

Executive Summary

ES.1 INTRODUCTION

Commercial sand and gravel dredging companies (the Dredgers) have filed applications with the Kansas City and St. Louis Districts of the U.S. Army Corps of Engineers (USACE) to continue extracting sand and gravel from the Missouri River, from its confluence with the Mississippi River (river mile [RM] 0) upstream to Rulo, Nebraska (RM 498). Activities to be conducted under permits issued by the USACE would include dredging of river sediments from the navigable waters of the lower Missouri River (LOMR), extraction of suitable sand and gravel, and return (discharge) of some of the dredged material into the river. These activities are regulated under Section 10 of the Rivers and Harbors Act (RHA) of 1899 (33 United States Code [USC] 403). Discharge of dredged material into a navigable water of the United States is also regulated under Section 404 of the Clean Water Act (CWA) (33 USC 1344).

Authorizing a permit by the USACE under Section 10 or Section 404 is a discretionary action that requires environmental review under the National Environmental Policy Act (NEPA). Permitting commercial dredging in the LOMR involves a decision about whether commercial dredging should be allowed to continue, the allowable amounts to be dredged, and the locations of dredging. Prior USACE decisions to permit current commercial dredging mandated that an environmental impact statement (EIS) be completed prior to further permitting of commercial dredging in the LOMR, to ensure that the USACE is fully informed about the environmental consequences of the permitted action. In 2008, the USACE St. Louis District agreed to participate with the USACE Kansas City District in preparing a joint EIS for all dredging in the LOMR. In 2009, the USACE extended the expiration date of all eight existing permits (to six applicants) to December 31, 2010, in order to allow time for the EIS to be completed (USACE 2009).

ES.2 BACKGROUND

Early development occurred on the Missouri River because the river offered (1) a reliable water supply for consumptive, agricultural, and industrial use; and (2) links to commerce and navigation. Since the 1930s, two major modifications to the river have been constructed, resulting in dramatic long-term

changes to the flows and habitat of the LOMR – the Missouri River Main Stem Reservoir System and the Missouri River Bank Stabilization and Navigation Project (BSNP).

Although records show that sand and gravel have been dredged or excavated from the LOMR since the 1930s, undocumented dredging may have begun earlier. Early dredging removed sand and gravel to aid in river navigation, and the materials removed were put to commercial use. In the 1930s, an active commercial sand and gravel industry developed to supply regional construction and road building industries. Recent dredging data indicate that commercial sand and gravel dredging primarily occurs near Kansas City, Jefferson City, and the St. Louis/St. Charles areas.

The LOMR exhibited river bed degradation in the latter 1900s. Recent investigations by the USACE Kansas City District of changes in water surface and river bed elevations have revealed that significant degradation of the river bed has occurred along major portions of the LOMR. Recent observations near Kansas City indicate that the rate of degradation is accelerating (USACE 2010).

In 2003 and 2004, the USACE Kansas City District received 10 applications from commercial sand and gravel companies for permits to extract sand and gravel from the LOMR. In August 2007, the USACE Kansas City District authorized four applicants to continue existing dredging operations; the remaining six applications for new or inactive dredging operations were not approved (USACE 2007). In conjunction with its review of the applications, the USACE Kansas City District determined that substantial river bed degradation was occurring in portions of the LOMR. The reaches of the river most degraded—Kansas City, Jefferson City, and St. Charles—were found to coincide with areas where commercial sand and gravel dredging was the greatest.

Additional concerns were that (1) dredging and associated river bed degradation could be contributing to impacts on habitats of federally listed threatened or endangered species; and (2) lowered water levels associated with river bed degradation were affecting the operation of municipal and industrial water intakes and the structural integrity of other public infrastructure. Because dredging was considered by the USACE Kansas City District to be one of the contributing causes of river bed degradation and related potential impacts to threatened and endangered species, approved dredging activity was restricted and limited under the reauthorized permits.

The new authorizations required that an EIS be prepared as the basis for any future permit reauthorizations and were limited to durations of 3 years, which was thought to be sufficient time for the EIS to be completed. In fall 2009, as it became obvious that the EIS would not be completed by the end of the year, the USACE extended the expiration date of all eight existing permits (to six applicants)

to December 31, 2010, in order to allow time for the EIS to be completed (USACE 2009). The commercial sand and gravel dredging operations on the LOMR will cease on January 1, 2011, and may not resume unless the dredging permits are reauthorized.

