ENVIRONMENTAL ASSESSMENT

INSTALLATION OF HYDROKINETIC TURBINES

Mississippi Lock and Dam No. 2 Hydroelectric Project
Project No. 4306-017
Minnesota

Federal Energy Regulatory Commission
Office of Energy Projects
Division of Hydropower Administration and Compliance
888 First Street, N.E.
Washington, DC 20426

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ACRONYMS

AC	alternating current
BMPs	Best management practices
°C	degrees Celsius
cfs	cubic feet per second
City	City of Hastings
Commission or FERC	Federal Energy Regulatory Commission
dB	decibel
DO	dissolved oxygen
EA	environmental assessment
EFH	essential fish habitat
ESA	Endangered Species Act
°F	degrees Fahrenheit
FMR	Friends of the Mississippi River
Forum	River Resources Forum
FWS	U.S. Fish and Wildlife Service
HKTA	hydrokinetic turbine array
kW	kilowatt
LTRMP	Long Term Resource Monitoring Program
MDNR	Minnesota Department of Natural Resources
m/s	meters per second
mg/L	milligrams per liter
MNRRA	Mississippi National River and Recreation Area
MOU	Memorandum of Understanding
MPCA	Minnesota Pollution Control Agency
MRCA	Mississippi River Critical Area
MRO	Midwest Reliability Organization
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NPS	National Park Service
NRHP	National Register of Historic Places
NWFR	National Wildlife and Fish Refuge
RM	river mile
RPS	Resource Portfolio Standards
SHPO	State Historic Preservation Officer
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
WQC	Water Quality Certificate

SUMMARY

The Mississippi Lock and Dam No. 2 Hydroelectric Project is located at the U.S. Army Corps of Engineers' (USACE) Lock and Dam No. 2 on the Mississippi River in Hastings, Minnesota, approximately 15 miles downstream of St. Paul. The existing project consists of (1) a powerhouse containing two generating units rated at 2,200 kW each; (2) transmission facilities consisting of (a) 6.6-kV generator leads; (b) two 3-phase, step-up transformers; (c) a 1,000-foot-long transmission line; and (3) appurtenant facilities.

The City of Hastings (City) proposes to install two hydrokinetic turbines rated at 35 kW each, suspended below a floating barge, in the tailrace of the existing project. The floating barge or platform, which would measure 65 feet wide by 50 feet long, would be tethered to the existing dam structure and anchored for stability.

Hydrokinetic turbine technology is new, and few, if any, studies of the effects of hydrokinetic turbine operation in any large river are yet available. Recent workshops (e.g., National Renewable Energy Laboratory, 2006), white papers (e.g., EPRI, Inc., 2006), and publications (e.g., Cada et al., 2007) have identified a range of potential effects, but these would be expected to vary a great deal, depending on turbine design, physical and biological conditions at each site, and other factors that might interact with hydrokinetic turbines to produce inter-related outcomes.

The City consulted with federal and state resource management agencies to identify and focus on the potential effects of installing and operating the hydrokinetic turbines at the existing project. Based on this consultation, the City proposes to monitor water quality for 1 month following installation of the turbines and to evaluate fish survival through the turbines using the HI-Z Turb'N Tag (balloon tag) tag and recapture methodology (Heisey et al., 1992). The City would protect native freshwater mussels, including the listed Higgins' eye pearlymussel, if encountered during anchoring of the turbine/barge. The City would document non-native zebra mussels if encountered during anchoring, and would follow standard procedures to prevent the spread of this invasive species.

Staff's recommendations include the City's proposals, with additional water quality monitoring, a broader approach to evaluating fish entrainment and survival, systematic mussel surveys, development of a control plan for zebra mussels, and development and implementation of a bird monitoring plan. We also recommend immediate modification of turbine operation or removal of the turbine/barge, if monitoring results show adverse effects on water quality, fish, or diving birds.

Based on our independent analysis as described in this EA, the Proposed Action, with our recommended measures, does not constitute a major federal action significantly affecting the quality of the human environment.

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ENVIRONMENTAL ASSESSMENT

Federal Energy Regulatory Commission
Office of Energy Projects
Division of Hydropower Administration and Compliance

Mississippi Lock and Dam No. 2 Hydroelectric Project
FERC Project No. 4306-017
Minnesota

1.0 APPLICATION

Application Type: Amendment of License

Date Filed: April 24, 2008, and supplemented on June 19, 2008 and September 25, 2008

Applicant's Name: City of Hastings

Water body: Mississippi River

County and State: Dakota County, Minnesota

Federal Lands: The existing project is located entirely on lands of the United States. The hydrokinetic turbine array would be located entirely within the existing project boundary.

The Mississippi Lock and Dam No. 2 Hydroelectric Project is located at the USACE's Lock and Dam No. 2 on the Mississippi River in Hastings, Minnesota, approximately 15 miles downstream of St. Paul (see Figure 1). The existing project consists of (1) a powerhouse containing two generating units rated at 2,200 kW each; (2) transmission facilities consisting of (a) 6.6-kV generator leads; (b) two 3-phase, step-up transformers; (c) a 1,000-foot-long transmission line; and (3) appurtenant facilities.

The City proposes to install a hydrokinetic turbine array (HKTA, or array) at the project. The array would consist of (1) two hydrokinetic turbines rated at 35 kW each, suspended below a floating barge; (2) two synchronous alternating current (AC) motor generating units that would sit atop the barge; (3) a 225-ampere molded case circuit breaker along with a 480-volt, three-phase feeder to connect the hydrokinetic units to the existing power plant distribution system; and (4) appurtenant facilities. The floating barge or platform, which would measure 65 feet wide by 50 feet long, would be tethered to the existing dam structure and anchored for stability (see Figure 2).

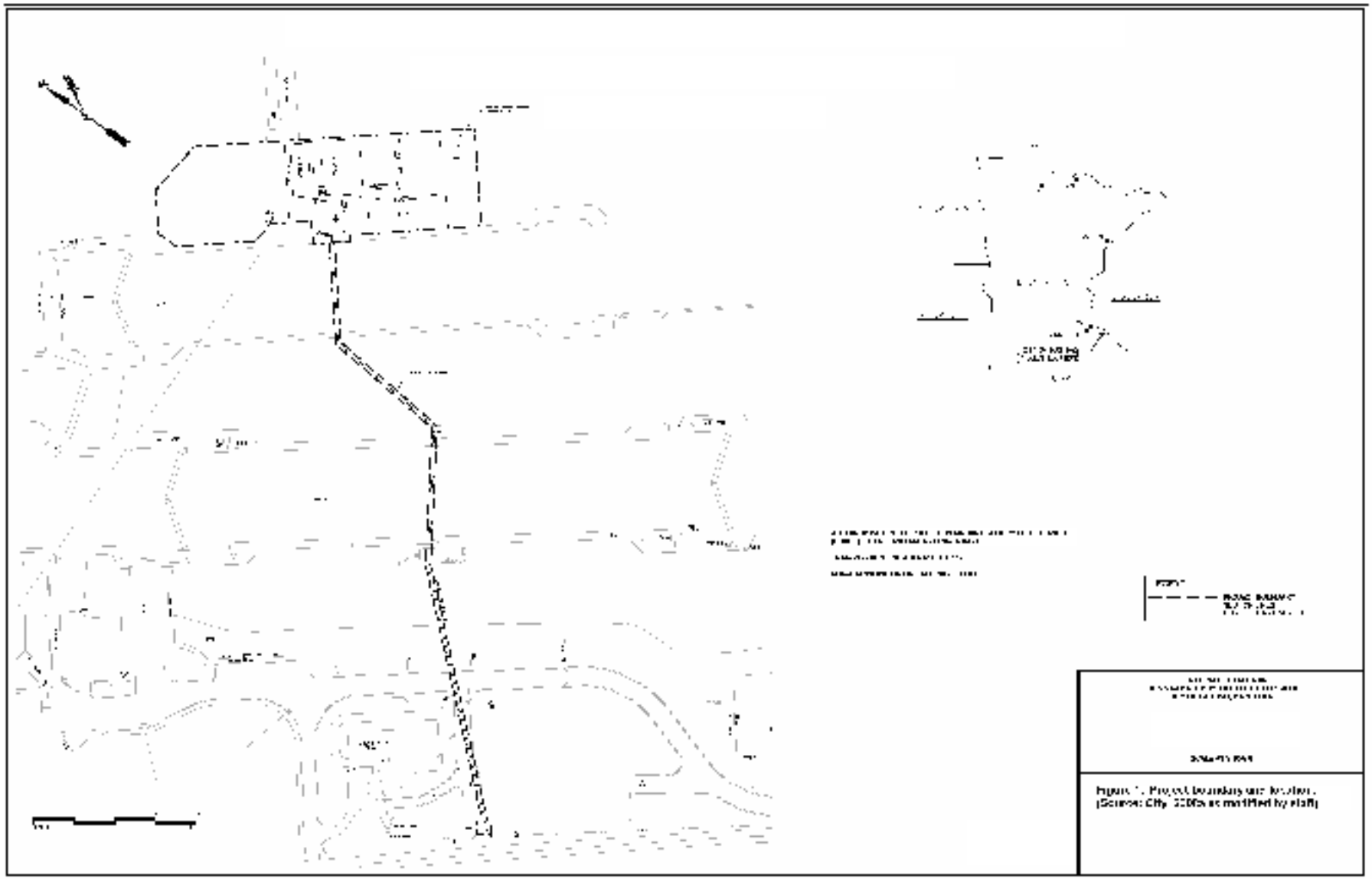

Figure 1 Project boundary and location. (Source: City, 2008a)

2.0 PURPOSE AND NEED FOR ACTION

2.1 PURPOSE OF ACTION

On April 24, 2008, the City filed an application to amend its license by installing two hydrokinetic turbines at the existing Mississippi Lock and Dam No. 2 Hydroelectric Project. On April 28, 2008, the Federal Energy Regulatory Commission (Commission, or FERC) issued a public notice of its intent to prepare an environmental document to determine the impacts of installing and operating the turbines (Proposed Action). The notice also solicited motions to intervene, protests, comments, recommendations, terms and conditions, and fishway prescriptions.

Commission staff has prepared this EA to evaluate site-specific and cumulative effects, if any, of the Proposed Action and a No-action Alternative. This EA does not address any effects that may be associated with the existing licensed project.

Commission staff has identified two primary resource issues for analysis in this EA based on the City's consultation with agencies and other interested parties and the letters received in response to the Commission's April 28, 2008 notice. These issues are water quality and fisheries. Other resources addressed include geology/soils, terrestrial resources, threatened and endangered species, wetlands, recreation, cultural and historic resources, land use, and aesthetics.

2.2 NEED FOR POWER

As stated on the licensee's website[1] "the Hydropower Department operates and maintains the City's hydropower plant located at Lock and Dam No. 2. The existing hydropower plant has a 4.4 MW generating capacity developed by two turbine/generator units. All electricity generated is sold directly to Xcel Energy Company." The estimated generation for the proposed development, including two 35 kW hydrokinetic turbines, is 364.12 MWh per year. We assume this energy will also be sold to Xcel.

To see how the demand for electricity is expected to change in the future in the service area, we reviewed the regional need for power as reported by the Midwest Reliability Organization (MRO). We note that the region is a summer peaking area. For the period of 2008 through 2015, MRO shows an average annual growth in summer total internal peak demand of about 1.7 percent. Demand will grow from 49,247 MW in 2008 to 55,518 MW by 2015. The summer reserve margins are forecast to decrease from

[1] See http://www.ci.hastings.mn.us/CityServices/PublicWorks/PWUtilities/PWHydroPlant/PWUTILHydro.html

about 21 percent in 2008 to about 8.2 percent in 2015 which is well below the target reserve of 15 percent (MRO, 2006).

Minnesota enacted legislation setting Resource Portfolio Standards (RPS) for the state including a special standard for Xcel Energy Company. The RPS for Xcel Energy Company requires that eligible renewable electricity account for 30 percent of total retail electricity sales (including sales to retail customers of a distribution utility to which Xcel Energy provides wholesale service) in Minnesota by 2020. Of the 30 percent renewables required of Xcel Energy in 2020, at least 25 percent must be generated by wind-energy systems, and the remaining 5 percent by other eligible technologies.[2]

We conclude that the region has a need for power over the near term. Installation of an HKTA at Mississippi Lock and Dam No. 2 Project, which would supply a part of the current regional electricity demand, could help meet part of the regional need for power and maintain reserve requirements.

3.0 PROPOSED ACTION AND ALTERNATIVES

3.1 PROJECT DESCRIPTION

The Mississippi Lock and Dam No. 2 Hydroelectric Project is located on the Mississippi River at river mile (RM) 815.2. The project consists of only a powerhouse, located on the west side of the USACE-owned Lock and Dam No. 2, and a 1,000-foot transmission line. Lock and Dam No. 2 impounds the 32.4-mile-long Pool 2, and marks the upstream extent of the 18.2-mile-long Pool 3.

The existing project is operated in a run-of-river mode in accordance with a Memorandum of Understanding (MOU) with the USACE. The MOU is incorporated into the project license. The project is required to have a continuous minimum flow of 1,700 cubic feet per second (cfs) or the inflow of the reservoir, whichever is less. The USACE is responsible for monitoring flows, as well as operation of the locks, dam and impoundment.

[2] See http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=MN14R&state=MN&CurrentPageID=1&RE=1&EE=1

3.2 PROPOSED ACTION

3.2.1 General Description of Construction

The HKTA would be installed in the tailrace of the Mississippi Lock and Dam No. 2 Hydroelectric Project powerhouse, approximately 50 feet downstream of the draft tube exits (see Figure 2). The entire project, including the tailrace, is located within a restricted access area maintained by the USACE. Coordination with USACE would be needed for construction personnel and equipment to access the site from the lock walkways or by boat from the river downstream of the dam.

The selected turbines are similar to wind turbines, with the driveshaft parallel to the direction of flow and the three 12-foot blades perpendicular to the direction of flow (see Figure 3). The blades would rotate at a speed of about 21 revolutions per minute (rpm). A mechanical transmission would convert the direction of rotation of the blades and shaft, and increase the speed of rotation to the level required by the electrical generator installed atop the barge.

The first Unit (Unit A) will be installed as soon as possible, and centered on the center line of Unit 1 of the existing project. Manufacturing of the second unit (Unit B) will not occur until the completion and installation of the first unit. Unit B will be centered on the centerline of Unit 2 of the existing project.

The first step in the construction sequence would be to install the tethering and anchoring system for the turbine/barge at the existing dam. Construction personnel would affix mooring cleats and bollards to the concrete. Concrete drilling would take place above the water line. Best management practices (BMPs) to protect water quality would focus on containment and proper disposal of drill cuttings.

The City and USACE both maintain rock scour protection areas downstream of the dam. These two areas, protected by 42-inch rip-rap capstone over 30-inch rockfill, extend a total of 280 feet downstream from the dam. To anchor the barge, a pre-cast anchor block would be lowered onto this rip-rap from a boat. The anchor would not be permanently attached or founded into the riverbed. Construction personnel would attach a lead line from the anchor block to a buoy until the turbine/barge is towed into place. Spuds will be dropped from spud wells in the barge onto riprap in the scour protection area. They will not be permanently attached or driven into the river bed.

