3.8 AQUATIC RESOURCES

3.8.1 Introduction

This section describes the aquatic habitats and organisms occurring in the LOMR that may be affected by the Proposed Action or the alternatives. The existing conditions described in this section are based on the current state of the Missouri River, in contrast to its historical condition, which was very different from today. Various sources of information were used to compile the affected environment, including field investigation reports, geographic information systems (GIS) data, literature searches, and review of maps and aerial photography. The spatial scope of the aquatic resources assessment includes the main channel and floodplain of the LOMR and main tributary mouths from Gavins Point Dam and the LOMR confluence with the Mississippi River.

3.8.2 Regulatory Setting

Aquatic resources in the Project area are protected or regulated by a variety of federal and state laws and policies. Key regulatory and conservation planning issues applicable to the Proposed Action and the alternatives are discussed below.

3.8.2.1 Federal

The Missouri River Recovery Program and the Missouri River Mitigation Project are related projects with objectives to enhance, restore, and mitigate the Missouri River's fish and wildlife habitat and hydrology. The locations and types of mitigation projects implemented by these programs and the potential for overlap with areas of the Proposed Action and the alternatives were considered in the analysis.

The Missouri River Recovery Program is a partnership between the USACE and the USFWS. They are conducting a collaborative, long-term study authorized by the Water Resources Development Act of 2007. The Missouri River Ecosystem Restoration Plan and Environmental Impact Statement will identify the actions required to mitigate losses of aquatic and terrestrial habitat; recover federally listed species under the Endangered Species Act; and restore the ecosystem to prevent further declines among other native species. The Missouri River Recovery Program will result in a plan that guides the USACE mitigation, restoration, and recovery efforts for the Missouri River for the next 30–50 years.

The USACE, in cooperation with state and federal fish and wildlife agencies as well as interested state and local groups, formed the Missouri River Mitigation Project. The project extends from Sioux City, Iowa to the mouth of the Missouri River near St. Louis, a length of 735 river miles. The Project's goal is to develop, on a site-by-site basis, mitigation for fish and wildlife habitat losses that resulted from past channelization efforts on the Missouri River. This is achieved by acquiring and developing aquatic and terrestrial habitat on individual sites, creating new wildlife areas, improving existing areas, and returning certain river features to historical conditions.

3.8.2.2 State

Bordering states of the LOMR manage sensitive species lists and conservation areas through their respective conservation programs (see Table 3.8-1).

Table 3.8-1 Governing Agencies Maintaining Special-Status Species List

State	Agency
Kansas	Kansas Department of Wildlife and Parks
Missouri	Missouri Department of Conservation
Nebraska	Nebraska Game and Parks Commission

3.8.3 Status of Aquatic Resources

The aquatic resources of the LOMR have been considerably altered because of development of the river during the 1900s for hydropower, flood control, navigation, and bank stabilization. The habitat available to aquatic organisms has been greatly simplified—chutes and side channels have been blocked and diverted, converting the once structurally complex, multi-channeled river into a single, stationary thread of deep, fast-moving water (Hesse 1995).

To mitigate these effects, aquatic habitats have been and continue to be constructed along the LOMR under the authority of the USACE Missouri River Recovery Program, in cooperation with local, state, and federal agencies (Van Sterner et al. 2009). These include bank notches, dike notches, and chute construction to create shallow-water habitat for warm-water fishes; and there are plans for additional similar projects.

To evaluate effects on aquatic resources, species were organized into guilds and communities and are described in the following sections.

3.8.4 Fishes

Fish species documented in the Missouri River include a wide variety of native and introduced species. Approximately 150 fish species are known to occur in the Missouri River basin (Hesse 1995, Galat et al. 2005). Fifty-four percent of the fish are classified as residing primarily in the main channel, and 93 percent of these are fluvial (river) dependent or fluvial specialists (Berry, Wildhaber, and Galat 2004).

Common fish species in the lower Missouri River include emerald shiner (*Notropis atherinoides*), river carpsucker (*Carpiodes carpio*), channel catfish (*Ictalurus punctatus*), gizzard shad (*Dorosoma cepedianum*), red shiner (*N. lutrensis*), shorthead redhorse (*Moxostoma macrolepidotum*), carp (*Cyprinus carpio*), bighead carp *(Hypophthalmichthys nobilis)*, silver carp (*Hypophthalmichthys molitrix*), and goldeye (*Hiodon alosoides*) (USACE 2004).