ES.3 PURPOSE AND NEED

The Proposed Action considered in this Draft EIS is (1) reauthorization by the USACE of eight existing dredging permits (to six applicants); (2) authorization of three additional proposed dredging permits; and (3) authorization of any as yet unforeseen proposed dredging permits. The Dredgers jointly propose to remove approximately 11.615 million tons of sand and gravel annually from specifically identified reaches of the LOMR that together comprise approximately 390 miles of the river between St. Louis, Missouri and Rulo, Nebraska. For purposes of the CWA, the basic purpose of the Proposed Action is to supply aggregate required to support the region's construction and manufacturing needs. The overall Project purpose is to profitably extract sand and gravel from the Missouri River that meet certain specifications in order to supply the region's construction and manufacturing needs. As stated by the Dredgers, the Project purpose is to economically provide sufficient quantities of quality sand and gravel to a wide variety of construction and manufacturing customers in the region.

The Project is needed because sand and gravel are essential components of construction materials, which are integral to the economy of the region that encompasses St. Joseph, Missouri; greater Kansas City; central Missouri; and greater St. Louis. Dredging in the LOMR represents one of the most cost-effective methods for supplying sand and gravel because the river provides sorted sand and gravel that does not require certain types of additional processing.

ES.4 ISSUES CONSIDERED

Issues to be evaluated in the EIS were developed through a NEPA scoping process that included public notice and opportunity for public and agency comment. Three public scoping meetings and a cooperating agency scoping meeting were conducted in the Project area. A total of 149 scoping comments were received and evaluated to form the scope of analysis for the EIS. Issues raised during the scoping process related to the alternatives evaluated: geomorphology of the river, including bed degradation and changes in water surface levels; effects of geomorphology on infrastructure and water supplies; economic effects of changing costs for commercial sand and gravel; impacts on the ecosystem and protected species; existing environmental programs; the NEPA process; recreation; and cumulative effects.

ES.5 ALTERNATIVES CONSIDERED

NEPA requires that the USACE evaluate the Proposed Action (the Dredgers' proposal), taking into consideration the No Action Alternative and a reasonable range of other alternatives. In addition to the Proposed Action and the No Action Alternative, three action alternatives were considered:

Alternative A, Alternative B, and Alternative C.

ES.5.1 Proposed Action

The Proposed Action includes approval of the 11 Department of the Army Permits (DA permits) for dredging of specified quantities of sand and gravel from designated reaches of the LOMR, with the existing permit conditions. The applicants include companies who would:

- Own and operate dredging equipment, tug boats, and barges and who would dredge sand and gravel from within their requested dredging reaches and deliver it to their own onshore sand plants;
- Own onshore sand plants and contract with other companies to dredge sand and gravel from within their requested dredging reaches and deliver it to onshore sand plants; and
- Own dredging equipment and contract to deliver sand and gravel dredged from their requested dredging reaches to onshore plants owned by other companies.

All applicants are existing dredge operators or contractors on the LOMR, except for The Master's Dredging Company, Inc., and Edward N. Rau Contractor Company. Together, the Dredgers propose being permitted to dredge up to 11,615,000 tons of sand and gravel from the LOMR annually. Average annual dredging from the LOMR from 2004 to 2008 (existing conditions) was 6,891,930 tons. In addition, two of the applicants propose constructing onshore facilities (sand plants) to support the proposed dredging operations.

ES.5.2 No Action Alternative

Under the No Action Alternative, the pending permit applications for dredging commercial sand and gravel in the LOMR would not be approved, and current commercial dredging permits would expire on December 31, 2010. Currently available alternate sources of commercial sand and gravel would supply sand and gravel needs in the market and region currently served by permitted commercial dredging.

The No Action Alternative would result in the cessation of commercial dredging in the LOMR following the denial of permit requests and expiration of existing extended permits held by the applicants.

ES.5.3 Alternative A

Under Alternative A, allowable commercial dredging would be set at 2,190,000 tons per year, a level at the lower end of the range that is reasonably expected to reduce the contribution of sand and gravel dredging to continued river bed degradation in the LOMR. Production of sand and gravel from alternate sources would need to increase in order to offset the reduced supplies from the LOMR.

ES.5.4 Alternative B

Under Alternative B, allowable commercial dredging would be set at 5,050,000 tons per year, a level at the upper end of the range that is reasonably expected to reduce the contribution of sand and gravel dredging to continued river bed degradation. Production of sand and gravel from alternate sources would need to increase under Alternative B in order to offset the reduced supplies from the LOMR.

