or rung that best corresponds with the word that characterizes your past experiences in public meetings involving some type of public or government agency.*

**[DESIRED EXPECTATIONS SLIDE - 14]**

*Second, we would now like you to look at the different options and select the number that corresponds to the word that best characterizes what you think is the appropriate level of citizen empowerment.*

**[ ] E. DEMOGRAHPHIC INVENTORY**

*In order for us to better meet the information needs of the audience we would like to first ask a few demographic questions.*

**[DEMOGRAPHIC QUESTIONS SLIDE – 14-18]**

**[ ] F. NUTRIENT PROBLEMS, SOURCES, AND IMPACTS**

*Before looking at specific management strategies we will first introduce some general information about nutrients, their sources, and their impacts in the Floyds Fork watershed.*

**[STRATEGY DESCRIPTION SLIDES – 26-60]**

**[ ] G. OVERVIEW OF MANAGEMENT STRATEGIES**

*As a result of the interview process, the research team has documented 20 different nutrient management strategies that have been suggested by various stakeholders. These strategies have been lumped into 4 broad categories:*

*Wastewater management*
*Agricultural management*
*Urban nutrient management*
*Policy strategies*

**[MEETING FINAL EVALUATION SLIDES - 61]**

Now that you have gone through this process, how effective do you think it was in providing you more information about the watershed and potential nutrient management strategies?

**[FINAL ARNSTEIN LADDER EVALUATION SLIDE - 62]**

*We previously introduced the Arnstein Ladder of Public Participation. How would you characterize tonight's meeting on this ladder.*

**[WEBSITE SLIDE - 63]**

In order to provide more information about the Floyds Fork watershed, nutrients, and nutrient management strategies we have developed a website that contains information about all of these topics. Alternatively, if you have any questions in the future, you can always contact our office at the number given in the green handout.

**[ ] H. GENERAL Q&A**

*Now that we have gone through our presentation, we would like to see if you have any questions that we may not have addressed. You ask us questions by either writing them down on the provided cards and handing them in, or stepping up to one of the mikes to ask your question.*

**[ ] I. Conclusion**

*We have had a great discussion and you have offered very valuable insights and opinions. Is there anything we missed during this discussion on the project you would like to add?*

*We want to thank all of you for participating in our discussion.*

**C7. Flyer for Scoring Meetings**

# Floyds Fork Watershed
# Nutrient Management Strategies
# Scoring Meetings

**Scoring Meetings**

Register your opinion about potential nutrient management strategies for the Floyds Fork Watershed.

For a list and description of strategies see: http://www.uky.edu/WaterResources/FF

**When and Where:**

Monday, August 26, 2013 at 7 pm to 9 pm—Middletown Community Center

11700 Main Street, Middletown, KY

Thursday, August 29, 2013 at 7 pm to 9 pm—LaGrange Community Center

307 W. Jefferson Street, LaGrange, KY

Monday, September 9, 2013 at 7 pm to 9 pm—Shepherdsville Community Center

176 Frank E Simon Avenue, Shepherdsville, KY

*This meeting is part of the Floyds Fork Stakeholder Engagement Project which is being administered by Kentucky Water Resources Research Institute and funded by the Kentucky Division of Water.*

*For more information please visit http://www.uky.edu/WaterResources/FF or call 859-257-1299.*

## C8. Discussion Guide for Scoring Meeting

### [ ] A. ARRIVAL AND INFORMED CONSENT

[ ] Have the opening slide of the ppt presentation showing **[SLIDE 1]**

[ ] Welcome participants at information table

[ ] Hand them an informational folder and keypad

[ ] Ask them to read the informed consent handout **[Green Handout]**

[ ] As soon as all the participants arrive, Introduce yourself, thank the attendees for coming.

[ ] Remind people about location of bathrooms and ask them to mute cell phones

[ ] Explain the contents of the informational folder:

**Handout A1:** The Informed Consent **[Green]**
**Handout A2:** Meeting Etiquette **[Green]**
**Handout B:** Powerpoint Presentation on Overview of the Project

[ ] Show **[SLIDE 2]** of ppt and summarize the activities for that evening.

