Appendix G:
U.S. Fish and Wildlife Service (USFWS) Coordination

This appendix contains the following documents:

1. USFWS Letter dated 21 July 2014
2. USFWS Letter dated 7 April 2014
3. USFWS Fish and Wildlife Coordination Act Report dated 28 March 2014
4. USFWS Fish and Wildlife Coordination Act Report dated June 1999

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Kentucky Ecological Services Field Office
330 West Broadway, Suite 265
Frankfort, Kentucky 40601
(502) 695-0468

July 21, 2014

Ms. Sharon M. Bond
Chief, Planning Branch
Louisville District, Army Corps of Engineers
P.O. Box 59
Louisville, Kentucky 40201-0059

Subject: FWS #2014-B-0283; Changes to Green and Barren Rivers Disposition Feasibility Study and Endangered Species Act effects determinations

Dear Ms. Bond:

The Service received your letter dated June 27, 2014 regarding the Corps' recommended changes to the draft Green and Barren Rivers Disposition Feasibility Study (Study). The recommendations that are proposed by the Corps differ from those contained in the draft Study submitted to USFWS on February 14, 2014. The newly-proposed recommendations were discussed via a June 20, 2014 teleconference between the Service and Corps. We were anticipating receipt of the proposed changes and appreciate the Corps' efforts to coordinate with us on these changes and Study.

It is our understanding that the plan for the final Study, as currently proposed, is limited to Congressional de-authorization of commercial navigation for Green River Lock and Dams 3, 4, 5, and 6 and Barren River Lock and Dam 1. The changes from the original Study to the current plan include:

1. Removal of Green River Dam 6 is not included in the revised plan;
2. The installation of a concrete plug on the upstream miter gates at Green River Lock 3 is not included in the revised plan;
3. Barricades and signage are not included in the revised plan, although the Corps intends to proceed with the installation of barricades and signage under its existing authority and using existing funds for Corps Operations and Maintenance activities; and
4. The disposal of project properties is not included in the revised recommended plan. However, following Congressional de-authorization of commercial navigation at these facilities, a logical next step would be to seek disposal of these properties and facilities through the established Corps and General Services Administration procedures as outlined in the Federal Property and Administrative Services Act of 1939 and Army regulations, and the Corps acknowledges that any potential environmental effects would need to be considered by the Corps before such action(s) could occur.

The Corps' June 27, 2014 letter also requested that the Service respond in writing to the new recommendations and specifically address the Corps' Endangered Species Act compliance responsibilities as they relate to the revised plan (as described above). Further, the Corps' requested our concurrence with the determination that the revised plan will have no effect on listed species.

With this letter, the Service acknowledges the changes to the plan, and we agree with the Corps' determination that the plan will have no effect on listed species. We agree with this determination because the Corps has, at this point, chosen to modify its action so that the revised plan a) is entirely a programmatic, administrative action and 2) removes all potential actions that could result in direct or indirect adverse effects on federally listed species. Therefore, we believe that the requirements of Section 7 of the Endangered Species Act of 1973, as amended, are fulfilled. The obligations of the Corps must be reconsidered if (1) new information reveals impacts of the proposed action that may affect listed species or critical habitat in a manner not previously considered, (2) the proposed action is subsequently modified to include activities which were not considered during this consultation, or (3) new species are listed or critical habitat designated that might be affected by the proposed action.

These constitute the comments of the U.S. Department of the Interior in accordance with the provisions of the Endangered Species Act (87 Stat. 884, as amended: 16 U.S.C. 1531 *et seq.).*

Thank you for the opportunity to comment on this Study and potential impact to listed species. Please contact myself or Mr. Leroy Koch at 502-695-0468 with any question regarding these comments.

Sincerely,

Virgil Lee Andrews, Jr.
Field Supervisor

cc: Doug Dawson, KDFWR, Frankfort, KY
Bobby Carson, MCNP, Mammoth Cave, KY
Nate Moulder, USACE, Louisville, KY

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Kentucky Ecological Services Field Office
330 West Broadway, Suite 265
Frankfort, Kentucky 40601
(502) 695-0468

April 7, 2014

Ms. Sharon Bond
Chief, Planning Branch
Army Corps of Engineers, Louisville District
P.O. Box 59
Louisville, Kentucky 40201-0059

Dear Ms. Bond:

On March 28, 2014, we provided the Corps with our Fish and Wildlife Coordination Act Report (Report) on the 2014 Green and Barren River Disposition Study (Study). In that Report, we identified some general issues and recommendations related to federally listed species and Endangered Species Act (ESA) compliance, but we did not provide specific recommendations on how we believe the Corps should achieve compliance with Section 7 of the Endangered Species Act (ESA) once a preferred alternative for disposing of Green River locks and dams 3, 4, 5, and 6 and Barren River Lock and Dam 1 is identified. This letter contains our concurrence that the Corps' work to this point and preliminary selection of preferred alternatives for each of the facilities would not result in adverse effects on federally listed species and our recommendation for how future consultation on the disposition of these facilities should proceed.

Regarding the Corps' current ESA compliance responsibilities, we understand that the information provided in the Study is primarily of a planning nature and does not represent a specific project proposal that the Corps is prepared to implement. As a result, the information and recommendations we have provided should be considered technical assistance associated with our initial ESA informal consultation with the Corps on the disposition of these facilities. We do not believe that a Biological Assessment (BA) should be prepared at this time, because (a) we do not believe that any adverse effects on federally listed species can be tied to the Corps' preliminary selection of preferred alternatives for each of the facilities; and (b) the specific project actions that would be implemented at each of the facilities and any resulting effects on federally listed species cannot be accurately determined based on the information currently available. Therefore, we do not believe that it is necessary at this time for the Corps to provide the effects and jeopardy determinations associated with the consultation and conference provisions contained in ESA sections 7(a)(2) and 7(a)(4), respectively.

Our recommendation for future ESA consultation on the disposition of these facilities is for the Corps to prepare a BA, make its effects determinations for federally listed species in the action area, and continue informal consultation or initiate formal consultation with us after the planning document is complete and the Corps intends to implement its chosen alterative(s).

Based on our review of the Study and our discussions with Corps staff, we believe that removal of Green River Lock and Dam 6 may result in adverse effects on federally listed freshwater mussels and the Kentucky cave shrimp and that formal consultation may be necessary. Please notify us of the Corps' final plans for the disposition of these facilities.

The Green River watershed in Kentucky is a critical area for aquatic species conservation, and we appreciate the close coordination that the Corps has provided us on this Study. As we noted in our Report recommendations, we hope the Corps will consider removing all of the dams covered by the Study or disposing of the dams to agencies or organizations that would prioritize removal of the dams for conservation and river restoration purposes.

If you have any questions on the contents of this letter, please contact Leroy Koch of my staff at (502) 695-0468 (ext. 106).

Sincerely,

Virgil Lee Andrews, Jr.
Field Supervisor

cc: Doug Dawson, KDFWR, Frankfort, KY
Bobby Carson, MCNP, Mammoth Cave, KY
Nate Moulder, USACE, Louisville, KY

USFWS Fish and Wildlife Coordination Act Report dated 28 March 2014

TOURISM, ARTS AND HERITAGE CABINET
KENTUCKY DEPARTMENT OF FISH & WILDLIFE RESOURCES

Steven L. Beshear
Governor

#1 Sportsman's Lane
Frankfort, Kentucky 40601
Phone (502) 564-3400
1-800-858-1549
Fax (502) 564-0506
fw.ky.gov

Bob Stewart
Secretary

March 28, 2014

Lee Andrews
US Fish and Wildlife Service
3761 Georgetown Road
Frankfort, KY 40601

RE: Draft Fish and Wildlife Coordination Act Report for the Draft Feasibility Report and Draft Environmental Assessment (EA) for the Green River Locks and Dams 3, 4, 5, and 6 and Barren River Lock and Dam 1 Disposition Study

Dear Mr. Andrews:

We have reviewed the information provided in the Draft Fish and Wildlife Coordination Act Report for the Green River Locks and Dams 3, 4, 5, and 6 and the Barren River Lock and Dam 1 Disposition Study. We find the conclusions and recommendations outlined in the draft FWCA report acceptable and have no significant comments regarding the document at this stage of the review process.

We appreciate the opportunity to comment. Should you require any additional information, please contact me at 502/564-7109, ext. 4472.

Sincerely,

Doug Dawson

Doug Dawson
Environmental Section Supervisor

cc: Environmental Section Files

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Kentucky Ecological Services Field Office
330 West Broadway, Suite 265
Frankfort, Kentucky 40601
(502) 695-0468

March 28, 2014

Ms. Sharon Bond
Chief, Planning Branch
Corps of Engineers, Louisville District
P.O. Box 59
Louisville, Kentucky 40201-0059

Dear Ms. Bond:

Enclosed is a copy of the Fish and Wildlife Service's (Service) Fish and Wildlife Coordination Act Report regarding the Louisville District's 2014 Green and Barren River Disposition Study. This is the Service's official report as required by Section 2(b) of the Fish and Wildlife Coordination Act. Included is a concurrence letter from the Kentucky Department of Fish and Wildlife Resources. You may include our report in your Feasibility Report for the Green and Barren Rivers study.

Thank you for your concern for the protection of fish and wildlife resources in the Green and Barren Rivers. If you have any questions, please contact Leroy Koch of my staff at 502-695-0468, ext. 106.

