Environmental Assessment of the Glenville (Linen Mill) Dam Removal

Final

Prepared by the Wisconsin Department of Natural Resources

for the

U.S. Fish and Wildlife Service, Division of Federal Aid, Region 3

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1. Purpose and Need

1.1 Purpose

The purpose of this draft environmental assessment is to determine the actions that may be taken by the U.S. Fish and Wildlife Service and the Wisconsin Department of Natural Resources to determine the future of the Glenville (Linen Mill) Dam.

1.2 The Environmental Assessment Process

This document is the final Environmental Assessment (EA) for a project that involves the removal of the Glenville (Linen Mill) Dam on the Baraboo River, in the Town of Greenfield, in Sauk County. The project is partially funded by the Federal Aid in Wildlife Restoration Program (Wildlife Conservation Restoration Subprogram) that is administered by the U.S. Fish and Wildlife Service and the Department of Natural Resources. Because of the funding source, the project must comply with both the National Environmental Policy Act (NEPA) and the Wisconsin Environmental Policy Act (WEPA) including Chapter NR 150, of the Wisconsin Administrative Code. This EA has been prepared to meet both Federal and State laws that require full public disclosure of projects that may affect the quality of the human environment.

The purpose of an EA is to disclose, explain, and evaluate the environmental effects of a proposed government action to the decision-makers and the public. The EA describes and evaluates alternatives to the proposed course of action. The Draft EA is circulated for public review and comment to assure public participation in the process. A public informational meeting was held during the public review period to provide an opportunity for the public to obtain information about and to comment on the project. The public review period also gave interested and/or affected persons a chance to review and discuss the project, alternatives, and potential impacts. This final EA incorporates recognition of public concerns and addresses those that are within the scope of the EA and purpose for its development.

1.3 Need

Under authority of Chapter 31, of Wisconsin Statutes and NR 333 of Wisconsin Administrative Code, the Glenville (Linen Mill) Dam was inspected by the Department of Natural Resources and it was determined that the dam would need substantial repairs or a complete reconstruction to bring it into compliance with this statute and code. According to the report from their regularly scheduled inspection, the Wisconsin Department of Natural Resources Dam Safety Engineer cited undermining and deterioration of the concrete spillway, as main reasons why the dam is unsafe. Any actions taken to address this situation would have to address the overall structural integrity of the dam, fish passage, concerns over impacts to historic properties, and be economically feasible. Therefore this project is directed toward meeting several needs: safety problems associated with the current dam (abandonment or repair), fish migration on the Baraboo River, and aquatic habitat improvement.

1.4 Decisions That Need to Made

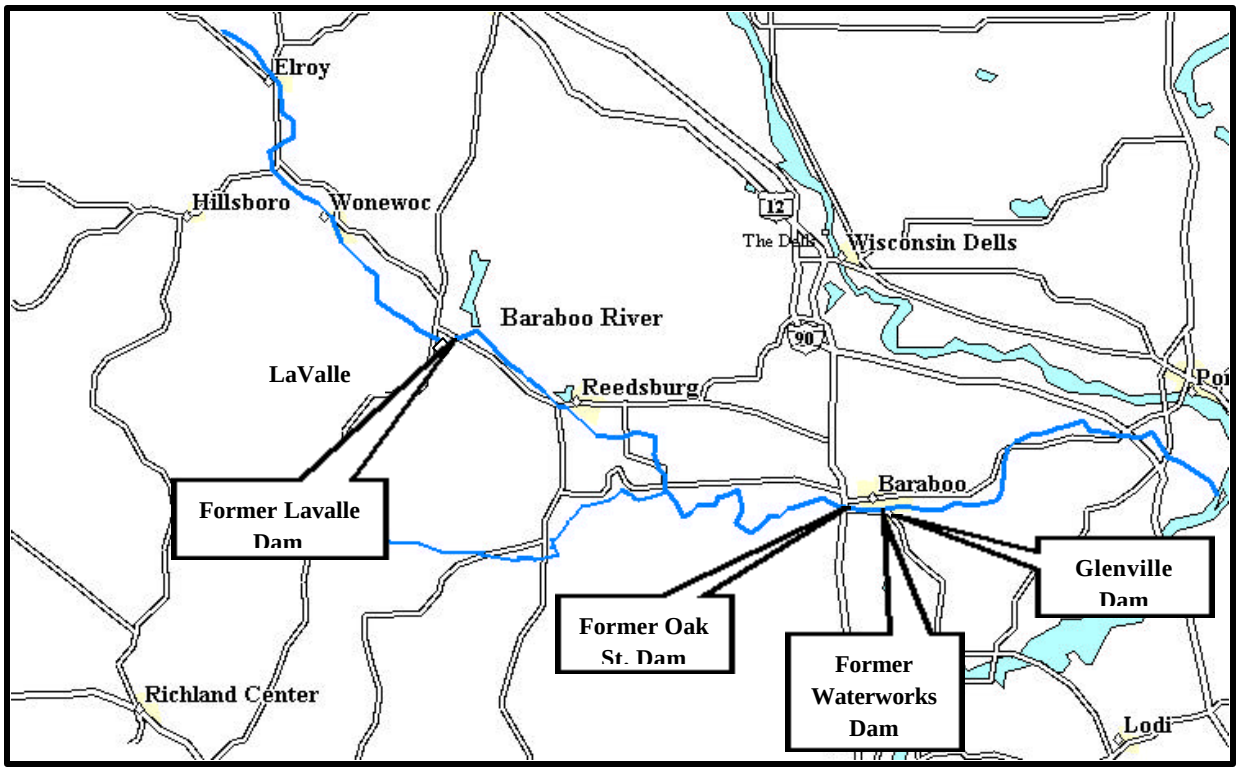
Upon completion of the public review the Regional Director (Region 3, USFWS) will make a decision on the alternative selected and whether or not a finding of no significant impact (FONSI) can be determined.

