Draft

Environmental Assessment for Estabrook Dam

Milwaukee County, Wisconsin

Prepared by:

AECOM
4135 Technology Parkway
Sheboygan, WI 53083

August 2014

Contents

1.0 Introduction 1-1

1.1 Project Background 1-1

1.2 National Environmental Policy Act (NEPA) and Wisconsin Environmental Policy Act (WEPA) 1-4

1.3 Proposed Action 1-4

1.4 Purpose and Need for Proposed Action 1-4

1.5 Applicable Regulatory Requirements and Coordination 1-5

1.5.1 Technical Advisory Team 1-6

1.6 Contamination Sediment Remediation and the Great Lakes Legacy Act Project 1-7

1.7 Fish Consumption Advisories 1-7

2.0 Identification of Alternatives and Physical Changes 2-1

2.1 Identification of Alternatives 2-1

2.2 Preliminary Screening of Alternatives 2-1

2.2.1 Proposed Action – Rehabilitate the Dam 2-2

2.2.2 Alternative 1A – Rehabilitate the Dam and Add Provisions for Fish Passage 2-3

2.2.2.1 Physical Changes to Terrestrial Resources 2-4

2.2.2.2 Physical Changes to Aquatic Resources 2-4

2.2.2.3 Buildings, Treatment Units, Roads, and Other Structures 2-6

2.2.2.4 Dam Operation Plan 2-6

2.2.3 Alternative 2 – Abandon and Remove the Dam 2-8

2.2.3.1 Physical Changes to Terrestrial Resources 2-8

2.2.3.2 Physical Changes to Aquatic Resources 2-8

2.2.3.3 Buildings, Treatment Units, Roads, and Other Structures 2-9

2.2.4 Alternative 3 – Abandon and Remove Dam, Providing a 5.5-Foot High Rock Ramp to Facilitate Fish Passage and Establish an Impoundment 2-9

2.2.5 Alternative 3A – Abandon and Remove Dam, Providing a 4-Foot High Rock Ramp to Facilitate Fish Passage and Establish an Impoundment 2-9

2.2.6 Alternative 4 – Gated Spillway Removed, Serpentine Overflow Spillway Lowered, and a 6.3-foot-High Rock Ramp Constructed 2-9

2.2.6.1 Physical Changes to Terrestrial Resources 2-10

2.2.6.2 Physical Changes to Aquatic Resources 2-11

2.2.7 Alternative 5 – No Action 2-11
2.2.8 Alternative 6 – New Dam 2-11
2.3 Feasible Alternatives 2-12
2.4 Actions Considered But Eliminated From Further Consideration 2-12
2.5 Capital and Operating Costs for Feasible Alternatives 2-13
2.5.1 Alternative 1A – Rehabilitate the Dam and Add Provisions for Fish Passage 2-13
2.5.2 Alternative 2 – Abandon and Remove the Dam 2-14
2.5.3 Alternative 4 – Gated Spillway Removed, Serpentine Overflow Spillway Lowered, and a 6.3-Foot High Rock Ramp Constructed 2-14
2.6 Present Worth Analysis 2-14
2.7 Funding 2-15

3.0 Affected Environment 3-1
3.1 Maps, Plans and Other Descriptive Material 3-1
3.2 Physical Environment 3-2
3.3 Biological Environment 3-4
3.3.1 Aquatic 3-4
3.3.2 Terrestrial 3-9
3.4 Cultural Environment 3-10
3.4.1 Land Use 3-10
3.4.1.1 Recreational Resources 3-10
3.4.2 Visual Resources 3-11
3.5 Socio/Economic 3-11
3.6 Archaeological/Historical and Paleontological Resources 3-12
3.7 Other Special Resources 3-13
3.8 Areas of Critical Environmental Concerns 3-13
3.9 Environmental Justice 3-13
3.10 Native American Religious Concerns 3-13
3.11 Wilderness 3-13
3.12 Forests 3-13
3.13 Lands With Wilderness Characteristics 3-14
3.14 Prime or Unique Farmland 3-14
3.15 Summary of Environmental Resources 3-14

4.0 Environmental Consequences 4-1
4.1 Physical 4-1
4.1.1 Alternative 1A - Rehabilitate the Dam and Add Provisions for Fish Passage 4-1
4.1.1.1 Wetland and Riparian Zone 4-2
4.1.1.2 Air Resources 4-2
4.1.1.3 Noise and Odor 4-2
4.1.1.4 Soil Resources 4-2
4.1.2 Alternative 2 - Abandon and Remove the Dam 4-2
4.1.2.1 Wetland and Riparian Zone 4-3
4.1.2.2 Air Resources 4-3
4.1.2.3 Noise and Odor 4-3
4.1.2.4 Soil Resources 4-3
4.1.3 Alternative 4 – Gated Spillway Removed, Serpentine Overflow Spillway Lowered, and a 6.3-Foot-High Rock Ramp Constructed 4-3
4.1.3.1 Wetland and Riparian Zone 4-5
4.1.3.2 Air Resources 4-5
4.1.3.3 Noise and Odor 4-5
4.1.3.4 Soil Resources 4-5
4.1.4 Physical Resources - Not Applicable 4-5
4.2 Biological 4-6
4.2.1 Wildlife 4-6
4.2.1.1 General, Federal, and State Sensitive and Threatened and Endangered Species 4-6
4.2.1.2 Migrator Birds 4-7
4.2.2 Fisheries 4-7
4.2.3 Mussels 4-8
4.2.4 Water Resources 4-10
4.2.4.1 Alternative 1A - Rehabilitate the Dam and Add Provisions for Fish Passage 4-10
4.2.4.2 Alternative 2 - Abandon and Remove the Dam 4-10
4.2.4.3 Alternative 4 – Gated Spillway Removed, Serpentine Overflow Spillway Lowered, and a 6.3-foot-High Rock Ramp Constructed 4-10
4.2.5 Water Depth 4-11
4.2.6 Plant Community 4-11
4.2.6.1 Noxious and Invasive Weeds 4-11

4.2.7 Endangered Resources 4-12
4.3 Cultural 4-12
4.3.1 Land Use 4-12
4.3.1.1 Recreation 4-12
4.3.1.2 Visual Resources 4-13
4.3.2 Socio/Economic 4-14
4.3.2.1 Dam Removal Impacts on Property Values 4-15
4.3.3 Archaeological/Historical and Paleontological Resources 4-16
4.3.4 Other State Resources 4-16
4.3.5 Areas of Critical Environmental Concerns 4-16
4.3.6 Environmental Justice 4-17
4.4 Summary of Adverse ImpactsThat Cannot be Avoided 4-17
4.4.1 Alternative 1A - Rehabilitate the Dam and Add Provisions for Fish Passage ..4-17
4.4.2 Alternative 2 - Abandon and Remove the Dam 4-18
4.4.3 Alternative 4 – Gated Spillway Removed, Serpentine Overflow Spillway Lowered, and a 6.3-Foot-High Rock Ramp Constructed 4-18
4.5 Significance of Risk 4-19
4.6 Significance of Precedent 4-19
4.7 Significane of Controversy Over Environmental Effects 4-19
4.8 Cumulative Impacts 4-20
4.8.1 Alternative 1A - Rehabilitate the Dam and Add Provisions for Fish Passage ..4-20
4.8.2 Alternative 2 - Abandon and Remove the Dam 4-21
4.8.3 Alternative 4 - Gated Spillway Removed, Serpentine Overflow Spillway Lowered, and a 6.3-Foot High Rock Ramp Constructed 4-21

5.0 Summary of Issue Identification Activities 5-1
5.1 Public Input 5-1
5.2 Agency, Government, or Other Public Input 5-1

LIST OF ATTACHMENTS

Attachment 1:	Figure 1 Aerial Map
Attachment 2	Estabrook Dam Historic Information
Attachment 3:	SEWRPC Technical Memo Dated April 25, 2014 Draft
Attachment 4:	SEWRPC email Dated April 29, 2014 Regarding Estabrook Dam Modeling With the Gates Closed and Stoplogs in Place
Attachment 5:	Excerpts from Lincoln Park/ Milwaukee County River Channel Sediments Phase II Pre-Final Remedial Design Report Dated January 2014, Prepared by EA Engineering, Science, and Technology, Inc.
Attachment 6:	County Parkways Map
Attachment 7:	Wetland Inventory Map
Attachment 8:	Wetland Related Correspondence
Attachment 9	Cost Estimate for Alternatives
Attachment 10	Operation Plan Information
Attachment 11	Milwaukee River Water Quality Information
Attachment 12	1937 Aerial Photo of Dam and Vicinity
Attachment 13	Historical Land Plat Survey
Attachment 14	Birds of Estabrook Park
Attachment 15	US Fish & Wildlife Trust Resource List

1.0 Introduction

Milwaukee County, a Wisconsin municipal body corporate, owns and operates Estabrook Dam in the Milwaukee River near Estabrook Drive and W. Hampton Avenue (Attachment 1). The Wisconsin Department of Natural Resources (WDNR) has issued an Administrative Order dated July 28, 2009, requiring the County to drawdown the impoundment until such time as the dam can be either repaired or abandoned.

The dam was built in the late 1930's and includes construction on an island which is under the jurisdiction of the United States Department of Interior, Bureau of Land Management (BLM). The construction also included excavation of a channel for the gated section of the dam. This environmental assessment (EA) is being prepared pursuant to the National Environmental Policy Act (NEPA) and the Wisconsin Environmental Policy Act (WEPA) to disclose the environmental impacts of alternatives under consideration to address the 2009 Administrative Order.

NEPA requirements pertain to the need to obtain an access easement to the island in the Milwaukee River to perform construction related to the project. This access easement is requested from BLM. WEPA requirements are applicable to the project due to the Operational Order for Estabrook Dam.

Milwaukee County has proposed repair of the dam, but has also solicited public input and regulatory input on a series of alternatives to repair, replace, or remove the dam. Upon receiving this input, Milwaukee County will finalize the EA based on the selected project and proceed with implementation.

1.1 Project Background

Estabrook Dam was constructed during the late 1930's by the Civilian Conservation Corps (CCC) and Civil Works Administration (CWA). The dam was constructed with gates that could be opened during times of flooding and closed during low water in order to maintain a pool of water above the dam for boating, bathing and fishing. The gated section of the dam extends from County owned parkland on the left (north) bank of the river to a central island under the jurisdiction of the BLM. A fixed crest spillway then extends from the island to private lands on the right (south) bank of the river. On May 26, 1937, Milwaukee County received authorization from the Public Service Commission (PSC) of Wisconsin to construct, operate and maintain the dam with a run-of-the-river and normal water operating level equal to the elevation of the fixed crest portion of the spillway (Attachment 2). Documentation describing when and the reasons for the County instituting a fall through spring pool drawdown are not known. The earliest correspondence describing manipulating the dam gates for purposes of abating flooding and drainage problems was a letter from the City of Milwaukee to the County Parks Director in 1986.

Prior to the dam, the area near the dam had a rock ledge where the bedrock was higher in this section of the river. The rock ledge maintained a deep, narrow, and low-gradient meandering channel bounded by expansive wetlands. Based on 1937 aerial photographs and numerous other surveys and topographic maps, the river morphology never included a widening or lake-like natural feature. Beginning in 1935, the rock ledge was excavated within the river channel, resulting in a deeper river channel that was widened and straightened for approximately 6,000 feet near the confluence of the east and west oxbows for purposes of abating flooding. The channel modifications were considered effective for mitigating flooding and ice dams, in particular between West Silver Spring Drive and Bender Road (Wisconsin State Planning Board, 1940). The buildup of ice dams along the river upstream of Silver Spring Drive were reported as recently as the winter of 2014 despite the dam gates being fully opened and the pool drained. The public requested the local government to construct a

dam to create a pool for enhancing parkland aesthetics and recreational purposes. The dam was built with 10 gates to allow for adjusting the upstream pool elevation presumably for maintenance of the dam, and to convey flow flows.

Estabrook Dam was inspected in 1995 and 2004. The following deficiencies were noted as work directives with timelines for completion:

- The gates of the dam require a variety of work and must be repaired and all returned to operating condition.
- The stoplogs and their supports on the fixed spillway need to be replaced.
- The left and right abutments of the dam need to be repaired and stabilized with firmly compacted soils and riprap.
- Concrete repairs need to be made to the piers of the dam.
- The icebreakers upstream of the gated section of the dam are deteriorated and must be removed or reconstructed.
- The concrete access stairs on both the left and right sides of the dam are unsafe and must be rebuilt.
- Trees and shrubs are growing in areas around the left and right abutments of both the gated sections of the dam and fixed crest spillway and must be removed and their holes filled with compacted tight soils and planted over with grass to stabilize the area.
- Extensive debris must be removed from both the fixed crest spillway and ice breakers upstream of the gated sections of the dam. Some of the debris is imbedded in the contaminated sediment behind the fixed crest spillway and must be removed and dealt with as contaminated material.
- Signing must meet specifications.
- A structural analysis including scour/undermining analysis of the dam must be completed.
- A written plan for operation, inspection, and maintenance must be developed as well as an Emergency Action Plan.

The WDNR Administrative Order dated July 28, 2009, requires the County to either repair or abandon the dam within established timelines and also requires the County to maintain the dam under a drawdown condition until the repairs are completed. The repairs pertain to structural improvements and reconditioning of the gates to maintain proper operation. The structural improvements include installing rock anchors to stabilize the dam under all loading conditions. In addition, debris which collects at the dam will be removed. Some tree removal near the dam structure is also required.

Milwaukee County retained AECOM to investigate the dam condition in 2010, to assess sediment quality and quantity upstream of the dam, and to design improvements to the dam to meet the WDNR's Administrative Order.

The United States Environmental Protection Agency (USEPA), WDNR and Milwaukee County have investigated the sediments upstream of Estabrook Dam. Contaminated sediment containing organic and inorganic pollutants including carcinogenic polycyclic aromatic hydrocarbon (CPAH) and polychlorinated biphenyls (PCBs) was removed from the west oxbow of the Milwaukee River and Lincoln Creek about 1 mile upstream from the dam (2011). Additional sediment is scheduled to be removed during the second half of 2014, which will include the sediments directly behind the fixed crest spillway. Further information on the sediment removal project can be found at the WDNR project website: http://dnr.wi.gov/topic/greatlakes/lincolnpark.html and Section 16.

AECOM found sediment containing PCBs upstream from the dam. This information was shared with the USEPA, WDNR and Milwaukee County and these sediments will be part of the river sediment cleanup program for 2014.

Improvements to the Estabrook Dam designed by AECOM and plans and specifications for these improvements are on file at Milwaukee County. Access easements are being acquired by the County to allow construction work at the dam regardless of the alternative. When the access easements are finalized, the County will submit the easements to WDNR so WDNR can then complete their review of the dam design improvements and provide comments/approval of the design documents.

A series of Technical Advisory Team meetings have taken place with representatives from Milwaukee County, Southeastern Wisconsin Regional Planning Commission (SEWRPC), BLM, WDNR, US Fish and Wildlife Service, US Army Corps of Engineers, Himalayan Consultants, and AECOM from 2012 to the present. The representatives provided input on Estabrook Dam and alternatives to the dam. The alternatives included a no-action alternative; rehabilitate the dam; rehabilitate the dam and provide fish passage; removal of the dam, a new dam, and remove the dam while installing a “rock ramp” to develop a pool upstream similar to a dam but would also allow fish passage (Aadland,[5] 2010).

The public has been very vocal regarding the Estabrook Dam. One segment of the public supports rehabilitation of the dam. A group, the Milwaukee River Preservation Association, has strongly supported the dam project. About 350 private property owners live upstream from Estabrook Dam and along the impoundment. The advocates for the dam enjoy the aesthetics of the impoundment, and the canoeing, kayaking, motor boating, and other water-based recreational opportunities provided by the impoundment. They contend that the impoundment is important to maintaining their property value.

Another segment of the public supports removal of the dam to create a free-flowing river for purposes of enhancing environmental quality, recreation, reducing flood damages, and at a cost savings to taxpayers. They cite the environmental benefits and cost savings that followed the removal of the North Avenue Dam in 1997 and 13 other dams removed along the Milwaukee River or its principal tributaries since 1987. In these examples, aquatic habitat, water and sediment quality, fish passage and overall biological integrity, based on measured fish assemblages, have improved. Recreational opportunities have also changed, some arguably for the better, in particular, those associated with fishing, kayaking, and canoeing. To date, there has been no evidence of negative impacts to riparian property values located along any of these former impoundments. In other instances requiring dam repairs, public and private dam owners have chosen to repair and maintain their dams in lieu of removal primarily over concerns over aesthetics, changes to property value and uses, and loss of preferred water-based recreational uses associated with deeper impoundments.

In addition to dam removals, investments have been made in order to facilitate fish passage and their access to spawning habitat including the removal or modification of culverts and bridges over 5 miles of concrete channel and drop structure removals, and construction of an engineered fishway around the Milwaukee River Thiensville Dam http://www.co.ozaukee.wi.us/619/Fish-Passage.

Milwaukee Riverkeeper has sued Milwaukee County and claims Estabrook Dam is a public nuisance. On May 24, 2012, the State of Wisconsin Circuit Court declared that Estabrook Dam is a public nuisance and ordered Milwaukee County to remedy the nuisance. Milwaukee County is proceeding with the EA to address Estabrook Dam and alternatives with the objective to provide the public with detailed information about the array of alternatives to be considered in the decision-making process http://www.mkeriverkeeper.org/content/estabrook-dam-removal.

1.2 National Environmental Policy Act (NEPA) and Wisconsin Environmental Policy Act (WEPA)

Major actions that have the potential to affect the human environment and that involve federal funding, require a permit, or other authorization from a federal agency are subject to the requirements of the National Environmental Policy Act of 1969 (NEPA; 42 USC 4321 et. seq.). The proposed project is subject to the requirements of NEPA because approval to perform construction work for the dam is necessary from BLM. In addition, approval from the US Army Corps of Engineers is required regarding potential wetland impacts as part of the dam repair project.

WDNR has offered the County a $400,000 grant from the Municipal Dam Program for dam repair (existing structure or rock ramps). The County would need to request a variance to use the money for dam removal, since the County originally indicated the money would be used for repairs. In addition, up to $1,000,000 from the Stewardship Program for dam repair (existing structure or rock ramp) or dam removal is potentially available, and funding levels depend on meeting the grant criteria. Additional information on funding is provided in Section 2.7. WDNR approval of the dam repair project or an alternative project will be required. The WEPA program is similar to the NEPA program. The Operational Order for the dam requires the WEPA involvement.

The NEPA/WEPA programs require an EA for these types of projects to determine the environmental impacts of the project. If the project's EA results in a finding of no significant impact, the project can proceed with implementation. If the EA of the project indicates significant impact to the environment, an Environmental Impact Statement (EIS) is required, which is a substantially more involved assessment of the project. Based on the significance of potential impacts of the project, an EA is required to evaluate these potential impacts and fulfill the NEPA and WEPA requirements.

1.3 Proposed Action

Milwaukee County has proposed repair of the dam but has also solicited public input and regulatory input on a series of alternatives to repair, replace, or remove the dam. Upon receiving this input, Milwaukee County will finalize the EA based on the selected project and proceed with implementation.

1.4 Purpose and Need for Proposed Action

An Environmental Assessment (EA) is required to evaluate feasible alternatives to the dam and to meet state and federal regulatory requirements for a WEPA and NEPA project.

Milwaukee County requests a permanent easement from BLM to access the island to perform work associated with the dam or associated with the other alternatives. The selected alternative must be acceptable to BLM based on the least impacts to the environment as compared to the alternatives as well as meeting other federal standards as appropriate to this project.

Repair of Estabrook Dam will address deteriorating structural components, provide public safety, comply with a WDNR Administrative Order requiring that Milwaukee County repair or abandon Estabrook Dam by December 31, 2014, maintain an impoundment, minimize adverse environmental impacts, solicit public and regulatory agency input, and address project costs.

The WDNR issued an Administrative Order for Dam Repair on September 26, 2008, after damage to a section of the fixed crest spillway (broken stoplogs) was observed. The Order required the

impoundment to be drawn down by October 5, 2008. Milwaukee County completed the repairs by July 10, 2009.

