



**United States Department of the Interior**  
**FISH AND WILDLIFE SERVICE**

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June 6, 2012

Mr. John Ballantyne  
U.S. Department of Transportation  
Federal Highway Administration  
330 West Broadway  
Frankfort, Kentucky 40601

Subject: FWS #2010-B-0327; Final Biological Opinion on the Paducah Riverfront  
Development Project, McCracken County, Kentucky, and its effects on federally  
listed mussels

Dear Mr. Ballantyne:

This document supercedes the July 6, 2010 U.S. Fish and Wildlife Service's (Service) biological opinion and the July 13, 2011 conference opinion on the previously proposed Paducah Riverfront Development Project. This biological opinion is based on our review of the relocated Paducah Riverfront Development Project at approximately Ohio River Miles 934.7 to 935.8 in McCracken County, Kentucky, and its effects on federally listed mussels under section 7(a)(2) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

The Federal Highway Administration's (FHWA) letter requesting formal consultation was received on January 19, 2011 and formal consultation was initiated on January 27, 2011, in a letter from the Service to the FHWA. This document also includes the U.S. Army Corps of Engineers (Louisville District) and the Service as cooperating agencies due to their involvement in the project as permitting and funding agencies, respectively.

This biological opinion is based on information provided in a January 12, 2012 Biological Assessment (BA) prepared by Redwing Ecological Services, Inc. (Redwing), a modification to the BA provided by Redwing on March 21, 2012, meetings (see consultation history), available literature, communications with experts on the federally listed species considered in this biological opinion, and other sources of information available to us and/or in our files. A complete administrative record of this consultation is on file at the Service's Kentucky Field Office in Frankfort, Kentucky (see address above).

The Service believes this project may affect and is likely to adversely affect the fat pocketbook, *Potamilus capax*; pink mucket, *Lampsilis abrupta*; orangefoot pimpleback, *Plethobasus cooperianus*; and sheepsnose, *Plethobasus cyphus*. The fat pocketbook is known to occur at the project site and the other three species are considered likely to occur at the project site.

Species not considered in this biological opinion that were included in the Biological Assessment include the spectaclecase, *Cumberlandia monodonta*; fanshell, *Cyprogenia stegaria*; ring pink, *Obovaria retusa*; clubshell, *Pleurobema clava*; rough pigtoe, *Pleurobema plenum*; and rabbitsfoot, *Quadrula cylindrica cylindrica*. The Service does not consider that these six species are likely to occur at the project site based on a lack of recent occurrences for these species in the project area, a lack of suitable habitat for several of the species, and recent mussel survey results that were provided in the BA; therefore, it is the Service's determination that this project is not likely to adversely affect those six species.

### **Consultation History**

Although considered as 'new' project in this Biological Opinion, this riverfront development project is essentially a continuance of a previous project, but it has been moved approximately 500 feet downstream. A biological opinion and conference opinion were completed on the previous project; however, the project was moved downstream, which necessitated a new review of the project. The consultation history for the previous project was summarized in the July 6, 2010 biological opinion and the July 13, 2011 conference opinion.

22 November 2011 – Redwing met with Service to discuss preliminary results of additional surveys and the preparation of a Biological Assessment Redwing was preparing based on moving the Shultz Park portion of the Paducah Riverfront project downstream approximately 500 feet.

19 January 2012 – Letter from Mr. John Ballantyne (Federal Highway Administration) regarding the transmittal of a Biological Assessment dated January 9, 2012 and a request for formal consultation with the Service.

27 January 2012 – Service letter to Mr. John Ballantyne of the Federal Highway Administration replying that the Service believed the BA was adequate for initiating formal consultation, and indicating that the Service's biological opinion would focus on four mussel species – the fat pocketbook, *Potamilus capax*; orangefoot pimpleback, *Plethobasus cooperianus*; pink mucket, *Lampsilis abrupta*; and sheepnose, *Plethobasus cyphus*.

20 March 2012 – Service met with Redwing to discuss modifications to the BA dealing with mussel habitat and Mussel Conservation Measures.

29 May 2012 – A draft final version of the biological opinion was provided to the FHWA, KYTC, and U.S. Army Corps of Engineers – Louisville District (COE), and comments on the draft final biological opinion were solicited from those agencies.



## **BIOLOGICAL OPINION**

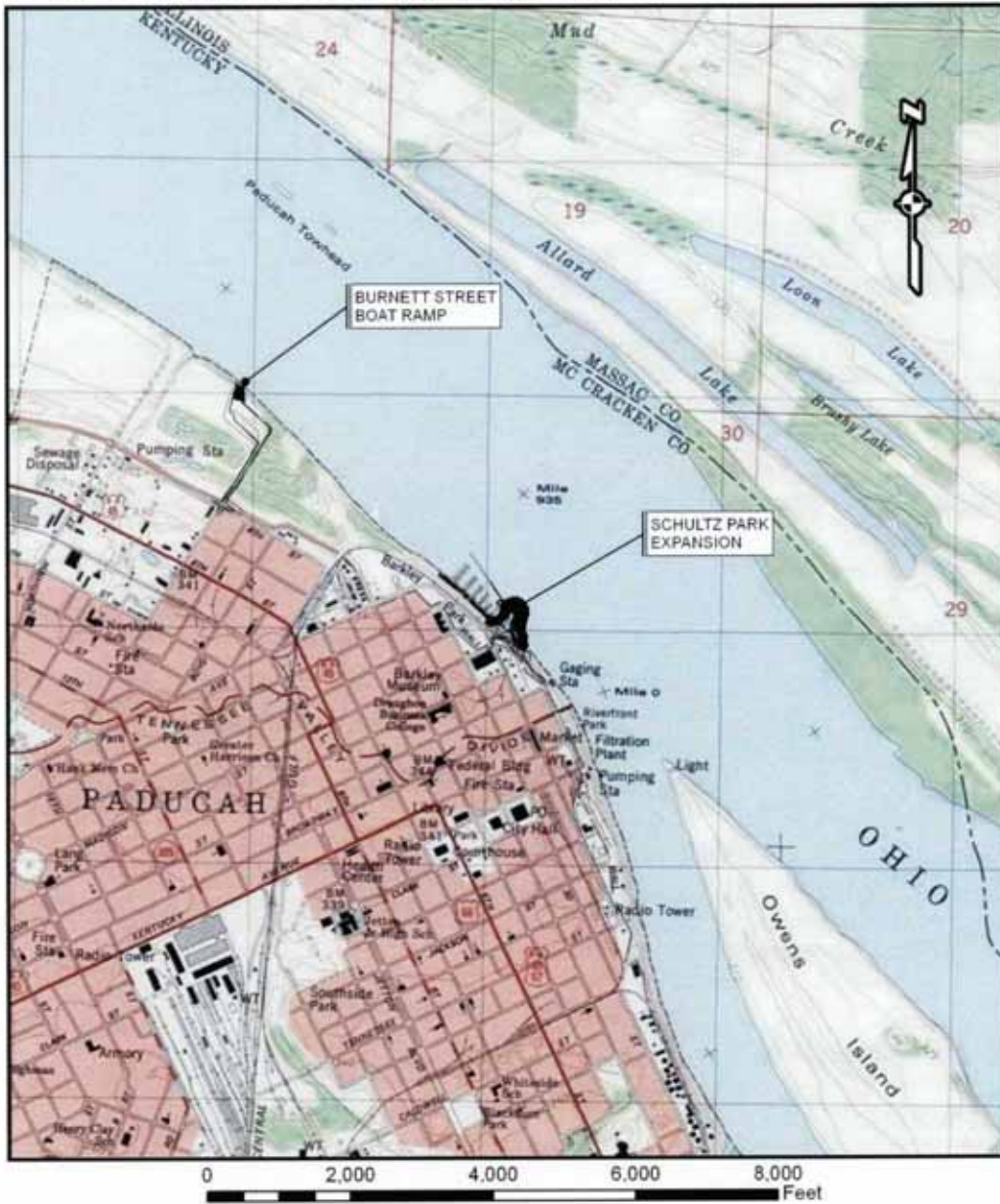
### **DESCRIPTION OF THE PROPOSED ACTION**

The Paducah Riverfront Redevelopment Project is a proactive revitalization effort, resulting from the collaborative effort of a diverse group of constituents including stakeholders, city staff, the general public and state and federal agencies that began in 2006. The Paducah Riverfront Redevelopment Plan has been in the design and planning phase since 1992. The plan's goal is to reconnect residents and neighbors with the City of Paducah's downtown riverfront as well as provide new tourism, recreation, and economic development opportunities for the city. Improvements to the riverfront outlined in the redevelopment plan include a terraced riverbank with overlooks, a performance plaza, recreational areas along a new greenway trail, landscaping, renovation of public infrastructure, public education and outreach through interpretative activities, and a five-lane boat launch. The plan's components will link public amenities, recreational facilities, public spaces, and Paducah's downtown to the Ohio River. Due to its long range goals and magnitude of the plan, it will be implemented using a phased approach, spanning several years. More information regarding the Paducah Riverfront Redevelopment Plan can be found on their website: [riverfrontpaducah.com](http://riverfrontpaducah.com). The BA focused on the first phase of the plan which includes the Burnett Street Boat Ramp and the Schultz Park Expansion marina/transient dock. These two components of the plan involve the only proposed direct impacts to the Ohio River (Figure 1).

Numerous alternative designs have been developed and presented to city staff, the USACE, U.S. Coast Guard, marine industry representatives, the public, and riverfront property owners. Based on a detailed alternatives analysis, the current location was ultimately chosen. Feasibility was determined based on availability of riverfront properties, avoidance of the Ohio River navigational channel, the least potential to interfere with future river operations, and avoidance of existing mussel resources. The two components of the proposed project assessed as part of the BA include the Burnett Street Boat Ramp and the Schultz Park Expansion and are described in more detail below. Each of these components also involves other interrelated federal actions. More specifically, the construction of the Burnett Street Boat Ramp would involve a federal boating access grant from the Service to the Kentucky Department of Fish and Wildlife Resources (KDFWR). KDFWR would then use this funding to pay for the City of Paducah's construction costs for the Burnett Street Boat Ramp. The project also includes a Boating Infrastructure Grant from the Service to KDFWR. KDFWR would then use this funding to pay for the City of Paducah's construction costs associated with the Schultz Park Expansion marina. While the granting of these federal funds do not result in direct impacts to federally listed species (i.e., they are administrative in nature), the use of these federal grant funds will lead to adverse effects on listed freshwater mussels as described below and in the "Effects of the Action" section of this biological opinion.

This biological opinion also is intended to address the interrelated federal actions and pending permits under sections 10, 401, and 404 of the Clean Water Act (CWA) that are necessary for construction of the proposed project.

Source: USGS 7.5' Topographic Maps: © 2011 National Geographic Society, i-cubed



**PADUCAH RIVERFRONT  
REDEVELOPMENT PROJECT  
McCRACKEN COUNTY, KENTUCKY**

FILE: Redwing/06-090-01/Figures/PrpAction  
 REDWING PROJECT 06-090-01  
 REVISED DATE 4.16.2012 | DRAWN BY BJO



**PROPOSED ACTIONS MAP**

**FIGURE 1**



## Burnett Street Boat Ramp

The Burnett Street Boat Ramp project will relocate the existing main boat ramp along the downtown riverfront to a currently undeveloped piece of property approximately one mile downstream so that the existing downtown riverfront can be converted back to its original use as a riverboat landing and community focal point.

The proposed ramp is located at approximately Ohio River Mile 935.8. This component of the redevelopment plan is being undertaken as a partnership with KDFWR through a USFWS Boating Access Grant. The proposed boat launch site is located on currently undeveloped property owned by the City of Paducah and will contain five launch lanes with parking for 100 vehicles and trailers (Figure 1) with 24-hour access to the river. The property can accommodate an additional 100 parking spaces in the future as needed. The proposed boat launch will be connected to the downtown Riverfront Park via a planned pedestrian and bicycle greenway trail along the river.

Construction of the Burnett Street Boat Ramp, its access route, and all of the associated parking will result in permanent impacts to jurisdictional wetlands. Mitigation for these impacts will be provided on site in accordance with the conditions of the approved Section 404 and 401 permits through a combination of preservation and restoration activities. Mitigation includes permanent preservation of approximately 34.4 acres of high quality forested wetland, restoration of 7.3 acres of forested wetland, preservation of 3.4 acres of forested riparian buffer, and restoration of 765 linear feet of riparian buffer along the Ohio River. These mitigation measures have been designed to ensure the functional components of the impacted wetlands will be maintained on site as well as enhance the quality of the Ohio River riparian corridor. These mitigation components will be monitored for five years to ensure long-term success. In addition, permanent preservation of these components through a conservation easement or deed restriction will ensure long-term indirect benefits through reduced streambank erosion and nonpoint source runoff into the Ohio River.

Impacts to the Ohio River associated with the construction of the boat ramp will consist of placing a subgrade base and precast concrete ramp faces. The ramp's footprint will cover approximately 0.3 acre of riverbank and extend no greater than 35 meters riverward from normal pool. It is estimated that an additional 0.3 acre area will receive indirect effects from the construction of the boat ramp, for a total of 0.60 acres of affected river substrate (Table 1).

Table 1: Effects Summary for River Substrate and Mussel Habitat

Impact Type	Schultz Park	Burnett Street Boat Ramp
Direct (fill)	3.49 acres	0.30 acre
Direct (fill non-mussel habitat)	2.29 acres	0 acre
Direct (mooring)	0.07 acres	NA
Indirect (sedimentation non-mussel habitat)	4.97 acres	0.30 acre
Indirect (sedimentation mussel habitat)	2.73 acres	0 acre
Total Ohio River Substrate Impacts	13.55 acres	0.60 acre
Total Mussel Habitat Effects	6.29 acres	0.30 acre

The compacted subgrade base material and concrete ramp face will be installed from shore and best management practices will be used to ensure erosion and sedimentation is minimized to the greatest extent possible. As required under the 404/401 permits, an erosion and sediment control plan will be designed, implemented, and maintained in effective operating condition at all times during construction to prevent degradation of waters of the Commonwealth. All fill material will consist of less than 5% fines, and silt fences and bank stabilization will be used where necessary and as appropriate to minimize the potential for bank erosion and sedimentation during construction. The proposed boat ramp orientation (i.e., angle in relation to river flow and ramp face slope) was designed to have minimal impact on the prevailing hydraulic conditions of the Ohio River. The slope of the ramp will largely follow the existing contours of the riverbank. The pre-cast ramp faces will be installed over a compacted coarse-granular foundation with a minimum slope of 7:1.

Modeling hydrodynamic processes specifically related to the proposed Burnett Street Boat Ramp was cost-prohibitive due to the relatively small proposed encroachment into the river and the data-intensive model input requirements. Therefore, the modeling results for the Schultz Park Expansion site (see EFFECTS OF THE ACTION – Analysis for Effects of the Action, below in this BO) were used as an estimate for relative hydrodynamic changes at the proposed Burnett Street Boat Ramp location.

### **Schultz Park Expansion**

The Schultz Park Expansion represents Paducah's continuing efforts to revitalize its riverfront and will serve as a catalyst for additional riverfront and downtown improvements as outlined in the Riverfront Redevelopment Plan. The proposed Schultz Park Expansion area is accessed via three existing openings in the floodwall and proposed expansion activities will extend from approximately Ohio River Mile 934.8 to 935.1 (Figure 2). Proposed park expansion activities include improvements to the adjacent Schultz Park, construction of a marina/transient dock, associated parking and infrastructure, and connection of park amenities with existing roads, and infrastructure. This component of the redevelopment plan is being undertaken as a partnership with KDFWR through a USFWS Boating Infrastructure Grant.