Sincerely,

Leroy M. Koch

for Virgil Lee Andrews, Jr.
Field Supervisor

cc: Doug Dawson, KDFWR, Frankfort, KY
Bobby Carson, MCNP, Mammoth Cave, KY
Nate Moulder, USACE, Louisville, KY

Fish and Wildlife Coordination Act Report
for the
Draft Feasibility Report and Draft Environmental Assessment (EA)
for the Green River Locks and Dams 3, 4, 5, and 6 and
Barren River Lock and Dam 1 Disposition Study

Prepared by:
Lee Andrews and Leroy Koch
U.S Fish and Wildlife Service
Ecological Services Field Office
Frankfort, Kentucky

March 27, 2014

Introduction

In accordance with the National Transfer Funding Agreement and the Scope of Work agreed to by our respective agencies, the Fish and Wildlife Service (Service) is providing the following draft Fish and Wildlife Coordination Act Report for the Corps of Engineers – Louisville District's (Corps) investigation of alternatives for the disposition of decommissioned lock and dam facilities on the Green River and Barren River in Kentucky.

This draft report has been prepared and submitted under authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), but does not constitute the final report of the Secretary of Interior as required by Section 2(b) of the Act. This draft report also addresses potential issues that may arise from the proposed disposition of these facilities pursuant to Section 7 of the Endangered Species Act.

Background

The Corps initiated a study on April 6, 1989, to determine the feasibility of restoring navigation on the Green River and Barren River from the confluence of the Green and Ohio rivers to Bowling Green, Kentucky. This study evaluated several multi-purpose lake alternatives with the primary objective of restoring navigation. The Fish and Wildlife Service (Service) submitted a preliminary planning aid report to the Corps in October 1989. The report identified fish and wildlife resources in the study area and the problems and needs associated with those resources, and provided a preliminary evaluation of potential impacts. A reconnaissance-level planning aid report was submitted to the Corps in March 1990, and the Corps' Reconnaissance Report was completed on March 30, 1990. This report identified one marginally feasible alternative – replacement of Green River Lock and Dam (L&D) 3 on the Green River. A supplemental reconnaissance planning aid report was completed by the Service and submitted to the Corps in March 1993. This report evaluated the potential impacts to fish and wildlife resources from construction of various types of navigation facilities. The 1989 study was initiated to make

decisions regarding the disposition of decommissioned navigation facilities on the Green River and Barren River.

All of the locks and dams upriver from Green River L&D 3 have been decommissioned and were, therefore, included in this study. The Service provided a Fish and Wildlife Coordination Act Report for the Green River Barren Rivers Disposition Study in June 1999. To the Service's knowledge, no action has been taken by the Corps to dispose of these facilities and/or remove any of the dams. The Corps has retained the facilities and associated properties in a caretaker status since then.

The Corps is again looking into the possible disposition of these facilities and has prepared an Environmental Assessment for the Disposition of Green River L&Ds 3, 4, 5, and 6 and Barren River L&D 1, dated January 2014. The following comments apply to the Corps' current assessment and proposed approach to dispose of the facilities. Much of the information in the Service's 1999 FWCA report is still relevant to the current Corps Feasibility of Disposition proposal. We have included some updates to the 1999 FWCA report below, and provided a summary of the Corps' current disposition alternatives in the Project Alternatives and Potential Impacts section. Further, we provide our current assessment of the Corps' proposed alternatives and our recommendations related to the disposition of these facilities in the Conclusions and Recommendations section below.

Study Area

The Green River originates in Lincoln County, Kentucky and flows in a southwesterly direction for approximately 31 miles where it then flows westerly for approximately 200 miles. From Rochester, Kentucky, the river flows 150 miles in a northwesterly direction to its confluence with the Ohio River near Evansville, Indiana at Ohio River Mile 784. The Green River watershed encompasses an area of 9,230 square miles and amounts to 23 percent of the drainage area of Kentucky. Elevations range from over 1,050 feet at the source to 337 feet (Ohio River pool elevation) at the mouth. The average river gradient is 1.9 feet per mile, and ranges from approximately four feet per mile in the headwater reach to 0.25 foot per mile near the confluence with the Ohio River.

Major tributaries from downstream to upstream are Panther Creek, Pond River, Rough River, Mud River, Barren River, and Nolin River. The Barren River, the largest tributary of the Green River, rises in Clay County, Tennessee, and Monroe County, Kentucky, and flows northwest for 158 miles where it joins the Green River at Green River Mile (GRM) 149.5. The Barren River watershed drains an area of 2,141 square miles and has an average gradient of 1.6 feet per mile.

The Green River basin includes all or part of 31 counties in Kentucky and three counties in Tennessee. However, for purposes of this report, the Fish and Wildlife Service will only consider project impacts on the Green and Barren Rivers in Butler, Edmonson, and Warren Counties.

Within the Corps' study area, the Green River and Barren River flow through the Low Plateau Province, which includes two physiographic regions. The Pennyroyal Region covers the central

and eastern portion of the drainage and is characterized by rolling limestone uplands and moderately wide floodplains. Numerous karst features and solution caverns formed by subsurface drainage are also common in this area. Gently rolling uplands and broad floodplains characterize the Western Coal Fields Region, which is located in the western part of the study area.

Approximately 95 percent of the Green River basin (including the Barren River drainage) is either cropland or forested habitat. Climate is of the humid, temperate type, with an average annual rainfall of 47 inches and a 180-day growing season. Agriculture is the primary, non-forest land use, and crops such as tobacco, corn, and wheat are grown primarily in the high quality soils on floodplain areas. Surface coal mining is the most extensive, non-agricultural industry in the basin and occurs primarily in the mid- to lower-portions of the basin. Surface coal mining is the typical method of coal extraction used in the major coal producing counties of this portion of the basin, but some underground mining activity is also conducted.

Forested habitats consist mainly of second-growth oak-hickory forest with ash, poplar, sugar maple, and elm as principal associate species. Large scale clearing has destroyed most of the virgin forest, but small tracts containing near-original vegetation may still exist on isolated private and public lands, such as Mammoth Cave National Park. The lower portion of the study area contains numerous forested, emergent, and scrub-scrub wetlands. "Swamp" species that are more-typical of southern wetland types have extended their ranges from the Mississippi alluvial valley into the lower Green River and its tributaries. Black willow, bald cypress, swamp and eastern cottonwood, pin oak, river birch, and silver maple may occur in the wetlands in the western portion of the study area. These species become less abundant or disappear in the central and upper parts of the basin.

The Green River, a major tributary to the Ohio River, and the Barren River has been used for commercial navigation purposes since the mid 1700's. The first navigation structures were constructed in the 1830's and additional structures have been constructed periodically since that time. Each navigation project was constructed to establish and maintain a minimum six-foot navigation channel. Original navigation facilities on the lower reach of the Green River at Green River Lock and Dam (L&D) 1 and Green River L&D 2 were built in the mid- to late-1800's; new navigation locks were completed and placed in operation in 1956. Green River L&D 3 and Green River L&D 4 were constructed in the mid-1800's; however, Green River Dam 4 was breached in 1965, and, consequently, the facility was closed to barge traffic. Green River L&D 5 and Green River L&D 6 were built in the early 1900's, and both were deactivated in 1951. Barren River L&D 1 was built in 1841. A new lock was completed in 1934, but this facility was closed to navigation when Green River L&D 4 was breached. Currently, navigation traffic is restricted to the lower reach of the Green River upriver to Green River L&D 3 at the town of Rochester, Kentucky.

The system of navigation locks and dams on the Green River has essentially created lentic conditions from the river's mouth to GRM 199. Substrate in the pooled reaches consists primarily of boulders, rubble, and bedrock overlain with silt, sand, and organic materials. Green River L&Ds 1 and 2 impound approximately 190 miles of the lower Green River, and have especially deep accumulations of bottom sediments that are frequently redistributed by barge

tows and high seasonal river flows. The pool created by Green River L&D 3 extends 41 miles upriver and also contains significant sediment deposits. Green River L&D 4 once maintained a pool 22 miles long; however, in 1965 the dam was breached and free-flowing conditions and riffles have been reestablished. Green River L&Ds 5 and 6 impound 13 miles and 17 miles of the Green River, respectively, with the pool at Green River L&D 6 extending approximately 17 miles up the Green River into Mammoth Cave National Park (MCNP) and 7 miles up the Nolin River. Barren River L&D 1 impounds approximately 15 miles of the river up to the City of Bowling Green, Kentucky.

There are several State-owned conservation and/or recreation areas located in the Green River basin, including Green River State Forest (Henderson County), Lake Malone State Park (Muhlenberg County), and several Wildlife Management Areas operated by the Kentucky Department of Fish and Wildlife Resources, among others. Within the study area, the Green River from Green River L&D 6 to Dennison Ferry at GRM 204.9 is a state-designated Wild River Area. The largest recreation area, by far, is the 52,830-acre MCNP. The park is primarily woodland and contains more than 200 miles of underground passages and chambers that are part of the world's longest known network of natural caves. In addition, a number of privately-owned and municipal recreation areas and public boat launching ramps are located throughout the study area.

Existing Fish and Wildlife Resources

The land and water resources in the Green River and Barren River basins provide habitat for a variety of fish and wildlife populations which generate numerous opportunities for both consumptive and non-consumptive recreational uses. Habitat quality is variable, however, and depends on adjacent and upstream land uses and other factors. River-oriented recreation can be limited, because (a) steep river banks can significantly restrict access for fishing and other recreational uses, (b) turbid waters, especially in the lower portions of the Green River watershed, can deter fishing, swimming, and other water-contact activities, and (c) adjacent land ownership is largely private, thus limiting the potential for public access. Collectively, all of these factors contribute to a general low use of most of the Green and Barren rivers. Higher use of the Green River occurs between the Green River Dam (Taylor County, Kentucky) and MCNP due to increased access availability and public recreation opportunities associated with MCNP. In spite of this, future increases in demand for recreational and developmental uses within these basins will result in more frequent conflicts over, and great competition for, these limited resources.

In general, the banks of the Green River support riparian vegetation which provides cover for fish and wildlife, maintains stable water temperatures, acts as a source of detritus for the aquatic system, aids in prevention of shoreline erosion, and acts as a buffer zone between the upland and the river. This riparian zone and adjacent forest land varies from approximately thirty feet to several thousands of feet in width. Although forested areas along the Green River and Barren River have undergone varying degrees of disturbance, few developments in the area have resulted in complete removal of riparian vegetation.

