CHAPTER 6

Potential Mitigation Measures

NEPA and its implementing regulations require that an EIS identify appropriate mitigation measures for the adverse impacts potentially resulting from a proposed action. Mitigation measures are actions that could be taken to avoid, offset, reduce, or compensate for adverse effects to the environment (40 CFR 1580. 20). The technical analyses presented in the previous chapters discuss the potential for some adverse environmental impacts to result from the Proposed Action and the alternatives. Most of the impacts are associated with the indirect effects of commercial dredging of sand and gravel in the LOMR on channel geomorphology (i.e., river bed elevations, water surface elevations, and sediment dynamics). The resources most affected by changes in river channel conditions are aquatic habitats, the federally listed pallid sturgeon, infrastructure, and cultural resources. Impacts related to air quality also may require mitigation.

Potential measures that would mitigate identified impacts are discussed below. The CEQ regulations provide for mitigation (1) in the form of alternatives (fully discussed in Chapter 2); (2) as an integral part of the design of the Proposed Action or the alternatives; (3) as additional measures that further reduce or offset impacts; and (4) as monitoring—monitoring to ensure that mitigation is being performed and is achieving the expected results (Sutley 2010) or monitoring for adaptive management. All of these measures have been considered in the EIS.

The USACE determination under the CWA Section 404(b)(1) Guidelines will be based on and coordinated with this EIS. Under these guidelines, the USACE has a formal process, requirements, and restrictions that must be met (see Section 1.4), including identification of the least environmentally damaging practicable alternative. Until that determination is made, the needed mitigation measures will not be fully known. The potential mitigation measures presented below will be considered pending the Section 404(b)(1) analysis, Final EIS, and ROD.

In the following sections, mitigation measures are discussed according to four general categories:

- Existing mitigation measures integrated into the Proposed Action and alternatives – measures included in recent dredging permits that are designed to avoid, minimize, or mitigate dredging impacts;

- Potential dredging restrictions and operational conditions – measures that could further reduce dredging impacts on river bed degradation by restricting the location or operation of dredging activities;
- Potential monitoring and adaptive management – measures that could be included to verify the implementation and effectiveness of mitigation on environmental conditions, monitor actual impacts to improve understanding in areas of uncertainty, trigger other mitigation measures, or provide a basis for adaptive changes to levels of commercial dredging of sand and gravel; and
- Other potential mitigation measures – measures to reduce impacts to environmental resources or address other human environment resources.

6.1 EXISTING MITIGATION MEASURES INTEGRATED INTO THE PROPOSED ACTION AND ALTERNATIVES

Commercial dredging of sand and gravel is an ongoing activity on the LOMR under permits issued by the USACE. The USACE issued a permit decision document in August 2007 that included specific dredging restrictions, operating procedures, and monitoring requirements intended to allow dredging to continue through December 31, 2009 with less-than-significant impacts while this EIS was being prepared (USACE 2007). In March 2008, the USACE issued a supplemental permit decision document with some minor modifications to the initially proffered permit in response to issues of appeal made by the applicants (USACE 2008). When it was apparent that this EIS would not be completed by December 31, 2009, the USACE extended the permits for an additional year to allow additional time to complete this EIS. Throughout this period, the USACE Kansas City District, the USFWS, and the Dredgers have informally consulted under Section 7 of the ESA on each permit and permit extension. The existing mitigation measures described in this section include the measures outlined in the original 2007 permit decision document, measures in the 2008 supplemental permit decision document, and measures in the 2009 permit extension—all resulting from informal consultation between the USACE, the USFWS, and the Dredgers.

Existing mitigation measures are listed in Section 2.4.3 and include (1) restrictions to dredging locations; (2) restrictions to dredging operations; and (3) monitoring requirements. As part of the restrictions to dredging locations, dredging is excluded from the areas listed in Table 2.2-6 as habitat areas for pallid sturgeon. These existing mitigation measures were included as part of the project description for the Proposed Action and Alternatives A, B, and C when the Environmental Consequences analysis was undertaken.