[ ] Show **[SLIDE 3**] of ppt: informed consent process

[ ] Ask participants to pull out **Handout A [Green]**

[ ] Solicit participants participation through use of the Informed Consent using **Script A**. Reiterate that participation is voluntary and that any participants who do not want to continue the study can leave.

### SCRIPT A

***Why are we here? Oral Presentation of Informed Consent***

**Informed Consent Procedures for the Floyds Fork Stakeholder Engagement Meetings**

We are doing an interesting study for which we need your help. In order to proceed we need your verbal consent.

I am going to ask 10 questions to explain the purpose of the study. I will then answer each of these questions. You can interrupt me at any point and ask questions.

1. Who are we?

*We're a team of researchers from the Kentucky Water Resources Research Institute located at the University of Kentucky. We are conducting this study to assist the local community to identify preferences for nutrient management strategies for the Floyds Fork watershed.*

2. Why are we here?

*The Kentucky Division of Water is currently investigating potential strategies for improving the water quality of the Floyds Fork watershed. During the past few years, several community members and organizations, including the Division of Water, have suggested different nutrient management strategies for the watershed. Today we will present these strategies and provide you with an opportunity to evaluate each of these scenarios.*

3. What are we asking you to do and why?

*During this meeting, we will ask you some general information about yourself in order to determine what types of people are attending the meeting. We will then show you 20 different nutrient management strategies and then ask your opinion about each scenario. This information will be collected anonymously through the use of the small electronic keypads that you were given when you checked in at the information table.*

6. Why were you invited to attend this meeting*?*

*We are looking to solicit input from members of the community with regard to potential nutrient management strategies for the Floyds Fork watershed.*

7. Why do we need your permission and how will you grant us permission to participate?

*All studies of this type (where we are asking you to provide us with information) require that the participants be told what the study is about and what they are being asked to do. That is what we are doing now. We have provided you with a description of the project goals on the informed consent handout (green handout) and your role in the project as well as etiquette guidelines for tonight's meeting (Green handout). If you agree all you need to do is to continue to take part in the meeting. During the meeting you can choose to participate or not participate at any time, or to leave at any time.*

6. What are the risk/benefits for you if you decide to participate in this study?

*As far as we know there are no risks from participating in this study. There are a number of benefits. By participating in this study, your views may affect what should be done with regard to nutrient management decisions that could affect the water quality in the Floyds Fork watershed.*

7. Will you receive any rewards for participating in this study?

*You will receive no rewards for participating in this study other than the benefit of having your opinion documented and recorded.*

8. What will it cost you to participate in this study?

*The only cost to you is the time required to travel to and from the meeting and the time involved for the discussion.*

9. If you have questions, whom do I contact?

*If you have questions about the study you can ask them now or at any time during the meeting. You can also call Dr. Lindell Ormsbee, the principal investigator of this study at any time at 859-*

*257-1299. You can also call the University of Kentucky Office of Research Integrity at 859-257-9428 or toll free at 1-866-400-9428.*

**[ ] B. REVIEW OF MEETING ETIQUETTE**

[ ] Review the guidelines for meeting etiquette using **Script B**

**SCRIPT B**

*The primary purpose of this meeting is collect information from you about your perspectives on potential management strategies for use in the Floyds Fork watershed. We will be providing you information about different nutrient management strategies and soliciting your feedback using the electronic keypads that you were given when you checked in at the information table. You will also be provided an opportunity to ask questions following the presentation. You will also be provided an opportunity to provide written questions at the end of the meeting. We ask that each person adhere to the following general ground rules.*

*1) We have a lot of material to cover this evening so we would please ask that members of the audience refrain from interrupting the speaker during the presentation. At the end of the of the presentation, we will field any questions related to the material presented.*

*2) In order to respect the time of the other attendees:*

*a) Please be respectful of others*

*b) Please keep your questions brief and to the point*

*c) Please refrain from making comments unrelated to the presented material*

*d) Please refrain from making disparaging comments about individuals or organizations*

*3) If someone chooses to violate these rules, we will poll the audience to determine if the conversation should continue or if we should move on.*

*4) By continuing to stay and participate in the meeting you are giving nonverbal consent of your agreement to the meeting ground rules.*

