INDIANA SILVER JACKETS

NORTH BRANCH ELKHART RIVER WEST LAKES TASK TEAM REPORT

MAY 2010

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Executive Summary

A recent extended period of above normal precipitation resulted in multiple flooding events in 2008 and 2009 throughout Indiana. A local steering group known as the "Flood Focus Committee of the Elkhart River Alliance" was formed. To assist the local committee, instead of creating a report with a single agency's perspective, a voluntary multi-agency group — the Silver Jackets North Branch Elkhart River West Lakes Task Team — brought federal, state and regional professionals together to develop this more broadly focused report.

In brief this review found:

- The North Branch Elkhart River (NBR Elkhart River) watershed/drainage basin is a fairly unique system. The extensive, naturally existing storage and the natural regional relationships between precipitation, geology, topography, stream flow, the groundwater resource, lake levels, and flooding have not been altered dramatically.
- Water level issues exist in many previously developed areas around lakes within the basin. These issues range from seasonal high water levels that persist over extended time frames and limit road access to existing homes, to infrequent but potentially devastating flood levels that could cause extensive property damage.
- Over several decades, studies have stated that flood damage in the watershed can be attributed to a combination of factors, with a major cause being the construction of structures in the floodplain, many at or below the minimum recommended elevation.
- Data show that during normal conditions, Waldron Lake's outlet channel carries a large rate of flow, and it responds with a substantial increase in flow during flooding events.

While no simple, single, feasible construction solution exists that can solve all water resource issues in this basin, this review found many opportunities to cumulatively improve the situation. This review also confirmed the unintended consequence of making flooding conditions in the basin much worse than currently experienced could occur if future human activities are not evaluated carefully and coordinated from a multi-county regional perspective.

The voluntary efforts of the Task Team end with this report. Future locally led efforts are encouraged to pursue the many opportunities to cumulatively reduce flood damage risk, which include: increase flood insurance coverage; identify and gather data for grant opportunities; seek to acquire, relocate, or elevate flood-prone homes; strengthen regional leadership using best floodplain management practices and ordinances; address access roads; seek to limit nutrient loading; seek sustainable growth; maintain existing streams using best management practices; prepare detailed basin hydrologic and hydraulic modeling to assess future projects; and protect existing natural flood storage areas using public/private resource partnerships.

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DETAILED SUMMARY

Summary

Many different, and sometimes opposing, water resource related concerns typically are found within any watershed/drainage basin due to the varying perspectives of the many stakeholders.

The North Branch Elkhart River (NBR Elkhart River) watershed/drainage basin is no exception. As explained in this report, basin geology and topography, the hydrologic cycle, natural resources stability, water quality, flood risk, seasonal access, and historic and future land use planning, are all interrelated issues.

The focus of this report — seeking ways to reduce flood induced risks in the West Lakes Chain area — was an intentionally unbiased and broad vision. In order to adequately address flooding issues on the West Lakes Chain, it was seemingly apparent this Report include information on the many water resource related variables found in the entire NBR Elkhart River watershed/drainage basin.

In a group effort, from all contributing authors to this report, the following highlights were compiled:

Purpose and Scope of Report:

- A recent extended period of above normal precipitation resulted in multiple flooding events in 2008 and 2009 in northeastern Indiana. Those flood events have again raised community interest in understanding and seeking ways to reduce flood-induced risks, specifically in the West Lakes Chain area.
- Unless otherwise stated, all elevations used in this report are referenced to the National Geodetic Vertical Datum of 1929, NGVD '29.

Chapter 1 – Overview of Previous Reports:

- Two 1980's reports stated that flooding in this watershed can be attributed to a combination of several factors, with the major cause being the construction of structures in the floodplain, many at or below the base flood elevation.
- In past reports (through 1983), many floods are referenced: 1969, 1974, 1976, 1978, 1981, and 1982.
- There is a large quantity of useful information and data already compiled and available for use in continued efforts to improve this watershed.

Chapter 2 – Physical Setting:

- The unique, physical and geological landscape of the NBR Elkhart River watershed/drainage basin provides an abundance of naturally existing flood storage and natural flood peak reduction.
- Because the NBR Elkhart River watershed/drainage basin has an abundance of natural storage (wetlands/geologic features), it has the ability to detain significant volumes of water for slower release, thereby reducing the peak elevation of flood waters in downstream channels, but flood flows may extend over longer periods of time.
- The primary reason lake levels can stay elevated for weeks, even while a substantial rate of flow is occurring out of the lakes, is because it can take time to drain the water from the extensive upstream storage, both wetlands and groundwater.
- The NBR Elkhart River has experienced stresses related to development, increased precipitation and concentration of runoff. However, with proper floodplain and watershed management, these stresses can be decreased over time.
- In spite of much alteration of the natural landscape over time (wetland draining/ditching, forest and riparian clearing, etc.), these activities do not appear to have dramatically altered the natural regional relationships between precipitation, geology, streamflow, groundwater, lake levels, and flooding for the NBR Elkhart River watershed/drainage basin.
- The NBR Elkhart River does not appear to be in a severely degraded condition, requiring major restoration.
- When compared, other similarly sized basins in Indiana respond to rainfall in a faster and more intense manner (i.e., they are more "flashy"). Runoff in such systems occurs rapidly with high flows over a short period of time. It appears that wetlands and upland storage play an important role in this difference in flood response.
- Protection of existing wetlands and upland storage should be a priority in the NBR Elkhart River watershed/drainage basin.
- Fifty (50) years of long-term rainfall records indicate the annual precipitation received in the region is increasing.
- During lower flow and drier times in the summer months, in-channel aquatic vegetation in an area defined as the "transition area" may be slowing water flow. This summer slow flow may be what has been keeping the lake chain from reaching the legal average level over the past few wetter than normal years. It does not appear, however, that in-channel aquatic vegetation is a controlling factor during large flood events.

- The USGS gage data show the outlet channel can carry a large rate of flow during normal lake levels, and appears to respond appropriately to flood events by showing a substantial increase in flow.

Chapter 3 – Natural Resources:

- Many of the State's rarest wildlife and plant species can be found in the NBR Elkhart River watershed/drainage basin.
- Numerous acres of Dedicated Nature Preserve can be found in the NBR Elkhart River watershed/drainage basin.
- Based on Indiana Department of Environmental Management (IDEM) sampling data, high quality fisheries habitat still exists in the lower portion of the NBR Elkhart River
- Based on IDEM data, there are impaired waters in the NBR Elkhart River watershed/drainage basin.
- Many practices that can improve water quality also have a positive impact on flood reduction by providing storage.
- Opportunities for conservation/best management practices can address several water resource related issues.
- Private partnerships have been used in the area to protect natural lands, and other opportunities for these partnerships should be sought.

Chapter 4: Lake Level Establishment, Structures, and Data

- Lake level outlet works for public freshwater lakes with court established lake levels function to assist in preventing or decreasing the impacts of low lake levels associated with drought or drought-like periods that frequently occur during the peak recreational season.
- Lake level outlet works typically are designed not to be restrictive and not to add flood storage.
- USGS gage data indicates that within the last 50 years, unlike Sylvan Lake and the Indian Lakes Chain, the West Lakes Chain has not seen a flood event that is equal to or exceeds the 1 percent annual chance (100-year) event.
- Additional gages in the watershed to record data related to rainfall, stream flow, and water levels would be helpful to track trends and could be used for future analysis and modeling calibration.

Chapter 5: Review of Local Floodplain Management Activities

- Throughout the nation, floodplain regulation is approached through a combination of federal, state, and local laws and ordinances.

- Within the NBR Elkhart River watershed, Noble County (unincorporated), Kendallville, Rome City, and LaGrange County (unincorporated) all participate in the National Flood Insurance Program.
- Misunderstandings about the National Flood Insurance Program are common.
- Only 201 homeowners in Noble County (unincorporated) purchase flood insurance through the National Flood Insurance Program.
- The minimum requirements for construction standards in floodplains often do not provide sufficient protection from all local flood hazards, nor do they account for the effects of development on future flood levels. Noble County has adopted a more restrictive standard in regards to compensatory storage requirements.
- Since 1991, Presidential Declarations (flood) for Noble County include: January 1991, September 1992, July 2003, May/June 2004, January/February 2005, January 2008, and March 2009.
- Within the identified North Branch Elkhart River/West Lakes Chain area of concern, 303 structures currently exist within the area of the 1 percent annual chance (100-year) floodplain. Of those 303 structures (primarily residential), 121 (36 percent) are located within areas also included in 50 percent annual chance (two-year) floodplain. Many of these structures were built prior to the adoption of local floodplain ordinances.
- Seasonal road access difficulties may be a more of a local concern than flood related property damage.
- A recent local survey found over half of the respondents showing interest in pursuing more information about buyouts that would allow residents to relocate to areas outside of the floodplain.
- The best method to reduce flood risk and eliminate property damage and loss is to allow known flood prone areas to remain undeveloped and either remove or relocate existing development to safer sites.
- Typical flood prediction modeling does not take into account or have a factor of safety against unpredictable events such as multiple smaller storms occurring consecutively before basins dry out, storm events that exceed the 1 percent annual chance (100-year) size, debris jams at bridges, or ice jams.
- Sylvan Lake Dam is a high hazard dam and has an Emergency Action Plan maintained by the Rome City Conservancy District. There is a need for Emergency Flood Response Planning for downstream residents during the potential operation of the structure in an extreme flood event.

Chapter 6: Engineering Project Considerations:

- An Engineering Review shows that existing downstream structural features (the dams at Benton and Goshen) have no impact on discharge flows from the NBR Elkhart River and lake levels at West Lakes Chain.
- Many previous debris and downed tree removal projects have occurred in the lower portion of the NRB Elkhart River. However, these projects alone did not and will not provide a permanent solution to flooding on West Lakes Chain.
- Actions to substantially increase outflow from any lake in the basin (in order to minimize flood level increase on that lake) will have adverse consequences to other downstream lakes and streams.

- Sylvan Lake contributes approximately only 25 percent of the total area that drains into the West Lakes Chain.
- If proposed activities are reviewed only from the perspective of their immediate surroundings, there seems to be an appropriate concern that unintended detrimental and cumulative consequences may occur elsewhere within the basin.

Chapter 7 – Agency Resources and Stakeholder Partnerships:

- Many post disaster grant opportunities exist for mitigation actions related to flood damage reduction and elimination, some of which are time sensitive.
- There are many Federal and State grant and cost-sharing programs available to address water related issues.
- Opportunities for public/private partnerships for protection of natural lands, regional planning, and lake management are available.

Future Local Actions and Considerations

The following future local actions and considerations were compiled and suggested through majority consensus of the contributing authors to this report.

These actions are presented in four (4) main categories:

1) Long-term elimination and/or reduction of flood related risks.
2) Shorter-term reduction of flood related risks.
3) Physical and/or structural "on-the-ground" activities to help decrease flood related risks and keep flooding from getting worse while the activities in category 1 and 2 are being considered.
4) Long-term local planning activities to assist in performing and properly maintaining activities considered in categories 1, 2, and 3.

CATEGORY 1: Long-Term Flood Elimination/Reduction

Priority	Future Action or Consideration ***Chapter Reference***	Remarks, Performance Steps, or Objectives
1	Pursue Federal and State grants to initiate a volunteer home acquisition and relocation program for homes located in the most vulnerable flood prone areas. **Chapters 5, 7*	Create and implement an acquisition / relocation program for willing sellers. Identify the lowest and most flood damage vulnerable areas and begin program in those areas. Identify upland areas available for relocation that can use the existing regional sewer utility. This is the only solution for removing flood risk for residents with a structure currently located in a high risk area.

CATEGORY 2: Shorter-Term Reduction Of Flood Related Risks

Priority	**Future Action or Consideration** **Chapter Reference*	**Remarks, Performance Steps, or Objectives**
1	Continue to work with homeowners to properly elevate flood prone homes and pursue additional funding opportunities for this activity. **Chapters 5, 7*	Seek available grant opportunities to fund elevation of existing structures. Consider ways to create incentives for privately funded home elevation projects. This activity will not fully remove flood risk for the structure or residents.
2	Flood Warning System **Chapters 5*	Reinvigorate the existing flood warning system. Routinely test, educate residents about, and seek opportunities to expand the system. Develop an Emergency Flood Response Plan, including evacuation planning, to be tested with the Sylvan Lake Emergency Action Plan.
3	Increase flood insurance coverage **Chapter 5*	Through public outreach, seek to provide education regarding the national flood insurance program. Explain typical costs, benefits, flood risks, and attempt to dispel myths regarding this type of insurance.
4	Elevate water well heads **Chapter 5, Appendix 9*	Work with homeowners, local health officials, or local zoning officials, to upgrade protection for water well heads located in a flood hazard area.
5	Anchor propane tanks (need to add to report)	Work with homeowners, local zoning officials, and local energy providers to anchor propane tanks located in flood plain areas.
6	Address flood prone access roads. **Chapters 5, 6*	Inventory and prioritize those areas where seasonal road access difficulties exist. Prepare a plan to reduce the access issue for the more vulnerable areas.

CATEGORY 3: Physical/Structural Activities

Priority	**Future Action or Consideration** **Chapter Reference*	**Remarks, Performance Steps, or Objectives**
1	Protect existing and historical, natural flood storage areas **Chapters 2, 3, 6, 7*	Create an inventory of natural areas that currently and historically provided natural storage and detention in the watershed/drainage basin. Seek funding and partnership opportunities to protect and/or restore these areas from future development.
2	Limit fertilizer, nutrient, and sediment loading. Target the “transition area” of the river. **Chapters 2, 3, 7*	Work with landowners, home owners, land management contractors, public utilities, and local agriculture agency officials to seek, construct, and implement conservation practices to limit fertilizer, nutrient and sediment loading. This is especially important for streams and drains discharging directly into the “transition area” identified in Chapter 2.
3	In-channel aquatic vegetation control in “transition area” described in Chapter 2. **Chapters 2, 3, 6, 7*	Once the source of nutrients is addressed, contact regulatory agencies to discuss authorizations needed to conduct in-channel aquatic vegetation removal at the “transition area” identified in Chapter 2.
4	Maintain existing streams using best management practices.	Work with local officials, adjoining property owners, recreation groups, and volunteer groups to fund and/or conduct routine stream maintenance and drainage projects consistent with the Indiana Drainage Handbook. For example, use volunteers to

	*Chapters 3, 6, Appendix 1	periodically remove downed trees to prevent them from accumulating over time and becoming substantial log jams.
5	Clear span at 900N bridge *Chapter 6	With the proper approvals, remove the obstruction associated with the outlet pipe that is protruding into the bridge waterway opening downstream of the bridge. Review the original configuration of the waterway opening under this bridge and the flow approach areas, and seek to restore the original flow area.
6	Increase gage network in basin *Chapters 4, 6	Installing and maintaining new gages to expand the coverage of documentation could prove useful to a broad base of stakeholders. Discuss partnering opportunities with the U.S. Geological Survey, and the National Weather Service.

CATEGORY 4: Long-Term Local Planning

Priority	Future Action or Consideration ***Chapter Reference***	Remarks, Performance Steps, or Objectives
1	Strengthen regional leadership regarding floodplain management practices	Create and/or strengthen an existing local group to be regional administrator of floodplain management practices (covering the communities and counties that are part of the NBR Elkhart River watershed/drainage basin). Develop consistent basin wide practices, seek, and be the local administrator for grant opportunities. Use this group to consider the

		activities in the remainder of this category.
2	Flood-related Public Education and Outreach **Chapter 7*	Organize a flood related public education and outreach event for the NBR Elkhart River watershed/drainage basin stakeholders. Provide a forum-style question and answer area with information tables, displays, staff from various Federal, State, Regional, and Local water resource agencies, and local officials. Routinely provide public outreach and education activities.
3	Identify and gather data for grant opportunities **Chapter 7*	Identify an experienced grant writer to gather data and help prepare grant applications.
4	Create a long-term strategic improvement plan	Develop a long-term strategic improvement plan to begin reducing flood risk for the basin. The strategic planning process would be founded upon a review of the North Branch Elkhart River basin's strengths, opportunities, weaknesses, and threats. A typical strategic plan would then identify and prioritize goals with measurable objectives set for each goal. Yearly action steps would then be outlined to begin addressing the many likely objectives. To be effective, the strategic planning creation, vision, and implementation must have the involvement and commitment of the local stakeholders.
5	Prepare detailed "unsteady flow" basin hydrologic and hydraulic model	Seek funding to create a detailed, calibrated, basin-wide hydrologic and hydraulic engineering computerized flow and flood level prediction model

	*Chapter 6	(an unsteady flow model). The creation and maintenance of these models can be used to more accurately predict and assess the benefits, disadvantages, and cumulative effects of any future proposed construction or development activities within the basin.
6	Utilize and strengthen existing ordinances *Chapter 1, 5	Ensure consistent regional use of flood plain management and storm water ordinances. Seek to strengthen these ordinances to incorporate best management practices.
7	Seek sustainable growth *Chapter 1, 5	To minimize future disruption to local business and area employment, seek to locate future economic growth opportunities in pre-planned, low risk zones, where natural hazards such as floods would not jeopardize the local business growth. Limit and, if possible, prohibit construction of new critical structures and utilities in flood hazard areas.

Conclusion of the Silver Jackets North Branch Elkhart River, West Lakes Task Team

The initial work concept (now complete) of the voluntary efforts from the Silver Jackets North Branch Elkhart River West Lakes Task Team initiative included:

- Participation in local meetings
- Regular Task Team member meetings
- Several tours of the area of concern by the team and local stakeholders
- Gathering of existing information such as the many previously published reports, historical hydrologic data including precipitation, lake level, stream-flow, and flood peak data, topographic data, and structure/infrastructure information
- Research on existing resources for potential flood-loss mitigation
- Synthesis of all Task Team findings and future local considerations for presentation to stakeholders and for the production of this report

- Development of these written Task Team findings and prioritized future local considerations which could lead to basin-wide reduced flood risks.

The voluntary efforts of the Silver Jackets North Branch Elkhart River West Lakes Task Team end with this report.

Locally led efforts to implement much of the guidance supplied by this document will require interaction with several of the contributing agencies represented by this Silver Jackets Task Team, as well as pursuing opportunities for private partnerships.

The many Federal, State and local agencies that participated have expressed their appreciation for this opportunity to work collaboratively and with the Flood Focus Committee of the Elkhart River Alliance on this regional water resource issue. They welcome the opportunity to assist, through their existing programs, in the local efforts to reduce flood risk.

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Focus Area & Scope Of Report

Background

Multiple flooding events in 2008 and 2009 in portions of Noble, LaGrange, and Elkhart counties, have again raised community interest in understanding and seeking ways to reduce flood-induced risks, especially in the West Lakes Chain Area in Noble County. As a result, a local steering group known as the "Flood Focus Committee of the Elkhart River Alliance" was formed. Members included:

Name	Representing
• Gene Lightner	Interim Chairman, Flood Focus Committee of the Elkhart River Alliance & member Elkhart River Alliance Steering Committee
• Bill Reynolds	West Lakes Marine, Inc.
• Dave Abbott	Rome City Conservancy District & President Rome City Town Board
• Dave Wick	West Lakes Homeowners Association
• Joy LeCount	Noble County Commissioner
• Ken Schuman	Ligonier City Council President & member Elkhart River Alliance Steering Committee
• Lynn Reynolds	West Lakes Marine, Inc.
• Mike Shellman	Member Elkhart River Alliance Steering Committee
• Nancy Brown	Elkhart River Restoration Association Board & Elkhart County SWCD
• Patty Fisel	Mayor of Ligonier
• John Richardson	J.F. New Associates

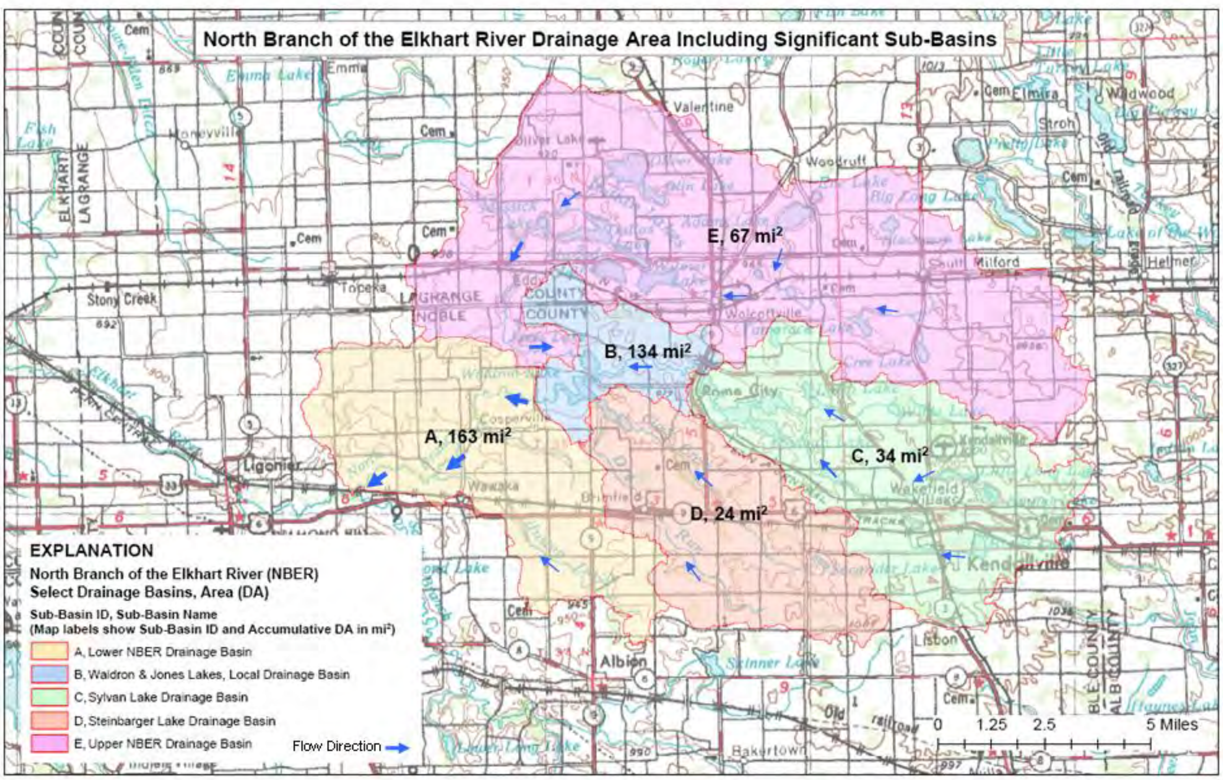
The Flood Focus Committee of the Elkhart River Alliance approached the U.S. Geological Survey and the Indiana Department of Natural Resources, seeking assistance. These two agencies asked the Indiana Silver Jackets (ISJ) if they could bring a multi-agency focus to this specific basin's issues. The ISJ volunteered to assist, and the North Branch Elkhart River West Lakes Task Team (Task Team), was formed in July of 2009. The following agencies volunteered to participate in this effort:

- Indiana Dept. of Homeland Security
- Indiana Dept. of Natural Resources
- Maumee River Basin Commission
- IUPUI, Polis Center
- National Weather Service
- Natural Resources Conservation Service
- U.S. Army Corps of Engineers
- U.S. Geological Survey

Focus Area:
Because of the critical relationship between a drainage basin's unique geology and its response to precipitation, the Task Team set the scope of this report to look broadly at the watershed/drainage basin of the North Branch Elkhart River (NBR Elkhart River). A broader understanding of this background is needed to better comprehend how the hydrologic cycle and system above and below the West Lakes Chain affects water level in the area of special focus — the West Lakes Chain and the system outlet below Waldron Lake.

The NBR Elkhart River watershed/drainage basin, for purposes of this report, is shown on the map below and consists of the area that:

- Combines with the South Branch Elkhart River drainage basin about three miles east of Ligonier.
- Includes, from the confluence of these two streams, land almost 16 miles east, past Kendallville near the boundary between Noble and DeKalb Counties.
- Extends, from north to south, as much as 12 miles from near Valentine in LaGrange County to just north of Albion in Noble County.
- Includes many tributaries and several series of interconnected lakes.



Report Scope:
Through this report, the Task Team seeks to assist the many stakeholders with an understanding of the science controlling regional relationships between precipitation, geology, stream flow, lake levels, natural resources, and flooding. Further, the Task Team seeks to investigate possible

non-structural and structural actions to reduce flood risks. Lastly, the report identifies financial and planning resources available through Federal and State Agencies.

More specifically, this report provides:

- An understanding of the extensive technical documentation previously created regarding this basin. This information and references are summarized in Chapter 1.
- An understanding of the science controlling regional relationships between precipitations, geology, stream flow, and lake levels. This information and references are summarized in Chapters 2 and 4.
- An overview of the natural resources and their relationship to water quality and flooding is included in Chapter 3.
- An understanding of current basin wide floodplain management activities, which are summarized in Chapter 5.
- A conceptual level technical review of structural considerations to reduce flood induced risks, which is summarized in Chapter 6.
- A review of current opportunities available through existing State and Federal Programs to reduce flood induced risks, which is included in Chapter 7.
- A summary, which includes highlights from the report and the prioritization of various local considerations that may lead to reduced flood risks, is found in Chapter 8.

The work of the Task Team initiative included:

- Participation in local meetings.
- Regular Task Team member meetings.
- A tour of the area of concern by members of the team and local stakeholders.
- Gathering of existing information such as the many previously published reports, historical hydrologic data including precipitation, lake level, stream flow, and flood peak data, topographic data, and structure/infrastructure information.
- Research on existing State and Federal resources for potential flood-loss mitigation.
- Synthesis of all Task Team findings and future local considerations for presentation to stakeholders and for the production of this report.
- Development of written Task Team findings and future local considerations.

Task Team agencies provided non-monetary resources including personnel time, travel costs, and/or data sets. No funding for action item implementation or project construction funding was promised or implied by involvement of the team agencies.

Unless otherwise stated, all elevations used in this report are referenced to the National Geodetic Vertical Datum of 1929, NGVD '29.

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CHAPTER 1 - PREVIOUS REPORTS

This Chapter identifies and summarizes previous reports that have been completed related to flooding and/or resource and data availability in and around the North Branch Elkhart River watershed, and specifically the West Lakes Chain, Noble County. The Silver Jackets/West Lakes Team used existing information, where appropriate, to supplement the understanding of this watershed and the history of flooding issues.

After reviewing the following nine reports, it was found that:

- Flooding has been documented for decades in the West Lakes Area.
- Two (2) reports in the 1980s attributed flooding at West Lakes primarily to the construction of homes in the floodplain.
- There are several locally established steering groups working towards finding and implementing solutions to resource problems in the watershed. The locally established groups may have different primary goals (water quality, flooding, recreation), but all goals are water resource related.
- There is a large quantity of useful information and data already compiled and available for use in continued efforts to improve this watershed.
- Noble County has been proactive in completing two (2) reports (Noble County Comprehensive Plan and Noble County Hazard Mitigation Plan) that outline goals and objectives to improve the watershed and reduce flood hazards through effective planning and appropriate regulatory oversight. In addition, the completion of the Noble County Hazard Mitigation Plan allows the County to be eligible for federal hazard mitigation funds, if needed.
- Multiple reports identify effective Floodplain and Stormwater Management as an effective tool to help eliminate damages due to flooding.
- Multiple reports identify the need for existing floodplain mapping to be reviewed and updated.

1970s: Flood Insurance Studies

A flood insurance study (FIS) is a study that is completed to assist communities in identifying flood hazard areas and to assist in the administration of the National Flood Insurance Program. These studies are done in cooperation with Federal, State, and local governmental authorities, and include a detailed hydrologic and hydraulic analysis for selected waterways. The studies typically include maps of flood hazard areas for use in local planning/regulation and for flood insurance purposes.

For areas in the North Branch Elkhart River watershed/drainage basin, a FIS is available for:

1. Noble County (unincorporated areas), which includes the West Lakes Chain, effective date 1979,
2. Rome City, effective date 1982,
3. Kendallville, effective date 1983,
4. LaGrange County (unincorporated areas), effective date 1994

The associated maps are also available in digital format on the Federal Emergency Management Agency's website at *www.FEMA.gov*. Copies of these maps also should be available at the office of the local flood plain administrator.

1980: "The Indiana Water Resource. Availability, Uses, and Needs", The Governor's Water Resources Study Commission, February 1980.

This Report was prepared by the Governor's Water Resources Study Commission to provide general information on the water resource on a statewide basis, as well as more detailed analysis on a regional basis. In this Report, the State is broken into 15 Regions. The West Lakes Area is included in Region Three A (3-a).

Statewide and for each Region, the Report presents information related to: 1) The Water Resource, 2) Utilization of the Water Resource, 3) Excess Water, and 4) Water Quality.

Of particular interest to the understanding of the drainage basin/watershed relationship to the hydrologic cycle in the West Lakes Area, the Report explains:

- An important landform from the water resource standpoint is the watershed/drainage basin.
- A watershed/drainage basin is an area that gathers water originating as precipitation, reduces the runoff because of the unique physical properties of the basin, and then contributes it ultimately downstream to a receiving stream or other body of water (such as to Waldron Lake, near the bottom of the North Branch Elkhart River watershed/drainage basin).
- On average 69 percent or about 26 inches of the average annual precipitation in Indiana is returned to the atmosphere as evapotranspiration (loss of water from the soil by evaporation and by transpiration from plants).
- The remaining approximately 12 inches of the annual precipitation represents the net supply of the water resource. This remaining water resource is divided between two major components, ground water and surface water.
- Ground water occurs in underground, geologic formations (water that infiltrates through the soil to underlying aquifers that have the ability to absorb, store, and transmit water).
- Surface water occurs in surface streams and lakes.

This Report provides a substantial amount of statewide and regional information for use by water resource planners to provide for wise use of our State's water resources.

1981: "Report of Preliminary Flooding Problems, North Branch Elkhart River and Associated Lakes, LaGrange and Noble Counties, Indiana", IDNR, Division of Water, December 1981.

This Report was prepared by the IDNR, Division of Water in response to requests by the local residents and local State Legislators. The Report investigated the flooding problems and considered alternatives to help alleviate flooding in the area. The Report's study area included West Lakes Chain, Indian Lakes Chain, and Oliver Lake in Noble and LaGrange counties.

This Report attributed the flooding problems in the area directly to the fact that homes have been constructed without adequate freeboard.

A reconnaissance of the North Branch Elkhart River channel indicated some areas were shown to have tree, debris, and sediment build-up.

A hydrologic study of the area was performed using survey data and stream flow characteristics to help predict discharge and stage values for different flood events.

The Report considered structural (clearing and snagging) and non-structural (flood plain management practices) alternatives. The Report looked at three plans for a clearing and snagging project, and included costs and effects on different flood events for each plan. The Report found that Noble County participated in the National Flood Insurance Program, making flood insurance available to property owners and requiring local units of government to adopt flood plain ordinances that regulate and control land use in flood prone areas. LaGrange County did not participate in this program.

The Report recommended the implementation of the lowest impact clearing and snagging project along the North Branch Elkhart River in conjunction with the adoption of a Flood Plain Management Ordinance by LaGrange County.

1983: "Section 208 Reconnaissance Report on Flood Control on the North Branch of the Elkhart River and the West Lakes Chain in Noble County, Indiana", Department of the Army, Detroit District, Corps of Engineers, August 1983.

This Report was prepared under the authority of Section 208 of the 1954 Flood Control Act at the request of the Noble County Commissioners in a letter dated March 22, 1982. The letter requested assistance from the U.S. Army Corps of Engineers (USACE) to study and clean the North Branch Elkhart River in Noble County.

The Report was prepared to determine the feasibility of a federal flood control project in this area based upon information related to economic and environmental justification, technical viability, social and institutional acceptability, and Federal interest. Clearing and snagging (the removal of fallen trees, overgrown vegetation and debris, within the channel) was the only project alternative investigated in this report.

The Report found that flooding in the watershed can be attributed to a combination of several factors, with the major cause being the construction of structures in the floodplain without appropriate freeboard. All 115 structures (100 percent) in the study area were found to be located in the five-year floodplain (20 percent chance of being equaled or exceeded each year), and 93 of the 115 structures (80 percent) were found to be located in the two-year floodplain (50 percent chance of being equaled or exceeded each year).

The Report included a benefit/cost analysis. Costs were calculated by using costs associated with initial project costs, land rights, and annual maintenance based on a 20-year project life. Benefits were calculated as the difference between average annual damages with existing conditions, and average annual damages with the proposed project. The benefit-cost ratio was found to be 0.7; therefore, the project could not be economically justified.

The Report recognized that flooding is threatening the safety and economic viability of the area but ultimately concluded a proposed clearing and snagging project was not feasible and that federal involvement would be terminated.

1987: "Water Resource Availability in the St. Joseph River Basin, Indiana" State of Indiana, Department of Natural Resources, Division of Water, 1987

This Report was prepared under a mandate of the Water Resource Management Act (formerly IC 13-2-6.1) to the Natural Resources Commission (NRC) to complete an assessment of water resource availability in the State of Indiana. The NRC divided Indiana into 12 water management basins for the Department of Natural Resources (DNR), Division of Water's technical staff to perform a series of basin-wide investigations. The St. Joseph River Basin, which includes the North Branch Elkhart River Watershed, was the first in the series of basins studied by the DNR.

The Report includes information related to: population and economic data, geologic framework, basin hydrology and available water supply, water use, and future water resource development.

This Report is intended to provide information to decision makers involved in water resources planning.

2005: "West Lakes Sediment Removal Plan, Steinbarger Lake to Waldron Lake Channel, Jones Lake to Waldron Lake Channel, Noble County, Indiana", September 2005.

This Plan was completed as part of an application by West Lakes Conservation, Inc., to request funds from the Lake and River Enhancement Program (LARE) administered by the Department of Natural Resources (DNR), Division of Fish and Wildlife.

The West Lakes Association requested LARE funding to perform two channel dredging projects in the West Lakes Chain to address boat access/recreational issues. The 700-foot long channel between Steinbarger Lake and Waldron Lake, and the 3,000-foot channel between Jones Lake and Waldron Lake were included in the Plan.

The Plan included a channel sediment field analysis, sediment laboratory analysis, and plans associated with a sediment disposal site. The Plan found no sampled metals exceeding the Environmental Protection Agency's maximum limits in the channel sediments.

The DNR approved funding for the projects in the 2007-2008 round of LARE grants in the amount of $65,650. The projects were initiated in the later half of 2009.

2005: "St. Joseph River Watershed Management Plan", 2005
This plan was completed in 2005 and was funded by the U.S. Environmental Protection Agency as a tool to unite stakeholders in the St. Joseph River Watershed, recognized as a critical component of the Great Lakes Basin.

This Plan includes information describing the location/size, land use and natural history, population, geology, topography, and hydrology of the St. Joseph River Watershed. The Plan identifies "critical areas" related primarily to issues associated with water quality and/or pollutants, and identifies goals and objectives to improve the condition of the watershed. Potential funding sources for implementation of goals and objectives are also included in the Plan.

The Plan describes the watershed as draining 4,685 square miles in Indiana and Michigan, with the Elkhart River identified as one of the major tributaries. The Plan states that agricultural activities have the most significant impact on surface waters in the watershed, and recognizes the increasing impact of residential and commercial development. The implementation of "best management practices" related to soil erosion, agricultural runoff and stormwater management is identified as a high priority.

In addition, among many goals and objectives related to education and outreach, the Plan recommends the unique natural features in the watershed that provide many benefits, including floodwater storage and groundwater recharge, should be protected and/or managed.

2007: "Noble County Comprehensive Plan", Noble County Planning Initiative, 1968, updated 1986, 2007.

This Plan was initially completed in 1968 and was updated in 1986 and again in 2007. According to Indiana Law, in order for a community to exercise the power of zoning, a comprehensive plan must be developed and maintained. This plan meets (and exceeds) the provisions of this requirement.

This Plan is intended to provide a vision for Noble County's future, including the identification of goals, objectives, and implementation measures. The 2007 updates were completed through the Noble County Planning Initiative, which included review and/or participation from a steering committee, interest groups, county leaders, and the general public.

Six (6) main topics, each related to an identified goal for the vision of Noble County, are covered in the Plan: Land Use and Growth Management; Economic Growth and Development; Transportation; Environment; Infrastructure and Public Services; and People and Relationships.

The Environmental Section of the Plan recognizes that the unique environmental and natural resources of the area contribute to the high quality of life in Noble County. The Plan reports nearly 83 percent of respondents in a Noble County Community Values Survey agreed that natural resources and environmental features should be protected from the impacts of development. To this end (and related to flooding issues), this section identifies specific goals/objectives, such as: conserve existing natural areas (including wetlands and floodplains); protect water quality in the watersheds; work to obtain accurately delineated floodplain maps; strongly discourage and restrict construction in the floodplain; encourage/require new development to be sensitive to environmental features and storm water management; restrict certain land uses and use best management practices to protect riparian corridors; and encourage the development of a county-wide stormwater ordinance.

The People and Relationships Section of the plan encourages cooperative relationships with partners who have similar goals through networking, with the acknowledgement that local organizations who work together toward a common goal often accomplish their own missions more efficiently.

2008: "Elkhart River Watershed Management Plan", V3 Companies, March 2008.

This Plan was completed by a private consulting firm at the request of the Elkhart River Restoration Association, Inc. and with the help of the Elkhart County Soil and Water Conservation District. The study was completed with funding assistance from an Environmental Protection Agency grant (319 Program) issued through the Indiana Department of Environmental Management.

This Plan was performed to identify and provide a plan to protect and enhance the resources in the Elkhart River Watershed. The watershed area included in the study encompasses the entire Elkhart River Watershed, including the North Branch Elkhart River.

This Study identified 26 “Critical Areas” in the Elkhart River Watershed. A critical area is defined as contributing to problems associated with *E. coli*, sediment, and nutrient loading (phosphorus and nitrogen). Critical Area “19” includes 5,885 acres in the West Lakes Chain and surrounding area. The Study states that implementation of best management practices in this area, especially in the agricultural areas, would help improve the condition of the Watershed.

The Study developed six goals for implementation in the Watershed, and included milestones and measurable goals for each. The six goals include:

1. Sustain and increase the capacity of a stakeholder group.
2. Reduce sedimentation and soil erosion.
3. Reduce *E. coli* levels.
4. Reduce nutrient loading.
5. Increase and protect open space.
6. Establish outreach and education programs.

2008: <u>“Noble County Multi-Hazard Mitigation Plan”, Christopher Burke Engineering, Ltd., March 2008</u>

This Plan was completed as a joint effort led by the Maumee River Basin Commission (MRBC) and Noble County Commissioners with participation by Noble County, Town of Albion, City of Kendallville, City of Ligonier, and Town of Rome City. The primary purpose for the preparation of the plan was to meet requirements of the Federal Disaster Mitigation Act of 2000 and allow the local communities to be eligible for future mitigation funds. The plan identifies natural hazards in the area as well as actions to reduce losses from those hazards.

Related to the hazard information on flooding, this Plan identifies the North Branch Elkhart River Watershed as the largest watershed in Noble County. The Plan states that improved land use planning, floodplain management activities, and stormwater management could significantly reduce loses associated with flooding. Specific to the West Lakes Chain, this Plan determined that to reduce flood damages, a detailed study of the Base Flood Elevation should be undertaken, and suggests that a more restrictive elevation criteria be considered (BFE + 4 feet) when construction activities take place in the floodplain around these lakes.

Section 5 of the Plan includes a list of mitigation practices to be implemented to offset losses identified in the plan. Flood hazard mitigation related practices include:

- Prohibit construction of new critical structures in known hazard areas (such as floodplains),
- Anchor all manufactured homes,
- Look into reciprocal agreements with surrounding counties for damage assessment inspections following hazard events,
- Increase public outreach and education,

- Update Flood Insurance Rate Maps and provide funding for continual floodplain analysis,
- Continue to maintain waterways and regulated drains,
- Provide opportunities for staff to become Certified Floodplain Managers,
- Encourage all communities to adopt more restrictive language in their Floodplain Ordinance, and
- Remove log jams.

INDIANA SILVER JACKETS
NORTH BRANCH ELKHART RIVER
WEST LAKES TASK TEAM

Chapter 2 – The Physical Setting

Introduction

This chapter, through several sections, will provide an overview of available information for the purpose of characterizing various components of physical setting for the drainage area of the North Branch Elkhart River (NBR Elkhart River) with a focus on flooding at West Lakes Chain. An effort has been made to limit the references and presentation when possible. The reader is encouraged to source the provided references for additional information and reference resources.

The Physical Setting of the NBR Elkhart River is best described as a young glacial landscape with numerous natural wetlands, lakes, and sinuous interconnecting streams. This is a landscape that naturally decreases direct runoff to streams, provides for considerable water storage, and strong long-term stream flow. These factors combine to reduce flood crest elevations while lengthening flood duration.

Evidence presented in this chapter will show that the system, as it presently exists, is functioning to provide improved peak flow reduction and abundant low flow for the river. The natural system does not seem to be impeding flood flow for larger floods. However, some evidence does exist to indicate flow is increasing in some areas, possibly as a result of loss of upland storage and "improved drainage." There are identified areas and conditions that possibly alter flow patterns and durations from the West Lakes Chain. These areas are likely not problematic for the higher flows. Some changes in these areas have been noted both seasonally and over the past few years, and could possibly increase lake stages for the more frequent and moderate flood events.

Changes in precipitation patterns appear to be a primary driver in seasonal flood patterns for the drainage basin. Seasonal timing of precipitation may be as critical to stream flow and flood crests as total precipitation due to seasonal variability in ground water recharge and evapotranspiration from the numerous lakes, wetlands, and forests.

Chapter 2, Section 1: Basin Area Topography and Geology:

The near-surface geology of the region of Indiana where the watershed for the NBR Elkhart River lies can be characterized as complex. The focus of this discussion is on those aspects of the near surface geology that potentially impact surface water flows. The intent of this restricted focus is for limiting discussion to information most related to groundwater storage, infiltration/recharge, and general aquifer characteristics. Most of this discussion can be referenced in the Water Resource Availability in the St. Joseph River Basin, Indiana (http://www.in.gov/dnr/water/4106.htm). The reader is encouraged to access this reference for expanded discussion regarding the geology of the watershed for the St. Joseph River Basin, of which the NBR Elkhart River Watershed lays near the center.

Information is presented in this section to show that the presence and distribution of sand and gravel, granular, deposits in the subsurface can impact surface water flow. A simplified view of the complex distribution of the granular deposits is discussed in this section with reference to the documented impact of those deposits to factors including ground water availability and aquifer recharge. In addition to the subsurface geology, the surficial geology and topography also impact surface water flow in this region.

Overview of the Near-Surface Geology:

The topography found in northeast Indiana and the watershed for the NBR Elkhart River is essentially the surface expression of a very complex near-surface geology. The complexity found in this area is associated with movements of glacial ice a few thousand years ago. The impact of glacial deposition on the landscape in this area cannot be understated.

Throughout the watershed, over 300 feet of geologic materials (for example, clay, mixed sand silt and clay, sand and gravel, marl, peat, etc.) commonly exist over the bedrock. These deposits occurred during multiple periods of glacial advance and retreat during the Pleistocene Epoch.

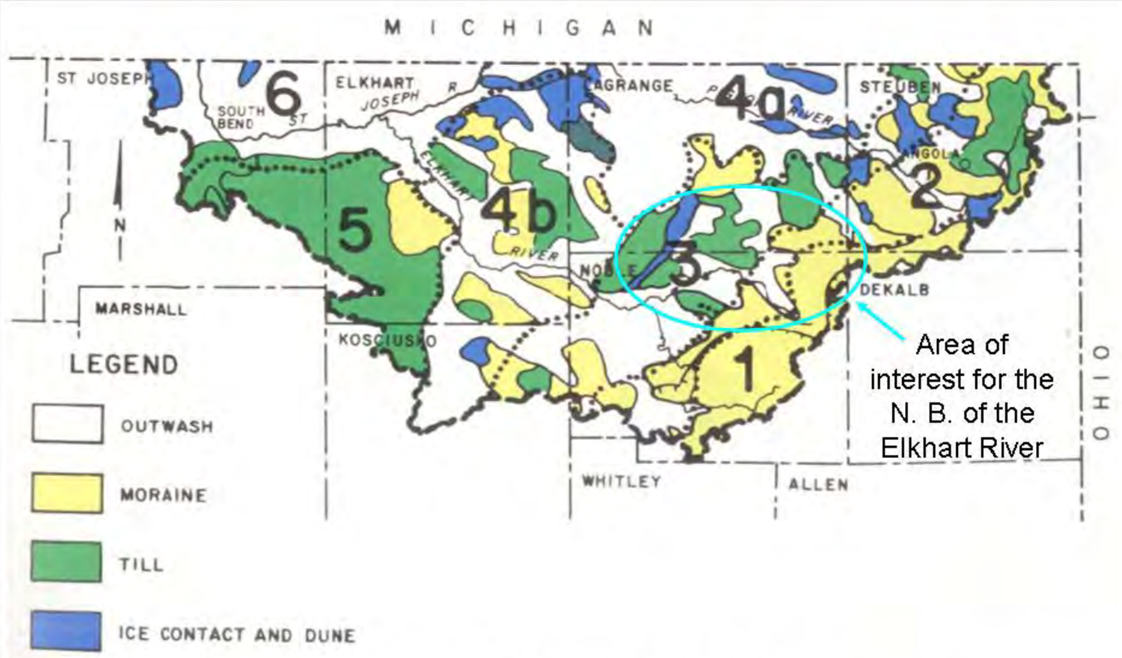
The near-surface topography and geology in this area resulted from the movement of two lobes of glacial ice from the most recent period of glacial activity in Indiana, the Wisconsinan Age (Figure 2-1). The line of lakes extending diagonally across northeast Indiana are a direct result of the interaction of the movement of the Saginaw and Erie lobes of glacial ice associated with this Age. These glaciers contained more than just ice. They contained much of the materials that make up the near-surface deposits of soil, sand, gravel, and boulders found in this watershed.

Chapter 2, Figure 1, Major Ice Lobes during the Wisconsinan Age

Their advance shaped and reformed the previous glacial deposits through both the abrasive movement and the erosion associated with the flow of melt waters. Their retreat is best described as a melting in place that resulted in a tremendous flow of outwash water, causing erosion and deposition of materials, shaping the overall watershed as well as the river valley.

The topography of the watershed for the NBR Elkhart River contains upland areas with a rugged land surface containing isolated mounds and depressions with internal drainage (hummocky topography), relatively level till plains, numerous natural lakes with broad wetlands, isolated wetlands, braded outwash channels, and outwash fans. The area also contains isolated hills or elongated ridges of stratified sand and gravel that were deposited in contact with glacial ice.

These areas can be somewhat subdivided into geomorphic regions, areas with similar origin, topographic, and geologic characteristics. The geomorphic regions (Figure 2-2, Clendenon and Beaty, 1987) would indicate the area associated with the NBR Elkhart River watershed is somewhat evenly divided between four categories: outwash, moraine, till, ice contact and dune. The larger area of ice contact falls along the western boundary

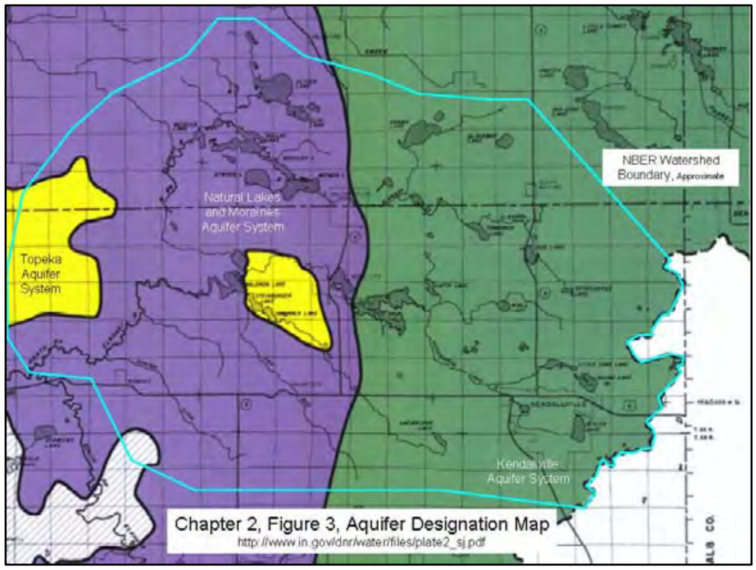


Chapter 2, Figure 2, Geomorphic Regions of the St. Joseph River Basin, Indiana

of the watershed with till plains shown in much of the upper parts of the watershed. The geomorphic regions can be somewhat recognized by observing the changes in topography while touring the watershed. In general, the topography provides for considerable, but highly variable, detention of direct precipitation prior to discharge or runoff.

In the publication "Water Resource Availability in the St. Joseph River Basin, Indiana," the complex near-surface geology of the watershed as related to groundwater used for water wells was characterized as a series of aquifer systems.

Four major aquifer systems are shown in the NBR Elkhart River. The description of these aquifer systems can be found in the publication. Figure 2-3 (Clendenon and Beaty, 1987) shows a portion of the aquifer mapping contained in the publication.



Chapter 2, Figure 3, Aquifer Designation Map
http://www.in.gov/dnr/water/files/plate2_sj.pdf

A very approximate watershed boundary for the NBR Elkhart River has been added to identify the area of interest. Three systems are shown to dominate the watershed. A fourth system is identified on the extreme southern boundary and is not significant for this discussion.

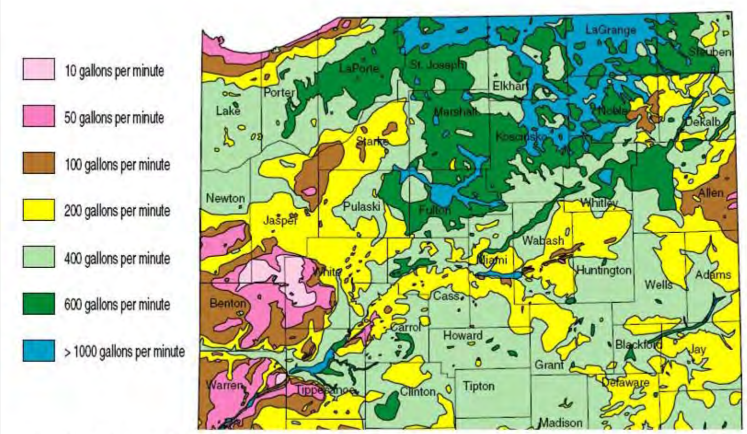
Of the three systems mapped in this watershed, both the Kendallville and the Natural Lakes and Moraines Aquifer Systems are described as being laterally extensive and having considerable amounts of clay in the upper 100 feet of the section. They also are described as having considerable variability, with sand and gravel sequences that can be rather thick, often 10 feet or more in thickness. Wells in both systems tend to be developed in the more consistent deeper aquifer materials.

However, the presence of the discontinuous shallower aquifers can play an important role in the infiltration rate of water into the deeper zones and in aquifer recharge. The clay rich soils and discontinuous nature of the upper portion of the section can slow infiltration and groundwater movement. This in turn can decrease the potential for contaminants to move rapidly through the system.

The description of the Topeka Aquifer System indicates more extensive sand and gravel deposits. This system also is described as grading into the Natural Lakes and Moraines Aquifer System. The location of the Topeka Aquifer System with the thicker aquifer zones would contribute to the “spring fed” nature of the lakes adjacent to the system, such as the West Lake Chain. The presence of near-surface extensive sand and gravel sequences will assist in providing for long periods of discharge of ground water to the surface water system.

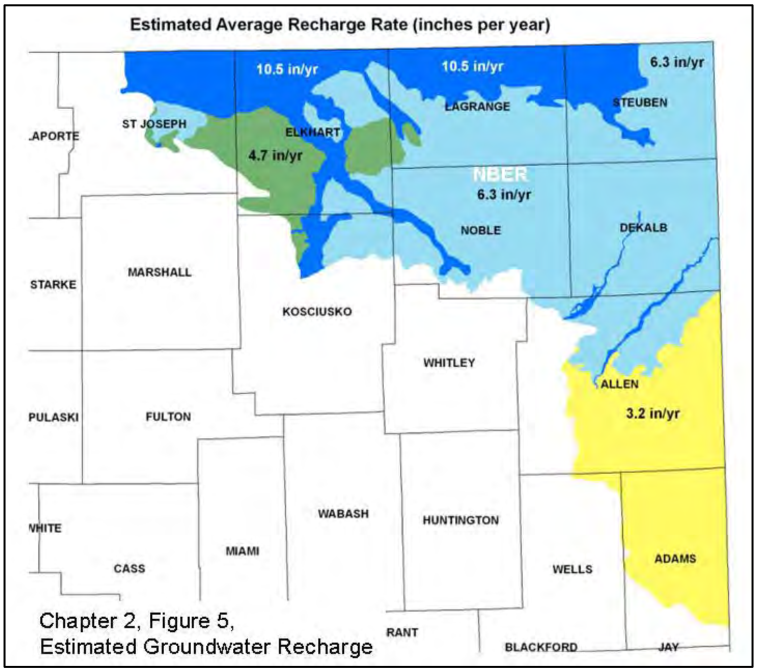
Ground-Water availability:
Figure 2-4 (Clark 1980, pg 33) shows the generalized groundwater availability for the northern part of Indiana. The generalized groundwater availability does not differentiate between deep vs. shallow aquifers, but does provide an overview of the potential for high groundwater production rates associated with thick aquifer sequences.