Prior to construction of the navigation lock and dam system, free-flowing conditions comprised of distinct habitat types probably existed in the Green River and Barren River. These habitats historically supported approximately 151 species of native fishes, making the fish faunas in these rivers among the most diverse in the United States. Free-flowing river reaches above GRM 199 presently contain diverse biotic communities and support populations of such species as smallmouth bass, darters, madtoms, sculpins, and other coolwater species. High quality riffle areas with sand and gravel substrate also contain a rich freshwater mussel fauna. Completion of the locks and dams altered riverine habitat by reducing flows, eliminating shoals and riffles, altering substrate composition from sand and gravel to finer sediments, and changing the rivers from free-flowing coolwater streams to slow-flowing warmwater streams. These changes in habitat type also resulted in species composition changes. Coolwater species were replaced by warmwater species such as largemouth bass, catfish, and bluegill. However, coolwater fisheries still exist in the river reaches above the impounded pools (i.e., above GRM 199 and above Bowling Green). This shift in habitat conditions has also resulted in increasing population levels of carp, gar, and shad and of some commercially important species, such as buffalo, redhorse, and freshwater drum.

Important sportfish species which occur in the Green River and Barren River include largemouth, spotted, and smallmouth bass; bluegill; white and black crappie; channel catfish; longear, redear, and green sunfish; walleye; rock bass; sauger; white bass; and striped bass. There are also naturally-occurring populations of Ohio muskellunge in the Green River and in the lower Barren River and Nolin River. Habitat for the muskellunge has diminished in Kentucky due to development, impoundment, and pollution, but the Green River and Barren River still support good populations of this game species. Until recently, the tailwaters of the Green River and Barren River Reservoirs have been stocked with rainbow trout to provide additional sport fishing opportunities. Although this fishery likely no longer exists, rainbow trout have been observed in subterranean waters in the Mammoth Cave system.

Construction of the navigation system on the Green River and Barren River has reduced the quantity and quality of freshwater mussel habitat. Many shoals with clean sand and gravel substrate have been replaced by slow-flowing, silt-bottomed pools. Currently, favorable habitat for remnant populations of the original mussel fauna generally exists immediately below the locks and dams and upstream from the Green River reach impounded by Green River L&D 6. Historically, the Green River mussel fauna was comprised of more than 70 species.

The Green River from Munfordville to the upper reaches of pool six still supports the most diverse and abundant mussel community in the Green River basin; approximately 57 species are presently known to occur in this portion of the river. Surveys conducted in 1987 and 1988 yielded 40 species in the Green River from Green River L&D 4 to Munfordville, Kentucky. Thirty species were collected in the lower Barren River, including two endangered species. Limited surveys above Barren River L&D 1 produced few live mussels; however, a survey conducted in 1990 revealed the presence of one endangered mussel species in the Barren River in the reach between Bowling Green and Barren River Lake. Because intensive surveys have not been conducted, the mussel faunas of most of the Green River's tributaries remain largely undescribed. However, mussels still persist, likely in reduced numbers, in the Pond, Mud,

Rough, and Nolin Rivers. These populations have been and continue to be impacted by development and pollution.

The rivers in the study area, their associated riparian habitats, and adjacent lands provide high quality habitat for a variety of wildlife species. These habitats support populations of well over 200 species of birds. Important game species include bobwhite quail, mourning dove, woodcock, and turkey. The area also provides winter habitat for waterfowl species such as mallard, black duck, scaup, pintail, gadwall, and American goldeneye. In addition, wood ducks occur as residents during the summer and nest in the area. Common non-game species inhabiting the area include the eastern bluebird, red-tailed hawk, cardinal, blue jay, barred owl, downy woodpecker, Carolina wren, and numerous other forest and open-land species.

There is a diverse mammalian fauna in the study area. Eastern cottontail, gray and fox squirrels, white-tailed deer, raccoon, woodchuck, and opossum are common game species. Numerous karst features in the study area provide habitat for cave-dwelling species, such as the big brown bat, little brown bat, eastern pipistrelle, Northern long-eared bat (which has been proposed for federal listing as an endangered species), and two endangered bat species – the gray bat and Indiana bat. Furbearers also occur in the area; important species include muskrat, mink, longtail weasel, striped and spotted skunk, beaver, raccoon, red fox, and gray fox.

Reptile and amphibian populations occur throughout the study area. Species composition is considered diverse due to the variety of habitat types that exist in the area. Common species include the spotted salamander, green frog, snapping turtle, eastern box turtle, ringneck snake, eastern hognose snake, and northern water snake.

The Green River and Barren River drainages contain abundant cave and karst features. These subterranean habitats contain unique species including one species of cave crayfish which is endemic to the Mammoth Cave area. Three species of cave shrimp, including one endemic species, and three endemic cave beetles, along with numerous other invertebrate species (e.g., insects, millipedes, etc.) also inhabit subterranean habitats in the study area.

Federally-Listed Species

Although portions of the study area provide high quality habitats and contain diverse and abundant populations of many fish and wildlife species, there are species that occur in the study area that are rare and some have been federally listed as either threatened or endangered due to threats such as the destruction of alteration of their habitats.

The Kentucky cave shrimp is endemic to the Mammoth Cave system. Populations of this rare species are thought to have been reduced by the impoundment of the Green River. Critical habitat has been designated for the species and includes the Roaring River passage of the Flint-Mammoth Cave system in the Edmonson County portion of MCNP.

Caves in the study area also provide habitat for the endangered gray bat and Indiana bat and for the Northern long-eared bat that has been proposed for federal listing under the Endangered Species Act. These caves are used primarily as hibernacula by these species, but there is at least one cave within the study area known to support a gray bat maternity colony. Future surveys in

the study area may reveal the presence of other gray bat maternity caves. In addition, several Indiana bat and Northern long-eared bat maternity colonies have been discovered in and near MCNP where they utilize hardwood forests and riparian areas for rearing of young, roosting, and foraging. Other, similar habitats in the study area may support additional maternity colonies of these species.

The study area is, or was historically, used by a number of federally listed species of birds. The rivers and reservoirs in the Green River basin provide suitable habitat for wintering populations of the bald eagle and may also be used for nesting. Nesting by bald eagles has been confirmed in areas to the west of the study area and on MCNP lands. Although no recent nesting has been reported, the American peregrine falcon occurs as a migrant or transient in the study area. Kirtland's warbler is also a transient in central Kentucky during its spring migration.

The Green River provides habitat for freshwater mussels, including populations of the following endangered species: rough pigtoe (*Pleurobema plenum*), pink mucket (*Lampsilis abrupta*), spectaclecase (*Cumberlandia monodonta*), sheepnose (*Plethobasus cyphyus*), rabbitsfoot (*Quadrula cylindrica cylindrica*), ring pink (*Obovaria retusa*), and fanshell (*Cyprogenia stegaria*). These species are known to occur, or are likely to occur, in river sections from Pool 6 downstream to Pool 3. The pink mucket and rough pigtoe have been collected recently in the Barren River.

Open woods and woodland edge habitats where limestone bluffs grade into river bottoms may support populations of Price's potato bean (*Apios priceana*), a federally threatened plant species.

Proposed critical habitat for the rabbitsfoot mussel extends from the Maple Springs Ranger Station road upstream to Green River dam, a distance of 109.1 miles. The diamond darter (Crystallaria cincotta) has critical habitat designated from the lower end of Cave Island (GRM 200.3) upstream to Roachville Ford (GRM 294.8). Critical habitat for the Kentucky Cave shrimp is the Roaring River passageway.

The Green River and Barren River study area also provides habitat for a number of rare species that are potential Federal candidates for listing. Terrestrial or aquatic habitats in the study area may support populations of the southeastern bat, Rafinesque's big-eared bat, small-footed bat, eastern small-footed bat, eastern woodrat, Bachman's sparrow, eastern sand darter, northern cave fish, southern cavefish, longhead darter, blue sucker, hellbender, Kirtland's water snake, copperbelly water snake, Kentucky creekshell (mussel), purple lilliput pearly mussel, false foxglove, pale false foxglove, royal catchfly, and Gattinger's lobelia. None of these species are currently considered to be candidate species; however, they could be elevated to such status and listed in the future if their numbers decline and threats to their survival continue.

Project Alternatives and Potential Impacts

The proposed actions under study involve disposition of one or more of the former navigation facilities on the Green River and Barren River (Green River Locks and Dams 3, 4, 5, and 6 and Barren River Lock and Dam 1). The alternatives proposed by the Corps include:

Alternative 1 (No Action): A 'no action' alternative would mean that the Federal government would retain ownership and responsibility for the properties. No alterations would be done to the facilities. The Louisville District would continue in caretaker status, maintaining "No Trespassing" signage and periodically inspecting the properties.

Regarding potential impacts, the Service believes that under this alternative, there would be no change and/or the impacts would be similar to those that have been occurring in recent years.

Alternative 2: With this alternative, the properties would be disposed of without any permanent alterations to the lock and dam structures. The Louisville District would remain responsible for the properties up to the point at which the ownership is transferred. Any action necessary to complete the real estate transfer would be included, but no construction is included in this alternative.

Regarding potential impacts, the Service believes that under this alternative the impacts would likely be of a minor nature to water quality, shoreline vegetation and banks, aquatic species, and instream habitat.

Alternative 3 (Disposal of Federal Ownership after Dam Removal and Lock Stabilization): With this alternative the dams would be removed and the locks would be stabilized before disposal. After the dam removal is accomplished, the property would be disposed through normal GSA and Corps of Engineers procedures. However, the Louisville District is only proposing Alternative 3 to be applied to Green River Dam #6. Reasons provided for excluding Green River Locks and Dams 3 and 5 are that removal would adversely affect municipal water supply intakes. Barren River Dam No. 1 was excluded because of anticipated water supply needs to the City of Bowling Green.

