Draft Supplemental Watershed Work Plan Number 4 and Environmental Assessment

For the Rehabilitation of Structure No. 9 (Rock Mill Dam) in the Upper Hocking Watershed Fairfield County, Ohio

Upper Hocking Structure 9

Prepared By:
U.S. Department of Agriculture
Natural Resources Conservation Service

Prepared For:
Hunter's Run Conservancy District
Fairfield Soil and Water Conservation District
Fairfield County Commissioners

December 2011

NRCS Natural Resources Conservation Service

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In Cooperation With:
Hunter's Run Conservancy District
Fairfield County Soil and Water Conservation District
Fairfield County Commissioners

AUTHORITY
The original work plan for the Upper Hocking Watershed (1958 Revised), and the works of improvement have been installed by the Sponsors and the USDA, Soil Conservation Service (now USDA Natural Resources Conservation Service [NRCS]), under the authority of Soil Conservation Act of 1935 Public Law 46, 74th Congress) and the Department of Agriculture Appropriation Act, 1954 (Public Law 156, 83rd Congress). Rehabilitation of Structure No. 9 (Rock Mill Dam) has been authorized under the authority of Public Law 83-566 (as amended), and further amended by Section 313 of Public Law 106-472.

ABSTRACT

Rock Mill Dam is a earthfill dam designed and constructed as a high hazard structure for the purpose of reducing downstream flood damages along the Hocking River upstream of Lancaster, Ohio. The dam also makes available the 11 acre public access fish and wildlife lake that is managed by ODNR, Division of Wildlife. Construction of the dam was completed in 1960. Evaluations completed as part of this Supplemental Watershed Plan and Environmental Assessment show that an estimated 200 houses, 50 commercial structures, and 300 people are at risk should the dam breach unexpectedly. Rock Mill Dam does not currently meet applicable NRCS or State of Ohio dam safety and performance standards for a high hazard dam. This document describes a proposed rehabilitation plan for Rock Mill Dam to meet all applicable USDA-Natural Resources Conservation Service (NRCS) and State of Ohio, Department of Natural Resources, Division of Water, Dam Safety Engineering Program, performance standards for high hazard dams and to extend the useful life of the dam for 100 years. The flood damage reduction, public recreation, and wildlife aspects realized by the existing Rock Mill Dam and lake would also be maintained.

COMMENTS AND INQUIRIES

Comments and inquiries must be received by February 3, 2012. Submit comments and inquires to: Michael J. Monnin, State Conservation Engineer, USDA-Natural Resources Conservation Service, 200 North High Street, Room 522, Columbus, Ohio 43215-2478 (614-255-2488)
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Upper Hocking Watershed Structure 9

Fairfield County, Ohio
Congressional District 7

Authorization

The original work plan for the Upper Hocking Watershed (1958 Revised), and the works of improvement have been installed by the Sponsors and the USDA, Soil Conservation Service (now USDA Natural Resources Conservation Service [NRCS]), under the authority of Soil Conservation Act of 1935 Public Law 46, 74th Congress) and the Department of Agriculture Appropriation Act, 1954 (Public Law 156, 83rd Congress). Rehabilitation of Structure No. 9 (Rock Mill Dam) has been authorized under the authority of Public Law 83-566 (as amended), and further amended by Section 313 of Public law 106-472.

Sponsors: Hunter's Run Conservancy District
Fairfield County Soil and Water Conservation District
Fairfield County Commissioners

Proposed Action

The objective of this project would be to bring the Upper Hocking Structure 9 (Rock Mill Dam) into compliance with current dam design, performance and safety criteria for a high hazard dam. It would allow the primary purpose of flood control to continue for 100 more years. Rock Mill Lake is an 11 acre public access fish and wildlife lake created by construction of Rock Mill Dam. The lake is within Rock Mill Lake State Wildlife Area, is managed by ODNR, Division of Wildlife, and offers the incidental use of fishing, boating, hunting, and wildlife watching.

Purpose and Need for Action

The original purpose of the Upper Hocking Watershed Plan was flood prevention and to reduce flood damages along the Hocking River as requested by the Hunter's Run Conservancy District. The purpose of this supplemental watershed plan is to bring Rock Mill Dam into compliance with current safety and performance standards for a high hazard dam and to maintain the present level of flood control benefits to downstream properties. The existing dam was constructed in 1960 as a high hazard dam according to criteria that existed at that time. The breach analysis confirms that the dam is correctly classified as a high hazard dam with a population at risk of 300 if the dam were to fail. High hazard dams in Ohio must store or safely pass the probable maximum flood (PMF). A hydraulic analysis was recently completed by NRCS that indicates the end of the dam and containment dike between the dam and auxiliary spillway would overtop during the probable maximum flood. Dispersive clays and sandy soils exist along areas of the exit section of the auxiliary spillway. If spillway flow occurs, severe erosion could result, and this could lead to failure of the spillway. Therefore, Rock Mill Dam does not meet current safety and performance standards and needs to be rehabilitated and upgraded to meet current dam design and safety requirements for a high hazard dam. ODNR, Dam safety Program, has required corrective action be taken to address these issues in a letter to the sponsor.

Description of Preferred Alternative

The preferred alternative is to rehabilitate Rock Mill Dam to meet current design, performance and safety criteria for a high hazard dam. Rehabilitation would include widening the auxiliary spillway from 300 to 320 feet, and lowering the crest of the auxiliary spillway three feet. A splitter dike would be constructed along the centerline of the auxiliary spillway to divide spillway flows into two 160 foot wide bays. The auxiliary spillway would be protected from potential erosion by replacing poor existing surface material with clay and compact in-place. The end of the dam at the auxiliary spillway would be raised, along with the containment dike, to prevent the probable maximum flood from overtopping the dam. Excess excavated material would be placed above the auxiliary spillway outside the flood

pool. Portions of the concrete of the principal spillway riser and outlet structure where surface deterioration has occurred would be removed, patched, and sealed. This would lengthen the service life of the dam for 100 more years after rehabilitation.

Resource Information

Upper Hocking Structure 9 is located in Section 31, Greenfield Township, Fairfield County, Ohio, at Latitude, decimal degree 39.74 and Longitude, decimal degree -82.7.

The watershed is within hydrologic unit code 05030204-04-01 as designated in the national Watershed Boundary Dataset (WBD).

The climate of the watershed is continental. The average temperature is about 28° F in winter and 71° F in summer. The project area could be described geologically as glaciated Allegany Plateau. The topography ranges from level to gently sloping in the upper watershed to very steep where the Hocking River breaches the Black Hand Sandstone before entering Rock Mill Lake.

Land Use:

Land Use / Land Cover	Upper Hocking Watershed (Acres)	Structure 9 Watershed (Acres)
Cropland	8,726	1,244
Pasture / Hayland	9,051	1,600
Woodland	5,848	711
Urban, farmstead	7,017	1002
Open Water	118	26
Total	30,760	4,583

Source: NASS 2009

Land Ownership within the Structure 9 watershed is 98 % private, 2 % State-local, 0 % federal.

According to 2005-2009 American Community Survey 5-year estimates from the Census Bureau, the population of Fairfield County was 140,842, and the county was about 89.6% white, 5.9% African American, 1.3% Hispanic or Latino, 0.1% Native American, and 0% Asian and Pacific Islander. There are approximately 1060 people in the Rock Mill Lake watershed. The only urban area in the Upper Hocking Watershed is the City of Lancaster, located about 3 miles downstream from the lake, with a population 36,860 (2010 Census data).

Relevant Resource Concerns identified during scoping

• Dam Safety • Public Health and Safety • Sedimentation • Floodplain Management • Flood damages • Scenic Beauty and Parklands • Fish and Wildlife Habitat • Water quality	• Wetlands • Natural areas • Riparian areas • Recreational opportunities • Transportation • Property values • Cost to sponsor • Land use

Alternative Plans Considered

1. No Action (Future without project) – This alternative does not involve Federal action and would consist of removing a minimum section of the earthen embankment of the dam to allow flow from a 100-year storm to pass through without impounding water behind the dam. This would eliminate the catastrophic flood hazard associated with potential dam failure. This would comply with the dam safety and performance deficiencies identified by NRCS and the state dam safety officials. Downstream flooding conditions would be similar to those that existed prior to the

construction of the dam. The downstream 100-year floodplain would increase from 974 acres to 1256 acres. Exposed areas would be vegetated for erosion and sediment control.

2. Rehabilitation of Structure 9 – This alternative would consist of widening the auxiliary spillway from 300 feet to 320 feet, and lowering the crest three feet to increase auxiliary spillway discharge. The end of the dam at the auxiliary spillway would be raised, along with the containment dike, to prevent the probable maximum flood from overtopping the dam. Poor materials in the auxiliary spillway would be replaced to protect the auxiliary spillway from excessive erosion. The concrete surfaces of the riser and outlet structure would be repaired and sealed. An additional side inlet port to the riser would be a design feature added to increase low flow capacity to reduce flooding duration and frequency on Mt. Zion Road located in the flood pool. A lake level gage would also be installed to provide emergency responders and local residence warning before Mt Zion Road would be submerged. All disturbed areas would be vegetated for erosion and sediment control. These measures would allow the dam to continue to provide flood protection for 100 more years.

Mitigation Measures

A Stormwater Pollution Prevention Plan (SWPPP) is required by Ohio EPA that describes and ensures the implementation of best management practices to reduce pollutants in stormwater discharges related to construction activities. No compensatory mitigation measures have been identified or are anticipated to be required as a result of implementing the preferred alternative.

Project Costs

Items	PL -566 funds	Other Funds	Total
Construction	$344,000	$151,000	$495,000
Engineering	$99,100	$0	$99,100
Project Administration	$19,400	$11,400	$30,800
Real Property Rights	$0	$38,900	$38,900
Total Installation Costs	**$462,500**	**$201,300**	**$663,800**
Annual O&M (non-Federal)	$0	$4,500	$4,500

1/ Price base 2011, amortized over 101 years at a discount rate of 4.00%

Project Benefits:

Economic average annual benefits of the project are derived from extending the service life of Rock Mill Lake and constructing modifications to meet current State of Ohio and NRCS dam safety and performance criteria. Benefits are based on a) continuing flood protection for downstream agricultural land, residences, businesses, and roads, b) recreational activities, and c) the avoided costs associated with removing the lake. Total average annual flood damage reduction benefits are estimated to be $167,700, which include benefits to agriculture ($151,500) for cropland and pastureland, rural properties, sediment and erosion, farm buildings and equipment; to roads and bridges ($9,200); and to urban properties ($14,200). Benefits also include $13,800 for continuing recreational uses. The Sponsors would not incur costs of breaching the dam, equating to an annual savings (benefit) of $55,000. Summing all benefits provides a total of $243,700 average annual benefits.

Number of Direct Beneficiaries

On-site: Several hundred Off-Site: NA

Due to the nature of the surrounding lake recreational area and the at-risk properties downstream, it is difficult to predict an exact number of people at risk. The public lake and surrounding recreational area could be used by several dozen people hunting, walking, or in boats on the water. There are an estimated 200 homes and 50 businesses within the breach inundation area downstream of the dam. There could also be several dozen people at risk on at least 6 bridges downstream of the dam on the Hocking River.

Description of Other Beneficial Physical Effects:

- Meet dam design, performance, and safety criteria
- Reduce the potential for loss of life for the next 100 years
- Protect existing fish and wildlife habitats
- Maintain local recreation opportunities for boating, fishing, hunting, birding, etc
- Benefit to cost ratio: 8.0 to 1.0
- Net Beneficial Effects (NED): $213,200

Funding Schedule (budget year + 1)

Federal Funds (budget year): $462,500
Non-federal Funds (budget year): $201,300
Non-federal Funds (year after budget year): $4,500 annually

Period of Analysis – 100 years

Project Life – 100 years

Environmental Effects:

Installation of the preferred alternative would result in disturbance of approximately 22 acres of grassland and cropland. This includes permanent land use changes for a maximum of five acres for spoil disposal and 1.5 acres for expansion of the auxiliary spillway. Minor temporary impacts during construction would be controlled through BMP's. All disturbed areas will be planted to grasses to protect from erosion. Temporary impacts would occur to fish and wildlife during construction when the water level is lowered two feet maximum to complete work on riser and make concrete repairs. No compensatory mitigation has been identified or is associated with the preferred alternative.

Major Conclusions:

Rehabilitation of Structure 9 will minimize the risk of loss of life within the breach inundation area, will have minor impact to the environment, and will allow flood prevention benefits and recreation opportunities to continue for 100 more years.

Areas of Controversy:

None known.

Issues to be Resolved:

A lake level gage sensor to alert drivers and landowners in the flood pool area when high water occurs over Mt. Zion Road is considered to be part of the plan. Instrumentation would automatically relay the lake water level to county emergency management. This would be incorporated into the Emergency Action Plan. Landrights costs are estimates and may change from those listed in this document.

Evidence of Unusual Congressional or Local Interest: The local sponsors have taken an active approach to upgrade this dam to meet current performance and safety standards.

Is this report in compliance with executive orders, public laws, and other statues governing the formulation of water resource projects? Yes __X__ No ____

PURPOSE AND NEED FOR ACTION

CHANGES REQUIRING PREPARATION OF A SUPPLEMENT

Structure No. 9 (Rock Mill Dam), was constructed in 1960 as a high hazard dam as part of the Upper Hocking Watershed Work Plan "pilot" project first approved in 1955 and later revised in 1958. Records indicate the dam was designed and constructed according the design criteria that was in place at the time of construction. The Ohio Department of Natural Resources, Dam Safety Program, and the Natural Resources Conservation Service (NRCS) concur that Upper Hocking Structure 9 (Rock Mill Dam) is still correctly classified as a high hazard dam due to a potential for loss of life if the dam were to fail. High hazard dams in Ohio must store or safely pass the probable maximum flood (PMF). A breach analysis recently completed by NRCS indicates that the PMF flow would overtop the end of the dam and containment dike. Also, poor materials in the auxiliary spillway would be erosive if flows occur in the spillway. These conditions could lead to failure of the dam or spillway. Therefore this dam does not meet the current performance and safety standards required for a high hazard dam. The watershed plan is being supplemented to document the condition of the dam, and the potential rehabilitation alternatives including their costs and impacts.

PURPOSE AND NEED FOR THE SUPPLEMENT

The purpose of the rehabilitation project is to:

- Modify the dam or spillway to comply with applicable design, performance, and safety criteria for a high-hazard dam,
- Maintain the current 100 year flood damage reduction level to roads, bridges, homes, businesses, and agricultural land downstream of Rock Mill Dam, and
- Maintain the existing fish and wildlife purpose developed on this property owned and operated by ODNR as Rock Mill Lake State Wildlife Area.

The need for this supplemental watershed plan arises from the fact that Rock Mill Dam does not meet current high hazard dam design, performance, and safety criteria. One end of the dam adjacent to the auxiliary spillway is low. This low end of the dam and the containment dike separating the dam from the auxiliary spillway would be overtopped during the probable maximum flood. Much of the exit section of the auxiliary spillway contains loose sands and dispersive clays under the topsoil layer. Flow over the dam or though the spillway could lead to severe erosion of dam and spillway causing failure. ODNR, Dam Safety Program, has required corrective action be taken to address these issues in a letter to the sponsor. Approximately 300 people are at risk should the dam breach unexpectedly. Also at risk for damage are an estimated 200 houses, 50 businesses, and 12 bridges downstream within the dam breach inundation area.

Rock Mill Lake, an 11 acre public access fish and wildlife lake, was created by construction of Rock Mill Dam. Rock Mill Lake State Wildlife Area, managed by ODNR, Division of Wildlife is used by approximately 1,400 anglers and 140 boaters every year. Other recreational opportunities include hunting and wildlife watching.

The dam has been well maintained and has been regularly inspected, but deterioration of the concrete riser and outlet structure has been documented in the ODNR dam safety reports since 1991. Rehabilitation would also include repair of the deteriorated concrete in the principal spillway riser and outlet structure.

Rock Mill Dam is one of eight flood control dams built in the watershed to reduce flooding and flood damage along the Hocking River on the west side of Lancaster, Ohio. The dam is now 50 years old and has exceeded its original 50 year service life. Rehabilitation will allow for continued flood damage reduction in the 100-year floodplain downstream, meet applicable NRCS and ODNR, Division of Water, Dam Safety Engineering Program standards for public health and safety, and reduce the risk of loss of human life for 100 more years.

SCOPE OF THE ENVIRONMENTAL ASSESSMENT

A scoping process was used to identify issues of economic, environmental, cultural, and social concerns in the watershed. Watershed concerns of the Sponsors and local citizens were expressed at planning and public meetings. The NRCS convened a group of interdisciplinary agency experts to review the actions of the alternatives being evaluated. The environmental evaluation conducted is fully documented on form NRCS-CPA-52 Environmental Evaluation Worksheet (filed at the NRCS state office, Columbus, Ohio. Table A presents a summary of the scoping process.

Table A. Summary of Scoping

Item / Concern	Relevant to the proposed action		Rationale
	YES	NO	
SOILS			
Sedimentation and erosion	X		100 year sediment storage required
Prime & Unique Farmland		X	Area of potential effects is prior converted to non-ag use
WATER			
Water Quality	X		Minor temporary impacts during construction
Regional Water Mgt. Plans & Coastal Zone Management Areas		X	None present in project area
Floodplain Management	X		Compliance with E.O. 11988
Wetlands	X		Minor temporary impacts to upper pool during construction
Wild and Scenic Rivers		X	None present in project area
Sole Source Aquifers		X	None present in project area
Waters of the USA	X		Waters of the USA flows through structure
AIR			
Air Quality		X	Minor temporary impacts, BMP.s in use
PLANTS			
Threatened/Endangered Species		X	No species identified.
Essential Fish Habitat		X	None present in project area
Invasive Species		X	Presence, introduction or spread of invasive species not anticipated
Natural Areas	X		Lake and surrounding area within a state wildlife area
Riparian Areas	X		Minor temporary affects during construction
Ecologically Critical Areas		X	–None present
Forest Resources		X	–Not affected by action
ANIMALS			
Fish and Wildlife Habitats	X		Temporary effects during construction

Coral Reefs		X	None present in project area
Threatened/Endangered Species		X	No effect
Invasive Species		X	Presence, introduction or spread of invasive species not anticipated
Migratory Birds / Bald and Golden Eagles		X	No effects expected
HUMANS			
Dam Safety	X		Concern for risk of loss of life during breach
Flood Damages	X		Concern for flood damages from breach
Cultural Resources & historic properties		X	None identified in project area
Public Health and Safety	X		Concern for public safety if dam breaches
Environmental Justice		X	Subject population not present
Scenic Beauty & Parklands	X		Area is within public wildlife area
Recreational Opportunities	X		Concern for loss of lake and wildlife area if lake is removed or breaches
Transportation	X		Concern for road flooding in flood pool and road damage due to breach
Property Values	X		Concern for change in land use and land values
Cost to sponsor	X		Project cost a concern of Sponsor
National Parks, Monuments, and Historical Sites		X	None present in project area
Land Use	X		Concern for change in land use and land values
Floodplain Management	X		Compliance with E.O. 11988

AFFECTED ENVIRONMENT

EXISTING CONDITIONS

Original Project

A plan for watershed protection and flood prevention in the Upper Hocking Watershed, in Fairfield County, Ohio was completed in 1955 as part of the Upper Hocking Work Plan for Watershed Protection and Flood Prevention. This "Pilot" project was originally authorized by congress to demonstrate a works of improvement program for small watersheds. The original purpose was to reduce downstream flood damages in the Hocking River floodplain located on the west side of the city of Lancaster. The project was originally to include nine flood control dams, and 74 stabilizing and sediment control structures. The plan was modified in 1958, and when completed in 1962, a total of eight flood control dams were constructed in the watershed along with 21 smaller dams built for grade stabilization and sediment control.

Description of Existing Dam

Rock Mill Dam was constructed in 1960 as a high hazard structure. The dam is an earthfill structure with a maximum height of 76 feet, a crest length of 1,010 feet, and a top width of 22 feet. The 300-foot wide auxiliary spillway is 40.2 feet in elevation above normal pool. There is 7.5 feet between the top of dam and auxiliary spillway. The dam impounds a 20 acre lake (as-built), and is owned and maintained by Hunters Run Conservancy District. Additional structural data can be found in Table B. Sedimentation over the last 50 years has reduced the pool area to 11 acres.

Table B. Existing Structural Data for Rock Mill Dam

Stream	Hocking River
Year Completed	1960
Purpose	Flood Prevention, Fish and Wildlife (incidental)
Total Drainage Area Controlled	4583 Acres (7.16 sq. mi.)
Dam Characteristics	
Maximum Height	76 feet
Type	Earthen
Volume of Fill	285,854 Cubic yards
Crest Length	1,010 Feet
Auxiliary Spillway Type	Vegetated
Auxiliary Spillway Bottom Width	300 Feet
Elevations (Mean Sea Level)	
Top of Dam	957.1 Feet (NAVD88) 1/
Flood Pool (crest aux. spillway)	949.4 Feet (NAVD88)
Normal Pool, Low Stage Prin. Spillway	909.4 Feet (NAVD88)
Storage Capacity	
Total (top of dam)	2600 Acre-Feet
Sediment (As-built)	174 Acre-Feet
Municipal Water Supply	0 Acre-Feet
Floodwater retarding	1850 Acre-Feet (Crest of Auxiliary Spillway)
Surface Area	
Permanent pool (As-built)	20 Acres
Floodwater retarding pool	91 Acres
Principal Spillway	
Stages	2
Conduit Size	4ft wide x 7ft high
Type	Reinforced Concrete Pipe

1/ Elevations contained in this document are referenced to North American Vertical Datum of1988 (NAVD 88

Upper Hocking Structure 9 (Rock Mill Dam) is located in Fairfield County, approximately three miles west of Lancaster, Ohio. The lake has a drainage area of 4,583 acres (7.16 square miles) and is located on the headwaters of the Hocking River. The Hocking River flows southeast through Fairfield County, then through Hocking and Athens Counties and into the Ohio River near Hockingport, Ohio. The lake and surrounding property is owned and managed by Ohio Department of Natural Resources as a Rock Mill Lake State Wildlife Area with public boat access from Mt. Zion Road. (Figure 1) Pictures of part of the lake, dam, riser, and outlet channel can be seen in Figures 2, 3, and 4.

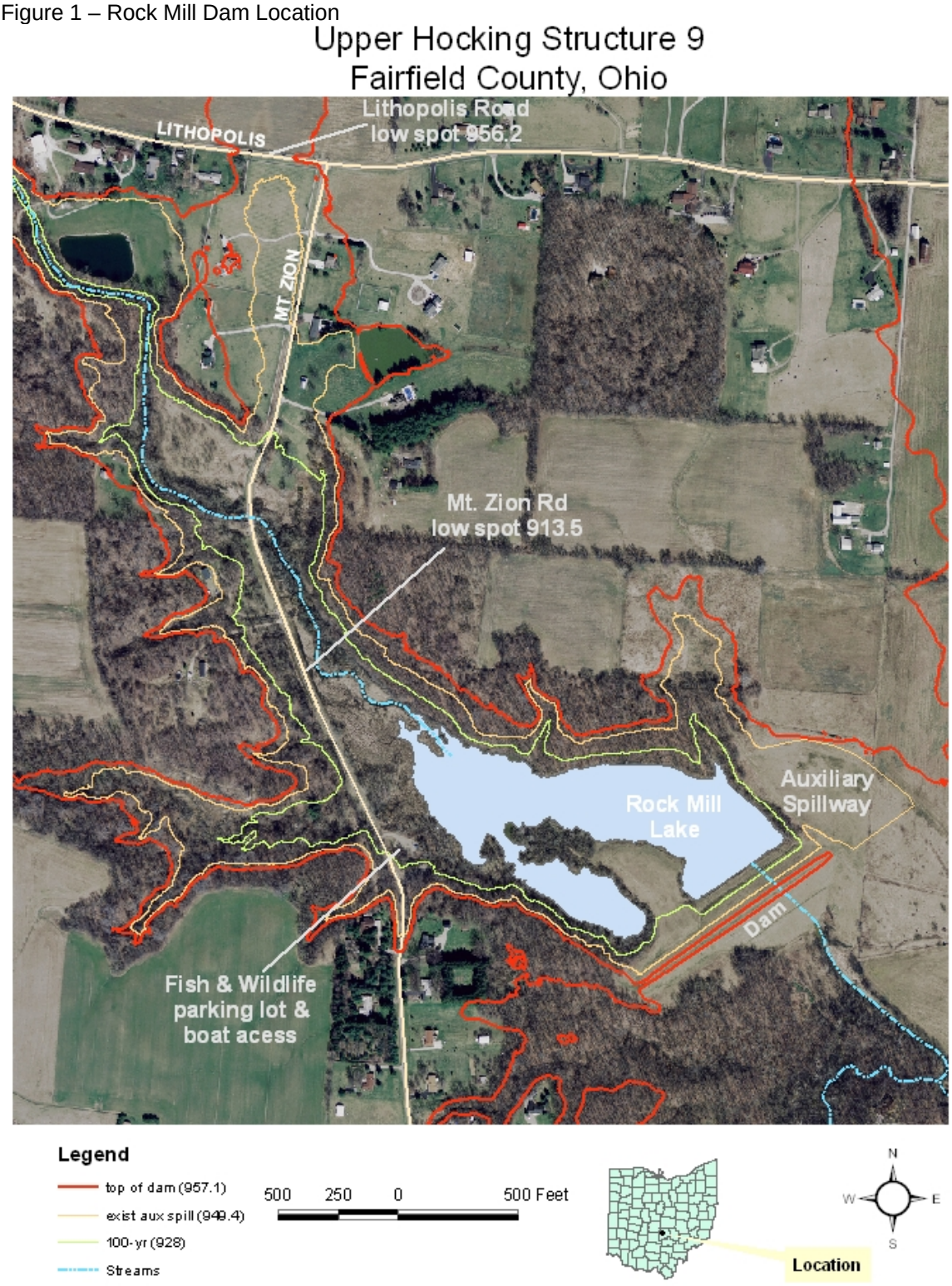
The hydrology and hydraulic study conducted for this planning effort by NRCS indicates the dam cannot pass the design flood (100% of the Probable Maximum Flood) without overtopping part of the dam, containment dike between dam and auxiliary spillway, and overflowing a low spot along the watershed divide in the upper pool area (see Figure 1). The Probable Maximum Flood (PMF) elevation of 958.6 (NAVD88) will exceed the auxiliary spillway capacity and flow over the containment dike and 50 feet of the east end of dam. The PMF is also 2.4 feet higher than the low spot in Lithopolis Road along the watershed divide in the upper area of the flood pool. Once the water exceeds this road elevation the water would flow to the north and by-pass the dam. Dispersive clays and sandy soils lie under the topsoil along most of the auxiliary spillway exit section. If the spillway experiences significant flows then severe erosion is likely and this could lead to head cutting failure in the spillway. ODNR has agreed that PMF flow through the auxiliary spillway would overtop part of the dam and containment dike, potentially cause severe erosion along the bottom of the spillway, and would jeopardize the safety of the dam. ODNR has required corrective action be taken to address these issues in a letter to the sponsor.

