Section 3 – Identify Problems

Group Concerns

The results of the Watershed Inventory and stakeholder concern analysis in Section 2 indicate that the group concerns can be described in six general areas. Table 47 lists the concerns that the group and the problem associated with each group. Some concerns are listed in several problem groups as they cover a wide variety of issues.

Table 47: Concerns and Associated Problems

Concern	Problem Category
-Encourage and improve public perception of native landscaping -Changing actions/perceptions towards fertilizer use -Encourage public participation -Outreach that is solution based -Education to the public -Education to the recreational users at marinas -Legislative action on phosphorus ban -Recognition of problems at State Level -Lack of regulations -Lack of Ag Stakeholder Involvement	Public Participation/Education and Outreach
-Quality of drinking water -Organic debris entering waterways -Quality of surface water runoff -Enhance wildlife habitat and recreational uses of the reservoir -Livestock access to streams -Streambank erosion -Lack of sufficient buffers	*E.coli* Levels
-Quality of drinking water -Organic debris entering waterways -Quality of surface water runoff -Changing actions/perceptions towards fertilizer use -Enhance wildlife habitat and recreational uses of the reservoir -Public concern over blue green algae -Legislative action on phosphorus ban -Recognition of problems at State level -Lack of regulations -Lack of sufficient buffers -Livestock access to streams	Nutrient Levels

Table 47, cont.: Concerns and Associated Problems	
Concern	**Problem Category**
-Quality of drinking water -Quality of surface water runoff -Erosion control and enforcement – Rule 5 -Dredging in the reservoir -Enhance wildlife habitat and recreational uses of the reservoir -Lack of conservation tillage practices in watershed -Livestock access to streams -Stream erosion -Lack of sufficient buffers	Erosion and Sedimentation
-Enhance wildlife habitat and recreational uses of the reservoir -Exotic species control (Eurasian Watermilfoil)	Exotic Species in the Reservoir
-Encourage and improve public perception of native landscaping -Enhance wildlife habitat and recreational uses of the reservoir -Outreach is solution based -Lack of funding sources for urban areas	Lack of Funding Sources for Urban Areas

Problem Statements

Problem statements were developed during the planning process in an effort to link watershed concerns with existing and historical water quality data and the six major concern categories. Following each problem statement is a brief synopsis on how the data analyzed within the Watershed Inventory correlates with the identified problem.

Public Participation/Education and Outreach

Stakeholders in the Geist Reservoir/Upper Fall Creek Watershed are not knowledgeable about their daily impact on the watershed and its water quality.

The data analyzed during the Watershed Inventory does not directly correlate to the Public Participation/Education and Outreach problem statement. It is difficult to measure the impacts of the lack of knowledge on a specific pollutant of concern; however conversations at the public meeting and steering committee meetings validated the concern.

E.coli Levels

E.coli levels in the watershed regularly exceed the state standard, based on current and historical water quality data results.

IDEM water quality data and the CIWRP study both verified the exceedances of *E.coli* levels and directly correlate to the problem statement. According to the CIWRP data, all subwatersheds exceeded the *E.coli* target of 235 CFU/100mL by at least 6,000%, while in the IDEM data all subwatersheds exceeded the target by at least 107%.

Nutrient Levels

Nutrient concentrations within all subwatersheds frequently exceed water quality targets thereby aiding the growth of algae within the reservoir.

IDEM 303d list, IDEM water quality data and the CIWRP study all verified the exceedances of nutrient concentrations and directly correlate to the problem statement. According to the CIWRP data, all subwatersheds exceeded the Nitrate + Nitrite target of 1.6 mg/L by at least 12%, while in the IDEM data one subwatershed was below the target and the other eight exceeded the target by at least 11%. Similarly, the phosphorus target of 0.076 mg/L was exceeded in all subwatersheds according to the CIWRP data by at least 58% and 5 subwatersheds exceeded the target by at least 7% in the IDEM data.

Erosion and Sedimentation

Soil erosion and sedimentation within the watershed is degrading the water quality and limiting the aesthetics, wildlife habitat, and aquatic health of the streams and reservoir within the watershed.

The CIWRP study verified the exceedances of total suspended solids that directly correlates to the problem statement. According to the CIWRP data, eight subwatersheds exceeded the TSS target of 30 mg/L by at least 60%, while in the IDEM data one subwatershed exceeded the target by 6%.

Exotic Species in the Reservoir

Excessive growth of exotic aquatic plants within the reservoir is negatively impacting the recreational uses of the reservoir and the survival of native species.

The data analyzed during the Watershed Inventory did not include information on aquatic plant species. Sampling conducted for the Aquatic Vegetation Management Plan in June and August 2009 did however verify the presence of Eurasian Watermilfoil at several locations within the reservoir.

Lack of Funding Sources for Urban Areas

There is a lack of funding for the implementation of Best Management Practices within urban areas.

The data analyzed during the Watershed Inventory does not directly correlate to the problem statement. It is difficult to measure the impacts of the lack of funding on a specific pollutant of concern; however the conversations at the public meeting and steering committee meetings validated the concern.

Section 4 – Identify Causes, Sources and Load Reductions

Potential Causes & Sources

A cause is an event, agent, or series of actions that produces an effect. In the context of a watershed management plan, the effect is the problem. Potential causes were identified for each problem statement based on the information summarized in the Watershed Inventory in Section 2. Where applicable, potential causes were related to specific pollutant parameters identified during the Watershed Inventory. A source is an activity, material or structure that results in nonpoint source pollution. Potential sources were identified for each problem statement based on the information analyzed in the Watershed Inventory in Section 2. Table 48 lists the potential causes and sources for each problem.

Table 48: Potential Causes & Sources

Problem Statement	Potential Causes	Potential Sources
Stakeholders in the Geist Reservoir/Upper Fall Creek Watershed are not knowledgeable about their daily impact on the watershed and its water quality.	-Lack of public awareness -Lack of unified approach -Lack of perceived benefits/impacts -Lack of interest -Lack of time and commitment -Lack of media coverage/educational material -Lack of understanding of nonpoint sources	- N/A, not applicable for administrative or social problems
E.coli levels in the watershed regularly exceed the state standard, based on current and historical water quality data results.	-Illegal or improper septic systems -Inadequately functioning septic systems -Unsewered communities -Undersized/old combined sewer systems -Improper disposal of pet/wildlife waste -Livestock access to ditches/streams -Lack of manure management -Lack of adequate buffers -Exceedances in NPDES permitted discharges	-Locations with improperly maintained septic systems and/or poor soils -Communities with Combined Sewers and Overflows into ditches/streams -Communities with no sewer systems and direct discharges to ditches/streams -Areas with inadequate buffers -Locations where pet/wildlife waste is disposed of directly into the reservoir and streams -Confined Feeding Operations -Areas where live stock have direct access to streams -Areas with inadequate buffers -Locations of NPDES permitted facilities not in compliance

Table 48: Potential Causes & Sources		
Problem Statement	**Potential Causes**	**Potential Sources**
Nutrient concentrations within all subwatersheds frequently exceed water quality targets thereby aiding the growth of algae within the reservoir.	-Application of fertilizers that include Phosphorus -Over application of fertilizers for its specific use -Timing of application of fertilizers -Improper disposal of yard waste -Lack of adequate buffers -Livestock access to ditches/streams	-Turf areas (e.g. residential, golf courses, parks, etc.) that drain directly to the reservoir/waterbody with no or inadequate buffers -Conventionally tilled agricultural fields that drain directly to ditches/streams with no or inadequate buffers -Areas with inadequate buffers
Soil erosion and sedimentation within the watershed is degrading the water quality and limiting the aesthetics, wildlife habitat, and aquatic health of the streams and reservoir within the watershed.	-Agricultural land/row crop production -Lack of temporary erosion control on construction sites -Lack of Rule 5 enforcement -Frequency of ditch maintenance -Lack of infiltration due to increased impervious areas -Streambank erosion -Livestock access to streams -Areas with inadequate stream buffers	-Conventionally tilled agricultural fields with no or inadequate buffers -Locations where on-going developments/construction sites have inadequate temporary erosion control measures -Locations where non-active construction sites have inadequate permanent erosion control measures -Ditches/streams that are frequently dredged/maintained
Excessive growth of exotic aquatic plants within the reservoir is negatively impacting the recreational uses of the reservoir and the survival of native species.	-Lack of native vegetation -Shallow body of water -Transfer of aquatic plant fragments -Uncontrolled growth in high density vegetation areas -Uncontrolled growth in recreational areas	-Public introducing aquarium plants into natural waterways -Vegetation fragmented by watercraft -Fragments transferred from watercraft in known infested waters
There is a lack of funding for the implementation of Best Management Practices within urban areas.	-Lack of unified approach -Lack of perceived benefits/impacts -Lack of interest -Lack of time and commitment	- N/A, not applicable for administrative or social problems

It should be noted that a non-active construction site is considered to be a site that has been hydrologically altered (e.g. trees have been cleared, topsoil/vegetation has been stripped) and the site is just bare ground with no permanent erosion control measures in place.

Pollutant Loading

Current Loading Calculation Methodology

Nitrate + Nitrite, Total Phosphorus, *E.coli* and Total Suspended Solids were identified as potential causes for several of the problem statements. In order to determine the extent of the current problem, current loads must be determined for comparison to target or known water quality targets.

There are several ways to estimate the current pollutant loads in a watershed, including nonpoint source modeling and actual sampling data. Both sources of information are available for the Geist Reservoir/Upper Fall Creek Watershed. With the extent of water quality data available from IDEM data and the CIWRP study, it was determined that the most accurate estimate would incorporate the available water quality data rather than the modeling results.

Two data sets, IDEM (2008-2009) and CIWRP (2003), sampled for Nitrate + Nitrite, Total Phosphorus, *E.coli* and TSS. Instead of averaging these two data sets together, the IDEM data was used for this calculation as it was the most recent data available. The mean value of each parameter was calculated on a subwatershed-wide scale.

For the purposes of a watershed management plan, the pollutant loads need to be calculated in either pounds per year or tons per year. Since the water quality data was provided in units of mg/L and CFU/100mL, a flow rate was needed for the conversion.

There is one USGS gaging station located within the Geist Reservoir/Upper Fall Creek Watershed. The station, number 03351500, is located on Fall Creek near Fortville. Average annual flow data is available for this station from 1942-2008. At the gage site, the drainage area is 169 square miles and the average annual flow is 182.1 cfs. This flow was scaled to each subwatershed.

IDEMs load calculation tool was then used to estimate the loads based on the flow and concentration data.

Target Loads

The target loads were identified based on known water quality guidelines or standards for each pollutant. These standards typically reference a concentration, therefore as described above, IDEMs load calculation tool was used to estimate the target loads based on the flow and standard concentration data.

The single sample state standard in Indiana for *E.coli* is 235 CFU/100 mL.

Levels of Total Nitrate and Nitrite greater than 10 mg/L exceed the water quality standard for Nitrate and Nitrite as described in the Indiana Administrative Code (IAC). However, for this analysis, a target of 1.6 mg/L was identified as the EPA nutrient criterion for this eco-region.

Levels of Total Phosphorus greater than 0.3 mg/L exceed the IDEM statewide draft TMDL target, while levels above 0.076 mg/L exceed the EPA recommended water quality targets. For this analysis, EPA's recommended maximum was used as the target.

Levels of TSS greater than 30 mg/L exceed the IDEM statewide draft TMDL target.

Load Reductions

Once the current loads and the target loads of each pollutant were determined, the required load reduction to meet the targets was calculated.

Tables 49-51 show the current, target and reduction loads of *E.coli*, Nitrate+Nitrite and Total Phosphorus within the watershed. Since the current TSS concentration was less than the target in eight of the nine subwatersheds, no reduction is required in these subwatersheds.

The Deer Creek Subwatershed averaged higher than the target in TSS at 31.9 mg/L. The current load of the Deer Creek Subwatershed was calculated to be 954.0 ton/year. With the target of 30 mg/L or 897.2 ton/year, the reduction required is 56.8 ton/year, or 6.0% for this subwatershed.

Only IDEM *E.coli* values were used to create Table 49. CIWRP data exists for this parameter, however, the IDEM data is more recent. Thorpe was not measured for *E.coli* based on the most recent IDEM data. There is older data from CIWRP, but it was not used in the creation of this table since the values were much larger than the IDEM data and the IDEM data is showing exceedances in all subwatersheds.

Table 49: *E.coli* Pollutant Loading

Subbasin	Flow Rate (cfs)	Current Loading		Target Loading		Reduction
		Concentration (CFU/100mL)	Load (CFU/year)	Concentration (CFU/100mL)	Load (CFU/year)	Needed (CFU/year)
Honey Creek	18.3	1646	$2.7x10^{14}$	235	$3.8x10^{13}$	$2.3x10^{14}$ (85.7%)
Sly Fork	19.1	5855	$1.0x10^{15}$	235	$4.0x10^{13}$	$9.6x10^{14}$ (96.0%)
Deer Creek	30.4	3326	$9.0x10^{14}$	235	$6.4x10^{13}$	$8.4x10^{14}$ (92.9%)
Prairie Creek	42.8	3646	$1.4x10^{15}$	235	$9.0x10^{13}$	$1.3x10^{15}$ (93.6%)
Headwaters Lick Creek	23.2	3771	$7.8x10^{14}$	235	$4.9x10^{13}$	$7.3x10^{14}$ (93.8%)
Foster Branch	17.0	5669	$8.6x10^{14}$	235	$3.6x10^{13}$	$8.2x10^{14}$ (95.9%)
McFadden Ditch	18.0	1436	$2.3x10^{14}$	235	$3.8x10^{13}$	$1.9x10^{14}$ (83.6%)
Flatfork Creek	30.0	487	$1.3x10^{14}$	235	$6.3x10^{13}$	$6.8x10^{13}$ (51.7%)
Thorpe Creek	37.3	Not Sampled	N/A	235	$7.8x10^{13}$	N/A

Table 50: Nitrate+Nitrite Pollutant Loading						
Subbasin	Flow Rate (cfs)	Current Loading		Target Loading		Reduction
		Concentration (mg/L)	Load (lb/year)	Concentration (mg/L)	Load (lb/year)	Needed (lb/year)
Honey Creek	18.3	3.4	122,400	1.6	57,600	64,800 (52.9%)
Sly Fork	19.1	2.1	79,000	1.6	60,200	18,800 (23.8%)
Deer Creek	30.4	2.5	149,600	1.6	95,800	53,800 (36.0%)
Prairie Creek	42.8	1.4	118,000	1.6	134,800	N/A (0.0%)
Headwaters Lick Creek	23.2	1.8	82,200	1.6	73,000	9,200 (11.1%)
Foster Branch	17.0	2.4	80,200	1.6	53,600	26,600 (33.3%)
McFadden Ditch	18.0	1.8	63,800	1.6	56,600	7,200 (11.1%)
Flatfork Creek	30.0	2.6	153,400	1.6	94,400	59,000 (38.5%)
Thorpe Creek	37.3	4.4	323,000	1.6	117,400	205,600 (64.0%)

Table 51: Total Phosphorus Pollutant Loading						
Subbasin	Flow Rate (cfs)	Current Loading		Target Loading		Reduction
		Concentration (mg/L)	Load (lb/year)	Concentration (mg/L)	Load (lb/year)	Needed (lb/year)
Honey Creek	18.3	0.098	3,600	0.076	2,800	800 (22.4%)
Sly Fork	19.1	0.065	2,400	0.076	2,800	N/A (0.0%)
Deer Creek	30.4	0.214	12,800	0.076	4,600	8,200 (64%)
Prairie Creek	42.8	0.062	5,200	0.076	6,400	N/A (0.0%)
Headwaters Lick Creek	23.2	0.069	3,200	0.076	3,400	N/A (0.0%)
Foster Branch	17.0	0.064	2,200	0.076	2,600	N/A (0.0%)
McFadden Ditch	18.0	0.081	2,800	0.076	2,600	200 (6.2%)
Flatfork Creek	30.0	0.083	5,000	0.076	4,400	600 (8.4%)
Thorpe Creek	37.3	1.066	78,200	0.076	5,600	72,600 (93.0%)

Section 5 – Set Goals and Identify Critical Areas

Goal Statements

Based on the identified concerns and possible sources, goal statements were developed for each problem statement. Implementation of policies and programs to meet these goal statements will improve watershed management in the Geist Reservoir/Upper Fall Creek Watershed.

The goal statements indicate the ultimate goal for a specific project. In some cases this goal may not be maintainable in the short term; therefore there is also a list of short term objectives included with each goal. Short term implies efforts will begin implementation in the years 0-5 and long term implies years 6-20. The goal statements themselves are typically the long term goal.

It should be noted that some objectives may relate to several goal statements, they are listed in each applicable category.

Public Participation/Education and Outreach

Problem Statement: Stakeholders in the Geist Reservoir/Upper Fall Creek Watershed are not knowledgeable about their daily impact on the watershed and its water quality.

Goal Statement: Develop and implement an education and outreach program within the watershed.

Short Term Objectives:

- Effectively share and communicate past, current and future activities within the watershed
- Educate stakeholders within the watershed on the function of a watershed and their impacts to water quality
- Educate all stakeholders on nature of nonpoint sources
- Coordinate with County SWCDs to get more agriculture stakeholders involved in plan implementation
- Educate homeowners in urban communities about the use of fertilizers
- Coordinate efforts with the UWRWA, local MS4s and any other education and outreach efforts being conducted within the watershed
- Work with Indiana Wildlife Federation on efforts to educate on and reduce the use of fertilizers containing phosphorus
- Educate stakeholders using septic systems about the importance of septic system maintenance

Long Term Objectives:

- Continue viable and effective short term objectives
- Work with local municipalities to incorporate smart growth principles and green infrastructure practices into zoning/stormwater ordinances and comprehensive plans

- Educate agricultural stakeholders about the use of Atrazine and its impacts to water quality
- Review education and outreach program within the watershed and continue development and implementation of the program

E.coli Levels

Problem Statement: *E.coli* levels in the watershed regularly exceed the state standard, based on current and historical water quality data results.

Goal Statement: Reduce *E.coli* concentrations to meet the state standard of 235 CFU/100mL.

Short Term Objectives:

- Partner with NRCS, SWCDs and County Officials/Boards to promote and implement cost share and/or education programs
- Encourage proper disposal of pet and/or Canada goose waste
- Educate stakeholders using septic systems about the importance of septic system maintenance
- Promote and implement agricultural BMPs that will reduce *E.coli* levels in the watershed (e.g. alternative watering systems, buffer/filter strips, exclusionary fencing, wetland restoration, etc.)

Long Term Objectives:

- Continue viable and effective short term goals
- Educate the agriculture stakeholders on the benefits of manure management practices
- Educate and work with point dischargers to reduce the amount of *E.coli* runoff from point sources, package plants, CFOs and CSOs
- Establish a monitoring program or group to collect samples

Pet and wildlife waste is not a fully documented problem, but was brought up at Steering Committee meetings as a concern. This was specifically commented on by UWRWA as well.

Nutrient Levels

Problem Statement: Nutrient concentrations within all subwatersheds frequently exceed water quality targets thereby aiding the growth of algae within the reservoir.

Goal Statement: Reduce the nutrient loads so that there are no exceedances of EPAs suggested targets for Nitrate + Nitrite of 1.6 mg/L and Total Phosphorus of 0.076mg/L.

Short Term Objectives:

- Educate the public and stakeholders of the importance of reduced application of fertilizers or use of low phosphorus or no phosphorus fertilizers
- Partner with NRCS, SWCDs, MS4s and County Officials/Boards to promote and implement cost share and/or education programs
- Educate local, regional, and state officials on the need for regulations for urban areas (specifically for phosphorus)

- Promote and implement agricultural BMPs that will reduce nutrient levels in the watershed (e.g. alternative watering systems, buffer/filter strips, exclusionary fencing, conservational tillage, reforestation, stream restoration, wetland restoration, etc.)
- Promote and implement urban BMPs that will reduce nutrient levels in the watershed (e.g. filtration basins, pervious pavement, bioretention practices, etc.)