The WDNR issued a second Administrative Order to address the outstanding deficiencies in 2009. The Order required the impoundment behind the dam to be drawn down in 2009 and not be refilled until all repairs have been completed. The impoundment has remained drawn down as the County has considered dam abandonment and repair options. The Milwaukee County Board has gone on record to repair the dam (Proposed Action). This EA evaluates repair of the dam as well as alternatives.

Milwaukee County is also required by the WDNR to prepare two different dam "Operation" documents for the Estabrook Dam:

1. Inspection, Operation, and Maintenance Plan (IOM). A safety manual required for large dams under NR 333.07. Details would include when the dam is inspected, what components are inspected, what is the maintenance schedule for the dam, and it explains how the dam is operated (e.g., during floods, normal conditions, winter, etc.)

2. Operational Order. A decision document that establishes water levels for the dam under s.31.02, Wis. Stats. Depending on the dam/situation, the Order sets levels such as maximum, minimum, and/or normal water levels and flow release rates, seasonal drawdowns, etc. This EA is needed to establish an Operational Order.

1.5 Applicable Regulatory Requirements and Coordination

The following federal, state, and local permits or approvals are required:

Federal:

1. Toxic Substances Control Act (TSCA) compliance
2. US Army Corps of Engineers Section 404
3. National Historic Preservation Act compliance
4. BLM access agreement to the river island in the center of the dam structure
5. Tribal historic/cultural review
6. Federal Emergency Management Agency (FEMA) review of regional floodplain elevations.

State of Wisconsin:

1. Wisconsin Chapter NR 30 permits for structures, shoreline stabilization, and dredging
2. Wisconsin Statutes Chapter 31 regulation of dams and bridges affecting navigable waters
3. Wisconsin Chapter NR 216 Wisconsin Pollutant Discharge Elimination System (WPDES) stormwater and wastewater permitting
4. Wisconsin Chapter NR 333 design standards for large dams
5. Wisconsin Chapter 116 floodplain approvals
6. Wisconsin Chapter 40 invasive species
7. National Heritage Inventory Compliance
8. State Archaeological site clearance required

Local:

1. Right of Entry Permits from adjacent landowners
2. Construction Site Erosion Control Permit from City of Milwaukee/City of Glendale
3. City of Milwaukee/City of Glendale Floodplain Zoning Ordinances

Other:

1. Approval from the local special waste landfill of acceptance of the materials with PCB concentrations less than 50 ppm.
2. Approval from the out of state landfill for acceptance of materials with PCB concentrations greater than 50 ppm.

1.5.1 Technical Advisory Team

Milwaukee County solicited technical input from federal, state, and local agencies to evaluate repair of the dam as well as to identify and assess dam alternatives. The team met multiple times from 2012 through 2014 to discuss the regulatory, environmental, and economic aspects of Estabrook Dam and alternatives. The team provided technical support to Milwaukee County staff and the County Board to allow the County Board to make long-term decisions based on sound technical documentation.

The Technical Advisory Team represented the following entities:

- Milwaukee County
- WDNR
- BLM
- SEWRPC
- US Fish and Wildlife Service
- US Army Corps of Engineers
- AECOM
- Himalayan Consultants

The technical areas represented by the team include river flow modeling, flood and drainage considerations, fish passage, fish, other aquatic life and wildlife populations and their habitats, wetlands, river sediment and sedimentation, water quality, civil engineering, dam design, and other related environmental and engineering fields.

Milwaukee County intends to issue a draft EA indicating the alternatives. On June 5, 2014, a public scoping meeting was held. A public information meeting is planned to seek public input on the feasible alternatives. The public will have the opportunity to provide comments at this meeting and also provide written comments through the County website after the meeting. The Milwaukee County staff and the County Board will review the compiled technical information, Technical Advisory Team input, and public input to determine a preferred plan.

1.6 Contamination Sediment Remediation and the Great Lakes Legacy Act Project

The sediment behind the fixed crest spillway of Estabrook Dam and other areas upstream from the dam are being addressed under a separate project under the Great Lakes Legacy Act. USEPA, Milwaukee County, and WDNR are working with the contractors for designing the sediment project which includes access roads, staging and documentation areas, dewatering pads, and wastewater treatment facility. The sediment removal project is independent of the Estabrook Dam alternatives, but the project teams are working together to identify common elements that can be used by both projects, such as access roads and easements on the south side of the river to access the fixed crest spillway.

Estabrook Dam impoundment has been drawn down since 2008, which is when WDNR issued a letter dated September 26, 2008, to Milwaukee County requiring the drawdown until dam repairs were completed.

The Milwaukee River has established a channel through the impoundment area. Accumulated polychlorinated biphenyl (PCB) and CPAH contaminated sediment and debris are present upstream and adjacent to Estabrook Dam. The sediment and debris will be removed prior to dam rehabilitation during a separate sediment removal project that will mechanically remove approximately 9,500 cubic yards of accumulated sediments from above the dam during the Phase II sediment removal project which is jointly being conducted by USEPA, WDNR, and Milwaukee County. Phase II of the sediment remediation project follows the Phase I completed in 2012, whereby 120,000 cubic yards of contaminated sediment were removed from Lincoln Creek and the west oxbow of the Milwaukee River. The goal of the remediation is to eliminate contaminants that threaten human health and the environment. One measure of the projects success is to ultimately reduce concentrations of PCBs in fish contaminated with PCBs. Remediation of contaminated sediment is beneficial to human health regardless of the selected dam management alternative. Sediment accumulation patterns are dependent on the dam alternative, but the contamination will be gone.

The extent of the Phase II sediment remediation footprint is about 1.4 acres in area. Attachment 5 contains an aerial map showing the proposed areas for sediment removal as part of the Phase II program. The area immediately above the dam is referenced as Zone 5, based on the Lincoln Park/Milwaukee County River Channel Sediments Phase II Pre-Final Remedial Design Report dated January 2014, prepared by EA Engineering Science, and Technology, Inc. Conducting the Phase II sediment remediation during drawdown of the impoundment is more effective and less costly.

1.7 Fish Consumption Advisories

The WDNR provides fish consumption advisories for Wisconsin lakes and rivers including the Milwaukee River at Estabrook Dam. Carp is the only fish species with a Do Not Eat advisory in this reach. The fish consumption advisory is as follows from the WDNR website http://dnr.Wi.gov/topic/fishing/consumption/index.html.

County:	Milwaukee, Ozaukee
Advisory Area:	Milwaukee River from City of Grafton to Estabrook Falls including Lincoln Creek
Includes:	Lincoln Creek, Milwaukee River

Women up to age 50 (child bearing age) and children (under age 15) may safely eat:

1 Meal Per Week:	black crappie, bluegill, rainbow trout less than 22”, rock bass
1 Meal Per Month:	brown trout less than 28”, bullheads, Chinook salmon, Coho salmon, largemouth bass, northern pike, rainbow trout larger than 22”, redhorses, smallmouth bass, walleye
6 Meals Per Year:	brown trout larger than 28”, channel catfish
Do Not Eat:	carp

All men (age 15 and older) and older women (50 and older) may safely eat:

1 Meal Per Week:	black crappie, bluegill, rainbow trout less than 22”, rock bass
1 Meal Per Month:	brown trout less than 28”, bullheads, Chinook salmon, Coho salmon, largemouth bass, northern pike, rainbow trout larger than 22”, redhorses, smallmouth bass, walleye
6 Meals Per Year:	brown trout larger than 28”, channel catfish
Do Not Eat:	carp

2.0 Identification of Alternatives and Physical Changes

This section provides an overview of the Proposed Action and alternatives considered regarding the Estabrook Dam. Physical changes with the alternatives are also presented in this section. This project has a long history of proponents in favor of maintaining or removing the dam. Important issues included the positive or negative effects of the dam, its impoundment and the existing and proposed dam and water level operational plan on fish, other aquatic life, wildlife habitat, water and sediment quality, sedimentation, flooding and drainage, water-based recreational uses and property values, water levels, institutional issues (e.g., access easements and permits, etc.), and costs. The Technical Advisory Team identified a number of issues that could potentially mitigate in whole or in part some of these negatively impacted issues. In addition, a public scoping meeting was held to obtain input for consideration of additional alternatives and issues that could be addressed in the EA. A preliminary screening of the alternatives was performed, and the most feasible alternatives were selected for a more in-depth evaluation of their benefits, impacts, and related costs. Public and agency review and comments from the EA will be solicited to provide Milwaukee County with the information needed to go forward with the Proposed Action or other dam or river management alternatives.

2.1 Identification of Alternatives

In addition to the Proposed Action – Rehabilitate the Dam, the Technical Advisory team and public identified the following alternatives for consideration for Estabrook Dam. These alternatives are as follows:

- Proposed Action – Rehabilitate the dam without fish passage.
- Alternative 1A – Rehabilitate the dam and add provisions for fish passage.
- Alternative 2 – Abandon and remove the dam.
- Alternative 3 – Abandon and remove the dam, providing a 5.5-foot high rock ramp to facilitate fish passage and establish an impoundment.
- Alternative 3A – Abandon and remove the dam, providing a 4-foot high rock ramp to facilitate fish passage and establish an impoundment.
- Alternative 4 – Gated spillway removed, serpentine overflow spillway lowered, and a 6.3-foot-high rock ramp constructed.
- Alternative 5 – No action.
- Alternative 6 – New dam.

2.2 Preliminary Screening of Alternatives

Milwaukee County decision makers and the public have decades of experience and technical tools available to weigh the socio-economic and environmental impacts, both positive and negative, associated with the Estabrook Dam. The Estabrook Dam was constructed in and around the Milwaukee River impounded in the late 1930s. Over the last several decades, Milwaukee County has deviated from the original PSC authorized run-of-the-river dam gates closed and full pool condition and elected to fill and drawdown the impoundment on a seasonal basis and in response to flood

events. More recently, the dam gates have remained open since 2008, until such time that repairs and other issues are resolved. These changes enable the public to visualize, experience, and react to the array of associated dam management alternatives proposed for this EA. Contaminated sediment remediation projects have required the inventory of physical, chemical, and biological information not previously available. Water quality improvements and the removal of other dams along the lower Milwaukee River and other barriers to fish passage have created a heavily used destination recreational fishery. Dam removal has only recently evolved as a cost effective, technically and environmental sound river management practice. In instances whereby decisions are made to retain a dam, engineered fish passage facility designs have evolved to be effective at passing native fish around dams based on their unique migration behavior, swimming, and leaping abilities. State of the art hydrologic and hydraulic models have been developed and used to accurately predict flooding and drainage problems associated with dams and various flood and dam operating scenarios. Finally, structural engineering standards and practices allow for more accurate estimates of capital, operation, and maintenance cost for various dam management alternatives. These and other assessment tools will allow all parties to objectively evaluate the environmental and socio-economic benefits and impacts of the dam management alternatives presented in this EA.

The following information is provided on each alternative and the preliminary screening of the alternatives.

2.2.1 Proposed Action – Rehabilitate the Dam

Proposed Action – Rehabilitate the dam consists of making the structural improvements to the dam to extend its life and to meet the requirements stipulated in the July 28, 2009 WDNR Administrative Order. Other improvements include upgrading the gates and tree removal at the dam structure. This alternative would also require a dam gate and water level operation plan. Briefly, over the past several decades, the County has operated the dam gates and pool water level based on two annual periods: a summer (mid-May to mid-September) whereby the gates are closed to maintain and impoundment maintains a full pool, and for the remainder of the year (mid-September to mid-May) the gates are opened and the pool is drained. Additional provisions are in place to adjust the summer gates and pool water level in the event of flooding.

Milwaukee County Board has voted to implement the Proposed Action. At that time, the concept of addressing other alternatives to the dam had not been presented. The NEPA and WEPA requirements include addressing alternatives. At that time, the Milwaukee County Board voted to implement the Proposed Action, the option to remove the dam was dismissed in favor of rehabilitating the dam.

Dams, as barrier to fish movement, fragment habitat needed for various life requisites (e.g., habitat types required for spawning, development, growth, etc.), reduce fish population resilience to environmental disturbances and elevated risks to local and watershed-scale extinctions, and diminished genetic diversity. Freshwater mussels are the most threatened and rapidly declining group of aquatic organisms. Mussels are dependent on fish, often specific fish species, to serve as intermediate hosts for reproduction. Dams and other barriers to fish migration have been documented as an important factor responsible for reduced and extinct mussel populations. The socio-economic benefits of the recreational fishery that have developed along the lower 32 miles of the Milwaukee River and its tributaries, including the Lake Michigan fall through spring runs of trout and salmon depends on the fish passage at the dams.

The Proposed Action would, therefore, have significant environmental and recreational fishing impacts and is therefore, eliminated from further consideration and a more detailed evaluation is warranted because other more environmentally protective alternatives are feasible.

2.2.2 Alternative 1A – Rehabilitate the Dam and Add Provisions for Fish Passage

Alternative 1A will require long-term annual operation and maintenance cost to operate the gates, to remove debris, and to maintain the dam. Alternative 1A is the Proposed Action with the addition of fish passage features. The provision for fish passage is a definite environmental benefit. Because of this substantial environmental benefit of fish passage, the environmental assessment will eliminate the Proposed Action from further consideration and will evaluate Alternative 1A.

Alternative 1A is a refinement of the Proposed Action with added environmental benefits. The fish passage provision allows fish to pass through the dam area in a designated passage section of the dam.

This alternative would require a water level Operation Plan. Briefly, two options for establishing a water level Operational Plan are considered:

1. Similar to the Proposed Action, a summer (mid-May to mid-September) whereby the gates are closed and impoundment maintains a full pool, and for the remainder of the year (mid-September to mid-May) the gates are opened and the pool is drained, or

2. A year-around gates closed full pool condition.

Alternative 1A includes an option for a year-around gates closed full pool option as a means to avoid potential negative environmental impacts associated with opening the gates and draining the pool. Both options propose that the County have a gate operator on staff to monitor river levels, weather, debris, and river ice conditions in order to operate the closed dam gates and adjust the pool to prevent dam related flood and drainage damages to upstream properties, and to limit the County's liability exposure associated with these damages. A more detailed description of the operation plan for Alternative 1A is contained in Attachment 10.

The Proposed Action and Alternative 1A are classified by WDNR as large dams because the dam structural height is more than 6 feet and impounds more than 50 acre-feet of water. In addition to consistent inspection, maintenance, repair, and operation, the regulatory requirements for a large dam are as follows:

- Operation, inspection, and maintenance plan must be developed.
- Emergency action plan must be developed.
- An owner inspection would be required every 10 years.

The fish passage will consist of a series of pools and riffles of rocks and boulders (Aadland, 2010)[5]. It will be located at the existing dam flashboards. These flashboards may or may not be eliminated from the dam, depending on the fish passage design. The fish passage allows fish to migrate during spawning and other periods of the year, which promotes fish diversity, enhances fishing opportunities, and is intended to replicate conditions in a free-flowing river.

2.2.2.1 Physical Changes to Terrestrial Resources

The following repairs will be made to the Estabrook Dam:

- Concrete will be repaired.
- Exposed reinforcing rod will be reconditioned.
- Supplemental reinforcing will be installed as necessary.
- Eleven grouted tie-down rock anchors and associated components on the upstream ends of the piers will be installed.
- Ten steel slide gates and their components will be reconditioned.
- Concrete and stone rubble overflow spillway will be repaired.
- Steel framing and associated components of the stoplogs at the north end of the fixed crest spillway will be reconditioned or replaced.
- Concrete icebreakers will be repaired or replaced.
- Slope protection (rock riprap over geotextile fabric) upstream and downstream of the gated dam structure will be installed.
- Dam safety signs on the island and gated structure and new portage signs will be installed.
- Vegetation will be cleared from the abutments, access roads, and staging areas.

The dam repair order calls for the permanent removal of all trees and shrubs from the area within 15 feet around the left (north) and right (south) abutments for both the fixed crest spillway and gated sections of the dam. Removal is to include the complete removal of the stumps and roots, filling of the holes created with compacted tight soils, and adding topsoil and grass seed to stabilize the area.

Milwaukee County Parks will work with the contractors and WDNR to determine the trees that must be preserved. All areas that are disturbed from this project will be restored to the satisfaction of the Milwaukee County Parks Department, other affected landowners, and WDNR. Temporary roads and staging areas will be constructed to access the dam for repairs and to remove the sediments behind the fixed crest spillway.

Access roads will allow for truck access to the dam for repairs. A perimeter fence will be constructed to restrict public access to the construction work zone. After the dam is repaired, the access road would be maintained and the perimeter fence will be removed.

2.2.2.2 Physical Changes to Aquatic Resources

The Estabrook Dam impoundment has been drawn down since 2008. The Milwaukee River has established a channel through the impoundment area. PCB contaminated sediment and debris are present upstream and adjacent to Estabrook Dam. The sediment and debris will be removed prior to dam rehabilitation or implementation of another alternative during a separate sediment removal project that will mechanically remove approximately 9,500 cy of accumulated sediments from above the dam during the Phase II sediment removal project which is jointly being conducted by USEPA, WDNR, and Milwaukee County. The extent of the sediment footprint is about 1.4 acres in area. Attachment 5 contains an aerial map showing the proposed areas for sediment removal as part of the Phase II program. The area immediately above the dam is referenced as Zone 5 based on the Lincoln Park/ Milwaukee County River Channel Sediments Phase II Pre-Final Remedial Design Report dated January 2014, prepared by EA Engineering, Science, and Technology, Inc.

The environmental impacts associated with Alternative 1A are fairly well known based on the dam operation from the 1930s until the dam gates remained open in 2008. This period allows for environmental assessment of the actual conditions experienced for this alternative.

Repair work on the dam spillway, embankments, and icebreakers will take place during drawdown conditions. Temporary diversion structures will be used during dam rehabilitation to direct flow through certain dam gates as other gates are being repaired. The diversion structures will be moved as needed until all gates have been repaired. Facilities and equipment will be located outside of the floodplain.

Access to the river from both the left and right banks will be required. Access to the northern portion of the dam will be through Estabrook Park. Access to the southern portion of the dam will have to come through negotiated access easements to private lands on the right (south) bank of the river.

The impoundment will be restored after completion of the dam rehabilitation project. At full pool elevation, the Estabrook impoundment is approximately 103 acres and extends beyond West Silver Spring Drive for an additional 0.9 miles upstream. Regarding the quantity and location of wetlands previously mapped as wetlands under Alternative 1A, no perennial wetland vegetative cover types will develop from exposed floodplain sediment during the fall through winter drawdown of the impoundment. The rehabilitated Estabrook Dam will have no changes to previous dam dimensions and flow characteristics. At flood level, the Milwaukee River will continue to overtop the fixed crest and gated sections of dam structure. From the dam to the upstream end of the impoundment is about 2.5 miles.

SEWRPC completed a detailed analysis of Alternative 1A on local hydraulic and the floodplain conditions. SEWRPC modeled the Estabrook Dam alternatives in 2014 (Attachment 3) under multiple flow conditions including mean flow, median flow, 10, 50, 100, and 500-year frequency flow events.

SEWRPC's river modeling takes into account the river cross sections and vegetative conditions of the river's floodplain. Vegetation has developed in some areas of the floodplain since the dam impoundment has been out of service. SEWRPC has adjusted some friction factors to account for this situation where warranted. These areas of recently developed vegetation represent a small fraction of the modeled river system as a whole. In addition, riverbed/bank vegetation would represent an insignificant barrier to floating ice.

SEWRPC also modeled Estabrook Dam with the gates closed to provide Milwaukee County with the technical understanding of the results of river levels under this scenario (Attachment 4). Under a 100-year frequency flood, and the 10 gates closed, the upstream river levels will exceed a 100-year flood elevation and will worsen the flood conditions. Under this scenario, the river levels will be as much as 1.5 feet greater than the 100-year flood elevation near the dam, and continue to exceed the 100-year flood elevation at West Bender Road. This situation provides potential liability issues for Milwaukee County. The County can staff a dam operator to continually monitor river flows and weather conditions to control the gates, but the possibility remains if the 10 gates malfunction due to debris, ice, an electrical power outage or gate mechanical failure, the County can be liable for flood damage to upstream properties.

Under Alternative 1A, the County plans to have a dam operator to monitor river and weather conditions, and to regulate the gates accordingly.

Alternative 1A will have the same river water surface elevations as the existing dam. Under normal (median) flow conditions, which assume that the Estabrook Dam gates are closed, the maximum water depth will be about 8.7 feet near the dam to about 2.4 to 9.1 feet in the upper reach defined as the river segment between the abandoned railroad bridge upstream of Lincoln Park and West Bender Road.