Development of the Schultz Park Expansion will be accomplished in several phases. The first phase includes riverward expansion of the existing Schultz Park and construction of a transient dock. Construction will begin by placing appropriately-sized coarse fill material below the Ohio River Normal Pool elevation of 302 feet to create a new peninsular landform with a footprint of approximately 5.78 acres. An additional area of sedimentation impact is estimated on 7.7 acres of additional Ohio River bottom, and there will be an estimated 0.07 acres of area covered by marina anchors. Therefore, the total acreage of potential and actual mussel habitat that will be impacted at the Schultz Park Expansion portion of the project is 13.55 acres (Table 1). The coarse fill material will meet KDOW Division of Environmental Protection water quality requirements and will not exceed 5% fines. Placement of the fill material may occur from land-side via truck or from river-side via barges depending on the location of source fill material,

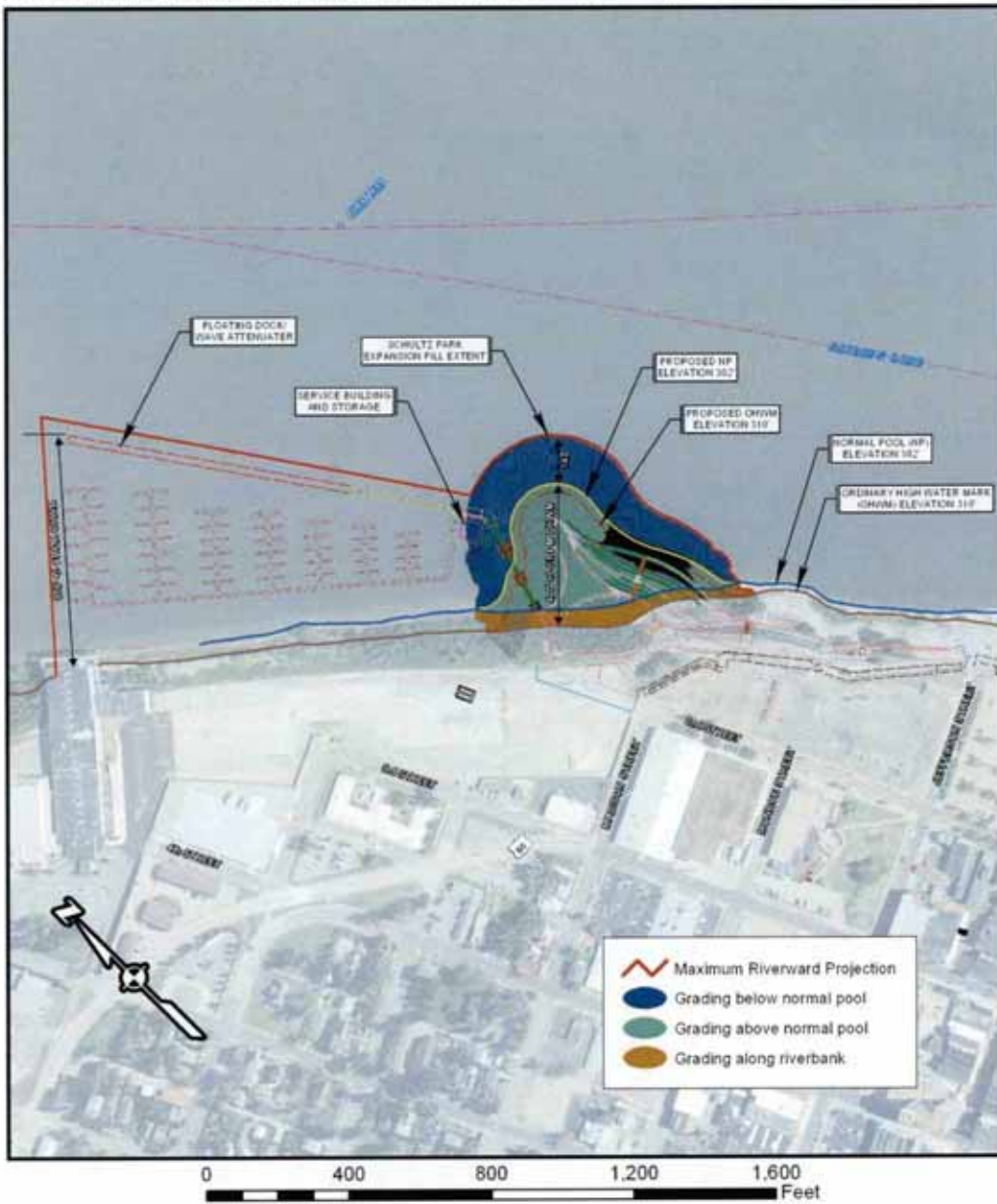


feasibility, and efficiency (i.e., The contract for doing this work likely will not limit contractor installation methods.). However, if material is transported and unloaded from barges, special conditions will be required to avoid disturbance of the existing mussel bed from potential barge anchoring or stray debris. The newly constructed landform foundation may be left to settle for approximately one year to stabilize prior to final grading and construction of the transient dock, marina, and other amenities. Once the foundation has settled, the remaining landform will be constructed using no steeper than a 3:1 slope. The landform will be protected by a combination of revetment techniques using coarse aggregate material and other naturalized components where applicable. Bioengineered slope stabilization will supplement stone revetment where applicable and native vegetation will be used extensively throughout the site.

Construction of the transient dock on the downstream side of the Schultz Park landform, which will be accessed via a floating gangway system, will begin once the landform has settled and stabilized. The floating gangway system will provide for approximately 150 boat slips. Currently, boaters are required to dock on the riverbank. The closest alternative on-water refueling/marina facilities for recreational boaters are located 33 miles upstream at Golconda, Illinois. The transient dock will serve as a continuation of the river walk for the public as well as a mooring dock for transient vessels. The transient dock will not provide dockage for excursion vessels such as the 'Delta Queen' steamboat or paddleboats. Impacts to the riverbed associated with the transient dock will be limited to placement of a maximum of 50 eight-foot deadman weight cubes for anchoring the floating dock and marina. The project will maintain a 300-foot buffer from the USACE Navigation Channel.

The second phase of the Schultz Park Expansion includes installation of park amenities. Planned park amenities include public open spaces and scenic overlooks, benches and picnic tables, additional parking, pedestrian/bicycle trails, educational/interpretive resources, and other landscape features. Marina accommodations include associated utility systems (e.g. fuel, water, electric, and sanitary) that will provide restrooms, showers, and a sundries store. While no specific details are yet available for these facilities, all fuel and wastewater systems must be designed to Kentucky state standards. A spill prevention plan will be required and developed and maintained by the marina operator. The spill prevention plan will comply with state codes and approved by the appropriate agency prior to marina operation.

Source: Bing Maps ©2010 Microsoft Corporation and its data suppliers; Basemap provided by JJR & Florence & Hutcheson



PADUCAH RIVERFRONT  
REDEVELOPMENT PROJECT  
McCRACKEN COUNTY, KENTUCKY

FILE: Redwing/06-090-01/Figures/Development_8x11
REDWING PROJECT 06-090-01
REVISED DATE 4.16.2012   DRAWN BY BJO



SITE  
DEVELOPMENT PLAN

FIGURE 2



## **ACTION AREA**

The Service considers the action area to include the lower Ohio River between J.T. Myers Lock and Dam at Ohio River Mile 846.0 downstream to the mouth of the Ohio River at ORM 981.0. This action area also includes the Cumberland River downstream of Barkley Dam and the Tennessee River downstream of Kentucky Dam. The action area is designated in this way because (a) it contains the entirety of the Burnett Street Boat Ramp and Schultz Park Expansion portions of the proposed action and (b) it contains the areas upstream and downstream of the proposed project where the indirect and cumulative effects of the proposed action are likely to occur. Regarding these upstream and downstream areas, the Service believes that the proposed action is likely to result in (a) hydrologic effects on the listed freshwater mussels addressed in this biological opinion and their habitats within and downstream of areas impacted by the Burnett Street Boat Ramp and Schultz Park Expansion portions of the proposed action, (b) localized population reductions of these freshwater mussels that will have corresponding effects on their populations within the described action area, and (c) a reduced likelihood that fish hosts for these freshwater mussel species will provide the same level of pre-project genetic flow throughout the described action area due to the anticipated population reductions of these species within the action area.

In the action area, the proposed boat ramp and park expansion and marina/transient dock is located at approximately Ohio River Mile 934.8 to 935.1, immediately downstream of an existing downtown boat launch, and consists of a relatively developed shoreline with armored riverbanks and a narrow park setting on the river side of the floodwall. The Ohio River within the vicinity of the City of Paducah experiences a high volume of boat and barge traffic due to its proximity to the existing downtown boat ramp and the nearby lower Ohio River navigation lock system. The City of Paducah is a major hub for commercial barge activity. Barges frequently use the shoreline in the proposed marina/transient dock area for staging purposes because of the high volume of barge traffic through the nearby locks. Barge staging often consists of beaching the nose of the barge onto the shore at an angle sufficient to maintain position in the river while waiting for lock traffic to clear. Many recreational boaters also use the area for fishing, water skiing, cruising, and other activities. There is a considerable volume of foot traffic along the existing riverfront park along the floodwall for fishing, sight-seeing, etc.

Table 1 provides a summary of the expected acreage of impact on the river substrate and mussel habitat. The extent of direct and indirect effects were determined based on the extent of the proposed fill required to construct the park expansion landform, the anticipated extent of hydrodynamic modifications caused by the proposed landform, and the anchor system for securing the transient dock and marina.

Based on mussel surveys conducted for this project, the project's impact area is greater than the area of occupied mussel habitat because mussels do not occur everywhere within the project site (e.g., near shore). Direct effects of the expansion of Schultz Park include the placement of fill material over a footprint covering approximately 3.56 acres that lies below the normal pool elevation and extending approximately 480 feet riverward. Direct effects also include placement of mooring anchors, totaling approximately 0.07 acre, to secure the transient dock and marina.

Therefore a total of 5.85 acres of “fill” will occur as a result of the proposed project. An additional affected area of 7.7 acres of river substrate, which includes 4.97 acres of unoccupied mussel substrate and 2.73 acres of mussel habitat, will be indirectly affected by anticipated hydrodynamic modifications and sedimentation. The proposed park’s shoreline at the maximum extent will be approximately 350 feet riverward from its current location. The location of the proposed expansion, as well as the orientation of the proposed landform, was designed to infringe as little as possible on river hydraulics as well as the commercial traffic in the river’s navigation channel. However, changes in river flow and, therefore, sediment transport patterns will likely change locally. The results of the hydrodynamic modeling performed by HCCL provide an estimation of these potential changes in deposition and entrainment patterns of sediment particles as a result of the proposed Schultz Park landform. The model predicts that under existing conditions, sediment entrainment potential (mobility index > 1) is limited to particle sizes less than 5 mm (fine gravel) occurring at river stages between 304 and 320 feet. After construction of the proposed landform, the model predicts entrainment potential for particles up to 5mm in size on the surface of the landform fill slope at a river stage of 320 feet. Because the fill slope will be constructed with coarse aggregate significantly greater in size than 5 mm, the effects discussion will be limited to sediment transport potential of particles less than 5 mm at river stages 304, 310, and 320 feet.

Results of the model show potential entrainment of 1mm particles, at river stage 304 feet, is likely to occur at the furthest riverward extent of the proposed landform. Other changes to the existing sediment transport dynamics of the river include potential deposition of 0.1 mm, 1 mm, and 2 mm particles primarily downstream and shoreward of the proposed landform.

Potential sedimentation or scour from boating activity within the transient dock marina is not likely to occur due to river depth and the slow speed required to effectively maneuver boats within the dock area. In addition, a wave attenuator was integrated into the transient dock design to buffer the boat harbor and shoreline from wave action generated from vessels navigating within the main river channel.

### **Mussel Conservation Measures**

Proposed mussel conservation measures that were included in the Biological Assessment are as follows:

Conservation measures proposed to minimize take of protected mussel species and to minimize impacts to mussel habitat as a result of the proposed project will consist of contributions to an appropriate resource conservation entity to support enhancement and/or protection of mussel habitat, and for mussel recovery efforts in the lower Ohio River. The proposed conservation measures are summarized below:

- **Habitat:** The City of Paducah will contribute a total of \$71,706 for the preservation, creation, enhancement, and/or protection of mussel habitat in the lower Ohio River. This contribution will be provided to minimize impacts to mussel habitat expected to occur on



this project. The contribution amount was derived using the average 2009 agricultural land value in Kentucky (Trimble 2009) of \$2,850 per acre and then applying a ratio of 4:1 for impacts to a total of 6.29 acres.

- **Propagation:** The City of Paducah will contribute \$19,000 for recovery efforts related to protected mussel species in the lower Ohio River. This contribution will be provided to minimize take expected to occur on this project. The contribution amount was an estimate based on take of 76 *P. capax* and a per mussel compensatory amount of \$250 per *P. capax* (This amount was utilized by the USFWS in the previous BO.). It is proposed that the contribution be applied to propagation efforts for *P. cooperianus*; however, it may be used for *P. capax* or other federally-listed mussel species in the lower Ohio River.

The Service recognizes that, individually and/or cumulatively, these mussel conservation measures that are included in the BA contribute to the avoidance and minimization of adverse effects to these listed mussels, but that these measures do not necessarily eliminate all adverse effects that may result from the proposed action.

These conservation measures are included with more detail, along with additional minimization actions, in the Reasonable and Prudent Measures and Terms and Conditions portion of this Biological Opinion.

## STATUS OF THE SPECIES/CRITICAL HABITAT

### Species/critical habitat description

This biological opinion covers the fat pocketbook, *Potamilus capax*; pink mucket, *Lampsilis abrupta*; orangefoot pimpleback, *Plethobasus cooperianus*, and sheepnose, *Plethobasus cyphyus*. All four species are federally listed as an endangered.

#### Fat pocketbook mussel

The fat pocketbook was first listed as endangered in 1976, and a recovery plan was written in 1985 and then revised in 1989 (USFWS 1985a, USFWS 1998). This species is currently undergoing a 5-year review to determine its current status by the Service's Mississippi Field Office. Critical habitat for this species has not been designated.

The following taxonomic information is gleaned from the recovery plan for this species (USFWS 1989). The fat pocketbook was described twice in 1832 by two authors giving it different names. It was first described by J. Green as *Unio capax* and by I. Lea as *Symphnota globosa*. A few name changes have occurred since 1832, and the current accepted name, which includes the author who first described it, is *Potamilus capax* (Green 1832).

The type locality is the upper Mississippi River at the Falls of St. Anthony in Minnesota. The fat pocketbook has a round to oblong shell that is greatly inflated and has a strong s-shaped hinge

line. The beak cavity is very deep (NatureServe 2007, Cummings and Mayer 1992). The shell is thin to moderately thick and the periostracum varies in color from light brown, yellow, or olive, and becoming dark brown in older individuals. The shell is typically rayless, smooth, and very shiny. Both anterior and posterior ends of the shell are rounded. Young fat pocketbook shells may have a few faint ridges on the umbo as well as have a small posterior wing present, but these characteristics are not necessarily visible in older individuals. The umbos are greatly inflated, elevated above the hinge line, and turned inward. The fat pocketbook is known to grow to a length of 5 inches. Internal morphology includes two pseudocardinal teeth in each valve, and both are thin, compressed, and elevated. There are two lateral teeth in the left valve and one in the right valve. Lateral teeth are thin and greatly curved in both valves. The nacre is bluish white and often iridescent; however, it may include some pink or salmon color in some specimens (Cummings and Mayer 1992).

#### Pink mucket

The pink mucket (*Lampsilis abrupta*) was listed as an endangered species on June 14, 1976 (Code of Federal Regulations 1976). No critical habitat has been designated for this species.

The pink mucket is a medium-sized mussel, growing to a length of approximately 4.5-5in. The shells are subquadrate or circular in shape and become thick and heavy in mature individuals. Anterior edges of the shells are rounded, with slightly curved dorsal and ventral margins. The posterior margins of the shells in females are slightly rounded to straight; shells of the males are rounded or bluntly pointed. A well-defined posterior ridge is present in the males. Color of the outer shell surface (periostracum) varies from light yellow or yellowish-brown to dark brown, occasionally marked with broken fine to fairly wide dark green rays. The color of the inner shell surface (nacre) varies from white to pink to salmon in color, with the posterior margin being iridescent (Parmalee and Bogan 1998).

#### Orangefoot pimpleback

The orangefoot pimpleback (*Plethobasus cooperianus*) is an Ohioan species (i.e., Interior Basin) species. Records are only known from the Ohio River basin. It was officially listed as an endangered species on July 14, 1976 (Code of Federal Regulations 1976). No critical habitat has been designated for this species.