This map indicates abundant groundwater resources for the four-county area near the Elkhart River watershed. The northern Noble County and southern LaGrange County areas are of particular interest for the NBR Elkhart River. A comparison can be made with the watershed for the St. Mary's River in Adams County. Groundwater availability for that watershed is considerably lower, with generally half the potential yield that could be expected in this Elkhart River watershed.



Chapter 2, Figure 4, Generalized Groundwater Availability

Recharge:
Part of the function of the geology with regard to surface water flow is the ability of the near-surface soils to capture and store precipitation. This ability can be viewed on a regional level as the recharge potential for the aquifer system. Recharge data (Figure 2-5) was compiled for the publication of water resource availability studies for northeastern Indiana (Clendenon and Beaty, 1987) and (Beaty, 1996). The map shows regional recharge in excess of 6 inches per year for the area of NBR Elkhart River watershed (NBER). This means approximately 1/6 of the normal annual precipitation for this area, just over 35 inches (Clendenon and Beaty, 1987, pg 19), can be taken into the ground to be available for discharge into wells or into streams, lakes, and wetlands. The map also shows areas to the southeast, south of Fort Wayne, where the recharge potential is considerably lower. In the comparison area, the St. Mary's River Watershed in Adams County, the recharge potential is approximately half that of the NBR Elkhart River. Areas to the north, in northern LaGrange County, show higher recharge where the near surface materials consist of thick sequences of sand and gravel.



Chapter 2, Figure 5,
Estimated Groundwater Recharge

The outwash deposits (Figure 2-2) that underlie much of this region have a profound influence on the drainage characteristics of the watershed. Because outwash deposits are coarse in texture (sand and gravel), they have a high infiltration capacity and provide efficient interconnection between surface-water bodies and the shallow aquifers of the area. With this high degree of connectivity, the shallow aquifers can readily accept and store water (recharge) during wet periods, and then discharge groundwater to the lakes and streams when conditions are dry. Through these combined processes of infiltration, storage, and slow release, the outwash deposits of the watershed tend to reduce peak surface-water elevations during floods but prolong the duration of the flood events — a phenomenon commonly referred to as flood attenuation.

Likewise, the numerous kettle lakes and wetlands that dot the landscape also produce this same flood-attenuation effect. When heavy rainfall occurs, or rapid snow melt produces abundant surface-water runoff, the lakes and wetlands of the region have the capacity to retain significant volumes of water for slower release, thereby reducing the peak elevation of flood waters in downstream channels.

Chapter 2, Section 2: Geomorphology of the NBR Elkhart River Watershed

Geomorphology is the study of landforms, their evolution, and the processes that shape the natural landscape. When describing the geomorphic features of the NBR Elkhart River Watershed, the two fundamental controls that have had the greatest influence on shaping the landscape are glacial and fluvial processes.

As previously discussed, the glacial history of the region established the primary landscape features of the watershed. More recently, fluvial processes (processes associated with water flowing in a defined stream channel) have refined and shaped the post-glacial landscape. Figure 2-11, in the Watershed Section of this chapter, shows the geographic extent of the watershed, identifies its largest sub-basins, and provides the names of the lakes and channels relevant to this discussion.

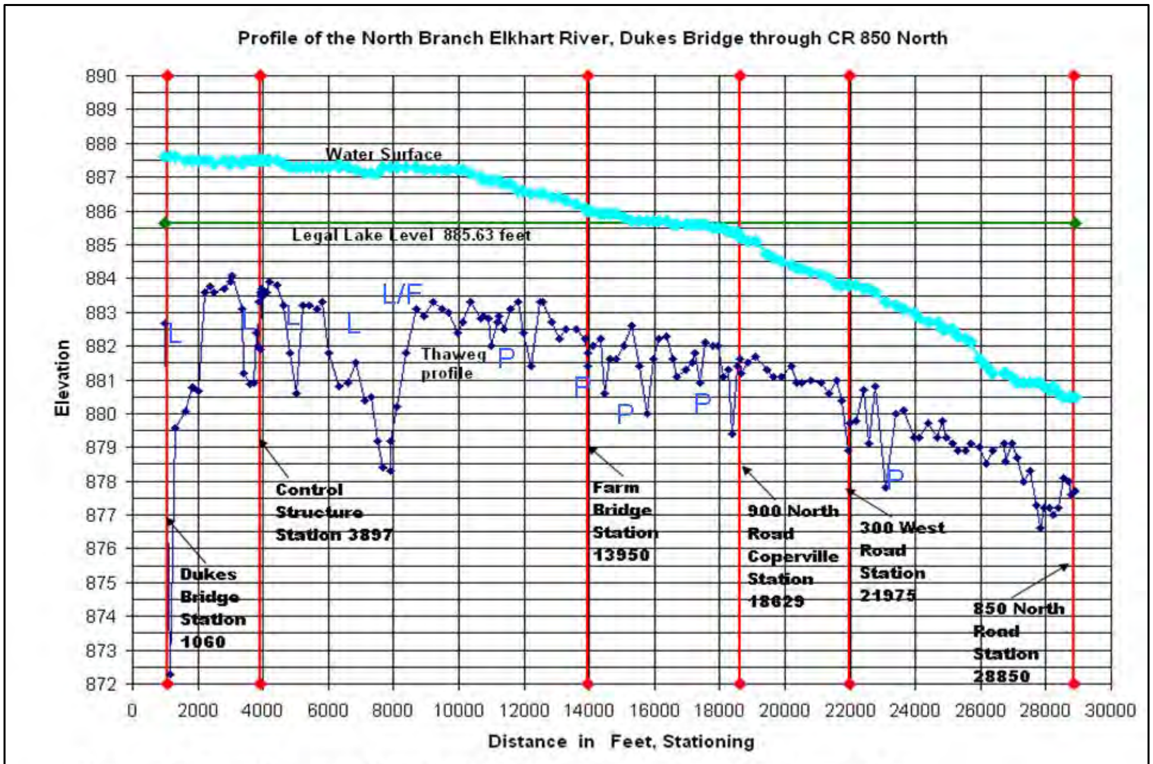
The NBR Elkhart River flows in a broad valley established when continental glaciers last retreated from northern Indiana. At the time of glacial retreat, this region was strewn with large ice blocks left by the waning glaciers and was overwhelmed by the coarse outwash — water-worked sediments typically composed of sand, gravel, cobbles, and boulders — carried by meltwater flowing from the retreating ice front. When the meltwater channels did not have the capacity to carry the sediment load derived from the glaciers, outwash deposits filled the channels, built the broad valleys, and partially or completely buried many of the remaining ice blocks.

Eventually, the ice blocks melted and the landscape depressions they produced filled with water to form the wetlands and natural lakes that are common in this region. (Lakes formed in this way are called "kettle lakes.")

Following glacial retreat and the formation of the numerous kettle lakes, stream (fluvial) processes have had the greatest influence on shaping the modern landscape. Through the processes of erosion and channel formation, a network of streams has been superimposed on the once isolated lakes. This network connects the lakes and defines the numerous pathways surface water may follow as it drains through and from the watershed.

From just south of Valentine, in the northern portion of the watershed, surface water flows generally to the south and southwest via Oliver, Hackenburg, Messick, Jones, and Waldron lake and the NBR Elkhart River. From the Kendallville area to the southeast, surface water drains to the northwest, west, and then southwest via Henderson Lake Ditch, Sylvan Lake, Middle Branch Elkhart River, Jones Lake, Waldron Lake, and the NBR Elkhart River. These are just two examples of the numerous flow paths surface water may follow as it drains from the basin and toward the Elkhart and St. Joseph Rivers.

To understand the nature of flood-water drainage from the West Lakes chain one must look in detail at the physical characteristics of the stream reach of NBR Elkhart River immediately downstream of Waldron Lake. A stream survey conducted by the IDNR in the summer of 2009 documented the elevation of the water surface from Dukes Bridge through County Road 850 North Bridge. This survey also documented the deepest point on the stream (the thalweg) approximately every 400 feet, along with significant features like bridges and the lake level outlet works.



Chapter 2, Figure 6, August 2009 Division of Water Profile of the North Branch of the Elkhart River from Dukes Bridge (1060) to County Road 850 North (28850).

Several notable features can be seen on the thalweg profile (Figure 2-6). Four areas labeled L can be seen between stations 3000 and 8000. These are consistent with small lake environments, and a continuation of the overall lake system as remnant depression from the time of glacial retreat. The lake level outlet works is located in the outwash stream bottom that connects these features, leading to the stream environment downstream.

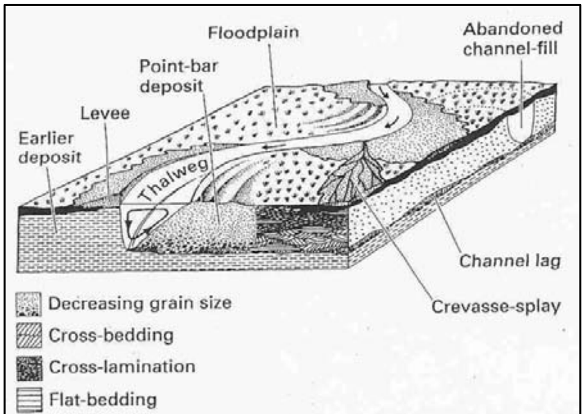
The stream survey conducted by IDNR in 2009 (Figure 2-6), along with the pattern of the outlet stream, and the adjacent topography (Figure 2-7) serve to document that the actual stream environment and resultant low stream gradient begins over 7,000 feet downstream of Dukes Bridge near station 8400. At this point (L/F on Figure 2-6), the lake-like (lacustrine) environment ends and the stream-like (fluvial) environment begins. The water surface profile tends to increase in slope below station 10000, over 9,000 feet downstream of Dukes Bridge. The actual thalweg remains relatively level from station 8600 to station 12000. This transition area is critical in establishing low flow characteristics for the upper reach of the stream and, therefore, the low flow discharge characteristics from the lake system.

The stream makes an abrupt turn south between stations11800 and 12200. The first cut bank thalweg scour or pool (P) appears to be located around station 12200. These features are common in fluvial environments and typically located along cut bank

Chapter 2, Figure 7, August 2009 Division of Water Profile of the North Branch of the Elkhart River from 8395 feet to 13078 feet downstream of Dukes Bridge with Noble County GIS Coverage showing Two Foot Topographic Mapping.

features (steep and possibly eroding banks adjacent to the thalweg, normally on bends of the river or stream). In the standard stream model, a riffle, sand bar, or slightly higher stream bottom commonly forms downstream of a pool as an area of deposition. Several relatively minor pool areas exist in this natural stream environment.

Bridges lock a stream into a specific flow location. Bridge opening, overall geometry, and maintenance are important in the dynamic process associated with a stream and riparian areas. A pool can often be associated with a bridge (generally referred to as a bridge scour). It is likewise common for a riffle or sand bar to develop downstream of a bridge with a scour. This pattern can be seen to varying degrees with the bridges on Figure 2-6. The County Road 900 North Bridge is the only bridge seen on Figure 2-6 to have an accompanying change in water surface profile on the day of the survey. Something near the bridge opening appears to be partially obstructing flow resulting in a slightly higher upstream water surface profile. During the August 2009 float trip (reconnaissance) of the river, the stream reach from County Road 300 West to County Road 800 North was noted to contain a few Condition 1 logjams (Appendix 1, Indiana Drainage Handbook). However, the water surface and resultant flow does not appear to be altered in this section. In fact, the relative difference between the water surface and the thalweg appears to decrease as the thalweg slope increases, possibly indicating increased flow velocity.



Chapter 2, Figure 8, Typical Stream Model

The natural stream valley is largely unaltered today except for the occasional road crossing. However, in the mid-1800s, a mill dam was located at Springfield Mills, present day Cosperville. The remains of this structure and its foundation likely exist at what is today County Road 900 North.

The USGS has maintained a stream gage at the County Road 900 North Bridge since October 1971. This long-term record of flow provides quality data for use in better understanding trends in streamflow. The long term observations do show some changes over time in the stage-discharge relation that would coincide with potential obstructions just downstream of the bridge and the removal of those obstructions. Examples of these types of obstructions could be relatively minor log jams or sand bars. The data indicate that in the moderate flow range for a given discharge, the associated gage heights have increased gradually over time since about 1999.

For example, on days when flows were about 80 cubic feet per second (cfs), the gage heights observed in 1999 were about a foot lower than those observed in 2008. This trend of increasing gage heights associated with a given flow is not so pronounced for days of larger flows, in the range of about 200 cfs.

Changes in the System:

To better understand the stream it can be helpful to consider how the stream functions as a component of the landscape for drainage of surface water. Natural streams adjust to compensate for changing flow/conveyance based on the confining geology and topography. Development (construction of roads, parking lots, tiles, drains, etc.) usually results in increased surface water runoff and therefore larger, more concentrated high-flow events. The long-term Standard Precipitation Index (SPI) data record for this region indicates a natural upward trend in precipitation during the last 100 years, a time of change and development in the watershed. The processes of erosion and deposition work to reshape the stream to adjust for the changes. These processes are not constant, largely because the forces are not constant, and local changes can result.

The natural processes of erosion and deposition can result in some stream sections becoming wider, some sections becoming deeper, and possibly some changes in the stream length. These adjustments, while natural, often result in undercutting of trees and the deposition of material in the stream. It can be a problematic process for the riparian environment as related to human use of the area. However, the process tends to be less problematic for the natural stream function if it occurs slowly and in response to other natural changes. An artificial, or man-made, increase in surface water drainage on a watershed level can initiate a process in the stream that is detrimental for stream function. The stream can be impacted in such a way that restoration of natural function is very difficult to attain, requiring major intervention on a watershed level to restore the flows to a more natural condition in order to achieve to restoration of the stream.

Chapter 2, Figure 9, Areas for Monitoring and BMP Implementation

As stated previously, the most critical section of the stream for discharge from the West Lakes system appears to lie from approximately station 8400 to station12000 (Figure 2-2). Stream observations for this section were recorded in August of 2006 and August of 2009 (Appendix 2). Aquatic vegetation, noted on both trips, was found to be more extensive in 2009. Several factors could contribute to the development of the aquatic plants in this section. Two agricultural drains do enter the stream at this point (Figure 2-9). Water quality entering the stream at this section would be critical and may need to be considered for monitoring. Sedimentation of this section could lead to continued widening of the stream and cause movement of the stream to the south, in the direction of the shaded section of the stream where aquatic vegetation tends to be less likely to develop. Implementation of Best Management Practices (BMPs) may be needed to decrease nutrient and/or sediment loading in this stream segment.

Finding:
Increasing precipitation, increased concentration of runoff in the watershed, and localized development in the stream valley have all combined to force changes in the stream channel. The impact of these processes on the stream cannot be fully quantified.

It seems likely the stresses placed on the stream by development can be decreased over time. This stream does not appear to be in a severely degraded condition requiring major restoration. Increased upland retention, decreased sediment loads, less restriction of flow at bridges, will decrease stresses on the system.

Alternatively, significant increases in flow, resulting from uncontrolled development or stream alterations, could be very detrimental to the overall condition of the stream, creating conditions more difficult to mitigate. Proper watershed and floodplain management are essential to maintain and restore the natural function of this watershed and stream. Selective and targeted implementation of Best Management Practices coupled with monitoring may provide the most cost effective means to decrease impacts on a changing system. Selective stream restoration may follow BMP implementation in the most critical section of the stream.

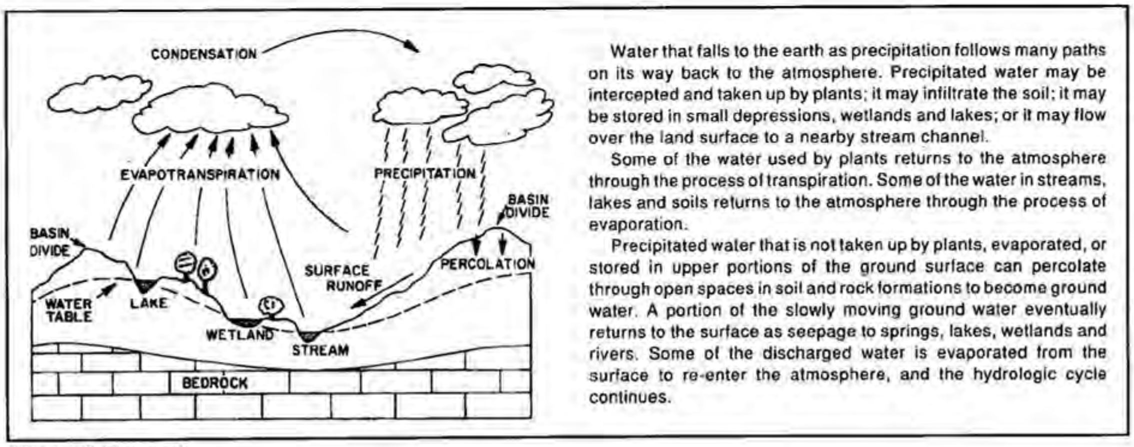
Chapter 2, Section 3: The Hydrologic Cycle

The Indiana Water Resource (Clark and Larrison 1980) provides a very good overview of the hydrologic cycle for Indiana. For more information, the reader is recommended to request this reference from the local library.

In the most simple description, the illustration of the hydrologic cycle is used to show the processes transforming atmospheric water that falls to earth as precipitation then undergoes several processes resulting in water returning to the atmosphere. This is not a new concept. “The versatility, pervasiveness, and mobility of water have long been noted. Several thousand years ago, the author of the biblical book of Ecclesiastes wrote (Eccl. 1:7) ‘All the rivers run to the sea; yet the sea is not full; unto the place from whence the river come; thither they return again.’ ” (Clark and Larrison, 1980).

Water is in a constant state of movement between the earth and the atmosphere. This movement is the hydrologic cycle.

A simple diagram of hydrologic cycle typical for northern Indiana can be seen in Figure 2-10 (Beaty, Gosine, and Smith, 1994). The hydrologic cycle for Indiana starts with an average annual precipitation of approximately 38 inches (Clark and Larrison, 1980, page 25). Of that initial 38 inches, 26 inches is discharged back to the atmosphere through the process of evapotranspiration. In the same reference, the statewide estimate for recharge



Chapter 2, Figure 10

to ground water (percolation) is about 3 to 3.6 inches. That leaves less than 9 inches of precipitation available for surface water runoff on average as a statewide estimate.

In northern Indiana, as presented in other sections of this chapter, the ground water recharge component can exceed 6 inches per year. The extensive surface water and wetland areas increase the evapotranspiration component. Therefore, much of northern Indiana has significantly less water available for direct surface water runoff than is found in the remainder of the state. However, there is a large seasonal component to evapotranspiration; very low in the winter and very high in late spring and summer. Recharge to groundwater can be reduced dramatically when the ground is frozen. Precipitation amounts, presented in subsequent sections of this chapter, vary on a per-year basis as well as a per-month basis. These factors combine to add complexity to the systems in northern Indiana. Therefore, it is not only the amount of precipitation but also the timing of the precipitation events, in combination with a host of other factors associated with the geology and land use, that determine the characteristics of flood events over a period of time for this region.

The hydrologic cycle is dynamic. The dynamic components are prevalent in the NBR Elkhart River drainage basin. The large forested areas, wetlands, and lakes evaporate large quantities of water during the late spring and summer. The thick glacial sediments and unique topography detain water, releasing it slowly over long periods of time providing for more sustained flow rates long after the initiating precipitation events.

However, the timing of the precipitation can be significant factor for flood events. Winter rains on frozen ground will generate considerably higher runoff than the same events in midsummer, because of decreased infiltration into the ground water and decreased evapotranspiration. Prolonged wet periods, commonly in springtime, will elevate ground water and provide for long term high flow throughout weeks of relatively dry conditions.

Under these conditions, the stream is often said to be spring fed, or a gaining reach of the stream. Conversely, some reaches of the stream that were draining water from the ground to the stream during wet periods can, during dry periods drain water from the stream into the groundwater aquifer. When water drains from a stream into the underlying aquifer, it typically is termed a loosing reach of the stream. These dynamic components of the hydrologic cycle add complexity to the discharge patterns associated with the streams that drain this relatively young landscape.

Chapter 2, Section 4: The Watershed

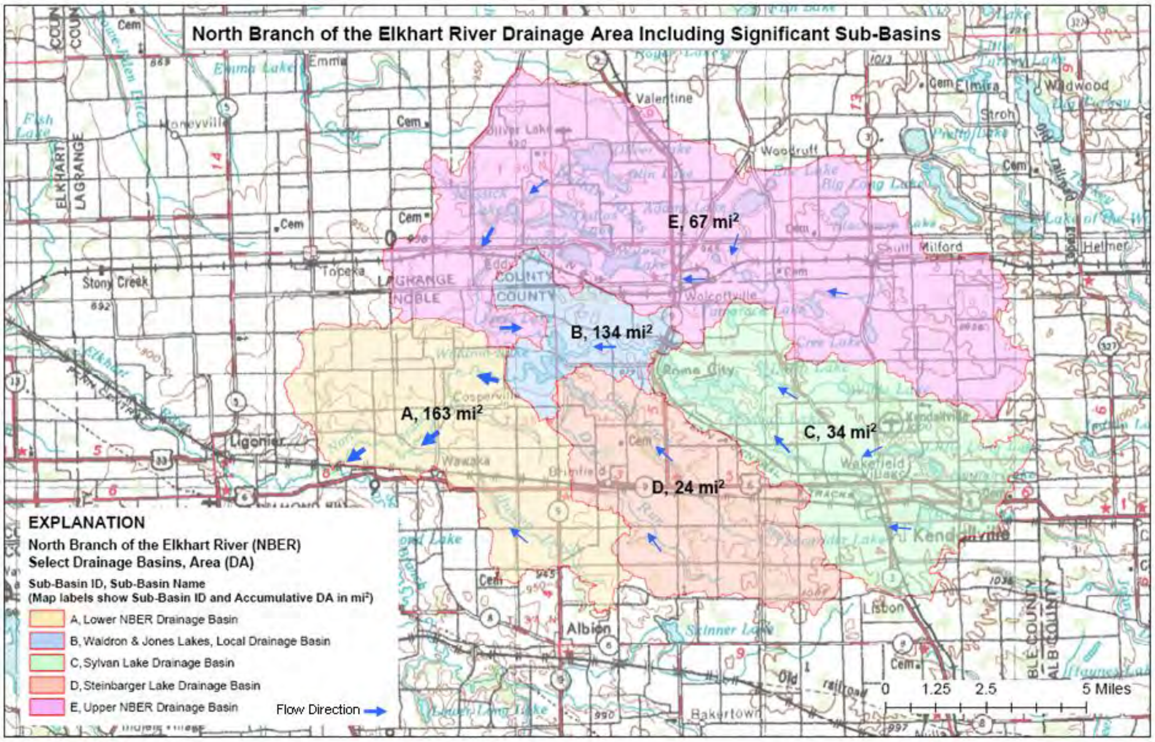
The term “watershed” is considered synonymous with the terms drainage basin or hydrographic basin. Understanding the concept of a drainage basin is an important step in understanding surface water flow. Drainage basin, or watershed, is defined as “a region or area bounded by a divide and occupied by a drainage system; specifying the tract of country that contributes water to a particular stream channel or system of channels or lake, reservoir, or other body of water.” (Bates and Jackson, Dictionary of Geological Terms, 1983)

A watershed or drainage basin can most easily be thought of as the region that contributes water to the surface water flow at a specific point on a stream. A drainage basin can be complex both on the surface and underground (groundwater flow). Some of these complexities have been explored in the previous sections. This section will focus on variation within a few specific sub-basins within the larger drainage basin of the NBR Elkhart River.

The drainage basin for the NBR Elkhart River based on the USGS Hydrologic Unit Code (HUC) can be seen in Appendix C along with an explanation of the HUC. These predefined sets of recognized sub-basins are presented in this report because they are required for many grants and regulatory applications. However, for the purposes of this report, some improved definition of specific sub-basins was considered important.

To facilitate the discussion in this report, a drainage basin map with the main contributing sub-basins to the NBR Elkhart River relative to West Lakes Chain was constructed and is presented on the same base map as the HUC basins (Figure 2-11; see next page). These sub-basins were chosen to better characterize flow characteristics for the area related to the West Lake Chain. Data for these sub-basins and additional variations can be seen in the subsequent tables.

From a more general perspective, the larger northern sub-basin noted as the “Upper NBER Drainage Basin” provides the most attenuated flow into the West Lake Chain. The sub-basin noted as “Steinbarger Lake Drainage Basin” consists of drainage mostly associated with Clock Creek and Dry Run Ditch. This basin, due to an increased slope and decreased wetland area, may provide less flow attenuation and may contribute earlier inflow to the lake system during higher flow events as proportionally compared to either the “Upper NBER Drainage Basin” or the “Sylvan Lake Drainage Basin” contributions to the “Waldron and Jones Lakes Drainage Basin.” The inflow from the Sylvan Lake Drainage Basin may be less attenuated than the Upper NBER Drainage Basin, but significantly more attenuated than flows from the Steinbarger Lake Drainage Basin.



Chapter 2, Figure 11

Drainage basin and sub-basins boundaries can be drawn by online software on the USGS Streamstats site (http://water.usgs.gov/osw/streamstats/indiana.html). This internet site was used to better define some of the characteristics of the drainage basin and sub-basins in the general relationships mentioned above. Each basin has some unique characteristics that can change if altered by human activity. The drainage basin characteristics found using USGS Streamstats do not represent the full set of parameters that control flow in a drainage system. These generalized drainage basin characteristics can provide a reasonable comparison between basins using the existing surficial features. Each basin contributes to the unique flow characteristics of the receiving stream.

Some screen captures from USGS Streamstats can be found in Appendix D. The drainage basins used for these comparisons were chosen to show the main contributions to the inflow at West Lake Chain, the discharge from West Lake Chain, and the discharge from the NBR Elkhart River.

In Table 1 (below), USGS Streamstats basin characteristics show some similarities and some differences between the three main contributing basins providing surface water

Table 1: Basin Characteristics from USGS Streamstats

	West Lakes	Indian Lakes	Sylvan Lake	Clock Creek
Slope	3.4 ft/mi	6.1 ft/mi	6.6 ft/mi	12 ft/mi
Drainage Area	135 mi^2	56 mi^2	33.5 mi^2	15.6 mi^2
Wetland Area	12.1%	13.6%	10.9%	8.5%
Urban Land	2.9%	1.4%	8.2%	0.9%

inflow to West Lakes. Indian Lakes has more in common with West Lakes than does Sylvan Lake. Indian Lakes, like West Lakes, is a chain of natural lakes with lake levels that may currently approximate the levels prior to 19th century development. These lakes have extensive wetlands connected to the lake environment providing the ability to store large volumes of water with a relatively small increase in the elevation of the water surface. Many other lakes in the NBR Elkhart River drainage basin also have extensive wetlands associated with the shoreline of the lake. Sylvan Lake is a public fresh water lake, but through it's origin as a reservoir, contains less area of connected wetlands. This results in a lower ratio of wetland water storage to open water than many of the other lakes in that area with glacial origin. The drainage basin for Sylvan Lake also has the most urbanization, including the city of Kendallville.

As can be seen in the table, the slopes for the drainage basins associated with Sylvan and Indian Lakes are very similar. The drainage basin for Sylvan Lake has the least wetland percent, however 11 percent wetlands is still very large, even for this region of the state. The urban land coverage for Sylvan is quite large compared to the other two basins. Basically, the factors that decrease storage and promote runoff are greater for the Sylvan Lake drainage basin than for the Indian Lakes drainage basin.

However, the small drainage basin for Clock Creek, located just southwest of the Sylvan Lake drainage basin, with the steeper slope and lesser wetland storage, can't be overlooked as a contributor to flow into the West Lake drainage basin. Indeed, the smaller local streams could contribute much of the first filling for the West Lakes Chain with the larger basins discharging a more attenuated flow.

Table 2: Basin Characteristics from USGS Streamstats

	North Branch	South Branch	Dry Run Ditch	Boyd Ditch	Huston Ditch	Jacobs Ditch
Slope	2.4 ft/mi	2 ft/mi	10.8 ft/mi	8.53 ft/mi	11.4 ft/mi	12.2 ft/mi
Drainage Area	162.8 mi^2	114.2 mi^2	7.7 mi^2	3.8 mi^2	8.6 mi^2	6.1 mi^2
Wetland Area	11 %	9.3 %	5.4 %	3.9 %	2.6 %	2.8 %
Urban Land	2.46 %	0.8 %	1.2 %	0.2 %	0.2 %	0 %

Table 2 (above) shows some of the drainage basin characteristics for the streams associated with the lower portion of the NBR Elkhart River. Also included in this table are the characteristics for the South Branch of the Elkhart River for comparison with those of the North Branch. The slope and wetland areas for the four ditches are much different than those of the overall North Branch and the sub basins in the previous table. These features were constructed to promote drainage and serve that function. However, these features may provide the first flush of water to the receiving stream, the NBR Elkhart River. More attenuated flow would be expected from the Sylvan Lake drainage basin and considerably more attenuated from the Indian Lakes drainage basin.

Maintaining wetland storage in all the basins is important but is likely more threatened in the Sylvan Lake drainage basin than some other basins due to urbanization. Upland storage on agricultural lands may provide some benefits for increasing flow attenuation. Increasing the attenuation of flow adjacent to each lake system may be somewhat beneficial for flood reduction. However, the benefits of these actions may be more in water quality than flood crest reduction. Increasing attenuation of flow for the drainage basins that are tributary to North Branch, downstream of West Lakes, and especially downstream of County Road 900 North, may have very limited benefit for flood level reduction at West Lake. These flows would likely pass downstream prior to the arrival of the more attenuated flows from higher in the drainage basin.

Comparison of the St. Mary's River Drainage Basin with the Elkhart River Drainage Basin:

As seen above, USGS Streamstats can provide characteristics about a drainage basin. In this section, information about the NBR Elkhart River drainage basin is compared to the drainage basin of the larger Elkhart River as defined by the location of the USGS stream gage at Goshen. The characteristics of the Elkhart River drainage basin from the USGS gage at Goshen are then compared with the St. Mary's drainage basin characteristics from the USGS gage at Decatur. Information from USGS Streamstats used in this report, showing the outline of the drainage basins, can be found in Appendix D.

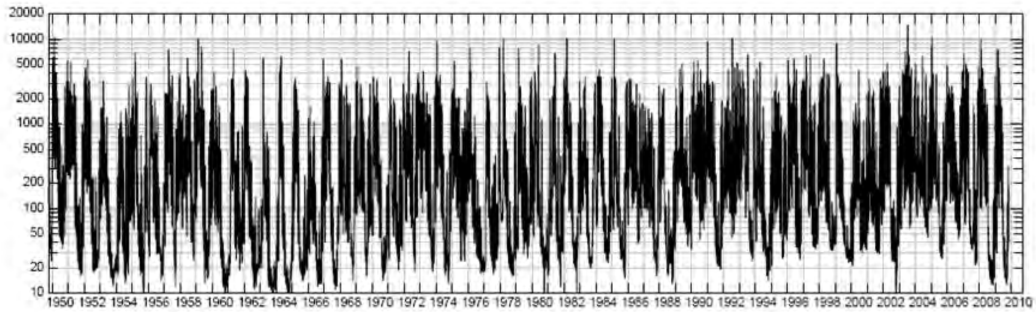
Table 3: Basin Characteristics from USGS Streamstats

	North Branch Elkhart River	South Branch Elkhart River	Elkhart River, at Goshen	St. Mary's River at Decatur
Slope	2.4 ft/mi	2 ft/mi	2.8 ft/mi	1.6 ft/mi
Drainage Area	162.8 mi^2	114.2 mi^2	588.1 mi^2	622 mi^2
Wetland Area	11 %	9.3 %	8.1 %	2.2 %
Urban Land	2.5 %	0.83 %	2.5 %	1.5 %

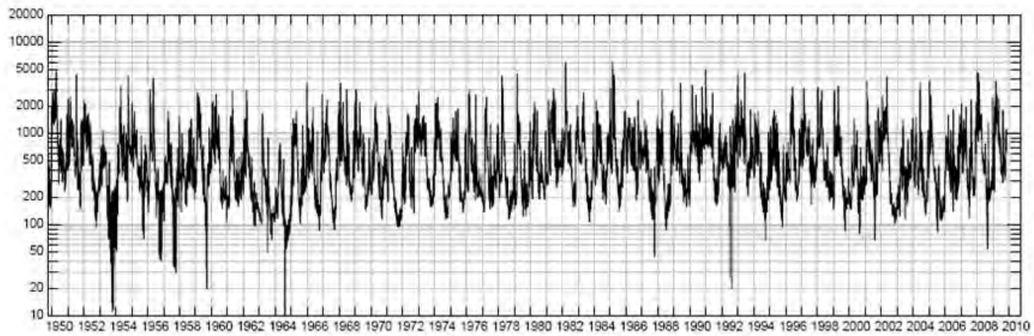
Table 3 (above) shows the relative similarity of the basin characteristics for both the North and South Branch of the Elkhart River. The NBR Elkhart River is larger than the South Branch, with slightly more wetlands and slightly more urban lands. The later two characteristics may somewhat compensate for one another, increasing the similarity between basins since the urban lands tend to intensify flow and the wetlands attenuate flow. These two drainage basins form the headwaters of the larger Elkhart River and represent approximately one half of the overall drainage area for the Elkhart River at Goshen. The drainage basin of the Elkhart River at Goshen is defined by the location of the USGS stream gage located just down stream of the City of Goshen. As can be seen in the table, the Elkhart River over all is slightly steeper, with slightly less wetlands and similar urban coverage as compared to the NBR Elkhart River.

The drainage basin for the St. Mary's River at Decatur is defined by the location of a USGS stream gage in the City of Decatur. The size of the drainage area is very similar to the Elkhart River at Goshen. The wetland area is greatly reduced, with a small reduction in urban lands. Channel conditions are somewhat different with the slope of St. Mary's River considerably less than the Elkhart River.

The difference in flow between the two Elkhart River and St. Mary's River drainage basins is dramatic. The graphs in Figure 2-12 (next page) show a long-term period of



St. Mary's River at Decatur, IN, Mean Daily Discharge, USGS Stream Gage



Elkhart River at Goshen, IN, Mean Daily Discharge, USGS Stream Gage

Chapter 2, Figure 12, USGS Stream Gage Flow Data Comparison

record from the USGS stream gages for the two drainage basins. As seen in the graphs, flows exceeding 10,000 cubic feet per second (cfs) for the St. Mary's River occurred several times with flows exceeding 5,000 cfs occurring many times. Occasionally the stream gage on the Elkhart River gage recorded a flow of 5,000 cfs. Flows exceeding 3,000 cfs were relatively common. These data would indicate that high flow for the St. Mary's is as much as twice that of the Elkhart. Low flow data may be even more interesting. The St. Mary's River frequently experiences flow below 30 cfs, whereas the Elkhart River experiences flow below 100 cfs only during very dry periods.

The flow characteristics of the Elkhart River clearly reflect the large wetlands coverage as well as geologic parameters discussed in the previous section. These conditions provide for attenuation of flood flow and moderate low flow, providing for improved habitat in the stream and more stable lake levels for the numerous upland lakes.

These two basins do not represent the limits of the extreme. Many drainage basins in southern Indiana have steeper slopes and even less wetland than the St. Mary's, with much faster flood responses and very low summer flows.

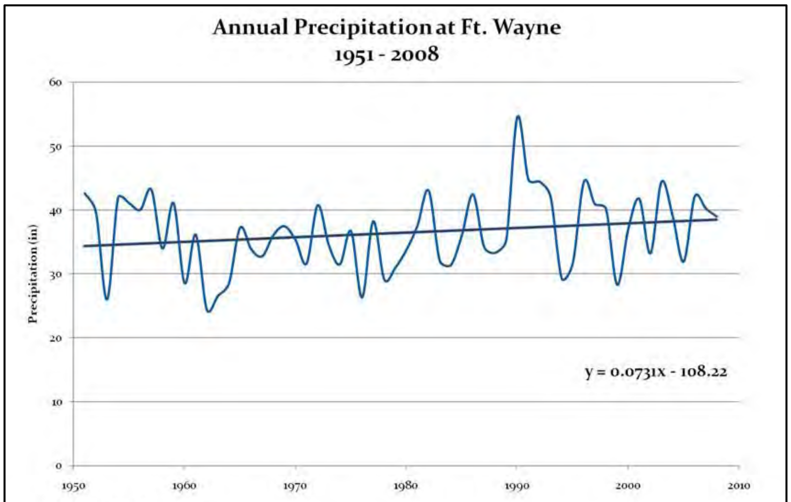
Finding:

The comparison of the drainage basins clearly shows the benefits of upland storage for the full spectrum of stream flow. Protection of the existing storage should be a top priority for protection of the environment associated with the natural lakes and the associated streams.

Chapter 2, Section 5: Regional Precipitation Trends

The science of relating precipitation to actual surface water flow and then to stream level is quite complex. The fields of study relating to hydrology and hydraulics work to understand and quantify this aspect for specific streams and specific theoretical precipitation events. This section will summarize the trends in precipitation that could impact surface water flow so those trends can be related to observations or trends in the actual lake level or stream flow records for this watershed.

Data from Fort Wayne provide the only long-term complete record of precipitation from one location near this watershed. This record is presented in Figure 2-13 as the annual total precipitation for long-term trend considerations. The graph shows the general trends of precipitation, providing the evidence of “dry” years vs. “wet” years. The slope of the line shows a general increase in the annual precipitation of ~ 0.0731 inches per year, or approximately 4 inches per year over the period of record. Two notable exceptions to the overall trend in the data occur, one being low and the other high. The period in the early 1960s was extremely dry. Much of Indiana was in a drought. This period is reflected in almost all lake and stream gage records that were active during that time. The other period was in the early 1990s with very high total precipitation rates. On the lake level graphs, the years 1991 and 1993 do stand out as high level events. One report cited ice related flood damage in the 1993 event on the West Lake Chain. Precipitation data at Fort Wayne would indicate 1991 was a wetter year than 1993. The lake level data could suggest the same was true for the local area with prolonged higher levels recorded for 1991 vs. the high peak flow seen in 1993 during an otherwise slightly above normal year.



Chapter 2, Figure 13

Flooding can occur in a year when total annual precipitation is normal or even below normal. The seasonal aspect of precipitation is important due to precipitation patterns, changes in infiltration rates, and evapotranspiration rates. Infiltration can be significantly decreased during times when the ground is frozen, thus increasing runoff and winter time flooding. During the growing season, plants can intercept precipitation through direct contact with the leaf surface and intake through the root zone. Plants transpire water during their growing cycle, removing the water from storage and therefore decreasing water availability for runoff. Water also can be removed from the system by direct evaporation.

Standard Precipitation Index (SPI) Data:

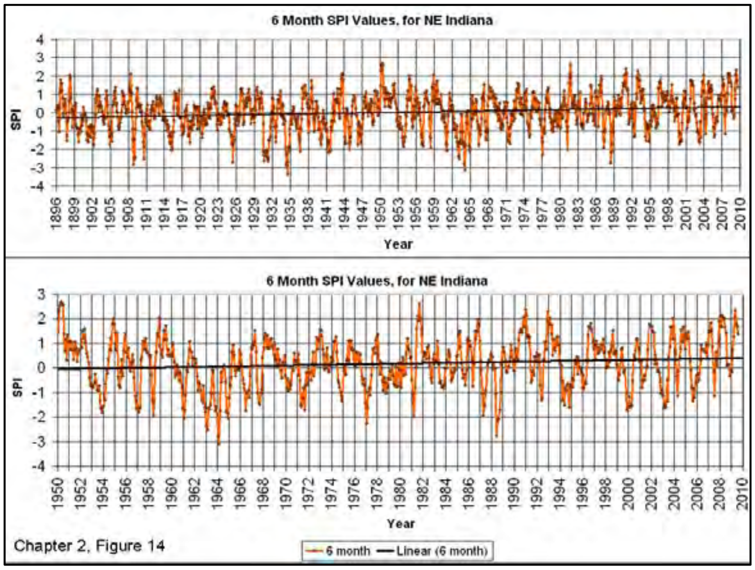
(Defined on NOAA, Western Regional Climate Center (WRCC):
http://www.wrcc.dri.edu/spi/explanation.html)

Standard Precipitation Index (SPI) is a computational tool used to standardize local data for use in a long-term data set for comparison of precipitation trends typically for drought determinations. The data are compiled for each of nine regions in Indiana by the Midwest Climate Center, NOAA. The regions divide Indiana into three rows and three columns along county lines. The NBR Elkhart River is in Region 3, the northeast region. The SPI process examines the deviation from normal for a specific period as compared to the long-term normal for that same period and region. This appears to be an effective method for looking at the long-term trends in this region. SPI is presented in standard deviation units rather than inches. SPI data compiled for six-month time periods have been used in this report for trend comparison. The six-month readings take the monthly value for that month along with the previous five months and compare that with the same six-month time period throughout the period of record. The deviation from normal is then expressed in standard deviation units on a monthly plot. Therefore, the plots are smoothed and seasonally adjusted as trends. The six month smoothing of the highly variable precipitation data provides more of a comparison that is reflective of the smoothing of precipitation as it relates to stream flow in a system with high interaction between surface water and ground water.

Long Term Trends in Precipitation

SPI data for the full period of available data indicate a slight upward trend over the approximately 110 years of data. The SPI data do show the drought years very clearly. The dust bowl years in the 1930s stand out as prolonged periods of below normal precipitation. Almost as dramatic as the dust bowl is the drought period in the early 1960s. The late 1980s drought is much less dramatic in this region.

The long-term record indicates some higher precipitation periods in the early part of the records, but the first period much above two standard deviations occurred in 1950. The record lake level recorded for West Lake Chain, see lake level data section of this report, appears to roughly coincide with the record level seen on the SPI Data in the early 1980s. In

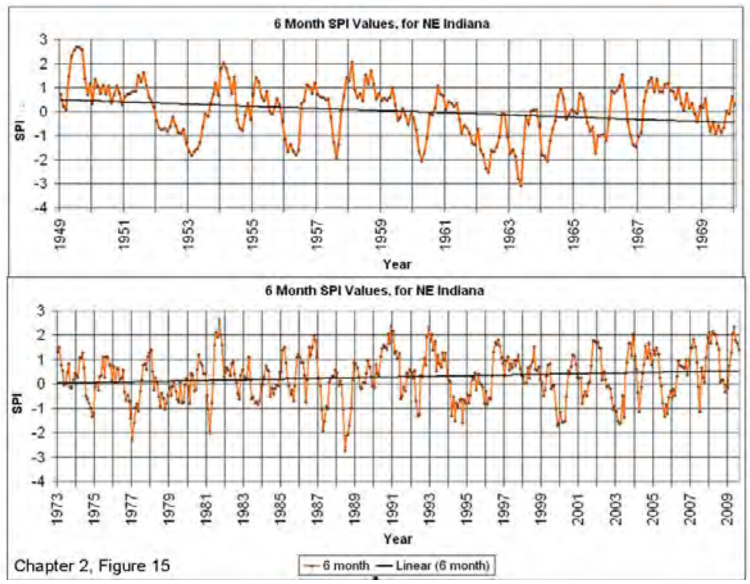


Chapter 2, Figure 14

addition, the period from late 2006 to present is shown as generally wet with an increasing trend.

The bottom graph on Figure 2-14 (see previous page) displays the same data over a shorter period. This function forces the trend line plot to follow the shorter period. What can be seen in the graph is that the increasing trend seems to become more pronounced over the shorter period.

The graphs seen in Figure 2-15 are used to further consider the trend in precipitation rates using SPI data. By analyzing the same data set, but selecting specific time periods for trends, the graph shows the trend from 1949 to 1970 was actually decreasing. This was a time period when water level data were collected for many lakes for the court establishment of lake level. The following period, 1973 to late 2009, shows the increasing trend of precipitation, using SPI data. The outlet structures for several lakes were constructed during the late 1960s through the early 1980s. This aspect will be discussed in the lake data section (Chapter 4). The outlet works for West Lake Chain were constructed in late 1971 and early 1972.



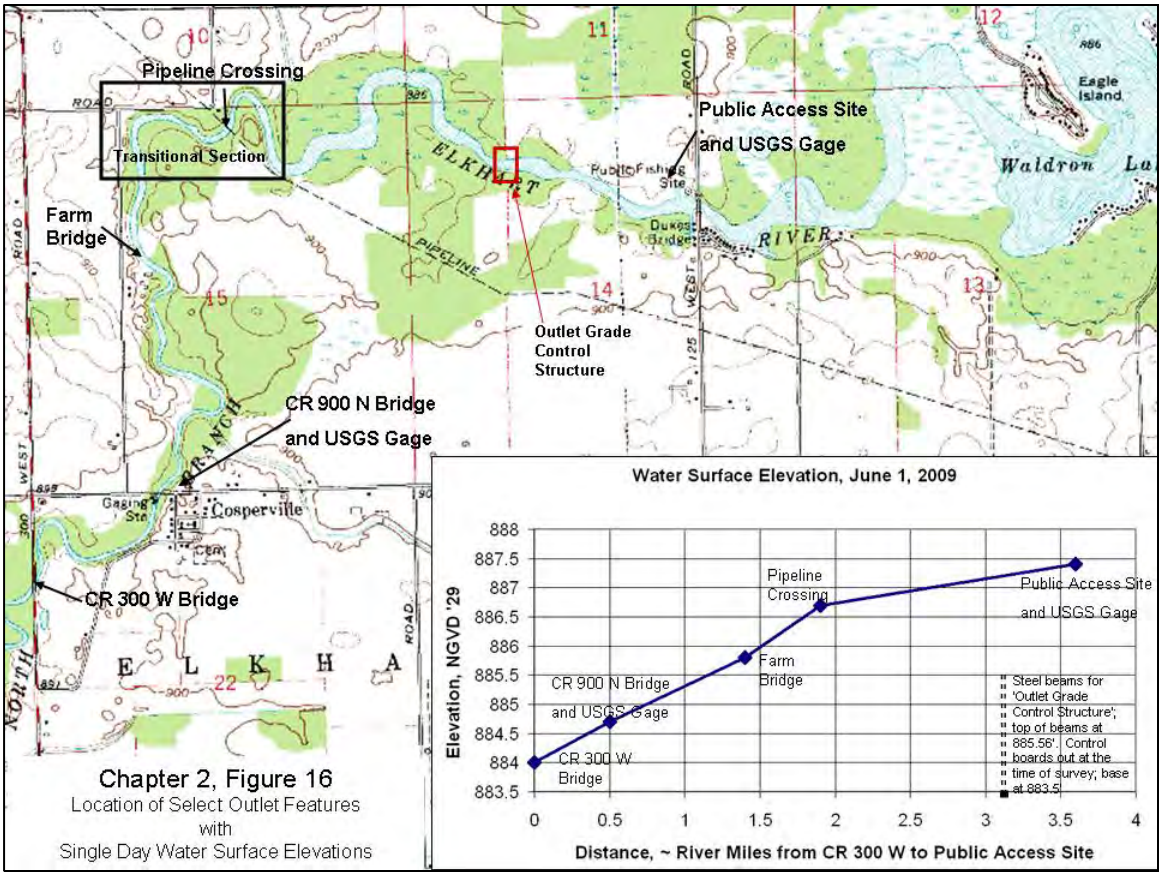
Chapter 2, Figure 15

Finding:

Precipitation data for long-term comparison to determine trends are somewhat limited for this specific site. However, the data that does exist would indicate an increasing overall trend, especially over the past 30 to 35 years. However, even within the increasing trend, dry periods do occur. The recent precipitation patterns are not out of the normal range considering the overall trend. Prudent planning based on this data should consider planning for increased precipitation in the coming years.

Chapter 4, Section 6: Transitional Section of NB Elkhart River, Impact on Data

The Geomorphology Section identified a transitional portion of the NBR Elkhart River as potentially critical for regulating both stream flow and lake level for West Lake Chain. It is in this stream segment that the lake environment ends and the stream environment begins. This transitional portion of the stream is more than 3,000 feet long beginning more than 7,000 feet downstream of Dukes Bridge. The channel gradient is very low, increasing gradually downstream. The channel width is relatively wide. The water depths



Chapter 2, Figure 16
Location of Select Outlet Features with Single Day Water Surface Elevations

in this segment are generally shallow. At least two agricultural drains enter the stream in this segment. Aquatic vegetation has been noted and under optimal conditions appears to be prolific in this stream segment. Some tree falls were noted in this segment during visual inspections in 2006 and 2009. The tree falls did not appear to be mobile, due to the low velocity of flow and wide channel.

Figure 2-16 shows the area from Dukes Bridge downstream through County Road 900 N, at Cosperville. This figure also provides a water surface profile at select points. For more information, a thalweg survey is available in the Geomorphology section of this report. The transitional segment lies from just upstream of the marked pipeline crossing to just downstream of the sharp turn south, upstream of the Farm Bridge. A seasonal change in channel capacity at this point due to aquatic vegetation can result in prolonged, somewhat higher stages upstream relative to downstream stages.

Figure 2-17 (see next page) shows the transitional segment using the Noble County Two-Foot topographic contour mapping. The portions of this stream segment with south trending banks are least likely to develop aquatic vegetation because they get the least sun exposure. Two of the off-stream sediment sources observed during the 2009 float trip are on the north side of the stream associated with the two marked agricultural drains. There is some short-term evidence that this segment is eroding portions of the south bank, resulting in an additional potential sediment source. This

Chapter 2, Figure 17, August 2009 Division of Water Profile of the North Branch of the Elkhart River from 8395 feet to 13078 feet downstream of Dukes Bridge with Noble County GIS Coverage showing Two Foot Topographic Mapping. Two more significant agricultural drains are marked in yellow.

likely is related to flow restrictions along the north bank associated with seasonal aquatic vegetation and sedimentation. The shade provided by the tree cover along the south bank decreases the growth of the aquatic vegetation increasing flow along this bank and possibly contributing to erosion and additional tree falls along the south bank. This combination of factors may form, in time, a progressively shallower and wider stream that is slightly more flow restrictive during the low-flow periods in the summer months.


Chapter 2, Figure 18, N. BR. Elkhart River from the August 2009 float trip showing the decreased growth of aquatic vegetation along the more densely shaded areas of the river near the center of the transitional section.

The figures below present a series of three graphs showing the relation between the water surface stage at the USGS gage for Waldron Lake, West Lake Chain, to the USGS gage at Cosperville, approximately three river miles downstream. Both gages use the same datum of 880.00’ NGVD 1929, making direct comparison relatively easy. The green line on the bottom shows the differential between the two gages as a simple subtraction of the upper **Waldron** data (blue, top) from the **Cosperville** data (pink, middle).

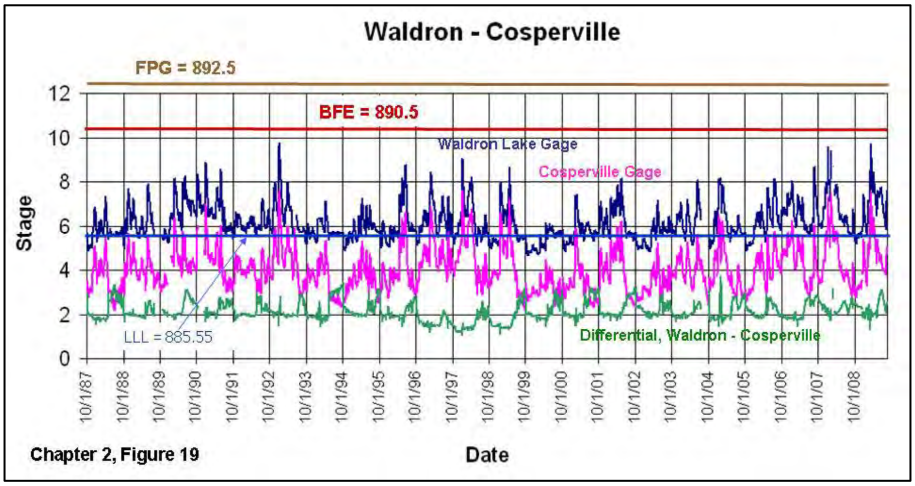


Figure 2-19: The highest flood recorded during this time occurred in January 1993. The lake crested on Jan. 7, 1993 at 9.78 feet with a stream crest of 7.59 on the same day. Some irregular gage readings occurred a few days later, likely ice related, causing the spikes.

