Individual septic sites must be evaluated on a case-by-case basis to determine septic system suitability. Systems for new construction cannot be placed in the 100-year flood plain and systems for existing homes must be above the 100-year flood elevation.

Exhibit 8 is a map of soil classes related to septic suitability within the watershed. Soils labeled "very limited" indicate that the soil has at least one feature that is unfavorable for septic systems. Approximately 91.5% of the Morse Reservoir/Cicero Creek Watershed is mapped as "very limited" with regards to soils being suitable for septic systems.

Approximately 1.4% of the soils within the watershed are "not rated." These soils have not been assigned a rating class because it is not industry standard to install a septic system in these geographic locations. Soils designated "not limited" were not found in the Morse Reservoir/Cicero Creek Watershed.

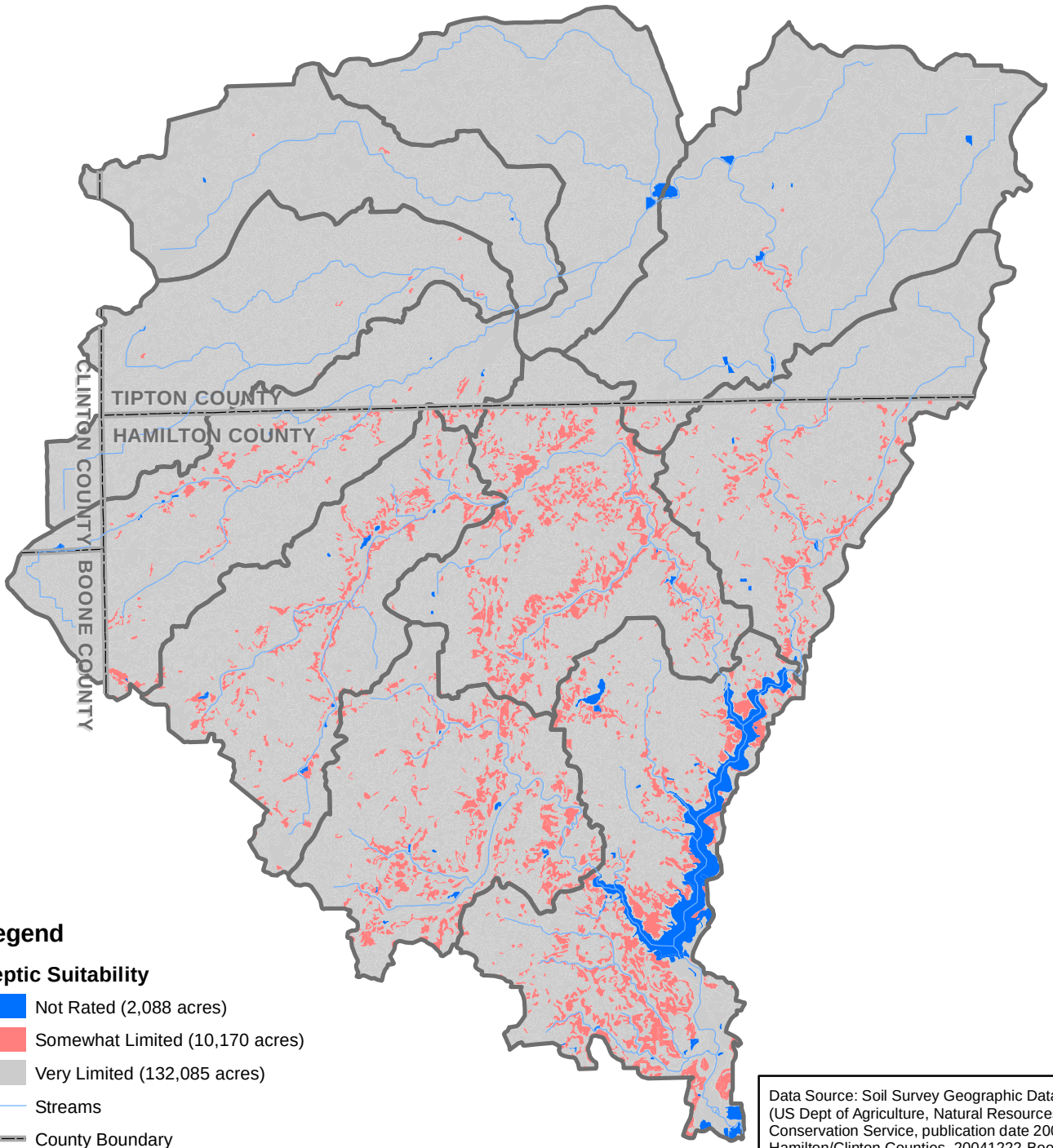
### Landuse

The Morse Reservoir/Cicero Creek Watershed consists of approximately 144,343 acres of mixed land use, according to the 2001 National Land Cover Data (NLCD) published by the USGS (Exhibit 9; Table 5). The NLCD 2001 includes nineteen land classifications ranging from cultivated crops to high intensity developed land. In order to utilize the most current available data, the 2008 National Agricultural Imagery Program orthophotography was obtained for Boone, Clinton, and Tipton Counties and the 2008 Hamilton County Orthophotography was obtained for Hamilton County. These aerial images were compared to the NLCD 2001 in order to determine if any changes in land use had occurred. Based on the 2008 aerial, the only landuse changes that had occurred since 2001 were the development of agricultural land into a few residential subdivisions. This change was considered minor to the overall watershed based on the acreage of the subdivisions being less than .1% of the total watershed size.

**Table 5: 2001 Watershed Landuse**

| Landuse Classification | Acres | Percentage |
|---|---|---|
| Open Water | 1,623 | 1.12% |
| Developed, Open Space | 9,527 | 6.60% |
| Developed, Low Intensity | 3,734 | 2.59% |
| Developed, Medium Intensity | 744 | 0.52% |
| Developed, High Intensity | 238 | 0.16% |
| Deciduous Forest | 4,432 | 3.07% |
| Evergreen Forest | 5 | 0.00% |
| Shrub/Scrub | 645 | 0.45% |
| Grassland/Herbaceous | 1,998 | 1.38% |
| Pasture Hay | 2,069 | 1.43% |
| Cultivated Crops | 118,803 | 82.31% |
| Woody Wetlands | 336 | 0.23% |
| Emergent Herbaceous | 189 | 0.13% |

This watershed has historically been natural areas that were drained and converted for agricultural uses. The area is dominated by agricultural land and based on the 2001 land use information comprises 83.74% (cultivated crops and pasture hay) of its area. Additionally, forests and wetlands comprise 6.38% (open water, forest, shrub/scrub,




## Legend

### Septic Suitability

- Not Rated (2,088 acres)
- Somewhat Limited (10,170 acres)
- Very Limited (132,085 acres)
- Streams
- County Boundary
- Cicero Creek Watershed (144,343 acres)

Data Source: Soil Survey Geographic Database (US Dept of Agriculture, Natural Resources Conservation Service, publication date 20080624-Hamilton/Clinton Counties, 20041222-Boone County, 20080625-Tipton County) Soil Reports Tabular Data fo Sewage Disposal

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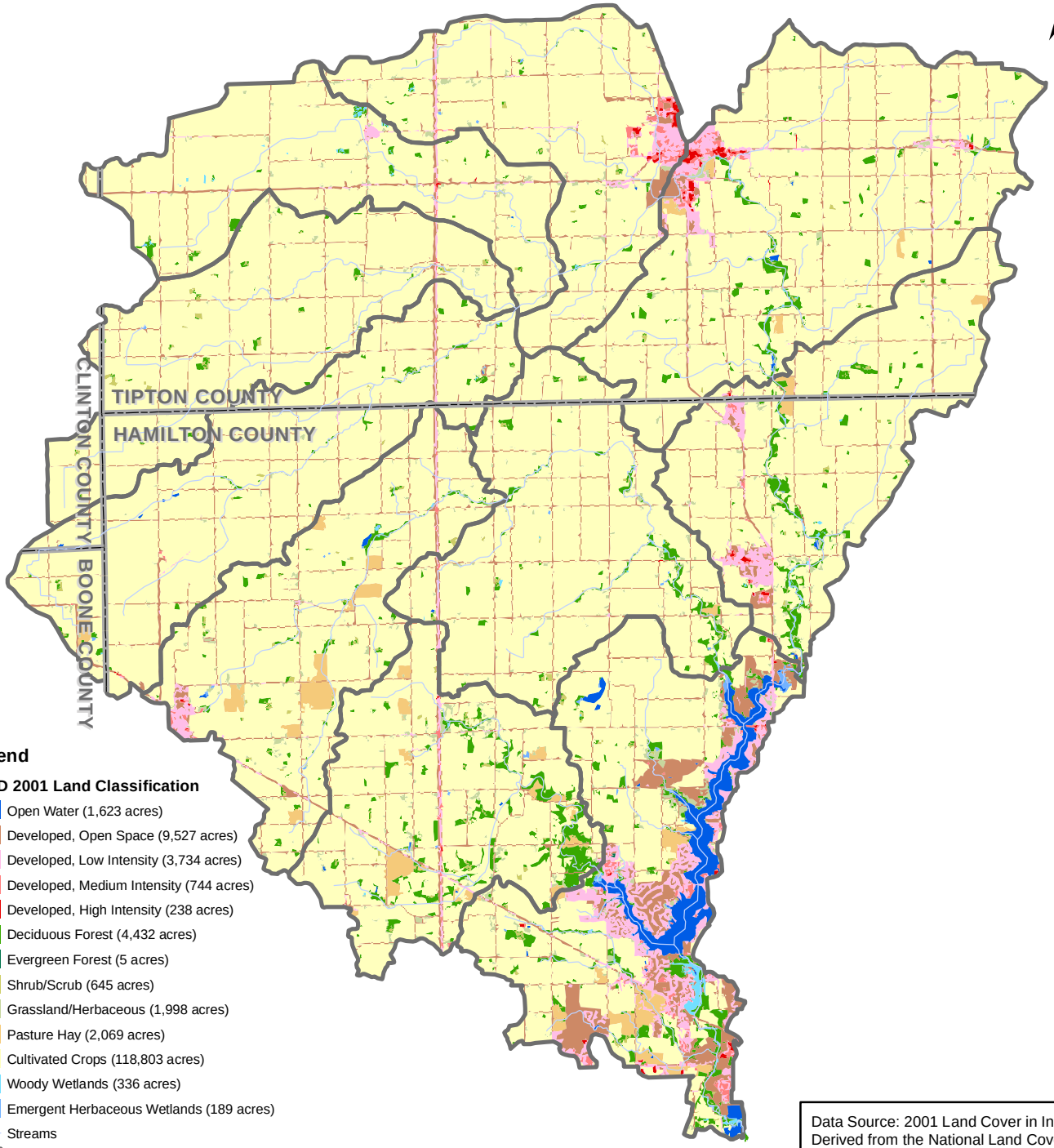
|---|---|---|---|---|
| TITLE: **Septic Suitability Map** | PROJECT: **Morse Reservoir/Cicero Creek Watershed Management Plan** | | | |
| BASE LAYER: NRCS Soil Survey | PROJECT NO. 09005 | EXHIBIT: 8 | SHEET: 1 OF: 1 | |
| CLIENT: Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206 | QUADRANGLE: N/A | DATE: 09/27/10 | SCALE: 1" = 15000' | |




**Legend**

**NLCD 2001 Land Classification**

- Open Water (1,623 acres)
- Developed, Open Space (9,527 acres)
- Developed, Low Intensity (3,734 acres)
- Developed, Medium Intensity (744 acres)
- Developed, High Intensity (238 acres)
- Deciduous Forest (4,432 acres)
- Evergreen Forest (5 acres)
- Shrub/Scrub (645 acres)
- Grassland/Herbaceous (1,998 acres)
- Pasture Hay (2,069 acres)
- Cultivated Crops (118,803 acres)
- Woody Wetlands (336 acres)
- Emergent Herbaceous Wetlands (189 acres)
- Streams
- Cicero Creek Watershed (144,343 acres)
- County Boundary

Data Source: 2001 Land Cover in Indiana, Derived from the National Land Cover Database (Indiana Geological Survey, publication date 20030901)

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|---|---|---|---|---|
| TITLE: **Landuse Map** | PROJECT: **Morse Reservoir/Cicero Creek Watershed Management Plan** | | | |
| BASE LAYER: NLCD 2001 | PROJECT NO. 09005 | EXHIBIT: 9 | SHEET: 1 OF: 1 | |
| CLIENT: Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206 | QUADRANGLE: N/A | DATE: 09/27/10 | SCALE: 1" = 15000' | |

grassland/herbaceous, woody wetlands and emergent herbaceous), and urban and residential lands comprise 9.87% of the watershed. Only 6.38% of the entire watershed is categorized as green space (e.g. forest and wetland areas). As urban areas continue to develop within the watershed, the agencies with regulatory authority should pay careful attention to the characteristics of the existing areas and require (as much as the law allows) that developments incorporate best management practices (including avoidance of significant natural areas, buffers, etc.) within their projects.

Based on a review of the 2010 Google and Bing Maps, there are two obvious areas of the reservoir that are acting as sediment traps. One is the entire reservoir area north of 236$^{th}$ Street (confluence with Cicero Creek) and the other is the entire reservoir area west of Little Chicago Road (confluence with Hinkle Creek) See Appendix N for reservoir aerial images. Both of these areas experience concentrated flows from creeks.

As this water enters the reservoir, the flow stays constant but the area in which the water has to flow is much larger than in the creek corridor. Therefore, based on basic flow calculations (Q=v*A: flow = velocity * area), the velocities seen in the reservoir would be much lower when compared to the velocities experienced in the creek. This lower velocity allows the sediments that are being carried in the creek system to drop out or settle once the water has entered into the reservoir. Bathymetric surveys of these areas would be beneficial to show the amount of sediment that has accumulated over time as well as to have a benchmark to start from to evaluate sediment loads in the future. The survey should include points through the reservoir that show the top of the sediment and the hard pan elevations.

### Notable Natural Resources and Recreational Facilities

The Indiana Department of Natural Resources Division of Nature Preserves was contacted to provide any Indiana Natural Heritage Data or related records for all high quality natural communities or natural areas documented within the Morse Reservoir/Cicero Creek Watershed. Their response indicated that there were no known areas within the watershed.

A number of recreational opportunities are scattered throughout the Morse Reservoir/Cicero Creek Watershed. The recreational facilities and parks serve as an opportunity for the public to enjoy the natural landscape within their community as well as learn about valuable natural resources. As shown in Table 6, the Indiana Department of Natural Resources Outdoor Recreational Facilities database indicated that there are nineteen recreational facilities (excluding schools) within the watershed.

| Table 6: Recreational Facilities | |
|---|---|
| **Name** | **Location** |
| Arcadia Park | Arcadia |
| Atlanta Little League Park | Atlanta |
| Central Park | Carmel |
| Dolls Park | Atlanta |
| Goldsmith Community Park | Goldsmith |
| Hague Road | Noblesville |
| McGregor Park | Westfield |
| Morse Park and Beach | Noblesville |
| Old Overdorf Lake Campground | Sheridan |
| Red Bridge Park | Cicero |
| Sheridan Community Center | Sheridan |
| Tecumseh Park and North Pool | Arcadia |
| The Wetlands Areas | Noblesville |
| Tipton 4-H Fairgrounds | Tipton |
| Tipton City Park | Tipton |
| Tipton County Family Center | Tipton |
| Tipton Little League Park | Tipton |
| Tipton Municipal Golf Course | Tipton |
| Veteran's Park | Sheridan |

### Other Planning Efforts

The Morse Reservoir/Cicero Creek Watershed and the Upper White River Watershed have been the focus of scientific research recently, and therefore some watershed planning and monitoring efforts have been ongoing that provide information to this WMP. Additionally, the Morse Reservoir/Cicero Creek Watershed is a developing watershed and the incorporated entities within the watershed have comprehensive plans and stormwater quality management plans that have been approved and are being used to manage growth within these communities. See Table 7 for available planning efforts being completed by the communities/agencies within the watershed. The list of Approved MS4 Communities was created using IDEM Rule 13 List of Designated MS4 Entities Currently Permitted, the SWQMPs were obtained from the community websites, and the information regarding the Long Term Control Plan for the City of Tipton was found in the Bacon/Prairie Ditch WMP.

These planning documents provide a glimpse into the future for potential land use change that may impact the water quality of the watershed. This data is important to incorporate and make our best attempt to look forward with non-point source modeling techniques to predict future conditions. As in many cases, land use is a primary determinant of water quality conditions.

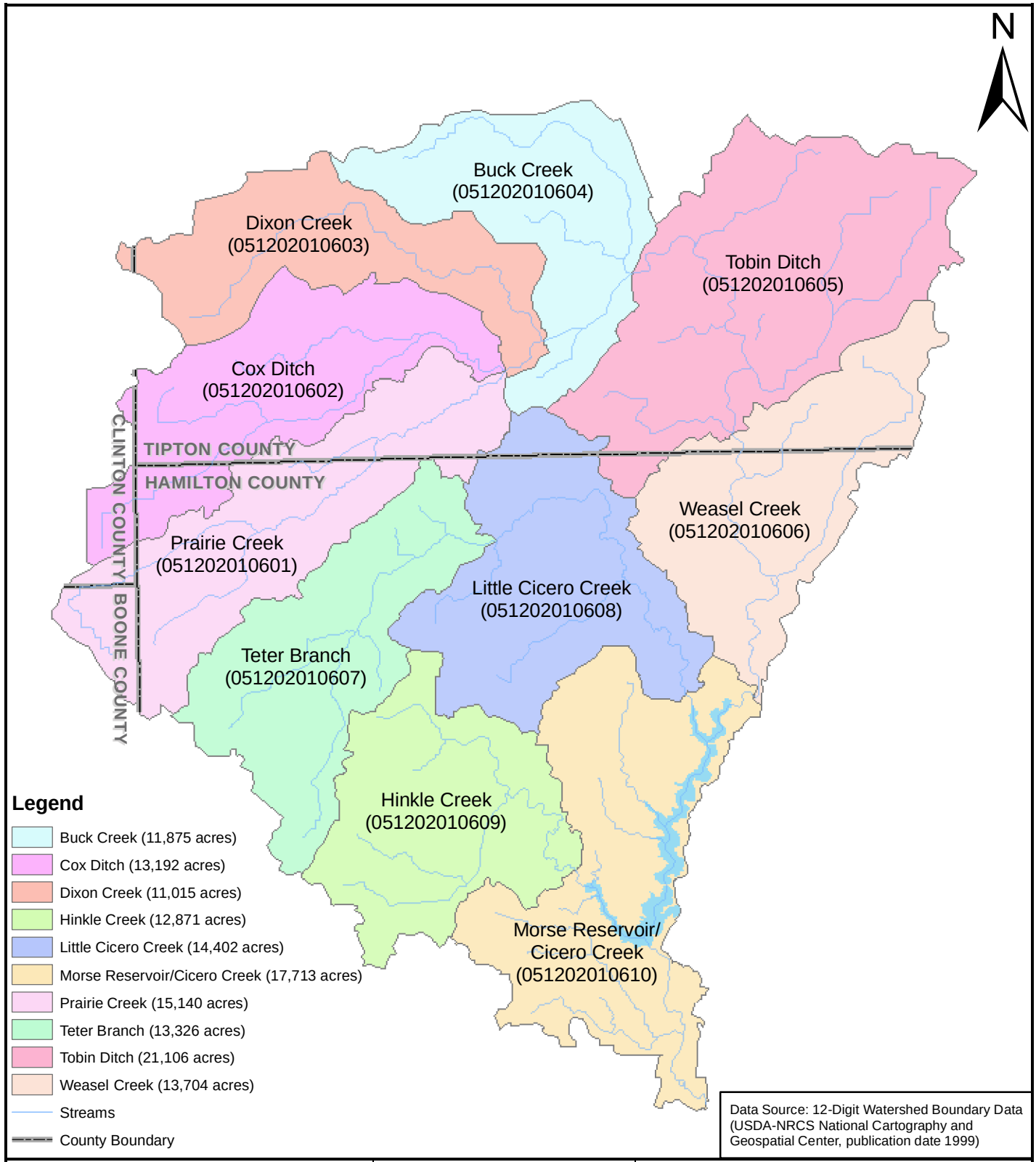
| Table 7: Other Planning Efforts | | |
|---|---|---|
| **Watershed Management Plans** | **Approved MS4 Communities** | |
| Little Cicero Creek | Boone County | |
| Bacon/Prairie Ditch | Hamilton County (SWQMP 1/31/2005) | |
| Buck Creek/Campbell Ditch | Town of Arcadia | |
| | Town of Cicero (SWQMP 1/31/2005) | |
| **Comprehensive Plans** | City of Noblesville (SWQMP 5/2005) | |
| Boone County | City of Westfield (SWQMP 2/2/2005) | |
| Hamilton County | | |
| Town of Cicero | **Long Term Control Plans (for Combined Sewer Overflows)** | |
| City of Noblesville | Community | No. of CSO's |
| City of Westfield | City of Noblesville | 7 |
| | City of Tipton | 8 |

## Part Two of the Watershed Inventory

Hydrologic unit codes (HUCs) were developed by the United States Geological Survey (USGS) in cooperation with the United States Water Resource Council (USWRC) and United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). Most federal and state agencies use this coding system. HUCs are a way of cataloguing portions of the landscape according to their drainage. Landscape units (watersheds) are nested within each other and described as successively smaller units. The hydrologic code attached to a specific watershed is unique, enabling different agencies to have common terms of reference and agreement on the boundaries of the watershed. These commonly understood boundaries foster understanding of how landscapes function, where water quality problems should be addressed, and who needs to be involved in the planning process. The Morse Reservoir/Cicero Creek Watershed in itself is a 10-digit HUC 0512020106 that, for this project, consists of ten (10) 12-digit Hydrologic Unit Codes or HUCs (Table 8, Exhibit 10).

| Table 8: 12-Digit Hydrologic Unit Codes | | | |
|---|---|---|---|
| **Subwatershed Name** | **HUC** | **Acres** | **Percentage** |
| Prairie Creek | 051202010601 | 15,140 | 10.49% |
| Cox Ditch | 051202010602 | 13,192 | 9.14% |
| Dixon Creek | 051202010603 | 11,015 | 7.63% |
| Buck Creek | 051202010604 | 11,875 | 8.23% |
| Tobin Ditch | 051202010605 | 21,106 | 14.62% |
| Weasel Creek | 051202010606 | 13,704 | 9.49% |
| Teter Branch | 051202010607 | 13,326 | 9.23% |
| Little Cicero Creek | 051202010608 | 14,402 | 9.98% |
| Hinkle Creek | 051202010609 | 12,871 | 8.92% |
| Morse Reservoir/Cicero Creek | 051202010610 | 17,713 | 12.27% |

Available water quality, biological and landuse information was collected for the watershed. This information was then analyzed on a subwatershed (HUC 12) scale in order to prioritize and rank the subwatersheds relative to one another. A list of the data and studies utilized for this Watershed Management Plan are detailed below, however the results/analysis are discussed in the respective 12-digit HUC subwatershed sections.




Data Source: 12-Digit Watershed Boundary Data (USDA-NRCS National Cartography and Geospatial Center, publication date 1999)

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|---|---|---|---|---|
| TITLE: **Subwatershed Map** | | PROJECT: **Morse Reservoir/Cicero Creek Watershed Management Plan** | | |
| BASE LAYER: HUC 12 Boundaries | | PROJECT NO. 09005 | EXHIBIT: 10 | SHEET: 1 OF: 1 |
| CLIENT: Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206 | | QUADRANGLE: N/A | DATE: 09/27/10 | SCALE: 1" = 15000' |

## Available Data and Studies

### Little Cicero Creek Watershed Management Plan

The Hamilton County Surveyor's Office obtained an IDEM Section 319 grant to complete a Watershed Management Plan for the Little Cicero Watershed. The project included two 14-digit HUCs, the Bennett Ditch/Taylor Creek subwatershed (13,449 acres) and the Teter Branch subwatershed (13,324) which are included in the 12-digit HUC 051202010608 Little Cicero Creek Subwatershed. There are six main streams within the project area: Jay Ditch, Symons Ditch, Ross Ditch, Bennett Ditch, Taylor Creek and Little Cicero Creek.

Jay Ditch, Symons Ditch and Ross Ditch were identified in the WMP as being critical for having the most degraded water quality while contributing the highest pollutant loads to the watershed. The Little Cicero Creek Watershed Management Plan was completed in February of 2007.

This report was used only for comparison purposes as the methodologies used for determining pollutant loads and ultimately the critical areas was based on limited data.

### Bacon/Prairie Ditch Watershed Management Plan

The Bacon/Prairie Ditch Watershed Management Plan was obtained through the Upper White River Watershed Alliance website. The Tipton County Soil and Water Conservation District was the project coordinator for the Bacon/Prairie Ditch Watershed Management Plan (HUC 05120201080060). This watershed is located in the south central portion of Tipton County, is approximately 12,423 acres and is a part of the 12-digit Tobin Ditch Subwatershed. The Plan included analyses on Stone Hinds Ditch, Schlater Ditch, Ressler Ditch, Sowers Ditch and Cicero Creek. This watershed is approximately 87% cropland with the majority of corn being conventional tilled and beans being no till.

Five priority water quality issues were identified as a result of the plan.

1. Combined Sewer Overflows (CSO's)
2. Septic Systems
3. Streambank Erosion
4. Agricultural/Residential Chemical Runoff
5. Industrial Discharges

The plan was submitted to IDEM for comments in May of 2003.

### Buck Creek/Campbell Ditch Watershed Management Plan

A copy of the Buck Creek/Campbell Ditch Watershed Management Plan was not obtainable and therefore a summary of this WMP is not included.

### IDEM 303(d) List

The IDEM Assessment Branch evaluates all the data they collect to develop the 305(b) report, and the 303(d) list. The 305(b) report is a document that summarizes the quality of surface waters throughout Indiana and the designated uses of these waters. Evaluations are based on different stream segments or lakes, and are discussed in the context of watersheds. To complete the evaluation, IDEM considers not only the data they collect, but data collected

by other entities as long as that data meets the rigorous quality controls that IDEM uses in the collection and analysis of their own data. Other data that does not meet these standards may be used informally to validate data that does meet the quality controls.