The orangefoot pimpleback is a medium-sized mussel, growing to a length of approximately 3.5 inches. The shell is circular or sub-triangular in shape, with prominent beaks that are directed anteriorly. The periostracum is brown to reddish-brown and the surface of the shell is marked by concentric growth lines. The posterior two-thirds of the shell are covered with numerous raised, irregular pustules (Parmalee and Bogan 1998). Nacre color varies from white to pink inside the pallial line, being more intense toward the hinge-teeth (Bogan and Parmalee 1983).

#### Sheepnose

The sheepnose is a recently federally listed species (Federal Register 2012). Critical habitat for this species has not yet been designated but will be determined within a year after the final listing rule.



The following taxonomic and descriptive information is summarized from the status review of this species (Butler, 2003). The sheepsnose was described by Constantine Rafinesque in 1820. The type locality is the Falls of the Ohio River near Louisville, Kentucky and adjacent Indiana.

The following description is generally summarized from Parmalee and Bogan (1998). This medium sized mussel reaches nearly 5.5 inches in length, and the shape of the shell is elongate ovate, moderately inflated, with the valves thick and solid. The anterior end of the shell is rounded and the posterior is truncate to bluntly pointed. The posterior ridge is gently rounded and flattened ventrally, and there is generally a row of large, broad tubercular swelling on the center of the shell extending from the beak to the ventral margin. A shallow sulcus lies between the posterior ridge and central swellings. Beaks are high and located near the anterior margin. In young individuals the periostracum is often light yellow to yellowish brown, becoming darker with age. The beak cavity is shallow to moderately deep and generally white in color. The right valve contains a large triangular pseudocardinal tooth and the lateral teeth are heavy, long and slightly curved.

## **Life History**

### Fat pocketbook

The fat pocketbook is a filter-feeding species from the Unionidea family. The fat pocketbook occurs primarily in sand and mud substrates, although the species has been found in fine gravel and hard clay occasionally (Parmalee 1967, Bates and Dennis 1983, Clarke 1985). The species occurs at water depths that range from a few inches to several feet (Parmalee 1967). The life cycle of the fat pocketbook is similar to that of other freshwater mussels, in which the glochidia (larvae) require a fish host to transform to the juvenile stage. Larval mussels must attach to a host (usually on a fish gill) where they metamorphose into free-living individuals called juveniles. The fat pocketbook is a long-term brooder, with females becoming gravid in the fall, retaining glochidia over winter, and releasing the progeny during spring and summer. The freshwater drum is the primary host fish for the species (Barnhart 1997, Watters 2007).

The fat pocketbook is a large-river species that is typically found in slow-flowing water with a mud (silt/clay), sand, or gravel substrate, at depths of a few inches to eight or more feet (USFWS 1997, Cummings and Mayer 1992, USFWS 1989, EA 2007, Parmalee 1967). In the St. Francis River in Arkansas and lower Wabash River, fat pocketbooks have been found to utilize sand, mud and fine gravel substrates (Bates and Dennis 1983, Clarke 1985). The fat pocketbook is known to exist in 200 miles of the St. Francis River watershed, which includes man-made ditches, bayous, and sloughs. These habitat types are characterized as depositional areas with slow-moving water, and surveys of the St. Francis River watershed indicate that the fat pocketbook is surviving and reproducing in these conditions (Miller and Payne 2005). The reproductive strategy of the fat pocketbook is not known, but it is suspected to be a long-term brooder (bradyctictic), which holds glochidia through the winter and releases them in the spring of the year (USFWS 1989). Several unpublished studies since the species Recovery Plan have reported that fat pocketbook glochidia successfully transformed on the freshwater drum (*Aplodinotus grunniens*) (Watters 1994, Barnhart 1996, Barnhart and Roberts 1996, Barnhart and

Riusech 1997). Barnhart (1997) found that fat pocketbook transformed only on freshwater drum among 29 fish species tested.

#### Pink mucket

The pink mucket inhabits areas in large rivers with swift currents, depths of 1.6 ft to 26.2 ft, and mixed sand/gravel/cobble substrate. Notwithstanding this, the pink mucket appears to have adapted to reservoir-type conditions in the upper reaches of some impoundments. This species is a long term brooder with a life span greater than 20 years. Females become gravid by age three and brood glochidia from August through June of the following year (Hubbs 2010b).

Reproduction is likely similar to other freshwater mussels. Males release sperm into the water column; the sperm are taken in by females during normal siphoning activity. Fertilized eggs are retained in specially modified gills (marsupia) until the larvae (glochidia) are fully developed. Once released, the glochidia must attach to the gills or fins of an appropriate fish host. They encyst and metamorphose into juvenile mussels. Fully developed juveniles drop from the fish host and settle to the river bottom. The glochidia are undescribed. Freshwater mussels feed by siphoning food items that drift in the water column. The pink mucket likely feeds on items similar to other mussel species including algae, zooplankton, diatoms, and detritus.

Host fishes identified through laboratory induced infections include largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieu*), spotted bass (*Micropterus punctulatus*), and walleye (*Sander vitreus*) (Barnhart et al. 1997) as well as white crappie (*Pomoxis annularis*) and sauger (*Sander canadense*) (J.B. Layzer and L.M. Madison, USGS, from pers. comm., in Williams et al. 2008). The use of large piscivorous fishes for hosts is consistent with the presence of a fish-like mantle lure in the pink mucket (Barnhart et al. 1997). Freshwater drum (*Aplodinotus grunniens*) was erroneously cited as being a host by Fuller (1974).

The pink mucket often inhabits regulated rivers, particularly those navigational waters modified by locks and dams. Although not reservoir tolerant *per se*, it is found in tailwaters having good riverine-quality habitat (generally rocky substrates swept free of excessive fine sediment deposits by adequate currents). Reservoir conditions (characterized by slackwater, low oxygen, and heavy silt deposition) are not conducive for its survival and population sustainability. However, its host fishes are more habitat generalists, being commonly found in reservoir, tailwater, and riverine habitats.

The mobility of its hosts and/or host fish tolerance for habitats unsuitable for the pink mucket may partially account for sometimes seemingly disjunct records of the mussel in streams like the Paint Rock River in Alabama, the Bourbeuse River in Missouri, and Bear Creek in Mississippi. It is possible that these highly sporadic occurrences in otherwise well-sampled streams do not actually represent populations but are merely occurrences of low-probability events (e.g., having a highly mobile host fish carry juveniles spawned from a nearby source population shed post-metamorphosed pink mucket into suitable habitat). Without a readily accessible source population (Tennessee River, Guntersville Dam tailwaters for Paint Rock River; Tennessee River, Wilson Dam tailwaters for Bear Creek; and Meramec River for Bourbeuse and Big Rivers), the pink mucket could possibly not exist in these streams.



Using the growth ring method, qualitative age estimations from external shell growth-rest ring counts (Neves and Moyer 1988) from 36 individuals collected from Osage River, Missouri suggests that the pink mucket has a lifespan of at least 36 years (Ecological Services Inc. 2003). It is probable the species lives several years longer considering that the growth ring method typically underestimates age compared to quantitative age determinations (thin sectioning shells) and that the older the specimen the greater the underestimate of age (Neves and Moyer 1988). Unfortunately, no empirical age data exists from thin sectioning pink mucket shells.

An experimental pond propagation study took place in early 2006 using pink mucket stock from Pickwick Landing Dam tailwater in the Tennessee River, Tennessee, and sheds light on aspects of its early life history (Don Hubbs 2009). Host fish (largemouth bass) were infested with mature glochidia teased out of a gravid female pink mucket and contained in a small pond enclosure. By late summer 2006, six juvenile individuals that had survived post-metamorphosis were released into an enclosure in their parent tailwaters to monitor survival, growth, and sexual activity. After approximately 20 months, they had all survived and grown from approximately 0.9 in length at the time of translocation to a range of 2.2-2.7 in, and were beginning to develop sexual dimorphic shell characters (apparently four females and two males). A reassessment of the grow-out experiment in March 2009 when the mussels were approaching age 3 found 100% survival and that there were indeed four females and two males. The females all had charged gills (whether with eggs or glochidia was unknown) and had grown to a length range of 2.4-2.8 in, while the males were larger at 3.1 and 3.2 in (Bob Butler 2010). From this age and growth data, it appears that at least female pink mucket reach sexual maturity at age 2+. Growth is rapid for the first few years, especially in males. In general, mussel growth slows considerably after the first few years, presumably when individuals become fully mature, with energy instead going towards gamete production and development (Baird 2000).

#### Orangefoot pimpleback

The orangefoot pimpleback is found in medium to large rivers with sand and gravel substrates (USFWS 1984). The reproductive cycle of the orangefoot pimpleback is likely similar to that of other native freshwater mussels. Males release sperm into the water column; the sperm are then taken in by the females through their siphons during feeding and respiration. The females retain the fertilized eggs in their gills until the larvae (glochidia) fully develop. The mussel glochidia are released into the water, and within a few days they must attach to the appropriate species of fish, which they parasitize for a short time while they develop into juvenile mussels. The orangefoot pimpleback is likely a short term brooder with spawning occurring in the spring and release of glochidia during summer months (USFWS 1984). Wilson and Clark (1914) collected two gravid females in early June. Utterback (1915) reported the orangefoot pimpleback to be a summer breeder and Yokley (1972a) observed one specimen with gills charged in August.

The glochidia of the orangefoot pimpleback have not been described, but the sexual glands and soft parts are usually pinkish in color and also grayish or brown (USFWS 1984). The glochidia have been observed to be pale orange in June (Hubbs 2010b). It is probable that the glochidia are semi-oval, and hookless, similar to those in the closely related species, sheepsnose (*Plethobasus cyphus*) (Ortmann 1912, 1919).

Specific glochidial hosts for this species are unknown; however, the sauger (*Stizostedion canadense*) is reported by Surber (1913) and Wilson (1916) to be the fish host for the orangefoot pimpleback. The Kentucky Department of Fish and Wildlife Resources, under the direction of Dr. Monte McGregor is planning studies to identify the species' fish host(s) and other life history aspects, and is maintaining captive individuals at their Center for Mollusk Conservation in Frankfort, Kentucky.

### Sheepnose

The life history information is summarized from the status review of this species (Butler 2003). Thick shelled, larger river mussels such as the sheepnose are thought to live longer than other species. The life span of the sheepnose is thought to be about 21 to 25 years. The reproductive cycle of the sheepnose is likely similar to that of other native freshwater mussels. As with most mussel species the sheepnose has separate sexes. Age at sexual maturity is unknown but is estimated at about 3 years. Female sheepnose utilize only the outer pair of gills as marsupium for its glochidia, and is considered to be a short-term brooder with most reproduction taking place in early summer (Parmalee and Bogan 1998). Glochidia are released in the form of conglomerates, which are narrow and lanceolate in outline, solid and red in color, and discharged in unbroken form (Oesch 1984). Several score to a few hundred glochidia probably occur in each conglomerate. Total fecundity per female sheepnose is probably in the tens of thousands.

Glochidia must come into contact with a specific host fish(es) to survive and develop further. Little is known regarding the host fish for the sheepnose but one known host is the sauger, *Stizostediaon canadense*. It is possible that other fish species may also serve as a suitable host. Newly metamorphosed juveniles drop off the host and begin a free living existence on the stream bottom.

The following habitat requirements of the sheepnose are summarized from Oesch (1984) and Parmalee and Bogan (1998). The sheepnose is primarily a larger stream species, usually occurring in shallow shoal habitats with moderate to swift currents over coarse sand and gravel. Habitats also may have mud, cobble, and boulders, and it may occur in deep runs.

Historical and current distribution information on the sheepnose is summarized from Butler (2003). The sheepnose historically occurred throughout much of the Mississippi River system with the exception of the upper Missouri River system and most lowland tributaries in the lower Mississippi River system. This species is known from the Mississippi, Ohio, Cumberland, Tennessee River main stems, and scores of tributary streams rangewide. It historically occurred in at least 77 streams in 15 states. The current distribution includes 26 streams in 14 states. The sheepnose has been eliminated from about two-thirds of the total number of streams from which it was historically known (26 streams currently compared to 77 streams historically), and has been eliminated from long reaches in streams in which it currently occurs. The sheepnose was historically known from 28 streams in the Ohio River system. Currently, only 11 streams are thought to have extant populations. The sheepnose was historically documented from the entire length of the Ohio River. The sheepnose has been recently recorded from the main stem Ohio River downstream of Paducah, and in several locations in the Tennessee River downstream of Kentucky Dam.



## **Population dynamics**

### Population size - fat pocketbook

Little is known on the population dynamics of the fat pocketbook; however, relatively dense populations do occur in portions of the St. Francis River drainage in Arkansas and Missouri, and sporadically elsewhere, but extensive surveys have not been conducted. Surveys conducted within the last 5-10 years in the lower Ohio River that have recorded this species, are usually targeted at specific projects (e.g., fleeting areas, loading/unloading facilities, Corps dredging needs, and sand and gravel dredging operations), or records have been obtained from commercial mussel fishermen working that portion of the lower Ohio River near Paducah, Kentucky, and Metropolis, Illinois. Based on these more recent records, it appears the fat pocketbook may be somewhat more common than previously believed in this reach of river, but no quantitative assessment is available. Many of these records are of young individuals (i.e., <5 years), so it is apparent the species has been able to successfully recruit in recent years.

### Population size - pink mucket

Despite its wide range in historical times, the pink mucket has apparently always been an uncommon species (Ortmann 1919, Johnson 1980, USFWS 1985b). Most literature records report very low population numbers. In addition, only 11 of 232 Ohio State University Museum of Zoology (OSUM) pink mucket records rangewide, over several decades, contained more than 10 specimens. All 11 of these OSUM lots represented collections made ca. 1980 from commercial sheller's cull piles in lower Tennessee and middle Cumberland Rivers, meaning the records represented protracted spatial and temporal collections from harvesting along several mile river reaches over extended collecting periods (L.M. Koch 2009).

Pink muckets collected during surveys tend to be large, old adult animals. Smaller juveniles or subadults are rarely if ever found in the vast majority of populations, despite recent quantitative quadrat sampling in several streams. If the species' rate of recruitment is characteristically very low (which there is no empirical data to support), this would at least partially explain the typical lack of evidence for recruitment that most populations exhibit. It is entirely possible that many of the populations now considered extant have recruitment rates that are below population maintenance levels if they don't suffer from outright recruitment failure. Below population maintenance levels indicate that a population is below the threshold of sustainability and that the population is in decline. Unless this downward population trend is arrested or reversed, the ultimate result will be extirpation. Considering the advanced age the pink mucket attains (36+ years), non-recruiting populations may take decades to become extirpated. Therefore, it may not be known whether most populations are viable or not for many years to come (Bob Butler 2010).

The tendency of pink muckets to inhabit larger streams and oftentimes deeper water habitats may partially account for apparent rareness, since most collectors historically were unable to sample these habitats effectively. But recruitment rates may play a significant role in dictating relative population size. Current pink mucket recruitment rates would appear to be very low given the scant evidence we have for the presence of juveniles in many populations and despite considerable effort expended conducting quantitative sampling. Considering the species

longevity and the fact that it has always appeared to be an uncommon species, it is possible that recruitment rates are naturally low for pink mucket. If true, having a low rate of recruitment would make populations inherently more susceptible to extirpation when factors act in concert to further compromise the already low recruitment level (Bob Butler 2010).

A contributing factor to the pink mucket being a rare species, is the fact that its inhabited range is a fraction of what it was historically (over a 100 years ago), having lost several thousand miles of large river habitat to habitat degradation. Considering the huge loss of range, it is likely the current total population size of pink mucket represents a small proportion of its historical numbers. Unfortunately, very little quantifiable information is available for estimating population size for this species either historically or currently (Bob Butler 2010).

#### Population size - orangefoot pimpleback

Historical records for the orangefoot pimpleback indicate this species is strictly an Ohioan or Interior Basin species (i.e., Ohio, Cumberland and Tennessee river drainages) (Ortmann, 1919). Populations of the orangefoot pimpleback continue to occur in the lower Ohio River and in the Tennessee River, while the best remaining population of the species occurs in the lower, free-flowing reach of the Ohio River, and in the riverine portion of Kentucky Lake downstream of Pickwick Landing Dam in Tennessee.

Hubbs (2010b) recently collected two individuals from the Pickwick Landing Dam tailwater that were approximately seven years in age, demonstrating recruitment in this Tennessee River population of the orangefoot pimpleback. It is not known if any genetic interchange is occurring between the two populations in the Ohio and Tennessee Rivers. The Cumberland River does not currently contain a known viable population of the species, but individuals may still exist there in low numbers (Widlak 2010).