The existing mitigation measures generally include:

- Volume restrictions – Under the currently authorized dredging permits, no more than 1,200,000 tons of material may be extracted within 1 year from any 10-mile reach of the Missouri River between RM 49.8 and RM 490.0. When monthly reports from all the dredge plant monitoring systems indicate that the total extraction of all dredgers in a 10-mile reach has reached 1,200,000 tons, all dredgers authorized to operate within that reach will be notified that the reach is closed to further dredging for the remainder of the calendar year. This restriction reduces the contribution of dredging to river bed degradation and the adverse effects of dredging on navigation, flood control, water intake structures, and endangered species and their habitat.
- Exclusion zones – In 2007, Dredgers were authorized to dredge within specific reaches of the river delimited by river mile. They were further restricted from dredging within set distances of: (1) the shoreline; (2) the confluence of tributaries; (3) infrastructure facilities (levees, pipeline crossings, dikes, and bridges); (4) water intake structures; and (5) pallid sturgeon habitat areas. By establishing these exclusion zones, the effects of dredging on shorelines and shoreline-based facilities and habitat are reduced. These restrictions reduce the effects of dredging on existing permeable aquifer material, reduce adverse impacts to the quality and quantity of water sources, reduce adverse impacts to municipal drinking water intake structures, and provide a mixing zone sufficient to reestablish water quality to background conditions on the Missouri River. Avoidance of dredging near certain pallid sturgeon habitats reduces potential effects to the pallid sturgeon and its habitat. The USFWS determination that recent levels of dredging activities are not likely to adversely affect endangered species was conditional and based, in part, on this restriction. The dredge operator is responsible for determining that the dredge does not operate within these exclusion areas. The dredge location is documented with GPS, and compliance with permit exclusion locations is documented in reports submitted to the USACE.
- Discharge and disposal requirements – To protect water quality, both in the river and as a supply source for municipal and industrial use, Dredgers are restricted from discharge of contaminated material back into the river during dredging operations. Activities related to the handling of fuel, lubricants, and other similar materials are regulated; and the Dredgers must prepare and implement appropriate pollution prevention plans. Dredgers must issue appropriate notification to operators of water intake structures when changes in water quality may occur.

- Navigation requirements – Dredgers must comply with all USCG, State of Missouri, State of Kansas (RM 367 to RM 490), and USACE regulations concerning the prevention of navigation obstructions in navigable waters of the United States. This requirement reduces adverse impacts to navigation from dredging-related activities.
- Monitoring and reporting requirements – Dredgers must prepare and implement monitoring plans to report the locations and volume of dredge materials removed, and must conduct annual bathometric surveys to monitor changes in river bed elevations. This information assists the USACE in monitoring the compliance of dredgers with permit conditions and the effectiveness of certain mitigation measures.

6.2 POTENTIAL DREDGING RESTRICTIONS AND OPERATIONAL CONDITIONS

Measures described in this section could be implemented through USACE permit conditions to further avoid, minimize, and mitigate adverse impacts from the Proposed Action and alternatives. These measures are directed primarily at reducing river bed degradation. These measures have not been included as part of the Proposed Action or Alternatives A, B, or C; nor were they included in the impact analyses.

6.2.1 Restrict Concentrated Dredging

The greatest potential for localized dredging-related impacts occurs when considerable dredging is concentrated in one portion of a river segment. Under existing dredging permits, the amount of material that may be dredged from any 10-mile reach is limited to 1,200,000 tons. Given the extent of river bed degradation that has occurred in areas of concentrated dredging to date, a more conservative approach may be warranted. Restricting concentrated dredging would require that the permitted dredging amount be apportioned throughout a permitted segment and would allow up to a set percentage of the annual permit amount for the segment to be dredged in a given portion of the segment. If this approach was to be used, the specific parameters would be determined during the decision regarding permitted dredging tonnages and permit conditions.

Reducing the amount removed from a concentrated area would reduce local dredging-related impacts on river bed elevations and water surface elevation changes. This mitigation likely would require Dredgers to travel longer distances to dredge locations and would require longer tow hauls to ship sand and gravel to land-based plants, increasing production costs.

6.2.2 Prohibit the Use of Cutter-Head Dredges

Cutter-head dredges were originally developed loosen densely packed deposits and cut through soft rock, and they can excavate a wide range of materials including clay, silt, sand, and gravel (Kleinfelder et al. 2002). Because they are equipped with a rotating cutter apparatus surrounding the intake end of the suction pipe, a cutter-head dredge can efficiently dig and pump all types of alluvial materials and compacted deposits, such as clay and hardpan (USACE 1983, Kleinfelder et al. 2002).