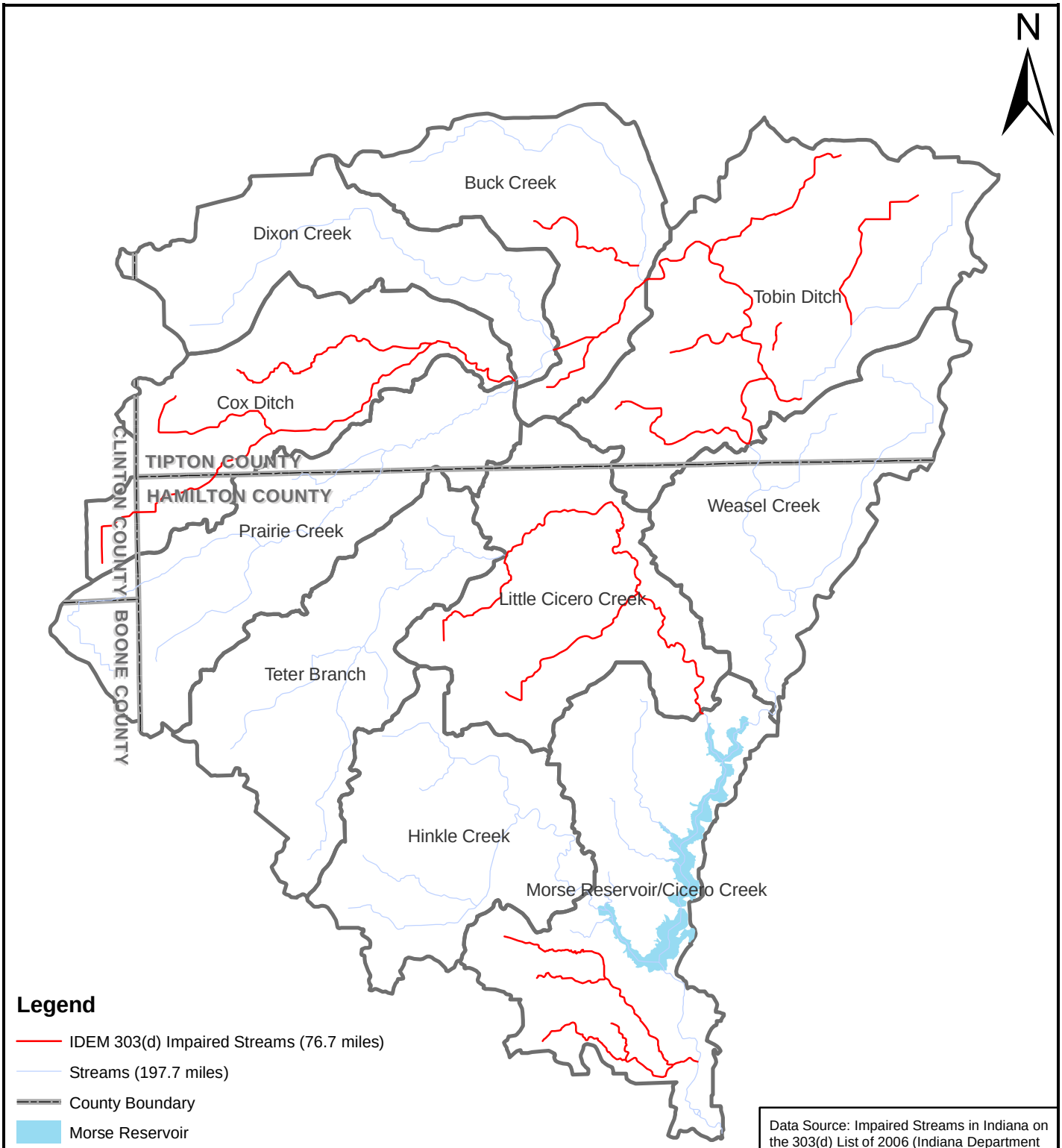
Section 303(d) of the 1972 Federal Clean Water Act (CWA) requires each state to identify those waters that do not meet the state's water quality targets for designated uses. These streams are to be listed on the State's 303(d) list of impaired waters. For such waters, the State is required to establish total maximum daily loads (TMDLs) to meet the state water quality targets. As defined by IDEM, a TMDL established under section 303(d) of the federal Clean Water Act, is a calculation of the maximum amount of pollutant that a waterbody can receive and still meet water quality targets, and allocates pollutant loadings among point and non-point sources.

To determine if a waterbody should be listed on Indiana's 303(d) list, the IDEM Assessment Branch has developed a surface water quality monitoring strategy to assess the quality of Indiana's ambient waters. The goals of this monitoring strategy are: measure the physical, chemical, bacteriological and biological quality of the aquatic environment in all river basins and identify factors responsible for impairment; assess the impact of human and other activities on the surface water resource; identify trends through the analysis of environmental data; and provide environmental quality assessment to support water quality management programs. Known impairments in this watershed are specified in Part Two of the Watershed Inventory: Subwatershed Summaries.

Once data is collected, waterbodies are evaluated by a team of water-quality professionals within IDEM to determine if the waterbodies meet the water-quality standards set by the State, and that all designated uses are met. If a stream fails to meet these requirements, as outlined in the 303(d) listing methodology, the waterbody is considered impaired and must be listed on the 303(d) list, and a TMDL developed to address the problem. Draft TMDLs have been determined for pollutants that do not already have state regulated targets. This information is provided within the appropriate pollutant section within this plan. The streams that have been evaluated by IDEM and were determined to be impaired streams are shown on Exhibit 11. The 303(d) list indicates that the streams within the watershed are impaired for nutrients, *E.coli* algae, and impaired biotic communities. The reservoir is impaired for algae, taste/odor and PCBs in fish tissue. These Impaired streams are also shown on the subwatershed exhibits as well as a summary of the specific streams within each subwatershed are impaired. It should be noted that if a stream is not listed on the 303(d) list it may be impaired; however the data (or lack thereof) does not indicate the impairment at the time of publication.

**IDEM Water Quality Sampling**

Available water quality data from the Indiana Department of Environmental Management (IDEM) for the Morse Reservoir/Cicero Creek Watershed between 1992 and 2006 was obtained and evaluated to determine where water-quality problems were noted in the watershed (Appendix F).




Data Source: Impaired Streams in Indiana on the 303(d) List of 2006 (Indiana Department of Environmental Management, publication date 20060621)

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|---|---|---|---|---|
| TITLE: **IDEM 303(d) Impaired Streams Map** | PROJECT: **Morse Reservoir/Cicero Creek Watershed Management Plan** | | | |
| BASE LAYER: 303(d) Impaired Streams | PROJECT NO. 09005 | EXHIBIT: 11 | SHEET: 1 OF: 1 | |
| CLIENT: Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206 | QUADRANGLE: N/A | DATE: 09/27/10 | SCALE: 1" = 15000' | |

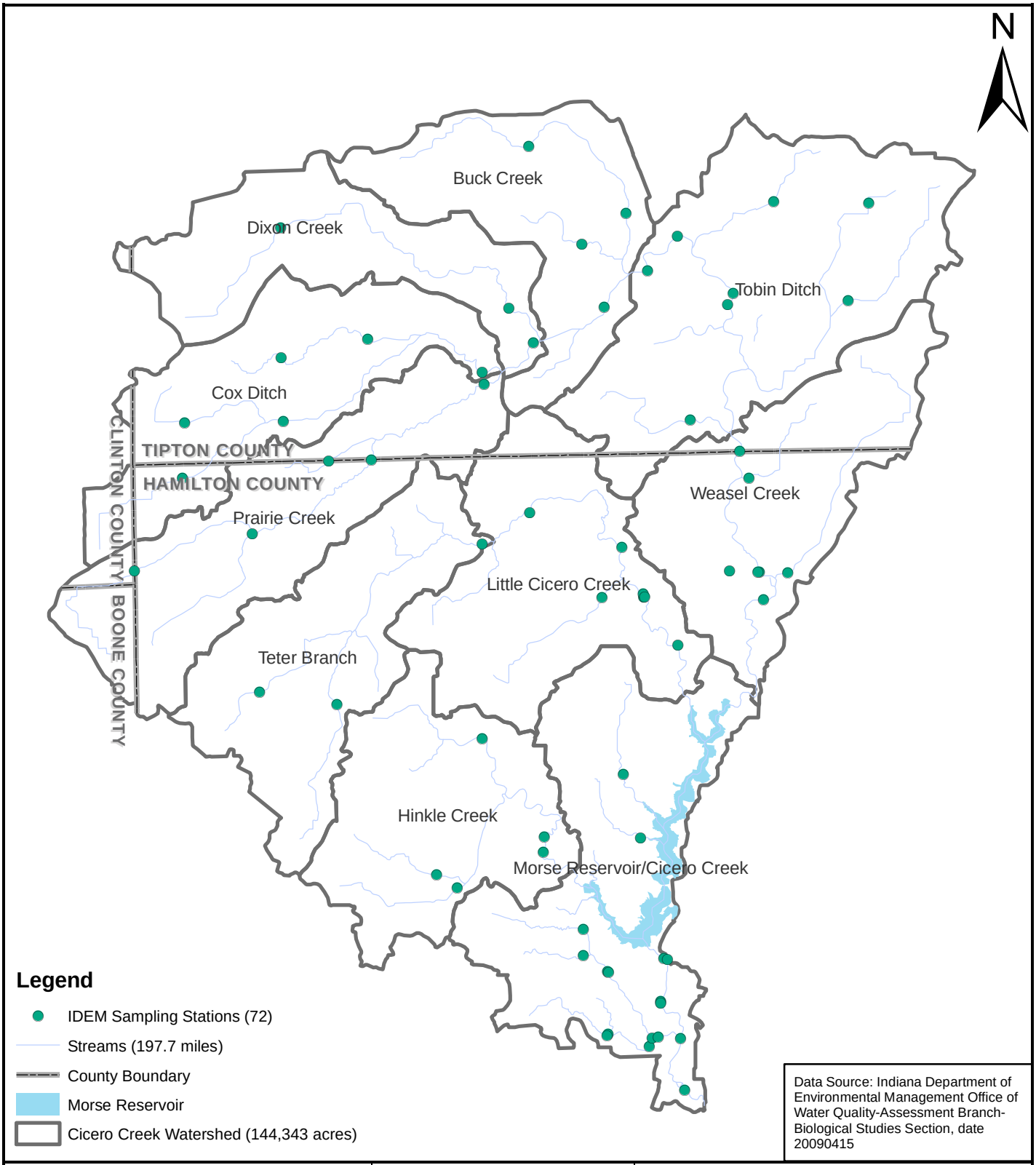
The IDEM data available within the watershed is listed below.

- 1991, 1996, 2001, 2006 Fish Tissue
- 1992, 2001 Macroinvertebrates
- 1996, 2001 Sediment Bio
- 1996 Synoptic
- 1996 Watershed
- 1999 - 2009 Fixed Station
- 2001 Cicero Creek Assessment
- 2001, 2006 Corvallis
- 2001 Corvallis Biological
- 2001 *E. coli* – Upper WFWR
- 2001 W Fk White River in Hamilton Co Assessment
- 2006 Corvallis *E. coli*
- 2006 IDEM *E.coli* sampling data for future Cicero Creek TMDL

It should be noted that five IDEM sampling locations were within Morse Reservoir. Four sampling locations were identified in the 2006 IDEM *E.coli* sampling data for future Cicero Creek TMDL study with data analyzed only for *E. coli*. One sampling location was noted in the 2001 *E. coli* – Upper WFWR Study and dissolved oxygen, temperature, pH, specific conductivity, turbidity and *E. coli* were analyzed at this location. The information associated with these locations was omitted in the data analysis portion of the WMP as it is reservoir specific and does not accurately depict water quality within the subwatershed. This information is, however, included in the Appendix for information and future use purposes.

The IDEM studies included 72 sampling locations throughout the watershed (see large exhibit in Appendix F). Not all samples within the subwatersheds were equally distributed. For example, Teter Branch is represented by only three IDEM sampling locations with information on *E.coli* only. In comparison, the Morse Reservoir/Cicero Creek subwatershed has 17 IDEM sampling locations, 15 of which are downstream of the reservoir and therefore do not provide a complete understanding of the water quality impairments that may be affecting the reservoir. Each subwatershed exhibit contains the locations of all sampling sites within the subwatershed for comparison purposes. The data that was analyzed included field data, general chemistry data and metals data where available. In comparison to the CIWRP data, the IDEM data was all inclusive without a differentiation between base flow or storm flow events. Therefore, an overall average approach of this data was used in order to get a better depiction of how the watershed actually functions at any given time. Site locations were spread throughout the watershed as shown on Exhibit 12 and the data was analyzed on a subwatershed scale as detailed in each subwatershed section.

Several water quality parameters which have standard targets associated with them were screened to determine which subwatersheds demonstrated impairments or degradations. The water quality parameters evaluated from the historical data set and their suggested targets are listed below with a detailed explanation of the parameter and the impairment that it may indicate. All parameters were summarized as means for comparison to water quality targets and other subwatersheds.

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| TITLE: **IDEM Sampling Stations** | | PROJECT: **Morse Reservoir/Cicero Creek Watershed Management Plan** | | |
| BASE LAYER: IDEM Sampling Locations | | PROJECT NO. 09005 | EXHIBIT: 12 | SHEET: 1 OF: 1 |
| CLIENT: Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206 | | QUADRANGLE: N/A | DATE: 09/27/10 | SCALE: 1" = 15000' |

*Dissolved Oxygen* – Dissolved oxygen is the gaseous form of oxygen and is essential for respiration of aquatic organisms (e.g. fish and plants). Dissolved oxygen enters water by diffusion from the atmosphere and as a byproduct of photosynthesis by algae and plants. Oxygen saturation in water would equal 100% if equilibrium were reached. Values greater than 100% saturation indicate photosynthetic activity within the water or highly turbulent water. Large amounts of dissolved oxygen in the water indicate excessive algae growth. Dissolved oxygen is consumed by respiration of aquatic organisms and during bacterial decomposition of plant and animal matter. Levels of Dissolved Oxygen less than 4 mg/L and greater than 12 mg/L exceed the water quality target for Dissolved Oxygen as described in Indiana Administrative Code (IAC) 327 IAC 2-1.5-8.

*Escherichia coli (E. coli)* – *E. coli* is a member of the fecal coliform group of bacteria. When this organism is detected within water samples, it is an indication of fecal contamination. *E. coli* is an indigenous fecal flora of warm-blooded animals. Contributions of detectable *E. coli* colonies may appear within water samples due to the input from human or animal waste. Failing septic tanks and wildlife are some known sources of *E. coli* impairments in waterbodies. Common sources of animal waste are agricultural feedlots (pigs, cattle, etc.), pet waste, or bird waste (such as Canada geese or gulls). Rain storm events or snow melts frequently wash waste and the associated *E. coli* into surface water systems. Rain storm events that exceed the capacity of local sewer systems result in combined sewer overflows that can also be a source of *E. coli*. Land use within the Morse Reservoir Watershed is predominately agricultural and requires drain tiles due to soil type. Field tiles are not sources of *E. coli* but they can carry *E. coli* from land applied manure and runoff from the fields and pastures. The single sample state standard in Indiana for *E. coli* according to Indiana Administrative Code (IAC) 327 IAC 2-1-6 is 235 CFU/100 mL. The measure of CFU per 100 mL means the count of colony forming units (CFU) that exist in 100 milliliters of water.

After 2000 IDEM began using the Most Probable Number (MPN) method instead of CFU for measuring *E. coli.* Based on a study performed by the Department of Statistical Science at Duke University, estimating procedures for MPN and CFU have intrinsic variability and are subject to additional uncertainty arising from minor variations in experimental protocol. It has been observed empirically that the standard multiple-tube fermentation (MTF) decimal dilution analysis MPN procedure is more variable than the membrane filtration CFU procedure, and that MTF derived MPN estimates are somewhat higher on average than CFU estimates, on split samples from the same water bodies.

*Nitrogen* – Nitrogen is an essential nutrient for organism growth. Nitrogen can enter water bodies from the air and as inorganic nitrogen and ammonia for use by bacteria, algae and larger plants. The four common forms of nitrogen are:

- Nitrite (NO2-) – is an intermediate oxidation state of nitrogen, both in the oxidation of ammonia to nitrate and in the reduction of nitrate. Nitrite is a negative charged ionized form of nitrogen (anion).
- Nitrate (NO3-) – Nitrate generally occurs in surface runoff from agricultural fields and can also be conveyed through some groundwater systems. In excessive amounts, it contributes to the illness known as methemoglobinemia in infants. Nitrate is a negative charged ionized form of nitrogen (anion).

- Ammonia (NH3) and Ammonium (NH4+ or simply NH4) – Ammonia has a polar charge and can be toxic to fish. Ammonium is a positive charged ionized form (cation) and is considered nontoxic. Ammonia is present naturally in surface waters. Bacteria produce ammonia as they decompose dead plant and animal matter. The concentration of ammonia is generally low in groundwater because it adheres to soil particles and clays and does not leach readily from soils. It can also be found in some areas with industrial discharges.
- Organic nitrogen (TKN) – is defined functionally as organically bound nitrogen in the trinegative oxidation state. Organic nitrogen includes nitrogen found in plants and animal materials, which includes such natural materials as proteins and peptides, nucleic acids and urea. In the analytical procedures, Total Kjeldahl Nitrogen (TKN) determines both organic nitrogen and ammonia. TKN is determined in the same manor as organic nitrogen with the exception that the ammonia is not driven off before the digestion step.

Levels of Nitrate and Nitrite greater than 10 mg/L exceed the water quality target for those waters designated as a drinking water source for Nitrate and Nitrite as described in Indiana Administrative Code (IAC) 327 IAC 2-1-6. However, for this analysis, levels above 1.6 mg/L were evaluated as the US EPA nutrient criterion for this eco-region.

*pH (Acidic and Alkaline)* – The pH of a water body reflects the hydrogen ion activity in the water body. pH is defined as the –log [H+]. A low pH signifies an acidic medium (lethal effects of most acids begin to appear at pH = 4.5) while a high pH signifies an alkaline medium (lethal effects of most alkalis begin to appear at pH = 9.5). Neutral pH is 7. The actual pH of a water sample indicates the buffering capacity of that water body. Levels of pH less than 6 and greater than 9 exceed the water quality target for pH as described in Indiana Administrative Code (IAC) 327 IAC 2-1.5-8. pH values can change rapidly when algae is present. Algae removes dissolve carbon dioxide during photosynthesis. Carbon dioxide is acidic and therefore this process will cause pH values to rise.

*Phosphorus* – Phosphorus is an essential nutrient for organism growth. Phosphorus can be found in dissolved and sediment-bound forms. However, phosphorus is often locked up in all plant life, including algae. In the watershed, phosphorus is found in fertilizers and in human and animal wastes. The availability of phosphorus determines the growth and production of algae and makes it a limiting nutrient in the system. 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 US EPA recommended water quality target. For this analysis, subwatersheds were evaluated based on EPA's recommended target.

*Total Suspended Solids (TSS)* – Total suspended solids is a water quality measurement which refers to the portion of total solids retained by a filter, where as total dissolved solids (TDS) refers to the portion that passes through the filter. The principal factors affecting separation of TSS and TDS are the type of filter holder, pore size, porosity, area, and thickness of the filter and the physical nature, particle size, and amount of material deposited on the filter. Measurements of TSS can vary widely in watershed streams based on stream flow at the time of sampling. TSS measurements and modeling are frequently used to represent

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

*Atrazine* – Atrazine is an herbicide used to stop pre- and post-emergence broadleaf and grassy weeds in major agricultural crops, especially corn. Atrazine is the most widely used herbicide in conservation tillage systems, which are designed to prevent soil erosion. It may also be used in conventional tillage applications. Its use is controversial due to its effects on nontarget species, such as on amphibians, and because of widespread contamination of waterways and drinking water supplies. There are also thought to be implications for human birth defects, low birth weights and menstrual problems. Levels of Atrazine greater than 0.003 mg/L exceed the US EPA drinking water standards.

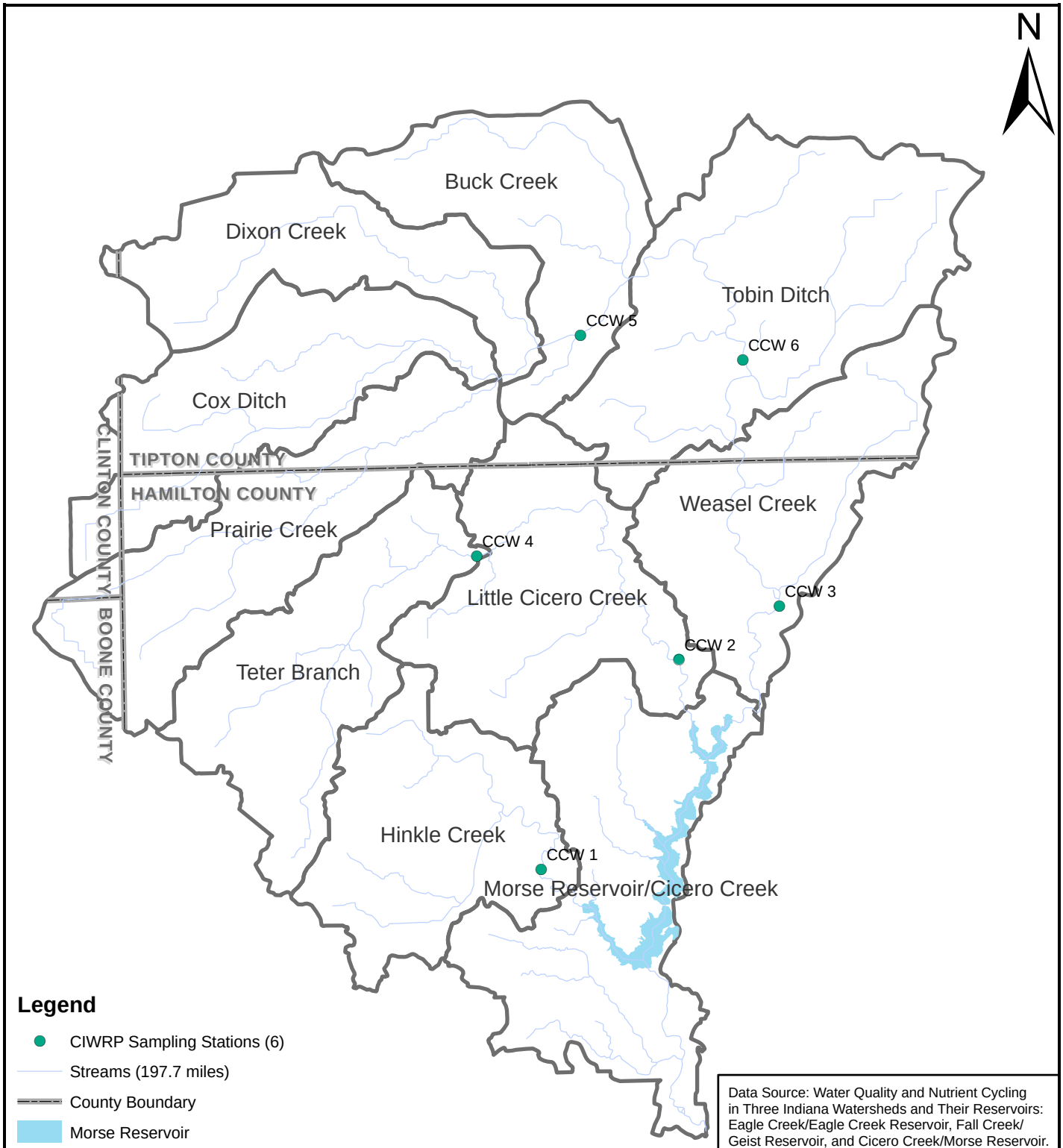
**Central Indiana Water Resources Partnership (CIWRP) Studies**

Central Indiana Water Resources Partnership is a long-term research and development partnership between IUPUI's Center for Earth and Environmental Sciences (CEES) and Veolia Water Indianapolis, LLC. In 2003, CIWRP completed a study encompassing Morse Reservoir and the Cicero Creek watershed (Appendix G). Water quality samples were collected within the watershed during seasonal base and event flow throughout 2003 at locations shown on Exhibit 13. Data collected for the CIWRP study was obtained for analysis for this watershed management plan.

The CIWRP Study included six sampling locations within the Morse Reservoir/Cicero Creek Watershed. Based on the sampling locations, not all subwatersheds could be defined by a sample location. In order to use this data for subwatershed comparisons, some subwatersheds were grouped together and represented by a single sampling site. Several water quality parameters which have standard targets associated with them were screened to determine which subwatersheds demonstrated impairments or degradations. All parameters were summarized as means for comparison to water quality targets and other subwatersheds.

Based on the information obtained for the CIWRP 2009 Research Program website, CIWRP also continues to do blue-green algae research within Morse Reservoir which recently has included documentation on the occurrence of taste and odor compounds as well as cyanotoxins. Exposure to a blue-green algae during recreational activities such as swimming, wading, and water-skiing may lead to rashes, skin, eye irritation, and other uncomfortable effects such as nausea, stomach aches, and tingling in fingers and toes.

There are three main goals for this continued research: 1) to document algal community composition and abundance; 2) to determine the relationship between physical and chemical reservoir conditions and algal community structure and abundance; and 3) to document the occurrence of cyanobacterial toxins and taste and odor compounds. Results of the 2008 study provided important information regarding differences and similarities of phytoplankton community structure and the occurrence of cyanotoxins and taste and odor metabolites in the reservoir. A summary of the 2008 research project as well as the presentation given by Dr. Lenore Tedesco, Nicolas Clercin (CEES) and Mark Gray (Veolia Water) on the findings specifically in Morse Reservoir can be found in Appendix G. The Morse Reservoir study sites included seven sites. All seven sites were evaluated for water




## Legend

- CIWRP Sampling Stations (6)
- Streams (197.7 miles)
- County Boundary
- Morse Reservoir
- Cicero Creek Watershed (144,343 acres)

Data Source: Water Quality and Nutrient Cycling in Three Indiana Watersheds and Their Reservoirs: Eagle Creek/Eagle Creek Reservoir, Fall Creek/ Geist Reservoir, and Cicero Creek/Morse Reservoir. Central Indiana Water Resources Partnership, publication date 20030430

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|---|---|---|---|
| TITLE: **CIWRP Sampling Stations** | PROJECT: **Morse Reservoir/Cicero Creek Watershed Management Plan** | | |
| BASE LAYER: CIWRP Sampling Locations | PROJECT NO. 09005 | EXHIBIT: 13 | SHEET: 1 OF: 1 |
| CLIENT: Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206 | QUADRANGLE: N/A | DATE: 09/27/10 | SCALE: 1" = 15000' |

quality parameters and two of these sites were evaluated for algal toxins. Samples were collected 11 times from May to November.