Regarding potential impacts for this preferred alternative, the Service believes that impacts could be significant, especially for water quality, shoreline vegetation and banks, aquatic fauna, and instream habitat.

Alternative 4 (Disposal of Federal Ownership after Lock Modification): With this alternative the locks would be modified before disposal (stabilized with rip rap and or concrete plug), but the dams would be left undisturbed.

Regarding potential impacts for this alternative, the Service believe that the impacts could be of a minor nature or moderate nature, depending on the type of activity utilized in the stabilization of the locks.

Louisville District Preferred Alternatives

The Louisville District selected Alternative 3 as their preferred alternative for Green River Lock and Dam 6.

The Louisville District selected Alternative 2 as the preferred alternative for Green River Locks and Dams 3, 4, and 5 and Barren River Lock and Dam 1.

Conclusions and Recommendations

1. The Service supports the Corps' selection of Alternative No. 3 for the removal of Green River Lock and Dam 6. Removal of Lock and Dam 6 on the Green River would potentially restore free-flowing conditions to approximately 17 miles of the Green River that flows through MCNP, about 7 miles of the lower Nolin River, and subterranean waters within MCNP. It is our understanding that Green River L&D 6 has the potential to experience uncontrolled failure if it is left in its current condition. If this happens, the aquatic fauna and habitat present upstream and for a distance downstream of Green River L&D 6, along with existing water withdrawal structures in Pool 5, may experience significant negative impacts (e.g., sediment release and subsequent deposition, physical damage to facilities or lands). Conversely, if this dam removal is accomplished carefully and in an appropriate manner so as to reduce negative impacts to the aquatic resources, the Green River upstream of Green River L&D 6 would be restored to a free-flowing condition. This would facilitate the natural re-colonization of that reach by native riverine fauna and avoid the unintended impacts to downstream facilities and lands.

   The Service recommends that the Corps grant the remaining property and structures to a suitable, qualified conservation organization that would ensure public access to the site after Green River L&D 6 is removed. MCNP would be a suitable organization for the portion of the Corps' facility on the south (or east) side of the Green River, because MCNP already borders that portion of the facility, and we would hope that MCNP would be willing to accept the entire facility.

2. The Service asks that the Corps reconsider its selection of Alternative 2 for Green River Locks and Dams 3, 4 and 5 and Barren River L&D 1. Although this approach relieves the Corps of future management responsibilities and costs at these facilities, the application of this alternative at these four facilities does not provide any assurances that disposition of these facilities will benefit fish and wildlife resources. To the contrary, we believe it will promote maintenance of these facilities which have historically resulted in significant impacts to the Green River system and continue to limit the quality of aquatic habitat and resources in the watershed. We strongly urge the Corps to utilize Alternative 3 for all of the facilities, as this would provide a significant and unique opportunity to undertake a major river restoration effort that has never been attempted in Kentucky or within the Louisville District. Restoring these river reaches to a free-flowing condition would provide the greatest benefit to aquatic and riparian resources in these watersheds. If all of these dams were removed, then approximately 94 miles of the Green River, approximately 15 miles of the Barren River, and approximately 7 miles of the Nolin River would be largely restored to their pre-navigation conditions.

3. In addition to the benefits that would be attained through the removal of Green River L&D 6, we encourage the Corps to evaluate the potential to implement other habitat protection and restoration options and/or projects in the study area. Such efforts would be important to the continued existence of the federally-listed mussel species that are present in the Green River and Barren River and for the Kentucky cave shrimp. For example, if removal of Green River L&D 5 was not pursued, we recommend the Corps

evaluate the need for modification of that facility to ensure that backwater from the facility does not impact the subterranean habitat of the Kentucky cave shrimp or restored mussel habitat above the current location of Green River L&D 6 within MCNP (i.e., assuming that facility has been removed).

4. Potential future owners of the facilities are unknown at this time and are unlikely to undertake actions that would improve conditions for fish and wildlife resources at the facilities. Future, non-conservation owners could further impact fish and wildlife resources if the future management objectives of the owners do not promote aquatic resource conservation. Therefore, we recommend that the Corps work with the Service, MCNP, and other organizations involved in conservation of the Green River (e.g., The Nature Conservancy) to evaluate and develop disposition plans that maximize benefits to resources in the watershed.

5. The Service recommends that the Corps evaluate and propose options that would address the issue of municipal water supply. Technological and engineering advances have provided alternatives to ensure municipal water supplies that do not require the maintenance of dams and the associated long-term costs of impoundments. For example, the City of Greensburg, Kentucky, intends to replace its existing water intake structure with a different structure that would ensure water supplies even during low flow conditions in an unimpounded portion of the upper Green River. We recommend that the Corps assist local communities and water authorities to develop alternatives that would make retention of the dams and associated impoundments unnecessary.

6. We recommend the Corps determine if Green River L&D 5 is likely to impact a portion of the reach upstream of Green River L&D 6 even if Green River L&D 6 is removed. If so, the estimated length of free-flowing river upstream of Green River L&D 6 may be over-estimated in the feasibility study, and we recommend that the Corps consider modifying Green River L&D 5 in order to prevent future pool influences in the restored reach above Green River L&D 6.

7. The January 2014 Environmental Assessment contains a limited amount of new biological information on the Green River system and, in some instances, has information that is no longer correct. For example, additional surveys have been conducted in the past ten years on freshwater mussels in the Green River and lower Barren River that would be pertinent to this feasibility study. The sheepnose (*Plethobasus cyphyus*), spectaclecase (*Cumberlandia monodonta*), and rabbitsfoot (*Quadrula cylindrica cylindrica*) have recently been added to the federal list of endangered and/or threatened mussels. In addition, critical habitat has been listed for the Kentucky cave shrimp which includes Roaring River passageway; and, proposed critical habitat for the rabbitsfoot mussel extends from Maple Springs Ranger Station Road upstream to Green River dam. Also, critical habitat has been designated for the diamond darter (Crystallaria cincotta) from the lower end of cave island (GRM200.3) upstream to Roachville Ford (GRM 294.8). A viable population of the spectaclecase mussel is now known to occur in about an approximately 10-mile reach of the Green River upstream of the confluence with the Barren River but below Green River L&D 5. Additional surveys of mussels have

documented a diverse (i.e., 30+ species) in this same reach of the Green River, and other surveys have shown that freshwater mussels occur with some diversity further downstream into the area below Green River L&D 4.

8. A statement on page 26 of the EA, indicates that certain species (e.g., orangefoot pearly mussel, purple catspaw, northern riffleshell) mussels are still present and/or reproducing in the Green River, is not likely correct since there is no recent evidence of these species existing in the Green River. Recent records of listed mussels and associated mussel fauna in this portion of the Green River watershed are far from complete; however, additional mussel surveys are necessary throughout this reach and are needed to provide a more-accurate assessment of the mussel fauna, including federally listed species. For example, the recently-discovered spectaclecase population in the Green River is one of only three viable populations known of this species east of the Mississippi River. Also, the ring pink is only known from the Green River with the last known individual observed in Pool 4 in 2013. Even though the Environmental Assessment is not completely accurate regarding the conservation status of freshwater mussels in the basin, it is sufficient to highlight the tremendous aquatic diversity that occurs in the portion of the Green River and Barren River as pertains to the Corps' disposition study. The Service recommends that the disposition study include a statement that listed mussels are known to occur at many, various locations is the study area and that federally listed mussels are likely to occur at any location where suitable habitat conditions exist.

9. The Service believes that federally listed species may be adversely affected by some of the specific facility disposition activities identified in the Corps' study. While the Corps' administrative action of disposing of the facilities is unlikely to have direct adverse effects, the implementation of the Corps' preferred alternatives at each of the facilities could have directly and/or indirect adverse effects on federally-listed species. In particular, we believe that implementation of the Corps' preferred alternatives at the facilities may result in the following adverse effects:

    a) Federally-listed freshwater mussels could be adversely affected by dewatering of habitat areas upstream of Green River L&D 6, release and downstream movement of sediment both upstream and downstream of Green River L&D 6, releases of contaminated sediments (if present), and alterations of normal behavior patterns and fish host availability as areas within the reach above Green River L&D 6 transition from a near-lentic habitat condition to a lotic (riverine) condition. This contradicts the Corps' contention that implementation of Alternate 3 at Green River L&D 6 is not likely to adversely affect federally-listed species.

    b) If land disturbances or tree clearing are necessary to undertake any of the actions associated with the preferred alternatives at the facilities, the Corps' proposed action could result in adverse effects on bat species that are federally-listed (i.e., Indiana bat, gray bat) or have been proposed for listing (i.e., Northern long-eared bat). Such effects could result from degradation or loss of forested roosting and foraging habitat or harassment due to disturbances during construction activities.

c) The endangered Kentucky cave shrimp may be adversely affected by the proposed removal of Green River L&D 6 due to changes in subterranean flows or sediment movement. In addition, the retention of Green River L&D 5 may result in similar effects after Green River L&D 5 is removed.

d) The Service believes that surveys for federally-listed species may need to be conducted to determine if species occur in the vicinity of the facilities and that a Biological Assessment (BA) may need to be prepared for any particular action that the Corps may implement. In particular, the removal of Green River L&D 6 is likely to require the development of a BA to address potential adverse effects on federally listed mussels and the Kentucky cave shrimp, including addressing critical habitat issues on the Kentucky cave shrimp, rabbitsfoot mussel and diamond darter. The Service believes that removal of Green River L&D 6 will likely benefit the Kentucky cave shrimp, federally-listed freshwater mussels, and the gray bat in the long-term, even though short-term adverse effects and incidental take make occur as the result from the dam removal.

