EAGLE CREEK WATERSHED MANAGEMENT PLAN
FINAL REPORT

EXECUTIVE SUMMARY

The Eagle Creek Watershed Alliance (ECWA) received an Indiana Department of Environmental Management 319 grant in December of 2009 with the objective of accomplishing three goals: to develop and implement a cost-share program which would help fund conservation practices in both agricultural and urban areas, perform water quality monitoring, and create an education and outreach program that would lead to behavioral changes benefitting water quality in the Eagle Creek area.

Fifteen landowners participated in the ECWA cost-share program. Best management conservation practices implemented included planting cover crops on farm fields, modifying farm equipment for no-till/conservation tillage practices, and installing native plantings in neighborhoods. These conservation practices will have a positive water quality impacting 10,495 acres of land. Over the period of this grant, practices prevented 22,937 tons of soil from eroding, 57,813 pounds of nitrate and 28,925 pounds of phosphorus were prevented from entering the waters of Eagle Creek Watershed. Estimated cost of these pollution prevention efforts was $18.25/acre. Additionally, these efforts helped generate awareness and early promotion of the Healthy Soils initiative that is becoming more recognized as an important water resource practice of the future.

Students and faculty from the IUPUI-Center for Earth and Environment Science (CEES) conducted monthly water quality sampling on Eagle Creek Reservoir and its tributaries. The purpose of the sampling was to continue to measure water quality changes, target sources of pollution, and provide data for future work to improve the overall quality of the Eagle Creek Watershed. Water samples collected from the 11 sites were analyzed for nitrate and phosphorus (common fertilizer pollutants), chloride, atrazine (and agricultural herbicide), sediment, and *E. coli* bacteria (associate with human and other animal waste). Data from some of the sites will support the National Water Quality Initiative (NWQI) in one of three critical watersheds selected in Indiana for this initiative. Approximately 580 samples were collected and 11,600 laboratory analyses performed throughout the period of the grant.

During the grant period, the ECWA has given two educational tours, held three educational workshops, participated in fourteen agricultural field days, five community events or festivals, and six homeowner association meetings. In addition to the above "in person" contacts ECWA installed 30 watershed/stream identification signs, three interpretative signs located in Eagle Creek Park, Village Walk subdivision and at the Zionsville USGS gaging station. To further aid in educational efforts, the ECWA, with the help of Green3, LLC, created a series of graphics depicting typical built conditions and environmentally-friendly alternatives for a variety of settings, including farmland, rural homesteads, suburban residential areas, and urban commercial areas. The award winning graphics are available on the web for other watershed and environmental groups to use.

From innovative cost share programs by our agricultural liaison, to an intensive monitoring program that companioned with the state-wide blue-green algae efforts and the active and passive educational programs; we feel the grant was well managed and successful in meeting its goals.

1.0 INTRODUCTION

The purpose of this project was to continue implementing the Eagle Creek Watershed Management Plan's (Tedesco et al., 2005) goals of improving water quality, increasing public awareness of watershed water quality, and encouraging stewardship of the watershed resources (Eagle Creek watershed 11-digit HUC# 05120201120). Specific water quality concerns identified within the watershed include nutrients, particularly nitrogen and phosphorus, nutrient loading, and resultant algal blooms; harmful levels of herbicides and other chemicals (including atrazine); high levels of *E. coli* and other pathogens; and sedimentation resulting in degradation of aquatic habitats. Activities identified to address these concerns (carried out under the U.S. Environmental Protection Agency (EPA) Clean Water Act Section 319 grant), under agreement with the Indiana Department of Environmental Management (IDEM) included:

1. Development and implementation of a cost-share program for agricultural and urban stormwater Best Management Practices (BMPs)
2. Implementation of a water quality monitoring program
3. Development and implementation of an education and outreach program designed to bring about behavioral changes that will lead to reduced nonpoint source pollution in the watershed

2.0 NARRATIVE SUMMARY

The following sections provide a summary of the activities implemented under the four grant agreement tasks:

Task A – Cost-Share Program (development & promotion)
Task B – Cost-Share Program (implementation)
Task C – Water Quality Monitoring Program
Task D – Education and Outreach Program

The project duration was 36-months.

TASK A

Task A required the sponsor to develop and promote a cost-share program to install agricultural and residential best management practices (BMPs) consistent with the goals and objectives of the watershed management plan, including rain gardens, swales, two-stage ditches, and conservation tillage.

TASK A ACTIVITIES

The project sponsor, with assistance from the watershed coordinator(s) successfully completed the requirements of Task A, as summarized below.

The Technical Committee updated the existing cost-share program in part because of lessons learned from the prior round of implementation, but also because of changes made by the EPA. The most significant changes included the addition of caps to each of the cost-share practices listed and redefining the priority/critical watersheds from an 11/14 digit HUC code to a 10/12 digit HUC code. The revised cost-share program was approved by IDEM on August 5, 2010. The Alliance requested an addendum to the Watershed Management as a result of data and concerns brought to the attention of the Alliance by the Marion County Health Department. The addendum requested that a specific site located in a non-critical watershed be considered critical and eligible for cost-share funding based on the supporting data. The addendum was approved by IDEM on July 11, 2011 and the cost-share document amendment was approved on August 9, 2011.

Harold Thompson was hired to serve as the Agricultural Liaison effective April 9, 2010. Mr. Thompson promoted the cost-share program by giving presentations and distributing postcards at county fairs, local field days, and Soil and Water Conservation District (SWCD) events. Specifics of these events are discussed in Task D. He also assisted with On Farm Network demonstrations and meetings in the Eagle Creek Watershed and worked with the Natural Resource Conservation Service (NRCS) on special Environmental Quality Incentives Program (EQIP) funding for the Eagle Creek Reservoir – Eagle Creek Subwatershed. The On-Farm Network is an ongoing project supported by the Indiana State Department of Agriculture designed to help row crop producers determine the appropriate amount of fertilizer through stalk nitrogen testing and aerial photography review. In addition, Mr. Thompson attended continuing education opportunities like the National No-Till Conference in January 2012, a Purdue University webinar about goat management on December 7, 2011, and the Soil and Water Conservation Society Annual Meeting July 22-25, 2012.

Mr. Thompson also had the pleasure of meeting with the Chinese Ministry of Water Resources (MWR) Delegation and presented a program about the Eagle Creek Watershed Alliance. Thompson noted that the delegates were very interested in how the alliance was formed and how the program was given direction. The delegates recognized the need for water quality in relation to the reservoir. The Chinese MWR were visiting to increase international cooperation and to improve research and management in soil erosion assessment and soil water conservation ecological restoration (see Appendix A for NRCS News Advisory).

TASK B

Task B involved the implementation of the cost-share program developed and described per Task A. All BMPs developed for the program conformed to the NRCS FOTG, or other applicable, approved specifications through consultation with IDEM. Under the Eagle Creek Watershed cost-share program, the federal Section 319 provided up to seventy-five (75) percent of the cost of the BMPs and the landowner or other non-federal funding source contributed the remaining amount, at least twenty-five (25) percent, as match contribution. The BMPs met the terms and conditions of either a 319A or 319U cost-share form and were only installed in critical areas as described in the Eagle Creek WMP. Additionally, as part of the cost-share documentation, the sponsor and watershed coordinator provided actual cost for all practices, location data (geographic coordinates), and, when applicable, sediment and nutrient load reductions for every BMP implemented as a result of this project, including BMPs not funded with this grant. Cost-share project information is further discussed and summarized later in this Final Report.

TASK B ACTIVITIES

<u>Implementation of Cost Share Program</u>

The ECWA Technical Committee, watershed coordinator and Agricultural Liaison worked with farmers in the watershed to award agricultural cost share projects. Through these efforts 15 landowners implemented agricultural and/or urban cost share BMP projects during the grant period. Some of these landowners implemented multiple practices. The landowners and the projects are summarized in Table 1.

In addition, Starkey Farms (a participating producer) was selected to receive the Hoosier Chapter Soil and Water Conservation Society award for Conservation Accomplishment Group Award for advancing the science of soil and water here in Indiana and for efforts in Eagle Creek watershed and other statewide conservation activities. The award was presented at the Connected Landscapes Conference on Nov. 17, 2011.

Other activities, non-agricultural in nature, were also pursued by the project sponsor, watershed coordinator and/or Technical Committee members, but were not implemented. These included:

- Willow Ridge HOA – retention pond retrofit
- Jeromy Moss – tree plantings in urban neighborhood
- Hamilton County SWCD opportunities through the Backyard Habitat program

Table 1: Implemented Cost-Share Projects

Landowner	Project	Subwatershed(s)	Acres
Cragun (2010)	Cover Crop	Fishback Creek	42
Cragun (2011)	Cover Crop	Fishback Creek	79
Cragun (2012)	Cover Crop	Fishback Creek	53.3
Cragun (2011)	No-Till Equipment Modifications	Fishback Creek, Mounts Run	483.3
Goutsouliaks	Exclusion Fencing & Alternative Watering System	Eagle Creek Reservoir	.09
Green	Cover Crop	Jackson Run	40
Lyon	No-Till Equipment Modifications	Dixon Branch	420.7
Maloney (2011)	Cover Crop	Eagle Creek Reservoir	477.9
Maloney (2012)	Cover Crop	Eagle Creek Reservoir	577.2
Padgett, A.	No-Till Equipment Modifications	Dixon Branch, Finley Creek, Mounts Run	307
Padgett, J. (2010)	Cover Crop	Dixon Branch, Finley Creek	503.9
Padgett, J.	No-Till Equipment Modifications	Dixon Branch, Finley Creek	503.9
Padgett, J. (2011)	Cover Crop	Dixon Branch, Finley Creek	414.3
Padgett, J. (2012)	Cover Crop	Dixon Branch, Finley Creek	492.1
Padgett, W.	No-Till Equipment Modifications	Dixon Branch, Mounts Run	391.2
Sedwick	No-Till Equipment Modifications	Dixon Branch	905.7
Starkey (2010)	Cover Crop	Eagle Creek Reservoir, Fishback Creek, Mounts Run	807.2
Starkey (2011)	Cover Crop	Eagle Creek Reservoir, Fishback Creek	1238.7
Starkey (2012)	Cover Crop	Eagle Creek Reservoir, Fishback Creek	1317.9
Stowers	No-Till Equipment Modifications	Dixon Branch, Finley Creek	831.9
Viehe (2010)	Cover Crop	Finley Creek	275
Viehe (2011)	Cover Crop	Finley Creek	272
Village Walk HOA	Naturalize Detention Basin	Jackson Run	0.48
Waitt	Cover Crop	Dixon Branch	60.3
Totals			**10,495.07**

TASK C

This task required the sponsor to conduct a monitoring program to document trends in the watershed and provide information to educational programs. Water quality monitoring was to be done monthly at no less than eleven (11) sites for at least flow, cation and anions, total suspended solids, atrazine, *E. coli*, nitrate, and phosphorus. This task also involved developing and submitting a Quality Assurance Project Plan (QAPP) for the monitoring activities at least one (1) month prior to initiating monitoring activities.