**[MEETING ETIQUETTE SLIDE - 4 ]**

**[ ] C. PROJECT GOALS/OVERVIEW REVIEW**

**[PROJECT OVERVIEW SLIDES – 5 thru 10]**

[ ] Briefly describe the project goal and what we mean by nutrients using the PowerPoint of the Project in **Handout B.** Mention that the protocol we are using tonight has been reviewed by the pilot group and formally reviewed and approved by UK's office of Research Integrity

**[ ] D. ARNSTEIN LADDER OF PUBLIC PARTICIPATION**

**[KEYPAD SLIDE - 11]**

*To register your experiences and expectations, we will be using a key-pad technology that uses these small transmitters to register your responses.*

**[ARNSTEIN SLIDE - 12]**

*Before we begin our presentation tonight, we would first like to get a sense of your past experiences and expectations of citizen involvement in public decision processes. To do this, we will be using Arnstein's Ladder of Public Participation.*

**[PAST EXPERIENCES SLIDE 13]**

*First, we would like you to look at the ladder and select the level or rung that best corresponds with the word that characterizes your past experiences in public meetings involving some type of public or government agency.*

**[DESIRED EXPECTATIONS SLIDE - 14]**

*Second, we would now like you to look at the different options and select the number that corresponds to the word that best characterizes what you think is the appropriate level of citizen empowerment.*

**[ ] E. DEMOGRAHPHIC INVENTORY**

*In order for us to better meet the information needs of the audience we would like to first ask a few demographic questions.*

**[DEMOGRAPHIC QUESTION SLIDES – 15-21]**

**[ ] F. NUTRIENT PROBLEMS AND LAND USE**

*Before looking at specific management strategies we will first introduce some general information about nutrients, and the primary landuse categories in the Floyds Fork watershed.*

**[STRATEGY DESCRIPTION SLIDES – 22-24]**

**[ ] G. OVERVIEW OF NUTRIENT SOURCES AND MANAGEMENT STRATEGIES**

*As a result of several months of interviews and stakeholder meetings, the research team has documented three broad categories of nutrient sources along with several different nutrient management strategies that have been suggested by the various stakeholders. These strategies have been lumped into 4 broad categories:*

*Wastewater management*
*Agricultural management*
*Urban nutrient management*
*Policy strategies*

**[OVERVIEW OF NUTRIENT SOURCES AND MANAGEMENT STRATEGIES]**
**[SLIDES – 25-66]**

## [ ] H. EVALUATION

Now that you have gone through this process, how effective do you think it was in providing you more information about the watershed and potential nutrient management strategies?

**[MEETING FINAL EVALUATION SLIDE - 67]**

*We previously introduced the Arnstein Ladder of Public Participation. How would you characterize tonight's meeting on this ladder.*

**[FINAL ARNSTEIN LADDER EVALUATION SLIDE - 68]**

In order to provide more information about the Floyds Fork watershed, nutrients, and nutrient management strategies we have developed a website that contains information about all of these topics. If you have any questions in the future, you can always contact our office at the number given in the green handout.

**[WEBSITE SLIDE - 69]**

## [ ] I. GENERAL Q&A

*Now that we have gone through our presentation, we would like to see if you have any questions that we may not have addressed. You can ask us questions by either writing them down on the provided cards or by asking them verbally.*

## [ ] J. Conclusion

*We have had a great discussion and you have offered very valuable insights and opinions.* ***Is there anything we missed during this discussion on the project you would like to add?***

*We want to thank all of you for participating in our discussion. We will be posting the results of tonight's meeting on our website.*

## C8. Powerpoint Slides for Scoring meeting

HANDOUT B

### Floyds Fork - Scoring Meetings

Lindell Ormsbee, Director
Kentucky Water Resources Research Institute
lindell.ormsbee@uky.edu
www.uky.edu/waterresources/ff

### Meeting Agenda

- Informed Consent/Meeting Etiquette
- Project Goals
- Prior Experiences
- Demographic Data
- Nutrient Sources
- Management Strategies
- Meeting Evaluation
- Questions?

### Informed Consent Process

1. Who are we?
2. Why are we here?
3. What are we asking you to do and why?
4. Why were you invited to this meeting?
5. Why do we need your permission and how will you grant us permission to participate?
6. What are the risks/benefits for you if you decide to participate in this meeting?
7. Will you receive any rewards for participating in this meeting?
8. What will it cost you to participate in this meeting?
9. If you have any questions, whom should you contact?