**V3 Reservoir Shoreline Investigation**

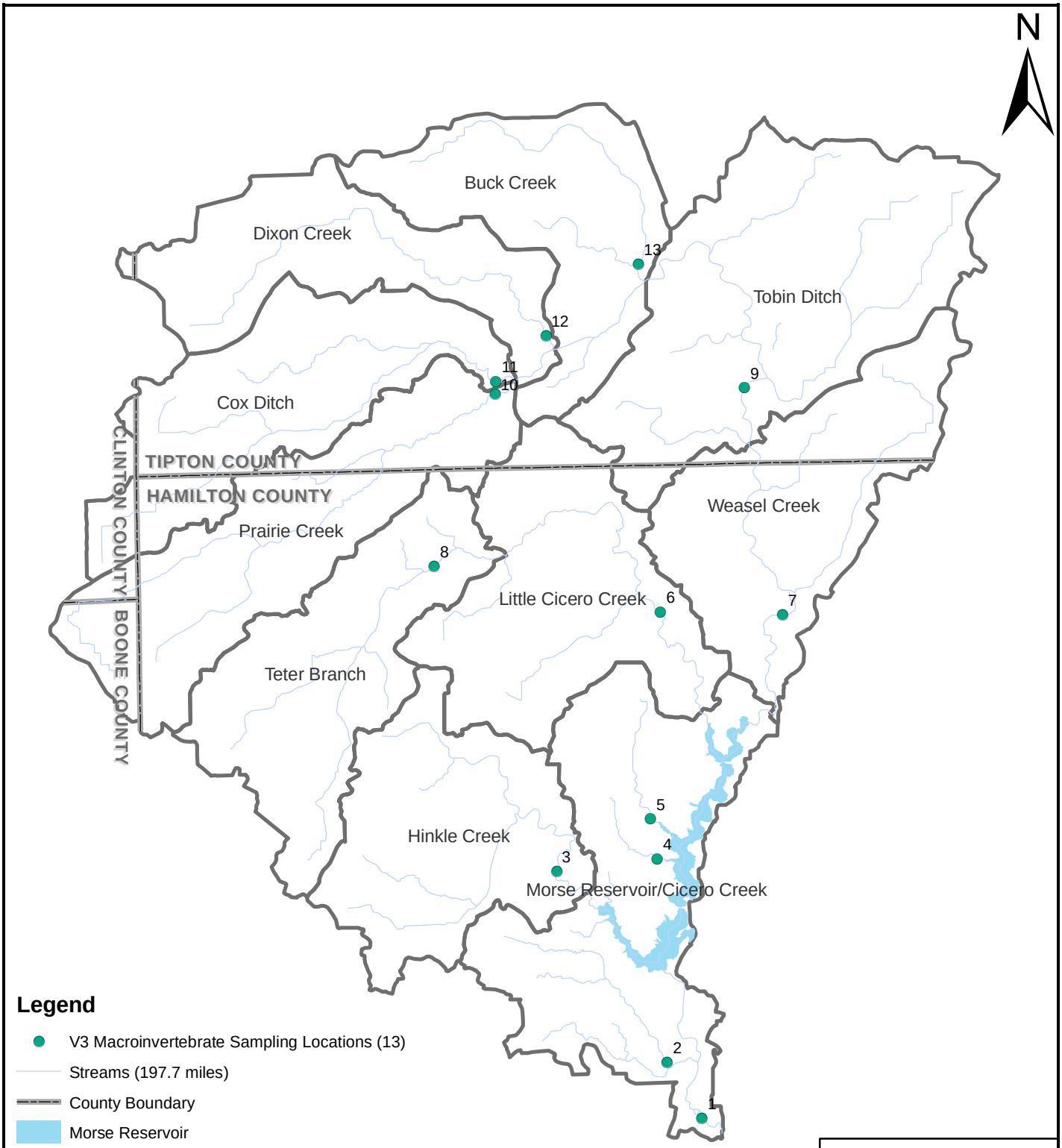
V3 completed at Reservoir Shoreline Investigation of Morse Reservoir in June 2009, using both field observations and aerial photography. During the survey, areas of unprotected shoreline were identified in order to gain an understanding of where erosion may be a concern as well as areas that can be included in implementation projects. Unprotected areas ranged from naturally eroding shoreline (e.g. tree coverage prohibiting vegetation growth with solid root mass for stabilization) to lack of sediment and erosion control measures causing eroded shoreline due to construction activities (e.g. Rule 5 violations). All other areas were considered unprotected as they all have the potential for erosion. An exhibit showing the areas of unprotected shoreline is included in Appendix K along with a copy of the field notes. Specific areas of erosion were not identified in this exhibit as the entire reservoir was not field verified and this information could not be ascertained from an aerial photograph.

**V3 Biological Sampling**

V3 completed a macroinvertebrate study in October 2009 in order to obtain a watershed wide view of the health of the streams based on biological data. As stated in IDEM's Surface Water Quality Assessment Program – Macroinvertebrate Community Assessment Program objectives, any biological community assessment is a measurement of an ecosystem and how it responds to environmental stresses and gives an overall picture of the conditions, at the point being assessed. When conducted in conjunction with chemical analysis of specific water quality parameters and aquatic habitat quality, this information can provide a complete and comprehensive understanding of the ecological quality of the watershed.

Thirteen stations within the Morse Reservoir/Cicero Creek Watershed were evaluated (Appendix H). Station 14, located on Turkey Creek in Tipton County, was used as the high quality reference station outside the watershed for comparative analysis. Sampling locations were chosen based on ease of access from bridge crossings and spatial locations throughout the watershed and were generally located at the most downstream location within each subwatershed. Prairie Creek, Cox Ditch, Dixon Creek, Buck Creek, Tobin Ditch, Weasel Creek, Teter Branch, Little Cicero Creek and Hinkle Creek subwatersheds all had one V3 sampling location. Morse Reservoir/Cicero Creek subwatershed had four V3 sampling locations.

Table 9 indicates the locations of each sample site. Sample locations are shown on Exhibit 14 and on each individual subwatershed exhibit.

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|---|---|---|---|---|
| TITLE: **V3 Macroinvertebrate Sampling Stations** | PROJECT: **Morse Reservoir/Cicero Creek Watershed Management Plan** | | | |
| BASE LAYER: V3 Macro Sampling Locations | PROJECT NO. 09005 | EXHIBIT: 14 | SHEET: 1 OF: 1 | |
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| Table 9: V3 Macroinvertebrate Sampling Stations | | |
|---|---|---|
| **Station #** | **Stream Name** | **Location** |
| 1 | Cicero Creek | River Avenue and 160th Street |
| 2 | East Fork Sly Run | Oakmont and SR 32 |
| 3 | Hinkle Creek | 216th Street and Hinkle Creek Rd |
| 4 | Cicero Creek | Royal Pine and Cedar |
| 5 | Bear Slide Creek | 226th Street and Schulley |
| 6 | Little Cicero Creek | 266th Street and Gwinn Rd |
| 7 | Cicero Creek | Mount Pleasant and 266th Street |
| 8 | Little Cicero Creek | 276th Street and I-31 |
| 9 | Cicero Creek | CR 450 S |
| 10 | Prairie Creek | CR 500 W |
| 11 | Cicero Creek | CR 500 W |
| 12 | Dixon Creek | CR 400 W |
| 13 | Buck Creek | CR 200 S |
| 14* | Turkey Creek (Tipton County) | SR 213 and CR 650 N |

Table 10 is provided to show what other samples or observations (e.g. IDEM, CIWRP or Windshield Survey) were taken/made at the V3 sampling locations. This information will help to compare the biological data to the water chemistry data where applicable as needed for implementation of the plan.

| Table 10: V3 Sample Locations vs. Other Sampling Locations | | | |
|---|---|---|---|
| **Station #** | **IDEM** | **CIWRP** | **Windshield Survey** |
| 1 | Y | N | Y |
| 2 | Y | N | N |
| 3 | Y | Y | Y |
| 4 | Y | N | N |
| 5 | N | N | N |
| 6 | Y | N | Y |
| 7 | Y | N | Y |
| 8 | N | N | N |
| 9 | N | N | Y |
| 10 | Y | N | Y |
| 11 | Y | N | Y |
| 12 | N | N | Y |
| 13 | N | N | N |

Macroinvertebrate monitoring followed the US EPA Rapid Bioassessment Protocol single habitat, family level approach method. The single habitat approach involves sampling riffle/run areas within the sampling reach. A composite sample was made from two kick samples. The collected organisms were sorted and identified to the family level using appropriate field guides. In addition, macroinvertebrate vouchers were sent to Purdue University to verify that all taxon identifications are correct. This collection procedure provides representative macroinvertebrate fauna from riffle/run substrate in the sampling reach.

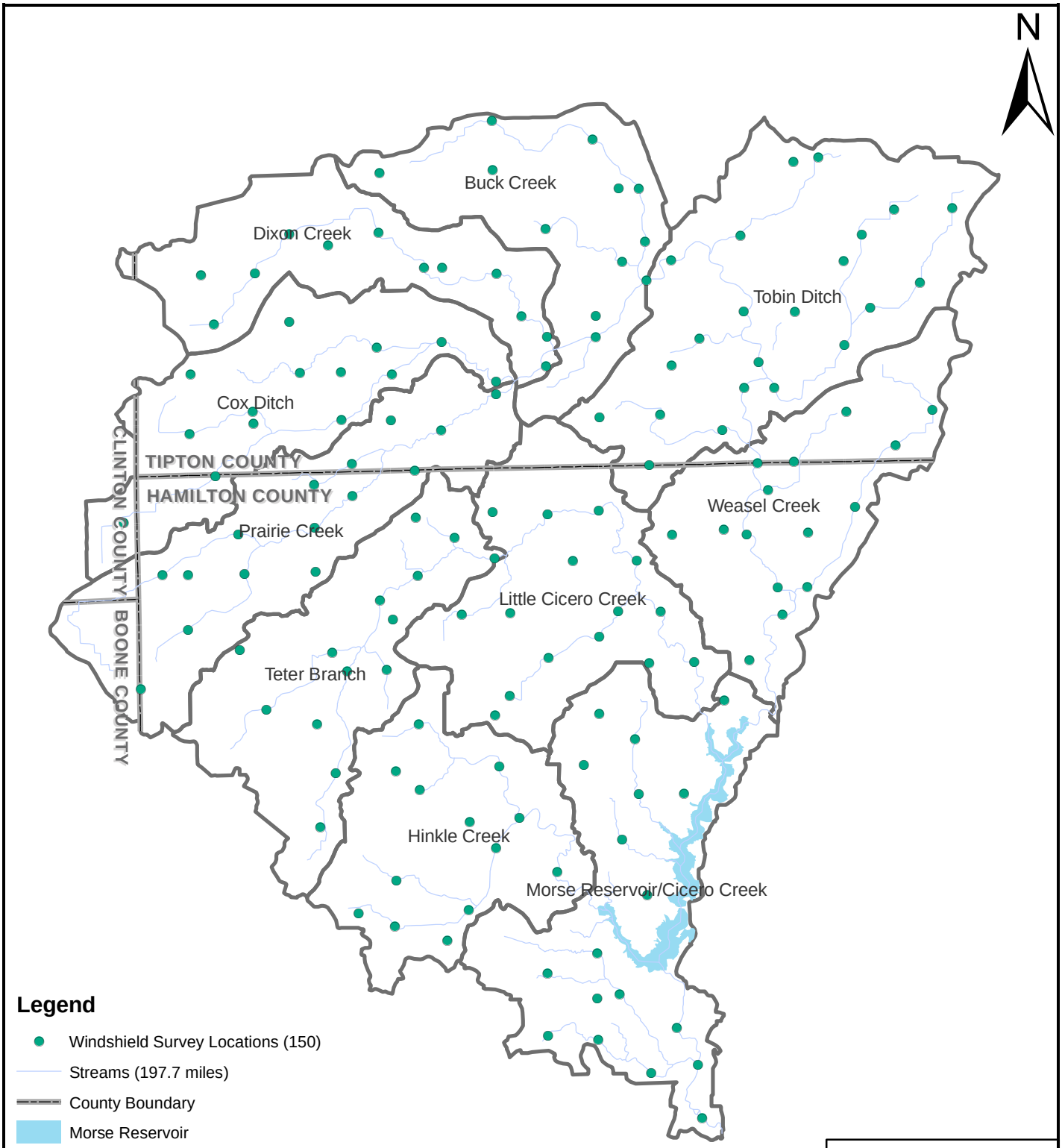
Macroinvertebrate data was analyzed based on IDEM's Macroinvertebrate Index of Biotic Integrity (mIBI) protocols that are consistent with IDNR LARE and US EPA collection procedures. The mIBI is designed to assess biotic integrity directly through ten metrics which evaluate a macroinvertebrate community's species richness, evenness, composition, and density within the stream. These metrics include the family-level HBI (Hilsenhoff's Family Biotic Index), number of taxa, number of individuals, Percent Dominant Taxa, EPT index, EPT count, EPT count to total number of individuals, EPT count to Chironomid count, Chironomid count, and number of individuals per number of squares sorted. Values for the ten metrics are compared with corresponding ranges and a rating of 0, 2, 4, 6, or 8 is assigned to each metric. A final score of 0 – 2 is a severely impaired stream, 2 – 4 is moderately impaired, 4 – 6 is slightly impaired and 6 – 8 is not impaired for biological quality. The average of these ratings gives a total mIBI score. When more than one data set was available, the mIBI scores were summarized as means for comparison to other subwatersheds. The mIBI impairments for each subwatershed vary and were not included in the main WMP document; however, site specific impairment information is included in the Appendix.

**Windshield Survey**

A windshield survey is a type of watershed assessment conducted by an observer traversing the watershed in a motorized vehicle. Real time data is then collected at predetermined stream crossings and accessible locations. Survey locations were split up per subwatershed based on the size of the subwatershed with a total of 100 waterway crossing points and 50 land points. The locations of the waterway crossing points were determined based on ease of access to the streams at roadway crossings (e.g. bridge and/or culvert crossings). The locations of the land points were also determined based on ease of access and were generally located at roadway crossings within the subwatershed. As shown in Exhibit 15, all of the locations identified for windshield survey analysis are spread out throughout each subwatershed in order to provide an overall representation of the subwatershed. The Windshield Survey index maps that show each survey location and its number/label are included in Appendix I.

Observations were made during October/November 2009 by Steering Committee volunteers. Observations including general site information (e.g. location and weather), land use, land odor, evidence of best management practices, water color/appearance, water odor, evidence of algae, streambank erosion, stream buffers & type, in stream debris, available shade/stream cover and in stream habitat were recorded for 150 locations throughout the watershed (Exhibit 15) on standardized survey forms (Appendix I). While all of this information is valid for an overall understanding of the subwatershed, five of the major parameters (animal access, tillage type, streambank erosion, stream buffers and in-stream debris) were used as a part of the subwatershed assessments and the identification of subwatershed priority areas and specific source critical areas. The remainder of the information obtained during the windshield survey should be reevaluated during the feasibility phases of plan implementation.

Example of Rip-Rap Stabilized Streambank




Data Source: Steering Committee
Windshield Survey, Fall 2009

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| TITLE: **Windshield Survey Stations** | | PROJECT: **Morse Reservoir/Cicero Creek Watershed Management Plan** | | |
| BASE LAYER: Windshield Survey Locations | | PROJECT NO. 09005 | EXHIBIT: 15 | SHEET: 1 OF: 1 |
| CLIENT: Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206 | | QUADRANGLE: N/A | DATE: 09/27/10 | SCALE: 1" = 15000' |

Streambank erosion is a natural process within a stream system; however erosion is often accelerated through alterations to the natural system (e.g. changes in landuse, animal access to streams, etc). This accelerated erosion can contribute high sediment loads to the receiving stream, 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. Suspended sediment is a component of the amount of particulate matter in the water column and contributes to increases in the total suspended solids values, making it more difficult and often times impossible for fish and aquatic macroinvertebrates to live. 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 the 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.

Example of Absent Stream Buffer

Stream buffers are areas of natural vegetation between a surface water body and the surrounding land use. Buffers were only identified as adequate if they were at least ten feet in width. As shown on the example picture, Absent Buffers are those where the agricultural land or development is farmed/built up to the top of the stream bank leaving no possibility of runoff from being filtered through a grassed or treed area before entering the stream. 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. Buffers provide water quality protection by reducing the amount of pollutants in the runoff before it enters the water body. Constructed filter strips can also provide localized erosion protection and habitat for wildlife. 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. In areas of agricultural drain tile, the effectiveness of stream buffers can be lower than in areas without these drainage systems especially for contaminants that are transported largely as dissolved load such as nitrate and certain pesticides, including Atrazine.

In-stream debris was also noted during the windshield survey. In-stream debris can inhibit wildlife and aquatic habitat, increase flooding risks, and introduce additional pollutants. This information is valuable for the purposes of determining public education opportunities. Debris was assessed on a subwatershed scale based on the presence and type of debris (trash, deposits, log jam, etc) identified during the windshield survey. Animal access was assessed on a subwatershed scale based on the presence of animals or indicators of access.

Example of Animal Access to Stream

**Nonpoint Source Pollution Modeling**

Nonpoint source pollution is a type of pollution generated from diffused sources in both public and private domains. As defined by EPA, the pollution from nonpoint sources originates from urban runoff, construction activities, manmade modification of hydrologic regime of a watercourse (e.g. retention, detention, channelization, etc.), silviculture, mining, agriculture, irrigation return flows, solid waste disposal, atmospheric deposition, stream bank erosion, and individual or zonal sewage disposal. Therefore, nonpoint pollution sources have their origin in a wide spectrum of public and private activities and, when not known or properly controlled, could affect, in a large percentage, the water quality in a certain area.

Since runoff from the rainfall flows over or through the land and collects pollutants and nutrients prior to entering waterways, the overall characteristics and land use types of a watershed greatly influences the water quality. Each land use type includes the cumulative effects of various land covers, and natural and man-made activities. Therefore, each land use type can have an adverse affect on water quality, by contributing different pollutant amounts and concentrations. The cumulative effect of this pollution throughout the watershed represents the contribution of nonpoint source pollution.

Nonpoint source pollution management is highly dependent on hydrologic simulation models, and use of computer modeling is often the only viable means of providing useful input information for adopting the best management decisions. As previously mentioned, the nonpoint pollution sources are generated by activities that are spatially distributed on the analyzed watershed or study area. Due to this spatial distribution of nonpoint pollution sources, the computation models used to study pollutant transport and stream bank erosion require large amounts of data for analysis in even a small watershed.

For the Morse Reservoir/Cicero Creek Watershed, a tabular based non-point source pollution loading model was used to assess the nonpoint source pollution of three main pollutant parameters (Total Nitrogen, Total Phosphorus and Total Sediment) that have been identified as elements of concern by both stakeholders and water sampling events (Appendix L). This model is known as the Spreadsheet Tool for Estimating Pollutant Load (STEPL). STEPL employs simple algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various best management practices (BMPs).

For each subwatershed, the annual nutrient loading is calculated based on the runoff volume and the pollutant concentrations in the runoff water as influenced by factors such as the land use distribution and management practices. The annual sediment load (sheet and rill erosion only) is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. The sediment and pollutant load reductions that result from the implementation of BMPs are computed using the known BMP efficiencies.

The STEPL model was executed for each HUC 12 subwatershed within the Morse Reservoir/Cicero Creek Watershed. It should be noted that all computation models have assumptions and limitations. Therefore, the provided analytical results may not represent the exact pollution loads. In these conditions, even if the results are relative, they still can

provide useful information for targeting and prioritizing subwatersheds for Best Management Practices (BMPs).

It is also important to note that the above presented nonpoint source modeling does not specifically include bank erosion and mass wasting, which can contribute additional pollutant loads of sediment, nitrogen, and phosphorus. However, certain landuses within the model have input values that incorporate some bank erosion that is typical for that land practice.

**NPDES Permitted Facilities & Confined Feeding Operations**

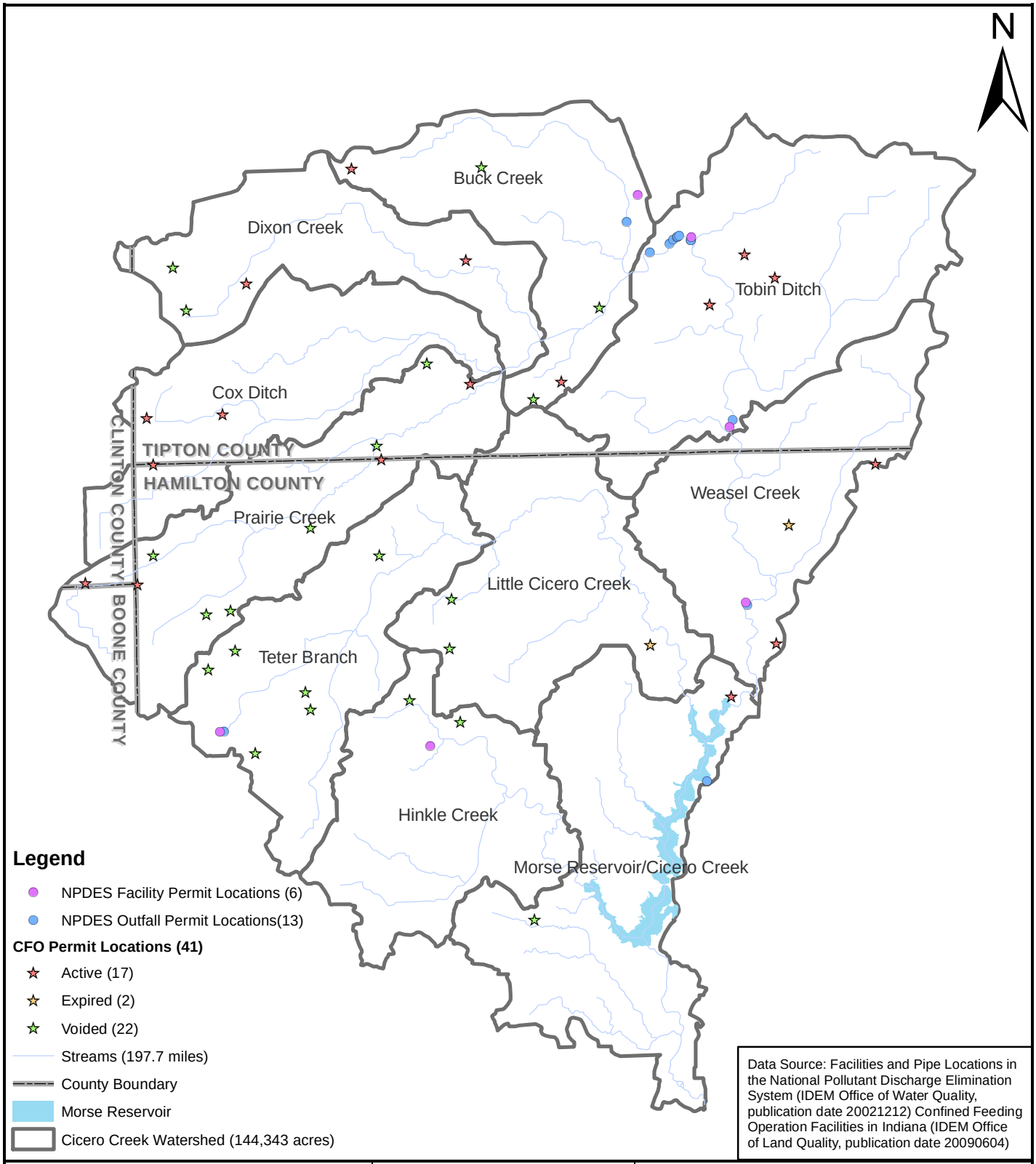
The National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. Point sources are discrete conveyances such as pipes or man-made ditches. Records for NPDES facilities and Confined Feeding Operations within the watershed were obtained from IDEM (Exhibit 16) and are analyzed on a subwatershed scale. The CFO compliance information obtained from IDEM did not include the type of operation for all of the CFOs within the watershed. Therefore, this information was not provided in the plan, however all obtained data is included on the Appendices CD. The permit status of the CFO is provided on Exhibit 16 as well as on each individual subwatershed exhibit and in each subwatershed section in the Subwatershed Summary.

Based on information obtained from IDEM, the State of Indiana's efforts to control the direct discharge of pollutants to waters of the State were inaugurated by the passage of the Stream Pollution Control Law of 1943. The vehicle currently used to control direct discharges to waters of the State is the NPDES Permit Program. This was made possible by the passage of the Federal Water Pollution Control Act Amendments of 1972 (also referred to as the Clean Water Act). These permits place limits on the amount of pollutants that may be discharged to waters of the State by each discharger. These limits are set at levels protective of both the aquatic life in the waters which receive the discharge and protective of human health.

There are several different types of permits that are issued in the NPDES permitting program including Municipal, Semi-Public or State (sanitary-type discharger); Industrial (wastewater generated in producing a product); and Wet Weather/Storm Water-related (wastewater resulting from precipitation coming in contact with a substance which is either dissolved or suspended in the water).

The purpose of the NPDES permit is to control the point source discharge of pollutants into the waters of the State such that the quality of the water of the State is maintained in accordance with the standards contained in 327 IAC 2. The NPDES permit requirements must ensure that, at a minimum, any new or existing point source must comply with technology-based treatment requirements that are contained in 327 IAC 5-5-2. According to 327 IAC 5-2-2, "Any discharge of pollutants into waters of the State as a point source discharge, except for exclusions made in 327 IAC 5-2-4, is prohibited unless in conformity with a valid NPDES permit obtained prior to discharge." This is the most basic principal of the NPDES permit program.

The majority of NPDES permits have existed since 1974. This means that most of the permit writing is for permit renewals. Approximately 10% of each year's workload is attributed to new permits, modifications and requests for estimated limits. NPDES permits are designed




Data Source: Facilities and Pipe Locations in the National Pollutant Discharge Elimination System (IDEM Office of Water Quality, publication date 20021212) Confined Feeding Operation Facilities in Indiana (IDEM Office of Land Quality, publication date 20090604)

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| BASE LAYER: NPDES Permitted Locations | PROJECT NO. 09005 | EXHIBIT: 16 | SHEET: 1 OF: 1 |
| CLIENT: Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206 | QUADRANGLE: N/A | DATE: 09/27/10 | SCALE: 1" = 15000' |

to be re-issued every five years but are administratively extended in full force and effect indefinitely if the permittee applied for a renewal before the current permit expires.

Confined Feeding Operations (CFOs) are also considered a point source requiring an NPDES permit. Indiana law defines a confined feeding operation as any animal feeding operation engaged in the confined feeding of at least 300 cattle, or 600 swine or sheep, or 30,000 fowl. IDEM regulates these confined feeding operations. The animals raised in confined feeding operations produce manure and wastewater which is collected and stored in pits, tanks, lagoons and other storage devices. The manure is then applied to area fields as fertilizer. When stored and applied properly, this beneficial reuse provides a natural source of nutrients for crop production. It also lessens the need for fuel and other resources that are used in the production of commercial fertilizer. Confined feeding operations, however, can also pose environmental concerns, including manure leakage or spillage from storage pits, lagoons or tanks; and improper application of manure to the land. These environmental concerns are manifest as excessive nutrients, especially nitrogen and phosphorus, and bacterial contamination (*E. coli*).