1.5 Background

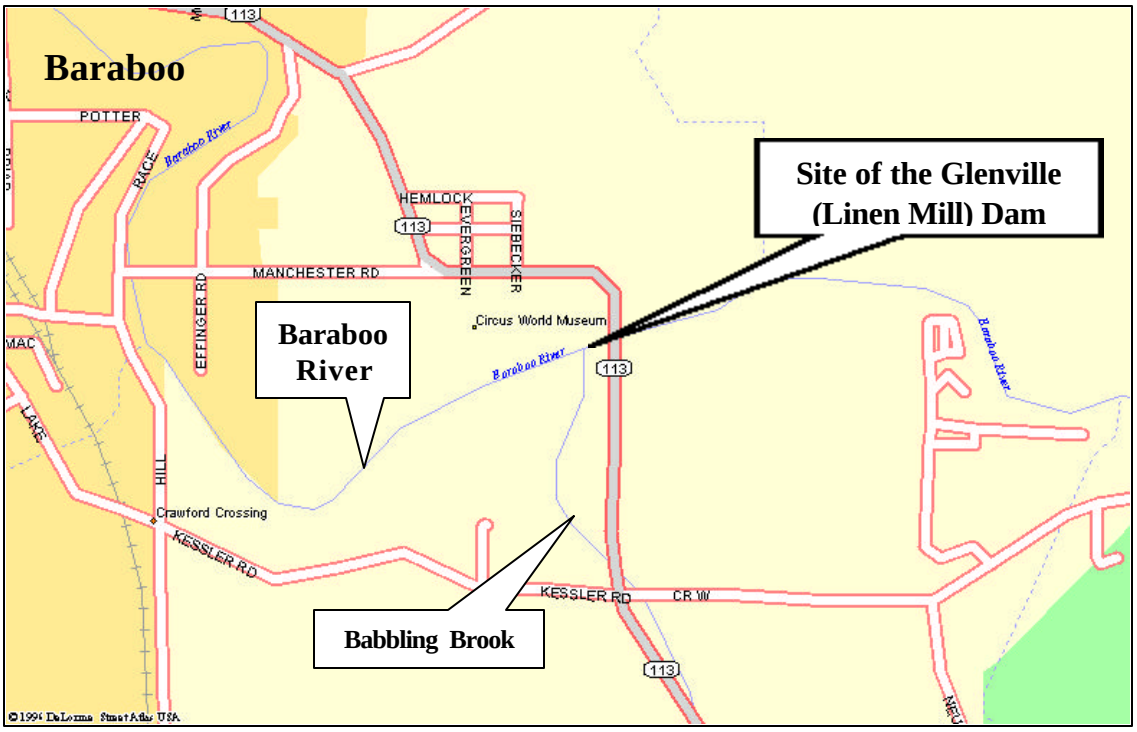
The Baraboo River flows approximately 120 miles from its headwaters near Hillsboro to its confluence with the Wisconsin River south of Portage. Its watershed encompasses 650 square miles, or about 415,000 acres and drops over 150 feet in elevation. This concentration of relatively steep gradient was recognized by early white settlers for its potential to generate mechanical power and in 1837 settlers began constructing dams on the Baraboo River. The dams that were built on the Baraboo River system date to the water power era, which began in the 1840s and 1850s. These dams were authorized under the Milldam Act, which dates to early statehood. This Act encouraged the development of dams for waterpower for logging and milling purposes. Before dams were constructed on the Baraboo River, the river had healthy fish populations with seasonal spawning runs of lake sturgeon, walleye, sauger, bigmouth buffalo, freshwater drum and other species. Riffle habitats, where many of the dams were built, provided critical spawning sites for these fish. The impoundments' slow current and deep pools allowed sediment from the watershed's developing agricultural lands to settle on the river bottom, covering once-productive aquatic habitat for invertebrates and the fish they support. Dams on the Baraboo River system are perhaps the major limiting factor to achieving healthy fish populations for those migratory species including fish populations of the Wisconsin River. Mussel populations have also suffered because of impediment to fish movement. Fish serve as hosts for mussel larvae and are a major influence on their distribution in a river system. There were four major dams on the Baraboo River and three of them have been removed (Waterworks, LaValle and Oak Street—see below). In August 2001, the DNR purchased the dam.

The previous owner of the dam had applied to abandon the dam. The dam is currently in bad repair and would require expensive repairs to bring it into compliance with state and federal dam safety codes and statutes. If the proposed alternative is selected, the dam will be will be removed with federal financial assistance.

Regional Map of the Baraboo River and Project Area



Site of the Glenville (Linen Mill) Dam



1.5.1 Removal of the Waterworks Dam (removed in 1997)

The Waterworks Dam, a municipal dam owned by the City of Baraboo was removed in 1997. The original dam was constructed circa 1860 under the Milldam Act. The dam was located near the city limits in southeast portion of the city and downstream from the Circus World Museum (see regional map). After numerous public meetings and successful negotiations between the City, WDNR, State Historical Society and the Circus World Museum, a decision was finally made to remove the Waterworks dam, on the condition that certain steps to mitigate the loss of the historic appearance the impounded river provided. In December 1997 breaching of the dam began, with final removal occurring in April 1998. By removing the Waterworks Dam, the City of Baraboo has permanently eliminated a major current and future liability, for less than one-third the cost of repairing the structure. The City was paying $5,000 annually in liability insurance for the dam and its associated structures. Positive changes in the habitat were immediately evident and additional monitoring is expected to show increased fishery benefits. Three-quarters of a mile of high-quality riffle habitat, rare in southern Wisconsin rivers, has been restored to its free-flowing condition following removal of the Waterworks Dam.

1.5.2 Removal of the Oak Street Dam (removed in 2000)

A Corps of Engineers inspection report (1980) states that the former Oak Street dam was originally constructed in 1885 of timber and rock and was used to generate power for a flour mill and for a towel mill factory beginning in 1910. The McArthur family owned the former dam since 1898 and also owns the Glenville (Linen Mill) Dam on the Baraboo River located approximately 1.5 miles downstream of the Oak Street Dam (see regional map). The dam had an impoundment of 64 - 195 acre-feet, surface area of 16 - 38 acres and a length of 0.8 miles. A steep river gradient is present at the dam site, and water will move through the area at a velocity higher than most areas along the river. During initial monitoring of this site before the dam was removed, coal tar deposits were discovered in the bed of the river. Alliant Energy removed the deposits at a cost of over $600,000. In addition to the removal of the dam and the work done on the powerhouse, bank stabilization and habitat enhancement was also accomplished. This should add to the benefits to the aquatic environment that are achieved by the removal of the dam.

1.5.3 The LaValle Dam (removed in 2001)

The Sand County Foundation purchased the dam and mill, located in the Village of LaValle, from the former owner in 1999, for the purpose of removing the dam and restoring the river to a natural state (see regional map). The LaValle Dam was removed in March of 2001. During the previous year, staff from the Department, the Sand County Foundation, Sauk County, and the US Fish and Wildlife Service had met with residents of LaValle to reach consensus on a plan for mitigation of the loss of the millpond after the dam removal. Restoration of the lakebed will follow this plan and should be complete by July 2002.