The Service recommends the Corps include the following factors and analysis, plus any other relevant information that would be pertinent to the proposed action, in the BA:

i. A thorough examination should be made of accumulated sediments upstream of the dam to determine the level of contaminants present, if any. If significant levels of contaminants are detected, the Corps should consider manually removing the contaminated sediment to an approved upland disposal site.
ii. Determine the appropriate method and removal of the dam to control the release of sediments downstream so that negative impacts to the aquatic fauna and downstream facilities and lands are avoided and/or minimized.
iii. Evaluate, in detail, all potential impacts to fish and wildlife resources resulting from implementation of the dam removal. Include impacts from sedimentation, reduced water levels in the pools, dewatering of aquatic habitats, and any other changes that may result from dam removal. Measures should be developed and included in the BA to avoid or minimize to the greatest extent possible adverse effects on federally-listed species.

10. If the Corps decides to move forward with disposition of these dams and associated properties as proposed, the Service is very interested in exploring the possibility of either taking possession of them or working with the Corps to identify a suitable conservation owner for the sites. We will discuss this option within our agency and with other federal agencies that might have an interest in the facilities and will include the Corps in those discussions.

USFWS Fish and Wildlife Coordination Act Report dated June 1999

United States Department of the Interior

FISH AND WILDLIFE SERVICE
446 Neal Street
Cookeville, TN 38501

July 14, 1999

Colonel Harry L. Spear, Jr.
District Engineer
U.S. Army Corps of Engineers
P.O. Box 59
Louisville, Kentucky 40201-0059

Re: Green and Barren Rivers Disposition Study

Attention: Ms. Jane Ruhl, P.E., Project Manager

Dear Colonel Spear:

Enclosed is a copy of the Fish and Wildlife Service's (Service) Fish and Wildlife Coordination Act Report regarding the Louisville District's Green and Barren Rivers Disposition Study. This is the Service's official report as required by Section 2(b) of the Fish and Wildlife Coordination Act, and contains a concurrence letter from the Director of the Kentucky Department of Fish and Wildlife Resources. You may include our report in your Feasibility Report for the Green and Barren Rivers study.

Thank you for your assistance. Your concern for the protection of fish and wildlife resources in the Green River and Barren River is greatly appreciated. If you have any questions, please contact Jim Widlak of my staff at 931/528-6481, ext. 202.

Sincerely,

for Lee A. Barclay, Ph.D.
Field Supervisor

Enclosure

FISH & WILDLIFE COMMISSION
Mike Boatwright, Paducah
Tom Baker, Bowling Green
Allen K. Gailor, Louisville
arles E. Bale, Hodgenville
James R. Rich, Taylor Mill
n Frank Brown, Richmond
Doug Hensley, Hazard
Dr. Robert C. Webb, Grayson
David H.Godby, Somerset

COMMONWEALTH OF KENTUCKY
DEPARTMENT OF FISH AND WILDLIFE RESOURCES
C. THOMAS BENNETT, COMMISSIONER

June 23, 1999

Dr. Lee A. Barclay
US Fish and Wildlife Service
446 Neal Street
Cookeville, TN 38501

RE: Fish and Wildlife Coordination Act Report for the Green and Barren Rivers Disposition Study, Louisville District Corps of Engineers.

Dear Dr. Barclay:

Members of my staff have reviewed the above-referenced report. Accordingly, we offer the following comments and recommendations.

The concern the Kentucky Department of Fish and Wildlife Resources (KDFWR) has with the proposed project is the impact any of the alternative on endangered species and freshwater mussel resources. The removal of the structures, especially Lock and Dam No. 6, will drastically alter water levels upstream of the action and may negatively impact these species. The Kentucky Cave Shrimp (*Palaemonias ganteri*), while impacted by sediment deposits, has begun to recover with the existing pool levels. How will this species be impacted by reduced pool levels, which may reduce available habitat and increase competition? Freshwater mussels now exist in sections of the river which have higher levels of water because of the locks and dams. If water levels are reduced, will areas that now harbor freshwater mussels be de-watered resulting in mortality to this resource? Again, this could impact federally listed endangered species of freshwater mussels.

KDFWR supports the re-establishment of the natural condition of the river but we are concerned that resources that are now endangered may depend upon the existing structures for their continued existence.

We appreciate the opportunity to comment. Members of my staff available should you or any of your staff have any questions regarding our comments.

Sincerely,

C. Tom Bennett
Commissioner

CTB/WLD/kh

Cc: Peter W. Pfeiffer, Director, Division of Fisheries
Edwin F. Crowell, Asst. Director, Division of Fisheries
Bonny Dale Laflin, Southwestern Fishery District Biologist
David E. Bell, Northwestern Fishery District Biologist
Environmental Section Files

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Fish and Wildlife Coordination Act Report for the Green and Barren Rivers Disposition Study

Prepared by:

James C. Widlak
Ecological Services Field Office
Cookeville, Tennessee

U.S. Fish and Wildlife Service
Southeast Region
Atlanta, Georgia

June, 1999

Introduction

In accordance with the National Transfer Funding Agreement and the Scope of Work agreed to by our respective agencies, the Fish and Wildlife Service (Service) is providing the following draft Fish and Wildlife Coordination Act Report in regard to the Louisville District, Corps of Engineers' (Corps) investigation of alternatives for the disposition of decommissioned lock and dam facilities on the Green River and Barren River in Kentucky.

This draft report has been prepared and submitted under authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), but does not constitute the final report of the Secretary of Interior as required by Section 2(b) of the Act. This draft report also addresses issues regarding Section 7 of the Endangered Species Act.

The Corps of Engineers initiated a study on April 6, 1989, to determine the feasibility of restoring navigation on the Green River and Barren River from the Ohio River to Bowling Green. This study evaluated several multi-purpose lake alternatives with the primary objective of restoring navigation. The Fish and Wildlife Service submitted a preliminary planning aid report to the Corps in October 1989. The report identified fish and wildlife resources in the study area and the problems and needs associated with those resources, and provided a preliminary evaluation of potential impacts. A reconnaissance-level planning aid report was submitted to the Corps in March 1990, and the Corps' Reconnaissance Report was completed on March 30, 1990. This report identified one marginally feasible alternative--replacement of Lock and Dam 3 on the Green River. A supplemental reconnaissance planning aid report was completed by the Fish and Wildlife Service and submitted to the Corps in March 1993. This report evaluated the potential impacts to fish and wildlife resources from construction of various types of navigation facilities. The current study has been initiated to make decisions regarding the disposition of decommissioned navigation facilities on the Green River and Barren River. All of the locks and dams upriver from Lock and Dam 3 have been decommissioned and are therefore included in this study.

Study Area

The Green River originates in Lincoln County, Kentucky, and flows in a southwesterly direction for approximately 31 miles to the town of Dunnsville. The river then turns and flows westward for 200 miles. From Rochester, Kentucky, the river flows 150 miles in a northwesterly direction to its confluence with the Ohio River near Evansville, Indiana (ORM 784). The Green River watershed encompasses an area of 9,230 square miles and amounts to 23 percent of the drainage area of the State. Elevations range from over 1,050 feet at the source to 337 feet (Ohio River pool elevation) at the mouth. The average river gradient is 1.9 feet per mile, and ranges from approximately four feet per mile in the headwater reach to 0.25 foot per mile near the confluence with the Ohio River.

Major tributaries from downstream to upstream are Panther Creek, Pond River, Rough River, Mud River, Barren River, and Nolin River. The Barren River, the largest tributary of the Green River, rises in Clay County, Tennessee, and Monroe County, Kentucky, and flows northwest for 158 miles where it joins the Green River (GRM 149.5). It drains an area of 2,141 square miles and has an average gradient of 1.6 feet per mile.

The Green River basin includes all or part of 31 counties in Kentucky and three counties in Tennessee (Figure 1). However, for purposes of this report, the Fish and Wildlife Service will only consider project impacts on the Green and Barren Rivers in Butler, Edmonson, and Warren Counties (Figure 2).

The Green River and Barren River in the study area flow through the Low Plateau Province, which includes two physiographic regions. The Pennyroyal Region covers the central and eastern portion of the drainage, and is characterized by rolling limestone uplands and moderately wide floodplains. Numerous karst features and solution caverns formed by subsurface drainage are also common in this area. Gently rolling uplands and broad floodplains characterize the Western Coal Fields Region, which is located in the western part of the study area.

Approximately 95 percent of the Green River basin (including the Barren River drainage) is either cropland or forested habitat. Climate is of the humid, temperate type, with an average annual rainfall of 47 inches and a 180-day growing season. Crops such as tobacco, corn, and wheat are grown primarily in the high quality soils on floodplain areas. Forested habitats consist mainly of secondary oak-hickory forest with ash, poplar, sugar maple, and elm as principal associate species. Large scale clearing has destroyed most of the virgin forest, but small tracts containing near-original vegetation may still exist on public lands such as Mammoth Cave National Park. The lower portion of the study area contains numerous forested, emergent, and scrub-shrub wetlands.

Typical southern "swamp" species have extended their ranges from the Mississippi alluvial valley into the lower Green River and its tributaries. Black willow, bald cypress, swamp and eastern cottonwood, pin oak, river birch, and silver maple may occur in the wetlands in the western portion of the study area. These species become less abundant or disappear in the central and upper parts of the basin, but tracts of bottomland hardwood still occur along the rivers and tributaries throughout the upper reaches of the study area.

Mineral resources in the Green River and Barren River drainages include coal, oil, gas, sand, gravel, limestone, and asphalt rock. An estimated 33 percent of coal production in Kentucky occurs in the Green River basin. Surface mining is the most common method of coal extraction in the major coal producing counties, but some underground mining activity is conducted.