Note that the while there are several events with crests above 8.5 feet during this period they are still below Base Flood Elevation, BFE. Also, note the higher crests tend to occur as a series over a period of time as do the lower events.

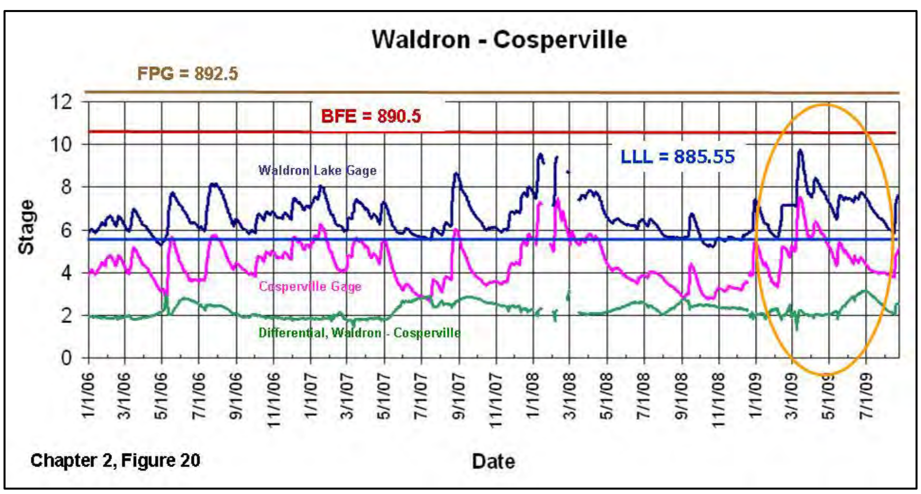


Figure 2-20: Note the sharp increase in flood levels associated with the March 2009 event did not generate an increase in differential levels between the two gages. However, the much more subtle increase in lake level seen in late May through late August did generate an increasing differential. That differential decreased as rain stopped and the flow gradually decreased. That period ended with a rain event on Aug. 17 and a sharp increase in levels for both gages.

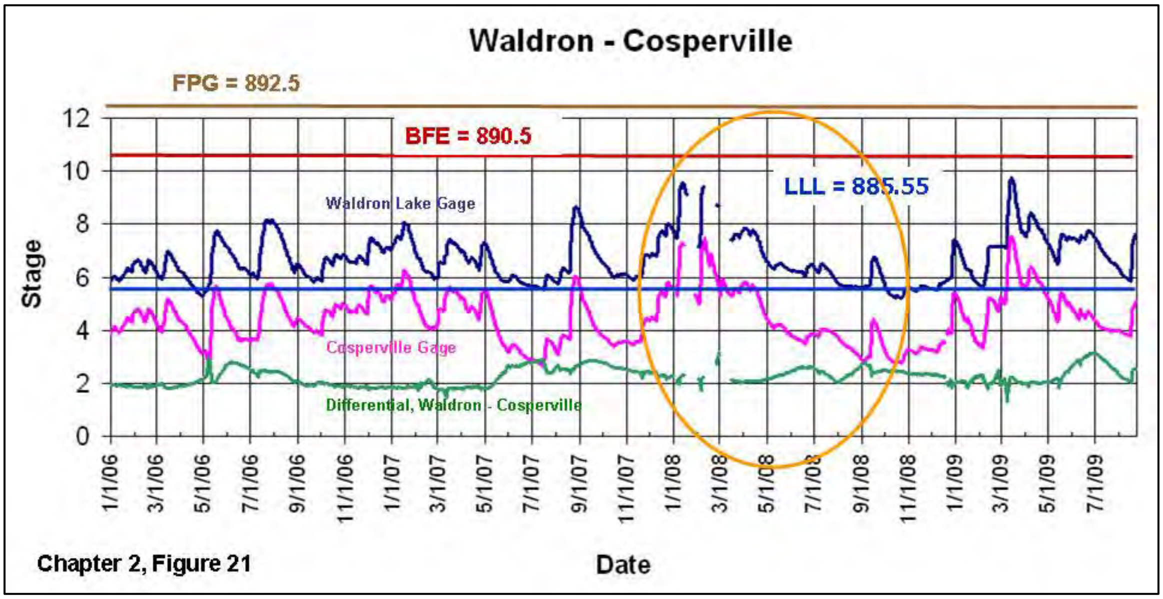
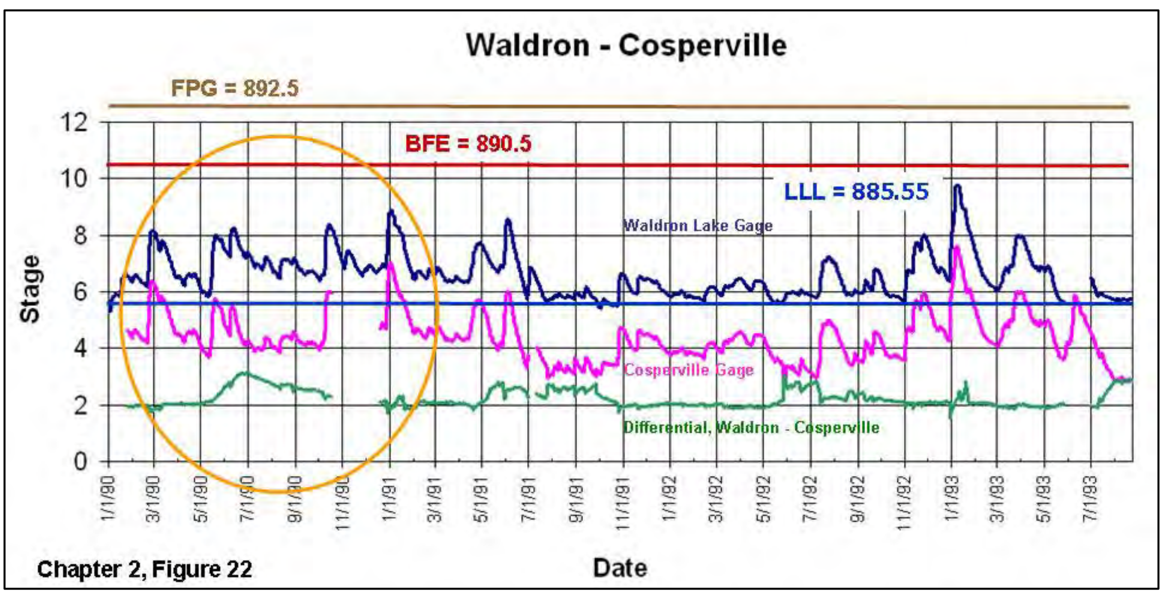


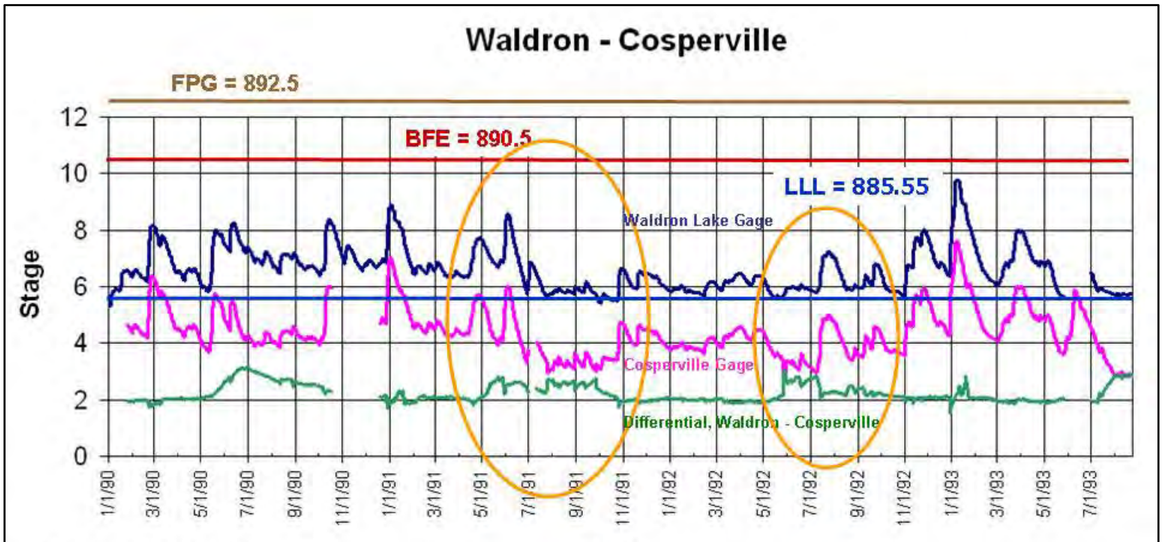
Figure 2-21: Note the sharp increase in flood levels associated with the January and February 2008 events did not generate an increase in differential levels between the two gages. Ice did cause some problems with the gages with some lost data during the flood events, but the crest for both events appears to have been captured on both gages.

A very subtle increase in lake level seen in late May through late July did generate an increased differential between the two gages of approximately 0.5 feet. In late July, the lake reached the control elevation (LLL) at 885.55 and the differential went to the normal of 2 feet then increased as the stream flow continued to decrease relative to lake level. A low flow increased differential of approximately 0.5 feet occurred just prior to a



significant rain event in early September; note the differential actually decreased slightly with the increased levels.

Figure 2-22: 1990 started with a high lake level event occurring in late February. That event appears to have drained by April with a relatively consistent gage differential of 2 feet. In early May, the water level in the lake was just above the established level. A second high water event occurred with an initial gage differential at 2 feet that increased during the month of June and July. Stream flow gradually returned to a normal level with lake level decreasing much more gradually. This may be an effect produced by the growth of aquatic plants in the transitional area of the outlet stream. The period ends in late October with another high level event where the gage differential appears to remain near 2 feet, not increasing, likely due to the end of the growth cycle for the plants. A high lake level event in January 1991 does not produce an increase in differential level, similar to the event in February 1990. Even though levels remain relatively high, the differential remains relatively constant at 2 feet until May 1991.



Chapter 2, Figure 23

Figure 2-23: Late April 1991 started with stream flow and lake level both up slightly, with a differential of approximately 2 feet. In May 1991, as the lake and stream receded, the differential level between the two actually increased. This increasing could be due to the growth of the aquatic vegetation in the transitional section of the stream. A sudden increase in lake level and stream flow occurred with a sudden, but brief, decrease in the differential (the stream flow increase was more than the lake level increase). This effect was short lived, possibly because the aquatic vegetation was only briefly displaced by the sudden increase in velocity through the transitional stream segment. By late July, the lake levels had returned to near normal and stream flow had decreased considerably. As the lake level approached the level of the top of the outlet works, the lake level stopped decreasing; however, the stream flow continued to decrease, likely producing a differential associated with the outlet works, rather than that caused by aquatic vegetation. When flow returned in the fall of 1991, the differential remained constant due to the lack of vegetation during a relatively dry late summer.

The winter of 1992 did not produce high water levels, but flow was maintained in the system sufficient to hold a standard differential between the lake stage and the stream stage at Cosperville. In May, a trend of decreasing stream flow, likely associated with the start of the growing season and the associated increase in evapotranspiration, caused the stream flow to decrease as the lake level became controlled by the outlet works. A precipitation event in July caused a sudden increase in lake level and a return to the standard differential, likely due to the absence of aquatic vegetation as associated with the dry channel conditions.

Finding:

Evidence suggests that aquatic vegetation in the downstream transitional area can and does interact with lake level under specific flow conditions. These conditions exist when lake level and associated stream flow are maintained approximately one-half foot or more above normal, during the months of May and June. The aquatic vegetation in the transition area may slow the outflow and prolong or attenuate the somewhat higher lake level conditions for weeks after the stream flow has returned to normal.

Chapter 2, Section 7: Possible Future Trends:

In 2009, the U.S. Geological Survey (USGS) compiled a report to address some aspects related to water resource planning for potential changes associated with climate change. The document provides some direction for consideration by professionals when making decisions concerning water resource management. Selected quotes from the document are included in this document. The full USGS document is available online for additional information.

"Key Point 1: The best available scientific evidence based on observations from long-term monitoring networks indicates that climate change is occurring, although the effects differ regionally.

"Key Point 2: Climate change could affect all sectors of water resources management, since it may require changed design and operational assumptions about resource supplies, system demands or performance requirements, and operational constraints. The assumption of temporal stationarity in hydroclimatic variables should be evaluated along with all other assumptions."

"As noted earlier, population growth in semiarid regions of the country has increased the demand for limited water supplies and has heightened vulnerability to drought. More population in flood plains and coastal areas has increased flood risk and has increased public demand for flood-risk-reduction measures. Land-use planning and zoning regulations can be used by State and local governments to limit development in vulnerable regions. The Federal Government can influence flood-plain requirements

through the National Flood Insurance Program, but it generally has limited authority over land-use planning decisions."

"Stationarity is the idea that while climate may exhibit variability, the underlying statistics that describe the climate (such as its mean and variance) do not change over time. Rather, these characteristics are stationary. This leads to an assumption that the past represents a reasonable proxy for the future. Water resource managers have traditionally relied on this assumption by using historical records of streamflow and weather variation to design and operate water resource systems. However, the assumption of stationarity is challenged by climate change, as well as by other changes to hydrologic systems, such as alterations of land use."

The basic challenge confronting water resource management professionals is having to rely on past data to quantify the resource. That data may not always be complete and is only available for a relatively short time period and for specific sites. If the period of data collection is not representative of the future resource, the decisions dependent on the data will not be as accurate as needed to provide for proper risk management associated with the resource. If the conditions driving the water resource change, the data used for planning become less relevant to the actual conditions. Therefore, some allowance for future variability and for deficient past data must be considered when critical water resource management decisions are under consideration for either water supply or flood loss reduction.

Circular 1331, USGS, 2009
Brekke, L.D., Kiang, J.E., Olsen, J.R., Pulwarty, R.S., Raff, D.A., Turnipseed, D.P., Webb, R.S., and White, K.D., 2009, Climate change and water resources management—A federal perspective: U.S. Geological Survey Circular 1331, 65 p. (Also available online at http://pubs.usgs.gov/circ/1331/.)

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Chapter 2: Key Points

1. The topography of the watershed for the NBR Elkhart River contains upland areas with a rugged land surface containing isolated mounds and depressions with internal drainage (hummocky topography), relatively level till plains, numerous natural lakes, with broad wetlands, isolated wetlands, braded outwash channels, and outwash fans.
2. The NBR Elkhart River system, as it presently exists, is functioning to provide improved peak flow reduction and abundant low flow for the river.
3. The numerous kettle lakes and wetlands that dot the landscape produce a substantial flood-attenuation effect.
4. The natural system does not seem to be impeding flood flow for larger floods. Flow and associated flood heights appear to be increasing in some areas, possibly as a result of loss of upland storage and 'improved drainage'.
5. The most critical section of the stream for discharge from the West Lakes system appears to lie in a 3,600-foot reach of stream situated about half way between the Cosperville Bridge and the Waldron Lake outlet structure, as seen in Figure 2-2, in an area this report refers to as the transitional area.

6. Changes in precipitation patterns appear to be a primary driver in seasonal flood patterns for the drainage basin.
7. Seasonal timing of precipitation may be as critical to stream flow and flood crests as total precipitation due to seasonal variability in ground water recharge and evapotranspiration from the numerous lakes, wetlands, and forests.
8. Some changes in the transitional area have been noted both seasonally and over the past few years, and could possibly increase lake stages for the more frequent and moderate flood events.
9. Aquatic vegetation in the transitional area appears to interact with the upstream lake level under specific flow conditions. These conditions exist when lake level and associated stream flow are maintained approximately one-half foot or more above normal, during the months of May and June. The aquatic vegetation in the transition area may slow the outflow and prolong or attenuate the somewhat higher lake level conditions for weeks after the stream flow has returned to normal.
10. Increasing precipitation, increased concentration of runoff in the watershed, and localized development in the stream valley have all combined to force changes in the stream channel.
11. Precipitation data for long term comparison, while limited, does indicate an increasing overall trend, especially over the past 30 to 35 years.
12. However, even within the increasing trend, dry periods do occur. The recent precipitation patterns are not out of the normal range considering the overall trend.
13. Prudent planning should consider planning for increased precipitation in the coming years.
14. Increased upland retention and decreased sediment loads will decrease stresses on the system.
15. Alternatively, significant increases in flow, resulting from uncontrolled development or stream alterations, could be detrimental to the overall condition of the stream, creating conditions that are much more difficult to mitigate.
16. Proper watershed and floodplain management are essential to maintain and restore the natural function of this watershed and stream.
17. Protection of the existing storage should be a top priority for protection of the environment associated with the natural lakes and the associated streams.

INDIANA SILVER JACKETS
NORTH BRANCH ELKHART RIVER
WEST LAKES TASK TEAM

CHAPTER 3 - NATURAL RESOURCES OF THE NORTH BRANCH, ELKHART RIVER

The watershed of the North Branch Elkhart River (NBR Elkhart River) lies entirely within the "Northern Lakes Natural Region" of Indiana. (Homoya et. al.). This natural region is a large section of landscape that shares a cohesive combination of natural features, including its physiography, soil types, vegetation, and flora and fauna.

Originally, prior to settlement, this large watershed was comprised of upland forests (oak-hickory on the gravelly kames and eskers, beech-maple on the more loamy soils), floodplain forests along the rivers, swamp forests on the mucky and peaty soils along the rivers and around lakes, prairies and savannas, and numerous types of wetlands, including bogs, fens, and marshes.

Numerous lakes, usually surrounded by large marshes and swamp forests, were common. The NBR Elkhart River and its tributaries were lined with margins of floodplain forests and marshes, and teemed with fish. In fact, the whole region teemed with wildlife. (An excellent description of this region, including what remains today, can be found in the Chapter "Half land-half water" in the book titled: <u>The Natural Heritage of Indiana</u>).

Settlement of this region, and the entire state, occurred rapidly. Forests were cleared, and today, no old growth forests remain, only scattered woodlots. The prairies and savannas were cleared and plowed, converted to agriculture. In addition, a large majority of the wetlands were drained and converted to agriculture. Many lakes are much smaller than their original size, and many of them are ringed with houses.

In contrast with much of the rest of Indiana, much of what makes this part of Indiana unique remains. The extensive muck soils and the glacially carved landscape have enabled the essence of this region to survive, especially its lakes, wetlands, and rivers.

Today, swamps, forested fens, and floodplain forests still border some of the lakes; fairly extensive marshes still occupy peat and muck soils in large swaths around some of the rivers and lakes; seeps still bloom in profusions of marsh marigolds and skunk cabbage; and several richly diverse bogs and fens remain intact. Some of Indiana's rarest wildlife that are characteristic to this region remain, including the four-toed salamander, spotted turtle, Blanding's turtle, Massasauga rattlesnake, star-nosed mole, and swamp sparrow. Numerous rare plants can still be found, tucked away in the most natural and least disturbed habitats. Some of these include red baneberry, slender cotton grass, wild calla, bog rosemary, spoon-leaved sundew, and shining ladies' tresses.

Strengths and Challenges of the Natural System

Wetlands are an extremely important link in the hydrologic cycle. Wetlands and lakes abound, and many of the streams and rivers have forested corridors and grass buffers. They store vast amounts of water, filter water, acting like a large kidney, and can help minimize flooding.

Fully forested stream and river corridors provide stable river banks and habitat for wildlife. The stable root systems help hold the banks during flooding events. These natural systems also act as reservoirs of biological diversity, providing food, cover, and habitat for numerous species of wildlife.

Vegetated stream corridors and wetlands provide many benefits. Altering these natural features can adversely impact the system. For example, in the area described in Chapter 2 as the stream/lake transition area, it appears the lack of stream corridor vegetation to provide a filter and shade, may be contributing to adverse impacts to the water quality and providing an environment for excessive aquatic vegetation in the stream. This is likely due to excessive nutrients in the stream, along with an open canopy allowing light to reach the stream. This dense transition area vegetation may slow water flow, increase deposition of sediment, and alter channel characteristics.

While it may be tempting to only remove the vegetation in the transition area to resolve the issue of slowed stream flow, the excessive vegetative growth is actually, in part, a natural response to the ongoing excess nutrient load. The vegetation is actually improving the water quality.

In fact, natural aquatic vegetation provides excellent habitat for fish and other aquatic organisms and is important for stream ecology. Removal of the transition-area vegetation without first addressing the ongoing nutrient inputs could be damaging to downstream water quality, and would not be cost effective, because the vegetation will continue to return until the excess nutrient source is remedied. This area may be a location to consider water quality stream monitoring to help identify the source of the nutrients.

In addition, generally speaking, removing the forests and wetland vegetation has enabled much quicker runoff and has allowed large quantities of sediments to get into the rivers, lakes, and wetlands. Over the last 200 years, nationally, the majority of the forests have been removed from the landscape (see Figure 3-1, next page). The forests have been converted into crop and pasture lands. Many wetlands have been ditched, drained, or filled throughout the watershed. Streams have been straightened and channelized. The low-lying floodplain areas, which are natural flood storage, have been developed into residential areas with summer cottages and year-around homes.

The cottages along the lakes and area communities provide a considerable ongoing source of nutrients into the waterways. These nutrients feed the algal blooms and excessive vegetative growth within the lakes and streams. In addition, the removal of the forested canopies along streams allows the vegetation in the streams to take advantage of the sunlight and explode into unnaturally dense mats of vegetation which can obstruct flow. Again, water quality stream monitoring can help identify the areas where nutrient loading is a problem.

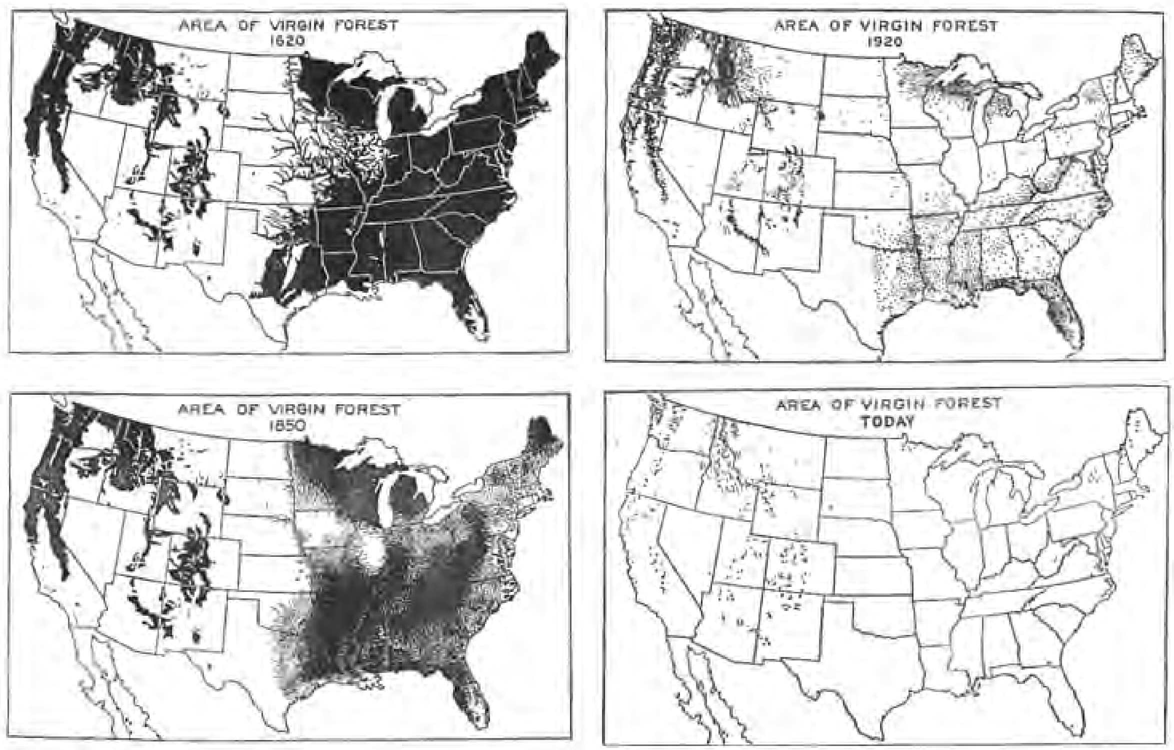

Figure 3-1, virgin forest areas of the United States over time.

When rain falls on a forested watershed or on a natural wetland, the moisture has a tendency to soak into the soil instead of run off the land. Removal of forested areas results in an increase in the amount of runoff seen after a rain event. Because the runoff is not soaking into the soil, it washes off the soil and takes with it sediment, nutrients, and pesticides. If this runoff drains into a wetland, the wetland can help slow the discharge of water, take up nutrients and pesticides, and filter sediment. The level of filtering effectiveness is dependant upon the size and the quality of the wetland. As stated earlier, many wetlands have been ditched and drained. A ditched and drained wetland cannot effectively provide flood storage and will not remove nutrients and pesticides, and will filter very little sediment from runoff.

For example, in this watershed, 200 years ago, when a large rain event occurred, the rain fell on forests, wetlands, and prairie. Due to the natural land cover, much of the water would soak into the ground or be absorbed by natural areas. What water was discharged into the streams was flowing slowly through wetlands and through small upper watershed streams into meandering streams with very low gradients. The water that did not infiltrate into the ground would be released slowly into the larger rivers over a relatively long period of time. The water quality of the stream would change very little, and there would be a minimal increase in the level of the river.

Under altered conditions, in many cases, rain falls on farmland, parking lots, rooftops or roadways that do not absorb rainfall as fast as natural areas. The water runs off, carrying sediment, nutrients, and pesticides. Water quality decreases rapidly, turbidity sharply increases due to sediment, and the river level may rise more quickly.

Each added acre of impermeable surface (parking lots, rooftops, roads) within the watershed increases the rate of water discharged into the stream or lake. Each field tile, drainage ditch, storm drain, or other artificial conveyance of water which bypasses the natural cycle, removes the natural filtering and buffering of the wetlands. This alteration results in dramatic increases of pollutants, an increase in the rate of discharge of water into the system, and an increase in the erosion that occurs.

In many cases in the watershed, water flows directly into a drain tile, which flows directly into a ditch in an area that used to be a wetland. That ditch then flows to a channelized stream which provides a direct route to the main river channel. Channelization of streams (removing the meanders) reduces stream length, causes higher water velocity, and increases the gradient of the stream. Channelization causes increased bank erosion within the system, because the new, shorter stream must handle the same amount of water within a shorter distance and at a steeper gradient. In this scenario, the rainfall picks up pollutants and flows directly into the river fairly quickly. Fish kills occasionally occur after rain events due to rapid increases of sediment, organic matter, and other pollutants into the stream, which can quickly reduce dissolved oxygen levels to lethal levels.

Current Conditions

Water Quality

The Indiana Department of Environmental Management (IDEM), Office of Water Quality, develops Indiana's 303(d) List of Impaired Waters every two years as part of the State's Integrated Water Monitoring and Assessment Report that is submitted to the U.S. EPA in accordance the Clean Water Act. This list shows several water quality issues within this watershed. The NBR Elkhart River and its tributaries are listed as impaired due to E.Coli inputs. Adams Lake, Oliver Lake and Olin Lake are listed due to contaminants such as mercury and PCBs. Messic Lake, Hackenburg Lake, Dallas Lake, and Witmer Lake are all listed as impaired. Decreases in water quality will result in the loss of sensitive species first and result in a community comprised of tolerant species. One of the sensitive fish species in northern Indiana is the cisco *(Coregonus artedi).*

Cisco were once common in several lakes within the watershed. Since the early 1900s, cisco have been on the decline in Indiana. In 1955, cisco were found in Atwood, Hackenburg, Messic, Olin, Oliver and Witmer lakes. Cisco need clean, clear, cold, oxygen-rich water to survive. Ongoing development within the watershed, combined with urban and agricultural runoff, has reduced the water quality to the point where cisco can no longer survive. Cisco currently are considered extirpated (no longer present) from all of these lakes.

Fisheries

Fish community sampling data from IDEM's Surface Water Quality Assessment Program show there is still relatively high quality habitat remaining in the lower stretch of the NBR Elkhart River. No detailed fish community studies were available for the upper watershed. IDEM studied a site on the NBR Elkhart River at County Road 450 West in Noble County. This section yielded a Qualitative Habitat Evaluation Index (QHEI) score of 81 out of a maximum of 100. A QHEI score greater than 75 is considered excellent. The high score is indicative of the lack of channelization in this portion of the river and the relatively intact riparian forest at this location.

An IBI (Index of Biotic Integrity) was also calculated for the site based upon the fish species collected. The site scored an IBI of 46 out of 60, indicating a good/fair rating. Sampling resulted in 22 species of fish of which six species were classified as sensitive species. While many of the streams in the watershed have been severely impacted, there are still some very high quality areas left.

Wetlands

The watershed of the NBR Elkhart River still has some large areas of wetlands. These are but a small percentage of the original expanses of wetlands. As mentioned earlier, wetlands serve extremely important functions in filtering nutrients and other pollutants and provide storage for flood waters. Wetlands are also important areas of wildlife habitat and several area wetlands have received long-term protection from development. There also are large expanses of wetlands found within the lakes. Department of Natural Resources (DNR)

Fisheries staff has been mapping wetland areas in some area lakes. These wetlands provide fish habitat, along with spawning and foraging areas for reptiles and amphibians, as well as fish. In-lake wetlands also absorb wave energy and help reduce shoreline erosion. By 1980, Indiana had lost 85 percent of its wetlands.

Figure 2. States with notable wetland loss, 1780's to mid-1980's. *(Source. Modified from Dahl, 1990.)*

Conservation of the Natural Heritage in the Watershed

Fortunately for the citizens of today and tomorrow, significant steps have been taken to protect many significant areas. A number of lands have been permanently set aside for conservation. These include lands owned by DNR (Rome City Wetland Conservation Area and Olin Lake Nature Preserve), The Nature Conservancy (Swamp Angel Nature Preserve), and the ACRES Land Trust (Hammer Wetlands Nature Preserve, and Marsh Wren Nature Preserve). Collectively, these lands contain many of the "pieces" of the original landscape of the NBR Elkhart River watershed, including a number of rare plant and animal species. They provide areas for nature study and numerous forms of recreation. They also help protect the water quality, provide for a high quality fishery, and help minimize flooding. (See Figure 3-3, next page)

Future Opportunities

Because a good amount of the watershed, especially around the lakes and along the rivers, remains in a natural condition, conservation opportunities abound. Protection of more of the remaining natural areas, especially wetlands, would enhance the quality of life for those who live here, in numerous ways. More of the natural heritage (plants and animals) would be available to enjoy, improving hunting, fishing, canoeing, birding, and nature study opportunities. Protecting more of the wetlands could also help minimize damages caused by flooding and nutrient over-loading.

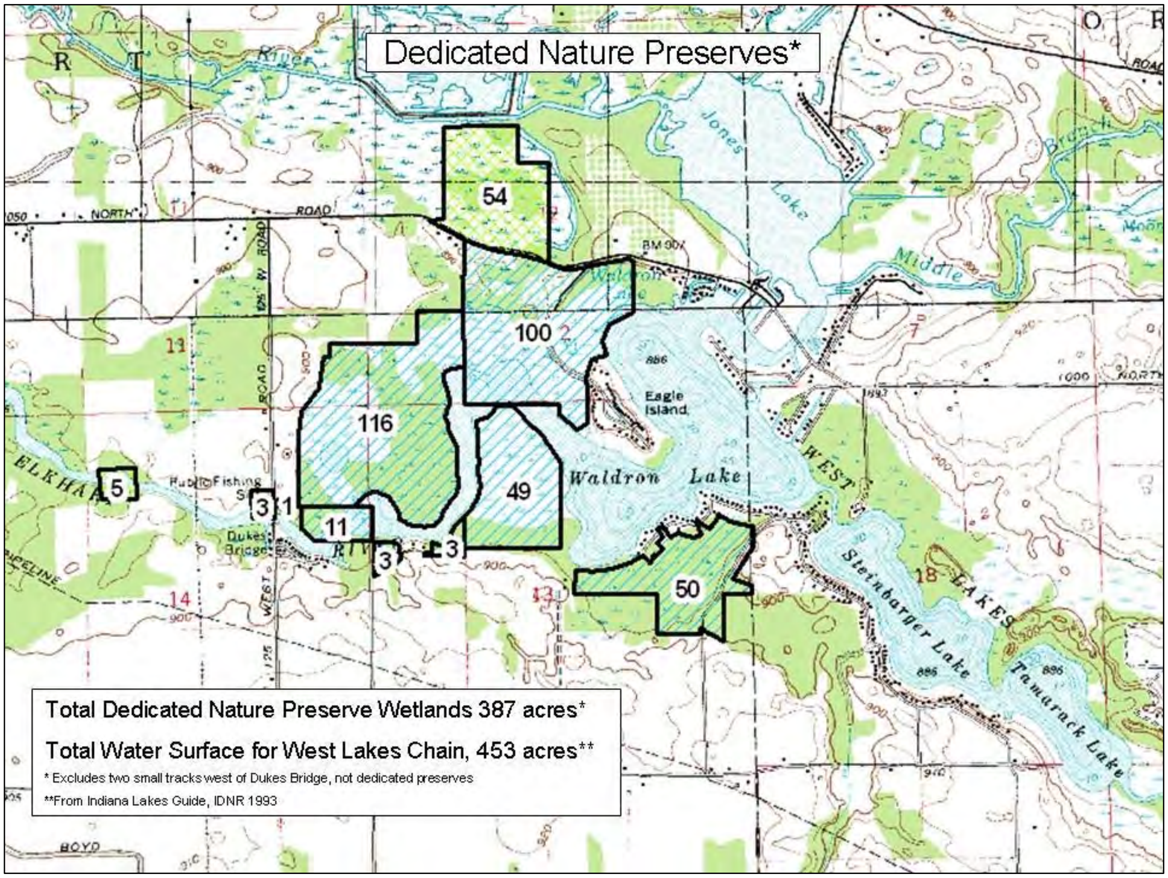

Figure 3-3

Public-private partnerships have been a big part of the success in protection of conservation lands to-date. The ACRES Land Trust and The Nature Conservancy have both been involved actively for more than 50 years. The Indiana Heritage Trust, which is funded by Indiana's environmental license plate, encourages partnerships, and matches funds raised by local land trusts. Lands acquired under this program can be dedicated as state nature preserves, ensuring the lands will be protected for future generations.

Use of more conservation practices in the most critical areas, such as along ditches and streams, would further enhance these benefits. As noted in the 2008 updated Noble County Comprehensive Plan, for instance, riparian corridors (and water quality) can be protected by using Best Management Practices, and sensitivity to natural features during development can help the rarest species to continue to survive.

Conservation programs, many of which are funded in partnership with the U.S. Department of Agriculture's Natural Resource Conservation Service, provide funds enabling landowners to install conservation practices, such as buffer strips that help minimize siltation and enhance flood storage.

The Lake and River Enhancement Program (LARE) administered by the DNR Division of Fish and Wildlife, provides technical assistance and financial assistance for projects that enhance aquatic habitat for fish and wildlife. Funding may be used for such things as identifying problems affecting lakes or streams, evaluation of identified problems, developing management plans, feasibility studies, engineering designs, and construction and water quality monitoring.

Restoring forest through planting trees improves wildlife habitat and reduces runoff. Tree seedlings are also available through the state nursery program. More information on some of the available funding opportunities is detailed in Chapter 7.

By implementing the plans that are in place (Noble County Conservation Plan, Elkhart Watershed Plan), by utilizing information from DNR biologists and soil scientists, by partnering with Land Trusts, Heritage Trust, and DNR, and by targeting both development and protection, more of the significant features in the watershed will be available for the enjoyment of the citizens, and more of the damages caused by flooding and siltation can be minimized and avoided.

Traps to Avoid

> *"The problem of flood prevention is a part of a larger problem which we have considered either in a fragmentary way or not at all. This larger problem is the development of the waters of our state as a natural resource. To regard a river as a menace because its higher stages, under present conditions, are destructive; or to consider a lake to be a waste area because it can not be plowed, indicates a very limited insight or selfish motives."*

This quote is from a paper presented at the 1914 Indiana Academy of Science by Will Scott titled "The Relation of Lakes to Floods, with Special Reference to Certain Lakes and Streams of Indiana."

One thing Scott's quote tells us is that flooding is not a new or special event. The classic trap to avoid is being convinced to spend all your efforts and resources addressing the symptoms, which will reoccur, while ignoring the cause or actual problem. Repeatedly treating symptoms through actions such as dredging of rivers, straightening or widening rivers, removal of all woody debris, removal of forested riparian canopies, or altering lake levels will not permanently fix any problem. In addition, repeatedly treating symptoms may continue to degrade the remaining natural flood reduction systems, natural resources, degrade water quality, destroy habitat and damage fish communities without offering a real solution. Stream monitoring and comprehensive watershed planning can help identify areas of concern and help focus resources on the source(s) of problems, and help develop a plan for long-term success.

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CHAPTER 4 – Lake Level Establishment, Structures and Data

This chapter provides information on lakes in the North Branch Elkhart River (NBR Elkhart River) watershed/drainage basin related to the establishment of legal lake levels, lake level control structures, Sylvan Lake Dam, and historic data related to lake levels and flooding events.

Lake Level Establishment

Several lakes or lake systems in the watershed of the NBR Elkhart River have court-established lake levels. These levels were established by the county courts following a process provided by State law. The establishment process provides for determination of the “average normal level” through a petition process to the county court.

The process included a report from the Department of Conservation (now Department of Natural Resources) providing data for the establishment. The data included recording daily lake level, typically over a 10-year period, considering testimony from local interests along with other data and testimony needed for the determination of the average normal level. The levels generally are established to protect the lake from being artificially lowered by development activities, such as outlet channel ditching and excavation, and to provide a guidance elevation for the construction of channel grade control works (often known as lake level control structures, outlet works, or in-channel dams).

While state laws providing the process for these establishments were enacted in the 1940s, many lake level establishments occurred in the 1960s. The driving mechanism for the establishments appears to be concerns about low lake levels during the summer recreational season. Droughts in the 1940s, 1950s, and especially 1963 (see Precipitation Section of this report) likely increased the local desire for pursuing the process, leading to the establishment of average normal levels by county courts.

The establishment process typically allows for, and sometimes documents, aspects for the construction of outlet works. These structures, often designed and built under the supervision of the State, were built with the intent of decreasing the impacts of low lake water levels in the summer while not restricting flow for the large flood events such as the regulatory flood event, which is the 1 percent annual chance recurrence level (100-year). These grade control works were never designed to reduce lake levels during larger flooding events. Throughout the state, these in-channel structures have many different forms and designs, and many different designs exist in this watershed. They all provide the same typical function. These structures sometime contain gates or boards that can be opened or removed to provide for additional flow over the structure. Some structures in the watershed do have minimal operation potential. None of the lakes in this watershed have a seasonally variable or dual level by court establishment.

Structures

In this watershed, the outlet structures for West Lakes, Indian Lakes, and Oliver Lake all have lake level control structures with boards or stop logs that can be removed to provide for lower than normal weir crest elevations. For these structures, lowering of the weir crest by removal of the stop logs during the non-recreational season typically does not result in a lake level lower than the established normal elevation due to natural conditions associated with the outlet channels.

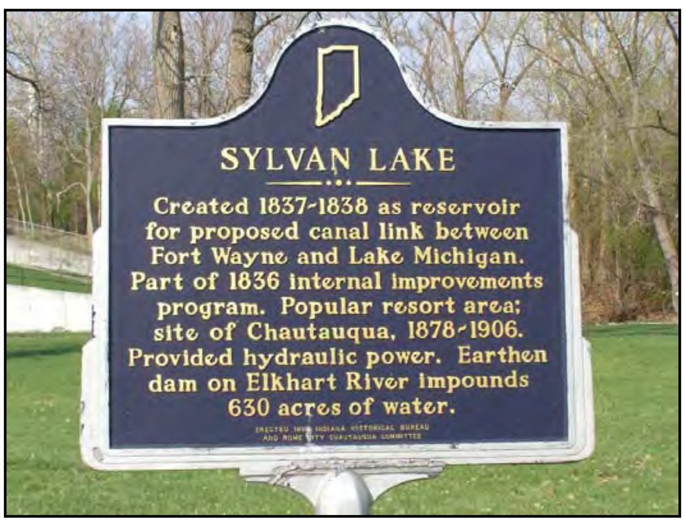
Most high stage flooding occurs during the non-recreational season. Increasing storage within the existing lake systems would require modification to the outlet structures, increasing weir crest elevations, likely construction of embankments, thus impacting lake levels significantly above the court established level, thus requiring modification of the level by the court. The increased flood levels would likely approach the regulatory or 1 percent chance occurrence per year flood level more often. Because of how low so many homes already have been built surrounding the lakes, this concept of increased storage within the existing lakes, would likely be very unpopular for local interests on the lake systems, further complicating court approval of the lake level modification.

The outlet structure for the West Lake Chain (Waldron, Steinbarger, Tamarak, and Jones lakes) is located at the outlet of Waldron Lake, approximately 1,300 feet downstream of Duke's Bridge on County Road 125 West, in Noble County. The structure is approximately 175-feet wide, consisting of steel "H" piles set vertically spaced every five feet with concrete stop logs between the piles. The structure has a concrete base set on a steel sheet piling cutoff wall. Construction of the outlet grade control structure was completed early in 1972 and remains unchanged. The lake level establishment by the Noble County Court provides for operation of the concrete stop logs in the structure (Petition March 1966). The Noble County Court established an average normal level of 885.55 feet (NGVD 1929).

Waldron, West Lakes, Outlet Control Structure,
Summer 2005, Low Flow Conditions, Stop Logs In Place

The outlet structure for the Indian Lakes Chain (Wrestler, Witmer, Dallas, Hackenburg, and Messick lakes) is located in the North Branch of the Elkhart River in the outlet from Messick Lake approximately 2,900 feet west of County Road 75 West in LaGrange County. The structure is much the same design as the structure for West Lake Chain with "H" piles and stop logs for a length of approximately 85 feet. The average normal level established by the LaGrange County Court for Indian Lakes is 897.36 feet (NGVD 1929).

The outlet works for Sylvan Lake are unique for this watershed. Sylvan Lake as is known today was created in the mid 1800s by the construction of a large embankment dam. The largest section of the embankment dam is approximately 2,000 feet in length lying adjacent to and under Indiana 9, just north of Rome City.



The outlet for Sylvan Lake is located in a section of embankment southwest of the largest section of the embankment. The outlet works (Figure 4-1, see next page) can easily be seen from Indiana 9. The outlet works consists of four components, each with a design capacity for discharge. The low fixed weir, where normal flows discharge, has an elevation of 915.97 feet and a width of 30 feet. The upper fixed weir has a crest height of 917.46 feet and a width of 25 feet. Both of these structures are fixed concrete weirs with no operable component.

Together these two structures can pass more than 740 cubic feet per second (cfs) of flow at a lake level elevation of 919.0 feet, or just less than three feet above the normal water level.

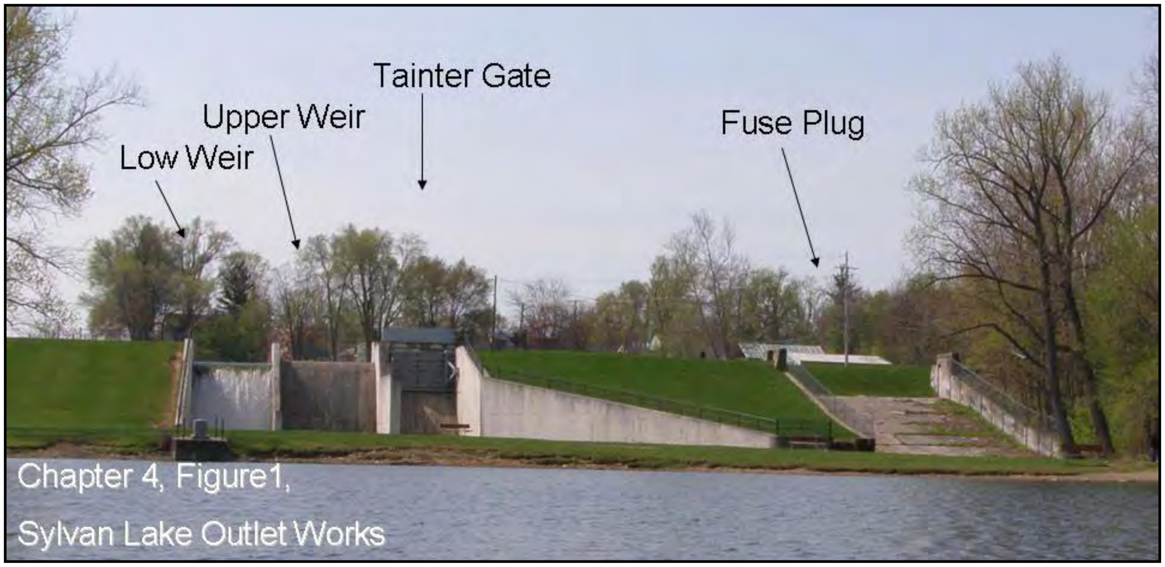


Figure 4-1

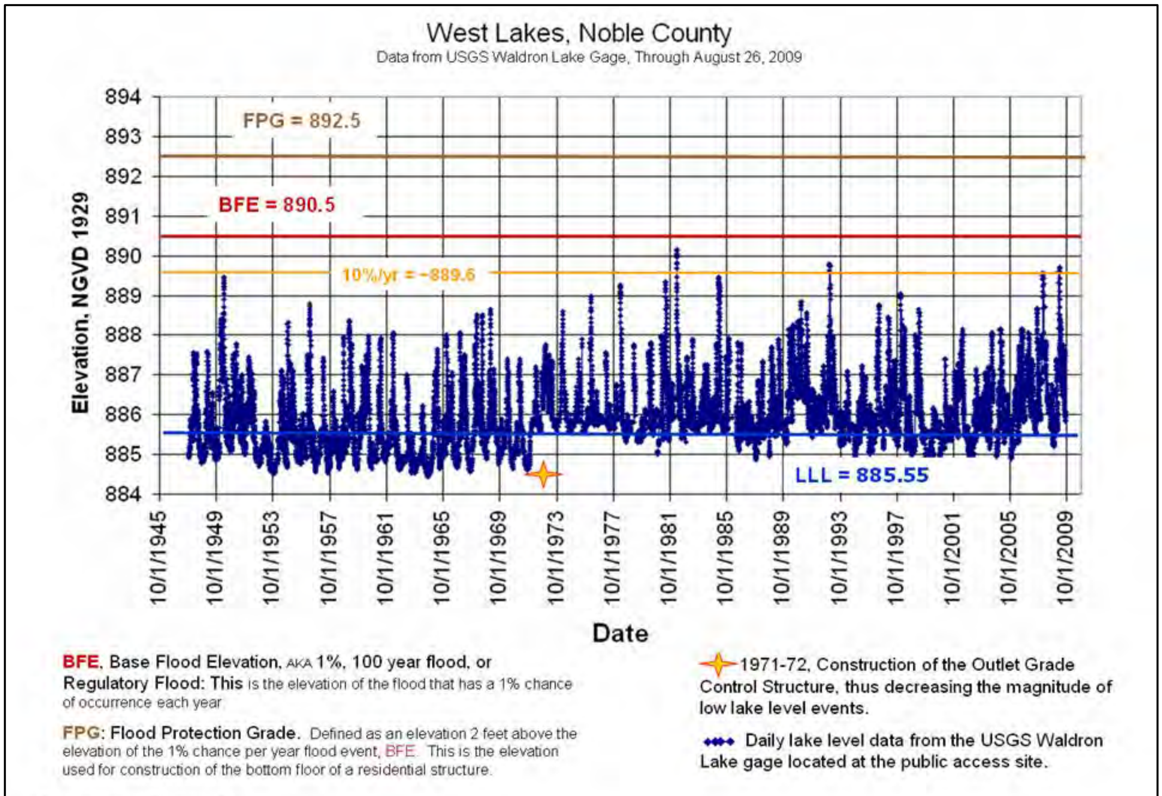
Two additional structures are placed in the dam to prevent overtopping and failure of the embankment during extreme events. The tainter gate can be operated under defined emergency conditions to discharge an additional flow of over 3,000 cfs at just above elevation 919 feet, which can increase to over 6,000 cfs before a fuse plug is activated. Activation of the fuse plug would occur only under extreme emergency lake level conditions. The fuse plug system can discharge much higher flows, but without any control once activated. Conditions leading to operation of the tainter gate and fuse plug are defined in the Emergency Action Plan (EAP) for Sylvan Lake. The discharge curve for this structure can be seen in Appendix E.

The Noble County Court established the average normal level for Sylvan Lake at 916.2 feet (NGVD 1929). The maximum pool of record in the last approximately 60 years occurred in March 2009 at 918.14 feet. The 1 percent chance per year recurrence (100-year) level for Sylvan Lake is 917.55 feet based on the Flood Insurance Study, FIS.

A discussion of each lake level outlet structure found in the watershed is beyond the scope of this report. Additional lakes in the North Branch of the Elkhart River watershed that have court-established average normal levels and outlet control works are: Oliver, Adams, Blackman, Cree, Bixler, and Little Long lakes.

Data

Lake data for West Lakes is available for a long term record through USGS gage records for Waldron Lake. The USGS gage is located at the public access site near Dukes Bridge. Several interesting features can be easily seen in the long term record for this gage, Figure 4-2 (see next page). The most obvious feature is related to the date of construction of the outlet works for the lake system. This construction, in the winter of 1971-1972, created a step in the low stage records upstream of the weir. It also resulted in a change of the average stage.