1.5.4 The Glenville (Linen Mill) Dam

The Glenville (Linen Mill) Dam is located at the downstream side and just east of the City of Baraboo, 45 miles northeast of Madison in Section 6, T11N, R7E. The dam was originally constructed in 1898 and has been modified, rebuilt, and rehabilitated several times since it was originally constructed. The length of the maximum pool upstream of the dam is approximately 1.5 miles and the size of the pool is 7 acres. The dam consists of a small powerhouse, a large uncontrolled spillway and a small auxiliary spillway. The original use of the dam was to provide power for a linen

mill. It presently is used to produce a small amount of electrical power. The structural portions of the facility consist of timber, concrete, masonry, rock and gravel fill, and earth. After inspection by the Department, the dam was found to have problems with its structural integrity and is not in compliance with Chapter 31, of Wisconsin Statutes and NR 333 of Wisconsin Administrative Code. As with the other dams, the Glenville (Linen Mill) Dam needs substantial repairs or a complete reconstruction to bring it into compliance with this statute and code. This dam is the last remaining blockage to fish migration, being the lowermost dam. If this blockage to fish migration, is removed, then fish can access the entire Baraboo River. The Wisconsin Department of Natural Resource purchased the dam in August 2001.

The Glenville (Linen Mill) Dam

2. Alternatives, Including the Proposed Action

2.1 Alternative Not Considered for Detailed Analysis

Besides the alternatives listed below, another alternative was considered for detailed analysis. The option of letting the structure remain in place and simply modifying the spillway to enable the river to flow freely through the structure was considered. This was rejected because the decaying dam structure would still be in place and would still need major repairs to bring the structure into compliance with statutes and codes and would still represent a significant financial burden for the owner. Leaving the spillway in place and allowing the water to flow through would represent a serious safety problem.

2.2 Alternatives Carried Forward for Detailed Analysis

2.2.1 Alternative A (Proposed Action) – Remove Dam and Restore the River Channel

The proposed action includes removing the Glenville (Linen Mill) Dam and restoring and enhancing habitat in the newly formed river channel. In addition, the previous owner of the dam did not wish to make costly repairs that would bring this dam into compliance with statutes and codes that regulate the safety aspects of this dam. Therefore, from an ecological and financial perspective, removal of the dam and restoration of the river channel is the desired alternative.

The Glenville (Linen Mill) Dam was constructed in 1898 under the Mill Dam Act of timber, rock, and gravel. In 1912, a new concrete flume and retaining wall was constructed. In 1928, additional repairs were made and a new powerhouse was installed. It still produces a relatively small amount of electrical power (100 KW capacity generator). The current structure consists of a 86 long fixed crest spillway with buttress supports and a small concrete chute auxiliary spillway.

If this alternative is chosen, the actions below will occur:

The dam spillway will be breached in a manner so that sediment moving downstream from the impounded area is minimized. The sediments in the impounded area have been sampled for laboratory analysis. If contamination is present, the affected area will be isolated and the material will be removed in compliance with the environmental remediation standards of NR 700, of Wisconsin Administrative Code.

Trees and brush will be cleared and a temporary gravel road constructed to access the right side (right and left is referred looking downstream) of the dam. The dam fixed crest spillway will be first breached at the right side next to the auxiliary spillway. The initial breach will be accomplished in a manner so that sediment moving downstream from the impounded area is minimized.

After the water level of the impoundment is lowered, the demolition of the fixed crest spillway will be approached from the left side next to the powerhouse. The rock fill of the timber structure on the upstream side of the support concrete wall will be rearranged to form a pad for the backhoe to easily traverse across the river along the upstream side of the spillway. A concrete wall will be constructed at the downstream side of the powerhouse to block the opening of the turbine pit exit. Part of the rock fill materials will then be placed against the foundation walls and pillars of the powerhouse to buttress the foundation against erosion and undermining.

From there, demolition will proceed to the right, forming the final river channel configuration as materials are removed and/or used in channel stabilization. The clean, sandy deposits located immediately upstream of the spillway will be evaluated for removal and if removed, they will be incorporated into the bank structure and other aspects of the site restoration. A small tributary stream referred to as “Babbling Brook” enters the river immediately upstream of the spillway. The entry point (Babbling Brook) will be evaluated and the tributary may be aligned slightly to allow high flows to merge with the river without bank erosion, scour, and/or adverse impacts to habitat. Excess material will be trucked off site for disposal at an approved landfill (approved under NR 500, of Wisconsin Administrative Code).

The area in front of the powerhouse (upstream) and the downstream side of the powerhouse will be filled in with suitable soil materials (meets engineering standards and specifications). Riprap will be placed along the

newly formed and disturbed riverbanks for stabilization. The temporary access road will be removed and all disturbed areas topsoiled and seeded for erosion control and a natural appearance.

The spillway removal will require modifications to the outfall structure for the City of Baraboo Wastewater Treatment Plant. The existing outfall elevation is set for the current water level in the millpond. When the water level decreases as a result of the elimination of the impounded area below the dam (if the dam is removed), earthwork, including grading and riprap placement, will be required to assure that the discharge from the plant will flow into the river efficiently without erosion or scour. The City of Baraboo will be coordinating the work with the Department of Natural Resources. Information about the outfall area has been submitted to relevant tribal organizations for review of cultural and sacred sites. If ground disturbance is needed then a review for impact on historic properties by the SHPO will be conducted in compliance with federal regulations. This outfall site has also been screened for impact to endangered and threatened species. Documentation will be provided to the Fish and Wildlife Service as needed.

Given the nature of the site, it is highly unlikely explosives will be used to remove concrete below the bed of the river. If they are used, they will be used by licensed operators in cooperation with the Town of Greenfield to ensure that the timing of their use is compatible with residents and businesses. These activities will be conducted in accordance with DNR manual code (9187.6) and Wisconsin Administrative Code (NR 231). The powerhouse and mill building will remain intact.

Borrow sites will be screened for endangered and threatened species and historic properties. Prior to any site disturbance, compliance documents will be obtained by the Wisconsin Department of Natural Resources and provided to the Fish and Wildlife Service as needed.