The Green River, a major tributary to the Ohio River, and the Barren River have been used for commercial navigation purposes since the mid-1700's. The first navigation structures were constructed in the 1830's and additional structures have been constructed periodically since that time. Each navigation project was constructed to establish and maintain a minimum six-foot navigation

Figure 1. Green River Drainage

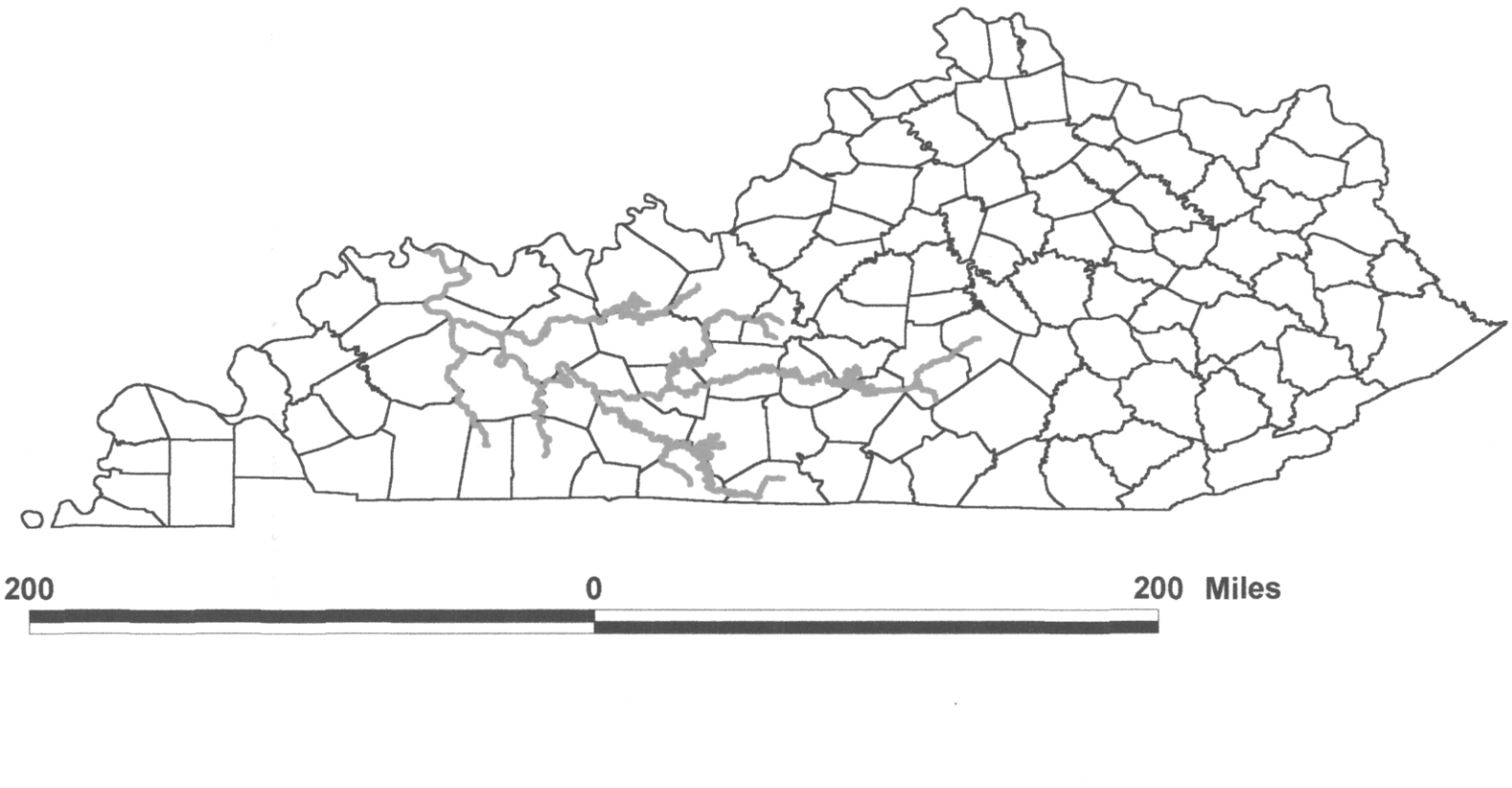
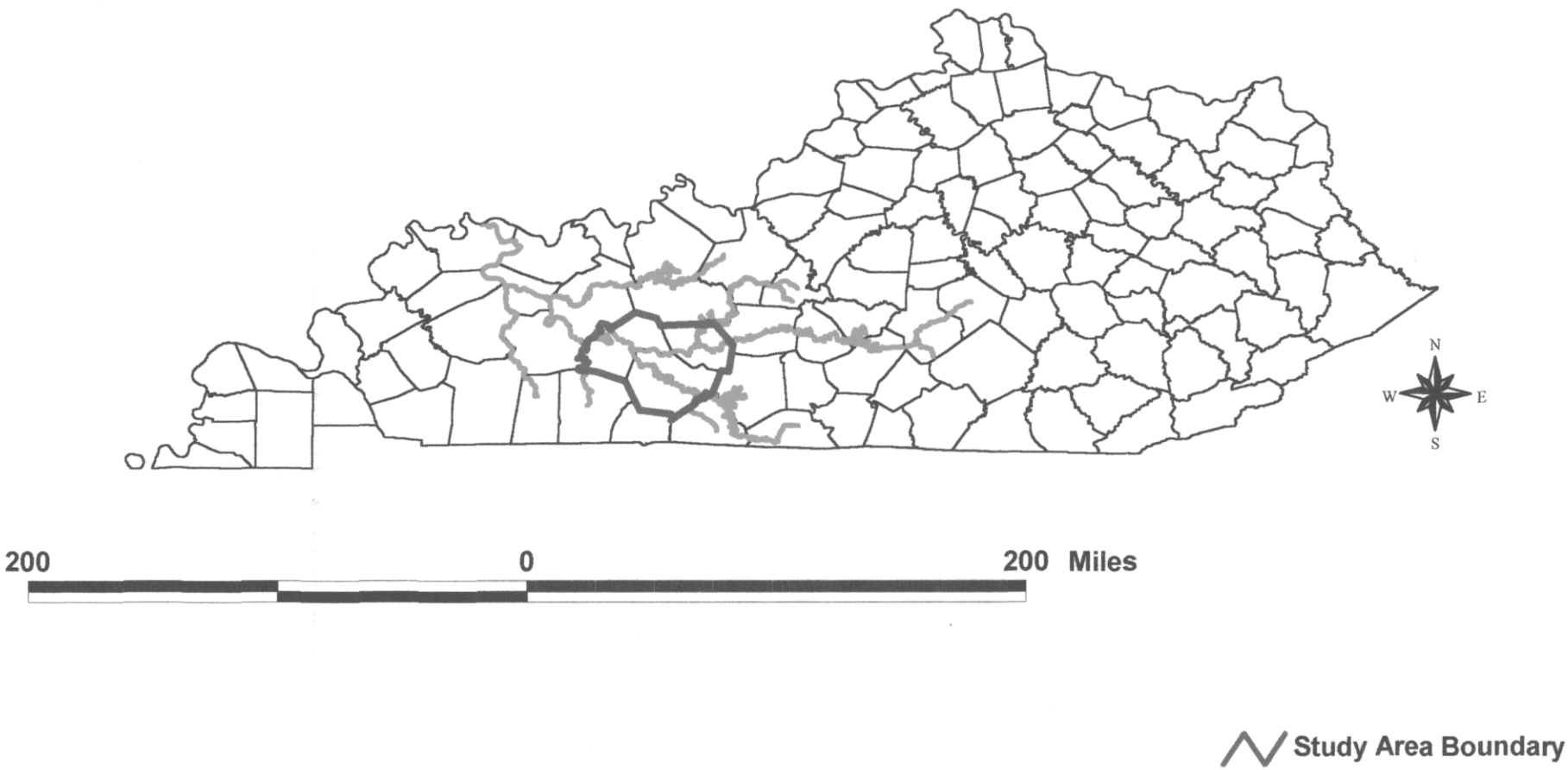


Figure 2. Green and Barren Rivers Disposition Study Area



channel. Original navigation facilities on the lower reach of the Green River (i.e., locks and dams 1 and 2) were built in the mid- to late 1800's; new navigation locks were completed and placed in operation in 1956. Locks and dams 3 and 4 were constructed in the mid-1800's; dam 4 was breached in 1965 and consequently closed to barge traffic. The upper navigation facilities on the Green River (i.e., locks and dams 5 and 6) were built in the early 1900's; both were deactivated in 1951. Barren River Lock and Dam 1 was built in 1841. A new lock was completed in 1934, but this facility was closed to navigation when Green River Lock and Dam 4 was breached. Currently, navigation traffic is restricted to the lower reach of the Green River upriver to Lock and Dam 3 at the town of Rochester.

The system of navigation locks and dams on the Green River have essentially created lentic conditions from the river's mouth to Mile 199. Substrate in the pooled reaches consists primarily of boulders, rubble, and bedrock overlain with silt, sand, and organic materials. Locks and Dams 1 and 2 impound approximately 109 miles of the lower Green River, and have especially deep accumulations of bottom sediments that are frequently redistributed by barge tows and high seasonal river flows. The pool created by Lock and Dam 3 extends 41 miles upriver and also contains significant sediment deposits. Lock and Dam 4 once maintained a pool 22 miles long; however, in 1965 the dam was breached and free-flowing conditions and riffles have become reestablished. Locks and Dams 5 and 6 impound 13 miles and 17 miles of the Green River, respectively; pool 6 extends approximately 17 miles up the Green River into Mammoth Cave National Park plus 7 miles up the Nolin River. Barren River Lock and Dam 1 impounds approximately 15 miles of the river up to the city of Bowling Green.

State recreation areas located in the Green River basin include John James Audubon State Park (Henderson County), Lake Malone State Park (Muhlenberg County), and the L.B. Danison Wildlife Management Area (Ohio County). Within the study area, the Green River from Lock and Dam 6 to Dennison Ferry at Mile 204.9 is a state-designated Wild River Area. The largest recreation area, by far, is the 52,830-acre Mammoth Cave National Park. The park is primarily woodland and contains more than 200 miles of underground passages and chambers which are part of the world's longest known network of natural caves. In addition, a number of privately-owned and municipal recreation areas and public boat launching ramps are located throughout the study area.