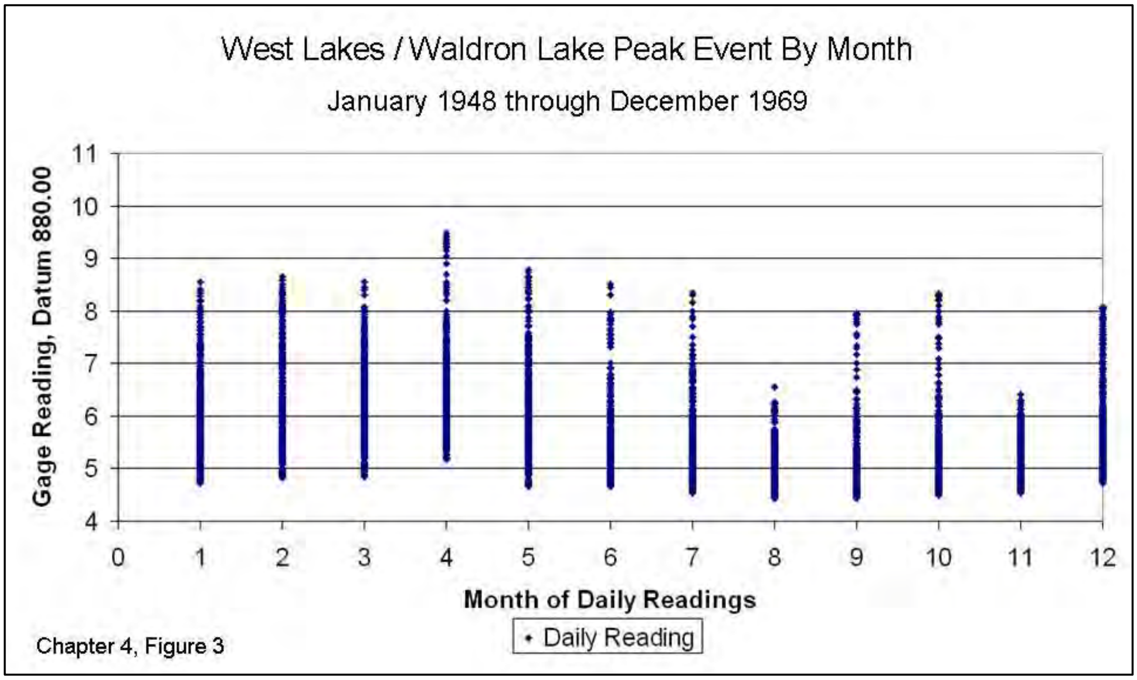
Chapter 4, Figure 2

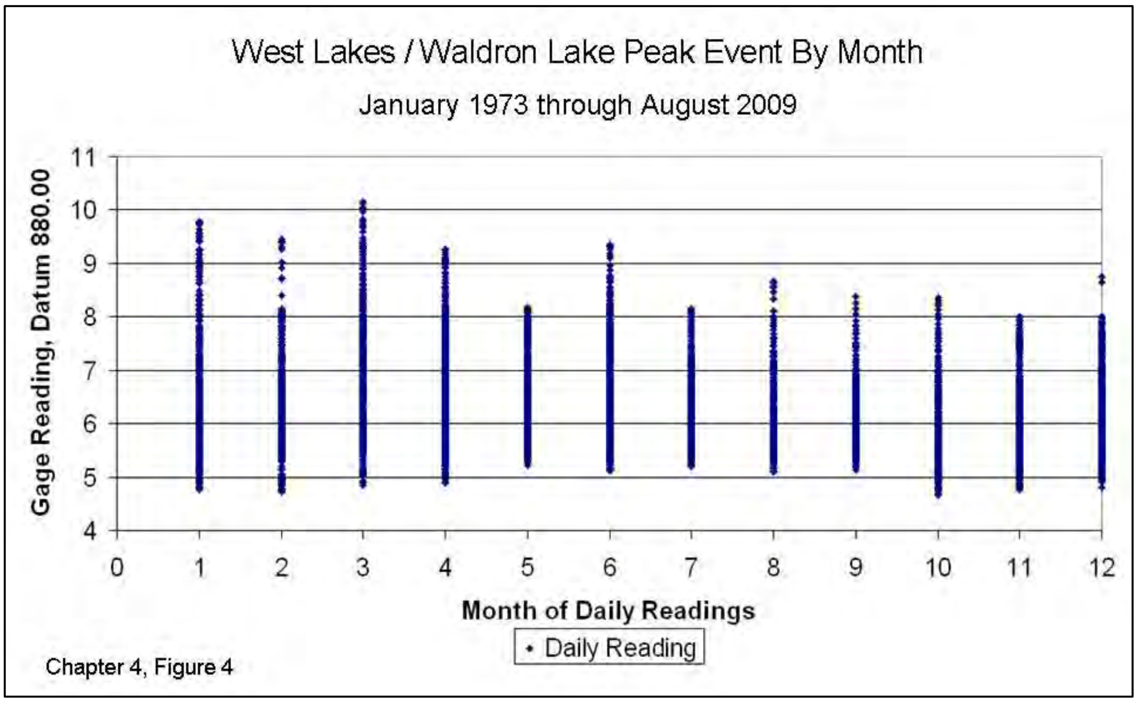
Prior to construction, the county court followed the recorded data to determine the average normal level of 885.55 feet (NGVD1929). As can be seen on the graph in Figure 4-2, this average included the uncontrolled seasonal low levels, including the 1963 drought. It also resulted in a change of the average stage.

Following construction of the outlet works, the seasonal low levels decreased significantly, improving recreational use of the lake. Daily stage records for each month over the period prior to and post construction of the outlet works (Figures 4-3 and 4-4, see next page) show that the high stage events both before and after construction occur during the non recreational season. More significantly, the magnitude of low stage events during the recreational season were reduced following construction of the outlet works (Figure 4-4).

The records also show that prior to construction of the outlet works the average lake level was on a slightly decreasing trend (Figure 4-5, see Page 7 of this chapter). The trend following construction (Figure 4-6), although over 0.6 feet higher, shows neither an increase nor a decrease over the almost 30-year-record when the most recent, above normal years, are included. However, the decreasing trend persisted when the period 2006 through 2009 are excluded from the data set.

During the period 1973 to 2009 several high stage events occurred, including the top four stages in the long term record, with one each in 2008 and 2009. The data presented on the graph (Figure 4-6) show above normal stage periods in the early 1980s, 1991 through

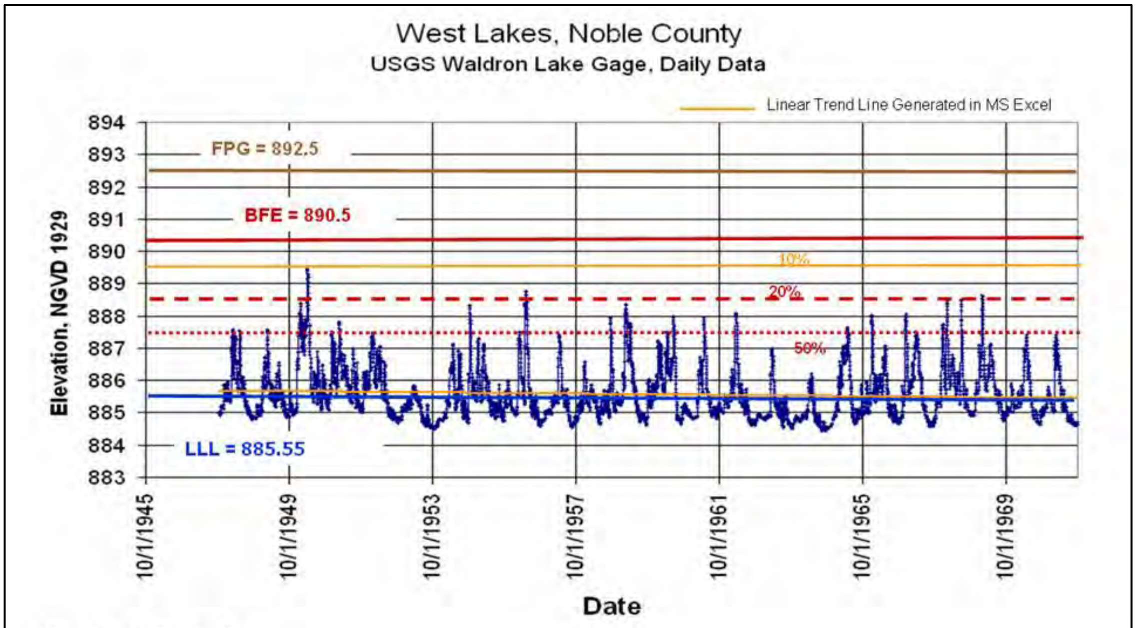




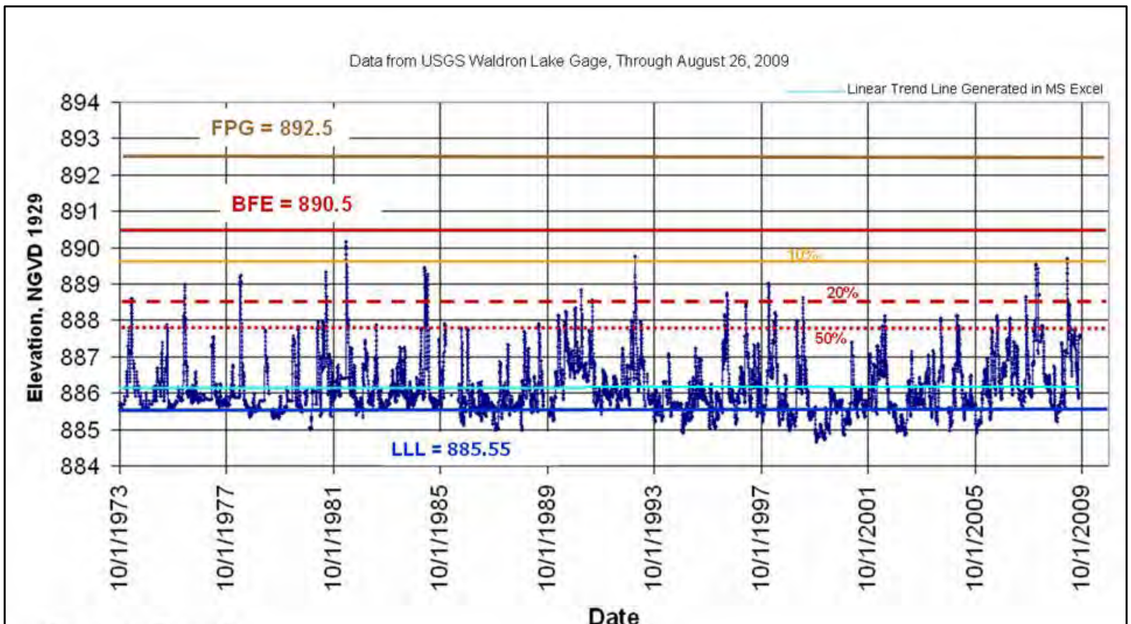
1993, and 2006 through 2009 (present). Precipitation data, in this report, can be used to better understand the recorded stages as compared to the long term precipitation records.

Stage data for Indian Lakes and Sylvan Lake can be found in Figures 4-7 through 4-11. This data can be related to the West Lakes data (Waldron Lake data) showing similar patterns, while unique for each system and event.

Data in Figure 4-7 (see page 8 of this chapter) show the long-term period of lake levels recorded for Sylvan Lake. Several times over the history of the lake, the level has been

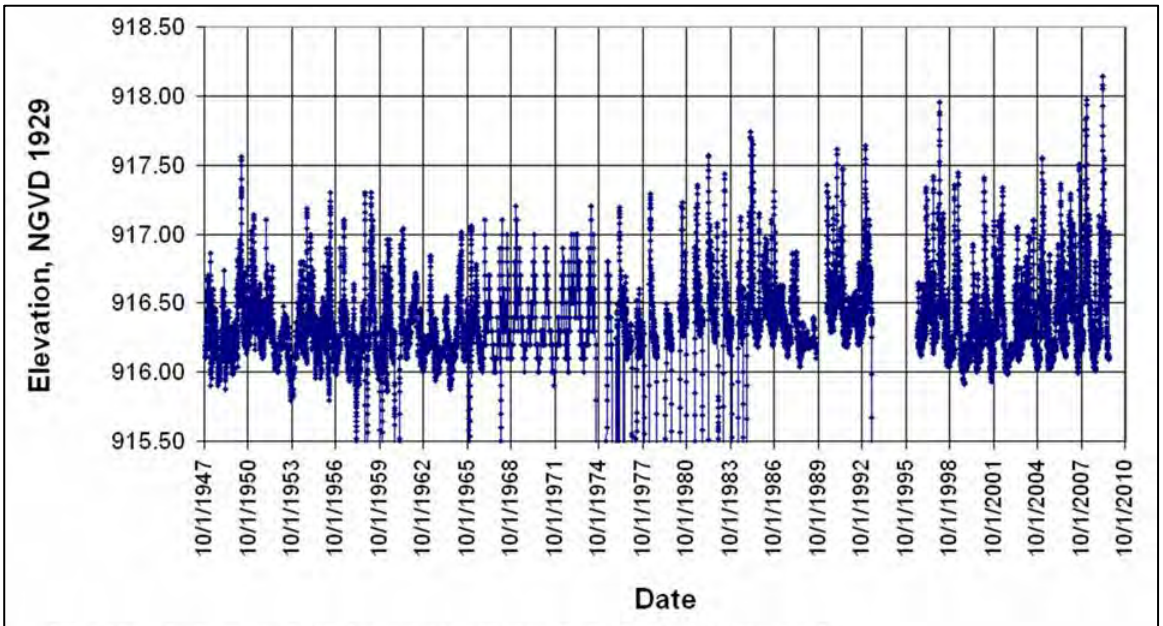


Chapter 4, Figure 5

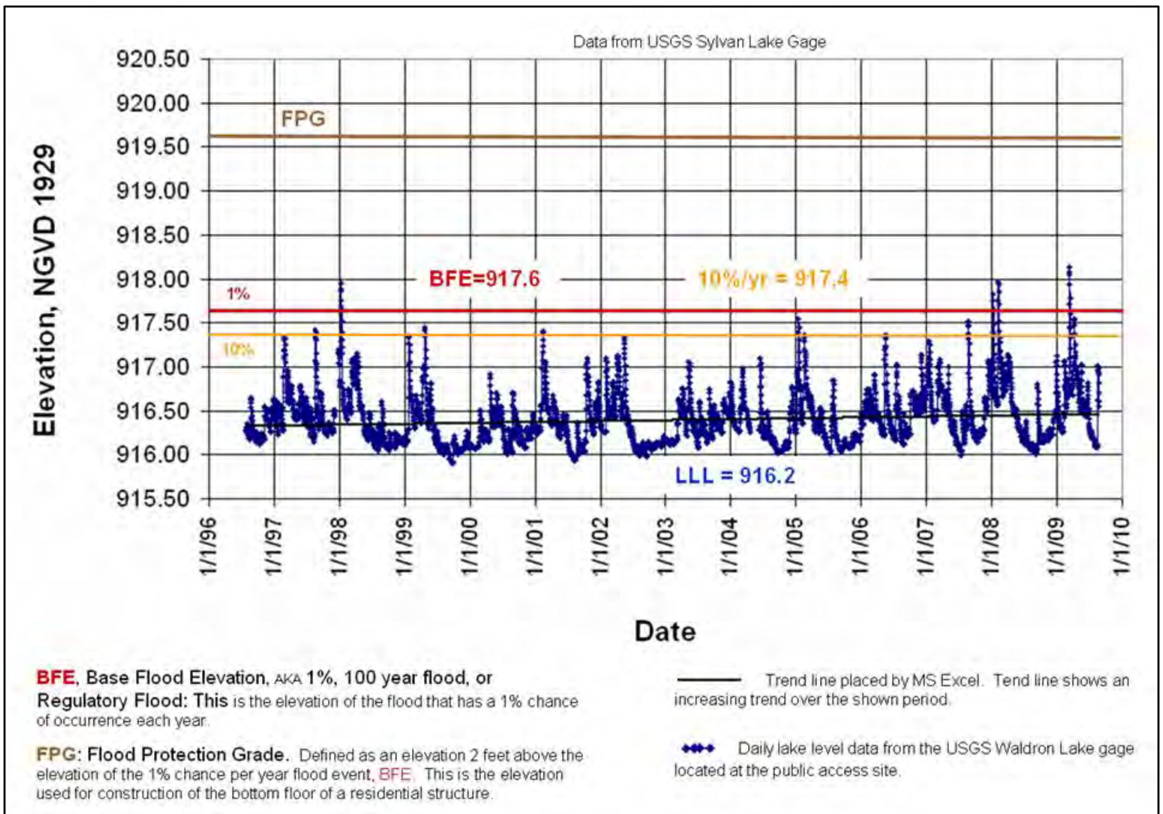


Chapter 4, Figure 6

lowered several feet by operation of boards used as gates for the lake. These operations resulted in the level of the lake dropping below the 915.5 elevation seen on the graph in Figure 4-7. These operations were done gradually. The most recent period of low water level operation, in the early 1980s was targeted to improve the quality of fish in the lake. That operation did not produce the needed results and another operation was conducted to improve the fish quality in 1983. From 1993 through early 1996, the lake was held six feet below normal level while improvements were made to the dam and the existing outlet works were constructed.



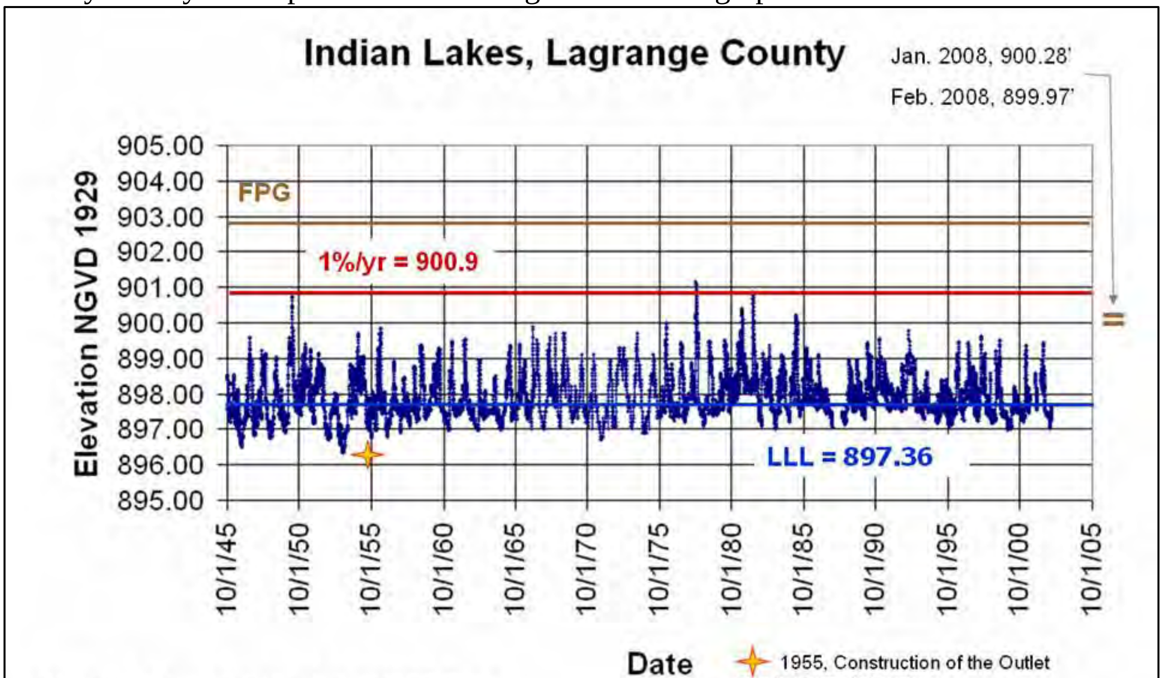
Chapter 4, Figure 7, Sylvan Lake Data, Full Period of Record



Chapter 4, Figure 8, Sylvan Lake Data

The present outlet works have been in operation since the spring of 1996. As described earlier, the only operable section of the present spillway is a large tainter gate. Since going into operation, the tainter gate has been dry tested several times by placing a bulkhead (a large heavy blocking wall section) in the lake upstream of the gate and opening the gate. The tainter gate has not been opened to discharge water from the lake or as a lake level control device. Therefore, the lake level data record is a record of the function of the fixed crest weirs. The outlet works were designed to function much like the previous outlet works under normal conditions, up to the 1 percent chance per year recurrence event. Data for the most recent period of record for Sylvan Lake can be seen in Figure 4-8. The data does indicate an increasing lake level trend over the period.

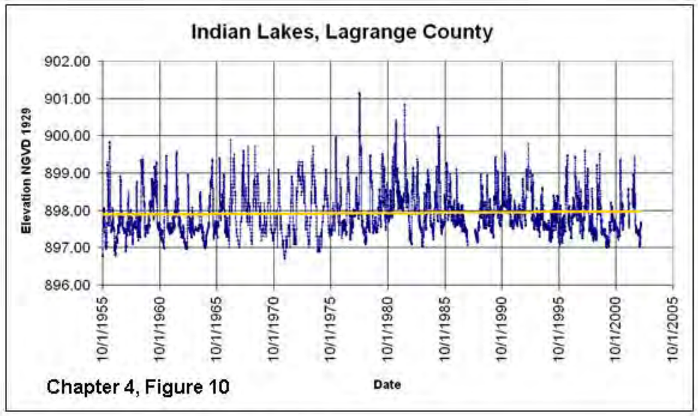
Lake level for the Indian Lakes Chain can be seen in Figure 4-9. Funding for the USGS gage for this system was discontinued in 2002. Therefore the data record is lost for the more recent events, except for the 2008 flood crest data supplied by the LaGrange County Surveyor and presented on the right side of the graph.



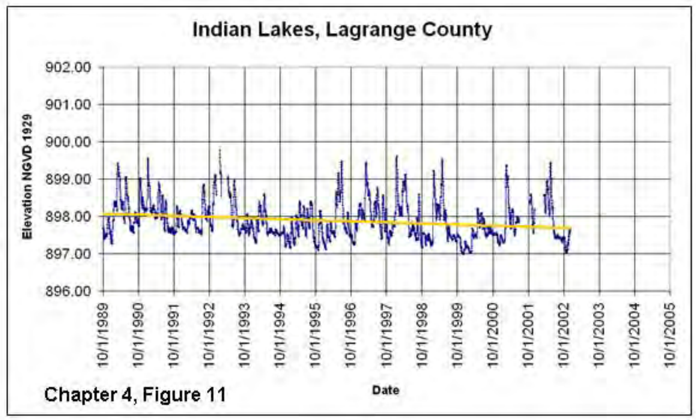
Chapter 4, Figure 9, Indian Lake, USGS Data

Data presented on Figure 4-9 show a relatively stable long term record with some notable features. Visual comparison of a 10-year period either side of 1955 would suggest that variability in lake level does not appear to have changed significantly as a function of the outlet works. A significant high stage occurred in 1950 and in the late 1970s. The early 1980s appears to be a time of higher than normal lake levels as was the case throughout much of northern Indiana due to higher precipitation. The late 1980s provided a contrasting period of low lake levels associated with a dryer than normal period throughout much of Indiana. The overall trend for lake level data is slightly increasing for the period, but more significantly the lake level trends above the average normal level by approximately one half of a foot.

The graph in Figure 4-10 shows the data after construction of the outlet works. This data indicates a very slight increasing trend toward an average level of approximately 897.9 feet. However, the late 1990s were generally a period of low lake levels. The data graphed in Figure 4-11 show the trend following the dry period in the late 1980s through the end of the record in 2002. Data from the other lakes, Sylvan and Waldron, indicate the period from 2006 to present was unusually wet, similar to the early 1980s. It is likely that the decreasing trend seen in the graph would be negated with a full record of the data through 2009.



Chapter 4, Figure 10



Chapter 4, Figure 11

Indian Lakes Chain shares many characteristics with West Lakes Chain. The outlet works and receiving stream conditions are very similar. Like West Lakes, Indian Lakes has also trended high on average for most of the record. The impact of the control structure on the low level periods at Indian Lakes is not as evident as for West Lakes. However, unlike West Lake Chain, both Indian Lakes Chain and Sylvan Lake have experienced high stage events that have met and exceeded the level for 1 percent chance annual occurrence (100-year flood level).

Chapter 4, Key Points

1. Lake level outlet works for public freshwater lakes with court established lake levels function to assist in preventing or decreasing the impacts of low lake levels associated with drought or drought like periods that frequently occur during the peak recreational season.

2. The outlet works typically are designed not to be restrictive and not to add flood storage. They typically are designed not to add additional flood depth on top of the naturally occurring lake flooding levels.

3. If operative boards or gates exist within a typical lake level outlet structure, their operation shortly before a substantial flooding event is unlikely to provide much if any reduction in flood levels. These structures are often already under water from downstream flooding, during larger flood events.

4. Lake levels are a function of a combination of natural factors that have been described in the Physical Settings Chapter of this report. The most obvious, and likely the most variable, natural feature that impacts lake level is precipitation.

5. The lake level data that exists for this watershed is best represented by the data presented in this section. Only partial data exist for some other lakes. However, the data on these three systems does indicate that relative to the 1 percent annual chance flood event (100-year flood) for each system, the West Lakes Chain may be experiencing the least flooding.

6. The data show lake levels at or above flood protection grade have not been recorded on any of these three lake gages over the period of record.

7. As a side note: Additional lake level, stream flow, and precipitation data could be considered for this watershed to be used for future improved flow modeling (Chapter 6). Partnerships with the U.S. Geological Survey, Hoosier River Watch, Indiana Department of Natural Resources, and Indiana University SPEA Volunteer Monitoring could provide assistance in collection, personnel training, or storage of data. A watershed steering group could search for the programs or equipment to assist local lake associations and groups to properly collect quality data and provide for useful storage of those data sources.

INDIANA SILVER JACKETS
NORTH BRANCH ELKHART RIVER
WEST LAKES TASK TEAM

CHAPTER 5 – Overview of Basin-Wide Floodplain Management Activities

Floodplain Management Facts

- "Floods are 'Acts of God,' but flood losses are largely acts of man." White, G.F. 1945. *Human Adjustment to Floods*. Department of Geography Research Paper no. 29. Chicago: The University of Chicago.
- Throughout the nation, floodplain regulation is approached through a combination of federal, state, and local laws and ordinances. Federal direction is primarily given through the requirements of the National Flood Insurance Program (NFIP). Indiana specific strategies and permitting requirements are found in regulations administered by the Department of Natural Resources, Division of Water (see www.IN.gov/dnr/water). While some local communities have adopted ordinances meeting minimum standards, other communities have adopted broader standards dealing with issues related to storm water management and compensating for lost flow area and storage due to development.
- Participation in the NFIP makes flood insurance available for all insurable structures, regardless of Flood Zone designation.
- New and substantially improved structures located in Special Flood Hazard Areas (SFHA) are required to meet minimum building protection standards. This requirement also applies to the repair/reconstruction of substantially damaged structures. The key requirement is to have the lowest floor located at or above the Flood Protection Grade, which is two feet above the 1 percent annual chance flood elevation (100-year), or the Base Flood Elevation (BFE).
- In addition to minimum federal and state standards required to participate in the NFIP, Noble County has adopted a more restrictive standard in regard to compensatory storage; requiring the volume of space occupied by fill or a structure placed in the floodplain below the BFE be compensated for and balanced by an equivalent volume of extraction taken below the BFE at least equal to the volume lost. Higher regulatory standards take precedence, and are encouraged.
- A majority of the homes (164) located in the North Branch Elkhart River (NBR Elkhart River)/West Lakes Chain was constructed prior to 1970, with the largest concentration (110) built in the 1950s and 1960s.
- More than half of the homes in the NBR Elkhart River/West Lakes Chain are seasonal homes.
- Accessibility during flood events is problematic for nearly every home in the NBR Elkhart River/West Lakes Chain.
- Elevating homes/buildings does not improve/change accessibility problems during flood events.
- In a recent survey, 58 property owners in the NBR Elkhart River/West Lakes Chain indicated some interest in a buyout of their home.

- It is important to identify areas for future development that will minimize potential losses due to flooding, avoid sensitive species, and avoid impacts to areas that have high natural resource values or high potential for wetland restoration and floodwater storage.

National Flood Insurance Program (NFIP)

In 1973, Noble County (unincorporated) began participating in the NFIP. This includes the area of the West Lakes Chain. Participation in the NFIP is voluntary, based on an agreement between the federal government and a local community.

This partnership requires the local community to adopt minimum floodplain regulations, which meet or exceed applicable federal and state floodplain regulations, regulating development in flood hazard areas. A key requirement is that new and/or substantially improved buildings must be constructed with the lowest floor at or above the Flood Protection Grade, which is two feet above the BFE. This includes structures that are substantially damaged. In return, the federal government makes flood insurance available for structures located within the community's jurisdiction**.** Noble County's participation in the NFIP makes flood insurance available for all insurable structures located in the unincorporated areas of the county. Additionally, participation in the NFIP makes certain federal disaster assistance available to residents of the community.

The Federal Emergency Management Agency (FEMA) provided Noble County an initial Flood Hazard Boundary Map in 1978 to identify approximate flood hazard areas within the unincorporated areas of the County. At that time, the County adopted floodplain regulations and incorporated those regulations into the Noble County Zoning Ordinance. In 1979, Noble County was provided its first Flood Insurance Rate Map (FIRM) and Flood Boundary Floodway Map (FBFM) along with the corresponding Flood Insurance Study (FIS), establishing BFEs for the many of the waterbodies in Noble County, including the West Lakes Chain. The 1979 FIS and corresponding maps are currently effective. (A project to update Noble County's Flood Insurance Rate Maps is in progress. Preliminary Countywide Digital FIRMs and corresponding FIS for Noble County are expected to be made available for public review in 2010 with final maps anticipated to be effective in 2011.)

Within the NBR Elkhart River watershed, Rome City, Kendallville, and LaGrange County (unincorporated) also participate in the National Flood Insurance Program.

Noble County Flood Insurance Study (FIS) excerpts - February 1978

The currently effective Noble County FIS, dated February 1978, includes valuable pertinent and historical information gathered as part of the studies performed for various streams within Noble County. Excerpts from the study's text provide documentation of the conditions and findings of that time.

> "*Several residences and a few businesses are located in flood-prone areas throughout the county.*"

"Concentrations of houses in flood-prone areas occur near certain lakes." Intermittent low-lying areas along the streams and lakes studied are subject to periodic flooding. The most severe flooding occurs during winter and spring months as a result of prolonged rain periods followed by intense rainfall. Adding to flood heights to a limited extent are snowmelt and ice jams. The stream gage record for the Elkhart River at Goshen for the years 1932 through 1969 was used to study seasonal probability."

"Floods of record causing unusual damage during the last 40 years have occurred in March 1939, May 1943, April 1950, July 1951, October 1954, February 1956, April 1956, December 1966, and February 1968. Of these floods, the largest were the 1943, 1950, 1951, and 1954 events which range in magnitude with regard to recurrence interval between 20 years and 30 years. Floods during the 1960 through 1976 period have been relatively small in comparison with what has occurred in the past and with what can be expected in the future."

Local Floodplain Administration

Until June 29, 2009, the Director of the Noble County Plan Commission was the designated Floodplain Administrator for the unincorporated areas of Noble County as appointed by the County Commissioners. The Noble County Building Inspector currently is appointed this role.

Higher Regulatory Standards of Flood Hazard Ordinance

Noble County is a member of the Maumee River Basin Commission (MRBC), a quasi State/Local Government entity charged by the Indiana Legislature to mitigate flood damages in the Maumee River watershed in Indiana. As a member of the MRBC, Noble County, along with the other five participating counties, has adopted higher regulatory standards and incorporated them into its respective Flood Hazard Ordinances.

In addition to the minimum federal and state standards, Noble County has adopted a more restrictive standard in regards to compensatory storage requirements. Although the NBR Elkhart River/West Lakes Chain is not located in the Maumee River Watershed, this requirement still applies, because it is required in all Special Flood Hazard Areas within unincorporated Noble County.

Noble County is to be commended for adopting higher regulatory standards. The NFIP's minimum requirements are just that — minimums. Federal Regulations, 44 CFR 60.1, also recognize the value of higher regulatory standards in stating "any floodplain management regulations adopted by a state or a community which are more restrictive than the criteria set for in this part are encouraged and shall take precedence."

The minimum requirements for construction standards often do not provide sufficient protection from all local flood hazards, nor do they account for the effects of development on future flood levels. Minimum requirements for development in flood hazard areas may allow floodwater conveyance areas to be reduced, essential valley storage to be filled, or velocities to be increased; all of which can adversely affect others in the floodplain and watershed.

Noble County Community Assistance Visit (CAV) History

As the State coordinating agency for the NFIP in Indiana, the Department of Natural Resources, Division of Water, periodically conducts a community assistance visit (CAV) with each participating community to determine the community's effectiveness in the program. The CAV provides a "snap shot" of a community's permit procedures and recent construction activities in flood hazard areas. CAVs were conducted with Noble County officials in 1981, 1988, 1991, 1994, 2000, and 2006. No deficiencies were noted.

More recently, Nov. 4, 2009, a CAV was conducted. Building Department officials indicated that 61 floodplain permits had been issued in the last year. Approximately 18 were for electrical and similar maintenance or code related improvements. Some of the permits issued in the past year were for reconstruction of flood-damaged structures with the remaining being additions and new construction. They reported that no variances have been issued in the floodplain in the last year.

The community's permit process appears to be adequate. The CAV has been closed. It appears Noble County is compliant with the NFIP.

Flood Insurance

Helpful flood insurance related definitions:

> **Repetitive loss:** flood-related damages sustained by a structure on two separate occasions during a 10-year period ending on the date of the event for which the second claim is made, in which the cost of repairing the flood damage, on the average, equaled or exceeded 25 percent of the market value of the structure at the time of each such flood event.
>
> **Increased Cost of Compliance (ICC):** the cost to repair a substantially damaged structure that exceeds the minimal repair cost and that is required to bring a substantially damaged structure into compliance with the local flood damage prevention ordinance. Acceptable mitigation measures are elevation, relocation, demolition, or any combination thereof. All renewal and new business flood insurance policies with effective dates on or after June 1, 1997, include ICC coverage.
>
> **Pre-FIRM:** construction or substantial improvement that started before the effective date of the initial Flood Insurance Rate Map (FIRM) of the community. (For Noble County, 1/3/1979)
>
> **Post-FIRM:** construction or substantial improvement that started on or after the effective date of the initial Flood Insurance Rate Map (FIRM) of the community. (For Noble County, 1/3/1979)

Participation in the NFIP makes flood insurance available for any insurable structure within the unincorporated areas of Noble County. According to FEMA's official site of the NFIP (www.FloodSmart.gov), the average flood insurance policy cost is $540 per year as of Nov. 2, 2009.

Flood insurance information for Unincorporated Noble County as of Aug. 31, 2009:

- Total number of policies 201
- Total premiums $112,761
- Average premium in Noble County $561

Additional flood insurance notes for Noble County:

- 195 policies are for residential structures with only two policies for manufactured homes. One policy is listed as other residential (condo). There are five policies shown for non-residential structures.
- 167 policies for structures in Zones A1-30 and AE (High Risk)
- 34 policies for structures in Zones B, C, and X (Low to Moderate Risk)
- 114 total closed/paid losses; total $916,461 (since 1978)
- Paid claims shown for structures in both the high risk and low to moderate risk zones
- 7 ICC claims (closed); total $195,000 *(approximately six listed North Branch Elkhart River/West Lakes Chain Area)* since 1994
- 150 policies are for Pre-FIRM structures
- 51 policies are for Post-FIRM structures
- 48 total repetitive losses *(approximately 15 listed for North Branch Elkhart River/West Lakes Chain Area)*
- One Post-FIRM building shown as a repetitive loss building

Flood Insurance Misinformation

Throughout the nation and the State, misinformation regarding flood insurance is common.

A common misconception is that fire insurance is more important than flood insurance. A home in a 1 percent annual chance floodplain (100-year) has at least a 26 percent chance of being damaged by a flood during the course of a 30-year mortgage, compared to only a 9 percent chance of fire.

Another common misconception is that the floodplain shown on insurance rate maps are the ultimate extent of what could be flooded. Again this is not true. FEMA reports that nationally, 26 percent of flood insurance claims are for structures located outside of identified Special Flood Hazard Areas. It is not uncommon for floods to occur that are significantly larger than the minimum criteria used for insurance purposes. Many times, even a smaller flood can behave like a larger flood due to unpredictable events such as ice jams, floating debris plugging bridge openings, and the cumulative behavior of back-to-back floods.

The financial benefit of constructing to at least minimum elevation expectations is often misunderstood. Compliant repair, reconstruction, and new construction not only is realized in the reduction of flood risk, but also in reduced flood insurance premiums. See Figures 5-1 through 5-

5 at the end of this chapter. (The rating information was provided by FEMA.) There is a significant flood insurance savings for building in compliance and at least elevating 2 feet above the BFE as required in Indiana.

On the heels of the January/February 2008 historic flooding, the Indiana Department of Insurance took steps to decrease misunderstandings and increase the knowledge of those selling, soliciting, or negotiating flood insurance policies.

On Feb. 12, 2008, Indiana Commissioner of Insurance directed a bulletin (Bulletin 160; www.IN.gov/idoi/files/Bulletin160.pdf) to all current and future licensed property and casualty insurance producers who sell, solicit, or negotiate flood insurance policies through the National Flood Insurance Program (NFIP). In part, the bulletin states: Flood insurance training is now required for producers selling, soliciting, or negotiating flood insurance policies. A producer who sells federal flood insurance policies shall demonstrate to the commissioner, upon request, compliance with the minimum flood insurance training requirement.

Noble County Multi-Hazard Mitigation Plan excerpts – March 2008

Flooding is a relatively common occurrence in Noble County. The National Climatic Data Center (NCDC) has identified three significant floods in Noble County between January 1993 *(according to local officials the report should state December 1990, not January 1993)* and June 2006. Estimated total property loss figures reported for all flood events is approximately $5 million with no deaths or injuries attributed to the events occurring during the 13-year period.

According to the NCDC, the worst recorded event occurred in January 1993 *(according to local officials the report should state December 1990/January 1991 for this event, not 1993)*, leading to $5 million in property damages. This damage was spread among nine counties, including Noble County. The Town of Rome City was especially hard hit in Noble County with damages estimated at $1 million and numerous lake homes flooded as lake levels countywide rose. According to the Noble County Comprehensive Hazard Analysis, more than 200 homes surrounding Steinbarger, Jones, and Waldron lakes west of Rome City were affected.

In January 1998, flooding near Waldron Lake was caused by several inches of rainfall. Piers along the inlet to the lake and mobile homes along the shoreline were damaged by rising lake levels. Near the City of Kendallville, nearly 4 inches of rain fell. In May 1996, County Road 100S collapsed as culverts were washed away by floodwaters, and several homes in the Town of Avilla were damaged. A disaster declaration was issued in December 1991 as nearly 50 homes in Rome City, 20 homes near Wolf Lake, and several homes scattered throughout the County experienced flood damages. According to the Comprehensive Hazard Analysis, many of the damaged homes did not have flood insurance.

Historical Crests – Stream Gage Record for Elkhart River at Goshen as of 12/2009

(1) 11.94 ft on 03/14/1982
(2) 11.87 ft on 02/24/1985
(3) 11.03 ft on 12/30/1990

(4) 10.46 ft on 03/17/1982
(5) 10.40 ft on 02/06/2008
(6) 10.33 ft on 07/10/1951
(6) 10.33 ft on 03/05/1979
(8) 10.27 ft on 10/11/1954
(9) 10.20 ft on 06/09/1993
(10) 10.15 ft on 04/04/1950

0’ Gage height = 769.43’ NGVD
USGS Gage Data

Recent Presidential Declarations (flood) - Noble County

- FEMA-891-DR-IN, January 1991
- FEMA-962-DR-IN, September 1992
- DR 1476, July 2003
- DR 1520, May/June 2004
- DR 1573, January/February 2005
- DR 1740, January 2008
- DR 1832, March 2009

2009 Post Flood Numbers/Information

The flood event that occurred in March 2009 impacted the entire North Branch Elkhart River/West Lakes Chain. According to information provided by the Noble County Plan Commission on May 12, 2009, there were 156 homes affected by floodwaters. Thirteen of the homes were elevated homes constructed during the years 2004 through 2009. While accessibility was an issue, no damage occurred to these homes. Another 31 homes reportedly had floodwaters only to the foundation and no resulting damage. Eighty-eight of those reported homes affected had floodwaters into the crawlspaces and only required the crawlspace areas to be dried out with no resulting damage to the structures. Flood waters reached the living areas of 15 homes; however, no damage was noted after the structures were dried out. Reportedly, nine homes sustained major damage. Of those, reportedly four were not covered by flood insurance and no building permits have been obtained to repair/reconstruct. Photos from the March 2009 event are shown in Figures 5-6 through 5-11.

1983 USACE Report – (*Section 208 Reconnaissance Report on Flood Control on the North Branch of the Elkhart River and the West Lakes Chain in Noble County, Indiana*)

This report prepared by the U.S. Army Corps of Engineers (USACE) covered areas identified as reaches 1-7. In the 1983 report, 115 homes were reported to be located within the area identified as 100-year floodplain (1percent statistical chance of being equaled or exceeded each year). Of the 115 homes identified, 93 homes (92 percent) were located within the area identified also as being in the 2-year floodplain (50 percent statistical chance of being equaled or exceeded each year).

Data Collection 2009

The Silver Jackets North Branch Elkhart River/West Lakes Chain Task Team sought to collect and collate current data for use as a comparison to the 1983 U.S. Army Corps of Engineers (USACE) Report that shall serve as the baseline data in this chapter. For evaluation purposes, the task team attempted to replicate the same “reach areas” (1-7) identified in the USACE Report, while adding seven additional reach areas (8-14) within the immediate area that were not included in the 1983 Report (See Figure 5-12 at the end of this chapter). Data collected included: property address, parcel number, parcel description, resident lake, structure data such as type of foundation, finished floor area, date of construction to determine Pre-FIRM/Post-FIRM status, assessed value of improvements and land, nearest contour to determine approximate flood-depth, elevation history, damage history, and mailing address to determine whether residency is permanent or seasonal. This method allows an analysis of present day conditions on a reach-by-reach basis and compares current conditions with those used for the same reaches included in the 1983 USACE Report.

Within the identified North Branch Elkhart River/West Lakes Chain area of concern, 303 structures currently exist within the area of the 1 percent annual chance (100-year) floodplain. Of those 303 structures (primarily residential), 121 (36 percent) are located within areas also included in 50 percent annual chance (2-year) floodplain.

The oldest structure was reported to have been built in 1900. Reportedly there were five structures built prior to 1930. Since then, the numbers of structures with known construction dates were as follows:

- 1930s 30 structures
- 1940s 51 structures
- 1950s 67 structures
- 1960s 66 structures
- 1970s 34 structures
- 1980s 15 structures
- 1990s 25 structures
- 2000s 8 structures

A majority of the structures were built prior to the flood studies of the NBR Elkhart River/West Lakes Chain and prior to adoption of any regulations regarding construction methods to reduce the risk of flood damage in these known high risk areas.

Approximately 47 of the structures are considered post-FIRM, built after the County entered the NFIP. The identification of the flood risks provided through the flood insurance study of the NBR Elkhart River/West Lakes Chain has provided vital information allowing for informed decision making by community officials, individual property owners, and developers.

Floodwater depths at these structures during the 1 percent annual chance (100-year) flood ranges from 0 to approximately 4 feet above existing grade, posing a major problem for access as previously referenced. While structures that have been elevated may not sustain structure damage, access during flood events remains difficult or impossible.

Another unique aspect of the NBR Elkhart River/West Lakes Chain area is that there are many seasonal homes. Of the 303 structures, 167 (approximately 56 percent) are seasonal homes.

Local 2009 NBR Elkhart River/West Lakes Survey

The Silver Jackets NBR Elkhart River/West Lakes Task Team coordinated with the local steering group to conduct a survey of property owners in the NBR Elkhart River/West Lakes Chain in Noble County. The survey consisted of 17 questions intended to gain knowledge about several factors related to property in the NBR Elkhart River/West Lakes Chain.

A total of 298 survey forms were mailed Nov. 4, 2009 to known property owners in the NBR Elkhart River/West Lakes Chain. The local steering group compiled the results of the returned surveys.

Property owners returned 163 completed surveys (59 percent of the total). Two of those survey forms were received after this compilation was completed, and that information is not included. An additional 12 surveys were returned undeliverable due to incorrect or expired addresses. Survey questions and results are located in Appendix F of this report.

Observations related to the questionnaires:

1. There is a discrepancy between the number reporting having flood insurance in question 1 and those answering questions 3 and 4.

2. Among the 50 with Flood Insurance, 16 reported having submitted claims at some time, and 10 had flooding in 2009.

3. Among those with flood insurance and/or have submitted claims against their insurance, 11 would sell or are not certain whether they would sell if there were a government buyout.

4. Several indicated they have taken steps to elevate or otherwise flood proof their property.

5. Several noted their property received no flood damage, but they either could not get to their property or could not leave their property because roads were flooded.

6. Many property owners who have never experienced flooding (both with and without flood insurance) have indicated an interest in selling their property should a government buyout be available and if the price is right. Some commented that flooding in the region has caused property values to decline.

7. It should be pointed out that any volunteer buyout program should include sufficient funding to pay off the debt of the West Lakes Regional Sewer District. Otherwise, the increased cost to those remaining property owners would be an extreme burden.

Chapter Key Points

1. Approximately 275 homes (about 91 percent) in the subject area were built between the period of 1900 and 1978 – prior to the adoption of floodplain management regulations in Noble County. It appears many of those homes were constructed during drier periods and built too low.

2. Approximately 56 percent of the homes in the NBR Elkhart River/West Lakes Chain are seasonal.

3. The County has maintained a good standing with the NFIP, making flood insurance available to county residents. However, not all owners of homes in the West Lake Chain area of concern carry this available protection.

4. Prior to March 2009, at least six homeowners in the NBR Elkhart River/West Lakes Chain used the Increased Cost of Compliance (ICC) component of their flood insurance policies to elevate their homes damaged by floods during earlier floods. As a result, these homes did not incur flood damage during the March 2009 flood event. *Additionally, flood insurance premiums for these elevated homes are substantially lower due to the reduced flood risk.*

5. Noble County adopted compensatory storage requirements, which are a higher regulatory standard. This requirement contributes to the protection of the natural features of this area and is viewed as a "good neighbor" policy – not negatively impacting another.

6. The best method to reduce flood risk and eliminate property damage and loss is to allow known flood prone areas to remain undeveloped and either remove or relocate existing development to safer sites. Regardless of the extent homes/buildings are affected during flood events, accessibility proves to be a common threat for homes in the NBR Elkhart River/West Lakes Chain. During winter flood events, which are common in this area, temperatures and ice can increase the risk of structural damage and further complicate accessibility. This accessibility issue contributes to the public safety issues in the area, particularly in regards to evacuation and emergency services. Structures that meet the building protection standards of the County's floodplain regulations have demonstrated that property damage and overall flood risk can be avoided or greatly reduced.

7. More than half of the structures in the West Lake Chain are seasonal/second homes and many are not covered by flood insurance. On homes that are not covered, in certain instances, there is no trigger to require compliance with the flood protection requirements of the County's floodplain regulations. These instances include non-substantial damage which do not require compliance with the flood protection requirements, repetitive damage which has not been documented or tracked, underestimated damage (intentional and unintentional), and flood damages not reported or identified. Flood waters are generally not great depths with many structures sustaining low or no damage – clean-up, carpeting, baseboards, crawlspace inundation, and access limitations. Many of the homes without flood insurance coverage and subject to greater flood depths have no insurance

funds to repair and subsequently are unable to use the Increased Cost of Compliance (ICC) benefit that accompanies a standard flood insurance policy. Also problematic is this area is subject to many winter flood events. It is not uncommon for ice to contribute to structural damage as well as making access to the flooded homes extremely difficult.

8. The new training requirement for insurance agents selling flood insurance will improve but not eliminate the problem of misinformation.

Additional Flood Risk Management Considerations:

Flood risk is most often measured by the probability of a water surface crest elevation occurring in a year. It is through the probability determination process that flood risk is most commonly measured, maps are drawn, and decisions are based. Appendix H contains map images depicting the aerial coverage of the flood that has a 1 percent annual chance (100-year), or the Special Flood Hazard Area, for the area around West Lakes Chain, Indian Lakes Chain, and Sylvan Lake. These areas are identified on the Flood Insurance Rate Maps which are available for viewing at the County government offices and on FEMA's website.

The 1 percent annual chance (100-year) occurrence flood shown on a flood insurance map should never be thought of as the largest flood that can occur. Typical flood prediction modeling does not take into account or have a factor of safety against unpredictable events such as multiple smaller storms occurring consecutively before basins dry out, storm events that exceed the 1 percent annual chance (100-year) size, debris jams at bridges, or ice jams. Standard 1 percent annual chance (100-year) flood insurance modeling also does not capture site-specific risk conditions that may exist, such as when residents live downstream of a large man-made dam. These flood risks are often thought to be limited to failure of the dam. However, dams are designed to minimize, to the extent possible, catastrophic failure of the embankment through the use of a controlled release of water to decrease the forces acting on the dam. When operated properly and under specific, predefined conditions, often extreme, a dam operator can still be faced with a need to release substantial amounts of water from the dam (because failing to release the water could result in a breach of the structure and total devastation to the downstream community).

The citizens along the NBR Elkhart River living downstream of Sylvan Lake Dam must be aware of the need to manage their personal risk associated with the required operation of the outlet works associated with the dam under specific conditions. Sylvan Lake Dam has a combination of features associated with the outlet works that were designed to maintain water level in the lake at the required level and then release water at a defined rate during increases in lake levels. (See Chapter 4 of this report for additional information regarding the Sylvan Lake Dam outlet works.) Under extreme conditions, additional water can and must be released to preserve the integrity of the dam. The operation of the gate and fuse plug associated with the outlet works for Sylvan Lake Dam has been defined by the Emergency Action Plan (EAP) for the structure. The Rome City Conservancy District maintains the operational status of the structure and the EAP.

Sylvan Lake Dam is a very old structure with a recent upgrade. As previously stated, the oldest residence currently on West Lakes Chain was built around 1900. Sylvan Lake dam was constructed from approximately1837 to 1839, over 60 years earlier than the oldest existing residential structure on West Lakes. A brief history of the early days of the structure can be found in “History of Orange Township” by MF Owen (Owen 1950). The dam catastrophically failed, breached, three times – 1839, 1844 and 1855. The 1855 failure was reported to have caused destruction of all in-channel dams and bridges downstream to Elkhart with only the bridge at Ligonier saved by local efforts. The dam nearly failed an additional time in 1877. The dam was upgraded extensively in the mid-1990s, including the addition of the present outlet works.

The outlet works are designed to release water as needed to secure the integrity of the embankment in an attempt to prevent catastrophic failure. However, an additional release from Sylvan Lake Dam is not factored into the 1 percent annual chance (100-year) flood levels for the downstream area, nor has any resultant breach wave should the dam fail. Therefore, this additional flow would increase the water levels to the downstream area beyond any mapped flood zone. Residents in the downstream area should factor that risk into their personal risk management plan. It is important the residents of the West Lakes area have in-place, and practice, an Emergency Flood Response Plan to accompany the Sylvan Lake Emergency Action Plan. This plan would provide for event notification along with evacuation notification and routes should these extreme measures be required.

Future Local Considerations

1. A concerted effort should be made to provide a comprehensive educational format to better inform local residents on flood insurance, opportunities, and to encourage all those at risk to obtain/maintain this vital protection. Focus should include:

    - Clear message that anyone can purchase flood insurance as long as their community participates in the NFIP
    - NFIP “minimum” requirements versus recommendations, and individual efforts to go beyond minimums to further reduce their property’s flood risk
    - Lenders’ role in NFIP
    - Coverage – what is and is not covered
    - Availability of contents coverage
    - Mitigation opportunities available through Standard Flood Insurance Policy – in addition to claims for repair after incurring flood damage, up to $30,000 is available for Increased Cost of Compliance (ICC) for substantially damaged structures and repetitive loss structures (ICC funds can be used for elevation, relocation, floodproofing, or demolition.)
    - Elevating a home in the flood hazard area can greatly reduce flood insurance premiums
    - Obtaining a Letter of Map Amendment, removing a home by letter from the Special Flood Hazard Area (SFHA) designation, will eliminate mandatory flood insurance requirements, but only indicates that the structure is in a lower flood

risk zone. Flood insurance premiums for structures in a low risk zone are substantially less than those in a SFHA.

- Grandfathering policy. New DFIRMs will be completed in little more than a year for Noble County. Property owners who have a structure where the flood zone will be changing from Zone X to Zone A can take advantage of FEMA's grandfathering policy by purchasing flood insurance prior to the effective date of the new maps – maintaining the less expensive Zone X rates.
- Flood Insurance should not be viewed any different (any less essential) than a Standard Homeowner's Insurance Policy covering fire, wind, tornado, etc.
- A home has a 26 percent chance of being damaged by a flood during the course of a 30-year mortgage in a high-risk area, compared to a 9 percent chance of fire.
- Last year, one-third of all claims paid by the NFIP were for policies in low-risk communities.
- Most homeowner's insurance does not cover flood damage.
- If you live in a Special Flood Hazard Area (SFHA) or high-risk area and have a federally backed mortgage, your mortgage lender requires you to have flood insurance.
- Just an inch of water can cause costly damage to your property
- Not all flood events qualify for a Presidential Disaster Declaration. Federal disaster assistance is only made available as a result of a Presidential Disaster Declaration.
- A flood insurance claim may be submitted and paid whether or not there has been Presidential Disaster Declaration.
- Most federal disaster assistance is in the form of loans (usually a Small Business Administration Disaster Loan), rather than grants. Disaster loans must be paid back with interest.
- Maintaining a flood insurance policy long term, particularly in a high risk zone, would be substantially less expensive than not having flood insurance and repaying a disaster loan after a damaging flood event. (For example: For a $50,000 loan at 4 percent interest, the monthly payment would be around $240 a month ($2,880 a year) for 30 years. Compare that to a $100,000 flood insurance premium, which is about $300-$775 a year.)

Staff from DNR Division of Water, MRBC, and IDHS would be a resource for this type of public education/outreach effort.

2. In addition to the above, the community may greatly benefit from having a "Flood Forum" held in a local venue much like the recent Upper Tippecanoe Flood Forum, which was organized by the local watershed foundation, Upper Tippecanoe Watershed Foundation, and the Kosciusko Lakes and Streams Program, which is centered at Grace College. Using the same "Flood Forum" format, attendees would have the opportunity to hear a short presentation providing an overview of the area and pertinent flood related information at the start of the event. This would be followed by an open house at which attendees have the opportunity to discuss their concerns one-on-one with representatives from various federal, state and local agencies. For late-comers, the presentation could be repeated later at a scheduled time during the event.