Alternative 1A will include a fish passage to allow fish to travel year-round upstream and downstream regardless of the dam gate operation. This environmental benefit is shared with all of the feasible alternatives. Invasive species already are present on both sides of the dam and therefore, the dam does not appreciably change their presence. The dam is overtopped during major floods and therefore, was not a blockade against the movement of aquatic invasive species (AIS) along the Milwaukee River. The seasonal opening of the gates over the last several decades has created an avenue for the passage of beneficial fisheries and the fairly recent and unanticipated arrival of AIS.

Alternative 1A will result in higher water temperatures due to the impoundment. Higher water temperatures result in lower dissolved oxygen in the water that can be detrimental to certain fish and aquatic life. Water quality data including river temperature is monitored by Milwaukee Riverkeeper and water quality information is provided in Attachment 11; (Milwaukee Riverkeeper[13, 14], 2014).

Sediment buildup over time will occur and can be detrimental to fish, mussels, and other aquatic life. When the gates are opened, the sudden flush of sediment can also be detrimental to fish, mussels, and other aquatic life.

2.2.2.3 Buildings, Treatment Units, Roads, and Other Structures

Alternative 1A has a small existing building associated with the dam. The dam is a structure that will be rehabilitated. There is no treatment units associated with the dam. Access roads are required to make improvements to the dam. The access road in Estabrook Park is existing. The access road across the river is on private property and will serve as access for the sediment removal project and the dam project. After the dam project is completed, the access road will be removed.

The approximately 222-foot long concrete dam and abutments with 10 steel slide gates connects the left (north) bank of the Milwaukee River at Milwaukee County's Estabrook County Park to an island in the center of the river. The BLM has jurisdiction over the mid-river natural island. A 562-foot long fixed crest concrete and grouted limestone spillway is located immediately west of the island and connects the island with the right (south) bank of the Milwaukee River. The property on the right bank of the river is privately owned and under the control of Securant Bank & Trust and is listed for sale, and Wheaton Franciscan Services, Inc., where the dam touches the west bank. A series of 28 concrete and steel pylons referred to as "ice breakers" were added upstream of the dam and spillway around 1955 to help protect the structure from debris and ice.

2.2.2.4 Dam Operation Plan

The dam operation plan considers a summer plan and balance of the year plan. The specifics of the plan are as follows:

1. Summer Operation Plan

The dam summer plan starts with refilling the pool no earlier than May 15 and has it draw down completely by September 15. The goal is to maintain a full pool during this period for aesthetics and recreational use. During this period, the 10 gates will be closed the majority of the time. The County will employ a dam gate operator to monitor river flows, river levels, debris, and weather conditions. The gates will be operated to limit the drawdown to 6 inches or less per day as per the WDNR requirements and minimum stage of the top of the fixed crest spillway. The fixed crest spillway is 6 inches lower than the gates. Estabrook Dam is required to pass at all times a minimum flow downstream at least 25 percent of the natural low flow which has been administratively set at Q7,10 S.Statutes 31.34, Wis. Stats.

The County proposes a normal water level in the pool based on the fixed crest spillway elevation. The gates will be operated as needed to establish the normal water level. If rising water levels occur above the normal, the County has the option to open gates to adjust pool levels accordingly.

2. Balance of the Year Operation Plan

The operation plan for the balance of the year consists of having the 10 gates opened. This approach reduces the water level to better accommodate ice flows and handle flood flows. The timing of the gates being opened is to allow the aquatic life to acclimate to the lower river levels before winter arrives. The drawdown will follow WDNR criteria of no more than 6 inches per day drawdown. Additional information on the Operation Plan, pool levels, and river rating curve are contained in Attachment 10.

Refer to Attachment 10 regarding structural elevations for the dam and fish passage.

3. Year-Round Full Pool Operation Plan Feasibility

A year-round, full pool operational plan was considered. There are environmental benefits to aquatic life with this scenario. Aesthetics of the pool year round are also a positive. The mitigative measures to accomplish this full pool option are challenging and include additional risk to the dam for potential structural damage to the gates, and potential for the gates to malfunction if they have not been operated for extended periods.

Structural/mechanical improvements would be necessary such as addition of an aerator at the 10 gates to minimize ice buildup at the gates. The upstream ice breakers serve a function to minimize large ice flows from damaging the gates, but the potential exists for a buildup of ice against these gates can result in structural damage during early spring ice out. The gates could be temporarily opened to pass the ice flows, but WDNR regulations limit the drawdown to 6 inches per day, which could readily be exceeded under these conditions.

The full pool, year-round scenario has environmental and aesthetic benefits, but the operational plan to accomplish this approach would require substantial dam operator attention to meet WDNR criteria and to protect the dam gates from potential structural damage. This option had significant operational challenges which would be difficult to consistently overcome. The potential for structural damage to the 10 gates is high. The design ice loading on these gates is 500 pounds per square foot, which reflects the power and force of these ice flows on the steel gates. Therefore, the operational challenges associated with a year-round full impoundment create a high risk for damaging the 10 gates and is not considered a feasible long-term operational procedure.

2.2.3 Alternative 2 – Abandon and Remove the Dam

Alternative 2 – Abandon and remove the dam would restore the river to a free flowing condition and provide fish passage. This alternative would eliminate the County's capital cost for dam repair and also eliminate the need for annual dam operation and maintenance costs. This alternative has merit and will be further addressed in the environmental assessment.

2.2.3.1 Physical Changes to Terrestrial Resources

This alternative consists of physically removing the entire dam consisting of the gated section and fixed crest spillway. The gated section consists of 10 gates with electric/mechanical operators to raise or lower the gates. The gated section is about 182 feet long, constructed of reinforced concrete. The fixed crest spillway is a concrete and grouted stone structure approximately 450 feet long.

Alternative 2 would require a temporary access road to remove the dam. A perimeter fence will be constructed to restrict public access to the construction zone. After the dam is removed, the access road would be restored and the perimeter fence will be removed.

Concrete removed from the dam will be recycled and reused where possible. Potential uses of the concrete are as an aggregate for a road base or in concrete.

2.2.3.2 Physical Changes to Aquatic Resources

Alternative 2 restores the Milwaukee River to a free-flowing river. Compared to 103 surface acre impoundment under Alternative 1A with gates closed and full pool conditions, the water surface area under Alternative 2 will decrease from 103 acres to 72 acres, assuming median river flow conditions. Emergent wetland vegetation will occur along the floodplain otherwise inundated by the impoundment under Alternatives 1A and 4. The impoundment under Alternative 4 at median flow is about 100 acres.

The river depth conditions (Table 2 of Attachment 3) for Alternative 2 will be lower than the existing river level conditions when the gates are open. Removal of the dam results in less restrictions in the river and an increase in flow capacity. These factors reduce the river level during a flood under Alternative 2 as compared to Alternative 1A.

The SEWRPC modeling of the river (Attachment 3) showed Alternative 2 results in a decrease in water surface elevations for each analyzed flow condition relative to existing dam conditions including at each storm sewer outfall. Under a 100-year frequency flood, the water surface elevations in the area upstream of the removed dam would decrease between 0.7 and 1.5 feet as compared to existing conditions. For a 100-year flood, the water surface elevation in the upper reach would decrease by up to 0.5 feet. Under normal (median) flow conditions, the water surface elevation in the lower reach (upstream of the removed dam) would decrease between 3.7 and 7.5 feet with a maximum water depth ranging between 0.7 and 2.5 feet. The normal elevation in the upper reach would decrease between 0.5 and 4.6 feet with a maximum water depth ranging between 0.8 and 4.5 feet. From West Silver Spring Drive to West Bender Road, the maximum water depths with this alternative would be 1.5 to 2.1 feet, based on normal conditions.

The river distance from Estabrook Dam to West Bender Road is 3.2 miles. The stretch of river will have decreased water levels as compared to Alternative 1A. Under median flow, the water level will be about 3.4 feet lower at West Silver Spring Drive as compared to Alternative 1A. At West Bender

Road, the water level under median flow conditions will be about 0.5 feet lower as compared to Alternative 1A.

2.2.3.3 Buildings, Treatment Units, Roads, and Other Structures

As previously discussed, the small building and dam will be removed. Access roads are also discussed above.

2.2.4 Alternative 3 – Abandon and Remove Dam, Providing a 5.5-Foot High Rock Ramp to Facilitate Fish Passage and Establish an Impoundment

Alternative 3 provides the benefits of an impoundment beginning 1,600 feet upstream of the existing dam site. The 5.5-foot high ramp would create an impoundment similar to a dam, but without the large capital expense to repair the dam and eliminates the annual operating and maintenance costs associated with the dam gates. But some maintenance, including debris cleaning, is anticipated. The rock ramp allows fish passage. The passive nature of a rock ramp is similar to a natural river with riffles. Similarly, the rock ramp height will dictate the extent of a pool upstream and will be limited to a height that does not interfere with a 100-year frequency flood elevation.

SEWRPC evaluated Alternative 3 and determined the 5.5-foot high rock ramp will exceed the 100-year frequency flood elevations (Attachment 3). Therefore, this alternative is eliminated from further consideration.

2.2.5 Alternative 3A – Abandon and Remove Dam, Providing a 4-Foot High Rock Ramp to Facilitate Fish Passage and Establish an Impoundment

Alternative 3A is very similar to Alternative 3 and would be located in the same location as Alternative 3, which is 1,600 feet upstream of the dam. Multiple iterations of rock ramp heights were evaluated and a rock ramp not to exceed 4 feet high would not impact the 100-year frequency flood event based on this rock ramp location. The rock ramp height results in the structure being considered a “small dam,” which has fewer regulatory requirements compared to those of a “large dam.” If the structural height was more than 6 feet and impounds more than 50 acre-feet of water, the rock ramp would be considered a large dam under s.31, Wis. Stats.

SEWRPC modeled Alternative 3A and found this option can handle a 100-year frequency flood without increasing the 100-year flood elevations (Attachment 3).

The one physical drawback to Alternative 3A is the impoundment depth is limited as compared to Alternative 1A or Alternative 4. Alternative 3A has potential, but Alternative 4 has more benefits and similar costs and drawbacks. For these reasons, the EA will address Alternative 4, and Alternative 3A will be dismissed.

2.2.6 Alternative 4 – Gated Spillway Removed, Serpentine Overflow Spillway Lowered, and a 6.3-Foot-High Rock Ramp Constructed

Alternative 4 presents a rock ramp option located at the gated section of the dam. This rock ramp is higher than the rock ramp option in Alternative 3A and therefore provides a deeper impoundment upstream. The rock ramp height results in the structure being considered as a large dam which has some regulatory requirements as discussed under Alternative 1A in Section 2.2.2.

Alternative 4 has merit as it provides for effective fish passage and will be further addressed in the EA.

Alternative 4 is located at the dam where the river is wider as compared to Alternatives 3 and 3A, which would be 1,600 feet upstream from the dam. Though Alternative 4 has a 6.3-foot high rock ramp as compared to Alternative 3 (5.5-foot high), the river modeling by SEWRPC demonstrates Alternative 4 can handle a 100-year frequency flood without exceeding the 100-year flood elevation (Attachment 3). Therefore, Alternative 4 has merit and will be further evaluated.

The gated section of the dam would be removed in order to construct the rock ramp. Concrete rubble from the dam's gated section will be used where possible to construct the lower portion of the rock ramp. The balance of the rock ramp will be constructed using stones and boulders (3 to 6 feet in size). Some smaller stones are also used to fill in the spaces between the larger stones to create a stone mass to avoid spaces between the stones. The rock ramp consists of constructing a section of rocks across the width of the former gated section. The rock ramp would slope up to a height above the river bed of 6.3 feet on average.

The rock ramp creates a relatively solid cross section. The rock ramp would have a 3 horizontal to 1 vertical slope on the upstream face and an arched weir shape on the downstream face that would direct flow generally to the center of the channel. The 3 to 5 percent longitudinal slope is similar to slopes of natural stream riffles and is gradual enough to enable fish passage and the downstream transport of ice and debris (Aadland,[5] 2010).

The objective of this alternative is to allow fish passage, maintain an impoundment upstream, provide a passive approach without the need to regulate the dam gates, and to create a natural environment similar to the bedrock ledge that existed at this location prior to the dam being constructed.

The impoundment would be year-round. The flashboards would still exist with this alternative, but are expected to be normally in place. The flashboards could be temporarily removed for maintenance of the rock ramp and allow for a lower pool elevation of 2.4 feet. The fixed crest spillway will be lowered from existing Elevation 616 to Elevation 615.4. The operation plan for Alternative 4 is contained in Attachment 10.

As noted above, WDNR would consider Alternative 4 as a large dam based on WDNR dam regulations because the structural height is more than 6 feet and impounds more than 50 acre-feet of water. In Aadland's book[5] on rock ramps, there is discussion about not recommending a rock ramp for large dams. AECOM contacted Luther Aadland, who clarified this matter. Aadland is referring to a large dam, in this case, as being 30 to 40 feet high, which becomes impractical for a rock ramp being constructed. He said a rock ramp of 6.3 feet is very realistic to construct and maintain long-term. According to Aadland, a broad rock ramp when properly sloped is more effective at passing debris and ice than spillways. This is true because the rock ramp does not have structural members and gates that can cause ice and debris to collect on the dam as observed at Estabrook Dam.

2.2.6.1 Physical Changes to Terrestrial Resources

Alternative 4 requires the gated section of the dam to be removed in order to construct the fish passage. Alternative 4 will also include lowering the fixed crest spillway and structural improvements to the dam.

The terrestrial resources are expected to be about the same as Alternative 1A because the impoundment extent is similar but slightly shallower and extends not as far upstream as Alternative 1A as discussed below. Vegetation along the river bank will be about the same as Alternative 1A.

2.2.6.2 Physical Changes to Aquatic Resources

Alternative 4 uses a rock ramp similar to a condition of pools and riffles found in nature to provide fish passage and an impoundment upstream.

The SEWRPC modeling of the river (Table 5, Attachment 3) indicates this alternative under normal (median) flow conditions results in a water surface elevation near the dam of about 1.2 feet lower than if the dam was present. The maximum water depth ranged from 6.2 to 7.5 feet from the dam to West Hampton Avenue. The normal elevation in the upper reach would decrease between 0.4 and 1.2 feet with a maximum water depth ranging from 1.9 to 7.9 feet from Lincoln Park to West Bender Road. From West Silver Spring Drive to West Bender Road, the maximum water depths with this alternative would be 1.9 to 3.8 feet based on normal conditions.

The impoundment under Alternative 4 is year-round. Fish and other aquatic life will be able to move freely through the fish passage. Water levels will fluctuate on seasonal and daily variations in river flows.

The river length from the dam to West Silver Spring Drive is 1.9 miles and will be somewhat shallower than Alternative 1A as discussed above. The impoundment would extend about 0.7 miles upstream of West Silver Spring Drive. This alternative provides a compromise between Alternatives 1A and 2. An impoundment for recreation is provided without the expense of dam gates and associated operational costs. This option was optimized to provide the deepest impoundment that could also handle a 100-year frequency flood without increasing the flood elevation.

2.2.7 Alternative 5 – No Action

Alternative 5 – No action refers to Milwaukee County taking no action to repair the dam or to abandon the dam. The No Action alternative would violate WDNR's July 28, 2009 Administrative Order. Alternative 5 would mean the dam gates could not be operated. The dam is in need of structural repair which could lead to continued degradation of the dam. The potential for an impoundment upstream could not be realized under this alternative. Therefore, Alternative 5 – No Action, is eliminated from further consideration because it violates WDNR's Administrative Order and is not a sustainable solution.

The structural elements of the dam are in need of repair. The concrete had deteriorated in spots and repair is necessary to maintain structural integrity and to reduce the potential for accelerated deterioration. The extent of the necessary repairs is further discussed in Section 2.2.2.1.

2.2.8 Alternative 6 – New Dam

Alternative 6 – New Dam would replace the existing dam. The existing dam, built in the 1930s, is in need of repair, but the costs to construct a new dam would be substantially higher. The dam can be repaired at a much lower cost. For this reason, Alternative 6 is eliminated from further consideration.

2.3 Feasible Alternatives

Based on the preliminary screening of alternatives, the following alternatives are deemed feasible and will be further evaluated in this environmental assessment.

- Alternative 1A – Rehabilitate the dam and add provisions for fish passage.
- Alternative 2 – Abandon and remove the dam.
- Alternative 4 – Gated spillway removed, serpentine overflow spillway lowered, and a 6.3-foot-high rock ramp constructed.
- Alternative 5 – No Action is eliminated from further consideration because it does not comply with the WDNR Administrative Order to repair the dam, does not allow for an impoundment as per the WDNR orders, and is not a sustainable solution over the long-term.

2.4 Actions Considered But Eliminated From Further Consideration

The following alternatives are eliminated from further consideration. Reasons for eliminating the alternative are discussed as follows:

Proposed Action – Rehabilitate the Dam

Section 2.2.1 describes the Proposed Action to rehabilitate the dam and excludes year-round fish passage. The Proposed Action would create a fish barrier during portions of the year when the gates are closed. This can result in a fragmented habitat needed for various life requisites (e.g., habitats for spawning, development, growth, etc.), reduces fish populations, and creates an elevated risk to local and watershed extinctions and diminished genetic diversity. Mussels are dependent on specific fish species as a host and can be likewise impacted due to dams.

Ozaukee County has invested $8 million in fish passages upstream of Estabrook Dam. Migrating fish from Lake Michigan would be limited to the Milwaukee River up to Estabrook Dam when the gates are closed. The environmental benefits and recreational benefits to upstream river users would be directly diminished if the migrating fish could not travel further upstream from Estabrook Dam.

For these reasons, the Proposed Action is eliminated from further consideration. Alternative 1A is the same as the Proposed Action with the addition of fish passage and is a feasible alternative.

Alternative 3 – Abandon and Remove Dam, Providing a 5.5-Foot High Rock Ramp to Facilitate Fish Passage and Establish an Impoundment

Section 2.2.4 describes Alternative 3 consisting of a 5.5-foot high rock ramp to be located about 1,600 feet upstream from Estabrook Dam. The rock ramp provides an impoundment for recreation and aesthetics, but exceeds the 100-year flood elevations during a 100-year flood event. Therefore, this alternative is eliminated from further consideration.

Alternative 3A – Abandon and Remove Dam, Providing a 4-Foot High Rock Ramp to Facilitate Fish Passage and Establish an Impoundment

This alternative is described in Section 2.2.5 and consists of a rock ramp similar to Alternative 3 and at the same proposed location, but would be 4 feet high instead of 5.5 feet high. The 4-foot high rock ramp could handle a 100-year frequency flood event without exceeding the 100-year flood elevations.

This alternative is feasible, but results in a shallower impoundment as compared to Alternative 4. The capital, operating, and maintenance costs for Alternative 3A would be similar to Alternative 4. The recreational benefits for motor boating regarding Alternative 3A are less than Alternative 4. For these reasons, Alternative 3A is eliminated from further consideration and Alternative 4 will be further evaluated.

Alternative 5 – No Action

The No Action alternative is eliminated from consideration because it does not address the WDNR Administrative Order, it would not allow an impoundment due to the WDNR restrictions, and is not a long-term sustainable solution. In the long-term, the dam would continue to deteriorate until it became a safety issue to County staff and the public. Section 2.2.7 contains additional information on this alternative.

Alternative 6 – New Dam

This alternative is described in Section 2.2.8 and consists of a new dam at the same general location as the existing dam. This alternative is cost prohibitive for the County, especially because the existing dam's life can be extended about 20 years through implementing some structural upgrades at a substantially lower cost. For these reasons, Alternative 6 is eliminated from further consideration.

2.5 Capital and Operating Costs for Feasible Alternatives

The economics of Estabrook Dam and the alternatives are the responsibility of Milwaukee County taxpayers. The following is an overview of the capital, operation, and maintenance costs for the dam and alternatives, plus a discussion on the potential funding sources.

The estimated capital and long-term annual operation and maintenance (O&M) costs of the three alternatives (Attachment 9) are as follows:

2.5.1 Alternative 1A – Rehabilitate the Dam and Add Provisions for Fish Passage

The operating costs include a dam gate operator who must be available to adjust the gates during high river flows and impending storm events. This is imperative to avoid flooding out upstream property owners during major storm events. Operating costs include routine dam gate maintenance and repair and debris removal, and these operating costs are long-term.