ES.5.5 Alternative C

Under Alternative C, allowable commercial dredging would be set at a level that approximates recent dredging amounts: 6,900,000 tons per year. Permitted dredging from the LOMR would equal or exceed existing demand levels; therefore, increased production from alternate sources would likely not be necessary.

ES.5.6 Other Actions Considered

During the EIS scoping process, the applicants, public, agencies, and organizations were provided the opportunity to submit suggestions for alternative means for achieving the Project purpose. Each alternative was considered with regard to the Project purpose and need, current laws and regulations, practicability, and other criteria. They were not carried forward into detailed environmental analysis for differing reasons including lack of practicability, lack of jurisdiction, or lack of sponsorship. The alternatives considered but not carried forward for analysis include (1) No Cap Mine-and-Relax Strategy; (2) Sand Supplied from Distant Sources; (3) Sand from Locally Available Alternate Sources; and (4) Increasing Sediment Supply in the Lower Missouri River.

ES.6 AFFECTED ENVIRONMENT

The Project area includes the main channel and floodplain of the LOMR, the most downstream portions of tributaries to the Missouri River to the extent that they may be indirectly affected by river bed degradation, and the region surrounding the river to the extent that specific resources may be affected by dredging or use of alternate sources of sand and gravel. The LOMR within the Project area was

divided into five segments for environmental analysis based primarily on the intersection of the LOMR with major tributaries. The segments, designated by river mile, include St. Joseph (RM 391 – RM 498), Kansas City (RM 357 – RM 391), Waverly (RM 250 – RM 357), Jefferson City (RM 130 – RM 250), and St. Charles (RM 0 – RM 130). For each segment, the environmental resources listed below were evaluated.

ES.6.1 Geology and Geomorphology

The EIS describes the geologic setting, geomorphic character, hydrology, sediment transport and loads, and existing river bed degradation for the LOMR. The St. Joseph segment exhibits decreased low-flow water surface elevations and a stable river bed. In the Kansas City segment, the river bed and low-flow water surface elevations have dropped 10–15 feet over the past 50 years, with one-half of the degradation occurring in the past 15 years. The Waverly segment has been stable or aggrading based on river bed elevation and water surface profiles. The Jefferson City segment has experienced moderate degradation over the past 40 years and exhibits the only instance of increase in low-flow water surface elevation among the Project area segments. The St. Charles segment also has experienced river bed degradation near the urban area.

Those areas where river bed degradation is most pronounced were found to be the same areas where commercial dredging has been most active.

ES.6.2 Infrastructure

Infrastructure in the Project area includes 31 water intake facilities, most of which are located in currently dredged segments that are experiencing river bed degradation; several large-capacity collector water supply wells; 147.5 miles of federal levees; and 97 non-federal levee systems. The Bank Stabilization and Navigation Project (BSNP) in the Project area includes more than 2,700 dike structures and approximately 540 miles of bank revetments. Additional infrastructure in the Project area includes 38 bridge crossings, 31 pipeline crossings, nine cable crossings, one water tunnel crossing, and 155 wharf and dock facilities.

ES.6.3 Navigation and Transportation

Existing navigation and surface transportation resources in the Project area include freight and raw materials transport via barges, tugs, and towboats in the main channel and an extensive network of roadways, including state and interstate highways, and secondary and municipal roads. Freight traffic commodities transported on the Missouri River by private companies include agricultural products;

chemicals and fertilizers; petroleum products; building materials; and river-related materials such as rock, sand, and gravel dredged from the river.

ES.6.4 Water Resources

The EIS describes the baseline conditions for surface water quality (nutrients, temperature, dissolved oxygen, total suspended solids and turbidity, sediment quality and toxicity, and metals) and groundwater resources.

ES.6.5 Aquatic Resources

The aquatic resources of the LOMR have been altered as a result of development of the river for hydropower, flood control, navigation, and bank stabilization. To mitigate these effects, shallow-water aquatic habitats continue to be constructed along the LOMR under the authority of the USACE Missouri River Recovery Program (MRRP), in cooperation with local, state, and federal agencies. Present in the Project area are fish, other aquatic biota, special-status species, and habitats (main channel, sand bar complexes, and shallow-water habitat).