This work will be conducted in cooperation with the Wisconsin State Department of Transportation. They have requested that appropriate spoil material (riprap) be used to protect the State Highway 113 bridge, located immediately downstream of the dam structure (within the project area). This work or any work that pertains to State Highway 113, would have their approval before proceeding.

2.2.1.1 Significance of Risk/Unknowns (This section required by WEPA)

There are no significant unknowns associated with this project. The results of dam removals are highly predictable. Pre-dam hydrology and stream morphology is restored. Hundreds of dams have been removed in the State of Wisconsin within the regulatory guidelines in Chapter 31 of the Wisconsin Statutes

2.2.1.2 Significance of Precedent (This section required by WEPA)

This action is not precedent setting. The benefits to habitat and water quality from dam removal are well documented in the scientific literature. Removal of this dam will demonstrate there are alternatives to repair and maintenance of aging dam structures. Removal of this dam will improve aquatic habitat and protect public rights in navigable waters.

2.2.1.3 Land Ownership Issues

A land use agreement with the Wisconsin Department of Transportation may be needed to do work within the highway right of way, where it crosses the river.

2.2.1.4 Authorities and Approvals (list local, state and federal permits or approvals required)

Army Corps of Engineers GP/LOP - General Permit/Letter of Permission required for dam removal and stream stabilization

Wisconsin Department of Natural Resources – Permit issuance under Section 31.185, of Wisconsin Statutes to transfer ownership of the dam to DNR contingent on removal. Manual Code Approval plans and specifications for removal and site restoration under Section 31.12, of Wisconsin Statutes, Public Information Meeting-(Opportunity for Hearing) under Section 31.253, Wisconsin Statutes, WEPA Compliance (Wisconsin Environmental Policy Act – NR 150, Wisconsin Administrative Code)

Town of Greenfield and Sauk County - Revise and amend the shoreland wetland and flood plain zoning maps and ordinances as necessary. The Department will conduct the analysis pertaining to these changes. Sauk County and the Town of Greenfield will incorporate these changes into their flood plain ordinance through the amendment process. No measurable changes in the flood profile are expected to occur.

Wisconsin Department of Transportation – Approval required to work on state owned right of way, easement and property

United States Fish and Wildlife Service (Federal Aid in Wildlife Restoration Act) – Selection of alternatives and FONSI determination

National Environmental Policy Act

Compliance with the Endangered Species Act

Compliance with Section 106 of the National Historic Preservation Act

2.2.2 Alternative B – (No Action)

The "no action" alternative includes keeping the dam and millpond in place as is. An inspection of the Glenville (Linen Mill) Dam noted several structural deficiencies and severe deterioration of the structural integrity of the dam. For this reason, a schedule for completing rehabilitation of the dam to meet Wisconsin State Dam Safety standards was not imposed on the dam owner. The cost to rehabilitate or rebuild the dam was estimated to be at a minimum $200,000. This is based on other dam construction projects and included engineering and contingencies. These projects include the dam removal and reconstruction projects in the Wisconsin villages and cities of Evansville, Baraboo (Waterworks and Oak Street), Cazenovia, and Afton. These dams are similar in the size and type of construction (i.e. structural height of 6-10 feet and impounded area) to the Glenville (Linen Mill) Dam. Moreover, these dams were built during the period when many mill dams were constructed (1840-1900) in Wisconsin and all have similar structural problems associated with aging. Repairs to correct the problems with these aging structures are usually not cost effective; communities have found it to be more economical to remove the dam or completely rebuild it.

Approval of plans according to Section 31.12, of Wisconsin Statutes for the removal and abandonment of the dam is pending. State approval of the application from the present owner of the dam cannot be denied if all of the conditions imposed as part of the plan approval are met. These primary conditions include insuring that the plan for abandonment includes constructing a stabilized river channel, following erosion control measures, and properly disposing of demolition material. If the dam is not abandoned and removed, it must be rehabilitated. In addition, it will be necessary to reconstruct the north end of the spillway to structurally separate the forebay of the powerhouse and the powerhouse/mill building, which is now under separate ownership, from the dam. This will be necessary to maintain the non-dam status of these structures.

Pursuing the "no action" alternative would result with an expense that would not be eligible for federal assistance, retain the blockage to fish migration and result with no benefit to the aquatic resources of the Baraboo River. The negative environmental impact of the dam will remain in perpetuity, because the dam will need to be rehabilitated to meet state dam safety standards. The impounded area which has poor water quality and large amounts of silt (average depth of 3 feet), would continue to have poor water quality into the future, would provide a limited fishery for sport fish and serve as a carp "nursery" for the rest of the river

2.2.3 Alternative C – Repair the Dam and Install Fish Passage

This alternative will require retaining the dam as described in the "no action" alternative. In order to negate some of the negative impacts of maintaining the dam, a fish passage could be constructed to allow movement of fish through the dam structure under normal to low flood conditions .

Under flood conditions, the dam becomes inundated and some degree of fish movement occurs. However, this inundation of the dam is highly unpredictable and may not coincide with annual fish spawning migrations. Thus, the dam still is a major impediment to fish migration.

Construction of a fish passage would be a major structural undertaking and would require almost complete reconstruction of the dam. The physical site conditions for constructing a fish passage are very restrictive. A state highway and bridge is located approximately 100 feet downstream of the dam. The property adjacent to the north side of the dam is under private ownership with commercial buildings. Immediately downstream of the dam is a large deep "fishing hole" and is heavily used by local anglers. Due to the physical size and configuration of a warm water fish passage, it would have a major impact on the highway bridge and the downstream "fishing hole". Because of the location of the highway and associated bridge immediately downstream there are major physical constraints to the installation of fish passage that would add great costs to its construction. The actual fish passage channel may have to be incorporated into the highway embankment and/or the bridge structure itself would have to be modified.

Based on cost estimates for construction of fish passage structures for other dams (such as the dam at Brodhead, Wisconsin on the Sugar River which ranged from $250,000 to $500,000) and rivers of similar size, the cost of a fish passage at this site would be approximately $250,000. This would be in addition to costs associated with dam reconstruction, which would be more costly than rehabilitation as described in the "no action" alternative.