The capital costs include rehabilitation of the dam and adding fish passage. This capital cost is intended to extend the dam life for an additional 20 years. After 20 years, more rehabilitation to the dam can be expected because the dam at that point will be about 100 years old. The anticipated capital costs to rehabilitate the dam in 20 years is unknown, but could be assumed to be in the same range or more than the current proposed capital cost plus inflation. If a new dam is needed, the

capital costs would be substantially more than the rehabilitation costs. These are important considerations when comparing the costs to the other two alternatives.

For Alternative 2, there are no future capital or operation and maintenance costs because the dam is removed. For Alternative 4, the rock ramp is not expected to need appreciable capital cost in the future, but some structural rehabilitation to the fixed crest spillway may be needed, but the associated cost would be relatively small. There are some operation and maintenance costs associated with Alternative 4, which are substantially less than Alternative 1A.

2.5.2 Alternative 2 – Abandon and Remove the Dam

The capital costs include demolition of the dam and removal. There are no long-term operation and maintenance costs which result in substantial savings to the County. This is the most sustainable alternatives based on costs.

2.5.3 Alternative 4 – Gated Spillway Removed, Serpentine Overflow Spillway Lowered, and a 6.3-Foot High Rock Ramp Constructed

The capital costs include demolition of the dam's gated section and revisions to the rest of the dam. Fish passage is included using the rock ramp.

The operating costs include provisions for debris removal similar to a dam. Provisions to annually move around rocks which may have been altered by ice flows is included, which is conservative because most rock ramps require little such maintenance for moving rocks due to their large size (5 feet, 5 ton boulders are typical). There are smaller rocks involved with the ramp, but tend to be more protected from movement due to the surrounding larger stones.

Alternative	Estimated Capital Cost	Estimated Annual Operation and Maintenance Cost
1A	$2,518,000	$160,000
2	$1,674,000	$0
4	$2,419,000	$55,000

The estimated O&M costs are annual costs and can be expected to increase over time due to inflation. These annual costs are long-term. In addition, these costs will increase the most for Alternative 1A as the dam gets older.

Based on these cost estimates, Alternative 1A, rehabilitating the dam with fish passage, has the highest capital cost and highest annual O&M costs of the three alternatives. Alternative 2, which removes the dam and returns the Milwaukee River to a free-flowing condition, has the lowest capital cost and no annual O&M cost.

2.6 Present Worth Analysis

A present worth analysis considers the capital and O&M costs over a 20-year period to determine the overall project costs for the three alternatives. The annual O&M costs are converted to a present worth based on an inflation rate of 2 percent per year over the 20-year period. The resulting present worth is the theoretical amount of money needed at today's costs to pay for the annual O&M costs over the next 20 years. The total present worth cost is the capital cost plus the present worth of the annual O&M costs over 20 years. The following chart summarizes these present worth costs.

Present Worth Analysis

Alternative	Estimated Total Present Worth Costs
1A	$5,134,000
2	$1,674,000
4	$3,318,000

Based on the present worth analysis, Alternative 1A has the highest total present worth cost. Alternative 2 has the lowest present worth cost and is about $3,460,000 lower in present worth than Alternative 1A. In terms of present worth, Alternative 1A is about three times as expensive as Alternative 2. Alternative 4 is about twice as expensive as Alternative 2, based on present worth.

2.7 Funding

Milwaukee County has $1,600,000 of Bonding capacity available through its annual budget process. WDNR's Municipal Dam Grant Program contains funds for repair to the dam (existing structure or rock ramps). The County would need to request a variance to use the money for dam removal, since the County originally indicated the money would be used for repairs. The grant contains criteria for eligibility and has allocated $400,000 with a Milwaukee County cost-share. The Wisconsin Stewardship Fund has funding up to $1 million that may be made available to the County for dam repair (existing structure or rock ramps), or dam removal. There is a Milwaukee County cost-share. The US Fish and Wildlife Service has authorized a grant for $220,000 for fish passage to the County.

The County's cost-share on these grants is summarized as follows:

1. WDNR Municipal Dam Grant – The County cost share is 50 percent of the first $400,000, then 25 percent of the next $800,000, with a maximum grant amount of $400,000 for a $1,200,000 project.

2. WDNR Stewardship Grant – The County cost-share is 25 percent of the eligible costs.

3. US Fish & Wildlife Service – The County's cost-share is projected at $355,000 and the US Fish & Wildlife grant amount is $220,000 for a total project of $575,000.

The annual operation and maintenance costs for the dam or rock ramp will need to be funded by the County. The County presently has a dedicated Estabrook Dam fund of about $100,000.

3.0 Affected Environment

This section identifies the affected environment of the three feasible Estabrook Dam alternatives in terms of physical environment, biological environment, cultural, socio/economic considerations, archaeological/ historical, and other special resources. Reference documents provided as attachments are identified.

3.1 Maps, Plans, and Other Descriptive Material

A listing of maps, plans, and other descriptive material provided in attachments are as follows.

Attachment 1:	Figure 1 Aerial Map
Attachment 2:	Estabrook Dam Historic Information
Attachment 3:	SEWRPC Technical Memo Dated April 25, 2014 Draft
Attachment 4:	SEWRPC email Dated April 29, 2014 Regarding Estabrook Dam Modeling With the Gates Closed and Stoplogs in Place
Attachment 5:	Excerpts from Lincoln Park/ Milwaukee County River Channel Sediments Phase II Pre-Final Remedial Design Report dated January 2014, prepared by EA Engineering, Science, and Technology, Inc.
Attachment 6:	County Parkways Map
Attachment 7:	Wetland Inventory Map
Attachment 8:	Wetland Related Correspondence
Attachment 9:	Cost Estimate for Alternatives
Attachment 10:	Operation Plan Information
Attachment 11:	Milwaukee River Water Quality Information
Attachment 12:	1937 Aerial Photo of the Dam
Attachment 13:	Historical Land Plat Survey
Attachment 14:	Birds of Estabrook Park
Attachment 15:	US Fish & Wildlife Trust Resources List

3.2 Physical Environment

The Estabrook Dam is located in the Milwaukee River basin. A basin report is available at http://dnr.wi.gov/water/basin/milw/milwaukee_801.pdf. The topography of the basin was formed by glacial deposits superimposed on underlying bedrock, and ranges from a high of 1,360 feet above sea level in the Northern Unit of the Kettle Moraine State Forest to 580 feet at the Milwaukee Harbor. The surface slopes downward from the north and west to the south and east. The physiography is typical of rolling ground moraine, although surface drainage networks are generally well connected, leaving relatively few areas of the watershed that are internally drained.

The dam and overflow spillway sit on a limestone ledge in the Milwaukee River. A mile long 200-foot wide, 6-foot deep channel was mined from the limestone ledge in the vicinity of the existing dam in the 1930s to help alleviate flooding in this area along the Milwaukee River. A dam was built on top of the limestone ledge at that time to maintain a pool of water above the dam, which was controlled by operating gates. This pool of water extends approximately 3.2 miles upstream at time of full pool and the riverbanks are only a few feet above normal water level.

Sediment Removal Project

Historic industrial activity in the watershed has contaminated sediment with PCB and other pollutants. USEPA, WDNR, and Milwaukee County are implementing Phase II of the sediment removal project to capture sediment from multiple locations from Lincoln Park and continuing downstream to Estabrook Dam. This Phase II will begin in 2014 and restoration will be completed in 2015. Additional information on this topic is found in Section 1.6.

Hazardous Materials

The sediment removal project involves removal of PCB and CPAH contaminated sediment which is separate from this EA. No hazardous materials are involved with this project.

River Flows and Water Resources

The floodplain of the Milwaukee River upstream from Estabrook Dam is defined on FEMA Flood Insurance Rate Maps. The 100-year frequency flood is based on Estabrook Dam having all 10 gates open. There is development upstream of the dam and property owners within the floodplain who have mortgages are required to carry flood insurance.

SEWRPC's river modeling was performed (Attachment 3) to evaluate the feasible alternatives and to address mean flow, median flow, 10-year, 50-year, 100-year, and 500-year frequency events. Water depth under these flow scenarios was addressed to reflect recreational and environmental conditions.

River flows at Estabrook Dam are summarized as follows (Attachment 3):

- Median Flow – 240 cfs
- Mean Flow 451 cfs
- 10-Year Frequency Flood – 8,790 cfs
- 50-Year Frequency Flood – 12,900 cfs
- 100-Year Frequency Flood – 14,800 cfs
- 500-Year Frequency Flood – 18,810 cfs

Wild and Scenic Rivers

The Milwaukee River is not classified as a Wild and Scenic River and therefore, is not applicable.

Wetland and Riparian Zones

Wetlands are present within the floodplains of the Milwaukee River. Alternatives 1A and 4 create an impoundment that can affect the water levels in the wetlands. Alternative 2 will result in lower water depths within the wetlands within the river floodplain.

According to the US Fish & Wildlife Service resources list (Attachment 15), the project area includes the following wetland types:

Wetland	NWI Classification Code	Total Acres
Freshwater Forested/Shrub Wetland	PF01/EMBg	0.5422
Freshwater Forested/Shrub Wetland	PF01 Bg	4.4097
Riverine	R2UBH	662.8964

Regarding the riparian zone, if Alternative 1A or 4 is implemented, the riparian zones will remain unchanged. If Alternative 2 is implemented, the former impoundment will result in more exposed land. This exposed land is expected to remain in the public domain.

Air Resources

Air resources will remain unchanged under the three feasible alternatives long-term. In the short-term, all three feasible alternatives would have similar air impacts due to construction and/or demolition activities for the alternative. Dust and construction equipment exhaust are the primary causes to affect localized air quality during the construction related activities for all feasible alternatives within the construction zone, immediate area, and access roads.

Global Climate Change

The project will not affect global climate change.

Livestock Grazing

The project will not affect livestock grazing. The land use is primarily urban and park land within the project area and no livestock grazing occurs in this area.

Noise and Odor

Noise will be a short-term issue during construction and/or demolition of the preferred alternative within the construction area and immediate vicinity. Noise will not be an issue long-term with any alternative.

Odor will not be an issue short-term or long-term with any alternative.

Soil Resources

Soil resources will not be appreciably affected by the alternatives. Alternative 1A will require concrete and stone riprap which means stone, gravel, and sand will be quarried at a commercial site for these materials.

Alternative 2 involves demolition of the dam, so construction materials will not be required. The demolished concrete will be recycled where feasible to be used as aggregate for road projects or other beneficial uses.

Alternative 4 will require stone, riprap, and some concrete work to rehabilitate parts of the dam and to construct the rock ramp. These materials will be obtained from commercial quarries.

3.3 Biological Environment

The biological environment is addressed in terms of aquatic and terrestrial for the alternatives.

3.3.1 Aquatic

The Estabrook Dam is located within the Milwaukee River South Watershed. The watershed covers about 168 square miles and is located in portions of Ozaukee and Milwaukee Counties. The Milwaukee River main stem enters the watershed west of the Village of Fredonia and flows for about 48 miles before entering the Milwaukee Harbor. Land cover in the watershed is a mix of rural and urban uses. Overall, the watershed is about 33 percent urban, with agriculture (25 percent), grasslands (21 percent), forests (12 percent), and wetlands (6 percent) making up the rest of the major land cover types. Fourteen cities and villages are found in this watershed. As with other watersheds in the basin, the streams in the Milwaukee River South Watershed exhibit a wide range of quality.[1]

Nearly 15 percent of all perennial stream miles in this watershed are significantly modified to the extent they have limited ability to sustain diverse biological communities. Many of these streams were straightened, enclosed, or lined with concrete to facilitate water movement downstream to alleviate flooding concerns. From a water quality and biological standpoint, this type of river modification causes wide fluctuations in water levels over short periods of time, increases channel scour, and provides little to no habitat for aquatic life. Establishing a natural channel with natural riparian buffer helps create more diverse habitat for biological activities. Where possible, the Milwaukee Metropolitan Sewerage District (MMSD) has implemented major flood water storage and river enhancement activities in Lincoln Creek, South Branch Creek, and Indian Creek and other areas.[1]

Approximately $8 million has been invested to construct fish passages on the Milwaukee River in Ozaukee County to bypass dams. Fish passage is a very important element to the ecosystem because many species of life are dependent directly or indirectly on fish. Fish passage for Estabrook Dam is important because it is downstream from these fish passages and fish migrating from Lake Michigan must pass through Estabrook Dam or its alternative to reach further upstream.

Approximately 61 miles of streams (10 percent of the total Milwaukee River basin stream miles) do not meet USEPA Clean Water Act water quality standards on a consistent basis and are listed as 303(d) impaired waters. With the exception of one stream in the North Branch Watershed, these lower quality stream miles are located in the most densely populated areas of the basin. Many of these streams were modified by straightening, enclosure, or concrete lining to move water off the land and

more quickly downstream. Approximately 2.4 miles of the Milwaukee River near the Estabrook Dam are impaired due to contaminated sediment, point, and non-point source pollutant impacts.[1]

Wisconsin Wetland Inventory data indicates that the Milwaukee River South Watershed currently contains more than 6,000 acres of wetlands. Note that wetlands are the most abundant in the northern watersheds, and are least abundant in the urbanized areas.[1]

Fish Community

The fish found within the Milwaukee River and Estuary are typical of riverine systems in Wisconsin.[1] The fish survey report reviewed included the river system within the Ozaukee and Milwaukee Counties. No specific survey was available for the Estabrook Impoundment. The connection to Lake Michigan has also allowed non-native species such as the Alewife, Sea Lamprey, Round Goby, Brown Trout, and Chinook Salmon to travel up river. Known or highly expected migrations occur from Lake Michigan and the Milwaukee Estuary up and down the river system. Barriers such as the Estabrook Dam can inhibit this migration, however, with the dam gates open, some migration is possible. Secondly, this dam is not a true barrier because the dam is submerged during a 100-year frequency flood. The Bridge Street Dam in Grafton was identified by WDNR and US Fish & Wildlife Service as the first complete barrier to aquatic invasive species.[1]

Some of the best smallmouth habitat on the Milwaukee River and southeast Wisconsin is located in between the Estabrook Dam and Milwaukee Estuary and upstream of the Kletsch Park Dam. Fish consumption advisories for the Milwaukee River watershed can be found on the website www.dnr.wi.gov/FCSexternalAdvQry/FishAdvisorySrch.aspx.

The Milwaukee River contains a diverse cool and warm water fish community which includes sport and forage fish species. Gamefish and panfish known to be present or suspected upstream and/or downstream of the Estabrook Dam include lake sturgeon, smallmouth and largemouth bass, walleye, muskellunge, northern pike, bluegill, green sunfish, pumpkinseed, rock bass, bluegill, channel catfish, flathead catfish, yellow and black bullhead, and yellow perch. Common forage or non-game species in the Milwaukee River may include fathead minnow, golden shiner, common carp, stoneroller, common shiner, horneyhead chub, white sucker, creek chub, central mud minnow, and redhorse. Fall migrations of Lake Michigan run Coho, chinook salmon, and brown trout and fall strains of rainbow trout, and spring running strains of rainbow trout occur. The Milwaukee River does not provide suitable habitat for significant reproduction and recruitment of these trout and salmon species. However, rainbow trout are able to spawn and successfully reproduce in Pigeon Creek, which discharges to the Milwaukee River at Thiensville in southern Ozaukee County. The Milwaukee River is classified as a warm water sport fish community per NR 102 and NR 104. Fish passage is a component of all the alternatives and will enhance the fish diversity and fish populations.

Invasive Species

Although Estabrook Dam, located 6.9 miles upstream of Lake Michigan, does obstruct fish movement when the gates are closed and river flow is below flood stage. The dam is not considered a complete barrier to aquatic invasive species (AIS) because the river overtops the dam during floods, as discussed above, and the leaping and swimming ability of Pacific salmon and rainbow trout. The WDNR and USFWS have identified the Milwaukee River, Village of Grafton's Bridge Street Dam, located 32 miles upstream of Lake Michigan, as the first complete barrier to fish and AIS. Round goby from Lake Michigan have migrated upstream to the Kletzsch Dam at river mile 10. Round goby have also been observed upstream and immediately downstream of the Thiensville Dam at river mile 20.

As of 2013, annual fishery surveys at multiple sites between the downstream of the Thiensville Dam and upstream of the Thiensville Dam did not include the capture of Round goby. These results suggest that the presence of Round goby upstream of the Thiensville Dam are the result of human introductions possibly by fisher bait releases.

Endangered, Threatened, and Special Concern Species

The Wisconsin Natural Heritage Working List contains species known or suspected to be rare in the state and natural communities native to Wisconsin. It includes species legally designated as "Endangered" or "Threatened" as well as species in the advisory "Special Concern" category. There are no federally listed fish species in the Milwaukee River Basin.

Endangered

The striped shiner is the only state-listed endangered fish species that potentially exist or are known to exist in the Milwaukee River.[1]

Striped Shiner

The striped shiner is ranked with a global element of G5 and a state element rank of S1.[1] These rankings reveal that this species is secure globally but is imperiled in Wisconsin. The S1 or critically imperiled ranking is due to extreme rarity defined as five or fewer occurrences per acre, very few remaining individuals, or some factors make it especially vulnerable to expiration in Wisconsin. During the mid-1990's, WDNR crews sampled multiple reaches at various times along the Milwaukee River and identified a single specimen from the river in Ozaukee County.[1] The striped shiner is a warm water species that spawns on clean coarse substrate, larger than coarse sand. The parents guard and ventilate their eggs keeping them clear of silt. They prefer flowing river habitats and their diet is predominantly macroinvertebrates. They are considered intolerant of degraded habitat.

Threatened

The state-listed threatened fish species that potentially exist or are known to exist in the Milwaukee River include the greater redhorse, redfin shiner, and longear sunfish.

Greater Redhorse

The greater redhorse is ranked globally as a G3 and has a state-wide ranking of S2S3.[1] These rankings reveal the greater redhorse is either very rare and local throughout its range, found locally abundant in a restricted range, or that other factors may make it vulnerable to extinction throughout its range. The Milwaukee River Basin is one of the most secure populations of greater redhorse in Wisconsin.[1] The greater redhorse is a warm water species. They spawn on clean coarse substrate, gravel-sized and larger. They inhabit large rivers and, among the various Redhorse species, they have also adapted to lake environments. Their diet is predominantly macroinvertebrates. There is no parental care; eggs are deposited on rock, rubble, or gravel where embryo and larvae develop without parental care. They are considered intolerant of degraded habitat.

Redfin Shiner

The redfin shiner is classified globally as G5 and has a state-wide ranking of S2.[1] These rankings reveal the redfin shiner is secure globally and is rare in parts of its range. In Wisconsin, it is very rare.

It has been collected in the Milwaukee River in Milwaukee County very infrequently (Becker, 1983, and Lyons, et al., 2000).[1] This fish is a warm water species that can tolerate more turbid waters. They prefer pool cover in large, low-gradient rivers over boulders, cobble, sand, or stable silt. They spawn by scattering their eggs with adhesive membrane that sticks to coarse clean substrate, submerged alive or dead aquatic plants or recently flooded vegetation, or sometimes on logs or branches. The parents do not build a nest nor do they guard their eggs or ventilate the eggs to keep them clear of silt. They prefer macroinvertebrates for their diet.

Longear Sunfish

The longear sunfish is ranked globally as a G5 and has a state-wide ranking of S2.[1] These rankings consider the longear sunfish to be secure globally but may be rare in areas of its range. It is very rare in Wisconsin. Milwaukee River Basin populations have declined with few remnant populations in Washington and Fond du Lac Counties (Lyons, et al., 2000).[1]

Special Concern

Three state-listed fish species of special concern that potentially exist or are known to exist include the banded killifish, least darter, and lake sturgeon.

Banded Killifish

The banded killifish is classified globally as G5 and state-wide as S3.[1] The fish is considered to be secure globally but can be rare in areas of the range. In Wisconsin, this fish is considered rare or uncommon. The fish has been identified in the Milwaukee River upstream in Ozaukee County.[1]

Least Darter

The least darter is classified globally as G3 and state-wide as S3.[1] These rankings indicate the fish is either rare and local throughout its range, or found locally in a restricted range. They are rare or uncommon in Wisconsin.