ES.6.6 Wetland, Floodplains, and Terrestrial Ecology

Past commercial dredging in the LOMR has contributed to river bed degradation, which affects the river stage level. River stage levels in turn affect the frequency, depth, and duration of surface water interaction with adjacent wetlands in the floodplain and the level of the alluvial aquifer that supports groundwater wetlands. Commercial dredging could indirectly affect wetland habitats adjacent to the river and its floodplain, as well as terrestrial species.

ES.6.7 Federally Listed Species

Federally listed threatened or endangered species that are known to occur or have the potential to occur in the general Project area and that may be affected by the Proposed Action and the alternatives include 10 federally listed species: one mammal, two birds, two fish, two invertebrates, and three plant species. No designated critical habitat for any of these species occurs in the Project area. The five species that were judged to be potentially affected by the Project are Indiana bat (*Myotis sodalis*), least tern (interior population) (*Sterna antillarum*), piping plover (*Charadrius melodus*), pallid sturgeon (*Scaphirhynchus albus*), and decurrent false aster (*Boltonia decurrens*).

ES.6.8 Land Use and Recreation

Agriculture is the predominant use along the river. Urban centers exist along the river at St. Charles, Jefferson City, Kansas City (Missouri and Kansas), and St. Joseph. Small towns are scattered along the river banks. Open space along the river includes areas dedicated for conservation and wildlife, some of which are also used for recreation. The LOMR is widely utilized for recreation.

ES.6.9 Economics and Demographics

The population in the primary market area¹ along the LOMR represents a substantial component of the population base in Missouri. Unemployment in the primary market area averaged 6.6 percent between October 2008 and November 2009, lower than the statewide average. In 2007, the largest concentration of employment was in the St. Charles market area followed by the Kansas City market area. The largest economic sectors in the primary market area are Other Services, Wholesale and Retail Trade, and Government (federal and state/local); the Natural Resources and Mining sector accounts for less than 1 percent) of total employment in the primary market area and the state. The Construction sector that relies on sand and gravel as a production input represents approximately 6.4 percent of the employment base in the state.

ES.6.10 Noise

Sources of noise in the Project area include operation of tug boats, engines, and processing equipment associated with dredging, and operation of onshore terminal facilities (use of front-end loaders, cranes, conveyors, and other processing equipment, and delivery trucks). Proposed changes in commercial dredging activity on the LOMR could change the level of noise generated by this activity and related onshore activities. Changes in dredging locations could expose noise-sensitive uses to dredging-related noise.

ES.6.11 Visual and Aesthetic Resources

The LOMR and its riparian corridor are the predominant visual features in the Project area landscape and viewshed. The majority of development along the river is comprised of rural areas and small towns and cities with roots as agricultural communities. The cities of St. Joseph, Kansas City, North Kansas City, Jefferson City, and the outlying suburbs of St. Louis are larger metropolitan centers in the Project area and along the river; these urban areas add to the view characteristics in the Project area.

¹ For this EIS, the "primary market area" is defined as the area encompassing an approximately 25-mile-wide radius from the processing facilities (sand plants) associated with existing and proposed dredging operations. The primary market area represents the total of the five individual market areas serving each segment.

ES.6.12 Cultural Resources

Cultural resources typically found in or near the LOMR include Native American habitation and burial sites, historic trails, settlements, farmsteads, shipwrecks, and bridges. Major themes that have shaped the cultural development of the Missouri River basin include exploration, settlement, and transportation. Known cultural resources in the Project area include shipwrecks, campsites, bridges, and archaeological sites.

ES.6.13 Air Quality and Climate Change

The St. Charles segment is the only river segment located in an area that is designated as nonattainment with regard to the National Ambient Air Quality Standards.

ES.7 ENVIRONMENTAL CONSEQUENCES

ES.7.1 Overview

Most of the direct and indirect environmental effects associated with the Proposed Action and action alternatives are closely related to (1) the volume, location, and direct localized effects of dredging activity; and (2) indirect effects related to changes in river bed and water surface elevations. Impacts for most environmental resources (excluding economics and air quality) are indirect impacts generated by dredging and its effects on water surface elevations, river bed elevations, and sediment dynamics.

The economic analysis, in part, addresses impacts related to increased production from alternate sources of sand and gravel. Under the No Action Alternative, Alternative A, and Alternative B; output, labor income, and employment would shift from the primary market area of the dredging industry along the LOMR to production of sand and gravel at alternate sources. The air quality analysis found that the Project could affect compliance with federal air quality regulations because of the existing ozone degradation in the St. Charles segment.