Existing Fish and Wildlife Resources

The land and water resources in the Green River and Barren River basins provide excellent habitat for a variety of fish and wildlife populations which generate numerous opportunities for both consumptive and non-consumptive recreational uses. However, river-oriented recreation is limited; steep banks significantly restrict bank fishing; turbid waters deter fishing, swimming, and other water-contact activities; and large tracts of privately owned land that limit public access all

contribute to low use of the Green River and Barren River. In spite of this, future increases in demand for recreational and developmental uses within these basins will result in more frequent conflicts over, and greater competition for, these limited resources.

In general, the banks of the Green River support riparian vegetation which provides excellent cover for fish and wildlife, maintains stable water temperatures, acts as a source of detritus for the aquatic system, aids in prevention of shoreline erosion, and acts as a buffer zone between the upland and the river. This riparian zone and adjacent forest land varies from approximately thirty feet to several thousands of feet in width. Although forested areas along the Green River and Barren River have undergone varying degrees of disturbance, few developments in the area have resulted in complete removal of riparian vegetation.

Prior to construction of the navigation lock and dam system, free-flowing conditions comprised of distinct habitat types probably existed in the Green River and Barren River. These habitats historically supported approximately 151 species of native fishes, making the fish faunas in these rivers among the most diverse in the United States. Free-flowing river reaches above Green River mile 199 presently contain diverse biotic communities and support populations of such species as smallmouth bass, darters, madtoms, sculpins, and other coolwater species. High quality riffle areas with sand and gravel substrate also contain a rich freshwater mussel fauna. Closure of the locks and dams altered riverine habitat by reducing flows, eliminating shoals and riffles, altering substrate composition from sand and gravel to finer sediments, and changing the rivers from free-flowing coolwater streams to slow-flowing warmwater streams. These changes in habitat type also resulted in species composition changes. Coolwater species were replaced by warmwater species such as largemouth bass, catfish, and bluegill. However, coolwater fisheries still exist in the river reaches above the impounded pools (i.e., above Green River Mile 199 and above Bowling Green). This shift in habitat conditions has also resulted in increasing population levels of "rough" species, predominantly carp, gar, and shad; and also of commercially important species such as buffalo, redhorse, and freshwater drum.

Important sportfish species which occur in the Green River and Barren River include largemouth, spotted, and smallmouth bass; bluegill; white and black crappie; channel catfish; longear, redear, and green sunfish; walleye; rock bass; sauger; white bass; and striped bass. There are also naturally-occurring populations of Ohio muskellunge in the Green River and in the lower Barren River and Nolin River. Habitat for the muskellunge is diminished in Kentucky due to development, impoundment, and pollution, but the Green River and Barren River still support good populations of this game species. Until recently, the tailwaters of the Green River and Barren River Reservoirs have been stocked with rainbow trout to provide additional sport fishing opportunities. Although this fishery likely no longer exists, rainbow trout have been observed in subterranean waters in the Mammoth Cave system. Commercial anglers also operate in the study area, with buffalo, suckers, and drum being important harvested species.

Construction of the navigation system on the Green River and Barren River has reduced the quantity and quality of freshwater mussel habitat. Many shoals with clean sand and gravel substrate have been replaced by slow-flowing, silt-bottomed pools. Currently, favorable habitat for remnant populations of the original mussel fauna generally only exists immediately below locks and dams and upstream from the river reach impounded by Lock and Dam 6. Historically, the Green River mussel fauna was comprised of more than 70 species, including at least six federally listed endangered species. A 1965 survey produced 46 species from the Green River; 39 species were reported from the free-flowing reaches above Mammoth Cave National Park; 34 species were collected from pools six, five, and the washed out pool four; and 29 species were found in the lower sections (i.e., pools one, two, and three). Recent surveys indicate that the Green River from Munfordville (GRM 225) to the upper reaches of pool six still supports the most diverse and abundant mussel community in the Green River basin; approximately 57 species are presently known to occur in this river section (Ronald Cicerello, Kentucky Nature Preserves Commission, personal communication). Surveys conducted in 1987 and 1988 yielded 40 species in the Green River from Lock and Dam 4 to Munfordville. Thirty species were collected in the lower Barren River, including two endangered species. Limited surveys above Barren River Lock and Dam 1 produced few live mussels, however, a survey conducted in 1990 revealed the presence of one endangered mussel species in the Barren River in the river reach between Bowling Green and Barren River Lake. Because intensive surveys have not been conducted, the mussel faunas of most of the Green River tributaries remain largely undescribed. However, mussels still persist in reduced numbers in the Pond, Mud, Rough, and Nolin Rivers. These populations have been and continue to be impacted by development and pollution. The ten most abundant mussel species that occur in the study area are the buckhorn (*Tritogonia verrucosa*), mapleleaf (*Quadrula quadrula*), deertoe (*Truncilla truncata*), three ridge (*Amblema plicata*), mucket (*Actinonaias carinata*), pink heelsplitter (*Proptera alata*), kidneyshell (*Ptychobranchus fasciolaris*), white heelsplitter (*Lasmigona complanata*), fluted shell (*Lasmigona costata*), and yellow sand shell (*Lampsilis teres*).

The rivers in the study area, their associated riparian habitats, and adjacent lands provide high quality habitat for a variety of wildlife species. These habitats support populations of well over 200 species of birds. Important game species include bobwhite quail, mourning dove, woodcock, and turkey. The area also provides winter habitat for important waterfowl species such as mallard, black duck, scaup, pintail, gadwall, and American goldeneye. In addition, wood ducks occur as residents during the summer and nest in the area. Common non-game species inhabiting the area include the eastern bluebird, red-tailed hawk, cardinal, blue jay, barred owl, downy woodpecker, and Carolina wren.

There is a diverse mammalian fauna in the study area. Eastern cottontail, gray and fox squirrels, white-tailed deer, raccoon, woodchuck, and opossum are common game species. Numerous karst features in the study area provide habitat for cave-dwelling species such as the big brown bat, little brown bat, eastern pipistrelle, and two endangered bat species; the gray bat and Indiana bat. Furbearers also occur in the area; important species include muskrat, mink, longtail weasel, striped and spotted skunk, beaver, raccoon, red fox, and gray fox.

Reptile and amphibian populations are prominent in the study area. Species composition is considered diverse due to the variety of habitat types that exist in the area. Common species include the hellbender, spotted salamander, green frog, snapping turtle, eastern box turtle, ringneck snake, eastern hognose snake, and northern water snake.

The Green River and Barren River drainages contain abundant cave and karst features. These subterranean habitats contain unique species including one species of cave crayfish which is endemic to the Mammoth Cave area. Three species of cave shrimp, including one endemic species, and three endemic cave beetle species also inhabit subterranean habitats in the study area.

Although portions of the study area provide high quality habitats and contain diverse and abundant populations of many fish and wildlife species, there are species that occur in the area that are rare; some are even threatened with extinction due to destruction or alteration of their habitats.

The Kentucky cave shrimp is endemic to the Mammoth Cave system. Populations of this rare species are thought to have been reduced by the impoundment of the Green River. Critical habitat has been designated for the species and includes the Roaring River passage of the Flint-Mammoth Cave system in the Edmonson County portion of Mammoth Cave National Park.

Caves in the study area also provide habitat for the endangered gray bat and Indiana bat. These caves are used primarily as hibernacula by these species, but there is one cave within the study area known to support a gray bat maternity colony. Future surveys in the study area may reveal the presence of other maternity colony caves. In addition, Indiana bat maternity colonies have been discovered in bottomland hardwood forests and other riparian areas in southern Illinois; mature, standing dead trees in riparian and upland forest habitats in western and northeastern Kentucky have also been found to be used by female Indiana bats as maternity sites. Therefore, it is possible that similar habitats in the study area may support maternity colonies of this species.

The study area is, or was historically, used by a number of federally listed species of birds. The rivers and reservoirs in the Green River basin provide suitable habitat for wintering populations of the threatened bald eagle and may also be used by nesting pairs. Nesting by bald eagles has been confirmed in areas to the west of the study area and may spread to the Green River and Barren River drainages as this species continues to expand its range. Although no recent nesting has been reported, the endangered American peregrine falcon occurs as a migrant or transient in the study area. Two extremely rare bird species may also utilize suitable habitats in the area; Bachman's warbler was historically reported to nest in Logan County in low, wet forested areas. There have been no recent confirmed sightings of this species in Kentucky, but a remnant population may still exist and nest in bottomland hardwood habitats in the study area. Kirtland's warbler is a transient in central Kentucky during its spring migration.

Reaches of the Green River that provide habitat for freshwater mussels contain populations of endangered species. The rough pigtoe (*Pleurobema plenum*), orange-footed pearly mussel (*Plethobasus cooperianus*), northern riffleshell (*Epioblasma torulosa rangiana*), and pink mucket

pearly mussel (*Lampsilis abrupta*) are known to occur in river sections below several of the Green River locks, and live and fresh-dead specimens of the fanshell (*Cyprogenia stegaria*) and rough pigtoe have been collected recently in the Barren River. Fresh-dead specimens of the ring pink (*Obovaria retusa*) and clubshell (*Pleurobema clava*) have been found recently, indicating that these species persist in the Green River. Other listed mussel species that may still occur in the study area are the fat pocketbook (*Potamilus capax*), tuberculed-blossom pearly mussel (*Epioblasma torulosa torulosa*), cracking pearly mussel (*Hemistena lata*), and purple catspaw pearly mussel (*Epioblasma sulcata sulcata*). The Green River may be the only river, or one of only a few rivers, in which the orange-footed pearly mussel, ring pink, and purple catspaw pearly mussel are still reproducing; therefore, habitat protection and restoration in the study area are extremely important to the continued existence of these listed mussel species.

Open woods and woodland edge habitats where limestone bluffs grade into river bottoms may support populations of Price's potato bean (*Apios priceana*), a federally threatened plant species. In addition, moderately disturbed woodland edges or periodically mowed fields may contain populations of the threatened Eggert's sunflower (*Helianthus eggertii*).