Lake Sturgeon

Lake sturgeon is classified globally as G3/G4 (vulnerable) and state-wide as S3.[1] Globally, the fish is very rare and local throughout its range. It is rare or uncommon in Wisconsin, but there is a secure population in the Wolf/Fox River basins. Occasionally, WDNR observes a lake sturgeon in the Milwaukee River Estuary. Stocking of these fish has been underway near Newburg in Ozaukee County in the Milwaukee River.[1]

Mussels

A recent study was done of the Milwaukee River in the vicinity of the Estabrook Dam, the Milwaukee River Greenway. The study made a qualitative analysis of the mussel populations in four areas of the river. The study identified 11 mussel species within the Milwaukee River Greenway (Elktoe, Spike, Wabash Pigtoe, Plain Pocketbook, Fat Mucket, White Heelsplitter, Fluted-shell, Giant Floater, Creeper, Lilliput, and Ellipse). However, 3 of these species (Spike, Lilliput, and Ellipse) were identified from shells and no live specimens were found. Of the 11 species identified, the Elktoe is classified as a species of Special Concern in the state of Wisconsin and the Ellipse is classified as a Wisconsin Threatened Species. The Elktoe is notable because of its status as a species of Special Concern in

Wisconsin and it was identified, alive, in the Milwaukee River Greenway. Its' typical habitat is flowing water with various substrates (silt, mud, sand, gravel, rock) that are stable. Natural or restored shorelines with vegetation, roots, logs, and natural structures can create stable sediments and substrates to help the species.[7]

It was noted that very few juveniles and sub-adult mussels were located during the study. This may indicate that the current condition of these areas of the river is not conducive to mussel reproduction. This may be due to conditions related to contaminants, low oxygen, silt movement, drought, and temperature change.[7]

Various construction activities within the river can have an impact on the mussel population. Dredging, dam removal, shoreline reconstruction, sediment removal, and other activities can negatively impact the existing mussel beds and the resulting population. Restoration of beds should be considered as part of a mitigation plan after such activities. Additionally, translocation and repatriation of mussel species also may be needed.[7]

Macroinvertebrates

No site-specific sampling of macroinvertebrates was performed for Estabrook Dam. SEWRPC[1] determined that riffle habitats contain the highest quality macroinvertebrate communities compared to pool, run, snag, or lake habitats in the Milwaukee River watershed. Habitat types such as lakes, pools, riffles, and runs generally contain very different compositions of substrates, water depths, and flows which affects the abundance and diversity of the macroinvertebrate community.

The Milwaukee River Watershed's macroinvertebrate community quality has generally remained in the good-to-very good Hilsenhoff Biotic Index (HBI) rating from 1975 to the present, within most of the watersheds.[1] Eight, or nearly 40 percent, of the subwatersheds contained sites that ranked in the fair HBI classification, which indicates some level of potential impairment to the macroinvertebrate abundance and diversity. Except for the Lincoln Creek subwatershed, most of the subwatersheds throughout the Milwaukee River watershed continue to sustain a fair to good-very good macroinvertebrate community.[1]

The five main groups of macroinvertebrates in the trophic structure include shredders, collectors, filterers, scrapers, and predators. The relative abundance of the groups is dependent upon the abundance of food and habitat. The types and diversity of these groups may be used as indicators of certain kinds of stream disturbance or pollution.[1]

The Lower Milwaukee River Watershed, referred to here as south of Ozaukee County, has been undergoing intensive development during the past 70 years, and open space has been declining. Increasing the population and also increasing the impervious surfaces usually results in degrading habitat.[1]

Aquatic Plants

Aquatic plants surveys of the Estabrook Impoundment are not included as part of the normal lake monitoring program and are not available. Submerged isolated patches of Potamogeton natans and P.pectinatus are present.

3.3.2 Terrestrial

Plant Communities

The plant community within and adjacent to the project site (Milwaukee River floodplain) is considered wetland complex and consists of wet meadow and second growth, southern wet to wet-mesic lowland hardwoods. No endangered or threatened plant species were found.

General, Federal, and State Sensitive and Threatened and Endangered Plant Species

No known general, federal, and state sensitive and threatened and endangered plant species will be affect by these alternatives.

Noxious and Invasive Weeds

The project involves construction activities within the river. The alternatives are not expected to affected noxious and invasive weeds.

Wildlife

The wildlife in the area of Estabrook Park is typical of southeastern Wisconsin. The grasses, bushes, trees, and wetlands along the river combined with Estabrook Park and Lincoln Park provide an environmental corridor and habitat for a variety of wildlife including deer, raccoons, squirrels, mink, rabbits, chipmunks, skunks, foxes, beaver, muskrat, river otter, and coyotes. Birds are likewise plentiful and include robins, cardinals, sparrows, crows, and grackles. Ducks consist of both locals and migratory species such as mallards, teal, and wood ducks. Herons are common along the river and marshes. As part of the Lake Michigan flyway, the corridor experiences diverse migrations of song birds and raptors. Osprey and Bald eagle are occasionally observed fishing the Milwaukee River corridor between upper Ozaukee County and as far downstream of the Estabrook Dam and Hubbard Park in the Village of Shorewood. Attachment 14 provides a list of birds observed at Estabrook Park compiled by Charles Hagner of the Friends of Estabrook Park and editor of Bird Watching Magazine.

General, Federal, and State Sensitive and Threatened and Endangered Species

The aquatic general, federal, and state sensitive and threatened and endangered species are presented earlier in this section. The state-threatened Butler's Gartersnake and habitat occur in Milwaukee County, but the dam and alternatives are not expected to affect the snake.

A discussion on the natural heritage inventory screen was performed for the USEPA sediment removal project which extends from Lincoln Park to Estabrook Dam. Refer to Section 4.2.1 for additional information. There were no federal listed threatened or endangered, proposed or candidate species located in the project area that would be affected by the proposed alternatives based on the Natural Heritage Inventory conducted on the USEPA sediment project.

Attachment 15 contains information from the US Fish & Wildlife Service regarding endangered species which could be in the project area. The northern long-eared bat is a proposed endangered species.

Migratory Birds

Migratory birds are found within the project area. Attachment 14 contains a listing of birds observed in Estabrook Park by Charles Hagner, editor of Bird Watching Magazine and a member of the Friends of Estabrook Park. The proposed alternatives are not expected to have a significant impact on the migratory birds. The birds may experience some disruption during the construction period, but this impact is short-term.

The US Fish & Wildlife Service's list of migratory birds in the project area is found in Attachment 15.

3.4 Cultural Environment

3.4.1 Land Use

The lands on the north bank of the Milwaukee River are located within the City of Milwaukee and are owned by Milwaukee County and are part of Estabrook and Lincoln Parks. The lands along the right (south) bank are located within the City of Glendale and are in commercial ownership west to Port Washington Road and single family residential west of I-43 for approximately 4-1/2 blocks to Lincoln Park. The right (south) bank of the river at the dam is in private ownership and is currently owned by Wheaton Franciscan Services, Inc.

3.4.1.1 Recreational Resources

The Milwaukee River is a public waterway. Much of the river corridor is characterized as primary environmental corridor. Recreational use of the river includes: fishing, swimming, wading, motor boating, canoeing, kayaking, hiking, bird watching, and other paddle sports. Among these activities, deeper drafting motorized boating would be the most impacted by the drawdown of the impoundment, especially during late summer and early fall base- and low-flow river conditions. Canoe and kayak may be limited in some access areas, most notably the upstream limits of the east oxbow with low water depth and the accumulation of debris. Accesses to lands formerly formed by the impoundment are generally accessible by walking, as these former sediments have become compacted, de-watered, and overgrown with vegetation. The sediment remediation project has significantly increased the effective water depth along Lincoln Creek and especially the west oxbow.

Estabrook Park is located on the north bank of the river near Estabrook Dam. The park provides activities including: picnic areas, disc-golf, sand volleyball, skate park, soccer fields, softball diamond, tot lot, restrooms, paved multi-use trail, parking areas, dog exercise area, and beer garden.

Residents upstream from Estabrook Dam have used the river for fishing, canoeing, kayaking, and motor boating. When the impoundment was present, these water sports were common. With the dam gates open, the water sports experiencing a decline in use is motor boating almost exclusively by riparians. There are no public launch facilities that also provide suitable parking for vehicle and trailers. Following drawdown of the impoundment, access for launching and landing small personal watercraft is available along accessible shorelines and road crossings.

3.4.2 Visual Resources

The visual resources of the alternatives vary by the alternative and involve personal preference to a degree.

Alternatives 1A and 4 create an impoundment that is viewed by some of the public very positively. Alternative 1A involves a seasonal impoundment from mid-May to mid-September and a drawdown for the balance of the year. During the drawdown, mud flats became exposed and are viewed as a detrimental impact from an aesthetic standpoint. The fill and draw nature of Alternative 1A does not allow these shallow areas from developing aquatic vegetation, thereby resulting in mud flats. Secondly, the impoundment promotes sediment accumulation which becomes evident in the exposed mud flats.

Alternative 2 provides a different visual experience than Alternatives 1A and 4. A free-flowing river is returned with vegetated banks. The existing mud flats will become vegetated naturally.

Alternative 4 will create a year-round impoundment. Mud flats will primarily remain below water level year-round, which improves the aesthetics.

3.5 Socio/Economic

Estabrook Dam is located in the Milwaukee River corridor within the highly urbanized City of Milwaukee. Urbanized development with more impervious areas contributes to flooding concerns in the area. Local residents who live adjacent to the river and impoundment created above the dam claim to have suffered the loss of recreational use, increased flooding, changed aesthetics, and disproportional loss of property values because the dam gates have been open since 2008.

Milwaukee County population in 2014 is about 953,000. The number of properties that directly benefit from the Estabrook Dam impoundment are about 350 properties. Based on an estimated population of 2.4 people per dwelling (US Census Bureau, Persons Per Household for Milwaukee County for 2008-2012), the 350 properties represent a population of about 840. In addition, the general public directly benefits from the aesthetics of the Milwaukee River and the nearby Estabrook Park and Lincoln Park. The Milwaukee River Parkway intersects the river at multiple locations and provides a scenic overlook of the river.

Downstream from Estabrook Dam is continuation of Estabrook Park, and urban development including residential, commercial, and industrial development. The Village of Shorewood is to the east of Estabrook Park, the City of Milwaukee is to the south of Estabrook Park, and the City of Glendale is to the north of Estabrook Park. The Milwaukee River includes a green space along the river corridor with a hiking/bike trail along parts of the river corridor and plans are underway to extend the hiking/bike trail in both directions from Estabrook Park. The Oak Leaf bike trail runs through Estabrook Park.

Upstream from Estabrook Park is Lincoln Park and primarily residential development in an urban setting. Lincoln Park and Estabrook Park provide an ideal recreation resource for the urban population and is a popular destination for biking, hiking, picnics, fishing, kayaking, canoeing, boating, bird watching, and enjoying nature in close proximity to populated cities and villages.

Section 2.5 contains a discussion of the estimated capital, operation, and maintenance for the feasible alternatives. Potential funding sources are also presented. The total present worth costs for the feasible alternatives is summarized below and further presented in Section 2.6 and Attachment 9.

Alternative	Estimated Total Present Worth Costs
1A	$5,134,000
2	$1,674,000
4	$3,318,000

The results show Alternative 2 is the most cost effective based on a present worth analysis. Alternative 4 is about twice as expensive in total present worth as Alternative 2. Alternative 1A is about three times more expensive as Alternative 2 in terms of total present worth.

The potential for expanded redevelopment upstream and downstream from Estabrook Dam is possible in properly zoned areas. Upstream from Estabrook Dam, there are pockets of commercial development that could benefit from any of the three feasible alternatives. Most of the upstream property from Estabrook Dam is either park or residential development. The residential development dates back to the 1940s to 1960s in general.

Downstream from Estabrook Dam includes parkland, some commercial, industrial, and residential. The three alternatives present similar opportunities for development downstream. Since the North Avenue Dam was removed from the Milwaukee River formerly located downstream of Estabrook Dam, the surrounding area has seen a substantial redevelopment along the river, including condos, restaurants, and other businesses in the vicinity of the former North Avenue Dam.

3.6 Archaeological/Historical and Paleontological Resources

A report[2] entitled “Phase 1 Archaeological Survey for the Rehabilitation of Estabrook Dam on the Milwaukee River, Milwaukee County, Wisconsin” dated August 2012 and prepared by AVD Archaeological Services, Inc., presents the findings from the archaeological survey of the dam area, island, and vicinity for access routes in Estabrook Park and along the south side of the river.

The findings from the report are that Estabrook Park contains an extensive distribution of artifacts in the ground. Various park related disturbances have destroyed the archaeological context in some parts of the site, but perhaps not in others. The proposed access road within the park has been regularly used in the past for similar purposes. If the present plan is not changed, there should be no damage to unaffected parts of the archaeological site.

The survey report was submitted to the State Historic Preservation Officer for review and the approval has been received. Eleven Tribal Historic Preservation Officers were contacted for comments concerning the project and only one response was received from the Stockbridge-Munsee Tribe, indicating the project was not within their area of interest.

AECOM has contacted the State of Wisconsin Historic Preservation Office in April 2014 to inquire about the historical significance of Estabrook Dam. The structure dates back to the 1930s. The State of Wisconsin Historic Preservation Officer (SHPO) has not responded as of July 2014. Milwaukee County retained Mead & Hunt to perform a study on the historical significance of Estabrook Park including the Estabrook Parkway, the bridges, and Estabrook Dam. The study concluded that

Estabrook Park, Estabrook Parkway, the bridges, and Estabrook Dam were eligible as a historic place and are recorded in the National Register of Historic Places.

Milwaukee County will prepare a Historic American Engineering Record (HAER) study on Estabrook Dam if discussions with SHPO conclude that a HAER study is warranted. If Alternative 1A is selected, a HAER study may or may not be necessary depending on how SHPO views the fish passage as a change to the dam. If Alternative 2 or 4 is preferred, a HAER study will probably be required after discussions with SHPO.

Based on the results of the HAER study, additional steps may be necessary prior to dam removal (Alternative 2) or significant alteration (Alternative 4). The additional steps taken on other dam projects where the dam was listed on the National Register of Historic Places include providing signage or a plaque recognizing the dam as a historically significant structure at the former dam site. The HAER study also includes past design documents for the dam to be a historic record for the structure.

3.7 Other Special Resources

There are no state natural areas or prime agricultural lands associated with this project.

3.8 Areas of Critical Environmental Concerns

The project area does include one area of environmental concern which is the sediment removal project from Lincoln Park to Estabrook Dam, as discussed in Section 1.6 This USEPA project involves WDNR and Milwaukee County and is separate from the Estabrook Dam EA.

3.9 Environmental Justice

Environmental justice is the fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.

The feasible alternatives provide equal opportunity for the public to enjoy the Milwaukee River. The addition of a public boat launch in the impoundment area is recommended to provide better public access regarding Alternatives 1A and 4. If Alternative 2 is selected, canoe and kayak access is available in the County parks and at bridges.

3.10 Native American Religious Concerns

The project does not involve a Native American Religious site. Refer to Section 3.6 for additional information.

3.11 Wilderness

The project does not involve a wilderness.

3.12 Forests

The project does not involve forests.

3.13 Lands With Wilderness Characteristics

The project does not involve lands with wilderness characteristics.

3.14 Prime or Unique Farmland

The project does not involve prime or unique farmland.

3.15 Summary of Environmental Resources

The following is an overview of the primary environmental resources addressed for the project and alternatives. Sections 3 and 4 provide specifics for the respective alternatives.

Resources Considered	Affected	Not Affected
Areas of Critical Environmental Concern		X
Environmental Justice		X
Fish Habitat	X	
Prime or Unique Farmlands		X
Fire and Fuels		X
Floodplains	X	
Forests		X
Native American Religious Concerns		X
Wilderness		X
Lands With Wilderness Characteristics		X
Wild and Scenic Rivers		X
Wetland and Riparian Zones	X	
Air Resources	X	
Archaeological / Historical Resources	X	
Paleontological Resources		X
Global Climate Change		X
Hazardous Materials		X
Livestock Grazing		X
Noise and Odor	X	
Recreation Resources	X	
Soil Resources	X	
General, Federal, and State Sensitive and T&E Plant Species		X
Noxious and Invasive Weeds		X
Visual Resources	X	
Water Resources	X	
General, Federal, and State Sensitive and T&E Wildlife Species		X
Migratory Birds	X	
Socioeconomics	X	

4.0 Environmental Consequences

Environmental consequences refer to the probable adverse and beneficial impacts including indirect and secondary impacts. This environmental assessment can draw upon the conditions when the dam was in operation as well as when the gates were open during the period of 2008 to the present to provide actual environmental benefits and negative impacts which could be expected for the three feasible Estabrook Dam alternatives.

4.1 Physical

4.1.1 Alternative 1A – Rehabilitate the Dam and Add Provisions for Fish Passage

The dam repairs will provide dam structure stability and public safety and improve dam operations. The impoundment could be drawn down in the future for inspections, maintenance, repairs, and invasive species management. Refilling the impoundment will change the riverine setting that has been in place since drawdown in 2009. At full pool, the impoundment will extend approximately 3.2 miles upstream of Estabrook Dam. Visual changes will occur from a free flowing river to an impoundment, shallow lake setting. New slope protection both upstream and downstream of the gated dam structure will stabilize and protect the embankment. The sediment from behind the fixed crest spillway and further upstream will be removed as part of the Phase II USEPA Sediment Removal Project in 2014 (Attachment 5).

SEWRPC modeled the river based on the 100-year flood and the dam gates open which resulted in determining the 100-year flood elevations from the dam and extending to approximately West Bender Road. SEWRPC has also modelled the river based on the 100-year flood and the dam gates being closed to determine the effect on flood elevations. If the 10 gates are closed during a 100-year frequency flood, the 100-year flood elevations will be exceeded and can contribute to upstream flooding. This situation has potential liability to the County due to flooding and associated property damage. This situation is a major concern to the County and additional precautions must be taken by the County to protect upstream property owners if Alternative 1A is implemented as follows:

1. Develop an Inspection, Operation, and Maintenance Plan for the dam to define the conditions and actions to be taken during significant storm events as well as seasonal operation of the dam. Further discussion on the Operation Plan is contained in Section 2.2.2.4.

2. Retain a dam gate operator to be available to regulate the dam gates to correspond to high river flows and impending storm events. Predicting significant storm events and high river flows can be a challenge and will require the County to have staff available to continually monitor river and weather conditions. A flood event somewhat greater than a 10-year frequency is large enough to cause upstream flooding equivalent to a 100-year flood if the 10 gates are closed at the time. This can be a huge liability issue to the County.

3. Provide a contingency plan to operate the dam gates in the event of gate malfunction due to a power outage or gate failure.

Long-term impacts include the positive aesthetics of the impoundment extending upstream from West Silver Spring Drive during normal (median) flow conditions.

A buildup of sediment in the impoundment can be expected over the long-term use of the dam. Sediment removal may be required in about 20 years. Some sediment will travel downstream during

the period when the gates are open. Best management practices for stormwater will be used during the construction activities. The impoundment can result in elevated water temperature which can result in lower dissolved oxygen levels.

4.1.1.1 Wetland and Riparian Zone

Alternative 1A will result in wetlands within the floodplain having a deeper water depth due to the impoundment from mid-May to mid-September. For the balance of the year, the impoundment will be drawn down and the wetlands will experience reduced water levels.

Regarding the riparian zone, the impoundment will be in place mid-May to mid-September. The balance of the year the water level will be lower and will include more exposed land. Property owners with boat houses will be able to use these structures for their intended use.

4.1.1.2 Air Resources

Air resources long-term will not be affected under Alternative 1A. During the construction at the dam, some dust will result, but will be short-term and primarily limited to the vicinity of the construction zone.

4.1.1.3 Noise and Odor

Short-term noise can be expected during construction activities. Long-term noise issues are not expected.

4.1.1.4 Soil Resources

Soil resources will not be appreciably affected by Alternative 1A, but materials such as gravel, sand, and stone will be needed for construction and will be obtained from a local quarry. Long-term soil resources do not apply to this alternative.

4.1.2 Alternative 2 – Abandon and Remove the Dam

The dam removal will return the river to a natural, free-flowing state. Dam demolition is a short-term condition which can result in dust, noise, and traffic congestion during the construction related activities. Best management practices for stormwater will be used during construction activities.