The turbine units will be assembled off site in Waite Park, Minnesota. The units will be transported by land to a dock located directly downstream from Lock and Dam No. 2. The barge structure will be trucked to the USACE boat ramp adjacent to the dock, where it will be launched. From the USACE dock, a crane will offload the turbine and lower it onto the barge structure. The turbine units will be bolted to the barge structures, with the work taking place on the deck of the barge while moored to the USACE dock.

The barge/turbine structure will then be floated by tug to the tailrace area of the hydro project. Once connected, the turbine units would be moved into the "running" position with the rotors locked in place, and the project would be energized.

Figure 2 Location of HKTA in relation to Lock and Dam No. 2 and existing project tailrace. (Source: City, 2008a as modified by staff)

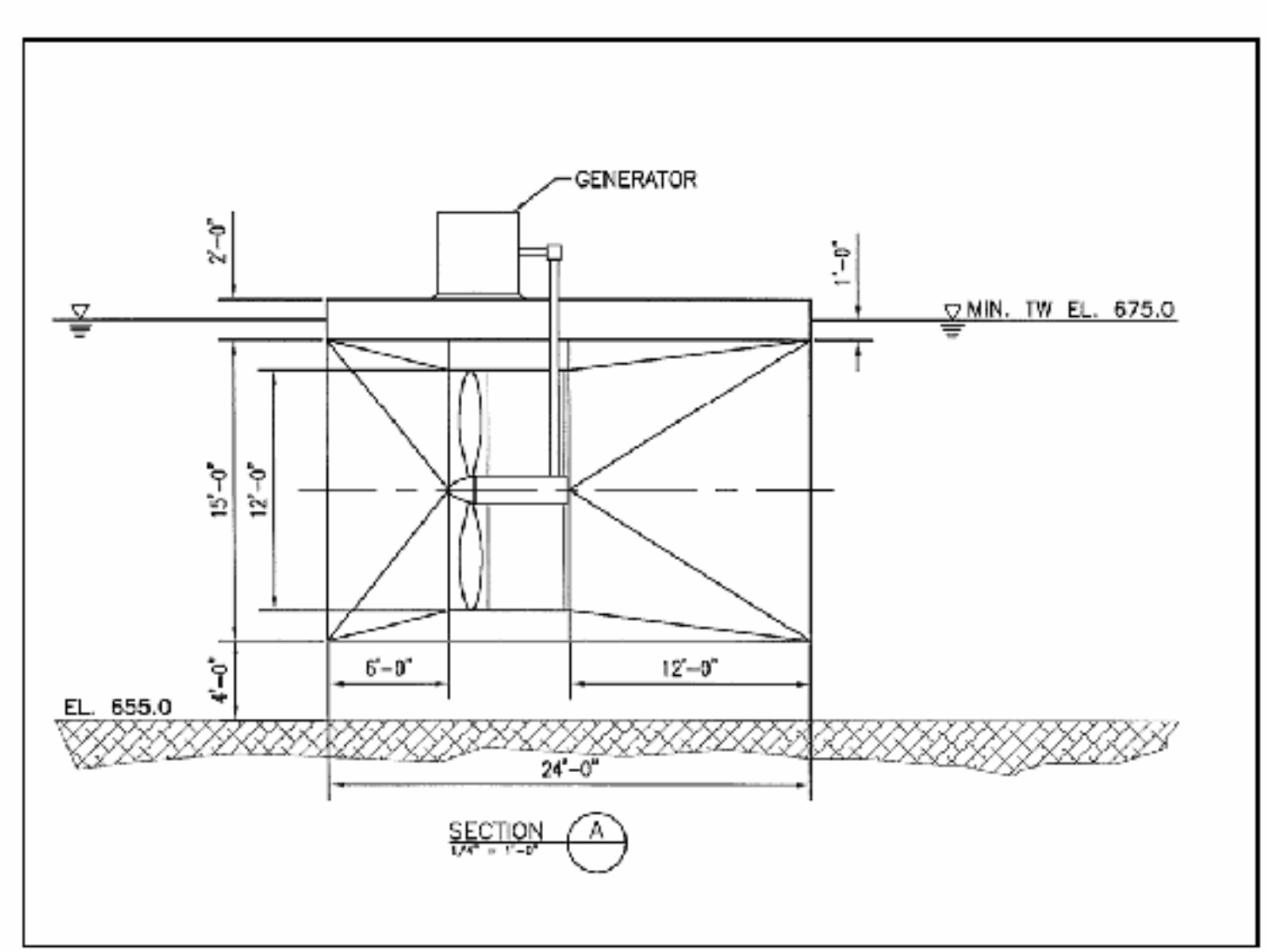

Figure 3 Conceptual hydrokinetic unit section view. (Source: City, 2008a as modified by staff)

The turbines would operate only in conjunction with the operation of the existing power plant, and would utilize a portion of the remaining hydraulic energy in the water exiting the draft tubes. The flow that the turbines are unable to use for energy production would flow around and under the turbines.

Planned outages for maintenance would coincide with those scheduled for the hydropower units. These outages occur once or twice a year for an average of five days. They are typically planned to coincide with low flows (e.g., 750 cfs).

Outages as a result of high flow conditions would occur when the existing hydropower plant is shut down due to low head (below 4 feet) or due to high flow conditions. This situation occurs from 10 to 20 days per year, typically during high spring runoff and occasionally during heavy rains in the fall. In the event of a major flood forecast, the City would move the turbines to high ground to prevent potential damage to the units.

If extremely cold conditions occur and persist during a maintenance outage, the City would install a bubbler system to prevent ice formation around the units. As an alternative, the City could demobilize each unit by raising it through a hatch at the bottom of the barge.

During construction, the City would implement City and USACE-required BMPs to minimize the risk of adverse effects on water quality. During operation, the City would implement the following measures to protect natural resources:

- Conduct water quality studies, including monitoring of temperature, dissolved oxygen, and turbidity for 1 month following turbine installation
- Conduct a fish tagging study focusing on turbine injury and survival
- Document the presence of native freshwater mussels, including Higgins' eye pearlymussel, if encountered during anchoring of the turbine/barge; and consult with the resource management agencies to remove or relocate them
- Document the presence of zebra mussels, if encountered during anchoring of the turbine barge; and consult with the resource management agencies prior to installation of the turbine/barge to develop specific control protocols, including inspections and cleaning of equipment

3.3 NO-ACTION ALTERNATIVE

Under the No Action Alternative, the project would continue to operate as licensed, but no HKTA would be installed. There would be no change in the potential for adverse effects on natural resources.

There would be no increase in power generation, and the No-action Alternative would not assist the Commission in meeting its strategic objective to stimulate appropriate infrastructure development. Predicted increases in demand for power would likely be met through other sources, such as fossil fuels.

3.4 STAFF PREFERRED ALTERNATIVE

Staff's Preferred Alternative includes environmental protection measures proposed by the City, with the following additional measures.

- Extend water quality monitoring to cover a 3-month period following turbine installation
- Increase the number of tagged fish to more accurately evaluate effects of turbine passage on the fish community
- Perform a desktop entrainment analysis
- Conduct a systematic baseline Higgins' eye pearlymussel survey
- Develop a zebra mussel control plan
- Develop and conduct a 1-year bird monitoring plan
- File Water Quality Certificate upon issuance
- Immediately modify turbine operations or demobilize and remove the turbine/barge if monitoring results show adverse environmental effects

4.0 CONSULTATION AND COMPLIANCE

The National Environmental Policy Act (NEPA) requires federal agencies to evaluate the environmental and social effects of actions they authorize, permit or fund. This section details the processes used to consult with the resources agencies and the public regarding the Proposed Action, and compliance with statutory requirements.

4.1 COMMENTS

On April 28, 2008, the Commission issued a public notice, soliciting comments, motions to intervene, and protests on its intent to prepare an environmental document for the installation of hydrokinetic turbines at the existing Mississippi Lock and Dam No. 2 Hydroelectric Project. The following agencies and stakeholders filed responses:

	Filing Entity	Date Filed	Comment or Motion to Intervene
1	D.E. Shaw and Co.	May 30, 2008	Comment
2	Brookfield Renewable Power	June 16, 2008	Comment
3	National Hydropower Association	June 23, 2008	Comment
4	U.S. Department of the Interior, National Park Service	June 23, 2008	Motion
5	U.S. Department of the Interior, Office of the Secretary	June 24, 2008	Comment
6	American Rivers, Inc.	June 27, 2008	Motion
7	American Whitewater	June 27, 2008	Motion
8	Congressman John Kline	June 27, 2008	Comment
9	Trout Unlimited	June 30, 2008	Motion

Staff has carefully considered agency and stakeholder comments and questions within the scope of the current proceeding, in order to focus the content of this document. The commentors raised the following issues:

- The effects of the hydrokinetic turbines on water quality
- The need for rigorous evaluation and monitoring of the effects on aquatic resources, and on fish entrainment, mortality, and movement, in particular
- Effects on diving birds
- Existing recreation use and potential for recreation enhancement in the project area
- Effects on historic properties

- Potential for the turbine/barge to break free of its tether and anchor system and wash ashore in the Mississippi National River and Recreation Area (MNRRA) or other sensitive area, with subsequent adverse effects of retrieving the units

- Effects on navigation, aesthetics and noise

- Cumulative effects of proposed hydrokinetic projects in the Mississippi River

4.2 AGENCY CONSULTATION AND INTERVENTIONS

The licensee held an introductory outreach meeting on April 6, 2007 to provide an initial briefing on the project to Federal and state agencies, affected Indian tribes, and local stakeholders. The licensees mailed a 1st stage draft license amendment application to stakeholders on June 13, 2007, and followed up with a public meeting on July 16, 2007. During the meeting, participants identified aquatic resources and water quality as important issues, and scheduled a conference call to discuss them in more detail. The licensee circulated a draft study plan focused on these issues on July 18, 2007, and the conference call was held on July 20, 2007. The licensee mailed a 2nd stage draft license amendment application on October 29, 2007. The City filed its final application for amendment on April 24, 2008 (City, 2008a). The Commission issued a letter to the City on June 4, 2008 requesting additional information about the project (FERC, 2008). On June 11, 2008, Commission staff held a site visit, inviting stakeholders to attend and provide relevant information to assist the Commission in preparing the EA. The City filed its response to the FERC AIR on June 19, 2008 (City, 2008b).

The following stakeholders have been consulted, through meeting attendance, conference calls, letters, or site visits: the St. Paul District of the USACE, FWS, U.S. Geological Survey (USGS), U.S. Environmental Protection Agency Region 5, National Park Service (NPS), U.S. Bureau of Indian Affairs, Congressman John Kline, Minnesota Pollution Control Agency (MPCA), Minnesota Department of Natural Resources (MDNR), Minnesota Department of Commerce Energy Division, Minnesota Public Utilities Commission, State Historic Preservation Office (SHPO), the Prairie Island Indian Community, the Dakota County Physical Development Division, and the Regional Council of Carpenters.

The primary issues identified to date are the potential effects of the project on water quality, fish (the risk of entrainment, in particular), and dispersal of zebra mussels. Because hydrokinetic turbine technology is new, stakeholders have emphasized the need for careful study and monitoring of its effects in these areas.

4.3 COMPLIANCE

4.3.1 Water Quality Certification

The Federal Clean Water Act gives authority to each state to issue a Section 401 Water Quality Certification. In Minnesota, MPCA is responsible for issuance of 401 certificates. MPCA has determined that an amendment to the current Water Quality Certificate (WQC) for the Mississippi Lock and Dam No. 2 Hydroelectric Project (issued on October 13, 1982) is necessary to allow for the installation and operation of the hydrokinetic turbine array. The City submitted a letter to the MPCA on March 20, 2008 requesting amendment. By letter dated June 24, 2008, the Commission requested that the City file the amended WQC as soon as possible in order for the Commission to proceed with consideration of the City's application for license amendment.

4.3.2 Section 10 and Section 404 Permits

The USACE's regulatory programs include Section 10 of the Rivers and Harbors Act of 1899 and Section 404 of the Clean Water Act. The St. Paul District of the USACE has jurisdiction over these permits in the state of Minnesota.

Section 10 requires a permit for any work in, over or under a navigable water of the U.S. The licensee has consulted with the Planning, Programs and Project Management Division, Project Management and Development Branch of the USACE. By letter dated July 20, 2007, the USACE stated that their support for hydropower development, provided it has no impact on navigation, the operation and maintenance of the USACE's facilities and property, and the safety of their staff and the general public. The hydrokinetic turbines would be located 200 feet riverward of the navigation channel, and would not affect navigation. For this reason, the USACE may determine that a Section 10 permit is not needed.

Section 404 requires a permit for discharge of any dredged or fill material into a water of the U.S. The Proposed Action does not involve discharge of dredged or fill material into waters of the U.S. For this reason, the project would not likely require a Section 404 permit.

4.3.3 Essential Fish Habitat

Pursuant to the amended Magnuson-Stevens Fishery Conservation and Management Act, the United States Congress mandated that habitats essential to federally managed commercial fish species be identified, and that measures be taken to conserve and enhance their habitat (Public Law 104-297). In the amended Act, Congress defined essential fish habitat (EFH) for federally managed fish species as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." EFH

is applicable to federally managed commercial species that live out at least one component of their lifecycle in marine waters (such as anadromous species). The Mississippi Lock and Dam No. 2 Project is located outside of the range of anadromous species or any other species with at least one component of their lifecycle in marine waters. Therefore, we conclude that the Proposed Action would not adversely affect EFH.

4.3.4 Endangered Species Act

In a letter dated December 14, 2007, the FWS commented that the federally endangered Higgins' eye pearlymussel (*Lampsilis higginsii*) occurs in Pools 2 and 3 of the upper Mississippi River, and recommended that the City assess project effects on this species. The Higgins' eye pearlymussel is found in gravel or sand substrates on river bottoms. The Proposed Action would be located in the project's tailrace, where the substrate is already armored with rock scour protection. The scour protection area extends approximately 140 feet downstream from the draft tubes, and was most recently re-armored with rip rap in 2007. The 140-foot zone extends past the location where the new turbines would be installed. The anchor would affect a very small area within the rock scour protection zone. Since it is unlikely that suitable habitat for the Higgins' eye pearlymussel is present, it is unlikely that the project would affect this species. However, as a conservative measure in light of the fact that an interagency work group (the Mussel Coordination Team) including FWS, USACE and MDNR, is working to recover this species by reintroducing it into Pools 2 and 3 (Wege et al., 2007), we recommend a limited survey for the presence of this mussel prior to turbine installation. With this measure in place, we find the project may affect, but is not likely to adversely affect, the Higgins' eye pearlymussel. By letter dated July 22, 2008, we requested concurrence from FWS with our finding. To date, the FWS has not responded.