### Meeting Etiquette

- Please be respectful of others
- Please keep your questions brief and to the point
- Please refrain from making comments unrelated to the presented material
- Please refrain from making disparaging comments about individuals or organizations

### Project Goal

- Identify community preferences for nutrient management strategies for the Floyds Fork Watershed, incorporating:
  - Community Values
  - Community-Based Visions for the Watershed

### Use of Project Results

- This project is being funded by the Kentucky Division of Water (KDOW).
- The results of this study will help to inform KDOW about the preferences of the community with regard to best management practices for nutrient management in the Floyds Fork Watershed.
- It is anticipated that KDOW will utilize the results of this study in determine what future steps to take in the Floyds Fork Watershed.

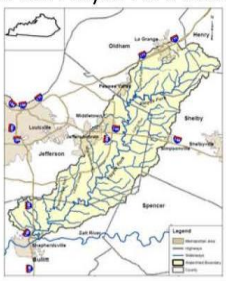
1

HANDOUT B

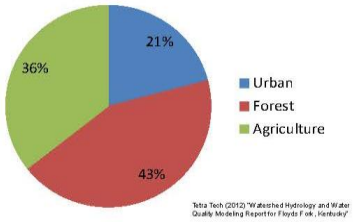
## What is a Watershed?

- A watershed is that area of land that drains to a common point.

## Map of the Floyds Fork Watershed




## Floyds Fork Land Use Distribution




Tetra Tech (2012) "Watershed Hydrology and Water Quality Modeling Report for Floyds Fork, Kentucky"

## What Are Nutrients?

Nutrients are substances that promote growth and maintenance of living things including streams, lakes, rivers, and ponds. Nutrients are essential for life, yet excess nutrients are not healthy for streams.

–Nitrogen

–Phosphorus

## Key Pad Technology


## The Arnstein Ladder: Degrees of Citizen Participation in Planning (Arnstein 1969)

HANDOUT B

What has been your past experience?

1. Manipulation
2. Therapy
3. Informing
4. Placation
5. Consultation
6. Partnership
7. Delegated Power
8. Citizen Control

What should be the goal?

1. Manipulation
2. Therapy
3. Informing
4. Placation
5. Consultation
6. Partnership
7. Delegated Power
8. Citizen Control

Where do you live?

1. Jefferson County
2. Bullitt County
3. Spencer County
4. Shelby County
5. Oldham County
6. Henry County
7. Other

Do you live in the Floyds Fork Watershed?

1. Yes
2. No
3. Not sure

Do you work in the Floyds Fork Watershed?

1. Yes
2. No
3. Not sure

Do you recreate in the Floyds Fork Watershed?

1. Yes
2. No
3. Not sure

Which of the following interests is most important to you?

1. Agricultural issues
2. Environmental issues
3. Recreational issues
4. Economic development
5. Preservation issues
6. Regulatory issues
7. Other issues

What is your age?

1. 20 and under
2. 21 - 30
3. 31 - 40
4. 41 - 50
5. 51 - 60
6. 61 -70
7. 71 and above

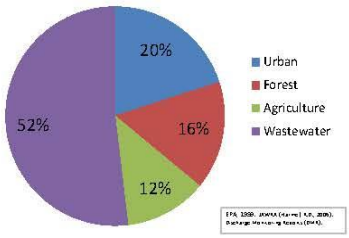
What is your gender?

1. Male
2. Female

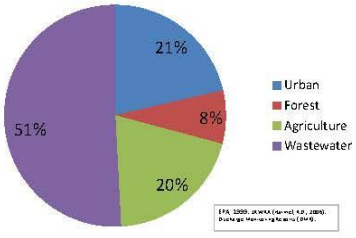
## Nutrient Sources

- Wastewater  2010 Discharge Monitoring Reports
- Agricultural  Harmel, R.D., S. Potter, P. Ellis, K. Reckhow, C.H. Green, and R.L. Haney. (2006).
- Urban  Horner, et al., (2007)
- Forest  Horner, et al., (2007)