Long Term Objectives:

- Continue viable and effective short term objectives
- Educate and work with point discharges (CFOS, NPDES permitted facilities) to reduce their nutrient loads
- Work with local municipalities to incorporate smart growth principles and green infrastructure practices into zoning/stormwater ordinances and comprehensive plans
- Establish a monitoring program or group to collect samples

Erosion and Sedimentation

Problem Statement: Soil erosion and sedimentation within the watershed is degrading the water quality and limiting the aesthetics, wildlife habitat, and aquatic health of the streams and reservoir within the watershed.

Goal Statement: Reduce sediment loads to meet the IDEM statewide draft TMDL target of 30 mg/L for TSS.

Short Term Objectives:

- Partner with NRCS, SWCDs, MS4s, County Officials/Boards, High Schools and FFA programs to promote and implement cost share and/or education programs in order to reduce erosion from agricultural lands
- Encourage enforcement of erosion control practices associated with the issuance of Rule 5 construction permits
- Promote and implement agricultural BMPs that will reduce TSS levels in the watershed (e.g. alternative watering systems, buffer/filter strips, exclusionary fencing, grassed waterways, naturalized stream buffers, conservational tillage, reforestation, stream restoration, wetland restoration, etc.)
- Promote and implement urban BMPs that will reduce nutrient levels in the watershed (e.g. filtration basins, infiltration trenches, naturalized detention basins, pervious pavement, rain barrels, rain gardens, bioretention practices, etc.)

Long Term Objectives:

- Continue viable and effective short term objectives
- Work with local municipalities to incorporate smart growth principles and green infrastructure practices into zoning/stormwater ordinances and comprehensive plans
- Establish a monitoring program or group to collect samples

Exotic Species in the Reservoir

Problem Statement: Excessive growth of exotic aquatic plants within the reservoir is negatively impacting the recreational uses of the reservoir and the survival of native species.

Goal Statement: Reduce and control the growth of exotic plants within the reservoir.

Short Term Objectives:

- Educate the public and stakeholders on how exotic species are introduced and ways to control new introductions
- Partner with the marinas, fishing tournament groups, homeowner organizations, etc to promote and implement cost share and/or education programs

Long Term Objectives:

- Continue viable and effective short term objectives
- Regular update of AVMP and implementation according to recommendations

Lack of Funding Sources for Urban Areas

Problem Statement: There is a lack of funding for the implementation of Best Management Practices within urban areas.

Goal Statement: Identify and utilize existing BMP funding sources and encourage the development and enhancement of additional and non-traditional funding sources.

Short Term Objectives:

- Educate homeowners and stakeholders on the benefits and importance of urban BMPs
- Partner with MS4s, SWCDs, foundations, community groups, judicial services, community service programs, high schools, etc to identify existing and develop new funding sources for urban BMP implementation
- Research/educate homeowners on do-it-yourself BMPs

Long Term Objectives:

- Continue viable and effective short term objectives
- Work with local municipalities to incorporate smart growth principles and green infrastructure practices into zoning/stormwater ordinances and comprehensive plans
- Encourage demonstration projects throughout the watershed in cooperation with MS4s Education and Outreach programs
- Partner with MS4s, SWCDs, foundations, community groups, judicial services, community service programs, high schools, etc to promote and implement cost share opportunities for implementation of BMPs

Indicators

Indicators are measurable parameters or criteria which can be used to determine the progress being made toward achieving a goal. Indicators were developed for each goal and objective. Some indicators may be appropriate for several categories and are listed for each applicable goal. As the watershed management plan is being implemented, it is anticipated that additional indicators will be identified; therefore this list is not intended to be comprehensive. Table 52 lists the indicators and the goals to which they are linked.

An Education/Outreach Menu was developed by the UWRWA and V3 and is included in Appendix L. This menu includes various media for education and outreach. Since it is unknown at this time the preferred methods of outreach, several indicators refer to this menu in addition to specific outreach tools.

Table 52: Goals and Indicators	
Goal	**Indicators**
Develop and implement an education and outreach program within the watershed	-Number of updates to website -Number of newspaper/newsletter articles or other media communications -Number of brochures/educational materials distributed or field days organized -Number of programs and ideas utilized from the Education/Outreach Menu
Reduce *E.coli* concentrations to meet the state standard of 235 CFU/100mL	-Observed *E.coli* loadings -Number or stream miles of stabilized streambanks and associated load reductions -Number of direct animal access to streams points eliminated and associated load reductions -Number or stream miles of improved/created buffer zones and associated load reductions -*E.coli* loadings from point dischargers
Reduce the nutrient loads so that there are no exceedances of EPAs suggested targets for Nitrate + Nitrite of 1.6 mg/L and Total Phosphorus of 0.076mg/L	-Observed Nitrate + Nitrite and Total Phosphorus Loadings -Number of stream miles of improved/created buffer zones and associated load reductions -Number of agricultural fields utilizing cover crops, conservation tillage, or other BMPs and associated load reductions -Number of urban BMPs installed (e.g. pond shoreline plantings, rain gardens) and associated load reductions -Nutrient loadings from point dischargers
Reduce sediment loads to meet the IDEM statewide draft TMDL target of 30 mg/L for TSS	-Observed TSS concentrations -Number of agricultural fields utilizing conservation tillage, cover crops or other BMPs and associated load reductions -Number or stream miles of improved/created buffer zones and associated load reductions -Number of inspections and/or enforcement actions on construction sites with Rule 5 permits -Number or stream miles of stabilized streambanks and associated load reductions -Number of direct animal access to streams points eliminated and associated load reductions
Reduce and control the growth of exotic plants within the reservoir	-Number of areas identified in updated AVMP -Number of areas treated according to AVMP recommendations -Number of areas with excessive growth
Identify and utilize existing BMP funding sources and encourage the development and enhancement of additional and non-traditional funding sources	-Number of existing funding sources utilized -Number of new/non-traditional funding sources indentified -Number of demonstration projects installed -Number of urban BMPs installed (e.g. pond shoreline plantings, rain gardens)

Critical Areas

Critical areas are defined as areas where project implementation can remediate current water quality impairments or reduce the impact of future water quality impairments. The critical areas within the Geist Reservoir/Upper Fall Creek Watershed were identified based on the Watershed Inventory, the identified problems and the goals of the Watershed Management Plan. Critical areas were split into two categories: Subwatershed Critical Areas and Specific Source Critical areas.

High Priority Subwatersheds

The Subwatershed Critical Areas were chosen based on the Watershed Inventory Rankings. Based on the Watershed Inventory, the lowest/worst ranked subwatersheds are the most impaired based on all of the available data. Projects within these subwatersheds would provide the greatest water quality benefit. The top four ranked subwatersheds were identified as the High Priority Subwatersheds.

Since the watershed management plan is a living document, the intent is not to limit projects to only the High Priority Areas as these may become less critical as the plan is implemented. In an effort to prioritize work, the remaining five subwatersheds were also categorized as medium priority and low priority. The intent of this ranking is that if all projects are implemented in the High Priority Areas, then a medium priority area should be evaluated for project implementation. Exhibit 25 shows these the priority subwatershed areas and the ranking of the remaining subwatersheds.

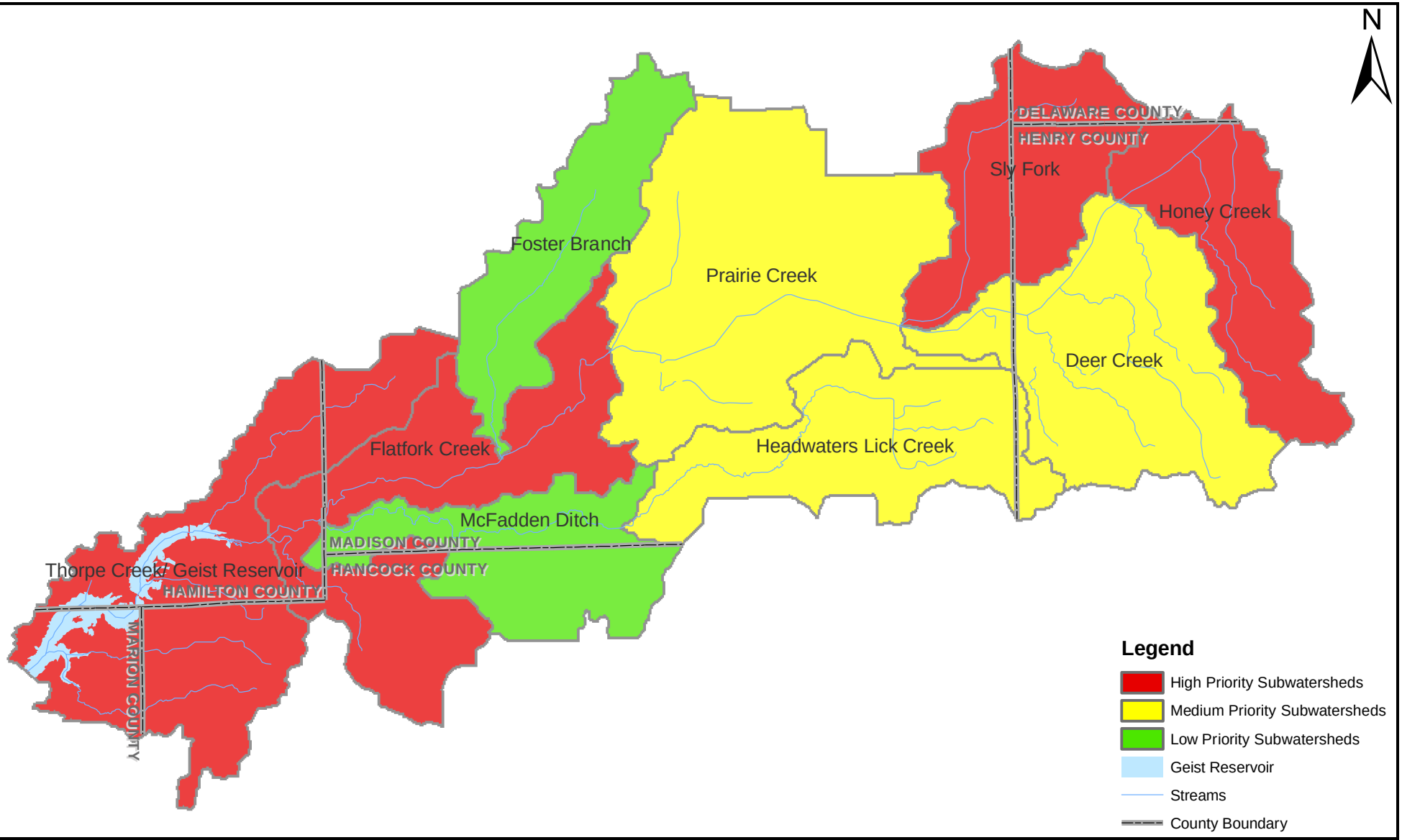
Thorpe Creek Subwatershed

As discussed in the Watershed Inventory in Section 2, the Thorpe Creek Subwatershed shows the highest level of water quality impairment and the highest level of land use and industrial impairments based on the available data. Geist Reservoir is also located within the subwatershed and serves as a drinking water supply to the Indianapolis Water Company's Fall Creek Water Treatment Facility.

The Thorpe Creek Subwatershed exceeded the targets of *E. coli* and the water quality targets for Nitrate + Nitrite, Phosphorus and TSS in the CIWRP study and exceeded the targets of Nitrate + Nitrite and Phosphorus in the IDEM data (no *E. coli* information was available within the IDEM data) and needs reductions of 64.0% and 93.0% for Nitrate+Nitrite and Phosphorus, respectively to meet the target loads set for the subwatershed.

During the windshield survey, 2 of the 16 stream sites showed areas of streambank erosion that exceeded 3 feet (see Exhibit 28), 13 sites showed areas with no or inadequate stream buffers (see Exhibit 27), 7 locations had in-stream debris and conventional tillage practices were seen in 4 locations (see Exhibit 29). Based on these findings and as outlined in Part Three of the Watershed Inventory (Watershed Ranking tables and summaries), the Thorpe Creek Subwatershed is a High Priority Subwatershed Area for Best Management Practice implementation.

The Thorpe Creek Subwatershed is 54% agricultural with urban areas concentrated in the western portion of the subwatershed associated with the City of Indianapolis, Town of Fishers, Town of McCordsville, and the City of Lawrence. Therefore the BMPs suggested in



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TITLE: **Subwatershed Priority Areas**		PROJECT: **Geist Reservoir/Upper Fall Creek Watershed Management Plan**	
BASE LAYER: HUC-12 Boundaries		PROJECT NO.: 09006	EXHIBIT: 25	SHEET: 1 OF: 1
CLIENT: Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206		QUADRANGLE: N/A	DATE: 09/30/10	SCALE: 1" = 16,000'

Table 54 for this subwatershed are agricultural/rural and urban focused and are beneficial in reducing pollutant loadings for more than one impairment.

The subwatershed is critical for *E. coli* (according to the CIWRP data). The Carefree Homes Mobile Home Park has a NPDES permit within the Thorpe Creek Subwatershed. There was one TSS exceedance reported for this outfall based on the information obtained from IDEM. There is also one active CFO located within the subwatershed. These could be potential sources for elevated *E. coli* levels. Even though there are no Urban BMPs that show a benefit for reducing *E. coli*, the potential for wetland restoration within the subwatershed is feasible due to 31.7% of the subwatershed being mapped with hydric soils. Wetland restoration has the potential to reduce pollutant loads by 80% for sediment and *E. coli*, 55% for phosphorus and 45% for nitrogen.

Although the windshield survey did not show any locations where animals could access streams, the subwatershed is critical for E. coli and 54% agricultural with one active CFO, indicating that there may be animal access locations that were not observed during the survey. Implementation of alternative watering systems as well as exclusionary fencing and eliminating the potential for animals to have direct access to the streams will help reduce pollutant loadings within the subwatershed.

The windshield survey results showed that the subwatershed has at least 9 sites with no stream buffers or evidence of streambank erosion greater than 3 feet in depth. The subwatershed has approximately 30 miles of major stream corridor which doesn't include the minor tributaries or other regulated drains within the subwatershed. Therefore, there is great potential for implementation of buffer/filter strips, reforestation along streams and stream restoration within the subwatershed as a best management practice for reducing, Nitrate+Nitrite, Total Phosphorus and TSS.

Since the subwatershed is 54% agricultural land with at least 4 locations from the windshield survey showing conventional tillage practices, promoting no-till or reduced till (conservation tillage) practices within this subwatershed would also help to reduce TSS and Nitrate+Nitrite loadings. Based on the information obtained from the Hamilton County SWCD, approximately 49% of corn fields in the County operate using conventional tillage practices. Tillage information for Hancock County (2007) indicates that approximately 3% of corn fields within the County operate using conventional tillage practices. Grassed waterways and Nutrient/Waste Management plans would also be a beneficial BMP within these agricultural areas for reduction of all pollutants.

The Thorpe Creek Subwatershed includes a portion of the City of Indianapolis, Town of Fishers, Town of McCordsville, and City of Lawrence. Urban runoff is often a significant source of nonpoint source pollution within a watershed. The implementation of BMPs such as bioretention practices, filtration basins, pervious pavement, naturalized detention basins, infiltration trenches, naturalized stream buffers, and rain barrels/rain gardens within urban areas has the potential to significantly reduce the pollutant loadings within the watershed. For example, the load reduction needed for Nitrate+Nitrite in this subwatershed is 64.0% in order to meet the target loads. Installation of pervious pavement has the potential to reduce Nitrate+Nitrite loads tributary to the pavement by 85% based on Table 53 Best Management Practice Load Reduction Summary in Section 6. Therefore, this practice

propagated throughout the watershed has the potential to significantly reduce nonpoint source pollution loadings.

Based on this information, BMP implementation projects are very feasible within the Thorpe Creek Subwatershed. However, specific locations and types of BMPs should be carefully planned out in coordination with the landowners and applicable local, state and federal agencies and with the load reduction needs of the subwatershed in mind.

Honey Creek Subwatershed

The Honey Creek Subwatershed shows a moderate level of current water quality impairment (ranked fourth) and a moderate level of land use and industrial impairments (ranked fourth) based on the available data. The Honey Creek Subwatershed exceeded the water quality targets for *E. coli*, Nitrate + Nitrite, Phosphorus and TSS in the CIWRP study and exceeded the water quality targets for *E. coli*, Nitrate + Nitrite and Phosphorus in the IDEM data. Reductions of 85.7%, 52.9% and 22.4% are needed for *E. coli*, Nitrate + Nitrite, and Phosphorus respectively to meet the target loads set for the subwatershed. The current loading of TSS (according to the IDEM data) within this subwatershed meets the target, therefore no reduction is necessary.

During the windshield survey, 2 of the 8 stream sites showed areas of streambank erosion that exceeded 3 feet (see Exhibit 28), 8 sites showed areas with no or inadequate stream buffers (see Exhibit 27) and conventional tillage practices were seen in 10 of the locations (see Exhibit 29) within the Honey Creek Subwatershed. Based on these findings and as outlined in Part Three of the Watershed Inventory (Watershed Ranking tables and summaries), the Honey Creek Subwatershed is a High Priority Subwatershed for Best Management Practice implementation.

The Honey Creek Subwatershed is approximately 84% agricultural with only a small urban area concentrated in the northwest portion of the subwatershed associated with Middletown. Therefore, the BMPs suggested in Table 54 for this subwatershed are agricultural/rural focused and are beneficial in reducing pollutant loadings for more than one impairment.

Although the windshield survey did not show any locations where animals could access streams, the subwatershed is critical for *E. coli* indicating that there may be animal access locations that were not observed during the survey. Implementation of alternative watering systems as well as exclusionary fencing and eliminating the potential for animals to have direct access to the streams will reduce pollutant loadings within the subwatershed. For example, the load reduction needed for E. coli in this subwatershed is 85.7% in order to meet the target loads. Implementation of the exclusionary fencing alone provides a 90% reduction in E. coli based on Table 53 Best Management Practice Load Reduction Summary in Section 6.

The windshield survey results also showed that the subwatershed has at least 4 sites with no stream buffers or evidence of streambank erosion greater than 3 feet in depth. The subwatershed has approximately 14 miles of major stream corridor which doesn't include the minor tributaries or other regulated drains within the subwatershed. Therefore, there is great potential for implementation of buffer/filter strips, reforestation along streams,

naturalized stream buffers and stream restoration within the subwatershed as a best management practice for reducing Nitrate+Nitrite, Total Phosphorus and TSS.

Since the subwatershed is 84% agricultural land with at least 10 locations from the windshield survey showing conventional tillage practices, promoting no-till or reduced till (conservation tillage) practices within this subwatershed would also help to reduce Nitrate+Nitrite loadings. Based on the tillage information for Henry County, approximately 24% of corn fields in the County operate using conventional tillage practices. Grassed waterways and Nutrient/Waste Management plans would also be a beneficial BMP within these agricultural areas for reduction of all pollutants.

Approximately 36.9% of the subwatershed is mapped as having hydric soils. These areas would be conducive for wetland restoration, which has the potential to reduce pollutant loads by 80% for sediment and *E. coli*, 55% for phosphorus and 45% for nitrogen.

Based on this information, BMP implementation projects are very feasible within the Honey Creek Subwatershed. However, specific locations and types of BMPs should be carefully planned out in coordination with the landowners and applicable local, state and federal agencies and with the load reduction needs of the subwatershed in mind.