ES.7.2 Comparison of Impacts of the Proposed Action and Alternatives

The Proposed Action could result in the greatest effects to environmental resources. Under existing conditions, river bed degradation was found to exist in the Kansas City, Jefferson City, and St. Charles segments. Effects of the Proposed Action would include increased river bed degradation in the LOMR where river bed degradation already has occurred. This includes portions of the LOMR at Kansas City, Jefferson City, and St. Charles where substantial additional river bed degradation is projected to occur. Increased dredging over current levels would cause moderate to substantial river bed degradation in

the St. Joseph segment while only slight river bed degradation is expected to occur in the Waverly segment. The environmental impacts on most affected resources are indirect effects of river bed degradation and changing water surface elevations; consequently, the environmental impacts on these resources under the Proposed Action are similar to the changes found for river bed degradation and changes in water surface elevations. The Proposed Action was projected to cause little change to regional or state output, income, or employment.

The No Action Alternative would result in no adverse effect to environmental resources directly from dredging and would lessen related river bed degradation and changes in water surface elevations. However, the No Action Alternative would lead to increased production of sand and gravel at existing alternate sources in the short term and could result in development of new floodplain open-pit mines or additional instream mining sites in the long term to offset the reduction in sand and gravel supplies from dredging in the LOMR. Additional production at existing alternate sources and development of new supply sources could result in increased air and noise emissions, disturbance of habitat, and dedication of land for industrial use. These impacts likely would occur in the vicinity of existing or new alternate sources.

Although the No Action Alternative is projected to result in the greatest negative economic effects (changes in output, labor income, and employment) in the primary market area of the LOMR, it would result in the greatest net economic gain statewide because of geographic and industry shifts in employment.

Adverse environmental consequences under Alternative A and Alternative B are expected to be substantially less than those under the Proposed Action. Alternative A would result in the least impact to environmental resources affected by dredging. Alternative B is expected to result in less impact than the Proposed Action but greater impact than Alternative A. Similar to the No Action Alternative, Alternative A and Alternative B would rely to some extent on increased production from alternate sources to offset the reduction in sand and gravel produced from the LOMR. Increased production from existing alternate sources in the short term and development of new alternate sources in the long term are expected to result in increased environmental consequences to alternate sources under Alternative A and Alternative B, but less than under the No Action Alternative.

Loss of output, income, and employment in the primary market area of the LOMR is likely to occur under Alternative A. However, geographic and industry shifts in employment would balance job losses

and would result in net statewide increases in output, income, and employment. Under Alternative B, a net loss in statewide output, income, and employment is projected to occur.

Alternative C would continue to generate impacts to environmental resources at current or cumulatively increasing levels. In particular, river bed degradation, which has previously occurred in the areas with the most concentrated dredging, would be expected to continue where dredging is most concentrated. The continuing trend of river bed degradation would further lower river bed elevation and further affect water surface elevations. Alternative C is not expected to increase reliance on alternate sources of sand and gravel; therefore, minimal change in the existing level of utilization of these resources is expected to occur under Alternative C. Alternative C would likely have a neutral effect on regional and statewide output, income, and employment.

ES.8 CUMULATIVE IMPACTS

“Cumulative impacts” are effects on the environment that result from the incremental impact of a proposed action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes the actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR Section 1508.7). The geographic scope for the cumulative impact analysis includes the Project area plus certain geographic areas beyond the Project area, depending on the resource. The selections of geographic boundaries were based on the natural boundaries of resources of concern. Projects and programs reasonably likely to occur within a 20-year time frame were evaluated.

ES.8.1 Past, Present, and Reasonably Foreseeable Future Actions

The Missouri River transformed during the 20th century to a channelized, hydrologically and physically altered river with highly regulated flow (NRC 2002). These changes have resulted in significant ecological effects on the river and its biota. Programs that led to development of dams, water diversion structures, and flood control and navigation structures have substantially altered the natural processes that structured the evolution of Missouri River species. Initial restoration efforts that began in 1984 focused on mitigating effects of the BSNP by restoring aquatic and terrestrial habitats. In 2004, restoration activities began to emphasize creation of shallow-water aquatic habitat.