4.3.5 National Historic Preservation Act

Section 106 of the National Historic Preservation Act (NHPA) requires the Commission to take into account the effect of agency actions on any historic properties and allow the Advisory Council on Historic Preservation a reasonable opportunity to comment on the Proposed Action. Historic properties are defined as any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register of Historic Places (NRHP) and includes areas of traditional importance to tribes (36 CFR 800.16[l]). In 1981, the Minnesota SHPO stated that the project area did not include any NRHP-eligible or listed properties. More recently (by e-mail dated September 21, 2007), USACE informed the licensee that Lock and Dam No. 2 is not eligible to the NRHP and is not within or part of any historic district. The 9-foot navigation channel maintained by the USACE along 284 miles of the upper Mississippi River, including Lock and Dam No. 2, could be considered eligible for listing in the future. However, the hydrokinetic units would be located 200 feet riverward of the active

lock, and would not affect the nature or characteristics of the navigation channel. By letter dated April 3, 2008, the licensee requested a determination from the NPS and Minnesota Historical Society confirming that the Proposed Action would not affect historic properties. By letter dated July 30, 2008, Commission staff informed the SHPO, NPS and Prairie Island Indian Community that it concludes the area does not contain any historic properties and that approval of the proposed amendment would not constitute an undertaking pursuant to Section 106 of the NHPA. Commission staff requested comments and recommendations regarding this finding. By letter dated August 29, 2008, the SHPO indicated they would need additional information in order to complete their review of the project. On September 23, 2008, Commission staff provided the SHPO with the requested information.

4.3.6 Consistency with Comprehensive Plans

Section 10(a)(2) of the Federal Power Act (FPA), 16 U.S.C. § 803(a)(2)(A), requires the Commission to consider the extent to which a project is consistent with federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the project. We reviewed the Mississippi National River and Recreation Area Comprehensive Management Plan (MNRRA plan), which is applicable to the Mississippi Lock and Dam No. 2 project. Our review determined that the licensee's proposed amendment is not inconsistent with the MNRRA plan with respect to land use, recreation, cultural resources, aesthetics, and economic development.

In addition to our review, the Secretary of the Interior is required, pursuant to 16 U.S.C. § 460(zz)(3), to review the proposed undertaking with regard to its compatibility with the MNRRA plan.

5.0 ENVIRONMENTAL ANALYSIS

The following sections describe existing conditions in the project area and potential environmental effects of the Proposed Action, compared to the No-action Alternative. Except where otherwise noted, this information is taken from the City's application for amendment and associated study plans and record of consultation; the City's response to our request for additional information; and public scoping comments, recommendations, and interventions.

5.1 GENERAL DESCRIPTION OF THE LOCALE

In the 1930s, construction of locks and dams along the upper Mississippi River created a stairway of water from St. Paul, Minnesota to St. Louis, Missouri. Each lock and dam impounds a reservoir, or pool.

Lock and Dam No. 2 impounds the 32.4-mile-long Pool 2. USACE considers Pool 2 to be the most engineered stretch of river in the St. Paul District, which begins in the river's headwaters and extends southward to Guttenberg, Iowa. Over 30 wing dams and miles of submerged revetments keep the higher velocity river flow within the main navigation channel area. Near Hastings, wind and boat-generated waves prevent the establishment of aquatic vegetation and side channels are slowly filling with sediments. More than 11,000 barges and 12,000 recreational boaters pass through the lock annually (Forum, 2004). Despite development and human activity along the river, Pool 2 also represents an important corridor of open space, aquatic habitat, and floodplain forests. Pool 2 is located within the National Park system's 72-mile-long MNRRA and the state-designated Mississippi River Critical Area (MRCA).

Pool 3, which begins at Lock and Dam No. 2, extends 18.2 miles downstream to RM 797.0. The river and floodplain characteristics of upper Pool 3 are influenced by gate adjustments at the dam. Several large tributaries enter the Mississippi in this reach, including the St. Croix and Vermillion rivers. Pool 3 is also located within the MNRRA/MRCA.

5.2 CUMULATIVE EFFECTS ANALYSIS

Cumulative effects are defined as the impact on the environment which results from the incremental impact of the Proposed Action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions (40 CFR § 1508.7). Cumulative effects can result from individually minor, but collectively significant actions taking place over a period of time, including hydropower and other water and land development activities. Based on information gathered through scoping and provided by the licensee, resource agencies, and the public, plus our independent analysis, we conclude that the Proposed Action could contribute to cumulative effects on fish populations in the upper Mississippi River through very small increases in entrainment, if any occur. However, the extent of entrainment is not known at this time, and cannot be predicted until the results of entrainment studies discussed in section 5.3.3 (*Aquatic Resources*), below, are available.

There are currently no other hydrokinetic turbines in place in the Mississippi River, although as of July, 2008, the Commission has issued preliminary permits for 59 projects on the river between Minnesota and Louisiana. Like the Proposed Action, the preliminary permits involve testing a few turbine units; however, large turbine arrays may be needed in the future to make the projects economically feasible. Without knowing the environmental effects at any location, because the technology is new, it is too early to predict the cumulative effects of larger installations at numerous locations on the Mississippi River. We agree that cumulative impact analysis will be important in the future, not only to evaluate potential negative effects, but anticipated benefits in terms of renewable energy.

5.3 RESOURCE ISSUES AND RECOMMENDED MITIGATION MEASURES

5.3.1 Geological and Soil Resources

Affected Environment

The Mississippi Lock and Dam No. 2 Hydroelectric Project is located in morainal terrain, with both active bedrock valleys and bedrock tunnel valleys that lie far beneath glacial till. In the project vicinity, the Mississippi River runs through nearly level outwash plains and terraces, between steep sandstone bluffs capped with limestone. Soils in the project vicinity belong to the Waukegan-Wakena-Hawick map unit (Hundley, 1983). These soils formed in loamy or silty sediments on level to very steep slopes that are generally underlain by sandy outwash.

Construction of Lock and Dam No. 2 in 1930 impounded a reach of the river now known as Pool 2 (Forum, 2004). The dam has trapped sediments in Pool 2 for almost 80 years, reducing the amount of sediment that is transported downstream.

To evaluate the characteristics of the substrate in the project tailrace below the dam, the City collected three dredge samples from the tailrace in July, 2007. All three samples were clear, a finding that is consistent with the presence of rip rap used to armor the bottom of the river within the tailrace. Since project construction, the City has maintained a scour protection area in the tailrace that extends approximately 140 feet downstream of the draft tubes. The scour protection consists of 30-inch minimum rockfill layer topped with 42-inch rip rap. The USACE also maintains a scour protection area, extending an additional 140 feet downstream, to approximately the end of the skirt wall. The City and the USACE periodically replace rip rap, as needed.

Environmental Effects and Recommendations

Construction near waterways has the potential to cause erosion and sedimentation, through ground disturbance and vegetation removal. However, the Proposed Action does not involve any disturbance of rock, soil or vegetation. The turbine/barge would be tethered to cleats and/or bollards drilled into the existing dam structure, and an anchor would be placed atop the rip rap that covers the scour protection area. The anchor would not be mounted into the riverbed or affixed to the rip-rap. For these reasons, we conclude there would be no risk of erosion during installation of the turbine/barge.

The operation of the turbines would cause a small local increase in water velocities because they would slow the water moving through them, increasing the flow of water around and under them. Based on the results of a velocity survey (Table 1), the City anticipates an increase of about 10 percent above the current exit flow from the draft tubes.

Table 1 Velocity (measured in meters per second, or m/s) survey summary. (Source: City, 2008a)

Distance downstream from draft tube exits (ft)	Normal free stream velocity at turbine inlet (m/s)	Expected velocity at turbine diffuser exit (m/s)
20	3	1
50	2.5	0.83
70	2	0.65

After installation of the hydrokinetic turbines, the City would continue to maintain the scour protection area in the tailrace. Although there would be a small increase in velocities around the turbines, the rip rap would prevent scour during turbine operation over the long-term.

The City proposes to collect turbidity data via data logger units or grab samples in the tailrace of the existing project both upstream and downstream of the hydrokinetic turbines for a period of 1 month following installation, as discussed in section 5.3.2 (*Water Resources*).

Effects of No-Action Alternative

Under the No-action Alternative, no hydrokinetic turbines would be installed. Velocities would remain the same as under existing conditions. The City would continue to maintain the scour protection area, and there would be no change in the risk of erosion.

5.3.2 Water Resources

Affected Environment

Water Quantity

The Mississippi River flows approximately 2,340 miles from its headwaters at Lake Itasca in northwestern Minnesota to its mouth in the Gulf of Mexico. With a drainage area of 1,129,766 square miles and a median annual discharge of approximately 450,000 cfs,[3] it is the longest and largest river in North America.

The Mississippi Lock and Dam No. 2 Project is located on the Mississippi River in Hastings, Minnesota, approximately 15 miles downstream from St. Paul, Minnesota at RM 815.2. The project has a total discharge capacity of 5,400 cfs and is operated in a run-of-river mode in accordance with a MOU with the USACE. The project is required

[3] As measured at Baton Rouge, Louisiana for the period 1978-1983.

to maintain a continuous minimum flow of 1,700 cfs, or the inflow of the reservoir, whichever is less. The remaining river flow at Lock and Dam No. 2 is passed primarily through spill gates, with some flow used to operate the locks. According to the City's application (City, 2008a), the percent of monthly average river flow passing through the turbines ranges from 16 to 90 percent; however, the actual flow through the turbines depends on water year type (wet or dry), turbine maintenance schedule, flood control operations, and low head conditions at the dam.

Climate

The climate within the Minneapolis/St. Paul metropolitan area is described as humid continental with moderate precipitation, wide daily temperature variations, warm humid summers and cold winters. The total average annual precipitation is approximately 27 inches, of which approximately one-third occurs in the months of June, July and August. The annual snowfall average is about 50 inches and is equivalent to approximately 5 inches of water (City of Bloomington, 2007). Temperatures throughout the year are highly variable, with extremes ranging from 114°F to negative 60°F. Average temperatures range from 5.7°F in January to 67.4°F in July.

Hydrology

The USACE records river flow at Lock and Dam No. 2 on the Mississippi River. Daily river flow data from 1987 to the present, the period that the existing power project has been in operation, was provided by the USACE and presented in the City's license application. The average annual river flow at the site from 1987 to 2004 was 14,818 cfs. Monthly average flows for the period of record at Lock and Dam No. 2 are shown in Table 2. The highest flows typically occur in March and April and the lowest flows typically occur in January and February.

Water Quality

The MPCA classifies all waters of the state into "beneficial uses" to protect against controllable pollution. The beneficial use classifications affect the required water quality standards for that stream. The designated beneficial uses for the Mississippi River within the project area (considered an "unlisted water")[4] are shown below:

- Class 2B waters, aquatic life and recreation (cool- and warm-water fisheries)

[4] If the water of interest is not listed in Minn. R. 7050.0470, then Minn. R. 7050.0430 (or Minn. R. 7050.0425 for wetlands) applies. This short but very important part of the rule classifies all unlisted waters (except wetlands) as Class 2B plus the other uses. It should be noted that the vast majority of surface waters in Minnesota are not listed.

- Class 3B waters, industrial consumption
- Class 4A waters, agricultural use, irrigation
- Class 4B waters, agricultural use, livestock and wildlife watering
- Class 5 waters, aesthetic enjoyment and navigation
- Class 6 waters, other uses and protection of border waters

Table 2 Monthly Average flow (cfs) at Lock & Dam No. 2. (Source: City, 2008a)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1987	10,129	9,018	13,290	16,400	10,671	11,827	8,668	8,116	4,923	4,987	5,650	5,339
1988	3,881	3,514	9,990	13,640	8,526	2,893	1,477	2,706	3,183	4,035	4,051	3,497
1989	3,648	3,893	7,526	24,097	15,768	7,840	5,852	2,945	5,216	4,517	4,610	3,656
1990	3,297	3,443	10,070	7,727	13,368	24,510	15,003	11,452	5,377	5,422	5,680	3,703
1991	3,277	3,054	8,659	22,873	34,590	36,160	26,107	15,194	18,093	9,574	12,597	12,435
1992	9,190	7,872	33,439	23,810	16,848	13,153	22,110	10,129	10,323	9,984	13,353	7,477
1993	5,400	4,989	8,116	47,267	42,948	52,110	65,523	41,248	25,210	13,439	12,590	11,287
1994	8,535	7,589	25,403	35,513	38,584	20,690	21,713	14,574	11,637	17,410	13,127	8,797
1995	6,832	5,746	22,235	41,110	38,984	24,983	21,232	18,797	10,823	23,968	22,730	10,797
1996	8,571	8,524	18,455	42,547	36,245	28,150	13,855	7,787	4,803	6,365	12,990	11,000
1997	8,223	7,464	19,432	82,897	34,339	14,073	32,665	21,690	10,240	8,784	8,673	7,716
1998	5,090	9,236	17,271	38,783	16,755	18,947	20,871	6,765	4,083	7,884	13,350	10,374
1999	5,687	6,968	13,104	35,390	39,670	27,155	20,360	14,565	12,437	9,703	8,123	5,850
2000	5,448	5,752	12,994	8,997	12,823	16,283	14,403	5,455	3,893	3,981	10,627	5,526
2001	5,245	4,771	5,190	90,703	63,758	45,853	17,855	7,906	5,740	6,194	7,380	9,461
2002	6,877	6,050	7,245	24,770	22,087	21,750	27,923	21,829	15,737	17,271	12,067	7,206
2003	5,068	3,382	7,300	16,637	27,274	18,863	23,832	5,681	3,537	3,332	4,087	3,534
2004	2,574	2,698	8,226	11,623	11,129	34,717	13,984	6,584	13,920	14,058	14,980	7,981
2005	5,390	6,486	8,323	33,873	26,313	35,623	16,284	6,413	11,240	26,219	12,920	12,774
2006	11,748	13,011	14,858	42,383	38,558	16,317	5,235	4,274	3,837	4,148	4,303	4,226
2007	4,939	3,186	21,281	36,403	20,071	14,623	4,697	4,851	4,440	18,096	NA	NA
Mean	**6,145**	**6,031**	**13,924**	**33,212**	**27,110**	**23,168**	**19,031**	**11,379**	**8,985**	**10,446**	**10,194**	**7,632**

In general, the numeric standards used most often to protect surface waters are the Class 2 aquatic life and recreation standards. If the Class 2 standards are met, the other usually "less sensitive" uses are protected as well. The applicable numeric water quality criteria for Class 2B designated water bodies that could potentially be affected by the Mississippi Lock and Dam No. 2 Project are shown in Table 3.