A concern of the local residences and Greenfield Township Trustees that was voiced at a Hunters Run Conservancy District meeting in May 2010, and again in June 2011, is the safety issue and frequency of flooding of Mt. Zion Road that crosses the flood pool just upstream of Rock Mill Lake. This section of road typically floods a couple times each year. Local residences state the road can flood relatively quickly and this not only impedes local traffic but makes it difficult for emergency responders and school buses. The trustees asked if an evaluation could be made to determine if modifications could be made to the riser, as part of the planning for rehabilitation, to reduce the frequency of flooding of the road, and provide additional warning time. The NRCS investigation shows that water begins to flow over the low spot in Mt. Zion Road when rainfall exceeds 1.6 inches in 24 hours. This is less than a 1-year return period rain event (2.2 inches in 24 hours). The NRCS investigation concluded that adding a low flow port to the riser would reduce the frequency and duration of flooding while increasing the time before flood waters would reach the road elevation. A lake water level gage would enable local officials to monitor the lake level at any time, and therefore increase the response time for any necessary action. Adding a low port to the riser, and installation of a lake level gage would address the concerns and would be incorporated into the preferred alternative.

The Army Corps of Engineers performed a Phase I Dam safety Inspection in 1979 that classified Rock Mill Dam as a high hazard dam. Subsequent safety inspections by the Ohio Department of Natural Resources, Division of Water, Dam Safety Engineering Program, have been performed in 1984, 1991, 1995, 2002, and 2007. According to these inspections and the annual inspections performed by the conservancy district the dam has been well maintained. Cracks and spalling in the concrete riser and outlet structure walls has been documented in the ODNR dam safety reports since 1991. The sponsors have patched and sealed the cracks at least twice. Eight flood control structures were completed in the Upper Hocking Pilot Watershed between 1954 and 1961. An engineering investigation and report (Upper Hocking Watershed, Deteriorating Concrete, 1989) conducted by NRCS (then known as SCS) described concrete deterioration on several of the Upper Hocking flood control dams that began within five years of construction that included spalling and cracking. The conclusion reached was that deterioration was primarily caused by poor quality coarse aggregates and resulting lack of resistance to freeze-thaw damage. A more thorough investigation including coring and lab testing was recommended. In 2010 NRCS let a contract with URS to investigate the concrete condition at Upper Hocking 9 that included inspection of the concrete, performing strength tests on concrete core samples taken, and petrographic testing to check susceptibility to freeze-thaw

damage. Results indicate the structural concrete elements are in fair to good condition and should have a remaining service life of at least 50 years. Replacement of part or all of the concrete structures was not considered necessary at this time. The recommendation made by URS was to thoroughly clean the surfaces to remove loose concrete, then patch and seal.

Figure 1 – Rock Mill Dam Location



A geological investigation was conducted in December 2009 in the auxiliary spillway area to evaluate the material that may be excavated and the spillway erosion potential. The materials encountered in the geologic exploration included Wisconsin and Illinoian glacial tills and outwashes as well as a layer of loess deposited between the Wisconsin and Illinoian glacial events. The Illinoian outwash is capped with a paleosol that was then buried by Wisconsin glacial till. The geology of the spillway is very complex. The materials were deposited and eroded by ice water and wind throughout a complex history. Much of the spillway has loose erodible sands and moderately dispersive clays directly under the 6 inch topsoil layer. Dispersive clays are more erosive than other clays and the loose sand outwash is very weak. Should the grass sod be eroded as a result of flows through the spillway, the weak soils underneath would erode quickly and this could lead to failure of the spillway.

There are at least five houses and several farm buildings in the breach inundation area within two miles downstream of the dam. The water would likely be over three feet deep inside two of these houses during a breach of the dam. The River Valley Mall is located just within the breach inundation area five miles downstream of the dam. Between the mall and US highway 22 located six miles downstream there are over 200 houses and 50 commercial buildings in the City of Lancaster that are within the breach inundation area. Ten bridges cross the downstream floodplain between the dam and US 22 in Lancaster including two major highways, several railroad bridges, county roads, and city streets. If the dam were to fail, public services and utilities would be disrupted as well as damages would likely occur to at least two city parks and one Junior High School. Failure of Rock Mill dam would eliminate this 11 acre public access fish and wildlife lake that is managed by ODNR.

Figure 2. – Looking upstream from dam at lake and riser

Figure 3. Upstream slope of Rock Mill Dam.

Figure 4. Looking downstream from dam at outlet structure and outlet channel

Physical Features and Environmental Factors

Project Location:
The Upper Hocking Watershed is located in Fairfield County. Structure 9 is located in Section 31, Greenfield Township, Fairfield County, Ohio. The watershed is within hydrologic unit code 05030204-04-01 as designated in the national Watershed Boundary Dataset (WBD).

The Upper Hocking Watershed is located west and north from and includes parts of the City of Lancaster, Ohio. The watershed includes all the tributaries at or above the City limits of Lancaster and is 30,760-acre (48.1 square mile) in size. The Hocking River flows southeast through Hocking and Athens Counties and into the Ohio River near Hockingport, Ohio.

Topography
The Upper Hocking Watershed is located in the Indiana Ohio Till Plain Major Land Resource Area close to its border with the Western Alleghany Plateau. The area around the watershed could be described geologically as glaciated Allegany Plateau. The topography ranges from level to gently sloping in the upper watershed to very steep where the Hocking River breaches the Black Hand Sandstone before entering Rock Mill Lake.

Climate
The climate of the watershed is continental. It is characterized by large annual and daily differences in temperature. The summers are warm and humid, and winters are cold. The average temperature is about 28^{o} F in winter and 71^{o} F in summer. The average growing season is 141 days from May 7 to October 6.

Thunderstorms occur on about 42 days each year. Most occur between May and August. Precipitation varies widely from year to year but is normally abundant and well distributed. The average annual precipitation is 39 inches; of this, nearly 60 percent falls between April and September. The area receives 28 inches of snow on average; however, the amount can vary.

Soils
The upland soils in the Upper Hocking 9 watershed consist of nearly level Patton and Marengo soils that formed in glacial lake bed deposits and glacial till. These poorly drained soils are well suited for cropland and agricultural uses. Slightly to moderately sloping soils consist of Bennington, Cardington and Amanda Silt Loams. These soils are well suited for agricultural uses and more recently have been used for residential development. The steep portions of the area may contain areas of soils formed in sandstone bedrock.

Geology
The watershed is located in an area of sandstone and shale Mississippian Age bedrock. The area was inundated by at least two different glaciers. Evidence of the Illinoian and Wisconsin Glaciers can be found. After the retreat of the last glacier, a glacial lake formed around what is now the channel of the Hocking River upstream of the reservoir. The most striking geologic feature is the Hocking River gorge through the Black Hand Sandstone located upstream of the reservoir. The gorge is narrow with steep sides up to 60 feet in height. This gorge is geologically the same as the gorges in the Black Hand that make up the Hocking Hills area to the south.

Water Quality
The stream through the Rock Mill Lake structure has a designated aquatic life use of warmwater habitat according to the Ohio Environmental Protection Agency. Based on data collected by the OEPA, reaches of the Hocking River above the structure are not in attainment of the water quality standards for the designated use. The major impairments are physical alteration of the stream and siltation; nutrients and organic enrichment are less significant impairments. The reach below the structure is meeting the water quality standards for the designated use. There are no obvious sources of pollutants emptying directly into the stream or lake. Chemical impairment has not been identified in the reaches of the stream near the project area.

Threatened and Endangered Species
The project area is located within the potential range of four Federally-listed or candidate species: Indiana Bat (*Myotis sodalis*), Clubshell Mussel (*Pleurobema clava*), Rayed Bean Mussel (*Villosa fabalis*) and Eastern Massasauga Rattlesnake (*Sistrurus catenatus*). There are no known records of any of these species in the projects site or the immediate area around it. The project site is 7-15 miles from recorded locations of the mussels; however the stream below the structure does have a limited amount of potential habitat for both mussels. There is no suitable habitat for the Massasuga on the project area. Upland forests and wooded riparian corridors that may be used by the Indiana Bat are present within the Rock Mill Lake area.

Fish and Wildlife Habitats
The Rock Mill Lake area contains a variety of wildlife habitat including upland forests, wetlands and old field areas. The quality of these habitats is moderate typical for the area. The forest is mostly upland and riparian deciduous trees with a shrub and herbaceous understory. In addition there is relatively poor quality habitat in the mowed grassy areas of the dam and spillway. Surrounding the Rock Mill Lake area is a mix of upland habits including woodlots, brushy areas, pasture and crop fields.

The lake provides approximately 11 acres of lentic habitat that supports a typical warm-water fishery of catfish, bass, centrarchids and cyprinids. It provides a variety of water depths as well shallow spawning sites, aquatic vegetation and habitat structure within the pool. The stream below the structure is 10 to 15 feet wide; the banks are wooded along much of the reach immediately below the structure. The bottom is cobble, silt and sand. There are some pools and riffles starting 250 feet below the structure. The flow is seasonal to permanent depending on outflow from the structure. The stream above the structure is affected by the backwater from the lake. The stream is shallow and braided immediately above the lake (in the former pool area). The bottom is primarily silt and sand.

Wetlands
Although wetlands are generally not common in this area, extensive areas of wetland have developed in the upper pool as a result of sedimentation since lake construction. There are approximately 9 acres of former open water that have reverted to wetland. Most of these are shallow and dominated by emergent vegetation. Hydrology of the wetlands is directly influenced by water levels in the lake.

Riparian Areas
Prior to the construction of Rock Mill Lake there was a small stream flowing through the area. The stream likely had a wooded corridor of varying widths along both sides. After the construction of the lake, the riparian corridor below the structure remains unchanged; it is mostly mature hardwood trees for 1,200 feet before changing to more open vegetation with scattered trees. In the upper reaches of the pool the riparian area is mostly shallow emergent wetland with scattered trees. The banks of the lake are primarily hardwoods.

Natural Areas, Scenic Beauty and Parklands
The Rock Mill Lake Wildlife Area is relatively undisturbed area within a predominantly agricultural landscape. The area is managed with fish and wildlife use in mind so some disturbance for habitat management purposes does occur. The lake, set among wooded hillsides, does provide an attractive site for fishing, hunting and other outdoor recreation.

Land Use
The major land use in Fairfield County is agricultural. The Upper Hocking Watershed has experienced changes over the life of the project with cropland being reduced by 30%, pasture/grassland reduced by 25%, and both woodland and urban areas approximately doubled. Table C and D show the changes in the Upper Hocking Watershed and Structure 9 Watershed, respectively, from 1955 to 2009. US Route 33 cuts across the watershed from northwest to southeast and is a vital transportation link that increases opportunities for growth and development in the area.

Table C. Upper Hocking Watershed Land Use

Land Use / Land Cover	1955 Watershed Work Plan (Acres)	Percentage of Total	2009 Watershed (Acres) 1/	Percentage of Total
Cropland	12,432	40.4	8,726	28.4
Pasture / Hayland	12,063	39.2	9,051	29.4
Woodland	2,642	8.6	5,848	19.0
Urban (roads/bldgs)	3,573	11.6	7,017	22.8
Water	50	0.2	118	0.4
Total	30,760		30,760	100.0

1/ source: NASS 2009

Table D. Structure 9 Watershed Land Use

Land Use / Land Cover	1955 Watershed Work Plan (Acres) 2/	Percentage of Total	2009 Watershed (Acres) 1/	Percentage of Total
Cropland	1,852	40.4	1,244	27.1
Pasture / Hayland	1,797	39.2	1,600	34.9
Woodland	394	8.6	711	15.5
Urban (roads/bldgs)	532	11.6	1,002	21.9
Water	9	0.2	26	0.6
Total	4,583	100.0	4,583	100.0

1/ source NASS 2009
2/ estimated from 1955 watershed plan

The NRCS State Cultural Resource Specialist conducted a file search at the Ohio Historic Preservation Office (OHPO), Columbus, Ohio. Based on the literature review and background research, NRCS determined that no adverse impacts are likely to any known cultural resources. Because of the prior ground disturbance that took place during original construction and the fact that new areas will not be disturbed, further archaeological work is not needed. The proposed dam improvements will not affect properties listed in or eligible for listing in the National Register of Historic Places. Consultation with the Ohio Historic Preservation Office is currently underway to obtain concurrence that this project would have no affect on historic properties.

There are no Federally recognized tribes in Ohio. There are no State-recognized tribes that have judicially established Indian land areas in Fairfield County where Rock Mill Lake is located. However, the Eastern Shawnee Tribe of Oklahoma and the Absentee - Eastern Shawnee Tribe of Oklahoma may have historic ties to the area. Consultation letters (May 2010) were sent to these two tribes and no responses were received.

Recreation
Rock Mill Lake is part of Rock Mill Lake Wildlife Area owned and operated by Ohio Department of Natural Resources (ODNR), Division of Wildlife. According to ODNR, the lake is a popular fishery with anglers and has a good population of largemouth bass, sunfish, and catfish. Paths are available around the lake that provides access to bank anglers, and approximately 1,400 anglers and 140 boaters use the lake yearly. A small boat ramp is available for small boat access. Electric boat motors are permitted on the lake as well as gasoline motors of 10 horsepower or less. ODNR estimates that 160 hunters use the lake for waterfowl hunting and the surrounding land within the wildlife area for deer and turkey hunting, and 365 use the area for wildlife watching.

Social and Economic Conditions
The Upper Hocking site lies three miles due west of Lancaster, Ohio within Fairfield County. The social and economic data in this section is shown in comparison with the U.S., state, county, and city of Lancaster when available. The information includes population, housing, education, unemployment, and income.

Population and Race
According to 2005-2009 American Community Survey 5-year estimates from the Census Bureau the population of Lancaster City was at 36,860 in 2009. This is about one quarter of the population in Fairfield County which is 1.2% of the State of Ohio (Table E). The population is primarily white (not Latino) with 95.6%, Black at 0.9%, American Indian or Alaska Native at 0.1%, Asian at 0.6% and 0.2% of some other race.

Table E. Population of the Study Area.

	Lancaster	Fairfield County	Ohio	US
Population				
Total population	36,860	140,842	11,511,858	301,461,533
Male	17,641	70,120	5,612,490	148,535,646
Female	19,219	70,722	5,899,368	152,925,887
Median age (years)				
Under 5 years	6.8%	7.0%	6.7%	7.3%
18 years and over	77.5%	80.4%	79.2%	79.4%
65 years and over	15.7%	12.6%	14.1%	13.3%
Race				
White (not latino)	95.6%	89.6%	81.4%	59.4%
Hispanic or Latino (of any race)	1.0%	1.3%	2.6%	15.1%
Black or African American	0.9%	5.9%	11.7%	12.4%
American Indian and Alaska Native	0.1%	0.1%	0.2%	0.8%
Asian	0.6%	1.0%	1.5%	4.4%
Native Hawaiian and Other Pacific Islander	0.0%	0.0%	0.0%	0.1%
Some other race	0.2%	0.4%	0.9%	5.6%
Two or more races	1.6%	1.7%	1.7%	2.2%

The comparison of the American Community Survey to the 2000 Census for Fairfield County showed some changes in population race. The size of the Latino population nearly doubled in the county to 1,858 from 993 since 2000. The black population had more than doubled in Fairfield County from 3,274 to 8,351 since 2000.

The age of the population in Lancaster City is a little older than the county or state. The population of 65 years or older is 15.7% for Lancaster city, 12.6% for Fairfield County, and 14.1% for the State of Ohio. The under age of five are similar across all compared areas.

Housing

The 2005-2009 American Community Survey 5-year estimates showed Lancaster City had 16,903 housing units (Table F). The occupation rate was similar to that of Fairfield County, 92.0% and 93.1% respectively. The owner-occupied rate was much lower in Lancaster (54.7%) than Fairfield County (71.7%) and close to the US average of 59%.

Table F. Housing Characteristics for the Study Area.

	Lancaster	Fairfield County	Ohio	US
Housing				
Total housing units	16,903	55,814	5,064,437	127,699,712
Occupied housing units	92.0%	93.1%	89.4%	88.2%
Owner-occupied housing units	54.7%	71.7%	62.1%	59.0%
Renter-occupied housing units	37.3%	21.5%	27.3%	29.2%
Vacant housing units	8.0%	6.9%	10.6%	11.8%
Owner-occupied homes	54.7%	71.7%	62.1%	59.0%
Median value (dollars)	$121,000	$166,600	$134,500	$185,400
Household Size				
Average household size	2.34	2.66	2.47	2.60
Average family size	2.94	3.08	3.06	3.19

The median value for Lancaster City is 121,000 which is less than the $166,600 for Fairfield County. The average household size for Lancaster City is also lower than Fairfield County, 2.34 and 2.66 respectively. The combination of higher rental rate, lower median value, and lower average household size suggest that Lancaster maybe a bedroom community to the city of Columbus which lies 20 miles to the northwest.

Education

The population of 25 and over education (Table G) shows that this area is above the state and national average for high school education. However, at 15.7%, the percentage of those having a bachelor's degree or higher for Lancaster City, is less across the board for than the county, state, or national average.

Table G. Education Characteristics for the Study Area.

	Lancaster	Fairfield County	Ohio	US
Education Level				
Population 25 years and over	25,107	92,842	7,671,550	197,440,772
High school graduate or higher	87.6%	90.9%	86.8%	84.6%
Bachelor's degree or higher	15.7%	23.2%	23.6%	27.5%

Employment, Income, and Poverty
The American Community Survey had all but the unemployment (Bureau of Labor Statistics) data for comparison. Lancaster City is below the median household income at $38,853 (Table H) as compared to the county, state, and US. The smaller household size (Table F) in Lancaster City results in a per capita income value of $22,052 which is close to the state value 2009 of $24,830.

Table H. Employment, Income, and Poverty for the Study Area.

	Lancaster	Fairfield County	Ohio	US
Employment				
In labor force (population 16 years and over)	18,241	73,259	5,899,737	153,407,584
Unemployment (BLS)		8.4%	10.1%	9.3%
Mean travel time to work in minutes (workers 16 years and over)	25	27	23	25
Income				
Median household income (in 2009 inflation-adjusted dollars)	38,853	56,955	47,144	51,425
Median family income (in 2009 inflation-adjusted dollars)	47,887	65,758	59,208	62,363
Per capita income (in 2009 inflation-adjusted dollars)	22,052	25,810	24,830	27,041
Families below poverty level	11.3%	6.8%	10.0%	9.9%
Individuals below poverty level	14.9%	9.3%	13.6%	13.5%

The 2009 average seasonally unadjusted unemployment data shows that Fairfield County has lower unemployment rate at 8.4% than the state and nation. The Fairfield County area has consistently had lower unemployment than the state average since 2001.

The poverty information combined with income and population data shows that Fairfield County as a whole is stable economically overall. However, Lancaster City at 11.3% within Fairfield County is above the state and nation average for poverty, at 10.0% and 9.9% respectively. Therefore, the town closest to the structure is in poorer economic condition than the county in which it resides.

STATUS OF OPERATION AND MAINTENANCE

The Hunter's Run Conservancy District serves as the dam's owner and operator. The last formal inspection of Rock Mill Dam was conducted by ODNR, Division of Water, Dam Safety Engineering Program on August 7, 2007. The inspection is documented by the *Dam Safety Inspection Report* sent to the Hunter's Run Conservancy District. As stated previously, parts of the concrete riser and outlet structure exposed to freeze-thaw cycles has visually deteriorated (cracking, spalling, delamination) since the mid 1970's. These areas have been patched and sealed at least twice. In this inspection report it was recommended that the entire principal spillway be inspected for concrete deterioration. A concrete integrity analysis of the principal spillway was completed in August 2010 and the concrete was found to be in good overall condition except the outlet structure wing walls which were in fair condition. Compressive strengths of the concrete are all well above specified minimums. This indicates that the integrity of the concrete is not in question. It was recommended that the concrete be repaired and sealed to prevent further deterioration.

Previous ODNR inspections occurred in 1978, 1984, 1995, and 2002. The sponsors inspect the dam, usually with NRCS, at least annually. Operation and maintenance [O&M] items have been completed as required except the brush adjacent to the stilling basin and fence across the auxiliary spillway. The foundation drainage, wet areas along toe, and concrete deterioration are several of the items that the sponsors monitor as required by ODNR. As the structure continues to age, future O&M will become increasingly complex and expensive.

SEDIMENTATION

Rock Mill Dam created a lake that is managed by ODNR for fishing and wildlife. There are two areas that provide boat access to the lake. The original design provided for a 50-year sediment storage volume of 174 acre-feet from the 7.14 square mile drainage area above the lake. This included 150 acre-feet submerged below normal pool elevation and 24 acre-feet aerated sediment above normal pool.

As a part of the planning process, a reservoir sediment survey was conducted in June 2009. The lake bottom was surveyed to calculate the volume of water in the lake. This was compared to the design storage volume at construction. The difference would be equal to the submerged sediment that has accumulated in the lake. The survey revealed that 82 acre-feet of submerged sediment had been deposited in the reservoir below the elevation of the normal pool (909.4). It has also been estimated that approximately 22 acre-feet of aerated sediment has been deposited above the permanent pool (in the flood water retarding pool) since its construction in 1960, for a total volume of sediment equal to 104 acre-feet. Calculations for the original design indicated that 15% (24 acre-feet) of the total sediment was expected to be deposited as aerated sediment above the water level. Actually, approximately 20% of the total amount of sediment (104 acre-feet) has been deposited above water. This aerated sediment has been building up along the stream adjacent to the road above the lake. Several feet of sediment has accumulated in this area above the normal water level and this has helped reduce the lake size from 20 acres at the time of construction to 11 acres at the time of the sediment survey in 2009. Only 60 percent of the design sediment storage volume (174 acre-feet) has filled with sediment. The actual sediment deposition rate over the 50 year life of the lake has averaged 2.1 acre-feet per year, compared to the original design rate of 3.5 acre-feet per year. There is currently 68 acre-feet of water remaining in the lake below normal pool.

A sediment yield study was conducted for the watershed above Rock Mill Lake to estimate future sediment storage needs. Sheet erosion was calculated using the Revised Soil Loss Equation (RUSLE) for the different land uses in the watershed. The new sediment rate based on current land use and erosion rates is 0.74 acre-feet per year. The number of cropland acres has decreased to approximately two-thirds the original 1960 design value, woodland acres has more than doubled, and pasture has increased slightly when compared to the original design values. The number of rural urban and farmstead acres has doubled. But the lots that have been developed are large 1 acre in size on existing roads. The lower rate from the sediment yield study is likely attributed to changes in

land use that allow better cover conditions to exist. There has also been an increase in reduced tillage farming practices that has dramatically reduced erosion soil loss rates. The potential for major development is relatively low based on the limited development observed over the past 50 years and the rural nature of the area. Land use is expected to change minimally. Therefore, the future sedimentation rate is expected to be the same as is currently occurring (0.74 acre-feet per year). Since approximately 20% of the actual volume has accumulated as aerated sediment above the lake level, the future sediment rate will also assume that 20% would be aerated. The required minimum volumes for future sediment storage are 63 acre-feet (submerged) and 11 acre-feet (aerated) for a total of 74 acre-feet. There is currently 68 acre-feet of submerged sediment storage volume available below normal water level. This will provide 100 years of submerged sediment storage capacity.

BREACH ANALYSIS AND HAZARD CLASSIFICATION

The existing dam is classified by the ODNR, Division of Water, Dam Safety Engineering Program as a Class I (high hazard) structure due to the potential of loss of life if the dam were to fail. A breach analysis was conducted to determine potential failure modes, impacts of a breach, and confirm hazard classification.

First, the water level expected at the dam and in the downstream floodplain during the100-year flood event and the Probable Maximum Flood (PMF) was determined. The middle of the dam, where the dam is the highest, is several feet higher in elevation than the abutments. The minimum constructed top of dam is at elevation 957.1 (1988 datum). The water in the flood pool behind the dam during the 100-year / 24-hour flood event would be at elevation 930.4. This is 21.0 feet above the normal pool level and 19.0 feet below the auxiliary spillway crest elevation. The 100-year flood event in the Hocking River valley would begin to flood homes near the River Valley Mall located 5.2 miles downstream from the dam.

The Probable Maximum Flood (PMF) is the design flood for all high hazard dams in Ohio. The PMF elevation in the flood pool of the dam is 958.6 (NAVD88) and is based on the Probable Maximum Precipitation (PMP) 26.9 inches in a 6-hour period. The last 50 feet on the east end of the dam (auxiliary spillway side), and the containment dike (max elev. 955.0) would overtop during a PMF event. The PMF event would also overtop approximately 350 hundred feet of Lithopolis Road (low spot elevation 956.2) along the watershed divide in the upper flood pool.

The PMF maximum discharge through the dam would be 26,900 cfs. The PMF discharge increases to 37,300 cfs approximately 4 miles downstream where the abandoned canal and its 13 square mile drainage area enters the Hocking River.

A “Sunny Day” failure and a failure during an extreme flood were both considered to determine the potential worst case downstream impacts:

> *NRCS “sunny day” failure*. In this scenario, failure would occur rapidly after the water reaches auxiliary spillway elevation. First, the peak breach discharge (Qmax) for this dam was calculated using NRCS *Technical Release 60, Earth Dams and Reservoirs* (TR-60) and the outflow breach hydrograph was derived using criteria in NRCS *Technical Release 66, Simplified Dam Breach Routing Procedure*. Peak breach discharge for a “sunny day” failure is 114,000 cfs. Flood discharges and water surface elevations expected downstream were determined by routing the breach hydrograph through valley cross sections downstream of the dam using the unsteady flow model in HEC-RAS (USACE). It was assumed that the 100-yr flood discharges were occurring in the Hocking River downstream of the dam when this breach occurs. Approximately 4 miles downstream where the abandoned canal enters the Hocking River the breach discharge would be reduced to approximately 20,000 cfs. The breach evaluation extended downstream to the point where the “sunny day” breach flood depth would be within 0.5 feet of the 100-year flood depth without a breach. The breach zone for this event extends approximately eight miles downstream of the dam and results in high flow depths and/ or velocities to more than 200 homes and 50 commercial businesses, clearly indicating the potential for loss of life.

Breach during an extreme flood. A PMF event (no breach) occurring in the Hocking River valley in this area would lead to overwhelming flooding and property damage in the Hocking River floodplain in Lancaster. A breach on top of this would be relatively insignificant in comparison. Therefore a detailed analysis of a breach occurring during a PMF event was not evaluated at this dam. However, approximately 50 feet of the east end of Rock Mill Dam adjacent to the auxiliary spillway and the containment dike would overtop during the PMF and it is assumed the dam would begin failing after water begins flowing over the dam.