3. Residents in the North Branch Elkhart River/West Lakes Chain (as well as the remaining areas of the County) should be adequately informed of the importance of reporting all flood damages, obtaining permits for repair, applicable building protection requirements, and the potential for ICC funds for those buildings covered by flood insurance.

4. ICC funds can be used to elevate, relocate, or demolish residential structures substantially damaged by flood or those that have incurred repetitive loss. Following future flood events, the community should carefully evaluate each and any insured structure(s) eligible for ICC and work with each property owner to achieve the best possible option. Particularly in situations where a buy-out may be desirable, ICC funds may be used to cover the non-federal portion of a mitigation grant.

5. The higher local standards regarding compensatory storage are vital to efforts to protect the unique and natural features in this area. Deviation from these higher standards should be discouraged.

6. In general, focus should be on protecting what exists – either by removing existing structures from the Special Flood Hazard Area (SFHA) or elevating existing structures in the SFHA. New development in the SFHA should be discouraged or prohibited to avoid putting additional development at risk from known risk, particularly in light of the accessibility problems during periods of flood. The properties of owners who may be interested in a buy-out program should be looked at on a case-by-case basis to see if there is a concentration of properties in one area to determine if this would be a worthwhile pursuit. Alternatives to address the issue related to the Regional Sewer District should be sought.

7. It is recommended that urban planners work diligently to identify areas for future development that will minimize potential losses due to flooding, avoid sensitive species, and avoid impacts to areas that have high natural resource values or high potential for wetland restoration and floodwater storage. Areas proposed for future development should also avoid the land adjacent to and in between the many nature preserves and protected wetlands areas which are logical areas for future expansion of flood water storage through restoration. By identifying appropriate areas in advance, it will be easier to attract new development and easier to preemptively avoid situations where considerable financial investments have been made in inappropriate areas. Identified areas should be sited well above local flood elevations and located in close proximity to existing infrastructure outside of flood prone areas. This should be an integral part of zoning decisions and any long range planning.

8. It is important the residents of the West Lakes area have an Emergency Flood Response Plan to accompany the Sylvan Lake Emergency Action Plan.

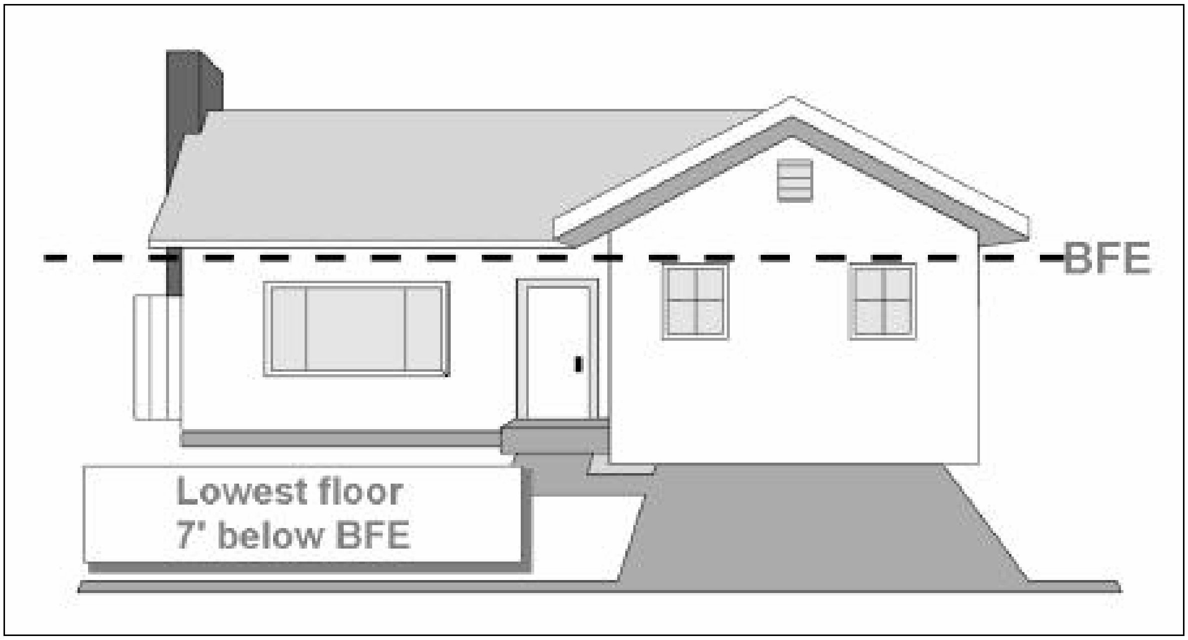


Figure 5-1. Pre-FIRM building. (Elevation is not part of the calculation). ***Annual premium: $846****. (Rate effective 10/1/2009 based on $100,000 coverage on building, single family, one floor, slab-on-grade, Zone AE, $1000 deductible, and no contents coverage; includes federal policy fee and ICC premium.)* ***Over the life of a 30-year mortgage premiums would equal $25,380.***

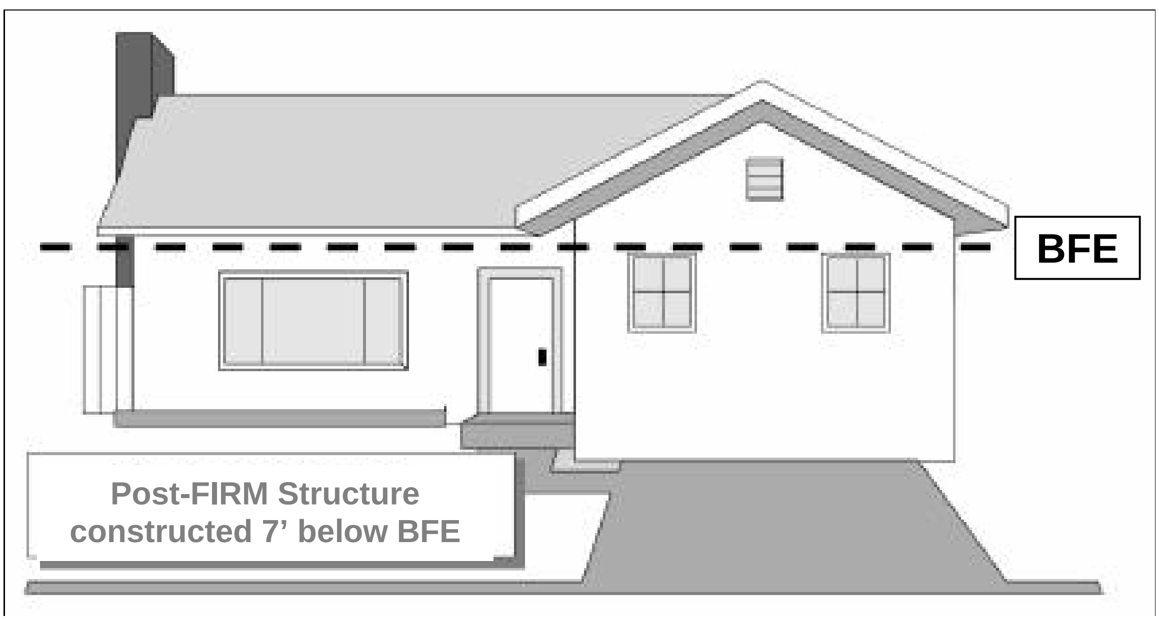


Figure 5-2. Post-FIRM structure constructed with lowest floor 7 feet below BFE. ***Annual premium: $13,417****. (Submit-to-Rate effective 10/1/2009 based on $100,000 coverage on building, single family, one floor, slab-on-grade, Zone AE, $1000 deductible, and no contents coverage; includes federal policy fee and ICC premium.)* ***Over the life of a 30-year mortgage this would equal $402,510****.*

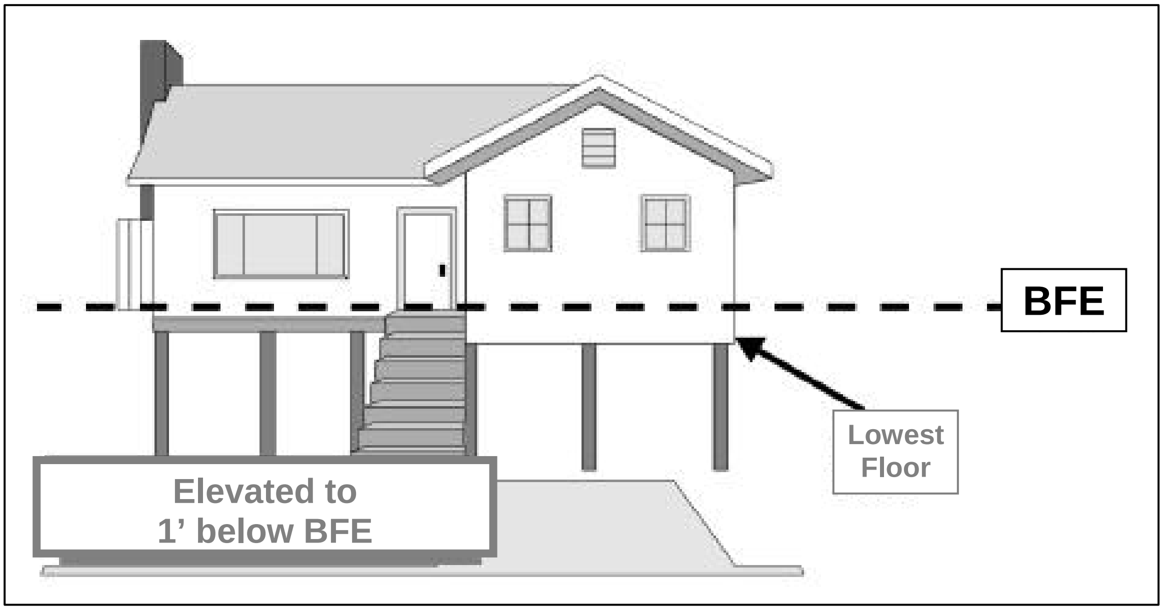


Figure 5-3. Post-FIRM structure constructed with lowest floor 1 foot below BFE. ***Annual premium: $2,875****. (Rate effective 10/1/2009 based on $100,000 coverage on building, single family, one floor, slab-on-grade, Zone AE, $1000 deductible, and no contents coverage; includes federal policy fee and ICC premium.)* ***Over the life of a 30-year mortgage this would equal $86,250.***

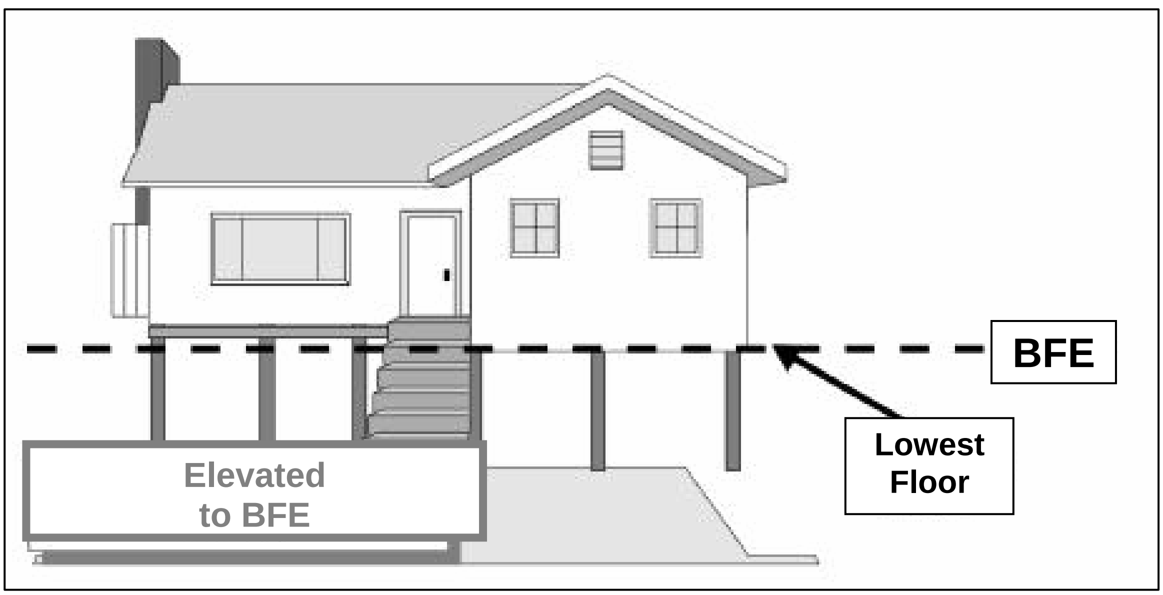


Figure 5-4. Post-FIRM structure constructed with lowest floor at the BFE). ***Annual premium: $941*** *(Rate effective 10/1/2009 based on $100,000 coverage on building, single family, one floor, slab-on-grade, Zone AE, $1000 deductible, and no contents coverage; includes federal policy fee and ICC premium.)* ***Over the life of a 30 year mortgage this would equal $28,230.***

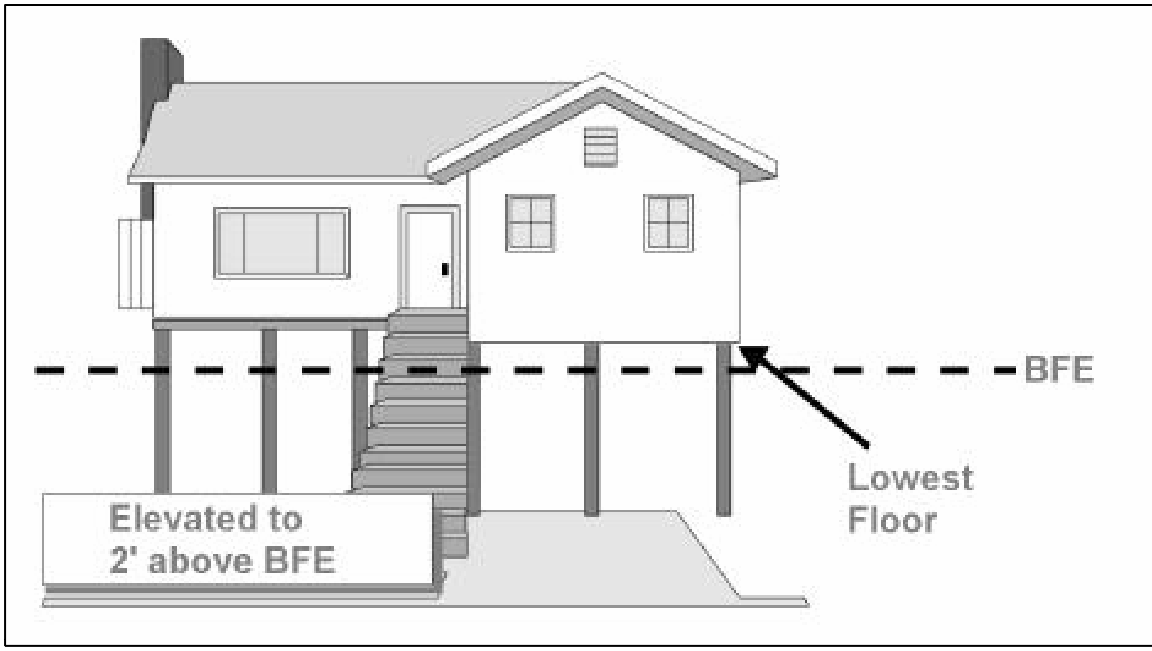


Figure 5-5. Post-FIRM structure constructed with lowest floor 2 feet above BFE. ***Annual premium: $305.*** *(Rate effective 10/1/2009 based on $100,000 coverage on building, single family, one floor, slab-on-grade, Zone AE, $1000 deductible, and no contents coverage; includes federal policy fee and ICC premium.)* ***Over the life of a 30-year mortgage this would equal $9,150.***

Figure 5-6. Waldron Lake – home damaged by 2008 flood repaired and elevated (enclosure beneath lowest floor with flood vents), utilizing flood insurance/ICC.

Figure 5-7. Waldron Lake – homes and accessory buildings surrounded by floodwaters in March 2009.

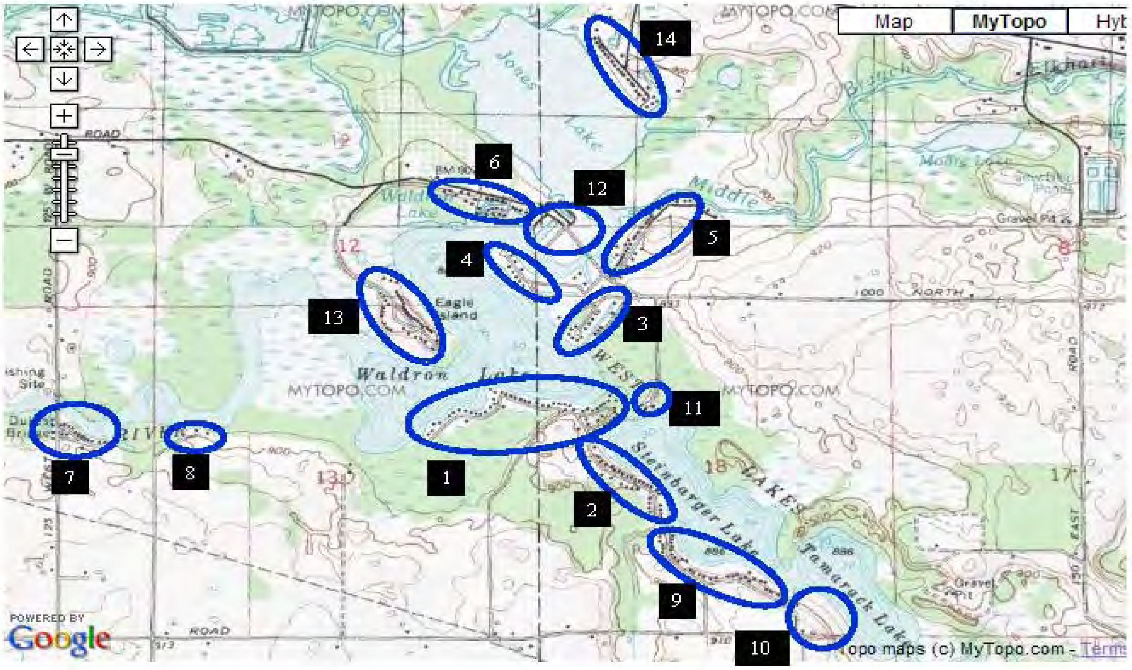
Figure 5-8. Waldron Lake – home with crawl space flooded and flooded garage in March 2009.

Figure 5-9. Waldron Lake – home damaged by 2008 flood in process of being repaired and elevated utilizing flood insurance/ICC in March 2009.

Figure 5-10. Waldron Lake – home damaged in 2008 repaired and elevated (stem wall construction), utilizing flood insurance/ICC undamaged in March 2009 flood.

Figure 5-11. Waldron Lake – sandbagging efforts to protect home in March 2009.

Figure 5-12. Topographic map of the West Lakes Chain area with the Reaches 1-14 identified.



INDIANA SILVER JACKETS
NORTH BRANCH ELKHART RIVER,
WEST LAKES TASK TEAM

CHAPTER 6 – Conceptual Review of Locally Suggested Activities and Structural Projects

Introduction

The Flood Focus Committee of the Elkhart River Alliance spoke with the ISJ Elkhart River, West Lakes Task Team (Task Team) about several activities and structural concepts that have been mentioned locally as potential projects that by themselves or in combination might help reduce seasonal flooding or larger flood risk in the West Lakes Chain.

To assist in developing the scope of the analysis for each activity, the Task Team grouped the list of concepts into two main groups: 1) Activities that should be studied for impacts on the more seasonal, higher frequency flood events, and 2) Activities that should be studied for impacts on the larger, lower frequency flood events. The conceptual activities and projects included:

Seasonal flood event impacts:

- Opening of a gate at the Benton Dam located on the Elkhart River at Benton, Elkhart County.
- Increasing the size of the opening below the county road bridge over the North Branch Elkhart River (NBR Elkhart River) at Cosperville.
- Managing in-channel aquatic vegetation.
- Fallen tree and obstruction removal in the NBR Elkhart River, downstream of West Lakes.

Larger flood event impacts:

- Raising selected access roads to existing residential areas.
- Construction of a bypass channel in the NBR Elkhart River, downstream of West Lakes.
- Creation of additional flood water storage basins upstream of the West Lakes Chain.
- Lowering the water level of Sylvan Lake 1-2 feet in the fall or winter to allow for additional spring flood storage.

At a conceptual/feasibility study level, these concepts were reviewed technically for this report with respect to their potential to affect flooding on the West Lakes Chain. Other project considerations were also identified. This analysis is a cursory review of the concepts and was not intended to be a final engineering analysis or a design. The levels of hydrologic and hydraulic calculations performed for the review of these projects were limited by the existing available data and existing stream modeling. While several older stream flow models exist, they do not have the ability to provide a detailed analysis of possible changes in watershed / drainage basin development and storage changes.

If these or any other potential projects are pursued in the future by the Flood Focus Committee of the Elkhart River Alliance, more in-depth data gathering, analysis, computer modeling, plan development, cost estimating procedures, and pre-permit agency coordination will be needed as part of normal engineering feasibility, design, and then permitting processes. Any such studies should be conducted by a multi-professional team, with a member being a professional engineer experienced in detailed water resource modeling.

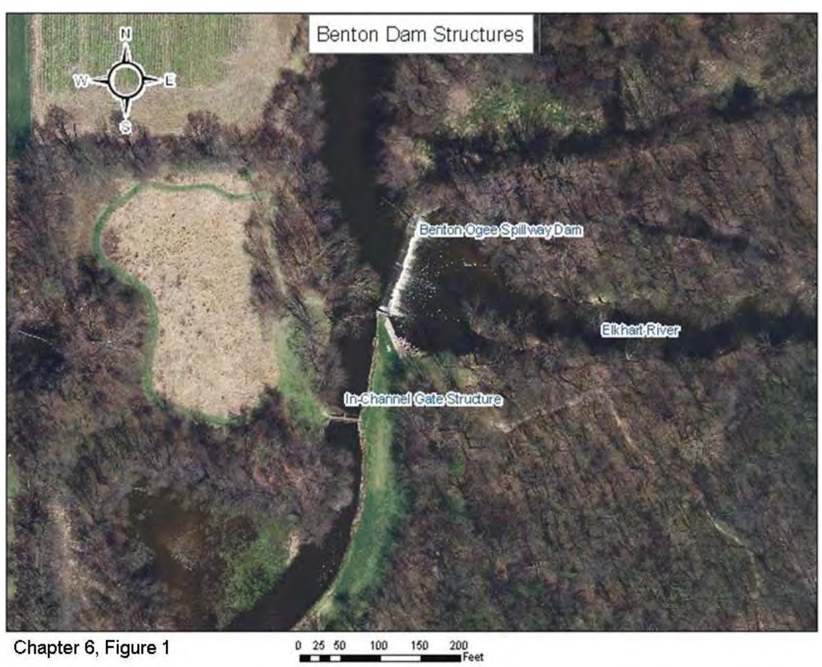
The development of a future basin-wide, detailed, timing based, modeling approach is recommended to get a comprehensive view of the NBR Elkhart River system. This will be beneficial in evaluating future development and land use changes. Due to the extensive existing wetlands and storage areas in the basin, a modeling approach referred to as "unsteady" is recommended. This modeling approach can properly account for the impacts and timing of storage areas during flood events and how they impact the flood elevations.

ACTIVITIES REVIEWED FOR SEASONAL FLOOD EVENT IMPACTS

Opening of the Gate at the Benton Dam Located on the Elkhart River at Benton, Elkhart County

A concept has been discussed locally that assumes if the gate at the downstream Benton Dam is opened, water will flow faster in the NBR Elkhart River system and possibly lower water levels in Waldron Lake.

The dam at Benton in Elkhart County is composed of a fixed concrete spillway in the river and an in-channel gate structure in the adjoining man-made canal (see Figure 1). The ogee spillway dam is a 4-foot-high concrete broad crest weir structure approximately 130 feet across. The man-made canal branches off the river. About 135 feet downstream of the beginning of the canal is an in-channel gate structure, which is a walking bridge approximately 35 feet across. Under the structure are six openings about 5-feet across. (See Figures 2 and 3.)



Chapter 6, Figure 1

The structures at Benton are 29.5 miles downstream of Waldron Lake. With the legal lake level of Waldron at 885.55 feet, and the crest of the diversion dam at 820.9 feet, there is a 64.6-foot vertical elevation change between the two sites.

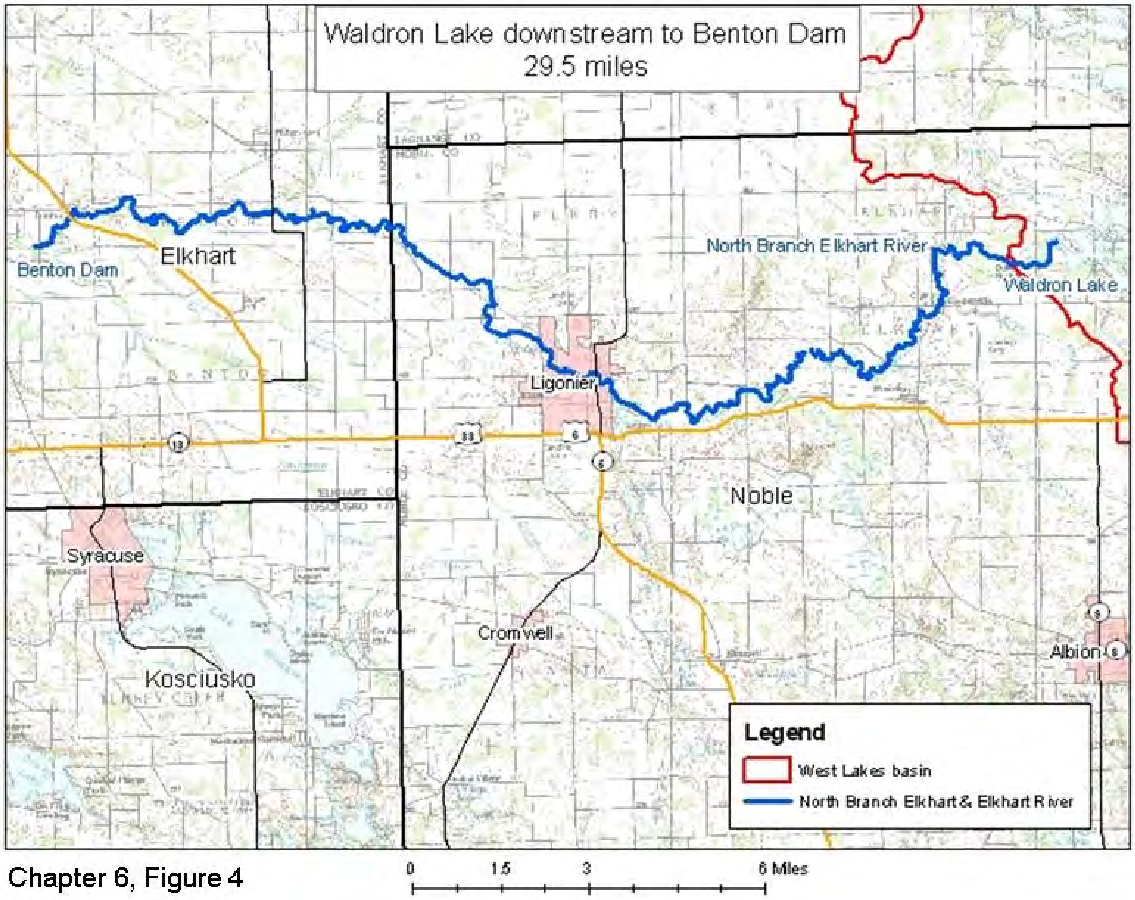
This slope, while not obvious to an observer on the ground along the river, over the course of 29.5 miles stream miles (see Figure 4) is a significant elevation change in the landscape.

Chapter 6, Figure 2

Chapter 6, Figure 3

Based on information from the Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS) for Elkhart County, the Benton structure does not increase flood elevations in the Elkhart River. (See Appendix G for Flood Profile Panels) Panel 28P shows the Benton structure labeled as "Diversion Dam" located in a steep portion of the river. During flood events the 4-foot-tall Benton Dam is overtopped by nearly two feet of water.

Certainly during lower flows, the dam does impound water upstream of the structure in the pool area. However, the flood insurance profile predictions and historic flood event profiles show the Benton Dam effects are limited and do not extend beyond the typical pool area upstream of the structure. Physically, the impact of the Benton spillway or canal in-channel gate structure cannot propagate 29.5 miles (or 64.6 feet vertically) upstream to the West Lakes Chain.



Chapter 6, Figure 4

As a comparison, other structures can be seen on the profiles showing an increase in the flood depth in the River for a short distance. Profiles 25P- 32P show the Elkhart River in Elkhart County, and profiles 52P - 55P show the NBR Elkhart River in Noble County. Restrictive structures can cause the flood profile to jump higher for a short distance on the upstream side compared to the downstream side. How far an increase can propagate upstream is dependent on how high the restriction is and how quickly the increasing slope of the channel negates the pool behind the restriction.

So, while structure can have various amounts of restriction, the Benton Dam structure shown on the profile 27P causes impacts only a minimal distance upstream and does not increase flood depths upstream to West Lakes Chain. The profile shows flood depths of roughly six feet both upstream of the NIPSCO Dam and downstream of the Benton Dam.

Activities associated with operational changes or reconstruction of either of the dams would not reduce large predicted flood flows, flood depths, or duration of floods in the West Lakes Chain.

Increase the Size of the Opening Below the County Road Bridge Over the North Branch Elkhart River at Cosperville

Another project identified as an activity that might help reduce flood risk was to increase the size of the opening below County Road 900 North over the NBR Elkhart River at Cosperville. The cross-sectional opening available to pass flow under the bridge is reviewed in this section.

As is typical for most bridges, the current waterway opening at this bridge is smaller than the combined channel and flood plain flow cross-sectional areas that adjoin the bridge. This is true looking either upstream or downstream of the bridge. Some small localized flood height reduction could be expected for a small distance upstream, if the bridge opening were increased (or the bridge deck raised). Increasing the bridge opening size may also slightly increase the volume of water passing downstream at any time. This may produce some slight increased flood depths downstream of the bridge.

Detailed computer modeling calculations could be used to predict specific benefits and/or downstream risks associated with various bridge size and dimension changes. A hydraulic study to evaluate alternative bridge sizes or dimensions for their affects was not conducted for this report.

Increasing the bridge’s waterway opening could be accomplished in at least three ways.

- Years of accumulated debris and sediment appear to have been deposited under the bridge near the bridge abutments outside of the low flow channel. The current waterway area could be increased by removing this build up and maintaining the maximum opening configuration that was available when the bridge was originally constructed.
- Immediately downstream of the bridge opening an apparent sewer outfall pipe has been constructed and covered with a protective rock mound. This pipe and rock mound run in the same east-to-west direction of the road and block a portion of the bridge’s waterway flow area. The pipe and its rock fill could be shortened, or reconfigured, in such a way as to not block the bridge waterway area.
- If the bridge becomes slated for a county rehabilitation or reconstruction project, providing a longer bridge span with a larger waterway area could be considered and analyzed to predict specific benefits or downstream risks associated with various bridge dimension improvements.

Managing In-Channel Aquatic Vegetation (Transition Area)

An issue previously mentioned in this report and during local site visits is the concept of managing in-channel aquatic vegetation in the area defined as the "transition area" in Chapter 2. Vegetative growth, under the right conditions, can be very extensive in this portion of the channel.

Aquatic vegetation typically is seen as excellent habitat for fish and other aquatic life, so any project to remove this type of vegetation should be carefully planned and strategically implemented. Aquatic vegetation control information and permitting requirements can be found on the Department of Natural Resources, Division of Fish & Wildlife's website *www.in.gov/dnr/fishwild/files/fw-Aquatic_Vegetation_Control_Permit_Information.pdf.*

While this activity would not reduce large predicted flood flows, or flood depths, this activity, if done correctly only in the transition area, seems to have some merit as it might slightly lower seasonal high water levels that often run a little above normal lake level. It appears the aquatic vegetation in the transition area lies down during higher and faster flood flows and does not seem to be a restriction to passing these larger events. During the dry times of summer, especially during lower and slower flow times, the vegetation in the transition appears to remain standing and may be slowing water flow. This summer slow flow caused by vegetative growth, may be a contributing factor to keeping the lakes from returning to their legal average level over the past few wetter than normal years. A more detailed discussion of the aquatic vegetation growth can be found in Chapter 2 of this report.

Fallen Tree and Obstruction Removal in the North Branch Elkhart River, Downstream of Waldron Lake

Various levels of minimalist or more aggressive fallen tree and obstruction removal projects have been implemented in this watershed. In summary:

- Traditional clearing and snagging projects (as practiced in the past) which can be environmentally destructive to the channel and the overbank areas often do not appear to provide significant, long-term benefit in flood reduction. These large-scale projects, as they typically open the channel up to sunlight, may cause an extensive growth of in-channel vegetation, thus being more harmful to flow capacity than what previously existed. These large-scale projects also often have the unintended consequence of making channel banks and remaining trees more unstable and more prone to erosion than previously existed.

- Minimal stream maintenance activities (removal of isolated fallen trees) also likely will not reduce large predicted flood flows or flood depths, but when done properly may provide some small benefit in passing lower and slower in-channel flows. This is specifically apparent in the area immediately downstream of the lakes and upstream of County Road 300 West. This activity would also be beneficial in improving boating and canoeing recreational opportunities along the NBR Elkhart River, and tourism opportunities in the community.

- As analyzed in a 1983 US Army Corps of Engineers study for this area, typically, for these projects, costs exceed any benefits achieved, especially when the primary purpose is to alleviate flooding.

Traditional Clearing and Snagging:

Removal of at-risk and fallen trees, obstructions, and significant vegetation removal along the overbanks, sometimes known as "Clearing and Snagging" is described in engineering literature from various sources. Haestad Methods, Inc., a publisher of stream modeling engineering computer software and literature, describes it as:

> Removing vegetation from the channel sides and along the bank and removing trees, debris, and stumps from the channel. The channel geometry and alignment usually remains unchanged with this solution, and the construction modifications simply result in slightly lowering the resistance presented to the flow of water.

Typically, computer modeling estimations of before and after project conditions will predict slight increases of flow velocities and slight decreases in stream flooding depths along the areas where this type of work is proposed. These slight changes, while potentially helpful during low flow (typically summer time) conditions, will not translate into meaningful decreases in lake levels during significant flooding events.

These removal activities also typically provide only minimal short-lived results, as much of the fallen trees, obstructions, and vegetation will reestablish within several seasonal cycles.

Studies by Wilson (1973), Pickles (1931), and Burkham (1976) for streams in Mississippi, Illinois, and Arizona, respectively, found the resistance to flow returning to previous levels and beyond, with increases ranging from 50 percent to more than 300 percent in the next few years following removal operations. This increase in resistance in a short timeframe is evidence of a large re-growth in vegetation along and in the stream. To perpetuate the results of removal activities, they need to be repeated on a fairly frequent cycle.

While permitting expectations often vary between federal laws, state laws, and local ordinances, significant detrimental environmental and cumulative effect may often result from this solution. Fish habitat and cover are removed, the shade given by vegetation is lost, increased bank erosion could occur, and bottom sediments are resuspended by clearing and snagging activities.

Of particular note in this watershed, the loss of shade and the increase in sunlight often has the adverse impact of increasing thick aquatic weed vegetation growth in the stream channel. During the summer, thick aquatic vegetation in the channel is already noted in the stream/lake transition area in the NBR Elkhart River below West Lakes.

Stream Maintenance, Best Management Practices:

The 1996 Indiana Drainage Handbook (Handbook) is a valuable resource for evaluating and implementing appropriate stream maintenance activities. The Handbook can be found at the DNR, Division of Water's website at www.in.gov/dnr/water/4892. The handbook is intended to be used by state and federal regulatory agencies as well as those performing local drainage work.

The Handbook: (1) explains and clarifies federal, state, and local laws and regulations affecting drainage improvement activities within Indiana (in place in 1996 when it was written, specific citations should be reviewed for current wording); (2) provides descriptions of specific "Best Management Practices," which define how work should be performed with a minimum of adverse environmental impact; and (3) explains procedures for timely access to agencies' drainage-related personnel.

The Handbook states that localized removal projects are preferred over full-scale (clearing and snagging) projects as shown below:

> "Effectiveness of large-scale river restoration projects in reducing flooding is limited only to small annual floods. Often times, the effect of these activities on reducing flood stages of larger, less frequent floods, is negligible or at best limited to 2 to 3 inches of stage reduction. In most cases, similar hydraulic benefits may be achieved by following the American Fisheries Society Stream Obstruction Removal Guide, i.e., removing only localized logjams, at a fraction of cost and time."

In order to appropriately identify, plan and direct an effective removal project, the Handbook uses an obstruction classification system based on the "American Fisheries Society Stream Obstruction Removal Guidelines." Five conditions are described along with management techniques based on each category: Condition 1 is the least severe, Condition 4 is the most obstructive, and Condition 5 describes a special case. (See Appendix A for descriptions of each condition from the Drainage Handbook).

The cumulative benefits of removal projects do not necessarily, or simply, result in improved flow at some distance upstream of the obstruction. A review of local stream gradient (slope) is important when identifying and evaluating the location and expected benefits of a particular removal project. In this area, partially based on the stream gradients, removal of an obstruction identified as a condition 1 or 2 obstruction in the Handbook, downstream of approximately County Road 300W, likely would have little, if any, impact on discharges (improved flows) from West Lakes Chain.

Over the years, several downed tree removal operations have occurred along this stream. They include:

1982 (local effort)
1986 (State-sponsored $55,313 to address 12.5 river miles),
(several years following this project were drier than normal)
1999 (State-sponsored $119,000 to address 7.4 river miles),
(several years following this project were drier than normal)

2007 (Noble County performed work, State contributed $10,000)
2009 (Noble County performed work, State contributed $10,000)
Additional volunteer efforts at cutting recreation obstructions (reportedly done by local canoeists), have been noted at various points and times along the stream.

Local testimony has indicated each of these efforts has seemed to provide some flood reduction benefit. However, some of the benefits may have been attributed to drier than normal years following the projects. Regardless, after a few years, the activities needed to be repeated.

In summary, the practice of obstruction removal can be beneficial, especially if the stream is significantly blocked; however, the benefits are typically only experienced for a few years. Particularly with traditional clearing and snagging projects, the regrowth is more restrictive, due in part to additional sunlight in the stream corridor allowed by removing the tree canopy. This practice often has significant negative impacts to the fish and wildlife dependent on the stream. It also requires frequent expenditures of funds and resources for maintenance for minimal benefit during flood events.

All local, state, and federal permit requirements should be followed, and appropriate access rights secured, if this practice is used.

ACTIVITIES REVIEWED FOR LARGER FLOOD EVENT IMPACTS

Raising Selected Access Roads to Residential Areas

A structural concept mentioned locally as a potential project is raising selected county and local access roads to residential areas that have been isolated during recent flooding events.

While this concept would not reduce predicted flood flows, flood depths, or the duration of flooding events, it seems to have some merit as it may increase the time property owners have access to their homes. It also would increase the time people have to evacuate their homes when large flooding events are anticipated.

This concept has not been studied for costs or to identify potential project areas in this report, but could be analyzed and considered by the various county engineers and community highway departments.

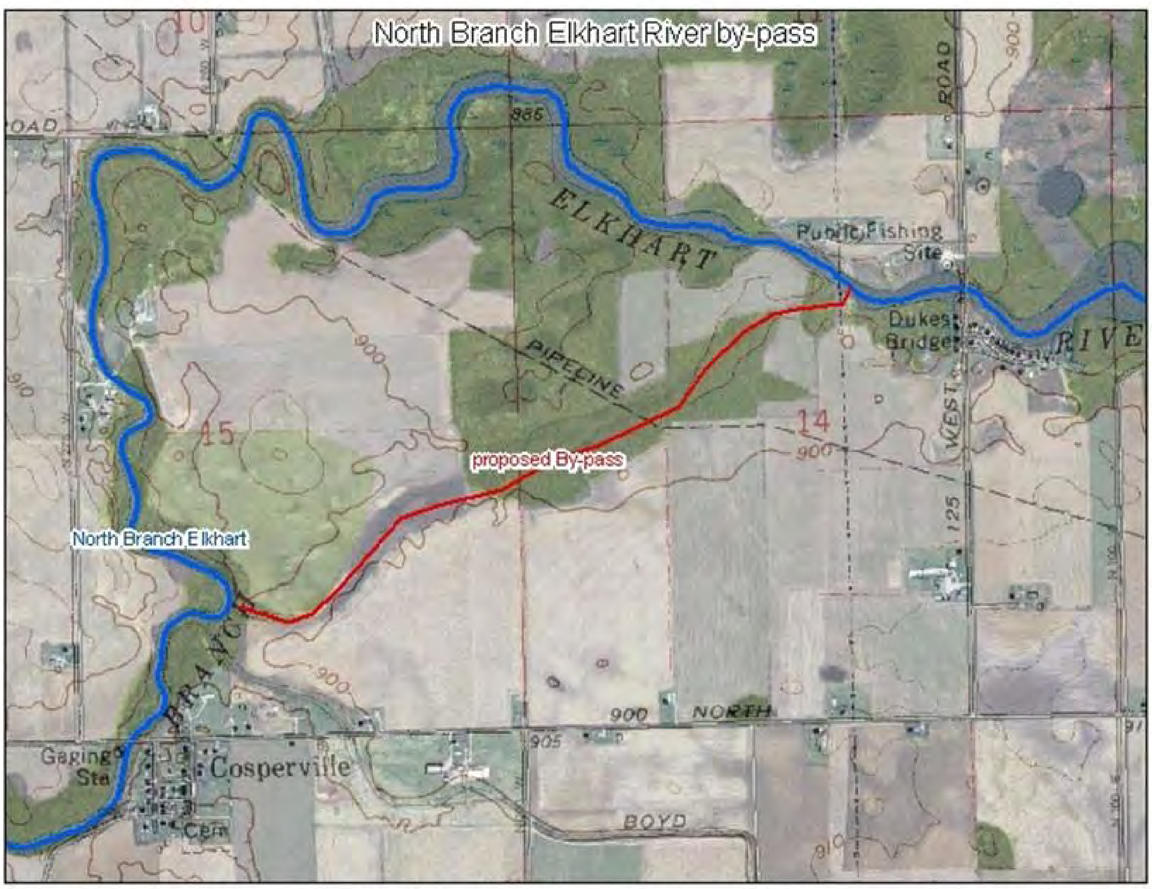
Construction of a Bypass Channel in the North Branch Elkhart River, Downstream of Waldron Lake

Building a bypass channel downstream of West Lakes to improve drainage during flood events and lower lake levels more quickly also has been identified as a potential local project.

Although a bypass channel can increase the rate of flow out of a lake during flooding events, a valid concern is that flow rates in the channel and floodplain downstream of the bypass channel will also increase. Depending on the specifics of the configuration and the precise timing of the flood flows, increased flood heights downstream of the by-pass channel may also increase for some distance. Extensive detailed hydrologic and hydraulic computer modeling would be required to evaluate and predict the changes to flood flow timing, flood flow rates, duration of flood events, and heights of flooding events for any specific proposed project of this type.

This chapter reviews a bypass channel configuration and location based upon a concept discussed locally, and confirmed by review of the natural topography, primarily to minimize excavation needs and cost. The conceptual by-pass channel evaluated in this report pulls water from near Dukes Bridge and discharges the lake water into the NBR Elkhart River upstream of Cosperville (see Figure 5).

- The flood event considered for reduction was a 1 percent annual chance flood event (100-year).
- Under current conditions, a 1 percent annual chance flood event (100-year) out of West Lakes into the NBR Elkhart River at Cosperville has a flow rate of 1,000 cubic feet per second (cfs).
- During a 1 percent annual chance event (100-year), the proposed by-pass channel



Chapter 6, Figure 5

would need to have the capacity to carry about 770 cfs to lower lake levels 1.1 feet.

- The March 2009 flood was about 0.8 feet lower than the expected 1 percent chance flood elevation of 890.5 feet.
- To achieve the lowering of the lake level 1.1 foot, under this scenario, the flow rate at Cosperville would need to increase from 1,000 cfs to 1,770 cfs.
- In order to be effective, the 6,500-foot-long by-pass channel was sized to be 160-feet wide and 5-feet deep, with 3:1 side slopes.
- The large top width is needed to have the channel capacity in this reach due to a low natural slope.
- An additional weir structure at the edge of the lake, with a crest width of at least 74 feet, would be needed to prevent the lake from lowering below normal level during dry seasons, but still allowing the design flow of 770 cfs to enter the by-pass channel.

The increase in flow from this conceptual by-pass channel when it re-enters the stream was shown, by basic hydraulic modeling, to increase flood stages in the NBR Elkhart River.

- While the by-pass channel could physically be constructed, the current 1 percent annual chance (100-year) level of 890.5 feet would only be reduced to 889.4 feet (1.1 feet).
- Homes would still be subject to flooding and access may still be an issue to many homes.

The increased discharge capacity from the by-pass channel would also significantly increase flood stages in the NBR Elkhart River downstream of the by-pass outlet.

- The total flow in the river during the March 2009 event was around 807 cfs, so the additional by-pass channel flow of 770 cfs needed to lower the lake 1.1 feet would almost double the total flow during flood events.
- The results of this increased flow produced flood stage surcharges of 1.5 ft more than three miles downstream of the outlet near Cosperville.
- Regulatory complexities could become expensive and timely to adequately address. The purchase of flood easements, habitat and/or wetland mitigation, and archeological reviews likely would be required.
- Additionally, the increased flood stages would require the Federal Emergency Management Agency (FEMA), Flood Insurance Study and maps to be updated to reflect the increased flood potential.
- FEMA charges this expense for remapping to the party requesting the project.
- The requesting party would be responsible for any flooding mitigation needed for increased elevations
- Many areas downstream of this potential by-pass channel would be included in the areas requiring the purchase of flood insurance that were not previously included.

A significant concern is that if constructed, a by-pass project sets a precedent for the other many lakes upstream of West Lakes to follow.

- If a by-pass channel is built, other upstream lake communities could assume they have the right to initiate and complete their own drainage projects to reduce their flood elevations.
- The upstream flood problem would then be passed downstream again to West Lakes, potentially cumulatively negating any benefits from this project, and potentially setting the stage for much worse flooding at West Lakes.

This was a simplified conceptual look at a by-pass channel's impacts. This was only the first step of an iterative design process. The above information should not be used for the basis of a construction project without further detailed study, modeling, analysis and permitting.

Creation of Additional Flood Water Storage / Detention Basins Upstream of West Lakes Chain

Many possible approaches to increase flood storage in the upper portions of the drainage basin could be conceived and studied. Depending on the timing of when stored or detained water eventually flows downstream, there is the opportunity to both reduce or increase flood discharges and flood levels, but there is also the possibility that the duration of minor flooding levels will be extended at West Lakes due to delayed release from detention basins. This option has some merit as it mimics and increases the current extensive naturally ongoing flood reduction process that this basin's unique geography provides.

To understand the magnitude of additional water storage discussed in this report, several terms need to be explained. While it is easy to understand how much volume is meant by a gallon of water, a unit of measurement more often used for volume of water is a cubic foot. A cubic foot of water contains 7.5 gallons of water.

The unit of measurement more often used for large volumes of water, the acre foot, also needs explanation. An acre-foot of water is:

- one acre of land covered by water one foot deep, or
- about a football field covered with water one foot deep, or
- contains about 325,900 gallons of water.
- one square mile (640 acres) covered by water one foot deep would be a volume of 640 acre-feet of water.

Storage of a Volume of Water (Without Considering the Refilling Affect of an Ongoing Flood)

One storage concept considered in this chapter:

- Assumes a volume of water in the West Lakes Chain, at a specific lake level, is transferred away from the lakes into some previously constructed but dry storage area.
- It also assumes waters could be drained into the new storage area faster than flood waters currently entering the lakes.
- It was further evaluated based on a specific volume of water that currently would be in the West Lakes Chain between specific lake level elevations.

- This concept does not consider that inflow and outflow during extended periods of high lake levels often extends for days (as during the spring 2009 event when the lakes were at or above 888 feet for periods of up to 15 days).
- This concept does not recognize that the continuing storm event runoff will quickly refill the one-time volume of water moved from the lakes to a storage facility.

Figure 6 is a table that lists the additional storage required in acre-feet for a one-time lowering of the lakes down to the elevation of 886 feet (5.4 inches above the Legal Level of 885.55 feet). It is being assumed that no additional flood flow comes into the lakes after the one time lowering

Storage Volume for one-time lowering to 886 ft				
Lake level	**Staff Gage**	**Surface Area at lake level**	**Storage above normal lake level**	**Pond size for one-time lowering**
(ft) NGVD	(ft) NGVD	Acres	Acre-ft	Acre-ft
885.55	5.55	established normal lake level		
886	6.0	864	223	
888	8.0	1567	2653	2430.5
889	9.0	1918	4396	4172.6
890	10.0	2269	6489	6266.0
891	11.0	2496	8871	8648.5
892	12.0	2723	11481	11258.0

Chapter 6, Figure 6

For example:

If the flood waters rose to 888 ft (or 8.0 on the USGS staff gage), which is a 50 percent annual chance flood event (2-year) elevation, and were lowered by a transfer to dry storage, only two feet to 886 ft (or 6.0 on the USGS staff gage),

- water would need to be transferred into a 2,430 acre-feet storage pond, or
- 243 acres flooded with 10 feet of water (similar to purchasing an average family farm to excavate and flood), or
- 243 football fields flooded with 10 feet of water, or
- 1 (one) square mile of land covered with about 3.8 feet of water.

To lower the West Lakes Chain only four inches (from 886 feet to the crest of the control structure), it would require an area of about 223 acre-feet of storage.

- This would be roughly 22 football fields flooded with 10 feet of water.

Even for modest and short-lived benefits, this option would require massive amounts of property acquisition and excavation.

The extensive area needed for storage is evidence of the existing extensive floodplain acreage around the lakes where flood water now spreads. The West Lakes Chain has significant existing storage volume capacity due the wetland areas surrounding the lakes. Without the storage area that already exists, the flood heights would likely be even higher. Thus, the flood storage pond size required to produce any benefit is extremely large.

Storage of a Volume of Water, During an Ongoing Flood Event

To discuss the potential benefits of additional water storage during an ongoing flood event, it is important to understand both:

- the existing ability of the system to pass flood water downstream, and
- the magnitude of how much flood water continues to enter into Waldron Lake throughout the many weeks it takes for a storm event to pass out of the entire drainage basin.

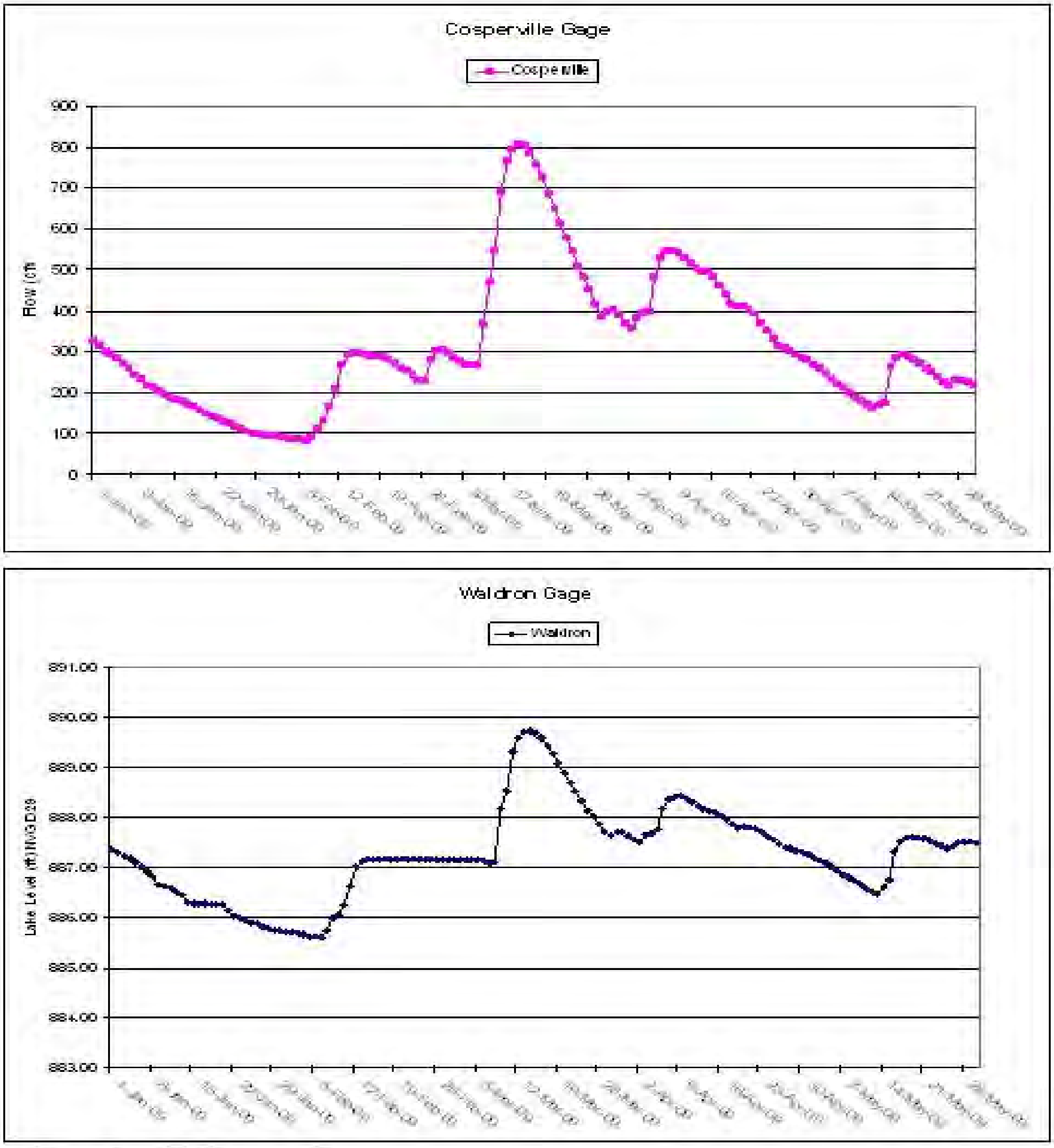
Existing Ability to Pass Flood Water:

It is understandable that during extended high lake levels one might assume significant flow is not occurring through the lake's natural outlet. When standing on a bridge observing stream flow, it is almost impossible to visually grasp the cumulative amount of water passing in any day.