Table 3 Selected Minnesota numeric water quality criteria applicable to Class 2B designated streams.[5] (Source: Minn. R. Ch. 7050)

Parameter	**Criteria**
Dissolved Oxygen	5.0 milligrams per liter (mg/L) as a daily minimum
Water Temperature	Must not exceed 5°F (2.8°C) above natural in streams, based on monthly average of maximum daily temperature, except in no case shall it exceed the daily average temperature of 86°F (30°C).
Turbidity	Must not exceed 25 NTU

mg/L= milligrams per liter
°F= degrees Fahrenheit
NTU= nephelometric turbidity units

Section 303(d) of the Clean Water Act requires states to publish and update a list of waters that are not meeting one or more of the applicable water-quality standards. The list, known as the 303(d) list, is updated every two years. In the upper Mississippi River basin, there are 54 rivers and creeks that are 303(d) listed for one or more of the following parameters: low dissolved oxygen (DO), impaired biota (fish and/or invertebrates), mercury, fecal coliform, turbidity, excess ammonia, chloride, PCBs, PFOS, and eutrophication.[6] The Mississippi River from the headwaters to the St. Croix River has the most reaches listed for impairment in the basin, at 20. The Mississippi River from Mississippi Lock and Dam No. 2 to the St. Croix River is 303(d) listed for PCBs (in fish tissue), PFOS (in fish tissue), mercury (in fish tissue), and turbidity.[7]

As described in the City's license application, DO concentrations are recorded at Lock and Dam No. 2 by the Metropolitan Council and are publicly accessible using its Environmental Information Management System. Weekly DO measurements (grab samples) recorded by the Metropolitan Council at Lock and Dam No. 2 from 1987 to 2007 are shown in Figure 4. All but two DO spot measurements (collected in 1987 and 1988) met or exceeded MPCA's 5.0 mg/L daily minimum.

[5] http://www.pca.state.mn.us/water/standards/revisorrules-7050.pdf
[6] http://www.pca.state.mn.us/water/tmdl/tmdl-303dlist.html
[7] http://www.pca.state.mn.us/publications/wq-iw3-15.xls

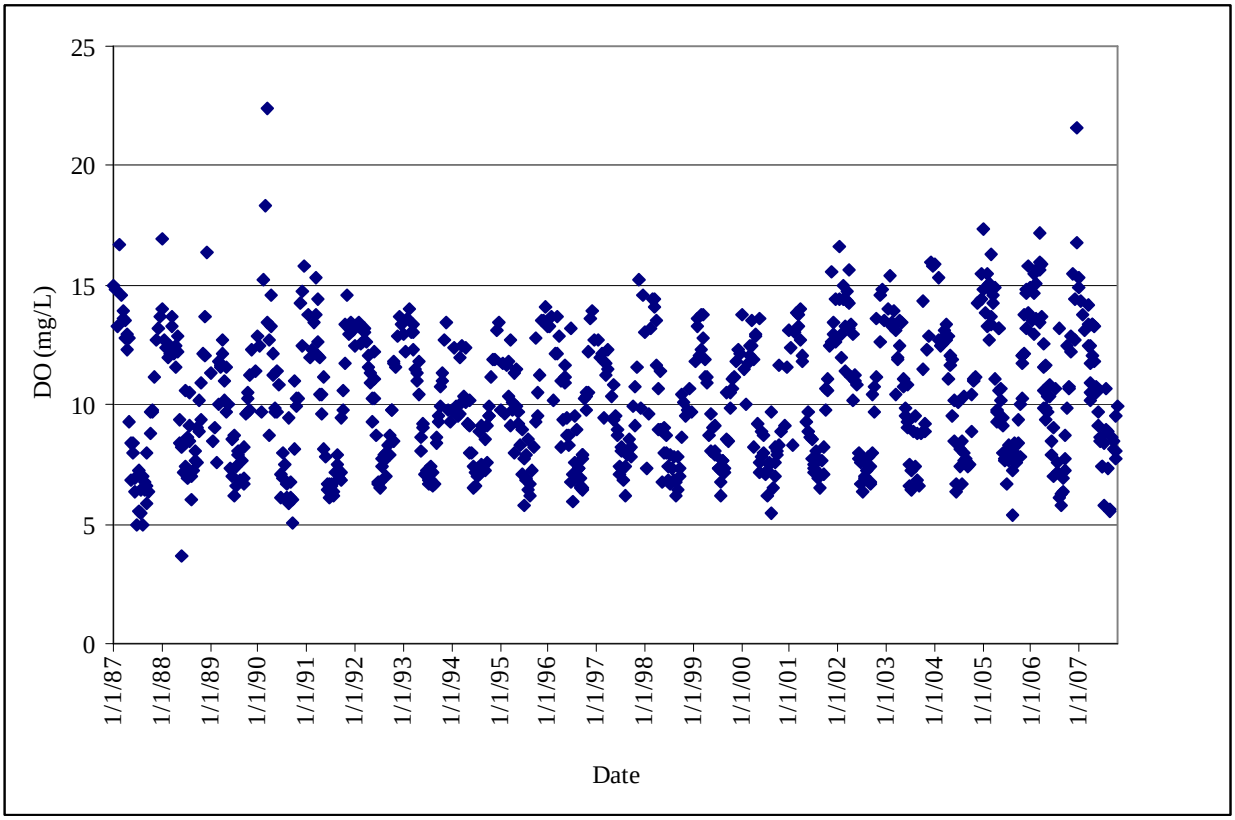

Figure 4 DO measurements (grab samples) recorded by the Metropolitan Council at Lock and Dam No. 2 from 1987 to 2007. (Source: City, 2008a)

Under its existing license, the City is also required to monitor DO when river flows drop below 14,000 cfs, water temperatures exceed 22°C, and DO levels drop below 5.5 mg/L (and to report any violations of the state DO criteria). The City's application (City, 2008a) indicates that this combination of conditions has not occurred at the project and the DO water quality standard has not been violated since June 1990 (the effective date of its Monitoring and Maintenance Plan).

Weekly water temperature and turbidity measurements (grab samples) are also recorded at Lock and Dam No. 2 by the Metropolitan Council and are publicly accessible using its Environmental Information Management System. Water temperatures recorded by the Metropolitan Council at Lock and Dam No. 2 from 1987 to 2007 are shown in Figure 5. Turbidity values recorded by the Metropolitan Council from 1987 to 2005 are shown in Figure 6. All but one of the weekly water temperature measurements collected during the 20 year monitoring period were below MPCA's maximum daily temperature criteria of 30°C; however, turbidity levels exceeded the state standard a total of 91 times. These exceedences were not related to Mississippi Lock and Dam No. 2 Project operations, as the monitoring location is located at RM 815.6, approximately 0.4 upstream of the project.

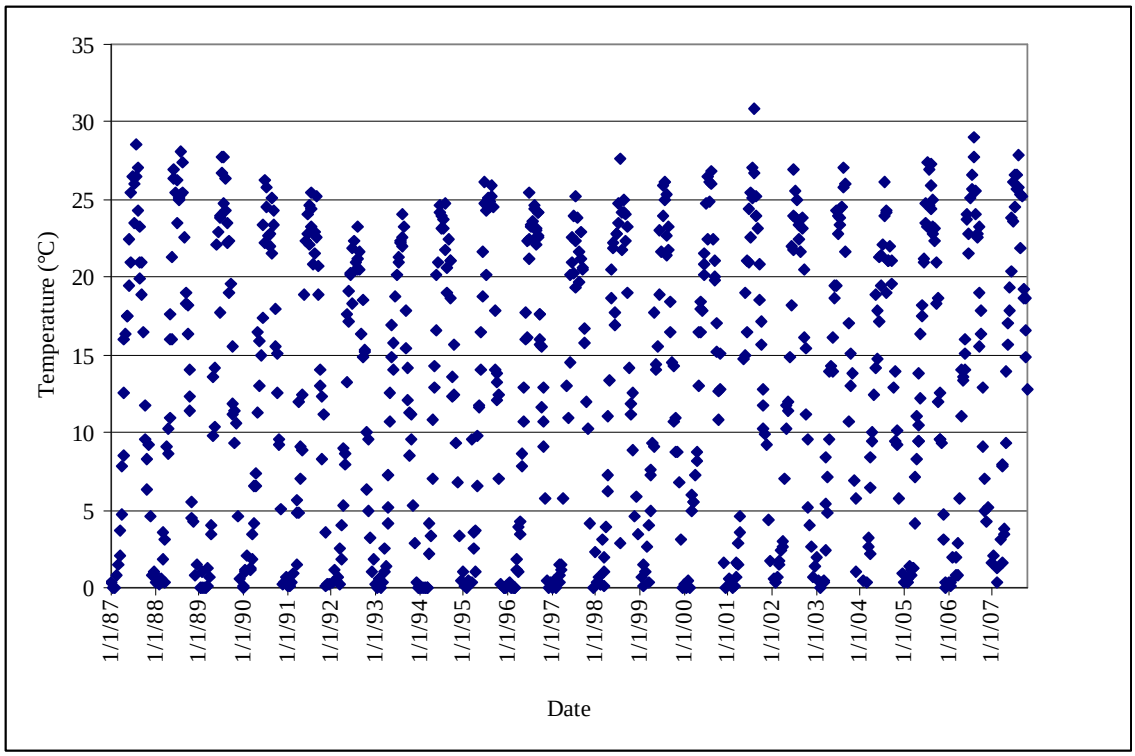

Figure 5 Average monthly water temperatures recorded by the Metropolitan Council at Lock and Dam No. 2 from 1987 to 2007. (Source: City, 2008a)

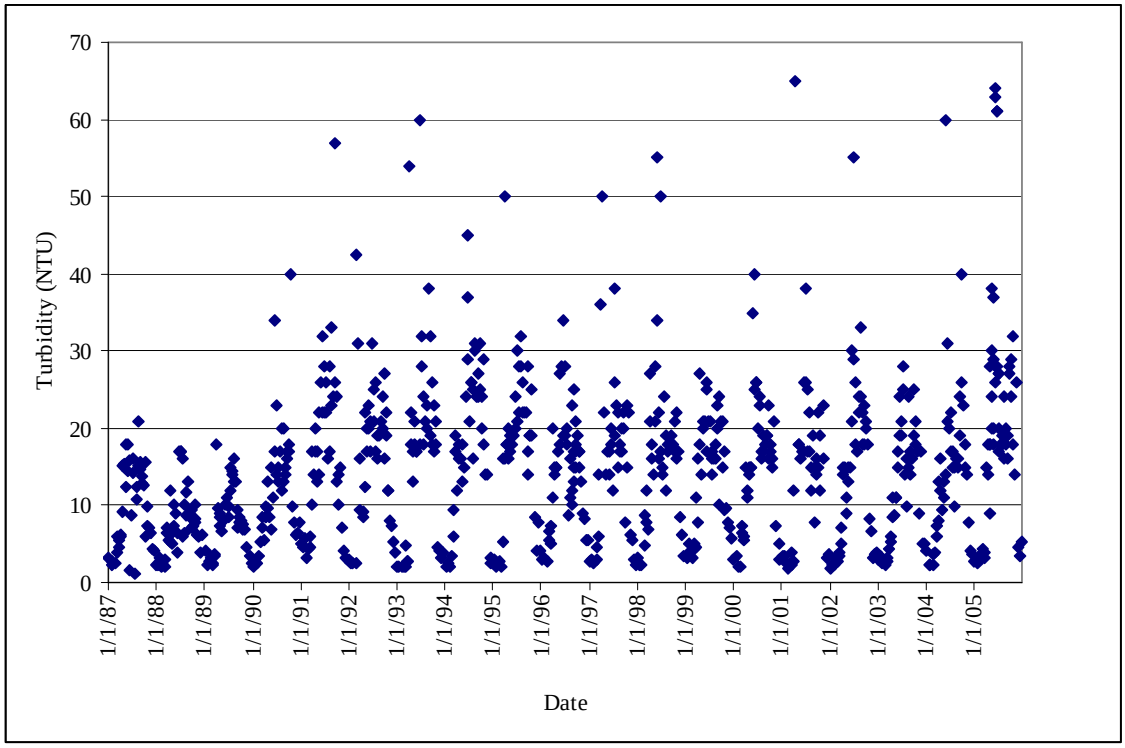

Figure 6 Average monthly turbidity recorded by the Metropolitan Council from 1987 to 2005. (Source: City, 2008a)

The MPCA issued a WQC to the project, pursuant to Section 401 of the Clean Water Act on October 13, 1982. However, the MPCA has determined that an amendment to the current WQC is still necessary for the Proposed Action. A formal letter request for amendment of the current WQC was submitted to the MPCA on March 20, 2008.

Environmental Effects and Recommendations

Installation and operation of the City's proposed hydrokinetic turbine array in the tailrace of the Mississippi Lock and Dam No. 2 Project has the potential to alter existing water quality conditions in the project vicinity, which could in turn affect aquatic resources. Although the effects of hydrokinetic developments on water quality are largely untested, we anticipate the water quality parameters most likely to be affected by the operation of such a facility would include DO and turbidity, due to altered current/flow velocities and the creation of turbulence and velocity shadows (EPRI, 2006). Operation of the hydrokinetic array would have no effect on instream flows and water temperature, as the facility would be operated in run-of-river mode, using only water that has passed through the existing project turbines.[8]

During the construction and installation of the hydrokinetic facility it is possible that construction equipment could release oils or other pollutants into the river. The turbine units used in the hydrokinetic array may also contain petroleum-based oils or other substances that could be released if they are damaged during an unanticipated high flow event or as a result of catastrophic equipment failure.

To address uncertainties regarding potential effects on water quality during project operation, the City proposes to conduct limited water temperature, DO, and turbidity monitoring and analyses to demonstrate their assertion that the hydrokinetic units will not have a degrading effect on the water quality in the project tailrace. Monitoring would be conducted for one month immediately following installation of the hydrokinetic units. If monitoring cannot demonstrate within that time frame that there is no significant difference in the DO, temperature and turbidity of the water entering and exiting the hydrokinetic units, a meeting would be held with MPCA to discuss an alternative monitoring approach. The City also indicates that work at the dam involving the installation of tethers and electrical equipment will follow BMPs for pollution prevention related to construction activities, and health and safety procedures in accordance with both the City and USACE guidelines.

As described above, installation and operation of the City's proposed hydrokinetic turbine array has the potential to alter existing DO and turbidity conditions in the project

[8] Thermal concerns at hydroelectric projects are usually related to stratification in impoundments.

tailrace. Although we anticipate project effects on these parameters would be minimal, the results of limited DO and turbidity monitoring could be used to determine if modifications of project operations are needed to meet state water quality standards.

Therefore, we recommend the City consult with the MPCA to develop a DO and turbidity monitoring plan. Monitoring should occur for a minimum of 3 months (June through August) during a period of normal project operations to confirm or refute that the proposed project is in compliance with state standards. The plan should identify locations to be monitored (upstream and downstream of the array), instrumentation and methods to be used, data analysis to be performed, reporting procedures, and the duration of the DO and turbidity monitoring program. The plan should be filed with the Commission along with comments provided by the resource agencies. Following approval of the plan by the Commission, the City should implement the plan.

In its application for an amended water quality certification dated March 20, 2008, the City notes that one of the most important attributes of the hydrokinetic turbines is that they can be shut down and removed from the water within minutes, if their operation causes adverse effects on water quality. However, no threshold for adverse effects has been defined. For this reason, we recommend that the City include in its water quality monitoring plan, a suite of appropriate threshold criteria, which if exceeded during the monitoring period, would trigger either an immediate change in project operations to minimize project-related adverse effects or the removal of the array from the river.

The use of commonly accepted BMPs during project construction and installation of the array would minimize the risk of leakage of lubricants or other toxic substances into the river and should reduce, to the extent possible, impacts associated with the construction activities. A Spill Control, Prevention, and Countermeasures Plan (developed in accordance with both the City and USACE guidelines) should be developed and implemented by the City during construction and installation to reduce or eliminate the potential for spills or leaks. The plan should include measures to: (1) inspect construction and drilling vessels and equipment daily for fuel and hydraulic leaks; and (2) contain and remove petroleum or other oil products in the event of a spill or leak.