TASK C ACTIVITIES

Water Quality Monitoring Program

The project sponsor conducted monthly monitoring at a minimum of 11 locations in the watershed and during select storm events. The 11 sampling locations allow for monitoring of spatial and temporal changes in water quality. Sample locations were selected to assess the contributions of analytes of concern from each of the subwatersheds to Eagle Creek. Preliminary site selection was based on map analysis and previous monitoring experience in the watershed and extends long-term water quality monitoring for longitudinal studies. Selected sample sites were located at road crossings to improve accessibility. A summary of these monitoring efforts is included in the Summary and Discussion section below.

Quality Assurance Project Plan (QAPP)

IUPUI-CEES updated and revised the QAPP from the prior grant for monitoring activities and submitted these updates to IDEM. After additional updates and revisions per IDEM's request, the QAPP was approved by IDEM on June 22, 2010.

In accordance with the QAPP, stream samples were collected by CEES staff and lab analyses were conducted by Veolia, and subsequently Citizens, lab. Stream grab samples were taken using a bottle then split into aliquots specific to the analytes measured. Water quality parameters assessed in the monitoring program included: nitrate, phosphorus, chloride, *E. coli*, total suspended solids (TSS), and dissolved organic carbon concentrations plus discharge measurements to allow for load estimates.

TASK D

This task required the sponsor to conduct an education and outreach program designed to bring about behavioral changes that will lead to reduced nonpoint source pollution in the watershed. At a minimum, this included:

- Conducting no less than six (6) watershed committee meetings per year of the previously formed committee
- Publishing and distributing the quarterly watershed newsletter to stakeholders
- Improving the project website to better reach the target audience, using results from the Social Indicator Survey located at: http://www.cees.iupui.edu/research/water_resources/eagle_creek_watershed_alliance/index.htm
- Developing graphics explaining BMPs and their relationship to water quality and using the graphics as needed in newsletters, brochures, web pages, etc.
- Submitting at least three (3) news releases updating the media on the project
- Developing a minimum of one (1) press kit designed to enhance media interest and understanding of watershed issues
- Creating a watershed distribution list to aid in project communication
- Holding a minimum of three (3) agricultural field days to educate landowners on specific BMPs
- Holding a minimum of two (2) educational tours to educate stakeholders on watershed issues
- Holding at least two (2) workshops focusing on water quality issues pertinent to Eagle Creek stakeholders
- Conducting pre and post tests at each of the two (2) workshops to assess workshop effectiveness
- Providing two (2) copies of the newsletters, graphics, and news releases to IDEM

TASK D ACTIVITIES

Most of Task D activities were overseen by the watershed coordinator(s). Watershed coordination was conducted by the team at Empower Results, LLC. Coordination included grant reporting responsibilities, load calculations for all BMP projects, all committee coordination, site visits and other agency/IDEM communication, development of web materials, oversight of contractors, authoring of newsletters, HOA presentations, stakeholder outreach calls, staffing events, drafting of outreach material such as postcards and posters, and planning, prep, and delivery of all workshops.

Committee Meetings

The ECWA steering committee met seven (7) times, communications committee met two (2) times, technical committee met twenty (20) times, and the education committee (including the BMP graphics sub-committee) met twenty (20) times.

Quarterly Newsletter

The ECWA newsletter was published quarterly. ECWA updates were also provided for CEES newsletters. ECWA was also featured in the Winter 2010 issue of the HHRC&D Backyard Conservation newsletter.

Eagle Creek Watershed Alliance Website

The Education Committee reviewed draft templates and approved a new website format. The website was updated monthly to include news articles, meeting minutes, a septic outreach page, BMP graphics, and featured events like National Drug Take Back Days, water quality workshops, and clean-up events.

BMP Graphics

A subcommittee was formed by Education and Technical Committee members to manage the BMP graphics project. Green 3, LLC (a landscape architecture firm) was hired by the ECWA to create BMP graphics. The graphics were completed in the summer of 2011. They were available for download on the FTP site for a period of time, and are now available by contacting the ECWA coordinator. The graphics were utilized in PowerPoint presentations, on the ECWA, Upper White River Watershed Alliance (UWRWA), the Big Walnut Watershed Alliance, and Clear Choices Clean Water websites, and were mentioned in several newsletters. Request for use of the graphics from other watershed group across the country also transpired as a result of their presence on the ECWA and UWRWA website. These graphics also recently won an award for Outstanding Innovation in Policy or Program from the UWRWA at its White River Festival Watershed Stewardship Awards Event.

News Releases

No-Till Farmer magazine, February 2011 issue, featured an article about two of ECWA's key farmers, Mike Starkey and Jack Maloney. The article discussed reducing nutrient runoff and boosting subsurface drainage in key environmental hotspots in the Eagle Creek watershed. Soil testing, tile outlet monitoring, cover crops, and all of the projects that are going on with IUPUI and the ECWA were mentioned in the article. It also promoted the cost-share program and how the tests and trials associated with the On-Farm Network have helped reduce application rates significantly.

Hoosier Ag Today featured an article about a tour of Starkey and Maloney Farms attended by ISDA Director Joe *Kelsay and Division of Soil and Water Conservation staff. The article was published on May 31, 2012 and* discussed the importance of conservation practices, the CREP and CRP programs, and a description of the Eagle Creek Watershed.

Zionsville Times Sentinel ran an article on September 8, 2010 discussing water quality and fish populations in Eagle Creek below the Zionsville Wastewater Treatment Plant. The report discusses the results of a survey conducted by Commonwealth Biomonitoring and indicates that the water quality in this particular section of stream is good.

NRCS announced on May 8, 2012 that producers in Eagle Creek Reservoir – Eagle Creek watershed were eligible for additional funding for voluntary conservation actions, such as cover crops and filter strips which are focused toward providing cleaner water. Eagle Creek Reservoir – Eagle Creek watershed was identified, along with two others, by state agencies, partners, and NRCS State Technical Committee to receive the funding through the National Water Quality Initiative.

A news release ran in the Indianapolis Star on October 23, 2012 highlighting the accomplishments of the Eagle Creek Watershed Alliance as the grant nears completion. The article talks about the number of landowners participating in the cost-share program and the acres of land impacted by their voluntary participation in the program. It also made mention of the workshops, water quality sampling, and graphics created.

Press Kit

A press kit built by the Education Committee to provide the media/press with materials and information about the watershed when researching and writing articles. The press kit includes things such as maps, timeline, brochure, and logo, several of which are included in Appendix A. The press kit is available on the Eagle Creek Watershed Alliance website: www.eaglecreekwatershed.org.

Watershed Distribution List

Names and addresses were sought and collected for the distribution list for the newsletter, homeowners associations (HOAs), and an overall distribution list.

Agricultural Field Days

Mr. Thompson partnered and presented at several Ag Field Days on behalf of the ECWA. The field days included:

1. The Purdue Farm Management Tour
2. The Soil, Nitrogen, Cover Crops, Woodlot Management, & Precision Farming Field Day hosted by Boone, Hendricks, and Putnam Counties. Approximately 85 people attended this field day.
3. The New Ross Grain Field Day at Starkey Farms – attended by approximately 55 people.
4. Hamilton County Cover Crop Tour – November 10, 2010 – only attended by 5 people.
5. Putnam County Cover Crop Tour – November 17, 2010 – attended by 35 people.
6. Boone Co. SWCD 2011 Annual Meeting – 60 attendees
7. Hendricks Co. SWCD No-Till/Cover Crop Meeting – 50 attendees
8. Boone Co. Healthy Soils & Cover Crop Workshop on 8/16/2011 – 54 attendees
9. New Ross Grain Field Day on 9/26/11 – 65 attendees
10. Starkey Farms field day on 12/2/2011 – 70-75 attendees
11. ECTC practice tour on 12/9/11 – 10 attendees
12. Boone County SWCD Annual Meeting on 1/24/12 – 60 attendees
13. Boone Co. SWCD meeting – 2/15/12
14. Boone Co. SWCD Annual Meeting – 4/16/12
15. Indiana Young Farmers workshop at Starkey Farms on 6/23/12 – 100 attendees
16. Boone Co. SWCD meeting – 7/18/12

Educational Tours

On October 15, 2010, ECWA partnered with Indiana ProjectWET and Indy Parks to hold the "Discover the Eagle Creek Watershed Workshop and Tour" at the Earth Discovery Center in Eagle Creek Park. Fifty people participated in this event.

On June 3, 2011, ECWA co-sponsored "Water Quality Challenges and Opportunities in the Urban-Rural Interface" at Starkey Farms – a tour that drew in 79 participants.

Workshops on Water Quality Issues (including pre and post tests)

On February 19, 2010 at the Eagle Creek Earth Discovery Center the workshop Healthy Water Healthy People was provided for 20 participants. This workshop focused on raising awareness and understanding about water quality and its relationship to personal, public and environmental health. It will help educators address science standards through interactive activities that interpret water quality concepts and promote diverse learning styles with foundations in the scientific method. Registration was free.

The ECWA worked with IUPUI-CEES and Veolia, as well as several other sponsors, to host the Blue-Green Algal Bloom and Nutrients that Cause Them: Exploring Indiana's Story Symposium. This June workshop was held at the Rathskellar in Indianapolis and attended by over 200 people. WTHR Channel 13 covered the event as part of its evening program. The Education Committee synthesized the pre and post test survey results from the symposium to help interpret future education outreach.

ECWA, in partnership with the DNR's Natural Resources Education Center (NREC), held a Water Quality & Human Health workshop on Oct. 7, 2011. This was a Healthy Water, Healthy People event that drew in 16 attendees and was held at the Belmont Wastewater Treatment Plant and featured a tour of the facility. The pre and post survey results were approved and are available for review.

Other Pertinent Events

On April 18th, 2010, the Education Committee worked at the Zionsville GreenFest to raise water quality awareness. Both a booth and activities were presented to attendees. The educational activity for kids was Project Wet's Journey of Water in which bracelets are made to represent and educate on the water cycle. Approximately 250 bracelets were made.

April 22nd, 2010 was "Go Green Community Night" at New Augusta Public Academy. 150 students attended and performed several activities. The ECWA Education Committee held one activity for students to participate in and also set up a display which engaged homeowners in Questions and Answers.

Z'GreenFest was held in Zionsville on April 22, 2012. ECWA staffed a booth for 4 hours and visited with an estimated 501 attendees.

"Go Green Community Night" was held again on April 24, 2012 at New Augusta Public Academy. The education committee handed out educational material and made 115 water cycle bracelets. Full attendance was estimated to be around 150.

The Education Committee set up a booth at the Zionsville Fall Festival on September 8-9, 2012. Hundreds of children made water cycle bracelets and adults learned about the Eagle Creek Watershed Alliance and the Clear Choices Clean Water campaign. Native plants, T-shirts, water bottles, and dog waste baggie carriers were handed out to those interested in the Clear Choices program. A poster was also created for this event that highlighted the ECWA's accomplishments over the past three years.