No new populations of orangefoot pimpleback have been discovered and populations have not yet been reestablished in historic habitat. The lower French Broad River and lower Holston River have, however, been recently designated for establishment of nonessential experimental populations of the species. When the orangefoot pimpleback is collected during surveys, older, often eroded, adult specimens of this species are sampled (Widlak 2010).

#### Population size – sheepsnose

The information below is summarized from the status review of this species by Butler (2003). The sheepsnose, although widespread in many Mississippi River system streams was rarely very common. Archaeological evidence on relative abundance indicates that it has been an uncommon or even rare species in many streams for centuries. Museum collections of this species, with few exceptions, are almost always small. Fair numbers were recorded historically from the upper Muskingum River system in Ohio, and the lower Wabash River. Cummings and Mayer (1992) considered it 'rare throughout its range'. The sheepsnose has experienced a significant reduction in range and most of its populations are disjunct, isolated, and appear to be declining rangewide. The extirpation of the sheepsnose from over 50 streams within its historical range indicates substantial population losses have occurred. In the vast majority of streams with extant populations, it appears to be uncommon at best. Small population size and/or restricted



stream reaches of current occurrences are currently the norm. No new populations of sheepsnose have been discovered and populations have not yet been reestablished in historic habitat.

#### Population variability - fat pocketbook

Little is known on the population variability of the fat pocketbook; however, in recent years in the lower Ohio River, young individuals may comprise the majority of a population. Densities are often so low that only a few individuals of various age groups comprise the population.

#### Population variability - pink mucket

Little is known on the population variability of the pink mucket. Few individuals are observed during survey efforts, making it difficult to accurately assess populations. Densities are often so low that only a few individuals may comprise a population.

#### Population variability - orangefoot pimpleback

This species is considered extremely rare wherever it is found. Little is known on the population variability of the orangefoot pimpleback. Few individuals are observed during survey efforts, making it difficult to accurately assess populations. In the Tennessee River, the Pickwick Landing Dam tailwater supports the only known population in which recent recruitment has been observed. The Tennessee Wildlife Resources Agency collected a seven year old individual at TRM 170 in the vicinity of Swallow Bluff Island in 2009. Finding mussels of this early age indicates that some level of recruitment is occurring in this reach of the Tennessee River (Don Hubbs 2010a). During a June 17-21, 2008 pre-project survey at TRM 160.7, one orangefoot pimpleback was collected and comprised <0.001 percent of the total species composition (11,090 native mussels, representing 17 species) (Shaw 2010).

#### Population variability - sheepsnose

This species is considered extremely rare wherever it is found. Little is known on the population variability of the sheepsnose. Few individuals are observed during survey efforts, making it difficult to accurately assess populations

#### Population stability - fat pocketbook

The stability of fat pocketbook populations is not well known; however, there have been examples of this species recolonizing areas that have been dredged in ditches in Arkansas. In most locations, the presence of fat pocketbooks is evident from occasional individuals or a few individuals recorded. In the Ohio River, the low numbers typically encountered during mussel surveys, is of little value other than indicating the species may be existing in a certain area over a relatively long period of time.

#### Population stability – pink mucket

The stability of pink mucket populations is not well known. In most locations where this species appears to be present, the presence of pink muckets is evident from occasional individuals or only a few individuals recorded. In the Ohio River, the low numbers typically encountered during mussel surveys, is of little value other than indicating the species may be existing in a certain area over a relatively long period of time.

#### Population stability – orangefoot pimpleback

The stability of orangefoot pimpleback populations is not well known. In most locations where this species appears to be present, the presence of orangefoot pimplebacks is evident from occasional individuals or only a few individuals recorded. In the Ohio River, the low numbers typically encountered during mussel surveys, is of little value other than indicating the species may be existing in a certain area over a relatively long period of time.

#### Population stability – sheepnose

The stability of sheepnose populations is not well known. In most locations where this species appears to be present, the presence of sheepnose is evident from occasional individuals or only a few individuals recorded. In the lower Ohio River and lower Tennessee River downstream of Kentucky Dam, the low numbers typically encountered during mussel surveys is of little value other than indicating the species may exist in a certain area over a relatively long period of time.

### **Status and distribution**

#### Reasons for listing - fat pocketbook

The primary causes for the decline of the fat pocketbook in its historic range are from navigation (e.g., maintenance dredging) and flood control activities on the rivers where it was once found (USFWS 1989). Channel dredging is a direct impact that physically removes fat pocketbooks from their habitat. Dredging activities can affect aquatic systems both physically (e.g., accelerated erosion, decreased habitat diversity, increased bedload, and increased habitat instability) and biologically (e.g., altered behavior of host fish from changing flow patterns, decreased biomass, and altered species composition and abundance) (USEPA 2007). Construction of impoundments for flood control in the river basins in which fat pocketbook had been collected has caused a loss of fat pocketbook habitat from inundation, changes in flow distributions, and sedimentation. Reductions in water quality (metals, pesticides, and other pollutants) from point sources discharges also have likely affected mussel populations. However, with the implementation of the U.S. Environmental Protection Agency's National Pollutant Discharge Elimination System in 1972, industrial discharges have been regulated, and point source pollutants have significantly declined in the large river systems, in which the fat pocketbook is reported. Non-point source pollution (stormwater runoff that includes complex mixtures of pesticides, fecal coliform bacteria, metals, suspended solids, and pharmaceuticals) may also have had a negative impact on mussel populations downstream of agricultural and urban areas, although the possible effects have not been adequately researched. Other causative factors in the decline of the fat pocketbook include competition of food and habitat resources with the invasive zebra mussel (*Dreissena polymorpha*) in some portions of their range (NPS 2006, Hunter et al. 1996, Scholesser et al. 1996). Zebra mussels were found to be a contributing factor in the decline of unionids located downstream of the Belleville Locks and Dam (EA 2005).

#### Reasons for listing – pink mucket

The recovery plan for the pink mucket provides reasons for listing this species including: impoundments, siltation, and pollution (USFWS 1985b). Impoundments alter flow, temperature regimes, and water quality and habitat conditions creating conditions unsuitable for riverine



mussels and/or their host fish. Siltation can increase turbidity which irritates or clogs the gills of mussels and can even physically smother the animal. Mussel life cycles can be affected indirectly from siltation by impacting host fish populations (e.g., smothering fish eggs or larvae, reducing food availability, etc.). Various forms of pollution from municipal, agricultural, and industrial sources can impact mussels in a variety of ways. Currently, the vast majority of the pink mucket's historical range has been altered and no longer offers suitable habitat (approximately an 80% loss). Despite the relatively large number of extant populations for a federally listed mussel, the total population size for pink mucket, although undetermined, appears to be relatively small based on significant loss of total range, infrequent occurrence in otherwise suitable habitat, very low relative abundance compared to other mussels, and overall rarity of the species). With few exceptions, its 29 extant populations are: 1) invariably small (rarely are more than one or two individuals found per sample and a third of its populations are known from only one or two animals collected over the past 25 years), 2) characteristically rare (having low relative abundance), 3) sporadically or occasionally distributed (despite the extent of seemingly suitable habitat it is very patchy in distribution and occurrence), 4) generally limited in linear extent (most less than 30 RMs), and typically lacking evidence for recent recruitment (despite considerable quantitative sampling efforts). With many disjunct populations and its overall scarcity, the species is highly susceptible to localized extirpations from the genetic implications of extremely low population size and because of threats that are extremely difficult if not impossible to control. Stochastic events are a real concern for all populations, particularly reach-limited ones and those associated with navigation channels and other major transportation arteries (Bob Butler 2010).

#### Reasons for listing - orangefoot pimpleback

The recovery plan for the orangefoot pimpleback provides reasons for listing this species including: impoundments, siltation, and pollution. Impoundments alter flow, temperature regimes, and water quality and habitat conditions creating conditions unsuitable for riverine mussels and/or their host fish. Siltation can increase turbidity which irritates or clogs the gills of mussels and can even physically smother the animal. Mussel life cycles can be affected indirectly from siltation by impacting host fish populations (e.g., smothering fish eggs or larvae, reducing food availability, etc.). Various forms of pollution from municipal, agricultural, and industrial sources can impact mussels in a variety of ways. The orangefoot pimpleback is an extremely rare mussel. Generally, only one or two individuals are collected, if any, in suitable habitat supporting an abundance of other mussel species. Historically, it had a relatively restricted distribution in that the species was only reported from the Ohio, Tennessee and Cumberland rivers and their larger tributary streams (USFWS 1984). Alteration and destruction of habitat, due to creation of impoundments for flood control, navigation, hydroelectric power production and recreation, and activities resulting in siltation which affected substrate quality (e.g., navigation traffic, sand and gravel mining), led to the listing of the orangefoot pimpleback; these impacts continue to affect the species' habitat (USFWS 1984; James Widlak 2010). The orangefoot pimpleback is not a species that is collected for commercial purposes; however, commercial mussel harvest may have contributed to some decline in populations due to the species being unintentionally collected along with commercially valuable species. However, these impacts are believed to be minor in regards to declining population levels (Widlak 2010).



#### Reasons for listing – sheepsnose

The following summary is primarily from Butler (2003). The sheepsnose has experienced a significant reduction in range and most of its populations are disjunct, isolated, and appear to be declining rangewide. The extirpation of the sheepsnose from over 50 streams within its historical range indicates substantial population losses have occurred. The decline of the sheepsnose is primarily the result of habitat loss and degradation from impoundments, sedimentation, and pollution. Chief among the causes of decline are impoundments, channelization, chemical contaminants, mining, and sedimentation. Impoundments result in the modification of riffle and shoal habitats and the resulting loss of mussel resources, especially in larger rivers. Dams interrupt most of a river's ecological processes by modifying flood pulses; controlling impounded water elevations; altering water flow, sediments, nutrients, and energy inputs and outputs; increasing depth; decreasing habitat heterogeneity; decreasing stability due to subsequent sedimentation; blocking host fish passage; and isolating mussel populations from fish hosts. Even small low-head dams can have some of these effects on mussels. In addition, dams can alter downstream water quality and habitat. Population losses due to impoundments have probably contributed more to the decline and imperilment of the sheepsnose than any other single factor. Channelization and dredging activities have also altered riverine habitats nationwide. Gravel mining activities may be a localized threat in some streams with extant sheepsnose populations. Chemical contaminants contained in point and non-point discharges can degrade water and substrate quality impacting mussel populations and may be most profound on juvenile mussels. Various forms of pollution from municipal, agricultural, and industrial sources can impact mussels in a variety of ways. Siltation can increase turbidity which irritates or clogs the gills of mussels and can even physically smother the animal. Mussel life cycles can be affected indirectly from siltation by impacting host fish populations (e.g., smothering fish eggs or larvae, reducing food availability, etc.). Currently, the vast majority of the historical range of the sheepsnose has been altered and no longer offers suitable habitat. With few exceptions, extant populations are: 1) invariably small (rarely are more than one or two individuals found per sample), 2) characteristically rare (having low relative abundance), 3) sporadically or occasionally distributed (despite the extent of seemingly suitable habitat it is very patchy in distribution and occurrence), and 4) generally limited in linear extent, and typically lacking evidence for recent recruitment. With many disjunct populations and its overall scarcity, the species is highly susceptible to localized extirpations from the genetic implications of extremely low population size and because of threats that are extremely difficult if not impossible to control. Stochastic events are a real concern for all populations, particularly reach-limited populations and those associated with navigation channels and other major transportation arteries. Other threats include exotic species, such as Asian clams, zebra mussels, and Asian carp.

#### Rangewide trend – fat pocketbook

Although the fat pocketbook was historically widespread within much of its original range, populations of this species and its range have declined in the last 50 years. The main reason for decline of the species is channelization, impoundment and dredging of rivers, but contributing factors include siltation and pollution, and possibly range reductions of fish hosts (USFWS 1989, 1997). More recently, infestations of the exotic invasive zebra mussel are contributing to the decline of all native Unionid mussels (Layzer et. al. 1996, Ricciardi et. al. 1998). Because of the severe reduction in range of the species, the fat pocketbook was listed as an endangered species



on June 14, 1976. No estimate of the total population was included in the 1985 recovery plan (USFWS 1985a).

The historic range of the species includes the upper Mississippi River above St. Louis; the Ohio River; the Wabash and White Rivers in Indiana; the St. Francis, White, and Black Rivers in Arkansas; the Spoon and Illinois Rivers in Illinois; the Des Moines and Iowa Rivers in Iowa; the Cumberland River in Kentucky; and the Neosho River in Kansas. It was also reported in the Des Moines River (Missouri) and the Illinois River. Since 1970, it has been collected from the St. Francis River and Right Hand Chute Little River and drainage ditches associated with these streams in Arkansas and Missouri, the lower Wabash and White Rivers in Indiana, the lower Ohio River, lower Tennessee River and lower Cumberland River in Kentucky, and the upper Mississippi River. Live and fresh-dead fat pocketbook specimens have been found at various locations in the Mississippi River from the mouth of the St. Francis (MRM 669), above Helena, Arkansas, downstream to just below Vicksburg, Mississippi (MRM 427). Additionally, they have been found in abandoned channels within batture lands as far south as Natchez, Mississippi (MRM 385), however, there have been no main channel searches for the species below MRM 427 (Paul Hartfield, 2008). The species is present in low densities at appropriate sites in at least 300 miles of the Lower Mississippi River between Natchez, Mississippi, and Memphis, Tennessee (Paul Hartfield, 2008). A single fat pocketbook was collected in 2003 from the White River in Arkansas near river mile 11, the first collection in that river since the 1960's (Harris and Christian 2003). The largest viable population currently exists in the St. Francis River system (Arkansas); however, other viable populations likely exist in the Wabash, Ohio, or Cumberland Rivers (USFWS 1989, 1997). In 1987, during a survey of the unionid fauna of the Wabash River drainage, nine live fat pocketbooks were found in the lower part of the river. Subsequent surveys of the Wabash River detected populations of various sizes at sample sites from the confluence with the Ohio River upstream to Knox County, Indiana (Cummings et al. 1990). Based on the results of these surveys, the population of fat pocketbooks in the lower Wabash River appears to be viable and large relative to other sympatric mussels. Fresh dead specimens (e.g., surveyors collected shells from mussels that had recently died) have been found occasionally in the lower Ohio River (e.g., Ohio River miles 848 and 938) since the late 1980s. The fat pocketbook is currently known to occur in several locations in the lower Ohio River from J.T. Myers Lock and Dam (ORM 846) downstream to the mouth of the Ohio River (ORM 981), a reach of approximately 135 miles. However, in 2008 the fat pocketbook was recorded from the Ohio River near the mouth of the Green River, approximately 65 upstream of the J.T. Myers Lock and Dam. This 2008 record at Ohio River Mile 784 indicates the fat pocketbook also occurs in the J.T. Myers pool. It is not known to what extent this species is distributed in the J.T. Myers pool.

#### Rangewide trend – pink mucket

The pink mucket is an Ohioan species with possibly the widest range known for a listed mussel. It is a rare larger-stream mussel that was widely distributed historically in at least 48 large rivers in 12 states. Presently, known populations occur in the Barren River, Big River, Black River, Clinch River, Cumberland River, Current River, Gasconade River, Green River, Kanawha River, Little Black River, Meramec River, Ohio River, Osage River, Paint Rock River, and Tennessee River (USFWS 1985; Parmalee and Bogan 1998). Of these extant populations, only a few have shown recent evidence of recruitment. Some taxonomists have recently postulated that the reproducing populations west of the Mississippi River are not *Lampsilis abrupta*, but rather are



more closely related to another endangered species, the Higgins eye pearly mussel (*Lampsilis higginsii*). If this is true, then there are fewer known reproducing populations of *L. abrupta* than originally thought. Although it has a relatively wide distribution and is apparently more tolerant of reservoir-type habitat conditions than other listed mussel species, the pink mucket is reported to occur in low numbers where it occurs.