A buildup of sediment is not expected because the river is free-flowing. The aesthetics of the river will be similar to the existing conditions. Some woody vegetation and shrubs have developed along the river edge which can restrict debris. Where appropriate, this additional riverbed/bank vegetation has been accounted for in the floodplain modeling and, in the opinion of SEWRPC staff, would represent an insignificant barrier to floating ice and large debris.

The North Avenue Dam was removed and returned to a free-flowing river. This dam removal is viewed by environmentalists and the general public as a very positive action. River aesthetics are improved, development along the river including condominiums and retail establishments has greatly expanded, and fish diversity and populations have likewise been well documented. The vegetation also provides wildlife habitat along the Milwaukee River environmental corridor.

Alternative 2 is capable of handling the 100-year frequency flood. This alternative actually lowers the 100-year flood elevation as compared to Alternative 1A. No County staff is needed during a flood to

operate dam gates or to remove debris as is the case with Alternative 1A. Alternative 2 provides a simpler, lowest cost, sustainable solution.

4.1.2.1 Wetland and Riparian Zone

Alternative 2 will result in wetlands within the floodplain to experience water levels similar as observed since 2008. As the river levels fluctuate, water levels within the wetlands will likewise see some fluctuation in water depth.

The riparian zone will experience more exposed land by removal of the dam. These exposed areas will continue to become vegetated with grasses, shrubs, and trees. Property owners with motor boats and boat houses will no longer be able to use their motor boats due to the shallower water, but use of canoes and kayaks will continue for the long-term.

4.1.2.2 Air Resources

Air resources long-term will not be affected by Alternative 2. In the short-term, air quality could be affected due to dust during demolition of the dam within the vicinity of the construction work.

4.1.2.3 Noise and Odor

In the short-term, noise can be expected during demolition of the dam if a person is in the vicinity of the construction zone. In the long-term, noise will not be an issue. Odor will not be an issue in either the short-term or long-term.

4.1.2.4 Soil Resources

Soil resources will not be an issue. Demolition of the dam will result in concrete that can be recycled for aggregate for road projects and thereby avoid the need to mine a comparable amount of aggregate.

4.1.3 Alternative 4 – Gated Spillway Removed, Serpentine Overflow Spillway Lowered, and a 6.3-Foot-High Rock Ramp Constructed

Alternative 4 requires the gated section of the dam to be removed, and a rock ramp built, and the fixed crest spillway lowered resulting in short-term impacts due to dust, noise, and traffic congestion during construction. Best management practices for stormwater will be used during the construction activities.

A buildup of sediment in the impoundment can be expected over the long-term use of the rock ramp. Sediment removal in the vicinity of the dam may be necessary long-term. Frequency of sediment removal is not known, but may be an event performed approximately every 20 years.

The rock ramp is intended to perform similar to the natural rock ledge which created an impoundment prior to the dam being constructed. The impoundment will extend to West Silver Spring Drive, but not quite as deep as Alternative 1A. Alternative 1A extends to 0.7 miles upstream from West Silver Spring Drive. The aesthetics of Alternative 4 will be similar to a shallow lake.

The rock ramp creates a flow condition similar to a natural pool and riffles which avoids the operation and maintenance associated with the dam. The rock ramp does not allow for lowering the water

levels as in the case of a dam. The flashboards will remain in place under normal operating conditions. The County will have the option to remove the flashboards to lower the impoundment for maintenance purposes such as removal of debris or sediment removal. The flashboards could lower the impoundment by about 2.4 feet for this alternative.

Water levels for Alternative 4 are further discussed in Section 2.2.6. An operation, inspection, and maintenance plan and an emergency action plan must be developed, and an owner inspection would be required every 10 years.

Debris removal such as trees and brush will be required annually when it collects on the rock ramp or behind the fixed crest spillway. This debris removal is similar to the conditions with Alternative 1A.

O&M costs associated with Alternative 4 are primarily with debris removal. O&M costs are also included to annually reposition rocks and boulders for the rock ramp if the boulders and stones get moved by ice flows or floods. This matter was discussed with Luther Aadland of the Minnesota DNR who wrote the book "Reconnecting Rivers: Natural Channel Design in Dam Removals and Fish Passage."[5] Mr. Aadland provided the following comments on rock ramps:

1. Debris maintenance for rock ramps is similar or less than maintenance on a dam because the debris tends to flow over the rock ramp when higher flows occur.

2. Moving rocks or boulders annually to reposition after spring floods or ice flows have not been a problem because the boulder size is typically 5 feet weighing 5 tons and, therefore, not susceptible to movement during floods. Smaller rocks are also part of the ramp, but are more protected in the pools by the larger boulders during floods or ice flows.

3. Rock ramps are not intended for high head dams due to the massive amount of rock required to build the ramp. High head dams refer to dams being 30 to 40 feet high. Alternative 4 having a 6.3-foot high rock ramp can be readily accomplished.

4. Mr. Aadland has been personally involved in over 75 rock ramp projects throughout the United States and the ramps have been very successful in providing replacements to conventional dams, providing an impoundment, providing recreational opportunities, and fish passage with less cost than a conventional dam (less capital and O&M costs). In some cases, the ramps provide fish passage around existing dams.

5. The rock ramps tend to be a safer environment than a conventional dam which can create powerful currents immediately downstream from the dam, which has been the reason for drownings at some dams.

6. The rock ramps provide fish passage and thereby enhance the fish diversity and population. Mussels and other aquatic creatures likewise benefit.

7. Design features should take into account other species. For example, larger spaces in riprap can create potential traps for turtles. Therefore, these openings should be filled in with smaller stones to protect the turtles from getting stuck in the riprap.

The aesthetics of the river will be similar to when the dam gates were closed, but the impoundment will not be quite as deep as Alternative 1A.

The river will look more natural after the dam is partially removed. The rock ramp will typically be submerged and will resemble natural riffles.

Alternative 4 provides capacity to handle the 100-year frequency flood. No County labor is necessary to open gates during floods. This is a huge advantage for the County as compared to Alternative 1A which has potential liability to the County if the gates are not opened in time or if the gates malfunction during a major flood event (15-year flood or greater).

The rock ramp provides a year-round recreational impoundment with relatively stable river levels. The impoundment tends to increase water temperatures which can result in lower dissolved oxygen levels.

4.1.3.1 Wetland and Riparian Zones

Alternative 4 will cause the wetlands within the floodplain to have a deeper water depth due to the year-round impoundment.

Regarding the riparian zone, the impoundment will result in a shallow lake. The property owners with boat houses will be able to use these structures for their intended use.

4.1.3.2 Air Resources

Air resources long-term will not be affected under Alternative 4. During construction at the rock ramp, some dust will result, but will be short-term and primarily limited to the vicinity of the construction zone.

4.1.3.3 Noise and Odor

Short-term noise will result during construction activities in the vicinity of the construction zone. Long-term noise issues are not expected. Odor will not be an issue in either the short-term or long-term.

4.1.3.4 Soil Resources

Soil resources will not be appreciably affected by Alternative 4, but materials such as stone will be needed to build the rock ramp. The gated section of the dam will be demolished and the concrete will be reused as the base of the rock ramp and then stones placed over this reused broken concrete. Long-term soil resources do not apply to this alternative.

4.1.4 Physical Resources – Not Applicable

The following physical resources do not apply to these alternatives as discussed in Section 3.

- Hazardous Materials
- Wild and Scenic Rivers
- Livestock Grazing

4.2 Biological

Biological impacts refers to the wildlife, fisheries, water resources, water depth, plant community, and endangered resources. The impacts are presented as follows.

4.2.1 Wildlife

Wildlife will be displaced to other available habitat in the Milwaukee River environmental corridor when the impoundment is filled for Alternatives 1A and 4. Alternative 2 will not affect the wildlife because it is very similar to the conditions that existed since 2009. During construction/demolition work, wildlife will be temporarily disrupted until the work is completed for all alternatives.

Aquatic habitat will change under Alternatives 1A and 4 with a deeper pool. For Alternative 2, the aquatic habitat will be very similar to the conditions that existed since 2009.

No comprehensive surveys of turtles and herptiles have been completed for the Milwaukee River in the vicinity of Estabrook Dam. Snapping turtles, painted turtles, bullfrogs, and green frogs are expected to inhabit the area. Care will be provided during design of Alternatives 1A or 4 where riprap is proposed to minimize the spaces between the rocks that could potentially trap turtles. These spaces between the rocks will be filled in with smaller stone where possible.

A natural heritage inventory screen was performed for the USEPA sediment removal project which extends from Lincoln Park to Estabrook Dam. This project area includes two sites for Butler's gartersnake and incidental take authorization was provided by WDNR Bureau of Endangered Resources. The following is expected from the Sediment Removal project Environmental Assessment:

> "Based on the information submitted to our office, we have evaluated the proposed site according to the criteria of the Butler's Gartersnake Conservation Strategy (http://dnr.wi.gov/org/land/er/review/Butler). Due to the size and quality of suitable Butler's gartersnake habitat, the project was classified as containing a portion of two Tier 1 Sites (Site of Minimal Conservation Value). The sites were on the southern boundary where there appears to be wetland as well as along the eastern boundary in a small non-agricultural section. As a result, the site is covered under the broad Incidental Take Authorization for Tier 1 Butler's Gartersnake sites (http://dnr.wi.gov/org/land/er/take/TierOneButlers.htm). Per the authorization, no conservation measures are required for the state-listed snake and any take that results from the proposed project is covered. However, it is recommended that the voluntary measures described within the above Strategy be incorporated into the project design to benefit the snake at the site."

Based on the Natural Heritage Inventory (NHI), there are no federal listed threatened or endangered, proposed or candidate species located in the project area that would be affected by the proposed alternatives.

4.2.1.1 General, Federal, and State Sensitive and Threatened and Endangered Species

There are no known general, federal, and state sensitive threatened and endangered plant species that will be affected by these alternatives.

The northern long-eared bat is a proposed endangered species as reviewed by the US Fish & Wildlife Service and is further discussed in Attachment 15. Also, the state-threatened Butler's Gartersnake habitat occurs in Milwaukee County, but the dam and alternatives are not expected to affect the snake. Based on the Natural Heritage Inventory conducted on the USEPA sediment project, there were no federal listed threatened or endangered, proposed or candidate species located in the project area that would be affected by the proposed alternatives.

4.2.1.2 Migratory Birds

Migratory birds may experience some disruption during the construction period with any of the alternatives, but this impact is short-term during the construction. Long-term impacts to migratory birds are not expected with any of the alternatives.

4.2.2 Fisheries

The removal of contaminated sediment and debris will improve the health of the impoundment and fishery as part of the Sediment Removal Project, as discussed in Section 1.6. The drawdown of the impoundment should have positive impacts as the result of dredging of contaminated sediment, sediment compaction, and decreased plant density as a result of the drawdown. Those fish that remain in the system should find improved conditions for spawning, feeding, and growing conditions leading to an expected overall improvement in fish populations.

All three feasible alternatives will allow fish passage which should increase the diversity and population of fish and will create a more natural environment. Recreational fishing opportunities will exist with all three alternatives.

The fish passage proposed under Alternatives 1A and 4, and the free-flowing river condition of Alternative 2, will increase the probability of developing sustainable populations of lake sturgeon and walleye within the waters. Recreational fishing opportunities would be greatly expanded along the river.

The impoundment created by Alternatives 1A and 4 will increase the water temperature. Higher water temperatures can adversely affect some fish species, especially cold water species such as trout. Alternative 2 provides better conditions for the fish by minimizing water temperature increases.

The impoundment created under Alternative 1A and 4 can increase the water temperature and thereby reduce the dissolved oxygen content which can affect fish species. Some fish species such as carp are more tolerant to higher water temperatures which can result in carp dominating the fish population. When this occurs, carp commonly uproot the vegetation and stir up the sediment resulting in muddy water within the impoundment which also reduces the aesthetics of the pool. These are all negative impacts which can be long-term.

The following is excerpted from the Sediment Removal project Environmental Assessment:[6]

> "The only other species (Butler's gartersnake) that came through in the NHI screen was the state-threatened greater redhorse. The WDNR Regional Ecologist suggested that we use methods to minimize disturbance to potential spawning areas and that we limit the use of rock in the waterway to the extent possible. The site areas are sediment deposition areas and not known to currently provide spawning habitat for the greater redhorse. Rock will be used for toe protection in high erosion areas along Lincoln Creek and some of the oxbow, and the rock spaces will be filled with granular material to avoid potential pitfall areas for other species."

The greater redhorse prefers clean water of medium to large rivers, over bottoms of sand, gravel, or boulders. Spawning occurs in May or June. The greater redhorse spawns over substrate consisting

of gravel with mixtures of sand and small rubble in moderate to swift currents. It generally feeds on a diet of aquatic insects, mollusks, crustaceans, and plant material (Becker, 1983).[1]

Construction of Alternatives 1A and 4 could cause disruption to the greater redhorse spawning if this fish is present at Estabrook Dam and is spawning at the time of construction. If this occurs, it is probable that the fish will temporarily relocate to spawn in another nearby area of suitable habitat. The fish passage construction may enhance the river for this fish to spawn here in the future.

During demolition of the dam (Alternative 2), the greater redhorse would also be temporarily displaced if it is found near Estabrook Dam. The displacement of this fish would only occur during the demolition period.

4.2.3 Mussels

The most highly threatened and rapidly declining group of freshwater organisms are mussels (Vaughn and Taylor, 1999[9]). A major factor in the decline of freshwater mussels has been the large-scale impoundment of rivers over the past 75 years (Vaughn and Taylor 1999[9]). Mussels can live for decades and are vulnerable to habitat disturbance. Mussels are sedentary filter-feeders that may remain in approximately the same location for their entire long life span, so mussels are very limited when their habitat is altered. The effects from altered seasonality of flow and temperature regimes, changed patterns of sediment scour and deposition, changes in particulate organic matter, the food base for mussels are all important factors that can occur with an impoundment (Vaughn and Taylor, 1999[9]).

Dams can have negative impacts on the indigenous mussel population in a river environment. The Estabrook Dam can be expected to have similar negative impacts on the mussel population in the Milwaukee River. Dean[8], et. al. (2001), states that freshwater mussels have been devastated in North America due to dam impoundments on rivers. Dams change the physical, chemical, and biological aspects of rivers by restricting the movement of fish, altering flow regimes, increasing siltation upstream and from scouring downstream from the dam[8]. Periodic opening of gates can result in slugs of silt moving downstream from the dam and impacting mussels. The results are the mussel population gets fragmented by the dam, which can alter fish populations and restrict the migration of host fish for the mussels[8].

Dams affect the dispersion and life cycle of mussels by inhibiting the movement and migration of the host fish species, thereby restricting the dispersal and distribution of mussels.[8] An integral part of the mussel life cycle is the host fish. The glochidia (mussel larvae) attach themselves through various means to a host fish which will then carry the larvae until they form into juveniles and drop off. Dams may create a barrier for the host fish preventing longitudinal migration. The lack of migration, in turn, adversely affects the dispersion and distribution of mussel species throughout the river system.[8] Fish passages may allow the host fish to migrate more freely, alleviating these negative effects to the river system.

The impoundment created by a dam can have adverse effects as well. The river section below impoundments differs significantly from free flowing-rivers. These effects include altered seasonal timing of flow and temperature regimes, changes to patterns of scour and deposition of sediment, and altered transport of particulate organic matter, food base for mussels.[9] The altered seasonal timing of flow can result in abnormally high or low flows, sometimes on a daily basis. These flows can often occur at the “wrong” time of year.

The seasonal drawdown proposed for Alternative 1A can have a detrimental effect on mussels in the Estabrook Dam impoundment, especially in areas that are relatively shallow under full pool conditions, and then result in little to no water during drawdown. These drawdown conditions result in the mussels being exposed to the elements, which can cause asphyxiation, desiccation, and predation. The mud flats can dry up, the mussels travel at a very slow rate such as 12 inches per day, which leaves them very vulnerable to large changes in water levels, as experienced with a dam drawdown. When the water level is drawn down, predators such as raccoons can readily catch the exposed mussels. If the water levels drop to points that the mussels are exposed to the atmosphere, they can die from asphyxiation. The slow rate of travel does not allow the mussels to move to a deeper area in time. If the mussel travels at 12 inches per day, it would take nearly a year to travel 300 feet. In winter, the seasonal drawdown can result in the mussels exposed and freezing.

A discharge that is either high during the wrong season or high too frequently can have devastating impacts on mussels. High water and high flows can displace juveniles before they can burrow or attach to substrate, resulting in a high mortality rate. The increased flow can produce a rise in erosion and subsequent deposition of material downstream; both of which may result in loss of mussel habitat. The erosion and scour also results in an altered distribution of sediment. Increased sediment deposition can clog mussel siphons and gills which interferes with feeding and reproduction.[9]

A discharge that is too low during the wrong season or abnormally low for extended periods can also have adverse impacts on mussels. Significant periods of low flow below an impoundment can result in stranding mussels. Mortality in these situations is usually due to desiccation, asphyxiation, predation, and thermal stress (mussels lack the ability to regulate their body temperature). If stranding does not result in mortality, the associated physiological stress reduces mussel condition and ultimately reproductive potential. Mussels in shallow isolated pools are also exposed to hypoxia from algal production and ammonia pulses from decaying organics;[15] both of which have a detrimental effect on the mussel population and reproductive potential as a whole.

In summary, the seasonal drawdown associated with Alternative 1A can have a detrimental effect on mussels.

The impoundments created by Alternatives 1A and 4 can impact mussels through siltation and through the buildup of sediment within the impoundment. Alternative 1A can also affect mussels by the sudden release of sediment when the dam gates are opened which can affect mussels downstream from the dam. The fish passage features will allow fish to travel, which will allow mussels to find host fish. Alternative 2 is the most environmentally compatible solution for mussels.

4.2.4 Water Resources

4.2.4.1 Alternative 1A – Rehabilitate the Dam and Add Provisions for Fish Passage

Alternative 1A will include seasonal drawdowns. The operation plan for Alternative 1A is discussed in Section 2.2.2.4 and additional information is contained in Attachment 10.

A seasonal drawdown is proposed to start filling no earlier than May 15 and have the drawdown complete no later than September 15. The 10 gates are open during the drawdown.

The seasonal drawdown is initiated in mid-September to allow the ecosystem to adjust accordingly before winter arrives. This approach reduces the potential for certain species being caught off guard such as turtles, which could be affected if they began to hibernate, then the impoundment was

lowered resulting in freezing out many species. As previously noted in Section 4.2.3, mussels still can be negatively impacted by the seasonal drawdown.

In mid-May, the gates will be closed to create a full impoundment. There is flexibility in the dates for establishing a full impoundment so if a better time to initiate a full impoundment is preferred, the dates can be resolved with the County.

The May 15 start to filling the impoundment could affect nesting waterfowl. If this is an issue, a later date to initiate filling the impoundment may be more appropriate.

The seasonal drawdown is proposed to eliminate the need to adjust 10 dam gates during spring floods. There is more potential for dam malfunction in spring when gates may freeze or malfunction after not being operated for several months. In Section 2.2.2.4, a year-round full pool scenario is discussed, but eliminated from further consideration due to the operational challenges and high risk of structural damage to the 10 gates.

The seasonal drawdown can better accommodate ice flows in late winter/early spring. The seasonal drawdown also provides an opportunity for the County to remove debris, make repairs on the dam, for property owners to make repairs on their waterfront, and for communities to make improvements, if needed, to the storm sewer structures when they discharge at the river.

4.2.4.2 Alternative 2 – Abandon and Remove the Dam

This alternative restores the river to a natural free flowing condition with the fluctuations in water levels and river flows over time. No seasonal drawdowns are necessary. The river will self-regulate, thereby saving the County time and money because there is no maintenance. The fish and other aquatic species will benefit from genetic diversity and increased populations. Fish passages associated with Alternatives 1A and 4 are beneficial features, but can be species selective or species exclusionary. A free-flowing river is the most positive approach to guarantee fish travel.