Additional Activities

The Education Committee created a standardized PowerPoint to deliver to area HOAs discussing water quality concerns, pollution sources, and what homeowners and HOAs can do to help. Presentations were made to:

- Pike Township HOA (20 attendees)
- Colony Square HOA (10 attendees)
- Zionsville HOA Roundtable (15 attendees)
- Working Together for Water Quality HOA Event in partnership with the Town of Zionsville and Boone County SWCD (19 attendees)
- Village Walk HOA (19 attendees)
- Coventry Ridge HOA (12 attendees)

3.0 DOCUMENTATION AND PRODUCTS

The following items are included as part of this final report and included on the CD (Appendix A).

- Newsletters
- BMP Graphics
- News Releases
- Workshop Flyers
- Cost-Share Promotional Materials

DATA
Data collected as part of this project is included on a CD as part of this report (Appendix B).

4.0 SUMMARY and DISCUSSION
4.1 Monitoring Results

Eagle Creek Watershed was monitored a total of thirty-seven times between 10/2009 and 10/2012 at eleven watershed monitoring stations. Sampling was conducted a total of twenty-eight times during low flow conditions and an additional nine times during periods of elevated, or event, flows (Figure 1). Monitoring stations were established throughout the watershed (Figure 2) a) at the three inflow points to Eagle Creek Reservoir (Stations 1, 2, and 3), b) at watershed locations where subwatersheds flow into trunk streams or at subwatershed pour points, and c) at headwater sites in the Mounts Run subwatershed (Stations 9, 10, and 11).

Monitoring data was analyzed for station to station variability in median concentrations at base flow, during event flows, and for any trends over the three year monitoring program.

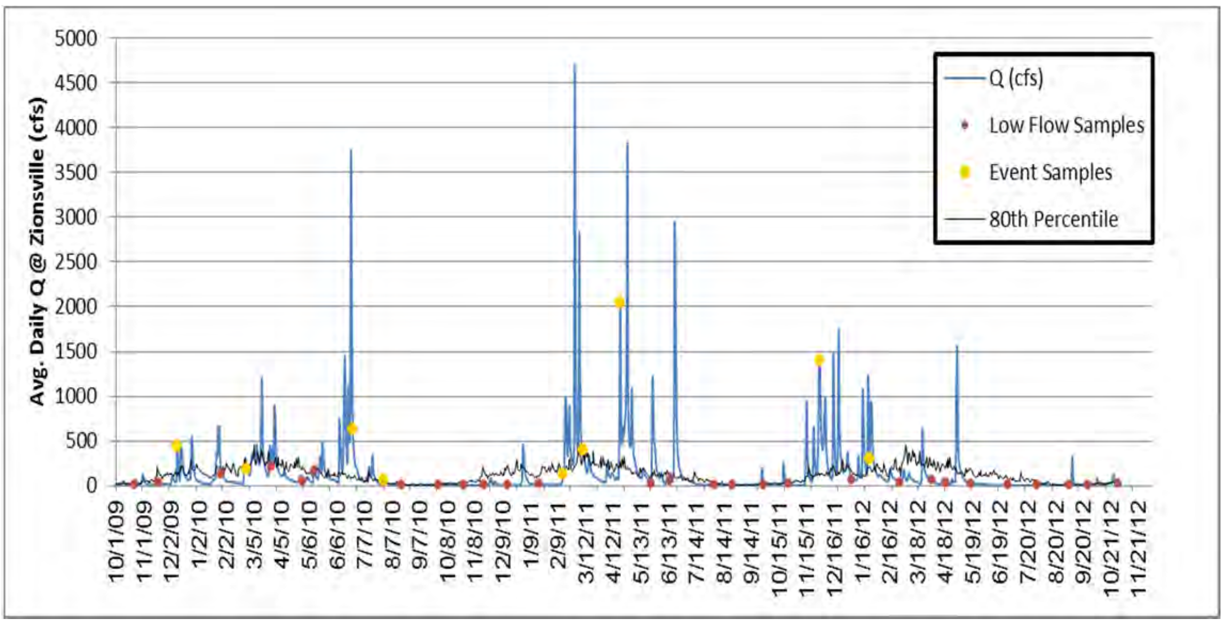


Figure 1: Eagle Creek Watershed 319 sampling events plotted relative to discharge at the USGS gage on Eagle Creek at Zionsville Road. Samples marked with a red dot indicate it was collected at a period of low flow while the samples marked with a yellow dot indicate it was collected at a period of elevated, or event, flow. Event samples were defined as those that achieved discharges in excess of the historical daily 80th percentile flows as illustrated by the black line.

Chloride

Chloride concentrations in surface waters have been utilized as a conservative tracer in understanding and isolating transport pathways of contaminants into surface waters (Brown et al., 1999; Sidle et al., 1999; Devito et al., 2000). However, at high enough concentrations in freshwater ecosystems, chloride concentrations may be detrimental to aquatic life. The US Environmental Protection Agency (EPA) National Recommended Water Quality Criteria for chloride in freshwater systems is reported as 860 mg/L for acute risk and 230 mg/L as chronic risk to aquatic communities.

Median low flow concentrations of chloride ranged from 21.15 mg/L at Station 7 to 153.72 mg/L at Station 5. The highest low flow concentrations of chloride at 115.46 mg/L and 153.72 mg/L, respectively, occurred at Stations 3 and 5 located downstream from wastewater treatment plants. At these stations, low flow occurrences of chloride in excess of the US EPA Chronic Risk to Aquatic Life of 230 mg/L was recorded four times at Station 3 and six times at Station 5 during the three year study period. The highest recorded value for chloride of 338.8 mg/L occurred at Station 3 in July, 2012. However, data collected at Bushs Run (Long -86°17'34.3"W, Lat 39°52'48.35"N), another site located within the Eagle Creek Watershed and situated in close vicinity to an Indiana Department of Transportation facility, experienced a median low flow concentration of 309.8 mg/L between October, 2009 and January, 2011 thereby exceeding the US EPA Chronic Risk to Aquatic Life of 230 mg/L. The highest low flow chloride concentration of 599.0 was recorded at this site in March, 2010.

Median event flows of chloride were generally lower throughout the watershed as it tends to be diluted at period of elevated flow. Concentrations ranged from 15.9 at Station 11 to 43.1 at Station 2. However, Bushs Run experienced three instances of elevated chloride concentrations of 436.6 mg/L, 485.5 mg/L, and 260.9 mg/L, in February, 2010, February, 2011, and March, 2011, respectively, and a median event chloride concentration of 178.8 mg/L.

Total Suspended Solids

Median low flow TSS values ranged from a low of 1.6 mg/L at Station 1 to a high of 13.4 mg/L at Station 11. Stations 9, 10, and 11 each had the highest median low flow TSS values at 6.2 mg/L, 7.3 mg/L, and 13.4 mg/L, respectively. The elevated TSS values at each of these three sampling stations can be attributed to their locations in, or draining, agricultural headwater ditches.

During event flows, median TSS values ranged from a low of 8.0 mg/L to 23.2 mg/L. During event flows, median TSS values were lowest in the agricultural headwaters (Stations 9, 10, and 11) and highest at Stations 2, 4, and 7 with values of 23.6, 20.0, and 23.2, respectively. Station 6 had the widest range of event flow median TSS values and, in addition to Stations 2, 3, and 4, had a 75th percentile TSS value exceeding the benchmark criteria value of 80mg/L (Waters, 1995) for protection of aquatic life. All sites, excluding Stations 5 and 11, had at least one outlying instance during which the benchmark criteria value of 80 mg/L was breached during an event flow.

E. coli

Median low flow *E. coli* concentrations ranged from 83 cfu to 387 cfu with the exception of Station 9 which was associated with a much higher concentration of 1733 cfu. Although median low flow values are not equivalent to the standards for measurement for determination of *E. coli* impairment, they provide a measure of long-term low flow *E. coli* concentrations in Eagle Creek Watershed streams. Stations 5, 9, and 10 each had the highest mean low flow concentrations of 387 cfu, 1733 cfu, and 345 cfu, respectively, thereby exceeding the *E. coli* standards of 235 cfu, while Stations 1 and 8, with concentrations of 225 cfu and 231 cfu, respectively, fell just below the quality standard. Sites 1, 3, 5, 9, and 10 each had 75th percentile values in excess of 500 cfu and showed the largest range of low flow values. All stations, excluding Stations 7 and 8, experienced at least one instance of a low flow concentration greater than the quantifiable limit for *E. coli* of 2420 cfu.

Median event flow *E. coli* concentrations where found to be greatly elevated relative those samples collected at reduced flows. Median event flow concentrations ranged from 387 cfu at Station 11 to 1733 cfu occurring at both Stations 3 and 8. All sites had median event concentrations well above the 235 cfu benchmark. Additionally, Stations 3, 5, 7, 8, and 9 each had median event *E. coli* concentrations that exceeded 1000 cfu. All stations, excluding Station 1, experienced at least one instance of an event flow concentration greater than the measurable limit for *E. coli* of 2420 cfu.

