

**Problem Cause and Stressor Identification**

Many of the concerns associated with the Pigeon Creek Watershed can be attributed to either poor water quality or flooding. IDEM has collected water quality data from surface waterbodies within the Pigeon Creek Watershed. The data from these studies are maintained within IDEM’s database and consist of Field Data, General Chemistry, Metals, Pesticides and Organics. The data from the Pigeon Creek Watershed within the Field Data database spans a time frame of July 1990 to October 2005 and includes the following parameters: dissolved oxygen, water temperature, percent DO saturation, pH, specific conductance, turbidity and water flowrate. As discussed in the previous section, the IDEM database includes recordings of *E. Coli*, combined nitrate+nitrite, and total phosphorus above recommended standards. The quality of water within the watershed has a direct impact on several resources, including lake pollution and habitat protection. It can be expected that as the water quality in the watershed decreases, so will the quality of recreational resources and wildlife. This section of the plan attempts to link the most commonly identified stakeholder concerns to actual problems identified in the watershed.

Long Lake Water Quality – As noted in the previous section, water quality sampling data provided by the Soil Conservation Service and Hoosier Riverwatch indicate elevated levels of nitrates, nitrites, and phosphates in Pigeon Creek upstream of Long Lake. Bacteria sampling data has also been provided, which indicates and *E. Coli* loading from upstream sources is also affecting the lake chain. Visually, a large sediment deposit can be seen at the Long Lake inlet. The deposit is reducing the depth of the lake’s normal pool, thus affecting the lake’s recreational and habitat capacity.

Water Quality / Water Pollution – Water quality problems for the watershed are generally consistent with the concerns for Long Lake. Long Lake’s problems may be amplified in that the lake is the first line of treatment for runoff from the upstream agricultural watershed, as well as the density of the affected population that resides in the vicinity of the lake. Elevated levels of nitrates, nitrites, and phosphates have been recorded throughout the watershed. In addition, concentrations of *E. Coli* have been measured upstream of Long Lake, which indicates a potential source in the upper watershed.

Prevent West Otter Lake Flooding - West Otter Lake has a flooding condition unique to the remainder of the study area. Under normal conditions, flow from West Otter Lake discharges to the north to Pigeon Creek through a box culvert under U.S. Route 20. Under flood conditions, the water in Pigeon Creek is confined to the channel section, thus the water elevation rises to a point above the water level in West Otter Lake. A flap gate has been provided on the box culvert to prevent flow from Pigeon Creek to back up into the lake. This places the lake in a “zero discharge” condition, where all runoff entering the lake is stored until either the water level in Pigeon Creek subsides or flow overtops the highway inundating multiple residential structures in the process. Therefore, any increases in runoff within the West Otter Lake watershed can have a significant impact on the flood levels of the lake.

Unsewered Areas / Non-Point Source - Unsewered areas typically require treatment of wastewater through septic fields, which over time leach treated water into the groundwater system, ultimately reaching downstream water bodies. When these systems age and are not maintained, the treatment efficiency can be reduced along with the quality of the discharge water (increased discharge of nitrates and bacteria). Septic fields can also be compromised during flood events, which can allow untreated material to release from the system.

Pigeon Creek Dredging – Many stakeholders believe dredging Pigeon Creek will improve flood conveyance in the watershed, especially downstream of Hogback Lake. This work has not been performed due to regulation by state and federal agencies (see “Opposition to Maintaining Regulated Drains” later in this section).

Flooding - Flooding is a severe problem in the watershed. Although there are many causes for a flood occurrence, the primary reason for flooding in the Pigeon Creek Watershed is the lack of storage in upstream areas, and as a result, the lack of conveyance capacity in the waterways to convey flood events. The watershed can experience overbank flooding in agricultural areas, as the runoff is too great to flow within the confines of the channel banks. Most flooding, and likewise the most damage, is reported near the lake chain due to development along the lake shore and a flow restriction at the Hogback Lake outlet. In addition to property damage, flooding also impacts water quality in the watershed, as residential septic units can be impacted by the flood waters.

Angola Bypass Sewage to Pigeon Creek – A combined sewer overflow event occurs at a treatment plant when the flow to the plant exceeds the plant capacity. During the event, sewage diluted with storm water can be released to a waterway without standard treatment and processing. As noted in the previous section, the Angola Wastewater Treatment Plant has implemented several measures to reduce sewer overflows and improve the water quality downstream of the WWTP. The most important measures have consisted of improvements to the plant and the separation of the city’s storm and sanitary sewer system. Due to the modifications, annual sewer overflow events have decreased from 152 to 10 in the period from 1999 to 2002. During this time, the annual volume of untreated flow released to Wood Ditch has also decreased from 193 MG to approximately 4 MG. In addition to the completed modifications, two 1.25 MG storage tanks are proposed to retain untreated sewage during extreme rainfall events to further reduce the potential for a sewage overflow. (The WWTP will submit a long term control plan to mitigate remaining combined sewer overflow events by November 2006 as part of the National Pollutant Discharge Elimination System permit requirements.)