Table 1: Comparison of Alternatives

	Alternative Number		
Characteristic	1. Proposed Alternative - Remove Dam and Restore/Enhance Channel	2. No Action – Repair the Dam Only	3. Repair the Dam and Install Fish Passage
Dam	Removal	Repair	Repair
Provide for Fish Passage	Yes	No	Partial
River Channel	Enhance habitat with riprap	Would not be restored	Would not be restored
Funds Available?	Yes	Unknown	Unknown
Alteration of Highway Required?	No	No	Maybe
Acceptable to Owner	Yes	No	No
Costs	$180,000	$200,000	$450,000

3. Affected Environment

3.1 Physical Environment

With a gradient of 1.59 feet per mile (see Appendix), the Baraboo River drops over 150 feet in elevation from its source to its mouth. Prior to building dams on the Baraboo River, rocky riverbed with riffle-pool-run habitat, and fast-moving reaches were more common. Riparian corridor along the Baraboo River is the dominant natural feature within the project area. Islands are located in the river channel above the dam. The river banks are approximately four feet high (impounded conditions) along much of the river channel within the project boundary. The river channel in the project area (see map) is approximately 3-5 feet deep and has a substrate of sand and rubble. The bottom substrate of the riverbed consists of fine silty material that overlays medium to coarse-grained sands with areas of gravel, cobble, and possibly boulders in some areas.

The impounded area above the dam is approximately 7 acres in size and the average depth is 1-4 feet. It is surrounded by a variety of wetland vegetation. Soundings indicate that the bed in the millpond is made up of sand, and characteristic sediment of the Baraboo River floodplain in the area.

Soils in the floodplain riparian corridor are level, poorly drained fluvaquents. Most of the areas are long and narrow with a wide range of soil characteristics. Surface layers range from a silt loam to sand and organic. Hydric units including Adrian, Houghton, Marshan, and Palms are found within this mapping series. Permeability of the fluvaquent unit is moderate to high, but frequent flooding and a higher water table keep the soils wet.

The dam spillway core is a rock filled timber crib structure with timber gates originally built in 1898. The length of the maximum pool upstream of the dam is approximately 1.5 miles and the size of the pool is 7 acres. Eventually the timber control gates were replaced with concrete and the timber crib spillway was capped over the concrete. The fixed crest spillway is 86 feet long.

3.2 Biological Environment

3.2.1 Habitat/Vegetation

The Baraboo River originates near Hillsboro in Vernon County, Wisconsin, and flows southeasterly through central Wisconsin before joining the Wisconsin River just downstream (south) in Columbia County, Wisconsin (see Figures B in the Appendix). The headwaters of the Baraboo River begin in the "Driftless Area" and join the Wisconsin River in the "Central Plain" region near Portage. Glacial drift consisting of sand and gravel is abundant in the area, with alluvial sand and gravel filling the Baraboo Valley. Land use along the river system is dominated by agriculture. Agricultural fields extend throughout the watershed and end at the river corridor, where a narrow forested line abuts the riverbank. Beginning at Reedsburg, Wisconsin, and extending upstream along the Baraboo River and most tributaries is a narrow shrub and timber swamp wetland corridor. The Baraboo River Corridor has many types of relict plant and forest communities listed along tributaries, such as the Floodplain Forest and Wet-Mesic Prairie, in addition to Pine and Hemlock Relicts.

3.2.2 Threatened, Endangered and Candidate Species

There are no federally threatened, endangered or candidate species present in the project area. The Natural Heritage Inventory (NHI) lists four state listed fish species and as present in the Wisconsin River downstream from the dam site and one state species that was recorded as being present in the Baraboo River several miles downstream. There is a historical record for the winged mapleleaf, *Quadrula fragosa*, a mussel listed as endangered both in Wisconsin and at the federal level. It is extremely unlikely this species still exists in the Baraboo or Wisconsin Rivers.

These fish species are as follows:

- ***Cycleptus elongatus*** (blue sucker) ***State***
- ***Etheostoma clarum*** (western sand darter) ***State***
- ***Macrhybopsis storeriana*** (silver chub) ***State***
- ***Macrhybopis aestivalis*** (speckled chub) ***State***
- ***Ictiobus niger*** (black buffalo) ***State***

It is highly unlikely these fish species are present at the dam site but it is possible that they will migrate (at specific times of the year) into project area following dam removal and as habitat conditions change. The NHI also lists numerous plant species in the Baraboo Hills at Devils Lake State Park and in the general vicinity of the project site.

Borrow sites outside of the project area will be reviewed for threatened and endangered species as these sites are identified.

3.2.3 Other Wildlife Species

The dominant sport fishery of the Baraboo River in the vicinity of the Glenville (Linen Mill) Dam includes northern pike, smallmouth bass, and channel catfish. Panfish are common, and rough and forage fish are abundant. Upstream areas in the Baraboo River are not fully populated by all of the species present in the system. A survey by Wisconsin Department of Natural Resources fisheries staff found that 10 species were present below the lower dam in Baraboo that were not found above. Fish populations below the dams were more typical of healthy riverine communities (darters, redhorse, etc.) while the impounded sections contained high populations of carp. The dams prevent the Baraboo River from serving as a nursery area for the Wisconsin River fishery.

Common wildlife (mammal) species in the vicinity of the Glenville (Linen Mill) Dam include muskrat, mink, raccoon, muskrat, gray and fox squirrel, chipmunk, coyote, and occasionally river otter. Common bird species include Robin, Catbird, House Wren, Kingfisher, Great Blue Heron, Red-winged Blackbird, flycatchers, Wood Ducks and marsh wrens. The dominant vegetation communities/habitat types present in the project area are floodplain forest, shallow marsh, and fresh wet meadow. Dominant Species types among the vegetation communities are as follows:

> Floodplain: Tree species include Green Ash (*Fraxinus pennsylvanica*), Black Ash (*Fraxinus negundo*), American elm (*Ulmus americana L.*), Willow spp. (*Salix spp*.), Cottonwood (*Populus deltoides*), Oak spp. (*Quercus spp*.), Box elder (*Acer negundo*). Shrub types include Willow spp. (*Salix spp*.), young Green ash (*Fraxinus pennsylvanica*), buckthorn, wild grape, dogwood, and sumac. Herbaceous layer inlcude Reed Canarygrass (*Phalaris arundinacea*), grass spp. (*Poa spp*.), Cattail, Carex lacustris, Carex spp., goldenrods (*Solidago spp*.).

3.3 Land Use

The Glenville (Linen Mill) Dam is in the Town of Greenfield and located near the City of Baraboo. The surrounding area is mixed woodland and agricultural (including hobby farms). There are several businesses located in the old mill building.