The analysis shows that:

- At least 100 homes, two dozen businesses, and many city streets and bridges would be impacted by a 100-year flood (no breach) further downstream in the city of Lancaster. This would cause major evacuations along the river.
- The flood depths expected during the PMF (no breach) downstream of the mall in downtown Lancaster would be 5 to 8 feet above the 100-year flood elevation. This would inundate 12 bridges and result in catastrophic damage.
- The "sunny day" breach results in higher discharges and water levels than the PMF until approximately 3.4 miles downstream between Collins Road and Ety Road. Downstream from this point, the PMF event (no breach) yields significantly higher discharges and water levels.
- The "sunny day" breach assumes a fast breach occurs with little to no warning.
- During an extreme flood event (greater than a 100-year) most of the floodplain would be under water, requiring evacuations. It is likely that no additional adverse impact (no significant effect) would occur if the breach of Rock Mill Dam also occurred.
- The "sunny day" breach event that would occur with the water at the crest elevation of the auxiliary spillway is the breach scenario that produces the potential worst case downstream scenario and was used to delineate the breach inundation area downstream of the dam (See Appendix C).

Results of the breach analysis are shown in Table K (Appendix D) including a summary comparison of peak discharge, water elevation, and approximate breach flow depth over the bridges downstream of the dam for the 100-year flood, probable maximum flood, and breach condition. The breach inundation area extends downstream to a point where the "sunny day" breach flood depth equals the 100-year flood depth (approximately eight miles downstream of the dam). Table L (Appendix D) shows approximate inundation depths in houses and businesses located within the first six miles downstream. Over 200 homes, 50 businesses, more than 18 bridges, and many miles of roads are located within the entire breach zone for this event and could potentially be damaged or destroyed.

Based on the breach analysis and consequences of failure, NRCS has confirmed the classification of the structure as a high hazard dam. High hazard dams are located where failure may cause loss of life, serious damage to homes, industrial and commercial buildings, public utilities, and main highways or railroads.

POTENTIAL MODES OF DAM FAILURE

The following potential modes of failure were considered while assessing the consequences of failure of Rock Mill Dam:

Hydrologic Capacity – Hydrologic failure of a dam can occur by breaching the auxiliary spillway or overtopping the dam. The integrity and stability of the auxiliary spillway is dependent upon the depth, velocity, duration of flow, the vegetative cover, and the spillway's resistance to erosion. Integrity of the embankment during overtopping is dependent on depth, velocity, duration of flow, vegetative cover, and the embankment's resistance to erosion.

Rock Mill Dam was originally designed to handle runoff from 19.7 inches of rainfall in 6 hours on an assumed saturated soil condition. The principal spillway is comprised of a standard two-stage riser, with a cumulative height of 43 feet. The low stage inlet allows water to drop 24 feet into a 7ft high by 4ft wide reinforced concrete pipe that is 363 feet long. The Phase I Inspection Report (1979) completed by the Army Corps of Engineers indicated that 100 percent of the PMF will pass through the auxiliary spillway without overtopping the dam. This was based on Probable Maximum Precipitation of 30.6 inches for 72-hour storm duration. Hydraulic evaluations by ODNR in 2007 indicated that the dam has adequate capacity / storage to store or pass the design flood (100% Probable Maximum Flood). Recent evaluations completed by NRCS during the planning for this project using the SITES program indicate the dam does not have capacity / storage to pass the design flood. The auxiliary spillway was originally designed not to function until a rain event produced greater than 6 inches of runoff in a 6-hour period. The spillway is 300 feet wide, has good vegetative cover, and has never flowed. However, dispersive soils and sandy soils in the auxiliary spillway could lead to failure caused by erosion if excessive flows occur.

Recent reservoir routings using SITES have included revisions for drainage area, runoff curve number, and time of concentration. The revised PMF is based on the Probable Maximum Precipitation (PMP) of 26.9 inches in a 6 - hour period. The Probable Maximum Precipitation (PMP) for Rock Mill Dam will produce 26,900 cubic feet per second (cfs) of peak outflow. The revised routing shows that 50 feet of the dam, and the entire containment dike, would overtop during the PMF and therefore the dam does not meet current criteria for high-hazard dams. Another issue is related to how the dam would function during the PMF. The full PMF flow (elevation 958.6) cannot be fully contained in the flood pool of the dam. A low spot on the watershed break in the upper pool area (elevation 956.2) is on Lithopolis Road. Although this low spot is below the minimum constructed top of dam (elevation 957.1), the PMF flow would spill over into the adjacent watershed to the north once water exceeded elevation 956.2. The potential for overtopping failure or breach through the auxiliary spillway at Rock Mill Dam during a PMF or near PMF event is high.

Seepage – Embankment and foundation seepage can contribute to failure of an embankment by removing [piping] soil material through the embankment or foundation. As the soil material is removed, the voids created allow even more water flow through the embankment or foundation until the dam collapses due to internal erosion. Seepage that increases with pool elevation is an indication of potential problems, as is stained or muddy water or "sand boils." Foundation and embankment drainage systems can alleviate the seepage problem by removing the water without allowing soil particles to be transported away from the dam. Rock Mill Dam has a foundation drain system under the downstream toe of the dam that was built to control seepage. Two wet areas have been observed since the dam was constructed and show no obvious signs of excessive seepage even during high flood pools. Although there is a chance of increased seepage volume during an extreme flood event, there is a low risk of dam failure due to seepage.

Seismic – The integrity and stability of an earthen embankment during an earthquake are dependent upon the presence of a stable foundation. Foundation movement through consolidations, compression, or lateral movement can cause the creation of voids within the embankment, separation of the principal spillway conduit joint, or in extreme cases, complete collapse of the embankment. The Upper Hocking Watershed is located in an area of low seismic risk, and no historical events that

would compromise structural integrity have been identified. Therefore, seismic activity reflects a low risk of dam failure.

Material Deterioration – Material used in the principal spillway system, the foundation and embankment drains, and the pool drainage systems are subject to weathering and chemical reaction due to natural elements within the soil, water, and atmosphere. Concrete risers and conduits can deteriorate and crack, metal components will rust and corrode, and leaks can develop. Embankment failure can occur from internal erosion caused by these leaks.

Rock Mill Dam has a concrete riser and poured in place reinforced rectangular conduit, along with foundation and embankment drains. The ODNR, Division of Water, Dam Safety Engineering Program has noted in their formal inspection reports since 1991 that minor concrete deterioration needs to be monitored. NRCS and the Hunters Run Conservancy District have also noted the concrete deterioration in their inspection reports since 1968. An engineering report prepared by NRCS (SCS at that time) in 1989 indicated that concrete deterioration was likely caused by lack of resistance to the freeze-thaw cycle due to poor coarse aggregate used in the concrete. A concrete analysis conducted by URS in 2010 concluded that there is some deterioration of concrete that needs to be repaired but that the integrity of the concrete is sound. This was verified by extracting concrete cores that were sent to a lab for compressive strength and petrographic testing. If the concrete deterioration continues without repair or replacement, the concrete integrity could be compromised. Therefore material deterioration of the concrete represents a medium risk of dam failure.

CONSEQUENCES OF DAM FAILURE

Rock Mill Dam is a high hazard dam, not because of its existing condition or potential of imminent failure, but because of the consequences of failure if a catastrophic breach were to occur. The exact mode and timing of a dam failure are difficult to predict. Under current conditions, the most probable cause of dam failure is flow overtopping the dam or excessive flow though the auxiliary spillway due to an extreme flood event. Excessive flows through the spillway would likely severely erode through the dispersive clays and sandy soils underlying the spillway. If Rock Mill Dam were to suddenly fail at a high reservoir stage (auxiliary spillway crest to top of dam elevation), regardless of failure mode, the downstream impacts would be similar to those described in the previous section titled, “Breach Analysis for Determining Hazard Classification.”

In analyzing the failure of Rock Mill Dam, the dam is assumed to breach catastrophically during a “sunny day” failure as water reaches the auxiliary spillway crest. There would be very little warning downstream. It is assumed that 100-yr peak discharges were occurring downstream, and structural collapse would occur quickly and result in 2,800 acre-feet of water and sediment being released. Resource inventories during the planning process indicate that a dam failure of Rock Mill Dam would jeopardize over 200 homes, 50 businesses, and place over 300 residents at imminent danger. Additionally, commuters on at least 18 bridges and dozens of roads would also be at fatal risk. See the Breach Inundation Map in Appendix C for the impacted area. Other effects would likely include extensive erosion and stream bank scouring, loss or severe damage to most of the bridges, loss of livestock and wildlife, and extensive damage to roads and utilities in the breach inundation zone.

In addition to property and infrastructure damage, a breach would catastrophically affect the entire City of Lancaster, including all city provided services and utilities. Since the river cuts through the middle of the city, access from the west side of the river to the east would be essentially cuts off. Fairfield County facilities located in Lancaster or services provided to Lancaster would also be severely hampered.

ALTERNATIVES

FORMULATION PROCESS

The Upper Hocking Watershed project was formulated to address the identified watershed problems and opportunities with full consideration of the effects of various alternative solutions on other watershed resource concerns. The Sponsors' objectives are to:

- Maintain or improve the current level of flood protection provided by Rock Mill Dam.
- Meet current design, performance, and safety criteria for a high hazard dam.
- Address major [high] concerns of local residents and stakeholders within the scope of the Dam Rehabilitation Program and this planning process.

All alternatives must meet the requirement of the Watershed Protection and Flood Prevention Act (PL 83-566) as amended by the Watershed Rehabilitation Amendments of 2000. In addition, formulation of alternative plans followed procedures outlined in the NRCS-National Watershed Program Manual, NRCS-National Watershed Program Handbook, NRCS-National Planning Procedures Handbook, and other NRCS watershed planning policy.

The formulation process began with formal discussions between the Sponsors and NRCS to address several issues including deteriorating concrete and the insufficient discharge / storage capacity of the dam. These items have been documented in previous dam safety inspections conducted by Ohio Department of Natural Resources, Dam Safety Engineering Program in 2007, 2002, and 1995. In addition, concerns, impacts and alternatives were discussed with ODNR Fish and Wildlife, local officials, and other stakeholders.

Planning evaluations were conducted to determine the condition of the concrete principal spillway, the volume of sediment in the lake and expected future sedimentation rate. A geological exploration was also completed within the auxiliary spillway area that led to the discovery of dispersive clays and sandy soils. Discussions were held with ODNR, Dam Safety, concerning the safety issues with this dam that include the low end of the dam and containment dike, and erosive nature of the soils in the auxiliary spillway and the potential failure that could happen if spillway flow occurs. ODNR has agreed that PMF flow through the auxiliary spillway would overtop part of the dam and containment dike, potentially cause severe erosion along the bottom of the spillway, and would jeopardize the safety of the dam. ODNR has required corrective action be taken to address these issues in a letter to the sponsor dated October 25, 2011.

Two alternatives that were required to be evaluated included a no Federal action (future without project) alternative, and a dam decommissioning alternative. The no action (Future Without Project) alternative serves as a baseline to evaluate the other alternatives. It represents the most probable future condition where no additional federal funds would be expended on this project. Without federal assistance the sponsors would likely breach the dam and eliminate the risk of damages from a breach. Decommissioning the dam would eliminate the hazard by removing the earthen embankment with full consideration of environmental and aesthetic issues, including proper stabilization and/or removal of sediments, protection/mitigation of wetland and wildlife habitat functional values, and other local considerations.

These studies led to a wide range of structural and non-structural alternatives. All structural options were considered to modify the dam to safely store or pass the design flood (Probable Maximum Flood) with due consideration to the stability of the auxiliary spillway.

ALTERNATIVES CONSIDERED BUT NOT DEVELOPED IN DETAIL

A wide range of structural and non-structural measures were considered. The following structural options include concrete repair of the principal spillway riser and outlet structure, repair of the existing embankment toe drains, reconstruction of the principal spillway outlet channel. Many combinations of auxiliary spillway and dam modifications were considered including:

Widen Auxiliary Spillway to 400 feet:
To avoid raising the dam, this alternative would widen the existing auxiliary spillway to 400 feet from the existing width of 300 feet. Widening the auxiliary spillway would require a splitter dike to be constructed down the middle of the auxiliary spillway to divide the flow area into two bays of width of 200 feet. The constructed splitter dike would begin in the entrance section of the auxiliary spillway just upstream of the control section and would continue downstream through the control section and the constructed exit section. The elevation of the top of the dike would be at the probable maximum flood elevation expected in the control section through the exit section and be constructed of compacted earthfill with ten foot top width and 3 horizontal to 1 foot vertical side slopes. This alternative would require 75,000 cubic yards of excavation and 7,000 cubic yards of earthfill. Disposal of the excess excavated material would be above the existing auxiliary spillway on park property or adjacent landowner. The estimated cost for this alternative is over $1,000,000 which is not cost effective relative to other rehabilitation options with equivalent public safety and flood protection benefits and without the impacts associated with this option.

Widen Auxiliary Spillway to 325 feet and raise Lithopolis Road:
This option would modify the previous alternative by reducing the volume of excavated material, eliminating the splitter dike in the auxiliary spillway, and the auxiliary spillway would only be widened to 325 feet. However, this alternative requires approximately 250 feet of Lithopolis Road to be elevated one foot in the upper pool area to prevent the probable maximum flood from overtopping the road into a different watershed. The estimated cost for this alternative is $815,000, which is not cost effective relative to other rehabilitation options with equivalent public safety and flood protection benefits and environmental effects associated with this option. Also, the sponsors and local officials would not find raising the road acceptable when other methods are available to meet project objectives.

Armor the Dam to provide overtopping protection:
This alternative would armor the surface of the existing dam, using RCC to protect the dam during the PMF event. The existing 300-foot wide auxiliary spillway must also be armored to prevent breaching through the spillway. The low spot in Lithopolis Road in the upper pool area would need to be raised. The estimated cost for this alternative would exceed $6,500,000. This option is over ten times the cost of the preferred alternative and is not an effective way to provide essentially the same public safety and flood protection benefits.

Raise the Dam with concrete walls and armor the existing auxiliary spillway:
This alternative consists of raising 50 feet of the existing dam to maintain the minimum top of dam required to contain the PMF without flow over the dam. The containment dike between the dam and the auxiliary spillway would also be raised several feet to protect the downstream side of the dam from auxiliary spillway flows. Approximately 50 feet on the west end of the dam would need to be raised one foot maximum. The existing 300-foot wide auxiliary spillway would be armored to prevent breaching through the spillway. The low spot in Lithopolis Road in the upper pool area would need to be raised. The estimated construction cost for this alternative is $3,000,000. Again, this alternative is not cost effective relative to other rehabilitation options with equivalent public safety and flood protection benefits.

A non-structural alternative considered is to remove downstream hazards to allow the existing structure to remain unchanged. This approach would require modification of 2,000 feet of a 4 lane divided highway (US Route 33) and removing or floodproofing all houses in the breach inundation zone to eliminate the potential for loss of life and to minimize property damage. There are at least 200 homes, 50 businesses, and 10 bridges in the breach inundation area below Rock Mill Lake. At least 90% of these homes, businesses and bridges are in the City of Lancaster. The feasibility of adequately modifying the section of US 33 and moving, acquiring, or floodproofing the 200 houses and 50 businesses would cost in excess of $40 million. This is much higher in cost than any other alternative under consideration. The excessive costs and social disruption caused by this approach are unreasonable, inefficient, and locally unacceptable. This also does not address the existing

performance and safety issues at the dam. Therefore, this alternative was excluded from further consideration.

Decommissioning Rock Mill Dam would involve removing the floodwater retarding capacity of the dam by cutting out a section of the embankment down to the valley floor, approximately 30 feet wide, to pass the flood resulting from the 100-year, 24-hour rainfall without impoundment behind the remaining embankment. Passing the 100-year flood is the minimum required by ODNR, Division of Dam Safety. For stability, the cut through the embankment would be shaped to a 3:1 slope from both sides of the channel. Approximately 100,000 cubic yards of material would be removed and disposed of in the existing auxiliary spillway area and 25 acres of critical area treatment would be installed. The existing accumulated sediment would remain in place and the entire 11-acre pool area would be re-vegetated. The new stream would be restored and stabilized with stream bank protection methods and obstructions removed as necessary. Approximately 2,200 feet of functional floodplain would be restored by dam removal. Approximately 25 acres would be disturbed during construction. All disturbed areas would be vegetated to control erosion. To limit public access and reduce liability, abandonment of the principal spillway structures would consist of demolition of the riser and impact basin and placement of grout plugs at each end of the conduits. The cost to physically decommission the dam as described above is estimated to cost over $1,500,000. This does not include the cost to provide a similar level of flood damage reduction that the dam now offers. Flood proofing or relocation of flood prone properties, and diking components similar in scope to the non-structural alternative above would be included with this alternative. Attainment of these measures is estimated to cost $40 million dollars. The excessive costs and social disruption caused by decommissioning the dam are unreasonable, inefficient, and locally unacceptable. Therefore, this alternative was excluded from further consideration.

DESCRIPTION OF ALTERNATIVE PLANS

Alternative No. 1 - No Action (Future without Project)
Under this alternative, no additional Federal funds would be expended on the project. This No Action Alternative specifically consists of:

- Excavating a minimal breach section through the embankment.
- Abandoning the existing principal spillway riser and conduit.
- Hydraulically reconnecting the stream channels located upstream of the reservoir and downstream of the embankment.
- Vegetating all disturbed areas, including designated disposal areas for excavated embankment material and re-establishment of a riparian area through the sediment pool.

Approximately 70,000 cubic yards of the earthfill embankment would be removed to construct a trapezoidal section with an assumed 30-foot bottom width through the dam to allow flow from a 100-year storm to pass through without impounding water behind the dam. This section would be lined with riprap to prevent erosion. The excavated channel through the reservoir sediment pool connecting the stream upstream of the reservoir and the excavated breach section through the embankment will be approximately 2,200 feet long. It would consist of a trapezoidal channel with a 15 to 20-foot bottom width and likely half of this length would need bank stabilization. The existing auxiliary spillway would likely be used as a spoil disposal area for all 90,000 cubic yards of excavated material. The existing pool area will need to be stabilized and reseeded. Approximately 25 acres would be disturbed during construction. All disturbed areas will be vegetated to control erosion according to a required Stormwater Pollution Prevention Plan (SWPPP).

To limit public access and reduce liability, abandonment of the principal spillway structure would consist of demolition of the riser and impact basin and placement of grout plugs at each end of the conduit. No additional work would be performed on the dam.

Estimated Total Costs: $1,314,000
Annual Operation and Maintenance: $3,300

Alternative No. 2 - Rehabilitate Dam

The rehabilitation alternative consists of dam modifications to address identified dam safety and performance deficiencies and extend the service life of this high hazard dam for an additional 100 years. Deficiencies include: the east end of the existing dam and containment dike would overtop during the PMF, and there are erosive soils in the auxiliary spillway exit section. If flows occur in the spillway, or over part of the dam, severe erosion could occur that could lead to dam or spillway failure.

These modifications to comply with current State and NRCS design criteria for a high hazard dam include provisions to:

- Widen the existing auxiliary spillway from 300 feet to 320 feet, lower the crest elevation of the auxiliary spillway by three feet, construct splitter dike along centerline of auxiliary spillway
- Raise the end of dam and containment dike between dam and auxiliary spillway
- Stabilize dispersive and erosion prone soil in auxiliary spillway
- Repair concrete of the principal spillway riser and outlet structure
- Repair or replace the toe drain outlet

Approximately 25,000 cubic yards of excess excavated material would be placed in a spoil area northeast of the auxiliary spillway on adjacent landowners property. A conceptual layout of the rehabilitation alternative is in Appendix C.

The sponsors are also interested in work to repair and seal the existing concrete riser and outlet structure, and modifying the riser to improve low flow efficiency. An additional low inlet (side port) would be cut into the riser to increase the area for low flows to get into the riser. This would reduce the frequency of flooding on Mt. Zion Road that cuts across the flood pool just upstream of the lake. A lake level gage would also be installed to provide warning time to local residents and emergency responders before Mt. Zion Road would go under water. This would be a part of the emergency action plan that is being developed for the dam. Approximately 11 acres would be disturbed during construction. All disturbed areas will be vegetated to control erosion according to a required Stormwater Pollution Prevention Plan (SWPPP).

Existing easements would need to be updated and revised to include restrictions on construction of new habitable dwellings for all parcel owners within the flood pool. Landrights would need to be acquired on approximately four acres adjacent to the auxiliary spillway outlet for disposal of excess excavated material. The rest of the construction, including disposal areas and staging and stockpile areas would be completed on property owned by the Ohio Department of Natural Resources, Division of Wildlife.

Estimated Total Costs: $663,800
Annual Operation and Maintenance: $4,500.

Table I. Summary and Comparison of Alternatives

Resource Concerns	Alternative No. 1 No Action (Future Without Project)	Alternative No. 2 Dam Rehabilitation
Resource Concern	Constructed breach through dam. Stabilize channel.	Update dam to meet dam safety criteria.
Investment		
PL 83-566 Funds	$0	$462,500
Other Funds	$1,314,000	$201,255
Total	$1,314,000	$663,755
National Economic Development Account 1/		
Average Annual Costs		
Installation	$57,200	$26,000
OMR	$3,300	$4,500
Total	$60,500	$30,500
Average Annual Benefits	$0	$243,700
Net Benefits	($60,500)	$213,200
Environmental Quality Account 2/		
Fish and Wildlife Habitat	Lose 11 acres of lentic aquatic habitat.	Maintain 11 acres of lentic aquatic habitat.
	Add 11 acres of low value upland wildlife habitat.	Temporary effects during construction, habitat returned to existing wildlife habitat
	Gain 2,200 feet of poor quality stream habitat.	Maintain existing stream.
Sedimentation	Temporary Increase may occur during and after construction. Loss of sediment pool	Continue to retain sediment load behind dam. Minor construction related erosion will be controlled. SWPPP in effect.
Water Quality	Temporary minor increase in turbidity and suspended sediment during construction. SWPPP in effect.	Temporary very minor increase in turbidity and suspended sediment during construction. SWPPP in effect.
Wetlands	Convert deepwater habitat to 5 acres palustrine wetland.	Maintain existing 4 acres fringe wetlands. Possible minor temporary impact during lowering of pool

Table I. Summary and Comparison of Candidate Plans (continued)

Resource Concerns	Alternative No. 1 No Action (Future Without Project)	Alternative No. 2 Dam Rehabilitation
Floodplain Management	Increase 100-year floodplain by 282 acres downstream.	Maintain existing downstream floodplain protection.
	Increase downstream flood depth/frequency, erosion, and scour.	Maintain existing flood depth/frequency, erosion, and scour.
	No flood protection for any storm events	Maintain existing 100-year flood pool.
Land Use	Change 11 acres of pool area to wildlife habitat.	Convert 1.5 acres of cropland to permanent grass within spillway, and convert 5 acres from cropland to permanent grass spoil disposal site
Threatened and Endangered Species	Not likely to adversely affect, May provide slight increase in potential Indiana Bat habitat	No Effect.
Air Quality	Minor amount of dust and exhaust during construction.	Minor amount of dust and exhaust during construction.
Important Farmland	Increased flooding frequency downstream.	Maintain existing level of protection against flooding downstream.
Natural Areas	Increase in upland component of wildlife area	No change
Riparian Areas	Reconnect stream through structure site	No change
Scenic Beauty and Parkland	Loss of aesthetic appeal of lake; replaced by stream	No change
Other Social Effects Account 2/		
Flood Damages (average annual $)	$257,700. Downstream flood damages would increase	$82,800. Maintain level of flood protection.
Dam Safety	Increased risk from higher flood frequency, depth, and velocities. Dam hazard removed.	Flood risks maintained at existing level. Dam meets NRCS and State safety criteria. Increased Dam Safety.
Public Health and Safety	Reduced threat to loss of life; Increase in risk due to increase in flooding.	Reduced threat to loss of life; maintain level of flood protection.
Recreation	Loss of water based recreation	Maintain water based recreation.
Transportation damages (average annual $)	$12,300. Increase cost to maintain roads in flood plain	$3,100. Reduced flooding and maintenance cost of Mt Zion Rd in flood pool
Cultural Resources	No effect	No effect

1/ Price base 2011 at a 101 year period of analysis at a discount rate of 4.0 percent. Based on total economic benefits and costs of alternatives as compared to No Action Alternative.
2/ The dollar figures for flood protection and transportation are the same dollar values included in the National Economic Development account shown above.

ENVIRONMENTAL CONSEQUENCES

Alternative plans of action can result in a multitude of effects on resources upstream and downstream of Rock Mill Dam. This section describes anticipated effects on resource concerns identified by the project Sponsors and by the public during public meetings. Effects of alternative plans of action on resource concerns of national importance are also included.

Dam Safety

Existing Conditions – Rock Mill Dam was built in 1960 as a high hazard dam with a minimum top of dam elevation of 957.1 (NAVD88). High hazard dams in Ohio must safely store or pass 100% of the PMF, according to current State and NRCS criteria. If the probable maximum flood (PMF) were to occur, the auxiliary spillway does not have adequate capacity to convey the PMF runoff without overtopping part of the dam and containment dike between the dam and spillway. The flood water would reach elevation 958.6 (NAVD88) causing the dam to overtop. This could lead to severe erosion and failure of the dam or auxiliary spillway. Analysis indicates there are 200 homes, 50 businesses, and dozens of roads and bridges in the dam breach inundation zone. Therefore, there is a threat of loss of life should the dam fail. The dam was originally designed to provide flood storage for up to 6 inches of runoff prior to flow through the auxiliary spillway at elevation 949.4 (NAVD88). According to a current design analysis, the existing dam can store 28% of the PMF (9.2 inches of rain in 6 hours) before flow occurs in the auxiliary spillway. This provides a level of safety by reducing flood damages to downstream infrastructure. The dam has been maintained in good condition, but the dam, does not meet current State or NRCS dam safety and performance requirements for a high hazard dam.

No Action [Future without Project] –Removing a section of the dam and reconnecting the stream through the flood pool would eliminate the dam breach safety concerns. There would be an increased risk to public safety through increased flood frequencies exposing local residents to floodwaters. Roads, bridges, agricultural land, and utility infrastructure would also be exposed to increased maintenance concerns that could pose a threat to public safety.