For Waldron Lake and its natural outlet stream, the NBR Elkhart River through Cosperville, it is fortunate that both a USGS stream gaging station and a lake level recording station have been funded and have existed for many years. These two USGS stations provide a true time-based record of the existing ability of the system to pass flood water downstream, and the associated time-based response of the lake level. These gaging and level recording stations provide the ability to look beyond theoretical calculations, to an actual measured system response to a flooding event.

The measurements of rate of flood flow over time at the NBR Elkhart River at Cosperville USGS gaging station, for an actual flooding event, Jan. 1 to May 30, 2009, are shown in Figure 7 (see next page). The lake level over the same time for Waldron Lake is also shown on Figure 7.

- During the March 2009 flood event, water level and flood flow were recorded by both of these USGS gaging and recording stations.
- Based on the measurements, the NBR Elkhart River flow rate response to high lake levels in the West Lakes Chain is very consistent, with changes being shown within the day.
- When lake levels increase, the downstream flow rates in the river also increase to a very high rate.
- When lake levels decrease, the downstream flow rates in the river also decrease.
- On March 14, (at the time of the highest lake level and the highest downstream flow rate), the flow going out of West Lakes past the Cosperville gage was 807 cfs.
- This rate of flow out of West Lakes during this flood is equivalent to a 5,500 gallon tanker truck pumped full of lake water passing under the Cosperville bridge every second. This is 86,400 trucks per day.
- This rate of flow 807 cfs, is also equal to about 1,600 acre-feet of water in a day (which is about 160 football fields flooded with 10 feet of water in a day).



Chapter 6, Figure 7

- During the March 2009 flood event, the river was passing significant amounts of flood water downstream; however, equally larger volumes of flood water are entering the lakes during the flood event, causing extended periods of time with higher than normal lake levels.

The magnitude of water that enters Waldron Lake throughout the many weeks that it takes for a storm event to pass:

A way to view the magnitude of water entering Waldron Lake during the weeks it often takes a storm event to pass is to look at the additional storage needed to sustain a lowering of the level of Waldron Lake during an ongoing flood event.

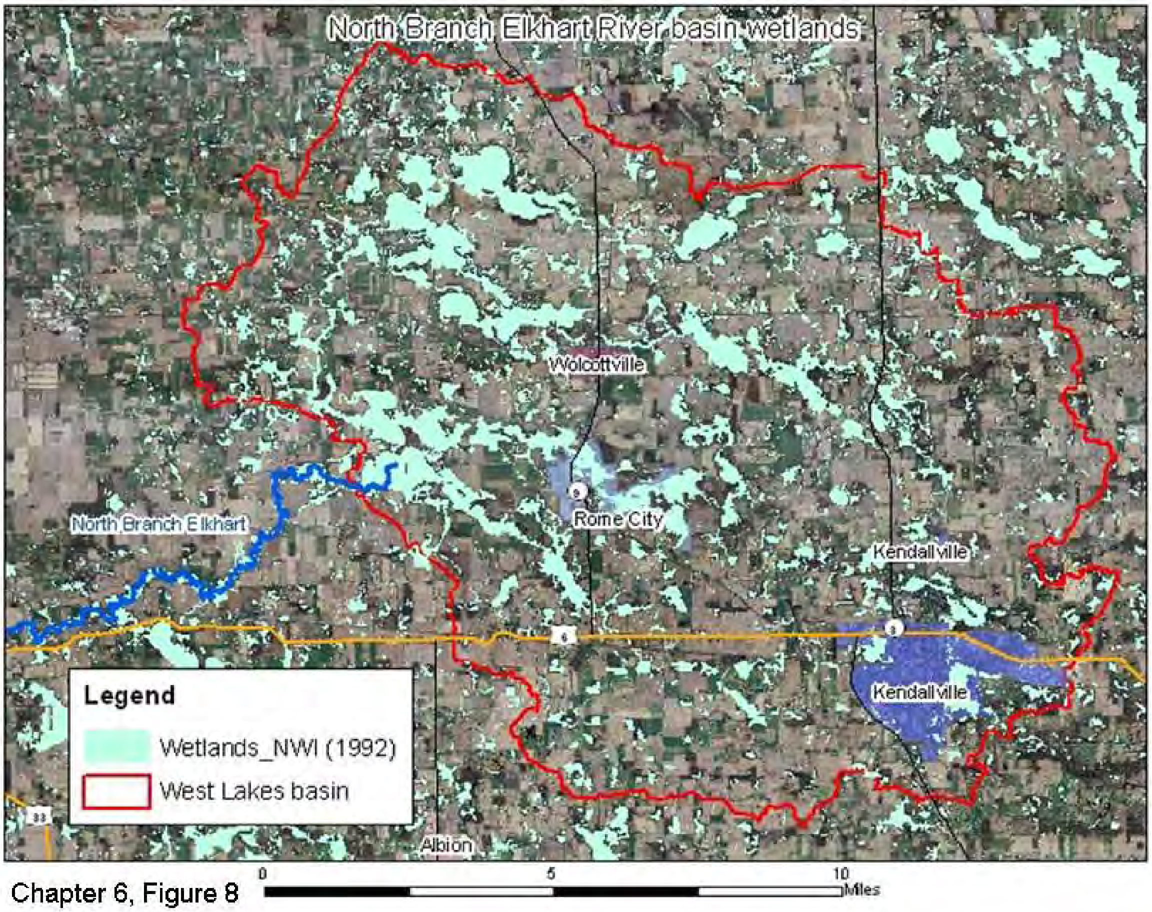
- With the West Lakes Chain at 888 feet, there are 1,567 acres of water surface. This includes surrounding land below an 888-feet elevation that would be covered by high water.
- To create and maintain only a one-inch lowering of water level over that water surface in a single day, for the entire 24-hour period the river would need to pass into storage an additional 65 cfs (cubic feet per second) more than the inflow to the lake, an additional 8 percent higher flow rate than would normally be occuring.
- For every 24-hour period of a flood event, to create and maintain only a one-inch lowering of water level, an additonal storage area holding about 5,600,000 cubic feet would be needed.
- This additional storage area is about 130 acre-feet per day. So an additional 13 football fields would need to be flooded with 10 feet of water per day to sustain lowering West Lakes Chain one inch.
- And the March 2009 event saw lake levels at or above 888 feet for a total of 26 days, which would mean 13 additional football fields 10 feet deep each day for 26 days, or 338 additional football fields for that flood event, for a one-inch benefit.

Even a 2,430 acre-feet pond could be filled in several days with the rate and volume of flood flow into the NBR Elkhart River from West Lakes during high water events as experienced in March 2009. Once the conceptual storage pond is filled, the waters in the lake would once again rise.

Another way to view the size requirements for additional on-going flood storage at West Lakes is to view storage capacity needed in terms of the volume of a totally dry Sylvan Lake. If the flood flows over and above the historical mean monthly flow for March were diverted to storage during the period Jan. 1 to May 30, 2009, how much could Sylvan Lake store? Below normal pool level, Sylvan has a storage capacity of 5,986 acre-feet. Based on the gage data, to keep the lake level of the West Lakes Chain at 886.5 feet, (one foot above Legal Level), it would require the filling of more than five dry lakes the size of Sylvan Lake.

Efforts to preserve existing wetland, flood plain, and ground water storage areas upstream and throughout the drainage basin, provides a more attainable way to ensure upstream storage and beneficial reduction in flood peaks. Returning previously existing natural storage areas to service is a further viable option to provide some benefit. All efforts to limit increased runoff from future development should be encouraged. Finding or building massive new storage areas seems unlikely, but should not be discouraged.

The NBR Elkhart River and associated lakes within the watershed/drainage basin function as a long system of linked lakes and wetlands that act as “rest areas” (see Figure 8, next page). If any of the upstream “speed bump” features such as wetlands and flood plains become filled or reduced in capacity, the bump is removed and water continues downstream faster and with a higher flow rate. When too much water gets to the same place at the same time it becomes a flooding situation. The “rest area” features inherent in the NBR Elkhart River and West Lakes systems currently store flood waters upstream and reduce the high flood peak events in the lower reaches of the system. This type of watershed/drainage basin still experiences flooding; however, without the "rest areas" of extensive upstream storage through out the watershed/drainage basin; the peak flood levels would be much higher. Where possible, previously existing upland wetland, flood plain, and natural depressional storage areas should be identified and restored, to provide their pre-development benefits.



Chapter 6, Figure 8

In summary, additional dry storage, while beneficial, would require vast new areas of storage to provide anything more than a minimal decrease in lake levels, and a brief shortening of the time span that higher flooding lake levels are experienced (lower levels of flooding may actually be experienced over longer time frames depending upon the timing of the release of the stored water). Eliminating high flood levels through new dry storage appears prohibitive due to cost and sheer size.

Lowering the Water Level of Sylvan Lake in the Fall or Winter to Allow for Additional Spring Flood Storage

A concept locally mentioned as a potential project is lowering Sylvan Lake during the winter months anywhere from six inches to several feet. This is expected to create storage for flood waters to fill back up to Sylvan Lake's legally established average level, thus reducing water moving downstream through the West Lakes Chain.

For this analysis, the one-time seasonal lowering of the lake two feet from the legal level of approximately 916 feet down to 914 feet was considered. Sylvan Lake has an increase in storage capacity of about 1,400 acre-feet between these lake levels, (see Figure 9 next page). Above 917 feet, flood damages around Sylvan Lake begin.

Sylvan Lake Storage at varying Lake level			
Lake Level	Total Storage	Storage Increase	Note
(ft)	(Acre-ft)	(Acre-ft)	
914	4520		
914 to 916.1	5920	1400	916.2 ft Sylvan Legal Level
916.1 to 917.1	6600	680	
917.1 to 918	7250	650	flooding on Sylvan Lake

Chapter 6, Figure 9

While Sylvan Lake does have storage capacity if lowered, the flood reduction benefits to the downstream West Lakes Chain has several limitations:

- Of the 134 square miles of total drainage area, the drainage area entering West Lakes chain from the NBR Elkhart River by way of Jones Lake is 67 square miles
- The drainage area entering Waldron and West Lakes Chain from Sylvan Lake is 34 square miles
- Sylvan Lake only represents about one-quarter of the entire drainage area contributing flood waters to the West Lakes Chain
- Sylvan Lake's potential one-time storage area volume of about 1,400 acre-feet equals only 10.7 days of lowering in the one-inch scenario explained above.

In a hypothetical situation, if Sylvan Lake could somehow intercept all the drainage area coming into the West Lakes Chain, its ability to reduce flooding would still be limited.

- During the high-water event experienced in March 2009, the potential Sylvan Lake storage of 1,400 acre-feet made available by lowering the lake two feet would be filled in less than four days.
- The West Lakes system routinely experiences both high-water levels and high outflow for extended periods.
- After four days, downstream flood flows would return to uncontrolled levels.
- Above normal flows were measured downstream of Waldron Lake in the NBR Elkhart River at Cosperville for over a month during the March 2009 event.
- It should also be noted that once Sylvan Lake would return to the legally established average level, either by being intentionally raised for the recreation season, or by a one-time filling from a flood, potential downstream flood reduction ability would no longer exist until such time in the future when Sylvan Lake could again be lowered.

- Lowering the lake level two feet could take weeks to again provide the ability to store any predicted heavy rainfall events.

This option would require funding a modification to the existing dam in order to design and construct a new spillway slide gate feature to allow this type of seasonal water level management. If this option is considered for further action, coordination would need to occur, at least, with the Noble County Circuit Court, the Department of Natural Resources, and the Rome City Conservancy District. If pursued, the Conservancy District would potentially be asked to provide a benefit outside of current District boundaries, and the District may request an annexation of the benefited downstream property to broaden its current assessment base.

In addition to funding design and construction, the Conservancy District will need to find a way to provide funds for the perpetual maintenance and operation of the new spillway slide gate.

CONCLUSION

The conceptual level review of the several targeted projects or activities are as follows:

- The Benton Dam located on the Elkhart River at Benton, Elkhart County was found to have no measurable impact (gates open or closed) on flow from West Lakes Chain.
- Increase the size of the opening below the county road bridge over the NBR Elkhart River at Cosperville may be further evaluated with improved hydrologic models, but is believed to only provide marginal benefits at low and moderate flow/stage events.
- Managing in-channel aquatic vegetation in a specific transitional section of the stream between Cosperville and the outlet works for the lake may have some positive impact on stage reduction for some low to moderate stages for seasonal events.
- Fallen tree and obstruction removal in the NBR Elkhart River, downstream of Waldron Lake may have limited benefits upstream of County Road 300W with little or no measurable benefits downstream of this point for Condition 1 or 2 obstructions.
- Raising selected access roads to residential areas would have direct benefits for access at some higher lake stages.
- Construction of a bypass channel in the NBR Elkhart River, downstream of Waldron Lake, likely would not pass a feasibility study review and would cause increased downstream discharges, high construction and maintenance costs, environmental damages, and potentially set an example for further upstream lake drainage bypass projects that would negate any conceivable benefit.
- Creation of additional flood water storage basins upstream of the West Lakes Chain could have some limited positive benefit over time for moderate level events but would require vast storage areas. Protection and expansion of existing storage, and restoration of previous storage areas, may prove more practical.

- Lowering the water level of Sylvan Lake a foot or two in the fall or winter to allow for additional spring flood storage would provide no practical benefit for flood levels at West Lakes Chain.

The results do indicate some items may provide limited help to decrease water levels in the low to moderate flood levels. Some of these items, if cumulatively practiced, could be of measurable benefit. The focus should be on maintaining a natural stream, but one that is relatively open upstream of approximately County Road 300 West to the West Lakes outlet structure. Activities that decreased the impact of aquatic vegetation in the transition area, tree falls, and bridge restrictions may provide some limited benefit. The benefits of these activities at decreasing higher flood stages for the lakes may not be realized. Increasing the elevation of critical structures, including access roads, may provide the best solution for risk management at higher stages.

Protection of the existing storage should be the top priority in the watershed. The area's currently considerable flood storage benefits from wetland storage. Incremental loss of this storage would adversely impact flooding in this watershed.

INDIANA SILVER JACKETS
NORTH BRANCH ELKHART RIVER
WEST LAKES TASK TEAM

CHAPTER 7 – Agency Resources & Stakeholder Partnerships

A number of funding mechanisms and stakeholder partnership opportunities are available to collectively address a variety of flooding and watershed related issues. Financially successful organizations typically pursue many varied avenues of fundraising, seeking to appeal to more potential partners and connect many small steps into a broader base of support towards a common goal. Some funding mechanisms and stakeholder partnership programs are administered by a State or Federal Agency directly, whereas others have an intermediate partner organization through whom the funding must flow. Still others are more of a public/private partnership. In the listing below is an outline of many funding sources and types of solutions each funding source may provide. As opportunities are always being created and as they often change, no single list could ever be complete. For the items on this list, the lead agency's contact information or website address is made available so the community may pursue any of the funding sources independently. Close attention should be paid to the funding time limitations. Some funds are on annual basis and others may be funded on some other cyclic time frame that may require more extensive work with the sponsoring agency.

This is a sampling of funding sources available and is by no means a complete listing of available opportunities. Funding sources will vary from one funding cycle to the next cycle. It is always best to contact the lead agency and determine if the program is funded and any changes within the programmatic guidance. New programs may also be made available, so it is imperative to stay abreast of new fund raising sources as they become available.

A. HAZARD MITIGATION

Mitigation defined:

Mitigation is the effort to reduce loss of life and property by lessening the impact of disasters. This is achieved through risk analysis, which results in information that provides a foundation for mitigation activities that reduce risk and flood insurance that protects financial investment. Effective mitigation measures can permanently break the cycle of disaster damage, reconstruction, and repeated damage.

Mitigation actions must address the source of damage, the items being damaged or the protection of life and property. Issues identified include:

- Access to homes and businesses due to low lying roads and/or road washouts
- Damage to home interiors due to entry of flood water

- Contamination of well water due to low well heads
- Water storage
- Foundation Damage
- Structural Damage

Federal Emergency Management Agency (FEMA)

National Flood Insurance Program (NFIP)

The NFIP is a Federal program enabling property owners in participating communities to purchase flood insurance as protection against flood losses, while requiring State and local governments to enforce floodplain management ordinances that reduce future flood damages.

Availability of Funds: Funds are available after each flood event upon filing a claim for eligible damages.

Eligible Entities: All property owners, whether you live in a flood plain or not.

Finances: Cost of insurance premium is based upon location within flood plain.

Eligible activities: Repair and/or replacement of structural components and if insured structural contents.

Additional Information and/or contact information:
http://www.fema.gov/government/mitigation.shtm#4

Increased Cost of Compliance (ICC)

The NFIP is a Federal program enabling property owners in participating communities to purchase flood insurance as protection against flood losses, while requiring State and local governments to enforce floodplain management ordinances that reduce future flood damages. Increased Cost of Compliance (ICC) is part of the flood insurance coverage under the standard flood insurance policy. It is an additional source of money to help pay the cost to comply with flood plain regulations.

Availability of Funds: Funds are available after each flood event upon filing a claim for eligible damages. The eligibility is dependent upon the substantial damage of a structure or several losses where total claims equals 51percent of the fair market value.

Eligible Entities: All property owners who live in a flood plain.

Finances: Cost of insurance premium is based upon location within flood plain.

Eligible activities: If a home or business is damaged by a flood, the owner may be required to meet certain building requirements to reduce future flood damage before the structure is repaired or rebuilt. To help you cover the costs of meeting those requirements, the National Flood Insurance Program (NFIP) includes Increased Cost of Compliance (ICC) coverage for all new and renewed Standard Flood Insurance Policies. There are three options.

1. **Elevation**. This raises a home or business to or above the flood elevation level adopted by your community.
2. **Relocation**. This moves a home or business out of harm's way.
3. **Demolition**. This tears down and removes flood-damaged buildings.

Additional Information and/or contact information:
http://www.fema.gov/plan/prevent/floodplain/ICC.shtm

FEMA - Through the Indiana Department of Homeland Security (IDHS)

Hazard Mitigation Grant Program (HMGP)

The Hazard Mitigation Grant Program (HMGP) provides grants to States and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster.

Availability of Funds: Funds are available after each federally declared disaster event. Funding is based on the amount of money expended by FEMA during the disaster event and fluctuates from one disaster event to another.

Eligible Entities: Sub-grant funds are available for qualified governmental entities such as incorporated cities, towns or counties. Sub-grantees must be a participant in a FEMA approved Multi-Hazard Mitigation Plan.

Finances: Grant funds provide up to 75 percent of the total eligible project costs. The local governmental entity must commit to providing 25 percent of the total project costs in matching funds and/or in-kind services.
Eligible activities: Property acquisition and demolition
Property acquisition and relocation

Additional Information and/or contact information:
http://www.fema.gov/government/grant/hmgp/index.shtm
http://www.in.gov/dhs/2402.htm

Pre-Disaster Mitigation Competitive (PDMC)

The Pre-Disaster Mitigation (PDM) program provides funds to States, territories, Indian tribal governments, communities, and universities for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event. Funding these plans and projects reduces overall risks to the population and structures, while also reducing reliance on funding from actual disaster declarations. PDM grants are awarded on a competitive basis and without reference to state allocations, quotas, or other formula-based allocation of funds.

Availability of Funds: Funds are available annually as allocated by Congress.

Eligible Entities: Sub-grant funds are available for qualified governmental entities such as incorporated cities, towns or counties. Sub-grantees must be a participant in a FEMA approved Multi-Hazard Mitigation Plan.

Finances: Grant funds provide up to 75 percent of the total eligible project costs. The local governmental entity must commit to providing 25 percent of the total project costs in matching funds and/or in-kind services. Maximum Project Grant is $3 million federal funds.

Eligible activities: Property acquisition and demolition
Property acquisition and relocation
Minor storm water projects

Additional Information and/or contact information:
http://www.fema.gov/government/grant/pdm/index.shtm
http://www.in.gov/dhs/2402.htm

Unified Hazard Mitigation *(Includes Flood Mitigation Assistance, Repetitive Flood Claims, and Severe Repetitive Loss Grant Programs)*

FEMA provides FMA funds to assist States and communities implement measures that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the National Flood Insurance Program. Under the Repetitive Flood Claims Program (RFC) FEMA provides funds to assist States and communities reduce flood damages to insured properties that have had one or more claims to the National Flood Insurance Program (NFIP). The Severe Repetitive Loss (SRL) grant program, like the Repetitive Flood Claims Program, provides funds to assist States and communities in reducing flood damages to insured properties. These properties are deemed severe loss properties due to the number of flood insurance claims and the dollar value of those claims.

Availability of Funds: Funds are available annually

Eligible Entities: Sub-grant funds are available for qualified governmental entities such as incorporated cities, towns or counties. Sub-grantees must be a participant in a FEMA approved Multi-Hazard Mitigation Plan.

Finances: Grant funds provide up to 75 percent of the total eligible project costs. The local governmental entity must commit to providing 25 percent of the total project costs in matching funds and/or in-kind services.

Eligible activities: Acquisition and demolition of structures from floodplain.

Additional Information and/or contact information:
http://www.fema.gov/government/grant/fma/index.shtm
http://www.fema.gov/government/grant/rfc/index.shtm
http://www.fema.gov/government/grant/srl/index.shtm
http://www.in.gov/dhs/2402.htm

B. WATERSHED/CONSERVATION PRACTICES

U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS)

Environmental Quality Incentives Program (EQIP)

The Environmental Quality Incentives Program is a voluntary conservation program that helps agricultural producers in a manner that promotes agricultural production and environmental quality as compatible goals. Through EQIP, farmers and ranchers receive financial and technical assistance to implement structural and management conservation practices that optimize environmental benefits on working agricultural land. EQIP was re-authorized through the Food, Conservation, and Energy Act of 2008 (2008 Farm Bill).

Availability of Funds: Annually as authorized by Congress

Eligible Entities: Applicants must prove control of the land for the contract period. This means the applicant must hold deed to the land, have a lease for the land over the contract period, or be able to provide a documented historical use of the land. Multiple activities are eligible, and a full listing may be found on the web page listed below. Sample activities include: Access Control - From Stream or Wetland or Woodland, Composting Facility, Critical Area Planting, Erosion control on forest trails and landings, and Pest Management.

Finances: Maximum of $300,000

Eligible activities: Financial and technical assistance to implement structural and management conservation practices that optimize environmental benefits on working agricultural land.

Additional Information and/or contact information:
http://www.in.nrcs.usda.gov/programs/eqip/eqiphomepage.html

Conservation Reserve Program (CRP)

The Conservation Reserve Program (CRP) provides technical and financial assistance to eligible farmers to address soil, water, and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. The program provides assistance to farmers in complying with Federal and State laws, and encourages environmental enhancement. The program is funded through the Commodity Credit

Corporation (CCC). The Farm Service Agency (FSA) administers CRP, and NRCS provides technical land eligibility determinations and conservation planning.

Availability of Funds: Annually as authorized by Congress

Eligible Entities: Farmers

Finances: Funding amount is set annually by Congress.

Eligible activities: The Conservation Reserve Program reduces soil erosion, protects the ability to produce food and fiber, reduces sedimentation in streams and lakes, improves water quality, establishes wildlife habitat, and enhances forest and wetland resources. CRP encourages farmers to convert highly erodible cropland or other environmentally sensitive acreage to vegetative cover, such as grass waterways, native grasses, wildlife plantings, trees, filter strips and riparian buffers. Farmers receive an annual rental payment for the term of the contract. Cost sharing is provided to establish the vegetative cover practices.

Additional Information and/or contact information: For Program assistance and questions contact the local USDA Service Center
http://www.in.nrcs.usda.gov/programs/CRP/crphomepage.html

Wetlands Reserve Program (WRP)
The Wetlands Reserve Program (WRP) is the Nation's premier wetlands restoration program. It is a voluntary program that offers landowners the means and the opportunity to protect, restore, and enhance wetlands on their property. The USDA Natural Resources Conservation Service (NRCS) manages the program as well as provides technical and financial support to help landowners that participate in WRP.

Availability of Funds: Annually as authorized by Congress

Eligible Entities: Agricultural land owners.

Finances: Funding is dependent upon allocation by Congress

Eligible activities: Program objectives are: 1) to purchase conservation easements from, or enter into cost-share agreements with willing owners of eligible land; 2) help eligible landowners, protect, restore, and enhance the original hydrology, native vegetation, and natural topography of eligible lands; 3) restore and protect the functions and values of wetlands in the agricultural landscape; 4) help achieve the national goal of no net loss of wetlands, and to improve the general environment of the country.

Additional Information and/or contact information: For Program assistance and questions contact the local USDA Service Center
http://www.in.nrcs.usda.gov/programs/WRP/WRPhomepage.html

Indiana Department of Natural Resources (IDNR)

Lake and River Enhancement Program (LARE)

The goal of the Division of Fish and Wildlife's Lake and River Enhancement Section is to protect and enhance aquatic habitat for fish and wildlife, to ensure the continued viability of Indiana's publicly accessible lakes and streams for multiple uses, including recreational opportunities. This is accomplished through measures that reduce non-point sediment and nutrient pollution of surface waters to a level that meets or surpasses state water quality standards.

Availability of Funds: As authorized by the State General Assembly and/or State Budget Committee.

Eligible Entities: Local entities, such as Lake Associations, or local governmental units.

Finances: Funding for the LARE Program is provided by an annual fee charged to boat owners. On average, the LARE program has provided over $1 million annually in grants and cost-sharing assistance to eligible projects.

Eligible activities: To accomplish this goal, the LARE Program provides technical and financial assistance for qualifying projects. Approved grant funding may be used for one or more of the following purposes:

1. Investigations to determine what problems are affecting a lake/lakes or a stream segment.
2. Evaluation of identified problems and effective action recommendations to resolve those problems.
3. Cost-sharing with land users in a watershed above upstream from a project lake or stream for installation or application of sediment and nutrient reducing practices on their land.
4. Matching federal funds for qualifying projects.
5. Watershed management plan development.
6. Feasibility studies to define appropriate lake and stream remediation measures.
7. Engineering designs and construction of remedial measures.
8. Water quality monitoring of public lakes.
9. Management of invasive aquatic vegetation
10. Sediment removal from qualifying lakes.

Additional Information and/or contact information:
Technical assistance to this program is provided through the LARE staff's aquatic biologists, and program specialists.
http://www.in.gov/dnr/fishwild/2364.htm

A map showing LARE funded projects in the watershed of the North and South Branches of the Elkhart River can be found in Appendix J.

Indiana Heritage Trust

The Indiana Heritage Trust buys land from willing sellers to protect Indiana's rich natural heritage for wildlife habitat and recreation.

General Assembly appropriations, Environmental License Plate sales and additional donations from patrons have helped IHT to protect more than 50,000 acres since the programs inception.

Availability of Funds: As authorized by the State General Assembly and/or State Budget Committee

Eligible Entities: Divisions of the Department of Natural Resources, and the general public, which includes non-profit organizations, local governments, corporations, individuals.

Finances: Funding is dependent upon General Assembly appropriations, private donations, and Heritage Trust license plate sales.

Eligible activities: Acquisition of property for new or existing state parks, state forests, nature preserves, fish and wildlife areas, and outdoor recreations, historic, or archeological sites.

Additional Information and/or contact information: For program assistance and questions contact the local USDA Service Center http://www.in.gov/dnr/heritage

Hoosier Riverwatch Program

Hoosier Riverwatch is a state-sponsored water quality monitoring initiative. The program started in 1994 to increase public awareness of water quality issues and concerns by training volunteers to monitor stream water quality. Hoosier Riverwatch collaborates with agencies and volunteers to:

- Provide education and training on watersheds and the relationship between land use and water quality.
- Increase public involvement in water quality issues.
- Promote responsible stewardship of water resources.
- Provide water quality information to citizens and government officials working to protect Indiana's rivers and streams.

Hoosier Riverwatch is sponsored by the Indiana Department of Natural Resources, Division of Fish and Wildlife. Funding is provided in part by the Federal Sport Fish Restoration Act Fund

Additional Information and/or contact information:
http://www.in.gov/dnr/nrec/3054.htm

Environmental Protection Agency (EPA), Through the Indiana Department of Environmental Management (IDEM)

Clean Water Act, Section 205(j) Grants

Section 205(j) funding is for water quality management planning projects, focusing on watershed management planning and protection or restoration of critical ecosystems. Funds are to be used to determine the nature, extent and causes of point and nonpoint source pollution problems and to develop plans to resolve these problems.

Availability of Funds: As authorized by Congress

Eligible Entities: Municipal governments, county governments, regional planning commissions, and other public organizations.

Finances: Amount varies, averages $350,000 annually.

Eligible activities: The program provides for projects that gather and map information on non-point and point source water pollution, develop recommendations for increasing the involvement of environmental and civic organizations in watershed planning activities, and develop watershed management plans.

Additional Information and/or contact information:
http://www.state.in.us/idem/4103.htm

Clean Water Act, Section 319(h) Grants

These grants are for projects that reduce documented non-point source water quality impairments. Funds may be available to develop and implement Total Maximum Daily Loads (TMDLs) and watershed management plans, provide technical assistance, demonstrate new technology, conduct assessments, and provide education and outreach.

Availability of Funds: As authorized by Congress

Eligible Entities: Non-profit organizations, universities, and local, state, and federal governmental agencies.

Finances: $4 million annually. Grants are for 60 percent of project costs; a 40 percent matching contribution is required. Federal funds cannot be used for matching.

Eligible activities: Applications are accepted for both Base and Incremental funds (see Program Guidance for definitions). The Section 319 Nonpoint Source Program priorities are:

- Watershed management planning in areas with waterbodies on the State 303(d) List of Impaired Waterbodies. See the 2008 303(d) List Categories 4A and 5A Only [XLS] for the list of non-point source impaired waterbodies.
- Implementing watershed management plans that meet IDEM's 2003 [DOC] or 2009 Watershed Management Plan Checklist.
- Watershed management planning and implementation in areas with approved Total Maximum Daily Loads (TMDLs). See the Total Maximum Daily Load Program for more information.
- Projects that support the mission of the sponsor and have a statewide applicability for water quality improvements or capacity building at the local level.

Additional Information and/or contact information:
http://www.state.in.us/idem/5225.htm

C. OPPORTUNITIES WITH THE U.S. ARMY CORPS OF ENGINEERS (USACE)

Planning Assistance to States Grant
Aquatic Ecosystem Restoration – Section 206 Grant
Clearing and Snagging for Flood Control – Section 208 Grant
Floodplain Management Services (FPMS) Grant
General Investigation (GI) Studies and Projects Grant

Availability of Funds: Annually as authorized by Congress

Eligible Entities: See attached fact sheets

Finances: See attached fact sheets

Eligible activities: See attached fact sheets

Additional Information and/or contact information:
http://www.vtn.iwr.usace.army.mil/environment/envrivers.htm

D. OPPORTUNITIES WITH THE U.S. GEOLOGICAL SURVEY (USGS)

USGS Cooperative Water Program

As the primary Federal science agency for water resource information, the USGS monitors the quantity and quality of water in the Nation's rivers and aquifers, assesses the sources and fate of contaminants in aquatic systems, develops tools to improve the application of hydrologic information, and ensures that its information and tools are available to all potential users.

This broad, diverse mission cannot be accomplished effectively without the contributions of the Cooperative Water (Coop) Program. For more than 100 years, the Coop Program has been a highly successful cost-sharing partnership between the USGS and water-resource agencies at the State, local, and Tribal levels. Throughout its history, the program has made important contributions to meeting USGS mission requirements, developing meaningful partnerships, sharing Federal and non-Federal financial resources, and keeping the agency focused on real-world problems

Availability of Funds: Annually as authorized by Congress

Eligible Entities: State, local, Tribal agencies

Finances: Up to 50 percent of projects that meet the USGS mission requirements. The USGS Water Science Center Director for each State is authorized to commit the funds if work is deemed within the Federal interest.

Eligible activities: USGS data collection of surface-water levels and flow (stream gages), ground-water levels, and ground-water quality; Hydrologic studies that define, characterize, and evaluate the extent, quality, and availability of water resources.

Additional Information and/or contact information: *William Guertal, Director, USGS Indiana Water Science Center, 317-290-3333* ext 175, wguertal@usgs.gov

Web Page: http://water.usgs.gov/coop/
http://in.water.usgs.gov

D. OPPORTUNITIES WITH PURDUE UNIVERSITY

Protecting Our Water and Environmental Resources (POWER)

The Planning with POWER Project is coordinated by the Illinois-Indiana Sea Grant College Program and the Purdue University Cooperative Extension Services. It is a statewide educational program that links land use planning with watershed planning at the local level. The project is designed to empower communities to prevent and solve natural resource problems resulting from changing land use in growing watersheds and to empower local officials to incorporate watershed protection measures into comprehensive land use plans.

Additional information and/or contact information:
http://www.planningwithpower.org

E. OPPORTUNITIES WITH INDIANA UNIVERSITY

Indiana Clean Lakes Program

The Indiana Clean Lakes Program was created in 1989 as a program within the Department of Environmental Management's Office of Water Quality. The program is administered through a grant to the Indiana University School of Public and Environmental Affairs (SPEA) in Bloomington. The Indiana Clean Lakes Program is a comprehensive, statewide public lake management program with five components: Public Information and Education, Technical Assistance, Volunteer Lake Monitoring, Lake Water Quality Assessment, and Coordination with other State and Federal Lake Programs.

Additional information and/or contact information:
http://www.indiana.edu/~clp/

US Army Corps
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Louisville District

PLANNING ASSISTANCE TO STATES

PURPOSE: Section 22 of the 1974 Water Resources and Development Act (WRDA), as amended, authorizes the Corps to help States, local governments, and other governmental non-Federal entities with comprehensive planning for the development, use, and conservation of water and related land resources. Projects are generally regional or statewide in scope, but can also be for individual communities as long as the project is compatible with the State Water Plan. Under this program, the Corps may not participate in any formal design or implementation activities.

TYPES OF PROJECTS: The following list gives examples of studies that can be done under the PAS program:

1) **Water Supply Studies**: Preparing inventories of major water suppliers, of users within the state, evaluation of alternative water sources, evaluation of future water needs, or analysis of a water distribution system.

2) **Water Conservation**: Examining current or projected water demands and potential conservation measures.

3) **Water Quality Modeling for Contaminant Dispersion**: Determining the effects on water quality of municipal or industrial discharges, runoff, or recreation uses.

4) **Flood Control and Floodplain Management**: Developing or updating rainfall/runoff of stream flow models, delineating flood areas, defining floodways, or assessing flood control alternatives.

5) **Flood Preparedness Plans**: Developing or updating evacuation plans and flood-warning systems. Evaluating nonstructural methods of flood protection.

6) **Wetlands Evaluation**: Evaluating the effects of current or future developments on wetlands. Developing an inventory of wetlands.

7) **Navigation**: Inventorying types of traffic, benefits, and maintenance costs for channels and harbors.

8) **Erosion and Sedimentation**: Evaluating erosion potential of proposed projects, surveying reservoirs and sampling inflows to determine effects of sedimentation on storage volumes, or sampling and monitoring movements of contaminated sediments.

9) **Dam Safety**: Assisting the state in inspecting dams and identifying solutions to problems. Running dam breach models and defining downstream inundation areas.

10) **Drought Planning**: Conducting low flow studies. Studying the effects of drought on water supply, water quality, and wildlife.

11) **Groundwater Studies**: Examining quantity and quality of well yields, compiling databases of groundwater sources and uses, determining recharge areas of groundwater sources.

12) **State Water Plan**: Assisting the state in developing or updating a statewide plan for water management, including the development of policies and regulations, and implementation of the plan.

13) **Recreational Master Planning**: Analyzing long-term recreational needs for a region or state.

Typical studies are limited to planning and do not include detailed design or project construction.

FUNDING: A maximum of $500,000 is available annually to each state under PAS and all studies must be completed within 12 months from the date an agreement is signed by both parties. The Corps of Engineers will accommodate as many studies as possible within the funding allotment. Costs are shared 50 percent Federal and 50 percent non-Federal. Up to 50 percent of the non-Federal share may be provided by in-kind services.

REQUESTS FOR ASSISTANCE: Requests for assistance should be submitted in the form of a Letter of Intent from a state or local government agency to U.S. Army Corps of Engineers, Louisville District. Samples are available upon request and should be mailed to **U.S. Army Corps of Engineers, Louisville District, Attn: Chief, Planning Branch, P.O. Box 59, Louisville, KY 40201**. After receipt of a written request, the Louisville District will contact the applicant by telephone and discuss particulars of the problem and of continuing the process.

FOR MORE INFORMATION: If you need more information, you may contact the Louisville District Outreach Coordinator:

Brandon R. Brummett, P.E., PMP
(502) 315-6883
Brandon.r.brummett@usace.army.mil

US Army Corps of Engineers
Louisville District

AQUATIC ECOSYSTEM RESTORATION SECTION 206

PURPOSE: Section 206 of the 1996 Water Resources Development Act authorizes the Corps of Engineers to participate in planning, engineering and design, and construction of projects to restore degraded ecosystem structure, function, and dynamic processes to a less degraded, more natural condition when the restoration will improve the environment, is in the public interest, and is cost-effective.

TYPES OF PROJECTS: Projects typically involve environmental restoration of aquatic and floodplain areas. Completed projects should involve little or no maintenance. Types of projects typically include providing water management, planting of hardwood trees or prairie grasses, and other restoration to enrich aquatic habitat. Limited recreational features compatible with the ecosystem outputs for which the project is designed are permissible.

PARTNERS: Projects require partnering with a non-Federal sponsor who may be a public agency, state or local government, or a large national non-profit environmental organization.

FUNDING: The initial step for a proposed ecosystem restoration project is the preparation of a Preliminary Restoration Plan (PRP). Each PRP is limited to $10,000 and 100% federally funded, taking approximately 2-6 months. For Section 206 projects with a Federal cost exceeding $1,000,000, a Feasibility phase is required. The non-Federal sponsor's share of the costs for all planning and design work, whether done in one or two stages, completed prior to execution of a project cooperation agreement will be initially federally financed. The non-Federal sponsor will be responsible for these costs when the project cooperation agreement is executed. The total project cost will be shared 65 percent Federal and 35 percent non-Federal. The non-Federal sponsor will provide all necessary lands, easements, rights-of-way, relocations, or disposal areas necessary for the projects. In-kind services may be credited toward the local share. The sponsor will be responsible for all operation and maintenance costs. The maximum Federal cost for each project is $5 million. The national limit for 206 projects is 25 million dollars per year.

REQUESTS FOR ASSISTANCE: Requests for assistance should be submitted in the form of a Letter of Intent from a state or local government agency to U.S. Army Corps of Engineers, Louisville District. Samples are available upon request and should be mailed to **U.S. Army Corps of Engineers, Louisville District, Attn: Chief, Planning Branch, P.O. Box 59, Louisville, KY 40201**. After receipt of a written request, the Louisville District will contact the applicant by telephone and discuss particulars of the problem and of continuing the process.

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CLEARING AND SNAGGING FOR FLOOD CONTROL SECTION 208

PURPOSE: Section 208 of the 1954 Flood Control Act authorizes the Corps of Engineers to participate in planning, engineering and design, and construction of projects involving removal of snags and other debris, in-stream clearing and limited embankment construction using material from the clearing operation to reduce damages caused by overbank flooding.

PARTNERS: Projects require partnering with a non-Federal sponsor who may be a public agency, state or local government.

PROCESS AND FUNDING: The initial step for a proposed clearing and snagging project is the preparation of a Planning Design Analysis (PDA), which will result in a determination of whether or not there is a Federal interest in a solution to the identified problem. The first $40,000 of the cost of the PDA is funded 100% Federal. The non-Federal sponsor's share of the costs for all planning and design work completed prior to execution of a project cooperation agreement will be initially federally financed. The non-Federal sponsor will be responsible for these costs when the project cooperation agreement (PCA) is executed. The total project cost will be shared 65% Federal and 35% non-Federal to include the cost of lands, easements, rights-of-way, relocations, or disposal areas necessary for the projects. The non-Federal local sponsor is required to provide 5% of the cost-sharing in cash. The Federal limit for a single project is $500,000. This Federal cost limitation includes all project-related costs for feasibility studies, planning engineering, construction, supervision, and administration. The sponsor is responsible for all costs over the Federal limit. The sponsor will also be responsible for all operation and maintenance costs.

REQUESTS FOR ASSISTANCE: Requests for assistance should be submitted in the form of a Letter of Intent from a state or local government agency to U.S. Army Corps of Engineers, Louisville District. Samples are available upon request and should be mailed to **U.S. Army Corps of Engineers, Louisville District, Attn: Chief, Planning Branch, P.O. Box 59, Louisville,**
KY 40201.

After receipt of a written request, the Louisville District will contact the applicant by telephone and discuss particulars of the problem and of continuing the process.

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Floodplain Management Services (FPMS)

PURPOSE: People that live and work in the flood plain need to know about the flood hazard and the actions that they can take to reduce property damage and to prevent the loss of life caused by flooding. The Flood Plain Management Services Program, known as FPMS, was developed by the Corps of Engineers specifically to foster public understanding of the options for dealing with flood hazards and to promote prudent use and management of the Nation's flood plains. Section 206 of the Flood Control Act of 1960 (PL 86-645), as amended, authorizes the U.S. Army Corps of Engineers to provide technical assistance to identify the magnitude of flood hazards and plan for wise use of floodplains.

TYPES OF ASSISTANCE AVAILABLE: A wide range of technical services and planning guidance on floods and floodplain issues are available under this program. The following list describes various types of work that can be done under FPMS:

1) Flood Damage Mitigation Study: A study of flooding problems within a community with recommendations of measures to alleviate flooding or reduce damages.	**8) Elevation Reference Mark Database:** This could include reference elevations for community planning purposes or for use by individuals.
2) Flood Warning or Preparedness Study: This may include a report or the design of a warning system and emergency evacuation plan based on river stages and rates of rise.	**9) Flood Control Planning Database:** A statewide inventory of all flood control structures and specific information about each.
3) Stormwater Management Study: Analysis of flooding problems caused by inadequate stormwater drainage and recommend improvements.	**10) Urbanization Analysis:** This could look at the effects of watershed development on flood flows and floodplain boundaries. This may be used by a community to set development policy.
4) Special Flood Hazard Information Report: Delineate the 100-year or other frequency floodplain and/or floodway. A local community could submit this report to FEMA to extend or revise FIS floodplains.	**11) Dam Failure Analysis:** Model and prepare maps showing the effects of a dam failure using a 3-dimensional flow model.
5) GIS Floodplain Maps: Mapping of floodplains using Geographic Information System.	**12) HEC-1 and HEC-2 Workshops:** Conduct Workshops on HEC-1 (hydrologic) and HEC-2 (stream profile) computer models.
6) Floodplain Delineation/Inundation Maps: Showing areas flooded at various river stages. This could be used for emergency planning or to set floodplain development policies.	**13) Floodproofing Workshops:** Conduct workshops on floodproofing methods for existing buildings located in floodplains.

7) Community Flood Zone Database: This could contain flood zone information of properties and structures located within designated floodplains.	**14) Community Rating System Support:** Assistance in qualifying for and preparing applications for FEMA's Community Rating System. This may include several of the above items as well as design of floodproofing for repetitive loss structures.

PROCESS AND FUNDING: The program develops or interprets site-specific data on obstructions to flood flows, flood formation and timing; flood depths or stages; flood-water velocities; and the extent, duration, and frequency of flooding. It also provides information on natural and cultural flood plain resources of note, and flood loss potentials before and after the use of flood plain management measures. On a larger scale, the program provides assistance and guidance in the form of "Special Studies" on all aspects of flood plain management planning including the possible impacts of off-flood plain land use changes on the physical, socioeconomic, and environmental conditions of the flood plain. This can range from helping a community identify present or future flood plain areas and related problems, to a broad assessment of which of the various remedial measures may be effectively used.

State and local governments can receive technical assistance free of charge. Requests are funded in the order in which they are received, subject to the availability of funds. Program services are also offered to non-water resource Federal agencies and to the private sector on a 100% cost recovery basis. For most of these requests, payment is required before services are provided. In an effort to reduce costs to the general public and to assure continued community interest, the Corps encourages the involvement of requestors. Local communities can participate by supplying field data, maps, or historic flood information.

All requestors are encouraged to furnish available field survey data, maps, historical flood information and the like, to help reduce the cost of services.

REQUESTS FOR ASSISTANCE: Requests for assistance should be submitted in the form of a Letter of Intent from a state or local government agency to U.S. Army Corps of Engineers, Louisville District. Samples are available upon request and should be mailed to **U.S. Army Corps of Engineers, Louisville District, Attn: Chief, Planning Branch, P.O. Box 59, Louisville, KY 40201**.

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General Investigation (GI) Studies and Projects

GI Studies are the traditional and most common way for us to help a community solve a water resource issue. Project candidates are those whose costs exceed those limited by our Continuing Authorities and include, but are not limited to, multipurpose projects. Types of GI projects include flood damage reduction, ecosystem restoration, navigation, hydropower, streambank stabilization, and watershed management. They involve jointly conducting a study with a sponsor and, if shown by the study to be feasible, the construction and implementation of the project. This approach requires that Congress provide us with authorization to construct or implement the project. Congressional authorizations are contained in public laws, and in resolutions of either the House Transportation and Infrastructure Committee or the Senate Environment and Public Works Committee. The “authority” gives the Corps the permission to conduct a study, implement a project, or do other actions.

PROCESS AND FUNDING: Before a project can be constructed, a planning study or decision document must be completed. There are several types of planning studies and/or decision documents, but for the GI process the most common studies are those that are conducted in two phases: the Reconnaissance Study [also known as a 905(b) study], funded by the Federal government and usually completed in less than 12 months, and the Feasibility Study, optimizing the plan(s) to be built, equally cost-shared, and usually completed in 24-36 months. The first $100,000 is federally funded. If the study cost exceeds $100,000, the cost share is 50 percent Federal and 50 percent non-Federal. Project implementation cost share is typically 65 percent Federal and 35 percent non-Federal. GI Studies require specific congressional appropriations and must be in the Corps budget or appropriated through a congressional add. 100% of the non-Federal share may be contributed as in-kind products or services.

REQUESTS FOR ASSISTANCE: Requests for assistance should be submitted in the form of a Letter of Intent from a state or local government agency to U.S. Army Corps of Engineers, Louisville District. Samples are available upon request and should be mailed to **U.S. Army Corps of Engineers, Louisville District, Attn: Chief, Planning Branch, P.O. Box 59, Louisville, KY 40201**.

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Louisville District

SMALL FLOOD DAMAGE REDUCTION PROJECTS

PURPOSE: Section 205 of the 1948 Flood Control Act provides authority for the Corps of Engineers to develop and construct small flood control projects through a partnership with non-Federal government agencies such as cities, counties, special authorities, or units of State government. Projects are planned and designed under this authority to provide the same complete flood control project that would be provided under specific Congressional authorization. Flood damage reduction projects are not limited to any particular type of improvement.

TYPES OF PROJECTS: Levee and channel modifications are examples of flood damage reduction projects constructed utilizing the Section 205 authority. Utility relocations and alterations of utilities, highways, bridges and public facilities are entirely local responsibilities to be accomplished at the non-Federal partner's expense.

PARTNERS: Projects require partnering with a non-Federal sponsor who may be a public agency, state or local government.

PROCESS AND FUNDING: Projects are undertaken on a cost-shared basis. The first step in the process is completion of a study that determines if there is Federal interest in participating in a solution to the identified problem. In the feasibility study the best solution to the problem and its cost are identified and the project design is developed. The solution must be economically feasible, environmentally sound, and it must have a local partnership. After the feasibility study, project implementation consists of preparation of plans and specifications, local right-of-way acquisition and construction. The feasibility study is 100% Federally funded up to $100,000. Costs over the $100,000 are cost-shared with the non-Federal partner on a 50 percent Federal and 50 percent non-Federal basis. Design and construction costs are shared 65 percent Federal and 35 percent non-Federal. The non-Federal partner must contribute 5% of the total project cost in cash. The value of lands, easements, rights-of-way, relocations, and disposal areas will be credited toward the 35% non-Federal share. The maximum Federal cost for project development and construction of any one project is $7,000,000.

HOW TO REQUEST ASSISTANCE: Requests for assistance should be submitted in the form of a Letter of Intent from a state or local government agency to U.S. Army Corps of Engineers, Louisville District. Samples are available upon request and should be mailed to **U.S. Army Corps of Engineers, Louisville District, Attn: Chief, Planning Branch, P.O. Box 59, Louisville, KY 40201**. After receipt of a written request, the Louisville District will contact the applicant by telephone and discuss particulars of the problem and of continuing the process.

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SECTION 5.4
LOGJAM REMOVAL AND RIVER RESTORATION

Logjams restrict the flow and conveyance of natural streams and ditches which can cause increased flooding, destruction of property and wildlife habitat, and erosion and sedimentation. However, not all in-stream structures cause problems. Submerged and overhanging logs provide important wildlife habitat. In many cases, the ripples caused by obstructions oxygenate the water to improve water quality. It is therefore useful to classify in-stream obstructions based on severity, and employ management techniques based on each category.

Localized logjam removal practices (Practices 401 and 402) are considered superior over large-scale river restoration techniques (Practice 403) because they maintain streams' natural meander geometry with long-term environmental and economical benefits. Because of their non-interference with the geometry of the stream channel and in-channel sediments, localized logjam removal practices are also institutionally more acceptable (usually no permits required) and easier to implement than large-scale river restoration works such as that described in practice 403.

Large-Scale River Restoration (Practice 403) may be accomplished in various ways. The best documented of these methods is the "Palmiter Technique". The Palmiter Technique combines clearing & snagging and inexpensive streambank protection measures to restore the stream channel to its perceived original, non-obstructed capacity. It includes removing logjams and severely leaning trees and using some of the removed material for protection of eroding streambanks. The technique also involves removing or raking of sediment bars, when needed, and revegetating the banks with trees to provide shade.

Effectiveness of large-scale river restoration or clearing & snagging projects in reducing flooding is limited only to small annual floods. **Often times, the effect of these activities on reducing flood stages of larger less frequent floods is negligible or at best limited to 2 or 3 inches of stage reduction.** In most cases, similar hydraulic benefits may be achieved by following the American Fisheries Society Stream Obstruction Removal Guide, i.e., removing only localized logjams, at a fraction of cost and time. (See "Maumee Master Plan" and "Urban Surface Water Management" references for more details.)

Regardless of their effectiveness and despite their drawbacks (in particular, a lengthy and expensive permitting process), large-scale river restoration/clearing and snagging projects are still popular and are pursued by many jurisdictions. So long as the safeguards described in Practice 403 are adhered to, the project may be implemented with minimal impact to the environment.