CFOs within the watershed were categorized based on their permitted status – active, expired or voided. An active CFO indicates that the farm has a current approval, the manure management plan is up to date and the farm can operate. An expired CFO indicates that the farm did not start construction within two years of their approval date, so their approval expired. A voided CFO indicates that the farm has closed or gone beneath the numbers required to be in the CFO program. The CFO information obtained from IDEM included permits that date as back to 1998 and are as recent as 2009. The CFO compliance information obtained from IDEM did not include the type of operation for all of the CFOs within the watershed. Therefore, this information was not provided in the plan, however all obtained data is included in the Appendix. The permit status of the CFO is provided on the NPDES Permit Locations exhibit as well as on each individual subwatershed exhibit and in each subwatershed section in the Subwatershed Summary.

**Indiana Clean Lakes Program**

The Indiana Clean Lakes Program was created in 1989 as a program within IDEM's Office of Water Management. The program is administered through a grant to Indiana University's School of Public and Environmental Affairs. The program is a comprehensive, statewide public lake management program focusing on public information and education, technical assistance, volunteer lake monitoring, lake water quality assessment and coordination with other state and federal lake programs.

Sampling information for Morse Reservoir is available through the Indiana Clean Lakes Program for the years 1991, 1996 and 2002. The sampling location had a maximum depth of 13.7m and secchi depths were measured at 1m, 1.1m and 0.9m in 1991, 1996, and 2002 respectively. This information along with the Chlorophyll a and Phosphorus readings indicate that the reservoir is considered eutrophic based on EPAs trophic index protocols.

**IDEM *Cylindrospermopsis raciborskii* Report**

*The Distribution and Abundance of Cylindrospermopsis raciborskii (C. raciborskii) in Indiana Lakes and Reservoirs* report was prepared by the Indiana University School of Public and Environmental Affairs program and was administered by the Indiana Department of

Environmental Management Office of Water Quality through the Clean Water Act Section 205(j) funds.

A sample was collected from Morse Reservoir during routine lake assessments through the Indiana Clean Lakes Program in August of 2002. The sample measured 19,640 cells/ml of *C. raciborskii* which is in the relatively mild and/or low probability of adverse health effects category. As mentioned in the report, the extent of this study was limited and should not be considered an all inclusive report on *C. raciborskii* in the Morse Reservoir. This information does however express that the overall health of the reservoir and that it is conducive to producing this potentially toxic alga.

**IDEM Mid-water Planktonic Invertebrate Report**

The purpose of this study was driven by the Eagle Creek fish kill in 2000 and was completed to determine the relative abundance of the populations of light responsive zooplankton within Eagle Creek, Morse and Geist Reservoirs. This study was completed to determine if the fish kill within the Eagle Creek Reservoir also had an impact on the zooplankton abundance not to determine the cause of the fish kill. Geist and Morse Reservoirs were used as control reservoirs to compare results to and not to determine the overall health of the reservoirs.

Three samples were taken within the Morse Reservoir, one sample at the upper end of the reservoir (shallow end sample), one in the middle and one at the downstream end of the reservoir (mid and deep end samples). Out of the three reservoirs, Morse had the highest number of collected zooplankton (18,622). The abundance of zooplankton, if detailed sample analysis was completed at a lower taxonomic level, would provide a better indication of reservoir health in that they are a food base for vertebrate and invertebrate predators.

**US Filter/Indianapolis Water (Veolia Water)**

Bi-weekly sampling near Morse Reservoir has been conducted since October of 2002. Three sampling sites are located at Little Chicago Road at Hinkle Creek, 226$^{th}$ Street at Bear Slide Creek, and Mt. Pleasant at Big Cicero Creek. Samples are collected biweekly for cations, anions, total phosphorus, alkalinity, turbidity and pH. This data was not included in the WMP analysis; however it may be useful during implementation to determine the downstream impact of Best Management Practices in the upper reaches of the watershed.

### Subwatershed Summary

The following sections break down the water quality information obtained for the WMP by subwatershed. Sample locations from the previously mentioned available data and studies are provided on a detailed exhibit for each subwatershed. Sample locations from these studies may occur at the same site with the symbols overlapping (symbols were chosen in order to determine whether the icons were overlapping). For clarification on individual study sites, the overall watershed maps should be consulted (Exhibits 12-15). A comparison of the subwatersheds is provided at the end of this section as a way to understand the differences in water quality parameters from one subwatershed to another.

In general, the overall characteristics and land use types of a watershed greatly influences the water quality since runoff from rainfall flows over or through the land and collects pollutants and nutrients prior to entering waterways. The IDEM data included 79 stations

within the watershed that analyzed *E.coli*, Nitrate+Nitrite, Total Phosphorus, Total Suspended Solids and Turbidity. The CIWRP Study included six sampling locations within the Morse Reservoir/Cicero Creek Watershed and analyzed *E.coli*, Nitrate+Nitrite, Total Phosphorus, Total Suspended Solids and Turbidity. The turbidity data in the Subwatershed Summary sections is included for information purposes only. Turbidity specific information was excluded from the subwatershed summaries and rankings based on comments/recommendations from the Steering Committee during the preparation of the WMP.

Based on the CIWRP sampling locations, not all subwatersheds could be defined by a sample location. In order to use the CIWRP data for subwatershed comparisons, some subwatersheds were grouped together and represented by a single CIWRP sampling site. CIWRP water quality samples were collected within the watershed during seasonal base and event flow. In comparison to the CIWRP data, the IDEM data was all inclusive without a differentiation between base flow or storm flow events. Therefore, an overall average approach of this data was used in order to get a better depiction of how the watershed actually functions at any given time. Depending on the pollutant, both types of samples can result in elevated values. For example, the *E.coli* values shown in the subwatershed tables are extremely elevated when compared to the IDEM data. This is a major concern in the watershed and is reflected so in the problems and goals described later in the WMP.

Nonpoint source pollution modeling is a quantitative way to evaluate the effects of land use on water quality for comparison purposes. A nonpoint source pollution model was created for the WMP. The results are provided in Table 11 and in Part Three of the Watershed Inventory. This information was not provided in each subwatershed summary since all computation models have assumptions and limitations and therefore may not represent the exact pollution loads. In these conditions, even if the results are relative, they still can provide useful information for targeting and prioritizing subwatersheds for Best Management Practices (BMPs). Part Three of the Watershed Inventory explores the relationships of nonpoint source modeling among all 10 of the subwatersheds.

**Table 11: NPS Modeling Summary**

| Subwatershed | N Load (lb/ac/yr) | P Load (lb/ac/yr) | Sediment Load (t/ac/yr) |
|---|---|---|---|
| Prairie Creek | 5.58 | 1.13 | 0.36 |
| Cox Ditch | 5.59 | 1.15 | 0.37 |
| Dixon Creek | 5.66 | 1.17 | 0.39 |
| Buck Creek | 5.74 | 1.16 | 0.37 |
| Tobin Ditch | 5.47 | 1.08 | 0.32 |
| Weasel Creek | 5.48 | 1.13 | 0.34 |
| Teter Branch | 5.64 | 1.11 | 0.35 |
| Little Cicero Creek | 5.48 | 1.12 | 0.35 |
| Hinkle Creek | 5.30 | 1.04 | 0.32 |
| Morse Reservoir/ Cicero Creek | 5.20 | 0.96 | 0.27 |

NPDES permits and locations of Confined Feeding Operations can also be indicative of the land use and the subsequent water quality of a subwatershed. Records for NPDES facilities

and Confined Feeding Operations within the watershed were obtained from IDEM and are analyzed on a subwatershed scale. The CFO compliance information obtained from IDEM did not include the type of operation for all of the CFOs within the watershed. Therefore, this information was not provided in the plan, however all obtained data is included on the Appendices CD. The permit status of the CFO is provided in each subwatershed section where appropriate in the Subwatershed Summary.

### Prairie Creek Subwatershed

The Prairie Creek Subwatershed (HUC 12 – 051202010601) encompasses portions of Hamilton, Boone, Clinton, and Tipton Counties as shown in Exhibit 17. The subwatershed covers approximately 15,140 acres and includes Prairie Creek, Endicott Ditch, Pearce Ditch and McKinzie Ditch.

**Water Quality Information**

According to the IDEM 305(b) list, the streams within the Prairie Creek Subwatershed are designated for Recreational, Fishable, and Aquatic Life Use. The 303(d) list indicates that none of the streams within the subwatershed are impaired. It should be noted that if a stream is not listed on the 303(d) list it may be impaired; however the data (or lack thereof) does not indicate the impairment at the time of publication.

A total of 5 IDEM water quality sampling stations are located within the Prairie Creek Subwatershed. Available IDEM data at these stations included sampling from the 2006 IDEM *E.coli* sampling data for future Cicero Creek TMDL Study.

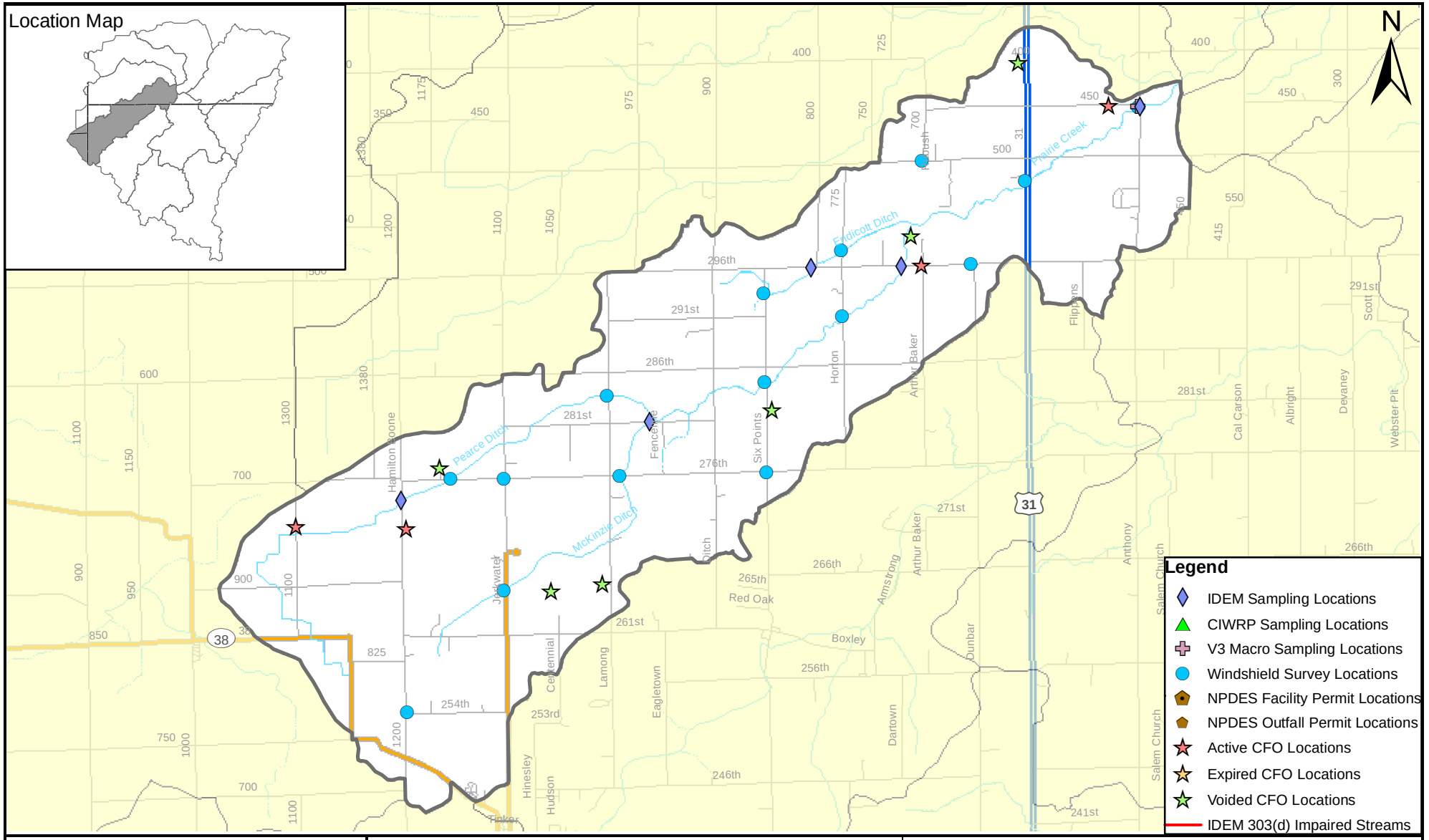
No CIWRP sampling sites were located within the Prairie Creek subwatershed; therefore it was grouped with the Cox Ditch, Dixon Creek, and Buck Creek subwatersheds and represented by site CCW5.

Table 12 summarizes the IDEM and CIWRP sampling mean value of each parameter for all of the data screened and the corresponding water quality target.

**Table 12: Prairie Creek IDEM and CIWRP Water Quality Sampling Summary**

| Water Quality Parameter | IDEM Mean Value | CIWRP Mean Value | Water Quality Target |
|---|---|---|---|
| Dissolved Oxygen | Not Sampled | 11.6 mg/L | between 4.0 and 12.0 mg/L |
| *E. coli* | 822 CFU/100mL | 1886 CFU/100mL | 235 CFU/100mL |
| Nitrate + Nitrite | Not Sampled | 7.5 mg/L | 1.6 mg/L |
| pH | Not Sampled | 7.7 | between 6.0 and 9.0 |
| Total Phosphorus | Not Sampled | 0.152 mg/L | 0.076 mg/L |
| TSS | Not Sampled | 40.1 mg/L | 30.0 mg/L |
| Turbidity | Not Sampled | 75.3 NTU | 10.4 NTU |
| Atrazine | Not Sampled | Not Sampled | 0.003 mg/L |

Based on the available water quality information, the Prairie Creek subwatershed consistently tests higher than the water quality targets in *E. coli*, Nitrate + Nitrite, Total Phosphorus and TSS. Dissolved Oxygen and pH fall within the acceptable ranges and therefore are not a concern for this subwatershed.

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TITLE:
**Prairie Creek Subwatershed (HUC-12: 051202010601) Map**

PROJECT:
**Morse Reservoir/Cicero Creek Watershed Management Plan**

BASE LAYER: StreetMap USA

CLIENT:
Upper White River Watershed Alliance
P.O. Box 2065
Indianapolis, Indiana 46206

| PROJECT NO.: | EXHIBIT: | SHEET: 1 OF: 1 |
|---|---|---|
| 09005 | 17 | |
| QUADRANGLE: | DATE: | SCALE: |
| N/A | 09/27/10 | 1" = 7000' |

**Landuse Information**
Landuse within the Prairie Creek Subwatershed consists primarily of agricultural uses. The Sheridan Airport is located in the southwest portion of the subwatershed.

During October/November 2009, the Steering Committee volunteers conducted a windshield survey at 150 site locations within the Morse Reservoir/Cicero Creek Watershed. This windshield survey included 10 stream crossing sites and 5 land/field sites within the Prairie Creek Subwatershed. Observations including streambank erosion, lack of stream buffers, animal access and fields under conventional till were recorded for each site and the results are summarized in Table 13 below.

**Table 13: Prairie Creek Windshield Survey Summary**

| Parameter | Observations |
|---|---|
| Streambank Erosion | 1/10 sites with erosion >3'<br>0/10 sites with erosion <3' |
| Stream Buffers | 2/10 sites with no buffers<br>4/10 sites with buffers <50' |
| In-stream Debris | 0/10 sites with debris |
| Animal Access | 1/10 site with animal access |
| Conventional Till | 3/15 sites under conventional till |

The number, type, and compliance records of all NPDES permits were obtained and analyzed for each subwatershed. The Prairie Creek subwatershed contains four active confined feeding operations and six voided CFOs. There were two violations reported for the CFOs within the subwatershed based on the inspection reports obtained from IDEM. One violation was reported in 2008 for lack of manure testing and record keeping and the other was reported in 2009 for lack of record keeping.

**Habitat/Biological Information**
V3 completed a macroinvertebrate study in October 2009 that included thirteen stations within the Morse Reservoir/Cicero Creek Watershed. One station (Station 10), located at the crossing of Prairie Creek on County Road 500 W in Tipton County, was analyzed within the Prairie Creek Subwatershed.

The calculated mIBI score of 4.2 indicates that the Prairie Creek Subwatershed is slightly impaired for macroinvertebrate communities. One IDEM sampling station and a windshield survey site were located in the vicinity of the macroinvertebrate station. The windshield survey did not include any information on the presence or quality of habitat at the site however notes taken during the macroinvertebrate sampling indicated that significant filamentous algae growth was covering rock substrate that could provide habitat for macroinvertebrate specie. This would indicate that the slight impairment seen in the macroinvertebrate community is not likely caused due to lack of habitat. At the IDEM sampling station, *E. coli* was the only water quality parameter analyzed. Levels of *E. coli* at this station average 619.4 CFU/100mL which does exceed the water quality target. Therefore, it is difficult to conclude if the slight impairment to the macroinvertebrate community is due solely to the water chemistry at the site since only *E.coli* was measured

and no other water chemistry parameters. Detailed analysis for each station can be found in Appendix H.

### Cox Ditch Subwatershed

The Cox Ditch Subwatershed (HUC 12 – 051202010602) is located primarily in Tipton County with small portions in Clinton and Hamilton Counties as shown in Exhibit 18. The subwatershed encompasses approximately 13,192 acres and includes Cicero Creek, Cox Ditch, Christy Ditch, Leander Boyle Ditch, Matthews Ditch and Kigin Ditch.

**Water Quality Information**

According to the IDEM 305(b) list, the streams within the Cox Ditch Subwatershed are designated for Recreational, Fishable, and Aquatic Life Use. The 303(d) list indicates that approximately 19.4 miles of streams within the subwatershed are impaired for nutrients, algae and impaired biotic communities, which includes every stream within the subwatershed.

A total of 6 IDEM water quality sampling stations are located within the Cox Ditch Subwatershed. Available IDEM data at these stations included sampling from the 2001 Corvallis Study, the 2006 Corvallis and 2006 Corvallis *E. coli* Studies and the 2006 IDEM *E.coli* sampling data for future Cicero Creek TMDL Study.

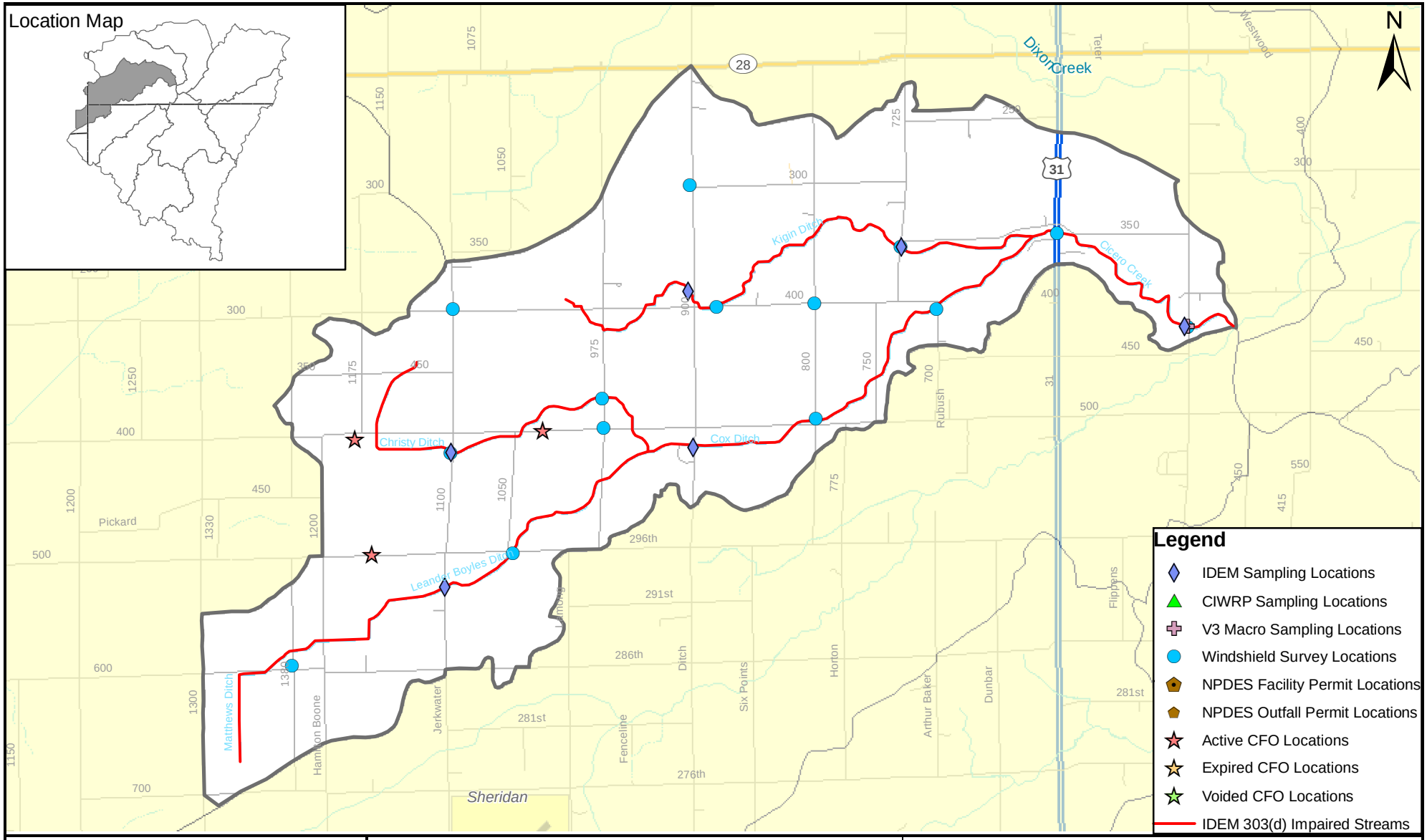
No CIWRP sampling sites were located within the Cox Ditch subwatershed; therefore it was grouped with the Prairie Creek, Dixon Creek, and Buck Creek subwatersheds and represented by the site CCW5.

Table 14 summarizes the IDEM and CIWRP sampling mean value of each parameter screened and the corresponding water quality target.

**Table 14: Cox Ditch IDEM and CIWRP Water Quality Sampling Summary**

| Water Quality Parameter | IDEM Mean Value | CIWRP Mean Value | Water Quality Target |
|---|---|---|---|
| Dissolved Oxygen | 10.1 mg/L | 11.6 mg/L | between 4.0 and 12.0 mg/L |
| *E. coli* | 638 CFU/100mL | 1886 CFU/100mL | 235 CFU/100mL |
| Nitrate + Nitrite | 7.4 mg/L | 7.5 mg/L | 1.6 mg/L |
| pH | 7.8 | 7.7 | between 6.0 and 9.0 |
| Total Phosphorus | 0.103 mg/L | 0.152 mg/L | 0.076 mg/L |
| TSS | 27.7 mg/L | 40.1 mg/L | 30.0 mg/L |
| Turbidity | 32.2 NTU | 75.3 NTU | 10.4 NTU |
| Atrazine | Not Sampled | Not Sampled | 0.003 mg/L |

Based on the available water quality information, the Cox Ditch subwatershed consistently tests higher than the water quality targets in *E. coli*, Nitrate + Nitrite and Total Phosphorus. TSS tested higher than the water quality targets in the CIWRP Study however it tested lower in the IDEM data. This is likely due to the fact that the CIWRP data specifically targeted some high flow events when TSS is known to be higher. Dissolved Oxygen and pH fall within the acceptable ranges and therefore are not a concern for this subwatershed.

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TITLE: **Cox Ditch Subwatershed (HUC-12: 051202010602) Map**

PROJECT: **Morse Reservoir/Cicero Creek Watershed Management Plan**

BASE LAYER: StreetMap USA

CLIENT: Upper White River Watershed Alliance
P.O. Box 2065
Indianapolis, Indiana 46206

| PROJECT NO.: | EXHIBIT: | SHEET: 1 OF: 1 |
|---|---|---|
| 09005 | 18 | |
| QUADRANGLE: | DATE: | SCALE: |
| N/A | 09/27/10 | 1" = 6000' |

**Landuse Information**
Landuse within the Cox Ditch Subwatershed consists primarily of agricultural uses.

During October/November 2009, the Steering Committee volunteers conducted a windshield survey at 150 site locations within the Morse Reservoir/Cicero Creek Watershed. This windshield survey included 9 stream crossing sites and 5 land/field sites within the Cox Ditch Subwatershed. Observations including streambank erosion, stream buffers, debris, animal access and fields under conventional till were recorded for each site and the results are summarized in Table 15 below.