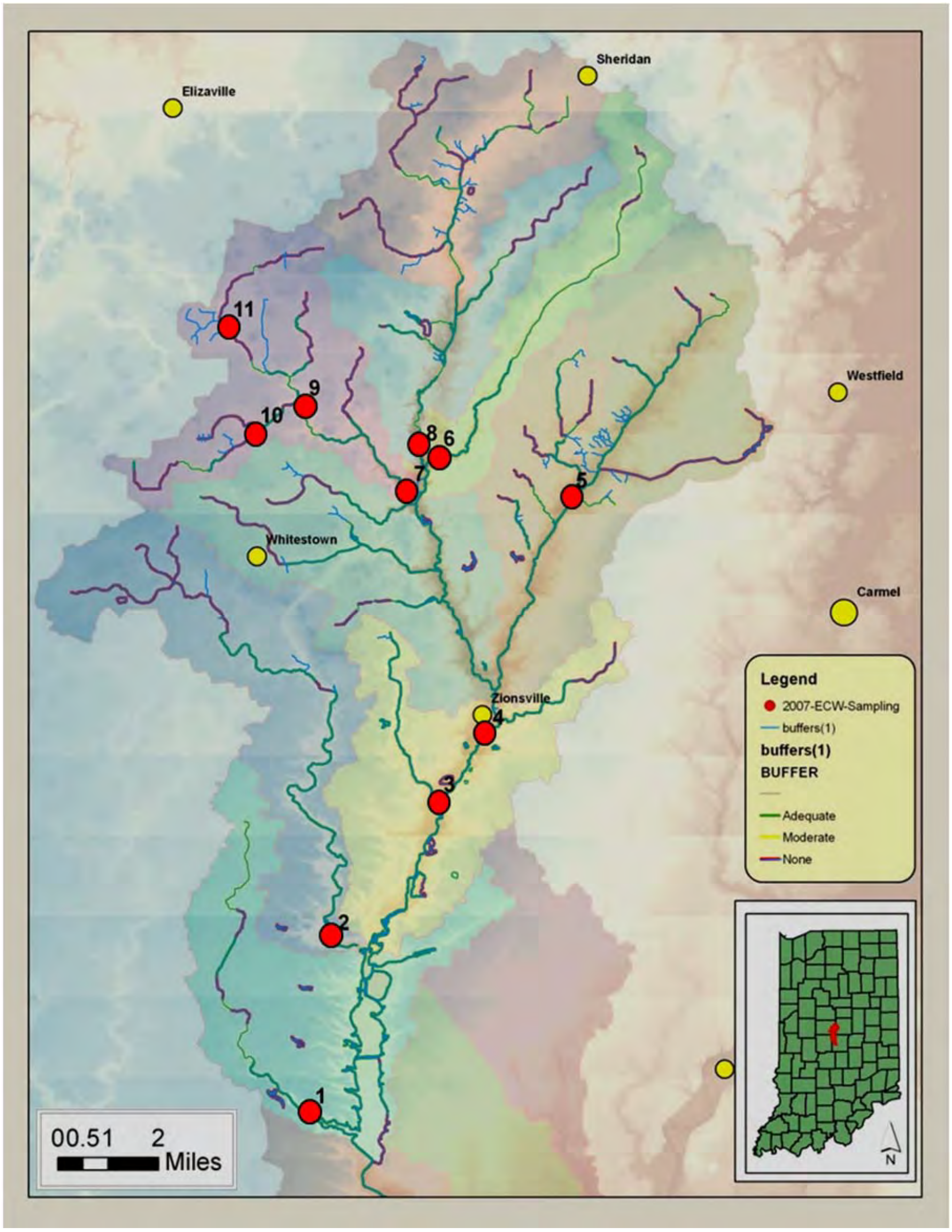


Figure 2: Location map of Eagle Creek Watershed monitoring stations (red circles). The USGS gage on Eagle Creek at Zionsville Road, where discharge measurements are taken, is located at Station 4.

<u>Atrazine</u>

Eagle Creek Reservoir has a designated use as a drinking water resource. As a result, subwatersheds have been characterized for atrazine and benchmarked against the number of times they exceeded the US Environmental Protection Agency's Primary Drinking Water Standard Regulations of 3 ppb. The Eagle Creek Watershed Alliance (ECWA) uses 3 ppb as a benchmark to indicate the level of treatment that might be required by the drinking water treatment systems and not as a measure of raw water stream compliance. The US EPA also has guidelines for aquatic life defined as 17.5 ppb for the Chronic Aquatic Community Life Guideline and 37 ppb as the Acute Toxicity for Vascular Plants (USEPA-OPP).

Documenting atrazine levels in Eagle Creek Watershed streams is very difficult. Atrazine concentrations in streams and reservoir are controlled by delivery and transport patterns. CIWRP research has shown that atrazine is transported to streams during high flow events utilizing both overland flow and tile drainage as pathways. However, high loadings of atrazine occur seasonally and are strongest during the spring thereby corresponding with the period of application by producers. Highest concentrations are found in the reservoir annually between May and July. Long-term data sets collected by CIWRP show a high degree of variability in stream and reservoir concentrations of atrazine that reflect complex relationships between the timing and intensity of rainfall events relative to the timing of application. As a result, efforts to characterize streams in the Eagle Creek Watershed for atrazine and/or changes in atrazine are difficult and the monitoring datasets are not sufficient to identify if there have been changes in atrazine loads in the watershed based on water quality measures.

Median low flow concentrations for atrazine across the eleven stations ranged from 0.06 ppb to 0.29 ppb, all below the 3 ppb benchmark. This is not unexpected given the nature of atrazine to be transported during event flows. However, during the three years of study, Stations 1, 2, 6, 7, 8, 9, 10, and 11 each had at least one instance of atrazine concentrations exceeding 3 ppb ranging from 3.4 ppb at Station 6 to 25.0 ppb at Station 2. It should be noted that all instances at all stations, excluding Stations 1 and 11, where low flow atrazine concentrations exceeded 3.0 ppb, occurred on a single sampling date in May, 2010. On this date, while flows did fall below the 80th percentile and was not considered at storm as it has been defined for the purposes of this report, the sampling did occur on the rising limb of what would become a small event and in fact breech the 80th percentile flow value soon after (Figure 3).

Due to the seasonal nature and difficulty capturing atrazine pulses in streams, median event flow concentrations across the three year study period were very similar to those of the low flow samples and ranged from 0.07 ppb to 0.25 ppb. Again, many of the stations experienced concentrations greater than 3 ppb and all of these points can be attributed to a single event occurring in June, 2011. Stations 3, 4, 5, 7, 8, and 9 had concentrations ranging from 3.0 ppb at Station 5 to 16.4 ppb at Station 7 (Figure 4).

These maps of atrazine concentrations highlight the difficult nature of capturing significant pulses of atrazine in streams due to the wide variability spatially across the landscape, temporally as a factor of seasonality and application, and as a result of its complex transport patterns, even during instances of lower flows. However, the elevated concentrations measured throughout the Mounts Run subwatershed (Stations 7, 9, 10, and 11), the Upper Eagle Creek subwatershed (Station 8), and the Fishback Creek subwatershed (Station 2) are cause for concern. The other elevated concentrations reflect diluted, but elevated, concentrations downstream transported from the source areas. These data document the importance of targeted BMP implementation for atrazine management in the Mounts Run subwatershed and Fishback Creek subwatershed. A significant challenge to implementation for BMPs for atrazine lies in the compounds tendency to be transported both via overland and tile flow. Unfortunately, watershed managers have a reduced number of BMP options available that are effective at managing dissolved loads sourced from tile drains.

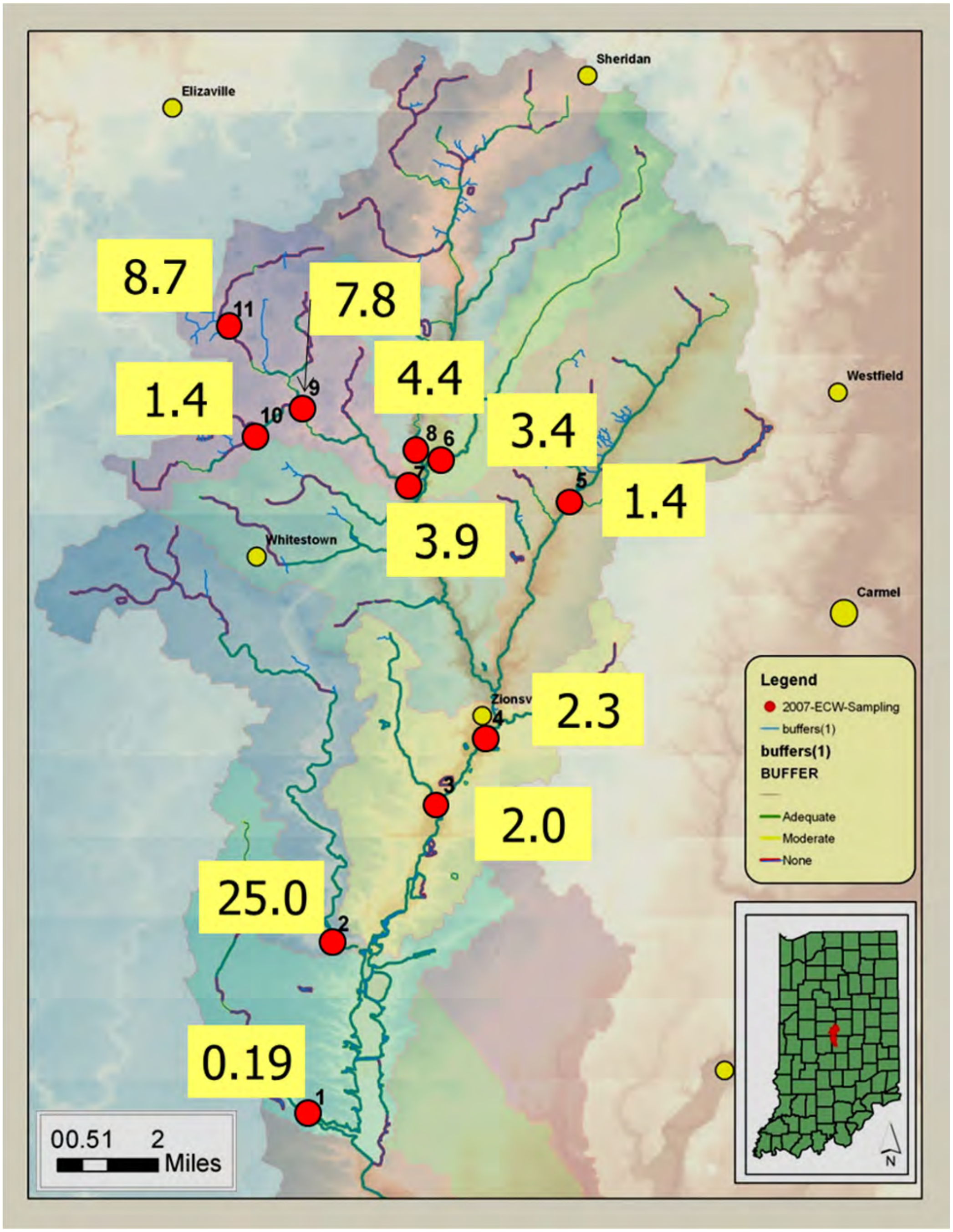


Figure 3: Atrazine concentrations in Eagle Creek Watershed occurring on the rising limb of a small event in May, 2010. Concentrations are listed as ppb. Six of the eleven sites exceed the US EPA Primary Drinking Water Standard of 3 ppb and one station (Station 2 at Fishback Creek) exceeded the US EPA Chronic Aquatic Community Guideline of 17.5.