Currently, 29 populations are considered extant. With few exceptions, the 29 extant populations are extremely small and occur in relatively short river reaches despite the extent of seemingly suitable habitat in many streams. Further, over one-third of its populations deemed extant are very sporadic in occurrence and known from only one or two individuals collected over approximately the past 25 years (e.g., Licking, French Broad, Clinch, Paint Rock, Sac, Bourbeuse, St. Francis, Current, Eleven Point Rivers; Bear Creek). A majority of populations are essentially limited to discrete reaches making the species in these streams highly susceptible to elimination from catastrophic stochastic events (Bob Butler 2010).

#### Rangewide trend – orangefoot pimpleback

The orangefoot pimpleback was historically known from the Ohio River (from western Pennsylvania to southern Indiana), the Wabash River (below Mt. Carmel, Illinois), the Cumberland River (from Cumberland County, Kentucky to near Nashville, Tennessee), the lower Clinch River (Anderson County, Tennessee) and the Tennessee River (near Knoxville to Benton County, Tennessee) and has also been reported from the Caney Fork, Holston, and French Broad Rivers in Tennessee, and the Green and Rough Rivers in Kentucky (NatureServe 2003). The largest known populations remain in the lower, free-flowing reach of the Ohio River downriver from the confluence of the Tennessee River at Paducah, and a short reach of the Tennessee River below Pickwick Landing Dam (USFWS 1984, Miller et al. 1986). The Cumberland River may continue to support individuals of the species, but none have been collected from that system in recent decades. The Service (Code of Federal Regulations 2007) is currently planning future releases of the orangefoot pimpleback into the lower French Broad and lower Holston Rivers Experimental Population Area, under a Nonessential Experimental Population designation to further the recovery and conservation of the species.

Live orangefoot pimplebacks have recently been recovered from commercial mussel harvesters in the vicinity of the lower Ohio River near Lock and Dam 52. Several of these individuals are currently being held by the KDFWR to be used for propagation and reintroduction purposes in the near future. Surveys of mussel beds in the lower Ohio River from July through October 2007 yielded 24 orangefoot pimplebacks (Widlak 2010). The TWRA collected a seven year old individual at TRM 170 in the vicinity of Swallow Bluff Island in 2009 and have collected several seven and eight year old orangefoot pimpleback mussels in the Pickwick Landing Dam tailwater in recent years, indicating that some level of recruitment is occurring in this reach of the Tennessee River. The orangefoot pimpleback also continues to be found in the lower Tennessee River downstream of Kentucky Dam, but no recruitment of the species has been recently noted in Kentucky waters (Lewis 2008). This individual, 3.1 inches in length, was discovered on June 18, 2008 during a pre-project survey of the proposed project area.



#### Rangewide trend – sheepnose

The sheepnose has experienced a significant reduction in range and most of its population are disjunct, isolated, and appear to be declining rangewide. It is extirpated from over 50 streams in its historical range. In the majority of streams with extant populations, the sheepnose appears to be uncommon at best. Several extant populations are thought to exhibit some level of population viability; however, given its current distribution, abundance, and trend information, the sheepnose appears to exhibit a high level of imperilment.

#### New threats

The zebra mussel, an exotic species that colonizes the shells of native mussels, is a relatively new threat to mussels including the fat pocketbook, pink mucket, orangefoot pimpleback, and sheepnose. It is present in the Ohio River and has been observed attached to native mussels, including these three species, and can restrict the ability of a mussel to move, feed, respire, and reproduce, especially if large numbers are present on the shell of the native mussel.

An additional new potential threat to both the rabbitsfoot and sheepnose is a molluscivore (mollusk predator) fish, the black carp, *Mylopharyngodon piceus*. It has recently been recorded in the Mississippi River near the mouth of the Ohio River.

#### **Analysis of the species/critical habitat likely to be affected**

The fat pocketbook, pink mucket, orangefoot pimpleback, and sheepnose mussels are federally listed species likely to be adversely affected in the action area of this project. No critical habitat has been designated for these mussel species; therefore, none will be affected.

### **ENVIRONMENTAL BASELINE**

#### **Status of the species within the action area**

A reconnaissance mussel survey was performed during August 5 – 8, 2008 in two portions of the river from near Ohio River Mile (ORM) 935.7 (Burnett Street Boat Ramp) and 934.7 (Schultz Park Expansion).

#### Fat pocketbook

The reconnaissance survey recorded a total of 21 live fat pocketbook mussels, six from the Burnett Street Boat Ramp area and 15 from the Schultz Park Expansion area. This species has also been recorded from other survey efforts within two to three miles both upstream and downstream of the action area. In the Ohio River, fat pocketbooks are known to occur primarily from the mouth of the Wabash River (ORM 848) downstream to the mouth of the Ohio River (ORM 981), a reach of approximately 133 miles; however, recent mussel surveys have extended the known distribution of this species in the Ohio River approximately 64 miles upstream of the mouth of the Wabash River to ORM 784 (Chad Lewis, 2008, personal communication). Throughout this portion of the Ohio River, the fat pocketbook is not evenly distributed and is likely to be found only in sites containing suitable habitat conditions. It is not known how much

suitable fat pocketbook habitat exists in the lower Ohio River. Mussel surveys that have been conducted in recent years in this 135-mile reach of river occasionally record the fat pocketbook; however, these surveys do not give a complete assessment of the available habitat or the status of the species. Surveys conducted within the last 5-10 years that have recorded this species are usually targeted at specific projects (e.g., fleeting areas, loading/unloading facilities, Corps dredging needs, and sand and gravel dredging operations), or records have been obtained from commercial mussel fishermen working that portion of the lower Ohio River near Paducah, Kentucky, and Metropolis, Illinois. Considering the widespread distribution of fat pocketbooks in the Mississippi River and certain tributaries to the Mississippi River, the Ohio River distribution is in itself a small subset of the overall range of this species.

#### Pink mucket

A reconnaissance mussel survey, such as was performed for the project, is not specifically intended or designed to detect extremely rare mussels such as the pink mucket, but it will usually provide sufficient information on the overall mussel assemblage and habitat that a determination can be made as to the likelihood such rare species could occur at the survey site. The reconnaissance mussel survey did not record any pink muckets; however, it is likely that the pink mucket occurs in the action area. The pink mucket has been recorded in the Ohio River within two to three miles of the action area, the mussel species assemblage in the action area is one in which the pink mucket is often associated, and portions of the action area contain suitable habitat.

#### Orangefoot pimpleback

A reconnaissance mussel survey, such as was performed for the project, is not specifically intended or designed to detect extremely rare mussels such as the orangefoot pimpleback, but it will usually provide sufficient information on the overall mussel assemblage and habitat that a determination can be made as to the likelihood such rare species could occur at the survey site. The reconnaissance mussel survey did not record any orangefoot pimpleback mussels; however, it is likely that this species occurs in the action area. The orangefoot pimpleback has been recorded in the Ohio River within two to three miles of the action area, the mussel species assemblage in the action area is one in which this species is often associated, and portions of the action area contain suitable habitat.

#### Sheepnose

A reconnaissance mussel survey, such as was performed for the project, is not specifically intended or designed to detect extremely rare mussels such as the sheepnose, but it will usually provide sufficient information on the overall mussel assemblage and habitat that a determination can be made as to the likelihood such rare species could occur at the survey site. The reconnaissance mussel survey did not record any sheepnose mussels; however, it is likely that this species occurs in the action area. The sheepnose has been recorded in the Ohio River downstream of the project site and occurs in the Tennessee River upstream of the project site within the action area as defined in this conference opinion.



## **Factors affecting species environment within the action area**

The habitat conditions within the action area consist primarily of sand, soft silt over sand, and small areas of gravel and/ or clay. Other factors possibly affecting the species environment in the action area include runoff from agriculture activities which can increase turbidity and add sediment, including possible contaminants from urban runoff, dams which can affect host fish movement and habitat conditions, sewer outfalls, and industrial complexes located upstream in the Ohio, Cumberland, and Tennessee Rivers. Barge traffic will continue to operate in the river channel riverward of the project footprint; however, barge groundings or 'parking' on the shoreline is expected to cease once the project is constructed.

## **Previous Incidental Take Authorizations**

### Fat pocketbook

Sixteen prior formal consultations involving the fat pocketbook have involved the United States Army Corps of Engineers (USACE), Federal Highway Administration (FHWA) and United States Forest Service (USFS). However, the formal consultation with the USFS did not authorize any incidental take of fat pocketbooks. Of the fifteen biological opinions issued by the Service authorizing incidental take of fat pocketbooks, ten were issued to the USACE primarily for maintenance dredging activities, barge fleeting/loading/unloading facilities, for bank stabilization, levee setback and bridge construction activities. Five biological opinions authorizing incidental take were issued to the FHWA for bridge replacement and construction and for scour repair. These biological opinions were issued between 1999 and 2010. A summary of these formal consultations is discussed below and provided in Appendix A.

The fifteen incidental take statements have authorized the loss of about 1,148 individuals, an indeterminate number of small individuals, the relocation of more than 3,257 individuals, and the placement of nine gravid female fat pocketbooks into a propagation facility. Eight of the biological opinions authorized take of fat pocketbook from relocation. The largest relocation authorized by these biological opinions allowed the relocation of up to 3,000 individuals prior to the start of maintenance activities on Stateline Outlet Ditch in Arkansas. The actual relocation was performed in 2002 and involved the relocation of 2,042 fat pocketbooks. Results from a 2005 post-relocation survey of this reach found the area re-populated with fat pocketbooks and at densities higher than those found during the pre-impact survey.

Service programmatic biological opinions in Regions 3 and 4 regarding section 10(a)(1)(A) permits for mussel species, including fat pocketbook, anticipate the incidental take of five individuals per year, per permit. There have been two reports of incidental take in the form of injury or death reported by two permittees in Kentucky in recent years; both were for less than five individuals.

The amount of actual take of fat pocketbook associated with these biological opinions is difficult to determine for several reasons:

1. Young mussels are small and may be difficult to detect.

2. Quantitative assessments of the number of mussels in a dredge pile are time-consuming and costly and are, therefore, not routinely recommended.
3. Mussels are long-lived and have a complex life-cycle making assessment of indirect effects difficult (e.g. effects of water quality changes, long-term relocation effects, impacts to host species, etc.).

Despite the inherent difficulties associated with assessing the actual amount of take associated with projects impacting mussels and the uncertainties associated with the long-term impacts, the fat pocketbook appears to be doing well range-wide and within impacted reaches such as Arkansas' Stateline Outlet Ditch. This coupled with the recent discoveries of previously undocumented populations of fat pocketbook and the Service's internal analysis, the Service concludes that the aggregate effects of the activities and incidental take covered in previous biological opinions on the fat pocketbook have not degraded the overall conservation status (i.e., environmental baseline) of the fat pocketbook.

#### Pink mucket

Thirty-six prior formal consultations involving the pink mucket have involved the United States Army Corps of Engineers (USACE), Federal Highway Administration (FHWA), Federal Energy Regulatory Commission (FERC), U. S. Fish and Wildlife Service (USFWS), Tennessee Valley Authority (TVA), Nuclear Regulatory Commission (NRC), and Natural Resources Conservation Service (NRCS). A summary of these formal consultations is discussed below and provided in Appendix B.

The incidental take statements from the above mentioned consultations have authorized the loss of about 44.5 acres of habitat, 255 individuals, an indeterminate number of individuals from several consultations indicating all individuals will be taken within a project area, and the relocation of five individuals. The amount of actual take of pink muckets associated with these biological opinions is difficult to determine for several reasons:

1. Young mussels are small and may be difficult to detect.
2. Quantitative assessments of the number of mussels taken were not always given.
3. Mussels are long-lived and have a complex life-cycle making assessment of indirect effects difficult (e.g. effects of water quality changes, long-term relocation effects, impacts to host species, etc.).

Despite the inherent difficulties associated with assessing the actual amount of take associated with projects impacting mussels and the uncertainties associated with the long-term impacts, the pink mucket appears to be persisting range-wide. The Service concludes that the aggregate effects of the activities and incidental take covered in previous biological opinions on the pink mucket have not degraded the overall conservation status (i.e., environmental baseline) of the pink mucket.

#### Orangefoot pimpleback

Twenty prior formal consultations involving the orangefoot pimpleback have involved the United States Army Corps of Engineers (USACE), Federal Highway Administration (FHWA),



U. S. Fish and Wildlife Service (USFWS), and Tennessee Valley Authority (TVA). A summary of these formal consultations is discussed below and provided in Appendix C.

The incidental take statements from the above mentioned consultations have authorized the loss of about 14.5 acres of habitat, 76 individuals, and an indeterminate number of individuals from several consultations indicating an unknown number of individuals will be taken within a project area. The amount of actual take of orangefoot pimpleback mussels associated with these biological opinions is difficult to determine for several reasons:

1. Young mussels are small and may be difficult to detect.
2. Quantitative assessments of the number of mussels taken was not always given.
3. Mussels are long-lived and have a complex life-cycle making assessment of indirect effects difficult (e.g. effects of water quality changes, long-term relocation effects, impacts to host species, etc.).

Despite the inherent difficulties associated with assessing the actual amount of take associated with projects impacting mussels and the uncertainties associated with the long-term impacts, the orangefoot pimpleback mussel appears to be persisting in the lower Ohio River and selected portions of the Tennessee River in Kentucky and Tennessee. The Service concludes that the aggregate effects of the activities and incidental take covered in previous biological opinions on the orangefoot pimpleback have not degraded the overall conservation status (i.e., environmental baseline) of the orangefoot pimpleback.

#### Sheepnose

We are not aware of any incidental take authorizations for this species other than a Conference Opinion on the Paducah Riverfront Development Project, McCracken County, Kentucky and its effects on rabbitsfoot and sheepnose mussels, in a letter from the Service to Mr. John Ballantyne, U.S. Dept. of Transportation dated July 13 2011, that is on file at the Kentucky Ecological Services Field Office in Frankfort, Kentucky. In that Conference Opinion take was provided for 7.5 acres of habitat and 5 sheepnose mussels.

## EFFECTS OF THE ACTION

### Factors to be considered

This section includes an analysis of the direct and indirect effects of the proposed action on the species and/or critical habitat and its interrelated and interdependent activities. While analyzing direct and indirect effects of the proposed action, the Service considered the following factors:

- Proximity of the action – We describe known species locations and designated critical habitat in relation to the action area and proposed action;
- Distribution – We describe where the proposed action will occur and the likely impacts of the activities;
- Timing – We describe the likely effects in relation to sensitive periods of the species' lifecycle;
- Nature of the effects – We describe how the effects of the action may be manifested in elements of a species' lifecycle, population size or variability, or distribution, and how individual animals may be affected;
- Duration – We describe whether the effects are short-term, long-term, or permanent;
- Disturbance frequency – We describe how the proposed action will be implemented in terms of the number of events per unit of time;
- Disturbance intensity – We describe the effect of the disturbance on a population or species; and
- Disturbance severity – We describe how long we expect the adverse effects to persist and how long it would take a population to recover.

#### Proximity of the action:

The proposed action will occur upstream of Lock and Dam 52 on the Kentucky side of the river near approximately Ohio River Mile 934.7 to 935.8, extending from the Kentucky shore out to the navigation channel. The proposed action area is known to contain fat pocketbooks and likely to contain pink muckets, sheepsnose, and orangefoot pimplebacks. Fat pocketbooks are known to be present in the project footprint portion of this reach in which a mussel survey was conducted. The pink mucket, orangefoot pimpleback, and sheepsnose likely occur within the project footprint and/or larger action area, because of their close proximity to the site, the occurrence of suitable habitat, and the associated mussel assemblage present in the action area.

#### Distribution:

Direct impacts to the fat pocketbook, pink mucket, orangefoot pimpleback, and sheepsnose mussels and their habitats will most likely occur within the project footprint and in other portions of the action area downstream and riverward of the project footprint. It is expected that the greatest impacts will be from the new fill to provide the terrestrial area at the Schultz Park Expansion site. Other potential impacts will be from changes to the surrounding riverine habitat from flow changes due to the fill, the presence and operation of the marina, and boat traffic activity at and near the project sites.



### Timing:

The proposed action can be divided into essentially two periods, a construction phase and an operation phase. Depending on when the actual construction occurs, the construction may impact the fat pocketbook, pink mucket, sheepsnose, and orangefoot pimpleback mussels during sensitive periods of their life cycle.