Opposition to Maintaining Regulated Drains - The Steuben County Surveyor’s Office is responsible for ditch maintenance within the county. This work is funded through a Ditch Tax paid by the residents of the county. Historically, the office has dredged channels, removed fallen trees, sediment, and other obstructions, and improved stream crossings to reduce road flooding. Some work has not been performed, such as recent dredging downstream of Hogback Lake and removal of obstructing sandbars, due to the regulation by both state and federal agencies. Furthermore, a recent measure to increase

the Ditch Tax assessment to fund additional maintenance activities within the watershed was rejected by stakeholders.

*Bacteria* – As noted in the previous section, elevated levels of *E. Coli* have been recorded in the watershed confirming bacteria as a water quality problem. Sampling downstream of the Angola Wastewater Treatment Plant has also confirmed that the plant discharge is not the sole source of bacteria. Other sources are present in the agricultural watershed, as well as bacteria that are naturally occurring.

*Soil Erosion* – Soil erosion from streams, shorelines, and uplands is a problem in the watershed, as evidenced by the accumulation of sediment at the Long Lake inlet and Hogback Lake outlet. Additional locations of channel erosion and incising were presented in the previous section.

*Less Development* – The development and change in usage of land generates many problems for a watershed. From a hydrology perspective, many features are modified, including: natural drainage paths and the amount of impervious area and runoff generated by the site. Detention or retention facilities are often required to limit the impact of additional runoff on downstream areas; however, their effects can be minimal if improperly designed or constructed.

Development also affects water quality by creating a new release point for sediment, hydrocarbons, and treated wastes. Adequate sediment control is required during and post construction to limit the amount of sediment removed from the site during rainfall events. Improper sediment control can often be identified by brownish water flowing overland from a construction site. This water contains earth and debris that ultimately reaches a storm sewer and lake or stream causing a decrease in flow conveyance, filling the channel or lake bed, and/or interacting with the chemistry of the water body.

New roadways and parking facilities are commonly associated with developments. Over time, repeated use by automobiles will release hydrocarbons (grease, oils, etc.) and sediment onto the roadway. As stated in the previous paragraph, these materials eventually will reach storm drains and have an adverse effect on water quality.

Commercial, industrial, and large residential developments can also have treated waste outlets tributary to the waterways. Sanitary sewage and chemical wastes are required to undergo treatment before release into the watershed, and similar point discharges are regulated by the EPA through the National Pollutant Discharge Elimination System.

For the Pigeon Creek Watershed, the impact of small pockets of development is difficult to quantify based on the available data. However, general observations can be made from a qualitative basis for development in general. As the majority of the watershed remains rural, development has had a small effect on flooding at the watershed level. Localized flooding may increase in the vicinity of the development if an adequate combination of runoff conveyance and storage is not provided. Development likely has had a larger impact on water quality, as increases in population inherently create additional treated sewage, hydrocarbons, and nutrients that are released into the waterways.

In addition to the problem causes presented, politics play an important role in resolving watershed issues. Specifically for the Pigeon Creek Watershed, there are several groups within the watershed with their own specific concerns. Farmers, lake associations, urban, rural, each group has their own problems, needs, and desires. In some cases, improving the situation for one group may create a hardship for another. Resolving these issues is a difficult undertaking that is only possible through the cooperation of all groups involved.

See Table 21 for a correlation of problem causes and stakeholder concerns.

Problem Cause ----- Stakeholder Concern	Elevated Levels of Nutrients	Elevated Levels of <i>E. Coli</i>	Sedimentation	Failing Septic Fields	Limited Maintenance	Inadequate Flood Conveyance / Storage	Federal / State Regulation	Shoreline and Upland Erosion
Long Lake Water Quality	X	X	X	X				X
Water Quality / Water Pollution	X	X	X	X				X
Prevent West Otter Lake Flooding			X			X		
Unsewered Areas / Non Point Source				X				
Pigeon Creek Dredging					X	X	X	
Flooding						X		
Angola Bypass Sewage to Pigeon		X				X		
Opposition to Maintaining Regulated Drains					X		X	
Bacteria		X						
Soil Erosion								X
Less Development	X	X				X		X

**Table 21: Correlation of Watershed Concerns and Probable Causes.**