Flatfork Creek Subwatershed

The Flatfork Creek Subwatershed shows a high level of current water quality impairment (ranked seventh) and a high level of land use and industrial impairments (ranked second) based on the available data. The Flatfork Creek Subwatershed exceeded the water quality targets for *E. coli*, Nitrate + Nitrite, Phosphorus and TSS in the CIWRP study and exceeded the water quality targets for *E. coli*, Nitrate + Nitrite and Phosphorus in the IDEM data. Reductions of 51.7%, 38.5%, and 8.4% are needed for *E. coli*, Nitrate + Nitrite, and Phosphorus respectively to meet the target loads set for the subwatershed. The current loading of TSS within this subwatershed meets the target (according to the IDEM data), therefore no reduction is necessary.

During the windshield survey, 2 of the 13 stream sites showed areas of streambank erosion that exceeded 3 feet (see Exhibit 28), 2 sites showed areas with no stream buffers (see Exhibit 27), 1 location had in-stream debris and conventional tillage practices were seen in 2 of the locations (see Exhibit 29) within the Flatfork Creek Subwatershed. Based on these findings and as outlined in Part Three of the Watershed Inventory (Watershed Ranking tables and summaries), the Flatfork Creek Subwatershed is a High Priority Subwatershed for Best Management Practice implementation.

The Flatfork Creek Subwatershed is approximately 71% agricultural with urban areas concentrated in the northeastern portion of the subwatershed associated with Town of Pendleton, the central portion of the subwatershed associated with Town of Ingalls, and in the western portion of the subwatershed associated with Town of Fortville. Therefore, the BMPs suggested in Table 54 for this subwatershed are agricultural/rural and urban focused and are beneficial in reducing pollutant loadings for more than one impairment.

The subwatershed is critical for *E. coli.* The Fortville Municipal Wastewater Treatment Plant has an outfall permit for seven locations within the Flatfork Creek Subwatershed. Similarly,

the Fall Creek RSD Wastewater Treatment Plant and the Flatfork Wastewater Treatment plant each have a permit for one outfall within the subwatershed which are all potential sources for elevated *E. coli* levels. There were 8 *E.coli*, 9 N and 5 P exceedances reported for these outfalls based on the information obtained from IDEM. Even though there are no Urban BMPs that show a benefit for reducing *E. coli*, the potential for wetland restoration within the subwatershed is feasible due to 32.3% of the subwatershed being mapped with hydric soils. Wetland restoration has the potential to reduce pollutant loads by 80% for sediment and *E. coli*, 55% for phosphorus and 45% for nitrogen.

Although the windshield survey did not show any locations where animals could access streams, the subwatershed is 71% agricultural and the subwatershed is critical for *E. coli* indicating that there may be animal access locations that were not observed during the survey. Implementation of alternative watering systems as well as exclusionary fencing and eliminating the potential for animals to have direct access to the streams will reduce pollutant loadings within the subwatershed. For example, the load reduction needed for *E. coli* in this subwatershed is 51.7% in order to meet the target loads. Implementation of the exclusionary fencing alone provides a 90% reduction in *E. coli* for area tributary to the fencing based on Table 53 Best Management Practice Load Reduction Summary in Section 6. Exclusionary fencing also provides 70% removal of TSS, 60% of Phosphorus and 65% of Nitrogen. Grassed waterways and Nutrient/Waste Management plans would also be a beneficial BMP within these agricultural areas for reduction of all pollutants.

The windshield survey results showed that the subwatershed has at least 4 sites with no stream buffers or evidence of streambank erosion greater than 3 feet in depth. The subwatershed has approximately 15 miles of major stream corridor which doesn't include the minor tributaries or other regulated drains within the subwatershed. Therefore, there is great potential for implementation of buffer/filter strips, naturalized stream buffers and stream restoration within the subwatershed as a best management practice for reducing *E. coli*, Nitrate+Nitrite, Total Phosphorus and TSS.

The Flatfork Creek Subwatershed includes a portion of the Town of Pendleton, Town of Ingalls and Town of Fortville. Urban runoff is often a significant source of nonpoint source pollution within a watershed. The implementation of BMPs such as infiltration trenches and rain barrels/rain gardens within urban areas has the potential to significantly reduce the pollutant loadings within the watershed.

Based on this information, BMP implementation projects are very feasible within the Flatfork Creek Subwatershed. However, specific locations and types of BMPs should be carefully planned out in coordination with the landowners and applicable local, state and federal agencies and with the load reduction needs of the subwatershed in mind.

Sly Fork Subwatershed

The Sly Fork Subwatershed shows a high level of current water quality impairment (ranked second) and a moderate level of land use and industrial impairments (ranked sixth) based on the available data. The Sly Fork Subwatershed exceeded the water quality targets for *E. coli*, Nitrate + Nitrite, Phosphorus and TSS in the CIWRP study and exceeded the water quality target for *E. coli*, Nitrate + Nitrite in the IDEM data. Reductions of 96.0% and 23.8%

needed for *E. coli* and Nitrate + Nitrite, respectively to meet the target loads set for the subwatershed.

During the windshield survey, 1 of the 8 stream sites showed areas of streambank erosion that exceeded 3 feet (see Exhibit 28), 7 sites showed areas with insufficient or no stream buffers (see Exhibit 27), 4 locations had in-stream debris and conventional tillage practices were seen in 3 of the locations (see Exhibit 29) within the Sly Fork Subwatershed. Based on these findings and as outlined in Part Three of the Watershed Inventory (Watershed Ranking tables and summaries), the Sly Fork Subwatershed is a High Priority Subwatershed for Best Management Practice implementation.

The Sly Fork Subwatershed is approximately 78% agricultural with the only urban area concentrated in the northeastern portion of the subwatershed associated with the Town of Middletown. Therefore, the BMPs suggested in Table 54 for this subwatershed are agricultural/rural focused and are beneficial in reducing pollutant loadings for more than one impairment.

Although the windshield survey did not show any locations where animals could access streams, the subwatershed is 78% agricultural and the subwatershed is critical for *E. coli* indicating that there may be animal access locations that were not observed during the survey. Implementation of alternative watering systems as well as exclusionary fencing and eliminating the potential for animals to have direct access to the streams will reduce pollutant loadings within the subwatershed. For example, the load reduction needed for *E. coli* in this subwatershed is 96.0% in order to meet the target loads. Implementation of the exclusionary fencing alone provides a 90% reduction in *E. coli* for area tributary to the fencing based on Table 53 Best Management Practice Load Reduction Summary in Section 6. Exclusionary fencing also provides 70% removal of TSS, 60% of Phosphorus and 65% of Nitrogen. Nutrient/Waste Management plans would also be a beneficial BMP within these agricultural areas for reduction of all pollutants.

The windshield survey results showed that the subwatershed has at least 2 sites with no stream buffers or evidence of streambank erosion greater than 3 feet in depth. The subwatershed has approximately 8 miles of major stream corridor which doesn't include the minor tributaries or other regulated drains within the subwatershed. Therefore, there is great potential for implementation of buffer/filter strips within the subwatershed as a best management practice for reducing *E. coli*, Nitrate+Nitrite, Total Phosphorus and TSS.

Approximately 39.1% of the subwatershed is mapped as having hydric soils. These areas would be conducive for wetland restoration, which has the potential to reduce pollutant loads by 80% for sediment and *E. coli*, 55% for phosphorus and 45% for nitrogen.

Based on this information, BMP implementation projects are very feasible within the Sly Fork Subwatershed. However, specific locations and types of BMPs should be carefully planned out in coordination with the landowners and applicable local, state and federal agencies and with the load reduction needs of the subwatershed in mind.

Medium Priority Subwatersheds

Deer Creek Subwatershed

The Deer Creek Subwatershed shows a moderate level of current water quality impairment (ranked fourth) and a moderate level of land use and industrial impairments (ranked sixth) based on the available data. The Deer Creek Subwatershed exceeded the water quality targets for *E. coli*, Nitrate + Nitrite, Phosphorus and TSS in the CIWRP study and exceeded the water quality targets for *E. coli*, Nitrate + Nitrite, Phosphorus and TSS in the IDEM data. Reductions of 92.9%, 36.0%, 64.1% and 6.0% are needed for *E. coli*, Nitrate + Nitrite, Phosphorus and TSS respectively to meet the target loads set for the subwatershed.

During the windshield survey, 1 of the 13 stream sites showed areas of streambank erosion that exceeded 3 feet (see Exhibit 28), 9 sites showed areas with inadequate or no stream buffers (see Exhibit 27), 3 locations had in-stream debris, 1 livestock access point to a stream was observed and conventional tillage practices were seen in 4 of the locations (see Exhibit 29) within the Deer Creek Subwatershed. Based on these findings and as outlined in Part Three of the Watershed Inventory (Watershed Ranking tables and summaries), the Deer Creek Subwatershed is a Medium Priority Subwatershed for Best Management Practice implementation.

The Deer Creek Subwatershed is approximately 82% agricultural with no significant urban areas. Therefore, the BMPs suggested in Table 54 for this subwatershed are agricultural/rural focused and are beneficial in reducing pollutant loadings for more than one impairment.

The subwatershed is critical for *E. coli.* The Middletown Wastewater Treatment Plant has an outfall permit for three locations within the Deer Creek Subwatershed. Similarly, the Shenandoah Middle and High School has a NPDES permit within the subwatershed which are all potential sources for elevated pollutant levels. There were 4 E.coli, 14 N and 2 TSS exceedances reported for these outfalls based on the information obtained from IDEM. The potential for wetland restoration within the subwatershed, to help reduce E. coli levels, is feasible due to 25.9% of the subwatershed being mapped with hydric soils. Wetland restoration has the potential to reduce pollutant loads by 80% for sediment and *E. coli*, 55% for phosphorus and 45% for nitrogen.

The windshield survey information showed that there is at least 1 location within the subwatershed where animals could access streams. Implementation of alternative watering systems as well as exclusionary fencing and eliminating the potential for animals to have direct access to the streams will reduce pollutant loadings within the subwatershed. For example, the load reduction needed for *E. coli* in this subwatershed is 92.9% in order to meet the target loads. Implementation of the exclusionary fencing alone provides a 90% reduction in *E. coli* for area tributary to the fencing based on Table 53 Best Management Practice Load Reduction Summary in Section 6. Exclusionary fencing also provides 70% removal of TSS, 60% of Phosphorus and 65% of Nitrogen.

The windshield survey results also showed that the subwatershed has at least 3 sites with no stream buffers or evidence of streambank erosion greater than 3 feet in depth. The subwatershed has approximately 27 miles of major stream corridor which doesn't include

the minor tributaries or other regulated drains within the subwatershed. Therefore, there is great potential for implementation of buffer/filter strips and stream restoration within the subwatershed as a best management practice for reducing *E. coli*, Nitrate+Nitrite, Total Phosphorus and TSS.

Since the subwatershed is 82% agricultural land with at least 4 locations from the windshield survey showing conventional tillage practices, promoting no-till or reduced till (conservation tillage) practices within this subwatershed would also help to reduce TSS and Phosphorus loadings. Based on the tillage information for Henry County, approximately 24% of corn fields in the County operate using conventional tillage practices. Nutrient/Waste Management plans would also be a beneficial BMP for reduction of all pollutants.

Based on this information, BMP implementation projects are very feasible within the Deer Creek Subwatershed. However, specific locations and types of BMPs should be carefully planned out in coordination with the landowners and applicable local, state and federal agencies and with the load reduction needs of the subwatershed in mind.

Prairie Creek Subwatershed

The Prairie Creek Subwatershed shows a moderate level of current water quality impairment (ranked sixth) and a high level of land use and industrial impairments (ranked third) based on the available data. The Prairie Creek Subwatershed exceeded the water quality targets for *E. coli*, Nitrate + Nitrite, Phosphorus and TSS in the CIWRP study and exceeded the water quality target for of *E. coli* in the IDEM data. Reductions of 93.6% for *E. coli*, is needed to meet the target load set for the subwatershed.

During the windshield survey, 2 of the 18 stream sites showed areas of streambank erosion that exceeded 3 feet (see Exhibit 28), 10 sites showed areas with no or inadequate stream buffers (see Exhibit 27) and 6 locations had in-stream debris. Based on these findings and as outlined in Part Three of the Watershed Inventory (Watershed Ranking tables and summaries), the Prairie Creek Subwatershed is a Medium Priority Subwatershed for Best Management Practice implementation.

The Prairie Creek Subwatershed is approximately 63% agricultural with urban areas concentrated in the northern portion of the subwatershed associated with Anderson, and in the western portion of the subwatershed associated with Pendleton. Therefore, the BMPs suggested in Table 54 for this subwatershed are agricultural/rural and urban focused and are beneficial in reducing pollutant loadings for more than one impairment.

Although the windshield survey did not show any locations where animals could access streams, the subwatershed is critical for *E. coli* indicating that there may be animal access locations that were not observed during the survey. Implementation of alternative watering systems as well as exclusionary fencing and eliminating the potential for animals to have direct access to the streams will reduce pollutant loadings within the subwatershed. For example, the load reduction needed for E. coli in this subwatershed is 93.6% in order to meet the target loads. Implementation of the exclusionary fencing alone provides a 90% reduction in E. coli based on Table 53 Best Management Practice Load Reduction Summary in Section 6.

The windshield survey results also showed that the subwatershed has at least 4 sites with no stream buffers or evidence of streambank erosion greater than 3 feet in depth. The subwatershed has approximately 14 miles of major stream corridor which doesn't include the minor tributaries or other regulated drains within the subwatershed. Therefore, there is great potential for implementation of buffer/filter strips, naturalized stream buffers and stream restoration within the subwatershed as a best management practice for reducing Nitrate+Nitrite, Total Phosphorus and TSS.

Since the subwatershed is 63% agricultural land and the tillage information for Madison County indicates that approximately 73% of corn fields in the County operate using conventional tillage practices, promoting no-till or reduced till (conservation tillage) practices within this subwatershed would also help to reduce pollutant loadings. Grassed waterways and Nutrient/Waste Management plans would also be a beneficial BMP within these agricultural areas for reduction of all pollutants.

Approximately 34.5% of the subwatershed is mapped as having hydric soils. These areas would be conducive for wetland restoration, which has the potential to reduce pollutant loads by 80% for sediment and *E. coli*, 55% for phosphorus and 45% for nitrogen.

The Prairie Creek Subwatershed includes a portion of the City of Anderson and the Town of Pendleton. Urban runoff is often a significant source of nonpoint source pollution within a watershed. The implementation of BMPs such as infiltration trenches and rain barrels/rain gardens within urban areas has the potential to significantly reduce the pollutant loadings within the watershed.

Based on this information, BMP implementation projects are very feasible within the Prairie Creek Subwatershed. However, specific locations and types of BMPs should be carefully planned out in coordination with the landowners and applicable local, state and federal agencies and with the load reduction needs of the subwatershed in mind.

Headwaters Lick Creek Subwatershed

The Headwaters Lick Creek Subwatershed shows a low level of current water quality impairment (ranked seventh) and a moderate level of land use and industrial impairments (ranked fifth) based on the available data. The Headwaters Lick Creek Subwatershed exceeded the water quality targets for *E. coli*, Nitrate + Nitrite, Phosphorus and TSS in the CIWRP study and exceeded the water quality target for *E. coli*, Nitrate + Nitrite in the IDEM data. Reductions of 93.8% and 11.1% needed for *E. coli* and Nitrate + Nitrite, respectively to meet the target loads set for the subwatershed.

During the windshield survey, 4 of the 9 stream sites showed areas of minor streambank erosion (see Exhibit 28), 8 sites showed areas with insufficient or no stream buffers (see Exhibit 27), 2 locations had in-stream debris, 1 location of animal access to the stream (Exhibit 26) was observed and conventional tillage practices were seen in 5 of the locations (see Exhibit 29) within the Headwaters Lick Creek Subwatershed. Based on these findings and as outlined in Part Three of the Watershed Inventory (Watershed Ranking tables and summaries), the subwatershed is a Medium Priority Subwatershed for Best Management Practice implementation.

The Headwaters Lick Creek Subwatershed is approximately 85% agricultural with the only urban area concentrated in the eastern portion of the subwatershed associated with Markleville. Therefore, the BMPs suggested in Table 54 for this subwatershed are agricultural/rural focused and are beneficial in reducing pollutant loadings for more than one impairment.

The windshield survey information showed that there is at least 1 location within the subwatershed where animals could access streams and there is 1 active CFO. Implementation of alternative watering systems as well as exclusionary fencing and eliminating the potential for animals to have direct access to the streams will reduce pollutant loadings within the subwatershed. For example, the load reduction needed for *E. coli* in this subwatershed is 93.8% in order to meet the target loads. Implementation of the exclusionary fencing alone provides a 90% reduction in *E. coli* for area tributary to the fencing based on Table 53 Best Management Practice Load Reduction Summary in Section 6. Exclusionary fencing also provides 70% removal of TSS, 60% of Phosphorus and 65% of Nitrogen.

The windshield survey results showed that the subwatershed has at least 6 sites with no stream buffers or evidence of streambank erosion. The subwatershed has approximately 25 miles of major stream corridor which doesn't include the minor tributaries or other regulated drains within the subwatershed. Therefore, there is great potential for implementation of buffer/filter strips within the subwatershed as a best management practice for reducing *E. coli*, Nitrate+Nitrite, Total Phosphorus and TSS.

Since the subwatershed is 85% agricultural land with at least 5 locations from the windshield survey showing conventional tillage practices, promoting no-till or reduced till (conservation tillage) practices within this subwatershed would also help to reduce Nitrate+Nitrite loadings. Based on the tillage information for Madison County, approximately 73% of corn fields in the County operate using conventional tillage practices. Nutrient/Waste Management plans would also be a beneficial BMP within these agricultural areas for reduction of all pollutants.

Approximately 30.1% of the subwatershed is mapped as having hydric soils. These areas would be conducive for wetland restoration, which has the potential to reduce pollutant loads by 80% for sediment and *E. coli*, 55% for phosphorus and 45% for nitrogen.

Based on this information, BMP implementation projects are very feasible within the Headwaters Lick Creek Subwatershed. However, specific locations and types of BMPs should be carefully planned out in coordination with the landowners and applicable local, state and federal agencies and with the load reduction needs of the subwatershed in mind.

Low Priority Subwatersheds

The McFadden Ditch and Foster Branch Subwatersheds are both considered Low Priority areas.

The McFadden Ditch Subwatershed shows a low level of current water quality impairment (ranked eighth) and a low level of land use and industrial impairments (ranked seventh). The Foster Branch Subwatershed shows a moderate level of current water quality impairment (ranked fifth) and a low level of land use and industrial impairments (ranked eighth).

Specific Source Critical Areas

Sources that would reduce loading of several pollutants of concern or address several identified problems at once if modified or eliminated were designated Specific Source Critical Areas. The specific source critical areas are found throughout the watershed and not confined to a specific subwatershed. These critical areas can and do overlap the Subwatershed Critical Areas.

The locations of the Specific Source Critical Areas were identified during the Windshield Survey, completed as part of the Watershed Inventory. The windshield survey only covered a finite number of locations within the watershed, so instances and locations of these sources may not be specifically identified, but are still considered critical areas.