Sport fish include channel catfish, blue catfish *(Ictalurus furcatus)* crappie (*Pomoxis* spp.), sauger (*Stizostedion canadense*), flathead catfish (*Pylodictus olivaris*), white bass (*Morone chrysops*), bluegill (*Lepomis macrochirus*), and paddlefish (USACE 2004). Species important to the commercial fishery on the lower Missouri River include buffalo (*Ictiobus* spp.), carp, carpsucker, and freshwater drum (*Aplodinotus grunniens*).

3.8.4.1 Fish Guilds

Use of fish guilds for the effects analysis is a practical and useful method for large-scale projects (Austen, Bayley, and Menzel 1994). Galat et al. (2004) used occurrence and distribution data on Missouri River fishes from recent publications (Hesse et al. 1989, 1993) and summarized fish use of habitats by placing each species into a macrohabitat guild category.

Benthic Fish Guild

Benthic fishes are species that use the river bottom for much of their life requirements, rather than using mid-depths or off channel habitats. The benthic fish guild includes commercial and recreational species, and a group of prey species that are important to river ecology and to the food webs of fish predators. Table 3.8-2 lists species grouped in the benthic fish guild.

Table 3.8-2 Common and Scientific Names of Species in the Benthic Fish Guild [a].

Federally and State-Listed Species[a]	Recreational Species	Commercial Species	Prey Species
Pallid sturgeon *Scaphirhynchus albus*	Channel catfish *Ictalurus punctatus*	Bigmouth buffalo *Ictiobus cyprinellus*	White sucker *Catostomus commersonii*
Flathead chub *Platygobio gracilis*	Blue catfish *Ictalurus furcatus*	Common carp *Cyprinus carpio*	Stonecat *Noturus flavus*
Sturgeon chub *Macrhybopsis gelida*	Flathead catfish *Plyodictis olivaris*	Smallmouth buffalo *Ictiobus bubalus*	Shorthead redhorse *Moxostoma macrolepidotum*
Sicklefin chub *Macrhybopsis meeki*	Walleye *Sander vitreum*		Fathead minnow *Pimephales promelas*
W. Silvery minnow *Hybognathus argyritis*	Sauger *Sander canadense*		Brassy minnow *Hybognathus hankinsoni*
Plains minnow *Hybognathus placitus*	Freshwater drum *Aplodinotus grunniens*		Sand shiner *Notropis stramineus*
Blue sucker *Cycleptus elongatus*			River carpsucker *Carpiodes carpio*
Shovelnose sturgeon *Scaphirhynchus platorynchus*			

[a] The "Federally and State-Listed Species" category refers to federally listed species and species listed by states as "species of concern" (modified from Berry, Wildhaber, and Galat 2004).

3.8.5 Other Aquatic Biota

Benthic Macroinvertebrates

Benthic invertebrates are a crucial part of the food web and an important food source for fishes, waterfowl, and shorebirds (Augustin, Grubaugh, and Marshall 1999; Brown et al. 2001). Migrant shorebirds spend most of their time foraging (Brown et al. 2001), thus invertebrate abundance and availability are important to meet the nutritional requirements for migration and recruitment.

Rich communities of benthic macroinvertebrates occur in the Missouri River, but their abundance is greater in the upper reaches (Galat et al. 2005, Poulton et al. 2003). Poulton (2004) identified benthic macroinvertebrate communities in the channelized reach of the lower Missouri River. Nearly one third of these taxa collected belonged to the sensitive insect orders (*Ephemeroptera*, *Plecoptera*, *Odonata*, and *Trichoptera*). In addition, Poulton et al. (2003) and Poulton (2004) found that artificial rock (material placed for bank and channel stability or for dike structures) contained a diverse macroinvertebrate community.

Freshwater Mussels

Prior to dam installation and channelization, mussel populations were noted in upper Missouri River tributaries but not in the mainstem (Hayden 1862; Over 1915; Coker and Southall 1915, as cited in Shearer et al. 2005). The mainstem Missouri River had been regarded as too turbid, sandy, and unstable to provide suitable habitat for mussels. After dam installation and channelization, Hoke (1983 as cited in Shearer, Backlund, and Wilson 2005) observed 13 mussel in the LOMR species along the Nebraska border; Perkins and Backlund's (2000) observed 19 species of freshwater mussels in a survey from Gavins Point Dam downstream to Ponca, Nebraska.