The fat pocketbook and pink mucket are thought to become gravid in the late summer or fall and brood glochidia over the winter (long-term brooders), and then release them in the spring. Sensitive periods (late summer-fall) for adults include the release of sperm into the water column and, for females, the fertilization of eggs and brooding of larvae as they transform into glochidia. Another sensitive period for female mussels is the time of release of glochidia and their attachment onto the fish host (spring-early summer). Sensitive periods for the juveniles include their attachment to excystment from the fish host as they drop to the riverbed and establish themselves in the substrate (spring-early summer). All these sensitive periods of the fat pocketbook and pink mucket will certainly occur during the post-construction or operation period and into the foreseeable future. In addition, both the fat pocketbook and pink mucket may be impacted if fish host behavior and presence are affected by the construction and operation phases of the proposed action.

The orangefoot pimpleback and sheepsnose mussels are thought to become gravid during spring and/or summer, brood glochidia for a short period of time and release larvae in the late summer (short-term brooder). Sensitive periods in late spring-summer for adults, include the release of sperm into the water column and the fertilization of eggs and brooding of larvae. Another sensitive period for female mussels is the time of release of partially developed larvae or glochidia, and their attachment onto the fish host (summer). Sensitive periods for the juveniles include their attachment to the host fish and excystment from the host fish as they drop to the riverbed and establish themselves in the substrate (summer). All these sensitive periods of the orangefoot pimpleback will certainly occur during the post-construction or operation period and into the foreseeable future. In addition, the orangefoot pimpleback may be impacted if fish host behavior and presence are affected by the construction and operation phases of the proposed action. The fish host for the orangefoot pimpleback is not known.

### Nature of the effect:

It is likely that the proposed action will have a variety of effects on the fat pocketbook, pink mucket, orangefoot pimpleback, and sheepsnose mussels. Any of the periods of these species life cycle can potentially be disturbed or disrupted by construction and/or operation activities; however, the construction phase of fill deposition and concomitant flow changes will likely be the greatest effect. For instance, any listed mussels remaining within the filled peninsula area will be killed. The operation phase of this project is likely to result in the (a) direct and/or indirect mortality of individual adults and juveniles from boat activity, (b) dislodgement of adults and/or juveniles due to flow alterations and/or navigation activity, (c) reduction or other modification in the availability of fish hosts that is caused by degradation/alteration of habitat and that may harm and/or harass individuals through interference with respiration, feeding, and reproduction, and (d) creation of turbidity and/or deposition of sediment that may directly and/or indirectly affect adults and/or juveniles by harm and/or harassment. In addition, these species

may be impacted if fish host behavior and presence is negatively affected by flow alterations, turbidity, or changes in sediment deposition.

Duration:

During the construction phase, potential impacts to the fat pocketbook, pink mucket, orangefoot pimpleback, and sheepnose will be direct and indirect, and remain for the duration of the construction. The effects of the operation phase are indeterminable, but any effects will likely be of a long-term duration. It is possible that the post-construction or operational phase will also result in changes to flows and other habitat conditions; however, the effects of these changes will not be known until sufficient monitoring reveals the extent and magnitude of the changes. The loss of habitat within the filled peninsula area will be permanent.

Disturbance frequency:

The construction phase disturbance will only occur once, but will result in a following unknown period of change. Any disturbances to the fat pocketbook, pink mucket, orangefoot pimpleback, and sheepnose produced during the operation phase are expected to occur on a regular basis with on-going boating activity. These disturbances (i.e., flow changes, increased turbidity, movement of sediment, etc.) are expected to occur over an unknown period of time as new flow conditions alter the makeup of the river's flow characteristics, sediment removal, and/or sediment transport/deposition patterns.

Disturbance intensity:

The disturbance intensity will likely be dissimilar throughout the action area and is expected to occasionally create habitat conditions that are unfavorable for the fat pocketbook, pink mucket, orangefoot pimpleback, and sheepnose.

Disturbance severity:

The disturbance severity of the fill portion of the construction phase is expected to be severe and permanent. The post-construction or operation phase is expected to primarily impact fat pocketbooks, pink muckets, orangefoot pimplebacks, and sheepnose nearest the fill portion of the project, along the perimeter of the fill area, and in shallow water due to sedimentation. The recovery rate to these mussel species in this part of the action area is unknown. Taken as a whole, the overall disturbance severity is expected to be minor to the population of fat pocketbooks in the lower Ohio River and range-wide; minor to the pink mucket in the lower Ohio River and range-wide; and of unknown severity to the orangefoot pimpleback and sheepnose in the lower Ohio River and range-wide.

**Analyses for effects of the action**

Beneficial effects:

No wholly beneficial effects have been identified or are expected to occur. The proposed action is expected to result in adverse effects on the fat pocketbook, pink mucket, orangefoot pimpleback, and sheepnose populations within the Shultz Park Expansion action area.



Direct effects:

Direct effects of the proposed action on the fat pocketbook, pink mucket, orangefoot pimpleback, and sheepsnose include harassment, harm, and mortality from construction of the fill area, flow alterations resulting from the fill area, construction of the marina, and resultant boating activities within the Shultz Park Expansion action area. In the Shultz Park Expansion action area, a total of approximately 6.29 acres of mussel habitat will be directly impacted. This includes 3.49 acres of direct fill, 2.73 acres of potential sedimentation area, and 0.07 acres of anchor sites for the marina (Table 1). A portion of the project area at the Shultz Park Expansion area is known to be occupied by numerous mussel species including the fat pocketbook; and, it is likely the pink mucket, orangefoot pimpleback and sheepsnose occur also in this area. Table 1 shows the anticipated acreages affecting actual known mussel habitat based on mussel surveys conducted for this project. Table 1 also indicates that there are portions of the area of fill that will not likely impact federally listed mussels because no mussels are known to occur there.

It is estimated that a total of approximately 6.29 acres of habitat, 76 fat pocketbook, 2 pink mucket, 2 orangefoot pimpleback, and 2 sheepsnose mussels will be impacted by these activities.

Since the pink mucket, orangefoot pimpleback and sheepsnose mussel were not recorded in the survey at this site, the number of individuals provided above is considered, at best, an estimated number based on other mussel surveys conducted in the Tennessee River downstream of Kentucky Lock and Dam and in the lower Ohio River. Some of these surveys recorded the species, while others did not record these species (See section below titled: **Species' response to proposed action**).

Hydrodynamic processes were modeled for existing and proposed conditions by HCCL River Engineering (HCCL) to estimate the potential change in deposition and entrainment patterns of sediment particles as a result of the proposed Schultz Park Expansion landform. The *Hydrotechnical Considerations: Technical Brief*, prepared by HCCL, details the methodology and results of the model and is provided in the BA. The model was built using the original design for the Schultz Park Expansion which was located approximately 500 feet upstream of its currently proposed location. Due to the overall scale of the model/processes and the relatively minor changes to the overall park design, the results of the model are likely still applicable to the new location for the purposes of this biological opinion. Sediment transport potential (i.e., deposition and entrainment), presented as a mobility index, was estimated from bed shear values modeled over a range of river stage elevations for a range of sediment particle sizes. Mobility index values greater than 1.0 indicate potential particle entrainment whereas mobility index values of less than 1.0 indicate potential particle deposition. Because a wide range of hydrodynamic conditions were modeled, only the subset of results pertaining to potential mussel impacts was included in the BA. River stages and particle sizes considered relevant to potential effects on mussels encompass a typical annual hydrograph range (based on hydrograph data from 1990 to 2011) and particle sizes corresponding to suitable mussel habitat. These include river stages 304, 310, and 320 and for particle sizes of 0.1 millimeter (mm) (very fine sand), 1 mm (very coarse sand), 2 mm (very fine gravel), and 5 mm (fine gravel). Particle sizes greater than 5 mm, although representative of suitable mussel substrate, are not included in the results discussion because they were not mobile within the project area for existing or proposed conditions according to the model. A river stage of 304 feet is slightly greater than the normal

pool elevation of 302 feet whereas a river stage of 320 feet corresponds with an approximately 10% exceedance probability. The City of Paducah Action Stage is 318 feet and Flood Stage is 325 feet. It should be noted that river stage elevations and actual local reach conditions are complicated by the effects of the Smithland Lock and Dam, Lock and Dam 52 and the Kentucky Lake Dam controlling flows and water levels.

Other direct effects to the fat pocketbook, pink mucket, orangefoot pimpleback, and sheepsnose include, but are not limited to, habitat modifications such as changes in flow and dissolved oxygen concentrations due to increased turbidity, and sediment deposition which could bury mussels, especially juveniles, and cause injury and/or mortality. These effects could also restrict mussel respiration (e.g., suffocation due to inability to purge sediment from gills), limit feeding (e.g., starvation due to inability to eliminate sediment), and interfere with reproduction (e.g., abortion from stress, host fish absence during critical reproductive periods). Direct effects of mussel relocation include harm, harassment and possible mortality due to the stress of being handled, processed, and relocated. These effects can result in premature release of sperm or aborted glochidia negatively impacting reproductive success. A trained biologist that holds a collection permit from either the Service or the Kentucky Department of Fish and Wildlife Resources, and who will accomplish any relocation work, will minimize some of these effects. In summary, the following direct effects are anticipated:

1. Mortality that is the result of a constructed fill area in occupied habitat. This action could damage, bury or crush fat pocketbook, pink mucket, sheepsnose, and orangefoot pimpleback mussels.
2. Harm resulting from the constructed fill area, marina construction and operation, and boating activities in occupied habitat may result in mussel dislodgement, increased turbidity, flow alterations, sediment removal, sediment deposition, and decreased dissolved oxygen levels. This may affect the ability of these mussel species to respire, reproduce, and feed. Direct physical harm (e.g., damaged shell or bruised animal) could result in the death of mussels.
3. Harassment in the form of induced stress including, but not limited to, displacement of mussels during construction activities, potential degradation of remaining/adjacent habitat, and handling of mussels during relocation. This harassment could result in decreased ability of these species to respire, reproduce, and feed.

All of these direct effects can lead to reduced population levels for these mussel species in this portion of the Ohio River, which, in turn, can reduce their reproductive capacity.

Interrelated and interdependent actions:

Interdependent and interrelated activities occur because of, or associated with, the proposed project activities. These activities would include potential harm from substrate disturbance from propeller wash, bank erosion from wave action, spills/debris as a result of increased boating traffic, and sediment disturbance from launching and extracting boats from the river.



Due to the depth of the river (>3m) where these activities will take place and the relatively small watercraft that will be using the ramp, the effects of propeller wash are not likely to occur. If sediment disturbance were to occur, the suspended sediment would be deposited downstream and riverward of the boat ramp. Because the majority of mussels were located upstream and further from shore than the proposed boat ramp, any potential interdependent and interrelated effects from substrate disturbance are not likely to adversely affect the existing mussel assemblage.

Increased wave action on riverbanks and spills/debris at the proposed facilities could occur due to the anticipated increase in boating activity associated with the proposed boat ramp. While the anticipated wave action would likely cause riverbank erosion and sedimentation, riverbank stabilization measures are proposed to combat these effects. Mitigation measures to specifically address riverbank stabilization as approved in the 404/401 permits include 765 linear feet of riparian buffer restoration and preservation of the riparian restoration area through a permanent deed restriction. The proposed boat ramp property will be maintained and monitored by the City of Paducah. Maintenance activities will include regularly scheduled trash/debris cleanup, garbage collection, and general facility maintenance to prevent degradation of the property, facilities, and the Ohio River. Based on the proposed mitigation activities for riparian impacts and the anticipated maintenance and monitoring schedule for the proposed facilities, interrelated and interdependent effects from wave action and spills/debris are not likely to occur.

Indirect effects:

Indirect effects of this project on the fat pocketbook, pink mucket, orangefoot pimpleback, and sheepnose include changes in fish host behavior and/or presence that could impact the ability of glochidia to attach to the fish at the proper time when released from the female mussel, and changes in flow regimes and sediment transport in the action area. In summary, the following indirect effects are anticipated:

1. Mortality of adult and juvenile mussels that results from changes in the flow regime around the constructed fill area and marina, redistributing sediments that smother mussels due to new deposition, and/or that result in sediment loss creating instability and loss of habitat.
2. Harm in the form of decreased ability to respire, reproduce, and feed as a result of the redistribution of sediments resulting from changes in flow regimes and/or boating activities in occupied habitat. These activities may affect turbidity, flows, dissolved oxygen levels, and the presence of host fish during the future reproductive seasons of these mussel species.
3. Harassment in the form of induced stress including, but not limited to, potential degradation of habitat from changes in flow regimes, and handling of mussels during survey and monitoring activity. This harassment could result in the mussels decreased ability to respire, reproduce, and feed.

## **Species' response to a proposed action**

### Numbers of individuals/populations in the action area affected:

#### Fat pocketbook

Based on the mussel assemblage and habitat conditions recorded during the survey, it is likely fat pocketbooks occur in suitable habitat throughout the action area; however, they are not expected to be evenly distributed in the action area.

In the Burnett Street Boat Ramp portion of the action area we do not believe fat pocketbooks will be affected by the proposed action. In the Schultz Park Expansion portion of the action area, we estimate that about 76 fat pocketbook mussels are present. Fat pocketbook mussels occur in the densities of approximately 12 per acre within the Schultz Park Expansion portion footprint. The exact number of fat pocketbook mussels in the action area is unknown. However, the total number of fat pocketbooks estimated to occur in the Burnett Street Boat Ramp and Schultz Park Expansion portions of the action area is 76. This estimate was derived from the data collected in the mussel survey. We expect the proposed action to appreciably affect the overall fat pocketbook population in the Schultz Park Expansion portion of the action area, since 6.29 acres within the 13.55 acres of covered fill and sediment impacted area, is expected to be directly impacted. We expect the aforementioned indirect impacts to adversely affect a portion of the fat pocketbooks in the Schultz Park Expansion action area to an unknown extent; however, it is not possible to accurately determine (or quantify) the indirect effects to fat pocketbooks in this area.

#### Pink mucket, Orangefoot Pimpleback, and Sheepnose

Based on the mussel assemblage and habitat conditions recorded during the survey, it is likely the pink mucket, orangefoot pimpleback, and sheepnose occur in suitable habitat throughout the Burnett Street Boat Ramp and Schultz Park Expansion portions of the action area; however, they are not expected to be evenly distributed within this area. Since the mussel survey did not record any of these three species, the exact number of these mussels in this portion of the action area is currently unknown. We base our estimates below on other mussel surveys that have recently been performed in close proximity to this proposed action.

The total number of pink mucket, orangefoot pimpleback, and sheepnose estimated to occur in the Burnett Street Boat Ramp and Schultz Park Expansion portions of the action area is not possible to accurately determine. We do not expect the proposed action to affect these species in the Burnett Street Boat Ramp portion of the action area. We do expect the proposed action to affect the overall population of these three species in the Schultz Park Expansion portion of the action area. The covered fill area is estimated at 13.55 acres, of which 6.29 acres consists of likely mussel habitat where these three species may occur. We expect the aforementioned indirect impacts to adversely affect these three species in the Schultz Park Expansion portion of the action area to an unknown extent; however, it is not possible to accurately determine (or quantify) the indirect effects to these species in this area.



### Sensitivity to change:

The degree to which the fat pocketbook, pink mucket, orangefoot pimpleback, and sheepnose are prone to change when disturbed is unknown. These four species are thought to be relatively sedentary within the substrate. As a result, they are likely unable to respond to change by moving great distances; however, it is possible they could move several meters. When disturbed, mussels, in general, tend to close their valves for a period of time; however, this response will vary depending on the disturbance. Mussels exposed to disturbance events will likely close their valves when disturbed and remain closed if continued to be disturbed. They are not likely to move out of the area of disturbance on their own because of their inability to move great distances in a short period of time and because their valves will likely remain closed.

### Resilience:

Resilience relates to the characteristics of populations or a species that allow them to recover from different magnitudes of disturbance. Assuming that the flow characteristics and habitat conditions in the action area are not appreciably changed, the magnitude of disturbance is expected to be low and resilience is not expected to change from its current level. However, this can only be determined through monitoring of the population and habitat over time.

### Recovery rate:

In this biological opinion, the recovery rate relates to the time required for a fat pocketbook, pink mucket, orangefoot pimpleback, and sheepnose individual or population to return to equilibrium after exposure to a disturbance. Mussel populations are expected to continue to spawn and recruit new individuals into the population; however, the level of successful recruitment to the adult stage is unknown, especially in areas that may be subjected to repeated degradation (i.e., the shallow, near-shore areas). The recovery rate for these four mussel species is likely to vary within the action area.