Dam Rehabilitation – The risk of dam failure from overtopping or breach of the auxiliary spillway would be minimized as a result of the proposed dam safety modifications. The dam would meet current dam safety standards and would safely pass, without overtopping, the Probable Maximum Precipitation (PMP) storm (26.9 inches of rain in 6 hours). The 50 foot crest section of the auxiliary spillway would be lowered 3 feet to elevation 946.4 (NAVD88) with minimal slope change upstream and downstream. After rehabilitation, the PMF would be lowered to elevation 956.8 (NAVD). The auxiliary spillway would be stable under all flow conditions. Flood storage would be reduced such that the same flood event that would be stored up to the auxiliary spillway crest elevation under existing conditions would cause flows 2.1 feet deep through the lowered auxiliary spillway. Although the spillway would flow sooner, the water level would rise a maximum of an additional 0.2 feet downstream of the dam when compared to the existing condition. No additional buildings or infrastructure would be impacted above what is already impacted. Even with the spillway lowered, it would take 8.1 inches of rain in 6 hours to make the spillway begin to flow. This exceeds the 1000 year return period flood and thus it is extremely unlikely that the spillway would ever flow.

Public Health and Safety

Existing Conditions - The threat to human life and safety from a dam failure exists. Rock Mill Dam provides flood protection to downstream houses, utilities, and roads, and bridges. The water treatment plant and waste water treatment plant for the City of Lancaster are located in the downstream floodplain. There are two houses and a barn upstream of the dam that have first floor elevations below top of existing dam. Two more houses have first floor elevations below the PMF elevation of 958.6 (NAVD88). Part of Mt. Zion Road is located in the flood pool adjacent to the lake and provides access to the houses, barns, and Rock Mill Dam State Wildlife Area parking lots and boat access maintained and operated by ODNR. This road begins to go under water after 1.6 inches

of rain in 24 hours. When a 2-yr rain occurs (2.6 inches of rain in 24 hours) water would rise to elevation 918.2 (NAVD88) and driveway access to 3 houses would be under water. The low spot on Lithopolis Road in the upper flood pool is elevation 956.2 (NAVD). Approximately 350 feet of Lithopolis Road will over flow a maximum of 2.4 feet during the PMF.

No Action (Future without Project) - The threat from a dam failure would not exist with the excavation of a breach section through the embankment, resulting in elimination of the impoundment reservoir. But, there would be an increase in risk to public health and safety because of an increase in frequency and depth of flood flows. Roads, bridges, and utilities would also be exposed to an increase in flood risk that could pose a threat to public safety. This infrastructure would need more maintenance due to the increase in flood depths.

Dam Rehabilitation – The threat to human health and safety from a dam failure by overtopping of the dam or breach of the auxiliary spillway would be greatly minimized. Potential risk of damage to downstream infrastructure and buildings would also be reduced. Flood protection benefits to downstream houses, roads, bridges, and utilities would continue as originally planned for another 100 years. The elevation of the top of the dam would be maintained at the same elevation. Current State of Ohio criteria do not require landrights to be obtained to top of dam elevation. However, NRCS criteria requires easements be obtained for all properties in the flood pool to prohibit habitable structures from being constructed in the flood pool below top of dam elevation. The Sponsors are working to complete the flood pool easements restrictions. The Sponsors have notified the property and home owners in the flood pool of the risk if severe flooding occurs.

Adding a new low flow inlet to the riser would reduce the frequency of flooding of Mt. Zion Road, and provide more time before water rises to the road elevation. For example, comparing a 2 inch rain, the water will be only 0.1 feet deep on the road instead of 1.6 feet, the water would be on the road only 3.2 hours instead of 15.1 hours, and there would be 2 more hours of warning time before water reaches the road elevation. The PMF flow over the low spot on Lithopolis Road would be significantly reduced from a maximum of 2.4 feet deep to a maximum of 0.6 feet.

To help give local residents enough warning and improve communications during an emergency at Rock Mill Dam, an emergency early warning system will be developed as part of the Emergency Action Plan (EAP) for Rock Mill Dam. All owners of high-hazard dams like Rock Mill Dam are required to have an EAP to be able to respond to an emergency at the dam or high water flooding. This early warning system would include a lake level gage that would relay the water level in the lake to a remote location. This system would be developed and coordinated with the Fairfield County Emergency Management Agency (EMA).

Flood Damages

Existing Conditions – The Sponsors have identified flood damages downstream of Rock Mill Dam as one of the primary concerns. Rock Mill Dam reduces flood damage by storing a large volume of flood water. The auxiliary spillway was originally designed to not flow until a rain event produced greater than 6 inches of runoff in a 6-hour period. According to current design analysis, the dam is storing 28% of the PMF (9.2 inches of rain in 6 hours) before the auxiliary spillway would flow. The City of Lancaster downstream of the dam complies with Federal floodplain management and flood insurance programs. The city realizes the value that Rock Mill Dam provides in flood protection benefits. The dam reduces the potential for loss of life from large flood events and decreases damage to bridges, roads, residences, utilities, and agricultural land. The primary flood protection benefits of the dam are to the transportation network, infrastructure, businesses, houses, and cropland. With the dam in place, estimated average annual flood damages are $3,100 for the transportation network, $15,400 for urban, and $64,300 for agriculture. Total estimated average annual flood damages are $82,800.

No Action [Future without Project] – With part of the dam embankment removed to eliminate flood storage, homes, businesses, infrastructure would experience increased flooding levels. Additional buildings and homes would experience flooding that are not already flooding during the same flood

event. Estimated average annual flood damages would be $12,300 for the transportation network, $29,600 for urban, and $215,800 for agriculture. Total estimated average annual flood damages are $257,700.

Dam Rehabilitation – After rehabilitation, the crest of the auxiliary spillway would be 3 feet lower than it is currently. This means that the same flood event that would be stored up to the crest of the existing auxiliary spillway would cause flow 2.1 feet deep through the rehabilitated spillway. However, this would lead to a water level that would only be 0.2 feet deeper immediately downstream of the dam, and the same water level as would occur under the existing condition 2 miles downstream. No additional buildings or roads would be flooded that are not currently being flooded. Although flood storage would be reduced, the dam would still store a large volume of runoff - 22% of the PMF (8.1 inches of rain in 6 hours) before the auxiliary spillway would flow. The full PMF flood upstream in the flood pool would be lowered 1.8 feet and be fully contained below top of dam elevation. Flood protection benefits realized downstream would be ensured for another 100 years.

Recreational Opportunities

Existing Conditions – Although Rock Mill Lake Dam was constructed primarily for flood protection, the lake and surrounding area is owned by ODNR Fish and Wildlife and is part of Rock Mill Lake State Wildlife Area. The lake provides substantial incidental recreational opportunities that include fishing, and boating, hiking, bird watching, hunting, and wildlife watching. The lake itself allows boating and fishing, but not swimming. ODNR Fish and Wildlife manages the lake and parking lot along Mt. Zion Road that provides boat access to the lake. ODNR estimates that approximately 1,400 anglers and 140 boaters use the lake every year.

No Action [Future without Project] – There would be a loss of incidental fishing and boating opportunities with the removal of Rock Mill Lake. ODNR Development of the area around the dam for enhanced recreation facilities would be terminated or greatly reduced with the loss of the dam.

Dam Rehabilitation – Same as Existing Condition. Incidental water based recreation in the form of fishing and boating would be maintained at Rock Mill Lake Dam for 75 more years; until sediment is expected to fill in most of the existing lake.

Fish & Wildlife Habitat

Existing Conditions –The Rock Mill Lake area contains a variety of wildlife habitat including upland forests, wetlands and old field areas. The forest is mostly upland and riparian deciduous trees with a shrub and herbaceous understory. In addition there is relatively poor quality habitat in the mowed grassy areas of the dam and spillway. Surrounding the Rock Mill Lake area is a mix of upland habits including woodlots, brushy areas, pasture and crop fields.

The lake provides approximately 11 acres of lentic habitat that supports a typical warm-water fishery of catfish, bass, centrarchids and cyprinids. It provides a variety of water depths as well shallow spawning sites, aquatic vegetation and habitat structure within the pool. The stream below the structure is 10 to 15 feet wide; the banks are wooded along mush of the reach immediately below the structure. The bottom is cobble, silt and sand. The flow is seasonal to permanent depending on outflow from the structure. The stream above the structure is affected by the backwater from the lake. The stream is shallow and braided immediately above the lake (in the former pool area). The bottom is primarily silt and sand.

No Action [Future without Project] – Approximately 11 acres of lentic warm water fish habitat would be eliminated. Fish habitat would be converted to approximately 2,200 feet of low quality lotic habitat in the stream conveying the existing stream flow through the former dam location. The stream substrate would consist primarily of silty sediment currently on the lake bottom. Upper reaches would be reconnected to the lower reaches. Habitat impairment of the stream below the lake (due to

sedimentation) would increase in the long term as sediment would pass through the reach unimpeded. There would be an increase in approximately 11 acres of wildlife habitat, primarily for upland species (i.e. raccoon, opossum, squirrel, rabbit, white-tail deer, etc.) in the formerly impounded area. This area would likely eventually revert to a forested community.

Dam Rehabilitation – Most of the areas habitat would remain unchanged. Approximately 5 acres of moderate quality early successional habitat would be added by the planting of the spoil disposal areas. This area is currently cropland or some early successional habitat. There would be minor temporary change of the habitat during construction until vegetation is re-established and as a result or minor sedimentation to streams. Also the area of lake would be temporarily reduced while water levels are lowered for repair of the riser.

Sedimentation and Erosion

Existing Conditions – Based on a sediment survey conducted by NRCS in 2009, 82 acre-feet of sediment has been deposited in the reservoir below the elevation of the normal pool and approximately 22 acre-feet of sediment has been deposited above the permanent pool (in the flood water retarding pool) since its construction in 1960. Only 68 acre-feet of sediment storage capacity remains. The sedimentation rate based on the actual volume of sediment in the lake since its construction is 2.08 acre-feet per year. This is 60% of the planned design rate of 3.48 acre-feet per year. The area above the dam has remained rural with mainland uses being woodland (15%), pasture/hay/grass (35%), cropland (27%), water (1%), and urban/open space (22%). Although there are a few areas of concern on agricultural land the majority of the watershed above the dam has good cover. Given the nature of the upstream watershed, sediments accumulated behind the dam do not have any known or likely toxic pollutants associated with them. Sediment retained behind the dam helps to reduce the loading of excess sediment downstream. The retention of sediment at the dam helps to remove some of the Hocking River Watershed Total Maximum Daily Load (TMDL) Adjusted Load Allocation for sediment as set by the Ohio Environmental Protection Agency (OEPA, 2009) to address identified stream impairments.

No Action [Future without Project] –Sediment accumulation within the limits of the existing reservoir would be essentially eliminated with construction of the no action alternative. The possibility of some additional sediment retention in the existing flood pool would exist when flood stage conditions exceed the 100-year flood event. In the long term, annual sediment loading to the existing site will pass through unimpeded, contributing further to the existing downstream impairments related to sediment and nutrients. An increase in sediment transport downstream of the dam site from erosion and transportation of previously deposited sediment in the reservoir would be anticipated during and after dam removal. However, the amount will be minimized by the use of approved erosion and sediment control practices.

Dam Rehabilitation – A sediment yield study was conducted in the watershed above Rock Mill Lake based on current and assumed future land use in the drainage area. The new sedimentation rate of 0.74 acre-feet per year was calculated based on current land use, sheet erosion, and some ephemerial gully erosion within the drainage area of the lake. This reduction in sedimentation rate can be attributed to an increase in reduced tillage farming practices and better cover conditions in the watershed. Also, since the 1960s, the acreage in row crops has been reduced while the acreage of woodland has increased in the watershed above the lake. The potential for major development in the future is relatively low based on the limited development observed over the past 50 years and the rural nature of the area. Land use is expected to change minimally. Therefore, the future sedimentation rate used for design of the proposed rehabilitation project is predicted to be 0.74 acre-feet per year. For the rehabilitated dam's 100-year design life, the future storage design volume for sediment is 74 acre-feet. Approximately 20 percent of this total (11 acre-feet) is expected to deposit above water level (aerated sediment), and 80 percent (63 acre-feet) is expected to be deposited below normal water level. There is currently 68 acre-feet available for future sediment storage up to the normal pool elevation.

Sediment retained behind the dam helps to reduce the loading of excess sediment downstream. A short-term increase in sedimentation during construction may occur. However, the amount will be minimized by the use of approved erosion and sediment control practices.

Transportation

Existing Conditions – Rock Mill Dam provides a level of safety by storing flood waters that protect downstream roads and bridges from flood damage. The auxiliary spillway was originally designed not to function until a rain event produced greater than 6 inches of runoff in a 6-hour period. Rock Mill Dam will store 25% PMF (8.8 inches rain in 6 hours) without discharge occurring through the auxiliary spillway. The downstream bridges and roads were the major source of flood protection benefits when the original plan was developed and continue to be a major source of flood benefits. The low spot on Mt. Zion Road in the flood pool of this dam is only 4.1 feet above normal pool elevation. The road will start to submerge when rainfall exceeds 1.6 inches over a 24 hour period. A 1-year return period rain (2.2 inches of rain in 24 hours) will overtop 800 feet of the road by at least 1 foot for over 18 hours and block driveway access to 2 houses. A 2-year return period rain (2.6 inches of rain in 24 hours) will overtop 1,200 feet of the road by at least 3 foot for over 24 hours and block driveway access to 3 houses.

No Action [Future without Project] – Removal of part of the dam will lead to increased flooding of downstream roads and bridges. This increased flooding will require additional maintenance activities by the township, Fairfield County, and City of Lancaster to ensure public safety is maintained and to keep roads open after flood events.

Dam Rehabilitation – The rehabilitated dam would continue to store 22% of the PMF (8.1 inches rain in 6 hours) without discharge occurring through the auxiliary spillway. For floods that are less severe than this the downstream water level would be the same as the existing condition. Floods that would cause the rehabilitated spillway to flow would exceed the 1000 year return period and would only increase the downstream water level 0.2 feet higher than existing condition. Flood damage would likely be severe enough already that an additional 0.2 feet of water depth would mean a very small increase in flood damage. Mt. Zion Road in the flood pool would not flood as frequently, and the duration of road flooding would decrease after the side inlet is added to the riser. The road will start to submerge only when rainfall exceeds 2.0 inches in 24 hours. For a 1-year return period rain (2.2 inches of rain in 24 hours) the maximum water level would drop 1.6 feet and only 300 feet of the road would be flooded for approximately 9 hours, and no driveways would be blocked. For a 2-year return period rain (2.6 inches of rain in 24 hours) the maximum water level would drop 1.6 feet and only 900 feet of the road would be flooded for approximately 15 hours, and block driveway access to only 2 houses.

Water Quality

Existing Conditions – The stream through the Rock Mill Lake structure has a designated aquatic life use of warmwater habitat according to the Ohio Environmental Protection Agency (OEPA). Based on data collected by the OEPA, reaches of the Hocking River above the structure are not in attainment of the water quality standards for the designated use. The major impairments are physical alteration of the stream and siltation; nutrients and organic enrichment are less significant impairments. The reach below the structure is meeting the water quality standards for the designated use.

No Action [Future without Project] – During construction, there may be a short-term increase in sediment delivered to the stream. However, the amount will be minimized by the use of approved erosion and sediment control practices. In the long term, annual sediment to the existing site will pass through unimpeded, contributing to downstream impairments related to sediment and nutrients. Also, the elimination of the permanent pool and its organic enrichment may slightly reduce the organic loading downstream.

Dam Rehabilitation – The effects will be essentially the same as existing conditions. During construction, there may be a short-term increase in sediment delivered to the stream. However, the amount will be minimized by the use of approved erosion and sediment control practices, and the fact that the significant land disturbance will take place well off-stream.

Wetlands

Existing Conditions – There are approximately 9 acres of former open water that have reverted to wetland. Extensive areas of wetland have developed in the upper pool as a result of sedimentation since the lake was constructed. This provides one of the larger wetland acreages in the area. Most of the wetland are shallow and dominated by emergent vegetation. Hydrology of the wetlands is directly influenced by water levels in the lake.

No Action [Future without Project] – Elimination of the water held back by the dam would remove a principal source of hydrology for wetlands associated with the lake. The extent to which wetlands would develop in the former pool area would depend on the degree to which the new floodplain is connected to the re-established stream; there would be no active attempt to make this connection. If the new floodplain is not frequently flooded, little wetland is expected to develop. Due to irregularities in the elevations of deposited sediment, it is difficult to estimate how much would be sufficiently flooded from stream flow or ponded from upland runoff to develop wetland characteristics. It is possible that 2 to 3 acres of palustine or riverine wetlands could develop over time. Initially, these would be herbaceous wetlands; however, they could be expected to transition to wooded wetlands over time.

Dam Rehabilitation – The effects would be similar to the existing conditions. The wetland community that has established since the lake was created 50 years ago would still be present. The wetlands would continue to provide beneficial functions associated with wetlands in the eco-region (i.e., water quality enhancement, wildlife habitat, etc.). In the future, additional wetlands would develop in newly deposited sediment as the level of sediment approaches the level of the permanent pool. There might be a very temporary impact to the existing wetlands due to the drawdown of the pool needed for riser repair. This would likely be no more significant than the effects of seasonal water level changes due to extended drought.

Land Use and Floodplain Management

Existing Conditions – There are approximately 974 acres in the 100-year floodplain along the Hocking River from Rock Mill Dam downstream through the City of Lancaster to Sugar Grove Road. Land uses in this100-year floodplain are pasture land, cropland, woodland, urban, roads, and bridges. It is estimated that half of this 100-year flood plain area is upstream of River Valley mall and all cropland, woodland. The remainder of the existing 100 year flood plain is essentially within the City of Lancaster and the land use is urban and roads and bridges. These areas have benefited from the dam by experiencing reduced flood frequencies and depths. The majority of the soils in the floodplain are prime or important farmland soils. Downstream of Campground Road, the existing floodplain is heavily influenced by flow in the Old Canal (drainage area 15 square miles) that connects to the Hocking River from the west. The City of Lancaster is currently in compliance with Federal floodplain management and flood insurance programs.

No Action [Future without Project] – If a section of the dam was removed to eliminate the flood storage function of the dam, the 100-year 24-hour floodplain downstream of the dam would increase by 282 acres. Almost all of the new flood plain area would be located upstream of the River Valley Mall; although there would be some small fringe areas along the existing floodplain downstream of the mall within the City of Lancaster. Flood depths and frequencies would increase as well. Increased erosion and scour in the floodplain would be expected relative to the existing condition. Within the existing flood pool, the normal pool area of 11 acres would be eliminated, and the existing 100-year flood pool of approximately 47 acres would be reduced to approximately half the existing lake size.

Dam Rehabilitation – The downstream 100-year floodplain would be the same as the Existing Condition. The flood storage within the lake, as measured to the auxiliary spillway crest, will decrease 16 acres with the associated 3.0 feet decrease in the auxiliary spillway crest elevation. Lowering the auxiliary spillway crest would mean the flood pool storage volume would also be reduced by 233 acre feet.

Threatened & Endangered Species

Existing Conditions – There are no records of any of the four Federally-listed species expected in the region for the project site. The Rock Mill Lake area does provide potential habitat for the Indiana Bat and possibly the Clubshell and Rayed Bean mussels. There does not appear to be any appropriate habitat for the Eastern Massasauga rattlesnake.

No Action [Future without Project] - Due to the lack of any known threatened or endangered species in the project area, there should be no effect associated with this alternative. Potential Indiana bat habitat might increase slightly with the restoration of a wooded riparian corridor along the restored stream over the long term.

Dam Rehabilitation – Although it has not been determined if Indiana Bats are present in the project area, there would be no effect to the species due to project activities. There would be no disturbance of wooded riparian areas or uplands used by this species. The old field and cropland areas that would be disturbed during the project are not appropriate habitat for this species. There will be no in-stream work done as part of this project. Therefore, there can be no effect to the Clubshell or Rayed Bean mussels even if they happened to be present in the stream reaches within or adjacent to the project. Measures to reduce sediment or other pollutant delivery to stream in the project area would eliminate any indirect effects on mussel habitat. There is no appropriate habitat for Eastern Massasauga rattlesnake, so no effect on this species would occur.

Cultural Resources

Existing Conditions – The original dam was constructed in the 1960. The NRCS cultural resource specialist conducted a site visit to the watershed and dam area and a file search at the Ohio Historic Preservation Office in Columbus, Ohio. Based on the results of the literature review and site reviews, no adverse affects are likely to any known archaeological sites, historic sites, or national register sites by any proposed rehabilitation projects. Because of the ground disturbance that took place during construction, and the lack of unique and indistinguishable characteristics of the site, the site does not warrant eligibility for National Register. Consultation with Ohio Historic Preservation Office is underway to obtain concurrence that this project would have no affect on historic properties.

No Action [Future without Project) - The No Action Alternative will have no significant affect on any cultural resources. Because of the ground disturbance that took place during construction and the lack of unique and indistinguishable characteristics of the site, the site does not warrant eligibility for National Register or Ohio Historic Inventory.

Dam Rehabilitation - Alterations to Rock Mill Dam riser structure and auxiliary spillway would have no direct impact on any cultural resources as this area was previously disturbed during dam construction. The area near the dam is steep sloped and has a very low potential to contain any historic properties. If any buried sites did exist in this location, they would have been impacted by the original dam construction. The selected spoil area is on existing cropland adjacent to the auxiliary spillway. This area was previously used as a borrow area for dam construction. Dam rehabilitation would have no negative impact to any downstream historic structures and may help protect them from future flood damage and thus protect their historic integrity. Consultation with Ohio Historic Preservation Office is underway to obtain their concurrence that this project would have no affect on historic properties.

Air Quality

Existing Conditions –Rock Mill Lake is located in Fairfield County and this county is part of the Columbus non-attainment area for particulate matter ($PM_{2.5}$). $PM_{2.5}$ particles are air pollutants with a diameter of 2.5 micrometers or less, small enough to invade even the smallest airways. These particles generally come from activities that burn fossil fuels, such as traffic, smelting, and metal processing.

No Action [Future without Project] - Minor amounts of exhaust and dust associated with construction activities will occur with this alternative. After construction of the breach is completed, the dry lake bed would provide a continuing source of dust emissions until vegetation is re-established.

Dam Rehabilitation – Minor amounts of exhaust and dust associated with construction activities will occur with this alternative. However, dust control would be required under the Storm Water Pollution Prevention Plan and construction specifications prepared for the project.

Prime Farmland

Existing Conditions – Much of the floodplain soils along the Hocking River below Rock Mill Lake are Aetna silt loam, Beaucoup silty clay loam and Eel silt loam. These are considered prime farmland soils (where drained for Aetna and Beaucoup). Undisturbed soils in the Rock Mill Lake area itself include Amanda silt loam which is a prime farmland soil.

No Action [Future without Project] - Prime farmland located downstream of the Rock Mill Lake Dam will experience greater flooding frequency with this alternative; they would still meet prime farmland criteria. Areas disturbed by the excavation and stream restoration under this alternative do not contain prime farmland soils. Prime farmland impacts would be minimal other than impacts to agricultural use as a result of increased flooding.

Dam Rehabilitation – Downstream effects to prime farmland would remain unchanged. Approximately 3-4 acres of prime farmland would be used for spoil disposal areas.

Riparian Areas

Existing Conditions – Prior to the construction of Rock Mill Lake, there was a small stream flowing through the area. Since the construction of the lake, the riparian corridor below the structure remains unchanged; it is mostly mature hardwood trees for 1,200 feet before changing to more open vegetation with scattered trees. In the upper reaches of the pool the riparian area is mostly shallow emergent wetland with scattered trees. The banks of the lake are primarily hardwoods.

No Action [Future without Project] – With the draining of the lake, the stream will be reconnected to the reaches above and below it. This will result in approximately 2,200 feet of stream with associated riparian areas. The banks of the restored stream will be vegetated. Depending on management by the Division of Wildlife, the riparian corridor may remain open or revert to a forested community. Reversion to a forested community on both sides is most likely.

Dam Rehabilitation – No changes will occur in the riparian area as a result of the dam rehabilitation alternative. Current and future conditions will be the same as existing conditions. As the lake fills in, there will be an increase in stream channel surrounded by wetlands as has already occurred in the upper pool.

Natural Areas, Scenic Beauty and Parklands

Existing Conditions – The Rock Mill Lake Wildlife Area is relatively undisturbed area within a predominantly agricultural landscape. The area is managed with fish and wildlife use in mind so some

disturbance for fish and wildlife habitat management does occur. The lake, set among wooded hillsides, does provide an attractive site for fishing, hunting and other outdoor recreation.

No Action [Future without Project] –This alternative would result in the loss of the lake and its aesthetic values. The lake would be replaced by a constructed channel which would like not be as aesthetically pleasing until re-vegetation produced a more mature plant community along the stream

Dam Rehabilitation –This alternative would not have any effects on the natural areas or scenic beauty of this area. The lake would be maintained as is. Long-term, the lake would continue to fill in and eventually be replaced by a shallow wetland.

Property Values

Existing Conditions – Residential and farm property values in the area have been consistent with market trends in the county. The lake and adjacent area around the lake is owned by State of Ohio, as part of the Rock Mill Dam State Wildlife Area, and is not subject to private property land value fluctuations. The dam itself is on property almost entirely within State property. The remainder of the dam is on private property. Half of the auxiliary spillway is owned by the State and the other half is private property. The sponsor has perpetual easements for the dam, spillway, and flood pool. The land surrounding the state wildlife area is private property that is primarily farmsteads, cropland, and single family houses on large lots. The area contained below the 100-year flood pool is mostly state property and private property along the floodplain. The area that is higher than the 100-year flood pool, consists of mainly single family houses on large lots.

No Action [Future without Project] – There are no houses on the shore of the lake, or that even have a view of the lake. As such, removal of the lake would likely not have an adverse effect on property values. The downstream floodplain area will flood more frequently and to greater depths than what currently happens for the same rainfall event.

Dam Rehabilitation – Same as the existing condition.

Cost to Sponsor

Existing Conditions – The Sponsor has associated cost with the operation and maintenance activities that would include mainly mowing the dam and spillway, clearing debris, and periodic inspection of the dam and principal spillway.

No Action [Future without Project] – Removing the dam would eliminate the need for maintenance activities as described above for the existing condition. However there would be a need for maintenance stream corridor and floodplain modifications. It is assumed that maintenance cost of the no action alternative would be less expensive than the current maintenance cost.

Dam Rehabilitation – The maintenance requirements for the rehabilitated structure would be the same as the current requirements described above. The auxiliary spillway would be larger and the splitter dike would also need to be mowed. Therefore the spillway area would take more time to mow. The planned lake level gage, as part of the early warning system, would also require periodic maintenance and inspection to assure that it functioning as planned.

Relationship to Other Plans and Policies

Existing Conditions – The Total Maximum Daily Load (TMDL) report prepared by OEPA indicates that the Hocking Creek headwaters suffer mostly from nutrient enrichment, sedimentation and habitat alteration. Major sources of impairment include row crop production, home sewage systems and drainage improvements. Rock Mill Lake itself is not listed as a source of impairment. The Rock Mill dam likely provides some benefit to trapping sediment and nutrients within the pool area. The Sponsors, county, and local municipalities have an objective of maintaining the dam for flood

protection. The City of Lancaster, downstream of the dam, complies with Federal floodplain management and flood insurance programs. The dam is not in compliance with current State and NRCS dam safety criteria for a high-hazard dam.