Livestock Access

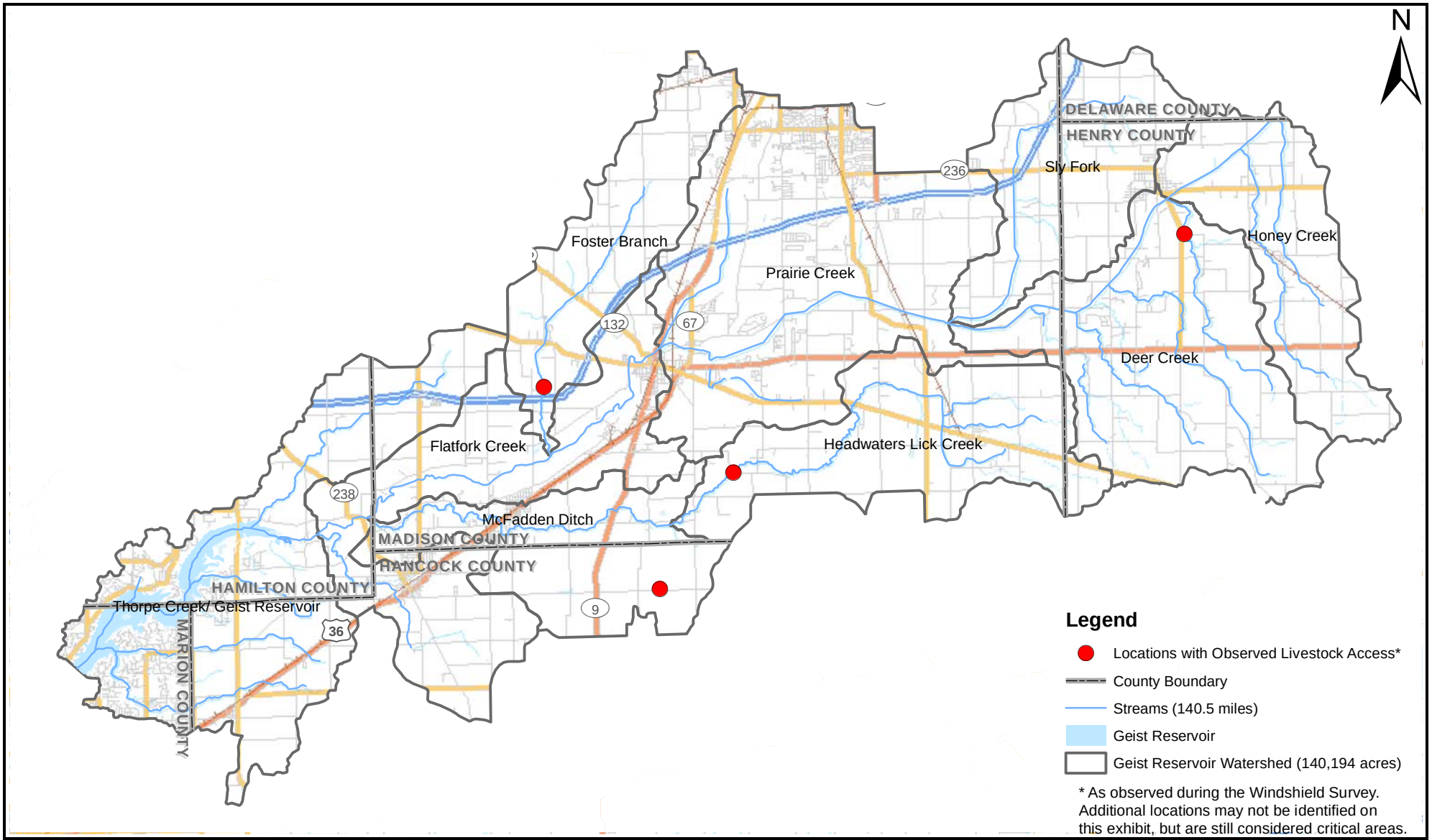
All areas in the watershed where livestock have direct access to the stream are identified as being critical.

Animal access within the stream can inhibit wildlife and aquatic habitat, increase flooding risks, and introduce additional pollutants. Animal waste is a large source of *E.coli* and when animals have access to the stream, *E.coli* is directly introduced to the stream. As livestock walk down the streambanks, existing vegetation can be dislodged enabling streambank erosion, thus introducing sediment and nutrients to the water. Exhibit 26 shows the locations where direct animal access to streams was identified during the windshield survey. As stated previously, the windshield survey only covered a finite number of locations within the watershed, so all instances and locations of direct animal access to streams may not be specifically identified, but are still considered critical areas.

Absent or Insufficient Stream Buffers

All areas where stream buffers are absent or insufficient are identified as being critical.

Stream buffers are areas of either planted or natural vegetation between a surface water body and the surrounding land use. Runoff from the surrounding land may carry sediment and organic matter, and plant nutrients and pesticides that are either bound to the sediment or dissolved in the water. The buffers provide water quality protection by reducing the amount of pollutants in the runoff before it enters the water body. Filter strips can also provide localized erosion protection and habitat for wildlife.



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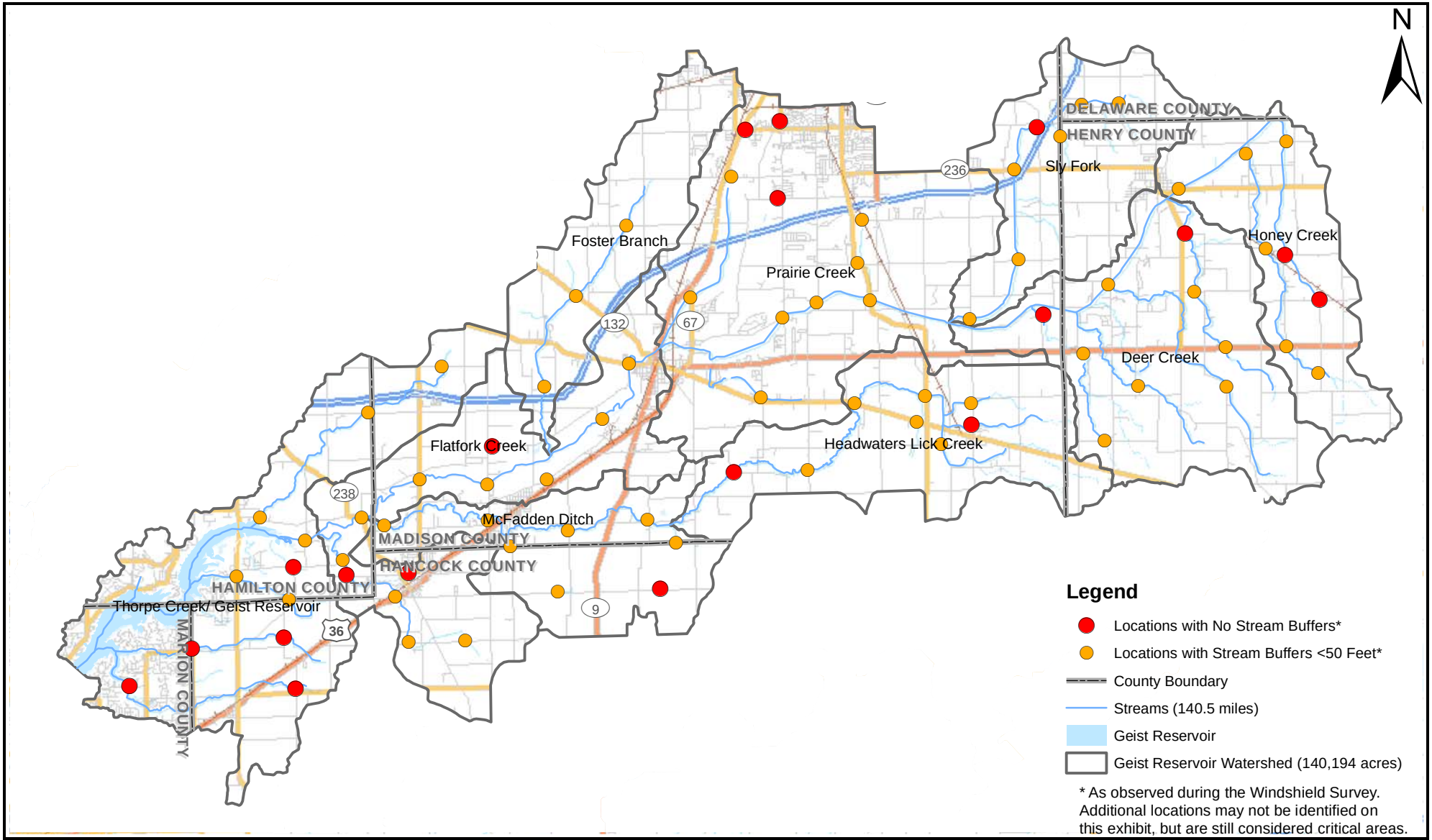
TITLE: **Livestock Access Critical Area Exhibit**		PROJECT: **Geist Reservoir/Upper Fall Creek Watershed Management Plan**	
BASE LAYER: HUC-12 Watershed Boundaries		PROJECT NO.: 09006	EXHIBIT: 26	SHEET: 1 OF: 1
CLIENT: Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206		QUADRANGLE: N/A	DATE: 09/30/10	SCALE: 1" = 16,000'



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TITLE: **Stream Buffers Critical Areas**		PROJECT: **Geist Reservoir/Upper Fall Creek Watershed Management Plan**	
BASE LAYER: HUC-12 Watershed Boundaries		PROJECT NO.: 09006	EXHIBIT: 27	SHEET: 1 OF: 1
CLIENT: Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206		QUADRANGLE: N/A	DATE: 09/30/10	SCALE: 1" = 16,000'

Stream buffers were assessed on a subwatershed scale at each of the waterway crossing points. Identification of buffers was broken up into the following categories: absent, present > 50 feet and present (minimum 10 feet) < 50 feet. Insufficent buffers include the buffers identified as less than 50 feet. Exhibit 27 shows the locations where absent or insufficient stream buffers were identified during the windshield survey. As stated previously, the windshield survey only covered a finite number of locations within the watershed, so instances and locations of absent or insufficient buffers may not be specifically identified, but are still considered critical areas. It should be noted that the 30 feet reference in the BMP section is in regards to the minimum required buffer width for funding opportunities from the USDA and in general is a standard minimum for water quality. The 50 foot reference is for the windshield survey. It was determined to use 50 feet instead of 30 feet since this parameter wasn't going to actually be measured but observed from a vehicle and therefore leaving some room for interpretation.

Excessive Streambank Erosion

All areas where excessive streambank erosion is occurring are identified as being critical.

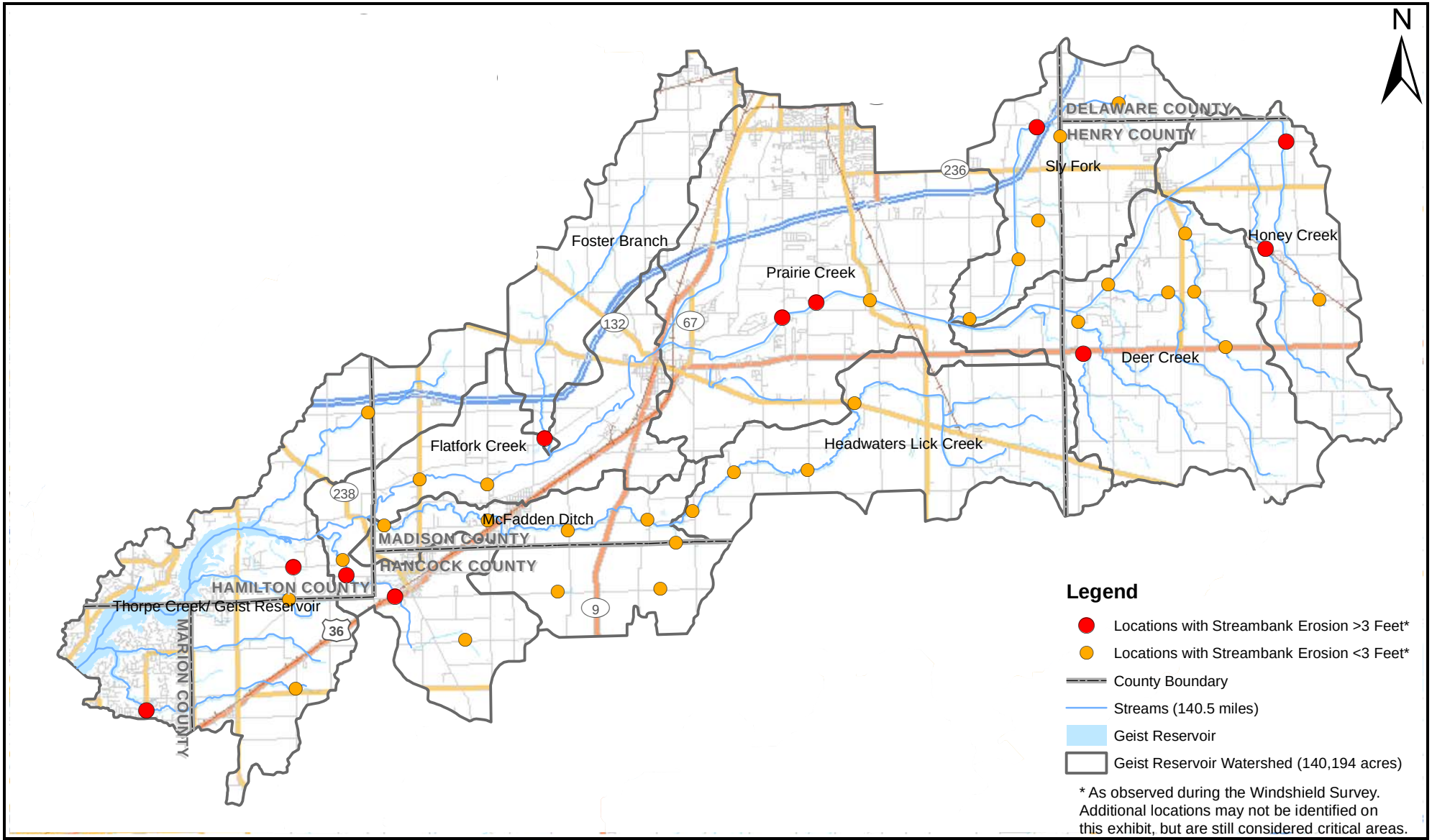
Accelerated erosion can contribute high sediment loads to receiving streams, which is a concern due both to the impacts of the sediment itself, and of the contaminants that often bind with, or otherwise reside in the sediment. The sediment itself can smother aquatic habitat and therefore negatively affect the aquatic flora and fauna. Sediment can also transport nutrients, especially phosphorus that tends to adhere to sediment particles causing excess algal growth leading to large swings in DO.

Streambank erosion was assessed on a subwatershed scale at each of the waterway crossing points. Identification of streambank erosion was broken up into the following categories: absent, stabilized (rip-rap, coir log, etc.), present > 3 feet tall and present < 3 feet tall. Excessive streambank erosion includes those areas where erosion was identified as being greater than 3 feet. Exhibit 28 shows the locations where excessive streambank erosion was identified during the windshield survey. As stated previously, the windshield survey only covered a finite number of locations within the watershed, so instances and locations of excessive streambank erosion may not be specifically identified, but are still considered critical areas.

Agricultural Areas Practicing Conventional Till

All agricultural areas where conventional till is practiced, especially those adjacent to waterways, are identified as being critical.

Conservation till and no till practices reduce the amount of runoff leaving a field. Crop residue protects the soil surface and allows water to infiltrate. As the amount of runoff is reduced and the velocities of runoff leaving the agricultural area are reduced, the amount of sediment, nutrients and pesticides carried in the runoff are reduced. Conventional till does not retain any crop residue and therefore contributes a large amount of sediment, nutrients and pesticides with an increased runoff rate. Exhibit 29 shows the locations where conventional till was identified during the windshield survey. As stated previously, the windshield survey only covered a finite number of locations within the watershed, so instances and locations of conventional till may not be specifically identified, but are still considered critical areas.



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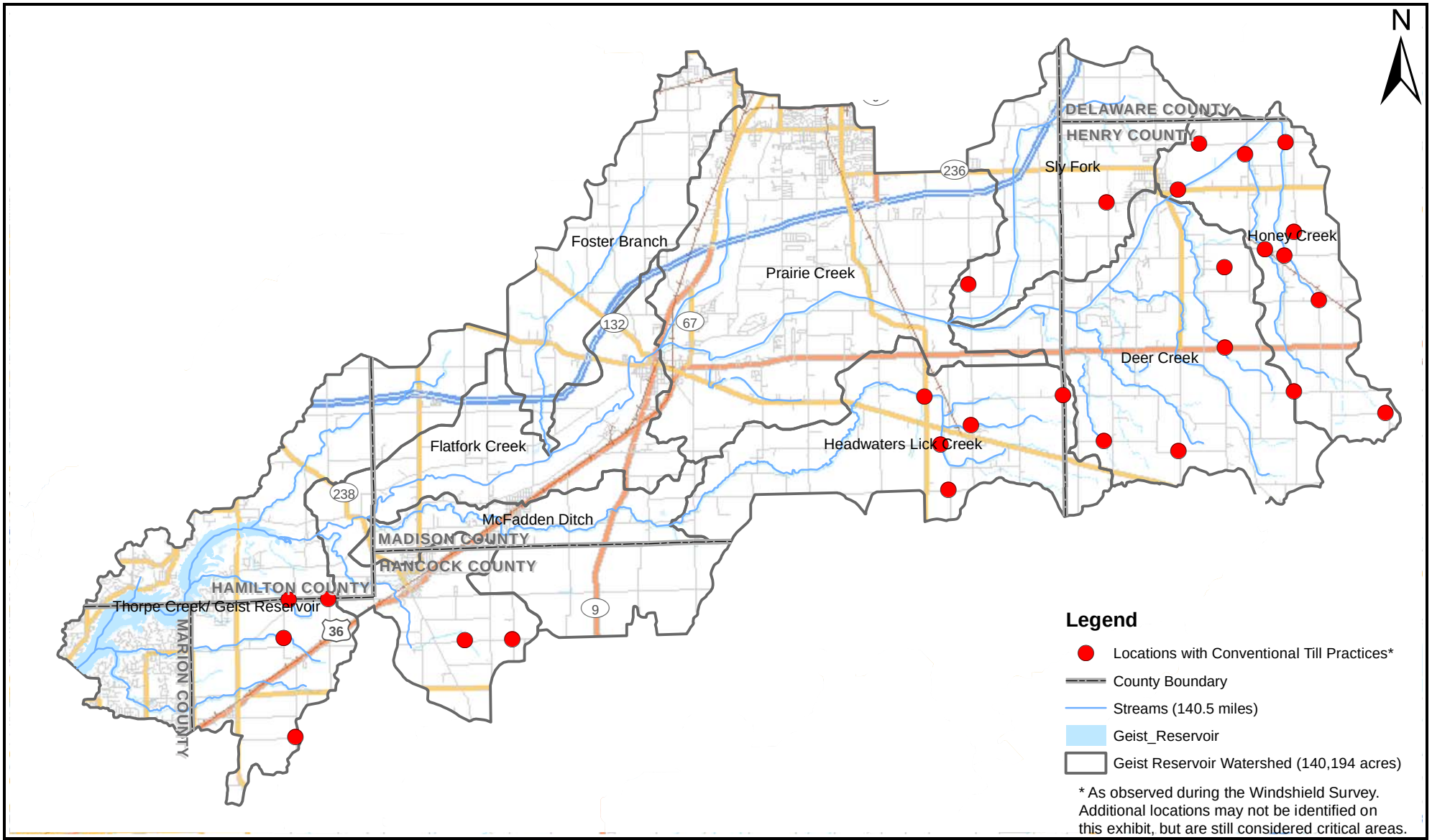
TITLE: **Streambank Erosion Critical Areas**		PROJECT: **Geist Reservoir/Upper Fall Creek Watershed Management Plan**	
BASE LAYER: HUC-12 Watershed Boundaries		PROJECT NO.: 09006	EXHIBIT: 28
CLIENT: Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206		QUADRANGLE: N/A	DATE: 09/30/10
		SHEET: 1 OF: 1	SCALE: 1" = 16,000'



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TITLE: **Conventional Till Critical Areas**		PROJECT: **Geist Reservoir/Upper Fall Creek Watershed Management Plan**		
BASE LAYER: HUC-12 Watershed Boundaries		PROJECT NO.: 09006	EXHIBIT: 29	SHEET: 1 OF: 1
CLIENT: Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206		QUADRANGLE: N/A	DATE: 09/30/10	SCALE: 1" = 16,000'

Section 6 – Choose Measures/BMPs to Apply

BMPs

The watershed restoration and management techniques described in this section, when applied to the Geist Reservoir/Upper Fall Creek Watershed, can help achieve the watershed goals and objectives to decrease the concentrations of sediment and nutrient loads identified in this WMP. The Steering Committee was provided a draft list of BMPs based on the impairments within the watershed and the measures that would improve the water quality within the watershed. Comments were received to add measures that some stakeholders had experience either implementing or educating landowners within the watershed. The selected measures and BMPs for improvement are categorized as Agricultural/Rural and Urban BMPs as well as Preventative Measures. The following BMP summaries are typical BMPs and are provided as a reference and generally describe each measure and its design components, it is not meant to be all inclusive list but only a guide.