**Floyds Fork Nitrogen From All Sources**




**Floyds Fork Phosphorus From All Sources**



## Wastewater Nutrient Sources

- Failing septic systems/straight pipes
- Sanitary sewer overflows
- Inefficient wastewater treatment plants

25

- Wastewater Management
  - Eliminate Failing Septic Systems (Repair, Replace, Cluster Systems)

26

## Eliminate Failing Septic Systems

1. Least Preferable
2. **
3. ***
4. ****
5. *****
6. ******
7. *******
8. ********
9. Most Preferable

27

- Wastewater Management
  - –Eliminate sanitary sewer overflows (SSOs)

Decrease inflows

28

## Eliminate SSOs by decreasing inflows

1. Least Preferable
2. **
3. ***
4. ****
5. *****
6. ******
7. *******
8. ********
9. Most Preferable

29

- Wastewater Management
  - –Eliminate sanitary sewer overflows (SSOs)

Increase capacity

30

## Eliminate SSOs by increasing sewer capacities

1. Least Preferable
2. **
3. ***
4. ****
5. *****
6. ******
7. *******
8. ********
9. Most Preferable

## • Wastewater Management

– Regionalization

## Regional Wastewater Treatment Plants

1. Least Preferable
2. **
3. ***
4. ****
5. *****
6. ******
7. *******
8. ********
9. Most Preferable

## • Wastewater Management

–Improve treatment efficiency

| Level Of Treatment | Total Nitrogen as Nitrogen (mg N/L) | Total Phosphorus as Phosphorus (mg P/L) | Total Present Worth Project Costs (Million $) 10 MGD |
|---|---|---|---|
| 1 | 15 | 4 | 110 |
| 2 | 8 | 1 | 150 |
| 3 | 6 | .2 | 180 |
| 4 | 3 | .1 | 210 |
| 5 | <2 | <0.02 | 300 |

Reference: Water Environment Research Foundation (2010)

## Improved Wastewater Treatment Technologies

1. Least Preferable
2. **
3. ***
4. ****
5. *****
6. ******
7. *******
8. ********
9. Most Preferable

## Agricultural Nutrient Sources

- Fertilizer
- Erosion
- Manure from Livestock


HANDOUT B

- Agricultural Nutrient Management
  - Manage the amount of fertilizer applied to crops


37

## Fertilizer application

1. Least Preferable
2. **
3. ***
4. ****
5. *****
6. ******
7. *******
8. ********
9. Most Preferable

35

- Agricultural Nutrient Management
  - Crop management (e.g. rotation, filter strips)

39

## Crop Management

1. Least Preferable
2. **
3. ***
4. ****
5. *****
6. ******
7. *******
8. ********
9. Most Preferable

40

- Agricultural Nutrient Management
  - Control Erosion


41

## Erosion Control

1. Least Preferable
2. **
3. ***
4. ****
5. *****
6. ******
7. *******
8. ********
9. Most Preferable

42

- Agricultural Nutrient Management

–Treat nutrient laden runoff (wetlands)

## Agricultural Wetlands

1. Least Preferable
2. **
3. ***
4. ****
5. *****
6. ******
7. *******
8. ********
9. Most Preferable

- Agricultural Nutrient Management

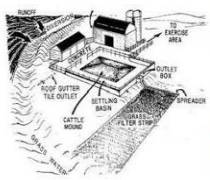
– Livestock management (e.g. eliminate livestock from streams)

## Livestock Management

1. Least Preferable
2. **
3. ***
4. ****
5. *****
6. ******
7. *******
8. ********
9. Most Preferable

- Agricultural Nutrient Management

– Manure management (e.g. storage, runoff, application)




## Manure Management

1. Least Preferable
2. **
3. ***
4. ****
5. *****
6. ******
7. *******
8. ********
9. Most Preferable

## Urban Nutrient Sources

- Pet litter
- Lawn Fertilizer
- Increased Erosion

## • Urban Nutrient Management

– Educational: Reduce nutrient loadings (e.g. lawn fertilizer-watering, pet litter)