Effects of No-action Alternative

Under the No-action Alternative, water quality within the project vicinity would be similar to that observed under existing conditions. During most years, DO and water temperatures in the project tailrace would meet the MPCA's water quality criteria, while turbidity levels would continue to exceed the state standard in most years.

5.3.3 Aquatic Resources

Affected Environment

Fish

The upper Mississippi River provides habitat for as many as 125 species of fish, including walleye, sauger, smallmouth and white bass, bluegill, crappie, northern pike, and catfish (MDNR, 2008a). These resources provide substantial economic benefits to local communities. In 1990, USGS estimated that economic benefits from sport fishing in the upper Mississippi River totaled $350 million (USGS, 1999). Between 1978 and 1991 the value of commercial fishing was estimated at approximately $2 million annually (USGS, 1999).

According to the River Resources Forum's (Forum) Fish and Wildlife Work Group, improvements in water quality in the Mississippi River since about 1990 have created conditions that may have increased fish abundance in the project vicinity (Forum, 2004). However, results of the Long Term Resource Monitoring Program for Pool 4 (which begins approximately 20 miles downstream of the project area) and Pool 8 (which begins approximately 112 miles downstream of the project area) do not demonstrate improving trends in either of the two population parameters for most species.[9] In addition, data presented on exploited species (those caught in sport and commercial fisheries) showed no notable systematic trends in fish abundance or other metrics (Ickes et al., 2005).

Little data is available on fish species composition in Pool 2 or in the tailrace of Lock and Dam No. 2, but the Long Term Resource Monitoring Program (LTRMP) results for Pool 4 documented the presence of 88 species between 1993 and 2004.[10] Many of the species documented in Pool 4 are also likely to be present in or near the project area. Data collected as part of an entrainment study at the project in 1990 and 1991 showed 11 species were entrained through the Mississippi Lock and Dam No. 2 Project turbines (Barnes-Williams, 1991) (Table 4). Table 5 shows the species composition by month. Based on net sampling, the majority of the fish entrained were gizzard shad (53 percent) and rosyface shiners (33 percent). Study authors estimated that approximately 112,000 fish were entrained at the project during the 11-month study period.[11]

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[9] Analysis of trends is difficult as a result of differences in sampling methodology over time, and likely large annual variability in fish abundance.

[10] A comprehensive list of all species encountered in Pool 4 can be found on the LTRMP website (www.umesc.usgs.gov/cgi-bin/ltrmp/fish/graphical/splistann_query.pl)

[11] No confidence intervals were developed for the mean estimate of 112,000. Data were based on expansion of hydroacoustic data collected over the same period as the netting.

Table 4 Estimated number of fish, by species, entrained through the Mississippi Lock and Dam No. 2 Hydroelectric Project powerhouse turbines in 1990-1991. (Source: Barnes-Williams 1991, Table 3 and Table 9, as modified by staff)

Species	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total[b]
Channel Catfish	1,586	900	20	0	0	0	0	0	0	0	0	2,505
Common Carp	0	0	0	371	0	0	0	0	0	0	0	371
Flathead Catfish	0	0	0	0	0	0	0	0	0	3,666	0	3,666
Freshwater Drum	1,586	900	277	0	361	0	3,475	1,078	0	3,666	4,385	15,727
Gizzard Shad	0	2,699	554	9,522	33,911	7,141	0	2,188	0	3,666	0	59,681
Largemouth Bass	0	0	0	0	180	0	0	0	0	0	0	180
Quillback Carpsucker	1,586	0	79	0	0	0	0	0	0	0	0	1,665
Rosyface Shiner	6,344	7,327	2,614	2,102	722	0	0	0	0	0	0	19,108
Spotted Gar	0	0	79	0	0	0	0	0	0	0	0	79
Sucker Species	1,586	0	317	0	0	0	0	0	0	0	0	1,903
White Bass	0	900	40	371	722	3,517	0	0	0	0	0	5,549
Total Entrained (TE)	12,687	12,725	3,980	12,366	35,895	10,658	3,475	3,266	0	10,998	4,385	110,435[c]
Estimated Total Project Passage (TEPP)[a]	54,432	44,848	8,386	20,576	69,436	20,120	4,911	3,717	0	28,358	26,969	281,753
Percent Entrained (TE/TEPP)	23%	28%	47%	60%	52%	53%	71%	88%	0%	39%	16%	39%

[a] Estimated Total Project Passage and Percent Entrained calculated by expanding entrainment data, by species, by taking mean monthly flow/maximum turbine discharge. The analysis assumes a 1:1 ratio of water to fish.

[b] No samples were collected in May, because the project was shut down.

[c] The TE of 110,435 is based on results of both the netting and hydroacoustics analyses (Barnes and Williams, 1991). Presenting the results by species, by month, yields slightly lower numbers than reported in the 1991 study (e.g., a total of 112,443 fish entrained), because percent species composition did not always sum to 100 percent. Data for March in Table 5, below, illustrates this difference.

Table 5 Percent species composition by month for the 1990-1991 Lock and Dam No. 2 turbine entrainment study. (Source: Barnes-Williams, 1991)

Species	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**[a]
Channel Catfish	12.5	7	0.5								
Common Carp				3							
Flathead Catfish										33	
Freshwater Drum	12.5	7	7		1		100	33		33	100
Gizzard Shad		21	14	77	94	67		67		33	
Largemouth Bass					0.5						
Quillback Carpsucker	12.5		2								
Rosyface Shiner	50	57	66	17	2						
Spotted Gar			2								
Sucker Species	12.5		8								
White Bass		7	1	3	2	33					

[a] No data were collected in May, because the project was shut down.

Freshwater Mussels

Freshwater mussels are mollusks that live in the sediments (mud, sand, gravel) of rivers, streams and lakes. A total of 21 of the 44 freshwater mussel species present in the upper Mississippi River system have been found in Pool 2 (Table 6). Freshwater mussels have a unique life history in that most use a fish as an intermediate host to complete their life cycle. Known fish hosts present in the project area for each of the 21 mussels found in Pool 2 are also listed in Table 6.[12]

Table 6 Native mussel species and fish hosts present in Pool 2. (Source: www.fws.gov/midwest/mussel/index.html)

Common Name	Scientific Name	Fish Hosts (Present in 1990-1991 Entrainment Study)
Black sandshell	*Ligumia recta*	Common Carp, Largemouth Bass
Creeper	*Strophitus undulatus*	Largemouth Bass
Deertoe	*Truncilla truncata*	Freshwater Drum
Elktoe	*Alasmidonta marginata*	Sucker species
Fat mucket	*Lampsilis siliquoidea*	Largemouth Bass
Fawnsfoot	*Truncilla donaciformis*	Sucker species
Fragile papershell	*Leptodea fragilis*	Freshwater Drum
Giant floater	*Pyganodon grandis*	Freshwater Drum, Sucker species, Common Carp, Gizzard Shad, Largemouth Bass, White Bass
Higgins' eye pearlymussel[a]	*Lampsilis higginsii*	Freshwater Drum
Mapleleaf	*Quadrula quadrula*	Channel Catfish, Flathead Catfish
Paper pondshell	*Utterbackia imbecillis*	Largemouth Bass
Pimpleback	*Quadrula pustulosa*	Channel Catfish, Flathead Catfish
Pink heelsplitter	*Potamilus alatus*	Freshwater Drum
Pink papershell	*Potamilus ohiensis*	Freshwater Drum
Plain pocketbook	*Lampsilis cardium*	Largemouth Bass
Rock pocketbook	*Arcidens confragosus*	Freshwater Drum, Gizzard Shad, Channel Catfish
Round pigtoe	*Pleurobema sintoxia*	None
Threehorn Wartyback	*Obliquaria reflexa*	None
Threeridge	*Amblema plicata*	Largemouth Bass, White Bass, Flathead Catfish
Wabash pigtoe	*Fusconaia flava*	None
Wartyback	*Quadrula nodulata*	Channel Catfish, Flathead Catfish, Largemouth Bass
White heelsplitter	*Lasmigona complanata*	Common Carp, Largemouth Bass

[a] Endangered Species Act (ESA) Listed

[12] A complete list of those fish species that act as intermediate hosts for all mussel species present in the Upper Mississippi River can be found under Life History at www.fws.gov/midwest/mussel/index.html.

One federally endangered species - the Higgins' eye pearlymussel – is known to occur in Pool 2 and Pool 3. We discuss this species in more detail in section 5.3.5 (*Threatened and Endangered Species*).

One non-native, highly invasive mussel species has also been documented in Pool 2. The zebra mussel (*Dreissena polymorpha*) is a fingernail-sized species native to the Caspian Sea region of Asia. Zebra mussels are believed to have been transported to the Great Lakes via ballast water from a transoceanic vessel. The ballast water, taken on in a freshwater European port was subsequently discharged into Lake St. Clair, near Detroit, where the mussel was discovered in 1988. Since that time, they have spread rapidly to all of the Great Lakes and waterways in many states, as well as Ontario and Quebec.[13] The species was first documented in Pool 8 of the upper Mississippi River in 1991.

Zebra mussels have been found in very small numbers (two) in a 4-mile reach of Pool 2. The USACE monitors for immature zebra mussels (called veligers) at Lock and Dam No. 2; to date, sampling has detected only a few veligers per meter of water sampled (City, 2008a).

Environmental Effects and Recommendations

Fish

Hydrokinetic turbine arrays represent a new technology, and very little information is available describing the effects of this equipment on aquatic communities in large river systems. Cada et al. (2007) reviewed the technology and listed five primary issues associated with hydrokinetic turbine impacts to aquatic communities: alteration of river bottom habitats, suspension of sediments, turbine strike, electromagnetic fields, noise and cumulative impacts. EPRI (2006) and the National Renewable Energy Laboratory (2006) noted that effects may vary from site to site, depending on turbine design, physical and biological conditions, and other factors that could interact with turbine operation to affect aquatic resources.

In consultation with MDNR and NPS, the City identified the following issues, given the proposed turbine design and existing conditions at the Mississippi Lock and Dam No. 2 Hydroelectric Project:

- Fish entrainment and survival
- Effects on aquatic biodiversity
- Effects on freshwater mussels present in the scour protection area

[13] http://www.great-lakes.net/envt/flora-fauna/invasive/zebra.html#overview

- The spread of zebra mussels as a result of turbine operation, maintenance and monitoring activities

Staff agrees with the City and the resource agencies that all three of these issues need to be addressed at the proposed project. Our analysis of these issues, the sampling methods proposed by the City, and the sampling methods recommended by the resource agencies is presented below.

Fish Entrainment and Survival

Fish entrainment is generally measured as the number of fish, by species, that enter the turbine units over an identified time period. Survival is measured as the percent of the fish entrained that are estimated to be alive and/or healthy after passage.

Based on results of entrainment and survival studies conducted at other U.S. projects, the City hypothesizes that the new hydrokinetic turbine impacts to the local fish community would be minimal. The City contends that entrainment at the Project would not be a concern unless fish are injured or killed as they pass through the units. For this reason, the City does not propose to conduct entrainment studies, but would develop direct estimates of fish survival rates for documenting hydrokinetic turbine impacts to aquatic communities at a population scale.

To measure fish passage survival through the turbine array, the City proposes to use the HI-Z Turb' N Tag tag-recapture technique. This fish tagging and recapture system allows researchers to develop precise estimates of turbine survival. The technology has been used extensively across the United States to measure fish passage survival rates through hydroelectric facilities. The number of tagged fish required for the study is based on the City's assumption that survival rates for small and large fish would be 98 percent and 90 percent, respectively. The City estimates that 650 fish are needed to meet the statistical precision required for the study ((ε = < +5 percent, 90 percent of the time, 1 - α = 0.90). If mortality levels exceed 98 and 90 percent, it is inferred that additional evaluations would be conducted to ascertain impacts to aquatic communities. However, the authors do not explain the basis for survival assumptions, or describe what these additional studies would entail (City, 2008a, Appendix A, letter from T. Brush, Senior Principal Scientist, Normandeau Associates, Inc. to T. Montgomery, Public Works Director, City of Hastings, dated October 25, 2007).

MDNR and NPS maintain that both entrainment and survival studies are needed to evaluate project effects on the aquatic community, for two reasons: (1) the technology is untested and its effects are unknown; and (2) the upper Mississippi River supports important and unique fisheries (MDNR, 2007). The agencies also recommend that these studies be undertaken as part of a 3 to 5-year pilot project to identify any impacts this new technology may have on aquatic resources, while at the same time allowing for power generation.

The agencies' recommended entrainment sampling methodology is full flow tailrace netting. Under this approach, nets would be attached to the downstream end of the hydrokinetic units that would allow for the capture, enumeration and examination of most fish (and other aquatic species) entrained into the project. By releasing control fish directly to the nets, estimates of injury and survival/mortality may be obtained. In their comments on the draft application for amendment, MDNR (2007) provided details on their recommended sampling effort, frequency and precision, collection efficiency (proof of concept) and data analysis. The MDNR did not provide a list of performance criteria, or the statistical precision required around these criteria for making management decisions regarding hydrokinetic turbine impacts to aquatic resources.

Fish Survival

We agree that estimates of fish passage survival through the hydrokinetic turbines are needed to document unit impacts to fish communities and overall aquatic diversity. The degree of impact would depend on resulting survival estimates by species. Whether resulting values are "low enough" to consider additional studies has not been defined by any party and should be determined prior to study initiation. Additionally, a precision level around these survival estimates should be established in advance, to assist in determining an appropriate sample size and frequency of sampling.

As mentioned above, the City anticipates that the new hydrokinetic turbine impacts to the local fish community would be minimal, because of the slow rotation rate (21rpm); the small number of blades (three), minimal shear effects; no vanes or wickets to hinder fish passage; and no decompression effects, because the unit is not pressurized (Franke et al. 1997, Cada et al. 1997). By comparison, conventional hydropower turbines (e.g., Kaplan units such as those in use at the existing project) may have rotation speeds greater than 100 rpm, four to six blades, high shear, vanes or wicket gates, and large pressure changes.

We agree that fish survival rates through hydrokinetic turbines are likely to be higher than is typical for conventional turbines. However, survival rates have not been tested, and without collecting and analyzing project specific data, the level of effects is speculative. Commission staff recommends that the fish survival study proposed by the City be initiated immediately after the units become operational.

Our analysis of the sampling methods proposed by the City and those recommended by the resource agencies indicates that both approaches would provide relatively similar results. We recommend the City's proposed HI-Z Turb'N Tag fish survival study for the following reasons:

Risks to fish survival: The City's proposed HI-Z Turb'N Tag study would provide real-time data on fish passage survival through the proposed turbine units, as they were

designed. If initial survival rates are low (less than 80 percent),[14] turbine operations could be immediately modified or stopped to protect fisheries resources. By contrast, because of the expected variability in results, the full-flow netting approach would require more time to gather the same information.