4.2.4.3 Alternative 4 – Gated Spillway Removed, Serpentine Overflow Spillway Lowered, and a 6.3-Foot-High Rock Ramp Constructed

This alternative is similar to riffles which allows fish passage and provides a shallow impoundment in a natural setting. The alternative is a sustainable solution requiring no labor to operate gates as is the case with a dam (Alternative 1A). The disadvantages are that the impoundment is not as extensive as the dam in place and the gates closed and provides swimming, canoeing, and boating opportunities extending up to West Bender Road. Another disadvantage is the impoundment cannot be drawn down as is the case with a dam, but is similar to a natural lake which likewise cannot be drawn down.

This alternative provides fish passage and has been implemented on over 75 projects throughout the United States. The fish passage promotes fish diversity and likewise enhances other species such as mussels, which use fish as hosts.

This alternative will increase water temperature as compared to Alternative 2. Increased water temperature in an impoundment can be detrimental to some fish species. During prolonged hot weather, fish die-offs could occur if water temperatures get too high, and dissolved oxygen is reduced due to the water temperature. This potential condition relates to Alternatives 1A and 4, but is less likely to occur with Alternative 2.

4.2.5 Water Depth

Water depths are discussed in Section 2 for the three feasible alternatives. The environmental impacts regarding water depths for the three alternatives are summarized as follows:

Alternative 1A: An impoundment will allow for recreational opportunities including boating. The impoundment extends to 0.9 miles upstream of West Silver Spring Drive. Aesthetically, the impoundment will resemble a shallow lake that will extend about 2.8 miles.

Alternative 2: A free flowing natural river will be restored. Water depths will provide opportunities for canoeing, except during dry periods.

Alternative 4: The rock ramp will create a shallow impoundment which extends to 0.7 miles upstream of West Silver Spring Drive (2.6 miles from Estabrook Dam). Recreational opportunities include canoeing and boating. The impoundment depth will be about 1.2 feet shallower than the Alternative 1A impoundment. This alternative is an opportunity for recreation and aesthetics similar to Alternative 1A but without the expensive operation and maintenance costs associated with a dam. Some maintenance costs can be expected with Alternative 4 if logs get caught on the rock ramp, though the rock ramp can better accommodate logs than the dam. Some sediment removal can be expected over a couple decades with this alternative.

4.2.6 Plant Community

No Federal or State-designated Special Concern, Threatened, or Endangered plant species were found during observations of the site. Some shifts in plant community types and population can be expected for Alternatives 1A and 4 when the impoundment floods out current plant communities. The impoundment will create more aquatic plant communities to replace the terrestrial plant communities.

4.2.6.1 Noxious and Invasive Weeds

The project activities for all alternatives are primarily within the river. These alternatives are not expected to affect noxious and invasive weeds.

For Alternative 2, plant communities will be very similar to the existing communities that have been established since 2008.

4.2.7 Endangered Resources

A State-designated Endangered fish, the Striped Shiner, and two State-designated Threatened fish, Greater Redhorse and Longeared Sunfish, are known to occur in this reach of the Milwaukee River. In addition, suitable habitat may be present for the State-designated Threatened Butler's Gartersnake. This species was recently delisted as Threatened by the DNR. A State-designated Special concern mussel, the Elktoe, was found in the impoundment. All three alternatives are not expected to have a long-term effect on the Butler's Gartersnake. Alternative 1A could affect the Elktoe mussel, if present, due to the drawdown of the impoundment which could strand the mussel if the water level leaves the mussel exposed to the atmosphere where it could be asphyxiated, desiccated, frozen, or eaten by a predator. These conditions are not relevant to Alternative 4 because a year-round impoundment is planned. Alternative 2 is not expected to affect this mussel because a free-flowing river will occur. Some disruption to this species may occur during construction work at the dam for all alternatives. Refer to Section 3.3 for additional discussion on endangered resources.

4.3 Cultural

Cultural impacts refer to the land use, social and economic elements, and archaeological and historical aspects of the project and area.

4.3.1 Land Use

In general, the current land uses in the area are expected to continue with any of the three dam alternatives. The area is primarily developed. Some redevelopment may arise as a result of implementing any of these alternatives, and because the river sediment cleanup project will be completed in 2015. Redevelopment in the vicinity of the former North Avenue Dam has occurred and can be contributed to improved river conditions coupled with its proximity to the City of Milwaukee's downtown and popular east side neighborhoods.

4.3.1.1 Recreation

Specific impacts for the three alternatives are as follows.

Alternative 1A: The impoundment will provide more boating opportunities due to the deeper water depth than the other two alternatives. Some residents prefer the aesthetics of the impoundment as compared to a river. The alternative requires a canoe portage around the dam site, which is already established. The public is able to use the impoundment from mid-May to mid-September for boating, canoeing, and kayaking without the attention to low or high river flow affecting their recreational use. The public can travel upstream or downstream on the impoundment without the concerns of river current. The impoundment will continue to have a current, but the effect is less in an impoundment especially under normal river flow. These are advantages with the impoundment as compared to a free-flowing river.

Boat access to the impoundment is currently limited to a boat launch and if this alternative is selected, a public boat launch would be beneficial from a recreational standpoint. The existing boat launch is located at the end of a street with very limited parking. Canoe access is possible at the parks and near bridges.

Alternative 1A will contribute to the development of mud flats in the impoundment area which acts as a large settling basin where sediment will collect. Mud flats are common in rivers and can be created by the natural processes such as deposition in the river, but the impoundment promotes the settling of particles in the pool. The seasonal drawdown of the pool exposes these unsightly mud flats. Secondly, the seasonal drawdown results in exposed unsightly mud flats in formerly shallow areas. Public comments on this impact have been raised under the current drawdown and the mud flats have become vegetated in many areas. Seasonal drawdown under Alternative 1A will return these mud flats to unsightly barren areas. Some of these mud flats are part of the Phase II sediment removal project and will be restored, but future mud flats will develop over time with Alternative 1A.

Alternative 2: Canoeing opportunities are available. The river is restored to its natural condition which has its own aesthetics which are enjoyed by many. Though canoeing and kayaking opportunities would exist with Alternative 2, the actual time when these recreational activities can occur are more limited than with Alternatives 1A and 4. When river flows are high, it can limit recreational activities to only those experienced canoe or kayak enthusiasts. During lower river flows, there may be limited opportunities because the crafts encounter protruding rocks. These natural restrictions on recreational use of the river are common and accepted by most people who enjoy the river experience.

Alternative 2 offers an abundance of positive environmental impacts beyond recreation. It is significantly better for the fish and mussels, provides aesthetics that differs from an impoundment but is very scenic in other ways. Other sections contain additional information on the positive attributes of Alternative 2.

Alternative 4: This rock ramp provides an impoundment that is shallower than Alternative 1A. Boating and canoeing opportunities will exist for three seasons and extend up to West Silver Spring Drive. In winter, the impoundment can provide hiking, cross country skiing, ice skating, and ice fishing opportunities. Aesthetics for an impoundment will be created as well as the aesthetics of riffles at the rock ramp in Estabrook Park. This alternative may require a canoe portage around the rock ramp site.

Alternative 4 will result in mud flats over time as the sediment settles out in the pool. The year round impoundment will not expose these mud flats as the case with Alternative 1A.

As noted under Alternative 1A, a public boat launch is recommended to increase public access for Alternative 4. Fishing opportunities will exist with all three alternatives which provide fish passage. Fishing is a popular activity on the Milwaukee River and the fish passage will enhance the fishing opportunities.

The recreational use of the impoundment can be year-round, when winter sports are considered, and is a major advantage of this alternative. Alternative 2 provides recreational use of the river when the flows are sufficient, and Alternative 1A provides recreational use during the late spring to early fall when the public is most likely to enjoy these activities.

4.3.1.2 Visual Resources

The visual resources differ among the three alternatives. Alternative 1A provides an impoundment which will resemble a small lake for the period of mid-May to mid-September. After the drawdown, the visual appearance will be similar to a free-flowing river except for the exposed mud flats in the shallower areas of the drawn down impoundment. The mud flats exist because the impoundment settles out the sediment. The seasonal drawdown does not allow vegetation to take hold, resulting in the mud flats being seen.

Alternative 2 results in the aesthetics of a free-flowing river. The former impoundment became vegetated over time and creates a natural setting.

Alternative 4 creates a year-round impoundment. Vegetation around the impoundment will create a natural setting along most of the river. Some commercial areas will continue to look more urban. Mud flats will not be observed because they will be submerged.

Areas downstream from the dam are expected to remain unchanged regardless of the alternative unless some redevelopment would occur in the future.

4.3.2 Socio/Economic

The bulk of the work for the dam rehabilitation will occur in Estabrook Park, the central river island owned by the Bureau of Land Management and property on the right (south) bank of the river owned by Wheaton Franciscan Services, Inc. Easements to access these non-County-owned properties will be obtained from those owners prior to the initiation of construction. No ethnic group or cultural group will be affected by any of the dam alternatives. Zoning will not be impacted by any of the alternatives.

The economics of the alternatives are presented in Section 3.5 and Attachment 9. Potential funding sources are available to address a portion of the capital costs. The actual funding will be determined at a later dated based on the funding criteria and actual project specifics. Long-term O&M costs will be the responsibility of Milwaukee County taxpayers.

Alternative 1A has the highest capital cost to rehabilitate the dam and to add fish passage. This alternative also has the highest long-term annual O&M costs of the three alternatives.

There are about 350 property owners who directly benefit from the impoundment and these properties are located upstream from the dam. Additional people in the vicinity can enjoy the aesthetics of the impoundment. Lincoln Park and Estabrook Park users also benefit from the impoundment if the users view the impoundment as a benefit as compared to a free-flowing river, as provided under Alternative 2.

The total present worth of Alternative 1A is three times higher than Alternative 2. These present worth costs reflect the long-term cost impacts associated with operation and maintenance of a dam.

Alternative 2 has the lowest estimated capital cost, no O&M cost, and lowest present worth of the three alternatives. From a Milwaukee County taxpayer standpoint, Alternative 2 is the most promising.

Alternative 4 has estimated capital costs slightly less than but similar to Alternative 1A. The long-term annual O&M costs for Alternative 4 are significantly less than Alternative 1A because there are no dam O&M costs with Alternative 4. The total present worth of Alternative 4 is about $3,318,000 as compared to Alternative 1A at $5,134,000 and Alternative 2 at $1,674,000.

Overall, Alternative 2 is the most cost-effective option of the three alternatives. Alternative 2 is about half the total present worth cost of Alternative 4 and is about one-third the total present worth cost of Alternative 1A. These cost savings over the 20-year period are substantial for Alternative 2 as compared to the other alternatives. In addition to the cost savings, Alternative 2 provides environmental benefits of a free-flowing river. As previously discussed, the North Avenue Dam removal has been a success story for Milwaukee and the area. Implementing Alternative 2 can have similar positive results.

A study of more than 30 removed dams of Wisconsin's 3,600 small dams provide the following findings (Born et al. 1998)[12]:

1. Dam removal has been complex and contentious with limited community-based support for removal and loss of the impoundment.

2. In the case study of 30 removed dams, the estimates costs of repairing the dam averaged more than three times the cost of removal.

3. Governmental funding and financing is a key factor in the dam removal determination.

4. Watershed ecological considerations are typically not a major factor for most local communities.

5. Watershed management and restoration increasingly incorporate dam removal options as part of an integrated approach.

Removal of the dam under Alternative 2 will impact property owners along the river in terms of the private boat houses, sea walls and related infrastructure. Boat houses will no longer be viable to store the boats to access the river because the river depth will be too low for boat operation for most of the year. The sea walls will no longer be needed due to the reduced water depth.

Municipalities may need to do some improvements to their storm sewer outlets at the river under Alternative 2. In most cases, the outlet will continue to function as is. In some cases, additional rip rap may be necessary to route the storm water discharge to the river. From a function standpoint, the storm sewer system may operate better due to lower flood levels and less concern with storm sewer backups on City streets.

Redevelopment along the Milwaukee River both upstream and downstream from Estabrook Park could occur through implementing any one of the three feasible alternatives and because of the USEPA's ongoing sediment cleanup project which will be completed in 2015. Redevelopment has occurred along the Milwaukee River in other areas.

4.3.2.1 Dam Removal Impacts on Property Values

Removal of the Estabrook Dam is expected to have little impact on property values in the area surrounding the existing waterway and current impoundment. Property values, real and assessed, are a significant concern for property owners and taxing authorities. Although little research has been focused on assessing the impacts of dam removal and loss of impoundment on property values, preliminary studies have indicated that riparian property values (after dam removal) have remained unchanged or decreased temporarily with a rebound within 2 years. After 10 years, property values showed no difference from the value prior to dam removal (Sarakinos[3], et. al., 2003). Based upon sales market data between 1993 and 2002, comparison of residential properties in south-central Wisconsin where a small dam remains intact, a small dam was removed, and the river or stream has been free-flowing for more than 20 years, indicate that there is no noticeable increase in property price between properties with shoreline frontage along a small impoundment and properties along a free-flowing river or stream. In fact, if the properties retain frontage on the stream, there is no significant change in property price, except for an increase related to the increase in lot size, after the stream has returned to a free-flowing riparian state (Provencher[4], et. al., 2006).

The rebound and potential for increased property values may be related to the desire of potential property buyers for homes with larger lot size, near free-flowing rivers as opposed to properties with less land area near impoundments. The potential for improved water quality and reduced flood risk may also create an increase in the intrinsic value of properties along free-flowing streams as opposed to man-made impoundments. Property adjacent to any water body (stream or impoundment) has a perceived, inherent value. It appears that over time the differences in value between riparian or lake frontage may not be significantly different. The proposed action may have short term impacts on property values in the area, but values can be expected to rebound to similar levels as expected prior to proposed activity at the dam.

4.3.3 Archaeological/Historical and Paleontological Resources

From the Phase1 archaeological survey for rehabilitation of Estabrook Dam (AVD Archaeological Services, Inc.[2], 2012), no archaeological or paleontological resources will be affected by this project for any of the alternatives unless the dam is altered significantly. Refer to Section 3.8 for additional information. Estabrook Dam is listed on the National Register of Historic Places.

Alternative 1A may require a HAER study, depending on the results from discussions with SHPO. The addition of the fish passage in the area of flashboards may or may not be considered by SHPO as a significant change.

Alternative 2 will require a HAER study because the dam would be removed. A plaque or signage would be located at the former dam site showing the historical aspects of the dam.

Alternative 4 will require a HAER study because the gated section of the dam would be replaced with the rock ramp. A plaque or signage would be located at the dam showing the historical aspects of the dam. In Section 3.7, information is provided on Estabrook Dam and filed with the National Register of Historic Places. In addition, Milwaukee County will prepare a Historic American Engineering Record (HAER) study on Estabrook Dam if discussions with SHPO conclude that a HAER study is warranted. If Alternative 1A is selected, a HAER study may or may not be necessary depending on how SHPO views the fish passage as a change to the dam. If Alternatives 2 or 4 are preferred, a HAER study will probably be required after discussions with SHPO.

Therefore, based on the results of the HAER study, additional steps may be necessary prior to dam removal (Alternative 2) or significant alteration (Alternative 4). The additional steps taken on other similar dam projects where the dam was listed on the National Register of Historic Places include providing signage or a plaque recognizing the dam as a historically significant structure at the former dam site.

4.3.4 Other State Resources

There are no state natural areas or prime agricultural lands associated with this project.

4.3.5 Areas of Critical Environmental Concerns

The selected Estabrook Dam alternative to be implemented will be phased so construction does not interfere with the sediment removal project. The schedule completion for the sediment removal project is 2015, which will have ended before the dam alternative is implemented. The important aspect of the sediment removal project is to remove the sediment immediately upstream from the dam before the dam alternative is implemented

4.3.6 Environmental Justice

If Alternative 1A or 4 is implemented, a public boat launch in the impoundment is recommended to expand the access of the public to the impoundments for recreation. The current access is very limited in terms of accessibility and parking in the impoundment.

4.4 Summary of Adverse Impacts That Cannot be Avoided

4.4.1 Alternative 1A – Rehabilitate the Dam and Add Provisions for Fish Passage

Short-term impacts include dust, noise, and traffic congestion during repair of the dam and during sediment removal. A buildup of sediment in the impoundment can be expected over the long-term use of the dam. Some sediment will travel downstream during the period when the gates are open. Best management practices for stormwater will be used during the construction activities.

Wildlife will be displaced to other available habitat in the Milwaukee River environmental corridor when the impoundment is filled. Aquatic life will be temporarily disrupted during construction at the dam. Aquatic habitat will change with a deeper pool.

The impoundment will increase the water temperature which results in lower dissolved oxygen content which can affect some fish species. Carp can tolerate higher temperatures, can dominate the fish population, can uproot the aquatic vegetation, and stir up the sediment. These turbid conditions can adversely affect the pool aesthetics and directly affect the aquatic life.

Mud flats will continue to exist as sediment accumulates. The seasonal drawdown will expose these mud flats and will not allow these areas to be vegetated.

The seasonal drawdown is intended to protect the dam gates, and timing is important to protect the aquatic life from being impacted by freezing or desiccation. In spring, nesting ducks and other wildlife could be impacted if the filling of the impoundment happens too soon and floods out the nests. A delayed filling of the impoundment may be necessary some years to protect the wildlife.

Mussels may be impacted when the dam gates are intermittently opened and flush sediment downstream thereby affecting downstream mussels. Secondly, mussels can be impacted as sediment accumulates in the impoundment for Alternative 1A and 4. Mussels can be negatively impacted by seasonal drawdown as proposed for Alternative 1A.

The aesthetics of a free flowing river will change to the aesthetics of a shallow lake impoundment. These aesthetics are not necessarily better or worse, but are different as long as the gates are closed.

Water levels will be deeper relative to the other alternatives considered due to the impoundment, which can be viewed as both a positive and negative impact, depending on a person's perspective. Some shifts in plant community types and population can be expected for Alternative 1A when the impoundment floods out current plant communities. The impoundment will create more aquatic plant communities to replace the terrestrial plant communities.

The alternative will require the County to invest in the dam repair as well as long-term operation and maintenance. On a total present worth basis, this alternative is three times more expensive than Alternative 2.

4.4.2 Alternative 2 – Abandon and Remove the Dam

Short-term impacts include dust, noise, and traffic congestion during demolition of the dam and during sediment removal. Aquatic wildlife will be temporarily displaced during demolition of the dam.

The aesthetics of a dam impoundment will be changed to the aesthetics of a free-flowing river as currently is the case while the dam gates have been open since 2008. The aesthetics are a personal preference and are not necessarily a negative. As a free-flowing river, fluctuations in water levels and river flows will occur, as is the case with the existing dam gates open. Recreational boating will be very limited to periods of high river flow, but other forms of recreation such as canoeing will be available where river flows are sufficient to allow canoeing.

The alternative will require the County to invest in the dam removal, which is a substantially lower cost than to repair the dam. Long-term dam operation and maintenance costs will be eliminated. The demolition of the dam may require additional procedural steps to allow implementation, depending on

the results of the HAER study. Removal of the dam is a long-term impact based on its historical significance.

The sediment will not be an issue with Alternative 2 as compared to Alternative 1A and 4. The presence of mud flats will be diminished or eliminated. Some existing mud flats will be removed under the sediment removal project in 2014. Other existing mud flats will become vegetated and aesthetically be improved.

Property owners along the river will no longer be able to use the boats and boat houses during most of the year.

Removal of dams has documented improved fish populations in terms of fish diversity and populations as seen since the North Avenue Dam was removed.

4.4.3 Alternative 4 – Gated Spillway Removed, Serpentine Overflow Spillway Lowered, and a 6.3-Foot-High Rock Ramp Constructed

Short-term impacts include dust, noise, and traffic congestion during demolition of the dam and during sediment removal. A buildup of sediment in the impoundment can be expected over the long-term use of the rock ramp. Best management practices for stormwater will be used during the construction activities. Wildlife will be displaced to other available habitat in the Milwaukee River environmental corridor when the impoundment is filled. Aquatic wildlife will be temporarily displaced during demolition of the dam gates and construction of the rock ramp. Aquatic habitat will change with a deeper pool.

Sediment accumulation in the impoundment can affect mussels as discussed under Alternative 1A. Water temperature will increase in the impoundment which can affect some fish species and fish diversity.

Water levels will be deeper due to the impoundment, which can be viewed as both a positive and negative impact depending on a person's perspective. Some shifts in plant community types and population can be expected for Alternative 4 when the impoundment floods out current plant communities. The impoundment will create more aquatic plant communities to replace the terrestrial plant communities. Water levels stay relatively constant year round providing more stable conditions for aquatic life and wildlife as compared to Alternative 1A. Year round recreation is provided.