3.4 Cultural/Paleontological Resources

The State Historic Protection Officer (SHPO) has determined that the Glenville (Linen Mill) Dam and its associated complex does not have historic significance hence there would be no impact to any historical properties within the project area (see appendix). All actions described within this document are within this project boundary. Borrow sites outside of the project area will be reviewed by SHPO if these sites are needed.

3.5 Local Social/Economic Conditions

The 1990 population of Sauk County was 46,975. Baraboo is the largest city in the County with a population of 9,203 (1990). Baraboo and Reedsburg are service centers for the surrounding area. Waterfowl hunting and canoeing are listed as important recreational functions. There are no prime agricultural lands in the immediate vicinity of the dam.

4. Environmental Consequences

4.1 Alternative A (Proposed Action) – Remove the Dam and Restore the River Channel

4.1.1 Fishery Impacts – Cumulative

The removal of the Glenville (Linen Mill) Dam will take away a barrier to fish migration that prevents several species of fish from reaching spawning areas in the upper reaches of the Baraboo River. This system wide impact of removing the three upstream dams will not be fully realized until the Glenville (Linen Mill) Dam (the last dam on the entire river) is removed. With no obstructions to movement, native fish populations will reestablish the traditional migratory patterns and regain access to critical habitats. Several fish species such as lake sturgeon, smallmouth bass, walleye, sauger, black buffalo (state threatened) and channel catfish will be able to access the upper reaches of the river and exploit historic spawning habitat.

The upstream distribution of a number of fish species on the Baraboo River terminates at or near the Glenville (Linen Mill) Dam. These species included musky, three redhorse species (silver, golden and shorthead), channel catfish, stonecat, three species rare in the Baraboo (warmouth, blackside darter and slenderhead darter) and walleye. Additionally, 1-4 specimens of three species usually limited to the river below the Glenville (Linen Mill) Dam (gizzard shad, spotted sucker and freshwater drum) were collected in small number below the Glenville (Linen Mill) Dam following heavy flooding in June 2000. With the removal of the dam, the main stem of the Baraboo River will be free flowing for it's entire length. As to direct and tangible benefits to humans, we will likely see improved fishing, especially for smallmouth bass, sauger, walleye, northern pike, white and yellow bass, and channel and flathead catfish. Fish populations that have been fragmented since the construction of the Glenville (Linen Mill) and other dams will be reconnected. Genetic health of species that had fragmented populations because of the dams blocking fish movement will be improved.

4.1.2 Site Specific Fishery and Habitat Impacts

At the dam site proper, the fish habitat will be improved immediately with the placement of rock riprap and restoration of the pre-dam, stream profile. The channel in the vicinity of the former dam will scour and the substrate will tend to become more rocky and thus the habitat will improve. Fish species such as smallmouth bass and walleye will regain access to spawning, feeding and nursery areas that have been unavailable to them since the construction of this dam. Rock-riffle substrates that are covered by silt, as a result of the impoundment, will recover and provide quality habitats to native riverine fishes such as smallmouth bass. Increase in the amount of rock-riffle habitat would benefit macroinvetebrate species diversity and increase mayfly and caddisfly populations. Non-native species, such as carp, and native species that are indicative of poor water quality and degraded habitats, such as black bullhead and green sunfish, will become less common as conditions improve for desirable riverine species.
Some areas affected by the dam impoundment will change. The river channel will be narrower upstream. The floodplain downstream of the dam will not be affected. Additional benefits to the fish population should occur through time and a comprehensive study is underway on the effects of the Baraboo River dam removals to document the changes to fishery and aquatic ecosystem. Preliminary findings indicate a positive response in the fish and aquatic insect populations.

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Temporary stockpiling of sand for later removal and transport out of the area from the bottom of the impoundment will occur on the south bank and immediately upstream of the current dam structure and will cover an area less than one acre in size. No other appreciable impacts to the adjacent banks are expected to occur.

4.1.3 Impact on Mussel Populations

The dam removal will improve conditions for mussel fauna of the Baraboo by exposing them to fish hosts and they will have access to additional stream habitats. Mussel species diversity and population levels should increase. The opportunity for glochidia (larval mussels) to be transported upstream through various species of fish hosts will be greatly enhanced by the dam removal.

4.1.4. Impact on Water Quality

Because the existing impounded area upstream from the dam will be eliminated, it will no longer serve as a carp nursery for the system. The impounded area upstream from the dam which is very eutrophic will be replaced by a higher quality flowing river reach. In addition, the impounded area upstream from the dam will no longer contribute water with low dissolved oxygen to the river system.

4.1.5 Safety

Removal of the dam would solve the current problem of the present unsafe condition of the dam.

4.1.6 Impact on Flooding Downstream

If the Glenville (Linen Mill) Dam is removed, the flooding of areas downstream will not increase to any noticeable degree. The Glenville (Linen Mill) Dam, is a "run of the river" dam and has no significant impact on the volume of water flowing in the river as a whole and does not function as flood control or flood storage structure. The dam becomes submerged at the less than the 10-year storm and the hydraulic analysis included in the appendix indicates that the dam during more frequent and smaller flood events has no measurable effect on flows. During larger events like the 25-year storm the flow reduction, from the dam, is as small as 0.5%, with no storage capacity. As a result, removal of the dam will not have any noticeable effect on the upstream or downstream flow and stage during major floods

Data and an analysis to support this assessment is covered in the attached appendix.

4.1.7 Cultural Resources

There are no historical properties in the project area. Borrow sites outside of the project area will be reviewed by SHPO once these sites are identified.

4.1.8 Endangered/Threatened Species

The state threatened fish species, *Ictiobus niger*, (black buffalo), which was recorded as being present several miles downstream from the project site, could possibly benefit from the proposed dam removal since it could then ascend the river upstream above the present dam site to spawn.

Borrow sites outside of the project area will be reviewed for endangered and threatened species once these sites are identified.

4.2 Alternative B - No Action - Repair the Dam Only

4.2.1 Fishery Impacts – Cumulative

This alternative would mean that the dam is repaired. The greatest environmental impact of this alternative is that the dam would continue to serve as a barrier to fish movement and fragment the river ecosystem. Several species of fish, such as walleye, sauger, lake sturgeon, fresh water drum and smallmouth bass are limited in their seasonal spawning movements because they cannot access the river above the Glenville (Linen Mill) Dam. Leaving the dam in place would continue to have a negative impact on the fishery of the Baraboo River.