Recent literature reviews identified dams as one of the primary causes for mussel declines and extinctions (Freeman et al. 2003, Lydeard et al. 2004). Upstream of dams, mussels depend on migratory fish hosts because their distribution is blocked by the dam. The area immediately downstream of the dams provides some suitable habitat for mussels. Perkins and Backlund (2000) note that conditions immediately downstream of Gavins Point Dam appear more productive for mussels due to firm substrates and nutrient-rich waters. Watters and Dunn (1995) support those observations by stating that, after dam construction in the Muskingam River in Ohio, widespread mussel distribution was drastically reduced to within a few miles of the dam–where oxygen-rich, clearer water and silt-free, stable substrate existed. Farther downstream of the dams, however, substrate instability and degradation from hydraulic regulation make it difficult for populations to persist or establish. Although mussel species are capable of reestablishing after being displaced (Waller, Gutreuter, and Rach 1999), evidence supports the need for stable environments for productive shellfish communities.

Historically, natural flood events mobilized the benthic environment, which resulted in mortality of some individuals, but this mortality was compensated for on a population level through species diversity, abundance, and widespread use of the benthic environment. Channel bottoms also maintained variable substrate sizes that provided a more stable environment in flood stages. Today, easily-mobilized sand and silt loads route through the Missouri River. Formerly seasonal, flood-related sediment movement is now continual because of decreased width and incised channel characteristics, and dike-diverted flows that have reduced the amount of stable habitats for mussels to establish. Mussels that establish in dredge areas can be destroyed by entrainment or mechanical damage. Mussels directly downstream of dredging activity could be smothered, in particular those species not tolerant to fine sediment or silt, or they can be adversely affected by the re-suspension of contaminants because they are filter feeders (Waters 2000). Headcutting in areas upstream of dredging and

tributaries can also affect mussels by mobilizing sediment, creating loss of habitat, and displacing shellfish (Waters 2000).

Plankton and Periphyton

Few studies have focused specifically on phytoplankton, zooplankton, and periphyton assemblages in the LOMR. Less is known regarding the effects of flooding on zooplankton in regulated rivers where floods are infrequent and water movement between the main channel and floodplain is limited (Hesse, Wolfe, and Cole 1988). In general, phytoplankton populations in the Project area are environmentally regulated by light, temperature, nutrients, and predation by zooplankton. If toxic levels of contaminants are present, they may result in local and temporary adverse effects on populations. Recent studies have shown that algal abundance in some rivers is comparable to moderately productive lentic (still water) systems with a well established plankton-based food web (Saunders and Lewis 1989).

Aquatic Plants

Aquatic vegetation is almost non-existent in the main channel of the LOMR because of high turbidity, unstable substrate, and variable discharge (Galat et al. 2005, 2001). Young cottonwoods (*Populus deltoides*) and willows (*Salix* sp.) primarily comprise the sparse vegetation found on sand bars (Galat, Wildhaber, and Dieterman 2005).

3.8.6 Special-Status Species

Special-status aquatic species that have not been federally listed as threatened or endangered with the potential to occur in the Project area are listed in Table 3.8-3. This table also identifies their habitat requirements, and assesses the likelihood of their occurrence in the Project area. Federally listed special-status aquatic species are further addressed in Section 3.10.

3.8.7 Habitats of the of the Lower Missouri River

This section describes the habitat types within with the Project area and the species commonly associated with those habitat types that could be affected by the Proposed Action or the alternatives.

Table 3.8-3 Special-Status Aquatic Species with the Potential to Occur in the Project Area

Common Name *Scientific Name*	Federal Status[a]	Missouri Status	Kansas Status	Nebraska Status	Habitat	Likelihood of Occurrence in the Study Area	Species Assessed in this Document?
Blue sucker *Cycleptus elongatus*			SINC		Species concentrates in chutes or rapids where the water is deep and the bottom is rocky, free of silt.	Occurs in the Missouri and Kansas Rivers	Yes
Brassy minnow *Hybognathus hankinsoni*			SINC		Prefers small clear streams with sluggish current and sandy bottoms overlaid by organic sediment, but this species is found in a small portion of the Missouri River.	Occurs in the Missouri River in Atchison County, Kansas	Yes
Chestnut lamprey *Ichthyomyzon castaneus*			T-CH		Species is parasitic to large fish (such as carp) in adult stage and larvae remain in bottom sediment of pools.	Species may occur in the Missouri River and lower Kansas River	Yes
Flathead chub *Platygobio gracilis*		E	T-CH		Species occurs in diverse habitats: pools of small creeks with moderately clear water over gravel and bedrock bottom or in large, turbid rivers with swift current and bottom of fine sand and gravel.	Occurs in the Missouri River	Yes
Lake sturgeon *Acipenser fulvescens*		E		T	Species occurs in large rivers over firm sand, gravel, or rocky bottom.	Species may occur in the Missouri River, in Missouri	Yes
Plains minnow *Hybognathus placitus*			SINC		Species prefers streams where sediments accumulate in shallow backwaters.	Species may occur in backwaters in the Missouri River	Yes
River shiner *Notropis blennius*			SINC		Species prefers flowing water over sand bottoms in large streams with broad, exposed channels.	Occurs in the Missouri River	Yes
Shovelnose sturgeon *Scaphirhynchus platorynchus*					Species inhabits open channels of large rivers with a swift current over a sand or gravel bottom. Species tolerates high turbidity.	Occurs commonly in the Missouri River	Yes