Ongoing restoration actions in the LOMR focus on the assessment of management actions; development of planning alternatives; and implementation of mitigation, restoration, and recovery efforts. Present and future actions or programs included in the cumulative effects analysis include

Regional Sediment Management, flow management under the Master Water Control Manual for the Missouri River basin, infrastructure development and management under the BSNP, the MRRP and related components, the Big Muddy National Fish and Wildlife Refuge expansion, the Missouri River Authorized Purposes Study (MRAPS), and the Missouri River Bed Degradation Feasibility Study.

ES.8.2 Cumulative Impact Assessment

The primary cumulative impacts of the Proposed Action and the alternatives are summarized below.

ES.8.2.1 Impacts on Geomorphology

The ongoing and reasonably foreseeable projects evaluated for potential cumulative effects on river bed degradation are those with the potential to change the sediment supply or sediment transport and that are likely to interact with commercial dredging of sand and gravel. The most significant project in terms of potential for changes in sediment availability is the Shallow Water Habitat Program mandated by a 2000 biological opinion that was amended in 2003 (*USFWS 2003 Amendment to the 2000 Biological Opinion on the Operation of the Missouri River Mainstem Reservoir System Operation and Maintenance of the Missouri River Bank Stabilization and Navigation Project and Operation of the Kansas River Reservoir System* [2003 Biological Opinion]) and subsequently has been embodied in the MRRP. In the long term, although the impact of MRRP restoration activities would offset impacts associated with commercial dredging, river bed degradation is still likely to occur in areas of concentrated dredging and likely would reduce the potential for shallow-water habitat creation in those areas.

ES.8.2.2 Impacts on Water Resources

Water resources in general were not considered to be cumulatively affected because dredging does not affect water quantity or water use in ways beyond those discussed in the Environmental Consequences analysis. However, given the attention that has been directed in recent years to the nutrient contributions of the Missouri and Mississippi Rivers to the anoxic zone conditions in the Gulf of Mexico, the analysis considers the contribution of dredging as a potential cumulative impact on water quality, specifically nutrients.

ES.8.2.3 Impacts on Aquatic Resources and Federally Listed Species

The LOMR includes shallow-water habitat that provides for primary and secondary productivity, production of forage fish, and early life stage development for native Missouri river aquatic species,

including federally listed threatened and endangered species. Considerable management efforts and funds have been directed toward restoration of shallow-water habitat, which is the goal of the 2003 Biological Opinion. River bed degradation impacts would affect the shallow-water habitat currently in the LOMR and would have the potential to reduce the effectiveness of efforts to create shallow-water habitat in the future. The incremental contribution of commercial dredging to cumulative impacts likely would be greatest in urban areas; in these areas, existing river bed degradation is the greatest and is projected to continue. Continued river bed degradation could result in a decrease in the quantity of natural and created shallow-water habitat, and could affect the success of restoration efforts to create shallow-water habitat.

ES.8.2.4 Regional Economic Effects

The socioeconomic analysis was based on a quantitative analysis of both local and regional effects. Reductions in dredging in the LOMR under some alternatives would result in increased production from existing alternate sources of supply in the short term, in order to satisfy the existing demand for commercial sand and gravel. A higher delivered cost of sand and gravel to consumers based on higher transportation costs also is likely to occur in the short term. The loss of jobs, income, and economic output in the dredging industry would be offset in some cases by increased employment in the trucking industry, as additional supplies would be hauled longer distances from the alternate sources of supply. In response to reduced supplies from the LOMR, new sand and gravel operations likely would be developed in the Missouri River floodplain in the long term. The long-term cumulative impacts associated with new floodplain operations most likely would be a decline in the cost of sand and gravel in the region relative to the use of existing sources because new floodplain sources likely would be located in proximity to the areas with the greatest demand. A reduction in the delivered cost of sand and gravel would benefit the construction industry with lower-cost inputs to production.

Other major factors that could influence the cumulative impacts of sand and gravel production by changing demand include population growth and road building. According to the 2010–2014 Missouri Statewide Transportation Improvement Program (MoDOT 2010), highway and bridge expenditures are expected to decline. A continuing decline in transportation funding could reduce demand for construction sand and gravel from the LOMR, and could place downward pressure on sand and gravel prices. If commercial dredging slowed in response, river bed degradation and its associated economic impacts would be lessened. Conversely, if economic conditions became much more favorable, the opposite could occur.