4.2.2 Site Specific Fishery and Habitat Impacts

Leaving the dam in place with repairs being made to bring it into compliance with safety standards would not allow for any habitat improvement work to be done. The riffle habitat that would be permanently exposed if the dam is removed would instead remain covered over with deposited sediment in the impounded area. Fish species requiring riffle habitat for spawning and cover would continue to be negatively impacted. Macroinvertebrate populations would continue to have low diversity and favor species that require sediment dominated substrate. The tailwater area would remain below the dam where fish concentrate at the limit of their upstream migration and thereby attracts anglers.

4.2.3 Mussel Populations

Mussel species and population would remain the same. Because the fish cannot move upstream above the dam, the mussel population of the upper river would not improve because fish host species cannot freely access the upper river and serve as vectors for population establishment.

4.2.4 Impact on Water Quality

As it currently exists, the impounded area upstream from the dam has a negative impact on water quality. The impounded area upstream from the dam impoundment would continue to have poor water quality because of its fertility (eutrophication) and because of the higher population of carp. Since the impoundment is very fertile, it could suffer from algae blooms which in turn suppress oxygen levels. Carp keep the sediments stirred up and this further distributes nutrients in the water column and has a negative impact on the river as whole. The impoundment serves as a prime breeding area for carp, which will move into the Baraboo River proper.

4.2.5 Safety

According to state safety standards the dam is currently unsafe. Under this alternative, the dam would remain in place and repairs would be made by the current owner to bring the dam into compliance with current safety standards.

4.2.6 Impact on Flooding Downstream

The Glenville (Linen Mill) Dam, is a "run of the river" dam and has no significant impact on the volume of water flowing in the river as a whole and does not function as flood control or flood storage structure. Runoff from a rainfall event is not retained by this dam---the impounded area behind this dam is maintained at a constant level. Data and an analysis to support this assessment is covered in the attached appendix.

4.2.7 Cultural Resources

There are no historical properties in the project area.

4.2.8 Endangered/Threatened Species

If the dam were repaired, it would continue to be a barrier to the migration of the Black Buffalo, *Ictiobus niger*, a fish listed as state threatened species list.

4.2 Alternative C – Repair the Dam and Install Fish Passage

4.3.1 Fishery Impacts – Cumulative

Under this alternative, fish passage would be installed at the dam (which would also have to receive major repairs as are described above). It cannot be predicted if fish passage would enable the full range of fish species that currently cannot ascend the river and are blocked by the current dam structure to reach spawning areas above the dam. It could be termed as a partial restoration of the river ecosystem.

4.3.2 Site Specific Fishery and Habitat Impacts

Habitat improvement work at the dam site could not be done with the dam structure repaired to meet safety standards. A fish passage structure would facilitate fish movement, but this improvement would only address one of a number of adverse impacts that the structure has on the aquatic environment. The riffle habitat (currently submerged) would not be permanently exposed if the dam remains and, diverse habitats present in free flowing rivers would not be restored at the dam site. Coarse substrate would instead remain covered with sediment deposits in the impounded area. Fish species requiring riffle habitat for spawning and cover would continue to be negatively impacted. Macroinvertebrate populations would continue to have low diversity and favor species that require sediment dominated susbtrate.

Installation of fish passage at the dam would involve a very minor disturbance of terrestrial habitat. This disturbance would be in the immediate vicinity of the dam site.

4.3.3 Mussel Populations

Mussel populations would be partially benefited by the installation of fish passage. It is expected that mussel populations would be benefited to the extent that fishes could utilize the fish passage that would be installed. As fish species make their upstream migrations, larval mussels are carried to upstream areas to new habitats.

4.3.4 Impact on Water Quality

With the installation of fish passage, including repair of the dam, the impounded area upstream from the dam would remain in place. As it currently exists, the impounded area upstream from the dam has a negative impact on water quality. The impoundment would continue to have poor water quality because of its fertility (eutrophication) and because of the high population of carp. Since the impoundment is very fertile, it may suffer from algae blooms which in turn suppress oxygen levels. Carp keep the sediments stirred up and this further distributes nutrients in the water column and has a negative impact on the river as a whole. The impoundment serves as a prime breeding area for carp, which inhabit other parts of the Baraboo River.

4.3.5 Safety

According to state safety standards the dam is currently unsafe. Under this alternative, the dam would remain in place and repairs would be made by the current owner to bring the dam into compliance with current safety standards.

4.3.6 Impact on Flooding Downstream

The Glenville (Linen Mill) Dam, is a "run of the river" dam and has no significant impact on the volume of water flowing in the river as a whole and does not function as flood control or flood storage structure. The dam does not store water to control flooding ---the impounded area behind this dam is maintained at a constant level. Data and an analysis to support this assessment are covered in the attached appendix.

4.3.7 Cultural Resources

There are no historical properties in the project area. Borrow sites outside of the project area will be reviewed by SHPO once these sites are identified.

4.3.8 Endangered/Threatened Species

The state threatened fish species, Black Buffalo (*Ictiobus niger),* which was recorded as being present several miles downstream from the project site, could possibly benefit from the installation of fish passage since it could then ascend the river upstream to spawn. However, riffle habitat, which is valuable for spawning and cover would continue to be negatively impacted since the dam structure would still be in place.

Borrow sites outside of the project area will be reviewed for endangered and threatened species once these sites are identified.