**Table 15: Cox Ditch Windshield Survey Summary**

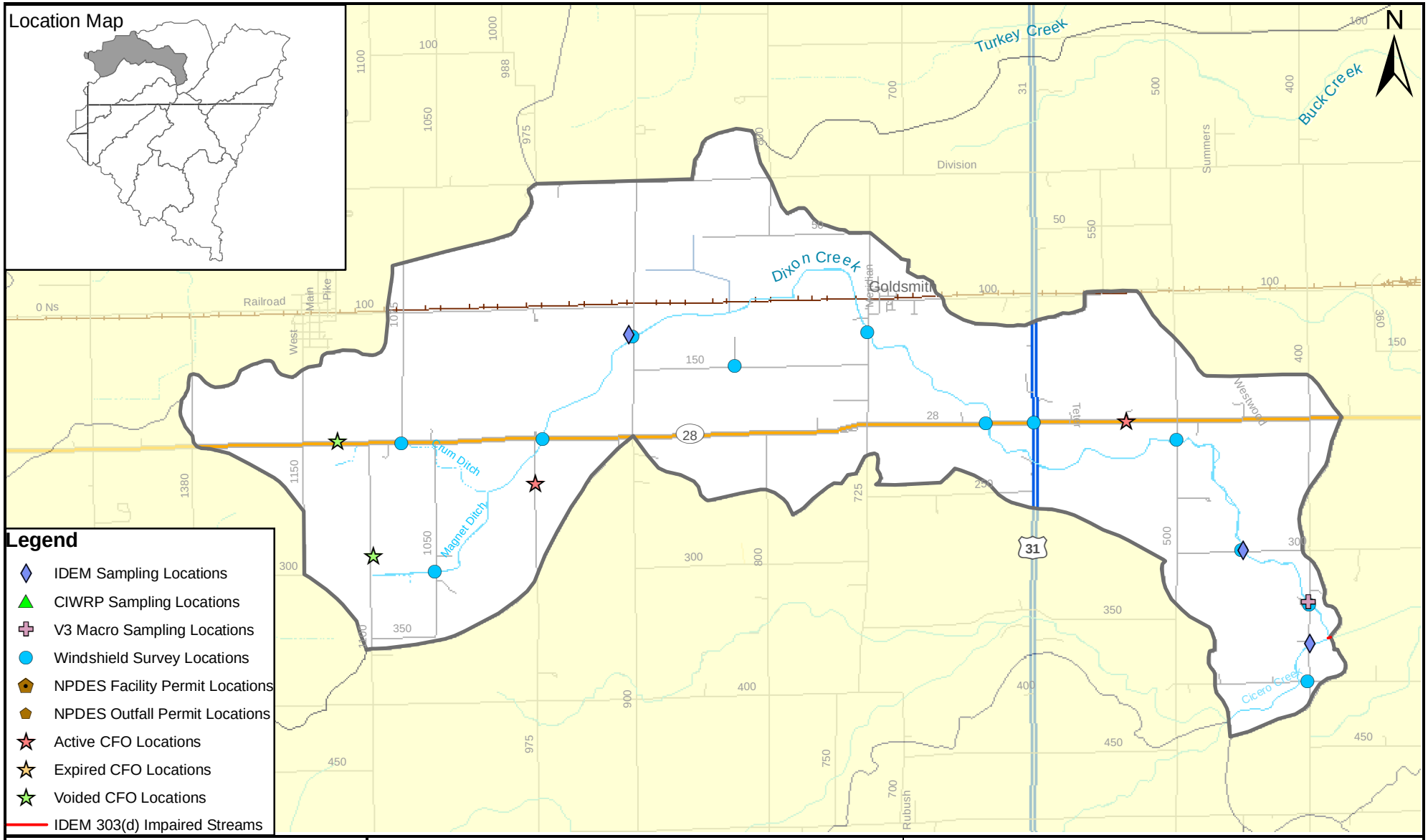
| Parameter | Observations |
|---|---|
| Streambank Erosion | 1/9 site with erosion >3'<br>0/9 sites with erosion <3' |
| Stream Buffers | 2/9 sites with no buffers<br>3/9 sites with buffers <50' |
| In-stream Debris | 1/9 site with debris |
| Animal Access | 1/9 site with animal access |
| Conventional Till | 0/14 sites under conventional till |

The Cox Ditch subwatershed contains three active confined feeding operations. There were no violations reported for the CFOs within the subwatershed based on the inspection reports obtained from IDEM.

**Habitat/Biological Information**
V3 completed a macroinvertebrate study in October 2009 that included thirteen stations within the Morse Reservoir/Cicero Creek Watershed. One station (Station 11), located at the crossing of Cicero Creek on County Road 500 W in Tipton County, was analyzed within the Cox Ditch Subwatershed.

The calculated mIBI score of 3.8 indicates that the Cox Ditch Subwatershed is moderately impaired for macroinvertebrate communities. One IDEM sampling station and a windshield survey site were located in the vicinity of the macroinvertebrate station. The windshield survey indicated that adequate habitat was available for macroinvertebrates in the form of underwater trees roots, sufficient cover, and the absence of erosion. This would indicate that the moderate impairment seen in the macroinvertebrate community is not likely caused by lack of habitat. At the IDEM sampling station, *E. coli* was the only water quality parameter analyzed. Levels of E. coli at this station average 291.3 CFU/100mL which do exceed the water quality target. Therefore, it is difficult to conclude if the moderate impairment to the macroinvertebrate community is due solely to the water chemistry at the site since only *E.coli* was measured and no other water chemistry parameters. Detailed analysis for each station can be found in Appendix H.

### Dixon Creek Subwatershed
The Dixon Creek Subwatershed (HUC 12 – 051202010603) is located primarily in Tipton County with a small portion in Clinton County as shown in Exhibit 19. The subwatershed

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TITLE: **Dixon Creek Subwatershed (HUC-12: 051202010603) Map**

PROJECT: **Morse Reservoir/Cicero Creek Watershed Management Plan**

BASE LAYER: StreetMap USA

CLIENT: Upper White River Watershed Alliance
P.O. Box 2065
Indianapolis, Indiana 46206

| PROJECT NO.: | EXHIBIT: | SHEET: 1 OF: 1 |
|---|---|---|
| 09005 | 19 | |
| QUADRANGLE: | DATE: | SCALE: |
| N/A | 09/27/10 | 1" = 5500' |

encompasses approximately 11,015 acres and includes Cicero Creek, Dixon Creek, Crum Ditch and Magnet Ditch.

**Water Quality Information**

According to the IDEM 305(b) list, the streams within the Dixon Creek Subwatershed are designated for Recreational, Fishable, and Aquatic Life Use. The 303(d) list indicates that none of the streams within the subwatershed are impaired. It should be noted that if a stream is not listed on the 303(d) list it may be impaired; however the data (or lack thereof) does not indicate the impairment at the time of publication.

A total of 3 IDEM water quality sampling stations are located within the Dixon Creek Subwatershed. Available IDEM data at these stations included sampling from the 2006 IDEM *E.coli* sampling data for future Cicero Creek TMDL Study.

No CIWRP sampling sites were located within the Dixon Creek subwatershed; therefore it was grouped with the Prairie Creek and Cox Ditch Creek subwatersheds and represented by the site CCW5.

Table 16 below summarizes the IDEM and CIWRP sampling mean value of each parameter screened and the corresponding water quality target.

**Table 16: Dixon Creek IDEM and CIWRP Water Quality Sampling Summary**

| Water Quality Parameter | IDEM Mean Value | CIWRP Mean Value | Water Quality Target |
|---|---|---|---|
| Dissolved Oxygen | Not Sampled | 11.6 mg/L | between 4.0 and 12.0 mg/L |
| *E. coli* | 329 CFU/100mL | 1886 CFU/100mL | 235 CFU/100mL |
| Nitrate + Nitrite | Not Sampled | 7.5 mg/L | 1.6 mg/L |
| pH | Not Sampled | 7.7 | between 6.0 and 9.0 |
| Total Phosphorus | Not Sampled | 0.152 mg/L | 0.076 mg/L |
| TSS | Not Sampled | 40.1 mg/L | 30.0 mg/L |
| Turbidity | Not Sampled | 75.3 NTU | 10.4 NTU |
| Atrazine | Not Sampled | Not Sampled | 0.003 mg/L |

Based on the available water quality information, the Dixon Creek subwatershed consistently tests higher than the water quality targets in *E. coli*, Nitrate + Nitrite, Total Phosphorus and TSS. Dissolved Oxygen and pH fall within the acceptable ranges and therefore are not a concern for this subwatershed.

**Landuse Information**

Landuse within the Dixon Creek Subwatershed consists primarily of agricultural uses. A small area of low intensity development is concentrated in the central portion of the watershed associated with the town of Goldsmith.

During October/November 2009, the Steering Committee volunteers conducted a windshield survey at 150 site locations within the Morse Reservoir/Cicero Creek Watershed. This windshield survey included 8 stream crossing sites and 4 land/field sites within the Dixon Creek Subwatershed. Observations including streambank erosion, stream buffers, debris,

animal access and fields under conventional till were recorded for each site and the results are summarized in Table 17.

| Table 17: Dixon Creek Windshield Survey Summary | |
|---|---|
| **Parameter** | **Observations** |
| Streambank Erosion | 3/8 sites with erosion >3'<br>0/8 sites with erosion <3' |
| Stream Buffers | 1/8 site with no buffers<br>1/8 site with buffers <50' |
| In-stream Debris | 1/8 site with debris |
| Animal Access | 0/8 sites with animal access |
| Conventional Till | 1/12 site under conventional till |

The Dixon Creek subwatershed contains two active confined feeding operations and two voided CFOs. There were no violations reported for the CFOs within the subwatershed based on the inspection reports obtained from IDEM.

**Habitat/Biological Information**

V3 completed a macroinvertebrate study in October 2009 that included thirteen stations within the Morse Reservoir/Cicero Creek Watershed. One station (Station 12), located at the crossing of Dixon Creek on County Road 400 W in Tipton County, was analyzed within the Dixon Creek Subwatershed.

The calculated mIBI score of 3.4 indicates that the Dixon Creek Subwatershed is moderately impaired for macroinvertebrate communities. One windshield survey site was located in the vicinity of the macroinvertebrate station. The windshield survey did not include any information on presence or quality of habitat at the site however notes taken during the macroinvertebrate sampling indicated that erosion at the site causes a silty substrate which would provide poor habitat for macroinvertebrates. This indicates that the moderate impairment seen in the macroinvertebrate community is likely caused by lack of quality habitat. However, no water chemistry information is available at this location; therefore there is insufficient data to determine if the moderate impairment is also due to the water chemistry at the site. Detailed analysis for each station can be found in Appendix H.

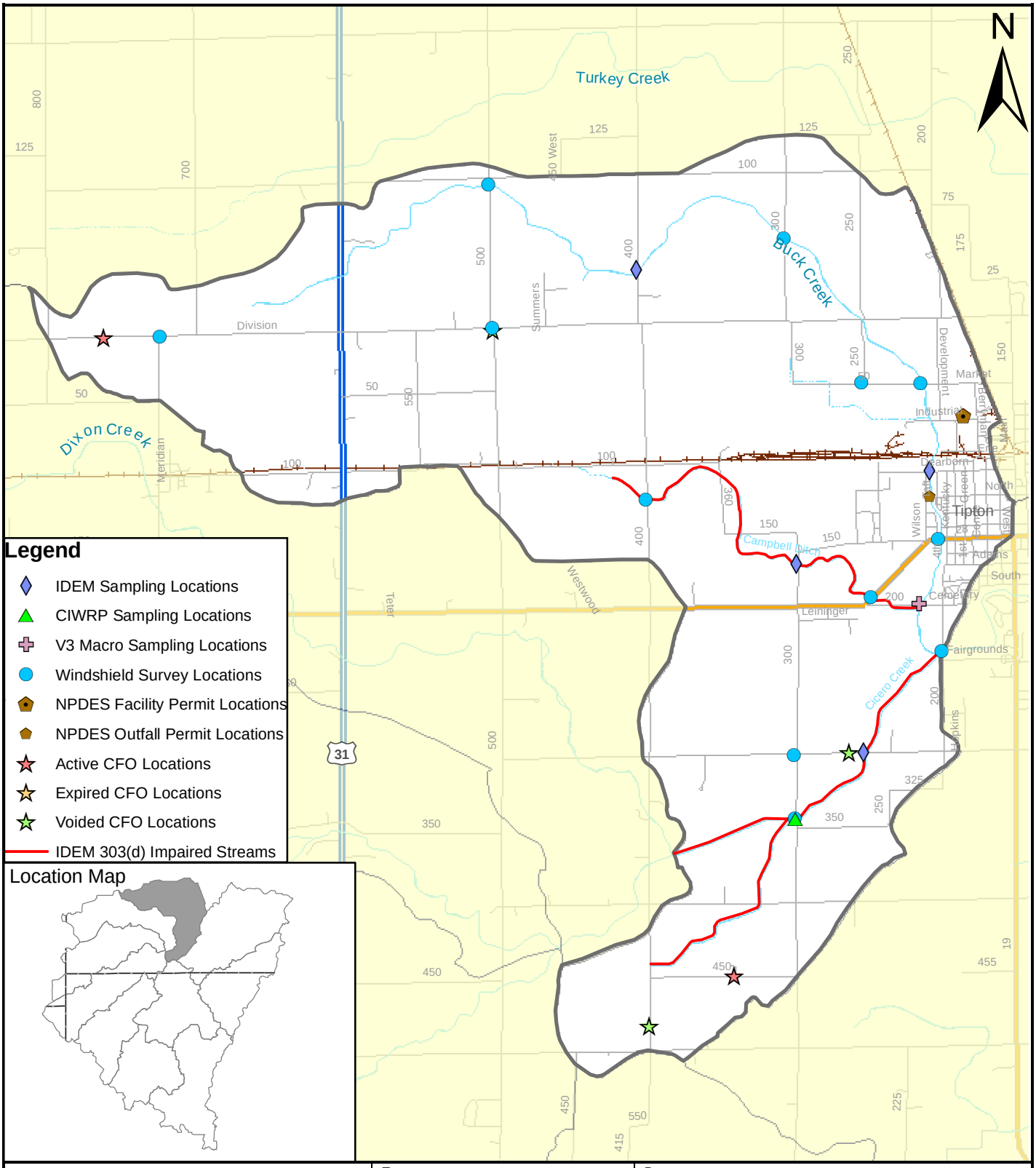
### Buck Creek Subwatershed

The Buck Creek Subwatershed (HUC 12 – 051202010604) is located within Tipton County as shown in Exhibit 20. The subwatershed encompasses approximately 11,875 acres and includes Cicero Creek, Buck Creek and Campbell Ditch.

**Water Quality Information**

According to the IDEM 305(b) list, the streams within the Buck Creek Subwatershed are designated for Recreational, Fishable, and Aquatic Life Use. The 303(d) list indicates that approximately 7.0 miles of streams (Campbell Ditch and Cicero Creek) within the subwatershed are impaired for *E. coli*.

A total of 4 IDEM water quality sampling stations are located within the Buck Creek Subwatershed. Available IDEM data at these stations included sampling from the 1996

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| | | | |
|---|---|---|---|
| TITLE: **Buck CreekSubwatershed Map (HUC-12: 051202010604)** | PROJECT: **Morse Reservoir/Cicero Creek Watershed Management Plan** | | |
| BASE LAYER: StreetMap USA | PROJECT NO. 09005 | EXHIBIT: 20 | SHEET: 1 OF: 1 |
| CLIENT: Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206 | QUADRANGLE: N/A | DATE: 09/27/10 | SCALE: 1" = 5000' |

Synoptic Study, the 2001 *E. coli*- WFWR Study and the 2006 IDEM *E.coli* sampling data for future Cicero Creek TMDL Study.

One CIWRP sampling site was located within the Buck Creek subwatershed; however it was located within the upstream reaches of the watershed. Therefore, the Buck Creek subwatershed was combined with the Tobin Ditch subwatershed and represented by the site CCW6. Table 18 below summarizes the IDEM and CIWRP sampling mean value of each parameter screened and the corresponding water quality target.

**Table 18: Buck Creek IDEM and CIWRP Water Quality Sampling Summary**

| Water Quality Parameter | IDEM Mean Value | CIWRP Mean Value | Water Quality Target |
|---|---|---|---|
| Dissolved Oxygen | 10.9 mg/L | 11.2 mg/L | between 4.0 and 12.0 mg/L |
| *E. coli* | 2464 CFU/100mL | 2462 CFU/100mL | 235 CFU/100mL |
| Nitrate + Nitrite | Not Sampled | 7.1 mg/L | 1.6 mg/L |
| pH | 8.1 | 7.7 | between 6.0 and 9.0 |
| Total Phosphorus | 0.097 mg/L | 0.172 mg/L | 0.076 mg/L |
| TSS | 74.8 mg/L | 60.0 mg/L | 30.0 mg/L |
| Turbidity | 16.8 NTU | 149.0 NTU | 10.4 NTU |
| Atrazine | Not Sampled | Not Sampled | 0.003 mg/L |

Based on the available water quality information, the Buck Creek subwatershed consistently tests higher than the water quality targets in *E. coli*, Nitrate + Nitrite, Total Phosphorus and TSS. Dissolved Oxygen and pH fall within the acceptable ranges and therefore are not a concern for this subwatershed.

**Landuse Information**

Landuse within the Buck Creek Subwatershed consists primarily of agricultural uses. Low and medium intensity development is concentrated in the eastern portion of the subwatershed associated with Tipton.

During October/November 2009, the Steering Committee volunteers conducted a windshield survey at 150 site locations within the Morse Reservoir/Cicero Creek Watershed. This windshield survey included 8 stream crossing sites and 4 land/field sites within the Buck Creek Subwatershed. Observations including streambank erosion, stream buffers, debris, animal access and fields under conventional till were recorded for each site and the results are summarized in Table 19 below.

**Table 19: Buck Creek Windshield Survey Summary**

| Parameter | Observations |
|---|---|
| Streambank Erosion | 0/8 sites with erosion >3'<br>0/8 sites with erosion <3' |
| Stream Buffers | 0/8 sites with no buffers<br>0/8 sites with buffers <50' |
| In-stream Debris | 0/8 sites with debris |
| Animal Access | 0/8 sites with animal access |
| Conventional Till | 2/12 sites under conventional till |

The Buck Creek subwatershed contains two active confined feeding operations and three voided CFOs. There was one violation reported for the CFOs within the subwatershed based on the inspection reports obtained from IDEM. The violation was reported in 2007 for lack of record keeping.

There are 2 NPDES permits active within the Buck Creek subwatershed. The Tipton Wastewater Treatment Plant, permit number IN0021474, is located at 909 East Jefferson Street in Tipton. The facility is located outside of the subwatershed; however one permitted outfall is located within the Buck Creek subwatershed. According to compliance records, there have been no formal enforcement actions within the last 5 years; however there have been 9 noted effluent exceedances within the last 3 years. These exceedances were reported for pH, *E. coli*, Nitrogen and Total Suspended Solids. D.C. Coaters Inc, permit number INP000106, is located at 550 West Industrial Drive in Tipton. According to compliance records for the facility, there has been no formal enforcement action within the last 5 years; effluent exceedance records for the last 3 years were not available for this facility.

**Habitat/Biological Information**

V3 completed a macroinvertebrate study in October 2009 that included thirteen stations within the Morse Reservoir/Cicero Creek Watershed. One station (Station 13), located at the crossing of Buck Creek on County Road 200 S in Tipton County, was analyzed within the Buck Creek Subwatershed.

The calculated mIBI score of 6.4 indicates that the Buck Creek Subwatershed is not impaired for macroinvertebrate communities. Detailed analysis for each station can be found in Appendix H.

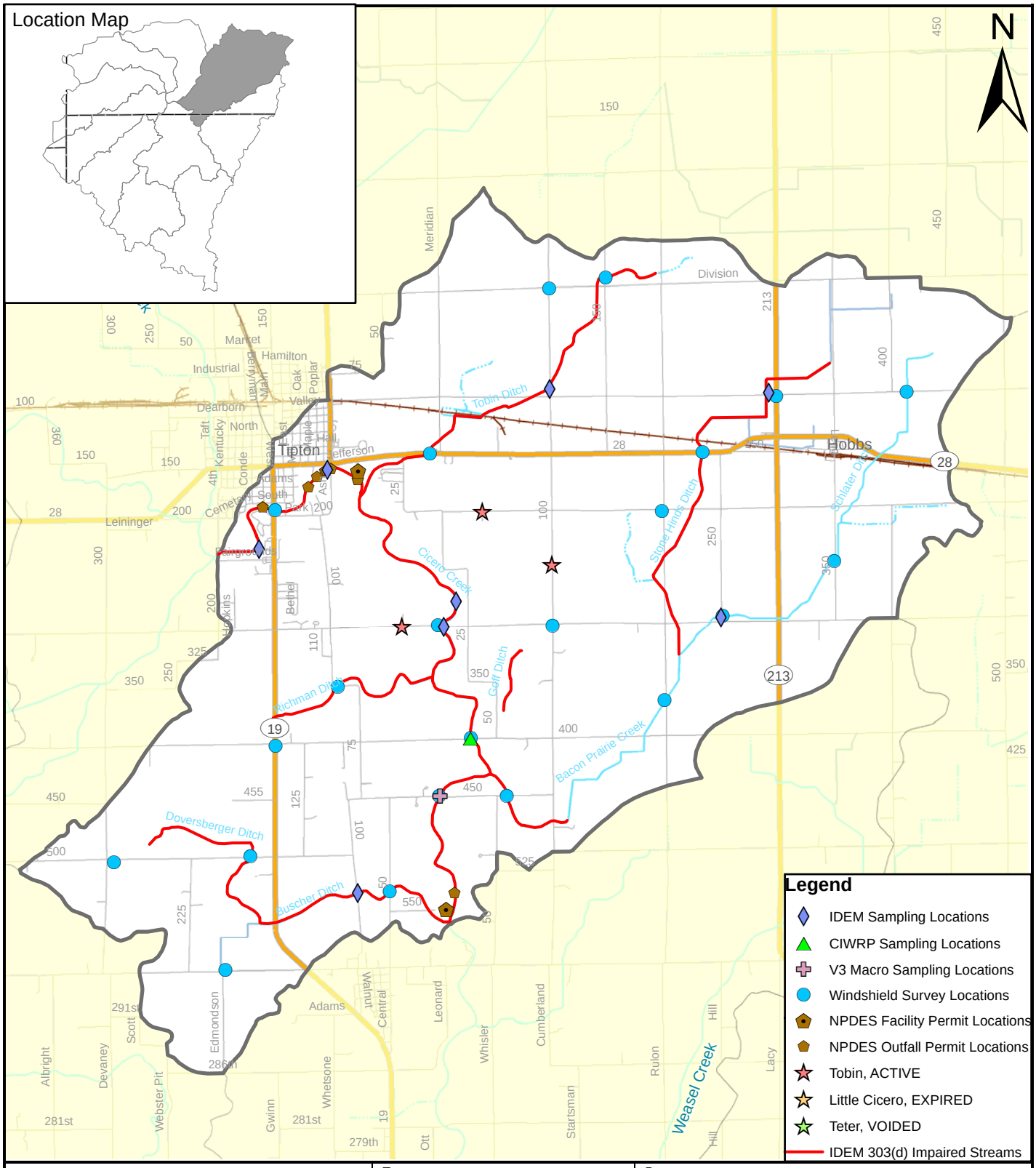
### Tobin Ditch Subwatershed

The Tobin Ditch Subwatershed (HUC 12 – 051202010605) is located primarily in Tipton County with a small portion in Hamilton County as shown on Exhibit 21. The subwatershed encompasses approximately 21,106 acres and includes Cicero Creek, Buscher Ditch, Doversberger Ditch, Bacon Prairie Creek, Stone Hinds Ditch, Schlater Ditch, Goff Ditch, Richman Ditch and Tobin Ditch.

**Water Quality Information**

According to the IDEM 305(b) list, the streams within the Tobin Ditch Subwatershed are designated for Recreational, Fishable, and Aquatic Life Use. The 303(d) list indicates that approximately 22.3 miles of streams (Stone Hinds Ditch, Goff Ditch, Tobin Ditch, Cicero Creek, Richman Ditch, Doversberger Ditch, Buscher Ditch and a portion of Bacon Prairie Creek) within the subwatershed are impaired for *E. coli*.

A total of 8 IDEM water quality sampling stations are located within the Tobin Ditch Subwatershed. Available IDEM data at these stations included sampling from the 1996 Watershed Study, the 2001 *E. coli*- WFWR Study, the 2006 Corvallis and 2006 Corvallis *E. coli* Studies and the 2006 IDEM *E.coli* sampling data for future Cicero Creek TMDL Study.

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TITLE: **Tobin Ditch Subwatershed Map (HUC-12: 051202010605)**

PROJECT: **Morse Reservoir/Cicero Creek Watershed Management Plan**

BASE LAYER: StreetMap USA

CLIENT: Upper White River Watershed Alliance
P.O. Box 2065
Indianapolis, Indiana 46206

| PROJECT NO. | EXHIBIT: | SHEET: 1 OF: 1 |
|---|---|---|
| 09005 | 21 | |
| QUADRANGLE: | DATE: | SCALE: |
| N/A | 09/27/10 | 1" = 6500' |

One CIWRP sampling site was located within the Tobin Ditch subwatershed. The Buck Creek subwatershed was combined with the Tobin Ditch subwatershed and represented by the site CCW6.

Table 20 below summarizes the IDEM and CIWRP sampling mean value of each parameter screened and the corresponding water quality target.

| Table 20: Tobin Ditch IDEM and CIWRP Water Quality Sampling Summary | | | |
|---|---|---|---|
| **Water Quality Parameter** | **IDEM Mean Value** | **CIWRP Mean Value** | **Water Quality Target** |
| Dissolved Oxygen | 10.4 mg/L | 11.2 mg/L | between 4.0 and 12.0 mg/L |
| *E. coli* | 1046 CFU/100mL | 2462 CFU/100mL | 235 CFU/100mL |
| Nitrate + Nitrite | 7.1 mg/L | 7.1 mg/L | 1.6 mg/L |
| pH | 8.1 | 7.7 | between 6.0 and 9.0 |
| Total Phosphorus | 0.118 mg/L | 0.172 mg/L | 0.076 mg/L |
| TSS | 13.5 mg/L | 60.0 mg/L | 30.0 mg/L |
| Turbidity | 17.2 NTU | 149.0 NTU | 10.4 NTU |
| Atrazine | Not Sampled | Not Sampled | 0.003 mg/L |

Based on the available water quality information, the Tobin Ditch subwatershed consistently tests higher than the water quality targets in *E. coli*, Nitrate + Nitrite and Total Phosphorus. TSS tested higher than the water quality targets in the CIWRP Study; however it was lower than the standards based on the IDEM data. Dissolved Oxygen and pH fall within the acceptable ranges and therefore are not a concern for this subwatershed.

**Landuse Information**

Landuse within the Tobin Ditch Subwatershed consists primarily of agricultural uses. Low and medium intensity development is concentrated in the western portion of the subwatershed associated with Tipton and a small area of low intensity development is concentrated in the northeastern portion of the subwatershed associated with the town of Hobbs.

During October/November 2009, the Steering Committee volunteers conducted a windshield survey at 150 site locations within the Morse Reservoir/Cicero Creek Watershed. This windshield survey included 15 stream crossing sites and 7 land/field sites within the Tobin Ditch Subwatershed. Observations including streambank erosion, stream buffers, debris, animal access and fields under conventional till were recorded for each site and the results are summarized in Table 21.

| Table 21: Tobin Ditch<br>Windshield Survey Summary | |
|---|---|
| **Parameter** | **Observations** |
| Streambank Erosion | 3/15 sites with erosion >3'<br>0/15 sites with erosion <3' |
| Stream Buffers | 3/15 sites with no buffers<br>3/15 sites with buffers <50' |
| In-stream Debris | 2/15 sites with debris |
| Animal Access | 0/15 sites with animal access |
| Conventional Till | 2/22 sites under conventional till |

The Tobin Ditch subwatershed contains three active confined feeding operations. There were no violations reported for the CFOs within the subwatershed based on the inspection reports obtained from IDEM.

There are 2 NPDES permits active within the Tobin Ditch subwatershed. The Tipton Wastewater Treatment Plant, permit number IN0021474, is located at 909 East Jefferson Street in Tipton. The facility and seven outfalls are located within the Tobin Ditch subwatershed. According to compliance records, there have been no formal enforcement actions within the last 5 years; however there have been 9 noted effluent exceedances within the last 3 years. These exceedances were reported for pH, *E. coli*, Nitrogen and Total Suspended Solids. The Atlanta Wastewater Treatment Plant, permit number IN0022306, is located at 38 E 550 S in Atlanta. According to compliance records for the facility, there has been no formal enforcement action within the last 5 years; however there have been 5 noted effluent exceedances within the last 3 years. These exceedances were reported for pH and Nitrogen.