## Education/Behavior Change

1. Least Preferable
2. **
3. ***
4. ****
5. *****
6. ******
7. *******
8. ********
9. Most Preferable

## • Urban Nutrient Management

– Reduce runoff through traditional stormwater infrastructure

## Detention Basins

1. Least Preferable
2. **
3. ***
4. ****
5. *****
6. ******
7. *******
8. ********
9. Most Preferable

## • Urban Nutrient Management

– Reduce runoff through green infrastructure

## Green Infrastructure

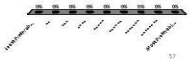
1. Least Preferable
2. **
3. ***
4. ****
5. *****
6. ******
7. *******
8. ********
9. Most Preferable

## • Urban Nutrient Management

– Treat runoff (e.g. retention basins/constructed wetlands)

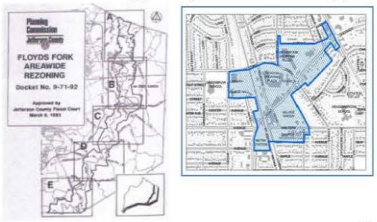
## Urban Wetlands

1. Least Preferable
2. **
3. ***
4. ****
5. *****
6. ******
7. *******
8. ********
9. Most Preferable



## • Policy Strategies

– Land Use Planning (Development Review Overlays)

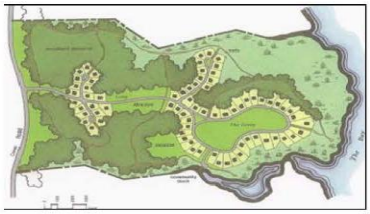



## Development Review Overlays

1. Least Preferable
2. **
3. ***
4. ****
5. *****
6. ******
7. *******
8. *********
9. Most Preferable

## • Policy Strategies

– Land Use Planning (conservation subdivisions)

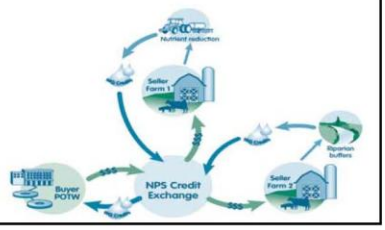


## Conservation Subdivisions

1. Least Preferable
2. **
3. ***
4. ****
5. *****
6. ******
7. *******
8. *********
9. Most Preferable

## • Policy Strategies

– Pollution Trading

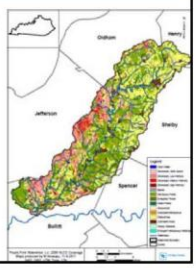



## Pollution Trading

1. Least Preferable
2. **
3. ***
4. ****
5. *****
6. ******
7. *******
8. *********
9. Most Preferable

## • Policy Strategies

– Forest Preservation




## Forest Preservation

1. Least Preferable
2. **
3. ***
4. ****
5. *****
6. ******
7. *******
8. *********
9. Most Preferable

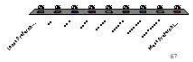
## • Policy Strategies

– Reduce Atmospheric Nitrogen Deposition

HANDOUT B

## Reduce Atmospheric Nitrogen Deposition

1. Least Preferable
2. **
3. ***
4. ****
5. *****
6. ******
7. *******
8. ********
9. Most Preferable



## Meeting Evaluation

How do you feel about the process used in tonight's meeting?

1. Very Negative
2. **
3. ***
4. ****
5. *****
6. ******
7. *******
8. ********
9. Very Positive

## How would you characterize tonight's meeting?

1. Manipulation
2. Therapy
3. Informing
4. Placation
5. Consultation
6. Partnership
7. Delegated Power
8. Citizen Control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## Appendix D: Online Survey Participant Comments

*I would like to see the data that supports the claims about nutrient sources especially the percentage claimed from waste water being in excess of 50%. You also claim as much as 30% coming from (coal). Your percentages don't add up if this is true. Another backdoor attack against coal? It's easy to target waste water plants and the coal industry but harder to attack auto emissions as every driver gets a vote. I don't believe your data!*