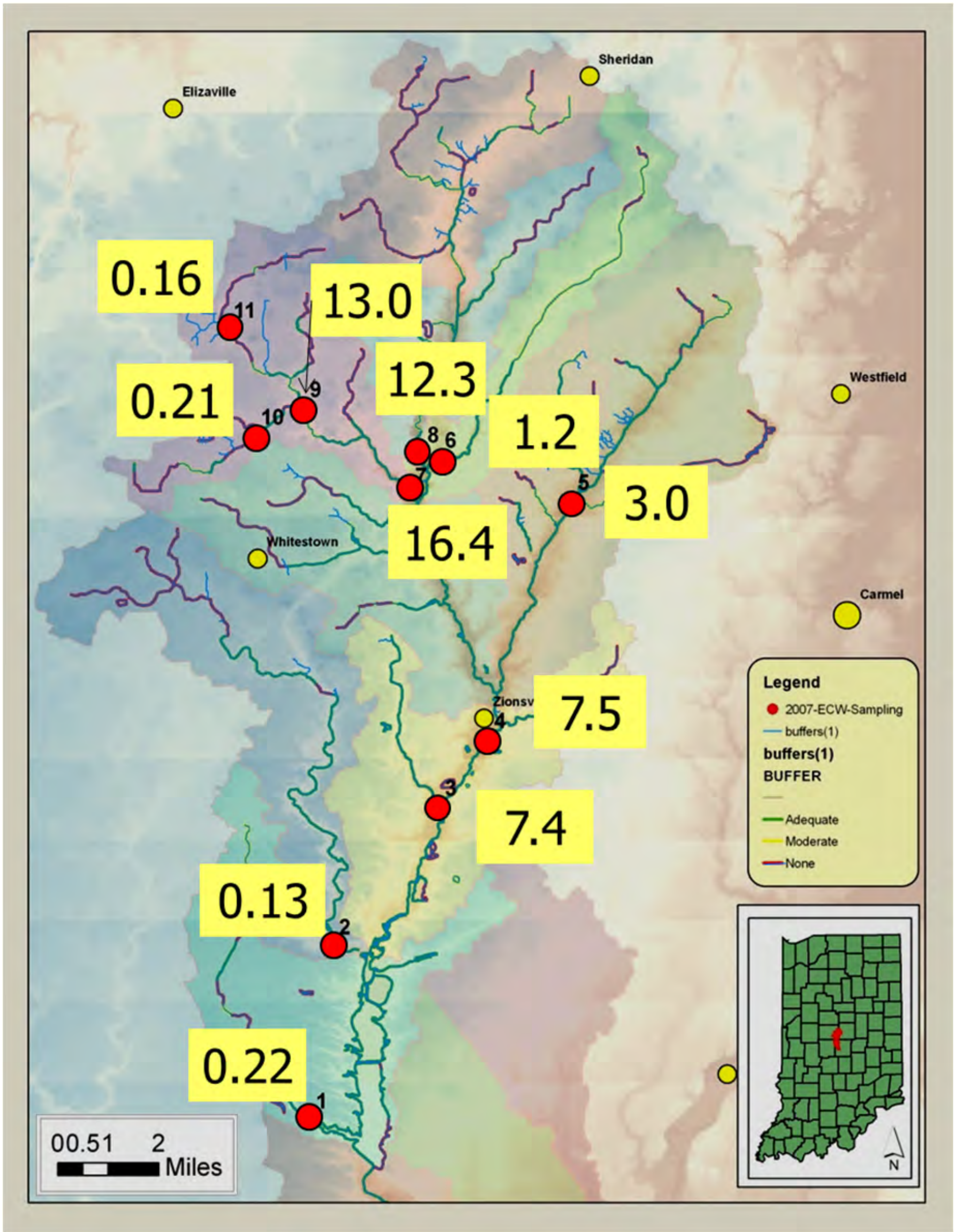


Figure 4: Atrazine concentrations in Eagle Creek Watershed in June, 2011. Notice the clustering of the highest concentrations near Stations 7, 8, and 9 and diluted, but elevated, concentrations downstream at Stations 3 and 4 on Eagle Creek transported from the source areas. Additionally, Fishback Creek which was associated with a very high concentration in May, 2010 has minimal detection of atrazine.

Nutrients

Nutrients are an important component of the watershed management plan for the Eagle Creek Watershed because of Eagle Creek Reservoir, among other reasons. Eagle Creek Reservoir has a designated use as a drinking water supply and is listed on the state 303(d) list as impaired for taste and odor compounds and algae. The occurrence of algae and the taste and odor compounds they produce are symptomatic of nutrient enrichment and analysis of reservoir nutrients, chlorophyll *a*, and water clarity results in Eagle Creek Reservoir being classified as a eutrophic system.

Total Nitrogen and Nitrate

Nitrogen is an essential nutrient for plant growth and both total nitrogen and nitrate are important monitoring parameters. Total nitrogen includes both inorganic and organic forms of nitrogen and may be particulate or dissolved. Nitrate is the primary form of inorganic dissolved nitrogen. The other form of inorganic nitrogen, nitrate, is rarely found above detection limits in surface waters. Organic forms of nitrogen are measured as total Kjeldahl nitrogen (TKN). TKN is the sum of organic nitrogen, ammonia (NH_3) and ammonium (NH_4^+), as well as a suite of humic and fluvic acids resulting from the breakdown of organic forms of nitrogen, especially plants. In the 319 monitoring program, total nitrogen is represented by the sum of nitrate, nitrite, and TKN and therefore provides a complete accounting for both organic and inorganic nitrogen in watershed systems.

Nitrate

Nitrate is widely known to be especially sourced from agricultural land use, especially row crop agriculture. It has also been shown by CIWRP researchers that the highest nitrate loads are associated with event flows and tile drainage (Wagner et al., 2008). There are several benchmarks for nitrate that the ECWA utilizes when evaluating nitrate loads in Eagle Creek Watershed. These include the IAC and Drinking Waters Standard of 10 mg/L, the US EPA Nutrient Criteria (2000) for ecoregion 55b that includes the Eagle Creek Watershed of 1.6 mg/L, and the average value of stream nitrate for watersheds that are 50-75% agriculture of 2.75 mg/L (Omernik, 1977). Note the EPA nutrient a criterion is defined as the sum of nitrate and nitrite. However, the ECWA is benchmarking against that value for nitrate as a gross majority of samples have nitrite concentration below the analytical detection limit of 0.04 mg/L and all sites for both low flows and event flows have median concentrations of less than the analytical detection limit of 0.04 mg/L.

Median low flow concentrations across the three year study period ranged from 0.20 mg/L at Station 2 to 3.44 mg/L at Station 3. Stations 3 and 5 had the highest median low flow concentrations of nitrate at 3.44 and 2.55 mg/L, respectively. This can likely be attributed to their placement downstream of wastewater treatment facilities. In addition to nitrate concentrations generally being elevated at Stations 3 and 5 relative to other sampling locations, during the summer months, loosely July-October, when flows are reduced in streams within the Eagle Creek Watershed, nitrate levels generally dropped at all stations except 3 and 5. While flows, and relative loads, were still lower during the summer months, the constant supply of effluent from upstream wastewater treatment facilities allowed for elevated concentrations of nitrate to persist throughout the summer months while concentrations were greatly reduced at all other stations thereby accounting for a higher median concentration over the study period as a whole. Median low flow concentrations of nitrate at Stations 10 and 11 also exceeded the US EPA Nutrient Criteria for the ecoregion of 1.6 mg/L with values of 2.11 and 1.71 mg/L, respectively. The agricultural nature of the headwaters of Station 1 and Station 8 accounted for slightly less elevated concentrations of 1.46 and 1.45 mg/L, respectively. Stations 1, 3, 5, 7, 8, 9, 10, and 11 each experienced at least one instance of median low flow nitrate concentration in the range of 6 mg/L to 10 mg/L with the highest measured low flow value occurring at Station 8 in September, 2011 with a concentration of 11.23 mg/L thereby exceeding the IAC and Drinking Waters Standard of 10 mg/L.

Median event flow concentration of nitrate were elevated relative to low flow samples and ranged from 2.01 mg/L at Station 2 to 5.30 mg/L at Station 9 indicating median event concentrations at all subwatershed stations exceeded the US EPA Nutrient Criteria of 1.6 mg/L. The highest median event flow concentrations of nitrate were found in the agricultural headwaters of Mounts Run (Stations 7, 9, 10, and 11) and the main trunk of Eagle Creek (Station 8) and generally decreased in downstream subwatersheds thereby highlighting the highly agricultural nature of the nitrate sourcing in Eagle Creek Watershed. The agricultural nature of the headwaters of Station 1 again caused it to stand out with a median event flow value of 3.30 mg/L and a 75th percentile value of close to 5mg/L. The highest measured event flow concentration of 7.37 mg/L was collected in Feb, 2011 at Station 11.

Total Nitrogen

Total nitrogen patterns are also indicative of the high levels of nutrient loading into the streams of Eagle Creek Watershed. The US EPA criterion (2000) for total nitrogen is 2.0 mg/L for nutrient ecoregion 55b where the Eagle Creek Watershed is located. Another important benchmark for comparison is the boundary between mesotrophic and eutrophic streams. For total nitrogen, this boundary is 1.5 mg/L (Dodd et al., 1998). The ECWA is particularly interested in benchmarks that are indicative of biological breakpoints due to the Alliance's long term goal of reducing the trophic status of Eagle Creek Watershed in an effort to reduce algal blooms. Finally, the national average total nitrogen concentration for agricultural watersheds with between 50% and 75% agricultural land use is 2.75 mg/L (Omernik, 1977). Total nitrogen is an important component of the nutrient balance of the reservoir.

Total nitrogen patterns across the watershed matched closely with those of nitrate. Given that nitrite concentrations are not a contributor to total nitrogen, those differences in concentrations between total nitrogen and nitrate that are present in that data can be attributed to organic nitrogen as measured by TKN. Median low flow concentration s of total nitrogen ranged from 0.86 mg/L at Station 2 to 4.69 mg/L at Station 3. Stations 3 and 5 had the highest low flow concentrations at 4.69 mg/L and 3.25 mg/L which can be attributed to their location downstream of wastewater treatment facilities. In addition to Stations 3 and 5, Stations 1, 6, 9, 10, and 11 also had low flow median concentrations in excess of the US EPA criterion of 2.0 mg/L.

One interesting finding relating to TKN values in the Eagle Creek Watershed was the seasonality and spatial distribution of elevated ammonia/ammonium concentrations. Detectable levels of ammonia/ammonium in streams are often difficult to capture and, in fact, all median low flow ammonia/ammonium concentrations were below detection at all stations except one, Station 6 (Finley Creek), where the median low flow concentration was 0.27 mg/L. However, Stations 1, 3, 6, 9, 10, and 11 had at least one concentration exceeding 0.5 mg/L over the three year study period. Stations 6 and 9 had the highest single instances of ammonia/ammonium concentrations reaching 3.01 mg/L and 2.29 mg/L, respectively, in September, 2012. At Stations 6 and 9, a seasonal pattern of elevated ammonia/ammonium concentrations appears to exist loosely beginning in July and persisting through December. These patterns may be the result of seasonal shifts in concentrations of organic carbon (see "Dissolved Organic Carbon") at these sites as a factor of surrounding land practice or simply decreased flows during the summer months as ammonia/ammonium are byproducts of aerobic microbial decomposition of organic matter, including plant material, deceased organisms, and animal waste, generally occurring in soils from where the compounds are subsequently transported to nearby surface waters.

Again, like nitrate, median event flow concentrations of total nitrogen were elevated relative to low flow samples and ranged from 3.02 mg/L at Station 5 to 6.09 mg/L at Station 11 indicating median event concentrations at all subwatershed stations exceeded the US EPA Nutrient Criteria of 2.0 mg/L. The highest median event flow concentrations of nitrate were found in the agricultural headwaters of Mounts Run (Stations 7, 9, 10, and 11) and the main trunk of Eagle Creek (Station 8) and generally decreased in downstream subwatersheds highlighting the highly agricultural nature of the nitrate sourcing in Eagle Creek Watershed. The agricultural nature of the headwaters of Station 1 again caused it to stand out with a median event flow value of 5.01 mg/L. The highest event flow concentration of 8.24 mg/L was collected in April, 2011 at Station 11.