The use of cutter-head dredges in the LOMR allows dredging of denser consolidated layers of sediment that are below the looser, regularly mobilized sediment layer on the river bottom. It appears that the Dredgers may sometimes mine consolidated deposits of coarser sand well below the active river bed to get a mix of sand that meets specifications The use of cutter-head dredges may exacerbate river bed degradation by cutting into these denser underlying deposits, destabilizing the river bed and stimulating the development of headcuts. Prohibiting the use of cutter-head dredges would reduce disturbance to any substrate that is not mobilized on a regular basis by ongoing fluvial processes, and might reduce the rate of river bed degradation in heavily dredged areas. Prohibitions on the use of cutter-head dredges have been used elsewhere to reduce potential impacts on the river bed and certain aquatic habitats (Frerker pers. comm.), as have restrictions on the depth of dredging to leave sand and gravel above the bottom or rock layers to protect the integrity of the channel and certain habitats (USACE 2007).

By prohibiting the use of cutter-head dredges, the amount of material dredged that meets specifications may be reduced in some areas or the effort needed to obtain them increase. A larger volume of material may need to be dredged in order to obtain sufficient sand and gravel that meet the required material specifications. Another result of prohibiting the use of cutter-head dredges is that the Dredgers may not be able to meet their allocated dredge limit solely by dredging in historically dredged areas. These circumstances may result in an increase in the total river bottom area being disturbed.

6.2.3 Limit the Dredging Season

Potential impacts to pallid sturgeon include mortality of eggs and larvae that may be entrained and pass through the dredge. Prohibiting dredging operations from May 15 to July 15, the period of highest larval pallid sturgeon drift, would reduce the entrainment-related mortality to larval pallid sturgeon. It is reasonable to assume that ceasing dredging during the time of highest larval pallid

sturgeon drift may prevent entrainment of some larvae, which may benefit the species as a whole. However, the rate of larval entrainment into dredges and entrainment mortality on pallid sturgeon are poorly understood, as are the possible population-level effects of entrainment. For these reasons, an option to this measure is to first monitor dredges for entrainment (see "Other Mitigation Measures").

6.2.4 Use a Mine-and-Relax Strategy to Limit Dredging Intensity

During the 2007 and 2009 permit extension processes and again during the EIS scoping process, certain dredgers proposed a mine-and-relax strategy to reduce the localized impacts of dredging activities on river bed degradation. The strategy would limit the period during which an area is dredged and would require sufficient time for its "recovery" before that area is dredged again. Conceptually, the strategy could include expanding the reaches to be mined, limiting dredging in a 1-mile reach to 1 week, and then resting that 1-mile reach for at least 4 weeks before dredging again. However, the proposed mine-and-relax strategy included no cap on the total amount dredged in a reach, and it would not limit the amount dredged by segment or by dredger. In addition, the effectiveness of the mine-and-relax may depend on how long it takes for a reach to recover, and the length of time for this to occur is currently not known because data are limited. Further work on determining the recovery time for a specific dredging location or reach is needed before such a strategy could be effectively employed.

Although the mine (dredge)-and-relax strategy has the potential to reduce localized dredging impacts, the effects on general degradation of a reach would depend on the total amount dredged in the reach. This is based on the need for dredging to balance with the bed load of the river at that location. For the strategy to be effective, it must include a cap on the total amount dredged in a reach and there must be better information on localized recovery time. The Restrict Concentrated Dredging measure discussed above is in some ways similar in approach.

6.3 MONITORING AND ADAPTIVE MANAGEMENT

Adaptive management strategies use monitoring and feedback to adjust the management of resources. In the case of commercial dredging in the LOMR, it may be beneficial to develop monitoring plans with certain pre-defined criteria that, when met, would prompt the adjustment of dredging levels or locations. Pre-defined criteria and adaptive management have been used in other recent decisions for commercial sand and gravel dredging on the Kansas River, Kansas (USACE 1990) and the Allegheny River, Pennsylvania (USACE 2007). In addition to monitoring

dredging amounts and locations, flows and geomorphic parameters such as sediment loads, water surface elevations, and channel cross sections could be monitored to provide information and feedback on dredging impacts as they occur. Monitoring and reporting requirements would provide a better understanding of where dredging is occurring. Monitoring and reporting could be used to limit the degree of river bed degradation and reduce associated adverse impacts on infrastructure, endangered species, riverine habitats, and other environmental resources.