*The question of fertilizers could have included the use of herbicides; I have seen the use of herbicides used on soybean crops that because of the destruction of deeper root systems and inhibiting the growth of adequate ground cover, even after the crops were harvested contributed significantly to continuing erosion, especially after the rains we have been having. Much of this was on land on the banks of Floyds Fork, in the Parklands, what will be called Turkey Run Park. Herbicides could have been conceptualized as a major factor in the runoff problem. Their use can be factored in as destructive to the ability of the land to deal with erosion and resulting in burden on the watershed. I saw the quality of many acres deteriorate this fall. Also, let me say that I live very close to the construction of the new Parklands and have seen much negligence on sites where the road through the park is going. Silt fences and retaining walls to protect ponds and streams, as mandated by the EPA for use during construction have not been used. Drive down Stout road off Broad Run rd and you will see the damage. As far as the abandon with which the herbicides are used, much of this is land owned by the Parklands, but used for cash crops, so good luck with changing that bit of political dealings. It is easy to mandate a timetable to get everyone off septic, but try changing the rampant use of pesticides, herbicides, etc. I don't mean to be cynical, but This is what I've seen for 15 plus years.*

*I think the 21st Century Parks plans are wonderful but it is very alarming to see the MSD signs up saying don't go near the water after a large rainfall! Millions have been spent creating this wonderful park land but Floyds Fork is full of crud.*

*Contains too much lingo that average person cannot understand.*

*The parkland project is a good example of how to develop an area and work with builders and developers to make the area more valuable in the whole. There are too many inconsistencies in enforcement by the government authorities. It is ok for farmers and government agencies to not use silt controls for example, but builders and developers are harassed and fined when even the slightest bit of silt leaves the job site. However, farmers have no regulation and can destroy a stream. MSD is good at picking on builders and developers but the same rules are not applied equally to them. I have hundreds of pictures to prove this point. What is good for government organizations is not ok for builders and developers and there are no rules for farmers in the same area doing much worse stream damage. We do not need more government control, we need less and the same rules should apply to everyone, not select groups. The EPA has way too much power and constantly harasses private citizens trying to make a living, with*

*intimidation and fines that can bankrupt a small business for doing the same thing the government agencies and farmers are doing except worse.*

*This survey is very biased leading the person taking the survey to "vote" for things that decrease economic development and jobs. Nowhere in the survey does it say what the cost is to do these different actions and the effect it would have on the local economy.*

*If things are not economically sustainable nothing else matters. We need to weigh solutions against cost. This survey does not speak to cost.*

*This survey is pretty good, however I wish it would explain how much each of these alternative management strategies cost comparable to each other. This will eventually cost someone and probably me money to reduce loadings in Floyds Fork. I am sure some of these strategies are much more expensive than others. I always encourage finding the least expensive alternative to the community.*

*There are not cost effectiveness benchmarks that allow a more informed assessment of strategies. Good public policy is not developed based on a survey of general opinions, it comes from the evaluation of cost, benefits, and legal/practical implementation discussions. This survey does not get to the core issues that include how much does each of these strategies cost, who pays, what are the benefits to WQ and who benefits? It seems this TMDL will lead to court challenges by different factions, and in the end will be a costly study with little benefits.*

*A bit confused. In summarizing sources of nitrogen the only reference to atmospheric contributions was in the Forest section. Then near the end of the survey, in ranking strategies, it is mentioned that atmospheric carbon from burning coal may account for as much as 30% of the nitrogen in the watershed. A contribution this significant should have had its own designation on the pie chart for sources of nitrogen. If I read this correctly, the 30% contribution from burning coal exceeds the individual contributions shown on the chart for Urban (20%), Forest (16%), or Agriculture (12%). The only way I see that the data in the charts can have any meaning is if those are the nitrogen contributions from the 4 sources EXCLUDING atmospheric deposition if 30% of total nitrogen is indeed coming from coal. I think this should be clarified, and if my understanding is correct, the description of atmospheric carbon only being described as coming from Forest as a source is quite misleading in both where the magnitudes of the source problems are and the extent to which one presumes the previously presented strategies would be effective.*

*APPEARS JEFFERSON COUNTY IS BEING PUNISHED WHEN THE 4 SURROUNDING, CONTRIBUTING COUNTIES DO NOT HAVE TO HANDLE*

*Seems the best way to protect the Floyds Fork Watershed would be to maintain the 40% forest coverage. Also any development should utilize green infrastructure and not clear the trees from property line to property line which is the way it is currently done.*

*Quit trying to soft sell pollution trading, the idea is to reduce / eliminate pollution, POLLUTION TRADING ALLOWS COMPANIES TO BUY THE RIGHT TO POLLUTE.*