No Action [Future without Project] - The loss of the dam would be inconsistent with the local flood protection objective in the upper Hocking River watershed. Within the City of Lancaster, the 100-year flood elevation without the project (No Action Alternative) is essentially the same as the existing condition. Therefore, the loss of the dam would not require a change to the existing Federal Emergency Management Agency (FEMA) floodplain in Lancaster to remain in compliance with Federal floodplain management and flood insurance programs. Sediment and associated pollutants identified in the TMDL would no longer be retained behind the dam. Reconnecting the stream through the structure site would address some of the habitat alteration concerns described in the TMDL; however the quality would only be low to moderate.

Dam Rehabilitation – Same as Existing Condition, except the dam would meet current State and NRCS dam safety criteria for a high hazard dam.

Cumulative Effects

Existing Conditions – Rock Mill Dam was constructed to reduce downstream flood damages along the Hocking River. The dam continues to provide reduced flood damages to downstream agriculture, urban areas and transportation systems. This has allowed continued use of areas downstream of the structure for agriculture and urban development. Mt. Zion road, above Rock Mill Lake, experiences flooding several times a year. Although the dam has been maintained in good condition, it does not currently meet state or NRCS dam safety requirements and is considered to be at increased risk of dam failure.

Land use in the Upper Hocking watershed has changed since the construction of Rock Mill Dam in 1960. At the time of the original project plan, agricultural use was the dominant land use with approximately 80% of the land in cropland, hayland or pasture. Although these land uses are still the majority, they now constitute only 58% of the land. Urban land use has increased from 12% to 23% and woodland has increased from 9% to 19%. Rock Mill Lake retains most of the sediment and associated pollutants behind the dam; nutrients are retained in the sediment and vegetation that has grown within the pool area. Rock Mill Lake provides hunting, fishing and other outdoor recreational opportunities for the area.

Outside actions in addition to those evaluated here are not known; there is no regional plan or similar action which identifies this area for any particular use associated with Rock Mill Lake. Additional improvements to the lake or upland areas associated with lake are not planned at this time.

No Action [Future without Project] - With the dam removed, sediment loads will not be retained and will be readily available to further degrade aquatic habitat below the dam. Implementation of the OEPA's Total Maximum Daily Loads strategy will need to be re-evaluated to address the agricultural sediment and nutrient loads throughout the watershed. Average annual flood damages to bridges and roads will increase by an estimated $9,200; for homes and other urban structures by $14,200; and for agricultural land by $151,500. Also, the threat of loss of life and property damage associated with more frequent, deeper and higher velocity flood flows would increase. This could negatively affect the amount of development in areas below Rock Mill Lake. The frequency of flooding on Mt. Zion Road would decrease. This might lead to a slight increase in potential development along this road. Removal of the dam would eliminate any threat of dam failure.

The loss of the dam will alter the use of the site as a local recreation attraction. The area around the former dam will be unsightly, since much of the existing embankment will remain in place and the stabilized stream through the site will not have a natural appearance. An additional 11 acres of upland wildlife habitat will be established, which is common throughout the watershed, with a corresponding loss of about 11 acres of deepwater warm water habitat, which is not as common

throughout the watershed. The ODNR, Division of Wildlife, would need to adjust its management of the area to meet the changing cover conditions. Fish and wildlife resources throughout the rest of the watershed are expected to remain similar to the current condition or improve slightly as more farms adopt conservation practices.

Dam Rehabilitation – Same as Existing Condition, except public safety will be vastly improved with the dam meeting current safety criteria. The flood protection and sediment retention benefits provided by the existing dam will be extended for 100 years. The recreation attraction that the dam and pool creates will be maintained for approximately the next 75 years. Eventually, as the pool fills with sediment, the nature of the recreational use of the site will change from open water based use to one focused on wetland and upland habitats. Fish and wildlife resources will gradually change as the pool converts to wetland habitat.

CONSULTATION, COORDINATION, AND PUBLIC INVOLVEMENT

PROJECT SPONSORS

Original sponsoring organizations include the Hunter's Run Conservancy District, Fairfield County Commissioners, and Fairfield County Soil and Water Conservation District. Discussions were held with representatives of these organizations to ascertain their interest and concerns regarding the rehabilitation of Rock Mill Dam. The Hunter's Run Conservancy District owns and operates the dam and has agreed to serve as "lead sponsor," being responsible for leading the planning process with assistance from NRCS. As lead sponsor they also agreed to provide non-Federal cost-share, property rights, and operation and maintenance needs for the project, as well as public participation during the planning process. Meetings with the Hunter's Run Conservancy District were held throughout the planning process and Fairfield County Soil and Water Conservation District provided representation at planning team and public meetings.

PLANNING TEAM

An Interdisciplinary Planning Team was provided for the "technical" development of this project. Technical development includes tasks pursuant to the NRCS nine-step planning process and planning procedures outlined in the NRCS-National Planning Procedures Handbook. Examples of tasks completed by the planning team include, but are not limited to, Preliminary Investigations, Hydrologic and Hydraulic Analysis, Reservoir Sedimentation Survey, geological investigation, concrete integrity analysis, Economic Analysis, Formulating and Evaluating Alternatives, and Writing the Supplemental Watershed Plan - Environmental Assessment. Data collected from partner agencies, databases, landowners, and others throughout the entire planning process were evaluated at planning team meetings held throughout the planning process. Informal discussions amongst the planning team, partner agencies, and landowners were conducted throughout the entire planning period.

There are no Federally recognized tribes in Ohio. There are no State recognized tribes that have judicially established Indian land areas in Fairfield County where Rock Mill Dam is located. However, consultation by letter describing rehabilitation needs dated June 8, 2010, has been sent to Eastern Shawnee Tribe of Oklahoma and the Absentee-Shawnee Tribe of Oklahoma. No responses have been received as of April 20, 2011.

A review of NEPA concerns was initiated early in the planning process. Identified NEPA concerns were evaluated and documented within the Environmental Consequences section of this environmental assessment and on form NRCS-CPA-52 (Environmental Evaluation).

The NRCS planning team determined that the actions of the preferred alternative will not individually or cumulatively have a significant effect on the environment and there are no extraordinary circumstances present.

PUBLIC PARTICIPATION AND CONSULTATION

The first of many meetings related to the Upper Hocking 9 (Rock Mill Dam) project was held on June 15, 2009. This meeting was conducted at the City of Lancaster Administration Building. Subsequent meetings were held at the Lancaster Service Center, in Lancaster, Ohio.

A planning meeting with NRCS and the Hunter's Run Conservancy District (HRCD) was held Nov 2, 2009 to provide update on planning activities and develop a timeline of future planning items.

A public meeting was held on Nov 17, 2009 to explain the dam rehabilitation program, discuss the need for rehabilitation, and hear concerns of local residents about the Rock Mill Dam project area. Local public officials were notified.

The HRCD conducted a regular board meeting on May 10, 2010, that was attended by several local residents and Greenfield Township Trustees. Concerns were voiced about the frequent flooding that occurs on Mt. Zion Road located within the flood pool of the lake.

Additional planning meetings with NRCS and HRCD were held on June 8, 2010, and August 10, 2010, February 15, 2011, May 10, 2011, September 14, 2011, and October 4, 2011 to provide update on planning activities including engineering alternatives, sediment survey results, geological exploration, reinforced concrete evaluation, landrights issues and requirements.

A public meeting was held June 9, 2011 to summarize planning accomplishments, review recommended plan and timeline, and discuss the Supplemental Plan and Environmental Assessment. The Sponsors also discussed the landrights and easement needs with the landowners and answered questions. Another meeting was conducted by the HRCD for the landowners in the flood pool and dam area on December 20, 2011, to review easements, provide project, and answer questions.

AGENCY AND ORGANIZATION PARTICIPATION

During planning, individual agencies and organizations were contacted directly that had jurisdiction or technical expertise in areas being evaluated. The ODNR, Division of Wildlife, participated in several meetings and assisted with general recreational use data for the park area and lake within the Rock Mill Wildlife Area.

ODNR, Division of Wildlife, representatives attended a HRCD meeting on Dec 14, 2009 to discuss the rehabilitation needs and rehabilitation program requirements, the potential impacts to park area around the lake, and explore sediment disposal areas within the park property. A follow-up teleconference with ODNR, Division of Wildlife, was held on October 27, 2011.

Meetings were conducted with Fairfield County Emergency Management Agency, Greenfield Township Trustees, and Green field Township Fire Department on November 9, 2011, and Dec 8, 2011, to discuss and finalize plans for an early warning system that is to be part of the Emergency Action Plan (EAP) for Rock Mill Dam.

Proposed project and site information was submitted to the Army Corps of Engineers as to the need to obtain a 404 permit. The response from the Army Corps of Engineers states that a permit is not required since the project does not involve temporary fills, stream crossings, and there are no wetlands in the cropland spoil area.

The following agencies, Native American tribes, and organizations will be contacted directly for comment and review of the Draft Supplemental Watershed Work Plan and Environmental Assessment:

Hunter's Run Conservancy District
Greenfield Township
Fairfield County Emergency Management Agency
Fairfield County Commissioners
Fairfield County Soil and Water Conservation District
Ohio Department of Natural Resources, Division of Wildlife
Ohio Department of Natural Resources, Division of Soil and Water Resources
Ohio Department of Transportation, District 5
Ohio Environmental Protection Agency
Ohio Historic Preservation Office
U.S. Army Corps of Engineers, Huntington District
U.S. Environmental Protection Agency, Region 5
U.S. Fish and Wildlife Service
USDA Forest Service
The City of Lancaster
Eastern Shawnee Tribe of Oklahoma
Absentee-Shawnee Tribe of Oklahoma

PLAN REVIEW

A preliminary draft of this Supplemental Watershed Plan - Environmental Assessment (Plan-EA) was submitted to the NRCS-National Water Management Center and project Sponsors. The Draft Supplemental Watershed Work Plan and Environmental Assessment was distributed for interagency review and to those groups on the distribution list (page 53) on __date_____. Copies of the document were also available in the Fairfield County Soil and Water District office at 831 College Avenue, Suite B, Lancaster, OH 43130. During the 30-day review period, a public meeting is planned to review the plan and comments received. Letters of comment received and NRCS responses will be included in Appendix A.

THE PREFERRED ALTERNATIVE

Alternative No. 3 is the preferred alternative. Rock Mill Dam would be modified to meet high hazard criteria and meet applicable NRCS and State of Ohio standards for public health and safety, and to extend the service life for flood control for another 100 years. The rehabilitation plan would include work to increase the auxiliary spillway capacity by widening the existing auxiliary spillway from 300 feet to 320 feet. The crest elevation of the auxiliary spillway would be lowered by three feet to elevation 946.4. The crest section of the auxiliary spillway would also be moved 25 feet downstream to straighten the entrance section approach to the control section. This improves the auxiliary spillway flow efficiency. Because the auxiliary spillway bottom width is greater than 200 feet, a splitter dike will need to be constructed along the centerline of the spillway to divide flows. The splitter dike will begin at the upstream edge of the control section and continue downstream to the end of the constructed exit channel.. The grades of the entrance and exit sections of the spillway would be decreased to lower the erosion potential during flows and reduce the volume of excavation. Approximately 25,000 cubic yards of excess excavated material would be placed in a spoil area northeast of the spillway on adjacent landowners' property. The east end of the dam adjacent to the auxiliary spillway would be raised to elevation 957.1 to fully contain the probable maximum flood without flow over the dam. The containment dike between the dam and auxiliary spillway, which would currently overflow during the probable maximum flood, would also be raised where necessary to prevent overflow from the probable maximum flood.

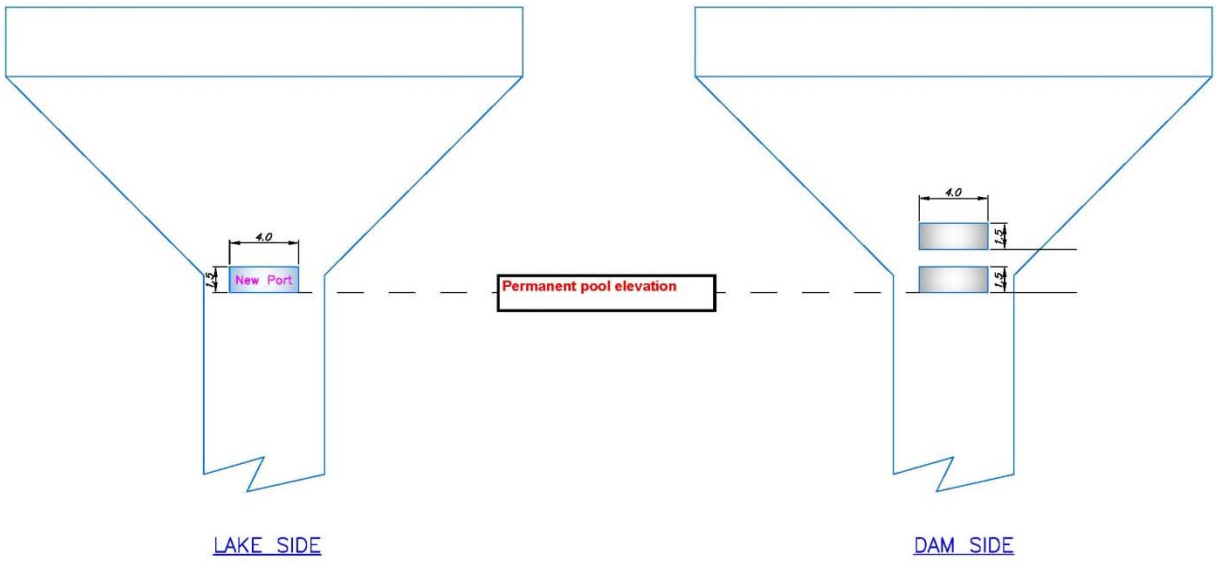
The minimum required flood pool storage elevation (which is determined by routing a 100-year, 24-hour storm through the principal spillway) was computed to be at elevation 930.1 (NAVD88). The planned auxiliary spillway crest elevation would be at elevation 946.4 (NAVD88). With the planned modifications, the required flood pool storage would still be 16.3 feet below the planned auxiliary spillway crest. The 100-year, 24-hour storm event is completely stored below the planned auxiliary spillway crest. Approximately 28% of the PMP storm (9.25" of rainfall) will be stored at the planned auxiliary spillway crest (elevation 946.4). This far exceeds even the 1,000-year, 24-hour storm of 7.77" of rainfall.

The geologic exploration and lab testing indicated that dispersive soils were present on or near the surface of much of the auxiliary spillway exit section. Since the soils are considered to be only moderately dispersive treatment was deemed not to be necessary for the dispersive soils. Sandy soils encountered on grade in the auxiliary spillway would be removed to a depth of one foot and replaced by a one foot layer of clay material that would be compacted in place.

These modifications would allow the dam to comply with current State and NRCS design and performance criteria for a high hazard dam. A conceptual layout of the rehabilitation alternative is in Appendix C. Refer to the Project Map (Appendix B) and the Flood Plain Map (Appendix C) for additional information.

The surface of the concrete on the concrete riser and outlet structure would be repaired and sealed. The sponsors plan to modify the riser to increase low flow through the principle spillway. Part of Mt. Zion Road located in the flood pool of this existing dam experiences frequent flooding. The low spot in this road begins to go under water when rain exceeds 1.6 inches in 24 hours (less than a 1-yr return period). The riser would be modified by cutting an additional low inlet (side port) into lake side of the riser. This new opening would be 1.5 feet high by 4 feet long and is identical to the size of the existing two openings (Figure 4). This would reduce the frequency of flooding of the road and provide more time before the road floods for the same rain event.

Figure 5. Riser low inlet proposed modification



Easements would need to be revised to include restrictions to prohibit habitable dwellings for all parcel owners within the flood pool below top of dam elevation. Landrights will need to be acquired on approximately four acres adjacent to the auxiliary spillway outlet for disposal of excess excavated material. The rest of the construction, including disposal areas and staging and stockpile areas would be completed on property owned by the Ohio Department of Natural Resources, Division of Wildlife.

All construction will be conducted so as to minimize erosion and sedimentation, including the development of a Stormwater Pollution Prevention Plan (SWPPP) required as part of the permitting process. Vegetation will be established immediately following construction on all land disturbed by construction activities. The use of potentially invasive plant species for re-vegetation will be minimized. The spillway is already seeded to tall fescue; reseeding disturbed or expanded areas of the spillway to tall fescue will not increase the likelihood of invasiveness in this area. Species used for vegetation spoil piles will be species not considered to be invasive. Appropriate plants for erosion control and wildlife habitat will be selected.

The rehabilitated dam will meet all current NRCS and Ohio dam safety and performance standards.

Prior to commencing construction, an Emergency Action Plan (EAP) would be prepared by the local watershed sponsors to outline appropriate actions and designate parties responsible for those actions in the event of potential dam failure. The breach inundation map is to be included in the EAP and would be the basis for potential areas to be affected and citizens to be notified. NRCS will determine that an EAP is prepared prior to the execution of fund obligating documents for construction of this project. The EAP shall be reviewed and updated by the sponsors annually. An emergency early warning system would be developed as part of the EAP to help warn residents of potential flooding or other emergencies at the dam. NRCS would provide technical assistance in the preparation and updating of the EAP.

RATIONALE FOR ALTERNATIVE PREFERENCE

Alternative No. 2 – Rehabilitation is the preferred alternative that would comply with dam safety criteria and meets the maximum number of resource concerns identified through the public scoping process. The No Action Alternative and the Decommission Alternative are not effective in providing flood control benefits. The No Action Alternative and the Decommission Alternative do not adequately address the human health and safety concerns to surrounding urban areas and

infrastructure downstream of Rock Mill Dam. Alternative No. 3 meets the purpose and need of maintaining the present level of flood control benefits and protecting downstream urban areas and infrastructure; complies with current dam safety and performance criteria; and assures that the dam will continue to function properly into the future. It is the National Economic Development (NED) plan. It is the most efficient way to accomplish the desired objectives, produces the most net monetary benefits, and addresses concerns expressed by the Sponsors and local people during the public scoping process. The local Sponsor has agreed to fund the local share of the costs.

MEASURES TO BE INSTALLED

The preferred alternative consists of structural modifications to Rock Mill Dam as follows:

- Widen auxiliary spillway from 300 ft to 320 ft
- Lower auxiliary spillway control section three feet and move downstream 25 feet
- Add a splitter dike in the auxiliary spillway from the control section downstream to the end of the exit channel
- Stabilize dispersive and erosion prone soil in auxiliary spillway
- Raise east end of dam a maximum of 2.5 feet and raise containment dike 1 to 2 feet
- Repair concrete surfaces of riser and outlet structure
- Repair or replace toe drain outlet
- Add an additional low inlet (side port) into lake side of the riser that would be 1.5 feet high by 4 feet long

The following table compares major features of the existing dam to the planned rehabilitated dam. Refer to Table 3 at the end of this section for more details concerning structural data for the planned dam.

Table J. Comparison of Structural Physical Data

Rock Mill Dam	Unit	As-Built 1/	Existing 2/ (2009)	Planned
Normal Pool Area	Acres	19.8	11.1	11.1
Elevation, Top of Dam	MSL 3/	957.1	957.1	957.1
Elevation, Auxiliary Spillway (A.S.)	MSL 3/	949.4	949.4	946.4
Elevation, Principal Spillway (normal pool)	MSL 3/	909.4	909.4	909.4
Elevation, Principal Spillway (high stage)	MSL 3/	922.4	922.4	922.4
Dam Crest Length	Feet	1010	1010	1010
Principal Spillway	W x H	4ft X 7ft	4ft X 7ft	4ft X 7ft
Auxiliary Spillway (A.S.) – bottom width	Feet	300	300	320
Sediment (submerged) 4/	Acre-Feet	150	82	68
Sediment (aerated) 4/	Acre-Feet	24	22	12
Flood Retarding Storage (at A.S. Crest) 5/	Acre-Feet	1850	1850	1617
Total Capacity - to top of dam 5/	Acre-Feet	2600	2600	2600

1/ As-built based on 1960 construction drawings
2/ Based on 2009 survey data
3/ Mean Sea Level, NAVD 1988
4/ "As-built" is original design volume, "Existing" is sediment in lake, "Planned" is future design volume
5/ Using Lidar data for stage storage capacity

MITIGATION

A Stormwater Pollution Prevention Plan (SWPPP) is required by Ohio EPA that describes and ensures the implementation of best management practices to reduce pollutants in stormwater discharges related to construction activities. It is anticipated that the best management practices that would be used to avoid or minimize impacts would include sediment controls such as seeding, mulching, silt fences, and wetting construction areas to reduce dust. There are no other planned mitigation measures associated with the recommended plan. Adverse impacts were either avoided or minimized through the planning process.

PERMITS AND COMPLIANCE

Installation of the recommended plan will assure Rock Mill Dam will be in compliance with the current dam safety criteria for high hazard dams for both NRCS and the State of Ohio. The dam owner, Hunter's Run Conservancy District, will be responsible for obtaining a Dam Permit from ODNR, Dam Safety Engineering Program prior to commencing construction. A Non-Point Discharge Elimination System (NPDES) permit will be required from the Ohio EPA. All work would be within the area previously disturbed during the original construction of the dam. The recommended plan does not require the placement of fill in waters of the United States, and there are no wetlands in the work area. The Corps of Engineers has reviewed information pertaining to the recommended plan and scope of work for this project and concurs a 404 permit is not required.

COSTS AND COST SHARING

Estimated costs for installing the project are shown in Tables 1 and 2. Total annualized costs are shown in Table 4. The costs shown in Tables 1, 2, and 4, and throughout the document are based on standard cost accounting practices required of Federal watershed planning agencies, such as NRCS. The cost accounting guidance is *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (U.S. Water Resources Council, 1983). Cost sharing for authorized projects under the Watershed Rehabilitation Program is based on the provisions of the dam rehabilitation amendments (PL-106-472) of the Watershed Protection and Flood Prevention program as follows:

The total cost of the rehabilitation project shall include all costs associated with construction, acquisition of property rights, project administration, non-Federal technical assistance, and contracting. Technical assistance provided by NRCS shall not be considered as part of the total cost. Technical services provided by the Sponsors during planning and installation shall be included. Sponsors shall be responsible for the cost of all water, mineral, and other resource rights, and all required permits. These costs shall not be considered part of the total cost.

Federal funds will be 65 percent of the above defined costs, not to exceed 100 percent of the construction costs. The Sponsors shall be responsible for 35 percent of the calculated total cost of the rehabilitation project based on the above definitions using non-Federal funds. In-kind contributions and the value of property rights acquired after November 9, 2000, may be counted as agreed to under a separate Memorandum of Understanding (MOU). The MOU for the Upper Hocking Structure 9 Watershed Project is being developed by the Sponsor and NRCS.

Based on this definition, the estimated cost sharing allocation for the planned project is as follows:

Works of Improvement	PL-566 Funds	Other Funds	Total
Rock Mill Dam Rehabilitation	$344,000 (65%)	$185,300 (35%)	$529,300 (100%)

The watershed agreement is based on the above cost estimates, rather than the costs shown in Tables 1, 2, 4, and elsewhere in the document.

INSTALLATION AND FINANCING

Installation of the project would be financed jointly by the Hunter's Run Conservancy District and NRCS. The works of improvement for rehabilitation of the dam are planned for installation in year one of the evaluation period. The actual installation period is contingent on the availability of funds for installation.

The NRCS share of installation costs will be provided from funds appropriated under the Watershed Protection and Flood Prevention Act (PL 83-566), Watershed Rehabilitation Program. This is not a fund-obligating document and Federal assistance is subject to the availability of congressional appropriations.

The Sponsors have analyzed their financial requirements for carrying out the plan, including components that are not eligible for Federal assistance as part of this plan. The Sponsors have available when needed, non-Federal grants and cash reservesand other non-Federal sources. Credit for in-kind contributions will be as specified in Memorandum of Understanding for this project currently being finalized.

The cost, if any, of all water, mineral, and other resource rights and all required permits are not eligible for Federal financial assistance. These costs shall be borne, in full, by the Sponsors. The Sponsors also understand that they will be fully responsible for costs incurred for the operation, maintenance, and replacement of installed measures.

NRCS will be responsible for the following:

- Design of the rehabilitation – drawings and specifications.
- Executing an implementation agreement with project Sponsors before either party commences work involving funds of the other party. Such an agreement, called a project agreement, will set forth in detail the financial and working arrangements and other conditions that are applicable to specific works of improvement.
- Providing limited contract administration technical assistance as needed.
- Providing construction management technical assistance (Inspector, Contracting Officer Technical Representative).
- Providing financial assistance equal to 65 percent of project costs, not to exceed 100 percent of actual construction costs, as appropriations become available under the Watershed Rehabilitation component of the Watershed Protection and Flood Prevention Program (PL 83-566).
- Certifying, in conjunction with ODNR, Division of Water, Dam Safety Engineering Program completion of all installed measures.

Hunter's Run Conservancy District will be responsible for the following:

- Securing all needed permits, easements, and rights for installation, operation, and maintenance.
- Completing an Emergency Action Plan for Rock Mill Dam.
- Ensuring that Greenfield Township continues to remain in compliance with Federal floodplain management and flood insurance programs.
- Executing the Memorandum of Understanding with NRCS which provides a framework within which cost-share funds are credited.
- Executing a revised Operation and Maintenance Agreement for Rock Mill Dam with NRCS.
- Executing a project agreement with NRCS before either party commences work involving funds of the other party. Such agreements will set forth in detail the financial and working arrangements and other conditions that are applicable to specific works of improvement
- Providing financial assistance or qualifying in-kind services at a rate equal to, or greater than, 35 percent of project costs using non-Federal funds.
- Providing all local administrative services necessary for installation of this project, including advertizing and awarding construction contract, pay estimates, change orders, etc.

Real Property

The Hunter's Run Conservancy District has the power of eminent domain and will exercise their authority as needed to acquire the necessary landrights. Easements were secured by the Hunters Run Conservancy District to construct the dam, provide for perpetual flooding at an established permanent water elevation, and provide for temporary flooding up to elevation 955.9 (NAVD88) when Rock Mill Dam was constructed in 1960. Recent hydraulic analysis completed by NRCS indicates the probable maximum flood (PMF) elevation for the existing dam is 958.6 (NAVD88). Completion of this rehabilitation project would reduce the PMF to elevation 956.8 (NAVD88). The sponsors will update the flood pool easements for all the parcels in the flood pool as follows:

- Existing easements for all properties within the flood pool will be modified to reflect the top of dam elevation of 957.1(NAVD 88). Metes and bounds descriptions are not required.
- Flood or flowage easements for all property in the flood pool below top of dam elevation must be obtained including assurance that no "habitable" structures will be built in the future below the top of dam elevation of 957.1(NAVD 88).