Implementation of a monitoring and adaptive management program could include the following elements.

- Development of a monitoring and adaptive management plan – A monitoring and adaptive management plan would address:
    1. Temporal scale – How often to measure various parameters depends on the variability of the parameter measured. For example, flows and sediment loads could be measured multiple times per year, while cross section changes could be surveyed less frequently.
    2. Spatial scale – Existing USGS stream gage stations are likely adequate for measuring flows, but additional locations may be selected to measure bed composition or sediment loads. Channel cross sections could be surveyed at a low density more frequently or at a high density less frequently.
    3. Implementation – Any monitoring and adaptive management plan needs to be cost effective, compatible with existing monitoring plans, and accepted by stakeholders. The plan would incorporate the monitoring activities that are part of the existing mitigation measures, including continuous monitoring of dredge location, dredge volumes, and other required monitoring parameters.
- Adjust dredging limits based on flows – The amount of sediment transported by the LOMR is related to the rate of flow in the river (see Appendix A for details). Although sediment loads at any given location on the LOMR are variable and dependent on many factors (including sediment availability, changes in flows, and watershed management), the principle factor when averaged over a year is flow. For example, bed material loads were lower for a period of below-average flows between 2000 and 2009 than for a period of approximately average flows between 1994 and 2009 (see Table 3.4-19). Therefore, flows forecasted may be used as part of the equation for adjusting commercial dredging levels. Adjusting dredging limits based on flows was suggested by an ad hoc panel of experts convened to review potential impacts from dredging in the Kansas City reach in 2003 (USACE 2003).

- Develop and implement a sediment monitoring plan – Monitoring or estimating bed material loads would provide key information for managing commercial sand and gravel dredging, which removes the same size fraction as the bed material load (see Figure 3.4-16). Both the USACE and the USGS have collected sediment data, and efforts are ongoing to review the available data (see Appendix A for details). In addition, a National Academy of Science study is underway to evaluate sediment issues (NAS 2010). A sediment monitoring plan could be developed specifically to monitor commercial dredging, or the monitoring could be included as part of a broader study or program. The objectives would be to measure sediment loads at key locations on the LOMR system and to adjust commercial dredging levels relative to measured sediment loads. The frequency, timing, and period of measurement and dredging adjustment are all important considerations and would affect their effectiveness and practicability.
- Monitor changes in channel cross sections and water surface elevation – The USACE and the USGS have collected data on low-flow water surface elevations and channel cross sections using various methods over the past 20 years (see Section 3.4.6.1). An ongoing USGS program collects channel cross section data at active gage sites along the river, and the USACE collects low-flow water surface elevation data as part of the BSNP maintenance programs. Both water surface elevations and bed elevations provide valuable data for monitoring river bed degradation and channel change. Measuring bed elevations is generally more accurate, and computed water surface elevations are based on calculations with larger associated standard error. The Dredgers are currently required, as a condition of their permit, to collect bed elevations at cross sections in 2007 and 2008, and the USACE collected such data in 2009. Data from these programs have been used to establish current conditions and will be used in the future for adaptive management and monitoring purposes, if the program continues. Dredging levels and locations could be adjusted based on changes in channel geometry over time. The issues of the appropriate survey locations and frequency would be made in consideration of the selected alternative.

6.4 OTHER MITIGATION MEASURES

Implementation of the following management actions could help to avoid, minimize, or mitigate the direct and indirect effects of dredging activities on various resources.

6.4.1 Repair or Stabilize Affected Infrastructure

- Water intake structures – Dredging activities could erode the channel or bank to a level that compromises the stability of water intake facilities or reduces water levels outside of the design elevations. Funding for the design and implementation of erosion countermeasures, rehabilitative construction, or other measures could be required before dredging could continue in that area to maintain the stability and continued operation of water intake facilities.
- Levee foundations – Dredging activities could erode the channel or bank to a level that compromises the stability of levee foundations. Channel cross sections could be monitored at levee locations where the levee slope projects directly into the channel section. If the channel or bank was eroded or degraded to a level that compromises the stability of the levee foundation (e.g., the projected slope), funding the design and implementation of erosion countermeasures could be required before dredging could continue in that area to maintain the stability and continued operation of the levee as it relates to the foundation.
- Pipeline crossings – Dredging activities could erode the river bed and cause exposure of buried pipelines. Annual bathymetric cross-section surveys at the limits of restricted dredging areas could be required to document local bed trends and adjustments to exclusion zones. If river bed degradation trends indicate that pipelines are at risk for exposure (i.e., the minimum cover has been eroded), funding for the design and implementation of erosion countermeasures to protect the pipeline crossing could be required before dredging could continue in that area.
- Boat ramps – Boat ramps are susceptible to local scour and deposition due to river bed degradation limiting or impeding access to the river. Boat ramps could be monitored periodically during low-flow seasons and repairs made to ensure access.