The Green River and Barren River study area also provides habitat for a number of rare species that are potential Federal candidates for listing. Terrestrial or aquatic habitats in the study area may support populations of the southeastern bat, Rafinesque's big-eared bat, small-footed bat, eastern small-footed bat, eastern woodrat, Bachman's sparrow, eastern sand darter, northern cave fish, southern cavefish, longhead darter, blue sucker, hellbender, Kirtland's water snake, copperbelly water snake, spectacle case pearly mussel, Kentucky creekshell (mussel), rabbits foot pearly mussel, purple lilliput pearly mussel, false foxglove, pale false foxglove, royal catchfly, and Gattinger's lobelia. None of these species are currently considered to be candidate species, however, they could be elevated to such status and listed in the future if their numbers decline and threats to their survival continue.

Fish and wildlife resources in the study area are expected to remain stable or exhibit slight declines as construction, development, and agricultural activities impact or alter terrestrial, subterranean, and aquatic habitats.

Project Alternatives and Potential Impacts

The proposed actions under study involve repair or removal of one or more of the navigation facilities on the Green River and Barren River above Lock and Dam 3. Repairs would involve those actions necessary to maintain safe conditions for visitors and recreationists. Since these facilities may qualify for registry as historic sites, interpretive displays may be constructed at one or more of the sites. Alternatives under consideration include:

No Action: Green River Locks and Dams 3, 4, 5, and 6; and Barren River Lock and Dam 1 would remain in place in their current conditions.

Repair facilities: Repairs needed to maintain safe conditions will be made where needed to appropriate facilities such as lock walls, approach walls, gates, etc.

Removal of facilities: Work under this alternative would involve complete removal of only the dams (the remaining portion of the dam would be removed at Lock and Dam 4). Lock walls, gates, and approach walls would remain. Lock chambers would either be filled with concrete or the gates would be welded shut. Other repairs would be made to the remaining facilities to maintain safe conditions. This alternative would be implemented on one or more of the above-listed facilities after coordination with and with support of the local governments and communities.

The "no action" alternative would likely result in short-term benefits to aquatic resources below the locks and dams. Although the dams pass high river flows, they likely retain sediment during low flow conditions. Consequently, the dams act as sediment traps and permit gradual flushing. However, since no maintenance has been done on these facilities for quite some time and no work would be done under this alternative, there is a possibility that the dams would eventually be breached as was Dam 4. Rapid drops in river level resulting from such breaches could cause significant sloughing of river banks and sediment deposition downriver. Also, at Lock and Dam 6, the river is cutting around the landward side of the lock. Emergency repairs were conducted by the Corps to alleviate this cutting. However, if the no action alternative is selected, this condition would likely continue. The uncontrolled release of impounded waters could result in significant bank erosion at and downriver from the lock.

Selection of the repair alternative would possibly result in the following work at each facility:

Green River

Lock and Dam 3 - Placement of large rock between the miter gates to an elevation equal to the dam to stabilize the gates and pool. Miter gates may be removed or cut off to a height equal to the dam if safety is a concern.

Lock and Dam 4 - Removal of miter gates if safety is a concern.

Lock and Dam 5 - Placement of large rock between the miter gates to an elevation equal to the height of the dam to stabilize the pool. Rock placed to fill in the land side valve pits and bulkhead

slots. Removal of walkway planks to eliminate access to sheet pile cells. Removal of miter gates or cutting the gates to the height of the dam if safety is a concern.

Lock and Dam 6 - Extension of the sheet pile cut off wall 15 feet farther into the riverbank to control seepage. Cutting of miter gates to a height equal to the concrete encasement if safety is a concern. Pushing the upper land side guide wall into the lock chamber. Placement of riprap against concrete steps on the outside of the monolith to stabilize the steps for use by anglers.

Barren River

Lock and Dam 1 - Placement of large rock between the miter gates to an elevation equal to the dam to stabilize the lock chamber. Removal of miter gates or cutting the gates to equal the height of the dam if safety is a concern. Placement of rock to fill bulkhead slots and valve pits to prevent falling hazard.

The purpose of this alternative would be to make the structures safe for future use by anglers and other recreationists. Since all work would be done on or inside the locks, no significant impacts to fish and wildlife resources would be anticipated. However, since no work would be done on the dams, there is a possibility that one or more might be breached in the future; impacts from that occurrence are discussed under the "no action" alternative. Long-term impacts would depend on commitments to perform future maintenance on these facilities.

Long-term impacts from removal of the navigation facilities on the Green River and Barren River would be beneficial to the native, pre-impoundment, fauna. Restoration of riverine conditions would allow for recolonization of previously impounded river reaches by fish species, such as darters and minnows, which inhabited those reaches prior to construction of the locks and dams. As they recolonize restored riverine habitats, those fish species that serve as hosts for glochidia of freshwater mussels would increase the potential for recolonization of restored riverine habitats by mussels. Removal of the dams would also likely lower the overall water level in the rivers and allow vegetation to become established on eroding riverbanks, thus reducing sedimentation of the rivers.

Removal of Green River Lock and Dam 6 would result in beneficial impacts to resources at Mammoth Cave National Park. The presence of this structure is the single greatest unresolved ecosystem management issue at Mammoth Cave National Park (Henry Holman, Mammoth Cave National Park, personal communication). Although quantitative data are not available, the presence of Lock and Dam 6 is believed to have resulted in significant sedimentation of the subterranean waters in the Park, the habitat of the Kentucky cave shrimp. Additionally, creation of the pool behind the dam has precluded access to previously accessible portions of the cave system (e.g., Echo River) and has caused sediment deposition in the river throughout the Park. During drought

conditions in 1988, the Green River in the Park exhibited nearly pre-impoundment conditions. Some degree of sediment flushing around islands in the river was observed by Park personnel (Henry Holman, personal communication). It is believed that if Lock and Dam 6 were removed, accumulated sediment around islands and in subterranean waters would eventually be flushed downriver, restoring habitat for freshwater mussels and cave-dwelling fauna. Tours to currently inaccessible portions of the cave could resume, and concessioners dealing in canoe and kayak rentals would be expected to experience significant increases in business. Ferries currently operating in the Park would be adversely affected by the lowering of water levels, however, with relatively minor extensions of the access roads, this would be a temporary impact (Henry Holman, personal communication).

Short-term adverse impacts to fish and wildlife resources could result from the removal of navigation facilities. Rapid removal of the dams could result in flushing of accumulated sediment in the pools behind the dams. If contaminants are present in accumulated sediments, resuspension and flushing of those sediments could degrade water quality downriver to an extent that the aquatic communities are adversely affected.

Conclusions and Recommendations

Although it has been heavily impacted by a variety of activities, the Green River still contains one of the most diverse aquatic faunas in the world. Impoundment of the Green River and Barren River for navigation, flood control, water supply, and recreation has significantly reduced native aquatic species for many miles and restricted extant populations to small reaches of the rivers where free-flowing conditions remain. Other activities in these drainages such as agriculture, urban development, timber harvest, coal mining, and oil and gas drilling have further impacted aquatic communities as a result of water quality degradation and sedimentation.

If the "no action" alternative is selected, impounded conditions in the Green River and Barren River, and associated adverse impacts to fish and wildlife resources, would remain. Without periodic maintenance, the structures would deteriorate and eventually fail, potentially resulting in more severe adverse impacts to downstream resources.

Removal of Lock and Dam 6 on the Green River would restore free-flowing conditions to 17 miles of the Green River through Mammoth Cave National Park, 7 miles of the Nolin River, and to subterranean waters in the park. Consequently, this river reach would be available for recolonization by riverine species of fish and freshwater mussels as accumulated sediment is flushed downriver and pre-impoundment habitat conditions (i.e., riffles and shoals with sand/gravel/cobble substrate) become reestablished.

If all four dams on the Green River (i.e., Dams 3, 4, 5, and 6) and Barren River Dam 1 were removed, approximately 94 miles of the Green River, 15 miles of the Barren River, and 7 miles of the Nolin River would be largely restored to their pre-navigation conditions. Such restoration, if conducted with protection of sensitive species in mind, should eventually result in recolonization by native aquatic species in surface and subterranean waters. Additionally, this alternative would contribute toward the recovery of 18 Federal and/or State-listed endangered, threatened, and rare species. Although fewer benefits to fish and wildlife resources would be gained if all the aforementioned dams are not removed, the removal of any of the identified structures would have significant benefits to native species.

Implementation of one of the actions under the removal alternative would result in long-term benefits to the native aquatic fauna. However, significant, but temporary, adverse impacts could result during removal of the dams. To minimize potential adverse impacts associated with the removal of any structure, the Service recommends that the Corps include the following measures in project plans:

1. Prior to beginning removal of a navigation facility, a thorough examination should be made of accumulated sediments behind the dam to determine the level of contaminants present, if any. If significant levels of contaminants are detected, the Corps should explore the possibility of manually removing as much of the contaminated sediment as possible and hauling the material to an approved upland disposal site.

2. Removal of an individual navigation dam should be accomplished gradually in stages to prevent downriver flushing of large amounts of sediment, and should be conducted only during a period of low-flow conditions.

3. As part of the plan development process, all potential impacts to fish and wildlife resources resulting from implemented of the selected alternative should be carefully documented. Impacts from sedimentation, reduced water levels in the pools, de-watering of aquatic habitats, and any other changes that may result from removal of existing facilities should be evaluated in detail. Measures should be developed and included in the final plans to avoid or minimize those impacts.

Upon selection of a preferred alternative for disposition of Corps of Engineers' navigation facilities on the Green River and Barren River, a biological assessment should be prepared and a determination should be made of whether or not the preferred alternative is likely to adversely affect federally listed species. If a "likely to adversely affect" finding is made, the Corps should initiate formal consultation with the Service.