The Sponsor will secure the permanent landrights for approximately 1.5 acres required to construct the enlarged auxiliary spillway, and approximately 5 acres to use for spoil placement. The Sponsor will secure additional flood pool easement for approximately 2.3 acres of land area that is above elevation 955.9 and below the top of dam elevation (957.1). No relocation of persons is needed in conjunction with the project. However, the first floor elevation of two houses and 1 barn are located within the flood pool below future PMF elevation (956.1). The landowners of the existing houses, driveways, or other structures within the flood pool below future PMF elevation have been notified that they and / or their property are at risk if severe flooding occurs. The Sponsor is working with these landowners to revise and update the flood pool easements.

Cultural Resources

There are several recorded archaeological sites and historic structures within 1 to 3 kilometers of the project area, although none are present within one kilometer of the dam or the current permanent pool. Of the sites within 3 kilometers there are 316 archaeological sites, 23 historic structures, two National Register eligible archaeological sites, and two listed National Register sites. Several archaeological investigations have occurred within 1-3 kilometers of the dam. The National Register Listed sites are Rock Mill and Rock Mill covered bridge. These two sites are located 5,000 feet upstream and northwest of the dam. Alterations to the dam will have no direct impact on any cultural resources. The selected spoil disposal area and land where the spillway would be widened are on lands disturbed during construction of the original dam. As such, these areas should need no further cultural resource investigation, as the area has been previously disturbed. If cultural resources are discovered during construction, NRCS will take action to mitigate the resources in accordance with Section 106 of the National Historic Preservation Act of 1966, as amended, and the regulations (36 CFR 800) of the Advisory Council on Historic Preservation. If cultural resources are discovered during construction, construction at this location will cease and NRCS will follow procedures as outlined in GM 420 Part 401, Discoveries.

Solid and Hazardous Wastes

There are no known solid or hazardous wastes identified in the project area. If such wastes are discovered during construction, the Sponsors will ensure that such wastes are identified and disposed of in accordance with all applicable Federal, State, and local rules and regulations. The Sponsors will be responsible for waste identification and disposal; and if warranted, testing of soil and ground water and remediation plans. These activities will generally require the services of a hazardous waste consultant certified by the Ohio EPA.

OPERATION AND MAINTENANCE AGREEMENT

Measures installed in this plan, and previously installed measures, will be operated and maintained by the Sponsors with technical assistance from Federal, State, and local agencies in accordance with their delegated authority. A new Operation and Maintenance (O&M) Agreement will be developed for Rock Mill Dam, utilizing the NRCS-National Operation and Maintenance Manual and will be executed when the project agreement is executed. The new O&M agreement will be for the evaluated life of the rehabilitation project, which is 100 years. The Hunter's Run Conservancy District will be fully responsible for all operation, maintenance, repair, and replacement of installed measures until such time that the structure is formally decommissioned in accordance with applicable laws and regulations. The O&M agreement will specify responsibilities of the Sponsors and include detailed provisions for retention, use, and disposal of property acquired or improved with PL 83-566 cost sharing, requirements for operation and inspection, financial plan for conducting O&M activities, consultation requirements for modifications to works of improvement, notification requirements for emergency situations, policy related to violations of the agreement, recurring review and update of the agreement, preparation and review requirements for an Emergency Action Plan, recordkeeping requirements, and other such requirements. Provisions will be made for free access of district, State, and Federal representatives to inspect all structural measures and their appurtenances at any time.

Table 1 - Estimated Installation Cost

Upper Hocking 9 Watershed, Ohio

Dollars 1/

Works of Improvement	Unit	PI 83-566 Funds	Other Funds 2/	Total Funds
Structure 9	1	$462,500	$201,300	$663,800

1/ Price Base: May 2011 Nov. 2011

2/ Includes $11,400 for in-kind service for local project administration as covered under the MOU

Table 2. Estimated Cost Distribution

Upper Hocking Watershed, OH

(Dollars) 1/

Item	Installation Costs - Public Law 83-566				Installation Costs - Other Funds						Total Installation Cost
	Construction 2/	Engineering	Project Admin.	Total PL 566	Construction 2/	Engineering	Real Property Rights	Required Permits	Project Admin. 3/	Total Other	
Structure No. 9	$344,000	$99,100	$19,400	$462,500	$151,000	-	$22,900	$16,000	$11,400	$201,300	$663,800

Nov. 2011

1/ Price Base: May 2011
2/ Includes assumed $24,000 cost for in installation of early warning system
3/ Includes $11,400 for in-kind services covered under the MOU

Table 3. Structural Data – Dam with Planned Storage Capacity.
Rock Mill Dam Rehabilitation, Upper Hocking Watershed

Item	Unit	Amount
NRCS Dam Classification-	-----	High
Ohio D.N.R. Classification		1
Seismic Zone	-----	1
Total Drainage Area Controlled	Mi^2	7.16
Condition II Runoff Curve Number	-----	77
Time of Concentration (Tc)	Hours	3.0
Elevation, Top of Dam	Feet (MSL 3/)	957.1
Elevation, Auxiliary Spillway Crest	Feet (MSL 3/)	946.4
Elevation, Principal Spillway Low Stage Orifices	Feet (MSL 3/)	909.4
Elevation, Principal Spillway High Stage Orifice	Feet (MSL 3/)	911.9
Elevation, Principal Spillway High Stage Weir	Feet (MSL 3/)	922.4
Maximum Height of Dam	Feet	76.0
Type of Dam	-----	Earthen
Dam, Volume of Fill 1/	Cu. Yd	285,854
Dam Crest Length	Feet	1,010
Auxiliary Spillway Type	-----	Vegetated
Auxiliary Spillway Bottom Width	Feet	320
Auxiliary Spillway Exit Slope	%	5.5
Total Capacity (Auxiliary Spillway Crest)	Ac. Ft	1,617
Sediment Submerged (100 yr)	Ac. Ft	68
Sediment Aerated	Ac. Ft	12
Municipal water supply	Ac. Ft	0
Floodwater Retarding	Ac. Ft	1,617
Surface Area		
Sediment Pool	Acres	11.0
Municipal water supply Pool	Acres	0
Floodwater Retarding Pool @ AS Crest	Acres	75
Principal Spillway Design		
Rainfall Volume, (1day)	Inches	5.54
Rainfall Volume, (10 day)	Inches	8.76
Runoff Volume, (10 day)	Inches	6.3
Capacity (all Orifices) @ High Stage Weir 2/	Cubic Ft/Sec	317
Capacity (High Stage Weir) @ AS Crest	Cubic Ft/Sec	902
Conduit Size (Height x Width)	Feet	7 x 4
Conduit Type		Reinforced Concrete
Auxiliary Spillway Frequency of Operation	% chance for 10-day storm	< 1%
Auxiliary Spillway Hydrograph		
Rainfall Volume	Inches	10.21
Runoff Volume	Inches	7.33
Storm Duration	Hours	6
Velocity of Flow (Ve)	Ft./Sec.	8.1
Maximum Surface Elevation	Feet (MSL 3/)	949.9
Freeboard Hydrograph (6-hr storm duration)		
Rainfall Volume	Inches	26.9
Runoff Volume	Inches	23.62
Maximum Elevation	Feet (MSL 3/)	956.8 4/
Velocity of Flow	Ft./Sec.	18.7
Storage capacity equivalents		
Submerged sediment	Watershed Inches	0.18
Aerated sediment	Watershed Inches	0.03
Municipal water supply	Watershed Inches	0
Floodwater Retarding	Watershed Inches	4.24

Nov. 2011

1/ Total Volume of Embankment Fill taken from the As-Built drawings
2/ New Orifice added to pool side of the riser contributes an additional 109.5 cfs to the Total Capacity
3/ NAVD 1988
4/ Top of dam elevation is 957.1 (NAVD 88)

Table 4. Estimated Average Annual NED Costs
Structure No. 9 (Rock Mill Dam), Upper Hocking Watershed
Fairfield County, Ohio
(Dollars) 1/

Evaluation Unit	Project Outlays		Other Direct Costs	Total
	Amortized Cost 1/	Operation, Maintenance and Replacement Cost		
Dam Rehabilitation	$26,000	$4,500	$0	$30,500

Nov. 2011

1/ Price base May 2011, amortized over 101 years at a discount rate of 4.00 percent.

Table 5. Estimated Average Annual Flood Damage Reduction Benefits
Structure No. 9 (Rock Mill Dam), Upper Hocking Watershed
Fairfield County, Ohio
(Dollars) 1/ 2/

Evaluation Unit	Estimated Average Annual Damages				Estimated Average Annual Benefit
	Future Without Project		Future With Project		
	Agricultural Related 3/	Nonagricultural Related	Agricultural Related 3/	Nonagricultural Related	
Floodwater					
Crop and Pasture	$37,400		$8,100		$29,300
Other ag	$52,300		$30,800		$21,500
Non-Ag	$92,900		$7,600		$85,300
Streambank Erosion	$4,700		$2,400		$2,300
Valley Trench Erosion	$200		$0		$200
Road and Bridge	$6,200		$500		$5,700
Downstream Roads	$1,300		$100		$1,200
Sediment					
Reservoirs and Ponds	$100		$100		$0
Transportation Facilities	$4,800		$2,500		$2,300
Urban Damage		$29,600		$15,400	$14,200
Drainage Ditches	$24,600		$13,400		$11,200
Overwash	$1,700		$900		$800
Downstream Sediment	$1,900		$1,000		$900
Grand Total	$228,100	$29,600	$67,400	$15,400	$174,900

Nov 2011

1/ Price base: 2011, amortized over 101 years at a discount rate of 4.00 percent.

2/ Damages and benefits will accrue from floods of greater magnitude than 1% frequency event, but these were not evaluated.

3/ Agriculture-related damage includes damages occurring in rural communities with a population of less than 50,000.

Table 6. Comparison of NED Benefits and Costs
Structure No. 9 (Rock Mill Dam), Upper Hocking Watershed
Fairfield County, Ohio
(Dollars) 1/

Evaluation Unit	Average Annual Benefit						Average Annual Cost 4/	Benefit to Cost Ratio
	Agricultural	Road and Bridge	Urban	Recreation 2/	Other 3/	Total		
Structure 9	$151,500	$9,200	$14,200	$13,800	$55,000	$243,700	$30,500	8.0 to 1.0
Grand Total	$151,500	$9,200	$14,200	$13,800	$55,000	$243,700	$30,500	8.0 to 1.0

Nov 2011

1/ Price base is 2011
2/ Ohio Department of Natural Resources, Division of Wildlife has built facilities in this single purpose flood control structure which allows public recreational opportunity
3/ Used the Future Without Project cost as a savings to society (Cost of the Most Likely Alternative) as per P&G 1.7.2(b)(3).
4/ From Table 4.

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Note: The preliminary draft supplemental watershed plan and Environmental Assessment was reviewed by NRCS technical specialists, including the NRCS National Water Management Center staff in Little Rock, Arkansas.

DISTRIBUTION LIST

The following agencies, Native American tribes, and organizations will be contacted directly for comment and review of the Draft Supplemental Watershed Work Plan and Environmental Assessment:

Hunter's Run Conservancy District

Greenfield Township

Fairfield County Emergency Management Agency

Fairfield County Commissioners

Fairfield County Soil and Water Conservation District

Ohio Department of Natural Resources, Division of Wildlife

Ohio Department of Natural Resources, Division of Soil and Water Resources

Ohio Department of Transportation, District 5

Ohio Environmental Protection Agency

Ohio Historic Preservation Office

U.S. Army Corps of Engineers, Huntington District

U.S. Environmental Protection Agency, Region 5

U.S. Fish and Wildlife Service

USDA Forest Service

The City of Lancaster

Eastern Shawnee Tribe of Oklahoma

Absentee-Shawnee Tribe of Oklahoma

INDEX

Appendix A. Comments and Responses

(TO BE INCLUDED IN THE
FINAL
SUPPLEMENTAL WATERSHED PLAN -
ENVIRONMENTAL EVALUATION)

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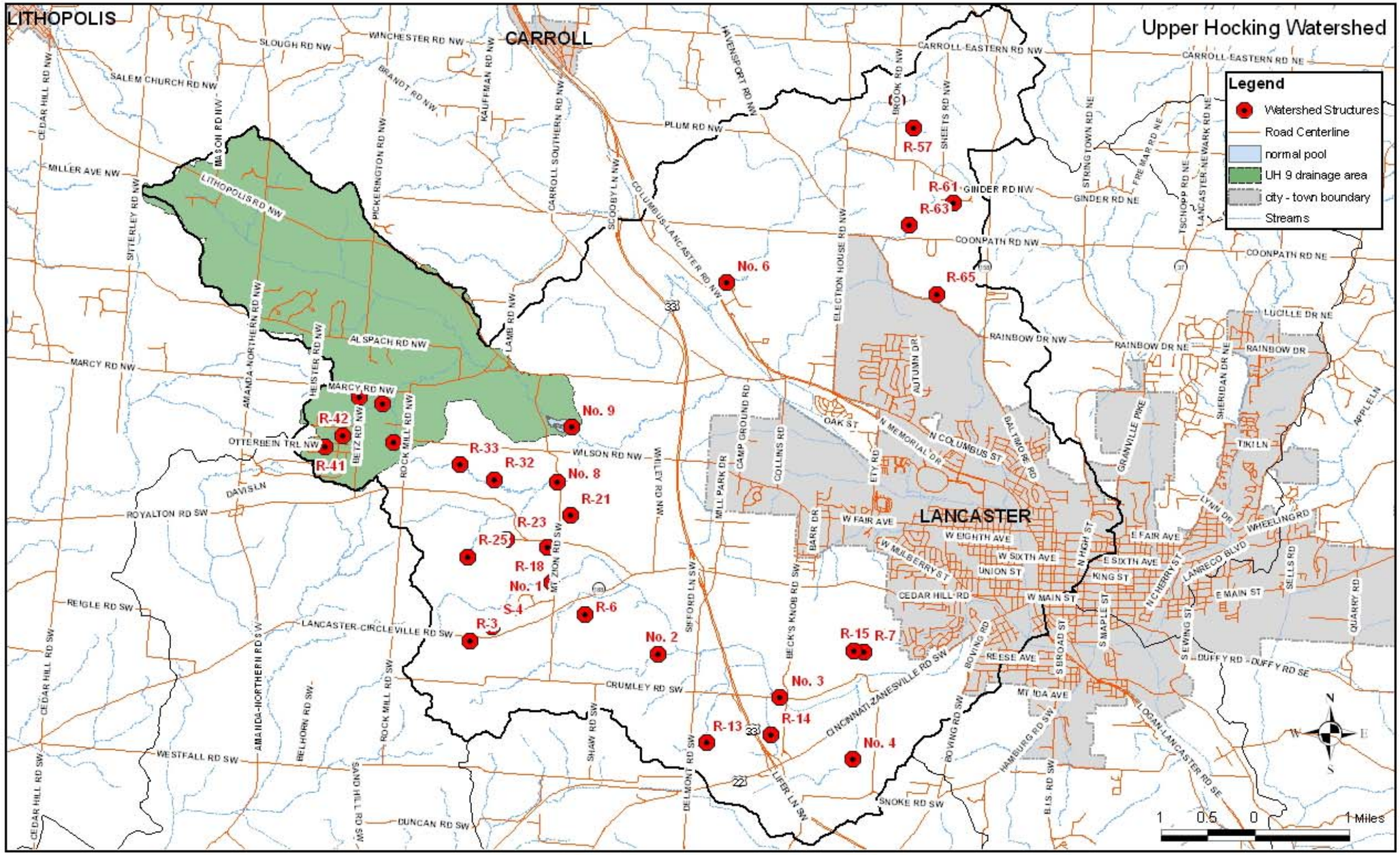
Appendix B. Project Map


Upper Hocking Watershed
LITHOPOLIS
CARROLL
LANCASTER
Legend
Watershed Structures
Road Centerline
normal pool
UH 9 drainage area
city - town boundary
Streams
No. 1
No. 2
No. 3
No. 4
No. 6
No. 8
No. 9
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WINCHESTER RD NW
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BRANDT RD NW
PLUM RD NW
MILLER AVE NW
LITHOPOLIS RD NW
ALSPACH RD NW
MARCY RD NW
OTTERBEIN TRL NW
WILSON RD NW
ROYALTON RD SW
REIGLE RD SW
LANCASTER-CIRCLEVILLE RD SW
CRUMLEY RD SW
WESTFALL RD SW
DUNCAN RD SW
SNOKE RD SW
CARROLL-EASTERN RD NW
CARROLL-EASTERN RD NE
GINDER RD NW
GINDER RD NE
COONPATH RD NW
COONPATH RD NE
RAINBOW DR NW
RAINBOW DR NE
LUCILLE DR NE
RAINBOW DR
TIKI LN
OAK ST
N COLUMBUS ST
W FAIR AVE
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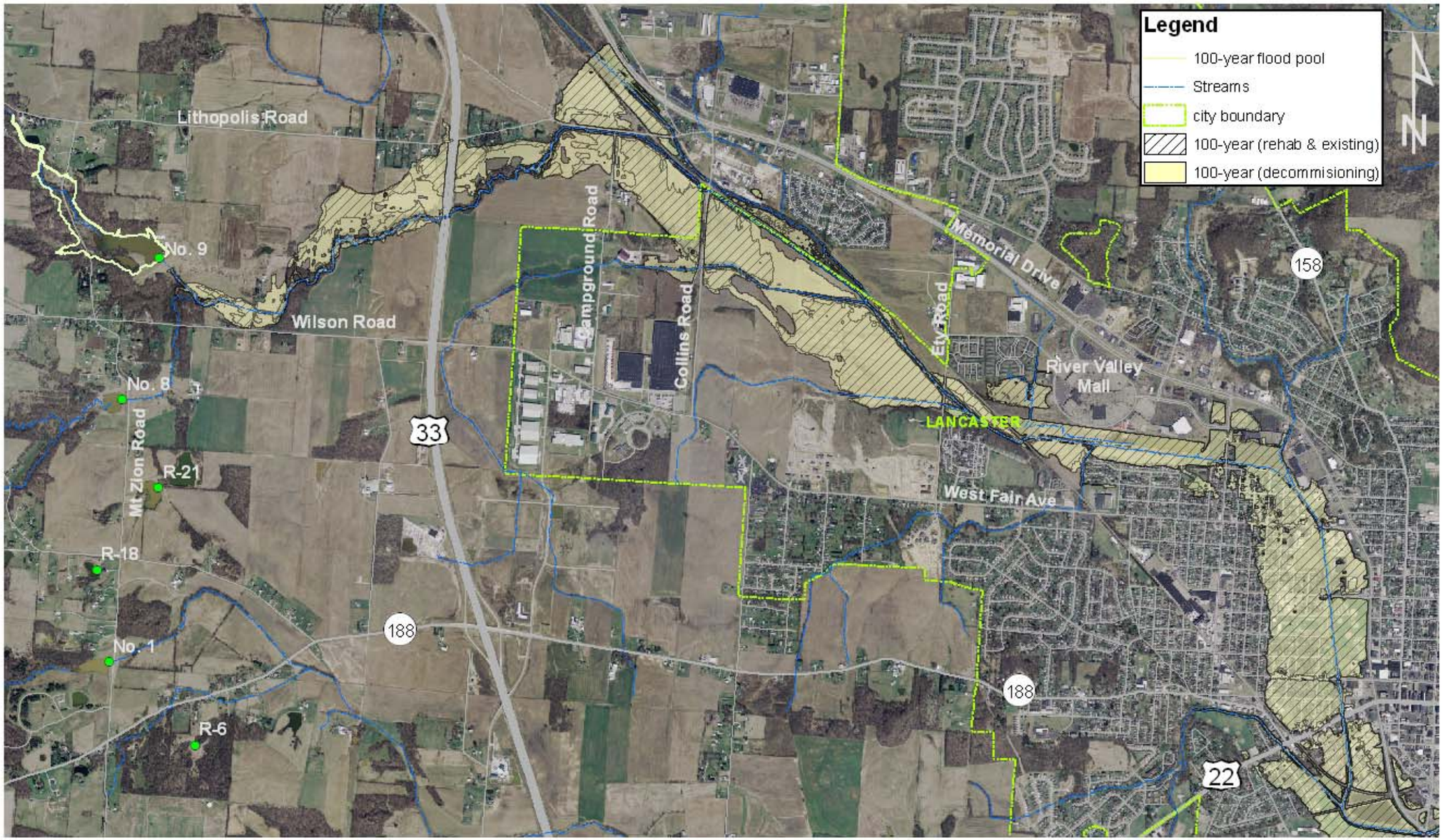
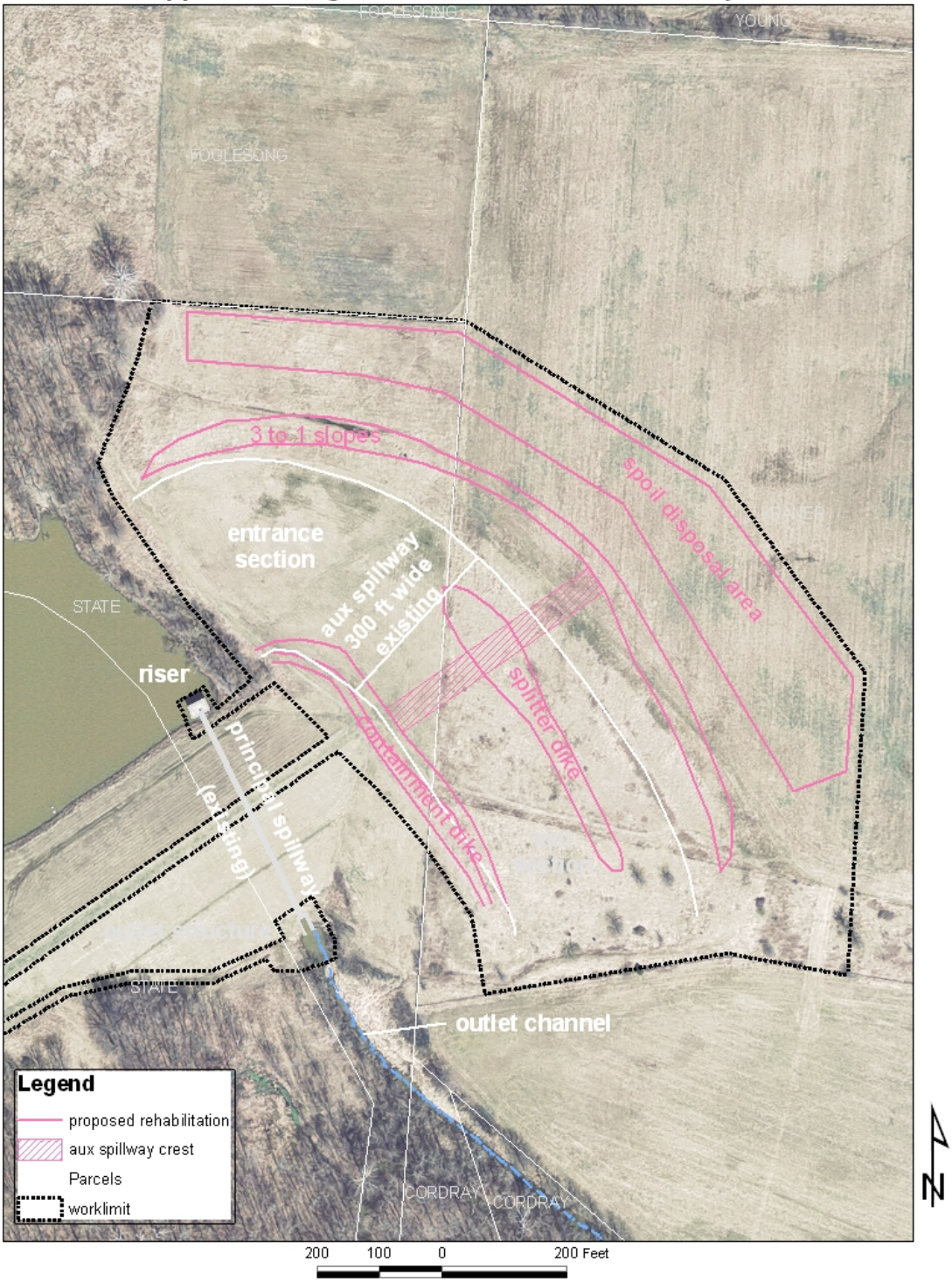
UNION ST
KING ST
W MAIN ST
E MAIN ST
CEDAR HILL RD
REESE AVE
MT IDA AVE
DUFFY RD - DUFFY RD SE
WHEELING RD
LANRECO BLVD
LYNN DR
SELLS RD
QUARRY RD
W MULBERRY ST
N HIGH ST
S MAPLE ST
S BROAD ST
N CHERRY ST
S SEWING ST
BROOK RD NW
SHEETS RD NW
STRINGTOWN RD NE
FRE MAR RD NE
FISCHOPP RD NE
LANCASTER-NEWARK RD NE
HAVENSPORT RD NW
CARROLL SOUTHERN RD NW
SCOOBY LN NW
COLUMBUS-LANCASTER RD NW
ELECTION HOUSE RD NW
AUTUMN DR
CAMP GROUND RD
COLLINS RD
MILL PARK DR
BARR DR
BECK'S KNOB RD SW
SIFFORD LN SW
DELMONT RD SW
LIPER LN SW
CINCINNATI-ZANESVILLE RD SW
BOVING RD
BOVING RD SW
HAMBURG RD SW
B I S RD SW
LOGAN-LANCASTER RD SE
GRANVILLE PIKE
SHERIDAN DR NE
APPLE LN
MASON RD NW
KAUFFMAN RD NW
PICKERINGTON RD NW
CEDAR HILL RD NW
SITTERLEY RD NW
AMANDA-NORTHERN RD NW
HEISTER RD NW
BETZ RD NW
ROCK MILL RD NW
LAMB RD NW
MT ZION RD SW
WILEY RD NW
DAVIS LN
CEDAR HILL RD SW
AMANDA-NORTHERN RD SW
BELHORN RD SW
ROCK MILL RD SW
SAND HILL RD SW
SHAW RD SW
N
S
E
W
1 0.5 0 1 Miles