To choose an appropriate BMP, it is essential to determine in advance the objectives to be met by the BMP and to calculate the cost and related effectiveness of alternative BMPs. Once a BMP has been selected, expertise is needed to insure that the BMP is properly installed, monitored, and maintained over time.

Agricultural/Rural BMPs

Agricultural/Rural BMPs are implemented on agricultural lands for the purpose of protecting water resources, protecting aquatic wildlife habitat, and protecting the land resource from degradation. These practices control the delivery of nonpoint source pollutants to receiving water resources by first minimizing the pollutants available.

Agricultural/Rural BMPs include:

- Alternative Watering System
- Buffer/Filter Strips
- Cover Crops
- Grassed Waterways
- Infiltration Trenches
- No-Till/Reduced Till (Conservation Tillage)
- Nutrient/Waste Management
- Rotational Grazing/Exclusionary Fencing
- Two Stage Ditches
- Stream Restoration
- Wetland Restoration
- Reforestation

Alternative Watering System

Alternative watering systems (e.g. nose pumps or gravity flow systems) protect surface water by eliminating livestock's direct access to the stream. Providing an alternative watering source for livestock reduces soil erosion and sedimentation and improves surface water quality by reducing *E.coli* concentrations and nutrient loading. Alternative watering

systems help to provide additional bank stabilization and assist in the preservation of riparian buffers through a reduction in compaction.

Buffer/Filter Strips

Creating and maintaining buffers along stream and river channels and lakeshores increases open space and can reduce some of the water quality and habitat degradation effects associated with increased imperviousness and runoff in the watershed. Buffers provide hydrologic, recreational, and aesthetic benefits as well as water quality functions, and wildlife habitat. TSS, phosphorus, and nitrogen are at least partly removed from water passing through a naturally vegetated buffer. *E.coli* concentrations are also reduced with buffers. The percentage of pollutants removed depends on the pollutant load, the type of vegetation, the amount of runoff, and the character of the buffer area. The most effective buffer width can vary along the length of a channel. Adjacent land uses, topography, runoff velocity, and soil and vegetation types are all factors used to determine the optimum buffer width. Buffers need to be a minimum of 30 feet wide to be eligible for most USDA programs. The greater the width of the buffer, the pollutant removal efficiency will be greater. Education is important in teaching farmers what options they have for funding. Several state and federal programs exist to provide incentives for maintaining riparian buffers. The Wetlands Reserve Program (WRP) makes funding available for the purchase and restoration of wetlands and riparian buffer connections between wetlands.

A filter strip is an area of permanent herbaceous vegetation situated between environmentally sensitive areas and cropland, grazing land, or otherwise disturbed land. Filter strips reduce TSS, particulate organic matter, sediment adsorbed contaminants, and dissolved contaminant loadings in runoff to improve water quality. Filter strips also restore or maintain sheet flow in support of a riparian forest buffer, and restore, create, and enhance herbaceous habitat for wildlife and beneficial insects.

Filter strips should be permanently designated plantings to treat runoff and should not be part of the adjacent cropland's rotation. Overland flow entering the filter strip should be primarily sheet flow. If there is concentrated flow, it should be dispersed so that it creates sheet flow. Filter strips cannot be installed on unstable channel banks that are eroding due to undercutting of the toe bank. Permanent herbaceous vegetation should consist of a single species or a mixture of grasses, legumes and/or other forbs (an herbaceous plant other than a grass) adapted to the soil, climate, and farm chemicals used in adjacent cropland. Filter strips must be properly maintained so that they function properly.

Filter strips should be located to reduce runoff and increase infiltration and groundwater recharge throughout the watershed. Filter strips should also be strategically placed to intercept contaminants, thereby enhancing the water quality in the watershed. Filter strip sizes should be adjusted to accommodate planting, harvesting, and maintenance equipment. Filter strip widths greater than that needed to achieve a 30 minute flow-through time at ½-inch depth will not likely improve the effectiveness of the strip in addressing water quality concerns created by TSS, particulate organics, and sediment adsorbed contaminants. Like buffers; filter strips decrease TSS and nutrient loading, reduce *E.coli* concentrations, and increase open space. Education will help to teach farmers where these practices should be applied and sources of possible funding. Implementation of filter

strips is part of the Conservation Reserve Program and assistance may be provided to eligible projects.

Cover Crops

Cover crops can be legumes or grasses, including cereals, planted or volunteered vegetation established prior to or following a harvested crop primarily for seasonal soil protection and nutrient recovery. Cover crops protect soil from erosion decreasing sediment concentrations in the creek and recover/recycle phosphorus in the root zone. They are grown for one year or less.

Cover crops are established during the non-crop period, usually after the crop is harvested, but can be interseeded into a crop before harvest by aerial application or cultivation. Cover crops reduce phosphorus transport by reducing soil erosion and runoff. Both wind and water erosion move soil particles that have phosphorus attached. Sediment that reaches water bodies may release phosphorus into the water. The cover crop vegetation recovers plant-available phosphorus in the soil and recycles it through the plant biomass for succeeding crops. The soil tilth also benefits from the increase of organic material added to the surface. Growing vegetation promotes infiltration, and roots enhance percolation of water supplied to the soil. This reduces surface runoff. Runoff water can wash soluble phosphorus from the surface soil and crop residue and carry it off the field.

Grassed Waterways

Grassed waterways are natural or constructed channels established for transport of concentrated flow at safe velocities using adequate channel dimensions and proper vegetation. They are generally broad and shallow by design to move surface water across farmland without causing soil erosion. Grassed waterways are used as outlets to prevent rill and gully formation. The vegetative cover slows the water flow, minimizing channel surface erosion. When properly constructed, grassed waterways can safely transport large water flows downslope. These waterways can also be used as outlets for water released from contoured and terraced systems and from diverted channels. This BMP can reduce sediment concentrations of nearby waterbodies and pollutants in runoff. The vegetation improves the soil aeration and water quality due to its nutrient removal through plant uptake and absorption by soil. The waterways can also provide wildlife corridors and allows more land to be natural areas.

No-till/Reduced Till Conservation Practices

This practice manages the amount, orientation, and distribution of crop and other plant residues on the soil surface year-round, while growing crops planted in narrow slots or tilled, residue free strips previously untilled by full-width inversion implements. The purpose of this conservation practice is to reduce sheet and rill erosion thereby promoting improved water quality by reducing sediment and nutrient loading in the waterways. Additional benefits of this practice are to reduce wind erosion, to maintain or improve soil organic matter content and tilth, to conserve soil moisture, to manage snow, to increase plant available moisture or reduce plant damage from freezing or desiccation, and to provide food and escape cover for wildlife. This technique includes tillage and planting methods commonly referred to as no-till, zero till, slot plant, row till, direct seeding, or strip till.

Residue management is when loose residues are left on the field, and then uniformly distributed on the soil surface to minimize variability in planting depth, seed germination, and emergence of subsequently planted crops. When combines or similar machines are used for harvesting, they are equipped with spreaders capable of distributing residue over at least 80% of the working width. No-till or strip till may be practiced continuously throughout the crop sequence, or may be managed as part of a system which includes other tillage and planting methods such as mulch till. Production of adequate amounts of crop residues is necessary for the proper functioning of this conservation practice and can be enhanced by selection of high residue producing crops and crop varieties in the rotation, use of cover crops, and adjustment of plant populations and row spacings.

Maintaining a continuous no-till system will maximize the improvement of soil organic matter content. Also, when no-till is practiced continuously, soil reconsolidation provides additional resistance to sheet and rill erosion. The effectiveness of stubble to trap snow or reduce plant damage from freezing or desiccation increases with stubble height. Variable height stubble patterns may be created to further increase snow storage.

Nutrient/Waste Management

Nutrient management is the management of the amount, source, placement, form, and timing of the application of plant nutrients and soil amendments to minimize the transport of applied nutrients into surface water or groundwater. Nutrient management seeks to supply adequate nutrients for optimum crop yield and quantity, while also helping to sustain the physical, biological, and chemical properties of the soil.

Nutrient management plans are generally developed with assistance from NRCS. A nutrient budget for nitrogen, phosphorus, and potassium is developed considering all potential sources of nutrients including, but not limited to, animal manure, commercial fertilizer, crop residue, and legume credits. Realistic yields are based on soil productivity information, potential yield, or historical yield data based on a 5-year average. Nutrient management plans specify the form, source, amount, timing, and method of application of nutrients on each field in order to achieve realistic production levels while minimizing transport of nutrients to surface and/or groundwater.

Animal waste is a major source of pollution to waterbodies. To protect the health of aquatic ecosystems and meet water quality targets, manure must be safely managed. Good management of manure keeps livestock healthy, returns nutrients to the soil, improves pastures and gardens, and protects the environment, specifically water quality. Poor manure management may lead to sick livestock, unsanitary and unhealthy conditions for humans and other organisms, and increased insect and parasite populations. Proper management of animal waste can be done by implementing BMPs, through safe storage, by application as a fertilizer, and through composting. Proper manure management can effectively reduce *E.coli* concentrations, nutrient levels and sedimentation. Manure management can also be addressed in education and outreach to encourage farmers to participate in this BMP.

Rotational Grazing and Exclusionary Fencing

Intensive grazing management is the division of pastures into multiple cells that receive a short but intensive grazing period followed by a period of recovery of the vegetative cover.

Pasture management practices that include the use of rotational grazing systems are beneficial for water and soil quality. Systems that include the riparian area as a separate pasture are beneficial because livestock access to these areas is controlled to limit the impact on the riparian plant communities.

The impacts of livestock grazing within riparian areas include manure and urine deposited directly into or near surface waters where leaching and runoff can transport nutrients and pathogens into the water. Unmanaged grazing may accelerate erosion and sedimentation into surface water, change stream flow, and destroy aquatic habitats. Improper grazing can reduce the capacity of riparian areas to filter contaminates, shade aquatic habitats, and stabilize stream banks.

A livestock exclusion system is a system of permanent fencing (board, barbed, etc) installed to exclude livestock from streams and areas, not intended for grazing. This will reduce erosion, sediment, and nutrient loading, and improve the quality of surface water. Education and outreach programs focusing on rotational grazing and exclusionary fencing are important in the success of this BMP.

Two Stage Ditches

Water, when confined to a channel such as a stream or ditch, has the potential to cause great destruction. If there is too much water moving through an undersized area of land, then there is nowhere for it to go but to rush out of its barriers. Bank erosion, scouring, and flooding are good indicators that there is problem with how the water is drained from the soil. Researchers have been working on a type of in-stream restoration called the two-stage ditch that has proven to help solve these problems.

The design of a two-stage ditch incorporates a floodplain zone, called benches, into the ditch by removing the ditch banks roughly 2-3 feet about the bottom for a width of about 10 feet on each side. This allows the water to have more area to spread out on and decreases the velocity of the water. This not only improves the water quality, but also improves the biological conditions of the ditches where this is located.

The benefits of a two-stage ditch over the typical agricultural ditch include both improved drainage function and ecological function. The two-stage design improves ditch stability by reducing water flow and the need for maintenance, saving both labor and money. It also has the potential to create and maintain better habitat conditions. Better habitats for both terrestrial and marine species are a great plus when it comes to the two-stage ditch design. The transportation of sediment and nutrients is decreased considerably because the design allows the sorting of sediment, with finer silt depositing on the benches and courser material forming the bed.

Stream Restoration

Stream restoration techniques are used to improve stream conditions so they more closely mimic natural conditions. For urban stream reaches, restoration to natural conditions may not be possible or feasible. For instance, physical constraints due to adjacent development may limit the ability to re-meander a stream. In addition, the natural stream conditions may not be able to accommodate the increased volume of flow from the developed watershed.

Even in cases where restoring the stream to its natural condition is not possible, the stream can still be naturalized and improved by reestablishing riparian buffers, performing stream channel maintenance, stabilizing streambanks using bioengineering techniques, and, where appropriate, by removing manmade dams and installing pool/riffle complexes. Stream restoration projects may be one component of floodplain restoration projects, and can be supplemented with trails and interpretive signs, providing recreational and educational benefits to the community.

Wetland Restoration

Because agriculture and urbanization have destroyed or degraded many of the remaining wetlands in the Geist Reservoir/Upper Fall Creek, wetland enhancement projects are necessary to improve the diversity and function of these degraded wetlands. The term enhancement refers to improving the functions and values of an existing wetland. Converted wetland sites (or sites that were formerly wetlands but have now been converted to other uses) can also be restored to provide many of their former wetland benefits. Wetland restoration is the process of establishing a wetland on a site that is not currently a wetland, but once was prior to conversion. Restoring wetlands can address many of the concerns of the *Geist* Creek Stakeholders. Wetlands have the ability to reduce *E.coli* concentrations, nutrient loading, TSS concentrations, and flood damage. Wetlands can be used to teach landowners about their importance with respect to plants and animals and also increases the amount of open space in the watershed.

Wetland functional values vary substantially from wetland to wetland; they receive special consideration because of the many roles they play. Because of the wetland protection laws currently in place, the greatest impact on wetlands from future development in the Geist Reservoir/Upper Fall Creek will likely be a shift in the types of wetlands. Often in mitigation projects, various types of marshes, wet prairies, and other wetlands are filled and replaced elsewhere, usually with existing open water wetlands. This replacement may lead to a shift in the values served by the wetland communities due to a lack of diversity of wetland types. The wetland restorations that are proposed in the Geist Reservoir/Upper Fall Creek should include a variety of different wetland types to increase the diversity of wetlands in the watershed. The restoration of wetlands can decrease flood damage by providing new stormwater storage areas, will improve water quality by treating stormwater runoff, and will create new plant and wildlife habitat. In addition to these values, wetlands can be part of regional greenways or trail networks. They can be constructed with trails to allow the public to explore them more easily, and they can be used to educate the public through signs, organized tours, and other techniques. Wetland restorations are an exceptional way to meet multiple objectives within a single project.

Reforestation

Reforestation is the restocking of existing forests and woodlands which have been depleted. Reforestation can be used to improve the quality of human life by soaking up pollution and dust from the air and rebuild natural habitats and ecosystems.

Urban BMPs

For the past two decades the rate of land development across the country has been more than two times greater than the rate of population growth. The increased impervious surface associated with this development will increase stormwater volume and degrade water quality, which will harm the overall watershed.

The best way to mitigate stormwater impacts from new developments is to use Urban BMPs to treat, store, and infiltrate runoff onsite before it can affect water bodies downstream. Innovative site designs that reduce imperviousness and smaller-scale low impact development practices dispersed throughout a site are excellent ways to achieve the goals of reducing flows and improving water quality.

The Urban BMPs include:

- Bioretention Practices
- Filtration Basin
- Naturalized Detention Basin
- Naturalized Stream Buffer
- Pervious Pavement
- Rain Barrels/Gardens
- Infiltration Trench
- Stream Restoration

Bioretention Practices

Bioretention practices (including bioinfiltration or biofiltration) are primarily used to filter runoff stored in shallow depressions by utilizing plant uptake and soil permeability. This practice utilizes combinations of flow regulation structures, a pretreatment grass channel or other filter strip, a sand bed, a pea gravel overflow treatment drain, a shallow ponding area, a surface organic mulch layer, a planting soil bed, plant material, a gravel underdrain system, and an overflow system to promote infiltration. Bioinfilitration systems such as swales are used to treat stormwater runoff from small sites such as driveways, parking lots, and roadways. They provide a place for stormwater to settle and infiltrate into the ground. Biofiltration swales are a relatively low cost means of treating stormwater runoff for small sites typifying much of the urban environment, such as parking, roadways, driveways, and similar impervious features. They provide areas for stormwater to slow down and pollutants to be filtered out. Careful attention to location and alignment of swales can lend a pleasing aesthetic quality to sites containing them.

In general, bioretention practices are highly applicable to residential uses in community open space or private lots. The bioretention system is very appropriate for treatment of parking lot runoff, roadways where sufficient space accommodates off-line implementation, and pervious areas such as golf courses. This BMP is not recommended for highly urbanized settings where impervious surfaces comprise 95% or more of the area due to high flow events and limited storage potential. This BMP can address most of the WMP goals including; reducing concentration of sediments and nutrients. Bioretention practices can also decrease flooding by storing stormwater and increase open space.

Filtration Basin
Filtration basins provide pollutant removal (including TSS, nutrients, and *E.coli*) and reduce volume of stormwater released from the basin. These basins utilize sand filters or engineered soils to filter stormwater runoff through a sand or engineered soil layer within an underdrain system that conveys the treated runoff to a detention facility or to the ultimate point of discharge. The filtration system consists of an inlet structure, sedimentation chamber, sand/engineered soil layer, underdrain piping, and liner to protect against infiltration.

Naturalized Detention Basins
Naturalized wet-bottom detention basins are used to temporarily store runoff and release it at a reduced rate. Naturalized wet-bottom detention basins are better than traditional detention basins because they encourage water infiltration, and thereby recharge groundwater tables. Native wetland and prairie vegetation also help to improve water quality by trapping sediment and other pollutants found in runoff, and are aesthetically pleasing. Naturalized wet-bottom detention basins can be designed as either shallow marsh systems with little or no open water or as open water ponds with a wetland fringe and prairie side slopes.

Naturalized Stream Buffer
Creating and maintaining buffers along stream and river channels and lakeshores increases open space and can reduce some of the water quality and habitat degradation effects associated with increased imperviousness and runoff in the watershed. Buffers provide hydrologic, recreational, and aesthetic benefits as well as water quality functions, and wildlife habitat. Sediment, phosphorus, and nitrogen are at least partly removed from water passing through a naturally vegetated buffer. The percentage of pollutants removed depends on the pollutant load, the type of vegetation, the amount of runoff, and the character of the buffer area. The most effective buffer width can vary along the length of a channel. Adjacent land uses, topography, runoff velocity, and soil and vegetation types are all factors used to determine the optimum buffer width. Buffers need to be a minimum of 30 feet wide to be eligible for most USDA programs. Other specific requirements for regulated drains should be determined during the feasibility stages of utilizing this practice.

Pervious Pavement
Pervious pavement has the approximate strength characteristics of traditional pavement but allows rainfall and runoff to percolate through it. This decreases sediment concentrations and flood damage in the watershed by slowing the water from entering the streams. The key to the design of these pavements is the elimination of most of the fine aggregate found in conventional paving materials. Pervious pavement options include porous asphalt and pervious concrete. Porous asphalt has coarse aggregate held together in the asphalt with sufficient interconnected voids to yield high permeability. Pervious concrete, in contrast, is a discontinuous mixture of Portland cement, coarse aggregate, admixtures, and water that also yields interconnected voids for the passage of air and water. Underlying the pervious pavement is a filter layer, a stone reservoir, and filter fabric. Stored runoff gradually drains out of the stone reservoir into the subsoil.

Modular pavement consists of individual blocks made of pervious material such as sand, gravel, or sod interspersed with strong structural material such as concrete. The blocks are

typically placed on a sand or gravel base and designed to provide a load-bearing surface that is adequate to support personal vehicles, while allowing infiltration of surface water into the underlying soils. They usually are used in low-volume traffic areas such as overflow parking lots and lightly used access roads. An alternative to pervious and modular pavement for parking areas is a geotextile material installed as a framework to provide structural strength. Filled with sand and sodded, it provides a completely grassed parking area.