Variability: The City's concern that full-flow netting results would exhibit a high degree of variability and thus would not be representative of long-term entrainment patterns, could be addressed by increasing sample size and frequency, but unless a netting study is implemented over multiple years (which then becomes cost prohibitive), both the tagging study and the full-netting study would provide data associated with a single snapshot in time. Variability in population abundance and level of entrainment through the units would have to be analyzed using statistical techniques under both approaches. Staff has identified existing data collected since 1993 that could be used for this purpose (see Fish Entrainment).

Cost: The cost of the City's proposed HI-Z Turb'N Tag study would be substantially lower than a full-flow netting study. We estimate that the City's proposed fish passage survival study would cost from $162,500 to $227,500, based on 650 tags priced at approximately $250-$350 per tag (pers. comm., M. LaRiviere, Senior Fisheries Biologist, Tacoma Power, July 11, 2008). Data presented in OTA (1997) indicate the average cost for a 12-month entrainment study using netting was $273,006. Adjusted for observed inflation, this would equate to approximately $361,000 in 2007 dollars.

Structural stability and worker safety: The tagging study would not require attachment of structures or equipment to the turbine/barge, other than the induction system (a pump, induction tank, and 4-inch-diameter flexible delivery hose). The full-flow netting approach would increase drag on the turbine/barge structure and its tethering/anchoring system, and could reduce its stability during the study.

Based on our review of the City's survival/injury study plan, staff believes the following items need to be addressed in more detail.

1. Species to be tested and rationale for their selection

The results of the 1990-1991 entrainment study indicated that at least 11 different species entered the existing turbine units during this time frame. Data presented in EPRI (1997) indicate that survival rates are likely to vary by species.

We recommend that survival/injury estimates be developed for a minimum of five species, in order to evaluate effects on aquatic biodiversity. According to the 1990-1991 data, five species made up over 90 percent of the fish entering the turbines at the existing

[14] Data presented in Franke et al. (1997) show that passage through Kaplan turbine units at relatively low head dams are generally greater than 80 percent for most species.

powerhouse (Barnes-Williams, 1991). Tagging a minimum of five species would also be needed to account for different life histories. Hydrokinetic turbine operation is expected to peak during August and dip to a low in April (Figure 7); species migrating at these times would experience a higher and lower risk, respectively, of entrainment. The City should consult with the agencies on species selection and document the reasoning used in the selection process.

2. Fish size to be tested

The City defines fish size on a relative basis, i.e., "large" and "small". The City does not state what size groups would be tested, or if groupings would vary by species or age class or both.

We recommend that survival/injury estimates be developed for a random sample of fish (by species and length) that may pass through the units. The length range of fish that should be tested (by species) can be found in the 1990-1991 entrainment study (Barnes-Williams, 1991). Based on data submitted by the City (City, 2008a, Appendix C, Table 1), we estimate that approximately 750 tags would be required for the survival/injury study (Table 7).

Table 7 Estimated sample size required for hydrokinetic turbine survival/injury study. (Source: City, 2008a, Appendix C, Table 1, as modified by staff)

Parameters	
Control Survival	98 percent
Recapture Rate	97 percent
Turbine Mortality	5 percent
Number of Species	5
# Tags Per Species	150
Total Tags	750

3. Metric(s) to be measured and supporting rationale

The two new hydrokinetic turbines associated with the proposed project would have a volumetric flow ranging from about 900 cfs to 3,000 cfs (City, 2008b). As they would be located downstream of the existing turbine units, they would capture approximately 17 percent to 60 percent of maximum turbine discharge, meaning that 40 to 83 percent of the flow would not pass through the turbines. It is therefore likely that a large portion of fish entering the tailrace would not be entrained into the hydrokinetic turbines, as not all water exiting the powerhouse would enter the units.

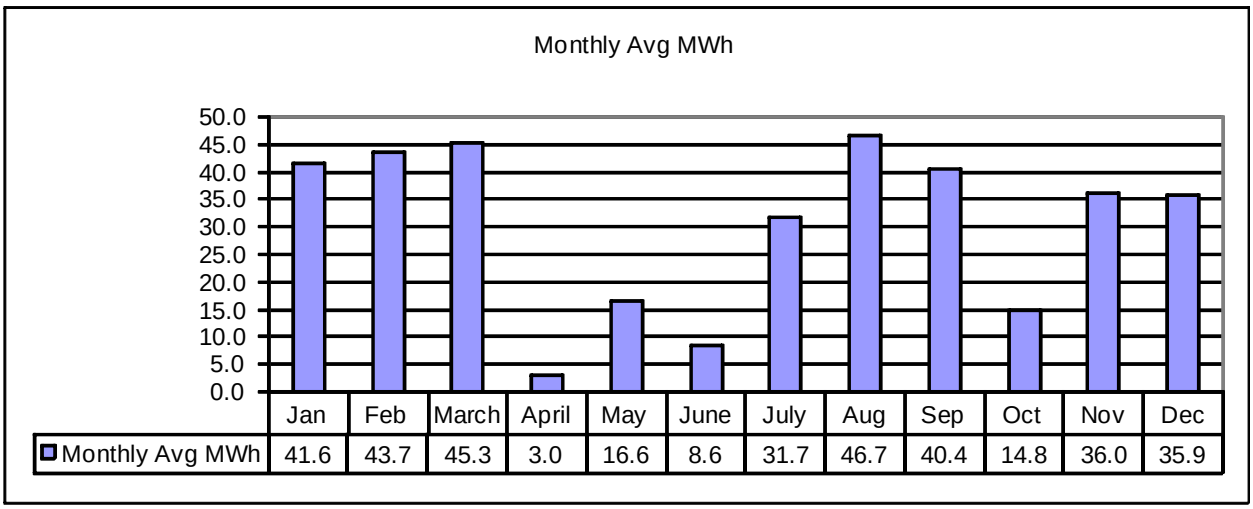

Figure 7 Estimated potential monthly average energy from the HKTA (MWh) based on an average water year. (Source: City, 2008b, Table B-2 as modified by staff)

Study protocols proposed by the City call for releasing test fish in a location where they would be committed to turbine passage, resulting in 100 percent of the test fish entering the hydrokinetic turbine units. This protocol is therefore in reality a measure of **unit effects** on fish survival, not **project effects**, because under normal (non-test) conditions, not all fish in the tailrace would pass through the turbines. The resulting estimate of fish passage survival should be considered the maximum impact the turbine units may have on fisheries resources, and reported accordingly.

The measurement of project effects would require that test fish be released just downstream (within feet) of the existing turbine discharge point. This release point would result in fewer fish being entrained into the hydrokinetic turbines, which could result in higher overall fish survival.[15]

The City also states that tailrace hydraulics would be impacted by unit operation. Data presented by the City show that water velocities at the turbine diffuser unit would be at least 50 percent lower than without the turbines in place (City, 2008a). A decrease in water velocity may allow predators to establish feeding stations closer to the face of the dam or downstream of the units in areas with reduced water velocity. These changes have the potential to alter tailrace predation rates. The City proposes to measure direct effects to test fish survival from unit passage, but not indirect effects such as predation.

[15] On page 13 of the study plan (Normandeau, 2008), the release point for control fish is described variously as “into the tailrace” and “immediately downstream of the spill area”. Staff assumes the release point is in the tailrace downstream of the hydrokinetic turbines.

The City notes that recapture rates of test fish are expected to be 98 percent unless predation is a significant problem. This implies that the City is able to estimate indirect predation effects to fish through the recapture metric. In presenting the results of the survival/injury study, the City should provide estimates of predation rate as implied by the recapture metric, for each test species.

Fish Entrainment

The City proposes to address only mortality resulting from entrainment, not to address the number or species of fish entrained through the turbines. The agencies recommend that full-flow netting be used to document project impacts to aquatic communities, because it would provide information on species composition and number of fish entrained, as well as injury and survival. Data would be collected over multiple years to account for known variability in fish population abundance and species diversity.

We conclude that with the exception of turbine survival data, sufficient information is currently available to develop an estimate of possible fish entrainment and survival through the hydrokinetic turbines. These data are available from the 1990-1991 entrainment study conducted by the City (Barnes-Williams, 1991) and from the Long Term Resource Monitoring Program (LTRMP) run by the USGS for the upper Mississippi River System (Ickes et al., 2005) (http://www.umesc.usgs.gov/ltrmp.html).

Data presented in the entrainment study conducted in 1990-1991 provides information on the number of fish by species entrained into the existing turbines at the project powerhouse (Table 7). Flow data from 1987-2007 presented in Exhibit-B was used to expand the entrainment data to estimate the total number of fish passing Lock and Dam No. 2 at that time (assumes 1:1 fish to flow ratio). The results of this simplified analysis provide estimates of the total number of fish by species passing the dam, as well as the numbers entrained by month.

The number of fish killed or injured passing through the turbines can then be calculated, once the survival rate for the hydrokinetic turbine is known. The estimated number of fish killed or injured at various hypothetical mortality rates is presented in Table 8.

We conclude that the agencies' concerns regarding year-to-year variability in species abundance and diversity may be accounted for statistically by using fisheries data collected by the LTRMP. The LTRMP has been designed by the agencies to determine resource trends and impacts, and develop management alternatives for the upper Mississippi River. The fish database of this program therefore contains detailed information on fish relative abundance, frequency of occurrence, community composition, and species richness from 1993-2004. The variance around these population parameters could be used to model a likely range of fish entrainment levels for the project.

Table 8 Estimated number of fish killed or injured through turbine units under various survival assumptions by species. (Source: City, 2008a)

		Mortality Rate			
Species	**# Fish Entrained**	**0.01**	**0.05**	**0.10**	**0.15**
Channel Catfish	2,505	25	125	251	376
Common Carp	371	4	19	37	56
Flathead Catfish	3,666	37	183	367	550
Freshwater Drum	15,727	157	786	1,573	2,359
Gizzard Shad	59,681	597	2,984	5,968	8,952
Largemouth Bass	180	2	9	18	27
Quillback Carpsucker	1,665	17	83	167	250
Rosyface Shiner	19,108	191	955	1,911	2,866
Spotted Gar	79	1	4	8	12
Sucker Species	1,903	19	95	190	285
White Bass	5,549	55	277	555	832
Totals	110,435	1,104	5,522	11,043	16,565

We recommend the City prepare a desktop analysis of possible entrainment rates and effects through the hydrokinetic turbines. The analysis should use data collected as part of the 1990-1991 entrainment study for the species to be included in the analysis, population information provided in the LTRMP database (or other appropriate database) for exploring population variability effects, and the results of the HI-Z Turb'N Tag survival study for assigning passage mortality and possible predation rates in the tailrace. In addition, if the turbine survival study finds that mortality rates are substantially higher than expected (i.e. greater than 10 percent), the City should expand its analysis to include an assessment of potential long-term population-level consequences for important fish species.

Freshwater Mussels

Native mussels

In Exhibit E of their final amendment application, the City indicates that native mussels may be found in the scour protection area located downstream of the proposed turbine array anchors, where it is possible that installation could adversely affect them. The USDI (2008) has indicated they are concerned about potential project effects on the federally-endangered Higgins' eye pearlymussel. The interagency Mussel Coordination Team is currently reintroducing this species into both Pool 2 and Pool 3. The FWS also requested an assessment of potential project effects on this species (City, 2008a, Appendix A, FWS letter dated December 14, 2007). We discuss potential project effects on this species in section 5.3.5 (*Threatened and Endangered Species*).

The City does not propose specific surveys for freshwater mussels, but if divers observe them incidentally during anchor installation, the City proposes to remove and relocate the mussels as recommended by the USACE (City, 2008a, Appendix A, USACE letter dated July 20, 2007). The City also notes that mussel presence in the tailrace is expected to be low, as high velocities from spillway flow adjacent to the powerhouse make this area uninhabitable.

We recommend the City consult with FWS to develop survey methods; conduct a systematic survey for freshwater mussels within the area that would be affected by turbine structures or operation; and file a survey report with FWS and the Commission prior to installing the turbine array.

Zebra mussels

Adult zebra mussels, about 2 inches in length, colonize all types of living and non-living surfaces including boats, water-intake pipes, buoys, docks, piers, plants, and slow moving animals such as native clams, crayfish, and turtles. They have been known to completely clog water-intakes, damage critical infrastructure, and alter native species assemblages. Because young zebra mussels are very small, they are spread easily by water currents and can drift for miles before settling. FWS estimates the potential economic impact at $5 billion from 2000 to 2010 to U.S. and Canadian water users within the Great Lakes region alone.[16]

The City does not anticipate that zebra mussels would affect the hydrokinetic turbine units, because the numbers of mussels in the project area are very low. However, in light of the potential for rapid spread, the City proposes to develop a zebra mussel control program within the project area to prevent the spread of this invasive species. If zebra mussels are found to colonize the portion of the river where the turbines would be installed, the City would develop equipment cleaning protocols that may include steam cleaning or desiccation for at least three days. No equipment would be moved off-site for at least three days, if the desiccation approach is implemented. The City does not propose long-term monitoring.

The resource management agencies also recommend a zebra control and monitoring program for the project (MDNR) or have identified zebra mussels as an issue (NPS). The MDNR recommends the City develop a plan that would specify design features for zebra mussel control, monitoring plans including methods and schedules and anticipated control methods.

Implementation of the freshwater mussel survey recommended above would provide results needed to determine whether zebra mussels are present, prior to installing the turbine/barge. If zebra mussels are present, we recommend the City sterilize all

[16] http://www.glsc.usgs.gov/_files/factsheets/2000-6%20Zebra%20Mussels.pdf

equipment prior to installation. We also recommend the City consult with MDNR to develop and implement a long-term zebra mussel control plan for the Mississippi Lock and Dam No. 2 Project and file the plan with the Commission within 6 months of issuance of any order approving the Proposed Action. The plan should describe the control procedures that would be used to prevent project activities from spreading this species into other waters, and the costs of the program. Monitoring should be focused on project structures and the effectiveness of control methods implemented by the City rather than broad-level monitoring in the project reach, where a wide variety of influences outside the City's control are likely to affect zebra mussel distribution and abundance.

Effects of No-action Alternative

Under the No-action Alternative, low levels of fish entrainment through the turbines at the existing project would continue to occur. There would be no potential for anchor structures to affect native or non-native mussels that might be present in the tailrace. The risk of zebra mussel infestation would be the same as under the Proposed Action, because normal river flows and the movement of boats and barges would continue to provide vectors for the spread of this invasive species.

5.3.4 Terrestrial Resources

Affected Environment

Vegetation

The Mississippi Lock and Dam No. 2 Hydroelectric Project lies in the Eastern Broadleaf Forest Province (Cleland et al., 1997). This province is a transitional zone between areas of the state that were historically dominated by prairie and the more humid mixed conifer-deciduous forests to the north. Originally, this zone supported river bottom forest plant communities, including species such as elm, ash, cottonwood, willow and hackberry; and wetlands dominated by species such as broad-leaved cattail, river bulrush, and broad-leaved arrowhead. Under current conditions, the same species are present, but scattered; very few native plant communities remain intact (City, 2000). Vegetation around the project area is a mix of native and non-native plants, including turf grasses and ornamental shrubs and trees. As mentioned above, wind and boat-generated wave action prevents the establishment of much emergent vegetation along the shoreline. Water depths of at least 20 feet, plus the presence of rockfill and rip-rap and high water velocities, prevent the establishment of aquatic vegetation in the tailrace.