Table 3.8-3 Special-Status Aquatic Species with the Potential to Occur in the Project Area

Sicklefin chub *Macrhybopsis meeki*		S3	E-CH		Species prefers the main channels of large turbid rivers with sand or fine gravel bottoms and strong current	Occurs in the mainstem Missouri River	Yes
Silver chub *Macrhybopsis storeriana*		S3	E-CH		Species is found in large sandy rivers near bottom sediments.	Occurs in the mainstem Missouri River	Yes
Silverband shiner *Notropis shumardi*		S3	T-CH		Species inhabits deep water where flow is sluggish and bottoms are silted but also occurs in strong currents of the main channel.	Occurs in the mainstem Missouri River	Yes
Sturgeon chub *Macrhybopsis gelida*		S3	T-CH	E (Nemaha County)	Species prefers large, turbid sandy rivers over substrate of small gravel and coarse sand.	Occurs in the mainstem Missouri River	Yes
Tadpole madtom *Norturus gyrinus*			SINC		Species is found beneath woody debris or vegetation during the day. Usually lives on a mud bottom.	Occurs in tributaries of the Missouri River near Atchison	Yes
Western silvery minnow *Hybognathus argyritis*		S2	T-CH		Species prefers relatively deep water where flow is sluggish and bottoms are silted, but it does occur in strong currents of the mainstream.	Occurs in the mainstem Missouri River	Yes

[a] Species Status:

C = Candidate for federal listing as endangered under the Endangered Species Act.
CH = Critical habitat has been designated in the State of Kansas.
SINC = Species in Need of Conservation in the State of Kansas.
E = Endangered.
KS = Kansas.
MO = Missouri.
NE = Nebraska.
T = Threatened.

Sources: www.ngpc.state.ne.us, www.mdc.mo.gov/nathis/endangered/endanger/, mdc4.mdc.mo.gov/applications/mofwis/Mofwis_Search1.aspx, kdwp.state.ks.us/news/Other-Services/Threatened-and-Endangered-Species.

Habitat for aquatic organisms is generally defined as the three-dimensional structure of physical and chemical characteristics in which the organism lives and varies spatially within a river channel and over time (Poff and Ward 1989). The combination of physical characteristics (velocity, depth, turbidity, and substrate size) and other factors, such as temperature, combine to create a range of habitats. Riverine physical aquatic habitat is substantially dependent on the interaction between flow regime and channel morphology (Jacobson and Galat 2006). Spatial variation of habitat in the LOMR is due to the hydraulic influence of wing dikes and other navigation structures (Jacobson, Laustrup, and Reuter 2002). Habitat varies over time with discharge, resulting in new combinations of depth, velocity, and substrate for a given discharge (Jacobson, Laustrup, and Reuter 2002). In general, habitats associated with islands, sand bars, and backwaters have declined over time in the LOMR; whereas deep and swift main channel habitats have increased (NRC 2002). The primary habitats in the Project area that are important to the life history needs of aquatic organisms are defined below. Figure 3.8-1 shows the general layout of habitats found in the LOMR.