The alternative will require the County to invest in the dam gate section demolition, the rock ramp, and some long-term maintenance costs to remove sediment behind the rock ramp, possibly on a 20-year frequency.

The aesthetics of a free flowing river, as currently is the case since the gates were open since 2009, will change to a shallow lake impoundment. These aesthetics are not necessarily better or worse, but are different.

The demolition of the dam may require additional procedural steps to allow implementation depending on the results of the HAER study. Removal of the dam gate section is a long-term impact based on its historical significance.

4.5 Significance of Risk

The three feasible alternatives for Estabrook Dam have environmental benefits and negative impacts, as discussed in this environmental assessment. The only significant risk is with Alternative 1A, due to the negative impact of increasing flood elevations exceeding the current 100-year flood levels when the dam gates are closed. The Operation Plan calls for the gates to be closed during summer but still passing at least minimum flow downstream at all times. If the Milwaukee River experiences a 100-year flood discharge during summer, closed gates at Estabrook Dam will result in flood elevations upstream of the dam in excess of the 100-year flood elevations determined assuming the spillway gates are open. This situation provides significant liability and risk to Milwaukee County.

Milwaukee County will have a dam operator available to monitor weather, river flows, and gate position. The dam operator will maintain a pool level based on the fixed crest spillway elevation. When water levels increase appreciably, the operator will open gates to pass the increased flow. The pool level will be lowered by no more than 6 inches per day to comply with WDNR requirements. If the gates malfunction due to a power outage or gate mechanical issue and all 10 gates are closed during the flood event, Milwaukee County is at risk of causing 100-year flood elevations upstream from the dam during a flood flow event only somewhat greater than a 10-year event. Manual overrides on the gates are provided, but operation of 10 gates manually can be a challenge during flood conditions. Public safety of County staff at the dam can become an important issue.

4.6 Significance of Precedent

All three alternatives have been successfully implemented at other locations. One topic of significant precedence involves Alternative 1A which will require the County's dam gate operator to monitor river level, weather, and gate positions to take action before a flood event occurs to avoid the gates being closed during a significant flood.

4.7 Significance of Controversy Over Environmental Effects

The public and regulatory agencies have the benefit to observe environmental effects of Alternative 1A and Alternative 2. Alternative 1A is demonstrated by the decades of use of the dam and the resulting impoundment. The public is aware of the recreational opportunities and aesthetics of the impoundment. The sediment buildup upstream of the dam is likewise well documented. Public support for the dam and against the dam are known facts on this project.

Alternative 1A with the proposed seasonal drawdown can have a negative impact on mussels located in shallow areas of the impoundment. When the pool is drawn down, the mussels can be exposed, resulting in asphyxiation, desiccation, and predation. The mussels move very slowly and, therefore, have limited capabilities to adapt to such fluctuations in water levels. Mussels are among the most threatened aquatic species in North America and dams are a significant factor in the decline of the mussel populations.

Alternative 2 will result in lower river levels as compared to the existing conditions experienced since 2009. This is the case because removing the dam increases the flow capacity in this reach, which results in lower water levels for a given flow. This can be a benefit when considering flood events, but can be a detriment under low river flows. Supporters of the dam prefer the impoundment for recreation, in particular, boating. This group also prefers the aesthetics of an impoundment resulting in a shallow lake setting. Their claim that the impoundment results in higher property values as

compared to water frontage on the river is debatable based on available literature and on Milwaukee County's review of property values in the vicinity of the dam.

Supporters of dam removal prefer a free flowing natural river which saves tax payers money, has no annual operation and maintenance costs, and is sustainable. Alternative 1A's total present worth cost is three times higher than Alternative 2. Alternative 4's total present worth cost is two times higher than Alternative 2. These cost savings over the 20-year period are substantial.

Alternative 4 provides a compromise to Alternatives 1A and 2 because it is sustainable, natural, resembles the natural conditions existing prior to the dam construction, and provides an impoundment extending upstream to West Silver Spring Drive and this impoundment is about 0.2 miles less than Alternative1A. Alternative 4 results in a somewhat shallower impoundment than Alternative 1A, but still provides the recreational opportunities including boating plus the aesthetics of an impoundment similar to Alternative 1A, but without the substantial long-term operation and maintenance costs of a dam (Alternative 1A).

Milwaukee County Board has gone on record to support rehabilitating the dam (Alternative 1, Proposed Action). Alternative 1A is the same as the Proposed Action with the addition of fish passage which is a substantial environmental benefit and consistent with the multi-million dollar investment in fish passage upstream by Ozaukee County.

4.8 Cumulative Impacts

The following summarizes the primary cumulative impacts for the three feasible alternatives.

4.8.1 Alternative 1A – Rehabilitate the Dam and Add Provisions for Fish Passage

1. Alternative 1A has the highest estimated capital cost at $2,518,000, highest annual estimated operation and maintenance cost at $160,000, and the highest total present worth cost of about $5,134,000 when compared to the other two feasible alternatives.

2. This alternative provides the aesthetics of an impoundment that can be enjoyed by the public for motor boating, canoeing, and other recreational activities.

3. The positive impact of fish passage is provided which allows for fish spawning, improves fish diversity, and expands sport fishing opportunities.

4. Seasonal drawdown of the impoundment is necessary to protect the dam gates from ice damage.

5. Seasonal drawdown from mid-September to mid-May can create environmental negative impacts to mussels and to potentially other aquatic life such as invertebrates. Mussels located in shallow areas of the impoundment can be left exposed to the atmosphere during a drawdown. Mussels, traveling at 12 inches per day, cannot respond quickly enough to protect themselves from seasonal drawdown. The negative impacts to the mussels are potential freezing, asphyxiation, desiccation, or predation. Fresh water mussels are the most threatened species in North America. Dams have been a major reason that mussels are in a decline based on the technical literature. Mussels can live for decades.

6. Siltation within the impoundment can likewise negatively impact mussels. In addition, siltation can affect fish spawning areas. Over time, possibly 20 years, the silt buildup upstream of the dam will need to be removed.

7. Periodic, sudden opening of the dam gates can result in collected sediment behind the gates being flushed downstream, which can suffocate mussels when they get covered by sediments and are unable to migrate the matter.

8. The seasonal drawdown can result in exposure of non-vegetative mud flats. These mud flats develop over time as the sediment settles out in the impoundment. The mud flats do not become vegetated because the seasonal impoundment restricts vegetation from growing. These mud flats are an aesthetic issue in addition to being a sediment issue.

4.8.2 Alternative 2 – Abandon and Remove the Dam

1. Alternative 2 has the lowest estimated capital cost at $1,674,000 and no operation and maintenance costs as compared to the other two feasible alternatives.

2. This alternative provides the aesthetics of a free-flowing river that can be enjoyed by the public for canoeing and kayaking, but motor boating would not be feasible during most of the year due to insufficient water depth.

3. This alternative results in a positive impact on the environment, especially for fishing and mussels.

4. A buildup of sediment is not an issue with this alternative as is the case with the other alternatives.

5. Alternative 2 will require a HAER study because demolition of the dam impacts a structure listed on the National Register of Historic Places.

4.8.3 Alternative 4 – Gated Spillway Removed, Serpentine Overflow Spillway Lowered, and a 6.3-Foot High Rock Ramp Constructed

1. Alternative 4 has costs that rank between Alternatives 1A and 2. The estimated capital cost is $2,419,000, and the estimated annual operation and maintenance costs are $55,000. The total present worth cost is about $3,318,000.

2. This alternative provides the aesthetics of an impoundment year-round that can be enjoyed by the public for motor boating, canoeing, and other recreational activities.

3. Fish passage is provided which is a positive impact.

4. Seasonal drawdown is not required, which is a positive impact on mussels and other aquatic life.

5. Siltation within the impoundment can impact mussels. In addition, siltation can affect fish spawning areas. Over time, possibly 20 years, the silt buildup upstream of the rock ramp will need to be removed.

6. The alternative will require a HAER study because demolition of a part of the dam is required. The dam is listed on the National Register of Historic Places.

5.0 Summary of Issue Identification Activities

5.1 Public Input

On June 5, 2014, Milwaukee County held a public scoping meeting on the Estabrook Dam Environmental Assessment. Representatives from Milwaukee County, AECOM, and SEWRPC provided an overview of the project history, condition of the dam, identification of alternatives, and selection of feasible alternatives. The County website allowed the public to provide written comments on the public scoping meeting until June 14, 2014. There were 125 responses from the public on the website pertaining to the meeting itself, alternatives, their preference, and related topics. There were 73 comments supporting the dam (Alternative 1A), 31 comments supporting removing the dam (Alternative 2), and 5 comments proposing the rock ramp (Alternatives 3A or 4). The balance of the comments pertained to related topics or did not provide a preference to the alternative. Two letters were also received by the County supporting the dam repair (Alternative 1A).

Some of the comments raised in the public survey are as follows:

- Provide a public boat launch upstream of the dam to allow people other than the property owner's access to the river/impoundment.
- The dam provides flood protection, and the other alternatives do not.
- The dam provides boating, canoeing, and kayaking opportunities with the impoundment.
- The current river levels allow for limited canoeing and kayaking because the river is either too high with fast current, or too low with rocks protruding.
- The impoundment directly benefits about 350 property owners and all Milwaukee County tax payers end up paying the long-term costs of the dam. Remove the dam.

The multiple comments about the dam providing flood protection were received. The technical basis needs to be clarified. The dam creates a substantial blockage in the river when the 10 gates are closed and the impoundment is in place. When the 10 gates are open, the dam can handle a 100-year frequency flood. The public views the gates open as flood relief, which is a true statement. If the 10 gates are closed, the dam will cause flood stages upstream similar to that of a 100-year flood event during an event only somewhat greater than a 10-year event. The County needs to be vigilant to monitor the weather and river flows to guard against this occurring if Alternative 1A is selected. If the gates malfunction due to a power outage or mechanical failure, the County is potentially liable for the upstream flooding caused by the dam.

Implementation of the other two Alternatives 2 and 4 would result in slightly lower flood stages during a 100-year event as compared to Alternative 1A (dam-in-place with gates open) (see Attachment 3, Table 7).

5.2 Agency, Government, or Other Public Input

The following is a listing of agencies, citizen groups and individuals either contacted or who provided input into the environmental assessment preparation.

Item	Date	Contact	Comment Summary
1	August 19, 2014	Charles Hagner, Friends of Estabrook Park	Bird Inventory for Estabrook Park
2	July 30, 2014	US Fish & Wildlife Service	Trust Resources List for Estabrook Dam
3	April 25, 2014	Mike Hahn, Chief Environmental Engineer, SEWRPC	Revised the April 8, 2014, Hydraulic Analysis Memo to include Alternative 4, rock ramp at dam.
4	April 16, 2014	Tanya Lourigan, WNDR	Provided an email requesting the Operational Plan be included in the EA.
5	April 16, 2014	Jim Keegan, Milwaukee County Parks	Provided an email requesting AECOM to include the Operational Plan in the EA.
6	April 16, 2014	Karl Stave, Milwaukee County	Provided an email summarizing the Operational Plan for Estabrook Dam.
7	April 15, 2014	David Dorner, Director, Milwaukee River Preservation Association	Provided email with comments on the SEWRPC Hydraulic Analysis for Estabrook Dam EA.
8	April 14, 2014	Sherman Banker, State Historic Preservation Officer (SHPO)	AECOM letter to SHPO requesting if the dam is classified as a historic structure.
9	April 14, 2014	Mike Hahn, Chief Environmental Engineer, SEWRPC	Email to Technical Advisory Team regarding the rock ramp alternative and DNR requirements if the rock ramp exceeds 6 feet and impounds more than 50 acre-feet of water is classified as a large dam.
10	April 11, 2014	Don Pirrung, AECOM	April 9, 2014 Meeting Minutes from Don Pirrung to Technical Advisory Team.
11	April 9, 2014	Estabrook Dam Technical Advisory Meeting	Technical Advisory meeting to discuss EA alternatives and river modeling.
12	April 8, 2014	Mike Hahn and SEWRPC Staff Chief Environmental Engineers, SEWRPC	Hydraulic Analyses for Estabrook Dam Environmental Assessment, Preliminary Draft April 8, 2014.
13	March 11, 2014	Glen Goebel, President Milwaukee River Preservation Association	Background information of the Milwaukee River and Estabrook Dam.
14	March 4, 2014	Don Pirrung, AECOM	Draft letter from Milwaukee County to Dean Grettinger at Bureau of Land Management regarding Estabrook Dam responding to February 6, 2014 letter from BLM.

Item	Date	Contact	Comment Summary
15	March 4, 2014	Don Pirrung, AECOM	Draft letter from Milwaukee County to Jesse Jensen, WDNR responding to WDNR's August 7, 2013 letter regarding Estabrook Dam.
16	March 3, 2014	Don Pirrung, AECOM	Email to Jesse Jensen WDNR regarding Estabrook Dam Critical Path schedule.
17	February 25, 2014	Glen Goebel, President Milwaukee River Preservation Association	Estabrook Dam Background Information.
18	February 22, 2014	Jesse Jensen, Water Management Specialist WDNR	Minutes from February 11, 2014 Estabrook Dam Technical Advisory Meeting.
19	February 12, 2014	Tanya Lourigan, Water Management Engineer, DNR	Template for an Inspection, Operation and Maintenance Plan (IOM) for a dam.
20	February 11, 2014	Estabrook Dam Technical Advisory Meeting	Discussion on Estabrook Dam Alternatives.
21	February 11, 2014	Marsha Burzinski, WDNR	EA Engineering, Science and Technology, Inc. Contaminated Zones and Deposits Figure for Phase II Milwaukee River and related text, dated January 2014.
22	February 6, 2014	Dean Grittinger, Field Manager Bureau of Land Management	February 6, 2014, letter to John Dargle, Milwaukee County Department of Parks, Recreation and Culture regarding Estabrook Dam Project.
23	February 2014	James Keegan, Milwaukee County Parks	Estabrook Dam EA Critical Path Schedule.
24	February 2014	Milwaukee River Preservation Association	Summary of Concerns to be included in Estabrook Dam EA Model.
25	January 19, 2014	Karl Stave, Milwaukee County	Draft Estabrook Dam Stipulation and Proposed Order, State of Wisconsin Circuit Court, Milwaukee County, Milwaukee Riverkeeper, Plantiff vs Milwaukee County, Case No. 11 - CV - O0878784.
26	August 28, 2013	Mike Hahn, SEWRPC Chief Environmental Engineer	August 28, 2013 memo from Joshua Murray, SEWRPC to Milwaukee County regarding Estabrook Dam alternatives.
27	February 7, 2013	Anthony Jernigan, US Army Corps of Engineers	Fax stating Wisconsin State Historic Preservation Officer finds the proposed undertaking will have no adverse effect on one or more historic properties within project regarding archaeological survey, October 26,

Item	Date	Contact	Comment Summary
			2013 statement, for Estabrook Dam project.
28	December 20, 2012	Don Pirrung, AECOM	November 28, 2012 Estabrook Dam Technical Advisory Team Meeting Minutes
29	November 28, 2012	Estabrook Dam Technical Advisory Team	Team Meeting to discuss Estabrook Dam and potential environmental impacts and alternatives.
30	November 27, 2012	Marsha Burzynski, WDNR	Lincoln Park EA for Sediment Removal Phase I.
31	October 26, 2012	Tanya Lourigan, WDNR	October 26, 2012 letter from DNR to James Keegan, Milwaukee County Parks regarding Estabrook Dam time extension.
32	August 6, 2012	Don Pirrung, AECOM	Revised Meeting Minutes for July 12, 2012 Estabrook Dam Technical Advisory Team meeting.
33	August 2012	Allen P. Van Dyke AVD Archaeological Services, Inc.	Phase I Archaeological Survey for the Rehabilitation of Estabrook Dam on the Milwaukee River, Milwaukee County, WI.
34	July 27, 2012	Don Pirrung, AECOM	Email to Karl Stave, Milwaukee County regarding wetland acreage affected by Estabrook Dam.
35	July 24, 2012	Karl Stave, Milwaukee County	Milwaukee River Parkway District, review of historic features including dam as a contributing factor to the history features of the area.
36	July 3, 2012	Steve Elver, AECOM	Project overview Estabrook Dam, sent to Bureau of Land Management.
37	February 27, 2012	Bernie Michaud, AECOM	Estabrook Park Dam Conceptual Fishway Design memo.
38	December 9, 2011	Tom Slawski, SEWRPC Principal Specialist - Biologist	SEWRPC No. CA-406-30 Wetland Inventory regarding Estabrook Dam project area.
39	June 30, 2011	Steve Elver, AECOM	Estabrook Dam - Removal of Dam Option Cost Estimate.

Item	Date	Contact	Comment Summary
40	September 8, 2010	Steve Elver, AECOM	Estabrook Park Dam Structural Repair Option Cost Estimate.

References

[1] "Environmental Assessment for Fish Passage in the Milwaukee River Watershed Project," prepared by National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Habitat Conservation, January 2010.

[2] Phase 1 Archaeological Survey for the Rehabilitation of Estabrook Dam on the Milwaukee River, Milwaukee County, Wisconsin," prepared by AVD Archaeological Services, Inc.

[3] "Social Perspectives on Dam Removal". *Dam Removal Research: Status and Prospects*. Sarakinos, Helen and S.E. Johnson. William Graf (editor). Washington D.C: The H. John Heinz III Center for Science, Economics and the Environment. Proceedings of The Heinz Center's Dam Removal Research Workshop, October 22-23, 2002. 2003.

[4] Provencher, Bill, Helen Sarakinos, and Tanya Meyer, "Does Small Dam Removal Affect Local Property Values? An Empirical Analysis". University of Wisconsin-Madison, Department of Agricultural & Applied Economics, Staff Paper Series, July 2006.

[5] Reconnecting Rivers: Natural Channel Design in Dam Removals and Fish Passage, Luther Aadland, Minnesota Department of Natural Resources, Ecological Resource Division, Fergus Falls, MN, 2010.

[6] "Environmental Analysis and Discussion of the Need for an Environmental Impact Statement (EIS), for Lincoln Park and Milwaukee River Channels Sediment Remediation Project," Wisconsin Department of Natural Resources, June 28, 2010.

[7] Mussels of the Milwaukee River Greenway: A Preliminary Survey, Gary S. Casper, Great Lakes Ecological Services, LLC; and Jason M. Dare, Dare Ecosystem Management, LLC, March 6, 2013.

[8] Effects of Lowhead Dams on Freshwater Mussels In Neosho River, Kansas, Joseph Dean, et al., Department of Biological Sciences, Emporia State University, Transactions of the Kansas Academy of Science 105 (3-4), pp 232-400, 2001.

[9] "Impoundments and Decline of Freshwater Mussels: A Case Study of an Extinction Gradient," Caryn C. Vaughn and Christopher M. Taylor, Conservation Biology pp912-920, Volume 13, No. 4, August 1999.

[10] "North Avenue Dam Feasibility Study, Application of the Fish Habitat Suitability Index Model for Dam Management Alternatives," Will Warzyn, Wisconsin Department of Natural Resources, January 1, 1997.

[11] "Effects of Tributary Spatial Position, Urbanization, and Multiple Low-Head Dams on Warmwater Fish Community Structures in a Midwestern Stream," Thomas M. Slawski, Francis M. Veraldi, Stephen M. Pescitelli, and Michael J. Pauers, North American Journal of Fisheries Management 28:1020 – 1035, 2008.

[13] Milwaukee River at South of Estabrook Park Dam, Station 10012616, Reporting Period January 1, 2006 to January 1, 2013 Monitoring Data Report, Milwaukee River Keeper, Wisconsin Citizen–Based Stream Monitoring Report.

[14] Milwaukee River South of Estabrook Park Dam, 2013 Continuous Temperature Chart, Milwaukee River Keeper.

[15] Spooner, Daniel E., Caryn C. Vaughn, and Heather S. Galbraith. "Physiological Determination of Mussel Sensitivity to Water management Practices in the Kiamichi River and Review and Summarization of Literature Pertaining to Mussels of the Kiamichi and Little River Watersheds, Oklahoma." Oklahoma Department of Wildlife Conservation, Federal Aid Grant No. T-10-P-1, 2005.