## **CUMULATIVE EFFECTS**

Cumulative effects include the effects of future, State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Private actions in the vicinity of the action area are primarily urban and agriculture-related activities. We are reasonably certain these actions will continue and do not expect these activities to change appreciably in the future from current conditions. Effects from urban and agricultural activities on fat pocketbooks, pink muckets, orangefoot pimplebacks, and sheepnose could include increased sediment deposition, turbidity, and herbicide/pesticide levels in localized portions of the Ohio River. However, these effects, if they are occurring, are indeterminable. Private boating and commercial navigation activities also occur in the Ohio River and are

expected to continue, but they are not expected to result in additional adverse effects even though they could potentially result in increased turbidity, physical disruption of habitat, and spills of petroleum products. Essentially, we cannot predict that these specific types of adverse effects will occur.

We are not aware of any other State, tribal or local actions to include under Cumulative effects.

## **CONCLUSION**

After reviewing the current status of the fat pocketbook, pink mucket, orangefoot pimpleback, and sheepsnose, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is the Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of these species, and is not likely to destroy or adversely modify designated critical habitat. At this time no critical habitat has been designated for these species; therefore, none will be affected.

## **INCIDENTAL TAKE STATEMENT**

Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act prohibit the take of endangered or threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the FHWA, Corps, and Service, so that they become binding conditions of any grant, permits or contracts, as appropriate, for the exemption in section 7(o)(2) to apply. The FHWA, Corps, and Service have a continuing duty to regulate the activity covered by this Incidental Take Statement. If the FHWA, Corps, and/or Service (1) fails to assume and implement the terms and conditions or (2) fails to require the Permittee to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms that are added to the grant, permit or contract, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the FHWA, Corps, and Service must report the progress of the action and its impact on the species to the Service as specified in the Incidental Take Statement [50 CFR § 402.14 (1)(3)].



## **AMOUNT OF TAKE EXPECTED**

The Service expects that 6.29 acres of mussel habitat could be taken as a result of this proposed action. The 6.29 acres of habitat estimated to be taken includes 3.49 acres from direct fill, 2.73 acres of mussel habitat impacted by sedimentation, and 0.07 acres of habitat covered by marina anchors. Indirect impacts include marina construction and operation, potential long-term sedimentation, and habitat disturbance.

The Service expects that 76 fat pocketbook mussels, 2 pink mucket mussels, 2 orangefoot pimpleback mussels, and 2 sheepsnose will be taken as a result of this proposed action. The take provided for the pink mucket, orangefoot pimpleback, and sheepsnose is set low because these species were not recorded from the project footprint area; however, the Service believes it is likely that some or all of these species could occur in the project footprint area. If so, the take provided will likely account for any of these species taken due to this projects activity.

In the "Analyses for effects of the action" section above, the Service determined that the proposed action would result in incidental take through (a) direct mortality as a result of the Schultz Park expansion fill area and relocation of any fat pocketbook, pink mucket, sheepsnose, and orangefoot pimpleback mussels; (b) harm from construction activities that will likely result in (1) physical harm (i.e., cracked shell, bruising) to mussels that were not included in the relocation, (2) negative effects of sedimentation that could entomb, starve, and/or suffocate individuals, (3) loss and/or degradation of habitat, (4) relocation efforts, and (5) disruption of host fish availability at key times during the reproductive cycle; and (c) harassment as a result of disruption in reproductive capabilities by, but not limited to, the spontaneous abortion of glochidia during relocation and/or monitoring efforts, individuals being dislodged downriver into unsuitable habitat, and potentially low dissolved oxygen levels.

## **EFFECT OF THE TAKE**

In the accompanying biological opinion, the Service determined that this level of expected take is not likely to result in jeopardy to the species or adverse modification of critical habitat.

## **REASONABLE AND PRUDENT MEASURES**

The Service believes the following reasonable and prudent measure(s) are necessary and appropriate to minimize take of fat pocketbooks.

1. The FHWA, Corps, and Service must ensure that the proposed action will occur as designed, planned, and documented in the BA, all supporting information provided by the City of Paducah, and this biological opinion.
2. The FHWA, Corps, and Service must ensure that the City of Paducah has a plan to replace fat pocketbooks, pink muckets, sheepsnose, and orangefoot pimplebacks likely to be taken by the proposed action.

3. The FHWA, Corps, and Service must ensure that the City of Paducah implements measures to minimize or eliminate impacts of the Burnett Boat Ramp and Schultz Park Expansion sites to fat pocketbooks, pink muckets, sheepnose, and orangefoot pimplebacks.

## TERMS AND CONDITIONS

In order to be exempt from the prohibitions of Section 9 of the Act, the FHWA and City of Paducah must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. The FHWA, Corps, Service and/or City of Paducah must agree to implement the proposed action as described in the BA, including mussel conservation measures listed in this biological opinion that are referred to in the BA, the BA's supporting documentation, and this biological opinion (see "Mussel Conservation Measures" section above). **This Term and Condition supports RPM 1 and 3.**
2. The FHWA, Corps, Service and/or City of Paducah shall develop a Mussel Relocation Plan and obtain the Service's prior written approval of the plan, prior to relocating fat pocketbook, pink mucket, orangefoot pimpleback mussels, sheepnose, and other mussel species, before any new construction activity occurs at or below the ordinary high water level. This plan will include a mussel relocation effort from within an area approximately 6.29 acres in size at the Schultz Park Expansion action area. We estimate that about 4,000 mussels occur in this 6.29 acre area. Relocation emphasis will be in the 3.49 area of impact by fill. An estimated 2,200 mussels occur in the 3.49 acre area direct fill portion. An estimated 1,800 mussels occur in the 2.8 acres of indirect and anchor locations. It is not expected that all mussels in the entire area will likely be relocated; however, the Service believes that if approximately 50 percent of mussels in this area are relocated that will be an adequate level of relocation effort. This effort should be targeted at the four federally listed species addressed in this BO and other species that are similar in appearance to the federally listed species. This Mussel Relocation Plan will also include a baseline 'monitoring' component. Future monitoring efforts are addressed in Terms and Conditions #3 below. All federally listed mussels will be tagged and either relocated to a nearby area of suitable habitat that is protected from navigation and fleeting activity, as indicated in the Mussel Relocation Plan, or as directed by the Service, to the KDFWR to be used in propagation and culture activities at the KDFWR Center for Mollusk Conservation in Frankfort, Kentucky. **This Term and Condition supports RPM 1.**
3. The FHWA, Corps, Service and/or City of Paducah shall contribute **\$20,000** to the Kentucky Waterways Alliance (KWA) Kentucky Aquatic Resources Fund (KARF) to be used for monitoring at the Schultz Park Expansion area, and the site relocated mussels will be placed. Monitoring will be done two years and five years after the baseline



monitoring described in Terms and Condition #1 is completed. The total contribution of \$20,000 shall be made using certified funds and should be made out to – “Kentucky Waterways Alliance” – with KARF and any other appropriate details in the memo section. The contribution shall be mailed to: Attention: Judith Petersen, Executive Director, Kentucky Waterways Alliance, 120 Webster Street, Suite 217, Louisville, Kentucky 40206. The Kentucky Waterways Alliance’s office telephone number is 270-524-1774. Contact Ms. Petersen if the contribution will be made by direct deposit or a wire transfer. **This Term and Condition supports RPM 1.**

4. The FHWA, Corps, Service and/or City of Paducah shall contribute a total of **\$71,706** to the Kentucky Waterways Alliance (KWA) Kentucky Aquatic Resources Fund (KARF) following issuance of this biological opinion and prior to initiating any construction below the ordinary high water level. This contribution amount was derived using the 2009 agricultural land value of \$2,850 per acre with a ratio of 4:1 for impacts to a total of 6.29 acres. This contribution will provide mussel habitat impact minimization and includes both direct and indirect impact to habitat. These funds will be used for the preservation, creation, enhancement, and/or protection of federally listed mussel habitat in the lower Ohio River. The total contribution of **\$71,706** shall be made using certified funds and should be made out to – “Kentucky Waterways Alliance” – with KARF and any other appropriate details in the memo section. The contribution shall be mailed to: Attention: Judith Petersen, Executive Director, Kentucky Waterways Alliance, 120 Webster Street, Suite 217, Louisville, Kentucky 40206. The Kentucky Waterways Alliance’s office telephone number is 270-524-1774. Contact Ms. Petersen if the contribution will be made by direct deposit or a wire transfer. **This Term and Condition supports RPM 3.**
  
5. The FHWA, Corps, Service and/or City of Paducah shall contribute **\$37,000** to the Kentucky Waterways Alliance (KWA) Kentucky Aquatic Resources Fund (KARF) following issuance of this biological opinion and prior to any construction below the ordinary high water level. These funds will be used in recovery efforts for the four federally listed mussels addressed in this biological opinion, thereby minimizing the take expected to occur on this project. To derive the figure of \$37,000, we estimated an amount that could be applied towards an approximately three year effort to replace the mussels estimated to be taken. These funds will be used to collect adult mussels and fish hosts, care for adult mussels and fish, propagate and culture juvenile mussels, and to monitor recovery efforts. **Fat pocketbook:** For the 76 fat pocketbooks taken we estimate \$19,000. This funding will provide additional funding to an already ongoing project to propagate and culture this species. Some considerations for the fat pocketbook effort include costs such as facilities and staff to work on the species, the species is sensitive to handling, has a known host fish that is a challenge to keep alive in captivity, has a relatively short life span, and food requirements are not well understood. We expect a relatively low cost to locate adults to use for propagation and culture. **Pink mucket:** For the 2 pink muckets taken, we estimate \$1,000. Considerations involved in deriving this amount include: (a) there would be a relatively high cost of obtaining adults to work with, (b) the fish host is already known and easily obtained, and (c) the species has previously been successfully propagated and cultured. **Orangefoot pimpleback:** For



the 2 orangefoot pimpleback taken, we estimated \$16,000. Considerations involved in deriving this amount include: (a) there is an anticipated very high cost to locate adults, (b) the fish host is unknown, (c) the species is a short term brooder and has never been propagated or cultured, (d) the species easily aborts larvae when handled, and (e) little is known regarding how this species will respond to captivity.

**Sheepnose:** For the 2 sheepnose taken, we estimated \$8,000. Considerations involved in deriving this amount include: (a) there is an anticipated high cost to locate adults, (b) the species is a short term brooder and easily aborts larvae when handled, (c) there has been previous success on fish host identification with this species, (d) there has been previous success on propagation and culture with this species, and (e) little is known regarding how this species will respond to captivity. We expect the contribution shall be made using certified funds and should be made out to – “Kentucky Waterways Alliance” – with KARF and any other appropriate details in the memo section. The contribution shall be mailed to: Attention: Judith Petersen, Executive Director, Kentucky Waterways Alliance, 120 Webster Street, Suite 217, Louisville, Kentucky 40206. The Kentucky Waterways Alliance’s office telephone number is 270-524-1774. Contact Ms. Petersen if the contribution will be made by direct deposit or a wire transfer. The contribution shall be made within 15 weekdays of the completion of the relocation effort. **This Term and Condition supports RPM 2.**

Upon locating a dead, injured, or sick individual of an endangered or threatened species, initial notification must be made to the Fish and Wildlife Service Law Enforcement Office at 601 W. Broadway, Suite 115A, Gene Snyder Courthouse, Louisville, Kentucky 40202 (phone 502/582-5989 extension 21). Additional notification must be made to the Fish and Wildlife Service Ecological Services Field Office at 330 West Broadway, Room 265, Frankfort, Kentucky 40601 (phone 502/695-0468). Care should be taken in handling sick or injured mussels. All federally listed mussels that are moribund or have died recently are to be preserved according to standard museum practices (preferably kept frozen and/or preserved in 95% ethyl alcohol and then frozen), properly identified or indexed (date of collection, complete scientific and common name, latitude and longitude of collection site, description of collection site), and submitted to the Kentucky Ecological Services Field Office in Frankfort, or to another location if instructed by the KYFO.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. The Service believes that no more than **76 fat pocketbooks, 2 pink muckets, 2 orangefoot pimplebacks, 2 sheepnose, and 6.59 acres** of occupied federally listed mussel habitat will be incidentally taken. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring re-initiation of consultation and review of the reasonable and prudent measures provided. In addition, if any other federally listed mussels are recorded during the mussel relocation activities, re-initiation of consultation and review of the reasonable and prudent measures provided is required. The Federal agency must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.



## **CONSERVATION RECOMMENDATION**

Section 7(a)(1) of the Act directs Federal agencies to use their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help carry out recovery plans, or to develop information.

The FHWA, Corps, and Service should consider implementing the following conservation recommendation:

Provide financial assistance to the Kentucky Department of Fish and Wildlife Resources Center for Mollusk Conservation to support programs that work to restore federally listed mussels and other native mussels in the lower Ohio River. Such assistance could take the form of protecting or enhancing similar habitat and/or providing funding to the CMC facility to propagate federally listed mussels and other native mussels.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, please provide notification to the Service's Kentucky Field Office of the implementation of any conservation recommendations.

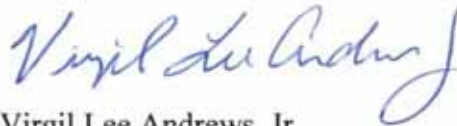
## **REINITIATION NOTICE**

This concludes formal consultation on the action outlined in the FHWA request. As written in 50 CFR 402.16, re-initiation of formal consultation is required where discretionary FHWA, Corps, and Service involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the FHWA, Corps, and Service actions that may affect listed species or critical habitat in a manner or to an extent not considered in this biological opinion; (3) the FHWA, Corps, and Service action is later modified in a manner that causes an effect to the listed species or critical habitat not considered in this biological opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease until re-initiation.

For this biological opinion, the incidental take would be exceeded, when the take exceeds 76 fat pocketbooks, 2 pink muckets, 2 orangefoot pimplebacks, and 2 sheepsnose which is what has been exempted from the prohibitions of section 9 by this biological opinion. The Service

appreciates the cooperation of the FHWA and Corps during this consultation. We would like to continue working with you and your staff regarding this project. For further coordination, please contact me or Leroy Koch of this office at 502/695-0468.

Sincerely,

A handwritten signature in blue ink that reads "Virgil Lee Andrews, Jr." The signature is written in a cursive style with a large, stylized "J" at the end.

Virgil Lee Andrews, Jr.  
Field Supervisor

cc: Doug Dawson, KDFWR, Frankfort, KY  
Matthew Mangan, USFWS, Marion, IL  
Michael Ricketts, USACE, Louisville District, IN  
Barbara Scott, KDOW, Frankfort, KY



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**APPENDIX A**

Fat pocketbook biological opinions including amount and form of incidental take exempted.