Wetlands

National Wetland Inventory maps show the Mississippi River in the vicinity of Lock and Dam No. 2 as a man-made impoundment over 6 feet in depth (NWI, 2008). The combination of depth, rip-rapped substrate, and high velocities exiting the draft tubes prevent the establishment of aquatic plant communities, and the NWI maps show this site as unconsolidated bottom, meaning that plants, if present, cover less than 30 percent of the area.

Several palustrine wetlands are located to the southwest of the powerhouse, below the dam. These areas include: wetlands that are dominated by emergent plants, such as cattails, sedges and rushes; Lake Rebecca, which supports submergent plants, such as pondweeds; and one small patch of forest that includes a mix of trees (e.g., green ash, cottonwood and peach-leaved willow), along with emergent herbaceous species.

Wildlife

The Dakota County Environmental and Natural Resource Management Policy Plan indicates there are few areas in the county that currently support high value wildlife habitat (Dakota County, 2005). However, many wildlife species are tolerant of human development and activity, to some degree, and would be likely to use riparian habitat along the river near Lock and Dam No. 2. Such species include white tailed deer, raccoons, foraging bats, and a variety of small mammals and songbirds (NPS, undated). Common map turtles and spiny softshell turtles are often found in open water areas along the upper Mississippi River (FWS, 1980).

About 40 percent of the North American continent's waterfowl migrate through the Mississippi Flyway (FWS, 2006), where the project is located. Quiet water in Pool 2 above Lock and Dam No. 2 would provide loafing and foraging habitat for large numbers of migratory ducks, geese, and swans during the spring and fall. Based on their occurrence in the upper Mississippi River National Wildlife and Fish Refuge (NWFR), located about 55 miles downstream of the City, these waterfowl would include a number of species that rely primarily on fish for their diet (e.g., pied-billed grebe, common goldeneye, bufflehead, hooded and common merganser [FWS, 1987]). Double-crested cormorant, great blue heron, osprey, bald eagle, ring-billed gull, herring gull, black tern, and belted kingfisher are other fish-eating (piscivorous) species that may occur or are documented in the project area. Commission staff observed ten great blue herons foraging along the shoreline during the site visit on June 11, 2008. Raptors, including bald eagles, migrate along the river corridor (MDNR, 2008b), and one bald eagle pair has nested at Lake Rebecca (a floodplain lake within an abandoned river channel just south of the project area) since at least 1997 (FMR, 2007). A recent bald eagle survey indicates a steady increase in the state's population over the past 30 years, with an estimated 1,312 active nests in 2005 (MDNR, 2005).

Environmental Effects and Recommendations

Terrestrial Habitat

Construction activities have the potential to affect terrestrial resources by disturbing soils, removing or altering vegetation, blocking wildlife migration or movement routes, or causing noise disturbance. However, the Proposed Action would not affect any terrestrial habitat, because the hydrokinetic turbines would be located in the tailrace, tethered to existing structures, and anchored to the river bottom within the scour protection zone. For the same reasons, the Proposed Action would not affect any terrestrial migration or movement routes for wildlife.

Installation of the turbines may cause temporary noise disturbance to wildlife species that use habitats near Lock and Dam No. 2. However, ambient noise levels are high, due to turbine discharge and power generation, as well as noise associated with the lock and dam. We conclude that effects would be about the same as under existing conditions, because equipment that would be used for installing the units would generate noise at levels similar to noise that occurs during routine operation and maintenance of the existing project and Lock and Dam No. 2 (e.g., generators, boats, barges, trucks, and cranes). In addition, wildlife that currently use terrestrial habitats near the tailrace would only include species (or individuals) that are habituated to human activities and noisy settings.

Wetlands

Construction along rivers and floodplains often has the potential to affect wetlands and special aquatic sites. However, tethering and anchoring of the turbine/barge would not affect any wetlands, because construction personnel and equipment would access the tailrace from existing roadways, walkways, and the river. Operation of the hydrokinetic turbines would not alter hydrologic support for any wetlands or affect any aquatic vegetation.

Wildlife Habitat

Water resource development often adversely affects aquatic habitat and wildlife species that use rivers and shorelines through direct effects on soils or vegetation, or indirectly, by altering habitat quality or causing disturbance. However, no aquatic vegetation is present in the tailrace under existing conditions, and installation of the hydrokinetic turbines would not affect aquatic habitat.

The suitability of the tailrace to support foraging by birds or aquatic mammals is likely limited, due to high turbidity,[17] high velocity, and the absence of aquatic vegetation, and project operators indicate that no birds or aquatic mammals are observed to forage in the tailrace. However, back-flows from the power plant provide foraging opportunities for great blue herons that stand on the right bank to hunt, as flows sweep by them. During the site visit on June 11, 2008, staff observed several great blue herons successfully using this area as a foraging station.

The analysis in section 5.3.3 above indicates that as many as 110,000 fish could be entrained through the hydrokinetic turbines, if entrainment through the units is similar to levels estimated for the existing hydropower project. If fish are injured or killed, entrainment could increase prey availability for several piscivorous birds. Foraging opportunities could increase in the tailrace for species such as gulls, terns and bald eagles, that typically take fish from the water surface or just below it.

Turbine operation is not anticipated to increase turbidity and to only slightly increase velocity, so there would be no change in the visibility of fish to species such as cormorants and mergansers that pursue their prey underwater. Under existing project operations, conditions are often turbid, and are not suitable for diving birds, which rely on visual acuity to capture fish. If existing conditions impair birds' ability to see, birds that dive to pursue their prey may not enter the tailrace, and would not risk entrainment in the turbines or turbine injury from blade strike. Should diving birds use the tailrace, their high maneuverability and the low blade speed would help to reduce the risk of turbine injury, even in turbid conditions. We conclude there is a low risk of turbine injury to diving birds, but no systematic surveys of piscivorous birds have been conducted in the project area, and there is no information about whether birds forage in the tailrace under existing conditions.

The turbines would generate underwater noise, but no decibel information is available to quantify turbine noise or ambient conditions. Noise levels would likely be low energy and low frequency, because of the 21-rpm blade speed. By comparison, boat propellers typically range from several hundred to several thousand rpms. The noise of tailrace discharge and boat traffic through the lock would be expected to generate substantial background noise under existing conditions. If birds currently use the tailrace for foraging, it is likely that they are acclimated to loud ambient conditions.

We conclude that installation and long-term operation of the turbines would not affect terrestrial habitat for wildlife or cause disturbance to species on land, but more information is needed to evaluate the potential for turbine injury to diving birds, which are protected by the Migratory Bird Treaty Act. Bald eagles, which are protected by the

[17] As discussed in section 5.3.2, the state standard for this reach of the Mississippi River is 25 NTU, a level that was exceeded 91 times between 1987 and 2005, likely during flood events.

Bald and Golden Eagle Protection Act, as well as the Migratory Bird Treaty Act, are also present in the project area and may forage in the tailrace. We recommend the licensee consult with FWS, MDNR and NPS to design and implement a bird monitoring plan to describe bird use of the tailrace. To capture seasonal effects, including spring and fall migrations, surveys should be conducted at monthly intervals for a year, at a minimum, to provide a basic understanding of how birds may use the tailrace, and to further evaluate whether there is any substantial risk of turbine injury. If monitoring results indicate that diving birds forage in the tailrace, we recommend that the licensees consult with the agencies to determine whether additional monitoring is needed.

Effects of No-action Alternative

Under the No-action Alternative, vegetation, including wetland habitats, would continue to be affected by impoundment, wind and wave action on the surface, and tailrace velocities. Wildlife that are tolerant of human activities would continue to use habitats, including man-made structures, along the river at the project site.

5.3.5 Threatened and Endangered Species

Affected Environment

The FWS reviewed the City's draft license amendment application and commented that the federally-endangered Higgins' eye pearly mussel (*Lampsilis higginsii*) occurs in Pools 2 and 3 of the Mississippi River (letter to Tom Montgomery, Public Works Director, City of Hastings, from Tony Sullins, FWS Field Supervisor, Twin Cities Field Office, dated December 14, 2007). A review of the MDNR threatened and endangered species website indicates that apart from the Higgins' eye pearlymussel, only one other federally listed species – prairie bush-clover (*Lespedeza leptostachya*) – occurs in Dakota County.

Prairie bush-clover is associated with upland prairie habitats. The project area does not contain any prairie habitat that would support prairie bush-clover. Therefore, we do not discuss this species further.

The Higgins' eye pearlymussel prefers sand and gravel substrate in large rivers, where current velocities are less than 1 m/s during low flow conditions (FWS, 2004). Freshwater mussels have a unique life cycle in that they require a fish to complete their life cycle. The glochidia stage of the mussel develops as a parasite on the gill tissue of the host fish. Attaching itself to the fish allows the sedentary mussel to disperse and populate habitats they could not otherwise reach.

This species has recently been reintroduced to Pool 2 and Pool 3. Higgins' eye pearlymussel relocation and monitoring efforts are in the sixth year of the implementation

phase. As of September 2006, more than 10,000 2- to 3-year-old sub-adults grown in cages have been placed in Mississippi River Pools 2, 3 and 4 as their final relocation sites. Almost 5,000 sub-adults have been moved to relocation sites in Pool 2, approximately 0.75 mile upstream of Lock and Dam No. 2 (Wege et al., 2007). Over 100 adults have been relocated to sites in Pool 3, approximately 1.7 miles downstream of Lock and Dam No. 2.

Environmental Effects and Recommendations

The tailrace area where the turbines would be installed is armored with rock scour protection, which extends approximately 140 feet downstream from the draft tubes of the existing project. The 40-inch rip-rap would not be likely to support Higgins' eye pearlymussel, which prefers finer substrate, and the small size of the anchor would affect very little habitat. For these reasons, it is unlikely that this species is present or if present, that it would be affected. However, in light of the fact that an interagency team, including FWS, is working to recover this listed species by reintroducing it into Pool 2 and Pool 3, we recommend the City conduct a survey for Higgins' eye pearlymussel in the area of the proposed turbine/barge prior to anchoring the turbine/barge. If Higgins' eye pearlymussel is detected, we recommend the City consult with FWS, NPS and MDNR to evaluate project effects.

Effects of No-action Alternative

Under the No-action Alternative, no turbine/barge would be anchored in the tailrace of the existing project, and there would be no risk of altering substrate or water velocities, that would affect the Higgins' eye pearlymussel, if present.

5.3.6 Cultural and Historic Resources

Affected Environment

Human use of the upper Mississippi River valley dates back 12,000 years to occupation by Paleo-Indians (USACE, 2003). The Oneonta cultural tradition appeared about 1,000 years ago. The Oneonta established villages, as well as seasonal hunting and fishing camps on terraces overlooking the floodplains; grew corn, squash and beans; and relied on the Mississippi River for fish, turtles, clams and plant foods (NPS and USACE, 2003). When Europeans entered the Mid-West in the mid-1600s, they encountered several different Native American groups, who are now known as the Dakota/Lakota/Nakota, living along the Mississippi River. The area opened to European settlement following the signing of the Treaty of Mendota in 1851. The tribes currently have reservations in Minnesota, Nebraska, South Dakota, North Dakota, Montana, Manitoba, and Saskatchewan (PIIC, undated). The reservation nearest the project area is

the Prairie Island Indian Community, located near Red Wing, approximately 15 miles downstream of Hastings.

The City was established as the county seat in 1857. It developed rapidly, but as other locks and dams were constructed in the upper Mississippi River, the reach near the City presented challenges to navigation (NPS and USACE, 2003). Lock and Dam No. 2 was constructed in 1930, as part of a plan to develop a minimum 9-foot-deep channel between St. Louis, Missouri and St. Paul.

Over 60 properties in the City are listed on the NRHP (Hastings Heritage Preservation Commission, undated). Many are located in the City's two NRHP historic districts. Lock and Dam No. 2 is not located in an historic district, and is not mapped as an NRHP property (Hastings Housing and Redevelopment Authority, undated).

Environmental Effects and Recommendations

Water resource development often has the potential to affect cultural resources or historic properties, because human activities have always tended to center on floodplains and terraces. However, the turbine/barge would be located in the tailrace of the existing hydropower project, and would not have the potential to affect archeological sites, if any were present. By e-mail the Prairie Island Indian Community indicated they had no comments on the City's draft amendment application (e-mail to H. Wahto, Hatch Energy, Inc. from H. Westra, PIIC, January 30, 2008).

As discussed in section 4.3.5 (*National Historic Preservation Act*), above, the Minnesota SHPO determined in 1981 that the project area did not include any NRHP-eligible or listed properties. More recently (by e-mail dated September 21, 2007), USACE informed the licensee that Lock and Dam No. 2 is not eligible for inclusion in the NRHP and is not within or part of any historic district.

In their comment letter dated June 24, 2008, NPS recommends that the Commission consult with the Minnesota SHPO and NPS for a current determination of effect on historic properties, as required by Section 106 of the NHPA. By letter dated April 3, 2008, the licensee requested a determination from the Minnesota Historical Society confirming that the Proposed Action would not affect historic properties. By letter dated July 30, 2008, Commission staff informed the SHPO, NPS, and Prairie Island Indian Community that it concludes that the area does not contain any historic properties and that approval of the proposed amendment would not constitute an undertaking pursuant to Section 106 of the NHPA. Commission staff requested comments and recommendations regarding this finding. The SHPO commented by letter dated August 29, 2008 that they would need additional information in order to complete their review of the project. On September 23, 2008, Commission staff provided SHPO with the requested information.

Installation of the hydrokinetic turbines would occur in an area that is already in use as the tailrace for the existing hydropower project, located at the existing lock and dam. Installation and operation of the hydrokinetic turbines would not alter existing project features or their operation, and would not require any ground disturbance that could expose historic or cultural properties.

The 9-foot navigation channel maintained by the USACE along 284 miles of the upper Mississippi River, including Lock and Dam No. 2, could be considered eligible for listing in the future. However, the hydrokinetic units would be located 200 feet riverward of the active lock, and would not affect on the nature or characteristics of the navigation channel. For this reason, we anticipate that installation of the hydrokinetic turbines would not affect any future NRHP listing of the Lock and Dam.

Effects of No-Action Alternative

Under the No-action Alternative, no turbine/barge would be anchored in the tailrace of the existing project, and therefore there would be no risk of altering archeological sites, if any were present, or altering any that may be eligible for listing in the future.

5.3.7 Recreation

Affected Environment

Congress established the MNRRA in 1988 as a unit of the National Park System. The MNRRA boundaries coincide with the boundaries of the MRCA, which was incorporated into the MNRRA as part of the Comprehensive Management Plan for the river. The Comprehensive Management Plan lays out policies to manage land use, resource protection, and open space within the river corridor.