Phosphorus as Total Phosphorus

Total phosphorus was monitored due to its importance as an essential nutrient for plant growth. Excessive phosphorus is problematic for both streams and the Eagle Creek Reservoir where nuisance algal blooms have led to recreational usage advisories as well as ongoing taste and odor issues for the drinking water supply. There are three benchmarks that were utilized for comparative purposes. The US EPA nutrient criterion for nutrient ecoregion 55b is 0.0625 mg/L (2000). The mesotrophic/eutrophic boundary for streams is 0.07 mg/L (Dodd et al., 1998). The national average for total phosphorus concentration for watersheds with 50% to 75% agricultural land use is 0.125 mg/L (Omernik, 1977).

Median low flow concentrations of total phosphorus ranged from 0.0455 mg/L at Station 1 to 0.200 mg/L at Station 5. Of the eleven sampling stations, nine were characterized by median total phosphorus concentrations exceeding the reference condition for eutrophic streams. Only Stations 1 and 2 did not exceed the 0.7 mg/L threshold. Stations 3, 5, and 11 had the highest values at 0.154, 0.200, and 0.180, respectively and illustrate the contributions from both wastewater treatment facilities (Stations 3 and 5) as well as from agricultural land use (Station 11).

Like total nitrogen and nitrate, total phosphorus concentrations are highest during event flows. Interestingly, the range of median event concentrations of total phosphorus narrowed dramatically relative to those of low flow conditions. Median event concentrations ranged from 0.15 mg/L at Station 2 to 0.24 mg/L at Station 11 indicating median event concentrations at all subwatershed stations were at least double the reference condition for eutrophic streams of 0.7 mg/L. One particular event occurring in April, 2011 highlights the severity of the nutrient loading of phosphorus into the Eagle Creek Watershed (Figure 5).

Dissolved Organic Carbon

The presence of organic carbon in streams may refer to any decomposed plant matter, fungal and microbial biomass, and/or metabolites that may exist, whether dissolved or bound to sediments. Due to the fact that the dissolved forms of organic carbon (DOC) are more easily accessible to biological uptake, it is this fraction that is generally measured as an indication of water quality. When introduced to surface waters, DOC has been shown to influence heterotrophic productivity and respiration in streams thereby influencing the rates of carbon cycling (Dalzell et al., 2005).

Median low flow concentrations of DOC ranged from 3.25 mg/L at Station 1 to 6.17 mg/L at Station 9. Highest concentrations occurred at Stations 6 and 9 with concentrations of 5.31 mg/L and 6.17 mg/L, respectively. Stations 6, 9, 10, and 11 each had at least one instance of low flow median DOC concentration greater than 15 mg/L with the highest recorded concentration of 26.84 mg/L occurring at Station 9 in December, 2010. At Stations 6 and 9, where median low flow DOC concentrations were highest, a seasonal pattern of elevated DOC concentrations appears to exist loosely beginning in July and persisting through December. These elevated DOC concentrations at these sites may be the result of seasonal shifts in concentrations as a factor of surrounding land practice or simply decreased flows during the summer months. Regardless, these hotspots of elevated concentrations of organic matter may be contributing to increased concentrations of ammonia/ammonium as they are byproducts of aerobic microbial decomposition of organic matter, including plant material, deceased organisms, and animal waste, generally occurring in soils where the compounds are then subsequently transported to nearby surface waters (see "Total Nitrogen).

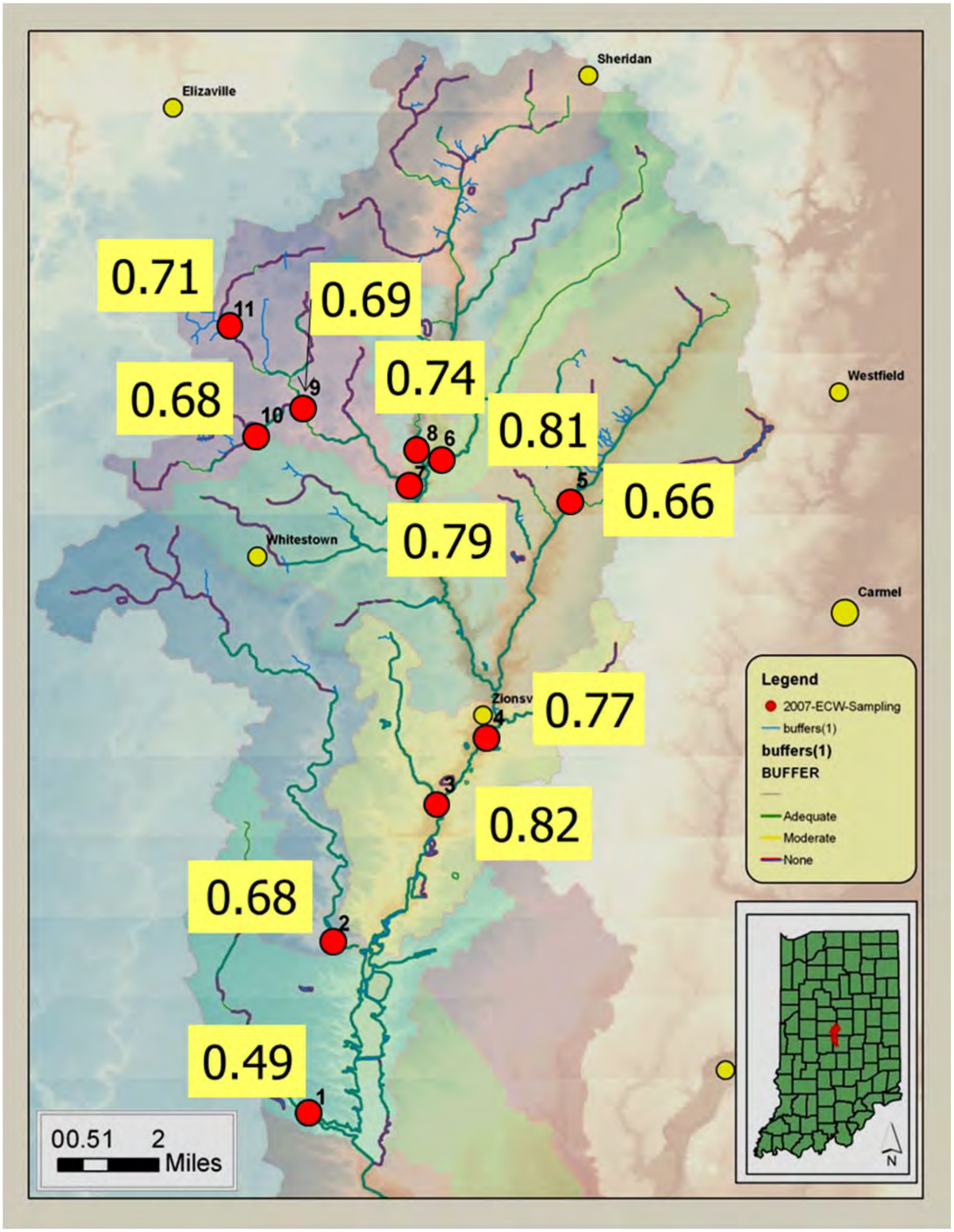


Figure 5: Event flow total phosphorus concentrations in Eagle Creek Watershed in April, 2011. Note all stations are associated with concentrations 7-13 times the US EPA nutrient criterion for ecoregion 55b, where Eagle Creek Watershed is located, of 0.0625 mg/L and 7-11 times the Eagle Creek Watershed Alliances' benchmark to assess stream eutrophication of 0.07 mg/L.

4.2 Water quality improvements

Direct water quality improvements as a result of BMP implementation include: 22,957 tons/yr of sediment inputs reduced, 28,925 lbs/yr of phosphorus inputs reduced, and 57,813 lbs/yr of nitrogen inputs reduced. The load reduction estimations were calculated as a part of the requirements for submission for payment for implemented practices. Load reductions for those participating in cover crop plantings over multiple years have been averaged in order to take into consideration the same acres that were planted over multiple years.

While the Eagle Creek Watershed Alliance has the benefit of an intensive monitoring program for water quality, monthly sampling does not provide a sufficient number of samples to show change in water quality. Statistical analyses are difficult. Using best fit statistical analyses shows that the 319 monitoring data for Eagle Creek Watershed has a lognormal probability distribution. The small sample size available from the monitoring data is particularly problematic for data with this type of distribution. Comparison of median values provides some information about the distribution of hotspots that can help focus best management practices and future research, but is not suitable for assessing change in water quality at either the station level or an annual level. As a result, those types of comparisons have not been made.

4.3 Effectiveness of education and outreach

Education of the mass public is hard to quantify, but the ECWA has seen noteworthy signs of improvement in education and awareness. Some of these include:

- Requests for presentations to homeowner associations and other groups
- Follow-up requests for additional information and recommendations related to stormwater management
- Requests for watershed brochures from partner organizations and local government staff for inclusion in their events
- Inclusion of ECWA data and messages into agricultural field days and tours
- Increasing urban exposure and participation at events like the New Augusta Public Academy South 'Go Green Night', Zionsville Fall Festival, and Z'GreenFest
- Requests for additional watershed signage for Zionsville Parks
- Increased circulation and subscription to the ECWA newsletter
- ECWA is increasingly viewed as a go-to resource for water quality data and concerns (Young Farmers requested our help for June 2012 tour, Town of Zionsville requested technical review of their rain garden sign)
- Widespread use of BMP graphics by different organizations
- Mention in the Hoosier Heartland RC&D newsletter, No-Till Farmer magazine, and Hoosier Ag Today
- Regional Watershed Stewardship Award Winner in the category of *Outstanding Innovation in Policy or Program* for reusable, easy-to-understand BMP graphics.

4.4 Public involvement and partnerships

ECWA has formed many partnerships in the past, and its reputation for being a solid resource for water quality issues continues to grow. Partnerships with IUPUI-CEES, Veolia, the Natural Resources Education Center, and IndyParks allowed for seamless workshop coordination. Partnerships with the Town of Zionsville and the local Soil and Water Conservation Districts have aided in getting our message out widely and effectively. A new partnership with Citizen Energy Group also evolved quickly when Indianapolis's Water Assets were transferred from Veolia.

Public involvement continues as a mainstay of ECWA efforts. Workshop attendees and cost-share participants continue to be engaged, and representation at Z'GreenFest and the Zionsville Fall Festival would not have been possible without the volunteer time of several interested citizens. The diversity of committee participants speaks to the depth of public involvement and partnerships. Multiple state, local, and federal agency partners participate regularly, as well as members of business, industry, environmental non-profits, and the general public.