In all cases, access routes for stream and ditch work should be selected to minimize disturbances to wetlands, floodplains, and riparian areas. All disturbed areas should be restored or replanted with native plant species.

The obstruction classification system used in this manual is based on the "American Fisheries Society Stream Obstruction Removal Guidelines" (see Section 6, References). Five conditions are described: Condition 1 (one) is the least severe, Condition 4 (four) is the most obstructive, and Condition 5 (five) describes special cases. The following discussions are taken from the above-noted document and a document entitled: "MRBC Obstruction Removal Assistance Program".

Condition 1

Minor flow impedance is present, but these obstructions are normally washed downstream or are naturally relocated during moderate flooding events. The obstructions do not pose a significant flood damage risk, and the overall conveyance is acceptable and expected to stay that way. It is recommended that obstructions in this class be left alone unless they are associated with or are within eye-sight of larger obstructions, in which case they may be removed using hand-held tools (Practice 401 Logjam Removal Using Hand-held Tools).

Exhibit 5.4a: Illustration of a Condition 1 Logjam (Source: American Fisheries Society Obstruction Removal Guidelines)

Condition 2

Stream or ditch segments contain small logjams that may be inter-locked and occasionally span the entire width of the stream. Logjams are isolated, but adjacent land use is such that a major obstruction at this location may cause damaging floods in the future. It is recommended that logjams be removed with hand-held tools such as axes, chain saws, and portable winches (Practice 401), unless the logjams are associated with, or are in close proximity to, larger obstructions that require heavy machinery to remove (Practice 402). The extent of the work should be limited to cutting, relocating, removing, or, if appropriate, securing (parallel to the streambanks) any free logs or affixed logs that are crossway in the channel. Isolated or single logs that are embedded, lodged, or rooted in the channel, but do not span the channel or cause any impediment to flow, do not need to be removed. Rooted stumps that do not pose potential blockage problems should remain in place where they will continue to protect the bank against erosion.

Exhibit 5.4b: Illustration of a Condition 2 Logjam (Source: American Fisheries Society Obstruction Removal Guidelines)

Condition 3

Stream or ditch segments contain large accumulations of lodged trees, root wads, and/or other debris that are inter-locked and frequently span the entire width of the stream. Large amounts of fine sediments have not yet covered or become lodged within the obstruction. Some flow can still move around the obstruction, though the flow is somewhat impeded. These obstructions pose an unacceptable flooding risk. It is recommended that stretches in this condition be restored using hand-held tools (Practice 401) if possible. Heavy machinery such as small tractors, bulldozers, log skidders, or other low ground pressure equipment may be used so long as they are not equipped for excavation (Practice 402). The extent of work shall be the same as Condition 2.

Exhibit 5.4c: Illustration of a Condition 3 Logjam (Source: American Fisheries Society Obstruction Removal Guidelines)

Condition 4

Stream or ditch segments contain major blockages that have caused severe and unacceptable flow conditions. Bank erosion and upstream ponding are evident. Existing flood potential will likely increase if the obstructions are not removed. The use of heavy machinery (Practice 402) is likely the only effective way to remove obstructions in this category. The extent of work shall be the same as Condition 2.

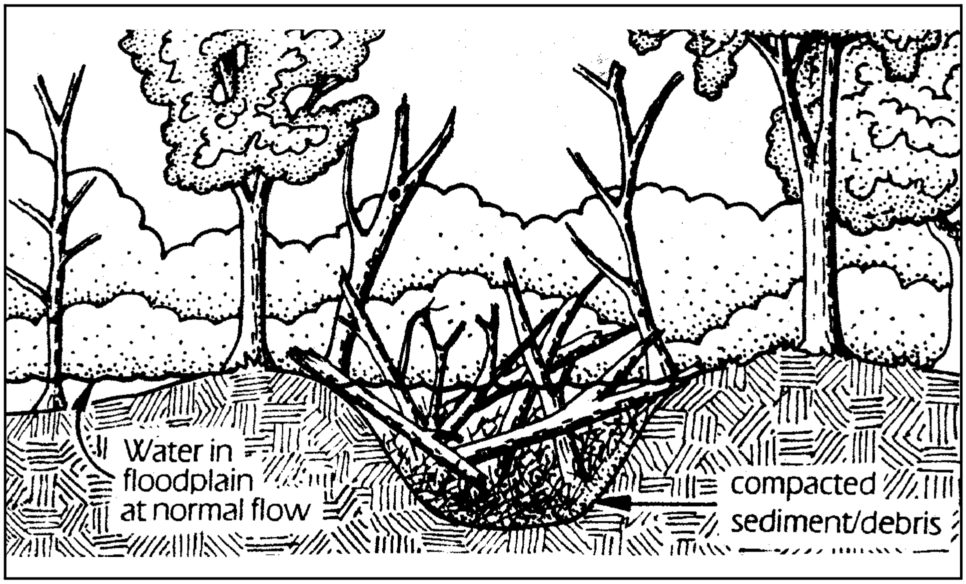


Exhibit 5.4d: Illustration of a Condition 4 Logjam (Source: American Fisheries Society Obstruction Removal Guidelines)

Condition 5

Stream or ditch segments possess unique, sensitive, or valuable ecological resources including rare plants and animals, and rare habitat. These include scenic or recreational rivers. The extent of obstructions may be similar to one of the four conditions described above. Removal of logjams in these streams must be approached on a case by case basis. Generally, obstruction removal using hand-held tools (Practice 401) is more acceptable than using heavy machinery.

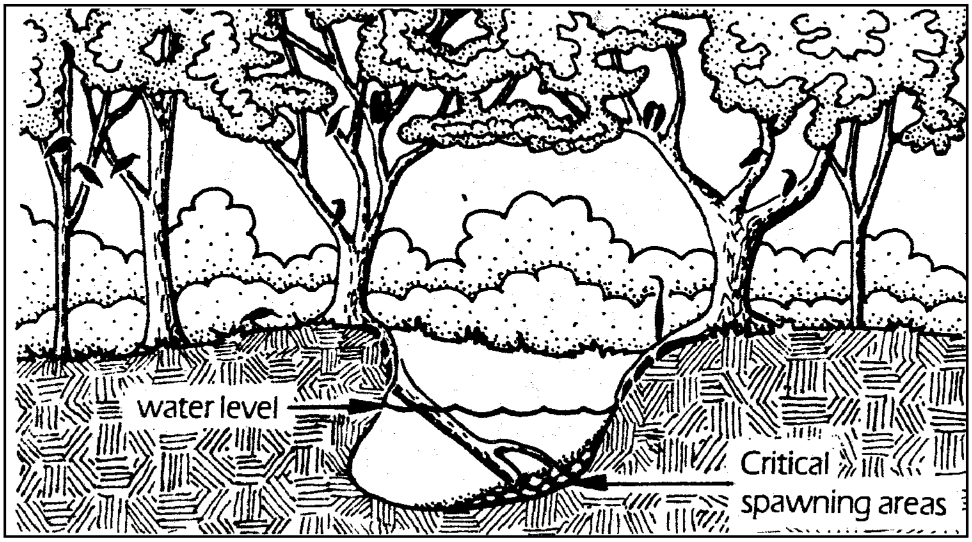


Exhibit 5.4e: Illustration of a Condition 5 Logjam (Source: American Fisheries Society Obstruction Removal Guidelines)

Division of Water
Memorandum

Date: **August 21, 2006**

To: **Ken Smith, P. E.**
Assistant Director

From: **David P. Nance, P. G.**
Engineering Geologist
Project Development Section

Subject: North Branch of the Elkhart River August 17 Float Trip Observations

SUMMARY

On August 17, 2006 Matt Buffington, Division of Fish and Wildlife and David Nance, Division of Water were accompanied by the Noble County Surveyor, Scott Ziegler and his assistant on a 3 to 4 mile river reconnaissance float trip down the North Branch of the Elkhart River. The float trip covered the reach from the public access site at Dukes Bridge, County Road 125 West, downstream to the bridge for County Road 800 North.

During the trip some debris was noted to exist in the channel, but no significant flow obstruction was observed with any of the debris.

- There was no evidence that any debris would, or could impact high lake levels for the upstream West Lakes Chain at the present time.
- At the time of observation all debris observed that would hinder boat or canoe passage could be removed using hand tools to the extent needed for safe passage.
- The downed trees in the channel were what would be typically expected on any stream.

Two large trees were observed approximately ½ distance from the public access site to Cosperville. These trees could appear to be impacting flow, but no apparent flow obstruction, evidence of erosion, or debris accumulation was observed at the time. The trees were visually significant but did not block small boat passage.

BACKGROUND

This float trip was scheduled in response to a request from Senator Meeks to address local lake resident concerns. The residents along West Lakes Chain were concerned that high lake levels in July were associated with obstructions along the river, decreasing discharge from the lake chain.

Initial review of the data provided by the USGS gages at Cosperville and on Waldron Lake, (West Lakes Chain) both indicated the July event was somewhat common and likely should be expected. Full data collection for the lake gage is expected later this fall from the USGS. At that time a more complete comparison of the data would be possible.

The stream gradient does change significantly along the observed reach. Upstream of Cosperville the stream gradient is significantly less than the downstream area. Generally, the sand bottom stream appears to adjust width-to-gradient effectively throughout the reach. Along areas where the gradient is reduced, width increases and the depth decreases. Conversely, where the gradient increases, width decreases and depth increases. The stream generally appears to be stable.

For definition purposes: Logjams are generally classified based on severity of obstruction from condition 1 (low) to condition 4 (high) which reflects the degree to which they impact flow and stream conditions. Condition 1 logjams are briefly and approximately defined as one tree fall extending partially across channel but not significantly impacting flow or significantly hindering small boat passage. Condition 2 logjams are briefly defined as multiple trees that are interlocking and can span the full stream. The lines defining each condition are gradational. Therefore there may be sites considered on the boundary between condition classifications.

Upstream of Cosperville

Upstream of Cosperville there are two sites (1 and 2) where large trees have recently fell in or near the river and could be relatively easily cut up and removed before the limbs become problematic for stream flow. At the present time the river does appear to effectively flow through, under, and around the two trees with out observed erosion. These sites are both located near the center of the north line of Section 15, T35N, R9E. They could be considered large condition 1 logjams. No condition 2 or above logjams were observed upstream of Cosperville.

Some construction activity observed in this section of the river may be checked for permit status. In addition, one discharge to the stream may be checked with IDEM for NPDES permit status.

Downstream of Cosperville

Minor bank erosion was observed on two sites (8 and 11), significant erosion on one site (9), and boat passage was somewhat obstructed on 2 additional sites (9A and 13). These sites are condition 1 to small condition 2 logjams. The sites were not causing significant flow obstruction.

On one site (9 and 9A) near the east line of Section 21, T35N, R9E a relatively minor right bank tree fall, condition 1 logjam, was shifting flow to the left bank at the leading section of the formation of a cut bank. This relatively minor flow diversion appears to be increasing the erosion of the cut bank and two or more trees on the top of the cut bank have been compromised by the erosion. These trees are in a position that will likely lead to additional tree falls into the river at this point producing a condition 2 logjam and may possibly develop into a condition 3 logjam in time.

Just downstream from the above mentioned location a large tree fall from the right bank was obstructing boat passage but not impacting flow. Both these sites (9 and 9A) could be addressed in the same operation. Access from the south, left bank may be relatively simple.

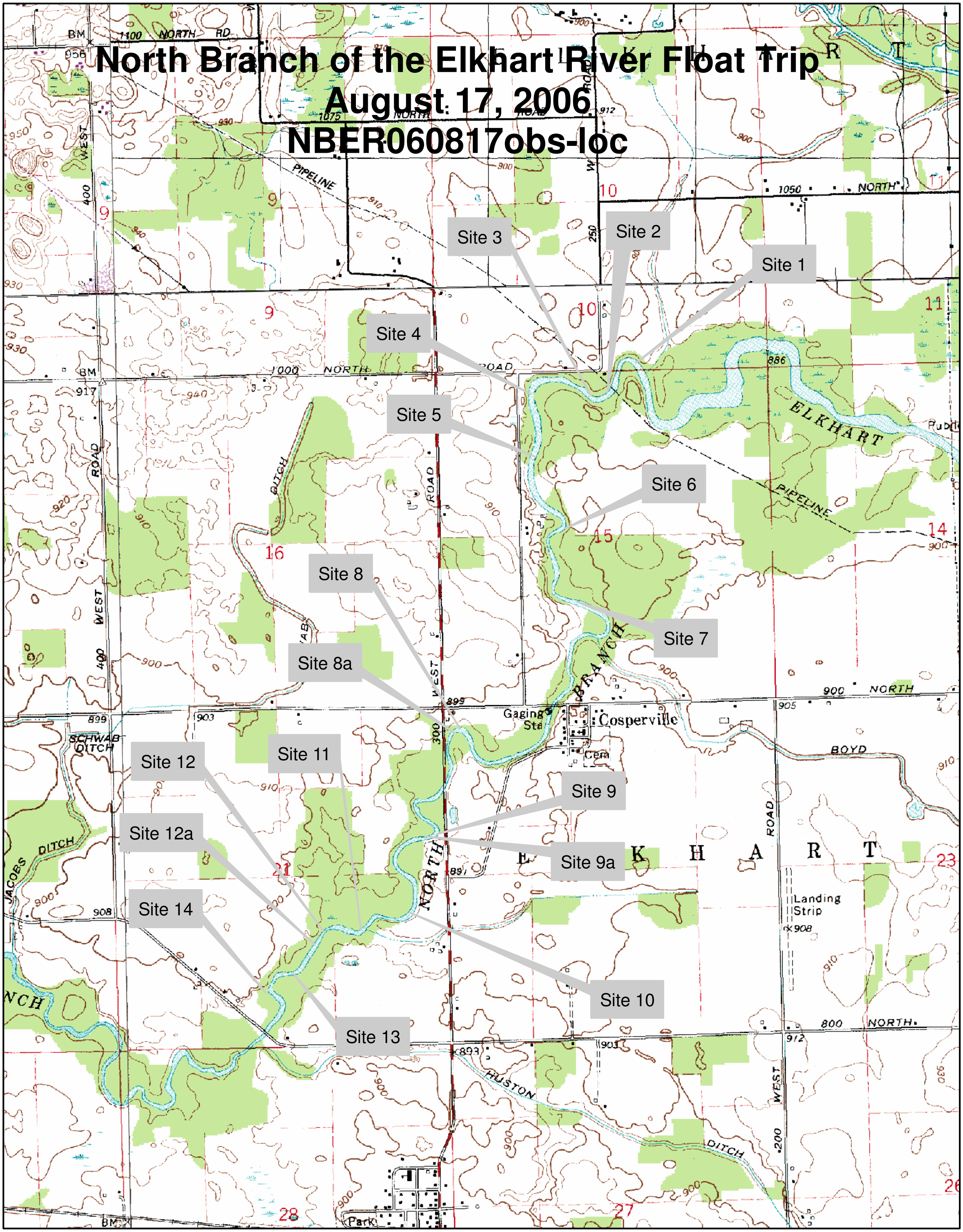
The additional relatively small condition 2 logjams downstream of Cosperville could all be removed using hand tools to the extent necessary for boat passage. One site (11) also contained two relatively small downstream trees leaning over the stream from the left bank and contacting trees on the right bank. These trees could be cut / trimmed and the site monitored.

One large pump and intake was noted near the end of the trip. The registration status of this pump and permit status for the intake may be checked.

During the float trip approximately 20 minutes of video was recorded to document 14 sites. Each site video includes an image of the GPS receiver and a brief narration of the observation. Additional still images from video and from a digital camera have been compiled to further document the trip and observations. The sites have been located on map images and saved in .pdf format for file record. All data has been transferred to a subdirectory, NBER060817, on the Project Development subdirectory located on the Division of Water common drive.

For a description of logjams and condition status please refer to the Division of Water internet site at:
http://www.in.gov/dnr/water/surface_water/DrainageHandbook/pdf/Sec5-4.pdf

North Branch of the Elkhart River Float Trip
August 17, 2006
NBER060817obs-loc



1:24,000

2,000 1,000 0 2,000 Feet

INDIANA DEPARTMENT OF NATURAL RESOURCES

Division of Water
Memorandum

Date: **August 24, 2009**

To: **Ken Smith, P. E.**
Assistant Director

From: **David P. Nance, P. G.**
Engineering Geologist
Project Development Section

Subject: North Branch of the Elkhart River August 6 Float Trip Observations

SUMMARY

On August 6, 2009 Doug Nusbaum, Division of Fish and Wildlife, and David Nance, Division of Water were accompanied by the Noble County Surveyor, Scott Ziegler, and his assistant on a 9 mile river reconnaissance float trip down the North Branch of the Elkhart River. The float trip covered the reach from the public access site at Dukes Bridge, County Road 125 West, downstream to the confluence with the South Branch; taking out at the public access site on the South Branch of the Elkhart River at US 6, approximate ¾ mile upstream of the confluence for a total trip length of approximately 10 miles. The total on-water time for the trip was 6 hours; therefore, little time was spent on individual site evaluation and little obstruction to canoe passage was encountered.

During the trip some debris was noted to exist in the channel, but no significant flow obstruction was observed with any of the debris.

- There was no evidence that any debris would, or could impact high lake levels for the upstream West Lakes Chain at the present time.
- The downed trees in the channel were typical of what would be expected on any stream of this size.
- At the time of observation all debris observed that would hinder boat or canoe passage could be removed using hand tools to the extent needed for safe passage.
- A few sites on the North Branch did pose an obstacle to canoe passage. There were possibly two actual portages where both occupants of the canoe had to get out too traverse a blockage.
- Most of the sites where woody debris had blocked canoe passage had been cut open by unconfirmed and unnamed volunteer labor, probably recreational users of the stream. Their efforts were appreciated by this author.
- No site was observed to have moved from the location of the initial fall and very little off site debris, natural or anthropogenic, was observed in any of the woody debris sites.
- Two sites of problematic bank erosion were noted along with one failed / eroded tile site. Sedimentation issues associated with sites were beyond this scope.
- Extensive aquatic vegetation was found in the areas of the stream with the most sun exposure. This was particularly evident in the North West quarter of Section 15, Township 35 North, Range 9 East. This area may warrant additional investigation as it

may be possibly restrictive at lower water levels and flows. Pondweed was observed in this section during the August 2006 trip, but not to the extent that it is currently present.

Maps were compiled showing the observation locations as referenced in this report. These maps can be found attached with additional information such as typical images and profile information.

Two sites where large trees had fell (sites 4 and 5) were observed approximately ½ distance from the public access site to Cosperville. These trees could appear to be impacting flow, but no apparent flow obstruction, evidence of erosion, or debris accumulation was observed at this time. The trees were visually significant but did not block small boat passage.

BACKGROUND

This float trip was scheduled in response to a request from Deputy Director Ron McAhron to document existing stream conditions for local lake and riparian resident concerns. The residents along West Lakes Chain were concerned that high lake levels in July were associated with obstructions along the river, thus decreasing discharge from the lake chain. Local riparian and recreational user interests were somewhat divided on the issue of problems associated with obstructions in the stream.

Initial review of the data provided by the USGS gages at Cosperville and on Waldron Lake, (West Lakes Chain) both indicated the high water levels and high flow in March of this year. Several events occurred this spring that held the discharge rates up but also held up the lake level beyond normal levels.

On the day of this trip the lake level was observed to be 6.12 feet on the USGS gage, or 886.12 feet, NGVD 1929. The stream gage at Cosperville was recording a stage of 3.91 feet and a flow of 42 cubic feet per second or 83 acre feet per day. The elevation datum for the stream gage at Cosperville is 880.12, NGDV 1929, therefore the water surface elevation recorded at the Cosperville gage at the time of the trip was 884.03 feet NGVD 1929; 2.09' feet lower than lake level.

The stream gradient does change significantly along the observed reach and does contribute significantly to the change in stream morphology. Stream profile graphs are available at Division of Water or in the FIS for Noble County. Upstream of Cosperville the stream gradient is significantly less than the downstream area.

The stream generally appears to be stable. Only two sites of potentially problematic bank erosion were observed. Comparison of the 2005 aerial photography and the 1972, USGS 1:24,000 scale topographic maps show a stream that has remained in approximately the same channel for the period. GPS points collected on this trip, downstream of Cosperville tend to fall in the channel as noted on the 2005 aerial. Unfortunately, GPS coordinates upstream of Cosperville were not recorded on this trip but were recorded on the 2006 trip and found to be consistent.

For definition purposes: Logjams are generally classified based on severity of obstruction from condition 1 (low) to condition 4 (high) which reflects the degree to which they impact flow and stream conditions. Condition 1 logjams are briefly and approximately defined as one tree fall extending partially across channel but not significantly impacting flow or significantly hindering small boat passage. Condition 2 logjams are briefly defined as multiple trees that are interlocking and can span the full stream. The lines defining each condition are gradational. Therefore there may be sites considered on the boundary between condition classifications. For additional information on logjams the reader is directed to the Indiana Drainage Handbook, Section 5.4. **http://www.in.gov/dnr/water/surface_water/DrainageHandbook/pdf/Sec5-4.pdf**

During the float trip approximately 30 minutes of video was recorded to document the sites and conditions. In addition, several still images from video and from two digital cameras have been compiled to further document the trip and observations. Some images were chosen to represent individual sites and can be found in the site photographs document attached. The video and additional images are available for additional views of specific sites and will be placed on the Division of Water H:/PD subdirectory for a short period of time due to the size of the files.

Several evaluations of this reach or portions of this reach of the North Branch of the Elkhart River have occurred over the past 25 years. An analysis or inclusion of this history is beyond the scope of this document. However, two previous projects on the stream have been completed. In 1986 the State spent $55,313 to address 12.5 river miles and in 1999 the state spent $119,000 to address log removal for 7.4 river miles.

Most recently a survey was conducted of the bridges from County Road 300 West up stream to the public access site for Waldron Lake, West Lake Chain. That survey included spot water surface elevations and profile for the reach at a time when the water surface was higher than on the day of this float trip. The graphic images depicting the results of that survey are also attached to this memo.

Upstream of Cosperville

Upstream of Cosperville, the first site noted (site 2 on the attached map) was the lake level outlet control structure. Water depth was checked starting approximately 50 feet up stream and for approximately 30 feet downstream of the structure. A relatively consistent depth of approximately 3 feet was observed, or a bottom elevation of approximately 883.1 feet, NGVD 1929. Depth at the site was checked in one pass, slightly south of the centerline of the structure. Additional observations could provide additional information for bottom configurations. The bottom material felt like sand at every point checked for depth and bottom material from the launch site to the area downstream of the structure, when at paddle depth. Over this reach the bottom was generally not visible due to water clarity and vegetation.

There was a relative abundance of aquatic vegetation in the channel near the outlet grade control structure. The vegetation did not appear to be restrictive to flow at the present level. Subtle evidence of flow was noted at this site.

As the trip progressed downstream, the channel entered a wide wetland area dominated by aquatic vegetation (site 3 on the attached map). A relatively clear channel or open area existed with mostly open water with no visible impediment to flow under existing conditions.

On the downstream end of the wetland area the outlet channel entered more of a stream environment. In this reach/section water clarity was significantly better than observed at the control structure approximately one half mile upstream. The sand bottom was visible even at depths that exceeded paddle depth. It is at this point (upstream of site 4 on the attached map) that the current becomes visible as movement on the aquatic vegetation. The vegetation also changes as it becomes dominated by pond weed with duckweed.

Just upstream of the pipeline crossing, upstream of site 4, there is a stream that enters the stream on the north, right bank. Some woody debris exists in this general location. The stream seems to become slightly wider and shallower at this point. The pondweed increases significantly at the pipeline crossing near site 4 and continues throughout the northwest quarter of Section 15, for approximately 2000 feet of stream. Throughout this section the stream bottom appeared to be sand when tested with the paddle. The water depth, where traversed, was generally less than a foot and a half. Pondweed development was minimal in areas of maximum shade, along the left or south bank. Conversely pondweed dominated the areas of the stream with full or maximum sun exposure. In this section there were a few observed areas, (Sites 4 through 5.1 on the attached map) where tree fall would constitute a condition 1 logjam. At these sites a relatively large tree or two had fallen into the stream but did not cross the stream and was not observed to be blocking flow. Passage by canoe was easy with 30 or more feet of open water. The area is defined to end at the farm bridge, (site 6 on the attached map). Just upstream of the farm bridge full sun exposure, wide and shallow depth resulted in a mass of pond weed. The shade of the bridge prevented full development of the plant and the shade downstream of this point marked a transition into a changing stream environment.

The next reach/section extends from the farm bridge to just upstream of the County Road 900 North Bridge. This sections is dominated by shade, has a water depth of generally less than one and one half foot, sand bottom with a few cobbles and very rare boulders. In this section a few relatively minor condition 1 logjams exist as noted on the map as sites 7 and 7.1. The stream is generally not as wide as the previous section and has notable current. Pondweed is not obstructive to canoe passage, possibly due to the shade or partial shade afforded much of the reach.

The area associated with the County Road 900 North Bridge is a bit unique. At some point less than 100 feet upstream of the bridge and possibly less than 50 feet, the bottom appears to become dominated by gravel to boulders as the bridge is approached. The velocity increases significantly in the approach to the bridge.

The reach that extends from just downstream of County Road 900 North to County Road 300 West is marked by an increased current velocity, a bottom that is dominated by sand and gravel with visible cobbles and occasional boulders. The section is somewhat narrower than the previous section with a water depth generally less than one and one half feet. Downstream of the bridge the stream bottom transitions from dominated by boulders and cobbles to dominated by sand and gravel over a relatively short distance. Pondweed development appears to correlate with sun exposure but does not appear to impede flow due to the velocity of the water as associated with a likely increase with stream slope. The floodplain is not well developed over much of this section. Only one minor condition 1 logjam, site 8 on the attached map, was observed in this reach. Minor stream bank erosion was noted along the right bank near County Road 300 West.

Downstream of Cosperville

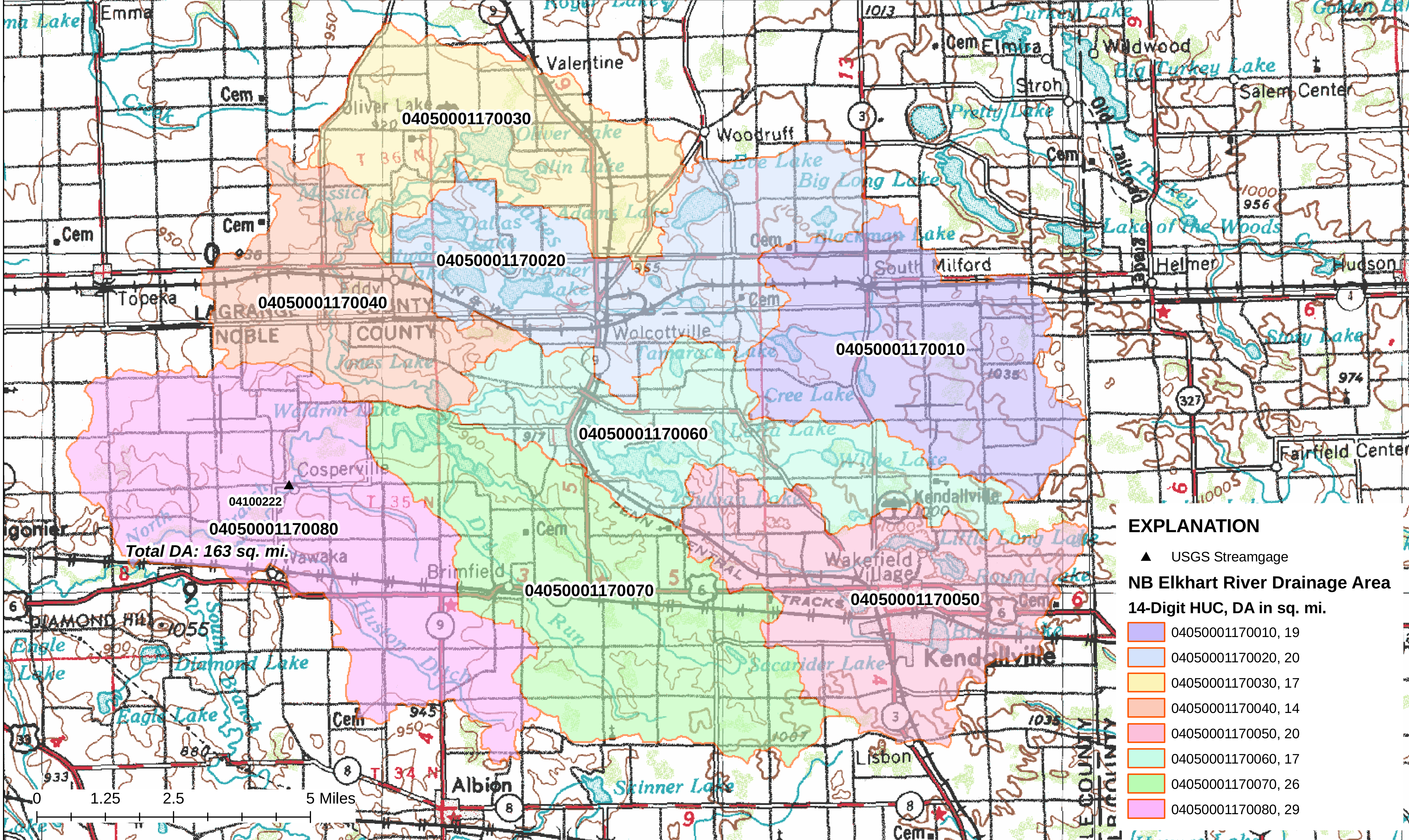
The reach extending from County Road 300 West to County Road 800 North can be characterized as generally less than one foot deep, slightly narrower than the previous section, with approximately the same or slightly less average current. This reach has a sand bottom with occasional gravel and some boulders. The floodplain appears to be fairly well developed over this section with a normal bank height of less than 3 feet. Some more significant condition 1 logjams exist in this reach. The area associated with site 9 was noted in the 2006 trip as a site of bank erosion. This erosion has progressed causing additional tree falls. The 2006 obstruction, extending from the right bank, was likely removed, but erosion progressed causing the stream to undercut some trees along the left bank. At the time of this trip the trees, while fully compromised, were not in the water; therefore do not fit the definition of a condition 1 logjam, but should be treated as a significant condition 1. Sites 11 through 13 are typical condition 1 logjams. Some posed an obstruction to canoe passage because they extend across the stream. Most have been cut through, to some extent, by recreational users of the stream minimizing the obstruction to canoe passage. None of the sites appeared to be causing an obstruction to flow.

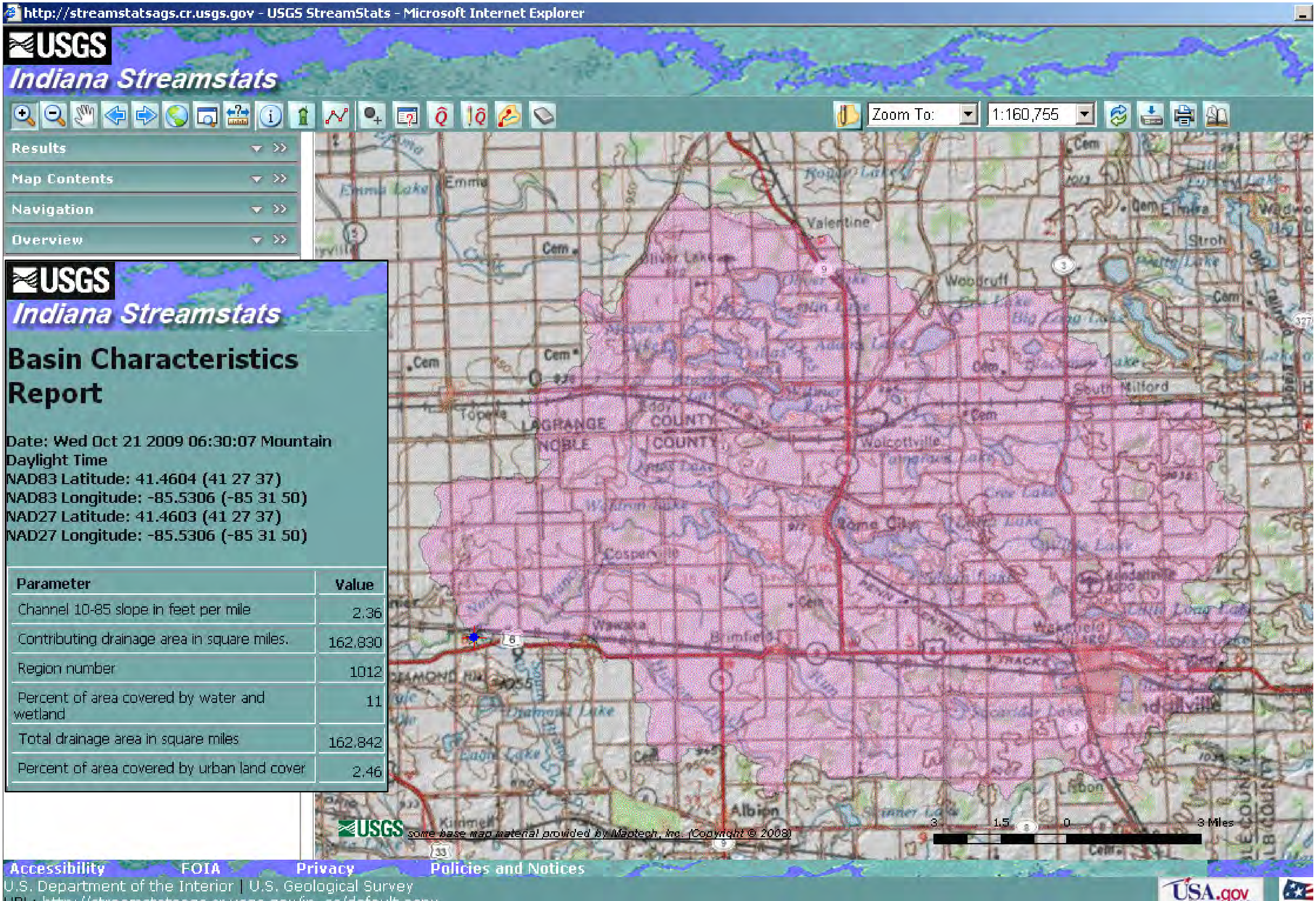
The next reach extends from County Road 800 North to downstream of County Road 450 West, extending to site 25, in the South East ¼ of Section 19, Township 35 North, Range 9 East. This reach is characterized by a slightly wider stream, water depths of generally less than one foot. The stream bottom is sand with little gravel and with an occasional or rare large boulder. The floodplain appears to be fairly well developed and fully forested, with a bank height of 2 to 3 feet. Several condition 1 logjams exist in this reach. Some are significant and may be considered low order condition 2 because they full extend across the stream and, although not interlocked, do contain more than one tree, but usually just from one bank. Some of these sites do pose an obstruction to canoe passage, but most have been cut by recreational users of the stream. Site 18 on the attached map is of particular interest due to evidence of significant bank erosion and the possible inclusion of additional large trees as the erosion progresses. Site 20 is also interesting due to the presence of a man made boulder feature in the stream. This is possibly the site of a small in channel dam or ford crossing. An accompanying linear feature may exist on the floodplain.

The last reach extends from approximately the south line of Section 19 to the confluence with the South Branch of the Elkhart River. This reach can be characterized as having a broad flat forested floodplain, bank heights of approximately 3 feet or more, a well defined stream with sand bottom and rare boulder. The reach appears relatively stable with a lower gradient. The railroad bridge was under construction at the time of the trip resulting in 75% of the opening closed with a coffer dam.

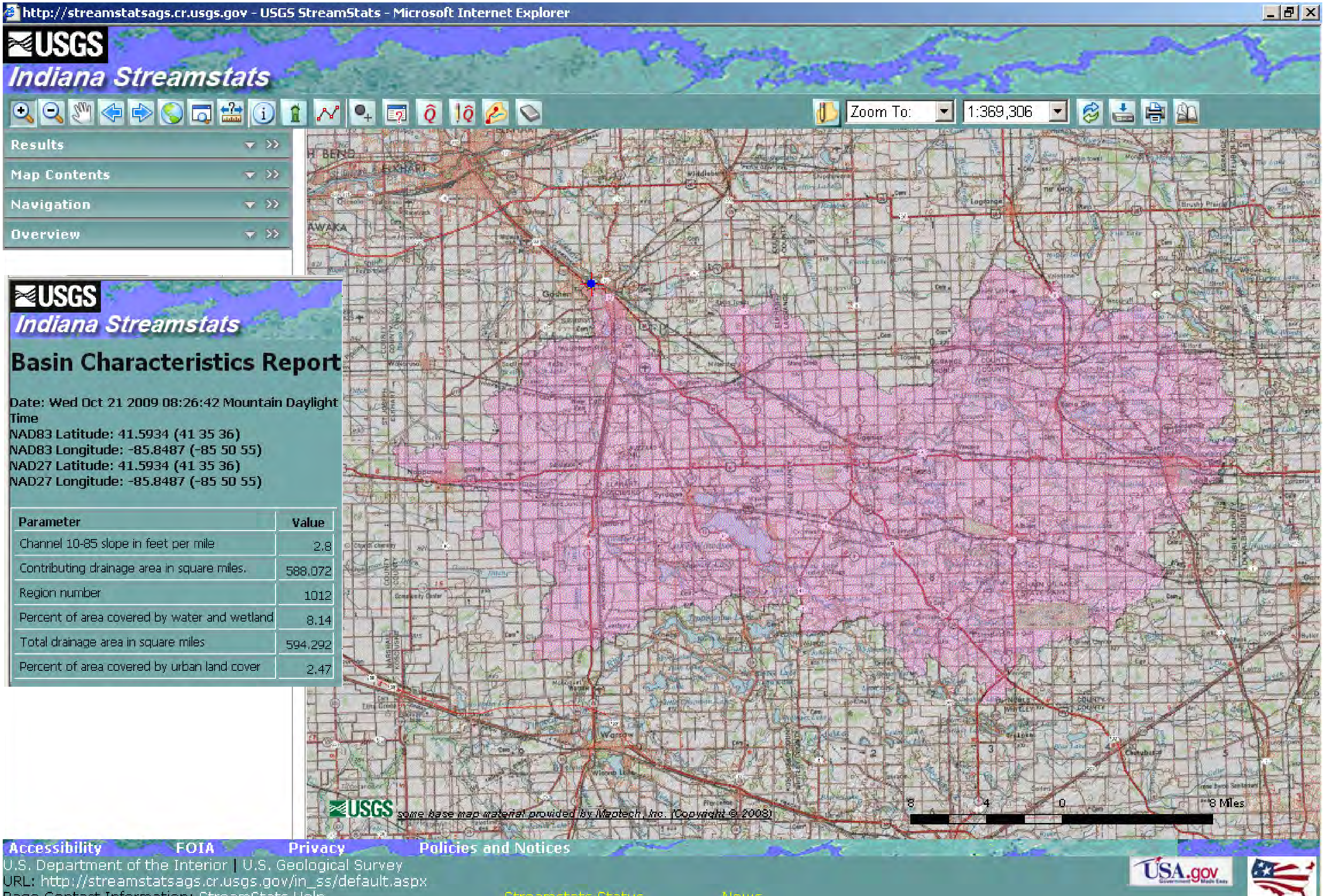
The trip ended at the public access site on the South Branch of the Elkhart River, just north of US 6. The reach had a few condition 1 logjams; two were problematic for canoe passage. The water clarity was much lower in this stream. The current was light enough to provide to acceptable canoe passage upstream approximately 4000 feet to the public access site.

North Branch of the Elkhart River Drainage Area Including 14-Digit HUCs

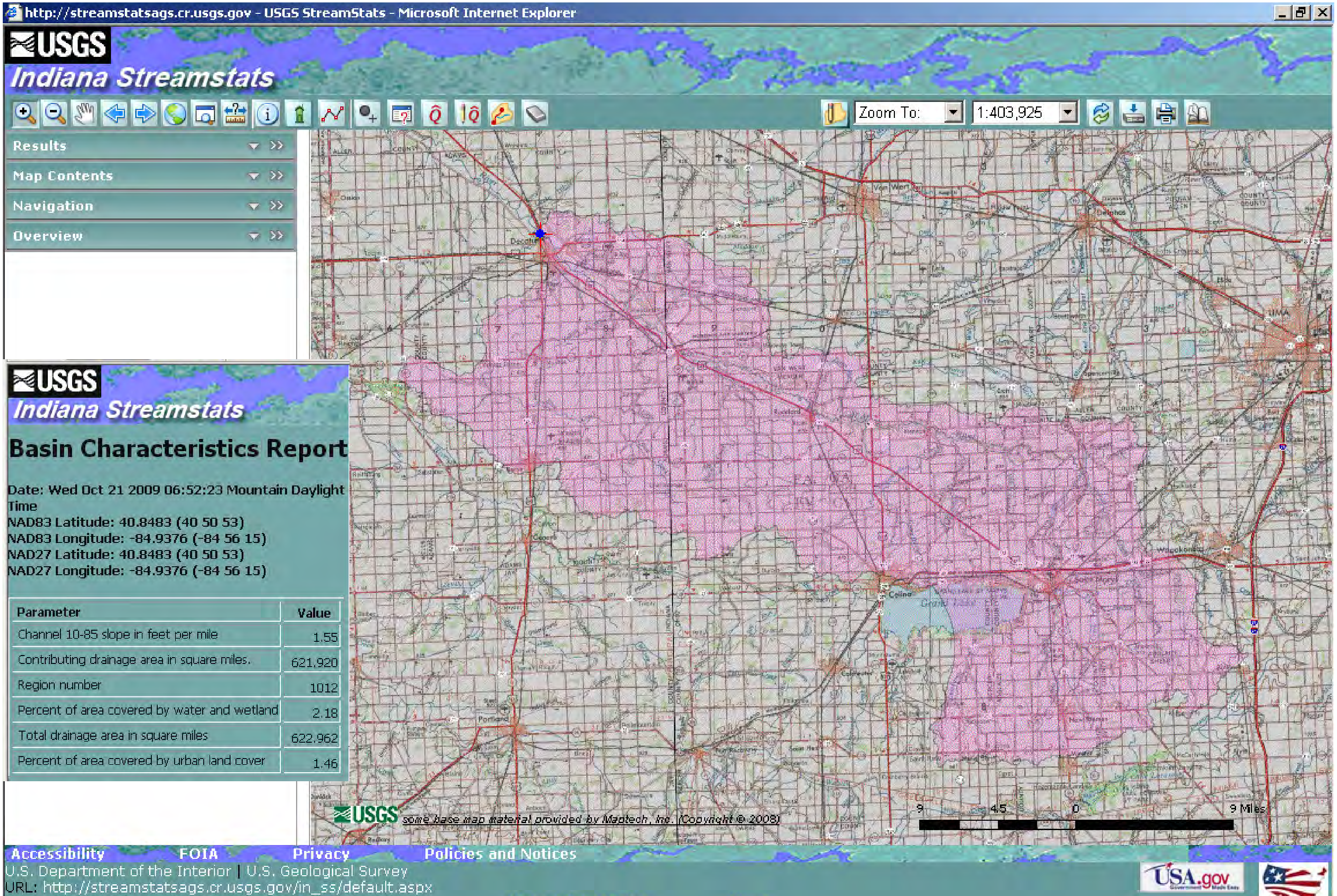




Appendix 6, Sheet 1: Computer screen captures from USGS StreamStats of the N. BR. Elkhart River, watershed :
http://water.usgs.gov/osw/streamstats/indiana.html

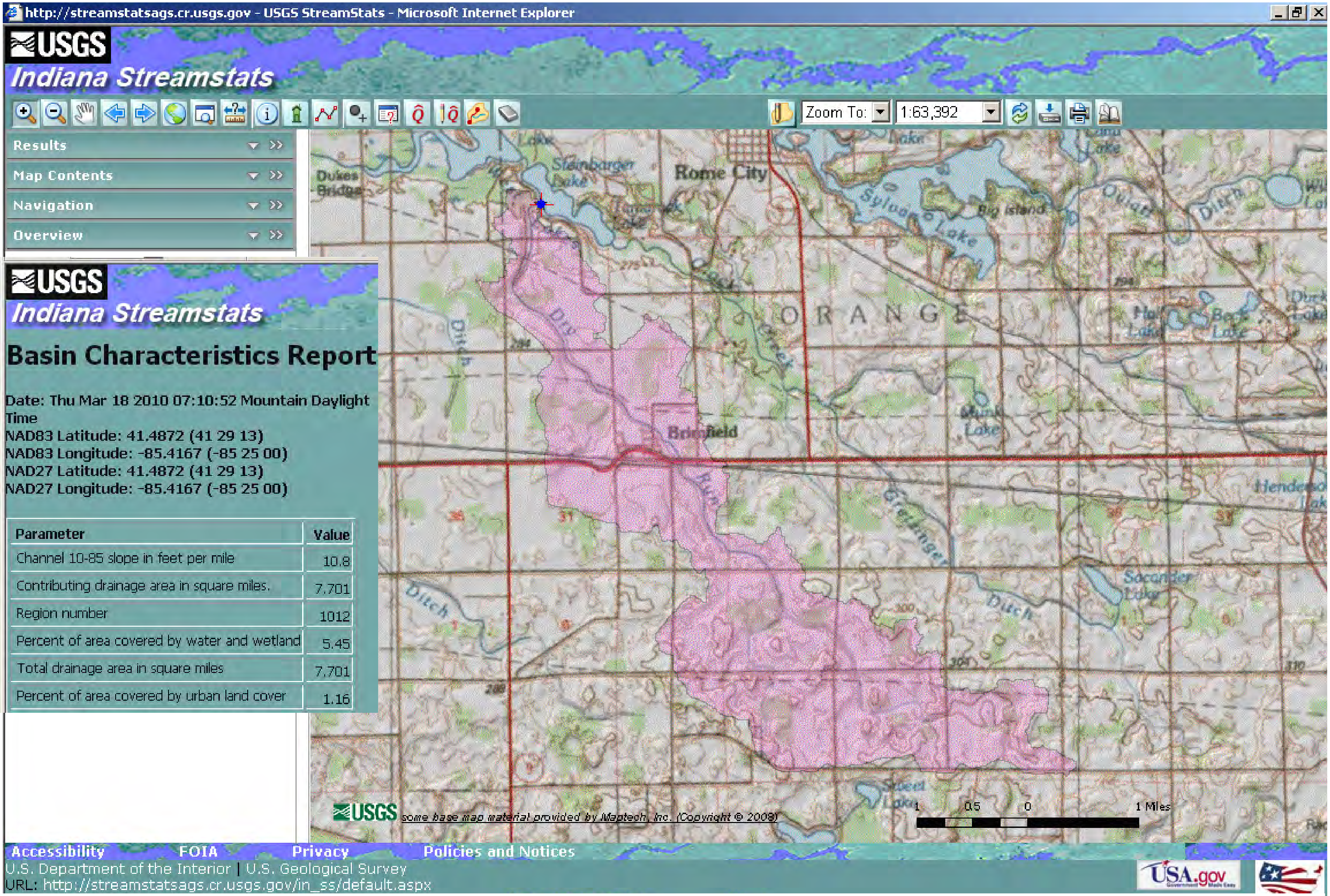


Appendix 6, Sheet 2: Computer screen captures from USGS StreamStats of the Elkhart River at Goshen watershed :
http://water.usgs.gov/osw/streamstats/indiana.html



Parameter	Value
Channel 10-85 slope in feet per mile	1.55
Contributing drainage area in square miles.	621.920
Region number	1012
Percent of area covered by water and wetland	2.18
Total drainage area in square miles	622.962
Percent of area covered by urban land cover	1.46

Appendix 6, Sheet 3: Computer screen captures from USGS StreamStats of the Saint Mary's River at Decatur watershed : http://water.usgs.gov/osw/streamstats/indiana.html



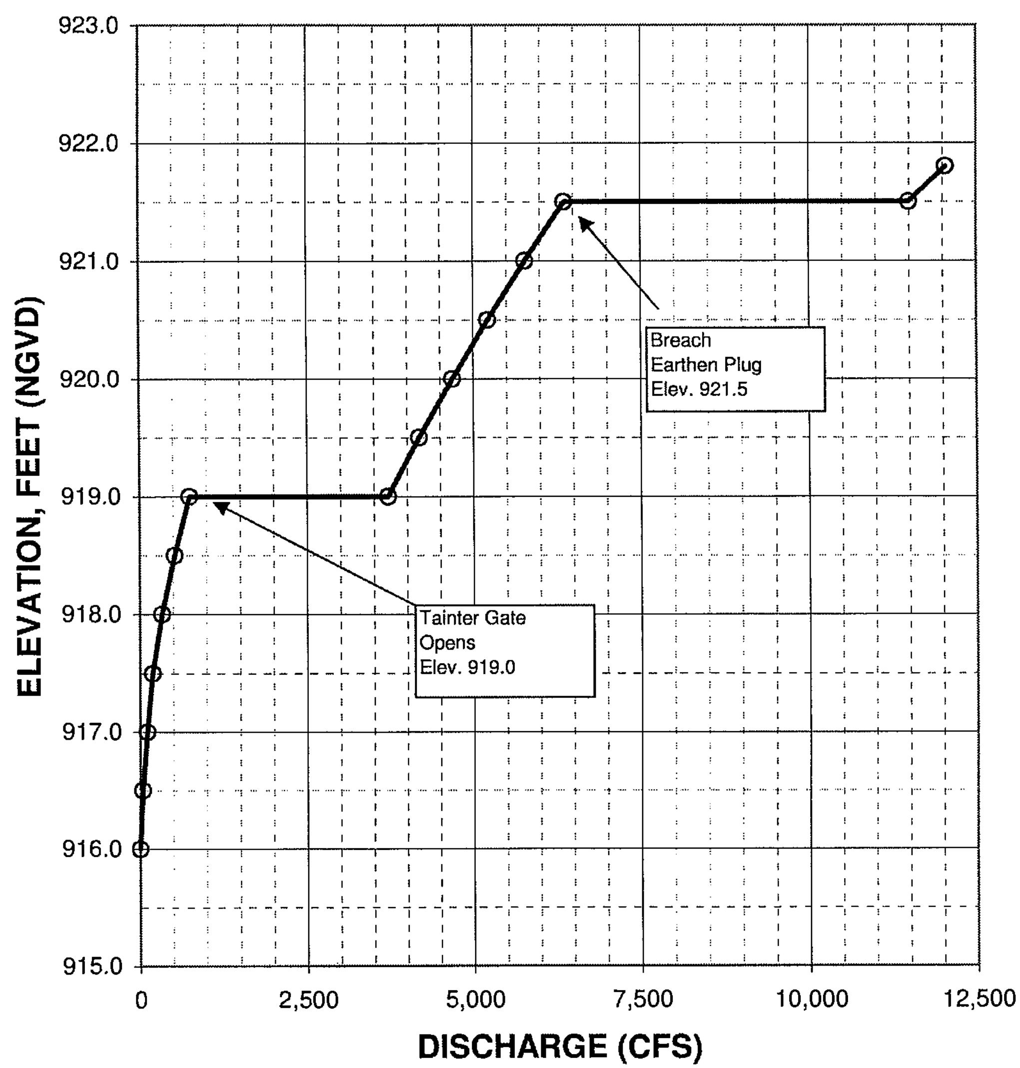
Parameter	Value
Channel 10-85 slope in feet per mile	10.8
Contributing drainage area in square miles.	7.701
Region number	1012
Percent of area covered by water and wetland	5.45
Total drainage area in square miles	7.701
Percent of area covered by urban land cover	1.16

Appendix 6, Sheet 4: Computer screen captures from USGS StreamStats of the Dry Run watershed :
http://water.usgs.gov/osw/streamstats/indiana.html

		Crest Elevation ft, NGVD	L (ft)	C
Spillway:	Lower Weir	915.97	25.0	3.95
	Upper Weir	917.46	30.0	3.95
Emergency Spillway	(1 Tainter Gate & Emergency Spillway)			
Open Gate #1 @ Elevation 919.0		908.79	23.0	3.95
Breach Plug @ Elevation 921.5		908.90	41.0	2.8

	Discharge			
	Principal Spillway			
Elevation (ft)	Lower (cfs)	Upper	Emerg. (cfs)	Total (cfs)
916.0	1	0	0	1
916.5	38	0	0	38
917.0	103	0	0	103
917.5	187	1	0	188
918.0	286	47	0	333
918.5	397	126	0	523
919.0	521	226	0	747
919.0	521	226	2,964	3,711
919.5	655	345	3,184	4,184
920.0	799	480	3,410	4,688
920.5	952	628	3,640	5,221
921.0	1,114	789	3,876	5,779
921.5	1,284	962	4,117	6,363
921.5	1,284	962	9,251	11,498
921.8	1,390	1,071	9,582	12,044

* Note: Rating Curve based on Lawson-Fisher Associates P.C. design coefficients and Rome City Conservancy District dam operation letter dated 8/24/07

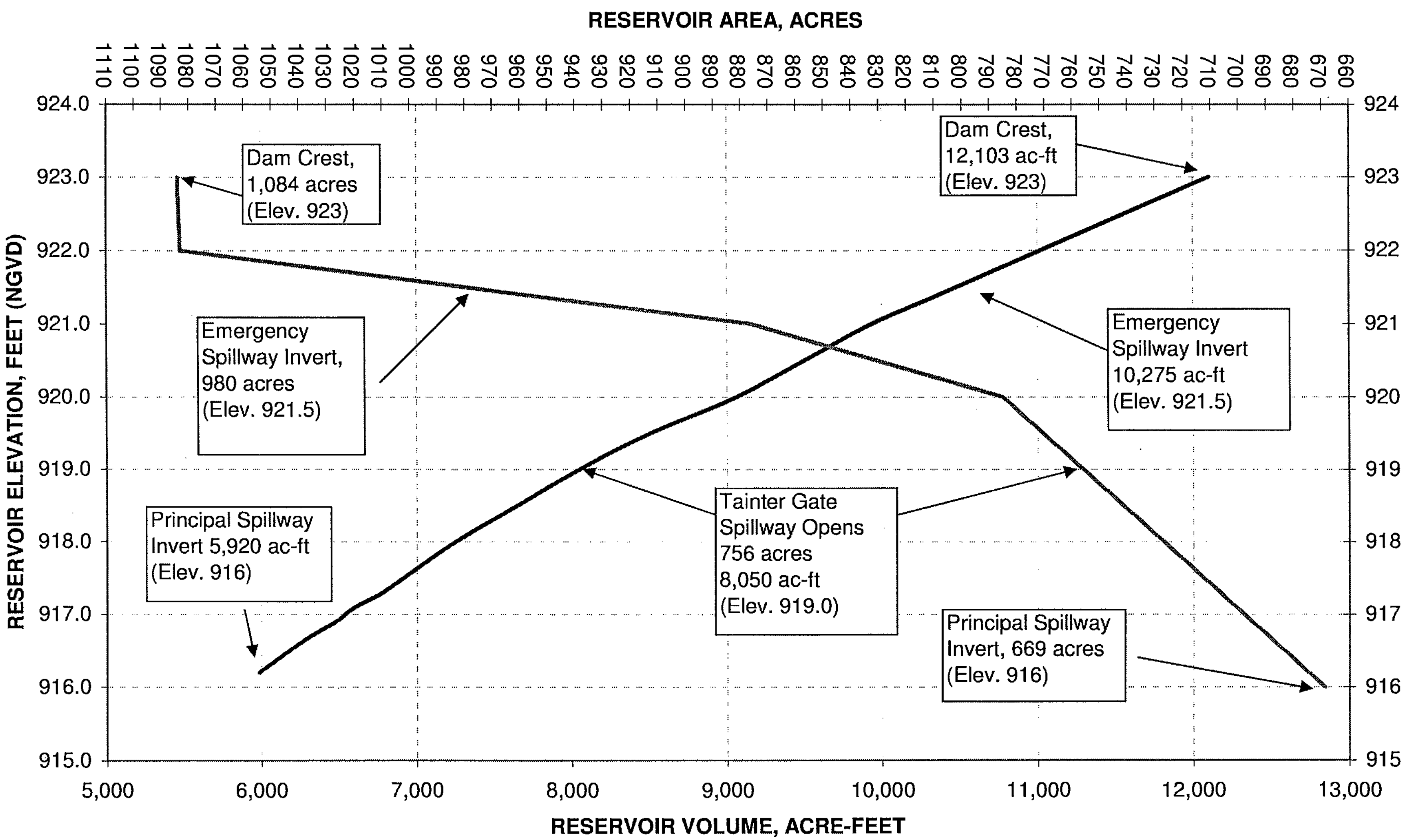


SYLVAN LAKE DAM EMERGENCY ACTION PLAN

SPILLWAY RATING CURVE

AUGUST 2007

FIGURE 5.5



SYLVAN LAKE DAM EMERGENCY ACTION PLAN	RESERVOIR AREA AND CAPACITY CURVE	
	April 2007	FIGURE 5.4

Chapter #7, Appendix 1

<u>Local 2009 North Branch Elkhart River West Lakes Chain Survey Results</u>

Respondents answered survey questions as follows:

1. Do you presently have a Flood Insurance Policy? *Yes - 50, No - 110, No Answer - 1*

2. If yes, please list the name of the insurance company. *Various companies were listed. Most listed the requested policy number.*

3. If yes, does the Flood Insurance Policy include contents coverage? *Yes - 29, No-24, No Answer - 108.*

4. Have you submitted claims against your Flood Insurance policy? *Yes - 16, No - 58, No Answer - 87*

5. If so, how many times? Dates of damage*? One time - 8, Two times - 4, Three times - 2, Four times - 3. Total claims paid: $296,232.38.*

6. Do you have a "Flood Damage" rider on your Homeowner's Insurance Policy*? Yes - 19, No-128, ? - 2, No Answer - 12.*

7. Do you have a "Contents Coverage" rider on your Homeowner's Insurance Policy? *Yes - 81, No - 58, ? - 3, No Answer - 19.*

8. What type of foundation supports your home? *Basement - 29; Crawl Space - 100; Slab - 23; Other - 9.*

9. Did floodwater enter your home during the March 2009 flood event? *Yes - 22, No - 137, No Answer - 2.*

10. If yes, what was the approximate water depth in your home? (Inches above lowest floor NOT INCLUDING basement floor or crawl space floor)? *Yes - 22, No - 137, No Answer - 2. Water in homes ranged from one inch to 22 inches.*

Some noted that they sandbagged to prevent flooding. Others used pumps to keep water out. Still others reported water in garages, crawl space or both. Some also noted that there was damage to their yards, shorelines, etc., but water was not in their homes.