Rain Barrels/Gardens

A rain barrel is a container that collects and stores rainwater from your rooftop (via your home's disconnected downspouts) for later use on your lawn, garden, or other outdoor uses. Rainwater stored in rain barrels can be useful for watering landscapes, gardens, lawns, and trees. Rain is a naturally soft water and devoid of minerals, chlorine, fluoride, and other chemicals. In addition, rain barrels help to reduce peak volume and velocity of stormwater runoff to streams and storm sewer systems.

Rain gardens are small-scale □ioretention systems that be can be used as landscape features and small-scale stormwater management systems for single-family homes, townhouse units, and some small commercial development. These units not only provide a landscape feature for the site and reduce the need for irrigation, but can also be used to provide stormwater depression storage and treatment near the point of generation. These systems can be integrated into the stormwater management system since the components can be optimized to maximize depression storage, pretreatment of the stormwater runoff, promote evapotranspiration, and facilitate groundwater recharge. The combination of these benefits can result in decreased flooding due to a decrease in the peak flow and total volume of runoff generated by a storm event. In addition, these features can be designed to provide a significant improvement in the quality of the stormwater runoff. These units can also be integrated into the design of parking lots and other large paved areas, in which case they are referred to as □ioretention areas.

Infiltration Trenches

Infiltration trenches are excavated trenches backfilled with a coarse stone aggregate and biologically active organic matter. Infiltration trenches allow temporary storage of runoff in the void space between the aggregate and help surface runoff infiltrate into the surrounding soil. Infiltration trenches remove fine sediment and the pollutants associated with them. Soil infiltration trenches can be effective at reducing sediment concentrations and nutrient loading. Soluble pollutants can be effectively removed if detention time is maximized. The degree to which soluble pollutants are removed is dependent primarily on holding time, the degree of bacterial activity, and chemical bonding with the soil. The efficiency of the trench to remove pollutants can be increased by increasing the surface area of the trench bottom. Infiltration trenches can provide full control of peak discharges for small sites. They provide groundwater recharge and may augment base stream flow.

Stream Restoration

Stream restoration techniques are used to improve stream conditions so they more closely mimic natural conditions. For urban stream reaches, restoration to natural conditions may not be possible or feasible. For instance, physical constraints due to adjacent development may limit the ability to re-meander a stream. In addition, the natural stream conditions may not be able to accommodate the increased volume of flow from the developed watershed.

Even in cases where restoring the stream to its natural condition is not possible, the stream can still be naturalized and improved by reestablishing riparian buffers, performing stream channel maintenance, stabilizing streambanks using bioengineering techniques, and, where appropriate, by removing manmade dams and installing pool/riffle complexes. Stream restoration projects may be one component of floodplain restoration projects, and can be supplemented with trails and interpretive signs, providing recreational and educational benefits to the community.

Preventative Measures

Conservation Design Developments

The goal of conservation design development is to protect open space and natural resources for people and wildlife, while at the same time allowing development to continue. Conservation design developments designate half or more of the buildable land area as undivided permanent open space. They are density neutral, allowing the same density as in conventional developments, but that density is realized on smaller areas of land by clustering buildings and infrastructure. In addition to clustering, conservation design developments incorporate natural riparian buffers and setbacks for streams, wetlands, other waterbodies, and adjacent agricultural.

The first and most important step in designing a conservation development is to identify the most essential lands to preserve in conservation areas. This will require coordination with local officials and the community as this practice is commonly added into ordinances and future planning efforts. Natural features including streams, wetlands, lakes, steep slopes, mature woodlands, native prairie, and meadow (as well as significant historical and cultural features) are included in conservation areas. Clustering is a method for preserving these areas. Clustered developments allow for increased densities on less sensitive portions of a site, while preserving the remainder of the site in open space for conservation and recreational uses (such as trails, soccer or ball fields).

Clustering can be achieved in a planned unit development (PUD) or planned residential development (PRD). PUDs contain a mix of zoning classifications that may include commercial, residential, and light industrial uses, all of which are blended together. Well-designed PUDs usually locate residences and offices within walking distance of each other to reduce traffic. Planned residential developments (PRDs) apply similar concepts to residential developments.

Greenways and Trails

Greenways can provide a large number of functions and benefits to nature and the public. For plants and animals, greenways provide habitat, a buffer from development, and a corridor for migration. Greenways located along streams include riparian buffers that protect water quality by filtering sediments and nutrients from surface runoff and stabilizing streambanks. By buffering the stream from adjacent developed land use, riparian greenways offset some of the impacts associated with increased impervious surface in a watershed. Maintaining a good riparian buffer can mitigate the negative impacts of approximately 5% additional impervious surface in the watershed.

Greenways also provide long, linear corridors with options for recreational trails. Trails along the river provide watershed stakeholders with an opportunity to exercise and enjoy the outdoors. Trails allow users to see and access the river, thereby connecting people to their river and the overall watershed. Trails can also be used to connect natural areas, cultural and historic sites and communities, and serve as a safe transportation corridor between work, school, and shopping destinations.

Techniques for establishing greenways and trails involve the development of a plan that proposes general locations for greenways and trails. In the case of trails, the plan also identifies who the users will be and provides direction on trail standards. Plans can be developed at the community and/or county level, as well as regionally, statewide, and in a few cases, at the national level. Public and stakeholder input are crucial for developing successful greenway and trail plans.

Several techniques can be used for establishing greenways and trails. Greenways can remain in private ownership, they can be purchased, or easements can be acquired for public use. If the lands remain in private ownership, greenway standards can be developed, adopted, and implemented at the local level through land use planning and regulation. Development rights for the greenway can be purchased from private landowners where regulations are unpopular or not feasible.

If the greenways will include trails for public use, the land for trails is usually purchased and held by a public agency such as a forest preserve district or local park system. In some cases, easements will be purchased rather than purchasing the land itself. Usually longer trail systems are built in segments, and completing connections between communities depends heavily on the level of public interest in those communities.

In new developing areas, the local planning authority can require trails. Either the developer or the community can build the trails. In some cases, the developer will voluntarily plan and build a trail connection through the development and use this as a marketing tool to future homebuyers. In other cases, the local planning authority may require the developer to donate an easement for the trail. To install trails through already developed areas, land can be purchased by a community agency with a combination of local, state, and federal funds. Impediments to land purchase can significantly slow up trail connections in already established areas.

Protected Ownership

There are several options for land transfer ranging from donation to fee simple land purchase. Donations can be solicited and encouraged through incentive programs. Unfortunately, while preferred by money-strapped conservation programs, land donations are often not adequate to protect high priority sites. A second option is outright purchase (or fee simple land purchase). Outright purchase is frequently the least complicated and most permanent protection technique, but is also the most costly. A conservation easement is a less expensive technique than outright purchase that does not require the transfer of land ownership but rather a transfer of use rights. Conservation easements might be attractive to property owners who do not want to sell their land at the present time, but would support perpetual protection from further development. Conservation easements can be donated or purchased.

Protecting Open Space and Natural Areas

Several techniques can be used for protecting natural areas and open space in both public and private ownership. The first step in the process is to identify and prioritize properties for protection. The highest priority natural areas should be permanently protected by the ownership or under the management of public agencies or private organizations dedicated to land conservation. Other open space can be protected using conservation design development techniques, and is more likely to be managed by homeowner associations.

Septic Tank/Field Maintenance and Repair

Septic, or on-site waste disposal systems, are the primary means of sanitary flow treatment in the unincorporated parts of the Geist Reservoir/Upper Fall Creek Watershed. Because of the prohibitive cost of providing centralized sewer systems to many areas, septic tank systems and fields will remain the primary means of treatment into the future. Annual maintenance of septic systems is crucial for their operation, particularly the annual removal of accumulated sludge. The cost of replacing failed septic tanks is about $5,000-$15,000 per unit based on industry standards.

Property owners are responsible for their septic systems under the regulation of the County Health Department. When septic systems fail, untreated sanitary flows are discharged into open watercourses that pollute the water and pose a potential public health risk. Septic systems discharging to the ground surface are a risk to public health directly through body contact or contamination of drinking water sources, provide conditions favorable to insect vectors such as flies and mosquitoes, and contribute significant amounts of nitrogen and phosphorus to the watershed as well as being a direct source for elevated *E.coli* counts. Therefore, it is imperative for homeowners not to ignore septic failures. If plumbing fixtures back up or will not drain, the system is failing. The difficulty with this issue is that perception is that if you don't see it then it's not a problem. Until damage occurs to the actual property or homeowner, regular maintenance or repair isn't happening. Funding for this practice is limited as well.

Threatened and Endangered (T&E) Species Protection

Threatened and endangered species are those plant and animal species whose survival is in peril. Both the federal government and the state of Indiana maintain lists of species that meet threatened or endangered criteria within their respective jurisdictions. Threatened species are those that are likely to become endangered in the foreseeable future. Federally endangered species are those that are in danger of extinction throughout all or a significant portion of their range. A state-endangered species is any species that is in danger of extinction as a breeding species in Indiana.

Considerations in protecting endangered species include making sure there is sufficient habitat available – food, water, and "living sites" (For animals, this means areas for making nests and dens and evading predators. For plants, it refers to availability of preferred substrate and other desirable growing conditions.); providing corridors for those species that need to move between sites; and protecting species from impacts due to urbanization.

Several techniques can be used to protect T&E species. One technique is to acquire sites where T&E species occur. Purchase and protection of the site where the species is located

(with adequate surrounding buffer) may be sufficient to protect that population. In some instances it is not feasible or possible to buy the needed land. Where the site and buffer area is not available for purchase, where an animal's range is too large of an area (or migrates between sites), or where changes in hydrology or pollution from outside the site affect the species, other techniques must be used to protect the T&E species.

Developing a resource conservation or management plan for the species and habitat of concern is the next step. Resource plans consider the need for buffer areas and habitat corridors, and consider watershed impacts from hydrology changes or pollutant loadings. The conservation plan will include recommendations for management specific to the species and its habitat, whether located on private or public lands. The conservation plan will guide both the property owner and the local unit of government that plans and permits adjacent land uses and how to manage habitat to sustain the species.

Wetland Enhancement and Protection

Wetlands provide a multitude of benefits and functions. Wetlands improve water quality by removing suspended sediment and dissolved nutrients from runoff. They control the rate of runoff discharged from the watershed and reduce flooding by storing rainfall during storm events. Wetlands also provide habitat for plants and animals including many of those that are threatened and endangered.

Because agriculture and urbanization have destroyed or degraded many of the remaining wetlands in the Geist Reservoir/Upper Fall Creek Watershed, wetland enhancement projects are necessary to improve the diversity and function of these degraded wetlands. The term enhancement refers to improving the functions and values of an existing wetland. Converted wetland sites (or sites that were formerly wetlands but have now been converted to other uses) can also be restored to provide many of their former wetland benefits. Wetland restoration is the process of establishing a wetland on a site that is not currently a wetland, but once was prior to conversion. Wetlands have the ability to reduce nutrient loading, sediment concentrations, and flood damage. Wetlands can be used to teach landowners about their importance with respect to plants and animals and also increases the amount of open space in the watershed.

Best Management Practices Load Reductions

Load reduction calculations were estimated for nitrogen, phosphorus and sediment based on the potential BMPs to be implemented within the Geist Reservoir/Upper Fall Creek Watershed. The percent reductions for each BMP were based on the review of EPA's Stormwater Menu of BMPs, EPAs National Management Measures to Control Nonpoint Source Pollution from Agriculture, The Nature Conservancy of Indiana, The Center for Watershed Protection and STEPL. The BMPs listed are typical BMPS and are provided as a reference, it is not meant to be all inclusive list but only a guide. The reductions only apply to the drainage area that is directly tributary to the BMP implemented. Therefore, when looking at overall reductions in a given subwatershed, an aggregate for all BMPs implemented with each associated tributary area will be need to be evaluated.

The actual efficiency of each BMP is based on several variables making it difficult to accurately determine the number required to equal the reduction goals (e.g. the location in the watershed, tributary area, soils, etc), therefore specific locations and types of BMPs should be carefully planned out in coordination with the landowners and applicable local, state and federal agencies and with the load reduction needs of the subwatershed in mind. Table 53 shows the expected load reductions and associated costs for each BMP.

Table 53: Best Management Practice Load Reduction Summary					
Agricultural/Rural Best Management Practices					
	Estimated Load Reductions				
BMP/Measure	**Sediment**	**Phosphorus**	**Nitrogen**	***E.coli***	**Cost**
Alternative Watering System	80%	78%	75%	N/A	$5,000/EA
Buffer/Filter Strips	65%	75%	70%	N/A	$5,000-$10,000/AC
Cover Crops	40%	45%	40%	N/A	$100/AC
Exclusionary Fencing	70%	60%	65%	90%	$50/Ft
Grassed Waterways	80%	30%	40%	N/A	$5,000-$10,000/AC
Nutrient/Waste Management	60%	90%	80%	85%	$5 - $30/AC
Infiltration Trench	100%	45%	45%	N/A	$10,000-$20,000/AC
No-Till/Reduced Till (Conventional Tillage)	75%	45%	55%	N/A	$20/AC
Reforestation	80%	42%	68%	N/A	$750/AC
Rotational Grazing	40%	20%	20%	N/A	N/A
Stream Restoration	75%	75%	75%	N/A	$100-$250/Ft
Two-Stage Ditches	38%	33%	17%	N/A	$15-$20/Ft
Wetland Restoration	80%	55%	45%	80%	$5,000-$10,000/AC
Urban Best Management Practices					
	Estimated Load Reductions				
BMP/Measure	**Sediment**	**Phosphorus**	**Nitrogen**	***E.coli***	**Cost**
Bioretention Practices	40%	80%	65%	N/A	$10,000-$20,000/AC
Filtration Basin	75%	65%	60%	N/A	$10,000-$20,000/AC
Naturalized Detention Basin	80%	55%	35%	N/A	$10,000-$20,000/AC
Naturalized Stream Buffer	75%	45%	40%	N/A	$10,000-$20,000/AC
Pervious Pavement	95%	85%	85%	N/A	$2 - $7/Sq. Ft
Rain Barrels	N/A	N/A	N/A	N/A	$75-$300/Each
Rain Garden	80%	20%	20%	N/A	$10,000-$20,000/AC
Stream Restoration	75%	75%	75%	N/A	$100-$250/Ft
Infiltration Trench	100%	45%	45%	N/A	$10,000-$20,000/AC

Subwatershed Best Management Practice Selection

Table 54 is a breakdown of the selected best management practices for each subwatershed based on the characteristics of the subwatershed that are degrading its water quality. The BMPs listed are typical BMPS and are provided as a reference, it is not meant to be all inclusive list but only a guide. The "Reason for being Critical" column was created based on the subwatershed specific analysis of the land use within the subwatershed, water quality data (IDEM, CIWRP and V3), and the findings of the windshield survey. The water quality parameters that require reduction loads equal to or greater than 50% based on Tables 49-51 were considered to be critical for that subwatershed. Similarly, the windshield survey parameters that ranked 1, 2, or 3 were considered to be critical for that subwatershed.

The "Suggested BMP" column was then created only including the BMPs that would provide better than a 50% reduction based on the information provided in Table 53 for its associated critical impairment. Certain BMPs are suggested for more than one impairment (i.e. Buffer/Filter Strips are suggested for *E.coli*, Nitrate+Nitrite, Total Phosphorus, Lack of Stream Buffers and Streambank Erosion). The table was created in this way so not to limit the possible projects if a specific impairment is to be targeted for implementation for a specific funding source.

Table 54: BMP Selection		
Critical Area	**Reason for being Critical**	**Suggested BMP**
High Priority Subwatersheds		
Thorpe Creek	*E.coli*	Alternative Watering System
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Nutrient/Waste Management
		Wetland Restoration
	Nitrate+Nitrite	Alternative Watering System
		Bioretention Practices
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Filtration Basin
		Nutrient/Waste Management
		No-till/Reduced Till (Conservation Tillage)
		Pervious Pavement
		Reforestation
		Stream Restoration
	Total Phosphorus	Alternative Watering System
		Bioretention Practices
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Filtration Basin
		Naturalized Detention Basin
		Nutrient/Waste Management
		Pervious Pavement
		Stream Restoration
		Wetland Restoration
	Conventional Tillage Practices	Education and Outreach
		Nutrient/Waste Management
		No-till/Reduced Till (Conservation Tillage)
	In-stream Debris	Education and Outreach
	Lack of Stream Buffers	Education and Outreach
		Buffer/Filter Strips
		Stream Restoration
	Streambank Erosion	Alternative Watering System
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Grassed Waterway
		Infiltration Trench
		Naturalized Stream Buffer
		Rain Barrel/Rain Garden
		Stream Restoration

Table 54 cont.: BMP Selection		
Critical Area	**Reason for being Critical**	**Suggested BMP**
High Priority Subwatersheds		
Honey Creek	*E.coli*	Alternative Watering System
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Nutrient/Waste Management
		Wetland Restoration
	Nitrate+Nitrite	Alternative Watering System
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Nutrient/Waste Management
		No-till/Reduced Till (Conservation Tillage)
		Reforestation
		Stream Restoration
	Conventional Tillage Practices	Education and Outreach
		Nutrient/Waste Management
		No-till/Reduced Till (Conservation Tillage)
	Streambank Erosion	Alternative Watering System
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Grassed Waterways
		Infiltration Trench
		Naturalized Stream Buffer
		Rain Barrel/Rain Garden
		Stream Restoration
Flatfork Creek	*E.coli*	Alternative Watering System
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Nutrient/Waste Management
		Wetland Restoration
	Lack of Stream Buffers	Education and Outreach
		Buffer/Filter Strips
		Stream Restoration
	Streambank Erosion	Alternative Watering System
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Grassed Waterway
		Infiltration Trench
		Naturalized Stream Buffer
		Rain Barrel/Rain Garden
		Stream Restoration

Table 54 cont.: BMP Selection		
Critical Area	**Reason for being Critical**	**Suggested BMP**
High Priority Subwatersheds		
Sly Fork Creek	*E.coli*	Alternative Watering System
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Nutrient/Waste Management
		Wetland Restoration
	In-stream Debris	Education and Outreach
Medium Priority Subwatersheds		
Deer Creek Prairie Creek Headwaters Lick Creek	*E.coli*	Alternative Watering System
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Nutrient/Waste Management
		Wetland Restoration
	Total Phosphorus	Alternative Watering System
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Nutrient/Waste Management
		Stream Restoration
		Wetland Restoration
	Livestock Access	Alternative Watering System
		Education and Outreach
		Exclusionary Fencing
		Nutrient/Waste Management
	Conventional Tillage Practices	Education and Outreach
		Nutrient/Waste Management
		No-till/Reduced Till (Conservation Tillage)
	In-stream Debris	Education and Outreach
	Lack of Stream Buffers	Education and Outreach
		Buffer/Filter Strips
		Stream Restoration
	Streambank Erosion	Alternative Watering System
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Grassed Waterway
		Infiltration Trench
		Naturalized Stream Buffer
		Rain Barrel/Rain Garden
		Stream Restoration

Table 54 cont.: BMP Selection		
Critical Area	**Reason for being Critical**	**Suggested BMP**
Low Priority Subwatersheds		
McFadden Ditch Foster Branch	*E.coli*	Alternative Watering System
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Nutrient/Waste Management
		Wetland Restoration
	Livestock Access	Alternative Watering System
		Education and Outreach
		Exclusionary Fencing
		Nutrient/Waste Management
Specific Source Critical Areas		
Livestock Access		Alternative Watering System
		Education and Outreach
		Exclusionary Fencing
		Nutrient/Waste Management
Absent or Insufficient Stream Buffers		Education and Outreach
		Buffer/Filter Strips
		Stream Restoration
Excessive Streambank Erosion		Alternative Watering System
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Grassed Waterway
		Infiltration Trench
		Naturalized Stream Buffer
		Rain Barrel/Rain Garden
		Stream Restoration
Agricultural Areas Practicing Conventional Tillage		Education and Outreach
		Nutrient/Waste Management
		No-till/Reduced Till (Conservation Tillage)

Incentives/Cost Share Opportunities

There are a number of incentive programs to implement BMP projects. Funding sources for wetland protection and restoration as well as technical assistance are available from programs at the local, regional, state, and federal levels of government including USEPA Section 319 grants. It will be the decision of the Steering Committee to prioritize the implementation projects for the watershed which will guide the decision of which funding opportunity to choose. The following is a description of the known funding sources applicable for implementation of this WMP.