4.5 Fulfillment of Expected Outcomes (from original grant application)

4.5.1 Outcomes

Project outcomes for this grant included implementation of BMPs to improve water quality (reduce sediment and nutrients), increased public knowledge about water quality pollutants and components of technical solutions (BMPs), approval and installation of low-impact development (LID) principles in new residential and commercial developments and retrofitting of older developments with LID practices, and improved knowledge of spatial and temporal distribution and concentration of key pollutants throughout the watershed and their trends.

Thanks to the strong outreach of our agricultural liaison and the urban outreach by our watershed coordinator, we were able to install many BMPs to improve water quality. A summary of these BMPs is listed above in Table 1. The Alliance was also successful in increasing public knowledge through the newsletter, workshops, and other educational events. Pre- and post-test results were very encouraging and are available for review in Appendix A. Efforts were made to meet and discuss LID principles with several proposed developments; however, no cost-share projects resulted from these meetings. Collaborative monitoring and sampling has provided the continuation of long-term data sets. BMP effectiveness and water quality impact remains unclear. Future monitoring is needed to understand the actual impact of the BMP effectiveness.

4.5.2 Measures of Success

Measures of Success stated in the original grant included indicators in three categories: Environmental, Administrative, and Social. Overall it was expected that several thousand individuals would be impacted by education programs annually. This expectation has been met. When rough numbers are totaled regarding attendees at our workshops and tours, public attendance at meetings and professional presentations, newsletter recipients, brochure recipients (watershed and septic) and those reached via newspaper coverage, the measure has been met.

Environmental: The environmental success measure was to be evaluated by monitoring water quality improvement at key locations along streams and subwatershed locations. Load reduction and monitoring results are summarized in above sections. The monitoring of the changes in land-use (e.g. implementation of BMPs) outlined in the grant can be measured by the number of acres and numbers of landowners involved in cost-share projects. Fifteen individual landowners across 3 different counties and 10,255 acres of land are now enrolled in long-term conservation practices.

Administrative: Data related to the numbers of material distributed, website activity, and students or others participating in ECWA events was also set as a measure of success. Although participation at all ECWA events has not been enumerated due in part to the format of some of the events, we know that our message and organization have been exposed to thousands of individuals through workshops, festivals, newsletter articles, and other opportunities. In addition, thousands of watershed brochures, Clear Choices Clean Water postcards, and septic care and maintenance brochures were distributed at various events.

Social: Survey tools employed at our workshops showed notable improvement in the public's understanding of pollution, watershed concepts, and their role in making a difference for water quality upon completion of each workshop (Appendix A).

4.6 Watershed Management Plan Implementation and Goals

Through the efforts of the cost-share program and its associated BMP implementation, pollutant loads were reduced in several areas of the watershed. Progress is being made toward meeting the WMP goals as outlined in Appendix E of the Watershed Management Plan. According to Appendix E, the sediment mean (tons/yr) is 26,000 and the target mean is 18,628. Based on the load reduction calculations, the first round of ECWA BMP implementation (Phase I) reduced the sediment mean by 5,266, or down to 20,734 tons/yr which is a 20.3% reduction. The target is a 28.4% reduction, thus requiring additional work to achieve the remaining 8.1% reduction. Load calculations from the current round of implementation (Phase II) reduced the sediment mean by

22,937 tons/yr (Table 2) or down to 3,063 tons/yr. The target 28.4% reduction and target sediment mean of 18,628 tons/yr have been met with the BMPs implemented in Phase II.

Again, according to the WMP, the phosphorus mean (lbs/yr) is 120,000 and the target was set at 50,000 lbs/yr or a 58% reduction. Based on the load reduction calculations, ECWA BMPs that were implemented as part of Phase I reduced the phosphorus mean by 6,974, or down to 113,026 which is a 5.8% reduction. Based on the load reduction calculations, ECWA BMPs that were implemented as part of Phase II reduced the mean by 28,925 lbs/yr (Table 2), or down to 91,075 which is a 24.1% reduction. Combined load reductions from Phase I and Phase II have reduced the phosphorus mean by 35,899 lbs/yr down to 84,101 lbs/yr. This is an overall reduction of 29.9%. The target is a 58% reduction, so additional phosphorus abatement BMPs are needed to achieve the additional necessary 28.1% reduction.

Similarly, the nitrogen mean (lbs/yr) is 1,780,000 and the target is 1,136,000 lbs/yr or a 36% reduction. According to the load reduction calculations, ECWA BMPs that were implemented as part of Phase I reduced the nitrogen mean by 14,830, or down to 1,765,170 which is a 0.8% reduction. Load reduction calculations show that ECWA BMPs that were implemented as part of Phase II reduced the mean by 57,813 lbs/yr (Table 2), or down to 1,722,187 which is a 3.2% reduction. The combined load reductions from Phase I and Phase II have reduced the nitrogen mean by 72,643 lbs/yr down to 1,707,357 lbs/yr. This is an overall reduction of 4%, leaving another necessary 32% reduction in order to meet the target 36% reduction.

Note that load reductions for those participating in cover crop plantings over multiple years have been averaged (Table 2) in order to take into consideration the same acres that were planted over multiple years. The averaged reductions were used in calculation the pollutant load goals. Table 3 lists the load reductions for cover crops on an annual basis.

Table 2: Load Reductions - Averaged Cover Crop Reductions

Practice	Description	Subwatershed	Acreage	**Soil Reduction (tons/yr)**	**Total P Reduction (lbs/yr)**	**Total N Reduction (lbs/yr)**
Cragun Cover Crop Average	Cover Crop (2010-2012)	Fishback Creek	58.1	**269.3**	**307.6**	**615.2**
Cragun Tillage Equipment Modifications	No-Till Equipment Modifications	Fishback Creek, Mounts Run	483.3	**1,731.4**	**2,324.7**	**4,644.5**
Goulsouliak	Exclusion Fencing, Pipeline, Alternative Watering Source	Eagle Creek Reservoir	0.09	**46.8**	**46.8**	**93.6**
Green Cover Crop	Cover Crop	Jackson Run	40	**195.4**	**228.8**	**458.0**
Lyon Tillage Equipment Modifications	No-Till Equipment Modifications	Dixon Branch	420.7	**1,507.1**	**2,023.6**	**4,042.9**
Maloney Cover Crop Average	Cover Crop (2010, 2012)	Eagle Creek Reservoir	527.5	**2,118.9**	**2,505.9**	**5,001.8**

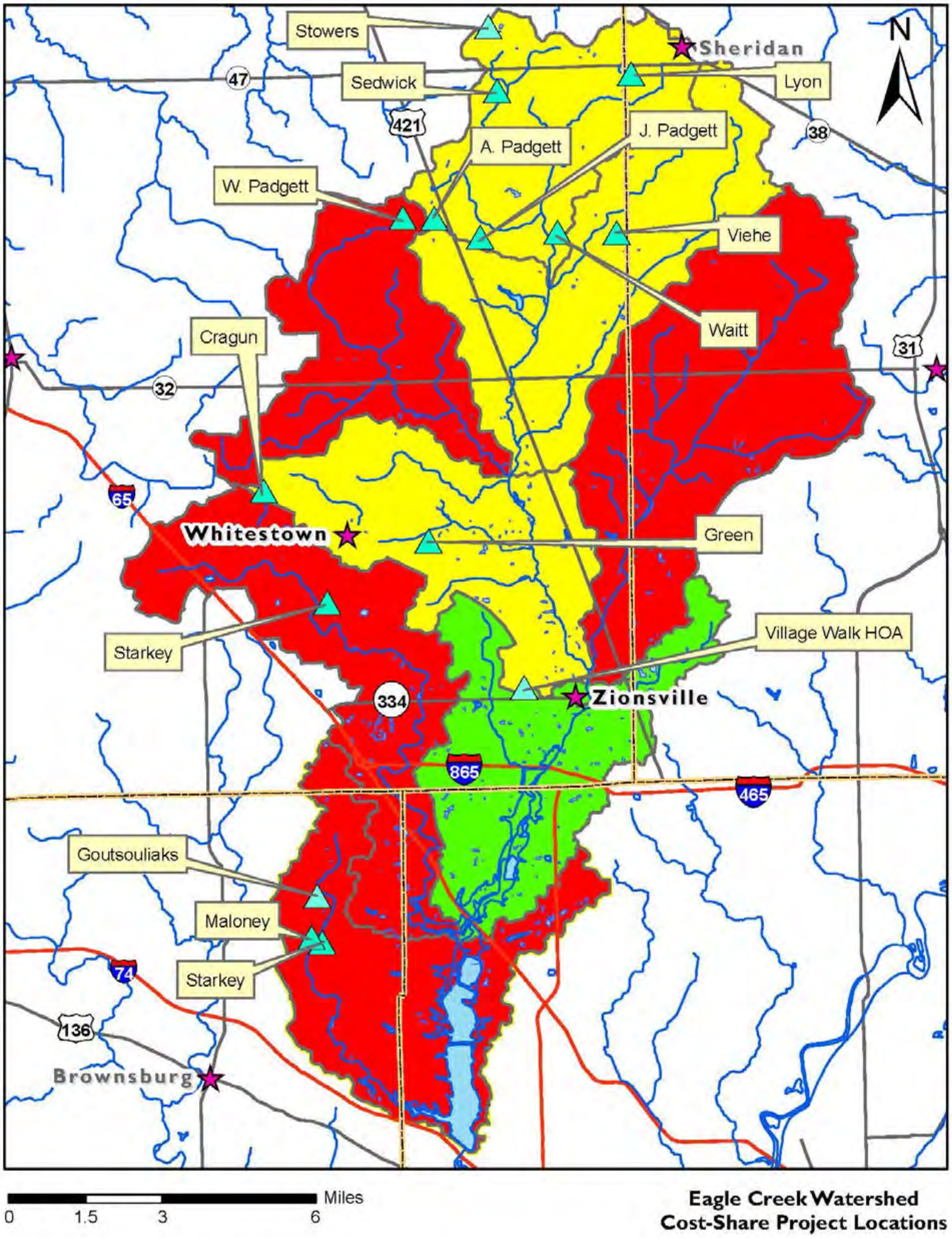
Padgett, A. Tillage Equipment Modification	Conversion to No-Till	Dixon Branch, Finley Creek, & Mounts Run	307	**1,149.8**	**1,476.7**	**2,950.3**
Padgett, J. Tillage Equipment Modifications	Conversion to No-Till	Dixon Branch & Finley Creek	503.9	**1,764.2**	**2,423.8**	**4,842.5**
Padgett, J. Cover Crop Average	Cover Crop (2010-2012)	Dixon Branch & Finley Creek	470.1	**1,673.8**	**2,261.2**	**4,517.7**
Padgett, W. Tillage Equipment Modification	Conversion to No-Till	Dixon Branch & Mounts Run	391.2	**1,433.3**	**1,881.7**	**3,759.4**
Sedwick Tillage Equipment Modification	Conversion to No-Till	Dixon Branch	905.7	**2,949.7**	**3,450.7**	**6,901.4**
Starkey Cover Crop Average	Cover Crop (2010-2012)	Eagle Creek Reservoir, Fishback Creek, & Mounts Run	1,121.27	**3,994.8**	**5,160.0**	**10,319.7**
Stowers Tillage Equipment Modifications	No-Till Equipment Modifications	Dixon Branch, Finley Creek	831.9	**2,777.1**	**3,169.5**	**6,339.1**
Viehe Cover Crop Average	Cover Crop (2010, 2011)	Finley Creek	273.5	**1,046.6**	**1,315.5**	**2,628.3**
Village Walk HOA	Naturalize Retention Pond	Jackson Run	0.48	**4.0**	**4.0**	**8.0**
Waitt Cover Crop	Cover Crop	Dixon Branch	60.3	**274.9**	**344.9**	**690.4**
TOTALS			6,395.04	**22,937.1**	**28,925.3**	**57,812.8**