Upper Hocking 9 100-year floodplain

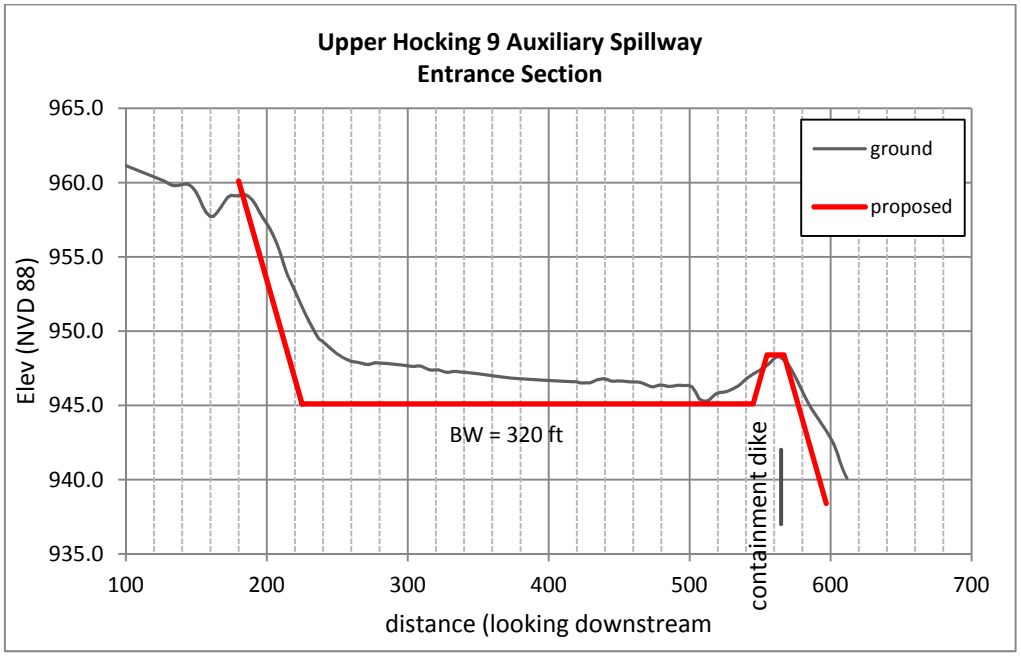


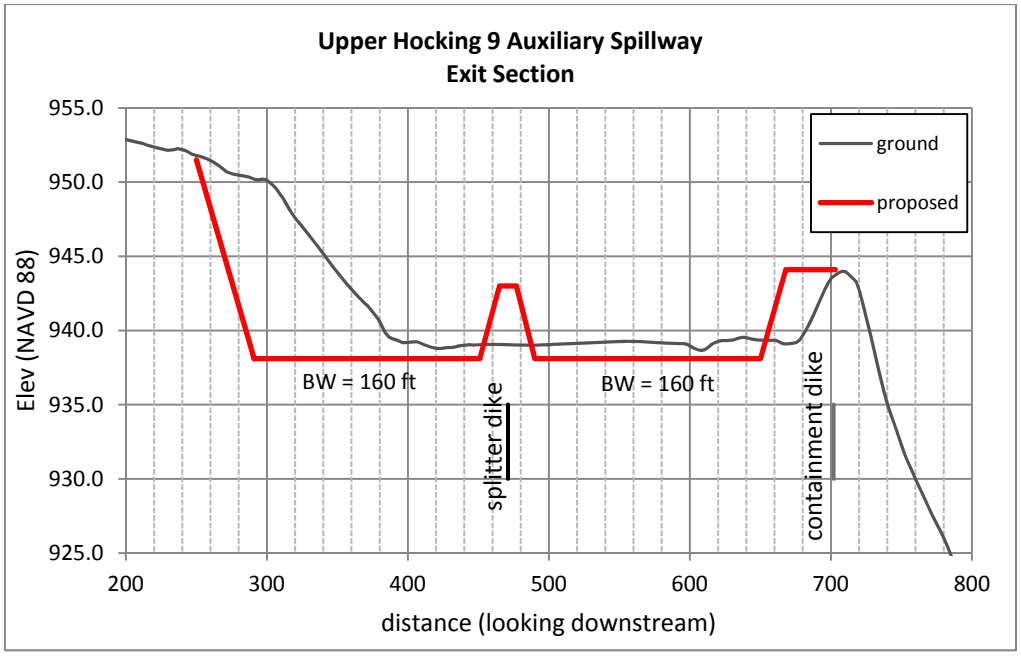
Appendix C

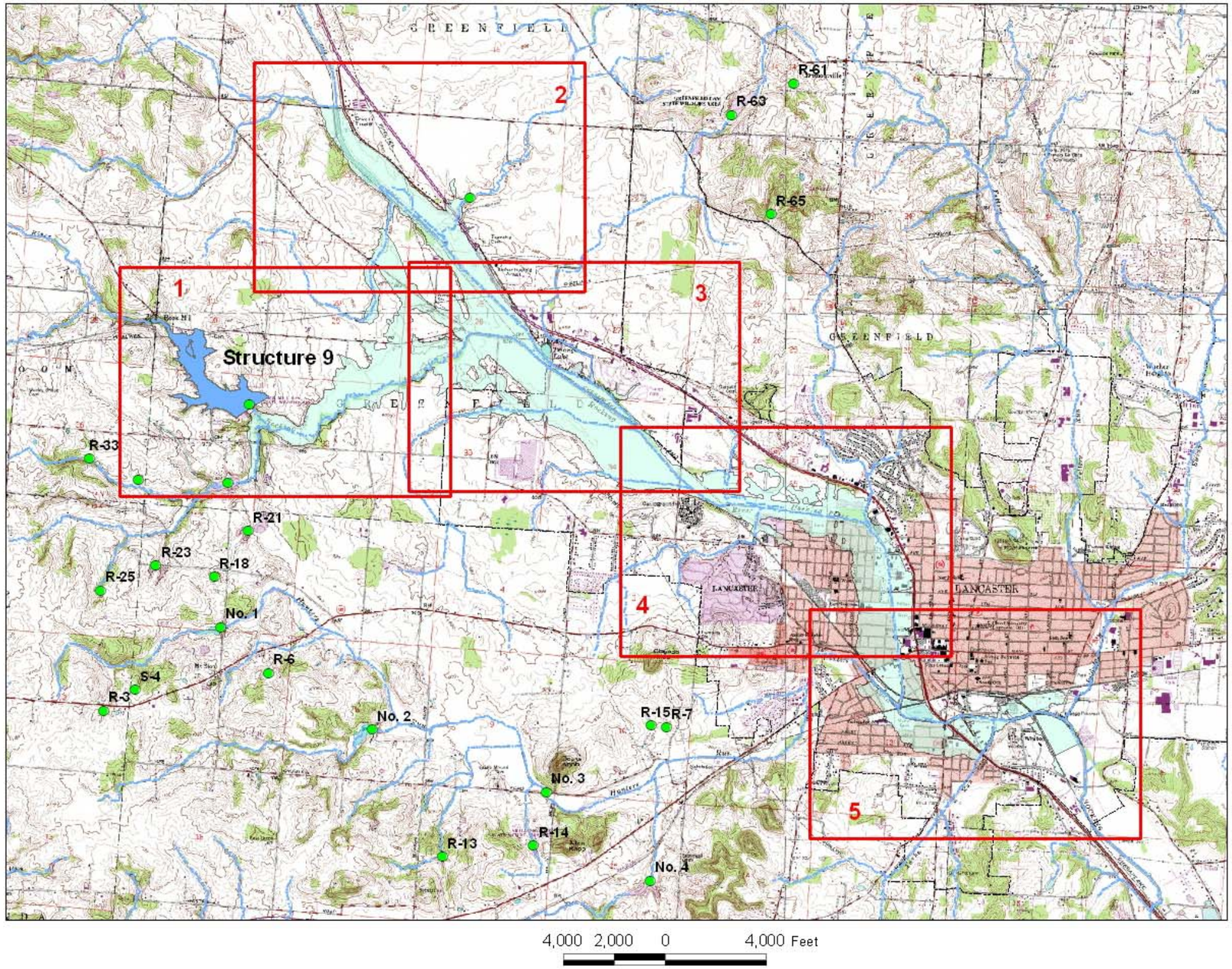
Upper Hocking 9 - Rehabilitation General Layout



Appendix C. Typical Auxiliary Spillway Rehabilitation Cross Sections







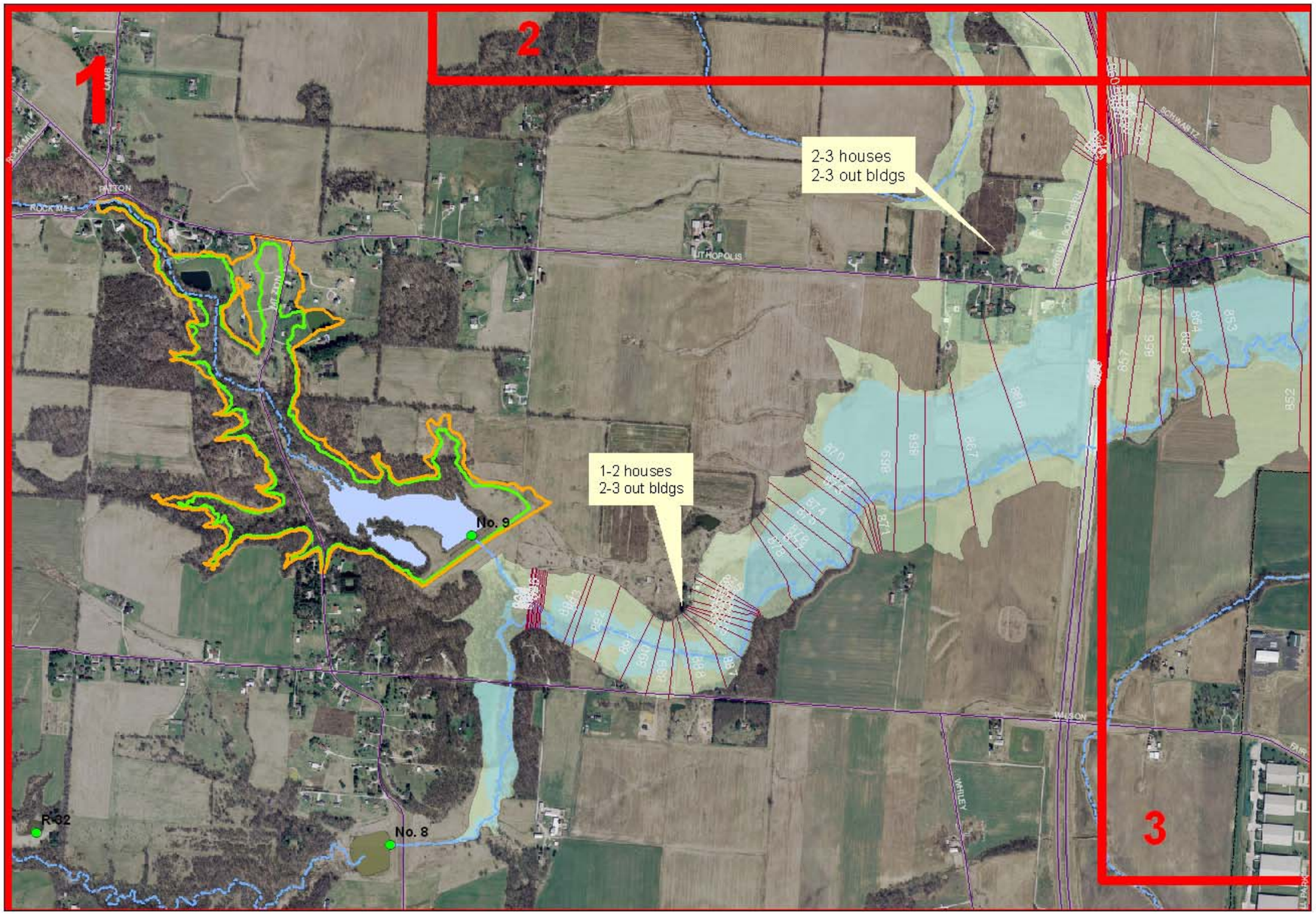
Upper Hocking
Structure 9
Breach Inundation Map

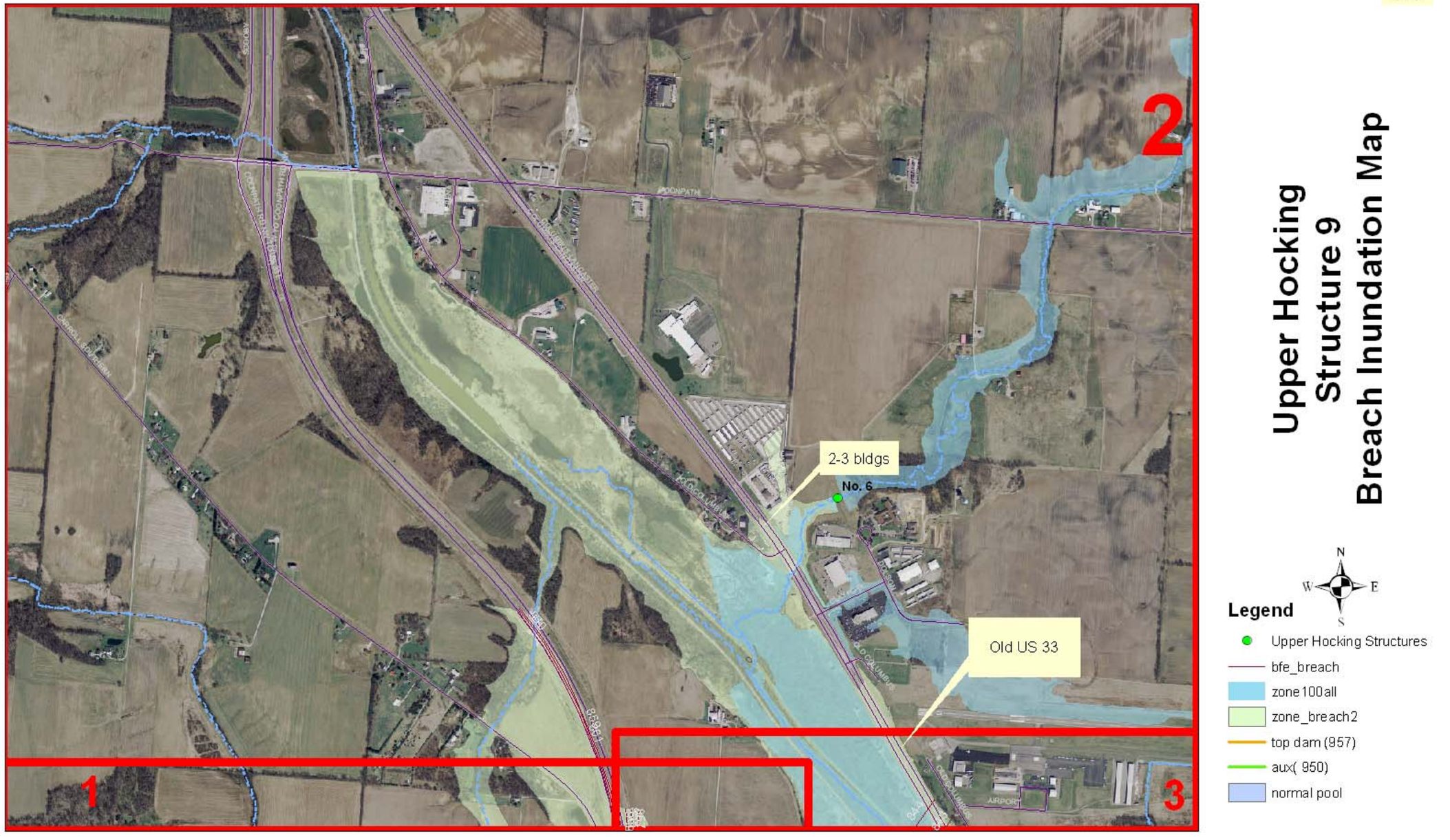
N
W E
S

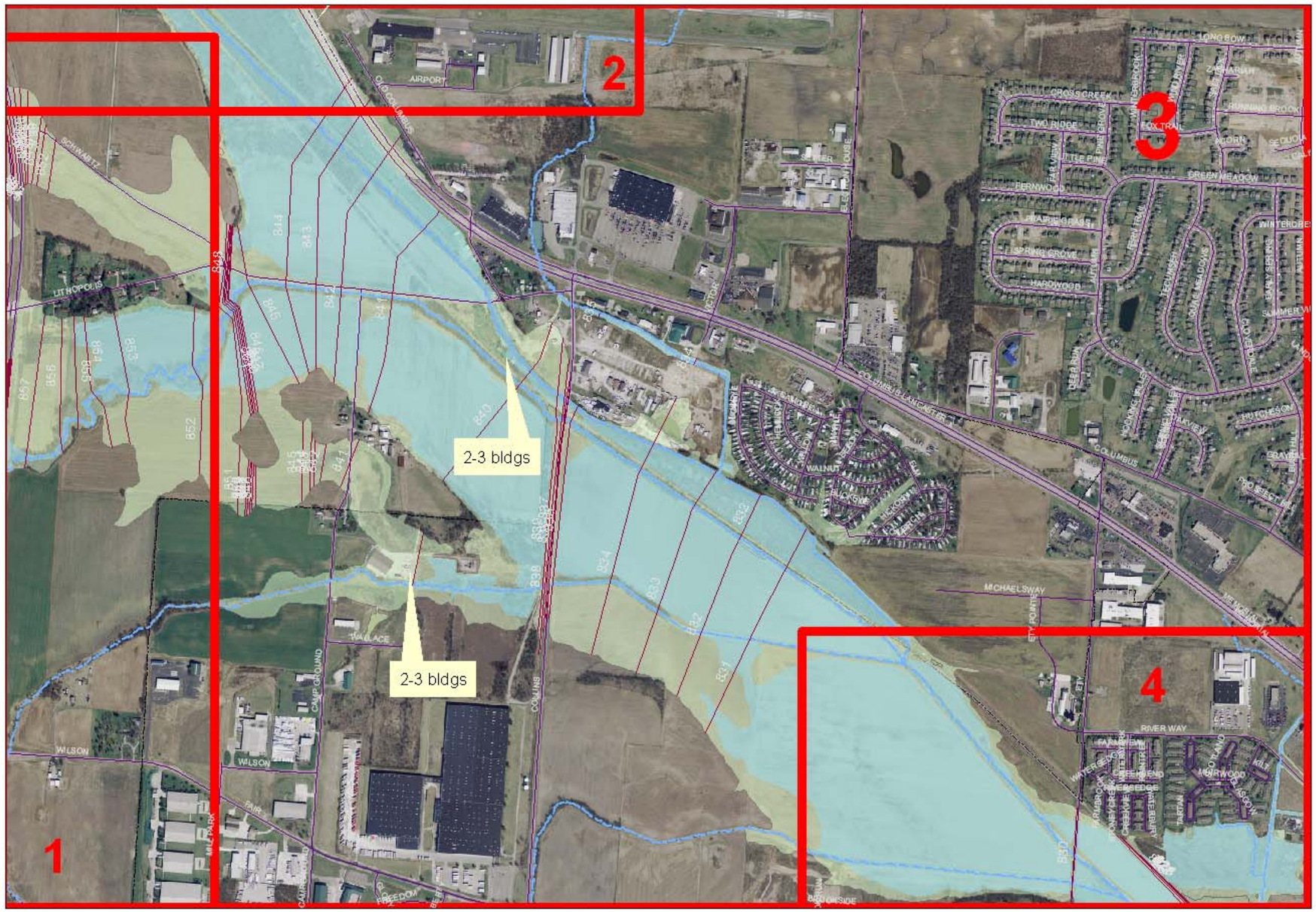
Legend

- Upper Hocking Structures
- zone_breach2
- top of dam flood pool

Upper Hocking Structure 9 Breach Inundation Map




2
1
3
2-3 bldgs
No. 6
Old US 33
POONPATH
AIRPORT
Upper Hocking
Structure 9
Breach Inundation Map
N
W
E
S
Legend
Upper Hocking Structures
bfe_breach
zone100all
zone_breach2
top dam (957)
aux(950)
normal pool
1,000 500 0 1,000 Feet

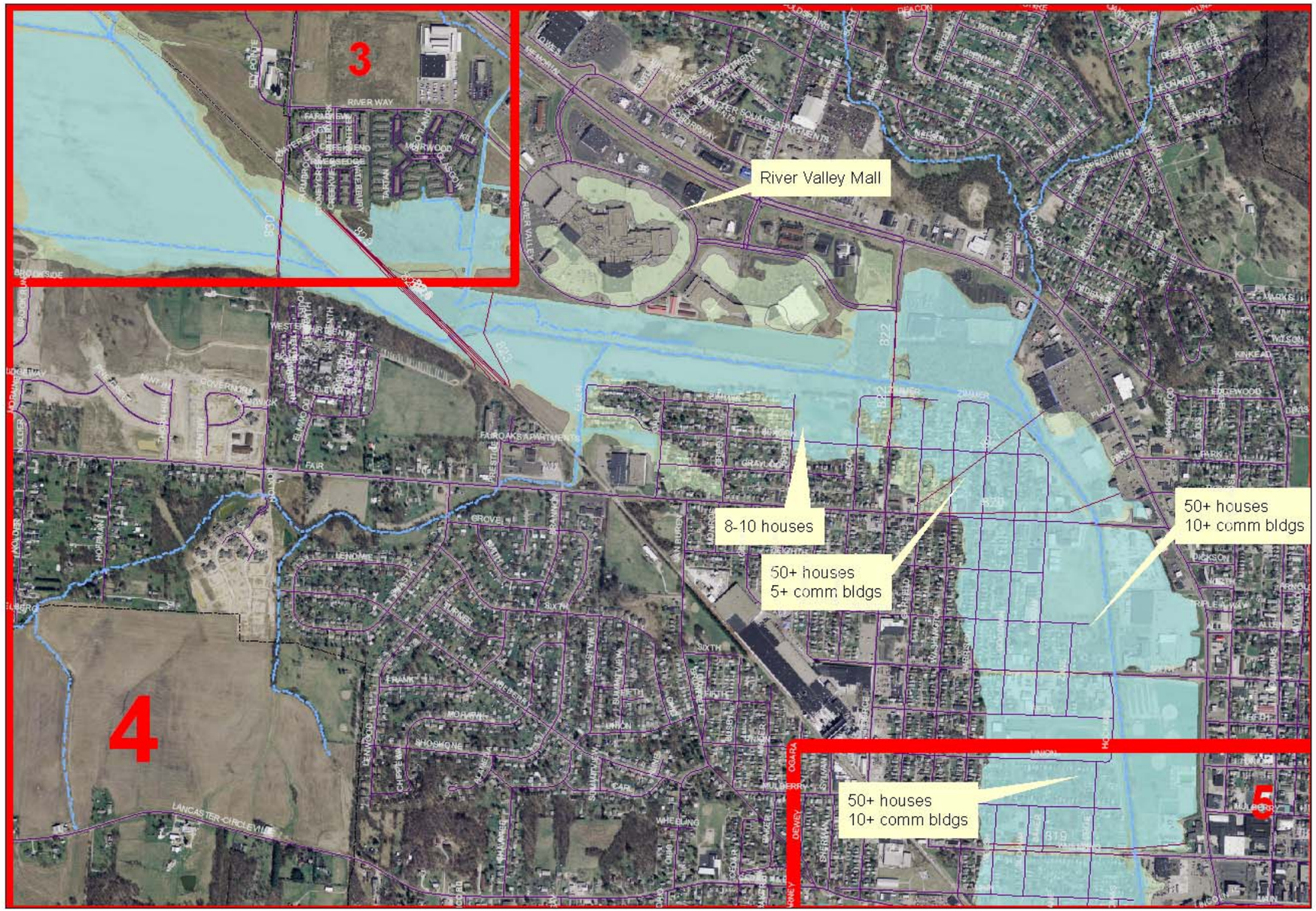


Upper Hocking Structure 9 Breach Inundation Map

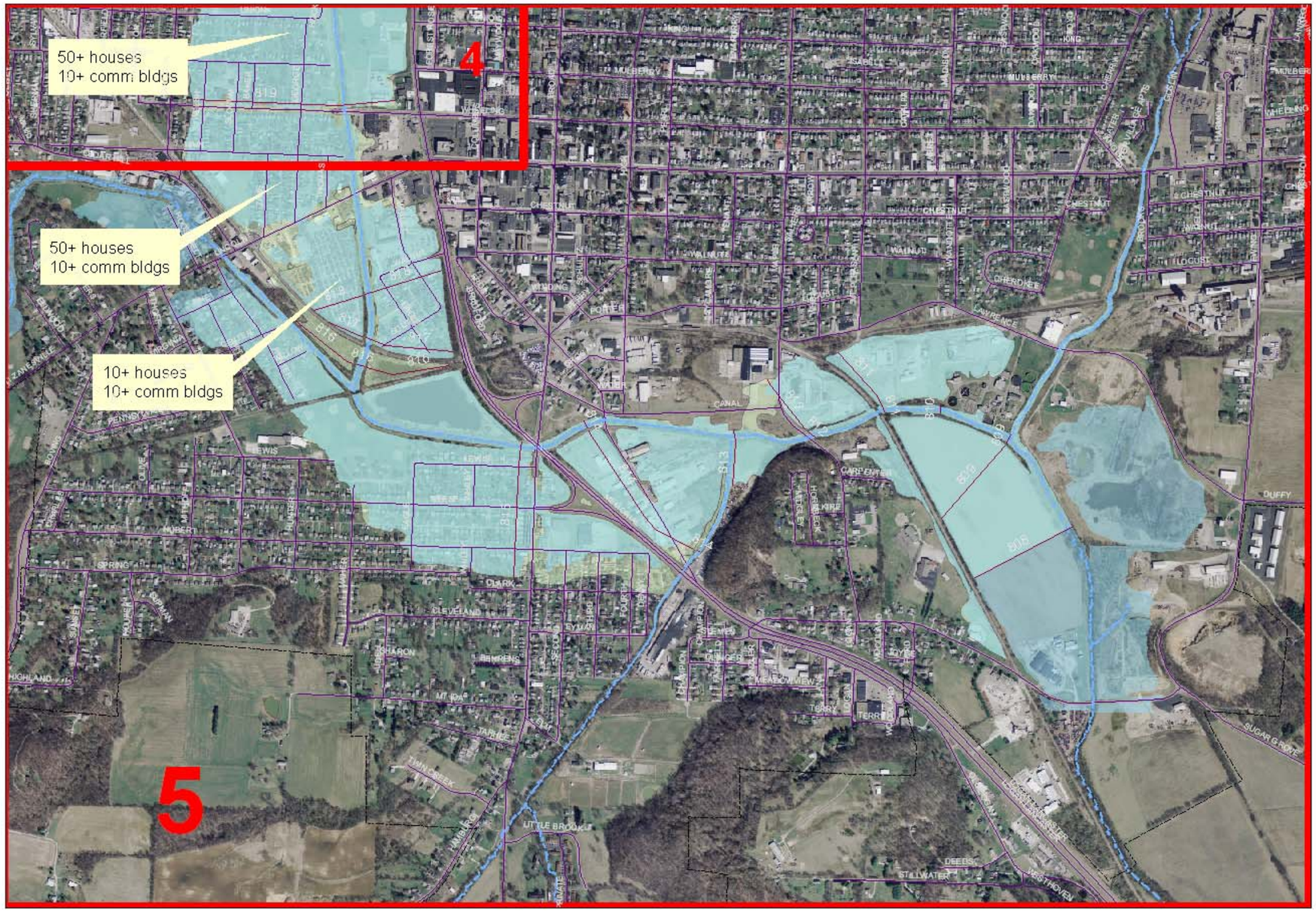
Legend

- Upper Hocking Structures
- bfe_breach
- zone100all
- zone_breach2
- top dam (957)
- aux(950)
- normal pool

1,000 500 0 1,000 Feet



Upper Hocking Structure 9
Breach Inundation Map



Upper Hocking Structure 9 Breach Inundation Map

N
W E
S

Legend

- Upper Hocking Structures
- bfe_breach
- zone100all
- zone_breach2
- top dam (957)
- aux(950)
- normal pool

1,000 500 0 1,000 Feet

Site Investigation Procedures
Topographic and imagery data was obtained through the Ohio Statewide Imagery Program (OSIP) including 1 ft color county photomosaic (MrSID format) and tiled 2.5 foot grid DEM. Lidar (Light Detection and Ranging) data was obtained for the dam, flood pool area, and downstream floodplain. This resulted in utilization of one-foot contour information and high resolution color orthophotography for planning for the same areas. A Kelch map, compiled from aerial mapping and plotted at two foot contour intervals, was also used during the planning for this project. This kelch map was developed in 2001 and shows good correlation with the Lidar data. A survey grade GPS unit was used to survey cross sections and profile of the auxiliary spillway area.