U.S. Army Corps of Engineers (USACE) Continuing Authorities Program

At the Federal level, the USACE Continuing Authorities Program (CAP) from Section 206 of the 1996 Water Resources Development Act targets wetland restoration. This section, also known as the "Aquatic Ecosystem Restoration" program gives the USACE the authority to carry out aquatic ecosystem restoration and protection if the projects will improve the quality of the environment, are in the public interest, and are cost effective. The objective of section 206 is to restore degraded ecosystem structure, function, and dynamic processes to a less degraded and more natural condition. The local sponsors of aquatic ecosystem restoration projects are required to contribute 35% towards the total project cost.

U.S Environmental Protection Agency (USEPA) Section 319 Grants

Section 319 of the Clean Water Act provides funding for projects that work to reduce nonpoint source water pollution. IDEM administers funds from the Section 319 program which are used to create watershed management plans, demonstrate new technology, provide education and outreach on pollution prevention, conduct assessments, develop and implement Total Maximum Daily Loads (TMDLs), provide cost share dollars for BMP implementation and provide technical assistance. Organizations that are eligible for funding include nonprofit organizations, universities, and local, State or Federal government agencies. An in-kind or cash match of the total project cost must be provided.

Lake and River Enhancement (LARE) Program

LARE grants are available on a competitive basis for several actions that can address the ecology and management of public lakes, rivers and their watersheds. All grants require a local cost share. The goal of the Division of Fish and Wildlife's Lake and River Enhancement Section is to protect and enhance aquatic habitat for fish and wildlife, to insure the continued viability of Indiana's publicly accessible lakes and streams for multiple uses, including recreational opportunities. This is accomplished through measures that reduce nonpoint sediment and nutrient pollution of surface waters to a level that meets or surpasses state water quality targets. Funding for the LARE program is provided by an annual fee charged to boat owners. LARE grants are available for preliminary lake studies, engineering feasibility studies of pollution control measures, design engineering of control measures, and performance appraisals of a constructed pollution measure. The projects listed above are considered "traditional" projects and the deadline to submit applications is January 15th. Approved projects are awarded grant money in the month of July. Additionally, LARE sets aside one-third of its annual funds for sediment removal or exotic species control. Land treatment cost share dollars for agricultural practices require the involvement of the County SWCDs as the grant sponsor.

Farm Service Agency (FSA) Programs

Indiana Farm Service Agency (FSA) supports farmers through a variety of Credit and Commodity Programs designed to stabilize and enhance rural landscape. The FSA administers and manages farm commodity, credit, disaster and loan programs, and conservation as laid out by Congress through a network of federal, state and county offices. Programs are designed to improve economic stability of the agricultural industry and to help farmers adjust production to meet demand. Economically, the desired result of these programs is a steady price range for agricultural commodities for both farmers and consumers.

Conservation Reserve Program (CRP)

The CRP is a voluntary program encouraging landowners for long-term conservation of soils, water, and wildlife resources. CRP is the US Department of Agriculture's single largest environmental improvement program and is administered through the Farm Service Agency (FSA) with 10 to 15 year contracts. The goal of the CRP program (and CREP - Conservation Reserve Enhancement Program) is to give incentives to landowners who take frequently flooded and environmentally sensitive land out of crop production and plant specific types of vegetation. Participants earn annual rental payments and sign-up incentives. This program offers up to 90% cost share. Rental payments are boosted by 20% for projects such as installation of riparian buffers and filter strips. Windbreaks, contour buffer strips, and shallow water areas are additional funded practices. The WHIP program is available for private landowners to make improvements for wildlife on their property. This program offers up to 75% cost share. This grant program is competitive and funding depends on the project's ranking compared to others in the state.

Conservation Stewardship Program (CSP)

The Conservation Stewardship Program (CSP) is a voluntary program that encourages agricultural producers to improve conservation systems by improving, maintaining, and managing existing conservation activities and undertaking additional conservation activities. The Natural Resources Conservation Service administers this program and provides financial and technical assistance to eligible producers. CSP is available on Tribal and private agricultural lands and non-industrial private forestland (NIPF) on a continuous application basis.

CSP offers financial assistance to eligible participants through two possible types of payments:

- Annual payment for installing and adopting additional activities; and improving, maintaining, and managing existing activities.
- Supplemental payment for the adoption of resource-conserving crop rotations..

Environmental Quality Incentives Program (EQIP)

EQIP is accommodating to grass-roots conservation and is another voluntary USDA conservation program for farmers faced with threats to soil, water, and related natural resources. Typically EQIP monies will fund 75% of land improvements and installation of conservation practices such as grade stabilization structures, grassed waterways, and filter strips adjacent to water resources (including wetlands). The goal of WRP is to restore and protect degraded wetlands such as farmed wetlands. WRP provides technical and financial assistance to eligible landowners to restore, enhance and protect wetlands. At least 70% of

each project area will be restored to natural site conditions to the extent practicable. WRP has three options available: permanent easements, 30-year easements and restoration agreements. The NRCS will reimburse the landowners for easements on the property plus a portion of the restoration costs based on the type of easement agreed to by the landowner. EQIP and WRP are only applicable to agricultural lands.

Wetlands Reserve Program (WRP)

The WRP is the Nation's premier wetlands restoration program. It is a voluntary program that offers landowners the means and the opportunity to protect, restore, and enhance wetlands on their property. The USDA NRCS manages the program as well as provides technical and financial support to help landowners participate in WRP. Program objectives include: purchasing conservation easements from, or entering into cost-share agreements with willing owners of eligible land, helping eligible landowners, protect, restore, and enhance the original hydrology, native vegetation, and natural topography of eligible lands, restoring and protecting the functions and values of wetlands in the agricultural landscape, helping to achieve the national goal of no net loss of wetlands, and improving the general environment of the country.

The emphasis of the WRP program is to protect, restore and enhance the functions and values of wetland ecosystems to attain: 1) first and foremost, habitat for migratory birds and wetland dependent wildlife, including threatened and endangered species; 2) protection and improvement of water quality; 3) lessen water flows due to flooding; 4) recharge of ground water; 5) protection and enhancement of open space and aesthetic quality; 6) protection of native flora and fauna contributing to the Nation's natural heritage; and 7) contribute to educational and scholarship.

Wildlife Habitat Incentive Program (WHIP)

The Wildlife Habitat Incentive Program (WHIP) is a voluntary program for people who want to develop and improve wildlife habitat primarily on private land. Through WHIP USDA's Natural Resources Conservation Service provides both technical assistance and up to 75 percent cost-share assistance to establish and improve fish and wildlife habitat. WHIP agreements between NRCS and the participant generally last from 5 to 10 years from the date the agreement is signed.

In order to provide direction to the State and local levels for implementing WHIP to achieve its objective, NRCS has established the following national priorities:

- Promote the restoration of declining or important native fish and wildlife habitats.
- Protect, restore, develop or enhance fish and wildlife habitat to benefit at-risk species
- Reduce the impacts of invasive species on fish and wildlife habitats; and
- Protect, restore, develop or enhance declining or important aquatic wildlife species' habitats

WHIP has proven to be a highly effective and widely accepted program across the country. By targeting wildlife habitat projects on all lands and aquatic areas, WHIP provides assistance to conservation minded landowners that are unable to meet the specific eligibility requirements of other USDA conservation programs.

Conservation Reserve Enhancement Program (CREP)

CREP is a federal-state natural resources conservation program that addresses agricultural-related environmental concerns at the state and national level. CREP participants receive financial incentives to voluntarily enroll in CRP in contracts of 14 to 15 years. Participants remove cropland from agricultural production and convert the land to native grasses, trees and other vegetation. The Indiana CREP is a partnership between USDA and the state of Indiana. The program targets the enrollment of 7,000 acres of land in the Pigeon-Highland, Tippecanoe, and Upper White River Watersheds where sediments, nutrients, pesticides and herbicides run off from agricultural land.

The program will improve water quality by creating buffers and wetlands that will reduce agricultural runoff into the targeted watersheds. Installing buffer practices and wetlands will enhance habitat for wildlife, including State and Federally-listed threatened and endangered species. The program will also reduce nonpoint source nutrient losses. The goals of the Indiana CREP are to: 1) enroll 7,000 acres of eligible cropland and marginal pastureland, including frequently flooded lands, into CREP to establish buffer practices and wetlands, 2) protect at least 2,000 linear miles of watercourses by installing buffer practices, 3) reduce by 15 percent the amount of sediment, nutrients and agricultural chemicals entering watercourses within the targeted watersheds, 4) enroll 30 percent of farmed riparian acreage in the watersheds in accordance with statutory and regulatory rules, 5) enroll 8 percent of eligible acres in voluntary state ten-year contract extensions with local Soil and Water Conservation Districts in the Tippecanoe Watershed; and 6) enroll 10 percent of eligible acres in voluntary state permanent easements in the Tippecanoe and Upper White River Watersheds.

Landowners may enroll any amount of eligible cropland in the federal program and voluntary state 14-15 year contract extensions. State permanent easements allow producers to offer non-cropped acreage when they enroll cropland. Installation of conservation practices must be completed within 12 months of the federal CREP contract effective date. Once enrolled in the CREP program the land cannot be developed (ie. no permanent structures or roads may be built). Existing abandoned structures and roads may remain if approved by DNR. Landowners must follow the Conservation Plan of Operation and land cannot go back into row crops or agricultural uses. The landowners retain the right to recreational use of their property providing it does not negatively impact the practices or cover established. The state CREP contract is attached to the land deed; thus, a producer who purchases land enrolled in an active state CREP contract is required to participate in the program or refund state money paid to date and incur other penalties.

Section 7 – Action Register and Schedule

Action Register

The success of a watershed management plan can be measured by how readily it is used by its intended audience and how well it is implemented. The Geist Reservoir/Upper Fall Creek WMP is very ambitious and continued implementation of the plan will require and even greater degree of cooperation and coordination among partners and funding for projects. It will be the decision of the Steering Committee to prioritize the implementation projects for the watershed which will also guide the decision of which funding opportunity to choose (as described in the Incentives/Cost Share Opportunities section of this WMP).

The action register is a tool used to easily identify each objective, milestone, estimated cost, and possible partners for easier implementation of the plan. The action register is divided based on the previously identified problem and goal categories. The problem and goal statements are also repeated in these sections for quick reference. It should be noted that some objectives may relate to several problem/goal statements, they are listed in each applicable category.

Public Participation/Education and Outreach

Problem Statement: Stakeholders in the Geist Reservoir/Upper Fall Creek Watershed are not knowledgeable about their daily impact on the watershed and its water quality.

Goal Statement: Develop and implement an education and outreach program within the watershed.

Table 55: Public Participation/Education and Outreach Action Register					
Objective		**Target Audience**	**Task**	**Cost**	**Possible Partner (PP) and Technical Assistance (TA)**
Short Term Objectives (0-5 Years)	Effectively share and communicate past, current and future activities within the watershed	All stakeholders and landowners within the watershed	-Update GWA website on a monthly basis -Link UWRWA Geist page to efforts on GWA website within 6 months	$400/month (Estimated $100/hour for 4 hours a month)	PP – UWRWA TA – UWRWA, Consultant
	Educate stakeholders within the watershed on the function of a watershed and their impacts to water quality/nature of nonpoint sources	All stakeholders and landowners within the watershed	-Compile a list of publications willing to feature watershed articles and complete within 6 months -Choose the 4 most effective outlets from the Education/Outreach Menu and complete 2 within 1 year	$750 - $8,600 (Estimated $100/hour for 6 hours to compile list and $150 - $8,000 for direct cost of chosen outlets per year)	PP – UWRWA, MS4s, SWCDs, County Surveyor's, Veolia, IDEM, DNR TA – UWRWA, MS4s, SWCDs, County Surveyor's, Veolia, IDEM, DNR, Consultant
	Coordinate with Count SWCDs to get more agriculture stakeholders involved in plan implementation	All stakeholders and landowners within the watershed	-Identify GWA liaison to coordinate with SWCDs within first 6 months -Meet with County SWCD representative within 1 year -Identify key Ag stakeholders and set up 2 meetings with appropriate SWCD representative to discuss plan implementation within 1 year	$1,000 - $2,600 (Estimated $100/hour for 6 hours to compile list and 2 hours per meeting for 2-10 meetings)	PP – SWCDs TA – SWCDs
	Educate homeowners in urban communities about the use of fertilizers	Homeowners in urban areas	-Choose the 4 most effective outlets from the Education/Outreach Menu and complete 2 within 1 year	$150 - $8,000 (for direct cost of chosen outlets per year)	PP – UWRWA, MS4s, SWCDs, County Surveyor's, Veolia, IDEM, DNR TA – UWRWA, MS4s, SWCDs, County Surveyor's, Veolia, IDEM, DNR, Consultant
	Coordinate efforts with the UWRWA, local MS4s and any other education and outreach efforts being conducted within the watershed	Other groups/ organizations with similar watershed goals	-Identify all Education & Outreach focused organizations and/or committees within the watershed and complete within 6 months -Attend at least one meeting for each organization/committee within the first 3 years -Evaluate the value of the meetings attended for further attendance /coordination	$1,000 - $2,600 (Estimated $100/hour for 6 hours to compile list and 2 hours per meeting for 2-10 meetings)	PP – N/A TA – N/A

Table 55, cont.: Public Participation/Education and Outreach Action Register					
Objective		**Target Audience**	**Task**	**Cost**	**Possible Partner (PP) and Technical Assistance (TA)**
Short Term Objectives (cont.) (0-5 Years)	Work with Indiana Wildlife Federation on efforts to educate on and reduce the use of fertilizers containing phosphorus	Indiana Wildlife Federation	-Identify GWA liaison to coordinate with IWF within first 6 months -Attend at least 1 meeting within 1 year	$200 (Estimated $100/hour for 2 hours)	PP – N/A TA – N/A
	Educate stakeholders using septic systems about the importance of septic system maintenance	Stakeholders and landowners with septic systems	-Choose the most effective outlet from the Education/Outreach Menu within 1 year -Complete chosen Education/Outreach mechanism within 2 years	$150 - $4,000 (for direct cost of chosen outlet)	PP – UWRWA, MS4s, SWCDs, County Surveyor's, County Health Dept., Veolia, IDEM, DNR TA – UWRWA, MS4s, SWCDs, County Surveyor's, County Health Dept., Veolia, IDEM, DNR, Consultant
Long Term Objectives (6-20 Years)	Continue viable and effective short term objectives				
	Work with local municipalities to incorporate smart growth principles and green infrastructure practices into zoning/stormwater ordinances and comprehensive plans	All stakeholders and landowners within the watershed	-Identify GWA liaison to coordinate with local officials -Meet with municipal staff representatives -Evaluate the value of the meetings attended for further attendance /coordination	$1,000 - $2,600 (Estimated $100/hour for 6 hours to compile list and 2 hours per meeting for 2-10 meetings)	PP – N/A TA – N/A
	Educate agricultural stakeholders about the use of Atrazine and its impacts to water quality	Agricultural landowners and operators	-Choose the most effective outlet from the Education/Outreach Menu -Complete chosen Education/Outreach mechanism	$150 - $4,000 (for direct cost of chosen outlet)	PP – UWRWA, MS4s, SWCDs, County Surveyor's, Veolia, IDEM, DNR TA – UWRWA, MS4s, SWCDs, County Surveyor's, Veolia, IDEM, DNR, Consultant
	Review education and outreach program within the watershed and continue development and implementation of the program	N/A	-Review tasks and effectiveness at GWA/Sub-Committee Meetings	N/A	PP – N/A TA – N/A

E.coli Levels

Problem Statement: *E.coli* levels in the watershed regularly exceed the state standard, based on current and historical water quality data results.

Goal Statement: Reduce *E.coli* concentrations to meet the state standard of 235 CFU/100mL.

Table 56: *E.coli* Levels Action Register

	Objective	Target Audience	Task	Cost	Possible Partner (PP) and Technical Assistance (TA)
Short Term Objectives (0-5 Years)	Encourage proper disposal of pet and/or Canada goose waste	Pet and open space owners	-Create a list of potential BMPs for immediate implementation within 6 months -Choose the 4 most effective outlets from the Education/Outreach Menu and complete 2 within 3 years	$750 - $8,600 (Estimated $100/hour for 6 hours of identification time and $150 - $8,000 for direct cost of chosen outlets per year)	PP – UWRWA, MS4s, County Surveyor's, Veolia TA – UWRWA, MS4s, County Surveyor's, Veolia, Consultant
	Partner with NRCS, SWCDs and County Officials/Boards to promote/implement cost share and/or education programs	Other groups/ organizations with similar watershed goals	-Identify all local, state and/or federal programs focused on *E.coli* within 1 year -Identify eligible project and complete within 5 years	Varies based on BMP chosen (see Section 6 for estimated costs)	PP – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's TA – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's, Consultant
	Educate stakeholders using septic systems about the importance of septic system maintenance	Stakeholders and landowners with septic systems	-Choose the most effective outlet from the Education/Outreach Menu within 1 year -Complete chosen Education/Outreach mechanism within 1 year	$150 - $4,000 (for direct cost of chosen outlet)	PP – UWRWA, MS4s, SWCDs, County Surveyor's, County Health Dept., Veolia, IDEM, DNR TA – UWRWA, MS4s, SWCDs, County Surveyor's, County Health Dept., Veolia, IDEM, DNR, Consultant
	Promote and implement agricultural BMPs	Agricultural landowners	-Identify/prioritize eligible projects and complete based on priority	Varies based on BMP chosen (see Section 6 for estimated costs)	PP – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's TA – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's, Consultant

Table 56, cont.: *E.coli* Levels Action Register					
Objective		**Target Audience**	**Task**	**Cost**	**Possible Partner (PP) and Technical Assistance (TA)**
Long Term Objectives (6-20 Years)	Continue viable and effective short term objectives				
	Educate agriculture stakeholders on the benefits of manure management practices	Agricultural landowners	-Choose the 4 most effective outlets from the Education/Outreach Menu and complete 2	$150 - $8,000 (for direct cost of chosen outlets per year)	PP – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's TA – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's, Consultant
	Educate and work with point dischargers to reduce the amount of *E.coli* runoff from point sources, package plants, CFOs and CSOs	NPDES Permittees	-Identify all currently permitted point dischargers -Research possible regulation changes -Coordinate/educate each point discharger to determine best practices	$800/Permittee (Estimated $100/hour for 8 hours of time)	PP – IDEM TA – IDEM
	Establish a monitoring program or group to collect samples	Other groups/ organizations with similar watershed goals	-Identify any monitoring efforts currently being within the watershed by other groups -If lack of sufficient data exists from current monitoring efforts, develop program guidelines and begin sampling efforts	$600 (Estimated $100/ hour for 6 hours of identification time) $2,800/ collection event (Estimated $100/ hour for 8 hours of collection time and $200 per sample for analysis of ten samples)	PP – IDEM, Hoosier Riverwatch TA – IDEM, Hoosier Riverwatch

Nutrient Levels

Problem Statement: Nutrient concentrations within all subwatersheds frequently exceed water quality targets thereby aiding the growth of algae within the reservoir.

Goal Statement: Reduce the nutrient loads so that there are no exceedances of EPAs suggested targets for Nitrate + Nitrite of 1.6 mg/L and Total Phosphorus of 0.076mg/L.