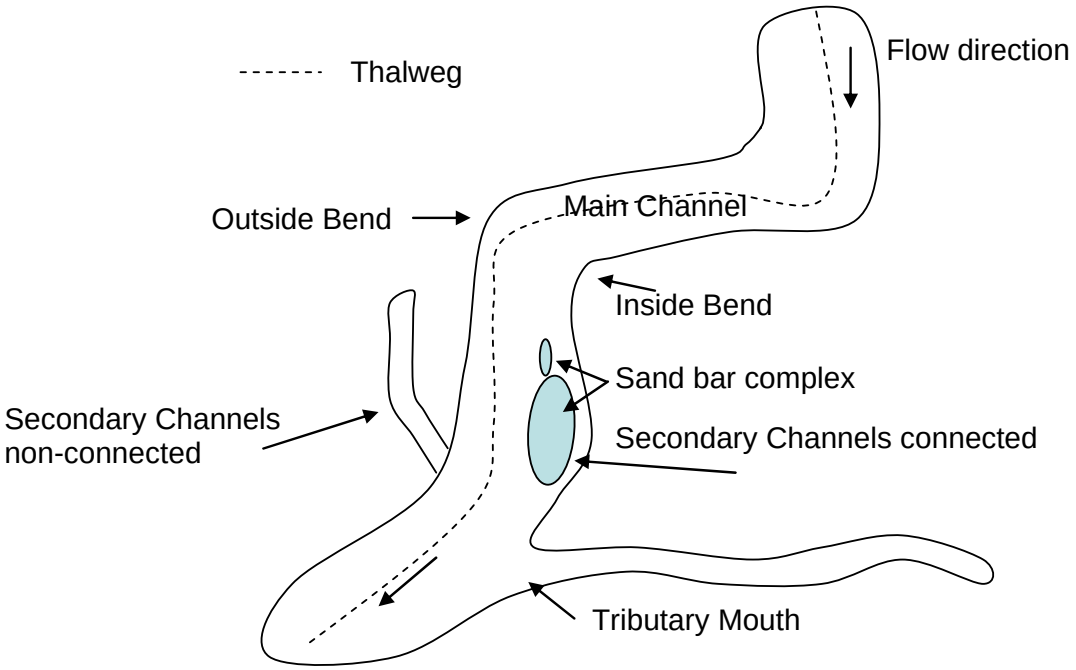

Figure 3.8-1 Schematic of Habitats Found in the Lower Missouri River (modified from Berry et al. 2004)

The dynamic condition of the LOMR prior to channelization and impoundment was one of annual flow fluctuations and large amounts of suspended sediment. The reduction of bed roughness and substrate

diversity subsequent to channelization and impoundment has affected the overall productivity of the river, and in particular, the reproductive success of substrate spawners (Hesse et al. 1993).

3.8.7.1 Main Channel

The main channel conveys the majority of the river discharge and has the highest water velocities. The deepest part of the main channel is typically defined as the thalweg and is usually associated with the middle parts of the river. Certain benthic fish, such as adult and juvenile sturgeon, tend to use habitats in and adjacent to main channels where environmental conditions can include bed load sediment transport and high near-bed flow velocities (Hurley et al. 2004). The main channel habitat can be grouped into three macrohabitat types: slow-velocity macrohabitats (tributary mouth, secondary channel non-connected), moderate-velocity areas (inside bends, secondary channels connected), and high-velocity areas (channel crossovers, outside bend).

3.8.7.2 Sand Bar Complexes

Sand bars in large rivers are generally defined by a ridge of silt or sand formed by the action of currents. Lee (2007) found that macroinvertebrate and larval fish abundance and distribution on sand bars were dependent on fine substrates, habitat complexity (e.g., the presence of tertiary channels), low current velocity, and temperature. The most common aquatic macroinvertebrate orders collected by Lee (2007) in sand bar complexes were *Diptera*, *Hemiptera*, *Coleoptera*, *Bivalvia*, and *Ephemeroptera*; the most frequent families were *Chironomidae*, *Ceratopogonidae*, *Corixidae*, *Heteroceridae*, and *Sphaeriidae*.

3.8.7.3 Shallow-Water Habitat

Shallow-water habitat is considered by the USFWS (2003) as shallow open water areas (e.g., submerged sand bars, main channel/side channel convergence areas, and island tips) connected to the Missouri River channel that are less than 5 feet deep and have a variable velocity of flow. Construction of dikes and revetments has narrowed and deepened the LOMR main channel and has prevented channel migration, which has greatly eliminated shallow-water habitat and increased water depth and current velocity (NRC 2002). In general, depths of 0–7 feet (0–2.1 m), and velocities less than 2.5 feet per second (76 centimeters per second) over sand bars are the preferred main channel habitat of species such as sauger, channel catfish, shovelnose sturgeon, and blue sucker during all or some of their life history (USFWS 2000). Survival and growth of many juvenile riverine fish are associated with

the availability of shallow water with slower water velocities (Hesse et al. 1993, 1989; Galat et al. 2005). Several species spawn in shallow-water habitat. After hatching, the juveniles rear in low water-velocity regions until the juveniles are large enough to survive and avoid predation in the main channel, which has higher water velocities. While some species are dependent on shallow-water habitats for spawning and juvenile stages, many aquatic species spend their entire lifetime in the portions of the river with low water velocities.

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