Table 2: Comparison of Environmental Consequences of the Alternatives

Alternative	A. Proposed Alternative Remove Dam and Restore Channel	B. No Action – Repair the Dam	C. Repair the Dam and Install Fish Passage
Fishery Impacts - Cumulative	Will restore spawning runs of several species, defragment aquatic ecosystem	Baraboo River will remain fragmented; fish cannot reach upper river for spawning	Will partially restore spawning potential for migratory fish in the headwaters
Site Specific Fishery and Habitat Impacts	Will improve riffle habitat for Smallmouth Bass and several other fish species	No improvement of fish habitat at dam site and immediately above the dam	No improvement in aquatic habitat at the site
Impacts on Mussel Populations	Will provide mussel species access to host fish species, should improve diversity and numbers of mussels	Mussel species diversity and numbers will continue to limited by the lack of host species	Mussel species diversity and numbers could see some improvement –depends on the fish species that eventually reach the upper river
Impacts on Water Quality	Should improve because carp are removed from impounded area upstream from the dam; the eutrophic impounded area upstream from the dam will be replaced by a flowing river segment	The poor water quality in the impounded area upstream from the dam will continue; this will continue to negatively impact the water quality of the river	The poor water quality in the impounded area upstream from the dam will continue; this will continue to negatively impact the water quality of the river
Safety	No longer an issue	Dam would remain and repairs made to meet safety requirements	Dam would remain and repairs made to meet safety requirements
Impact on Flooding Downstream	No impact	No impact	No impact
Cultural	No impacts	No impacts	No impacts
Endangered/ Threatened Species	Positive impact to the Black Buffalo, *Ictiobus niger*, a fish listed as state-threatened, because it could then migrate upstream to spawn.	Dam would continue to be a barrier to the migration of the Black Buffalo, *Ictiobus niger*. a fish listed as state-threatened	The state threatened fish species, Black Buffalo, *Ictiobus niger*, could possibly benefit from the installation of fish passage since it could then ascend the river upstream to spawn. However, riffle habitat, which is valuable for spawning and cover would continue to be negatively impacted since the dam structure would still be in place.

4.4 Environmental Justice

None of the alternatives will have a negative impact on the human environment. None of the alternatives will have a negative impact on a minority population or ethnic group. None of the alternatives will negatively impact the economically disadvantaged.

5. List of Preparers

Name	Affiliation	Contributions
Andy Morton	Wisconsin DNR	Overall Document Preparation
Konstantine Margosky	Wisconsin DNR	Dam and Water Resources Engineer
Ron Grasshoff	Wisconsin DNR	Permit Issues/Compliance
Jeff Schure	Wisconsin DNR	Permit Issues/Compliance
Tom Pellett	Wisconsn DNR	Aquatic Ecosystems/Fisheries Research
Dave Marshall	Wisconsin DNR	Aquatic Ecosystems

6. Consultation and Coordination With the Public and Others

List of agencies, groups and individuals contacted regarding the project

The removal of the Glenville (Linen Mill) Dam is part of a much larger effort that is focused on the restoration of the Baraboo River System as a whole. Listed below is a summary of the meetings and contacts with the public concerning this project.

Date	**Meeing/Event/Action**
8/91	FERC notifies owner that the dam needs to be relicensed
12/94	Fishery survey of the Baraboo River conducted by WDNR
6/97-12/98	Negotiations with previous owner to buy rights to remove the dam
12/99-present	At least 15 Tours of dam removals for state and federal agency personnel, interest groups, and concerned citizens have been given
1/99	Corps of Engineers Approval of 206 Aquatic Restoration Plan for the Baraboo River
1999-present	Research Study on the effects of dam removal on aquatic resources including fish populations, fish movement, and aquatic insects.

7/00	Initiation of research project studying impact of dam removal on fauna of the Baraboo River
6/99-1/00	Corps of Engineers Historical Analysis and DOE - Because it was planned that federal funding (COE 206 funding) was to be used to remove the Glenville Dam, the COE was the designated lead federal agency. They submitted a DOE (Historical Resources) to SHPO. The public was involved in this process.
5/01	Lower Wisconsin Integrated Plan Open House held at Baraboo, Wisconsin. A display covering the Baraboo River Restoration (including removal of the Glenville Dam) was present at the meeting.
8/02 /01	DNR exercised its option to purchase the Glenville dam.
8/21/01	Public informational meeting on the dam removal and river restoration project.
9/20/01	Natural Heritage Inventory conducted for the Baraboo River

7. Public Comment on Draft EA/EIS and Response

The following table is a summary of the comments received during the comment period and the response by the Wisconsin Department of Natural Resources. None of the issues identified would warrant a change in the Department of Natural Resources proposal to remove the dam.

Commentor	Issues	Agency Response
Area Maintenance Supervisor, Wisconsin Department of Transportation	Has no problem with the removal of the Glenville Dam. Recommends that 70 cubic yards of heavy rip-rap be placed on the upstream bridge abutment immediately downstream of the dam site.	This riprapping is described in the EA and will be done in conjunction with the removal proposed dam removal project.
Private Citizen	Wants dam removed	This is the proposed action
State Representative, Wisconsin Legislature	Concerned about how the removal would impact flooding on the Baraboo River downstream.	Since this is a "run of the river" dam and the area impounded by the dam has very little storage capacity. The dam as it exists now does not affect flooding downstream to any significant degree. This is addressed in the EA.
Private Citizen	Supports removal of the dam. Would like a historical marker placed on the river to commemorate the historical importance of dams to the Baraboo Area	This is the proposed action DNR, as part of its municipal dam grant fund (for the removal of the Waterworks Dam) will cost share 50% of the cost of a historical marker pertaining to all of the former dams on the Baraboo River. WDNR supports this activity. However, recognizing the historical significance of the dam is beyond the scope of this particular project.
Private Citizen	Asked about what work will be done on the small tributary that joins the Baraboo River immediately upstream of the dam site.	The plan is to remove the spillway, complete restoration activity, and determine what work is necessary at this location after one year. This is described in the EA.

Commentor	Issues	Agency Response
Citizens for Waterfront Revival, Baraboo, WI, 53913	The group supports removal of the dam.	This is the proposed action
	Will sediment be removed from the millpond?	Removal will be limited to an area immediately upstream of the spillway as described in the EA.
	Is there a quantity calculated for the above amount of sediment?	Not at this time, material will be worked into the banks as fill as described in the EA.
	Are there plans for watershed improvement for the tributary that joins the river immediately upstream of the dam site?	No, that is beyond the scope of this project.
	Will the sewer outfall be modified for the post dam river stage?	Yes, described in the EA.
	Will the bridge abutments from the old truss bridge downstream of the spillway be preserved?	Yes, assuming they will not interfere with navigation, bank stability, or habitat work.
	Concerned about historical significance of the dams.	DNR, as part of its municipal dam grant fund (for the removal of the Waterworks Dam) will cost share 50% of the cost of a historical marker pertaining to all of the former dams on the Baraboo River. However, recognizing the historical significance of the Glenville Dam is beyond the scope of this project.
Private Citizen	Would like powerhouse removed	The powerhouse is still in private ownership and is not part of the proposed project.
	He also asked questions about sheet piling and piers, sediment, springs, and why the state purchased the dam.	Sheetpiling, piers, and sediment will be handled in a way that reduces to the extent possible the navigation hazard and also improves the habitat at the immediate dam site. The WDNR took ownership of the dam to enable them to remove the structure.