Table 57: Nutrient Levels Action Register

	Objective	Target Audience	Task	Cost	Possible Partner (PP) and Technical Assistance (TA)
Short Term Objectives (0-5 Years)	Educate the public and stakeholders of the importance of reduced application of fertilizers or use of low phosphorus or no phosphorus fertilizers	Urban & agricultural landowner, fertilizer companies and operators	-Choose the 4 most effective outlets from the Education/Outreach Menu and complete 2 within 1 year	$150 - $8,000 (for direct cost of chosen outlets per year)	PP – UWRWA, MS4s, SWCDs, County Surveyor's, Veolia, IDEM, DNR TA – UWRWA, MS4s, SWCDs, County Surveyor's, Veolia, IDEM, DNR, Consultant
	Partner with NRCS, SWCDs, MS4s and County Officials/Boards to promote/implement cost share and/or education programs	Other groups/ organizations with similar watershed goals	-Identify all local, state and/or federal programs focused on nutrient management within 1 year -Identify eligible project and complete within 5 years	Varies based on BMP chosen (see Section 6 for estimated costs)	PP – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's TA – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's, Consultant
	Educate local, regional, and state officials on the need for regulations for urban areas (specifically for phosphorus)	Local, regional and state officials	-Identify GWA liaison within 1 year -Coordinate with IWF & ILMWG on on-going efforts at the state level within 3 years -Identify avenues to communicate concerns to officials on local and regional level within 3 years	$600 - $1,200 (Estimated $100/hour for 6 to 12 hours of time)	PP – UWRWA, NRCS, SWCDs TA – N/A
	Promote and implement agricultural BMPs	Agricultural landowners	-Identify/prioritize eligible projects and complete based on priority	Varies based on BMP chosen (see Section 6 for estimated costs)	PP – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's TA – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's, Consultant
	Promote and implement urban BMPs	Urban/Residential landowners	-Identify/prioritize eligible projects and complete based on priority	Varies based on BMP chosen (see Section 6 for estimated costs)	PP – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's TA – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's, Consultant

Table 57, cont.: Nutrient Levels Action Register					
Objective		**Target Audience**	**Task**	**Cost**	**Possible Partner (PP) and Technical Assistance (TA)**
Long Term Objectives (6-20 Years)	Continue viable and effective short term objectives				
	Educate and work with point discharges (CFOS, NPDES permitted facilities) to reduce their nutrient loads	NPDES Permittees	-Identify all currently permitted point dischargers -Research possible regulation changes -Coordinate/educate each point discharger to determine best practices	$800/Permittee (Estimated $100/hour for 8 hours of time)	PP – IDEM TA – IDEM
	Work with local municipalities to incorporate smart growth principles and green infrastructure practices into zoning/stormwater ordinances and comprehensive plans	All stakeholders and landowners within the watershed	-Identify GWA liaison to coordinate with local officials -Meet with municipal staff representatives -Evaluate the value of the meetings attended for further attendance /coordination	$1,000 - $2,600 (Estimated $100/hour for 6 hours to compile list and 2 hours per meeting for 2-10 meetings)	PP – N/A TA – N/A
	Establish a monitoring program or group to collect samples	Other groups/ organizations with similar watershed goals	-Identify any monitoring efforts currently being within the watershed by other groups within -If lack of sufficient data exists from current monitoring efforts, develop program guidelines and begin sampling efforts	$600 (Estimated $100/ hour for 6 hours of identification time) $2,800/ collection event (Estimated $100/ hour for 8 hours of collection time and $200 per sample for analysis of ten samples)	PP – IDEM, Hoosier Riverwatch TA – IDEM, Hoosier Riverwatch

Erosion and Sedimentation

Problem Statement: Soil erosion and sedimentation within the watershed is degrading the water quality and limiting the aesthetics, wildlife habitat, and aquatic health of the streams and reservoir within the watershed.

Goal Statement: Reduce sediment loads to meet the IDEM statewide draft TMDL target of 30 mg/L for TSS.

Table 58: Erosion and Sedimentation Action Register					
	Objective	**Target Audience**	**Task**	**Cost**	**Possible Partner (PP) and Technical Assistance (TA)**
Short Term Objectives (0-5 Years)	Partner with NRCS, SWCDs, MS4s, County Officials/Boards, High Schools and FFA programs to promote/implement cost share and/or education programs in order to reduce erosion from agricultural lands	Other groups/ organizations with similar watershed goals	-Identify all local, state and/or federal programs focused on erosion and sediment control within 1 year -Identify eligible project and complete within 5 years	Varies based on BMP chosen (see Section 6 for estimated costs)	PP – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's TA – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's, Consultant
	Encourage enforcement of erosion control practices associated with the issuance of Rule 5 construction permits	Local MS4s and SWCDs	-Identify enforcement officers within 6 months -Educate public on how to identify potential violators utilizing most effective Education/Outreach outlet within 3 years -Establish reporting mechanism with enforcement officers within 5 years	$750 - $4,600 (Estimated $100/hour for 6 hours of identification time and $150 - $4,000 for direct cost of chosen outlet) Cost of reporting mechanism will vary	PP – IDEM, MS4s, SWCDs TA – IDEM, MS4s, SWCDs, Consultant
	Promote and implement agricultural BMPs	Agricultural landowners	-Identify/prioritize eligible projects and complete based on priority	Varies based on BMP chosen (see Section 6 for estimated costs)	PP – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's TA – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's, Consultant
	Promote and implement urban BMPs	Urban/Residential landowners	-Identify/prioritize eligible projects and complete based on priority	Varies based on BMP chosen (see Section 6 for estimated costs)	PP – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's TA – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's, Consultant

Table 58, cont.: Erosion and Sedimentation Action Register					
Objective		**Target Audience**	**Task**	**Cost**	**Possible Partner (PP) and Technical Assistance (TA)**
Long Term Objectives (6-20 Years)	Continue viable and effective short term objectives				
	Work with local municipalities to incorporate smart growth principles and green infrastructure practices into zoning/stormwater ordinances and comprehensive plans	All stakeholders and landowners within the watershed	-Identify GWA liaison to coordinate with local officials -Meet with municipal staff representatives -Evaluate the value of the meetings attended for further attendance /coordination	$1,000 - $2,600 (Estimated $100/hour for 6 hours to compile list and 2 hours per meeting for 2-10 meetings)	PP – N/A TA – N/A
	Establish a monitoring program or group to collect samples	Other groups/ organizations with similar watershed goals	-Identify any monitoring efforts currently being within the watershed by other groups -If lack of sufficient data exists from current monitoring efforts, develop program guidelines and begin sampling efforts	$600 (Estimated $100/ hour for 6 hours of identification time) $2,800/ collection event (Estimated $100/ hour for 8 hours of collection time and $200 per sample for analysis of ten samples)	PP – IDEM, Hoosier Riverwatch TA – IDEM, Hoosier Riverwatch

Exotic Species in the Reservoir

Problem Statement: Excessive growth of exotic aquatic plants within the reservoir is negatively impacting the recreational uses of the reservoir and the survival of native species.

Goal Statement: Reduce and control the growth of exotic plants within the reservoir.

Table 59: Exotic Species in the Reservoir Action Register

	Objective	Target Audience	Task	Cost	Possible Partner (PP) and Technical Assistance (TA)
Short Term Objectives (0-5 Years)	Educate the public and stakeholders on how exotic species are introduced and ways to control new introductions	Reservoir Users	-Choose the 4 most effective outlets from the Education/Outreach Menu and complete 2 within 3 years	$150 - $8,000 (for direct cost of chosen outlets per year)	PP – UWRWA, MS4s, Veolia, IDEM, DNR TA – UWRWA, MS4s, Veolia, IDEM, DNR, Consultant
	Partner with the marinas, fishing tournament groups, homeowner organizations, etc to promote/implement cost share and/or education programs	Reservoir Users	-Identify reservoir organizations within 1 year -Choose the 4 most effective outlets from the Education/Outreach Menu and complete 2 within 3 years	$750 - $8,600 (Estimated $100/hour for 6 hours of identification time and $150 - $8,000 for direct cost of chosen outlets per year)	PP – UWRWA, MS4s, Veolia, IDEM, DNR TA – UWRWA, MS4s, Veolia, IDEM, DNR, Consultant
Long Term Objectives (6-20 Years)	Continue viable and effective short term objectives				
	Regular update of AVMP and implement according to recommendations	Reservoir Users	-Complete AVMP update	$5,000-$10,000 per update	PP – DNR TA – Consultant

Lack of Funding Sources for Urban Areas

Problem Statement: There is a lack of funding for the implementation of Best Management Practices within urban areas.

Goal Statement: Identify and utilize existing BMP funding sources and encourage the development and enhancement of additional and non-traditional funding sources.

Table 60: Lack of Funding Sources for Urban Areas Action Register

	Objective	Target Audience	Task	Cost	Possible Partner (PP) and Technical Assistance (TA)
Short Term Objectives (0-5 Years)	Educate homeowners and stakeholders on the benefits and importance of urban BMPs	Urban landowners	-Choose the 4 most effective outlets from the Education/Outreach Menu and complete 2 within 1 year	$150 - $8,000 (for direct cost of chosen outlets per year)	PP – UWRWA, MS4s, Veolia, IDEM, DNR TA – UWRWA, MS4s, Veolia, IDEM, DNR, Consultant
	Partner with MS4s, foundations, community groups, judicial services, community service programs, high schools, etc to identify existing and develop new funding sources for urban BMP implementation	Other groups/organizations with similar watershed goals	-Identify existing funding sources within 6 months -Identify/encourage organizations/entities to incorporate funding mechanisms not already in place within 1 year	$600 - $1,200 (Estimated $100/hour for 6 to 12 hours of time)	PP – UWRWA, MS4s, County Surveyor's TA – N/A
	Research/educate homeowners on do-it-yourself BMPs	Urban landowners	-Create a list of potential BMPs for immediate implementation within 6 months -Choose the 4 most effective outlets from the Education/Outreach Menu and complete 2 within 3 years	$750 - $8,600 (Estimated $100/hour for 6 hours of identification time and $150 - $8,000 for direct cost of chosen outlets per year)	PP – UWRWA, MS4s, County Surveyor's TA – UWRWA, MS4s, County Surveyor's, Consultant

Table 60, cont.: Lack of Funding Sources for Urban Areas Action Register					
Objective		**Target Audience**	**Task**	**Cost**	**Possible Partner (PP) and Technical Assistance (TA)**
Long Term Objectives (6-20 Years)	Continue viable and effective short term objectives				
	Encourage demonstration projects throughout the watershed in cooperation with MS4s Education and Outreach programs	Urban landowners	-Identify/prioritize eligible projects and complete based on priority	Varies based on BMP chosen (see Section 6 for estimated costs)	PP – UWRWA, MS4s, County Surveyor's TA – UWRWA, MS4s, County Surveyor's, Consultant
	Partner with MS4s, foundations, community groups, judicial services, community service programs, high schools, etc to promote and implement cost share opportunities for implementation of BMPs	Other groups/organizations with similar watershed goals	-Identify eligible projects and complete	$600 - $1,200 (Estimated $100/hour for 6 to 12 hours of time)	PP – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's TA – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's, Consultant

Partnerships

To help achieve the objectives of the Watershed Management Plan, three sub-committees have been formed to spearhead and guide the activities necessary. The sub-committees will work to develop beneficial partnerships with other local and regional groups. These sub-committees include:

1. Education and Outreach/Awareness and Communications Sub-Committee
2. Fund Raising Sub-Committee
3. Product/Services Sub-Committee

The Education and Outreach/Awareness and Communications Sub-Committee will work with local schools, corporations, and government bodies to assist with natural resource education. Members of this committee will research and provide or create educational materials that promote watershed awareness. They will develop key themes and messages for the watershed. Members will also write editorials and solicit donations or grants to cover publication and outreach costs. Coordination with the UWRWA, MS4s, SWCDs, County Officials/Boards and other local groups on education and outreach materials will be the responsibility of this sub-committee.

The Fund Raising Sub-Committee effort is focused on the securing of funds for efforts of implementation within the watershed. Members will work to ensure the ability of the group to match grant requirements and raise funds for special events or actions. The sub-committee will work to create a community/resident base sponsorship/partnership, corporate sponsorship/partnership and local business sponsorships/partnerships. Members will research additional grant sources and opportunities for the watershed.

The Product/Services Sub-Committee will help ensure “green” product availability and ensure “green” communications awareness at retail locations. Members will also work directly with lawn care service providers to educate and obtain a commitment to offer “green solutions”. Members will identify and establish collaborative relationships with entities that have potential influence on water quality and will contact legislators and other influential members of local government to inform of current Geist Reservoir/Upper Fall Creek Watershed activities and issues.

The establishment and specific tasks assigned to each of the Sub-Committee groups will allow for multiple avenues of watershed improvement to be pursued. Awareness of issues and impairments within the watershed will increase stakeholder participation and will hopefully increase membership of the Geist Reservoir/Upper Fall Creek Watershed Steering Committee.

Section 8 – Tracking Effectiveness

Evaluating Plan Performance

This Management Plan is meant to be a flexible tool to achieve water quality improvements within the Geist Reservoir/Upper Fall Creek Watershed. The WMP will be evaluated by assessing the progress made on each of the six goals. The evaluation and adaptation of the plan will be the responsibility of the Steering Committee.

The plan should be evaluated every five years to assess the progress made as well as to revise the plan, if appropriate, based on the progress achieved. The plan will also have a comprehensive review every 15 years. Amendments and changes may be made more frequently as laws change or new information becomes available that will assist in providing a better outlook for the watershed. As goals are accomplished and additional information is gathered, efforts may need to be shifted to watershed issues of higher priority.

Tracking Strategy

In addition to the official 5 year evaluation and update, the Steering Committee will have a key role in evaluating implementation progress on an annual basis. The Steering Committee will review the status of actions recommended in the Action Register at least once per year and then identify the top priority concerns and actions for the following years focus.

In order to evaluate the implementation progress, a milestone completion log (Table 61) was completed for all milestones identified in the Action Register. An indicator tracking log (Table 62) was also created to evaluate the overall impact of implementation of the WMP. The indicators will be based on records maintained by the Steering Committee and in coordination with the partners identified within the Action Register. Available sampling data from IDNR, IDEM and CIWRP on-going studies and/or an implemented water monitoring program will be utilized to determine the loading of pollutants and changes based on the implementation of the plan.

Other opportunities for evaluating the status of plan implementation include the completion of quarterly project reports or Steering Committee meeting minutes. Since this plan is a flexible tool, the provided logs are suggestions on ways to evaluate progress; however changes/modifications are anticipated based on usability and changes in priority throughout the implementation of the WMP.

It was assumed that implementation would begin in January 2010. Dates were assigned to each milestone timeframe based on the implementation start date.

Table 61: Task Completion Log		
Task	**Start Date**	**Completion Date**
Monthly (Beginning March 2011)		
Update GWA website on a monthly basis		
6 months (Completed September 2011)		
Link UWRWA Geist page to efforts on GWA website		
Compile a list of publications willing to feature watershed articles		
Identify all Education and Outreach focused organizations/ committees within the watershed		
Identify GWA liaison to coordinate with IWF		
Identify GWA liaison to coordinate with County SWCDs		
Identify erosion control enforcement officers within the watershed		
Research/compile a list of all available existing urban BMP funding sources		
Create a list of potential do-it-yourself BMPs for homeowners		
Create a list of potential BMPs for Canada goose waste disposal		
1 year (Completed March 2011)		
Identify all local, state and/or federal programs focused on nutrient management, erosion control and *E.coli* reduction		
Identify reservoir organizations for partnership on education and funding opportunities for exotic species management		
Meet with County SWCDs and identified key Ag stakeholders		
Complete 2 Education/Outreach Menu items focused on stakeholders and their impact to the watershed and nature of nonpoint sources		
Complete 2 Education/Outreach menu items focused on the use of fertilizers and low/no phosphorus products		
Complete 2 Education/Outreach Menu items on use of low/no P fertilizers		
Complete 1 Education/Outreach Menu item focused on importance of septic system maintenance		
Identify/encourage organizations to incorporate funding mechanisms for urban BMPs		
Attend at least one meeting focused on coordinating efforts with IWF		
Promote and implement agricultural BMPs		
Promote and implement urban BMPs		
2 years (Completed March 2012)		
Complete 1 Education/Outreach Menu item focused on importance of septic system maintenance		
Promote and implement agricultural BMPs		
Promote and implement urban BMPs		

Table 61, cont.: Task Completion Log		
Task	**Start Date**	**Completion Date**
3 years (Completed March 2013)		
Coordinate with IWF and ILMWG on on-going efforts at the state level		
Identify avenues to communicate P regulation concerns to local officialsl		
Educate public on how to identify potential erosion control violators		
Attend at least one meeting for each educational and outreach organization and evaluate the required efforts for coordination		
Complete 2 Education/Outreach Menu items focused on do-it-yourself BMPs for homeowners		
Complete 2 Education/Outreach Menu items focused on exotic species and methods to control introduction		
Complete 2 Education/Outreach Menu items focused on the proper disposal of Canada goose waste		
Promote and implement agricultural BMPs		
Promote and implement urban BMPs		
5 years (Completed March 2015)		
Identify eligible projects for cost share opportunities in nutrient management and complete at least 1		
Identify eligible projects for cost share opportunities in erosion and sediment control and complete at least 1		
Establish reporting mechanism for erosion and sediment control violations		
Promote and implement agricultural BMPs		
Promote and implement urban BMPs		
6-20 years (March 2016 – February 2030)		
Identify GWA liaison to coordinate with local officials with regards to incorporation of smart growth principles and green infrastructure practices into ordinances and comprehensive plans		
Complete 1 Education/Outreach Menu item focused on use of Atrazine and its impacts to water quality within Ag community		
Review education and outreach program and continue development and implementation		
Complete 2 Education/Outreach Menu items focused on manure management practices		
Identify all currently permitted point dischargers		
Research possible regulation changes for point dischargers		
Educate to determine best practices and reducing pollutant targets		
Establish a monitoring program or group to collect samples for nutrients, sediment and *E.coli*		
Identify GWA liaison to coordinate with local, regional and state officials for phosphorus regulations		
Indentify/prioritize eligible urban BMPs and complete based on priority		
Identify areas where conservation tillage is currently practiced and identify/incorporate eligible cost share programs		
Complete AVMP update		
Identify/prioritize eligible eroded streambank projects and complete based on priority		

Table 62: Indicator Tracking Log																
Year of Implementation	# of updates to website	# of programs/ideas utilized from Education/Outreach Menu	# of existing funding sources utilized for urban BMPs	# of new/nontraditional funding sources for BMP implementation utilized	# of agricultural fields that have stopped utilizing Atrazine	# of point dischargers reducing their pollutant loadings	# of observed Nitrate + Nitrite loadings above WQ target	# of observed *E.coli* loadings above WQ target	# of stream miles of improved/created buffer zones	# of stream miles of stabilized streambanks	# of miles of exclusionary fencing installed	# of agricultural fields utilizing cover crops, conservation tillage, or other BMPs	# of urban BMPs installed	# of inspections/enforcement actions on Rule 5 permit holders	# of demonstration projects installed	# of areas in reservoir treated according to AVMP recommendations
1																
2																
3																
4																
5																
6-10																
11-15																
16-20																

Section 9 – Appendices

Appendix A – Acronyms and Abbreviations

Appendix B – References

Appendix C – Stakeholder Groups & Related Organizations

Appendix D – Steering Committee Meeting Agendas, Sign-In Sheets & Minutes

Appendix E – Public Meeting Agendas & Sign-In Sheets

Appendix F – IDEM Data

Appendix G – CIWRP Data

Appendix H – Windshield Survey Data

Appendix I – NPDES/CFO Compliance

Appendix J – Reservoir Shoreline Investigation

Appendix K – Nonpoint Source Modeling

Appendix L – Education and Outreach Menu

Appendix M – Highly Erodible Land Documentation