11. Have you ever received FEMA assistance? *Yes - 9, No - 152.*

12. If yes, what years? Approximate amount? *(See surveys for years) Total FEMA Assistance: $153,933.09. (One did not list an amount.)*

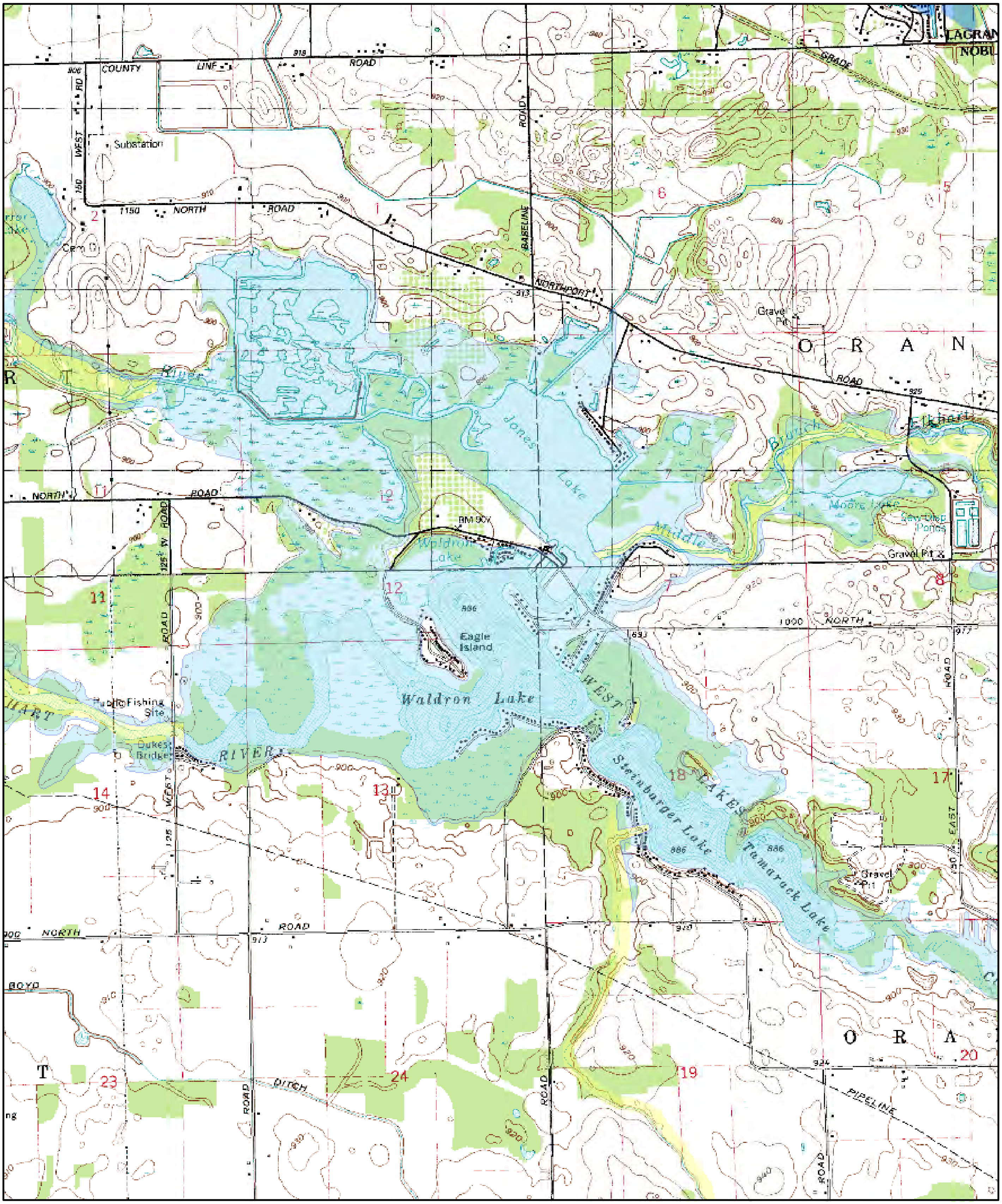
13. Homeowners with active Flood Insurance Policies,

A. Has your insurance agent ever mentioned the National Flood Insurance Program's Increased Cost of Compliance (ICC) Grant as a means of elevating your home? *Yes - 8, No - 75, No Answer – 78*

B. To the best of your knowledge, has your home ever been elevated from its original foundation? *Yes - 8, No - 92, No Answer - 61.*

14. What is your primary reason for owning property in the West Lakes Chain? *Like lake living - 109, Property has been in the family for years - 22, Other - 13, Combination - 14, No Answer - 2; Business - 1.*

15. If funds were available, would you be interested in participating in a government buy-out program of your West Lakes property? *Yes - 58, No - 89, ? - 10, No Answer - 4.*



Appendix 8, Sheet 1, Special Flood Hazard Area for West Lakes Chain

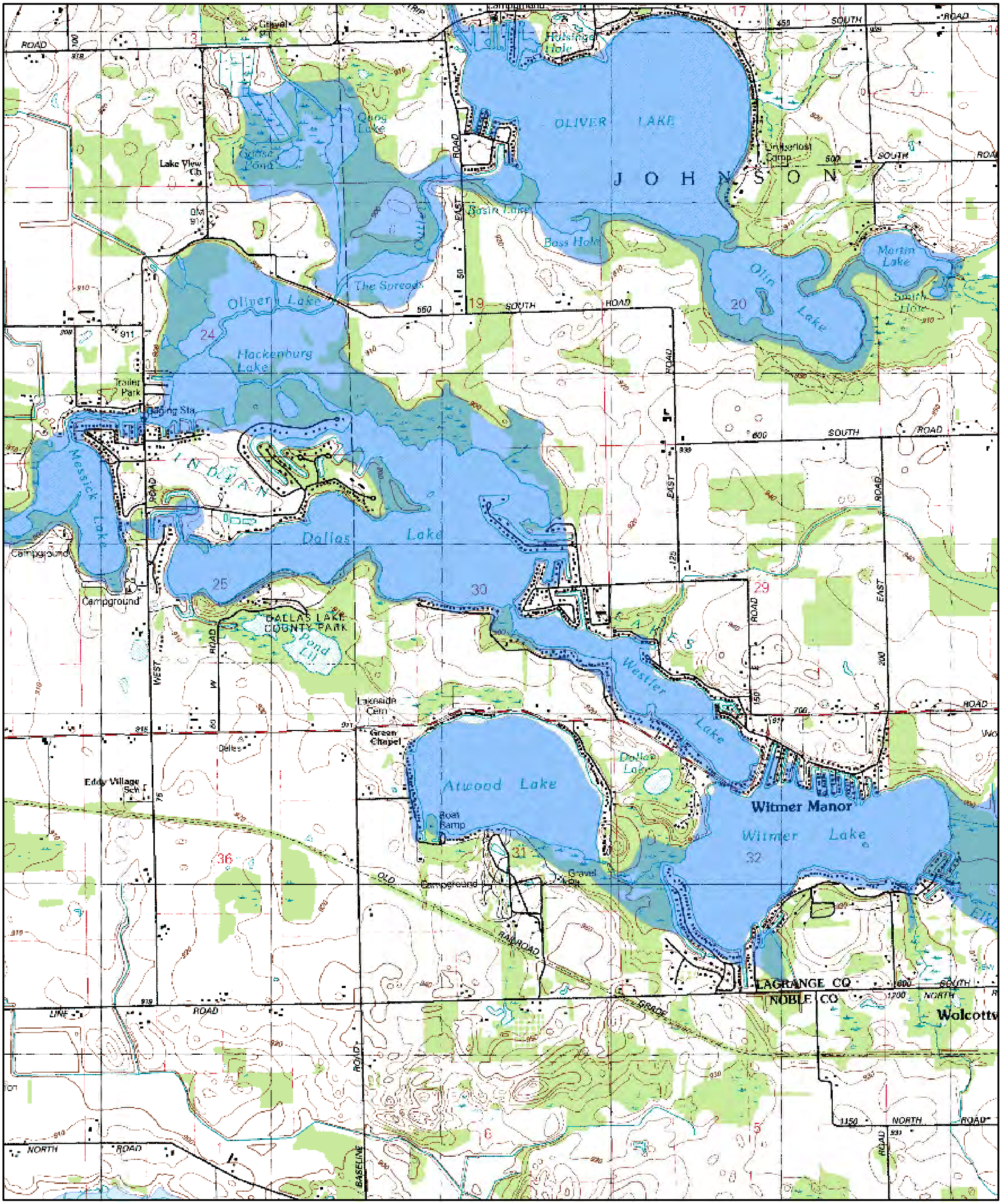
N
W E
S

1 inch = 2,465 feet

0 1,000 2,000 Feet

- Zone AE/Floodway, 1% annual chance
- Zone A, 1% annual chance
- Zone AE, 1% annual chance
- Zone X, 2% annual chance

INDIANA DEPARTMENT OF NATURAL RESOURCES



Appendix 8, Sheet 2, SFHA for Indian Lakes Chain and Oliver Lake

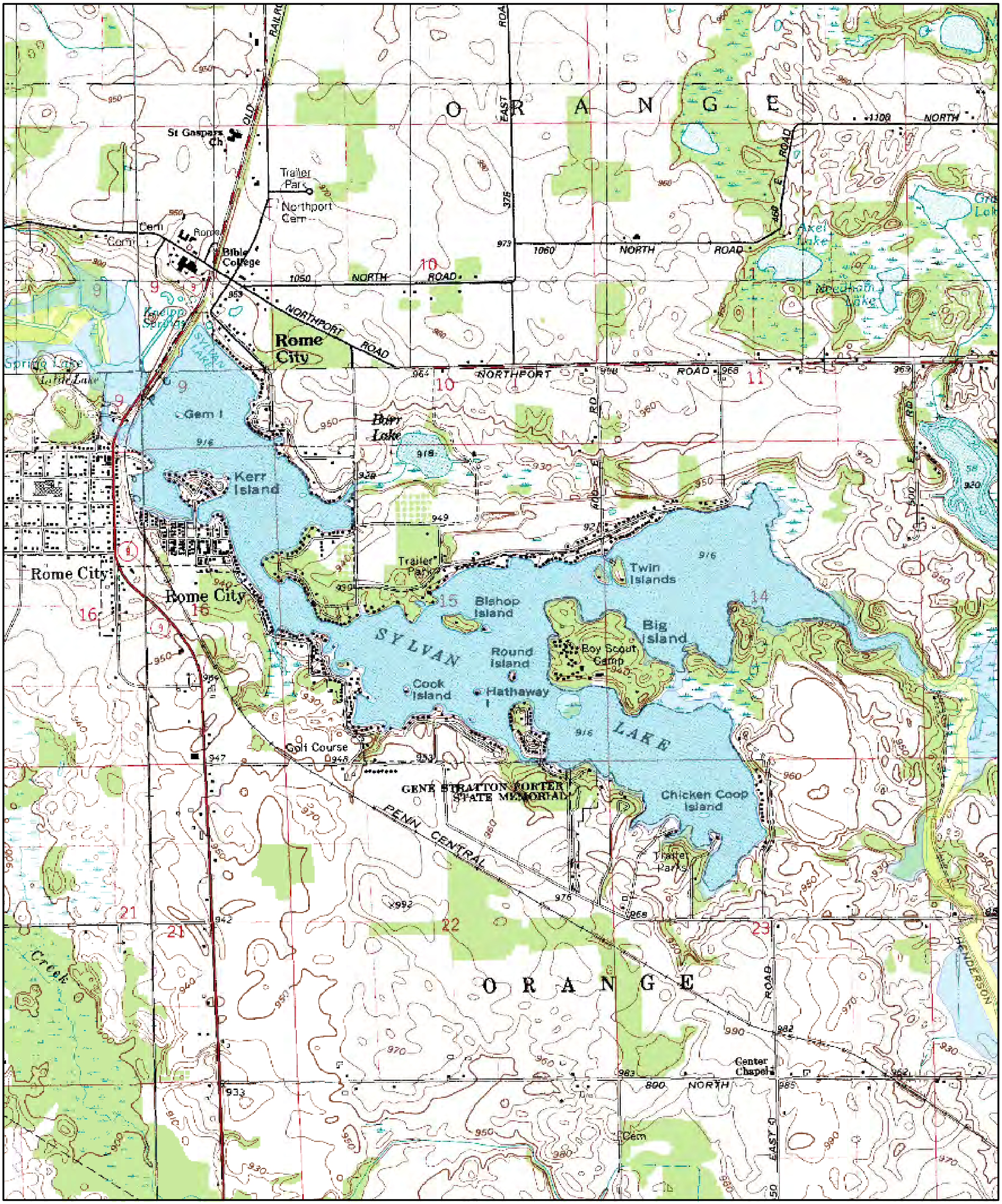
N
W E
S

1 inch = 2,613 feet

0 850 1,700 Feet

- Zone AE/Floodway, 1% annual chance
- Zone A, 1% annual chance
- Zone AE, 1% annual chance
- Zone X, 2% annual chance

INDIANA DEPARTMENT OF NATURAL RESOURCES



Appendix 8, Sheet 3, SFHA for Sylvan Lake

N
W E
S

1 inch = 2,263 feet

0 800 1,600 Feet

- Zone AE/Floodway, 1% annual chance
- Zone A, 1% annual chance
- Zone AE, 1% annual chance
- Zone X, 2% annual chance

INDIANA DEPARTMENT OF NATURAL RESOURCES

Appendix 9

Water well modifications:

Most of the residential areas near lakes in northern Indiana are supplied by private ground water wells. The West Lakes area is no exception, with a well likely located at each private residence. The construction of private water supply wells is regulated by IDNR through IC 25-39 & 312 IAC 13. There are specific construction standards for wells placed on land that is in a Special Flood Hazard Area.

If not properly constructed, a water well can leak flood water into the casing and that water can enter the ground water aquifer contaminating the aquifer with the nutrient and bacteria present in the flood waters. It is common for many wells to draw ground water from a common aquifer. A leak at any well can cause contamination to the aquifer supplying several wells. The resulting problem can be difficult and costly to correct, requiring long term treatment, testing, and in some cases development of an alternate supply. Maintaining properly constructed wells can be relatively easy. Correcting improperly constructed wells can range from relatively simple and low cost to difficult and expensive, but is necessary to protect the aquifer from contamination.

The first step in determining the risk of contamination is to define the wells that exist in the mapped Special Flood Hazard Area. Each well located on a land surface with an elevation below the BFE will need to be inspected by a licensed water well driller or plumber to determine if it requires modification to meet or exceed the standards and thus is properly protected from potential flood water contamination. If the well requires modification, the licensed professional can recommend modification that may include elevating the riser pipe or installing a watertight well cap with a vent at least two feet above the BFE.

Water Well Casings

Following Well Construction Requirements set forth by IC 25-39 & 312 IAC 13

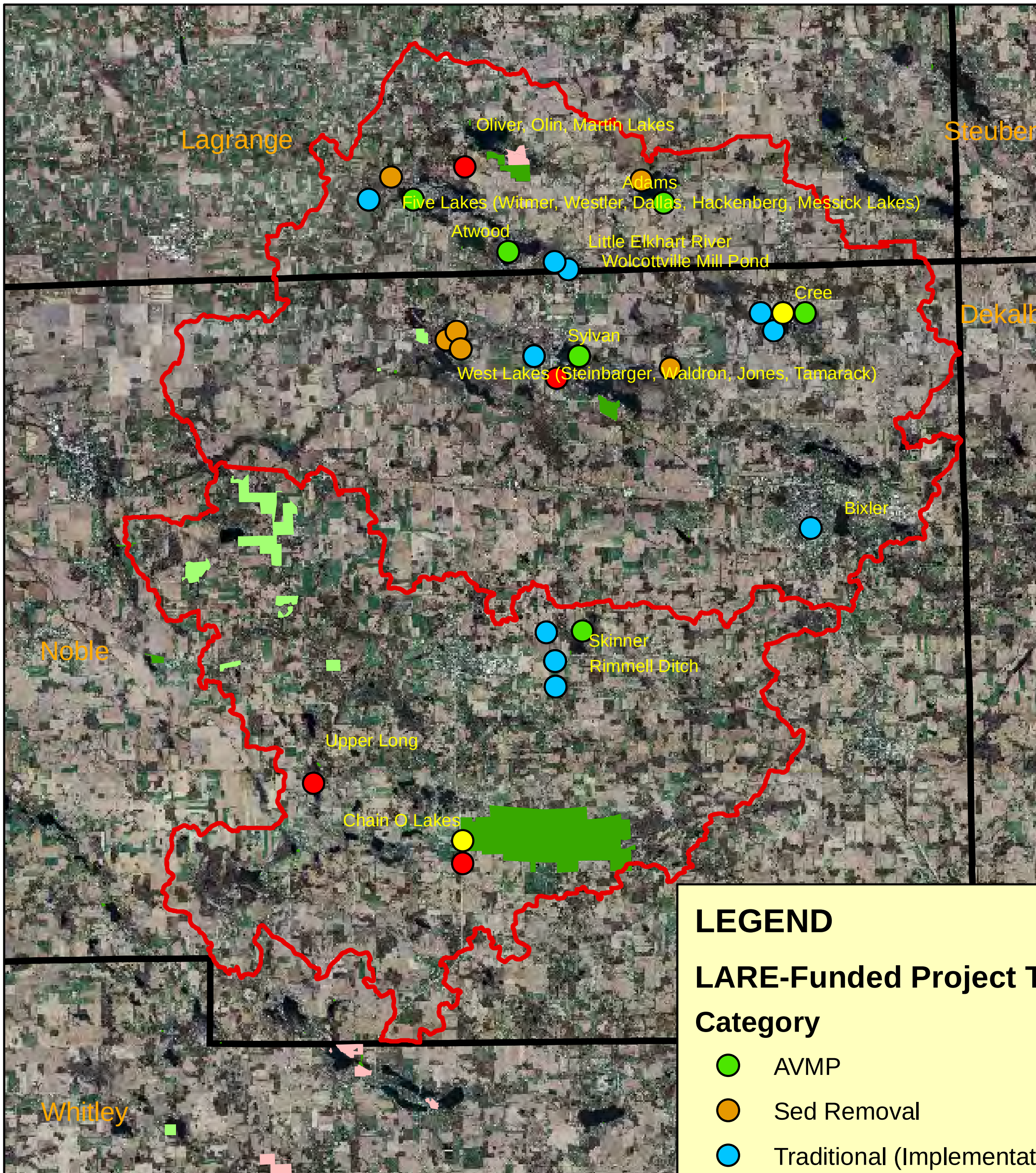
Finished well casings must extend at least one foot above ground level, and

If located in a Special Flood Hazard Area must:

1. Be at least two feet above the elevation of the regulatory flood elevation; or
2. Be equipped with a watertight pitless unit cap or well seal and vented to an elevation at least two feet above the regulatory flood elevation.

Section 2w, Figure 1

North & South Branch Elkhart River Watersheds



LEGEND

LARE-Funded Project Types

Category

- AVMP
- Sed Removal
- Traditional (Implementation)
- Traditional (Study)
- WLTP
- Watershed Boundary (11-digit HUC)

DNR Owned or Managed Lands

ACCESS

- OPEN
- OPEN WITH RESTRICTIONS
- RESTRICTED
- CLOSED OR UNKNOWN

N

0 2 4 8 Miles

IDNR Division of Fish & Wildlife
Lake & River Enhancement Program
July 20, 2009

INDIANA SILVER JACKETS
NORTH BRANCH ELKHART RIVER
WEST LAKES TASK TEAM

Overview Of Silver Jackets

Many Agencies, One Solution

Indiana Silver Jackets (ISJ) is a voluntary inter-agency natural hazard mitigation team of professional / technical staff working together to protect life, property, and resources.

In 2006, multiple Indiana State and Federal agencies began this voluntary cooperative effort. It was recognized the public often asked very broad multi-disciplined questions that no one agency had the ability to completely and independently answer. Cooperative sharing of the unique talents of our organizations' staff provided a way to begin addressing specific larger watershed /drainage basin and regional issues.

The genesis of this Silver Jacket concept is found in the National Response Plan issued in December 2004 by the U.S. Department of Homeland Security. It provides the framework for collaboration between Federal, State, local and tribal agencies, in addition to nongovernmental organizations, private-sector and emergency management entities in order to prepare for, respond to, and recover from major disasters.

Past planning and implementation of preventive measures typically grew from the limited vision of individual agencies' knowledge base, processes and procedures. Often local steering groups seeking assistance approached multiple agencies one after another, causing the same issues to be revisited time after time. Even though some agencies and local governments have been successful in maintaining strong partnerships, overall nationwide interagency collaboration for pre-disaster activities has been intermittent.

Because flooding is the nation's leading natural disaster, as a starting point, an interagency pilot program with focus on flood mitigation was implemented. The pilot program was named Silver Jackets. Silver Jackets team efforts have begun in many other states.

The ISJ team was formed to bring staff from Federal, State, regional agencies, and universities together to serve the citizens of Indiana.

The ISJ governance is provided through a multi-agency task team (a sub group of the larger ISJ team). The team's vision follows.

ISJ VISION STATEMENT
BE A CATALYST IN DEVELOPING
COMPREHENSIVE AND SUSTAINABLE SOLUTIONS
TO NATURAL HAZARD ISSUES,

SEEKING TO PROTECT LIFE, PROPERTY, AND RESOURCES

The member agencies of ISJ are committed to the mission of mitigating risk of natural hazards through:

- Enabling the effective and efficient sharing of information
- Fostering the leveraging of available agency resources
- Providing improved service to our mutual customers, and
- Promoting wise stewardship of the taxpayers' investment.

Member agencies of the ISJ include:

- Federal Emergency Management Agency
- Indiana Department of Homeland Security
- Indiana Department of Natural Resources
- Indiana Department of Transportation
- Indiana Department of Environmental Management
- Indiana National Guard
- Indiana University
- Indiana University Purdue University – Indianapolis / Polis Center
- Maumee River Basin Commission
- National Weather Service
- Purdue University
- U.S. Army Corps of Engineers
- U.S. Department of Agriculture
- U.S. Department of Housing and Urban Development
- U.S. Geological Survey

The ISJ has undertaken several initiatives, some of which are completed and some of which are ongoing. Initiatives are developed through consensus in answer to Statewide or regional problems related to natural hazards. One of these ISJ initiatives – formation of the North Branch Elkhart River, West Lakes Task Team – is the subject of this report.

On all projects to date, team agencies have provided non-monetary resources including personnel time, travel costs, and/or data sets. No funding for implementation of future local considerations or project construction funding is promised or implied by involvement of the team agencies.

One question often asked is why the name Silver Jackets. We have all seen the colorful logos and jackets worn by many individual organizations and teams. Some organizations or teams wear red jackets, some wear blue, black, or brown. Silver Jackets was chosen as a color that could represent a valuable combination of a multi-agency, multi-disciplined team effort.

CONCEPTS AND DEFINITIONS

Acre-foot (acre-ft) - the volume of water required to cover 1 acre of land (43,560 square feet) to a depth of 1 foot. Equal to 325,851 gallons or 1,233 cubic meters. *U.S. Geological Survey, Water Science Glossary of Terms, http://ga.water.usgs.gov/edu/dictionary.html#G*

Base flow - sustained flow of a stream in the absence of direct runoff. It includes natural and human-induced streamflows. Natural base flow is sustained largely by ground-water discharges. *U.S. Geological Survey, Water Science Glossary of Terms http://ga.water.usgs.gov/edu/dictionary.html#G*

Cubic feet per second (cfs) - a rate of the flow, in streams and rivers, for example. It is equal to a volume of water one-foot high and one-foot wide flowing a distance of one foot in one second. One "cfs" is equal to 7.48 gallons of water flowing each second. As an example, if a car's gas tank is 2 feet by 1 foot by 1 foot (2 cubic feet), then gas flowing at a rate of 1 cubic foot/second would fill the tank in two seconds. A flow of 1cfs for a day approximately equals the volume of 1 Olympic size swimming pool per day.

Datum – a point, line, or surface used as a reference, as in surveying.

Discharge - the volume of water that passes a given location within a given period of time. Usually expressed in cubic feet per second. Also referred to as "streamflow." *U.S. Geological Survey, Water Science Glossary of Terms, http://ga.water.usgs.gov/edu/dictionary.html#G*

Drainage Basin - The land area drained by a river and its tributaries; also called the watershed or drainage area

Evapotranspiration – a collective term that includes water discharged to the atmosphere as a result of evaporation from the soil and surface-water bodies and by plant transpiration.

Flood (generally) - A general and temporary condition of partial or complete inundation of normally dry land areas from the overflow, the unusual and rapid accumulation, or the runoff of surface waters from any source. An overflow of water onto lands that are used or usable by man and not normally covered by water. Floods have two essential characteristics: The inundation of land is temporary; and the land is adjacent to and inundated by overflow from a river, stream, lake, or ocean. *U.S. Geological Survey, Water Science for Schools, Water Science Glossary of Terms, http://ga.water.usgs.gov/edu/dictionary.html*

Flood (for flood insurance purposes) - A general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties (at least one of which is the policyholder's property) from: Overflow of inland or tidal waters; Unusual and rapid accumulation or runoff of surface waters from any source; or Mudflow; or Collapse or subsidence of land along the shore of a lake or similar body of water as a result of erosion or undermining caused by waves or currents of water exceeding anticipated cyclical levels that result in a flood as defined above.

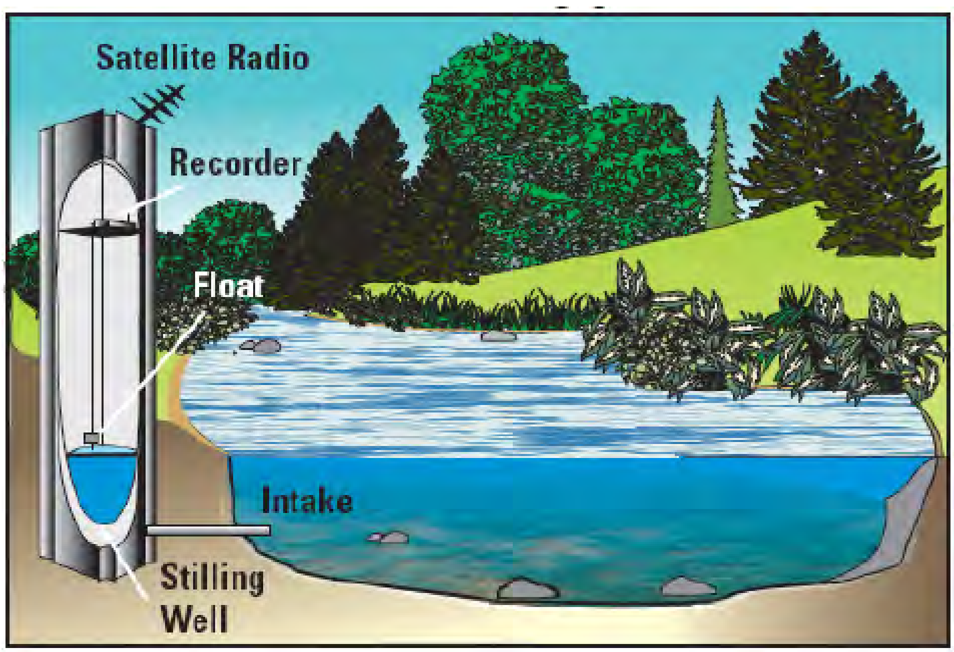
Flood attenuation – combined processes such as infiltration, storage, and slow release that reduce surface water elevations during floods, but prolong the duration of the flood events.

Flood peak - the highest value of the stage or discharge attained by a flood; thus, peak stage or peak discharge. *Langbein, W.B., and Iseri, K.T., 1960, General introduction and hydrologic definitions, Manual of Hydrology: Part 1. General surface-water techniques: U.S. Geological Survey Water-Supply Paper 1541–A, 29 p., accessed September 6, 2008, at http://pubs.er.usgs.gov/usgspubs/wsp/wsp1541A*

Flood plain - a strip of relatively flat and normally dry land alongside a stream, river, or lake that is covered by water during a flood. *U.S. Geological Survey, Water Science for Schools, Water Science Glossary of Terms, http://ga.water.usgs.gov/edu/dictionary.html*
The active flood plain is continually formed by sediment suspended and delivered by the stream, and it floods frequently. *Sherwood, J.M., and Huitger, C.A., 2005, Bankfull Characteristics of Ohio Streams and Their Relation to Peak Streamflows. U.S. Geological Survey Scientific Investigations Report 2005–5153, http://pubs.usgs.gov/sir/2005/5153/*

Fluvial processes – processes associated with water flowing in a defined channel; of or pertaining to rivers.

Gaging station - a site on a stream, lake, reservoir or other body of water where observations and hydrologic data are obtained. The U.S. Geological Survey measures stream discharge at gaging stations. *U.S. Geological Survey, Water Science Glossary of Termshttp://ga.water.usgs.gov/edu/dictionary.html#G*
A gaging station on a stream or river is often called a "streamgage." The USGS operates a network of about 8,000 gages nationwide and about 190 gages in Indiana. Data are transmitted from streamgages in near real-time and also are stored long term.

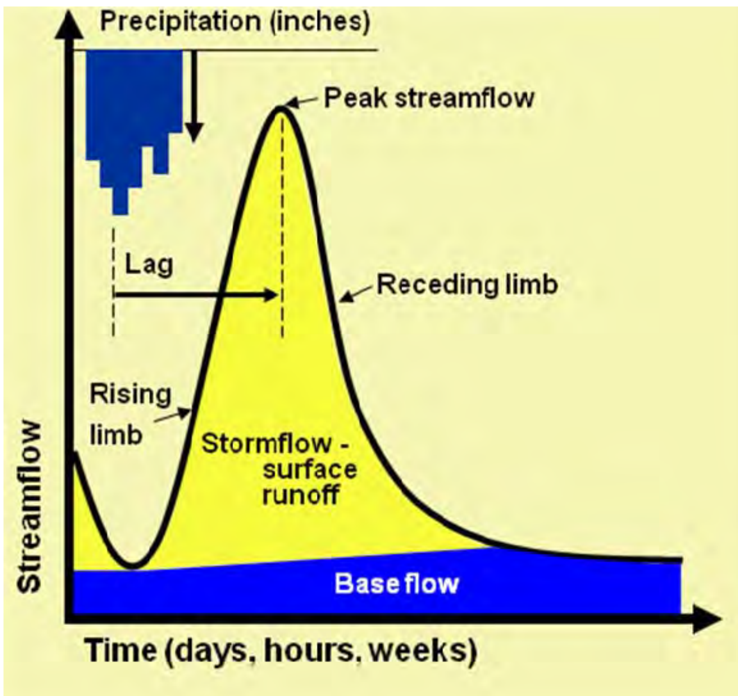


Schematic of USGS streamgage

Geomorphology – the study of the evolution and configuration of landforms.

Ground water - Groundwater is water below the surface of the landscape. Groundwater begins with rain and snow melt that seeps or infiltrates into the ground. Rain and snow melt that seeps into the ground continues downward under the force of gravity until it reaches a depth where water fills all of the openings (pores) in the soil or rock. *Raymond, L.S., 1988, "What is groundwater," New York State Water Resources Institute Bulletin No. 1, Cornell University, accessed at the Marquette County Community Information System, http://www.mqtinfo.org/planningeduc0019.asp*

Hydrograph - a graph of streamflow with time. A hydrograph can be separated into components based on the source of the water. Surface runoff from precipitation causes streamflow (and water level, also called stage) to rise, peak, and then recede. Lag is the time between the peak precipitation and the peak streamflow. *Science in Your Watershed, General Introduction and Hydrologic Definitions, http://water.usgs.gov/wsc/glossary.html*



Hydrograph conceptual sketch. *Bigelow Laboratory for Ocean Sciences, How Our Rivers Run http://www.bigelow.org/virtual/water_sub2.html*

Hydrologic Cycle – the cycle that controls the distribution of Earth's water as it evaporates from bodies of water, condenses, precipitates, and returns to those bodies of water.

Hydrologic Unit Code - The Water Resources Council developed a hierarchial classification of hydrologic drainage basins in the United States. Each hydrologic unit is identified by a unique hydrologic unit code (HUC) consisting of two to eight digits based on the four levels of classification in the hydrologic unit system.

Infiltration - flow of water from the land surface into the subsurface. *U.S. Geological Survey, Water Science Glossary of Terms, http://ga.water.usgs.gov/edu/dictionary.html#G*
Insurable Structure (or "eligible building" for flood insurance purposes) - A structure with two or more outside rigid walls and a fully secured roof that is affixed to a permanent site.

Land use - present and historical uses of land, such as for agriculture, mining, recreation and grazing. *U.S. Geological Survey, Geologic Glossary, http://geomaps.wr.usgs.gov/parks/misc/glossaryt.html*
Lowest Floor - The lowest floor of the lowest enclosed area (including a basement). An unfinished or flood-resistant enclosure, usable solely for parking of vehicles, building access, or storage in an area other than a basement area, is not considered a building's lowest floor provided that such enclosure is not built so as to render the structure in violation of requirements.

National Flood Insurance Program (NFIP) - The federal program that makes flood insurance available to owners of property in participating communities nationwide through the cooperative efforts of the Federal Government and the private insurance industry.

Outwash – water worked sediments typically composed of sand, gravel, cobbles, and boulders; sand and gravel deposited by meltwater streams in front or beyond the margin of active glacial ice.

Physiography - the terrain texture, rock type, and geologic structure and history. *U.S. Geological Survey, Physiographic regions, http://tapestry.usgs.gov/physiogr/physio.html*

Precipitation – Return of water from the atmosphere to earth in liquid or frozen form. *U.S. Geological Survey, The water cycle (water science for schools), http://ga.water.usgs.gov/edu/watercycle.html*

Recharge (groundwater) – the process by which water is absorbed and added to the zone of saturation.

Recurrence interval - the average interval of time within which the given flood will be equaled or exceeded once. *Langbein, W.B., and Iseri, K.T., 1960, General introduction and hydrologic definitions, Manual of Hydrology: Part 1. General surface-water techniques: U.S. Geological Survey Water-Supply Paper 1541–A, 29 p., accessed September 6, 2008, at http://pubs.er.usgs.gov/usgspubs/wsp/wsp1541A*

Repetitive Loss - Flood-related damages sustained by a structure on two separate occasions during a 10-year period ending on the date of the event for which the second claim is made, in which the cost of repairing the flood damage, on the average, equaled or exceeded 25% of the market value of the structure at the time of each such flood event.

Riparian – of, on, or relating to the banks of a natural course of water.

Runoff - That part of the precipitation, snow melt, or irrigation water that appears in uncontrolled surface streams, rivers, drains or sewers. Runoff may be classified according to speed of appearance after rainfall or melting snow as direct runoff or base runoff, and according to source as surface runoff, storm interflow, or ground-water runoff. *U.S. Geological Survey, Water Science Glossary of Terms, http://ga.water.usgs.gov/edu/dictionary.html#G*

Sinuous – characterized by many curves or turns; winding.

Substantial Damage - Damage of any origin sustained by a structure whereby the cost of restoring the structure to it's before damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred.

Substantial Improvement - Any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure before the "start of construction" of the improvement. This term includes structures that have incurred "repetitive loss" or "substantial damage" regardless of the actual repair work performed. The term does not include improvements of structures to correct existing violations of state or local health, sanitary, or safety code requirements or any alteration of a "historic structure", provided that the alteration will not preclude the structures continued designation as a "historic structure".

Thalweg – deepest point of the stream bottom a line connecting the deepest point along a stream channel.

Topography - graphic representation of the surface features of a plce or region on a map, indicating their relative positions and elevations.

Weir – a dam placed across a river or canal to raise or divert the water, as for a millrace, or regulate or measure the flow.

Water quality - a term used to describe the chemical, physical, and biological characteristics of water, usually in respect to its suitability for a particular purpose. *U.S. Geological Survey, Water Science Glossary of Terms, http://ga.water.usgs.gov/edu/dictionary.html#G*

Watershed - an area of land that drains all the streams and rainfall to a common outflow point, such as the outflow of a reservoir, mouth of a bay, or any point along a stream channel. The word watershed is sometimes used interchangeably with "drainage basin." *USGS, Water Science for Schools – What is a Watershed? http://ga.water.usgs.gov/edu/watershed.html*

Wetland - areas where water covers the soil, or is present either at or near the surface of the soil all year or for varying periods of time during the year, including during the growing season. Water saturation (hydrology) largely determines how the soil develops and the types of plant and animal communities living in and on the soil. Wetlands may support both aquatic and terrestrial species. The prolonged presence of water creates conditions that favor the growth of specially adapted plants (hydrophytes) and promote the development of characteristic wetland (hydric) soils. Inland wetlands are most common on floodplains along rivers and streams (riparian wetlands), in isolated depressions surrounded by dry land (for example, playas, basins, and "potholes"), along the margins of lakes and ponds, and in other low-lying areas where the groundwater intercepts the soil surface or where precipitation sufficiently saturates the soil (vernal pools and bogs). Inland wetlands include marshes and wet meadows dominated by herbaceous plants, swamps dominated by shrubs, and wooded swamps dominated by trees. *U.S. Environmental Protection Agency, What are Wetlands?* *http://www.epa.gov/owow/wetlands/vital/what.html*

Common Acronyms:

BFE – Base Flood Elevation
BMP- Best Management Practices
CFS – Cubic Feet per Second
DA – Drainage Area
FEMA – Federal Emergency Management Agency
FIS – Flood Insurance Study
HUC – Hydrologic Unit Code
IDEM - Indiana Department of Environmental Management
IDHS – Indiana Department of Homeland Security
IDNR – Indiana Department of Natural Resources
ISJ – Indiana Silver Jackets
LLL – Legal Lake Level
MRBC – Maumee River Basin Commission
NBR Elkhart River – North Branch Elkhart River
NGVD – National Geodetic Vertical Datum
NOAA – National Oceanic and Atmospheric Administration
SPI – Standard Precipitation Index
USACOE – United States Army Corps of Engineers
USGS – United States Geological Survey

REFERENCES

Beaty, J.E., editor, 1996, Water Resource Availability in the Maumee River Basin, Indiana: Indiana Department of Natural Resources, Division of Water, Water Resource Assessment 96-5, 235 p.

Beaty, J. E., Gosine, R., Smith, M. A., editors, 1994, Water Resource Availability in the Lake Michigan Region, Indiana: Indiana Department of Natural Resources, Division of Water, Water Resource Assessment 94-4, 257p

Brekke, L.D., Kiang, J.E., Olsen, J.R., Pulwarty, R.S., Raff, D.A., Turnipseed, D.P., Webb, R.S., and White, K.D., 2009, Climate change and water resources management—A federal perspective: U.S. Geological Survey Circular 1331, 65 p. (Also available online at http://pubs.usgs.gov/circ/1331/.)

Christopher Burke Engineering, Ltd., March 2008. Noble County Multi-Hazard Mitigation Plan.

Clark, G. D. and Larrison, D., editors, 1980, The Indiana Water Resource, Availability, Uses, and Needs: Indiana Department of Natural Resources

Clendenon, C.J. and Beaty, J.E., editors, 1987, Water Resource Availability in the St. Joseph River Basin, Indiana: Indiana Department of Natural Resources, Division of Water, Water Resource Assessment 87-1, 139 p.

Department of the Army, Detroit District, Corps of Engineers, August 1983. Section 208 Reconnaissance Report on Flood Control on the North Branch of the Elkhart River and the West Lakes Chain in Noble County, Indiana.

Friends of the St. Joe River Association, 2005. St. Joseph River Watershed Management Plan

Owen, M. F., History of Orange Township, Indiana State Library I, 977.201 N747Q, pg 31-38

Indiana Department of Environmental Management (IDEM) 2008. 303(d) List of Impaired Waters

Indiana Department of Natural Resources, Division of Water, December 1981. "Report of Preliminary Flooding Problems, North Branch Elkhart River and Associated Lakes, LaGrange and Noble Counties, Indiana"

Pearson, Jed, March 30, 2001. IDNR, Cisco population status and management in Indiana

Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI). June 2006. OHIO EPA Technical Bulletin EAS/2006-06-1

Noble County Planning Initiative, 1968, updated 1986, 2007. Noble County Comprehensive Plan.

Sobat, Stacey L. November 12, 2009. [Personal Communication]. Located at: Indiana Department of Environmental Management (IDEM), Assessment Information Management System (AIMS) Database, Indianapolis, Indiana.

State of Indiana, Department of Natural Resources, Division of Water, 1987. Water Resource Availability in the St. Joseph River Basin, Indiana.

State of Indiana, the Governor's Water Resources Study Commission, February 1980. "The Indiana Water Resource. Availability, Uses, and Needs",

USDA-NRCS PLANTS Database / Britton, N.L., and A. Brown. 1913. *An illustrated flora of the northern United States, Canada and the British Possessions*. Vol. 1: 83.

V3 Companies, March 2008. Elkhart River Watershed Management Plan.

Wetzel, R. G., 1966. Variations in productivity of Goose and hypereutrophic Sylvan lakes, Indiana, Investigations of Indiana Lakes and Streams Volume VII: 147-184.

West Lakes Conservation, Inc., September 2005. West Lakes Sediment Removal Plan, Steinbarger Lake to Waldron Lake Channel, Jones Lake to Waldron Lake Channel, Noble County, Indiana.

Will Scott, 1914. The Relation of Lakes to Floods, with Special Reference to Certain Lakes and Streams of Indiana, Indiana Academy of Science.

Hydrologic Unit Code:
http://www.nrcs.usda.gov/programs/rwa/Watershed_HU_HUC_WatershedApproach_defined_6-18-07.pdf

ACKNOWLEDGEMENTS

This report was made possible by the many volunteer hours supplied by the public servants who participated in this multi-agency effort. It is with sincere gratitude to the Task Team and with deserving respect to the local stakeholders, that the Indiana Silver Jackets presents this report and its findings to the citizens of the North Branch Elkhart River/West Lakes Watershed.

Indiana Silver Jackets, West Lakes Task Team:

Kenneth Smith, IDNR Division of Water, Compliance and Projects Branch
Manuela Johnson, Indiana Department of Homeland Security
Scott Morlock, U.S. Geological Survey
Mary Weidel, U.S. Army Corps of Engineers, Detroit District
Rodney Renkenberger, Maumee River Basin Commission
Christian Ritz, Natural Resource Conservation Service

Additional Task Team Members:

Don Arvin, U.S. Geological Survey
John Bacone, IDNR Division of Nature Preserves
Jomary Baller, IDNR Division of Water, Project Development Section
Phil Bloom, IDNR Division of Communications
George Bowman, IDNR Division of Water, Flood Plain Management Branch
Jan Crider, Indiana Department of Homeland Security
Jon Eggen, IDNR Division of Water, Compliance and Public Assistance Section
Jack McGriffin, IDNR Division of Reclamation
Darrin Miller, IDNR Division of Water, Northern Engineering Team
Anita Nance, IDNR Division of Water, Flood Plain Management Section
David Nance, IDNR Division of Water, Project Development Section
Doug Nusbaum, IDNR Division of Fish and Wildlife
Michael Rehbein, National Weather Service
Brett Robinson, U.S. Geological Survey

Flood Focus Committee of the Elkhart River Alliance:

Gene Lightner, Chairman
Bill Reynolds, West Lakes Marine Inc.
Dave Abbott, Rome City Conservancy District & President Rome City Town Board
Dave Wick, West Lakes Homeowners Association
Joy LeCount, Noble County Commissioner
Ken Schuman, Ligonier City Council President
Lynn Reynolds, West Lakes Marine Inc.
Mike Shellman, Member Elkhart River Alliance Steering Committee
Nancy Brown, Elkhart River Restoration Association Board & Elkhart County SWCD
Patty Fisel, Mayor of Ligonier
John Richardson, JF New & Associates

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Robert Barr, IUPUI, Center for Earth and Environmental Science
Kari Evans, Indiana Department of Natural Resources
Bill Guertal, U.S. Geological Survey
Gregory Main, Chair Association of State Floodplain Managers
Ron McAhron, Indiana Department of Natural Resources
Michael Neyer, Indiana Department of Natural Resources
Roger Setters, US Army Corps of Engineers, Louisville District

EPILOGUE

Flood damage in the United States continues to escalate. Vulnerability of floodplain inhabitants and their property persists; federal, state, and local taxpayer expenditures for disaster relief and recovery continue to grow; and natural functions of floodplains continue to deteriorate.

Community development as practiced in the past was often counterproductive to long-term resiliency and sustainability of our communities. We know that loss of life and property damage can be reduced during most natural events – particularly flooding. However, hastily constructed redevelopment for the sake of returning a community to "normal" as soon as possible was and is too often the goal after a disaster, setting the stage for the next disaster.

It doesn't have to continue this way; there are better options.

We have the opportunity to rethink and start the reversal. Individuals and communities across the nation are beginning to understand this important message – limiting the human-caused contribution to such natural disasters, planning better, developing smarter, and building for sustainability. Building for sustainability in a community may include:

- Retrofitting existing infrastructure, retreating from high natural hazard areas, ensuring the community has proactive zoning authority, building/development codes to reflect unique regional conditions, and the resources to oversee and enforce them.
- Practicing flood risk management, which provides a framework for balancing the multiple complimentary and competing factors that affect risk. Strategies should consider associated risks and opportunities instead of just focusing on the usual structural attempts for managing floodwaters.
- Adopting a "No Adverse Impact" (NAI) floodplain management strategy as proposed by the Association of State Floodplain Managers (ASFPM). NAI floodplain management takes place when the actions of one property owner are not allowed to adversely affect the rights of other property owners. The adverse effects or impacts can be measured in terms of increased flood peaks, increased runoff, loss of natural upland and floodplain storage areas, loss of floodplain flow area, higher flood velocities, increased erosion and sedimentation, or other impacts the community considers important.
- Local community mitigation, including mitigating damage from increased runoff from urbanizing areas, improved land use practices, better emergency management, and workable systems for warning and evacuation.

President Franklin D. Roosevelt, speaking of the devastating 1927 Mississippi River valley flood, said he "envisioned a nation that refused to leave the problems of our common welfare to be solved by the winds of chance and the hurricanes of disaster."

This call for sustainable flood plain management still rings true. At this time, the many stakeholders of the North Branch Elkhart River basin have an opportunity to practice innovative sustainable flood plain management, to educate future stakeholders, to mitigate past limited planning efforts, to improve their community, to reduce future flood damages, and an opportunity to be seen as a community that is a model for others in the nation to follow. It is possible to have success, measured when foreseeable flooding events will not cause personal disasters.

Gregory A. Main
Chair, Association of State Floodplain Managers