Hydrology and Hydraulics
Dam break modeling performed for this project demonstrated that loss of life could occur as a result of dam failure, and as a result, the hazard classification for the dam has been confirmed as a high-hazard. This dam must meet two basic criteria:

- The 100-year, 10-day Principal Spillway Hydrograph (PSH) storm event cannot overtop the auxiliary spillway; and
- The PMF does not overtop the dam.

The design to meet these new standards required development of event flow rates (in a HEC-HMS model) for the watersheds above and immediately below the structure. This model was used in sizing the structure (spillway dimensions) and in defining impacts and benefits associated with project alternatives. Hydrology and hydraulic data for this Rock Mill Dam rehabilitation study are documented and available in the planning folders (including the methods, data, and assumptions used before and after rehabilitation).

The original hydrology, geotechnical investigation and analysis, and final design were completed in 1959. The design criteria that was used to establish the principal and auxiliary spillway dimensions and top of dam elevation in 1959 is different than what is used today. The planning analysis for this dam rehabilitation was done by using the NRCS Water Resource Site Analysis Program (SITES) (USDA-NRCS, 2005), which is based in part, on NRCS TR-60, Earth Dams and Reservoirs (USDA-NRCS, 2005).

Engineering
Engineering planning efforts were completed to meet the following project objectives:

- Maintain flood control benefits.
- Upgrade the dam to comply with minimum Federal and State dam safety requirements.
- Minimize impacts to the surrounding landowners.

The preferred alternative which best meets the project objectives is rehabilitation of the dam by construction of dam safety modifications developed to address identified dam safety deficiencies and what is needed to meet current high hazard classification.

Designed dam safety modifications include widening the existing auxiliary spillway and lowering the crest three feet. The new auxiliary spillway crest level was set based on the minimum elevation necessary to pass the PMF and keep the water elevation below the top of dam elevation (957.1 NAVD). The normal water level set in 1959 will be used for the rehabilitation project. Based on the future sedimentation rate the lake will have 100 years of submerged sediment storage capacity.

Engineering work items completed as part of the development of this planning study include:

- Gathering, reviewing, and updating existing site data.(i.e. Tc, RCN, drainage area)
- Identifying problems, opportunities, and concerns.
- Conducting planning studies, included:

- Analyzing existing data and original design folders.
- Conducting an environmental evaluation.
- Conducting an integrity analysis of the reinforced concrete in the principal spillway.
- Conducting field investigations to evaluate the condition of existing structures and obtain additional data (e.g., survey and geotechnical data).
- Developing topographic mapping for the watershed using Lidar technology.
- Conducting underwater surveys for sediment survey.
- Conducting a future watershed sediment yield analysis.
- Conducting engineering, environmental, geologic, hydrologic, hydraulic, social, and economic analyses in accordance with the requirements of NRCS design criteria (e.g., National Engineering Handbook, technical releases, technical notes, design notes, SITES, HEC-RAS, and HEC-HMS software).
- Calculate how modification to the riser of the principal spillway could improve low flow rate to localized road flooding in the flood pool.

- Developing design layouts and cost estimates for evaluation of design alternatives including:
  - No Action Alternative
  - Decommission Alternative
  - Rehabilitation Alternatives including various modifications to spillway and top of dam:
    - Expansion of existing spillway
    - Expansion and modification to existing spillway
- Developing inundation maps for impact comparisons associated with the proposed design modifications.
- Providing public involvement support services, including coordinating with local NRCS offices, site landowners, Sponsors, and the public; preparing presentations to the public; and attending public meetings.

Preparing a Supplemental Watershed Plan and Environmental Assessment for the project Sponsors on behalf of the NRCS.

The NRCS SITES program was used to test alternative auxiliary spillway geometries and layouts.

Sedimentation Survey
A sediment survey of Rock Mill Lake was completed in 2009 using a Garmin GPS Chart plotter mounted on a boat. The bottom of the lake was surveyed with over 500 GPS points recorded. A contour map of the bottom of the lake was then developed. The existing sediment deposition volume was determined by comparing the original design stage – storage data to current data. The sediment storage volume available for the future in the lake is the volume of water in the lake.

Watershed Sediment Yield Analysis
Future sediment storage capacity was based on a new sediment yield study conducted in the watershed above Rock Mill Dam. Future sediment volume expected in Rock Mill Lake is based on assumptions regarding future land use anticipated in the drainage area, erosion rates, transport to the lake, and retention within the lake. Data was compiled including NASS land use data, soil information and RUSLE2 erosion rates for all land uses in the watershed. The watershed was divided into two areas with two distinctly different sediment delivery ratios. In the northern two thirds of the watershed that contains an old lake bed area that serves as an upstream sediment trap, the sheet erosion

delivery ratio is estimated to be 20%. In the southern third where there are short and steep paths to the lake, the sheet erosion delivery ratio is estimated to be 40%. The composite delivery ratio for sheet erosion for the entire 7.16 square mile watershed is estimated to be 27%. Therefore, out of the total annual sheet erosion of 3,218 tons, only 869 is expected to be delivered to the lake. An ephemeral gulley inventory was then completed using high resolution ortho photography. The gulley inventory used a voided area estimation to determine the sediment yield from ephemeral gullies. About two thirds of the estimated 200 tons of gully erosion is expected to be delivered annually to the lake.

Breach Analysis Data

Results of the breach analysis are shown in Table K including a summary comparison of peak discharge, water elevation, and approximate breach flow depth over the bridges downstream of the dam for the 100-year flood, probable maximum flood, and breach condition. The breach inundation area extends downstream to a point where the "sunny day" breach flood depth equals the 100-year flood depth (approximately eight miles downstream of the dam). The breach inundation area was overlaid onto ortho photography. Based on visual observation and contours developed form Lidar dgrid data along the floodplain, over 200 homes, 50 businesses, more than 18 bridges, and many miles of roads are located within the entire breach zone for this event and could potentially be damaged or destroyed. Table L shows approximate inundation depths in houses and businesses located within the first 6 miles downstream.

Based on the breach analysis and consequences of failure, NRCS has confirmed the classification of the structure as a high hazard dam. High hazard dams are located where failure may cause loss of life, serious damage to homes, industrial and commercial buildings, public utilities, and main highways or railroads.

Table K. Results of a "Sunny Day" Dam Breach Routing for Rock Mill Dam

			breach		**PMF**		**100-yr flood**		**Maximum Depth of flow over bridge deck**		
Bridge Location	Deck Elev	Dist DS of dam (miles)	Q Total (cfs)	W.S. Elev (MSL)	Q Total (cfs)	W.S. Elev (MSL)	Q Total (cfs)	W.S. Elev (MSL)	Breach	PMF	100-yr Flood
Private Drive	873.8	0.4	101498	889	15406	880.7	1480	877	15.2	6.9	3.2
US 33 By-Pass	860.8	1.6	77932	863	15406	855.7	1480	852.3	2.2	-5.1	-8.5
Campground Rd	841.3	2.7	50961	841.3	15406	838.5	1480	836.9	0.0	-2.8	-4.4
Collins Rd / RR	835.2	3.2	47479	837.3	15406	835.6	1480	831.2	2.1	0.4	-4.0
Ety Rd	829.1	4.5	19095	829.6	37326	831.6	2960	823.6	0.5	2.5	-5.5
RR	827.6	4.9	17036	826.1	37326	829.6	2960	821.1	-1.5	2.0	-6.5
Pierce Rd	823.4	5.7	10996	822	40883	827.5	3360	820.6	-1.4	4.1	-2.8
Fair Ave	820.4	6.2	9298	819.4	40883	826.16	3360	818.7	-1.0	5.8	-1.7
Sixth Ave	820.7	6.5	6748	819.2	40883	825.9	3360	818.2	-1.5	5.2	-2.5
Wheeling St	819.5	6.9	6724	818.8	40883	825.5	3360	817.6	-0.7	6.0	-1.9
US 22 / Lincoln St	819	7.0	6675	818.4	40883	825.25	3360	816.7	-0.6	6.3	-2.3
RR	820.2	7.3	6274	816.5	40883	825.04	3360	815.5	-3.7	4.8	-4.7
RR	820	7.4	5772	815.6	51129	824.6	4100	814.8	-4.4	4.6	-5.2
US 33 / SR 729	817.7	7.8	5677	814.75	51129	823.85	4100	814	-3.0	6.1	-3.7
Columbus St	819.5	7.9	5571	813.7	51129	823.7	4100	813.3	-5.8	4.2	-6.2
Maple St	818.3	8.3	5388	812.1	55000	822.6	4330	811.6	-6.2	4.3	-6.7
Abandoned RR	820.2	8.5	5314	811.2	55000	820.2	4330	810.9	-9.0	0.0	-9.3
Sugar Grove Rd	807.4	9.3	4990	806.2	74240	813.8	5130	806.5	-1.2	6.4	-0.9

Shading indicates water levels higher than the bridge deck

Table L. Depth of First Floor Flooding for Rock Mill Dam Breach.

			breach		PMF		100-year flood	
Structure Description	Approximate floor elev	Dist DS of dam (miles)	W.S. Elev	Depth of Inundation (ft)	W.S. Elev	Depth of Inundation (ft)	W.S. Elev	Depth of Inundation (ft)
house	885	0.6	885.4	0.4	876.7	-8.3	872.7	-12.3
building	875	0.7	878.7	3.7	873.3	-1.7	870.1	-4.9
building	875	0.7	878.7	3.7	873.3	-1.7	870.1	-4.9
building	880	0.7	878.7	-1.3	873.3	-6.7	870.1	-9.9
house	866	1.3	866.9	0.9	860.1	-6.0	857.3	-8.7
building	858	1.6	865.8	7.8	858.2	0.2	853.6	-4.4
building	862	1.6	865.8	3.8	858.2	-3.8	853.6	-8.4
building	864	1.6	865.8	1.8	858.2	-5.8	853.6	-10.4
house	858	1.6	865.9	7.9	858.2	0.2	852.9	-5.1
house	862	1.6	865.9	3.9	858.2	-3.8	852.9	-9.1
house	865	1.6	865.9	0.9	858.2	-6.8	852.9	-12.1
building	838	2.6	843.5	5.5	840.0	2.0	838.5	0.5
building	842	2.6	843.5	1.5	840.0	-2.0	838.5	-3.5
building	842	2.6	843.5	1.5	840.0	-2.0	838.5	-3.5
building	836	3.0	840.2	4.1	837.6	1.6	832.7	-3.3
building	836	3.0	840.2	4.1	837.6	1.6	832.7	-3.3
building	838	3.1	840.0	2.0	837.5	-0.5	832.7	-5.3
River Valley Mall	824	5.0	822.9	-1.1	828.3	4.3	821.1	-3.0
River Valley Mall	824	5.2	822.7	-1.3	828.1	4.0	821.0	-3.0
5 houses	820	5.2	822.7	2.7	828.0	8.0	821.0	1.0
5 houses	822	5.2	822.6	0.6	827.9	5.9	821.0	-1.0
River Valley Mall	824	5.4	822.6	-1.4	827.8	3.8	821.0	-3.0
5 houses	820	5.4	822.6	2.6	827.7	7.7	821.0	1.0
5 houses	822	5.4	822.6	0.5	827.7	5.7	821.0	-1.0
8 houses	820	5.5	822.6	2.5	827.7	7.7	821.0	1.0
7 houses	822	5.6	822.6	0.5	827.7	5.7	821.0	-1.0
10 houses	820	5.7	822.5	2.5	827.7	7.7	821.0	1.0
10 houses	822	5.7	822.5	0.5	827.6	5.6	820.9	-1.1

Shading indicates depth of inundation higher than first floor elevation

Condition of Dam
Condition was assessed by reviewing ODNR formal dam safety investigation reports, annual operation and maintenance inspection reports, and an engineering inspection of the structure and spillway systems.

Alternative Costs and Engineering
Costs for each of the above features were based on construction bids for recent projects in Ohio involving these items. In addition, RCC costs were based on compilations of similar RCC structures, as prepared by the Portland Cement Association. The total cost for the various alternatives were combinations of the cost for each of the applied features.

Environmental Evaluation

The scope of the evaluation of environmental concerns was limited to the immediate vicinity of the Rock Mill Lake Wildlife Area as well as the surrounding area and streams above and below the structure. Given the limited extent of physical effects from the preferred alternative, the environmental evaluation was limited to areas within a mile of the site and focused on the immediate (in temporal terms) effects of the actions included under this alternative. For the no action alternative, potentially affected area was considered further downstream because of the likelihood of these effects extending downstream if the dam is removed.

For all resource concerns identified on the Environmental Evaluation Worksheet (NRCS-CPA-52), any available and relevant information concerning the particular resource concern was reviewed by NRCS personnel with experience in that resource concern. This included published reports or documents; information from other agencies that was available on-line; and discussion with knowledgeable persons from other agencies or organizations. In addition, NRCS personnel made on-site inspection of the project area and surrounding areas to evaluate effects on resource concerns identified on the NRCS-CPA-52.

For soil, water and air resource concerns, there were no detailed procedures or techniques used. For each resource concern, NRCS personnel with expertise in these resource concerns evaluated the anticipated effect on the resource of the actions described under the alternatives. The expected effects were based on the impact the action would have on the physical resource considering both the typical implementation of the action and any variations in the action dictated by the implementation in this specific case.

Wildlife concerns (including effects on listed species) were evaluated by a NRCS biologist. Existing habitats were evaluated using habitat models and professional experience; this was based on general cover conditions. Areas evaluated included those directly impacted by actions taken under the alternative actions; areas immediately adjacent to the project site; and reaches of the stream downstream and upstream of the project site for aquatic resources. The predicted change in cover conditions for areas impacted by alternative actions was then evaluated in the same way to determine the change in expected habitat conditions. The evaluation compared the changed habitat conditions (if any) for the alternative actions; this considered both short-term and long-term effects on fish and wildlife habitat. For listed threatened and endangered species, the presence of preferred habitat for these species was surveyed in the project area. These habitats were based on US Fish and Wildlife Service (USFWS) information and professional knowledge of the NRCS biologist. The presence, or absence, of preferred habitats was noted. If preferred habitats were present, the NRCS biologist determined if there would be an effect on the listed species; again this was based on USFWS information on effects of various actions and the professional judgment of the NRCS biologist. No field surveys for the presence of individuals of listed species was conducted. Use of information in the Ohio Natural Heritage Database and USFWS descriptions of likely areas of occurrence were used to determine likely presence of the species.

Special environmental concerns were evaluated by determining the presence or applicability of the concerns. For those determined to be present or the applicable, NRCS evaluated effects on the

concern according to the applicable policy or regulation. Generally, the presence or applicability was determined using appropriate documents, maps or information from agencies responsible for regulating the particular special concern. Decisions on effects were made independently by NRCS or in consultation with the appropriate agency.

Economic Evaluation

Benefits

The benefits for Upper Hocking 9 project require disclosure of two alternative procedures under the Economic and Environmental Principles and Guidelines for Water and Related Land Resource Implementation Studies (P&G, 1983). The first procedure is the use of abbreviated procedures for estimation when more expensive ones are not expected to change results. The other procedure is the use of the Cost of the Most Likely Alternative.

Abbreviated Procedures

The Upper Hocking Watershed was originally designed to use flood detention structures to reduce flood peaks on row crop agriculture in the common floodplain of Upper Hocking River. The majority of the economic benefits are from reducing flood damages of smaller events such as the two year or less.

The landscape has changed somewhat since the original 1955 plan, but the watershed and area around structure 9 are still primarily in some form of agriculture with some conversion to housing. Structure 9 land area has had a conversion of nearly 500 acres to urban build-up such as roads and buildings. Other changes were to pasture and woodland which still allow some form of agricultural production (Table D-Structure 9 Watershed Land Use).

The common floodplain still has agricultural activity (Table C - Upper Hocking Watershed Land Use) so the economic analysis can be done using abbreviated procedures as allowed in the P&G. Under 1.7.2(a)(4)(ii) (P&G) allows reducing the extent of the analysis and amount of data collected where greater accuracy or detail is clearly not justified by the cost of the plan components being analyzed.

The reason for the supplemental analysis of the Upper Hocking 9 watershed site is due to public safety issues. The other social effect (OSE) of public safety outweighs the need for accuracy of an economic effect for monetized benefits. This is due to the funding ranking for all potential watershed rehabilitation (16 U.S.C. Section 1012) is based on population at risk.

The abbreviated procedure uses the original flood damage reduction benefits and updates these flood damage reduction benefits to present day values. The updating for Upper Hocking 9 (Table M) is based on land index values for agricultural benefits; consumer price index (CPI) for the general non-agriculture category, the engineering and news construction cost index for housing; roads and bridges, Stream erosion, and other sediment damage is indexed with Civil Work Construction Cost Index System (CWCCIS).

Agricultural benefits are primarily to the common floodplain so the protection afforded by structure 9 relative to other floodwater retarding structures (FWRS) was estimated. This was done by calculating the percent drainage area controlled of structure 9 relative to other FWRS in the watershed. The analysis of the original data had structure 9 providing 24.8% of the protection to the common floodplain based on detention storage. The benefits were reduced on a per acre basis due to agricultural land retirement in the common floodplain.

There were no acres in other temporary or perpetual agricultural land retirement programs. The remaining available agricultural lands were then allocated to Site 9 as 24.8% percent of common floodplain. The agricultural benefits were then updated from 1955 to 2011 using the Ohio Agricultural Land Index. Other benefits were updated from 1955 to 2011 as listed in Table M.

Table M – Index Values for the Original Benefits

Damages	Index	1955	1967	2011	Factor	Source
Floodwater						
Crop and Pasture	land value	$162	$0	$5,525	34.15	NASS
Other Agriculture	land value	$162	$0	$5,525	34.15	NASS
Non-ag	CPI	$27	$0	$226	8.43	BLS
Streambank Erosion	CWCCIS-16	$660	$1,074	$754	12.26	USACE
Valley Trench Erosion	CWCCIS-09	$660	$1,074	$748	12.17	USACE
Roads and bridges	CWCCIS-08	$660	$1,074	$744	12.10	USACE
Downstream Roads	CWCCIS-08	$660	$1,074	$744	12.10	USACE
Sediment Damage						
Reservoirs and Ponds	CWCCIS-09	660	1074	747.64	12.17	USACE
Transportation facilities	CWCCIS-08	660	1074	743.66	12.10	USACE
Urban Damage	CCI	$27	$0	$226	8.43	ENR
Drainage Ditches	CWCCIS-09	660	1074	747.64	12.17	USACE
Overwash	CWCCIS-09	660	1074	747.64	12.17	USACE
Downstream Sediment Damage	CWCCIS-09	660	1074	747.64	12.17	USACE

Table M shows the index used for each benefit category evaluated in this analysis. Two benefit categories were not updated from the original analysis. The first category is indirect damage which should be captured under the land index value appreciation. Flood protection afforded caused reductions in indirect damages such as loss of work from flooding, reduced health, etc. These savings are assumed to be reflected in the changing land values. The other category not evaluated was upland erosion damage. It is assumed that the now existing practices installed originally, or changed land use above the structure, would stay in place for the without and with project conditions. Therefore, no changes between the different alternatives were evaluated.

Recreation

Upper Hocking Structure 9 was originally built as a single purpose flood control with no estimate of benefits associated with any recreational activity. The FWRS is located in the Rock Mill Lake State Wildlife Area near Lancaster, Ohio. The Ohio Department of Natural Resources, Division of Wildlife, added improvements at this location such as a boat ramp to encourage public recreation on the site. Division of Wildlife personnel estimated that the area has 1,400 angler, 360 waterfowl hunting, and 140 boater user days annually.

In order to capture the economic benefits of the recreation two methods were considered. One was a benefit transfer method (Loomis and Rosenberger 2001) and the other was the Unit Day Value Method in P&G (pps. 83-87). The benefit transfer method is best when matching site conditions, recreation activities, user population, etc.

The benefit transfer method also has problems when there are close substitute recreation sites. The point estimates of Benefit Transfer may not be transferable when characteristics of the study site and policy site are substantially different. When using a national database of recreational studies (Loomis 2005), it was found that none of the listed studies for Ohio match the study area.

The study area has two other state wildlife areas near this site. The benefits at this site being evaluated are only due to benefits associated with pond type habitat. The only studies found specifically for Ohio in Loomis (2005) were dissimilar to the specified site. The studies mostly dealt with large lakes (Lake Erie) instead of pond systems or the recreation activity being evaluated does not match the items in this evaluation.

Due to the problems with use of the Benefits Transfer method in this analysis the User Day Method was utilized for estimation. The Division of Wildlife was contacted to estimate the user days for the without and with conditions (Table N). Also, the state group completed tables VIII-3-2 and VIII-3-3 for the general and specialized recreation attributes.

Table N – Structure 9 Unit Day Valuation.

Activity	User days	UDV	Annual Value
Fishing	1400	$4.53	$6,346.51
Boating	140	$22.23	$3,111.64
Waterfowl	360	$24.65	$8,872.79

The unit day values (UDV) were updated from 1982 to 2011 using the CPI. The resulting analysis yielded a little over $18,300 of annual recreational activity. This is a single purpose flood control structure and thus will be a dry structure when sediment storage is gone with only temporary flood detention. Under these conditions the recreation calculation was done two ways for comparison.

The first estimate is based on state game and fish department projections that benefits would be the same for fifty years then decrease to zero in the seventy-fifth year. Using this methodology and discounting benefits at the 4.00% discount rate over the period with a one-year installation period results in average annual benefits of $16,361.76.

The second was to reduce the present benefits estimate based on changes in lake size over time. Table O contains the expected lake depth and size for various time periods after implementation. Also, included are the benefit percentages and values expected to occur based on changes is lake size. The benefits stream was stopped in year 75 as suggested by the state game and fish department. The resultant benefits under this scenario is $13,799.80.

Table O – Expected Lake Depth and Size Changes and Effects on Benefits

Years into the Future	Lake Depth (ft)	Lake Size (acres)	Benefit Percent	Benefits Values
0	14	11	100%	$18,330
+25	10.5	8	73%	$13,331
+50	7	7	64%	$11,665
+75	3.5	5	45%	$8,332
+100	0	0	0%	$0

Based on the analysis we have a range of benefits of around $13,800 to $16,360 a year for the lake under the rehabilitation alternative. The figure of $13,800 is value selected for inclusion in Economic Table 6 – Comparison of NED Benefits and Costs.

Cost of the Most Likely Alternative

The Cost of the Most Likely Alternative is listed in section 1.7.2(b)(3) of P&G to use in calculation of benefits for a particular output if non-federal entities are likely to provide a similar output in the absence of alternative plans. For Upper Hocking 9 the future without project or No-Action alternative requires construction expenditures to remove all existing monetary flood damage reduction benefits. Thus, the cost savings of not installing the No-Action alternative costs are being used as a benefit of the rehabilitation alternative. The cost of the most likely alternative is $55,000 on an average annual basis.

Costs

The costs for each alternative are placed on an average annual equivalent basis as required by 1.7.1(h) of P&G. Calculation of net benefits (2.1.3 P&G) requires discounting benefits and cost streams to the beginning of the period of analysis (1.4.12 P&G). The discount rate for the analysis was 4.00% as required for Federal Water Resource implementation studies in November 2011. The

amortization was calculated for the 101 year period of analysis with a one year installation period and a one hundred year operation period. Again the rate of discount for the amortization was the 4.00% rate. The amortization of the present valued dollars converts the dollars to comparable average annual equivalents.

Benefit-Cost Ratio

The benefit-cost ratio is average annual benefits divided by average annual costs. A benefit-cost ratio above unity means that a project has net benefits. Table 6 discloses the benefit-cost ratio of the preferred alternative which is also the national economic development (NED) plan.

Risk and Uncertainty in the Economic Analysis

Risk and uncertainty is inherent in any flood damage reduction analysis. P&G describes risk as a potential outcome that can be described in a reasonably well known probability distribution. Uncertainty is potential outcomes that cannot be described in objectively known probability distributions. Both of these exist in the Upper Hocking 9 economic analysis.

The risk of damage levels relative to specified flood events were estimated and included in the original 1955 analysis. Uncertainty is associated with the changes in land use and price levels relative to the original discount rate. The future demographics and price level changes over the next hundred years add more uncertainty to economic effects of this project. However, the reason for the implementation study was for reducing the level of risk to the population at risk below the structure 9.

Analytical Results

The watershed analysis resulted in a 8.0:1.0 $243,700/$30,500) benefit/cost ratio. One of the driving forces of the high B/C ratio is with the level of investment for rehabilitation versus other alternatives. Structure 9 did not require replacement of the principle spillway and only minor changes to the auxiliary spillway. This was due to the site being initially built to earlier prescribed high hazard standards. Additionally, the site is also being designed for a 100-year operational life. Any additional increase in operational life would require modifications to the principle spillway and additional work on the auxiliary spillway and dam elevations.

Another factor in the higher B/C ratio is the requirements for a state affiliated government agency (conservancy district) to remove the site in an environmentally efficient and safe manner. This requirement places the sponsor decommissioning alternative (without project) near the level of work for the federally sponsored decommissioning alternative. In this instance the rehabilitation cost is half of the “Without Project” alternative.