Table 3: Load Reductions – Yearly Cover Crop Reductions

Practice	Description	Subwatershed	Acreage	**Soil Reduction (tons/yr)**	**Total P Reduction (lbs/yr)**	**Total N Reduction (lbs/yr)**
Cragun Cover Crop (2010)	Cover Crop	Fishback Creek	42	**201.8**	**240.2**	**480.9**
Cragun Cover Crop (2011)	Cover Crop	Fishback Creek	79	**358.8**	**377.6**	**754.5**
Cragun Tillage Equipment Modifications (2011)	No-Till Equipment Modifications	Fishback Creek, Mounts Run	483.3	**1,731.4**	**2,324.7**	**4,644.5**
Cragun Cover Crop (2012)	Cover Crop	Fishback Creek	53.3	**247.4**	**304.9**	**610.3**
Goulsouliak	Exclusion Fencing, Pipeline, Alternative Watering Source	Eagle Creek Reservoir	0.09	**46.8**	**46.8**	**93.6**
Green Cover Crop	Cover Crop	Jackson Run	40	**195.4**	**228.8**	**458.0**
Lyon Tillage Equipment Modifications	No-Till Equipment Modifications	Dixon Branch	420.7	**1,507.1**	**2,023.6**	**4,042.9**
Maloney Cover Crop (2010)	Cover Crop	Eagle Creek Reservoir	477.9	**1,946.3**	**2,270.0**	**4,540.1**
Maloney Cover Crop (2012)	Cover Crop	Eagle Creek Reservoir	577.2	**2,291.4**	**2,741.7**	**5,483.4**
Padgett, A. Tillage Equipment Modification	Conversion to No-Till	Dixon Branch, Finley Creek, & Mounts Run	307	**1,149.8**	**1,476.7**	**2,950.3**
Padgett, J. Cover Crop (2010)	Cover Crop	Dixon Branch & Finley Creek	503.9	**1,764.2**	**2,423.8**	**4,842.5**
Padgett, J. Cover Crop (2011)	Cover Crop	Dixon Branch, Finley Creek	492.1	**1,772.9**	**2,367.0**	**4,729.1**

Padgett, J. Tillage Equipment Modifications (2011)	Conversion to No-Till	Dixon Branch & Finley Creek	503.9	**1,764.2**	**2,423.8**	**4,842.5**
Padgett, J. Cover Crop (2012)	Cover Crop	Dixon Branch, Finley Creek	407.6	**1,460.2**	**1,960.6**	**3,917.0**
Padgett, W. Tillage Equipment Modification	Conversion to No-Till	Dixon Branch & Mounts Run	391.2	**1,433.3**	**1,881.7**	**3,759.4**
Sedwick Tillage Equipment Modification	Conversion to No-Till	Dixon Branch	905.7	**2,949.7**	**3,450.7**	**6,901.4**
Starkey Cover Crop (2010)	Cover Crop	Eagle Creek Reservoir, Fishback Creek, & Mounts Run	807.2	**2,793.8**	**3,336.1**	**6,671.4**
Starkey Cover Crop (2011)	Cover Crop	Eagle Creek Reservoir, Fishback Creek	1,238.7	**4,512.6**	**5,883.8**	**11,767.6**
Starkey Cover Crop (2012)	Cover Crop	Eagle Creek Reservoir, Fishback Creek	1,317.9	**4,678.0**	**6,260.0**	**11,767.6**
Stowers Tillage Equipment Modifications	No-Till Equipment Modifications	Dixon Branch, Finley Creek	831.9	**2,777.1**	**3,169.5**	**6,339.1**
Viehe Cover Crop (2010)	Cover Crop	Finley Creek	275	**1,052.4**	**1,322.8**	**2,642.8**
Viehe Cover Crop (2011)	Cover Crop	Finley Creek	272	**1,040.9**	**1,308.3**	**2,613.9**
Village Walk HOA	Naturalize Retention Pond	Jackson Run	0.48	**4.0**	**4.0**	**8.0**
Waitt Cover Crop	Cover Crop	Dixon Branch	60.3	**274.9**	**344.9**	**690.4**
TOTALS			10,495.07	**37,978.2**	**48,204.1**	**96,368.0**

Figure 6: Cost-Share Locations Map



5.0 PROJECT SUCCESSES and FAILURES/LESSONS LEARNED

5.1 Successes

One of the ECWA's greatest successes continues to be the number of people that are regularly engaged in meetings, projects, events, and presentations. Lockstep with these successes is the incredible amount of scientific data that allows the ECWA to communicate important messages and trends about water quality. The ECWA is seen by many stakeholder groups as a conservation leader and source of knowledge regarding water quality and land management solutions.

Other direct successes such as the implementation of diverse and widespread BMP projects are also a noteworthy success. Our agricultural liaison and technical committee have engaged in coordination and cooperation with different agencies, technical staff, and landowner types to ensure that beneficial projects come to fruition. Similarly, the Education Committee has reached out to multiple audiences, crafting different approaches and materials to suit each. Homeowner associations have been very receptive to our presentation, leading to an exciting urban cost-share project at Village Walk in Zionsville.

5.2 Challenges

Implementing cost-share projects in the urban areas was a definite challenge, in part because the subwatershed containing the Town of Zionsville is not a priority area, eliminating much of the urban land from cost-share eligibility. Several residents in eligible areas inquired about native plantings around their neighborhood retention ponds, but were unsuccessful in gaining homeowner association support for the project.

The ECWA was approached by the Marion County Health Department regarding water quality sampling results downstream from a dairy farm in the watershed. Reports continually showed high levels of *E. coli,* ortho phosphate, and ammonium. The Alliance agreed to be a resource to the farm and provide assistance if willing to implement best management practices. With the agreement to assist the dairy, the ECWA first had to amend the WMP as the dairy farm was not located in a critical area and therefore not eligible for cost-share funding. The ECWA took on the challenge of writing an addendum to the WMP which would allow the dairy to be a critical area. Approval of the addendum was received from IDEM on July 11, 2011. Before the addendum was approved by IDEM, Agricultural Liaison Harold Thompson and ECWA Chair John Ulmer began discussions with dairy, primarily the dairy manager, offering suggestions about best management practices. The dairy manager understood the need to change management styles and that the farm was in a highly visible location. Designs for a waste storage facility were put together as well as cost estimates. Efforts continued throughout the life of the grant to move past the design stage, but no progress could be made with the owner. The dairy switched to a water mattress system for the cows instead of straw bedding and it was at that point that a chance of getting the waste storage facility installed was over. Additional site visits were made to see if other practices could be implemented, but the owner continued to be unwilling and had no interest in remediating the problem. While remediation was not achieved, the responsiveness and adaptability of the ECWA, as well as the thorough technical assistance provided to the landowner, were certainly project successes. Conservation adoption by certain individual may always remain a challenge regardless of the knowledge and dollars brought to bear on a given situation.

The Central Indiana Water Resources Partnership (IUPUI-CEES and Veolia Water) presented a unique opportunity for additional and complimentary research to be conducted parallel to the monitoring associated with this project/grant. As a result, significant progress was made toward the understanding of various pollutant run-off trends and the likely effectiveness of certain conservation practices on the treatment of run-off events. Upon the transfer of the City of Indianapolis's water assets to Citizen's Energy Group, Veolia's involvement in the ECWA and the Central Indiana Water Resources Partnership ended. Stream monitoring associated with this project/grant was transferred to Citizens and continued as planned. Similarly, algal sampling of reservoirs also continued through Citizen's as was being done by Veolia Water. The ECWA's ability to weather this transition and be viewed by Citizen's as an important technical partners was as success for the group. However, upon conclusion of this watershed project, future stream and reservoir sampling is uncertain. This uncertainty presents a challenge to future efforts to measure changes in water quality throughout the watershed.

5.3 Lessons Learned

Similar to our previous 319 grant, it was realized during this grant period how long it takes for a cost-share project (particularly in urban areas) to move from the initial planning phase to completion. The requirement for homeowner association approval is an added step – underscoring the need for pursuing these projects early in the grant cycle. Additionally, communicating the benefits of such projects to homeowner associations is vital to having the project approved – many neighborhoods simply view the projects as added work and expenses.

One must remember that the cost-share program is a voluntary program. No matter how bad the situation and how hard one might try to fix the problem, unless the owner is willing to improve the situation it is not going to happen. A shift in larger cultural awareness is really necessary before conservation will be possible across all landowners.

The public-private partnership that previously existed between CEES and Veolia Water was very unique and somewhat dependent on key personal relationships and the share understanding of mutual benefits. Rebuilding such a unique and beneficial relationship will take time and committed personnel on both sides. When possible, if IDEM or other key agencies could help facilitate these relationships, the impact to watershed project would be enormous and incredibly positive.

6.0 FUTURE ACTIVITY

The future coordination and structure of the ECWA is uncertain. While there are a number of dedicated citizens interested in continuing the efforts of the ECWA, there is no stable funding source to continue formal, professional coordination of the Alliance's activities. To help fill this void, the ECWA is becoming more involved with the regional watershed group, the Upper White River Watershed Alliance (UWRWA). The UWRWA has a paid coordination team as well as non-profit incorporation status that helps it seek, secure and hold grants and other more stable funding sources. Because some of the key educational programming of the ECWA is linked to UWRWA effort such as Clear Choice Clean Water, the ECWA is exploring how best to utilize the resources of the UWRWA, yet remain active locally. The UWRWA is currently working on capacity building with other area reservoir watershed groups (namely Morse and Geist reservoirs), so has offered to fold ECWA efforts into their structure where possible. It is probable that the ECWA and UWRWA will work together to seek grants for continued implementation of practices in the ECW. Undoubtedly, there will be some growing pains, but also likely some efficiencies gained from this expanded partnership. The ECWA webpage will maintain its identity, but will begin being hosted by the UWRWA upon conclusion of this project/grant. The Town of Zionsville is also an active member in the UWRWA so it too can help fill in any voids in leadership and programming the ECWA may have going forward. The Town of Zionsville is committed to Eagle Creek water quality improvements, so local events and projects focused on water quality will continue.

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