The MNRRA/MRCA, which encompasses the project area, provides a wealth of recreational opportunities, including boating, fishing, and biking along and in the Mississippi River. An estimated 12,000 boaters pass through the lock at Lock and Dam No. 2 each year (Forum, 2004). The USACE maintains an interpretive center and public observation deck at Lock and Dam No. 2, but the lock structures and dam are not open to the public. The USACE also maintains a restricted area in the river, extending 600 feet upstream of the dam and 300 feet downstream of the dam, to ensure safety and security. The FERC project boundary for the Mississippi Lock and Dam No. 2 Hydroelectric Project is entirely within this restricted area.

In addition to the USACE observation deck and the lock itself, four other recreational facilities provide river or shoreline access near the project area. Just south of Lock and Dam No. 2, the City is collaborating with NPS, MDNR, the Friends of the

Mississippi River (FMR) and local volunteers to restore native plant communities in the 80-acre Lake Rebecca and adjacent 4.1-acre park. The park provides for a mix of uses, such as public paths, playfields, a picnic area, a canoe launch, and an interpretive center.

The 30-acre Jaycees Park provides a picnic area, benches, and a bike and pedestrian path. MDNR maintains a public boat ramp to the Mississippi River at the park.

The Riverfront Trail extends almost 3 miles along an earthen berm between Lake Rebecca and Lock and Dam No. 2. The trail follows Lock and Dam Road through Jaycees Park and along the river shoreline to Veterans Memorial Levee Park in downtown Hastings.

Veterans Memorial Levee Park is located at the eastern terminus of the Riverfront Trail. Amenities include a picnic area, benches, an observation deck, and a monument to the Veterans of American Wars.

Environmental Effects and Recommendations

In their comments on the license amendment application dated June 24, 2008, NPS notes the importance of the Mississippi River as a recreational resource, and recommends the City consult with NPS to discuss recreational enhancement opportunities in the project area. NPS notes that high numbers of recreational boaters lock through and pass directly adjacent to the project during boating season, and that public access is available just downstream at a developed boat launch and new public dock.

The hydrokinetic turbines would be located in the tailrace of the existing hydropower project, which is not accessible to the public. The USACE restricts access, due to safety and security concerns. The USACE is likely to continue to restrict access into the foreseeable future. Because the project is located within the restricted area, there is no recreational activity (e.g., boating, fishing, wildlife viewing, scuba, or passive shoreline recreation) that could be affected by installation of the hydrokinetic turbines.

Installation of the hydrokinetic turbines at the project would not remove recreational opportunities that currently do exist at the locks or at public access points just downstream, including the USACE observation deck, Lake Rebecca, Jaycees Park, Riverfront Trail, or Veterans Memorial Levee Park. The Proposed Action would not affect the quality of the recreational experience of boaters, or impede access to the locks or boat launches during either the installation period or during operation. For these reasons, we conclude the project would have no effect on recreation.

Effects of No-Action Alternative

Under the No-action Alternative, no turbine/barge would be anchored in the tailrace of the existing project, and therefore there would be no risk to recreational resources.

5.3.8 Land Use and Aesthetics

Affected Environment

As mentioned above, the Mississippi Lock and Dam No. 2 Hydroelectric Project is located within the boundaries of the MNRRA. The Comprehensive Management Plan for the MNRRA recognizes the importance of economic activities on and along the river and provides for the commercial use of the corridor, as well as recognizing the national significance of the riverine ecosystem. The plan is intended to protect both aspects of the MNRRA.

The project is also located within an area designated in the City's comprehensive plan (City of Hastings, 2000) as Urban Diversified District. The City's goals for the Urban Diversified District are "to maintain the present diversity of commercial, industrial, residential and public uses of the lands, including the existing transportation use of the river; to protect historical sites and areas, natural scenic and environmental resources; and to expand public access to and enjoyment of the river. New commercial, industrial, residential, and other uses may be permitted if they are compatible with these goals."

The Urban Diversified District of Hasting includes a mix of commercial, industrial, residential land uses, park, public, and quasi-public land uses. The dominant visual feature in the project area is Lock and Dam No. 2 and the hydropower project, which characterize the river's use for commerce, power generation, and flood control. The setting for the lock and dam and powerhouse is the river itself, which flows between floodplains, terraces, and bluffs rising to almost 200 feet. In addition to recreational boating and paddling on the river downstream of the project, adjacent parks provide opportunities for biking and walking on pedestrian paths.

The acoustic environment includes noise from tailrace discharge, powerhouse generation, operation of the locks, and navigation use of the river. The lock provides passage to over 11,000 commercial vessels and approximately 12,000 recreational boaters annually (Forum, 2004). Vehicle traffic on adjacent roads and bridges also contributes to noise levels in the project area.

Environmental Effects and Recommendations

In their comment letter dated June 24, 2008, NPS identified four concerns relating to land use and aesthetics. These include (1) the potential for adverse effects on National Park System or other sensitive lands in the event of HKTA dislodgement and subsequent retrieval; (2) effects on navigation; (3) noise and (4) aesthetic impacts.

Dislodgement: Installation of the turbine/barge would add a new project feature to the City's existing, licensed hydropower project, which is inspected annually under Part 12 of the Federal Power Act. The annual inspections evaluate "any condition, event, or action at the project which might compromise the safety, stability, or integrity of any project work or the ability of any project work to function safely for its intended purposes". If the inspection reveals a deficiency, Part 12 requires licensees to file corrective plans with the Commission and carry out corrective measures when they are approved by the Commission's Regional Engineer. With this requirement in place, we conclude that routine operation of the HKTA would not pose a risk to downstream resources. In addition, the City proposes to remove the turbine/barge to high ground when flood events are predicted. The ability to rapidly remove the HKTA to respond to changing weather and flow conditions would further reduce the risk that the turbine/barge would break free of its moorings under catastrophic conditions.

Navigation: The Proposed Action would not affect navigation, because the units would be installed within the tailrace of the existing hydropower project, over 200 feet from the navigation channel. The project area, including the tailrace, is within a restricted zone maintained by USACE in the interests of safety and security, and no boating access is available.

Noise: Installation of the turbine/barge would likely cause a small, local, and temporary increase above ambient noise levels over a period of about 5 days. Equipment used to tether and install the turbine/barge would likely include a generator, a compressor, and a small crane. By comparison, the noise of a generator (70-82 decibel [dB]), a compressor (78-80 dB), or an average-size crane (81-85 dB) measured at 50 feet (FHWA, 2006) would be less than the noise generated by a garbage truck (about 100 dB) measured at 50 feet (NPC, undated), and would likely be similar to the sounds of equipment used in routine operation and maintenance of the lock, dam, and power plant.

Over the long term, project-related noise would be about the same as current conditions. The turbines would not be audible above-ground when in operation, but the sound of the generators would be similar to the noise of the existing environment.

Aesthetics: Our review of the City's comprehensive plan (City of Hastings, 2000) indicates that installation of the hydrokinetic turbines would be consistent with the City's goals for the Urban Diversified District. The Urban Diversified Designation allows for new development, as described above. Based on the simulated view of the turbine/barge

shown in Appendix G of the City's amendment application, the HKTA would appear similar to the barges and other vessels that use the locks, and would be compatible with existing hydroelectric project features at Lock and Dam No. 2.

Effects of No-action Alternative

Under the No-action Alternative, the turbine/barge would not be installed, and there would be no change in land use or aesthetics at the existing project or in the tailrace.

5.3.9 Project Economics

In this section, we look at the City's use of the Mississippi River for hydropower purposes to see what effect the installation of new hydrokinetic turbines would have on costs and power benefits associated with the new development. Consistent with the Commission's approach to economic analysis, the power benefit of the project is determined by estimating the cost of obtaining the same amount of energy and capacity using the likely alternative generating resources available in the region. In keeping with the Commission policy as described in *Mead*, our economic analysis is based on current electric power cost conditions and does not consider future escalation of fuel prices in valuing the hydropower project's power benefits.[18]

To determine the net power benefit, we compare project costs to the value of the power output as represented by the cost of a likely alternative source of power in the region. A positive net annual power benefit indicates that the project power costs less than the current cost of alternative generation resources, and a negative net annual benefit indicates that project power costs more than the current cost of alternative generation resources. This estimate helps to support an informed decision concerning what is in the public interest with respect to a proposed license. However, project economics is only one of many public interest factors the Commission considers in determining whether, and under what conditions, to issue a license. For this amendment, an important public interest factor would be the potential to support the advancement and orderly development of innovative hydrokinetic technologies, in accordance with the Commission's Strategic Plan (FERC, 2006).

Our estimate of the energy and capacity value was developed from the most reasonable alternative generation available; the fixed cost to construct and operate a combined-cycle combustion turbine plant fueled by natural gas in the West North Central region of the United States, and a regional energy cost of 50.13 mills/kWh. We estimate

[18] See *Mead Corporation, Publishing Paper Division*, 72 FERC ¶ 61,027 (1995). In most cases, electricity from hydropower would displace some form of fossil-fueled generation, in which fuel cost is the largest component of the cost of electricity production.

the energy cost based on information in Energy Information Administration, Annual Energy Outlook 2007.[19] We assume a capacity value of $96 per kilowatt (kW)-year.[20] The licensee states that the dependable capacity of the operating project would be 13.13 kW.[21] Under these conditions, the total energy and capacity cost is $53.83/MWh. For our economic analysis, we use the parameters, values (2008$), and sources shown below in Table 9.

Table 9 Parameters for economic analysis of the Mississippi Lock and Dam No. 2 Hydroelectric Project. (Source: City, 2008a, FERC staff)

Parameters	**Values (2008$)**
Period of analysis	30 years
Term of financing	20 years
Interest/cost of capital	6.2 percent
Escalation rate	0.0 percent
Federal tax rate	0 percent
Net investment	$627,000
Cost of license amendment (included in net investment)	$75,000
Operation and maintenance cost[22] ($/year)	$12,500
Energy and capacity value	$53.83/MWh

Comparison of Alternatives

In the following sections, we evaluate the economic costs and benefits of three alternatives – No-action Alternative, Proposed Action (the City's proposal), and the Proposed Action with Staff Recommendations. Table 10 compares the annual cost, power benefits, and annual net benefits of each alternative.

[19] See http://www.eia.doe.gov/oiaf/aeo/index.html.

[20] The capacity value is the cost to provide dependable alternative energy generated from a combined-cycle combustion turbine plant.

[21] The Licensee indicated that dependable capacity would correlate to the summer months of June, July and August and equal 29,000 kWh. Dividing by 2,208 hours yields a dependable capacity of 13.13 kW.

[22] Staff have estimated annual O&M cost as 2 percent of the capital cost to include insurance, fees and routing maintenance.

No-Action Alternative

Under the No-action Alternative, the City would continue to operate the project under the terms and conditions of the existing license, and no hydrokinetic turbines would be constructed. The resulting annual net benefit would be $-5,600.

Proposed Action (City of Hastings' Proposal)

The City proposes to install two 35-kW hydrokinetic turbines. The City also proposes to employ BMPs consistent with the City's and USACE requirements; conduct water quality monitoring for one month following installation of the turbines; conduct a fish tagging study to evaluate turbine passage and survival; survey for freshwater mussels; and implement measures to control zebra mussels. Based on the parameters in Table 10 and the cost of measures proposed by the City, we estimate that the annual cost of the Proposed Action would be about $75,600 ($207.62/MWh). The annual power value would be $19,600 ($53.83/MWh) for an estimated annual generation of 364,120 kWh. The resulting annual net benefit would be $-56,000 (-$153.80/MWh).

Proposed Action with Staff Recommendations

Staff reviewed the proposed project and recommends the following additions and/or modifications to the proposed project: extend water quality monitoring to cover a three-month period; increase the number of tagged fish to more accurately evaluate effects of turbine passage on the fish community; conduct a desk-top entrainment study; and monitor bird use of the tailrace monthly for one year following turbine installation. Based on the parameters in Table 10 and the cost of measures recommended by staff, we estimate that the annual cost of operating the project under the staff alternative would be about $81,300 ($223.28/MWh). The annual power value would be $19,600 ($53.83/MWh) for an estimated annual generation of 364,120 kWh. The resulting annual net benefit would be $-61,700 (-$169.45/MWh).

Table 10 Summary of annual net benefits of the alternatives for the Mississippi Lock and Dam No. 2 Hydroelectric Project. (Source: FERC staff)

ırameter	No Action	Proposed Action	Proposed Action with Staff Recommendations
Annual generation (MWh)	0	364.12	364.12
Installed capacity (kW)	0	70	70
Annual power value ($)	0	19,600	19,600
Annual cost ($)	5,600	75,600	81,300
Annual net benefit ($)	-5,600	-56,000	-61,700

Table 10 indicates that in comparison to a combustion turbine alternative, the project economics are not attractive. However, there are many other factors that may make the investment beneficial to the City and its power purchaser, Xcel. First, it is an opportunity to test, on a relatively small scale, an emerging renewable technology. Second, it would contribute to meeting Minnesota Renewable Portfolio Standards. Third, there may be other financial incentives, such as grants or credits, that were not available for staff analysis, but that would substantially increase the economic viability of the proposal.

6.0 FINDING OF NO SIGNIFICANT IMPACT

Based on our independent analysis, installation and operation of two hydrokinetic turbines at the existing Mississippi Lock and Dam No. 2 Hydroelectric Project would have no adverse effects on geology or soils, wildlife habitat, recreation, cultural or historic resources, land use, or aesthetics. Our analysis indicates that effects on water quality, fish, and diving birds are likely to be minor, but that additional monitoring of these resources is needed to fully evaluate the consequences of turbine operation. We find the project may affect, but is not likely to adversely affect, the federally listed Higgins' eye pearlymussel, and have requested concurrence with our finding from FWS. The costs of the staff-recommended monitoring measures are high in comparison to the anticipated increase in generation; however, we conclude that the benefits outweigh the costs, because the monitoring plans would provide critical information for further development, analysis, permitting, and operation of hydrokinetic turbines at this site, should the licensees consider expansion of a hydrokinetic array in the future. Implementation of the staff-recommended alternative would support the advancement and orderly development of innovative hydrokinetic technologies, in accordance with the Commission's Strategic Plan (FERC, 2006).

On the basis of our independent analysis, the Proposed Action, with the licensee's and staff's recommended mitigation measures, would not constitute a major federal action significantly affecting the quality of the human environment.

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8.0. LIST OF PREPARERS

Andrea Claros – Task Monitor, Aquatic Resources (Ecologist, M.S. Biology, B.S. Biology)

Kelly Houff – Engineering (Environmental Protection Specialist, B.S. Integrated Science and Technology with Concentrations in Energy and Environment)

Christopher Yeakel – Terrestrial Resources, Recreation, Cultural/Historic Resources, Land Use/Aesthetics (Environmental Biologist, B.S. Environmental Resource Management)

Kevin Malone – Aquatic Resources (Fisheries Biologist; M.S., Biology; B.A., Biology)

Eileen McLanahan – Task Manager, Terrestrial Resources, Recreation, Cultural/Historical Resources, Land Use/Aesthetics (Terrestrial Biologist; M.S., Biology; B.S., Biology)

George Gilmour – Water Resources (Fisheries Biologist; B.A., Biology)

Mark Killgore – Engineering and Project Economics (Water Resources Engineer; M.S., Civil Engineering/Water Resources; B.S., Civil Engineering/Water Resources)

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