**Habitat/Biological Information**

V3 completed a macroinvertebrate study in October 2009 that included thirteen stations within the Morse Reservoir/Cicero Creek Watershed. One station (Station 9), located at the crossing of Cicero Creek on County Road 450 S in Tipton County, was analyzed within the Tobin Ditch Subwatershed.

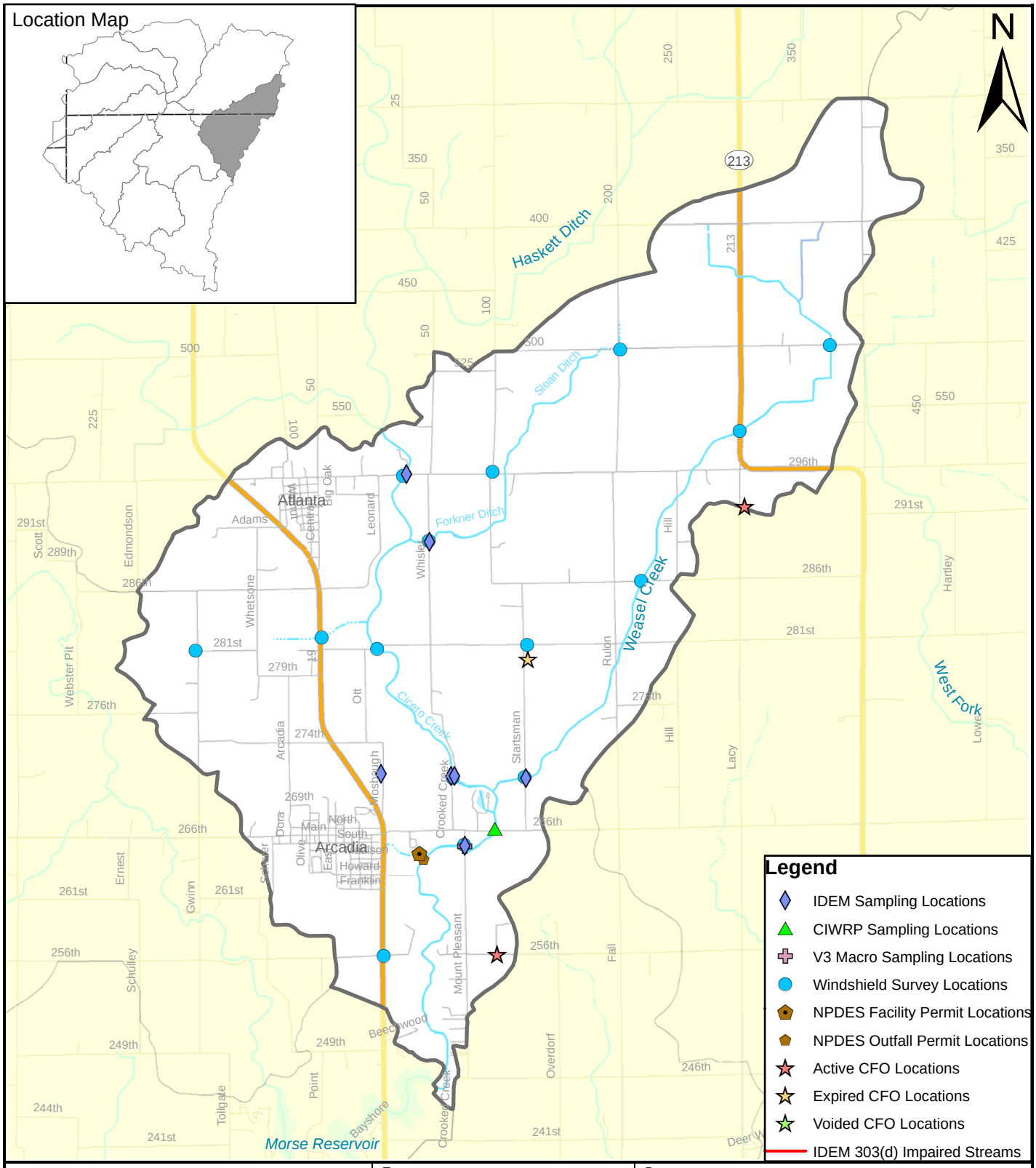
The calculated mIBI score of 6.2 indicates that the Tobin Ditch Subwatershed is not impaired for macroinvertebrate communities. Detailed analysis for each station can be found in Appendix H.

### Weasel Creek Subwatershed

The Weasel Creek Subwatershed (HUC 12 – 051202010606) is located within Tipton and Hamilton Counties as shown in Exhibit 22. The subwatershed encompasses approximately 13,704 acres and includes Cicero Creek, Weasel Creek, Forkner Ditch and Sloan Ditch.

**Water Quality Information**

According to the IDEM 305(b) list, the streams within the Weasel Creek Subwatershed are designated for Recreational, Fishable, and Aquatic Life Use. The 303(d) list indicates that none of the streams within the subwatershed are impaired. It should be noted that if a stream is not listed on the 303(d) list it may be impaired; however the data (or lack thereof) does not indicate the impairment at the time of publication.

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| | | | |
|---|---|---|---|
| TITLE: **Weasel Creek Subwatershed Map (HUC-12:051202010606)** | | PROJECT: **Morse Reservoir/Cicero Creek Watershed Management Plan** | |
| BASE LAYER: StreetMap USA | | PROJECT NO. 09005 | EXHIBIT: 22 |
| CLIENT: Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206 | | QUADRANGLE: N/A | DATE: 09/27/10 |
| | | SHEET: 1 OF: 1 | SCALE: 1" = 6000' |

A total of 7 IDEM water quality sampling stations are located within the Weasel Creek subwatershed. Available IDEM data at these stations included sampling from the 1996 Synoptic Study, the 1999-2009 Fixed Station Study, the 2001 *E. coli* Study and the 2006 IDEM *E.coli* sampling data for future Cicero Creek TMDL Study.

One sampling site is located within the Weasel Creek subwatershed, CCW3.

Table 22 below summarizes the IDEM and CIWRP sampling mean value of each parameter screened and the corresponding water quality target.

**Table 22: Weasel Creek IDEM and CIWRP Water Quality Sampling Summary**

| Water Quality Parameter | IDEM Mean Value | CIWRP Mean Value | Water Quality Target |
|---|---|---|---|
| Dissolved Oxygen | 9.9 mg/L | 10.6 mg/L | between 4.0 and 12.0 mg/L |
| *E. coli* | 2041 CFU/100mL | 4566 CFU/100mL | 235 CFU/100mL |
| Nitrate + Nitrite | 6.1 mg/L | 5.7 mg/L | 1.6 mg/L |
| pH | 8.1 | 7.7 | between 6.0 and 9.0 |
| Total Phosphorus | 0.109 mg/L | 0.180 mg/L | 0.076 mg/L |
| TSS | 27.9 mg/L | 27.2 mg/L | 30.0 mg/L |
| Turbidity | 29.9 NTU | 70.4 NTU | 10.4 NTU |
| Atrazine | Not Sampled | Not Sampled | 0.003 mg/L |

Based on the available water quality information, the Weasel Creek subwatershed consistently tests higher than the water quality targets in *E. coli*, Nitrate + Nitrite and Total Phosphorus. TSS, Dissolved Oxygen and pH fall within the acceptable ranges and therefore are not a concern for this subwatershed.

**Landuse Information**

Landuse within the Weasel Creek Subwatershed consists primarily of agricultural uses. Several areas of deciduous forest are located along the corridor of Cicero Creek. Low and medium intensity development is concentrated in the northwestern portion of the subwatershed associated with Atlanta, and in the southwestern portion of the subwatershed associated with Arcadia.

During October/November 2009, the Steering Committee volunteers conducted a windshield survey at 150 site locations within the Morse Reservoir/Cicero Creek Watershed. This windshield survey included 10 stream crossing sites and 5 land/field sites within the Weasel Creek Subwatershed.

Observations including streambank erosion, stream buffers, debris, animal access and fields under conventional till were recorded for each site and the results are summarized in Table 23.

| Table 23: Weasel Creek Windshield Survey Summary | |
|---|---|
| **Parameter** | **Observations** |
| Streambank Erosion | 1/10 sites with erosion >3'<br>0/10 sites with erosion <3' |
| Stream Buffers | 2/10 sites with no buffers<br>1/10 site with buffers <50' |
| In-stream Debris | 2/10 sites with debris |
| Animal Access | 1/10 site with animal access |
| Conventional Till | 3/15 sites under conventional till |

The Weasel Creek subwatershed contains two active confined feeding operations and one expired CFO. There was one violation reported for the CFOs within the subwatershed based on the inspection reports obtained from IDEM. The violation was reported in 2006, 2007 and 2008 for an exceedance in nitrogen and ammonia levels.

There is one NPDES permit active within the Weasel Creek subwatershed. The Arcadia Wastewater Treatment Plant, permit number IN0021334, is located at 9099 E 266th Street in Arcadia. The facility and one outfall are located within the Weasel Creek subwatershed. According to compliance records, there have been no formal enforcement actions within the last 5 years; however there have been 19 noted effluent exceedances within the last 3 years. These exceedances were reported for Chlorine, *E. coli*, Nitrogen, Dissolved Oxygen, Phosphorus and Total Suspended Solids.

**Habitat/Biological Information**

V3 completed a macroinvertebrate study in October 2009 that included thirteen stations within the Morse Reservoir/Cicero Creek Watershed. One station (Station 7), located at the crossing of Cicero Creek at Mount Pleasant and 266$^{th}$ Street in Hamilton County, was analyzed within the Weasel Creek Subwatershed.

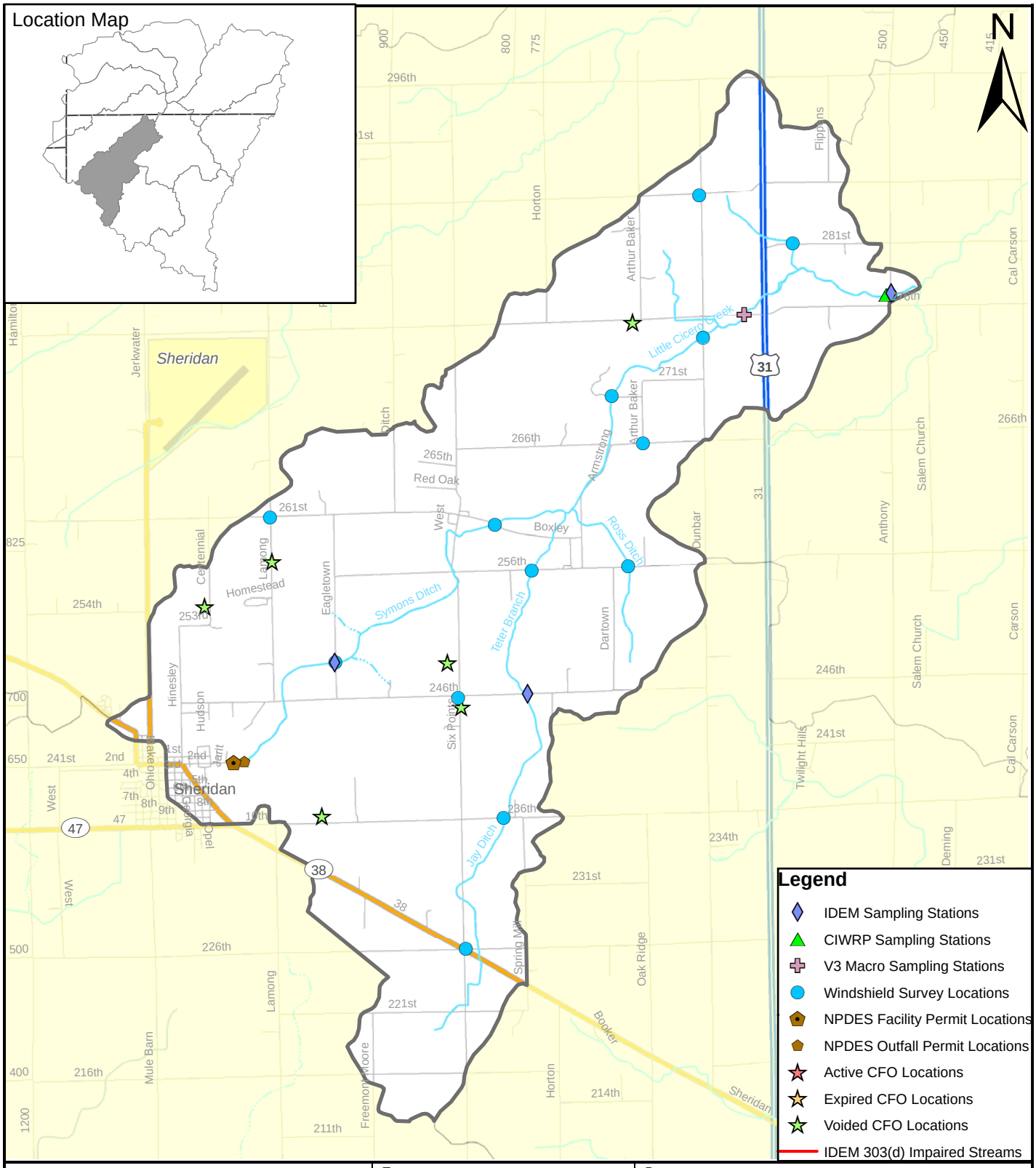
The calculated mIBI score of 6.8 indicates that the Weasel Creek Subwatershed is not impaired for macroinvertebrate communities. Detailed analysis for each station can be found in Appendix H.

### Teter Branch Subwatershed

The Teter Branch Subwatershed (HUC 12 – 051202010607) is located primarily in Hamilton County with a small portion in Tipton County as shown on Exhibit 23. The subwatershed encompasses approximately 13,326 acres and includes Little Cicero Creek, Ross Ditch, Teter Branch, Jay Ditch and Symons Ditch.

**Water Quality Information**

According to the IDEM 305(b) list, the streams within the Teter Branch Subwatershed are designated for Recreational, Fishable, and Aquatic Life Use. The 303(d) list indicates that none of the streams within the subwatershed are impaired. It should be noted that if a stream is not listed on the 303(d) list it may be impaired; however the data (or lack thereof) does not indicate the impairment at the time of publication.

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TITLE: **Teter Branch Subwatershed Map (HUC-12: 051202010607)**

PROJECT: **Morse Reservoir/Cicero Creek Watershed Management Plan**

BASE LAYER: StreetMap USA

CLIENT: Upper White River Watershed Alliance
P.O. Box 2065
Indianapolis, Indiana 46206

| PROJECT NO. | EXHIBIT: | SHEET: 1 OF: 1 |
|---|---|---|
| 09005 | 23 | |
| QUADRANGLE: | DATE: | SCALE: |
| N/A | 09/27/10 | 1" = 6000' |

A total of 3 IDEM water quality sampling stations are located within the Teter Branch subwatershed. Available IDEM data at these stations included sampling from the 2006 IDEM *E.coli* sampling data for future Cicero Creek TMDL Study.

One sampling site is located within the Teter Branch subwatershed, CCW4.

Table 24 below summarizes the IDEM and CIWRP sampling mean value of each parameter screened and the corresponding water quality target.

**Table 24: Teter Branch IDEM and CIWRP Water Quality Sampling Summary**

| Water Quality Parameter | IDEM Mean Value | CIWRP Mean Value | Water Quality Target |
|---|---|---|---|
| Dissolved Oxygen | Not Sampled | 11.8 mg/L | between 4.0 and 12.0 mg/L |
| *E. coli* | 2585 CFU/100mL | 1572 CFU/100mL | 235 CFU/100mL |
| Nitrate + Nitrite | Not Sampled | 4.4 mg/L | 1.6 mg/L |
| pH | Not Sampled | 7.8 | between 6.0 and 9.0 |
| Total Phosphorus | Not Sampled | 0.204 mg/L | 0.076 mg/L |
| TSS | Not Sampled | 26.5 mg/L | 30.0 mg/L |
| Turbidity | Not Sampled | 32.4 NTU | 10.4 NTU |
| Atrazine | Not Sampled | Not Sampled | 0.003 mg/L |

Based on the available water quality information, the Teter Branch subwatershed consistently tests higher than the water quality targets in *E. coli*, Nitrate + Nitrite and Total Phosphorus. TSS, Dissolved Oxygen and pH fall within the acceptable ranges and therefore are not a concern for this subwatershed.

**Landuse Information**

Landuse within the Teter Branch Subwatershed consists primarily of agricultural uses. Low and medium intensity development is concentrated in the southwestern portion of the subwatershed associated with Sheridan.

During October/November 2009, the Steering Committee volunteers conducted a windshield survey at 150 site locations within the Morse Reservoir/Cicero Creek Watershed. This windshield survey included 9 stream crossing sites and 5 land/field sites within the Teter Branch Subwatershed.

Observations including streambank erosion, stream buffers, debris, animal access and fields under conventional till were recorded for each site and the results are summarized in Table 25.

| Table 25: Teter Branch<br>Windshield Survey Summary | |
|---|---|
| **Parameter** | **Observations** |
| Streambank Erosion | 5/9 sites with erosion >3'<br>1/9 site with erosion <3' |
| Stream Buffers | 1/9 site with no buffers<br>4/9 site with buffers <50' |
| In-stream Debris | 3/9 sites with debris |
| Animal Access | 3/9 sites with animal access |
| Conventional Till | 3/14 sites under conventional till |

The Teter Branch subwatershed contains no active confined feeding operations, however there are 6 voided CFOs located within the watershed.

There is one NPDES permit active within the Teter Branch subwatershed. The Sheridan Wastewater Treatment Plant, permit number IN0031071, is located at 801 E 2nd Street in Sheridan. The facility and one outfall are located within the Teter Branch subwatershed. According to compliance records, there have been no formal enforcement actions within the last 5 years and there have been no noted effluent exceedances within the last 3 years.

**Habitat/Biological Information**

V3 completed a macroinvertebrate study in October 2009 that included thirteen stations within the Morse Reservoir/Cicero Creek Watershed. One station (Station 8), located at the crossing of Little Cicero Creek at 276$^{th}$ Street and State Road 31 in Hamilton County, was analyzed within the Teter Branch Subwatershed.

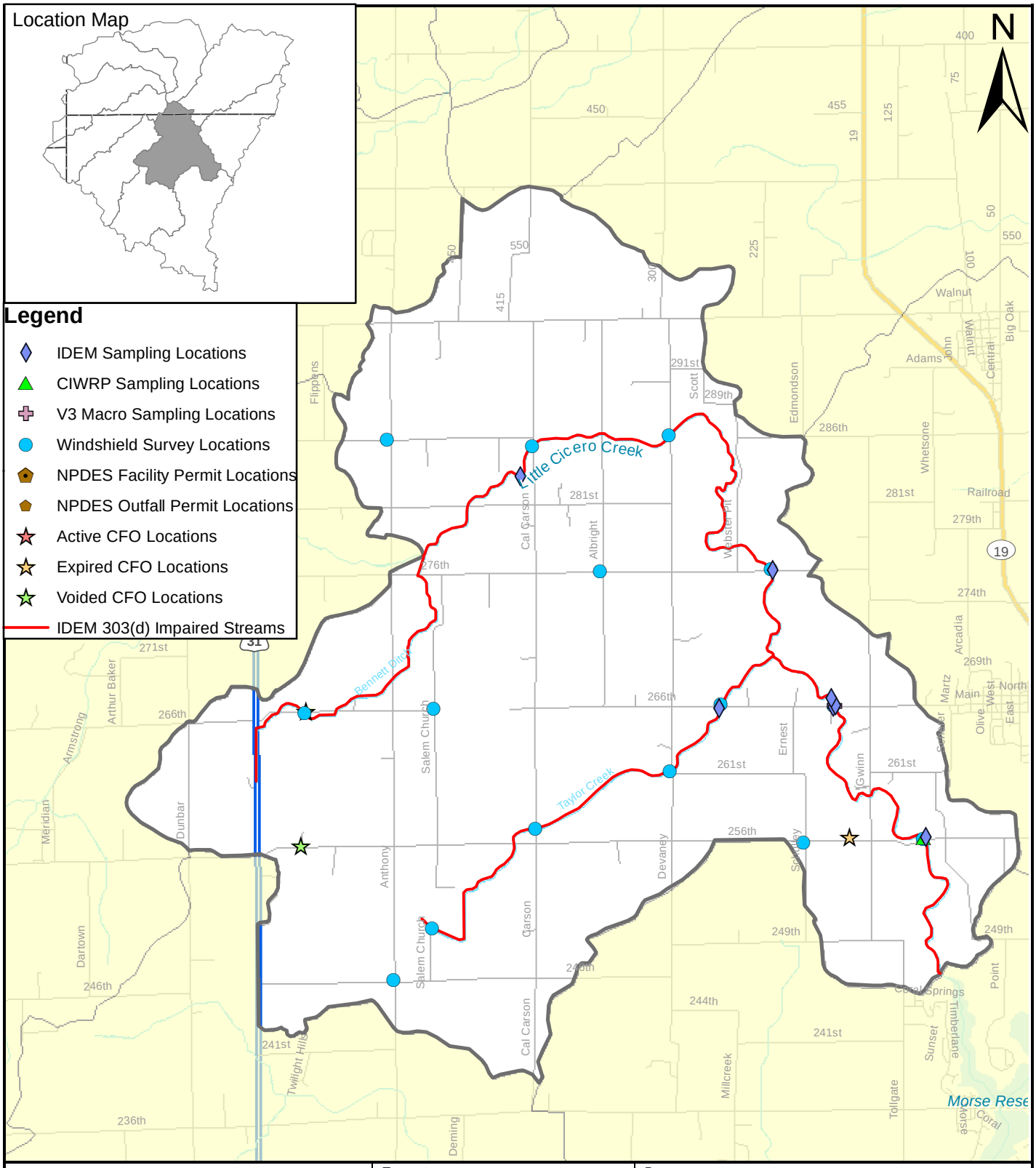
The calculated mIBI score of 4.0 indicates that the Teter Branch Subwatershed is slightly impaired for macroinvertebrate communities. No additional sampling sites were located within the vicinity of the macroinvertebrate station. However, notes taken during the macroinvertebrate sampling indicated the presence of a silty substrate which would provide poor habitat for macroinvertebrates. This indicates that the slight impairment seen in the macroinvertebrate community is likely caused by lack of quality habitat. No water chemistry information is available at this location; therefore there is insufficient data to determine if the slight impairment is also due to the water chemistry at the site. Detailed analysis for each station can be found in Appendix H.

### Little Cicero Creek Subwatershed

The Little Cicero Creek Subwatershed (HUC 12 – 051202010608) is located primarily in Hamilton County with a small portion in Tipton County as shown in Exhibit 24. The subwatershed encompasses approximately 14,402 acres and includes Little Cicero Creek, Taylor Creek and Bennett Ditch.

**Water Quality Information**

According to the IDEM 305(b) list, the streams within the Little Cicero Creek Subwatershed are designated for Recreational, Fishable, and Aquatic Life Use. The 303(d) list indicates that approximately 15.9 miles of streams within the subwatershed are impaired for *E. coli*. This includes all of the streams within the subwatershed.

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TITLE: **Little Cicero Creek Subwatershed Map (HUC-12: 051202010608)**

PROJECT: **Morse Reservoir/Cicero Creek Watershed Management Plan**

BASE LAYER: StreetMap USA

CLIENT: Upper White River Watershed Alliance
P.O. Box 2065
Indianapolis, Indiana 46206

| PROJECT NO. | EXHIBIT: | SHEET: 1 OF: 1 |
|---|---|---|
| 09005 | 24 | |
| QUADRANGLE: | DATE: | SCALE: |
| N/A | 09/27/10 | 1" = 5500' |

A total of 7 IDEM water quality sampling stations are located within the Little Cicero Creek subwatershed. Available IDEM data at these stations included sampling from the 1996 Synoptic Study, the 2001 Corvallis and 2001 *E. coli* – Upper WFWR Studies and the 2006 IDEM *E.coli* sampling data for future Cicero Creek TMDL Study.

One sampling site is located within the Little Cicero Creek subwatershed, CCW2.

Table 26 below summarizes the IDEM and CIWRP sampling mean value of each parameter screened and the corresponding water quality target.

**Table 26: Little Cicero Creek IDEM and CIWRP Water Quality Sampling Summary**

| Water Quality Parameter | IDEM Mean Value | CIWRP Mean Value | Water Quality Target |
|---|---|---|---|
| Dissolved Oxygen | 9.3 mg/L | 11.0 mg/L | between 4.0 and 12.0 mg/L |
| *E. coli* | 3934 CFU/100mL | 2771 CFU/100mL | 235 CFU/100mL |
| Nitrate + Nitrite | 7.9 mg/L | 6.2 mg/L | 1.6 mg/L |
| pH | 8.0 | 7.8 | between 6.0 and 9.0 |
| Total Phosphorus | 0.792 mg/L | 0.186 mg/L | 0.076 mg/L |
| TSS | 46.4 mg/L | 32.9 mg/L | 30.0 mg/L |
| Turbidity | 32.4 NTU | 36.3 NTU | 10.4 NTU |
| Atrazine | Not Sampled | Not Sampled | 0.003 mg/L |

Based on the available water quality information, the Little Cicero Creek subwatershed consistently tests higher than the State standard for *E. coli*, and water quality targets for Nitrate + Nitrite, Total Phosphorus and TSS. Dissolved Oxygen and pH fall within the acceptable ranges and therefore are not a concern for this subwatershed.

**Landuse Information**

Landuse within the Little Cicero Creek Subwatershed consists primarily of agricultural uses. Several areas of deciduous forest are located along the corridor of Little Cicero Creek.

During October/November 2009, the Steering Committee volunteers conducted a windshield survey at 150 site locations within the Morse Reservoir/Cicero Creek Watershed. This windshield survey included 10 stream crossing sites and 5 land/field sites within the Little Cicero Creek Subwatershed.

Observations including streambank erosion, stream buffers, debris, animal access and fields under conventional till were recorded for each site and the results are summarized in Table 27.

| Table 27: Little Cicero Creek Windshield Survey Summary | |
|---|---|
| **Parameter** | **Observations** |
| Streambank Erosion | 3/10 sites with erosion >3'<br>3/10 sites with erosion <3' |
| Stream Buffers | 3/10 sites with no buffers<br>2/10 sites with buffers <50' |
| In-stream Debris | 6/10 sites with debris |
| Animal Access | 3/10 sites with animal access |
| Conventional Till | 9/15 sites under conventional till |

The Little Cicero Creek subwatershed contains no active confined feeding operations; however there are 2 voided CFOs and 1 expired CFO located within the watershed.

There are no other NPDES permits active within the Little Cicero Creek subwatershed.