ES.8.2.5 Effects on Cultural Resources and Infrastructure

Cultural resources and infrastructure located in the Project area may be adversely affected by the indirect effects of river bed degradation, headcutting, erosion, and scouring of the bed of the LOMR and its tributaries near bridge abutments. Effects to cultural resources and infrastructure, therefore, are intimately linked to changes in the geomorphology of the LOMR and management of water flows. Maintenance of the BSNP may both prevent and contribute to effects to cultural resources and infrastructure over time. Maintaining the BSNP structures contributes cumulatively to the same indirect effects as the Proposed Action; however, by keeping the BSNP operational, the system prevents flooding and more widespread erosion from occurring within the Missouri River Valley, thus reducing broader effects to cultural resources and infrastructure.

ES.8.2.6 Greenhouse Gas Emissions and Climate Change

No scientific or regulatory consensus exists regarding a threshold above which emissions would be considered adverse in the context of NEPA. Estimated greenhouse gas (GHG) emissions generated by the Project are very small in comparison to current and projected global GHG emissions. However, because GHG are a topic of increasing concern, any Project-related net increase in GHG emissions compared to baseline emissions was considered an adverse effect in the analysis of air quality and climate change. General climate changes predicted for the Project area include warmer temperatures, smaller snowpack, earlier snowmelt, reduced river flows and water quantities, increased drought, increased spring flooding, increased winter precipitation (rain), and changes in evapotranspiration and soil moisture. The long-term implications of these climate change impacts for commercial dredging of sand and gravel include (1) reduced river flows and water quantities, which could lead to restricted dredging in certain areas and changes in the amount and location of sediment deposited along the river bottom; (2) more frequent flooding in low-lying cities near rivers and streams, resulting in an increased need for bags of sand and gravel; and (3) safety hazards and delays in the regional transportation systems, thereby affecting distribution of sand and gravel.

ES.8.2.7 Environmental Resources Not Cumulatively Affected

The remainder of the resources addressed in the Draft EIS (navigation and transportation; wetlands, floodplains, and terrestrial ecology; land use and recreation; noise; and visual and aesthetic resources) were judged not to be cumulatively affected. One of the following is true for each resource: (1) the resource did not meet the general criteria outlined above; (2) commercial dredging of sand and gravel and operations were judged not to significantly affect the resource; (3) the potential range of cumulative

impacts were adequately addressed in the geomorphology impact analysis; or (4) no other reasonably foreseeable future projects or programs would interact with dredging to create synergistic impacts on the resource.

ES.9 POTENTIAL MITIGATION MEASURES

The EIS describes existing and potential measures to avoid, minimize, or mitigate adverse effects of the Proposed Action and the alternatives. Mitigation measures resulting from the previous permit decisions (2007 and 2009) and consultation with the U.S. Fish and Wildlife Service include volume restrictions, exclusion zones, discharge and disposal requirements, navigation requirements, and monitoring and reporting requirements. These measures were incorporated into the descriptions of the Proposed Action and Alternatives A, B, and C, and into the respective impact analyses.

The USACE determination under the Clean Water Act 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, including identification of the least environmentally damaging practicable alternative. Until that determination is made, the needed mitigation measures will not be fully known. The mitigation measures presented below are potential measures, to be considered pending the Section 404(b)(1) analysis, Final EIS, and Record of Decision.

Additional dredging restrictions and operational conditions are proposed to avoid, minimize, or mitigate identified impacts. These include restrictions on dredging volumes, restrictions on concentrated dredging, excluding the use of cutter-head dredges, limits on dredging times, and a revised version of the Dredgers' proposed mine-and-relax strategy. These measures were not incorporated into the descriptions of the Proposed Action or Alternative A, B, or C; nor were they included in the respective impact analyses.

Management actions could include implementation of a detailed monitoring and adaptive management plan for geomorphic parameters. The plan elements could include (1) details related to temporal scale, spatial scale, and implementation; (2) adjusting dredging limits based on flows; (3) developing and implementing a sediment monitoring plan; and (4) monitoring changes in channel cross sections and water surface elevations. Other potential mitigation measures include repairing or stabilizing vulnerable infrastructure, developing a Programmatic Agreement for protection of cultural resources that includes a Historic Properties Management Plan, dredging to create shallow-water habitat, removing or repositioning submerged objects, monitoring fish entrainment and mortality in dredges, and

implementing emissions control technology on equipment and vehicles to reduce nitrogen oxide (NO_x) and GHG emissions.

ES.10 REFERENCES

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