6.4.2 Develop a Programmatic Agreement for Cultural Resources

Although no direct effects to historic properties would be associated with dredging activities, indirect effects may result from headcutting, erosion, scour, and fluctuations in high and low water surface elevations. To address these potential adverse impacts, a PA may be developed. The PA would outline (1) procedures for coordinating further cultural resource surveys and inventories related to identification of historic properties; and (2) development of measures to address indirect effects to these historic properties.

Within the PA, a Historic Properties Management Plan (HPMP) would be developed to address the long-term management and treatment of cultural resources in the APE. The HPMP would be a

living document that would inform USACE planning and management practices along the LOMR, and would be developed in coordination with the Section 106 consulting parties. More specifically, the HPMP would address the following:

- Appropriate avoidance, minimization, and treatment of shipwrecks in the main channel of the LOMR and BSNP structures.
- Identification of specific areas in the APE that are indirectly affected by dredging (examples of indirect effects include river bed degradation, tributary headcutting, and erosion caused by extremes in water surface levels).
- A program to conduct cultural resource surveys within indirectly affected areas to identify and evaluate cultural resources; determine effects to historic properties; and develop avoidance, minimization, or treatment measures as appropriate. These measures would include:
    1. A Monitoring Plan for historic properties indirectly affected by dredging;
    2. An Avoidance Plan to protect the character-defining features of NRHP-eligible sites;
    3. An Inadvertent Discoveries Plan that outlines the processes of notification, evaluation, and actions to be taken should unanticipated cultural resources be found during dredging or during monitoring activities; and
    4. A Treatment Plan for historic properties that are adversely affected by dredging in the LOMR.

6.4.3 Dredge in Dike Fields/Bank Line to Create Shallow-Water Habitat

The USACE has considered excavating sediments from the dike fields/bank line under the MRRP, or requiring Dredgers to do so, to create shallow-water habitat for nursery and refugia for young pallid sturgeon and other native fish. Under the MRRP, shallow-water habitat typically is constructed by widening the top width of the river channel and restoring chutes and side channels. This is accomplished by excavating pilot channels, notching structures and letting the natural river/chute meandering process widen the river. It may be possible to require or encourage commercial dredging in certain suitable areas, including dike fields, to create or enhance shallow-water habitats.

6.4.4 Remove or Reposition Submerged Objects

Continuing river bed degradation could result in hazards to navigation by exposing previously submerged structures (e.g., sunken vessels, old bridge piers, pipelines, and rock/clay outcroppings) on the river bed (USACE 2009). The submerged object could be removed or sunken further. By dredging under and around the object, it would settle and be re-buried beneath the surface of the river bed. The Dredgers could be required to contribute to or assist in these efforts.

6.4.5 Monitor Fish Entrainment and Mortality in Dredges

The analysis of potential entrainment impacts for fish and the endangered pallid sturgeon identified that limited studies and data are available to estimate entrainment rates or entrainment mortality for fishes in the LOMR. This may be particularly important for pallid sturgeon, for which information also is limited about the early life history stages. An entrainment monitoring plan could be developed to provide better information for management decisions about the impact of entrainment and the need for additional management measures to avoid, reduce, or mitigate those impacts.

6.4.6 Implement Measures to Reduce NO_X Emissions

The permit applicants could be required to implement emissions control technology on all equipment and vehicles, and to reduce fuel consumption in order to reduce NO_X and GHG emissions. Such measures may include, but are not limited to, the following.

For dredges:

- Pursue a program to retrofit engines to the latest USEPA Tier 3 standard or replace Tier 0 engines with engines that are USEPA Tier 3 certified.
- Replace dredge engines with hybrid electric engines.
- Reduce engine idling time.

For tugboats, materials-handling equipment and haul trucks:

- Reduce engine idling time.

6.5 REFERENCES

6.5.1 Printed Literature

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6.5.2 Personal Communication

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