**Habitat/Biological Information**

V3 completed a macroinvertebrate study in October 2009 that included thirteen stations within the Morse Reservoir/Cicero Creek Watershed. One station (Station 6), located at the crossing of Little Cicero Creek at 266th Street and Gwinn Road in Hamilton County, was analyzed within the Little Cicero Creek Subwatershed.

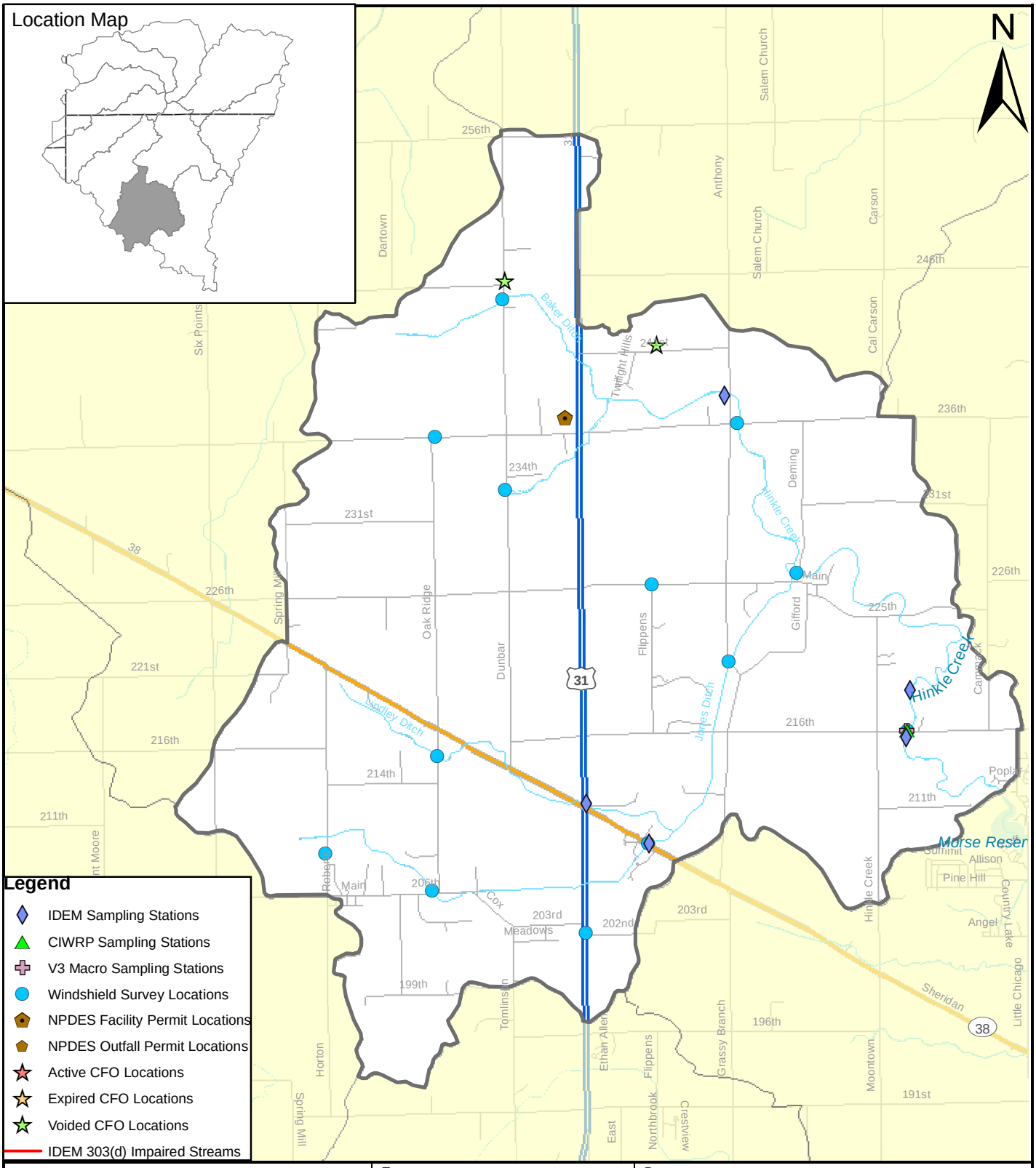
The calculated mIBI score of 3.0 indicates that the Little Cicero Creek Subwatershed is moderately impaired for macroinvertebrate communities. Two IDEM sampling stations and a windshield survey site were located in the vicinity of the macroinvertebrate station. The windshield survey indicated that adequate habitat was available for macroinvertebrates in the form of underwater tree roots, sufficient cover, and deep and shallow areas. This would indicate that the moderate impairment seen in the macroinvertebrate community is not likely caused by lack of habitat. At the IDEM sampling station *E. coli*, TSS and Phosphorus were analyzed. Levels of *E. coli* at this station average 635.3 CFU/100mL, TSS averages 47.2 mg/L and Phosphorus averages 0.15 mg/L. All of these values exceed the water quality targets indicating the moderate impairment may be caused by the poor water chemistry at the site. Detailed analysis for each station can be found in Appendix H.

### Hinkle Creek Subwatershed

The Hinkle Creek Subwatershed (HUC 12 – 051202010609) is located in Hamilton County as shown in Exhibit 25. The subwatershed contains approximately 12,871 acres and includes Hinkle Creek, Jones Ditch, Lindley Ditch and Baker Ditch.

**Water Quality Information**

According to the IDEM 305(b) list, the streams within the Hinkle Creek Subwatershed are designated for Recreational, Fishable, and Aquatic Life Use. The 303(d) list indicates that none of the streams within the subwatershed are impaired. It should be noted that if a stream is not listed on the 303(d) list it may be impaired; however the data (or lack thereof) does not indicate the impairment at the time of publication.

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| | | | |
|---|---|---|---|
| TITLE: **Hinkle Creek Subwatershed Map (HUC-12: 051202010609)** | PROJECT: **Morse Reservoir/Cicero Creek Watershed Management Plan** | | |
| BASE LAYER: StreetMap USA | PROJECT NO. 09005 | EXHIBIT: 25 | SHEET: 1 OF: 1 |
| CLIENT: Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206 | QUADRANGLE: N/A | DATE: 09/27/10 | SCALE: 1" = 5000' |

A total of 5 IDEM water quality sampling stations are located within the Hinkle Creek subwatershed. Available IDEM data at these stations included sampling from the 2001 Corvallis and 2001 *E. coli* – Upper WFWR Studies and the 2006 IDEM *E.coli* sampling data for future Cicero Creek TMDL Study.

One sampling site is located within the Hinkle Creek subwatershed, CCW1.

Table 28 summarizes the IDEM and CIWRP sampling mean value of each parameter screened and the corresponding water quality target.

**Table 28: Hinkle Creek IDEM and CIWRP Water Quality Sampling Summary**

| Water Quality Parameter | IDEM Mean Value | CIWRP Mean Value | Water Quality Target |
|---|---|---|---|
| Dissolved Oxygen | 8.5 mg/L | 11.5 mg/L | between 4.0 and 12.0 mg/L |
| *E. coli* | 1919 CFU/100mL | 4810 CFU/100mL | 235 CFU/100mL |
| Nitrate + Nitrite | 7.3 mg/L | 2.7 mg/L | 1.6 mg/L |
| pH | 8.1 | 7.6 | between 6.0 and 9.0 |
| Total Phosphorus | 0.186 mg/L | 0.334 mg/L | 0.076 mg/L |
| TSS | 23.7 mg/L | 32.9 mg/L | 30.0 mg/L |
| Turbidity | 14.4 NTU | 32.8 NTU | 10.4 NTU |
| Atrazine | Not Sampled | Not Sampled | 0.003 mg/L |

Based on the available water quality information, the Hinkle Creek subwatershed consistently tests higher than the water quality targets in *E. coli*, Nitrate + Nitrite and Total Phosphorus. TSS tested higher than the water quality targets in the CIWRP Study however it tested lower in the IDEM data. Dissolved Oxygen and pH fall within the acceptable ranges and therefore are not a concern for this subwatershed.

**Landuse Information**

Landuse within the Hinkle Creek Subwatershed consists primarily of agricultural uses. Several areas of deciduous forest are located along the corridor of Hinkle Creek.

During October/November 2009, the Steering Committee volunteers conducted a windshield survey at 150 site locations within the Morse Reservoir/Cicero Creek Watershed. This windshield survey included 9 stream crossing sites and 4 land/field sites within the Hinkle Creek Subwatershed.

Observations including streambank erosion, stream buffers, debris, animal access and fields under conventional till were recorded for each site and the results are summarized in Table 29.

| Table 29: Hinkle Creek Windshield Survey Summary | |
|---|---|
| **Parameter** | **Observations** |
| Streambank Erosion | 3/9 sites with erosion >3'<br>1/9 site with erosion <3' |
| Stream Buffers | 1/9 site with no buffers<br>8/9 sites with buffers <50' |
| In-stream Debris | 6/9 sites with debris |
| Animal Access | 3/9 sites with animal access |
| Conventional Till | 0/13 sites under conventional till |

The Hinkle Creek subwatershed contains no active confined feeding operations; however there are 2 voided CFOs located within the watershed.

There is one NPDES permit active within the Hinkle Creek subwatershed. The Gas America Hinkle Creek Wastewater Treatment Plant, permit number IN0059943, is located at 1650 E 236th Street in Noblesville. According to compliance records, there have been no formal enforcement actions within the last 5 years; however there have been 9 noted effluent exceedances within the last 3 years. These exceedances were reported for Chlorine, *E. coli*, Nitrogen and Dissolved Oxygen.

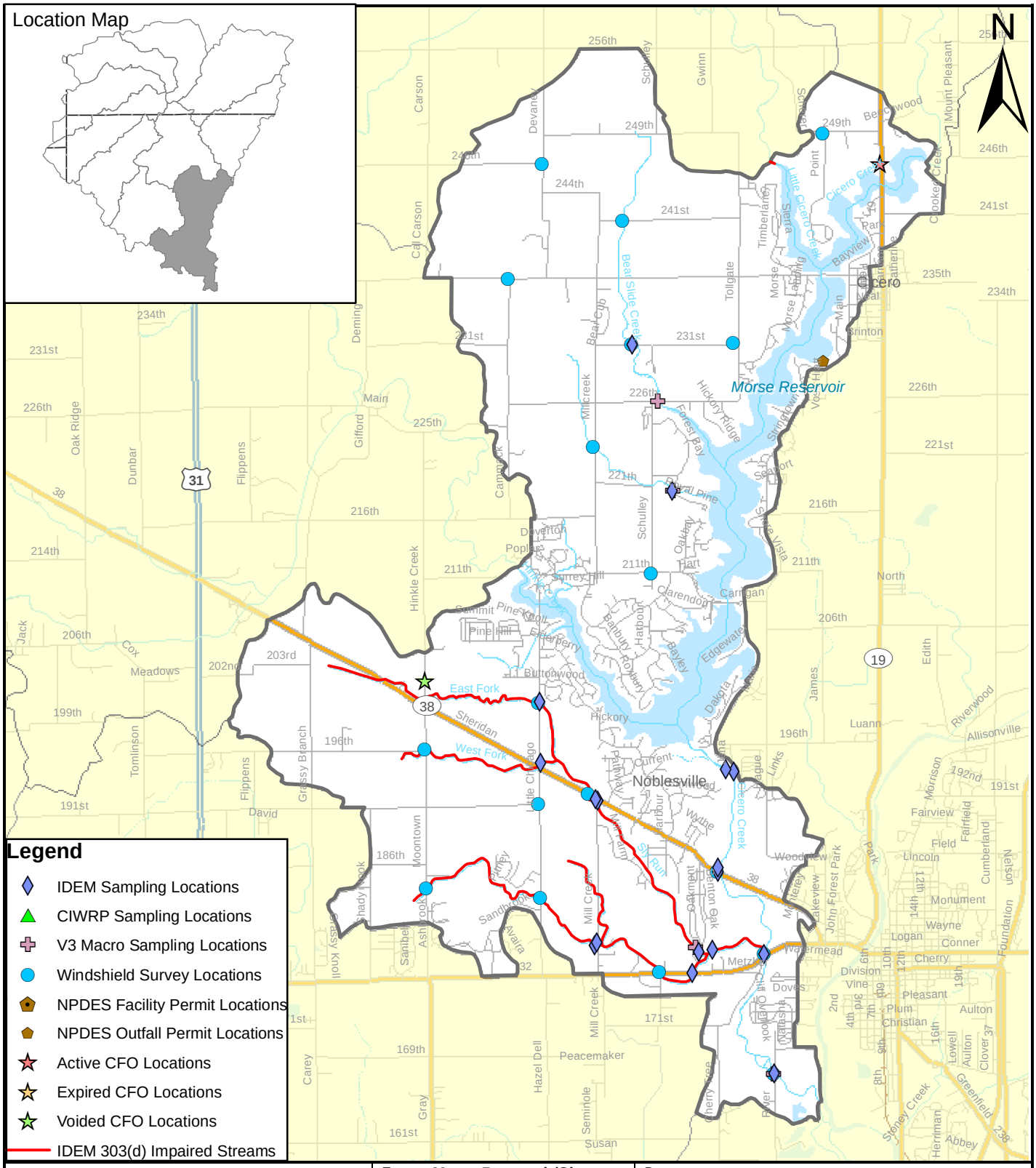
**Habitat/Biological Information**

V3 completed a macroinvertebrate study in October 2009 that included thirteen stations within the Morse Reservoir/Cicero Creek Watershed. One station (Station 3), located at the crossing of Cicero Creek at Royal Pine and Cedar Road in Hamilton County, was analyzed within Hinkle Creek Subwatershed.

The calculated mIBI score of 4.0 indicates that the Hinkle Creek Subwatershed is slightly impaired for macroinvertebrate communities. One IDEM sampling station, one CIWRP sampling station and a windshield survey site were located in the vicinity of the macroinvertebrate station. The windshield survey indicated that adequate habitat was available for macroinvertebrates in the form of underwater tree roots, sufficient cover, and deep and shallow areas which indicates that slight impairment seen in the macroinvertebrate community is not likely caused by lack of habitat. At the IDEM sampling station, *E. coli* was the only water quality parameter analyzed. Levels of *E. coli* at this station average 384.8 CFU/100mL which does exceed the water quality target. At the CIWRP sampling station *E. coli*, TSS, Nitrogen and Phosphorus were all analyzed. Levels of *E. coli* at this station average 4809.7 CFU/100mL, TSS averages 32.9 mg/L, Nitrogen averages 2.7 mg/L and Phosphorus averages 0.3 mg/L. All of these values exceed the water quality targets indicating the slight impairment may be caused by the poor water chemistry at the site. Detailed analysis for each station can be found in Appendix H.

### Morse Reservoir/Cicero Creek Subwatershed

The Morse Reservoir/Cicero Creek Subwatershed (HUC 12 – 051202010610) is located in Hamilton County as shown in Exhibit 26. The subwatershed contains approximately 17,713 acres and includes Cicero Creek, West Fork, East Fork, Sly Run, Hinkle Creek, Bear Slide Creek

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| | | | |
|---|---|---|---|
| TITLE: **Morse Reservoir/Cicero Creek Subwatershed Map (HUC-12: 051202010610)** | PROJECT: **Morse Reservoir/Cicero Creek Watershed Management Plan** | | |
| BASE LAYER: StreetMap USA | PROJECT NO. 09005 | EXHIBIT: 26 | SHEET: 1 OF: 1 |
| CLIENT: Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206 | QUADRANGLE: N/A | DATE: 09/27/10 | SCALE: 1" = 6500' |

and Little Cicero Creek. Morse Reservoir is located along the eastern portion of the subwatershed.

**Water Quality Information**

According to the IDEM 305(b) list, the streams within the Morse Reservoir/Cicero Creek Subwatershed are designated for Recreational, Fishable, and Aquatic Life Use and the reservoir itself is also designated as a Drinking Water source. The 303(d) list indicates that approximately 11.8 miles of streams (West Fork, East Fork, and Sly Run) within the subwatershed are impaired for *E. coli* and the reservoir is impaired for Algae, Taste/Odor and PCBs in Fish Tissue.

A total of 24 IDEM water quality sampling stations are located within the Morse Reservoir/Cicero Creek subwatershed. Available IDEM data at these stations included sampling from the 1996 Synoptic Study, the 2001 Cicero Creek Assessment, 2001 Corvallis and 2001 *E. coli* – Upper WFWR Studies and the 2006 IDEM *E.coli* sampling data for future Cicero Creek TMDL Study. It should be noted that there are some IDEM sampling locations within the reservoir itself. These sites were not analyzed with the stream sampling data as the in-lake and stream sampling analyses are not comparable to each other.

The 2003 CIWRP Study included six sampling locations within the 10-digit HUC 0512020106 Morse Reservoir/Cicero Creek Watershed. There are no sampling locations within this subwatershed. The 2008 Morse Reservoir Blue-Green Algae Study include seven sampling locations in the reservoir. Samples were collected 11 times from May to November. This data was not analyzed as it is reservoir specific, but is included in Appendix G for information purposes.

Table 30 below summarizes the IDEM and CIWRP sampling mean value of each parameter screened and the corresponding water quality target.

**Table 30: Morse Reservoir/Cicero Creek IDEM and CIWRP Water Quality Sampling Summary**

| Water Quality Parameter | IDEM Mean Value | CIWRP Mean Value | Water Quality Target |
|---|---|---|---|
| Dissolved Oxygen | 8.7 mg/L | Not Sampled | between 4.0 and 12.0 mg/L |
| *E. coli* | 1030 CFU/100mL | Not Sampled | 235 CFU/100mL |
| Nitrate + Nitrite | 6.1 mg/L | Not Sampled | 1.6 mg/L |
| pH | 8.0 | Not Sampled | between 6.0 and 9.0 |
| Total Phosphorus | 0.074 mg/L | Not Sampled | 0.076 mg/L |
| TSS | 9.6 mg/L | Not Sampled | 30.0 mg/L |
| Turbidity | 8.3 NTU | Not Sampled | 10.4 NTU |
| Atrazine | Not Sampled | Not Sampled | 0.003 mg/L |

Based on the available water quality information, the Morse Reservoir/Cicero Creek subwatershed consistently tests higher than the water quality targets in *E. coli* and Nitrate + Nitrite. Dissolved Oxygen, pH, Total Phosphorus and TSS fall within the acceptable ranges and therefore are not concerns for this subwatershed.

**Landuse Information**

Landuse within the Morse Reservoir/Cicero Creek Subwatershed consists primarily of agricultural uses however significant development is also located within the subwatershed. Medium and high intensity development is concentrated along the eastern edge of the subwatershed associated with Cicero and Noblesville.

During October/November 2009, the Steering Committee volunteers conducted a windshield survey at 150 site locations within the Morse Reservoir/Cicero Creek Watershed. This windshield survey included 12 stream crossing sites and 6 land/field sites within the subwatershed. Observations including streambank erosion, stream buffers, debris, animal access and fields under conventional till were recorded for each site and the results are summarized in Table 31 below.

**Table 31: Morse Reservoir/Cicero Creek Windshield Survey Summary**

| Parameter | Observations |
|---|---|
| Streambank Erosion | 7/12 sites with erosion >3'<br>3/12 site with erosion <3' |
| Stream Buffers | 1/12 site with no buffers<br>9/12 sites with buffers <50' |
| In-stream Debris | 10/12 sites with debris |
| Animal Access | 0/12 sites with animal access |
| Conventional Till | 5/20 sites under conventional till |

The Morse Reservoir/Cicero Creek subwatershed contains one active confined feeding operation and one voided CFO located within the watershed. There was one violation reported for the CFOs within the subwatershed based on the inspection reports obtained from IDEM. The violation was reported in 2004 for lack of record keeping and lagoon freeboard markers.

There is 1 NPDES permit active within the Morse Reservoir/Cicero Creek subwatershed. The Cicero Municipal Wastewater Treatment Plant, permit number IN0022586, is located at 1159 Stringtown Pike in Cicero. The facility is located outside of the subwatershed; however one permitted outfall is located within the Morse Reservoir/Cicero Creek subwatershed. According to compliance records, there have been no formal enforcement actions within the last 5 years; however there have been 13 noted effluent exceedances within the last 3 years. These exceedances were reported for BOD, *E. coli* and Total Suspended Solids.

**Habitat/Biological Information**

V3 completed a macroinvertebrate study in October 2009 that included thirteen stations within the Morse Reservoir/Cicero Creek Watershed. Four stations were analyzed within Morse Reservoir/Cicero Creek Subwatershed.

The calculated mIBI score for the station located on Cicero Creek at River Avenue and 160$^{th}$ Street in Hamilton County (Station 1) was 5.4 indicating a slight impairment. The calculated mIBI score for the station located on East Fork Sly Run at Oakmont and State Road 32 in Hamilton County (Station 2) was 4.6 indicating a slight impairment. The calculated mIBI score for the station located on an unnamed tributary at Royal Pine Lane and Cedar Lane in

Hamilton County (Station 4) was 3.0 indicating a moderate impairment. And the calculated mIBI score for the station located on Bear Slide Creek at 226th Street and Schulley Road in Hamilton County (Station 5) was 5.0 indicating a slight impairment.

The mean mIBI score of 4.5 indicates that the Morse Reservoir/Cicero Creek Subwatershed is slightly impaired for macroinvertebrate communities. One IDEM sampling station and one windshield survey site were located in the vicinity of macroinvertebrate station number 1. The windshield survey indicated that adequate habitat was available for macroinvertebrates in the form of underwater tree roots, sufficient cover, and deep and shallow areas. This would indicate that the slight impairment seen in the macroinvertebrate community is not likely caused by lack of habitat. At the IDEM sampling station, *E. coli* was the only water quality parameter analyzed. Levels of *E. coli* at this station average 951.6 CFU/100mL which does exceed the water quality target. Therefore, it is difficult to conclude if the slight impairment to the macroinvertebrate community is due solely to poor water quality at the site since only *E.coli* was measured and no other water chemistry parameters.

One IDEM sampling station was located in the vicinity of macroinvertebrate station number 2. At the IDEM sampling station, *E. coli* was the only water quality parameter analyzed. Levels of *E. coli* at this station average 473.7 CFU/100mL which does exceed the water quality target. Therefore, it is difficult to conclude if the slight impairment to the macroinvertebrate community is due solely to poor water quality at the site since only *E.coli* was measured and no other water chemistry parameters.

One IDEM sampling station was located in the vicinity of macroinvertebrate station number 4. At the IDEM sampling station, *E. coli* was the only water quality parameter analyzed. Levels of *E. coli* at this station average 1397.5 CFU/100mL which does exceed the water quality target. Therefore, it is difficult to conclude if the slight impairment to the macroinvertebrate community is due solely to poor water quality at the site since only *E.coli* was measured and no other water chemistry parameters. However, notes taken during the macroinvertebrate sampling indicated the presence of leaf litter which would provide poor habitat for macroinvertebrates. This indicates that the moderate impairment seen in the macroinvertebrate community may be caused by lack of quality habitat.

No additional sampling sites were located within the vicinity of macroinvertebrate station number 5. No habitat or water chemistry information is available at this location; therefore there is insufficient data to determine the cause of the slight impairment. Detailed analysis for each station can be found in Appendix H.

## Part Three of the Watershed Inventory

### Watershed Inventory Summary and Ranking

As detailed in Part Two of the Watershed Inventory, available water quality, biological and landuse information was analyzed on a subwatershed (HUC 12) scale. The following tables with subwatershed rankings summarize the data that was analyzed and presented in Part Two of the Watershed Inventory for easy comparison between the subwatersheds.

In order to gain an understanding of the relationships between the subwatersheds and identify the areas of highest concern, a ranking system was established. Ranking was assigned based on each data set with the most impacted subwatershed (subwatershed of the greatest concern) receiving the lowest score (e.g. 1). The scores were then averaged based on the number of data sets that were available for that subwatershed and the lowest average scoring subwatershed received the lowest overall score (e.g. 1). Therefore a subwatershed with a ranking of 1 is the lowest ranked subwatershed meaning it is the worst ranked subwatershed for that specific data set/pollutant and is of highest concern. A subwatershed with a ranking of 10 is the highest ranked subwatershed meaning it is the best ranked subwatershed for that specific data set/pollutant. A value of NR, or Not Ranked, is given for those subwatersheds where the parameter or pollutant was not collected or sampled. Specific ranking methodologies are explained for each table.

It should be noted that average (overall) ranks were provided for the IDEM Water Quality Sampling Summary, CIWRP Studies Summary and NPS Modeling Summary due to the amount of data that was obtained for these studies. The V3 Biological Data, Windshield Survey Data and NPDES Permits Summary information was not averaged so not to dilute this information due to the importance of each of these parameters. This methodology was discussed and agreed to during the Steering Committee meetings.