<b>PROJECTS</b>	<b>SERVICE OFFICE AND DATE BO ISSUED</b>	<b>INCIDENTAL TAKE (IT) FORM</b>	<b>TAKE EXEMPTED OR SURROGATE MEASURE TO MONITOR</b>
Effects of scour repair at Arkansas Highway 77 crossings of Right Hand Chute on the endangered fat pocketbook mussel ( <i>Potamilus capax</i> )	Arkansas ES Office April 27, 1999	Harm, harass or kill	Up to 50 mussels relocated and up to 5 mussels killed due to relocation. Indeterminate amount of small mussels not relocated and buried.
Potential impacts of ditch maintenance activities within Stateline Outlet Ditch, Mississippi County, Arkansas on the fat pocketbook mussel ( <i>Potamilus capax</i> )	Arkansas ES Office October 3, 2001	Harm, harass or kill	Up to 3,000 individuals relocation and up to 5 killed during the relocation. Up to 30 dead individuals in dredge disposal pile.
Bridge replacement over the St. Francis River	Arkansas ES Office November 8, 2001		2 individuals
Potential impacts of three scour repair areas in the St. Francis Floodway on the fat pocketbook mussel ( <i>Potamilus capax</i> )	Arkansas ES Office April 2002	Harm, harass or kill	Up to 200 individuals relocation and up to 2 killed during the relocation. Indeterminate amount of small mussels not relocated and buried.
Proposed maintenance dredging of the Ohio River navigation channel at Wabash Island located in Posey County, Indiana, Gallatin County, Illinois and Henderson County, Kentucky and its effects on the fat pocketbook pearly mussel ( <i>Potamilus capax</i> )	Bloomington, IN ES Office September 2002	Harm, harass, collect or kill	Undefined but discovery of more than 3 live mussels in dredged material from a single event indicates take has been exceeded
Arkansas Highway 14 bridge replacement over Ditch 10 near the city of Harrisburg, AK	Arkansas ES Office October 31, 2002		1 individual



Emergency consultation for a sewage lagoon embankment stabilization near the city of Madison, Arkansas	Arkansas ES Office June 10, 2003		6 individuals relocated, 9 gravid females taken to propagation facility
Potential effects of the construction of a Union Pacific Railroad Bridge across the St. Francis floodway on the fat pocketbook ( <i>Potamilus capax</i> )	Arkansas ES Office October 29, 2003		3 individuals
Potential impacts of ditch maintenance activities within Ditch 10 on the fat pocketbook mussel ( <i>Potamilus capax</i> )	Arkansas ES Office April 28, 2004		10 individuals
Potential impacts of constructing a pre-cast concrete bridge across Ditch 61 on the federally endangered fat pocketbook mussel ( <i>Potamilus capax</i> )	Arkansas ES Office September 2, 2007	Harm, harass or kill	3 individuals: 1 relocated and 2 killed
Potential effects of the removal and replacement of the Route 15 bridge over the Wabash River at Mount Caramel, Indiana on the fat pocketbook ( <i>Potamilus capax</i> )	Bloomington, IN ES Office October 22, 2007	Injury or direct mortality	4 individuals: 2 during relocation, 2 during construction.
Potential impacts of the proposed setback of Elk Chute Levee in Dunklin County, Missouri on the federally endangered fat pocketbook ( <i>Potamilus capax</i> )	Missouri ES Office January 10, 2008	Death or injury	5 individuals
Biological Opinion on the USDA Forest Service Application Of Fire Retardants On National Forest System Lands	Washington DC February 2008	No take provided	No take provided
Biological Opinion on the Construction of Smithland Hydroelectric Project, Livingston County, KY	Kentucky ES Office January 9, 2009	Mortality, harm or harassment	486 individuals and 40 acres of habitat
Biological Opinion on fleeting and loading facilities for the River View Coal Company, Union County, KY	Kentucky ES Office September 11, 2009	Harm, harass, or kill	61 individuals and 12.2 acres of habitat

Biological Opinion on Paducah Riverfront Project, McCracken County, KY	Kentucky ES Office December 21, 2010	Mortality, harm or harassment	546 individuals and 7.5 acres of habitat
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## APPENDIX B

Pink mucket (*Lampsilis abrupta*) biological opinions including amount and form of take exempted.

PROJECTS	SERVICE OFFICE AND DATE BO ISSUED	INCIDENTAL TAKE (IT) FORM	TAKE EXEMPTED or SURROGATE MEASURE TO MONITOR
USACE – Biological Opinion on the Issuance of Permits for Dixie Cement Co. Barge Terminal Construction and Access Channel Dredging in Tennessee River	May 21, 1982 ES Field Office Asheville, NC	Harm, harass, or kill	All individuals within proposed project area and an undetermined number downstream and adjacent to project area
USACE – Final Biological Opinion on the Effects on Threatened and Endangered Species on the Lower Ohio River Navigation Feasibility Study	June 13, 1985 ES Field Office Asheville, NC	N/A	No take authorized
FERC - Biological Opinion on the Effects of Threatened and Endangered Species from the Construction and Operation of a Hydroelectric Facility at Lock and Dam #5 on the Green River in Warren and Butler counties, KY	June 25, 1985 ES Field Office Asheville, NC	N/A	No take authorized
USFWS – Biological Opinion on the Effects of Conducting Taxonomic Studies	September 3, 1987 SE Regional Office Atlanta, GA	Collect and kill	Ten individuals (Five each from two divergent populations)  NO INCIDENTAL TAKE
FERC – Biological Opinion on the FEIS for Hydropower Development in the Upper Ohio River Basin	January 13, 1989 Pennsylvania Field Office State College, PA	Harm, harass or kill	Can not be determined. Level of authorized take measured by community structure.
TVA – Biological Opinion on the Proposed Wood Chipping and Barge-Loading Facilities on the Tennessee River	December 2, 1992 SE Regional Office Atlanta, GA	N/A	No take authorized
USACE – Biological Opinion on the Effects of Work on a Coal Loading Facility on the Kanawha River RM 90.4, Fayette County, WV	July 7, 1993 ES Field Office Elkins, WV	Harm or Harass	Can not be determined

USACE - Biological Opinion for Proposed Channel Maintenance Dredging of the Cumberland River (CRM 304.0 to 307.0) Smith County, TN	October 1993 ES Field Office Cookeville, TN	Harm or harass	All individuals within the project area
USACE – Biological Opinion for the Proposed City of Florence Municipal Treated Sewage Outfall, Tennessee River, Lauderdale County, AL	October 1994 ES Field Office Cookeville, TN	Harm or harass	All individuals within the project area
FHWA - Biological Opinion for the Construction of the Patton Island Bridge	November 23, 1994 ES Field Office Daphne, AL	Harm or harass	One individual
TVA & NRC - Biological Opinion for the Proposed Operation of the Watts Bar Nuclear Plant, Rhea County, TN	March 1995 ES Field Office Cookeville, TN	N/A	No take authorized
Biological Opinion for Endangered Species Permit Approval for the Rescue of Critically Endangered Mussels in KY, AL and TN	October 1996 ES Field Office Cookeville, TN	Collection of live individuals	Up to 30 live individuals, not more than ten individual per population
USACE – Biological Opinion on the Effects of the Joe S. Towing Co., Inc. Barge Fleeting Facility, Wood County, WV	March 18, 1997 ES Field Office Elkins, WV	Harm or harass	Can not be determined. Take has been exceed if there is a decline of up to 25% of the mussel bed density or decline of up to 25% in the live-to-dead ratio or decline of up to 25% in the total number of species encountered
USACE & TVA – Biological Opinion For The Proposed City of Florence Municipal Treated Sewage Outfall Tennessee River Lauderdale County, AL	1998 ES Field Office Daphne, AL	Harm, harass or kill	Can not be determined
FHWA – Biological Opinion for the Proposed Keller Bridge Demolition Project in Limestone and Morgan Counties, AL	June 8, 1998 ES Field Office Daphne, AL	Harm, harass, or kill	One individual within impact area, all individuals within study area



USFWS – Programmatic Biological Opinion Addressing Effects of Section 10(a)(1)(A) Permitting on Freshwater Mussels in Region 4	August 1, 1998 SE Regional Office Atlanta, GA	Harm or kill	Up to five adult mussels per year
USACE – Biological Opinion for Proposed Maintenance Dredging in the Tennessee River at Diamond Island, Hardin County, TN	July 1999 ES Field Office Cookeville, TN	Harm or harass	Approximately seven acres of habitat loss
USACE – Supplement to the 1991 Biological Opinion For The Proposed Bridges and Alignments Modification to the Kentucky Lock Addition Project Livingston and Marshall Counties, Kentucky	January 2000 ES Field Office Cookeville, TN	Harm or kill	All individuals within the 0.04 acre of habitat impacted by drilling and construction activities
FHWA – Biological Opinion for the Proposed US 231 Bridge Replacement Over the Tennessee River in Madison and Morgan Counties, AL	February 18, 2000 ES Field Office Daphne, AL	Harm, harass or kill	17 individuals
FHWA & USACE – Biological Opinion on the Proposed Replacement of the State Route 2 Bridge over the Tennessee River, Loudon County, TN	February 2001 ES Field Office Cookeville, TN	Harm, harass or kill	All individuals within the project corridor
FHWA and TVA – Amended Biological Opinion for the Proposed Replacement of the State Route 2 Bridge Over the Tennessee River, Loudon County, Tennessee	February 2002 ES Field Office Cookeville, TN	Harm or harass	All individuals within the project corridor
USACE – Chickamauga Lock Project Hamilton County, Tennessee	February 2002 ES Field Office Cookeville, TN	Habitat loss and/or degradation	All within disturbed area
USACE – Biological Opinion on the Effects of Navigational Dredging on the White River in Arkansas	March 1, 2002 ES Field Office Conway, AR	Kill	Five individuals per year

USACE – Mussel relocation Experiment on Tennessee River Near Diamond Island, Hardin County, TN	September 9, 2002 ES Field Office Cookeville, TN	Harm or harass	One individual
TVA – Proposed Public Marina Expansion at Ditto Landing on the Tennessee River, Madison County, AL	November 22, 2002 ES Field Office Daphne, AL	Harm, harass or kill	One individual
USACE – Olmsted Lock and Dam Construction  Replaces the 1993 BO	July 16, 2003 ES Field Office Cookeville, TN	N/A	No incidental take authorized
FHWA – Biological Opinion on the Construction of the Rockport Bridge Across the Ouachita River	July 29, 2003 ES Field Office Conway, AR	Harm or harass	Can not be determined
USACE – Tennessee River, Pickwick Landing Dam Mussel Relocation Study, Hardin County, Tennessee	November 13, 2003 ES Field Office Cookeville, TN	Harm, harass, or collect	One individual
TVA – Proposed Wilson Hydro Plan Modernization of Hydroturbine Project, Lauderdale and Colbert counties, AL	2004 ES Field Office Daphne, AL	Harm, harass or kill	20 individuals
TVA – Biological Opinion on the proposed Reservoir Operations Study in the Tennessee River Valley of AL, GA, KY, MS, NC, TN, and VA	February 9, 2004 ES Field Office Cookeville, TN	Harm or harass	Can not be determined. 30 miles of habitat altered or degraded
FHWA – Biological Opinion on the Proposed Construction of the Highway 46 Bridge Across The Saline River Grant County, AR	July 7, 2004 ES Field Office Conway, AR	Harm, harass or kill	Five through relocation and no more than one killed
USFWS – Amendment to Programmatic Section 7 Biological Opinion Addressing Effects of Section 10(a)(1)(A) Permitting on Freshwater Mussels in Region 4	July 16, 2004 ES Field Office Conway, AR	N/A	No change



FHWA – Biological Opinion on the Proposed Construction of the Highway 167 Bridge, Dallas and Grant counties, AR	January 30, 2006 ES Field Office Conway, AR	Harm, harass or kill	No more than two individuals
NRCS - Programmatic Biological Opinion for the Arkansas Healthy Forest Reserve Program	September 25, 2006 ES Field Office Conway, AR	Harm	Can not be determined. Any take would be associated with a return to baseline conditions and would not involve individuals associated with pre- or post-baseline riparian conditions.
TVA – Biological Opinion on the Routine Operation and Maintenance of TVA Dams in AL, GA, KY, MS, NC, TN, and VA	October 17, 2006 ES Field Office Cookeville, TN	Harm or harass	Can not be determined. All in two mile reaches of the river below Douglas, Cherokee, Fort Loudoun, Watts Bar, Nickajack, Guntersville, Wheeler, Wilson, Pickwick Landing, and Kentucky dams
TVA – Biological Opinion on the Dike stabilization at Johnsonville Fossil Plant Ash disposal Area No. 2 (Johnsonville Island) between Tennessee River Mile 99 – 100, Humphreys Co., TN	February 1, 2010 ES Field Office Cookeville, TN	Harass	151 individuals
Biological Opinion on Paducah Riverfront Project, McCracken County, KY	Kentucky ES Office December 21, 2010	Mortality, harm or harassment	Nine individuals and 7.5 acres of habitat

## APPENDIX C

Orangefoot pimpleback (*Plethobasus cooperanus*) biological opinions including amount and form of take exempted.

PROJECTS	SERVICE OFFICE AND DATE BO ISSUED	INCIDENTAL TAKE (IT) FORM	TAKE EXEMPTED or SURROGATE MEASURE TO MONITOR
USACE – Biological Opinion on the Consolidated Grain and Barge Co. Proposed Cargo Fleeting Area on the Ohio River. Pulaski County, IL	April 3, 1985 MW Regional Office Ft. Snelling, MN	N/A	Jeopardy Opinion – No take authorized
USACE – Final Biological Opinion on the Effects on Threatened and Endangered Species on the Lower Ohio River Navigation Feasibility Study	June 13, 1985 ES Field Office Asheville, NC	N/A	No take authorized
TVA – Biological Opinion on the Proposed Wood Chipping and Barge-Loading Facilities on the Tennessee River	December 2, 1992 SE Regional Office Atlanta, GA	N/A	No take authorized
USACE – Biological Opinion on the Construction of the Olmstead Lock and Dam Facility  Supplemental to 1985 BO	January 15, 1993 ES Field Office Cookeville, TN	Habitat loss	No take authorized
USACE – Biological Opinion for the Proposed Construction of Barge Fleeting Facilities on the Ohio River, Ballard County, KY	September 1993 SE Regional Office Atlanta, GA	N/A	No take authorized
FHWA - Biological Opinion for the Construction of the Patton Island Bridge	November 23, 1994 ES Field Office Daphne, AL	Harm or harass	One individual
USFWS – Rescue of Critically Endangered Mussels in TN, KY and northern AL	October 1996 ES Field Office Cookeville, TN	Collection of live individuals	Up to 30 live individuals, not more than 10 individual per population



USFWS – Programmatic Biological Opinion Addressing Effects of Section 10(a)(1)(A) Permitting on Freshwater Mussels	August 1, 1998 SE Regional Office Atlanta, GA	Harm or kill	Up to five adult mussels per year
USACE – Biological Opinion for Proposed Maintenance Dredging in the Tennessee River at Diamond Island, Hardin County, TN	July 1999 ES Field Office Cookeville, TN	Harm or harass	Approximately seven acres of habitat loss
Supplement to the 1991 Biological Opinion For The Proposed Bridges and Alignments Modification to the Kentucky Lock Addition Project Livingston and Marshall Counties, Kentucky	January 2000 ES Field Office Cookeville, TN	Harm or kill	All individuals within the 0.04 acre of habitat impacted by drilling and construction activities
FHWA & USACE – Biological Opinion on the Proposed Replacement of the State Route 2 Bridge over the Tennessee River, Loudon County, TN	February 2001 ES Field Office Cookeville, TN	Harm, harass or kill	All individuals within the Project corridor
FHWA and TVA – Amended Biological Opinion for the Proposed Replacement of the State Route 2 Bridge Over the Tennessee River, Loudon County, TN	February 2002 ES Field Office Cookeville, TN	Harm or harass	All individuals within the project corridor
USACE – Chickamauga Lock Project Hamilton County, Tennessee	February 2002 ES Field Office Cookeville, TN	Habitat loss and/or degradation	All within disturbed area
USACE – Mussel relocation Experiment on Tennessee River Near Diamond Island, Hardin County, TN	September 9, 2002 ES Field Office Cookeville, TN	Harm or harass	One individual
USACE – Olmsted Lock and Dam Construction  Replaces the 1993 BO	July 16, 2003 ES Field Office Cookeville, TN	N/A	No incidental take authorized

USACE – Tennessee River, Pickwick Landing Dam Mussel Relocation Study, Hardin County, Tennessee	November 13, 2003 ES Field Office Cookeville, TN	Harm, harass, collect	One individual
TVA _ Proposed Wilson Hydro Plan Modernization of Hydroturbine Project, Lauderdale and Colbert counties, AL	2004 ES Field Office Daphne, AL	Harm, harass or kill	20 individuals
USFWS- Amendment to the 1998 Programmatic Section 7 Biological Opinion Addressing Effects of Section 10(a)(1)(A) Permitting on Freshwater Mussels in Region 4	July 16, 2004 ES Field Office Conway, AR	Harm or mortality	Five individuals per 100 handled
TVA – Biological Opinion on the Routine Operation and Maintenance of TVA Dams in AL, GA, KY, MS, NC, TN, and VA	October 17, 2006 Cookeville, TN ES Field Office	Harm, harass	Can not be determined. All in 2 mile reaches of the TN River below Fort Loudoun, Watts Bar, Gunterville, Pickwick Landing and Kentucky dams.
Biological Opinion on Paducah Riverfront Project, McCracken County, KY	Kentucky ES Office December 21, 2010	Mortality, harm or harassment	18 individuals and 7.5 acres of habitat