**Water Quality Information**

The IDEM 303(d) Summary information is ranked based on the number of impairments per subwatershed. For example, Morse Reservoir/Cicero Creek had four types of impairments; the highest number of impairments compared to the other subwatersheds and therefore was ranked 1 for this data set. Cox Ditch had 3 impairments and therefore ranked second. Buck Creek, Tobin Ditch and Little Cicero Creek each had one impairment and were therefore third in the rankings for the IDEM 303(d) Summary.

| Table 32: IDEM 303(d) Summary | | |
|---|---|---|
| **Subwatershed** | **IDEM 303(d) Impairments** | **IDEM 303(d) Ranking** |
| Prairie Creek | Not Listed | **NR** |
| Cox Ditch | IBC, Nutr, Algae | **2** |
| Dixon Creek | Not Listed | **NR** |
| Buck Creek | *E. coli* | **3** |
| Tobin Ditch | *E. coli* | **3** |
| Weasel Creek | Not Listed | **NR** |
| Teter Branch | Not Listed | **NR** |
| Little Cicero Creek | *E. coli* | **3** |
| Hinkle Creek | Not Listed | **NR** |
| Morse Reservoir/ Cicero Creek | *E. coli*, Algae, Taste/Odor, PCBs in fish tissue | **1** |

The IDEM Water Quality Sampling Summary information is ranked for each impairment based on the value of the impairment (e.g. Buck Creek had the third highest value for *E. coli*). For example, for TSS the highest value of 74.8 is in Buck Creek and therefore Buck Creek is ranked 1 for TSS. The ranking for the impairments were then averaged to determine an overall rank for the IDEM water quality information. The Overall IDEM WQ Rank left column was determined based on adding each impairment rank and dividing by the number of times it was ranked. For example, Prairie Creek has a total rank of 8 (8 for *E. coli* and no other rankings for the other impairments). Therefore, 8 divided by the number of times it was ranked (1) is 8. Similarly, Cox Ditch has a total rank of 20 (9+2+5+4) and was ranked for all 4 impairments. Therefore, Cox Ditch has an Overall IDEM Rank of 5 (20/4). The right column of the Overall IDEM WQ Rank is ranking the left column from 1 to 10 (1 being the worst case and 10 being the best case).

| Table 33: IDEM Water Quality Sampling Summary | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Subwatershed** | ***E. coli* (CFU/100ml)** | | **Nitrate + Nitrite (mg/L)** | | **Total Phosphorus (mg/L)** | | **TSS (mg/L)** | | **Overall IDEM WQ Rank** | |
| | **Value** | **Rank** | **Value** | **Rank** | **Value** | **Rank** | **Value** | **Rank** | | |
| Prairie Creek | 822 | 8 | -- | NR | -- | NR | -- | NR | 8 | **9** |
| Cox Ditch | 638 | 9 | 7.4 | 2 | 0.103 | 5 | 27.7 | 4 | 5 | **7** |
| Dixon Creek | 329 | 10 | -- | NR | -- | NR | -- | NR | 10 | **10** |
| Buck Creek | 2464 | 3 | -- | NR | 0.097 | 6 | 74.8 | 1 | 3.33 | **3** |
| Tobin Ditch | 1046 | 6 | 7.1 | 4 | 0.118 | 3 | 13.5 | 6 | 4.75 | **6** |
| Weasel Creek | 2041 | 4 | 6.1 | 5 | 0.109 | 4 | 27.9 | 3 | 4 | **5** |
| Teter Branch | 2585 | 2 | -- | NR | -- | NR | -- | NR | 2 | **2** |
| Little Cicero Creek | 3934 | 1 | 7.9 | 1 | 0.792 | 1 | 46.4 | 2 | 1.25 | **1** |
| Hinkle Creek | 1919 | 5 | 7.3 | 3 | 0.186 | 2 | 23.7 | 5 | 3.75 | **4** |
| Morse Reservoir/ Cicero Creek | 1030 | 7 | 6.1 | 5 | 0.074 | 7 | 9.6 | 7 | 6.75 | **8** |

The methodology behind the ranking system for the CIWRP Studies Summary is the same as the ranking system used for Table 33: IDEM Water Quality Sampling Summary.

| Table 34: CIWRP Studies Summary | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Subwatershed** | ***E. coli* (CFU/100ml)** | | **Nitrate + Nitrite (mg/L)** | | **Total Phosphorus (mg/L)** | | **TSS (mg/L)** | | **Overall CIWRP WQ Rank** | |
| | **Value** | **Rank** | **Value** | **Rank** | **Value** | **Rank** | **Value** | **Rank** | | |
| Prairie Creek | 1886 | 5 | 7.5 | 1 | 0.152 | 6 | 40.1 | 2 | 3.5 | **3** |
| Cox Ditch | 1886 | 5 | 7.5 | 1 | 0.152 | 6 | 40.1 | 2 | 3.5 | **3** |
| Dixon Creek | 1886 | 5 | 7.5 | 1 | 0.152 | 6 | 40.1 | 2 | 3.5 | **3** |
| Buck Creek | 2462 | 4 | 7.1 | 2 | 0.172 | 5 | 60.0 | 1 | 3 | **2** |
| Tobin Ditch | 2462 | 4 | 7.1 | 2 | 0.172 | 5 | 60.0 | 1 | 3 | **2** |
| Weasel Creek | 4566 | 2 | 5.7 | 4 | 0.180 | 4 | 27.2 | 4 | 3.5 | **3** |
| Teter Branch | 1572 | 6 | 4.4 | 5 | 0.204 | 2 | 26.5 | 5 | 4.5 | **4** |
| Little Cicero Creek | 2771 | 3 | 6.2 | 3 | 0.186 | 3 | 32.9 | 3 | 3 | **2** |
| Hinkle Creek | 4810 | 1 | 2.7 | 6 | 0.334 | 1 | 32.9 | 3 | 2.75 | **1** |
| Morse Reservoir/ Cicero Creek | -- | NR | -- | NR | -- | NR | -- | NR | -- | **NR** |

According to the IDEM 303(d) list, five of the subwatersheds do not meet their designated uses. This is supported by the data compiled from IDEM water quality studies and the CIWRP 2003 study. *E. coli* standards were exceeded in all subwatersheds, with Hinkle Creek being the greatest contributor in the CIWRP study and Little Cicero Creek in the IDEM data. Nitrate + Nitrite and phosphorus levels were also exceeded in the majority of the subwatersheds, with Little Cicero Creek being the largest contributor of both in the IDEM data. Hinkle Creek is the largest contributor of phosphorus in the CIWRP study, while Prairie Creek, Cox Ditch, and Dixon Creek tie for the largest contributor of Nitrate + Nitrite. Total sediment loads were analyzed based on the total suspended solids in the samples. Total suspended solid levels were exceeded in seven of the ten subwatersheds based on the CIWRP data, however only 2 subwatersheds exceeded the targets based on the IDEM data. Buck Creek was the largest contributor in the IDEM data, with Buck Creek and Tobin Ditch tied in the CIWRP data.

**Habitat/Biological Information**

The V3 Biological Sampling Summary ranking is a straight rank based on the mIBI Score for each subwatershed. A subwatershed with a ranking of 1 is the lowest ranked subwatershed meaning it is the worst ranked subwatershed based on mIBI score and is of highest concern. A subwatershed with a ranking of 10 is the highest ranked subwatershed meaning it is the best ranked subwatershed based on mIBI score.

| Table 35: V3 Biological Sampling Summary | | |
|---|---|---|
| **Subwatershed** | **mIBI Score** | **V3 Bio Ranking** |
| Prairie Creek | 4.2 | **5** |
| Cox Ditch | 3.8 | **3** |
| Dixon Creek | 3.4 | **2** |
| Buck Creek | 6.4 | **8** |
| Tobin Ditch | 6.2 | **7** |
| Weasel Creek | 6.8 | **9** |
| Teter Branch | 4.0 | **4** |
| Little Cicero Creek | 3.0 | **1** |
| Hinkle Creek | 4.0 | **4** |
| Morse Reservoir/ Cicero Creek | 4.5 | **6** |

**Landuse Information**

Windshield survey observations were made during October/November 2009 by Steering Committee volunteers. Observations including general site information (e.g. location and weather), land use, land odor, evidence of best management practices, water color/appearance, water odor, evidence of algae, streambank erosion, stream buffers & type, in stream debris, available shade/stream cover and in stream habitat were recorded for 150 locations throughout the watershed on standardized survey forms. It was determined by the Steering Committee to collect as much data as possible at all of these sites. While all of this information is valid for an overall understanding of the subwatershed, only the five major parameters (streambank erosion, stream buffers, in-stream debris, conventional till and livestock access) were used as a part of the subwatershed assessments, the identification of subwatershed priority areas and specific source critical areas as these parameters help verify the water quality data and BMP recommendations. The results of the survey are summarized in Table 36. The remainder of the information obtained during the windshield survey should be reevaluated during the feasibility phases of plan implementation.

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. Absent and stabilized streambanks are not considered to be a concern and therefore were not included in the subwatershed summaries or rankings. However, the data is included in Appendix I for information purposes. Stream buffers were broken up into the following categories: absent, present > 50 feet and present (minimum 10 feet) < 50 feet. Stream buffers that were categorized as present>50 feet are not considered to be a concern and therefore were not included in the subwatershed summaries or rankings. However, the data is included in Appendix I for information purposes. Absent and stabilized streambanks are not considered to be a concern or reason for impairment and therefore were not included in the subwatershed summaries or rankings. However, the data is included in Appendix I for information purposes. No, there isn't an overall ranking column for the Windshield Survey Summary ranking table. It was discussed during the Steering Committee meetings to not do an overall average as it would dilute the importance of the parameters summarized in this table. In-stream debris, conventional till and livestock access were evaluated based on the

number of sites identified. The Windshield Survey Summary ranking is a straight rank based on the Value for each parameter.

| Table 36: Windshield Survey Summary | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Subwatershed** | **Streambank Erosion (sites with >3ft/<3ft)** | | **Stream Buffer (sites with absent/ insufficient)** | | **In-Stream Debris (number of sites)** | | **Conventional Till (number of sites)** | | **Livestock Access (number of sites)** | |
| | **Value** | **Rank** | **Value** | **Rank** | **Value** | **Rank** | **Value** | **Rank** | **Value** | **Rank** |
| Prairie Creek | 1/0 | 6 | 2/4 | 3 | 0 | 6 | 3 | 3 | 1 | 2 |
| Cox Ditch | 1/0 | 6 | 2/3 | 4 | 1 | 5 | 0 | 6 | 1 | 2 |
| Dixon Creek | 3/0 | 5 | 1/1 | 9 | 1 | 5 | 1 | 5 | 0 | 3 |
| Buck Creek | 0/0 | 7 | 0/0 | 10 | 0 | 6 | 2 | 4 | 0 | 3 |
| Tobin Ditch | 3/0 | 5 | 3/3 | 1 | 2 | 4 | 2 | 4 | 0 | 3 |
| Weasel Creek | 1/0 | 6 | 2/1 | 5 | 2 | 4 | 3 | 3 | 1 | 2 |
| Teter Branch | 5/1 | 2 | 1/4 | 8 | 3 | 3 | 3 | 3 | 3 | 1 |
| Little Cicero Creek | 3/3 | 3 | 3/2 | 2 | 6 | 2 | 9 | 1 | 3 | 1 |
| Hinkle Creek | 3/1 | 4 | 1/8 | 7 | 6 | 2 | 0 | 6 | 3 | 1 |
| Morse Reservoir/ Cicero Creek | 7/3 | 1 | 1/9 | 6 | 10 | 1 | 5 | 2 | 0 | 3 |

Morse Reservoir/Cicero Creek had the largest number of instances for both streambank erosion and in-stream debris. Tobin Ditch had the largest number of sites with inadequate stream buffers, while Little Cicero Creek had the highest frequency of areas under conventional till. Little Cicero Creek, Teter Branch, and Hinkle Creek all tied for the largest numbers of direct livestock access.

The NPS Modeling Summary ranking is the same as the ranking system used for Table 33: IDEM Water Quality Sampling Summary.

| Table 37: NPS Modeling Summary | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Subwatershed** | **N Load (lb/ac/yr)** | | **P Load (lb/ac/yr)** | | **Sediment Load (t/ac/yr)** | | **Overall NPS Modeling Rank** | |
| | **Value** | **Rank** | **Value** | **Rank** | **Value** | **Rank** | | |
| Prairie Creek | 5.58 | 5 | 1.13 | 4 | 0.36 | 3 | 4 | **4** |
| Cox Ditch | 5.59 | 4 | 1.15 | 3 | 0.37 | 2 | 3 | **3** |
| Dixon Creek | 5.66 | 2 | 1.17 | 1 | 0.39 | 1 | 1.33 | **1** |
| Buck Creek | 5.74 | 1 | 1.16 | 2 | 0.37 | 2 | 1.67 | **2** |
| Tobin Ditch | 5.47 | 7 | 1.08 | 7 | 0.32 | 6 | 6.67 | **7** |
| Weasel Creek | 5.48 | 6 | 1.13 | 4 | 0.34 | 5 | 5 | **6** |
| Teter Branch | 5.64 | 3 | 1.11 | 6 | 0.35 | 4 | 4.33 | **5** |
| Little Cicero Creek | 5.48 | 6 | 1.12 | 5 | 0.35 | 4 | 5 | **6** |
| Hinkle Creek | 5.30 | 8 | 1.04 | 8 | 0.32 | 6 | 7.33 | **8** |
| Morse Reservoir/ Cicero Creek | 5.20 | 9 | 0.96 | 9 | 0.27 | 7 | 8.33 | **9** |

Buck Creek was the largest contributor of nitrogen loading (pounds per acre) according to the nonpoint source modeling results. Compared to Morse Reservoir/Cicero Creek (the lowest contributor), the percent difference was only 9.9% showing that all subwatersheds contribute a similar amount of nitrogen based on landuse information. Phosphorus loading showed a similar trend with Dixon Creek being the largest contributor, only 19.7% different than Morse Reservoir/Cicero Creek the lowest contributor. More variability was seen with the sediment loading results with a 37.3% difference between the largest and lowest contributors, Dixon Creek and Morse Reservoir/Cicero Creek, respectively.

The NPDES Permits Summary ranking is a straight rank based on the Value for each parameter.

**Table 38: NPDES Permits Summary**

| Subwatershed | CFOs (violations active/expired/void) | | NPDES Outfalls (Exceedances) | |
|---|---|---|---|---|
| | Value | Rank | Value | Rank |
| Prairie Creek | 2 vio. 4/0/6 | 1 | No outfalls | NR |
| Cox Ditch | 0 vio. 3/0/0 | 3 | No outfalls | NR |
| Dixon Creek | 0 vio. 2/0/2 | 4 | No outfalls | NR |
| Buck Creek | 1 vio. 2/0/3 | 2 | 6- *E.coli*, 1-N, 1-TSS | 3 |
| Tobin Ditch | 0 vio. 3/0/0 | 3 | 6-*E.coli*, 5-N, 1-TSS | 1 |
| Weasel Creek | 1 vio. 2/1/0 | 2 | 1-*E.coli*, 7-N, 1-P, 3-TSS | 1 |
| Teter Branch | 0 vio. 0/0/6 | 6 | No exceedances | 5 |
| Little Cicero Creek | 0 vio. 0/1/2 | 5 | No outfalls | NR |
| Hinkle Creek | 0 vio. 0/0/2 | 7 | 2-*E.coli*, 2-N | 4 |
| Morse Reservoir/ Cicero Creek | 1 vio. 1/0/1 | 2 | 1-*E.coli*, 10-TSS | 2 |

Prairie Creek has the largest number of confined feeding operations, whereas Tobin Ditch has the largest number of facilities and outfalls permitted through the NPDES program.

**Current Water Quality Impairment**

The current water quality impairment category includes all pertinent available water quality studies and quantitative data that were utilized in this analysis. It should be noted that not all available data for the watershed was used in the analysis. This data is easily compared to standard water quality targets and therefore easily used to gage the current health of the subwatersheds. Table 39 identifies the rankings of the subwatersheds based on the current water quality impairments.

The left column of the Current Rank for the Current Water Quality Impairment Ranking is based on the total of each parameter ranking divided by the number of times it was ranked. For example, Weasel Creek has a Current Rank of 5.67 which correlates to (3+5+9)/3. The right column is a straight ranking based on the left column. A subwatershed with a ranking of 1 is the lowest ranked subwatershed meaning it is the worst ranked subwatershed based on the Current Water Quality Impairment and is of highest concern. A subwatershed with a ranking of 10 is the highest ranked subwatershed meaning it is the best ranked subwatershed and a value of NR, or Not Ranked, is given for those subwatersheds where the parameter or pollutant was not collected or sampled.

**Table 39: Water Quality Impairment Ranking**

| Subwatershed | IDEM 303(d) | CIWRP WQ | IDEM WQ | V3 Bio | WATER QUALITY RANK | |
|---|---|---|---|---|---|---|
| Prairie Creek | NR | 3 | 9 | 5 | 5.67 | **8** |
| Cox Ditch | 2 | 3 | 7 | 3 | 3.75 | **4** |
| Dixon Creek | NR | 3 | 10 | 2 | 5 | **7** |
| Buck Creek | 3 | 2 | 3 | 8 | 4 | **5** |
| Tobin Ditch | 3 | 2 | 6 | 7 | 4.5 | **6** |
| Weasel Creek | NR | 3 | 5 | 9 | 5.67 | **8** |
| Teter Branch | NR | 4 | 2 | 4 | 3.33 | **3** |
| Little Cicero Creek | 3 | 2 | 1 | 1 | 1.75 | **1** |
| Hinkle Creek | NR | 1 | 4 | 4 | 3 | **2** |
| Morse Reservoir/Cicero Creek | 1 | NR | 8 | 6 | 5 | **7** |

**Land Use and Industrial Impairments and Concerns**

The land use and industrial impairments and concerns category includes land use and social based data. This data is not easily compared to water quality targets but can be helpful in determining the chances of ongoing or future water quality impairments. Table 40 includes a summary of the rankings from the Windshield Survey Summary (Table 36), the NPS Modeling Summary (Table 37) and the NPDES Permits Summary (Table 38) then ranks each subwatershed based on those rankings. The two columns of rankings under the Land Use Rank column were determined in the same manner as the Water Quality Rank columns in Table 39.

| Table 40: Land Use and Industrial Impairments and Concerns Ranking | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Subwatershed** | **NPS Modeling** | **Stream Erosion** | **Stream Buffer** | **In-Stream Debris** | **Conven-tional Till** | **Live-stock Access** | **CFOs** | **NPDES Facilities** | **LAND USE RANK** | |
| Prairie Creek | 4 | 6 | 3 | 6 | 3 | 2 | 1 | NR | 3.57 | **4** |
| Cox Ditch | 3 | 6 | 4 | 5 | 6 | 2 | 3 | NR | 4.14 | **7** |
| Dixon Creek | 1 | 5 | 9 | 5 | 5 | 3 | 4 | NR | 4.57 | **8** |
| Buck Creek | 2 | 7 | 10 | 6 | 4 | 3 | 2 | 3 | 4.63 | **9** |
| Tobin Ditch | 7 | 5 | 1 | 4 | 4 | 3 | 3 | 1 | 3.5 | **3** |
| Weasel Creek | 6 | 6 | 5 | 4 | 3 | 2 | 2 | 1 | 3.63 | **5** |
| Teter Branch | 5 | 2 | 8 | 3 | 3 | 1 | 6 | 5 | 4.13 | **6** |
| Little Cicero Creek | 6 | 3 | 2 | 2 | 1 | 1 | 5 | NR | 2.89 | **1** |
| Hinkle Creek | 8 | 4 | 7 | 2 | 6 | 1 | 7 | 4 | 4.88 | **10** |
| Morse Reservoir/ Cicero Creek | 9 | 1 | 6 | 1 | 2 | 3 | 2 | 2 | 3.25 | **2** |

**Overall Subwatershed Ranking**

Once the subwatersheds were ranked based on the two established criteria, an overall ranking was assigned. Table 41 illustrates the results of the overall rankings. The right column of the Overall Rank is ranking the left column from 1 to 10 (1 being the worst case and 10 being the best case).

| Table 41: Overall Subwatershed Ranking | | | | |
|---|---|---|---|---|
| **Subwatershed** | **Water Quality Rank** | **Land Use Rank** | **OVERALL RANK** | |
| Prairie Creek | 8 | 4 | 6 | **4** |
| Cox Ditch | 4 | 7 | 5.5 | **3** |
| Dixon Creek | 7 | 8 | 7.5 | **7** |
| Buck Creek | 5 | 9 | 7 | **6** |
| Tobin Ditch | 6 | 3 | 4.5 | **2** |
| Weasel Creek | 8 | 5 | 6.5 | **5** |
| Teter Branch | 3 | 6 | 4.5 | **2** |
| Little Cicero Creek | 1 | 1 | 1 | **1** |
| Hinkle Creek | 2 | 10 | 6 | **4** |
| Morse Reservoir/Cicero Creek | 7 | 2 | 4.5 | **2** |

Overall the inventory identified the Little Cicero Creek Subwatershed as showing the highest level of current water quality impairments.

### Analysis of Stakeholder Concerns

As discussed in Section 1, stakeholder concerns were gathered at the public meetings. The Watershed Inventory provided a means of verifying these concerns or in some cases developing additional concerns. Further discussion on which concerns the steering committee wanted to focus on occurred during the October and November Steering Committee meetings. Table 42 lists these concerns and identifies which concerns are supported by evidence from the Watershed Inventory (windshield survey, IDEM Data, CIWRP data, V3 Biological Survey, etc.) and which concerns will be focused on by the group. This table helps verify which concerns are supported by the collected data versus what is perception, what evidence there is for each concern, whether the concern is quantifiable, and whether the concern is outside the project's scope. For example, streambank erosion was a concern identified during both public meetings. This concern is supported by data based on the water crossing windshield survey locations that identified severe erosion (greater than 3 feet) or moderate erosion (less than 3 feet but had evidence of erosion) throughout the watershed and therefore shows the linkage between the concerns and the windshield survey data (as well as the other data sources evaluated as a part of this WMP).

| Table 42: Analysis of Stakeholder Concerns | | | | | |
|---|---|---|---|---|---|
| **Concern** | **Supported by Data?** | **Evidence** | **Quanti-fiable?** | **Outside Scope?** | **Group Focus?** |
| Silt Inputs from watershed into Morse Reservoir | Yes | Aerial photograph review and brought up during Steering & Public Meetings | Yes | No | Yes |
| Stormwater after rain event | Yes | IDEM, CIWRP Data (*E. coli*, N, P, TSS) | Yes | No | Yes |
| Big Cicero erosion | Yes | Windshield Survey | Yes | No | Yes |
| Water clarity | Yes | IDEM, CIWRP Data (N, P, TSS) | Yes | No | Yes |
| Polluted runoff – nonpoint source pollution | Yes | IDEM, CIWRP Data (*E. coli*, N, P, TSS) | Yes | No | Yes |
| Failing septic systems impact to water quality | No | Not enough data to specify exact source | No | No | Yes |
| Streambank deterioration caused by severe erosion | Yes | Windshield Survey | Yes | No | Yes |
| *E. coli* in Little Cicero | Yes | IDEM, CIWRP Data (*E. coli*) | Yes | No | Yes |
| Landfill leaking | No | None, brought up during Public Meeting | No | Yes | No |
| Leaking of oil and gas while using reservoir for recreational purposes | No | None, brought up during Public Meeting | No | Yes | No |
| Phosphorus | Yes | IDEM, CIWRP Data (P) | Yes | No | Yes |
| Brown water | Yes | IDEM, CIWRP Data (N, P, TSS) | Yes | No | Yes |
| Debris in curbs and grates | No | None, brought up during Public Meeting | No | Yes | No |
| Grass clippings/litter in water | No | None, brought up during Public Meeting | No | Yes | No |
| Conflict between water quality and production agriculture | No | None, brought up during Public Meeting | No | No | Yes |
| Nutrient management | Yes | IDEM, CIWRP Data (N, P) | Yes | No | Yes |
| Subsurface drainage | No | None, brought up during Public Meeting | No | Yes | No |
| Ditch maintenance | Yes | Windshield Survey | Yes | No | Yes |
| Farming in Tipton County increase sediment & nutrients to watershed | No | None, brought up during Public -Meeting | No | No | Yes |
| Atrazine | No | None, brought up during Public Meeting | Yes | No | Yes |
| Buffer areas | Yes | Windshield Survey | Yes | No | Yes |
| Manure management | Yes | Windshield Survey | Yes | Yes | Yes |
| Livestock access to surface water within the watershed | Yes | Windshield Survey | Yes | No | Yes |
| Combined sewer overflows – Tipton County | Yes | EPA NPDES Compliance Records | Yes | No | No |
| Cost of streambank maintenance | No | None, brought up during Public Meeting | No | Yes | No |

| Table 42: Analysis of Stakeholder Concerns, cont. | | | | | |
|---|---|---|---|---|---|
| **Concern** | **Supported by Data?** | **Evidence** | **Quanti-fiable?** | **Outside Scope?** | **Group Focus?** |
| Water level | No | None, brought up during Public Meeting | No | Yes | No |
| Water quality pre & post development | Yes | IDEM, CIWRP Data (N, P, TSS) | Yes | No | Yes |
| Silt from construction sites | Yes | IDEM, CIWRP Data (TSS) | Yes | No | Yes |
| Runoff from construction sites | Yes | IDEM, CIWRP Data (TSS) | Yes | No | Yes |
| Building zoning restriction | No | None, brought up during Public Meeting | No | Yes | No |
| Construction Site erosion control | Yes | IDEM, CIWRP Data (TSS) | Yes | No | Yes |
| Residential fertilizer use | Yes | IDEM, CIWRP Data (N, P) | Yes | No | Yes |
| Need for dredging | No | None, brought up during Public Meeting | Yes | Yes | Yes |
| Construction clearing | No | None, brought up during Public Meeting | No | Yes | No |
| Streambank erosion | Yes | Windshield Survey | Yes | No | Yes |
| Habitat degradation | Yes | Windshield Survey, mIBI | Yes | No | Yes |
| Streambank stabilization | Yes | Windshield Survey | Yes | No | Yes |
| Canada geese waste impact on water quality | No | None, brought up during Public Meeting | No | Yes | No |
| Big Cicero habitat degradation | Yes | Windshield Survey | Yes | No | Yes |
| Increase in Canada geese population | No | None, brought up during Public Meeting | No | Yes | No |
| Safety of using Morse Reservoir recreationally | No | None, brought up during Public Meeting | No | Yes | No |
| Flooding | No | None, brought up during Public Meeting | No | Yes | No |
| Wastewater package plants | Yes | EPA NPDES Compliance Records | Yes | No | No |
| Fish consumption advisories/safety | Yes | IDEM 303d List | Yes | Yes | No |
| Effectiveness of Indianapolis drinking water treatment | No | None, brought up during Public Meeting | No | Yes | No |
| Odor/taste of water | Yes | IDEM 303d List | Yes | Yes | No |
| Wastewater treatment plant operation/lime in water | Yes | NPDES Permit Compliance | Yes | Yes | No |
| How to prioritize numerous watershed concerns for maximum improvement | No | None, brought up during Public Meeting | No | No | Yes |
| Need for water storage reservoir by Anderson | No | None, brought up during Public Meeting | No | Yes | No |
| Education and outreach of watershed issues | No | None, brought up during Public Meeting | No | No | Yes |
| Cooperation/communication between counties | No | None, brought up during Public Meeting | No | Yes | Yes |
| Changing public perception of stormwater as a bi-product | No | None, brought up during Public Meeting | No | No | Yes |

| Table 42: Analysis of Stakeholder Concerns, cont. | | | | | |
|---|---|---|---|---|---|
| **Concern** | **Supported by Data?** | **Evidence** | **Quanti-fiable?** | **Outside Scope?** | **Group Focus?** |
| Stewardship quality/too few interested parties within watershed | No | None, brought up during Public Meeting | No | No | Yes |
| Public concern over blue-green algae | Yes | CIWRP Data | Yes | No | Yes |
| Skin irritation/toxin | Yes | CIWRP Data | Yes | Yes | Yes |
| Safety of using water for irrigation due to presence of blue-green algae | No | None, brought up during Public Meeting | No | Yes | Yes |
| Effectiveness of algae treatments | No | None, brought up during Public Meeting | No | Yes | No |

It should be noted that TSS readings from the watershed do not necessarily indicate silt inputs into the reservoir. Deposition may occur prior to entry to the reservoir, therefore without actual reservoir silt data, it cannot be stated that this concern is supported by data.

It should be noted that Nitrogen and Phosphorus are both essential nutrients for organism growth, the concern stated at the public meeting included sediment and algae in the streams. The presence of excess N & P can be indicative of excess algae which would cause water clarity issues.